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Westinghouse Hanford Company Operational Environmental Monitoring Annual Report

Calendar Year 1994

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WESTINGHOUSE HANFORD COMPANY OPERATIONAL ENVIRONMENTAL MONITORING ANNUAL REPORT

Calendar Year 1994

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ABSTRACT

This document presents the results of the Westinghouse Hanford Company near-facility operational environmental monitoring for 1994 in the 100, 200/600, and 300/400 Areas of the Hanford Site, in south-central Washington State. Surveillance activities included sampling and analyses of ambient air, surface water, groundwater, soil, sediments, and biota. Also, external radiation measurements and radiological surveys were taken at waste disposal sites, radiologically controlled areas, and roads. These activities were conducted to assess and control the effects of nuclear facilities and waste sites on the local environment. In addition, diffuse sources were monitored to determine compliance with Federal, State, and/or local regulations. In general, although effects from nuclear facilities are still seen on the Hanford Site and radiation levels are slightly elevated when compared to offsite locations, the differences are less than in previous years.

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EXECUTIVE SUMMARY

Near-Field Environmental Monitoring

The Near-Field Environmental Monitoring Program operated by Westinghouse Hanford Company provides environmental monitoring to protect the environment adjacent to facilities and ensure compliance with local, State, and Federal environmental regulations.

Specifically, the near-field environmental monitoring program monitors new and existing sites, processes, and facilities for potential impacts and releases, fugitive emissions and diffuse sources from contaminated areas, and surplus facilities before decontaminating or decommissioning. External radiation dose, ambient air particulates, surface water, soil, sediment, and biota were sampled. Parameters included, as appropriate, radionuclides; radiation exposure; hazardous constituents, such as nitrates; pH; and water temperature.

While the analytical results showed a high degree of variability, in general, the samples collected from media located on or directly adjacent to the waste disposal and other nuclear facilities had significantly higher concentrations than those farther away. As expected, certain radionuclides were found in higher concentrations within different operational areas. Generally speaking, the predominant radionuclides were activation products/gamma emitters in the 100 Areas, fission products in the 200/600 Areas, and uranium in the 300 Area.

Air Monitoring. Radioactivity in air was sampled by a network of continuously operated samplers at 41 locations near facilities: 4 in the 100 N Area, 4 in the 100 K Area, 31 in the 200/600 Areas, 1 near the 300 Area Treated Effluent Disposal Facility, and 1 station collocated with the Surface Environmental Surveillance Project and the Washington State Department of Health at the Wye Barricade. Air samplers were primarily located at or near sites and/or facilities having the potential for or history of release, with an emphasis on the prevailing downwind directions. Of the radionuclide analyses performed, ^{90}Sr, ^{137}Cs, $^{239,240}Pu$, and uranium were consistently detectable in the 200 Areas and ^{60}Co was consistently detectable in the 100 N Area. Air concentrations for these radionuclides were elevated near facilities when compared to the concentrations measured off site by the Surface Environmental Surveillance Project.

Monitoring of Surface-Water Disposal Units and Seeps. Sampling of surface-water disposal units included water, sediment, and aquatic vegetation. Samples taken at river shoreline seeps consisted of water only. Radiological analysis of sediment and aquatic vegetation included total alpha, total beta, ^{3}H, $^{239,240}Pu$, and gamma-emitting radionuclides. Nonradiological analyses performed included pH, temperature, and nitrates.

Radionuclide concentrations in surface-water disposal units were below the applicable Derived Concentration Guides used as indices of performance and, in most cases, were at or below the analytical detection limit. Although some slightly elevated levels were seen in both aquatic vegetation and sediment, in all cases the radiological analytical results were well below the standards for radiological control. The results for pH were well within the pH range of 2.0 to 12.5, the standard for liquid effluent discharges required

by the *Resource Conservation and Recovery Act of 1976*. The analytical results for nitrates were all below the 45-mg/L Drinking Water Standard.

Groundwater seeps along the 100 N Area shoreline are sampled to verify the reported radionuclide releases to the Columbia River from past operations of the N Reactor. By characterizing the radionuclide concentrations in the seeps along the shoreline, the results can be compared to the concentrations measured in the facility effluent monitoring well.

In 1994, the concentrations detected in the seep samples were highest in those seeps nearest the facility effluent monitoring well, although the seep concentrations were considerably lower than those measured in the well.

Radiological Surveys. Approximately 2,756 ha (6,364 acres) of outdoor surface contamination and 981 ha (2,423 acres) of underground radioactive material were posted sitewide in 1994. These areas were typically associated with cribs, burial grounds, tank farms, and covered ponds, trenches, and ditches. The number of posted surface contamination areas varied because of an ongoing effort to clean, stabilize, and remediate areas of known contamination while new areas of contamination were being identified. New areas may have been identified because of either contamination migration or the increased effort being made to investigate outdoor areas for radiological contamination. It was estimated that the external dose rate for 80 percent of the identified outdoor surface contamination areas was less than 1 mrem/h, although isolated radioactive specks [smaller than 0.6 cm (0.25 in.)] could be considerably higher. Contamination levels of this type would not significantly add to external dose rate calculations for the public or Site employees.

Soil and Vegetation Monitoring. Soil and vegetation samples were also collected on or adjacent to waste disposal units and from locations downwind and within the operating environment of facilities. Special samples were taken where physical or biological transport problems were identified. Soil and vegetation sample concentrations for some radionuclides were elevated near facilities when compared to the concentrations measured off site. The concentrations show a large degree of variability; in general, samples collected on or directly adjacent to waste disposal facilities had significantly higher concentrations than those collected farther away.

External Radiation. External radiation fields were surveyed near operating facilities and waste-handling, storage, and disposal sites to measure, assess, and control the effects of operations.

Hand-held microroentgen meters (to measure low-level radiation exposure) were used in the 100 N Area to survey points near and within the N Springs area, 1301-N Liquid Waste Disposal Facility, and 1325-N Liquid Waste Disposal Facility. The radiation rates measured in the N Springs area continued to decline in 1994, reflecting the continuing decay of the radionuclide inventory in the near-by 1301-N Liquid Waste Disposal Facility. Radiation measurements taken at the 1325-N Liquid Waste Disposal Facility in 1994 and in the previous year were slightly elevated. Discontinued discharges to the facility resulted in the loss of the water that normally provided shielding for the gamma-emitting radionuclides in sediments at the facility and has been determined to be responsible for these elevated readings.

Radiation levels measured with thermoluminescent dosimeters were highest near facilities that had contained or received liquid effluent from N Reactor,

primarily the 1325-N Liquid Waste Disposal Facility and the 1301-N Liquid Waste Disposal Facility. Dose rates for 1994 for these two facilities decreased approximately 5 percent from 1993.

The highest dose rates measured in the 200/600 Areas were near waste-handling facilities, such as tank farms. The average annual dose rate for 1994 in the 200/600 Areas was 133 mrem/yr, which was an increase of 2 percent from the average dose rate of 130 mrem/yr measured in 1993.

The highest dose rates in the 300 Area were measured near waste-handling facilities such as the 340 Waste Handling Facility. The average annual dose rate measured in the 300 Area in 1994 was 170 mrem/yr. This represents a decrease of 13 percent from the average dose rate of 190 mrem/yr measured in 1993. This comparison does not include the six new TLD locations established early in 1994 near the 300 Area Treated Effluent Disposal Facility.

The highest dose rates measured in the 400 Area were near the 437 building, where railroad cars are staged before shipping radioactive materials. The average annual dose rate for 1994 in the 400 Area was 115 mrem/yr, an increase of 16 percent from the average annual dose rate of 100 mrem/yr in 1993.

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SUMMARY

Operational (Near-Field) Environmental Monitoring

Several types of environmental media are sampled near nuclear facilities to monitor the effectiveness of waste management and restoration activities and effluent treatment and control practices. These media include air, surface water and seeps, groundwater, surface contamination, soil, sediments, and biota, and external radiation. Sampling and analysis information and analytical results for 1994 for each of these media are summarized below.

Near-Field Environmental Monitoring at Hanford

Near-Field Environmental Monitoring is defined as routine monitoring near facilities that have the potential to discharge or have discharged, stored, or disposed of radioactive or hazardous contaminants. Monitoring locations are associated mostly with major nuclear facilities, such as the Plutonium Uranium Extraction (PUREX) Plant and N Reactor, and waste storage or disposal facilities such as burial grounds, tank farms, ponds, cribs, trenches, and ditches.

Much of the monitoring program consists of collecting and analyzing environmental samples and methodically surveying areas near facilities releasing effluents and waste streams. The program also evaluates acquired analytical data, determines the effectiveness of facility effluent monitoring and controls, measures the adequacy of containment at waste disposal units, and detects and monitors unusual conditions. The program implements applicable portions of U.S. Department of Energy (DOE) Orders 5400.1, 5484.1, 5400.5, and 5820.2A.

Monitoring activities routinely include sampling and monitoring ambient air, water from surface-water disposal units, external radiation dose, soil, sediment, vegetation, and animals. Some of the parameters typically monitored are pH, radionuclide concentration, radiation exposure level, and some limited hazardous chemical constituents. Samples are collected from known or expected effluent pathways. These pathways are generally downwind of potential or actual airborne releases and downgradient of liquid discharges. The annual routine activities of near-field monitoring are summarized in Table S-1, which summarizes the type, quantity, and location of samples collected. A detailed discussion of results for groundwater wells used specifically to monitor operating facilities may be found in Section 3 of this report.

Waste disposal sites and the terrain surrounding them are surveyed to detect and characterize any radioactive surface contamination. Routine survey locations include cribs, trenches, retention basin perimeters, pond perimeters, ditch banks, solid waste disposal sites (for example, burial grounds, trenches), unplanned release sites, tank farm perimeters, stabilized waste disposal sites, roads, and firebreaks in and around the Site operational areas.

Table S-1. Near-Field Routine Environmental Samples and Locations, 1994.

Samples	Total	100 Areas	200 Areas	300/400 Areas
Air	41	8	32[a]	1
Surface water	21	9	12	0
External radiation	292	213[b]	58[c]	21[c]
Soil	86	12	57	17
Vegetation	74	20	37	17

[a]Includes one sampler located at the Wye Barricade.
[b]Includes thermoluminescent dosimeters and surveys using hand-held μR meters.
[c]Includes thermoluminescent dosimeters only.

Air Monitoring

Near-field air sampling monitors the effectiveness of waste management and effluent treatment and controls in reducing effluents and emissions; these systems also monitor diffuse source emissions.

Sample Collection and Analysis

Radioactivity in air was sampled by a network of continuously operating samplers at 41 locations near nuclear facilities: 4 in the 100 N Area, 4 in the 100 K Area, 31 in the 200/600 Areas, 1 near the 300 Area Treated Effluent Disposal Facility, and 1 background station, which was collocated with samplers operated by the Surface Environmental Surveillance Project and the Washington State Department of Health (DOH) at the Wye Barricade. To avoid duplication of sampling, the near-field environmental monitoring program used existing Surface Environmental Surveillance Project air samplers in the 300 and 400 Areas. Results for these areas are reported in the *Hanford Site Environmental Report*, Section 5.2, "Air Surveillance" (Dirkes and Hanf 1995), and are not discussed here. Air samplers were primarily located at or near [within approximately 500 m (1,500 ft)] sites and/or facilities having the potential for, or history of, environmental releases, with an emphasis on the prevailing wind directions.

Samples were collected according to a schedule established before the monitoring year [*Routine Operational Environmental Monitoring Schedule, CY 1994*, WHC-SP-0098-5 (Schmidt 1993)]. Airborne particles were sampled at each station by drawing air through a glass-fiber filter. The filters were collected biweekly, field-surveyed for gross radioactivity to detect any unusual trends or off-normal occurrences, held for at least 7 days, and then analyzed for total alpha and beta activity. The 7-day holding period was necessary to allow for the decay of naturally occurring radionuclides that would otherwise obscure detection of longer-lived radionuclides associated with emissions from nuclear facilities. The total radioactivity measurements were used to indicate changes in trends in the near-field environment.

For most radionuclides, the amount of radioactive material collected on a single filter during a 2-week sampling period was too small to be measured accurately. The accuracy of the sample analysis was increased by compositing the samples into one biannual sample for each location. Each biannual composite sample was then sent to International Technology Corporation, Inc., Richland, Washington, to be analyzed for strontium (^{90}Sr), plutonium (^{238}Pu, $^{239/240}Pu$), uranium ($^{234,235,238}U$), and gamma-emitting (^{60}Co, ^{137}Cs) radionuclides.

Results

Of the radionuclide analyses performed, ^{90}Sr, ^{137}Cs, $^{239,240}Pu$, and uranium were consistently detectable in the 200 Areas and ^{60}Co was detectable in the 100 N Area. Air concentrations for these radionuclides were elevated near facilities compared to the concentrations measured off site. Figure S-1 shows average values for 1994 and the preceding 5 years for selected radionuclides compared to Derived Concentration Guides and the background air concentration as measured by the Surface Environmental Surveillance Project. The Derived Concentration Guides are reference values that are used as indices of performance. The data indicate a large degree of variability. In general, samples collected from air samplers located at or directly adjacent to nuclear facilities had significantly higher concentrations than did those samples collected farther away. The data also show, as expected, that concentrations of certain radionuclides were higher within different operational areas. Generally, the predominant radionuclides are activation products (i.e., gamma emitters) in the 100 Areas and fission products in the 200/600 Areas. A more detailed data summary is provided in Section 2.

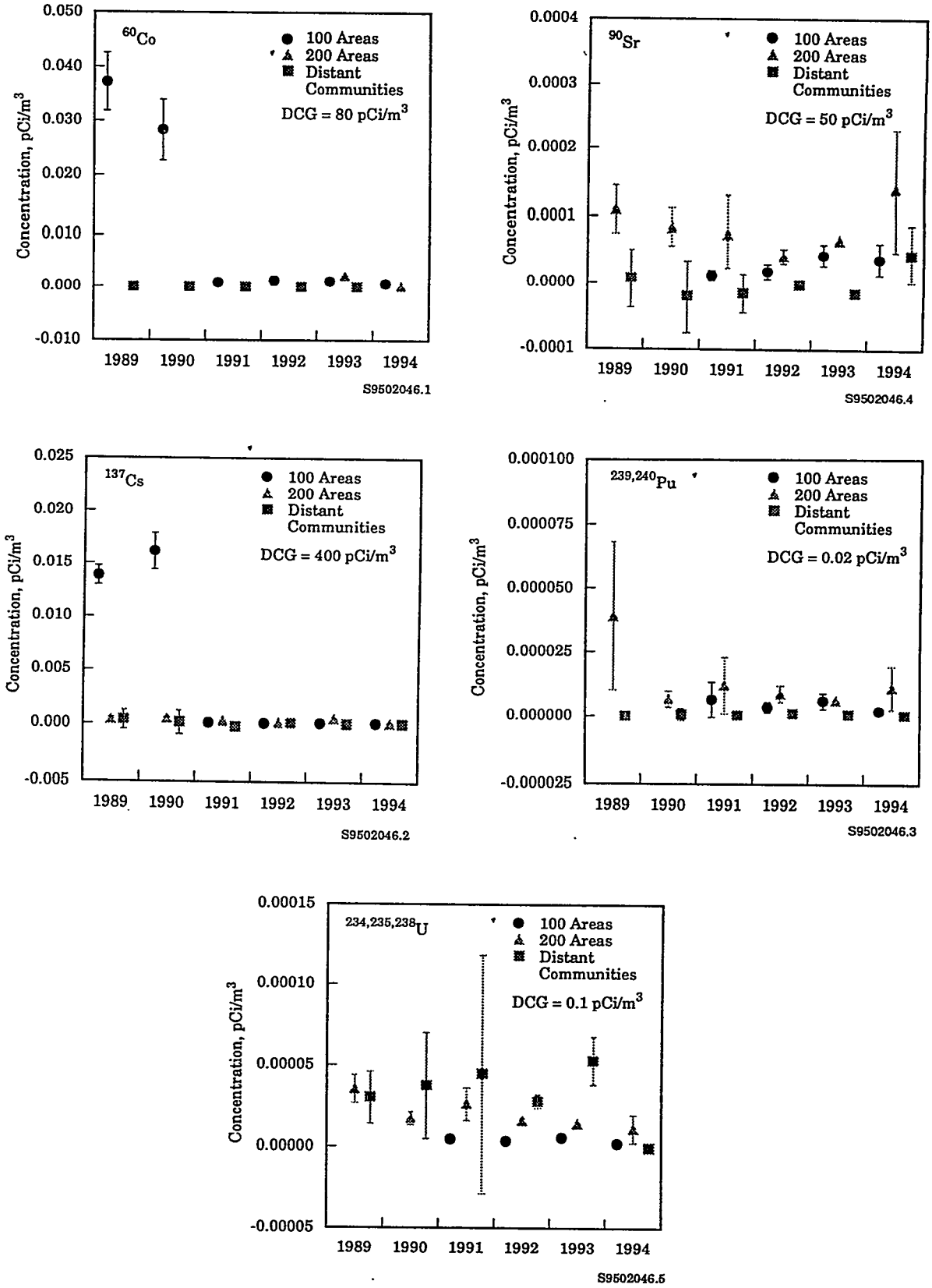
100 N Area

Analytical results from air samples taken in the 100 N Area continued to be at or near those concentrations measured at the distant community for most radionuclides as a result of facility shutdowns, improved effluent controls, and improved waste and restoration management practices. These levels were much less than the Derived Concentration Guides. However, they were greater than levels measured off site.

100 K Area

Analytical results from air samples taken in the 100 K East Area showed radionuclide concentrations at or near minimum detection levels. This was the first year for environmental air sampling at the 100 K East Area, thus trend analysis was not possible.

Figure S-1. Average Values for Selected Radionuclides (1989-1994).



200 Areas

Analytical results from air samples taken in the 200 Areas were on a downward trend for most radionuclides as a result of facility shutdowns, better effluent controls, and improved waste management practices. These levels, although much less than the Derived Concentration Guides, were greater than levels measured off site and were higher for ^{90}Sr, $^{239,240}Pu$, and uranium than levels measured in the 100 N Area.

Surface-Water Disposal Units and Seep Monitoring

Surface-water disposal units (open ponds and ditches) used by the operating facilities and seeps along the 100 N Area Columbia River shoreline are monitored to assess the effectiveness of effluent and contamination controls. The number of surface water disposal units declined in 1994 from a maximum of 12 to 4 (see Section 6 for more details). Nine seeps were sampled in 1994.

Sample Collection and Analysis

Samples from surface-water disposal units and Columbia River shoreline seeps were collected from various locations in the operational areas. A more detailed description of sampling locations is given in Section 7 of this report. Samples collected from surface-water disposal units included water, sediment, and aquatic vegetation. Only water samples were taken at river shoreline seeps. The sampling methods are discussed in detail in *Operational Environmental Monitoring*, WHC-CM-7-4. To avoid duplication of sampling, the near-field environmental monitoring program used surface-water sample data collected by the Surface Environmental Surveillance Project for the 400 Area. Results for the 400 Area sampling are reported in the *Hanford Site Environmental Report for Calendar Year 1994*, Section 5.3, "Surface-Water Surveillance" (Dirkes and Hanf 1995), and are not discussed here.

Radiological analyses of water samples from surface-water disposal units included total alpha, total beta, ^{3}H, $^{239,240}Pu$, and gamma-emitting radionuclides. Total alpha and beta measurements provided a general indication of radionuclide contamination. Radiological analyses of sediment and aquatic vegetation samples were performed for ^{90}Sr, $^{239,240}Pu$, uranium, and gamma-emitting radionuclides. Nonradiological analyses were performed for pH, temperature, and nitrates. Analytes of interest were selected based on their presence in effluent discharges and their importance in verifying effluent control and determining compliance with applicable effluent discharge standards. Surface-water disposal units that received potentially radioactively contaminated effluents were within posted radiological control areas.

Radiological Results

Surface-Water Disposal Units

Radiological analytical results for individual surface-water disposal units (ponds and ditches) located in the 200 Areas are summarized in Table S-2. In

all cases, radionuclide concentrations in surface-water disposal units were less than the Derived Concentration Guides and in most cases were equal to or less than the analytical detection limit. One location had an elevated reading for tritium (^3H) of 106,000 pCi/L. The sample was the last collected from the 216-U-14 ditch before it was stabilized. Receding water levels made collecting a sample that was free of foreign materials difficult. No other samples were collected from this location because liquid discharge to the ditch has ceased and the ditch has been stabilized.

Radiological analytical results for aquatic vegetation and sediment (surface) samples taken from surface-water disposal units located in the 200 Areas are summarized in Tables S-3 and S-4, respectively. Although some elevated levels occurred in aquatic vegetation and sediment, in all cases the radiological analytical results were much less than the Westinghouse Hanford Company standards used for radiological control (see Appendix J). A more detailed data summary for samples taken to monitor surface-water disposal units is provided in Section 6.

Seeps

In the past, radioactive effluent streams sent to the 1301-N and 1325-N Liquid Waste Disposal Facilities in the 100 N Area contributed to the release of radionuclides to the Columbia River through their migration with the groundwater. Radionuclides enter the Columbia River along the riverbank region known as the N Springs. Releases into the river are calculated based on analysis of weekly samples collected from a monitoring well located near the shoreline. A more detailed discussion of the release calculation may be found in *Environmental Releases for Calendar Year 1994* (Gleckler 1995).

Groundwater seeps along the 100 N Area shoreline are sampled annually to verify that the reported radionuclide releases to the Columbia River are conservative (i.e., not underreported). Release reporting uses conservatively high radionuclide concentrations in samples collected from the facility effluent monitoring well, multiplied by the estimated groundwater discharge into the river. The N Springs groundwater flow rate was estimated using a computer model developed by Gilmore et al (1992). The estimated groundwater flow rate used to calculate 1994 releases from N Springs was 38 L/min (10 gal/min). By characterizing the radionuclide concentrations in the seeps along the shoreline, these results can be compared to the concentrations measured in the facility effluent monitoring well, ensuring that the effluent monitoring well is located in the groundwater migration route that contains the highest concentrations of radionuclides.

Table S-2. Radiological Results for Liquid Samples from Surface Water Disposal Units, 200 Areas, 1994 (pCi/L).

Sample Location[a]	No. of samples		Total alpha	Total beta	^{3}H	^{90}Sr	^{137}Cs
200 West Area Ditches	25	Mean	4.6 E-01	2.2 E+01	6.6 E+03	6.2 E+01	5.8 E+01
		Maximum	3.3 E+00	2.3 E+02	1.1 E+05	1.1 E+01	1.9 E+02
200 West Area Ponds	27	Mean	2.8 E-01	2.0 E+00	7.1 E+02	4.6 E+01	5.3 E+01
		Maximum	1.4 E+00	4.6 E+00	2.3 E+03	8.3 E+01	6.0 E+01
200 East Area Ditches	16	Mean	2.7 E-01	2.5 E+00	4.5 E+02[b]	5.2 E+01	5.2 E+01
		Maximum	6.1 E-01	5.0 E+00	4.5 E+02	9.3 E+01	6.1 E+01
200 East Area Ponds	23	Mean	3.6 E-01	2.8 E+00	1.8 E+03	5.5 E+01	5.2 E+01
		Maximum	6.8 E-01	6.0 E+00	1.1 E+04	1.2 E+01	7.7 E+01

[a]200-West Area Ditches: 216-T-4, 216-U-14, 216-T-1
200-West Area Ponds: Powerhouse Pond, 216-Z-21
200-East Area Ditches: 216-B-3-3, Powerhouse Ditch
200-East Area Ponds: 216-B-3 (East), 216-B-3 (South), 216-B-3A (Outflow), 216-B-3C, 216-B-3A (Input)

[b]The detection limit for ^{3}H is 450 pCi/L

Table S-3. Radiological Analytical Results for Aquatic Vegetation Samples from the 200 Areas, 1994 (pCi/g).

Sample Location[a]	No. of samples		^{90}Sr	^{137}Cs	$^{239,240}Pu$	U total
200 West Area Ditches	2	Mean	1.2 E+00	2.2 E+00	1.6 E+00	9.0 E-09
		Maximum	1.5 E+00	2.4 E+00	1.6 E+00	1.0 E-08
200 West Area Ponds	2	Mean	1.2 E+00	2.2 E+00	2.3 E+00	2.7 E-08
		Maximum	1.2 E+00	2.2 E+00	2.5 E+00	4.5 E-08
200 East Area Ditch	1	Maximum	1.0 E+00	<2.0 E-02	1.7 E+00	2.8 E-08
200 East Area Pond	1	Maximum	1.2 E+00	<4.3 E+00	3.5 E+00	1.3 E-08

[a]200-West Area Ditches: 216-T-4, 216-U-14
200-West Area Ponds: Powerhouse Pond, 216-Z-21
200-East Area Ditch: Powerhouse Ditch
200-East Area Pond: 216-B-3C

Table S-4. Radiological Results for Sediment Samples from Surface-Water Disposal Units, 200 Areas, 1994 (pCi/g).

Sample Location[a]	No. of samples		^{90}Sr	^{137}Cs	$^{239,240}Pu$	U total
200 West Area Ditches	2	Mean	2.5 E+00	1.7 E+02	1.2 E+00	2.3 E-07
		Maximum	4.5 E+00	1.9 E+02	2.0 E+00	4.5 E-07
200 West Area Ponds	2	Mean	6.6 E-01	8.3 E-01	4.6 E-01	1.8 E-07
		Maximum	7.6 E-01	1.7 E+00	4.9 E-01	3.3 E-07
200 East Area Ditch	1	Maximum	6.3 E-01	4.5 E-01	5.9 E-01	7.9 E-07
200 East Area Pond	1	Maximum	2.7 E+00	7.1 E+00	4.9 E-01	2.5 E-07

[a]200-West Area Ditches: 216-T-4, 216-U-14
200-West Area Ponds: Powerhouse Pond, 216-Z-21 Basin
200-East Area Ditch: Powerhouse Ditch
200-East Area Pond: 216-B-3C

In 1994, the concentrations detected in the seep samples were highest in seeps nearest the facility effluent monitoring well, although seep concentrations were considerably lower than concentrations measured in the well. The data from the seep sampling are summarized in Table S-5. A more detailed data summary is provided in Section 6.

Table S-5. Concentrations (pCi/L) of Radionuclides in 100 N Area Columbia River Shoreline Seeps, 1994.

Radionuclide	Facility Effluent Monitoring Well (09/08/94)	Seeps		
		Maximum	Mean	DCG
^{3}H	2.6 E+04	4.5 E+02	1.8 E+02	2.0 E+06
^{60}Co	1.7 E+01	3.1 E+00	<1.7 E-01	5.0 E+03
^{90}Sr	6.6 E+03	1.2 E+02	3.7 E+01	1.0 E+03

DCG = Derived Concentration Guide (see Appendix J).

Nonradiological Results for Surface-Water Disposal Units

Nonradiological analytical results for water samples taken from surface-water disposal units located in the 200 Areas are summarized in Table S-6. The results for pH were well within the pH standard of 2.0 to 12.5 for liquid effluent discharges based on the discharge limits listed in *Resource Conservation and Recovery Act of 1976* (RCRA). The analytical results for nitrates were all less than the detection limit of 1.4 mg/L and less than the 45-mg/L Drinking Water Standard for public water supplies.

Radiological Surveys

Radiological surveys are used to monitor and detect radiological contamination and to reduce the number of radiologically controlled areas on the Hanford Site. The Site contains two types of posted radiologically controlled areas: one designating underground radioactive materials and the other surface/soil contamination.

Underground radioactive material areas are posted areas where contamination is contained below the surface soil. These areas are typically "stabilized" cribs; burial grounds; and covered ponds, trenches, and ditches. Barriers over the contamination sources are used to inhibit radionuclide transport to the surface environs. These areas are routinely surveyed (at least annually) to document the current radiological status.

Surface/soil contamination areas may or may not have been associated with an underground radioactive material structure. A breech in the barrier of an underground radioactive materials area may have resulted in the growth of contaminated vegetation. Insects or animals could have burrowed into an underground radioactive materials area and brought contamination to the surface. Vent pipes or risers from an underground structure could have been a

Table S-6. Nonradiological Results for Liquid Samples from Surface-Water Disposal Units, 200 Areas, 1994.

Sample locations[a]	pH				NO_3 (mg/l)		
	No. of samples	Mean	Maximum	Minimum	No. of Samples	Mean	Maximum
200 West Area Ditches	110	7.68	9.08	6.10	11	<1.4	<1.4
200 West Area Ponds	120	8.32	9.76	6.94	10	<1.4	<1.4
200 East Area Ditches	72	7.87	10.45	6.70	6	<1.4	<1.4
200 East Area Ponds	98	7.82	8.75	6.66	12	<1.4	<1.4

[a]200 West Area Ditches: 216-T-1, 216-T-4, 216-U-14.
200 West Area Ponds: Powerhouse Pond, 216-Z-21 Basin.
200 East Area Ditches: 216-B-3-3, Powerhouse Ditch.
200 Area Ponds: 216-B-3 (East), 216-B-3 (South), 216-B-3A (Outflow), 216-B-3C, 216-B-3A (Input).

source of speck contamination. Fallout from stacks or unplanned releases from previously operating facilities may have caused an area of surface contamination that was not related to a subsurface structure. All types of surface contamination areas are susceptible to contamination migration. Surface contamination areas are routinely surveyed (at least annually) to document the current radiological status.

In 1994, approximately 2,756 ha (6,364 acres) were posted as outdoor surface contamination areas and 981 ha (2,423 acres) were posted as underground radioactive materials areas. Except for the tank farms, these figures do not include active facilities. The number of hectares (acres) of surface contamination areas is approximately three times larger than the underground radioactive materials areas. This is primarily because of the BC Controlled Area located south of the 200 East Area. This site was posted as a Radiologically Controlled Area in 1959 because of widespread speck contamination and currently encompasses approximately 1,000 ha (2,500 acres). Table S-7 lists the acreage for surface contamination areas and underground radioactive material areas, showing the net change from 1993 to 1994. The large change in reported area from 1993 to 1994 is because, for the first time, the tank farms were included and a global positioning system that enhances accuracy was used. In past years the sizes of the contaminated areas were based on less precise and unconfirmed estimates in source documents. Area measurements for 1994 have been entered into the Hanford Geographical Information System maintained by the Environmental Restoration Contractor. Table S-8 summarizes the number of contaminated hectares (acres) that changed status in 1994.

The area of posted surface contamination varies between years because of an ongoing effort to clean, stabilize, and remediate areas of known contamination. During this time new areas of contamination are also being identified. Table S-8 indicates the changes resulting from stabilization activities during 1994. Approximately 49 ha (122 acres) were reclassified from surface/soil contamination areas to underground radioactive material areas. Newly identified areas may have resulted from contamination migration or an increased effort to investigate outdoor areas for radiological contamination, as shown in Table S-7. Vehicles equipped with radiation detection devices and an ultrasonic ranging and data system identified areas of contamination that were previously undetected.

It was estimated that the external dose rate at 80 percent of the identified outdoor surface contamination areas was less than 1 mrem/h, although direct doses rate readings from isolated radioactive specks [a diameter less than 0.6 cm (0.25 in.)] may have been considerably higher. Contamination levels of this magnitude would not have added significantly to dose rates for the public or Hanford Site workers in 1994.

Table S-7. Outdoor Contamination Status, 1994 [approximate surface area in hectares (acres)].

Hanford Site Area	Surface Contamination[a]	Net Change[b]	Underground Radioactive Material[c]	Net Change
100 B/C	8 (20)	0	039 (96)	0
100 KE/KW	11 (26)	-10 (25)	52 (129)	10 (25)
100. N	29 (73)	0	0.3 (1)	0
100 D/DR	6 (15)	0	33 (81)	0
100 H	0.4 (1)	-2 (5)	13 (33)	2 (5)
100 F	8 (20)	-2 (5)	30 (74)	2 (5)
200 East[d]	2,270 (5,608)	-34 (85)	139 (343)	34 85)
200 West[e]	222 (549)	-1 (2)	656 (1,621)	1 (2)
300	21 (52)	0	13 (31)	0
400	0	0	0	0
600	0	0	6 (14)	0
Totals	2,756 (6,364)	-49 (122)	981 (2,423)	49 (122)

[a]Includes areas posted as "surface/soil contamination" or as "Radiologically Controlled" and areas that had both underground and surface/soil contamination.
[b]Minus sign (-) indicates a decrease.
[c]Includes areas with only underground contamination. Does not include areas that had surface as well as underground radioactive material.
[d]Includes tank farms, BC controlled zone, and waste disposal facilities outside the 200-E boundary which received waste from 200 East facilities (ie., 216-A-25, 216-B-3-3, etc.).
[e]Includes tank farms, and waste disposal facilities outside the 200-W boundary which received waste from 200 West facilities (ie., 216-S-19, 216-U-11, etc.).

Table S-8. Zone Status Change by Area, 1994.

Location	Zone Change	Area ha (acres)
100 Areas	SCA to URM	14 (35)
200 East Area	SCA to URM	34 (85)
200 West Area	SCA to URM	1 (2)
300 Area	SCA to URM	0
400 Area	SCA to URM	0
600 Area	SCA to URM	0

SCA = Surface Contamination Area
URM = Underground Radioactive Materials

Soil and Vegetation Sampling from Operational Areas

Soil and vegetation samples were collected on or adjacent to waste disposal units and from locations downwind and near or within the boundaries of the operating facilities. Samples were collected to detect potential migration and deposition of facility effluents. Migration can occur as the result of resuspension from radioactively contaminated surface areas, absorption of radionuclides by the roots of vegetation growing on or near underground and surface-water disposal units, or by waste-site intrusion by animals. In 1994, routine annual soil and vegetation sampling was eliminated in the 100 Areas except for the 100 N Area. Historical data indicated that the 100 Area sites previously monitored exhibited no signs of contamination migration and continued monitoring would not be cost effective. These areas will be revisited periodically and special samples collected. Special samples were also taken where physical or biological transport problems were identified. Soil sampling in the 200 Areas was modified to be more cost effective by collecting 55 soil samples each year from alternating locations. The results of the sampling effort are discussed in the following paragraphs.

Sample Collection and Analysis

The sampling methods and locations used are discussed in detail in *Operational Environmental Monitoring*, WHC-CM-7-4. Radiological analyses of soil and vegetation samples included ^{90}Sr, $^{239,240}Pu$, uranium, and gamma-emitting radionuclides.

Soil Results

Of the radionuclide analyses performed, ^{60}Co, ^{90}Sr, ^{137}Cs, $^{239,240}Pu$, and uranium were consistently detectable. Soil concentrations for these radionuclides were elevated near and within facility boundaries when compared to the concentrations measured off site. Figure S-2 shows average values for

1994 and the preceding 5 years. The concentrations show a large degree of variability. In general, concentrations in samples collected on or directly adjacent to waste disposal facilities were significantly higher than concentrations in samples collected farther away. The data also show, as expected, that concentrations of certain radionuclides were higher within different operational areas. Generally, the predominant radionuclides were activation products and ^{90}Sr in the 100 N Area, fission products in the 200/600 Areas, and uranium in the 300 Area. A more detailed data summary is provided in Section 4.

100 N Area

Analytical results from soil samples collected in the 100 N Area in 1994 generally exhibited concentrations similar to 1993 levels, but were greater than those measured off site, and the concentrations of ^{60}Co were greater than those measured in the 200/600 and 300/400 Areas. The ^{60}Co in the 100 N Area soils resulted from past discharges to waste disposal structures, primarily the 1301-N Liquid Waste Disposal Facility.

200/600 Areas

Analytical results from soil samples taken in the 200/600 Areas were on a downward trend for most radionuclides as a result of facility shutdowns, improved effluent controls, and waste management practices. However, these levels were greater than those measured off site and were shown to be higher for ^{90}Sr, ^{137}Cs, and $^{239,240}Pu$ when compared to values from the 100 and 300/400 Areas.

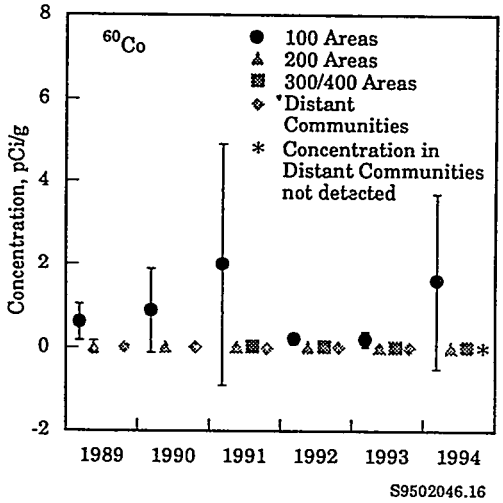
300/400 Areas

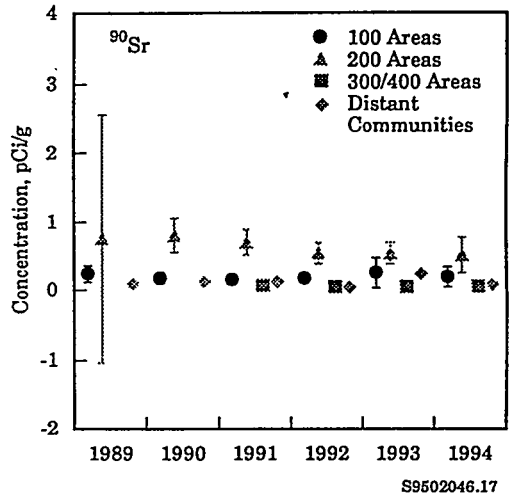
This was the fourth sampling year for the 300/400 Areas' Near-field Environmental Monitoring Program. The data for these areas were compared to results for other operational areas and to those measured off site. The levels of uranium for the 300/400 Area were higher than those measured from the 100 Area and the 200/600 Areas and also higher than the results from previous years. This difference was expected because the uranium is the result of past fuel fabrication operations conducted in the 300 Area.

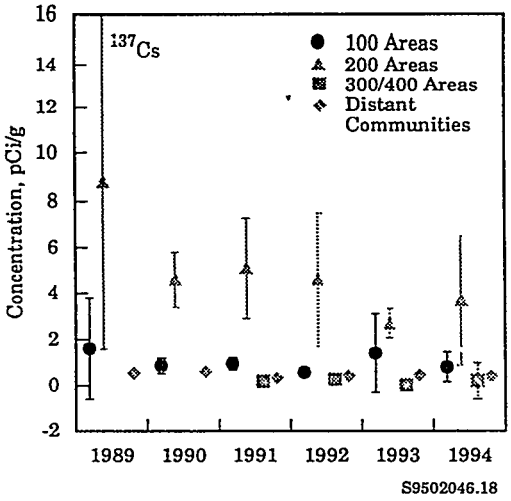
Vegetation Results

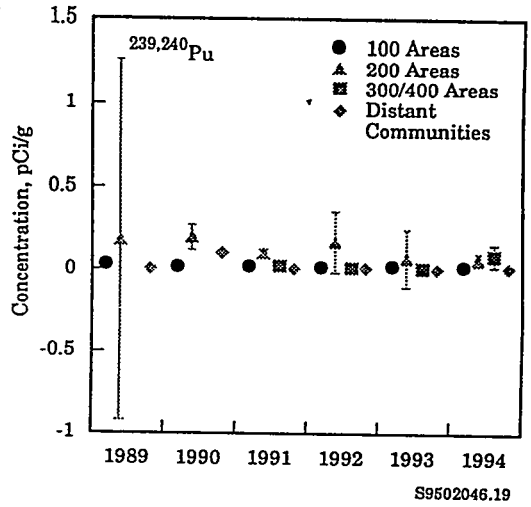
Of the radionuclide analyses performed, ^{60}Co, ^{90}Sr, ^{137}Cs, $^{239,240}Pu$, and uranium were consistently detectable. Concentrations of these radionuclides in vegetation were elevated near and within facility boundaries compared to the concentrations measured off site. Figure S-3 shows average values for 1994 and the preceding 5 years. The concentrations show a large degree of variability. In general, concentrations in samples collected on or directly adjacent to the waste disposal facilities were significantly higher than concentrations in samples collected farther away. As with the soil samples, the data show that certain radionuclides were found in higher concentrations in vegetation within different operational areas. Except for ^{90}Sr (a fission product) detected in vegetation from the N Springs, the predominant

Figure S-2. Average Radionuclide Concentrations in Soil (1989-1994).









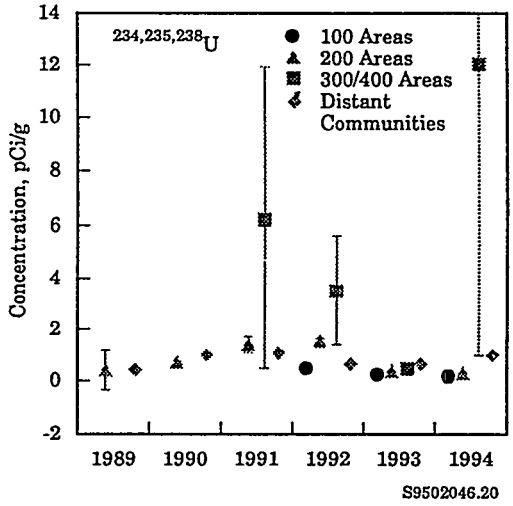
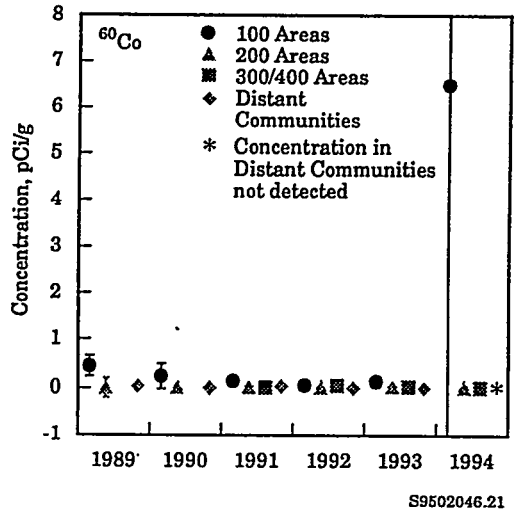
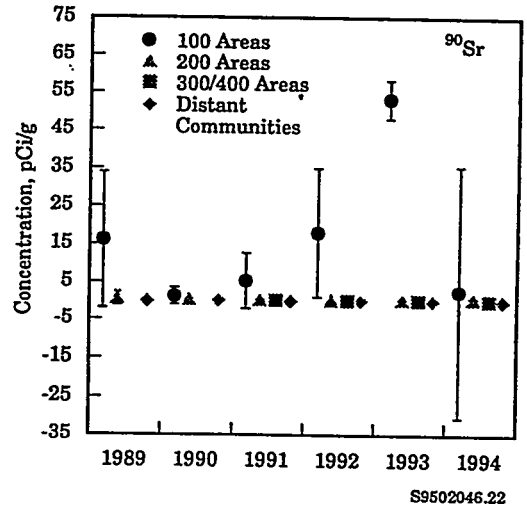
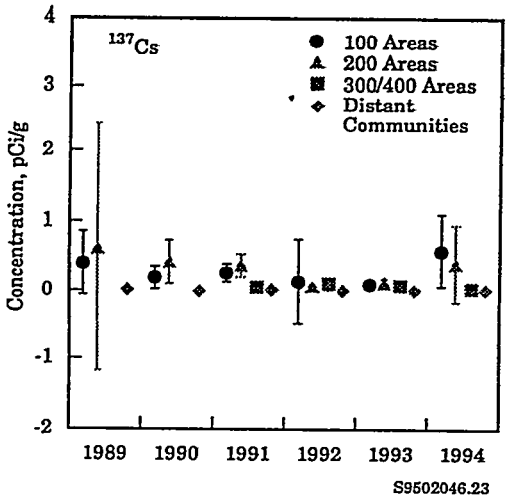
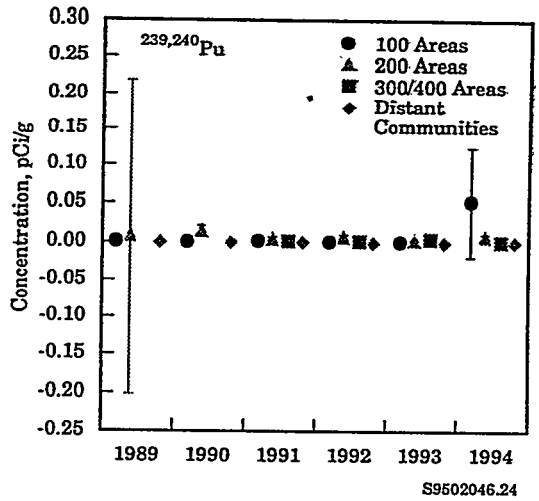


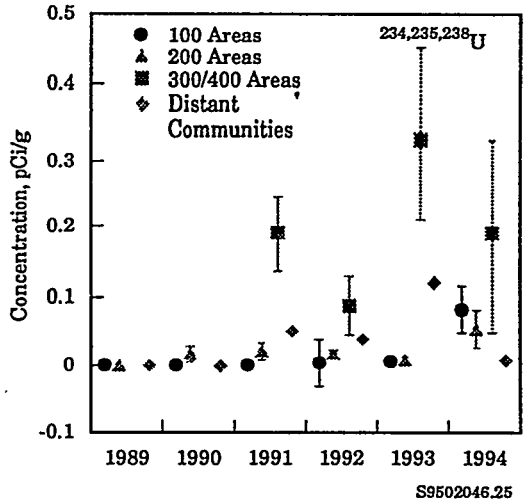
Figure S-3. Average Radionuclide Concentrations in Vegetation (1989-1994).











radionuclides are activation products (i.e., gamma emitters) in the 100 Areas, fission products in the 200/600 Areas, and uranium in the 300 Area. A more detailed data summary is provided in Section 4.

100 N Area

Analytical results from vegetation samples collected in the 100 N Area in 1994 were generally higher than those seen in 1993. The maximum values observed were for ^{90}Sr in samples collected near the N Springs. Increases in radionuclide concentrations in vegetation samples collected nearest the 1301-N Liquid Waste Disposal Facility were observed in 1994. This is likely attributed to uptake of the contaminants by deep-rooted vegetation. The 1994 levels were also greater than those measured off site and levels for ^{60}Co and ^{90}Sr were higher compared to the 200/600 and 300/400 Areas.

200/600 Areas

Analytical results from vegetation samples taken in the 200/600 Areas are on a downward trend for most radionuclides as a result of facility shutdowns, better effluent controls, and improved waste management practices. Before 1992, radionuclide levels in these areas were greater than those measured off site and were higher for ^{137}Cs and $^{239,240}Pu$ compared to the 100 and 300/400 Areas. During 1994, the average concentrations for ^{137}Cs and $^{239/240}Pu$ were similar for onsite and offsite areas, and within the various operational areas.

300/400 Areas

Generally, the levels of most radionuclides measured in the 300 Area were greater than those measured off site and levels for uranium were higher than those in the 100 and 200/600 Areas. This difference was expected because uranium was released during past fuel fabrication operations conducted in the 300 Area. The levels measured in the 400 Area were at or near those measured off site.

External Radiation

External radiation fields were measured near facilities and waste handling, storage, and disposal sites to measure, assess, and control the impacts of operations.

Field Measurements and Analysis

Two methods were used for measuring external radiation fields. Hand-held microroentgen (μR) meters were used at individual points of interest to give real-time radiation field assessments. Thermoluminescent dosimeters were used at numerous fixed locations to absorb radiation energy over longer periods of time and can be read later by thermal excitation of the detector. TLD sample results can be averaged to determine dose rates of an area throughout the sampling period. The measurement methods used for external radiation measurements and descriptions of sampling locations are detailed in Section 7.

Results

Radiation Measurements

Hand-held μR meters were used to survey points near and within three waste disposal locations in the 100 N Area: N Springs, 1301-N Liquid Waste Disposal Facility, and 1325-N Liquid Waste Disposal Facility. These radiation measurements were taken at a height of approximately 1 m (3.28 ft) and are not necessarily a true measure of exposure. The hand-held μR meters are known to over respond to low-energy gamma radiation. The radiation levels measured along the 100 N Area shoreline in 1994 were comparable to 1993 levels (Figure S-4). The radiation measurements taken at the 1301-N and 1325-N Liquid Waste Disposal Facilities in 1994 continued to drop with the decay of ^{60}Co (Table S-9). A more detailed summary is provided in Section 5 of this report.

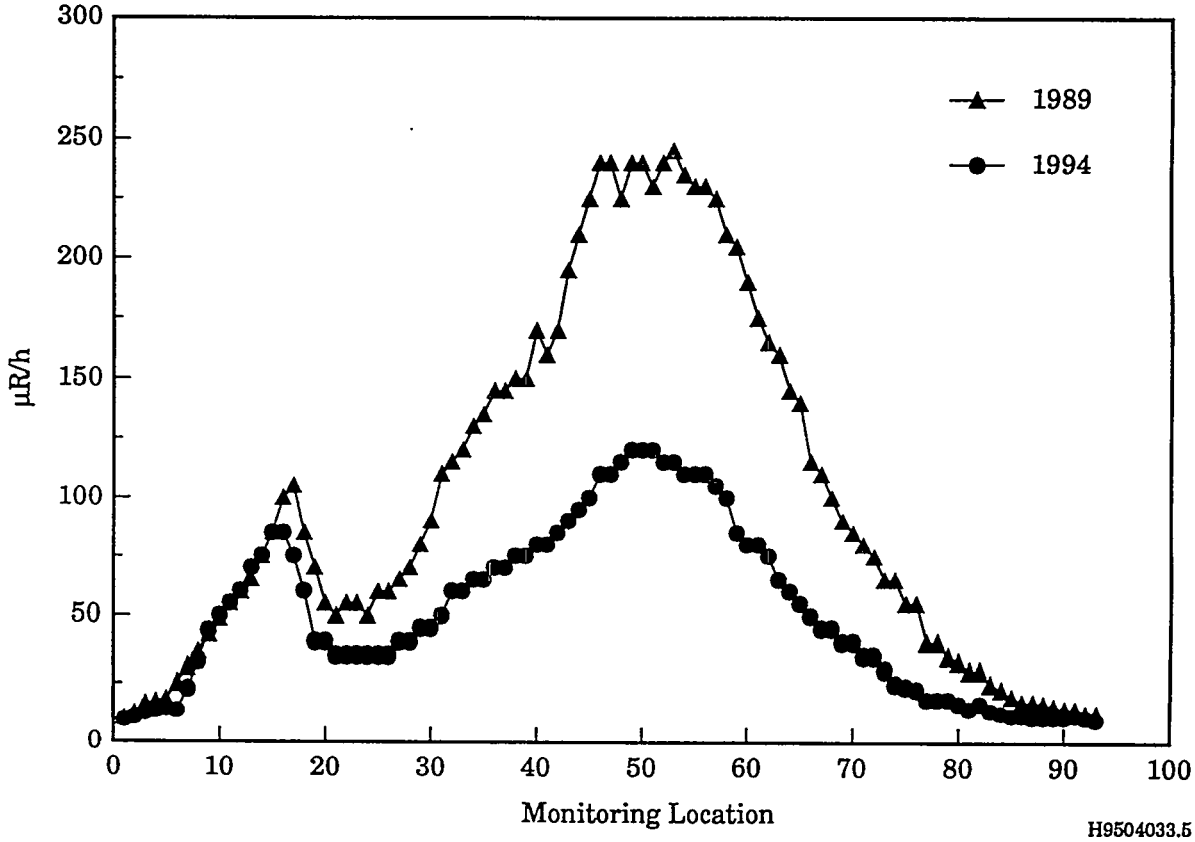
TLDs

100 Areas. TLDs in the 100 Areas were located in the 100 N and 100 K Areas; results are presented in Table S-10. At the 100 N Area, the 1994 TLD results indicate that direct radiation levels were highest near facilities that had contained or received liquid effluent from the N Reactor. These facilities primarily include the 1301-N Liquid Waste Disposal Facility and 1325-N Liquid Waste Disposal Facility. While the results for these two facilities were noticeably higher than those for other 100 N Area TLD locations, they were approximately 5 percent lower than exposure levels measured at these locations in 1993. See Section 5 of this report for a historical summary of the dose rates measured around these two facilities. Decreases result from decay of the radionuclide inventories in the facilities. Increases result from loss of shielding and decreased attenuation factors as the liquid dried up following facility shutdown.

In 1994, 11 TLDs were relocated from the 100 N Area and placed at the 100 K Area, surrounding the 105 K East and 105 K West reactor buildings. Elevated readings in the 100 K Area were caused by the sporadic outdoor storage of radiologically contaminated materials such as internally contaminated ion-exchange modules used to maintain water quality in the nearby 105 KE fuel storage basin. A more detailed data summary and description are provided in Section 5.

200/600 Areas. Thirty-three TLD monitoring sites were eliminated and 35 new TLD monitoring sites were established in the 200/600 Area network to better evaluate the remaining operational facilities and to begin monitoring new facilities constructed to fulfill the environmental restoration mission. Table S-10 summarizes the results for the 24 TLDs and locations that were not repositioned between the 1993 and 1994 sampling periods. The highest dose rates were measured near waste-handling facilities, such as tank farms. The highest dose rate was measured at the 241-A Tank Farm complex located in the 200 East Area. The average annual dose rate measured in 1994 by TLDs was 160 mrem/yr, which was an decrease of 6 percent over the average dose rate of 170 mrem/yr measured by these TLDs in 1993. A more detailed data summary is provided in Section 5.

Figure S-4. Radiation Survey Measurements Along the 100 N Area Shoreline (1989 and 1994).



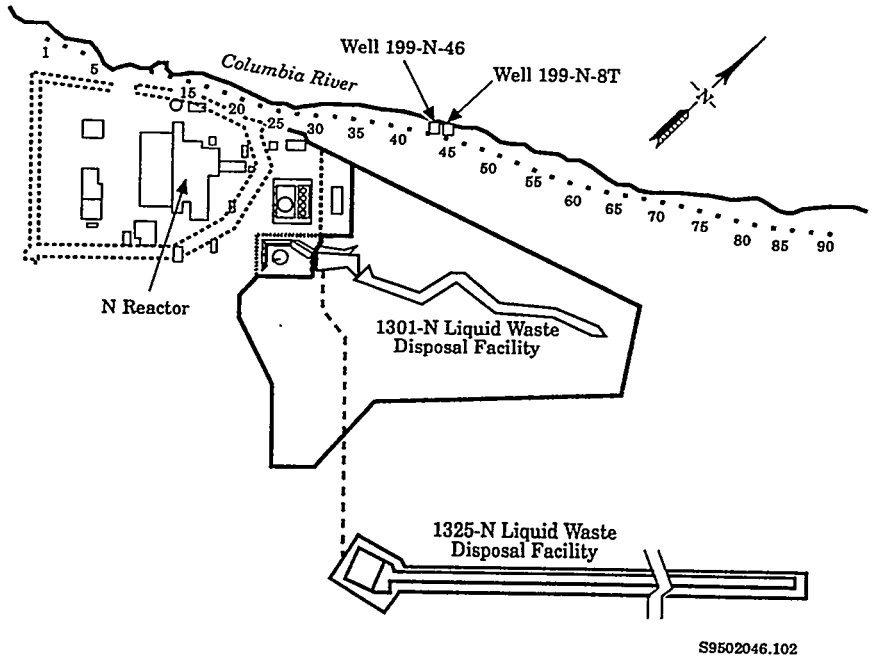


Table S-9. 100-N Liquid Waste Disposal Facilities Direct Radiation Measurements, 1993 and 1994 (μR/h).

LWDF	1993 Average	1994 Average
1301-N	1.6 E+03	1.3 E+03
1325-N	7.3 E+02	5.5 E+03

Table S-10. Thermoluminescent Dosimeter Results for Waste-Handling Facilities in the Operations Areas, 1993 and 1994 (mrem/yr, based on 24 hour days).

Area	No. of Sites, 1994	1993, Annual Average		1994, Annual Average		% Change[a]
		Maximum	Mean	Maximum	Mean	
100-K	11	13,800	820	14,700	1,100	34
100-N	30	14,640	1,700	15,500	1,560	-8
200/600	60 (24)[c]	1,100	170	770	160	-6
300	8	830	200	540	170	-15
300 TEDF	6	NS	NS	120	110	NA
400	7	130	100	210	115	15

[a]Numbers indicate a decrease (-) or increase from 1993.
[b]24 of 60 data points were applicable to this table.
NA = not applicable.
NS = not sampled

300/400 Areas. Table S-10 compares 1994 TLD results to those of 1993 for the 300/400 Areas. Six new TLD locations were established to monitor dose rates around the new 300 Area Treated Effluent Disposal Facility. The highest dose rates in the 300 Area were measured near waste-handling facilities such as the 340 Waste Handling Facility. The average annual dose rate measured in the 300 Area in 1994 was 170 mrem/yr. This is a decrease of 15 percent from the average dose rate of 200 mrem/yr measured in 1993. This comparison does not include the six new TLD locations established near the 300 Area Treated Effluent Disposal Facility.

The average annual dose rate measured in the 400 Area in 1994 was 115 mrem/yr, an increase of 15 percent from the average dose rate of 100 mrem/yr measured in 1993. This increase is because railroad cars that transport radioactive material are staged near the 437 building. A more detailed data summary is provided in Section 5.

Investigative Sampling

Investigative sampling, an important part of the near-field monitoring program, was conducted in the operations areas to confirm the absence of or detect the presence of radioactive and/or hazardous chemical constituents.

Investigative sampling took place near facilities such as storage and disposal sites for at least one of the following reasons:

- To follow up radiological surface surveys that indicated the presence of radioactive contamination
- To quantify the radiological and hazardous chemical condition at a site before facility construction or operation
- To quantify the radiological condition of a site before remediation
- To determine if biotic intrusion (e.g., animal burrows or deep-rooted vegetation) had created a potential for the spread of contaminants
- To determine the integrity of waste containment systems.

The data in this summary include the maximum concentrations of radioactive materials from analytical results of investigative samples, and field instrument readings in counts per minute (cpm) and/or millirad per hour (mrad/h). Complete data results are listed in Section 8 and Appendix I.

Generally, the predominant radionuclides were activation products and ^{90}Sr in the 100 Areas, fission products in the 200/600 Areas, and isotopes of uranium in the 300 Area. Quantities of hazardous chemicals that exceed regulatory levels have not been identified in surface water samples or in preoperational environmental monitoring samples from the operations areas.

Sample Collection and Analysis

The types of investigative samples collected previously have included air; water; snow; sediments; soil; vegetation such as grasses, tumbleweeds (i.e., Russian thistle), sagebrush, trees, and fruits; and various organisms such as spiders, termites, ants, fish, toads, snakes, birds, mice, rabbits, coyotes, and bobcats.

Investigative samples collected in 1994 included air, water, soil (including sediment and radioactive specks), two kinds of vegetation (cattail and watercress), freshwater clams, gopher snake, western rattlesnake, western kingbird nest, cliff swallow nest, deer mouse, and coyote feces (Table S-11).

Methods for collecting or otherwise obtaining investigative samples are found in *Operational Environmental Monitoring* (WHC 1991b). Field monitoring was conducted to detect radioactivity before samples were collected. Field monitoring results were expressed as cpm when a Geiger-Mueller detector was used or as mrad/h when an ion chamber was used. Laboratory sample analysis results were expressed in pCi/g. Maximum concentrations of radionuclides, rather than averages, are presented in this subsection.

Results

Investigative samples were collected where known or suspected radioactive contamination was present, or to verify radiological conditions at project

sites. In 1994, 50 such samples were analyzed for radionuclides. Thirty-three of them showed levels of radioactivity exceeding 10 pCi/g for at least 1 radionuclide. Another 123 contamination incidents were discovered and disposed of to low-level waste disposal burial grounds during cleanup operations without being sampled for laboratory analyses. A more detailed data summary is provided in Section 8.

Air

Investigative air samples collected in 1994 were used to determine the fugitive and diffuse air emissions from four waste treatment and disposal sites. These sites included the Plutonium Finishing Plant in the 200 West Area, the 241-BY Tank Farm in the 200 East Area, the 1301-N Liquid Effluent Trench in the 100 N Area, and the 300 Area Process Ponds and Trenches. Air monitoring was initiated at the 118-B-1 Burial Ground near 100 B/C Area to monitor possible fugitive emissions during exhumation operations. Radionuclides monitored included ^{60}Co, ^{90}Sr, ^{137}Cs, $^{239/240}$Pu, and total uranium. All analytical results for these nuclides were well below the Derived Concentration Guide values.

Surface Water

A sample of runoff water was collected at the 241-U tank farm in the 200 West Area in 1994 to determined if radionuclide contaminants were present. Measurable radionuclides included ^{90}Sr (5.2 E+02 pCi/g), ^{137}Cs (1.3 E+02 pCi/g), and $^{239/240}$Pu (4.5 E-01 pCi/g), indicating that runoff water may be a source of radionuclide contamination outside the tank farms. A sample of discolored effluent water taken from the 216-B-3-3 ditch as it was being decommissioned in 1994 was analyzed for potential hazardous chemicals. Results indicated near background levels of radiation. Results of surface water sampling are listed in Tables 8-1 and I-1.

Soil

Of the 19 investigative soil samples taken in 1994, 8 showed levels of radioactivity exceeding 10 pCi/g for at least 1 radionuclide. The radionuclides of highest concentration were ^{90}Sr (4.8 E+03 pCi/g), ^{137}Cs (8.0 E+04 pCi/g), ^{210}Pb (4.8 E+03 pCi/g), $^{239/240}$Pu (4.0 E+06 pCi/g), and ^{241}Am (8.8 E+03 pCi/g), all from samples near the 241-A Tank Farm Complex in the 200 East Area. In addition, 75 contaminated specks from various operations areas were found during radiological surveys and disposed of to low-level burial grounds (Table I-3).

Vegetation

In 1994, two vegetation samples were analyzed for radionuclide concentrations (Table S-11). Analytical results were well below Westinghouse Hanford Company radiological control limits (WHC 1991a). In addition, 37 instances of contaminated tumbleweed (35) and big sagebrush (2) were recorded in operational areas in 1994. These vegetation samples were found during remedial operations, surveyed with field instruments, and disposed of. In

1994 field-instrument readings ranged from less than 1 mrad/h (100 cpm) to 75 mrad/h (100,000 cpm), which were within historical ranges. The number of samples found to be contaminated was also within historical range. In the past, the greatest number of contaminated vegetation samples (42) were submitted for analyses in 1978.

Wildlife

Of the 27 special animal (including nests and feces) samples analyzed in 1994, 24 showed levels of radioactivity exceeding 10 pCi/g for at least 1 radionuclide. The maximum concentrations for individual radionuclides in wildlife were ^{60}Co (1.6 E+04 pCi/g) in a rattlesnake near 105-D, ^{90}Sr (9.0 E+04 pCi/g) in a deer mouse from the 244-A Lift Station in the 200 East Area, ^{137}Cs (2.5 E+05 pCi/g) in a deer mouse from the 2711-E Garage in the 200 East Area, and $^{239,240}Pu$ (6.8 E+01 pCi/g) in the 105-D rattlesnake (see Table S-11). One of two fresh water clam samples from 216-B-3-3 Ditch near the 200 East Area showed slightly elevated ^{137}Cs (16 pCi/g); all other radionuclides were within environmental background levels. Three coyote feces samples from the 200 West Area and 600 Area were within environmental background concentrations for all radionuclides. In addition, 11 cases of contaminated animals or feces were found during cleanup operations, which were disposed of to a low-level waste burial ground without being analyzed. The total number of animals found to be contaminated with radioactivity, the radioactivity levels, and the ranges of radionuclide concentrations were within historical ranges. The number of incidents decreased slightly from 32 in 1993 and 26 in 1992. The greatest number of contaminated animals submitted for analysis was found in 1982 (44, mostly pigeons).

Special Characterization Sampling

Special characterization projects were conducted to verify the radiological and, in some cases, hazardous chemical status of several operations. These included the following:

- Results of ambient air monitoring to determine the levels of fugitive diffuse air emissions at the Plutonium Finishing Plant in the 200 West Area, at the 241-BY Tank Farm in the 200 East Area, at the 1301-N Liquid Effluent Trench in the 100 N Area, and at the 300 Area Process Ponds and Trenches in the 300 Area can be found in the *Final Report of Fugitive and Diffuse Emissions Evaluations at the Hanford Site, CY 1994* (Schmidt and Gleckler 1995).

- Ambient air sampling at the TRU waste retrieval trenches in the 200 West Area did not detect diffuse emissions above background during TRU waste retrieval operations.

- Installation of ambient air sampling and TLDs at the 300 Area Treated Effluent Disposal Facility.

- Soil and sediment sampling was conducted during decontamination and decommissioning of the 216-B-3-3 Ditch and 216-B-3 Pond.

- Biota sampling at the 244-A Lift Station and the 241-C Tank Farm was expanded to determine the extent of radionuclide contamination and transport by mice.

- Continued preoperational monitoring for the cross-site transfer line replacement, and completed sampling for the 200 Areas Effluent Treatment Facility and associated facilities.

- Preoperational monitoring was initiated at the expansion projects of the Solid Waste Operations Complex in 200 West Area.

Table S-11. Investigative Samples Collected from the Operations Areas (1994). (2 sheets)

Sample Type	Collection Area (Number of Samples)	Elevated Radionuclides	Maximum Concentration
Water	200 Areas (2)	^{90}Sr ^{137}Cs $^{239/240}Pu$	5.2 E+02 pCi/L[a] 1.3 E+02 pCi/L 4.5 E-01 pCi/L
Soil	200 Areas (28)	^{90}Sr ^{137}Cs $^{Total}U$ $^{239/240}Pu$ ^{241}Am	4.8 E+03 pCi/g[b] 8.0 E+04 pCi/g 3.8 E+05 pCi/g[c] 4.0 E+06 pCi/g 8.8 E+03 pCi/g
Inactive Transfer Line Scraping	200 East Area (1)	^{90}Sr ^{137}Cs ^{210}Pb $^{Total}U$ $^{239/240}Pu$ ^{241}Am	1.6 E+02 pCi/g 3.3 E+02 pCi/g 4.8 E+03 pCi/g 4.1 E+02 pCi/g 3.7 E+03 pCi/g 5.3 E+02 pCi/g
Vegetation	200 Areas (2)	^{90}Sr ^{99}Tc ^{137}Cs $^{Total}U$ $^{239/240}Pu$	3.1 E+00 pCi/g 8.6 E+00 pCi/g 3.6 E+00 pCi/g 7.3 E+00 pCi/g <1.4 E+00 pCi/g
Mollusks	200 East Area (2)	^{90}Sr ^{99}Tc ^{137}Cs $^{239/240}Pu$	8.3 E+00 pCi/g <1.6 E+02 pCi/g 1.6 E+01 pCi/g <2.2 E+00 pCi/g
Rattlesnake	100 N (1)	^{60}Co ^{90}Sr ^{137}Cs $^{Total}U$ $^{239/240}Pu$ ^{241}Am	1.6 E+04 pCi/g 5.5 E+01 pCi/g 1.1 E+03 pCi/g 4.1 E-01 pCi/g 6.8 E+02 pCi/g 9.2 E+01 pCi/g
Gopher Snake	200 Areas (3)	^{90}Sr ^{137}Cs $^{Total}U$ $^{239/240}Pu$ ^{241}Am	7.8 E+02 pCi/g 1.7 E+03 pCi/g 1.1 E-01 pCi/g <6.3 E-01 pCi/g <2.5 E+01 pCi/g
Western Kingbird Nest	100 K (1) 200 Areas (1)	^{60}Co ^{90}Sr ^{137}Cs $^{Total}U$ $^{239/240}Pu$ ^{90}Sr ^{137}Cs $^{Total}U$	9.7 E-01 pCi/g 8.4 E+00 pCi/g 3.4 E+01 pCi/g 4.0 E-03 pCi/g 1.7 E+00 pCi/g 1.4 E+01 pCi/g 5.2 E+00 pCi/g 1.1 E-01 pCi/g

Table S-11. Investigative Samples Collected from the Operations Areas (1994). (2 sheets)

Sample Type	Collection Area (Number of Samples)	Elevated Radionuclides	Maximum Concentration
Cliff Swallow	200 West Area (1)	^{60}Co	4.6 E-01 pCi/g
		^{90}Sr	2.1 E+01 pCi/g
		^{137}Cs	2.0 E+01 pCi/g
		$^{Total}U$	2.0 E-03 pCi/g
		$^{239/240}Pu$	<8.7 E-01 pCi/g
Deer Mouse	200 Areas (15)	^{90}Sr	9.0 E+04 pCi/g
		^{137}Cs	2.5 E+05 pCi/g
		$^{Total}U$	1.2 E-01 pCi/g
		$^{239/240}Pu$	<1.6 E+01 pCi/g
Coyote Feces	200 Areas (2)	^{90}Sr	6.4 E-01 pCi/g
		^{137}Cs	<2.1 E-01 pCi/g
		$^{Total}U$	2.0 E-03 pCi/g
		$^{239/240}Pu$	<6.8 E-01 pCi/g
	600 Area (1)	^{90}Sr	2.2 E+00 pCi/g
		^{137}Cs	<1.1 E+00 pCi/g
		$^{Total}U$	7.0 E-03 pCi/g
		$^{239/240}Pu$	<1.6 E+00 pCi/g

[a]picocuries per liter
[b]picocuries per gram
[c]suspect result--did not correlate with field instrument readings.

TERMS

2SEM	Standard Error of the Mean
ACV	administrative control value
AEC	U.S. Atomic Energy Commission
ALARA	as low as reasonably achievable
AMU	aqueous make-up
APHA	American Public Health Association
ASTM	American Society for Testing and Materials
BHI	Bechtel Hanford, Inc.
CAM	continuous air monitor
CERCLA	*Comprehensive Environmental Response, Compensation, and Liability Act of 1980*
cpm	counts per minute
CWC	Central Waste Complex
D&D	decontamination and decommissioning
DCG	derived concentration guides
DCRT	double-contained receiver tanks
DOE	U.S. Department of Energy
DST	double-shell tank
DWS	drinking water standard
Ecology	Washington State Department of Ecology
EDE	effective dose equivalent
EDP	electronic data processing
EDT	effluent discharge trench
EML	Environmental Measurements Laboratory
EPA	U.S. Environmental Protection Agency
ERC	environmental restoration contractor
ETF	effluent treatment facility
FFTF	Fast Flux Test Facility
HEHF	Hanford Environmental Health Foundation
HEPA	high-efficiency particulate air
HGP	Hanford Generation Plant
HPGe	high-purity germanium
HPT	health physics technician
HSWMUR	*Hanford Site Waste Management Units Report*
HVAC	heating, ventilation, and air conditioning
ICF-KH	ICF Kaiser Hanford Company
ITAS-RL	International Technologies Analytical Services-Richland
LWDF	liquid waste disposal facility
MEI	maximum exposed individual
MSCM	mobile surface contamination monitor
MW	mixed waste
NaI	sodium iodide
NCRPM	National Council on Radiation Protection and Measurements
OEC	Operations and Engineering Contractor
OEM	Operational Environmental Monitoring (Program)
PCB	polychlorinated biphenyl
PEDF	Protective Equipment Decontamination Facility
PFP	Plutonium Finishing Plant
PNL	Pacific Northwest Laboratory
PPF	Plutonium Processing Facility
PRF	Plutonium Reclamation Facility
PUREX	Plutonium/Uranium Extraction (Plant)

TERMS (cont.)

PWR	pressurized water reactor
QA	quality assurance
RCA	radiological control areas
RCRA	*Resource Conservation and Recovery Act of 1976*
RL	U.S. Department of Energy, Richland Operations Office
RMA	Remote Mechanical A
RMC	Remote Mechanical C
RPS	retention process sewer
RWC	radioactive waste container
SALDS	state-approved land disposal structure
SCA	surface contamination area
SEM	standard error of the mean
SNM	special nuclear material
SST	single-shell tank
SWOL	Solid Waste Operations Complex
TEDE	total effective dose equivalent
TLD	thermoluminescent dosimeters
Tri-Party Agreement	*Hanford Federal Facility Agreement and Consent Order*
TRU	transuranic
TRUSAF	Transuranic Waste Storage and Assay Facility
TSD	treatment, storage, and disposal (sites)
UNH	uranyl-nitrate-hexahydrate
UO_3	uranium trioxide
URM	underground radioactive material
USRADS	Ultrasonic Ranging and Data System
UST	United States Testing Company
WAC	waste acceptance criteria
WESF	Waste Encapsulation and Storage Facility
WDOH	Washington State Department of Health
WHC	Westinghouse Hanford Company
WIDS	Waste Information Data System
WIPP	Waste Isolation Pilot Plant

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1.0 INTRODUCTION

1.1 BACKGROUND

The Hanford Site, consisting of 1,450 km^2 (560 mi^2), is located within the Pasco Basin in south-central Washington State, approximately 270 km (170 mi) southeast of Seattle and 200 km (120 mi) southwest of Spokane. As shown in Figure 1-1, the 100 Area is located in the north-central part of the Hanford Site, along the southern (right) bank of the Columbia River. The locations of facilities within the 100 Area are shown in Figure 1-2. The 200 Areas are almost in the center of the Hanford Site, 11 km (7 mi) south of the Columbia River. The locations of facilities, tank farms, solid waste burial grounds, and liquid waste disposal sites in the 200 Areas are shown in Figures 1-3 and 1-4. The 300 and 400 Areas are located in the southwestern part of the Hanford Site, as shown in Figure 1-5.

Westinghouse Hanford Company (WHC) conducts the Operational Environmental Monitoring Program in the 100, 200, 300, and 400 Areas at the Hanford Site to monitor diffuse sources and the impact of effluent releases and waste management practices at and near the facilities and waste disposal sites.

1.2 OPERATIONAL ENVIRONMENTAL MONITORING PROGRAM OBJECTIVES

The objectives of the Operational Environmental Monitoring (OEM) program are to evaluate the following:

- Compliance with the U.S. Department of Energy (DOE), U.S. Environmental Protection Agency (EPA), Washington State Department of Ecology (Ecology), Washington State Department of Health (WDOH), and internal environmental protection requirements and guidelines
- Performance of radioactive waste confinement systems
- Trends of radioactive materials in the environment at and adjacent to nuclear facilities, waste disposal units, and restoration units so that appropriate control actions can be taken in a timely manner.

Environmental protection requirements have been developed by WHC using administrative control values (ACVs) (Appendix J) to establish operating limits for radionuclide concentrations. These control limits were established to implement a DOE policy to maintain radiation exposures to levels that are as low as reasonably achievable (ALARA) (DOE 1986) and to ensure that offsite limits are not exceeded by establishing the operating limits well below regulatory limits. Operational monitoring is an essential component to demonstrate compliance with these requirements and policies. For these reasons, the scope of the WHC OEM has been designed to meet the facility-specific needs of the Hanford Site.

Figure 1-1. The Hanford Site.

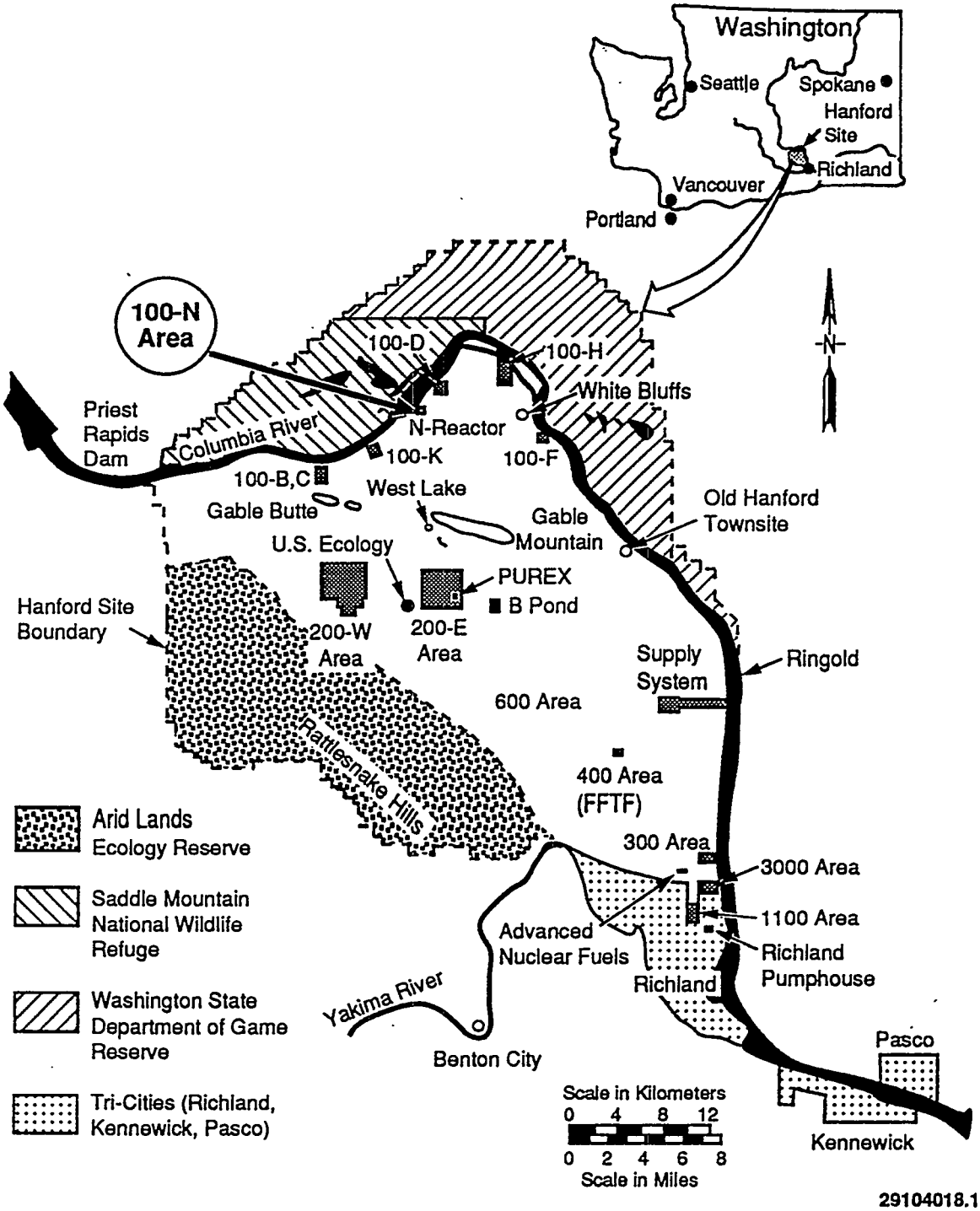


Figure 1-2. 100 Areas.

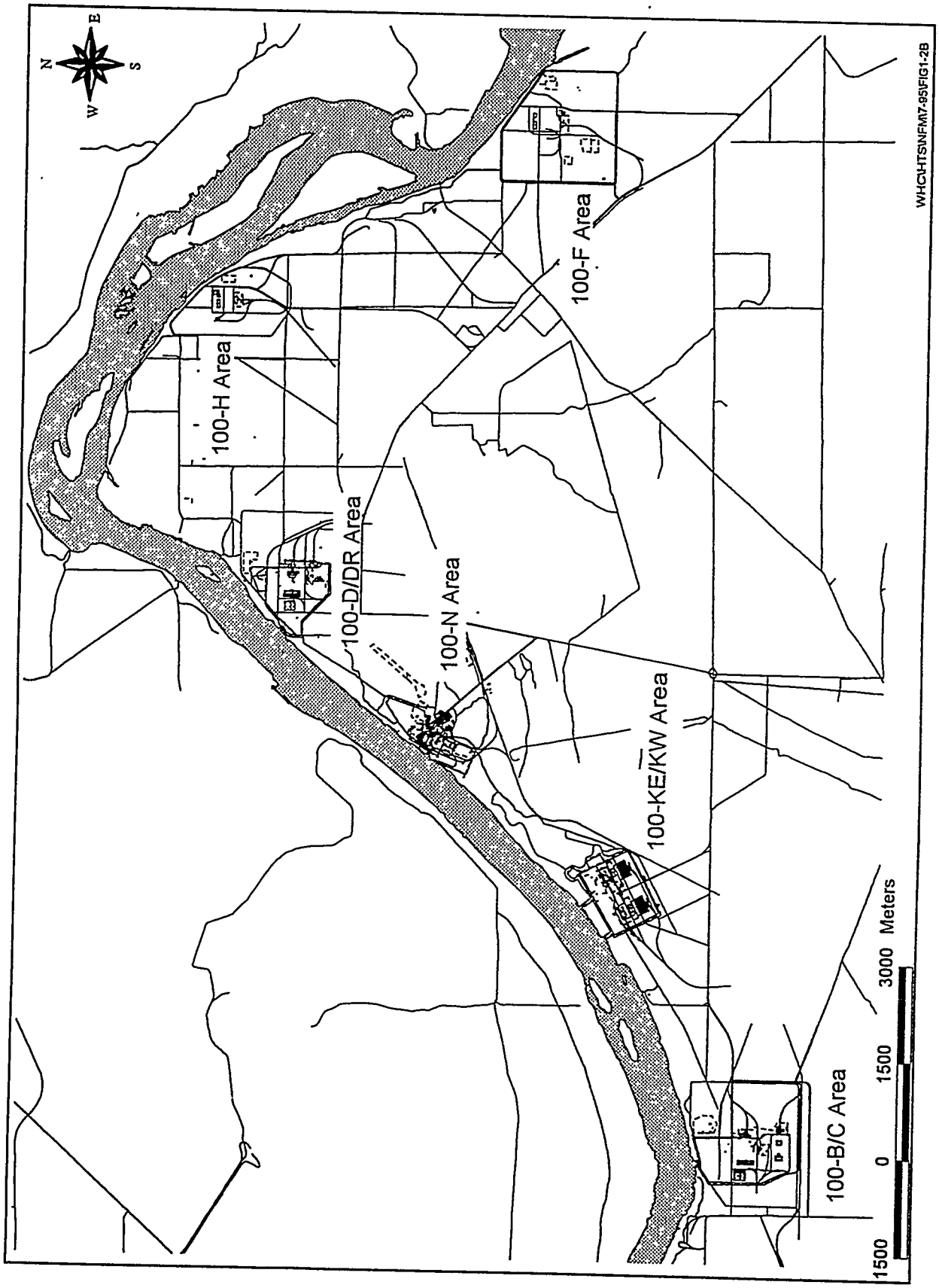


Figure 1-3. 200 East Area.

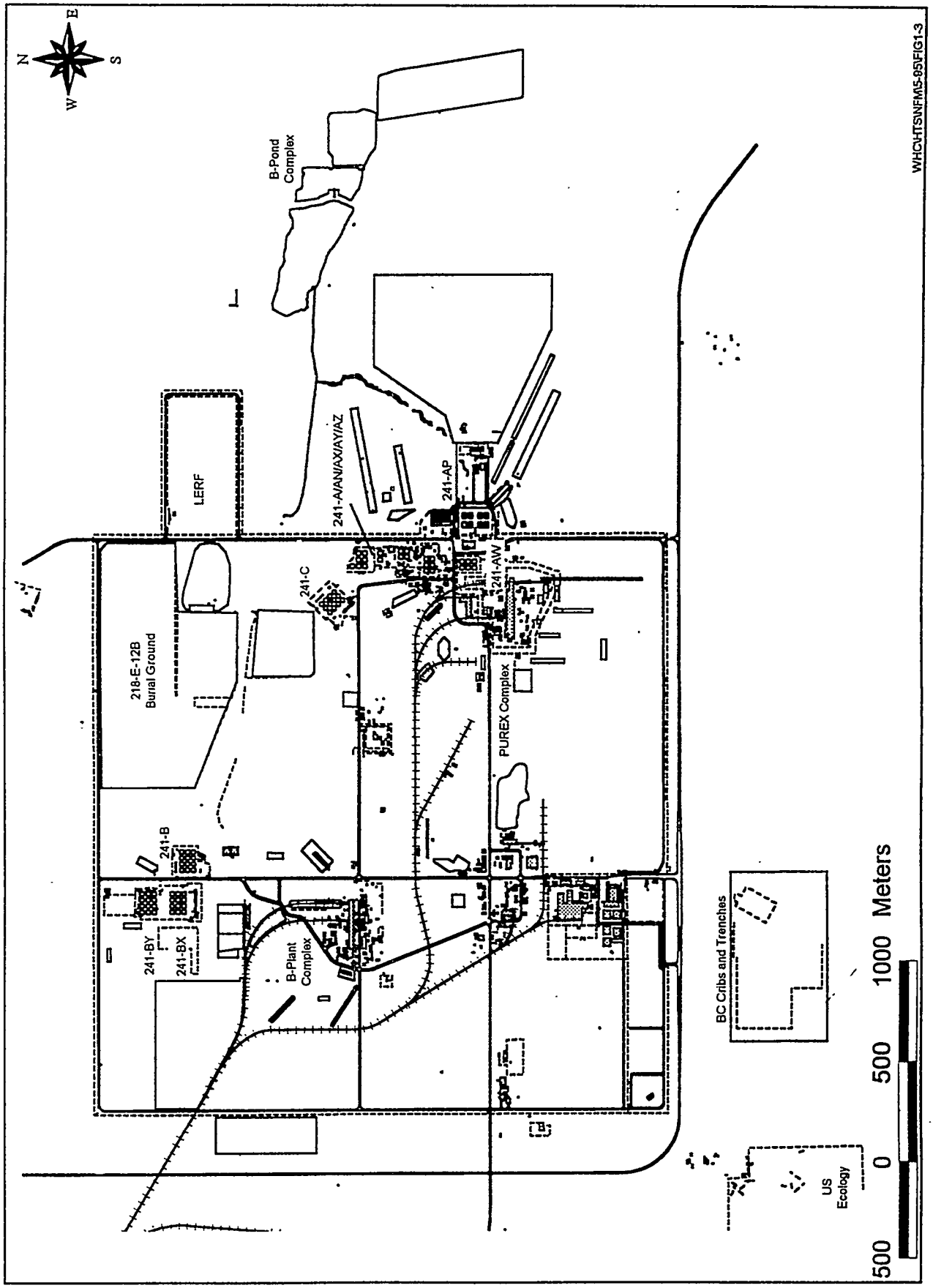


Figure 1-4. 200 West Area.

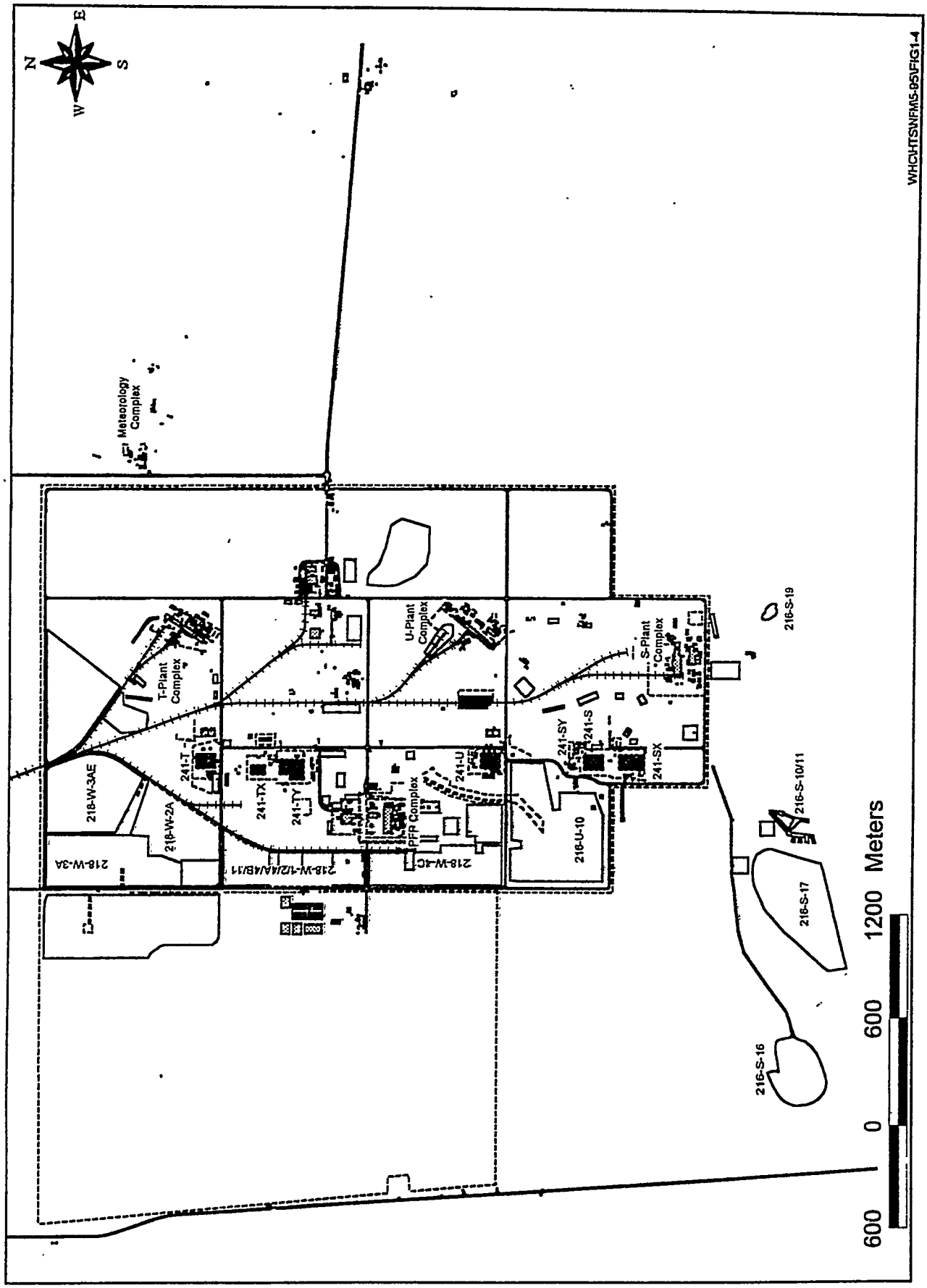
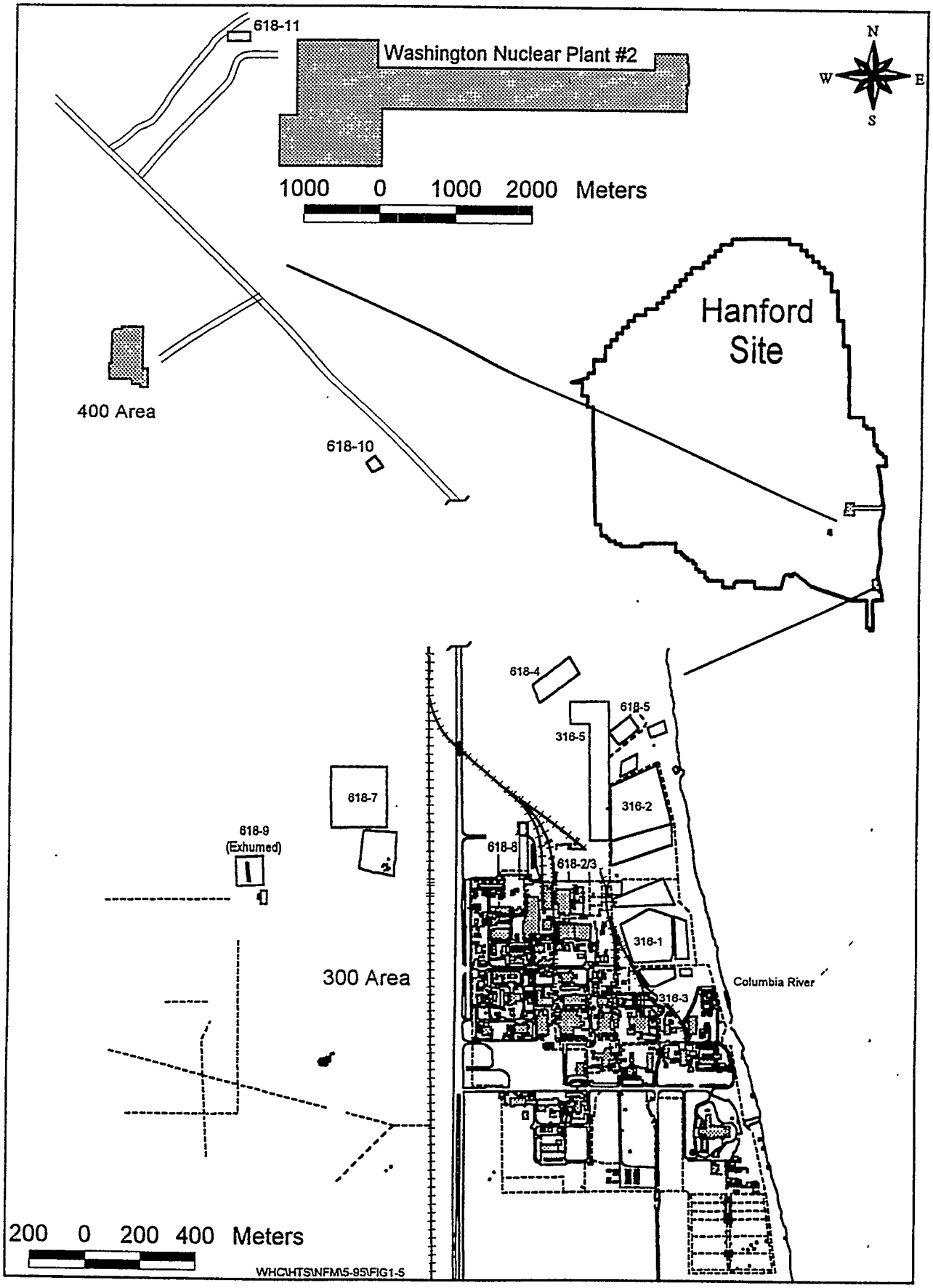


Figure 1-5. 300/400 Areas.



This report presents and interprets the results of the operational environmental monitoring activities performed at the Hanford Site during 1994.

1.3 NEAR-FACILITY TRANSPORT PATHWAYS

The Hanford Site consists of semiarid shrub-steppe land, of which approximately 6 percent has been disturbed and actively used for processing nuclear material. This disturbed land, about 82.9 km^2 (32 mi^2) or 8,090 ha (20,000 acres), is divided into large operational areas: the 100, 200, 300, 400, and 1100 Areas. Radioactive emissions from the Site are grouped into two broad categories for regulatory purposes: point source emissions and diffuse source emissions. Point sources are easily defined and recognized as facilities with effluent emission structures such as stacks and are typically equipped with filtering and monitoring systems. Diffuse sources are extremely varied, do not have or cannot have direct monitoring systems, and are measured through the near-facility environmental monitoring systems. A facility may be considered a point source and still contribute to diffuse emissions. The 600 Area designates the remaining land outside the operational areas. Almost all point and diffuse sources of radionuclide emissions are within the five operational areas; two minor point sources are in the 600 Area. Emissions from point sources, such as stacks and vents, are measured directly or calculated from process knowledge. Diffuse emissions are measured through a network of monitoring systems near and/or adjacent to active and inactive waste sites.

The Hanford Site was acquired in 1943 and dedicated to producing plutonium for national defense and managing the resulting production wastes. Restoring the Hanford Site environment is the new mission that has largely supplanted the previous operational objectives. The environmental restoration effort will entail activities such as decontaminating and decommissioning more than 100 facilities and cleaning up and restoring about 1,500 waste sites. Until the restoration and cleanup work is completed, diffuse radioactive emissions potentially may be released from hundreds of sources, in addition to the 117 point-source stacks and vents registered with the WDOH. Emissions and offsite doses to the public are reported annually to the EPA (see DOE-RL 1995).

1.3.1 Environmental Transport Sources

The presently identified actual or potential sources of biotic transport and diffuse radionuclide emissions to the environment at the Hanford Site are described in this section. Among the sources that could contribute diffuse radionuclide emissions are several kinds of waste handling and disposal facilities, such as cribs, ponds, ditches, trenches, retention basins, valve pits, French drains, reverse wells, tanks, and burial grounds. Operating facilities or facilities on standby, that are inactive, or that are being remediated also could contribute diffuse emissions. Tables 1-1 and 1-2 show the types of waste sites and the sources of diffuse emissions, respectively. Each site or facility usually has one or more unique features or characteristics that may enhance the contribution to diffuse emissions. Features may include structures such as passive vents, risers, equipment access doors and one personnel access door. Exhausters on facilities are point sources and are monitored at the stack or main point of effluent

release. Characteristics may include an undetected leak, unburied waste, or an absence of intrusion barriers. Various environmental conditions such as changing atmospheric pressures, wind speed, erosion, evaporation, percolation, biotic intrusion, and/or resuspension influence rates of diffuse emissions.

Table 1-1. Types of Waste and Number of Waste Sites at the Hanford Site (1994).

Types of Waste	Number of Waste Sites
Nonhazardous	184
Hazardous	142
Radioactive	146
Mixed	949
Total	1,421

Table 1-2. Sources of Diffuse Emissions (1994).

Types of Diffuse Emissions	Active	Inactive
Tanks (tank farms)	28	149
Cribs	16	115
Trenches, ponds, ditches, retention basins	21	120
Reverse or injection wells	0	11
French drains	21	47
Unplanned spill sites	0	229
Burial grounds	9	68
Total	95	739

1.3.2 General Types of Facilities

Sections 1.3.2.1 through 1.3.2.12 briefly describe general types of sites and facilities and the potential primary sources of diffuse emissions and environmental transport pathways from each.

1.3.2.1 Crib. Low-level liquid waste is discharged to the ground via structures called cribs. These are generally subsurface systems, similar to sanitary drain fields, that allow the liquid component of the waste to percolate into the soil. The natural properties of the soil are used to

remove radioactive material from the effluent through filtration, ion-exchange, precipitation reactions, absorption, and adsorption.

Many cribs are vented to the atmosphere through engineered structures called vents and pipe risers. These engineered structures promote downward flow of liquids disposed of in the cribs, but also provide a pathway to the surface and atmosphere. Secondary routes for diffuse emissions include erosion, biotic uptake, and intrusion followed by wind-caused resuspension.

1.3.2.2 **Pond.** Ponds were used to manage the large quantities of water (i.e., cooling water and chemical-sewer waste water) associated with chemical processing operations. Normally, these liquid effluents are nonradioactive. The ponds allow percolation of the liquid effluent into the soil column. Diffuse emissions from ponds are primarily by wind-caused resuspension.

1.3.2.3 **Ditch.** A ditch is an open, unlined excavation that was used for disposing of liquid effluents or for transporting liquid effluents to ponds for disposal. Diffuse emissions from ditches are wind-caused resuspension.

1.3.2.4 **Trench.** Early disposal practices included disposing of liquid effluents into unlined trenches, then filling the trenches with soil over time. These trenches were replaced with cribs, such as the BC-cribs where both structures can be found. Diffuse emissions from trenches are primarily the result of erosion, biotic uptake, or intrusion, followed by wind-caused resuspension.

1.3.2.5 **Retention Basin.** Retention basins generally were lined with concrete and used to hold liquids before routing them to ditches, ponds, trenches, or the Columbia River. Diffuse emissions from retention basins are primarily by wind-caused resuspension.

1.3.2.6 **Diversion Box.** A diversion box is usually an underground, concrete structure formed around a junction of transfer lines carrying liquid effluent. Diffuse emissions from diversion boxes may occur when they are opened for maintenance.

1.3.2.7 **Valve Pit.** A valve pit is similar in structure to a diversion box, but contains piping valves. The primary source of diffuse emissions from a valve pit is when the pit is opened for maintenance.

1.3.2.8 **French Drain and Reverse or Injection Well.** A French drain is a rock-filled encasement inserted into the ground. A reverse or injection well is an ordinary well used for mixing liquid waste with groundwater. These subsurface systems manage potentially contaminated liquid waste by promoting percolation into the soil. The natural filtration properties of the soil remove radionuclide material from effluent water. Diffuse airborne emissions from French drains and reverse wells could occur from erosion, biotic uptake, or intrusion, followed by wind-caused resuspension.

1.3.2.9 **Tank.** A tank generally is a large, reinforced, metal structure that receives liquid effluent for storage. Examples are the double-shell tanks (DSTs) and single-shell tanks (SSTs) in the 200 Areas, which are typically arrayed in clusters called tank farms. Sources of diffuse emissions from tanks include vents and exhausters directly to the atmosphere plus deposition and resuspension from surface soil contamination. A significant proportion of

surface soil contamination incidents have common boundaries with the tank farms and associated transfer systems.

1.3.2.10 Burial Ground. Burial grounds are trenches in which contaminated solid waste is buried. This waste is generated by various activities on the Hanford Site. Waste packaging procedures and burial practices depend on the type of waste. Sources of diffuse emissions from burial grounds include direct emission to the atmosphere until the waste is buried, then erosion, biotic uptake, or intrusion followed by wind-caused resuspension.

1.3.2.11 Decontamination and Decommissioning Activities. WHC and Bechtel Hanford, Inc. (BHI) activities also involve decontaminating and decommissioning (D&D) of retired facilities, equipment, and waste disposal sites. These activities are aimed at preventing the release or spread of contamination and reducing the number of acres of surface contamination. In some cases, contaminated material may be exposed to the atmosphere, but steps to isolate contamination and reduce its spread are taken as the contamination is identified. Sources of diffuse emissions are primarily the result of exposing certain mated surfaces such as walls and floors; however, planning and procedures minimize these exposures. Monitoring is also increased at the time of demolition to detect any increased radioactivity. To date no significant increases have occurred. By the end of 1994, the majority of these activities were transferred to BHI.

1.3.2.12 Radioactively Contaminated Surface Areas. All radioactive burial grounds, cribs, trenches, retention basins, and unplanned release sites are surveyed routinely. The surveys are performed at least annually, but may be done more frequently when needed. The number of surface-contaminated acres varies. The number is not fixed because a continuing effort to clean, stabilize, or remediate known contaminated areas is under way, while new areas of contamination continue to be identified. Newly identified contamination may be because of preexisting contamination that has migrated, by way of wind-caused resuspension or biological intrusion, to previously uncontaminated areas or because the radiological criteria have become more stringent. Approximately 80 percent of all areas of surface contamination are estimated to have dose rates of less than 1 mrem/h.

Contaminated areas are posted as "Surface Contaminated Area," "Radiologically Controlled Area," or "Underground Radioactive Material Area." Radiologically controlled areas are large areas with a potential for speck contamination (i.e., single grains of soil, rust particles, feces, or pieces of vegetation). Surface contaminated areas are large and small areas with identified contamination. Underground radioactive material signs mark cribs, burial grounds, covered trenches, and ponds that have no identified surface contamination. If an area has surface and underground contamination, such as the surface above a crib, it will have both postings. Table 1-3 shows the general location (by area), the approximate area of surface contamination, and the volume of underground contamination. Sources of diffuse emissions from surface-contamination areas include erosion, biotic uptake, or intrusion followed by wind-caused resuspension.

A more detailed description of specific sites and facilities can be found in *Radionuclide Air Emissions Report for the Hanford Site, Calendar Year 1994*, DOE/RL-94-49 (DOE-RL 1995), and in the facility effluent monitoring plans for major facilities, which are referenced in this report.

Table 1-3. Hanford Site Surface and Underground Contamination.

Hanford Site Area	Surface Contamination,[a] ha (acres)	Underground Radioactive Material,[b] ha (acres)
100 Areas	62 (155)	167 (414)
200 Areas[c]	2,492 (6,157)	795 (1,964)
300 Area (north)	21 (52)	13 (31)
600 Area	0	6 (14)
Total	2,575 (6,364)	981 (2,423)

[a]Includes areas posted as "surface/soil contamination" or as "radiologically controlled" and areas that had both underground and surface/soil contamination.
[b]Includes areas with only underground contamination. Does not include areas that had surface as well as underground radioactive material.
[c]Includes tank farms, BC controlled zone, and waste disposal facilities outside the 200-E boundary that received waste from 200 East facilities (i.e., 216-A-25, 216-B-3-3, etc.), and waste disposal facilities outside the 200 West boundary that received waste from 200 West facilities (i.e., 216-S-19, 216-U-11, etc.).

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2.0 AMBIENT AIR MONITORING

2.1 INTRODUCTION

Ambient air monitoring is conducted to determine baseline concentrations of radionuclides in the operations areas, to assess the impact of operations on the local environment, and to monitor diffuse emissions from sources located within the operations area. These measurements also provide an indication of the WHC-and BHI-managed facilities' performance and are used to demonstrate compliance with environmental protection criteria. The WHC air monitoring program in the 100 and 200 Areas, as illustrated in Figures C-1, C-2, C-3, C-4, and C-5 (Appendix C) takes into consideration prevailing and high wind directions, as well as potential source terms. Air monitoring within the 300 and 400 Areas is performed by Pacific Northwest Laboratory (PNL) as part of the Site Environmental Surveillance Program, with one exception. WHC operates one ambient air sampler near the 300 Area Treated Effluent Disposal Facility (TEDF) (Figure C-6). The results for ambient air monitoring in these areas are summarized in this report. A more detailed discussion of the ambient air monitoring results for the 300 and 400 Areas can be found in the *Hanford Site Environmental Report for Calendar Year 1994* (Dirkes and Hanf, 1995). Meteorological conditions are monitored continuously by PNL meteorology stations, which are strategically positioned around the Hanford Site.

Hanford Site air samplers in the 100 and 200/600 Areas operate at a flow rate of 0.056 m^3/min (2 ft^3/min), drawing a sample through a 47-mm (2 in.), open-faced filter about 2 m (6 ft) above ground. Changes were made in 1994 to sample at a height of 2 m (6 ft) to achieve conformance with the *DOE Environmental Regulatory Guide for Radiological Effluent Monitoring and Environmental Surveillance*, DOE/EH-0173T (DOE 1991).

The exchange rate was changed in the beginning of 1993 from weekly to biweekly as a result of the decreased emissions. Individual stations are monitored to determine if dust loading may be occurring. If indications of dust loading are discovered, the exchange frequency of that station is adjusted to prevent future problems with dust loading.

All sample filters were exchanged biweekly, held one week (to allow for decay of the short-lived natural radioactivity), and then sent to the 222-S Laboratory for initial analysis of gross alpha and gross beta activity. These initial analyses serve as an indicator of potential environmental problems.

The filters were stored until the end of the 6-month sampling period and were then collected by sample location (or as deemed appropriate) and sent to an offsite laboratory for specific radionuclide analysis. Collecting air filters by site provides a larger sample size and, thus, a more sensitive and accurate measurement of the concentration of airborne radionuclides.

To help assess the impact of Site operations, the results obtained are compared to Derived Concentration Guides and results from the distant communities of Yakima and Sunnyside as reported by the Site Environmental Surveillance Program. WHC set up the one distant station located on site (Figure C-7) to compare data from samples collected in the operating areas

using sampling techniques identical to the rest of the program and to compare with data from samples collected by the Site Environmental Surveillance Program, WDOH, and Washington Public Power Supply System.

2.2 AIR SAMPLING, 1994

2.2.1 100 N Area

The concentrations of airborne radionuclides measured at the 100 N Area were many times less than the derived or designed concentration guide (DCG). The 1994 air sampling results were comparable to the 1993 results and are presented in Appendix C, Table C-1. The annual average concentrations of ^{60}Co detected in the 100 N Area ambient air samples since 1981 are presented in Figure 2-1. Annual average concentrations of ^{60}Co detected near the 1301-N Liquid Waste Disposal Facility (LWDF) since 1982 are presented in Figure 2-2. The increased ^{60}Co concentrations in 1987 were caused by structural modifications to the inlet portion of the 1301-N facility between October and December of that year. Disturbance of the surface of the crib during construction caused resuspension of radionuclides in the vicinity. After completion, the area was stabilized through the addition of several feet of clean soil and gravel. The sudden drop indicated in Figure 2-1, which began in 1991, is likely attributable to the change in sample collection initiated that year. Previously, air sample filters were collected monthly, analyzed, and disposed of. In 1991, the filters were collected weekly, analyzed for gross radioactivity only, and held for 6-month isotopic analyses. To derive an ambient air concentration based on the radioactivity measured on a filter, the radioactivity measured on the filter is divided by the volume of air that passed through the sampling system during the sample collection period. Sample compositing for 6 months increases the volume of air used in this calculation, thereby increasing the total activity on the filters, thus making it more readily detectable. Radionuclides with extremely low concentrations may not exhibit enough activity even after composition to be detectable. The results of the isotopic analyses are detailed in the following subsections.

2.2.1.1 Cobalt-60. The maximum annual result for ^{60}Co was at Site N-101 at the 1301-N LWDF Site (Table 2-1). The air concentration was 1.4 E-03 $\pm$ 65% pCi/m^3, which was much less (<<0.1 percent) than the DCG. For comparison purposes, this value was 22 times greater than the annual average concentration reported by the Site Environmental Surveillance Program for the distant communities of Yakima and Sunnyside.

Table 2-1. ^{60}Co in Air, 100 N Area, 1994 (pCi/m^3).

Maximum Annual Result $\pm$2SEM(%)	Annual Average $\pm$2SEM(%)	DCG	Distant Community $\pm$ 2SEM(%)
1.4 E-03 $\pm$65%	6.7 E-04 $\pm$68%	8.0 E+01	6.3 E-05 $\pm$26%

Figure 2-1. Average Concentrations of ^{60}Co Detected in 100 N Area Ambient Air from 1982 to 1994.

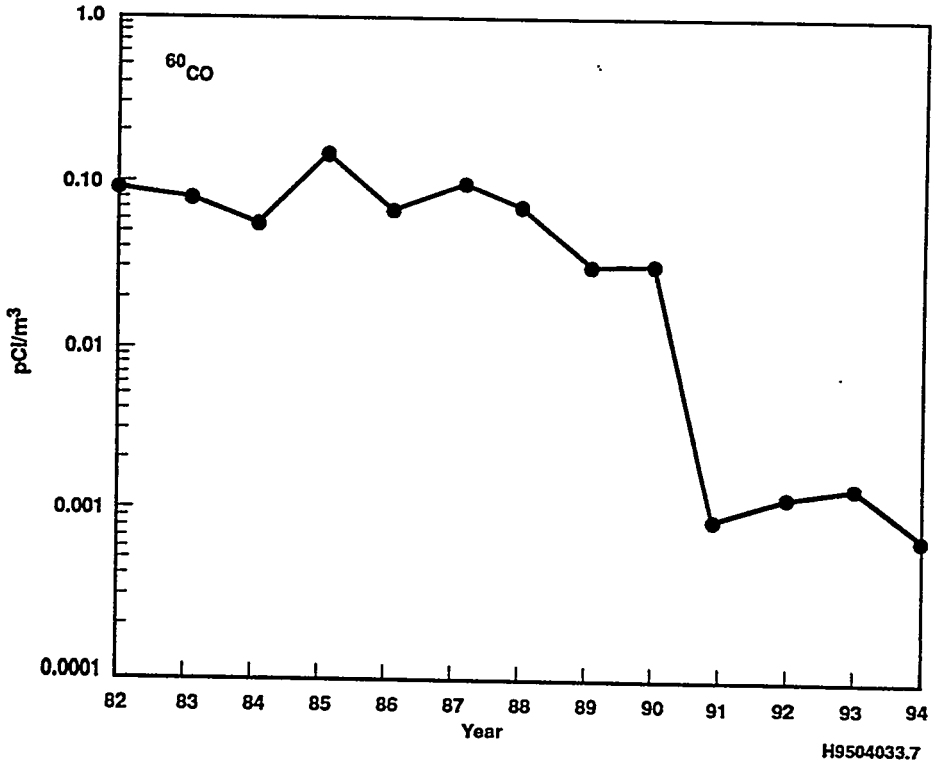
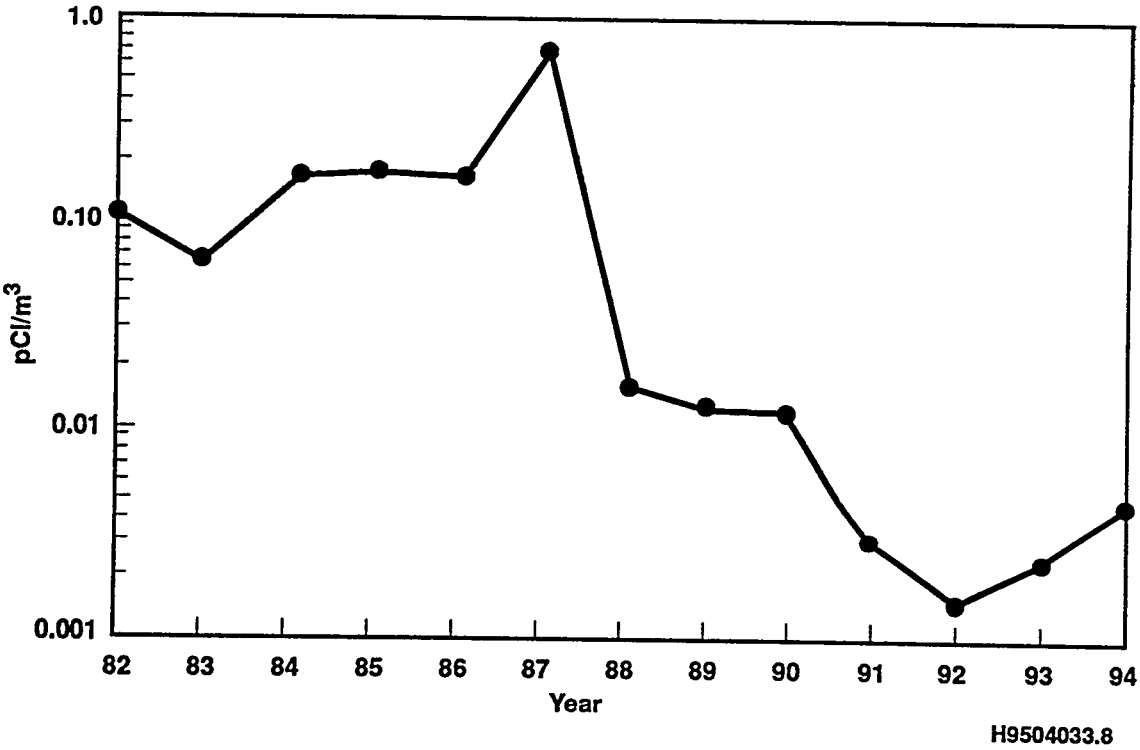


Figure 2-2. Average Concentrations of ^{60}Co Detected in 1301-N Air Samples from 1982 to 1994.



2.2.1.2 Strontium-90. The maximum annual result for ^{90}Sr was at Site N-101 at the 1301-N LWDF Site (Table 2-2). The air concentration was <7.9 E-05 ± 91% pCi/m^3, which was less than 0.1 percent of the DCG. For comparison purposes, this value was twice the annual average concentration reported by the Site Environmental Surveillance Program for the distant communities of Yakima and Sunnyside.

Table 2-2. ^{90}Sr in Air, 100 N Area, 1994 (pCi/m^3).

Maximum Annual Result ±2SEM(%)	Annual Average ±2SEM(%)	DCG	Distant Community ± 2SEM(%)
<7.9 E-05 ±91%	3.9 E-05 ±68%	9.0 E+00	4.6 E-05 ±95%

Less-than symbol (<) indicates results at or near background levels of radioactivity.

2.2.1.3 Cesium-137. The maximum annual result for ^{137}Cs was at Site N-102 at N Springs (Table 2-3). The air concentration was 2.4 E-04 ±64% pCi/m^3, which was less than 0.1 percent of the DCG. For comparison purposes, this value was three times the annual average concentration reported by the Site Environmental Surveillance Program for the distant communities of Yakima and Sunnyside.

Table 2-3. ^{137}Cs in Air, 100 N Area, 1994 (pCi/m^3).

Maximum Annual Result ±2SEM(%)	Annual Average ±2SEM(%)	DCG	Distant Community ± 2SEM(%)
2.4 E-04 ±64%	1.4 E-0 ±61%	4.0 E+02	8.0 E-05 ±162%

2.2.1.4 Plutonium 239/240. The maximum annual result for $^{239/240}Pu$ was at Site N-105 at the 1325-N LWDF site (Table 2-4). The air concentration was 2.6 E-06 ±98% pCi/m^3, which was less than 0.1 percent of the DCG. For comparison purposes, this value was 11 times greater than the annual average concentration reported by the Site Environmental Surveillance Program for the distant communities of Yakima and Sunnyside.

Table 2-4. $^{239/240}Pu$ in Air, 100 N Area, 1994 (pCi/m^3).

Maximum Annual Result ±2SEM(%)	Annual Average ±2SEM(%)	DCG	Distant Community ± 2SEM(%)
2.6 E-06 ±98%	2.0 E-06 ±77%	2.0 E-02	2.2 E-07 ±68%

2.2.2 100 K Area

The concentrations of airborne radionuclides measured at the 100 KE Area were many times less than the DCG. The 1994 air sampling results are presented in Table C-1.

2.2.2.1 Cobalt-60. The maximum annual result for ^{60}Co was at Site N-402 at the 105 KE Site (Table 2-5). The air concentration was 4.3 E-04 ± 159% pCi/m^3, which was much less (<<0.1 percent) than the DCG. For comparison purposes, this value was seven times the annual average concentration reported by the Site Environmental Surveillance Program for the distant communities of Yakima and Sunnyside.

Table 2-5. ^{60}Co in Air, 100 K Area, 1994 (pCi/m^3).

Maximum Annual Result ± 2SEM(%)	Annual Average ± 2SEM(%)	DCG	Distant Community ± 2SEM(%)
4.3 E-04 ± 159%	-1.4 E-04 ± 103%	8.0 E+01	6.3 E-05 ± 26%

Negative value indicates results at or near background levels of radioactivity.

2.2.2.2 Strontium-90. The maximum annual result for ^{90}Sr was at Site N-401 at the 105 KE Site (Table 2-6). The air concentration was 2.7 E-04 ± 32% pCi/m^3, which was less than 0.1 percent of the DCG. For comparison purposes, this value was six times the annual average concentration reported by the Site Environmental Surveillance Program for the distant communities of Yakima and Sunnyside.

Table 2-6. ^{90}Sr in Air, 100 K Area, 1994 (pCi/m^3).

Maximum Annual Result ± 2SEM(%)	Annual Average ± 2SEM	DCG	Distant Community ± 2SEM(%)
2.7 E-04 ± 38%	1.3 E-04 ± 60%	9.0 E+00	4.6 E-05 ± 95%

2.2.2.3 Cesium-137. The maximum annual result for ^{137}Cs was at Site N-401 at the 105 KE Site (Table 2-7). The air concentration was 1.6 E-03 ± 33% pCi/m^3, which was less than 0.1 percent of the DCG. For comparison purposes, this value was 20 times the annual average concentration reported by the Site Environmental Surveillance Program for the distant communities of Yakima and Sunnyside.

Table 2-7. ^{137}Cs in Air, 100 K Area, 1994 (pCi/m^3).

Maximum Annual Result ± 2SEM(%)	Annual Average ± 2SEM(%)	DCG	Distant Community ± 2SEM(%)
1.6 E-03 ± 33%	5.2 E-04 ± 90%	4.0 E+02	8.0 E-05 ± 162%

2.2.2.4 Plutonium 239/240. The maximum annual result for $^{239/240}Pu$ was at Site N-402 at the 105 KE Site (Table 2-8). The air concentration was 4.6 E-06 ± 79% pCi/m^3, which was less than 0.1 percent of the DCG. For comparison purposes, this value was 21 times the annual average concentration reported by

the Site Environmental Surveillance Program for the distant communities of Yakima and Sunnyside.

Table 2-8. $^{239/240}Pu$ in Air, 100 K Area, 1994 (pCi/m^3).

Maximum Annual Result ± 2SEM(%)	Annual Average ± 2SEM(%)	DCG	Distant Community ± 2SEM(%)
4.6 E-06 ± 79%	3.2 E-06 ± 50%	2.0 E-02	2.2 E-07 ± 68%

2.2.3 200 Areas

The concentrations of airborne radionuclides measured in 1994 in the 200 Areas were many times less than the DCG. The 1994 air sampling results for the 200 Areas are summarized in Table C-1 (Appendix C). The annual average concentrations since 1979 are illustrated in Figures 2-3 through 2-5. All results were well below the applicable DOE guidelines (see Appendix J) in 1994. Radionuclide concentrations detected in the ambient air continue to decline within the 200 Areas. Increasing trends seen in the past are associated with the operation of nuclear facilities such as the Plutonium/Uranium Extraction (PUREX) Plant. The results of the isotopic analyses are detailed in the following subsections.

As a result of decreased emissions and to decrease duplication of sampling efforts, air sampling stations that were located near stations operated by the PNL Site Environmental Surveillance Program were removed. Two air sampling stations located southeast of the 200 East Area were also relocated to the 200 East/West vent station to monitor areas of concern. The air sampling station located southwest of the 241-C facility was restarted.

2.2.3.1 Strontium-90. The highest air concentration for ^{90}Sr was at Site N-976, west of the 241-C Tank Farm in 200 East Area (Table 2-9). The result was 9.7 E-04 ± 32% pCi/m^3, which was less than 0.1 percent of the DCG. For comparison purposes, this value was 21 times the annual average concentration reported by the Site Environmental Surveillance Program for the distant communities of Yakima and Sunnyside.

Table 2-9. ^{90}Sr in Air, 200 Areas, 1994 (pCi/m^3).

Maximum Annual Result ± 2SEM(%)	Annual Average ± 2SEM(%)	DCG	Distant Community ± 2SEM(%)
9.7 E-04 ± 32%	1.4 E-04 ± 64%	9.0 E+00	4.6 E-05 ± 95%

2.2.3.2 Cesium-137. The highest air concentration for ^{137}Cs was at Site N-019, southwest of the 221-B Plant in the 200 East Area (Table 2-10). The result was 5.2 E-04 ± 40% pCi/m^3, which was less than 0.1 percent of the DCG. For comparison purposes, this value was seven times the annual average concentration reported by the Site Environmental Surveillance Program for the distant communities of Yakima and Sunnyside.

Table 2-10. ^{137}Cs in Air, 200 Area, 1994 (pCi/m^3).

Maximum Annual Result ±2SEM(%)	Annual Average ±2SEM(%)	DCG	Distant Community ± 2SEM(%)
5.2 E-04 ±40%	1.3 E-04 ±40%	4.0 E+02	8.0 E-05 ±162%

2.2.3.3 Plutonium. The highest air concentration for $^{239/240}Pu$ was at Site N-165, near the 216-Z-19 Ditch in the 200 West Area (Table 2-11). The result was 1.8 E-04 ±15% pCi/m^3, which was less than 0.1 percent of the DCG. For comparison purposes, this value was 800 times the annual average concentration reported by the Site Environmental Surveillance Program for the distant communities of Yakima and Sunnyside.

Table 2-11. $^{239/240}Pu$ in Air, 200 Area, 1994 (pCi/m^3).

Maximum Annual Result ±2SEM(%)	Annual Average ±2SEM(%)	DCG	Distant Community ± 2SEM(%)
1.8 E-04 ±15%	1.1 E-05 ±79%	2.0 E-02	2.2 E-07 ±68%

2.2.3.4 Uranium. The highest air concentration for uranium was at Site N-158, near the 241-AX Tank Farm in the 200 East Area (Table 2-12). The result was 5.9 E-05 ±55% pCi/m^3 (the sum of the uranium isotopes), which was less than 0.1 percent of the DCG. For comparison purposes, this value was 1.5 times the annual average concentration reported by the Site Environmental Surveillance Program for the distant communities of Yakima and Sunnyside.

Table 2-12. Uranium in Air, 200 Area, 1994 (pCi/m^3).

Uranium	Maximum Annual Result ±2SEM(%)	Annual Average ± 2SEM(%)	DCG	Distant Community ± 2SEM(%)
^{234}U	1.5 E-05 ±68%	6.6 E-06 ±27%	1.0 E-01	
^{235}U	1.7 E-06 ±250%	4.9 E-07 ±122%	1.0 E-01	
^{238}U	4.4 E-05 ±41%	7.7 E-06 ±38 %	1.0 E-01	
Total	5.9 E-05 ±55%	1.5 E-05 ±34%	1.0 E-01	3.7 E-05 ±84%

Figure 2-3. Annual Average ^{137}Cs Concentration in Air for the 200/600 Areas.

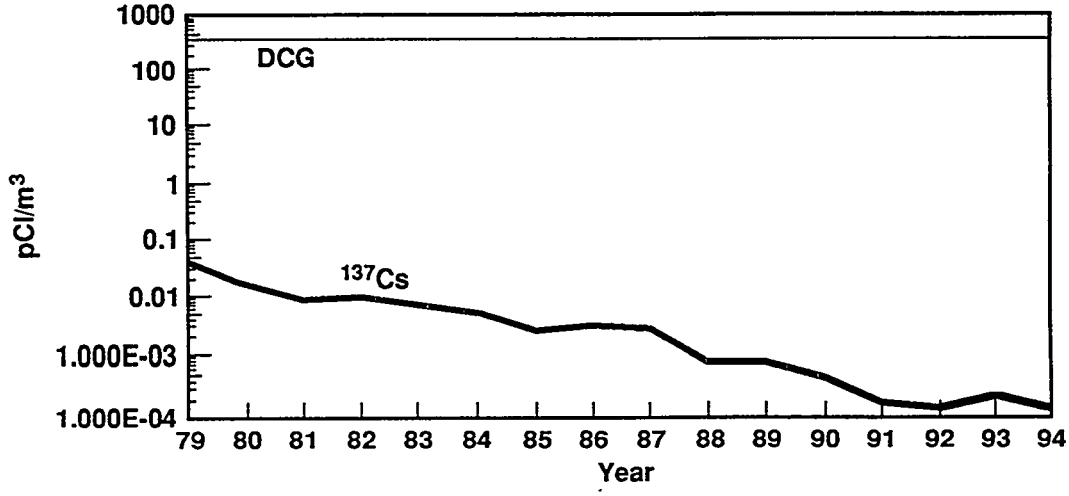


Figure 2-4. Annual Average ^{90}Sr Concentration in Air for the 200/600 Areas.

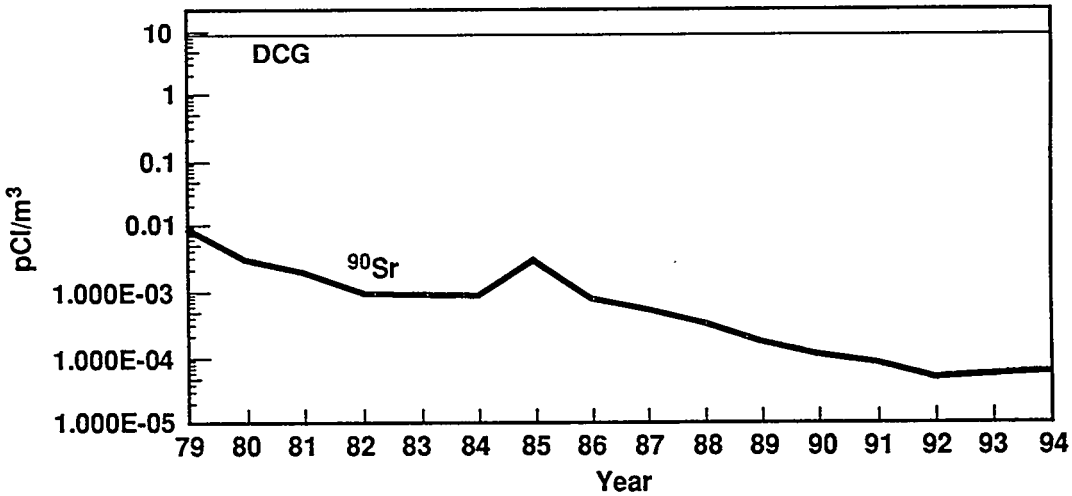
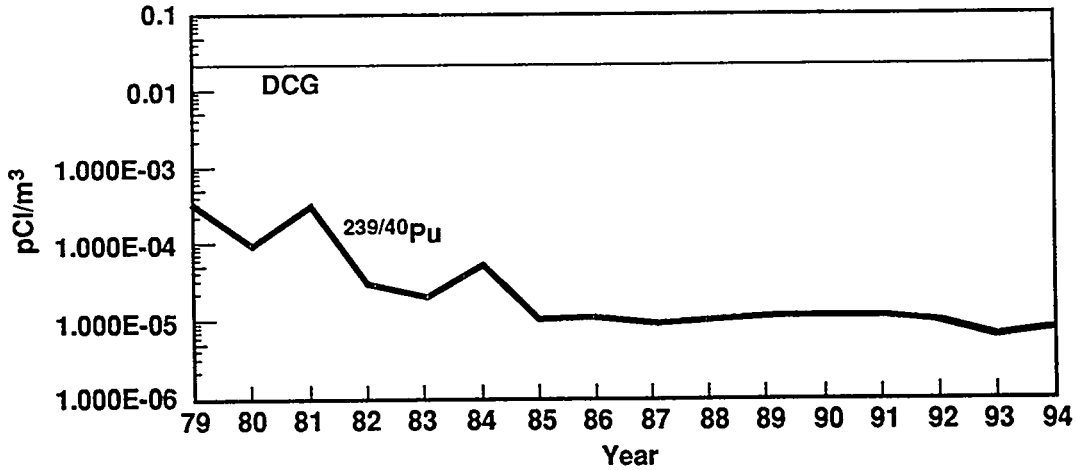


Figure 2-5. Annual Average $^{239/240}Pu$ Concentration in Air for the 200/600 Areas.



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2.2.4 300/400 Areas

The concentrations of airborne radionuclides measured during 1993 in the 300 and 400 Areas were many times less than the DCG. Air monitoring near the operating facilities in the 300 and 400 Areas is provided by PNL and the data are transferred to WHC after review and validation. One ambient air sampler, located at the 300 Area Treated Effluent Disposal Facility (TEDF), is operated and reported by the OEM. For a more detailed discussion, refer to the *Hanford Site Environmental Report for Calendar Year 1994* (Dirkes and Hanf 1995).

2.2.4.1 Strontium-90. The air concentration for ^{90}Sr for the 300 Area was -3.3 E-05 ±64% pCi/m^3 as reported by the Site Environmental Surveillance program and 2.7 E-05 ±399% pCi/m^3 for the 300 Area TEDF (Table 2-13). These concentrations were many times (<<0.01 percent) less than the DCG. For comparison purposes, there is no significant difference from the annual average concentration reported by the Site Environmental Surveillance Program for the distant communities of Yakima and Sunnyside.

The air concentration for ^{90}Sr for the 400 Area was -3.3 E-06 ± 900% pCi/m^3, which was many times (<<0.01 percent) less than the DCG. For comparison purposes, there is no significant difference from the annual average concentration reported by the Site Environmental Surveillance Program for the distant communities of Yakima and Sunnyside.

Table 2-13. ^{90}Sr in Air, 300/400 Area, 1994 (pCi/m^3).

Area	Annual average ± 2SEM(%)	DCG	Distant Community ±2SEM(%)
300 (PNL)	-3.3 E-05 ±64%	9.0 E+00	4.6 E-05 ±95%
300 Area TEDF N-130	2.7 E-05 ±399%		
400 Area	-3.3 E-06 ±900%		

Negative value indicates results at or near background levels of radioactivity.

2.2.4.2 Plutonium. The air concentration for $^{239/240}Pu$ for the 300 Area was 6.0 E-08 ±2,177% pCi/m^3 as reported by the Site Environmental Surveillance program and -1.8 E-07 ±194% pCi/m^3 as reported for the 300 Area TEDF (Table 2-14). These concentrations were many times (<<0.01 percent) less than the DCG. For comparison purposes, there is no significant difference from the annual average concentration reported by the Site Environmental Surveillance Program for the distant communities of Yakima and Sunnyside.

The air concentration for $^{239/240}Pu$ for the 400 Area was 1.3 E-07 ±300% pCi/m^3, which was many times (<<0.01 percent) less than the DCG. For comparison purposes, there is no significant difference from the annual average concentration reported by the Site Environmental Surveillance Program for the distant communities of Yakima and Sunnyside.

Table 2-14. $^{239/240}Pu$ in Air, 300/400 Area, 1994 (pCi/m^3).

Area	Annual Average ± 2SEM(%)	DCG	Distant Community ±2SEM(%)
300 (PNL)	6.0 E-08 ±2177%	2.0 E-02	-2.2 E-07 ±68%
300 Area TEDF N-130	-1.8 E-07 ±194%		
400 Area	1.3 E-07 ±300%		

Negative value indicates results at or near background levels of radioactivity.

2.2.4.3 Uranium. The air concentration for total uranium for the 300 Area was 5.7 E-04 ±91% pCi/m^3 as reported by the Site Environmental Surveillance program and 3.3 E-05 ±75% pCi/m^3 as reported for the 300 Area TEDF (Table 2-15). These concentrations were many times (<<0.01 percent) less than the DCG. For comparison purposes, the reported value was 15 times the annual average concentration reported by the Site Environmental Surveillance Program for the distant communities of Yakima and Sunnyside.

The total uranium for the 400 Area was not reported in 1994.

Table 2-15. Total Uranium in Air, 300/400 Areas, 1994 (pCi/m^3).

Area	Annual Average ± 2SEM(%)	DCG	Distant Community ±2SEM(%)
300 (PNL)	5.7 E-04 ±91%	9.0 E-02	3.7 E-05 ±84%
300 Area TEDF N-130	3.3 E-05 ±75%		
400 Area	NR		

NR = Not Reported

2.3 CONCLUSIONS

Operational activities in the 100, 200/600, and the 300/400 Areas contributed to average air radionuclide concentrations that were above background. Over the past 12 years, the average ambient air concentrations generally have decreased because of overall improvement in the operational environmental controls and reduced Site operations. All airborne radionuclide concentrations in air were below the DCG in 1994.

3.0 SUBSURFACE MONITORING

Subsurface monitoring at treatment, storage, and disposal (TSD) sites in WHC-operated areas consists of two primary components: borehole radionuclide logging of the soil column (vadose zone) and groundwater monitoring of the uppermost aquifer. Summaries of borehole logging and groundwater monitoring activities for 1994 are discussed separately in the following sections.

3.1 BOREHOLE LOGGING SUMMARY

Contaminants in the soil column beneath liquid waste disposal sites, underground storage tanks, and/or spill sites are potential sources of groundwater contamination. Knowing the status of vertical contaminant movement is therefore an integral component of groundwater protection (DOE/RL 1994). Borehole logging or monitoring of the vadose zone at TSD sites provides an early warning of any unusual movement of existing contamination and assists in detecting leakage from liquid-waste storage tanks. Borehole logging results are also used to provide empirical data for developing risk and performance assessment models. The following paragraphs summarize the program and highlights for 1994.

3.1.1 Program Description

Vadose zone monitoring activities are conducted in two major areas: tank farms and liquid waste disposal sites (DOE/RL 1994). The tank farm network consists of more than 700 dry wells located immediately adjacent to SSTs. Additional details are described in *Technical Baseline for Leak Detection Surveillance at Waste Storage Tanks*, WHC-SD-WM-TI-573, Rev. 0 (WHC 1995).

Tank Farms. Spectral gamma logging (by in situ gamma energy analysis) for the tank farms is conducted under a separate contract with the U.S. Department of Energy, Richland Operations Office. The primary radionuclides of interest that are detectable by down-hole or in situ gamma energy analysis include ^{60}Co, ^{137}Cs, ^{154}Eu, and ^{241}Am. Information from this program is not included in this report.

Liquid Waste Sites. Changes in the status of the depth and lateral distribution of radioactive wastes in the soil column beneath liquid waste disposal sites are also evaluated by WHC using spectral gamma logging system. After the baseline for a disposal facility is established, a monitoring schedule is determined and the data are collected periodically for comparison with the baseline. Activities conducted during 1994 are described in Section 3.1.2.

3.1.2 Borehole Logging Results for 1994

During 1994, 56 new boreholes were logged by WHC with the high-purity, germanium (HPGe) logging sensor. More than 150 separate logging surveys were needed to complete the work. The data were analyzed, plotted, and filed in the geophysical logging files for ready reference. Table 3-1 lists the wells logged and Figures 3-1 and 3-2 are representative plots of the data.

Table 3-1. Logged Wells, 1994. (3 sheets)

Well	Site	Date
Wells Logged with HPGe Instrument		
0299-E26-054	216-A-24 Crib	8/24/94
0299-E26-062	216-A-24 Crib	8/26/94
0299-E26-063	216-A-24 Crib	8/29/94
0299-E26-067	216-A-24 Crib	8/23/94
0299-E26-069	216-A-24 Crib	8/23/94
0299-E26-072	216-A-24 Crib	8/24/94
0299-E26-073	216-A-24 Crib	8/29/94
0299-E26-003	216-A-24 Crib	6/15/94
0299-E26-004	216-A-24 Crib	6/22/94
0299-E26-055	216-A-24 Crib	6/21/94
0299-E26-056	216-A-24 Crib	6/06/94
0299-E26-057	216-A-24 Crib	6/08/94
0299-E26-058	216-A-24 Crib	6/10/94
0299-E26-059	216-A-24 Crib	6/13/94
0299-E26-061	216-A-24 Crib	6/24/94
0299-E26-064	216-A-24 Crib	6/08/94
0299-E26-066	216-A-24 Crib	6/30/94
0299-E26-068	216-A-24 Crib	7/06/94
0299-E26-071	216-A-24 Crib	6/28/94
0299-E26-074	216-A-24 Crib	6/27/94
0299-E26-075	216-A-24 Crib	7/06/94
0299-E26-002	216-A-24 Crib	12/30/94
0299-E28-086	216-B-62 Crib	6/03/94
0299-E28-087	216-B-62 Crib	6/03/94
0299-E28-088	216-B-62 Crib	6/01/94
0299-E28-089	216-B-62 Crib	6/01/94
0299-E28-075	216-B-62 Crib	4/20/94
0299-E28-084	216-B-62 Crib	4/11/94
0299-E28-085	216-B-62 Crib	4/12/94
0299-E28-091	216-B-62 Crib	4/15/94
0299-E33-005	216-B-43 Crib	12/08/94
0299-W22-018	216-S-1 Crib	1/04/94
0299-W22-001	216-S-1 Crib	1/25/94
0299-W22-002	216-S-1 Crib	1/21/94
0299-W22-005	216-S-1 Crib	1/11/94
0299-W22-010	216-S-1 Crib	2/25/94
0299-W22-067	216-S-1 Crib	1/10/94
0299-W19-002	216-U-8 Crib	2/09/94
0299-W19-070	216-U-8 Crib	2/07/94
0299-W19-071	216-U-8 Crib	2/02/94

Table 3-1. Logged Wells, 1994. (3 sheets)

Well	Site	Date
0299-W19-094	216-U-8 Crib	1/18/94
0299-W10-022	216-T-2 Ditch	9/15/94
0199-K-106A	K Basin	2/02/94
0199-K-107A	K Basin	3/14/94
0199-K-108A	K Basin	3/29/94
0299-W10-037	W-152 Project	8/19/94
0299-W19-035	200-UP-1	2/28/94
0299-W19-34A	200-UP-1	4/18/94
0299-W19-34B	200-UP-1	8/31/94
0299-W18-003	200-ZP-1	4/26/94
0299-W18-004	200-ZP-1	4/25/94
0699-038-068A	200-UP-1	6/20/94
0299-W23-231	200-UP-2	3/14/94
0299-W19-098	200-UP-2	3/18/94
0299-E27-014	241-C Farm	3/01/94
0299-W10-196	241-T-106 Tank	2/03/94
C30-03-01	241-C-103 Tank	2/22/94
C30-03-03	241-C-103 Tank	2/18/94
C30-03-05	241-C-103 Tank	2/17/94
C30-03-07	241-C-103 Tank	2/15/94
C30-03-09	241-C-103 Tank	2/14/94
Wells Logged with NaI Instrument		
Well	Site	Date
0299-E26-002	216-A-24 Crib	12/02/94
0299-E26-005	216-A-24 Crib	11/11/94
0299-E26-051	216-A-24 Crib	11/08/94
0299-E26-052	216-A-24 Crib	11/09/94
0299-E26-053	216-A-24 Crib	11/10/94
0299-E26-060	216-A-24 Crib	11/08/94
0299-E26-076	216-A-24 Crib	11/09/94
0299-E33-001	216-B-43 Crib	10/19/94
0299-W11-001	216-T-6 Crib	10/13/94
0299-W11-054	216-T-6 Crib	10/24/94
0299-W11-055	216-T-6 Crib	10/27/94
0299-W11-056	216-T-6 Crib	9/16/94
0299-W11-058	216-T-6 Crib	10/25/94
0299-W11-059	216-T-6 Crib	10/12/94
0299-W11-060	216-T-6 Crib	10/27/94
0299-W11-061	216-T-6 Crib	10/25/94

Table 3-1. Logged Wells, 1994. (3 sheets)

Well	Site	Date
0299-W11-062	216-T-6 Crib	9/22/94
0299-W11-063	216-T-6 Crib	10/24/94
0299-W11-064	216-T-6 Crib	11/07/94
0299-W11-065	216-T-6 Crib	10/12/94
0299-W11-067	216-T-6 Crib	10/18/94
0199-K-109A	100K	8/02/94
0199-K-110A	100K	5/17/94
0199-K-111A	100K	6/08/94
0299-W10-022	216-T-2 Ditch	8/15/94
0699-048-077	C-018H	3/31/94
0699-048-077C	C-018H	4/14/94
0699-048-077D	C-018H	1/19/94
0699-049-077C	C-018H	3/01/94
99-W19-34B	200-UP-1	4/04/94
0699-038-068A	200-UP-1	4/27/94
0699-036-070A	U12-Crib	1/11/94
0199-F05-003	100F	7/25/94
0199-H-51B	100H	7/26/94
0699-091-046B	100H	9/26/94
0699-093-048A	100H	7/29/94
50-00-10	241-T Tank Farm	1/13/94
50-06-04	241-T Tank Farm	1/13/94
50-06-05	241-T Tank Farm	1/13/94
50-06-16	241-T Tank Farm	1/13/94
30-03-01	241-C Tank Farm	3/04/94
30-03-03	241-C Tank Farm	3/04/94
0199-K-107A	K Basin	3/11/94
LYSIMETER A-1	Lysimeter	4/21/94
LYSIMETER B-1	Lysimeter	4/27/94
0699-048-035	Site	5/25/94
0699-054-37A	Site	12/06/94
0699-054-37B	Site	12/13/94
0699-63-89	Site	12/05/94
LIGO WATER WL	Site	5/18/94
0699-023-034B	Solid Waste	1/11/94

Figure 3-1. Borehole 299-E26-62 Spectral Gamma-Ray Survey for Synthesized Radionuclides.

Project: A-24 Crib Monitoring Log Date: Aug 26, 1994

Borehole: 299-E26-62 Anal. Date: Aug 26, 1994

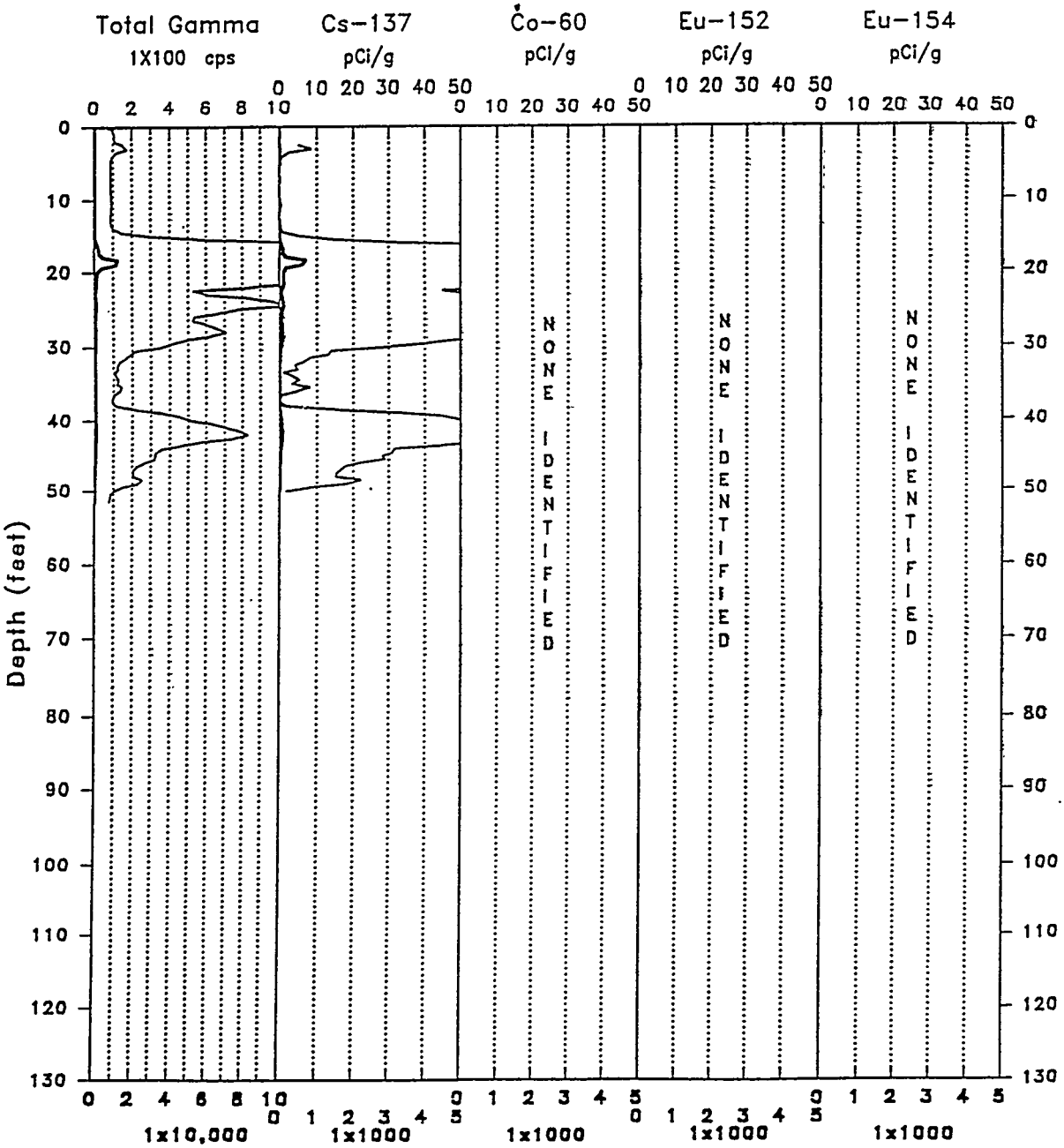
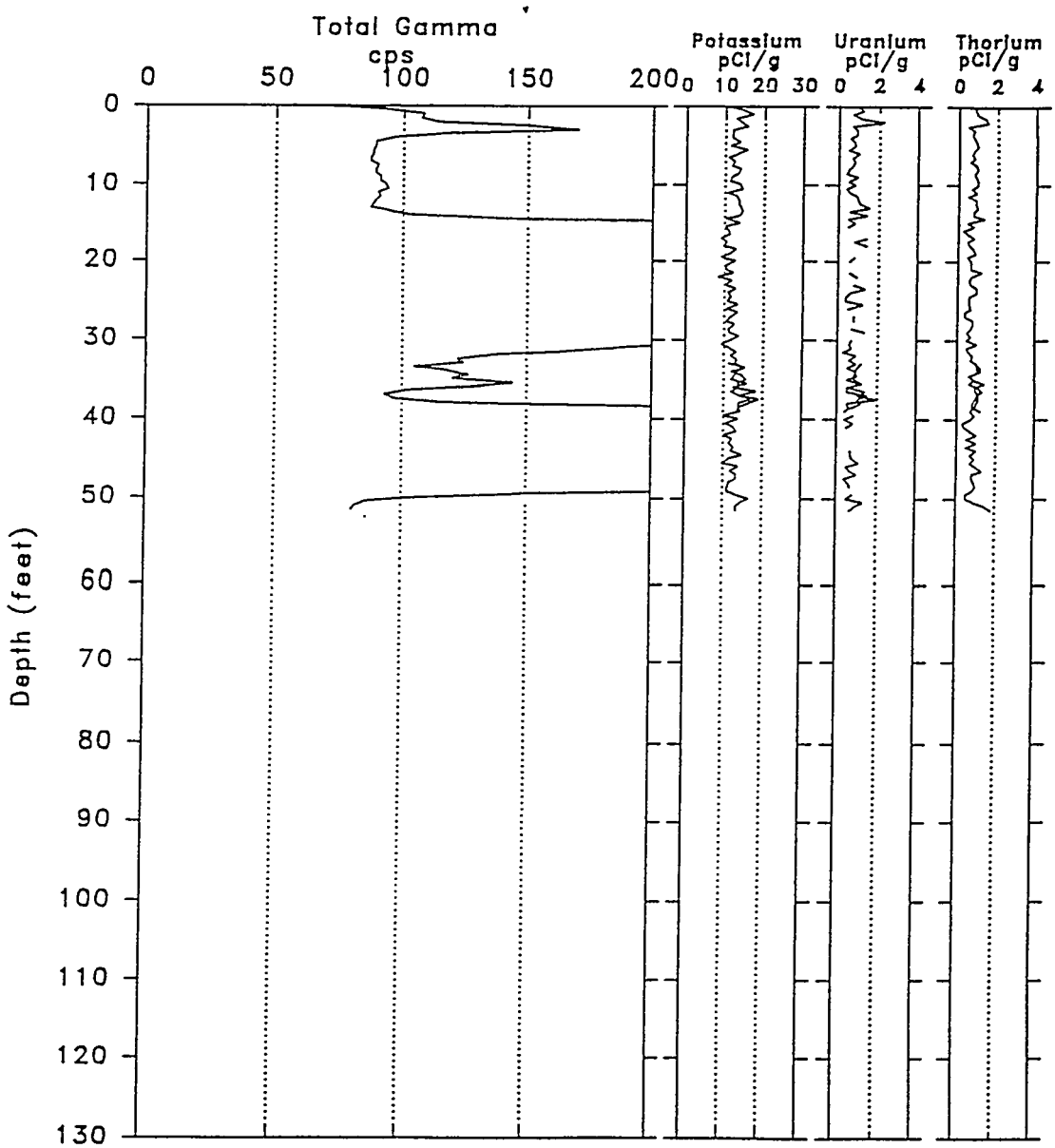


Figure 3-2. Borehole 299-E26-62 Spectral Gamma-Ray Survey for Naturally Occurring Radionuclides.

Project: A-24 Crib Monitor
Borehole: 299-E26-62

Log Date : Aug 26, 1994
Anal Date: Aug 26, 1994



The data are analyzed using software that applies corrections specific to a borehole (e.g., casing intervals, casing thickness, water level, etc.) and calculates radionuclide activity in picocuries per gram versus depth. The activities of both synthesized radionuclides and the naturally occurring radionuclides potassium, uranium, and thorium (KUT) are determined for each borehole and plotted. The most commonly encountered anthropogenic nuclides are ^{60}Co, ^{137}Cs, and two isotopes of europium (^{152}Eu and ^{154}Eu). Radioisotopes of antimony, plutonium, uranium, and others also have been detected.

Well 299-E33-05 in the 216-B Cribs was relogged (monitored) after 3 years. Lateral migration of radionuclide contamination was found to have taken place in a soil layer about 3 m (10 ft) thick at a depth of about 35 m (115 ft). The migration was determined to be lateral because no increase in the level of contamination was detected lower in the borehole. The migration amounted to a 20-percent decrease in total activity, after the decrease caused by physical decay was subtracted from the profile (Figure 3-3).

During 1994, the 216-A-24 and 216-B-62 Cribs were extensively logged. Both cribs have a wide distribution of boreholes, which is not typical across the Hanford Site. The vadose zone below both of these cribs is contaminated with significant, thick intervals of ^{137}Cs, with the greater portion generally distributed within the first 12 m (40 ft) of the bottom of the crib, as shown in Figure 3-1. The ^{137}Cs contamination in the 216-A-24 Crib occurs at the ground surface and extends to 15 m (50 ft). The most intense activity of greater than 4,000 pCi/g occurs at approximately 6 m (20 ft) (see Figure 3-4). In the 216-B-62 Crib, the contamination begins at or very near ground surface and extends to 40 m (130 ft). The most intense activity occurs between 12 and 20 m (40 and 65 ft), including two peaks of about 600 pCi/g (see Figure 3-5). A detailed characterization report on the contamination in these cribs is in preparation, and these facilities will now be monitored at regular intervals. Most of the remaining boreholes logged around facilities show similar distributions of contaminants.

Since the start of the borehole logging activity, 176 boreholes and wells have been logged with the HPGe instrument to define and monitor contaminant plumes, and approximately another 70 boreholes, wells, or access ports have been logged for other projects.

A spectral sodium iodide (NaI) logging sensor has been installed on a logging van that was received from the University of Washington. Some wells previously logged with the Radionuclide Logging System (RLS) have been relogged with the NaI to determine how well the NaI sensor would serve as a monitoring logging system. This tool is also used for "geologic" logging, that is, to help determine the lithology a borehole penetrates by an analysis of the KUT and to simply detect contaminants. It has been used most often for this purpose.

A soil neutron moisture measurement probe has been modified and calibrated to determine the soil moisture surrounding the steel-cased vadose boreholes at the Hanford Site. Because moisture is the driving force for any contaminant movement, this probe (logging sonde) will be used to profile the moisture regime in the vadose zone to better define lateral and depth distribution characteristics. Only test logging runs were completed in 1994, but logging with this sonde could become routine in the future.

Figure 3-3. Comparison of RLS Logs from 1991 to 1994 Showing ^{60}Co Movement.

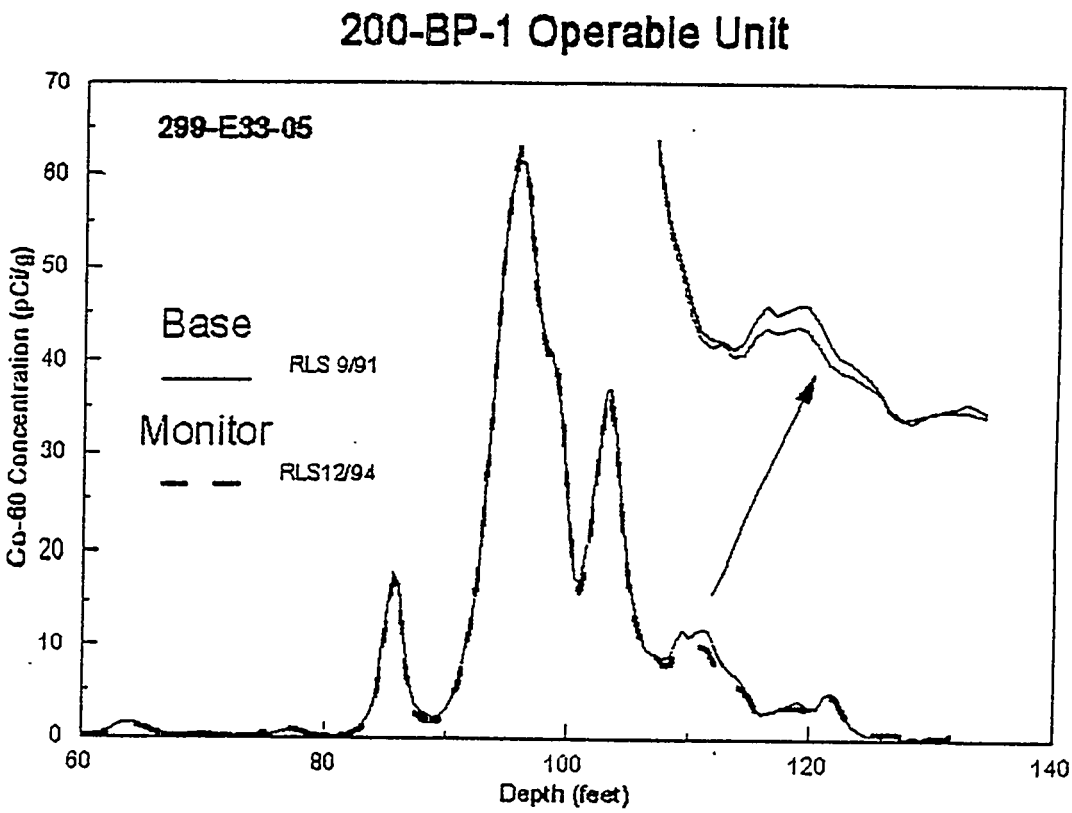


Figure 3-4. Borehole 299-E26-63 Spectral Gamma-Ray Survey for Synthesized Radionuclides.

Project: A-24 Crib Monitoring
Borehole: 299-E26-63

Log Date: Aug 29, 1994
Anal. Date: Aug 29, 1994

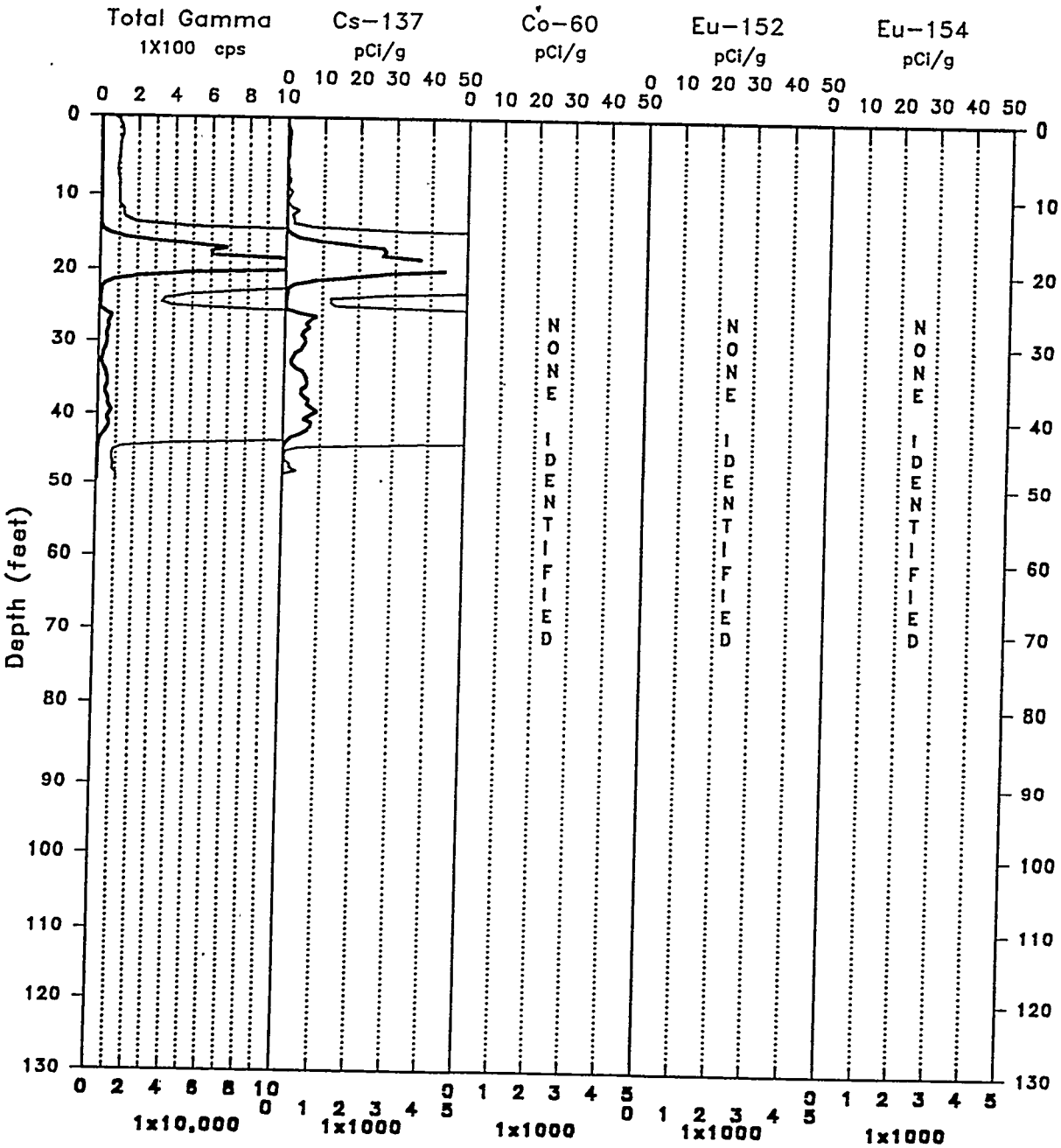
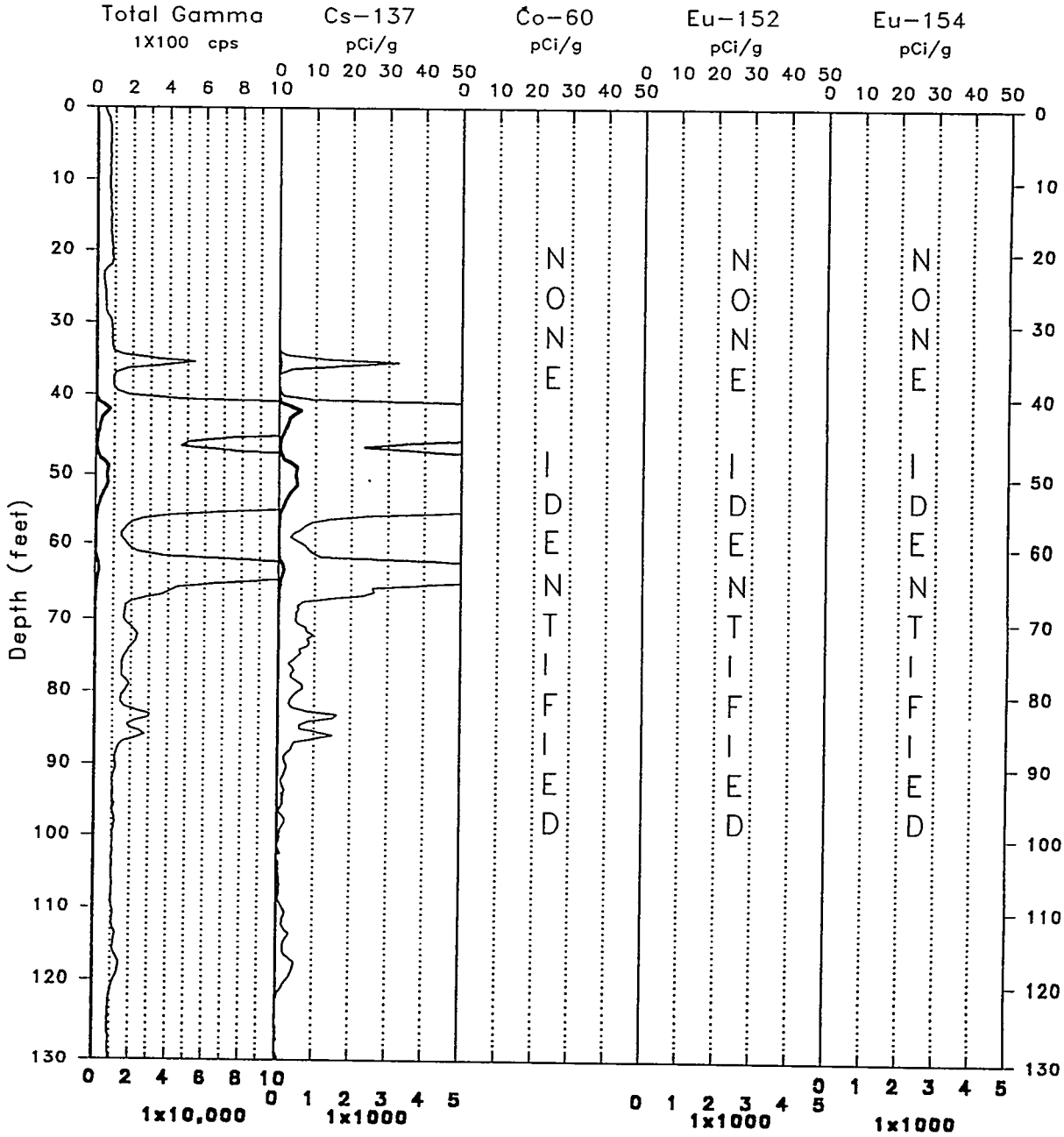


Figure 3-5. Borehole 299-E28-75 Gamma-Ray Survey for Synthesized Radionuclides.

Project: B-62 Crib Monitoring
Borehole: 299-E28-75

Log Date: Apr 21, 1994
Anal. Date: Aug 18, 1994



3.2 GROUNDWATER MONITORING SUMMARY

Groundwater monitoring at WHC-managed facilities is conducted at both *Resource Conservation and Recovery Act of 1976* (RCRA) and non-RCRA operational facilities. The primary purposes of groundwater monitoring in WHC-operated areas are to comply with interim- and final-status state and federal RCRA requirements, to assess the potential impact of facilities on groundwater quality and movement, and to provide an early warning of unusual occurrences and trends (WHC-CM-7-4, WHC-CM-7-5). The RCRA facilities include both liquid- and solid-waste TSD facilities. Those facilities with the potential to contaminate the uppermost aquifer require groundwater monitoring as prescribed in Title 40 *Code of Federal Regulation* (CFR) Parts 264 and 265 and *Washington Administrative Code* (WAC) 173-303-400 (interim status) and WAC 173-303-645 (final status). The non-RCRA facilities are controlled under DOE orders and by *Hanford Federal Facility Agreement and Consent Order* (Tri-Party Agreement) (Ecology et al. 1994) milestones. The latter consist primarily of soil column disposal facilities for chemical and radioactive liquid wastes that were associated with nuclear material processing, refining, and waste treatment activities. A schedule was established for terminating all such discharges by 1995. During the interim, detailed evaluation of the impact of certain non-RCRA-regulated facilities on groundwater quality was required. In addition, an agreement was reached in December 1991 to include all miscellaneous waste streams and/or any new waste stream discharged to the ground under the Washington State waste discharge permit program (WAC 173-216). Some of the "216 permit" sites also require groundwater monitoring.

The sitewide groundwater surveillance program, administered by PNL, addresses "far-field" and offsite groundwater contaminant migration, while the RCRA and Operational Environmental Monitoring programs address more facility- and site-specific contamination. In addition, the environmental restoration contractor (ERC) conducts site-specific groundwater monitoring to support groundwater remediation projects. Coordination among all programs is required to avoid duplication of effort. Integration across programs and the Hanford Site is facilitated through the *Hanford Environmental Monitoring Plan, United States Department of Energy, Richland Operations Office*, DOE/RL-91-50 (DOE-RL 1994) and the *Hanford Site Groundwater Protection Management Plan* (DOE-RL 1986).

3.2.1 RCRA Groundwater Monitoring Projects

During calendar year (CY) 1994, more than 330 wells were sampled quarterly or semi-annually for a total of 900 sampling events. The formal sampling results are supplemented with data collected for other programs to assess the impact of adjacent contaminant plumes. The status of Hanford Site RCRA monitoring projects during 1994 is shown in Table 3-2 and the locations of the various monitored facilities are shown in Figure 3-6.

The RCRA projects meet the federal requirements for "Interim Status Standards for Owners and Operators of Hazardous Waste Treatment, Storage, and Disposal Facilities," 40 CFR 265, Subpart F, and "Criteria for Classification of Solid Waste Disposal Facilities and Practices," 40 CFR 257, for nonhazardous waste.

Table 3-2. Status of Hanford Site RCRA Interim-Status Groundwater Monitoring Projects as of September 30, 1994. (3 sheets)

Project (date initiated)	Program status			Regulatory requirements
	Background monitoring	Indicator parameter evaluation	GW quality assessment	
100 D Ponds (4/92)		X		40 CFR 265.93(b) WAC 173-303-400
183-H Basin (6/85)			X (6/85)	*Consent Agreement and Compliance Order*[a]
1301-N LWDF (12/87)	X[b]			40 CFR 265.92(c) WAC 173-303-400
1324-N/NA Pond (12/87)			X (5/89) Spe cond, TOX	40 CFR 265.93(d) WAC 173-303-400
1325-N LWDF (12/87)		X		40 CFR 265.93(d) WAC 173-303-400
216-B-3 Pond (11/88)			X (5/90) TOX	40 CFR 265.93(d) WAC 173-303-400
216-A-29 Ditch (11/88)			X (6/90) Spe cond	40 CFR 265.93(d) WAC 173-303-400
216-A-36B Crib (5/88)		X		40 CFR 265.93(b) WAC 173-303-400
216-A-10 Crib (11/88)		X		40 CFR 265.93(b) WAC 173-303-400
216-B-63 Trench (8/91)		X		40 CFR 265.93(b) WAC 173-303-400
216-S-10 Pond (8/91)		X		40 CFR 265.93(b) WAC 173-303-400
216-U-12 Crib (9/91)			X (1/93) Spe cond	40 CFR 265.93(d) WAC 173-303-400
LERF (7/91)		X		40 CFR 265.93(b) WAC 173-303-400
2101-M Pond (8/88)		X		40 CFR 265.93(b) WAC 173-303-400

Table 3-2. Status of Hanford Site RCRA Interim-Status Groundwater Monitoring Projects as of September 30, 1994. (3 sheets)

Project (date initiated)	Program status			Regulatory requirements
	Background monitoring	Indicator parameter evaluation	GW quality assessment	
LLBG				
WMA 1 (9/88)		X		40 CFR 265.93(b) WAC 173-303-400
WMA 2 (9/88)		X		40 CFR 265.93(b) WAC 173-303-400
WMA 3 (10/88)	X			40 CFR 265.92(c) WAC 173-303-400
WMA 4 (10/88)		X		40 CFR 265.93(b) WAC 173-303-400
WMA 5 (3/92)		X		40 CFR 265.93(b) WAC 173-303-400
SST				
WMA-A-AX (2/90)		X		40 CFR 265.93(b) WAC 173-303-400
WMA-B-BX-BY (2/90)		X		40 CFR 265.93(b) WAC 173-303-400
WMA-C (2/90)		X		40 CFR 265.93(b) WAC 173-303-400
WMA-S-SX (10/91)		X		40 CFR 265.93(b) WAC 173-303-400
WMA-T (2/90)			X (7/93) Spec cond	40 CFR 265.93(d) WAC 173-303-400
WMA-TX-TY (9-10/91)			X (7/93) Spec cond	40 CFR 265.93(d) WAC 173-303-400
WMA-U (10/91)		X		40 CFR 265.93(d) WAC 173-303-400

Table 3-2. Status of Hanford Site RCRA Interim-Status Groundwater Monitoring Projects as of September 30, 1994. (3 sheets)

Project (date initiated)	Program status			Regulatory requirements
	Background monitoring	Indicator parameter evaluation	GW quality assessment	
300 Area Process Trenches (6/85)			X (6/85)	*Consent Agreement and Compliance Order*
NRDWL (10/86)		X		40 CFR 265.93(b) WAC 173-303-400

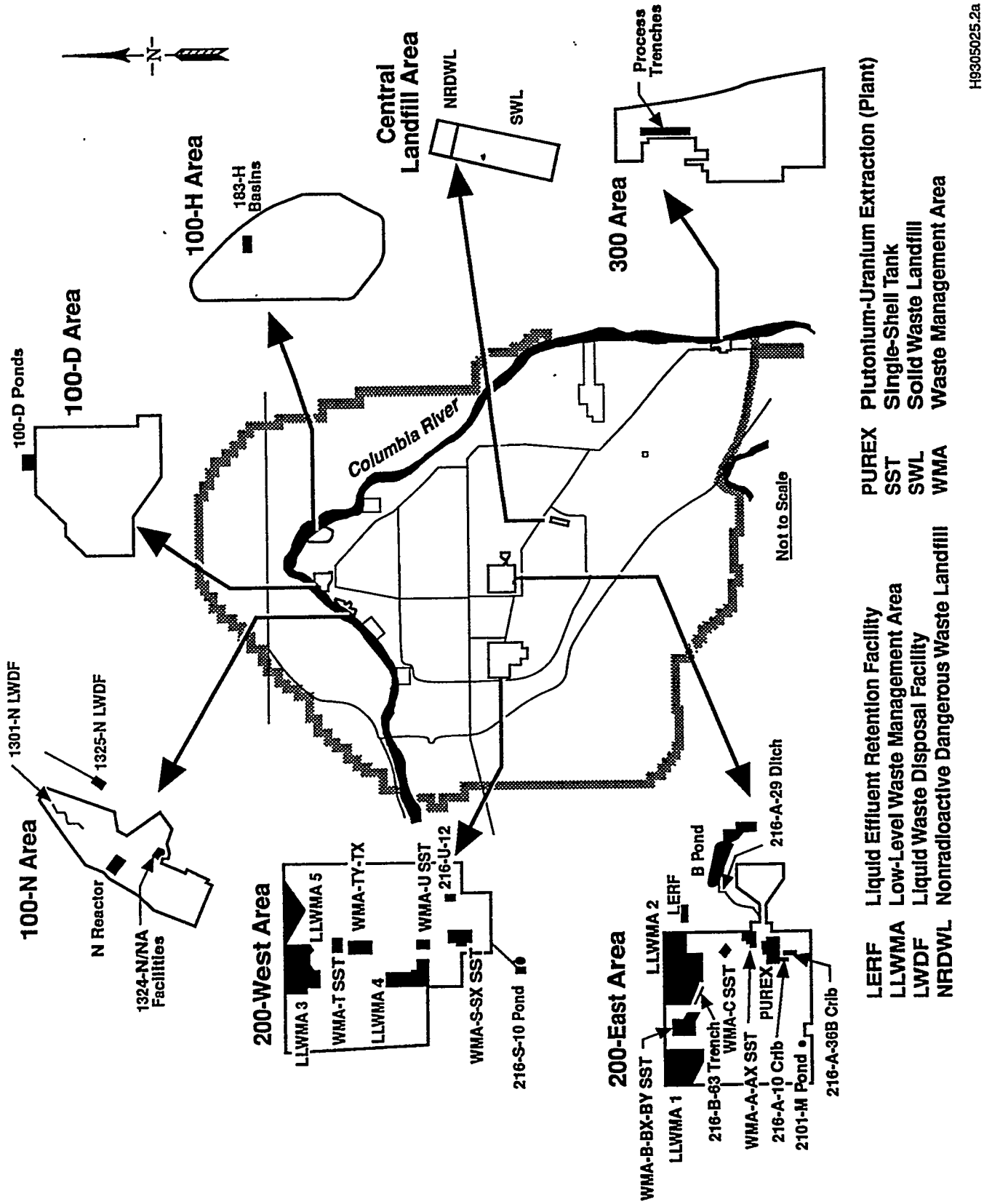
Note: An X and a date in the third column indicate the following:
The date that the assessment was initiated
The indicator parameter that triggered assessment monitoring

[a]Ecology and EPA, 1986, *Consent Agreement and Compliance Order*, Ecology No. DE 86-133, Washington State Department of Ecology and U.S. Environmental Protection Agency, Olympia, Washington.

[b]Background monitoring was reinstated in March 1993 and completed in November 1994.

CFR	*Code of Federal Regulations*
GW	groundwater
LERF	Liquid Effluent Retention Facility
LLBG	low-level burial grounds
LWDF	Liquid Waste Disposal Facility
NRDWL	Nonradioactive Dangerous Waste Landfill
Spe cond	specific conductance
SST	single-shell tanks
TOX	total organic halogen
WAC	*Washington Administrative Code*
WMA	waste management area

Figure 3-6. Locations of the RCRA Monitoring Projects and Landmarks on the Hanford Site.



Results of the RCRA groundwater monitoring projects are reported to Ecology quarterly and annually in accordance with WAC 173-303 and -304. The annual reports discuss results by geographical area and include an overview of the Hanford Site hydrogeology. The quarterly and annual reports should be consulted for details about specific RCRA project results.

3.2.2 Non-RCRA Groundwater Monitoring

The impacts of non-RCRA facilities on groundwater quality are assessed in accordance with Tri-Party Agreement Milestone M-17-13 and DOE Orders 5400.1 (DOE 1988a) and 5820.2A (DOE 1988b). Locations of major waste water disposal sites, including those designated as RCRA facilities, are shown in Figure 3-7. Table 3-3 lists the waste streams discharged to each disposal facility and its status during 1994. Miscellaneous waste streams and disposal sites requiring 216 Discharge Permits are listed in Table 3-4.

Primary emphasis for groundwater monitoring at non-RCRA sites is on liquid-waste disposal facilities. These sites generally involve several wells that are located immediately adjacent to the disposal facility and that were intended to detect the breakthrough of contaminants from the soil column directly beneath the disposal structure.

The network currently includes approximately 50 wells associated with active or recently active liquid waste disposal facilities. Samples are collected quarterly at active discharge sites and semiannually or annually at all other sites. Up to about 100 additional wells have been sampled annually to supplement available data for defining near-field plume distribution patterns. The latter sampling may decline significantly as *Comprehensive Environmental Response, Compensation, and Liability Act of 1980* (CERCLA) groundwater pump-and-treat sampling expands. Monitoring wells are sampled for site-specific chemical and radiological constituents, as well as general indicator parameters. Water-table elevations in selected wells are used to determine the direction of groundwater movement in the vicinity of waste disposal and storage sites. As noted, most of the monitoring wells are located immediately adjacent to the monitored facility, but others are located further away to aid in defining plume boundaries. Where possible, data from upgradient or local area background wells are used for comparison with downgradient wells to assess the impact from a specific facility. The direction of groundwater movement is determined from water-table elevation maps that are based on area-wide and facility-specific water-level measurements.

3.2.3 Project Highlights and Findings

Major changes in groundwater contamination patterns and/or new occurrences associated with the RCRA/operational groundwater monitoring at WHC-operated facilities during CY 1994 are summarized in the following paragraphs.

3.2.3.1 100 K Area Nuclear Fuel Storage Basins. The last of six new groundwater monitoring wells designed to serve as leak-detection wells was installed at the KE and KW basins. (See Figure D-1.) The most significant finding from these new wells was the occurrence of ^{90}Sr concentrations of up

Figure 3-7. Major Past and Present Waste Water Disposal Sites.

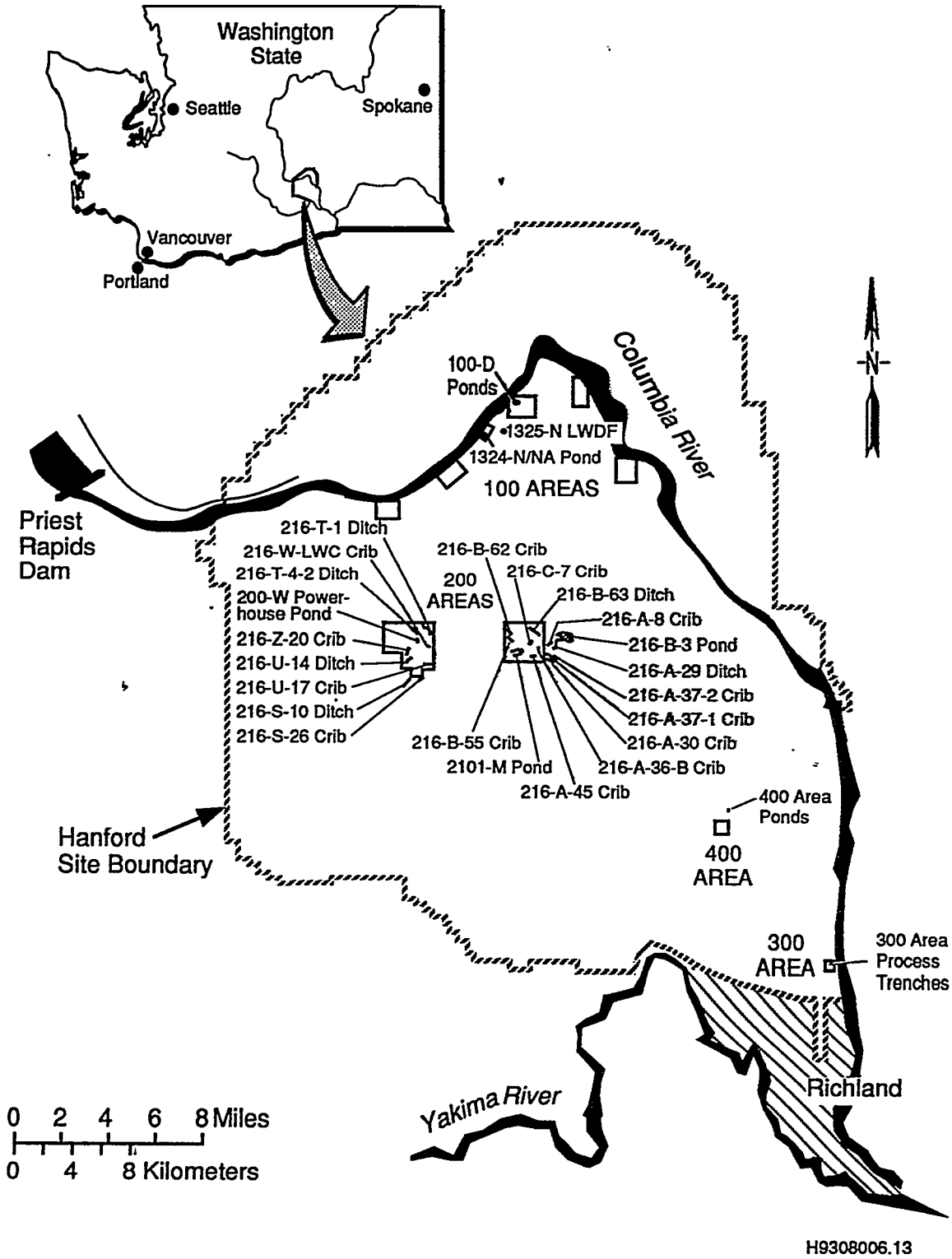


Table 3-3. Liquid Effluent Streams and Receiving Site Status, June 1994. (2 sheets)

Receiving Site		Associated Effluent Stream	Receiving Site Status
1 100 D Ponds	R	183D filter backwash waste water	Inactive
2 1324N/NA Pond	R	163N Demineralization Plant waste water	Inactive
3 1325N LWDF Crib	R	N Reactor effluent	Inactive
4 216-A-8 Crib		241A and AZ Tank Farm steam condensate	Inactive
5 216-A-29 Ditch	R	PUREX Plant chemical sewer	Inactive
6 216-A-30 Crib		PUREX Plant steam condensate	Inactive
7 216-A-36B Crib	R	PUREX Plant ammonia scrubber condensate	Inactive
8 216-A-37-1 Crib		242-A Evaporator process condensate	Inactive
9 216-A-37-2 Crib		PUREX Plant steam condensate	Inactive
10 216-A-45 Crib		PUREX Plant process condensate	Inactive
11 216-B-3 Pond System	R	PUREX Plant chemical sewer	Active
11 216-B-3 Pond System	R	PUREX Plant cooling water	Active
11 216-B-3 Pond System	R	242-A Evaporator cooling water	Active
11 216-B-3 Pond System	R	B Plant cooling water	Active
11 216-B-3 Pond System	R	241-A Tank Farm cooling water	Active
11 216-B-3 Pond System	R	284-E Power Plant waste water	Active
11 216-B-3 Pond System	R	244-AR Vault cooling water	Active
11 216-B-3 Pond System	R	242-A Evaporator steam condensate	Active
12 216-B-55 Crib		B Plant steam condensate	Inactive
13 216-B-62 Crib		B Plant process condensate	Inactive
14 216-B-63 Trench	R	B Plant chemical sewer	Inactive
15 216-C-7 Crib		209-E Laboratory reflector water	Active
16 216-S-10 Facility	R	S Plant waste water	Active
17 216-S-26 Crib		222-S Laboratory waste water	Active
18 216-T-1 Ditch		T Plant laboratory waste water	Active
19 216-T-4-2 Ditch		T Plant waste water	Active
20 216-U-14 Ditch		UO_3/U Plant waste water	Active
20 216-U-14 Ditch		242-A Evaporator steam condensate	Active

Table 3-3. Liquid Effluent Streams and Receiving Site Status, June 1994. (2 sheets)

Receiving Site	Associated Effluent Stream	Receiving Site Status
21 216-U-17 Crib	UO_3 Plant process condensate	Active
22 216-W-LC Crib	2724-W Laundry waste water	Active
23 216-Z-20 Crib	Plutonium Finishing Plant waste water	Active
24 200 W Powerhouse Pond	284-W Power Plant waste water	Active
25 2101-M Pond R	2101-M Laboratory waste water	Inactive
26 300 Area Process Trenches R	300 Area process waste water	Active
27 400 Area Ponds	400 Area secondary cooling water	Active

PUREX Plutonium-Uranium Extraction (Plant)
R *Resource Conservation and Recovery Act of 1976* site

Table 3-4. Liquid Effluent Receiving Sites Requiring a Groundwater Impact Assessment and WAC 173-216 SWD Permit.

Tri-Party Agreement Milestone M-17-06E (only groundwater impact assessment)	
300 Area Process Trenches, Project L-045H	
Interim Compliance Waste Streams: Tri-Party Agreement Milestone M-17-13A (only groundwater impact assessments)	
216-U-14 Ditch	1325-N LWDF
216-W-LC Crib	216-Z-20 Crib
216-U-17 Crib	216-S-26 Crib
216-T-1 Ditch	216-T-4-2 Ditch
284 West Powerhouse Pond	2101-M Pond
Other Phase II Waste Streams: Tri-Party Agreement Milestone M-17-13-A and WAC 173-216 State Waste Discharge Permit	
400 Area Ponds	
100 D Ponds	
216-B-3 Pond System	
Miscellaneous Waste Streams: WAC 173-216 State Waste Discharge Permit	
216-C-9 Pond	400 Area septic system
200 West Powerhouse ash pit	200 East Powerhouse ash pit
300 Area Powerhouse ash pit	300 Area sanitary sewer
100 N sewage lagoon	300 Area Backwash Pond
216-Z-21 Seepage Basin (207-Z Retention Basin)	200 East chemical drain field
183-N Backwash Discharge Pond	Unidentified waste streams-to be determined.
Planned Waste Streams: WAC 173-216 State Waste Discharge Permit	
Project C-018H Treated Effluent Disposal Site	
Project W-049H Treated Effluent Disposal Site	

to 800 pCi/L in well K-109A. This new RCRA-compliant monitoring well is located near the K-109A. This new RCRA-compliant monitoring well is located near the northwest corner of the 105 KE reactor building. The origin of the ^{90}Sr is currently thought to be related to past-practice disposal sites located in that area. A groundwater monitoring and assessment plan was prepared to address this occurrence, as well as the routine monitoring program in the 100 K Area (Johnson et al. 1995a). Close coordination with the ERC is needed for subsurface investigations at this facility because the 105 K Basin is located within both groundwater and source operable units (100 KR-4 and 100 KR-2, respectively).

Tritium concentrations declined during the year in well K-27 (located immediately downgradient from the suspected leak at the construction joint between the basin proper and the loading chute at the KE Basin). (See Figure D-1.) Concentrations peaked at over 600,000 pCi/L in the spring and decreased to around 200,000 pCi/L by the end of the year. The semiannual project reports for this site evaluate other contaminant concentrations in the 100 K Area (Peterson 1994, Johnson 1995).

3.2.3.2 Contaminant Plumes in the 200 Areas. Shifts in contaminant plumes continued in the 200 Areas in response to declining or terminated discharges to soil column disposal facilities. The discharges of relatively clean cooling water to the -3C lobe of B Pond continue to drive the spread of groundwater radially outward from the pond (Johnson et al. 1995b). The movement of relatively uncontaminated cooling water is gradually displacing contaminated groundwater in the vicinity of previous disposal sites.

3.2.3.3 100 N Area Springs and Groundwater. Composite grab samples from the series of shallow wells along the stream bank at 100 N continue to exhibit maximum ^{90}Sr concentrations of several thousand picocuries per liter. Remedial investigation of the residual strontium-90 in the aquifer downgradient from the 1325-N and 1301-N cribs, the past-practice sources of ^{90}Sr at N Springs, is currently under way. Two pumping wells and six new groundwater monitoring wells are being installed by the ERC for this purpose.

Currently the only groundwater wells located in the 100 N Area that are monitored through the Operational Environmental Monitoring Program are wells N-47 and N-48. Samples are collected monthly and are analyzed for gamma-emitting radionuclides. Trend analyses provide indications on the integrity of the underground piping associated with the 107-N facility. Wells N-47 and N-48 are located adjacent to the 107-N Fuel Storage Basin Recirculation Facility (see Figure D-1). Radionuclide concentrations detected in the groundwater samples are presented in Table D-1. The concentrations reported in 1994 depict values consistent with those reported in previous years.

3.2.4 Project Reports

Reports resulting from groundwater monitoring and assessment activities at WHC-operated facilities since 1990 are listed as follows. These reports should be consulted for details about specific sites or for additional information about the program.

3.2.4.1 RCRA Projects. Both quarterly and annual reports are produced for the RCRA groundwater monitoring projects. However, only the annual reports are

included in the following listing. Report numbers for the quarterly reports are included in each annual report for the respective report year. The quarterly reports are primarily data reports, while the annual report includes interpretive analysis of the data. The annual reports for the last five years are as follows:

- 1991, *Annual Report for RCRA Groundwater Monitoring Projects at Hanford Site Facilities for 1990*, DOE/RL-91-03, U.S. Department of Energy, Richland Operations Office, Richland, Washington.
- 1992, *Annual Report for RCRA Groundwater Monitoring Projects at Hanford Site Facilities for 1991*, DOE/RL-92-03, U.S. Department of Energy, Richland Operations Office, Richland Washington.
- 1993, *Annual Report for RCRA Groundwater Monitoring Projects at Hanford Site Facilities for 1992*, DOE/RL-93-09, U.S. Department of Energy, Richland Operations Office, Richland Washington.
- 1994, *Annual Report for RCRA Groundwater Monitoring Projects at Hanford Site Facilities for 1993*, DOE/RL-93-88, U.S. Department of Energy, Richland Operations Office, Richland. Washington.
- 1995, *Annual Report for RCRA Groundwater Monitoring Projects at Hanford Site Facilities for 1994*, DOE/RL-94-136, U.S. Department of Energy, Richland Operations Office, Richland, Washington.

3.2.4.2 Non-RCRA/Operational Reports. Groundwater monitoring at active non-RCRA waste water disposal facilities intensified beginning in 1989 and resulted in several site-specific monitoring and assessment project reports and annual reports. All operational groundwater monitoring and related reports generated from 1990 to the present are listed in chronological order as follows:

- Johnson, V. G. and B. F. Ford, 1990, *Liquid Effluent Study: Groundwater Characterization Report*, WHC-EP-0366, Westinghouse Hanford Co., Richland Washington.
- Rojay, V. J., V. G. Johnson, A. G. Law, B. H. Ford, and K. R. Fecht, 1990, *Liquid Effluent Study Final Project Report*, WHC-EP-0367, Westinghouse Hanford Company, Richland, Washington.
- Tyler, D. K., 1991, *A Methodology for Assessing Impacts to Groundwater from Disposal of Liquid Effluent to the Soil at the Hanford Site*, WHC-SD-EN-EV-008, Rev. 0, Westinghouse Hanford Company, Richland, Washington.
- Peterson, R. E. and V. G. Johnson, 1992, *Riverbank Seepage of Groundwater Along the 100 Areas Shoreline, Hanford Site*, WHC-EP-0609, Westinghouse Hanford Company, Richland, Washington.
- Tyler, D. K., 1992, *Assessment of Potential Environmental Impacts from Continued Discharge to the 300 Area Process Trenches at Hanford*, WHC-SD-WM-EE-005, Rev. 0, Westinghouse Hanford Company, Richland, Washington.

- Tyler, D. K., 1992, *Groundwater Impact Assessment Report for the 400 Area Ponds*, WHC-EP-0587, Westinghouse Hanford Company, Richland Washington.

- Reidel, S. P., V. G. Johnson, and N. W. Kline, 1993, *Groundwater Impact Assessment Report for the 216-U-17 Crib, 200 West Area*, WHC-EP-0664, Westinghouse Hanford Company, Richland, Washington.

- Alexander, D. J., 1993, *Groundwater Impact Assessment Report for the 100-D Ponds*, WHC-EP-0666, Westinghouse Hanford Company, Richland, Washington.

- Alexander, D. J. and V. G. Johnson, 1993, *Groundwater Impact Assessment Report for the 1325-N Liquid Waste Disposal Facility*, WHC-EP-0675, Westinghouse Hanford Company, Richland Washington.

- Alexander, D. J., V. G. Johnson, and K. A. Lindsey, 1993, *Groundwater Impact Assessment Report for the 284-WB Powerplant Ponds*, WHC-EP-0679, Westinghouse Hanford Company, Richland, Washington.

- Johnson, V. G., 1993a, *Groundwater Impact Assessment Report for the 216-Z-20 Crib, 200 West Area*, WHC-EP-0674, Westinghouse Hanford Company, Richland, Washington.

- Lindberg, J. W., S. D. Evelo, and D. J. Alexander, 1993, *Groundwater Impact Assessment Report for the 216-S-26 Crib*, WHC-EP-0690, Westinghouse Hanford Company, Richland, Washington.

- Chou, C. J., V. G. Johnson, and F. N. Hodges, 1993, *Statistical Application of Groundwater Monitoring Data at the Hanford Site*, WHC-SA-1792-FP, Westinghouse Hanford Company, Richland, Washington.

- Lindsey, K. A. and V. G. Johnson, 1993, *Hydrogeologic Characterization Plan: I. Principal Recharge Zone for the Hanford Site 200 Areas Waste Storage and Disposal Sites, Cold Creek Valley Area, Western Hanford Site*, WHC-SD-EN-AP-133, Westinghouse Hanford Company, Richland, Washington.

- Johnson, V. G., 1993, *Westinghouse Hanford Company Operational Groundwater Status Report 1991-1992*, WHC-EP-0595, Westinghouse Hanford Company, Richland, Washington.

- Williams, B. A. and R. E. Peterson, 1994, *Installation of Groundwater Monitoring Wells in Support of the 100-K Area Fuel Storage Basins*, WHC-SD-EN-AP-153, Rev 1, Westinghouse Hanford Company, Richland, Washington.

- Kasza, G. L., M. J. Hartman, W. A. Jordon, and D. C. Weeks, 1994, *Groundwater Maps of the Hanford Site, June 1993*, WHC-EP-0394-7, Westinghouse Hanford Co., Richland, Washington (updated semi-annually).

- Peterson, R. E., 1994, *Groundwater Monitoring Results for the 100-K Area Fuel Storage Basins: January 1 to March 31, 1994*, WHC-SD-EN-TI-280, Rev 0, Westinghouse Hanford Company, Richland, Washington.

- Johnson, V. G., C. J. Chou, and F. N. Hodges, 1994, *Some Statistical Aspects of Background Based Groundwater Standards at an Arid Hazardous Waste Site*, WHC-SA-2358-FP, Westinghouse Hanford Company, Richland, Washington; also in the proceedings of the Institute of Materials Management Annual Meeting, July 1994, Naples, Florida.

- Singleton, K. M. and K. A. Lindsey, 1994, *Groundwater Impact Assessment Report for the 216-U-14 Ditch*, WHC-EP-0698, Westinghouse Hanford Company, Richland, Washington.

- Johnson, V. G., A. G. Law, S. P. Reidel, S. D. Evelo, D. B. Barnett, and M. D. Sweeny, 1995, *Groundwater Impact Assessment Report for The 216-B-3 Pond System*, WHC-EP-0813, January, 1995, Westinghouse Hanford Company, Richland, Washington.

- Alexander, D. J., S. D. Evelo, V. G. Johnson, and M. D. Sweeney. 1995, *Groundwater Impact Assessment Report for the 216-T-4-2 Ditch*, WHC-EP-0815, February 1995, Westinghouse Hanford Company, Richland, Washington.

- Sweeney, M. D., D. J. Alexander, S. D. Evelo, K. A. Lindsey, V. M. Johnson, and K. M. Singleton, 1995, *Groundwater Impact Assessment Report for the 216-T-1 Ditch*, WHC-EP-0814, Westinghouse Hanford Company, Richland, Washington.

- Johnson, V. G., C. J. Chou, and J. W. Lindberg, 1995, *Environmental Monitoring and Assessment Plan for the 100-K Area Fuel Storage Basins*, WHC-SD-EN-AP-174, Rev 0, Westinghouse Hanford Company, Richland, Washington.

- Johnson, V. G., 1995, *Westinghouse Hanford Company Groundwater Status Report for 1993-1994*, WHC-EP-0595, (Rev. 1 in preparation), Westinghouse Hanford Company, Richland, Washington.

- Johnson, V. G., 1995, *Groundwater Monitoring Results for the 100-K Area Nuclear Fuel Storage Basins: March through December 1994*, WHC-SD-EN-TI-280, Rev. 1, Westinghouse Hanford Company, Richland, Washington.

4.0 SOIL AND VEGETATION MONITORING

4.1 INTRODUCTION

The radionuclide content of soil and vegetation was measured to evaluate long-term trends in environmental accumulation of radioactivity in the 100, 200, and 300/400 Areas. Soil and vegetation samples were collected on or near facilities that store, handle, or dispose of radioactive waste. A total of 82 soil samples (12 in the 100 N Area, 55 in the 200 Areas, and 15 in the 300/400 Areas) and 75 vegetation samples (20 in the 100 N Area, 40 in the 200 Areas, and 15 in the 300/400 Areas) were collected from locations shown in Appendix E, Figures E-1 through E-12. Collection of soil and vegetation samples near the retired 100 Areas was discontinued in 1993. Trend analysis of the data collected since 1980 indicated that migration of the contaminants was not occurring and therefore sample collection and analysis was no longer a cost effective endeavor. The analytical results of the data obtained from samples collected at the 100 N Area are presented in Tables E-1 through E-8.

Each soil sample represents a composite of five plugs of soil 2.5 cm (1 in.) in depth and 10 cm (4 in.) in diameter collected from each site. Each vegetation sample consists of new-growth leaf cuttings taken from the available species of interest at each sample location. Often, the vegetation sample collected is a composite of several like members of the sampling site community to avoid decimation of any individual plant through over-harvesting.

Early in the summer of each year, soil and vegetation samples are collected and submitted for radioanalyses. The analyses include those for radionuclides expected to be found in the areas sampled (i.e., gamma-emitting radionuclides, strontium isotopes, uranium, and/or plutonium isotopes). The results are then compared to levels found at the distant communities of Yakima and Sunnyside. These levels are derived from data reported by the Site Environmental Monitoring Program to determine the difference between contributions from site operations and contributions from natural causes and worldwide fallout. The results also are compared to soil concentration limits (Appendix J) developed for use by WHC at the Hanford Site.

Radioactive soil concentration limits for WHC are established to ensure that effective dose equivalents (EDE) to the public do not exceed the established limits for any reasonable scenario (such as direct exposure, inadvertent ingestion, inhalation, and ingestion as food crops, including animal products). Conservatism inherent in pathway programming ensures that the required degrees of protection are in place. The concentration limits specified apply to the Hanford Site with respect to onsite disposal operations, stabilization and cleanup, decontamination and decommissioning operations, and certification of soils.

Special investigative soil and biota (plant and animal) samples are collected for site-specific monitoring or whenever radiological contamination is known or suspected to have occurred. These special samples are discussed in Section 8.0.

4.2 SOIL SAMPLING, 1994

4.2.1 100 N Area

Surface soil samples collected near the 1301-N LWDF contain radionuclides that were typically present in the effluent stream discharge. Generally, the samples collected near this facility exhibit relatively higher radionuclide concentrations than those collected at the seven other locations at 100 N. Average radionuclide concentrations detected in the surface soil samples near the 1301-N LWDF from 1980 through 1993 are presented in Table 4-1. Average radionuclide concentrations detected in the surface soil samples collected in the 100 N Area from 1980 through 1993 are presented in Table 4-2. The 1994 maximum average, distant community, and accessible soil concentration limits are compared in Table 4-3.

4.2.1.1 Cobalt-60. The highest ^{60}Co result was found at Site 3 [Electronic Data Processing (EDP) code Y603], located near the 1301-N LWDF. The ^{60}Co concentration was 1.3 E+01 $\pm$10% pCi/g. The distant community average for ^{60}Co pCi/g was not reported in the *Hanford Site Environmental Report for Calendar Year 1994* (Dirkes and Hanf 1995). The average concentration of ^{60}Co in soils in the 100 N Area was 1.6 E+00 $\pm$127% pCi/g.

4.2.1.2 Cesium-137. The highest ^{137}Cs result was found at Site 3 (EDP Code Y603), located near the 1301-N LWDF. The ^{137}Cs concentration was 4.0 E+00 $\pm$10% pCi/g, or 10 times greater than the distant community measured concentration of 4.6 E-01 $\pm$7% pCi/g reported in the *Hanford Site Environmental Report for Calendar Year 1994* (Dirkes and Hanf 1995). The average concentration of ^{137}Cs in soils in the 100 N Area was 8.1 E-01 $\pm$ 81% pCi/g.

4.2.1.3 Strontium-90. The highest ^{90}Sr result was found at Site 3 (EDP Code Y603), located near the 1301-N LWDF. The ^{90}Sr concentration was 9.0 E-01 $\pm$19% pCi/g, or 10 times greater than the distant community measured concentration of 9.4 E-02 $\pm$11% pCi/g reported in the *Hanford Site Environmental Report for Calendar Year 1994* (Dirkes and Hanf 1995). The average concentration of ^{90}Sr in soil in the 100 N Area was 1.9 E-01 $\pm$78% pCi/g.

4.2.1.4 Plutonium 239/240. The highest $^{239/240}Pu$ result was found at Site 3 (EDP Code Y603), located near the 1301-N LWDF. The $^{239/240}Pu$ concentration was 7.8 E-02 $\pm$13.1% pCi/g, or 7 times greater than the distant community measured concentration of 1.1 E-02 $\pm$9% pCi/g reported in the *Hanford Site Environmental Report for Calendar Year 1994* (Dirkes and Hanf 1995). The average concentration of $^{239/240}Pu$ in soil in the 100 N Area was 1.6 E-02 $\pm$ 80.9% pCi/g.

Table 4-1. Average Radionuclide Concentrations Detected in Soil Samples Near the 1301-N Liquid Waste Disposal Facility from 1980 through 1994 (pCi/g).

Year	^{60}Co	^{90}Sr	^{137}Cs	^{238}Pu	$^{239,240}Pu$
1980	1.3 E+01	3.5 E-01	4.1 E+00	NR	2.5 E-02
1981	4.0 E+00	7.0 E-01	6.1 E+00	NR	4.4 E-02
1982	6.3 E+00	2.7 E-01	2.7 E+00	NR	1.8 E-02
1983	5.4 E+00	1.3 E+00	3.8 E+00	NR	4.3 E-02
1984	2.8 E+00	2.1 E-01	1.1 E+00	NR	1.7 E-02
1985	1.3 E+01	6.5 E-01	3.9 E+00	NR	3.2 E-02
1986	4.5 E+00	2.2 E-01	2.5 E+00	NR	1.7 E-02
1987	5.1 E+00	3.4 E-01	1.6 E+00	5.4 E-03	2.2 E-02
1988	7.8 E+00	3.5 E-01	2.0 E+00	2.3 E-03	1.7 E-02
1989	2.3 E+00	1.5 E-01	5.0 E-01	6.4 E-03	4.0 E-02
1990	4.7 E+00	3.2 E-01	1.7 E+00	4.6 E-03	3.5 E-02
1991	1.3 E+01	2.7 E-01	1.3 E+00	7.7 E-03	5.3 E-02
1992	6.7 E+00	2.2 E-01	1.1 E+00	3.5 E-03	2.3 E-02
1993	1.0 E+00	8.7 E-01	6.2 E+00	1.3 E-02	6.9 E-02
1994	3.7 E+00	3.3 E-01	1.5 E+00	9.3 E-03	2.8 E-02

NR = Not reported

Table 4-2. Average Radionuclide Concentrations Detected in 100 N Area Surface Soil Samples from 1980 through 1994 (pCi/g).

Year	^{60}Co	^{90}Sr	^{137}Cs	^{238}Pu	$^{239,240}Pu$
1980	8.5 E-01	1.8 E-01	5.0 E-01	NR	1.8 E-02
1981	1.3 E+00	2.1 E-01	1.0 E+00	NR	1.1 E-02
1982	1.6 E+00	9.9 E-02	3.4 E-01	NR	5.0 E-03
1983	2.7 E+00	2.9 E-01	4.4 E-01	NR	8.5 E-03
1984	8.8 E-01	2.8 E-01	6.2 E-01	NR	1.4 E-02
1985	1.2 E+00	1.3 E-01	5.2 E-01	NR	1.3 E-02
1986	4.1 E-01	8.3 E-02	5.0 E-01	NR	8.2 E-03
1987	4.1 E-01	1.1 E-01	3.9 E-01	1.1 E-03	6.7 E-03
1988	3.4 E-01	1.6 E-01	3.9 E-01	4.5 E-04	9.5 E-03
1989	1.4 E-01	2.1 E-01	1.3 E-01	1.1 E-03	1.3 E-02
1990	3.0 E-01	1.2 E-01	4.4 E-01	6.7 E-04	1.0 E-02
1991	4.3 E-01	1.1 E-01	4.5 E-01	6.2 E-04	7.8 E-03
1992	8.6 E-02	9.5 E-02	3.6 E-01	5.1 E-04	7.6 E-03
1993	3.0 E-02	1.2 E-01	1.6 E-01	1.8 E-04	3.4 E-03
1994	1.6 E+00	1.9 E-01	8.1 E-01	4.2 E-03	61.6 E-02

NR = Not reported.

4.2.1.5 **Uranium.** The highest total uranium was found at Site 1 (EDP Code Y601), located near the 1301-N LWDF. The uranium concentrations were 1.4 E-01 ±13.1% pCi/g for ^{234}U, 4.1 E-03 ±55.3% pCi/g for ^{235}U, and 1.3 E-01 ±13.3% pCi/g for ^{238}U or 2.7 E-01 pCi/g uranium total. The total uranium concentration was 3 times less than the distant community concentration of 9.0 E-01 ±133% pCi/g reported in the *Hanford Site Environmental Report for Calendar Year 1994* (Dirkes and Hanf 1995). The average concentration for total uranium in soil in the 100 N Area was 1.5 E-01 ±20% pCi/g.

4.2.2 200 Areas

Soil samples from 55 of 110 sample locations were collected in 1994. Radionuclide concentrations are listed in Appendix E, Table E-2. The following sections are a discussion of the highest analytical result for specific radionuclides and a comparison to the offsite average as measured by PNL. Maximum, average, distant community, and accessible soil concentration limits are compared in Table 4-4.

Table 4-3. 100 N Area Soils (pCi/g).

	^{60}Co	^{137}Cs	^{90}Sr	$^{239/240}Pu$	^{234}U	^{235}U	^{238}U
Maximum ± Counting Error(%)	Site 3	Site 3	Site 3	Site 3	Site 1	Site 3	Site 1
	1.3 E+01 ± 10%	4.0 E+01 ± 10%	8.0 E-01 ± 19%	7.8 E-01 ± 13%	1.4 E-01 ± 13%	7.6 E-03 ± 37%	1.3 E-01 ± 13%
Average ± 2SEM(%)	1.6 E+00 ± 127%	8.1 E-01 ± 81%	1.9 E-01 ± 78%	1.6 E-02 ± 81%	7.7 E-02 ± 17%	3.7 E-03 ± 29%	8.0 E-02 ± 15%
PNL Distant Community Average ± 2SEM (%)	NR	4.6 E-01 ± 7%	9.0 E-02 ± 11%	1.0 E-02 ± 9%	NR	1.7 E-01 ± 92%	8.1 E-01 ± 140%
Accessible soil concentration limits	7.1 E+00	3.0 E+01	2.8 E+03	1.9 E+02	6.3 E+02	1.7 E+02	3.7 E+02

2SEM = 2 standard error of the mean.
NR = Not reported.

Table 4-4. 200 Area Soils (pCi/g).

	^{60}Co	^{137}Cs	^{90}Sr	$^{239/240}Pu$	^{234}U	^{235}U	^{238}U
Maximum ± Counting Error(%)	Site 18	Site 30	Site 64	Site 44	Site 30	Site 30	Site 30
	2.4 E-02 ± 42%	6.3 E+01 ± 10%	5.8 E+00 ± 18%	1.0 E+00 ± 27%	6.5 E-01 ± 11%	3.3 E-02 ± 22%	6.9 E-01 ± 11%
Average ± 2SEM(%)	2.1 E-03 ± 119%	3.7 E+00 ± 76%	5.1 E-01 ± 50%	6.3 E-02 ± 62%	1.3 E-01 ± 15%	6.1 E-03 ± 19%	1.4 E-01 ± 16%
PNL Distant Community Average ± 2SM(%)	NR	4.6 E-01 ± 7%	9.0 E-02 ± 11%	1.0 E-02 ± 9%	NR	1.7 E-01 ± 92%	8.1 E-01 ± 140%
Accessible soil concentration limits for area of sample results	7.1 E+00	3.0 E+01	2.8 E+03	1.9 E+02	6.3 E+02	1.7 E+02	3.7 E+02

2SEM = 2 standard error of the mean.
NR = Not reported.

4.2.2.1 Cobalt-60. The highest ^{60}Co result was found at Site 18 (EDP Code D018), located southwest of the 207-T Basin. The ^{60}Co concentration was 2.4 E-02 ±42% pCi/g. The distant community average for ^{60}Co pCi/g was not reported in the *Hanford Site Environmental Report for Calendar Year 1994* (Dirkes and Hanf 1995). The average concentration of ^{60}Co in soils in the 200 Areas was 2.1 E-03 ±119% pCi/g.

4.2.2.2 Cesium-137. The highest ^{137}Cs result was found at Site 30 (EDP Code D030), located southwest of the 216-U-14 Ditch. The ^{137}Cs concentration was 6.3 E+01 ±10% pCi/g, or 136 times the distant community measured concentration of 4.6 E-01 ±7% pCi/g reported in the *Hanford Site Environmental Report for Calendar Year 1994* (Dirkes and Hanf 1995). The average concentration of ^{137}Cs in soils in the 200 Areas was 3.7 E+00 ± 76% pCi/g.

4.2.2.3 Strontium-90. The highest ^{90}Sr result was found at Site 64 (EDP Code D064), located southwest of the 241-C Tank Farm. The ^{90}Sr concentration was 5.3 E+00 ±18% pCi/g, or 64 times the distant community measured concentration of 9.0 E-02 ±11% pCi/g reported in the *Hanford Site Environmental Report for Calendar Year 1994* (Dirkes and Hanf 1995). The average concentration of ^{90}Sr in soil in the 200 Areas was 5.1 E-01 ± 50% pCi/g.

4.2.2.4 Plutonium-239/240. The highest $^{239/240}Pu$ result was found at Site 44 (EDP Code D044), located west of the 216-U-1 and -2 Crib. The $^{239/240}Pu$ concentration was 1.0 E+00 ±27% pCi/g, or 100 times the distant community measured concentration of 1.0 E-02 ±9% pCi/g reported in the *Hanford Site Environmental Report for Calendar Year 1994* (Dirkes and Hanf 1995). The average concentration of $^{239/240}Pu$ in soil in the 200 Areas was 6.3 E-02 ± 62% pCi/g.

4.2.2.5 Uranium. The highest total uranium was found at Site 30 (EDP Code D030), located west of the 216-U-14 Ditch. The uranium concentrations were 6.5 E-01 ±11% pCi/g for ^{234}U, 3.3 E-02 ±22% pCi/g for ^{235}U, and 6.9 E-01 ±11% pCi/g for ^{238}U or 1.3 E+00 ±11% pCi/g uranium total. The total uranium concentration was 1.4 times the distant community concentration of 9.6 E-01 ±133% pCi/g reported in the *Hanford Site Environmental Report for Calendar Year 1994* (Dirkes and Hanf 1995). ^{234}U was not reported by PNL. The average concentration for total uranium in soil in the 200 Areas was 2.7 E-01 ±15% pCi/g.

4.2.3 300/400 Areas

This was the fourth year of sampling from locations established to monitor the near-field in the 300/400 Areas. Soil samples from 15 sample locations were collected in 1994, 14 from the 300 Area, and 1 from the 400 Area. Radionuclide concentrations are listed in Appendix E, Table E-4. Maximum, average, distant community, and accessible soil concentration limits are compared in Table 4-5.

Table 4-5. 300/400 Areas Soil Sample (pCi/g).

	^{60}Co	^{137}Cs	^{90}Sr	$^{239/240}Pu$	^{234}U	^{235}U	^{238}U
Maximum ± Counting Error(%)	Site S-6	Site S-6	Site S-6	Site S-7	Site S-7	Site S-5	Site S-7
	1.0 E-01 ± 20%	7.8 E-01 ± 11%	1.6 E-01 ± 20%	5.6 E-01 ± 11%	4.2 E+01 ± 12%	2.4 E+00 ± 13%	4.9 E+01 ± 12%
Average ± 2SEM(%)	7.8 E-03 ± 156%	2.1 E-01 ± 38%	5.5 E-02 ± 37%	8.4 E-02 ± 85%	6.1 E+00 ± 86%	3.1 E-01 ± 96%	6.3 E+00 ± 92%
PNL Distant Community average ± 2SEM(%)	NR	4.6 E-01 ± 7%	9.0 E-02 ± 11%	1.0 E-02 ± 9%	NR	1.7 E-01 ± 92%	8.1 E-01 ± 140%
Accessible soil concentration limits	7.1	30	2,800	190	630	170	370

2SEM = 2 standard error of the mean.
NR = Not reported.

4.2.3.1 Cobalt-60. The highest ^{60}Co result that was above the overall counting error was found at Site S-6 (EDP Code D121), located northeast of the 316-1 Process Pond. The ^{60}Co concentration was 1.0 E-01 ±20% pCi/g. The distant community concentration of ^{60}Co was not reported in the *Hanford Site Environmental Report for Calendar Year 1994* (Dirkes and Hanf 1995). The average concentration of ^{60}Co in soil in the 300/400 Areas was 7.8 E-03 ± 156% pCi/g.

4.2.3.2 Cesium-137. The highest ^{137}Cs result was found at Site S-6 (EDP Code D121), located northeast of the 316-1 Process Pond. The ^{137}Cs concentration was 7.8 E-01 ±11% pCi/g, and was not significantly different than the distant community measured concentration of 4.6 E-01 ±7% pCi/g reported in the *Hanford Site Environmental Report for Calendar Year 1994* (Dirkes and Hanf 1995). The average concentration of ^{137}Cs in soil in the 300/400 Areas was 2.1 E-01 ±38% pCi/g.

4.2.3.3 Strontium-90. The highest ^{90}Sr result was found at Site S-6 (EDP Code D121), located northeast of the 316-1 Process Pond. The ^{90}Sr concentration was 1.6 E-01 ±20% pCi/g, and was not significantly different than the distant community measured concentration of 9.0 E-02 ±11% pCi/g reported in the *Hanford Site Environmental Report for Calendar Year 1994* (Dirkes and Hanf 1995). The average concentration of ^{90}Sr in soil in the 300/400 Areas was 5.5 E-02 ±37% pCi/g.

4.2.3.4 Plutonium-239/240. The highest $^{239/240}Pu$ result was found at Site S-7 (EDP Code D122), located south of the 316-1 Process Pond. The $^{239/240}Pu$ concentration was 5.6 E-01 ±11% pCi/g, or 50 times the distant community measured concentration of 1.0 E-02 ±9% pCi/g reported in the *Hanford Site Environmental Report for Calendar Year 1994* (Dirkes and Hanf 1995). The average concentration of $^{239/240}Pu$ in soil in the 300/400 Areas was 8.4 E-02 ±85% pCi/g.

4.2.3.5 Uranium. The highest uranium result was found at Site S-7 (EDP Code D122), located south of the 316-1 Process Pond. The uranium concentrations were 4.2 E+01 ±12% pCi/g for ^{234}U, 2.4 E+00 ±13% pCi/g for ^{235}U, and 4.9 E+01 ±12% pCi/g for ^{238}U or 9.3 E+01 ±12% pCi/g uranium total. The total uranium concentration was 51 times the distant community concentration of 9.6 E-01 ±133% pCi/g reported in the *Hanford Site Environmental Report for Calendar Year 1994* (Dirkes and Hanf 1995). ^{234}U and ^{235}U were not reported separately by PNL. The average concentration of total uranium in soil in the 300/400 Areas was 1.2 E+01 ±87% pCi/g.

4.3 VEGETATION SAMPLING, 1994

4.3.1 100 Area

Vegetation samples collected near the 1301-N and 1325-N LWDFs contain radionuclides that were typically present in the effluent stream discharge. The samples collected near the 1301-N facility exhibit higher radionuclide concentrations than those collected at the other locations at 100 N. These significant increases are likely attributable to uptake of the contaminants by the deep-rooted vegetation nearest the facility (sample locations 2 and 3) (Appendix E, Figure E-7). Although these levels of contaminant concentrations

are low, the increase from previous years' averages merits closer observation of the trend in contaminant concentrations at all 100 N Area sampling sites to better determine the cause of the increases. Average radionuclide concentrations detected in the vegetation samples near the 1301-N LWDF from 1980 through 1994 are presented in Table 4-6. Average radionuclide concentrations detected in the vegetation samples collected in the 100 N Area from 1980 through 1994 are presented in Table 4-7.

Table 4-6. Average Radionuclide Concentrations Detected in Vegetation Samples Near the 1301-N Liquid Waste Disposal Facility from 1980 to 1994 (pCi/g).

Year	^{60}Co	^{90}Sr	^{137}Cs	^{238}Pu	$^{239,240}Pu$
1980	4.0 E+00	NR	1.1 E+00	NR	NR
1981	1.2 E+01	1.8 E+00	1.8 E+00	NR	7.1 E-03
1982	1.6 E+00	1.2 E-01	2.6 E-01	NR	2.6 E-03
1983	1.9 E+00	6.0 E-01	3.9 E-01	NR	3.2 E-03
1984	1.0 E+00	1.2 E-01	8.3 E-02	NR	8.5 E-04
1985	1.7 E+00	1.9 E+00	1.0 E-01	NR	1.5 E-03
1986	3.5 E+00	7.3 E-02	6.5 E-01	NR	2.6 E-03
1987	2.8 E+00	6.3 E-02	2.0 E-01	1.2 E-03	5.6 E-03
1988	2.0 E+00	1.2 E-01	1.3 E-01	4.3 E-04	1.7 E-03
1989	1.3 E+00	3.8 E-02	1.5 E-01	2.8 E-04	2.0 E-03
1990	1.3 E+00	3.1 E-02	1.2 E-01	2.7 E-04	1.1 E-03
1991	6.3 E-01	1.5 E-02	6.0 E-01	8.1 E-05	1.2 E-03
1992	2.0 E-01	6.5 E-03	2.0 E-01	-2.8 E-05	1.6 E-04
1993	2.2 E-01	5.7 E-02	2.1 E-01	-7.8 E-04	4.1 E-04
1994	2.5 E+01	4.8 E+00	1.8 E+00	3.3 E-02	2.0 E-01

NR = Not reported.
Negative value indicates results at or below background levels of radioactivity.

Table 4-7. Average Radionuclide Concentrations Detected in 100 N Vegetation Samples from 1980 to 1994 (pCi/g).

Year	^{60}Co	^{90}Sr	^{137}Cs	^{238}Pu	$^{239,240}Pu$
1980	1.0 E+00	NR	2.8 E-01	NR	NR
1981	2.5 E+01	5.8 E-01	7.1 E-01	NR	2.1 E-02
1982	1.5 E+00	2.0 E-01	1.3 E-01	NR	7.8 E-03
1983	1.0 E+00	2.9 E-01	9.0 E-02	NR	8.6 E-03
1984	4.6 E-01	8.1 E-02	9.0 E-02	NR	1.3 E-03
1985	1.4 E+00	5.1 E-02	1.6 E-01	NR	8.7 E-04
1986	9.5 E-01	2.2 E-01	7.9 E-01	NR	1.1 E-03
1987	7.0 E-01	2.6 E-01	9.4 E-02	1.3 E-04	5.7 E-04
1988	8.0 E-01	2.5 E-01	1.6 E-01	1.7 E-04	6.6 E-04
1989	3.2 E-01	6.8 E-02	1.5 E-01	1.1 E-04	8.7 E-04
1990	1.1 E-01	9.3 E-03	3.6 E-02	-9.6 E-05	1.7 E-04
1991	1.3 E-01	9.4 E-03	3.4 E-03	1.6 E-04	2.5 E-03
1992	5.6 E-02	5.6 E-02	7.8 E-02	-5.2 E-06	1.3 E-04
1993	1.0 E-01	3.6 E-02	6.5 E-02	-5.2 E-05	3.3 E-04
1994	6.5 E+00	2.5 E+01	5.8 E-01	8.6 E-03	5.3 E-02

NR = Not reported.
Negative value indicates results at or below background levels of radioactivity.

Vegetation samples collected along the 100 N Area shoreline (N Springs) contain radionuclides that were not completely retained in the soil columns beneath the 1301/1325-N LWDFs. Biotransport via root uptake of ^{60}Co, ^{90}Sr, and ^{137}Cs was evident in the reed canary grass samples collected from this region. Most notable were the average levels of ^{90}Sr, which exhibited concentrations two to four orders of magnitude higher than the offsite average. Average radionuclide concentrations detected in the vegetation samples collected along the N Springs from 1980 through 1994 are presented in Table 4-8.

Table 4-8. Radionuclide Concentrations Detected in N Springs Vegetation Samples from 1980 to 1994 (pCi/g).

Year	^{60}Co	^{90}Sr	^{137}Cs	^{238}Pu	$^{239,240}Pu$
1980	5.6 E+00	NR	4.4 E-01	NR	NR
1981	3.3 E+00	2.0 E+02	NR	NR	3.7 E-03
1982	2.8 E+00	4.8 E+02	NR	NR	8.3 E-03
1983	3.0 E+00	3.3 E+02	4.0 E-02	NR	8.0 E-03
1984	NS	NS	NS	NS	NS
1985	1.2 E+00	4.2 E+02	1.7 E-01	NR	4.4 E-04
1986	1.1 E+00	2.2 E+02	2.1 E-01	NR	4.2 E-04
1987	9.0 E-01	2.9 E+02	1.1 E-01	-1.3 E-04	7.6 E-04
1988	1.4 E+00	1.2 E+02	2.0 E-01	8.5 E-05	2.0 E-04
1989	4.3 E-01	8.0 E+01	1.5 E-01	1.1 E-03	4.5 E-04
1990	NS	NS	NS	NS	NS
1991	1.5 E-01	3.1 E+01	1.6 E-01	1.2 E-04	2.9 E-03
1992	4.2 E-02	7.8 E+01	3.0 E-01	1.5 E-04	2.9 E-04
1993	4.5 E-01	2.6 E+02	2.0 E-01	2.3 E-03	-8.5 E-04
1994	1.4 E-01	6.0 E+01	1.5 E-01	3.6 E-04	2.0 E-03

NR = Not reported.
NS = No sample results.
Negative value indicates results at or below background levels of radioactivity.

4.3.1.1 Cobalt-60. The highest ^{60}Co result was found at Site 3 (EDP Code Y703), located near the 1301-N LWDF. The ^{60}Co concentration was 7.9 E+01 ± 10% pCi/g. The distant community average for ^{60}Co was not reported in the *Hanford Site Environmental Report for Calendar Year 1994* (Dirkes and Hanf 1995). The average concentration of ^{60}Co in vegetation in the 100 N Area was 6.5 E+00 ± 132% pCi/g.

4.3.1.2 Cesium-137. The highest ^{137}Cs result was found at Site 3 (EDP Code Y703), located near the 1301-N LWDF. The ^{137}Cs concentration was 4.1 E+00 ± 14% pCi/g. The distant community average concentration for ^{137}Cs was not reported in the *Hanford Site Environmental Report for Calendar Year 1994* (Dirkes and Hanf 1995). The average concentration of ^{137}Cs in vegetation in the 100 N Area was 5.8 E-01 ± 90% pCi/g.

4.3.1.3 Strontium-90. The highest ^{90}Sr result was found at Site 20 (EDP Code Y720), located at the east end of the N Springs shoreline area. The ^{90}Sr concentration was 3.4 E+02 ± 17% pCi/g, or 21,000 times the distant community measured concentration of 1.6 E-02 ± 19% pCi/g reported in the *Hanford Site Environmental Report for Calendar Year 1994* (Dirkes and Hanf 1995).

The average concentration of ^{90}Sr in vegetation in the 100 N Area was 2.5 E+01 ±129% pCi/g.

4.3.1.4 Plutonium 239/240. The highest $^{239/240}Pu$ result was found at Site 2 (EDP Code Y702), located near the 1301-N LWDF. The $^{239/240}Pu$ concentration was 6.9 E-01 ±11% pCi/g, or 4,000 times greater than the distant community measured concentration of 1.8 E-04 ±72% pCi/g reported in the *Hanford Site Environmental Report for Calendar Year 1994* (Dirkes and Hanf 1995). The average concentration of $^{239/240}Pu$ in vegetation in the 100 N Area was 5.3 E-02 ±135% pCi/g.

4.3.1.5 Uranium. The highest total uranium was found at Site 15 (EDP Code Y715), located near the west end of the N Springs shoreline area. The uranium concentrations were 1.4 E-01 ±14% pCi/g for ^{234}U, 7.8 E-03 ±48% pCi/g for ^{235}U, and 1.1 E-01 ±15% pCi/g for ^{238}U or 2.6 E-01 pCi/g uranium total. The concentration of ^{238}U was 16 times the distant community concentration of 9.0 E-03 ±75% pCi/g reported in the *Hanford Site Environmental Report for Calendar Year 1994* (Dirkes and Hanf 1995). The concentration of ^{235}U was not reported by PNL. The average concentration for total uranium in vegetation in the 100 N Area was 2.8 E-02 ±47% pCi/g.

4.3.1.6 Comparisons. The maximum, average, distant community, and guide values for posting surface contamination area for 100 Area vegetation are compared in Table 4-9.

4.3.2 200 Areas

In 1994, 40 vegetation samples were taken. Radionuclide concentrations for all sites sampled are listed in Table E-2 (Appendix E). The following sections provide more detailed discussions of the highest results for specific radionuclides.

4.3.2.1 Cobalt-60. The highest ^{60}Co result above the counting error was found at Site 84 (EDP Code V084), located near the 216-N-6. The ^{60}Co concentration was 1.8 E-01 ±96% pCi/g. The distant community concentration of ^{60}Co was not reported in the *Hanford Site Environmental Report for Calendar Year 1994* (Dirkes and Hanf 1995). The average concentration of ^{60}Co in vegetation in the 200 Areas was 1.1 E-02 ±171% pCi/g.

4.3.2.2 Cesium-137. The highest ^{137}Cs result was found at Site 25 (EDP Code V025), located near the headend of the 216-T-1 Ditch. The ^{137}Cs concentration was 5.0 E+00 ±18% pCi/g. The distant community measured concentration of ^{137}Cs was not reported in the *Hanford Site Environmental Report for Calendar Year 1994* (Dirkes and Hanf 1995). The average concentration of ^{137}Cs in vegetation in the 200 Areas was 4.2 E-01 ± 112% pCi/g.

4.3.2.3 Strontium-90. The highest ^{90}Sr result was found at Site 25 (EDP Code V025), located near the head end of the 216-T-1 Ditch. The ^{90}Sr concentration was 5.0 E+00 ±18% pCi/g, or 310 times the distant community measured concentration of 1.6 E-02 ±19% pCi/g reported in the *Hanford Site Environmental Report for Calendar Year 1994* (Dirkes and Hanf 1995). The average concentration of ^{90}Sr in vegetation in the 200 Areas was 6.2 E-01 ±55% pCi/g.

Table 4-9. 100 Areas Vegetation (pCi/g).

	^{60}Co	^{137}Cs	^{90}Sr	$^{239/240}Pu$	^{234}U	^{235}U	^{238}U
Maximum ± Counting Error(%)	Site 3	Site 3	Site 20	Site 2	Site 15	Site 15	Site 15
	7.9 E+01 ± 10%	4.1 E+00 ± 14%	3.4 E+02 ± 17%	6.9 E-01 ± 11%	1.4 E-01 ± 14%	7.8 E-03 ± 40%	1.1 E-01 ± 15%
Average ± 2SEM(%)	6.5 E+00 ± 132%	5.8 E-01 ± 90%	2.5 E+01 ± 129%	5.3 E-02 ± 135%	4.4 E-02 ± 41%	1.4 E-02 ± 62%	3.9 E-02 ± 39%
PNL Distant Community Average ± 2SEM(%)	NR	NR	1.6 E-02 ± 19%	1.8 E-04 ± 72%	3.9 E-03 ± 99%	NR	5.1 E-03 ± 60%
Guide for posting surface contamination	7.1 E+00	3.0 E+01	2.8 E+03	1.9 E+02	6.3 E+02	1.7 E+02	3.7 E+02

NR = Not reported.
2SEM = 2 standard error of the mean.

4.3.2.4 Plutonium-239/240. The highest $^{239/240}Pu$ result was found at Site 78 (EDP Code V-078), located south of 216-A-10 Crib. The $^{239/240}Pu$ concentration was 2.9 E-01 ±11% pCi/g, or 1,600 times greater than the distant community measured concentration of 1.8.E-04 ±72% pCi/g reported in the *Hanford Site Environmental Report for Calendar Year 1994* (Dirkes and Hanf 1995). The average concentration of $^{239/240}Pu$ in vegetation in the 200 Areas was 1.4 E-02 ±99% pCi/g.

4.3.2.5 Uranium. The highest uranium result was found at Site 94 (EDP Code V-094) located near the 216-A-37-2 Crib. The uranium concentrations were 2.1 E-01 ±13% pCi/g for ^{234}U, 7.8 E-03 ±47% pCi/g for ^{235}U, and 2.2 E-01 ±12% pCi/g for ^{238}U or 4.3 E-01 ±13% pCi/g total uranium. The total isotopic uranium concentration was 48 times the distant community measured concentration of 9.0 E-03 ±80% pCi/g reported in the *Hanford Site Environmental Report for Calendar Year 1994* (Dirkes and Hanf 1995). The concentration of ^{235}U was not reported. The average concentration of total uranium in vegetation in the 200 Areas was 6.6 E-03 ±50% pCi/g.

4.3.2.6 Comparisons. The maximum, average, distant community, and guide values for posting surface contamination area are compared for 200 Areas vegetation in Table 4-10.

4.3.3 300/400 Areas

This was the fourth year of sampling from locations established to more directly monitor facilities and active/inactive waste sites. In 1994, 17 vegetation samples were taken from 14 locations in the 300 Area and one in the 400 Area. Radionuclide concentrations for all sites sampled are listed in Appendix E, Table E-9. The following sections provide more detailed discussions of the highest results for specific radionuclides.

4.3.3.1 Cobalt-60. The highest ^{60}Co result was found at Site V-13 (EDP Code V127), located northwest of the 618-9 Burial Ground. The ^{60}Co concentration was 6.8 E-02 ±92% pCi/g. The distant community measured concentration for ^{60}Co was not reported in the *Hanford Site Environmental Report for Calendar Year 1994* (Dirkes and Hanf 1995). The average concentration of ^{60}Co in vegetation in the 300/400 Areas was 7.7 E-03 ±350% pCi/g.

4.3.3.2 Cesium-137. The highest ^{137}Cs result was found at Site V-01 (EDP Code V130), a duplicate sample located near the northeast corner of the 618-4 Burial Ground. The ^{137}Cs concentration was not reported for the distant community in the *Hanford Site Environmental Report for Calendar Year 1994* (Dirkes and Hanf 1995). The average concentration of ^{137}Cs in vegetation in the 300/400 Areas was 3.0 E-02 ±70% pCi/g.

4.3.3.3 Strontium-90. The highest ^{90}Sr result was found at Site V-15 (EDP Code V129), located near the 400 Area Process Pond. The ^{90}Sr concentration was 1.0 E-01 ±28% pCi/g, or 6 times the distant community measured concentration of 1.6 E-02 ±19% pCi/g reported in the *Hanford Site Environmental Report for Calendar Year 1994* (Dirkes and Hanf 1995). The average concentration of ^{90}Sr in vegetation in the 300/400 Areas was 3.4 E-02 ±70% pCi/g.

Table 4-10. 200 Areas Vegetation (pCi/g).

	^{60}Co	^{137}Cs	^{90}Sr	$^{239/240}Pu$	^{234}U	^{235}U	^{238}U
Maximum ± Counting Error(%)	Site 84	Site 25	Site 25	Site 78	Site 94	Site 47	Site 94
	1.8 E-01 ± 96%	9.7 E+00 ± 12%	5.0 E+00 ± 18%	2.9 E-01 ± 11%	2.1 E-01 ± 13%	7.8 E-03 ± 47%	2.2 E-01 ± 12%
Average ± 2SEM(%)	1.1 E-02 ± 171%	4.2 E-01 ± 19%	6.2 E-01 ± 55%	1.4 E-02 ± 99%	3.3 E-02 ± 48%	1.2 E-03 ± 69%	3.2 E-02 ± 51%
PNL Distant Community Average ± 2SEM(%)	NR	NR	1.6 E-02 ± 19%	1.8 E-04 ± 72%	3.9 E-03 ± 99%	NR	5.1 E-03 ± 60%
Guide for posting surface contaminatio n	7.1 E+00	3.0 E+01	2.8 E+03	1.9 E+02	6.3 E+02	1.7 E+02	3.7 E+02

NR = Not reported.
2SEM = 2 standard error of the mean.

4.3.3.4 Plutonium 239/240. The highest $^{239/240}Pu$ result was found at Site V-08 (EDP Code V122), located near the south corner of the 316-3 Process Pond. The $^{239/240}Pu$ concentration was 4.3 E-03 ±22% pCi/g, or 24 times the distant community measured concentration of 1.8 E-04 ±72% pCi/g reported in the *Hanford Site Environmental Report for Calendar Year 1994* (Dirkes and Hanf 1995). The average concentration of $^{239/240}Pu$ in vegetation in the 300/400 Areas was 7.3 E-04 ±66% pCi/g.

4.3.3.5 Uranium. The highest uranium result was found at Site V-06 (EDP Code V120), located near the northeast corner of the 316-1 Process Pond. The uranium concentrations were 4.8 E-01 ±11% pCi/g of ^{234}U, 3.5 E-02 ±21% pCi/g of ^{235}U, and 5.5 E-01 ±11% pCi/g of ^{238}U or 1.1 E+00 ±11% pCi/g total isotopic uranium. The total isotopic uranium concentration was 122 times the distant community measured concentration of 9.0 E-03 ±80% pCi/g reported in the *Hanford Site Environmental Report for Calendar Year 1994* (Dirkes and Hanf 1995). The concentration of ^{235}U was not reported. The average concentration of total uranium in vegetation in the 300/400 Areas was 1.9 E-01 ±77% pCi/g.

4.3.3.6 Comparisons. The maximum, average, distant community, and guide values for posting surface contamination area are compared for 300/400 Areas vegetation in Table 4-11.

4.4 CONCLUSIONS

The impact of past and current operations on the near-field environment, although above the distant community measured concentrations as measured and reported by PNL, were well below the accessible soil concentration limits used by WHC (Appendix J, Tables J-3, J-4). Trending of the average concentrations, contained in the summary, indicate the decrease in concentrations of certain radionuclides. As the data show, the concentrations have a large degree of variance. In general, the samples collected on or directly adjacent to the waste disposal facilities had significantly higher concentrations of radionuclides than those further away. The data also show, as expected, that certain radionuclides had higher concentrations within different operating areas. Generally speaking, the predominant radionuclides are: activation products/gamma emitters in the 100 Areas, fission products in the 200 Areas, and uranium in the 300 Areas. No changes in facility or waste site operations were deemed necessary as a result of the data acquired through this year's monitoring program.

Table 4-11. 300/400 Areas Vegetation (pCi/g).

	^{60}Co	^{137}Cs	^{90}Sr	$^{239/240}Pu$	^{234}U	^{235}U	^{238}U
Maximum ± Counting Error(%)	Site V13	Site V01	Site V15	Site V08	Site V06	3.5 E-02	Site V06
	6.8 E-02 ± 92%	1.2 E-01 ± 91%	1.0 E-01 ± 28%	4.3 E-03 ± 22%	± 11%Site V-06	4.8 E-01 ± 21%	5.5 E-01 ± 11%
Average ± 2SEM(%)	7.7 E-03 ± 350%	3.0 E-2 ± 70%	3.4 E-02 ± 42%	7.3 E-04 ± 66%	9.5 E-02 ± 74%	5.2 E-03 ± 85%	7.7 E-02 ± 77%
PNL distant community measured Average ± 2SEM(%)	NR	NR	1.6 E-02 ± 19%	1.8 E-04 ± 72%	3.9 E-03 ± 99%	NR	5.1 E-03 ± 60%
Guide for posting surface contamination	7.1 E+00	3.0 E+01	2.8 E+03	1.9 E+02	6.3 E+02	1.7 E+02	3.7 E+02

NR = Not reported.
2SEM = 2 standard error of the mean.

5.0 EXTERNAL RADIATION MONITORING

5.1 INTRODUCTION

A network of thermoluminescent dosimeters (TLDs) was positioned in and around the 100, 200, and 300/400 Areas to monitor dose rates from external radiation sources (primarily gamma rays). The TLD measurements were taken to determine dose rates in the operations area environment. From these data, the contribution of Hanford Site activities to the dose rates in these areas can be discerned. Figures showing these sites and the dose analyses can be found in Appendix F.

The environmental TLDs measure dose rates from all types of external radiation sources. These include cosmic radiation, naturally occurring radioactivity in air and soil, and fallout from nuclear weapons testing, as well as any contribution from Hanford Site activities. These outside radiation sources cause an expected $\pm$20-percent deviation in TLD analyses. The results are reported in units of millirems per year (mrem/yr).

The TLDs consist of four LiF (TLD-700) and one CaF_2:Dy (TLD-200) chips in a plastic card. Each card was placed in a translucent, waterproof, plastic holder; three cards were mounted about 1 meter (3 ft) above ground at each location. The TLDs were placed at active and inactive surface-water disposal sites, and near facilities (tank farms, active cribs, and the facility fence lines). The TLDs were exchanged and analyzed each calendar quarter. Each quarterly measurement is an average of the three cards exposed at the same location. The PNL Radiation Calibration Laboratory has calibrated the response of the chips; results were reported in terms of external dose (mrem).

SECTION 5

5.2 RESULTS

5.2.1 100 Area

5.2.1.1 100 N. The 1994 TLD results indicate that the DOE exposure guidelines for nonradiation area workers (100 mrem/yr) were not exceeded in any nonradiologically controlled area except near the N Springs shoreline. Reasons for this elevated radiation level are discussed later in this section. The overall trend is that dose rates at these locations continue to decrease.

Direct radiation levels were predictably higher near facilities that had contained or received liquid effluent from N Reactor or where mixed (radiological/hazardous) waste is stored. These facilities included the 1301-N LWDF, the 1325-N LWDF, the 1304-N Emergency Dump Tank, and 116-N-8 (the 163 N Mixed Waste and Hazardous Waste Container Storage Pad).

Dose rates measured near the 1301-N LWDF in 1994 showed an annual average decrease of approximately 2 percent compared to the 1993 levels. This decline represents a continuing trend of decreased dose rates at this facility, primarily caused by the decay of ^{60}Co (5.3-year half life).

The average environmental dose rates measured near the 1325-N LWDF in 1994 were approximately 6.3 percent lower than the 1993 levels. All of the

four TLD sites at this facility showed decreases in 1994. This decline represents a trend of decreased dose rates at this facility, similar to that of the 1301-N LWDF, primarily caused by the decay of ^{60}Co.

Dose rates measured near the 1304-N EDT (Sites 7 and 29) in 1994 were approximately 17 percent lower than the 1993 levels.

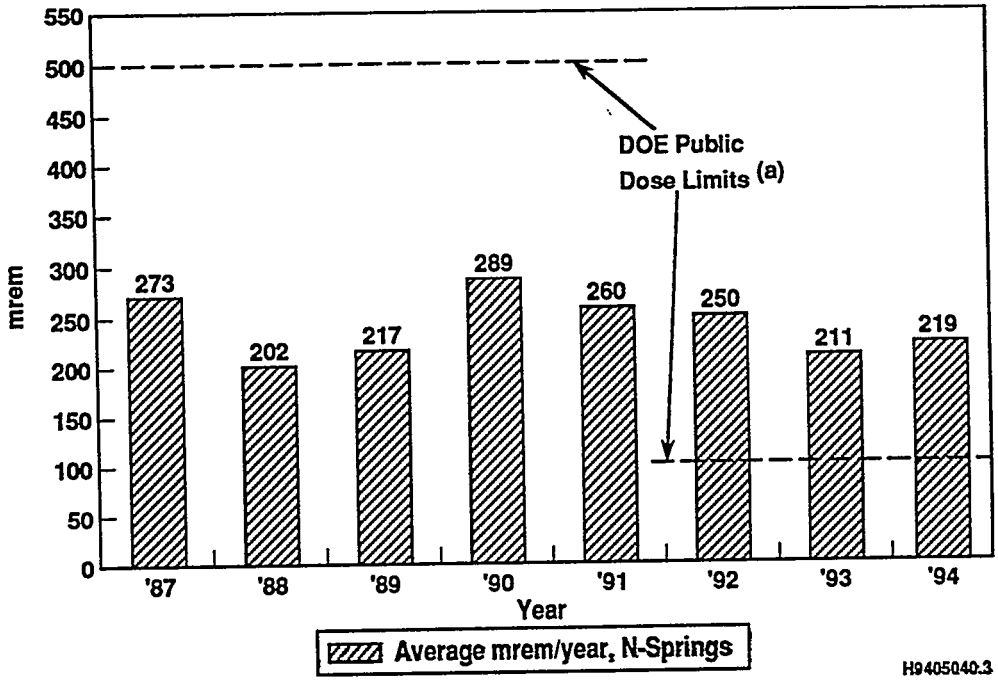
Dose rates were measured at the N Springs shoreline to determine potential external radiation doses to the public as well as to a Hanford worker. Because of the "skyshine" effect from the 1301-N LWDF, dose rates at the N Springs were elevated above 100 mrem/year, the DOE annual external dose limit to members of the public. However, neither a member of the public nor a Hanford worker would conceivably spend an entire year at the N Springs; therefore, the values shown in Figure 5-1 are for comparison purposes only. N Springs dose reduction measures are currently being studied.

Measurements obtained from TLD Site 18, when compared to 1993 levels, showed a marked decrease during 1994. This TLD site is near the 1310-N Radioactive Waste Storage Pad, which received items in late 1992 that had higher than normal dose rates. In late summer 1993, the relocation of all items in this facility began and dose rates fell far below recent levels once all of the items were removed.

The seemingly apparent increase in dose rates observed for TLD 17 was the result of its relocation in August of 1993. Previously, Site 17 was located inside the 105 N Reactor building. Site 17 is now located near 116-N-8 (163 N Mixed Waste and Hazardous Waste Container Storage Pad). The TLD measurements from the 100 N Area for 1987 through 1994 are summarized in Figure 5-2; they are compared for 1993 and 1994 in Table 5-1.

5.2.1.2 100 K. With the exception of Sites K-8, K-9, and K-10, the dose rates observed at each of the remaining TLD locations at 100 K Area were at typical Hanford background levels. Sites K-8 and K-9 are near the designated staging area for rail cars used to transport irradiated fuel from the fuel storage basin at 105 KE to the 200 Areas. TLD Site K-10 is near an area used for staging spent ion-exchange modules used in maintaining water quality levels in the 105 KE Fuel Storage Basin before they are transported.

Figure 5-1. Annual Average Dose Rate at N Springs.



(a) DOE Limits were reduced from 500 mrem/yr to 100 mrem/yr in 1992. The lower value was selected in recognition of the International Commission of Radiation Protection (ICRP) recommendation to limit the long-term average effective dose equivalent to 100 mrem (1mSv) per year or less. (DOE 5400.5)

Figure 5-2. Comparison of TLD Results at 100 N Area (1987-1994).

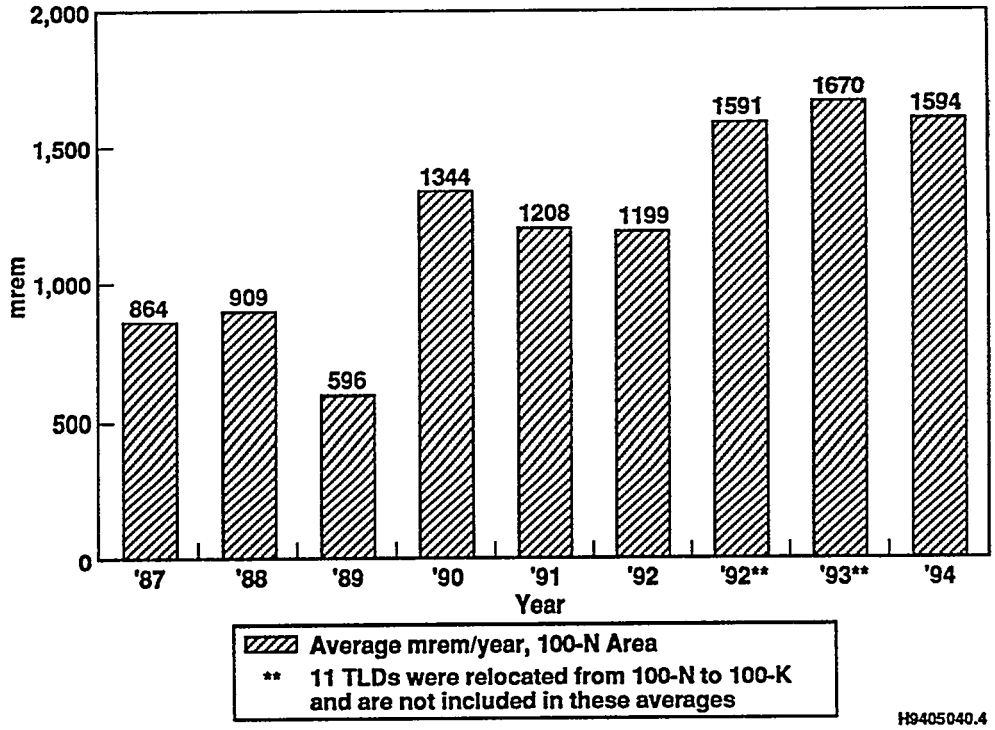


Table 5-1. 100 Areas Thermoluminescent Dosimeter Exposure Results (mrem/yr).

100 N Area Site I.D.	1993 average	1994 average	94 vs 93 % change
1	1.1E+03	1.1E+03	0%
2	1.0E+03	1.0E+03	3%
3	4.3E+02	4.3E+02	0%
4	1.8E+03	1.9E+03	4%
5	6.1E+02	6.4E+02	6%
6	2.3E+02	2.5E+02	8%
7	1.0E+03	9.9E+02	-6%
8	6.4E+01	7.3E+01	14%
10	5.5E+01	6.5E+01	18%
12	7.6E+01	8.9E+01	17%
13	1.2E+02	1.4E+02	22%
14	4.5E+02	4.2E+02	-7%
15	8.5E+02	8.2E+02	-4%
16	2.4E+02	2.6E+02	8%
17	1.1E+02	4.7E+02	338%
18	1.2E+03	4.2E+02	-66%
22	5.6E+02	5.6E+02	0%
26	2.1E+02	2.2E+02	4%
28	2.4E+02	2.3E+02	-6%
29	2.1E+03	1.6E+03	-22%
30	7.4E+03	6.9E+03	-6%
31	4.7E+02	4.4E+02	-5%
32	1.9E+02	2.1E+02	12%
33	3.3E+02	3.9E+02	17%
34	1.4E+04	1.3E+04	-7%
35	1.4E+04	1.3E+04	-8%
36	3.9E+02	3.7E+02	-4%
37	3.9E+02	3.8E+02	-4%
38	1.4E+02	1.1E+02	-22%
41	3.7E+02	3.3E+02	-10%
average	1.7E+03	1.6E+03	-7

1301-N Site I.D.	94 vs 93 % change
1	0%
2	3%
3	0%
4	4%
5	6%
6	8%
15	-4%
18	-66%
22	0%
32	12%
33	17%
average	-4%

1325-N Site I.D.	94 vs 93 % change
30	-0.06
34	-0.07
35	-0.08
36	-0.04
average	-0.0625

100 K Area Site I.D.	94 vs 93 % change
1	24%
2	6%
3	20%
4	20%
5	14%
6	10%
7	6%
8	21%
9	194%
10	4%
11	15%
average	30%

5.2.2 200 Areas

The 1994 TLD results for the 200 Areas indicated that the DOE exposure guidelines for nonradiation area workers (100 mrem/year) were not exceeded in any nonradiologically controlled areas.

5.2.2.1 External Radiation Trends, 200 Areas. Thirty-three TLD sites were removed in and around the 200 Areas because radiation sources were reduced by remediation activities and the cessation of nuclear processes. Thirty-five new sites were established to more effectively evaluate the remaining areas of concern, such as tank farm perimeters, and to assess new facilities constructed to perform tasks supporting environmental remediation, such as the Waste Sampling and Characterization Facility and the proposed Hanford Waste Vitrification Plant. Table 5-2 compares the results of the 24 TLD sites remaining the same between 1993 and 1994. Results indicated that operations in the 200 Areas did not contribute significantly to the external radiation dose rates of the general environment. The overall annual dose rate in the 200 Areas showed 92 percent increase from 1993 to 1994. Consequently, the exposure rate in the general 200 Areas environment was not significantly different from the exposure rate received off site from natural radiation sources. As expected, external radiation levels were elevated at certain sites, radiological control areas, and facilities, reflecting the proximity to radioactive waste management activities (e.g., Site 258). TLDs are relocated to measure facilities of higher impact, as was the case in 1989, when the average annual dose rate increased from 106 to 241 mrem per year, when the TLDs were removed from the grid configuration, where many were located in remote areas, to a configuration closer to operations facilities (Figure 5-3).

5.2.3 300/400 Areas

This was the fourth year of external radiation monitoring in the 300/400 Areas. Figure 5-4 graphically compares the external radiation monitoring results for 1991 through 1994. Six new TLD locations were established around the 300 Area Treated Effluent Disposal Facility. The 1994 TLD results for the 300/400 Areas indicate that the DOE exposure guidelines were not exceeded in any nonradiologically controlled area.

5.2.3.1 External Radiation Trends 300/400 Areas. Comparing the results of external monitoring for 1994 to those from 1993 indicates that the 300/400 Areas did not contribute significantly to the external radiation dose rates of the general environment, as shown in Table 5-3. Consequently, the dose rate in the general 300/400 Areas environment was not significantly different from the dose rate received off site from natural radiation sources. As expected, radiation levels were elevated at certain waste sites, radiological control areas, and facilities, reflecting the proximity to radioactive waste management activities. (Site 2, near the 437 Maintenance and Storage Facility.)

Table 5-2. 200 Area Thermoluminescent Dosimeter Comparisons for 1993 and 1994 (mrem/yr).

Site I.D.	1993 Average	1994 Average	94 vs 93 % Chan
202	9.2 E+01	1.0 E+02	10.3
203	9.6 E+01	1.0 E+02	6.8
205	9.2 E+01	9.6 E+01	4.1
208	1.7 E+02	1.8 E+02	4.6
209	9.2 E+01	9.8 E+01	7.0
210	1.2 E+02	1.2 E+02	-1.1
219	8.3 E+01	1.0 E+02	23.9
220	1.0 E+02	1.1 E+02	6.9
221	1.0 E+02	1.1 E+02	11.4
229	1.0 E+02	1.0 E+02	4.0
230	1.3 E+02	1.3 E+02	-1.8
231	9.6 E+01	1.1 E+02	17.4
234	1.1 E+02	1.2 E+02	10.1
241	1.1 E+02	1.1 E+02	1.7
242	9.6 E+01	1.1 E+02	16.9
247	8.8 E+01	1.0 E+02	13.5
250	1.5 E+02	1.5 E+02	-0.2
252	1.1 E+02	1.3 E+02	20.4
253	9.6 E+01	1.0 E+02	6.5
255	1.1 E+02	1.4 E+02	28.1
256	5.4 E+02	5.1 E+02	-5.8
258	1.1 E+03	7.7 E+02	-30
259	1.3 E+02	1.3 E+02	-1.7
261	1.0 E+02	1.1 E+02	9.0
Average	1.7 E+02	1.6 E+02	-6

Note: Comparisons include the 24 TLD locations that remained unchanged between 1993 and 1994.

Figure 5-3. Comparison of TLD Results at the 200 Areas.

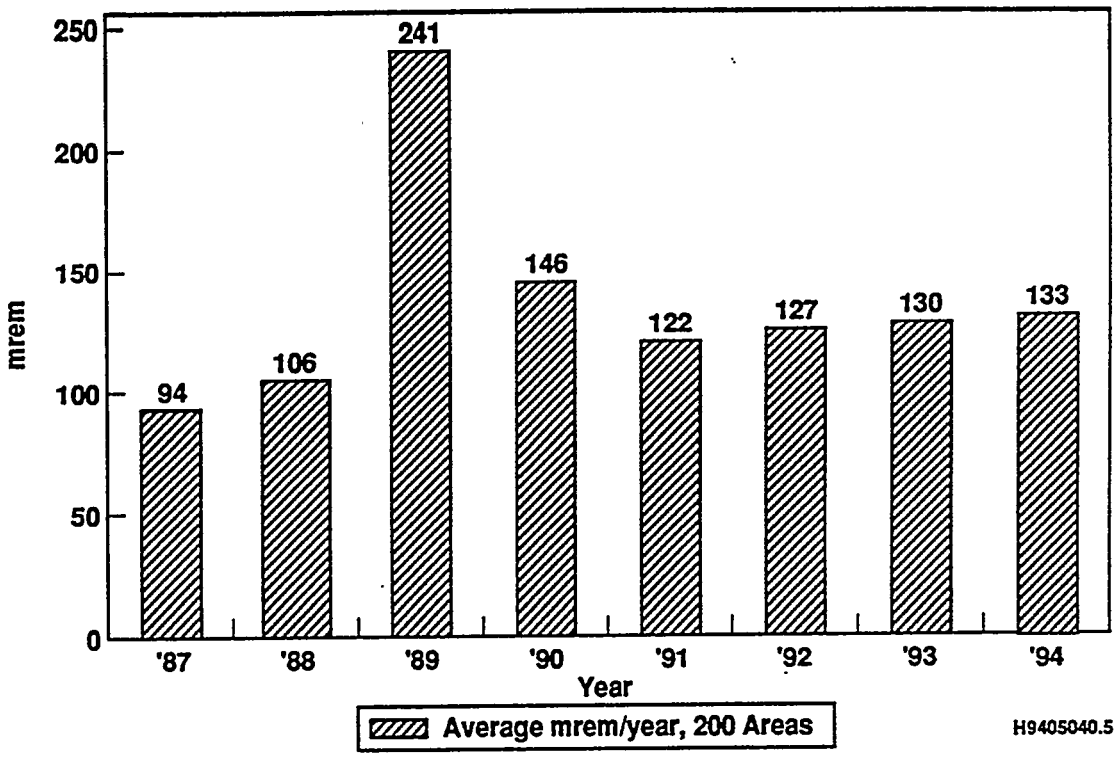
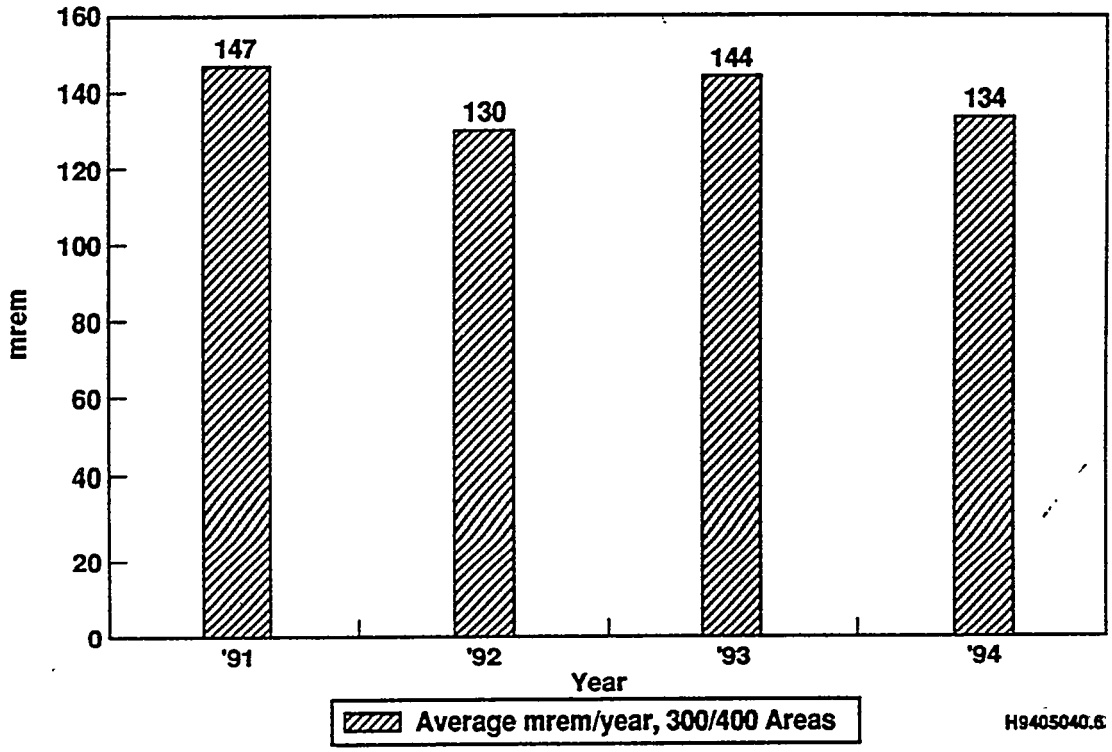


Table 5-3. 300/400 Areas Thermoluminescent Dosimeter Comparisons for 1993 and 1994 (mrem/yr).

Site I.D. 300 Area	1993 Average	1994 Average	94 vs 93 % Change
1	8.8 E+01	9.1 E+01	3.7
2	8.3 E+01	9.4 E+01	13.5
3	9.6 E+01	1.0 E+02	4.4
4	1.7 E+02	1.8 E+02	3.4
5	8.3 E+01	9.1 E+01	9.9
6	1.3 E+02	1.1 E+02	-13.7
7	7.9 E+02	5.4 E+02	-31.6
8	1.1 E+02	1.4 E+02	27.8
Average	1.9 E+02	1.7 E+02	-13.2
Site I.D. TEDF (300 Area)	1993 Average	1994 Average	94 vs 93 % Change
301	NS	1.0 E+02	NA
302	NS	1.1 E+02	NA
303	NS	1.2 E+02	NA
304	NS	1.1 E+02	NA
305	NS	1.1 E+02	NA
306	NS	1.1 E+02	NA
Site I.D. 400 Area	1993 Average	1994 Average	94 vs 93 % Change
1	8.3 E+01	9.2 E+01	10.6
2	1.1 E+02	2.1 E+02	88.3
3	1.1 E+02	1.2 E+02	5.9
4	8.3 E+01	9.0 E+01	8.5
5	1.2 E+02	9.2 E+01	-23.2
6	8.3 E+01	9.5 E+01	14.2
7	9.6 E+01	1.0 E+02	4.0
Average	9.8 E+01	1.1 E+02	15.6

NA = Not applicable

Figure 5-4. Comparison of TLD Results at the 300/400 Areas.



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6.0 SURFACE WATER DISPOSAL UNITS AND SEEPAGES

6.1 INTRODUCTION

Water, vegetation, and sediment samples were collected from the active ponds and ditches and the N Springs in 1994. Springs, ponds, and ditches in the 100, 200, and 300/400 Areas receive or have received waste water from the chemical processing plants and other facilities. All water was sampled at the point of discharge to ensure compliance with internal company standards and applicable DOE standards. As an additional operational check, the WHC OEMP collects water samples from the ponds and ditches. Sampling locations are shown in Appendix G. Sources of liquid effluents are listed in Table G-1.

Water samples of 1-L were collected weekly from the active ponds and ditches. The pH was determined each week, then the samples were composited and analyzed monthly for gross alpha, gross beta, gamma-emitting radionuclides, and ^{90}Sr. Each site has replicate samples taken for 1 month (4 weeks) on a rotating basis. In addition, a 1-L sample was taken quarterly from each site for nitrate and ^{3}H analyses. Samples of aquatic vegetation are collected from ponds and ditches yearly to determine root uptake of radionuclides from potentially contaminated sediments. Along with vegetation samples, samples of surface sediment are collected to measure the accumulation of radionuclides. Surface samples consist of a composite of five plugs, each 10 cm in diameter by 2.5 cm deep. The vegetation and sediments were analyzed for gamma-emitting radionuclides ^{90}Sr, ^{239}Pu, and uranium.

6.2 RESULTS

6.2.1 Water

6.2.1.1 100 Areas. Seepage wells and groundwater seepages along the 100 N Area shoreline (N Springs) were sampled to verify that the reported radionuclide releases to the Columbia River via the N Springs were credible. Release reporting uses conservatively based radionuclide concentrations, multiplied by the estimated groundwater flow into the river. After characterizing the radionuclide concentrations in the seeps along the shoreline at the 100 N Area, the results can be compared to the radionuclide concentrations measured in the effluent monitoring well. Historically, the highest concentrations of radionuclides have been shown to be in the area of the effluent monitoring well, and these biased concentrations were applied to the entire N Springs discharge region, thereby providing conservatively high release values.

With the shutdown of N Reactor in January 1987 and the resultant decreased effluent flow to the 1325-N LWDF, concentrations of most of the radionuclides that were typically present in the N Springs discharge during reactor operation have significantly decreased. Exceptions to this were the levels of tritium and ^{90}Sr.

The shoreline seepage well samples were collected using a peristaltic sampling pump. A weighted Tygon[1] sampling tube was carefully lowered into each well water column to avoid sediment suspension and a 4-L sample was collected. Tables 6-1 and 6-2 represent the historic concentrations of these radionuclides from samples collected from the N Springs shoreline wells, including Well N-46. Since 1986, ^{90}Sr concentrations have exceeded the DOE DCG values only in the sample locations in the vicinity of the effluent monitoring well. Because of river fluctuations and groundwater discharge rates, some wells may not have been sampled; results from those wells are not shown in Tables 6-1 and 6-2.

Samples were collected on September 27, 1994 (for sample locations, see Figure G-1). Four of the five upstream sampling locations (Wells 1, 2, 4, and 5) were dry at the time of sample collection. This was noticeably unusual and is likely attributable to the cesssation of discharges to the 1325-N LWDF in 1991, and the return of the natural groundwater migration pattern at the N Springs. The results obtained from the eight wells that were sampled indicated that the seepage wells with the highest radionuclide concentration were in the vicinity of the effluent monitoring well, indicating that this well continues to monitor N Springs discharge in the region of highest conservatism.

6.2.1.2 200 Area. Water, sediment, and aquatic vegetation samples were collected from 12 sample locations from active ponds and ditches located in the 200 Areas. The number of sample locations was reduced to four during 1994 because eight liquid waste disposal units were remediated, as shown in Table 6-3. Ponds and ditches in the 200 Areas receive potentially contaminated waste water from the chemical processing plants and other facilities. All water is sampled continuously at the point of discharge to ensure compliance with internal company standards and applicable DOE standards. As an additional check, the OEMP collects water samples at the ponds and ditches used to dispose of this waste water. All potentially contaminated waste waters are disposed of to ditches or ponds that are radiologically controlled areas.

The cessation of waste water discharges to the 216-U-14 Ditch resulted in excessively low water levels causing difficulty collecting a sample without particles of sediment tainting the water. This resulted in the highest ^{3}H reading of 1.1 E+05 pCi/L. Radioanalytical results from water sampling of ponds and ditches are summarized in Appendix G.

6.2.1.3 300/400 Area. Currently, no surface water was sampled in the 300 Area. The 400 Area FFTF Process Pond is sampled by PNL and the results are reported in the Hanford Site Environmental Report. To avoid duplication of effort, the data are shared with WHC after they have been validated by PNL. Total alpha and ^{22}NA concentrations were less than the detection levels (1.5 and 6.0 pCi/L, respectively) during the year. Total beta concentrations in the Fast Flux Test Facility (FFTF) pond water were within the range observed in previous years. The concentrations of ^{3}H were comparable to those measured in the FFTF pond in the past. For a more detailed discussion, see Section 5.3.1, "Surface Water Surveillance," *Hanford Site Environmental Report Calendar Year 1994* (Dirkes and Hanf 1995).

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[1]Tygon is a registered trademark of Norton Company.

Table 6-1. N Springs Shoreline Tritium Concentrations, 1987 to 1994 (pCi/L).

Year	Site 1	Site 2	Effluent Monitoring Well	Site 3	Site 4	Site 5	Site 6
1987	6.8 E+04	7.6 E+04	9.5 E+04	9.2 E+04	9.4 E+04	8.8 E+04	7.9 E+04
1988	5.7 E+03	2.8 E+04	7.5 E+04	6.9 E+04	7.4 E+04	NS	NA
1989	2.5 E+04	2.8 E+04	3.9 E+04	3.6 E+04	5.0 E+04	NS	6.8 E+04
1990	2.9 E+04	3.2 E+04	3.8 E+04	3.6 E+04	NS	NS	3.4 E+03
1991	2.2 E+02	8.4 E+01	3.7 E+04	2.6 E+03	3.4 E+04	NS	4.0 E+02
1992	7.2 E+02	NS	5.0 E+04	9.5E-01	NS	NS	1.5 E+02
1993	2.8 E+02	1.3 E+02	2.7 E+04	1.4 E+02	5.6 E+02	1.0 E+02	1.8 E+02
1994	NS	NS	2.6 E+04	4.0 E+01	NS	NS	1.2 E+02

Year	Site 7	Site 8	Site 9	Site 10	Site 11	Site12	Site 13
1987	7.3 E+04	4.6 E+04	7.5 E+04	4.0 E+03	5.8 E+04	2.1 E+04	1.3 E+03
1988	1.1 E+04	3.0 E+04	1.0 E+04	NA	2.9 E+04	1.9 E+04	3.0 E+03
1989	NS	7.7 E+04	7.0 E+04	3.5 E+04	4.2 E+04	NS	NS
1990	NS	1.4 E+04	3.5 E+03	9.7 E+03	3.8 E+04	2.0 E+04	NS
1991	8.1 E+02	2.1 E+03	6.5 E+03	7.9 E+02	7.1 E+02	2.4 E+03	9.3 E+00
1992	NS	NS	3.0 E+02	4.3 E+02	6.5 E+02	1.7 E+02	NS
1993	NS	NS	NS	NS	NS	NS	NS
1994	8.5 E+01	1.3 E+02	8.4 E+01	4.0 E+02	4.5 E+02	2.9 E+02	NS

NS = Not Sampled
NA = Not Applicable

Table 6-2. N Springs Shoreline ^{90}Sr Concentrations, 1987 to 1994 (pCi/L).

Year	Site 1	Site 2	Effluent Monitoring Well	Site 3	Site 4	Site 5	Site 6
1987	1.7 E+03	2.7 E+03	6.1 E+03	8.3 E+03	4.1 E+03	9.5 E+02	7.2 E+02
1988	8.7 E+02	3.0 E+03	7.9 E+03	9.1 E+03	3.5 E+03	NS	NS
1989	9.8 E+02	2.1 E+03	6.5 E+03	5.4 E+03	3.8 E+03	NS	8.9 E+02
1990	2.4 E+03	2.9 E+03	4.9 E+03	7.1 E+03	NS	NS	1.5 E+02
1991	1.6 E+01	2.4 E+01	6.9 E+03	1.4 E+03	3.2 E+03	NS	8.6 E+01
1992	NS	NS	6.3 E+03	1.5 E+02	NS	NS	9.6 E+00
1993	1.2 E+01	8.3 E+01	7.4 E+03	1.2 E+02	4.1 E+03	4.1 E+01	1.3 E+01
1994	NS	NS	6.6 E+03	1.2 E+02	NS	NS	6.4 E+00

Year	Site 7	Site 8	Site 9	Site 10	Site 11	Site12	Site 13
1987	1.3 E+01	4.2 E+01	2.4 E+02	5.7 E+01	6.6 E+02	5.8 E+01	5.0 E+01
1988	1.5 E+01	3.2 E+01	4.1 E+01	NS	3.4 E+02	4.0 E+01	5.8 E+01
1989	NS	7.8 E+01	2.9 E+02	1.6 E+02	9.5 E+02	NS	NS
1990	NS	9.0 E+01	4.4 E+01	3.1 E+01	5.8 E+02	5.4 E+01	NS
1991	1.4 E+01	2.8 E+01	1.0 E+02	1.5 E+01	4.0 E+02	8.9 E+00	8.1 E+00
1992	NS	NS	8.1 E+00	6.7 E+00	1.1 E+02	7.1 E+00	NS
1993	NS	NS	NS	NS	NS	NS	NS
1994	3.8 E+00	1.2 E+01	3.4 E+00	3.8 E+00	5.1 E+01	1.8 E+01	NS

NS = Not Sampled

Table 6-3. Liquid Waste Disposal Facility that Stopped Receiving Waste Water in 1994.

Location Description (RM Code)	Date Effluents Ceased (Last Date Sampled)
216-T-4 Ditch (RM 3)	12-29-94
216-B-3-3 Ditch (RM 21)	3-14-94
216-B-3 Pond, Outfall (RM 22)	3-14-94
216-B-3 Pond, South (RM 23)	3-7-94
216-B-3A Pond, Outfall (RM 26)	4-19-94
216-U-14 Ditch (RM 55)	9-12-94
216-T-1 Ditch (RM 56)	4-19-94
216-B-3A, Inlet (RM 57)	3-28-94

6.2.2 Nonradiological Parameters

6.2.2.1 100 Area. No samples were analyzed for nonradioactive parameters in the 100 Areas during 1994.

6.2.2.2 200 Area. Results of pH and nitrate determinations are summarized in Table G-2. The pH annual averages ranged from neutral to slightly basic. The highest annual average pH of 8.7 was found at the 200 West Area Powerhouse Pond. The results for pH were well within the pH standard of 2.0 to 12.5 for liquid effluent discharges based on the discharge limits listed in the RCRA. All of the nitrate results were less than the detection limit (approximately 1.4 mg/L) and well below the Drinking Water Standard (40 CFR 141) for nitrates (45 mg/L).

6.2.2.3 300/400 Area. Currently, no surface water is sampled in the 300 Area. The 400 Areas process pond is sampled by PNL and the results are reported in the Hanford Site Environmental Report. To reduce duplication of effort the data are shared with WHC after they have been validated by PNL.

6.2.3 Aquatic Vegetation

6.2.3.1 100 Area. No aquatic vegetation samples were analyzed in the 100 Areas during 1994.

6.2.3.2 200 Area. Aquatic vegetation samples are collected from ponds and ditches that have growing aquatic vegetation. Six vegetation samples were collected from six ponds and ditches in 1994. Each sample consisted of growing stems and leaves from the predominant plant species at each location. The vegetation was analyzed for gamma-emitting radionuclides, as well as ^{90}Sr, ^{239}Pu, and uranium with the results reported in Table G-3.

6.2.3.3 300/400 Area. No aquatic vegetation was sampled in the 300 and 400 Areas by PNL.

6.2.4 Sediment (Surface Samples)

6.2.4.1 100 Area. No samples were analyzed for radioactive parameters in the 100 Areas during 1994.

6.2.4.2 200 Area. The results of pond and ditch sediment sampling are provided in Table G-4. The highest ^{137}Cs result was 1.7 pCi/g at the 200 West Powerhouse Pond. The highest Pu result was 2.0 pCi/g found at the 216-U-14 Ditch. All ponds and ditches that receive potentially contaminated water were within posted radiological control areas.

6.2.4.3 300/400 Area. Currently, no surface water sediment is sampled in the 300 Area. The 400 Areas process pond sediment is sampled by PNL and the results are reported in the *Hanford Site Environmental Report for Calendar Year 1994* (Dirkes and Hanf 1994). To avoid duplication of effort, the data are shared with WHC when validated by PNL.

6.3 CONCLUSIONS

No significant increases in radioactivity were observed in surface water samples from ponds and ditches in 1994. All surface waters associated with separations-area operations were below the DCG for all radionuclides. The analytical results of vegetation samples taken at the ponds and ditches revealed that, while some physiological uptake of radionuclides occurred, the amounts were relatively low. Sediment samples taken demonstrated elevated levels (above background) of mainly ^{137}Cs and Pu. However, all ponds and ditches that receive potentially contaminated water were within posted RCAs.

The decrease in the number of seep sampling points at N Springs indicates the cessation of discharge of liquid effluents to the soil column via LWDFs 1301-N and 1325-N. Historical trending of these seep samples reveals an overall decrease in radionuclide concentrations in the seeps. However, as in past years, the seepage wells with the highest radionuclide concentrations were in the vicinity of the effluent monitoring well, indicating that this well continues to monitor N Springs discharges into the region of the highest concentrations.

7.0 RADIOLOGICAL SURVEYS

7.1 INTRODUCTION

Radiological surveys are conducted to determine changes in the radiological status of the 100, 200, and 300/400 Areas outdoor waste sites. These sites include surface water disposal units, cribs, trenches, burial grounds, French drains, and reverse wells. Trends in radiation levels or radiological contamination may aid in assessing the adequacy of waste containment indicating movement of radioactive material away from radiological control areas, or detect releases that might otherwise go undetected. The radiological survey locations are shown in Figures H-1 through H-10.

7.2 ROADS AND RAILROADS

7.2.1 ROADS

Road surveys are performed with the Mobile Surface Contamination Monitor (MSCM) tractor or a vehicle equipped with NaI detectors mounted on the undercarriage. The detector height is adjustable. The average survey height is 30 cm (1 ft) above the pavement.

The vehicle is driven at approximately 3 km/h (2 mi/h). When activity is detected, the vehicle is stopped and a thorough survey is made with a Geiger-Mueller portable survey instrument equipped with a thin-window, pancake-type probe. Appropriate management is notified if contamination is identified and corrective actions are initiated.

All frequently traveled blacktop and improved roads and parking lots in and around the 200 Areas are surveyed bimonthly to detect the presence of radioactive material. Roads less frequently traveled or with low contamination potential were surveyed either quarterly or semiannually. Contamination was detected on two roads in 1994, the bus turn around on 7th Street at 221-B and Baltimore Avenue between 241-BX/BY and 241-B Tank Farms in the 200 East Area. In both cases, the contamination was from past underground radioactive waste line leaks and the roadway surfaces were non-smearable. Both areas were repaved to bring the contamination down to background levels.

7.2.2 RAILROADS

Radiological surveys of railroads are conducted with a vehicle equipped with "high railers," which allow the vehicle to travel on both the roads and railroad tracks, and adjustable-height NaI detectors. The average survey height is 30 cm (1 ft). The vehicles are driven at less than 8 km/hr (5 mph). When activity is detected, the vehicle is stopped and portable hand-held survey instruments are used to thoroughly survey the area and identify the extent of the contamination. Appropriate management is notified when contamination is identified and corrective actions are initiated.

Railroad surveys are done semiannually on the rail between the 300 and 400 Areas and inside the 200 West Area, including spurs and sidings. All railroads outside the facilities are surveyed annually, including spurs and

sidings and up to Columbia Center. Only one area of contamination was found during 1994, a speck (with a maximum contamination level of 2,500 cpm) outside the posted surface contamination area at the Reduction Oxidation (REDOX) facility rail spur. This was picked up and disposed of in the low-level burial grounds.

7.3 SURFACE WATER DISPOSAL UNITS

Surface water disposal units (pond and ditch banks) are routinely surveyed to identify potential contamination. The thin-window, pancake-type Geiger-Mueller probe is the principal instrument used in these surveys. Special survey plots are designated around the perimeters of these sites. They are marked with metal posts and numbered. The contamination levels remained at less than detectable values and no apparent changes were noted for 1994.

7.4 SOLID WASTE DISPOSAL SITES

The retired solid waste disposal sites are surveyed semiannually or annually to detect radiological changes, primarily via biological intrusion. Solid-waste disposal sites are located in each of the operating Areas 100 B, C, D, DR, F, K, 200 East and 200 West, and the 600 Areas. (See Figures H-1 through H-10.)

Contaminated vegetation and specks were identified at the 218-W-2, 218-W-3A, 218-E-2, 218-E-2A, 218-E-8, 218-E-9, 218-E-10, 218-E-12A, and 218-E-12B Burial Grounds in 1994 with a maximum contamination level of 80,000 cpm (26 mrad/h). The contamination was removed and/or backfilled shortly after it was identified. The restabilization effort, started in 1993, was completed on the 218-E-12A and 12B Burial Grounds in 1994.

7.5 200 AREAS LOW-LEVEL LIQUID WASTE DISPOSAL SITES

Low-level liquid waste disposal sites, other than open ponds and ditches, consist of cribs, French drains, reverse or injection wells, trenches, covered ponds and ditches, and unplanned release sites. As with solid-waste disposal sites, liquid-waste sites are surveyed at least annually, and as often as quarterly, to detect changes in surface radiological conditions. The most significant survey results in 1994 are listed below. Sites remediated or backfilled to meet radiological down-posting requirements are listed in Section 7.12.

The Environmental Restorations Contractor and Tank Waste Remediation Systems develop annual schedules for remediating identified contamination. Sites are cleaned or stabilized as soon as possible, but, because of previously scheduled remediation and prioritization of the sites, contamination may not always be stabilized in the same year it is found.

7.5.1 216-A Sites

At the 216-A-40 Basin, the standing water was drained and the contamination was consolidated at one end of the basin. The basin was

backfilled with clean soil and the area including UN-216-E-43 was stabilized and down posted from surface contamination (SC) to underground radioactive materials (URM) (see Figure H-7).

The 216-A-27 crib was surveyed and downposted from SC to URM.

Contaminated vegetation and specks were found on the 216-A-30 and 216-A-42 Cribs with maximum contamination readings of 55,000 cpm.

7.5.2 216-B Sites

Spotty contamination was noted in the 216-B-7b, 216-B-8, and 216-B-9 Cribs, in the stabilized portion of the 216-B-2-2 Ditch Area (up to 2,000 cpm, and in the 216-B-64 Basin area. With the exception of the 216-B-7B Crib and the 216-B-64 Basin areas, the contamination was picked up and placed in the low-level waste burial grounds. The zones were extended to include the contamination found in the 216-B-7B Crib and 216-B-64 Basin surface contamination areas.

The 216-B-5 and 216-B-57 Cribs, the 216-B-3-3 and 216-B-63 Ditches, and the 216-B-3 Pond were stabilized in 1994. The A lobe of the 216-B-3 Pond was surveyed, soil samples analyzed and the posting removed with the exception of the trench in the center of the pond which remains posted as SC.

7.5.3 216-S Sites

Speck contamination (e.g., single grains of soil, rust particles, feces, or pieces of vegetation) measuring up to 3,000 cpm were found outside the 216-S-17 Crib. The area was posted and a Radiation Problem Report was issued recommending that the area be decontaminated and stabilized.

The 216-S-17 Pond and the 216-S-20 Crib were stabilized in 1994.

7.5.4 216-T Sites

Contamination was found outside the surface contamination zones at the 216-T-30 Crib and at the 216-T-4 Pond. The zones were extended to include the newly discovered contamination.

The 216-T-19 Crib was surveyed and downposted from SC to URM in 1994.

7.5.5 216-U Sites

Contaminated tumbleweeds and soil with readings of up to 80,000 cpm were found in the 216-U-8 Crib, 216-U-14 Ditch, and the surface-stabilized 216-U-11 Pond. Stabilization of these areas is scheduled for 1995.

7.5.6 216-Z Sites

Contaminated specks and vegetation were found at the 216-Z-7 and 216-Z-10 Cribs. The contamination was removed and placed in the low-level waste burial grounds.

7.5.7 Unplanned Release Sites

The most noteworthy contamination was found at the following unplanned release sites.

UN-216-E-41. The area south of the cross-site transfer line, west of the 241-ER-151 Diversion Box, and east of the railroad tracks was found to be contaminated with the highest reading, 20,000 cpm direct beta/gamma. Contamination was attributed to soil and vegetation. The area was posted indicating the status change.

Several contaminated areas were found outside the surface contamination area, up to 5,000 cpm (15 mR/h), in the 200 West Area portion of the cross-site transfer line. The contamination, which was easily removed, was decontaminated at the time of the survey. The new surface contamination area was added to the existing SC area in the 200 West Area.

This unplanned release site is scheduled for decontamination and stabilization in 1995.

UN-216-E-43. The unplanned release site at the 244-A Lift Station, known as UN-216-E-43, and adjacent to the 216-A-40 Basin was cleaned up and stabilized in 1994.

UN-216-W-5. UN-216-W-5 was also stabilized and downposted in 1994.

UN-216-W-36. Shotcrete used to stabilize the UN-216-W-36 Site in 1991 is working well to keep the covered contamination contained.

7.6 TANK FARM PERIMETERS

Tank farm perimeters and associated facilities are surveyed semiannually to detect any migration of contamination. Tank farms and related facilities are sources of environmental contamination migration. Recontamination along the same fence lines from year to year seems to be associated with the prevailing wind direction and the contamination located within the tank farms and associated with tank farm activities.

Areas adjacent to and south of the 241-C Farm and 271-CR Vault, including a portion of 7th Street, were found to be contaminated in 1994 (up to 8,000 cpm [2.6 mrad/h]). The contamination appeared to be from animal intrusion and windborne activity both inside and outside the tank farm. The areas were posted as surface contamination. The area south of the 241-C Tank Farm and north of the 244-A Lift Station was included in the cleanup and stabilization of the 216-A-40 Basin and UN-216-E-43.

With the exception of the contamination south of the 241-C Tank Farm, the schedule for cleanup of the areas around the tank farms has not been determined. Treatment of the interiors of the tank farms with a soil-

retention spray was continued in 1994 to prevent further windborne contamination spreads from the tank farms.

Several other areas of spot contamination were discovered in 200 East (near the 241-A, 241-AN, 241-AX, and 241-AZ Tank Farms, west of the 241-BX/BY Tank Farm, and near the 241-B-154 and 241-B-155 Diversion Boxes) and 200 West (near the 241-S/SX/SY, 241-T, TX, TY, and 241-U Tank Farms) while performing the semiannual tank farm perimeter surveys. The specks consisted of tumble weed fragments, soil, and rabbit/mice feces. The areas were decontaminated.

7.7 BC CRIBS AND CONTROLLED AREA

Contamination was found in the 216-B-14 through 216-B-34 BC Cribs and Trenches (up to 2,500 cpm).

The BC cribs and trenches (Figure H-9) are a series of liquid-waste disposal sites that were active in the mid-1950's. In 1959, animals were discovered to have burrowed into one trench and transported radioactivity over an area estimated to exceed 1,000 ha (2,500 acres). In 1979, special survey plots were established throughout the controlled area to monitor for migration of the contamination. Data accumulated during the 10-year period indicate that no significant additional migration of contamination away from the area has occurred. The cribs and trenches were surface stabilized in 1982. This area, approximately 5.18 km^2 (2 mi^2), is currently posted as a radiological controlled area (RCA) and bounds the south and east side of an area leased to the U.S. Department of Ecology (Ecology).

7.8 100 N AREA RADIATION SURVEYS

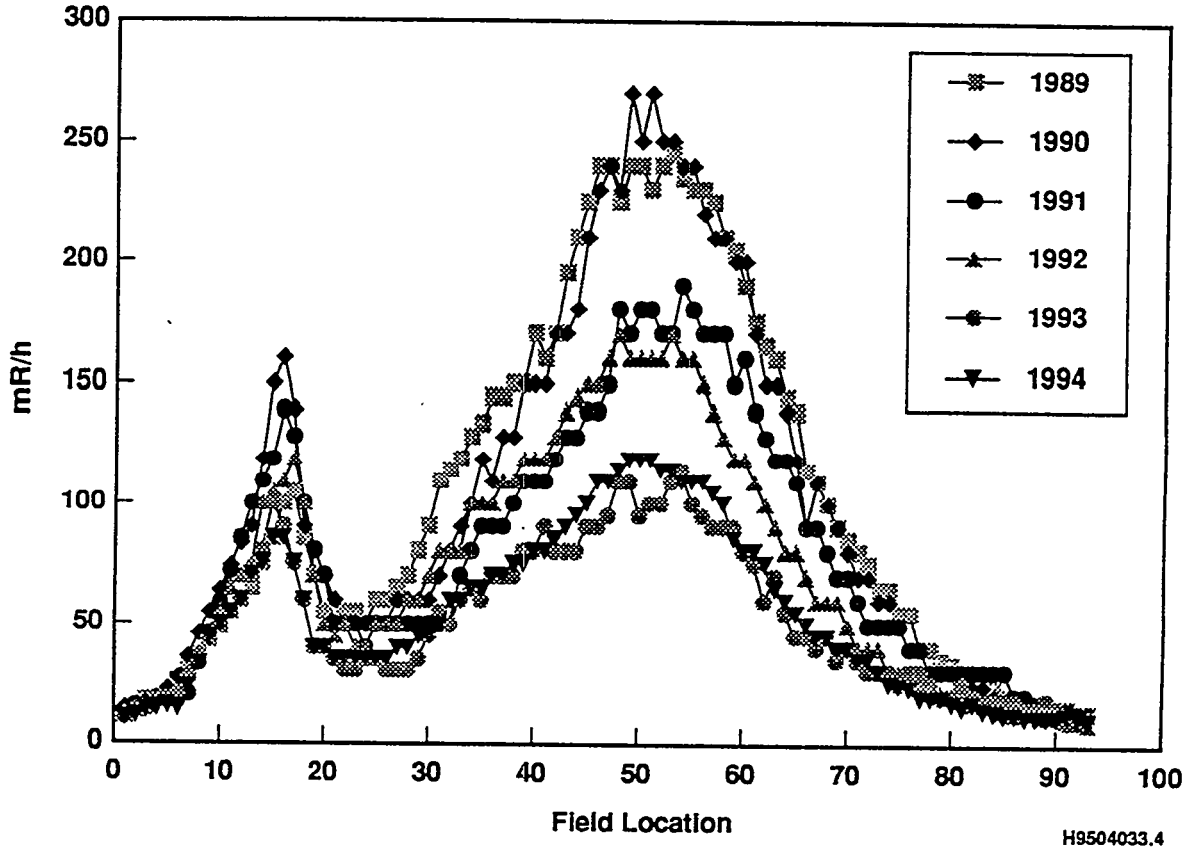
Direct radiation levels are measured annually along the 100 N Area portion of the Columbia River shoreline. Annual environmental radiation surveys also are conducted at intersecting points of survey grids established around the 1301-N and 1325-N LWDFs to monitor radiation levels associated with the disposal facilities.

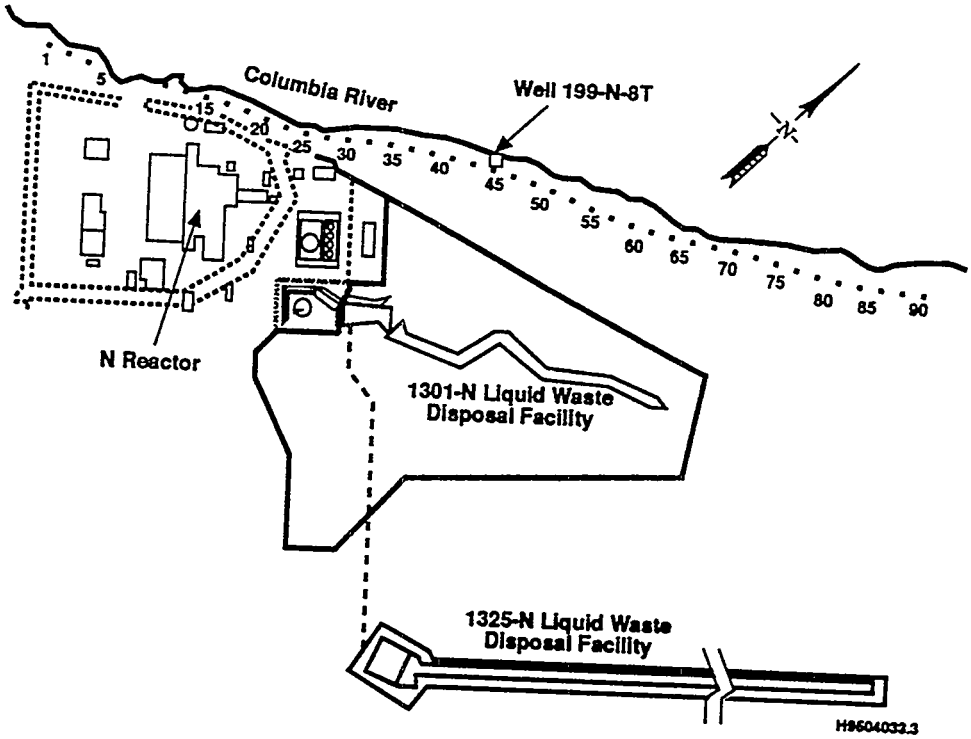
Each survey relied on the use of a portable micro-Roentgen meter. The meter was calibrated by PNL to a ^{137}Cs source. All readings were taken at a height of 1 m (3.28 ft) at 15.24-m (50-ft) intervals. The micro-R readings obtained for these surveys reflect dose rates that are relative to each other only. They do not indicate actual whole-body penetrating dose rates because this type of instrument is overly sensitive to penetrating low-energy gamma-emitting radiation sources.

7.9 COLUMBIA RIVER SHORELINE SURVEY

Relative dose rates were measured along the Columbia River shoreline starting near the N Area outfall (field location 5) and proceeding downstream past the N Springs. A graphic representation of the shoreline survey data is presented in Figure 7-1. The locations of the 100 N Area facilities that

Figure 7-1. 100 N Area Shoreline Survey Results.





potentially contribute to dose rates measured near the river shoreline are shown. At the time of the survey, N Reactor was shut down. The 1304-N Emergency Dump Tank was empty. There was no flow to the 1325-N LWDF. The 1310-N Radioactive Chemical Waste Storage Facility was empty.

Graphs depicting the relative environmental exposure rates from 1994 annual surveys along the Columbia River shoreline opposite the 1301-N LWDF were similar in shape to the 1993 graphs, but the rates were lower. The decrease is attributable to the continuing decay of ^{60}Co (5.3-yr half life), one of the major residual radionuclides in the 1301-N facility. As of September 19, 1985, this facility no longer was used and no longer contained water that shielded direct radiation levels during operations. Results of the shoreline survey are presented in Table H-1 (Appendix H).

7.10 100 N AREA LIQUID WASTE DISPOSAL FACILITY RADIATION SURVEYS

7.10.1 Introduction

The 1301-N and 1325-N LWDFs are secured facilities posted as radiological control areas and/or surface contamination areas. Because of the potential for radionuclide contamination and direct radiation exposure, a security fence surrounds the facilities. Only trained personnel are allowed access to the disposal facilities. Even then, workers do not spend large amounts of time in these areas.

7.10.2 1301-N Liquid Waste Disposal Facility Survey Results

Figure H-11 (Appendix H) shows the relative environmental exposure rates detected around the 1301-N LWDF. The N Reactor was not operating at the time of the survey. The 1325-N LWDF was not receiving liquid effluent. The 1310-N Radioactive Chemical Treatment Facility was empty.

The data indicate that the areas near the "weir box" (inlet) portion of the 1301-N LWDF and the first leg of the 1301-N Trench have the highest background exposure rates. The absence of water from the LWDF is the major factor contributing to the dose rates. During operation, water levels in the crib shielded much of the radiation emitted by the contaminated sediments. The relative exposure dose rates measured at this facility decreased 20 percent overall in 1994. The reduction is the result of the continued decay of the radionuclide inventory contained in the 1301-N.

7.10.3 1325-N Liquid Waste Disposal Facility

The relative environmental exposure rates detected around the 1325-N LWDF are presented in Figure H-12 (Appendix H). The N Reactor was not operating at the time and the 1325-N LWDF was not receiving liquid effluent. The 1310-N Radioactive Chemical Waste Storage Facility was empty. The 1325-N LWDF did not contain liquid effluent.

In 1994, the 1325-N LWDF showed an overall decrease of 27 percent in relative exposure rates compared to the 1993 survey. This reduction is caused by the continued decay of the radionuclide inventory contained in the 1325-N LWDF.

7.10.4 Retired 100 Area Waste Disposal Facilities

Routine environmental surveillance was performed semiannually on the retired 100 Area waste disposal facilities in 1994. The contamination levels remained at less than detectable values except at the 116-B URM area with levels of up to 70,000 cpm, the 118-B-1 URM area with levels of up to 20,000 cpm, and the 116-C-1 area with levels up to 6,000 cpm. Contamination has been noted in previous radiation surveys of these areas.

7.11 STABILIZATION AND SITE REMEDIATION

In 1994, several contaminated sites were interim surface stabilized by scraping the contaminated topsoil and consolidating the contamination into smaller areas. These smaller areas were covered with 15.24 cm (6 in.) of clean dirt. Other sites were backfilled with 15.24 cm to 0.61 m (6 in. to 2 ft) of clean dirt. Either method resulted in surface contamination area postings being reduced to underground radioactive material areas or being released from radiological control. The sites remediated and/or radiologically reposted in 1994 are shown in Table 7-1.

Table 7-1. Sites Remediated or Radiologically Reposted in 1994 (approximate surface area in acres).

Site Designation	Status change	Area ha (acres)
107 F and 107 H Basins	SCA to URM	3.6 (9.0)
100 KE and 100 KW Flood Plains	SCA to URM or released	10.2 (25.3)
216-B-27 Crib	SCA to URM	0.04 (0.1)
216-A-40 Basin and UN-216-E-43	SCA to URM	1.4 (3.5)
216-B-3 Pond	SCA to URM	13.2 (40.0)
216-B-3 Pond "A" Lobe	SCA to URM	4.5 (11.0)
216-B-3-3 Ditch	SCA to URM	0.7 (1.8)
216-B-5 Crib and 241-B-361 Tank	SCA to URM	0.04 (0.1)
216-B-57 Crib	SCA to URM	0.04 (0.1)
216-B-63 Ditch	SCA to URM	0.24 (0.6)
216-S-17 Pond	SCA to URM	0.04 (0.1)
216-S-20 Crib	SCA to URM	0.03 (0.07)
216-T-19 Crib	SCA to URM	0.4 (1.0)
218-E-12A and 12B	SCA to URM	11.3 (28.0)
UN-216-W-5	SCA to URM	0.4 (1.0)

SCA = surface contamination area.
URM = underground radioactive material.
Released = released from posting.

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8.0 INVESTIGATIVE SAMPLING, MONITORING, AND SPECIAL CHARACTERIZATION PROJECTS

8.1 INTRODUCTION

Investigative samples were collected in and near facility and waste site environments (i.e., operations areas) at the Hanford Site during 1994 to confirm the absence or detect the presence of potential radioactive contaminants. Investigative sampling and monitoring were conducted to determine whether effluent controls and waste containment systems were adequate. Samples for investigative monitoring could be collected from:

- A broader area of a routinely monitored site when results from a radiological survey showed elevated contamination levels
- An area where scheduled activities (e.g., demolition or stabilization) at or near a contamination source made it necessary to demonstrate the radiological condition of the area
- A site where biotic intrusion (e.g., animal burrows or deep-rooted vegetation) had created the potential for the spread of contaminants
- A site where the integrity of waste maintenance systems needed to be demonstrated
- A spill or release site to determine the concentrations of radioactive contamination.

Types of investigative samples in previous years have included air; water; snow; sediment; soil; vegetation such as grass, tumbleweed, sagebrush, trees, and fruit; and various wildlife and their products (e.g., nests and feces) such as spiders, ants, termites, fish, toads, snakes, birds, rabbits, mice, and carnivores (e.g., coyotes and bobcats).

The results of the Operational Environmental Monitoring Program have been combined in a single report only since 1991. Therefore, comparisons (e.g., when checking for trends of contamination) must be made with care. For example, to identify a trend in Russian thistle (tumbleweed) contamination over the entire Hanford Site, it would be necessary to look at various contractors' annual environmental reports from the years before 1991 for each of the areas (e.g., 100, 200, and 300 Areas), the *Westinghouse Hanford Company Operational Environmental Monitoring Annual Report* since 1991, and the *Hanford Site Environmental Report* produced by PNL. Also, some incidents of radioactive contamination were discovered during operations (e.g., cleanup) and not reported directly to OEMP staff. Incidents of radioactively contaminated soil or biota found during radiological surveys of individual operations (e.g., 241-C tank farms) are reported through the Health Physics Radiation Problem Report (RPR). This section also includes a synopsis of the RPR data (Appendix I, Tables I-3, I-5, and I-7). Radioisotopic analyses were not done for these contaminated specimens, so only field-instrument readings were available.

8.2 1994 SAMPLE TYPES

Samples in 1994 included water (one runoff sample from a tank farm and discolored water in an effluent ditch, soil (including surface soil, core soil, sediment, and pipe scrapings), two kinds of aquatic vegetation (watercress and cattails), fresh-water clams, gopher snakes, a western rattlesnake, western kingbird nests, cliff swallow nest, deer mice, and coyote feces.

8.3 COLLECTION AND ANALYSES METHODS

Methods for collecting or otherwise obtaining investigative samples, as well as instructions for field preparation of samples, are found in *Operational Environmental Monitoring*, WHC-CM-7-4. Investigative samples were sent to the WHC 222-S Analytical Laboratory in the 200 West Area because radioactive contamination levels were known or suspected to be above environmental levels.

8.3.1 Air

Investigative air samples were collected at selected surface contamination sites to evaluate several of Hanford's major diffuse emission sources and evaluate the effectiveness of monitoring these sources individually rather than collectively (Schmidt et al. 1994).

8.3.2 Surface Water

Investigative surface water samples were taken at two locations in 1994. Runoff water from one of the tank farms in the 200 West Area and some discolored water in the 216-B-3-3 Ditch were sampled for radionuclides and hazardous constituents (i.e., metals), respectively.

8.3.3 Soil

Investigative soil samples were collected either from areas previously identified as being contaminated or from areas to be characterized. If contamination was known or suspected, samples were collected from the contaminated area rather than randomly from the surface.

8.3.4 Vegetation

Investigative vegetation samples were collected either from plants previously identified as being contaminated or from areas to be characterized as part of preoperational monitoring. Contaminated vegetation was not randomly collected.

8.3.5 Wildlife

Concern about exposing employees to hantavirus resulted in a moratorium on rodent sampling and handling in 1994 by both field-sampling and laboratory personnel until the nature of the virus's transmission was understood and barriers developed. Hantavirus research specialists and small mammal handlers were consulted, and it was decided that taking samples for hantavirus analysis would not enhance safety, because mammals in Washington are already known to carry the virus; rather, safe handling procedures were prescribed. Exposure to all wildlife-borne diseases (e.g., hantavirus, plague, and rabies) were prevented by physical and administrative barriers that eliminated respiratory or skin contact with rodents.

Animals that were captured or carcasses found near facilities or waste disposal sites were collected by Site Surveillance Radiological Control or by Animal Control Operations under authority of the pest control license or the scientific permit, both granted through the Washington State Department of Fish & Wildlife, and submitted to the site laboratory for analyses.

8.3.6 Laboratory Analyses of Biota

Physical and administrative barriers at the laboratory were found to be adequate to prevent transmission of wildlife-borne diseases to laboratory staff. Animal samples of selected larger specimens (e.g., rattlesnake) were divided into portions to separate skin, gastro-intestinal organs, muscle, and bone. Small animals were dissolved in acid before analysis because dissection would not yield a large enough sample.

Vegetation samples occasionally included the entire plant, including roots if required. However, in most situations terminal branches and leaves were collected.

8.4 RESULTS

Field monitoring results are expressed as counts per minute or millirads per hour. They were obtained using a Geiger-Mueller Counter or dose rate meter. Laboratory sample analyses are expressed in picocuries per gram for most solid samples (e.g., soil or animals), picocuries per liter for liquids, and picocuries per sample for extremely small samples. Analytical results of the more biologically important radionuclides can be found in Table 8-1. Tables I-1 through I-7 in Appendix I contain the complete analytical results.

8.4.1 Air

In 1994 a special study was conducted to evaluate several of the Hanford Site's major diffuse emission sources and the effectiveness of monitoring these sources individually rather than collectively. The results from this evaluation also may be used to demonstrate WHC's compliance with the applicable air emissions regulations and determine if additional studies and/or evaluations are necessary.

Table 8-1. Investigative Samples Collected from the Operations Areas, 1994. (sheet 1 of 7)

Sample type	Sample location	Selected radionuclides	Concentration
Water	241-U Tank Farm/200 West Area (runoff water on south perimeter)	^{137}Cs ^{90}Sr $^{239/240}Pu$	pCi/L[a] 1.3 E+02 5.2 E+02 4.5 E-01
	216-B-3-3 Ditch/200 East Area (discolored effluent water)	Metals Sr Si Ca Sm S Mg Na K	uG/ml[b] 9.5 E-02 2.0 E 00 1.8 E+02 1.4 E-01 4.3 E 00 4.7 E 00 3.3 E 00 1.1 E 00
Soil	East of 241-A Tank Farm/ 200 East Area	$^{239/240}Pu$ ^{137}Cs	pCi/sample[c] 4.0 E+06 8.0 E+04
	East of 241-AN Tank Farm/ 200 East Area	^{137}Cs $^{239/240}Pu$ ^{90}Sr $^{Total}U$	pCi/g[d] 5.6 E+03 5.0 E+05 4.8 E+02 9.2 E+02
	216-B-3A Pond/200 East Area (northwest corner core)	^{137}Cs $^{239/240}Pu$ ^{90}Sr $^{Total}U$	pCi/g <1.0 E-01 <4.7 E-01 4.7 E-01 2.0 E-01
	216-B-3A Pond/200 East Area (south of northwest corner core)	^{137}Cs $^{239/240}Pu$ ^{90}Sr $^{Total}U$	pCi/g <2.1 E-01 <4.9 E-01 1.2 E 00 2.0 E-01
	216-B-3A Pond/200 East Area (northcentral area core)	^{137}Cs $^{239/240}Pu$ ^{90}Sr $^{Total}U$	pCi/g <1.2 E-01 <4.8 E-01 5.2 E-01 2.2 E-01

Table 8-1. Investigative Samples Collected from the Operations Areas, 1994. (sheet 2 of 7)

Sample type	Sample location	Selected radionuclides	Concentration
Soil (continued)	216-B-3A Pond/200 East Area (westcentral area core)	^{137}Cs $^{239/240}Pu$ ^{90}Sr $^{Total}U$	pCi/g 1.4 E-01 <4.6 E-01 1.2 E 00 1.5 E-01
	216-B-3A Pond/200 East Area (eastcentral core)	^{137}Cs $^{239/240}Pu$ ^{90}Sr $^{Total}U$	pCi/g <8.9 E-02 <4.7 E-01 <6.6 E-01 1.3 E-01
	216-B-3A Pond/200 East Area (southeast corner outlet core)	^{137}Cs $^{239/240}Pu$ ^{90}Sr $^{Total}U$	pCi/g <1.1 E-01 <5.1 E-01 7.7 E-01 2.2 E-02
	216-B-3A Pond/200 East Area (northwest corner surface)	^{137}Cs $^{239/240}Pu$ ^{90}Sr $^{Total}U$	pCi/g <6.5 E-01 <4.5 E-01 9.2 E-01 2.0 E-01
	216-B-3A Pond/ 200 East Area (south of northwest corner surface)	^{137}Cs $^{239/240}Pu$ ^{90}Sr $^{Total}U$	pCi/g 1.4 E+01 2.7 E 00 1.5 E 00 3.5 E-01
	216-B-3A Pond/200 East Area (northcentral surface)	^{137}Cs ^{90}Sr $^{Total}U$	pCi/g 1.1 E+01 1.2 E+01 3.8 E+05
	216-B-3A Pond/200 East Area (eastcentral surface)	^{137}Cs $^{239/240}Pu$ ^{90}Sr $^{Total}U$	pCi/g 6.1 E 00 1.8 E 00 6.6 E-01 2.5 E-01
	216-B-3A Pond/200 East Area (southeast outlet surface)	^{137}Cs $^{239/240}Pu$ ^{90}Sr $^{Total}U$	pCi/g 2.9 E+01 6.6 E 00 5.9 E-01 6.1 E-01

Table 8-1. Investigative Samples Collected from the Operations Areas, 1994. (sheet 3 of 7)

Sample type	Sample location	Selected radionuclides	Concentration
Soil (continued)	216-B-3 Pond/200 East Area (surface)	^{137}Cs $^{239/240}Pu$ ^{90}Sr $^{Total}U$	pCi/g 1.2 E+02 8.8 E 00 9.3 E-01 8.9 E-01
	216-B-3 Pond/200 East Area (northcentral surface)	^{137}Cs $^{239/240}Pu$ ^{90}Sr	pCi/g 7.7 E+01 2.0 E+01 5.2 E 00
	216-B-3 Pond/200 East Area (central surface)	^{137}Cs $^{239/240}Pu$ ^{90}Sr $^{Total}U$	pCi/g 8.3 E+01 1.0 E+01 1.7 E+01 3.8 E-01
	216-B-3 Pond/200 East Area (southcentral surface)	^{137}Cs $^{239/240}Pu$ ^{90}Sr $^{Total}U$	pCi/g 5.9 E 00 <8.5 E-01 1.8 E 00 1.4 E-01
Old Pipeline Scraping	241-AN Tank Farm/ 200 East Area (east)	^{137}Cs $^{239/240}Pu$ ^{90}Sr $^{Total}U$	pCi/g 3.3 E+02 3.7 E+03 1.6 E+02 4.1 E+02
Vegetation	216-B-3-3 Ditch (watercress)	^{137}Cs $^{239/240}Pu$ ^{90}Sr $^{Total}U$ ^{129}I ^{99}Tc	pCi/g 3.6 E 00 <1.4 E 00 3.1 E 00 7.3 E 00 <6.4 E 00 8.6 E 00
	216-S-10 Ditch (ditch head cattails)	^{137}Cs $^{239/240}Pu$ ^{90}Sr $^{Total}U$	pCi/g <8.3 E-01 <8.8 E-01 <4.7 E-01 1.9 E-01
Mollusks	216-B-3-3 Ditch/ 200 East Area (fresh water clams from outflow)	^{137}Cs $^{239/240}Pu$ ^{90}Sr $^{Total}U$ ^{129}I ^{99}Tc	pCi/g 3.4 E 00 <7.8 E-01 <4.2 E 00 1.3 E-05 <1.0 E 00 <1.6 E+02

Table 8-1. Investigative Samples Collected from the Operations Areas, 1994. (sheet 4 of 7)

Sample type	Sample location	Selected radionuclides	Concentration
Mollusks (continued)	216-B-3-3 Ditch/ 200 East Area (fresh water clams from ditch head)		pCi/g
		^{137}Cs	1.6 E+01
		$^{239/240}Pu$	<2.2 E 00
		^{90}Sr	8.3 E 00
		^{129}I	<6.0 E-01
		^{99}Tc	<3.5 E-02
Reptiles	105-N/100 N Area (rattlesnake stomach contents)		pCi-g
		^{60}Co	1.4 E+02
		^{137}Cs	1.4 E+02
		$^{239/240}Pu$	<1.2 E+01
		^{90}Sr	5.5 E+01
		$^{Total}U$	2.1 E-01
	105-N/100 N Area (rattlesnake body)		pCi/g
		^{60}Co	1.6 E+04
		^{137}Cs	1.1 E+03
		$^{239/240}Pu$	6.8 E+02
		^{90}Sr	1.1 E+01
		$^{Total}U$	4.1 E-01
	105-N/100 N Area (rattlesnake head)		pCi/g
		^{60}Co	1.3 E+02
		^{137}Cs	1.1 E+02
		$^{239/240}Pu$	<4.8 E-01
		^{90}Sr	3.8 E+01
		$^{Total}U$	3.7 E-02
	221-T Plant/200 West Area (25 cm pink gopher snake)		pCi/g
		^{137}Cs	<4.2 E 00
		^{90}Sr	1.1 E+01
		$^{Total}U$	2.9 E-03
	221-B Plant/200 East Area (40 cm gopher snake)		pCi/g
		^{137}Cs	6.3 E+02
		$^{239/240}Pu$	<6.3 E-01
		^{90}Sr	3.6 E+02
		$^{Total}U$	2.1 E-02
	2713-WB/200 West Area (60 cm gopher snake)		pCi/g
		^{137}Cs	1.7 E+03
		$^{239/240}Pu$	<4.0 E-01
		^{90}Sr	7.8 E+02
		$^{Total}U$	1.6 E-02
Birds	MO-327/200 East Area (western kingbird nest)		pCi/g
		^{137}Cs	5.2 E 00
		^{90}Sr	1.4 E+01
		$^{Total}U$	1.1 E-01

Table 8-1. Investigative Samples Collected from the Operations Areas, 1994. (sheet 5 of 7)

Sample type	Sample location	Selected radionuclides	Concentration
Birds (continued)	MO-973/200 West Area (cliff swallow nest - 100 cpm)	^{60}Co ^{137}Cs $^{239/240}Pu$ ^{90}Sr $^{Total}U$	pCi/g 4.6 E-01 2.0 E+01 <8.7 E-01 2.1 E+01 1.9 E-03
	105-KE/100 K Area (western kingbird nest - 400 cpm)	^{60}Co ^{137}Cs $^{239/240}Pu$ ^{90}Sr $^{Total}U$	pCi/g 9.7 E-01 3.4 E+01 1.7 E 00 8.4 E 00 3.8 E-03
Mammals	MO-543/200 East Area (mouse skeleton found under trailer)	^{137}Cs ^{90}Sr $^{Total}U$	pCi/g 4.9 E-01 1.3 E+01 4.2 E-03
	272-S Insulator Shop/ 200 West Area (deer mouse - 12,500 cpm)	^{137}Cs $^{239/240}Pu$ ^{90}Sr $^{Total}U$	pCi/g 1.6 E+03 <6.8 E-01 1.4 E+03 1.0 E-03
	244-A Lift Station/ 200 East Area (deer mouse - >100,000 cpm)	^{137}Cs $^{239/240}Pu$ ^{90}Sr $^{Total}U$	pCi/g 2.1 E+03 <4.2 E+01 9.0 E+04 3.2 E-03
	244-A Lift Station/ 200 East Area (deer mouse - 30,000 cpm)	^{137}Cs $^{239/240}Pu$ ^{90}Sr $^{Total}U$	pCi/g 6.9 E+02 <1.4 E+01 2.3 E+03 2.9 E-03
	244-A Lift Station/ 200 East Area (deer mouse - 6,000 cpm)	^{137}Cs $^{239/240}Pu$ ^{90}Sr $^{Total}U$	pCi/g 2.4 E+01 <2.0 E+01 3.2 E+02 2.9 E-03
	244-A Lift Station/ 200 East Area (deer mouse - 20,000 cpm)	^{137}Cs $^{239/240}Pu$ ^{90}Sr $^{Total}U$	pCi/g 2.7 E+03 <2.3 E+01 2.8 E+04 5.4 E-03

Table 8-1. Investigative Samples Collected from the Operations Areas, 1994. (sheet 6 of 7)

Sample type	Sample location	Selected radionuclides	Concentration
Mammals (continued)	244-A Lift Station/ 200 East Area (deer mouse - 5,000 cpm)	^{137}Cs $^{239/240}Pu$ ^{90}Sr $^{Total}U$	pCi/g 9.2 E+01 <1.5 E+01 3.8 E+03 3.8 E-03
	2711-E Garage/200 East Area (deer mouse - 12,500 cpm)	^{137}Cs $^{239/240}Pu$ ^{90}Sr $^{Total}U$	pCi/g 2.5 E+05 <4.1 E 00 2.1 E+03 9.0 E-03
	2713-WB Green Hut/200 West Area (deer mouse - 2,000 cpm)	^{137}Cs $^{239/240}Pu$ ^{90}Sr $^{Total}U$	pCi/g 2.1 E+02 <3.4 E 00 1.3 E+04 7.0 E-03
	231-Z/200 West Area (deer mouse - >100,000 cpm)	^{137}Cs $^{239/240}Pu$ ^{90}Sr $^{Total}U$	pCi/g 4.4 E+01 <7.1 E-01 1.9 E+02 4.2 E-03
	241-S Tank Farm Complex/DACS Trailer/ 200 West Area (deer mouse)	^{137}Cs $^{239/240}Pu$ ^{90}Sr $^{Total}U$	pCi/g 2.4 E+03 <8.6 E-01 2.8 E+02 1.3 E-03
	241-BX Tank Farm/200 East Area (deer mouse - 8,000 cpm)	^{137}Cs $^{239/240}Pu$ ^{90}Sr $^{Total}U$	pCi/g 2.5 E+04 <1.6 E+01 7.2 E+03 1.1 E-02
	241-C Tank Farm/ 271-CR Vault/200 East Area (deer mouse - 2,500 cpm)	^{137}Cs $^{239/240}Pu$ ^{90}Sr $^{Total}U$	pCi/g 3.5 E+01 <7.8 E 00 1.6 E+03 1.2 E-01
	241-C Tank Farm/ 271-CR Vault/200 East Area (deer mouse - 1,800 cpm)	^{137}Cs $^{239/240}Pu$ ^{90}Sr $^{Total}U$	pCi/g <1.7 E+01 <6.9 E 00 <2.0 E 00 1.3 E-03

Table 8-1. Investigative Samples Collected from the Operations Areas, 1994. (sheet 7 of 7)

Sample type	Sample location	Selected radionuclides	Concentration
Mammals (continued)	216-B-63 Crib/Pit 64/ 200 East Area (deer mouse - >100,000 cpm)	^{137}Cs $^{239/240}Pu$ ^{90}Sr $^{Total}U$	pCi/g 7.5 E 00 <3.0 E 00 1.1 E+04 5.6 E-02
	Intersection of Route 2 South & RR Tracks (coyote feces)	^{137}Cs $^{239/240}Pu$ ^{90}Sr $^{Total}U$	pCi/g <1.1 E 00 <1.6 E 00 2.2 E 00 6.7 E-03
	218-W-5 Burial Ground/ 200 West Area (coyote feces - south)	^{137}Cs $^{239/240}Pu$ ^{90}Sr $^{Total}U$	pCi/g <2.1 E-01 <3.3 E-01 3.9 E-01 2.2 E-03
	218-W-5 Burial Ground/ 200 West Area (coyote feces - north)	^{137}Cs $^{239/240}Pu$ ^{90}Sr $^{Total}U$	pCi/g <2.1 E-01 <6.8 E-01 6.4 E-01 1.3 E-03

[a] - picocuries per liter
[b] - micrograms per milliliter (uG/ml).
[c] - picocuries per sample (indicates sample was extremely small).
[d] - picocuries per gram
< - ("less than" symbol) indicates uncertainty in the analytical results because of the small sample mass.

Air sampling results from four waste handling and storage facilities were collected for 1 week and analyzed. The following sampling sites were selected:

- Plutonium Finishing Plant
- 241-BY Tank Farm
- 1301-N Trench
- 300 Area Trenches and North Ponds.

These sites were chosen as being representative of most of the Hanford waste sites, which are known to be diffuse emission sites. The following criteria were used to evaluate the sites:

- Physical size
- Surface contamination level
- Geology
- Vegetation density
- Surface cover
- Potential for occupational exposure
- Potential for public exposure.

The characteristics of the selected sites vary greatly based on these selection criteria parameters, therefore the sites should provide representative data for most of Hanford's waste sites.

The total alpha, total beta, and isotopic analytical results indicate that the emissions from these selected diffuse sources were below or slightly above the minimum detection limits of the analytical processes used. In most cases, the analytical results for samples collected downwind were not statistically different than those collected upwind, which would indicate that, for the meteorological conditions during sampling, emissions from these diffuse sources were not measurable. In two cases, $^{239/240}Pu$ at PFP and ^{60}Co at 1301-N, the downwind samples were statistically higher than the upwind samples. In these cases, the isotopes were well below the DCGs. DCGs are concentration values of a radionuclide in air or water that, under conditions of continuous exposure for 1 year by 1 exposure mode (i.e., ingestion of water, submersion in air, or inhalation), would result in an EDE of 100 mrem, 0.1 rem (1 microsievert) to a reference man.

A detailed study of diffuse emissions is currently not justified, because the existing air sample data indicate that these emission sources contribute much less than 0.1 mrem/yr total effective dose equivalent (TEDE) to the maximum exposed individual (MEI). For 1992 and 1993, the EDE for the MEI caused by emissions from diffuse sources were estimated to be 0.035 and 0.028 mrem/y, respectively. Results are in the *Final Report of Fugitive and Diffuse Emissions Evaluations at the Hanford Site* (WHC-SD-WM-TRP-227).

8.4.2 Surface Water

A sample of runoff water was collected at the 241-U Tank Farm in the 200 West Area in 1994 to determine if radionuclide contaminants were present. Measurable radionuclides included ^{90}Sr (5.2 E+02 pCi/g), ^{137}Cs (1.3 E+02 pCi/g), and $^{239/240}Pu$ (4.5E-01 pCi/g), indicating that runoff water may be a source of radionuclide contamination outside the tank farms. A sample of

discolored effluent water taken from the 216-B-3-3 Ditch as it was being decommissioned in 1994 was analyzed for potential hazardous chemicals. Results indicated near background levels of radiation and potential hazardous contaminants. Results of surface water sampling are listed in Table 8-1 and in Appendix I, Table I-1.

8.4.3 Soil

In 1994, 19 investigative soil samples were taken (Table 8-1 and in Appendix I, Table I-2). The radionuclides of highest concentration were ^{137}Cs (80,000 pCi/g), ^{90}Sr (4,800 pCi/g), and $^{239/240}Pu$ (4,000,000 pCi/g), all from samples taken near the 241-A Tank Farm complex in the 200 East Area. A soil sample from 216-B-3A Pond sediment had total uranium values higher than expected (380,000 pCi/g). The high uranium value at that pond was determined to be a laboratory reporting error. The error determination was made because rechecks of field instrument readings on this sample indicated only background radioactivity and because 11 other samples from that pond were all within environmental ranges for radionuclide levels. In addition, 75 incidents of contaminated soil and specks were found during radiological surveys and disposed of to low-level burial grounds without isotopic analyses (Appendix I, Table I-3).

The ^{90}Sr, ^{137}Cs, ^{210}Pb, $^{239/240}Pu$, and ^{241}Am values were from three samples taken during excavation for a new transfer pipeline. During excavation an out-of-service vitreous clay pipeline was exhumed and broken open exposing a solidified green material contained significant levels of alpha, beta, and gamma radiation contamination. The number of contamination incidents, radioactivity levels, and ranges of radionuclide concentrations were within historical ranges. Areas where special soil sampling or surveys indicated radioactivity levels greater than WHC radiological control limits (WHC 1991a) were posted as radiological control areas as dictated in the *Hanford Site Radiological Control Manual*, HSRCM-1, Revision 2 (DOE 1994).

In 1994, the number of contamination incidents, radioactivity levels, and range of radionuclide concentrations were within historical ranges.

8.4.4 Biota

8.4.4.1 Vegetation. In 1994, two vegetation samples (i.e., cattails and watercress) from the 216-B-3-3 Ditch were analyzed for radionuclide concentrations (Table 8-1 and in Appendix I, Table I-4). Analytical results were well below WHC radiological control limits (WHC 1991a). In addition, 37 instances of contaminated vegetation (i.e., tumbleweeds, other weeds, and big sagebrush) were recorded in operational areas in 1994 (Appendix I, Table I-5). This vegetation was found during remedial operations, surveyed with field instruments, and disposed of to low-level burial grounds. Field instrument readings, analytical results, and the amount of contaminated vegetation were within results reported for the past few years. The greatest number of contaminated vegetation samples (42) were submitted for analyses in 1978.

8.4.4.2 Wildlife. Animals were collected either as part of a pest control program designed to limit the exposure and potential contamination of animals to radioactive material, as a result of finding a radiologically contaminated dead animal, or as part of investigations to determine radionuclide concentrations in wildlife at existing or planned facilities or projects. Field instrument surveys were performed after collection to determine whether an animal was radioactively contaminated. If an animal was free of contamination, it was taken to a suitable habitat area and released. If an animal was contaminated, whether to collect it as a sample or dispose of it to a low-level burial ground was decided based on the level of contamination, facility, and frequency of occurrence.

In 1994, 27 investigative wildlife (including nests and feces) samples were analyzed, of which 23 showed some level of radioactivity above background levels (Table 8-1 and in Appendix I, Table I-6). The radionuclides found at the greatest concentration were ^{60}Co (16,000 pCi/g) also in a western rattlesnake from the 100 N Area; ^{90}Sr (90,000 pCi/g) in a deer mouse from the north stairwell of the 244-A Lift Station in 200 East Area; ^{137}Cs (250,000 pCi/g) in a deer mouse from 2711-E Garage in the 200 East Area; and $^{239/240}Pu$ (680 pCi/g) in the western rattlesnake from the 100 N Area. The western rattlesnake was particularly interesting because the radioactivity appeared to be originating from a large lump of digesting prey in the snake's stomach. Dissection of the snake did not allow identification of the prey, but the size and mass indicated that it was probably a mouse. Other notable incidents were deer mice at the 200 East Garage (a previously uncontaminated building), at the 241-A Lift Station, and the 241-C Tank Farm in the 200 East Area. One of two freshwater clam samples from 216-B-3-3 Ditch near the 200 East Area showed slightly elevated ^{137}Cs (16 pCi/g); all other radionuclides in the clams were within environmental background levels. Three coyote feces samples, two from the 200 West Area and one from the 600 Area, were within environmental background concentrations for all radionuclides. Also, there were 11 cases of contaminated animals or feces found during cleanup operations, which were disposed to a low-level waste burial ground without being analyzed (Appendix I, Table I-7). Field instrument readings of radioactive contamination ranged from 200 to 240,000 cpm. The total number of animals found to be contaminated with radioactivity, the radioactivity levels, and the range of radionuclide concentrations was within historical limits. However, the number of wildlife found contaminated was lower than the 30 found in 1993; 26 were found in 1992. The greatest number of contaminated animals was found in 1982 when 44, mostly pigeons, were found.

The practical results of these data, in addition to those mentioned previously were to identify locations where pest control, waste containment, or biotic barriers needed to be improved or added. Benefits derived from this sampling included improved worker health and safety, reduced potential exposures, and reduced cleanup costs.

8.5 SPECIAL CHARACTERIZATION SAMPLING

Special characterization projects were conducted to verify the radiological and, in some cases, hazardous chemical status of several operations. These included the following:

- Ambient air monitoring to determine the levels of fugitive diffuse air emissions at the Plutonium Finishing Plant in the 200 West Area, the 241-BY Tank Farm in the 200 East Area, the 1301-N Liquid Effluent Trench in the 100 N Area, and at the 300 Area Process Ponds and Trenches.

- Ambient air sampling at the transuranic (TRU) waste retrieval trenches at the 218-W-4C Burial Ground in the 200 West Area to detect potential diffuse emissions during TRU waste retrieval operations.

- Soil and sediment sampling during decontamination and decommissioning of the 216-B-3 Pond and 216-B-3-3 Ditch.

- Ambient air sampling and installation of TLDs at the 300 Area TEDF.

- Biota sampling at the 244-A Lift Station and the 241-C Tank Farm to determine the extent of radionuclide contamination and transport by animals.

- Continued preoperational monitoring for the Cross-site Transfer Line replacement (Project W-058).

- Completed preoperational monitoring for the 200 Areas Effluent Treatment Facility and associated facilities (Project C-018H).

- Preoperational monitoring at the three main expansion projects (Waste Receiving and Packaging, Mixed Waste Storage, and Central Waste Complex) of the Solid Waste Operations Complex in the 200 West Area.

Diffuse emissions measured at the 107-C Retention Basin in the 100 B/C Area, the 118-B-1 Burial Ground near the 100 B/C Area, the 107 KE/KW Basins in the 100 K Area, the 1301-N Liquid Effluent Trench in the 100 N Area, the Plutonium Finishing Plant in the 200 West Area, the 241-BY Tank Farms in the 200 East Area, and the 300 Area Process Ponds and Trenches were collected during typical meteorological conditions and were sometimes measurable but not significant. Detailed results of the fugitive diffuse emissions study can be found in the *Final Report of Fugitive and Diffuse Emissions Evaluations at the Hanford Site, CY 1994* (WHC 1995a).

Ambient air monitoring at the 218-W-4C Burial Grounds in the 200 West Areas during trial TRU Waste Retrieval did not indicate increased diffuse radionuclide emissions during these operations.

The 216-B-3-3 Ditch and the 216-B-3 Pond were decommissioned in 1994. The 216-B-3A Pond was surface stabilized but left in place. The values for radionuclides in samples of sediment soil, surface soil (dried-out pond sediment), watercress, and freshwater clams were near background levels for

radionuclides, and only occasionally measurable by laboratory analyses (Table 8-1, and in Appendix I, Tables I-1, I-2, I-4, and I-6). A single uranium concentration of 380,000 pCi/g in a surface soil sample from 216-B-3A Pond was considered to be in error because the field instrument readings of the sample did not indicate measurable radioactivity and the analytical results for the other 11 soil samples from this pond did not show elevated concentrations of radionuclides.

Construction was completed on the 300 Area Treated Effluent Disposal Facility in 1994. An ambient air sampler and six TLDs began collecting baseline environmental data before startup.

Biotic contamination in the environs of the 216-C Tank Farm and the 244-A Lift Station in the 200 East Area received special attention in 1994 to document the extent and levels of contamination because Animal Control Operations activities had repeatedly discovered contaminated mice. Significant levels of contamination were identified in five deer mouse samples. Contamination, as measured by field instruments, ranged from 5,000 cpm beta/gamma to greater than 100,000 cpm. Laboratory analyses indicated the maximum ^{90}Sr contamination at 90,000 pCi/g and the maximum ^{137}Cs levels at 2,700 pCi/g. Maximum radionuclide concentrations are listed in Table 8-1 and in Appendix I, Table I-6.

In 1994, additional preoperational monitoring and characterization samples of soil and vegetation were collected at the 200 Areas Cross-Site Transfer Line Replacement Project. Samples were analyzed for both radioactive and chemical contaminants. Both radionuclide and hazardous chemical concentrations were near environmental background levels. Detailed results of the preoperational environmental monitoring for Project W-058 and for Project C-018H will be published in the final reports: *Preoperational Environmental Survey Report: 200 Areas Cross-site Transfer Line Replacement* (WHC 1995d), and *Preoperational Environmental Survey Report: 200 Areas Effluent Treatment Facility (ETF) and State-approved Land Disposal Structure (SALDS)* (WHC 1995e).

Preoperational monitoring for the Solid Waste Operations Complex will be published in a final report to be issued in 1996.

8.6 RESULTS OF BIOTA RADIOLOGICAL MONITORING IN THE 200 AREA ENVIRONS FROM 1965 TO 1993

In 1994, a document (Johnson et al. 1994) that included biota monitoring records from 85 separate environmental monitoring reports of the 200 Areas and environs, dating from 1965 to 1993, was released. The source records of environmental monitoring were published annually and the bulk of the data were obtained from those records. Additional sources of data included records of specific facilities, such as site characterization documents and preoperational environmental surveys. All these data were available in documents released for public use. Records from before 1965 are still being researched and are not included in this document. The intent of compiling these data into a single source was to identify past and current concentrations of radionuclides in biota at specific waste sites within each operable unit. This information may be used to help guide cleanup activities

to be completed under the *Comprehensive Environmental Response, Compensation, and Liability Act of 1980* (CERCLA).

The 200 Areas were the locations of the Hanford Site separation and process facilities and waste management units. These areas, consisting of about 40 km^2 (9,900 acres), are centrally located within the Hanford Site about 10 km (6.2 mi) south of the Columbia River and 30 km (18.6 mi) northwest of Richland, Washington (Figure 1-1).

For the purposes of this document, a sample was of interest if a radioactivity detection instrument indicated radioactivity above 200 cpm, or if a radionuclide concentration equaled or exceeded 10 pCi/g in laboratory analyses. About 4,500 instances of monitoring for radionuclide uptake or transport in biota in the 200 Areas environs have been identified. About 1,900 (45%) of these biota had radionuclide concentrations in excess of 200 cpm or 10 pCi/g. These radionuclide transport or uptake cases were distributed among 45 species of wildlife and 30 species of vegetation. The wildlife species most commonly associated with radioactive contamination were the house mouse and the deer mouse; the most common vegetation species was the Russian thistle.

The highest radionuclide concentration in vegetation was in Russian thistle (3.2 E+06 pCi/g of strontium-90) in 1981 at the 216-BC Cribs. As a comparison, the strontium-90 soil standard for releasing an area from radiological controls in the 200 Areas is 2.8 E+03 pCi/g. Since 1965 about 1,100 cases of radionuclide uptake by vegetation that resulted in concentrations greater than 10 pCi/g were recorded in the 200 Areas.

The highest radionuclide concentration in wildlife (6.6 E+10 pCi/g of strontium-90) was in a house mouse found at the 241-BX Tank Farm in the 200 East Area in 1991. Since 1965, about 830 cases of radionuclide uptake by wildlife that resulted in concentrations greater than 10 pCi/g have been discovered in the 200 Areas. Forty-two of the 50 highest radionuclide concentrations found in biota in the 200 Areas since 1965 have been in wildlife; only 8 have been in vegetation; the highest 10 concentrations all were in wildlife. Comparing the data showed that of about 2,400 biotic samples collected during routine monitoring near the operations areas, only about 120 (5%) exceeded 10 pCi/g. Of about 2,100 biotic samples collected during special investigations at known or suspected contaminated sites, about 1,800 (86%) exceeded background concentrations. The conclusion of this study was that biotic-spread radioactivity is an important factor near facilities, but does not become an important factor offsite. Therefore, a near-facility monitoring program serves a useful purpose.

The monitoring data indicated that radionuclide contamination has remained relatively localized even though it has spread beyond the intended waste site boundaries. The Hanford Site Environmental Surveillance Program, which routinely monitors known pathways to man, rarely detects contamination that originated from those sources beyond the operations areas in the 200 Areas. Conversely, the OEM Program routinely detects contamination at some waste sites. Noticeable improvements in availability to biota of radionuclide contamination were evident from those areas that have been interim stabilized, such as the 216-A-24 Crib, the 216-A-25 Pond, the 216-B-1, -2, and -3 Ditches, the 216-S Ponds, the 216-U-10 Pond, and the 216-BC Cribs. Other historical sources of radionuclide uptake, including the 200 Areas

Cross-site Transfer Line, the 244-A Lift Station, the 216-A-40 Basin, and the 216-B-3 Pond were interim stabilized in 1994.

Because of the variation in reporting results, cause and effect relationships between contamination concentrations observed in biota and definitive sources often was not possible beyond identifying contaminated areas of known access to biota. The data are still useful to help make clean-up decisions and maintain clean operations. The data do seem to indicate an overall downward trend in both numbers of biota that are taking up radionuclides and levels of uptake. This reduction is most likely a result of the decrease in radionuclide half-lives over time, cessation of operation activities, and, in some instances, improved barriers to biotic intrusion.

8.7 SUSPECT WASTE SITE INVESTIGATIONS

In 1994, 52 suspect waste site investigations were complete by Near-Field Monitoring personnel at the request of regulators or contractors. Forty-seven of these sites met the criteria for entry into the Waste Information Data System (WIDS) (Table 8-2).

The Hanford Federal Facility Agreement and Consent Order, also known as the Tri-Party Agreement (Ecology et al. 1994) identifies the WIDS as the official listing of Hanford Site waste management units. In response to RCRA 3004(u) of HSWA, the annual *Hanford Site Waste Management Units Report* (HSWMUR) is developed using the WIDS. During the fall of 1994, BHI was contracted by DOE to administer the WIDS and HSWMUR. Until then, WHC performed this activity.

Before a waste management unit is entered into the WIDS, a suspect waste site investigation is conducted and the site is evaluated. Not all sites investigated become WIDS entries. Table 8-2 describes the investigations of suspect waste sites that WHC conducted in 1994.

Individual contractor responsibility for suspect waste investigation and WIDS entries are being reviewed. Presently WHC Near-Field Monitoring personnel investigate suspect waste sites and complete WIDS entries for WHC and ICF Kaiser Hanford Company (ICF-KH) activities only.

Table 8-2. Results of Suspect Waste Site Investigations, 1994.

SITE IDENTIFICATION	LOCATION	RESULT	WIDS ENTRY
DB-15 Well	600 Area, north of B pond	Preexisting BWIP drill pad, failed revegetation	No
W-049 Green Soil	200 East, east of 241-A farm entrance road	Preexisting, previously unidentified radioactive soil excavated during project W-049 (low-level waste)	Yes (unplanned release)
246-L Catch Tank	200 West, 500 ft north of 272-S and 300 ft NW of 242-S.	Preexisting inactive tank that received personnel decon liquid (low-level waste)	Yes (catch tank)
W-291 VCP Excavation	200 West, 64 m (213 ft) south of the south end of 221-T	Preexisting previously unidentified contaminated soil excavated during project W-291 (mixed waste)	Yes (unplanned release)
100 BC Surface Chemical Dumping Area	100 BC, 360 m (1,180 ft) NE of 105-C reactor building	Large area with intermittent bare areas and miscellaneous debris	Yes (dumping area)
100 BC Laydown Yard	100 BC, 350 m (1,150 ft) NE of 105-C reactor building	Preexisting inactive storage area for treated power poles, light fixtures, experimental equipment, etc (nonhazardous, nonradioactive)	Yes (dumping area)
100 B Building Foundation Southwest	100 B, SW of 100 BC Area, 165 m (540 ft) SW of 118-B-1	Concrete pad with small amounts of debris (nonhazardous, nonradioactive)	No
100 B Building Foundation	100 B, 760 m (2,500 ft) NE of 105-B reactor building	Rectangular neatly stacked stones and bermed soil, possibly from farming or military activity	No

Table 8-2. Results of Suspect Waste Site Investigations, 1994.

SITE IDENTIFICATION	LOCATION	RESULT	WIDS ENTRY
118-K-3 Filter Crib	100 K, could not be located	Existence of this crib cannot be verified	No
1706 KE Caustic Tank	100 KE, east and adjacent to 1706 KE building	Inactive aboveground steel tank for sodium hydroxide storage, heel remains (hazardous waste)	Yes (storage tank)
1706 KE Sulfuric Acid Tank	100 KE, east and adjacent to 1706 KE building	Inactive aboveground steel tank for sulfuric acid storage, heel left in tank and transfer lines (hazardous waste)	Yes (storage tank)
1706 KE Chemical Storage Tank Dry Well	100 KE, east and adjacent to 1706 KE building	Inactive subsurface vertical concrete pipe, received acid and caustic overflow from associated tanks (hazardous waste)	Yes (French drain)
183-KE Sulfuric Acid Tank East	100 KE, 14 m (47 ft) NE of 120-KE-4	Aboveground horizontal sulfuric acid storage tank, tank removed after 1962, U-shaped base remains (hazardous waste)	Yes (storage tank)
183-KE Sulfuric Acid Tank West	100 KE, 8.2 m (27 ft) NE of 120-KE-4	Aboveground horizontal sulfuric acid storage tank, tank removed after 1962, U-shaped base remains (hazardous waste)	Yes (storage tank)
183-KE Sandblasting Site	100 KE, west of 183-KE alum storage tanks (126-KE-1 and -2)	Graveled area covered with purple garnet where components were sandblasted (nonhazardous, nonradioactive)	Yes (dumping area)
183-KE Acid Neutralization Pit and Overflow French Drain	100 KE, 9 m (30 ft) SW of most westerly 183-KE alum storage tank	Subsurface pit that received overflow and drainage from 183-KE day use sulfuric acid tank (hazardous waste)	Yes (neutralization unit)

Table 8-2. Results of Suspect Waste Site Investigations, 1994.

SITE IDENTIFICATION	LOCATION	RESULT	WIDS ENTRY
183-KE Acid Neutralization Pit	100 KE, adjacent and <1 m (2 ft) west of 183-KE building	Subsurface brick-lined concrete box that received overflow from nearby sulfuric acid tanks (hazardous waste)	Yes (neutralization unit)
165-KE Ethylene Glycol Tanks	100 KE, north of 165-KE and west of the personnel entry door	Two horizontal subsurface ethylene glycol storage tanks, removed 1994 (hazardous waste)	Yes (storage tank)
183-KE Bauxite Tank	100 KE, 38 ft SE of 183-KE	Inactive aboveground vertical tank that stored dry bauxite (nonhazardous, nonradioactive)	Yes (storage tank)
183-KE Sodium Silicate Storage Tank East	100 KE, south of 183-KE, 4 m (14 ft) SW of 120-KE-5	Aboveground vertical tank used to store sodium silicate, tank removed, concrete base remains (hazardous waste)	Yes (storage tank)
183-KE Sodium Silicate Storage Tank West	100 KE, 11 m (35 ft) SE of 183-KE	Aboveground vertical tank used to store sodium silicate, tank removed, concrete base remains (hazardous waste)	Yes (storage tank)
183-KE Caustic Soda Storage Tank	100 KE, 12 m (40 ft) NE of 183-KE	Aboveground tank used for sodium hydroxide storage, tank removed, grade-level concrete remains (hazardous waste)	Yes (storage tank)
183-KE Caustic Neutralization Pit	100 KE, 22 m (73 ft) NE of 183-KE	Subsurface brick-lined concrete box for neutralization and disposal of sodium hydroxide overflow (hazardous waste)	Yes (neutralization unit)
Acid Neutralization Pit Near 120-KE-4 and -5	100 KE, 2 m (8 ft) SW of 120-KE-5	Subsurface brick-lined concrete box that received overflow from nearby sulfuric acid tanks (hazardous waste)	Yes (neutralization unit)

Table 8-2. Results of Suspect Waste Site Investigations, 1994.

SITE IDENTIFICATION	LOCATION	RESULT	WIDS ENTRY
118-KE-2 French Drain (104 K Dry Well) North	100 KE, 2 m (5 ft) NW of 118-KE-2 horizontal control rod cave	Subsurface vertical steel pipe that received drainage from 118-KE-2	Yes (French drain)
118-KE-2 French Drain (104 K Dry Well) South	100 KE, 2 m (5 ft) NW of 118-KE-2 Horizontal Control Rod Cave	Subsurface vertical steel pipe that received drainage from 118-KE-2	Yes (French drain)
183-KW Sulfuric Acid Tank West	100 KW, 8 m (27 ft) NE of 120-KW-4	Aboveground horizontal sulfuric acid storage tank, tank removed after 1962, U-shaped base remains (hazardous waste)	Yes (storage tank)
183-KW Sulfuric Acid Tank East	100 KW, 14 m (47 ft) NE of 120-KW-4	Aboveground horizontal sulfuric acid storage tank, tank removed after 1962, U-shaped base remains (hazardous waste)	Yes (storage tank)
183-KW Liquid Alum Storage Tank	100 KW, south of 183-KW	Aboveground vertical tank originally used to store liquid alum and later used for diesel fuel and purge water (hazardous waste)	Yes (storage tank)
183-KW Acid Neutralization Pit	100 KW, adjacent and <1 m (2 ft) west of 183-KW building	Subsurface brick-lined concrete box that received overflow from nearby sulfuric acid tanks (hazardous waste)	Yes (neutralization unit)
165-KW Ethylene Glycol Tanks	100 KW, north of 165-KW and west of the personnel entry door	Two horizontal subsurface ethylene glycol storage tanks, removed 1993 (hazardous waste)	Yes (storage tank)
183-KW Bauxite Tank	100 KW, 12 m (38 ft) SE of 183-KW	Inactive aboveground vertical tank that stored dry bauxite (nonhazardous, nonradioactive)	Yes (storage tank)

Table 8-2. Results of Suspect Waste Site Investigations, 1994.

SITE IDENTIFICATION	LOCATION	RESULT	WIDS ENTRY
183-KW Sodium Silicate Storage Tank East	100 KW, SE of 183-KW	Aboveground vertical tank used to store liquid sodium silicate, tank removed, grade-level concrete base remains (hazardous waste)	Yes (storage tank)
183-KW Sodium Silicate Storage Tank West	100 KW, SE of 183-KE	Aboveground vertical tank used to store liquid sodium silicate, tank removed, grade-level concrete base remains (hazardous waste)	Yes (storage tank)
183-KW Caustic Soda Storage Tank	100 KW, 12 m (40 ft) NE of 183-KW	Aboveground tank used for sodium hydroxide storage, tank removed, grade-level concrete remains (hazardous waste)	Yes (storage tank)
183-KW Caustic Neutralization Pit	100 KW, 22 m (73 ft) NE of 183-KW	Subsurface brick-lined concrete box for neutralization and disposal of sodium hydroxide overflow (hazardous waste)	Yes (neutralization unit)
Acid Neutralization Pit Near 120-KW-3 and -4	100 KW, 2 m (8 ft) SW of 120-KW-3	Subsurface brick-lined concrete box that received overflow from nearby sulfuric acid tanks (hazardous waste)	Yes (neutralization unit)
118-KW-2 French Drain (104 K Dry Well) North	100 KW, 2 m (5 ft) NW of 118-KW-2 horizontal control rod cave	Subsurface vertical steel pipe that received drainage from 118-KW-2	Yes (French drain)
118-KW-2 French Drain (104 K Dry Well) South	100 KW, 2 m (5 ft) NW of 118-KW-2 horizontal control rod cave	Subsurface vertical steel pipe that received drainage from 118-KW-2	Yes (French drain)

Table 8-2. Results of Suspect Waste Site Investigations, 1994.

SITE IDENTIFICATION	LOCATION	RESULT	WIDS ENTRY
100 N May 1993 Soil Contamination Site #1	100 N, 120 m (394 ft) NE of 1120 N	May 1993 radiation survey identified ^{60}Co, photos show equipment stored at location (low-level waste)	Yes (unplanned release)
100 N/DDR Concrete Foundation	600 Area, 1,170 m (3,840 ft) SW of 105-DR reactor building	Preexisting 6-ft square concrete foundation (nonhazardous, nonradioactive)	No
128N-FS-3	100 N, 500 m (1,640 ft) and east of 1120 N	Preexisting ash covered area with glass, wire coil, pipe, cans, metal, and other debris present; tested positive for PCB (hazardous waste)	Yes (burning pit)
100 N Corridor 22	100 N, just outside Corridor 22 doorway	Preexisting radioactive liquid spilled (low-level waste)	Yes (unplanned release)
100 N caustic truck spill	100 N, 43 m (140 ft) NW of 116-N-2	Preexisting sodium hydroxide spill during tanker truck unloading (hazardous waste)	Yes (unplanned release)
100 N Military Artillery Site	100 N, 1,100 m (3,600 ft) SE of 105-N reactor building	Preexisting military site including 10 concrete foundations, walkways, asphalt road, sewer manholes, miscellaneous debris (nonhazardous, nonradioactive)	Yes (military installa-tion)
100 N Military Ash Pit	100 N, 1,170 m (3,840 ft) SE of 105 N reactor building	Preexisting area covered with uniform dark ash	Yes (ash pit)
100 N French Drain 1	100 N, 64 m south of 116-N-2	Subsurface structure with 3-ft diameter metal cover at grade	Yes (French drain)

Table 8-2. Results of Suspect Waste Site Investigations, 1994.

SITE IDENTIFICATION	LOCATION	RESULT	WIDS ENTRY
100 N French Drain 2	100 N, 8 ft north of 13-N building	Subsurface vertical concrete pipe, with vented metal cover	Yes (French drain)
1705-N Septic Tank and Cesspool	100 N, 14 m (46 ft) north of 1714-NB	Subsurface structure with 3.5 ft square metal cover at ground surface (nonhazardous, nonradioactive)	Yes (septic tank)
100 N May 1993 Soil Contamination Site #2	100 N, 430 m (1,400 ft) east of 1120-N	May 1993 radiation survey identified ^{137}Cs (low-level waste)	Yes (dumping area)
128N-FS-1	100 N, 420 m (1,380 ft) east of 1120-N	Preexisting gravel/cobbled area used to burn paper, wood, trash from 100 N activities	Yes (burning pit)
100 N Dumping Area	100 N, 410 m (1,345 ft) east of 1120-N	Preexisting construction debris including asphalt, concrete, metal pipe	Yes (dumping area)

9.0 REFERENCES

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APPENDIX A

QUALITY ASSURANCE

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QUALITY ASSURANCE

Quality Assurance (QA) may be defined as the actions necessary to ensure the accuracy of a program. Westinghouse Hanford Company's (WHC) environmental surveillance QA program consists of procedures and guides to demonstrate that environmental monitoring techniques and analyses are performed within established limits of acceptance. This is documented in the Operational Environmental Monitoring Program (OEMP) QA Project Plan (Schmidt 1993).

Written operating procedures are an integral part of the WHC OEMP QA program. Procedures for field operations are provided in an internal WHC manual. This appendix briefly describes the essential components of the WHC OEMP QA program.

DOCUMENTATION

Record keeping is a vital part of any environmental monitoring program. Maintenance of environmental data is important from a QA standpoint, from a regulatory standpoint, and for trend analysis and optimization of environmental monitoring procedures. For these reasons, each phase of the WHC OEMP is documented. This documentation includes sampling logs, annual reports, and occurrence reports.

SAMPLE REPLICATION

Replicate sampling and subsequent analysis are the primary means of assessing sample variability. Duplicate samples of air, water, soil, sediment, and vegetation are collected as part of the routine OEMP.

DATA ANALYSIS

Environmental data are reviewed to determine compliance with applicable Federal and company guides. The data are analyzed both graphically and by standard statistical tests to determine trends and impacts on the environment. Newly acquired data are compared with historical data and natural background levels. Routine environmental data are stored on both magnetic media (i.e., in a computer environment) and hard-copy printouts.

TRAINING

To ensure quality and consistency in sample collection and handling, all personnel performing such work received formal training. All WHC Health Physics Technicians (HPT) are required to complete a certification program through the WHC Health Physics Department. In addition, those HPTs assigned to environmental programs receive special classroom orientation and on-the-job training by experienced personnel. Environmental Engineering Studies personnel, in addition to their formal training received while obtaining

professional degrees, received training in such courses as "Radiation in the Environment," taught through the Tri-Cities University Center, courses taught at the Harvard School of Public Health, and various short courses.

SAMPLE FREQUENCY

The frequency of sample collection is presented below.

1. Ambient air sample filters and water samples from active ponds and ditches are collected biweekly.

2. Radiological surveys of roads are performed on a quarterly or bimonthly basis, as stated in Section 7.0.

3. The thermoluminescent dosimeters (TLD) at facilities, ponds, and ditches are exchanged quarterly.

4. Radiological surveys of waste sites are performed quarterly, semiannually, or annually depending on the operating status, condition, and history of the site.

5. The soil, vegetation, and fecal samples are collected annually. Mud and vegetation samples from active ponds and ditches also are collected annually.

ANALYTICAL PROCEDURES

Three laboratories provided analytical support to the WHC OEMP; these are the International Technology Analytical Services-Richland Laboratory (ITAS-RL), the Radiation Standards and Engineering Laboratory at Pacific Northwest Laboratory (PNL), and the WHC 222-S Analytical Laboratory. The environmental samples are analyzed in accordance with prescribed procedures and quality control guides. The analytical procedures necessary to implement the environmental monitoring program are described briefly below and are listed according to the respective laboratory.

International Technology Analytical Services

Much of the OEMP involves measuring radionuclide concentrations at or near background levels. These environmental measurements require a very low detection limit and typically are performed at ITAS-RL. The analytical laboratory routinely performs analyses on soil, vegetation, animal feces, and air samples. Analyses are performed according to procedures and quality control guides described by the Environmental Measurements Laboratory (EML 1972), the U.S. Atomic Energy Commission (AEC 1974), and the National Council on Radiation Protection and Measurements (NCRPM 1976).

1. Air Samples

   a. Gamma Energy Analysis - Gamma-emitting radionuclides are measured by direct counting of the air sample filter with a high pure germanium detector. The gamma spectra are analyzed using a Nuclear Data 7700 software system.

   b. Strontium - Airborne ^{89}Sr and ^{90}Sr are determined by leaching the composited air sample filters with nitric acid and initially precipitating them as a nitrate. The sample is purified by iron and barium scavenging. The final precipitate, strontium carbonate, then is counted for total beta (needed to set the ^{89}Sr value) with a low-background beta proportional counter. Both ^{89}Sr and ^{90}Sr are calculated from the resulting count data using a computer.

   c. Plutonium - The various plutonium isotopes are leached from the air sample filter with nitric acid and passed through an ion-exchange resin. Further decontamination from lead, bismuth, and other transuranics by washing with nitric and hydrochloric acids is done. The plutonium then is eluted from the resin and electrodeposited on a stainless-steel disk, where it is counted using a surface barrier alpha spectrometer, and data are collected on a Nuclear Data system.

   d. Uranium - The uranium is leached from the air sample filter and extracted as tetrapropyl ammonium uranyltrinitrate followed by back extraction into water. Following treatment with sodium and LiF, the aqueous sample is analyzed with a fluorometer to determine the mass of uranium.

2. Groundwater Samples

   a. Total Alpha and Beta Activity - The total activity caused by alpha- and beta-emitting radionuclides is measured by directly counting the dried residue with a gas-flow proportional counter.

   b. Strontium-90 - The strontium is removed from the water sample by precipitating it as a nitrate using nitric acid. The sample is purified by repeated scavenging with barium chromate and precipitating with barium carbonate. The strontium carbonate then is counted with a low-background gas-flow proportional counter.

   c. Gamma Energy Analysis - Gamma-emitting radionuclides are analyzed by directly counting the water sample with a Germanium-Lithium Ge(Li) detector equipped with a multichannel pulse-height analyzer.

   d. Tritium - Water samples are analyzed for tritium with a liquid scintillation spectrometer.

   e. Total Uranium - The water samples are analyzed for uranium first by treating them with sodium and lithium fluoride and then analyzing them with a fluorometer.

3. Soil Samples

a. Gamma Energy Analysis - Gamma-emitting radionuclides in soil are measured using a Marinelli beaker and counting with a Ge(Li) detector equipped with a multichannel pulse-height analyzer.

b. Strontium-90 - The ^{90}Sr is removed from the soil sample by leaching the dried sample with nitric acid. The strontium in solution is converted to an oxalate followed by precipitation as strontium carbonate. The carbonate is deposited on a planchet and counted in the same manner as the ^{90}Sr water samples.

c. Technetium-99 - The ^{99}Tc is isolated from other elements using hydroxide carbonate coprecipitation, leaving it in solution as the pertechnethe ion (TcO_4^-). Further purification is achieved by an anion-exchange column path, followed by liquid scintillation spectrometry.

4. Vegetation Samples

a. Gamma Energy Analysis - Gamma-emitting radionuclides in vegetation are measured by direct counting of the sample with a Ge(Li) detector equipped with a multichannel pulse height analyzer.

b. Strontium-90 - The ^{90}Sr is removed from the vegetation sample by leaching the dried sample with nitric acid. The strontium in solution is converted to an oxalate followed by precipitation as strontium carbonate. The carbonate is deposited on a planchet and counted in the same manner as the ^{90}Sr water samples.

c. Technetium-99 - The ^{99}Tc is isolated from other elements using hydroxide carbonate coprecipitation, leaving it in solution as the pertechnethe ion (TcO_4^-). Further purification is achieved by an anion-exchange column path, followed by liquid scintillation spectrometry.

Pacific Northwest Laboratory Radiation Standards and Engineering

Thermoluminescent Dosimeters - External radiation levels are measured using TLDs. Three TLDs at each sampling location monitor facilities, water sampling sites, active tank farms and various cribs, and trenches associated with the PUREX Plant operation. The TLDs consist of four lithium fluoride LiF (TLD-700) and one calcium fluoride containing dysprosium as an impurity CaF_2:Dy (TLD-200) chip in a plastic card.

The TLDs are calibrated, packaged, and read by the PNL Radiation Calibration Laboratory, Radiation Standards and Engineering Department. All TLD work is performed in accordance with the procedures and specific guides from the American National Standards Institute (ANSI 1975) and PNL.

Westinghouse Hanford 222-S Analytical Laboratory

The WHC 222-S Laboratory also provides analytical support to the OEMP. This laboratory is the one normally used for samples containing higher-than-normal environmental levels of radioactivity. Analytical procedures and quality control guides are described by the EML (EML 1972), the American Society for Testing and Materials (ASTM 1976), the American Public Health Association (APHA 1980), and the U.S. Environmental Protection Agency (EPA 1979). A brief description of the routine analyses performed by the 222-S Laboratory is presented below.

1. Pond and Ditch Water

   a. Total Alpha and Beta Activity - An aliquot of the pond or ditch water is added to a stainless-steel dish and evaporated to dryness. The total alpha and beta activities are measured by direct counting with a gas flow proportional counter.

   b. Gamma Energy Analysis - The liquid sample is sealed inside a geometrically approved container. The gamma-emitting radionuclides are measured by direct counting with a Ge(Li) detector equipped with a multichannel analyzer.

   c. Strontium-90 - The ^{90}Sr is removed from the aqueous sample by precipitating the ^{90}Sr out with barium carbonate. The strontium carbonate is purified by redissolving with nitric acid, precipitating as a nitrate, and precipitating again as a carbonate. The ^{90}Sr activity is determined by beta counting with a gas flow proportional counter.

   d. Plutonium - Actinides are removed from the aqueous sample by precipitation with iron. The precipitate is redissolved in hydrochloric acid and the plutonium is separated from the other actinides by ion exchange. The plutonium is electrodeposited on a planchet and counted using alpha spectrometry.

2. Pond and Ditch Mud and Sediment

   a. Gamma Energy Analysis - The gamma-emitting radionuclides are measured by direct counting of the dried sediment sample using a Ge(Li) detector equipped with a multichannel analyzer.

   b. Soil Leach - Strontium, plutonium, americium, and other elements are leached from the soil sample using a mixture of hydrochloric and nitric acids. The leachate is then analyzed for specific radionuclides as is done with the liquid samples.

3. Pond and Ditch Vegetation

   a. Gamma Energy Analysis - The liquid sample is sealed inside a geometrically approved container. The gamma-emitting radionuclides are measured by direct counting with a Ge(Li) detector equipped with a multichannel analyzer.

b. Vegetation Leach - The vegetation samples are dry ashed in a furnace and then leached with a mixture of hydrochloric and nitric acids. The leachate is analyzed for specific radionuclides as is done with the liquid samples.

APPENDIX B

GLOSSARY

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GLOSSARY

Definitions

Aboveground Tank - A tank situated so that its entire surface area is completely above the plane of the adjacent surrounding surface and the entire surface area of the tank (including the tank bottom) is able to be visually inspected (WAC 173-303-040).

Accessible Soils - Hanford soils that are not behind security fences must meet the Table 6.2 values found in the Westinghouse Hanford Company *Environmental Compliance Manual*, WHC-CM-7-5. The values reflect a 10-mrem/yr EDE limit from Hanford operations to the most exposed member of the public.

Administrative Control Value (ACV) - Operating contractor's internally imposed release limit for an airborne or liquid effluent. The ACV is usually expressed as a fraction or multiple of the derived concentration guide (DCG)-public but may also be expressed as a total release value (curies per year for Kr-85 and tritium). In applying the ACV, the "Unity Rule" applies; the sum of the fractions of the ACV in an effluent shall not exceed 1.

Airborne Radioactive Effluents - Radioactive particles, mists, vapors, fumes, and/or gases contained or entrained in airborne effluents.

Aquifer - A subsurface formation consisting of sufficient saturated permeable material to yield significant quantities of water.

Areal Contamination - Contamination generally confined to less than the first centimeter of soil. Numerically, the radioactivity content averaged over a suitable area.

As Low As Reasonably Achievable (ALARA) - The implementation of ALARA is described in WHC-CM-4-11, ALARA Program Manual. This concept applies to maintaining releases at or below prescribed regulatory limits.

Assure - To remove any doubt, to promise.

Audit - An announced examination of a facility or operation to determine compliance with the specific requirements.

Average Soil Contamination - Contamination generally dispersed through the soil. Numerically, the radioactivity content averaged over a suitable mass of soil

Backfill Soil - The soil used as a plant growth medium between the depths of 30-120 cm as measured at the restabilization site.

Background Radiation - Refers to regional levels of radioactivity produced by sources other than those of specific interest (e.g., the nuclear activities at the Hanford Site).

Barrier or Engineered Barrier - At a disposal site, a man-made addition designed to retard or preclude radionuclide or other contaminant transport and/or preserve the integrity of the disposal site.

Becquerel (Bq) - The standard international unit of radioactivity. One Bq is one disintegration per second or:

$$Bq = 2.7\ E - 11\ Ci$$

Biological Transport - Means of biological transport may include one or more of the following processes:

- Movement of subsurface radioactivity to the surface by physiological vegetative processes
- Dispersion of such vegetation by the wind
- Contaminated urine and feces deposited by animals that have gained access to and ingested radioactive materials
- Contaminated animals themselves that have ingested radioactive materials directly or ingested other contaminated animals or plants
- Physical displacement of radioactive materials by burrowing animals
- Nests built using contaminated materials.

Biota - The plant and animal life of a specific region.

Building - A structure created to shelter any form of human activity, such as a house, barn, church, hotel, or similar structure; it also may refer to a historically related complex, such as a courthouse and jail; or at Hanford, buildings to include: old reactor buildings, office buildings, e.g., 2750 Building, 222-S Laboratory Building, etc.

Burial Ground - An area specifically designated for the subsurface disposal and/or storage of solid, dry radioactive waste.

Burial Ground - A land area specifically designated to receive contaminated solid or solidified liquid waste packages and equipment. The contaminated articles are usually placed in trenches and covered with overburden.

By-Product - A material that is not one of the primary products of a production process and is not solely or separately produced by the production process. Examples are process residues such as slags or distillation column bottoms. The term does not include a co-product that is produced for the general public's use and is ordinarily used in the form in which it is produced by the process.

Calibration - Determining the deviation of an instrument from a standard traceable to the National Bureau of Standards (NIST) or other recognized agency and reporting the deviations and/or eliminating them by adjustment.

Central Landfill - The contractor-operated, U.S. Department of Energy (DOE)-owned disposal site used for disposal of trash and other nonhazardous nonradioactive wastes.

Chemical Processing - Chemical treatment of material to separate desired components selectively. At the Hanford Site, plutonium, uranium, and fission products were chemically separated from irradiated fuels.

Chemical Substance - Any organic or inorganic substance except:

1. Any mixture.

2. Any pesticide when used as a pesticide.

3. Any tobacco product.

4. Any source material, special nuclear material, or by-product material.

5. Any firearms, shells, or cartridges.

6. Any food, food additive, drug, cosmetic, or device, when used for its intended purpose.

   Manufacture for Commercial Purpose - To import, produce, or manufacture with the purpose of obtaining commercial advantage for the manufacturer, including manufacturing any amount of a chemical substance or mixture for the following reasons:

   1. Distribution in commerce

   2. Use by the manufacturer, including use for product research and development, or as an intermediate. The definition of manufacturer includes extracting a chemical from another chemical substance or mixture of substances.

Chemical Trench - The central landfill trench that is for the disposal of chemicals, hazardous wastes, and hazardous substances.

Committed Dose Equivalent - The predicted total dose equivalent to a tissue or organ over a 50-year period after a known intake of a radionuclide into the body. It does not include contributions from external dose. Committed dose equivalent is expressed in units of rem (or sievert).

Committed Effective Dose Equivalent - The sum of the committed dose equivalents to various tissues in the body, each multiplied by the appropriate weighing factor. Committed effective dose equivalent is expressed in units of rem (or sievert).

Composite Sample - A number of random samples initially collected from a waste and combined into a single sample; this sample is analyzed for the contaminants of concern.

Comprehensive Environmental Response, Compensation, and Liability Act of 1980 **(CERCLA)** - Commonly known as "Superfund," CERCLA was enacted to respond to uncontrolled releases of hazardous substances to the environment, primarily at inactive sites that were not adequately addressed by the *Resource Conservation and Recovery Act of 1976* (RCRA). CERCLA also applies to actively-managed facilities and any onshore or offshore facility.

Confined Aquifer - A subsurface water-bearing region having defined and relatively impermeable upper and lower boundaries.

Conserve - Use methods and procedures necessary to protect any endangered or threatened species. Such methods and procedures include, but are not limited to, activities associated with scientific resources management such as research, census, law enforcement, habitat acquisition and maintenance, propagation, live trapping, and transplantation. In the extraordinary case where population pressures within a given ecosystem cannot be otherwise relieved, methods and procedures may include regulated taking.

Controlled Area - An area where access is controlled to protect individuals from exposure to radiation and radioactive materials.

Construction - Addition, enlargement, modification, replacement, alteration, or restart (after a period of 5 years of nonoperation) of any process or stationary source, which may increase emissions or ambient air concentrations of any contaminant for which federal or state ambient or emission standards have been established.

Contamination Limit - That concentration limit or activity limit for radioactive materials below which posting restrictions and environmental controls to protect personnel or the environment are not necessary.

Crib - A subsurface, low-level, liquid-waste disposal site that allows the liquid waste to percolate into surrounding soil.

Crib - An underground structure designed to receive liquid waste that percolates into the soil directly or percolates into the soil after having traveled through a connected tile field.

Decommissioning - Actions taken to reduce the potential health and safety impacts of DOE-controlled contaminated facilities. Actions could include stabilizing, reducing, or removing radioactivity or demolishing the contaminated facilities.

Decommissioning - The process of removing a facility or area from operation, often involving decontamination and/or disposal and incorporating appropriate controls and safeguards.

Decontamination - The removal of contamination from a surface or from within another material.

Decontamination - The removal of radioactive or hazardous contamination from facilities, equipment, or soils by washing, heating, chemical or electrochemical treating, mechanical cleaning, or other techniques.

Demolition Waste - Solid waste, made up largely of inert waste resulting from the demolition or razing of buildings, roads, and other man-made structures. Demolition waste consists of, but is not limited to, concrete, brick, bituminous concrete, wood and masonry, composition roofing and roofing paper, steel, and minor amounts of other metals like copper.

Plaster (sheet rock or plaster board), asbestos, or any material other than wood that is likely to produce gases or a leachate during the decomposition process is not considered to be demolition waste.

Derived Concentration Guide for Occupational Exposure (DCG-Occupational) - Those concentrations in air or water that an occupationally exposed individual would have to inhale/ingest in a year to result in 5,000 mrem/50 year dose commitment.

Derived Concentration Guide for Public Exposure (DCG-Public) - The concentration of radioactive materials in air or water specified in Appendix A, "Derived Concentration Guides for Controlling Exposure to Members of the Public," of this manual. The DCG-Public are those concentrations of radionuclides in air or water that would result in a maximum effective committed dose equivalent to 100 mrem per year using ICRP-30 dose methodology under conditions of continuous exposure or use (i.e., continuously breathing or being immersed in contaminated air or exclusively drinking contaminated water).

Diffuse Source - A source or sources of radioactive or chemical contaminants released into the environment that do not have a defined point or origin of release (a nonpoint source). Such sources are also known as area sources.

Dispersible - Capable of being widely spread.

Disposal - Discharging, discarding, or abandoning dangerous wastes, or the treatment, decontamination, or recycling of such wastes once they have been discarded or abandoned. This includes the discharge of any dangerous wastes into or on any land, air, or water (WAC 173-303-040). This definition also includes radioactive materials.

Disposal Facility - Any facility or part of a facility where hazardous and/or radioactive waste is intentionally placed or where any land or water waste will remain after closure.

District - A geographically definable area (urban or rural) which has a significant concentration, linkage, or continuity of sites, buildings, structures, or objects united either by past events or aesthetically by planned physical development. A district may also be individual elements that are separated geographically but linked by association or history.

Disturbance - Includes, but is not limited to, the following: leveling; firebreak, road, or utility line construction; excavation of pits, foundations and trenches; quarrying and borrowing of rock and soils; seismic testing; and stockpiling of earth.

Ditch - An open surface site for transport of liquid wastes to a pond or trench structure designed for percolation.

Ecology - The Washington State Department of Ecology.

Effective Dose Equivalent (EDE) - The summation of the products of the dose equivalent received by specified tissues of the body and a tissue-specific weighing factor. This sum is a risk-equivalent value and can be used to estimate the health-effects risk of the exposed individual. The tissue-specific weighing factor represents the fraction of the total health risk resulting from uniform whole-body irradiation that would be contributed by that particular tissue. The EDE includes the committed EDE from internal deposition of radionuclides and the EDE due to penetrating radiation from sources external to the body. EDE is expressed in units of rem (or sievert).

Effluent - An airborne or liquid discharge from a facility after all engineered waste treatment and effluent controls have been performed. The term includes onsite discharges to the atmosphere, lagoons, ponds, cribs, injection wells, French drains, or ditches. The term does not include solid waste stored or removed for disposal or wastes that are contained in retention basis or tanks prior to treatment and/or disposal.

Emissions Unit - Regarding air pollutant emissions, any part of a stationary source that emits or would have the potential to emit any pollutant subject to regulation.

Ensure - To make certain, make sure, make safe.

Environmental Monitoring Plan (EMP) - A two-part document prepared for each site, facility, or process that uses, generates, releases, or manages significant pollutants or hazardous materials.

Exhaust System - A stack, gaseous effluent system, building ventilation system, or any system that vents air or gaseous material to the atmosphere.

Expedited Response Action - An interim response action (IRA) or interim measure (IM) process. This includes any onsite response action (under CERCLA or RCRA authority) to mitigate site contamination conducted before initiation of remedial action or corrective action in accordance with final record of decision (ROD) or permit modifications.

Facility - A processing plant, tank farm, shop, laboratory, powerhouse, or laundry. Including all contiguous land and structures, other appurtenances, and improvements on land used for recycling, reusing, reclaiming, transferring, storing, treating of dangerous waste (including treatment, storage, and disposal sites as well as groundwater wells). (40 CFR 264, "Standards for Owners and Operators of Hazardous Waste Treatment Storage and Disposal Facilities," and WAC 173-303-040.)

Facility-Specific Environmental Monitoring - Routine environmental monitoring of all environmental media (air, biota, etc.) around facility parameters.

Field Blank - Aliquots of analyte-free water or solvents brought to the field in sealed containers and transported to the laboratory with the sample container. Field blanks include trip blanks and equipment blanks.

Field Duplicate - Field duplicates are collected at specified frequencies and are used to document precision. The field duplicate precision depends on the variance of waste composition, sampling techniques, and analytical technique.

Fish or Wildlife - Any member of the animal kingdom including (without limitation) any mammal, fish, bird, amphibian, reptile, mollusk, crustacean, arthropod, or other invertebrate--including any part, product, egg, offspring, or the dead body or parts of the offspring.

French Drain - A covered or rock-filled encasement with the bottom end open to allow liquids to seep into the ground.

Fugitive Emissions - Material that is generated incidental to an operation, process, or activity and that is released or dispersed into the open air. Fugitive emissions occur via pathways that do not allow routine measurement at the point of release.

Grab Sample - A single sample removed from a stream over a short time interval.

Groundwater - Water that exists below the water table, also referred to as the zone of saturation. However, the capillary fringe directly above can be completely saturated if the sediment is fine enough. To avoid this ambiguous term, the use of phreatic water, which is water that enters freely into wells under both confined and unconfined conditions is suggested. Phreatic water is a term originally applied only to water that occurs in the upper part of the zone of saturation under water table conditions (unconfined groundwater or well water), but has come to be applied to all water in the zone of saturation, thus making it an exact synonym of groundwater. Above the water table is the vadose zone, where water pressures are less than atmospheric pressure. This zone still contains water, but the water is held to the soil particles or other groundwater material by capillary force. Thus, while this water still can move within the vadose zone, it cannot move out of the zone into a well or other places that are exposed to atmospheric pressure. The dividing line between water in the vadose zone and phreatic water is the atmospheric pressure between the two, with the pressure of vadose water below atmospheric pressure and that of phreatic water (i.e., groundwater) above atmospheric pressure.

High Efficiency Particulate Air (HEPA) Filter - To qualify as a HEPA, a filter must achieve an efficiency of 99.97 percent under laboratory conditions and 99.95 percent after installation for the removal of airborne particulates greater than 3 E-05 cm (0.3 microns).

High-Level Nuclear Waste - Spent nuclear fuel or radioactive waste resulting directly from the dissolution and reprocessing of spent nuclear fuel. Secondary waste streams resulting from the dissolution and reprocessing of spent nuclear fuel are not considered high-level waste.

Immobile Radionuclides - All those radionuclides that are sorbed onto Hanford soils and usually would not migrate through the vadose zone or the groundwater below the future control zone.

Inaccessible Soils - Areas from which the general public is excluded (by fences, posting, patrols, or distance), but that are still subject to meteorological effects, are subject to a 10-mrem/yr operational EDE limit, as reflected in Table 6-1.

Inactive Crib - A crib that has been designated as permanently out of service.

Inactive Radioactive Waste Site - Any waste site that is no longer needed for current operational programs and that is not currently an active waste disposal site.

Inactive Waste Sites - Inactive waste sites include units such as burial grounds, unplanned release sites, cribs, ditches, ponds, trenches, and basins, abandoned storage areas, drains, single-shell tank piping, transfer pits, and jumper boxes.

Injection Well - A well used for mixing liquid waste with groundwater.

Inert Wastes - Noncombustible, nondangerous solid wastes that are likely to retain their physical and chemical structure under expected conditions of disposal, including resistance to biological attack and chemical attack from acidic rainwater.

Insure - To cover by insurance against loss.

Less Than Detectable - An analytical term for a concentration in a sample that is lower than the minimum detection capabilities of that analytical equipment or process.

Low-Level Waste - Any gaseous, liquid, or solid radioactive waste not classified as high-level waste, transuranic (TRU) waste, or spent nuclear fuel, as defined by DOE 5820.2. Also see Threshold Concentrations.

Maximum Contaminant Level (MCL) - The drinking water standards specified in 40 CFR 141, "National Primary Drinking Water Regulations." See Appendix C, "Maximum Contaminant Levels."

Minimum Detection Limit - See detection limit.

Mixed Waste - Dangerous waste that also contains enough radioactivity to be classified as radioactive waste in accordance with this manual, Section 7.4, "Radioactive Solid Waste Storage and Disposal."

Modification - Any physical or operational change to a stationary source which results in an increase in the rate of emission to the atmosphere of an air pollutant to which a standard applies.

Monitored Sample - A sample collected in a monitoring system and used to alert operations to nonroutine releases and to provide process control.

Monitoring System - Instrumentation that provides measurement of an airborne or liquid waste stream parameters. The system includes a detector and associated readout components. A continuous monitoring system measures the stream parameters on a near-real-time basis or as specified in applicable EPA regulations 40 CFR 52, "Approval and Promulgation of Implementation Plans," Appendix E; 40 CFR 51, "Requirements for Preparation, Adoption, and Submittal of Implementation Plans," Appendix P or as defined in applicable ANSI Standards. A radiation monitoring system is a system in which radiation or radioactivity is the measured parameter. An integrating monitoring system totals the instantaneously measured parameter over some time period. A sampling system does not measure or read out an instantaneous stream parameter.

Naturally Occurring Radioactive Materials - Also see Threshold Concentrations.

Nonroutine Activities - Any actions on a large-scale (>5 acres), including stabilization, soil removal, fixative or sealant application, other surface treatments, or other activities that could impact future remediation activities in an inactive waste site.

Normally Contaminated Airborne or Liquid Effluent - An airborne or liquid effluent from a facility or area that contains dispersible or unsealed radioactive materials in quantities sufficient to cause releases of radioactive materials in excess of 10 percent of the ACL averaged over 1 year (i.e., the total activity present times an appropriate suspendable or immersible fraction divided by the total annual flow exceeds 10 percent of the ACL).

Operate - As used in this section with respect to the activities of WHC, the term "operate" (and other forms of the term) will refer to the performance by WHC of its day-to-day activities in connection with the tanks and tank systems. Such activities shall be subject to the overall management, control, and oversight by DOE.

Operational Environmental Monitoring - The collection and analysis of samples of air, water, soil, biota, and other media near nuclear facilities on DOE sites and their environs and the measurement of external radiation for purposes of demonstrating compliance with applicable standards, assessing radiation exposures to employees and members of the public, and the near-field environment.

Operations - In this report this term loosely refers to WHC activities including chemical processing, waste management, and decommissioning.

Operations - The contractor organization responsible for operating plants and facilities.

Overall Error - In this report, this term means the overall analytical error supplied by the laboratory performing the analysis.

Percolation - Downward movement of water through the interstices of unsaturated rock or soil because of gravity or hydrostatic pressure.

Pesticide - In this manual, as defined in 40 CFR 162, the term pesticide covers all pest control chemicals such as herbicides, rodenticides, and insecticides.

Plutonium Processing and Handling Facility - Any facility constructed primarily to process plutonium (including ^{238}Pu) and that handles in-process plutonium.

Plutonium Storage Facility - Any facility constructed to store strategic (category I) quantities of plutonium.

Point of Release - The point at which a material is released to the environment such as the top of a stack or the end of a pipe.

Point Source - A single defined point (origin) of an airborne release, such as a vent or stack.

Pond - A surface impoundment used to contain or percolate low-level liquid radioactive wastes, mixed wastes, or hazardous wastes.

Potentially Contaminated Airborne or Liquid Effluent - An airborne or liquid effluent from a facility or area that contains radioactive materials in quantities sufficient to cause releases of radioactive materials in excess of 10 percent of the ACV averaged over 1 year (the total activity present times a reasonable suspendable or immersible fraction divided by the annual flow equals more than 10 percent of the ACV).

Potentially Corrosive Liquid Waste Stream - Any liquid waste stream that has been identified as having the potential, during upset conditions, to discharge liquid with a pH value of less than or equal to 2, or greater than or equal to 12.5.

Previously Disturbed Ground - Ground that has had its contours altered by leveling, filling, or excavation or that has been contaminated by radiation or dangerous chemicals to the extent that an individual cannot enter the area without wearing protective clothing. Disturbance is determined by observation, aerial photographs, and topographic maps.

Quality Assurance - A process designed to maintain the quality of the results of a program within established limits of acceptance.

Quality Assurance - All those planned and systematic actions necessary to provide adequate confidence that a structure, system, or component will perform satisfactorily in service.

Radiation Survey - Evaluation of an area or object with portable instruments to identify radioactive materials and radiation fields present.

Radioactive Byproduct - Any radioactive material (except special nuclear material) yielded in or made radioactive by exposure to the radiation incident to the process of producing or utilizing special nuclear material (*Atomic Energy Act of 1954*, as amended). The nonradioactive hazardous component of the waste material will be subject to regulation under *Resource Conservation and Recovery Act of 1976* (RCRA).

Radioactive Liquid Effluent - A liquid effluent that has a reasonable potential for containing radioactive materials in quantities such that the annual average concentration is equal to or greater than the MCL. Also see Threshold Concentrations.

Radioactive Solid Waste - See Threshold Concentrations.

Radiological Control Area - An area where access is controlled to protect individuals from exposure to radiation and/or radioactive materials. Radiological control areas include, but are not limited to, areas posted as Radiation Area, Surface Contamination, and Underground Radioactive Materials, to describe the radiological condition of the area within.

Radiological Posting - Information in the form of signs and chains to inform people of conditions that warrant avoidance or special precautions for entry.

Release From Radiological Posting - Removal of signs and chains when access to an area no longer needs to be restricted for radiological protection purposes.

Representative Sample - The average stream parameter being measured occurs in the sample in the same average proportion that it occurs in the environmental discharge.

Retired Waste Site - A waste site that is isolated and no longer available to receive waste in any form.

Reverse Well - Same as injection well.

Routine Activities - Any actions on a small-scale (<5 acres), including radioactive hot-spot removal, vegetation removal, fencing, posting, herbicide spraying, stabilization, or immediate spill response) in an inactive waste site. In general, these routine actions shall not interfere with RCRA/CERCLA response or site investigations.

Routine Emissions - Air emissions of pollutants or releases from accidents are not considered routine. However, releases of air pollutants to the atmosphere that result from normal operations, and releases, that are not routine but are more likely than not to occur, are included as routine emissions.

Sampling System - Instrumentation and equipment that remove a part of a liquid or airborne wastestream for subsequent quantitative determination of stream parameters. The system generally employs such devices as filters, other sample collection media, or effluent traps of some kind. A continuous sampling system removes a part of the stream continuously except during sample

change, maintenance, repair, or other necessary outages. A grab sampling system removes an instantaneous part of the stream or removes a part of the stream over a time period.

Sealed - A container having a cover bonded with the container or a cover strong enough to prevent contact with and dispersion of the contents of the container under conditions of use and wear for which it was designed.

Sediment Column - The sediment beneath a crib. It can mean either all the sediment beneath the bottom of the crib extending to the water table or all sediment beneath a crib contaminated by radioactive materials.

Separation Areas - The fenced 200 Areas and those areas (such as B Pond and Gable Mountain Pond) that have received or continue to receive liquid waste discharged from previous or current chemical processing and waste management operations. The future control zone includes the separation area.

Separations Area - The primary area on the Hanford Site where chemical processing and most waste management activities are performed. It includes the 200 Areas and nearby 600 Area sites. WHC is landlord of the Separations Area.

Site - The location of a significant event, a prehistoric or historic occupation or activity, or a building or structure (whether standing, ruined, or vanished) where the location itself maintains historical or archeological value, regardless of the value of any existing structure.

Soil at depth - Soil below 36 in.

Solid Waste - Any discarded material that is not excluded by WAC 173-303-017(2) or that is not excluded by a variance granted under WAC 173-303-017(5). Materials are solid waste if they are: (1) abandoned by being disposed of, burned, or incinerated, or (2) accumulated, stored, or treated (but not recycled) before (or in lieu of) being abandoned by being disposed of, burned, or incinerated. In addition, a solid waste includes any material considered to be inherently waste-like.

Specific Contamination - Single grains of soil, rust particles, feces, or pieces of vegetation.

Speculative Accumulation - A material accumulated before being recycled. If the material is potentially recyclable and at least 75 percent is recycled during the calendar year (commencing on January 1), it is <u>not</u> a speculative accumulation.

Spent Materials - Used materials that are no longer usable without being regenerated, reclaimed, or reprocessed. Examples are spent solvents, spent activated carbon, spent catalysts, and spent acids. Does not include spent fuel from reactors.

Spot Contamination - A spot or quantity of contamination less than 1 cm^3 in volume, or areal contamination less than 15 cm^2 in area.

Stabilization - The process of covering surface contaminated areas with clean backfill or topsoil.

Standard - A specified set of rules or conditions concerned with the classification of components; delineation of procedures; definition of terms; designation of materials, performance, design, or operations; or measurements of quality in describing materials, products, systems, services, or practices. A standard is more general than a procedure or specification and more specific than a criterion.

Standard Error of the Mean - A measure of the uncertainty in the estimated averages of data because of random variations.

Stationary Source - Any building, structure, facility, or installation that emits or may emit any air pollutant.

Structure - A work constructed by man that consists of interdependent and interrelated parts in a definite pattern of organization. It is often a large-scale engineering project.

Suitable Surface Area - Area no more than 15 cm^2 over which spot contamination may be averaged in determining areal contamination.

Sump - Any stationary pit or reservoir, including those troughs/trenches connected to it, that serve to collect oil products, hazardous substances, low-level radioactive material, dangerous waste, mixed waste, high-level radioactive materials, or TRU materials.

Surface Contamination - A radiological control status that refers to radioactivity on the surface of the ground that exceeds the soil contamination standard.

Surface Soil - Soil from 0- to 2-in. deep.

Surface Stabilization - A remedial action program on waste disposal sites that includes the addition of at least 46 to 50 cm (18 to 20 in.) of clean soil followed by revegetation. It is designed to cover surface contamination and inhibit biological and wind transport.

Surplus Facilities - Surplus facilities include all facilities that have been accepted into a decommissioning program.

Survey - A method to detect the release, disposal, or presence of radioactive materials or hazardous substances under a specific set of conditions to determine actual or potential hazards. Such an evaluation may include, but is not limited to, tests, physical examinations, and measurements of radiation or concentrations of materials.

Suspect Waste Site - A site, believed to have been previously unknown or undocumented, that, because of characteristics present at the site or historical information about the site, is suspected of containing waste (i.e., non-dangerous, hazardous, dangerous, mixed, and radioactive).

Suspendable Fraction - The fraction of material that may become airborne.

Taking of Any Animal - To harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect any animal or attempt to engage in any such activity.

Tank - A stationary device designed to contain an accumulation of oil products, hazardous substances, low-level radioactive material, dangerous waste, mixed waste, high-level radioactive materials, or TRU materials, which are constructed primarily of nonearthen materials (e.g., wood, concrete, steel, plastic) that provide structural support.

Tank Farm - An area of large underground tanks designed to store up to 1 Mgal each of high-level liquid waste.

Technologically Enhanced Naturally Occurring Radioactivity - Refined or processed ores or other materials containing naturally occurring radioactive materials, such that radiation exposure or potential radiation exposure is increased.

Thermoluminescent Dosimeter - A chip or series of chips used for measuring external gamma radiation. It consists of a material capable of absorbing energy imparted by ionizing radiation, then emitting light as a result of thermal stimulation. A measure of that light is proportional to the radioactivity absorbed.

Threshold Concentrations - Those concentrations of radionuclides in various wastes or substances that do not require the controls of radioactive waste disposal.

1. Air. No threshold value exists.

2. Liquid. Liquids containing radionuclides in a concentration of less than 0.04 x DCG may be disposed of as nonradioactive liquid waste. This threshold level is equivalent to the EPA Drinking Water Standard (40 CFR 141).

3. Soil/Solid. Soils or other solids containing radionuclides below those listed in Table 6-1 (on hold) may be released for onsite disposal as nonradioactive waste. No offsite release criteria exist. (See Section 7.4).

Threshold Limit Value (TLV) - Threshold limit value time-weighted average (TLV-TWA). The time-weight average concentration for a normal 8-hour workday and a 40-hour workweek, to which nearly all workers may be repeatedly exposed, day after day, without adverse effect.

Topsoil - The soil used as a plant growth medium at the surface to a depth of 30 cm as measured at the restabilization site. Topsoil is added soil to support the stabilization of a retired disposal facility with the objective of controlling erosion, establishing the growth of perennial grasses, and preventing the growth of deep-rooted vegetation. Topsoil shall fall within the requirements stated in Section 7.7, "Mixed Waste."

Transuranic (TRU) Radionuclide - Any radionuclide having an atomic number greater than 92 (DOE Order 5820.2).

Transuranic Waste - Without regard to source or form, radioactive waste that at the end of institutional control periods is contaminated with alpha-emitting transuranium radionuclides with half-lives greater than 20 years and concentrations greater than 100 nCi/g (3700 Bq/g). The Waste Isolation Pilot Plant, high-level waste, and spent nuclear fuel as defined by DOE Order 5820.2 are specifically excluded from this definition.

Trip Blank - A type of field blank used to accompany sample containers to and from the field and to detect contamination or cross-contamination that occurs during sample handling and transportation.

Unconfined Aquifer - An aquifer that has a water table or surface at atmospheric pressure.

Uncontaminated Soil - A soil or a land area that requires no controls or restrictions in any way for radiation protection purposes and/or meets the contamination limit specifications of Section 7.3, "Dangerous Waste Control."

Underground Radioactive Material - A radiological posting status where subsurface radioactivity is present but where surface contamination does not exceed the soil standards.

Underground Storage Tank - Any one or any combination of tanks (including underground connection pipes) that are used to contain an accumulation of regulated substances. At least 10 percent of the volume of the tanks (including the volume of underground pipes) is beneath the surface of the ground (WAC 173-360-120). A tank situated in an underground area (such as a basement, cellar, etc.) is not considered to be underground if the tank is situated on or above the surface of the floor (WAC 173-360-110). Surface impoundments, pits, ponds, lagoons, storm water collection systems, or septic tanks are not considered to be underground storage tanks, and are not subject to the underground storage tank requirements (WAC 173-360-110).

Unity Rule - If more than one radionuclide is present, the sum of the fractions represented by each radionuclide concentration divided by its respective limiting concentration (ACV) shall not exceed unity. This rule could also apply to parameters other than radionuclide concentration.

Unplanned Radioactive Release Site - Any site thought to contain radioactive material that is released unintentionally (spills, windblown contamination, tumbleweeds, etc.).

Unplanned Release Site - An area that was contaminated by an unplanned release of radioactive contamination, making it a radiological control area.

Unrestricted Release - Values below which unrestricted release of soils will occur will be defined in an applicable record of decision.

Unsampled Liquid Disposal Site - A liquid waste disposal site that is currently receiving an effluent stream that does not require sampling.

U.S. Environmental Protection Agency (EPA) - The federal agency chartered with carrying out and monitoring the environmental regulations.

Vadose Zone - The zone of aeration in the earth's crust above the groundwater level.

Vadose Zone - The unsaturated region of soil or the zone of aeration between the ground surface and the water table.

Vector - A vertebrate or invertebrate that can transmit toxic, radioactive, or infectious material from a disposal or storage site to uncontrolled areas like flies, birds, and mice.

Waste Information Data System (WIDS) - A database that identifies waste management units on the Hanford Site. It provides the current status of each unit, as well as descriptive information.

Waste Management - The activity involved with storing, disposing, shipping, handling, and monitoring all radioactive waste.

Waste Sites - Any facility used for the planned disposal of hazardous, radioactive, toxic, or nonradioactive/nontoxic waste.

Water Table - The upper boundary of an unconfined aquifer below which saturated groundwater occurs.

Table B-1. Radionuclide Nomenclature

Radionuclide	Symbol	Half-Life	Radionuclide	Symbol	Half-Life
tritium	^{3}H	12.3 yr	cesium-137	^{137}Cs	30.3 yr
beryllium-7	^{7}Be	53.28 d	cerium-144	^{144}Ce	284.6 d
carbon-14	^{14}C	5,715 yr	promethium-147	^{147}Pm	13.4 m
sodium-22	^{22}Na	2.6 yr	europium-152	^{152}Eu	13.5 y
potassium-40	^{40}K	1.26×10^{9} yr	europium-154	^{154}Eu	8.6 y
argon-41	^{41}Ar	1.8 h	europium-155	^{155}Eu	4.7 yr
chromium-51	^{51}Cr	27.7 d	thallium-208	^{208}Tl	3.1 min
manganese-54	^{54}Mn	312 d	bismuth-212	^{212}Bi	60.6 min
cobalt-57	^{57}Co	271.8 d	lead-212	^{212}Pb	10.6 h
cobalt-60	^{60}Co	5.3 yr	polonium-212	^{212}Po	0.3×10^{-6} s
nickel-63	^{63}Ni	100 yr	polonium-216	^{216}Po	0.15 s
zinc-65	^{65}Zn	243.8 d	radon-220	^{220}Rn	55.6 s
krypton-85	^{85}Kr	10.7 yr	radium-226	^{226}Ra	1,600 yr
strontium-89	^{89}Sr	50.5 d	radium-228	^{228}Ra	5.75 yr
strontium-90	^{90}Sr	29.1 yr	thorium-232	^{232}Th	1.4×10^{10} yr
niobium-95	^{95}Nb	35.0 d	uranium total	U or uranium	--
zirconium-95	^{95}Zr	64.0 d	uranium-234	^{234}U	2.4×10^{5} yr
molybdenum-99	^{99}Mo	2.7 d	uranium-235	^{235}U	7×10^{8} yr
technetium-99	^{99}Tc	2.12×10^{5} yr	uranium-236	^{236}U	2.3×10^{7} yr
ruthenium-103	^{103}Ru	39.4 d	uranium-238	^{238}U	4.5×10^{9} yr
ruthenium-106	^{106}Ru	1.0 yr	plutonium-238	^{238}Pu	87.7 yr
tin-113	^{113}Sn	115 d	neptunium-239	^{239}Np	2.4 d
antimony-125	^{125}Sb	2.7 yr	plutonium-239	^{239}Pu	2.4×10^{4} yr
iodine-129	^{129}I	1.7×10^{7} yr	plutonium-240	^{240}Pu	6537 yr
iodine-131	^{131}I	8.0 d	plutonium-241	^{241}Pu	14.4 yr
barium-133	^{133}Ba	10.53 yr	americium-241	^{241}Am	433 yr
cesium-134	^{134}Cs	2.1 yr			

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APPENDIX C

AMBIENT AIR MONITORING FIGURES AND TABLES

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Figure C-1. The 100 KE/KW Reactors Area Air Sampler Locations.

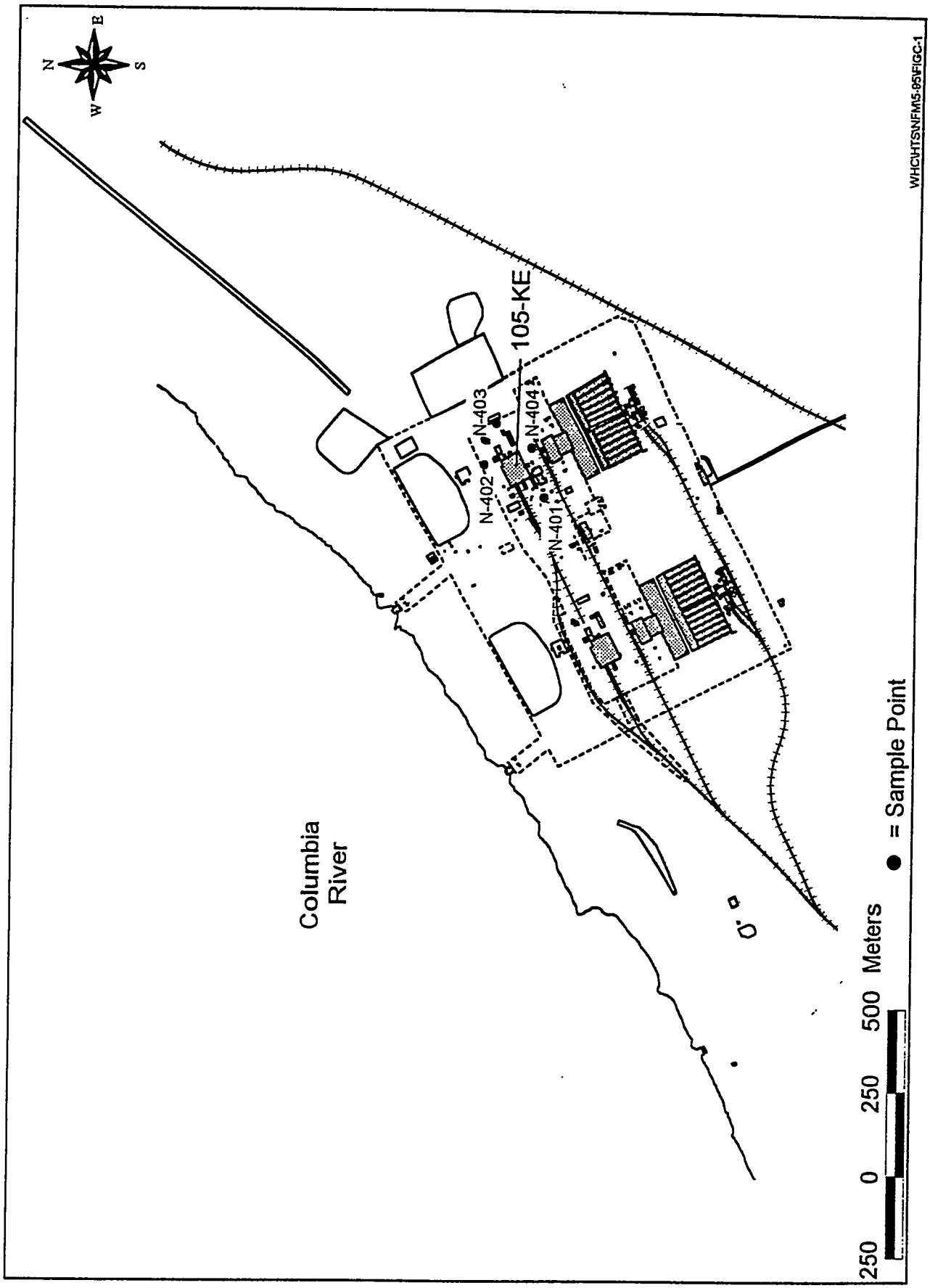

Figure C-2. The 100 N Reactor Area Air Sampler Locations.

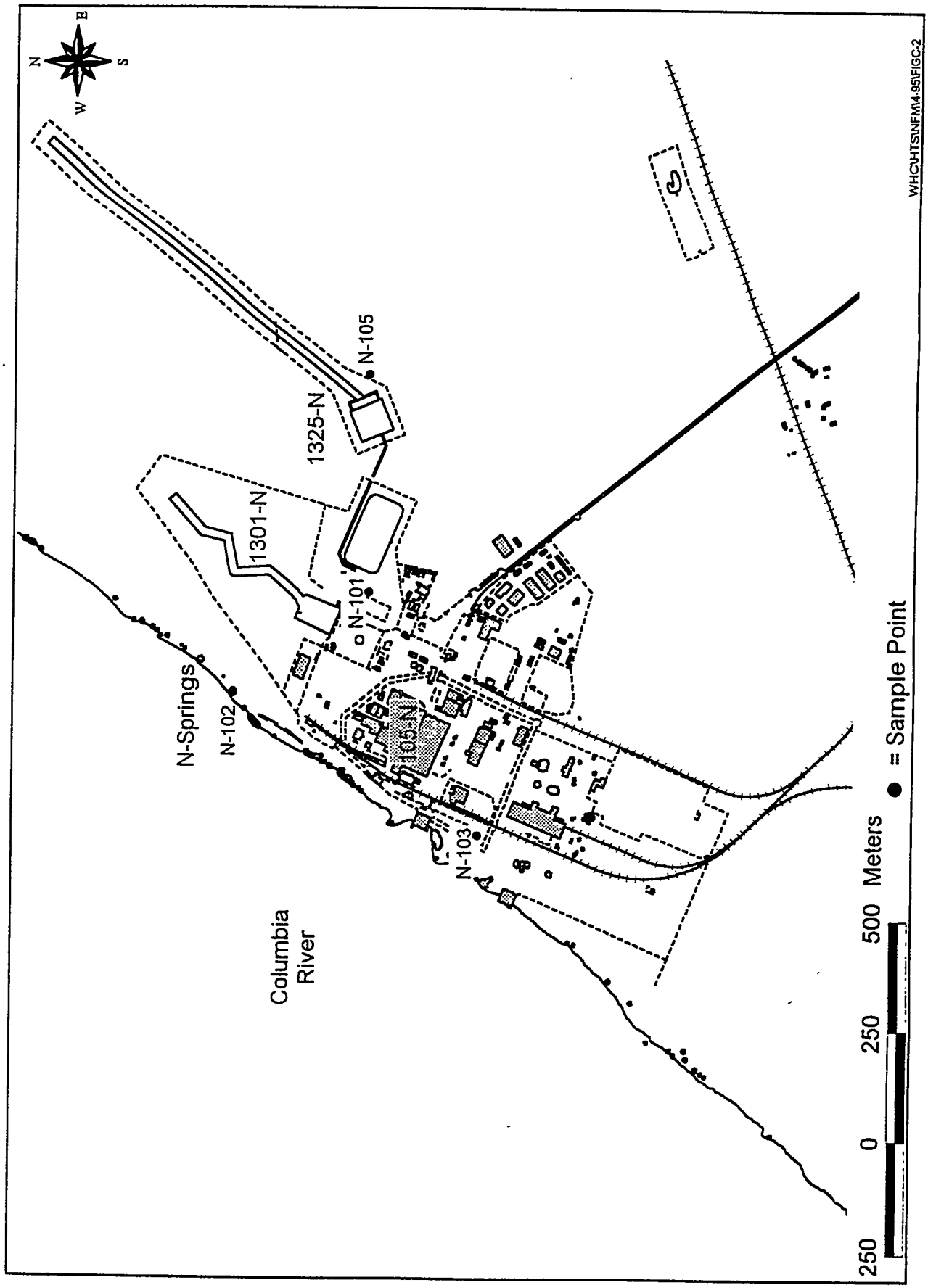

Figure C-3. The 200 East Area Air Sampler Locations.

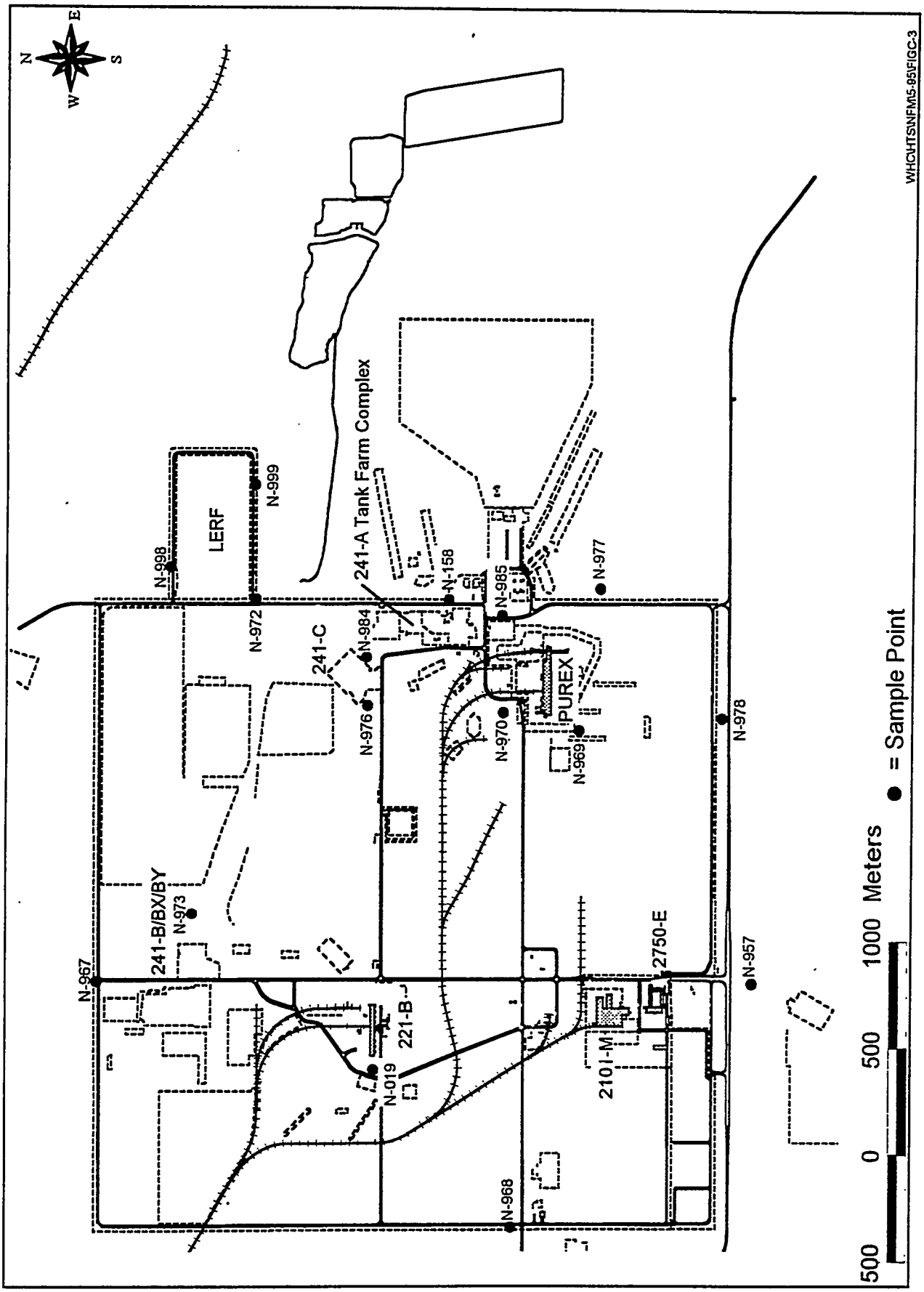

Figure C-4. 200 West Area Air Sampler Locations.

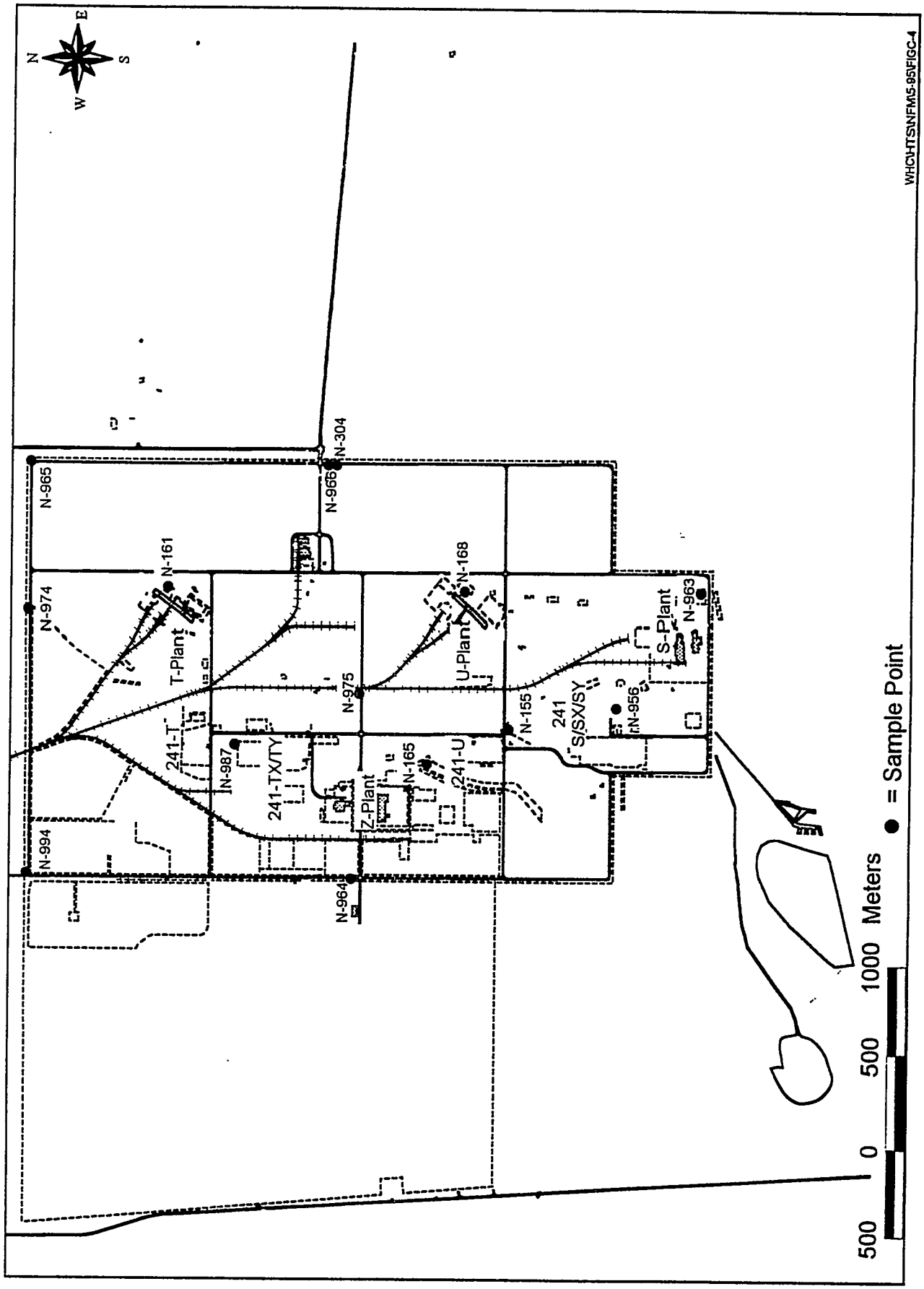

Figure C-5. 200 East/West Areas Vent Station Air Sampler Locations.

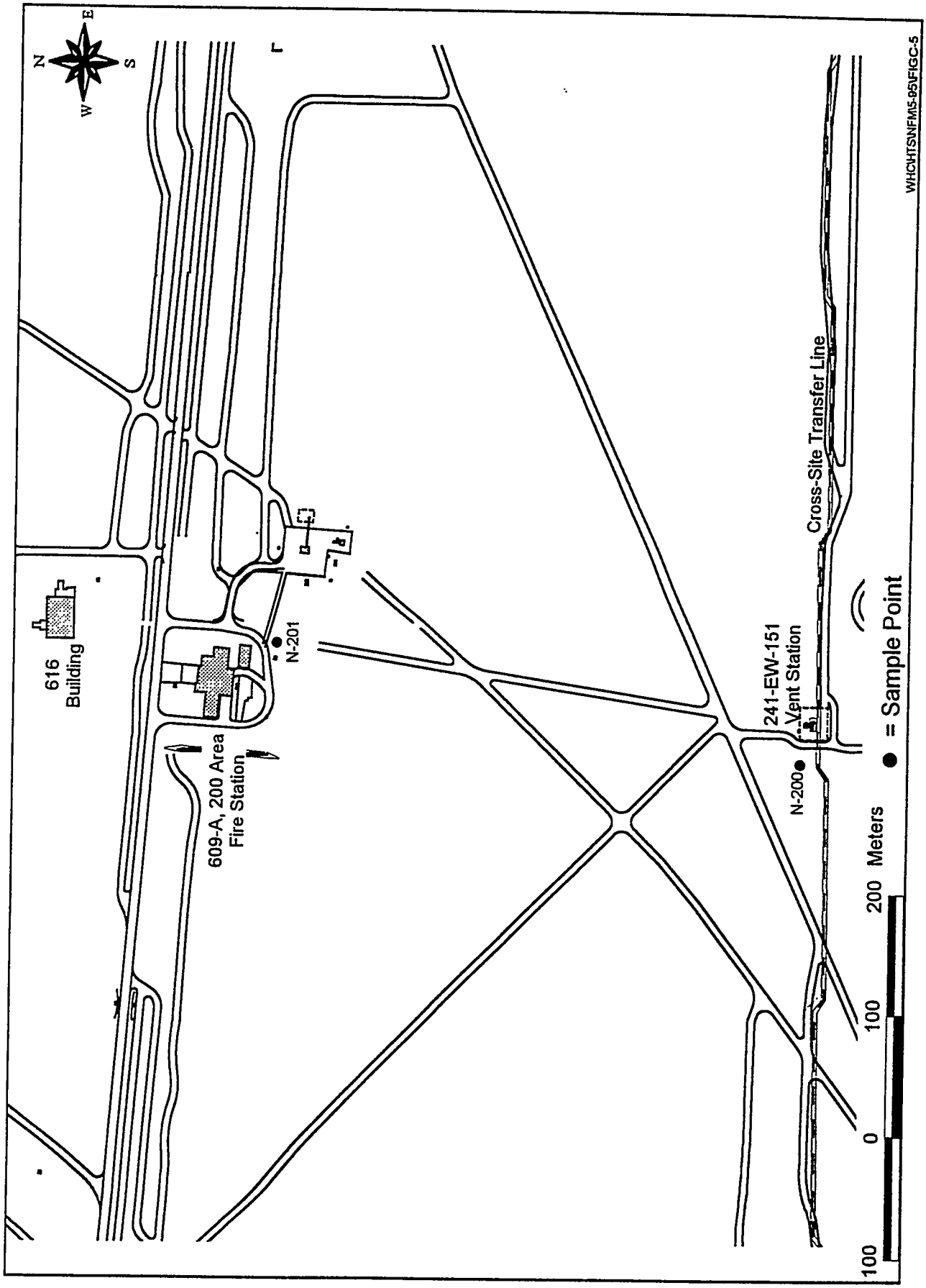

Figure C-6. The 300 Area TEDF Air Sampler Location.

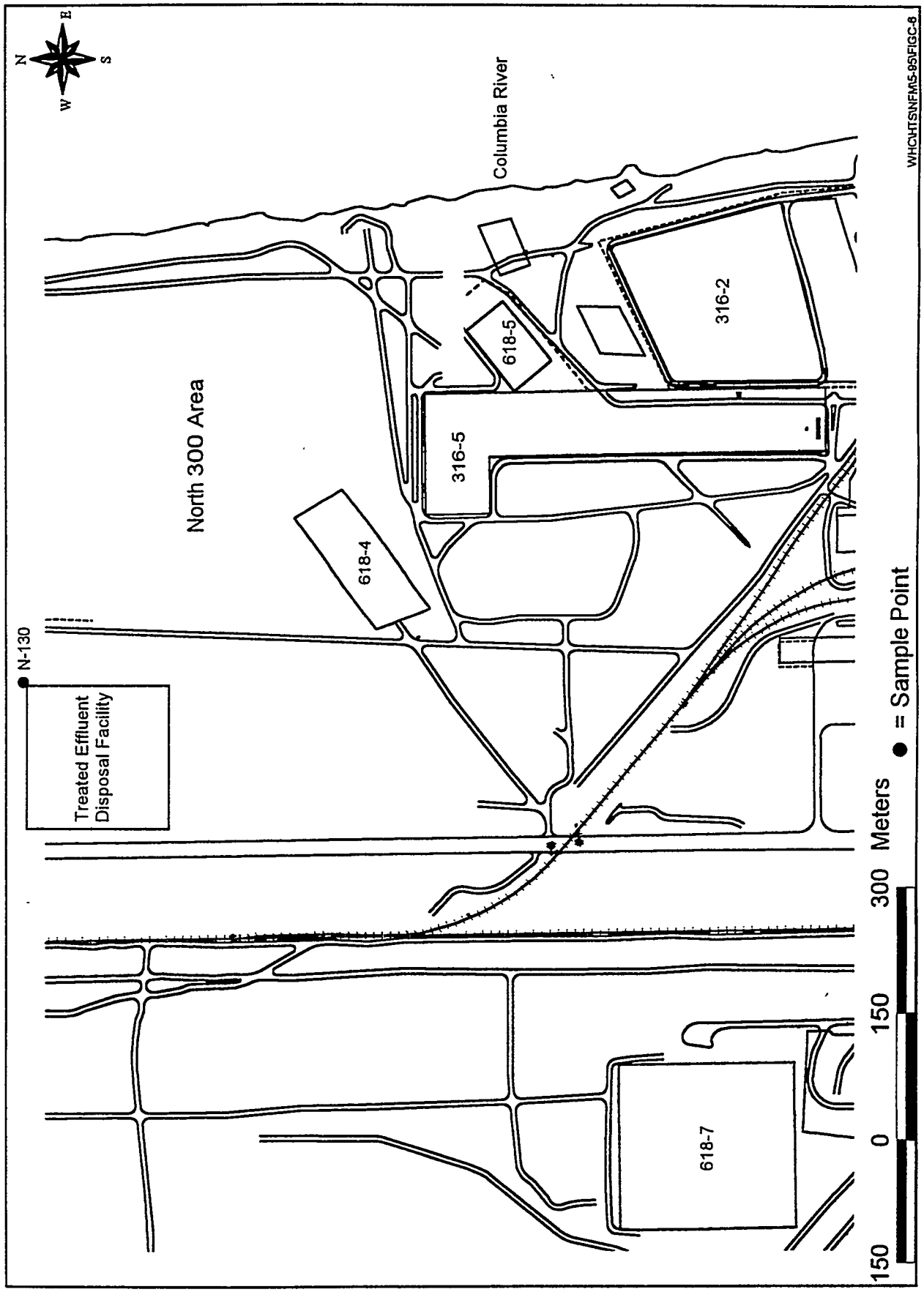

Figure C-7. The 600 Area Air Sampler Location.

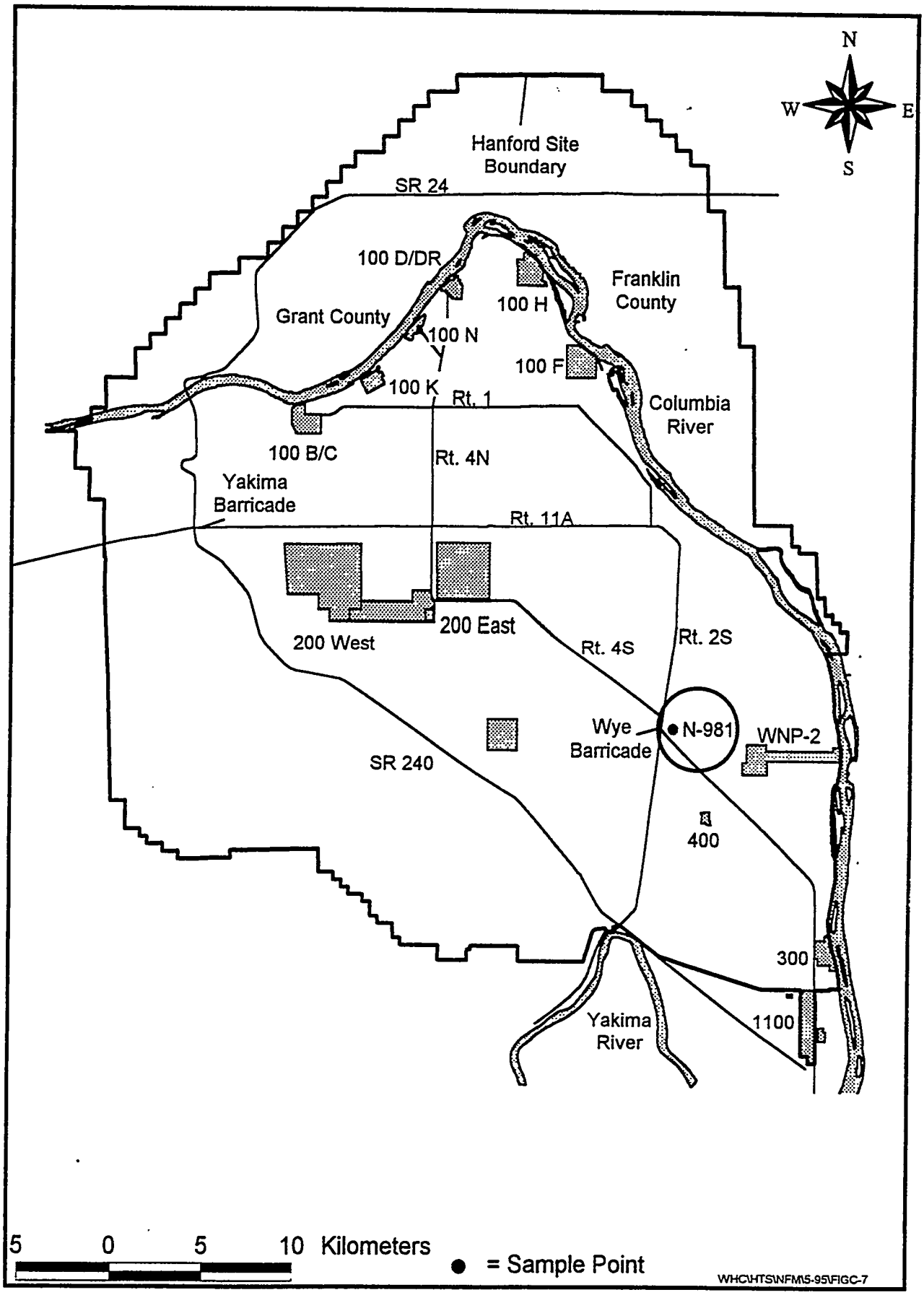

Table C-1. Ambient Air Sample Results, 1994 (pCi/m^3).

		1st Half Result	Overall Error	2nd Half Result	Overall Error	Average Annual Result	Average Error
100 N Area							
N101	^{40}K	3.5 E-03	59	1.1 E-02	35	7.0 E-03	47
N101	^{60}Co	1.9 E-03	27	9.4 E-04	39	1.4 E-03	33
N101	^{65}Zn	5.6 E-04	107	-1.1 E-03	70	-2.5 E-04	89
N101	^{90}Sr	LA		7.9 E-05	91	7.9 E-05	91
N101	^{95}Zr	3.0 E-03	49	-1.2 E-03	173	9.1 E-04	111
N101	^{106}Ru	5.0 E-04	323	1.1 E-03	170	8.2 E-04	247
N101	^{125}Sb	1.7 E-04	239	1.2 E-04	318	1.5 E-04	279
N101	^{134}Cs	1.8 E-04	68	-5.0 E-05	424	6.7 E-05	246
N101	^{137}Cs	-7.2 E-05	210	3.0 E-04	78	1.1 E-04	144
N101	^{144}Ce	-1.7 E-04	754	7.5 E-04	264	2.9 E-04	509
N101	^{154}Eu	3.4 E-04	82	-4.1 E-04	155	-3.5 E-05	119
N101	^{155}Eu	-3.4 E-05	695	8.4 E-05	418	2.5 E-05	556
N101	^{234}U	LA		3.5 E-06	171	3.5 E-06	171
N101	^{235}U	LA		-7.1 E-08	2742	-7.1 E-08	2742
N101	^{238}U	LA		1.8 E-07	2670	1.8 E-07	2670
N101	^{238}Pu	LA		-3.8 E-07	363	-3.8 E-07	363
N101	$^{239,240}Pu$	LA		4.1 E-06	75	4.1 E-06	75
N102	^{40}K	8.2 E-03	34	1.0 E-02	39	9.2 E-03	37
N102	^{60}Co	1.3 E-04	213	3.6 E-05	613	8.2 E-05	413
N102	^{65}Zn	5.7 E-05	774	-5.8 E-04	122	-2.6 E-04	448
N102	^{90}Sr	LA		3.7 E-05	156	3.7 E-05	156
N102	^{95}Zr	4.4 E-04	373	-1.0 E-03	201	-3.0 E-04	287
N102	^{106}Ru	8.7 E-04	150	-1.2 E-03	177	-1.9 E-04	163
N102	^{125}Sb	1.2 E-04	279	5.0 E-05	805	8.6 E-05	542
N102	^{134}Cs	3.7 E-06	4064	1.1 E-04	155	5.7 E-05	2109
N102	^{137}Cs	2.0 E-04	71	2.9 E-04	58	2.4 E-04	64
N102	^{144}Ce	-4.4 E-04	331	-6.5 E-04	288	-5.5 E-04	309
N102	^{154}Eu	-2.4 E-04	245	-4.8 E-05	1147	-1.4 E-04	697
N102	^{155}Eu	1.3 E-04	150	2.3 E-04	156	1.8 E-04	153
N102	^{234}U	LA		1.2 E-05	63	1.2 E-05	63
N102	^{235}U	LA		3.6 E-07	719	3.6 E-07	719
N102	^{238}U	LA		5.2 E-06	111	5.2 E-06	111

Table C-1. Ambient Air Sample Results, 1994 (pCi/m^3).

		1st Half Result	Overall Error	2nd Half Result	Overall Error	Average Annual Result	Average Error
N102	^{238}Pu	LA		-3.7 E-07	385	-3.7 E-07	385
N102	^{239,240}Pu	LA		1.1 E-06	196	1.1 E-06	196
N103	^{40}K	6.2 E-03	50	6.3 E-03	54	6.2 E-03	52
N103	^{60}Co	2.5 E-04	84	2.0 E-04	108	2.3 E-04	96
N103	^{65}Zn	1.8 E-04	274	NR		1.8 E-04	274
N103	^{90}Sr	LA		4.3 E-06	1310	4.3 E-06	1310
N103	^{95}Zr	8.6 E-04	151	2.1 E-04	981	5.3 E-04	566
N103	^{106}Ru	5.3 E-04	279	-6.7 E-04	313	-7.0 E-05	296
N103	^{125}Sb	-1.0 E-04	395	3.2 E-04	153	1.1 E-04	274
N103	^{134}Cs	8.7 E-05	192	-5.9 E-05	401	1.4 E-05	296
N103	^{137}Cs	1.1 E-04	107	1.3 E-04	140	1.2 E-04	124
N103	^{144}Ce	-1.4 E-03	114	8.5 E-04	254	-2.7 E-04	184
N103	^{154}Eu	2.2 E-05	2370	4.6 E-04	121	2.4 E-04	1245
N103	^{155}Eu	3.9 E-05	746	1.4 E-04	215	9.2 E-05	480
N103	^{234}U	LA		4.3 E-06	138	4.3 E-06	138
N103	^{235}U	LA		-1.4 E-06	85	-1.4 E-06	85
N103	^{238}U	LA		2.3 E-06	225	2.3 E-06	225
N103	^{238}Pu	LA		-9.9 E-07	95	-9.9 E-07	95
N103	^{239,240}Pu	LA		7.1 E-08	2847	7.1 E-08	2847
N105	^{40}K	4.3 E-03	60	9.2 E-03	39	6.7 E-03	49
N105	^{60}Co	1.4 E-03	31	4.1 E-04	65	9.0 E-04	48
N105	^{65}Zn	-2.8 E-05	1810	-1.8 E-04	344	-1.0 E-04	1077
N105	^{90}Sr	LA		3.5 E-05	185	3.5 E-05	185
N105	^{95}Zr	-3.8 E-04	379	-1.4 E-04	1333	-2.6 E-04	856
N105	^{106}Ru	-2.6 E-04	566	2.5 E-04	575	-2.0 E-06	570
N105	^{125}Sb	-4.6 E-04	94	1.5 E-04	325	-1.6 E-04	210
N105	^{134}Cs	6.0 E-05	273	-9.5 E-06	2004	2.5 E-05	1138
N105	^{137}Cs	4.3 E-05	402	7.7 E-05	250	6.0 E-05	326
N105	^{144}Ce	6.5 E-04	199	-1.4 E-03	108	-4.0 E-04	154
N105	^{154}Eu	1.3 E-04	361	-3.7 E-05	1811	4.9 E-05	1086
N105	^{155}Eu	-2.0 E-04	120	-1.4 E-04	245	-1.7 E-04	183
N105	^{234}U	LA		4.9 E-06	122	4.9 E-06	122
N105	^{235}U	LA		6.7 E-07	296	6.7 E-07	296

Table C-1. Ambient Air Sample Results, 1994 (pCi/m^3).

		1st Half Result	Overall Error	2nd Half Result	Overall Error	Average Annual Result	Average Error
N105	^{238}U	LA		2.0 E-06	238	2.0 E-06	238
N105	^{238}Pu	LA		2.9 E-08	4583	2.9 E-08	4583
N105	^{239,240}Pu	LA		2.6 E-06	98	2.6 E-06	98
100-K Area							
N401	^{40}K	7.8 E-03	50	5.2 E-03	76	6.5 E-03	63
N401	^{60}Co	5.4 E-05	659	-1.6 E-04	133	-5.2 E-05	396
N401	^{65}Zn	-3.7 E-04	181	1.5 E-04	420	-1.1 E-04	300
N401	^{90}Sr	3.2 E-04	32	2.2 E-04	46	2.7 E-04	39
N401	^{95}Zr	-2.4 E-04	582	-4.6 E-04	417	-3.5 E-04	499
N401	^{106}Ru	2.7 E-03	76	-1.2 E-03	195	7.9 E-04	135
N401	^{125}Sb	-8.6 E-05	812	-9.1 E-05	538	-8.9 E-05	675
N401	^{134}Cs	5.8 E-05	322	7.7 E-05	222	6.8 E-05	272
N401	^{137}Cs	1.8 E-03	36	1.5 E-03	30	1.6 E-03	33
N401	^{144}Ce	7.1 E-05	2811	1.3 E-04	1472	9.8 E-05	2141
N401	^{154}Eu	9.6 E-04	64	3.2 E-05	2018	5.0 E-04	1041
N401	^{155}Eu	3.1 E-04	124	-1.3 E-04	317	9.3 E-05	221
N401	^{234}U	5.7 E-05	141	1.0 E-06	534	2.9 E-05	338
N401	^{235}U	-4.1 E-07	4768	9.3 E-07	301	2.6 E-07	2535
N401	^{238}U	8.9 E-06	686	3.1 E-06	167	6.0 E-06	426
N401	^{238}Pu	-2.8 E-07	294	1.3 E-06	169	5.0 E-07	232
N401	^{239,240}Pu	4.8 E-06	55	1.6 E-06	198	3.2 E-06	127
N402	^{40}K	1.7 E-02	65	2.0 E-02	32	1.9 E-02	49
N402	^{60}Co	-5.3 E-04	184	-3.2 E-04	135	-4.3 E-04	160
N402	^{65}Zn	1.4 E-03	132	-5.4 E-04	157	4.6 E-04	144
N402	^{90}Sr	2.1 E-04	59	2.2 E-05	363	1.2 E-04	211
N402	^{95}Zr	-2.5 E-03	157	-5.3 E-04	394	-1.5 E-03	275
N402	^{106}Ru	1.1 E-02	49	4.6 E-04	599	5.9 E-03	324
N402	^{125}Sb	1.4 E-03	94	-1.9 E-04	406	6.3 E-04	250
N402	^{134}Cs	-6.4 E-05	994	1.7 E-04	138	5.6 E-05	566
N402	^{137}Cs	2.4 E-04	235	2.7 E-04	88	2.6 E-04	162
N402	^{144}Ce	1.9 E-03	264	-2.4 E-04	1016	8.2 E-04	640
N402	^{154}Eu	-1.5 E-04	1150	2.4 E-04	360	4.4 E-05	755
N402	^{155}Eu	-3.7 E-04	244	7.7 E-05	714	-1.5 E-04	479
N402	^{234}U	1.0 E-06	1451	-1.2 E-06	607	-8.5 E-08	1029
N402	^{235}U	3.2 E-06	220	2.6 E-06	149	2.9 E-06	185

Table C-1. Ambient Air Sample Results, 1994 (pCi/m^3).

		1st Half Result	Overall Error	2nd Half Result	Overall Error	Average Annual Result	Average Error
N402	^{238}U	7.6 E-07	1797	2.8 E-07	2326	5.2 E-07	2062
N402	^{238}Pu	-2.9 E-06	133	-2.5 E-07	725	-1.6 E-06	429
N402	$^{239,240}Pu$	7.9 E-06	79	1.4 E-06	200	4.6 E-06	140
N403	^{40}K	4.3 E-03	86	5.1 E-03	89	4.7 E-03	87
N403	^{60}Co	-2.1 E-04	110	6.8 E-05	289	-6.8 E-05	200
N403	^{65}Zn	5.3 E-04	114	3.9 E-04	175	4.6 E-04	144
N403	^{90}Sr	6.6 E-05	76	4.5 E-05	160	5.6 E-05	118
N403	^{95}Zr	-2.7 E-04	596	4.3 E-04	537	7.9 E-05	567
N403	^{106}Ru	6.7 E-04	321	-3.2 E-03	85	-1.2 E-03	203
N403	^{125}Sb	3.6 E-04	176	6.5 E-05	916	2.1 E-04	546
N403	^{134}Cs	-8.2 E-05	273	2.5 E-05	968	-2.9 E-05	620
N403	^{137}Cs	1.2 E-04	178	1.3 E-04	174	1.3 E-04	176
N403	^{144}Ce	-1.2 E-03	176	-2.1 E-03	111	-1.6 E-03	143
N403	^{154}Eu	2.1 E-04	290	2.8 E-05	2370	1.2 E-04	1329
N403	^{155}Eu	2.1 E-04	180	1.2 E-04	284	1.7 E-04	232
N403	^{234}U	3.2 E-06	226	5.3 E-06	122	4.3 E-06	174
N403	^{235}U	1.4 E-06	219	-9.8 E-07	193	2.0 E-07	206
N403	^{238}U	-1.2 E-07	5068	2.1 E-07	2320	4.8 E-08	3694
N403	^{238}Pu	2.9 E-07	325	-5.5 E-07	341	-1.3 E-07	333
N403	$^{239,240}Pu$	4.6 E-06	55	1.5 E-06	133	3.0 E-06	94
N404	^{40}K	5.7 E-03	73	7.4 E-03	49	6.5 E-03	61
N404	^{60}Co	-3.2 E-05	627	3.8 E-05	388	3.0 E-06	507
N404	^{65}Zn	-2.1 E-04	345	-9.5 E-05	772	-1.5 E-04	559
N404	^{90}Sr	1.0 E-04	61	1.2 E-05	532	5.6 E-05	297
N404	^{95}Zr	-3.3 E-04	600	1.8 E-03	85	7.5 E-04	343
N404	^{106}Ru	7.4 E-04	272	-1.0 E-03	186	-1.4 E-04	229
N404	^{125}Sb	5.5 E-04	119	-1.0 E-04	439	2.3 E-04	279
N404	^{134}Cs	1.9 E-05	1183	NR		1.9 E-05	1183
N404	^{137}Cs	1.8 E-04	165	-6.7 E-05	245	5.8 E-05	205
N404	^{144}Ce	2.8 E-04	660	5.7 E-05	2811	1.7 E-04	1735
N404	^{154}Eu	1.2 E-04	508	-5.3 E-04	112	-2.1 E-04	310
N404	^{155}Eu	2.7 E-04	147	-5.3 E-05	609	1.1 E-04	378
N404	^{234}U	3.7 E-06	203	5.0 E-06	123	4.3 E-06	163
N404	^{235}U	2.8 E-06	129	4.6 E-07	444	1.6 E-06	287
N404	^{238}U	2.0 E-06	321	-3.3 E-08	9999	9.6 E-07	6686

Table C-1. Ambient Air Sample Results, 1994 (pCi/m^3).

		1st Half Result	Overall Error	2nd Half Result	Overall Error	Average Annual Result	Average Error
N404	^{238}Pu	1.3 E-06	117	-4.8 E-07	364	4.1 E-07	241
N404	^{239,240}Pu	3.5 E-06	65	4.9 E-07	352	2.0 E-06	208
200 Areas							
N019	^{40}K	4.0 E-03	77	8.8 E-03	47	6.4 E-03	62
N019	^{60}Co	6.3 E-05	289	1.6 E-04	148	1.1 E-04	219
N019	^{65}Zn	-4.6 E-04	157	-6.2 E-04	107	-5.4 E-04	132
N019	^{90}Sr	5.1 E-05	67	5.9 E-05	107	5.5 E-05	87
N019	^{95}Zr	-4.0 E-04	597	-9.8 E-04	189	-6.9 E-04	393
N019	^{106}Ru	-1.5 E-04	1337	5.8 E-04	280	2.2 E-04	809
N019	^{125}Sb	4.7 E-04	106	1.9 E-04	226	3.3 E-04	166
N019	^{134}Cs	-3.6 E-05	632	-3.4 E-05	557	-3.5 E-05	594
N019	^{137}Cs	6.8 E-05	288	9.8 E-04	41	5.2 E-04	164
N019	^{144}Ce	-1.2 E-03	178	7.8 E-04	246	-2.0 E-04	212
N019	^{154}Eu	6.9 E-04	67	8.0 E-05	509	3.8 E-04	288
N019	^{155}Eu	3.1 E-05	1129	-3.0 E-04	123	-1.4 E-04	627
N019	^{234}U	1.8 E-06	311	3.2 E-06	153	2.5 E-06	232
N019	^{235}U	9.1 E-07	291	1.3 E-06	151	1.1 E-06	221
N019	^{238}U	7.3 E-06	80	5.8 E-06	88	6.5 E-06	84
N019	^{238}Pu	7.0 E-07	578	3.5 E-08	3314	3.7 E-07	1945
N019	^{239,240}Pu	1.7 E-05	69	1.8 E-06	156	9.6 E-06	112
N155	^{40}K	5.0 E-03	55	5.5 E-03	65	5.3 E-03	60
N155	^{60}Co	1.7 E-04	82	-1.1 E-04	181	3.0 E-05	131
N155	^{65}Zn	-7.6 E-04	110	9.5 E-05	633	-3.3 E-04	371
N155	^{90}Sr	2.8 E-05	106	2.4 E-05	244	2.6 E-05	175
N155	^{95}Zr	-7.8 E-04	344	-1.3 E-03	138	-1.0 E-03	241
N155	^{106}Ru	5.2 E-04	463	1.5 E-03	118	1.0 E-03	291
N155	^{125}Sb	-2.0 E-04	256	3.9 E-04	101	9.5 E-05	178
N155	^{134}Cs	-4.0 E-05	524	-1.1 E-05	1504	-2.6 E-05	1014
N155	^{137}Cs	2.6 E-04	91	4.0 E-04	56	3.3 E-04	73
N155	^{144}Ce	-1.0 E-03	250	-7.3 E-04	214	-8.7 E-04	232
N155	^{154}Eu	1.2 E-04	542	4.0 E-04	82	2.6 E-04	312
N155	^{155}Eu	1.1 E-04	458	2.5 E-06	9999	5.7 E-05	6221
N155	^{234}U	3.4 E-06	165	7.5 E-06	89	5.5 E-06	127
N155	^{235}U	2.3 E-06	125	7.4 E-07	306	1.5 E-06	216
N155	^{238}U	1.4 E-05	54	1.5 E-05	51	1.4 E-05	53

Table C-1. Ambient Air Sample Results, 1994 (pCi/m^3).

		1st Half Result	Overall Error	2nd Half Result	Overall Error	Average Annual Result	Average Error
N155	^{238}Pu	4.7 E-08	761	5.5 E-07	288	3.0 E-07	525
N155	^{239,240}Pu	6.3 E-06	35	1.2 E-05	46	8.9 E-06	41
N158	^{40}K	1.0 E-03	473	1.3 E-02	32	6.8 E-03	252
N158	^{60}Co	-3.5 E-05	587	1.3 E-04	167	4.9 E-05	377
N158	^{65}Zn	4.6 E-05	1679	-2.0 E-05	3301	1.3 E-05	2490
N158	^{90}Sr	1.3 E-04	37	5.6 E-04	29	3.5 E-04	33
N158	^{95}Zr	-2.0 E-04	1282	1.3 E-03	156	5.3 E-04	720
N158	^{106}Ru	-1.7 E-03	162	-3.8 E-04	584	-1.0 E-03	373
N158	^{125}Sb	5.0 E-04	98	7.3 E-05	585	2.9 E-04	342
N158	^{134}Cs	6.9 E-06	3024	4.0 E-05	491	2.4 E-05	1757
N158	^{137}Cs	6.6 E-04	43	2.7 E-04	82	4.6 E-04	63
N158	^{144}Ce	-2.6 E-03	94	1.2 E-04	1478	-1.3 E-03	787
N158	^{154}Eu	1.0 E-04	685	6.1 E-04	87	3.5 E-04	386
N158	^{155}Eu	-1.4 E-04	315	-2.8 E-06	9999	-7.0 E-05	6394
N158	^{234}U	2.2 E-05	54	7.6 E-06	82	1.5 E-05	68
N158	^{235}U	2.7 E-06	187	6.8 E-07	314	1.7 E-06	250
N158	^{238}U	7.6 E-05	27	1.2 E-05	55	4.4 E-05	41
N158	^{238}Pu	1.5 E-07	493	3.2 E-09	9999	7.6 E-08	9999
N158	^{239,240}Pu	3.4 E-06	55	1.3 E-06	134	2.4 E-06	95
N161	^{40}K	5.2 E-03	84	1.3 E-02	36	9.2 E-03	60
N161	^{60}Co	3.5 E-05	509	2.3 E-04	72	1.3 E-04	290
N161	^{65}Zn	-3.5 E-04	181	5.8 E-04	118	1.2 E-04	149
N161	^{90}Sr	5.7 E-05	65	2.4 E-05	272	4.0 E-05	168
N161	^{95}Zr	-3.2 E-03	84	-3.0 E-04	584	-1.7 E-03	334
N161	^{106}Ru	-2.1 E-03	100	-1.1 E-03	224	-1.6 E-03	162
N161	^{125}Sb	1.4 E-04	309	2.5 E-04	234	1.9 E-04	272
N161	^{134}Cs	7.7 E-06	2868	-2.7 E-05	670	-9.8 E-06	1769
N161	^{137}Cs	8.7 E-05	208	1.5 E-04	118	1.2 E-04	163
N161	^{144}Ce	1.0 E-03	188	2.2 E-04	947	6.3 E-04	568
N161	^{154}Eu	2.6 E-05	2378	3.2 E-04	166	1.7 E-04	1272
N161	^{155}Eu	6.6 E-05	518	1.5 E-05	2703	4.0 E-05	1611
N161	^{234}U	2.8 E-06	201	4.0 E-08	9999	1.4 E-06	7328
N161	^{235}U	1.7 E-06	168	-1.3 E-06	160	2.2 E-07	164
N161	^{238}U	5.1 E-06	106	-2.2 E-07	2113	2.5 E-06	1110
N161	^{238}Pu	1.9 E-07	328	3.3 E-07	512	2.6 E-07	420

Table C-1. Ambient Air Sample Results, 1994 (pCi/m^3).

		1st Half Result	Overall Error	2nd Half Result	Overall Error	Average Annual Result	Average Error
N161	^{239,240}Pu	1.8 E-05	24	1.3 E-05	44	1.5 E-05	34
N165	^{40}K	6.3 E-03	59	7.9 E-04	614	3.6 E-03	336
N165	^{60}Co	1.6 E-04	166	-2.7 E-04	156	-5.4 E-05	161
N165	^{65}Zn	5.6 E-04	129	-2.7 E-04	344	1.4 E-04	236
N165	^{90}Sr	2.8 E-05	129	5.1 E-05	178	4.0 E-05	154
N165	^{95}Zr	-2.8 E-03	145	2.1 E-03	118	-3.5 E-04	132
N165	^{106}Ru	4.1 E-05	6771	-2.2 E-04	1493	-9.0 E-05	4132
N165	^{125}Sb	3.3 E-04	174	-2.7 E-04	269	3.3 E-05	221
N165	^{134}Cs	7.5 E-05	280	9.3 E-05	318	8.4 E-05	299
N165	^{137}Cs	3.2 E-04	72	5.6 E-05	452	1.9 E-04	262
N165	^{144}Ce	1.1 E-03	243	5.0 E-05	5000	5.7 E-04	2621
N165	^{154}Eu	5.1 E-04	90	5.8 E-04	139	5.5 E-04	115
N165	^{155}Eu	-6.2 E-05	753	-2.7 E-05	1612	-4.4 E-05	1182
N165	^{234}U	1.5 E-05	95	1.1 E-05	96	1.3 E-05	95
N165	^{235}U	1.6 E-06	316	2.0 E-06	193	1.8 E-06	254
N165	^{238}U	1.6 E-05	79	5.0 E-06	165	1.0 E-05	122
N165	^{238}Pu	2.4 E-06	71	2.4 E-06	137	2.4 E-06	104
N165	^{239,240}Pu	1.7 E-04	13	1.9 E-04	17	1.8 E-04	15
N168	^{40}K	7.1 E-03	41	1.1 E-02	32	9.0 E-03	37
N168	^{60}Co	-7.4 E-05	380	5.8 E-05	290	-8.1 E-06	335
N168	^{65}Zn	-2.3 E-04	346	7.1 E-04	80	2.4 E-04	213
N168	^{90}Sr	1.9 E-04	31	-2.7 E-06	2255	9.5 E-05	1143
N168	^{95}Zr	-3.2 E-03	102	2.0 E-03	73	-6.2 E-04	87
N168	^{106}Ru	-1.3 E-03	173	-9.5 E-04	200	-1.1 E-03	186
N168	^{125}Sb	1.0 E-04	464	-1.1 E-05	4514	4.7 E-05	2488
N168	^{134}Cs	1.3 E-05	1542	-1.9 E-04	98	-9.0 E-05	821
N168	^{137}Cs	-9.5 E-05	283	-7.6 E-05	242	-8.6 E-05	263
N168	^{144}Ce	-1.3 E-03	171	-4.7 E-04	395	-8.9 E-04	283
N168	^{154}Eu	NR		-7.1 E-05	722	-7.1 E-05	722
N168	^{155}Eu	3.7 E-04	131	2.7 E-04	106	3.2 E-04	119
N168	^{234}U	3.6 E-06	263	2.6 E-05	37	1.5 E-05	150
N168	^{235}U	2.2 E-06	321	1.1 E-06	243	1.6 E-06	282
N168	^{238}U	-3.7 E-06	281	2.5 E-05	37	1.1 E-05	159
N168	^{238}Pu	-5.2 E-08	1178	1.5 E-07	1198	4.9 E-08	1188
N168	^{239,240}Pu	1.7 E-05	24	1.8 E-06	127	9.2 E-06	76

Table C-1. Ambient Air Sample Results, 1994 (pCi/m^3).

		1st Half Result	Overall Error	2nd Half Result	Overall Error	Average Annual Result	Average Error
N200	^{40}K	4.5 E-03	77	3.8 E-03	100	4.2 E-03	89
N200	^{60}Co	-4.3 E-05	618	-3.5 E-05	645	-3.9 E-05	631
N200	^{65}Zn	-2.3 E-04	334	-4.2 E-04	156	-3.3 E-04	245
N200	^{90}Sr	3.4 E-05	76	-1.0 E-05	552	1.2 E-05	314
N200	^{95}Zr	-1.5 E-03	159	-2.2 E-04	770	-8.8 E-04	465
N200	^{106}Ru	1.7 E-03	140	-5.1 E-04	419	5.9 E-04	279
N200	^{125}Sb	-3.0 E-04	167	-2.2 E-04	220	-2.6 E-04	194
N200	^{134}Cs	1.8 E-04	101	2.4 E-05	886	1.0 E-04	493
N200	^{137}Cs	1.6 E-04	64	5.3 E-05	340	1.1 E-04	202
N200	^{144}Ce	2.2 E-03	85	-5.1 E-04	379	8.4 E-04	232
N200	^{154}Eu	1.0 E-04	611	4.1 E-05	1251	7.2 E-05	931
N200	^{155}Eu	-3.3 E-04	102	-2.1 E-04	164	-2.7 E-04	133
N200	^{234}U	-3.1 E-07	1223	1.3 E-06	363	5.1 E-07	793
N200	^{235}U	1.2 E-07	983	-7.5 E-07	124	-3.1 E-07	553
N200	^{238}U	-1.4 E-06	210	-1.7 E-06	207	-1.6 E-06	209
N200	^{238}Pu	-9.1 E-09	4720	-9.1 E-07	94	-4.6 E-07	2406
N200	$^{239,240}Pu$	8.3 E-07	121	4.6 E-07	360	6.5 E-07	241
N201	^{40}K	3.3 E-03	128	2.2 E-02	36	1.3 E-02	82
N201	^{60}Co	1.5 E-05	2012	-9.9 E-05	444	-4.2 E-05	1228
N201	^{65}Zn	1.6 E-04	469	-5.9 E-04	239	-2.1 E-04	354
N201	^{90}Sr	5.1 E-05	69	-3.6 E-05	309	7.7 E-06	189
N201	^{95}Zr	-1.1 E-03	274	4.4 E-03	174	1.6 E-03	224
N201	^{106}Ru	3.8 E-04	491	4.1 E-03	101	2.3 E-03	296
N201	^{125}Sb	1.4 E-04	429	-3.3 E-04	317	-9.5 E-05	373
N201	^{134}Cs	-7.7 E-05	334	-7.9 E-05	558	-7.8 E-05	446
N201	^{137}Cs	9.3 E-05	243	1.5 E-04	207	1.2 E-04	225
N201	^{144}Ce	1.0 E-03	222	-2.6 E-03	177	-7.7 E-04	199
N201	^{154}Eu	-6.1 E-04	112	1.1 E-03	108	2.5 E-04	110
N201	^{155}Eu	3.3 E-04	151	-6.8 E-04	114	-1.7 E-04	133
N201	^{234}U	3.2 E-07	1789	-5.1 E-06	179	-2.4 E-06	984
N201	^{235}U	1.7 E-07	1182	-1.5 E-06	275	-6.8 E-07	729
N201	^{238}U	6.8 E-07	719	-1.4 E-07	7035	2.7 E-07	3877
N201	^{238}Pu	-1.7 E-07	288	-1.5 E-06	106	-8.3 E-07	197
N201	$^{239,240}Pu$	2.9 E-06	55	-2.2 E-06	91	3.4 E-07	73
N304	^{40}K	3.9 E-03	67	6.1 E-03	53	5.0 E-03	60

Table C-1. Ambient Air Sample Results, 1994 (pCi/m^3).

		1st Half Result	Overall Error	2nd Half Result	Overall Error	Average Annual Result	Average Error
N304	^{60}Co	-4.3 E-04	75	1.1 E-04	166	-1.6 E-04	120
N304	^{65}Zn	5.7 E-04	102	4.0 E-04	150	4.8 E-04	126
N304	^{90}Sr	3.3 E-05	75	9.6 E-06	615	2.1 E-05	345
N304	^{95}Zr	-2.7 E-03	101	-1.0 E-03	190	-1.9 E-03	145
N304	^{106}Ru	-9.9 E-04	252	1.9 E-03	101	4.7 E-04	177
N304	^{125}Sb	3.5 E-04	109	3.3 E-04	127	3.4 E-04	118
N304	^{134}Cs	-1.0 E-05	2009	-1.0 E-04	176	-5.7 E-05	1092
N304	^{137}Cs	1.3 E-04	118	-9.9 E-06	1491	5.8 E-05	805
N304	^{144}Ce	-5.4 E-04	393	2.2 E-04	848	-1.6 E-04	621
N304	^{154}Eu	-1.7 E-03	56	4.3 E-04	121	-6.5 E-04	88
N304	^{155}Eu	-2.5 E-04	151	-6.4 E-05	423	-1.6 E-04	287
N304	^{234}U	5.1 E-06	151	1.1 E-07	3869	2.6 E-06	2010
N304	^{235}U	-1.2 E-06	94	7.1 E-07	319	-2.4 E-07	207
N304	^{238}U	7.0 E-06	115	8.9 E-06	67	7.9 E-06	91
N304	^{238}Pu	1.1 E-07	559	-4.6 E-07	378	-1.8 E-07	469
N304	^{239,240}Pu	5.2 E-06	40	2.0 E-06	110	3.6 E-06	75
N956	^{40}K	1.5 E-03	226	1.3 E-02	30	7.2 E-03	128
N956	^{60}Co	2.2 E-04	67	1.9 E-04	103	2.0 E-04	85
N956	^{65}Zn	-2.8 E-04	0	-6.6 E-04	121	-4.7 E-04	121
N956	^{90}Sr	1.5 E-04	38	7.2 E-05	93	1.1 E-04	66
N956	^{95}Zr	5.1 E-04	0	-1.5 E-03	155	-4.7 E-04	155
N956	^{106}Ru	-2.0 E-03	0	2.4 E-03	80	2.0 E-04	80
N956	^{125}Sb	3.8 E-04	94	3.1 E-04	145	3.4 E-04	120
N956	^{134}Cs	-1.0 E-05	0	-3.1 E-05	589	-2.1 E-05	589
N956	^{137}Cs	4.3 E-04	42	7.4 E-05	301	2.5 E-04	172
N956	^{144}Ce	-6.8 E-04	0	2.1 E-03	86	7.3 E-04	86
N956	^{154}Eu	2.7 E-04	0	4.2 E-05	1250	1.6 E-04	1250
N956	^{155}Eu	NR		-1.7 E-04	219	-1.7 E-04	219
N956	^{234}U	4.4 E-06	0	7.3 E-06	81	5.8 E-06	81
N956	^{235}U	1.4 E-06	0	9.4 E-08	1834	7.4 E-07	1834
N956	^{238}U	-9.6 E-08	0	9.5 E-06	62	4.7 E-06	62
N956	^{238}Pu	-2.4 E-07	0	1.1 E-06	180	4.1 E-07	180
N956	^{239,240}Pu	6.0 E-06	55	1.1 E-05	45	8.6 E-06	50
N957	^{40}K	7.8 E-03	39	1.0 E-02	38	8.9 E-03	38
N957	^{60}Co	-1.5 E-04	125	6.3 E-05	330	-4.4 E-05	227

Table C-1. Ambient Air Sample Results, 1994 (pCi/m^3).

		1st Half Result	Overall Error	2nd Half Result	Overall Error	Average Annual Result	Average Error
N957	^{65}Zn	-5.3 E-04	97	2.6 E-04	205	-1.3 E-04	151
N957	^{90}Sr	7.9 E-05	51	2.7 E-05	278	5.3 E-05	165
N957	^{95}Zr	-3.2 E-04	599	2.9 E-03	61	1.3 E-03	330
N957	^{106}Ru	-9.6 E-04	149	4.9 E-04	322	-2.4 E-04	236
N957	^{125}Sb	1.4 E-05	2871	-4.0 E-04	119	-1.9 E-04	1495
N957	^{134}Cs	1.9 E-06	7604	3.5 E-05	484	1.8 E-05	4044
N957	^{137}Cs	-2.0 E-04	78	1.9 E-04	110	-6.0 E-06	94
N957	^{144}Ce	7.4 E-04	196	-1.5 E-04	1311	3.0 E-04	754
N957	^{154}Eu	-2.1 E-04	252	4.2 E-05	1250	-8.7 E-05	751
N957	^{155}Eu	1.3 E-04	204	-3.1 E-05	1215	4.8 E-05	710
N957	^{234}U	5.8 E-06	96	6.7 E-06	85	6.2 E-06	91
N957	^{235}U	-3.0 E-07	589	7.2 E-07	222	2.1 E-07	406
N957	^{238}U	3.7 E-06	131	4.2 E-06	114	3.9 E-06	122
N957	^{238}Pu	-7.1 E-06	94	-1.4 E-06	136	-4.2 E-06	115
N957	^{239,240}Pu	3.1 E-07	612	3.3 E-06	106	1.8 E-06	359
N963	^{40}K	5.6 E-03	53	6.9 E-03	76	6.3 E-03	64
N963	^{60}Co	5.2 E-05	289	-4.1 E-04	77	-1.8 E-04	183
N963	^{65}Zn	6.1 E-05	775	-3.7 E-04	181	-1.6 E-04	478
N963	^{90}Sr	1.8 E-04	33	3.1 E-05	277	1.1 E-04	155
N963	^{95}Zr	1.9 E-03	90	-1.0 E-03	230	4.3 E-04	160
N963	^{106}Ru	4.3 E-04	406	-2.0 E-03	143	-8.0 E-04	274
N963	^{125}Sb	-2.5 E-04	140	-1.7 E-04	335	-2.1 E-04	238
N963	^{134}Cs	1.2 E-04	133	-3.8 E-04	75	-1.3 E-04	104
N963	^{137}Cs	1.3 E-05	1248	5.7 E-05	414	3.5 E-05	831
N963	^{144}Ce	-9.1 E-04	157	3.5 E-04	639	-2.8 E-04	398
N963	^{154}Eu	-3.3 E-04	223	3.9 E-04	151	3.1 E-05	187
N963	^{155}Eu	2.9 E-04	87	-1.4 E-04	282	7.7 E-05	184
N963	^{234}U	2.0 E-06	291	-3.7 E-07	1732	8.0 E-07	1011
N963	^{235}U	1.6 E-06	165	1.9 E-06	164	1.8 E-06	165
N963	^{238}U	2.2 E-06	235	8.8 E-06	85	5.5 E-06	160
N963	^{238}Pu	5.5 E-05	25	2.6 E-05	34	4.1 E-05	29
N963	^{239,240}Pu	7.3 E-06	46	1.4 E-05	46	1.0 E-05	46
N964	^{40}K	2.9 E-03	70	1.4 E-04	3323	1.5 E-03	1696
N964	^{60}Co	2.7 E-05	509	2.2 E-04	98	1.2 E-04	304
N964	^{65}Zn	1.8 E-04	372	-3.4 E-04	244	-8.4 E-05	308

Table C-1. Ambient Air Sample Results, 1994 (pCi/m^3).

		1st Half Result	Overall Error	2nd Half Result	Overall Error	Average Annual Result	Average Error
N964	^{90}Sr	5.6 E-05	61	1.3 E-06	4742	2.9 E-05	2401
N964	^{95}Zr	-2.6 E-03	73	2.7 E-04	604	-1.2 E-03	338
N964	^{106}Ru	1.0 E-03	138	-1.2 E-03	191	-1.0 E-04	165
N964	^{125}Sb	2.6 E-04	153	-1.0 E-04	503	7.9 E-05	328
N964	^{134}Cs	-8.7 E-05	177	1.3 E-04	138	1.9 E-05	157
N964	^{137}Cs	2.3 E-04	61	-5.1 E-06	4505	1.1 E-04	2283
N964	^{144}Ce	4.2 E-04	358	-8.8 E-04	214	-2.3 E-04	286
N964	^{154}Eu	1.3 E-04	290	-7.6 E-04	95	-3.1 E-04	193
N964	^{155}Eu	2.7 E-04	85	3.1 E-04	130	2.9 E-04	107
N964	^{234}U	5.7 E-06	114	1.5 E-06	320	3.6 E-06	217
N964	^{235}U	-2.3 E-06	68	-4.0 E-07	354	-1.3 E-06	211
N964	^{238}U	4.8 E-06	118	3.8 E-06	131	4.3 E-06	125
N964	^{238}Pu	2.6 E-06	302	-4.8 E-07	357	1.1 E-06	330
N964	^{239,240}Pu	4.4 E-06	63	3.1 E-06	88	3.7 E-06	75
N965	^{40}K	4.4 E-03	53	8.9 E-03	44	6.6 E-03	48
N965	^{60}Co	-5.7 E-05	363	-1.4 E-04	153	-9.8 E-05	258
N965	^{65}Zn	-2.0 E-04	239	2.9 E-04	151	4.4 E-05	195
N965	^{90}Sr	6.0 E-05	60	-1.8 E-05	339	2.1 E-05	199
N965	^{95}Zr	-3.6 E-04	324	-4.6 E-04	378	-4.1 E-04	351
N965	^{106}Ru	-1.2 E-03	121	-1.5 E-04	1149	-6.8 E-04	635
N965	^{125}Sb	1.7 E-04	211	9.1 E-05	406	1.3 E-04	308
N965	^{134}Cs	-9.0 E-05	193	4.3 E-05	418	-2.4 E-05	306
N965	^{137}Cs	-6.1 E-05	231	-1.3 E-04	138	-9.5 E-05	184
N965	^{144}Ce	-9.9 E-05	1389	-7.2 E-05	2381	-8.5 E-05	1885
N965	^{154}Eu	-1.0 E-04	445	-5.6 E-05	627	-7.8 E-05	536
N965	^{155}Eu	7.5 E-05	321	-7.3 E-05	403	1.1 E-06	362
N965	^{234}U	9.3 E-06	136	4.4 E-06	144	6.8 E-06	140
N965	^{235}U	7.7 E-06	129	-1.2 E-06	161	3.3 E-06	145
N965	^{238}U	2.8 E-06	505	7.1 E-06	88	4.9 E-06	297
N965	^{238}Pu	-4.1 E-06	169	2.5 E-08	7530	-2.0 E-06	3849
N965	^{239,240}Pu	9.7 E-07	218	3.3 E-07	686	6.5 E-07	452
N966	^{40}K	5.3 E-03	48	2.9 E-03	123	4.1 E-03	85
N966	^{60}Co	7.7 E-05	259	6.0 E-05	289	6.9 E-05	274
N966	^{65}Zn	3.2 E-04	187	-1.8 E-04	455	7.3 E-05	321
N966	^{90}Sr	1.0 E-04	45	2.3 E-05	269	6.1 E-05	157

Table C-1. Ambient Air Sample Results, 1994 (pCi/m^3).

		1st Half Result	Overall Error	2nd Half Result	Overall Error	Average Annual Result	Average Error
N966	^{95}Zr	-1.7 E-03	111	-6.0 E-04	414	-1.1 E-03	262
N966	^{106}Ru	-9.6 E-04	159	1.2 E-03	162	1.0 E-04	161
N966	^{125}Sb	2.1 E-04	132	3.8 E-04	143	3.0 E-04	137
N966	^{134}Cs	-2.6 E-04	63	9.0 E-05	220	-8.6 E-05	142
N966	^{137}Cs	1.5 E-04	100	-4.9 E-05	317	5.1 E-05	209
N966	^{144}Ce	6.1 E-04	222	-9.8 E-05	2030	2.6 E-04	1126
N966	^{154}Eu	2.0 E-05	2372	NR		2.0 E-05	2372
N966	^{155}Eu	-1.3 E-04	219	-8.3 E-05	456	-1.0 E-04	337
N966	^{234}U	5.1 E-06	126	4.1 E-06	149	4.6 E-06	137
N966	^{235}U	1.3 E-06	233	6.8 E-07	314	1.0 E-06	274
N966	^{238}U	7.2 E-06	83	6.8 E-06	89	7.0 E-06	86
N966	^{238}Pu	-2.6 E-06	274	4.1 E-08	4692	-1.3 E-06	2483
N966	^{239,240}Pu	3.1 E-06	81	4.0 E-06	75	3.5 E-06	78
N967	^{40}K	6.8 E-03	46	1.3 E-02	33	9.6 E-03	39
N967	^{60}Co	1.2 E-04	204	4.7 E-06	3354	6.1 E-05	1779
N967	^{65}Zn	-9.9 E-05	589	-2.1 E-04	417	-1.6 E-04	503
N967	^{90}Sr	1.3 E-04	42	3.9 E-05	216	8.3 E-05	129
N967	^{95}Zr	-1.4 E-03	129	1.8 E-04	1251	-5.9 E-04	690
N967	^{106}Ru	7.0 E-04	216	-1.5 E-03	140	-4.1 E-04	178
N967	^{125}Sb	-1.8 E-04	222	5.9 E-04	81	2.0 E-04	152
N967	^{134}Cs	-2.4 E-05	672	-4.4 E-05	372	-3.4 E-05	522
N967	^{137}Cs	2.2 E-04	91	2.4 E-04	102	2.3 E-04	97
N967	^{144}Ce	1.4 E-03	114	1.1 E-03	170	1.2 E-03	142
N967	^{154}Eu	1.7 E-04	360	NR		1.7 E-04	360
N967	^{155}Eu	2.3 E-04	105	2.1 E-04	194	2.2 E-04	150
N967	^{234}U	1.3 E-05	81	1.9 E-06	261	7.5 E-06	171
N967	^{235}U	1.9 E-06	261	-3.1 E-07	610	7.8 E-07	435
N967	^{238}U	5.4 E-06	154	8.1 E-06	75	6.7 E-06	114
N967	^{238}Pu	-6.1 E-06	129	2.8 E-06	127	-1.7 E-06	128
N967	^{239,240}Pu	2.6 E-06	102	1.5 E-06	226	2.0 E-06	164
N968	^{40}K	6.0 E-03	53	6.8 E-03	53	6.4 E-03	53
N968	^{60}Co	2.6 E-04	64	2.8 E-04	61	2.7 E-04	63
N968	^{65}Zn	NR		-2.9 E-04	246	-2.9 E-04	246
N968	^{90}Sr	5.9 E-05	66	-4.6 E-05	135	6.8 E-06	101
N968	^{95}Zr	1.9 E-04	979	4.9 E-04	427	3.4 E-04	703

Table C-1. Ambient Air Sample Results, 1994 (pCi/m^3).

		1st Half Result	Overall Error	2nd Half Result	Overall Error	Average Annual Result	Average Error
N968	^{106}Ru	-1.3 E-04	1333	-1.3 E-03	167	-7.1 E-04	750
N968	^{125}Sb	-4.3 E-04	119	5.7 E-05	873	-1.9 E-04	496
N968	^{134}Cs	-1.1 E-04	167	-1.0 E-04	193	-1.1 E-04	180
N968	^{137}Cs	-6.7 E-05	214	6.1 E-05	253	-3.1 E-06	233
N968	^{144}Ce	-2.3 E-03	83	-1.0 E-03	157	-1.6 E-03	120
N968	^{154}Eu	3.4 E-05	1941	2.8 E-04	165	1.6 E-04	1053
N968	^{155}Eu	4.2 E-05	652	-8.5 E-05	336	-2.1 E-05	494
N968	^{234}U	1.3 E-05	82	7.5 E-06	86	1.0 E-05	84
N968	^{235}U	-3.4 E-07	1000	3.9 E-07	485	2.6 E-08	742
N968	^{238}U	1.0 E-05	84	3.5 E-06	144	7.0 E-06	114
N968	^{238}Pu	-1.8 E-06	479	-2.1 E-08	5283	-9.1 E-07	2880
N968	^{239,240}Pu	2.8 E-06	102	2.2 E-06	99	2.5 E-06	100
N969	^{40}K	5.7 E-03	53	2.4 E-03	183	4.0 E-03	118
N969	^{60}Co	1.5 E-04	121	1.9 E-04	76	1.7 E-04	99
N969	^{65}Zn	-1.9 E-04	333	-2.1 E-04	333	-2.0 E-04	333
N969	^{90}Sr	7.7 E-05	54	1.1 E-05	606	4.4 E-05	330
N969	^{95}Zr	-7.3 E-04	195	-1.8 E-04	1216	-4.5 E-04	706
N969	^{106}Ru	1.2 E-03	155	-1.6 E-03	148	-2.1 E-04	152
N969	^{125}Sb	-3.4 E-04	110	-7.6 E-04	70	-5.5 E-04	90
N969	^{134}Cs	8.9 E-05	198	5.1 E-05	422	7.0 E-05	310
N969	^{137}Cs	1.3 E-04	82	4.7 E-05	407	8.8 E-05	245
N969	^{144}Ce	5.3 E-05	2800	1.3 E-03	157	6.8 E-04	1478
N969	^{154}Eu	-3.6 E-04	153	-1.2 E-03	70	-7.8 E-04	111
N969	^{155}Eu	5.3 E-05	484	7.9 E-05	402	6.6 E-05	443
N969	^{234}U	4.6 E-06	120	1.1 E-06	455	2.8 E-06	288
N969	^{235}U	9.5 E-07	227	1.1 E-06	186	1.0 E-06	206
N969	^{238}U	4.8 E-06	107	3.6 E-06	141	4.2 E-06	124
N969	^{238}Pu	7.9 E-06	119	-4.8 E-07	340	3.7 E-06	230
N969	^{239,240}Pu	4.6 E-07	496	5.9 E-06	65	3.2 E-06	281
N970	^{40}K	5.0 E-03	55	1.4 E-02	41	9.3 E-03	48
N970	^{60}Co	9.2 E-06	2379	-1.1 E-04	298	-5.2 E-05	1339
N970	^{65}Zn	6.7 E-04	64	-4.5 E-04	189	1.1 E-04	127
N970	^{90}Sr	4.5 E-05	65	3.8 E-06	2303	2.4 E-05	1184
N970	^{95}Zr	-4.3 E-04	380	-8.9 E-04	441	-6.6 E-04	411
N970	^{106}Ru	-2.7 E-05	7969	2.5 E-03	80	1.3 E-03	4025

Table C-1. Ambient Air Sample Results, 1994 (pCi/m^3).

		1st Half Result	Overall Error	2nd Half Result	Overall Error	Average Annual Result	Average Error
N970	^{125}Sb	-1.5 E-04	274	-3.3 E-05	2048	-9.3 E-05	1161
N970	^{134}Cs	1.5 E-04	84	2.3 E-04	118	1.9 E-04	101
N970	^{137}Cs	1.1 E-04	137	2.3 E-04	110	1.7 E-04	124
N970	^{144}Ce	-4.4 E-05	3816	-1.1 E-03	245	-5.6 E-04	2030
N970	^{154}Eu	-4.0 E-04	152	3.8 E-04	198	-8.5 E-06	175
N970	^{155}Eu	1.8 E-04	153	-1.2 E-04	344	3.0 E-05	248
N970	^{234}U	1.7 E-05	58	7.1 E-06	111	1.2 E-05	84
N970	^{235}U	9.5 E-07	259	-1.0 E-07	2409	4.2 E-07	1334
N970	^{238}U	6.7 E-06	104	7.0 E-06	105	6.9 E-06	105
N970	^{238}Pu	-8.4 E-07	1047	-6.1 E-09	9999	-4.2 E-07	9999
N970	^{239,240}Pu	1.1 E-06	228	-2.3 E-07	1126	4.4 E-07	677
N972	^{40}K	5.4 E-03	53	1.4 E-03	335	3.4 E-03	194
N972	^{60}Co	-1.5 E-05	1148	2.0 E-04	94	9.1 E-05	621
N972	^{65}Zn	1.8 E-04	275	5.2 E-04	90	3.5 E-04	182
N972	^{90}Sr	8.5 E-05	39	-9.7 E-07	6129	4.2 E-05	3084
N972	^{95}Zr	1.2 E-03	97	1.6 E-03	133	1.4 E-03	115
N972	^{106}Ru	1.4 E-04	1253	1.6 E-03	118	8.5 E-04	686
N972	^{125}Sb	-3.3 E-04	142	2.0 E-04	248	-6.6 E-05	195
N972	^{134}Cs	5.2 E-05	205	-1.2 E-04	162	-3.3 E-05	184
N972	^{137}Cs	-3.1 E-05	590	1.1 E-04	153	4.1 E-05	372
N972	^{144}Ce	7.5 E-04	196	6.2 E-04	288	6.8 E-04	242
N972	^{154}Eu	-9.2 E-04	75	1.6 E-04	331	-3.8 E-04	203
N972	^{155}Eu	-9.7 E-05	243	-6.6 E-05	515	-8.1 E-05	379
N972	^{234}U	1.0 E-05	75	7.6 E-06	76	9.0 E-06	75
N972	^{235}U	-6.2 E-07	443	1.4 E-08	8811	-3.0 E-07	4627
N972	^{238}U	1.2 E-05	66	8.1 E-06	68	1.0 E-05	67
N972	^{238}Pu	-6.0 E-08	9999	-1.7 E-07	716	-1.1 E-07	5357
N972	^{239,240}Pu	1.5 E-06	149	-6.5 E-08	1804	7.4 E-07	977
N973	^{40}K	5.5 E-03	58	1.1 E-02	37	8.2 E-03	47
N973	^{60}Co	1.6 E-04	82	2.1 E-04	108	1.9 E-04	95
N973	^{65}Zn	-4.8 E-04	131	3.0 E-04	338	-9.1 E-05	235
N973	^{90}Sr	6.2 E-05	53	8.1 E-05	105	7.1 E-05	79
N973	^{95}Zr	2.3 E-04	777	6.4 E-05	3038	1.5 E-04	1907
N973	^{106}Ru	-5.1 E-04	404	-1.6 E-03	140	-1.1 E-03	272
N973	^{125}Sb	5.5 E-05	916	-2.0 E-04	280	-7.3 E-05	598

Table C-1. Ambient Air Sample Results, 1994 (pCi/m^3).

		1st Half Result	Overall Error	2nd Half Result	Overall Error	Average Annual Result	Average Error
N973	^{134}Cs	-2.3 E-06	9469	1.5 E-05	1180	6.6 E-06	5324
N973	^{137}Cs	5.3 E-05	402	1.9 E-04	128	1.2 E-04	265
N973	^{144}Ce	6.8 E-04	216	-1.1 E-03	165	-2.3 E-04	191
N973	^{154}Eu	3.8 E-04	171	-4.7 E-04	157	-4.4 E-05	164
N973	^{155}Eu	1.3 E-04	211	3.4 E-04	112	2.3 E-04	161
N973	^{234}U	5.0 E-07	1039	8.4 E-06	79	4.5 E-06	559
N973	^{235}U	-7.2 E-07	226	-5.7 E-07	155	-6.4 E-07	191
N973	^{238}U	1.2 E-05	58	5.2 E-06	108	8.7 E-06	83
N973	^{238}Pu	-6.4 E-06	125	-2.6 E-07	506	-3.3 E-06	315
N973	^{239,240}Pu	1.1 E-07	1972	1.4 E-06	159	7.6 E-07	1065
N974	^{40}K	4.7 E-03	58	5.5 E-03	68	5.1 E-03	63
N974	^{60}Co	1.2 E-04	138	-2.0 E-04	106	-3.9 E-05	122
N974	^{65}Zn	6.3 E-04	80	-1.7 E-04	343	2.3 E-04	212
N974	^{90}Sr	3.1 E-05	97	1.8 E-05	408	2.4 E-05	253
N974	^{95}Zr	4.8 E-04	428	5.7 E-04	321	5.2 E-04	374
N974	^{106}Ru	9.3 E-05	1448	-1.1 E-03	187	-4.9 E-04	818
N974	^{125}Sb	8.9 E-05	414	1.6 E-04	250	1.2 E-04	332
N974	^{134}Cs	8.5 E-05	198	3.8 E-05	395	6.2 E-05	296
N974	^{137}Cs	9.3 E-05	137	-2.1 E-04	91	-5.9 E-05	114
N974	^{144}Ce	5.1 E-04	290	-1.4 E-03	144	-4.3 E-04	217
N974	^{154}Eu	3.9 E-04	147	-1.9 E-04	268	1.0 E-04	208
N974	^{155}Eu	-1.3 E-04	173	4.8 E-05	599	-3.9 E-05	386
N974	^{234}U	2.4 E-06	272	1.5 E-07	3157	1.3 E-06	1714
N974	^{235}U	-1.1 E-06	104	-3.1 E-07	631	-7.1 E-07	367
N974	^{238}U	1.5 E-06	390	-1.5 E-06	244	3.0 E-08	317
N974	^{238}Pu	2.1 E-06	72	-5.1 E-07	320	8.0 E-07	196
N974	^{239,240}Pu	2.2 E-06	68	2.1 E-06	112	2.1 E-06	90
N975	^{40}K	7.7 E-03	37	4.1 E-03	132	5.9 E-03	84
N975	^{60}Co	2.0 E-04	71	2.4 E-04	98	2.2 E-04	85
N975	^{65}Zn	2.3 E-04	186	5.2 E-04	131	3.7 E-04	158
N975	^{90}Sr	8.7 E-05	52	-1.7 E-05	359	3.5 E-05	205
N975	^{95}Zr	-2.3 E-03	92	-4.1 E-03	78	-3.2 E-03	85
N975	^{106}Ru	8.6 E-04	188	-2.7 E-04	938	2.9 E-04	563
N975	^{125}Sb	7.1 E-05	592	-3.3 E-04	174	-1.3 E-04	383
N975	^{134}Cs	-7.1 E-05	223	1.4 E-04	153	3.4 E-05	188

Table C-1. Ambient Air Sample Results, 1994 (pCi/m^3).

		1st Half Result	Overall Error	2nd Half Result	Overall Error	Average Annual Result	Average Error
N975	^{137}Cs	8.5 E-05	177	1.4 E-04	119	1.1 E-04	148
N975	^{144}Ce	1.2 E-03	138	1.4 E-04	1824	6.8 E-04	981
N975	^{154}Eu	-2.3 E-04	253	5.4 E-04	76	1.5 E-04	165
N975	^{155}Eu	-7.2 E-06	3491	4.6 E-05	713	2.0 E-05	2102
N975	^{234}U	1.9 E-05	68	3.3 E-06	160	1.1 E-05	114
N975	^{235}U	2.4 E-06	185	1.2 E-07	1533	1.2 E-06	859
N975	^{238}U	8.2 E-06	115	5.7 E-06	93	6.9 E-06	104
N975	^{238}Pu	7.4 E-07	122	-3.7 E-07	367	1.8 E-07	244
N975	^{239,240}Pu	3.0 E-05	20	2.6 E-05	31	2.8 E-05	26
N976	^{40}K	7.1 E-04	421	1.1 E-02	34	6.1 E-03	228
N976	^{60}Co	2.8 E-05	511	2.2 E-04	91	1.2 E-04	301
N976	^{65}Zn	2.5 E-04	213	-9.9 E-05	676	7.7 E-05	444
N976	^{90}Sr	1.3 E-04	37	1.8 E-03	27	9.7 E-04	32
N976	^{95}Zr	-2.4 E-03	108	-2.2 E-03	110	-2.3 E-03	109
N976	^{106}Ru	-7.1 E-04	244	9.9 E-04	210	1.4 E-04	227
N976	^{125}Sb	-2.4 E-04	181	1.8 E-04	219	-3.0 E-05	200
N976	^{134}Cs	9.1 E-05	132	2.6 E-05	781	5.9 E-05	457
N976	^{137}Cs	-1.5 E-05	1125	2.4 E-04	105	1.1 E-04	615
N976	^{144}Ce	-7.8 E-04	192	-3.3 E-04	593	-5.6 E-04	392
N976	^{154}Eu	2.0 E-04	208	-1.5 E-04	381	2.5 E-05	294
N976	^{155}Eu	9.7 E-05	244	1.6 E-04	219	1.3 E-04	232
N976	^{234}U	2.0 E-05	54	1.0 E-05	77	1.5 E-05	65
N976	^{235}U	2.2 E-06	161	2.8 E-06	120	2.5 E-06	141
N976	^{238}U	6.9 E-06	103	1.6 E-05	51	1.1 E-05	77
N976	^{238}Pu	-1.4 E-07	505	2.5 E-07	1056	5.3 E-08	781
N976	^{239,240}Pu	4.5 E-07	211	3.5 E-06	95	2.0 E-06	153
N977	^{40}K	1.6 E-03	163	9.7 E-03	44	5.6 E-03	103
N977	^{60}Co	5.1 E-05	469	-4.8 E-05	444	1.8 E-06	457
N977	^{65}Zn	1.6 E-04	219	-5.4 E-04	140	-1.9 E-04	180
N977	^{90}Sr	2.1 E-05	149	-1.1 E-05	599	4.9 E-06	374
N977	^{95}Zr	2.4 E-03	90	-4.0 E-04	600	1.0 E-03	345
N977	^{106}Ru	-2.9 E-04	738	2.3 E-04	1025	-2.5 E-05	882
N977	^{125}Sb	-2.6 E-04	161	-1.7 E-05	2959	-1.4 E-04	1560
N977	^{134}Cs	7.1 E-05	283	4.7 E-05	414	5.9 E-05	349
N977	^{137}Cs	2.1 E-04	81	-7.7 E-05	245	6.6 E-05	163

Table C-1. Ambient Air Sample Results, 1994 (pCi/m^3).

		1st Half Result	Overall Error	2nd Half Result	Overall Error	Average Annual Result	Average Error
N977	^{144}Ce	1.7 E-04	1143	2.6 E-04	747	2.1 E-04	945
N977	^{154}Eu	4.4 E-04	105	6.8 E-04	68	5.6 E-04	86
N977	^{155}Eu	1.4 E-04	292	-9.1 E-05	413	2.3 E-05	352
N977	^{234}U	4.8 E-06	172	1.6 E-06	349	3.2 E-06	260
N977	^{235}U	-1.4 E-06	103	8.9 E-07	291	-2.4 E-07	197
N977	^{238}U	2.3 E-06	300	5.6 E-06	107	4.0 E-06	203
N977	^{238}Pu	-3.0 E-07	87	-1.8 E-06	108	-1.1 E-06	97
N977	^{239,240}Pu	1.6 E-06	77	1.8 E-06	222	1.7 E-06	150
N978	^{40}K	7.2 E-03	49	8.4 E-03	46	7.8 E-03	47
N978	^{60}Co	7.0 E-05	290	-1.3 E-04	192	-3.0 E-05	241
N978	^{65}Zn	6.3 E-04	102	5.9 E-04	71	6.1 E-04	87
N978	^{90}Sr	4.7 E-05	96	1.9 E-05	376	3.3 E-05	236
N978	^{95}Zr	8.5 E-04	220	-7.5 E-04	292	5.1 E-05	256
N978	^{106}Ru	-2.9 E-04	939	-3.3 E-04	598	-3.1 E-04	768
N978	^{125}Sb	5.8 E-04	89	-2.2 E-04	263	1.8 E-04	176
N978	^{134}Cs	-3.8 E-05	633	-2.3 E-05	996	-3.0 E-05	814
N978	^{137}Cs	1.3 E-04	156	2.2 E-05	772	7.4 E-05	464
N978	^{144}Ce	6.5 E-04	305	-2.9 E-04	697	1.8 E-04	501
N978	^{154}Eu	4.4 E-04	139	-1.3 E-04	445	1.6 E-04	292
N978	^{155}Eu	-6.1 E-06	4585	-2.3 E-04	183	-1.2 E-04	2383
N978	^{234}U	2.6 E-06	371	5.0 E-06	171	3.8 E-06	271
N978	^{235}U	2.2 E-06	277	1.2 E-06	326	1.7 E-06	301
N978	^{238}U	-2.9 E-07	3072	1.2 E-05	87	5.8 E-06	1579
N978	^{238}Pu	1.5 E-08	5047	-2.6 E-06	116	-1.3 E-06	2582
N978	^{239,240}Pu	-1.6 E-07	221	8.4 E-07	248	3.4 E-07	234
N984	^{40}K	4.9 E-03	45	2.5 E-03	166	3.7 E-03	105
N984	^{60}Co	-5.7 E-05	457	-1.2 E-05	2056	-3.5 E-05	1256
N984	^{65}Zn	-2.2 E-04	321	-1.7 E-04	415	-1.9 E-04	368
N984	^{90}Sr	2.3 E-04	30	8.5 E-04	25	5.4 E-04	28
N984	^{95}Zr	-1.2 E-03	130	-8.0 E-05	2350	-6.2 E-04	1240
N984	^{106}Ru	NR		-3.1 E-04	860	-3.1 E-04	860
N984	^{125}Sb	9.8 E-06	4048	-5.8 E-04	101	-2.9 E-04	2074
N984	^{134}Cs	-3.8 E-05	486	-3.7 E-05	578	-3.8 E-05	532
N984	^{137}Cs	1.4 E-04	128	3.7 E-04	68	2.6 E-04	98
N984	^{144}Ce	5.7 E-04	263	1.2 E-03	168	8.7 E-04	216

Table C-1. Ambient Air Sample Results, 1994 (pCi/m^3).

		1st Half Result	Overall Error	2nd Half Result	Overall Error	Average Annual Result	Average Error
N984	^{154}Eu	-2.9 E-04	191	1.1 E-04	513	-9.0 E-05	352
N984	^{155}Eu	2.4 E-04	99	3.6 E-05	1058	1.4 E-04	579
N984	^{234}U	1.4 E-05	86	6.9 E-06	109	1.1 E-05	98
N984	^{235}U	6.3 E-07	940	3.1 E-07	831	4.7 E-07	885
N984	^{238}U	3.6 E-06	212	3.3 E-06	188	3.5 E-06	200
N984	^{238}Pu	-4.1 E-07	281	-5.1 E-07	510	-4.6 E-07	396
N984	^{239,240}Pu	6.1 E-07	282	-1.0 E-06	288	-2.1 E-07	285
N985	^{40}K	4.1 E-03	50	1.3 E-02	35	8.4 E-03	43
N985	^{60}Co	-8.9 E-05	195	-3.8 E-04	77	-2.3 E-04	136
N985	^{65}Zn	-3.3 E-05	1519	-2.2 E-04	333	-1.2 E-04	927
N985	^{90}Sr	7.1 E-05	55	3.0 E-04	38	1.9 E-04	47
N985	^{95}Zr	-1.0 E-03	210	-2.4 E-03	85	-1.7 E-03	148
N985	^{106}Ru	4.1 E-04	470	2.3 E-04	1025	3.3 E-04	748
N985	^{125}Sb	-1.4 E-04	294	NR		-1.4 E-04	294
N985	^{134}Cs	-2.7 E-04	71	-1.5 E-04	162	-2.1 E-04	117
N985	^{137}Cs	6.8 E-05	303	3.0 E-04	70	1.8 E-04	186
N985	^{144}Ce	6.0 E-04	339	2.2 E-04	951	4.1 E-04	645
N985	^{154}Eu	NR		2.5 E-04	259	2.5 E-04	259
N985	^{155}Eu	-2.4 E-04	141	-1.1 E-04	296	-1.8 E-04	218
N985	^{234}U	2.4 E-05	120	1.1 E-05	68	1.8 E-05	94
N985	^{235}U	-1.2 E-05	164	1.5 E-06	173	-5.2 E-06	169
N985	^{238}U	2.6 E-05	137	1.1 E-05	64	1.8 E-05	100
N985	^{238}Pu	1.1 E-06	101	-5.1 E-07	448	2.8 E-07	274
N985	^{239,240}Pu	1.1 E-06	105	5.4 E-07	277	8.4 E-07	191
N987	^{40}K	6.1 E-03	39	3.1 E-03	164	4.6 E-03	101
N987	^{60}Co	9.5 E-05	165	3.2 E-05	509	6.4 E-05	337
N987	^{65}Zn	-8.9 E-05	589	6.0 E-04	93	2.5 E-04	341
N987	^{90}Sr	7.6 E-05	53	5.3 E-05	166	6.4 E-05	110
N987	^{95}Zr	5.5 E-05	3036	4.2 E-04	452	2.4 E-04	1744
N987	^{106}Ru	1.6 E-04	981	-1.3 E-03	180	-5.5 E-04	581
N987	^{125}Sb	-3.7 E-04	107	5.2 E-05	967	-1.6 E-04	537
N987	^{134}Cs	-9.0 E-05	144	1.5 E-04	128	2.9 E-05	136
N987	^{137}Cs	5.1 E-05	289	8.1 E-05	235	6.6 E-05	262
N987	^{144}Ce	5.5 E-04	251	4.7 E-04	440	5.1 E-04	345
N987	^{154}Eu	-5.6 E-04	100	8.6 E-05	509	-2.4 E-04	304

Table C-1. Ambient Air Sample Results, 1994 (pCi/m^3).

		1st Half Result	Overall Error	2nd Half Result	Overall Error	Average Annual Result	Average Error
N987	^{155}Eu	-1.5 E-04	180	8.6 E-05	441	-3.3 E-05	311
N987	^{234}U	-1.5 E-06	561	6.2 E-06	95	2.3 E-06	328
N987	^{235}U	6.1 E-07	932	6.6 E-07	287	6.3 E-07	609
N987	^{238}U	7.2 E-06	124	1.6 E-06	271	4.4 E-06	197
N987	^{238}Pu	6.3 E-07	150	-4.8 E-07	404	7.6 E-08	277
N987	^{239,240}Pu	8.8 E-06	32	5.5 E-06	73	7.1 E-06	53
N994	^{40}K	2.8 E-03	107	6.6 E-03	58	4.7 E-03	83
N994	^{60}Co	7.5 E-05	241	9.0 E-05	186	8.3 E-05	213
N994	^{65}Zn	-4.5 E-04	137	-2.9 E-04	181	-3.7 E-04	159
N994	^{90}Sr	7.4 E-05	51	-4.2 E-05	150	1.6 E-05	101
N994	^{95}Zr	1.0 E-03	208	-1.8 E-03	112	-3.9 E-04	160
N994	^{106}Ru	-6.4 E-04	289	-1.0 E-03	187	-8.4 E-04	238
N994	^{125}Sb	-1.8 E-04	286	-3.3 E-04	147	-2.6 E-04	216
N994	^{134}Cs	2.0 E-04	95	-4.8 E-05	352	7.7 E-05	224
N994	^{137}Cs	-6.7 E-06	2473	5.4 E-05	296	2.4 E-05	1385
N994	^{144}Ce	-9.4 E-04	206	-1.6 E-03	96	-1.3 E-03	151
N994	^{154}Eu	-5.6 E-04	121	-8.8 E-04	84	-7.2 E-04	103
N994	^{155}Eu	2.1 E-04	189	9.0 E-05	323	1.5 E-04	256
N994	^{234}U	4.9 E-06	200	3.0 E-06	179	3.9 E-06	190
N994	^{235}U	1.4 E-06	464	3.2 E-07	441	8.4 E-07	453
N994	^{238}U	8.9 E-06	121	1.2 E-06	354	5.1 E-06	238
N994	^{238}Pu	-3.2 E-07	89	-1.1 E-06	96	-7.0 E-07	93
N994	^{239,240}Pu	1.4 E-06	84	2.5 E-06	123	1.9 E-06	103
N998	^{40}K	1.2 E-02	44	2.4 E-02	40	1.8 E-02	42
N998	^{60}Co	3.8 E-04	72	9.9 E-04	53	6.8 E-04	62
N998	^{65}Zn	-3.8 E-04	333	-5.1 E-04	441	-4.5 E-04	387
N998	^{90}Sr	1.6 E-05	338	4.3 E-05	444	2.9 E-05	391
N998	^{95}Zr	-2.3 E-03	175	3.0 E-03	230	3.6 E-04	202
N998	^{106}Ru	6.3 E-04	538	-5.5 E-03	118	-2.5 E-03	328
N998	^{125}Sb	-3.8 E-05	2005	-1.7 E-04	813	-1.0 E-04	1409
N998	^{134}Cs	5.5 E-05	592	5.9 E-05	868	5.7 E-05	730
N998	^{137}Cs	-1.2 E-05	1725	3.3 E-04	180	1.6 E-04	953
N998	^{144}Ce	-2.4 E-04	1265	-1.6 E-03	377	-9.1 E-04	821
N998	^{154}Eu	-2.1 E-04	444	2.6 E-04	689	2.7 E-05	566
N998	^{155}Eu	1.3 E-04	386	-1.3 E-03	84	-6.0 E-04	235

Table C-1. Ambient Air Sample Results, 1994 (pCi/m^3).

		1st Half Result	Overall Error	2nd Half Result	Overall Error	Average Annual Result	Average Error
N998	^{234}U	1.6 E-05	188	1.3 E-06	993	8.8 E-06	590
N998	^{235}U	1.2 E-06	1162	7.3 E-06	121	4.3 E-06	642
N998	^{238}U	8.0 E-06	250	1.7 E-05	94	1.2 E-05	172
N998	^{238}Pu	1.8 E-07	512	2.7 E-07	1645	2.3 E-07	1078
N998	$^{239,240}Pu$	3.1 E-06	78	-1.0 E-06	146	1.1 E-06	112
N999	^{40}K	3.9 E-03	107	2.8 E-02	37	1.6 E-02	72
N999	^{60}Co	1.7 E-04	155	-3.9 E-04	184	-1.1 E-04	170
N999	^{65}Zn	-2.4 E-04	380	1.6 E-03	86	6.7 E-04	233
N999	^{90}Sr	4.1 E-05	107	-7.1 E-05	198	-1.5 E-05	153
N999	^{95}Zr	-1.6 E-04	2480	-1.5 E-03	396	-8.1 E-04	1438
N999	^{106}Ru	-1.4 E-03	174	-3.3 E-03	167	-2.4 E-03	171
N999	^{125}Sb	-1.6 E-04	454	6.2 E-04	133	2.3 E-04	293
N999	^{134}Cs	7.5 E-05	346	2.6 E-04	154	1.7 E-04	250
N999	^{137}Cs	-1.3 E-04	187	1.1 E-04	415	-9.0 E-06	301
N999	^{144}Ce	3.0 E-03	93	-4.3 E-04	1016	1.3 E-03	555
N999	^{154}Eu	-1.8 E-04	424	5.5 E-04	259	1.8 E-04	341
N999	^{155}Eu	-1.6 E-04	369	-3.5 E-04	230	-2.5 E-04	300
N999	^{234}U	8.2 E-06	107	1.0 E-05	125	9.3 E-06	116
N999	^{235}U	1.4 E-06	264	7.3 E-07	441	1.1 E-06	352
N999	^{238}U	9.4 E-06	86	9.9 E-06	121	9.7 E-06	103
N999	^{238}Pu	-1.9 E-07	468	-6.8 E-07	744	-4.3 E-07	606
N999	$^{239,240}Pu$	8.3 E-07	122	4.5 E-07	1530	6.4 E-07	827
300 Area							
N130	^{40}K	1.3 E-02	53	7.1 E-03	54	1.0 E-02	54
N130	^{60}Co	1.8 E-04	240	9.5 E-05	116	1.4 E-04	178
N130	^{65}Zn	-3.6 E-04	379	3.2 E-04	213	-1.9 E-05	296
N130	^{90}Sr	4.4 E-05	129	1.0 E-05	670	2.7 E-05	399
N130	^{95}Zr	-3.2 E-03	121	-1.3 E-04	1492	-1.6 E-03	807
N130	^{106}Ru	-1.7 E-03	292	1.7 E-03	119	5.0 E-06	206
N130	^{125}Sb	-5.2 E-04	220	1.3 E-04	414	-2.0 E-04	317
N130	^{134}Cs	-3.6 E-05	1072	5.6 E-05	418	9.7 E-06	745
N130	^{137}Cs	4.9 E-04	79	1.8 E-04	116	3.4 E-04	97
N130	^{144}Ce	-1.2 E-04	3793	9.3 E-04	244	4.0 E-04	2018
N130	^{154}Eu	9.7 E-04	134	2.0 E-04	361	5.8 E-04	247
N130	^{155}Eu	2.3 E-04	408	-1.5 E-04	255	3.7 E-05	331

Table C-1. Ambient Air Sample Results, 1994 (pCi/m^3).

		1st Half Result	Overall Error	2nd Half Result	Overall Error	Average Annual Result	Average Error
N130	^{234}U	1.7 E-05	91	8.9 E-06	79	1.3 E-05	85
N130	^{235}U	2.5 E-06	258	1.3 E-06	171	1.9 E-06	215
N130	^{238}U	1.6 E-05	90	7.4 E-06	84	1.2 E-05	87
N130	^{238}Pu	-2.6 E-07	515	6.2 E-07	292	1.8 E-07	403
N130	$^{239,240}Pu$	4.1 E-07	228	-7.8 E-07	159	-1.8 E-07	194
N981	^{40}K	3.3 E-03	75	1.1 E-02	32	7.1 E-03	54
Wye Barricade (Collocated)							
N981	^{60}Co	2.6 E-05	133	9.3 E-05	185	6.0 E-05	185
N981	^{65}Zn	9.9 E-05	420	-6.7 E-05	1038	1.6 E-05	1038
N981	^{90}Sr	6.4 E-05	46	-1.2 E-05	521	2.6 E-05	290
N981	^{95}Zr	-6.4 E-04	417	-1.2 E-03	170	-9.2 E-04	170
N981	^{106}Ru	9.0 E-04	195	1.9 E-03	101	1.4 E-03	101
N981	^{125}Sb	7.7 E-05	538	3.5 E-04	116	2.1 E-04	116
N981	^{134}Cs	-2.6 E-05	222	-1.1 E-04	180	-6.9 E-05	180
N981	^{137}Cs	1.4 E-04	30	1.9 E-05	1025	7.9 E-05	1025
N981	^{144}Ce	-6.8 E-04	1472	2.4 E-04	710	-2.2 E-04	710
N981	^{154}Eu	1.4 E-04	2018	-7.1 E-05	721	3.3 E-05	721
N981	^{155}Eu	-8.3 E-05	317	-5.3 E-05	548	-6.8 E-05	548
N981	^{234}U	6.2 E-06	534	9.1 E-06	85	7.7 E-06	154
N981	^{235}U	-2.5 E-06	301	1.5 E-06	173	-4.9 E-07	173
N981	^{238}U	2.7 E-06	167	2.5 E-06	228	2.6 E-06	228
N981	^{238}Pu	-5.4 E-07	169	-5.1 E-07	422	-5.3 E-07	422
N981	$^{239,240}Pu$	2.0 E-06	198	5.0 E-07	477	1.3 E-06	284

NR = Sample result not reported.
LA = Sample was lost during analysis as the result of a laboratory accident.

APPENDIX D

GROUNDWATER MONITORING FIGURES AND TABLE

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Figure D-1. Location of Groundwater Wells at 100 K Area.

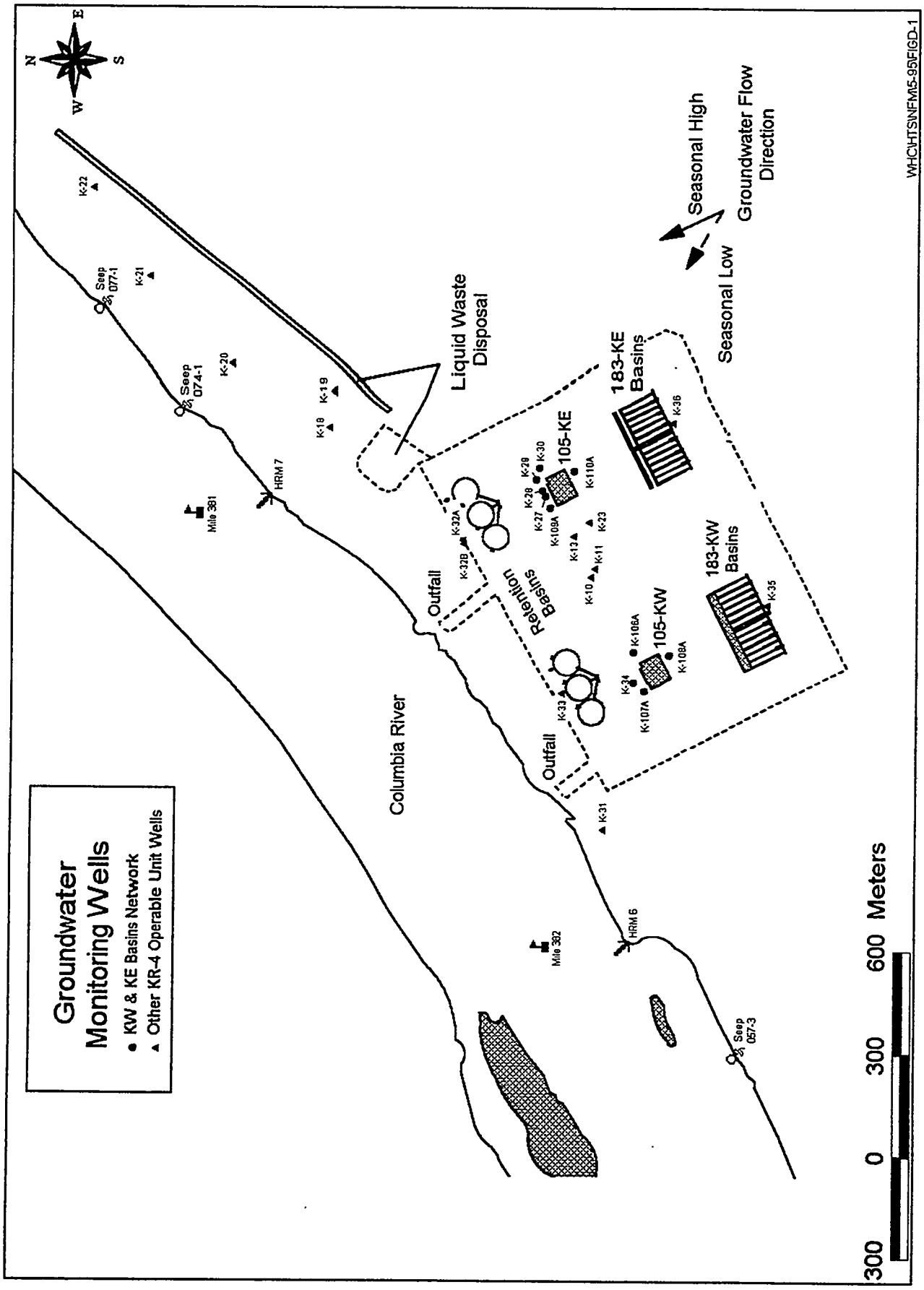
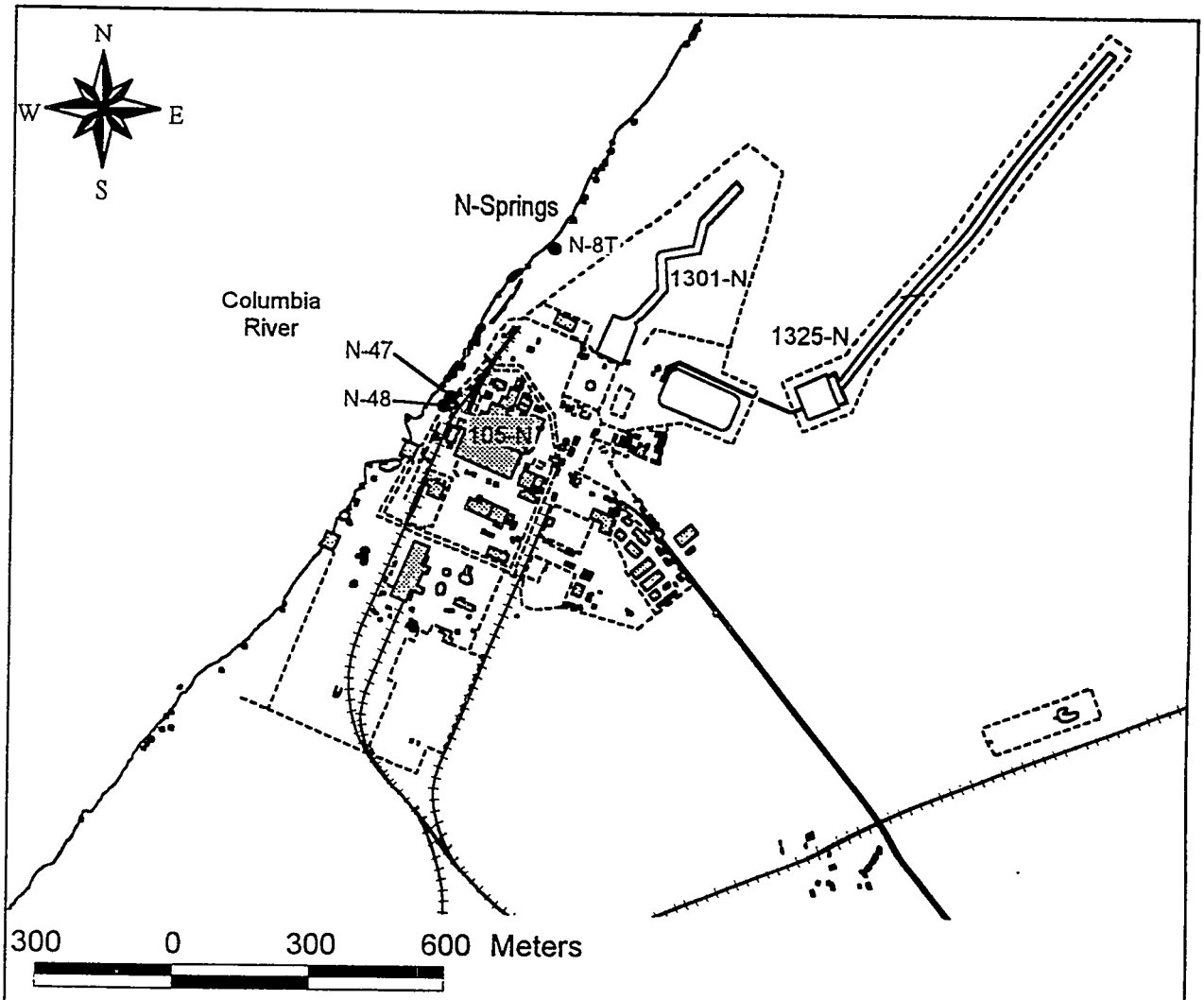


Figure D-2. Location of Groundwater Wells at 100 N Area.



Note: The wells shown here are those used in support of the Operation Environmental Monitoring Program. There are numerous wells at 100-N that are monitored in support of other programs that are not shown here. See section 3.0 for discussion.

WHC\HTS\NFM\5-95\FIGD-2

Table D-1. Liquid Sample Results, N-47 Groundwater Well (μCi/ml).

Isotope	^{40}K	^{60}Co	^{65}Zn	^{95}Zr	^{106}Ru	^{125}Sb	^{134}Cs	^{137}Cs	^{144}Ce	^{154}Eu	^{155}Eu
	3.5 E-07	3.1 E-11	2.7 E-10	1.6 E-09	6.7 E-09	9.1 E-09	2.2 E-09	9.2 E-10	3.0 E-09	1.1 E-08	3.8 E-09
	1.2 E-07	5.2 E-09	7.2 E-10	5.8 E-10	2.0 E-08	1.4 E-08	1.2 E-09	5.0 E-10	2.9 E-08	1.7 E-09	2.7 E-09
	2.4 E-07	4.5 E-09	1.3 E-08	5.3 E-09	5.2 E-09	1.0 E-08	1.7 E-10	2.6 E-10	3.1 E-08	1.3 E-08	2.2 E-09
	5.3 E-08	4.3 E-09	6.6 E-09	1.7 E-08	2.3 E-08	4.0 E-09	3.0 E-11	3.8 E-09	2.8 E-09	6.3 E-09	3.9 E-09
	7.1 E-08	2.5 E-09	1.5 E-08	1.3 E-08	3.2 E-08	2.8 E-09	1.4 E-09	2.0 E-09	1.1 E-08	1.5 E-08	8.5 E-09
	3.0 E-07	1.6 E-10	8.6 E-09	7.1 E-09	3.5 E-08	1.4 E-08	2.3 E-09	6.5 E-09	2.3 E-08	4.0 E-09	8.1 E-09
	2.7 E-07	7.7 E-10	3.7 E-09	2.0 E-08	3.0 E-08	2.4 E-09	5.6 E-10	1.1 E-09	1.5 E-08	6.3 E-09	3.1 E-09
	2.2 E-07	3.5 E-09	3.7 E-09	6.8 E-09	4.5 E-08	5.9 E-09	1.1 E-09	2.2 E-09	1.5 E-08	6.4 E-09	6.7 E-09
Samples	8	8	8	8	8	8	8	8	8	8	8
Average	2.0 E-07	8.7 E-10	2.6 E-09	1.1 E-09	1.0 E-08	3.7 E-09	8.6 E-11	8.4 E-10	4.8 E-09	-5.7 E-10	3.7 E-10
Maximum	3.5 E-07	5.2 E-09	1.5 E-08	2.0 E-08	4.5 E-08	1.4 E-08	2.3 E-09	6.5 E-09	3.1 E-08	1.5 E-08	8.5 E-09
Minimum	5.3 E-08	3.1 E-11	2.7 E-10	5.8 E-10	5.2 E-09	2.4 E-09	3.0 E-11	2.6 E-10	2.8 E-09	1.7 E-09	2.2 E-09
2SEM	7.3 E-08	2.2 E-09	6.2 E-09	7.8 E-09	1.8 E-08	5.8 E-09	9.7 E-10	2.0 E-09	1.4 E-08	6.3 E-09	3.8 E-09

Table D-2. Liquid Sample Results N-48 Groundwater Well (μCi/ml).

Isotope	^{40}K	^{60}Co	^{65}Zn	^{95}Zr	^{106}Ru	^{125}Sb	^{134}Cs	^{137}Cs	^{144}Ce	^{154}Eu	^{155}Eu
	1.5 E-08	3.2 E-09	9.5 E-10	3.4 E-09	3.3 E-08	3.3 E-09	6.4 E-10	3.8 E-09	1.9 E-08	5.0 E-09	9.3 E-10
	2.2 E-07	4.1 E-09	3.2 E-09	3.7 E-09	2.3 E-08	1.6 E-08	8.8 E-10	4.6 E-09	1.5 E-08	1.2 E-08	5.3 E-09
	3.1 E-07	1.7 E-10	1.7 E-08	4.5 E-09	1.3 E-08	1.2 E-08	3.5 E-09	1.0 E-10	2.4 E-08	1.3 E-08	1.7 E-09
	2.4 E-07	5.0 E-09	1.3 E-08	8.0 E-09	1.5 E-08	1.1 E-08	3.7 E-10	4.2 E-10	7.9 E-09	1.6 E-08	5.6 E-09
	1.5 E-07	5.7 E-09	2.0 E-08	8.7 E-09	4.2 E-08	8.7 E-09	1.8 E-09	4.7 E-10	1.4 E-09	1.1 E-08	8.0 E-09
	3.3 E-07	2.2 E-09	2.0 E-08	8.1 E-09	5.4 E-09	5.8 E-09	1.2 E-09	1.4 E-09	2.9 E-08	8.2 E-09	2.5 E-10
	4.5 E-07	1.3 E-09	3.0 E-09	1.3 E-08	5.0 E-09	3.5 E-09	1.1 E-09	2.1 E-09	2.5 E-09	2.6 E-08	1.4 E-08
	2.7 E-07	3.1 E-09	8.2 E-09	1.7 E-08	6.0 E-08	3.1 E-09	1.5 E-09	1.1 E-09	2.5 E-09	2.1 E-08	8.9 E-09
Samples	8	8	8	8	8	8	8	8	8	8	8
Average	2.5 E-07	1.6 E-09	1.3 E-09	2.6 E-09	1.4 E-08	9.5 E-10	4.7 E-10	6.5 E-11	3.3 E-09	1.2 E-08	2.2 E-09
Maximum	4.5 E-07	5.7 E-09	2.0 E-08	1.7 E-08	6.0 E-08	1.6 E-08	3.5 E-09	4.6 E-09	2.9 E-08	2.6 E-08	1.4 E-08
Minimum	1.5 E-08	1.7 E-10	9.5 E-10	3.4 E-09	5.0 E-09	3.1 E-09	3.7 E-10	1.0 E-10	1.4 E-09	5.0 E-09	2.5 E-10
2SEM	8.5 E-08	2.2 E-09	8.7 E-09	6.5 E-09	1.9 E-08	6.4 E-09	1.1 E-09	1.6 E-09	1.3 E-08	7.0 E-09	4.8 E-09

Table D-3. Liquid Sample Results, N Springs (μCi/ml).

Well No.	^{3}H	^{40}K	^{60}Co	^{65}Zn	^{90}Sr	^{95}Zr	^{106}Ru	^{125}Sb	^{137}Cs
3	-4.0 E-08	4.2 E-08	1.1 E-09	-8.7 E-09	1.1 E-07	1.1 E-09	9.0 E-E-09	-3.8 E-09	-5.7 E-10
6	1.2 E-07	5.1 E-08	-2.4 E-09	-4.2 E-09	6.3 E-09	2.8 E-09	-2.6 E-10	-6.7 E-09	-1.3 E-10
7	8.5 E-08	1.1 E-07	-9.4 E-10	3.6 E-09	3.8 E-09	3.3 E-09	-1.8 E-08	6.9 E-09	-1.0 E-09
8	1.3 E-07	7.0 E-08	3.1 E-09	1.9 E-09	1.2 E-08	-4.3 E-09	1.7 E-08	-3.0 E-09	-6.9 E-10
9	8.3 E-08	6.5 E-08	-2.1 E-09	-7.7 E-10	3.4 E-09	3.0 E-09	-3.2 E-09	-1.9 E-10	-1.3 E-09
10	4.0 E-07	2.0 E-08	-2.6 E-09	-8.0 E-10	3.8 E-09	2.8 E-08	1.7 E-08	-1.1 E-09	-5.0 E-10
11	4.5 E-07	1.1 E-07	1.2 E-09	-2.4 E-09	5.1 E-08	1.9 E-10	-1.5 E-08	1.4 E-09	-3.4 E-10
12	2.9 E-07	4.3 E-08	9.2 E-10	NR	1.8 E-08	-3.2 E-09	8.2 E-09	1.2 E-09	-2.2 E-10
EMW	2.6 E-05	5.1 E-07	1.7 E-08	-1.5 E-08	6.6 E-06	-3.4 E-08	-6.9 E-08	-8.8 E-09	-4.5 E-09

Minus sign (-) indicated negative MDA reported.
EMW = effluent monitoring well.
NR = not reported.

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APPENDIX E

SOIL AND VEGETATION MONITORING FIGURES AND TABLES

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Table E-1 lists the EDP codes used to identify the sample locations on the maps provided in Figures E-1 through E-12 for both 1993 and 1994, along with descriptions of the sample location. The maps show only the 1994 codes.

Table E-1. EDP Code Conversion Chart.

New EDP code	Old EDP code	Location description
100 N Area Soil Samples		
Y601	N1	1325-N Retention Basin
Y602	N2	1301-N SE
Y603	N3	1301-N SW
Y604	N4	1301-N NE
Y605	N5	1301-N NW
Y606	N6	1301-N N (Outside)
Y607	N7	100 N Area SE
Y608	N8	1325-N N Headend
Y609	N9	N Springs N
Y610	N10	1325-N S Headend
Y611	N11	1325-N E
Y612	N12	1325-N W
100 N Area Vegetation Samples		
Y701	N1	1325-N Retention Basin
Y702	N2	1301-N SE
Y703	N3	1301-N SW
Y704	N4	1301-N NE
Y705	N5	1301-N NW
Y706	N6	1301-N N (Outside)
Y707	N7	100 N Area SE
Y708	N8	1325-N N Headend
Y709	N9	N Springs N
Y710	N10	1325-N S Headend
Y711	N11	1325-N E
Y712	N12	1325-N W

Table E-1. EDP Code Conversion Chart.

New EDP code	Old EDP code	Location description
Y718	NS1	N Springs
Y719	NS2	N Springs
Y720	NS3	N Springs
Y721	NS4	N Springs
Y722	NS5	N Springs
Y723	NS6	N Springs
Y724	NS7	N Springs
Y725	NS8	N Springs
200 Areas Soil Samples		
D001	001	216-U-10 Pond South
D002	002	216-U-10 Pond North
D003	003	216-S-21 Crib
D004	004	216-U-14 Ditch Southwest
D005	005	218-W-4B Burial Site South
D006	006	216-Z-12 Crib South
D007	007	216-Z-12 Crib North
D008	008	216-Z-19 Ditch
D009	009	216-Z-16 Crib
D010	010	216-Z-7 Crib
D011	011	216-T-19 Crib
D012	012	241-TX Tank Farm West
D013	013	241-TX Tank Farm East
D014	014	241-TY Tank Farm East
D015	015	216-T-36 Crib East
D016	016	216-T-36 Crib West
D017	017	241-T Tank Farm North
D018	018	207-T Basin Southwest
D019	019	216-T-35 Crib South
D020	020	216-T-35 Crib North

Table E-1. EDP Code Conversion Chart.

New EDP code	Old EDP code	Location description
D021	021	216-T-33 Crib Northeast
D022	022	T-Plant Unloading Station
D023	023	216-T-6 Crib
D024	024	2706-T North
D025	025	216-T-1 Ditch Headend
D026	026	291-T Stack Area
D027	027	241-SX Tank Farm South
D028	028	241-S Tank Farm West
D029	029	241-SY Tank Farm North
D030	030	216-U-14 Ditch Northeast
D031	031	UN-216-W-30 Northeast
D032	032	241-U Tank Farm Northwest
D033	033	241-U Tank Farm East
D034	034	UN-216-W-35
D035	035	216-T-26-28 Cribs North
D036	036	216-T-26-28 Cribs Southeast
D037	037	UN-216-W-24 Southeast
D038	038	211-S Tanks West
D039	039	291-S Stack Area
D040	040	216-U-16 Crib
D041	041	216-U-12 Crib
D042	042	216-U-8 Crib
D043	043	UN-216-W-33 East
D044	044	216-U-1 and -2 Cribs West
D045	045	216-U-1 and -2 Cribs East
D046	046	216-U-17 Crib
D047	047	200-W-8 Burial Site
D048	048	Cross-Site Transfer Line
D049	049	Cross-Site Transfer Line

Table E-1. EDP Code Conversion Chart.

New EDP code	Old EDP code	Location description
D050	050	LWC Crib
D051	051	216-S-26 Crib
D052	052	216-S-25 Crib
D053	053	200 East Area Fenceline North
D054	054	Baseline Site #51
D055	055	241-BY Tank Farm Northwest
D056	056	241-BY Tank Farm East
D057	057	241-BX Tank Farm South
D058	058	241-B Tank Farm South
D059	059	216-B-63 Ditch
D060	060	216-B-2-2 Ditch
D061	061	200 East Area Fenceline Northeast
D062	062	216-B-64 Basin
D063	063	218-C-9 Trench East
D064	064	241-C Tank Farm Southwest
D065	065	241-C Tank Farm East
D066	066	241-C Tank Farm North
D067	067	244-A Lift Station
D068	068	216-A-40 Basin
D069	069	241-AN Tank Farm West
D070	070	241-AZ Tank Farm West
D071	071	241-A Tank Farm South
D072	072	241-AW Tank Farm North
D073	073	241-A Tank Farm East
D074	074	241-AP Tank Farm Northeast
D075	075	Baseline Site #10
D076	076	Baseline Site #11
D077	077	216-A-36 Crib North
D078	078	216-A-10 Crib South

Table E-1. EDP Code Conversion Chart.

New EDP code	Old EDP code	Location description
D079	079	218-E-1 Burial Site East
D080	080	Cross-Site Transfer Line
D081	081	Gable Mountain Pond North
D082	082	Gable Mountain Pond South
D083	083	216-N-1 Pond
D084	084	216-N-6 Pond
D085	085	UN-216-E-31 North
D086	086	UN-216-E-31 Southwest
D087	087	216-B-3 Pond North
D088	088	216-B-3 Pond Overflow
D089	089	216-B-3C Pond
D090	090	216-A-24 Crib East
D091	091	Outside 200 East Area Fenceline
D092	092	216-A-29 Ditch Headend
D093	093	216-A-37-1 Crib
D094	094	216-A-37-2 Crib
D095	095	216-A-30 Crib
D096	096	BC Controlled Area Northeast
D097	097	BC Controlled Area Southeast
D098	098	BC Controlled Area Southwest
D099	099	BC Controlled Area Northwest
D100	100	Cross-Site Transfer Line
D101	101	151-EW Vent Station
D102	102	Cross-Site Transfer Line
D103	103	216-S-10 Ditch
D104	104	216-U-11 Ditch North
D105	105	216-S-16 Pond
D106	106	216-S-17 Pond
D107	107	216-S-10 Pond

Table E-1. EDP Code Conversion Chart.

New EDP code	Old EDP code	Location description
D108	108	216-S-6 Crib
D109	109	216-S-19 Pond
D110	110	216-U-11 Ditch South
D111	052	Dup. Soil Sample 216-S-25 Crib
D112	072	Dup. Soil Sample AW Tank Farm North
D113	082	Dup. Soil Sample Gable Pond South
D114	092	Dup. Soil Sample 216-A-29 Headend
D115	094	Dup. Soil Sample 216-A-37-2 Crib
200 Areas Vegetation Samples		
V001	001	216-U-10 Pond South
V002	002	216-U-10 Pond North
V003	003	216-S-21 Crib
V004	004	216-U-14 Ditch Southwest
V005	005	218-W-4B Burial Site South
V006	006	216-Z-12 Crib South
V007	007	216-Z-12 Crib North
V008	008	216-Z-19 Ditch
V009	009	216-Z-16 Crib
V010	010	216-Z-7 Crib
V011	011	216-T-19 Crib
V012	012	241-TX Tank Farm West
V013	013	241-TX Tank Farm East
V014	014	241-TY Tank Farm East
V015	015	216-T-36 Crib East
V016	016	216-T-36 Crib West
V017	017	241-T Tank Farm North
V018	018	207-T Basin Southwest
V019	019	216-T-35 Crib South
V020	020	216-T-35 Crib North

Table E-1. EDP Code Conversion Chart.

New EDP code	Old EDP code	Location description
V021	021	216-T-33 Crib Northeast
V022	022	T-Plant Unloading Station
V023	023	216-T-6 Crib
V024	024	2706-T North
V025	025	216-T-1 Ditch Headend
V026	026	291-T Stack Area
V027	027	241-SX Tank Farm South
V028	028	241-S Tank Farm West
V029	029	241-SY Tank Farm North
V030	030	216-U-14 Ditch Southwest
V031	031	UN-216-W-30 Northeast
V032	032	241-U Tank Farm Northwest
V033	033	241-U Tank Farm East
V034	034	UN-216-W-35
V035	035	216-T-26-28 Cribs North
V036	036	216-T-26-28 Cribs Southeast
V037	037	UN-216-W-24 Southeast
V038	038	211-S Tanks West
V039	039	291-S Stack Area
V040	040	216-U-16 Crib
V041	041	216-U-12 Crib
V042	042	216-U-8 Crib
V043	043	UN-216-W-33 East
V044	044	216-U-1 and -2 Cribs West
V045	045	216-U-1 and -2 Cribs East
V046	046	216-U-17 Crib
V047	047	200-W-8 Burial Site
V048	048	Cross-Site Transfer Line
V049	049	Cross-Site Transfer Line

Table E-1. EDP Code Conversion Chart.

New EDP code	Old EDP code	Location description
V050	050	LWC Crib
V051	051	216-S-26 Crib
V052	052	216-S-25 Crib
V053	053	200 East Area Fenceline North
V054	054	Baseline Site #51
V055	055	241-BY Tank Farm Northwest
V056	056	241-BY Tank Farm East
V057	057	241-BX Tank Farm South
V058	058	241-B Tank Farm South
V059	059	216-B-63 Ditch
V060	060	216-B-2-2 Ditch
V061	061	200 East Area Fenceline Northeast
V062	062	216-B-64 Basin
V063	063	218-C-9 Trench East
V064	064	241-C Tank Farm Southwest
V065	065	241-C Tank Farm East
V066	066	241-C Tank Farm North
V067	067	244-A Lift Station
V068	068	216-A-40 Basin
V069	069	241-AN Tank Farm West
V070	070	241-AZ Tank Farm West
V071	071	241-A Tank Farm South
V072	072	241-AW Tank Farm North
V073	073	241-A Tank Farm East
V074	074	241-AP Tank Farm Northeast
V075	075	Baseline Site #10
V076	076	Baseline Site #11
V077	077	216-A-36 Crib North
V078	078	216-A-10 Crib South

Table E-1. EDP Code Conversion Chart.

New EDP code	Old EDP code	Location description
V079	079	218-E-1 Burial Site East
V080	080	Cross-Site Transfer Line
V081	081	Gable Mountain Pond North
V082	082	Gable Mountain Pond South
V083	083	216-N-1 Pond
V084	084	216-N-6 Pond
V085	085	UN-216-E-31 North
V086	086	UN-216-E-31 Southwest
V087	087	216-B-3 Pond North
V088	088	216-B-3 Pond Overflow
V089	089	216-B-3C Pond
V090	090	216-A-24 Crib East
V091	091	Outside 200 East Area Fenceline
V092	092	216-A-29 Ditch Headend
V093	093	216-A-37-1 Crib
V094	094	216-A-37-2 Crib
V095	095	216-A-30 Crib
V096	096	BC Controlled Area Northeast
V097	097	BC Controlled Area Southeast
V098	098	BC Controlled Area Southwest
V099	099	BC Controlled Area Northwest
V100	100	Cross-Site Transfer Line
V101	101	151-EW Vent Station
V102	102	Cross-Site Transfer Line
V103	103	216-S-10 Ditch
V104	104	216-U-11 Ditch North
V105	105	216-S-16 Pond
V106	106	216-S-17 Pond
V107	107	216-S-10 Pond

Table E-1. EDP Code Conversion Chart.

New EDP code	Old EDP code	Location description
V108	108	216-S-6 Crib
V109	109	216-S-19 Pond
V110	110	216-U-11 Ditch South
V111	007	Dup. Veg. Sample 216-Z-12 North
V112	032	Dup. Veg. Sample U Farm Northwest
V113	083	Dup. Veg. Sample 216-N-1 Pond
V114	096	Dup. Veg. Sample BC Control Area NE
V115	NA	Dup. To Be Determined
300/400 Areas Soil Samples		
D116	S-1	618-4 Burial Site Northeast
D117	S-2	316-5 Process Trench North
D118	S-3	618-5 Burial Site South
D119	S-4	316-2 Process Pond Northeast
D120	S-5	316-2 Process Pond South
D121	S-6	316-1 Process Pond Northeast
D122	S-7	316-1 Process Pond South
D123	S-8	316-3 Process Pond South
D124	S-9	618-8 Burial Site Northwest
D125	S-10	618-3 Burial Site Southwest
D126	S-11	618-2 Burial Site Northwest
D127	S-12	618-7 Burial Site South
D128	S-13	618-9 Burial Site Northwest
D129	S-14	618-13 Burial Site North
D130	S-15	400 Area Process Pond
D131	S-4	Dup. Soil Sample 316-2 P.P. NE
D132	S-5	Dup. Soil Sample 316-2 P.P. South
300/400 Area Vegetation Samples		
V116	V-1	618-4 Burial Site Northeast
V117	V-2	316-5 Process Trench North

Table E-1. EDP Code Conversion Chart.

New EDP code	Old EDP code	Location description
V118	V-3	618-5 Burial Site South
V119	V-4	316-2 Process Pond Northeast
V120	V-5	316-2 Process Pond South
V121	V-6	316-1 Process Pond Northeast
V122	V-7	316-1 Process Pond South
V123	V-8	316-3 Process Pond South
V124	V-9	618-8 Burial Site Northwest
V125	V-10	618-3 Burial Site Southwest
V126	V-11	618-2 Burial Site Northwest
V127	V-12	618-7 Burial Site South
V128	V-13	618-9 Burial Site Northwest
V129	V-14	618-13 Burial Site North
V130	V-15	400 Area Process Pond
V131	V-1	Dup. Veg. Sample 618-4 B.G. NE
V132	V-8	Dup. Veg. Sample 316-3 P.P. South

Figure E-1. Soil Sampling Locations in the 100 N Area.

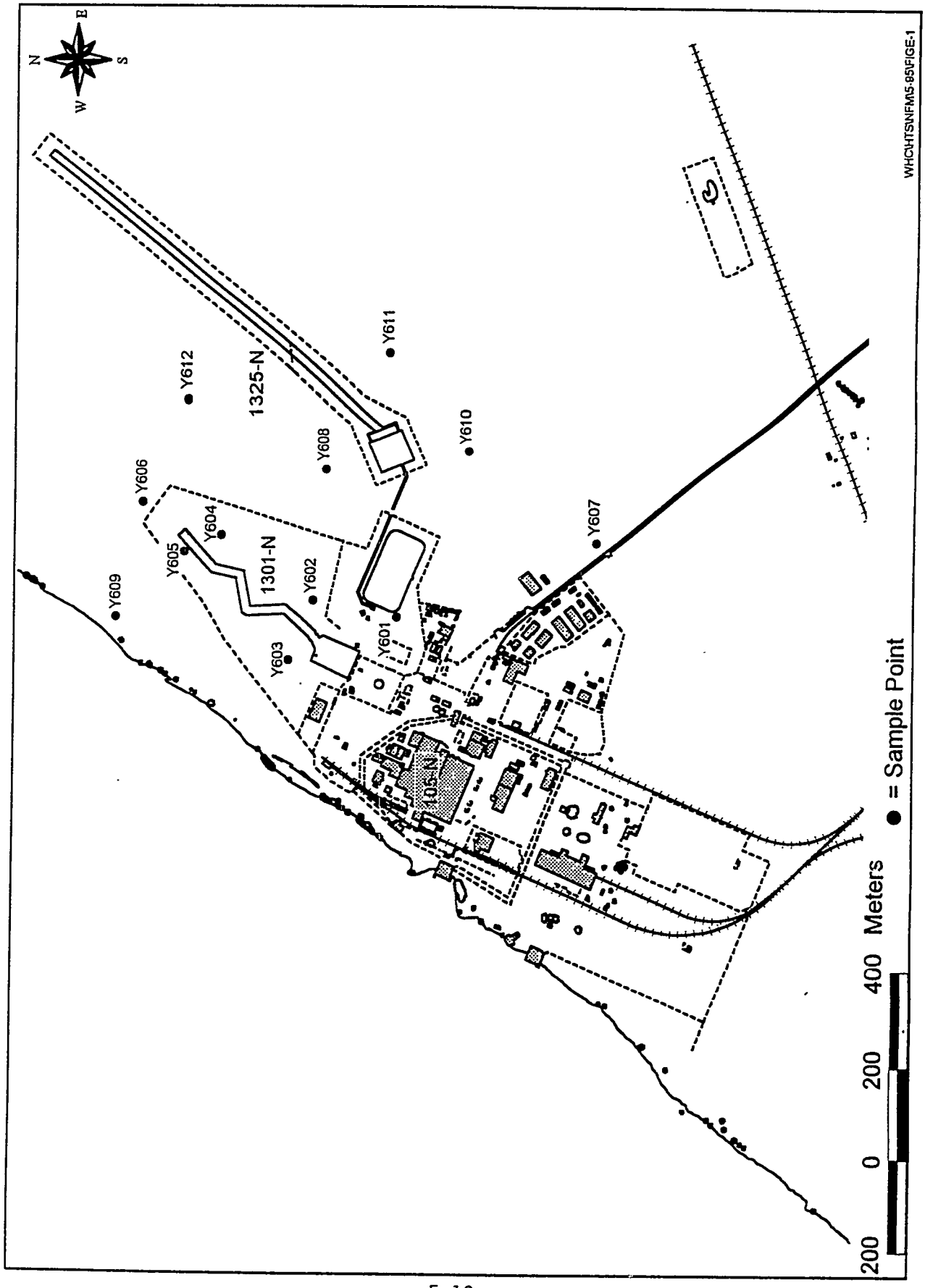

Figure E-2. Soil Sampling Locations in the 200 East Area.

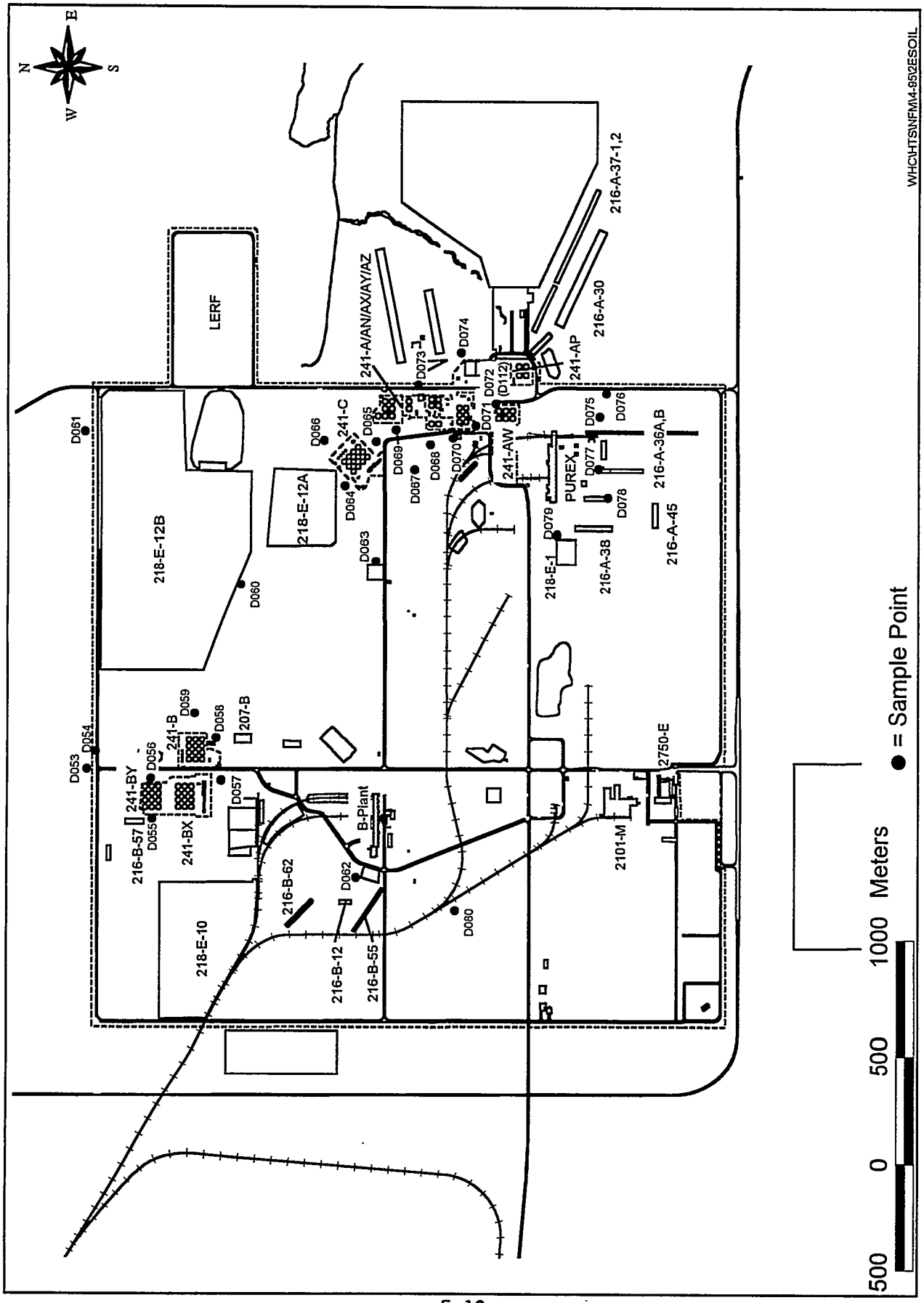

Figure E-3. Soil Sampling Locations in the 200 West Area.

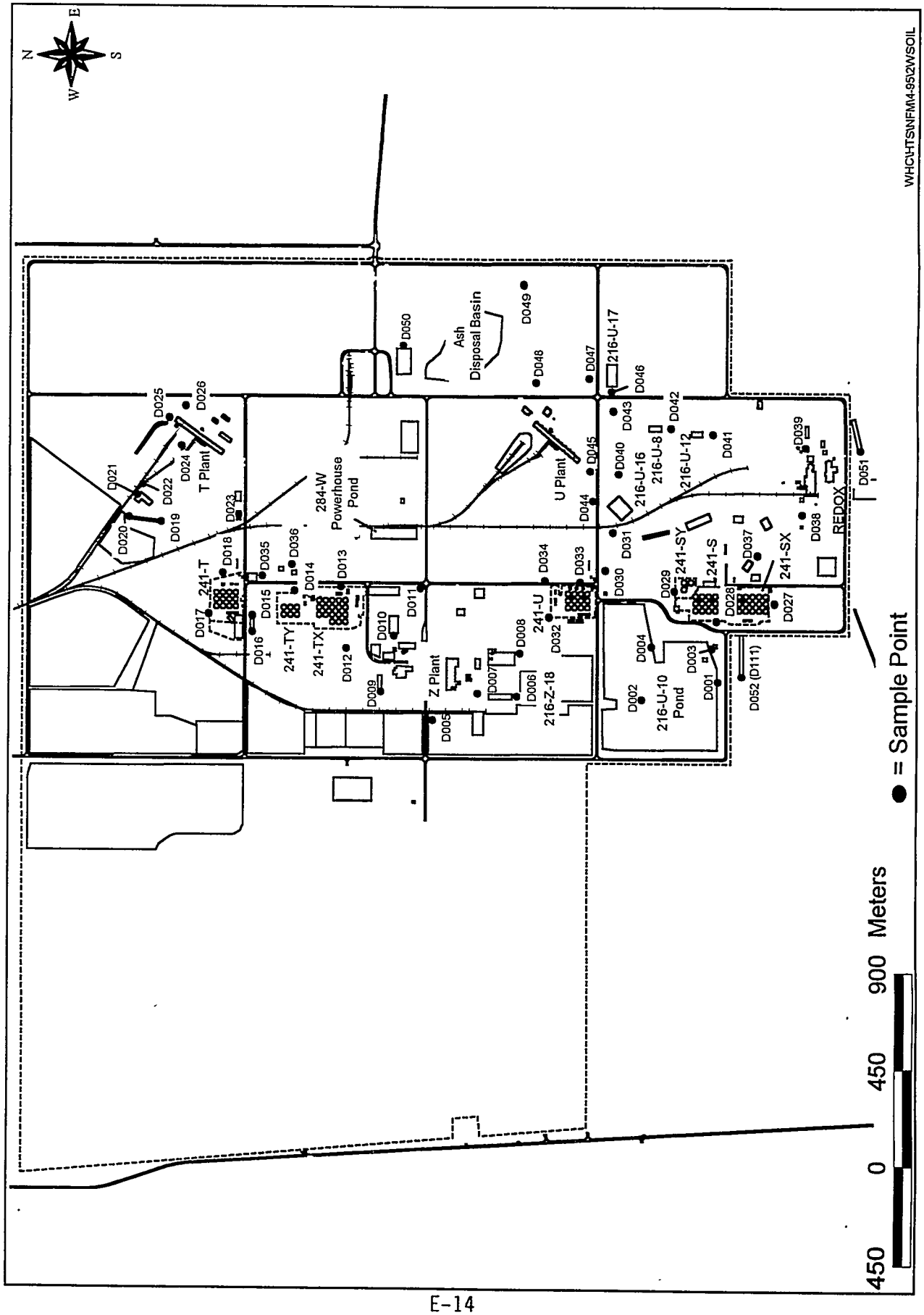

Figure E-4. Soil Sampling Locations in the 600 Area.

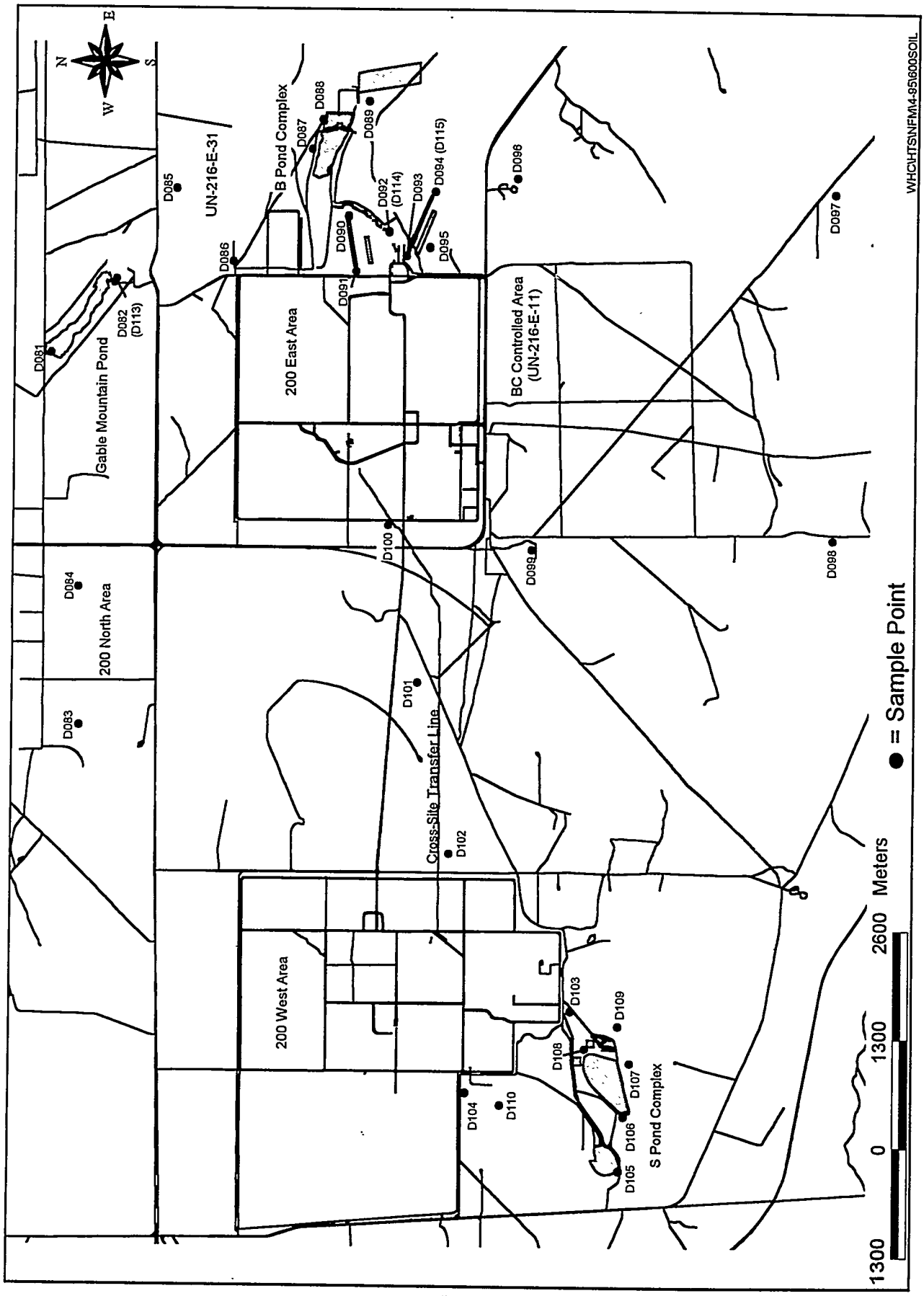

Figure E-5. Soil Sampling Locations in the 300 Area.

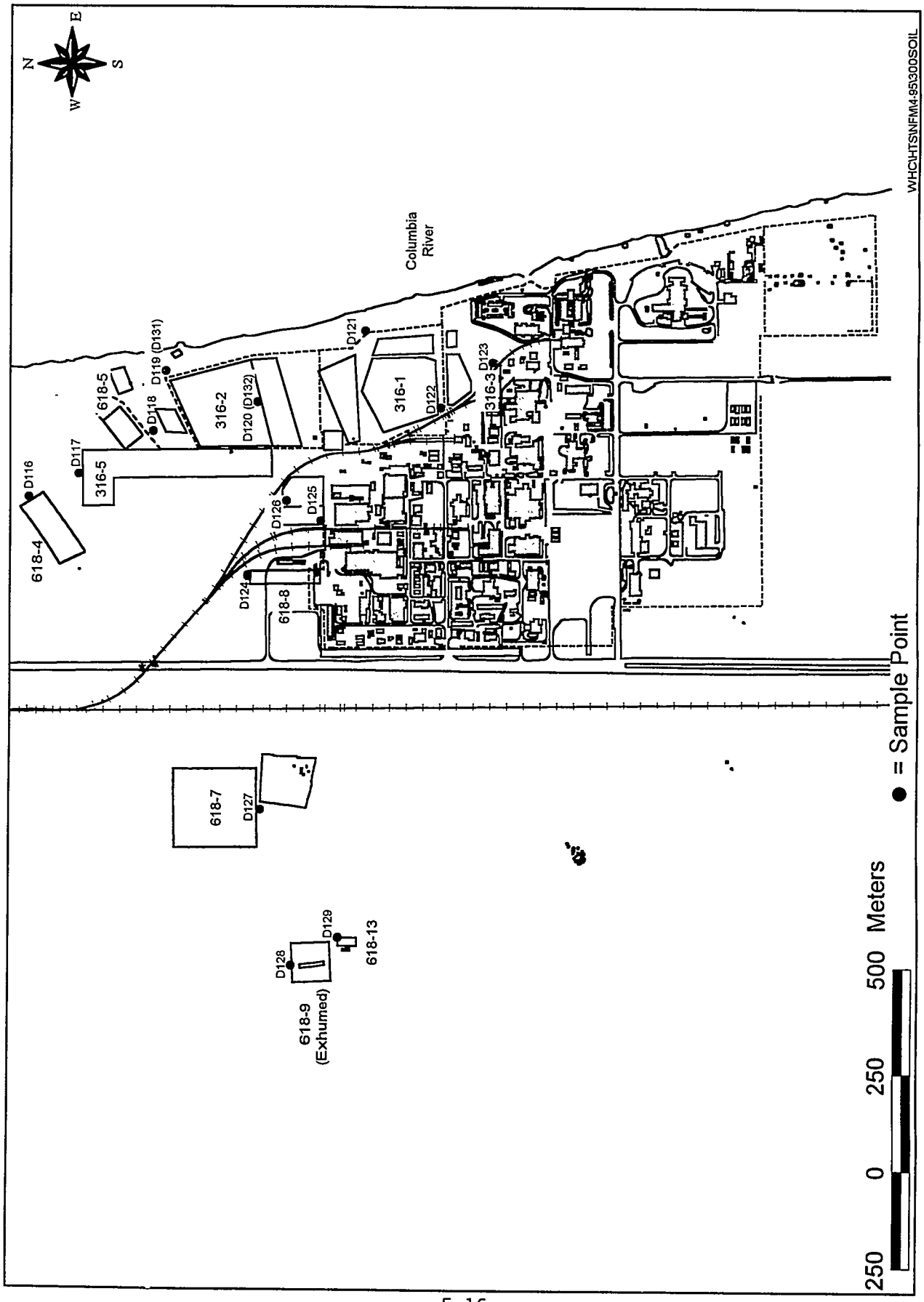

Figure E-6. Soil Sampling Locations in the 400 Area.

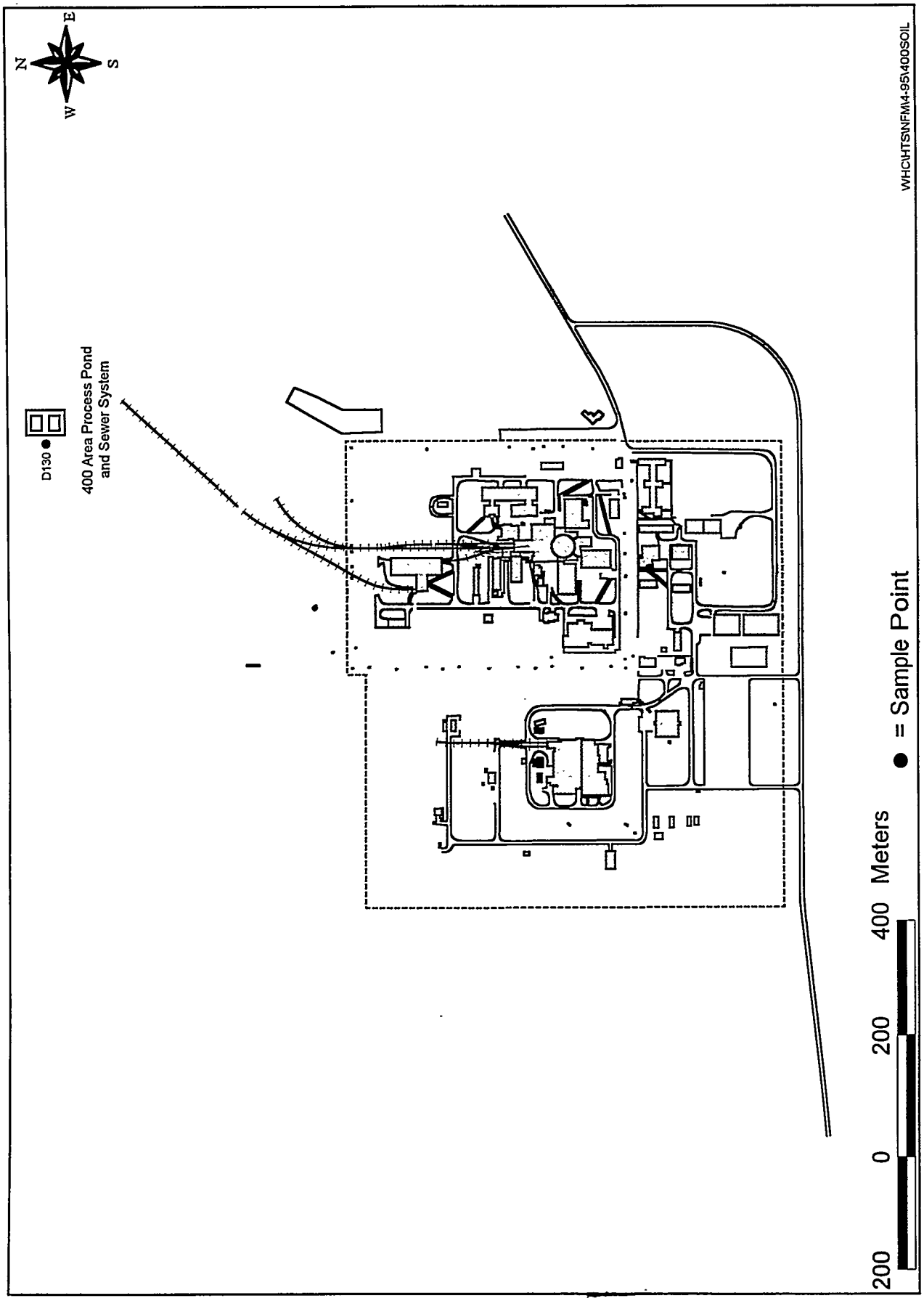

Figure E-7. Vegetation Sampling Locations in the 100 N Area.

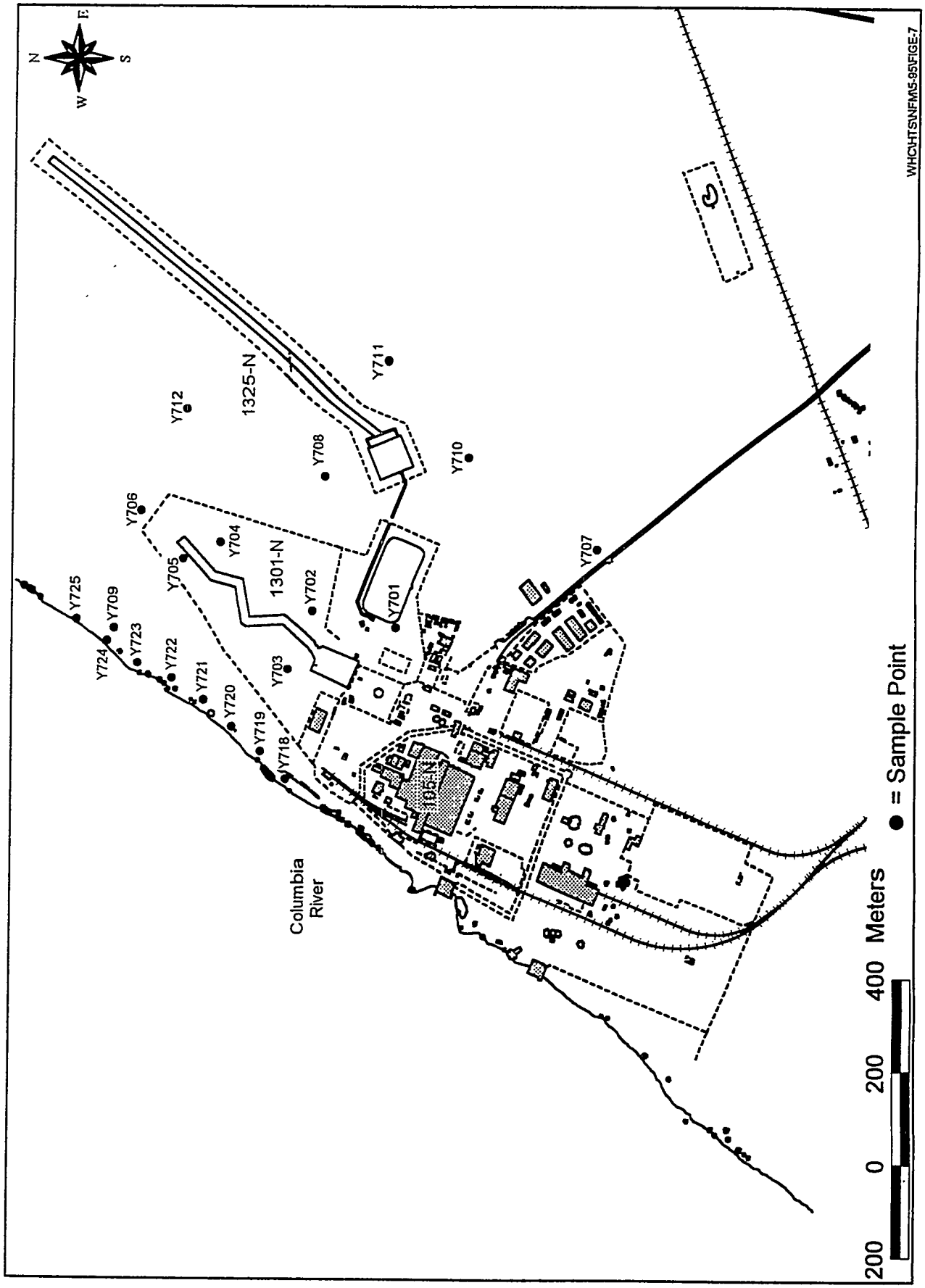

Figure E-8. Vegetation Sampling Locations in the 200 East Area.

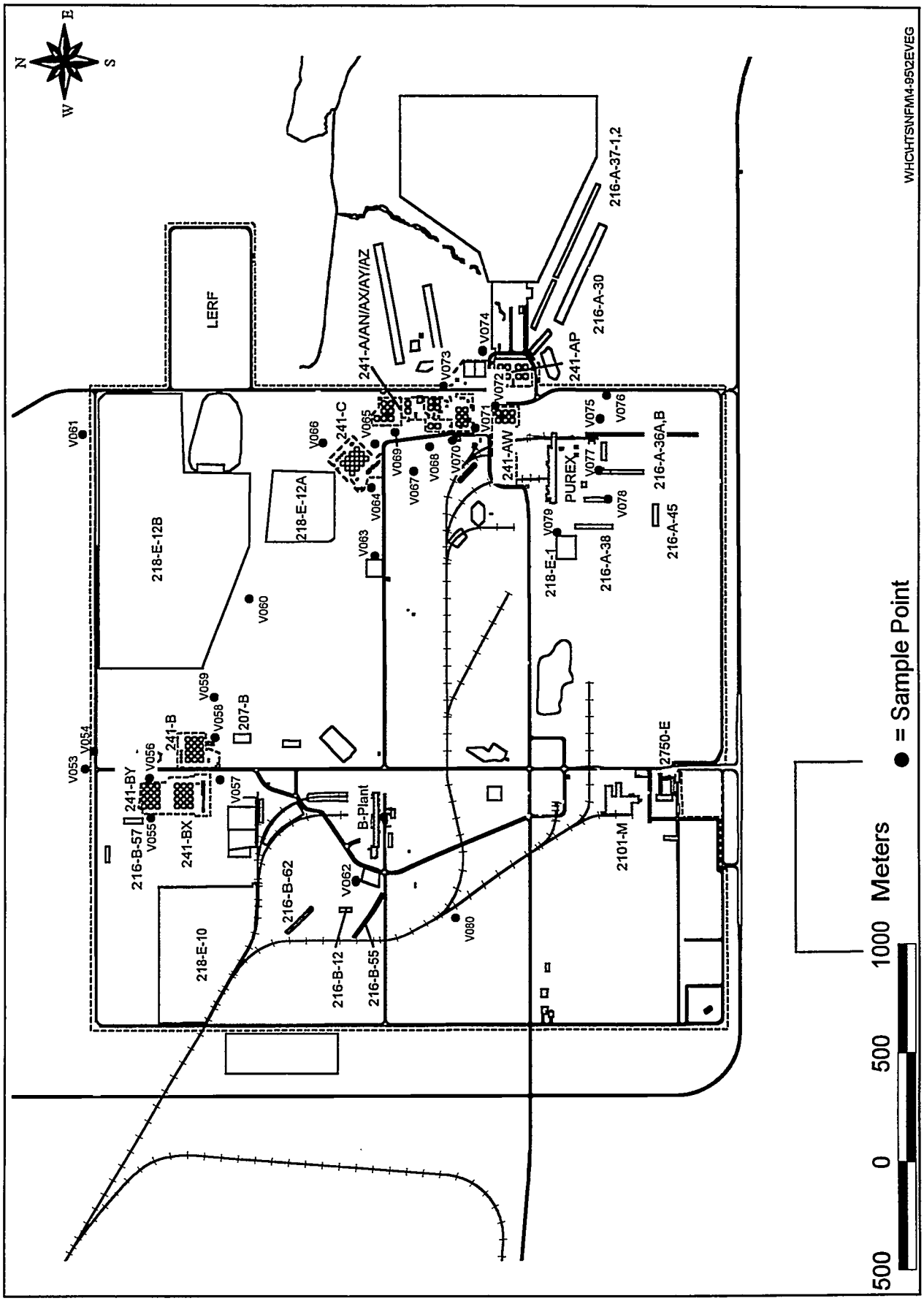

Figure E-9. Vegetation Sampling Locations in the 200 West Area.

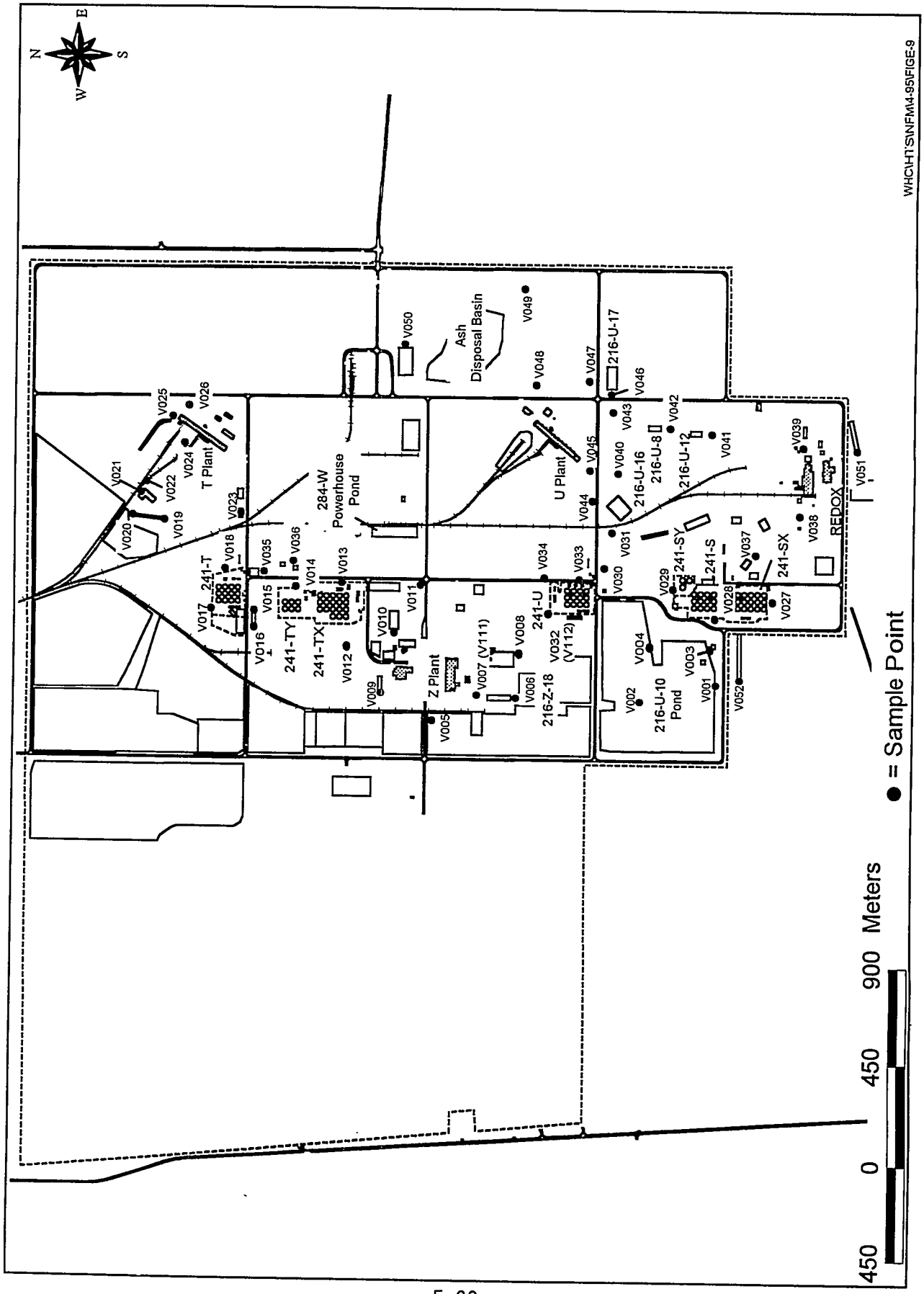

Figure E-10. Vegetation Sampling Locations in the 600 Areas.

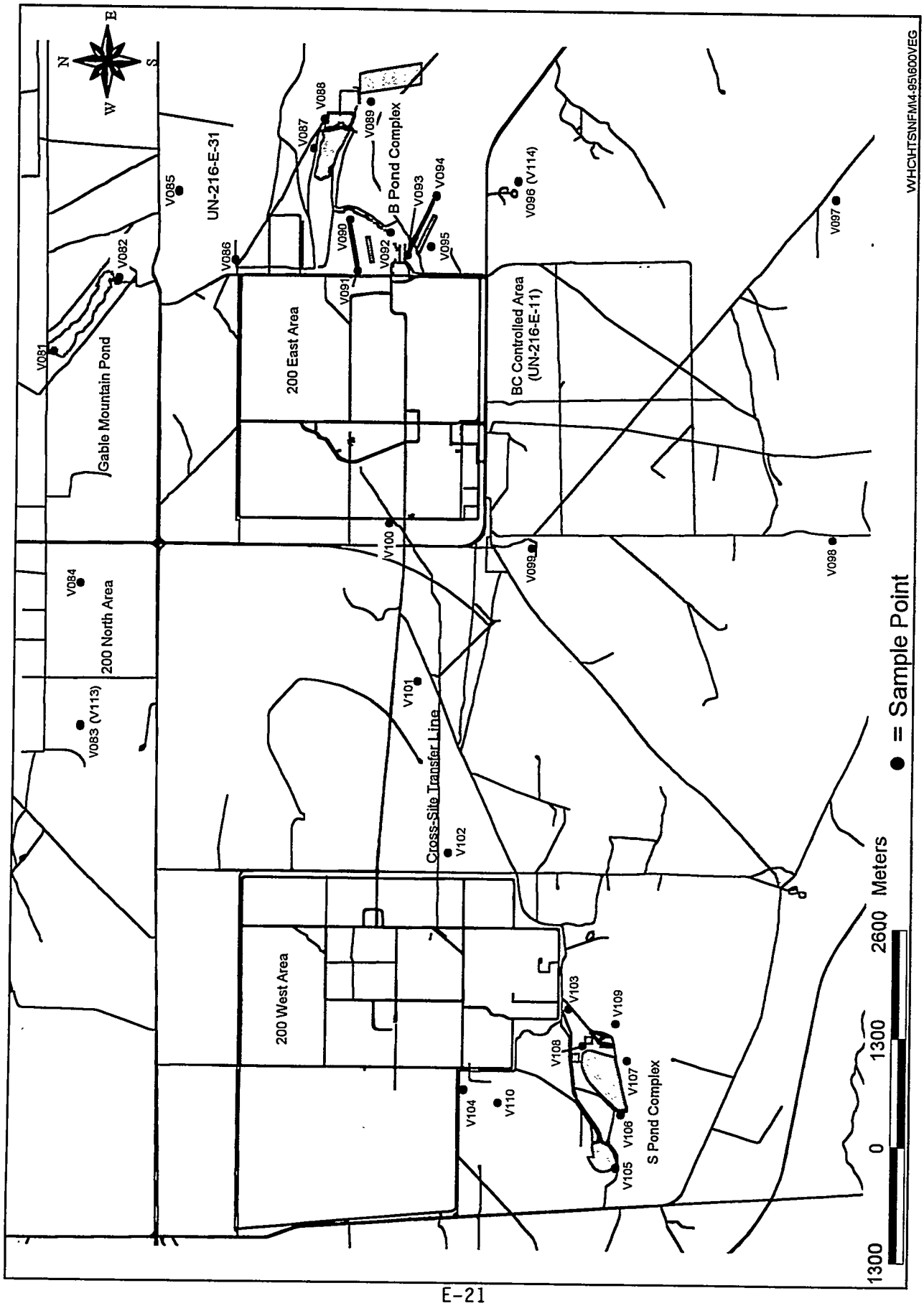

Figure E-11. Vegetation Sampling Locations in the 300 Area.

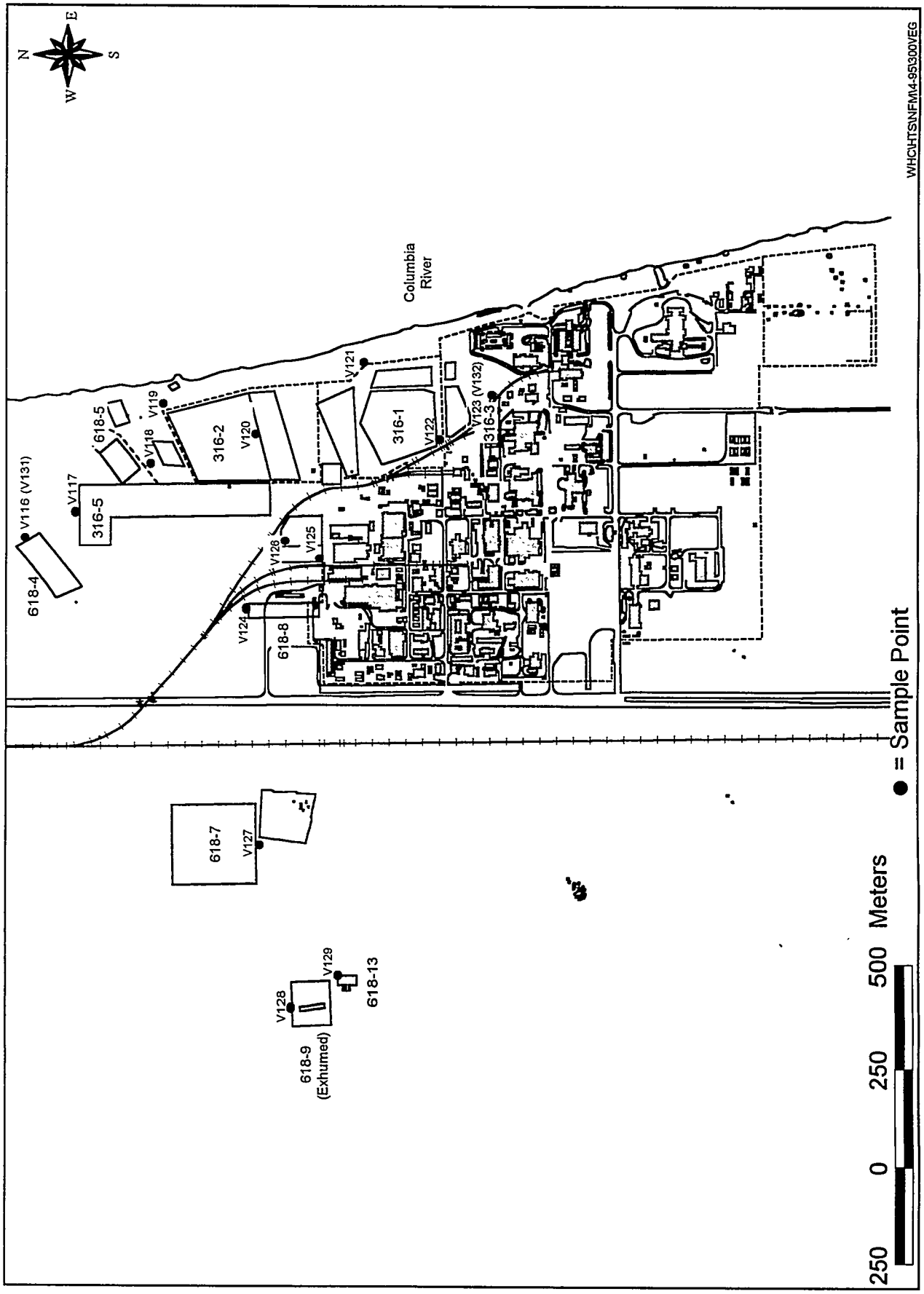

Figure E-12. Vegetation Sampling Locations in the 400 Area.

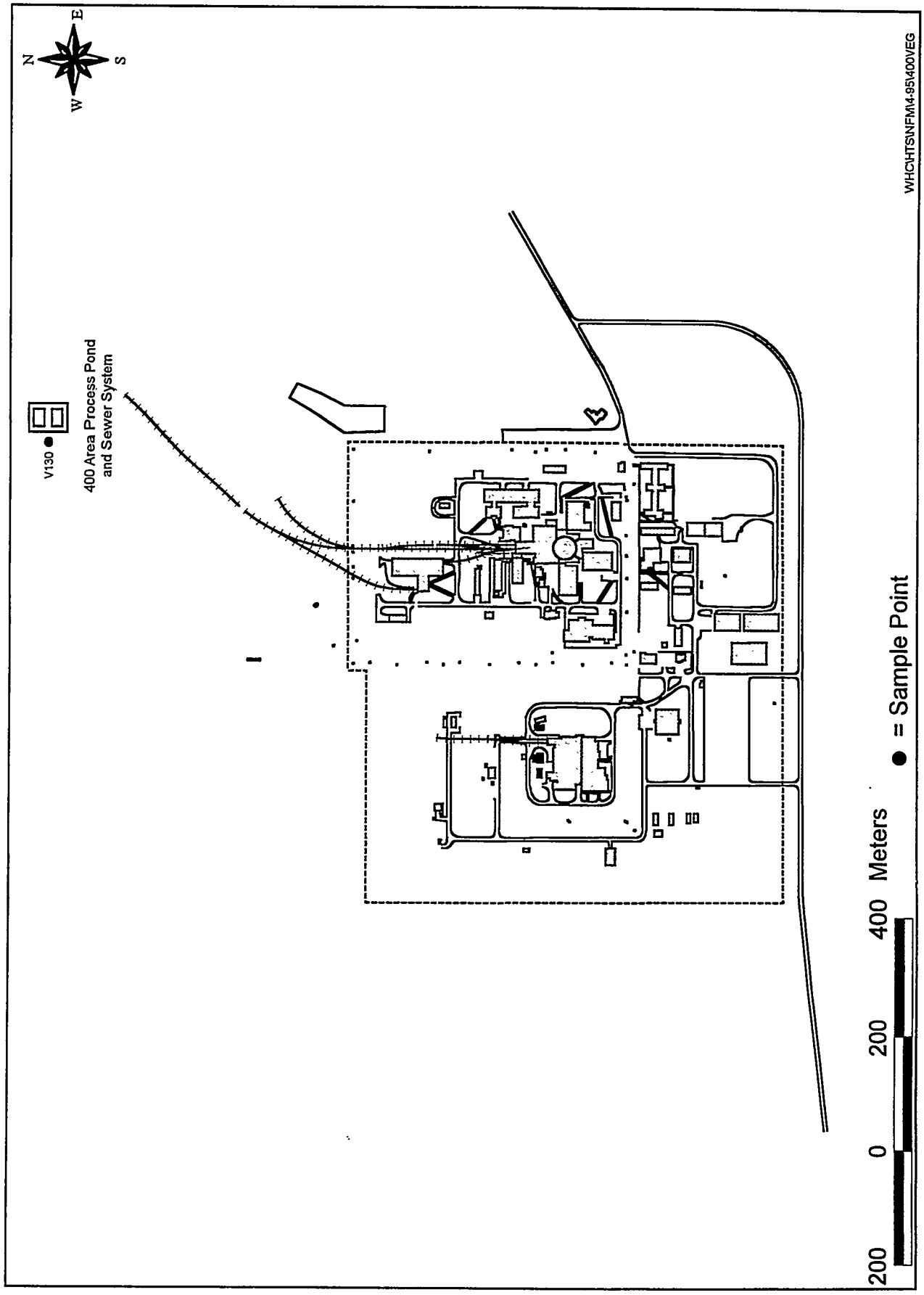

Table E-2. 100 Area Soil Sample Results (pCi/g).

Site I.D.	^{40}K		^{60}Co		^{65}Zn		^{90}Sr		^{95}Zr	
	Result	% Error	Result	% Error	Result	% Error	Result	% Error	Result	% Error
Y601	1.2 E+01	11	8.7 E-01	11	-1.2 E-02	228	2.4 E-02	30	-9.8 E-02	30
Y602	1.5 E+01	11	4.0 E+00	10	-1.9 E-03	****	5.4 E-01	18	-6.4 E-02	69
Y603	1.3 E+01	11	1.3 E+01	10	-1.2 E-01	79	9.0 E-01	19	6.1 E-02	118
Y604	1.4 E+01	11	3.4 E-01	13	-2.4 E-01	22	1.5 E-01	20	6.4 E-02	51
Y605	1.5 E-01	****	3.2 E-01	16	-1.7 E-01	26	4.4 E-02	25	2.2 E-02	148
Y606	1.6 E+01	11	9.5 E-02	25	-1.9 E-01	27	7.2 E-02	23	4.6 E-02	82
Y607	1.4 E+01	11	4.9 E-02	37	-7.2 E-02	37	1.4 E-01	21	-4.5 E-02	64
Y608	1.1 E+01	11	2.8 E-01	13	-1.8 E-02	156	6.4 E-03	68	-1.0 E-01	31
Y609	1.5 E+01	11	1.5 E-02	85	-2.1 E-01	24	4.5 E-02	27	3.5 E-02	102
Y610	1.6 E+01	11	1.6 E-01	18	-1.0 E-02	285	1.0 E-01	23	-1.5 E-01	26
Y611	1.5 E+01	11	3.6 E-01	13	-7.0 E-02	46	2.3 E-01	20	-9.2 E-02	39
Y612	1.1 E+01	11	7.4 E-02	28	-8.9 E-02	36	1.9 E-02	37	-2.9 E-02	122

Site I.D.	^{106}Ru		^{125}Sb		^{134}Cs		^{137}Cs		^{144}Ce	
	Result	% Error	Result	% Error	Result	% Error	Result	% Error	Result	% Error
Y601	7.5 E-02	103	3.0 E-03	774	-3.4 E-03	223	5.1 E-02	34	-7.6 E-02	133
Y602	-1.3 E-01	112	3.4 E-02	128	8.3 E-03	160	2.3 E+00	10	4.5 E-02	333
Y603	8.4 E-02	279	3.7 E-02	186	-3.1 E-02	78	4.0 E+00	10	-5.4 E-02	420
Y604	3.1 E-04	****	4.4 E-03	757	-1.2 E-01	16	8.0 E-01	11	9.4 E-03	****
Y605	-1.7 E-02	550	2.4 E-02	127	-3.3 E-02	36	2.4 E-01	4	-7.5 E-02	181
Y606	-7.4 E-02	156	-1.1 E-02	309	-3.7 E-02	36	2.5 E-01	13	-3.6 E-02	420
Y607	2.3 E-02	323	2.1 E-02	112	-1.1 E-02	73	4.7 E-01	11	1.2 E-02	940
Y608	2.2 E-02	358	-1.8 E-02	129	3.7 E-03	211	1.1 E-01	23	8.8 E-02	117
Y609	-3.4 E-02	274	1.5 E-02	193	-5.3 E-02	25	8.7 E-02	20	5.4 E-02	249
Y610	7.2 E-02	122	2.3 E-02	123	1.9 E-03	481	4.4 E-01	12	3.3 E-02	369
Y611	-1.8 E-02	474	1.3 E-02	218	9.4 E-03	99	7.8 E-01	11	8.6 E-02	142
Y612	-8.4 E-02	101	-6.5 E-03	358	4.9 E-03	167	1.1 E-01	18	-4.7 E-02	241

Site I.D.	^{154}Eu		^{155}Eu		^{234}U		^{235}U		^{238}U	
	Result	% Error	Result	% Error	Result	% Error	Result	% Error	Result	% Error
Y601	-1.2 E-02	250	5.1 E-02	53	1.4 E-01	13	4.1 E-03	55	1.3 E-01	13
Y602	2.8 E-02	152	4.8 E-02	76	9.3 E-02	13	5.9 E-03	40	8.9 E-02	13
Y603	1.5 E-02	450	5.1 E-02	136	9.0 E-02	14	7.6 E-03	37	9.1 E-02	14
Y604	-4.6 E-02	94	4.9 E-02	88	8.0 E-02	15	3.4 E-03	62	7.9 E-02	15
Y605	3.5 E-03	****	5.1 E-02	83	5.7 E-02	15	3.0 E-03	59	6.1 E-02	15
Y606	-3.1 E-02	151	4.9 E-02	97	6.9 E-02	14	2.3 E-03	68	7.1 E-02	14

Table E-2. 100 Area Soil Sample Results (pCi/g).

Site I.D.	^{154}Eu		^{155}Eu		^{234}U		^{235}U		^{238}U	
	Result	% Error	Result	% Error	Result	% Error	Result	% Error	Result	% Error
Y607	6.1 E-03	538	3.1 E-02	87	6.4 E-02	15	2.6 E-03	69	6.3 E-02	15
Y608	-2.7 E-02	123	4.9 E-02	56	9.2 E-02	13	6.0 E-03	39	1.0 E-01	13
Y609	7.7 E-03	549	6.1 E-02	68	5.8 E-02	15	1.5 E-03	88	6.0 E-02	15
Y610	-3.8 E-02	103	6.4 E-02	48	7.1 E-02	14	3.3 E-03	56	7.3 E-02	14
Y611	3.2 E-02	110	8.3 E-02	41	6.8 E-02	14	2.2 E-03	65	7.3 E-02	14
Y612	-2.4 E-02	145	1.6 E-02	206	4.8 E-02	16	1.9 E-03	75	5.9 E-02	15

Site I.D.	^{238}Pu		$^{239,\ 240}Pu$	
	Result	% Error	Result	% Error
Y601	1.2 E-03	54	5.2 E-03	27
Y602	9.1 E-03	14	4.6 E-02	11
Y603	1.4 E-02	17	7.8 E-02	13
Y604	1.8 E-02	21	9.6 E-03	26
Y605	4.0 E-03	28	1.7 E-03	42
Y606	4.2 E-04	103	3.9 E-03	34
Y607	3.4 E-04	102	1.6 E-02	18
Y608	3.1 E-04	120	1.9 E-03	46
Y609	1.8 E-04	98	1.2 E-03	38
Y610	1.1 E-03	56	7.0 E-03	25
Y611	1.0 E-03	57	2.1 E-02	17
Y612	-1.6 E-05	****	5.1 E-04	80

**** = Greater than 999% error.

Table E-3. 200/600 Area Soil Sample Results (pCi/g).

Site I.D.	^{40}K		^{60}Co		^{65}Zn		^{90}Sr		^{95}Zr	
	Result	% Error	Result	% Error	Result	% Error	Result	% Error	Result	% Error
D002	1.3 E+01	11	8.3 E-03	104	-9.7 E-03	239	4.7 E-01	23	-5.3 E-02	48
D004	1.5 E+01	11	-9.4 E-03	113	-1.3 E-01	26	9.5 E-02	20	2.9 E-02	96
D006	1.1 E+01	11	NR		2.5 E-03	862	5.6 E-02	23	-4.6 E-02	52
D008	1.3 E+01	11	6.9 E-03	122	-2.1 E-02	109	1.1 E-02	43	-7.3 E-02	36
D010	1.3 E+01	11	3.0 E-03	275	-1.1 E-02	216	4.4 E-02	24	-5.2 E-02	46
D012	1.4 E+01	11	-1.0 E-03	****	-1.8 E-02	134	5.6 E-01	19	-7.5 E-02	39
D014	1.3 E+01	11	8.0 E-03	148	-1.8 E-01	24	2.7 E+00	18	-8.3 E-03	362
D016	1.4 E+01	11	3.3 E-03	329	-3.5 E-02	85	2.5 E-01	20	-2.4 E-02	120
D018	1.2 E+01	11	2.4 E-02	42	-2.2 E-02	104	1.1 E+00	18	-7.8 E-02	34
D020	1.5 E+01	11	-2.0 E-03	515	-1.4 E-02	179	4.4 E-02	24	-5.2 E-02	55
D022	1.4 E+01	11	1.1 E-03	****	-2.4 E-01	20	3.3 E-01	21	2.5 E-02	124
D024	1.3 E+01	11	-8.1 E-03	139	-2.0 E-01	21	4.3 E-02	25	2.6 E-03	****
D026	1.3 E+01	11	-6.6 E-03	138	-2.0 E-02	121	3.2 E-01	19	-8.8 E-02	36
D028	1.2 E+01	11	-4.4 E-03	193	-1.9 E-02	109	8.1 E-01	18	-5.2 E-02	45
D030	1.4 E+01	11	2.8 E-02	44	-1.9 E-02	143	1.1 E+00	18	-4.2 E-02	70
D032	NS									
D034	1.4 E+01	11	1.9 E-03	469	-2.8 E-02	85	2.2 E+00	18	-7.3 E-02	37
D038	1.5 E+01	11	8.6 E-04	****	-1.5 E-01	26	2.4 E-01	22	-4.4 E-02	70
D040	1.5 E+01	11	-1.1 E-02	109	3.6 E-02	66	6.2 E-02	25	-5.2 E-02	55
D042	1.4 E+01	11	7.1 E-03	169	-2.5 E-01	20	2.0 E-01	20	7.4 E-03	440
D044	1.4 E+01	11	1.3 E-02	78	-1.6 E-02	165	3.2 E-01	20	-4.1 E-02	69
D046	1.4 E+01	11	3.3 E-03	308	-1.4 E-02	175	4.7 E-02	24	-6.5 E-02	43
D048	1.4 E+01	11	-5.0 E-03	216	-1.7 E-01	23	1.6 E-01	25	3.3 E-02	84
D050	1.4 E+01	11	2.8 E-02	42	-2.5 E-02	103	3.9 E-02	27	-8.1 E-02	38
D052	1.4 E+01	11	1.4 E-03	671	-1.5 E-02	167	4.9 E-02	24	-4.1 E-02	69
D054	1.3 E+01	11	-1.5 E-02	67	-4.2 E-02	64	3.7 E-01	20	-1.3 E-01	26
D056	1.4 E+01	11	-6.8 E-03	149	-2.5 E-02	95	5.3 E-02	25	-7.8 E-02	40
D058	1.2 E+01	11	8.6 E-03	122	-1.5 E-01	24	3.4 E+00	19	2.5 E-02	108
D060	1.5 E+01	11	1.4 E-02	69	-2.5 E-02	96	2.6 E-01	20	-7.3 E-02	40
D062	1.3 E+01	11	-2.6 E-03	343	-4.5 E-02	54	2.4 E-01	19	-9.2 E-02	31
D064	1.4 E+01	11	1.1 E-02	84	-2.4 E-02	95	5.8 E+00	18	-6.4 E-02	46
D066	1.2 E+01	11	9.2 E-03	103	1.1 E-03	****	1.9 E+00	18	-4.4 E-02	53
D070	1.2 E+01	11	3.7 E-03	243	-7.4 E-02	36	3.0 E-01	19	-3.6 E-03	688
D072	1.3 E+01	11	4.6 E-03	183	-1.6 E-02	141	2.5 E-01	19	-8.1 E-03	296
D074	1.5 E+01	11	6.1 E-03	189	-1.5 E-01	27	1.5 E-01	21	2.0 E-02	160

Table E-3. 200/600 Area Soil Sample Results (pCi/g).

Site I.D.	^{40}K		^{60}Co		^{65}Zn		^{90}Sr		^{95}Zr	
	Result	% Error	Result	% Error	Result	% Error	Result	% Error	Result	% Error
D076	1.3 E+01	11	-1.4 E-02	71	-2.5 E-02	90	9.4 E-02	20	-8.1 E-02	33
D078	1.6 E+01	10	1.0 E-02	91	-2.4 E-02	103	5.7 E-01	24	-4.1 E-02	60
D080	1.2 E+01	11	-6.7 E-03	145	-2.6 E-03	881	1.5 E-01	23	-1.1 E-01	28
D082	1.2 E+01	11	7.3 E-04	****	-3.5 E-02	58	2.5 E-02	34	-7.3 E-02	34
D084	1.5 E+01	11	4.3 E-03	245	-2.2 E-02	119	9.2 E-02	22	-4.8 E-02	59
D086	1.4 E+01	11	-6.4 E-03	173	-2.3 E-02	110	1.4 E-01	22	-8.9 E-02	33
D088	1.3 E+01	11	-3.7 E-03	225	-6.3 E-02	37	3.1 E-02	30	-6.6 E-02	38
D090	9.3 E+00	11	-8.5 E-04	892	-7.8 E-03	223	2.2 E-01	19	-7.5 E-02	31
D092	1.4 E+01	11	1.0 E-02	81	-2.6 E-02	93	1.2 E-01	21	-1.0 E-01	28
D094	1.3 E+01	11	4.9 E-03	219	-1.9 E-01	20	9.9 E-02	21	-2.6 E-03	****
D096	1.2 E+01	11	5.4 E-03	150	-2.1 E-02	108	1.1 E+00	19	-6.7 E-02	42
D098	1.4 E+01	10	-1.6 E-03	663	-1.8 E-01	23	2.4 E-01	20	2.1 E-02	157
D100	1.4 E+01	11	1.2 E-02	77	-2.3 E-02	109	6.1 E-02	23	-9.6 E-02	32
D102	1.3 E+01	11	-3.8 E-03	221	-6.4 E-02	38	1.7 E-01	20	-9.5 E-02	30
D104	1.4 E+01	11	-1.2 E-02	90	-3.7 E-03	638	3.1 E-02	30	-8.5 E-02	34
D106	1.2 E+01	11	5.2 E-03	149	-1.3 E-02	172	6.6 E-01	19	-6.4 E-02	41
D108	1.3 E+01	11	-1.1 E-02	113	-1.6 E-01	26	2.4 E-01	19	-1.6 E-02	201
D110	1.4 E+01	11	-7.4 E-03	155	-1.1 E-01	33	1.0 E-01	21	1.0 E-02	307
D111	1.2 E+01	11	6.1 E-03	170	-1.4 E-01	25	6.0 E-02	24	-4.3 E-03	659
D112	1.2 E+01	11	7.2 E-03	112	3.9 E-03	562	1.3 E-01	21	-8.6 E-02	32
D113	1.2 E+01	11	-1.4 E-03	736	-2.0 E-01	21	2.1 E-02	32	1.5 E-02	193
D114	1.5 E+01	11	-1.1 E-02	87	-2.7 E-02	96	1.7 E-01	19	-7.1 E-02	41
D115	1.2 E+01	11	5.7 E-03	172	-3.4 E-04	****	2.7 E-01	20	-8.9 E-02	35

Site I.D.	^{106}Ru		^{125}Sb		^{134}Cs		^{137}Cs		^{144}Ce	
	Result	% Error	Result	% Error	Result	% Error	Result	% Error	Result	% Error
D002	-8.6 E-03	888	3.3 E-03	902	-3.2 E-03	254	3.0 E+00	10	1.0 E-01	115
D004	7.7 E-03	****	2.3 E-02	142	-3.8 E-02	29	2.0 E+00	10	-2.6 E-02	473
D006	-8.3 E-02	79	-1.5 E-02	119	2.3 E-03	275	1.4 E-01	15	4.3 E-02	215
D008	5.9 E-02	115	5.3 E-03	379	-1.1 E-02	66	4.0 E-02	29	-2.2 E-02	445
D010	9.2 E-02	74	-8.3 E-03	249	-3.4 E-03	209	1.8 E-01	14	1.0 E-01	94
D012	-7.0 E-03	****	4.0 E-02	121	-7.7 E-04	****	8.3 E+00	10	-1.1 E-01	136
D014	3.1 E-01	95	-1.7 E-01	82	-2.4 E-02	119	5.2 E+01	10	3.8 E-02	956
D016	-3.7 E-02	286	7.6 E-03	580	-4.8 E-02	26	4.5 E+00	10	-7.6 E-02	189
D018	2.6 E-02	340	9.1 E-03	415	2.7 E-05	****	5.4 E+00	10	-1.0 E-01	132

Table E-3. 200/600 Area Soil Sample Results (pCi/g).

Site I.D.	^{106}Ru		^{125}Sb		^{134}Cs		^{137}Cs		^{144}Ce	
	Result	% Error	Result	% Error	Result	% Error	Result	% Error	Result	% Error
D020	-1.2 E-02	704	3.6 E-03	688	-3.6 E-03	214	9.5 E-02	24	2.4 E-02	461
D022	2.2 E-03	****	1.6 E-02	205	-4.2 E-02	29	1.2 E+00	10	-8.2 E-02	169
D024	3.7 E-02	206	-1.0 E-02	235	-4.3 E-02	25	1.3 E-01	16	-1.8 E-02	620
D026	2.7 E-02	260	-7.7 E-03	267	5.2 E-03	151	1.9 E-01	14	-8.9 E-02	118
D028	-2.1 E-02	325	1.1 E-02	223	-2.4 E-03	308	1.5 E+00	10	7.0 E-03	****
D030	-6.6 E-02	367	7.0 E-02	176	-4.0 E-02	62	6.3 E+01	10	-1.6 E-01	213
D032	NS									
D034	-6.3 E-02	180	-2.3 E-02	225	-4.9 E-03	245	1.1 E+01	10	-1.5 E-01	109
D038	3.3 E-02	260	-1.1 E-02	282	-4.5 E-02	26	1.1 E+00	11	-4.5 E-02	298
D040	-2.6 E-02	313	1.6 E-02	162	3.7 E-03	226	3.4 E-01	12	-2.7 E-02	417
D042	-5.1 E-02	268	1.6 E-02	366	-5.2 E-02	31	7.5 E+00	10	-7.5 E-02	252
D044	1.2 E-02	862	1.3 E-02	353	-3.8 E-03	282	6.3 E+00	10	7.5 E-02	195
D046	-3.1 E-02	253	1.3 E-02	177	4.3 E-03	181	1.6 E-01	15	-3.2 E-02	348
D048	3.6 E-02	229	7.3 E-03	359	-4.3 E-02	25	4.8 E-01	11	-9.4 E-02	125
D050	1.4 E-02	541	-1.2 E-02	181	1.2 E-04	****	1.9 E-01	15	3.7 E-03	****
D052	9.1 E-03	765	3.6 E-03	588	-2.6 E-03	282	2.5 E-01	13	-7.3 E-02	140
D054	5.0 E-02	137	-3.6 E-03	677	1.0 E-03	679	2.5 E-01	14	5.4 E-02	196
D056	1.5 E-02	529	-8.3 E-03	314	5.6 E-04	****	9.0 E-01	11	1.5 E-01	74
D058	-5.3 E-03	****	-2.2 E-02	219	-7.2 E-02	21	5.9 E+00	10	1.7 E-01	96
D060	-2.9 E-02	300	-1.6 E-02	192	-3.4 E-03	244	1.6 E+00	10	2.0 E-02	576
D062	5.7 E-02	150	9.2 E-03	369	-5.1 E-04	****	4.5 E+00	10	-7.7 E-03	****
D064	-3.5 E-02	257	-8.1 E-04	****	3.8 E-03	218	4.0 E+00	10	4.0 E-02	325
D066	-5.8 E-02	179	1.7 E-02	286	5.7 E-03	182	1.2 E+01	10	1.2 E-01	139
D070	5.5 E-02	133	1.9 E-02	131	-3.9 E-02	25	8.6 E-01	11	-1.7 E-01	70
D072	-5.2 E-02	138	-3.4 E-02	73	-9.9 E-04	724	9.1 E-01	11	-1.1 E-01	94
D074	4.5 E-02	203	-2.2 E-02	144	-3.2 E-02	35	8.1 E-01	11	6.0 E-02	197
D076	1.8 E-02	360	9.6 E-03	196	-2.3 E-03	306	1.9 E-01	14	1.1 E-02	891
D078	4.3 E-02	166	-2.3 E-03	983	1.6 E-03	450	9.0 E-01	11	3.8 E-02	274
D080	-4.9 E-02	150	9.3 E-03	250	2.4 E-03	307	7.3 E-01	11	-2.6 E-02	408
D082	5.3 E-02	110	3.1 E-03	610	-2.1 E-03	292	3.1 E-02	37	1.1 E-02	850
D084	2.0 E-02	388	3.3 E-02	64	-9.2 E-03	90	1.7 E-01	14	-1.3 E-01	89
D086	8.5 E-02	86	7.4 E-03	299	-6.5 E-03	123	8.5 E-02	25	-4.3 E-03	****
D088	-3.8 E-03	****	-2.0 E-02	101	1.2 E-03	578	1.2 E-01	17	-2.1 E-02	436
D090	3.1 E-02	205	7.1 E-03	303	-9.1 E-04	700	1.4 E+00	10	-4.3 E-02	221
D092	3.6 E-02	205	8.1 E-03	274	-2.8 E-03	263	3.2 E-01	12	-1.8 E-03	****

Table E-3. 200/600 Area Soil Sample Results (pCi/g).

Site I.D.	^{106}Ru		^{125}Sb		^{134}Cs		^{137}Cs		^{144}Ce	
	Result	% Error	Result	% Error	Result	% Error	Result	% Error	Result	% Error
D094	1.0 E-02	719	6.9 E-04	****	-5.9 E-02	20	2.2 E-01	13	3.4 E-02	339
D096	-2.8 E-02	225	-1.1 E-03	****	-4.4 E-03	158	3.0 E-01	12	-6.8 E-03	****
D098	-5.9 E-02	151	2.9 E-03	912	-5.3 E-02	22	1.1 E-01	16	5.8 E-02	207
D100	-2.4 E-02	325	4.5 E-03	503	-8.3 E-03	95	2.7 E-01	13	-6.9 E-03	****
D102	5.3 E-02	130	1.8 E-02	110	-6.5 E-03	109	4.4 E-01	11	3.1 E-02	312
D104	-2.7 E-02	272	1.9 E-03	****	-8.2 E-03	94	6.1 E-02	27	-5.8 E-02	175
D106	2.1 E-02	349	-7.6 E-03	375	-4.4 E-04	****	2.0 E+00	10	8.3 E-02	128
D108	3.1 E-02	310	-1.5 E-02	221	-5.1 E-02	23	1.5 E+00	10	-9.5 E-02	145
D110	-1.1 E-01	79	2.3 E-02	116	-3.4 E-02	31	1.9 E-01	13	1.9 E-02	679
D111	-4.6 E-02	174	-1.3 E-02	191	-2.7 E-02	36	2.9 E-01	12	-3.7 E-02	307
D112	3.0 E-03	****	3.0 E-02	70	2.5 E-03	268	6.0 E-01	11	3.9 E-02	246
D113	2.6 E-02	335	-1.1 E-02	211	-2.3 E-02	42	3.1 E-02	49	2.1 E-03	****
D114	-1.5 E-02	512	-3.5 E-02	68	3.6 E-03	214	3.8 E-01	12	-2.5 E-02	441
D115	-1.9 E-02	402	5.8 E-03	401	6.5 E-03	111	2.4 E-01	13	-3.3 E-02	324

Site I.D.	^{154}Eu		^{155}Eu		^{234}U		^{235}U		^{238}U	
	Result	% Error	Result	% Error	Result	% Error	Result	% Error	Result	% Error
D002	1.3 E-02	209	2.0 E-02	155	1.3 E-01	12	4.2 E-03	49	1.3 E-01	12
D004	-1.9 E-02	189	2.3 E-02	153	1.1 E-01	14	2.0 E-02	26	1.0 E-01	14
D006	-1.5 E-02	180	3.3 E-02	77	1.0 E-01	14	4.2 E-03	50	1.1 E-01	13
D008	-1.6 E-02	197	4.1 E-02	63	9.9 E-02	14	4.6 E-03	52	1.1 E-01	14
D010	3.4 E-02	84	3.4 E-02	75	1.3 E-01	15	3.9 E-03	67	1.5 E-01	14
D012	-5.0 E-02	68	5.3 E-02	76	9.0 E-02	16	4.7 E-03	58	9.9 E-02	15
D014	3.5 E-02	106	1.1 E-01	104	9.1 E-02	15	2.4 E-03	79	1.1 E-01	14
D016	-2.6 E-02	152	3.2 E-02	126	8.7 E-02	17	3.3 E-03	77	1.1 E-01	15
D018	1.3 E-03	****	1.8 E-02	184	1.1 E-01	17	6.5 E-03	56	1.1 E-01	16
D020	-1.6 E-04	****	5.6 E-02	55	1.3 E-01	15	6.9 E-03	49	1.3 E-01	14
D022	3.4 E-02	111	1.0 E-02	397	1.1 E-01	15	5.1 E-03	54	1.3 E-01	14
D024	4.2 E-04	****	3.5 E-02	101	1.6 E-01	14	9.6 E-03	42	1.6 E-01	14
D026	-1.3 E-02	224	2.5 E-02	116	8.2 E-02	14	3.8 E-03	55	9.0 E-02	14
D028	1.4 E-02	198	3.1 E-02	79	1.1 E-01	13	5.0 E-03	48	1.1 E-01	13
D030	3.2 E-02	106	7.9 E-02	103	6.5 E-01	11	3.3 E-02	22	6.9 E-01	11
D032	NS									
D034	NR		-8.2 E-03	549	1.2 E-01	13	6.2 E-03	41	1.2 E-01	13
D038	-2.2 E-02	174	2.2 E-02	151	1.6 E-01	14	7.7 E-03	47	1.7 E-01	14

Table E-3. 200/600 Area Soil Sample Results (pCi/g).

Site I.D.	^{154}Eu		^{155}Eu		^{234}U		^{235}U		^{238}U	
	Result	% Error	Result	% Error	Result	% Error	Result	% Error	Result	% Error
D040	-5.2 E-04	****	4.2 E-02	71	9.8 E-02	15	4.9 E-03	58	1.3 E-01	14
D042	2.2 E-02	183	5.3 E-02	105	1.1 E-01	15	3.2 E-03	76	1.2 E-01	15
D044	2.3 E-02	150	3.9 E-02	95	1.9 E-01	12	7.9 E-03	39	1.9 E-01	12
D046	9.9 E-04	****	6.6 E-02	48	1.1 E-01	14	4.7 E-03	52	1.2 E-01	14
D048	4.3 E-02	82	1.1 E-02	326	2.6 E-01	11	1.0 E-02	33	2.6 E-01	11
D050	-7.4 E-03	446	5.2 E-02	54	8.8 E-02	16	3.3 E-03	72	9.1 E-02	15
D052	2.8 E-02	100	1.7 E-02	150	1.0 E-01	15	2.8 E-03	74	1.3 E-01	14
D054	-8.0 E-03	393	3.4 E-02	86	1.1 E-01	14	6.3 E-03	43	1.2 E-01	13
D056	1.8 E-02	160	4.4 E-02	68	1.4 E-01	13	4.4 E-03	57	1.3 E-01	13
D058	4.4 E-03	815	8.3 E-04	****	1.1 E-01	14	5.6 E-03	48	1.1 E-01	14
D060	2.8 E-02	113	3.7 E-02	83	1.2 E-01	14	7.8 E-03	39	1.2 E-01	13
D062	3.9 E-02	75	3.6 E-02	96	1.2 E-01	14	4.0 E-03	61	1.3 E-01	14
D064	-1.6 E-02	194	3.4 E-02	101	1.7 E-01	15	5.9 E-03	64	1.7 E-01	15
D066	1.0 E-02	230	8.5 E-02	49	1.2 E-01	13	6.8 E-03	40	1.3 E-01	13
D070	5.0 E-02	60	1.8 E-02	165	1.2 E-01	14	6.0 E-03	47	1.1 E-01	14
D072	1.5 E-02	180	2.1 E-02	120	1.4 E-01	13	6.7 E-03	42	1.4 E-01	13
D074	-5.0 E-04	****	1.2 E-02	280	1.4 E-01	13	6.6 E-03	44	1.3 E-01	13
D076	1.4 E-02	208	2.8 E-02	84	1.4 E-01	14	4.5 E-03	63	1.6 E-01	14
D078	2.4 E-02	119	2.7 E-02	96	9.4 E-02	18	6.8 E-03	61	9.6 E-02	18
D080	2.1 E-02	135	1.4 E-02	199	1.1 E-01	14	5.5 E-03	46	1.2 E-01	14
D082	-2.0 E-02	142	4.3 E-02	52	9.7 E-02	16	5.2 E-03	55	9.7 E-02	16
D084	1.7 E-02	181	4.1 E-02	69	1.2 E-01	13	5.2 E-03	48	1.2 E-01	13
D086	9.1 E-04	****	5.2 E-02	54	9.9 E-02	15	4.6 E-03	57	9.9 E-02	15
D088	8.1 E-03	367	1.8 E-02	132	1.4 E-01	13	4.3 E-03	52	1.4 E-01	12
D090	2.4 E-02	95	3.4 E-02	73	1.7 E-01	15	5.8 E-03	58	1.6 E-01	15
D092	-7.6 E-03	385	4.1 E-02	66	8.8 E-02	15	4.1 E-03	58	8.8 E-02	15
D094	-1.2 E-03	****	5.9 E-02	63	1.7 E-01	13	5.4 E-03	49	1.8 E-01	12
D096	-1.2 E-02	229	2.6 E-02	102	9.0 E-02	17	4.5 E-03	69	8.8 E-02	17
D098	-3.5 E-03	****	2.7 E-02	139	1.0 E-01	14	5.6 E-03	45	1.2 E-01	13
D100	3.7 E-02	82	2.4 E-02	120	1.2 E-01	16	3.8 E-03	81	1.3 E-01	16
D102	-4.1 E-02	74	3.5 E-02	78	1.2 E-01	13	6.4 E-03	41	1.3 E-01	13
D104	-2.2 E-02	146	4.5 E-02	59	9.9 E-02	17	1.9 E-03	109	9.0 E-02	17
D106	9.1 E-03	279	5.1 E-02	56	1.2 E-01	15	5.5 E-03	55	1.3 E-01	15
D108	2.2 E-02	166	6.6 E-02	64	2.1 E-01	13	7.4 E-03	46	2.2 E-01	13
D110	-1.3 E-02	297	9.0 E-02	44	1.0 E-01	14	4.3 E-03	56	1.2 E-01	14

Table E-3. 200/600 Area Soil Sample Results (pCi/g).

Site I.D.	^{154}Eu		^{155}Eu		^{234}U		^{235}U		^{238}U	
	Result	% Error	Result	% Error	Result	% Error	Result	% Error	Result	% Error
D111	-1.1 E-02	328	3.1 E-02	113	9.4 E-02	18	3.8 E-03	86	1.3 E-01	16
D112	4.8 E-03	581	3.4 E-02	79	1.2 E-01	14	4.1 E-03	58	1.3 E-01	14
D113	8.7 E-04	****	5.1 E-02	69	8.6 E-02	17	5.2 E-03	58	8.2 E-02	17
D114	-1.9 E-02	166	4.5 E-02	72	1.4 E-01	18	7.0 E-03	64	1.5 E-01	17
D115	2.0 E-02	151	3.3 E-02	85	2.1 E-01	12	9.6 E-03	37	2.5 E-01	12

Site I.D.	^{238}Pu		$^{239,\ 240}Pu$	
	Result	% Error	Result	% Error
D002	2.3 E-03	34	6.6 E-02	13
D004	5.8 E-04	45	2.9 E-02	12
D006	2.1 E-03	28	1.0 E-01	11
D008	9.1 E-04	48	3.5 E-02	14
D010	1.0 E-03	44	5.2 E-02	13
D012	1.9 E-03	25	6.5 E-02	11
D014	2.2 E-03	23	5.8 E-02	11
D016	8.8 E-04	45	2.7 E-02	13
D018	4.1 E-03	21	3.2 E-01	11
D020	1.8 E-04	78	8.6 E-03	15
D022	9.8 E-03	17	2.1 E-02	14
D024	3.2 E-04	130	6.8 E-03	26
D026	5.1 E-04	58	5.1 E-02	12
D028	9.6 E-04	35	1.8 E-02	13
D030	5.2 E-03	17	2.6 E-01	10
D032	NS			
D034	5.2 E-03	17	3.1 E-01	10
D038	5.0 E-03	23	3.4 E-02	14
D040	8.2 E-04	58	2.3 E-02	16
D042	5.5 E-04	60	2.7 E-02	13
D044	3.0 E-02	59	1.0 E+00	27
D046	1.5 E-03	35	5.5 E-02	12
D048	1.3 E-03	40	4.6 E-02	13

Table E-3. 200/600 Area Soil Sample Results (pCi/g).

Site I.D.	^{238}Pu		$^{239,240}Pu$	
	Result	% Error	Result	% Error
D050	3.4 E-04	70	1.3 E-02	14
D052	9.9 E-04	52	2.7 E-02	16
D054	1.7 E-04	111	4.8 E-04	70
D056	-1.6 E-05	****	1.6 E-03	36
D058	1.7 E-05	394	3.2 E-03	23
D060	4.3 E-05	476	3.9 E-03	28
D062	1.4 E-04	112	6.4 E-03	19
D064	8.5 E-04	60	5.8 E-02	14
D066	6.5 E-04	64	2.1 E-02	16
D070	6.8 E-05	207	1.4 E-03	36
D072	2.0 E-04	109	9.2 E-03	19
D074	2.2 E-04	102	4.9 E-03	21
D076	3.8 E-04	128	4.9 E-03	32
D078	1.9 E-02	15	3.6 E-01	11
D080	1.0 E-03	41	2.9 E-02	13
D082	9.6 E-05	175	9.8 E-04	41
D084	2.0 E-04	83	3.6 E-03	21
D086	-4.1 E-05	127	9.4 E-04	54
D088	9.1 E-06	****	2.2 E-03	36
D090	6.4 E-05	319	4.8 E-03	27
D092	1.4 E-03	49	8.2 E-02	15
D094	2.3 E-04	126	8.2 E-03	20
D096	1.2 E-04	157	7.3 E-03	21
D098	2.0 E-04	141	1.3 E-03	48
D100	4.0 E-04	94	8.8 E-03	24
D102	7.7 E-04	79	2.5 E-02	20
D104	8.0 E-05	183	2.2 E-03	28
D106	1.3 E-03	36	5.1 E-02	12
D108	1.8 E-03	38	8.5 E-02	12
D110	6.2 E-04	66	1.6 E-02	18

Table E-3. 200/600 Area Soil Sample Results (pCi/g).

Site I.D.	^{238}Pu		$^{239,240}Pu$	
	Result	% Error	Result	% Error
D111	1.8 E-03	29	4.1 E-02	12
D112	6.7 E-05	223	2.0 E-03	29
D113	3.5 E-05	370	3.7 E-04	76
D114	2.6 E-04	65	5.7 E-02	11
D115	1.3 E-04	169	1.0 E-02	18

**** = Greater than 999% error
NR = Not reported
NS = Not sampled.

Table E-4. 300/400 Area Soil Sample Results (pCi/g).

300/400 Area Soils										
Site I.D.	^{40}K		^{60}Co		^{65}Zn		^{90}Sr		^{95}Zr	
	Result	% Error	Result	% Error	Result	% Error	Result	% Error	Result	% Error
D116	1.6 E+01	10	1.5 E-03	635	-3.1 E-02	77	1.2 E-01	20	-7.1 E-02	42
D117	1.5 E+01	11	-1.4 E-02	76	-4.6 E-02	55	5.9 E-02	22	-4.7 E-02	58
D118	1.6 E+01	11	-2.1 E-04	****	-1.3 E-01	34	1.8 E-02	31	1.0 E-02	344
D119	1.6 E+01	11	7.1 E-03	174	-1.3 E-01	28	7.6 E-02	23	8.1 E-02	44
D120	1.2 E+01	11	-3.1 E-03	379	-1.8 E-01	25	4.0 E-02	29	1.3 E-01	35
D121	1.3 E+01	11	1.0 E-01	20	-3.2 E-01	19	1.6 E-01	20	5.0 E-03	964
D122	1.5 E+01	11	1.5 E-03	808	-1.4 E-02	232	2.2 E-02	175	3.8 E-01	20
D123	1.4 E+01	11	1.8 E-03	575	-1.9 E-01	21	3.3 E-03	87	1.3 E-02	226
D124	1.5 E+01	11	-3.2 E-03	367	-2.2 E-01	21	6.0 E-02	22	-2.4 E-02	138
D125	1.6 E+01	11	1.4 E-03	806	-7.2 E-02	48	3.2 E-02	29	-2.1 E-02	175
D126	1.5 E+01	11	-7.8 E-03	119	-4.5 E-02	53	2.5 E-02	34	-5.6 E-02	50
D127	1.5 E+01	11	8.3 E-03	104	-2.9 E-02	82	9.1 E-02	23	-3.8 E-02	74
D128	1.4 E+01	10	1.1 E-02	67	-3.4 E-02	66	9.9 E-02	22	-5.8 E-02	46
D129	1.5 E+01	11	2.5 E-03	387	-4.1 E-02	70	2.8 E-02	35	-6.3 E-02	48
D130	1.5 E+01	11	8.2 E-03	148	-1.0 E-01	31	4.0 E-03	82	1.4 E-03	****
D131	1.5 E+01	11	-3.2 E-03	307	4.9 E-03	491	6.9 E-02	24	2.2 E-02	148
D132	1.2 E+01	11	1.6 E-02	61	4.8 E-03	499	2.7 E-02	34	-3.0 E-02	133
	^{106}Ru		^{125}Sb		^{134}Cs		^{137}Cs		^{144}Ce	
	Result	% Error	Result	% Error	Result	% Error	Result	% Error	Result	% Error
D116	5.8 E-02	123	9.9 E-03	227	-3.3 E-03	222	2.7 E-01	13	9.4 E-02	108
D117	-8.8 E-02	86	6.4 E-03	334	NR		1.4 E-01	15	1.9 E-03	****
D118	-7.6 E-02	119	-7.8 E-03	366	-3.6 E-02	34	1.1 E-01	20	7.0 E-02	174
D119	-2.1 E-02	415	-1.7 E-02	157	-3.8 E-02	30	2.6 E-01	14	-6.7 E-02	196
D120	-3.9 E-02	249	4.5 E-03	693	-3.7 E-02	33	1.5 E-01	15	-1.1 E-01	150
D121	-2.8 E-02	423	-4.5 E-02	93	-4.3 E-02	34	7.8 E-01	11	-8.5 E-02	209
D122	8.1 E-02	131	-2.4 E-02	129	4.7 E-03	209	2.1 E-01	16	-3.2 E-01	62
D123	-6.6 E-02	126	2.5 E-03	967	-5.2 E-02	23	-2.8 E-03	384	-8.0 E-03	****
D124	-7.6 E-03	****	-9.1 E-03	287	-2.0 E-02	47	2.0 E-01	13	-1.5 E-01	81
D125	3.1 E-02	292	-1.4 E-02	202	-3.1 E-02	38	2.7 E-01	14	1.1 E-02	****
D126	-5.2 E-03	****	1.2 E-02	169	1.1 E-02	65	8.5 E-02	21	3.6 E-02	251
D127	1.4 E-02	521	2.2 E-02	94	-1.6 E-04	****	2.7 E-01	13	3.2 E-02	316
D128	-1.5 E-02	419	-2.6 E-02	74	-3.1 E-03	214	1.7 E-01	13	-4.2 E-02	226
D129	5.0 E-02	137	4.7 E-03	453	-1.6 E-03	462	9.3 E-02	19	2.8 E-02	365

Table E-4. 300/400 Area Soil Sample Results (pCi/g).

	^{106}Ru		^{125}Sb		^{134}Cs		^{137}Cs		^{144}Ce	
	Result	% Error	Result	% Error	Result	% Error	Result	% Error	Result	% Error
D130	-3.6 E-02	231	-3.5 E-02	74	-5.2 E-02	22	7.4 E-02	26	-8.2 E-02	137
D131	6.0 E-02	120	-6.8 E-03	312	4.1 E-03	173	2.4 E-01	13	-1.8 E-01	67
D132	6.7 E-02	109	1.2 E-02	196	3.9 E-03	209	1.6 E-01	16	-4.2 E-02	320
Site I.D.	^{154}Eu		^{155}Eu		^{234}U		^{235}U		^{238}U	
	Result	% Error	Result	% Error	Result	% Error	Result	% Error	Result	% Error
D116	-9.8 E-03	321	3.1 E-02	87	2.5 E-01	11	1.2 E-02	31	2.5 E-01	11
D117	4.2 E-03	725	2.2 E-02	119	2.7 E-01	11	1.4 E-02	28	2.6 E-01	11
D118	-4.3 E-02	106	4.0 E-02	87	1.1 E+00	14	5.5 E-02	29	9.1 E-01	14
D119	-2.4 E-02	164	3.8 E-02	100	9.8 E+00	11	4.9 E-01	13	9.7 E+00	11
D120	-2.2 E-02	191	2.0 E-02	269	2.4 E+01	12	2.4 E+00	13	2.2 E+01	12
D121	1.3 E-02	363	7.4 E-02	75	6.4 E+00	11	7.1 E-02	20	6.2 E+00	11
D122	-4.7 E-02	85	1.4 E-01	38	4.2 E+01	12	1.8 E+00	20	4.9 E+01	12
D123	-1.4 E-02	243	3.2 E-02	95	3.7 E-01	11	2.2 E-02	23	3.9 E-01	11
D124	4.5 E-02	80	3.6 E-02	99	3.5 E-01	11	1.7 E-02	24	3.4 E-01	11
D125	-5.5 E-04	****	2.8 E-02	118	8.5 E-01	12	4.1 E-02	26	7.3 E-01	12
D126	-3.2 E-02	101	5.7 E-02	44	3.7 E-01	12	1.4 E-02	36	3.2 E-01	12
D127	1.9 E-02	161	3.9 E-02	68	2.3 E-01	14	1.1 E-02	49	2.3 E-01	14
D128	-1.7 E-02	165	3.1 E-02	84	1.8 E-01	16	8.2 E-03	59	2.6 E-01	14
D129	-9.1 E-04	****	8.4 E-03	312	1.1 E-01	16	4.9 E-03	63	1.2 E-01	15
D130	-3.0 E-03	****	3.7 E-02	86	1.6 E-01	16	8.9 E-03	53	1.6 E-01	15
D131	1.4 E-02	214	5.5 E-02	54	7.1 E+00	10	3.5 E-01	12	7.1 E+00	10
D132	-3.5 E-02	89	8.9 E-02	43	1.0 E+01	11	4.3 E-01	12	1.0 E+01	11

	Pu-238		Pu239/40	
	Result	% Error	Result	% Error
D116	4.4 E-04	58	6.7 E-03	17
D117	2.8 E-04	100	5.1 E-03	23
D118	4.0 E-04	51	2.5 E-03	21
D119	6.3 E-03	21	1.8 E-01	12
D120	3.6 E-03	25	7.3 E-02	12
D121	4.3 E-03	21	2.7 E-01	11
D122	2.1 E-03	32	5.6 E-01	11
D123	-5.2 E-06	****	5.2 E-03	24

Table E-4. 300/400 Area Soil Sample Results (pCi/g).

	Pu-238		Pu239/40	
	Result	% Error	Result	% Error
D124	2.8 E-04	81	4.7 E-03	22
D125	9.7 E-04	35	2.9 E-03	21
D126	3.1 E-04	65	2.1 E-03	27
D127	2.5 E-04	71	7.4 E-03	15
D128	3.8 E-04	139	5.5 E-03	27
D129	-9.0 E-05	368	2.3 E-03	39
D130	3.1 E-04	92	1.4 E-03	37
D131	4.4 E-03	19	2.6 E-01	10
D132	1.8 E-03	29	5.5 E-02	11

**** = Greater than 999% error.

Table E-5. 100 Area Vegetation Sample Results (pCi/g).

Site I.D.	^{40}K		^{60}Co		^{65}Zn		^{90}Sr		^{95}Zr	
	Result	% Error	Result	% Error	Result	% Error	Result	% Error	Result	% Error
Y701	7.7 E+00	28	8.5 E-01	20	2.1 E-01	101	1.2 E-01	24	3.1 E-02	681
Y702	1.1 E+00	220	7.9 E+01	10	1.2 E+00	63	5.3 E+00	18	1.5 E-01	430
Y703	4.0 E+00	95	4.3 E+01	10	1.2 E-01	488	1.8 E+01	19	-1.7 E-01	280
Y704	3.6 E+00	76	1.3 E+00	22	-4.5 E-02	522	7.3 E-01	19	8.9 E-02	296
Y705	6.1 E+00	33	7.9 E-02	109	-2.6 E-02	519	5.4 E-02	34	-2.0 E-02	849
Y706	3.6 E+00	48	-1.2 E-02	709	5.8 E-02	218	1.4 E-01	31	-3.1 E-01	53
Y707	3.0 E+00	46	7.3 E-02	116	-3.9 E-01	51	1.4 E-01	30	1.3 E-02	****
Y708	3.7 E+00	43	2.1 E+00	15	-3.8 E-01	71	2.6 E+00	18	2.9 E-02	857
Y709	7.3 E+00	41	1.2 E-01	108	-3.4 E-02	697	7.3 E-01	20	-1.3 E-01	194
Y710	5.4 E-01	416	2.0 E-01	47	3.6 E-02	522	1.5 E-01	37	-2.5 E-01	83
Y711	1.9 E+00	97	1.8 E+00	16	8.1 E-03	****	2.3 E-01	33	1.8 E-01	105
Y712	4.1 E+00	45	-4.0 E-02	190	1.2 E-01	132	3.0 E-02	45	-1.6 E-01	117
Y718	1.7 E+01	18	8.2 E-02	116	-3.7 E-01	82	3.9 E+01	17	4.5 E-02	****
Y719	9.6 E+00	20	1.3 E-01	67	-1.2 E-01	155	3.3 E+01	19	-2.1 E-02	793
Y720	9.2 E+00	22	-6.2 E-03	****	-3.1 E-02	561	1.0 E+01	19	1.0 E-01	177
Y721	8.8 E+00	19	7.5 E-02	86	-9.3 E-02	150	4.0 E+00	19	-6.2 E-02	255
Y722	3.7 E+00	56	2.0 E-01	39	4.2 E-02	346	7.5 E+00	19	-1.2 E-01	140
Y723	5.8 E+00	33	6.8 E-03	894	5.2 E-02	267	1.6 E+00	19	-1.2 E-01	140
Y724	8.2 E+00	30	4.3 E-01	29	-1.5 E-01	122	4.3 E+01	17	1.7 E-01	107
Y725	9.9 E+00	35	1.6 E-01	74	-1.1 E-01	247	3.4 E+02	17	2.8 E-01	104

Site I.D.	^{106}Ru		^{125}Sb		^{134}Cs		^{137}Cs		^{144}Ce	
	Result	% Error	Result	% Error	Result	% Error	Result	% Error	Result	% Error
Y701	-5.2 E-02	****	-1.0 E-01	225	-3.7 E-02	229	2.2 E-01	45	3.3 E-01	209
Y702	3.4 E+00	58	1.1 E-01	431	1.5 E-01	124	3.9 E+00	16	8.9 E-01	136
Y703	1.1 E+00	142	-3.1 E-01	114	-1.9 E-01	83	4.1 E+00	14	1.4 E-01	673
Y704	1.2 E-01	741	4.4 E-03	****	-4.0 E-03	****	7.9 E-01	27	-5.7 E-01	136
Y705	-2.2 E-01	246	1.2 E-02	****	-9.9 E-03	626	2.3 E-01	34	2.1 E-01	240
Y706	1.8 E-01	299	-1.3 E-01	127	6.4 E-02	87	1.9 E-01	49	7.5 E-01	63
Y707	-3.2 E-01	191	3.0 E-02	609	-8.1 E-03	771	2.2 E-01	35	4.6 E-01	131
Y708	-5.1 E-01	180	2.3 E-02	****	-4.2 E-02	212	1.7 E-01	55	-4.3 E-01	168
Y709	6.1 E-01	145	4.6 E-02	484	-1.0 E-03	****	1.5 E-01	63	-3.1 E-01	232
Y710	-6.0 E-01	127	2.5 E-02	686	4.9 E-02	133	1.5 E-01	49	-3.5 E-01	170
Y711	-3.9 E-01	178	9.4 E-02	188	6.3 E-02	99	2.7 E-01	30	-3.2 E-02	****
Y712	2.5 E-01	245	3.8 E-02	437	5.8 E-02	95	2.3 E-02	299	-2.8 E-01	185

Table E-5. 100 Area Vegetation Sample Results (pCi/g).

Site I.D.	^{106}Ru		^{125}Sb		^{134}Cs		^{137}Cs		^{144}Ce	
	Result	% Error	Result	% Error	Result	% Error	Result	% Error	Result	% Error
Y718	-6.1 E-01	152	-1.1 E-03	****	-2.0 E-02	430	6.1 E-01	22	3.7 E-02	****
Y719	-6.9 E-01	85	6.5 E-02	252	-2.6 E-02	239	2.4 E-01	36	-2.8 E-01	215
Y720	-7.2 E-02	821	3.3 E-02	527	-1.3 E-02	500	1.3 E-01	51	-2.7 E-01	209
Y721	7.7 E-01	69	-4.3 E-02	333	-1.9 E-02	320	2.2 E-02	294	2.8 E-01	199
Y722	-7.8 E-01	72	-1.6 E-02	917	-1.4 E-02	391	8.6 E-02	75	4.6 E-01	101
Y723	-5.0 E-01	116	-1.5 E-01	100	-4.8 E-02	123	-2.9 E-02	212	3.9 E-01	125
Y724	8.8 E-02	702	-9.0 E-02	185	-1.6 E-02	392	2.9 E-02	244	-2.1 E-01	247
Y725	-1.3 E+00	80	2.5 E-02	****	1.5 E-01	63	3.3 E-02	347	6.7 E-01	149

Site I.D.	^{154}Eu		^{155}Eu		^{234}U		^{235}U		^{238}U	
	Result	% Error	Result	% Error	Result	% Error	Result	% Error	Result	% Error
Y701	-2.5 E-01	117	-5.1 E-02	384	3.0 E-03	101	9.2 E-04	222	4.1 E-03	69
Y702	-1.1 E-01	450	1.4 E-01	209	3.8 E-02	21	1.5 E-03	149	3.2 E-02	22
Y703	8.0 E-02	482	-1.7 E-02	****	2.2 E-02	27	8.6 E-04	224	2.9 E-02	23
Y704	1.0 E-01	296	1.1 E-01	162	1.6 E-02	45	-1.2 E-03	148	1.9 E-02	37
Y705	8.4 E-02	199	-6.7 E-02	180	1.6 E-02	41	1.6 E-03	186	1.5 E-02	40
Y706	-1.1 E-01	154	-2.5 E-02	458	5.5 E-02	17	4.6 E-04	411	5.1 E-02	18
Y707	1.6 E-02	****	-4.4 E-02	391	4.4 E-02	19	1.4 E-03	149	4.3 E-02	19
Y708	-1.1 E-01	264	1.0 E-01	196	1.5 E-02	43	8.6 E-04	253	6.9 E-03	62
Y709	2.4 E-01	122	2.2 E-01	78	1.0 E-02	47	8.4 E-04	257	1.4 E-02	37
Y710	-7.3 E-02	287	4.5 E-02	327	5.7 E-02	18	2.9 E-03	85	5.3 E-02	18
Y711	8.3 E-02	273	-6.3 E-02	236	3.6 E-02	21	1.2 E-03	168	3.8 E-02	20
Y712	-1.4 E-01	167	2.2 E-02	624	8.0 E-03	54	-3.1 E-04	515	4.5 E-03	69
Y718	-6.6 E-02	468	4.5 E-02	501	1.4 E-02	33	2.3 E-04	703	1.1 E-02	34
Y719	-9.7 E-02	236	7.9 E-02	223	1.9 E-02	31	9.7 E-04	208	1.8 E-02	29
Y720	-1.3 E-01	159	-1.4 E-01	125	1.4 E-01	14	7.8 E-03	48	1.1 E-01	15
Y721	1.5 E-01	110	-6.5 E-02	218	1.0 E-02	43	-2.8 E-04	668	1.0 E-02	40
Y722	-8.9 E-02	206	7.6 E-02	149	5.8 E-02	21	-7.4 E-04	249	4.3 E-02	23
Y723	-3.8 E-01	56	4.2 E-02	272	7.4 E-02	17	1.7 E-03	130	6.3 E-02	17
Y724	5.4 E-02	346	-3.3 E-02	381	1.3 E-01	13	4.1 E-03	65	1.2 E-01	14
Y725	-4.2 E-02	752	1.7 E-01	130	1.1 E-01	16	2.9 E-03	110	1.0 E-01	17

Site I.D.	Pu-238		Pu239/40	
	Result	% Error	Result	% Error
Y701	4.3 E-03	26	2.5 E-02	14

Table E-5. 100 Area Vegetation Sample Results (pCi/g).

Site I.D.	Pu-238		Pu239/40	
	Result	% Error	Result	% Error
Y702	1.1 E-01	13	6.9 E-01	11
Y703	4.8 E-02	13	2.8 E-01	11
Y704	1.2 E-03	60	1.1 E-02	22
Y705	1.9 E-04	131	8.3 E-04	61
Y706	2.1 E-04	139	2.1 E-03	36
Y707	6.9 E-04	98	2.7 E-03	46
Y708	4.4 E-03	35	6.3 E-03	30
Y709	5.1 E-05	293	4.2 E-04	101
Y710	1.2 E-03	82	4.9 E-03	38
Y711	5.1 E-04	106	6.6 E-03	31
Y712	-2.2 E-05	****	6.0 E-04	148
Y718	4.4 E-04	86	4.6 E-03	28
Y719	8.1 E-04	67	2.6 E-03	38
Y720	8.4 E-04	66	2.7 E-03	37
Y721	2.0 E-04	156	1.3 E-03	56
Y722	1.3 E-04	168	1.5 E-03	39
Y723	1.2 E-04	166	2.5 E-04	113
Y724	2.1 E-04	169	7.2 E-04	123
Y725	1.4 E-04	309	2.3 E-03	74

**** = Greater than 999% error.

Table E-6. 200/600 Area Vegetation Sample Results (pCi/g).

Site I.D.	^{40}K		^{60}Co		^{65}Zn		^{90}Sr		^{95}Zr	
	Result	% Error	Result	% Error	Result	% Error	Result	% Error	Result	% Error
V002	3.9 E+01	13	5.0 E-02	174	-1.5 E-01	155	3.3 E+00	19	5.8 E-02	408
V007	6.8 E+01	12	-2.0 E-02	657	-5.8 E-02	526	LA		3.0 E-01	88
V009	1.6 E+01	16	-3.1 E-02	276	2.1 E-02	937	4.1 E-01	21	-8.4 E-02	260
V025	3.8 E+01	17	1.7 E-02	****	-2.2 E-01	257	5.0 E+00	18	4.7 E-01	106
V032	2.2 E+01	15	1.2 E-02	649	-1.9 E-01	19	2.2 E-02	41	-1.2 E-01	180
V034	9.7 E+00	30	1.0 E-01	90	-9.3 E-02	234	3.0 E-01	20	-2.1 E-01	114
V037	2.2 E+01	17	-2.5 E-02	382	1.7 E-02	****	1.2 E-01	25	4.5 E-02	476
V043	2.2 E+01	15	8.0 E-02	79	-5.1 E-02	316	1.3 E-01	24	-2.4 E-01	78
V044	2.1 E+01	21	4.5 E-02	296	-9.2 E-02	316	2.7 E+00	18	4.0 E-01	74
V048	2.1 E+01	16	3.5 E-03	****	2.7 E-02	569	5.8 E-02	29	3.5 E-03	****
V050	1.8 E+01	18	1.1 E-01	74	-8.0 E-02	271	1.0 E-01	30	-1.3 E-01	214
V055	1.8 E+01	18	1.1 E-01	74	-8.0 E-02	271	1.0 E-01	30	-1.3 E-01	214
V059	2.5 E-01	****	-6.8 E-02	154	-1.2 E-01	181	1.3 E+00	20	-1.0 E-01	268
V067	1.0 E+01	23	-9.7 E-02	65	-9.0 E-02	172	2.8 E-01	20	1.9 E-02	784
V078	8.6 E+00	19	-3.5 E-02	150	-5.1 E-02	215	1.9 E-01	21	-2.2 E-02	649
V079	1.7 E+01	16	-2.6 E-02	290	1.7 E-01	101	3.8 E-02	35	-1.0 E-02	****
V080	2.3 E+01	19	-2.4 E-02	488	2.5 E-01	111	2.9 E-01	20	-4.4 E-01	83
V081	1.1 E+01	21	4.8 E-02	122	1.2 E-01	114	3.5 E-02	30	-1.1 E-01	167
V082	1.0 E+01	23	2.4 E-02	280	8.4 E-02	184	1.1 E-01	21	1.2 E-01	157
V083	1.2 E+01	29	-7.3 E-02	155	-1.4 E-01	192	LA		6.9 E-02	427
V084	1.7 E+01	39	1.8 E-01	96	-1.1 E-02	****	2.9 E+00	20	7.6 E-02	737
V085	1.7 E+01	17	-3.4 E-03	****	2.3 E-02	593	2.8 E-02	46	1.1 E-01	172
V088	1.9 E+01	15	-6.3 E-02	114	-1.0 E-02	****	2.2 E-02	32	-5.8 E-02	347
V090	1.3 E+01	15	4.3 E-02	86	6.4 E-02	166	2.2 E-01	20	-2.7 E-02	489
V092	1.0 E+01	34	-3.3 E-02	469	NR		4.3 E-01	29	1.1 E-01	355
V094	1.3 E+01	15	1.4 E-02	290	-1.4 E-01	84	8.6 E-02	24	-2.0 E-01	67
V095	2.1 E+00	130	1.3 E-01	84	-2.6 E-01	117	3.3 E-01	23	-5.1 E-02	652
V096	1.7 E+01	17	2.3 E-02	230	-9.2 E-02	169	1.3 E-01	22	1.1 E-01	165
V097	2.6 E+01	14	4.6 E-02	120	3.4 E-02	405	2.8 E-01	32	1.1 E-01	140
V098	1.1 E+01	17	-4.8 E-02	109	-3.8 E-02	294	6.7 E-01	26	-1.7 E-01	78
V099	3.2 E+01	12	1.9 E-02	289	-9.4 E-02	157	7.3 E-01	24	-1.5 E-02	910
V100	1.5 E+01	18	4.7 E-02	131	-6.2 E-02	274	5.6 E-02	42	-5.0 E-02	385
V101	2.0 E+01	18	3.5 E-02	218	9.3 E-03	****	1.5 E-02	138	-1.7 E-01	140
V102	1.3 E+01	20	-5.9 E-02	117	-4.8 E-02	326	7.2 E-03	112	-9.2 E-03	****
V104	8.7 E+00	18	2.3 E-02	202	7.5 E-02	139	6.9 E-02	22	1.2 E-01	108

Table E-6. 200/600 Area Vegetation Sample Results (pCi/g).

Site I.D.	^{40}K		^{60}Co		^{65}Zn		^{90}Sr		^{95}Zr	
	Result	% Error	Result	% Error	Result	% Error	Result	% Error	Result	% Error
V105	1.7 E+01	14	-4.5 E-02	109	-2.8 E-02	366	5.2 E-01	19	3.1 E-02	393
V106	1.6 E+01	18	-1.9 E-02	404	7.7 E-03	****	6.5 E-02	30	1.9 E-02	****
V110	1.7 E+01	16	2.0 E-03	****	1.7 E-01	59	6.5 E-02	24	-2.5 E-02	608
V111	7.0 E+01	12	1.7 E-02	595	-2.8 E-01	97	1.1 E+00	20	1.1 E-01	244
V113	7.4 E+00	61	-4.1 E-02	511	-1.2 E-01	343	6.1 E-02	46	-4.4 E-01	129
V114	2.6 E+01	14	6.4 E-02	113	-1.2 E-01	132	2.3 E-01	19	-6.9 E-02	301

Site I.D.	^{106}Ru		^{125}Sb		^{134}Cs		^{137}Cs		^{144}Ce	
	Result	% Error	Result	% Error	Result	% Error	Result	% Error	Result	% Error
V002	-1.8 E-01	444	-1.5 E-02	****	1.4 E-02	558	1.8 E-01	55	-6.4 E-02	****
V007	-3.0 E-01	323	3.5 E-01	69	-7.7 E-03	****	1.9 E-01	56	-1.2 E-01	672
V009	4.6 E-01	131	5.2 E-02	386	7.5 E-04	****	1.2 E-02	629	6.7 E-02	****
V025	2.1 E+00	68	1.8 E-01	320	4.3 E-02	413	9.7 E+00	12	1.2 E-01	****
V032	7.6 E-01	85	-2.4 E-01	82	-8.2 E-02	91	-9.4 E-02	76	2.2 E-01	298
V034	-1.8 E-01	432	3.8 E-02	612	8.1 E-03	****	1.6 E-03	****	-5.0 E-01	169
V037	-6.3 E-02	****	-4.3 E-02	490	2.6 E-02	267	3.5 E-01	33	7.0 E-02	****
V043	-2.3 E-02	****	2.3 E-02	612	-3.1 E-03	****	6.4 E-02	94	-3.0 E-01	170
V044	3.3 E-01	316	1.5 E-01	180	9.4 E-02	111	2.1 E-01	51	1.7 E-01	546
V048	-4.9 E-01	124	-1.8 E-01	90	2.9 E-02	184	8.0 E-02	73	4.1 E-01	116
V050	3.4 E-01	222	-1.4 E-01	159	-2.0 E-02	422	4.9 E-02	161	-1.7 E-01	426
V055	3.4 E-01	222	-1.4 E-01	159	-2.0 E-02	422	4.9 E-02	161	-1.7 E-01	426
V059	-1.1 E-01	728	-1.7 E-01	125	7.1 E-03	****	9.5 E-01	21	1.3 E-01	590
V067	1.4 E-01	339	7.2 E-02	187	8.2 E-03	614	4.9 E-02	118	3.4 E-01	133
V078	-2.9 E-01	145	8.0 E-03	****	2.1 E-02	233	7.8 E-01	17	-5.7 E-01	68
V079	-1.3 E-01	451	1.6 E-01	112	-5.1 E-03	****	4.1 E-02	164	2.1 E-01	294
V080	-5.4 E-01	200	-3.3 E-01	82	-3.0 E-02	319	7.0 E-02	155	-5.9 E-01	149
V081	1.0 E-01	481	4.2 E-03	****	-6.6 E-03	834	-3.7 E-03	****	9.0 E-02	498
V082	-3.0 E-01	199	-6.8 E-03	****	-4.3 E-03	****	8.1 E-03	695	1.4 E-01	376
V083	-6.4 E-01	143	1.6 E-01	136	5.1 E-04	****	5.5 E-01	41	-5.7 E-01	123
V084	1.9 E+00	79	6.2 E-02	703	7.3 E-02	227	1.3 E-01	123	-8.5 E-01	166
V085	-3.8 E-02	****	4.5 E-02	308	4.0 E-02	130	4.2 E-03	****	-4.1 E-02	****
V088	5.9 E-03	****	7.8 E-02	180	-6.0 E-02	99	-4.3 E-02	132	-6.1 E-02	814
V090	1.8 E-01	183	-2.0 E-02	541	2.0 E-02	189	1.4 E+00	13	-1.6 E-01	224
V092	6.9 E-02	****	7.5 E-02	426	-9.6 E-02	126	9.7 E-02	135	3.4 E-01	336
V094	1.0 E-01	332	1.3 E-03	****	1.1 E-03	****	1.6 E-01	39	-9.3 E-02	310

Table E-6. 200/600 Area Vegetation Sample Results (pCi/g).

Site I.D.	^{106}Ru		^{125}Sb		^{134}Cs		^{137}Cs		^{144}Ce	
	Result	% Error	Result	% Error	Result	% Error	Result	% Error	Result	% Error
V095	1.7 E+00	58	-3.7 E-01	86	-3.2 E-02	394	1.6 E-01	76	3.9 E-01	238
V096	-9.9 E-03	****	3.8 E-02	352	-8.6 E-03	623	3.6 E-02	173	5.0 E-01	97
V097	-4.1 E-01	126	1.0 E-01	121	2.0 E-02	246	-4.1 E-03	****	2.4 E-01	177
V098	2.4 E-01	197	-4.4 E-02	271	2.2 E-02	212	-4.5 E-03	****	-2.0 E-01	201
V099	3.3 E-01	121	5.2 E-02	212	-2.7 E-02	168	-3.1 E-02	154	1.1 E-01	339
V100	-2.2 E-01	265	1.8 E-01	81	-2.0 E-02	308	7.5 E-02	75	-5.6 E-01	96
V101	-3.4 E-01	193	-8.2 E-02	258	-5.5 E-02	141	6.2 E-02	129	6.6 E-01	84
V102	-5.8 E-01	97	8.9 E-02	159	-8.8 E-03	703	2.9 E-02	230	-6.8 E-02	681
V104	-2.8 E-01	133	5.0 E-02	200	1.2 E-02	300	-4.6 E-04	****	-1.1 E-01	376
V105	-3.0 E-01	125	3.4 E-02	294	4.4 E-02	81	-1.9 E-02	237	-6.7 E-02	520
V106	6.0 E-02	****	-1.9 E-02	812	1.0 E-02	581	7.5 E-03	926	1.7 E-01	298
V110	-3.3 E-01	131	-1.5 E-01	80	2.8 E-02	160	3.6 E-02	120	-5.2 E-02	755
V111	3.3 E-01	227	9.9 E-02	193	-3.5 E-02	229	7.7 E-02	104	1.2 E-01	569
V113	-2.5 E-01	634	-3.8 E-01	113	3.5 E-02	459	-9.6 E-02	196	-6.4 E-01	201
V114	-4.0 E-02	****	-4.2 E-03	****	-7.2 E-02	89	1.1 E-02	651	2.1 E-03	****

Site I.D.	^{154}Eu		^{155}Eu		^{234}U		^{235}U		^{238}U	
	Result	% Error	Result	% Error	Result	% Error	Result	% Error	Result	% Error
V002	2.5 E-02	****	1.5 E-01	143	6.4 E-03	62	-1.1 E-03	136	8.4 E-03	46
V007	-1.2 E-01	337	1.9 E-01	116	6.7 E-03	57	3.6 E-04	493	5.8 E-03	56
V009	1.1 E-01	243	-1.4 E-01	144	3.7 E-03	99	-1.5 E-04	****	5.5 E-03	64
V025	7.8 E-01	68	2.0 E-01	221	2.3 E-02	38	9.9 E-03	58	1.1 E-02	57
V032	2.2 E-01	96	-7.1 E-02	193	4.0 E-03	119	-2.5 E-04	810	6.9 E-03	66
V034	7.0 E-03	****	-8.3 E-02	230	7.3 E-03	55	7.3 E-04	259	3.1 E-03	86
V037	2.3 E-01	106	7.0 E-02	243	2.1 E-02	31	3.1 E-03	89	1.3 E-02	39
V043	5.9 E-02	341	-7.1 E-03	****	5.4 E-03	82	3.6 E-05	****	1.0 E-02	49
V044	6.3 E-02	598	2.7 E-01	78	1.0 E-02	38	7.9 E-04	240	8.3 E-03	39
V048	4.3 E-02	495	2.6 E-02	458	1.3 E-02	36	-5.3 E-04	306	7.9 E-03	44
V050	2.8 E-01	80	4.1 E-02	424	1.0 E-02	50	4.1 E-04	504	9.3 E-03	50
V055	2.8 E-01	80	4.1 E-02	424	1.0 E-02	50	4.1 E-04	504	9.3 E-03	50
V059	3.1 E-01	82	-4.9 E-03	****	5.8 E-02	19	1.8 E-03	133	5.6 E-02	19
V067	4.7 E-03	****	7.4 E-02	140	4.7 E-03	70	-9.0 E-04	147	5.5 E-03	58
V078	-1.7 E-01	86	3.2 E-02	261	1.5 E-01	13	4.1 E-03	66	1.3 E-01	13
V079	1.6 E-01	150	-2.9 E-02	601	2.6 E-03	143	-4.9 E-04	326	2.3 E-03	123
V080	2.1 E-01	165	4.6 E-02	456	4.7 E-02	20	2.2 E-03	110	4.7 E-02	19

Table E-6. 200/600 Area Vegetation Sample Results (pCi/g).

Site I.D.	^{154}Eu		^{155}Eu		^{234}U		^{235}U		^{238}U	
	Result	% Error	Result	% Error	Result	% Error	Result	% Error	Result	% Error
V081	-2.8 E-01	78	8.7 E-02	113	1.1 E-01	14	6.4 E-03	50	1.1 E-01	14
V082	6.4 E-02	280	5.8 E-02	207	3.0 E-02	28	8.9 E-05	****	3.8 E-02	24
V083	-1.5 E-01	232	6.2 E-02	257	6.3 E-02	18	8.3 E-04	268	6.7 E-02	17
V084	-2.1 E-01	273	3.2 E-01	103	7.7 E-03	59	-1.5 E-03	91	6.5 E-03	57
V085	1.6 E-01	99	-3.0 E-02	365	8.1 E-03	58	-6.8 E-04	218	4.9 E-03	72
V088	1.4 E-01	135	5.2 E-02	214	2.6 E-02	35	2.2 E-03	148	1.4 E-02	48
V090	1.0 E-01	120	8.3 E-02	95	1.7 E-01	13	6.7 E-03	51	1.8 E-01	13
V092	-6.8 E-02	575	-2.5 E-02	996	8.5 E-02	21	1.9 E-04	****	8.6 E-02	21
V094	-2.1 E-01	67	-7.2 E-03	916	2.1 E-01	13	7.8 E-03	48	2.2 E-01	12
V095	3.5 E-01	94	1.3 E-01	152	1.8 E-02	33	-5.2 E-05	****	1.9 E-02	31
V096	1.6 E-01	110	-1.0 E-02	****	4.4 E-03	81	-6.9 E-04	223	1.9 E-03	120
V097	3.1 E-02	556	6.4 E-02	158	5.2 E-03	83	-6.2 E-04	244	3.3 E-03	101
V098	1.9 E-02	649	-5.3 E-03	****	4.0 E-03	94	-4.4 E-04	376	3.5 E-03	88
V099	-1.3 E-01	121	7.9 E-03	****	4.5 E-03	88	2.5 E-04	823	4.9 E-03	78
V100	-1.5 E-01	144	-9.3 E-02	141	1.3 E-02	40	-7.5 E-04	214	6.3 E-03	56
V101	-2.1 E-01	122	2.3 E-02	621	1.0 E-02	86	2.0 E-03	198	1.8 E-03	292
V102	-2.0 E-01	105	5.2 E-02	192	7.1 E-03	85	-1.3 E-03	156	2.9 E-03	138
V104	2.9 E-02	411	-2.6 E-02	370	2.1 E-03	156	3.0 E-05	****	2.1 E-04	****
V105	4.0 E-02	338	1.6 E-02	572	7.5 E-04	387	-1.1 E-03	142	2.9 E-03	100
V106	4.1 E-02	489	1.6 E-01	79	3.6 E-03	104	1.4 E-04	****	2.9 E-03	107
V110	7.8 E-02	185	-4.5 E-02	216	5.7 E-03	70	-7.7 E-04	217	4.3 E-03	73
V111	-1.3 E-01	252	3.2 E-02	533	2.2 E-02	43	1.3 E-03	237	1.9 E-02	44
V113	2.5 E-01	218	-3.6 E-02	736	1.5 E-02	39	1.6 E-03	174	1.4 E-02	38
V114	-1.4 E-01	157	8.2 E-02	148	1.1 E-03	276	-7.4 E-04	228	7.6 E-04	276

Site I.D.	^{238}Pu		$^{239,240}Pu$	
	Result	% Error	Result	% Error
V002	3.4 E-04	118	2.3 E-02	16
V007	1.6 E-03	84	1.9 E-02	25
V009	1.4 E-03	48	1.0 E-02	20
V025	-5.4 E-05	****	7.2 E-03	37
V032	1.2 E-04	281	2.8 E-02	15
V034	8.1 E-04	66	5.0 E-02	14
V037	4.8 E-04	107	3.3 E-03	41

Table E-6. 200/600 Area Vegetation Sample Results (pCi/g).

Site I.D.	^{238}Pu		$^{239,240}Pu$	
	Result	% Error	Result	% Error
V043	-2.3 E-07	****	1.6 E-02	27
V044	8.1 E-04	78	2.4 E-02	17
V048	-1.0 E-04	111	2.2 E-03	45
V050	2.5 E-04	129	2.2 E-03	43
V055	2.5 E-04	129	2.2 E-03	43
V059	-2.6 E-05	751	2.2 E-03	37
V067	-1.4 E-04	123	5.1 E-04	78
V078	1.5 E-02	18	2.9 E-01	11
V079	-7.7 E-05	102	1.2 E-03	48
V080	5.4 E-05	595	2.2 E-03	54
V081	-1.7 E-05	****	4.2 E-04	87
V082	-3.5 E-05	597	3.1 E-04	132
V083	5.9 E-04	126	1.1 E-02	27
V084	-3.7 E-04	111	6.8 E-04	192
V085	2.4 E-04	124	6.7 E-04	74
V088	-1.3 E-05	****	2.1 E-04	213
V090	6.6 E-05	245	1.9 E-03	45
V092	-9.0 E-05	522	1.2 E-02	27
V094	2.6 E-04	158	5.8 E-03	28
V095	-5.2 E-04	299	1.3 E-03	123
V096	1.4 E-04	107	5.4 E-04	57
V097	9.1 E-05	246	3.4 E-03	38
V098	8.6 E-05	195	6.1 E-04	60
V099	8.0 E-05	296	6.0 E-04	74
V100	4.2 E-05	546	3.3 E-04	113
V101	7.0 E-05	472	4.5 E-04	96
V102	1.0 E-03	119	1.7 E-03	108
V104	9.2 E-05	159	7.6 E-04	54
V105	3.1 E-04	86	1.1 E-02	18
V106	-2.2 E-06	****	2.3 E-03	32

Table E-6. 200/600 Area Vegetation Sample Results (pCi/g).

Site I.D.	^{238}Pu		$^{239,240}Pu$	
	Result	% Error	Result	% Error
V110	1.7 E-05	647	1.2 E-03	35
V111	3.3 E-03	43	1.6 E-02	21
V113	-5.6 E-04	127	3.9 E-03	52
V114	3.1 E-05	269	1.3 E-03	38

**** = Greater than 999% error
LA = Sample was lost during analysis as a result of a laboratory accident.
NR = Not reported.

Table E-7. 300/400 Area Vegetation Sample Results (pCi/g).

Site I.D.	^{40}K		^{60}Co		^{65}Zn		^{90}Sr		^{95}Zr	
	Result	% Error	Result	% Error	Result	% Error	Result	% Error	Result	% Error
V116	1.4 E+01	17	2.0 E-02	268	4.8 E-02	251	3.2 E-02	50	2.1 E-01	62
V117	2.0 E+01	20	-3.9 E-02	284	-2.5 E-01	105	2.1 E-02	136	1.5 E-01	167
V118	1.1 E+01	20	-4.0 E-03	****	1.5 E-01	119	3.1 E-02	58	9.5 E-02	224
V119	6.8 E+00	32	-9.5 E-02	81	1.1 E-02	****	2.1 E-02	82	-9.7 E-02	187
V120	1.8 E+01	21	-9.7 E-02	126	-1.4 E-01	175	2.0 E-02	99	-2.7 E-01	109
V121	1.9 E+01	18	6.0 E-02	151	2.0 E-02	****	3.3 E-02	55	8.9 E-02	261
V122	1.0 E+01	26	7.5 E-03	959	6.0 E-02	225	4.4 E-02	50	3.1 E-01	62
V123	1.9 E+01	18	-2.4 E-02	295	6.6 E-02	230	1.4 E-02	128	1.4 E-01	119
V124	1.4 E+01	26	-7.5 E-03	****	-2.3 E-01	116	5.5 E-02	52	1.1 E-01	262
V125	1.4 E+01	20	-1.7 E-02	693	-2.6 E-01	100	3.2 E-03	365	-1.6 E-01	163
V126	1.4 E+01	15	3.4 E-02	168	-1.2 E-01	142	1.4 E-02	71	1.4 E-02	****
V127	1.5 E+01	18	6.8 E-02	92	-2.1 E-01	87	4.1 E-02	32	1.2 E-01	137
V128	1.8 E+01	19	-5.6 E-03	****	-8.5 E-03	****	9.7 E-02	32	NR	
V129	1.4 E+01	17	1.1 E-01	48	-9.5 E-03	****	1.0 E-01	28	1.0 E-03	****
V130	1.6 E+01	21	1.1 E-01	116	-2.4 E-01	111	4.6 E-03	377	2.5 E-01	127
V131	1.3 E+01	17	1.2 E-02	490	5.9 E-02	211	NR		5.3 E-02	293
V132	1.8 E+01	18	2.4 E-03	****	-4.3 E-02	498	1.0 E-02	162	4.3 E-02	500

Site I.D.	^{106}Ru		^{125}Sb		^{134}Cs		^{137}Cs		^{144}Ce	
	Result	% Error	Result	% Error	Result	% Error	Result	% Error	Result	% Error
V116	1.9 E-01	245	2.0 E-02	652	1.3 E-03	****	2.2 E-02	258	2.7 E-01	157
V117	4.7 E-01	181	NR		-5.3 E-02	169	-3.5 E-02	271	-4.1 E-01	174
V118	2.5 E-02	****	3.8 E-02	465	-3.3 E-02	210	4.1 E-02	154	-1.9 E-01	320
V119	-1.8 E-01	328	2.6 E-02	609	3.0 E-02	195	4.5 E-02	135	5.1 E-01	108
V120	2.2 E-01	385	-6.5 E-02	394	-8.1 E-02	125	-4.7 E-03	****	5.2 E-01	152
V121	-1.2 E-01	680	1.1 E-01	175	4.3 E-02	199	7.0 E-02	123	-1.2 E-01	536
V122	NR		-1.0 E-01	156	-2.9 E-02	214	3.3 E-02	195	2.6 E-01	209
V123	3.4 E-01	172	-1.1 E-01	138	-3.4 E-02	184	1.1 E-02	536	2.4 E-01	201
V124	9.1 E-02	****	4.9 E-02	546	1.2 E-01	82	-3.9 E-02	270	2.8 E-02	****
V125	-5.2 E-01	155	2.0 E-01	111	-3.8 E-02	232	1.5 E-02	598	2.3 E-01	336
V126	-8.4 E-02	635	-1.1 E-01	143	-5.3 E-02	114	3.5 E-02	173	-4.8 E-02	****
V127	8.7 E-01	67	3.7 E-02	392	-4.7 E-03	****	5.7 E-02	103	-4.4 E-01	111
V128	9.0 E-01	89	-1.8 E-02	****	5.5 E-03	****	1.0 E-01	85	-1.8 E-02	****
V129	2.2 E-01	223	1.4 E-01	87	5.3 E-03	****	-3.8 E-02	141	2.8 E-02	****
V130	-3.3 E-01	290	-9.5 E-02	306	-2.3 E-02	470	1.2 E-01	91	-7.4 E-01	120

Table E-7. 300/400 Area Vegetation Sample Results (pCi/g).

Site I.D.	^{106}Ru		^{125}Sb		^{134}Cs		^{137}Cs		^{144}Ce	
	Result	% Error	Result	% Error	Result	% Error	Result	% Error	Result	% Error
V131	-2.1 E-02	****	1.4 E-01	101	1.3 E-02	457	3.7 E-02	161	1.2 E-01	394
V132	-1.2 E-01	614	1.5 E-01	132	4.2 E-02	179	3.6 E-02	229	2.1 E-01	339

Site I.D.	^{154}Eu		^{155}Eu		^{234}U		^{235}U		^{238}U	
	Result	% Error	Result	% Error	Result	% Error	Result	% Error	Result	% Error
V116	-1.6 E-01	114	3.0 E-02	327	1.0 E-02	44	2.6 E-03	99	7.4 E-03	51
V117	5.7 E-02	513	-5.3 E-02	336	1.5 E-02	37	-2.5 E-04	680	1.5 E-02	34
V118	-3.3 E-02	752	-5.5 E-02	336	1.6 E-02	31	4.2 E-03	67	1.2 E-02	35
V119	2.4 E-01	78	-8.9 E-02	164	3.8 E-02	20	4.0 E-03	66	3.9 E-02	19
V120	-4.9 E-01	70	-3.9 E-02	464	4.8 E-01	11	3.5 E-02	21	5.5 E-01	11
V121	-1.1 E-01	245	-1.2 E-01	135	7.1 E-02	19	2.6 E-03	110	6.5 E-02	19
V122	-5.0 E-02	430	2.9 E-02	442	4.4 E-01	12	1.7 E-02	35	4.4 E-01	12
V123	-5.4 E-02	414	-1.6 E-02	707	2.6 E-01	12	1.6 E-02	32	2.4 E-01	12
V124	2.0 E-01	162	8.7 E-02	221	5.6 E-02	18	2.4 E-03	99	4.2 E-02	19
V125	6.0 E-02	556	1.7 E-01	128	2.9 E-02	29	1.4 E-03	195	3.3 E-02	26
V126	-2.4 E-01	93	2.1 E-02	766	3.2 E-02	33	1.6 E-03	217	3.6 E-02	31
V127	9.6 E-02	209	-2.1 E-02	565	6.4 E-03	68	5.4 E-05	****	2.9 E-03	110
V128	2.2 E-01	137	-1.5 E-01	129	5.7 E-02	23	2.3 E-03	149	6.6 E-02	22
V129	NR		-6.4 E-02	161	4.0 E-02	26	-2.6 E-04	748	5.2 E-02	23
V130	1.4 E-01	240	4.3 E-02	488	5.1 E-03	91	-1.0 E-03	175	7.4 E-03	65
V131	-1.6 E-01	119	9.3 E-03	****	8.8 E-03	68	3.0 E-03	120	1.0 E-02	56
V132	8.9 E-02	310	3.3 E-02	506	5.1 E-02	27	-2.5 E-03	114	3.8 E-02	30

Site I.D.	^{238}Pu		$^{239,240}Pu$	
	Result	% Error	Result	% Error
V116	-7.6 E-05	315	5.5 E-05	546
V117	4.6 E-04	84	1.4 E-05	****
V118	1.2 E-04	167	8.5 E-04	60
V119	1.8 E-04	136	7.2 E-04	55
V120	7.0 E-05	265	6.2 E-04	61
V121	5.8 E-05	187	4.4 E-04	75
V122	2.8 E-04	93	4.3 E-03	22
V123	-1.9 E-05	****	5.8 E-04	70
V124	1.2 E-04	256	5.6 E-04	77

Table E-7. 300/400 Area Vegetation Sample Results (pCi/g).

Site I.D.	^{238}Pu		$^{239,240}Pu$	
	Result	% Error	Result	% Error
V125	-8.8 E-05	147	2.3 E-04	116
V126	-1.0 E-04	158	1.3 E-03	55
V127	-1.8 E-05	****	-1.8 E-05	****
V128	9.1 E-05	702	1.2 E-03	66
V129	-2.6 E-04	130	9.3 E-04	82
V130	-2.3 E-05	737	5.3 E-04	74
V131	-3.5 E-04	133	-6.8 E-04	119
V132	-8.6 E-05	258	9.3 E-04	61

**** = Greater than 999% error.

APPENDIX F

EXTERNAL RADIATION MONITORING FIGURES AND TABLES

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Figure F-1. Thermoluminescent Dosimeter Locations in the 100 K Area.

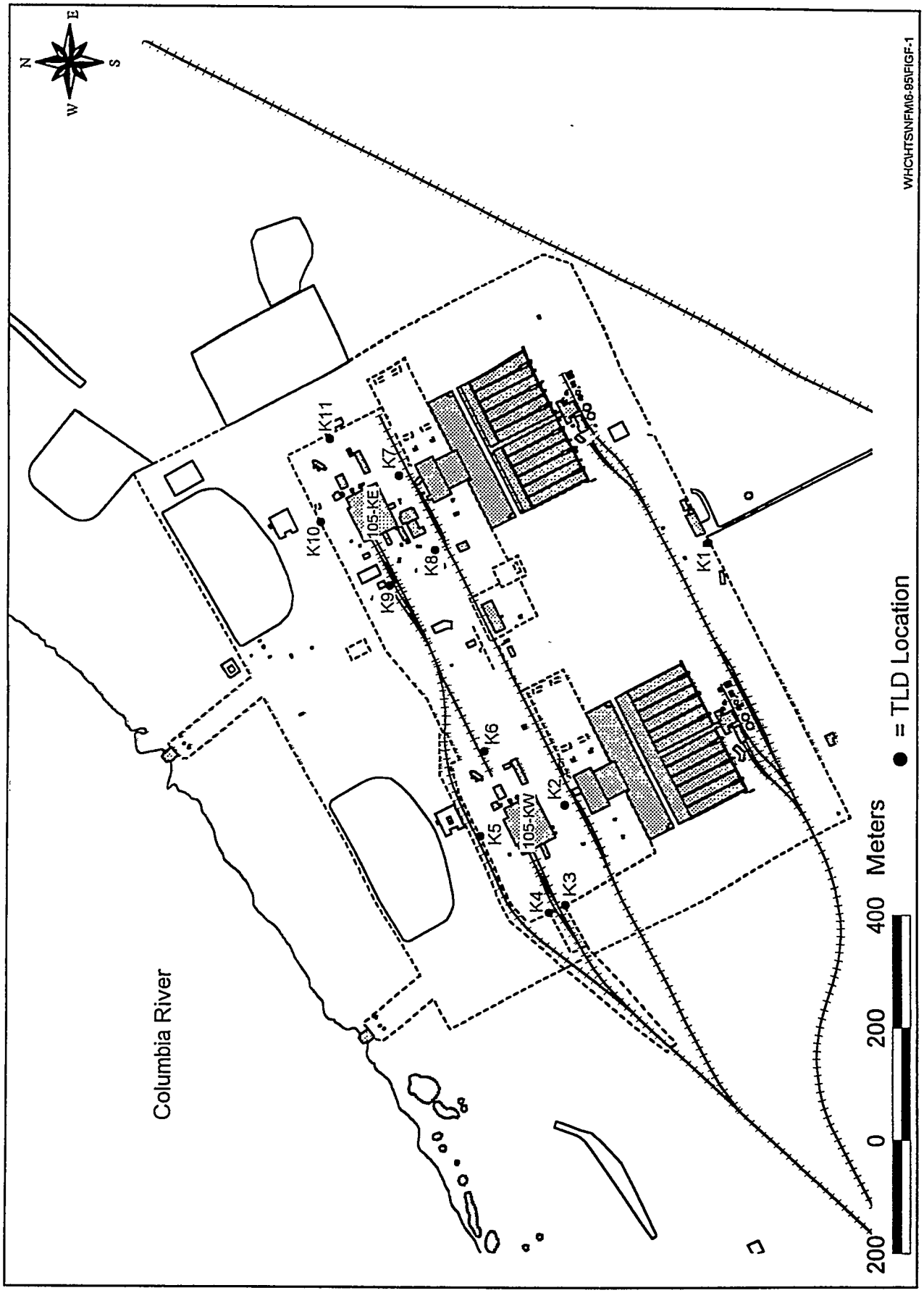

Figure F-2. Thermoluminescent Dosimeter Locations in the 100 N Area.

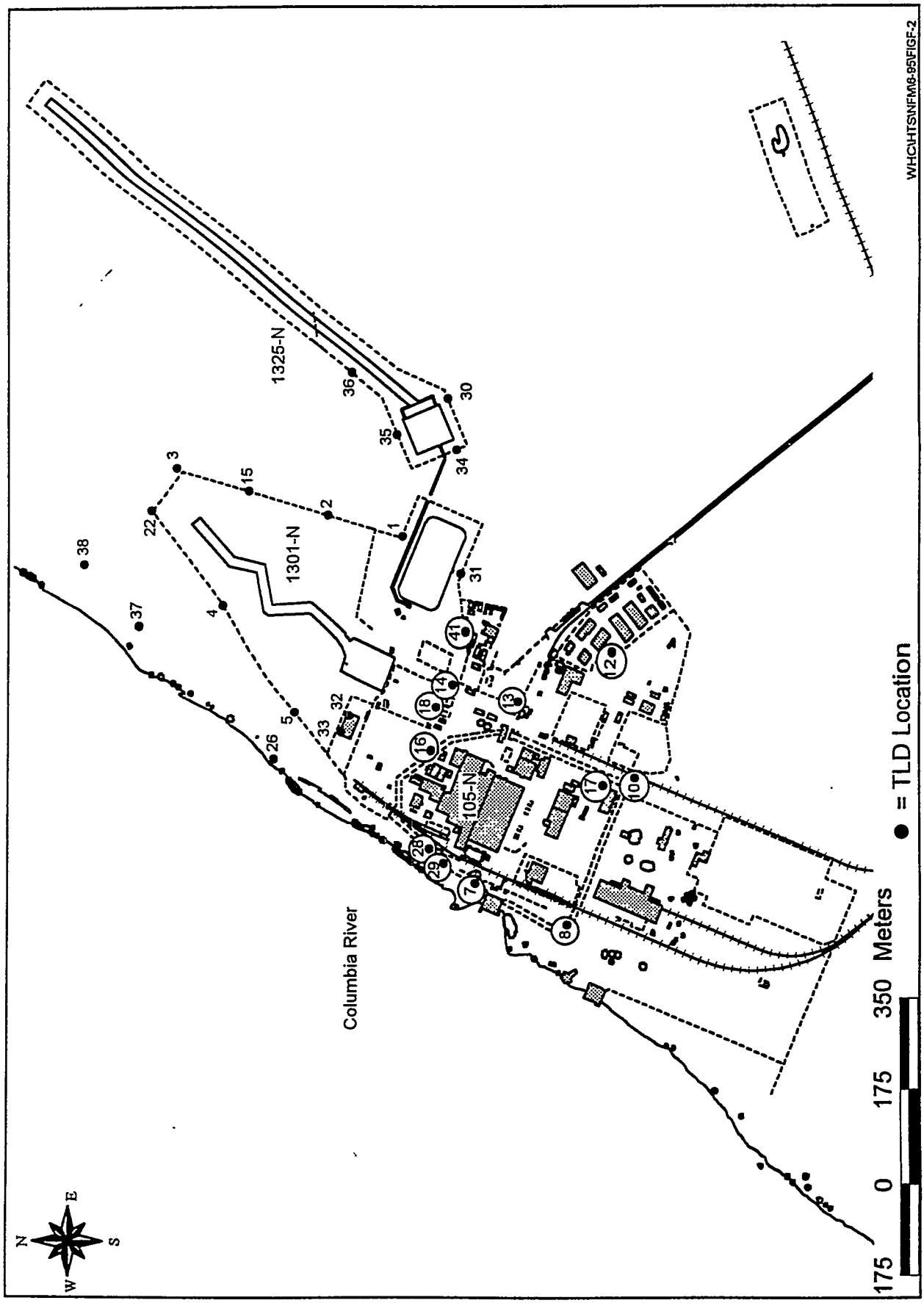

Figure F-3. Thermoluminescent Dosimeter Locations in the 200 East Area.

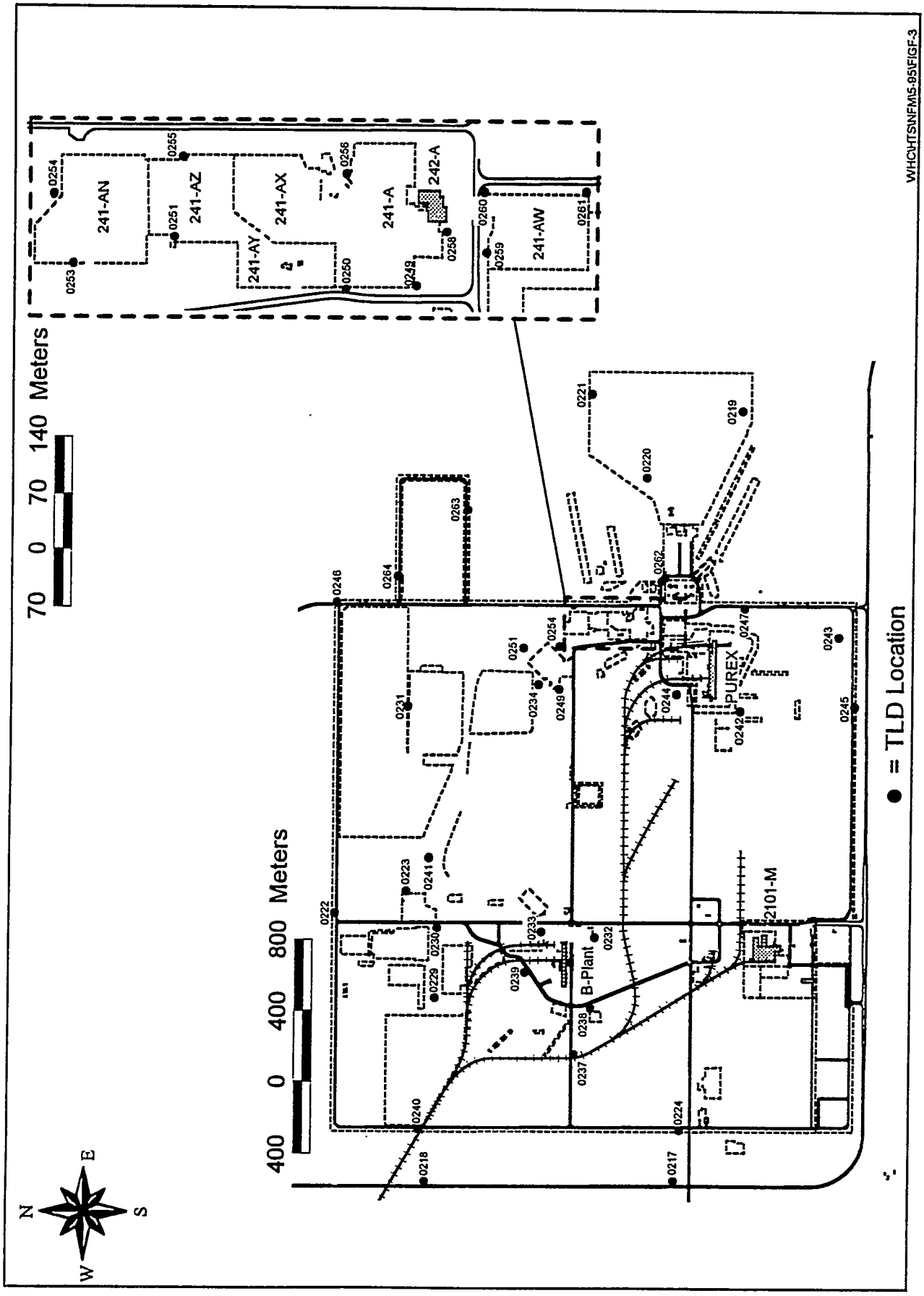

Figure F-4. Thermoluminescent Dosimeter Locations in the 200 West Area.

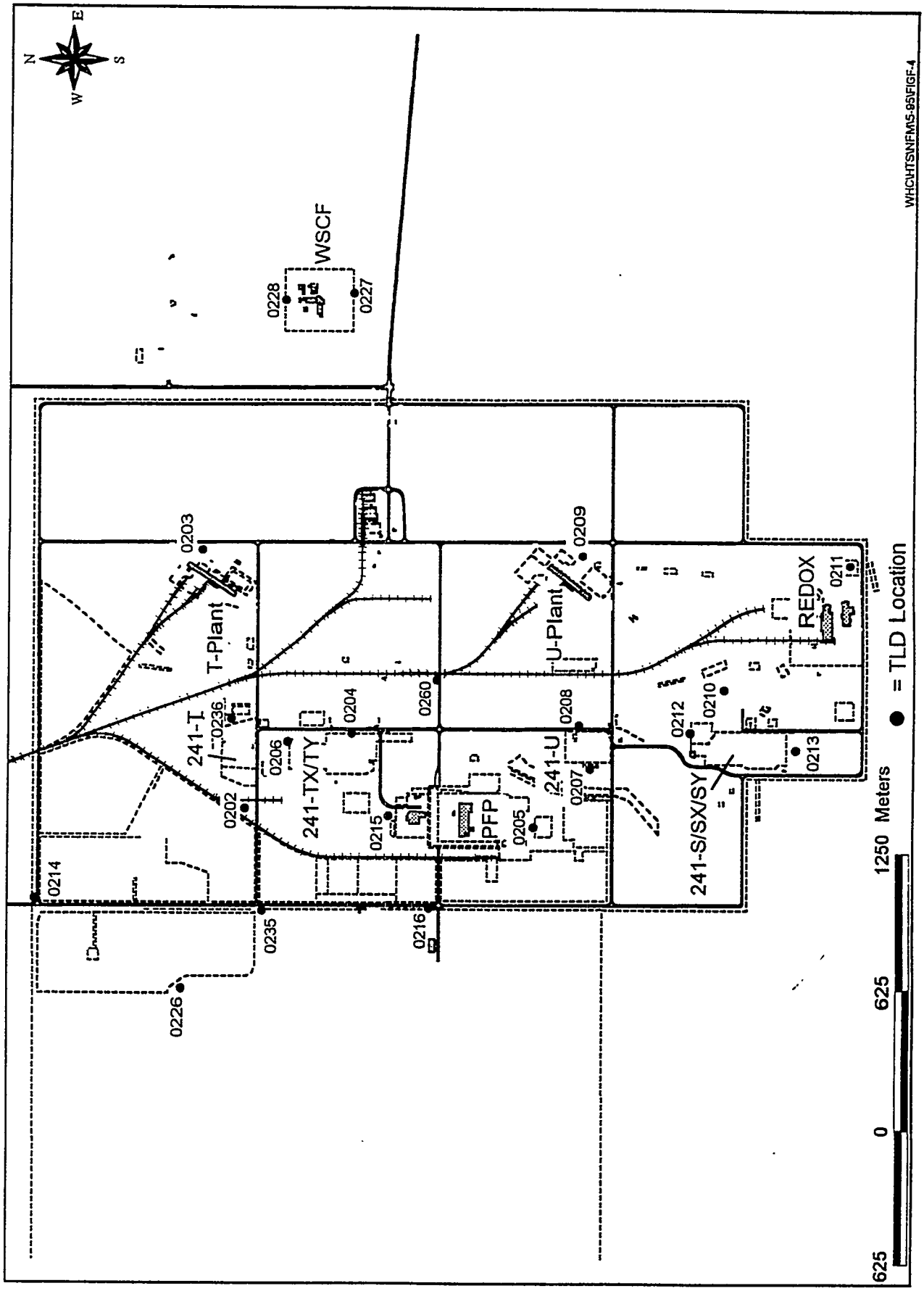

Figure F-5. Thermoluminescent Dosimeter Locations in the 300 Area.

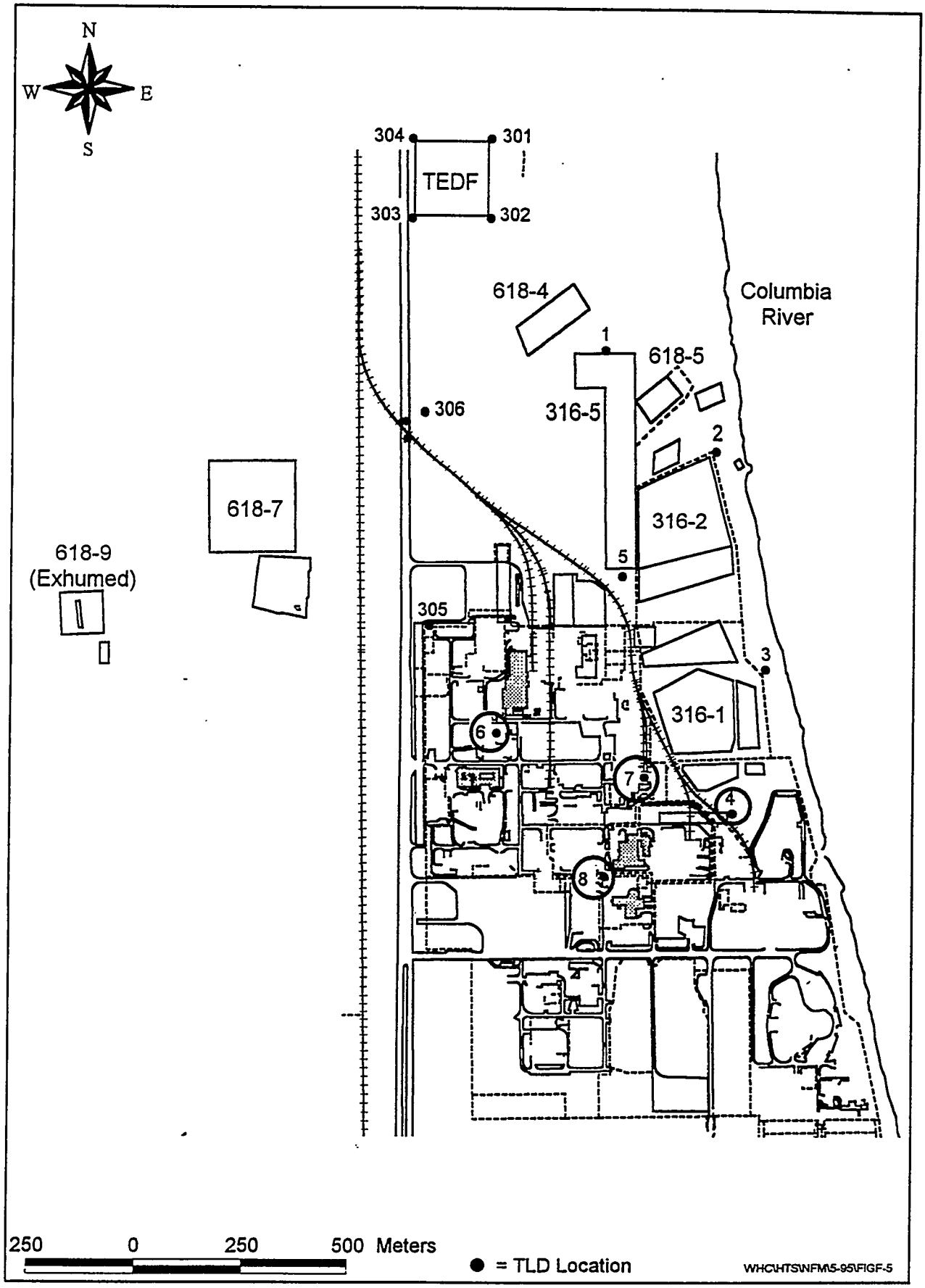

Figure F-6. Thermoluminescent Dosimeter Locations in the 400 Area.

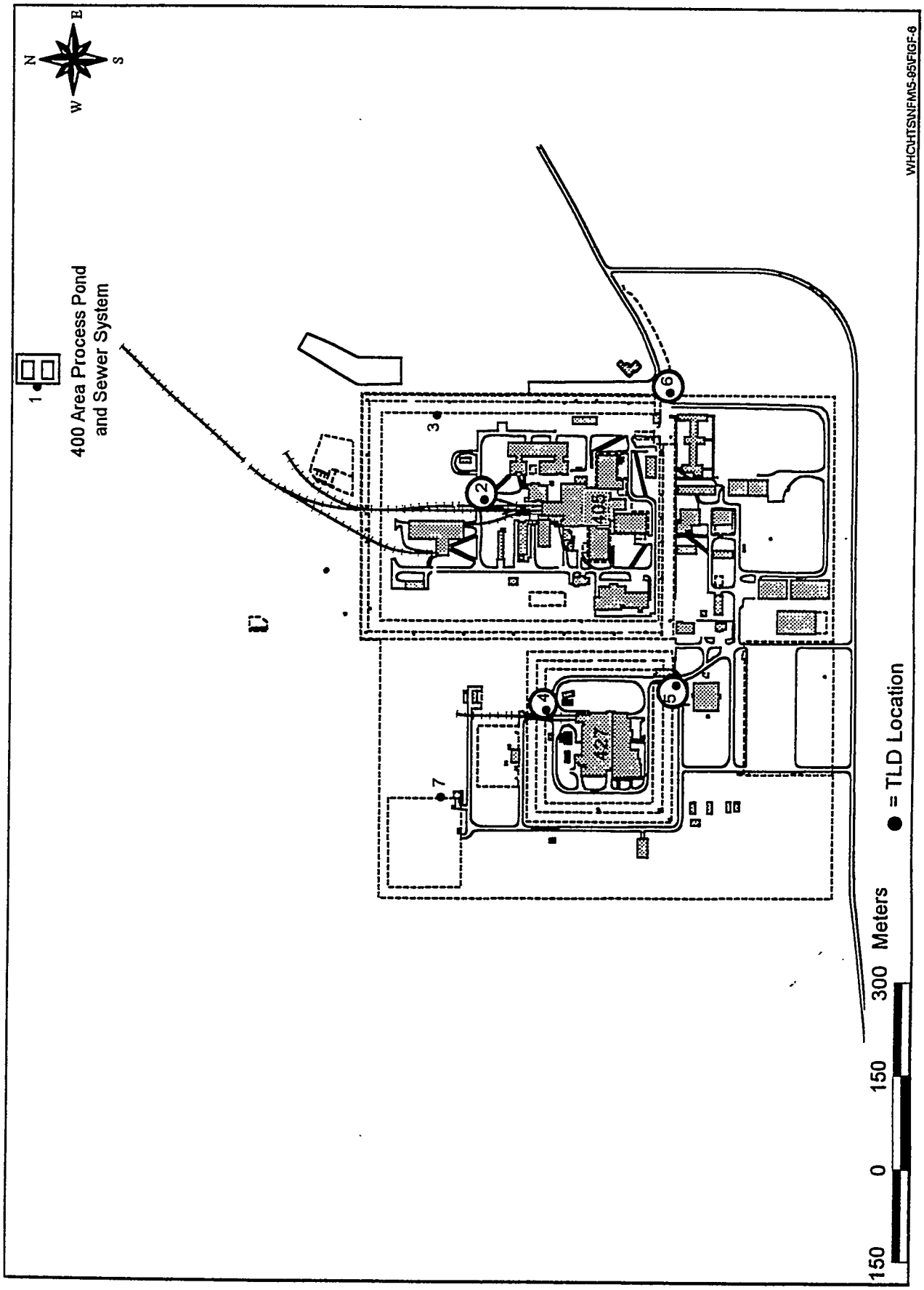

Table F-1. 100 N/100 K Thermoluminescent Dosimeter Exposure Results, Calendar Year 1994.

100 N Site I.D.	1st Quarter		2nd Quarter		3rd Quarter		4th Quarter		Annual Results (mrem/yr)		
	mrem/hr	mrem/yr	mrem/hr	mrem/yr	mrem/hr	mrem/yr	mrem/hr	mrem/yr	Max	Min	Avg
1	1.3E-01	1.1E+03	1.4E-01	1.2E+03	1.3E-01	1.1E+03	1.2E-01	1.0E+03	1.2E+03	1.0E+03	1.1E+03
2	1.2E-01	1.0E+03	1.3E-01	1.2E+03	1.2E-01	1.1E+03	1.1E-01	1.0E+03	1.2E+03	1.0E+03	1.1E+03
3	5.4E-02	4.7E+02	5.6E-02	4.9E+02	5.5E-02	4.8E+02	4.9E-02	4.3E+02	4.9E+02	4.3E+02	4.7E+02
4	2.5E-01	2.2E+03	2.1E-01	1.8E+03	2.1E-01	1.9E+03	1.9E-01	1.7E+03	2.2E+03	1.7E+03	1.9E+03
5	8.9E-02	7.8E+02	7.4E-02	6.5E+02	7.6E-02	6.7E+02	6.9E-02	6.1E+02	7.8E+02	6.1E+02	6.8E+02
6	3.5E-02	3.1E+02	3.3E-02	2.9E+02	3.2E-02	2.8E+02	2.9E-02	2.5E+02	3.1E+02	2.5E+02	2.8E+02
7	1.3E-01	1.1E+03	1.1E-01	9.9E+02	1.2E-01	1.0E+03	1.1E-01	9.5E+02	1.1E+03	9.5E+02	1.0E+03
8	1.2E-02	1.1E+02	1.3E-02	1.2E+02	1.2E-02	1.1E+02	1.2E-02	1.1E+02	1.2E+02	1.1E+02	1.1E+02
10	1.1E-02	9.5E+01	1.2E-02	1.1E+02	1.1E-02	1.0E+02	1.1E-02	9.9E+01	1.1E+02	9.5E+01	1.0E+02
12	1.6E-02	1.4E+02	1.5E-02	1.3E+02	1.4E-02	1.2E+02	1.3E-02	1.1E+02	1.4E+02	1.1E+02	1.2E+02
13	2.1E-02	1.8E+02	2.2E-02	1.9E+02	2.1E-02	1.8E+02	1.8E-02	1.6E+02	1.9E+02	1.6E+02	1.8E+02
14	5.5E-02	4.8E+02	5.4E-02	4.8E+02	5.0E-02	4.4E+02	4.9E-02	4.3E+02	4.8E+02	4.3E+02	4.6E+02
15	9.8E-02	8.6E+02	1.1E-01	9.2E+02	9.7E-02	8.5E+02	8.8E-02	7.7E+02	9.2E+02	7.7E+02	8.5E+02
16	3.3E-02	2.9E+02	3.6E-02	3.2E+02	3.4E-02	3.0E+02	3.1E-02	2.7E+02	3.2E+02	2.7E+02	2.9E+02
17	3.4E-02	3.0E+02	8.1E-02	7.1E+02	7.2E-02	6.3E+02	4.2E-02	3.7E+02	7.1E+02	3.0E+02	5.0E+02
18	5.6E-02	4.9E+02	5.4E-02	4.7E+02	5.2E-02	4.5E+02	4.5E-02	4.0E+02	4.9E+02	4.0E+02	4.5E+02
22	7.6E-02	6.6E+02	7.2E-02	6.3E+02	6.4E-02	5.6E+02	6.1E-02	5.3E+02	6.6E+02	5.3E+02	6.0E+02
26	3.4E-02	2.9E+02	2.7E-02	2.4E+02	2.9E-02	2.5E+02	2.7E-02	2.3E+02	2.9E+02	2.3E+02	2.5E+02
28	3.4E-02	2.9E+02	2.7E-02	2.4E+02	3.1E-02	2.7E+02	2.8E-02	2.5E+02	2.9E+02	2.4E+02	2.6E+02
29	5.0E-03	4.4E+01	3.4E-01	3.0E+03	2.1E-01	1.9E+03	1.9E-01	1.6E+03	3.0E+03	4.4E+01	1.6E+03
30	8.9E-01	7.8E+03	7.4E-01	6.5E+03	7.9E-01	6.9E+03	7.4E-01	6.5E+03	7.8E+03	6.5E+03	6.9E+03
31	5.4E-02	4.7E+02	5.6E-02	4.9E+02	5.8E-02	5.1E+02	5.1E-02	4.5E+02	5.1E+02	4.5E+02	4.8E+02
32	5.6E-02	4.9E+02	4.6E-02	4.0E+02	4.7E-02	4.1E+02	4.4E-02	3.8E+02	4.9E+02	3.8E+02	4.2E+02

Table F-1. 100 N/100 K Thermoluminescent Dosimeter Exposure Results, Calendar Year 1994.

100 N Site I.D.	1st Quarter		2nd Quarter		3rd Quarter		4th Quarter		Annual Results (mrem/yr)		
	mrem/hr	mrem/yr	mrem/hr	mrem/yr	mrem/hr	mrem/yr	mrem/hr	mrem/yr	Max	Min	Avg
33	3.1E-02	2.7E+02	2.7E-02	2.3E+02	2.9E-02	2.6E+02	2.6E-02	2.3E+02	2.7E+02	2.3E+02	2.5E+02
34	1.8E+00	1.6E+04	1.3E+00	1.1E+04	1.5E+00	1.3E+04	1.4E+00	1.3E+04	1.6E+04	1.1E+04	1.3E+04
35	1.8E+00	1.6E+04	1.2E+00	1.1E+04	1.5E+00	1.3E+04	1.5E+00	1.3E+04	1.6E+04	1.1E+04	1.3E+04
36	4.7E-02	4.1E+02	4.4E-02	3.9E+02	4.8E-02	4.2E+02	4.7E-02	4.1E+02	4.2E+02	3.9E+02	4.1E+02
37	5.3E-02	4.7E+02	4.7E-02	4.1E+02	4.4E-02	3.9E+02	4.5E-02	3.9E+02	4.7E+02	3.9E+02	4.1E+02
38	2.2E-02	1.9E+02	2.3E-02	2.0E+02	NA	NA	2.1E-02	1.8E+02	2.0E+02	0.0	1.4E+02
41	4.0E-02	3.5E+02	4.4E-02	3.9E+02	4.4E-02	3.9E+02	4.0E-02	3.5E+02	3.9E+02	3.5E+02	3.7E+02

100-K Site I.D.	1st Quarter		2nd Quarter		3rd Quarter		4th Quarter		Annual Results (mrem/yr)		
	mrem/hr	mrem/yr	mrem/hr	mrem/yr	mrem/hr	mrem/yr	mrem/hr	mrem/yr	Max	Min	Avg
1	1.0E-02	8.9E+01	1.2E-02	1.1E+02	1.0E-02	9.1E+01	9.8E-03	8.6E+01	1.1E+02	8.6E+01	9.3E+01
2	1.2E-02	1.0E+02	1.1E-02	9.9E+01	1.1E-02	9.3E+01	1.1E-02	9.3E+01	1.0E+02	9.3E+01	9.7E+01
3	1.4E-02	1.2E+02	1.1E-02	1.0E+02	1.1E-02	9.6E+01	9.9E-03	8.7E+01	1.2E+02	8.7E+01	1.0E+02
4	1.5E-02	1.3E+02	1.4E-02	1.2E+02	1.4E-02	1.2E+02	1.2E-02	1.0E+02	1.3E+02	1.0E+02	1.2E+02
5	1.3E-02	1.2E+02	1.2E-02	1.0E+02	1.2E-02	1.0E+02	1.1E-02	9.5E+01	1.2E+02	9.5E+01	1.0E+02
6	1.2E-02	1.1E+02	9.9E-03	8.7E+01	1.0E-02	9.1E+01	1.0E-02	8.9E+01	1.1E+02	8.7E+01	9.3E+01
7	3.9E-02	3.4E+02	3.6E-02	3.1E+02	4.5E-02	4.0E+02	4.1E-02	3.6E+02	4.0E+02	3.1E+02	3.5E+02
8	2.6E-01	2.3E+03	1.3E+00	1.1E+04	2.3E-01	2.0E+03	2.0E-01	1.8E+03	1.1E+04	1.8E+03	4.4E+03
9	1.7E+00	1.5E+04	1.9E-01	1.7E+03	1.0E+00	8.9E+03	3.7E-01	3.3E+03	1.5E+04	1.7E+03	7.1E+03
10	1.6E-02	1.4E+02	1.7E-02	1.5E+02	1.5E-02	1.3E+02	1.5E-02	1.3E+02	1.5E+02	1.3E+02	1.4E+02
11	1.4E-02	1.2E+02	1.4E-02	1.2E+02	1.5E-02	1.3E+02	1.4E-02	1.2E+02	1.3E+02	1.2E+02	1.2E+02

Table F-2. 200/600 Areas Thermoluminescent Dosimeter Exposure Results, Calendar Year 1994.

Site I.D.	1st Quarter		2nd Quarter		3rd Quarter		4th Quarter		Annual Results (mrem/yr)		
	mrem/hr	mrem/yr	mrem/hr	mrem/yr	mrem/hr	mrem/yr	mrem/hr	mrem/yr	Max	Min	Avg
202	1.2E-02	1.1E+02	1.3E-02	1.1E+02	1.1E-02	9.3E+01	1.1E-02	9.4E+01	1.1E+02	9.3E+01	1.0E+02
203	1.2E-02	1.1E+02	1.2E-02	1.1E+02	1.0E-02	9.2E+01	1.2E-02	1.1E+02	1.1E+02	9.2E+01	1.0E+02
204	1.9E-02	1.7E+02	2.1E-02	1.8E+02	1.8E-02	1.5E+02	1.9E-02	1.7E+02	1.8E+02	1.5E+02	1.7E+02
205	1.1E-02	9.5E+01	1.1E-02	9.5E+01	1.0E-02	9.0E+01	1.2E-02	1.0E+02	1.0E+02	9.0E+01	9.6E+01
206	1.9E-02	1.6E+02	1.6E-02	1.4E+02	1.5E-02	1.3E+02	1.5E-02	1.4E+02	1.6E+02	1.3E+02	1.4E+02
207	1.5E-02	1.3E+02	1.3E-02	1.2E+02	1.1E-02	9.9E+01	1.3E-02	1.2E+02	1.3E+02	9.9E+01	1.2E+02
208	2.1E-02	1.8E+02	2.1E-02	1.8E+02	1.9E-02	1.6E+02	2.1E-02	1.8E+02	1.8E+02	1.6E+02	1.8E+02
209	1.2E-02	1.0E+02	1.2E-02	1.0E+02	1.0E-02	9.0E+01	1.1E-02	9.9E+01	1.0E+02	9.0E+01	9.8E+01
210	1.3E-02	1.2E+02	1.4E-02	1.3E+02	1.2E-02	1.0E+02	1.5E-02	1.3E+02	1.3E+02	1.0E+02	1.2E+02
211	1.2E-02	1.0E+02	1.1E-02	1.0E+02	1.0E-02	8.7E+01	1.2E-02	1.0E+02	1.0E+02	8.7E+01	9.8E+01
212	1.5E-02	1.3E+02	1.6E-02	1.4E+02	1.5E-02	1.3E+02	1.6E-02	1.4E+02	1.4E+02	1.3E+02	1.4E+02
213	2.3E-02	2.0E+02	2.5E-02	2.2E+02	2.2E-02	1.9E+02	2.5E-02	2.2E+02	2.2E+02	1.9E+02	2.1E+02
214	1.3E-02	1.1E+02	1.0E-02	8.9E+01	8.7E-03	7.6E+01	1.1E-02	9.2E+01	1.1E+02	7.6E+01	9.2E+01
215	1.4E-02	1.2E+02	1.2E-02	1.1E+02	1.0E-02	8.9E+01	1.2E-02	1.0E+02	1.2E+02	8.9E+01	1.1E+02
216	1.4E-02	1.2E+02	1.2E-02	1.0E+02	1.2E-02	1.0E+02	1.4E-02	1.2E+02	1.2E+02	1.0E+02	1.1E+02
217	1.1E-02	9.8E+01	1.1E-02	9.5E+01	9.5E-03	8.4E+01	1.1E-02	9.3E+01	9.8E+01	8.4E+01	9.2E+01
218	1.1E-02	1.0E+02	1.1E-02	9.3E+01	9.2E-03	8.1E+01	1.1E-02	1.0E+02	1.0E+02	8.1E+01	9.3E+01
219	1.1E-02	9.7E+01	1.3E-02	1.1E+02	1.0E-02	9.1E+01	1.2E-02	1.1E+02	1.1E+02	9.1E+01	1.0E+02
220	1.3E-02	1.1E+02	1.4E-02	1.2E+02	9.8E-03	8.6E+01	1.2E-02	1.1E+02	1.2E+02	8.6E+01	1.1E+02
221	1.5E-02	1.3E+02	1.3E-02	1.2E+02	1.0E-02	8.8E+01	1.3E-02	1.1E+02	1.3E+02	8.8E+01	1.1E+02
222	1.8E-02	1.6E+02	1.4E-02	1.3E+02	1.3E-02	1.1E+02	1.5E-02	1.3E+02	1.6E+02	1.1E+02	1.3E+02
223	2.1E-02	1.8E+02	1.9E-02	1.6E+02	1.6E-02	1.4E+02	1.9E-02	1.7E+02	1.8E+02	1.4E+02	1.6E+02
224	1.1E-02	9.6E+01	1.2E-02	1.0E+02	9.0E-03	7.9E+01	1.1E-02	9.5E+01	1.0E+02	7.9E+01	9.4E+01

Table F-2. 200/600 Areas Thermoluminescent Dosimeter Exposure Results, Calendar Year 1994.

Site I.D.	1st Quarter		2nd Quarter		3rd Quarter		4th Quarter		Annual Results (mrem/yr)		
	mrem/hr	mrem/yr	mrem/hr	mrem/yr	mrem/hr	mrem/yr	mrem/hr	mrem/yr	Max	Min	Avg
226	4.2E-03	3.7E+01	1.3E-02	1.1E+02	9.2E-03	8.1E+01	1.1E-02	9.4E+01	1.1E+02	3.7E+01	8.0E+01
227	1.1E-02	1.0E+02	1.2E-02	1.0E+02	9.8E-03	8.6E+01	1.1E-02	9.4E+01	1.0E+02	8.6E+01	9.5E+01
228	1.2E-02	1.0E+02	1.1E-02	9.4E+01	9.6E-03	8.4E+01	1.1E-02	9.2E+01	1.0E+02	8.4E+01	9.3E+01
229	1.3E-02	1.1E+02	1.2E-02	1.1E+02	1.1E-02	9.6E+01	1.2E-02	1.0E+02	1.1E+02	9.6E+01	1.0E+02
230	1.4E-02	1.2E+02	1.5E-02	1.4E+02	1.4E-02	1.2E+02	1.5E-02	1.3E+02	1.4E+02	1.2E+02	1.3E+02
231	1.7E-02	1.5E+02	1.3E-02	1.2E+02	9.3E-03	8.2E+01	1.1E-02	9.9E+01	1.5E+02	8.2E+01	1.1E+02
232	1.4E-02	1.3E+02	1.8E-02	1.6E+02	1.6E-02	1.4E+02	1.3E-02	1.1E+02	1.6E+02	1.1E+02	1.3E+02
233	1.8E-02	1.5E+02	1.3E-02	1.1E+02	1.0E-02	8.8E+01	1.1E-02	9.7E+01	1.5E+02	8.8E+01	1.1E+02
234	1.2E-02	1.1E+02	1.5E-02	1.3E+02	1.2E-02	1.1E+02	1.6E-02	1.4E+02	1.4E+02	1.1E+02	1.2E+02
235	1.6E-02	1.4E+02	1.3E-02	1.2E+02	9.7E-03	8.5E+01	1.1E-02	9.4E+01	1.4E+02	8.5E+01	1.1E+02
236	1.3E-02	1.1E+02	1.3E-02	1.1E+02	1.1E-02	9.7E+01	1.2E-02	1.1E+02	1.1E+02	9.7E+01	1.1E+02
237	1.4E-02	1.3E+02	1.1E-02	9.7E+01	8.3E-03	7.3E+01	1.1E-02	9.8E+01	1.3E+02	7.3E+01	9.8E+01
238	1.4E-02	1.2E+02	1.4E-02	1.2E+02	1.1E-02	9.5E+01	1.2E-02	1.1E+02	1.2E+02	9.5E+01	1.1E+02
239	1.4E-02	1.2E+02	1.4E-02	1.2E+02	1.1E-02	9.5E+01	1.1E-02	9.7E+01	1.2E+02	9.5E+01	1.1E+02
240	1.5E-02	1.3E+02	1.1E-02	1.0E+02	1.0E-02	8.8E+01	1.0E-02	9.1E+01	1.3E+02	8.8E+01	1.0E+02
241	1.2E-02	1.1E+02	1.4E-02	1.3E+02	1.1E-02	9.8E+01	1.3E-02	1.1E+02	1.3E+02	9.8E+01	1.1E+02
242	1.5E-02	1.3E+02	1.3E-02	1.2E+02	1.2E-02	1.0E+02	1.1E-02	9.8E+01	1.3E+02	9.8E+01	1.1E+02
243	1.4E-02	1.2E+02	1.2E-02	1.0E+02	9.5E-03	8.4E+01	1.1E-02	9.5E+01	1.2E+02	8.4E+01	1.0E+02
244	1.3E-02	1.2E+02	1.6E-02	1.4E+02	1.1E-02	1.0E+02	1.3E-02	1.2E+02	1.4E+02	1.0E+02	1.2E+02
245	1.4E-02	1.2E+02	1.3E-02	1.1E+02	9.1E-03	8.0E+01	1.0E-02	8.9E+01	1.2E+02	8.0E+01	1.0E+02
246	1.2E-02	1.1E+02	1.2E-02	1.1E+02	9.0E-03	7.9E+01	1.1E-02	9.2E+01	1.1E+02	7.9E+01	9.6E+01
247	1.4E-02	1.2E+02	1.3E-02	1.1E+02	9.4E-03	8.2E+01	9.8E-03	8.5E+01	1.2E+02	8.2E+01	1.0E+02
249	9.5E-03	8.3E+01	1.8E-02	1.6E+02	1.3E-02	1.2E+02	6.0E-03	5.3E+01	1.6E+02	5.3E+01	1.0E+02

Table F-2. 200/600 Areas Thermoluminescent Dosimeter Exposure Results, Calendar Year 1994.

Site I.D.	1st Quarter		2nd Quarter		3rd Quarter		4th Quarter		Annual Results (mrem/yr)		
	mrem/hr	mrem/yr	mrem/hr	mrem/yr	mrem/hr	mrem/yr	mrem/hr	mrem/yr	Max	Min	Avg
250	1.6E-02	1.4E+02	2.0E-02	1.8E+02	1.5E-02	1.3E+02	1.8E-02	1.6E+02	1.8E+02	1.3E+02	1.5E+02
251	1.5E-02	1.3E+02	1.7E-02	1.5E+02	1.6E-02	1.4E+02	2.0E-02	1.8E+02	1.8E+02	1.3E+02	1.5E+02
252	1.7E-02	1.5E+02	1.7E-02	1.5E+02	1.1E-02	9.6E+01	1.6E-02	1.4E+02	1.5E+02	9.6E+01	1.3E+02
253	1.3E-02	1.2E+02	1.1E-02	9.7E+01	1.0E-02	9.1E+01	1.2E-02	1.1E+02	1.2E+02	9.1E+01	1.0E+02
254	1.2E-02	1.1E+02	2.1E-02	1.8E+02	1.8E-02	1.6E+02	3.2E-02	2.8E+02	2.8E+02	1.1E+02	1.8E+02
255	2.0E-02	1.8E+02	1.8E-02	1.6E+02	1.3E-02	1.1E+02	1.3E-02	1.2E+02	1.8E+02	1.1E+02	1.4E+02
256	7.1E-02	6.2E+02	6.0E-02	5.2E+02	4.7E-02	4.1E+02	5.5E-02	4.8E+02	6.2E+02	4.1E+02	5.1E+02
258	9.4E-02	8.2E+02	8.9E-02	7.8E+02	9.7E-02	8.5E+02	7.3E-02	6.4E+02	8.5E+02	6.4E+02	7.7E+02
259	1.3E-02	1.1E+02	1.8E-02	1.6E+02	1.3E-02	1.1E+02	1.5E-02	1.3E+02	1.6E+02	1.1E+02	1.3E+02
260	1.4E-02	1.3E+02	1.3E-02	1.2E+02	8.7E-03	7.6E+01	1.1E-02	9.3E+01	1.3E+02	7.6E+01	1.0E+02
261	1.1E-02	9.3E+01	1.4E-02	1.2E+02	1.2E-02	1.0E+02	1.3E-02	1.2E+02	1.2E+02	9.3E+01	1.1E+02
262	1.2E-02	1.1E+02	1.4E-02	1.2E+02	9.2E-03	8.1E+01	1.1E-02	9.5E+01	1.2E+02	8.1E+01	1.0E+02
263	1.0E-02	9.0E+01	1.0E-02	9.1E+01	8.0E-03	7.0E+01	9.3E-03	8.2E+01	9.1E+01	7.0E+01	8.3E+01
264	1.3E-02	1.1E+02	1.1E-02	9.5E+01	8.7E-03	7.6E+01	1.1E-02	1.0E+02	1.1E+02	7.6E+01	9.6E+01

Table F-3. 300/400 Areas Thermoluminescent Dosimeter Exposure Results, Calendar Year 1994.

300 Area Site I.D.	1st Quarter		2nd Quarter		3rd Quarter		4th Quarter		Annual Results (mrem/yr)		
	mrem/hr	mrem/yr	mrem/hr	mrem/yr	mrem/hr	mrem/yr	mrem/hr	mrem/yr	Max	Min	Avg
1	1.1E-02	9.5E+01	1.0E-02	9.0E+01	1.0E-02	9.1E+01	1.0E-02	8.9E+01	9.5E+01	8.9E+01	9.1E+01
2	1.0E-02	9.2E+01	1.1E-02	9.4E+01	1.1E-02	9.9E+01	1.1E-02	9.2E+01	9.9E+01	9.2E+01	9.4E+01
3	1.2E-02	1.1E+02	1.1E-02	9.5E+01	1.2E-02	1.0E+02	1.1E-02	9.8E+01	1.1E+02	9.5E+01	1.0E+02
4	2.0E-02	1.8E+02	2.0E-02	1.7E+02	1.9E-02	1.6E+02	2.2E-02	1.9E+02	1.9E+02	1.6E+02	1.8E+02
5	1.1E-02	9.7E+01	1.1E-02	9.3E+01	9.9E-03	8.7E+01	1.0E-02	8.8E+01	9.7E+01	8.7E+01	9.1E+01
6	1.5E-02	1.3E+02	1.2E-02	1.1E+02	1.2E-02	1.0E+02	1.2E-02	1.1E+02	1.3E+02	1.0E+02	1.1E+02
7	6.5E-02	5.7E+02	7.5E-02	6.5E+02	5.4E-02	4.8E+02	5.3E-02	4.6E+02	6.5E+02	4.6E+02	5.4E+02
8	1.6E-02	1.4E+02	1.7E-02	1.5E+02	1.5E-02	1.4E+02	1.6E-02	1.4E+02	1.5E+02	1.4E+02	1.4E+02
400 Area Site I.D.	**1st Quarter**		**2nd Quarter**		**3rd Quarter**		**4th Quarter**		**Annual Results (mrem/yr)**		
	mrem/hr	mrem/yr	mrem/hr	mrem/yr	mrem/hr	mrem/yr	mrem/hr	mrem/yr	Max	Min	Avg
1	1.1E-02	9.5E+01	1.1E-02	9.5E+01	9.9E-03	8.7E+01	1.0E-02	9.0E+01	9.5E+01	8.7E+01	9.2E+01
2	2.5E-02	2.2E+02	2.4E-02	2.1E+02	2.3E-02	2.0E+02	2.2E-02	2.0E+02	2.2E+02	2.0E+02	2.1E+02
3	1.4E-02	1.2E+02	1.3E-02	1.2E+02	1.3E-02	1.1E+02	1.3E-02	1.2E+02	1.2E+02	1.1E+02	1.2E+02
4	1.1E-02	1.0E+02	1.0E-02	8.9E+01	9.6E-03	8.4E+01	1.0E-02	8.8E+01	1.0E+02	8.4E+01	9.0E+01
5	1.2E-02	1.1E+02	9.9E-03	8.7E+01	9.4E-03	8.2E+01	1.1E-02	9.3E+01	1.1E+02	8.2E+01	9.2E+01
6	1.2E-02	1.1E+02	1.1E-02	9.5E+01	9.6E-03	8.4E+01	1.1E-02	9.3E+01	1.1E+02	8.4E+01	9.5E+01
7	1.1E-02	9.8E+01	1.2E-02	1.0E+02	1.1E-02	9.3E+01	1.2E-02	1.1E+02	1.1E+02	9.3E+01	1.0E+02
300 TEDF Site I.D.	**1st Quarter**		**2nd Quarter**		**3rd Quarter**		**4th Quarter**		**Annual Results (mrem/yr)**		
	mrem/hr	mrem/yr	mrem/hr	mrem/yr	mrem/hr	mrem/yr	mrem/hr	mrem/yr	Max	Min	Avg
301	1.2E-02	1.0E+02	1.2E-02	1.1E+02	1.2E-02	1.1E+02	1.1E-02	9.9E+01	1.1E+02	9.9E+01	1.0E+02
302	1.4E-02	1.2E+02	1.3E-02	1.2E+02	1.3E-02	1.1E+02	1.2E-02	1.0E+02	1.2E+02	1.0E+02	1.1E+02
303	1.6E-02	1.4E+02	1.3E-02	1.1E+02	1.3E-02	1.1E+02	1.1E-02	1.0E+02	1.4E+02	1.0E+02	1.2E+02
304	1.6E-02	1.4E+02	1.3E-02	1.1E+02	1.3E-02	1.1E+02	1.1E-02	9.5E+01	1.4E+02	9.5E+01	1.1E+02
305	1.6E-02	1.4E+02	1.2E-02	1.1E+02	1.2E-02	1.1E+02	1.1E-02	9.6E+01	1.4E+02	9.6E+01	1.1E+02
306	1.7E-02	1.5E+02	1.2E-02	1.0E+02	1.2E-02	1.1E+02	1.1E-02	1.0E+02	1.5E+02	1.0E+02	1.1E+02

APPENDIX G

SURFACE WATER DISPOSAL UNIT (POND AND DITCH) MONITORING FIGURES AND TABLES

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Figure G-1. N Springs Sample Sites.

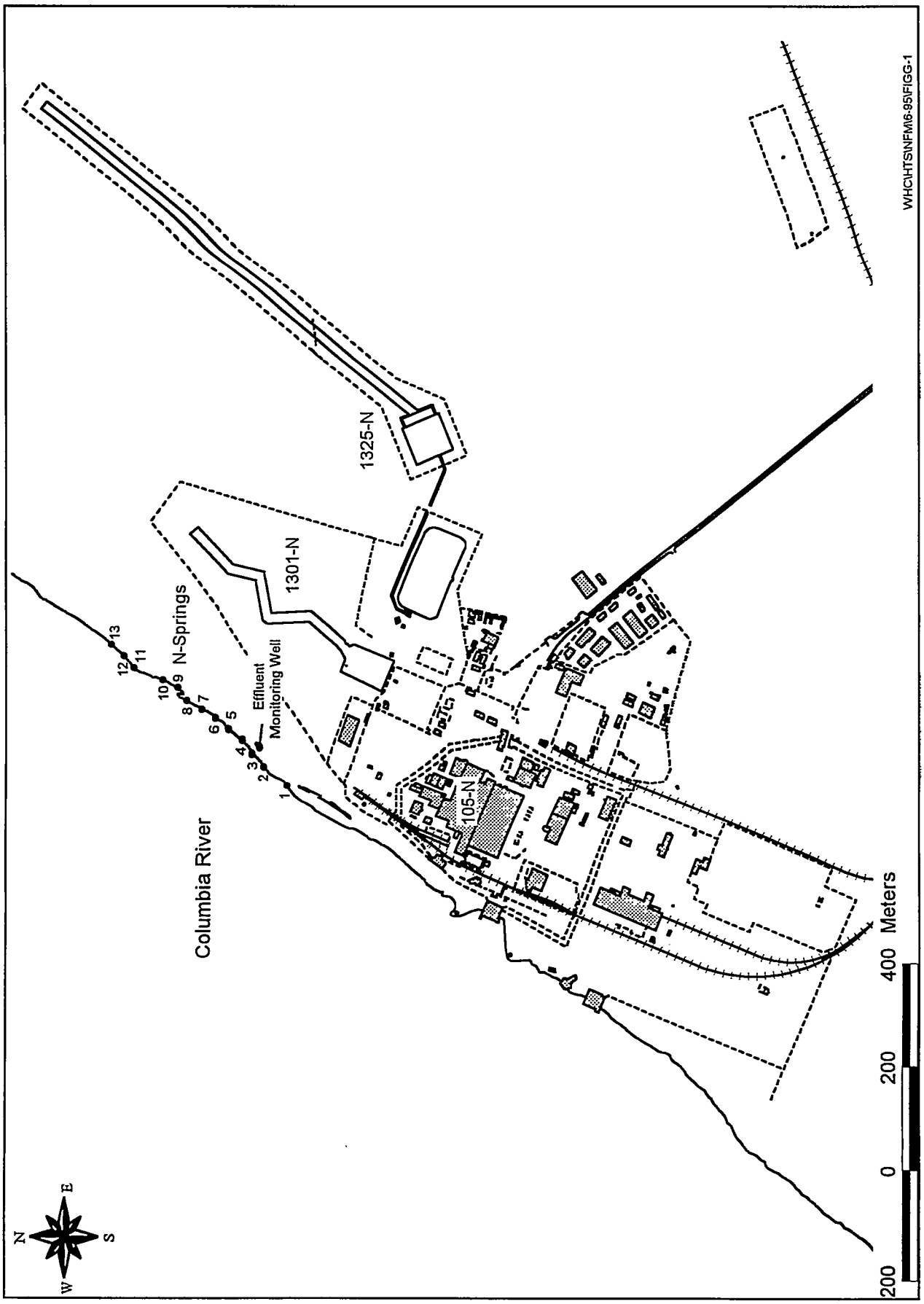

Figure G-2. 200 East and West Areas Pond and Ditch Sample Sites.

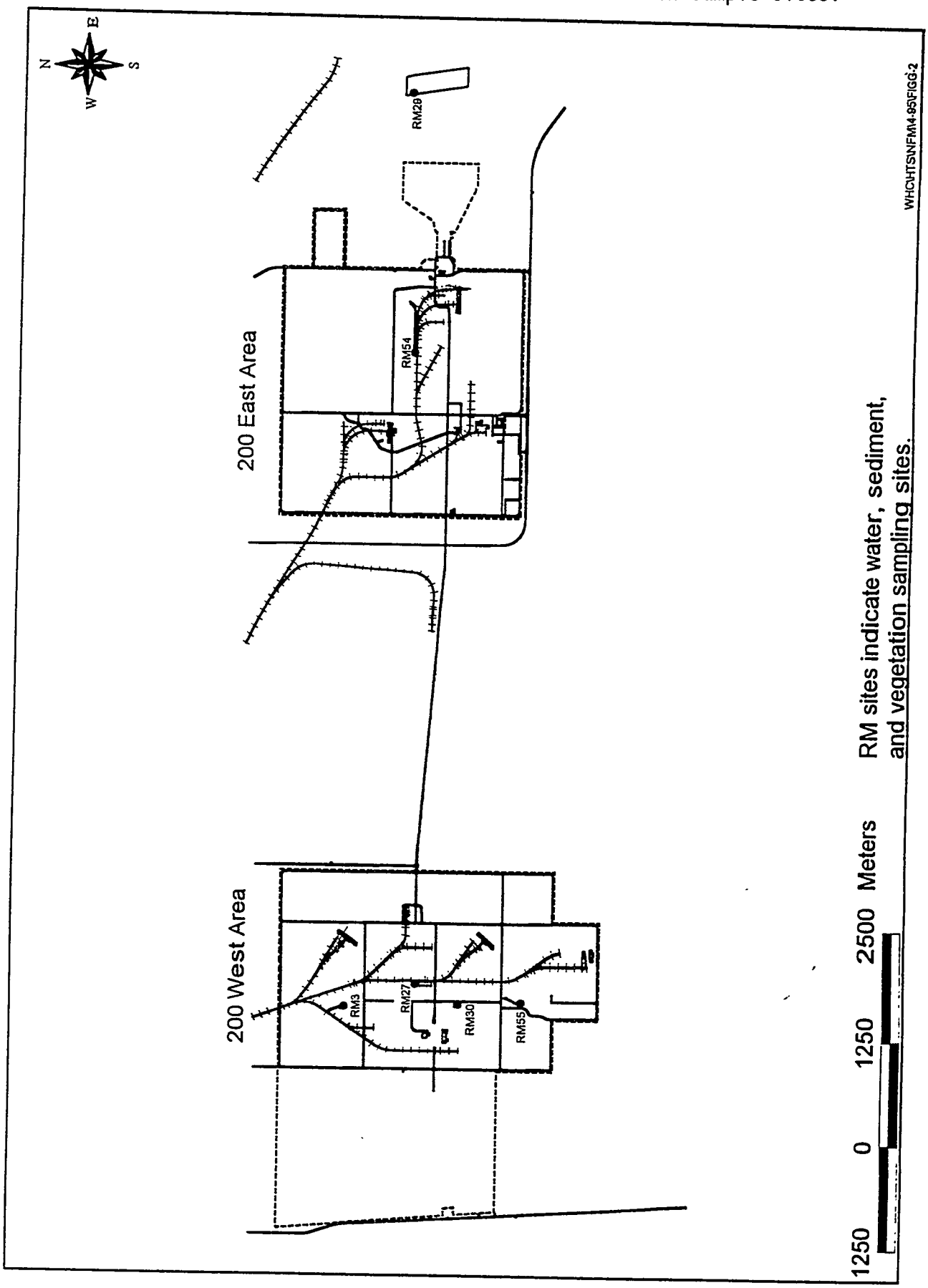

Table G-1. Radiological Results for Liquid Samples from Surface Water Disposal Units 200/600 Areas, 1994 (pCi/L).

Sample Locations	# of Samples		Total Alpha	Total Beta	137Cs	90Sr	3H[a]
216-T-4 Ditch	12	Mean	5.1E-01	4.0E+01	6.5E+01	5.9E+00	<4.5E+02
		Max	3.3E+00	2.3E+02	1.9E+02	9.6E+00	<4.5E+02
		Min	9.8E-02	2.5E+00	2.0E+01	2.6E+00	<4.5E+02
216-B-3-3 Ditch	2	Mean	3.3E-01	2.6E+00	2.5E+01	7.2E+00	<4.5E+02
		Max	5.1E-01	3.8E+00	4.0E+01	8.9E+00	<4.5E+02
		Min	1.4E-01	1.3E+00	1.0E+01	5.5E+00	<4.5E+02
216-B-3 Pond (East)	2	Mean	3.5E-01	4.4E+00	5.5E+01	6.1E+00	<4.5E+02
		Max	6.0E-01	5.9E+00	5.9E+01	6.5E+00	<4.5E+02
		Min	1.0E-01	2.8E+00	5.2E+01	5.8E+00	<4.5E+02
216-B-3 Pond (South)	2	Mean	5.1E-01	2.4E+00	5.6E+01	8.5E+00	<4.5E+02
		Max	6.8E-01	3.0E+00	5.7E+01	8.5E+00	<4.5E+02
		Min	3.4E-01	1.8E+00	5.6E+01	8.5E+00	<4.5E+02
216-B-3A Overflow Pond	3	Mean	4.9E-01	3.7E+00	3.1E+01	5.9E+00	1.3E+03
		Max	5.8E-01	6.0E+00	4.4E+01	8.5E+00	1.7E+03
		Min	3.1E-01	-1.6E-01	1.2E+01	1.1E+00	<4.5E+02
200 West Powerhouse Pond	12	Mean	3.9E-01	2.1E+00	5.4E+01	4.2E+00	7.7E+03
		Max	1.4E+00	3.8E+00	6.0E+01	7.2E+00	3.7E+04
		Min	4.8E-02	-2.4E-02	2.0E+01	2.6E+00	<4.5E+02
216-B-3C Overflow Pond	12	Mean	3.2E-01	2.6E+00	5.8E+01	4.3E+00	3.1E+03
		Max	5.3E-01	5.1E+00	6.1E+01	9.4E+00	1.1E+04
		Min	1.6E-01	-5.3E-01	5.5E+01	1.1E+00	<4.5E+02
216-Z-21 Basin	12	Mean	1.7E-01	2.0E+00	5.1E+01	5.0E+00	1.3E+03
		Max	8.8E-01	4.6E+00	6.0E+01	8.3E+00	2.7E+03
		Min	-2.7E-02	2.5E-01	1.5E+01	2.5E+00	<4.5E+02
200 East Powerhouse Ditch	12	Mean	2.6E-01	2.5E+00	5.6E+01	4.9E+00	<4.5E+02
		Max	6.1E-01	1.0E+01	6.2E+01	9.3E+00	<4.5E+02
		Min	4.3E-02	-2.0E-01	3.3E+01	2.8E+00	<4.5E+02
216-U-14 Ditch	9	Mean	5.1E-01	2.1E+00	4.9E+01	6.2E+00	1.8E+04
		Max	8.7E-01	3.9E+00	6.3E+01	1.1E+01	1.1E+05
		Min	3.2E-01	-3.9E-02	1.2E+01	2.8E+00	<4.5E+02
216-T-1 Ditch	4	Mean	2.0E-01	1.4E+01	5.6E+01	1.4E+01	<4.5E+02
		Max	5.1E-01	4.0E+01	8.1E+01	4.0E+01	<4.5E+02
		Min	3.7E-02	4.8E+00	3.6E+01	4.8E+00	<4.5E+02
216-B-3A Inlet	4	Mean	3.1E-01	2.0E+00	4.2E+01	8.9E+00	<4.5E+02
		Max	3.9E-01	4.1E+00	7.7E+01	1.2E+01	<4.5E+02
		Min	1.9E-01	1.5E-02	1.7E+01	6.5E+00	<4.5E+02
DCG			3.0E+01[b]	1.0E+03[c]	3.0E+03	1.0E+03	2.0E+04

Note: Negative values indicate results at or near background levels of radioactivity.

[a] ^{3}H analysis performed quarterly

[b] Using ^{239}Pu for comparison

[c] Using ^{90}Sr for comparison

Table G-2. Nonradiological Results for Liquid Samples from Surface Water Disposal Units.

Location/Sample	pH				Nitrate (NO_3) mg/L			
	# of samples	Mean	Max	Min	# of samples	Mean	Max	Min
216-T-4 Ditch	37	7.0E+00	8.0E+00	6.1E+00	4	<1.4	<1.4	<1.4
216-B-3 Ditch, Headend	11	7.4E+00	8.1E+00	6.7E+00	1	<1.4	<1.4	<1.4
216-B-3 Pond Outflow	11	7.7E+00	8.3E+00	7.1E+00	1	<1.4	<1.4	<1.4
216-B-3 Pond S.	10	7.7E+00	8.3E+00	6.8E+00	1	<1.4	<1.4	<1.4
216-B-3B Outflow	15	7.6E+00	8.3E+00	6.7E+00	3	<1.4	<1.4	<1.4
200W Powerhouse Pond	50	8.7E+00	9.8E+00	7.1E+00	5	<1.4	<1.4	<1.4
216-B-3C Pond	50	8.2E+00	8.8E+00	7.2E+00	5	<1.4	<1.4	<1.4
216-Z-21 Basin	51	8.0E+00	9.3E+00	6.9E+00	5	<1.4	<1.4	<1.4
200E Powerhouse Ditch	51	8.3E+00	1.0E+01	7.2E+00	5	<1.4	<1.4	<1.4
216-U-14 Ditch	35	8.0E+00	8.9E+00	7.1E+00	4	<1.4	<1.4	<1.4
216-T-1 Ditch	14	8.0E+00	9.1E+00	6.8E+00	3	<1.4	<1.4	<1.4
216-B-3A Inlet	8	7.9E+00	8.2E+00	7.5E+00	2	<1.4	<1.4	<1.4

Table G-3. Radiological Results for Aquatic Vegetation from Surface Water Disposal Units, 200/600 Areas (pCi/g dry weight), 1994.

Sample Location	137 Cs	90 Sr	239, 240 Pu	Total U (g/g)
216-T-4 Ditch	2.1E+00	1.5E+00	1.6E+00	1.0E-08
200W Powerhouse Pond	5.8E+00	1.1E+00	2.5E+00	1.0E-08
216-B-3C Overflow Pond	4.3E-07	1.2E+00	3.5E+00	1.3E-08
216-Z-21 Basin	3.9E-01	1.2E+00	2.1E+00	4.5E-08
200E Powerhouse Ditch	1.8E-08	1.0E+00	1.7E+00	2.8E-08
216-U-14 Ditch	2.4E+00	9.2E-01	1.6E+00	8.1E-09

Table G-4. Radiological Results for Sediment (Surface) Samples from Surface Water Disposal Units, 200/600 Areas (pCi/g dry weight), 1994.

Sample Location	^{137}Cs	^{90}Sr	$^{239,240}Pu$	$^{Total}U$
216-T-4 Ditch	1.5E-04	5.1E-01	3.9E-01	4.5E-07
200W Powerhouse Pond	1.7E+00	5.6E-01	4.9E-01	3.3E-07
216-B-3C Overflow Pond	7.1E-06	2.7E+00	4.9E-01	2.5E-07
216-Z-21 Basin	8.8E-08	7.6E-01	4.2E-01	3.6E-08
200E Powerhouse Ditch	4.5E-07	6.3E-01	5.9E-01	7.9E-07
216-U-14 Ditch	1.9E-04	4.5E+00	2.0E+00	1.5E-09

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APPENDIX H

RADIOLOGICAL SURVEYS FIGURES AND TABLES

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Figure H-1. Radiological Survey Locations in the 100 B and C Area.

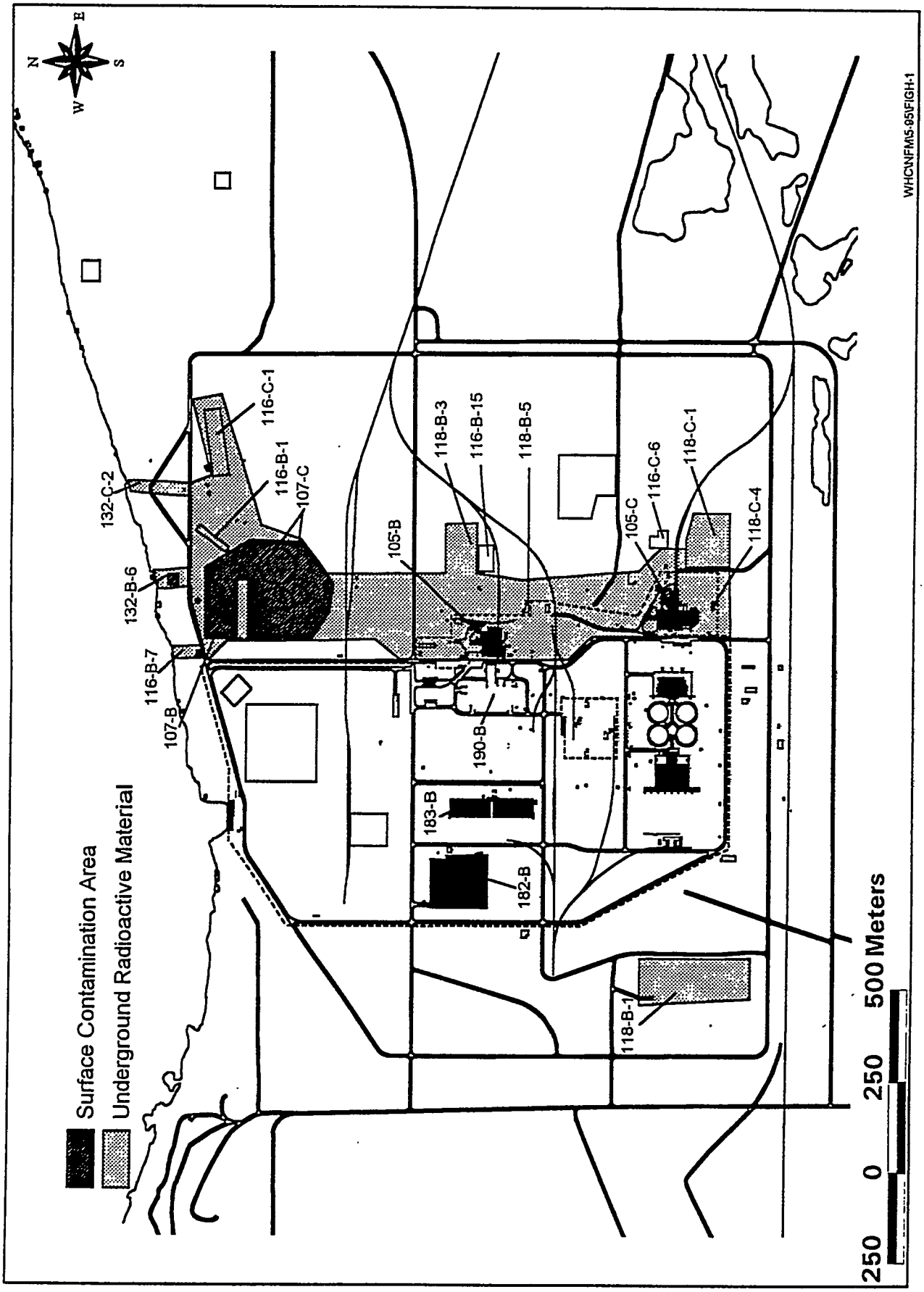

Figure H-2. Radiological Survey Locations in the 100 D and DR Area.

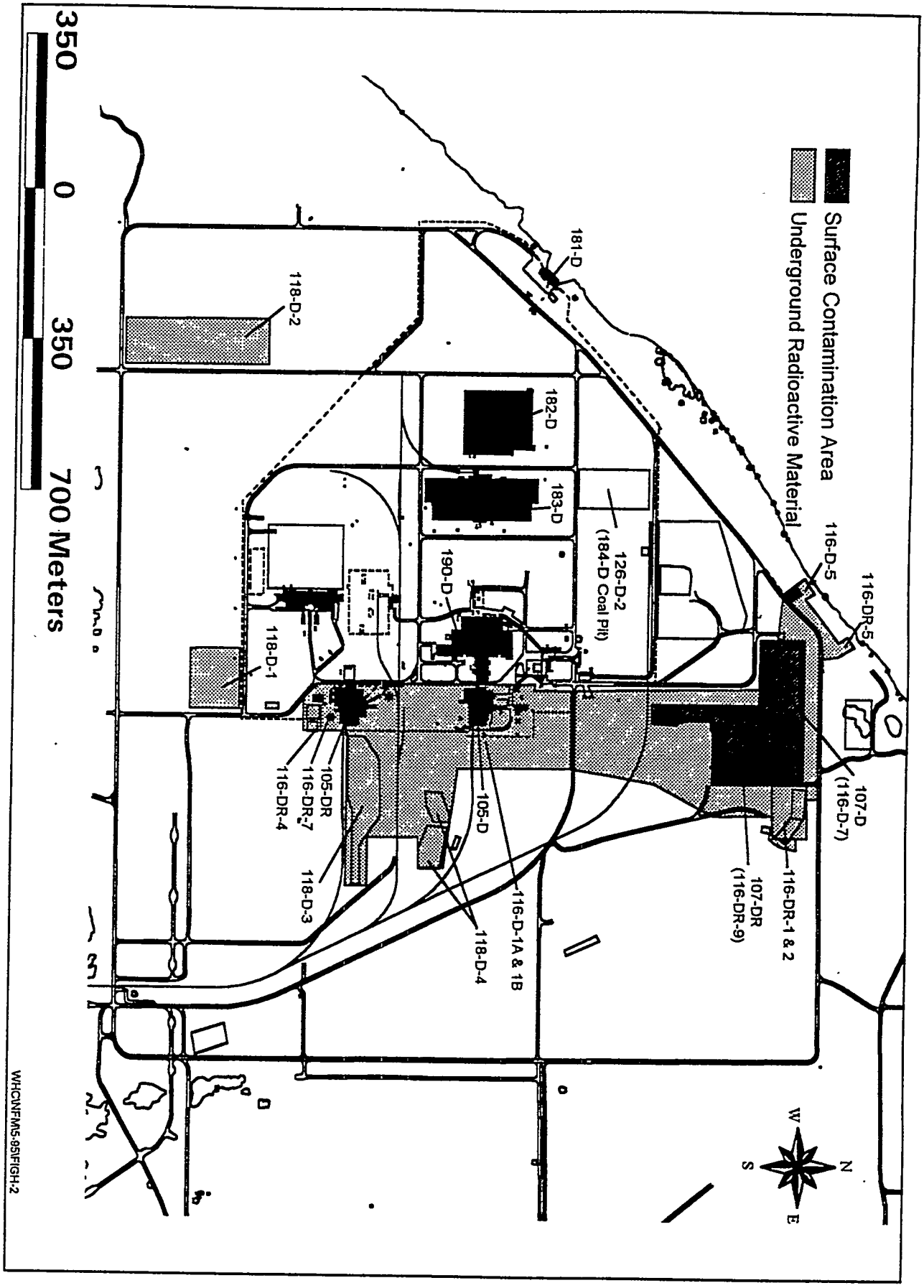

Figure H-3. Radiological Survey Locations in the 100 F Area.

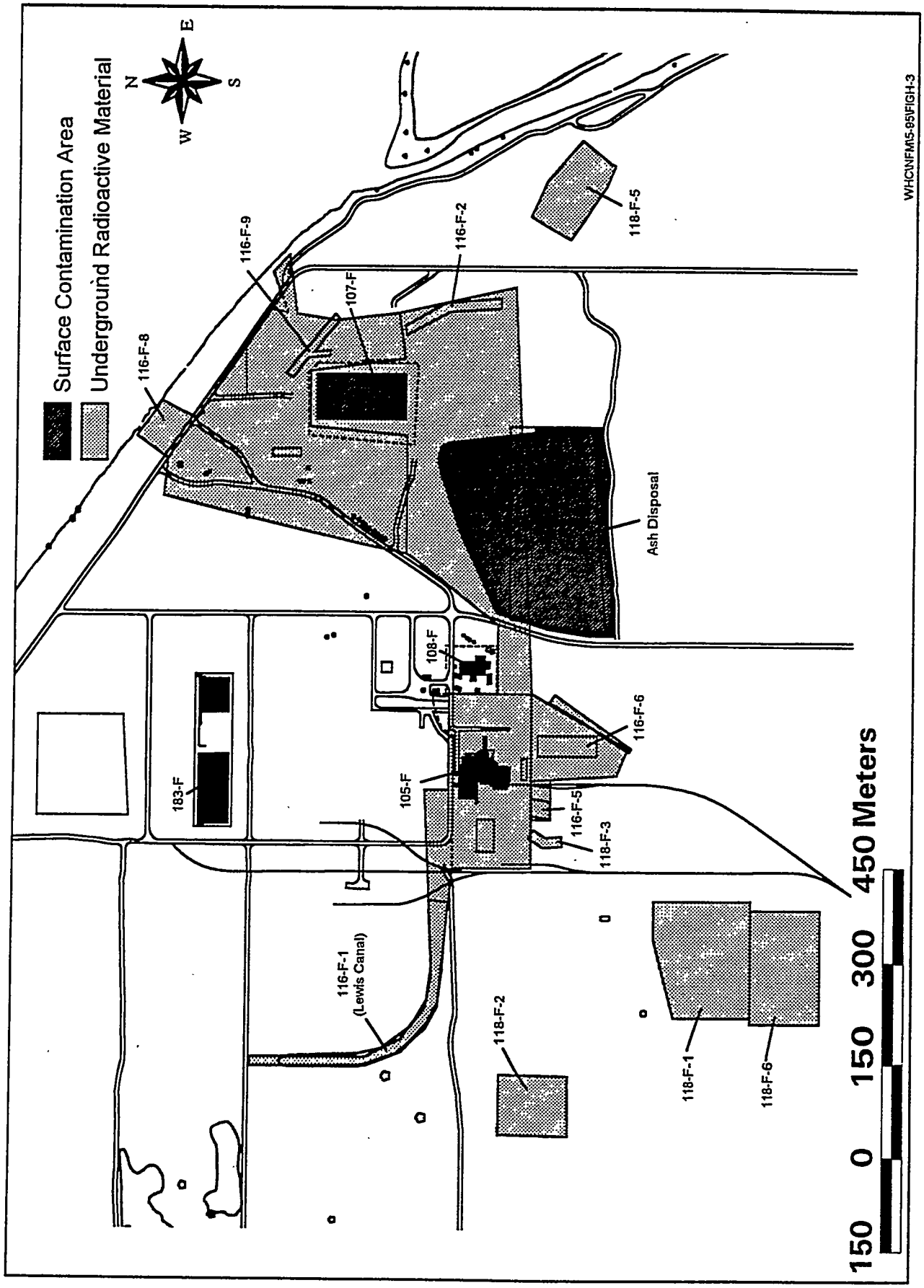

Figure H-4. Radiological Survey Locations in the 100 H Area.

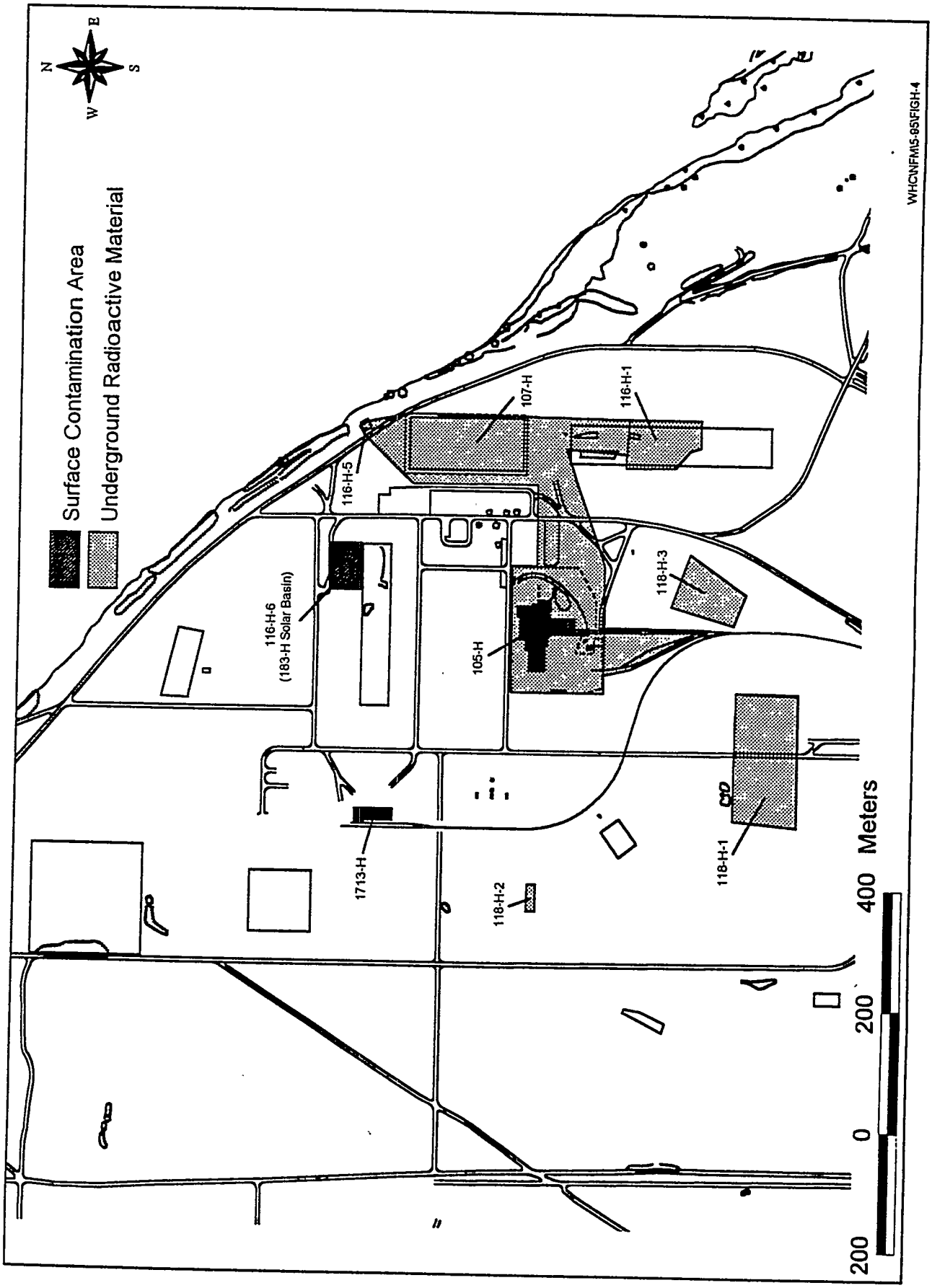

Figure H-5. Radiological Survey Locations in the 100 K Area.

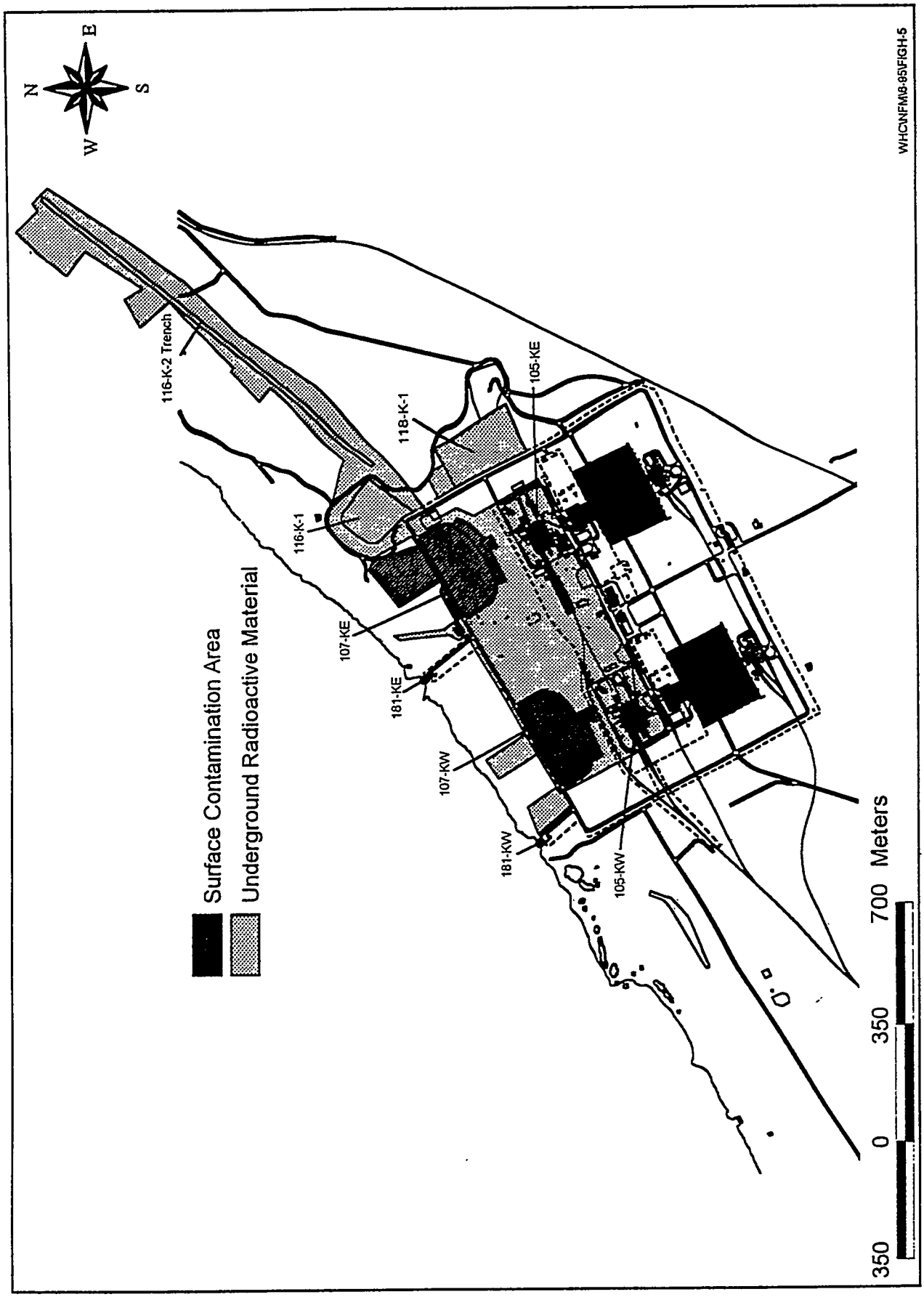

Figure H-6. Radiological Survey Locations in the 100 N Reactor Area.

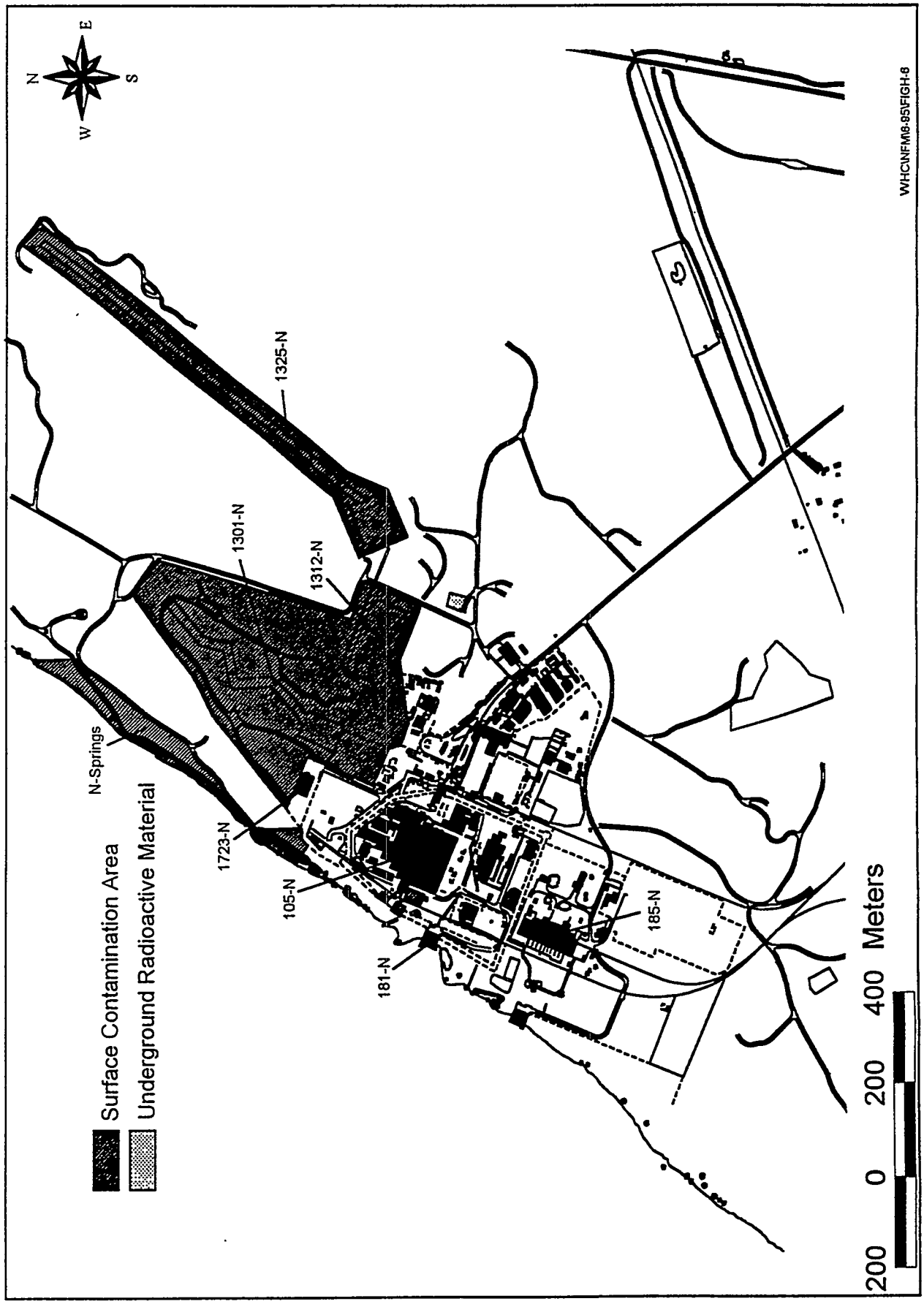

Figure H-7. Radiological Survey Locations in the 200 East Area.

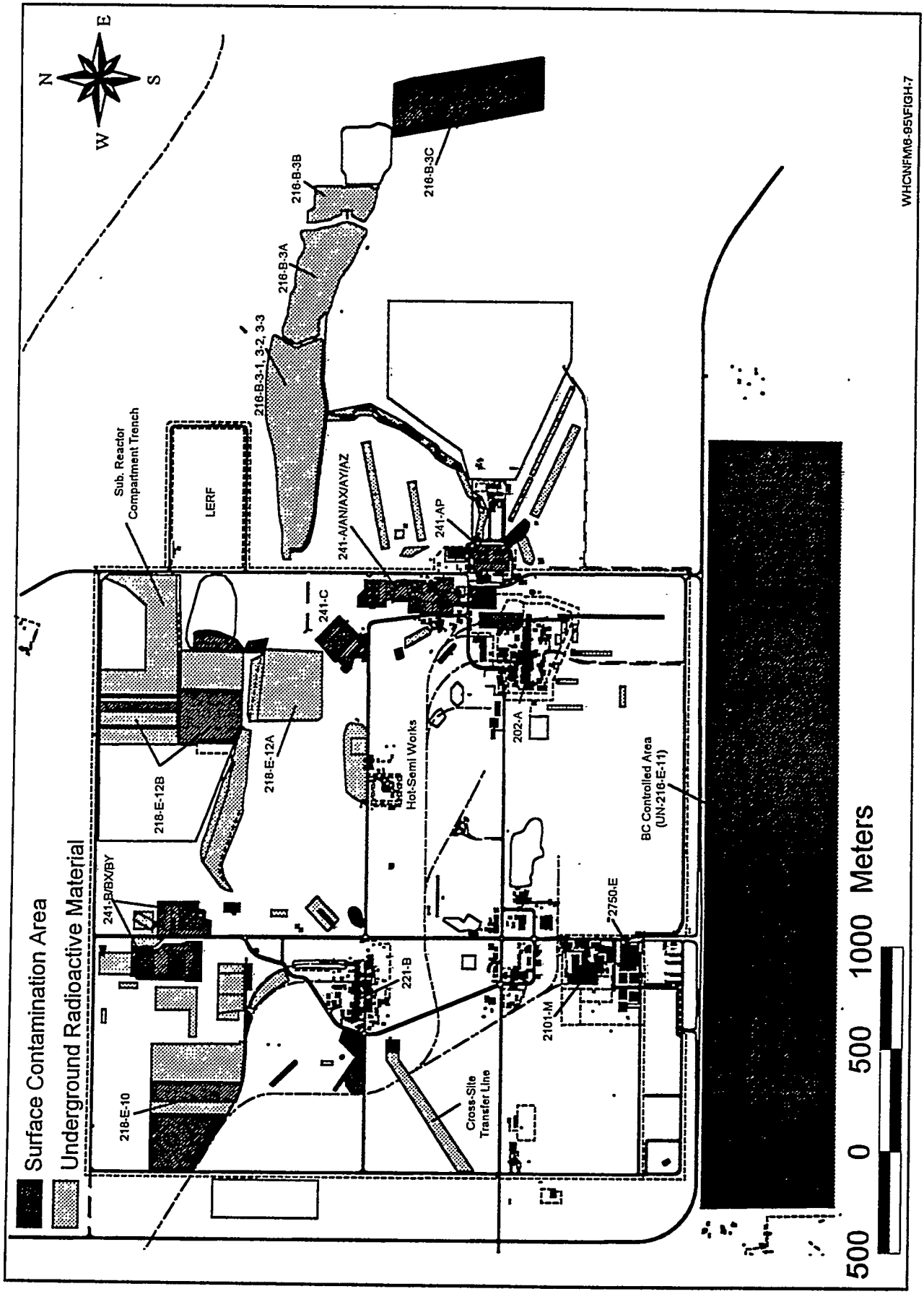

Figure H-8. Radiological Survey Locations in the 200 West Area.

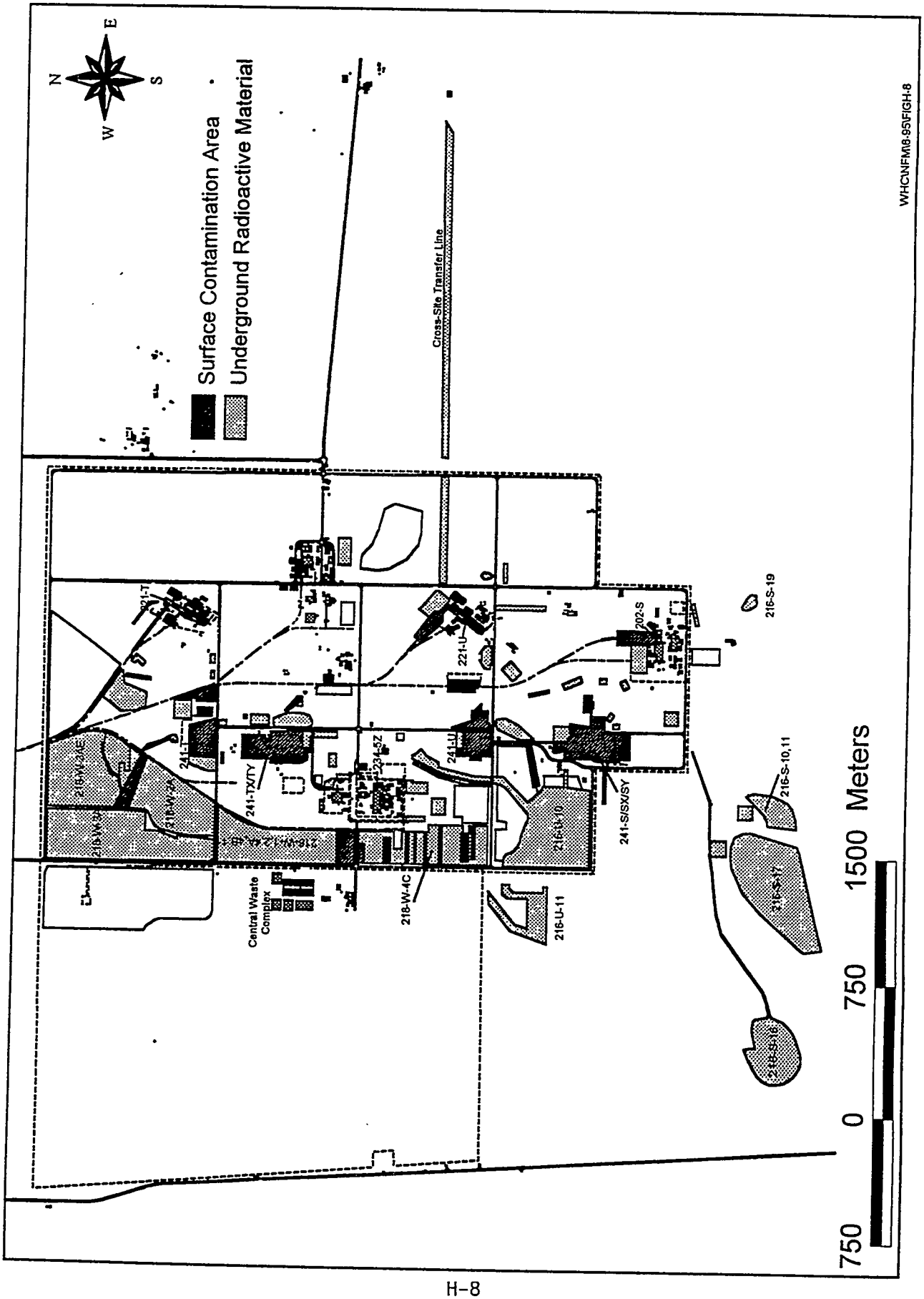

Figure H-9. Radiological Survey Locations in the 600 Area.

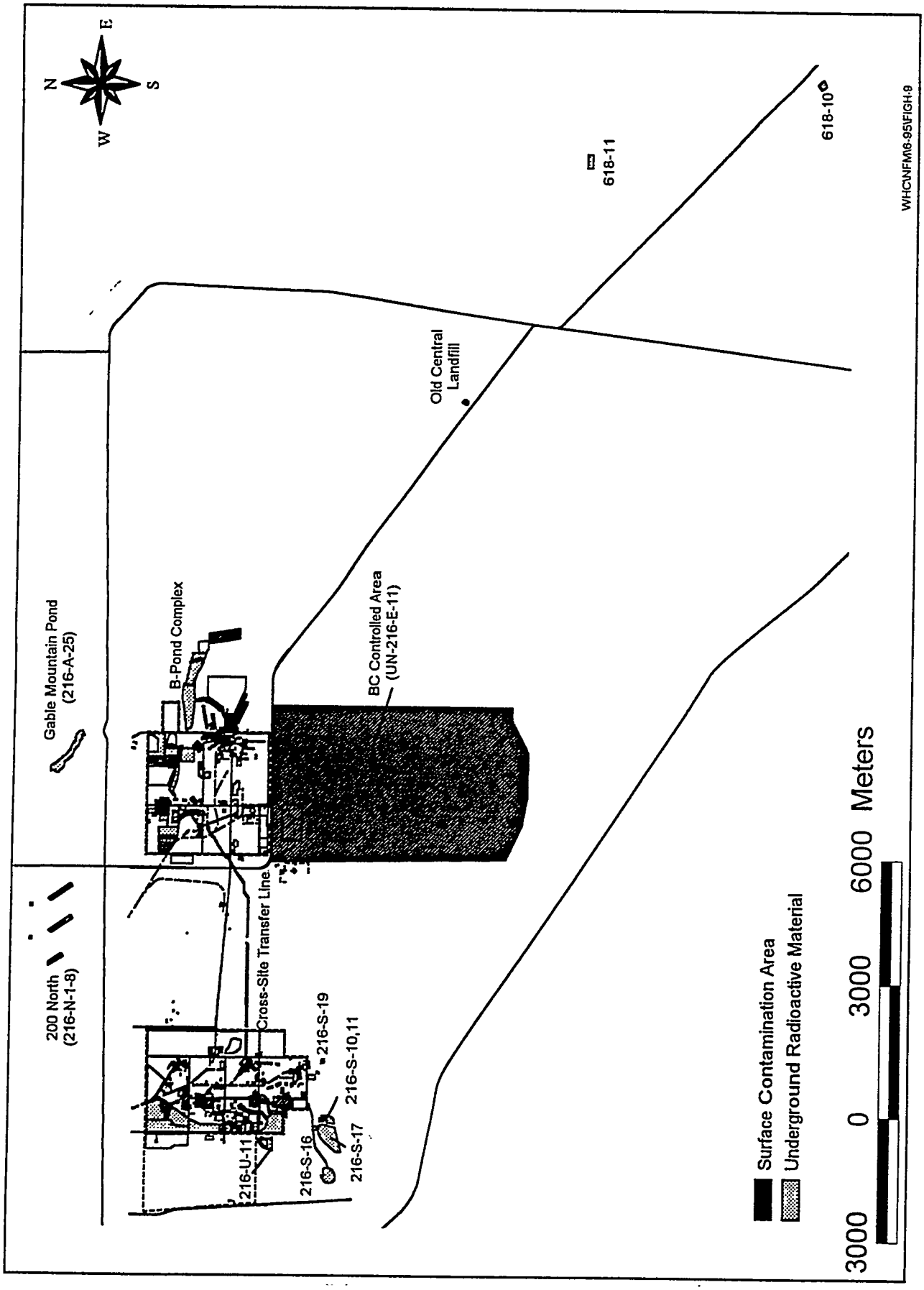

Figure H-10. Radiological Survey Locations in the 300 Area.

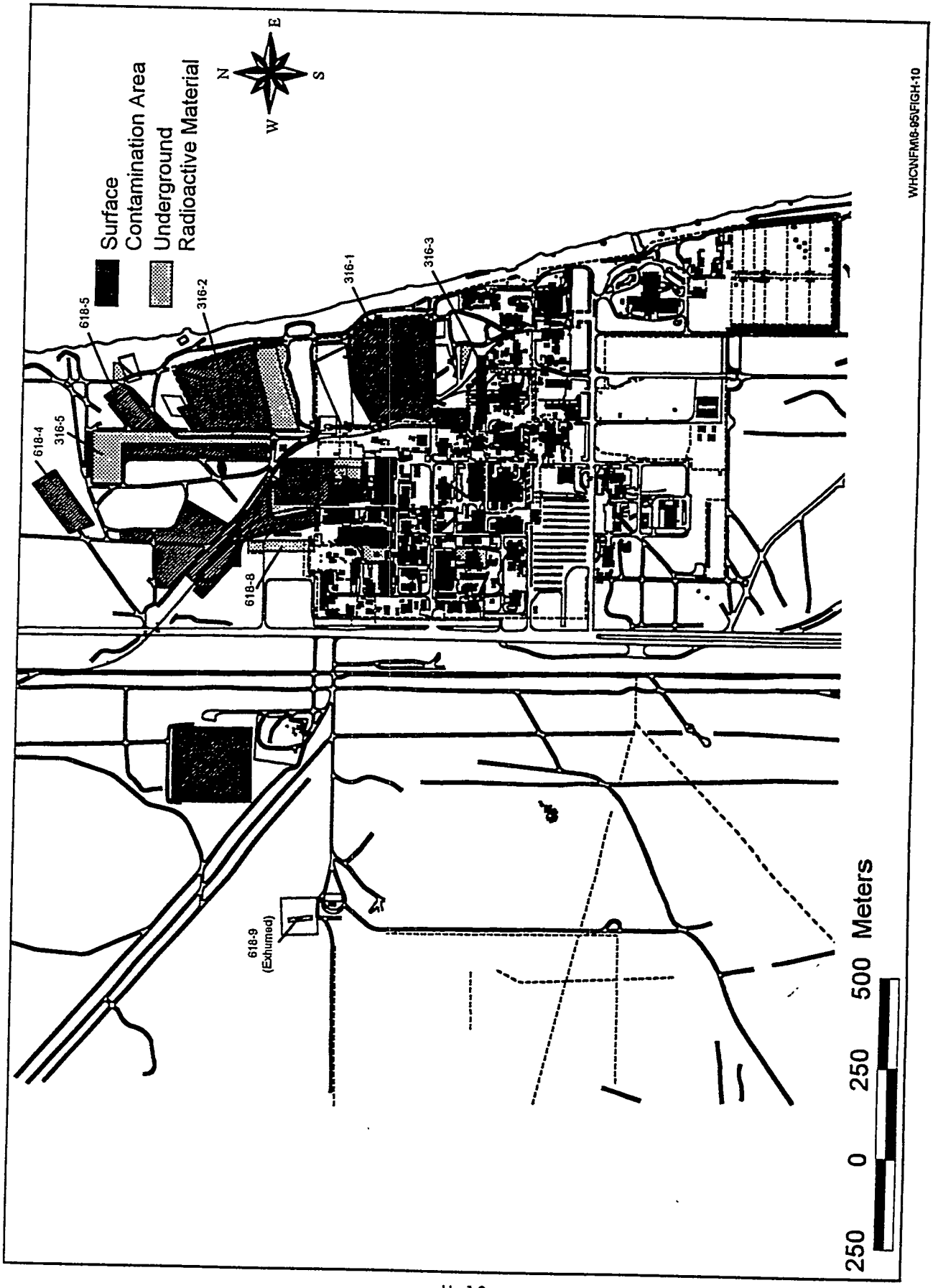

Figure H-11. 100 N Environmental Dose Rates Survey Results Around the 1301-N LWDF, 1993 (μR/h).

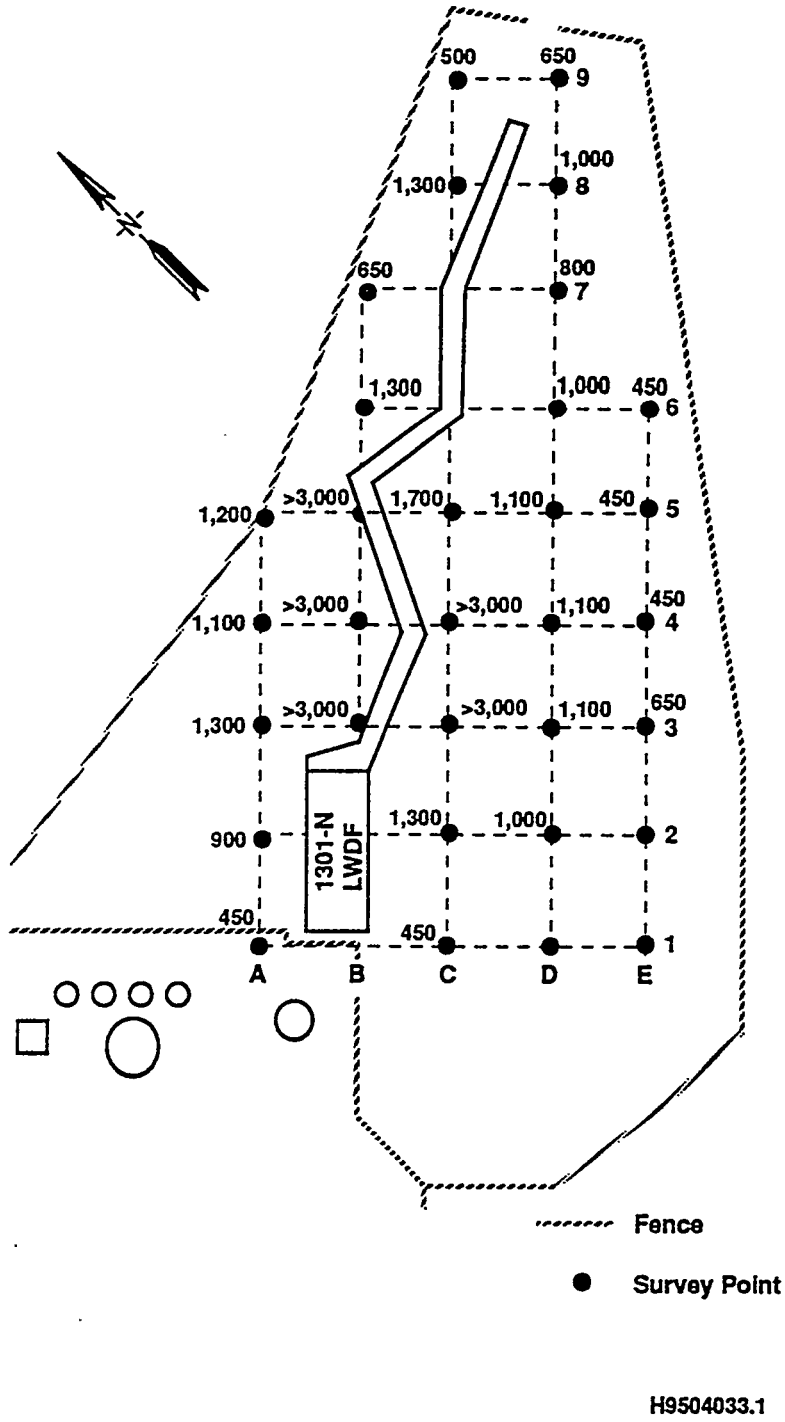

Figure H-12. 100 N Environmental Dose Rates Survey Results Around the 1325-N LWDF, 1993 (μR/h).

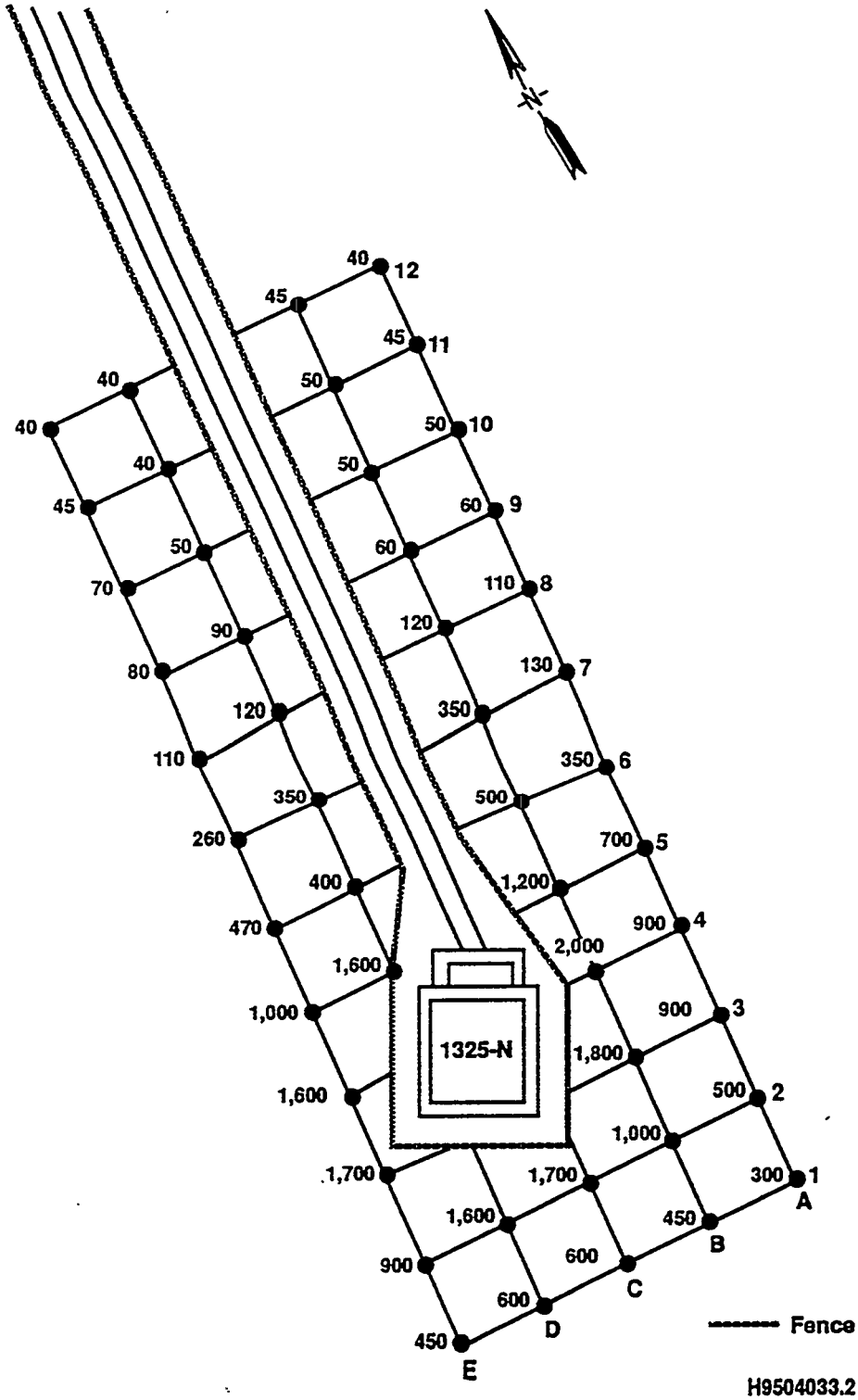

Table H-1. 100 N Area Shoreline Radiation Surveys (uR/hr).
(4 sheets)

Location*	1987	1988	1989	1990	1991	1992	1993	1994
1	16	33	11	14	11	12	11	10
	18	34	13	14	15	13	13	11
	20	35	17	16	14	14	14	13
	21	38	18	18	17	18	17	14
	26	39	19	22	18	18	18	15
	30	43	25	27	17	20	20	14
	38	67	31	36	20	28	27	23
	46	91	36	46	33	37	35	33
	55	115	43	55	46	46	45	44
10	60	138	49	64	59	55	50	50
	70	162	55	74	72	65	55	55
	75	186	60	83	85	70	60	60
	80	210	65	90	100	75	70	70
	90	270	75	120	110	100	80	75
	110	320	85	150	120	105	100	85
	110	380	100	160	140	110	90	85
	105	350	105	140	130	120	75	75
	100	370	85	90	100	100	60	60
	90	380	70	80	80	70	40	40
20	85	460	55	70	70	50	40	40
	80	460	50	60	50	45	35	35
	95	490	55	50	50	50	30	35
	100	490	55	50	50	40	30	35
	115	480	50	50	40	40	35	35
	120	440	60	50	50	50	35	35
	140	420	60	50	50	50	30	35
	150	410	65	60	50	50	30	40
	170	380	70	60	50	60	30	40
	200	390	80	60	50	60	35	45
30	230	390	90	60	50	70	45	45

Table H-1. 100 N Area Shoreline Radiation Surveys (uR/hr).
(4 sheets)

Location*	1987	1988	1989	1990	1991	1992	1993	1994
	260	400	110	70	50	80	55	50
	300	400	115	80	50	80	50	60
	320	420	120	90	70	80	60	60
	325	390	130	100	80	100	65	65
	310	370	135	120	90	100	60	65
	300	340	145	110	90	100	70	70
	290	310	145	130	90	110	70	70
	290	290	150	130	100	110	70	75
	280	300	150	150	110	120	80	75
40	270	270	170	150	110	120	80	80
	270	260	160	150	110	120	90	80
	270	270	170	170	120	130	80	85
	280	250	195	170	130	140	80	90
	290	250	210	180	130	145	80	95
	290	250	225	210	140	150	90	100
	300	280	240	230	140	150	90	110
	310	290	240	240	150	160	95	110
	340	290	225	230	180	170	110	115
	330	300	240	270	170	160	110	120
50	350	320	240	250	180	160	95	120
	350	330	230	270	180	160	100	120
	370	320	240	250	170	160	100	115
	400	310	245	250	170	170	110	115
	380	320	235	240	190	160	115	110
	370	320	230	240	180	160	100	110
	360	290	230	220	170	150	95	110
	350	300	225	210	170	140	90	105
	340	290	210	210	170	130	90	100
	320	290	205	200	150	120	90	85
60	300	260	190	200	160	120	80	80

Table H-1. 100 N Area Shoreline Radiation Surveys (uR/hr).
(4 sheets)

Location*	1987	1988	1989	1990	1991	1992	1993	1994
	280	260	175	170	140	110	75	80
	250	240	165	150	140	100	70	75
	240	230	160	150	130	90	70	65
	220	200	145	140	120	80	55	60
	210	180	140	120	120	80	45	55
	180	180	115	90	110	70	45	50
	170	170	110	110	90	60	40	45
	160	150	100	100	90	60	45	45
	140	140	90	90	80	60	35	40
70	130	120	85	80	70	50	40	40
	120	100	80	70	70	40	35	35
	110	100	75	70	60	40	30	35
	110	80	65	60	50	40	30	30
	90	80	65	60	50	30	30	25
	80	80	55	50	50	30	25	24
	70	70	55	40	50	27	30	23
	70	60	40	40	40	26	30	19
	60	60	40	30	40	22	25	19
	50	50	35	30	30	21	20	19
80	40	50	33	30	30	20	20	17
	40	45	30	25	30	19	25	15
	40	35	30	24	30	17	20	17
	35	35	25	24	30	17	18	14
	30	33	23	20	30	16	18	13
	30	32	20	18	30	14	18	12
	20	29	18	18	20	13	18	12
	20	27	18	19	20	14	15	11
	20	22	17	17	15	14	15	11
	20	22	16	15	15	12	18	11
90	18	22	15	15	15	12	15	11

Table H-1. 100 N Area Shoreline Radiation Surveys (uR/hr).
(4 sheets)

Location*	1987	1988	1989	1990	1991	1992	1993	1994
	18	20	15	13	14	11	10	12
	15	19	13	13	13	10	10	11
	12	15	13	13	12	9	12	10

APPENDIX I

IINVESTIGATIVE SPECIAL SAMPLE TABLES

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Table I-1. Investigative Water Samples Collected from the Operations Areas in 1994.

Sample Type	Sample Location	Constituents	Concentration
Water	241-U Tank Farm/200 West Area (runoff storm water on south perimeter)	Radionuclides ^{137}Cs ^{90}Sr $^{239/240}Pu$	pCi/L[a] 1.3 E+02 5.2 E+02 4.5 E-01
Water	216-B-3-3 Ditch/200 East Area (discolored effluent water)	Metals Sr Si Ca Sm S Mg Na K	uG/ml[b] 9.5 E-02 2.0 E 00 1.8 E+02 1.4 E-01 4.3 E 00 4.7 E 00 3.3 E 00 1.1 E 00

[a]picocuries per liter
[b]micrograms per milliliter (uG/ml).

Table I-2. Investigative Soil Samples Collected from the Operations Areas in 1994. (3 sheets)

Sample Type	Sample Location	Radionuclides	Concentration
Old Pipeline Scraping	241-AN Tank Farm/200 East Area (east)		pCi/g[a]
		^{241}Am	5.3 E+02
		^{137}Cs	3.3 E+02
		^{234m}Pa	1.8 E+04
		^{210}Pb	4.8 E+03
		^{234}Th	9.5 E+03
		$^{239/240}Pu$	3.7 E+03
		^{90}Sr	1.6 E+02
		$^{Total}U$	4.1 E+02
Soil	East of 241-A Tank Farm/200 East Area		pCi/sample[b]
		$^{239/240}Pu$	4.0 E+06
		^{137}Cs	8.0 E+04
Soil	East of 241-AN Tank Farm/ 200 East Area		pCi/g
		^{241}Am	8.8 E+03
		^{137}Cs	5.6 E+03
		^{234m}Pa	1.8 E+04
		^{234}Th	7.6 E+03
		$^{239/240}Pu$	5.0 E+05
		^{90}Sr	4.8 E+02
		$^{Total}U$	9.2 E+02
Soil	216-B-3A Pond/ 200 East Area (northwest corner core)		pCi/g
		^{137}Cs	<1.0 E-01
		$^{239/240}Pu$	<4.7 E-01
		^{90}Sr	4.7 E-01
		$^{Total}U$	2.0 E-01
Soil	216-B-3A Pond/ 200 East Area (south of northwest corner core)		pCi/g
		^{137}Cs	<2.1 E-01
		^{212}Pb	9.9 E-01
		^{228}Ac	1.7 E 00
		$^{239/240}Pu$	<4.9 E-01
		^{90}Sr	1.2 E 00
		$^{Total}U$	2.0 E-01
Soil	216-B-3A Pond/ 200 East Area (north-central area core)		pCi/g
		^{137}Cs	<1.2 E-01
		^{212}Pb	4.8 E-01
		$^{239/240}Pu$	<4.8 E-01
		^{90}Sr	5.2 E-01
		$^{Total}U$	2.2 E-01

Table I-2. Investigative Soil Samples Collected from the Operations Areas in 1994. (3 sheets)

Sample Type	Sample Location	Radionuclides	Concentration
Soil	216-B-3A Pond/ 200 East Area (west-central area core)		pCi/g
		^{137}Cs	1.4 E-01
		^{208}Tl	3.5 E-01
		^{212}Pb	8.2 E-01
		^{214}Pb	1.2 E 00
		$^{239/240}Pu$	<4.6 E-01
		^{90}Sr	1.2 E 00
		$^{Total}U$	1.5 E-01
Soil	216-B-3A Pond/ 200 East Area (east-central core)		pCi/g
		^{137}Cs	<8.9 E-02
		$^{239/240}Pu$	<4.7 E-01
		^{90}Sr	<6.6 E-01
		$^{Total}U$	1.3 E-01
Soil	216-B-3A Pond/ 200 East Area (southeast corner outlet core)		pCi/g
		^{137}Cs	<1.1 E-01
		^{208}Tl	3.1 E-01
		^{212}Pb	6.7 E-01
		^{214}Bi	6.5 E-01
		^{214}Pb	5.8 E-01
		$^{239/240}Pu$	<5.1 E-01
		^{90}Sr	7.7 E-01
		$^{Total}U$	2.2 E-02
Soil	216-B-3A Pond/ 200 East Area (northwest corner surface)		pCi/g
		^{137}Cs	<6.5 E-01
		^{212}Pb	8.6 E-01
		^{214}Pb	1.3 E 00
		$^{239/240}Pu$	<4.5 E-01
		^{90}Sr	9.2 E-01
		$^{Total}U$	2.0 E-01
Soil	216-B-3A Pond/ 200 East Area (south of northwest corner surface)		pCi/g
		^{137}Cs	1.4 E+01
		^{208}Tl	3.1 E-01
		^{212}Pb	8.9 E-01
		$^{239/240}Pu$	2.7 E 00
		^{90}Sr	1.5 E 00
		$^{Total}U$	3.5 E-01
Soil	216-B-3A Pond/ 200 East Area (north-central surface)		pCi/g
		^{137}Cs	1.1 E+01
		^{90}Sr	1.2 E+01
		$^{Total}U$	3.8 E+05

Table I-2. Investigative Soil Samples Collected from the Operations Areas in 1994. (3 sheets)

Sample Type	Sample Location	Radionuclides	Concentration
Soil	216-B-3A Pond/ 200 East Area (west-central inlet surface)	^{137}Cs ^{212}Pb $^{239/240}Pu$ ^{90}Sr $^{Total}U$	pCi/g 6.5 E 00 1.2 E 00 8.3 E-01 1.2 E 00 9.5 E-02
Soil	216-B-3A Pond/ 200 East Area (east-central surface)	^{40}K ^{137}Cs ^{208}Tl ^{212}Pb $^{239/240}Pu$ ^{90}Sr $^{Total}U$	pCi/g 1.4 E+01 6.1 E 00 5.2 E-01 7.9 E-01 1.8 E 00 6.6 E-01 2.5 E-01
Soil	216-B-3A Pond/ 200 East Area (southeast outlet surface)	^{137}Cs $^{239/240}Pu$ ^{90}Sr $^{Total}U$	pCi/g 2.9 E+01 6.6 E 00 5.9 E-01 6.1 E-01
Soil	216-B-3 Pond/200 East Area (surface)	^{137}Cs $^{239/240}Pu$ ^{90}Sr $^{Total}U$	pCi/g 1.2 E+02 8.8 E 00 9.3 E-01 8.9 E-01
Soil	216-B-3 Pond/200 East Area (north-central surface)	^{137}Cs $^{239/240}Pu$ ^{90}Sr	pCi/g 7.7 E+01 2.0 E+01 5.2 E 00
Soil	216-B-3 Pond/200 East Area (central surface)	^{137}Cs $^{239/240}Pu$ ^{90}Sr $^{Total}U$	pCi/g 8.3 E+01 1.0 E+01 1.7 E+01 3.8 E-01
Soil	216-B-3 Pond/200 East Area (south-central surface)	^{137}Cs ^{212}Pb ^{214}Pb $^{239/240}Pu$ ^{90}Sr $^{Total}U$	pCi/g 5.9 E 00 8.2 E-05 7.9 E-01 <8.5 E-01 1.8 E 00 1.4 E-01

[a]picocuries per gram
[b]picocuries per sample (indicates sample was extremely small).
"Less than" symbol (<) indicates uncertainty in the analytical results because of the small sample mass.

Table I-3. Radiologically Contaminated Soil Disposed from the Operations Areas in 1994. (4 sheets)

Sample Type	Location	External Radioactivity
Soil Specks	241-BX/BY/200 East Area	200 cpm[a]-25,000 cpm
Soil	241-AX Tank Farm/200 East Area	15,000 cpm
Soil Specks	216-E-6/200 East Area	100,000-200,000 cpm
Soil Specks	241-C Tank Farm/200 East Area	15,000-20,000 cpm (2.4-4.0 mrad/h)[b]
Soil	241-BX/R Vault/200 East Area	20 mrad/h
Soil	204-AR Elevated Pit/200 East Area	2,000 cpm
Soil specks	241-C Tank Farm south perimeter/216-A-40 Basin/ 244-A Lift Station/200 East Area	2,000-10,000 cpm (up to 300 cpm on tires in nearby parking lot)
Soil	241-BX Tank Farm Vehicle Entrance/200 East Area	6,000 cpm
Soil specks	241-C Tank Farm east fenceline/200 East Area	Windblown contamination from 500-100,000 cpm
Spotty contamination	241-B Tank Farm/200 East Area	6,500 cpm
Soil specks	241-B-151-ER Diversion Box/ 200 East Area	100,000 cpm
Soil specks	241-BX/BY Tank Farm/200 East Area	100-2,000 cpm
Soil speck	241-BY Tank Farm/200 East Area	800,000 cpm
Soil specks	241-BX/BY Tank Farms/200 East Area	200-25,000 cpm
Soil spots	UN-216-E-6/200 East Area (near 241-BX-155 Diversion Box)	10,000 and 20,000 cpm
Soil	241-BX Tank Farm at R Vault Gate/200 East Area	200,000 cpm
Soil	204-AR Pits/200 East Area	Up to 2,000 cpm
Soil	241-C Tank Farm/200 East Area	2,000->100,000 cpm
Soil spots	241-BX Tank Farm vehicle access area/200 East Area	Up to 6,000 cpm
Soil specks	241-C Tank Farm east fenceline/200 East Area	500->100,000 cpm
Soil	241-B Tank Farm/200 East Area	6,500 cpm

Table I-3. Radiologically Contaminated Soil Disposed from the Operations Areas in 1994. (4 sheets)

Sample Type	Location	External Radioactivity
Soil spots	241-B-151-ER Diversion Box/ 200 East Area	Up to 180,000 cpm
Soil specks	241-BX/BY Tank Farms east fenceline/200 East Area	100-2,000 cpm
Soil speck	241-B Tank Farm north perimeter/200 East Area	750 cpm
Soil speck	241-BX/BY Tank Farms west perimeter/200 East Area	2,000 cpm
Soil specks	241-TX/TY Tank Farm northwest perimeter/200 West Area	500-100,000 cpm
Soil speck	216-U-8 Crib southwest/ 200 West Area	30,000 cpm
Soil speck	242-A Evaporator east side/ 200 East Area	15,000 cpm
Soil speck	241-S Tank Farm Complex (northwest of 202-S)/200 West Area	1,500 cpm
Soil speck	241-ER-151 perimeter/200 East Area (UN-216-E-12)	2,000 cpm
Soil speck	241-EW-151 Vent Station southwest perimeter/600 Area	10,000 cpm
Soil	Burn Pit near 216-E-8 Burial Ground/200 East Area	600 cpm
Soil speck	221-BF north side/200 East Area	700 cpm
Green sludge	241-A Tank Farm east of Canton Avenue (in exhumed clay pipe)/200 East Area	>10,000 dpm[c] alpha and 1 rad/h beta/gamma
Soil (1.5 meters^2 - surface to 20 cm deep)	Unidentified Radioactive Transfer Line east of 241-A Tank Farm/200 East Area	800 cpm
Soil specks	105-D northeast corner/100 D	3,000 and 15,000 cpm
Soil specks	218-E-1 Burial Ground/200 East Area	3,500 cpm
Soil specks	218-E-12B Burial Ground north perimeter/200 East Area	30,000 cpm

Table I-3. Radiologically Contaminated Soil Disposed from the Operations Areas in 1994. (4 sheets)

Sample Type	Location	External Radioactivity
Soil (two areas - 2.25 meters^2 & 12 feet^2)	202-S Railroad Cut (northwest)/200 West Area	6,000-180,000 cpm (90 mrad/h)
Soil speck	202-U Stack/200 West Area	55,000 cpm
Soil specks	216-S-17 Pond/200 West Area	300 cpm
Soil specks (9 areas)	118-B-1 Burial Ground/100 B/C Area	Up to 15,000 cpm
Soil	116-B-2 Crib/100 B/C Area	70,000 cpm
Soil (five small areas)	118-C-1 Burial Ground/100 B/C Area	Up to 8,000 cpm
Soil (area 110 meters^2)	116-C-1 Crib/100 B/C Area	Up to 1,000 cpm
Soil (three areas of 80 meters^2)	116-C-4 Crib/100 B/C Area	Up to 10,000 cpm
Soil	216-B-51 Crib/200 East Area	800 cpm
Soil (area 36 meters^2)	216-B-1A Crib/200 East Area	Up to 15,000 cpm
Soil specks (3)	241-U Tank Farm (north perimeter)/200 West Area	Up to 5,000 cpm
Soil specks	244-S Lift Station/200 West Area	1,200 cpm
Soil specks (area 90 meters^2)	241-TX/152 Diversion Box/ 200 West Area	Up to 10,000 cpm
Soil specks (area 36 meters^2)	Cross-site Transfer Line/ 600 Area (between 200 East and 200 West Areas)	Up to 30,000 cpm (15 mrad/h)
Soil speck	244-U Lift Station/200 West Area	5,000 cpm
Soil speck	241-SY Tank Farm/200 West Area	5,000 cpm
Soil specks	241-U Tank Farm/200 West Area	3,000-25,000 cpm
Soil specks	244-S Lift Station/200 West Area	Up to 3,000 cpm
Soil speck	244-S Lift Station/200 West Area	6,000 cpm
Soil (area 0.10 meters^2)	241-SY Tank Farm Satellite Accumulation Area/200 West Area	500 cpm
Soil speck	241-U Tank Farm/200 West Area	2,000 cpm

Table I-3. Radiologically Contaminated Soil Disposed from the Operations Areas in 1994. (4 sheets)

Sample Type	Location	External Radioactivity
Soil speck	244-S Lift Station/200 West Area	6,000 cpm
Soil speck	Cross-site Transfer Line/ 600 Area (between 200 East and West Areas	1,000 cpm
Soil speck	241-S Tank Farm Satellite Accumulation Area/200 West Area	1,500 cpm
Soil specks	241-BX Tank Farm/200 West Area	6,000 cpm
Soil specks	207-T Basin perimeter/200 West Area	150-60,000 cpm
Soil specks	241-SX Tank Farm perimeter/200 West Area	60,000 cpm
Soil specks	241-S Tank Farm Complex perimeter/200 West Area	1,000 cpm
Soil specks	Cross-site Transfer Line/151-EW Vent Station/ 600 Area (between 200 East and 200 West Areas	1,000 cpm
Soil specks	241-S Tank Farm Satellite Accumulation Area/200 West Area	400-4,000 cpm
Soil specks	244-TX Lift Station/200 West Area	Up to 30,000 cpm
Soil specks	242-S Evaporator Laundry Storage/200 West Area	Up to 5,000 cpm
Soil specks	241-TX/TY Tank Farm perimeters/200 West Area	Up to 25,000 cpm
Soil specks	241-U Tank Farm perimeters/ 200 West Area	Up to 25,000 cpm
Soil specks	241-S Tank Farm Complex perimeter northwest corner/ 200 West Area	9,000-25,000 cpm
Soil specks	242-T Evaporator/200 West Area	Up to 300 cpm
Soil specks	241-T Tank Farm perimeter northeast corner/200 West Area	600-2,000 cpm

[a]counts per minute
[b]millirad per hour
[c]disintegrations per minute

Table I-4. Investigative Vegetation Samples Collected from the Operations Areas in 1994.

Sample Type	Sample Location	Sample Number	Radionuclides	Concentration
Watercress	216-B-3-3 Ditch	1		pCi/g[a]
			^{137}Cs	3.6 E 00
			^{40}K	3.8 E 00
			$^{239/240}Pu$	<1.4 E 00
			^{90}Sr	3.1 E 00
			$^{Total}U$	7.3 E 00
			^{129}I	<6.4 E 00
			^{99}Tc	8.6 E 00
Cattails	216-S-10 Ditch (ditch head)	1		pCi/g
			Total Beta	8.3 E 00
			Total Alpha	<2.3 E-01
			^{214}Pb	5.4 E 00
			^{137}Cs	<8.3 E-01
			$^{239/240}Pu$	<8.8 E-01
			^{90}Sr	<4.7 E-01
			$^{Total}U$	1.9 E-01

[a]picocuries per gram
"Less than" symbol (<) indicates uncertainty in the analytical results because of the small sample mass.

Table I-5. Radiologically Contaminated Vegetation Disposed from the Operations Areas in 1994. (2 sheets)

Sample Type	Location	External Radioactivity
Tumbleweed fragments	241-AN Tank Farm north fenceline/200 East Area	2,000 cpm[a]
Tumbleweed fragments	241-AZ East Fenceline/ 200 East Area	30,000 cpm
Tumbleweed fragments	241-BX Tank Farm Vehicle Access/200 East Area	600 cpm
Tumbleweed fragments	241-BX/BY Tank Farm/200 East Area	100-2,000 cpm
Tumbleweed	241-BY Tank Farm/200 East Area	25,000 cpm
Tumbleweed fragments	241-B-151-ER Diversion Box/200 East Area	15,000 cpm
Tumbleweed fragments	241-BX Tank Farm vehicle access area/200 East Area	Up to 600 cpm
Tumbleweed fragments	241-BX/BY Tank Farms east fenceline/200 East Area	100-2,000 cpm
Tumbleweed	241-BY Tank Farm/200 East Area	25,000 cpm
Tumbleweed fragments	241-B-151-ER Diversion Box/200 East Area	150,000 cpm
Tumbleweed fragments	241-AN Tank Farm/200 East Area	1,000 cpm
Vegetation fragments	UN-216-W-33 northeast edge/200 West Area (between 216-U-8 Crib and 224-U Facility)	350 and 950 cpm
Dry vegetation	Burn Pit near 216-E-8 Burial Ground/200 East Area	600 cpm
Tumbleweeds (windblown)	218-E-1 Burial Ground/ 200 East Area	3,500 cpm
Vegetation	218-E-12B Burial Ground north perimeter/200 East Area	30,000 cpm
Tumbleweeds	216-Z-7 Crib/200 West Area (cave-in area)	400 cpm
Sagebrush (2)	202-U Stack/200 West Area	1,000 cpm
Vegetation	216-B-9 Crib/200 East Area	Up to 10,000 cpm
Vegetation	216-S-17 Pond/200 West Area	Up to 10,000 cpm

Table I-5. Radiologically Contaminated Vegetation Disposed from the Operations Areas in 1994. (2 sheets)

Sample Type	Location	External Radioactivity
Tumbleweeds	216-B-51 Crib/200 East Area	800 cpm
Tumbleweeds (area 5 m^2)	216-B-7B Crib/200 East Area	Up to 600 cpm
Tumbleweed (windblown)	Gate 815/200 East Area	400 cpm
Tumbleweeds (2)	Gate 612/200 West Area	300 and 1,000 cpm
Tumbleweeds	207-U Retention Basin/ 200 West Area	200-30,000 cpm
Tumbleweed	241-U Tank Farm/200 West Area	500 cpm
Tumbleweed fragments	241-BX Tank Farm/200 East Area	Up to 6,000 cpm
Tumbleweed fragments	221-BA/200 East Area	20,000 cpm
Tumbleweed fragments	221-B Railroad Cut/200 East Area	5,000 cpm
Tumbleweed fragments	221-B/200 East Area	Unspecified levels of contamination
Tumbleweed fragments	216-U-8 Pipeline/200 West Area	Unspecified levels of contamination
Tumbleweed	218-E-12B Burial Ground Submarine Trench/200 East Area	2,500 cpm
Tumbleweeds (2)	218-E-12B Burial Ground Submarine Trench/200 East Area	1,000 cpm
Tumbleweeds	218-W-3A Burial Ground/ 200 West Area	Up to 10,000 cpm
Tumbleweed	241-AN Tank Farm/200 East Area	6,000 cpm
Tumbleweeds (2)	241-T Tank Farm (northwest)/200 West Area	600 and 1,000 cpm
Tumbleweed (windblown)	209-E/200 East Area	Unspecified levels of contamination
Tumbleweed fragments	241-C Tank Farm/271-CR Vault/200 East Area	Unspecified levels of contamination

[a]counts per minute

Table I-6. Investigative Wildlife Samples Collected from the Operations Areas in 1994. (4 sheets)

Sample Type	Sample Location	Sample Number	Radionuclides	Concentration
Mollusk (fresh-water clams)	216-B-3-3 Ditch/200 East Area	1 kilogram		pCi/g[a]
			^{137}Cs	3.4 E 00
			$^{239/240}Pu$	<7.8 E-01
			^{90}Sr	<4.2 E 00
			$^{Total}U$	1.3 E-05
			^{129}I	<1.0 E 00
			^{99}Tc	<1.6 E+02
Mollusk (fresh-water clams)	216-B-3-3 Ditch/200 East Area	1 kilogram		pCi/g
			^{137}Cs	1.6 E+01
			$^{239/240}Pu$	<2.2 E 00
			^{90}Sr	8.3 E 00
			^{129}I	<6.0 E-01
			^{99}Tc	<3.5 E-02
Western Rattlesnake	105-N/100 N Area	1	stomach	pCi/g
			^{60}Co	1.4 E+02
			^{137}Cs	1.4 E+02
			$^{239/240}Pu$	<1.2 E+01
			^{90}Sr	5.5 E+01
			$^{Total}U$	2.1 E-01
			body	pCi/g
			^{241}Am	9.2 E+01
			^{60}Co	1.6 E+04
			^{137}Cs	1.1 E+03
			$^{239/240}Pu$	6.8 E+02
			^{90}Sr	1.1 E+01
			$^{Total}U$	4.1 E-01
			head	pCi/g
			^{60}Co	1.3 E+02
			^{137}Cs	1.1 E+03
			$^{239/240}Pu$	<4.8 E-01
			^{90}Sr	3.8 E+01
			$^{Total}U$	3.7 E-02
Gopher Snake (coral pink)	221-T Plant/200 West Area	1		pCi/g
			^{241}Am	<2.5 E+01
			^{137}Cs	<4.2 E 00
			^{90}Sr	1.1 E+01
			$^{Total}U$	2.9 E-03
Gopher Snake	221-B Plant/200 West Area	1		pCi/g
			^{137}Cs	6.3 E+02
			$^{239/240}Pu$	<6.3 E-01
			^{90}Sr	3.6 E+02
			$^{Total}U$	2.1 E-02

Table I-6. Investigative Wildlife Samples Collected from the Operations Areas in 1994. (4 sheets)

Sample Type	Sample Location	Sample Number	Radionuclides	Concentration
Gopher Snake	2713-WB/200 West Area	1		pCi/g
			^{137}Cs	1.7 E+03
			$^{239/240}Pu$	<4.0 E-01
			^{90}Sr	7.8 E+02
			$^{Total}U$	1.6 E-02
Western Kingbird Nest	MO-327/200 East Area	1		pCi/g
			^{228}Ac	8.7 E-01
			^{137}Cs	5.2 E 00
			^{90}Sr	1.4 E+01
			$^{Total}U$	1.1 E-01
Cliff Swallow Nest	MO-973/200 West Area	1		pCi/g
			^{60}Co	4.6 E-01
			^{137}Cs	2.0 E+01
			^{214}Pb	1.1 E 00
			$^{239/240}Pu$	<8.7 E-01
			^{90}Sr	2.1 E+01
			^{208}Tl	2.5 E-01
			$^{Total}U$	1.9 E-03
Western Kingbird Nest	105-KE/100 K Area	1		pCi/g
			^{57}Co	2.9 E 00
			^{60}Co	9.7 E-01
			^{137}Cs	3.4 E+01
			$^{239/240}Pu$	1.7 E 00
			^{90}Sr	8.4 E 00
			$^{Total}U$	3.8 E-03
Mouse (skeleton)	MO-543/200 East Area	1		pCi/g
			^{228}Ac	4.5 E-01
			^{212}Bi	4.0 E-01
			^{214}Bi	5.2 E-01
			^{137}Cs	4.9 E-01
			^{212}Pb	4.8 E-01
			^{214}Pb	5.5 E-01
			^{90}Sr	1.3 E+01
			^{208}Tl	1.8 E-01
			$^{Total}U$	4.2 E-03
Deer Mouse (12,500 cpm)	272-S Insulator Shop/200 West Area	1		pCi/g
			^{137}Cs	1.6 E+03
			$^{239/240}Pu$	<6.8 E-01
			^{90}Sr	1.4 E+03
			$^{Total}U$	1.0 E-03
Deer Mouse (>100,000 cpm)	244-A Lift Station/ 200 East Area	1		pCi/g
			^{137}Cs	2.1 E+03
			$^{239/240}Pu$	<4.2 E+01
			^{90}Sr	9.0 E+04
			$^{Total}U$	3.2 E-03

Table I-6. Investigative Wildlife Samples Collected from the Operations Areas in 1994. (4 sheets)

Sample Type	Sample Location	Sample Number	Radionuclides	Concentration
Deer Mouse (30,000 cpm)	244-A Lift Station/ 200 East Area	1	^{137}Cs $^{239/240}Pu$ ^{90}Sr $^{Total}U$	pCi/g 6.9 E+02 <1.4 E+01 2.3 E+03 2.9 E-03
Deer Mouse (6,000 cpm)	244-A Lift Station/200 East Area	1	^{137}Cs $^{239/240}Pu$ ^{90}Sr $^{Total}U$	pCi/g 2.4 E+01 <2.0 E+01 3.2 E+02 2.9 E-03
Deer Mouse (20,000 cpm)	244-A Lift Station/200 East Area	1	^{137}Cs $^{239/240}Pu$ ^{90}Sr $^{Total}U$	pCi/g 2.7 E+03 <2.3 E+01 2.8 E+04 5.4 E-03
Deer Mouse (5,000 cpm)	244-A Lift Station/ 200 East Area	1	^{137}Cs $^{239/240}Pu$ ^{90}Sr $^{Total}U$	pCi/g 9.2 E+01 <1.5 E+01 3.8 E+03 3.8 E-03
Deer Mouse (12,500 cpm)	2711-E Garage/200 East Area	1	^{137}Cs $^{239/240}Pu$ ^{90}Sr $^{Total}U$	pCi/g 2.5 E+05 <4.1 E 00 2.1 E+03 9.0 E-03
Deer Mouse (2,000 cpm)	2713-WB/200 West Area	1	^{137}Cs $^{239/240}Pu$ ^{90}Sr $^{Total}U$	pCi/g 2.1 E+02 <3.4 E 00 1.3 E+04 7.0 E-03
Deer Mouse (>100,000 cpm)	231-Z/200 West Area	1	^{137}Cs $^{239/240}Pu$ ^{90}Sr $^{Total}U$	pCi/g 4.4 E+01 <7.1 E-01 1.9 E+02 4.2 E-03
Deer Mouse	241-S Tank Farm Complex/DACS Trailer/ 200 West Area	1	^{137}Cs $^{239/240}Pu$ ^{90}Sr $^{Total}U$	pCi/g 2.4 E+03 <8.6 E-01 2.8 E+02 1.3 E-03

Table I-6. Investigative Wildlife Samples Collected from the Operations Areas in 1994. (4 sheets)

Sample Type	Sample Location	Sample Number	Radionuclides	Concentration
Deer Mouse (8,000 cpm)	241-BX Tank Farm/200 East Area	1		pCi/g
			^{137}Cs	2.5 E+04
			$^{239/240}Pu$	<1.6 E+01
			^{90}Sr	7.2 E+03
			$^{Total}U$	1.1 E-02
Deer Mouse (2,500 cpm)	241-C Tank Farm/271-CR Vault/200 East Area	1		pCi/g
			^{137}Cs	3.5 E+01
			$^{239/240}Pu$	<7.8 E 00
			^{90}Sr	1.6 E+03
			$^{Total}U$	1.2 E-01
Deer Mouse (1,800 cpm)	241-C Tank Farm/271-CR Vault/200 East Area	1		pCi/g
			^{137}Cs	<1.7 E+01
			$^{239/240}Pu$	<6.9 E 00
			^{90}Sr	<2.0 E 00
			$^{Total}U$	1.3 E-03
Deer Mouse (>100,000 cpm)	216-B-63 Crib/Pit 64/200 East Area	1		pCi/g
			^{137}Cs	7.5 E 00
			$^{239/240}Pu$	<3.0 E 00
			^{90}Sr	1.1 E+04
			$^{Total}U$	5.6 E-02
Coyote (feces)	Intersection of Route 2 & Railroad Tracks/600 Area	1		pCi/g
			^{137}Cs	<1.1 E 00
			$^{239/240}Pu$	<1.6 E 00
			^{90}Sr	2.2 E 00
			$^{Total}U$	6.7 E-03
Coyote (feces)	281-W-5 Burial Ground (north)/200 West Area	1		pCi/g
			^{137}Cs	<2.1 E-01
			$^{239/240}Pu$	<3.3 E-01
			^{90}Sr	3.9 E-01
			$^{Total}U$	2.2 E-03
Coyote (feces)	281-W-5 Burial Ground (north)/200 West Area	1		pCi/g
			^{137}Cs	<2.1 E-01
			$^{239/240}Pu$	<6.8 E-01
			^{90}Sr	6.4 E-01
			$^{Total}U$	1.3 E-03

[a]picocuries per gram
"Less than" symbol (<) indicates uncertainty in the analytical results because of the small sample mass.

Table I-7. Radiologically Contaminated Wildlife Disposed of from the Operations Areas in 1994.

Sample Type	Sample Location	External Radioactivity
Mouse nest	244-CR Vault/200 East Area	240,000 cpm[a] beta/gamma (120 mrad/h[b]), <500 dpm[c] alpha
Contaminated rodent feces	271-CR Vault/200 East Area	200-3,000 cpm beta/gamma
Mouse feces	241-AY Vehicle RCA/ 200 East Area	10,000 cpm beta/gamma, <500 dpm alpha
Mouse nest	244-CR Vault/200 East Area	30,000 cpm
Mouse nest and feces	241-C Tank Farm/200 East Area	Unspecified levels of contamination
Rodent feces	271-CR Evaporator/200 East Area	200-3,000 cpm
Mouse feces	241-AY Tank Farm/200 East Area	10,000 cpm
Mouse urine in trap	241-AX/AY change trailer/200 East Area	1,000 cpm
Mouse feces	MO-973/200 West Area	400 cpm
Mouse feces	241-SY Tank Farm/DACS trailer/200 West Area	6,000 cpm
Mouse feces	242-S Evaporator/laundry storage/200 West Area	5,000 cpm

[a]counts per minute
[b]millirad per hour
[c]disintegrations per minute.

APPENDIX J

CONCENTRATION GUIDES

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Table J-1. Airborne Derived Concentration Guides.

Radionuclide	DCG[a] (pCi/m3)
^{90}Sr	9
^{137}Cs	400
^{106}Ru	30
^{239}Pu	0.02

[a]Derived Concentration Guides.

Table J-2. Groundwater Administrative Control Value Versus Derived Concentration Guides for Water (pCi/L).

Administrative control values				
Radionuclide	200 East	200 West	600 Area	DCG[a]
^{3}H	None	None	None	2.0 E+05
^{60}Co	5.0 E+03	5.0 E+03	5.0 E+03	5.0 E+03
^{90}Sr	7.4 E+01	4.8 E+02	4.0 E+01	1.0 E+03
^{99}Tc	4.0 E+03	4.0 E+03	4.0 E+03	1.0 E+05
^{106}Ru	6.0 E+03	6.0 E+03	2.4 E+02	6.0 E+03
^{129}I	2.0 E+01	2.0 E+01	2.0 E+01	5.0 E+02
^{137}Cs	2.1 E+02	1.2 E+03	1.2 E+02	3.0 E+03
^{234}U	2.0 E+01	2.0 E+01	2.0 E+01	5.0 E+02
^{235}U, ^{238}U	2.4 E+01	2.4 E+01	2.4 E+01	6.0 E+02
^{238}Pu	2.0 E+00	3.6 E+00	1.6 E+00	4.0 E+01
^{239}Pu, ^{240}Pu	1.2 E+00	1.2 E+00	1.2 E+00	3.0 E+01

[a]Derived Concentration Guides.

Table J-3. Inaccessible Soil Concentration Limits, pCi/g. (2 sheets)

Radionuclide	100-BDKN	100-F, H	200-W	200-E	300 Area	400 Area
^{3}H	1.4 E+08	7.4 E+07	3.7 E+08	2.0 E+08	9.5 E+06	1.4 E+07
^{14}C	6.2 E+05	6.2 E+05	6.2 E+05	6.2 E+05	6.2 E+05	6.2 E+05
^{55}Fe	9.7 E+06	9.7 E+06	3.6 E+10	1.9 E+10	1.0 E+07	1.4 E+09
^{58}Co	9.8 E+06	9.8 E+06	8.1 E+09	4.3 E+09	1.2 E+07	3.1 E+08
^{60}Co	9.9 E+05	9.9 E+05	5.7 E+08	3.0 E+08	1.0 E+06	9.9 E+06
^{63}Ni	1.5 E+08	1.5 E+08	6.9 E+09	6.9 E+09	1.5 E+08	2.2 E+08
^{90}Sr*	8.3 E+05	8.3 E+05	2.2 E+08	1.2 E+08	8.3 E+05	8.4 E+06
^{99}Tc	1.3 E+07	1.3 E+07	1.3 E+07	1.3 E+07	1.3 E+07	1.3 E+07
^{106}Ru*	2.0 E+07	2.0 E+07	5.7 E+08	3.0 E+08	1.5 E+07	2.2 E+07
^{125}Sb*	9.1 E+06	9.1 E+06	5.7 E+09	3.0 E+09	9.2 E+06	1.1 E+08
^{129}I	2.8 E+05	2.8 E+05	2.8 E+05	2.8 E+05	2.2 E+05	2.8 E+05
^{134}Cs	1.7 E+04	1.7 E+04	2.5 E+08	1.4 E+08	2.4 E+04	9.7 E+06
^{137}Ce*	1.7 E+04	1.7 E+04	3.5 E+08	1.8 E+08	1.7 E+04	1.3 E+07
^{144}Cs*	1.4 E+06	1.4 E+06	7.4 E+08	4.0 E+08	1.9 E+06	2.8 E+07
^{147}Pm	3.4 E+07	3.4 E+07	7.4 E+09	4.0 E+09	3.5 E+07	2.8 E+08
^{152}Eu	4.5 E+06	4.5 E+06	1.2 E+09	6.2 E+08	4.6 E+06	4.5 E+07
^{154}Eu	3.3 E+06	3.3 E+06	8.8 E+08	4.7 E+08	3.3 E+06	3.4 E+07
^{155}Eu	2.3 E+07	2.3 E+07	6.9 E+09	3.7 E+09	2.4 E+07	2.6 E+08
^{226}Ra*	1.3 E+05	1.3 E+05	2.1 E+05	2.1 E+05	1.3 E+05	1.4 E+05
^{227}Ac*	2.4 E+03	2.4 E+03	5.4 E+04	2.9 E+04	1.4 E+03	2.1 E+03
^{232}Th*	2.0 E+04	2.0 E+04	2.0 E+04	2.0 E+04	4.7 E+03	7.1 E+03
^{232}U*	5.5 E+04	5.5 E+04	1.4 E+05	1.4 E+05	9.9 E+03	1.5 E+04
^{233}U	4.5 E+05	4.5 E+05	4.5 E+05	4.5 E+05	6.7 E+04	1.0 E+05
^{234}U	4.6 E+05	4.6 E+05	4.6 E+05	4.6 E+05	6.9 E+04	1.0 E+05
^{235}U*	4.9 E+05	4.9 E+05	4.9 E+05	4.9 E+05	7.3 E+04	1.1 E+05
^{236}U	4.9 E+05	4.9 E+05	4.9 E+05	4.9 E+05	7.1 E+04	1.1 E+05
^{238}U*	4.7 E+05	4.7 E+05	4.7 E+05	4.7 E+05	7.7 E+04	1.2 E+05

Table J-3. Inaccessible Soil Concentration Limits, pCi/g. (2 sheets)

Radionuclide	100-BDKN	100-F, H	200-W	200-E	300 Area	400 Area
^{237}Np*	8.9 E+02	8.9 E+02	8.9 E+02	8.9 E+02	8.9 E+02	8.9 E+02
^{238}Pu	1.3 E+04	1.3 E+04	8.8 E+05	4.7 E+05	1.3 E+04	3.4 E+04
^{239}Pu	1.2 E+04	1.2 E+04	1.2 E+04	1.2 E+04	1.2 E+04	1.2 E+04
^{240}Pu	1.2 E+04	1.2 E+04	1.4 E+04	1.4 E+04	1.2 E+04	1.2 E+04
^{241}Pu	6.1 E+05	6.1 E+05	4.2 E+07	2.2 E+07	6.1 E+05	1.2 E+06
^{241}Am	2.5 E+04	2.5 E+04	7.4 E+05	4.0 E+05	1.9 E+04	2.8 E+04

Note: Asterisks mark nuclides with progeny that are assumed to be present in equilibrium amounts. However, ^{234}U was not included in the ^{238}U limits. For supporting references see WHC-SD-EN-TI-070.

Table J-4. Accessible Soil Concentration Limits, pCi/g. (2 sheets)

Radionuclide	100-BDKN	100-F, H	200-W	200-E	300 Area	400 Area
^{3}H	1.4 E+08	7.4 E+07	3.7 E+08	2.0 E+08	9.5 E+06	1.4 E+07
^{14}C	6.2 E+05	6.2 E+05	6.2 E+05	6.2 E+05	6.2 E+05	6.2 E+05
^{55}Fe	5.3 E+05	5.3 E+05	5.3 E+05	5.3 E+05	5.3 E+05	5.3 E+05
^{58}Co	1.8 E+01	1.8 E+01	1.8 E+01	1.8 E+01	1.8 E+01	1.8 E+01
^{60}Co	7.1 E+00	7.1 E+00	7.1 E+00	7.1 E+00	7.1 E+00	7.1 E+00
^{63}Ni	2.5 E+07	2.5 E+07	2.5 E+07	2.5 E+07	2.5 E+07	2.5 E+07
^{90}Sr*	2.8 E+03	2.8 E+03	2.8 E+03	2.8 E+03	2.8 E+03	2.8 E+03
^{99}Tc	1.0 E+06	1.0 E+06	1.0 E+06	1.0 E+06	1.0 E+06	1.0 E+06
^{106}Ru*	7.7 E+01	7.7 E+01	7.7 E+01	7.7 E+01	7.7 E+01	7.7 E+01
^{125}Sb*	3.7 E+01	3.7 E+01	3.7 E+01	3.7 E+01	3.7 E+01	3.7 E+01
^{129}I	1.0 E+04	1.0 E+04	1.0 E+04	1.0 E+04	1.0 E+04	1.0 E+04
^{134}Cs	1.0 E+01	1.0 E+01	1.0 E+01	1.0 E+01	1.0 E+01	1.0 E+01
^{137}Cs*	3.0 E+01	3.0 E+01	3.0 E+01	3.0 E+01	3.0 E+01	3.0 E+01
^{144}Ce*	3.3 E+02	3.3 E+02	3.3 E+02	3.3 E+02	3.3 E+02	3.3 E+02
^{147}Pm	1.1 E+06	1.1 E+06	1.1 E+06	1.1 E+06	1.1 E+06	1.1 E+06

Table J-4. Accessible Soil Concentration Limits, pCi/g. (2 sheets)

Radionuclide	100-BDKN	100-F, H	200-W	200-E	300 Area	400 Area
^{152}Eu	1.5 E+01	1.5 E+01	1.5 E+01	1.5 E+01	1.5 E+01	1.5 E+01
^{154}Eu	1.4 E+01	1.4 E+01	1.4 E+01	1.4 E+01	1.4 E+01	1.4 E+01
^{155}Eu	6.3 E+02	6.3 E+02	6.3 E+02	6.3 E+02	6.3 E+02	6.3 E+02
^{226}Ra*	1.0 E+01	1.0 E+01	1.0 E+01	1.0 E+01	1.0 E+01	1.0 E+01
^{227}Ac*	1.0 E+01	1.0 E+01	1.0 E+01	1.0 E+01	1.0 E+01	1.0 E+01
^{232}Th*	5.9 E+00	5.9 E+00	5.9 E+00	5.9 E+00	5.9 E+00	5.9 E+00
^{232}U*	1.0 E+01	1.0 E+01	1.0 E+01	1.0 E+01	1.0 E+01	1.0 E+01
^{233}U	6.3 E+02	6.3 E+02	6.3 E+02	6.3 E+02	6.3 E+02	6.3 E+02
^{234}U	6.3 E+02	6.3 E+02	6.3 E+02	6.3 E+02	6.3 E+02	6.3 E+02
^{235}U*	1.7 E+02	1.7 E+02	1.7 E+02	1.7 E+02	1.7 E+02	1.7 E+02
^{236}U	6.7 E+02	6.7 E+02	6.7 E+02	6.7 E+02	6.7 E+02	6.7 E+02
^{238}U*	3.7 E+02	3.7 E+02	3.7 E+02	3.7 E+02	3.7 E+02	3.7 E+02
^{237}Np*	4.8 E+01	4.8 E+01	4.8 E+01	4.8 E+01	4.8 E+01	4.8 E+01
^{238}Pu	2.1 E+02	2.1 E+02	2.1 E+02	2.1 E+02	2.1 E+02	2.1 E+02
^{239}Pu	1.9 E+02	1.9 E+02	1.9 E+02	1.9 E+02	1.9 E+02	1.9 E+02
^{240}Pu	1.9 E+02	1.9 E+02	1.9 E+02	1.9 E+02	1.9 E+02	1.9 E+02
^{241}Pu	1.0 E+04	1.0 E+04	1.0 E+04	1.0 E+04	1.0 E+04	1.0 E+04
^{241}Am	1.8 E+02	1.8 E+02	1.8 E+02	1.8 E+02	1.8 E+02	1.8 E+02

Note: Asterisks mark nuclides with progeny that are assumed to be present in equilibrium amounts. However, ^{234}U was not included in the ^{238}U limits. For supporting references see WHC-SD-EN-TI-070.

APPENDIX K

DATA SUMMARY METHODS

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Measuring any physical quantity has some degree of inherent uncertainty. This uncertainty results from the combination of all possible inaccuracies in the measurements process, including such factors as the reading of the result, the calibration of the measuring device, and numerical rounding errors. In this report, individual radioactive measurements are accompanied by a plus or minus (±) value, which is the uncertainty term known as a two-sigma counting error.

The two-sigma counting error gives information on what the measurement might be if the same sample were counted again under identical conditions. The two-sigma counting error implies that approximately 95 percent of the time, a recount of the same sample would give a value within plus or minus the two-sigma counting error at the value reported.

Values in the tables that are less than the minimum detectable activity indicate that the reported result might have come from a sample with no radioactivity. Such values are considered below the detection limits of the measuring instrument. Also note that each radioactive measurement must have the random background radioactivity of the measuring instrument subtracted; therefore, negative results are possible, especially when the sample has very little radioactivity.

Reported averages also are accompanied by two standard errors of the mean. If the data fluctuate randomly, the standard error is a measure of the uncertainty in the estimated average of the data because of this randomness. If trends of periodic fluctuation are present, the standard error is primarily a measure of the variability in the trends and fluctuations about the average of the data, rather than a measure of the uncertainty of the estimated average because of random fluctuations in the data.

The mean, $\bar{X}$, is computed as:

$$\bar{X} = \frac{1}{n} \sum_{i=1}^{n} X_i$$

where X_i is the ith measurement and n is the number of measurements.

The standard error of $\bar{X}$ was computed as:

$$SEM = \sqrt{\left(S^2 \frac{N}{M} \right)}$$

where $S^2{}_M{}^n$, the variance of the n measurements, was computed as:

$$S^{2\,n}_{M} = \frac{1}{n-1} \sum_{i=1} (X_i - \overline{X})^2$$

This estimator, $S^2{}_M{}^n$, includes the variance among the samples and the counting variance. The estimated $S^2{}_M{}^n$ occasionally may be less than the average counting variance.

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