5.0 Air Pathway

This chapter describes the air-pathway monitoring program used to track and evaluate airborne emissions from the Fernald Preserve. It includes a discussion of radiological air particulates and direct radiation.

Results in Brief: 2009 Air Pathway

Radiological Air Particulates—Data collected from the site boundary AMSs show that average concentrations for each radionuclide monitored were less than 1 percent of the corresponding DOE derived concentration guide.

Direct Radiation—2009 direct radiation measurements at the site boundary were similar to those measured in 2008. The maximum measured annual dose at the site boundary was 9 mrem above background.

Air-pathway monitoring focuses on airborne pollutants carried from the site as particles or gas and how these pollutants are distributed in the environment. The physical form and chemical composition of pollutants influence their dispersal in the environment and the delivered radiation dose. For example, fine particles and gases remain suspended, while larger, heavier particles tend to settle and deposit on the ground. Chemical properties determine whether the pollutant will dissolve in water, be absorbed by plants and animals, or remain in sediment and soil.

The final year of soil remediation at the Fernald Preserve was 2006. By the end of October 2006, all major sources of airborne contamination were removed from the site or placed in the OSDF. Therefore, the number of air monitoring stations (AMSs) was decreased from 17 to 11 in April 2006 (DOE 2006c) and from 11 to 6 in November 2006 (DOE 2006d). The six remaining monitors are located at five boundary locations and one background location (Figure 5−1). They have been used to demonstrate that wind erosion of the remediated soil and air emissions from controlled burns (conducted in 2009) pose no significant threat to the public or the environment. An evaluation of the data collected from the air monitoring stations during the past three years demonstrates that radiological concentrations in air remain low (i.e. at or near background). Based on the data indicating emissions are at or near background and the determination by EPA Office of Air and Radiation that three years of air monitoring following closure was appropriate, DOE ended the boundary air monitoring program January 4, 2010.

The site's air monitoring approach (presented in the IEMP) provides an ongoing assessment of the particulate emissions originating from wind erosion of soil, as well as direct radiation levels at the site boundary, hiking trails, and the Visitors Center. Results of the 2009 assessment indicate that particulate and direct-radiation measurements remain at the low levels observed in 2008, which reflects the absence of any significant surface contamination source on the Fernald Preserve.

5.1 Activities Affecting the Air Pathway

As the mission of the Fernald Preserve changed from production to remediation to wildlife preserve, work activities also changed. This change in work scope altered the characteristics of sources that emit pollutants in the environment via the air pathway. During the production years, the primary emission sources were point sources (i.e., stacks and vents) from process facilities. During remediation, the dominant emission sources were associated with construction activities in the form of fugitive emissions (i.e., excavation, hauling and processing of waste and contaminated soil, demolition of production facilities, and general activities supporting the remediation process) and the storage of radon-generating waste materials.

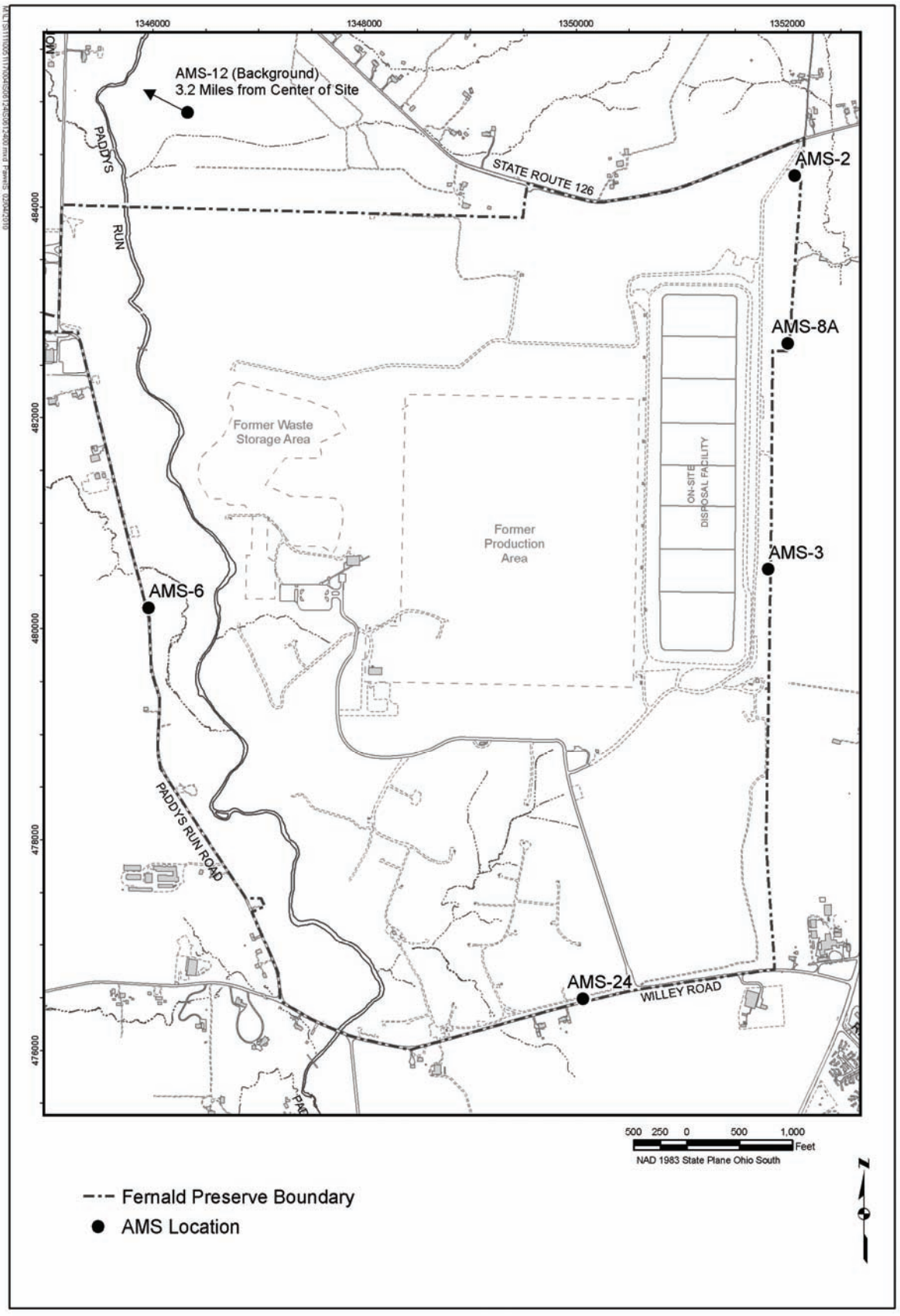

Figure 5–1. Radiological AMS Locations

During 2009, minor construction activities that could have affected the air pathway were those associated with mowing, soil conditioning and reseeding, construction and maintenance of hiking trails, and controlled burns. One other noteworthy event was the nesting of birds in the AMS-8A air monitor station (May and June).

5.2 Air Monitoring Program Summary for 2009

The site's air monitoring program, as defined in the IEMP, consists of two components:

- Radiological air particulate
- Direct radiation

Radon was dropped from the program in 2008, and 2009 will be the last year for particulate air monitoring (DOE 2009b). Monitoring for direct radiation will continue in the future.

Each component of the air monitoring program is designed to address a unique aspect of air-pathway monitoring, and each has distinct sampling methodologies and analytical procedures. The key elements of the air monitoring program design are:

- **Sampling**—Sample locations, frequency, and the constituents were selected to address DOE and EPA requirements for assessing radiological emissions from the Fernald Preserve. Key considerations in the design of the sampling program included prevailing wind directions and the location of off-property receptors.
- **Data Evaluation**—The data evaluation process focuses on tracking and trending data against historical ranges and DOE, EPA, and OEPA standards. Sections 5.3 and 5.4 in this chapter present the air data and a comparison to applicable standards and guidelines.
- **Reporting**—All data are reported through the annual Site Environmental Report.

5.3 Radiological Air Particulate Sampling Results

As described in the IEMP, high-volume air particulate monitoring stations are used to measure the collective contributions from fugitive particulate emissions from the site. Many factors contribute to the amount of particulate captured at the stations; the most significant factors are the frequency of soil disturbance, amount of vegetation cover, moisture content of the soil, and average daily wind speeds. Figure 5−1 provides the locations of the AMSs in operation during 2009. As the predominant wind direction is from the southwest (Appendix C, Attachment C.3), three of the five boundary monitors are located along the northeastern perimeter of the site.

The sampling and analysis program for the site boundary and background locations consists of monthly total uranium and total particulate analyses, and a quarterly composite sample. The quarterly composite sample is analyzed for radium-226, thorium-228, thorium-230, thorium-232, uranium-234, uranium-235, and uranium-238 to evaluate compliance with the following:

- NESHAP Subpart H requirements that stipulate radionuclide emissions (excluding radon) to the ambient air from DOE facilities shall not exceed amounts that would cause any member of the public to receive an effective dose equivalent of 10 mrem/yr (0.1 mSv/yr) above background levels. This dose is reported in the annual NESHAP Subpart H compliance report, which is attached as Appendix D.

- DOE Order 5400.5, *Radiation Protection of the Public and the Environment*, guidelines for concentrations of radionuclides in air emissions. These guidelines, referred to as derived concentration guide values, are concentrations of radionuclides that, under conditions of continuous exposure for one year by one exposure mode (e.g., inhalation or ingestion), would result in a dose of 100 mrem (1.0 mSv) to the public. These derived concentration guide values are not limits, but serve as reference values to assist in evaluating the radiological air particulate data.

Table 5−1 presents a summary of the minimum, maximum, and average concentrations for total uranium and total particulate in 2009 and 2008, as based on monthly samples. The 2009 maximum values for uranium and particulate are slightly lower than the 2008 maximums. At the five boundary stations, uranium ranged from 4.2×10^{-6} to 20×10^{-6} picocuries per cubic meter (pCi/m^3), which is much less than 1 percent of the DOE derived concentration guide value of $100{,}000 \times 10^{-6}$ pCi/m^3. Total particulate concentrations at the boundary ranged from 7.6 to 47 micrograms per cubic meter ($\mu g/m^3$). There are no general or site-specific regulatory limits associated with total particulate measurements.

Table 5–1. Summary of Total Uranium Activity and Particulate Concentrations in Air

Location	2009 Total Uranium (pCi/m^3)	2008 Total Uranium (pCi/m^3)	2009 Total Particulate ($\mu g/m^3$)	2008 Total Particulate ($\mu g/m^3$)
Boundary Locations				
Minimum	4.2×10^{-6}	5.1×10^{-6}	7.6	4.0
Maximum	20×10^{-6}	77×10^{-6}	47	65
Average	10×10^{-6}	13×10^{-6}	23	26
Background Location				
Minimum	7.8×10^{-6}	8.1×10^{-6}	15	17
Maximum	12×10^{-6}	13×10^{-6}	42	44
Average	9.2×10^{-6}	11×10^{-6}	24	26

Figure 5−2 shows total uranium variation at the boundary and background locations. Monthly results for 2009 are shown with the reported analytical uncertainty plotted as error bars. June and July samples for AMS-8A have no uranium or particulate results, as the samples were fouled by nesting birds, and DOE and OEPA concluded the results were invalid. Measurement uncertainty indicates that most monthly results for the boundary monitors slightly exceed the uranium activity measured at the background location. However, the measured uranium activity at the boundary is much less than the DOE derived concentration guidance value ($100{,}000 \times 10^{-6}$ pCi/m^3). Additional statistical analysis and graphical displays of the 2009 data are provided in Appendix C, Attachment C.1.

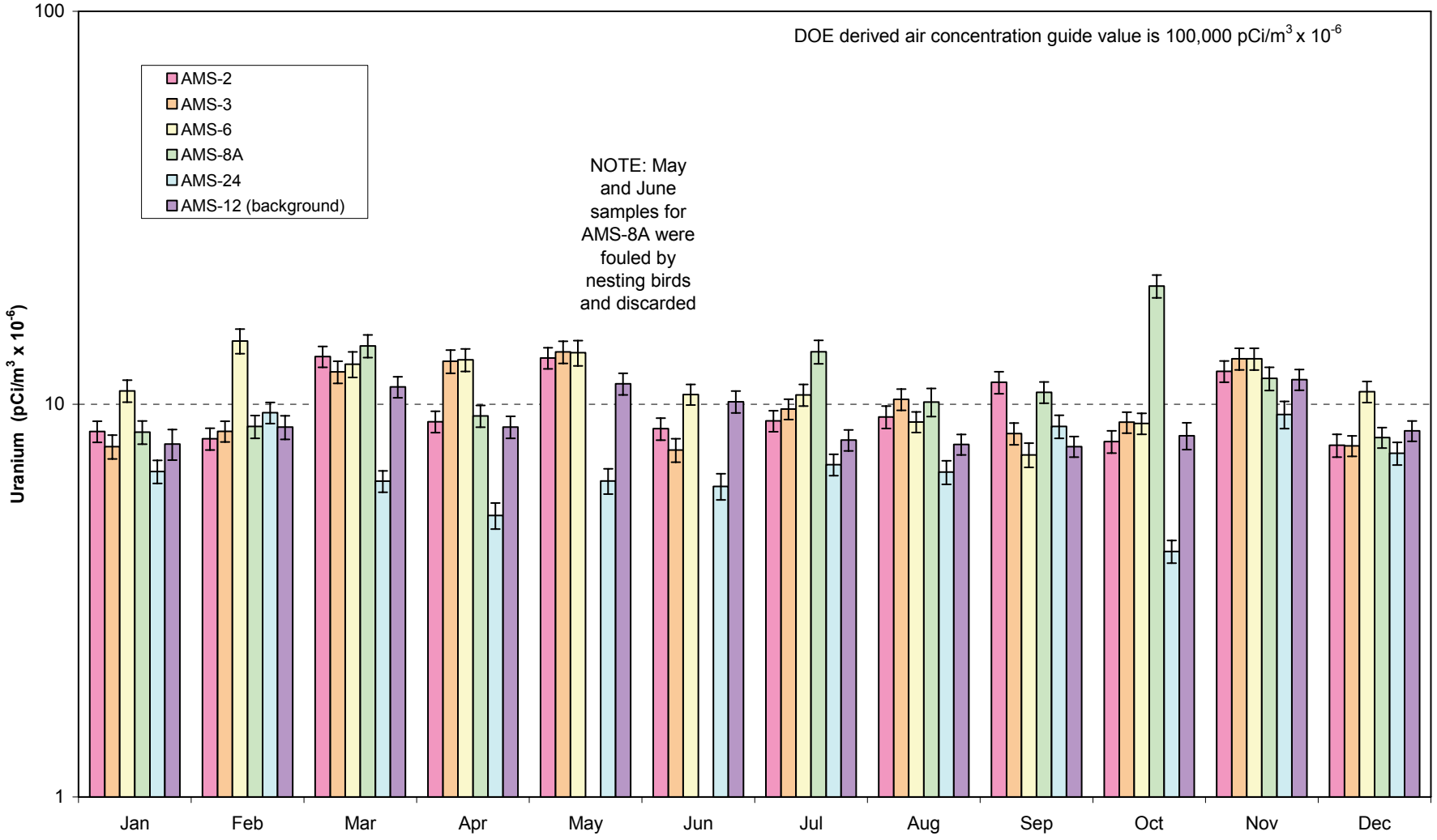

Figure 5–2. Monthly Results and Measurement Error for Uranium in Collected Air Particulate

In 2009, the quarterly composite samples were formed for each monitor from the monthly samples and analyzed for radium-226, thorium-228, thorium-230, thorium-232, uranium-234, uranium-235, and uranium-238. As noted above, June and July samples (representing the months of May and June) from AMS-8A were fouled by nesting birds and results are not reported. Therefore, the second-quarter sample for AMS-8A was a single sample from the month of April.

Figure 5−3 plots the annual activity and uncertainty for the quarterly results to show that boundary results are similar to background, with the exception of a lower thorium-228 and uranium-234 activity for AMS-24. Appendix C, Attachment C.1 presents the complete annual summary for the data, and Appendix D documents that the results are in compliance with the NESHAP 10 mrem/yr (0.1 mSv/yr) dose limit (the maximum dose for 2009 is 0.034 mrem/yr [0.00034 mSv/yr] at AMS-6).

5.4 Monitoring for Direct Radiation

Direct radiation originates from sources such as cosmic radiation, naturally occurring radionuclides in soil and food, and anthropogenic radioactive materials. Gamma rays and X-rays are the dominant types of radiation that create a public exposure concern because they penetrate into the deep tissues of the body. The largest historical source of direct radiation at the Fernald Preserve was waste material associated with the Silos Project. The last waste material associated with the Silos Project was removed from the site in 2006. Presently, there are no significant sources for direct radiation at the Fernald Preserve. During 2009, direct radiation levels at the Fernald Preserve were continuously measured at four trail locations, the Visitors Center, five boundary locations, and one background location with optically stimulated luminescence (OSL) dosimeters. The background location is located 3.2 miles from the center of the Fernald Preserve (Figure 5−4). The energy response of the OSL dosimeters is different from that of the thermoluminescent dosimeters (TLDs) used in previous years, which accounts for the difference in absolute values for each detector. However, the difference between the background and boundary monitors is similar for both types of detectors, and this difference (dose above background) is used to assess receptor dose.

Table 5−2 provides the annual range of direct radiation measurements for 2009 and 2008, and Figure 5−5 illustrates the quarterly results for 2009. Each quarterly result represents the average of three measurements obtained from three separate dosimeters placed at each location (except for the fourth quarterly result for OSL-52 because two of the three dosimeters were stolen). In general, the first-quarter results were slightly less than other quarters. On the basis of background results, most results are slightly higher, and the Visitors Center results are lower due to the shielding provided by the building materials. However, as noted in Appendix C, Attachment C.2, the boundary measurements are similar to background when statistical variability is evaluated, which is in agreement with removal of the last direct radiation sources in 2006. This observation should be noted when reviewing the dose assessment presented in Chapter 6 and Appendix D (i.e., there is no significant dose associated with direct radiation).

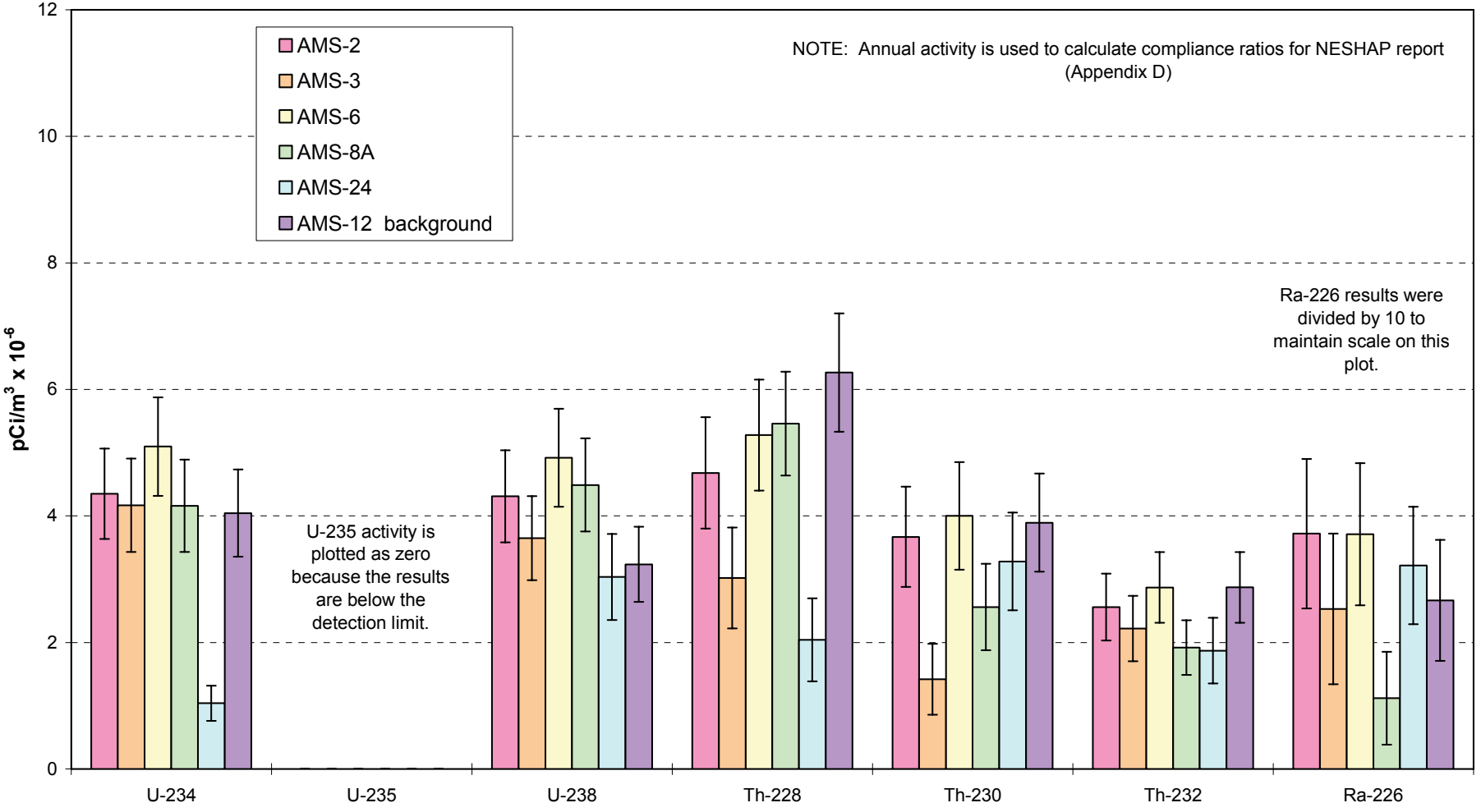

Figure 5–3. Annual Activity and Uncertainty for Isotopes Used in NESHAP Analysis

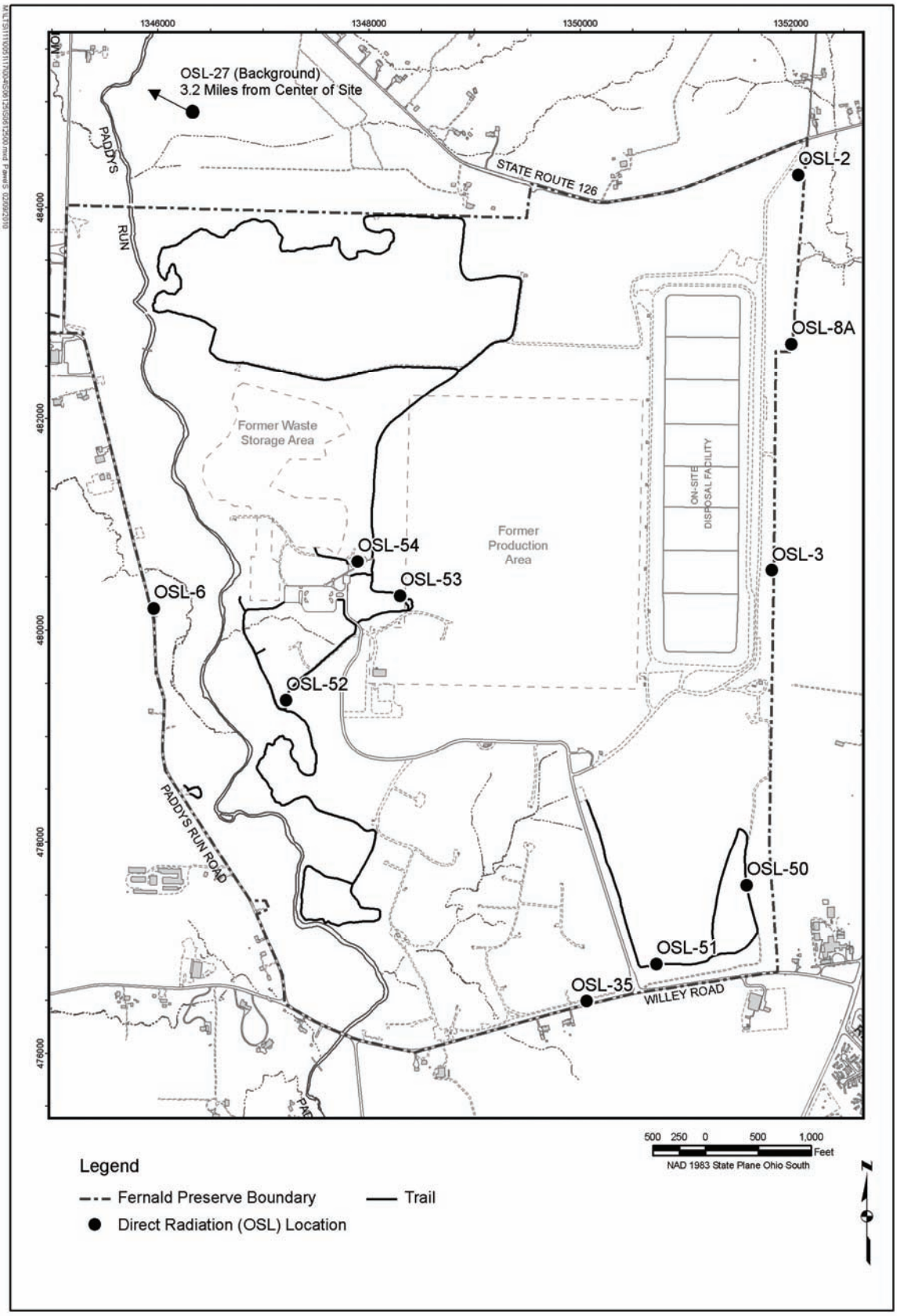

Figure 5–4. Direct Radiation (OSL) Monitoring Locations

Table 5–2. Direct Radiation (OSL/TLD) Measurement Summary

Location	Direct Radiation (mrem)	
	Sum of 2009 Quarterly Results[a]	Sum of 2008 Quarterly Results
On Site		
Minimum	20	48
Maximum	29	54
Background[b]		
Minimum	20	48
Maximum	20	48

[a]2009 values are less than 2008 because the 2009 OSL dosimeters have a different energy response, relative to TLDs used in 2008. The difference between background and boundary is used to assess the receptor dose, and this difference is similar for 2008 and 2009.
[b]The minimum and maximum results are identical because there is only one background dosimeter.

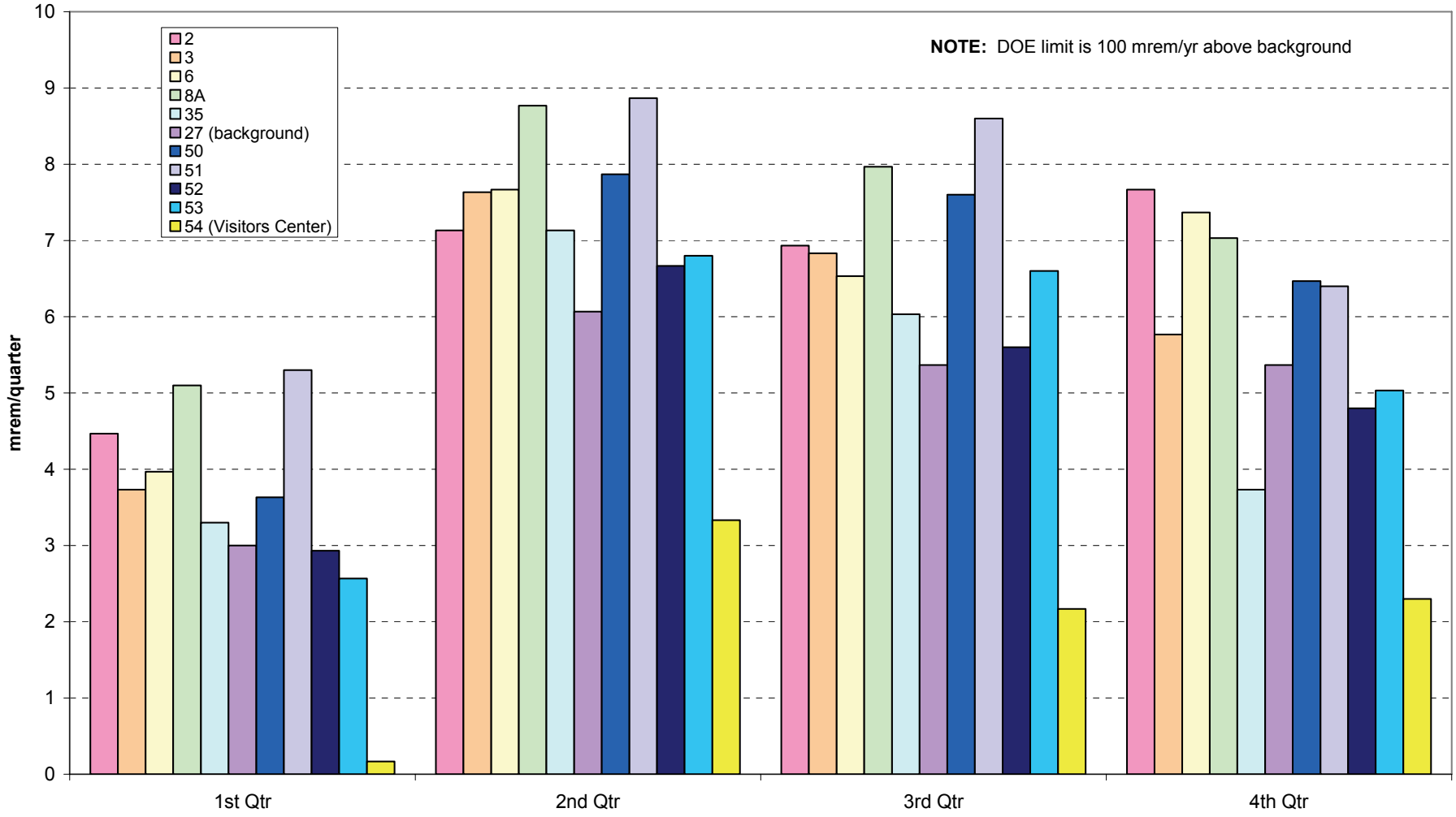

Figure 5–5. Quarterly Results for OSL Monitoring Locations