6.0 Air Monitoring

CJ Perkins, SJ Johnson

Air quality is monitored using stack sampling at the sources and ambient air monitoring at receptor locations. The specific objectives are to measure airborne radionuclides and chemicals to calculate the doses to humans, plants, and animals. Measured and calculated results are compared with the U.S. Department of Energy (DOE), U.S. Environmental Protection Agency (EPA), and/or Washington State Department of Health (WDOH) standards. This report presents 2016 measurement results.

6.1 Effluent Monitoring of Stack Air Emissions

SJ Johnson

Hanford Site contractors monitor airborne emissions from site facilities to determine compliance with federal and state regulatory requirements and to assess the effectiveness of emission control equipment and pollution management practices. Measuring devices quantify most facility emission flows, while other emission flows are calculated using process information or the fan manufacturers' specifications. Most facility radioactive air emission units are actively ventilated stacks sampled either continuously or periodically. Airborne emissions with potential to contain radioactive materials at prescribed threshold levels are measured for gross alpha and gross beta concentrations and, as warranted, specific radionuclides. Nonradioactive constituents and parameters are monitored directly, sampled and analyzed, or estimated based on inventory usage.

Emission data are documented in this current and other reports, all of which are available to the public. For example, DOE annually submits the Radionuclide Air Emissions Report for the Hanford Site (e.g., DOE/RL-2017-17) a report of Hanford Site radionuclide air emissions in compliance with 40 CFR 61, Subpart H, 61.94, "Compliance and Reporting" and WAC 246-247, "Radiation Protection – Air Emissions." The Radionuclide Air Emissions Report for the Hanford Site for the prior year's sampling effort is due annually to EPA and WDOH no later than June 30.

6.1.1 Radioactive Airborne Emissions

Small quantities of particulate and volatilized forms of radionuclides are emitted to the environment through state- and federally-permitted radioactive emission point sources (i.e., stacks and vents) during routine operations. The isotopes most commonly measured include: tritium (i.e., hydrogen-3), strontium-90, iodine-129, cesium-137, plutonium-238, plutonium-239/240, plutonium-241, americium-241, and protactinium-231. Emission points are monitored continuously if they have the potential to exceed 1% of the public dose limit of 10 mrem/yr or 100 microsievert (µSv)/yr.

Distinguishing Hanford Site-produced radionuclides in the environment is challenging because concentrations of site stack emissions are comparable to widespread background concentrations of radionuclides that originated from historical atmospheric nuclear weapons testing. Gross alpha and gross beta concentrations in stack emissions are, on average, equivalent to concentrations in the environment, including concentrations at distant locations upwind of the Hanford Site. Radioactive emissions decreased on the Hanford Site largely because the production and processing of nuclear materials ceased more than 30 years ago in 1987 when the Site's current mission of environmental cleanup and remediation was initiated.

The continuous monitoring of radioactive emissions from facilities requires analyzing samples collected at points of discharge to the environment, usually a stack. Samples are analyzed for gross alpha and gross beta as well as for selected radionuclides. Specific radionuclides are selected for sampling, analysis, and reporting based on an evaluation of the hypothetical maximum potential of emissions of known radionuclide inventories in a facility or an outside activity occurring under normal operating conditions. Other factors that are considered include removal of the calculated effect of pollution-abatement equipment, sampling criteria provided in contractor environmental compliance manuals, and the potential of each radionuclide to contribute to the public dose. Continuous air monitoring systems with alarms also are used at selected emission points where the potential exists for radioactive emissions to exceed normal operating ranges to levels that require immediate personnel alert.

Radioactive emission points are located on the Hanford Site in the 100, 200, 300, and 400 Areas. The prime sources of emissions and the number of emission points by operating area are as follows:

- In the 100 Area, two radioactive emission points were active in 2016. Emissions originated from cleanup activities at the 100-K West Fuel Storage Basin, which in previous years contained irradiated nuclear fuel, and from the Cold Vacuum Drying Facility.

- In the 200 Areas, 35 radioactive emission points were active in 2016. The primary locations of these emission points were the Plutonium Finishing Plant, T Plant, B Plant, Waste Encapsulation and Storage Facility, underground tanks storing high-level radioactive waste, a waste evaporator (242-A Evaporator), the Waste Receiving and Processing Facility, 222-S Laboratory, and Plutonium Uranium Extraction Facility.

- In the 300 Area, four radioactive emission points were active in 2016. The primary sources of these emissions were laboratories and research facilities, including the 324 Waste Technology Engineering Laboratory, 325 Applied Chemistry Laboratory, and 331 Life Sciences Laboratory.

- In the 400 Area, three radioactive emission points were active in 2016; however, these sources have been shut down. Emission point locations in the 400 Area include: Fast Flux Test Facility, Maintenance and Storage Facility, and the Fuels and Materials Examination Facility.

Air emission data collected in 2016 were comparable to those collected in 2015. Table 6-1 summarizes Hanford Site radioactive airborne emissions in 2016.

Table 6-1. Hanford Site Radioactive Airborne Emissions in Calendar Year 2016. (2 Pages)

Radionuclide	Half-Life[b]	Calendar Year 2016 Releases, Ci[a]				
		100 Area	200-East Area	200-West Area	300 Area	400 Area
Actinium-227	21.6	NA	NA	NA	3.1×10^{-10}	NA
Alpha (gross)[c]	NA	1.0×10^{-05}	1.6×10^{-06}	2.7×10^{-05}	1.0×10^{-07}	7.5×10^{-07}
Americium-241	432.2	2.7×10^{-06}	1.2×10^{-07}	2.1×10^{-06}	4.8×10^{-10}	NA
Americium-243	7,380	NA	NA	NA	4.8×10^{-08}	NA
Beta (gross)[d]	NA	1.3×10^{-05}	5.7×10^{-05}	5.5×10^{-06}	4.9×10^{-06}	1.9×10^{-06}

Table 6-1. Hanford Site Radioactive Airborne Emissions in Calendar Year 2016. (2 Pages)

Radionuclide	Half-Life[b]	Calendar Year 2016 Releases, Ci[a]				
		100 Area	200-East Area	200-West Area	300 Area	400 Area
Carbon-14	5,730	NA	NA	NA	1.2×10^{-04}	NA
Cesium-134	2.1	ND	ND	ND	NA	NA
Cesium-137	30	2.6×10^{-06}	7.7×10^{-06}	ND	1.2×10^{-08}	1.1×10^{-11}
Cobalt -60	NA	NA	NA	NA	9.7×10^{-08}	NA
Curium-243/244	29.1	NA	NA	NA	ND	NA
Europium-152	13.5	ND	ND	ND	1.9×10^{-09}	NA
Europium-154	8.6	ND	ND	ND	1.1×10^{-08}	NA
Gadolinium-153	240.4 days	NA	NA	NA	8.0×10^{-11}	NA
Iodine-129	16,000,000	NA	9.8×10^{-04}	NA	NA	NA
Krypton-85	10.7	NA	NA	NA	2.8×10^{-07}	NA
Neptunium-237	2,144,000	NA	NA	NA	1.4×10^{-08}	NA
Plutonium-238	87.7	5.0×10^{-07}	ND	1.4×10^{-07}	3.7×10^{-08}	NA
Plutonium-239/240	24,110	2.9×10^{-06}	3.2×10^{-08}	9.0×10^{-06}	2.1×10^{-09}	2.3×10^{-13}
Plutonium-241	14.4	8.8×10^{-06}	ND	9.9×10^{-08}	ND	NA
Protactinium-231	32,760	NA	ND	NA	NA	NA
Radium-226	1,600	NA	NA	NA	3.7×10^{-10}	NA
Radon-220	55.6 sec	NA	NA	NA	$1.8 \times 10^{+02}$	NA
Ruthenium-106	373.6 days	ND	ND	ND	1.3×10^{-09}	NA
Sodium-22	2.6	NA	NA	NA	NA	2.1×10^{-10}
Strontium-90	29.1	3.2×10^{-06}	2.2×10^{-05}	4.2×10^{-07}	1.7×10^{-07}	NA
Technetium-99	211,100	NA	NA	NA	4.1×10^{-06}	NA
Tritium (elemental)	12.3	NA	NA	NA	$2.4 \times 10^{+01}$	NA
Tritium (tritiated water vapor)	12.3	NA	NA	NA	$2.4 \times 10^{+02}$	1.6×10^{-02}
Uranium-232	68.9	NA	NA	NA	8.6×10^{-09}	NA
Uranium-233	159,200	NA	NA	NA	2.7×10^{-08}	NA

[a] To convert to the International System of Units; multiply pCi/g by 0.037 to obtain Bq/g.
[b] In years, unless otherwise specified.
[c] For dose modeling, gross alpha is assumed to be plutonium-239/240.
[d] For dose modeling, gross beta is assumed to be cesium-137.
NA = Not Applicable
ND = Not Detected

6.1.2 Criteria and Toxic Air Pollutants

Criteria and toxic air pollutants emitted from chemical-processing and electricity-generating engines fueled by petroleum and/or propane gas are monitored when activities known to release nonradioactive pollutants of concern (i.e. particulate matter, sulfur oxides, nitrogen oxides, volatile organic compounds, carbon monoxide, and lead) occur Total annual releases of these constituents are reported in accordance with the air quality standards established in WAC 173-400, "General Regulations for Air Pollution Sources." Based on the quantities of petroleum and propane fuel consumed at multiple emission units locations from across the Site, annual emissions e are either measured or calculated using EPA-approved formulas (*Compilation of Air Pollutant Emission Factors, Volume I: Stationary Point and Area Sources* [EPA 1995]). Table 6-2 summarizes the Hanford Site emissions of nonradioactive criteria and toxic air pollutants discharged to the atmosphere.

Table 6-2. Hanford Site Criteria and Toxic Air Pollutant Emissions.

Constituent	2016 Releases	
	lb	kg
Criteria Pollutants		
Particulate matter-total	0	0
Particulate matter-10	4,000	1,814
Particulate matter-2.5	0	0
Lead	0	0
Nitrogen oxides	30,000	13,608
Sulfur oxides	0	0
Carbon monoxide	14,000	6,350
Volatile organic compounds	10,000	4,536
Ammonia	4,000	1,814
Toxic Air Pollutants		
Acetic acid	0	0
Acetone	2	1
Benzene	0	0
1-Butanol	1	0.5
Carbon tetrachloride	5	2.3
Chloroform	0	0
Dichloromethane	0	0
1,1,1-Trichloroethane	0	0
Trichloroethylene	0	0
Trichlorofluoromethane	0	0

6.2 Ambient Air Monitoring

CJ Perkins

Atmospheric releases of radioactive materials from Hanford Site facilities and operations to the surrounding region are potential sources of exposure to humans. Radioactive constituents in air are monitored at Hanford Site facilities and operations at locations away from site facilities, offsite around

the perimeter, as well as in nearby and distant communities. Information about these ambient air-monitoring efforts, including detailed descriptions of air sampling and analysis techniques, is provided in the *Hanford Site Environmental Monitoring Plan* (DOE/RL-91-50).

Comparing measured radionuclide concentrations from locations on and around the Hanford Site with those at upwind locations assumed to be uninfluenced by Hanford Site operations provides an evaluation of the impact of radionuclide air emissions from the Hanford Site on surrounding ambient air.

6.2.1 Hanford Site Ambient Air Monitoring

A network of continuously operating samplers at 60 locations across the Hanford Site was used during 2016 to monitor radioactive airborne materials in air near Hanford Site facilities and operations (Table 6-3). Most air samplers were located at or within approximately 1,640 ft (500 m) of sites and facilities having the potential for or a history of environmental releases. The samplers were primarily located in the prevailing downwind direction. Samples were collected according to a schedule established before the 2016 monitoring year. Airborne particle samples were collected at each location by drawing air through a cellulose filter. The filters were collected biweekly, field-surveyed for gross radioactivity, held for at least 5 days, and then analyzed for gross alpha and beta activity. The 5-day holding period is necessary to allow for the decay of naturally occurring, short-lived radionuclides that would otherwise obscure the detection of longer-lived radionuclides associated with emissions from nuclear facilities. The gross radioactivity measurements were used to indicate changes in trends in the onsite facility environment.

Table 6-3. Hanford Site Monitoring Locations and Analyses for Ambient Air Monitoring Samples. (2 Pages)

Air Monitoring Locations	Number of Samplers	EDP Codes	Analyses Bi-Weekly	Monthly	Semi-Annual Composite
100-K Area	6	N476, N534, N535, N575, N576[a], N578	Alpha, Beta		^{90}Sr, Pu-iso, U-iso, ^{241}Pu, ^{241}Am, GEA
200-East Area	18	N019, N158, N498, N499[a], N582, N957, N967, N968, N969, N970, N972, N973, N976, N977, N978, N984, N985, N999	Alpha, Beta		^{90}Sr, Pu-iso, U-iso, GEA
Canister Storage Building (200-East)	2	N480, N481	Alpha, Beta		^{90}Sr, Pu-iso, U-iso, ^{241}Pu, ^{241}Am, GEA
Integrated Disposal Facility (200-East)	2	N532, N559	Alpha, Beta		^{90}Sr, Pu-iso, U-iso, GEA
200-West Area	16	N161, N168, N200, N304, N441, N442, N449, N456, N457, N956, N963, N965, N966, N974, N987, N994	Alpha, Beta		^{90}Sr, Pu-iso, U-iso, GEA
Plutonium Finishing Plant (200-West Area)	7	N155, N165[a], N433, N554[a], N555[a], N964, N975[a]	Alpha, Beta		^{90}Sr, Pu-iso, U-iso, ^{241}Pu, ^{241}Am, GEA

Table 6-3. Hanford Site Monitoring Locations and Analyses for Ambient Air Monitoring Samples. (2 Pages)

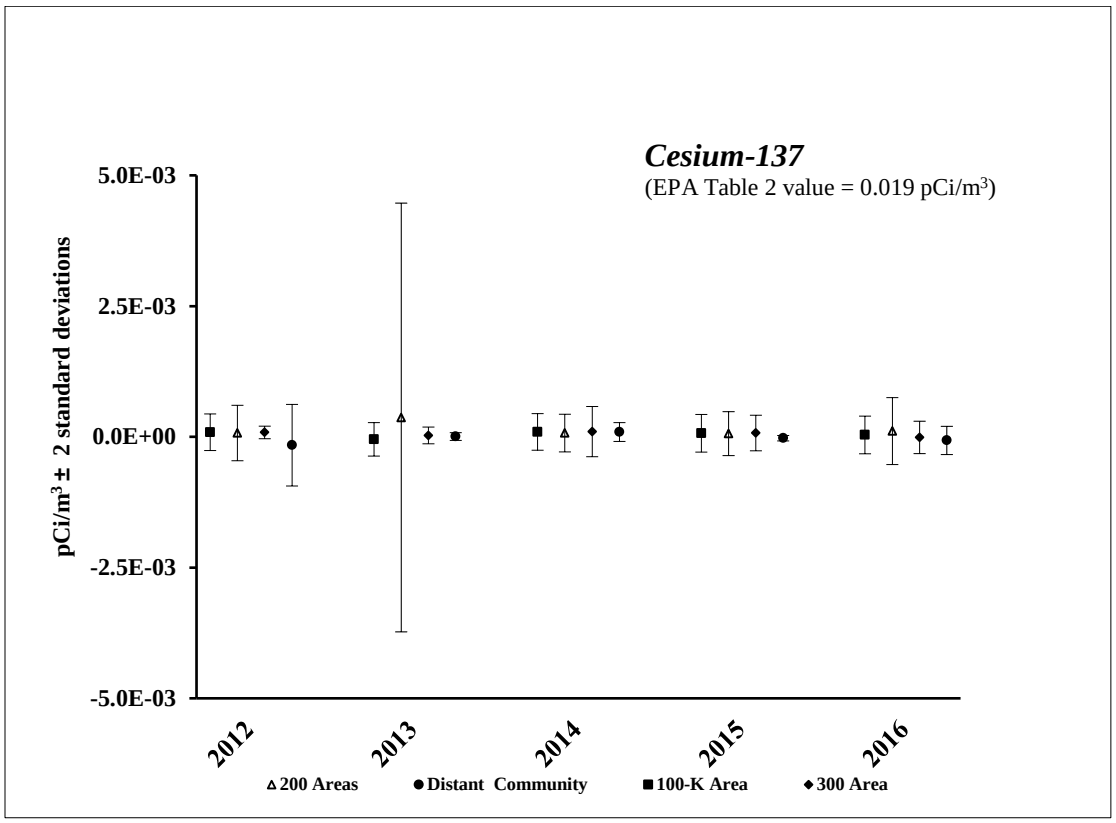
Air Monitoring Locations	Number of Samplers	EDP Codes	Analyses Bi-Weekly	Monthly	Semi-Annual Composite
300 Area	1	N130	Alpha, Beta	Tritium	^{90}Sr, Pu-iso, U-iso, GEA
618-10 Burial Ground	4	N548[a], N549, N579, N580	Alpha, Beta		^{90}Sr, Pu-iso, U-iso, GEA
Environmental Restoration Disposal Facility (ERDF)	3	N482[a], N517, N518	Alpha, Beta		^{90}Sr, Pu-iso, U-iso, GEA
Wye Barricade	1	N981[a]	Alpha, Beta		^{90}Sr, Pu-iso, U-iso, GEA

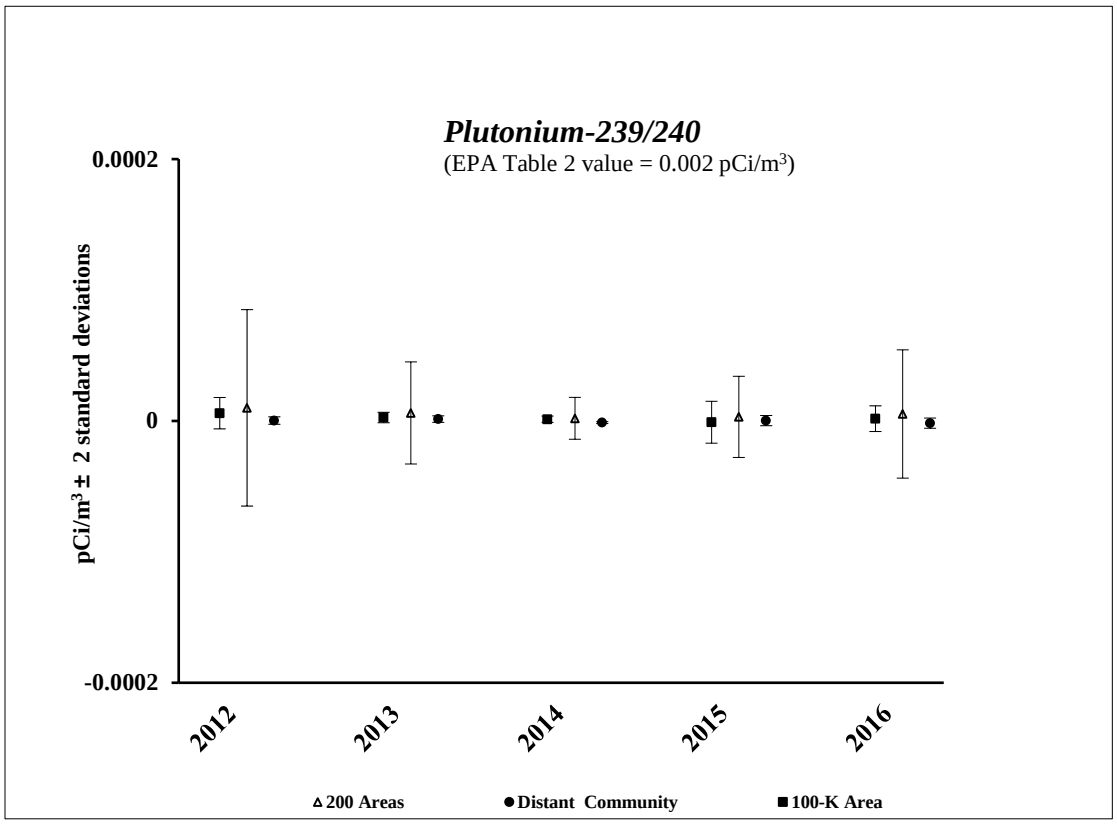
[a] Collocated sampling location with WDOH

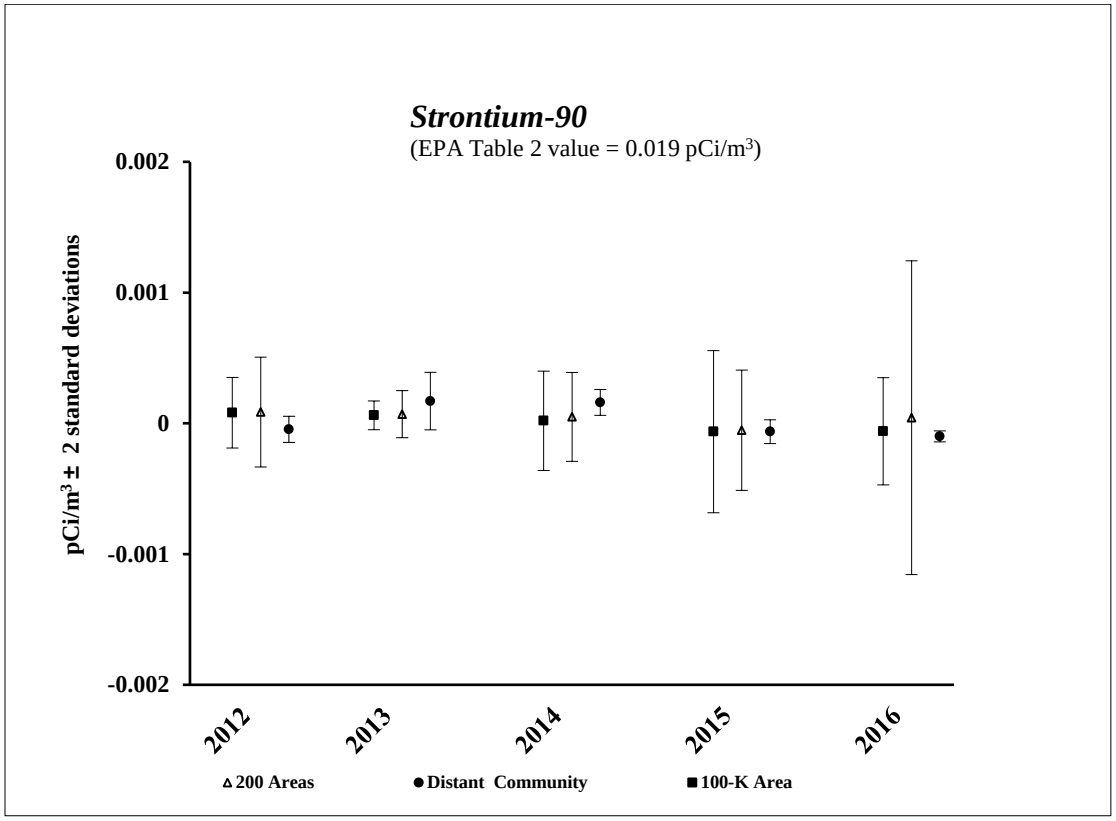
GEA = Gamma Energy Analysis

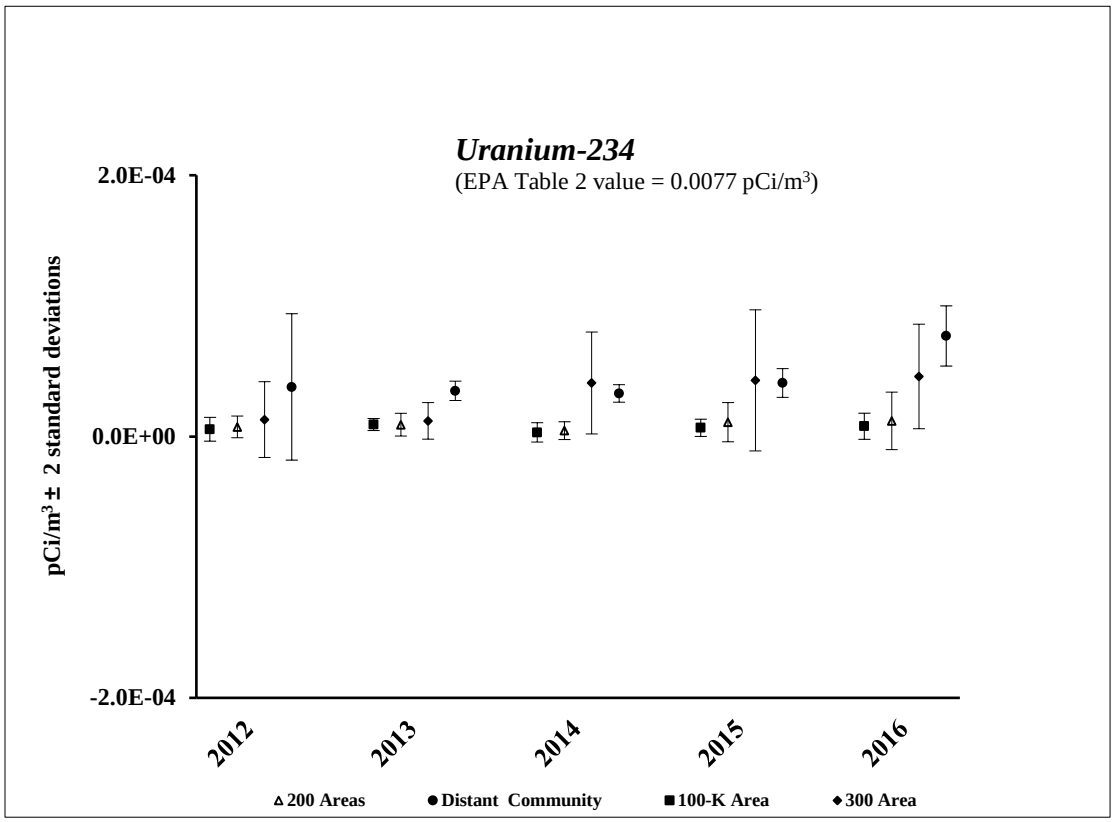
For most specific radionuclide analyses, radioactive material collected on a single filter during a 2-week period was too small to be measured accurately. Individual samples collected at each location were combined into semiannual, location-specific composite samples (Table 6-3) to increase accuracy. Composite samples were routinely analyzed for gamma-emitting isotopes, strontium-90, uranium-234, uranium-235, plutonium-238, uranium-238, and plutonium-239/240. Americium-241 and plutonium-241 were analyzed at locations associated with spent nuclear fuel processing.

Figure 6-1 shows the annual average air concentrations of selected radionuclides in the 100, 200, and 600 Areas compared to EPA concentration values and air concentrations measured in distant communities. EPA concentration values for environmental compliance (40 CFR 61, Appendix E, Table 2) are dose-based reference values used as indices of performance. The concentration values are concentrations that would result in a dose of 10 mrem (100 µSv)/yr under conditions of continuous exposure. The 2016 data indicate a large degree of variability by location. Air samples collected from locations at or directly adjacent to Hanford Site facilities had higher radionuclide concentrations than samples collected farther away. In general, analytical results for most radionuclides were at or near Hanford Site background levels, which are much less than EPA concentration values but greater than those measured offsite. Data also show that concentrations of certain radionuclides were higher and widely variable within different Hanford Site operational areas. Appendix C, Table C-4 shows the annual average and maximum concentrations of radionuclides in air samples collected near Hanford Site facilities and operations during 2016.


Cesium-137
(EPA Table 2 value = 0.019 pCi/m3)
5.0E-03
2.5E-03
0.0E+00
-2.5E-03
-5.0E-03
pCi/m3 ± 2 standard deviations
2012
2013
2014
2015
2016
200 Areas
Distant Community
100-K Area
300 Area


Plutonium-239/240
(EPA Table 2 value = 0.002 pCi/m3)
0.0002
0
-0.0002
pCi/m3 ± 2 standard deviations
2012
2013
2014
2015
2016
200 Areas
Distant Community
100-K Area


Strontium-90
(EPA Table 2 value = 0.019 pCi/m3)
0.002
0.001
0
-0.001
-0.002
pCi/m3 ± 2 standard deviations
2012
2013
2014
2015
2016
200 Areas
Distant Community
100-K Area


Uranium-234
(EPA Table 2 value = 0.0077 pCi/m3)
2.0E-04
0.0E+00
-2.0E-04
pCi/m3 ± 2 standard deviations
2012
2013
2014
2015
2016
200 Areas
Distant Community
100-K Area
300 Area

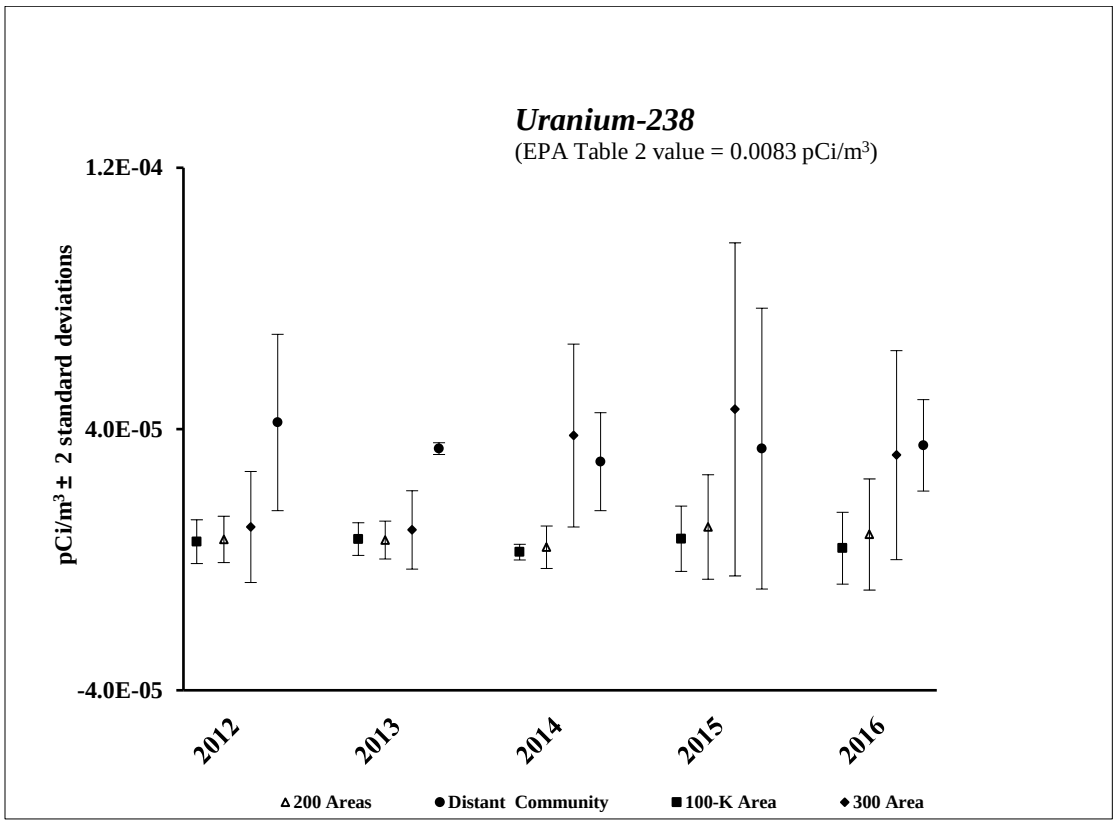


Figure 6-1. Hanford Site Average Radionuclide Concentrations in Ambient Air Samples Compared to Distant Community Samples.
NOTE: Because of figure scale, some uncertainties (error bars) are concealed by the point symbol

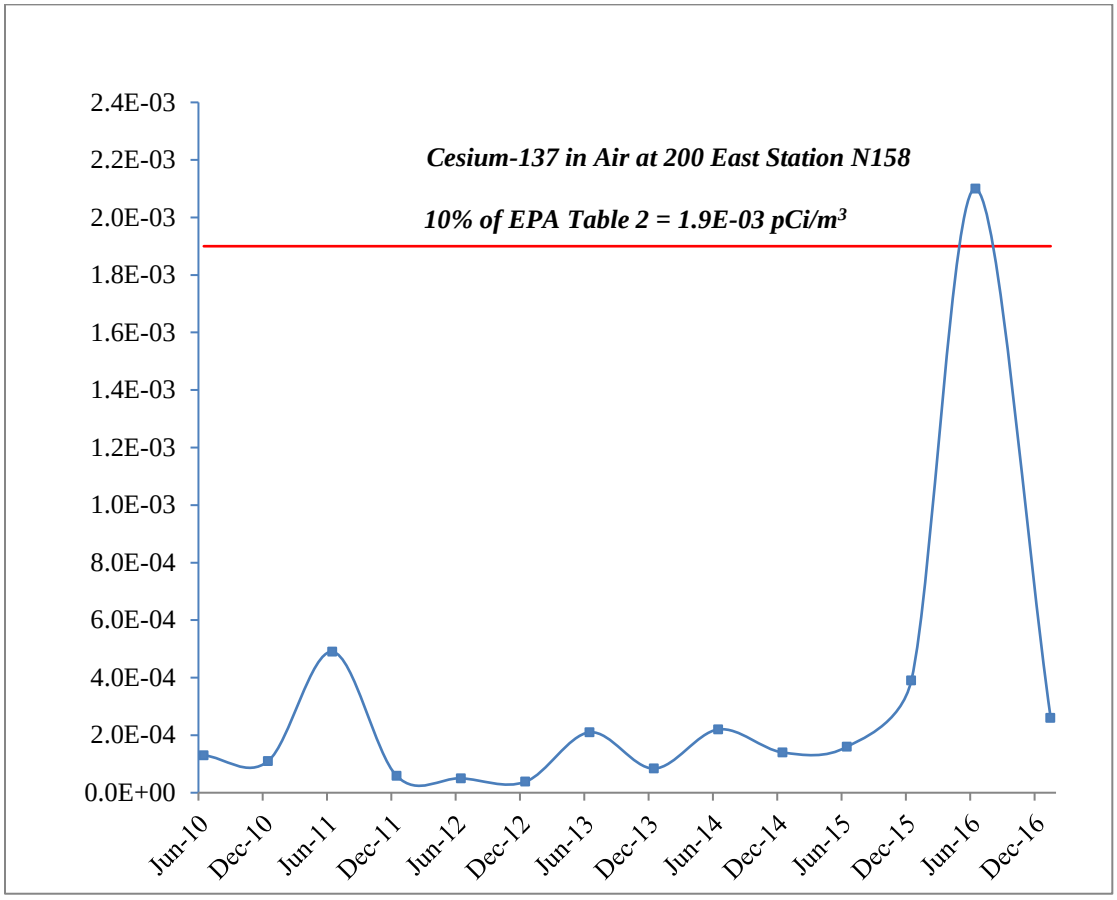
Ambient air was monitored in 2016 at six locations in the 100-K Area, and analytical results showed radionuclide concentrations at or below typical Hanford Site levels. Uranium-234 and -238 were detected in approximately 20% of the samples, and tritium was detected in approximately 28% of the samples. All other radionuclides of concern were below analytical detection limits.

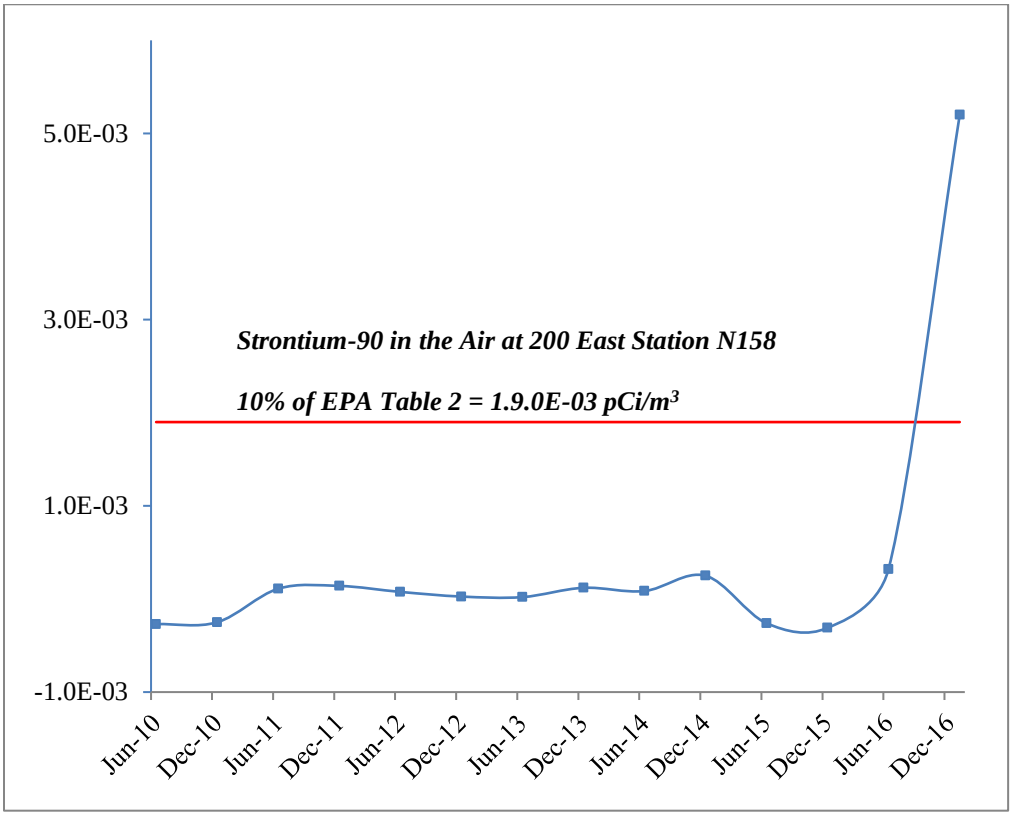
Air sampling was conducted at 21 locations in the 200-East Area during 2016. Generally, radionuclide levels measured in the 2016 air composite samples were similar to those measured in previous years. Uranium-234 and -238 were detected in approximately 28% of the samples. Air sampling station N158, located east of the 241-AX Tank Farm, showed air monitoring results for cesium-137 during the first half of 2016 and for strontium-90 during the second half of the year (see Figure 6-2), greater than 10% of EPA's concentration values (40 CFR 61, Appendix E, Table 2). Both instances may have been attributable to minor fugitive releases during radioactive waste transfer activities that were conducted throughout the year. As required by the Hanford Site Radioactive Emissions License (#FF-01), both elevated air sample results were reported to the WDOH.

Air sampling was conducted at 23 locations in the 200-West Area during 2016. Radionuclide levels measured were similar to results for previous years. Uranium-234 and -238 were detected in approximately 26% of the samples. Plutonium-239/240 was detected in approximately 5% of the samples. Air sampling station N165, located near the 216-ZPIC trench southeast of the Plutonium

Finishing Plant, showed one air monitoring result for plutonium-239/240 during the second half of 2016 (see Figure 6-2), greater than 10% of EPA's concentration values (40 CFR 61, Appendix E, Table 2). This was likely attributable to resuspension of radioactive materials believed to be contained in the surface soils along back roads near the facility that saw increased vehicle traffic in support of decommissioning activities that began in late summer. As required by the Hanford Site Radioactive Emissions License (#FF-01), this elevated air sample result was reported to the WDOH. At the 300 Treatment Effluent Disposal Facility station, components for tritium sampling were added in July. The results from these 4-week samples showed slightly lower tritium concentrations than those seen in stations located in/near the 300 Area. Air sampling was conducted at five locations at ERDF (200-West Area). Radionuclide levels measured at this site were comparable to previous years.

Air monitoring was conducted at four locations at the 618-10 Burial Ground Project north of the 300 Area. Radionuclide levels measured at this site were comparable to previous years.





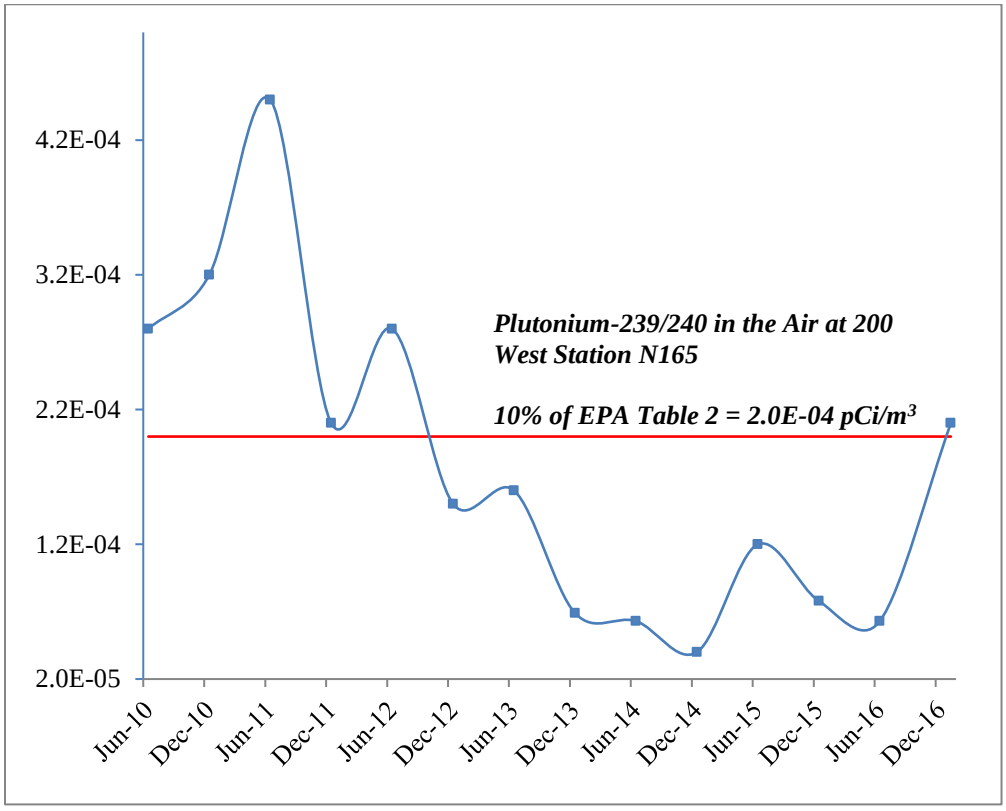


Figure 6-2. Ambient Air Sample Results Above Reporting Thresholds in 2016.

6.2.2 Hanford Site and Offsite Ambient Air Monitoring

Airborne radionuclide samples were collected in 2016 by 40 continuously operating samplers at or in the vicinity of the Hanford Site. The stations were grouped into four location categories: Hanford Site (21 stations), perimeter (11 stations), nearby Hanford Site communities (7 stations), and distant community (1 station; Figure 6-3; Appendix C, Table C-5). Hanford Site air samplers were located primarily around major operational areas to maximize the ability to detect radiological contaminants resulting from site operations. Perimeter samplers were located around the site boundary with emphasis on prevailing downwind directions to the south and east. Samplers located in Basin City, Benton City, Kennewick, Mattawa, Othello, Pasco, and Richland, Washington, provided data for the nearest population centers. A sampler in Yakima, Washington, provided background data from a community essentially unaffected by Hanford Site operations.

As a result of infrastructure reduction measures at the Hanford Site that resulted in removal of old electrical power lines, two onsite sampling stations ("100-F Met Tower" [N921] and "Hanford Townsite" [N922]) located in the River Corridor area were retired from service in August 2016. Dose rate monitoring with environmental thermoluminescent dosimeters was established during September 2016 to provide continued radiological monitoring at these two locations.

6.2.2.1 Sampling and Analysis. Samples were collected and analyzed according to a schedule established prior to the monitoring year for offsite samples (DOE/RL-2013-53, Rev. 2, *Hanford Site Environmental Surveillance Master Sampling Schedule Calendar Year 2016*). Airborne particle samples were collected biweekly at each location by continuously drawing air through a glass-fiber filter. The samples were transported to an analytical laboratory and stored for at least 72 hrs, allowing for the decay of short-lived naturally occurring radionuclides (e.g., radon gas decay products) that would otherwise obscure the detection of longer-lived radionuclides potentially present from Hanford Site emissions. The filters were then analyzed for gross beta radiation, with select filters analyzed for gross alpha radiation. For most radionuclides, the amount of radioactive material collected on a filter, historically during a 2-week period, has been too small to analyze accurately. Biweekly samples were combined into semiannual composite samples to increase the sensitivity and accuracy of the analysis. The compositing procedure results in a 26-week average concentration for specific radionuclides present in the atmosphere as particulates. Composite samples were analyzed as shown in Table 6-4.

Atmospheric water vapor was collected for tritium analysis at 20 locations in 2016 by continuously drawing air through multi-column samplers containing adsorbent silica gel. The water-vapor samplers were exchanged every 4 weeks to prevent sample loss as a result of breakthrough (i.e., oversaturation). The collection efficiency of the silica gel adsorbent is discussed in "Ambient Air Sampling for Tritium-Determination of Breakthrough Volumes and Collection Efficiencies for Silica Gel Adsorbent" (Patton et al. 1997). The collected water was distilled from the silica gel and analyzed for its tritium content.

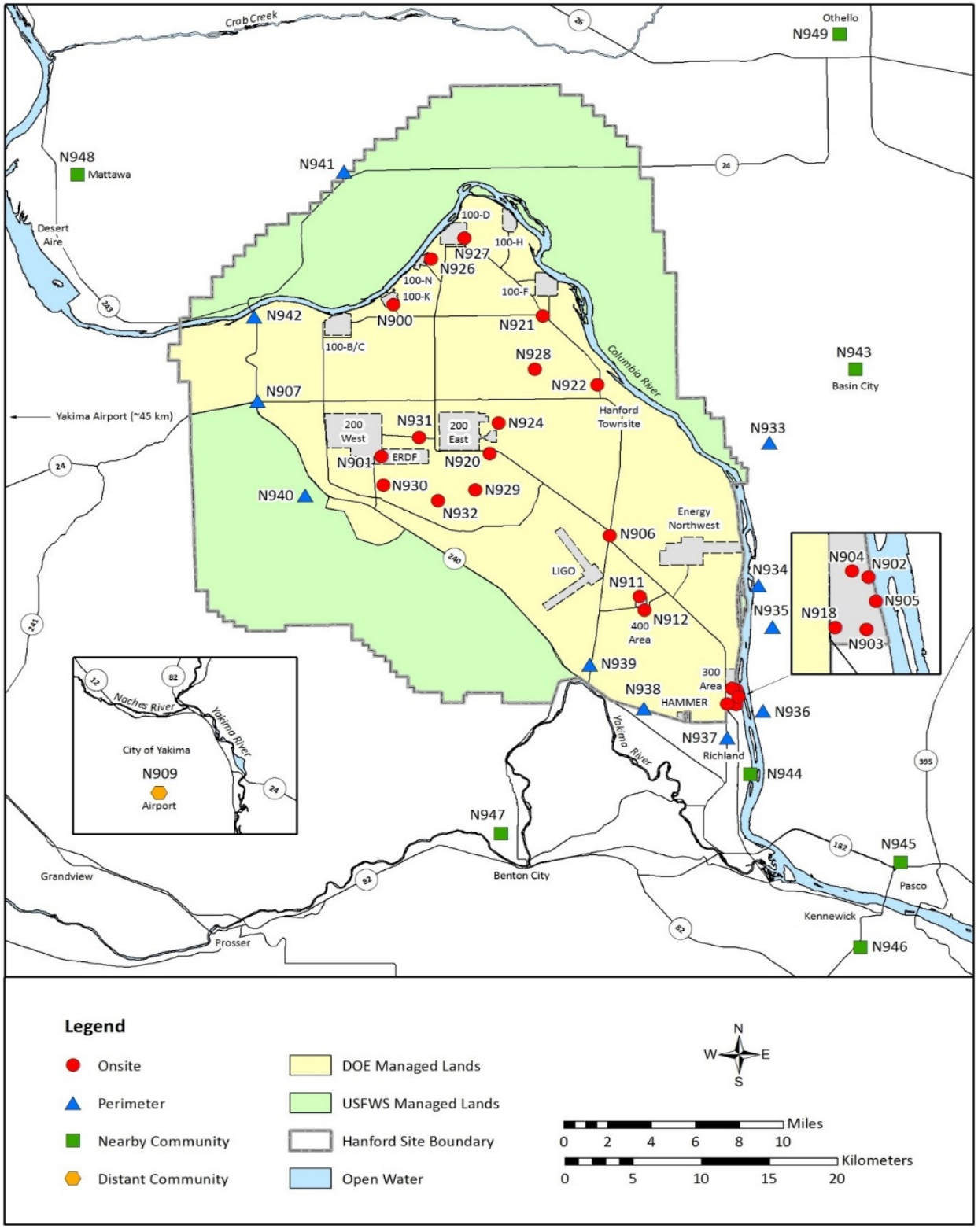


Figure 6-3. Ambient Air Sampling Locations.

Table 6-4. Hanford Site and Offsite Ambient Air Sampling Locations and Analytes. (2 Pages)

EDP Code[a]	Location	Analyses		
		Bi-Weekly	Monthly[b]	Composite
Hanford Site				
N900	100-K Area	Alpha, Beta	Tritium	GEA, strontium-90, plutonium-238, 239/240, uranium-234,235,238
N926	100-N-1325 Crib	Alpha, Beta	Tritium	GEA, strontium-90, plutonium-238, 239/240, uranium-234,235,238
N927	100-D Area	Alpha, Beta		GEA, strontium-90, plutonium-238, 239/240, uranium-234,235,238
N921	100-F Met Tower	Alpha, Beta		GEA, strontium-90, plutonium-238, 239/240, uranium-234,235,238
N922	Hanford Townsite	Alpha, Beta		GEA, strontium-90, plutonium-238, 239/240, uranium-234,235,238
N928	Gable Mountain	Alpha, Beta		GEA, strontium-90, plutonium-238, 239/240, uranium-234,235,238
N920	200-East SE	Alpha, Beta	Tritium	GEA, strontium-90, plutonium-238, 239/240, uranium-234,235,238
N929	S of 200-East	Alpha, Beta		GEA, strontium-90, plutonium-238, 239/240, uranium-234,235,238
N924	B-Pond	Alpha, Beta		GEA, plutonium-238, 239/240, uranium-234,235,238
N930	Army Loop Camp	Alpha, Beta		GEA, strontium-90, plutonium-238, 239/240, uranium-234,235,238
N931	200 Tel. Exchange	Alpha, Beta	Tritium	GEA, strontium-90, plutonium-238, 239/240, uranium-234,235,238
N932	SW of B/C Cribs	Alpha, Beta		GEA, strontium-90, plutonium-238, 239/240, uranium-234,235,238
N901	200-West SE	Alpha, Beta		GEA, strontium-90, plutonium-238, 239/240, uranium-234,235,238
N905	300 Water Intake[c, d]	Alpha, Beta	Tritium	GEA, strontium-90, plutonium-238, 239/240, uranium-234,235,238
N903	300 South Gate[e, f]	Alpha, Beta	Tritium	GEA, strontium-90, plutonium-238, 239/240, uranium-234,235,238
N918	300 South West[e]	Alpha, Beta	Tritium	GEA, strontium-90, plutonium-238, 239/240, uranium-234,235,238
N904	300 Trench[e]	Alpha, Beta	Tritium	GEA, strontium-90, plutonium-238, 239/240, uranium-234,235,238
N902	300-NE[e]	Alpha, Beta	Tritium	GEA, strontium-90, plutonium-238, 239/240
N911	400-N	Alpha, Beta		GEA, strontium-90, plutonium-238, 239/240
N912	400-S	Alpha, Beta	Tritium	GEA, strontium-90, plutonium-238, 239/240
N906	Wye Barricade[c, f]	Alpha, Beta		GEA, strontium-90, plutonium-238, 239/240, uranium-234,235,238
Hanford Site Perimeter				
N933	Ringold Met Tower	Alpha, Beta	Tritium	GEA, plutonium-238, 239/240
N934	W End of Fir Road[c, d]	Alpha, Beta	Tritium	GEA, strontium-90, plutonium-238, 239/240, uranium-234,235,238
N935	Dogwood Met Tower	Alpha, Beta	Tritium	GEA, strontium-90, uranium-234,235,238
N936	Byers Landing	Alpha, Beta	Tritium	GEA, strontium-90, plutonium-238, 239/240, uranium-234,235,238
N937	Battelle Complex[c, d]	Alpha, Beta	Tritium	GEA, uranium-234,235,238
N938	Horn Rapids Substa.	Alpha, Beta		GEA, strontium-90, plutonium-238, 239/240
N939	Prosser Barricade[c, d]	Alpha, Beta	Tritium	GEA, strontium-90, plutonium-238, 239/240
N907	Yakima Barricade[c]	Alpha, Beta		GEA, strontium-90, plutonium-238, 239/240
N940	Rattlesnake Springs	Alpha, Beta		GEA, strontium-90, plutonium-238, 239/240
N941	Wahluke Slope	Alpha, Beta	Tritium	GEA, strontium-90, plutonium-238, 239/240
N942	S End Vernita Bridge	Beta, Alpha		GEA, strontium-90, plutonium-238, 239/240
Nearby Hanford Site Communities				
N943	Basin City School	Alpha, Beta	Tritium	GEA, plutonium-238, 239/240, uranium-234,235,238

Table 6-4. Hanford Site and Offsite Ambient Air Sampling Locations and Analytes. (2 Pages)

EDP Code[a]	Location	Analyses		
		Bi-Weekly	Monthly[b]	Composite
N944	Leslie Groves-Richland	Alpha, Beta	Tritium	GEA, strontium-90, plutonium-238, 239/240, uranium-234,235,238
N945	Pasco	Beta		GEA, strontium-90, plutonium-238, 239/240, uranium-234,235,238
N946	Kennewick-Ely Street	Alpha, Beta		GEA, strontium-90, plutonium-238, 239/240, uranium-234,235,238
N947	Benton City	Beta		GEA
N948	Mattawa	Beta		GEA
N949	Othello	Beta		GEA, uranium-234,235,238
Distant Hanford Site Community				
N909	Yakima	Alpha, Beta	Tritium	GEA, strontium-90, plutonium-238, 239/240, uranium-234,235,238

[a] EDP code=environmental data point code = sampler location code; refer to Figure 6-2.
[b] Atmospheric water vapor samples for tritium analysis are collected every 4 weeks using silica gel columns.
[c] WDOH particulate air sampler also at this location.
[d] WDOH tritium air sampler also at this location.
[e] Two tritium samples are collected from this location, one as a Quality Assurance duplicate sample.
[f] Quality assurance duplicate sample collected at this location.

GEA = gamma energy analysis

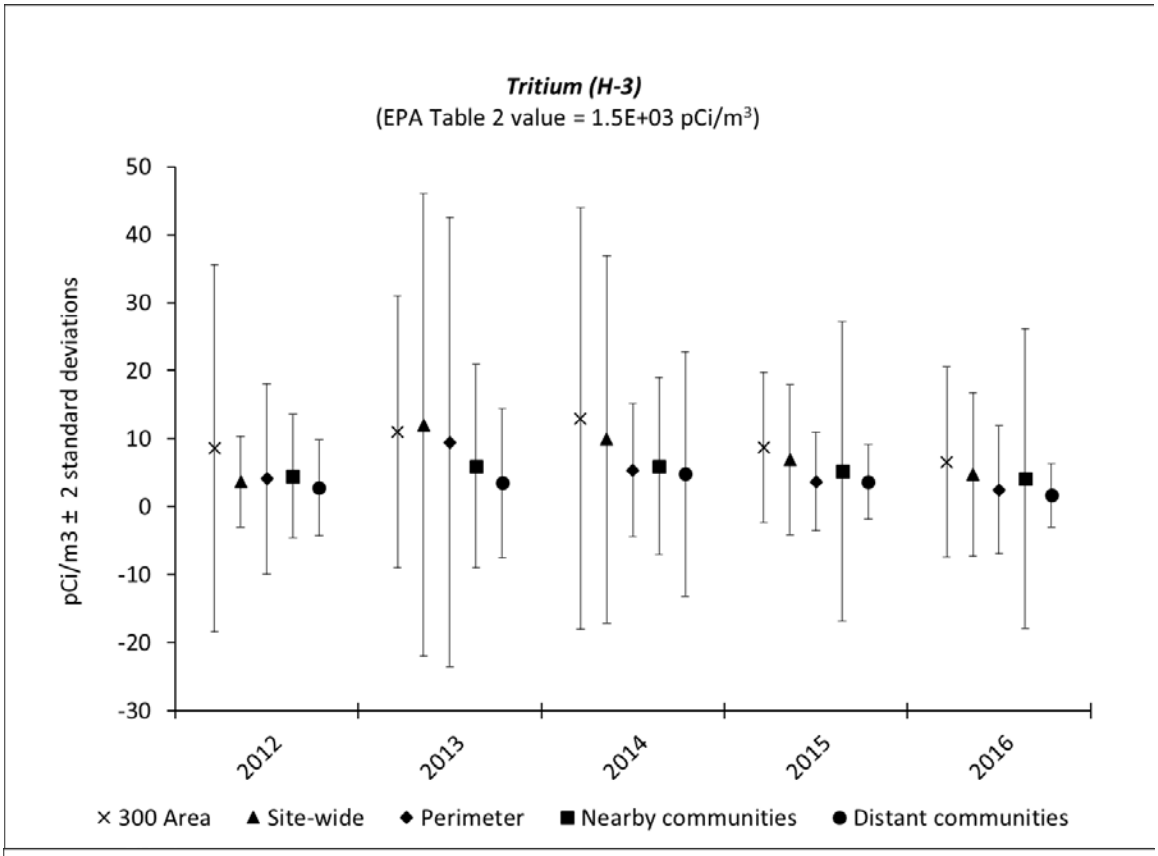
6.2.2.2 Monitoring Results. All sample results in 2016 showed very low radiological concentrations in air. All radionuclide concentrations (Appendix C, Table C-5) were less than their respective EPA Table 2 concentration values. The EPA concentration values (40 CFR 61, Appendix E, Table 2) are concentrations that would result in an annual dose of 10 mrem (100 µSv)/yr from airborne radiological material.

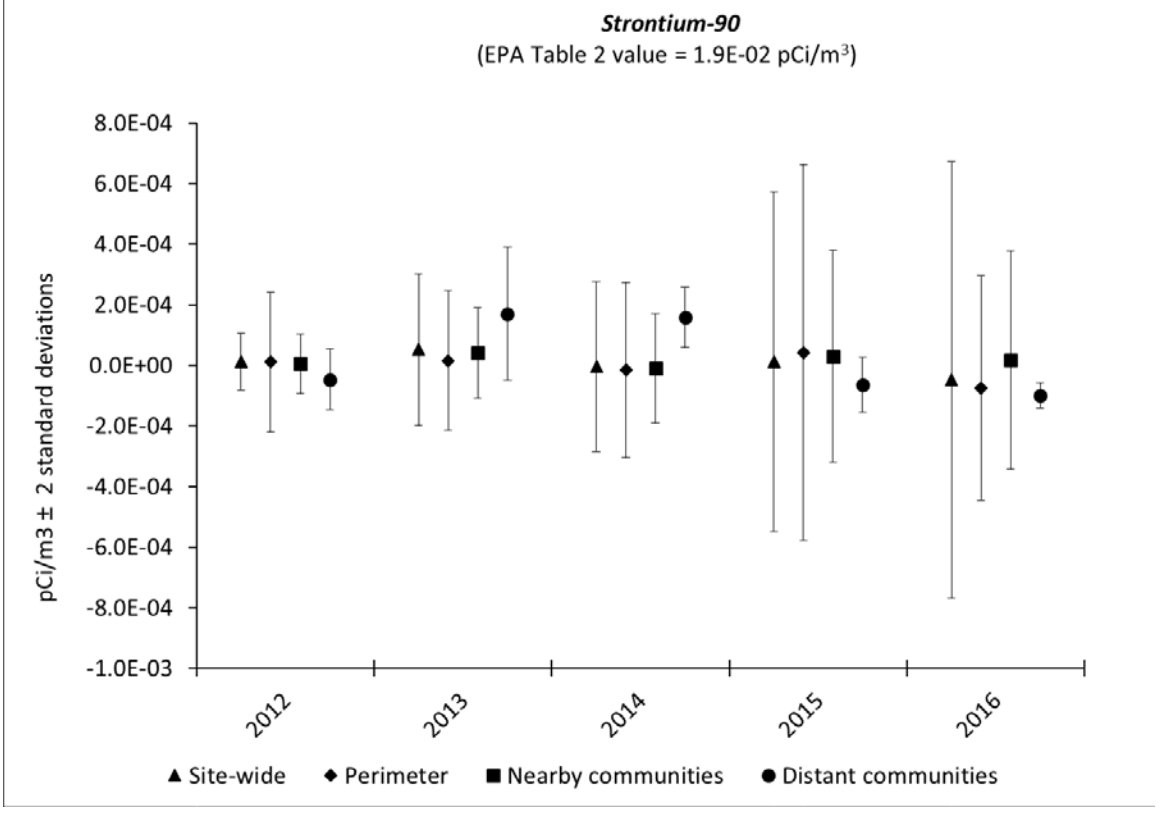
Gross alpha and gross beta concentrations in the air samples collected in 2016 from Hanford Site, perimeter, and nearby Hanford Site communities were comparable to each other and slightly higher than samples from the distant community. Concentrations in 2016 were comparable to concentrations seen in the previous 5 years. Gross beta and gross alpha concentrations in air peak during the fall and winter months, exhibiting a pattern of natural radioactivity fluctuations (Eisenbud 1987). This fluctuation is seen in both Hanford Site and distant location concentrations.

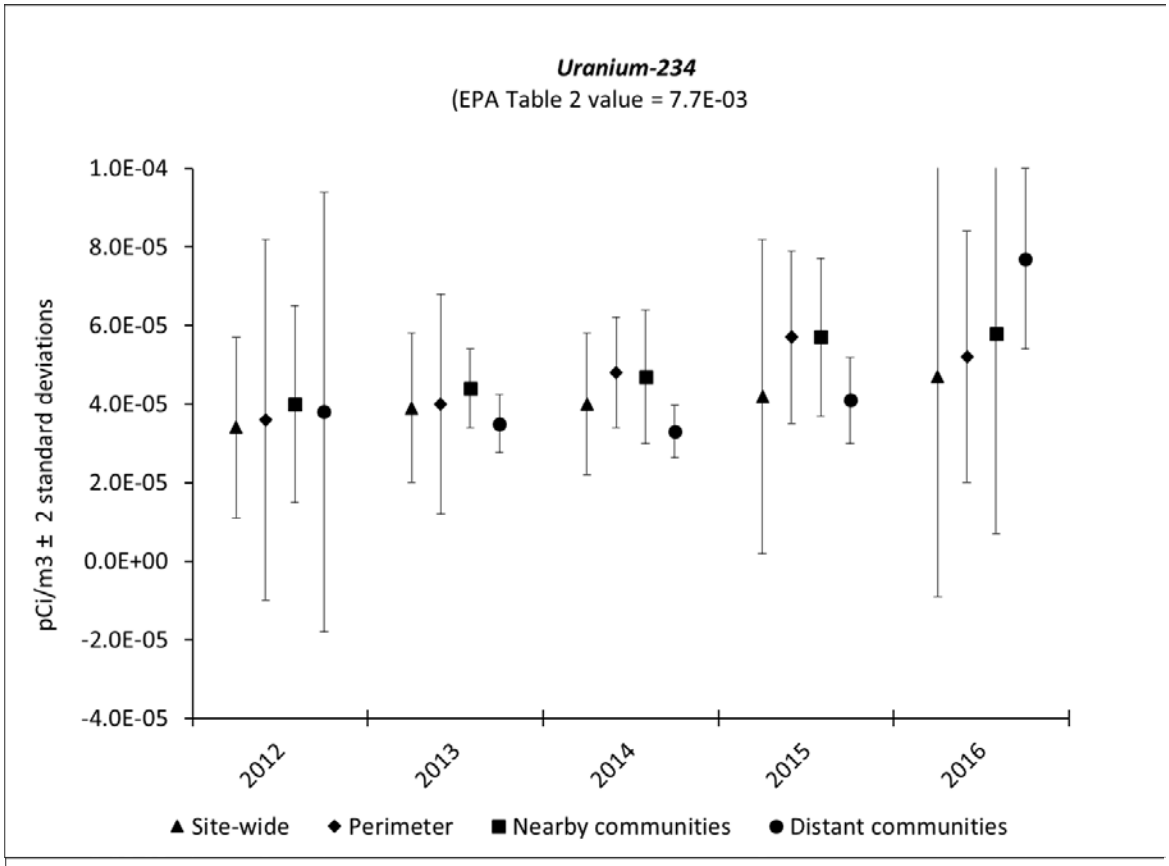
Plutonium-239/240 was not detected in any of the offsite air samples collected in 2016. Figure 6-4 shows plutonium-239/240 concentrations in the air samples collected in 2016 and in previous years.

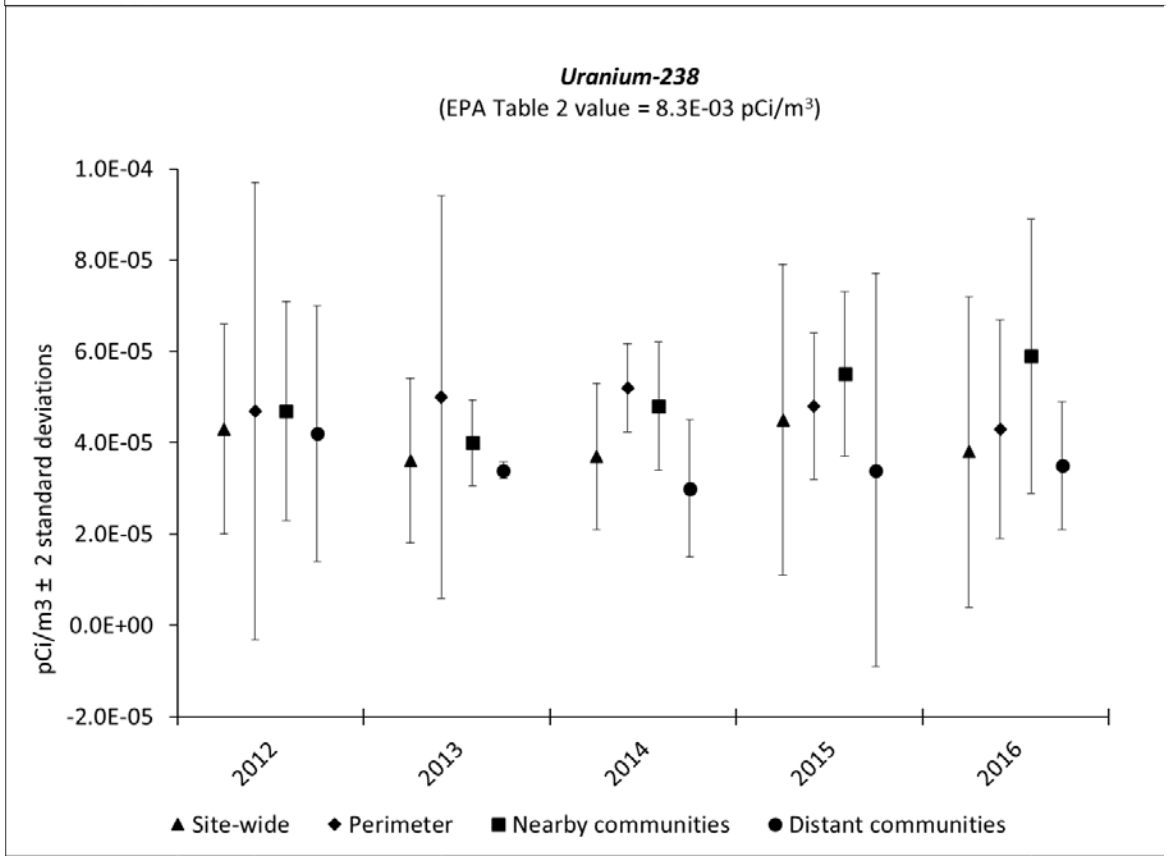
Uranium-234 and -238 were both detected in approximately 65% of the air samples collected in 2016 from all locations. Figure 6-4 shows that uranium-234 and uranium-238 concentrations were at levels similar to those measured in previous years. The maximum concentrations measured in all locations were less than 10% of the EPA concentration values for both radionuclides.

Tritium was detected in approximately 10% of the samples collected in 2016. Slightly more than half of the samples with detectable tritium concentrations were collected from stations located near the 300 Area. Cesium-137 and strontium-90 was not detected in any of the samples collected during 2016.


Tritium (H-3)
(EPA Table 2 value = 1.5E+03 pCi/m3)
pCi/m3 ± 2 standard deviations
50
40
30
20
10
0
-10
-20
-30
2012
2013
2014
2015
2016
× 300 Area
▲ Site-wide
◆ Perimeter
■ Nearby communities
● Distant communities


Strontium-90
(EPA Table 2 value = 1.9E-02 pCi/m3)
pCi/m3 ± 2 standard deviations
8.0E-04
6.0E-04
4.0E-04
2.0E-04
0.0E+00
-2.0E-04
-4.0E-04
-6.0E-04
-8.0E-04
-1.0E-03
2012
2013
2014
2015
2016
▲ Site-wide
◆ Perimeter
■ Nearby communities
● Distant communities


Uranium-234
(EPA Table 2 value = 7.7E-03
1.0E-04
8.0E-05
6.0E-05
4.0E-05
2.0E-05
0.0E+00
-2.0E-05
-4.0E-05
pCi/m3 ± 2 standard deviations
2012
2013
2014
2015
2016
Site-wide
Perimeter
Nearby communities
Distant communities


Uranium-238
(EPA Table 2 value = 8.3E-03 pCi/m3)
1.0E-04
8.0E-05
6.0E-05
4.0E-05
2.0E-05
0.0E+00
-2.0E-05
pCi/m3 ± 2 standard deviations
2012
2013
2014
2015
2016
Site-wide
Perimeter
Nearby communities
Distant communities

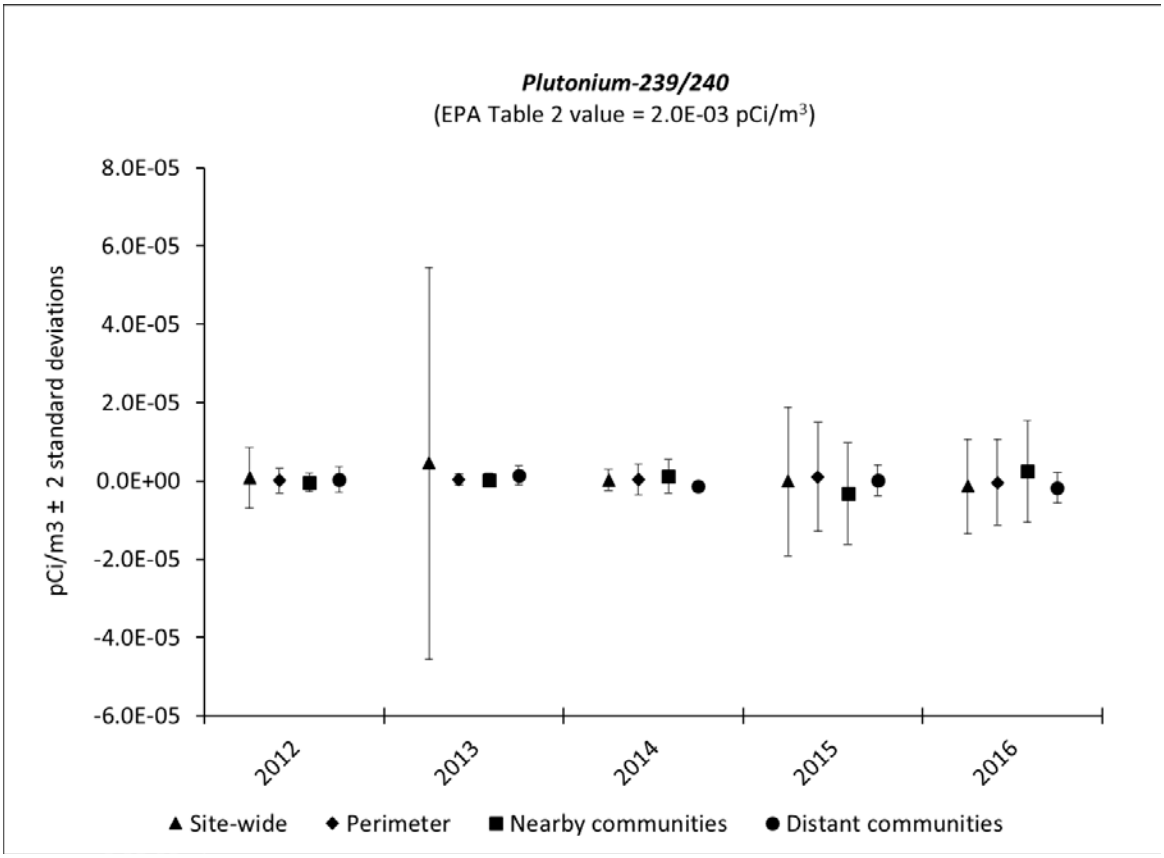


Figure 6-4. Radionuclide Concentrations in Ambient Air Samples (1 pCi = 0.037 Bq).