4.4 Food and Farm Product Surveillance

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Food products, including fruits, leafy vegetables, milk, potatoes, and wine, were collected routinely during 2002 at several locations surrounding the Hanford Site (Figure 4.4.1). Routine samples were collected primarily from locations in the prevailing downwind directions (south and east of the site) where airborne effluent or fugitive dust from the Hanford Site could be deposited. Samples were collected also in generally upwind directions and at locations somewhat distant from the site to provide information on reference radiation levels in foodstuff.

Routine food and farm product sampling assesses the potential influence of Hanford Site releases in three ways:

- Through the comparison of results reported from the same regions over long periods of time.
- Through the comparison of results from downwind locations to those from generally upwind or distant locations.
- Through the comparison of results from locations irrigated with Columbia River water withdrawn downstream from the Hanford Site to results from locations irrigated with water from other sources.

The food and farm product sampling schedule was modified during 1996 by establishing a 2- or 3-year rotation to sample certain farm products (DOE/RL-91-50; PNNL-13749). Analyses for some radionuclides that (1) historically have not been detected in food or farm products and (2) are not likely to increase have been discontinued (Table 4.4.1).

Gamma scans (cobalt-60, cesium-137, and other radionuclides; Appendix F) and strontium-90 analyses were performed for nearly all products. Milk was analyzed for iodine-129 and tritium; wine also was analyzed for tritium. Results for fruits and vegetables are reported in picocuries per gram (pCi/g) wet weight. Results for tritium are reported in picocuries per liter (pCi/L). Most tritium is found as water, and very little tritium is organically bound to other constituents present in food products.

Tritium and iodine-129 from site facilities are released to the atmosphere and to the Columbia River via riverbank springs. Strontium-90 from Hanford is released to the Columbia River through riverbank springs. Cesium-137 is present in atmospheric fallout from weapons testing and is found in Hanford Site radiological waste sites.

For many radionuclides, concentrations in farm produce are below levels that can be detected by the analytical laboratory. When this occurs for an entire group of samples, a nominal detection limit is estimated by using two times the total propagated analytical uncertainty. This value from a group of samples is used as an estimate of the lower level of detection for that analyte and particular food product. This value is then used to estimate the relatively low dose received to consumers of the produce (Chapter 5). The total propagated analytical uncertainty includes all sources of analytical error associated with the analysis (e.g., counting errors and errors associated with weight and volumetric measurements). Theoretically, re-analysis of the sample should yield a result that falls within the range of the uncertainty 95% of the time. Results and uncertainties not given in this report may be found in PNNL-14295, APP. 1. Radiological dose considerations were calculated and reported in Chapter 5.

4.4.1 Milk Samples and Analytes of Interest

Composite samples of raw, whole milk were collected during 2002 from three dairy farms in the East Wahluke area and from three dairy farms in the Sagemoor area. These sampling areas are located near the site perimeter in the prevailing downwind direction (Figure 4.4.1). Milk samples also were collected from three dairy farms in the

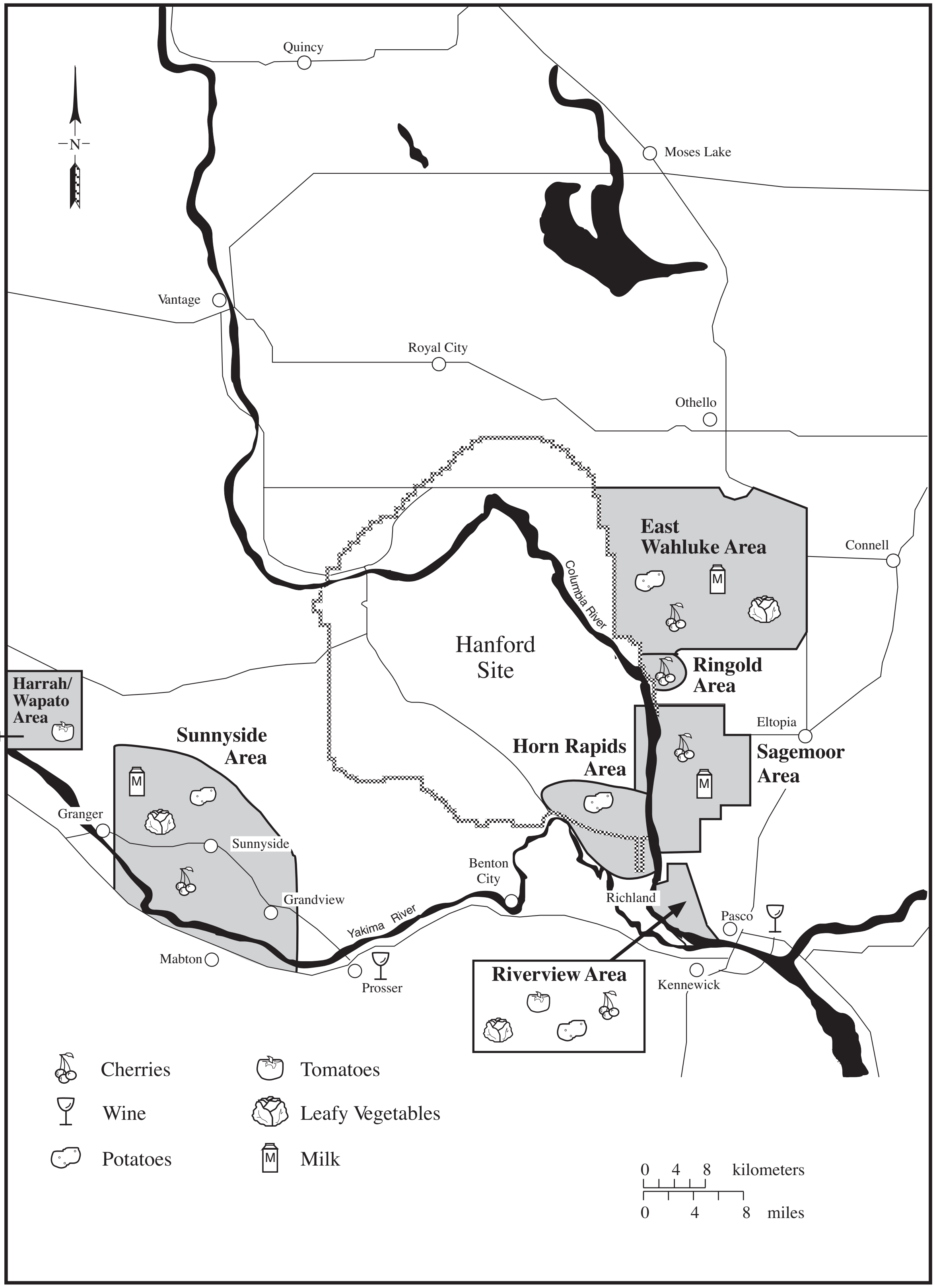

Figure 4.4.1. Food and Farm Product Sampling Locations Around the Hanford Site, 2002

Table 4.4.1. Sampling Locations, Frequencies, and Analyses Performed for Food and Farm Products Routinely Sampled Around the Hanford Site, 2002[(a)]

	Number of Locations			Number of Samples Analyzed			
Product	Upwind	Downwind	Sampling Frequency[(b)]	^{3}H	Gamma	^{90}Sr	^{129}I
Milk	1	2	Q or SA	12	12	12	6
Vegetables	2	3	A	2	7	7	0
Fruit	1	4	A	0	7	7	0
Wine	2	2	A	8	8	0	0

(a) Products may include multiple varieties for each category.
(b) Q = quarterly, SA = semiannually, A = annually.

Sunnyside area to represent reference radionuclide concentrations at a generally upwind region.

Samples of milk were analyzed for strontium-90, iodine-129, tritium, and gamma emitters such as cesium-137 because these radionuclides have the potential to move through the air-pasture-cow-milk or water-pasture-cow-milk food chains to humans.

Worldwide fallout radionuclides in feed and/or drinking water may be a significant source of radionuclides in milk products; however, measured levels of radionuclides in milk from private dairies near the Hanford Site are usually near levels considered to be background. During 2002, gamma scans and strontium-90 analyses of milk samples were conducted quarterly, and iodine-129 analyses were conducted on two semiannual composite samples. Since 1995, tritium concentrations have been below the detection level of standard liquid scintillation counting methods. During 1998, another analytical technique (DOE/RL-91-50) was instituted to measure low levels of tritium in milk samples. The technique has a detection limit of ~10 pCi/L (~0.37 Bq/L) of water distilled from milk as compared to ~180 pCi/L (~6.66 Bq/L) for the analytical technique used prior to 1996. The protection guideline for human consumption of tritiated water is 20,000 pCi/L (740 Bq/L) (Appendix D, Table D.2).

Strontium-90 was not detected in 12 milk samples analyzed in 2002. The results reported during 2002 appear consistent with results reported in previous years. Only 6 of 36 results were reported above the analytical detection limit in 1999, 2000, and 2001 combined. While there is no strontium-90 standard for milk, the drinking water standard (based on a 2-liter [0.5-gallon] per day consumption rate) is 8 pCi/L (0.3 Bq/L) (40 CFR 141). The maximum milk consumption rate for estimating dose is ~270 liters (~71 gallons) per year (Appendix E, Table E.2).

Iodine-129 concentrations were determined by high-resolution mass spectrometry in six milk samples. In recent years, the levels of iodine-129 in milk collected from generally downwind dairies in the Sagemoor and East Wahluke areas have persisted at concentrations greater than levels measured upwind in Sunnyside (Figure 4.4.2). Iodine-129 concentrations have declined with the end of nuclear materials production at the Hanford Site. While there is no iodine-129 standard for milk, the drinking water standard is 1.0 pCi/L (0.037 Bq/L), one thousand times

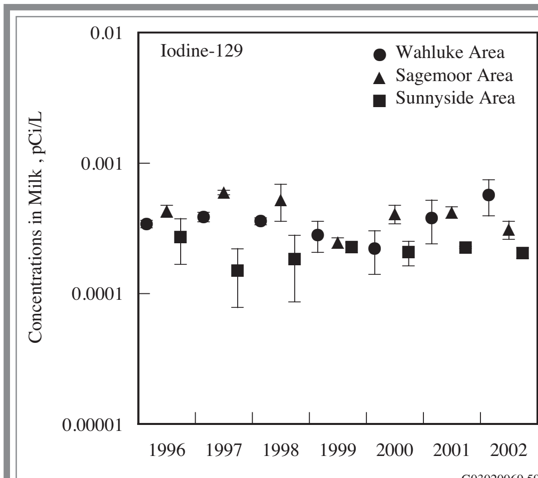

Figure 4.4.2. Median, Maximum, and Minimum Iodine-129 Concentrations in Milk Samples Collected Near the Hanford Site, 1996 through 2002

greater than results reported for milk samples from these three areas over the past 4 years (EPA-570/9-76-003).

No manmade gamma emitters (including cesium-137) were detectable in 2002 milk samples (PNNL-14295, APP. 1).

Tritium was analyzed in quarterly composite milk samples from the East Wahluke, Sagemoor, and Sunnyside areas (Figure 4.4.1) during 2002. The results indicate Sagemoor area milk had higher (approximately four times) median and maximum tritium concentrations when compared to milk from both the Sunnyside and the East Wahluke areas (Figure 4.4.3). Elevated tritium concentrations in milk from the Sagemoor area are consistent with results in previous years (Figure 4.4.3). Tritium concentrations in Sagemoor area milk appear to decline at a rate consistent with radiological decay. Dilution of the groundwater (PNNL-13230) in the aquifer used by Sagemoor area dairies may also reduce tritium levels.

In the 1999 Hanford Site environmental report (PNNL-13230, Section 4.4), tritium concentrations in dairy water were reported in conjunction with the milk samples and illustrated the ability to predict tritium concentrations in dairy milk from tritium concentrations in the well water used by the dairies. The dairies in all three of the areas sampled during 2001 used well water. The Franklin County aquifers used by the dairies in the Sagemoor and East Wahluke areas have historically been recharged by Columbia River water brought into the areas by the Columbia Basin Irrigation Project. Water for the Columbia Basin Irrigation Project is obtained from the Columbia River upstream of the Grand Coulee Dam. Tritium levels in Columbia River water in the 1960s ranged from 800 to 5,540 pCi/L (30 to 205 Bq/L). These concentrations were influenced by fallout from worldwide aboveground nuclear-weapons testing (Wyerman et al. 1970). Irrigation water from the Columbia River containing these comparatively high tritium levels entered the groundwater aquifers in Franklin County as a result of over application and leaking canals.

Over the past 30 years, tritium levels in the aquifer have slowly decreased as a result of radiological decay and possible dilution caused by subsequent recharge with reduced levels of tritium in irrigation water. Based on a 12.3-year half-life, if we assume an aquifer having a tritium concentration of 1,000 pCi/L (37 Bq/L) during 1963 (assumes some dilution with natural groundwater), the estimated level after three half-lives in 2002 would be ~111 pCi/L (~4.1 Bq/L). While the relationships between tritium in milk and groundwater used by the dairies are interesting, the actual levels of tritium in milk are a minor contributor to the radiological dose received by those who consume milk (Chapter 5). There is no tritium standard for milk; however, the standard for drinking water is 20,000 pCi/L (740 Bq/L), over 100 times greater than values reported in Sagemoor area dairy milk over the past 4 years (Figure 4.4.3).

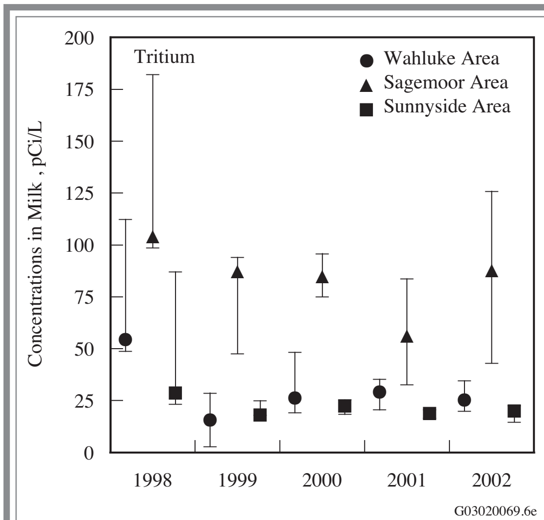

Figure 4.4.3. Median, Maximum, and Minimum Tritium Concentrations in Milk Samples Collected Near the Hanford Site, 1998 through 2002

4.4.2 Vegetable Samples and Analytes of Interest

Leafy vegetables are routinely sampled to monitor airborne contaminants. Samples of leafy vegetables (i.e., beets and cabbage) and vegetables (i.e., potatoes and tomatoes) were obtained during the summer from gardens and farms located within selected sampling areas (Figure 4.4.1). The Riverview area also was sampled because of its exposure to potentially contaminated irrigation water withdrawn from the Columbia River downstream of the Hanford Site. All vegetable samples from all sampling areas were analyzed for gamma-emitting radionuclides and strontium-90.

Measurements of cesium-137 in vegetable and leafy vegetable samples collected in 2002 were all less than their detection limit (0.02 pCi/g [0.0007 Bq/g]) and were consistent with results seen in recent years (PNNL-14295, APP. 1). Strontium-90 was not detected in potato, tomato, or leafy vegetable samples collected during 2002. Strontium-90 concentrations in vegetable samples obtained from the Riverview area also fell below the analytical detection limit (<0.006 pCi/g [<0.00022 Bq/g]). Tritium was not detected in tomato samples obtained from the Riverview or Harrah/Wapato areas. In recent years, few vegetable samples have had measurable concentrations of strontium-90 or cesium-137. Consequently, it is not possible to discern upwind or downwind distribution patterns of these radionuclides in vegetables.

4.4.3 Fruit Samples and Analytes of Interest

Cherry samples were analyzed for gamma-emitting radionuclides and strontium-90 (Figure 4.4.1). Measurable levels of cesium-137 were reported in cherries collected from the Riverview area (0.007 ± 0.004 pCi/g [0.00026 ± 0.00015 Bq/g]). No other radionuclides were detected in cherries in 2002. These results are consistent with measurements in grapes, cherries, and melons over recent years (PNL-10575; PNNL-11140; PNNL-11473; PNNL-11796; PNNL-12088; PNNL-13230; PNNL-13910). The nominal level of detection for cesium-137 was ~0.01 pCi/g (~0.00037 Bq/g) wet weight and strontium-90 was 0.002 to 0.05 pCi/g (0.000074 to 0.0019 Bq/g) dry weight.

4.4.4 Wine Samples and Analytes of Interest

Locally produced red and white wines (2002 vintage grapes) were analyzed for gamma-emitting radionuclides and tritium. The wines were made from grapes grown at individual vineyards downwind of the site and at an upwind location in the lower Yakima Valley. Two samples each of red and white wine were obtained from each location and analyzed. An electrolytic enrichment method was used for tritium analysis in water distilled from the wine.

Tritium levels in 2002 wine samples were consistent with past results. While there is no tritium standard for wine, the drinking water standard is 20,000 pCi/L (740 Bq/L), ~430 times greater than maximum concentrations reported in wines from these two areas in 2002 (EPA-570/9-76-003). Tritium concentrations were higher in Columbia Basin wines when compared to Yakima Valley wines (Figure 4.4.4). Red wine from the Columbia Basin contained similar levels of tritium as those found in white wine sampled from the same region. The observed differences between wines and/or regions are consistent with past results and are likely related to irrigation/well water sources as discussed with tritium in milk (Section 4.4.1). Gamma spectroscopy did not indicate the presence of cesium-137 or any other gamma-emitting manmade radionuclide in any of the 2002 wine samples.

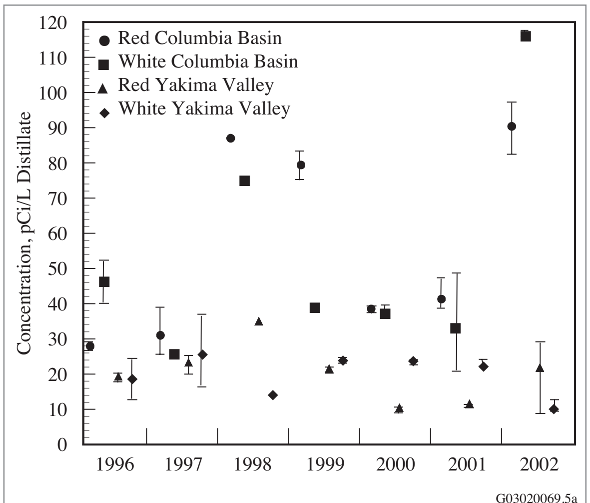

Figure 4.4.4. Median, Maximum, and Minimum Tritium Concentrations in Wine Samples Collected Near the Hanford Site in 1996 through 2002 (1998 results from Washington State Department of Health)