
4.1 Air Surveillance

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Atmospheric releases of pollutants from the Hanford Site to the surrounding region are a potential source of human exposure. Thus, radioactive and nonradioactive materials in air are monitored at a number of locations on and around the Site. The influence of Hanford emissions on local pollutant concentrations was evaluated by comparing air concentrations measured at distant locations within the region to concentrations measured at the Site perimeter. This section discusses sample collection techniques and analytical methods and summarizes the analytical results of the Hanford air surveillance program. A complete listing of all analytical results summarized in this section is reported separately by Bisping (1996). A detailed description of all radiological sampling and analytical techniques is provided in the *Environmental Monitoring Plan* (DOE 1994a).

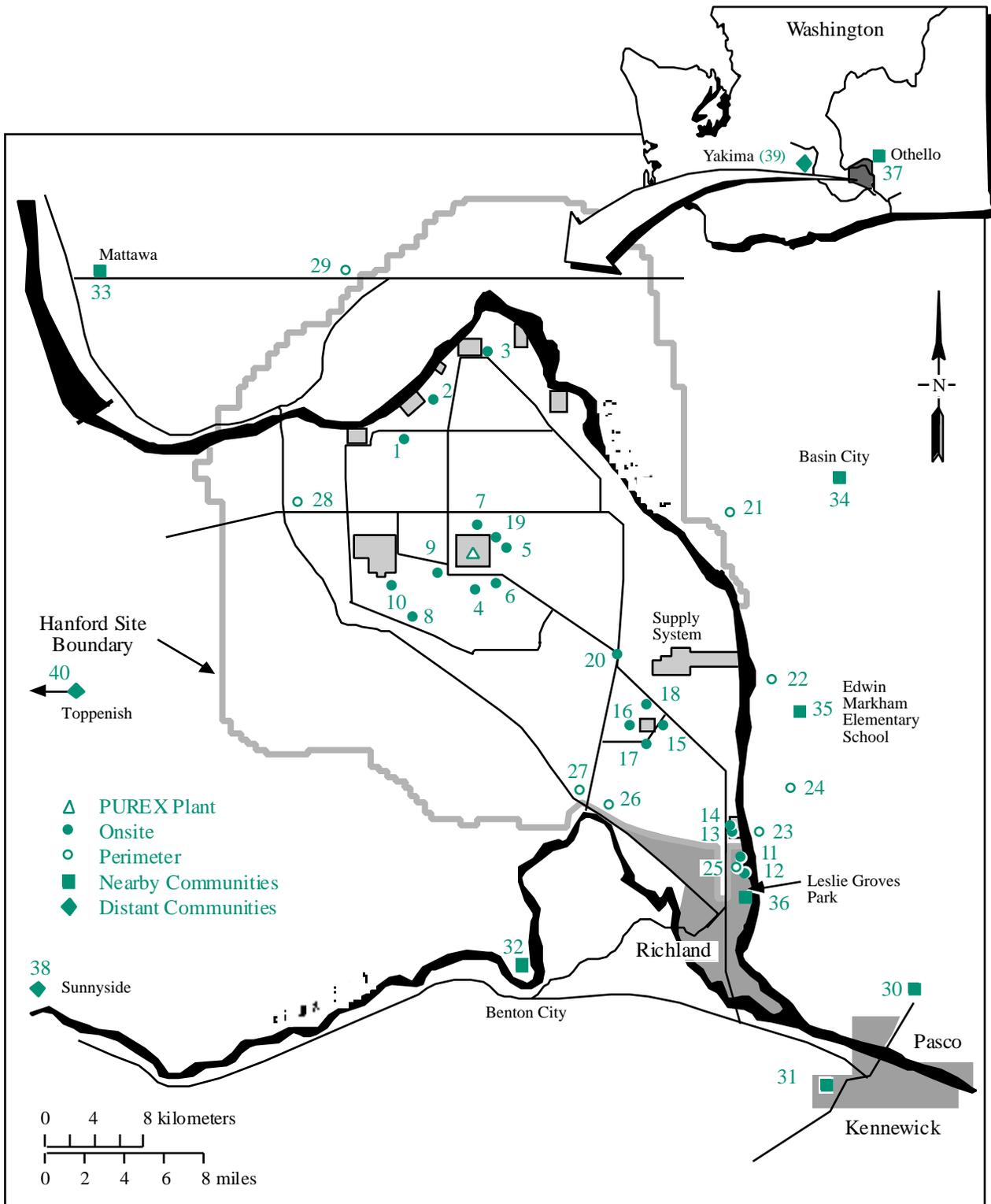
Collection and Analysis of Radiological Air Samples

Airborne radionuclides were sampled by a network of 40 continuously operating samplers: 20 on the Hanford Site, 9 near the Site perimeter, 8 in nearby communities, and 3 in distant communities (Figure 4.1.1 and Table 4.1.1). Eight of the stations were community-operated environmental surveillance stations (see Section 6.4) that were managed and operated by local school teachers. Air samplers on the Hanford Site were located primarily around major operational areas to maximize the ability to detect contaminants resulting from Site operations. Perimeter samplers were located around the Site, with emphasis on the prevailing downwind directions to the south and east of the Site (see Figure 6.1.1). Continuous samplers located in Benton City, Richland, Kennewick, Mattawa, Othello, and Pasco provided data for the nearest population centers. Samplers in the distant communities of Sunnyside, Toppenish, and Yakima provided background data for communities essentially unaffected by Site operations.

Samples were collected according to a schedule established before the monitoring year (Bisping 1995a). Air sampling locations are listed in Table 4.1.1, along with specific analyses for each location. Airborne particles were sampled at each of these locations by continuously drawing air through a high-efficiency glass-fiber filter. The filters were collected every 2 weeks, field surveyed with hand-held instruments for total radioactivity to detect any unusual occurrences. Field measurements of radioactivity in samples are used to monitor changes in environmental conditions that could warrant attention before the more detailed and sensitive laboratory analyses are completed. The samples were transported to an analytical laboratory and stored for at least 7 days. The storage period was necessary to allow for the decay of short-lived, naturally occurring radionuclides (e.g., radon gas decay products) that would otherwise obscure detection of longer-lived radionuclides potentially present from Hanford emissions. The filters were then analyzed for total beta radioactivity and most filters were also analyzed for total alpha radioactivity.

For most radionuclides, the amount of radioactive material collected on the filter during the 2-week period was too small to be readily measured. The sensitivity and accuracy of sample analysis was increased by combining biweekly samples for nearby locations (or in some cases a single location) into quarterly composite or annual composite samples. The quarterly composite samples were analyzed for specific gamma-emitting radionuclides (Appendix E). The quarterly composite samples were then used to form annual composite samples (Table 4.1.2). Annual composites were analyzed for strontium and plutonium isotopes, with selected annual composites also analyzed for uranium, americium, or gamma-emitting radionuclides.

Gaseous iodine-131 was sampled at four locations by drawing air through a cartridge containing chemically treated activated charcoal. These cartridges were exchanged biweekly and were located downstream of a particle filter. Iodine-131 has a short half-life (8 days) and is potentially present in the environment only around



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Figure 4.1.1. Air Sampling Locations, 1995 (see Table 4.1.1 for location names)

Table 4.1.1. Air Sampling Locations, Sample Composite Groups, and Analyses, 1995

Map ^(a) Location	Sampling Location	Analyses ^(b)	Composite Group	Analyses ^(c)
Onsite				
1	100-K	Beta, alpha, ³ H	100 Areas	Gamma, Sr, Pu
2	100-N, 1325 Crib	Beta, alpha, ³ H		
3	100-D	Beta, alpha		
4	S of 200-East	Beta, alpha	South of 200-East	Gamma, Sr, Pu, U
5	E of 200-East	Beta, alpha	East of 200-East	Gamma, Sr, Pu, U
6	200-East SE	Beta, alpha, ³ H, ¹²⁹ I, SVOC ^(d)	200-East SE	Gamma, Sr, Pu, U, Am
7	N of 200-East	Beta	North of 200-East	Gamma - Annual
8	Army Loop Camp	Beta, alpha	200-West, South, and East	Gamma, Sr, Pu, U
9	GTE Building	Beta, alpha, ³ H		
10	200-West SE	Beta, alpha	200-West	Gamma, Sr, Pu, U
11	300 Water intake	Beta	300 Area	Gamma, Sr, Pu, U
12	300-South Gate	Beta, alpha, ³ H SVOC		
13	300 NE	Beta, alpha, ³ H	300 NE	Gamma, Sr, Pu, U
14	300 Trench	Beta, alpha, ³ H		
15	400-East	Beta, alpha, ³ H	400 Area	Gamma, Sr, Pu
16	400-West	Beta, alpha		
17	400-South	Beta, alpha		
18	400-North	Beta, alpha		
19	B Pond	Beta, alpha	B Pond	Gamma, Sr, Pu, U
20	Wye Barricade	Beta, alpha	Wye Barricade	Gamma, Sr, Pu, U, Am
Perimeter				
21	Ringold Met. Tower	Beta, alpha, ³ H, ¹²⁹ I, ¹³¹ I	Ringold Met. Tower	Gamma, Sr, Pu
22	W End of Fir Road	Beta, alpha	W End of Fir Road	Gamma, Sr, Pu, U, Am
23	Byers Landing	Beta, alpha, ³ H, ¹²⁹ I, ¹³¹ I	Byers Landing	Gamma, Sr, Pu, U, Am
24	Dogwood Met. Tower	Beta, alpha, ³ H	Dogwood Met. Tower	Gamma, Sr, Pu, U, Am
25	Battelle Complex	Beta	Battelle Complex	Gamma - Annual
26	Horn Rapids Road Substation	Beta, alpha	Prosser Barricade	Gamma, Sr, Pu, U
27	Prosser Barricade	Beta, alpha, ³ H		
28	Yakima Barricade	Beta, alpha, SVOC ^(e)	Yakima Barricade	Gamma, Sr, Pu

Table 4.1.1. Air Sampling Locations, Sample Composite Groups, and Analyses, 1995 (contd)

Map ^(a) Location	Sampling Location	Analyses ^(b)	Composite Group	Analyses ^(c)
29	Wahluke Slope	Beta, alpha, ³ H	Wahluke Slope	Gamma, Sr, Pu
Nearby Communities				
30	Pasco	Beta	} Tri-Cities	Gamma, Sr, Pu
31	Kennewick	Beta, alpha		
32	Benton City	Beta	Benton City	Gamma - Annual
33	Mattawa	Beta	Mattawa	Gamma - Annual
34	Basin City	Beta, alpha, ³ H	Basin City Elem. School	Gamma, Sr, Pu, U
35	North Franklin County	Beta, alpha, ³ H, ¹³¹ I	Edwin Markham Elem. School	Gamma, Sr, Pu, U, Am
36	Richland	Beta, alpha, ³ H	Leslie Groves Park	Gamma, Sr, Pu, U
37	Othello	Beta	Othello	Gamma - Annual
Distant Communities				
38	Sunnyside	Beta, alpha, ³ H	Sunnyside	Gamma, Sr, Pu, U
39	Yakima	Beta, alpha, ³ H, ¹²⁹ I, ¹³¹ I	Yakima	Gamma, Sr, Pu, U, Am
40	Toppenish	Beta, alpha, ³ H	Toppenish	Gamma, Sr, Pu, U

(a) See Figure 4.1.1.

(b) Beta, alpha, and ¹³¹I samples are collected biweekly (every 2 weeks), ³H samples are collected monthly (every 4 weeks), and ¹²⁹I samples are collected monthly (every 4 weeks) and combined into a quarterly composite sample for each location.

(c) Gamma scans are performed on quarterly composite samples (or on annual composite samples [Gamma - Annual]); Sr, Pu, U, and Am analyses are performed on annual composite samples.

(d) SVOC = Semivolatile organic compounds.

(e) These semivolatile organic compound samples were actually collected at Rattlesnake Springs (Figure 1.0.1).

active nuclear reactors. With the shutdown of all DOE nuclear reactors on the Hanford Site, there is no active DOE source of this radioisotope. Any iodine-131 released to the environment from past DOE operations would have decayed to undetectable amounts. Therefore, sampling for iodine-131 was discontinued in May 1995.

Iodine-129 (16,000,000-year half-life) was sampled at 4 locations using a similar technique as that used to collect iodine-131; however, a special low-background petroleum-charcoal cartridge was used for increased sensitivity. Samples were collected monthly and combined to form quarterly composite samples for each location.

Atmospheric water vapor was collected for tritium analysis at 19 locations by continuously passing air through cartridges containing silica gel, which were exchanged every 4 weeks. The collection efficiency of the silica gel adsorbent is discussed in Patton et al. (1995). The collected water was distilled from the silica gel and analyzed for its tritium content.

Some of the environmental surveillance air samples were collected at eight community-operated environmental surveillance stations (see Section 6.4) located at Basin City Elementary School in Basin City, Edwin Markham Elementary School in Franklin County, Leslie Groves

Table 4.1.2. Airborne Radionuclide Concentrations in the Hanford Environs, 1995 Compared to Values from the Previous 5 Years

Radionuclide	Location Group ^(a)	No. of Samples	1995		No. of Samples	1990-1994		1995 Concentration Guide ^(d) pCi/m ³
			Maximum ^(b) pCi/m ³	Average ^(c) pCi/m ³		Maximum ^(b) pCi/m ³	Average ^(c) pCi/m ³	
Total beta	Onsite	514	0.069 ± 0.0073	0.017 ± 0.00090	2,351	0.13 ± 0.012	0.020 ± 0.00053	
	Perimeter	205	0.065 ± 0.0069	0.017 ± 0.0014	1,291	0.15 ± 0.014	0.019 ± 0.00072	
	Nearby Communities	201	0.062 ± 0.0062	0.016 ± 0.0011	880	0.10 ± 0.0098	0.019 ± 0.00087	
	Distant Communities	71	0.061 ± 0.0064	0.015 ± 0.0025	387	0.12 ± 0.013	0.018 ± 0.0013	
			aCi/m ³	aCi/m ³		aCi/m ³	aCi/m ³	aCi/m ³
⁹⁰ Sr	Onsite	15	300 ± 96	47 ± 49	82	4,200 ± 810	100 ± 130	9,000,000
	Perimeter	7	0.32 ± 12	-1.6 ± 1.5	53	2,300 ± 430	170 ± 140	
	Nearby Communities	4	2.7 ± 16	-1.4 ± 3.2	44	6,300 ± 1,200	210 ± 300	
	Distant Communities	3	-1.8 ± 9.7	-7.1 ± 6.8	30	68 ± 120	-5.1 ± 9.2	
¹²⁹ I	Onsite	4	50 ± 12	40 ± 11	20	110 ± 10	52 ± 10	70,000,000
	Perimeter	8	2.3 ± 0.28	1.1 ± 0.48	40	5.2 ± 0.39	1.5 ± 0.27	
	Distant Communities	4	0.056 ± 0.0054	0.035 ± 0.018	20	0.40 ± 0.046	0.10 ± 0.034	
¹³¹ I	Perimeter	22	5,900 ± 3,700	-3,300 ± 7,700	325	13,000 ± 11,000	5.0 ± 250	400,000,000
	Nearby Communities	10	2,700 ± 4,500	-210 ± 1,700	230	28,000 ± 19,000	470 ± 410	
	Distant Communities	10	4,000 ± 4,200	990 ± 1,500	161	7,200 ± 8,900	50 ± 330	
¹³⁷ Cs	Onsite	45	550 ± 440	60 ± 64	203	1,200 ± 880	65 ± 42	400,000,000
	Perimeter	29	450 ± 250	-16 ± 97	161	1,400 ± 1,100	24 ± 68	
	Nearby Communities	19	300 ± 460	41 ± 47	120	990 ± 1,500	4.9 ± 62	
	Distant Communities	11	280 ± 410	3.2 ± 120	80	1,300 ± 1,200	36 ± 93	
U total ^(e)	Onsite	39	25 ± 4.3	10 ± 2.4	189	3,400 ± 330	66 ± 48	100,000
	Perimeter	12	36 ± 5.7	17 ± 7.9	78	64 ± 13	21 ± 3.9	
	Nearby Communities	9	26 ± 6.3	12 ± 6.3	54	44 ± 12	19 ± 3.9	
	Distant Communities	9	19 ± 3.7	11 ± 5.3	72	230 ± 30	21 ± 7.0	
²³⁸ Pu	Onsite	15	0.18 ± 0.33	-0.21 ± 0.20	82	2.0 ± 1.2	0.26 ± 0.14	30,000
	Perimeter	7	0.19 ± 0.37	0.078 ± 0.070	52	3.1 ± 4.1	0.078 ± 0.24	
	Nearby Communities	4	0.28 ± 0.62	0.096 ± 0.16	44	1.8 ± 1.6	0.029 ± 0.14	
	Distant Communities	3	0.047 ± 0.52	0.019 ± 0.030	30	5.3 ± 3.1	0.50 ± 0.44	

Table 4.1.2. Airborne Radionuclide Concentrations in the Hanford Environs, 1995 Compared to Values from the Previous 5 Years (contd)

Radionuclide	Location Group ^(a)	1995			1990-1994			1995 Concentration Guide ^(d) aCi/m ³
		No. of Samples	Maximum ^(b) aCi/m ³	Average ^(c) aCi/m ³	No. of Samples	Maximum ^(b) aCi/m ³	Average ^(c) aCi/m ³	
^{239,240} Pu	Onsite	15	3.1 ± 1.2	0.92 ± 0.54	82	12 ± 3.0	1.7 ± 0.48	20,000
	Perimeter	7	1.5 ± 0.77	0.54 ± 0.42	52	2.5 ± 2.0	0.82 ± 0.20	
	Nearby Communities	4	0.41 ± 0.29	0.20 ± 0.17	44	3.3 ± 1.5	0.85 ± 0.26	
	Distant Communities	3	1.2 ± 1.2	0.46 ± 0.77	30	3.9 ± 1.3	0.53 ± 0.42	
²⁴¹ Am ^(f)	Onsite	2	0.12 ± 1.1	0.11 ± 0.015	4	0.90 ± 1.2	0.44 ± 0.40	20,000
	Perimeter	3	0.33 ± 0.66	0.19 ± 0.14	5	0.43 ± 1.2	-0.27 ± 0.60	
	Nearby Communities	1	0.061 ± 0.56	0.061	2	-0.32 ± 0.76	-0.48 ± 0.32	
	Distant Communities	1	-0.34 ± 0.38	-0.34	2	-0.47 ± 1.1	-0.77 ± 0.61	
Total alpha ^(g)	Onsite	463	2,100 ± 610	440 ± 25	988	8,300 ± 1,400	740 ± 63	
	Perimeter	179	1,900 ± 680	490 ± 43	537	12,000 ± 1,700	1,200 ± 120	
	Nearby Communities	101	1,200 ± 340	500 ± 48	236	6,200 ± 1,300	790 ± 110	
	Distant Communities	71	1,400 ± 480	380 ± 64	125 ^(h)	6,500 ± 1,100	850 ± 180	

(a) Location groups are identified in Table 4.1.1.

(b) Maximum single sample result ±2 total propagated analytical uncertainty. Negative concentration values are explained in the section, "Helpful Information."

(c) Average of all samples ±2 times the standard error of the mean.

(d) From DOE Derived Concentration Guide (see Appendix C).

(e) Summation of Uranium-234, -235, and -238.

(f) Americium-241 sampling was initiated in 1993.

(g) Total alpha values for 1991 and 1992 were not included because extended storage of these samples before analysis likely resulted in anomalously high concentrations through the ingrowth of alpha-emitting radon and thoron decay products (Sheets and Thompson 1992).

(h) Two results from the distant communities were excluded as anomalous values through the use of a Q-test (26,000 ± 3,400 aCi/m³ at Yakima and 8,000 ± 1,000 aCi/m³ at Sunnyside (Skoog and West 1980)).

Park in Richland, Pasco at Columbia Basin College, Kennewick, Othello, Mattawa, and Toppenish at Heritage College (see Table 4.1.1). These samples were collected by local teachers using the same equipment and procedures as the routine surveillance program. This work is part of an ongoing DOE-sponsored program to promote public awareness of Hanford environmental monitoring programs.

Radiological Results for Air Samples

Radiological air sampling results for onsite, Site perimeter, nearby communities, and distant communities for total beta, total alpha, and specific radionuclides are summarized in Table 4.1.2. Some specific radionuclides (cobalt-60, cesium-134, cesium-137, europium-154, and europium-155) were occasionally ($\geq 88\%$ of results were below detection limits) identified in the quarterly or annual composite gamma-scan analyses (Appendix E), but none of Hanford origin was detected consistently. In addition, naturally occurring beryllium-7 and potassium-40 were routinely identified by gamma-scan analyses.

Total beta concentrations in air for 1995, as shown in Figure 4.1.2, peaked during the winter, repeating a pattern of natural annual radioactivity fluctuations (Eisenbud 1987). The average total beta concentrations were about the same onsite as at the Site perimeter and in nearby and distant communities, indicating that the observed levels were predominantly a result of natural sources and worldwide radioactive fallout.

The average concentration of total alpha radioactivity at the Site perimeter was elevated compared to the concentrations measured at the distant stations (Table 4.1.2), and the difference was statistically significant (log transformed, two-tailed t-test, 5% significance level). However, the concentrations were not beyond the range of measurements from previous years (Figure 4.1.3).

The airborne concentrations of tritium from 1990 to 1995 are given in Table 4.1.3. Table 4.1.3 provides a consistent treatment of the historical data because previous Hanford Site reports used differing methods to report suspect tritium results. Tritium concentrations measured in 1995 were similar to values reported for 1990 and did not show the highly elevated concentrations and widely

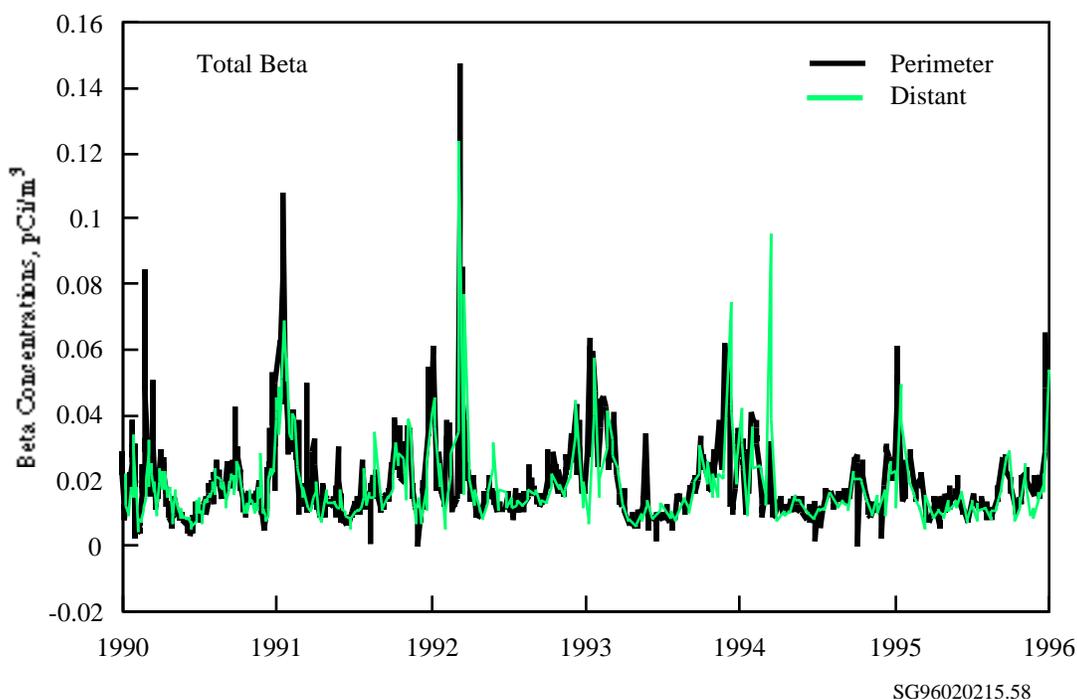


Figure 4.1.2. Total Beta Radioactivity in Airborne Particulate Samples, 1990 Through 1995

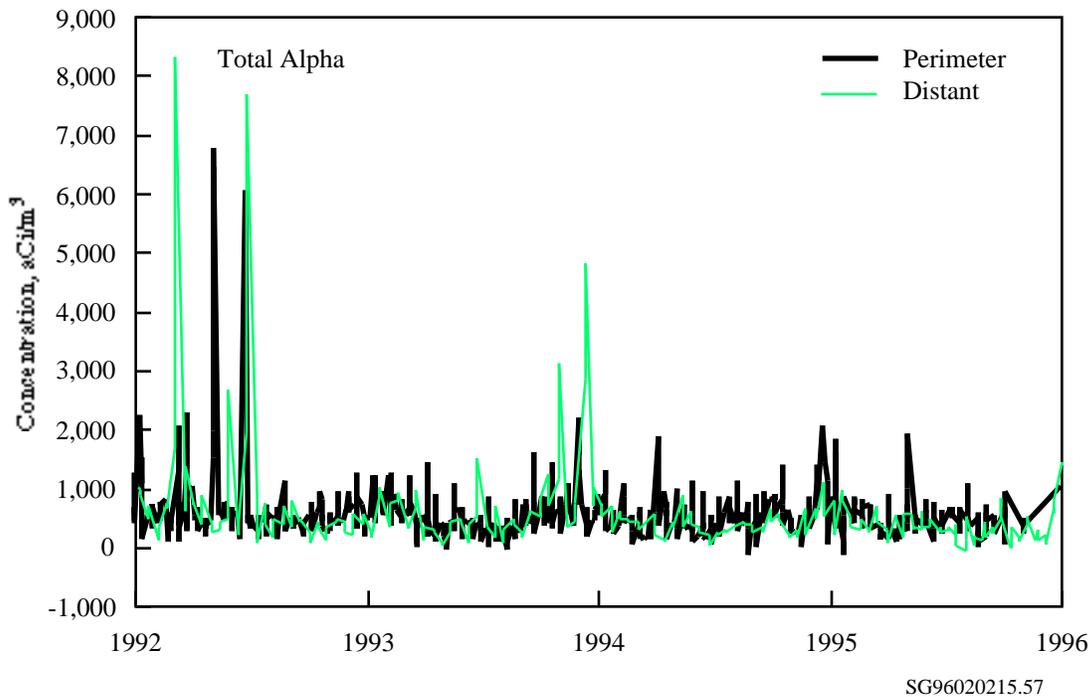


Figure 4.1.3. Total Alpha Radioactivity in Airborne Particulate Samples, 1992 Through 1995

variable results reported for 1991 and 1992 (Woodruff et al. 1993). The 1991 and 1992 results are highly suspect and are likely the result of cross-contamination at the analytical laboratory because even the concentrations at distant locations were high and variable. No individual tritium air concentrations for 1995 were above 100 pCi/m³ and no sampling station measured consistently elevated concentrations. Even the highest individual concentration measured for 1995 (24 ± 20 pCi/m³ [Location #9, Figure 4.1.1]) was only 0.02% of the 100,000 pCi/m³ DOE Derived Concentration Guide. For 1995, the annual average tritium concentration measured at the Site perimeter (1.8 ± 0.71 pCi/m³) was elevated compared to the annual average value at the distant locations (0.77 ± 0.42 pCi/m³); however, the difference was not statistically significant (log transformed, two-tailed t-test, 5% significance level). The annual average tritium concentration at the Site perimeter in 1995 was 0.002% of the DOE Derived Concentration Guide.

Only 4 of 29 strontium-90 results (Table 4.1.2) for air samples for 1995 were above a nominal detection limit of 40 aCi/m³, with all detectable concentrations occurring onsite. The highest concentration (300 ± 96 aCi/m³) was measured at East of 200-E (Location #5, Figure 4.1.1)

and this concentration is 0.003% of the 9,000,000 aCi/m³ DOE Derived Concentration Guide.

Iodine-129 was sampled downwind of the Plutonium-Uranium Extraction Plant (onsite location #6, Figure 4.1.1), at two downwind perimeter locations, and at a distant location (Yakima) in 1995. Onsite concentrations in 1995 were elevated compared to those measured at the Site perimeter, and perimeter concentrations were higher than those measured at Yakima (Figure 4.1.4, Table 4.1.2). Iodine-129 concentration differences between these locations were statistically significant (log transformed, two-tailed t-test, 5% significance level) and showed a Hanford source. Onsite and perimeter air concentrations have remained at their respective levels from 1990 to 1995 (Figure 4.1.4). Onsite air concentrations of iodine-129 were influenced by minor emissions (0.0089 Ci, Table 3.1.1) from the Plutonium-Uranium Extraction Plant and possible releases from waste storage tanks and cribs. The annual average iodine-129 concentration at the downwind perimeter in 1995 (1.1 ± 0.48 aCi/m³) was 0.000002% of the 70,000,000 aCi/m³ DOE Derived Concentration Guide.

Plutonium-238 was not detected in any air samples for 1995 (nominal detection limit of 1 aCi/m³). The detection

Table 4.1.3. Airborne Concentrations^(a) of Tritium in the Hanford Environs (pCi/m³), 1990 to 1995

Location Group ^(b)	No. of Samples	Maximum ^(c)	Average (All Data) ^(d)	No. of Samples	Average Excluding Data ≥ 100 pCi/m ³ ^(e)
1990					
Onsite	48	71 \pm 2.3	3.1 \pm 1.5	48	3.1 \pm 1.5
Perimeter	96	12 \pm 1.3	1.5 \pm 0.21	96	1.5 \pm 0.21
Distant Comm.	24	3.4 \pm 1.4	1.3 \pm 0.22	24	1.3 \pm 0.22
1991^(f)					
Onsite	91	2,900 \pm 250	59 \pm 71	85	2.8 \pm 1.4
Perimeter	68	4,700 \pm 400	140 \pm 200	66	2.1 \pm 1.1
Nearby Comm.	30	4,900 \pm 420	210 \pm 340	28	1.9 \pm 0.86
Distant Comm.	29	350 \pm 31	18 \pm 25	27	2.2 \pm 2.2
1992^(g)					
Onsite	90	770 \pm 6.0	53 \pm 30	78	5.0 \pm 1.8
Perimeter	63	1,600 \pm 9.4	82 \pm 64	54	4.8 \pm 2.2
Nearby Comm.	40	1,600 \pm 8.4	120 \pm 100	31	6.0 \pm 5.6
Distant Comm.	26	380 \pm 5.4	43 \pm 43	23	5.0 \pm 6.0
1993^(h)					
Onsite	91	600 \pm 4.2	12 \pm 14	89	3.4 \pm 2.2
Perimeter	64	9.9 \pm 1.2	0.90 \pm 0.40	64	0.90 \pm 0.40
Nearby Comm.	34	120 \pm 3.6	4.5 \pm 7.2	33	0.95 \pm 0.40
Distant Comm.	26	3.8 \pm 4.1	0.83 \pm 0.52	26	0.83 \pm 0.51
1994^(h)					
Onsite	101	530 \pm 46	7.8 \pm 11	99	1.3 \pm 0.90
Perimeter	65	3.0 \pm 2.8	0.59 \pm 0.17	65	0.59 \pm 0.18
Nearby Comm.	39	21 \pm 2.2	1.2 \pm 1.1	39	1.2 \pm 1.1
Distant Comm.	26	2.2 \pm 1.5	0.54 \pm 0.29	26	0.54 \pm 0.29
1995					
Onsite	101	24 \pm 20	1.6 \pm 0.61	101	1.6 \pm 0.61
Perimeter	65	12 \pm 22	1.8 \pm 0.71	65	1.8 \pm 0.71
Nearby Comm.	40	16 \pm 15	2.4 \pm 1.3	40	2.4 \pm 1.3
Distant Comm.	35	5.2 \pm 5.0	0.77 \pm 0.42	35	0.77 \pm 0.42

(a) 1995 DOE Derived Concentration Guide = 100,000 pCi/m³.

(b) Location groups are provided in Table 4.1.1.

(c) Maximum single sample result \pm 2 total propagated analytical uncertainty.

(d) Average of samples \pm 2 times the standard error of the mean.

(e) Average was calculated by excluding results greater than 100 pCi/m³ to produce a more representative mean that was not influenced by highly suspect results.

(f) 1991 results reported in this table include some values that were excluded from the 1991 Hanford Site Environmental Report because of suspected laboratory contamination. These results are still considered highly suspect but have been included to provide a consistent treatment of the monitoring data. The suspect results were presented in the 1991 data summary (Bisping and Woodruff 1992).

(g) These results contain values that are suspect and may be the result of laboratory contamination (Woodruff et al. 1993). The results differ from the 1992 Hanford Site Environmental Report (Woodruff et al. 1993) to provide a consistent treatment of the data for this table.

(h) These results contain some values that are suspect and may be the result of laboratory contamination (Dirkes and Hanf 1995).

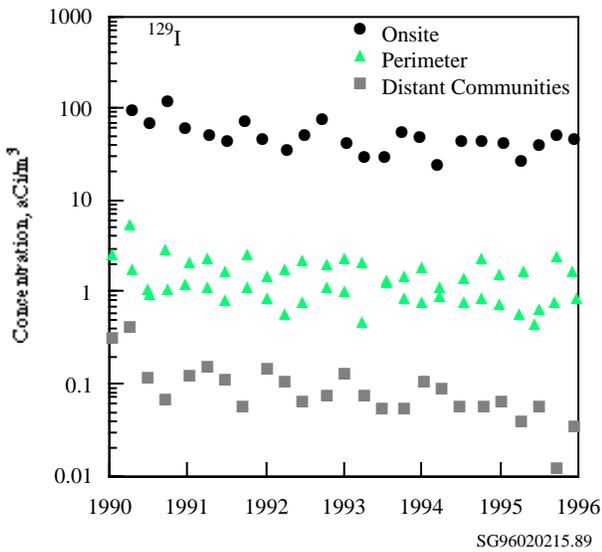


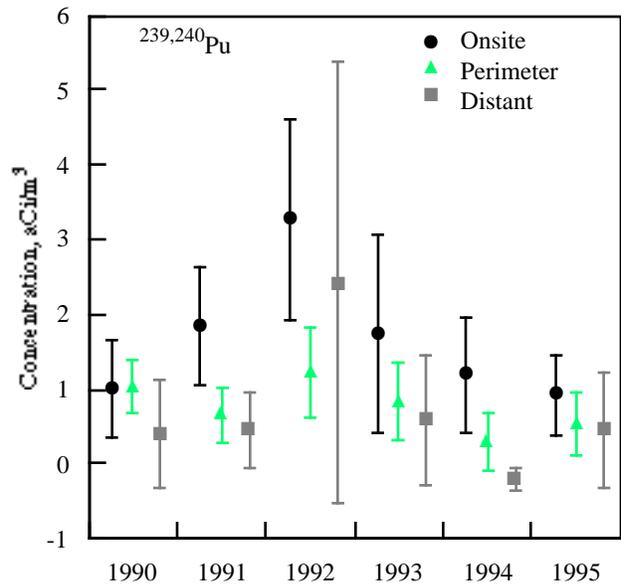
Figure 4.1.4. Concentrations of Iodine-129 in Air, 1990 Through 1995

limit represents 0.003% of the 30,000 aCi/m³ DOE Derived Concentration Guide for plutonium-238.

The average plutonium-239,240 concentrations for Hanford Site and offsite air samples are shown in Table 4.1.2 and Figure 4.1.5. The annual average air concentration of plutonium-239,240 at the Site perimeter was 0.54 aCi/m³ ± 0.042, which is 0.003% of the 20,000 aCi/m³ DOE Derived Concentration Guide. The annual average air concentration was slightly higher for the Site perimeter locations compared to the distant locations; however, this difference was not statistically significant (log transformed, two-tailed t-test, 5% significance level). The maximum Hanford Site plutonium-239,240 air concentration was measured at the 200-West Area (3.1 ± 1.2 aCi/m³ or 0.02% of the DOE Derived Concentration Guide).

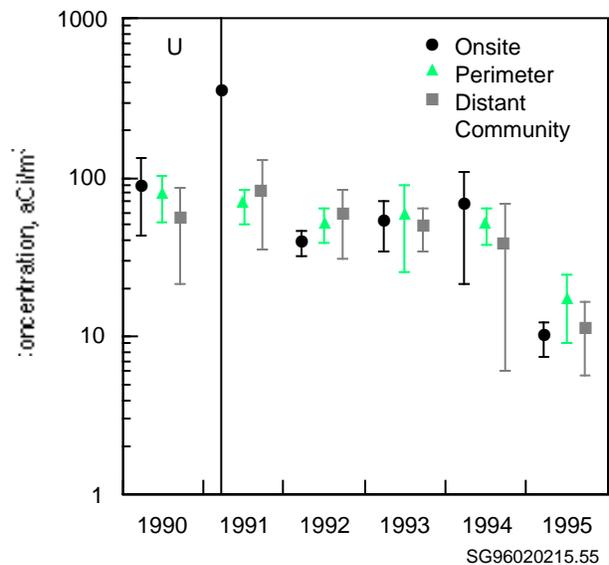
Uranium concentrations (sum of uranium-234, -235, and -238) in airborne particulate matter in 1995 were similar at the Site perimeter and at distant communities (Table 4.1.2 and Figure 4.1.6). The 1995 annual average concentration for the Site perimeter was 17 ± 7.9 aCi/m³, which was 0.02% of the 100,000 aCi/m³ DOE Derived Concentration Guide.

Seven annual air composite samples were analyzed for americium-241 in 1995 and all results (Table 4.1.2) were



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Figure 4.1.5. Annual Average Concentrations (± standard error of the mean) of Plutonium-239,240 in Air, 1990 Through 1995. As a result of figure scale, some uncertainties are concealed by point symbol.



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Figure 4.1.6. Annual Average Concentrations (± standard error of the mean) of Uranium in Air, 1990 Through 1995

below a nominal detection limit of 1 aCi/m³. This concentration represents 0.005% of the 20,000 aCi/m³ DOE Derived Concentration Guide. Americium-241 was added to the sampling schedule in 1993 to estimate the regional background air concentrations before the initiation of large-scale remediation work at Hanford; none of the 20 air samples analyzed since 1993 have had detectable concentrations.

Cesium-137 associated with airborne particulate matter, and iodine-131 collected on charcoal cartridges, were routinely monitored through gamma-scan analyses. Results were generally below detectable concentrations both on and off the Hanford Site. Only 5 of 104 cesium-137 samples and 2 of 42 iodine-131 samples had concentrations above the detection limits. The cesium-137 and iodine-131 results for 1995 samples are included in Table 4.1.2. Even the maximum individual measurements for these radionuclides were less than 0.001% of their DOE Derived Concentration Guide.

Collection and Analysis of Nonradiological Air Samples

Samples for semivolatile organic compounds (PCBs, chlorinated pesticides, phthalate ester plasticizers, and polycyclic aromatic hydrocarbons) in air were collected at the 300 Area South Gate (Figure 4.1.1, location #12), at 200-East southeast (Figure 4.1.1, location #6), and at a background location near Rattlesnake Springs (Figure 1.0.1). The Rattlesnake Springs location is typically upwind of major Hanford Site facilities (Figure 6.1.1). Air samples for semivolatile organic compounds were collected using EPA Method TO-4 (EPA 1988), which uses high-volume air samplers equipped with glass-fiber filters and polyurethane-foam adsorbent traps. Air samples were analyzed by the Sequim Marine Laboratory using capillary gas chromatography with either electron capture detection or mass selective detection.

Nonradiological Results for Air Samples

A review of chemicals of concern for environmental surveillance at the Hanford Site (Blanton et al. 1995a)

identified a PCB technical mixture (Aroclor 1254), a polycyclic aromatic hydrocarbon (benzo(a)pyrene), and a phthalate ester plasticizer (bis(2-ethylhexyl)phthalate as possible candidates for environmental monitoring. All of these compounds are classified as semivolatile organic compounds because they are found in both the gas phase (vapors) and associated with airborne particles. The PCBs and phthalate ester plasticizers have been widely used by modern society and are ubiquitous environmental contaminants. The polycyclic aromatic hydrocarbons are products from the incomplete combustion of fossil fuels and are common air pollutants. A set of twelve samples were collected in 1995 to evaluate the concentrations of semivolatile organic compounds in Hanford Site ambient air. The chlorinated pesticides were included in the list of compounds analyzed because of possible past use at Hanford. The samples were analyzed for 28 individual PCB congeners, 18 polycyclic aromatic hydrocarbons, 2 phthalate ester plasticizers, and 25 chlorinated pesticides. There are no ambient air standards for these semivolatile organic compounds; therefore, the ambient air concentrations measured on the Hanford Site are compared to carcinogenic and non-carcinogenic risk-based concentrations.^(a) Ambient air concentrations below the risk-based concentrations have associated risks that are less than 1×10^{-6} for carcinogenic risk and less than 1.0 of a hazard quotient for non-carcinogenic risk. These risk-based concentrations are used as an initial screening tool to evaluate if additional monitoring or more detailed risk calculations should be undertaken.

Fourteen polycyclic aromatic hydrocarbons were found above the detection limits for the ambient air samples (Figure 4.1.7; Appendix A, Table A.9). Phenanthrene was the only polycyclic aromatic hydrocarbon with average air concentrations above 500 pg/m³, with average values ranging from 800-2500 pg/m³. Fluoranthene, pyrene, fluorene, chrysene, benzo(b)fluoranthene, and anthracene were the only other polycyclic aromatic hydrocarbon compounds with average concentrations above 100 pg/m³. Benzo(a)pyrene (identified in the review of contaminants of concern) was not detected in any air samples with a nominal detection limit of 20 pg/m³ for a 1,000 m³ sample. The detection limit for benzo(a)pyrene was well below the risk-based concentration of 1,000 pg/m³. Overall, the 300 Area had higher average concentrations of polycyclic aromatic hydrocarbons compared to the 200 Area and the background location near Rattlesnake Springs. The air concentrations at the 300 Area are influenced by sources on the Hanford Site

(a) U.S. EPA Region III Risk-Based Concentration Table, R. L. Smith, February 9, 1995.

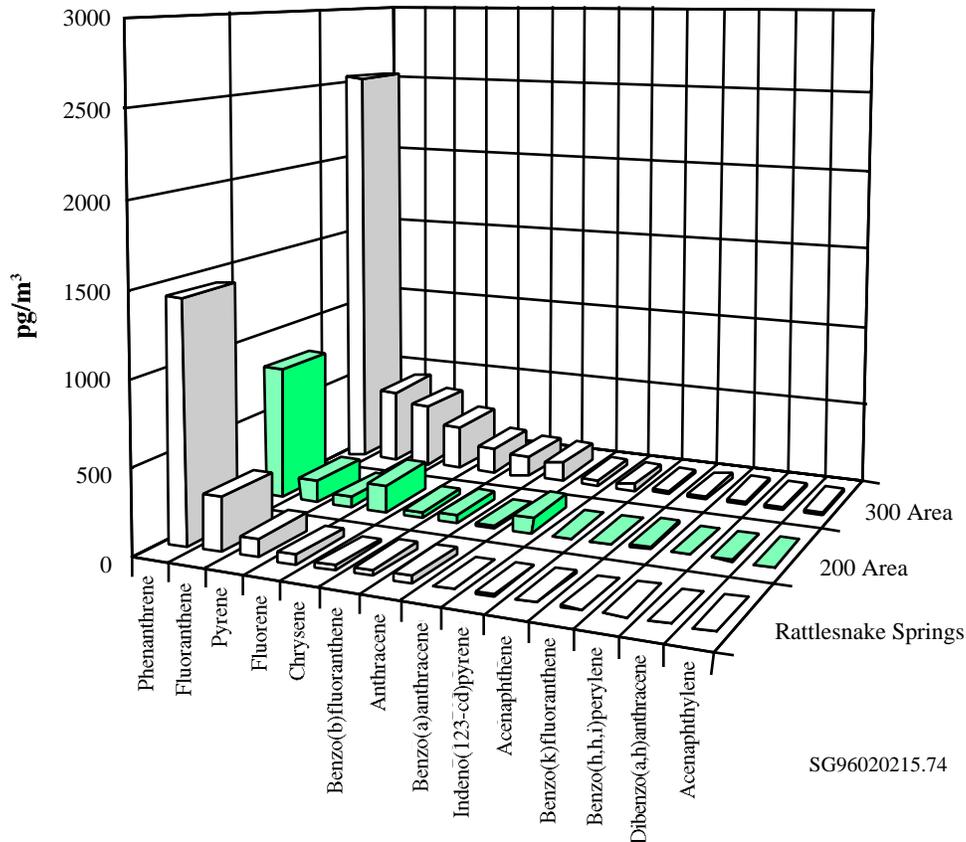


Figure 4.1.7. Annual Average Concentrations of Polycyclic Aromatic Hydrocarbons in Hanford Air, 1995

and from nearby communities. All polycyclic aromatic hydrocarbon concentrations measured in air were well below applicable risk-based concentrations (Appendix A, Table A.9).

The air samples were analyzed for two phthalate ester plasticizers [bis(2-ethylhexyl)phthalate and di-n-octyl phthalate]. Neither of these compounds were found above the detection limits; however, both of these compounds had high concentrations in the sample blanks which resulted in elevated detection limits of approximately 27,000 pg/m³ for bis(2-ethylhexyl)phthalate and 720 pg/m³ for di-n-octyl phthalate (assuming a 1,000 m³ air sample). The detection limits for these compounds were well below their respective risk-based concentrations (450,000 pg/m³ for carcinogenic risk for bis(2-ethylhexyl)phthalate and 73,000,000 pg/m³ for non-carcinogenic risk for di-n-octyl phthalate).

Nineteen PCB congeners were found above the detection limits for the Hanford Site samples (Figure 4.1.8; Appendix A, Table A.10). Eight congeners (#101, #138, #87,

#118, #105, #153, #28, and #52) accounted for over 80% of the average PCB concentrations at all three sampling locations. The average total PCB congener concentrations ranged from 490-660 pg/m³, which were similar to values reported from a previous Hanford Site study (Patton et al. 1994). All individual congener PCB concentrations and all average total PCB concentrations were below the risk-based concentration of 810 pg/m³ for carcinogenic risk. However, the maximum concentrations for total PCBs exceeded the risk-based concentrations by a factor of 2.

Sixteen chlorinated pesticides were found above the detection limits for Hanford Site air samples (Figure 4.1.9; Appendix A, Table A.11). Endosulfan I and Endosulfan II had the highest average air concentrations, with average concentrations for Endosulfan I ranging from 550-3,500 pg/m³ and Endosulfan II ranging from 65-750 pg/m³. The maximum concentrations of Endosulfan I and II were for an August 1995 sample from the 300 Area. This sample was re-analyzed using gas chromatography-negative ionization mass spectrometry,

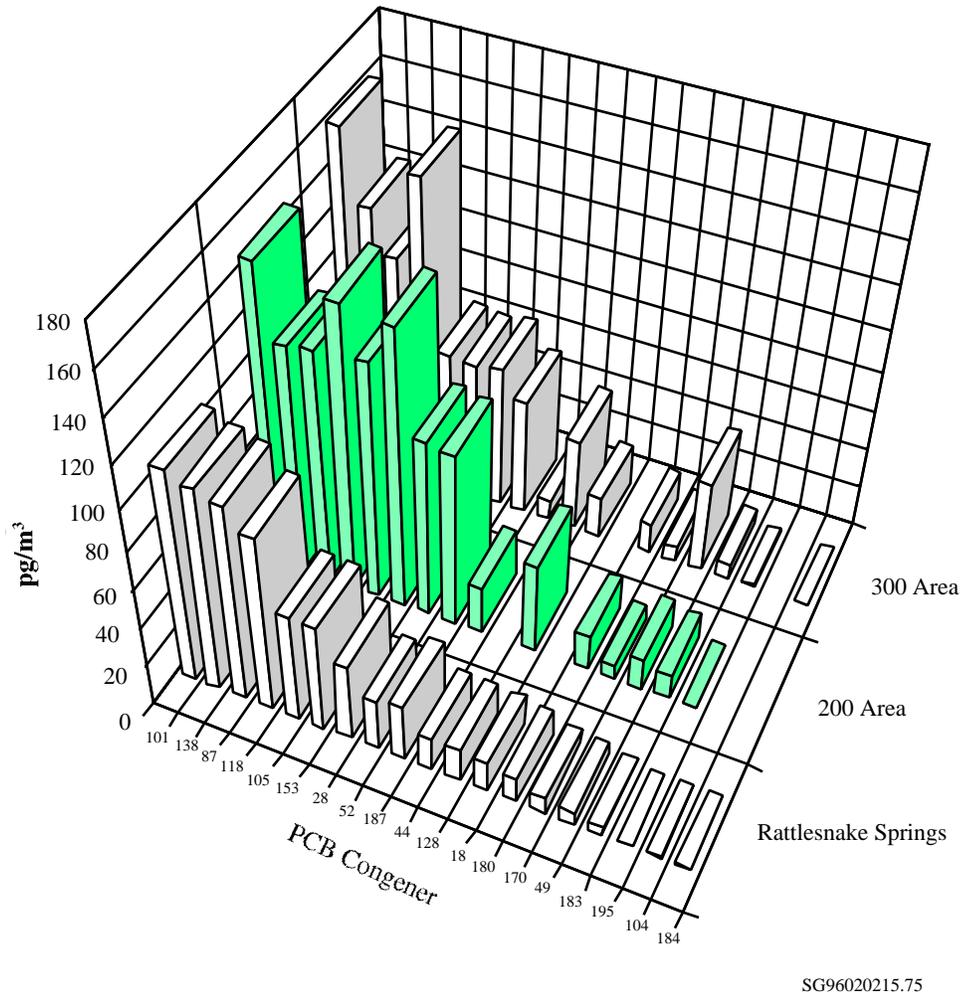


Figure 4.1.8. Annual Average Concentrations of PCBs in Hanford Air, 1995

which confirmed the elevated concentrations. All other average pesticide concentrations were below 100 pg/m^3 . The measured pesticide concentrations were orders of magnitude below the applicable risk-based concentrations (Appendix A, Table A.11).

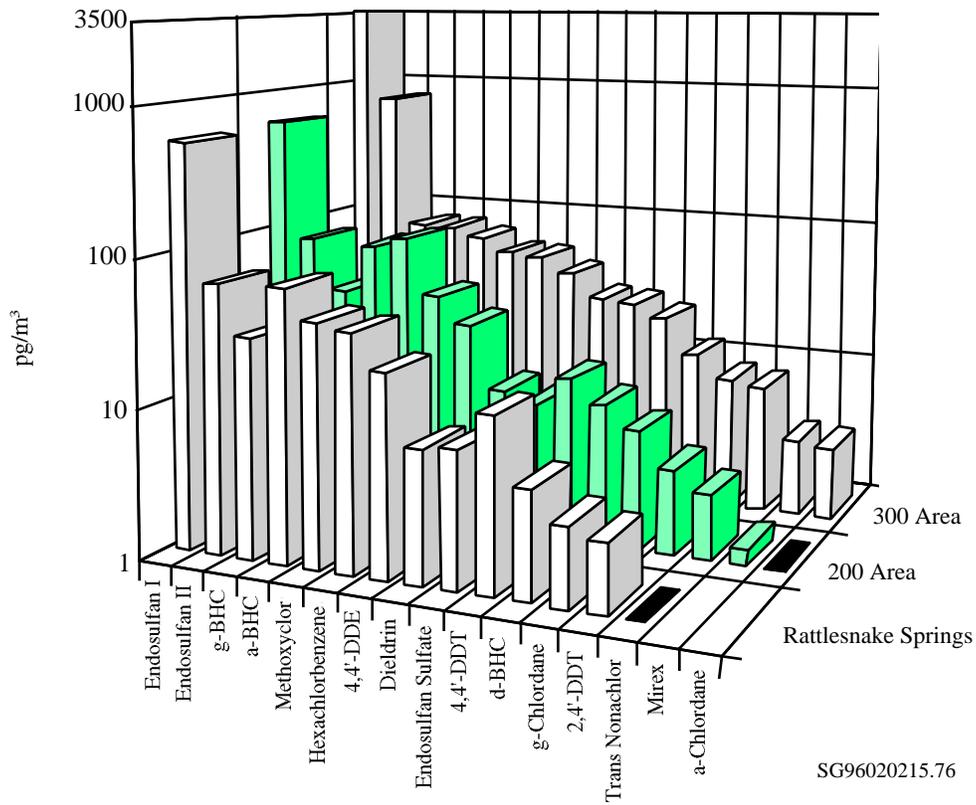


Figure 4.1.9. Annual Average Concentrations of Chlorinated Pesticides in Hanford Air, 1995