4.4 Food and Farm Product Surveillance

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Food products, including milk, vegetables, fruits, and wine, were collected routinely in 2001 at several locations surrounding the Hanford Site (Figure 4.4.1). Samples of alfalfa also were collected at selected locations. Routine samples were collected primarily from locations in the prevailing downwind directions (south and east of the site) where airborne effluents 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 determines the potential influence of Hanford Site releases in two ways:

- 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- through the comparison of results from locations irrigated with Columbia River water withdrawn downstream from the Hanford Site to results from locations irrigated with water from other sources.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 in 1996 by establishing a 2- or 3-year rotation to sample certain farm products. Specific details of the 2001 food and farm product sampling, including sampling locations and radionuclides analyzed, are reported in DOE/RL-91-50 and PNNL-13418, and are summarized in Table 4.4.1. Analyses for some radionuclides that historically have not been detected in food or farm products have been discontinued.

Gamma scans (cobalt-60, cesium-137, and other radionuclides; see 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 wet weight. Radionuclide levels in alfalfa are reported in picocuries per gram dry weight. Results for tritium are reported in picocuries per liter of liquid distilled from milk and wine. 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.

For many radionuclides, concentrations 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 (2 sigma). 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. 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-13910, APP. 1. Radiological dose considerations were calculated and reported in Section 5.0.

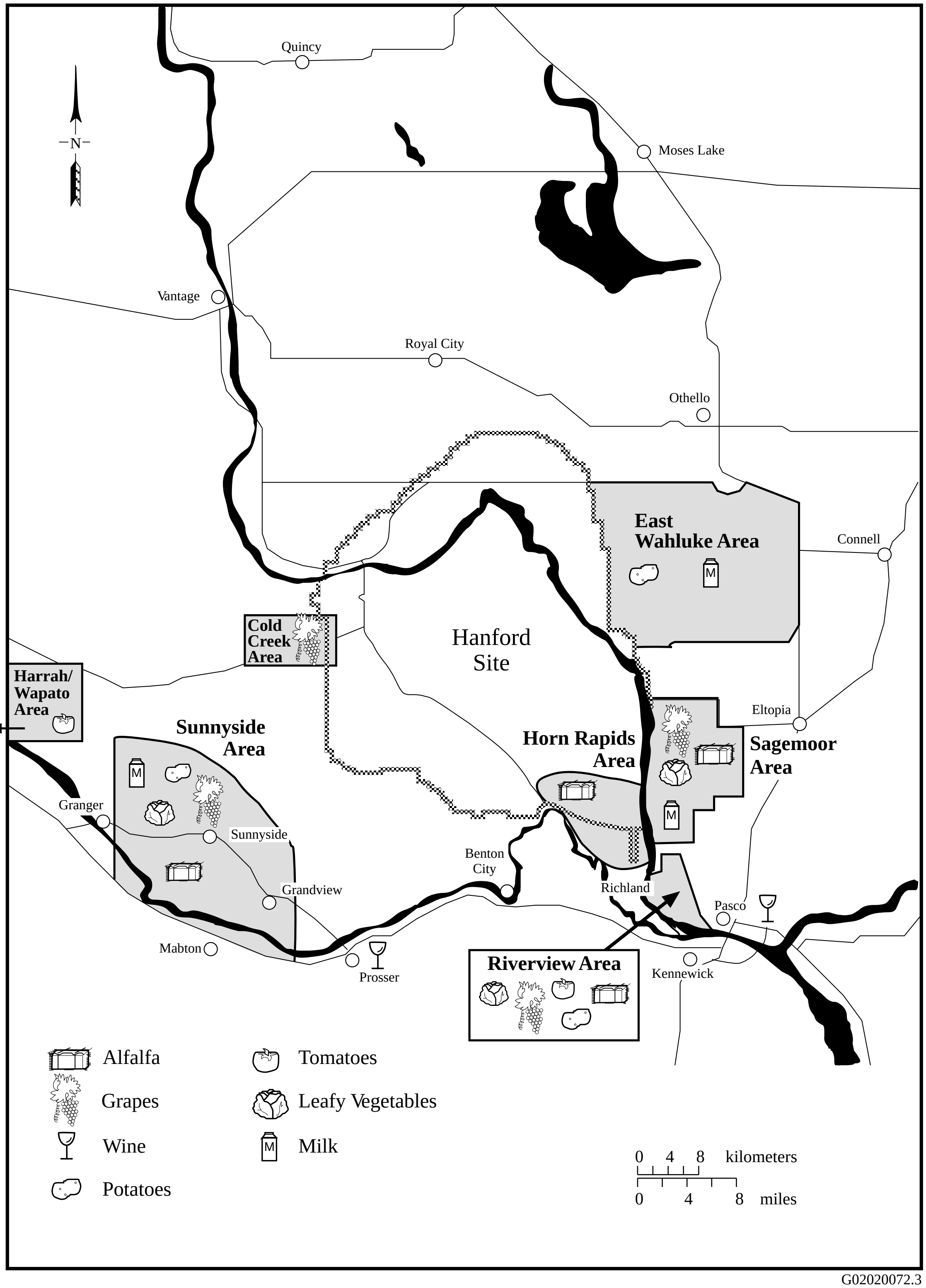

Figure 4.4.1. Sampling Locations for Food and Farm Products, 2001

Table 4.4.1. Locations, Sampling Frequencies, and Analyses Performed for Routinely Sampled Food and Farm Products, 2001[(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	2	A	2	6	6	0
Fruit	3	2	A	0	4	4	0
Wine	2	2	A	4	4	0	0
Alfalfa	1	3	BE	0	4	4	0

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

4.4.1 Milk Samples and Analytes of Interest

Composite samples of raw, whole milk were collected in 2001 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 (see Figure 4.4.1). Milk samples also were collected from a Sunnyside Area dairy to indicate background radionuclide concentrations at a generally upwind location.

Samples of milk were analyzed for tritium, strontium-90, iodine-129, 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. In 2001, 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. In 1998, an electrolytic enrichment technique (DOE/RL-91-50) to measure low levels of tritium in milk samples was instituted. The electrolytic enrichment 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.

Strontium-90 was detected in 2 of 12 (17%) milk samples analyzed in 2001. These two positive results (0.46 and 0.41 pCi/L [0.017 and 0.015 Bq/L]) were reported in one of four Sunnyside Area samples and in one of four Wahluke Area samples. These concentrations are close to the analytical detection limit (0.35 pCi/L [0.013 Bq/L]) and are consistent with 4 of 24 results found above the analytical detection limit in 1999 and 2000 combined. While there is no strontium-90 standard for milk, the drinking water standard (based on a 2-liter per day consumption) is 8 pCi/L (0.3 Bq/L) (40 CFR 141). The maximum milk consumption rate for estimating dose is ~0.75 liter per day (see 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 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 greater than results reported for milk samples from these three areas over the past decade (EPA-570/9-76-003).

No manmade gamma emitters (including cesium-137) were detectable in 2001 milk samples (PNNL-13910, APP. 1).

Tritium was analyzed by an electrolytic enrichment method in quarterly composite milk samples from the East Wahluke, Sagemoor, and Sunnyside Areas (see Figure 4.4.1) in 2001. The results indicate Sagemoor Area milk had higher (approximately two times) median tritium concentrations when compared to milk

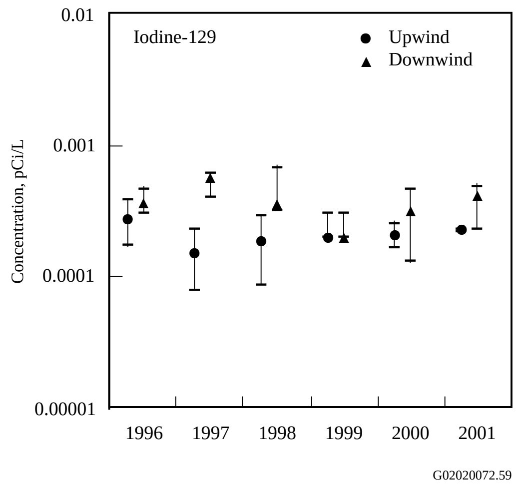

Figure 4.4.2. Median, Maximum, and Minimum Iodine-129 Concentrations in Milk Samples, 1996 through 2001

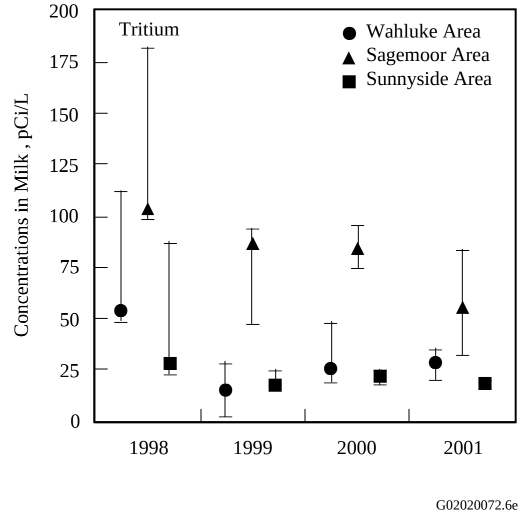

Figure 4.4.3. Median, Maximum, and Minimum Tritium Concentrations in Milk Samples Collected near the Hanford Site, 1998 through 2001

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 (see results in Figure 4.4.3).

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 in 2001 use 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. Background 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 overapplication 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 less-contaminated irrigation water. Based on a 12.3-year half-life, if we assume an aquifer having a concentration of 1,000 pCi/L (37 Bq/L) in 1963 (assumes some dilution with natural groundwater), the estimated level after three half-lives in 1999 would be 115 pCi/L (4.26 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 dose received by those who consume milk (see Section 5.0). While there is no tritium standard for milk, the standard for drinking water is 20,000 pCi/L (740 Bq/L).

4.4.2 Vegetable Samples and Analytes of Interest

Leafy vegetables are routinely sampled to monitor for airborne contaminants. Samples of leafy vegetables (i.e., cabbage and beets) and vegetables (i.e., tomatoes and potatoes) were obtained during the summer from gardens and farms located within selected sampling areas (see 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 gamma emitters in vegetable and leafy vegetable samples were all less than their respective detection limit (0.02 pCi/g [0.00054 Bq/g]) and were consistent with results seen in recent years (PNNL-13910, APP. 1). Strontium-90 was not detected in any vegetable (potato and tomato) samples but was detected in one of three leafy vegetable samples collected in 2001. The single result reported above the analytical detection limit in 2001 was similar to previous years and between the upwind concentration (from Sunnyside) and other downwind concentrations (from East Wahluke) seen in recent years (PNNL-13487). Results from another downwind location, the Riverview Area, fell below the analytical detection limit (0.002 to 0.006 pCi/g [0.000074 to 0.00022 Bq/g]).

4.4.3 Fruit Samples and Analytes of Interest

Concord grapes were collected during the fall harvest from the areas shown in Figure 4.4.1. All grape samples were analyzed for gamma-emitting radionuclides and strontium-90. Measurable levels of cesium-137 were reported slightly above the detection limit (0.007 ± 0.004 pCi/g [0.00026 ± 0.00015 Bq/g]) from the Riverview Area. Strontium-90 and other manmade gamma-emitting radionuclides were not detected in grapes in 2001. 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). 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 (2001 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 2001 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 2001 (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. Gamma spectroscopy did not indicate the presence of cesium-137 or any other gamma-emitting manmade radionuclide in any of the 2001 wine samples. 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 (see Section 4.4.1).

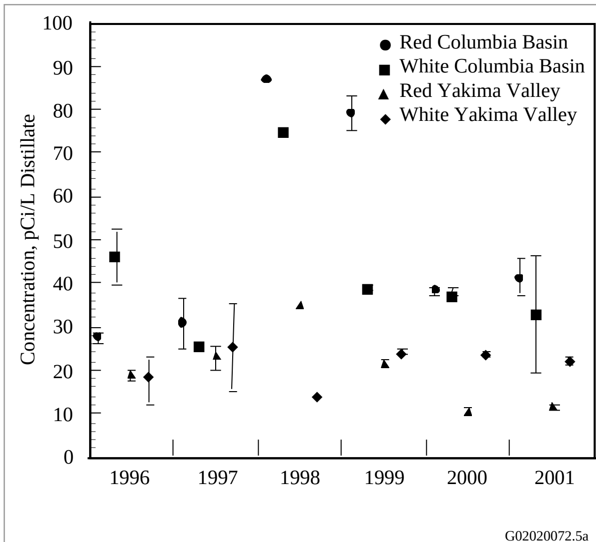

Figure 4.4.4. Median, Maximum, and Minimum Tritium Concentrations in Wine Samples Collected in 1996 through 2001 (1998 results from Washington State Department of Health)

4.4.5 Alfalfa

Alfalfa samples were collected during harvest from the areas shown in Figure 4.4.1. All samples were analyzed for gamma-emitting radionuclides and strontium-90. Measurable levels of cesium-137 and other manmade gamma-emitting radionuclides were not detected in alfalfa in 2001. The nominal level of detection for cesium-137 in alfalfa was 0.02 pCi/g (0.00074 Bq/g) dry weight. Strontium-90 was found above the analytical detection limit (0.02 to 0.05 pCi/g [0.00074 to 0.00185 Bq/g] dry weight) in two of the four samples submitted for analysis in 2001. The highest concentration (0.15 ± 0.08 pCi/g [0.0056 ± 0.003 Bq/g] dry weight) was detected in a sample from the Horn Rapids Area. These results were consistent with measurements in alfalfa in past years (PNL-10575; PNNL-11140; PNNL-11473; PNNL-11796; PNNL-12088; PNNL-13230).