8.8 Food and Farm Products Monitoring

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Food and farm products, including asparagus, grapes, leafy vegetables, milk, potatoes, tomatoes, and wines, were collected routinely during 2004 at places around the Hanford Site (Figure 8.8.1) and analyzed to monitor concentrations of radiological contaminants. Samples were obtained from locations generally downwind (east and southeast) of the site where airborne emissions or contaminated dust from the Hanford Site would normally be deposited, from other locations generally upwind of and distant from the site to provide information on reference (background) contaminant levels, and from farms irrigated with water taken from the Columbia River downstream of the site. Results of sample analyses are used to assess the amounts of Hanford Site contaminants in food and farm products by: (1) comparing analytical results obtained from like samples collected from the same regions over long periods of time, (2) comparing analytical results from samples collected at downwind locations to results from samples obtained from generally upwind or distant locations, and (3) comparing analytical results from samples collected in areas irrigated with water withdrawn from the Columbia River downstream from the Hanford Site to analytical results from samples obtained from locations irrigated with water from other regional sources. The concentrations of most radionuclides in food and farm product samples in 2004 were below levels that could be detected by the analytical laboratories. However, some contaminants potentially from Hanford (strontium-90, tritium, iodine-129) were found at low levels in some samples. These findings are discussed in the following sections. Data for naturally occurring potassium-40 and beryllium-7 are included to show these concentrations in food products relative to concentrations of materials potentially from Hanford. Radiological doses associated with possible Hanford-produced contaminants that were detected are discussed in Section 8.14.

8.8.1 Collection of Food and Farm Product Samples

Some food and farm product samples are collected every year on quarterly or annual schedules. Others may only be sampled every 2 or 3 years. The rationale for sampling and analyzing some media more frequently than others is discussed in the Hanford Site Environmental Monitoring Plan (DOE/RL-91-50). The types and number of samples scheduled for collection in any given year are documented in the annual Hanford Site Surveillance Master Sampling Schedule (e.g., PNNL-14553). Table 8.8.1 shows the types, sampling locations and frequencies, and numbers of food and farm product samples collected and analyzed for radioactive contaminants during 2004. Most samples were obtained from commercial dairies and farms. Leafy vegetables and tomatoes were obtained from backyard gardens because commercial growers could not be located.

8.8.2 Milk

During 2004, milk samples were obtained quarterly from three dairies in the East Wahluke sampling area, three in the Sagemoor sampling area, and one in the Sunnyside sampling area (Figure 8.8.1). The Sagemoor and East Wahluke sampling areas are located downwind of the site, near the site perimeter, and could potentially be affected by airborne contaminants from Hanford. The Sunnyside area is a reference location generally upwind of the site. Milk samples from all dairies within a sampling area were combined, and the combined (composite) samples from each area were analyzed for gamma-emitting radionuclides, strontium-90, and tritium. Twice each year, additional milk was obtained from each area to monitor for iodine-129 (Table 8.8.1). Milk sampling was conducted

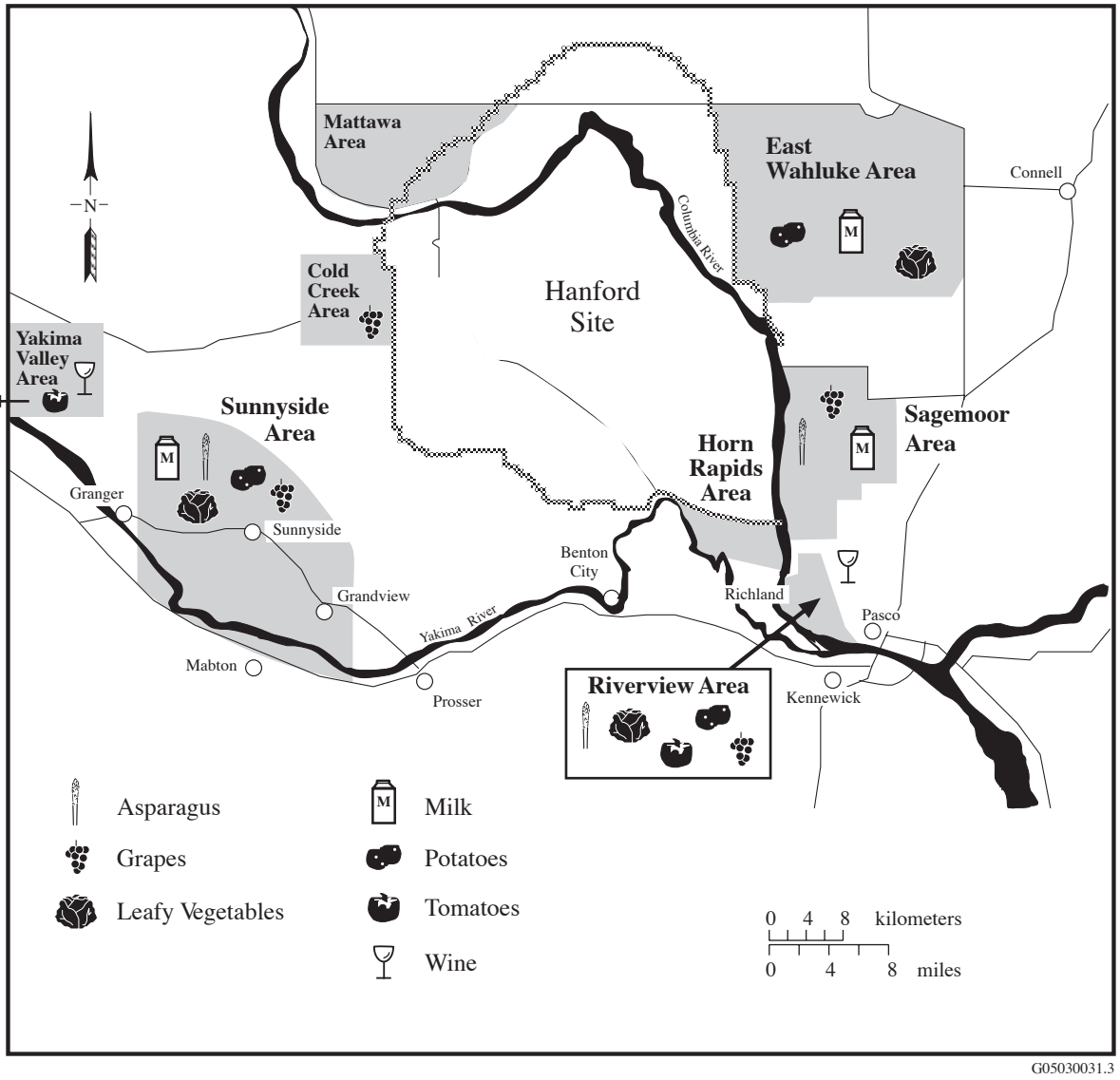

Figure 8.8.1. Food and Farm Product Sampling Locations, 2004

because Hanford-produced radionuclides have the potential to move through the air-pasture-cow-milk or water-pasture-cow-milk food chains to humans. However, in recent years, the levels of Hanford-produced radiological contaminants in milk samples have diminished, and concentrations in samples obtained from dairies located downwind of the site are now similar to levels measured in samples obtained from the dairy located generally upwind of the site.

Strontium-90 – Strontium-90 was detected in three of four combined milk samples collected in 2004 from the Sagemoor sampling area, two of four samples from the East Wahluke sampling area, and one of four samples from the Sunnyside sampling area. Concentrations were low (<1 pCi/L [0.037 Bq/L), were similar at all locations, and were comparable to concentrations measured in past years (PNNL-14687; PNNL-14295).

Tritium – Concentrations of tritium are generally monitored in all milk samples each year. However, in 2004, tritium concentrations were measured in only three of twelve samples. Analyses for tritium were stopped early in 2004 because of problems at the analytical laboratory. A replacement laboratory was identified in 2004 (Severn Trent Laboratory, Richland) but analyses of milk samples

Table 8.8.1. Sampling Locations, Frequencies, and Analyses Performed for Food and Farm Products Sampled Around the Hanford Site, 2004[a]

	Number of Locations			Types of Analyses and Number of Samples Analyzed				
Product	Upwind	Downwind	Sampling Frequency	^{3}H	Gamma	^{90}Sr	^{129}I	U
Milk	1	2	Q or SA	12	12	12	7	0
Asparagus	1	2	A	0	3	3	0	3
Grapes	2	2	TE	0	4	4	0	0
Leafy vegetables	1	2	A or BE	0	3	3	0	0
Tomatoes	1	1	A	2	2	2	0	0
Potatoes	1	2	A	0	3	3	0	0
Wine	2	2	A	4	4	0	0	0

(a) Products may include multiple varieties for each category.
A = Annually.
BE = Biennially.
Q = Quarterly.
SA = Semiannually.
TE = Triennially.

collected from mid- to late-2004 had not been started by the end of 2004. The milk samples collected during the last half of 2004 are scheduled to be analyzed in 2005. The three 2004 milk samples analyzed were obtained from the Sagemoor sampling area in February and April and from the East Wahluke sampling area in April. Tritium was detected in all three samples and the highest concentration measured was 229.5 pCi/L (8.49 Bq/L) in the February sample from the Sagemoor area. This concentration is a little higher than concentrations measured in milk from this area in the recent past (PNNL-14295). In past years, tritium concentrations in Sagemoor area milk samples have been consistently higher than concentrations in samples from the East Wahluke and Sunnyside sampling areas (PNNL-14687). A reason for this has been proposed that suggests a relationship between tritium concentrations in Columbia River water used for irrigation in the Sagemoor area during past years and concentrations in groundwater used by some Sagemoor area dairies (PNNL-13910).

The tritium data for the 2003 milk samples were received in mid-2004. Twelve samples were submitted for analysis but only seven were analyzed. Five of the samples were lost at the laboratory. Tritium was detected in all of the samples analyzed and one sample from the Sagemoor sampling area had an unusually high tritium concentration (2,593 ± 50 pCi/L [95.9 ± 1.85 Bq/L]). A re-analysis of this sample to confirm the result was not possible because of the work stoppage discussed in the preceding paragraph. Of the other six samples analyzed, one was from the Sagemoor area, two were from the Wahluke area, and three were from the Sunnyside area. The highest tritium concentration measured in these samples (160.8 ± 5.3 pCi/L [5.95 ± 0.2 Bq/L]) was seen in the sample from the Sagemoor area. This concentration was within the range of concentrations measured in milk in past years (PNNL-14687). While there is no standard for tritium in milk, the health-based standard for drinking water is an annual average of 20,000 pCi/L (740 Bq/L).

Iodine-129 – Iodine-129 was detected in all milk samples collected for iodine-129 analyses in 2004. Concentrations were low, ranging from 0.0008 pCi/L (29.6 x 10^{-6} Bq/L) in a Wahluke area sample to 0.0002 pCi/L (7.4 x 10^{-6} Bq/L) in a Sunnyside area sample. The average concentration for five samples collected from dairies located downwind of Hanford was 0.0005 pCi/L (18.5 x 10^{-6} Bq/L). The average concentration in two samples from an upwind dairy was 0.0004 pCi/L (14.8 x 10^{-6} Bq/L). There is no iodine-129 standard for milk, but the health-based standard for drinking water is an annual average of 1.0 pCi/L (0.037 Bq/L).

Cesium-137 – There were no manmade gamma emitters (including cesium-137) detected in milk samples collected and analyzed in 2004 (PNNL-15222, APP. 1).

Potassium-40 – Potassium-40 is a naturally occurring radionuclide that is found in soil and in fertilizers applied to soil. It is the predominant radionuclide in foods and human tissues (Eisenbud 1987). Potassium-40 was detected in all milk samples collected in 2004. Concentrations ranged from a maximum of 1,360 pCi/L (50.3 Bq/L) in a Wahluke area sample to a minimum of 939 pCi/L (34.7 Bq/L) in a Sunnyside area sample. Average concentrations for the individual areas were 1,215 pCi/L (44.9 Bq/L) for the Sagemoor area; 1,205 pCi/L (44.6 Bq/L) for the East Wahluke area; and 1,087 pCi/L (40.2 Bq/L) for the Sunnyside area.

8.8.3 Asparagus

Three samples of asparagus shoots were collected in the spring from commercial fields in the Riverview, Sagemoor, and Sunnyside sampling areas (Figure 8.8.1). Samples were analyzed for gamma-producing radionuclides, strontium-90, and uranium isotopes (Table 8.8.1). The only radionuclide detected in the samples was naturally occurring potassium-40. Concentrations of potassium-40 in all samples were less than 3 pCi/g (0.11 Bq/L) wet weight.

8.8.4 Grapes

Four samples of concord grapes were collected in the fall from the Riverview, Sagemoor, Cold Creek, and Sunnyside sampling areas (Figure 8.8.1). Samples were analyzed for gamma-producing radionuclides and strontium-90 (Table 8.8.1). The only radionuclide found in measurable quantities was naturally occurring potassium-40. Concentrations of potassium-40 in all samples were low (<3 pCi/g [0.11 Bq/L] wet weight).

8.8.5 Leafy Vegetables

Three samples of leafy vegetables were collected during the summer from the East Wahluke, Riverview, and Sunnyside sampling areas (Figure 8.8.1). Leafy plants are sampled to monitor the potential deposition of airborne contaminants on agricultural food products. The Riverview area was also sampled because crops in this area were irrigated with Columbia River water withdrawn at places downstream of the Hanford Site. All samples were analyzed for gamma-producing radionuclides and strontium-90 (Table 8.8.1). Low concentrations (<6 pCi/g [0.22 Bq/L] wet weight) of naturally occurring potassium-40 were detected in the samples collected from all three areas. Another naturally occurring radionuclide, beryllium-7, was found at low levels (<6 pCi/g [0.22 Bq/L] wet weight) in the East Wahluke and Riverview area samples. Strontium-90, a possible contaminant from the Hanford Site, was measured in both the Riverview and East Wahluke areas samples. The maximum strontium-90 concentration (0.05 ± 0.008 pCi/g [0.002 ± 0.0003 Bq/L] wet weight) was similar to concentrations measured in leafy vegetable samples from these areas in past years, although in recent years, few vegetable samples have contained measurable levels of this radionuclide (PNNL-14687; PNNL-14295; PNNL-13910).

8.8.6 Potatoes and Tomatoes

Three samples of potatoes and two samples of tomatoes were collected from both upwind and downwind sampling areas (Figure 8.8.1) in the summer and fall. All samples were analyzed for gamma-emitting radionuclides and strontium-90. Tomato samples were also monitored for tritium (Table 8.8.1). The only radionuclide detected in the samples was naturally occurring potassium-40. Concentrations of potassium-40 in all samples were less than 6 pCi/g [0.22 Bq/L] wet weight.

8.8.7 Wines

Samples of a red wine and a white wine were obtained from a winery in the vicinity of Pasco and a winery near Yakima. The wines were produced from 2004 vintage grapes that were harvested in the fall from vineyards located just north of Pasco (downwind of the site) and just east of Yakima (generally upwind of the site) (Figure 8.8.1). Each wine was divided (split) into two samples and all samples were analyzed for gamma-emitting radionuclides and tritium (Table 8.8.1).

Cesium-137 – There were no manmade gamma emitters (including cesium-137) detected in wine samples collected and analyzed in 2004 (PNNL-15222, APP. 1).

Potassium-40 – Potassium-40, a naturally occurring gamma emitter, was measured in all wine samples collected

in 2004. Concentrations in all samples ranged from 110 to 170 pCi/L (4.1 to 6.3 Bq/L).

Tritium – Wine samples collected in 2004 were provided to an analytical laboratory for tritium analyses but the analyses were not completed in time to include the analytical data in this report.

Samples of red and white wines were also collected in 2003. Each wine was divided (split) into two samples and all samples were analyzed by gamma spectroscopy for gamma-emitting radionuclides and by an electrolytic enrichment method for tritium. The data from the gamma spectroscopy analyses were discussed in the 2003 Hanford Site environmental report (PNNL-14687), but tritium data for the wine samples were not available until after the 2003 report was published. The wines analyzed in 2003 were produced from 2003 vintage grapes that were harvested in the fall from vineyards located just north of Pasco and just east of Yakima. Tritium concentrations in all 2003 samples were elevated relative to concentrations seen in wines sampled in past years (PNNL-14295). Concentrations in the 2003 samples ranged from a low of 105 ± 3 pCi/L (3.88 ± 0.11 Bq/L) in a white wine from Yakima to a high of 812 ± 10 pCi/L (30.0 ± 0.37 Bq/L) in a red wine from Pasco. For comparison, tritium concentrations in all 2001 and 2002 samples combined ranged from 8.6 to 116.1 pCi/L (0.32 ± 4.29 Bq/L). These concentrations are more in keeping with concentrations measured in prior years (PNNL-13910). The reason for the elevated 2003 concentrations is not known. A letter from the laboratory that accompanied the data did not indicate any problems with the data or analysis process. However, the fact that concentrations both upwind and downwind of the site were elevated may indicate a problem with the laboratory analyses (e.g., laboratory contamination). The fact that there was generally poor agreement between tritium concentrations in the sample splits may support this. The Pasco red and white wine split samples differed by 16% and 282%, respectively, and the Yakima red and white wine split samples differed by 262% and 430%, respectively. In 2001 and 2002, the differences in red and white split sample analyses ranged from 0.9% to 57.7% and 13.8% and 67%, respectively. While there is no tritium standard for wine, the drinking water standard is an annual average concentration of 20,000 pCi/L (740 Bq/L). All tritium concentrations in 2003 wine samples were well below this health-based standard.