Chapter 7: Environmental Monitoring Programs – Agricultural Products, Wildlife, Soil, and Direct Radiation

CHAPTER 7

Radionuclides released by Idaho National Laboratory (INL) Site operations and activities have the potential to be assimilated by agricultural products and game animals, which can then be consumed by humans. These media are thus sampled and analyzed for human-made radionuclides because of the potential transfer of radionuclides to people through food chains. Strontium-90 was detected in 2 of 14 milk samples at concentrations that are consistent with past measurements; this is likely due to the presence of fallout radionuclides in the environment. The results were well below the Derived Concentration Standard established for strontium-90 in milk by the U.S. Department of Energy (DOE) for the protection of human health. Human-made radionuclides were not detected in any of the other agricultural products (e.g., lettuce, grain, potatoes, alfalfa) collected in 2022 except strontium-90 in one alfalfa sample.

No human-made radionuclides were detected in road-killed animal samples collected in 2022. Three human-made radionuclides (e.g., cobalt-60, strontium-90, zinc-65) were detected in some tissue samples of waterfowl collected on ponds in the vicinity of the Advanced Test Reactor Complex and Test Area North at the INL Site. The source of these radionuclides was most likely the radioactive wastewater evaporation pond, which can be accessed by waterfowl, but not the public.

Bat carcasses have been collected on the INL Site since the summer of 2015. Three human-made radionuclides (e.g., cobalt-60, strontium-90, and cesium-137) were detected in 2022 in some of the bats sampled. While cesium-137 and strontium-90 may be of fallout origin, the presence of cobalt-60 may indicate that the bats have visited radioactive effluents ponds on the INL Site.

Soil samples were collected on and off the INL Site in 2022. Samples were collected from 13 offsite and 17 onsite locations. Results for the monitoring locations were consistent with previous measurements and were less than the background values.

Direct radiation measurements made at boundary and offsite locations were consistent with background levels. The average annual dose equivalent from external exposure was estimated from dosimeter measurements to be 118 mrem off the INL Site. The total background dose from natural sources to an average individual living in southeast Idaho was estimated to be approximately 384 mrem per year.

Radiation measurements taken in the vicinity of waste storage and soil contamination areas near INL Site facilities were consistent with previous measurements. Direct radiation measurements using a radiometric scanner system at the Radioactive Waste Management Complex and the Idaho Comprehensive Environmental Response, Compensation, and Liability Act Disposal Facility were near background levels.

7. ENVIRONMENTAL MONITORING PROGRAMS – AGRICULTURAL PRODUCTS, WILDLIFE, SOIL, AND DIRECT RADIATION

This chapter summarizes results of environmental monitoring of agricultural products, wildlife, soil, and direct radiation on and around the INL Site during 2022. Details of these programs may be found in the *Idaho National Laboratory Site Environmental Monitoring Plan* (DOE-ID 2021). INL and the Idaho Cleanup Project (ICP) contractors monitor soil, vegetation, biota, and direct radiation on and off the INL Site to comply with applicable DOE orders and other requirements. The focus of the monitoring conducted by INL and ICP contractors is on the INL Site, particularly on and around facilities, as shown in Table 7-1. The INL contractor's primary responsibility is to monitor the presence of contaminants in environmental media, which may originate from INL Site releases, as can be seen in Table 7-1. To improve the readability of this chapter, INL contractor data tables are included when monitoring results exceed three sigma (3σ) and/or background upper threshold limits. Media results for 2022 are provided in quarterly surveillance reports (INL 2023a, INL 2023b, INL 2023c, and INL 2023d).

Table 7-1. Environmental monitoring of agricultural products, biota, soil, and direct radiation on and around the INL Site.

AREA/FACILITY[a]	MEDIA				
	AGRICULTURAL PRODUCTS	BIOTA	ECOLOGICAL	SOIL	DIRECT RADIATION
IDAHO NATIONAL LABORATORY CONTRACTOR					
INL Site/Regional	•	•	•	•	•
IDAHO CLEANUP PROJECT CONTRACTOR					
ICDF[b]	—[d]	—	—	—	•
RWMC[c]	—	—	—	—	•

a. INL Site = Idaho National Laboratory Site facility areas and areas between facilities.
b. ICDF = Idaho Comprehensive Environmental Response, Compensation, and Liability Act Disposal Facility.
c. RWMC = Radioactive Waste Management Complex.
d. — = media not sampled.

7.1 Agricultural Products and Biota Sampling

Agricultural products and game animals are sampled by the INL contractor because of the potential transfer of radionuclides to people through food chains, as was shown in Chapter 4, Figure 4-1. Figure 7-1 shows the locations where agricultural products were collected in 2022.

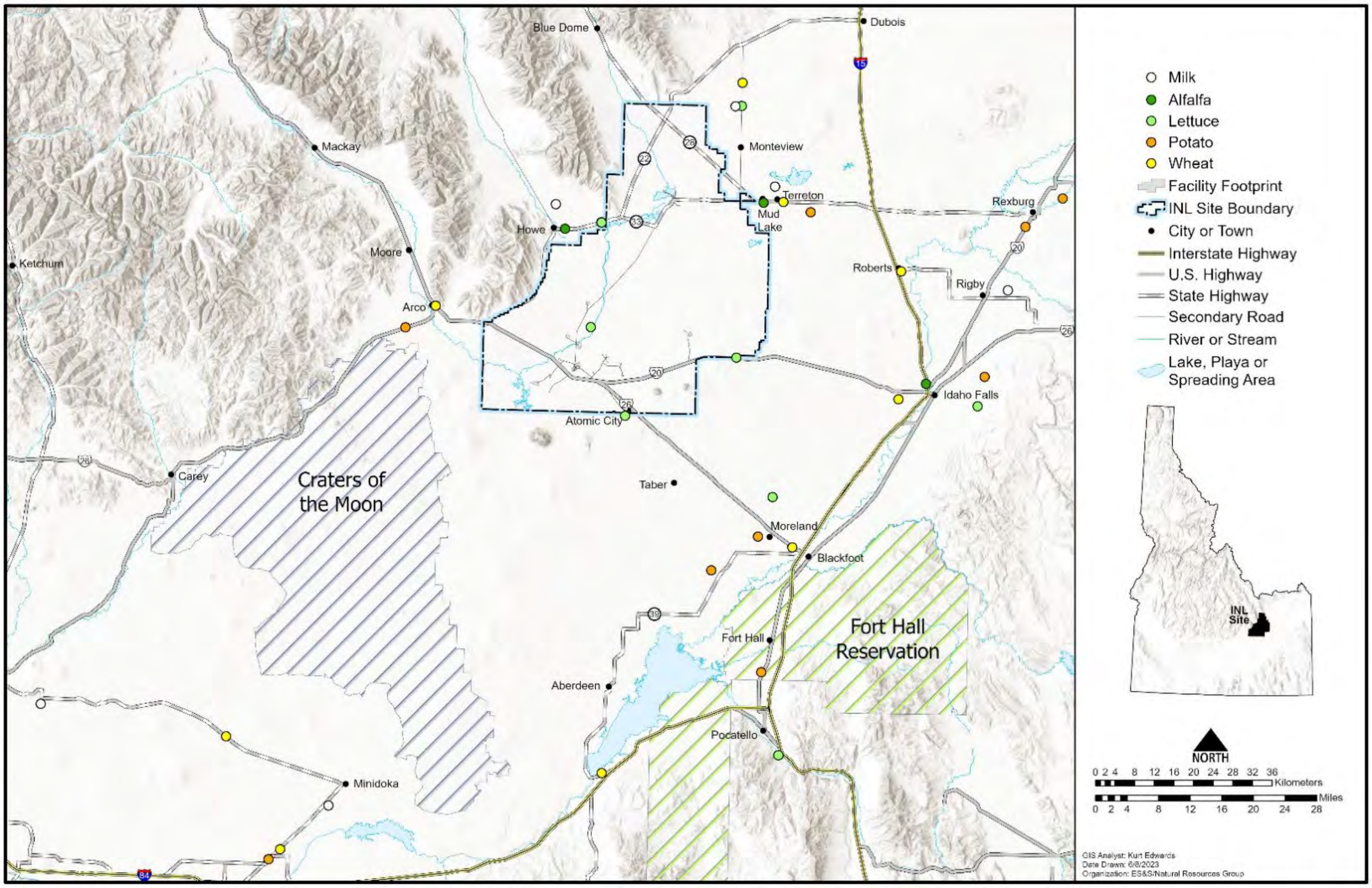

Figure 7-1. Locations of agricultural product samples collected (2022).

7.2 Sampling Design for Agricultural Products

Agricultural products could become contaminated by radionuclides released from INL Site facilities, which are transported offsite by wind and deposited in soil and on plant surfaces. This is important, since approximately 45% of the land surrounding the INL Site is used for agriculture (DOE-ID 1995). Additionally, many residents maintain home gardens that could be impacted by INL Site releases. Animals could also eat contaminated crops and soil and in turn transfer radionuclides to humans through consumption of meat and milk.

Agricultural product sampling began in the vicinity of the INL Site in the 1960s with milk and wheat as part of the routine Environmental Surveillance program. Currently, the program focuses on milk, leafy green vegetables, alfalfa, potatoes, and grains.

As specified in the *DOE Handbook Environmental Radiological Effluent Monitoring and Environmental Surveillance* (DOE 2015), representative samples of the pathway-significant agricultural products grown within 16 km (10 miles) of the INL Site should be collected and analyzed for radionuclides potentially present from INL Site operations. These samples should be collected in at least two locations: (1) the place of expected maximum radionuclide concentrations and (2) a "background" location unlikely to be affected by radionuclides released from the INL Site.

Sample design was primarily guided by wind direction and frequencies and farming practices. Air dispersion modeling, using CALPUFF and INL Site meteorological data measured from 2006 through 2008, was performed to develop data quality objectives for radiological air surveillance for the INL Site using the methodology documented in Rood and Sondrup (2014). The same methodology was used to discern deposition patterns. The dispersion and deposition patterns resulting from these sources reflect wind patterns typical of the INL Site. Prevailing winds at most INL Site locations are from the southwest during daytime hours. During evening hours, the winds will sometimes shift direction and blow from the north or northeast but at a lower velocity. Model results show the location of maximum offsite deposition is located between the southwest INL Site boundary and Big Southern Butte. Because there are no agricultural activities in this region, sampling is focused on other agricultural areas west and northeast of the INL Site. In addition, the sampling design considers locations of interest to the public as well as those of historical interest, which is why some samples are collected at extended distances from the INL Site.

7.2.1 Methods

Fresh produce and milk are purchased from local farmers when available. In addition, lettuce is grown by the INL contractor in areas that have no commercial or private producers.

7.2.2 Milk Results

Milk is sampled to monitor the pathway from potentially contaminated, regionally grown feed to cows, then to milk, which is then ingested by humans. During 2022, the INL contractor collected 184 milk samples (including duplicates and controls) at various locations off the INL Site (Figure 7-1) and from commercially available milk from outside the state of Idaho (the control). The number and location of the dairies can vary from year to year as farmers enter and leave the business. Milk samples were collected weekly from dairies in Rigby and Terreton, Idaho, and monthly at other locations around the INL Site.

All milk samples were analyzed for gamma-emitting radionuclides, including iodine-131 (^{131}I) and cesium-137 (^{137}Cs). During the second and fourth quarters, samples were analyzed for strontium-90 (^{90}Sr) and tritium.

Iodine is an essential nutrient and is readily assimilated by cows or goats that eat plants containing the element. Iodine-131 is of particular interest because it is produced by nuclear reactors or weapons, is readily detected, and, along with cesium-134 and ^{137}Cs, can dominate the ingestion dose regionally after a severe nuclear event, such as the Chernobyl accident (Kirchner 1994) in Ukraine or the 2011 accident at Fukushima in Japan. The ingestion of milk pathway is the main route of internal ^{131}I exposure for people. Iodine-131 has a short half-life (eight days) and, therefore, does not persist in the environment. Past releases from experimental reactors at the INL Site and fallout from atmospheric nuclear weapons tests and Chernobyl are no longer present. Most of the ^{131}I released in 2022 was from the Materials and Fuels Complex (approximately 0.09 Ci). None was detected in air samples collected at or beyond the INL Site boundary (see Chapter 4). Iodine-131 was not detected in any milk sample collected during 2022.

Cesium-137 is chemically analogous to potassium in the environment and behaves similarly by accumulating in many types of tissue, most notably in muscle tissue. It has a half-life of about 30 years and tends to persist in soil. If in a soluble form, it can readily enter the food chain through plants. It is widely distributed throughout the world from historic nuclear weapons detonations, which occurred between 1945 and 1980, and has been detected in all environmental media at the INL Site. Regional sources include releases from INL Site facilities and resuspension of previously contaminated soil particles. Three milk samples collected during 2022 indicated ^{137}Cs was present, however, further review of the data determined these were false positives and that a confirming peak for ^{137}Cs was not present in the samples. Cesium-137 was not detected in any milk sample collected in 2022.

Strontium-90 is an important radionuclide because it behaves like calcium and can deposit in bones. Strontium-90, like ^{137}Cs, is produced in high yields either from nuclear reactors or from detonations of nuclear weapons. It has a half-life of about 29 years and can persist in the environment. Strontium tends to form compounds that are more soluble than ^{137}Cs and is therefore comparatively mobile in ecosystems. Strontium-90 was detected in two of the 14 milk samples analyzed. Concentrations ranged from -0.04 ± 0.16 pCi/L at Terreton to 0.55 ± 0.13 pCi/L at Minidoka, as observed in Table 7-2. These levels were consistent with levels reported by the U.S. Environmental Protection Agency (EPA) as resulting from worldwide fallout deposited on soil and taken up by cows through the ingestion of grass. Results from EPA Region 10, which includes Idaho, for a limited dataset of seven samples collected from 2007 through 2016, ranged from 0 to 0.54 pCi/L (EPA 2017). The maximum concentration detected in the past 10 years was 2.37 ± 0.29 pCi/L, measured at Fort Hall in November 2013.

DOE has established Derived Concentration Standards (DCSs) (DOE 2021) for radionuclides in air, water, and milk. A DCS is the concentration of a radionuclide in air, water, or milk that would result in a dose of 100 mrem from ingestion, inhalation, or immersion in a gaseous cloud for one year. The DCS for ^{90}Sr in milk is 5,800 pCi/L. Therefore, the maximum observed value in milk samples (0.55 ± 0.13 pCi/L) is approximately 0.009% of the DCS for milk.

Tritium, with a half-life of about 12 years, is an important radionuclide because it is a radioactive form of hydrogen, which combines with oxygen to form tritiated water. The environmental behavior of tritiated water is like that of water and can be present in surface water, precipitation, and atmospheric moisture. Tritium is formed by natural processes, as well as by reactor operation and nuclear weapons testing. Tritium enters the food chain through surface water that people and animals drink and from plants that contain water. Tritium was detected in one of the milk samples analyzed during 2022, as observed in Table 7-2. Concentrations varied from -72.00 ± 23.50 pCi/L in a sample from Monteview in November 2022 to 123.00 ± 25.70 pCi/L in the control sample collected in May 2022. These concentrations are similar to those of previous years and are consistent with those found in atmospheric moisture and precipitation samples. The DCS for tritium in milk is 12,000,000 pCi/L.

Table 7-2. Strontium and tritium concentrations[a] in milk samples collected offsite in 2022.

STRONTIUM-90 (pCi/L)		
LOCATION	**MAY 2022**	**NOVEMBER 2022**
Dietrich	0.13 ± 0.10	0.06 ± 0.11
Howe	0.52 ± 0.19	0.09 ± 0.06
Minidoka	**0.55 ± 0.13**	0.12 ± 0.11
Monteview	0.05 ± 0.13	0.19 ± 0.08
Rigby	0.15 ± 0.13	0.08 ± 0.08
Terreton	-0.04[b] ± 0.16	0.35 ± 0.12
Control (Colorado)	**0.46 ± 0.13**	0.22 ± 0.13
TRITIUM (pCi/L)		
LOCATION	**MAY 2022**	**NOVEMBER 2022**
Dietrich	58.60 ± 24.80	-12.50 ± 24.80
Howe	-9.98 ± 24.00	15.90 ± 26.00
Minidoka	34.60 ± 25.40	-36.90 ± 24.50
Monteview	2.72 ± 24.20	-72.00 ± 23.50
Rigby	23.90 ± 25.30	48.00 ± 25.20
Terreton	3.87 ± 25.10	-25.10 ± 24.10
Control (Colorado)	**123.00 ± 25.70**	-26.70 ± 24.10

a. Results ± 1σ. Results greater than 3σ uncertainty are considered statistically detected and are indicated with a **bold** value.

b. A negative result indicates that the measurement was less than the laboratory background measurement.

7.2.3 Lettuce Results

Lettuce was sampled because radionuclides in air can be deposited on soil and plants, which can then be ingested by people, as shown in Figure 4-1. The uptake of radionuclides by plants may occur through root uptake from soil and from absorption of deposited material on leaves. For most radionuclides, uptake by foliage is the dominant process for contamination of plants (Amaral et al. 1994). For this reason, green, leafy vegetables, such as lettuce, have higher concentration ratios of radionuclides to soil than other kinds of plants. The INL contractor collects lettuce samples every year from areas on and adjacent to the INL Site, as observed in Figure 7-1. The number and locations of gardens have changed from year to year, depending on whether vegetables were available. Home gardens have been replaced with portable lettuce planters, as shown in Figure 7-2, because the availability of lettuce from home gardens was unreliable at some key locations.

Figure 7-2. Portable lettuce planter.

In addition, planters can be placed, and the lettuce collected at areas previously unavailable to the public such as on the INL Site and near air samplers. The planters can allow radionuclides deposited from the air to accumulate on the soil and plant surfaces throughout the growth cycle. The planters are placed in the spring, filled with soil and potting mix, sown with lettuce seed, and self-watered through a reservoir.

Five lettuce samples were collected from portable planters at Atomic City, the Experimental Field Station, the Federal Aviation Administration Tower, Howe, and Monteview. In 2022, soil from the vicinity of the sampling locations was used in the planters. This soil was amended with potting soil as a gardener in the region would typically do when they grow their lettuce. In addition to the portable samplers, a sample was obtained from farms in Ammon, Blackfoot, and Pocatello, Idaho, and a control sample was purchased at the grocery store from an out-of-state location (California).

The samples were analyzed for ^{90}Sr and gamma-emitting radionuclides. Strontium-90 was not detected in the lettuce samples collected during 2022. Strontium-90 is present in the environment as a residual of fallout from above-ground nuclear weapons testing, which occurred between 1945 and 1980. No other human-made radionuclides were detected in any of the lettuce samples. Although ^{137}Cs from nuclear weapons testing fallout is measurable in soils, the ability of vegetation, such as lettuce, to incorporate cesium from soil in plant tissue is much lower than for strontium (Fuhrmann et al. 2003; Ng, Colsher, and Thompson 1982; Schulz 1965). In addition, the availability of ^{137}Cs to plants depends highly on soil properties, such as clay content or alkalinity, which can act to bind the radionuclide (Schulz 1965). Soils in southeast Idaho tend to be moderately to highly alkaline.

7.2.4 Grain Results

Grain (including wheat and barley) is sampled because it is a staple crop in the region. In 2022, the INL contractor collected grain samples at 10 locations from areas surrounding the INL Site (Figure 7-1); an additional duplicate sample was collected from American Falls. A control sample was purchased from outside the state of Idaho. The locations were selected because they are typically farmed for grain and are encompassed by the air surveillance network. Exact locations may change as growers rotate their crops. No human-made radionuclides were found in any samples. Agricultural products, such as fruits and grains, are naturally lower in radionuclides than green, leafy vegetables (Pinder et al. 1990).

7.2.5 Potato Results

Potatoes are collected because they are one of the main crops grown in the region and are of special interest to the public. Because potatoes are not exposed to airborne contaminants, they are not typically considered a key part of the ingestion pathway. Potatoes were collected by the INL contractor at nine locations in the vicinity of the INL Site and an additional duplicate sample was collected from Moreland (Figure 7-1). A control sample was purchased from outside the state of Idaho. None of the potato samples (including duplicates) collected during 2022 contained a detectable concentration of any human-made radionuclides. Potatoes, like grain, are generally less efficient at removing radioactive elements from soil than leafy vegetables such as lettuce.

7.2.6 Alfalfa Results

In addition to analyzing milk, the INL contractor began collecting data in 2010 on alfalfa consumed by milk cows. A sample of alfalfa was collected in June 2022 from locations in the Mud Lake area, Howe, and Idaho Falls. Mud Lake is an agricultural area with a high potential for offsite contamination via the air pathway are shown in Figure 8-6. (Note: The highest offsite air concentration used for estimating human doses was located southeast of the INL Site’s east entrance; however, there is limited agriculture near that location.) The samples were analyzed for gamma-emitting radionuclides and ^{90}Sr. Strontium-90 was detected in the Mud Lake (90.8 ± 19.5 pCi/kg) sample collected in 2022. Concentrations for ^{90}Sr ranged from -8.5 ± 17.1 pCi/kg to 90.8 ± 19.5 pCi/kg. No gamma-emitting radionuclides were detected in the alfalfa samples collected during 2022.

7.2.7 Big Game Animals Results

Muscle, liver, and thyroid samples were collected, under a scientific collection permit, from five big game animals. The muscle and liver samples were analyzed for ^{137}Cs because it is an analog of potassium and is readily incorporated into muscle and organ tissues. Thyroids are analyzed for ^{131}I because they selectively concentrate in the thyroid gland when assimilated by many animal species, thus they are an excellent bio-indicator of atmospheric releases.

Iodine-131 was not detected in the thyroid samples. No ^{137}Cs or other human-made, gamma-emitting radionuclides were found in any of the muscle or liver samples.

7.2.8 Waterfowl Results

Waterfowl are collected, under a scientific collection permit, each year at ponds on the INL Site and at a location offsite. Three waterfowl collected from wastewater ponds located at the Advanced Test Reactor (ATR) Complex, one waterfowl from INTEC, one waterfowl from Test Area North (TAN), and three control waterfowl collected from Swan Valley were analyzed for gamma-emitting radionuclides, ^{90}Sr, and actinides americium-241 (^{241}Am), plutonium-238 (^{238}Pu), and plutonium-239/240 ($^{239/240}$Pu). These radionuclides were selected because they have historically been measured in liquid effluents from some INL Site facilities. Each sample was divided into the following three subsamples: (1) edible tissue (e.g., muscle, gizzard, heart, liver), (2) external portion (e.g., feathers, feet, head), and (3) all remaining tissue.

Three human-made radionuclides were detected in edible, exterior, and remainder subsamples from the ducks collected at the ATR Complex ponds and TAN. The radionuclides were cobalt-60 (^{60}Co), ^{90}Sr, and ^{65}Zn. An American Wigeon collected from the sewage lagoons at ATR Complex had one of these radionuclides in edible tissue identified in Table 7-3.

Because more human-made radionuclides were found in ducks from the ATR Complex than other locations and at higher levels, it is assumed that the evaporation pond associated with this facility is the source of these radionuclides. The ducks were not taken directly from the two-celled Hypalon-lined radioactive wastewater evaporation pond, but rather from an adjacent sewage lagoon. However, it is likely the ducks also spent time at the evaporation pond. The hypothetical dose to a hunter who eats a contaminated duck from the ATR Complex ponds is presented in Chapter 8, Section 8.3.1.

Table 7-3. Radionuclide concentrations detected in waterfowl collected in 2022.

RADIONUCLIDES DETECTED IN WATERFOWL TISSUE (pCi/kg)				
LOCATION	**SPECIES**	**PORTION**	**RADIONUCLIDE**	**CONCENTRATION**
ATR Complex	American Wigeon	Edible	^{90}Sr	38.7 ± 6.74
		Exterior	^{60}Co	18.5 ± 2.15
			^{90}Sr	89.6 ± 5.86
		Remainder	^{90}Sr	113.0 ± 6.96
	Gadwall	Remainder	^{90}Sr	17.2 ± 5.42
	Blue-Winged Teal	Exterior	^{60}Co	18.4 ± 5.36
		Remainder	^{90}Sr	25.5 ± 3.95
TAN	Ruddy Duck	Exterior	^{65}Zn	4.32 ± 0.57

7.2.9 Bats Results

Bat carcasses have been collected on the INL Site since the summer of 2015 under a scientific collection permit. Bat carcasses are used to identify if the death is related to a particular species and needs to be examined. Since bat carcasses are discovered in facility buildings or outside in areas near facilities, the carcasses may be sent to a qualified laboratory to assess the presence of radionuclides. The analysis results can be used to calculate the potential dose bats receive. Bats are typically desiccated when received and generally weigh about a few grams each. The samples collected in 2022 were analyzed for gamma-emitting radionuclides, for specific alpha-emitting radionuclides (plutonium isotopes and ^{241}Am), and for ^{90}Sr (a beta-emitting radionuclide).

The bat carcasses were divided and composited by the following areas in 2022: TAN, Naval Reactors Facility, Materials and Fuels Complex, Central Facilities Area, and ATR Complex/INTEC.

The bat analysis results are summarized in Table 7-4. The following radionuclides were detected in at least one sample during 2022: ^{137}Cs, ^{60}Co, and ^{90}Sr. Cesium-137 is ubiquitous in the environment because of fallout from historical nuclear weapons tests. Strontium-90 is another fallout radionuclide. Cobalt-60, which is a fission product, may indicate that the bats visited radioactive effluent ponds on the INL Site such as at the ATR Complex ponds. The potential doses received by bats are discussed in Chapter 8, Section 8.8.2.

Table 7-4. Radionuclide concentrations measured in bats collected in 2022.

BAT TISSUE CONCENTRATIONS (pCi/kg)			
RADIONUCLIDE	MINIMUM[a]	MAXIMUM[b]	NUMBER OF DETECTIONS[c]
Americium-241	ND[d]	ND	0
Cesium-137	1,510 ± 134	2,870 ± 153	2
Cobalt-60	667 ± 130	5,450 ± 229	3
Plutonium-238	ND	ND	0
Plutonium-239/240	ND	ND	0
Strontium-90	182 ± 46	9,200 ± 117	5

a. Minimum detected concentration.

b. Maximum detected concentration.

c. Out of five composites analyzed.

d. ND = not detected.

7.3 Soil Sampling

In the early 1970s, the DOE Radiological and Environmental Sciences Laboratory (RESL) established a routine program for collecting surface and subsurface soils (0–5 cm and 5–10 cm deep) on and around the INL Site. At that time, RESL established extensive onsite soil sampling grids outside INL Site facilities. Offsite locations were also established by RESL during this process to serve as background sites. RESL analyzed all samples (onsite and offsite) for gamma-emitting radionuclides while a subset onsite analyzed for ^{90}Sr, ^{241}Am, and isotopes of plutonium. In addition, all soil from the surface component (0–5 cm) of the offsite samples was analyzed for ^{90}Sr and alpha-emitting radionuclides (^{241}Am and isotopes of plutonium).

Between 1970 and 1978, RESL extensively sampled the onsite grids outside INL Site facilities and then reduced the onsite sampling frequency to a seven-year rotation that ended in 1990 with sampling at the Test Reactor Area (now known as the ATR Complex). Surface soils were sampled at offsite and boundary locations annually from 1970 to 1975, and the collection interval for offsite soils was extended to every two years starting in 1978.

The INL contractor currently completes soil sampling on a five-year rotation at the INL Site to evaluate long-term accumulation trends and to estimate environmental radionuclide inventories. Sampling occurred in 2022 and is next scheduled for 2027. Data from previous years of soil sampling and analysis on the INL Site show slowly declining concentrations of short-lived radionuclides of human origin (e.g., ^{137}Cs), with no evidence of detectable concentrations depositing onto surface soil from ongoing INL Site releases, as discussed in INL (2016).

7.3.1 Soil Sampling Design

The basis for the current INL contractor soil sampling design is defined in the *Data Quality Objectives Supporting the Environmental Soil Monitoring Program for the INL Site* (INL 2022b). The data quality objectives used historical data, current emissions data, and soil-deposition modeling for establishing the quality and quantity of data needed to support decision making for protecting human health and the environment. Figure 7-3 shows the INL Site soil monitoring locations for 2022, most of which are near the Radioactive Waste Management Complex (RWMC).

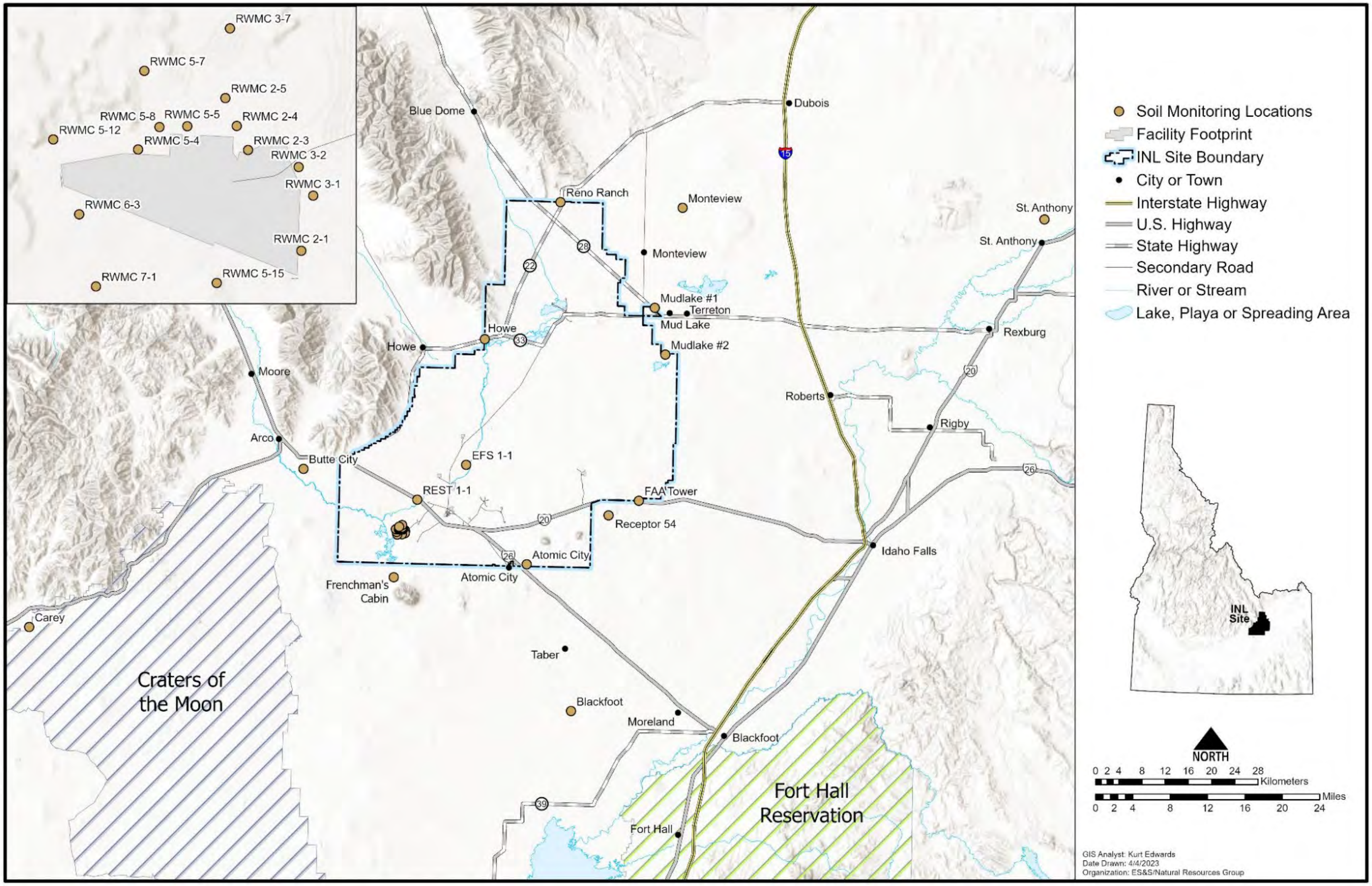

Figure 7-3. Soil sampling locations in 2022.

To determine the need for soil sampling, potential releases from each INL facility were modeled using CALPUFF, a non-steady-state Lagrangian puff dispersion model (Rood and Sondrup 2014), and estimated particulate deposition rates (INL 2016). The results showed that for the onsite facilities, only the RWMC has the potential for soil accumulations to be detectable in less than a decade. Results for the other facilities (e.g., Idaho Nuclear Technology and Engineering Center and Materials and Fuels Complex) showed the potential for surface accumulations to be detectable only after hundreds to thousands of years (INL 2016). In addition, at best, soil sampling is of questionable value in attempting to estimate small increments of deposition over a period of a few years or less because of the large uncertainties in sampling itself and the inherent variability in soil (EML 1997). Accordingly, the INL contractor uses a graded approach that considers extensive historical knowledge about soil conditions from past releases and current knowledge about facility emissions (INL 2016).

The INL contractor began performing near-facility monitoring at the RWMC in 2017 on a five-year rotation focusing on radionuclides that could be detectable in the relative near term (i.e., plutonium isotopes, ^{90}Sr, and gamma emitters). The original sampling points established by RESL were selected as logical monitoring locations for data comparisons. Of the approximately 50 sampling points established by RESL, historical data were collected mostly southwest and northeast of the facility, with the highest radionuclide concentrations being in the prevalent wind direction to the northeast. For the current sampling, a systematic, random sampling design was used to determine which of these points would be used as routine monitoring locations, as shown in Figure 7-3.

Additional soil monitoring away from RWMC includes two INL Site ambient air-monitoring locations (U.S. Highway 20/26 Rest Stop [REST] and the Experimental Field Station [EFS]) that were chosen so that soil, ambient air, and direct radiation data can be compared. These locations were also chosen because they have higher modeled deposition potential from major facility emissions than other ambient air monitor locations.

7.3.2 Methods

Soil is collected near each sampling post in an undisturbed area in a 100-m^2 area. Using techniques and equipment similar to those developed by RESL, each sample is a composite of five cores. Using a hammer, samplers force a metal ring that resembles a 10-cm-diameter and 5-cm-deep cookie cutter into the ground at the corners and center of the 100 m^2 area. Discreet samples are collected from each of the two depths: 0–5 cm and 5–10 cm. The soil inside each subsample is sieved through a 35-mesh screen, mixed in a pan, and composited into a single jar for that location.

7.3.3 Soil Sampling Results

Samples were collected from locations described in Figure 7-3. Background values for EFS, REST, Frenchmans Cabin, and Receptor 54 have not been determined since the minimum number of data points have not been met to calculate the INL site specific background values. As more data are collected from these sites, background values will be computed and comparisons will be made. For the remaining sampling locations, sitewide background values are available (INL 2017), and the radionuclides and concentrations at these locations are similar to those documented in Rood et al. (1996). Results obtained from monitoring sites were consistent with previous results and all the measured activities were less than the background values in Table 7-5.

7.4 Direct Radiation

7.4.1 Sampling Design

Thermoluminescent dosimeters (TLDs) were historically used to measure cumulative exposures in air (in milliRoentgen or mR) to ambient ionizing radiation. The TLD packets contain four lithium fluoride chips and were placed approximately 1 m (about 3 ft) above the ground at specified locations. Beginning with the May 2010 distribution of dosimeters, the INL contractor began collocating optically stimulated luminescent dosimeters (OSLDs) with TLDs. The primary advantage of the OSLD technology over the traditional TLD is that the nondestructive reading of the OSLD allows for dose verification (i.e., the dosimeter can be read multiple times without destruction of the accumulated signal inside the aluminum oxide chips). TLDs, on the other hand, are heated, and once the energy is released, they cannot be reread. The last set of INL contractor TLD results were from November 2012, whereas the last set of Environmental Surveillance, Education, and Research (ESER) TLD results were from November 2021.

Table 7-5. 2022 Soil results compared to background.

LOCATIONS	^{241}Am		^{137}Cs		^{238}Pu		$^{239/240}$Pu		^{90}Sr	
	RESULTS	BACKGROUND	RESULTS	BACKGROUND	RESULTS	BACKGROUND	RESULTS	BACKGROUND	RESULTS	BACKGROUND
	(pCi/kg)	(pCi/kg)	(pCi/kg)	(pCi/kg)	(pCi/kg)	(pCi/kg)	(pCi/kg)	(pCi/kg)	(pCi/kg)	(pCi/kg)
BOUNDARY										
Butte City	1.11E+01	9.42E+01	**4.18E+02**[a]	1.25E+03	3.83E+00	3.37E+01	**2.45E+01**	4.87E+01	**1.83E+02**	5.60E+02
FAA Tower	9.09E+00	3.56E+01	**4.81E+02**	1.62E+03	3.63E+00	7.43E+01	**1.88E+01**	8.29E+01	**1.37E+02**	8.06E+02
Frenchmans Cabin	4.92E+00	—[b]	**2.03E+02**	—	0.00E+00	—	**2.37E+01**	—	5.82E+01	—
Monteview	6.84E+00	1.94E+01	**2.93E+02**	1.11E+03	-8.91E-07	3.50E+01	**1.42E+01**	4.77E+01	4.29E+01	2.68E+02
Mud Lake[c]	6.76E+00	8.75E+01	**1.36E+02**	6.24E+02	4.72E+00	5.14E+01	**1.35E+01**	8.92E+01	1.60E+00	3.35E+02
Receptor 54	**2.06E+01**	—	**8.19E+02**	—	3.10E+00	—	**4.72E+01**	—	**1.38E+02**	—
OFFSITE										
Blackfoot	2.37E+00	4.05E+01	**1.43E+02**	2.70E+03	0.00E+00	1.54E+02	5.79E+00	2.39E+02	3.90E+01	3.98E+02
Carey	1.57E+01	5.56E+01	**5.47E+02**	9.63E+02	5.90E+00	4.47E+01	**2.85E+01**	6.71E+01	**8.68E+01**	5.34E+02
St. Anthony	8.98E+00	4.22E+01	**4.65E+02**	1.76E+03	3.68E+00	8.57E+01	**1.69E+01**	9.54E+01	**1.31E+02**	9.48E+02
ONSITE										
Atomic City	5.89E+00	2.78E+01	**2.90E+02**	1.01E+03	5.13E+00	2.27E+01	**2.05E+01**	5.73E+01	**7.63E+01**	7.34E+02
EFS	9.39E+00	—	**6.20E+02**	—	4.94E+00	—	**1.90E+01**	—	**2.11E+02**	—
Howe	4.95E+00	1.00E+01	**3.37E+02**	7.00E+02	1.53E+00	1.19E+01	**1.91E+01**	3.53E+01	-1.06E+01	6.70E+02
Reno Ranch	8.89E+00	2.68E+01	**6.09E+02**	1.58E+03	6.36E+00	1.44E+01	**2.85E+01**	6.77E+01	9.37E+01	9.11E+02
Hwy 26 Rest Area	**1.25E+01**	—	**3.34E+02**	—	4.45E+00	—	**2.03E+01**	—	**1.06E+02**	—
RWMC[c]	**1.53E+02**	8.40E+03	**3.72E+02**	3.54E+03	7.10E+00	5.80E+01	**1.51E+02**	2.57E+03	**9.69E+01**	2.47E+03

a. Results greater than 3σ uncertainty are considered statistically detected and are indicated with a **bold** value.

b. — = Insufficient amount of data to calculate background values.

c. Average of all sample locations.

Following the October 1, 2021, ESER transition to BEA their dosimetry sample locations were incorporated into the INL Environmental Dosimetry program with the first set of dosimeters being placed in the field on May 1, 2022. Offsite and boundary dosimeter locations are shown in Figure 7-4. The sampling periods for 2022 were from November 2021 to April 2022 and May 2022 to October 2022.

INL contractor was notified of plans to move radiological work occurring at IF-670 Bonneville County Technology Center to a new location. Beginning May 2022 dosimetry was established around the new location at IF-652A Lindsay Building (Figure B-16).

Dosimeters on the INL Site are placed at facility perimeters, concentrated in areas likely to detect the highest gamma radiation readings. Other dosimeters on the INL Site are located near radioactive materials storage areas and along roads.

7.4.2 Methods

Environmental OSLDs are placed in the field for six months. After the six-month period, the OSLDs are collected and returned to the supplier for analysis. Transit control dosimeters are shipped with the field dosimeters to measure any dose received during shipment.

Background radiation levels are highly variable; therefore, historical information establishes localized regional trends to identify variances. It is anticipated that 5% of the measurements will exceed the background dose. If a single measurement is greater than the background dose, it does not necessarily qualify that there is an unusually high amount of radiation in the area. When a measurement exceeds the background dose (Table 7-7), the measurement is compared to other values in the area and to historical data to determine if the results may require further action as described in *Data Quality Objectives Supporting the Environmental Direct Radiation Monitoring Program for the Idaho National Laboratory* (INL 2022a). The method for computing the background value as the upper tolerance limit (UTL) is described in EPA (2009) and EPA (2016). The ProUCL Version 5.1 software (EPA 2016) has been used to compute UTLs, given all available data in the area since 2012.

7.4.3 Results

The INL contractor OSLD data measured at boundary and offsite locations around the INL Site in 2022 are shown in Table 7-6. Using OSLD data collected by the INL contractor, the mean annual ambient dose was estimated at 118 mrem (1,180 µSv) for boundary and 118 mrem (1,180 µSv) for offsite locations. The mean annual ambient dose for all locations combined is 118 mrem (1,180 µSv). The annual mean ambient dose for all groups is consistent with past data (Table 7-6).

The 2022 direct radiation results collected by the INL contractor at boundary, offsite, and onsite locations are provided in Appendix B. Results are reported in gross units of ambient dose equivalent (mrem), rounded to the nearest mrem. The 2022 reported values for field locations were primarily below the historic six-month UTL. Table 7-7 shows locations that exceeded the specific six-month UTL. It should be noted that the UTLs for each six-month collection period are different since the *Data Quality Objectives Supporting the Environmental Direct Radiation Monitoring Program for the Idaho National Laboratory* (INL 2022a) was updated in July 2022. The UTLs for the May collection period were calculated using results measured from 2009 through 2018 (INL 2019). UTLs for the November collection period were calculated using results measured from 2012 through 2021 (INL 2022a). As discussed in Section 7.4.2, a result greater than the background level UTL does not necessarily mean that radiation levels have increased since it is anticipated that 5% of the measurements will exceed the background dose. Rather it indicates that the measurement should be compared to other values in the area and to historical data to provide context and determine if the results may require further action.

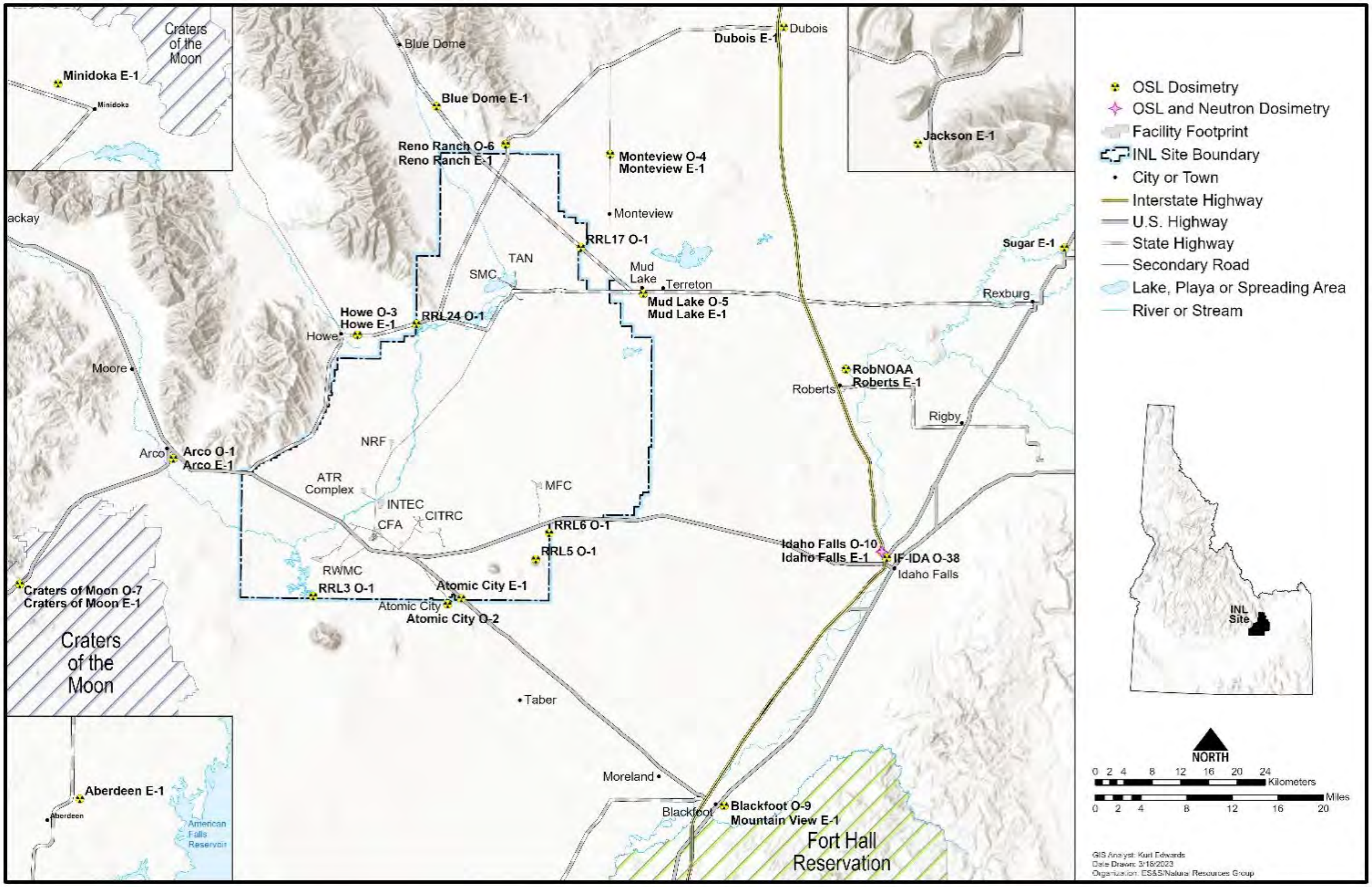

Figure 7-4. Offsite and boundary direct radiation monitoring locations (2022).

Table 7-6. Annual environmental radiation doses using OSLDs at all offsite locations (2018–2022).

LOCATION	2018		2019		2020		2021		2022
	ESER[a] (mrem)	INL[b] (mrem)	ESER (mrem)	INL (mrem)	ESER (mrem)	INL (mrem)	ESER (mrem)	INL (mrem)	INL[c] (mrem)
OFFSITE									
Aberdeen	123	NA[d]	134	NA	125	NA	134	NA	130
Blackfoot (Mountain View Middle School)	110	125	116	113	115	121	109	115	111[e]
Craters of the Moon	118	132	122	116	118	133	118	132	118[e]
Dubois	103	NA	110	NA	102	NA	106	NA	99
Idaho Falls	118	126	134	114	115	134	127	121	117[e]
IF-IDA	NA	119	NA	106	NA	112	NA	106	102
Jackson	109	NA	113	NA	108	NA	113	NA	114
Minidoka	109	NA	118	NA	111	NA	113	NA	110
Roberts[f]	130	145	134	133	129	138	134	128	134[e]
Sugar City	151	NA	156	NA	144	NA	149	NA	134
MEAN	**119**	**129**	**126**	**116**	**119**	**128**	**122**	**120**	**118**
BOUNDARY									
Arco	122	134	127	118	122	127	128	128	114[e]
Atomic City	122	132	135	112	124	125	130	130	124[e]
Birch Creek Hydro[g]	110	119	114	110	105	113	113	108	112[e]
Blue Dome	106	NA	111	NA	99	NA	109	NA	94
Howe	119	129	121	119	117	117	120	111	111[e]
Monteview	119	130	127	119	125	134	125	118	124[e]
Mud Lake	132	143	131	130	133	139	128	129	138[e]
MEAN	**119**	**131**	**124**	**120**	**118**	**126**	**122**	**121**	**118**

a. ESER = Environmental Surveillance, Education, and Research Program.

b. INL = Idaho National Laboratory.

c. The ESER program was transitioned to the INL contractor in October 2021. The first set of dosimeters, under the INL Environmental Dosimetry program, were placed in the field on May 1, 2022.

d. NA = Not applicable. Neither contractor samples at this location.

e. The value was calculated by averaging the annual dose for both the former ESER location and the INL contractor location (Appendix B, Figure B-12).

f. INL contractor calls this location RobNOAA.

g. INL contractor calls this location Reno Ranch.

Table 7-7. Dosimetry locations above the six-month background UTL (2022).

LOCATION	MAY 2022 SAMPLE RESULT (mrem)	BACKGROUND LEVEL UTL[a] (mrem)	NOV. 2022 SAMPLE RESULT (mrem)	BACKGROUND LEVEL UTL[a] (mrem)
ANL O-21	88.1	86.3	—	87.5
EBR I O-2	91.9	91.0	—	91.0
Hwy22 T28 O-1	—[b]	67.6	77.8	68.1
ICPP O-20	293.5	197.1	—	347.0
ICPP O-27	—	197.1	232.9	230.2
ICPP O-30	218.6	197.1	—	347.0
IF-638S O-3	74.2	66.9	—	66.4
RWMC O-13A	98.10	86.7	90.6	88.0
RWMC O-9A	—	86.7	93.5	88.0

a. The UTL is the value such that 95% of all the doses in the area are less than that value with 95% confidence. That is, only 5% of the doses should exceed the UTL.

b. — = Sample did not exceed the UTL for the collection period.

The facility perimeter dosimeters that exceeded the background level UTL in 2022 are listed in Figure 7-7. The exceedances at Argonne National Laboratory (ANL) (Figure B-6), Experimental Breeder Reactor I (EBR I) (Figure B-14), and Highway 22 T28 (Hwy22 T28) (Figure B-11) are only slightly above their UTLs. Locations at Idaho Nuclear Technology and Engineering Center (listed as Idaho Chemical Processing Plant [ICPP]), (Figure B-4), specifically ICPP O-20 appears to follow a pattern of elevated measurements. It should be noted with the UTL updates in June 2022 the location did not exceed the limit at the November collection. ICPP O-27 only slightly exceeded the UTL during the November collection. ICPP O-30 did exceed the UTL during the May collection, but when the UTL was recalculated, the November result did not exceed the UTL. It is anticipated the elevation is due to the work being performed in the area. Locations IF-638S (Figure B-5), RWMC O-13A, and RWMC O-9A (Figure B-9) are only slightly above the UTL. All 2022 environmental dosimetry results were provided to the Radiation Control Department for their consideration.

Neutron dose monitoring is conducted around buildings in Idaho Falls, Idaho, where sources may emit or generate neutron radiation. These buildings include IF-675 Portable Isotopic Neutron Spectroscopy Laboratory, IF-670 Bonneville County Technology Center, and IF-638 Physics Laboratory. Additional neutron dosimeters are placed at the INL Research Center along the south perimeter fence and at the background location Idaho Falls O-10. Onsite locations with neutron badges include Transient Reactor Test Facility and Remote-Handled Low-Level Waste Facility. All neutron dosimeters collected in 2022 were reported as “M,” which denotes the dose equivalents are below the minimum measurable quantity of 10 mrem. The background level for neutron dose is zero, and the current dosimeters have a detection limit of 10 mrem. Any neutron dose measured is considered present due to sources inside the building. The INL contractor follows the recommendations of the manufacturer to prevent environmental damage to the neutron dosimetry by wrapping each in aluminum foil. To keep the foil intact, the dosimeter is inserted into an ultraviolet protective cloth pouch when deployed.

Table 7-8 summarizes the calculated effective dose a hypothetical individual would receive on the Snake River Plain from various natural background radiation sources (e.g., cosmic and terrestrial). This table includes the latest recommendations of the National Council of Radiation Protection and Measurements (NCRP) in Ionizing Radiation Exposure of the Population of the United States (NCRP 2009).

Table 7-8. Calculated effective dose from natural background sources (2022).

SOURCE OF RADIATION DOSE	TOTAL AVERAGE ANNUAL DOSE	
	CALCULATED (mrem)	MEASURED[a] (mrem)
EXTERNAL IRRADIATION		
Terrestrial	70[b]	NA[c]
Cosmic	57[d]	NA
Subtotal	**127**	**118**
INTERNAL IRRADIATION (PRIMARILY INGESTION)[e]		
Potassium-40	15	NM[f]
Thorium-232 and uranium-238	13	NM
Others (carbon-14 and rubidium-87)	1	NM
INTERNAL IRRADIATION (PRIMARILY INHALATION)[d]		
Radon-222 (radon) and its short-lived decay products	212	NM
Radon-220 (thoron) and its short-lived decay products	16	NM
TOTAL	**384**	**NM**

a. Calculated from the average annual external exposure at all offsite locations measured using OSLDs (see Table 7-6).

b. Estimated using concentrations of naturally occurring radionuclide concentrations in soils in the Snake River Plain.

c. NA indicates terrestrial and cosmic radiation parameters were not measured individually but were measured collectively using dosimeters.

d. Estimated from Figure 3.4 of NCRP Report No. 160.

e. Values reported for average American adult in Table 3.14 of NCRP Report No. 160.

f. NM = not measured.

The terrestrial natural background radiation exposure estimate is based on concentrations of naturally occurring radionuclides found in soil samples collected from 1976–1993, as summarized by Jessmore, Lopez, and Haney (1994). Concentrations of naturally occurring radionuclides in soil do not change significantly over this relatively short period. Data indicate the average concentrations of uranium-238 (^{238}U), thorium-232 (^{232}Th), and potassium-40 (^{40}K) were 1.5, 1.3, and 19 pCi/g, respectively. The calculated external dose equivalents received by a member of the public from ^{238}U plus decay products, ^{232}Th plus decay products, and ^{40}K based on the above-average area soil concentrations were 21, 28, and 27 mrem/yr, respectively, for a total of 76 mrem/yr (Mitchell et al. 1997). Because snow cover can reduce the effective dose that Idaho residents receive from soil, a correction factor must be made each year to the estimated 76 mrem/yr. In 2022, this resulted in a reduction in the effective dose from soil to a value of 70 mrem.

The cosmic component varies primarily with increasing altitude. Using Figure 3.4 in NCRP Report No. 160 (NCRP 2009), it was estimated that the annual cosmic radiation dose near the INL Site is approximately 57 mrem. Cosmic radiation may vary slightly because of solar cycle fluctuations and other factors.

Based on this information, the sum of the terrestrial and cosmic components of external radiation dose to a person residing on the Snake River Plain in 2022 was estimated to be 127 mrem/yr. This is similar to the 118 mrem/yr measured at offsite locations using OSLD data. Measured values are typically within normal variability of the calculated background doses. Therefore, it is unlikely that INL Site operations contributed to background radiation levels at offsite locations in 2022.

The component of background dose that varies the most is inhaled radionuclides. According to the NCRP, the major contributor of effective dose received by a member of the public from ^{238}U plus decay products is short-lived decay products of radon (NCRP 2009). The amount of radon in buildings and groundwater depends, in part, upon the natural radionuclide content of soil and rock in the area. The amount of radon also varies among buildings of a given geographic area depending on the materials each contains, the amount of ventilation and air movement, and other factors. The United States average of 212 mrem/yr was used in Table 7-8 for this component of the total background dose. The NCRP also reports that the average dose received from thoron, a decay product of ^{232}Th, is 16 mrem.

People also receive an internal dose from ingestion of ^{40}K and other naturally occurring radionuclides in environmental media. The average ingestion dose to an adult living in the United States was reported in the NCRP Report No. 160 to be 29 mrem/yr (NCRP 2009).

With all these contributions, the total background dose to an average individual living in southeast Idaho was estimated to be approximately 387 mrem/yr, as identified in Table 7-8. This value was used to calculate background radiation dose to the population living within 50 miles of INL Site facilities, shown in Table 8-6.

7.5 Waste Management Surveillance Sampling

For compliance with DOE O 435.1, “Radioactive Waste Management,” vegetation and soil are sampled at the RWMC, and direct surface radiation is measured at the RWMC and the Idaho Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) Disposal Facility (ICDF).

7.5.1 Vegetation Sampling at the Radioactive Waste Management Complex

At the RWMC, vegetation was historically collected from four major areas, identified in Figure 7-5, and a control location approximately seven miles south of the Subsurface Disposal Area (SDA) at the base of Big Southern Butte. Russian thistle was collected in even-numbered years. Crested wheatgrass and rabbitbrush were collected in odd-numbered years. In 2018, the ICP contractor decided, using guidance from DOE-HDBK-1216-2015 (DOE 2015), to discontinue further biota sampling activities. This decision was based on an evaluation of biota sample data trends, which concluded that vegetation is not considered a major mode of radionuclide transport through the environment surrounding the SDA at RWMC.

7.5.2 Soil Sampling at the Radioactive Waste Management Complex

Waste management surveillance soil sampling has been conducted triennially at the SDA at the RWMC since 1994. The last triennial soil sampling event was conducted in 2015. In 2017, the results of soil sampling from 1994–2015 were reviewed for each constituent of interest and compared to their respective environmental concentration guide; these guidelines were established in 1986 in *Development of Criteria for the Release of Idaho National Engineering Laboratory Sites Following Decontamination and Decommissioning* (INL 1986). All results were well below their respective environmental concentration guide.

The footprint at the RWMC has changed drastically since this soil sampling began. The area where soil sampling has been performed at the SDA at RWMC is now a heavily disturbed area. Structures cover most of the area, and fill has been brought in where subsidence has occurred. Gravel has been applied for road base. The DOE Handbook, *Environmental Radiological Effluent Monitoring and Environmental Surveillance* (DOE 2015) states, “Except where the purpose of soil sampling dictates otherwise, every effort should be made to avoid tilled or disturbed areas and locations near buildings when selecting soil sampling locations.”

In 2017, a decision was made to discontinue soil monitoring based on several factors: (1) the limited availability of undisturbed soils, (2) sufficient historical data being collected previously to satisfy the characterization objectives, and (3) the conclusion that planned activities in the SDA do not have the potential to change surface soil contaminant concentrations prior to the installation of the surface cover over the entire SDA under the CERCLA program.

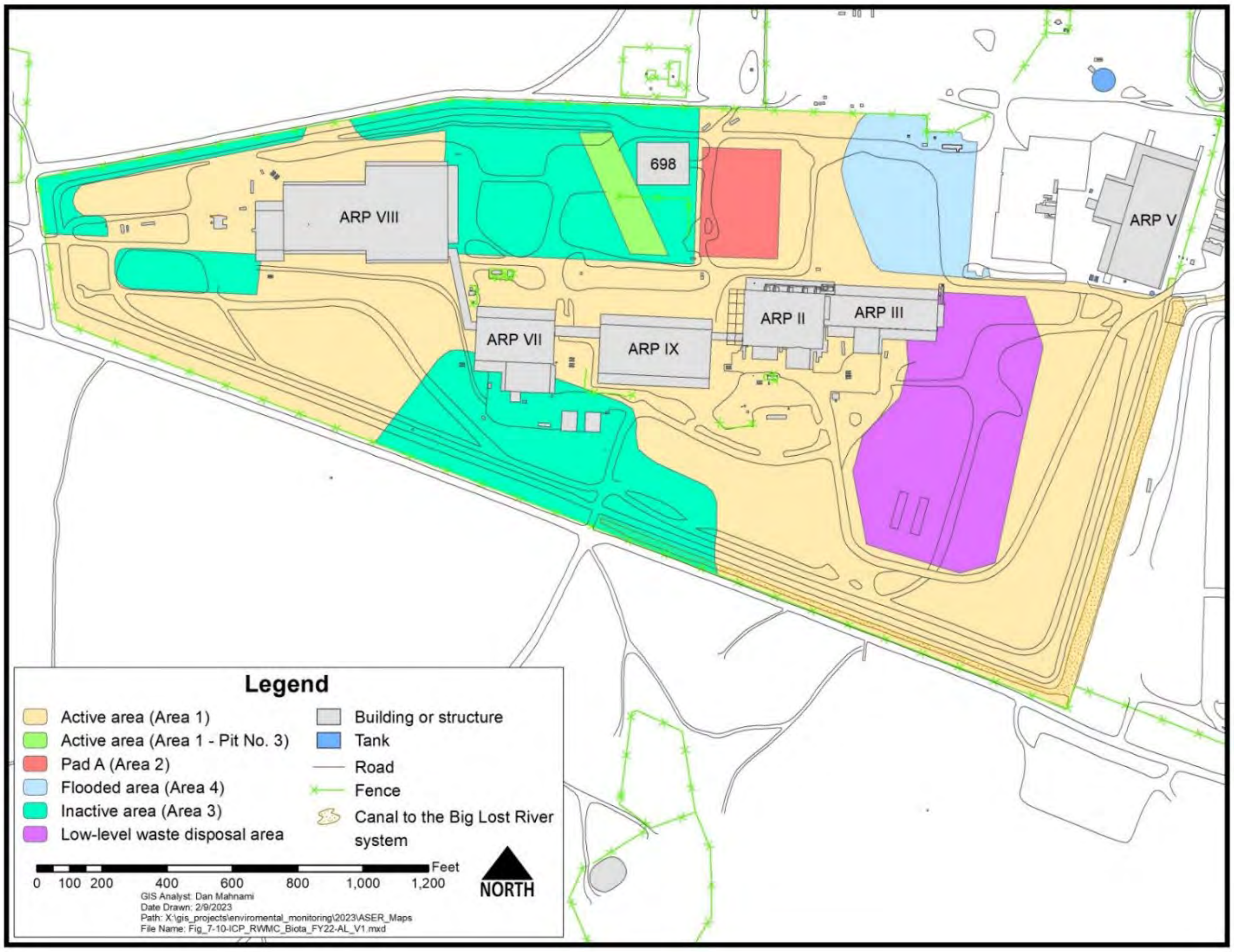

Figure 7-5. Historical vegetation sampling areas at the RWMC.

7.5.3 Surface Radiation Survey at the Radioactive Waste Management Complex and the Idaho CERCLA Disposal Facility

Surface radiation surveys are performed to characterize gamma radiation levels near the ground surface at waste management facilities. Comparing the data from these surveys year to year helps to determine whether radiological trends exist in specific areas. This type of survey is conducted at the SDA at RWMC and at the ICDF to complement air sampling. The SDA contains legacy waste, of which some is in the process of being removed for repackaging and shipment to an offsite disposal facility. The ICDF consists of a landfill and evaporation ponds, which serve as the consolidation points for CERCLA-generated waste within the INL Site boundaries.

A vehicle-mounted Global Positioning Radiometric Scanner (GPRS) system (Radiation Solutions, Inc., Model RS-701) was used to conduct this year's soil surface radiation (gross gamma) surveys to detect trends in measured levels of surface radiation. The RS-701 system consists of two sodium iodide (NaI) scintillator gamma detectors, housed in two separate metal cabinets, and a Trimble global positioning system receiver, mounted on a rack attached to the front bumper of a four-wheel drive vehicle. The detectors are approximately 24 inches above ground. The detectors and the global positioning system receiver are connected to a system controller and to a laptop computer located inside the cabin of the field vehicle. The GPRS system software displays the gross gamma counts and spectral second-by-second data from the detectors, along with the corresponding latitude and longitude of the system in real-time on the laptop screen. The laptop computer also stores the data files collected for each radiometric survey. During radiometric surveys, the field vehicle is driven 5 mph (7 ft/second), and the GPRS system collects latitude, longitude, and gamma counts per second from both detectors. Data files generated during the radiological surveys are saved and transferred to the ICP spatial analysis laboratory for mapping after the surveys are completed. The maps indicate areas where survey counts were at or near background levels and areas where survey counts are above background levels. No radiological trends were identified in 2022 in comparison to previous years.

Figure 7-6 shows a map of the area that was surveyed at RWMC in 2022. Some areas that had been surveyed in previous years could not be accessed due to construction activities and subsidence restrictions. Although readings vary slightly from year to year, the 2022 results are comparable to measurements in previous years. Most of the active low-level waste pit was covered during 2009, and, as a result of the reduced shine, elevated measurements from the buried waste in pits and trenches are more visible. Average background values near or around areas that were radiometrically scanned were generally at or below 4,000 counts per second. Most of the 2022 RWMC gross gamma radiation measurements were at or near background levels. The 2022 maximum gross gamma radiation measurement on the SDA was 40,152 counts per second, as compared to the maximum 2021 measurement of 27,874 counts per second. In previous years, maximum readings were measured in a small area at the western end of the soil vault row (SVR)-7, but measurements were lower for this location in 2022. The maximum readings in 2022 were observed directly north of the Accelerated Retrieval Project Storage Enclosure (WMF-698). This is likely attributed to waste operations and waste storage located within the building during the time of the survey.

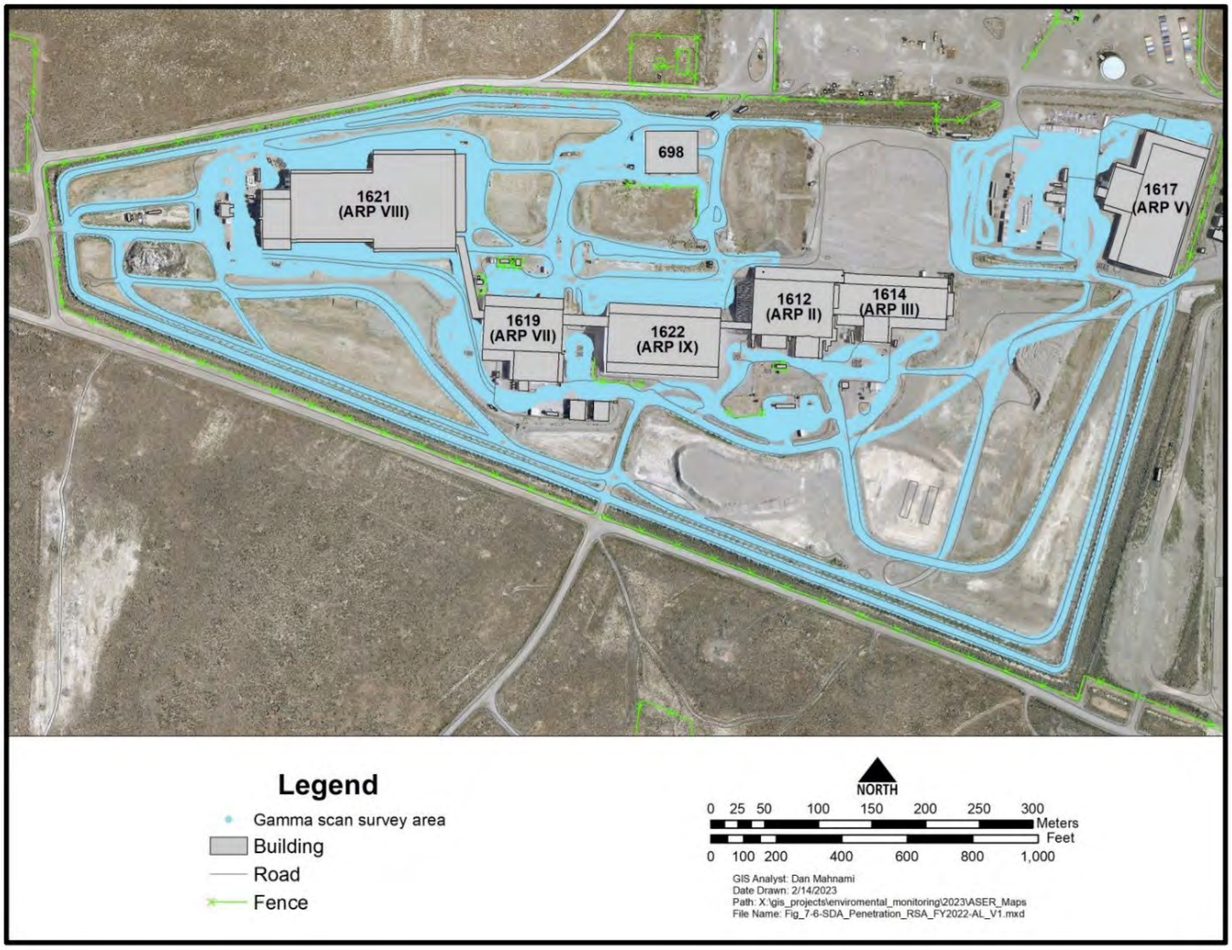

Figure 7-6. SDA surface radiation survey area (2022).

The area that was surveyed at the ICDF is shown in Figure 7-7. The readings at the ICDF vary from year to year. These variations are related to the disposal and burial of new CERCLA remediation wastes in accordance with the ICDF waste placement plan (EDF-ER-286, 2017). In 2022, the readings were either at background levels or slightly above background levels (approximately 3,000 counts per second), which is expected until the facility is closed and capped.

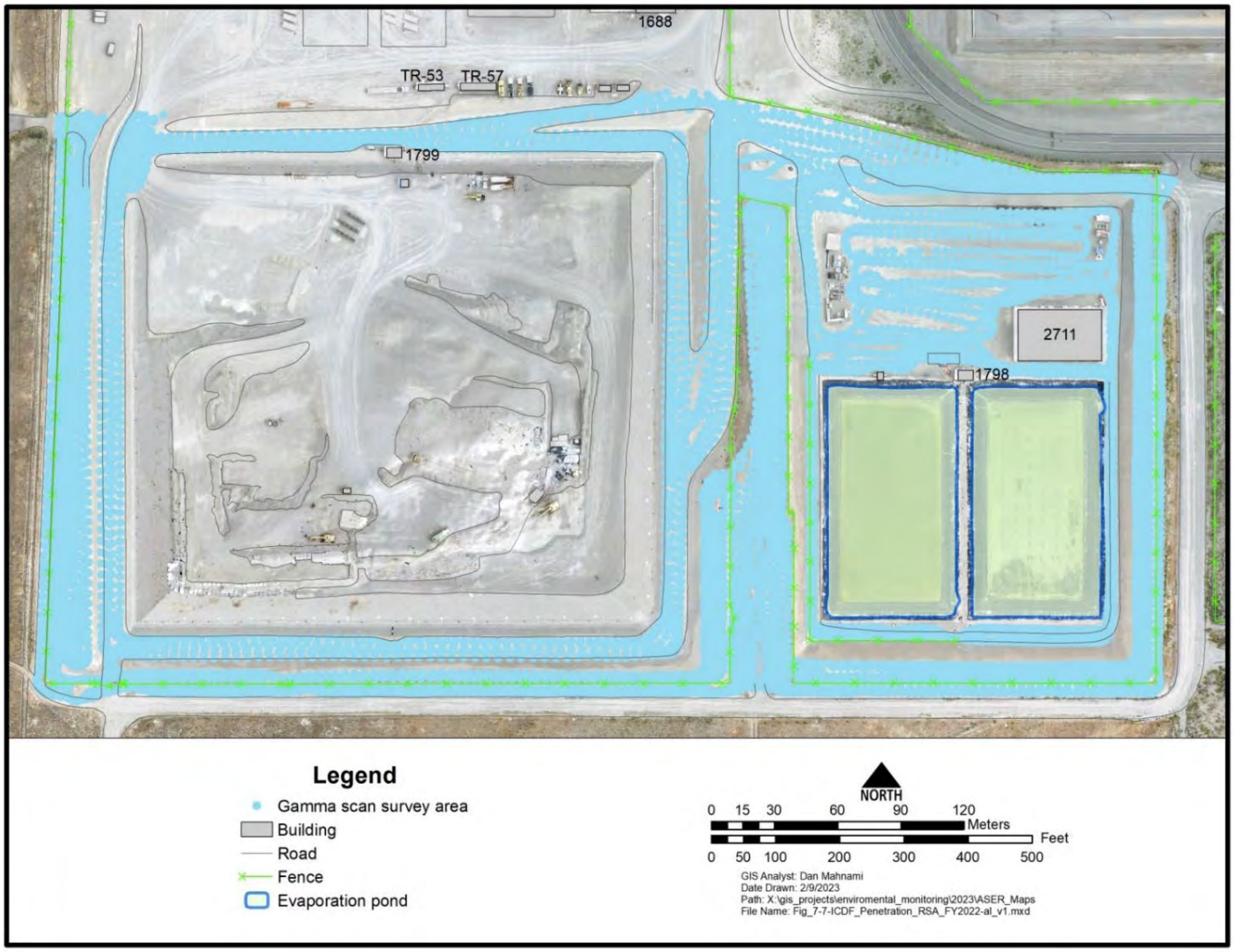

Figure 7-7. ICDF surface radiation survey area (2022).

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