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Air-Sampling Data from Area G: A Radioactive-Waste Management Site

Los Alamos
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Cover: To produce the cover graphic, a color aerial photo of Area G, corrected for topographic and other effects, was draped over a three-dimensional model of the area generated from LIDAR measurements. Structures (gold objects), roads, and air-sampling stations (red blocks) were added to the drape. The structures were "extruded" vertically to simulate building height. The entire image was then rotated to obtain this view. (Graphic by Richard E. Kelly.)

LA-14090
Issued: January 2004

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Keith W. Jacobson
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AIR-SAMPLING DATA FROM AREA G: A RADIOACTIVE-WASTE MANAGEMENT SITE

by

Keith W. Jacobson and Craig F. Eberhart

ABSTRACT

The Meteorology and Air Quality (MAQ) Group at the Los Alamos National Laboratory (LANL) maintains and operates a large network of environmental air samplers called AIRNET. Some of these samplers are placed in or near Area G, a radioactive waste management site in the semiarid environment of the Pajarito Plateau, near Los Alamos. Area G contains both active and inactive (capped) low-level radioactive waste pits and shafts. In addition, a significant amount of handling and storage of transuranic and low-level mixed waste occurs at Area G, and activities at Area G have had impacts on the local air quality that have been detected by AIRNET. For example, one Area G location has had the highest measured concentration of tritium in the Los Alamos area because of tritium vapor released from nearby buried radioactive waste. This report presents air-sampling data taken in or near Area G from 1995 to 2002.

I. INTRODUCTION

The MAQ group uses a network of air samplers around Area G to monitor airborne levels of radionuclides. The locations of these stations are shown in Figure 1. In addition, LANL maintains and operates a meteorological monitoring system that includes a tower located 1 km to the east of Area G. AIRNET sampling media consist of a filter and silica gel and are exchanged once every two weeks. Filters are immediately counted to determine gross alpha- and beta-emitter radioactivity. Each quarter of the year, filters from each sampler are made into a composite sample that is radiochemically analyzed for isotopic composition.

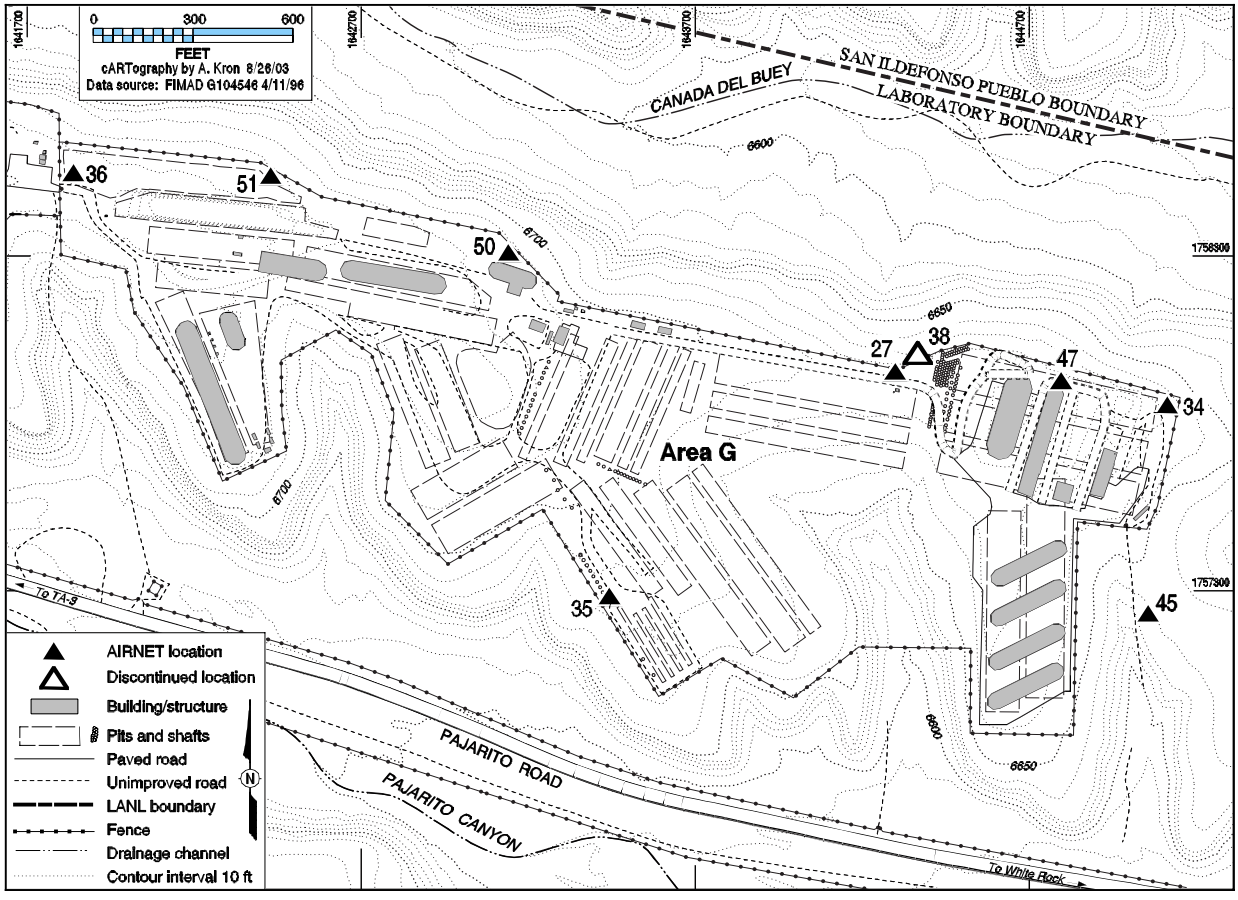


Figure 1. The locations of AIRNET stations at Area G, the main facility at TA-54.

Alpha and beta counting data are transferred to the AIRNET database and evaluated against preset action levels. Values that exceed an action level are flagged for immediate investigation by a health physicist. The same procedures also occur for quarterly isotopic results when we receive them. The counting of alpha and beta activity on individual sample filters and the rapid turnaround of the isotopic analysis have resulted in swift identification of new sources of contamination at Area G. This has enabled site operators to quickly address and remedy site issues. One example involved the identification of supposedly "clean" fill material that had actually been contaminated prior to reaching the site.

The MAQ Group compares ambient air concentrations, as calculated from the AIRNET sample measurements, with background concentrations and with environmental compliance standards or with workplace exposure standards, depending on the location of the sampler. Concentrations in controlled access areas are usually compared with Department of Energy (DOE) Derived Air Concentrations (DACs) for workplace exposure (DOE, 1998) because access to these areas is generally limited to workers with a need to be in the controlled area.

The usefulness of a site-specific air-sampling network has been demonstrated at Area G, in particular because of the rapid sample turnaround by the analytical lab, health physics review of the data, and prompt release of the sampling results. Upon receiving the analytical chemistry data for biweekly and quarterly data, RRES-MAQ personnel calculate air concentrations and review them to determine if any values indicate an unplanned release or unexpected result. Two action levels have been established: "investigate" and "alert." "Investigate" levels are based on historical measurements and are designed to indicate that an air concentration is higher than expected. "Alert" levels are based on potential dose and require a more thorough, immediate follow-up.

II. STATION DESCRIPTION AND SETTING

Physical Setting

Area G is a 63-acre site on a finger-like mesa top called Mesita del Buey (see Figure 2). The site is surrounded by sparsely populated juniper and piñon brushland. Canada del Buey

is a shallow canyon north of Area G. Pajarito Canyon lies to the south. The difference in height between the canyon bottoms and the mesa top is about 40 meters. The subsurface material is Bandelier tuff, a nonwelded to welded volcanic ash and pumice (Abeele et al., 1981). Area G contains about 35 low-level radioactive-waste disposal pits and some 260 shafts. The site began operation in 1957. The older pits have been excavated to a depth of 8 to 15 meters and the shafts to a depth of 20 m (Mayfield and Hansen, 1983).

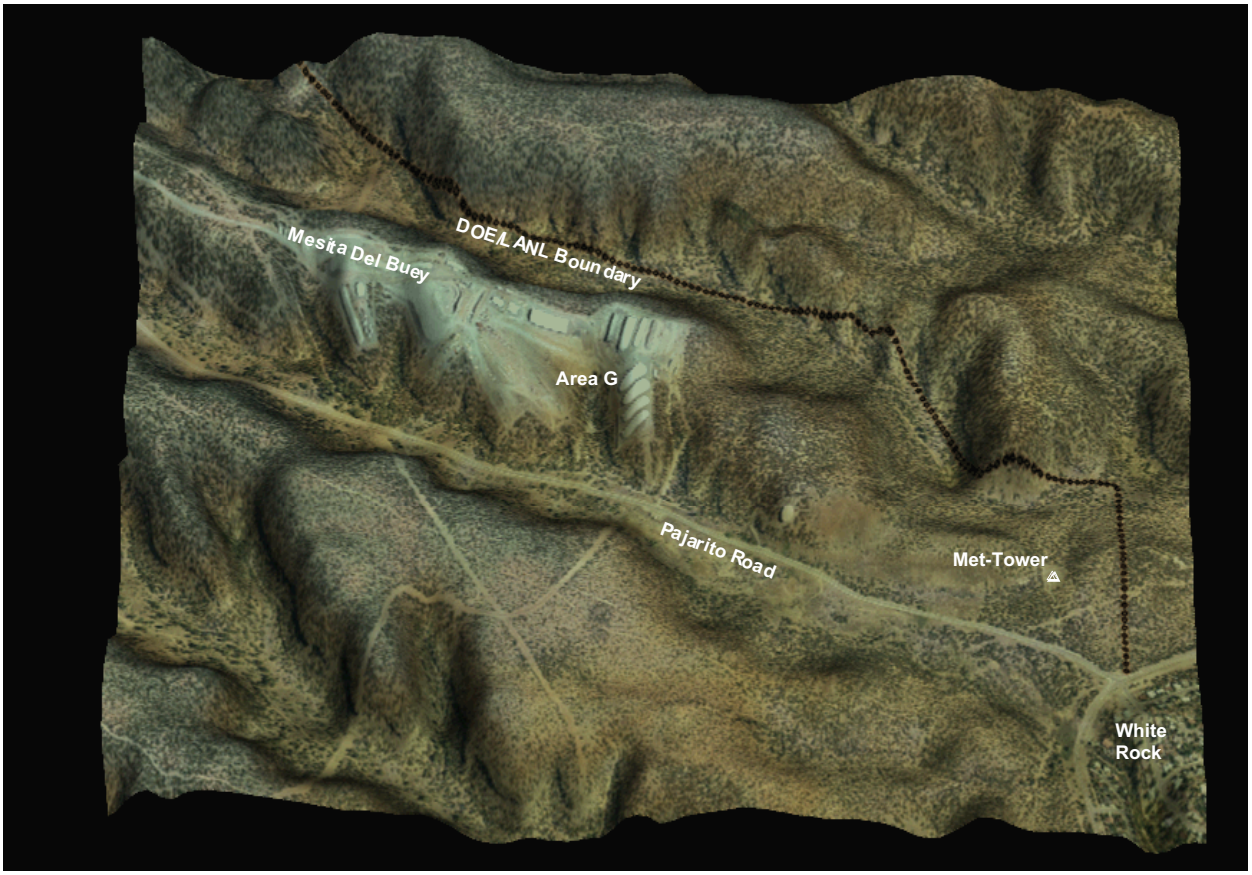


Figure 2. Area G and vicinity in an aerial photo with enhanced three-dimensionality.

As we write this report, there are a number of active disposal trenches and pits at Area G (see Figures 3 and 4). In addition, there are transuranic-waste storage pads and membrane-covered domes. There is a facility for decontaminating radioactive-waste containers, and two facilities are used to compact low-level radioactive solid waste. An uninhabited portion of the San Ildefonso Native American pueblo lies about 1 km to the north of Area G, and the town of White Rock, population 6000, lies about 2 km to the southeast.

Figure 3. Aerial photo of the new waste trench at the northwest end of Area G.

Figure 4. Aerial photo of Area G showing the membrane-covered domes used to handle waste. Also visible are pits and trenches containing low-level radioactive waste packages.

Weather and Climate

The following discussion is summarized from Bowen's "Los Alamos Climatology" (Bowen, 1990) The Pajarito Plateau has a semiarid, temperate mountain climate. Most days are sunny with light winds. There is usually a large diurnal variation in daily temperature, especially during the summer months. Surface winds are normally light at TA-54, averaging less than 3 m/s (6 mph). Wind speeds are strongest from March through June and weakest in December and January. Sustained wind gusts are common in the spring. Annual rainfall and mean wind speed measurements from 1992 to 2002 are provided in Table 1. A wind rose showing the relative frequency of wind by direction and speed is given in Appendix A. Table 2 presents a seasonal average of wind speed measurements collected at the TA-54 meteorological ("met") tower, as well as typically peak daily wind gusts by season. A recent study in New Mexico suggests that wind erosion over one week is more strongly related to daily peak wind velocities than to daily average velocities (Whicker et al., 2001). Absolute humidity, which is used in tritium analysis, has been reported only since 1998. The annual average absolute humidity for Area G is 3.85 g/m^3. However, daily values can vary over a wide range, e.g., from 0.10 g/m^3 to 14.10 g/m^3.

Table 1. Selected annual meteorological data measured at the TA-54 meteorological tower.

Year	Annual precipitation (in.)	Mean wind speed (m/s)
1992	12.76	2.63
1993	13.08	2.70
1994	16.95	2.71
1995	13.31	2.76
1996	14.82	2.86
1997	17.78	2.64
1998	12.69	2.70
1999	16.85	2.73
2000	14.03	2.77
2001	9.07	2.66
2002	9.37	2.92

Table 2. Seasonal values of selected meteorological data measured at the TA-54 meteorological tower.

Season	Typical daily peak wind gust (m/s)	Typical daily sustained wind gust (m/s)
Spring	12.9	9.3
Summer	12.6	9.0
Fall	10.2	7.3
Winter	9.2	6.7

For semiarid locations such as the mesa top of Area G, wind will serve as a mechanism for both on-site and off-site transport of contaminants. A significant increase in transport of soil by wind can occur in areas that are mechanically disturbed (Sehmel, 1980). This has occurred at Area G, resulting in localized increases in air concentrations that have been detected by AIRNET samplers.

Particulate matter in the atmosphere is primarily caused by aerosolized soil, which depends on meteorological conditions. Windy, dry days can increase soil entrainment or resuspension, but precipitation (rain or snow) can wash particulate matter out of the air. Consequently, changing meteorological conditions often cause large daily and seasonal fluctuations in airborne radioactivity concentrations. Unforeseen events can also have major impacts: during 2000, a major forest fire (the Cerro Grande Fire) dramatically increased short-term ambient concentrations of particulate matter. The fire burned near the western end of Area G but not into the controlled area.

History of Changes in Sampling Stations

Typically, samplers are located near active and past waste-handling and -disposal operations to ensure that the air sampled represents worst-case potential emissions. The first air sampler at Area G was located where Station 27 is now located and was installed in 1976 as part of the LANL-wide air-monitoring network. Another station (38) with a sampler identical to that at Station 27 was placed next to Station 27 for quality assurance (QA) purposes. Four stations

were placed around the general perimeter of Area G in October 1984. Three of these stations, 34, 35, and 36, remain active as of 2003. In May 1993, five additional stations were installed at Area G to monitor potential emissions from the waste remediation effort known as the Transuranic Waste Inspectable Storage Project (TWISP). This project involved the uncovering and repackaging of 16,500 barrels of transuranic (TRU) waste at the far eastern edge of Area G. Figure 5 shows the original locations of these added sites.

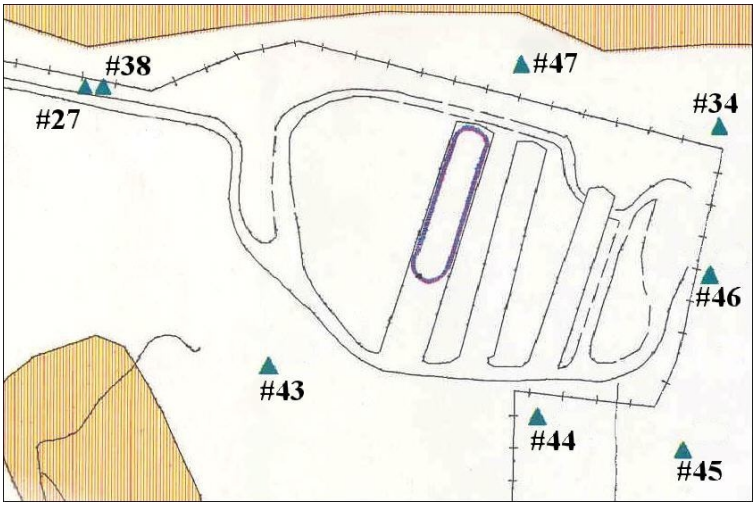


Figure 5. Map showing the locations of the TWISP project and the original locations of nearby Area G samplers.

Only two of the TWISP stations remain active today: 45 and 47. Stations 44 (at the south perimeter of Area G) and 46 (at the east perimeter of Area G) were discontinued in 1995. Three new stations were also added to Area G in 1995: 50, 51, and 52. However, Station 52 was discontinued after one year of operation. Also, Station 38 (the QA station) was discontinued at the end of 2002. Results from side-by-side Stations 27 and 38 are provided later in this report. As of 2003, there are 8 stations in operation inside Area G. The MAQ Group maintains historical records of all of the data collected at both the active and the currently inactive stations. The coordinates and operating status of the AIRNET stations in Area G are shown in Table 3.

Table 3. Coordinates and status of AIRNET stations in Area G.

Current station no.	Station name	UTM easting* (m)	UTM northing* (m)	Start of operation	End of operation
27	Area G	388,288	3,965,984	Jan. 1976	NA
34	Area G-1	388,528	3,965,962	Oct. 1984	NA
35	Area G-2	388,029	3,965,728	Oct. 1984	NA
36	Area G-3	387,523	3,966,197	Oct. 1984	NA
37	Area G-4	388,740	3,965,446	Oct. 1984	Nov. 1996
38	Area G QA Station	388,288	3,965,984	Nov. 1983	Jan. 2003
43	Area G-S of Dome (48)	388,335	3,965,844	May 1993	Dec. 1994
44	Area G-S of Perimeter	388,447	3,965,838	May 1993	Nov. 1995
45	Area G-SE Perimeter	388,511	3,965,796	May 1993	NA
46	Area G-E Perimeter	388,515	3,965,860	May 1993	Nov. 1995
47	Area G-North Perimeter	388,408	3,965,983	May 1993	NA
50	Area G Expansion (1)	387,913	3,966,118	Mar. 1995	NA
51	Area G Expansion Pit	387,708	3,966,165	Mar. 1995	NA
52	Area G Expansion (2)	387,257	3,966,304	Mar. 1995	Jan. 1996

*Universal Transmercator Coordinates, Zone 13, North American Datum, 1983.
The values given here are accurate to about ± 10 m.

III. METHODS

Procedures

The AIRNET program is described in detail in the AIRNET Sampling and Analysis Plan (SAP) and is operated according to a prescribed set of peer-reviewed procedures. All staff train to the SAP and its procedures at least once a year. Some of the procedures are listed in Table 4.

Table 4. Some of the AIRNET procedures, which are available, along with the AIRNET SAP, at http://www.airquality.lanl.gov/QA.htm#GWD.

Procedure No.	Title	Topics
201	Establishing and Using AIRNET Action Levels	Periodically calculating AIRNET action levels, evaluating AIRNET data against "investigate" and "alert" action levels, and the actions to take in response to AIRNET monitoring data that exceed these levels.
202	Environmental Sampling of Airborne Particulate Radionuclides	Collecting particulate samples from the air-sampling stations, preparing the samples for analysis, and submitting the samples for analysis for airborne radionuclides.
204	Sampling of Ambient Airborne Tritium	Field sampling of water from the air, the distillation process, and submitting a sample for analysis for the presence of tritium.
205	Calibration of Air Sampling Stations	Replacing AIRNET sampling pumps and calibrating the airflow through the pumps after installation.
207	Evaluation of AIRNET Sampler Sites Against Siting Criteria	Evaluating AIRNET sampler sites against criteria for air-flow-obstructing trees and other potential obstructions.
208	Technical Evaluation of AIRNET Data and Calculated Air Concentrations	Evaluating periodic AIRNET field, laboratory analytical, and calculated air-concentration data for acceptance, qualification, or rejection.
216	Management of AIRNET Field Data	Electronically recording and storing the field data on palmtop computers and transferring the data to the Microsoft Access database.

Sample Analysis

The radioactive materials handled during nuclear weapons research at LANL have primarily been tritium, plutonium, and enriched or depleted uranium. Most of the weapons-grade plutonium handled at LANL consists primarily of the isotope Pu-239 (97 to 75 wt.%) and the isotope Pu-240 (3 to 21 wt.%) (Clow et al., 1994). Other radioactive materials have been handled during scientific research, such as Pu-238 for NASA and depleted uranium for the military. AIRNET samples are analyzed for tritium in the form of water vapor (HTO), Pu-238, Pu-239/Pu-240, U-234, U-235, and U-238. [Plutonium-239 and -240 are indistinguishable by alpha spectroscopy and are therefore lumped together for analytical purposes (Eberhart, 1998).] The radioisotope Am-241 occurs with Pu-239/Pu-240 and is also included in the sample analysis.

Background Sites

Four regional sampling stations determine regional background and fallout levels of atmospheric radioactivity for the AIRNET program. These regional stations are located at least 15 km away, in the towns of Espanola and El Rancho and at two locations in Santa Fe. Table 5 presents the annual average backgrounds at these sites from 1998 to 2002.

Table 5. The air concentrations at 95% confidence intervals measured at the AIRNET background stations.

Alpha fCi/m^3	Beta fCi/m^3	Tritium pCi/m^3	Pu-238 aCi/m^3	Pu-239/ Pu-240 aCi/m^3	Am-241 aCi/m^3	U-234 aCi/m^3	U-235 aCi/m^3	U-238 aCi/m^3
0.88±0.11	13±0.6	0.3±0.4	0.0±0.1	0.2±0.2	0.2±0.3	17±3.2	1.3±0.6	17±3.4

Associated Sites

Several AIRNET stations are located within a few kilometers of Area G. Three stations are 2 to 3 km away in the town of White Rock. We hypothesize that elevated air concentrations recorded from time to time at these stations could be due to emissions related to Area G.

Operation

Generally, each AIRNET sampler continuously collects particulate matter and water-vapor samples for approximately two weeks per sample. Thus, sampling media are exchanged once every two weeks. Air is drawn into the sampler by means of a rotary carbon vane vacuum pump. The sampling equipment is contained in an all-weather housing made of aluminum, with louvered openings on all four sides. The louvers of the sampling station act as air inlets to the interior space, where an open-face filter is situated. In a recent study, this sampling design was shown to operate favorably when compared to other air-monitoring inlets at wind speeds typical for Los Alamos. However, this same study showed that the sample design can oversample during periods of high wind speed, e.g., greater than 12.5 m/s (Rodgers et al., 2000).

Sample media consist of a plastic-fiber filter for collecting airborne particulates and a silica-gel canister for collecting water vapor. Particulate matter is collected on 47-mm-dia. polypropylene filters and vertically mounted canisters that each contain about 135 grams of silica gel, which collects the water-vapor samples. Table 6 provides additional information regarding sample media. Flow rate is held constant throughout the two-week sample period by commercial flow regulators.

Table 6. AIRNET sample media.

	Water vapor	Particulate matter
Media	135 g silica gel	47-mm-dia. polypropylene filter
Manufacturer	Eagle Chemical	Web Dynamics
Collection period	336 h	336 h
Air flow rate	200 cm^3/min.	0.11 m^3/min. (4 cfm)
Flow regulator	Matheson rotameter	Radeco panel
Total air volume sampled	4 m^3	2300 m^3

The flow rate for the silica-gel side of the sampling train is calibrated every six months using an A.P. Buck Model C-30 or M-5 calibrator. Likewise, the flow rate for the filter side

of the sampling train is calibrated every six months using an SAIC-Radeco Model C-828 calibrator. The regulators are sent to their respective manufacturers for calibration once a year. The calculated air concentrations are not adjusted to standard temperature and pressure conditions.

We use a palmtop computer to record the sampler data in the field, including timer readings and volumetric airflow rates at the beginning and end of the sampling period. As an added error prevention technique, the data entry software requires confirmation of measurements that are outside the range of typical values. We also receive the radioanalytical data in electronic form and load it into the AIRNET database.

Two concentration measurements are needed to estimate the ambient levels of tritium as an oxide (in the form of water): water vapor concentrations in the air and tritium concentrations in the water vapor. Both of these measurements must be accurate to obtain an accurate estimate of the ambient tritium concentrations. In early 1998, it was found that the silica-gel collection medium could not remove all of the moisture from the sampled air stream (Eberhart, 1998). Collection efficiencies were as low as 10% to 20% in the middle of the summer when the ambient concentrations of water vapor were the highest. Because 100% of the water was not collected on the silica gel and this water was used to measure water-vapor concentrations, the atmospheric water vapor, and therefore the tritiated water, had been underestimated. However, data from the meteorological monitoring network provide accurate measurements of atmospheric water-vapor concentrations and have been combined with the analytical results to calculate all the ambient tritium concentrations given in this report. In particular, two-week absolute humidity measurements are used to calculate the concentrations of tritium in air. Any spatial variation in absolute humidity between the AIRNET sites and the LANL meteorological towers has been demonstrated to be small. Thus, the measured changes in absolute humidity reflect regional changes in conditions (Eberhart, 1999). The average seasonal change in humidity as recorded by the TA-54 meteorological tower is shown in Figure 6.

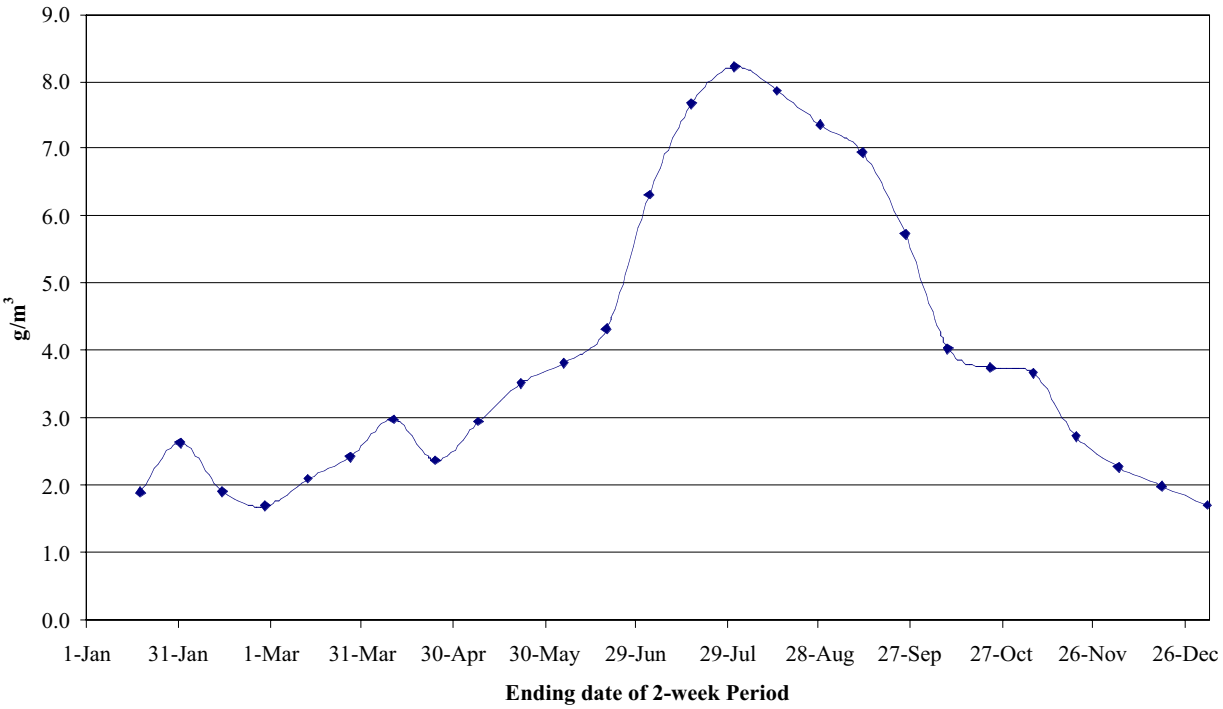


Figure 6. Two-week average absolute humidity measured at the TA-54 meteorological tower.

Filters collected after the two-week sample period are first submitted for counting of gross alpha and beta activity on each individual filter. After this counting, filters are halved, then half-filters from the six or seven sampling periods at each site are combined to make quarterly composite samples for isotopic analysis. Additional details regarding sample analysis are provided in Table 7.

Table 7. AIRNET Sample Analysis.

	Alpha and beta	Tritium	Radioisotopes
Analysis method	Gas proportional counter	Liquid scintillation counter	Chemical dissolution and separation, alpha spectroscopy
Count time (s)	3,000	5,400	80,000
Sample size	Whole filter	7 ml water	Composite of 6–7 half-filters
Minimum detectable sample activity	1 pCi (alpha) 2 pCi (beta)	0.5 pCi/ml	0.04–0.05 pCi
Minimum detectable air concentration	0.5 fCi/m^3 (alpha) 1.0. fCi/m^3 (beta)	0.1 pCi/m^3	2–3 aCi/m^3

In 1999, the MAQ Group reviewed the effectiveness of existing action levels and decided to recalculate them to provide more useful information. We calculated new action levels for plutonium, americium, and tritium, based on a more robust statistical treatment of outliers and an evaluation of seasonal fluctuations of tritium from Area G. Then we developed new methods for determining action levels for gross alpha, gross beta, tritium, and uranium (Dawson, 1999). These revised action levels were implemented in 2000. When a measured air concentration exceeds an action level, the MAQ Group verifies that the calculations were done correctly and that the sample air concentrations are likely to be representative, that is, no cross contamination has taken place. Next, we work with personnel from Area G to assess potential sources and possible mitigation for the elevated concentrations.

The next section of the report presents data collected by the Area G samplers and discusses possible hypotheses for and trends in the results.

IV. RESULTS AND DISCUSSION

Previous Studies

The airborne tritium, plutonium, and uranium concentrations measured at Area G have periodically exceeded background levels. Station 27, the original Area G station, measured "greatly elevated" concentrations of Pu-239/Pu-240 from 1977 to 1979, and "large increases" in airborne tritium concentrations were noted in 1976 and 1977 (Mayfield, 1983). Another report noted the high readings recorded in 1986 for Pu-238 at Station 34 and for Pu-239/Pu-240 at Station 36 (ESG, 1987). Statistically evaluated Pu-239/Pu-240 readings were identified at Station 27, elevated uranium concentrations were detected at Station 36, and high tritium concentrations occurred at Station 35 during 1987 (Soholt, 1990). Results from the majority of the air sampling conducted at Area G since 1976 have been published each year in the Environmental Surveillance Report (ESR) for the Los Alamos National Laboratory.

Gross Alpha and Beta Results

We use gross alpha and beta analyses primarily to evaluate general radiological air quality, to identify potential trends, and to detect sampling problems. If gross activity in a sample is consistent with past observations and background, immediate special analyses for specific radionuclides are not necessary. If the gross analytical results appear to be elevated, then immediate analyses for specific radionuclides may be performed to investigate a potential problem, such as an unplanned release. Currently there are two action levels established for gross alpha and beta air concentrations measured at Area G.

Long-lived gross alpha and beta activity in air exhibits considerable environmental variability. The longer-lived progeny of radon can move independently over great distances and maintain significant concentrations in the atmosphere for days—even when separated from the parent source (NCRP, 1984). The environmental sources of variability generally overwhelm any LANL contributions. Gross alpha activity measured by AIRNET is almost entirely from the decay of natural radionuclides, primarily Po-210 in the radon decay chain, and depends on variations in natural conditions such as atmospheric pressure, atmospheric mixing, and seasonal temperature (NCRP, 1987). Recent gross alpha and beta readings for the currently operating Area G samplers are presented in Figures 7 and 8.

From Figure 7, we can see that the average alpha activity is about 1 fCi/m^3 and that there have been a few cases of readings at some stations being higher than those recorded at other stations. The high reading recorded at Station 45 during March 2002 triggered an action level that led to further investigations of potential causes. Further investigation indicated that a large-scale soil sieving operation to separate larger rocks and debris from soil that had been used to cover and shield TRU waste was the likely source. We also note a possible cyclic variation in the results that is more evident in the gross beta results, which are discussed next.

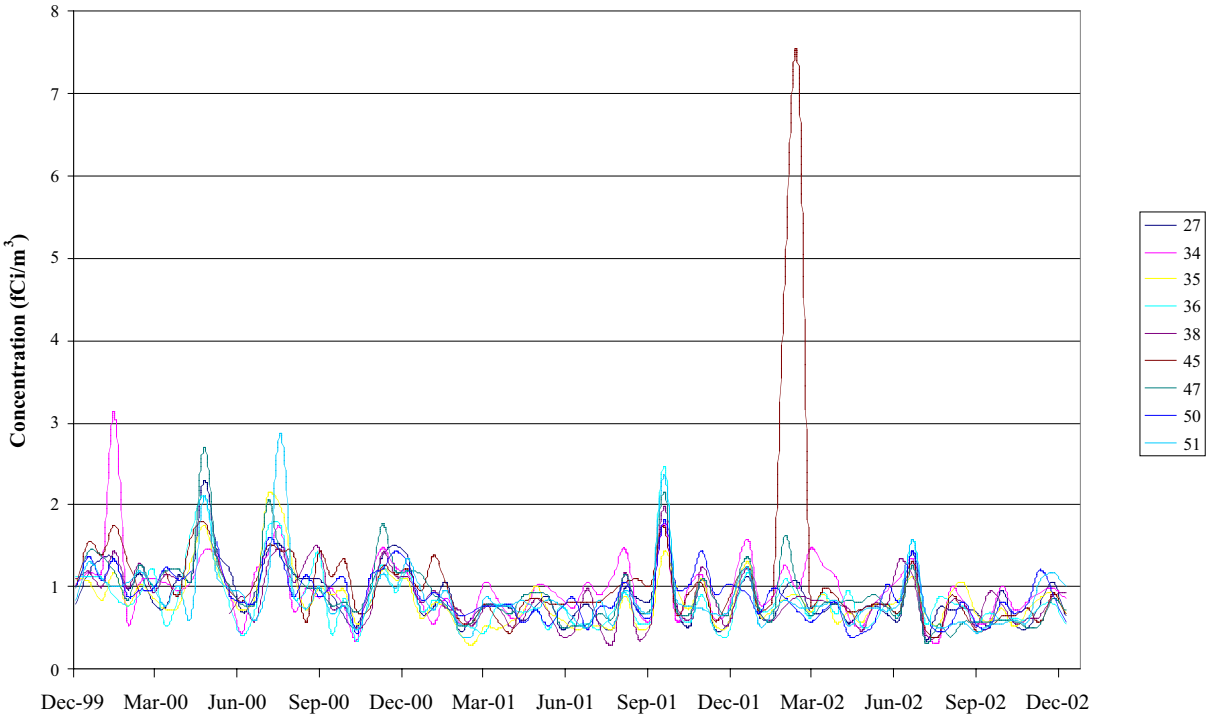


Figure 7. Gross alpha results for Area G stations.

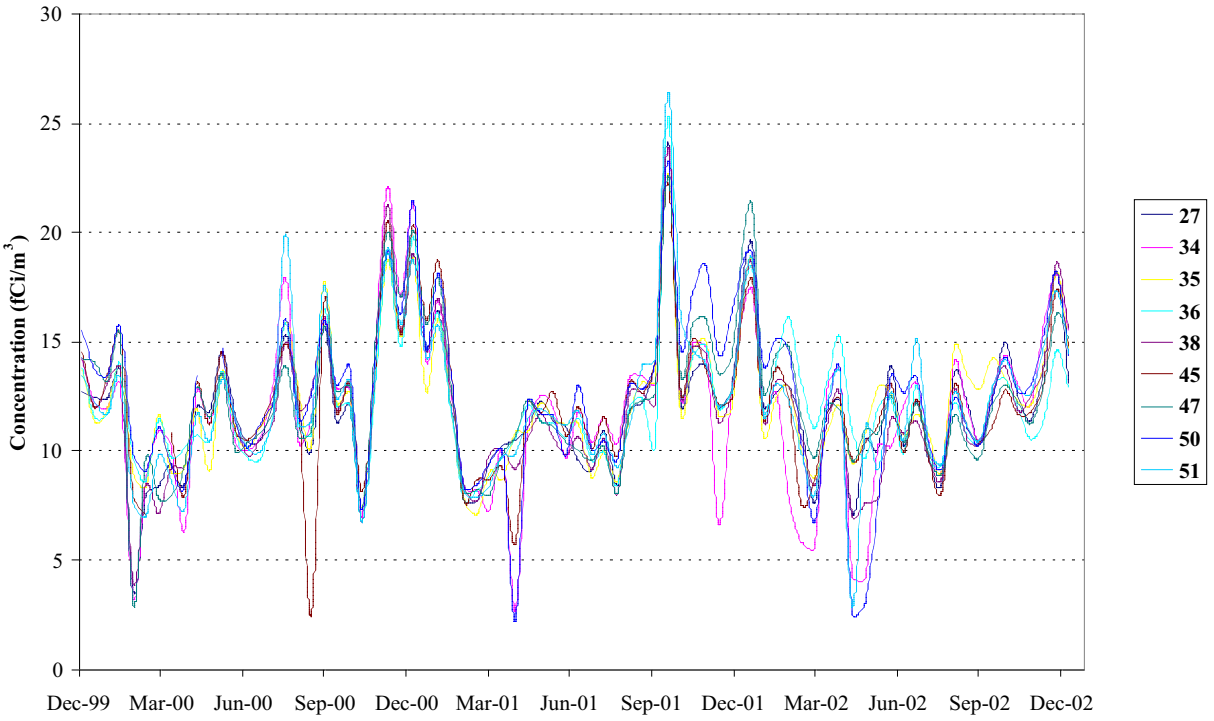


Figure 8. Gross beta results for Area G stations.

Most long-lived gross beta activity comes from naturally occurring radionuclides, primarily from the radon decay chain, especially that of Pb-210 and Bi-210. Several features are apparent in Figure 8. First, gross beta in air concentrations can vary dramatically between two-week sample periods. However, the readings vary together. That is to say that the variability between sites is usually much less than the variability over time. This leads to the conclusion that the fluctuations are mainly due to changing atmospheric conditions, in particular, dust loading in the air for a given two-week period. However, we note that there are some exceptions to the uniform changes in beta concentrations. A good example is the Station 45 value in August 2000. These lower-than-expected concentrations have helped us identify problems in our sampling system.

Tritium Results

Tritium is present in the environment primarily as the result of nuclear weapons tests and natural production by cosmogenic processes (Eisenbud and Gesell, 1997). Tritium results for the three western-most air samplers at Area G are given in Figure 9.

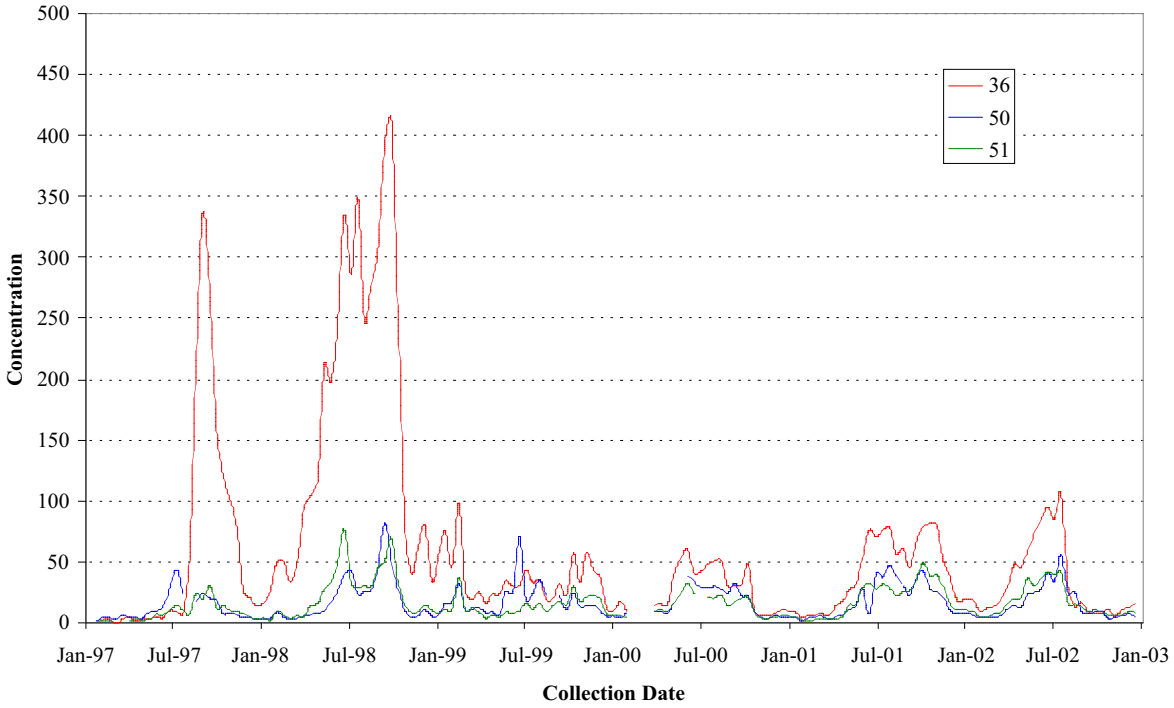


Figure 9. Tritium concentrations measured by stations on the west side of Area G.

Results from the three samplers located on the eastern side of Area G are given in Figure 10 (note scale change). We note that except for the higher-than-normal readings at Station 36 in 1997 and 1998, the results are similar for both sets of stations.

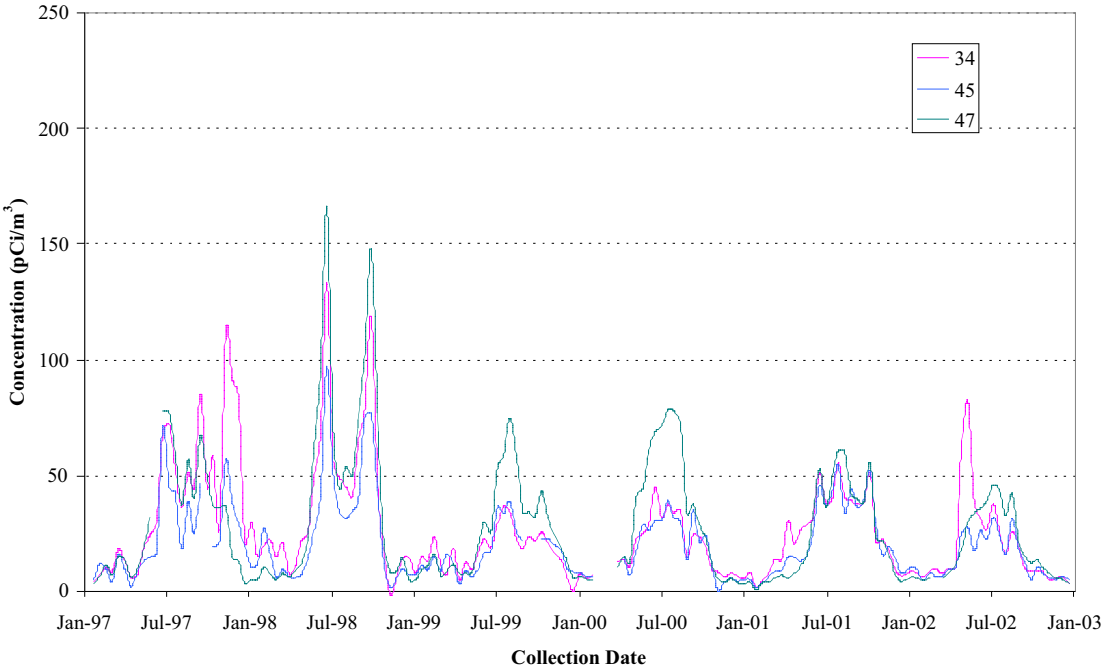


Figure 10. Tritium concentrations measured by stations on the east side of Area G.

Station 38, the QA station, was operated next to Station 27 until the beginning of 2003. Results from these two stations are given in Figure 11.

Over 150 samples have been collected in the past six years at each station. Note the significant peak in air concentration that occurs each summer. The overall sample means from each sampler compare well, with an average of 34.9 pCi/m^3 at Station 27 and 35.9 pCi/m^3 at Station 38. These two stations are at the middle of the north fence line of Area G.

The most notable tritium data were measured at Station 35, which is at the middle of the south fence line of Area G. The data are shown in Figure 12. Note again the reoccurring peak in air concentration that occurs each summer.

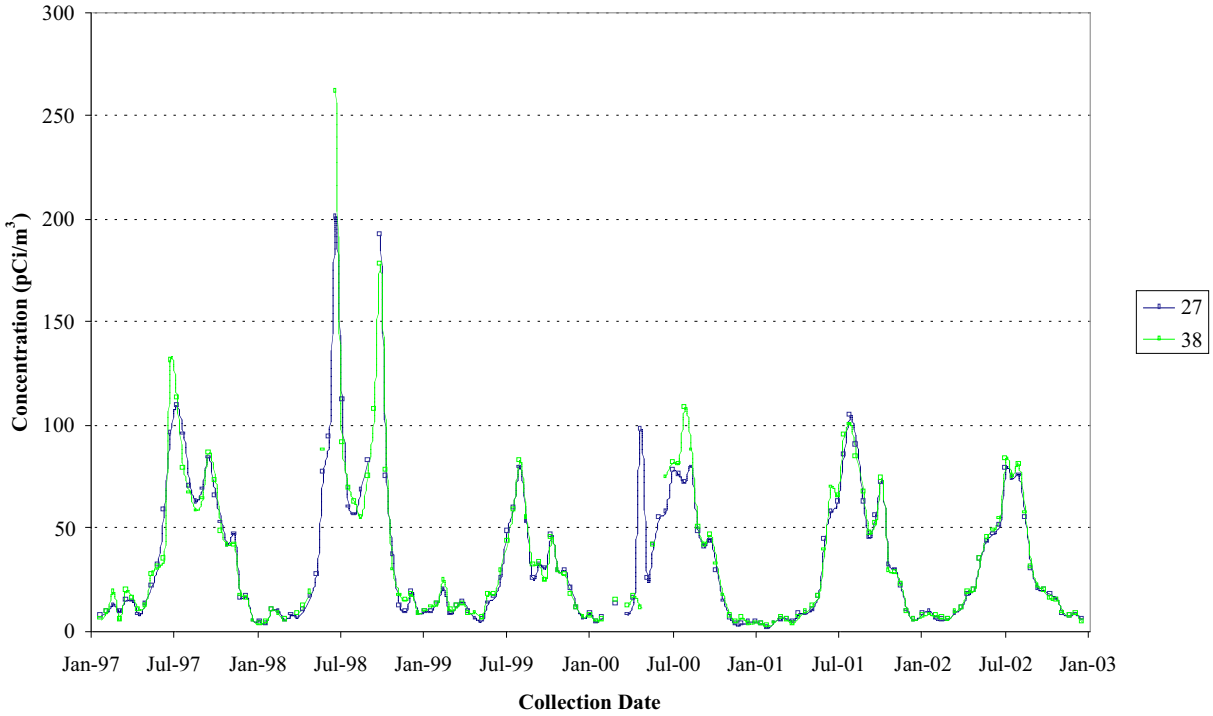


Figure 11. Tritium concentrations measured by Stations 27 and 38, which are side by side.

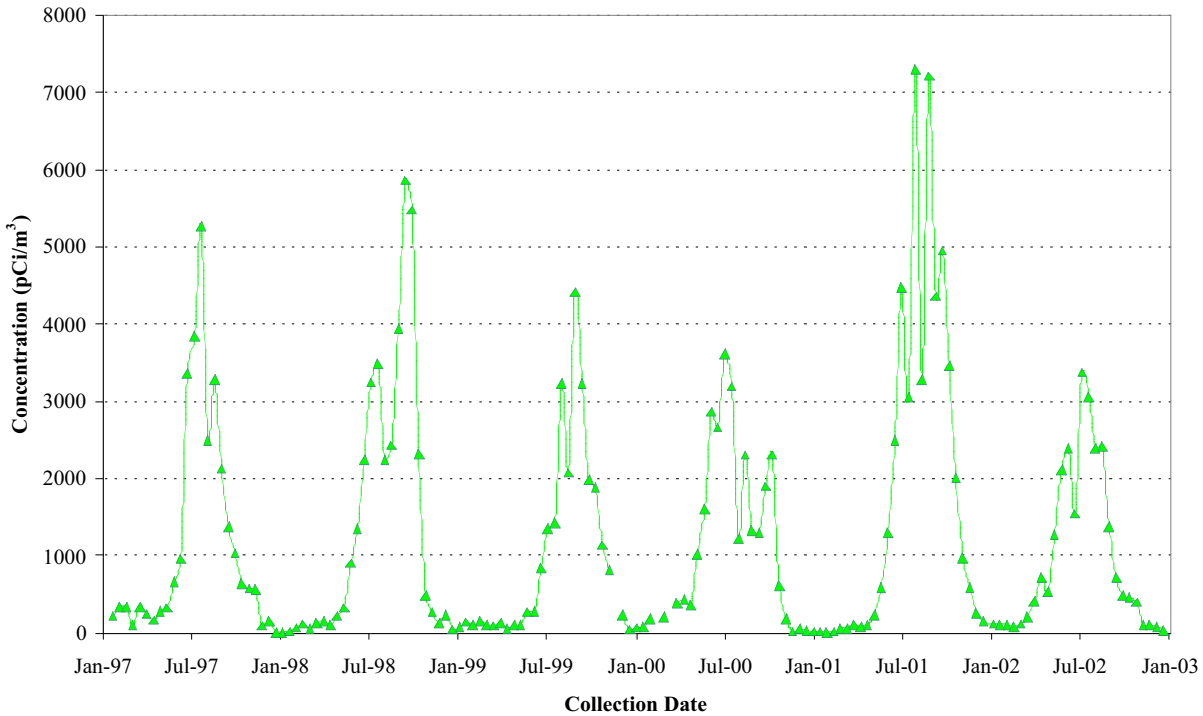


Figure 12. Tritium concentrations measured by Station 35.

We hypothesize that the reoccurring peak is caused by tritium vapor contained in buried waste that comes out of the ground faster in the summer, when solar radiation and temperatures are higher. Potential evapotranspiration (PE) is the amount of water that would be lost from soil and vegetation if moisture were available (Ahrens, 1994). In Figure 13 is our calculation of a two-week PE using solar radiation, air temperature, and other data collected at the nearby meteorological tower. We used the "modified Penman-Montieth" equation for this calculation and adjusted the equation with site-specific parameters—if they were known (Allen et al., 1998). The calculation assumes a constant source of soil moisture, although previous studies at LANL have shown that the soil moisture can depend dramatically on the frequency of precipitation events, but these studies also demonstrated a strong summer peak in the evapotranspiration rates (Nyhan et al., 1989; Nyhan et al., 1998).

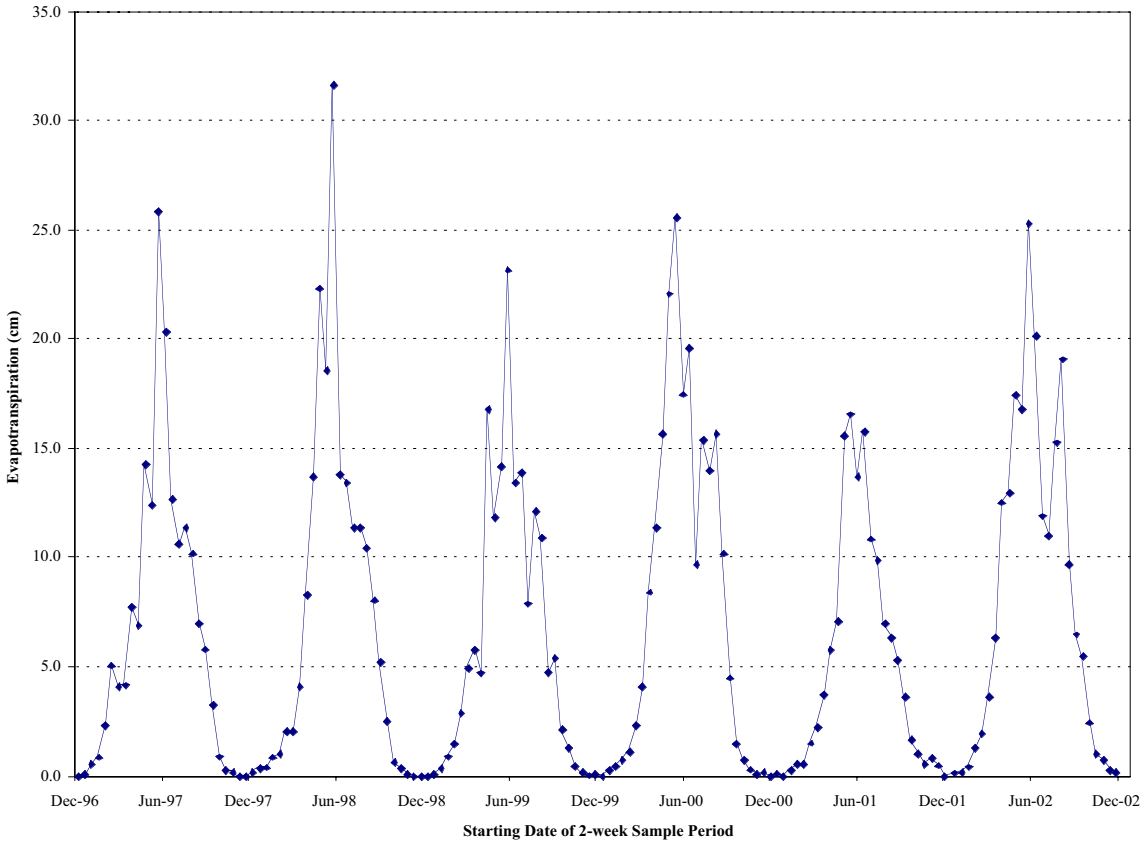


Figure 13. Potential evapotranspiration at TA-54 calculated with the Penman-Montieth model.

To compare the measured tritium concentrations at Station 35 and the calculated values of PE, we normalized both sets of results so they could be plotted together, as shown in Figure 14. We note that the changes in airborne tritium concentrations tend to lag changes in the estimated PE by an average of 2 to 4 weeks. If our hypothesis about Area G tritium emissions being correlated with PE is correct, this time lag may suggest further conjectures about the source of the tritium. The seasonal change in absolute humidity (see Figure 6) also probably contributes to these fluctuating tritium concentrations. We leave it to the reader to draw conclusions regarding our analysis.

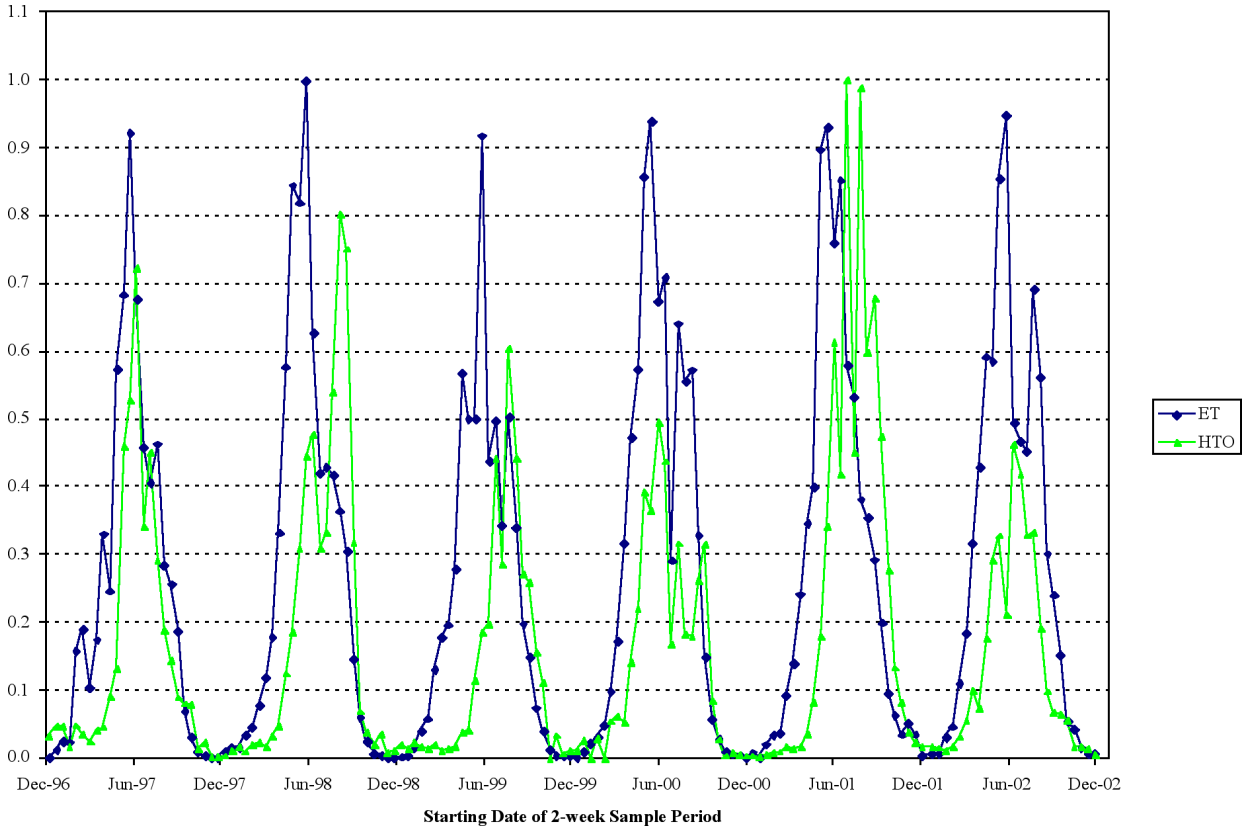


Figure 14. Normalized potential evapotranspiration (ET) and airborne tritium (HTO) concentrations measured at Station 35.

Plutonium and Americium Results

Plutonium is not naturally present in measurable quantities in ambient air. All measurable sources are from nuclear weapons explosions, the nuclear fuel cycle, and related activities. With a few local exceptions, worldwide fallout from atmospheric testing of nuclear

explosives is the primary source of plutonium. Four isotopes of concern can be present in the atmosphere: plutonium-238, plutonium-239, plutonium-240, and plutonium-241. Plutonim-241 is not measured because it decays by beta emission to americium-241. This beta decay is not only hard to measure, but the dose is insignificant when compared to americium-241.

A review of the data from the past few years yields a number of observations. First, sites towards the western end of Area G show little or no impact from airborne plutonium and americium, while sites located to the eastern side of Area G have sometimes recorded air concentrations greatly exceeding background levels. Many of the elevated concentrations have been traced to a source or event at Area G. Even though air concentrations have exceeded background values at Area G, they have still been too low to cause health or cancer risk concerns. Because of the great variability in readings over the years, the MAQ Group recently established two action levels: "investigate" and "alert." If an "investigate level" is exceeded at a particular site, the MAQ Group initiates an investigation into the possible cause of the elevated reading(s). If an "alert" level is exceeded, a release or other significant problem may have occurred, and special actions are necessary to document the release or problem. Plutonium air concentrations have exceeded the "investigate" or "alert" levels at Area G three times. These readings have been identified with specific Area G activities. Table 8 summarizes the more notable events.

Table 8. Notable events of elevated readings of Pu-238, Pu-239/Pu-240, and Am-241 at Area G.

Activity	Most-impacted sites	Other sites affected	Time period
Road grading of old fill material with a "hotspot" of contamination into new roadbed.	27, 38	none	96Q1–97Q3
Excavating and repackaging of TRU waste drums.	34	none	99Q1–99Q3
Large-scale sieving of soil used to cover/shield TRU waste drums.	45, 46	34	02Q1

We have also observed that even though at least four different stations have measured elevated plutonium and americium concentrations, the values tended to return to background levels after the suspected source was identified and dealt with. Overall, the decreasing concentrations measured in Area G in the last five years are due to increased engineering and fugitive dust controls at Area G. As of the fourth quarter of 2002, the concentrations of plutonium and americium appeared to be heading towards background levels.

In the following section, we provide graphical results of the plutonium and americium measurements, starting with stations located on the western side of Area G (where levels of plutonium and americium are near background) and proceeding to the east side of Area G (where there are higher levels of plutonium and americium).

Station 36 has typically had near-background averages for plutonium and americium, with seven-year averages of 1.4 aCi/m^3 and 0.9 aCi/m^3, respectively (see Figure 15). Typically, Station 51 has also measured low annual average concentrations of plutonium and americium, with seven-year averages of 2.2 aCi/m^3 and 0.9 aCi/m^3, respectively (see Figure 16). The measurements for Station 50 are presented in Figure 17, with average concentrations for the period shown of 4.3 aCi/m^3 and 1.3 aCi/m^3, respectively. Station 35 typically measured lower air concentrations than Stations 35, 51, and 50 did, with average concentrations for the period shown of 0.5 aCi/m^3 and 0.4 aCi/m^3, respectively (see Figure 18).

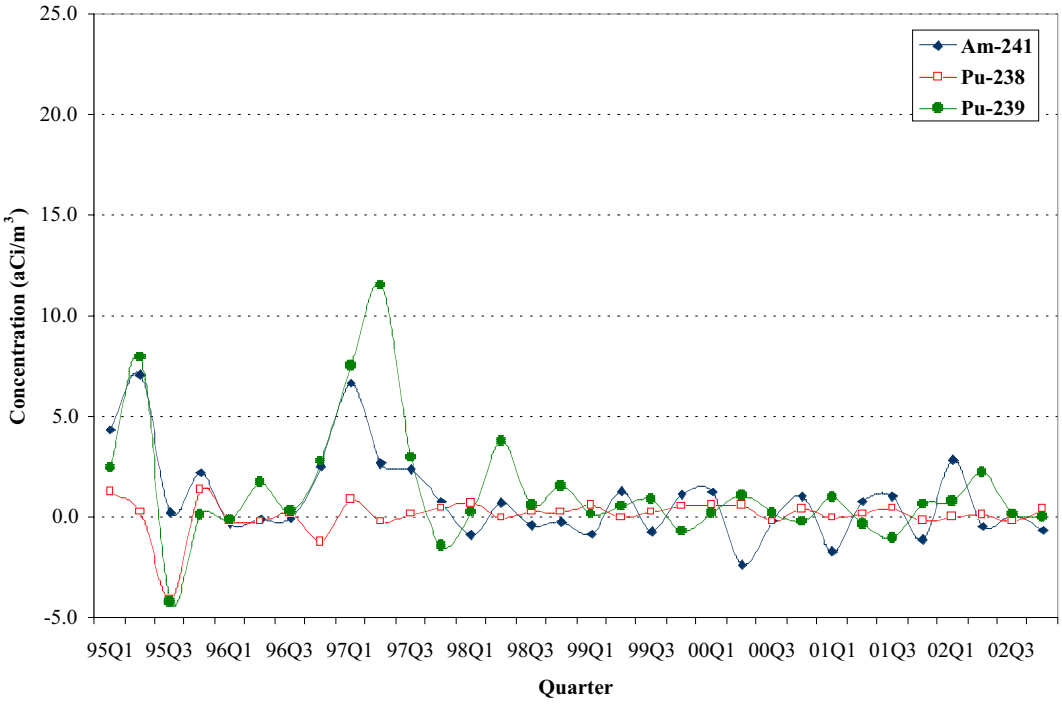


Figure 15. Plutonium and americium concentrations measured at Station 36. (Pu-239/Pu-240 is identified in the legend as "Pu-239.")

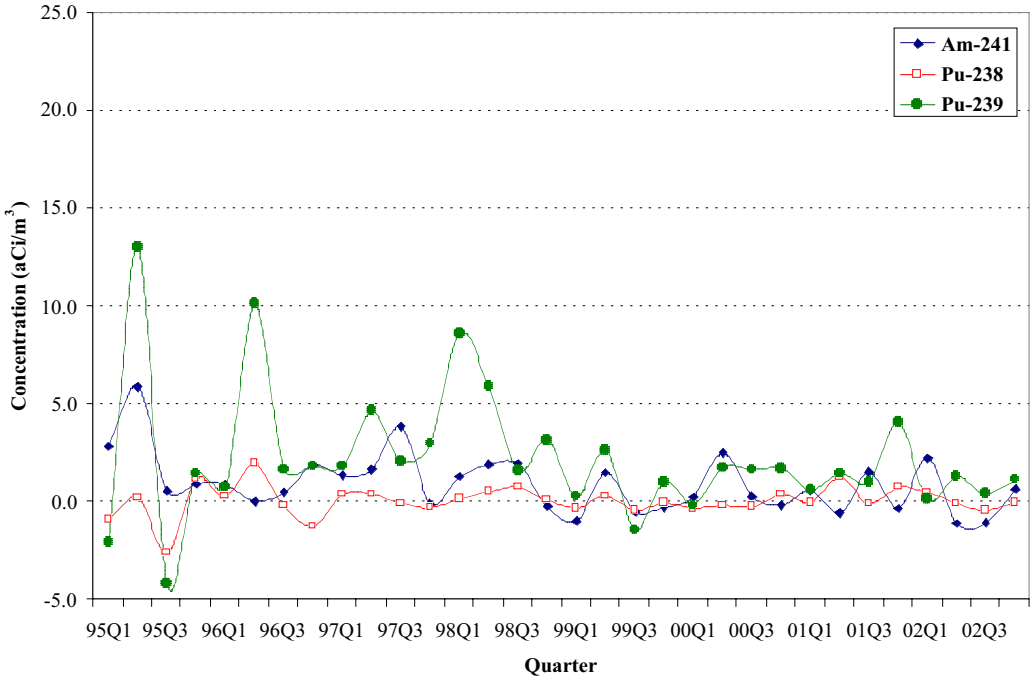


Figure 16. Plutonium and americium concentrations measured at Station 51.

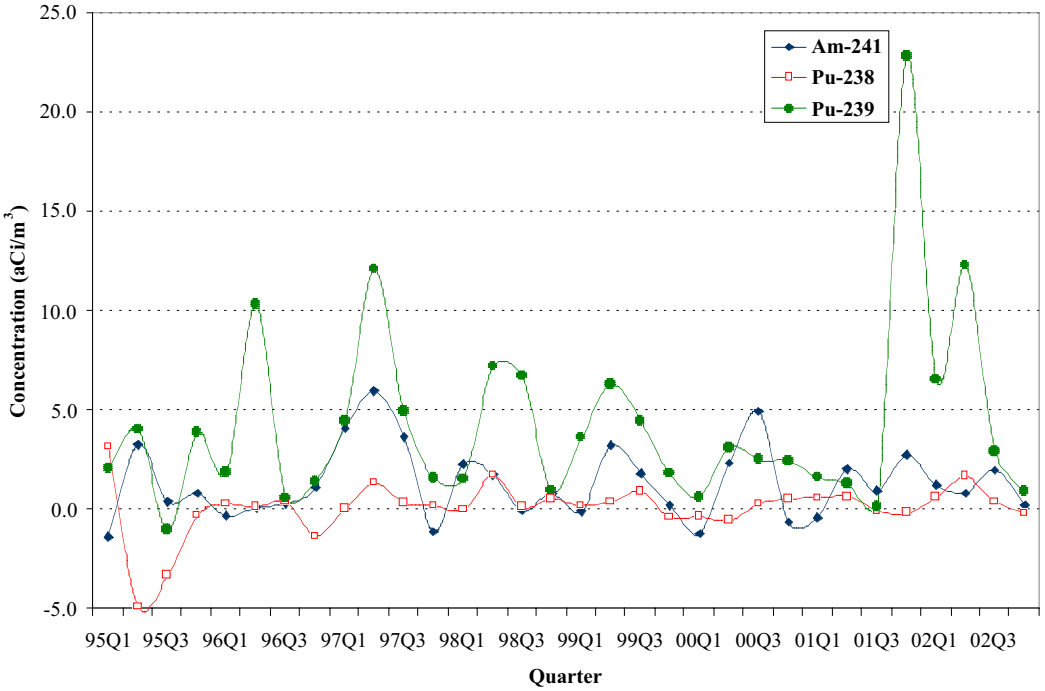


Figure 17. Plutonium and americium concentrations measured at Station 50.

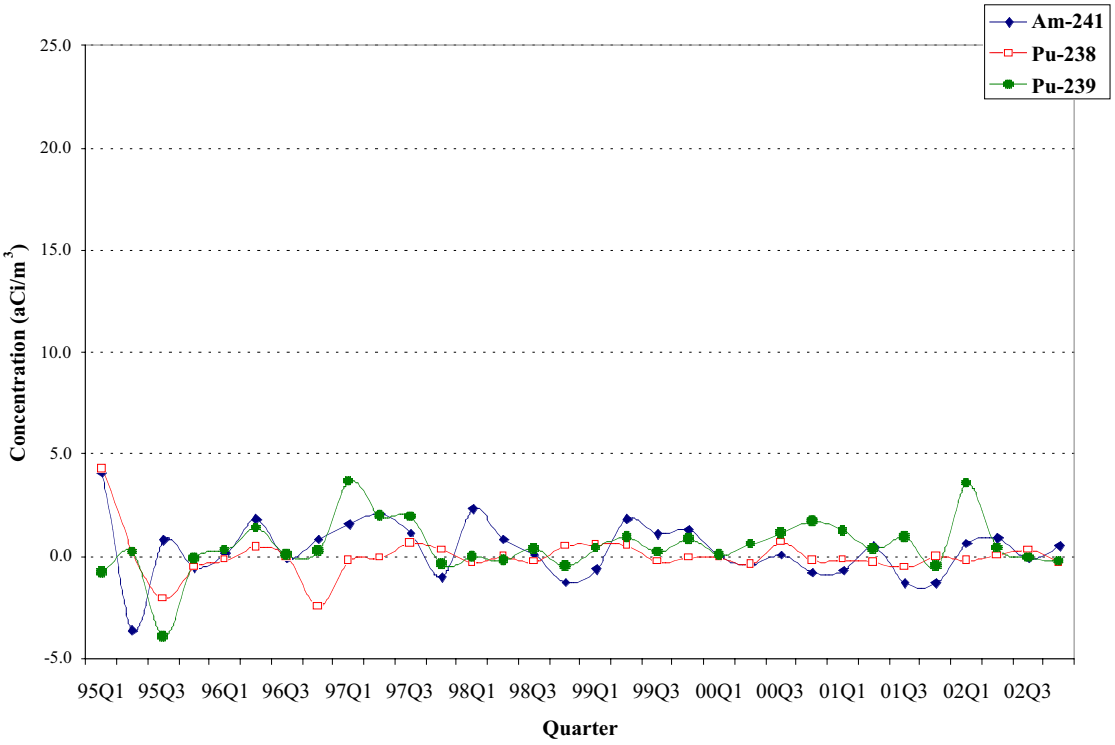


Figure 18. Plutonium and americium concentrations measured at Station 35.

Starting with the second quarter of 1996, Stations 27 and and 38 showed much increased concentrations of plutonium and americium (see Figure 19). We determined that the elevated readings were caused by a hotspot of soil contamination near the stations. We discuss these results and remedial actions taken to address them in Section V.

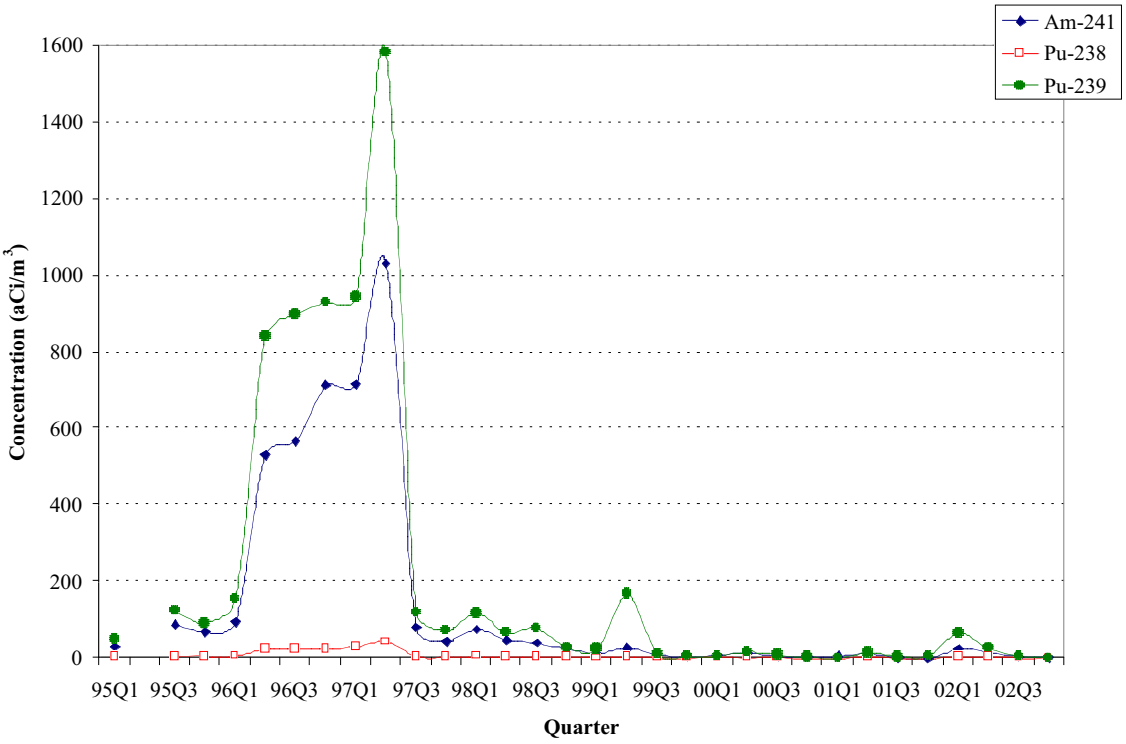


Figure 19. Plutonium and americium concentrations measured at Station 27.

Until the second quarter of 2002, the annual average air concentrations of plutonium and americium at Station 47 were 6.2 aCi/m^3 and 5.3 aCi/m^3, respectively (see Figure 20). However, in the second quarter of 2002, this station recorded significantly elevated readings, as occurred in the same time period at Station 45. We determined that the elevated readings were caused by a large-scale soil sieving operation near the northeast corner of Area G. We discuss the suspected cause of the elevated value in Section V.

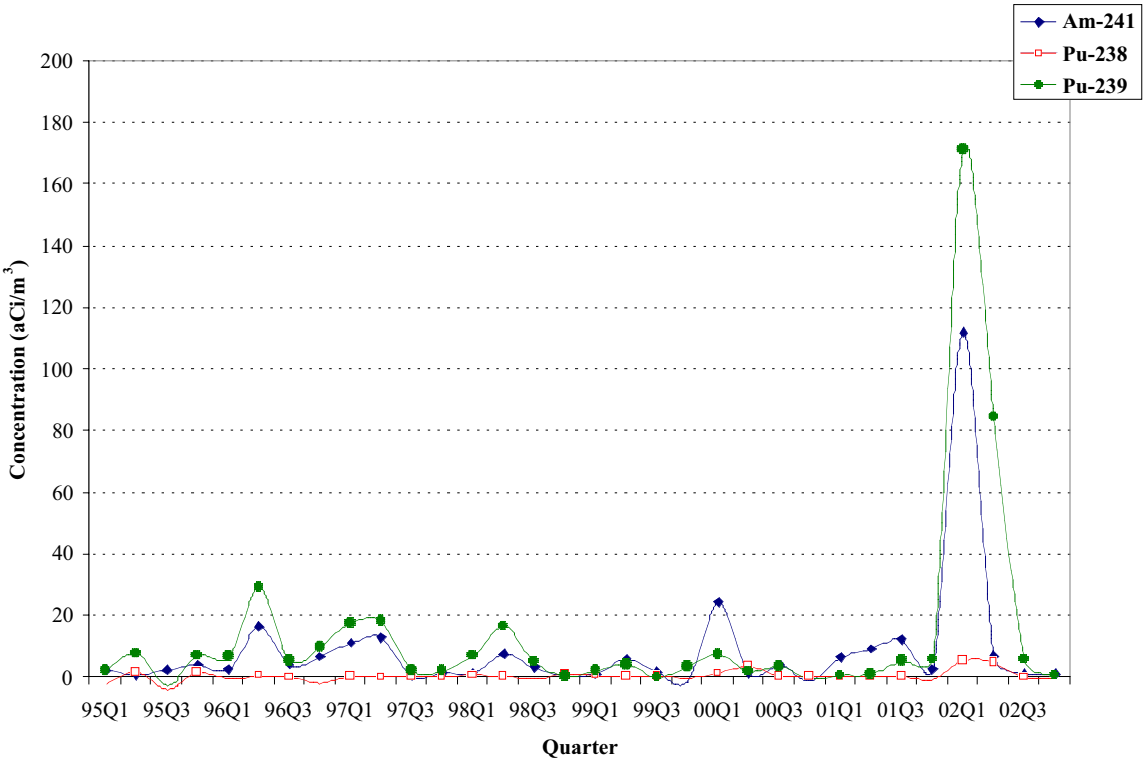


Figure 20. Plutonium and americium concentrations measured at Station 47.

In the first quarter of 1999, Station 34, at the northeast corner of Area G, detected elevated concentrations of plutonium and americium that continued into the second and third quarters but returned to more expected levels by the fourth quarter. This pattern repeated in the next three years (see Figure 21).

Stations 45 and 47 both measured greatly elevated concentrations during the second quarter of 2002. Until then, the annual average concentrations for Station 45 were 13.3 aCi/m^3 and 4.3 aCi/m^3, respectively (see Figure 22). However, in the second quarter of 2002, this station recorded significantly elevated readings, which returned to expected levels by the third quarter of 2002. Gross alpha measurements from this station indicated that a problem began at the end of February 2002, continued into the first sample period of March 2002, then stopped. We discuss this unusual reading and its cause in Section V.

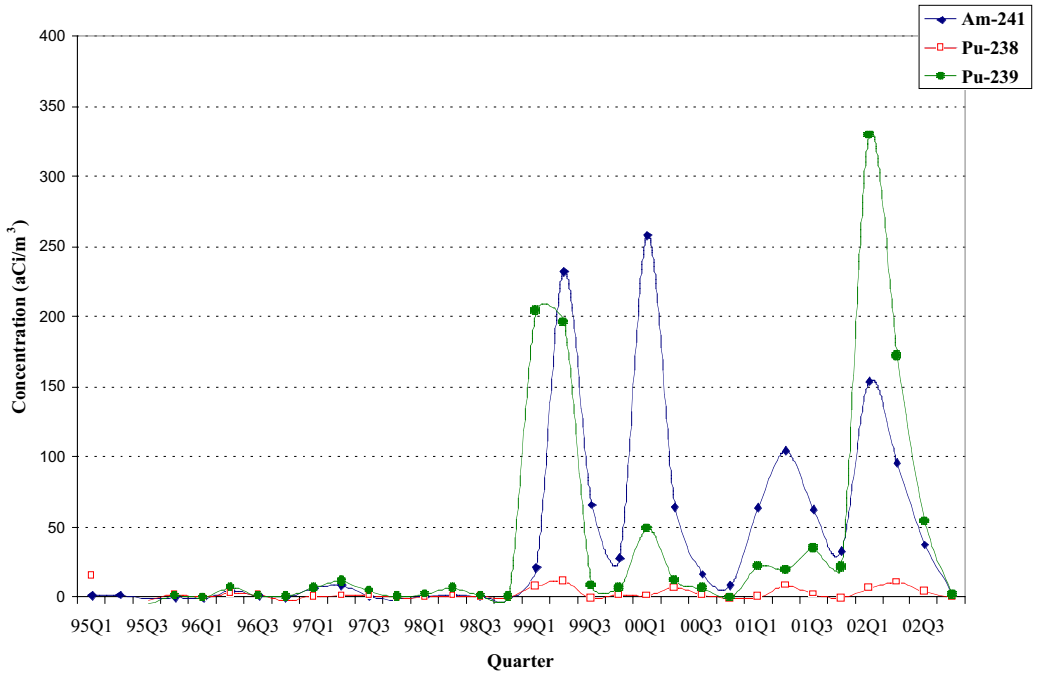


Figure 21. Plutonium and americium concentrations measured at Station 34.

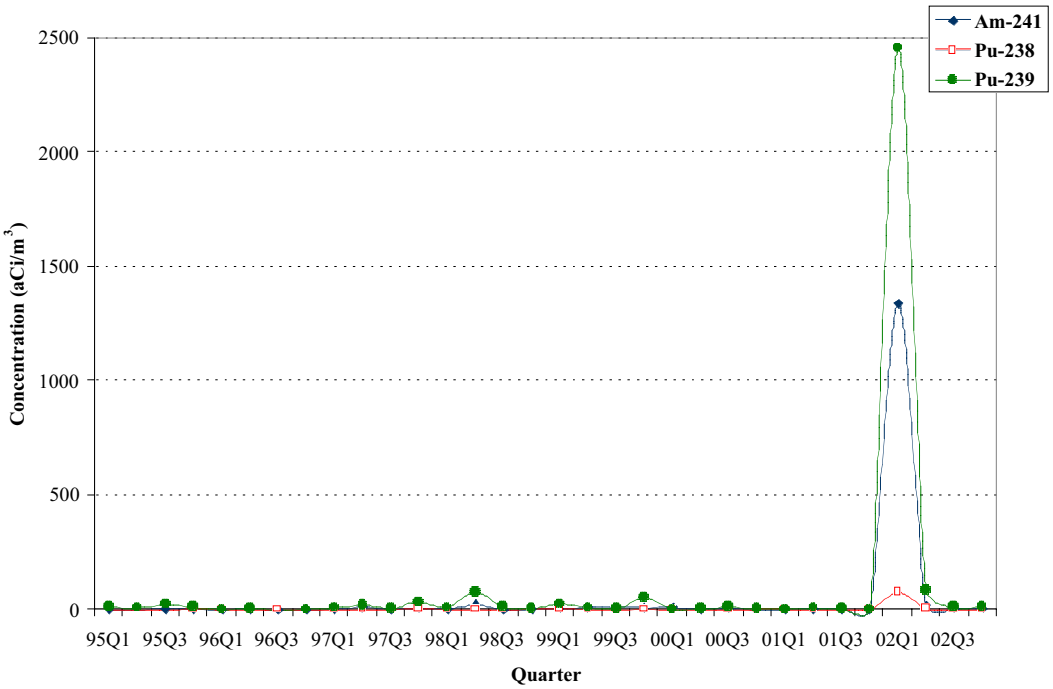


Figure 22. Plutonium and americium concentrations measured at Station 45.

Uranium Results

Three uranium isotopes are naturally present in ambient air: U-234, U-235, and U-238. The natural sources of uranium are crustal rocks and soils. Therefore, the ambient concentrations depend on the mass of suspended particulate matter, the uranium concentrations in the parent material, and any local sources (Eberhart, 1998). The graphs of airborne uranium concentrations reveal a seasonal variability at most, if not all, of the stations in Area G.

The Laboratory has measured isotopic uranium concentrations in particulate matter composites since the first quarter of 1995. As previously described, this analytical change has allowed us to identify and quantify LANL's impact on ambient concentrations of uranium, which are either enriched uranium (excess U-234 and U-235) or depleted uranium (excess U-238). In comparing the network-wide uranium isotopic concentrations by quarter, even though the annual and quarterly concentrations vary, peak concentrations for all three isotopes occur during the second quarter of each year. Furthermore, the U-238 concentrations have sometimes been slightly higher than the U-234 concentrations since the first quarter of 1998, indicating the presence of depleted uranium in some samples.

Depleted uranium has usually been detected in at least one sample per quarter—most notably in the first quarters of 1997 and 2001, when significant differences (3σ) were detected in some of the samples. The number of quarterly composites with depleted uranium was higher in 2001 than in any of the years since isotopic measurements started in 1995. We are investigating these increases but believe that the loss in ground cover and vegetation from the Cerro Grande Fire, combined with below-average precipitation for the last several years, may have increased resuspension of depleted uranium from old firing sites located elsewhere on LANL property.

Only a few AIRNET samples have shown excess enriched uranium. Most of these samples were taken in 1996, with one case in Area G at Station 35. There is some evidence that these samples were contaminated in a laboratory, but this contamination has not been proven, and the concentrations are still considered valid environmental measurements. In the following

graphs, we present airborne uranium measurements for each station, starting with Station 36 on the west end of Area G and ending with Station 45 on the east end of Area G.

Figure 23 shows that depleted uranium may have been detected three times at Station 36: during the third quarter of 1999, the first quarter of 2002, and the fourth quarter of 2002. We also note that the quarterly average uranium concentrations for the second quarter are usually more than twice the average concentrations of the other three quarters. The average total uranium concentration for the time period shown in Figure 23 was 40.1 aCi/m^3. Also, despite the variability of the results shown in the graph, there may be a slight downward trend in the measurements.

Figure 24 shows that depleted uranium may have been detected two times at Station 51. We also note that the second-quarter average uranium concentrations are usually more than twice the average concentrations of the other three quarters. The station's measurements provide the best example of airborne uranium's seasonal variation. Again, even with the data's considerable variability, there may be a slight downward trend in the measurements.

Concentrations of airborne uranium at Station 50 are presented in Figure 25 (note scale change). This data shows the same second-quarter peak and at least one case of detecting depleted uranium. Note that the measurements for the second quarter of 1999 are higher than normal. Station 35 data are provided in Figure 26. This station is located along the southern fence line of Area G (upwind) and has recorded the lowest overall uranium concentrations, with an average of 27.8 aCi/m^3 from 1995 to 2002. The data in Figure 26 may also have a slight upward trend.

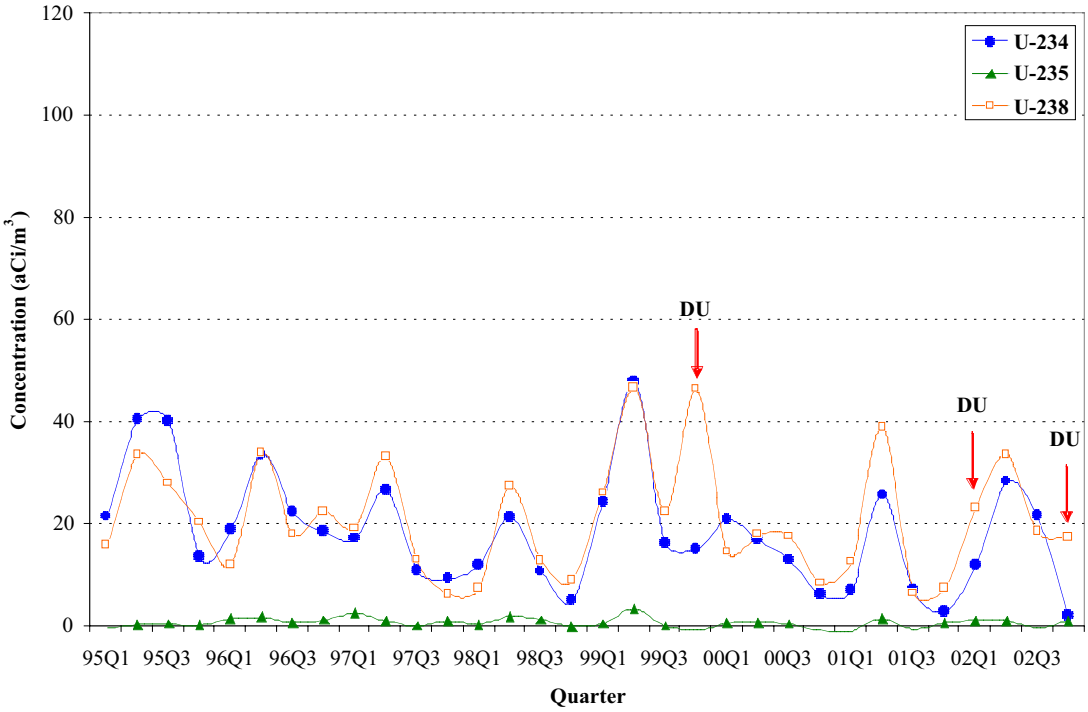


Figure 23. Uranium concentrations measured at Station 36.

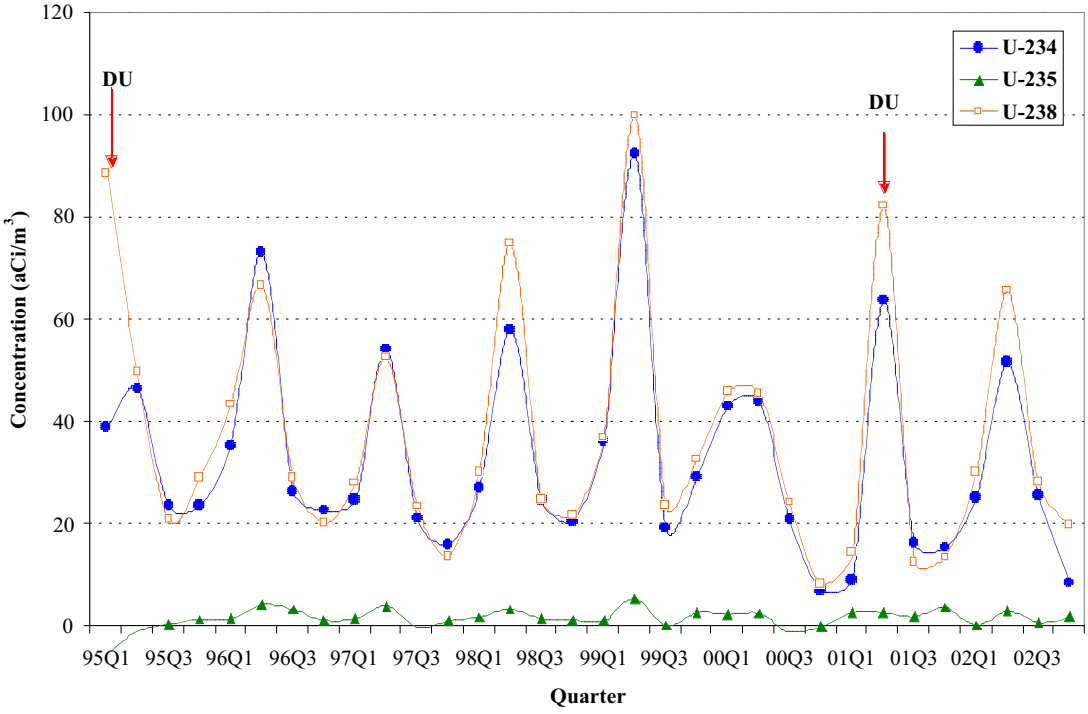


Figure 24. Uranium concentrations measured at Station 51.

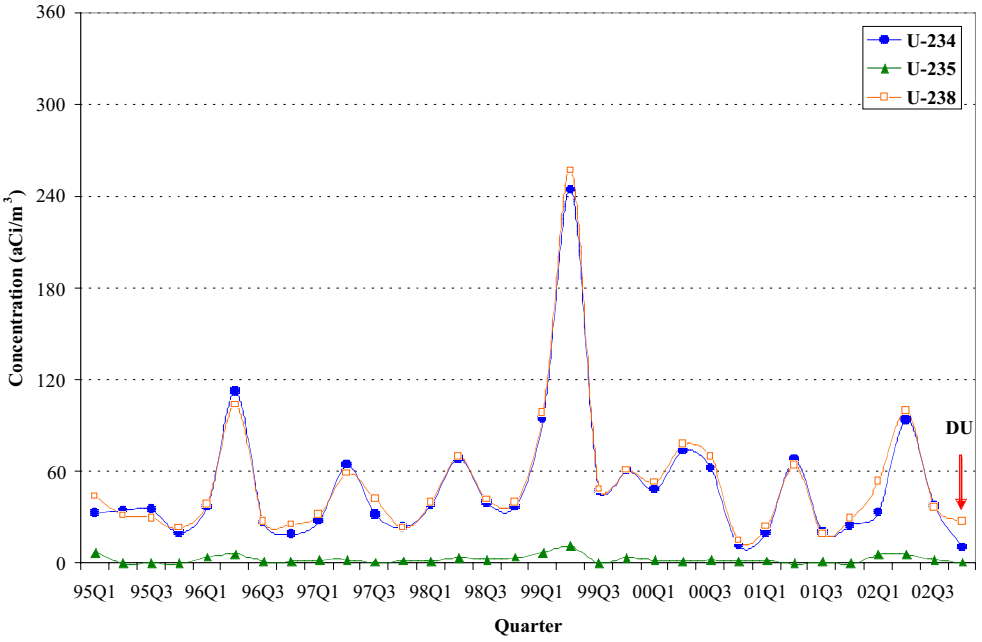


Figure 25. Uranium concentrations measured at Station 50.

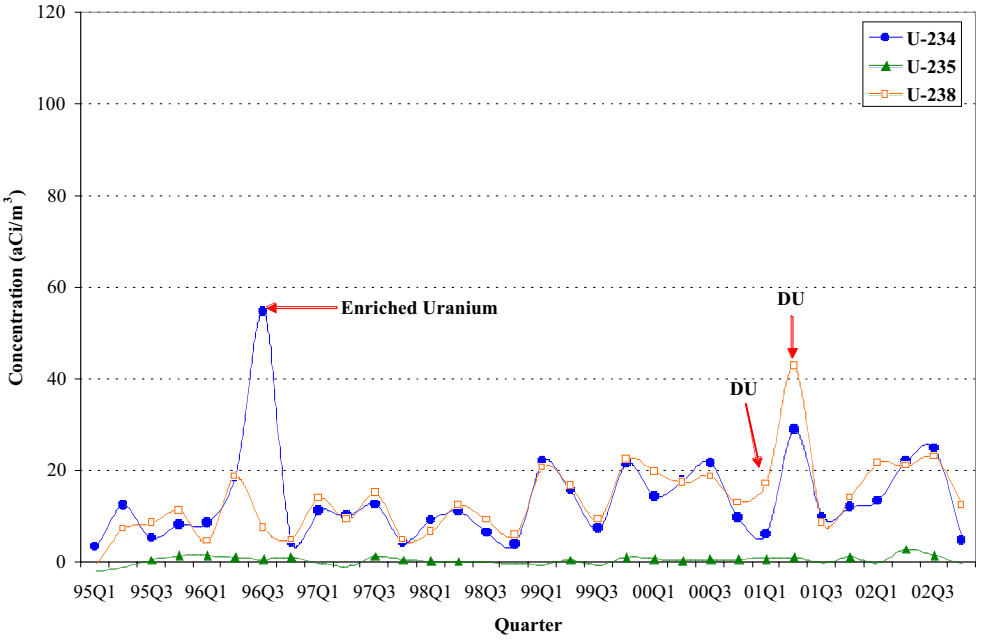


Figure 26. Uranium concentrations measured at Station 35.

Airborne uranium measurements for the original Area G air-sampling site, where Station 27 is now located, are provided in Figure 27 (note scale change). Station 27 is about 360 meters from Station 35 and predominately downwind of Station 35. The significantly elevated reading at Station 27 in the second quarter of 1999 exceeded the alert level and was caused, we believe, by high dust loading produced by mechanical disturbances near the sampler. Station 27's average concentration from 1995 to 2002 was the highest in Area G, about 103 aCi/m^3.

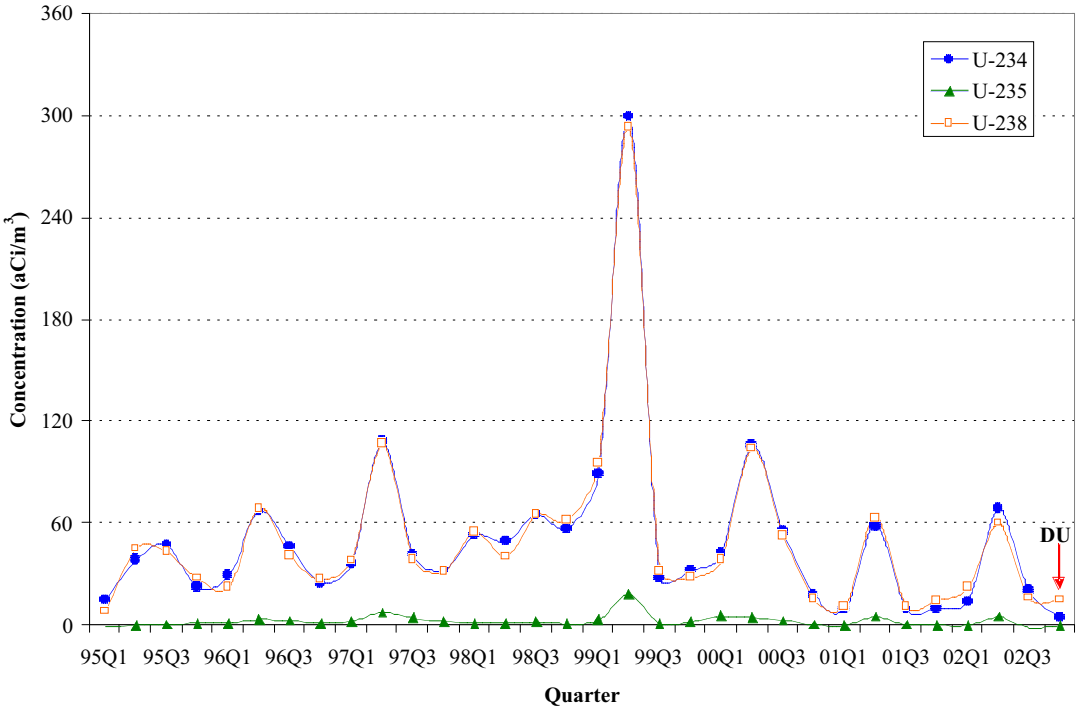


Figure 27. Uranium concentrations measured at Station 27.

Station 47 is about 120 m due east of Station 27, with an average total uranium concentration from 1995 to 2002 of 43 aCi/m^3. Station 47 measurements are presented in Figure 28. Station 34 is in the northeast corner of Area G, with an average total uranium concentration from 1995 to 2002 of 65 aCi/m^3. Station 34 data is shown in Figure 29. Again, there may be a slight upward trend in the data. Station 45 measurements, provided in Figure 30, show an average concentration from 1995 to 2002 of 83 aCi/m^3. No trend is present. Finally, the total uranium data for Area G's side-by-side stations are shown in Figure 31.

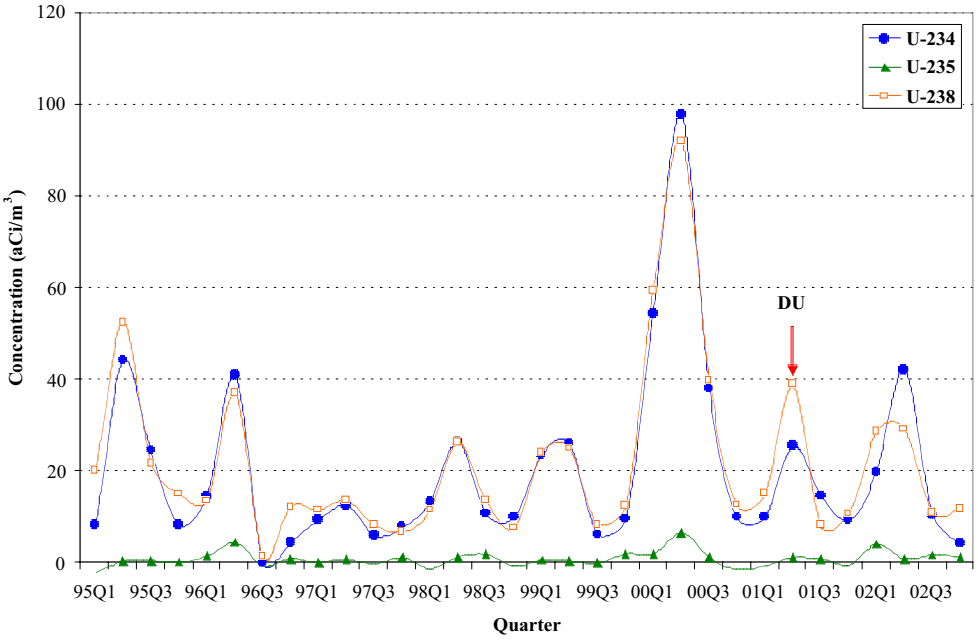


Figure 28. Uranium concentrations measured at Station 47.

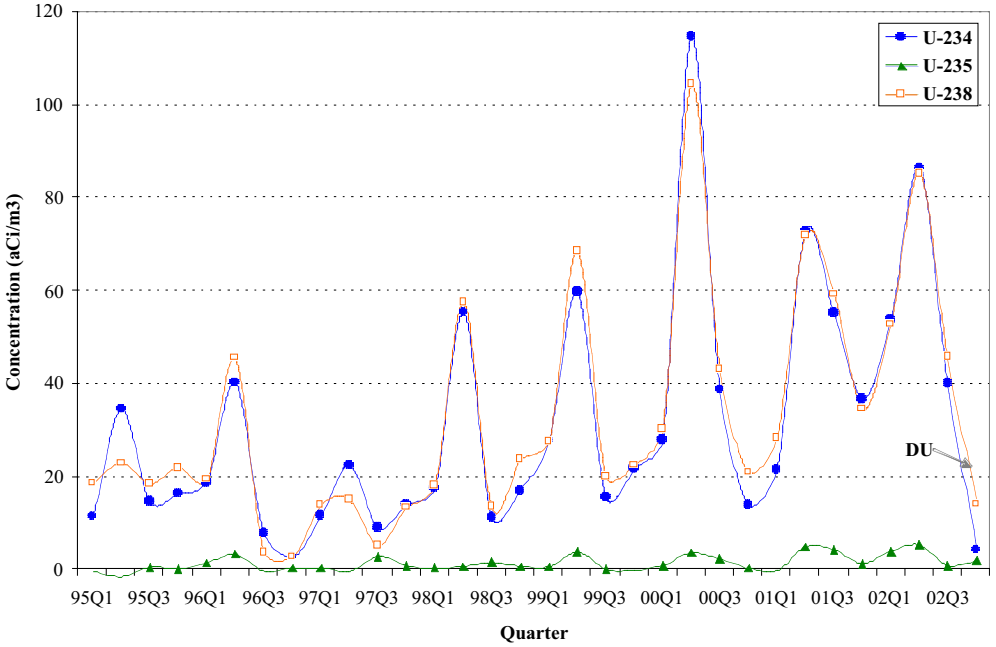


Figure 29. Uranium concentrations measured at Station 34.

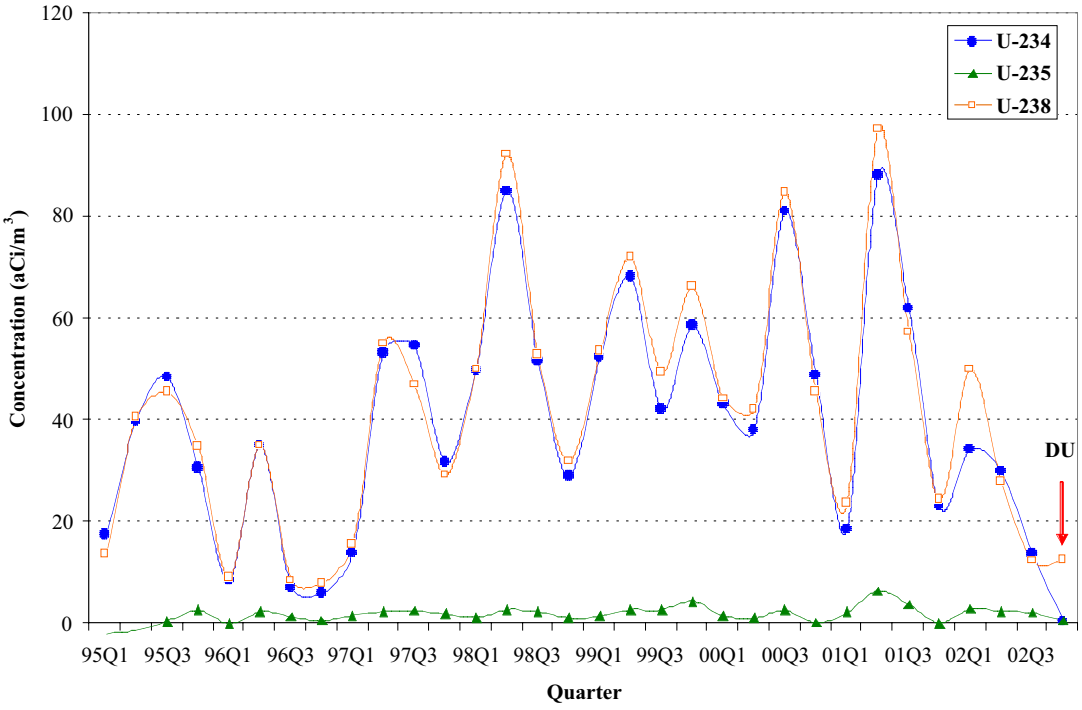


Figure 30. Uranium concentrations measured at Station 45.

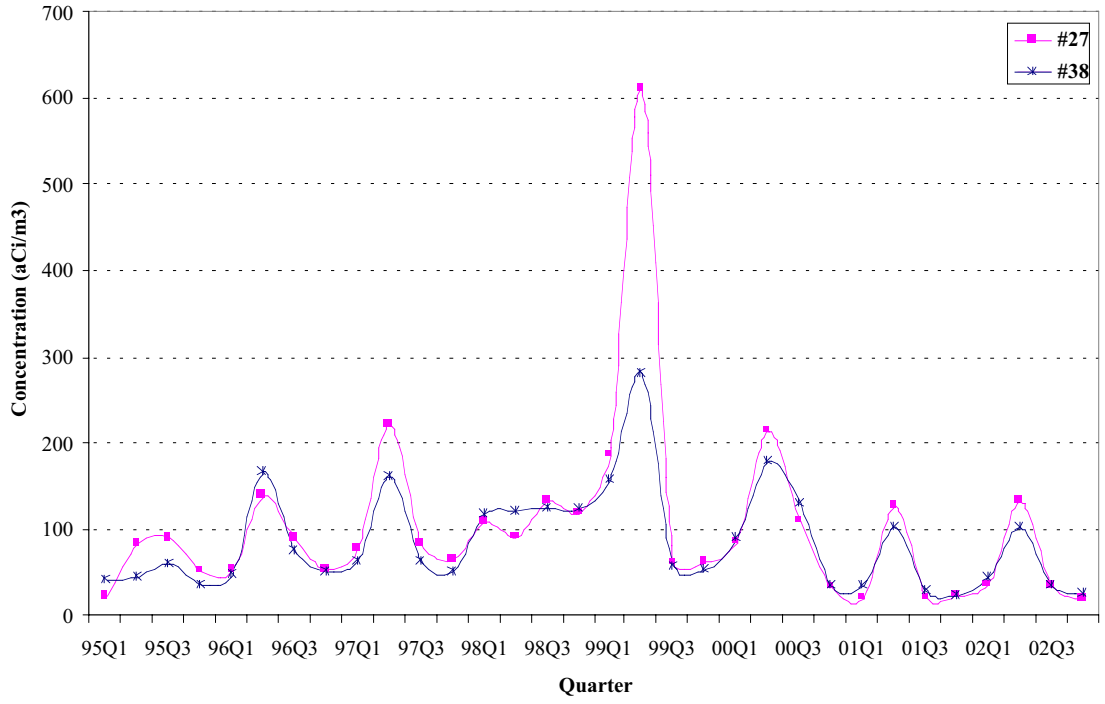


Figure 31. Uranium concentrations measured at Stations 27 and 38.

V. DISCUSSION OF SAMPLING RESULTS AND RELATED EVENTS BY YEAR

1995 Events and Discussion

Elevated tritium concentrations were observed at a number of Area G Stations, with the highest maximum concentrations at Stations 25, 35, and 36 and the highest annual mean concentrations at Station 35. Tritium air concentrations at Stations 35 and 36 were observed to be higher than readings from the other samplers in Area G. The mean annual air concentrations at Stations 35 and 36 for 1995 were 370 pCi/m^3 and 49 pCi/m^3, respectively. All the other air samplers at Area G measured tritium concentrations within the range of those observed elsewhere. Stations 35 and 36 are located near shafts used to dispose of higher-activity waste containing tritium. Data from these stations show elevated tritium air concentrations near these shafts.

Station 27 recorded the highest annual mean concentrations of Pu-239/Pu-240, at 108 aCi/m^3. Station 27 also recorded the highest concentration of Am-241, at 82.6 aCi/m^3.

1996 Events and Discussion

Elevated tritium concentrations continued to be observed at a number of Area G stations, with the highest maximum and annual mean concentrations at Station 35. The highest annual mean for Pu-238 was at Station 27, on the north perimeter of Area G, at 19.8 ± 10.0 aCi/m^3 (see Figure 32).

Starting in 1996, the MAQ Group began formally reviewing air-monitoring data to assess whether ambient air concentrations of radionuclides were above what we had seen in recent history. During the review, we identified elevated air concentrations of plutonium and americium at Station 27. We found that these were not isolated incidents but part of an increasing trend that started in the first quarter of 1991. Analysis of data from Station 27 indicates an increasing trend for Pu-239/Pu-240 and Am-241. Station 27 gave the highest reading for these isotopes in Area G in 1995. We believe there was a significant increase in the air concentration of these radioisotopes at this location starting with the second quarter of 1995.

Figure 32. The concentrations of Pu-238 measured at Stations 27 and 38.

The air concentrations increased somewhat during the first quarter of 1995 and to a significantly higher level during the second quarter of 1996 (see Figures 33 and 34). These increases were seen only at one station and suggested that the source of contamination was very small and very close to the side-by-side samplers.

An interesting observation was that the Pu-239/Pu-240 and Am-241 concentrations increased by a factor of as much as 100, whereas Pu-238 concentrations were elevated only by a factor of 5. Other radionuclides were not elevated significantly. None of the other air monitoring Stations at Area G showed evidence of this increasing trend, and neither did the nearby off-site stations, including those in White Rock. We concluded that a new source of contamination must have been created very close to Stations 27 and 38.

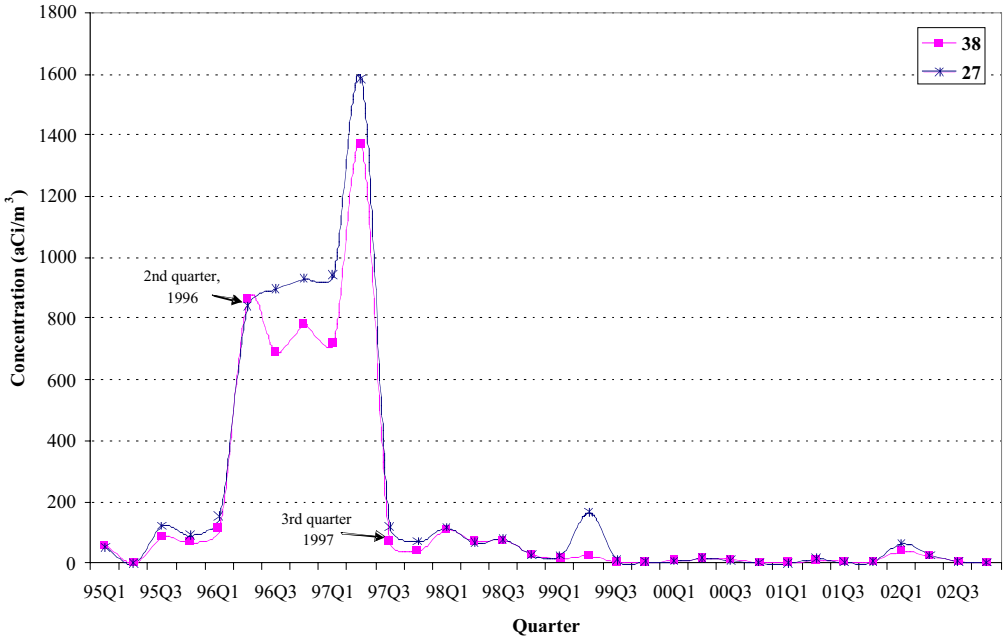


Figure 33. The concentrations of Pu-239/Pu-240 measured at Stations 27 and 38.

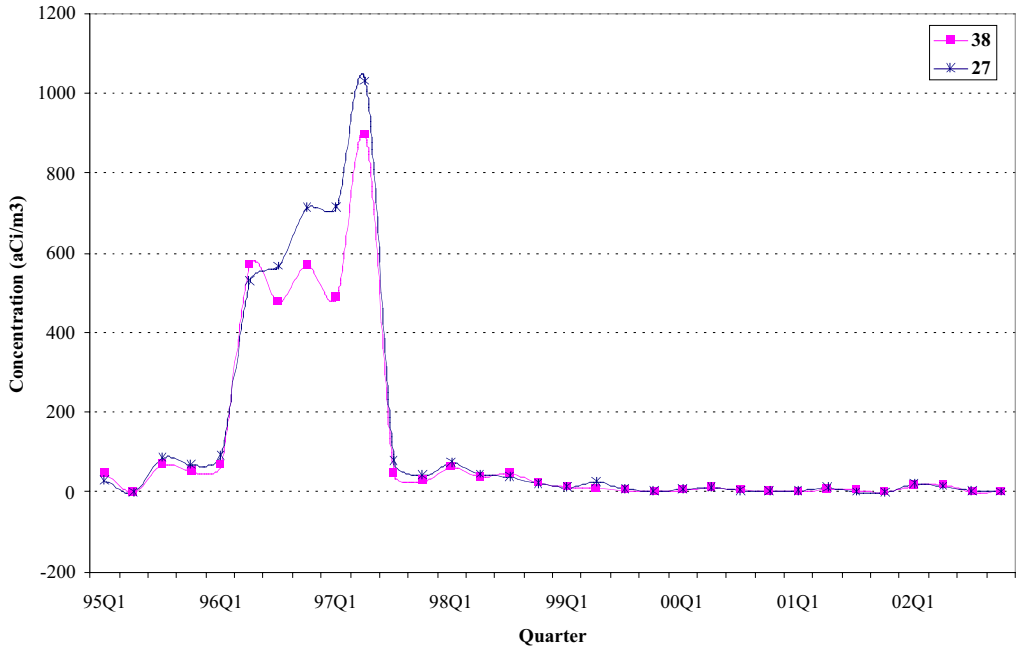


Figure 34. The concentrations of Am-241 measured at Stations 27 and 38.

A ground survey of the vicinity using a "Violinist" instrument[1] revealed a small area a few tens of meters from the station that had soil contaminated at levels about 100 times the average concentrations nearby. The survey was completed in May 1996 and showed one small area of approximately 10 m x 15 m where contamination was significantly higher than in adjacent areas.

Discussion with Area G personnel revealed that the entire road area in the vicinity of the air-monitoring station had been moved and reworked during the previous year. Additionally, trenching for waterlines along the northern edge of the road passed within a couple of meters of Station 27. A trenching operation occurred in February 1995 and appears to have been synchronous with the initial small rise in air concentrations. Another trenching operation and a complete reworking of the road surface was begun in the spring of 1996, closely matched in time with the much more significant increase in air concentrations. The road was actually moved in early 1996, and that move appears to have taken the road directly over the contaminated area. Our preliminary conclusion is that trenching or road work may have brought some contaminated material to the surface of the road and that heavy vehicle traffic associated with the TWISP operations has provided an efficient mechanism to get the contamination airborne in the immediate vicinity of Station 27.

Although the elevated results did not indicate either a compliance issue or a health and safety concern, a mitigation plan was developed. The mitigation plan included covering the surface contamination with a mix of gravel and sand to isolate the contamination. Relevant air-sampling data would be analyzed at an increased frequency (biweekly instead of quarterly) to evaluate the effectiveness of the remediation.

1997 Events and Discussion

Elevated Readings at Stations 27 and 38

Increases in plutonium and americium levels continued to occur at Stations 27 and 38. Station 27 recorded the maximum Area G quarterly concentration for Pu-239/Pu-240 in the

[1] A scintillation detector with a multiple channel analyzer that can detect the low levels of gamma radiation associated with the decay of Pu-239/Pu-240 and Am-241.

second quarter, at 1160 aCi/m^3. As already noted, there was a significant increase in the air concentrations of Pu-239/Pu-240 at Station 27 beginning during the second quarter of 1995 and continuing at least through the second quarter of 1997 (see Figure 33). Because Stations 27 and 38 are in the same location, they both show about the same results (e.g., compare Figures 19 and 35). In contrast, none of the other stations in Area G or any stations in White Rock show elevated results. The upward trend began in 1995, with most of the increase occurring in 1996 and early 1997. The highest concentrations of Am-241 were also measured at Station 27. The annual concentration was about 470 aCi/m^3, nearly 100 times higher than the next highest annual concentration. We calculated potential doses to a worker that might have been continuously exposed to these concentrations for the second quarter of 1997, using the applicable air-concentration standards (see Table 9). Personnel from Area G, the MAQ Group, and the Hazardous and Solid Waste Group continued to investigate the cause of this trend.

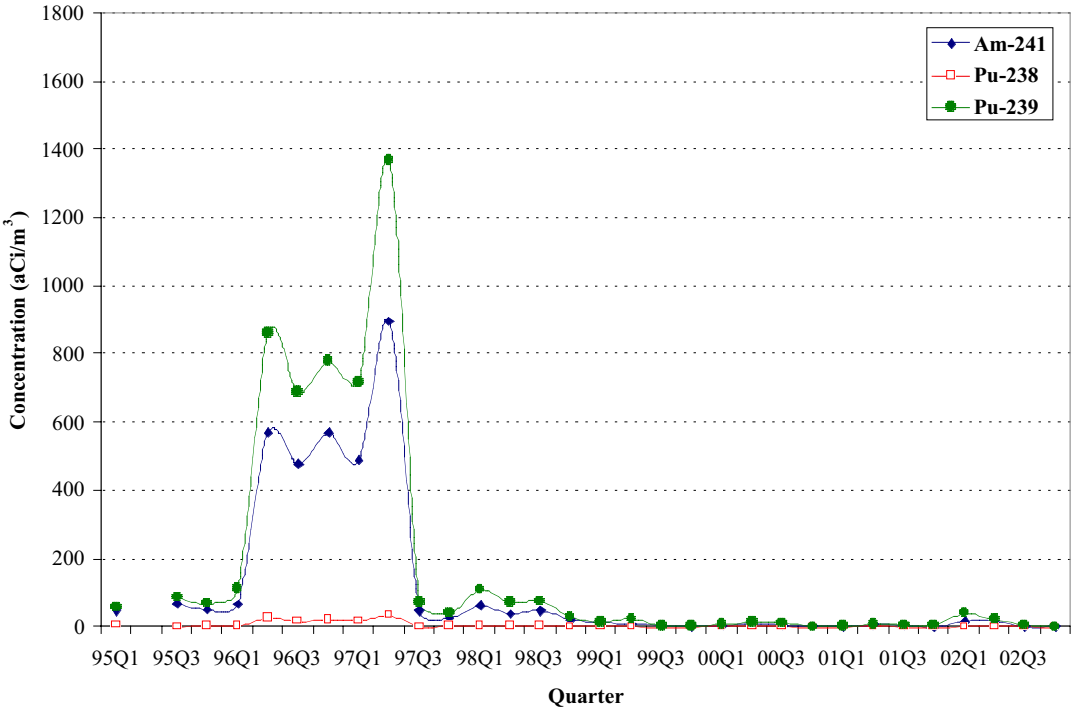


Figure 35. Plutonium and americium concentrations measured at Station 38.

Table 9. Concentrations of plutonium and americium measured at Station 27 during the second quarter of 1997.

Radioisotope	Concentration (aCi/m^3)	Concentration guideline* (aCi/m^3)	Potential worker dose (mrem)
Am-241	1032	2×10^6	0.43
Pu-239/Pu-240	1584	2×10^6	0.99
Pu-238	42.5	3×10^6	0.03

*(DOE, 1993)

As mentioned in a previous section, discussion with Area G personnel revealed that in 1995, when the elevated readings first appeared, some trenching work had been performed within several meters of the two stations. Additionally, the dirt access road near the stations was relocated in the spring of 1996, which coincided with a very significant increase in air concentration. A second trenching operation was also completed at about this time. It appears that contaminated material was brought to the surface during the trenching, which, combined with the increased local traffic, increased resuspension of the material contaminated soil in the vicinity of the air-monitoring stations.

The trenching had occurred next to the sampler during 1995 and 1996, and the nearby road had been rerouted during early 1996. Our conclusion that trenching or road work brought some contaminated material to the surface of the road and that heavy vehicle traffic associated with operations provided an efficient mechanism to get the contamination airborne in the immediate vicinity appears to be valid. Further discussion with members of LANL's Environmental Restoration Program indicated the material brought in to cover old burial pits in the area was actually contaminated soil removed during a 1960s remediation of experimental sites that were in use during the early years of the Laboratory.[2]

A complete remediation of the problem by covering the contamination with approximately 30 cubic yards of clean dirt was completed in 1997. During this time, the MAQ Group had biweekly AIRNET samples from Station 27 radiochemically analyzed for plutonium and

[2] Fill material was believed to have been brought in from contaminated areas of the old TA-1 site, one of the original sites used during the Manhattan Project.

americium isotopes to assess whether airborne concentration levels had dropped as a result of the dirt cover. With reductions due to mitigation, the third and fourth quarter Pu-239/Pu-240 readings dropped to about 100 aCi/m^3, and Am-241 levels dropped from about 1,000 aCi/m^3 to 60 aCi/m^3. Although these are major reductions, the concentrations do not appear to have dropped below pre-1995 levels. Area G personnel were informed of this situation and are considering what additional mitigation efforts may be necessary.

1998 Events and Discussion

Area G station continued to measure the highest airborne tritium concentrations at LANL. In 1998, tritium air concentrations increased for three stations at the far western end of Area G. Station 36, which is at the entrance gate to Area G, has shown the largest increase, while Stations 50 and 51 have increased slightly. Annual concentrations at Station 36 have increased from 5 pCi/m^3 in 1996 to 33 pCi/m^3 in 1997 and to 107 pCi/m^3 in 1998. These increases appear to be limited to this area and apparently began in the summer of 1997. Area G personnel believe that these increases are due to disposal of additional tritium-contaminated material.

The highest concentrations of Am-241 were measured at the Area G stations, especially at Station 27, where the annual concentration was nearly 4 times higher than the next highest annual concentration. However, the average concentration dropped an order of magnitude, from 470 aCi/m^3 in 1997 to 46 aCi/m^3 in 1998, because of mitigation efforts. The elevated measurements of Pu-239/Pu-240 and Am-241 in 1998 at Stations 27 and 38 are consistent with previous quarterly data that show dramatic decreases in ambient concentrations since the middle of 1997. The source of these elevated levels was mitigated in 1997 (Kraig et al., 1998). Nevertheless, concentrations did not drop to pre-1995 levels. Concentrations of U-234 and U-238 are also typically elevated at these two sites, but the ratio of the two isotopes indicates that the high levels are due to high dust loading and the natural uranium associated with this dust.

The maximum annual uranium concentrations were measured at Station 38, the QA station in Area G (see Figure 36). The concentrations at the adjacent station, Station 27, were comparable but slightly lower. The maximum annual U-234 concentration was 61 aCi/m^3. The U-235 concentration was 4.4 aCi/m^3, but three of the four quarterly concentrations were below the MDA, and the remaining value was only equal to the MDA. The associated U-238 concentration was 62 aCi/m^3. For 1998, the annual mean concentrations for both U-234 and U-238 were above 50 aCi/m^3 at three other Area G stations (27, 38, and 45). This value is well above regional background readings. However, the relative abundances of U-234, U-235 and U-238 indicate that the higher uranium concentrations at Area G are attributable to natural uranium. Therefore, these higher uranium concentrations are apparently caused by the natural uranium associated with higher levels of resuspended particulate matter from unpaved roads and ongoing surface soil disturbances at Area G.

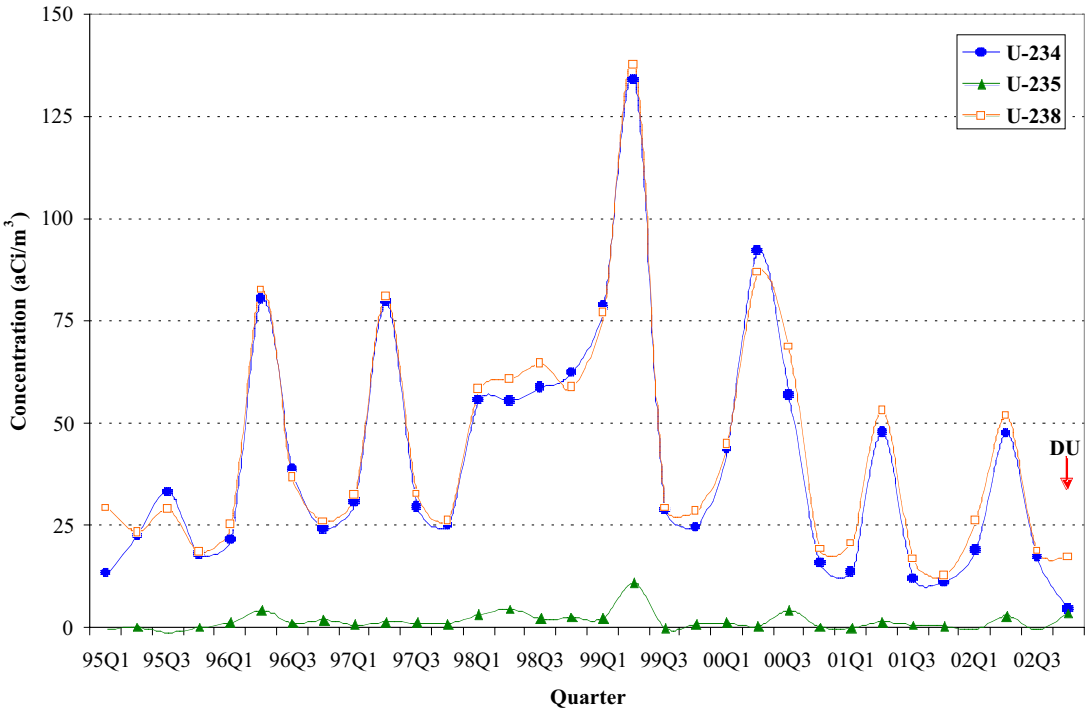


Figure 36. Uranium concentrations measured at Station 38.

1999 Events and Discussion

The annual average concentration for Station 27, which had been the highest concentration for the two previous years, dropped from 73 aCi/m^3 in 1998 to 51 aCi/m^3 in 1999, apparently because the nearby gravel road was paved in early 1999. The highest annual Pu-239/Pu-240 concentration was recorded by Station 34, at 105 aCi/m^3, more than 27 times the 1998 annual concentration for this station. Also, the highest annual Am-241 concentration was recorded by Station 34, at 89.7 aCi/m^3, nearly 6 times higher than the second highest annual concentration in Area G.

Elevated Readings at Station 34

Compared to previous measurements, the 1999 first quarter concentrations at Station 34 were considerably elevated for Pu-239/Pu-240, at 206 aCi/m^3, and Am-241, at 24 aCi/m^3. (The plutonium data are shown in Figure 37. The plutonium and americium data are shown together in Figure 21.) The concentrations were well above the six-year averages for these radionuclides: 5 aCi/m^3 and 19 aCi/m^3, respectively. Concentrations of Pu-238 were also elevated. Discussions with operations staff at Area G regarding this information revealed the following.

On March 15, 1999, a 55-gal. drum was retrieved as part of the TWISP operations at TA-54. Inspection revealed a small hole on the bottom of the drum, and alpha contamination was detected. Workers removed surface contamination and sealed the drum within a second drum. However, before the contamination was remediated, small amounts of radionuclides were released to the air. These releases caused increased concentrations at Station 34, which is very close to the TWISP operations. If the releases had been large or widespread, we would also have seen increases at other air-monitoring stations nearby. The operations group instituted radiologically engineered controls to help minimize future releases to the air during the TWISP operations. These controls included more complete monitoring of drum surfaces at each step of drum handling, immediate bagging of drums with suspected contamination, continuous local air sampling, enhanced area swiping to identify contamination, and training all employees in the new operation procedures.

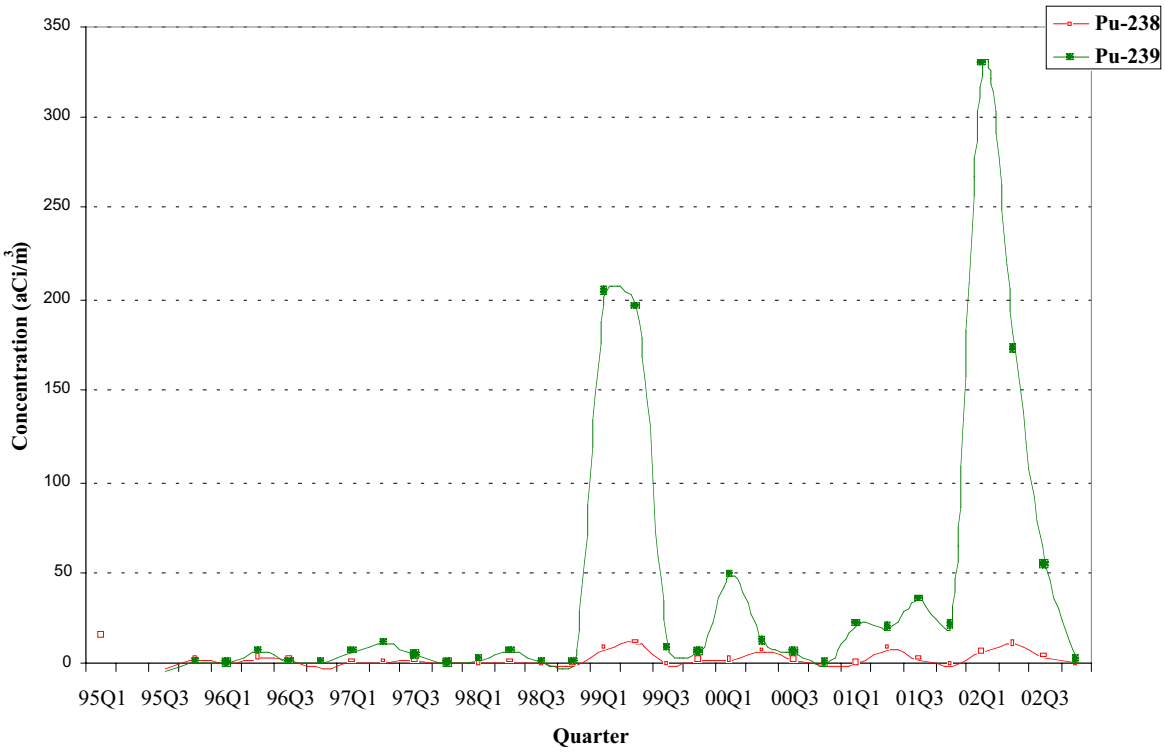


Figure 37. Plutonium concentrations measured at Station 34.

In spite of these mitigation measures, air concentrations increased during the second quarter. The Pu-239/Pu-240 and Am-241 concentrations were 197 aCi/m^3 and 233 aCi/m^3, respectively. The operations group evaluated additional mitigation measures and implemented them during the third quarter. Plutonium concentrations returned to pre-1999 concentrations during the third quarter. Americium concentrations declined greatly by the third and fourth quarters to 66 aCi/m^3 and 29 aCi/m^3, respectively, but were still higher than the pre-1999 concentrations of 1–12 aCi/m^3.

Elevated Readings at Station 45

During the fourth quarter of 1999, Station 45 recorded an elevated concentration of Pu-239/Pu-240. The concentration of 52 aCi/m^3 was the highest value recorded during 1999 but was similar to the highest values recorded in 1997 and 1998 at this station. The probable cause of this elevated value was resuspension of residual soil contamination at the eastern

end of Area G. The 7-year annual average air concentration of Pu-239/Pu-240 at Station 45 was 24.5 aCi/m^3.

2000 Events and Discussion

Cerro Grande Fire

The dry winter and spring of 1999–2000, combined with exceptionally high winds, produced worst-case wildfire conditions in May 2000. In early May, a prescribed, or management, burn went out of control and grew to become a large wildfire (the Cerro Grande Fire) that threatened the town of Los Alamos and facilities at LANL. From May 10 to May 15, the fire burned out of control along the boundaries and into the interior of LANL. The Cerro Grande Fire produced very high emissions of particulate matter, with ambient concentrations 2 to 20 times national ambient air quality standards (ESH, 2001). The fire was completely contained in early June. A drier-than-normal summer rainfall season limited some of the potential for high runoff events following the Cerro Grande Fire. It is estimated that the wildfire burned on and over 7,000 to 7,500 acres of LANL property (Jacobson, 2001)

Ambient air samples were changed and analyzed much more frequently than normal during the Cerro Grande Fire. Elevated levels of gross alpha and gross beta were measured in locations impacted by the smoke. These increases were due to the resuspension of naturally occurring radionuclides produced by the decay of radon. High short-term uranium concentrations were measured, which appear to be attributable to the high winds that also spread the fire. The quarterly concentrations, which include these short-term measurements, were comparable to historical measurements, with several on-site locations having low but measurable concentrations of depleted uranium.

Calculated short-term concentrations of uranium, plutonium, and americium during the fire were more variable than historical quarterly concentrations with higher and lower concentrations. For the Lab-wide AIRNET program, all but two of the measured plutonium and americium concentrations were below their 3σ measurement uncertainties, with one of these samples from Station 34 in Area G.

Many of the uranium measurements were above their uncertainties and much higher than the quarterly concentrations, but isotopic comparisons generally indicated that the uranium was natural. The high winds during the fire appear to be the primary cause of the high short-term concentrations. At LANL, winds faster than 7 m/s dramatically increase ambient concentrations of particulate matter (Whicker et al., 2000). During the second quarter of 2000, about 24% of these high winds occurred on May 10 and May 11, based on TA-54 meteorological tower data. The percent expected to occur on these days was only 2.2%. Therefore, these windy days and the physical turbulence from the fire could cause much higher concentrations of natural uranium simply by resuspending more particulate matter.

Elevated Readings at Station 34

Station 34 had the highest concentrations of all three transuranic radionuclides. Action levels were exceeded for Am-241 the first three quarters of 2000, and Pu-239/Pu-240 concentrations were exceeded for the first two quarters. One quarterly Pu-238 measurement exceeded the action level for this location, but it was less than its associated uncertainty. Higher concentrations have been measured at this site since the first quarter of 1999. These higher concentrations are apparently associated with TWISP operations.

Based on the first-quarter data from this sampler in 1999, the Area G operations group instituted radiologically engineered controls to help minimize future releases to the air during the TWISP operations. These controls appeared to reduce ambient concentrations of plutonium and americium, but the concentrations were still above background levels. Because this sampler is very close to the TWISP operations and other Area G samplers do not appear to be impacted, the releases appear not to have been large or widespread. The action levels for Station 34 were developed using pre-1999 data and have since been revised to reflect current operational activities.

2001 Events and Discussion

As discussed in a previous section, we noted that each year, as the ambient temperature increases, the tritium concentrations at TA-54 increase because of the diffusion of tritium from stored waste. Because this effect is a known, repeated phenomenon, we use a moving average to determine if unexpected results are being measured. At Station 35, which is located next to tritium waste disposal shafts, this temperature effect is accentuated. During sample periods ending July 30, August 27, and September 24, airborne tritium levels at this station exceeded the moving-average action levels. The maximum two-week concentration at Station 35 was 7316 pCi/m^3. These "investigate" concentrations peaked at approximately twice the highest values previously recorded in other years. An investigation identified no specific explanation for these new peaks. Weather conditions, a "wave" of tritium diffusion through the soil, or physical changes in the buried waste containers may have caused this increase. The 2001 mean concentration at this site was about 1800 pCi/m^3, which is higher than the 2000 mean concentration (~1100 pCi/m^3) but is still only 0.01% of the DOE DAC for worker exposure, which is 20,000,000 pCi/m^3.

Americium and Pu-239/Pu-240 exceeded action levels at Station 34 for all four quarters of 2001. In addition, one quarterly sample at this station exceeded its Pu-238 "investigate" concentration. The concentrations of all three radionuclides at this station have been higher since early 1999. High concentrations for more than two years and the absence of similar increases at other locations in the eastern part of Area G indicate that these "investigate" concentrations remain localized and are caused by nearby waste-handling activities. These concentrations are less than 0.01% of the DOE workplace exposure standards. Also, during the fourth quarter of 2001, the Pu-239/Pu-240 concentration at Station 50 was 23 aCi/m^3. However, the analytical results over the last several years have been on the order of 0–5 aCi/m^3. It is not yet known what caused this increase.

2002 Events and Discussion

Concentrations of plutonium and americium at Area G had been decreasing for several years, but Area G operations are suspected to have caused all these radionuclides to increase for a short time in 2002. As described in the 2002 Environmental Surveillance Report, soil screening activities during February and March at Area G released measurable quantities of plutonium and americium into the atmosphere (LANL, 2003). This soil or overburden had been used to bury TRU waste drums. After the drums were exhumed, this soil was sampled for possible contamination. Apparently there were pockets of contamination that were not detected by the soil sampling. This release was first detected by the significantly higher gross alpha measurements, many times higher than the "investigate" level of 1.5 fCi/m^3 (see Figure 38).

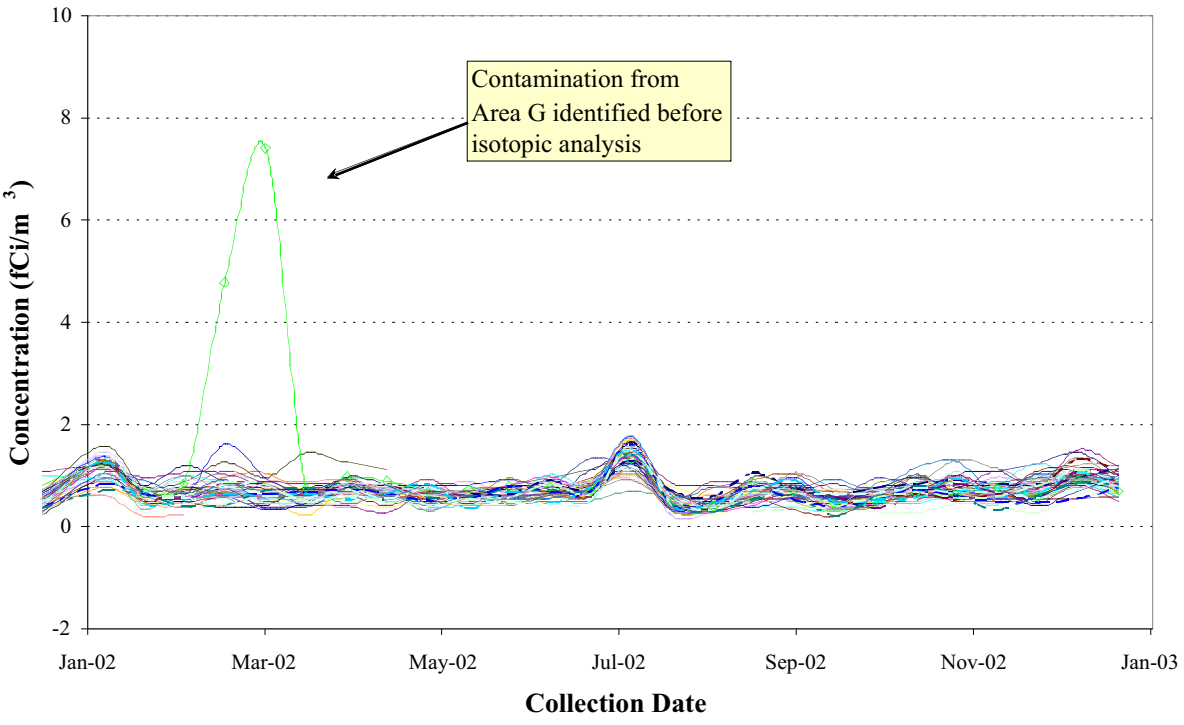


Figure 38. The gross alpha concentrations measured at all AIRNET stations during 2002.

The suspected contamination was confirmed by subsequent alpha spectroscopy of the quarterly composites and individual half filters as previously shown in Figure 22 for Station 45. All three quarterly measurements of the transuranic radionuclides were the highest concentrations ever measured on a quarterly AIRNET sample. These values and smaller increases at other Area G stations caused upward spikes in the TA-54 concentration trends. In addition to impacting nearby samplers, the emissions were measured off-site at Station 13, which is located in White Rock. These measurements are among the highest ever measured off-site, but summed together, they still only represent about 1.4% of the EPA annual public dose limit of 10 mrem for air emissions (EPA, 1990). Several other detectable concentrations were above their uncertainties in White Rock but at much lower concentrations than those at Station 13.

Trend Analysis

We performed a trend analysis for the seven years of filter-collected air concentrations and for each station at Area G. Since the total number of measured concentrations (32 in most cases) was less than 40, we could apply the Mann-Kendall test for trend given in Gilbert (1987) by calculating the test statistic S and comparing the calculated values against a table of probability values for S given in Hollander and Wolfe (1973). Table 10 shows the results of the analysis.

Table 10. Stations with radionuclide air concentrations that indicate some trend as measured by the Mann-Kendall test.

Station	Radionuclide	7-Year trend	S-Statistic	Associated p value	N
27	Pu-239/Pu-240	down	-258	0.000	31
34	Pu-239/Pu-240	up	+180	0.002	32
36	Pu-239/Pu-240	down	-92	0.070	32
38	Pu-239/Pu-240	down	-261	0.000	31
51	Pu-239/Pu-240	down	-88	0.080	32
27	Pu-238	down	-231	0.000	31
45	Pu-238	up	+129	0.018	32
34	U	up	+176	0.002	32
35	U	up	+161	0.005	32
36	U	down	-107	0.043	32
51	U	down	-94	0.066	32

The downward trends at Stations 27 and 38 are the result of deliberate actions taken to remediate a contaminated area, as discussed earlier. For other stations exhibiting a trend, we also performed a seasonal Mann-Kendall test for trend since we believe there is added variation in the data caused by a seasonal effect, particularly with the measured uranium concentrations. The seasonal trend analyses were conducted with the computer program TREND (Gilbert, 1987). The calculated test statistic (one-tailed test) was compared to a table[3] value that corresponds to Z_{alpha} of 95%, or 1.645. Results of the trend tests are provided in Table 11. We also report the seasonal Kendal slope estimator, which reflects both the direction of the trend and the magnitude of the trend, even with seasonality present (Gilbert, 1987).

Table 11. Seasonal Mann-Kendall test for trend.[a]

Station	Radionuclide	Seasonal Mann-Kendall Z-statistic	Seasonal-Kendall estimate of slope[b]
34	Pu-239/Pu-240	+2.832	+3.0
36	Pu-239/Pu-240	–1.056	NA
51	Pu-239/Pu-240	–1.860	–0.21
45	Pu-238	+1.860	+0.24
34	U	+3.897	+10.7
35	U	+2.951	+3.4
36	U	–1.670	–1.7
51	U	–1.546	NA

[a]Seasonally adjusted.
[b]NA means that the null hypothesis of the trend test (Ho=true) cannot be rejected, that is, there is not significant evidence of a trend with this test.

The analysis shows significant upward trends in both plutonium and uranium concentrations at Station 34 and an upward trend at Station 35 for total uranium concentrations. Also interesting is the upward trend in Pu-238 readings recorded at Station 45. The cause of this upward trend is not known and is being investigated.

[3] Statistical table of the Cumulative Normal Distribution of values of P corresponding to Zp for the normal curve.

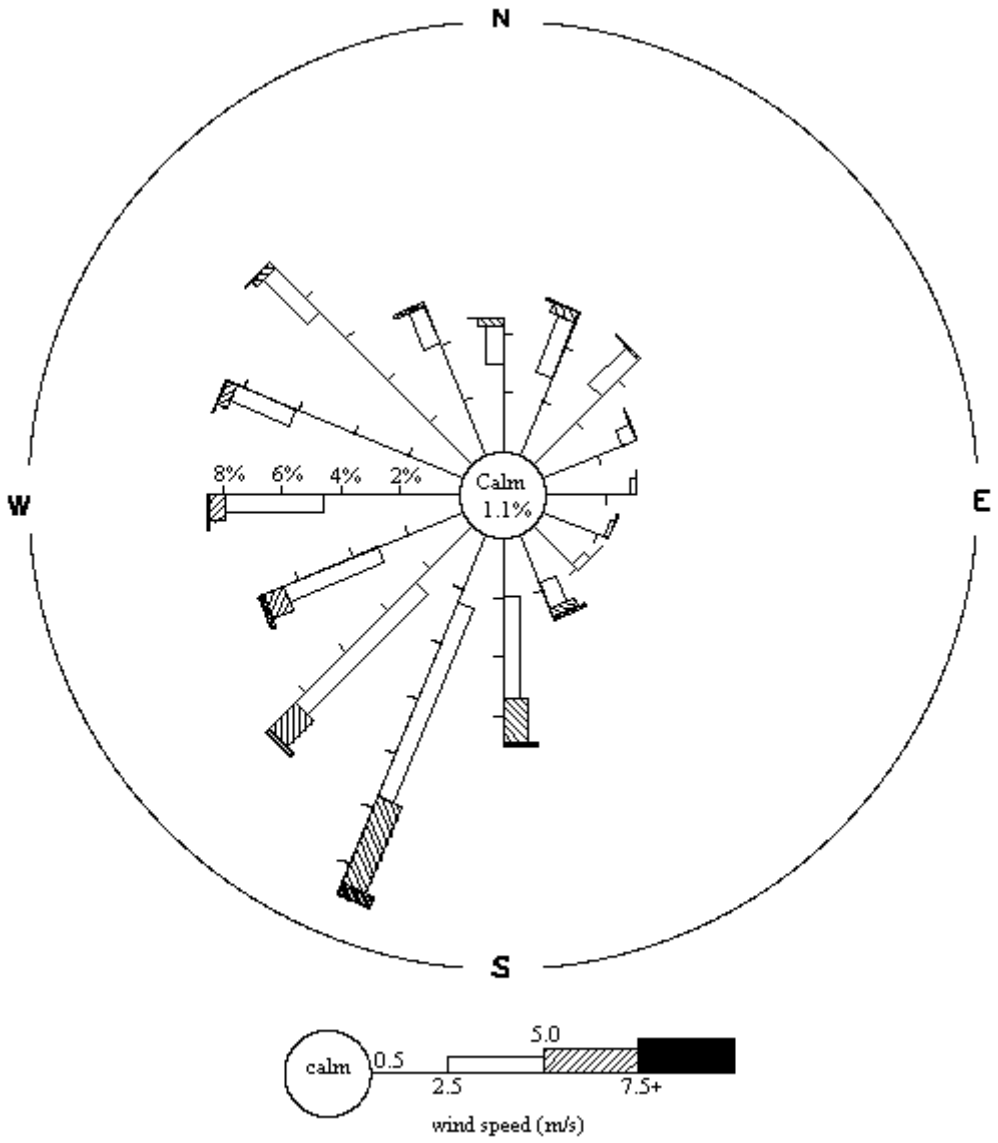
Previously we had speculated that there might be a downward trend in total uranium concentrations at Station 51. However, the statistical analysis does not support that notion. Interestingly, the analysis shows a downward trend in plutonium readings at this same site.

VI. SUMMARY

The operation of the AIRNET system at Area G has provided information regarding the overall impact of the site on air quality. In particular, the AIRNET program at Area G has demonstrated that Area G is well run, with minor impacts on the local environment. The combination of rapid turnaround of sample analysis, use of action levels, and technical review of data has identified specific problems at Area G. In response, site operators have been able to address the identified problems early enough to prevent spread of contamination. Air-quality impacts at the site are well below the applicable radiological standards. Recent air-sampling results from the individual Area G sampling stations are provided in Appendix B.

Appendix A

1995 to 2002 Wind Rose for TA-54 Meteorological Tower



The spikes represent the wind direction. Wind speed, direction, and frequency measurements were taken 12 meters above the ground.

APPENDIX B

1997 to 2002 Results for Tritium at TA-54 Area G.			Station Number								
Analyte	**Sample Dates**	**units**	**27**	**34**	**35**	**36**	**38**	**45**	**47**	**50**	**51**
H-3	1/6/1997 – 1/21/1997	pCi/m^3	7.4	4.7	234.5		6.2	5.1	3.8	1.8	
H-3	1/21/1997 – 2/3/1997	pCi/m^3	9.6	7.6	346.6	3.0	9.7	12.4	7.1	4.8	2.8
H-3	2/3/1997 – 2/17/1997	pCi/m^3	13.0	10.6	346.8	4.3	19.5	9.9	12.0	5.6	2.8
H-3	2/17/1997 – 3/3/1997	pCi/m^3	9.9	8.9	121.7		5.9	4.4	7.5	3.8	
H-3	3/3/1997 – 3/17/1997	pCi/m^3	15.2	18.6	353.5	3.8	19.8	16.4	15.6	6.9	
H-3	3/17/1997 – 3/31/1997	pCi/m^3	14.8	12.9	259.7	6.0	16.4	9.6	13.4	5.4	2.1
H-3	3/31/1997 – 4/14/1997	pCi/m^3	8.2	6.5	179.6	2.0	10.3	2.3	6.4	5.1	3.7
H-3	4/14/1997 – 4/28/1997	pCi/m^3	13.1	7.5	303.5	3.6	12.3	8.8	10.0	4.6	2.9
H-3	4/28/1997 – 5/12/1997	pCi/m^3	22.1	19.1	331.4	4.3	28.1	13.4	19.6	9.4	3.7
H-3	5/12/1997 – 5/26/1997	pCi/m^3	32.6	24.6	673.1	5.7	31.4	15.2	32.8	10.2	8.0
H-3	5/26/1997 – 6/9/1997	pCi/m^3	59.3	29.9	966.3	4.8	35.7	16.8		14.4	7.5
H-3	6/9/1997 – 6/23/1997	pCi/m^3	96.7	69.3	3364.1	11.1	131.8	71.1	78.5	27.8	10.5
H-3	6/23/1997 – 7/7/1997	pCi/m^3	109.7	72.8	3853.6	10.2	113.8	45.0	77.6	44.8	15.5
H-3	7/7/1997 – 7/21/1997	pCi/m^3	95.9	53.6	5280.5	8.0	78.9	43.0	60.3	25.1	11.5
H-3	7/21/1997 – 8/4/1997	pCi/m^3	70.6	36.7	2501.6	55.8	67.4	18.6	37.5		8.2
H-3	8/4/1997 – 8/18/1997	pCi/m^3	63.2	51.7	3300.4	215.4	58.8	38.9	57.1	18.3	25.1
H-3	8/18/1997 – 9/1/1997	pCi/m^3	69.2	45.0	2135.4	337.2	64.4	25.7	40.6	25.0	20.2
H-3	9/1/1997 – 9/15/1997	pCi/m^3	84.5	85.7	1382.1	267.3	87.1	46.6	67.7	20.4	31.2
H-3	9/15/1997 – 9/29/1997	pCi/m^3	65.6	45.3	1045.4	158.8	73.9		49.7	19.8	13.1
H-3	9/29/1997 – 10/13/1997	pCi/m^3	53.1	59.0	655.8	122.1	48.7	19.2	37.5	8.6	15.1
H-3	10/13/1997 – 10/27/1997	pCi/m^3	41.6	27.2	590.6	102.4	42.2	21.7	36.6	9.0	11.2
H-3	10/27/1997 – 11/10/1997	pCi/m^3	47.3	113.1	571.3	78.7	42.3	57.3	36.7	7.3	10.5
H-3	11/10/1997 – 11/24/1997	pCi/m^3	16.6	91.2	104.2	26.2	17.7	38.1	14.7	4.9	8.3
H-3	11/24/1997 – 12/8/1997	pCi/m^3	17.4	85.6	168.4	21.2	16.6	29.9	13.6	5.6	6.2
H-3	12/8/1997 – 12/22/1997	pCi/m^3	5.4	21.6	19.2	14.9	5.4	19.6	4.0	3.7	3.6
H-3	12/22/1997 – 1/5/1998	pCi/m^3	5.4	30.4	23.5	17.5	4.1	10.9	5.3	3.8	4.8

1997 to 2002 Results for Tritium at TA-54 Area G.			Station Number								
Analyte	Sample Dates	units	**27**	**34**	**35**	**36**	**38**	**45**	**47**	**50**	**51**
H-3	1/5/1998 – 1/19/1998	pCi/m^3	4.1	15.6	29.3	27.0	5.0	12.2	5.1	4.5	3.1
H-3	1/19/1998 – 2/2/1998	pCi/m^3	10.7	19.9	78.0	51.3	10.8	27.4	10.7	9.6	10.8
H-3	2/2/1998 – 2/16/1998	pCi/m^3	9.6	22.4	134.1	50.8	8.5	16.3	7.8	5.7	7.1
H-3	2/16/1998 – 3/2/1998	pCi/m^3	5.7	15.2	72.3	34.7	5.7	6.4	5.2	3.9	4.4
H-3	3/2/1998 – 3/16/1998	pCi/m^3	8.1	21.6	145.4	51.3		10.0	8.0	4.6	7.2
H-3	3/16/1998 – 3/30/1998	pCi/m^3	7.2	8.1	174.1	95.0	8.4	6.7	6.4	6.4	6.2
H-3	3/30/1998 – 4/13/1998	pCi/m^3	10.4	10.9	118.3	105.0	12.9	6.3	9.4	7.6	14.7
H-3	4/13/1998 – 4/27/1998	pCi/m^3	17.0	22.2	232.1	118.7	19.3	7.9	12.4	8.7	16.8
H-3	4/27/1998 – 5/11/1998	pCi/m^3	27.8	25.7	337.5	212.5		15.0	24.0	11.2	28.3
H-3	5/11/1998 – 5/25/1998	pCi/m^3	77.5	51.0	913.9	198.4	88.3	27.0	64.5	18.5	34.3
H-3	5/25/1998 – 6/8/1998	pCi/m^3	94.6	67.1	1365.9	242.4		41.1	95.2	26.3	49.5
H-3	6/8/1998 – 6/22/1998	pCi/m^3	200.9	133.3	2261.2	335.0	262.4	97.4	166.4	39.9	77.0
H-3	6/22/1998 – 7/6/1998	pCi/m^3	112.4	55.8	3260.3	286.1	91.9	50.1	67.4	43.4	32.8
H-3	7/6/1998 – 7/20/1998	pCi/m^3	60.6	49.5	3503.0	349.3	69.9	34.9	44.5	24.3	28.9
H-3	7/20/1998 – 8/3/1998	pCi/m^3	56.9	45.7	2260.4	248.8	63.0	31.9	54.0	26.6	31.2
H-3	8/3/1998 – 8/17/1998	pCi/m^3	69.0	41.4	2439.3	276.7	55.8	34.9	50.4	27.4	30.7
H-3	8/17/1998 – 8/31/1998	pCi/m^3	82.9	64.0	3952.5	310.1	75.2	38.8	74.1	47.9	46.1
H-3	8/31/1998 – 9/14/1998	pCi/m^3	-10.9	79.5	5878.6	392.8	107.6	75.9	103.4	82.2	51.0
H-3	9/14/1998 – 9/28/1998	pCi/m^3	192.4	119.1	5493.1	414.5	178.4	76.7	148.1	52.7	70.3
H-3	9/28/1998 – 10/12/1998	pCi/m^3	75.6	47.5	2325.8	250.3	77.9	43.6	77.6	27.4	33.9
H-3	10/12/1998 – 10/26/1998	pCi/m^3	37.2	17.8	504.1	74.3	30.0	14.3	22.9	11.1	15.4
H-3	10/26/1998 – 11/9/1998	pCi/m^3	12.5		282.5	41.0	17.8		8.7	5.4	8.8
H-3	11/9/1998 – 11/23/1998	pCi/m^3	9.3	6.3	142.5	63.1	15.2	6.1	9.3	6.9	9.8
H-3	11/23/1998 – 12/7/1998	pCi/m^3	19.5	14.5	246.3	80.5	17.9	9.8	14.5	11.7	15.6
H-3	12/7/1998 – 12/21/1998	pCi/m^3	8.8	14.9	55.5	34.5	8.8	7.6	5.2	6.1	10.8
H-3	12/21/1998 – 1/4/1999	pCi/m^3	9.4	8.2	87.1	57.0	10.1	7.7	5.2	7.9	8.5

1997 to 2002 Results for Tritium at TA-54 Area G.			Station Number								
Analyte	**Sample Dates**	**units**	**27**	**34**	**35**	**36**	**38**	**45**	**47**	**50**	**51**
H-3	1/4/1999 – 1/18/1999	pCi/m^3	9.9	15.4	151.7	76.6	12.0	11.5	9.6	16.7	12.5
H-3	1/18/1999 – 2/1/1999	pCi/m^3	13.9	13.6	113.3	46.4	13.5	9.6	11.6	18.0	11.2
H-3	2/1/1999 – 2/15/1999	pCi/m^3	20.6	23.7	163.6	98.3	25.1	15.4	16.7	32.7	38.2
H-3	2/15/1999 – 3/1/1999	pCi/m^3	8.6	11.9	120.1	25.5	10.3	9.2	7.1	10.8	10.5
H-3	3/1/1999 – 3/15/1999	pCi/m^3	12.5	7.6	103.3	19.6	12.3	16.5	9.1	12.4	13.6
H-3	3/15/1999 – 3/29/1999	pCi/m^3	14.5	19.2	147.6	25.9	13.8	12.4	12.0	13.4	9.8
H-3	3/29/1999 – 4/12/1999	pCi/m^3	9.3	5.0	73.3	17.1	9.0	3.3	8.1	9.6	4.4
H-3	4/12/1999 – 4/26/1999	pCi/m^3	6.4	12.9	111.4	24.4	9.1	9.4	8.2	9.7	7.6
H-3	4/26/1999 – 5/10/1999	pCi/m^3	5.6	9.8	118.2	23.7	7.1	6.8	8.6	7.1	6.0
H-3	5/10/1999 – 5/24/1999	pCi/m^3	14.0	17.8	281.7	35.3	18.4	10.8	21.1	26.8	9.7
H-3	5/24/1999 – 6/7/1999	pCi/m^3	16.8	22.7	294.3	30.5	18.1	16.9	30.4	24.9	8.8
H-3	6/7/1999 – 6/21/1999	pCi/m^3	25.5	19.3	848.1	31.8	29.9	18.0	26.0	70.9	11.0
H-3	6/21/1999 – 7/5/1999	pCi/m^3	49.1	29.8	1355.8	44.8	44.1	36.6	53.8	19.3	17.2
H-3	7/5/1999 – 7/19/1999	pCi/m^3	60.2	36.9	1435.5	33.7	59.3	34.0	58.7	24.5	12.5
H-3	7/19/1999 – 8/2/1999	pCi/m^3	79.8	34.9	3239.9	35.9	83.1	39.1	75.5	35.9	16.8
H-3	8/2/1999 – 8/16/1999	pCi/m^3	53.8	22.9	2090.5	19.4	55.6	26.0	58.9	23.0	10.4
H-3	8/16/1999 – 8/30/1999	pCi/m^3	26.0	18.9	4425.3	21.1	32.9	21.8	34.8		15.0
H-3	8/30/1999 – 9/13/1999	pCi/m^3	33.0	23.8	3243.5	32.7	33.2		34.6	22.5	18.9
H-3	9/13/1999 – 9/27/1999	pCi/m^3	31.2	22.1	1990.9	23.5	24.8		32.9	11.7	15.9
H-3	9/27/1999 – 10/11/1999	pCi/m^3	46.7	26.0	1898.7	57.9	45.8	22.8	43.5	24.9	30.6
H-3	10/11/1999 – 10/25/1999	pCi/m^3	29.4	21.6	1145.9	34.1	29.4	23.0	32.5	14.4	18.2
H-3	10/25/1999 – 11/8/1999	pCi/m^3	29.8	17.6	825.9	58.5	27.5	20.5	25.4	15.4	21.9
H-3	11/8/1999 – 11/22/1999	pCi/m^3	20.9	13.7		43.4	18.6	18.2	18.7	15.4	22.7
H-3	11/22/1999 – 12/6/1999	pCi/m^3	11.7	7.2	244.2	38.4	11.3	10.3	13.8	10.4	20.5
H-3	12/6/1999 – 12/20/1999	pCi/m^3	6.4	0.3	51.5	12.6	7.2	8.9	6.2	6.4	7.8
H-3	12/20/1999 – 1/3/2000	pCi/m^3	8.9	8.0	79.9	10.6	8.1	8.3	7.1	6.7	7.0

1997 to 2002 Results for Tritium at TA-54 Area G.			Station Number								
Analyte	**Sample Dates**	**units**	**27**	**34**	**35**	**36**	**38**	**45**	**47**	**50**	**51**
H-3	1/3/2000 – 1/17/2000	pCi/m^3	4.7	5.9	88.3	18.1	5.3	7.0	5.7	5.5	6.4
H-3	1/17/2000 – 1/31/2000	pCi/m^3	6.8	7.2	200.0	10.5	6.2	7.0	5.2	9.0	5.2
H-3	1/31/2000 – 2/14/2000	pCi/m^3									
H-3	2/14/2000 – 2/28/2000	pCi/m^3	13.2	19.4	216.7	12.6	15.7	17.4	16.2	14.3	11.8
H-3	2/28/2000 – 3/13/2000	pCi/m^3									
H-3	3/13/2000 – 3/27/2000	pCi/m^3	8.2	13.4	395.4	15.9	12.3		10.9	9.8	9.9
H-3	3/27/2000 – 4/10/2000	pCi/m^3	16.1	13.9	441.2	16.2	17.4	15.1	15.4	11.0	12.5
H-3	4/10/2000 – 4/24/200	pCi/m^3	98.1	11.1	375.9	15.7	11.4	7.4	12.7	9.0	10.1
H-3	4/24/2000 – 5/8/2000	pCi/m^3	25.7	23.3	1027.0	40.6		17.7	41.5	17.1	17.0
H-3	5/8/2000 – 5/22/2000	pCi/m^3	42.6	25.0	1617.3	54.9	42.0	29.1	44.7		25.8
H-3	5/22/2000 – 6/5/2000	pCi/m^3	55.3	29.6	2872.9	60.6		27.1	61.4	40.0	32.7
H-3	6/5/2000 – 6/19/2000	pCi/m^3	58.1	45.0	2672.0	41.7	75.0	30.7	69.1	34.1	24.4
H-3	6/19/2000 – 7/3/2000	pCi/m^3	77.9	32.4	3627.7	43.5	82.0	31.0	71.9	29.7	863.4
H-3	7/3/2000 – 7/17/2000	pCi/m^3	76.0	37.8	3204.3	48.8	81.7	39.4	78.7	29.1	21.1
H-3	7/17/2000 – 7/31/2000	pCi/m^3	72.6	34.3	1228.5	51.6	108.5	31.8	78.2	30.6	20.9
H-3	7/31/2000 – 8/14/2000	pCi/m^3	79.8	35.5	2319.2	52.1	88.3	30.5	72.7	28.4	23.6
H-3	8/14/2000 – 8/28/2000	pCi/m^3	48.5	14.8	1335.7	31.1	50.4	14.1	33.9	25.3	14.8
H-3	8/28/2000 – 9/11/2000	pCi/m^3	41.3	24.5	1313.7	31.1	42.3	35.2	38.1	33.5	18.1
H-3	9/11/2000 – 9/25/2000	pCi/m^3	44.3	24.0	1910.6	32.3	46.9	21.9	29.1	22.7	21.2
H-3	9/25/2000 – 10/9/2000	pCi/m^3	29.8	18.7	2314.0	49.0	32.9	24.6	23.2	22.4	21.5
H-3	10/9/2000 – 10/23/2000	pCi/m^3	14.9	9.9	619.7	9.7	17.7	11.2	12.1	11.0	9.9
H-3	10/23/2000 – 11/6/2000	pCi/m^3	6.9	8.8	201.2	7.8	7.9		5.6	5.1	4.0
H-3	11/6/2000 – 11/20/2000	pCi/m^3		6.9	27.8	7.2	4.7	4.5	4.2	4.6	4.6
H-3	11/20/2000 – 12/4/2000	pCi/m^3	3.6	8.2	61.4	9.0	7.1	5.9	6.0	7.7	5.8
H-3	12/4/2000 – 12/18/2000	pCi/m^3	4.6	7.1	48.8	11.2	4.3	4.6	4.0	4.9	6.4
H-3	12/18/2000 – 1/1/2001	pCi/m^3	5.0	5.7	28.8	11.1	4.5	5.3	3.6	5.9	6.4

1997 to 2002 Results for Tritium at TA-54 Area G.			Station Number								
Analyte	**Sample Dates**	**units**	**27**	**34**	**35**	**36**	**38**	**45**	**47**	**50**	**51**
H-3	1/1/2001 – 1/15/2001	pCi/m^3	4.1	8.3	29.4	9.9	4.1	5.4	4.2	5.1	6.0
H-3	1/15/2001 – 1/29/2001	pCi/m^3	1.8	2.3	12.5	5.2	2.9	2.0		2.3	3.3
H-3	1/29/2001 – 2/12/2001	pCi/m^3	4.5	5.2	30.2	7.5	4.4	4.0	4.1	4.9	2.7
H-3	2/12/2001 – 2/26/2001	pCi/m^3	6.1	8.6	64.8	7.8	7.2	6.9	4.5	6.3	3.2
H-3	2/26/2001 – 3/12/2001	pCi/m^3	6.2	14.2	73.0	8.2	5.7	8.8	5.9	6.2	3.7
H-3	3/12/2001 – 3/26/2001	pCi/m^3	5.3	14.0	117.6	6.9	4.3	9.4	7.3	4.0	3.6
H-3	3/26/2001 – 4/9/2001	pCi/m^3	8.7	30.8	99.8	14.4	7.2	15.0	6.3	5.8	3.6
H-3	4/9/2001 – 4/23/2001	pCi/m^3	8.7	20.9	119.6	18.5	9.4	15.0	8.1	7.6	6.1
H-3	4/23/2001 – 5/7/2001	pCi/m^3	10.9	26.7	249.8	28.1	12.8	13.4	11.1	12.2	15.7
H-3	5/7/2001 – 5/21/2001	pCi/m^3	17.2	29.3	601.1	32.7	17.4	16.2	16.6	15.2	16.0
H-3	5/21/2001 – 6/4/2001	pCi/m^3	45.1	32.1	1314.1	54.2	39.8	26.2	33.9	29.1	29.1
H-3	6/4/2001 – 6/18/2001	pCi/m^3	58.0	51.5	2503.6	76.7	70.1	45.9	53.1	8.4	32.9
H-3	6/18/2001 – 7/2/2001	pCi/m^3	62.8	38.2	4489.9	71.5	66.0	37.4	36.8	42.1	28.6
H-3	7/2/2001 – 7/16/2001	pCi/m^3	86.2	40.2	3067.5	76.9	95.7	43.9	49.9	38.3	32.6
H-3	7/16/2001 – 7/30/2001	pCi/m^3	104.6	56.0	7316.1	78.8	100.8	55.0	61.1	47.8	29.5
H-3	7/30/2001 – 8/13/2001	pCi/m^3	90.4	40.7	3293.5	58.0	84.9	33.9	60.7	39.7	23.3
H-3	8/13/2001 – 8/27/2001	pCi/m^3	63.0	39.4	7226.6	61.8	67.7	44.6	42.5	31.5	26.2
H-3	8/27/2001 – 9/10/2001	pCi/m^3	45.6	37.8	4372.1	46.1	47.9	36.3	40.1	23.4	27.4
H-3	9/10/2001 – 9/24/2001	pCi/m^3	56.6	38.5	4957.7	67.8	52.4	39.7	38.3	37.6	36.7
H-3	9/24/2001 – 10/8/2001	pCi/m^3	72.9	51.7	3473.6	79.2	74.4	52.2	55.7	43.7	49.8
H-3	10/8/2001 – 10/22/2001	pCi/m^3	32.4	21.7	2032.1	82.7	29.5	28.8	23.5	28.6	39.2
H-3	10/22/2001 – 11/5/2001	pCi/m^3	30.2	22.5	980.0	81.3	28.8	16.1	22.1	26.5	40.5
H-3	11/5/2001 – 11/19/2001	pCi/m^3	21.8	17.8	598.5	52.5	22.9	19.5	16.0	21.6	30.5
H-3	11/19/2001 – 12/3/2001	pCi/m^3	10.0	9.9	277.1	38.5	10.0	14.8	7.8	11.4	17.2
H-3	12/3/2001 – 12/7/2001	pCi/m^3	5.7	7.2	160.6	19.7	5.6	8.2	4.6	8.9	11.6
H-3	12/17/2001 – 1/7/2002	pCi/m^3	9.0	9.0	125.8	20.7	7.6	11.0	6.4	8.9	11.5

1997 to 2002 Results for Tritium at TA-54 Area G.			Station Number								
Analyte	**Sample Dates**	**units**	**27**	**34**	**35**	**36**	**38**	**45**	**47**	**50**	**51**
H-3	1/7/2002 – 1/21/2002	pCi/m^3	9.9	8.1	119.8	18.4	8.3	9.7	5.9	7.1	9.7
H-3	1/21/2002 – 2/4/2002	pCi/m^3	6.2	6.4	115.3	10.5	7.6	4.8	5.0	5.3	5.9
H-3	2/4/2002 – 2/18/2002	pCi/m^3	5.8	9.4	90.5	13.3	6.5	8.7	6.2	5.4	5.7
H-3	2/18/2002 – 3/4/2002	pCi/m^3	6.3	9.9	129.4	14.7	6.3	6.6		5.4	8.4
H-3	3/4/2002 – 3/18/2002	pCi/m^3	9.0	8.1	224.2	19.0	9.7	7.0	6.1	6.5	9.2
H-3	3/18/2002 – 4/1/2002	pCi/m^3	11.2	10.4	415.5	29.3	11.5	10.1	8.3	12.2	16.6
H-3	4/1/2002 – 4/15/2002	pCi/m^3	18.1	10.8	734.8	48.7	19.4	10.4	12.3	14.8	20.1
H-3	4/15/2002 – 4/29/2002	pCi/m^3	20.3	61.0	542.8	46.2	20.2	25.0	17.9	13.8	21.1
H-3	4/29/2002 – 5/13/2002	pCi/m^3	35.7	82.3	1286.7	59.4	35.3	28.1	30.1	24.1	37.4
H-3	5/13/2002 – 5/27/2002	pCi/m^3	44.3	39.1	2129.6	73.4	45.8	17.8	34.3	25.5	31.1
H-3	5/27/2002 – 6/10/2002	pCi/m^3	47.3	32.0	2404.5	86.5	49.2	26.7	36.2	28.4	37.4
H-3	6/10/2002 – 6/24/2002	pCi/m^3	51.6	27.2	1554.2	95.9	55.0	22.7	39.3	43.1	42.9
H-3	6/24/2002 – 7/8/2002	pCi/m^3	79.5	37.9	3380.1	86.4	83.9	32.2	46.4	35.3	40.9
H-3	7/8/2002 – 7/22/2002	pCi/m^3	74.3	25.7	3066.8	106.3	75.7	24.8	44.3	56.9	43.3
H-3	7/22/2002 – 8/5/2002	pCi/m^3	75.8	16.6	2406.0	30.4	81.0	16.5	33.2	24.6	16.7
H-3	8/5/2002 – 8/19/2002	pCi/m^3	55.6	26.3	2431.4	14.5	57.7	31.8	42.5	26.7	16.0
H-3	8/19/2002 – 9/2/2002	pCi/m^3	30.6	20.0	1393.1	18.0	31.7	18.5	21.9	10.4	14.4
H-3	9/2/2002 – 9/16/2002	pCi/m^3	21.3	10.5	719.4	10.4	22.4	13.6	15.9	9.0	10.5
H-3	9/16/2002 – 9/30/2002	pCi/m^3	20.1	9.3	498.7	8.9	20.3	5.5	12.7	9.7	11.5
H-3	9/30/2002 – 10/14/2002	pCi/m^3	18.0	9.3	465.2	8.1	16.0	11.1	13.7	10.9	10.0
H-3	10/14/2002 – 10/28/2002	pCi/m^3	15.7	8.7	411.4	12.7	15.5	7.8	10.3	4.6	7.7
H-3	10/28/2002 – 11/11/2002	pCi/m^3	8.6	5.3	125.7	5.8	9.1	6.3	8.2	5.2	6.9
H-3	11/11/2002 – 11/25/2002	pCi/m^3	7.9	6.1	117.8	12.0	7.6	5.5	5.9	6.5	7.5
H-3	11/25/2002 – 12/9/2002	pCi/m^3	8.2	6.6	99.4	13.6	8.7	6.9	5.5	8.6	9.6
H-3	12/9/2002 – 12/23/2002	pCi/m^3	6.2	3.7	44.0	17.3	5.1	5.2	3.8	6.3	9.4

1997 to 2002 Results for Tritium at TA-54 Area G.				Station Number								
Analyte	**Data Type**	**year**	**units**	**27**	**34**	**35**	**36**	**38**	**45**	**47**	**50**	**51**
H-3	Annual Mean	1997	pCi/m^3	40.3	40.0	1119.7	61.8	40.3	24.0	29.8	11.8	9.9
H-3	Annual Mean	1998	pCi/m^3	46.5	40.3	1395.9	169.9	54.1	28.7	42.5	20.4	25.3
H-3	Annual Mean	1999	pCi/m^3	24.8	18.1	982.2	37.6	25.8	17.4	25.8	19.7	14.9
H-3	Annual Mean	2000	pCi/m^3	36.3	19.6	1172.8	28.9	35.1	19.4	31.3	18.1	50.2
H-3	Annual Mean	2001	pCi/m^3	33.4	26.1	1830.2	43.0	34.0	23.7	25.0	20.1	20.6
H-3	Annual Mean	2002	pCi/m^3	27.5	20.0	996.2	35.2	28.7	15.0	19.7	16.6	18.4

1995 to 2002 Results for ^{238}Pu at TA-54 Area G.				Station Number												
Analyte	**Sample Dates**	**period**	**units**	**27**	**34**	**35**	**36**	**37**	**38**	**44**	**45**	**46**	**47**	**50**	**51**	**52**
Pu-238	1/3/1995 – 3/27/1995	95Q1	aCi/m^3	3.0	15.6	4.3	1.3	1.0	6.2	2.7	-3.5	-2.0	-1.9	3.2	-0.9	-11.4
Pu-238	3/27/1995 – 6/20/1995	95Q2	aCi/m^3			0.3	0.3	0.2		-1.1	-3.0	10.3	1.8	-4.9	0.2	0.2
Pu-238	6/20/1995 – 9/25/1995	95Q3	aCi/m^3	2.5	-1.2	-2.1	-4.1	-4.9	-0.2	-4.9	-2.9	2.3	-3.8	-3.3	-2.6	-2.9
Pu-238	9/25/1995 – 1/3/1996	95Q4	aCi/m^3	3.5	2.9	-0.5	1.4	0.7	3.4	8.6	2.8	0.8	1.7	-0.3	1.2	3.4
Pu-238	1/3/1996 – 3/25/1996	96Q1	aCi/m^3	4.5	0.5	-0.2	-0.1		3.4		-0.3		-0.3	0.3	0.3	
Pu-238	3/25/1996 – 6/28/1996	96Q2	aCi/m^3	24.3	3.5	0.5	-0.2	-0.1	25.8		0.1		0.7	0.1	2.0	
Pu-238	6/28/1996 – 9/23/1996	96Q3	aCi/m^3	23.9	2.3	0.0	0.2	-0.3	17.6		-0.2		0.2	0.4	-0.2	
Pu-238	9/23/1996 – 12/16/1996	96Q4	aCi/m^3	24.3	-1.7	-2.4	-1.2		21.9		-1.7		-1.8	-1.3	-1.2	
Pu-238	12/16/1996 – 3/31/1997	97Q1	aCi/m^3	27.8	1.3	-0.2	0.9		19.1		0.0		0.5	0.0	0.4	
Pu-238	3/31/1997 – 6/23/1997	97Q2	aCi/m^3	42.5	1.7	-0.1	-0.2		35.5		1.1		0.2	1.4	0.4	
Pu-238	6/23/1997 – 9/29/1997	97Q3	aCi/m^3	3.3	1.9	0.7	0.2		1.9		0.6		0.2	0.3	-0.1	
Pu-238	9/29/1997 – 1/5/1998	97Q4	aCi/m^3	2.1	0.5	0.3	0.5		3.6		3.7		0.5	0.2	-0.3	
Pu-238	1/5/1998 – 3/30/1998	98Q1	aCi/m^3	5.2	0.6	-0.3	0.7		5.1		0.5		0.9	0.0	0.1	
Pu-238	3/30/1998 – 6/22/1998	98Q2	aCi/m^3	1.8	1.5	0.0	0.0		4.9		1.3		0.4	1.7	0.5	
Pu-238	6/22/1998 – 9/28/1998	98Q3	aCi/m^3	2.0	1.0	-0.2	0.3		3.0		0.2		-0.4	0.1	0.8	
Pu-238	9/28/1998 – 12/21/1998	98Q4	aCi/m^3	2.0	0.3	0.6	0.3		1.7		1.4		1.1	0.5	0.1	
Pu-238	12/21/1998 – 3/29/1999	99Q1	aCi/m^3	0.4	8.8	0.6	0.6		1.3		2.0		0.7	0.2	-0.3	
Pu-238	3/29/1999 – 6/21/1999	99Q2	aCi/m^3	3.8	12.1	0.6	0.0		1.3		0.6		0.6	0.4	0.3	
Pu-238	6/21/1999 – 9/27/1999	99Q3	aCi/m^3	0.1	0.0	-0.2	0.3		-0.6		-0.1		0.6	0.9	-0.4	
Pu-238	9/27/1999 – 12/20/1999	99Q4	aCi/m^3	0.1	2.4	-0.1	0.6		0.1		1.8		-0.1	-0.4	-0.1	
Pu-238	12/20/1999 – 3/27/2000	00Q1	aCi/m^3	1.3	2.0	0.0	0.6		1.7		-0.4		1.5	-0.3	-0.3	
Pu-238	3/27/2000 – 6/19/2000	00Q2	aCi/m^3	0.1	7.5	-0.4	0.6		1.1		-0.7		3.6	-0.5	-0.2	
Pu-238	6/19/2000 – 9/25/2000	00Q3	aCi/m^3	0.3	2.6	0.7	-0.2		1.0		0.9		0.5	0.3	-0.2	
Pu-238	9/25/2000 – 12/18/2000	00Q4	aCi/m^3	-0.8	0.0	-0.2	0.4		0.3		0.0		0.3	0.5	0.4	
Pu-238	12/18/2000 – 3/26/2001	01Q1	aCi/m^3	-0.4	0.9	-0.2	0.0		0.0		0.4		0.2	0.6	0.0	
Pu-238	3/26/2001 – 6/18/2001	01Q2	aCi/m^3	1.6	9.0	-0.3	0.2		2.0		0.7		0.2	0.7	1.2	
Pu-238	6/18/2001 – 9/24/2001	01Q3	aCi/m^3	0.1	2.8	-0.5	0.4		-0.3		0.1		0.4	0.0	-0.1	

1995 to 2002 Results for ^{238}Pu at TA-54 Area G.				Station Number												
Analyte	**Sample Dates**	**period**	**units**	**27**	**34**	**35**	**36**	**37**	**38**	**44**	**45**	**46**	**47**	**50**	**51**	**52**
Pu-238	9/24/2001 – 12/17/2001	01Q4	aCi/m^3	-0.5	0.1	0.0	-0.2		0.2		0.4		-0.6	-0.2	0.8	
Pu-238	12/17/2001 – 3/18/2002	02Q1	aCi/m^3	2.0	7.0	-0.2	0.0		1.2		77.0		5.5	0.6	0.5	
Pu-238	3/18/2002 – 6/24/2002	02Q2	aCi/m^3	2.9	11.3	0.1	0.1		1.1		4.1		4.8	1.7	-0.1	
Pu-238	6/24/2002 – 9/30/2002	02Q3	aCi/m^3	0.0	4.6	0.3	-0.2		1.0		0.2		0.2	0.4	-0.4	
Pu-238	9/30/2002 – 12/23/2002	02Q4	aCi/m^3	0.8	0.7	-0.3	0.4		0.3		0.3		-0.2	-0.2	-0.1	
Pu-238	Samples with Results >2σ	all	%	45	52	3	3	0	38	0	13	0	8	3	3	0

1995 to 2002 Results for ^{238}Pu at TA-54 Area G.				Station Number												
Analyte	**Data Type**	**year**	**units**	**27**	**34**	**35**	**36**	**37**	**38**	**44**	**45**	**46**	**47**	**50**	**51**	**52**
Pu-238	Annual Mean	1995	aCi/m^3	3.0	5.8	0.5	-0.3	-0.8	3.2	1.3	-1.7	2.9	-0.6	-1.3	-0.5	-2.7
Pu-238	Annual Mean	1996	aCi/m^3	19.2	1.1	-0.5	-0.3	-0.2	17.2	na	-0.5	na	-0.3	-0.1	0.2	na
Pu-238	Annual Mean	1997	aCi/m^3	18.9	1.4	0.2	0.3	na	15.1	na	1.4	na	0.3	0.5	0.1	na
Pu-238	Annual Mean	1998	aCi/m^3	2.7	0.9	0.0	0.3	na	3.7	na	0.8	na	0.5	0.6	0.4	na
Pu-238	Annual Mean	1999	aCi/m^3	1.1	5.8	0.2	0.4	na	0.5	na	1.1	na	0.5	0.3	-0.1	na
Pu-238	Annual Mean	2000	aCi/m^3	0.2	3.0	0.0	0.4	na	1.0	na	-0.1	na	1.5	0.0	-0.1	na
Pu-238	Annual Mean	2001	aCi/m^3	0.2	3.2	-0.2	0.1	na	0.5	na	0.4	na	0.1	0.3	0.5	na
Pu-238	Annual Mean	2002	aCi/m^3	1.4	5.9	0.0	0.1	na	0.9	na	20.4	na	2.6	0.6	0.0	na

1995 to 2002 Results for ^{239,240}Pu at TA-54 Area G.				Station Number												
Analyte	**Sample Dates**	**period**	**units**	**27**	**34**	**35**	**36**	**37**	**38**	**44**	**45**	**46**	**47**	**50**	**51**	**52**
Pu-239	1/3/1995 – 3/27/1995	95Q1	aCi/m^3	50.5	488.6	-0.8	2.5	0.6	58.7	0.8	11.8	-0.8	2.4	2.1	-2.1	2.7
Pu-239	3/27/1995 – 6/20/1995	95Q2	aCi/m^3			0.3	8.0	3.0		4.2	8.5	3.6	7.8	4.0	13.0	6.1
Pu-239	6/20/1995 – 9/25/1995	95Q3	aCi/m^3	122.9	-3.4	-3.9	-4.2	-4.2	86.5	-0.3	24.1	1.8	-2.5	-1.0	-4.2	-4.0
Pu-239	9/25/1995 – 1/3/1996	95Q4	aCi/m^3	91.6	1.7	-0.1	0.2	-1.2	69.0	32.9	11.8	-0.3	7.2	3.9	1.5	-5.4
Pu-239	1/3/1996 – 3/25/1996	96Q1	aCi/m^3	153.7	0.5	0.3	-0.1		112.9		1.2		6.8	1.9	0.8	
Pu-239	3/25/1996 – 6/28/1996	96Q2	aCi/m^3	840.7	7.7	1.4	1.7	0.2	861.5		5.3		29.3	10.3	10.2	
Pu-239	6/28/1996 – 9/23/1996	96Q3	aCi/m^3	897.3	1.6	0.1	0.3	0.4	690.3		-0.5		5.6	0.6	1.7	
Pu-239	9/23/1996 – 12/16/1996	96Q4	aCi/m^3	931.3	1.3	0.3	2.8		781.7		2.3		10.1	1.4	1.8	
Pu-239	12/16/1996 – 3/31/1997	97Q1	aCi/m^3	942.6	7.5	3.7	7.5		719.3		7.6		17.8	4.5	1.8	
Pu-239	3/31/1997 – 6/23/1997	97Q2	aCi/m^3	1584.4	12.0	2.0	11.5		1369.4		21.6		18.3	12.1	4.7	
Pu-239	6/23/1997 – 9/29/1997	97Q3	aCi/m^3	119.3	5.3	2.0	3.0		72.2		7.3		2.4	4.9	2.1	
Pu-239	9/29/1997 – 1/5/1998	97Q4	aCi/m^3	71.4	1.0	-0.4	-1.4		40.6		34.1		2.2	1.6	3.0	
Pu-239	1/5/1998 – 3/30/1998	98Q1	aCi/m^3	116.4	2.9	0.0	0.3		110.8		10.9		7.1	1.6	8.6	
Pu-239	3/30/1998 – 6/22/1998	98Q2	aCi/m^3	66.9	7.3	-0.2	3.8		72.4		76.1		16.7	7.2	5.9	
Pu-239	6/22/1998 – 9/28/1998	98Q3	aCi/m^3	78.2	1.8	0.4	0.6		76.9		11.7		5.1	6.7	1.6	
Pu-239	9/28/1998 – 12/21/1998	98Q4	aCi/m^3	26.9	1.2	-0.5	1.6		29.1		5.4		0.5	1.0	3.2	
Pu-239	12/21/1998 – 3/29/1999	99Q1	aCi/m^3	24.4	204.8	0.4	0.2		16.4		26.9		2.3	3.7	0.3	
Pu-239	3/29/1999 – 6/21/1999	99Q2	aCi/m^3	166.2	196.5	1.0	0.6		25.3		9.4		4.3	6.3	2.7	
Pu-239	6/21/1999 – 9/27/1999	99Q3	aCi/m^3	10.0	9.3	0.2	0.9		3.9		7.2		0.0	4.5	-1.4	
Pu-239	9/27/1999 – 12/20/1999	99Q4	aCi/m^3	4.3	7.0	0.9	-0.7		2.8		51.9		3.7	1.8	1.0	
Pu-239	12/20/1999 – 3/27/2000	00Q1	aCi/m_	6.5	49.6	0.1	0.2		9.0		2.7		7.6	0.6	-0.2	
Pu-239	3/27/2000 – 6/19/2000	00Q2	aCi/m_	16.2	12.8	0.6	1.1		14.7		3.2		2.2	3.2	1.7	
Pu-239	6/19/2000 – 9/25/2000	00Q3	aCi/m_	8.7	7.1	1.2	0.2		13.0		11.2		3.6	2.5	1.6	
Pu-239	9/25/2000 – 12/18/2000	00Q4	aCi/m^3	2.2	0.6	1.7	-0.2		1.9		3.2		-0.2	2.5	1.7	
Pu-239	12/18/2000 – 3/26/2001	01Q1	aCi/m^3	-0.1	22.7	1.3	1.0		3.0		1.4		0.7	1.6	0.6	
Pu-239	3/26/2001 – 6/18/2001	01Q2	aCi/m^3	14.4	20.4	0.4	-0.4		9.2		7.7		1.1	1.3	1.4	
Pu-239	6/18/2001 – 9/24/2001	01Q3	aCi/m^3	3.5	35.6	1.0	-1.0		6.2		4.1		5.4	0.1	1.0	
Pu-239	9/24/2001 – 12/17/2001	01Q4	aCi/m^3	5.9	21.9	-0.5	0.7		6.5		2.9		5.8	22.8	4.1	

1995 to 2002 Results for ^{239,240}Pu at TA-54 Area G.				Station Number												
Analyte	**Sample Dates**	**period**	**units**	**27**	**34**	**35**	**36**	**37**	**38**	**44**	**45**	**46**	**47**	**50**	**51**	**52**
Pu-239	12/17/2001 – 3/18/2002	02Q1	aCi/m^3	64.4	329.7	3.6	0.8		40.2		2460.2		171.2	6.5	0.1	
Pu-239	3/18/2002 – 6/24/2002	02Q2	aCi/m^3	24.9	172.8	0.4	2.3		23.3		85.6		84.5	12.3	1.3	
Pu-239	6/24/2002 – 9/30/2002	02Q3	aCi/m^3	5.9	54.8	0.0	0.2		7.1		12.2		5.8	3.0	0.4	
Pu-239	9/30/2002 – 12/23/2002	02Q4	aCi/m^3	1.1	2.1	-0.2	0.0		0.4		12.5		0.7	0.9	1.2	
Pu-239	Samples with Results >2σ	all	%	90	68	13	22	0	73	25	68	0	53	50	31	0

1995 to 2002 Results for ^{239,240}Pu at TA-54 Area G.				Station Number												
Analyte	**Data Type**	**year**	**units**	**27**	**34**	**35**	**36**	**37**	**38**	**44**	**45**	**46**	**47**	**50**	**51**	**52**
Pu-239	Annual Mean	1995	aCi/m^3	88.3	162.3	-1.1	1.6	-0.4	71.4	9.4	14.0	1.1	3.7	2.3	2.1	-0.2
Pu-239	Annual Mean	1996	aCi/m^3	705.7	2.7	0.5	1.2	0.3	611.6	na	2.1	na	12.9	3.6	3.6	na
Pu-239	Annual Mean	1997	aCi/m^3	679.4	6.4	1.8	5.2	na	550.4	na	17.6	na	10.2	5.8	2.9	na
Pu-239	Annual Mean	1998	aCi/m^3	72.1	3.3	-0.1	1.6	na	72.3	na	26.0	na	7.4	4.1	4.8	na
Pu-239	Annual Mean	1999	aCi/m^3	51.2	104.4	0.6	0.2	na	12.1	na	23.8	na	2.6	4.1	0.6	na
Pu-239	Annual Mean	2000	aCi/m^3	8.4	17.5	0.9	0.3	na	9.6	na	5.1	na	3.3	2.2	1.2	na
Pu-239	Annual Mean	2001	aCi/m^3	5.9	25.1	0.5	0.1	na	6.2	na	4.0	na	3.3	6.5	1.8	na
Pu-239	Annual Mean	2002	aCi/m^3	24.1	139.9	0.9	0.8	na	17.8	na	642.6	na	65.6	5.7	0.8	na

1995 to 2002 Results for ^{241}Am at TA-54 Area G.				Station Number												
Analyte	**Sample Dates**	**period**	**units**	**27**	**34**	**35**	**36**	**37**	**38**	**44**	**45**	**46**	**47**	**50**	**51**	**52**
Am-241	1/3/1995 – 3/27/1995	95Q1	aCi/m^3	29.2	1.9	4.1	4.4	13.0	47.4	4.1	1.0	1.1	2.6	-1.4	2.8	3.4
Am-241	3/27/1995 – 6/20/1995	95Q2	aCi/m^3		2.2	-3.6	7.1	0.8		2.1	-0.7	2.7	0.9	3.3	5.9	0.7
Am-241	6/20/1995 – 9/25/1995	95Q3	aCi/m^3	87.3	-0.2	0.8	0.3	-1.5	68.9	0.5	3.9	-0.4	2.6	0.4	0.6	0.2
Am-241	9/25/1995 – 1/3/1996	95Q4	aCi/m^3	68.5	0.5	-0.5	2.2	-1.0	52.1	7.8	1.7	4.6	4.2	0.8	0.9	1.1
Am-241	1/3/1996 – 3/25/1996	96Q1	aCi/m^3	93.3	0.0	0.2	-0.3		67.9		0.9		2.7	-0.3	0.9	
Am-241	3/25/1996 – 6/28/1996	96Q2	aCi/m^3	529.8	5.2	1.8	-0.1	-1.1	570.4		1.8		16.6	0.1	0.0	
Am-241	6/28/1996 – 9/23/1996	96Q3	aCi/m^3	566.7	1.8	-0.1	0.0	0.2	477.7		0.2		4.2	0.3	0.5	
Am-241	9/23/1996 – 12/16/1996	96Q4	aCi/m^3	714.1	0.8	0.9	2.6		570.2		0.3		6.8	1.1	1.9	
Am-241	12/16/1996 – 3/31/1997	97Q1	aCi/m^3	716.0	7.0	1.6	6.7		489.8		3.3		11.3	4.1	1.4	
Am-241	3/31/1997 – 6/23/1997	97Q2	aCi/m^3	1031.6	9.3	2.1	2.7		897.4		11.2		13.0	6.0	1.7	
Am-241	6/23/1997 – 9/29/1997	97Q3	aCi/m^3	79.2	1.0	1.2	2.4		47.4		1.3		0.4	3.7	3.9	
Am-241	9/29/1997 – 1/5/1998	97Q4	aCi/m^3	41.9	-0.9	-1.0	0.8		29.1		7.9		1.5	-1.1	-0.1	
Am-241	1/5/1998 – 3/30/1998	98Q1	aCi/m^3	75.2	1.2	2.4	-0.9		63.0		1.8		1.6	2.3	1.3	
Am-241	3/30/1998 – 6/22/1998	98Q2	aCi/m^3	45.2	2.3	0.9	0.7		39.1		23.6		7.6	1.8	1.9	
Am-241	6/22/1998 – 9/28/1998	98Q3	aCi/m^3	39.2	1.2	0.1	-0.4		47.8		1.2		3.4	0.0	2.0	
Am-241	9/28/1998 – 12/21/1998	98Q4	aCi/m^3	22.4	-1.1	-1.2	-0.2		24.0		2.0		0.4	0.8	-0.2	
Am-241	12/21/1998 – 3/29/1999	99Q1	aCi/m^3	13.2	21.6	-0.6	-0.8		13.8		4.4		1.4	-0.1	-1.0	
Am-241	3/29/1999 – 6/21/1999	99Q2	aCi/m^3	25.7	232.7	1.9	1.3		10.0		11.0		5.9	3.2	1.5	
Am-241	6/21/1999 – 9/27/1999	99Q3	aCi/m^3	8.4	66.3	1.1	-0.7		5.1		9.0		2.0	1.8	-0.5	
Am-241	9/27/1999 – 12/20/1999	99Q4	aCi/m^3	3.5	28.7	1.3	1.2		1.9		9.1		-1.2	0.2	-0.2	
Am-241	12/20/1999 – 3/27/2000	00Q1	aCi/m^3	7.2	258.4	0.0	1.3		4.7		9.7		24.6	-1.2	0.3	
Am-241	3/27/2000 – 6/19/2000	00Q2	aCi/m^3	12.3	64.9	-0.4	-2.3		11.6		3.0		1.5	2.4	2.5	
Am-241	6/19/2000 – 9/25/2000	00Q3	aCi/m^3	4.0	17.3	0.1	-0.2		5.8		5.8		4.0	5.0	0.3	
Am-241	9/25/2000 – 12/18/2000	00Q4	aCi/m^3	2.9	9.2	-0.8	1.0		3.0		-0.5		-0.9	-0.6	-0.2	
Am-241	12/18/2000 – 3/26/2001	01Q1	aCi/m^3	4.3	64.4	-0.7	-1.7		2.0		-0.3		6.5	-0.4	0.6	
Am-241	3/26/2001 – 6/18/2001	01Q2	aCi/m^3	11.2	105.3	0.5	0.8		7.3		2.7		9.4	2.0	-0.5	
Am-241	6/18/2001 – 9/24/2001	01Q3	aCi/m^3	0.7	63.1	-1.3	1.1		5.7		2.9		12.3	0.9	1.5	

1995 to 2002 Results for ^{241}Am at TA-54 Area G.				Station Number												
Analyte	**Sample Dates**	**period**	**units**	**27**	**34**	**35**	**36**	**37**	**38**	**44**	**45**	**46**	**47**	**50**	**51**	**52**
Am-241	9/24/2001 – 12/17/2001	01Q4	aCi/m^3	0.1	33.7	-1.3	-1.1		0.3		1.5		2.8	2.8	-0.3	
Am-241	12/17/2001 – 3/18/2002	02Q1	aCi/m^3	22.6	154.4	0.7	2.9		17.3		1340.4		112.1	1.3	2.2	
Am-241	3/18/2002 – 6/24/2002	02Q2	aCi/m^3	15.1	96.6	0.9	-0.5		18.0		18.1		7.0	0.8	-1.1	
Am-241	6/24/2002 – 9/30/2002	02Q3	aCi/m^3	3.4	38.1	-0.1	0.1		1.8		4.5		1.3	2.0	-1.1	
Am-241	9/30/2002 – 12/23/2002	02Q4	aCi/m^3	1.6	3.6	0.5	-0.6		1.4		5.8		1.3	0.2	0.7	
Am-241	Samples with Results >2 σ	all	%	84	63	6	9	17	68	0	42	0	42	13	3	0

1995 to 2002 Results for ^{241}Am at TA-54 Area G.				Station Number												
Analyte	**Data Type**	**year**	**units**	**27**	**34**	**35**	**36**	**37**	**38**	**44**	**45**	**46**	**47**	**50**	**51**	**52**
Am-241	Annual Mean	1995	aCi/m^3	61.7	1.1	0.2	3.5	2.8	56.1	3.6	1.5	2.0	2.6	0.8	2.6	1.4
Am-241	Annual Mean	1996	aCi/m^3	476.0	1.9	0.7	0.5	-0.4	421.5	na	0.8	na	7.6	0.3	0.8	na
Am-241	Annual Mean	1997	aCi/m^3	467.2	4.1	1.0	3.1	na	365.9	na	5.9	na	6.6	3.2	1.7	na
Am-241	Annual Mean	1998	aCi/m^3	45.5	0.9	0.5	-0.2	na	43.5	na	7.1	na	3.2	1.2	1.2	na
Am-241	Annual Mean	1999	aCi/m^3	12.7	87.3	0.9	0.2	na	7.7	na	8.4	na	2.0	1.3	0.0	na
Am-241	Annual Mean	2000	aCi/m^3	6.6	87.4	-0.3	0.0	na	6.3	na	4.5	na	7.3	1.4	0.7	na
Am-241	Annual Mean	2001	aCi/m^3	4.1	66.6	-0.7	-0.2	na	3.8	na	1.7	na	7.8	1.3	0.3	na
Am-241	Annual Mean	2002	aCi/m^3	10.7	73.2	0.5	0.5	na	9.6	na	342.2	na	30.4	1.1	0.2	na

1995 to 2002 Results for ^{234}U at TA-54 Area G.				Station Number												
Analyte	**Sample Dates**	**period**	**units**	**27**	**34**	**35**	**36**	**37**	**38**	**44**	**45**	**46**	**47**	**50**	**51**	**52**
U-234	1/3/1995 – 3/27/1995	95Q1	aCi/m^3	15.2	11.4	3.4	21.5	2.7	13.5	18.6	17.6	21.3	8.2	33.2	39.1	47.3
U-234	3/27/1995 – 6/20/1995	95Q2	aCi/m^3	38.5	34.6	12.4	40.5	11.4	22.7	13.5	39.7	35.4	44.2	34.7	46.5	7.3
U-234	6/20/1995 – 9/25/1995	95Q3	aCi/m^3	47.3	14.7	5.3	40.1	4.5	33.3	31.8	48.5	24.2	24.6	35.6	23.6	3.6
U-234	9/25/1995 – 1/3/1996	95Q4	aCi/m^3	22.5	16.4	8.3	13.5	2.5	18.1	11.6	30.6	24.7	8.4	20.2	23.8	14.8
U-234	1/3/1996 – 3/25/1996	96Q1	aCi/m^3	29.4	18.9	8.5	18.9		21.7		8.4		14.4	36.9	35.4	
U-234	3/25/1996 – 6/28/1996	96Q2	aCi/m^3	67.2	40.3	18.7	33.7	21.6	80.5		35.0		41.0	112.3	73.2	
U-234	6/28/1996 – 9/23/1996	96Q3	aCi/m^3	46.2	8.0	54.8	22.4	2.0	38.8		7.2		0.0	26.7	26.3	
U-234	9/23/1996 – 12/16/1996	96Q4	aCi/m^3	24.8	2.8	4.4	18.5		24.4		6.0		4.5	19.0	22.7	
U-234	12/16/1996 – 3/31/1997	97Q1	aCi/m^3	36.8	11.7	11.3	17.2		31.0		13.9		9.4	27.9	24.9	
U-234	3/31/1997 – 6/23/1997	97Q2	aCi/m^3	108.4	22.5	10.2	26.6		79.7		53.4		12.6	64.6	54.3	
U-234	6/23/1997 – 9/29/1997	97Q3	aCi/m^3	41.5	9.0	12.6	11.0		29.6		54.7		6.0	32.1	21.2	
U-234	9/29/1997 – 1/5/1998	97Q4	aCi/m^3	32.4	14.1	4.3	9.3		25.0		31.7		7.9	23.9	16.0	
U-234	1/5/1998 – 3/30/1998	98Q1	aCi/m^3	53.1	17.6	9.1	12.0		55.9		49.9		13.4	38.1	27.1	
U-234	3/30/1998 – 6/22/1998	98Q2	aCi/m^3	49.7	55.4	11.1	21.4		55.6		85.0		26.5	69.0	58.1	
U-234	6/22/1998 – 9/28/1998	98Q3	aCi/m^3	65.4	11.3	6.5	10.7		58.8		51.8		10.8	39.8	24.9	
U-234	9/28/1998 – 12/21/1998	98Q4	aCi/m^3	57.0	17.1	4.0	5.0		62.5		29.0		10.1	37.1	20.7	
U-234	12/21/1998 – 3/29/1999	99Q1	aCi/m^3	89.0	27.8	22.0	24.3		78.5		52.5		23.7	95.0	36.4	
U-234	3/29/1999 – 6/21/1999	99Q2	aCi/m^3	299.9	59.8	15.7	47.8		134.1		68.3		26.1	244.6	92.4	
U-234	6/21/1999 – 9/27/1999	99Q3	aCi/m^3	28.0	15.6	7.4	16.3		28.9		42.1		6.2	47.4	19.3	
U-234	9/27/1999 – 12/20/1999	99Q4	aCi/m^3	32.4	22.0	21.7	15.1		24.6		58.6		9.7	61.4	29.3	
U-234	12/20/1999 – 3/27/2000	00Q1	aCi/m^3	42.1	28.0	14.4	20.9		43.8		43.3		54.5	48.6	43.1	
U-234	3/27/2000 – 6/19/2000	00Q2	aCi/m^3	105.7	114.7	17.9	17.0		92.2		38.0		97.9	74.1	44.0	
U-234	6/19/2000 – 9/25/2000	00Q3	aCi/m^3	55.2	38.8	21.7	13.0		57.0		81.2		38.2	62.2	21.0	
U-234	9/25/2000 – 12/18/2000	00Q4	aCi/m^3	18.0	13.9	9.7	6.3		15.9		48.9		10.0	11.9	7.2	
U-234	12/18/2000 – 3/26/2001	01Q1	aCi/m^3	9.5	21.5	6.1	7.0		13.9		18.5		10.1	20.5	9.2	
U-234	3/26/2001 – 6/18/2001	01Q2	aCi/m^3	58.6	72.8	29.0	25.8		47.9		88.3		25.7	68.2	63.9	
U-234	6/18/2001 – 9/24/2001	01Q3	aCi/m^3	9.6	55.3	9.9	7.0		12.1		61.8		14.6	20.3	16.3	
U-234	9/24/2001 – 12/17/2001	01Q4	aCi/m^3	10.0	36.8	12.0	2.9		11.4		23.2		9.5	25.1	15.4	

1995 to 2002 Results for ^{234}U at TA-54 Area G.				Station Number												
Analyte	**Sample Dates**	**period**	**units**	**27**	**34**	**35**	**36**	**37**	**38**	**44**	**45**	**46**	**47**	**50**	**51**	**52**
U-234	12/17/2001 – 3/18/2002	02Q1	aCi/m^3	14.2	53.8	13.4	12.0		19.1		34.3		19.9	33.8	25.3	
U-234	3/18/2002 – 6/24/2002	02Q2	aCi/m^3	68.6	86.5	22.1	28.4		47.6		30.0		42.2	94.3	51.7	
U-234	6/24/2002 – 9/30/2002	02Q3	aCi/m^3	20.1	40.2	24.9	21.6		17.4		13.8		10.4	37.4	25.6	
U-234	9/30/2002 – 12/23/2002	02Q4	aCi/m^3	4.5	4.3	4.8	2.1		4.6		0.5		4.3	10.6	8.6	
U-234	Samples with Results >2σ	all	%	100	97	84	94	17	82	50	79	100	79	100	100	25

1995 to 2002 Results for ^{234}U at TA-54 Area G.				Station Number												
Analyte	**Data Type**	**year**	**units**	**27**	**34**	**35**	**36**	**37**	**38**	**44**	**45**	**46**	**47**	**50**	**51**	**52**
U-234	Annual Mean	1995	aCi/m^3	30.9	19.3	7.3	28.9	5.3	21.9	18.9	34.1	26.4	21.3	30.9	33.3	18.2
U-234	Annual Mean	1996	aCi/m^3	41.9	17.5	21.6	23.4	11.8	41.3	na	14.2	na	15.0	48.7	39.4	na
U-234	Annual Mean	1997	aCi/m^3	54.8	14.3	9.6	16.0	na	41.3	na	38.4	na	9.0	37.1	29.1	na
U-234	Annual Mean	1998	aCi/m^3	56.3	25.4	7.7	12.3	na	58.2	na	53.9	na	15.2	46.0	32.7	na
U-234	Annual Mean	1999	aCi/m^3	112.3	31.3	16.7	25.9	na	66.5	na	55.4	na	16.5	112.1	44.4	na
U-234	Annual Mean	2000	aCi/m^3	55.2	48.9	15.9	14.3	na	52.2	na	52.9	na	50.2	49.2	28.8	na
U-234	Annual Mean	2001	aCi/m^3	21.9	46.6	14.2	10.6	na	21.3	na	48.0	na	15.0	33.5	26.2	na
U-234	Annual Mean	2002	aCi/m^3	26.8	46.2	16.3	16.0	na	22.2	na	19.6	na	19.2	44.0	27.8	na

1995 to 2002 Results for ^{235}U at TA-54 Area G.				Station Number												
Analyte	**Sample Dates**	**period**	**units**	**27**	**34**	**35**	**36**	**37**	**38**	**44**	**45**	**46**	**47**	**50**	**51**	**52**
U-235	1/3/1995 – 3/27/1995	95Q1	aCi/m^3	-0.4	-0.4	-1.9	-0.4	1.0	-0.4	-0.3	-1.9	-0.4	-1.9	7.2	-5.2	-6.3
U-235	3/27/1995 – 6/20/1995	95Q2	aCi/m^3	0.4	-1.4	-1.2	0.4	-1.1	0.3	0.3	-1.3	-1.3	0.4	0.3	-1.0	-0.9
U-235	6/20/1995 – 9/25/1995	95Q3	aCi/m^3	0.5	0.6	0.5	0.5	0.6	-1.0	2.7	0.5	0.5	0.5	0.5	0.5	0.5
U-235	9/25/1995 – 1/3/1996	95Q4	aCi/m^3	1.4	0.3	1.5	0.3	0.3	0.2	0.8	2.7	0.9	0.2	0.2	1.4	4.7
U-235	1/3/1996 – 3/25/1996	96Q1	aCi/m^3	1.5	1.5	1.5	1.5		1.5		0.0		1.5	4.3	1.5	
U-235	3/25/1996 – 6/28/1996	96Q2	aCi/m^3	3.6	3.4	1.0	1.8	1.0	4.3		2.4		4.5	6.2	4.4	
U-235	6/28/1996 – 9/23/1996	96Q3	aCi/m^3	2.8	-0.2	0.6	0.7	0.3	1.4		1.4		-0.6	1.5	3.3	
U-235	9/23/1996 – 12/16/1996	96Q4	aCi/m^3	1.5	0.4	1.0	1.3		2.1		0.6		0.9	1.4	1.3	
U-235	12/16/1996 – 3/31/1997	97Q1	aCi/m^3	2.6	0.4	-0.1	2.5		0.9		1.6		0.2	2.3	1.6	
U-235	3/31/1997 – 6/23/1997	97Q2	aCi/m^3	7.6	-0.3	-0.9	1.1		1.6		2.4		0.8	2.4	4.0	
U-235	6/23/1997 – 9/29/1997	97Q3	aCi/m^3	4.5	2.9	1.2	0.1		1.4		2.6		-0.1	0.9	-0.1	
U-235	9/29/1997 – 1/5/1998	97Q4	aCi/m^3	2.6	0.9	0.6	1.1		1.2		1.9		1.2	1.9	1.2	
U-235	1/5/1998 – 3/30/1998	98Q1	aCi/m^3	1.4	0.4	0.3	0.4		3.4		1.3		-1.2	1.6	1.9	
U-235	3/30/1998 – 6/22/1998	98Q2	aCi/m^3	1.5	0.7	0.1	2.0		4.7		2.7		1.3	4.0	3.4	
U-235	6/22/1998 – 9/28/1998	98Q3	aCi/m^3	2.3	1.6	0.0	1.2		2.4		2.4		1.9	2.6	1.6	
U-235	9/28/1998 – 12/21/1998	98Q4	aCi/m^3	1.1	0.7	-0.2	0.0		2.8		1.2		-0.6	4.1	1.3	
U-235	12/21/1998 – 3/29/1999	99Q1	aCi/m^3	3.2	0.7	-0.5	0.6		2.5		1.6		0.7	7.4	1.2	
U-235	3/29/1999 – 6/21/1999	99Q2	aCi/m^3	18.6	3.9	0.5	3.4		11.0		2.7		0.5	11.3	5.6	
U-235	6/21/1999 – 9/27/1999	99Q3	aCi/m^3	1.4	0.1	-0.5	0.1		0.1		2.8		0.0	0.5	0.3	
U-235	9/27/1999 – 12/20/1999	99Q4	aCi/m^3	2.3	0.0	1.1	-0.7		1.1		4.4		2.0	4.0	2.7	
U-235	12/20/1999 – 3/27/2000	00Q1	aCi/m^3	5.6	0.9	0.8	0.6		1.4		1.6		2.1	2.1	2.3	
U-235	3/27/2000 – 6/19/2000	00Q2	aCi/m^3	5.0	3.7	0.4	0.8		0.7		1.1		6.6	1.4	2.5	
U-235	6/19/2000 – 9/25/2000	00Q3	aCi/m^3	3.1	2.4	0.7	0.5		4.4		2.7		1.2	2.6	-1.0	
U-235	9/25/2000 – 12/18/2000	00Q4	aCi/m^3	0.5	0.3	0.6	-0.7		0.3		0.2		-1.3	1.6	0.0	
U-235	12/18/2000 – 3/26/2001	01Q1	aCi/m^3	0.2	-0.1	0.8	-0.8		0.2		2.3		-0.6	2.1	2.7	
U-235	3/26/2001 – 6/18/2001	01Q2	aCi/m^3	5.1	4.9	1.0	1.4		1.6		6.4		1.1	-0.1	2.6	
U-235	6/18/2001 – 9/24/2001	01Q3	aCi/m^3	0.5	4.3	-0.1	-0.5		0.8		3.7		0.9	1.2	2.0	
U-235	9/24/2001 – 12/17/2001	01Q4	aCi/m^3	0.3	1.4	1.1	0.7		0.6		0.2		-0.3	0.2	3.7	

1995 to 2002 Results for ^{235}U at TA-54 Area G.				Station Number												
Analyte	**Sample Dates**	**period**	**units**	**27**	**34**	**35**	**36**	**37**	**38**	**44**	**45**	**46**	**47**	**50**	**51**	**52**
U-235	12/17/2001 – 3/18/2002	02Q1	aCi/m^3	0.3	4.0	0.0	1.2		-0.2		2.9		4.2	6.0	0.3	
U-235	3/18/2002 – 6/24/2002	02Q2	aCi/m^3	5.2	5.3	2.9	1.2		3.1		2.4		1.0	6.1	3.1	
U-235	6/24/2002 – 9/30/2002	02Q3	aCi/m^3	-1.2	1.0	1.5	-0.2		-0.2		2.2		1.7	2.6	0.8	
U-235	9/30/2002 – 12/23/2002	02Q4	aCi/m^3	0.3	1.9	-0.2	1.2		3.6		0.6		1.3	1.0	1.9	
U-235	Samples with Results >2σ	all	%	47	28	3	9	0	26	0	26	0	13	41	22	0

1995 to 2002 Results for ^{235}U at TA-54Area G.				Station Number												
Analyte	**Data Type**	**year**	**units**	**27**	**34**	**35**	**36**	**37**	**38**	**44**	**45**	**46**	**47**	**50**	**51**	**52**
U-235	Annual Mean	1995	aCi/m^3	0.5	-0.2	-0.3	0.2	0.2	-0.2	0.9	0.0	-0.1	-0.2	2.1	-1.1	-0.5
U-235	Annual Mean	1996	aCi/m^3	2.4	1.3	1.0	1.3	0.7	2.3	na	1.1	na	1.6	3.4	2.6	na
U-235	Annual Mean	1997	aCi/m^3	4.3	1.0	0.2	1.2	na	1.3	na	2.1	na	0.5	1.9	1.7	na
U-235	Annual Mean	1998	aCi/m^3	1.6	0.9	0.1	0.9	na	3.3	na	1.9	na	0.3	3.1	2.0	na
U-235	Annual Mean	1999	aCi/m^3	6.4	1.2	0.1	0.8	na	3.7	na	2.9	na	0.8	5.8	2.4	na
U-235	Annual Mean	2000	aCi/m^3	3.5	1.8	0.6	0.3	na	1.7	na	1.4	na	2.1	1.9	1.0	na
U-235	Annual Mean	2001	aCi/m^3	1.5	2.6	0.7	0.2	na	0.8	na	3.1	na	0.3	0.9	2.8	na
U-235	Annual Mean	2002	aCi/m^3	1.2	3.1	1.0	0.8	na	1.6	na	2.0	na	2.0	3.9	1.5	na

1995 to 2002 Results for ^{238}U at TA-54 Area G.				Station Number												
Analyte	**Sample Dates**	**period**	**units**	**27**	**34**	**35**	**36**	**37**	**38**	**44**	**45**	**46**	**47**	**50**	**51**	**52**
U-238	1/3/1995 – 3/27/1995	95Q1	aCi/m^3	7.9	18.8	-0.3	16.0	2.2	29.4	19.5	13.8	15.8	20.3	43.8	88.6	24.6
U-238	3/27/1995 – 6/20/1995	95Q2	aCi/m^3	45.4	23.0	7.2	33.6	5.2	23.4	18.1	40.5	44.6	52.6	31.5	49.7	6.8
U-238	6/20/1995 – 9/25/1995	95Q3	aCi/m^3	43.4	18.6	8.6	28.0	5.0	29.1	32.3	45.6	29.3	21.8	29.9	20.9	1.1
U-238	9/25/1995 – 1/3/1996	95Q4	aCi/m^3	27.8	22.0	11.2	20.3	11.3	18.6	17.4	34.9	26.4	15.0	23.1	29.1	24.1
U-238	1/3/1996 – 3/25/1996	96Q1	aCi/m^3	22.5	19.5	4.6	12.0		25.3		9.0		13.5	39.0	43.5	
U-238	3/25/1996 – 6/28/1996	96Q2	aCi/m^3	69.2	45.5	18.7	34.0	19.1	82.7		35.1		37.1	104.1	66.7	
U-238	6/28/1996 – 9/23/1996	96Q3	aCi/m^3	40.9	3.7	7.5	18.0	4.6	36.7		8.6		1.4	27.3	29.0	
U-238	9/23/1996 – 12/16/1996	96Q4	aCi/m^3	27.0	2.7	4.9	22.5		26.0		8.0		12.2	25.5	20.2	
U-238	12/16/1996 – 3/31/1997	97Q1	aCi/m^3	38.4	14.0	14.0	19.2		32.6		15.7		11.6	31.6	28.2	
U-238	3/31/1997 – 6/23/1997	97Q2	aCi/m^3	106.8	15.1	9.3	33.1		81.0		55.0		13.6	58.9	52.7	
U-238	6/23/1997 – 9/29/1997	97Q3	aCi/m^3	39.1	5.3	15.1	13.0		32.7		46.9		8.3	42.0	23.5	
U-238	9/29/1997 – 1/5/1998	97Q4	aCi/m^3	31.7	13.5	5.0	6.4		26.4		29.3		6.8	23.3	13.7	
U-238	1/5/1998 – 3/30/1998	98Q1	aCi/m^3	54.8	18.2	6.6	7.5		58.5		49.9		11.5	40.3	30.1	
U-238	3/30/1998 – 6/22/1998	98Q2	aCi/m^3	40.8	57.5	12.5	27.4		60.8		92.2		26.3	69.6	75.0	
U-238	6/22/1998 – 9/28/1998	98Q3	aCi/m^3	65.5	13.6	9.1	12.7		64.6		53.0		13.6	41.9	24.8	
U-238	9/28/1998 – 12/21/1998	98Q4	aCi/m^3	61.9	23.9	6.0	8.9		58.9		31.9		7.7	40.2	21.7	
U-238	12/21/1998 – 3/29/1999	99Q1	aCi/m^3	95.2	27.6	20.8	26.1		77.2		53.6		24.0	98.7	36.9	
U-238	3/29/1999 – 6/21/1999	99Q2	aCi/m^3	293.3	68.5	16.7	46.7		137.7		72.0		25.0	257.4	99.9	
U-238	6/21/1999 – 9/27/1999	99Q3	aCi/m^3	32.2	20.0	9.3	22.4		29.3		49.5		8.4	48.4	23.7	
U-238	9/27/1999 – 12/20/1999	99Q4	aCi/m^3	28.1	22.5	22.5	46.4		28.6		66.3		12.5	61.2	32.8	
U-238	12/20/1999 – 3/27/2000	00Q1	aCi/m^3	38.6	30.3	19.8	14.6		45.0		44.3		59.4	53.4	45.9	
U-238	3/27/2000 – 6/19/2000	00Q2	aCi/m^3	104.2	104.6	17.4	17.9		86.9		42.2		92.0	77.8	45.6	
U-238	6/19/2000 – 9/25/2000	00Q3	aCi/m^3	52.8	43.2	18.9	17.7		68.8		84.8		39.8	69.8	24.4	
U-238	9/25/2000 – 12/18/2000	00Q4	aCi/m^3	16.0	20.9	13.0	8.4		19.4		45.6		12.7	15.0	8.2	
U-238	12/18/2000 – 3/26/2001	01Q1	aCi/m^3	11.3	28.4	17.3	12.6		20.7		23.7		15.2	24.2	14.5	
U-238	3/26/2001 – 6/18/2001	01Q2	aCi/m^3	63.4	71.9	42.8	39.0		53.1		97.2		39.0	64.5	82.3	
U-238	6/18/2001 – 9/24/2001	01Q3	aCi/m^3	11.0	59.2	8.6	6.4		16.8		57.3		8.2	19.2	12.5	
U-238	9/24/2001 – 12/17/2001	01Q4	aCi/m^3	14.6	34.6	14.2	7.4		12.8		24.5		10.9	29.6	13.6	

1995 to 2002 Results for ^{238}U at TA-54 Area G.				Station Number												
Analyte	**Sample Dates**	**period**	**units**	**27**	**34**	**35**	**36**	**37**	**38**	**44**	**45**	**46**	**47**	**50**	**51**	**52**
U-238	12/17/2001 – 3/18/2002	02Q1	aCi/m^3	22.6	52.8	21.6	23.3		26.3		50.1		28.8	53.6	30.1	
U-238	3/18/2002 – 6/24/2002	02Q2	aCi/m^3	60.1	85.3	21.1	33.7		51.9		27.8		29.2	99.9	65.8	
U-238	6/24/2002 – 9/30/2002	02Q3	aCi/m^3	16.2	45.7	23.0	18.6		18.7		12.4		11.1	36.6	28.2	
U-238	9/30/2002 – 12/23/2002	02Q4	aCi/m^3	14.9	14.2	12.5	17.5		17.4		12.5		11.8	27.6	19.8	
U-238	Samples with Results >2σ	all	%	100	94	91	100	50	84	75	84	100	82	100	100	50

1995 to 2002 Results for ^{238}U at TA-54 Area G.				Station Number												
Analyte	**Data Type**	**year**	**units**	**27**	**34**	**35**	**36**	**37**	**38**	**44**	**45**	**46**	**47**	**50**	**51**	**52**
U-238	Annual Mean	1995	aCi/m^3	31.1	20.6	6.7	24.5	5.9	25.1	21.8	33.7	29.0	27.4	32.1	47.1	14.2
U-238	Annual Mean	1996	aCi/m^3	39.9	17.9	8.9	21.6	11.8	42.7	na	15.2	na	16.0	49.0	39.9	na
U-238	Annual Mean	1997	aCi/m^3	54.0	12.0	10.8	17.9	na	43.2	na	36.7	na	10.1	38.9	29.5	na
U-238	Annual Mean	1998	aCi/m^3	55.7	28.3	8.6	14.1	na	60.7	na	56.8	na	14.8	48.0	37.9	na
U-238	Annual Mean	1999	aCi/m^3	112.2	34.7	17.3	35.4	na	68.2	na	60.4	na	17.5	116.4	48.3	na
U-238	Annual Mean	2000	aCi/m^3	52.9	49.8	17.3	14.7	na	55.0	na	54.2	na	51.0	54.0	31.0	na
U-238	Annual Mean	2001	aCi/m^3	25.1	48.5	20.7	16.4	na	25.8	na	50.7	na	18.3	34.4	30.7	na
U-238	Annual Mean	2002	aCi/m^3	28.4	49.5	19.5	23.2	na	28.6	na	25.7	na	20.2	54.4	36.0	na

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