



4.6 Soil and Vegetation Surveillance

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Soil surveillance provides information on long-term contamination trends and baseline environmental radionuclide activities at undisturbed locations (DOE/RL-91-50, Rev. 2). Surveillance of perennial vegetation provides information on atmospheric deposition of radioactive materials in uncultivated areas and at onsite locations adjacent to potential sources of man-made radioactivity. Accordingly, radionuclide concentration in soil and perennial vegetation provide a baseline against which unplanned releases can be compared.

Soil and perennial vegetation samples have been collected on and around the Hanford Site for greater than 50 years. Consequently, a large database exists that thoroughly documents onsite and offsite concentrations of man-made radionuclides in soil and natural vegetation at specific locations. Because the current site mission includes environmental restoration and cleanup, and because routine plutonium production operations at the site have ceased, the need for annual soil and perennial vegetation surveillance has diminished. There are several additional reasons for the reduced need for soil and perennial vegetation sampling. Man-made radionuclides with

short half-lives have decayed to stable isotopes and are no longer present. Moreover, radionuclide releases from the Hanford Site in recent years have been small, and, therefore, baseline radionuclide activities have not changed appreciably for a number of years. Because only radionuclides with relatively long half-lives presently are found in soil and vegetation, sitewide environmental surveillance sampling of soil and vegetation can be less frequent. Routine radiological surveillance of soil and vegetation was last conducted in 1998 (Section 4.6 in PNNL-12088). In 1999, two special studies were conducted. One study involved the analysis of samples from mulberry trees and reed canary grass collected from the Hanford Site along the Columbia River shoreline. Another study involved the analysis of soil samples collected in and near the former 1100 Area. Five different species of plants collected from the Hanford Site by the Wanapum People also were analyzed for radiological contaminants.

Other soil and vegetation sampling was conducted near active facility release points and waste sites. Results are discussed in Section 3.2, "Near-Facility Environmental Monitoring."

4.6.1 Surveillance of Columbia River Shoreline Vegetation

Samples of mulberry trees and reed canary grass were collected along the Columbia River shoreline in early summer 1999 and analyzed for gamma emitters, tritium, strontium-90, technetium-99, and uranium isotopes. These radionuclides are present in groundwater and are known to enter the Columbia River in shoreline springs. Samples consisted of stems, leaves and, when available, mulberries. Samples were collected in the vicinity of shoreline

springs at locations where elevated concentrations of radionuclides were seen in samples collected in 1990 to 1992 (PNL-8797). Background samples were collected upstream of the Hanford Site near the Vernita Bridge and immediately downstream of the site near the Port of Benton's dock in north Richland (Figure 4.6.1). Shallow groundwater was collected with drive point sampling tubes installed in the rooting zones of some mulberry trees. A drive point

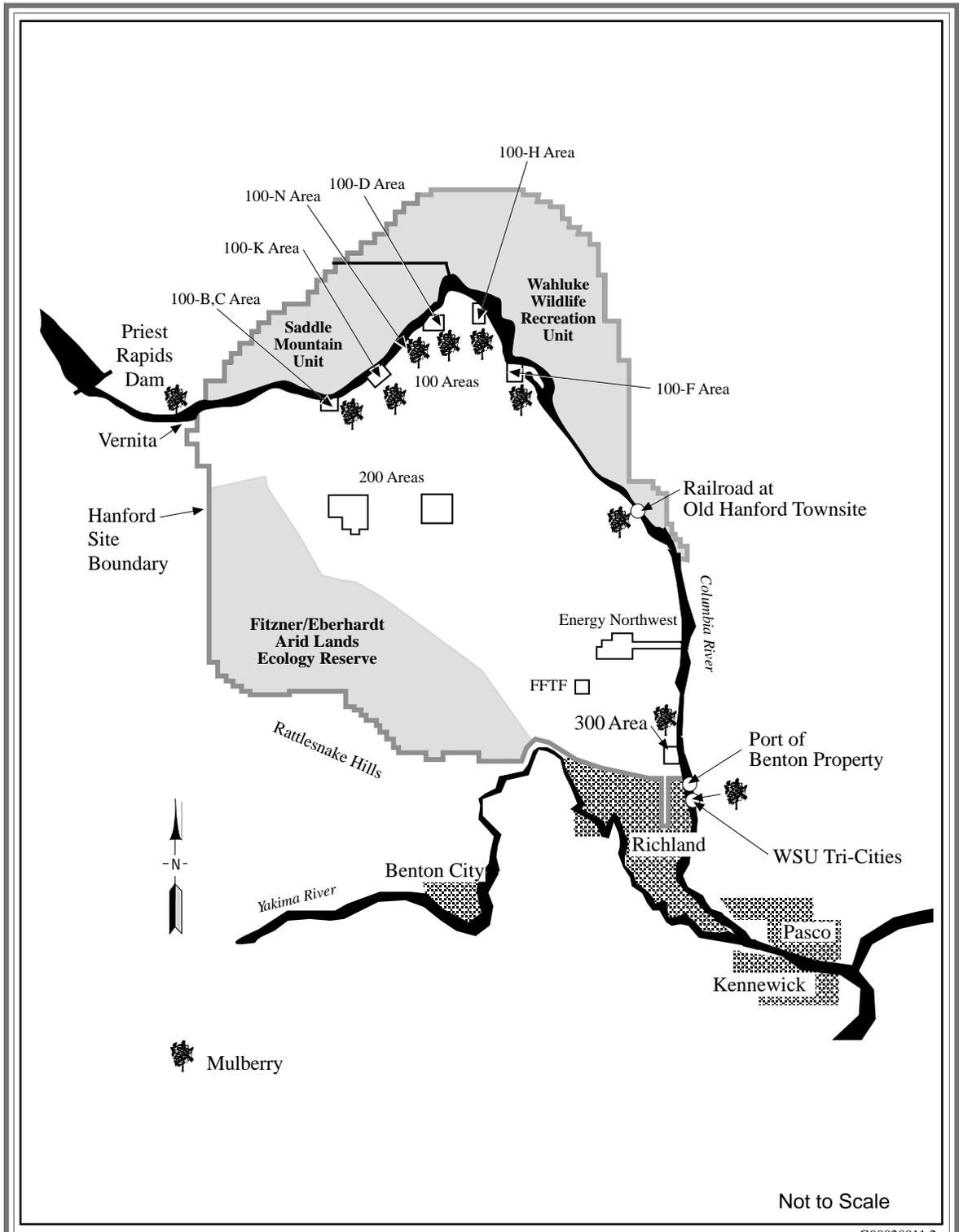


Figure 4.6.1. Columbia River Shoreline Vegetation Sampling Locations on and Near the Hanford Site, 1999



sampling tube is a plastic tube with a metal cone on one end that is driven into the ground to obtain water. Slots are cut into the tube near the cone and covered with a fine mesh screen to exclude soil particles. Some mulberry trees were also re-sampled in the fall to determine if radionuclide concentrations had increased over the summer growing season. Observed concentrations of radionuclides were compared to concentrations observed in shoreline vegetation samples collected in 1990 to 1992.

Tritium was measured in water that was distilled from the vegetation samples and submitted to the analytical laboratory for analysis. Concentrations of tritium in the 1999 samples were similar to concentrations observed in the 1990 to 1992 samples (Figure 4.6.2). A concentration of 20,000 pCi/L of plant distillate was observed at the 100-B,C Area. This value exceeded concentrations observed in past sampling, but is not considered unusual because of the known presence of groundwater tritium plumes in the area. The tritium concentration in the mulberry tree sampled at the Old Hanford Townsite was

close to background. This sample was expected to be elevated based on past sampling results and known levels of tritium in groundwater at the Old Hanford Townsite.

The pattern of strontium-90 concentrations in shoreline vegetation mirrored observations made in 1990 to 1992 (Figure 4.6.3). The highest values were observed at N Reactor and slightly lower values were observed near the other reactor areas. At areas upstream and downstream of the reactor areas, concentrations of strontium-90 were at background levels of around 0.1 pCi/g. Strontium-90 accumulates through the growing season and is deposited in bark and tree leaves. Concentrations of strontium-90 collected in October at Vernita, the 100-B,C Area, and the 100-H Area were 1.9 to 3.8 times higher than the concentrations observed in early summer (Figure 4.6.4). Early summer and fall comparative samples collected at the 300 Area and near the Washington State University Tri-City Campus did not show the summer increase, however.

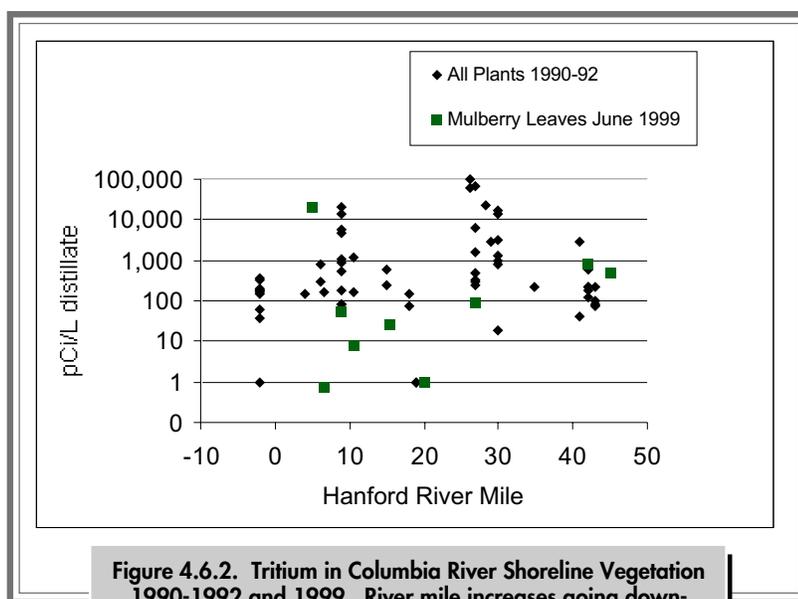
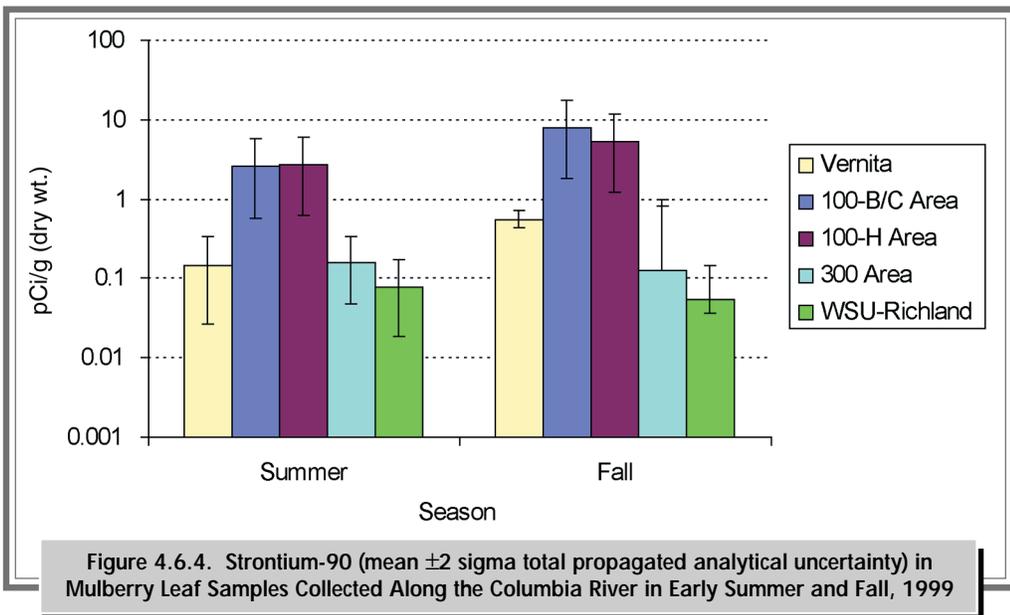
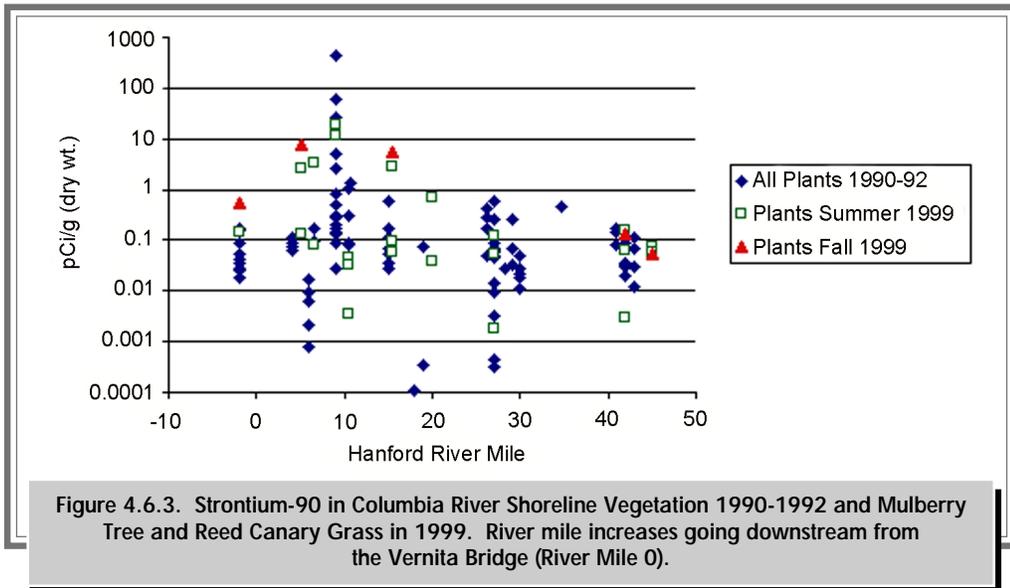


Figure 4.6.2. Tritium in Columbia River Shoreline Vegetation 1990-1992 and 1999. River mile increases going downstream from the Vernita Bridge (River Mile 0).



Concentrations of uranium isotopes and technetium-99 were generally below detection and when detected, were not different then values

observed in 1990 to 1992. Sample results are listed in PNNL-13230, APP. 1.

4.6.2 Special Soil Samples

In July 1999, surface soil samples were collected in and around the former 1100 Area in north Richland and analyzed for radiological contamination. The

1100 Area was a 311-hectare (768-acre) parcel of land located between the 300 Area and the city of Richland (see Figure 1.0.1) that was transferred from



the DOE to the Port of Benton in 1998. Under DOE ownership, this area was generally used for nonresearch and nonnuclear activities. However, nuclear materials were occasionally stored there, potentially radiologically contaminated equipment was serviced there, and some cleanup of contaminated railroad equipment occurred there. Prior to transferring the property to the Port, the DOE Richland Operations Office inspected facilities within the area for radiological contamination. After transferring the property, DOE decided surface soil within the area should also be monitored. Potential sources of contaminants, in addition to those mentioned above, included airborne materials from DOE facilities on the site, airborne materials from private nuclear facilities on and around the site, and materials that could have been carried into the area by railroad operations or other means.

A total of 16 samples from 12 locations (Figure 4.6.5) were collected and submitted to analytical laboratories for analysis. Four of the samples were collected by the Pacific Northwest National Laboratory, four were collected by the Washington State Department of Health, and four were collected jointly and each was split between the two agencies. Ten of the sampling locations were thought to have the greatest potential to have received contamination

over the years. Two relatively undisturbed sites near the former 1100 Area were selected as background locations. Global positioning system readings were taken at each sampling location. Quanterra, Inc. in Richland analyzed the Pacific Northwest National Laboratory samples and the Washington State Public Health Laboratory in Seattle analyzed the Washington State Department of Health samples.

Samples were analyzed for strontium-90, uranium isotopes (uranium-234, -235, and -238), plutonium isotopes (plutonium-238 and -239/240), and gamma emitters (beryllium-7, potassium-40, cobalt-60, ruthenium-106, antimony-125, cesium-134 and -137, europium-154 and -155). A summary of analytical results for both the Pacific Northwest National Laboratory and the state are provided in Table 4.6.1. Also included for comparative purposes are Pacific Northwest National Laboratory data for Hanford Site perimeter locations collected from 1992 through 1997. In all cases, radionuclide concentrations in 1100 Area soil samples collected in 1999 were similar to concentrations measured in the background samples collected near the 1100 Area and were near or below values measured at Hanford Site perimeter locations between 1992 and 1997. Detailed analytical results are reported in PNNL-13230, APP. 1.

4.6.3 Vegetation Samples Submitted by the Wanapum People

Five different species of plants were collected from the Hanford Site by members of the Wanapum People in June 1999. Samples were submitted for analysis by the Surface Environmental Surveillance Project and analyzed for radioactive materials. Neither uranium isotopes, plutonium-238, nor cesium-137 contaminants were detected. Plutonium-239/240 was marginally detected in two of the five plants

at a concentration of 0.00002 ± 0.0003 pCi/g dry weight. Strontium-90 was measured in all five samples. Concentrations ranged from 0.014 ± 0.006 to 0.040 ± 0.014 pCi/g dry weight (Table 4.6.2). These strontium-90 concentrations are comparable to past monitoring results for strontium-90 in both terrestrial upland vegetation and shoreline vegetation associated with undeveloped areas of the site.

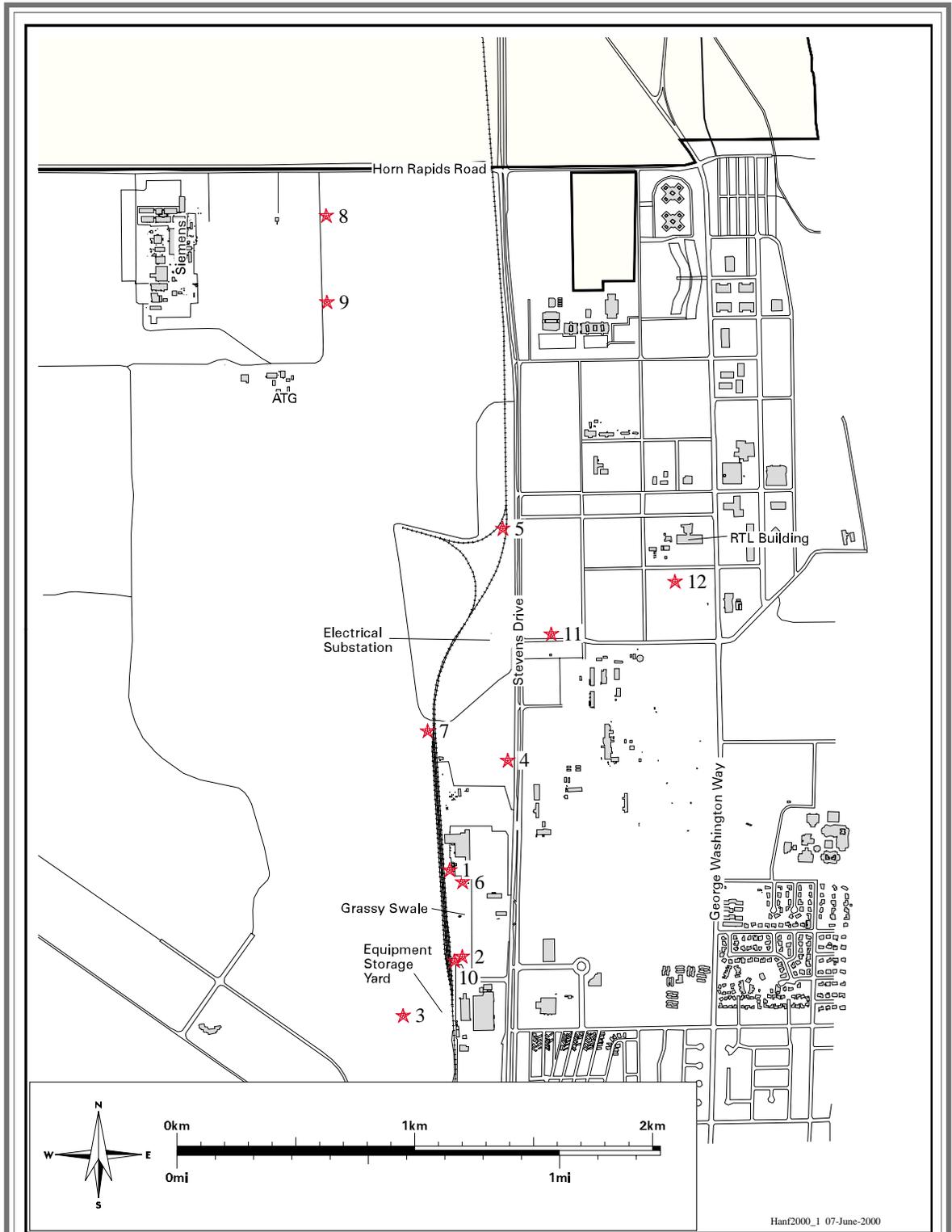


Figure 4.6.5. Soil Sampling Locations in and Near the Former 1100 Area, 1999

Table 4.6.1. Concentrations of Selected Radionuclides in Surface Soil Samples (pCi/g, dry wt.) Collected in and Near the Former 1100 Area in July 1999 and at Hanford Site Perimeter Locations in Previous Years

Radionuclide	Location	Pacific Northwest National Laboratory ^(a)			Washington State Department of Health ^(b)			Perimeter Locations 1992-1997 ^(c)	
		Maximum ^(d)	Minimum ^(d)	Mean ^(e)	Maximum ^(d)	Minimum ^(d)	Mean ^(e)	Mean ^(e)	Maximum ^(d)
Strontium-90	1100 Area	0.115 ± 0.029	0.031 ± 0.01	0.073 ± 0.028	0.11 ± 0.01	0.003 ± 0.005	0.039 ± 0.028	0.078 ± 0.016	0.15 ± 0.03
	Background	0.129 ± 0.031	0.020 ± 0.007		0.1 ± 0.01				
Cesium-137	1100 Area	0.55 ± 0.064	0.143 ± 0.032	0.343 ± 0.111	0.545 ± 0.034	0.02 ± 0.007	0.202 ± 0.148	0.35 ± 0.095	0.95 ± 0.12
	Background	0.664 ± 0.076	0.106 ± 0.027		0.655 ± 0.017				
Uranium-234	1100 Area	0.804 ± 0.130	0.622 ± 0.100	0.712 ± 0.030	0.75 ± 0.09	0.49 ± 0.09	0.54 ± 0.07	0.54 ± 0.14	0.88 ± 0.11
	Background	0.638 ± 0.099	0.666 ± 0.085		0.6 ± 0.1				
Uranium-235	1100 Area	0.011 ± 0.007	0.003 ± 0.005	0.008 ± 0.003	ND ^(f)	ND	ND	0.03 ± 0.03	0.27 ± 0.15
	Background	0.012 ± 0.008	0.004 ± 0.005						
Uranium-238	1100 Area	0.767 ± 0.095	0.653 ± 0.086	0.716 ± 0.020	0.7 ± 0.1	0.54 ± 0.08	0.626 ± 0.052	0.71 ± 0.10	1.1 ± 0.51
	Background	0.666 ± 0.085	0.601 ± 0.076		0.8 ± 0.1				
Plutonium-238	1100 Area	0.0005 ± 0.0003	0.0002 ± 0.0002	0.0004 ± 0.0001	0.006 ± 0.005	-0.0001 ± 0.0032	0.002 ± 0.002	0.0003 ± 0.0002	0.001 ± 0.001
	Background	0.0006 ± 0.0004	0.0001 ± 0.0001		0.0006 ± 0.0027				
Plutonium-239/240	1100 Area	0.025 ± 0.004	0.0033 ± 0.0008	0.010 ± 0.006	0.016 ± 0.005	0.002 ± 0.002	0.005 ± 0.004	0.008 ± 0.002	0.021 ± 0.003
	Background	0.016 ± 0.003	0.0013 ± 0.0004		0.012 ± 0.005				

(a) Includes data for 1100 Area locations 3, 4, 5, 8, 9, 10, and background locations 11 and 12.

(b) Includes data for 1100 Area locations 1, 2, 3, 4, 6, 7, 8, and background location 11.

(c) Surface Environmental Surveillance Project analytical data.

(d) ± total propagated analytical uncertainty (2 sigma).

(e) ±2 standard error.

(f) No data provided.





**Table 4.6.2. Strontium-90 Concentrations (pCi/g, dry wt.)
in Vegetation Samples Collected on the Hanford Site
by the Wanapum People, June 1999**

<u>Plant Name</u>	<u>Species</u>	<u>Concentration</u> ^(a)
Yarrow	<i>Achillea sp.</i>	0.040 ± 0.014
Globemallow	<i>Sphaeralcea sp.</i>	0.023 ± 0.008
Tumble mustard	<i>Sisymbrium sp.</i>	0.014 ± 0.006
Willow	<i>Salix sp.</i>	0.014 ± 0.005
Balsamroot	<i>Balsamorhiza sp.</i>	0.020 ± 0.007

(a) ± total propagated analytical uncertainty (2 sigma).