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NEVADA TEST SITE
RADIONUCLIDE INVENTORY AND DISTRIBUTION PROGRAM:
REPORT #3. AREAS 3, 7, 8, 9, AND 10

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ABSTRACT

As part of the Nevada Test Site Radionuclide Inventory and Distribution Program, 115 soil samples were collected and more than 1,200 *in situ* measurements of gamma-emitting radionuclides were made in the northern and eastern parts of Yucca Flat. Analysis of the data led to estimated inventories of 215 Ci of $^{239,240}Pu$, 128 Ci of ^{137}Cs, 92 Ci of ^{90}Sr, 36 Ci each of ^{241}Am and ^{60}Co, 31 Ci of ^{102m}Rh, 27 Ci of ^{238}Pu, 25 Ci of ^{174}Lu, 10 Ci of ^{152}Eu, 8 Ci of ^{155}Eu, 7 Ci of ^{154}Eu, 5 Ci of ^{125}Sb, 4 Ci of ^{101}Rh, and 2 Ci of ^{134}Cs in the surface soil of the accessible portion of Areas 8 and 10. Similar calculations with the data from Areas 3, 7, and 9 gave estimates of 145 Ci of $^{239,240}Pu$, 89 Ci of ^{152}Eu, 62 Ci of ^{90}Sr, 25 Ci of ^{137}Cs, 14 Ci of ^{154}Eu, 11 Ci of ^{241}Am, 6 Ci each of ^{60}Co and ^{238}Pu, and 4 Ci of ^{155}Eu. Additional *in situ* measurements at 30 locations in the southern part of Yucca Flat confirmed the low levels of radioactivity found there by an aerial survey.

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ACKNOWLEDGMENTS

The Radionuclide Inventory and Distribution Program (RIDP) is a joint effort of the U.S. Department of Energy (DOE) and several contracting agencies, including Lawrence Livermore National Laboratory (LLNL), Reynolds Electrical and Engineering Co., Inc. (REECo), EG&G Inc., and the Desert Research Institute (DRI). Many people have contributed to the work reported here, and it must be confessed that the authors probably do not even know most of them. Those whom we are able to single out for special appreciation include JoAnne Burrows (DOE), the Project Officer; Lynn Anspaugh (LLNL), the Scientific Director of the program; Ron Reiman and Willie McGlothen (EG&G), who supervised the collection of the *in situ* data; Virginia Hawkins (REECo), who supervised the collection and processing of the soil samples; Bob Heft (LLNL), who assisted in the processing and analysis of the data; and Karen Gray (DRI), who helped with the data analysis and prepared many of the figures. To all these people, and to the many others who have not been individually mentioned, we extend our thanks.

SECTION 1
INTRODUCTION

More than 100 nuclear tests have taken place in Yucca Flat since testing began on the Nevada Test Site in 1951. Many of these tests have been underground and have caused little or no contamination of the surface soil, but numerous atmospheric tests and several vented underground tests have deposited radioactive material on the surface. A 1978 aerial radiological survey of the area by EG&G was reported by Fritzsche (1982). Figure 1 and Table 1, both taken from Fritzsche's report, show the distribution of radioactivity in Yucca Flat and identify the major sources of contamination.

The task of the RIDP is to quantify the exposure rates computed from the aerial survey data in terms of the amounts of the individual radionuclides present. The project does this primarily by using *in situ* spectrometry to measure the flux of gamma rays coming from the soil. The RIDP collected gamma-ray spectra at nearly 1,900 locations in Yucca Flat (Figure 2). The results (soil data, inventory estimates, and distribution maps) from the western side were reported in the first two RIDP reports (McArthur and Kordas, 1983 and 1985); this report presents the results from the rest of the region.

TABLE 1. MAJOR CONTAMINATED AREAS AT YUCCA FLAT (from Fritzsche, 1982)

Location Code[a]	Nevada Grid Coordinates N	E	Identification[b]
1	838750	664700	Easy, Simon, Apple-2, Galileo
2	840500	663000	Waste Dump (removed)
3	856250	662000	Waste Dump
4	855000	662500	Waste Dump
5	854000	664700	Fox, Kepler, Nancy, Apple-1
6	856000	663000	Waste Dump
7	866000	663250	Shasta
8	866500	658300	Waste Dump
9	870000	660000	How, Badger, Turk, Whitney
10	874000	662500	Diablo
11	872200	658800	Waste Dump
12	889000	653800	A-12 Core Library
13	882500	665000	Baneberry
14	887750	674250	Smoky
15	884000	681000	Sedan
16	869000	682500	Wilson, Lassen, Wheeler, Hood, Owens, Charleston, Morgan, Rushmore
17	865000	680500	Ganymede
18	866000	684000	Waste Dump
19	864000	685000	Vesta
20	854000	687500	Boltzmann, Quay
21	853000	690750	Waste Dump
22	851000	687500	Franklin Prime, LaPlace, Doppler Newton, Stokes, Mora, Lea, Socorro, DeBaca
23	839000	690000	Waste Dump (recovered)
24	837750	685000	Pascal-C
25	837000	688500	Moth, Annie, George, Franklin
26	837500	691250	Pike
27	836750	692750	Waste Dump
28	834000	687000	Harry, Hornet
29	831000	685500	Fizeau
30	796800	684300	Current Decon. Pond
31	795000	679700	Old Decon. Pond (removed)

[a]Codes correspond to identified locations on Figure 1.

[b]Event identification supplied by E.R. Sorom, REECo.

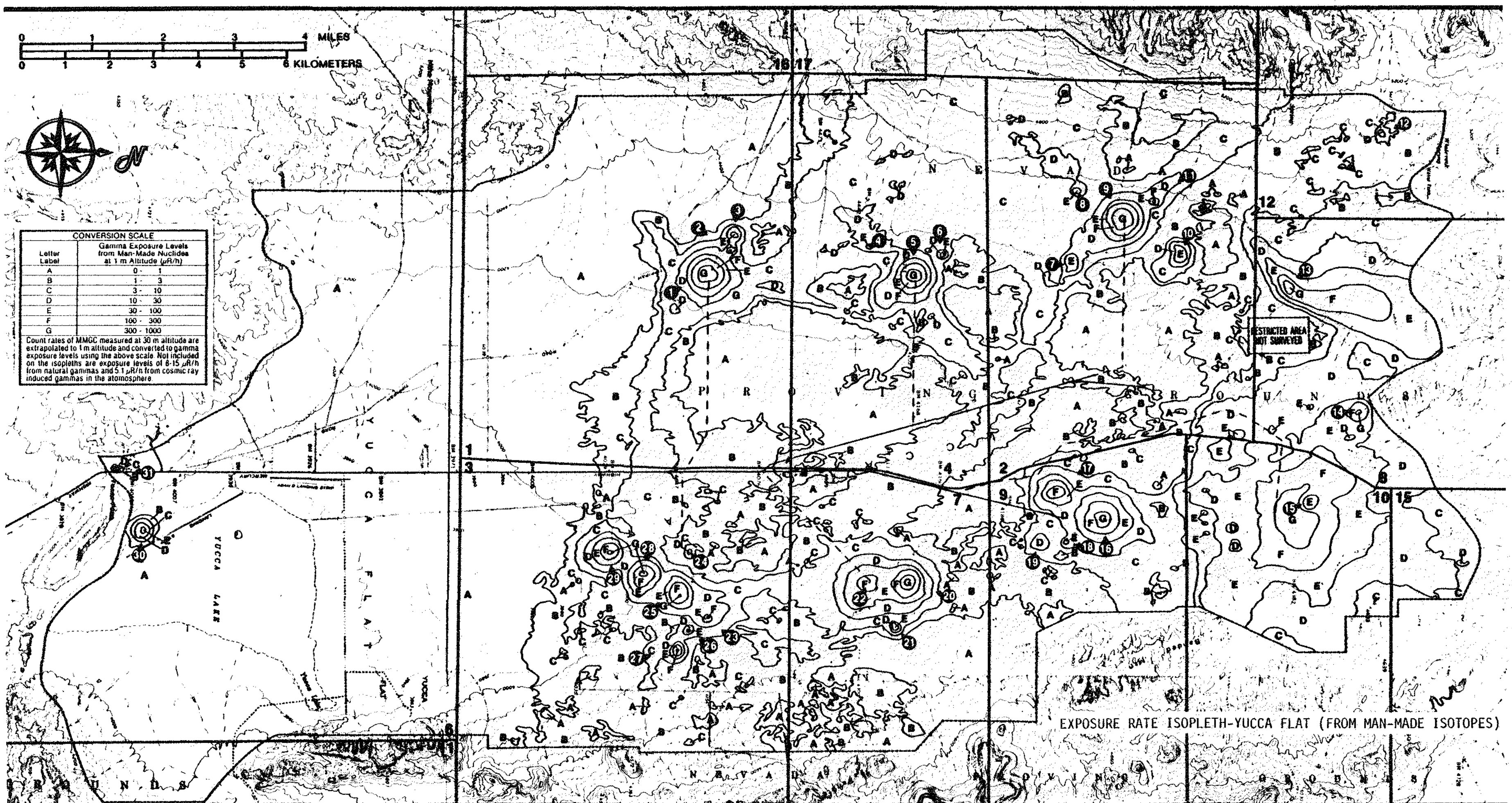


Figure 1. Exposure rates from man-made isotopes at Yucca Flat (from Fritzsche, 1982).

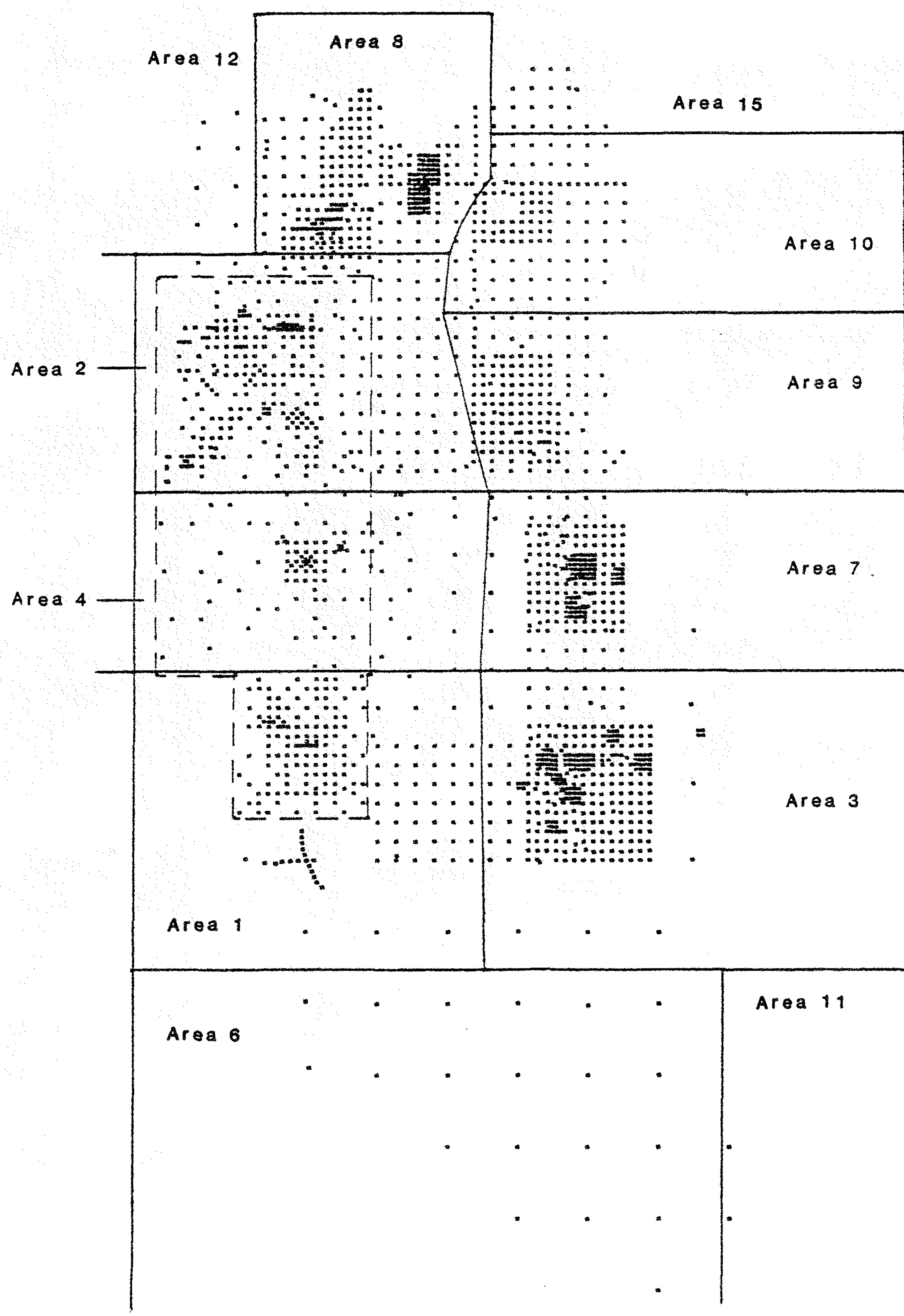


Figure 2. Locations of in situ measurements in Yucca Flat. The dashed line encloses the region covered in the first two RIDP reports.

SECTION 2
METHODS

The data collection and processing was organized by dividing the region into five areas roughly coinciding with the NTS areas involved. Following the usual RIDP practice, the areas were given the name of a ground zero (GZ): Baneberry (Area 8), Sedan (Area 10), Wilson (Area 9), Quay (Area 7), and Hornet (Area 3). The same names are used here to refer to the somewhat different areas for which distribution estimates are made. This use of the event names is only a convenience; it does not imply that these five events are the most important sources of contamination in the region.

The procedures for collecting the gamma-ray spectra and the soil samples were described by McArthur and Kordas (1983) and remained essentially the same throughout the entire project. Some of the methods for analyzing the data presented in this report differ from those previously used, as described below.

SOIL ANALYSES

Soil samples were collected and analyzed to provide data about both the distribution of radionuclides with depth and the concentrations of important radionuclides that are not usually detectable by the *in situ* system. The 115 *in situ* measurement points where soil samples were collected are listed in Appendix A. The chosen points were usually on two perpendicular transects through a GZ area. Most points were sampled in a vertical profile of four increments to a total sampling depth of 15 cm, but only three increments (to 10 cm) could be collected at one point in the Quay area and eight points near the Sedan GZ were sampled in six increments to a depth of 30 cm. Each sample was oven-dried, homogenized with a ball mill, and sieved through a 10-mesh screen before analysis.

The fine fractions of the soil samples were counted by gamma-ray spectrometers at the REECo Analytical Laboratory. Most of the REECo spectra were then analyzed at LLNL using the GAMANAL computer program (Gunnink and Niday, 1971) to determine radionuclide concentrations. The results of these analyses, presented in Appendix B, were used to calculate inverse relaxation lengths as described in the next subsection. The 15 spectra from the Baneberry soil samples were not available for analysis by LLNL, and the results given for those samples were obtained by REECo.

In addition, the fine fraction of the top increment from 39 locations was chemically analyzed for ^{238}Pu, $^{239,240}Pu$, and ^{90}Sr by the REECo laboratory. The results are presented in Table C-4 of Appendix C, which describes the quality assurance program for the soil analyses. Ratios of $^{238}Pu/^{241}Am$, $^{239,240}Pu/^{241}Am$, and $^{90}Sr/^{137}Cs$ were used to infer inventories of plutonium and strontium from the estimated ^{241}Am and ^{137}Cs inventories.

The factors for converting photopeak counts to radionuclide activities were computed assuming an air density of 0.001204 g/cm^3, a wet soil density of 1.5 g/cm^3, and a soil moisture content of 10 percent. The mass attenuation coefficients for all energies of interest were obtained by interpolation from Beck _et_ _al_. (1972). Several representative values are shown below.

Air:	cm^2/g	Soil:	cm^2/g
60 keV	0.177	60 keV	0.248
662 keV	0.0770	662 keV	0.0781
1332 keV	0.0550	1332 keV	0.0558

INVERSE RELAXATION LENGTHS

If the radionuclide concentration in the soil is assumed to decrease exponentially with depth, the depth distribution can be parameterized by the inverse relaxation length α in cm^{-1}. The methods used to compute α for this report differ somewhat from the methods described previously. As explained below, the new methods do not assume that no activity exists below the lowest soil sample. Furthermore, the use of upper limit values is limited by the special rules described near the end of this subsection. (Upper limit values are computed by GAMANAL for radionuclides whose peaks are searched for but not found. The formula is U.L. = $2\sqrt{B}/tC$, where B is the integrated background in the peak region, t is the count time, and C is the detector conversion factor.)

The GAMANAL analysis of the soil measurements provides activity values (in pCi/g) and a standard deviation (in percent) for each radionuclide of interest in each sample. Using terminology similar to that in McArthur and Kordas (1983), we define the following key quantity:

> I_i = the total activity in a 1 - cm^2 column of the ith-level sample. I_i has the units pCi/cm^2. The values apply to the natural "wet" soil, and the index i usually takes the values a, b, c, or d, indicating the sample depth as follows: a = 0 - 2.5 cm, b = 2.5 - 5 cm, c = 5 - 10 cm, and d = 10 - 15 cm. (Note, however, that eight of the Sedan samples were taken at 6 levels, each of which was 5 cm thick).

The I_i are obtained from the computed activities in pCi/g by multiplying by three factors: the ratio of the sieved weight to the wet weight, the wet density, and the thickness (l_i) of the sample.

I_a can also be expressed as follows:

$$I_a = I_s \int_0^{2.5} e^{-\alpha z}\, dz = (I_s/\alpha)\ [1 - e^{-2.5\alpha}] \qquad (1)$$

where, as before, I_s is the activity per unit volume at the soil surface and α is the inverse relaxation length in cm^{-1}. Similarly,

$$I_b = I_s/\alpha\ [e^{-2.5\alpha} - e^{-5.0\alpha}] \qquad (2)$$

$$I_c = I_s/\alpha\ [e^{-5\alpha} - e^{-10\alpha}] \qquad (3)$$

$$I_d = I_s/\alpha\ [e^{-10\alpha} - e^{-15\alpha}] \qquad (4)$$

An expression for α based on the top two samples (a and b) can be obtained from equations (1) and (2) as follows:

$$I_a/I_b = (1 - e^{-2.5\alpha})/(e^{-2.5\alpha} - e^{-5\alpha})$$
$$= (1 - e^{-2.5\alpha})/[e^{-2.5\alpha}(1 - e^{-2.5\alpha})] = e^{2.5\alpha}$$

$$\ln(I_a/I_b) = 2.5\alpha$$

$$\alpha = 0.4 \ln(I_a/I_b) \qquad (5)$$

We obtain the standard deviation (SD) for α in terms of the percent standard deviation (%SD) supplied by GAMANAL as follows:

Setting $I_a/I_b = x$, we have from equation (5):

$$\alpha = 0.4 \ln x$$
$$d\alpha = 0.4 \ (dx/x)$$

and hence

$$SD\alpha = .004 \ (\%SD\ x)$$

where

$$\%SD\ x = \sqrt{(\%SD\ I_a)^2 + (\%SD\ I_b)^2} \qquad (6)$$

When sufficient information is available about the activities of the lower sample levels, we use the following expressions for α and $SD\alpha$, which are obtained using equations (1) through (4) and methods similar to those used above:

$$\alpha = 0.2 \ln[(I_a + I_b)/I_c] \qquad (7)$$

$$SD\alpha = .002\sqrt{[\%SD(I_a + I_b)]^2 + (\%SD\ I_c)^2} \qquad (8)$$

For the case in which sufficient information is available about the "d" sample, we use the expressions:

$$\alpha = -0.2 \ln[0.5(\sqrt{1 + 4R} - 1)] \tag{9}$$

$$SD\alpha = 0.4SDR/(1 + 4R - \sqrt{1 + 4R}) \tag{10}$$

where $R = (I_c + I_d)/(I_a + I_b)$ and SDR is the standard deviation of R, which can be calculated from the percent standard deviations produced by GAMANAL.

We have used the following rules to determine the appropriate expressions for α and $SD\alpha$:

1. If the calculated value of α is less than .05, set $\alpha = .05$ and indicate with a footnote that sampling did not extend deep enough.

2. If all samples produce only upper limit values for a particular radionuclide, then no α value is calculated for that radionuclide. Otherwise, use rule 3. (Note that an upper limit value, at least, is calculated by GAMANAL for all radionuclides used in determining α values).

3. If sample "b" and all deeper samples yield only upper limit values, then equations (5) and (6) are used to calculate α and $SD\alpha$. If sample "b" yields a "proper value" (a measured photopeak above the detection limit), use rule 4.

4. If samples "c" and "d" yield only upper limit values, then equations (7) and (8) are used to calculate α and $SD\alpha$. If sample "c" yields a proper value, use rule 5.

5. If sample "d" yields only an upper limit value, then equations (7) and (8) are used to calculate α and $SD\alpha$. If sample "d" yields a proper value, equations (9) and (10) are used to calculate α and $SD\alpha$.

6. If a proper value occurs below an upper limit value, that upper limit value is treated as a proper value for the purposes of these calculations.

For the Sedan area, the eight sets of deep-sampling data were used. The α's were calculated as follows, using the six 5-cm samples extending to 30 cm:

$$\alpha = (1/15)\ \ln[(I_a+I_b+I_c)/(I_d+I_e+I_f)]$$

$$SD\alpha = (1/1500)\sqrt{[\%SD\ (I_a+I_b+I_c)]^2 + [\%SD\ (I_d+I_e+I_f)]^2}$$

DATA ANALYSIS

As is evident from Figure 2, the <u>in situ</u> measurement locations were selected on rectangular grids, with the grid spacing smaller in the areas shown by the aerial survey to have higher levels of radioactivity. The extent of the area sampled was determined both by the aerial survey results and by inaccessible terrain to the north and east.

The original plan was to analyze the resulting data by kriging, a geostatistical method of spatial analysis that takes into account the relative locations of the data points (Journel and Huijbregts, 1978). At that time it was assumed that kriging could compensate for the obvious bias inherent in sampling more intensively in regions known to have high activity. However, investigations with earlier RIDP data (McArthur and Kordas, 1983 and 1985) and an independent simulation experiment (McArthur, in preparation) have shown this not to be the case, at least as far as the estimation of radionuclide inventories is concerned, and a simpler but more robust method of estimation will be used here.

The first step was to define the region within which inventories would be estimated. This region includes parts of Areas 1 through 4 and 7 through 10. The data from Areas 12 and 15 will be included in a future report, and the southern part of Yucca Flat will be treated separately in this report. Eight isolated measurements on the eastern edge of Yucca Flat in Areas 3 and 7 are reported in Section 4 but are excluded from the inventory estimation.

Next, the region was partitioned into smaller regions of approximately constant sampling density, as shown in Figure 3. This resulted in 21 separate regions with grid spacings ranging from 400 feet to 3,200 feet. Radionuclide inventories in each region were then estimated by multiplying the average activity in the region by the area of the region.

The simulation study referred to above suggests that this procedure gives unbiased and reasonably precise estimates of radionuclide inventories. However, because the data were collected on a regular grid, it is not possible to compute a statistically valid estimate of the error. A discussion of the sampling error of these inventory estimates is planned for Report #4.

The question of uncertainty is further clouded by the varying quality of the data. A particular radionuclide may be reported at some points but not at others, or it may be reported as an upper limit value. In analyzing the _in situ_ data, the upper limit values are treated in the same manner as the other data. Points where a radionuclide was not reported at all were not used in computing the average activity of that radionuclide.

Radionuclide distributions were estimated by first using kriging to interpolate the activities on an 800-foot grid of points covering the region under consideration. The covariance structure of the data was estimated using the automatic structure identification option of the kriging program, BLUEPACK (Delfiner _et_ _al_., 1976). The interpolated values were inspected and adjusted, if necessary, to ensure that they were consistent with the original data. Isopleths of activity were then drawn from the array of interpolated values by the NCAR subroutine CONREC (Wright, 1977). Because of the limitations of the contouring program, the isopleths could only be drawn over rectangular regions. The five regions used, shown by dashed lines in Figure 3, therefore do not include exactly the same area as the inventory estimates.

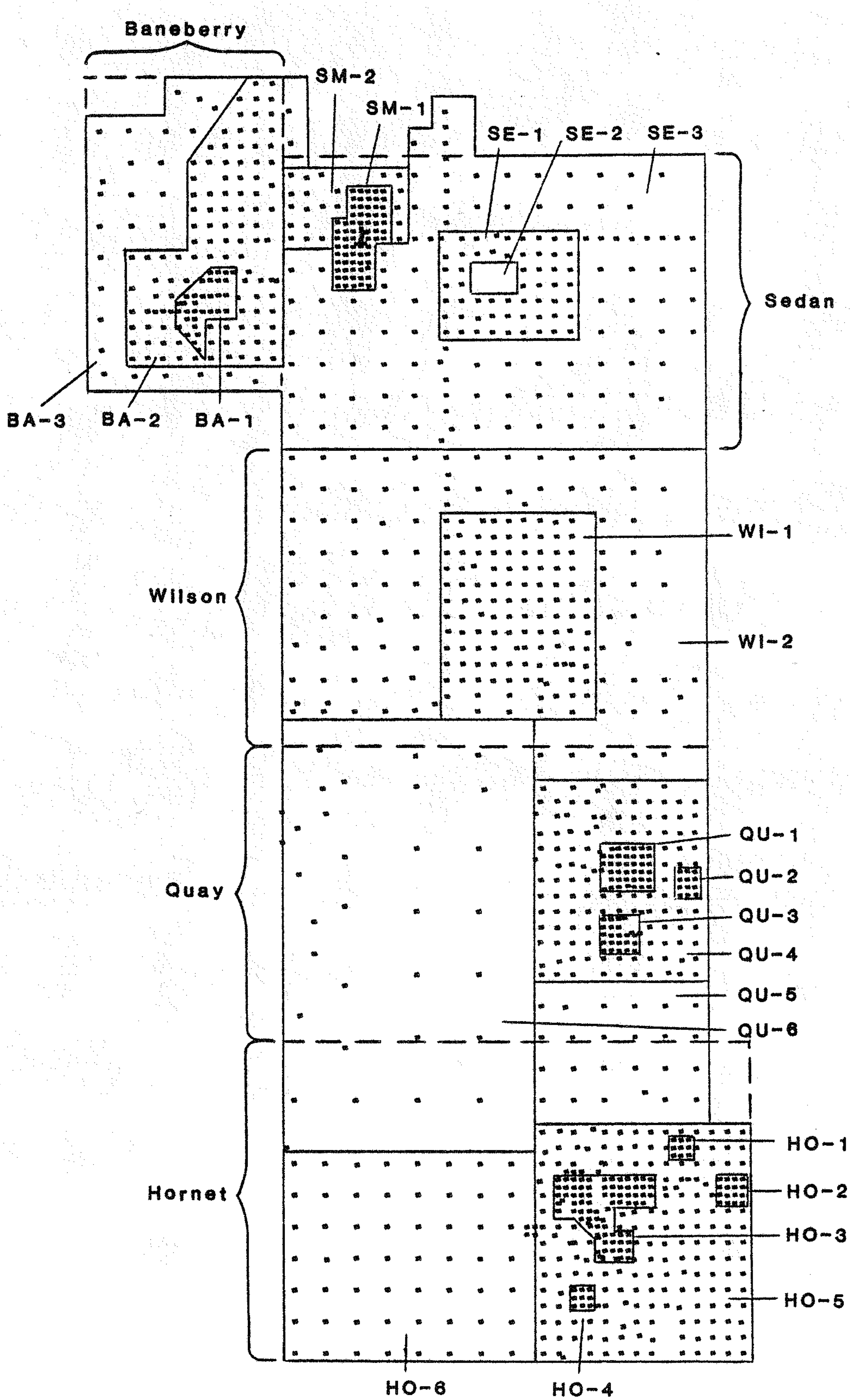


Figure 3. Regions used for inventory estimates (solid lines) and distribution estimates (dashed lines).

SECTION 3
AREAS 8 AND 10

Three of the more unusual GZ areas in Yucca Flat are in the northernmost part: Baneberry, an underground test that vented into the atmosphere in December 1970; Oberon and Ceres, two safety shots south of the Smoky GZ; and Sedan, a Plowshare project that ejected a large amount of soil and produced a large crater. Several radionuclides (^{134}Cs, ^{174}Lu, ^{101}Rh, ^{102m}Rh, and ^{125}Sb) were found here that were not found elsewhere in Yucca Flat, and the ^{241}Am levels near the safety shots are the highest yet measured by the RIDP.

Most of the measurements in the Baneberry area were made between May and July 1982. A few additional points in the region between Baneberry and Smoky were measured in June 1983. Measurements in the Sedan area were made between August and October 1982, and 25 additional points near the Oberon and Ceres sites were measured in December 1985.

SOIL SAMPLES

The locations at which soil samples were collected are shown in Figures 4, 5, and 6. Table 2 gives the inverse relaxation lengths calculated from the data in Appendix B, while Table 3 gives the inverse relaxation length values used by GAMANAL to analyze the *in situ* spectra. Note that different sets of inverse relaxation lengths were used for points near the Smoky and Sedan GZs and for points farther away. The averaged results of the radiochemical analyses and gamma-spectrometric assays of selected top-increment samples are given in Table 4. The accompanying ratios are used to estimate the inventories of plutonium and strontium.

The areas referred to in Tables 2, 3, and 4 are the original areas defined for collecting and analyzing the spectra. We do not identify these original sampling areas in this report because doing so would serve no useful purpose for most readers. Anyone wishing to examine the data in detail will need to use the RIDP database, and there the original area is identified by a site code such as BA for Baneberry or OB for Oberon/Ceres.

The Smoky area, however, is not distinguished from the Sedan area in the database (both have site code SE), so some explanation is necessary. The Smoky area is defined as the region shown in Figure 5; any points with site code SE that are not in this region are considered Sedan points. The _in situ_ measurements made in the Smoky area in the fall of 1982 were analyzed using the Smoky α values in Table 3. Five additional measurements made there in June 1983, shown by an "x" in Figure 5, were considered part of Baneberry and were analyzed using the Baneberry α values. The Oberon/Ceres measurement points are interspersed among the Smoky points in the region labeled "SM-1," and these were analyzed using the Oberon/Ceres α values. For reasons of clarity, Figure 5 does not distinguish the Smoky points from the Oberon/Ceres points.

IN SITU MEASUREMENTS

Figures 7 through 17 show the above-background _in situ_ measurements of 11 radionuclides. Five of the figures (7, 8, 10, 13, and 16) cover the entire region in which spectra were recorded; the others leave out large areas in which either no results were reported (as was the case for ^{174}Lu and ^{101}Rh in the Baneberry spectra) or the only reported results were upper limit values. (An exception is ^{152}Eu, which was measured at less than 100 nCi/m^2 at two isolated points near point 109 in the Baneberry area.) Points at which a spectrum was recorded but no result was reported for a particular radionuclide are not shown on the plot for that radionculide. For example, ^{102m}Rh was reported from only 9 of the 200 Baneberry spectra, and the other Baneberry points are therefore not shown in Figure 16. Upper limit values are plotted as "0" (not detected) in all figures, even though the numerical value may exceed 400 nCi/m^2.

^{239}Pu was found at measurable levels in seven of the Oberon spectra. These measurements were not used to estimate an inventory, but they are of some interest because ^{239}Pu is seldom present at levels high enough to be detected by the in situ system:

Point:	nCi/m^2
91......	1,897,000
93........	253,700
96......	4,709,000
97........	375,500
98......	1,498,000
99........	210,400
100.......	283,600

SUPPLEMENTARY MEASUREMENTS

The in situ measurement vehicles could only get within about 250 feet of the Sedan crater lip. Consequently, in situ measurements could not be obtained at several points on the 800-foot grid used near the crater. However, the area near the edge of the crater is of particular interest in terms of soil activities, as it involves the thickest layer of ejected soil and, in general, the highest activities. The regular in situ measurements were therefore supplemented in March 1985 with readings from four hand-held exposure-rate meters. All four meters used sodium iodide detectors; the two Bicron meters (Bicron, 12345 Kinsman Road, Newbury, Ohio 44065) provided by LLNL were calibrated with ^{137}Cs, while the two Ludlum Model 19 micro-R meters (Measurements, Inc., P.O. Box 810-5010, Sweetwater, Texas 79556) provided by REECo were calibrated with ^{60}Co.

The procedure began with measurements at a grid point at which an in situ measurement had previously been made. Using a compass and a tape measure to determine their location, the survey team then proceeded to make additional readings at 100-foot intervals in the direction of other grid points. In this way, they obtained measurements at or near six previously measured grid points in region SE-1 and at four previously unmeasured grid points in region SE-2 (shown with an "x" in Figure 6), in addition to the measurements at 100-foot intervals. They also made informal surveys of the radiation level changes as they moved radially toward the crater lip and as they walked part way around the crater near the lip. These informal surveys indicated that the radiation levels did not change greatly as a function of changes in distance on the order of 100 feet.

To obtain quantitative measures of the radiation levels at the four grid points nearest the crater, the averaged $\mu R/h$ readings were compared with the previous in situ measurement results for six grid points. The average ratios of the measured nCi/m^2 to the $\mu R/h$ readings were then used to infer activity levels for nine radionuclides at the four previously unmeasured grid points. The results are plotted along with the regular in situ measurement data in Figures 7, 8, and 10 through 16.

DATA ANALYSIS

As described above, the inventory estimates were calculated from the average activity in regions of constant sampling density. To eliminate a source of bias, points that were not part of the basic sampling grid in each region were not used in computing the average activity. Region SE-3, for example, has two transects of points 800 feet apart that were included in the hope of getting a better variogram estimate for kriging; the points on these transects that are not on the 1,600-foot grid were excluded. Also excluded were six measurements near the Oberon and Ceres GZs that were made after the original sampling revealed very high activity there.

Table 5 gives the estimated inventories of 14 radionuclides. The plutonium and strontium inventories in region SM-1 were computed from the average of the ratios at the nine Smoky, Oberon, and Ceres points in Table 4. The area given for region SE-2 is the area of the rectangle shown in Figure 3 minus the area of the Sedan crater, which was assumed to be a circle 1,400 feet in diameter. The estimated inventories thus do not include whatever radioactivity is present in the Sedan crater.

Table 5 also gives the number of points in each estimation region where each radionuclide was reported and the number of points at which it was found above the detectable minimum. Thus ^{134}Cs was reported at all 91 points in region SE-3, but only at upper limit values, while ^{174}Lu was not reported at all from region BA-1. Estimates that are based largely on upper limit values are naturally likely to be over-estimates of the true inventory.

Distribution maps for five radionuclides found at measurable levels in the Baneberry area are shown in Figures 18 through 22, while Figures 23 through 31 show the estimated distributions of nine radionuclides in the Sedan area.

TABLE 2. CALCULATED INVERSE RELAXATION LENGTHS FROM AREAS 8 AND 10

	Inverse relaxation length and standard deviation (cm^{-1})									
Point	^{60}Co		^{137}Cs		^{152}Eu		^{155}Eu		^{241}Am	
Baneberry[a]										
101	1.2	--	0.6	--	----[b]		----		----	
102	0.73	--	0.548	--	----		----		----	
103	0.316	--	0.304	--	----		----		----	
104	1.2	--	0.6	--	----		----		----	
105	0.6	--	0.557	--	----		----		----	
106	0.6	--	0.584	--	----		----		----	
107	0.596	--	0.573	--	----		----		----	
108	0.283	--	0.234	--	----		----		----	
109	0.91	--	0.777	--	----		----		----	
110	0.6	--	0.447	--	----		----		----	
111	0.6	--	0.608	--	----		----		----	
112	1.2	--	0.6	--	----		----		----	
113	0.767	--	0.672	--	----		----		----	
114	0.6	--	0.6	--	----		----		----	
115	0.6	--	0.796	--	----		----		----	
Smoky										
64	0.050	--[c]	0.262	0.016	0.050	--	0.161	0.454	----	
65	0.224	0.005	0.601	0.013	0.050	--	0.474	0.358	0.501	0.263
66	0.050	--	0.765	0.272	0.050	--	0.050	--	0.812	0.161
67	0.050	--	0.050	--	0.050	--	0.050	--	0.050	--
68	0.103	0.003	1.092	0.331	0.050	--	0.972	0.163	0.404	0.223
69	0.050	--	0.683	0.050	0.050	--	0.142	0.346	0.425	0.364
70	0.050	--	0.071	0.005	0.050	--	0.050	--	0.073	0.054
71	0.416	0.004	0.754	0.012	0.129	0.003	0.824	0.338	0.946	0.365
72	0.251	0.007	0.231	0.005	0.079	0.008	0.149	0.064	----	
73	0.645	0.014	0.642	0.005	0.218	0.006	0.461	0.060	0.744	0.365
Oberon										
91	0.230	0.017	0.561	0.023	0.050	--	----		0.863	0.035
92	0.294	0.006	0.591	0.005	0.050	--	0.582	0.351	0.727	0.008
93	0.266	0.010	0.366	0.004	0.050	--	0.212	0.055	0.374	0.007
94	0.331	0.013	0.569	0.016	0.050	--	1.098	0.145	0.553	0.030
95	0.401	0.031	0.583	0.011	0.050	--	0.160	0.074	0.572	0.353
Ceres										
96	0.255	0.021	0.516	0.017	----		----		----	
97	0.402	0.230	0.647	0.032	0.111	0.012	0.163	0.085	0.839	0.044
98	0.326	0.209	0.745	0.332	0.056	0.019	0.488	0.355	1.199	0.056
99	0.551	0.055	0.798	0.077	0.086	0.012	1.125	0.138	0.772	0.042
100	0.679	0.027	0.735	0.011	0.131	0.016	0.390	0.105	0.755	0.061
Sedan										
24	0.853	0.122	0.633	0.007	0.588	0.338	0.574	0.041	0.966	0.447
25	1.182	0.134	0.614	0.016	----		0.660	0.183	0.883	0.218
26	0.295	0.007	0.111	0.003	0.050	--	0.205	0.031	0.178	0.347
27	0.223	0.021	0.199	0.008	0.240	0.192	----		----	
28	1.133	0.145	0.050	--	----		----		----	
29	0.698	0.332	0.473	0.044	0.631	0.226	0.050	--	----	
30	1.331	0.133	0.992	0.330	0.105	0.500	0.054	0.079	0.401	0.346
31	0.086	0.002	0.092	0.001	0.064	0.011	0.073	0.008	0.078	0.011
32	0.122	0.001	0.032	0.001	0.123	0.014	0.090	0.013	0.216	0.016
33	0.042	0.001	0.028	0.001	0.029	0.016	0.040	0.012	0.055	0.020
34	0.057	0.001	0.030	0.001	0.065	0.011	0.055	0.006	0.058	0.016
35	0.055	0.001	0.027	0.001	0.077	0.007	0.057	0.004	0.059	0.016
36	0.057	0.001	0.030	0.001	-0.013	0.003	0.046	0.005	0.059	0.014
37	0.121	0.001	0.070	0.001	0.099	0.010	0.109	0.009	0.101	0.015
38	0.385	0.010	0.402	0.012	0.123	0.009	0.184	0.014	0.308	0.015

[a]Standard deviations were not reported for values computed from the Baneberry data.

[b]Value could not be obtained because of insufficient data.

[c]Values of 0.050 with no standard deviation are estimates necessitated by insufficient sampling depth.

TABLE 3. INVERSE RELAXATION LENGTHS USED BY GAMANAL FOR AREAS 8 AND 10

Area	Inverse relaxation length (cm^{-1})					
	^{241}Am	^{60}Co	^{137}Cs	^{152}Eu	^{154}Eu	^{155}Eu
Baneberry	0.6	0.6	0.6	0.3	0.3	0.6
Smoky GZ area	0.6	0.1	0.4	0.05	0.05	0.6
Other Smoky points	0.6	0.4	0.4	0.3	0.3	0.6
Oberon and Ceres	0.6	0.4	0.6	0.05	0.05	0.6
Region SE-1	0.05	0.05	0.05	0.05	0.05	0.05
Other Sedan points	0.4	0.4	0.4	0.3	0.3	0.4

TABLE 4. RADIONUCLIDE CONCENTRATIONS AND RATIOS IN SOIL SAMPLES FROM AREAS 8 AND 10

		Concentration (pCi/g)[a]					Ratio[b]		
Area	Point	^{241}Am	^{137}Cs	$^{239,240}Pu$	^{238}Pu	^{90}Sr	$^{239,240}Pu/^{241}Am$	$^{238}Pu/^{241}Am$	$^{90}Sr/^{137}Cs$
Baneberry	107	9.1	1500	33	4.8	300	3.6	0.53	0.20
	105	2.4	140	9.5	2.3	42	4.0	0.97	0.30
	109	3.2	440	13	1.8	110	3.9	0.57	0.26
	Mean:						3.9	0.69	0.25
Sedan	32	8.0	33	44	8.8	25	5.5	1.1	0.77
	34	17	71	100	19	58	5.8	1.1	0.82
	35	21	64	110	20	51	5.1	0.94	0.79
	36	36	87	190	35	77	5.4	0.99	0.89
	37	20	54	120	23	46	5.8	1.10	0.85
	Mean:						5.5	1.0	0.82
Smoky	65	61	72	480	15	100	7.8	0.24	1.4
	66	6.1	66	45	7.2	220	7.4	1.2	3.2
	69	14	110	93	11	350	6.8	0.83	3.1
	71	23	140	160	15	310	7.1	0.65	2.2
	Mean:						7.2	0.72	2.5
Oberon	91	130,000	45	940,000	18,000	65	7.0	0.14	1.5
	92	680	55	4,300	79	85	6.4	0.12	1.5
	Mean:						6.6	0.13	1.5
Ceres	96	230,000	56	1,400,000	28,000	88	6.0	0.12	1.6
	98	400	8.9	2,800	45	13	7.0	0.11	1.4
	100	420	57	3,000	57	120	7.0	0.14	2.0
	Mean:						6.7	0.12	1.7

[a]Most concentration values are an average of several measurements.

[b]Ratios were computed from concentration values with more significant figures than are shown here, and may differ slightly from the ratios of the tabulated concentrations.

TABLE 5. INVENTORY ESTIMATES FOR AREAS 8 AND 10

			Radionuclide Inventory (Ci)													
Region	n[a]	Area ($ft^2 \times 10^6$)	^{241}Am	^{238}Pu	^{239,240}Pu	^{60}Co	^{134}Cs	^{137}Cs	^{90}Sr	^{152}Eu	^{154}Eu	^{155}Eu	^{174}Lu	^{101}Rh	^{102m}Rh	^{125}Sb
BA-1	32	8.111	0.056 (8)[b]	0.039	.22	1.0 (22)	0.062 (9)	3.6 (32)	0.9	0.041 (1)	0.084 (0)	0.046 (0)	---- (0/0)[c]	---- (0/0)	0.13 (1/1)	0.17 (8)
BA-2	106	82.1865	0.60 (25)	0.41	2.3	5.7 (81)	0.35 (36)	16. (104)	0.4	0.42 (1)	0.85 (0)	0.42 (6)	0.35 (2/0)	0.14 (2/0)	0.29 (7/5)	0.94 (39)
BA-3	26	69.1575	0.36 (6)	.25	1.4	2.2 (22)	0.14 (3)	6.8 (26)	1.7	0.36 (0)	0.65 (0)	0.28 (1)	---- (0/0)	---- (0/0)	---- (0/0)	0.36 (0)
SM-1	71	11.54	14. (68)	5.5	97.	0.59 (68)	0.032 (0)	2.1 (71)	4.2	5.7 (45)	0.41 (22)	0.098 (36)	0.082 (13)	0.032 (51/3)	0.11 (61)	0.075 (0)
SM-2	21	19.025	0.41 (21)	.30	3.0	0.17 (18)	0.027 (0)	2.1 (21)	5.3	0.23 (7)	0.16 (0)	0.12 (13)	0.15 (15/15)	0.039 (15/2)	0.19 (18/16)	0.0096 (0)
SE-1	57	36.48	14. (56)	14.	77.	19. (57)	0.47 (0)	53. (57)	43.	1.6 (15)	2.2 (11)	4.3 (41)	18. (55/52)	2.7 (52)	22. (57)	1.8 (0)
SE-2	4	2.30	0.95	0.95	5.2	1.8	----	4.7	3.9	0.14	0.15	0.36	1.3	0.22	2.0	----
SE-3	91	265.42	5.3 (63)	5.3	29.	6.0 (71)	0.56 (0)	40. (91)	33.	1.9 (5)	2.9 (1)	2.1 (21)	4.9 (55)	0.98 (25)	6.2 (76)	2.0 (0)
Total	408	494.22	36.	27.	215.	36.	1.6	128.	92.	10.4	7.4	7.7	25.	4.1	31.	5.4

[a]Number of measurement points.

[b]Number of values above the detection limit.

[c]Number of points with values reported (if less than n)/number of values above the detection limit.

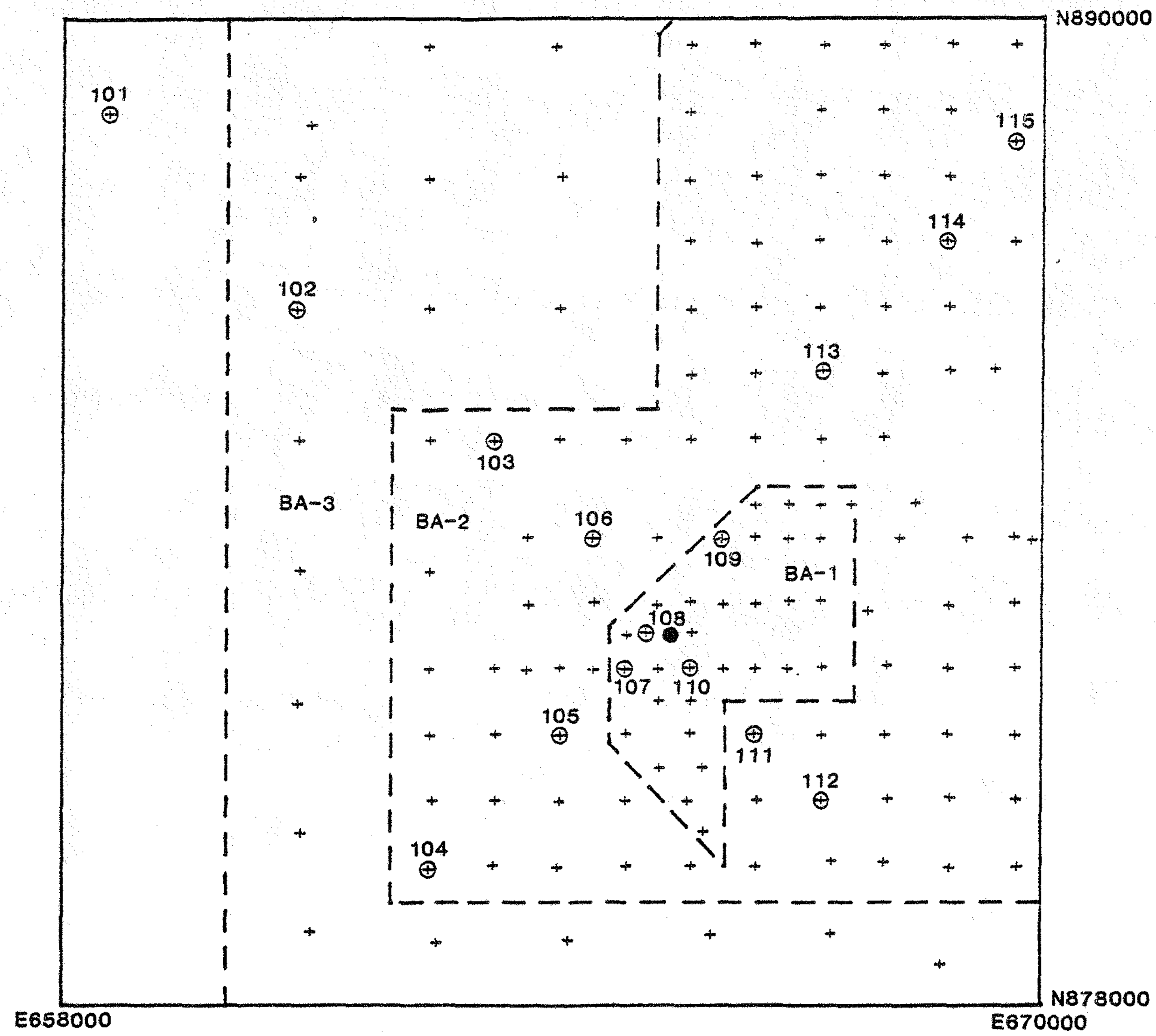


Figure 4. Locations of soil samples near the Baneberry ground zero.

+ = location of <u>in situ</u> measurement
○ = location of soil sample
● = ground zero

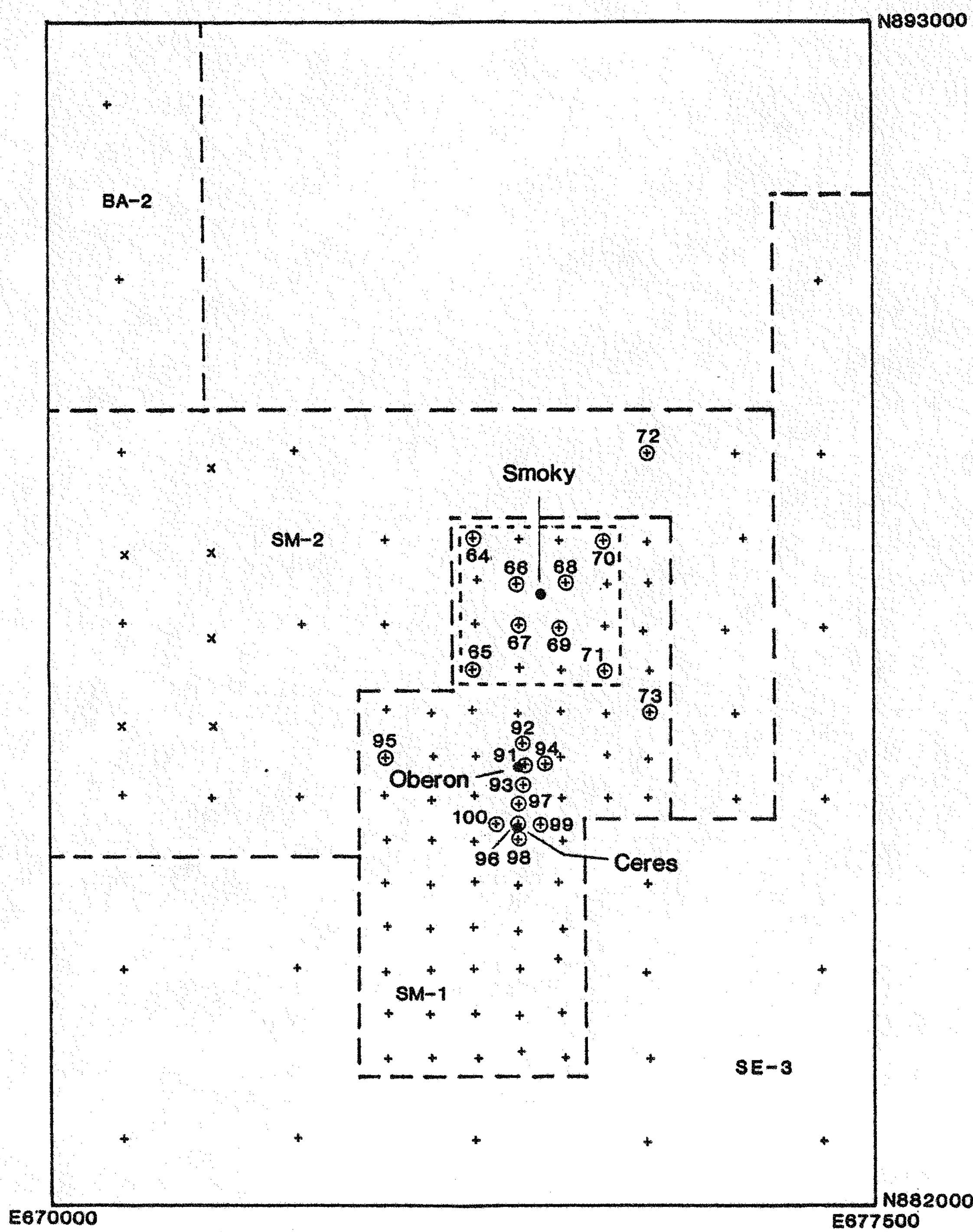


Figure 5. Locations of soil samples near the Smoky ground zero. The dotted line encloses the points considered "near" the Smoky GZ when choosing inverse relaxation lengths.

\+ = location of <u>in situ</u> measurement (Smoky or Oberon/Ceres)
x = location of <u>in situ</u> measurement (Baneberry)
O = location of soil sample
● = ground zero

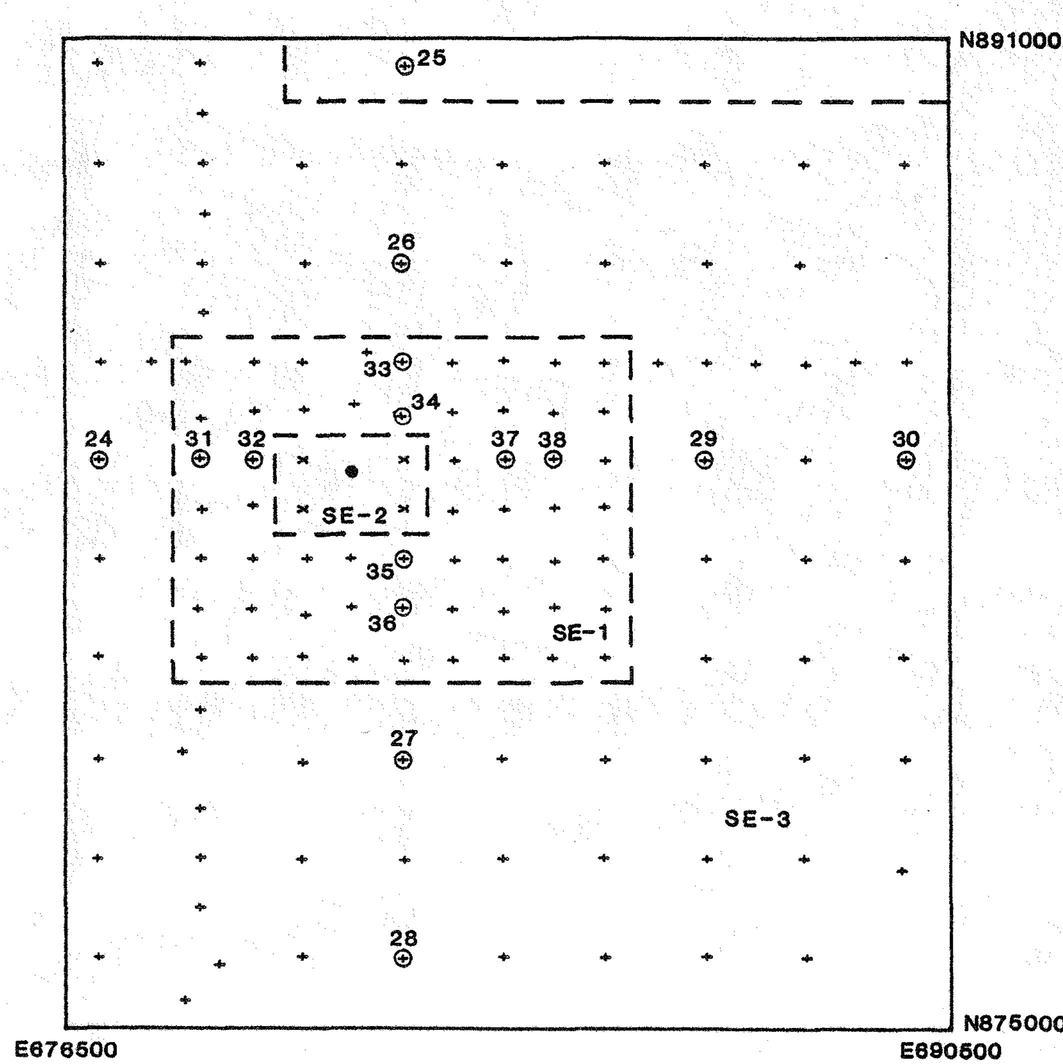


Figure 6. Locations of soil samples near the Sedan ground zero.

+ = location of <u>in situ</u> measurement
x = location of supplementary measurement
O = location of soil sample
● = ground zero

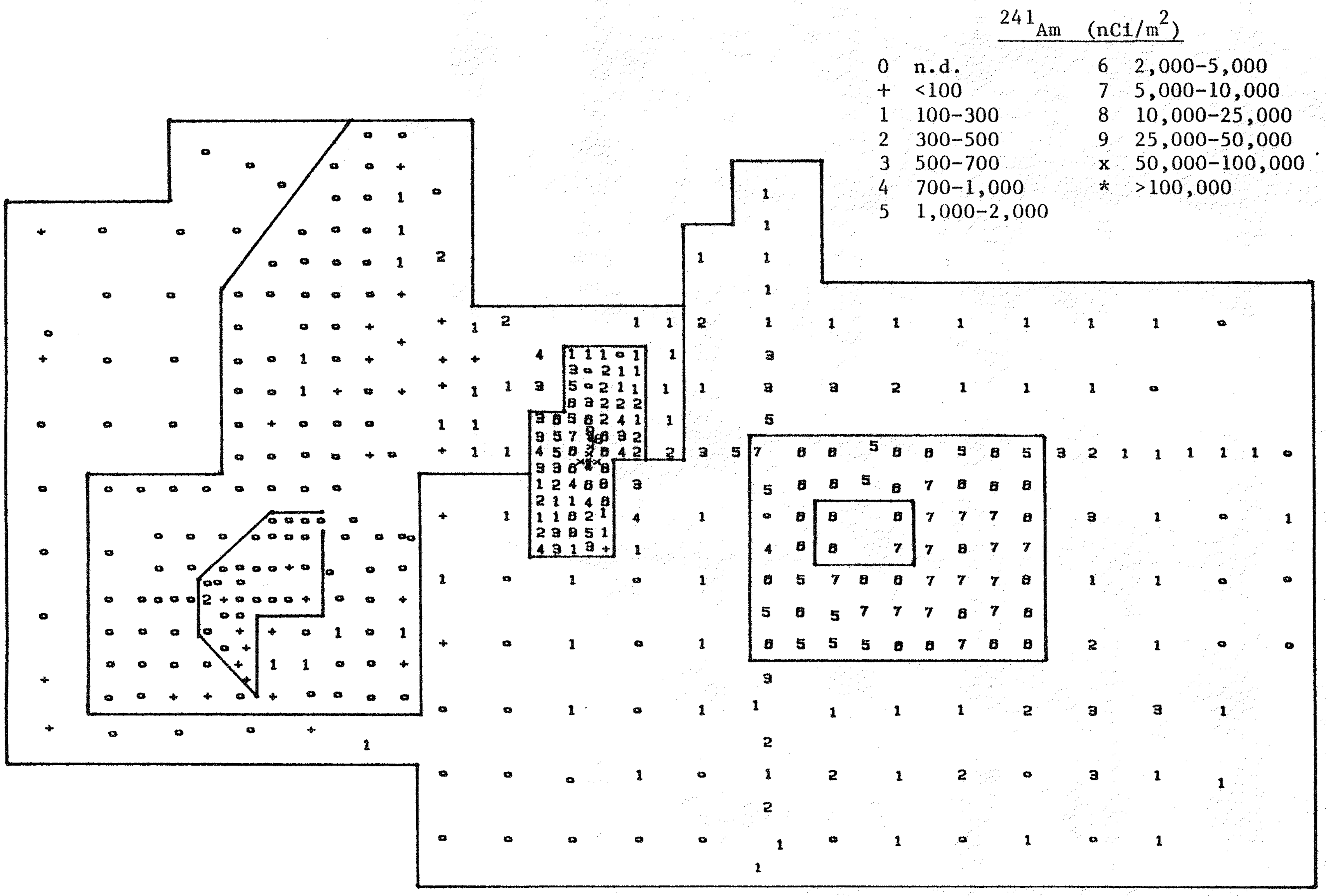


Figure 7. Measured ^{241}Am activities in Areas 8 and 10.

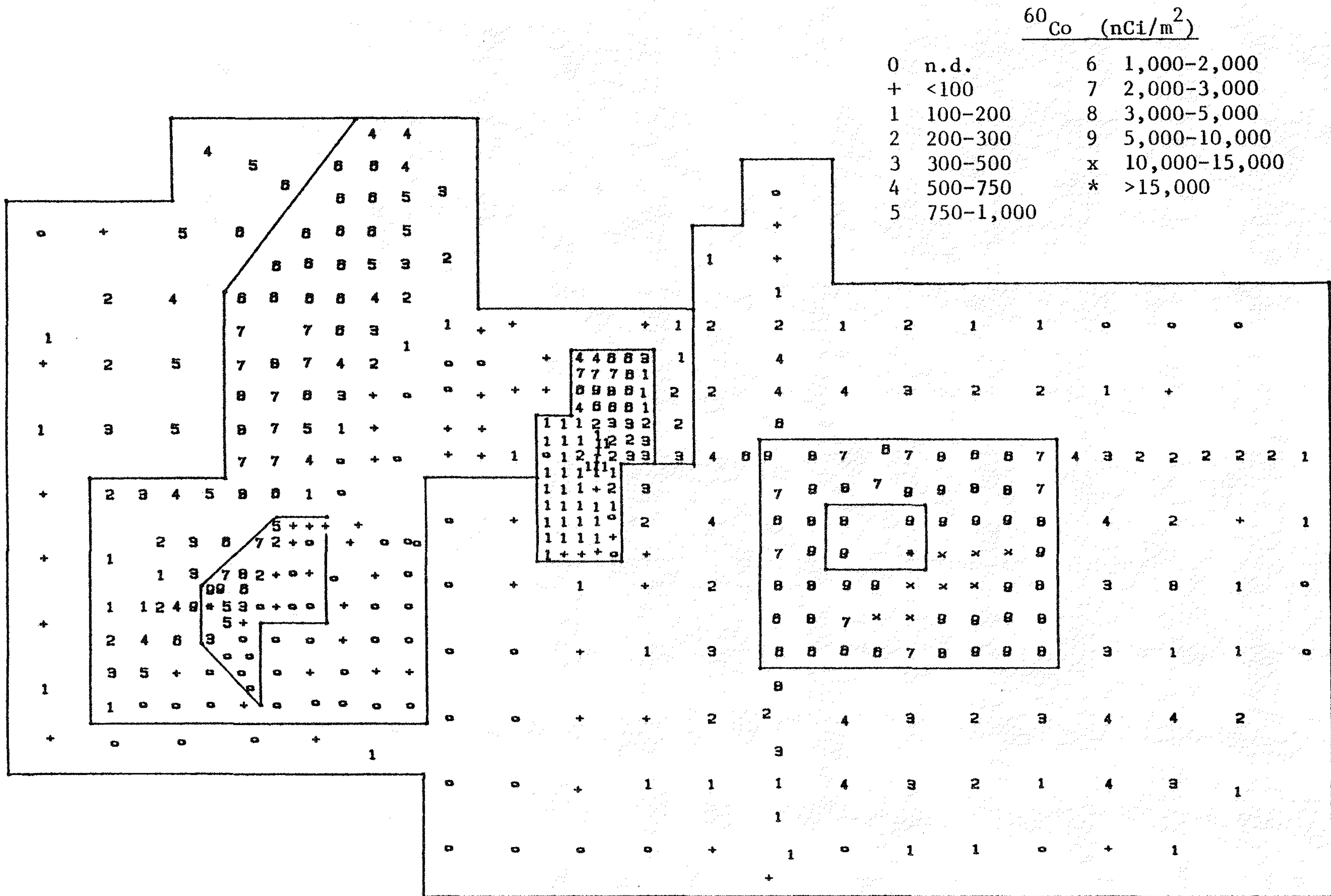
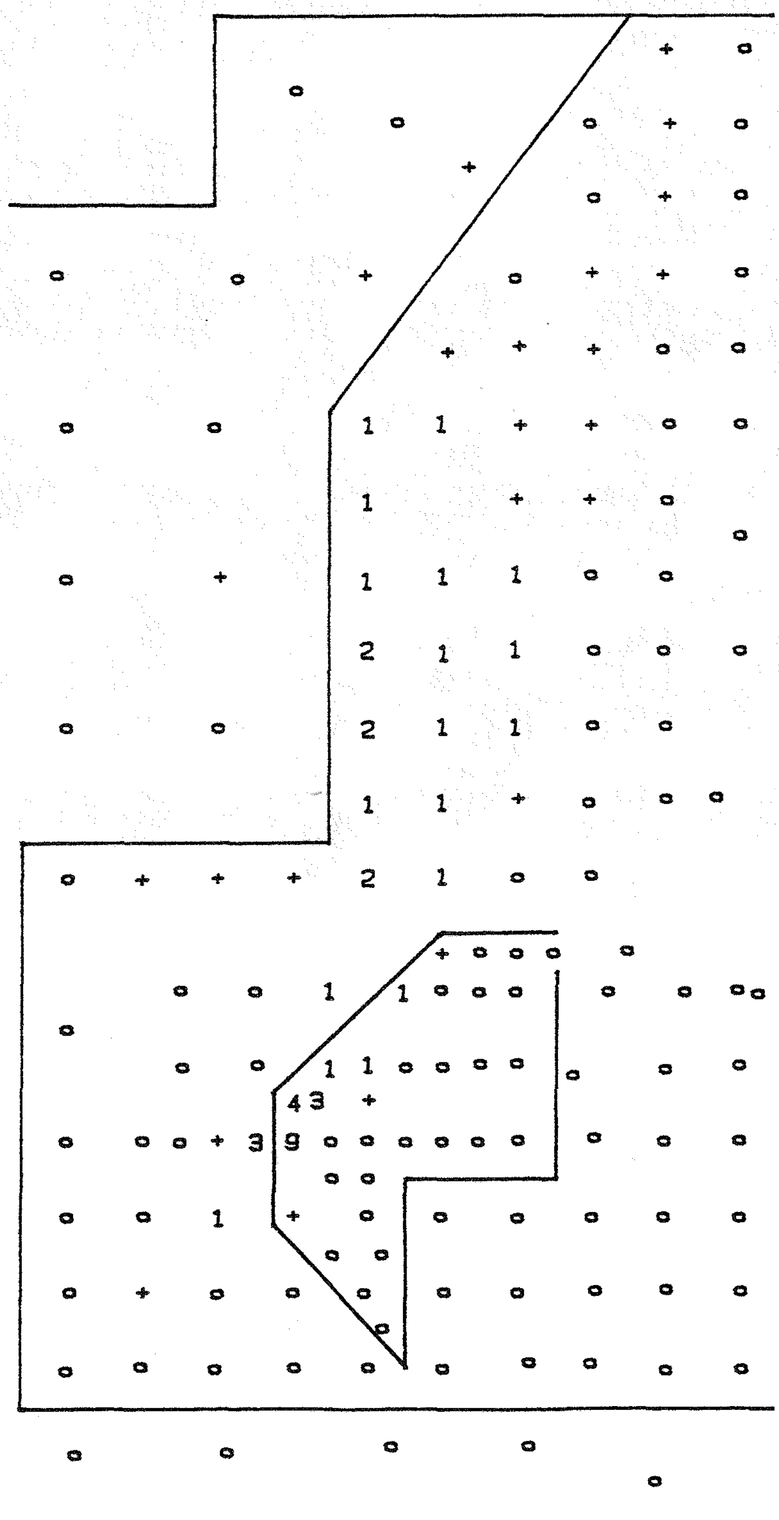


Figure 8. Measured ^{60}Co activities in Areas 8 and 10.



^{134}Cs	(nCi/m^2)
0	n.d.
+	<100
1	100-200
2	200-300
3	300-400
4	400-500
5	500-600
6	600-700
7	700-800
8	800-900
9	900-1,000

Figure 9. Measured ^{134}Cs activities in Area 8.

^{137}Cs (nCi/m^2)

0	n.d.	6	1,000-2,000
+	<100	7	2,000-5,000
1	100-200	8	5,000-10,000
2	200-300	9	10,000-20,000
3	300-500	x	20,000-30,000
4	500-750	*	>30,000
5	750-1,000		

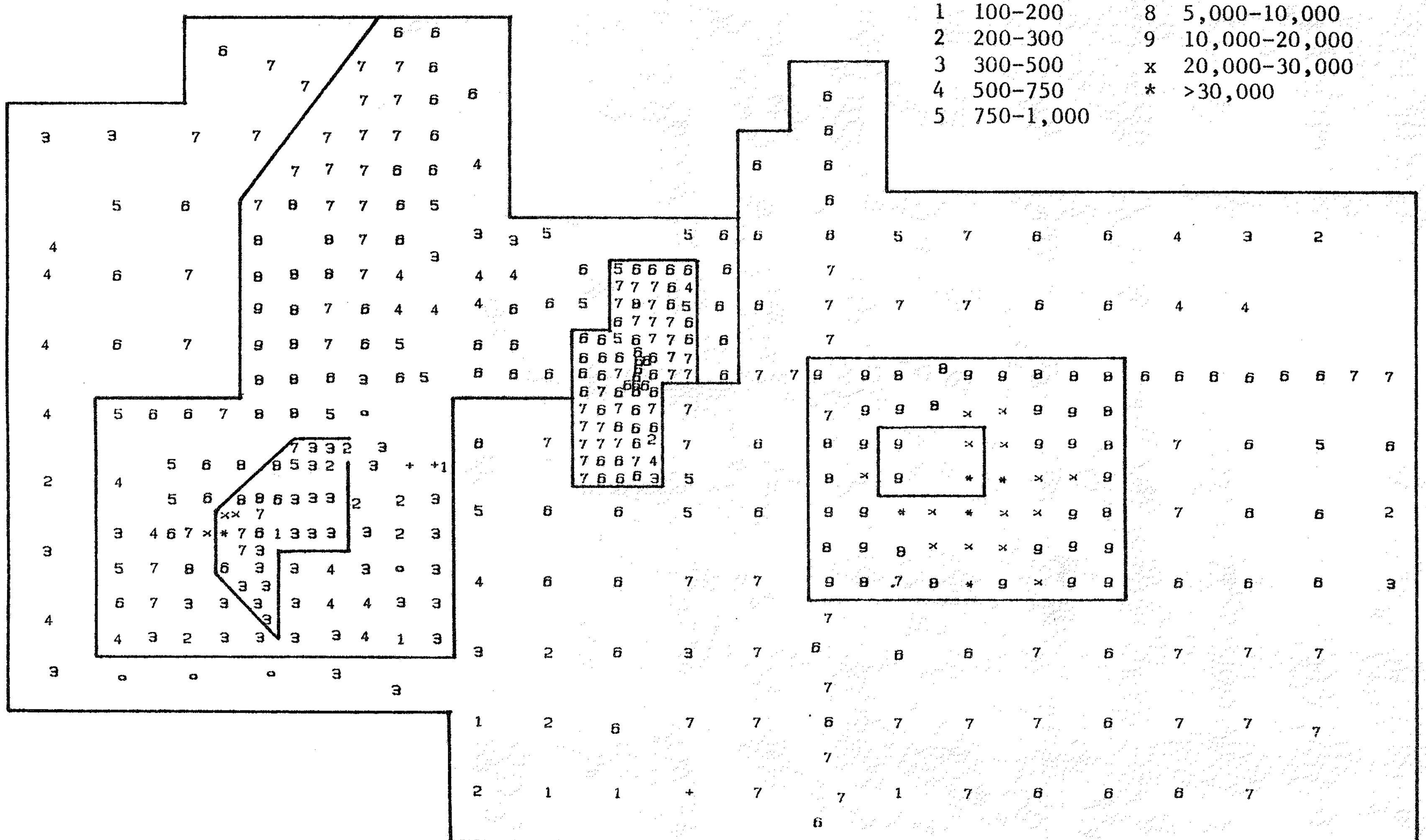
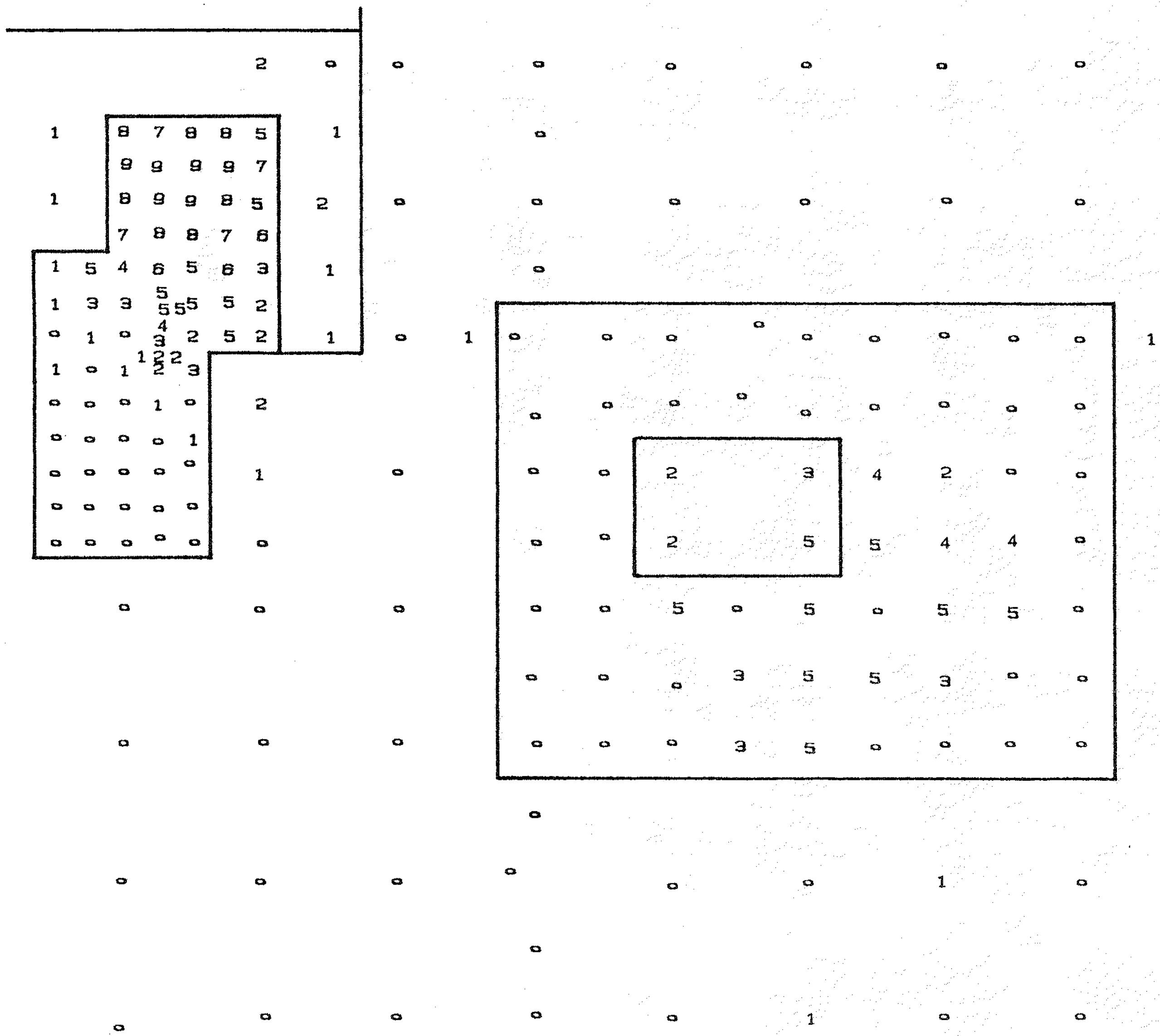


Figure 10. Measured ^{137}Cs activities in Areas 8 and 10.



^{152}Eu (nCi/m^2)

0	n.d.
+	<100
1	100-300
2	300-500
3	500-700
4	700-1,000
5	1,000-2,000
6	2,000-5,000
7	5,000-10,000
8	10,000-20,000
9	20,000-50,000
x	50,000-100,000
*	>100,000

Figure 11. Measured ^{152}Eu activities in Areas 8 and 10.

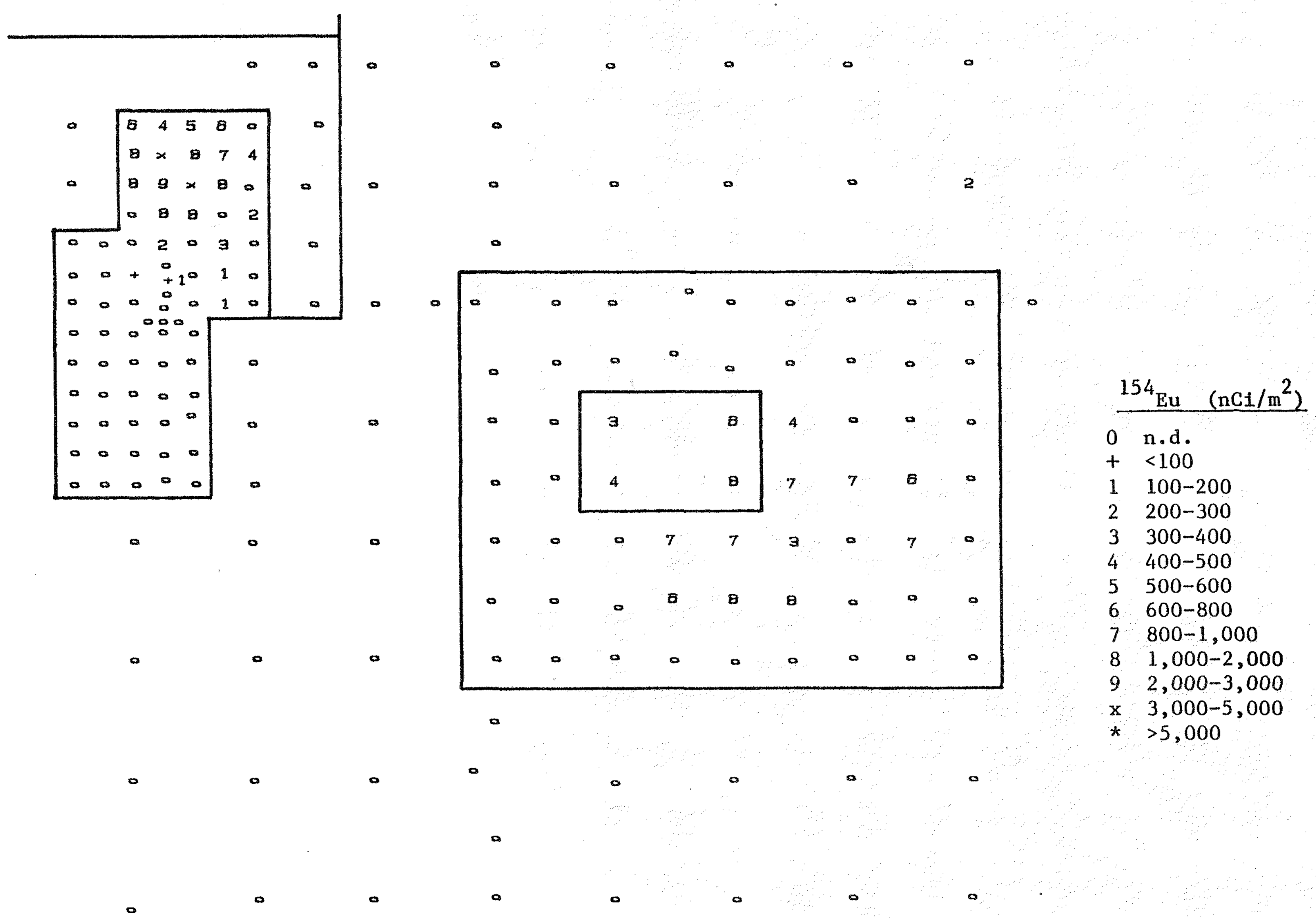


Figure 12. Measured ^{154}Eu activities in Areas 8 and 10.

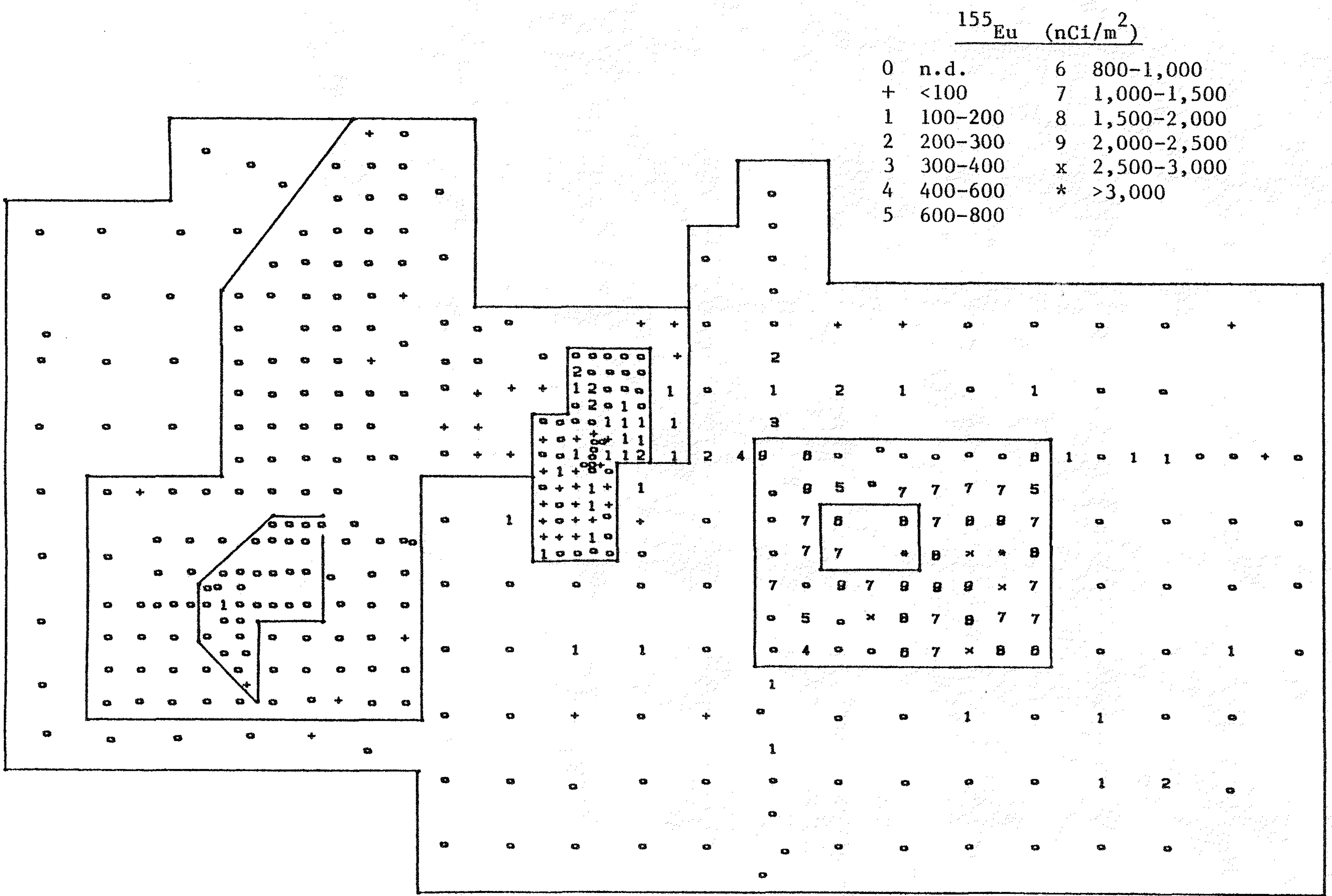
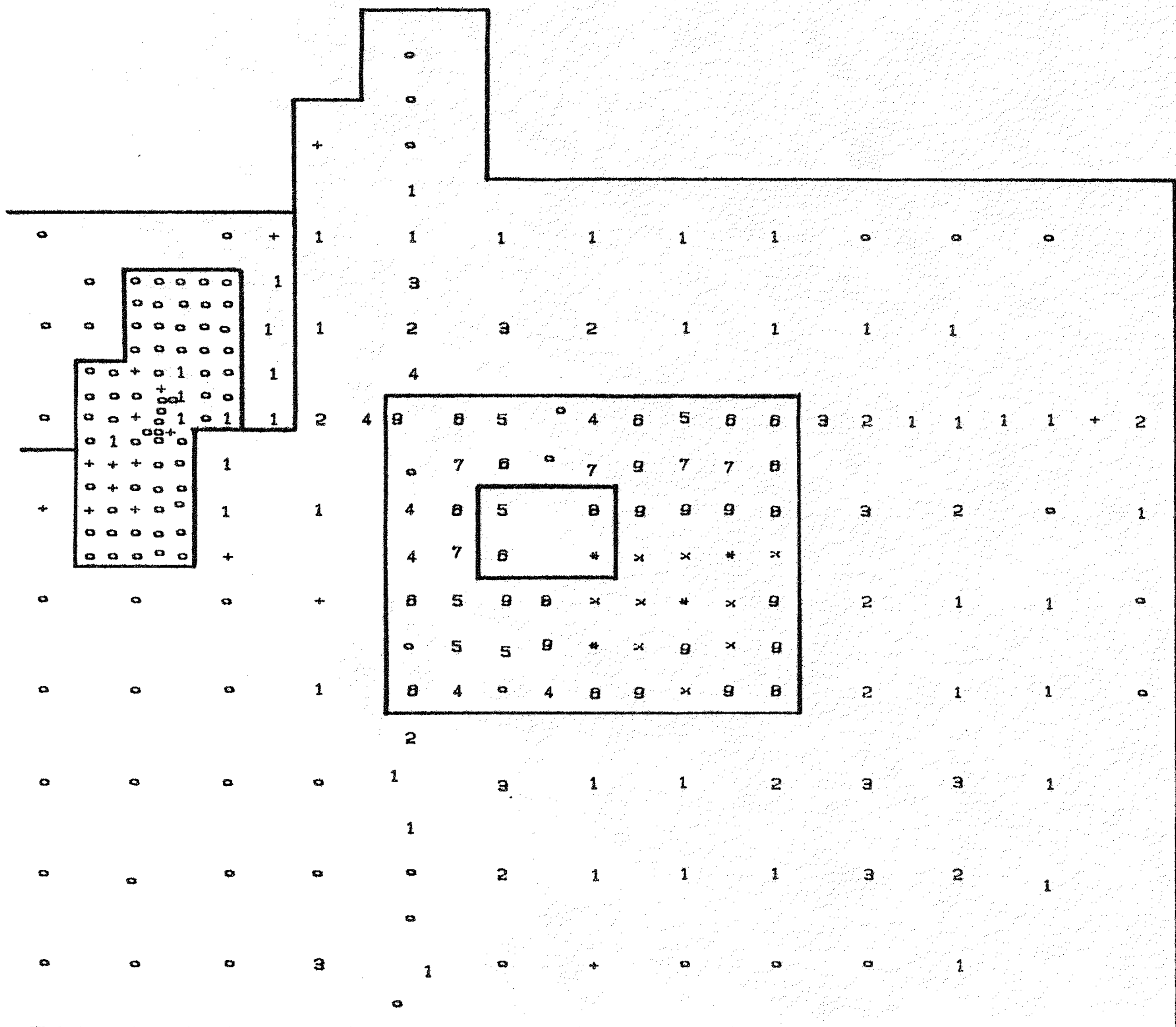
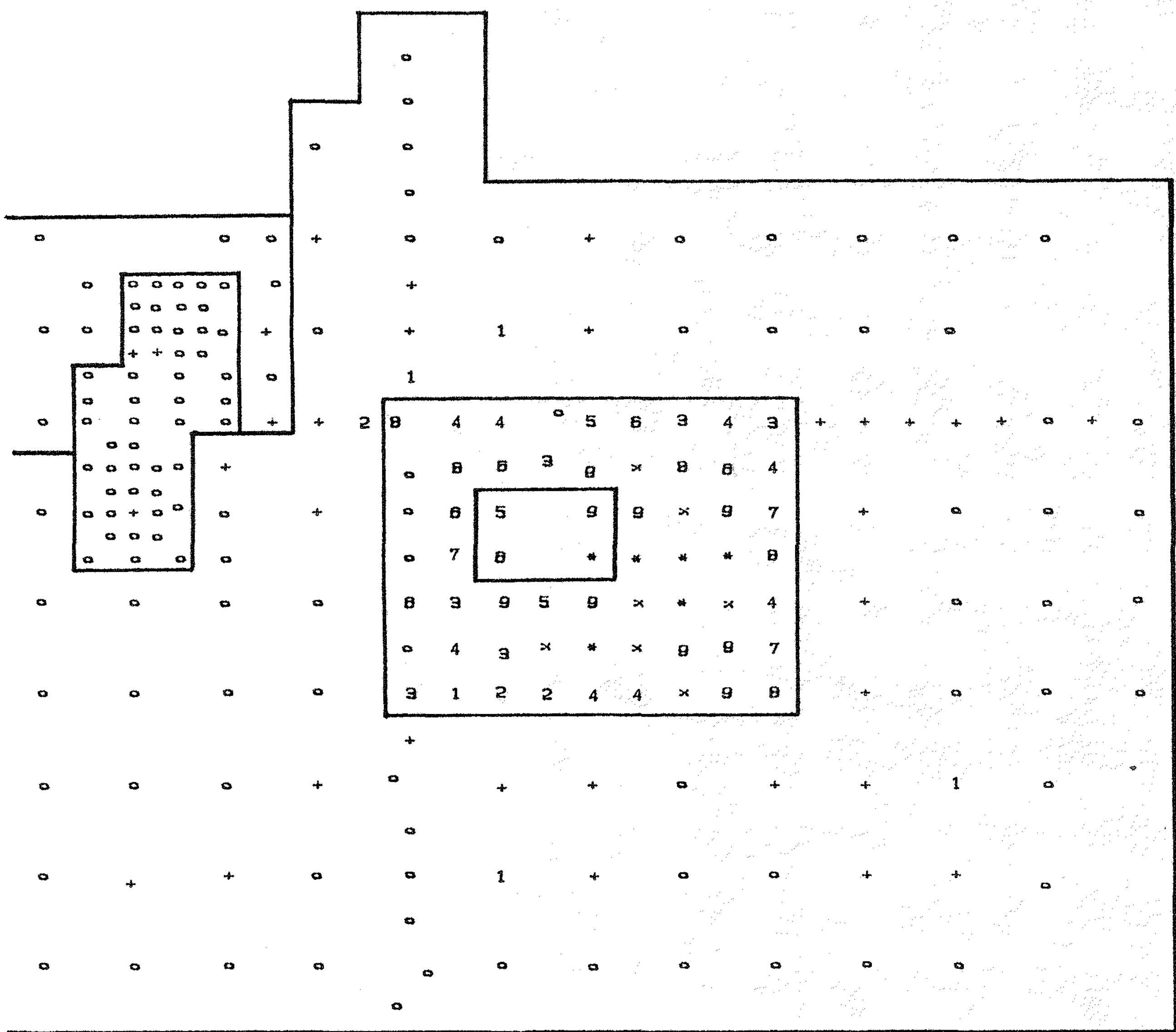


Figure 13. Measured ^{155}Eu activities in Areas 8 and 10.



^{174}Lu	(nCi/m^2)
0	n.d.
+	<100
1	100-300
2	300-500
3	500-1,000
4	1,000-2,000
5	2,000-3,000
6	3,000-4,000
7	4,000-5,000
8	5,000-6,000
9	6,000-8,000
x	8,000-10,000
*	>10,000

Figure 14. Measured ^{174}Lu activities in Areas 8 and 10.



^{101}Rh	(nCi/m^2)
0	n.d.
+	<100
1	100-200
2	200-300
3	300-400
4	400-500
5	500-600
6	600-700
7	700-800
8	800-1,000
9	1,000-1,200
x	1,200-1,500
*	>1,500

Figure 15. Measured ^{101}Rh activities in Areas 8 and 10.

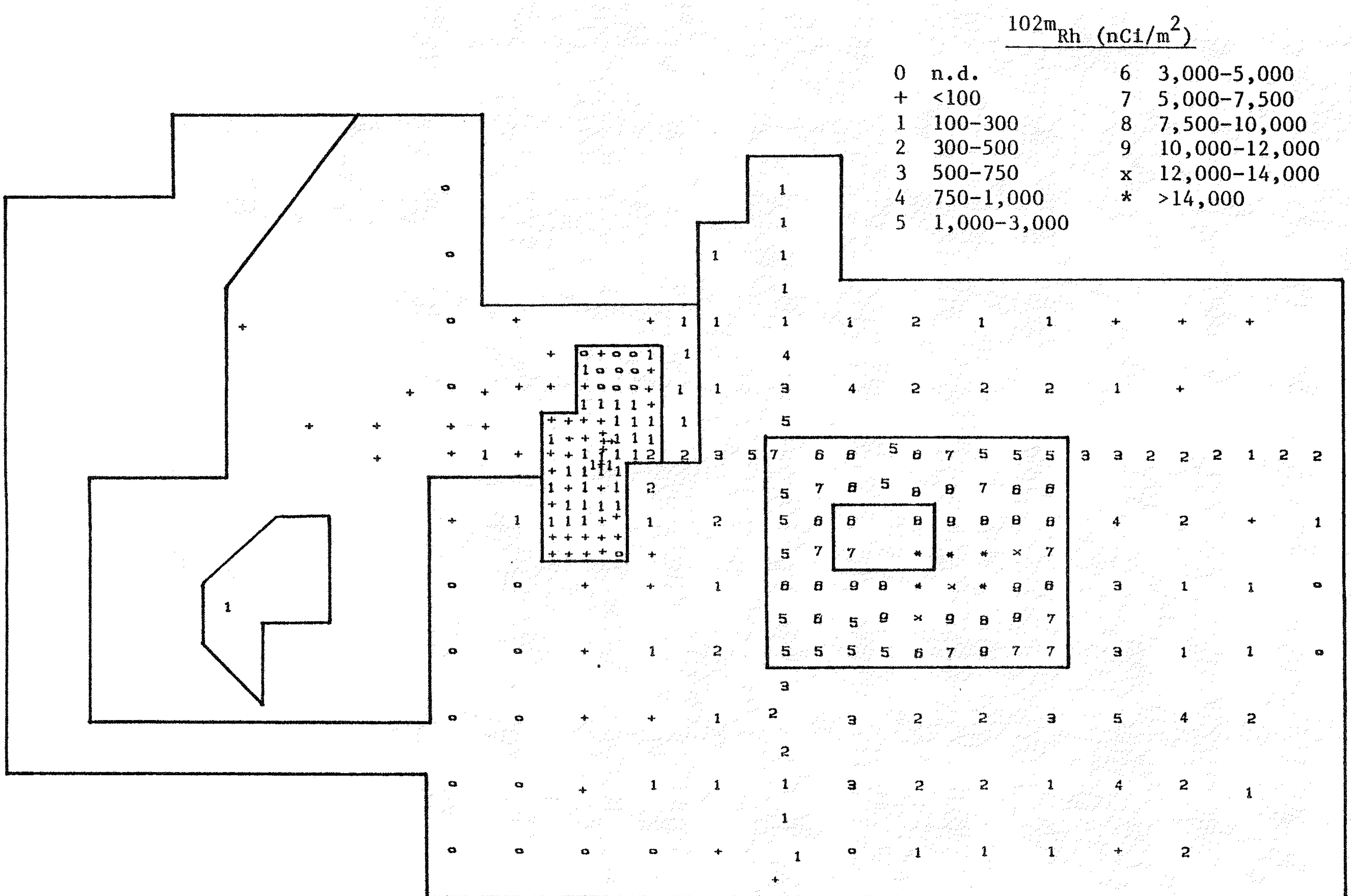
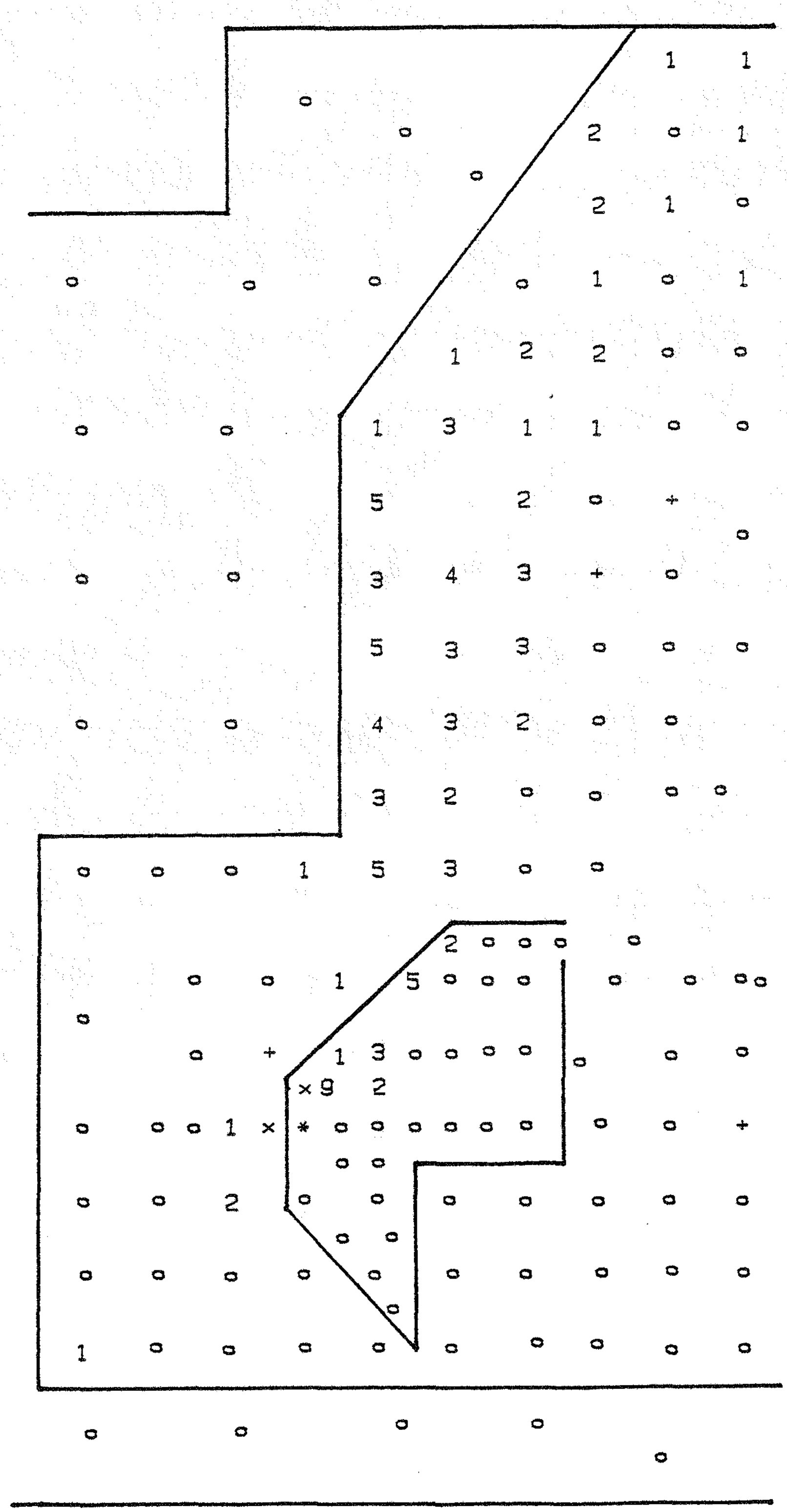


Figure 16. Measured ^{102m}Rh activities in Areas 8 and 10.



^{125}Sb (nCi/m^2)	
0	n.d.
+	<100
1	100-200
2	200-300
3	300-400
4	400-500
5	500-600
6	600-700
7	700-800
8	800-900
9	900-1,000
x	1,000-2,500
*	>2,500

Figure 17. Measured ^{125}Sb activities in Area 8.

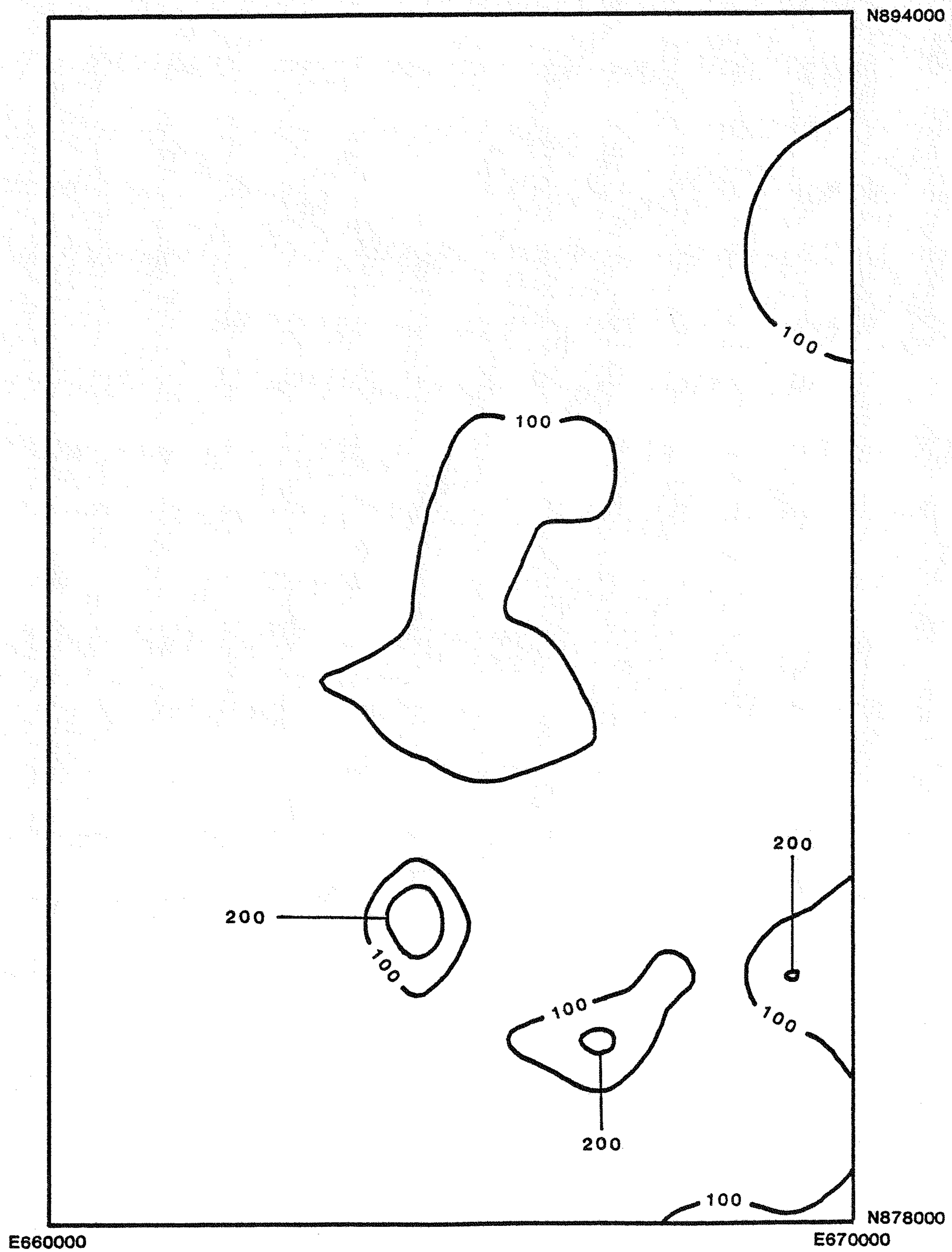


Figure 18. ^{241}Am distribution (nCi/m^2) in the Baneberry area.

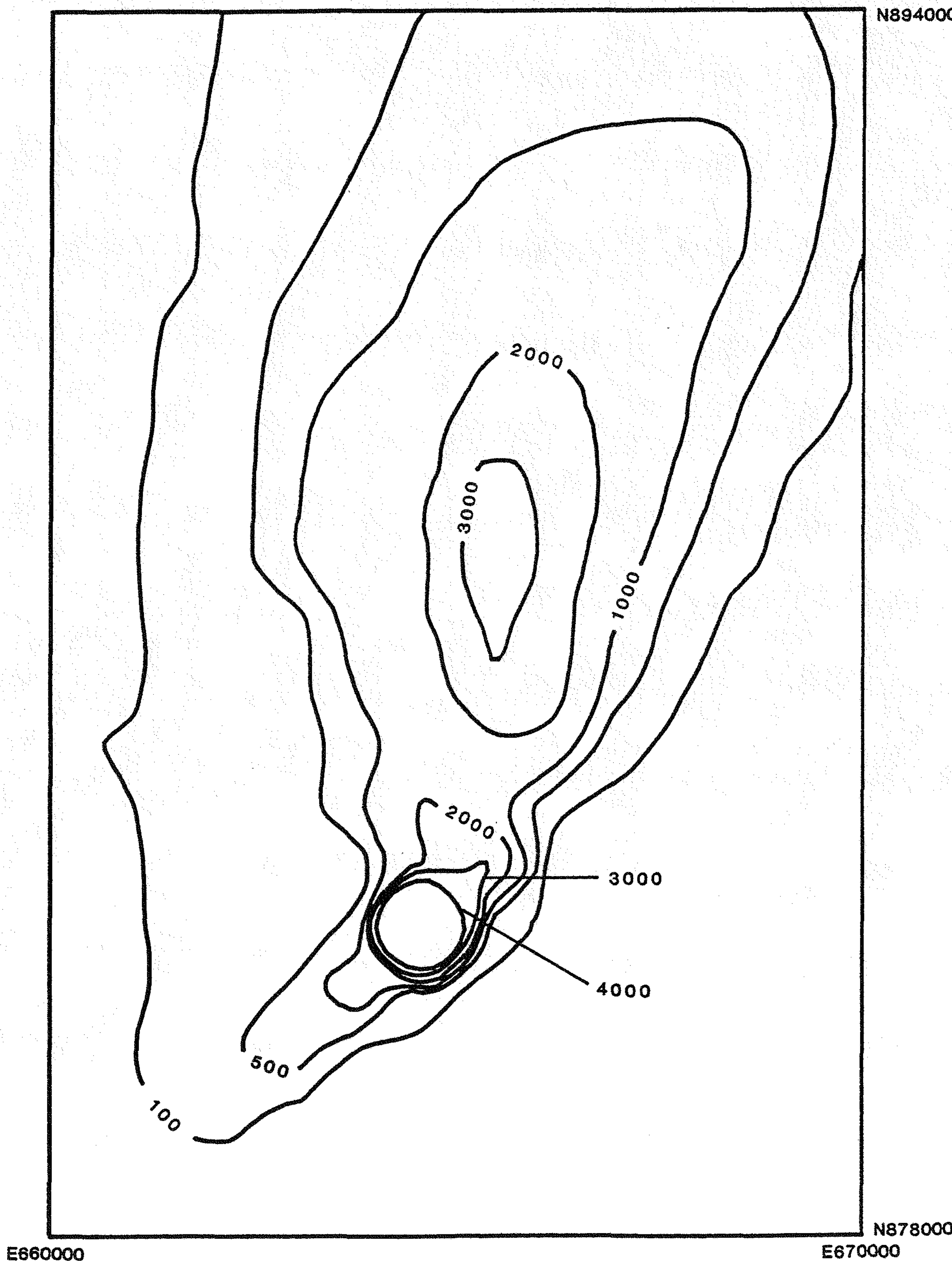


Figure 19. ^{60}Co distribution (nCi/m^2) in the Baneberry area.

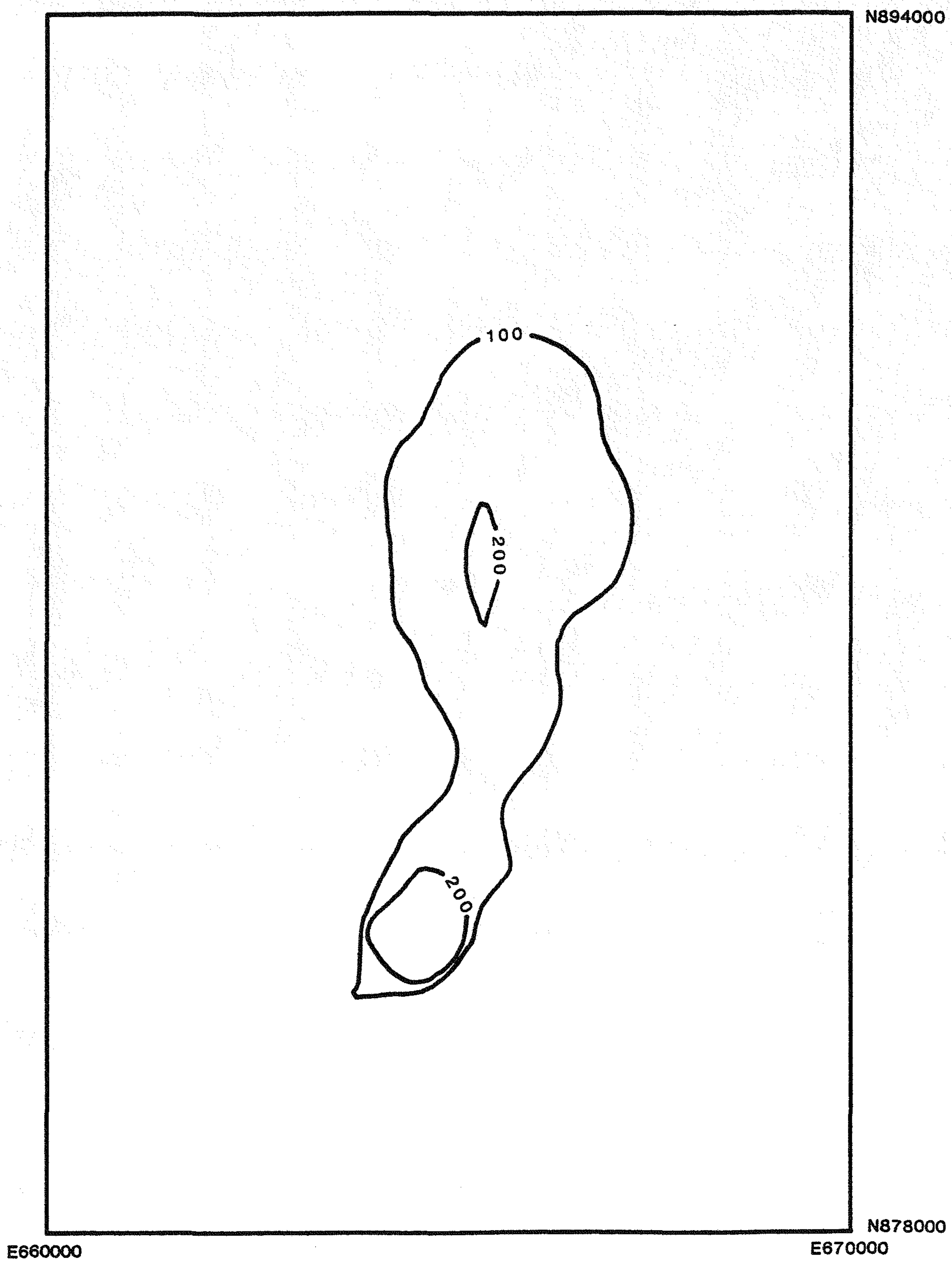


Figure 20. ^{134}Cs distribution (nCi/m^2) in the Baneberry area.

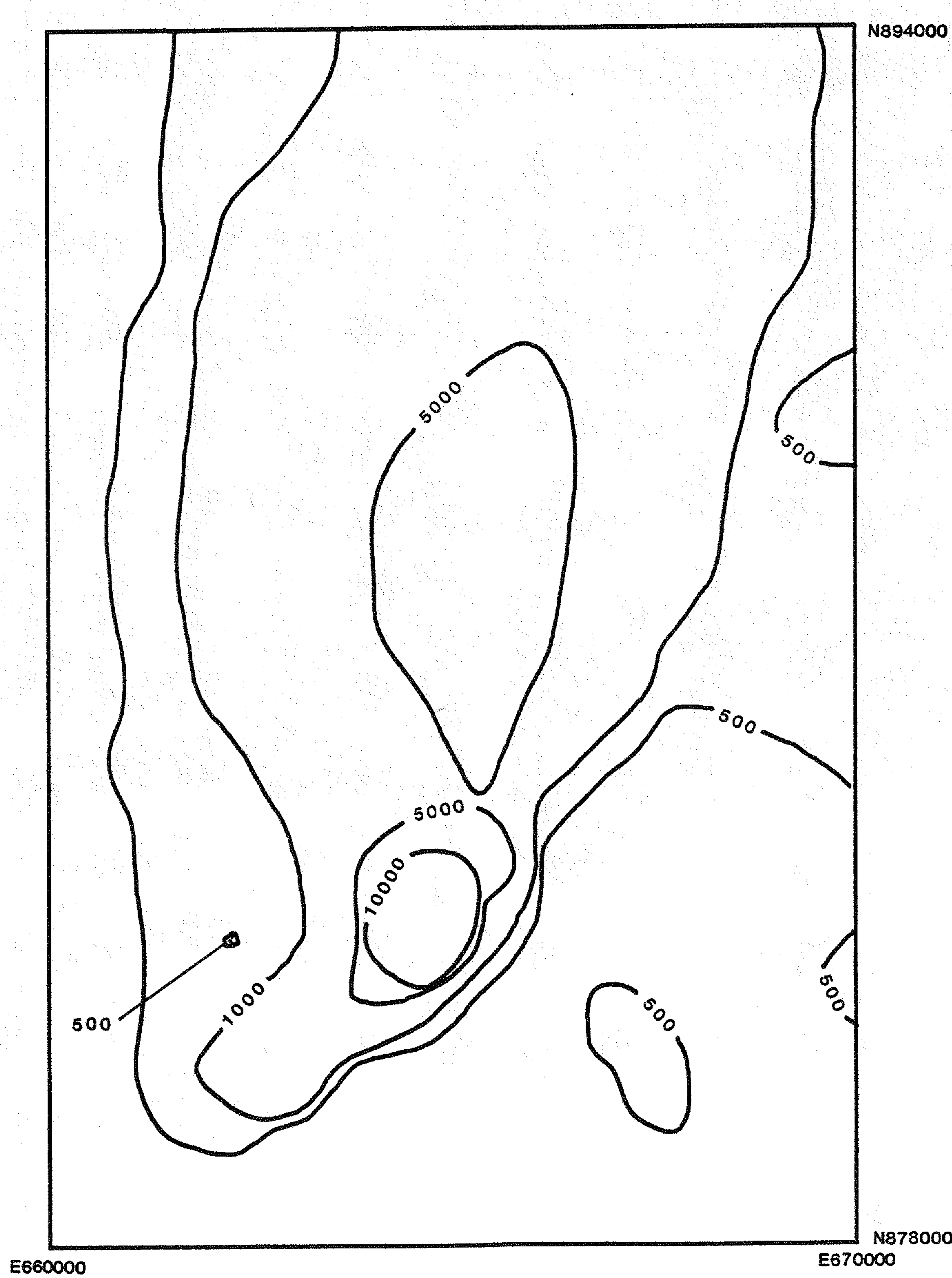


Figure 21. ^{137}Cs distribution (nCi/m^2) in the Baneberry area.

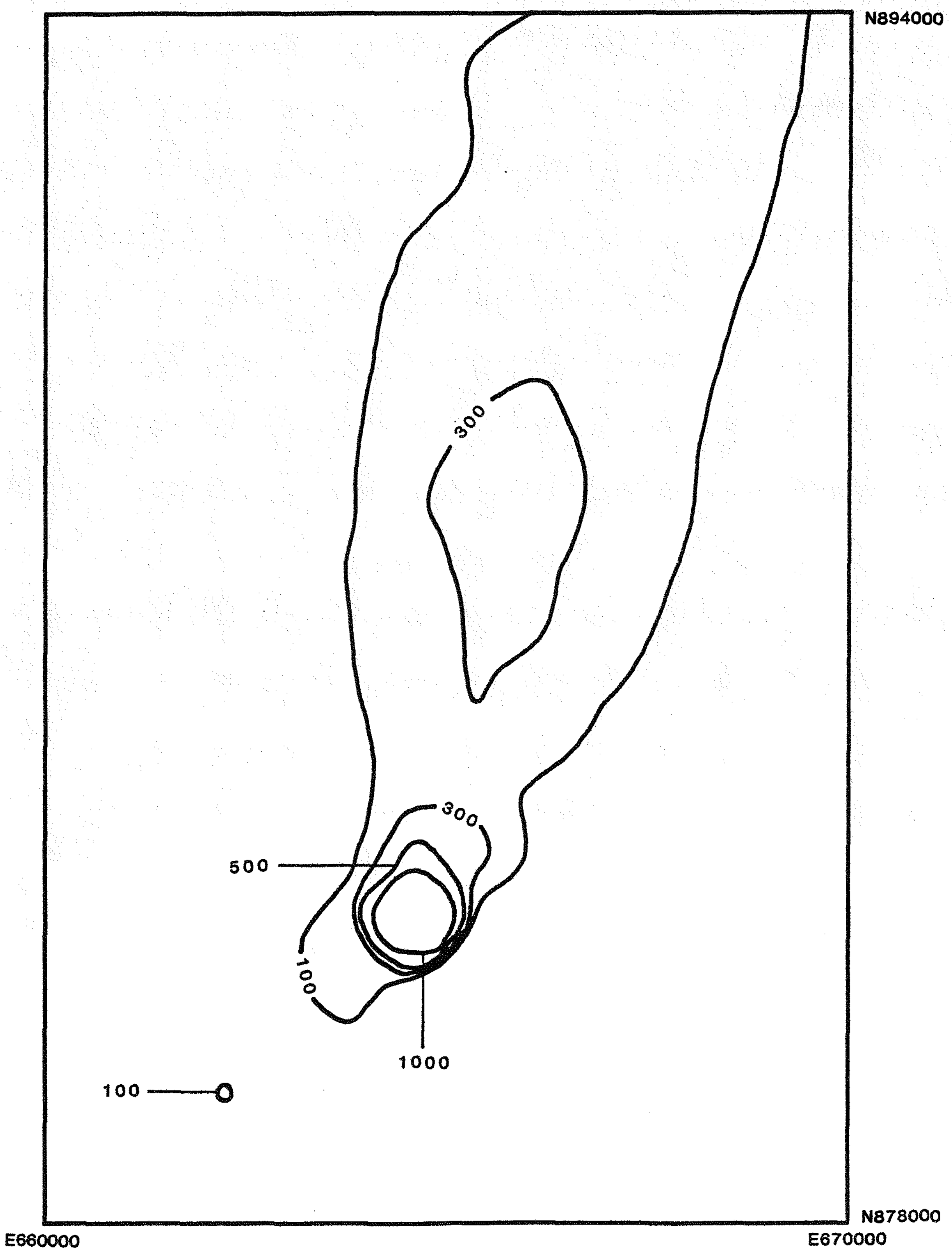


Figure 22. ^{125}Sb distribution (nCi/m^2) in the Baneberry area.

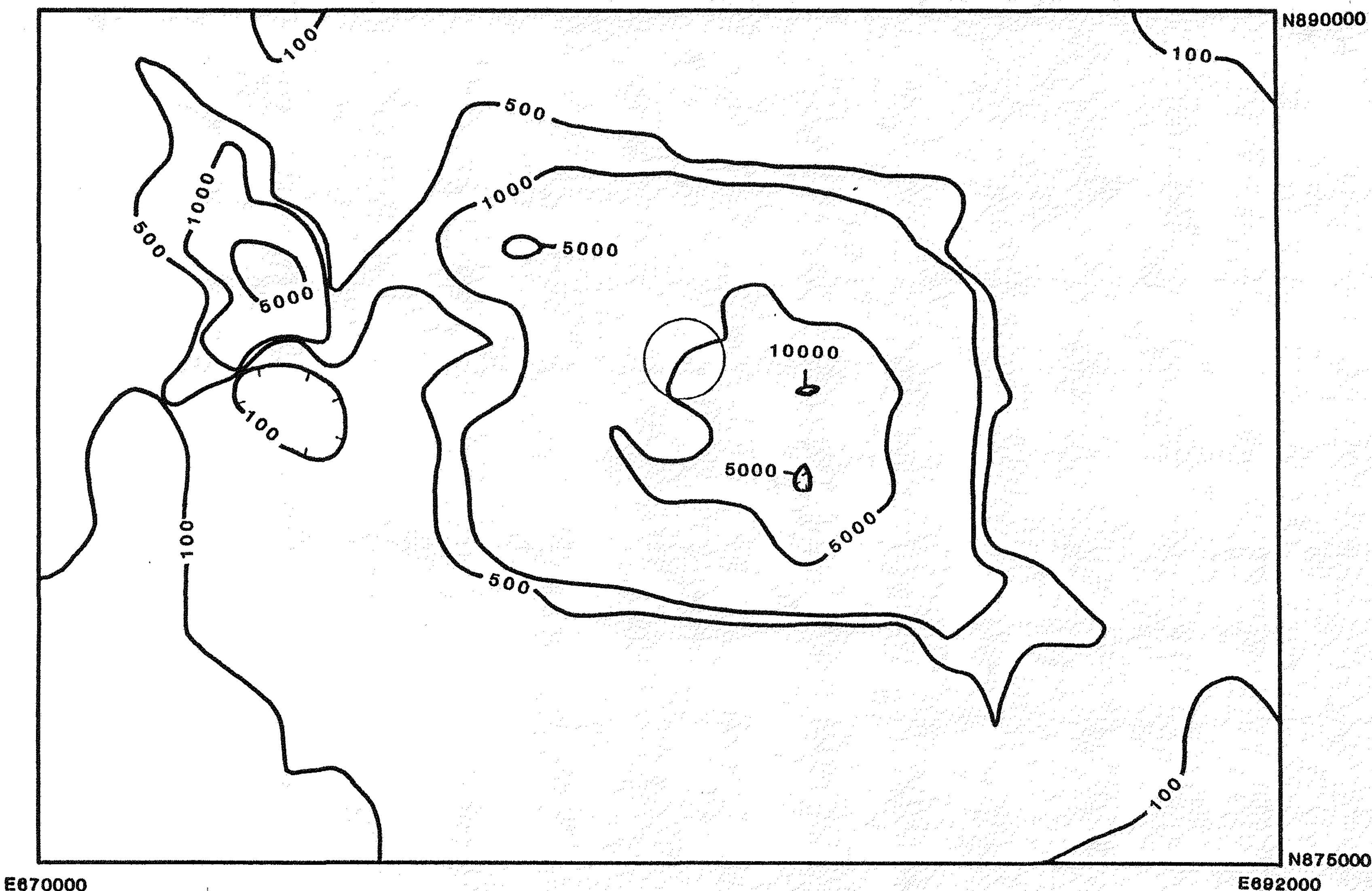


Figure 23. ^{241}Am distribution (nCi/m^2) in the Sedan area. The circle shows the approximate location of the Sedan crater.

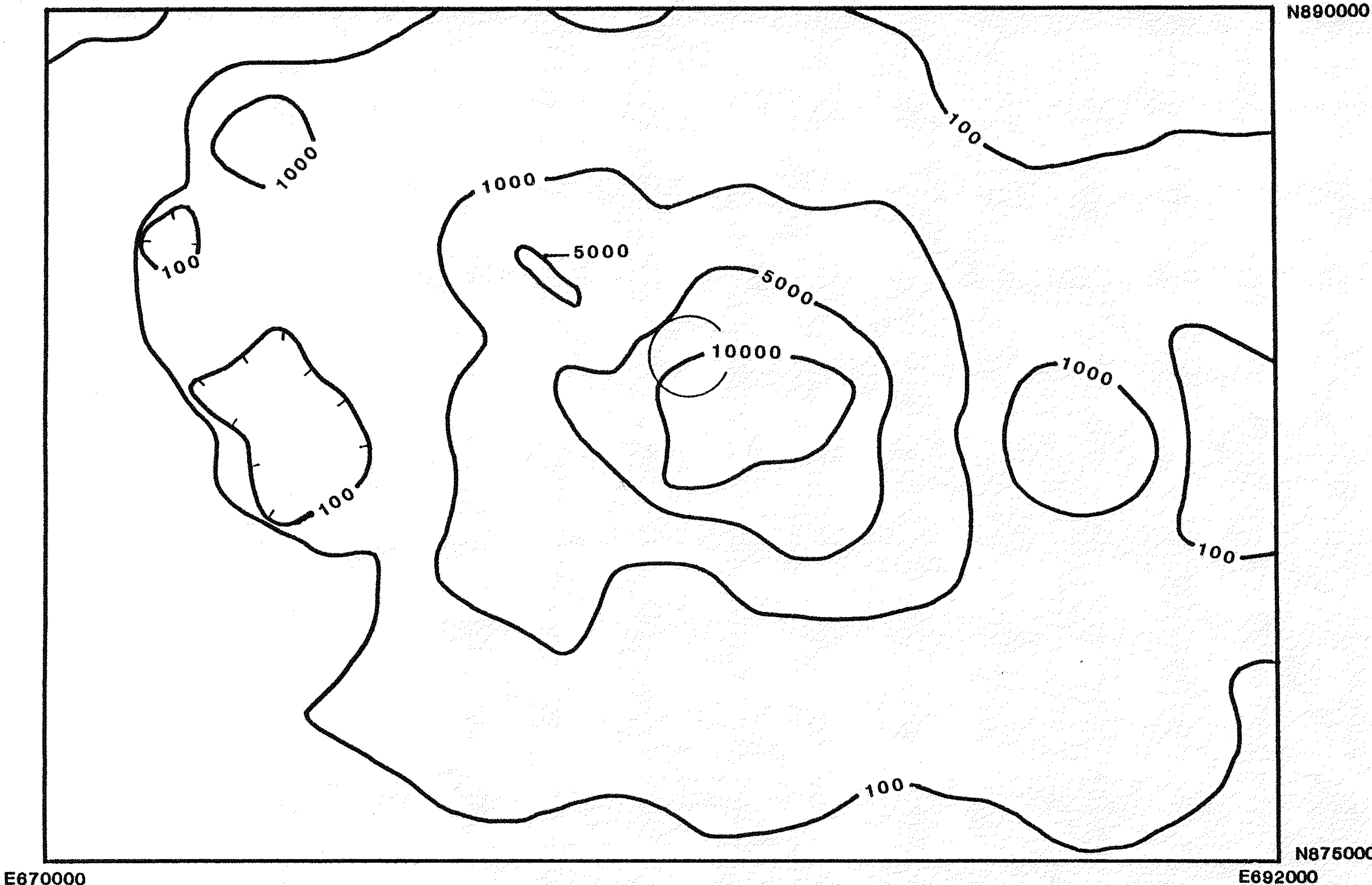


Figure 24. ^{60}Co distribution (nCi/m^2) in the Sedan area. The circle shows the approximate location of the Sedan crater.

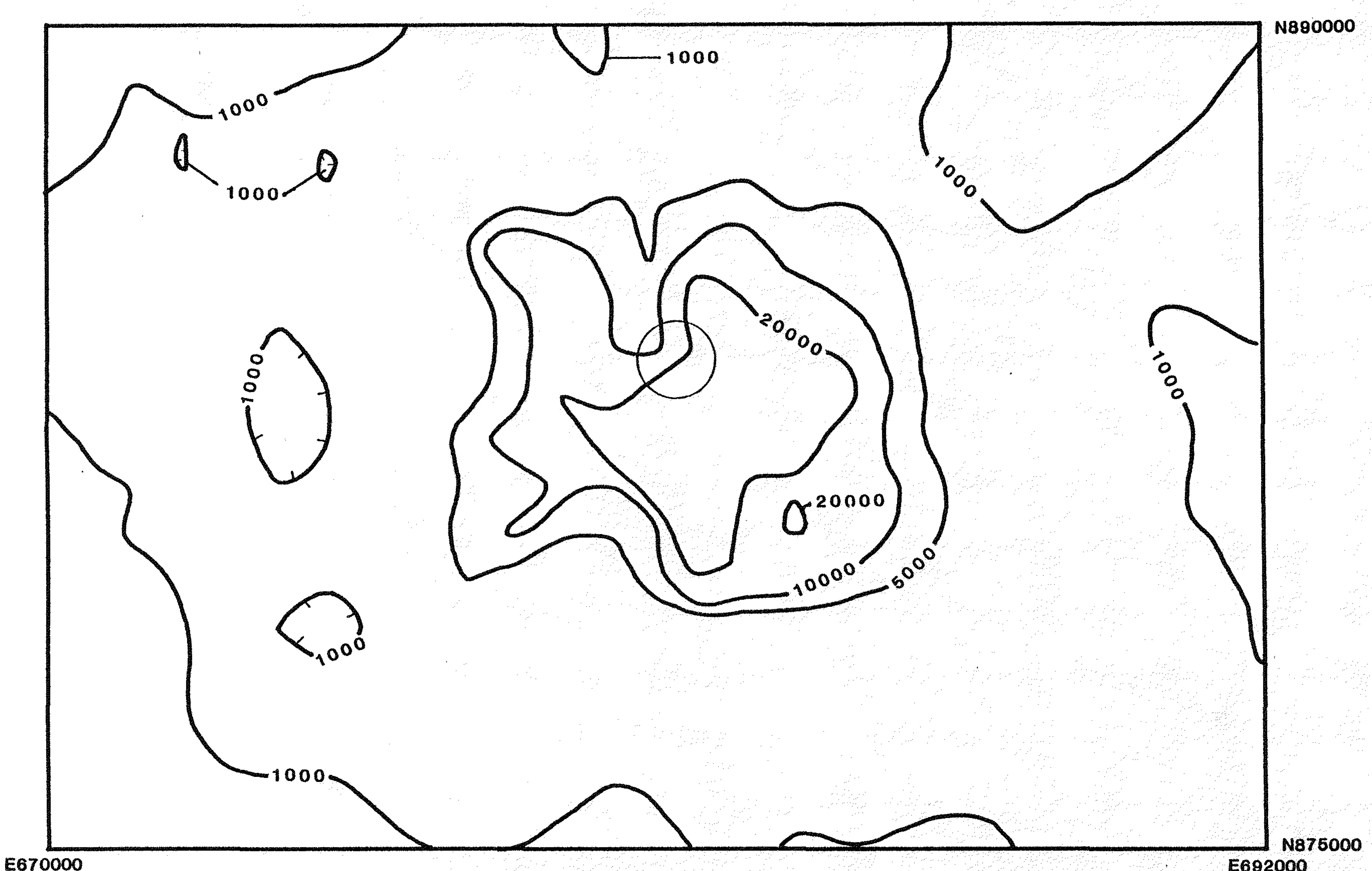


Figure 25. ^{137}Cs distribution (nCi/m^2) in the Sedan area. The circle shows the approximate location of the Sedan crater.

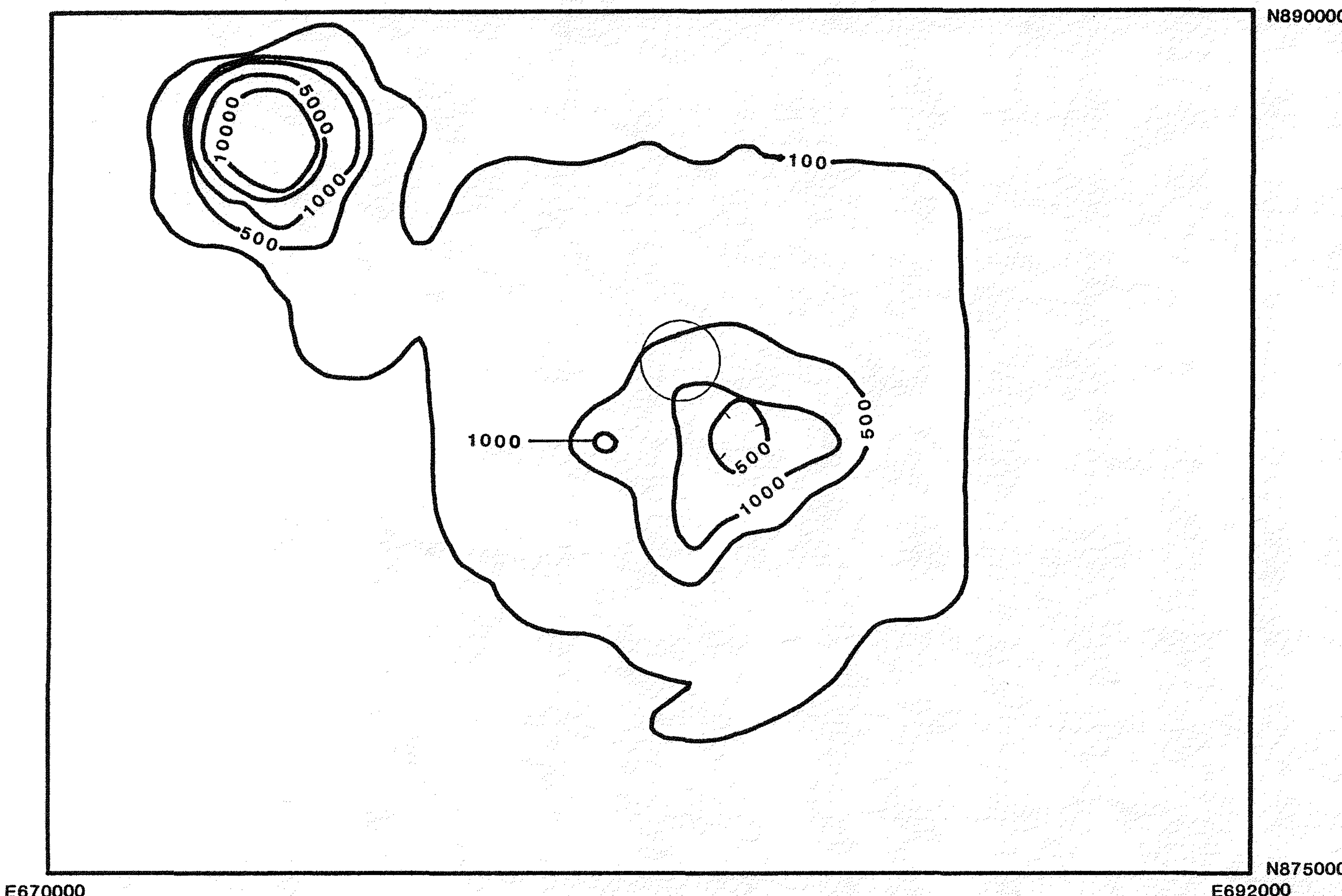


Figure 26. ^{152}Eu distribution (nCi/m^2) in the Sedan area. The circle shows the approximate location of the Sedan crater.

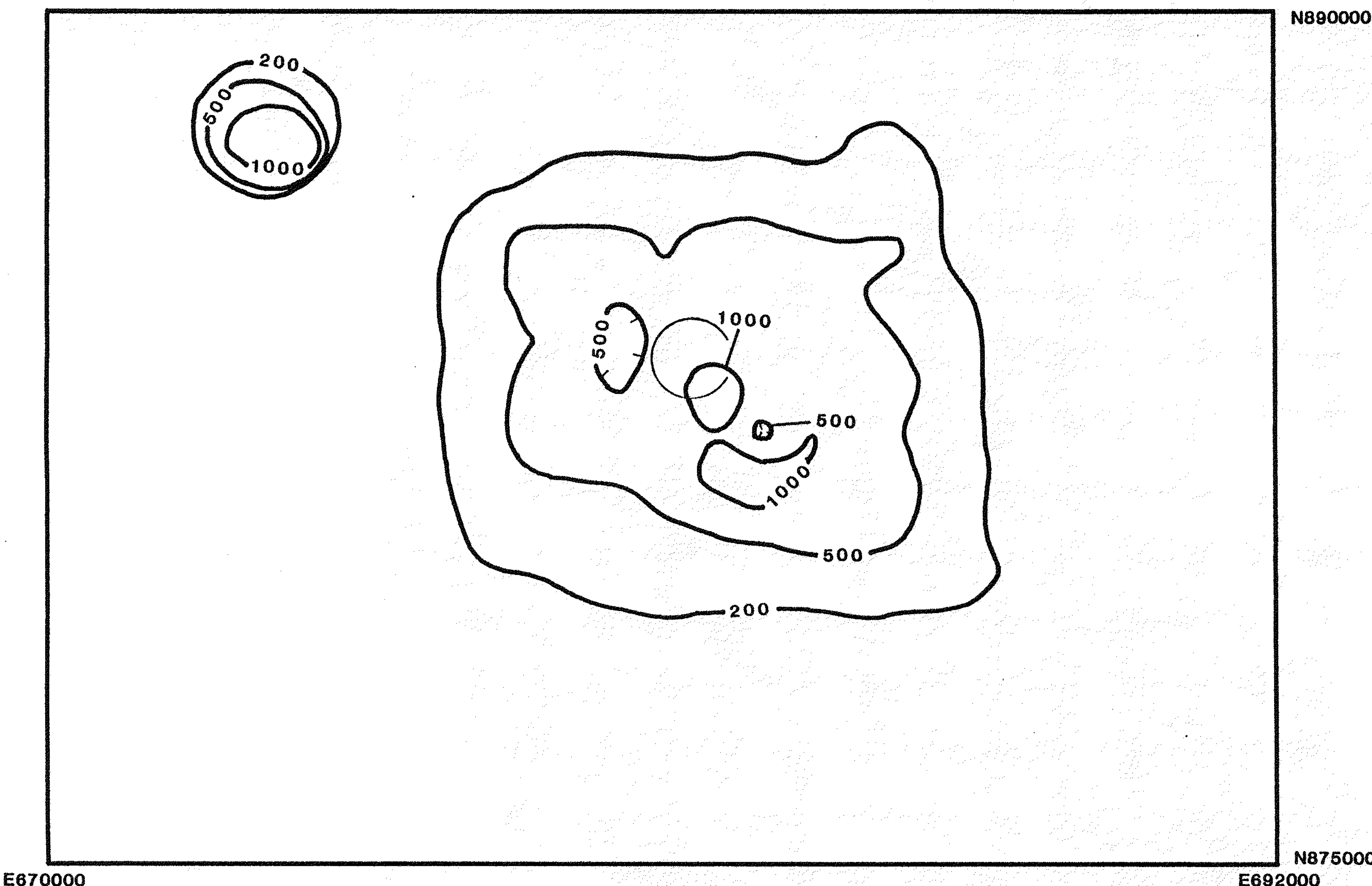


Figure 27. ^{154}Eu distribution (nCi/m^2) in the Sedan area. The circle shows the approximate location of the Sedan crater.

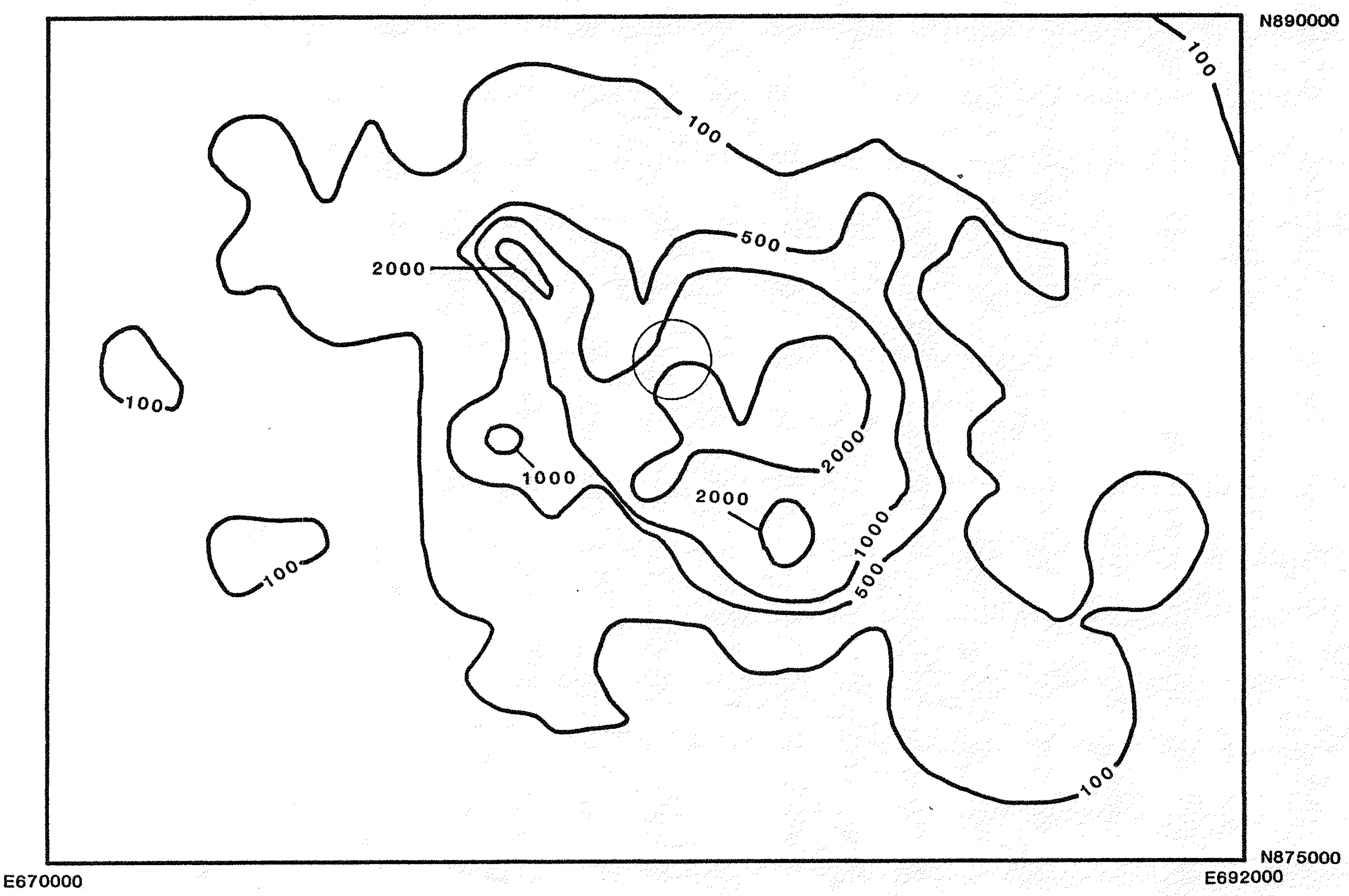


Figure 28. ^{155}Eu distribution (nCi/m^2) in the Sedan area. The circle shows the approximate location of the Sedan crater.

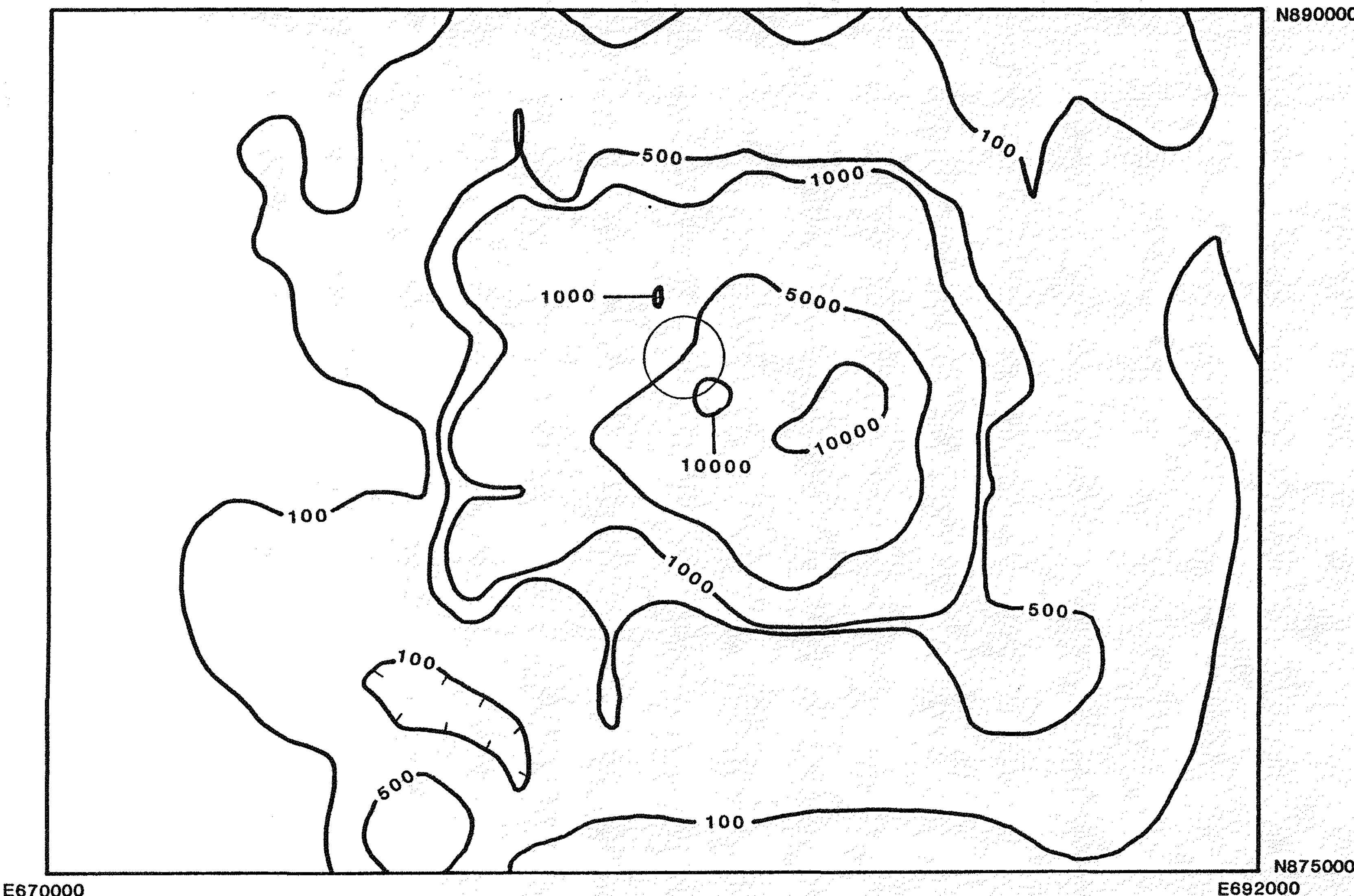


Figure 29. ^{174}Lu distribution (nCi/m^2) in the Sedan area. The circle shows the approximate location of the Sedan crater.

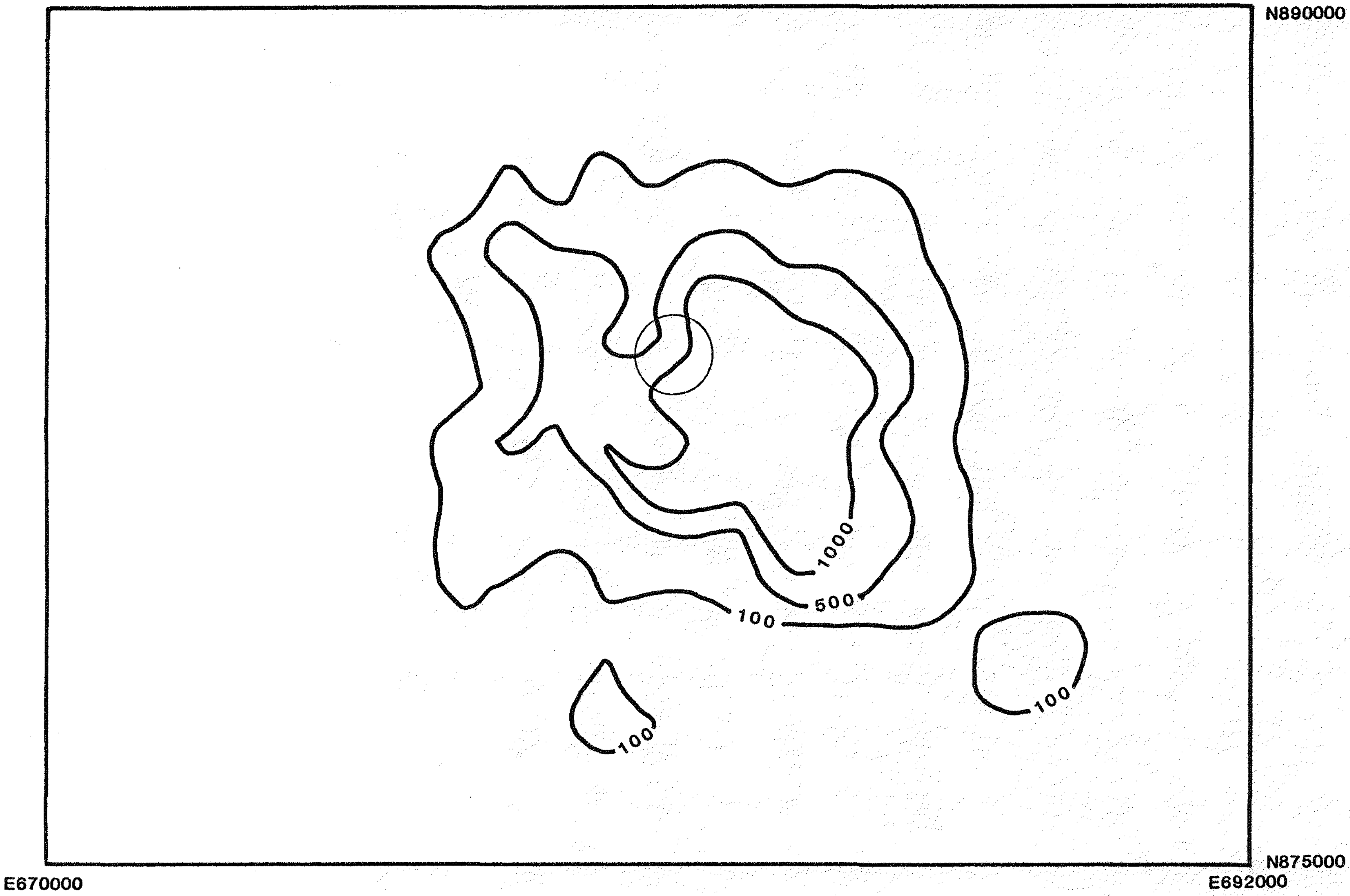


Figure 30. ^{101}Rh distribution (nCi/m^2) in the Sedan area. The circle shows the approximate location of the Sedan crater.

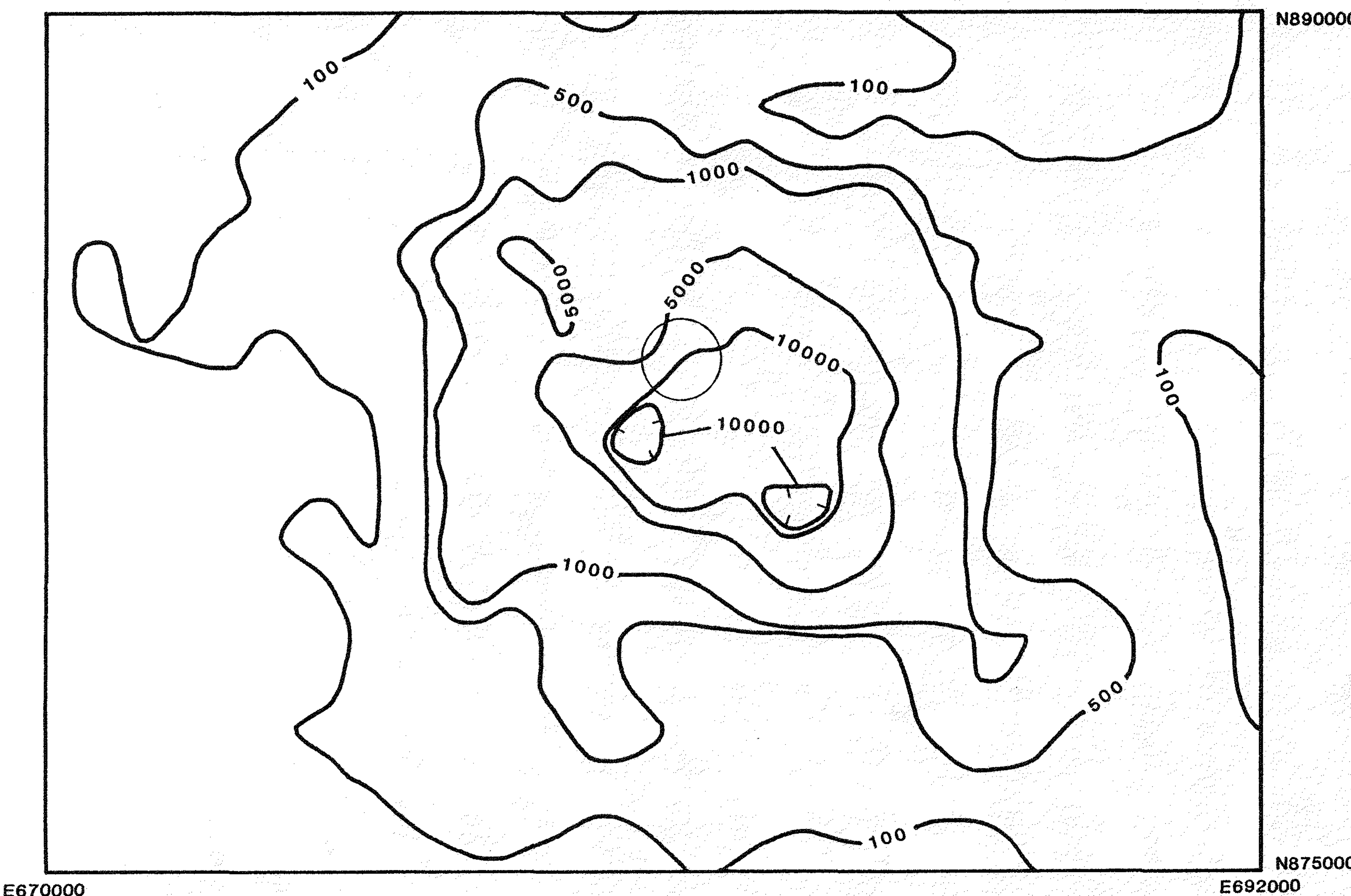


Figure 31. ^{102m}Rh distribution (nCi/m^2) in the Sedan area. The circle shows the approximate location of the Sedan crater.

SECTION 4

AREAS 3, 7, AND 9

More than 80 above-ground nuclear tests were conducted in these three areas on the east side of Yucca Flat. Most of the data presented in this section are from the Wilson, Quay, and Hornet sampling areas and were collected between October 1982 and May 1983. A few points measured earlier in the Galileo, Kepler, and Sedan areas are also included.

The results are presented in the same kinds of figures and tables used for Areas 8 and 10 in the previous section. Figures 32 through 34 show the locations at which soil samples were collected. Table 6 gives the calculated inverse relaxation lengths, Table 7 gives the inverse relaxation lengths used in GAMANAL, and Table 8 gives the results of the radiochemical analyses and radionuclide ratios.

The measured values of the six man-made radionuclides reported from this region are plotted in Figures 35 through 40. Table 9 gives the estimated inventories for the region, and the distribution maps are shown in Figures 41 through 55. Maps were not drawn for ^{155}Eu because of the small number of measurements above the detection limit.

TABLE 6. CALCULATED INVERSE RELAXATION LENGTHS FROM AREAS 3, 7, AND 9

Point	Inverse relaxation length and standard deviation (cm^{-1}) ^{60}Co	^{137}Cs	^{152}Eu	^{155}Eu	^{241}Am
Wilson					
1	0.196 0.373	0.612 0.333	0.050 --	0.429 0.230	0.090 0.254
2	0.097 0.008	0.881 0.258	0.113 0.002	0.210 0.387	0.247 0.443
3	0.050 --[a]	0.050 --	0.050 --	----[b]	----
4	0.082 0.327	0.052 0.141	0.050 --	----	0.050 --
5	0.050 --	0.278 0.016	0.050 --	0.050 --	----
6	0.050 --	0.328 0.180	0.050 --	0.146 0.797	0.136 0.484
7	0.050 --	0.050 --	0.050 --	----	----
8	0.050 --	0.050 --	0.050 --	----	----
9	0.050 --	0.828 0.332	0.050 --	0.346 0.365	0.329 0.379
10	0.556 0.181	0.066 0.017	0.063 0.010	0.441 0.210	0.539 0.304
11	0.161 0.010	0.428 0.009	0.093 0.004	0.332 0.361	0.543 0.318
12	0.585 0.333	0.574 0.035	0.076 0.029	0.472 0.364	0.572 0.343
13	0.050 --	0.050 --	0.050 --	----	----
14	0.050 --	0.636 0.158	0.050 --	0.299 0.407	0.447 0.378
15	0.074 0.006	0.230 0.004	0.060 0.003	0.148 0.060	0.327 0.049
16	0.213 0.025	0.497 0.176	0.101 0.008	0.050 --	0.435 0.318
17	0.050 --	0.312 0.160	0.050 --	0.157 0.615	----
18	0.100 0.032	1.086 0.139	0.075 0.004	0.050 --	----
19	0.050 --	0.343 0.016	0.050 --	0.309 0.436	0.816 0.197
20	0.050 --	0.830 0.332	0.050 --	0.487 0.234	0.373 0.256
21	0.050 --	0.096 0.028	0.050 --	----	----
22	0.085 0.021	1.311 0.136	0.084 0.004	0.050 --	1.960 0.255
23	0.050 --	0.619 0.330	0.050 --	0.194 0.229	0.716 0.393
Quay					
74	0.050 --	1.000 0.331	0.050 --	0.060 0.485	0.823 0.336
75	0.050 --	0.084 0.016	0.050 --	----	0.050 --
76	0.050 --	0.918 0.331	0.050 --	0.838 0.207	0.849 0.380
77	0.134 0.002	0.738 0.017	0.111 0.002	0.542 0.430	1.152 0.379
78	0.050 --	0.050 --	0.050 --	0.192 0.222	0.870 0.159
79	0.050 --	0.281 0.016	0.050 --	0.271 0.423	0.430 0.028
80	0.050 --	0.228 0.138	0.050 --	----	----
81	0.050 --	0.201 0.010	0.050 --	0.149 0.505	0.536 0.350
82	0.058 0.006	1.408 0.135	0.050 --	----	0.676 0.160
83	0.068 0.004	2.043 0.133	0.050 --	0.782 0.183	0.937 0.225
84	0.050 --	0.535 0.187	0.050 --	----	0.309 0.190
85	----	0.751 0.333	0.052 0.002	----	0.542 0.174
86	0.050 --	1.119 0.330	0.050 --	0.504 0.387	1.969 0.152
87	0.050 --	0.050 --	0.050 --	----	0.800 0.164
88	0.050 --	0.767 0.333	0.053 0.002	----	0.665 0.179
89	0.050 --	0.455 0.112	0.050 --	0.077 0.097	2.069 0.152
90	0.050 --	1.480 0.139	0.050 --	0.335 0.199	1.129 0.166
Hornet					
39	0.050 --	0.637 0.332	0.050 --	----	----
40	0.050 --	0.050 --	0.050 --	----	0.050 --
41	0.050 --	0.573 0.126	0.050 --	0.207 0.097	0.592 0.361
42	0.050 --	0.243 0.010	0.050 --	0.130 0.467	1.041 0.158
43	0.788 0.152	1.323 0.138	0.050 --	0.050 --	----
44	0.050 --	0.147 0.010	0.050 --	0.248 0.522	0.271 0.330
45	0.095 0.012	0.893 0.331	0.050 --	0.050 --	0.424 0.390
46	0.050 --	0.386 0.367	0.050 --	----	0.348 0.184
47	0.050 --	0.050 --	0.050 --	0.050 --	0.050 --
48	0.087 0.006	0.524 0.211	0.050 --	0.264 0.416	0.544 0.347
49	0.050 --	0.050 --	0.050 --	0.492 0.197	0.080 0.028
50	0.053 0.003	0.891 0.284	0.050 --	0.418 0.384	0.564 0.351
51	0.050 --	0.150 0.114	0.050 --	----	0.878 0.139
52	0.050 --	0.529 0.117	0.050 --	0.495 0.388	0.672 0.332
53	0.050 --	0.698 0.047	0.050 --	1.078 0.146	0.614 0.335
54	0.103 0.009	1.011 0.331	0.068 0.003	0.368 0.419	0.722 0.336
55	0.050 --	0.446 0.027	0.063 0.001	0.531 0.423	0.756 0.145
56	0.050 --	0.050 --	0.050 --	0.050 --	0.050 --
57	0.086 0.008	0.654 0.059	0.068 0.002	0.275 0.452	0.360 0.356
58	0.099 0.015	0.106 0.013	0.095 0.004	0.108 0.104	0.060 0.035
59	0.050 --	0.050 --	0.050 --	0.339 0.269	0.050 --
60	0.064 0.004	1.799 0.133	0.067 0.002	----	----
61	0.050 --	1.362 0.135	0.050 --	0.490 0.282	----
62	0.050 --	0.203 0.006	0.050 --	0.284 0.377	0.415 0.374
63	0.050 --	0.318 0.143	0.050 --	0.783 0.151	0.423 0.332

[a]Values of 0.050 with no standard deviation are estimates necessitated by insufficient sampling depth.

[b]Value could not be obtained because of insufficient data.

TABLE 7. INVERSE RELAXATION LENGTHS USED BY GAMANAL FOR AREAS 3, 7, AND 9

	Inverse relaxation length (cm^{-1})					
Area	^{241}Am	^{60}Co	^{137}Cs	^{152}Eu	^{154}Eu	^{155}Eu
Wilson GZ area	0.6	0.1	0.4	0.05	0.05	0.6
Other Wilson points	0.6	0.4	0.4	0.3	0.3	0.6
Quay GZ area	1.0	0.05	1.0	0.05	0.05	1.0
Other Quay points	1.0	0.4	1.0	0.4	0.4	1.0
Hornet GZ area	0.4	0.05	0.3	0.05	0.05	0.4
Other Hornet points	0.4	0.4	0.4	0.3	0.3	0.4

TABLE 8. RADIONUCLIDE CONCENTRATIONS AND RATIOS IN SOIL SAMPLES FROM AREAS 3, 7, AND 9

Area	Point	Concentration (pCi/g)[a]					Ratio[b]		
		^{241}Am	^{137}Cs	$^{239,240}Pu$	^{238}Pu	^{90}Sr	$^{239,240}Pu/^{241}Am$	$^{238}Pu/^{241}Am$	$^{90}Sr/^{137}Cs$
Wilson	14	4.8	13	110	2.4	24	24	0.49	1.8
	15	4.5	17	140	3.4	28	32	0.77	1.6
	16	9.3	10	79	2.8	21	8.5	0.33	2.2
							Mean: 21	0.52	1.9
Quay	74	12	5.9	87	1.8	18	7.1	0.15	3.0
	75	4.4	3.5	39	0.95	7.0	8.8	0.21	2.0
	76	56	14	420	12	32	7.6	0.21	2.3
	77	670	150	4200	130	290	6.2	0.20	1.9
	79	12	4.0	100	2.3	7.8	8.5	0.19	2.0
	86	210	140	1500	79	260	7.1	0.38	1.9
	89	92	65	690	43	150	7.5	0.47	2.2
							Mean: 7.5	0.26	2.2
Hornet	40	3.0	3.3	29	1.7	10	9.6	0.58	3.0
	42	6.6	31	49	16	48	7.5	2.34	1.6
	45	1.9	5.0	17	1.2	28	9.3	0.64	5.6
	47	4.1	3.6	32	1.0	12	7.8	0.25	3.4
	48	25	18	196	4.7	56	7.8	0.19	3.2
	50	6.5	21	61	11.0	45	9.5	1.7	2.1
	51	3.8	5.4	27	1.4	18	7.2	0.36	3.3
	54	4.8	5.1	30	0.80	22	6.3	0.17	4.4
	57	3.8	16	30	3.8	50	8.0	0.99	3.1
	58	3.2	3.3	24	1.8	11	7.5	0.54	3.2
	59	39	5.5	270	4.9	14	7.0	0.13	2.5
	62	10	44	100	5.4	160	10.0	0.53	3.7
							Mean: 8.1	0.70	3.3

[a]Most concentration values are an average of several measurements.

[b]Ratios were computed from concentration values with more significant figures than are shown here, and may differ slightly from the ratios of the tabulated concentrations.

TABLE 9. INVENTORY ESTIMATES FOR AREAS 3, 7, AND 9

Region	n[a]	Area ($ft^2 \times 10^6$)	Radionuclide Inventory (Ci) ^{241}Am	^{238}Pu	$^{239,240}Pu$	^{60}Co	^{137}Cs	^{90}Sr	^{152}Eu	^{154}Eu	^{155}Eu
WI-1	117	83.2	3.0	1.6	63.	1.4	2.9	5.5	31.	2.9	0.44
			(51)[b]			(47)	(110)		(90)	(14)	(5)
WI-2	91	243.9	1.2	.62	25.	0.45	5.9	11.	1.4	2.2	0.87
			(18)			(8)	(84)		(4)	(0)	(1)
QU-1	41	6.72	0.81	.21	6.1	1.2	0.41	.90	17.	0.95	0.062
			(17)			(39)	(36)		(41)	(26)	(3)
QU-2	12	1.92	0.0078	.0020	.039	0.0026	0.0095	.021	0.019	0.016	0.0071
			(0)			(0)	(8)		(7)	(0)	(0)
QU-3	23	4.	0.040	.010	.30	0.25	0.045	.099	4.2	0.29	0.023
			(10)			(23)	(19)		(23)	(14)	(1)
QU-4	117	80.06	0.37	.096	2.8	0.60	1.0	2.2	8.4	1.1	0.26
			(17)			(26)	(106)		(71)	(8)	(0)
QU-5	24	64.8	0.45	.12	3.4	0.12	1.4	3.1	0.42	0.59	0.20
			(8)			(1)	(24)		(4)	(0)	(1)
QU-6	32	286.	1.6	.42	12.	0.49	4.0	8.8	1.6	2.6	0.84
			(14)			(1)	(30)		(1)	(0)	(1)
HO-1	9	1.44	0.012	.0084	.097	0.0042	0.089	.29	0.048	0.0077	0.0069
			(3)			(6)	(9)		(9)	(0)	(0)
HO-2	16	2.56	0.19	.13	1.5	0.011	0.081	.27	0.026	0.016	0.0087
			(16)			(4)	(15)		(4)	(0)	(0)
HO-3	80	14.54	1.2	.84	9.7	0.97	1.1	3.6	17.	0.88	0.11
			(64)			(47)	(78)		(55)	(23)	(3)
HO-4	9	1.44	0.11	.077	.89	0.37	0.60	2.0	2.8	0.21	0.049
			(7)			(9)	(9)		(9)	(9)	(4)
HO-5	184	114.42	1.4	.98	11.	0.41	4.2	14.	4.5	0.98	0.47
			(83)			(57)	(181)		(81)	(2)	(12)
HO-6	59	137.8	1.1	.77	8.9	0.22	3.0	9.9	0.59	1.1	0.47
			(38)			(3)	(55)		(3)	(0)	(1)
Total	822	1,042.8	11.	5.9	145.	6.5	24.7	62.	89.	14.	3.8

[a]Number of measurement points.

[b]Number of values above the detection limit.

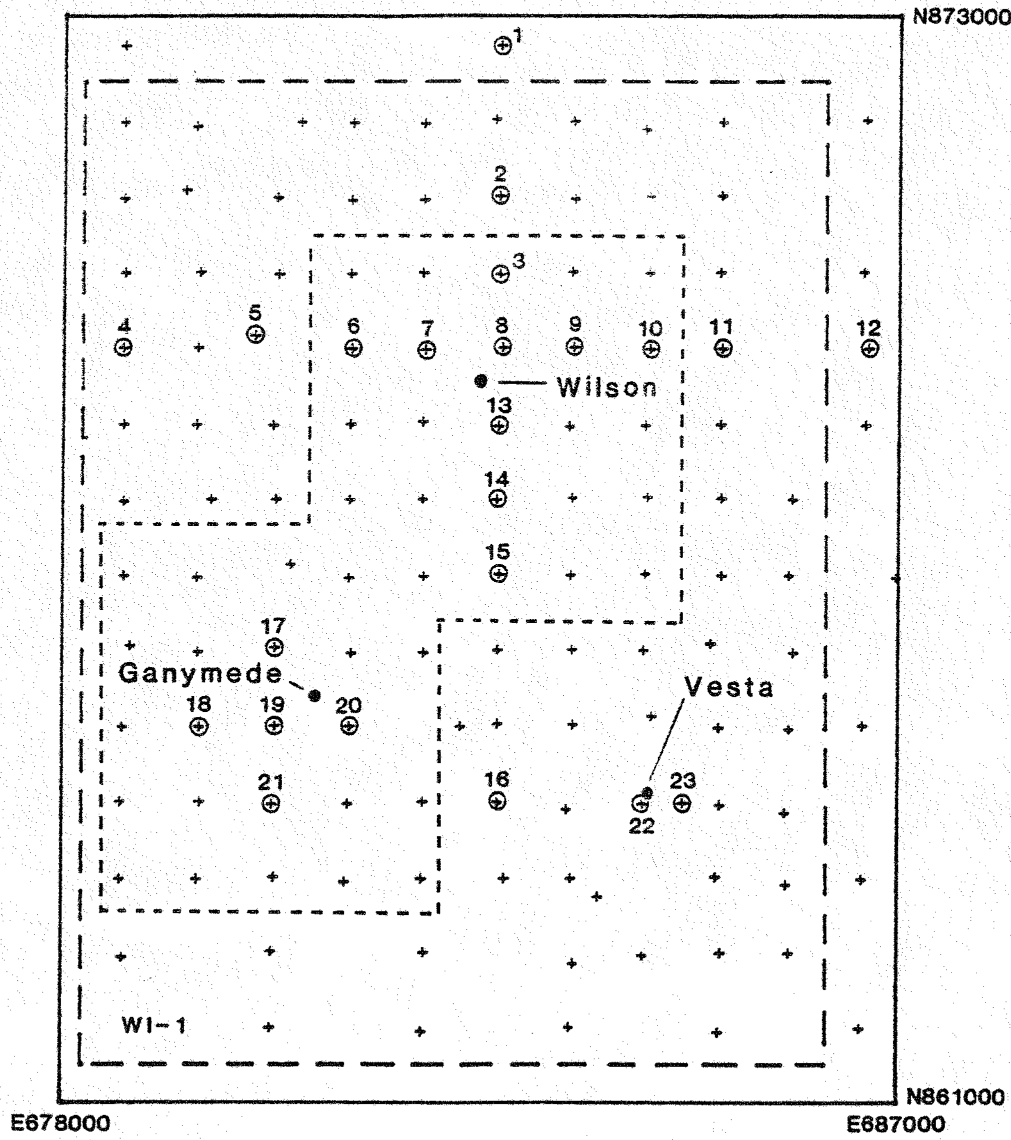


Figure 32. Locations of soil samples near the Wilson ground zero. The dotted lines enclose the points considered "near" ground zeros when choosing an inverse relaxation length.

+ = location of <u>in situ</u> measurement
O = location of soil sample
● = ground zero

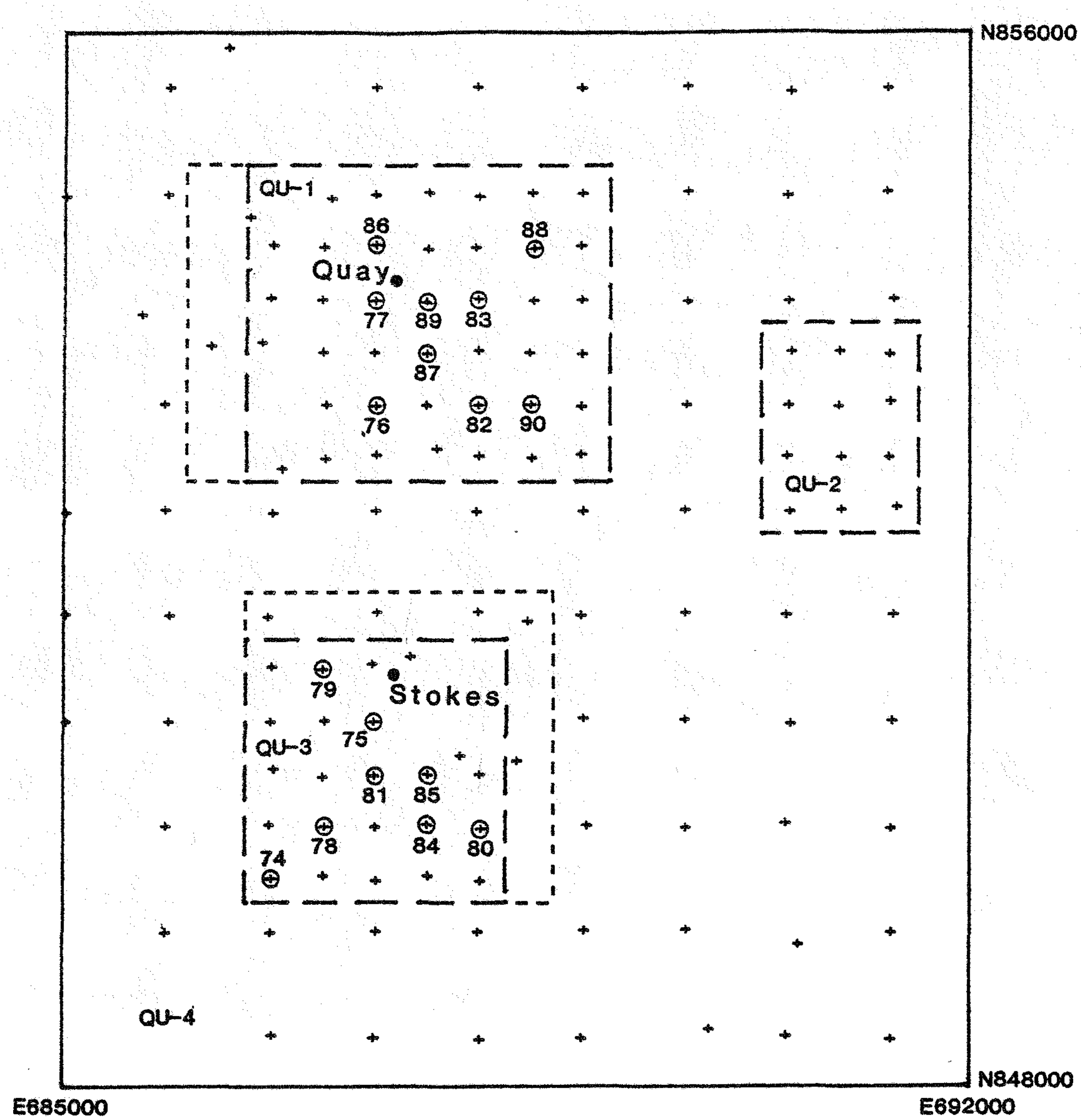


Figure 33. Locations of soil samples near the Quay ground zero. The dotted lines enclose the points considered "near" ground zeros when choosing an inverse relaxation length.

+ = location of <u>in situ</u> measurement
O = location of soil sample
● = ground zero

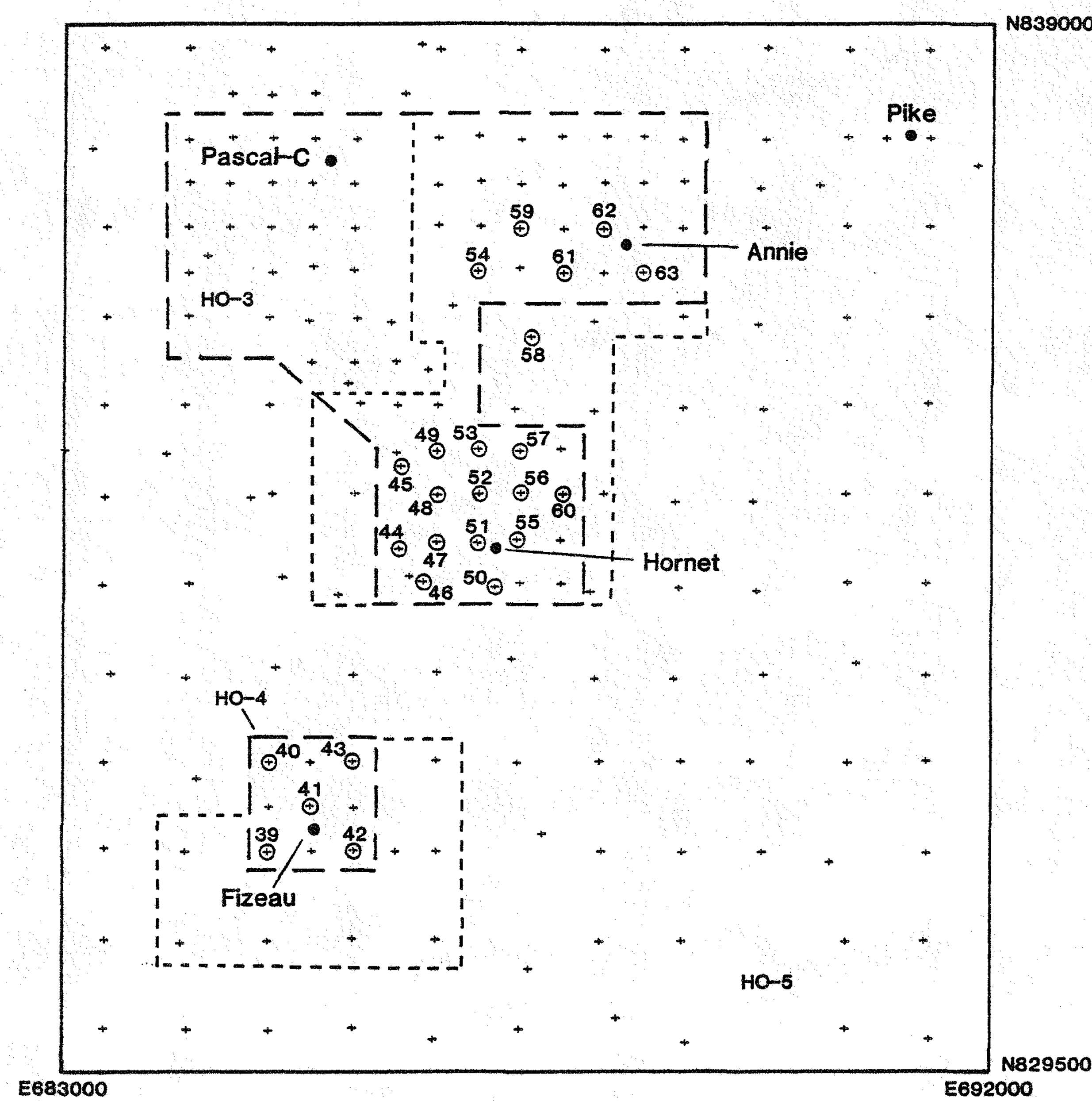


Figure 34. Locations of soil samples near the Hornet ground zero. The dotted lines enclose the points considered "near" ground zeros when choosing inverse relaxation lengths.

+ = location of *in situ* measurement
O = location of soil sample
● = ground zero

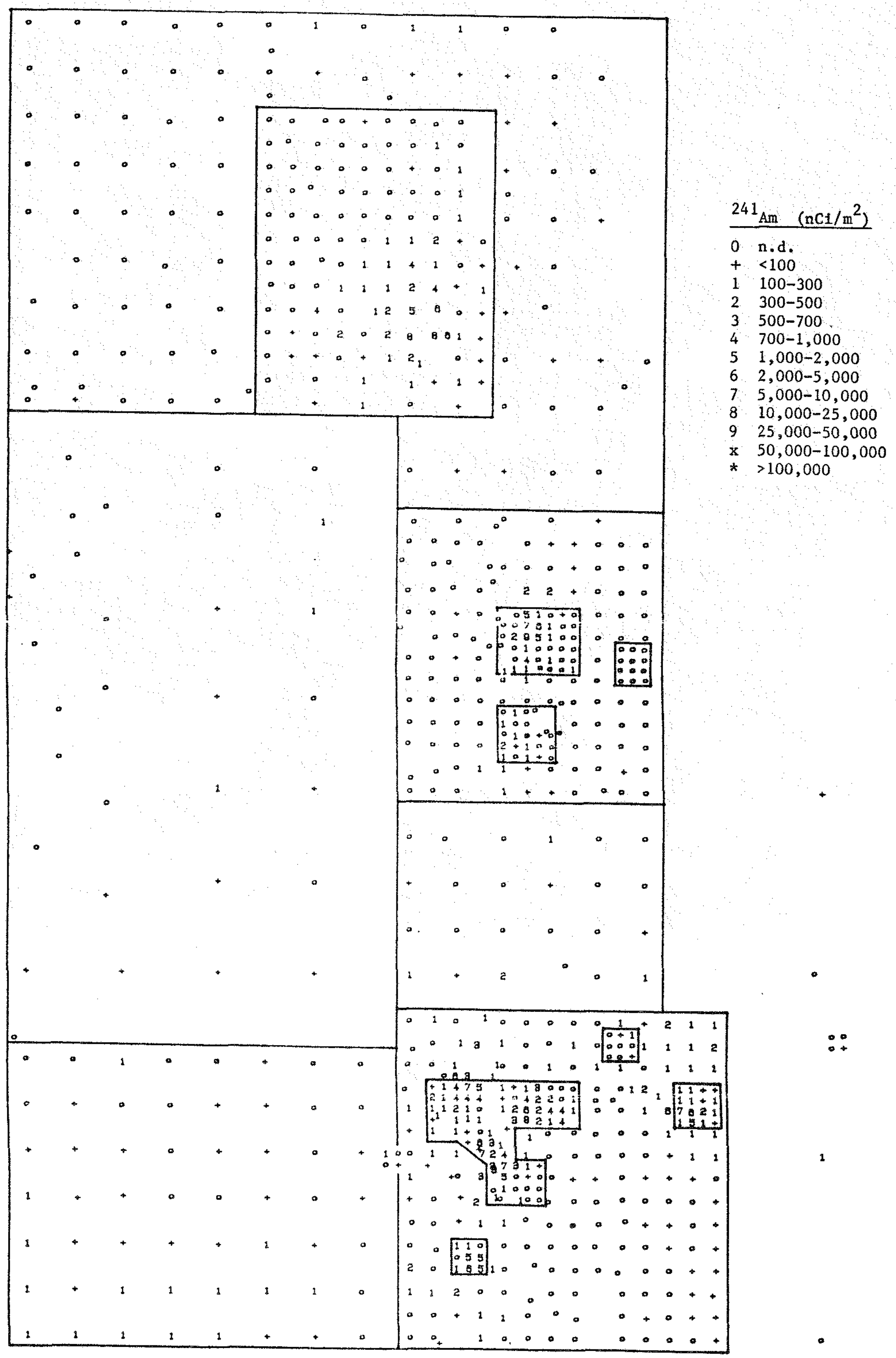


Figure 35. Measured ^{241}Am activities in Areas 3, 7, and 9.

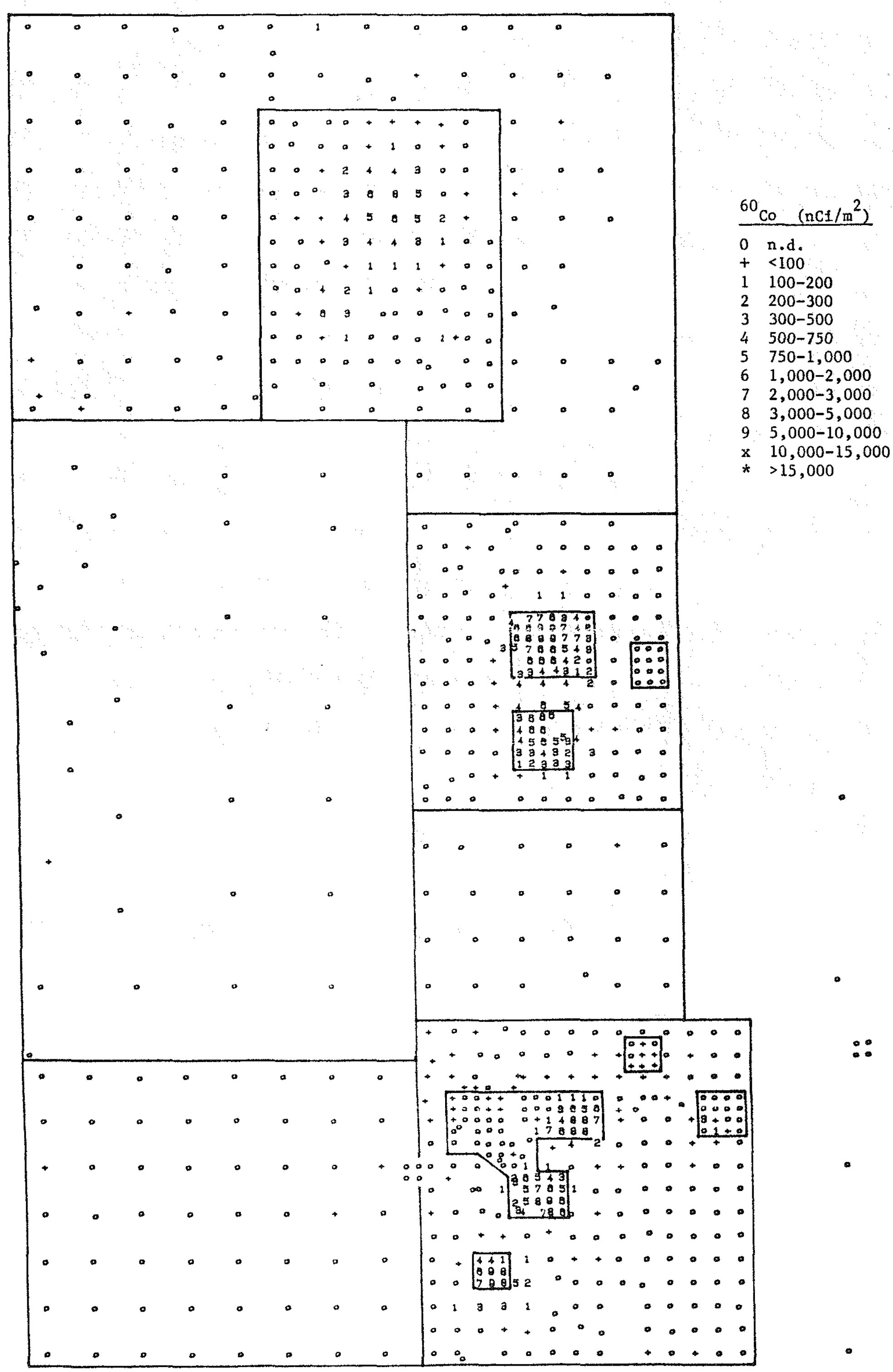


Figure 36. Measured ^{60}Co activities in Areas 3, 7, and 9.

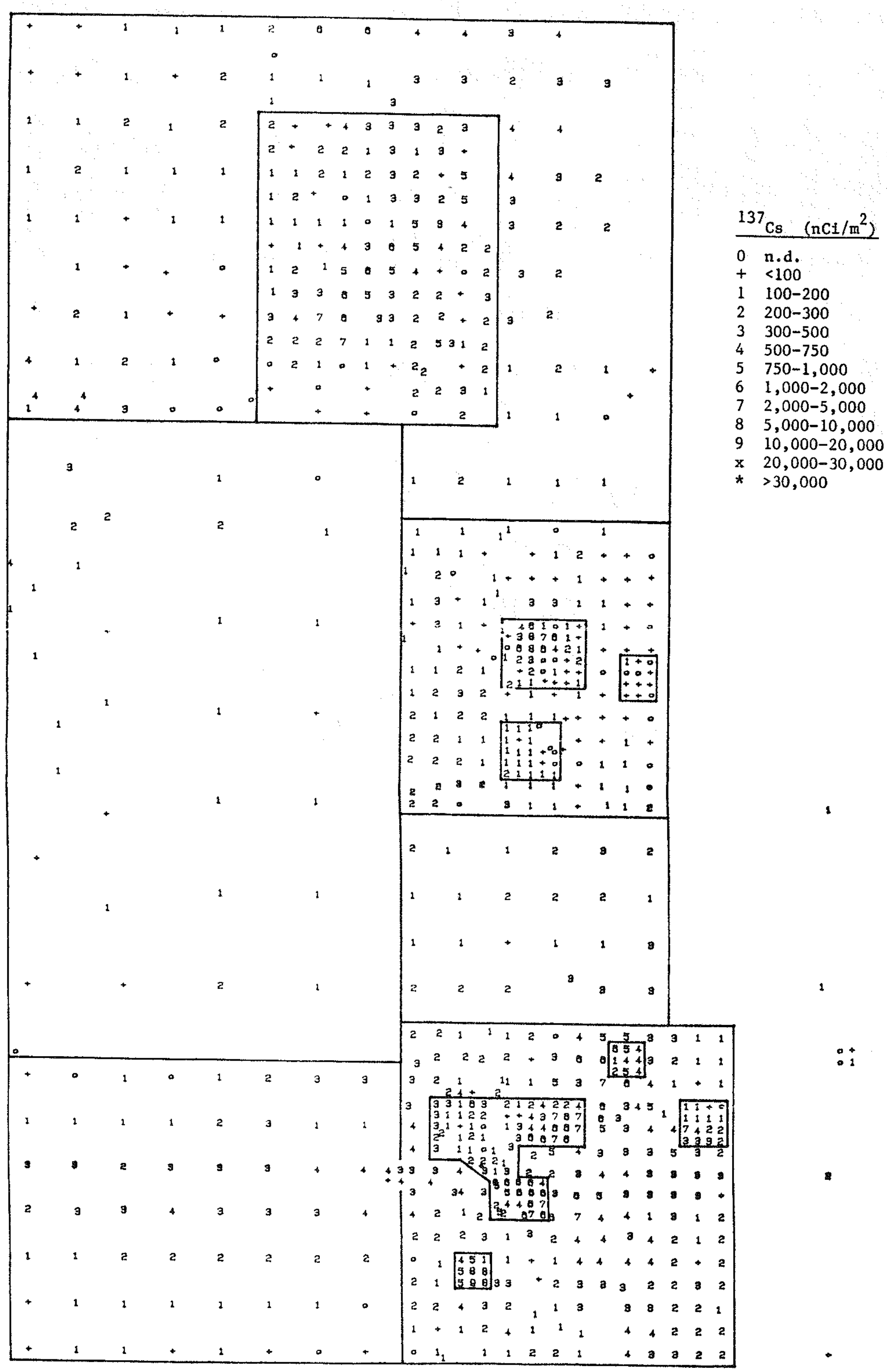


Figure 37. Measured ^{137}Cs activities in Areas 3, 7, and 9.

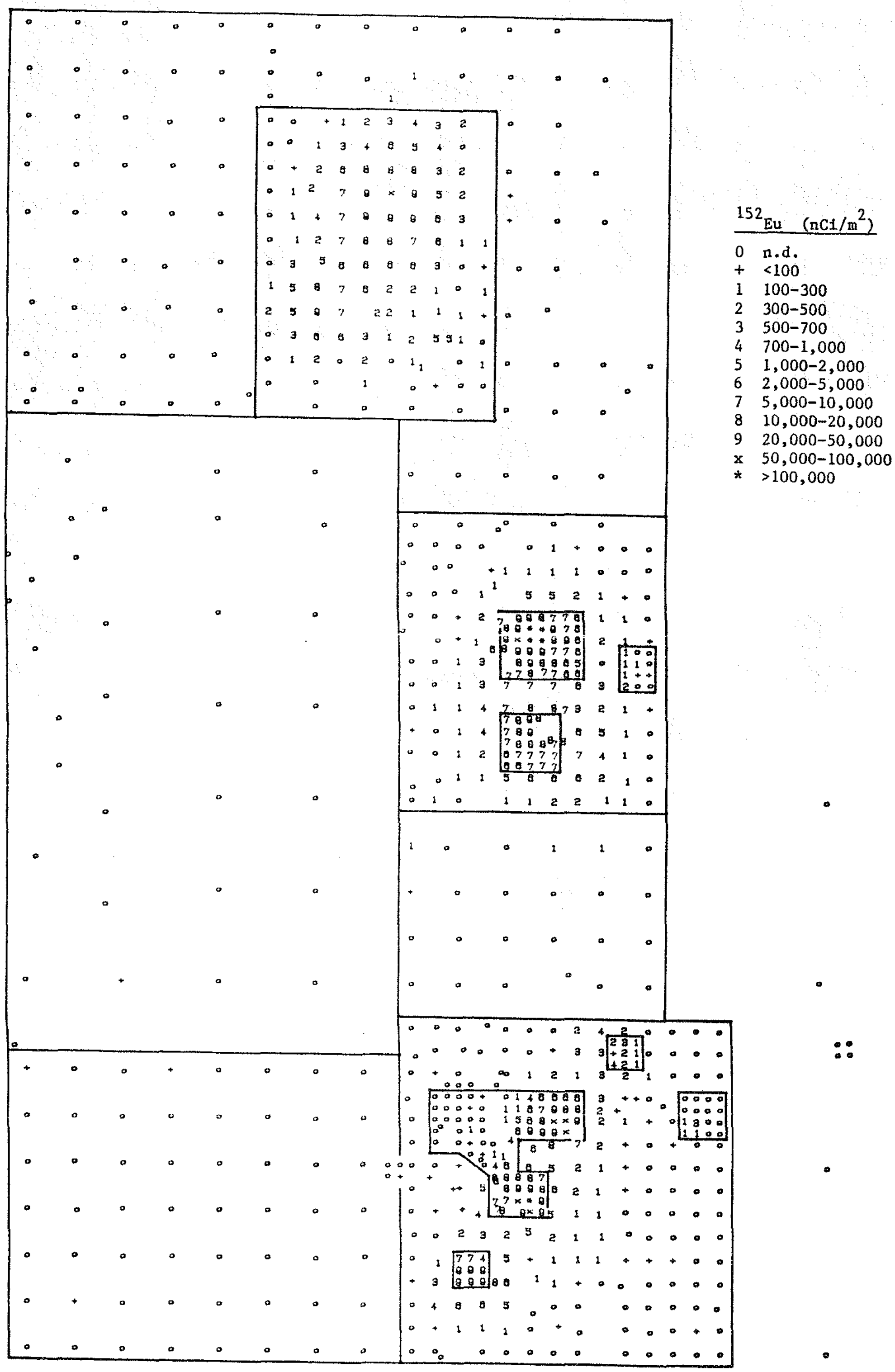


Figure 38. Measured ^{152}Eu activities in Areas 3, 7, and 9.

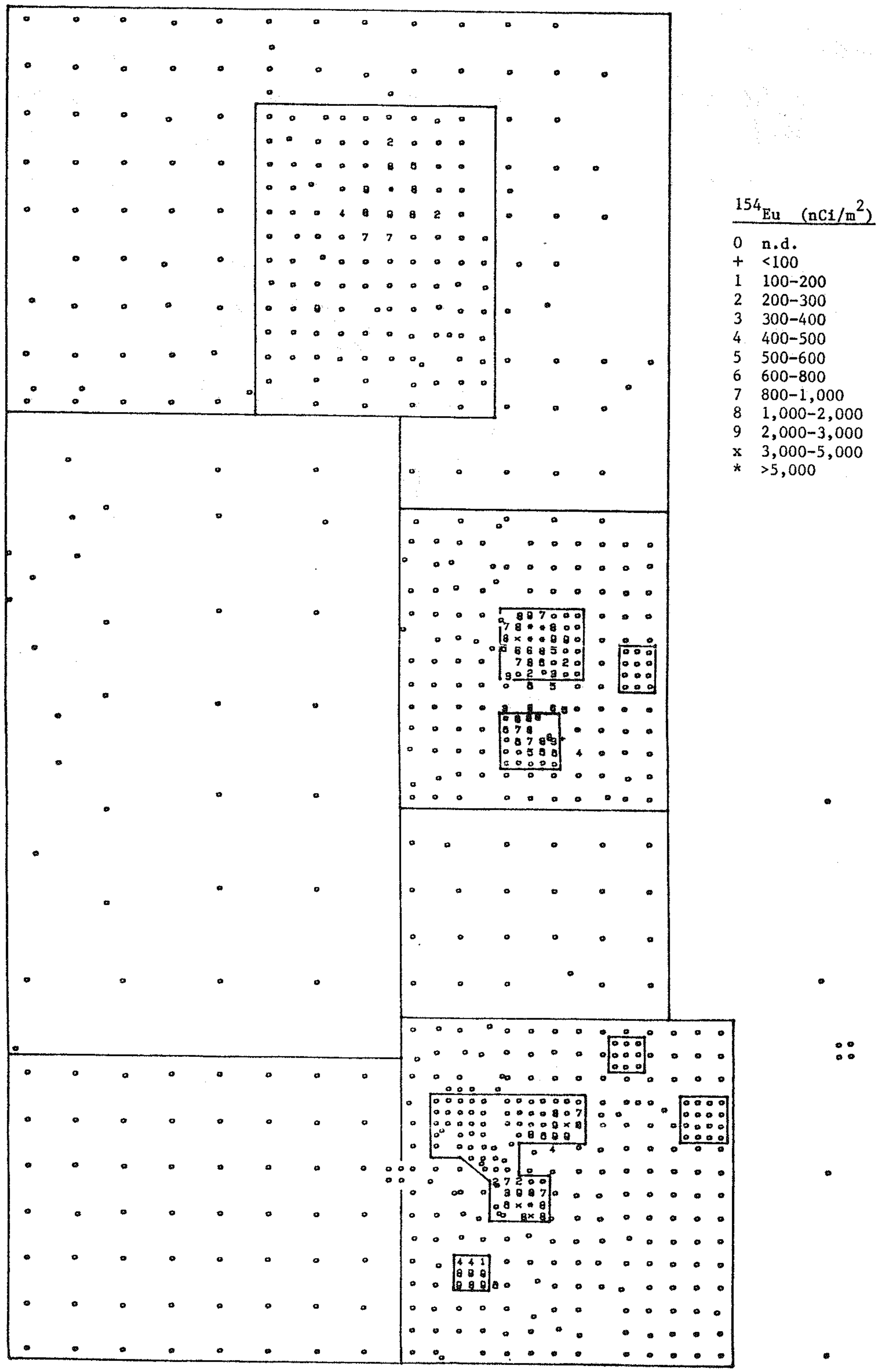


Figure 39. Measured ^{154}Eu activities in Areas 3, 7, and 9.

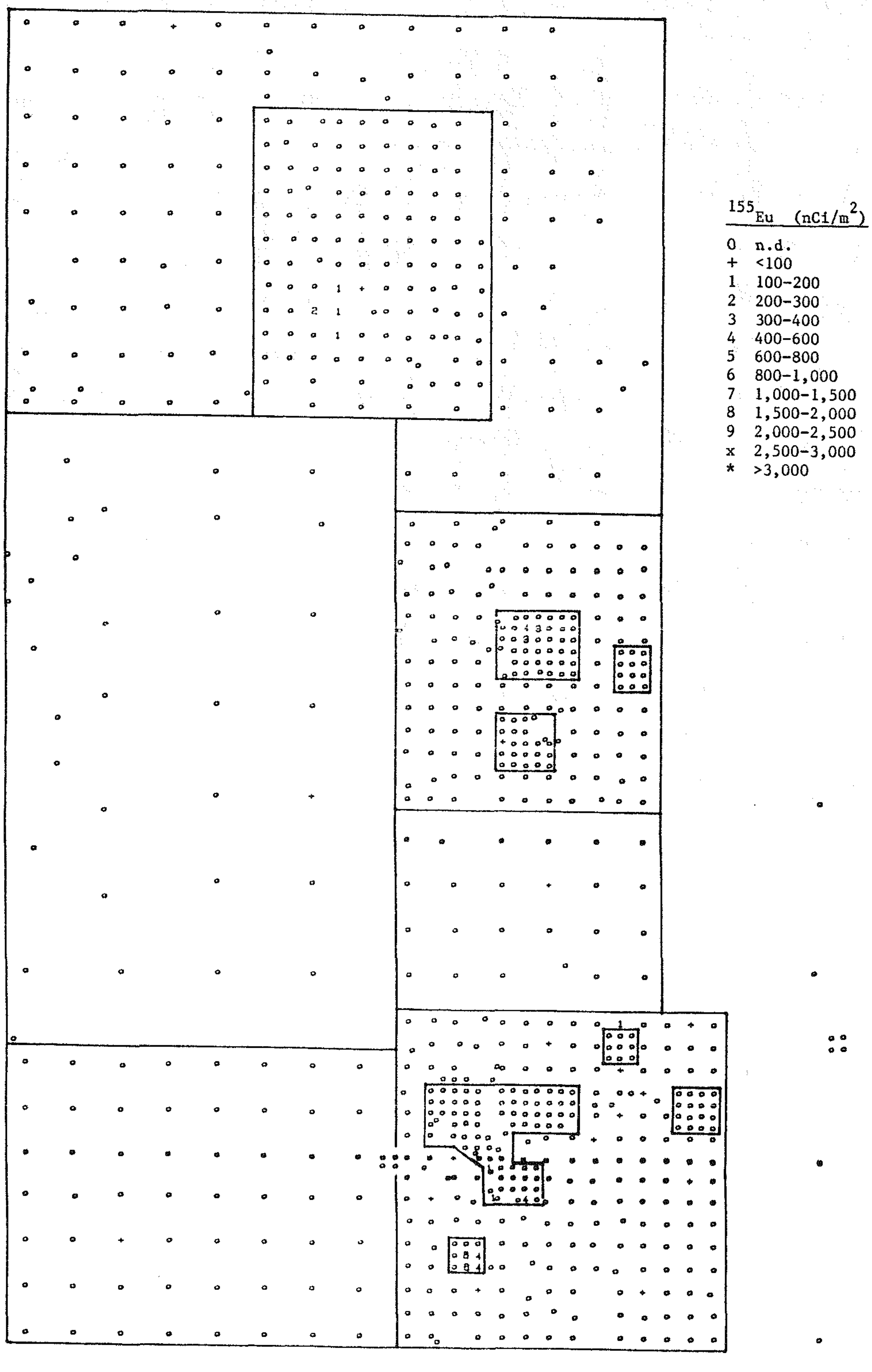


Figure 40. Measured ^{155}Eu activities in Areas 3, 7, and 9.

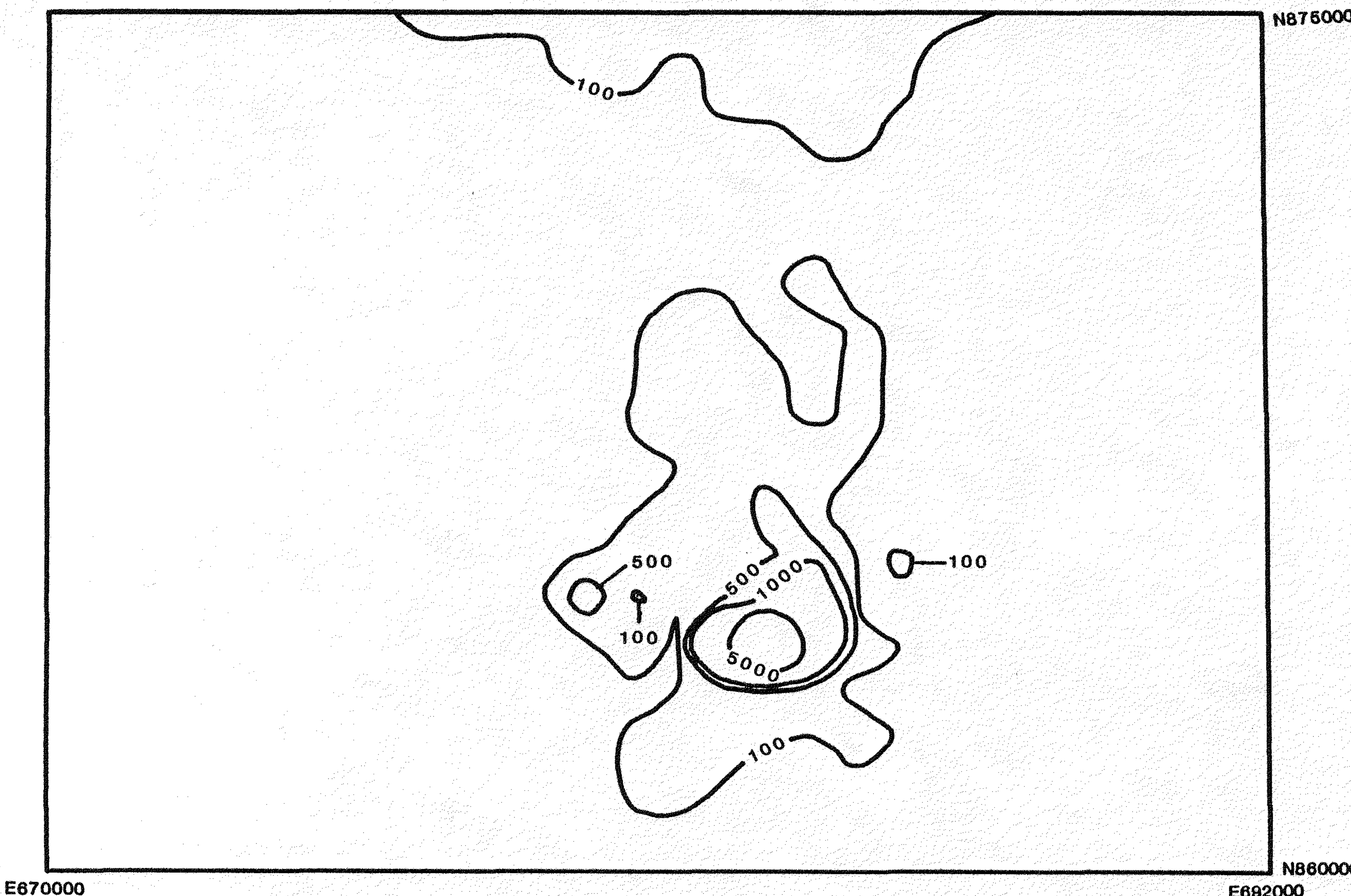


Figure 41. ^{241}Am distribution (nCi/m^2) in the Wilson area.

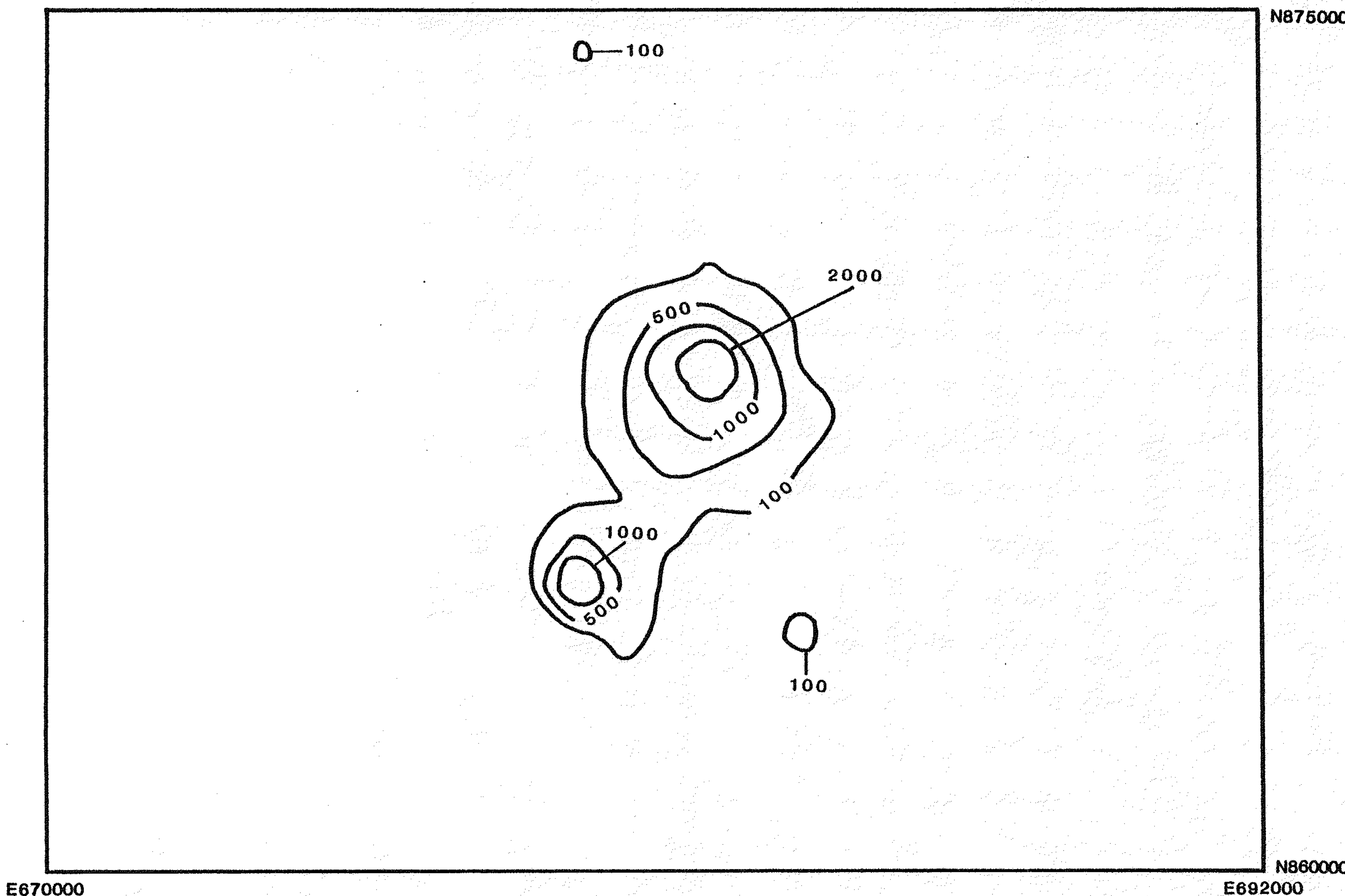


Figure 42. ^{60}Co distribution (nCi/m^2) in the Wilson area.

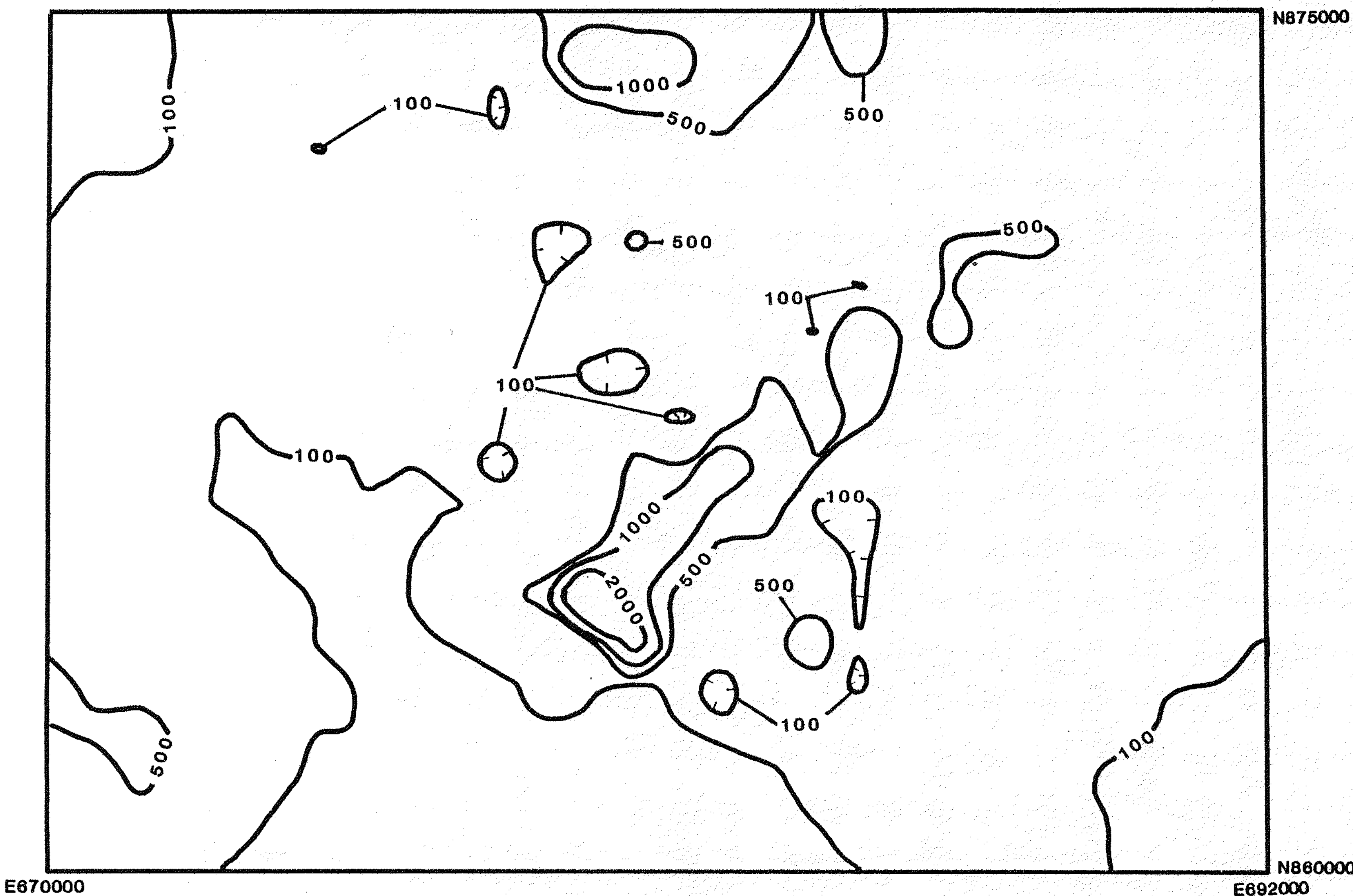


Figure 43. ^{137}Cs distribution (nCi/m^2) in the Wilson area.

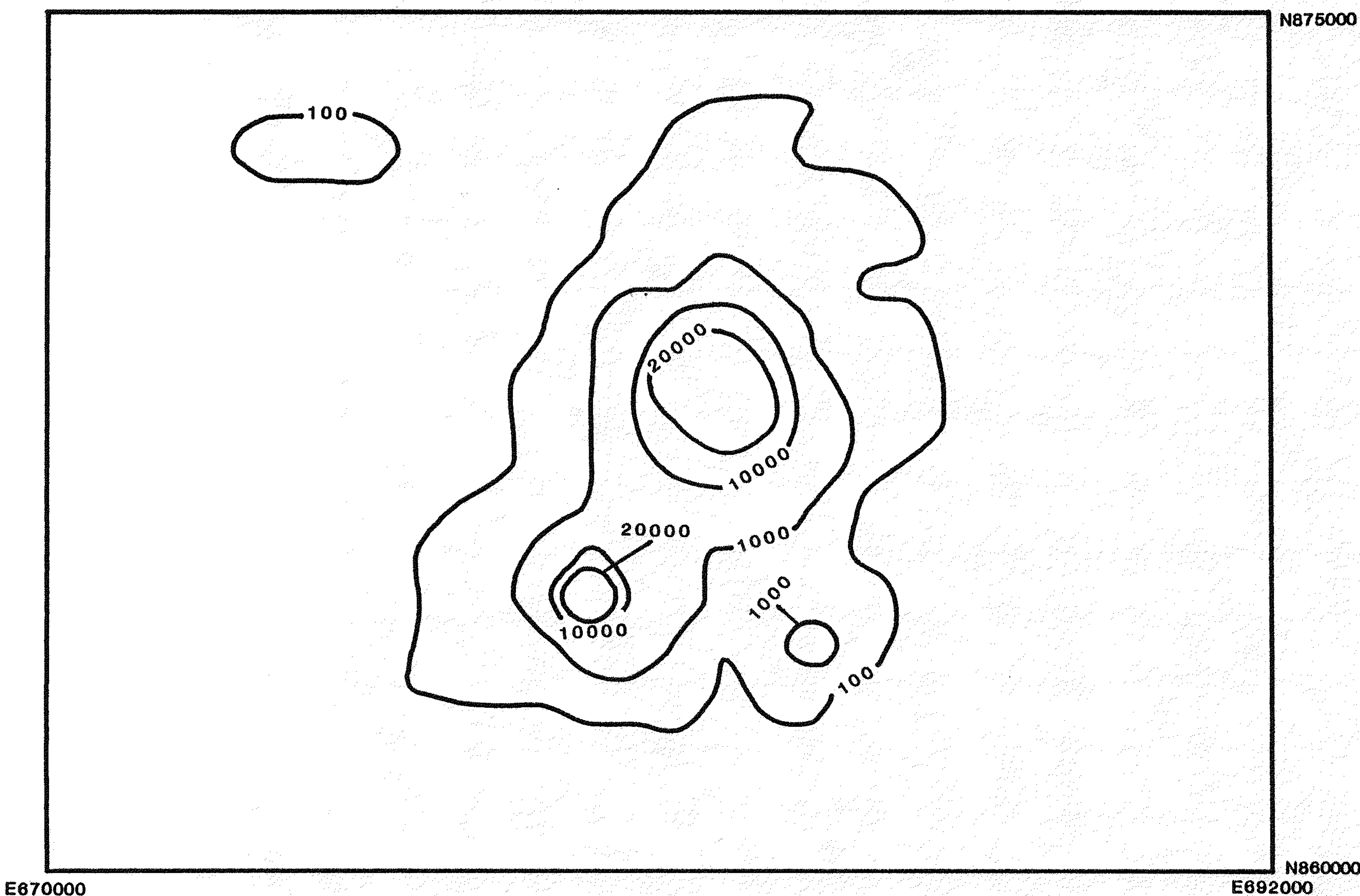


Figure 44. ^{152}Eu distribution (nCi/m^2) in the Wilson area.

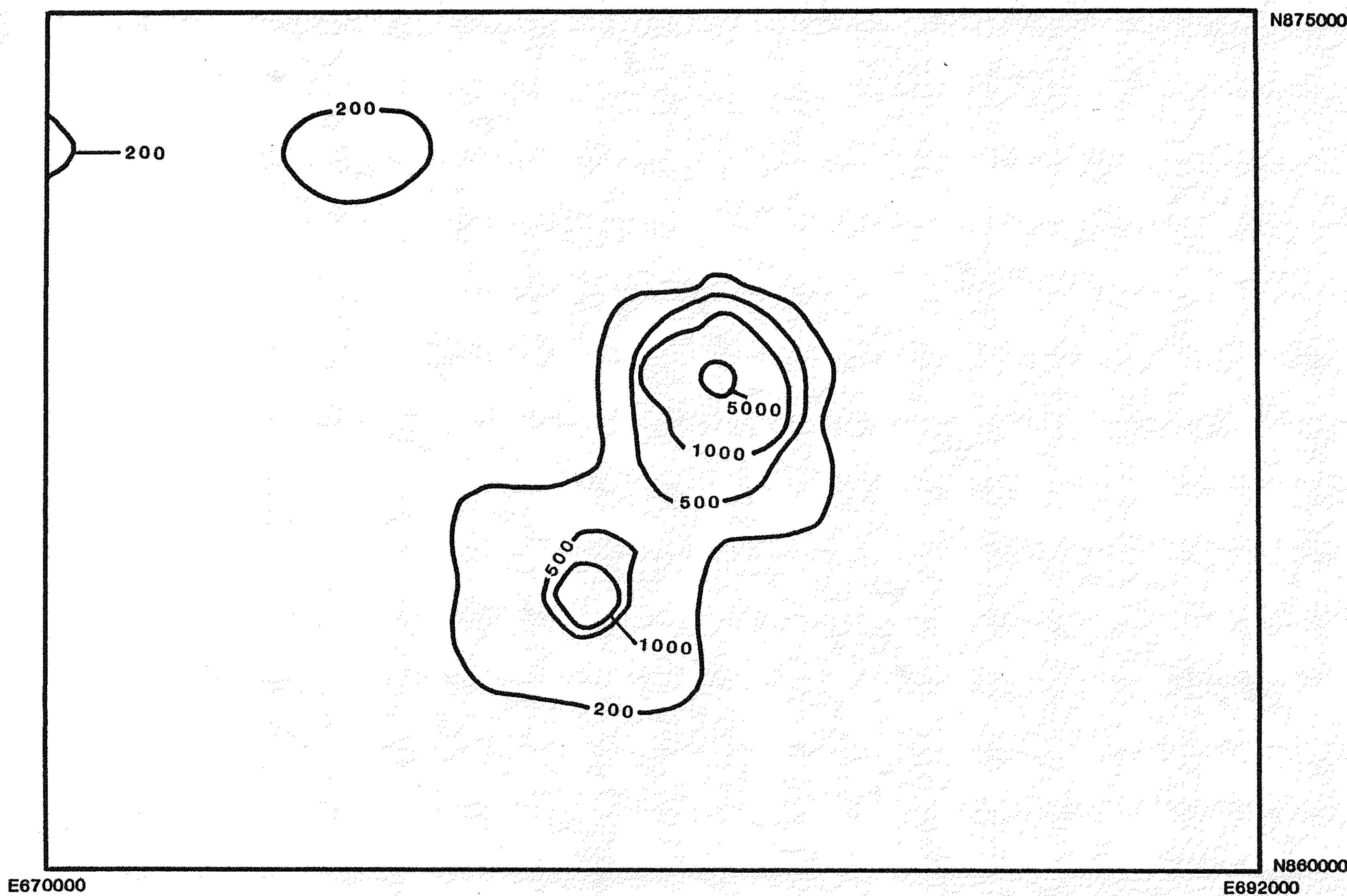


Figure 45. ^{154}Eu distribution (nCi/m^2) in the Wilson area.

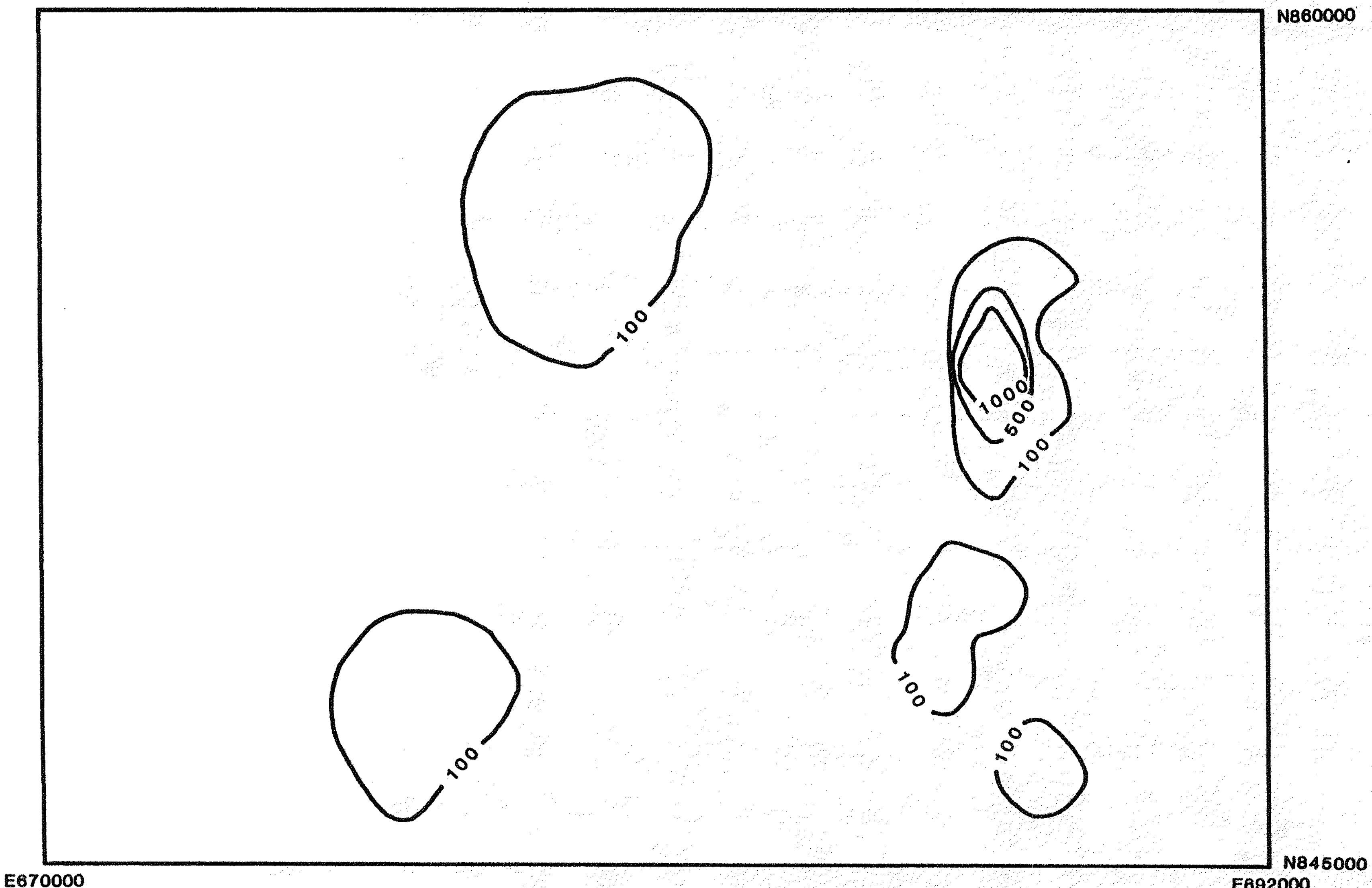


Figure 46. ^{241}Am distribution (nCi/m^2) in the Quay area.

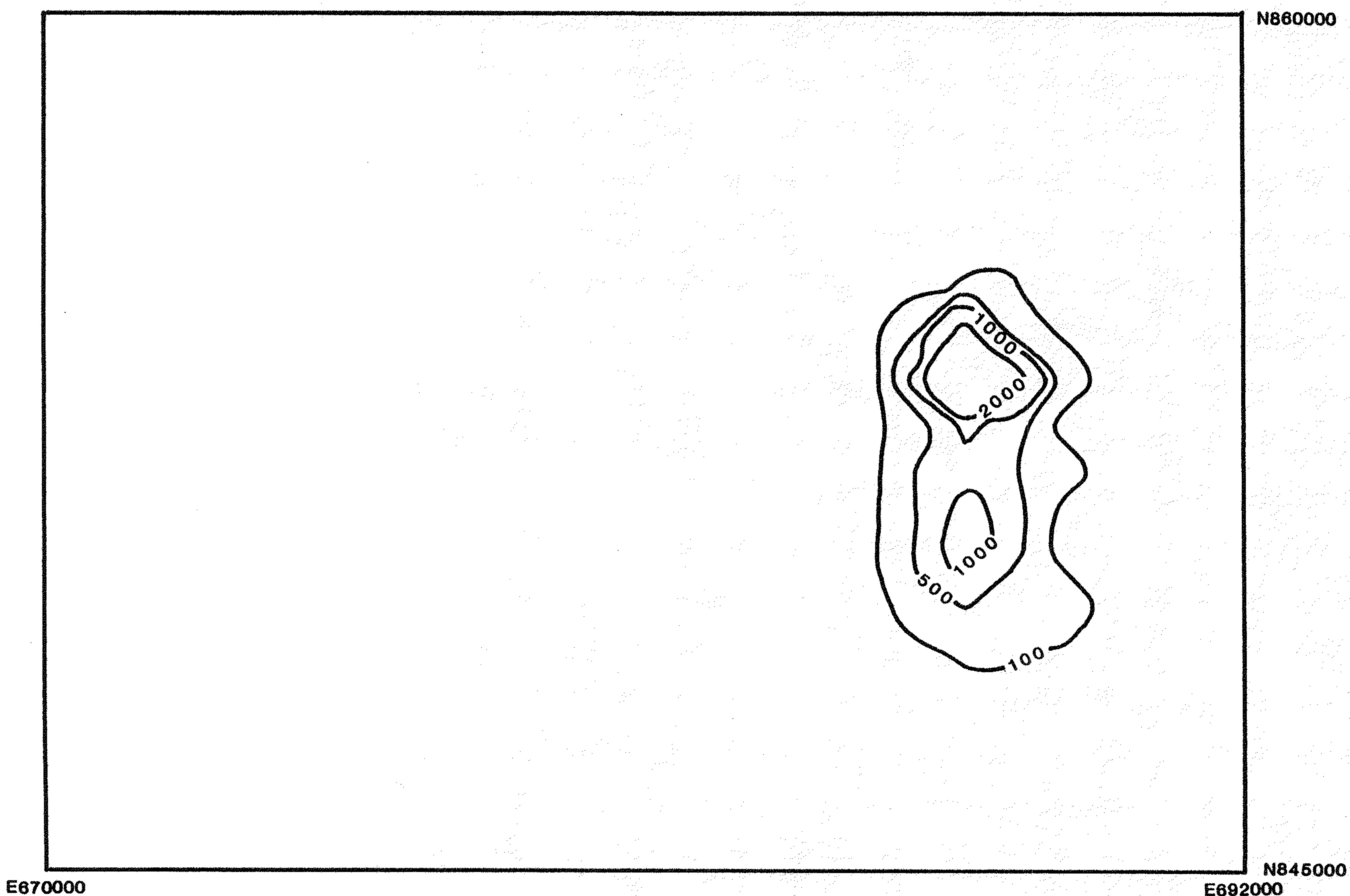


Figure 47. ^{60}Co distribution (nCi/m^2) in the Quay area.

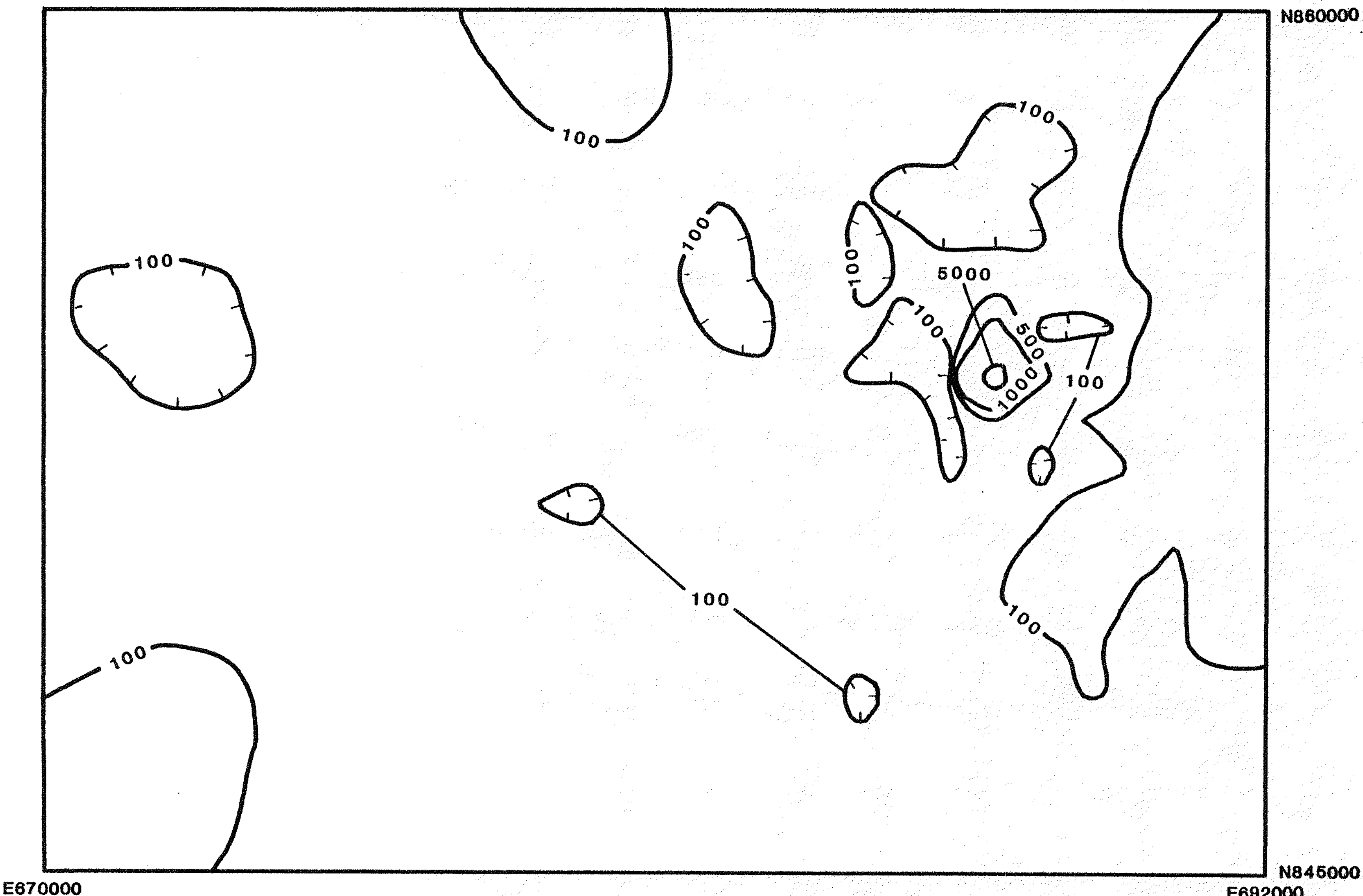


Figure 48. ^{137}Cs distribution (nCi/m^2) in the Quay area.

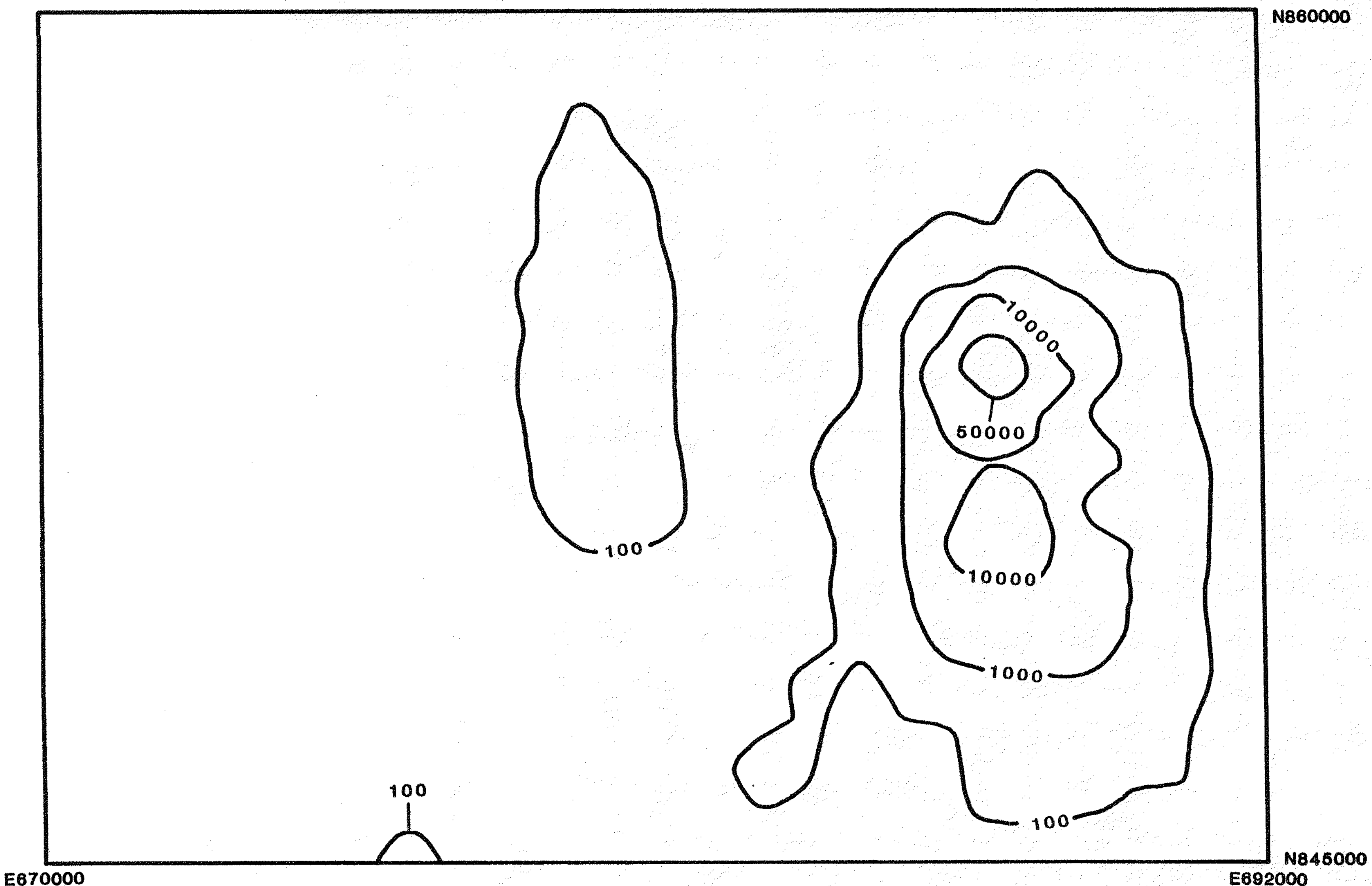


Figure 49. ^{152}Eu distribution (nCi/m^2) in the Quay area.

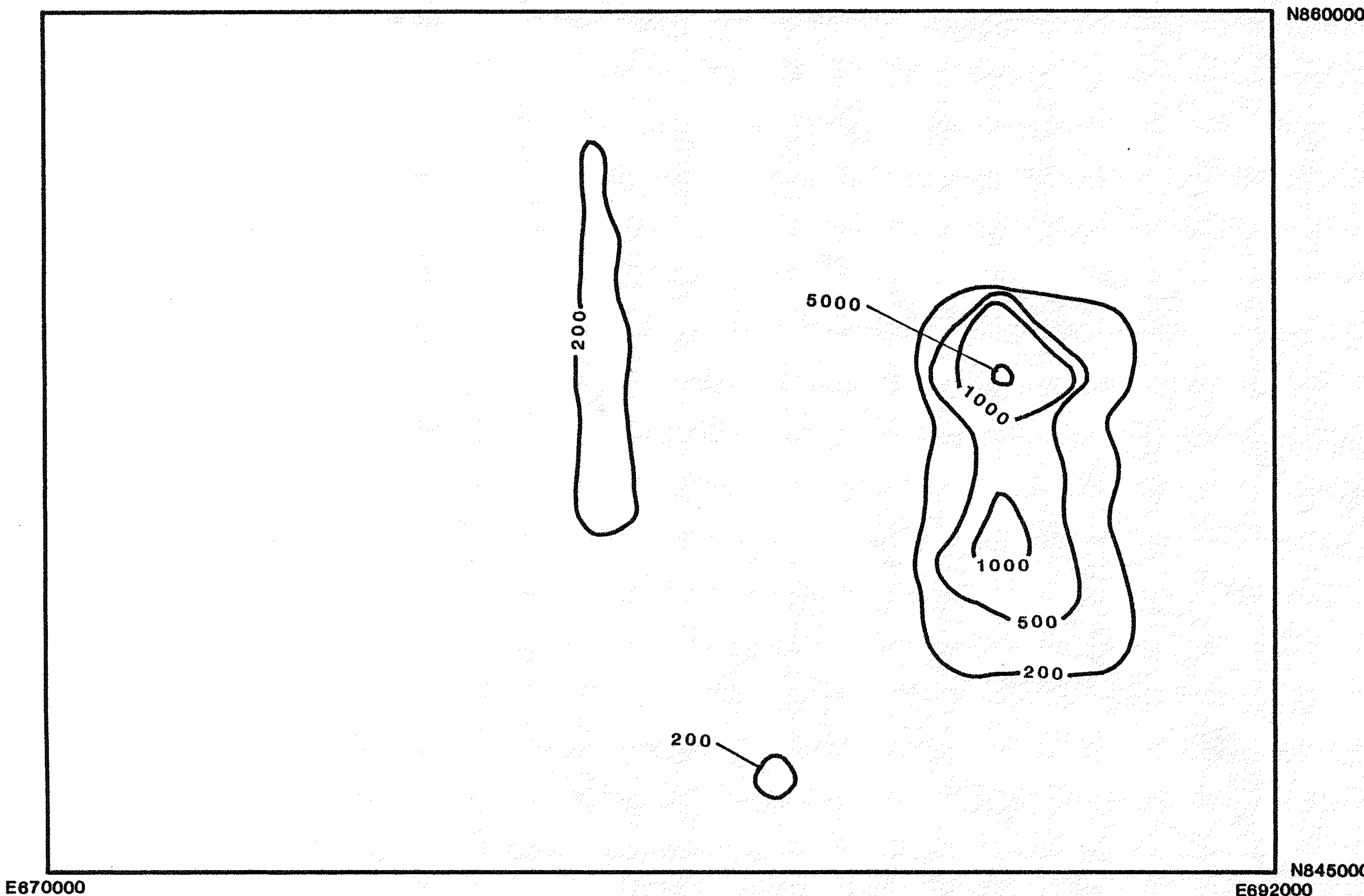


Figure 50. ^{154}Eu distribution (nCi/m^2) in the Quay area.

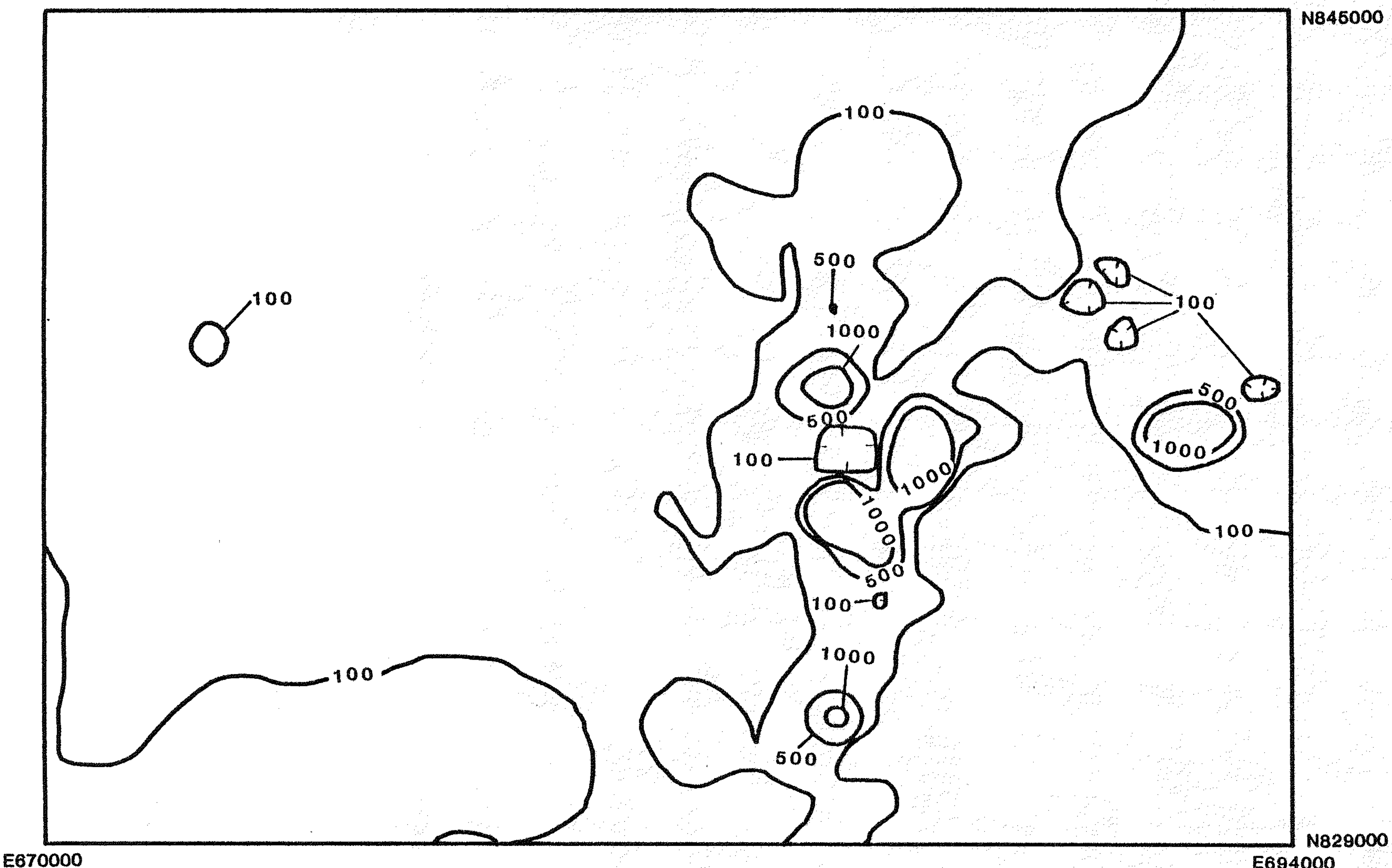


Figure 51. ^{241}Am distribution (nCi/m^2) in the Hornet area.

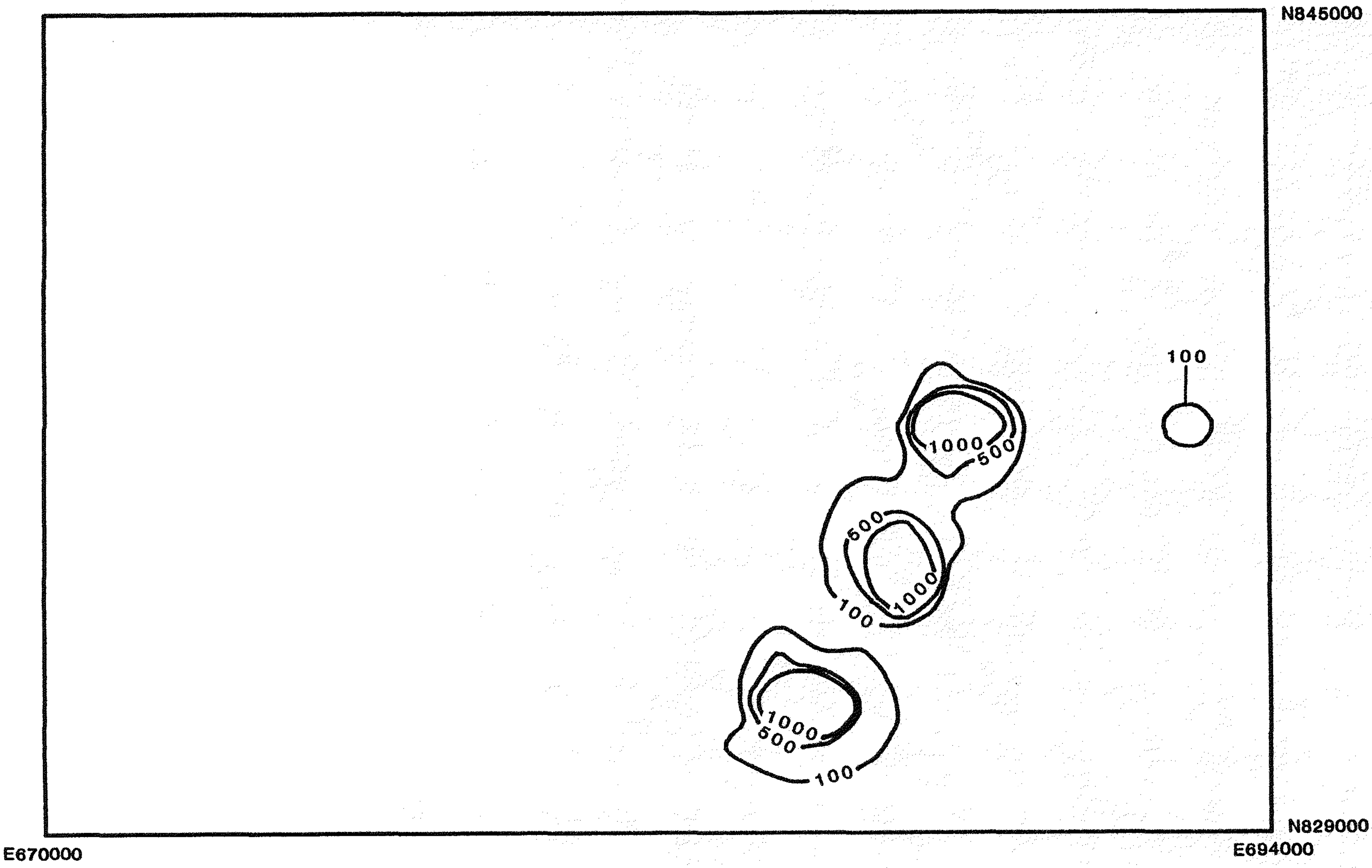


Figure 52. ^{60}Co distribution (nCi/m^2) in the Hornet area.

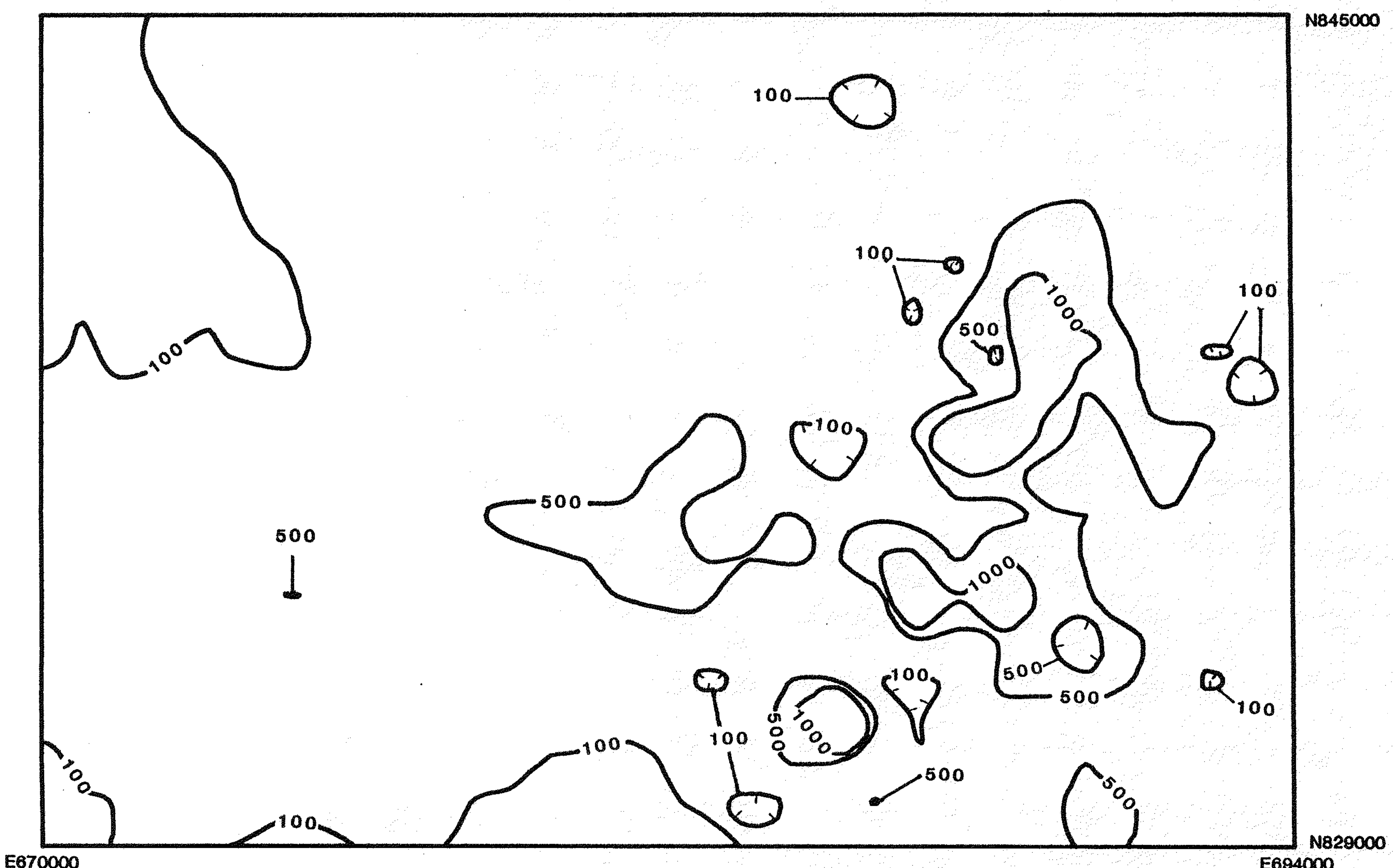


Figure 53. ^{137}Cs distribution (nCi/m^2) in the Hornet area.

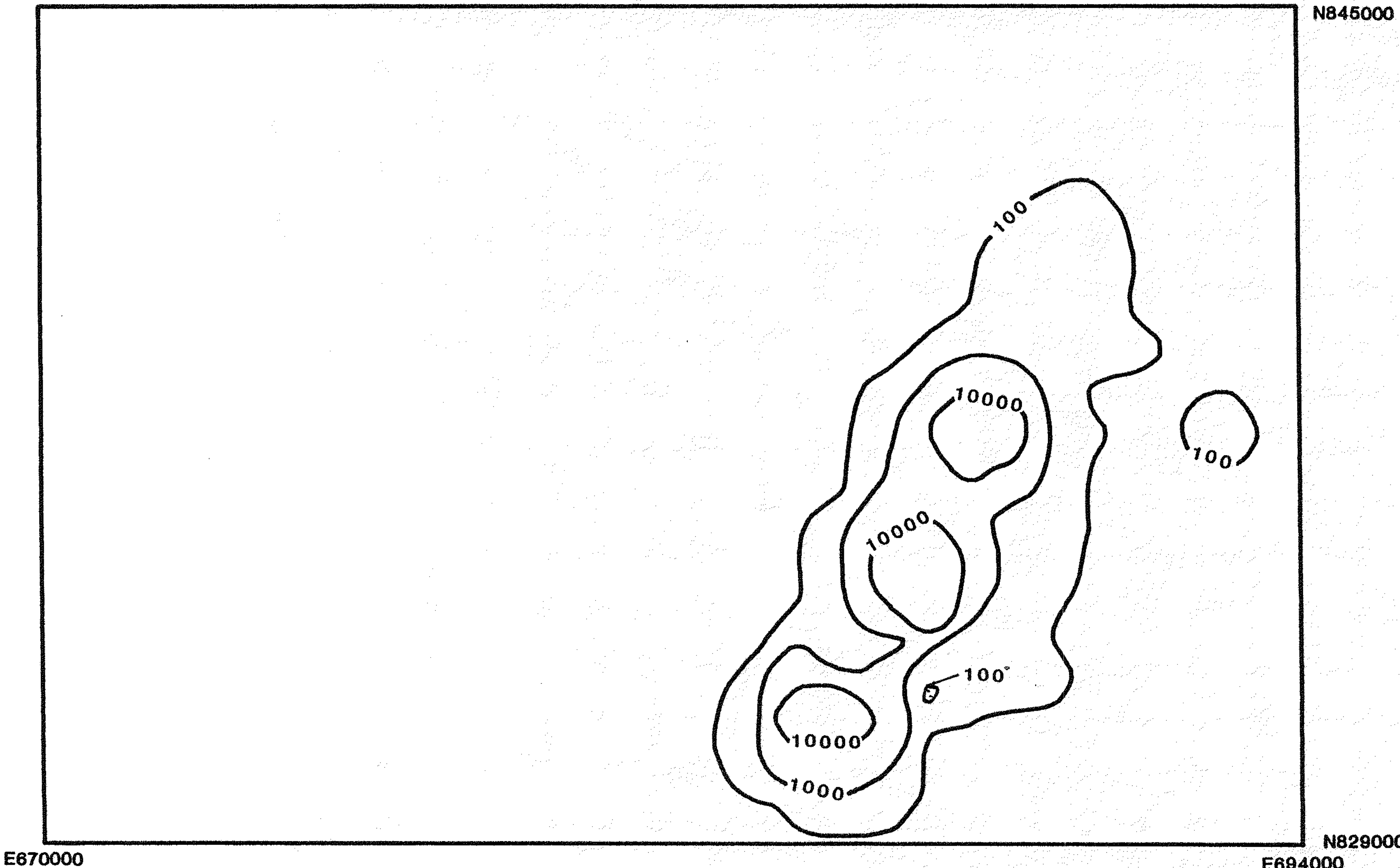


Figure 54. ^{152}Eu distribution (nCi/m^2) in the Hornet area.

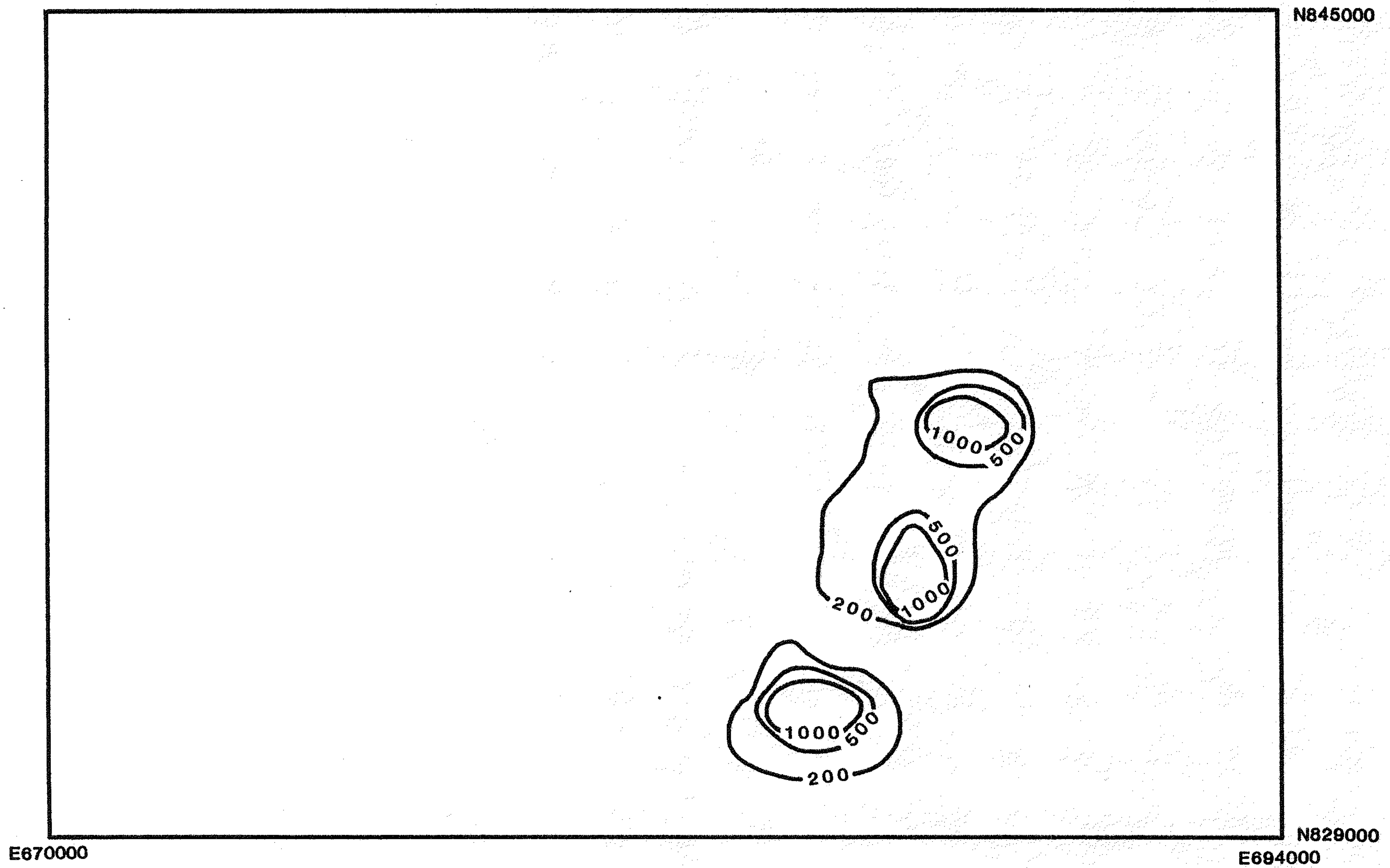


Figure 55. ^{154}Eu distribution (nCi/m^2) in the Hornet area.

SECTION 5
SOUTH YUCCA FLAT

The aerial survey showed low levels of radioactivity in the part of Yucca Flat south of the Galileo and Hornet GZs. *In situ* measurements were made in this region on a 6,000-foot grid as far south, west, and east as the terrain permitted. These measurements were taken only to confirm that activity in the region was low; there was no intent to estimate inventories or distributions from such widely-spaced measurements.

The results are summarized in Table 10. Except for ^{137}Cs, all radionuclides were reported as upper limit values at most of the sampling points. A relatively high level of ^{241}Am was found at one point directly south of the Galileo GZ, and an additional 16 measurements were taken near this point to help show the extent of the contamination. The ^{241}Am data are shown in Figure 56, and the ^{137}Cs data are shown in Figure 57.

TABLE 10. SUMMARY OF RADIONUCLIDE MEASUREMENTS FROM 30 POINTS IN THE SOUTHERN PART OF YUCCA FLAT

	Activity (nCi/m^2)			Number of measurements above the detection limit
	Minimum	Mean	Maximum	
^{241}Am	21	42	137	3
^{60}Co	4	10	13	1
^{137}Cs	12	42	90	23
^{152}Eu	19	33	41	1
^{154}Eu	25	61	84	0
^{155}Eu	23	35	47	1

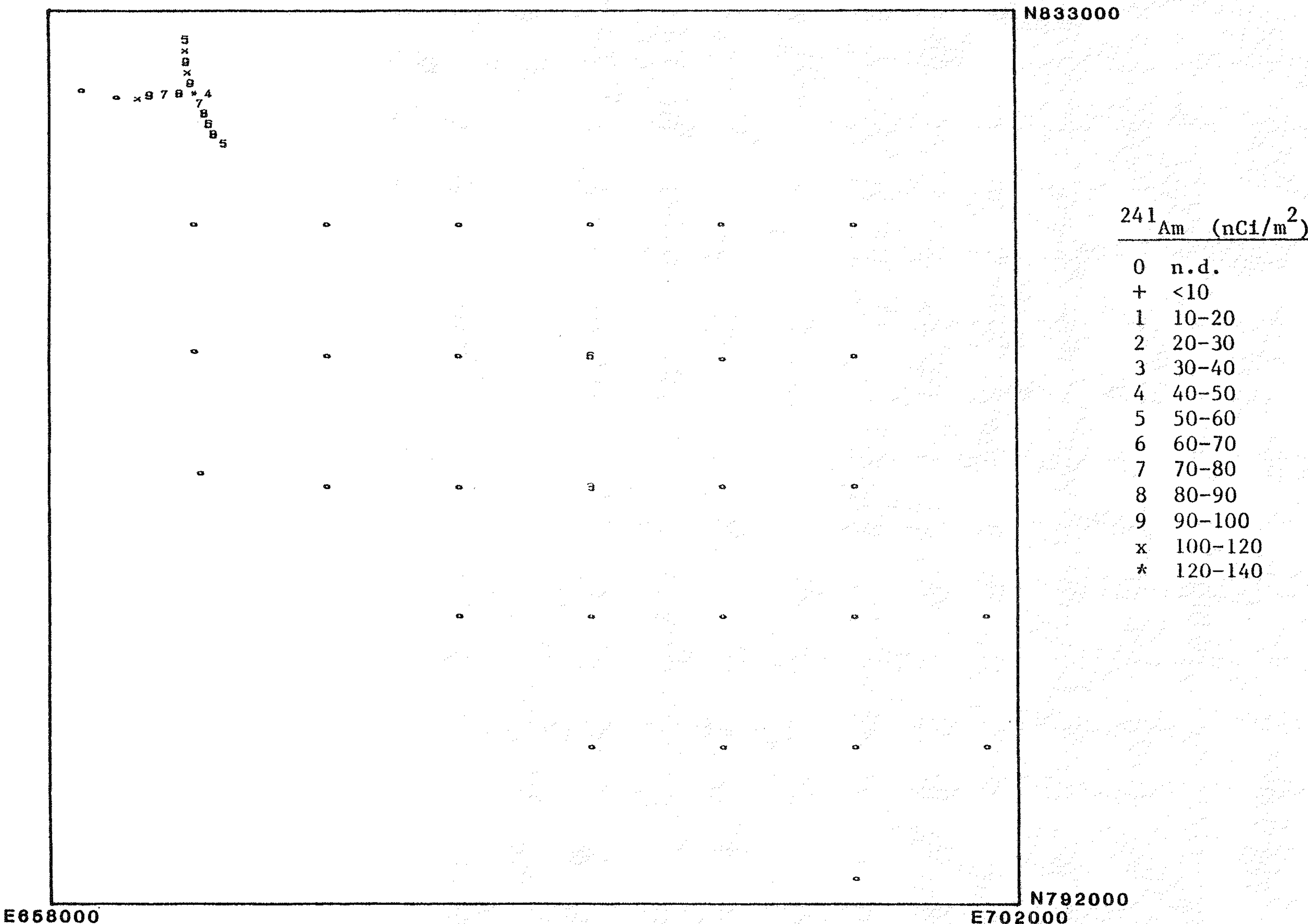


Figure 56. Measured ^{241}Am activities in the southern part of Yucca Flat.

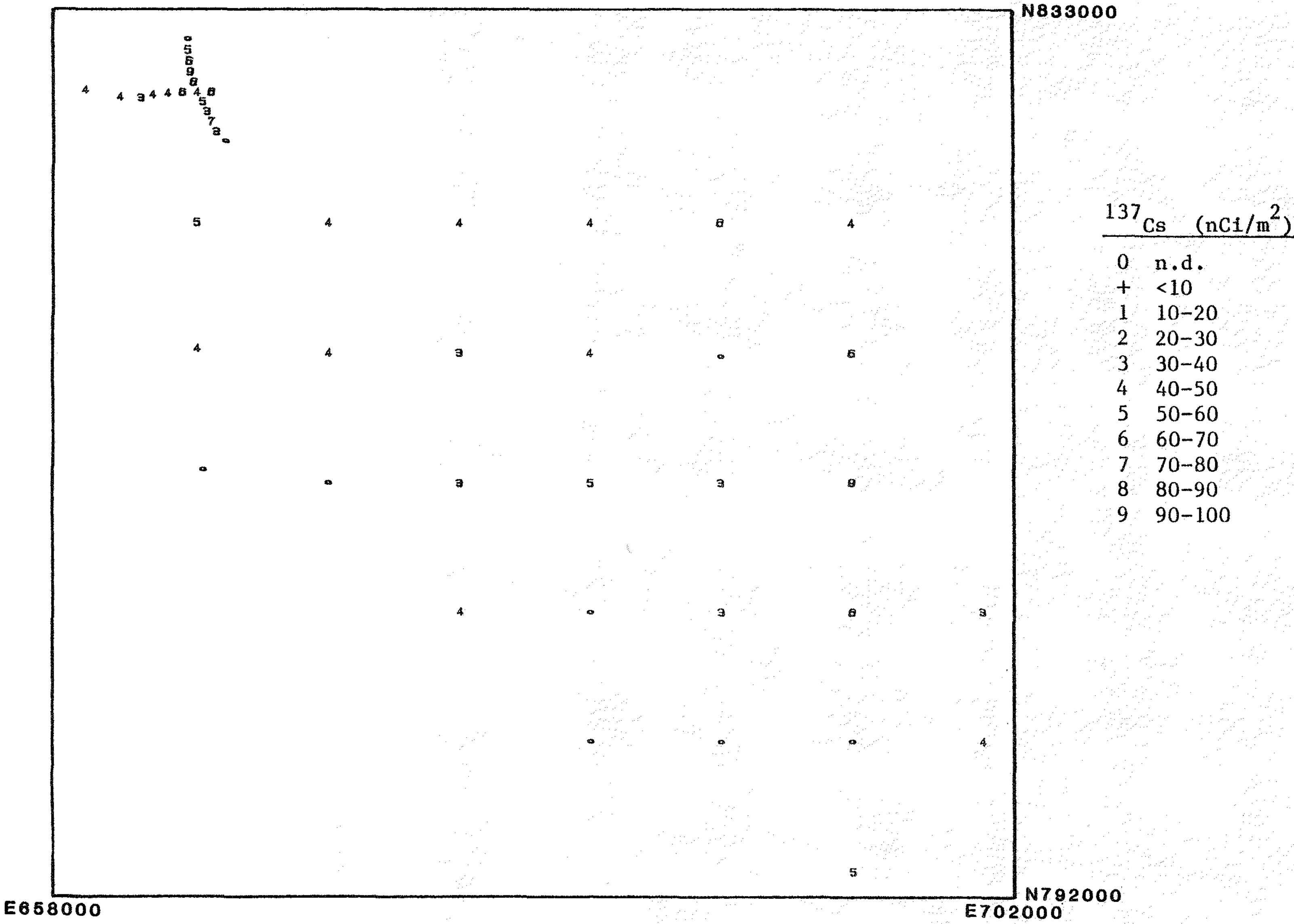


Figure 57. Measured ^{137}Cs activities in the southern part of Yucca Flat.

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APPENDIX A

LOCATIONS OF SOIL SAMPLES

APPENDIX A: LOCATIONS OF SOIL SAMPLES

Listed below are the Nevada Grid Coordinates and the original designation of each sampling location and the library numbers assigned to the samples from each location.

Point	Coordinates East	Coordinates North	Original Designation	Library Numbers
1	682641	872186	Wilson 20	19741-744
2	682631	870590	Wilson 45	19745-748
3	682637	869763	Wilson 61	19749-752
4	678623	868984	Wilson 68	19753-756
5	680022	869114	Wilson 70	19757-760
6	681057	868974	Wilson 71	19761-764
7	681846	868962	Wilson 72	19765-768
8	682669	868988	Wilson 73	19769-772
9	683442	868992	Wilson 74	19773-776
10	684279	868973	Wilson 75	19777-780
11	685057	868977	Wilson 76	19781-784
12	686675	868976	Wilson 77	19785-788
13	682629	868158	Wilson 90	19789-792
14	682615	867380	Wilson 102	19793-796
15	682637	866588	Wilson 119	19797-800
16	682622	865001	Wilson 149	19801-804
17	680234	865811	Wilson 129	20257-260
18	679437	864970	Wilson 145	20261-264
19	680236	864983	Wilson 146	20265-268
20	681041	864976	Wilson 147	20269-272
21	680208	864153	Wilson 161	20273-276
22	684206	864157	Wilson 166	20277-280
23	684645	864168	Wilson 167	20281-284
24	677029	884197	Sedan 79	19805-808
25	681871	890562	Sedan 138	19817-820
26	681801	887385	Sedan 140	19821-824
27	681810	879357	Sedan 146	19841-844
28	681802	876136	Sedan 148	19845-848
29	686582	884190	Sedan 206	19857-860
30	689816	884199	Sedan 232	19861-864
31	678617	884217	Sedan 97	20209-214
32	679441	884196	Sedan 113	20215-220
33	681819	885795	Sedan 141	20221-226
34	681800	884902	Sedan 142	20227-232
35	681837	882603	Sedan 143	20233-238
36	681819	881810	Sedan 144	20239-244
37	683438	884206	Sedan 165	20245-250
38	684196	884214	Sedan 176	20251-256
39	684983	831568	Hornet 105	20061-064
40	684993	832375	Hornet 107	20065-068
41	685382	831982	Hornet 123	20069-072
42	685803	831584	Hornet 134	20073-076
43	685785	832387	Hornet 136	20077-080
44	686223	834296	Hornet 151	20081-084
45	686242	835036	Hornet 152	20085-088
46	686457	834003	Hornet 163	20089-092
47	686588	834358	Hornet 164	20093-096
48	686595	834781	Hornet 165	20097-100
49	686591	835170	Hornet 166	20101-104
50	687157	833955	Hornet 177	20105-108
51	686982	834351	Hornet 178	20109-112
52	686999	834791	Hornet 179	20113-116
53	686989	835191	Hornet 180	20117-120
54	686973	836788	Hornet 181	20121-124
55	687369	834382	Hornet 190	20125-128
56	687405	834798	Hornet 191	20129-132
57	687394	835174	Hornet 192	20133-136
58	687497	836199	Hornet 194	20137-140

Point	Coordinates East	North	Original Designation	Library Numbers
59	687383	837169	Hornet 196	20141-144
60	687808	834788	Hornet 203	20145-148
61	687805	836768	Hornet 205	20149-152
62	688197	837164	Hornet 218	20153-156
63	688590	836775	Hornet 225	20157-160
64	673843	888212	Sedan 30	19865-868
65	673834	886993	Sedan 33	19869-872
66	674231	887789	Sedan 44	19873-876
67	674253	887412	Sedan 45	19877-880
68	674684	887801	Sedan 49	19881-884
69	674623	887384	Sedan 50	19885-888
70	675032	888191	Sedan 54	19889-892
71	675039	886985	Sedan 57	19893-896
72	675444	889003	Sedan 58	19897-900
73	675458	886599	Sedan 61	19901-904
74	686597	849583	Quay 87	19953-956
75	687385	850770	Quay 90	19957-960
76	687399	853170	Quay 94	19961-964
77	687390	853971	Quay 95	19965-967
78	687007	849974	Quay 101	19968-971
79	686990	851170	Quay 104	19972-975
80	688213	849959	Quay 110	19976-979
81	687391	850359	Quay 111	19980-983
82	688192	853177	Quay 116	19984-987
83	688187	853983	Quay 117	19988-991
84	687797	849990	Quay 125	19992-995
85	687806	850370	Quay 126	19996-999
86	687393	854395	Quay 197	20000-003
87	687796	853561	Quay 207	20004-007
88	688619	854366	Quay 211	20008-011
89	687791	853958	Quay 215	20012-015
90	688593	853178	Quay 216	20016-019
91	674305	886110	Sedan 274	20489-492
92	674282	886310	Sedan 276	20493-496
93	674288	885921	Sedan 273	20497-500
94	674492	886116	Sedan 275	20501-504
95	673042	886173	Sedan 242	20505-508
96	674242	885554	Sedan 270	20509-512
97	674247	885743	Sedan 272	20513-516
98	674240	885409	Sedan 268	20517-520
99	674445	885546	Sedan 271	20521-524
100	674042	885555	Sedan 269	20525-528
101	658562	888839	Baneberry 7	19325-328
102	660838	886456	Baneberry 16	19321-324
103	663266	884859	Baneberry 31	19317-320
104	662467	879652	Baneberry 29	19277-280
105	664076	881273	Baneberry 48	19273-276
106	664467	883675	Baneberry 49	19313-316
107	664862	882085	Baneberry 53	19269-272
108	665125	882525	Baneberry 60	19297-300
109	666061	883663	Baneberry 81	19281-284
110	665671	882096	Baneberry 73	19285-288
111	666463	881290	Baneberry 90	19289-292
112	667289	880489	Baneberry 115	19293-296
113	667295	885709	Baneberry 105	19301-304
114	668843	887282	Baneberry 133	19305-308
115	669666	888494	Baneberry 143	19309-312

APPENDIX B

RADIONUCLIDE CONCENTRATIONS IN SOIL SAMPLES

APPENDIX B: RADIONUCLIDE CONCENTRATIONS IN SOIL SAMPLES

The depth increments are a = 0 - 2.5 cm, b = 2.5 - 5 cm, c = 5 - 10 cm, d = 10 - 15 cm, except at points 31 through 38, where they are a = 0 - 5 cm, b = 5 - 10 cm, c = 10 - 15 cm, d = 15 - 20 cm, e = 20 - 25 cm, f = 25 - 30 cm. Concentration values apply to the natural (wet) soil. Values with 100% error are upper limit values. Concentrations have been omitted when all of the values for a particular radionuclide were upper limit values.

Point & Increment	Weight (g)			Concentration (pCi/g) and s.d. (%)									
	Wet	Dry	Fine	^{60}Co		^{137}Cs		^{152}Eu		^{155}Eu		^{241}Am	
1 a	446	391	347	1.93e-01	18.4	3.97e+00	5.2	1.30e+00	5.1	3.70e-01	47.0	4.56e-01	54.3
b	494	432	411	7.16e-02	40.4	5.64e-01	9.6	7.11e-01	7.3	1.18e-01	100.0	3.41e-01	100.0
c	928	808	932	3.91e-02	100.0	8.30e-02	42.1	9.66e-01	8.4	3.69e-01	41.4	4.21e-01	100.0
d	864	745	704	3.51e-02	100.0	3.75e-02	100.0	7.83e-01	10.1	2.31e-01	28.9	4.00e-01	100.0
2 a	413	373	326	2.71e+00	4.4	1.12e+01	2.6	4.82e+01	1.2	1.05e+00	29.1	1.50e+00	37.9
b	486	439	376	1.35e+00	3.6	1.32e+01	2.2	1.59e+01	1.8	1.12e+00	28.1	6.40e-01	43.3
c	977	868	759	9.74e-01	7.2	1.50e-01	25.7	1.42e+01	2.3	3.82e-01	46.7	3.15e-01	100.0
d	958	849	750	1.06e+00	5.7	4.27e-02	100.0	1.44e+01	1.4	1.81e-01	100.0	3.13e-01	100.0
3 a	348	307	305	2.92e+00	2.8	2.19e+00	11.3	5.81e+01	1.8	2.73e-01	100.0	4.31e-01	100.0
b	392	369	363	2.22e+00	2.7	1.85e+00	12.8	4.14e+01	1.6	2.35e-01	100.0	5.56e-01	63.8
c	758	679	644	3.36e+00	1.8	5.04e+00	6.6	6.03e+01	2.1	2.10e-01	100.0	5.87e-01	68.1
d	860	781	578	3.96e+00	1.8	3.59e+00	12.5	6.37e+01	1.6	2.02e-01	100.0	2.42e-01	100.0
4 a	283	212	180	1.04e-01	23.2	1.38e+00	5.7	1.54e-01	35.4	6.76e-02	100.0	3.32e-01	23.0
b	477	434	310	1.41e-01	12.6	1.84e+00	3.5	4.32e-01	11.8	3.36e-01	18.8	2.03e-01	39.4
c	942	850	723	6.83e-02	30.3	1.04e+00	13.7	4.11e-01	23.0	2.61e-01	37.7	2.07e-01	55.7
d	952	862	721	3.54e-02	100.0	3.80e-02	100.0	3.95e-01	22.4	3.16e-01	49.2	4.23e-01	100.0
5 a	265	237	212	4.54e-01	13.9	2.88e+00	5.2	3.02e+00	4.7	4.54e-01	28.1	4.20e-01	100.0
b	461	418	377	4.44e-01	8.3	3.44e+00	3.1	3.56e+00	3.0	4.38e-01	55.1	4.30e-01	100.0
c	778	689	648	3.73e-01	8.2	8.81e-01	8.0	4.33e+00	3.0	3.69e-01	70.4	2.37e-01	100.0
d	896	786	722	4.18e-01	7.5	7.41e-02	71.3	4.98e+00	2.8	2.95e-01	67.4	2.53e-01	100.0
6 a	398	382	196	2.24e+00	4.2	4.91e+00	4.5	2.60e+01	1.7	4.20e-01	94.0	9.12e-01	43.5
b	368	341	268	2.32e+00	2.9	6.29e+00	3.6	2.58e+01	1.9	5.42e-01	98.9	6.98e-01	54.6
c	725	646	516	2.58e+00	3.3	9.54e-01	17.8	2.78e+01	2.1	2.04e-01	100.0	3.41e-01	100.0
d	743	679	417	1.97e+00	3.0	5.26e-02	100.0	2.43e+01	1.8	3.64e-01	46.8	2.98e-01	100.0
7 a	347	327	264	6.89e+00	1.9	2.50e+00	10.9	9.88e+01	1.4	3.41e-01	100.0	5.32e-01	100.0
b	424	384	344	6.68e+00	1.5	3.22e+00	4.2	1.07e+02	1.2	5.66e-01	48.3	2.67e-01	100.0
c	777	706	677	6.78e+00	1.5	6.23e+00	10.7	1.18e+02	1.6	2.84e-01	100.0	4.95e-01	51.3
d	745	674	650	6.75e+00	2.3	2.47e+00	12.9	1.12e+02	1.0	2.71e-01	100.0	3.22e-01	100.0
8 a	322	301	270	2.05e+01	1.0	3.19e+00	7.8	2.88e+02	1.2	3.83e-01	100.0	4.20e-01	100.0
b	454	412	380	2.13e+01	2.0	2.48e+00	13.6	2.98e+02	1.6	3.97e-01	100.0	4.41e-01	100.0
c	802	722	670	2.22e+01	1.1	1.81e+00	9.0	3.18e+02	1.0	1.83e+00	86.6	1.10e+00	100.0
d	813	733	637	2.20e+01	1.2	2.46e+00	6.9	3.13e+02	1.0	6.50e-01	100.0	1.06e+00	100.0

Point & Increment	Weight (g) Wet	Dry	Fine	Concentration (pCi/g) and s.d. (%) ^{60}Co		^{137}Cs		^{152}Eu		^{155}Eu		^{241}Am	
9 a	360	343	303	3.78e+00	2.1	7.30e+00	4.3	6.33e+01	1.5	5.66e-01	85.0	2.76e+00	24.0
b	488	454	338	5.24e+00	1.8	2.76e+00	7.7	6.38e+01	1.4	2.89e-01	100.0	2.64e+00	29.4
c	886	819	651	6.16e+00	1.8	8.71e-02	100.0	7.80e+01	1.5	8.36e-01	73.4	5.45e-01	100.0
d	853	788	603	6.01e+00	1.8	8.68e-02	100.0	7.99e+01	1.1	3.35e-01	100.0	5.41e-01	100.0
10 a	365	337	252	8.39e-02	30.9	6.25e-01	9.3	1.01e+00	6.3	1.49e-01	40.7	2.47e-01	68.6
b	318	289	206	2.23e-02	100.0	1.70e-01	16.7	4.80e-01	7.7	5.29e-02	100.0	6.86e-02	100.0
c	883	816	473	7.41e-02	21.8	5.10e-01	10.1	9.97e-01	5.7	1.50e-01	49.9	2.34e-01	53.6
d	859	796	426	1.47e-02	100.0	1.26e-01	13.1	2.01e-01	15.3	4.94e-02	100.0	6.64e-02	100.0
11 a	419	377	230	7.61e-01	4.2	1.54e+01	5.3	4.37e+00	3.1	1.04e+00	15.8	4.28e+00	14.4
b	395	358	216	5.24e-01	6.2	7.39e+00	3.4	3.17e+00	2.8	4.01e-01	32.6	1.51e+00	14.1
c	836	792	429	2.92e-01	6.9	1.54e+00	3.2	2.49e+00	2.8	1.46e-01	50.4	2.05e-01	29.7
d	810	767	338	1.89e-01	8.3	7.22e-02	28.5	1.98e+00	2.4	5.09e-02	100.0	6.29e-02	100.0
12 a	396	354	208	4.90e-01	4.8	1.12e+01	1.8	4.98e-01	8.4	8.65e-01	19.9	1.97e+00	10.5
b	345	305	217	1.58e-01	11.5	3.60e+00	3.4	2.67e-01	13.8	2.72e-01	19.3	5.18e-01	19.9
c	971	900	508	1.83e-02	100.0	3.62e-01	12.0	1.74e-01	23.4	5.64e-02	100.0	7.44e-02	100.0
d	739	675	460	1.74e-02	100.0	8.71e-02	69.8	2.51e-01	26.3	1.40e-01	79.2	6.93e-02	100.0
13 a	448	410	345	6.52e-01	9.3	4.35e-01	17.7	1.08e+01	1.8	9.13e-02	100.0	1.12e-01	100.0
b	463	423	371	1.31e+00	4.5	5.90e-01	29.0	2.30e+01	1.9	4.17e-01	54.6	2.90e-01	100.0
c	933	858	748	8.52e+00	1.6	2.68e+00	11.4	1.28e+02	1.2	4.67e-01	100.0	7.72e-01	100.0
d	971	895	795	2.09e+01	1.3	2.66e+00	9.7	3.12e+02	1.0	2.38e+00	91.8	1.24e+00	100.0
14 a	384	341	302	3.00e+00	2.4	1.35e+01	3.6	4.36e+01	1.8	1.39e+00	28.5	4.98e+00	21.3
b	415	381	289	2.56e+00	2.5	2.99e+00	6.6	3.64e+01	1.9	4.24e-01	37.6	1.11e+00	29.7
c	789	727	513	2.93e+00	2.4	4.07e-01	15.5	4.26e+01	1.8	2.40e-01	100.0	3.87e-01	100.0
d	848	753	620	3.50e+00	3.4	6.97e-02	100.0	5.01e+01	1.9	2.72e-01	100.0	4.41e-01	100.0
15 a	350	318	283	1.26e+00	3.8	1.66e+01	1.7	1.38e+01	2.8	9.61e-01	47.0	5.14e+00	21.8
b	317	280	249	1.44e+00	3.5	2.13e+01	1.5	1.44e+01	2.5	1.42e+00	26.3	1.05e+01	20.4
c	877	794	638	8.95e-01	4.2	6.54e+00	2.2	9.50e+00	1.9	5.82e-01	42.8	1.59e+00	28.8
d	859	761	640	8.14e-01	4.8	2.03e+00	5.9	1.01e+01	2.1	3.31e-01	39.6	3.82e-01	30.9
16 a	314	276	230	6.13e-01	5.3	8.55e+00	3.5	3.19e+00	4.0	5.21e-01	50.4	9.28e+00	20.1
b	424	376	290	2.63e-01	10.3	2.73e+00	3.3	2.92e+00	3.4	2.69e-01	59.0	7.76e+00	21.3
c	853	744	676	9.77e-02	18.9	4.27e-01	17.4	1.54e+00	6.3	2.96e-01	90.4	8.67e-01	28.2
d	882	747	682	8.79e-02	23.3	2.30e-02	100.0	1.13e+00	7.3	1.05e-01	100.0	1.96e-01	100.0
17 a	408	402	310	1.53e+00	4.7	4.37e+00	5.7	2.88e+01	1.8	7.97e-01	70.0	6.50e-01	100.0
b	434	418	339	1.58e+00	4.7	2.70e+00	9.9	2.76e+01	2.5	8.20e-01	76.2	6.44e-01	100.0
c	842	785	736	1.54e+00	4.3	6.52e-01	15.1	2.74e+01	1.2	3.26e-01	100.0	7.66e-01	100.0
d	662	615	578	1.12e+00	5.1	6.76e-02	100.0	1.94e+01	1.6	2.54e-01	100.0	5.96e-01	100.0
18 a	328	317	293	4.43e-01	9.6	7.54e-01	10.7	6.18e+00	2.3	4.21e-01	86.6	4.31e-01	100.0
b	363	345	319	3.32e-01	11.5	5.08e-02	100.0	5.91e+00	2.2	3.68e-01	68.8	4.21e-01	100.0
c	695	652	616	2.51e-01	14.0	4.80e-02	100.0	4.22e+00	2.5	3.27e-01	31.1	4.55e-01	100.0
d	782	726	700	1.26e-01	55.9	4.52e-02	100.0	2.76e+00	5.7	4.40e-01	57.5	4.66e-01	100.0

Point & Increment	Weight (g)			Concentration (pCi/g) and s.d. (%)									
	Wet	Dry	Fine	^{60}Co		^{137}Cs		^{152}Eu		^{155}Eu		^{241}Am	
19 a	377	371	289	6.83e+00	2.5	4.62e+01	1.7	9.62e+01	1.6	3.73e+00	20.6	9.83e+00	36.6
b	409	385	352	6.74e+00	2.2	1.42e+01	4.6	1.06e+02	1.2	2.01e+00	67.6	1.14e+00	100.0
c	765	708	639	7.09e+00	2.0	3.34e+00	13.2	1.20e+02	1.1	5.86e-01	100.0	1.30e+00	100.0
d	760	703	629	5.47e+00	2.3	2.74e+00	11.4	9.12e+01	1.3	5.12e-01	100.0	1.14e+00	100.0
20 a	334	327	198	2.03e+00	5.5	1.10e+01	3.9	3.26e+01	2.2	1.02e+00	48.3	1.70e+00	54.8
b	415	397	251	1.64e+00	5.6	3.09e-01	23.0	3.50e+01	1.5	2.95e-01	100.0	6.57e-01	100.0
c	698	657	429	1.59e+00	4.6	8.58e-02	100.0	3.12e+01	1.8	2.92e-01	100.0	6.52e-01	100.0
d	892	835	568	1.18e+00	5.5	7.45e-02	100.0	2.32e+01	2.3	6.00e-01	73.9	6.27e-01	100.0
21 a	436	422	401	5.22e-01	8.5	8.96e-01	10.9	8.65e+00	1.6	1.97e-01	100.0	4.84e-01	100.0
b	368	354	334	5.20e-01	6.2	3.16e-01	23.5	8.46e+00	2.3	3.82e-01	97.1	2.29e-01	100.0
c	830	787	762	5.38e-01	7.6	4.00e-01	17.8	8.34e+00	2.1	4.84e-01	91.2	2.96e-01	100.0
d	673	629	594	3.75e-01	8.9	2.13e-01	34.5	5.26e+00	3.0	2.49e-01	37.0	2.28e-01	100.0
22 a	381	370	249	3.18e-01	10.4	8.49e-01	8.6	7.19e+00	2.1	3.40e-01	98.0	2.50e+01	54.5
b	385	366	253	2.08e-01	13.4	3.19e-02	100.0	4.94e+00	2.8	3.40e-01	80.5	1.85e-01	100.0
c	877	823	598	1.59e-01	13.3	2.90e-02	100.0	3.96e+00	2.8	3.44e-01	85.2	2.00e-01	100.0
d	790	738	510	1.20e-01	21.8	2.67e-02	100.0	2.52e+00	3.6	3.16e-01	70.9	1.74e-01	100.0
23 a	384	378	281	7.69e-01	6.3	3.45e+00	5.0	1.26e+01	2.2	3.18e-01	46.8	1.91e+01	22.6
b	383	371	304	1.02e+00	4.4	2.18e+00	7.9	1.76e+01	2.0	1.81e-01	100.0	1.17e+00	30.8
c	704	677	519	9.87e-01	4.6	1.30e-01	32.7	1.82e+01	1.9	4.59e-01	62.3	2.82e-01	100.0
d	738	701	588	8.85e-01	5.0	4.19e-02	100.0	1.54e+01	2.1	1.85e-01	100.0	2.85e-01	100.0
24 a	261	258	185	2.49e+01	1.8	6.78e+01	2.5	2.49e+00	10.3	7.11e+00	9.5	2.13e+01	39.2
b	352	340	221	1.25e+01	1.3	5.38e+01	2.8	2.19e+00	9.6	4.18e+00	12.7	1.12e+01	44.1
c	772	741	378	3.66e-01	12.1	3.37e+00	3.3	1.69e-01	39.7	3.22e-01	24.3	1.81e-01	100.0
d	798	760	406	2.11e-02	100.0	2.94e-01	12.8	5.60e-02	100.0	1.42e-01	36.7	1.33e-01	100.0
25 a	396	389	330	8.61e-01	5.9	2.64e+01	5.3	1.64e-01	100.0	7.08e-01	31.8	3.35e+00	43.5
b	363	348	328	4.13e-02	100.0	4.20e+00	3.9	9.44e-02	100.0	1.25e-01	100.0	3.40e-01	100.0
c	806	777	702	2.66e-02	100.0	5.83e-01	7.6	8.60e-02	100.0	1.24e-01	100.0	3.37e-01	100.0
d	841	796	669	3.27e-02	100.0	1.49e-01	17.9	8.38e-02	100.0	1.21e-01	100.0	3.27e-01	100.0
26 a	258	250	249	1.21e+01	2.1	3.52e+01	3.4	1.22e+00	17.0	3.11e+00	8.6	9.10e+00	28.6
b	348	320	319	1.51e+01	4.1	4.95e+01	1.1	1.38e+00	14.9	4.01e+00	10.7	1.22e+01	28.2
c	708	648	630	3.80e+00	3.4	3.79e+01	1.1	1.11e+00	12.3	1.49e+00	18.4	4.60e+00	28.2
d	813	749	718	2.38e-01	15.3	2.33e+00	4.6	1.14e-01	100.0	3.46e-01	57.1	4.24e-01	100.0
27 a	333	320	270	4.85e+00	6.4	2.49e+01	2.9	9.85e-01	34.8	8.39e-01	100.0	2.28e+00	100.0
b	348	321	277	2.98e+00	8.8	1.72e+01	3.7	5.51e-01	100.0	7.45e-01	100.0	1.91e+00	100.0
c	693	622	581	1.49e+00	12.8	9.01e+00	5.5	5.02e-01	100.0	6.11e-01	100.0	1.66e+00	100.0
d	778	688	669	1.37e-01	12.7	1.18e+00	2.6	4.39e-02	100.0	6.23e-02	100.0	1.01e-01	100.0
28 a	346	332	300	2.61e-01	14.9	2.07e+00	14.0	5.26e-02	100.0	6.90e-02	100.0	1.13e-01	100.0
b	295	272	253	1.56e-02	100.0	1.20e+00	8.1	3.69e-02	100.0	5.35e-02	100.0	7.84e-02	100.0
c	793	731	689	6.03e-02	25.1	1.73e+00	12.6	1.13e-01	58.1	8.52e-02	100.0	1.06e-01	100.0
d	760	714	626	1.90e-02	100.0	1.66e+00	9.4	1.84e-01	39.8	3.41e-01	46.5	1.02e-01	100.0

Point & Increment		Weight (g) Wet	Dry	Fine	Concentration (pCi/g) and s.d. (%) ^{60}Co		^{137}Cs		^{152}Eu		^{155}Eu		^{241}Am	
29	a	291	264	183	2.26e+00	4.0	8.30e+00	2.4	2.59e-01	45.9	6.41e-01	38.9	5.14e-01	100.0
	b	655	621	243	2.08e-01	17.5	1.06e+00	6.2	9.07e-02	100.0	3.11e-01	63.6	3.18e-01	100.0
	c	838	754	555	3.45e-02	100.0	1.89e-01	46.4	3.92e-01	36.0	3.41e-01	66.8	3.26e-01	100.0
	d	883	817	498	3.60e-02	100.0	2.89e-01	22.0	1.86e-01	49.6	3.91e-01	43.3	3.25e-01	100.0
30	a	622	590	262	2.08e+00	4.0	2.07e+01	1.1	3.62e-01	56.1	1.06e+00	40.1	1.66e+00	80.0
	b	504	470	365	4.35e-02	100.0	9.07e-01	11.5	2.00e-01	49.4	3.93e-01	47.3	3.54e-01	100.0
	c	773	696	640	3.57e-02	100.0	3.97e-02	100.0	1.06e-01	100.0	4.50e-01	60.7	3.97e-01	100.0
	d	871	805	371	3.45e-02	100.0	3.65e-02	100.0	9.07e-02	100.0	2.77e-01	45.9	3.19e-01	100.0
31	a	557	561	512	5.92e+00	1.2	2.14e+01	1.4	4.63e-01	18.6	1.83e+00	13.5	6.18e+00	22.9
	b	745	710	634	1.29e+01	0.9	4.47e+01	0.8	1.13e+00	18.6	4.11e+00	7.1	1.47e+01	16.4
	c	714	672	608	1.23e+01	1.1	3.93e+01	1.7	1.02e+00	16.4	3.46e+00	12.8	1.25e+01	30.7
	d	840	780	733	7.32e+00	2.6	2.21e+01	1.3	6.47e-01	17.4	2.44e+00	11.8	8.65e+00	11.2
	e	851	781	740	2.52e-02	35.0	3.80e-01	18.4	1.28e-01	35.0	1.10e-01	35.0	1.99e-01	35.0
	f	617	546	536	2.26e-02	35.0	8.71e-02	35.0	1.17e-01	35.0	2.31e-01	35.0	1.63e-01	35.0
32	a	614	603	408	1.03e+01	2.0	4.05e+01	3.0	7.61e-01	21.2	2.50e+00	16.6	9.40e+00	35.0
	b	662	638	499	1.15e+01	2.2	4.79e+01	0.9	1.05e+00	14.5	3.04e+00	8.1	1.28e+01	22.4
	c	806	746	447	3.24e+00	3.0	2.63e+01	1.8	3.64e-01	35.0	8.95e-01	28.0	3.18e+00	35.0
	d	740	688	420	1.34e+00	3.2	2.60e+01	2.7	1.07e-01	35.0	6.48e-01	33.5	2.84e-01	35.0
	e	701	662	436	1.29e+00	3.3	2.74e+01	3.3	1.15e-01	35.0	5.46e-01	35.0	2.85e-01	35.0
	f	862	822	444	1.35e+00	3.3	2.58e+01	2.1	1.18e-01	35.0	5.65e-01	31.8	2.86e-01	35.0
33	a	629	620	505	7.50e+00	1.6	2.90e+01	3.1	5.81e-01	24.1	2.07e+00	19.8	5.44e+00	35.0
	b	639	619	486	4.18e+00	3.4	2.07e+01	3.3	4.14e-01	32.9	1.17e+00	22.1	3.08e+00	35.0
	c	679	648	471	1.96e+00	2.7	1.54e+01	2.7	2.40e-01	31.6	6.06e-01	35.0	1.49e+00	35.0
	d	811	720	556	1.49e+00	3.2	1.52e+01	2.3	2.34e-01	31.1	4.36e-01	35.0	2.70e-01	35.0
	e	810	783	565	3.00e+00	2.2	1.67e+01	2.8	2.95e-01	35.0	6.89e-01	25.4	1.81e+00	35.0
	f	739	699	510	3.11e+00	2.9	1.34e+01	2.9	3.12e-01	35.0	1.07e+00	16.7	2.42e+00	35.0
34	a	557	537	438	2.78e+01	1.1	8.94e+01	1.9	2.10e+00	12.9	6.89e+00	9.1	2.03e+01	35.0
	b	794	741	602	1.51e+01	1.9	7.84e+01	0.8	1.06e+00	16.3	3.55e+00	11.7	1.19e+01	23.7
	c	841	785	619	1.01e+01	1.6	5.84e+01	1.0	8.33e-01	18.5	2.34e+00	12.5	7.88e+00	28.3
	d	763	682	530	8.70e+00	2.3	5.34e+01	1.1	7.02e-01	23.1	2.14e+00	12.8	6.07e+00	35.0
	e	687	643	422	8.70e+00	2.4	4.89e+01	1.0	5.38e-01	26.5	2.12e+00	12.0	6.38e+00	27.9
	f	756	702	529	6.25e+00	2.5	5.26e+01	0.9	3.15e-01	35.0	1.65e+00	13.4	4.98e+00	31.2
35	a	581	573	432	4.85e+01	0.7	1.09e+02	0.9	4.95e+00	6.4	1.19e+01	6.6	4.36e+01	25.6
	b	803	777	584	5.54e+01	0.8	1.27e+02	0.9	4.99e+00	7.2	1.35e+01	7.1	5.25e+01	26.0
	c	718	681	571	5.77e+01	3.2	1.62e+02	1.1	4.74e+00	9.1	1.45e+01	8.4	5.77e+01	30.2
	d	778	732	481	3.26e+01	2.0	1.16e+02	0.9	2.40e+00	11.8	7.79e+00	7.7	3.01e+01	26.0
	e	566	529	403	3.40e+01	1.0	1.35e+02	1.2	1.77e+00	22.5	8.04e+00	9.6	3.04e+01	35.0
	f	930	882	351	1.15e+01	2.0	6.57e+01	1.1	8.37e-01	26.0	3.01e+00	11.9	9.66e+00	31.0
36	a	561	550	445	4.02e+01	0.7	8.99e+01	0.9	4.38e+00	7.3	1.02e+01	8.2	4.31e+01	23.7
	b	681	661	557	2.70e+01	1.9	8.21e+01	1.1	3.15e+00	10.1	7.11e+00	10.6	2.58e+01	31.8
	c	732	701	591	2.02e+01	2.0	7.02e+01	0.8	2.83e+00	7.4	5.66e+00	8.5	1.85e+01	23.7
	d	631	602	530	1.92e+01	1.8	6.33e+01	0.9	3.17e+00	6.2	5.30e+00	7.5	2.01e+01	21.5
	e	661	632	509	5.05e+00	2.0	3.83e+01	2.2	4.41e+00	2.9	2.21e+00	12.7	4.41e+00	35.0
	f	621	590	489	9.15e+00	1.8	4.50e+01	2.8	5.35e+00	4.4	3.18e+00	12.5	7.55e+00	35.0

Point & Increment		Weight (g)			Concentration (pCi/g) and s.d. (%)									
		Wet	Dry	Fine	^{60}Co		^{137}Cs		^{152}Eu		^{155}Eu		^{241}Am	
37	a	495	483	385	1.56e+01	1.0	3.62e+01	1.9	1.46e+00	18.6	4.07e+00	12.1	1.28e+01	18.4
	b	789	737	591	2.40e+01	0.7	5.63e+01	0.8	2.10e+00	13.3	5.93e+00	6.9	2.01e+01	18.0
	c	754	699	577	1.84e+01	0.8	4.96e+01	2.2	1.52e+00	16.6	4.44e+00	9.9	1.48e+01	18.0
	d	872	797	656	4.70e+00	1.3	2.37e+01	1.4	5.90e-01	20.8	1.42e+00	13.1	5.46e+00	35.0
	e	849	777	511	3.08e+00	1.6	1.73e+01	1.2	3.72e-01	24.1	3.67e-01	35.0	3.23e+00	27.2
	f	892	815	727	5.91e-01	5.2	6.99e+00	2.1	9.61e-02	35.0	6.03e-01	35.0	8.00e-01	35.0
38	a	547	537	481	3.66e+01	0.7	9.67e+01	1.8	3.71e+00	12.6	8.86e+00	7.0	2.85e+01	18.3
	b	753	710	575	4.84e+00	1.3	1.34e+01	1.6	4.62e-01	20.8	1.24e+00	10.4	4.61e+00	12.4
	c	811	751	549	6.65e-01	4.8	1.87e+00	5.2	1.42e-01	35.0	2.97e-01	35.0	6.22e-01	35.0
	d	753	692	518	1.46e-02	35.0	8.63e-02	35.0	7.90e-02	35.0	6.07e-02	35.0	9.51e-02	35.0
	e	804	726	431	7.44e-02	22.7	9.32e-02	19.7	7.23e-01	9.2	3.67e-01	35.0	8.94e-02	35.0
	f	772	713	491	1.42e-02	35.0	1.57e-02	35.0	5.86e-02	35.0	2.77e-01	35.0	8.91e-02	35.0
39	a	442	339	371	7.15e+00	1.3	2.17e+00	3.5	6.78e+01	1.1	1.85e-01	100.0	2.34e-01	100.0
	b	465	412	392	7.31e+00	1.4	6.57e-01	9.9	7.24e+01	1.0	1.87e-01	100.0	2.37e-01	100.0
	c	791	687	668	8.33e+00	1.3	5.83e-02	100.0	8.87e+01	0.9	2.29e-01	100.0	2.96e-01	100.0
	d	890	758	733	6.97e+00	1.4	4.69e-01	37.3	8.33e+01	1.1	2.33e-01	100.0	3.06e-01	100.0
40	a	361	346	319	1.59e+00	3.0	2.98e+00	2.2	2.26e+01	1.2	1.22e-01	100.0	3.09e+00	8.9
	b	346	322	289	1.61e+00	2.8	4.47e+00	1.7	2.17e+01	1.2	2.37e-01	68.3	3.52e+00	7.3
	c	867	786	595	3.30e+00	1.7	7.82e+00	2.3	3.67e+01	1.0	5.49e-01	68.2	4.24e+00	8.2
	d	863	776	723	3.44e+00	1.7	3.47e+00	4.1	3.95e+01	1.0	1.78e-01	100.0	1.47e+00	17.7
41	a	353	325	299	1.48e+01	1.4	6.53e+01	1.6	9.31e+01	1.3	6.84e+00	16.8	1.92e+01	20.6
	b	411	362	344	1.46e+01	2.2	5.15e+01	3.5	1.12e+02	1.4	5.77e+00	20.8	1.26e+01	19.8
	c	898	776	754	1.32e+01	1.3	3.35e+00	12.5	1.57e+02	1.3	1.69e+00	88.3	8.28e-01	100.0
	d	949	806	763	8.95e+00	2.3	1.04e-01	100.0	1.18e+02	1.2	1.42e+00	76.7	7.13e-01	100.0
42	a	315	295	271	8.52e+00	1.8	2.88e+01	2.9	7.53e+01	1.5	2.72e+00	30.6	6.76e+00	21.7
	b	424	386	360	7.87e+00	1.5	9.22e+00	4.1	7.82e+01	1.5	9.85e-01	92.0	5.08e-01	100.0
	c	778	702	670	8.83e+00	1.8	5.50e+00	6.4	9.68e+01	1.4	9.62e-01	70.4	8.89e-01	47.6
	d	816	715	696	9.84e+00	1.7	1.81e+00	10.8	1.07e+02	1.3	4.64e-01	100.0	6.63e-01	100.0
43	a	395	382	246	1.80e-01	18.7	6.49e-01	10.0	1.54e+00	4.7	2.62e-01	88.6	1.74e-01	100.0
	b	465	431	277	2.62e-02	100.0	2.48e-02	100.0	1.14e-01	51.9	2.38e-01	38.0	1.57e-01	100.0
	c	748	644	554	1.08e-01	34.0	2.63e-02	100.0	1.02e+00	7.5	3.54e-01	89.3	1.87e-01	100.0
	d	929	818	686	1.31e-01	16.6	1.06e-01	21.4	1.53e+00	6.3	3.00e-01	65.5	2.10e-01	100.0
44	a	368	300	292	1.03e+00	5.8	5.55e+00	3.9	1.59e+01	1.9	8.81e-01	32.8	9.84e+00	19.9
	b	359	292	282	1.06e+00	4.6	3.94e+00	4.8	1.77e+01	1.8	6.21e-01	86.4	1.53e+00	26.6
	c	772	621	609	1.31e+00	4.0	3.15e+00	5.8	1.98e+01	1.6	2.17e-01	100.0	1.48e+00	27.9
	d	824	672	649	6.64e-01	6.0	2.18e-01	27.0	1.01e+01	1.6	3.49e-01	43.6	2.67e-01	100.0
45	a	383	376	344	8.33e-01	5.3	4.74e+00	3.1	9.34e+00	2.0	6.10e-01	65.4	2.00e+00	23.4
	b	370	369	337	4.26e-01	9.6	8.73e-02	33.3	7.44e+00	1.8	3.14e-01	45.6	3.20e-01	36.2
	c	794	749	725	4.17e-01	6.1	2.73e-02	100.0	7.12e+00	1.9	4.57e-01	56.0	1.37e-01	100.0
	d	772	725	704	2.09e-01	16.5	4.37e-02	100.0	4.69e+00	3.5	4.71e-01	60.0	4.78e-01	100.0

Point & Increment		Weight (g)			Concentration (pCi/g) and s.d. (%)									
		Wet	Dry	Fine	^{60}Co		^{137}Cs		^{152}Eu		^{155}Eu		^{241}Am	
46	a	375	344	287	2.54e+00	3.7	1.17e+00	18.3	4.29e+01	1.6	3.36e-01	100.0	1.79e+00	32.2
	b	351	316	282	2.78e+00	4.6	2.36e-01	32.7	4.60e+01	1.8	3.46e-01	100.0	7.15e-01	100.0
	c	830	730	703	2.50e+00	3.5	9.33e-02	100.0	3.99e+01	1.9	3.77e-01	100.0	8.13e-01	100.0
	d	729	641	593	1.36e+00	4.8	7.17e-02	100.0	2.29e+01	1.4	2.82e-01	100.0	6.18e-01	100.0
47	a	552	476	389	8.89e-01	6.3	3.98e+00	6.1	1.46e+01	2.1	4.96e-01	33.0	3.61e+00	21.2
	b	564	484	428	5.30e-01	8.9	1.09e+00	11.1	8.68e+00	2.4	5.25e-01	74.7	7.87e-01	40.0
	c	1030	891	801	3.36e+00	3.4	5.06e+00	6.4	5.31e+01	1.5	4.80e-01	100.0	6.20e+00	20.3
	d	1024	843	807	8.13e+00	3.4	1.78e+00	17.5	1.41e+02	1.4	2.18e+00	70.5	1.57e+00	12.5
48	a	344	337	301	3.44e+00	3.2	1.64e+01	4.0	4.33e+01	1.5	1.37e+00	29.6	2.49e+01	15.1
	b	410	392	357	3.25e+00	3.7	1.19e+01	4.2	4.97e+01	1.6	1.41e+00	40.9	2.52e+01	15.3
	c	736	678	609	2.30e+00	3.9	1.09e+00	20.9	4.68e+01	1.9	3.91e-01	100.0	1.74e+00	34.5
	d	733	650	578	1.55e+00	4.8	7.56e-02	100.0	2.64e+01	1.9	2.97e-01	100.0	6.43e-01	100.0
49	a	290	285	260	2.35e+00	2.2	1.07e+01	2.1	3.22e+01	1.1	8.84e-01	36.5	1.05e+02	7.4
	b	328	322	311	1.96e+00	3.7	8.88e+00	3.4	2.99e+01	2.0	2.45e-01	100.0	6.70e+01	19.2
	c	589	567	518	3.62e+00	2.5	3.17e+01	1.9	4.76e+01	1.7	1.74e+00	35.3	8.83e+01	19.2
	d	807	761	716	4.09e+00	2.4	2.54e+01	1.7	6.52e+01	1.3	3.94e-01	100.0	1.18e+01	21.4
50	a	475	413	321	7.03e+00	2.7	2.03e+01	2.9	9.26e+01	1.5	2.54e+00	32.7	6.52e+00	21.2
	b	577	495	427	8.22e+00	1.8	1.96e+01	1.8	7.62e+01	1.0	1.75e+00	14.5	5.10e+00	7.8
	c	1073	916	752	5.95e+00	1.7	2.34e-01	28.3	1.04e+02	1.0	2.66e-01	100.0	3.48e-01	100.0
	d	1006	840	717	4.47e+00	3.4	1.34e-01	100.0	8.81e+01	1.3	5.55e-01	100.0	1.19e+00	100.0
51	a	371	333	285	1.06e+01	1.2	5.71e+00	5.7	1.95e+02	1.0	3.56e-01	100.0	3.42e+00	11.2
	b	477	427	367	1.44e+01	1.0	3.20e+00	3.6	2.29e+02	1.0	3.82e-01	100.0	3.80e-01	100.0
	c	989	878	727	1.29e+01	1.0	2.20e+00	10.7	2.05e+02	1.0	1.33e+00	57.5	4.36e-01	100.0
	d	785	671	651	6.44e+00	1.5	7.11e-02	100.0	9.57e+01	1.0	2.78e-01	100.0	2.80e-01	100.0
52	a	338	333	290	5.69e+00	1.4	2.60e+01	1.4	1.04e+02	1.1	2.74e+00	32.0	1.22e+01	4.8
	b	337	332	279	6.97e+00	1.5	2.64e+01	1.3	1.21e+02	0.9	2.50e+00	24.0	6.21e+00	6.6
	c	707	681	501	8.30e+00	1.3	2.21e+00	11.7	1.76e+02	1.0	2.63e-01	100.0	3.83e-01	100.0
	d	593	541	523	7.99e+00	1.2	6.63e-02	100.0	1.34e+02	1.1	2.26e-01	100.0	3.31e-01	100.0
53	a	308	304	268	2.59e+00	2.0	2.47e+01	1.2	4.08e+01	1.2	1.91e+00	15.6	7.09e+00	6.1
	b	341	333	324	1.63e+00	3.2	5.21e-01	10.5	3.40e+01	1.0	1.18e-01	100.0	1.97e+00	14.0
	c	702	664	657	1.89e+00	2.2	1.68e-01	50.1	3.39e+01	0.9	4.27e-01	44.5	1.99e-01	100.0
	d	639	584	571	1.41e+00	2.9	2.12e-01	14.8	2.22e+01	1.0	1.07e-01	100.0	1.60e-01	100.0
54	a	303	295	279	6.92e-01	4.2	4.59e+00	3.0	6.56e+00	2.6	6.68e-01	33.2	4.60e+00	10.4
	b	331	321	296	4.30e-01	6.5	1.20e+00	3.5	5.97e+00	2.1	2.12e-01	20.5	3.78e+00	5.1
	c	681	642	622	3.22e-01	5.7	1.85e-02	100.0	4.52e+00	2.2	6.99e-02	100.0	1.13e-01	100.0
	d	700	649	633	2.13e-01	8.7	1.71e-02	100.0	3.09e+00	2.6	6.62e-02	100.0	1.06e-01	100.0
55	a	353	326	306	1.26e+01	1.1	3.28e+01	1.0	3.38e+02	1.1	2.21e+00	19.4	2.79e+00	15.0
	b	469	418	390	1.55e+01	1.0	2.41e+00	14.9	3.01e+02	1.0	1.34e+00	63.7	4.39e-01	100.0
	c	864	788	252	1.27e+01	1.2	2.04e+00	5.9	2.59e+02	1.2	3.65e-01	100.0	4.01e-01	100.0
	d	736	699	561	1.79e+01	1.9	1.59e+00	21.7	3.52e+02	0.8	2.12e+00	46.2	2.15e+00	100.0

Point & Increment		Weight (g) Wet	Dry	Fine	Concentration (pCi/g) and s.d. (%) ^{60}Co		^{137}Cs		^{152}Eu		^{155}Eu		^{241}Am	
56	a	314	292	279	4.57e+00	2.5	4.53e+01	1.4	7.07e+01	1.4	4.14e+00	20.7	3.87e+00	22.9
	b	328	296	273	4.84e+00	3.0	2.79e+01	4.7	1.12e+02	1.4	3.21e+00	32.6	2.63e+00	38.7
	c	683	626	568	7.18e+00	2.4	3.60e+01	1.6	1.38e+02	1.6	4.29e+00	28.4	3.39e+00	30.9
	d	631	606	586	5.00e+00	2.8	2.51e+01	6.2	9.16e+01	1.5	2.64e+00	39.1	3.81e+00	29.6
57	a	289	283	273	2.25e+00	5.7	1.46e+01	3.2	3.90e+01	1.7	1.13e+00	41.3	3.88e+00	19.6
	b	314	307	288	1.74e+00	4.4	9.84e+00	5.8	2.96e+01	1.7	9.53e-01	46.7	4.19e+00	18.4
	c	690	664	637	1.26e+00	5.1	2.82e-01	42.4	2.53e+01	1.6	2.66e-01	100.0	6.72e-01	100.0
	d	678	639	609	9.34e-01	5.6	2.10e-01	43.5	1.75e+01	1.8	4.15e-01	29.0	5.76e-01	100.0
58	a	342	334	313	6.53e-01	7.7	3.11e+00	7.7	1.04e+01	2.6	5.76e-01	36.7	4.00e+00	18.0
	b	321	313	279	4.45e-01	9.8	9.74e-01	12.1	8.01e+00	2.4	3.81e-01	70.7	8.45e-01	45.9
	c	588	571	529	5.35e-01	8.0	1.92e+00	6.5	9.27e+00	2.2	4.40e-01	62.0	3.15e+00	18.2
	d	529	505	473	0.	0.0	0.	0.0	0.	0.0	0.	0.0	0.	0.0
59	a	313	307	296	6.28e-01	8.7	5.67e+00	3.4	9.34e+00	1.9	4.37e-01	58.6	3.96e+01	14.7
	b	277	271	267	3.90e-01	11.1	4.53e+00	3.5	8.67e+00	2.2	1.84e-01	100.0	3.55e+01	15.8
	c	584	558	540	4.09e-01	5.5	6.60e+00	1.8	7.38e+00	1.6	1.02e-01	100.0	3.56e+01	7.5
	d	538	507	481	8.11e-01	6.9	1.87e+01	1.8	1.27e+01	1.7	1.04e-01	100.0	1.09e+02	3.5
60	a	308	302	281	2.05e+00	2.4	3.71e+00	3.6	4.17e+01	1.0	1.32e-01	100.0	1.94e-01	100.0
	b	333	327	306	1.99e+00	2.4	4.11e-02	100.0	3.68e+01	1.4	1.21e-01	100.0	1.76e-01	100.0
	c	682	663	643	1.55e+00	2.6	3.56e-02	100.0	3.00e+01	1.3	1.23e-01	100.0	1.84e-01	100.0
	d	526	508	482	9.33e-01	5.4	6.28e-02	100.0	1.71e+01	1.8	2.08e-01	100.0	5.37e-01	100.0
61	a	359	350	324	2.41e+00	3.3	2.93e+00	6.9	5.40e+01	1.1	9.92e-01	62.4	8.01e-01	100.0
	b	341	315	306	1.80e+00	4.5	9.77e-02	100.0	4.13e+01	1.6	2.93e-01	100.0	7.04e-01	100.0
	c	684	655	624	2.18e+00	3.7	1.28e+01	3.1	2.57e+01	1.4	1.14e+00	22.2	7.75e-01	100.0
	d	651	626	614	3.77e+00	2.3	1.15e+01	3.7	7.49e+01	1.3	1.17e+00	43.5	5.73e-01	100.0
62	a	239	235	205	9.65e+00	1.8	4.26e+01	2.2	1.30e+02	1.3	3.35e+00	11.7	1.07e+01	21.4
	b	375	364	347	1.06e+01	1.6	7.18e+00	10.3	2.17e+02	1.3	1.23e+00	57.0	3.35e+00	29.4
	c	685	651	608	1.06e+01	1.5	1.83e+00	6.7	2.28e+02	1.5	5.45e-01	100.0	8.72e-01	100.0
	d	541	500	471	1.29e+01	1.8	1.04e+01	3.0	2.66e+02	0.9	5.10e-01	100.0	7.41e-01	100.0
63	a	318	311	271	9.08e+00	1.8	3.32e+01	1.5	1.50e+02	1.2	3.06e+00	18.4	2.41e+01	4.3
	b	319	310	284	1.20e+01	1.7	8.20e+00	2.4	2.35e+02	0.9	4.14e-01	100.0	1.02e+01	7.1
	c	668	626	616	1.39e+01	2.7	3.93e+00	14.2	3.01e+02	0.9	2.53e+00	59.3	1.94e+00	100.0
	d	695	645	621	1.04e+01	3.1	2.04e-01	100.0	2.38e+02	1.0	6.97e-01	100.0	1.69e+00	100.0
64	a	369	332	247	3.18e+00	3.0	8.64e+00	4.3	3.40e+01	1.8	7.81e-01	42.5	6.70e-01	100.0
	b	438	371	296	3.07e+00	3.0	3.63e+00	5.8	3.53e+01	1.6	5.56e-01	45.5	6.49e-01	100.0
	c	862	735	577	3.13e+00	2.9	1.27e+00	13.2	3.91e+01	1.6	3.00e-01	100.0	7.25e-01	100.0
	d	861	754	481	2.92e+00	2.8	1.00e+00	12.4	3.60e+01	1.5	2.77e-01	100.0	6.69e-01	100.0
65	a	313	310	155	7.75e+00	2.7	6.47e+01	1.1	1.38e+01	2.4	2.40e+00	19.6	9.30e+01	26.3
	b	483	462	258	6.95e+00	1.9	6.00e+01	1.2	1.71e+01	2.3	1.70e+00	19.4	4.16e+01	19.2
	c	850	809	354	1.95e+00	3.6	3.20e+00	6.4	2.09e+01	2.4	2.35e-01	100.0	6.69e+00	18.4
	d	756	695	421	1.48e+00	3.7	6.02e-01	20.5	1.79e+01	2.4	1.64e-01	100.0	2.62e-01	100.0

Point & Increment	Weight (g)			Concentration (pCi/g) and s.d. (%)									
	Wet	Dry	Fine	^{60}Co		^{137}Cs		^{152}Eu		^{155}Eu		^{241}Am	
66 a	381	357	220	1.63e+01	1.5	6.10e+01	3.0	1.29e+02	1.2	3.90e+00	28.0	5.89e+00	23.0
b	388	354	238	1.80e+01	1.3	7.19e+00	8.6	1.96e+02	1.3	1.33e+00	66.8	7.28e-01	100.0
c	843	749	590	2.10e+01	2.2	6.16e-01	27.1	2.43e+02	0.8	1.92e+00	71.6	1.76e+00	100.0
d	766	676	533	1.79e+01	2.2	1.98e-01	100.0	2.02e+02	1.0	6.50e-01	100.0	1.54e+00	100.0
67 a	323	297	269	3.37e+01	1.0	1.82e+02	1.3	1.17e+02	1.3	1.06e+01	18.4	1.46e+01	17.6
b	338	306	254	3.57e+01	1.1	1.80e+02	3.4	1.09e+02	1.7	1.30e+01	11.2	6.95e+00	24.0
c	775	665	610	5.52e+01	1.1	2.88e+02	1.7	1.26e+02	1.3	2.10e+01	14.3	9.34e+00	23.9
d	736	645	526	4.32e+01	1.1	2.22e+02	2.9	1.20e+02	1.4	1.59e+01	12.5	1.95e+01	20.0
68 a	255	239	153	6.98e+00	1.8	2.61e+01	2.7	4.56e+01	1.7	2.47e+00	23.7	9.21e-01	44.9
b	452	418	260	3.58e+00	2.2	1.13e+00	14.8	4.18e+01	1.8	2.27e-01	100.0	3.50e-01	100.0
c	754	689	443	3.11e+00	2.1	5.90e-02	100.0	3.75e+01	1.9	2.21e-01	100.0	3.48e-01	100.0
d	901	825	490	2.12e+00	2.7	5.04e-02	100.0	2.61e+01	1.9	1.88e-01	100.0	3.00e-01	100.0
69 a	359	370	178	2.09e+01	1.6	1.12e+02	1.7	9.56e+01	1.3	6.12e+00	10.4	1.24e+01	16.1
b	502	500	130	8.43e+00	8.4	8.73e+00	2.5	9.15e+01	1.2	7.74e-01	59.6	1.33e+00	33.3
c	726	677	448	1.18e+01	1.6	1.41e+00	28.7	1.31e+02	1.4	1.29e+00	78.4	6.32e-01	100.0
d	981	899	428	1.04e+01	1.5	2.57e-01	29.5	1.16e+02	1.3	3.74e-01	100.0	5.88e-01	100.0
70 a	406	370	225	3.50e+00	2.1	1.19e+01	2.9	2.63e+01	1.9	7.46e-01	61.0	1.28e+00	31.5
b	367	322	228	3.74e+00	2.7	1.13e+01	3.6	3.09e+01	1.8	5.21e-01	75.7	6.19e-01	37.7
c	693	711	379	3.32e+00	2.1	7.22e+00	4.2	3.06e+01	1.5	6.07e-01	95.2	4.45e-01	50.1
d	838	737	433	3.56e+00	2.5	8.04e+00	4.1	2.92e+01	2.0	2.06e-01	100.0	7.77e-01	36.5
71 a	388	366	298	2.06e+01	1.2	1.39e+02	1.7	3.05e+01	1.9	7.17e+00	9.2	2.97e+01	19.4
b	468	430	302	1.56e+01	1.3	8.68e+01	3.3	3.65e+01	1.9	6.72e+00	11.9	1.11e+01	21.1
c	837	783	378	2.07e+00	2.7	3.28e+00	6.0	2.07e+01	2.3	1.77e-01	100.0	2.93e-01	100.0
d	749	694	363	1.82e+00	2.9	9.10e-01	15.4	1.96e+01	1.9	1.66e-01	100.0	2.65e-01	100.0
72 a	368	321	256	1.87e+00	3.0	1.64e+01	1.6	2.56e+00	5.0	7.05e-01	15.1	4.02e-01	100.0
b	357	302	238	2.24e+00	2.6	2.32e+01	1.5	2.64e+00	5.1	7.28e-01	37.5	4.49e+00	22.0
c	626	538	343	6.88e-01	4.7	7.73e+00	3.7	2.73e+00	5.2	4.93e-01	46.2	1.19e+00	24.8
d	933	859	192	6.51e-01	5.2	6.44e+00	1.7	2.40e+00	3.1	3.47e-01	28.8	1.03e+00	28.8
73 a	359	331	283	1.65e+01	1.2	1.01e+02	1.1	9.82e+00	3.3	5.02e+00	15.1	1.80e+01	19.7
b	474	432	327	4.96e+00	1.6	3.95e+01	0.9	5.78e+00	2.7	2.38e+00	13.4	6.70e+00	20.3
c	850	779	530	3.60e-01	8.2	3.34e+00	2.4	2.48e+00	3.1	2.59e-01	36.9	3.66e-01	38.6
d	749	704	348	2.46e-01	15.1	3.26e-01	21.3	2.33e+00	4.4	3.11e-01	49.7	3.26e-01	100.0
74 a	368	368	318	7.59e-01	3.7	7.09e+00	2.3	8.57e+00	1.7	4.85e-01	32.5	1.13e+01	7.7
b	424	413	384	6.17e-01	4.4	1.19e+00	5.7	8.68e+00	1.5	2.34e-01	84.0	3.22e+00	9.1
c	757	717	620	6.04e-01	5.2	2.96e-02	100.0	9.76e+00	1.7	2.86e-01	68.3	1.27e-01	100.0
d	807	760	633	5.51e-01	6.2	3.72e-02	100.0	9.37e+00	2.7	1.48e-01	100.0	2.56e-01	100.0
75 a	315	312	249	2.91e+00	3.1	3.04e+00	9.3	5.06e+01	1.7	2.52e-01	100.0	4.00e+00	22.1
b	420	412	325	3.72e+00	3.4	2.75e+00	10.1	6.34e+01	1.1	3.64e-01	100.0	3.85e+00	23.5
c	875	848	571	4.89e+00	1.5	2.82e+00	6.8	7.02e+01	1.2	1.78e-01	100.0	5.69e+00	11.4
d	867	834	610	4.60e+00	2.9	8.98e-01	27.6	7.79e+01	1.4	3.38e-01	100.0	3.12e+00	28.3

Point & Increment		Weight (g) Wet	Dry	Fine	Concentration (pCi/g) and s.d. (%) ^{60}Co		^{137}Cs		^{152}Eu		^{155}Eu		^{241}Am	
76	a	290	289	223	4.00e+00	3.0	1.30e+01	2.9	5.60e+01	1.6	1.65e+00	40.0	5.28e+01	19.2
	b	364	361	221	3.04e+00	4.5	3.70e-01	46.6	5.81e+01	1.7	2.57e-01	100.0	1.09e+00	42.0
	c	656	634	453	3.08e+00	2.6	7.55e-02	100.0	5.64e+01	1.7	8.25e-01	77.4	4.28e-01	100.0
77	a	338	336	265	2.86e+01	1.2	1.44e+02	2.8	3.10e+02	1.1	1.53e+01	28.4	5.67e+02	19.0
	b	310	303	247	2.68e+01	1.1	4.57e+00	4.0	4.08e+02	1.1	2.07e+00	97.4	1.09e+01	21.2
	c	476	453	345	2.34e+01	1.2	2.06e+00	8.3	3.54e+02	1.1	6.24e-01	100.0	9.84e-01	100.0
	d	0	0	0	0.	0.0	0.	0.0	0.	0.0	0.	0.0	0.	0.0
78	a	357	355	191	8.29e-01	5.6	1.69e+00	8.3	1.09e+01	2.4	2.68e-01	44.6	2.43e+00	22.0
	b	504	495	333	7.56e-01	4.5	2.66e-01	31.2	1.22e+01	1.8	1.34e-01	100.0	2.24e-01	100.0
	c	824	791	446	8.85e-01	5.4	9.58e-01	17.4	1.37e+01	2.3	1.54e-01	100.0	2.58e-01	100.0
	d	798	755	569	1.40e+00	2.6	7.90e-01	10.2	2.03e+01	1.2	3.91e-01	29.7	4.26e-01	100.0
79	a	258	255	218	2.42e+00	2.2	3.71e+00	4.4	3.77e+01	1.3	4.07e-01	35.3	3.40e+01	7.6
	b	335	331	291	3.32e+00	1.8	3.96e+00	9.2	4.65e+01	1.5	7.05e-01	36.2	1.75e+01	8.2
	c	720	702	511	3.57e+00	2.0	1.09e+00	5.5	4.94e+01	1.0	1.74e-01	100.0	3.09e+00	13.1
	d	889	866	446	4.02e+00	1.8	4.57e-01	28.2	5.01e+01	1.9	1.65e-01	100.0	1.31e+00	45.3
80	a	228	225	191	9.83e-01	4.2	1.18e+00	11.5	2.35e+01	2.1	1.17e-01	100.0	3.91e-01	100.0
	b	330	325	287	1.01e+00	3.6	1.07e+00	6.7	2.11e+01	1.7	1.13e-01	100.0	1.89e+00	44.4
	c	752	725	631	1.84e+00	3.9	3.67e-01	12.0	3.79e+01	1.6	1.60e-01	100.0	5.50e-01	100.0
	d	681	646	524	1.58e+00	2.8	4.35e-02	100.0	3.13e+01	1.6	1.38e-01	100.0	4.63e-01	100.0
81	a	296	294	227	1.97e+00	3.2	4.15e+00	5.7	3.57e+01	1.6	3.44e-01	64.5	9.87e+00	19.8
	b	350	394	260	2.67e+00	2.2	4.77e+00	8.7	4.13e+01	1.7	5.24e-01	47.0	1.06e+01	12.6
	c	717	685	577	4.08e+00	1.8	1.70e+00	4.2	6.02e+01	1.1	1.92e-01	100.0	6.57e-01	100.0
	d	516	489	309	3.20e+00	1.9	5.27e-01	9.7	4.88e+01	1.1	1.55e-01	100.0	5.24e-01	100.0
82	a	334	330	248	2.60e+00	2.7	3.12e+00	7.4	3.49e+01	1.9	2.13e-01	100.0	3.50e+00	22.5
	b	418	390	307	2.28e+00	3.7	9.34e-02	100.0	3.48e+01	1.7	4.73e-01	31.6	6.52e-01	100.0
	c	872	798	671	2.00e+00	5.0	1.23e-01	100.0	3.32e+01	2.0	4.28e-01	100.0	1.05e+00	100.0
	d	863	780	618	1.16e+00	4.9	6.87e-02	100.0	1.97e+01	1.3	2.31e-01	100.0	5.83e-01	100.0
83	a	317	315	235	7.81e+00	2.6	2.05e+01	3.8	1.06e+02	1.1	2.33e+00	31.8	7.97e+00	45.5
	b	284	279	147	7.39e+00	2.3	1.78e-01	100.0	1.20e+02	1.3	4.73e-01	100.0	1.10e+00	100.0
	c	842	790	274	7.29e+00	4.2	1.56e-01	100.0	1.14e+02	1.0	4.51e-01	100.0	1.06e+00	100.0
	d	566	514	372	5.33e+00	3.3	1.34e-01	100.0	9.25e+01	1.3	4.18e-01	100.0	9.91e-01	100.0
84	a	334	329	281	2.03e+00	6.0	3.80e-01	33.0	3.88e+01	1.6	2.80e-01	100.0	1.53e+00	34.3
	b	383	362	329	2.22e+00	4.4	9.76e-02	100.0	4.16e+01	1.7	2.90e-01	100.0	6.93e-01	100.0
	c	649	601	537	2.40e+00	3.8	9.17e-02	100.0	4.15e+01	1.5	3.08e-01	100.0	7.51e-01	100.0
	d	756	695	598	1.98e+00	3.5	8.36e-02	100.0	3.47e+01	1.7	2.95e-01	100.0	7.13e-01	100.0
85	a	323	320	262	1.16e-01	100.0	4.08e+00	4.6	4.44e+01	1.1	3.08e-01	100.0	2.69e+00	28.2
	b	382	366	284	2.87e+00	3.2	9.22e-01	16.3	5.06e+01	1.2	3.19e-01	100.0	7.58e-01	100.0
	c	693	654	494	2.73e+00	2.4	6.54e-02	100.0	4.45e+01	1.7	2.42e-01	100.0	3.90e-01	100.0
	d	686	647	309	2.37e+00	2.7	6.34e-02	100.0	4.10e+01	1.8	2.34e-01	100.0	3.76e-01	100.0

Point & Increment	Weight (g)			Concentration (pCi/g) and s.d. (%)									
	Wet	Dry	Fine	^{60}Co		^{137}Cs		^{152}Eu		^{155}Eu		^{241}Am	
86 a	362	360	276	2.40e+01	2.0	1.41e+02	1.4	2.85e+02	1.3	1.84e+01	21.8	2.12e+02	18.9
b	438	435	340	2.53e+01	1.3	3.69e+00	19.6	4.26e+02	1.2	7.19e+00	45.0	1.52e+00	100.0
c	832	817	617	2.49e+01	1.5	2.77e-01	100.0	4.23e+02	1.0	1.06e+00	100.0	1.69e+00	100.0
d	661	639	494	1.62e+01	1.4	1.56e-01	100.0	2.75e+02	1.3	1.64e+00	81.6	9.10e-01	100.0
87 a	227	226	147	1.32e+00	4.5	1.25e+00	14.9	2.22e+01	2.2	1.74e-01	100.0	1.59e+00	24.5
b	436	432	303	3.85e-01	8.9	2.77e-01	21.2	6.07e+00	2.3	2.79e-01	69.3	2.00e-01	100.0
c	1044	1019	111	3.66e+00	2.7	1.27e+00	16.1	5.31e+01	1.6	7.63e-01	75.3	1.33e+00	33.9
d	751	735	370	3.24e+00	2.3	2.48e+00	10.3	5.24e+01	1.7	8.41e-01	90.8	2.51e+00	26.1
88 a	317	314	294	2.17e+00	5.3	4.14e+00	3.8	3.22e+01	1.3	2.14e-01	100.0	1.59e+00	30.2
b	333	327	288	1.99e+00	3.0	4.93e-01	29.8	3.15e+01	1.8	2.01e-01	100.0	3.23e-01	100.0
c	447	427	368	2.31e+00	2.7	5.58e-02	100.0	3.06e+01	1.8	2.02e-01	100.0	3.22e-01	100.0
d	734	680	495	1.50e+00	4.7	4.86e-02	100.0	2.00e+01	1.8	1.75e-01	100.0	2.87e-01	100.0
89 a	228	227	191	2.26e+01	1.4	6.03e+01	2.6	2.44e+02	1.4	6.81e+00	34.1	8.71e+01	19.0
b	547	537	249	2.26e+01	1.2	1.33e+00	23.2	3.34e+02	1.2	1.97e+00	111.3	9.08e-01	100.0
c	536	500	416	2.61e+01	1.3	3.39e+00	10.9	3.71e+02	1.0	3.07e+00	82.6	2.90e+00	43.9
d	480	444	341	2.07e+01	1.2	1.69e-01	100.0	2.97e+02	1.2	1.97e+00	77.0	9.00e-01	100.0
90 a	236	234	109	1.27e+00	4.9	3.25e+00	10.5	1.81e+01	2.8	3.14e-01	37.3	3.64e+00	25.2
b	163	161	52	1.77e+00	7.2	1.16e-01	100.0	1.92e+01	4.2	1.97e-01	100.0	3.13e-01	100.0
c	701	645	620	9.07e-01	4.5	2.30e-01	31.6	1.50e+01	2.0	1.55e-01	100.0	2.59e-01	100.0
d	813	730	204	5.10e-01	7.5	4.05e-02	100.0	9.65e+00	2.2	2.49e-01	51.2	2.07e-01	100.0
91 a	344	354	224	1.92e+00	10.9	2.26e+01	13.7	3.62e+00	37.6	8.25e+00	100.0	1.29e+05	19.3
b	530	506	230	5.41e-01	9.6	8.76e+00	1.9	2.56e+00	12.9	7.71e-01	100.0	2.66e+04	19.0
c	714	663	389	3.45e-01	6.0	9.95e-01	5.9	3.19e+00	2.8	3.06e-01	54.8	1.09e+03	4.3
d	786	729	387	2.49e-01	7.1	1.07e-01	20.4	3.05e+00	3.6	3.57e-01	25.7	1.08e+02	3.6
92 a	333	329	233	5.28e+00	1.3	5.32e+01	1.1	7.61e+00	2.9	2.58e+00	14.9	7.28e+02	3.3
b	514	490	319	1.97e+00	2.0	2.28e+01	0.9	6.88e+00	2.0	9.42e-01	16.0	3.16e+02	3.3
c	715	655	595	6.64e-01	3.9	1.53e+00	2.6	6.38e+00	1.9	7.80e-02	100.0	7.41e+00	4.6
d	1357	1305	338	5.80e-01	4.7	5.47e-01	11.0	5.57e+00	2.2	2.56e-01	42.8	1.36e+01	3.8
93 a	296	293	134	3.65e+00	2.4	3.96e+01	1.8	2.90e+00	5.0	2.51e+00	6.1	9.09e+02	3.3
b	512	506	121	1.05e+00	3.3	1.37e+01	1.6	2.14e+00	4.5	9.40e-01	14.0	6.40e+02	3.3
c	853	793	602	3.32e-01	5.7	2.45e+00	1.9	2.08e+00	3.9	4.03e-01	37.6	6.39e+01	3.3
d	616	583	225	2.26e-01	15.3	6.53e-01	5.1	1.73e+00	4.5	9.12e-02	39.3	1.37e+01	4.2
94 a	393	386	225	4.77e+00	1.3	3.69e+01	1.2	4.94e+00	2.7	2.01e+00	14.9	7.38e+01	3.3
b	326	312	253	2.11e+00	2.0	1.82e+01	1.3	4.22e+00	2.3	9.52e-02	100.0	7.52e+01	3.3
c	889	845	591	3.73e-01	9.6	1.17e+00	5.8	3.64e+00	2.7	1.60e-01	100.0	2.56e+00	19.2
d	724	659	605	2.96e-01	11.0	3.61e-01	26.3	3.14e+00	4.4	2.17e-01	76.5	2.00e+00	25.3
95 a	344	340	107	3.96e+00	2.8	5.44e+01	1.0	1.26e+00	10.2	2.37e+00	9.4	2.55e+01	15.0
b	453	430	295	6.33e-01	7.2	1.01e+01	2.7	8.72e-01	13.2	6.78e-01	20.5	3.17e+00	19.5
c	816	747	589	1.31e-01	19.2	8.52e-01	5.4	9.97e-01	12.7	3.25e-01	60.5	3.96e-01	100.0
d	824	787	411	6.23e-02	35.1	1.15e-01	30.9	9.44e-01	8.5	2.99e-01	76.6	3.66e-01	100.0

Point & Increment	Weight (g) Wet	Dry	Fine	Concentration (pCi/g) and s.d. (%) ^{60}Co		^{137}Cs		^{152}Eu		^{155}Eu		^{241}Am	
96 a	454	442	270	2.76e+00	10.5	3.72e+01	7.6	1.41e+00	100.0	1.28e+01	100.0	2.03e+05	17.8
b	421	389	326	7.08e-01	16.0	1.80e+01	5.5	1.42e+00	92.6	5.96e+00	100.0	1.04e+05	26.7
c	839	758	653	3.06e-01	12.2	1.47e+00	8.2	2.80e+00	4.7	2.20e-01	100.0	3.74e+03	15.9
d	406	370	276	2.27e-01	14.9	4.82e-01	15.0	2.17e+00	4.5	1.57e-01	100.0	1.19e+03	13.1
97 a	545	537	203	2.20e+00	4.0	2.46e+01	2.0	1.78e+00	11.5	1.04e+00	21.1	7.54e+02	48.8
b	362	335	305	2.93e-01	15.8	2.68e+00	3.1	1.42e+00	6.7	3.12e-01	49.4	2.67e+01	6.0
c	916	861	474	1.38e-01	22.5	3.44e-01	18.0	1.18e+00	7.0	2.78e-01	69.9	3.06e+00	19.1
d	993	961	248	4.64e-02	100.0	2.21e-01	37.0	9.12e-01	10.0	2.54e-01	47.0	5.09e+00	22.6
98 a	470	454	307	6.91e-01	5.0	8.59e+00	4.0	6.40e-01	19.1	4.34e-01	82.4	3.75e+03	21.6
b	480	445	421	1.03e-01	19.2	1.32e+00	5.8	5.65e-01	12.0	9.55e-02	100.0	2.13e+01	19.2
c	748	691	485	8.20e-02	20.2	1.26e-01	38.8	5.72e-01	12.0	9.09e-02	100.0	3.12e+00	21.8
d	680	621	360	2.72e-02	100.0	2.28e-02	100.0	4.47e-01	11.8	2.22e-01	85.7	1.79e-01	66.4
99 a	350	341	226	3.36e+00	2.0	3.31e+01	2.5	1.83e+00	8.0	1.82e+00	9.9	6.92e+02	19.0
b	391	371	242	3.76e-01	7.3	4.56e+00	2.9	9.33e-01	6.9	1.14e-01	100.0	5.87e+02	25.1
c	862	808	472	7.42e-02	29.4	4.08e-01	7.4	7.58e-01	9.8	2.12e-01	66.8	9.27e+00	19.9
d	851	774	599	5.81e-02	50.0	2.53e-02	100.0	7.55e-01	7.4	2.53e-01	68.1	2.63e+00	23.3
100 a	329	317	257	6.27e+00	1.8	5.33e+01	2.7	1.16e+00	12.1	2.49e+00	11.6	4.29e+02	27.4
b	247	231	142	6.32e-01	5.9	6.79e+00	2.3	6.85e-01	10.6	3.65e-01	53.0	4.76e+01	19.3
c	726	677	318	1.29e-01	16.7	1.15e+00	5.3	6.62e-01	8.0	1.87e-01	54.1	8.05e+00	20.9
d	674	627	280	8.36e-02	24.0	2.09e-01	17.4	5.40e-01	9.7	2.24e-01	97.3	1.77e+00	23.4
101 a	502	495	236	2.17e+00	6.0	1.11e+01	4.0	----		----		----	
b	430	415	338	----		1.15e+00	6.0	----		7.49e-01	19.0	----	
c	751	711	581	----		----		----		----		----	
d	557	530	294	----		----		----		----		----	
102 a	370	364	205	5.44e+00	4.0	1.87e+01	4.0	----		----		----	
b	362	354	169	1.47e+00	6.0	5.37e+00	4.0	----		----		----	
c	928	905	216	2.07e-01	14.0	1.59e+00	6.0	----		----		----	
d	795	767	398	----		1.45e-01	18.0	----		----		----	
103 a	740	734	138	1.52e+01	4.0	5.13e+01	4.0	----		----		----	
b	409	393	316	3.62e+00	5.0	1.31e+01	4.0	----		----		----	
c	709	670	526	7.40e+00	7.0	2.60e+00	5.0	----		----		----	
d	948	906	426	3.36e-01	12.0	1.54e+00	6.0	----		----		----	
104 a	403	397	291	3.01e+00	8.0	1.18e+01	4.0	----		----		----	
b	412	405	287	----		1.33e+00	10.0	----		----		----	
c	754	730	570	----		----		----		----		----	
d	806	772	621	----		----		----		----		----	
105 a	447	442	267	3.83e+01	4.0	1.33e+02	4.0	----		----		----	
b	332	325	272	7.27e+00	6.0	2.78e+01	4.0	----		----		----	
c	592	574	538	----		3.20e+00	6.0	----		----		----	
d	554	529	481	----		4.83e-01	18.0	----		----		----	

Point & Increment	Weight (g) Wet	Dry	Fine	Concentration (pCi/g) and s.d. (%) ^{60}Co	s.d.	^{137}Cs	s.d.	^{152}Eu	^{155}Eu	s.d.	^{241}Am	s.d.
106 a	410	403	173	1.62e+01	4.0	5.61e+01	4.0	----	----		----	
b	372	360	275	2.78e+00	6.0	1.02e+01	4.0	----	----		----	
c	745	709	569	----		1.10e+00	6.0	----	----		----	
d	890	847	615	----		----		----	----		----	
107 a	369	364	287	3.90e+02	4.0	1.45e+03	4.0	----	----		----	
b	349	340	283	2.22e+01	4.0	9.72e+01	4.0	----	----		----	
c	799	774	657	1.00e+01	5.0	3.99e+01	4.0	----	----		----	
d	743	713	592	4.34e-01	20.0	4.52e+00	6.0	----	----		----	
108 a	314	311	130	1.10e+02	4.0	3.92e+02	4.0	----	----		----	
b	399	386	266	2.38e+02	4.0	9.48e+01	4.0	----	----		----	
c	583	564	417	1.19e+01	4.0	5.40e+01	4.0	----	----		----	
d	701	676	555	9.29e-01	10.0	7.37e+00	4.0	----	----		----	
109 a	297	292	187	1.46e+02	4.0	4.23e+02	4.0	----	----		----	
b	481	471	253	8.28e+00	6.0	3.30e+01	4.0	----	----		----	
c	750	734	261	1.46e+00	12.0	7.32e+00	5.0	----	----		----	
d	942	906	513	----		8.49e-01	12.0	----	----		----	
110 a	379	372	289	1.05e+01	4.0	5.18e+01	4.0	----	2.33e+00	18.0	----	
b	359	353	250	1.00e+00	12.0	8.46e+00	4.0	----	----		----	
c	689	661	608	----		2.45e+00	6.0	----	----		----	
d	800	753	616	----		----		----	----		----	
111 a	307	303	184	----		2.84e+00	6.0	----	----		----	
b	259	254	202	----		8.89e+00	4.0	----	----		----	
c	611	594	384	----		3.28e-01	21.0	----	----		----	
d	420	401	282	----		----		----	----		----	
112 a	416	411	237	4.49e-01	16.0	1.30e+01	4.0	----	----		2.92e+02	18.0
b	325	318	291	----		2.95e+00	6.0	----	----		----	
c	836	816	431	----		----		----	----		----	
d	467	449	401	----		1.07e+00	8.0	----	----		----	
113 a	397	368	256	1.09e+01	4.0	3.53e+01	4.0	----	----		----	
b	424	408	249	7.01e-01	9.0	2.85e+00	5.0	----	----		----	
c	886	862	458	1.63e-01	20.0	4.94e-01	10.0	----	----		----	
d	1006	996	642	----		3.22e-01	13.0	----	----		----	
114 a	579	573	188	2.31e+00	6.0	2.08e+01	4.0	----	9.11e-01	20.0	----	
b	569	554	301	2.62e-01	14.0	2.87e+00	5.0	----	----		----	
c	781	754	301	----		----		----	----		----	
d	1591	1551	331	----		3.14e-01	12.0	----	----		----	
115 a	485	482	193	4.76e+00	5.0	1.52e+01	4.0	----	6.61e-01	22.0	1.94e+00	32.0
b	416	409	272	8.44e-01	8.0	3.63e+00	5.0	----	----		----	
c	840	816	477	----		1.78e-01	20.0	----	----		----	
d	800	777	416	----		----		----	----		----	

APPENDIX C

RELIABILITY OF SOIL ANALYSES

APPENDIX C: RELIABILITY OF SOIL ANALYSES

by E.H. Essington (Quality Assurance Referee)
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Soil samples from 115 locations were collected and analyzed to provide the data necessary for calculating inverse relaxation lengths and specific radionuclide ratios. A quality assurance (QA) program was conducted along with the sample analyses to test the reliability of the analytical results. The elements of the QA program were interlaboratory comparisons, analyses of blind and background samples, and analyses of hidden replicate samples.

METHODS

As described in the Methods section of this report, soil samples were taken in several (usually four) increments at each location. A library number was assigned to the bulk sample from each increment upon collection. After being dried, ball-milled, and sieved, the bulk samples (usually 200 to 500 g after preparation) were counted by gamma-ray spectrometers at REECo. The spectra were then analyzed with the GAMANAL program at LLNL to provide the data in Appendix B.

Aliquots from the bulk sample of the top increment from 39 locations were also submitted for radiochemical analysis. The aliquots were prepared under the supervision of the Referee, who randomly assigned them laboratory numbers from a list provided by the REECo soils laboratory. Background samples, blinds, and replicates were also prepared and assigned laboratory numbers such that the identity of each sample was unknown to the analyst. Only after acceptance of the final results by the Referee and the principal investigator was the identity of the samples made known. Upon preparation of aliquots from a single bulk sample, the labeled aliquot containers were photographed together with the bulk sample container to document the integrity of the labeling. Those photographs and sample identification logs are maintained by the Referee.

A few aliquots of blind, background, and randomly-selected bulk samples, prepared at the same time as the aliquots for the REECo laboratory, were sent independently to the Referee and to EAL Corporation to provide confirmatory results.

Sample preparation was conducted to assure representative aliquots to support QA and meet the requirements set forth by the contributing analytical laboratories. For example, the REECo laboratory requested that samples be submitted in sets of seven, to allow the analyst to include blanks and references for internal quality control, and that sufficient sample be provided to allow sub-aliquoting into duplicate fractions that could be used as an internal check of analytical performance. Only averages of results from the two internal replicates would be reported as official results unless problems in reproducibility were observed. Each set of seven samples included one of the replicates and one or more aliquots of the blind or background samples prepared by the Referee.

Each sample sent to the REECo laboratory was a 20-g aliquot; two such aliquots were prepared from each bulk sample to provide sample replicates. In the laboratory, each 20-g aliquot was partitioned into two 10-g subaliquots and each was assayed by gamma spectrometry for ^{241}Am, ^{137}Cs, and ^{60}Co. The results for each radionuclide were then evaluated for consistency. If they passed the analyst's acceptance criteria, the two subaliquots were submitted for $^{239,240}Pu$, ^{238}Pu, and ^{90}Sr analyses. If they failed, they were recounted. If the subaliquots passed the acceptance criteria after recounting, they were submitted for analysis; if they still failed, they were recombined, mixed, realiquoted, and remeasured, then submitted for analysis. This method of evaluating the samples for consistency was considered necessary by the REECo laboratory to internally test its performance on actual sample matrices.

Radiochemical analyses of the soil samples consisted of complete dissolution in HF + HNO_3 + HCl (including carbonate fusion of any residue), followed by chemical isolation of the target radionuclides from aliquots of the resultant solution. The plutonium concentration was determined by ion exchange separation of the plutonium fraction from one aliquot followed by alpha spectrometry. Strontium-90 was isolated from another aliquot by oxalate precipitation and then measured by beta-counting the ^{90}Y recovered from the purified strontium fraction. Chemical yield tracers were used in both separations and were added to the respective solutions after dissolution and aliquoting. Analytical results were reported to the Referee, who flagged questionable results and attempted to resolve problems by consulting with the analyst.

Americium-241 was also determined on a small set of samples from the Sedan area (plus blinds and background) by chemical isolation and alpha spectrometry. The reason for this special effort was the possible interference with the 60-keV gamma peak of ^{241}Am by the Yb X-rays produced in the decay of ^{174}Lu, a radionuclide found in the Sedan area.

Evaluation of the results included a screening test of the replicate results. The test flagged a result if the absolute value of the result minus the mean of replicates was larger than 3 times the standard deviation for the result as specified by the analytical laboratory. REECo's stated error was the greater of the counting error and the standard deviation of the two individual 10-g aliquots, but did not include a consideration of calibration or density errors. Typical errors quoted by REECo were in the 4 to 10 percent range, but some ^{137}Cs results included an error term of 1 percent or less. In view of these considerations, the flagged results were carefully re-examined as explained below, but were not necessarily rejected.

After a result was flagged, the analyst was consulted for possible transcription errors and consideration of various factors that might have caused results to appear erroneous. One such factor previously demonstrated to occur in certain samples from safety shot sites is the "hot particle problem" (HPP). The HPP refers to the presence of a small number of discrete particles of concentrated radioactivity in a matrix of relatively low radioactivity; those particles tend to withstand ball-milling or normal soil particle size reduction techniques. About 40,000 pCi of radioactivity is associated with a 44-μm particle of $^{239,240}PuO_2$. The probability of uniformly distributing a limited number of those particles in a sample aliquot is quite small. The PuO_2 particles observed at the safety shot sites contain ^{241}Am and generally the ratio of $^{239,240}Pu$ to ^{241}Am remains constant among those particles within a given site.

RESULTS

In general, the bulk sample gamma-spectrometric results appear to be reliable by virtue of their similarity to 10-g aliquot results reported independently by REECo, EAL, and the Referee. Table C-1 compares the bulk sample results and the REECo aliquot results. In only two cases, L20517 and L19972, was the ^{241}Am flagged. In sample L20517, the bulk ^{241}Am value of 3750 pCi/g is not consistent with the average of 399 pCi/g from the two replicate aliquots provided to the laboratory. The $^{239,240}Pu$ to ^{241}Am ratio calculated from the aliquot results was about 7, and that ratio for the bulk sample, determined from both the plutonium and ^{241}Am gamma peaks, was also about 7. Thus the difference in the ^{241}Am results was assumed to have derived from the HPP.

The discrepancy observed for sample L19972 has not been resolved. The result from the GAMANAL spectrum reduction procedure gave 34.0 pCi/g for the bulk sample, whereas the preliminary REECo result for the bulk sample was 11.5 pCi/g. The latter value agrees with the 12.2 pCi/g reported as the average for the 10-g replicates. It appears that the bulk result reported in Table C-1 should be rejected in favor of the 10-g result.

Table C-2 summarizes results that can be compared among the three contributing laboratories. None of the results was flagged and this suggests that the three laboratories were reporting comparable results.

Determining the reliability of the results of the gamma-spectrometric and radiochemical analyses of 10-g aliquots included the evaluation of the blind and background results, comparison of the replicates, and comparison of the REECo results to those of the Referee and EAL. Table C-3 summarizes the blind and background results obtained by REECo relative to the set number in which they were sent to the laboratory. Sample L21037 is the main blind reference, one of which was included with each set. Sample L17835 is a secondary blind that had been used in previous analyses of soils and has since been discontinued. It was included here to provide a measure of continuity of analytic results generated for other programs as well as to provide a very different matrix for analysis (refer to Table C-3 for a comparison). Sample L21039 was prepared as a background; the material was collected from a relatively uncontaminated area on the NTS in Area 2 and has the same general matrix characteristics as the blind material. Results of the two blinds (L21037 and L17835) indicate very good reproducibility from set to set and support the general acceptance of the analytical results. The ^{239,240}Pu value for set 7 (1,230 pCi/g) did not pass the first screening test; however, all of the radiochemical results for set 7 were initially rejected by the analyst upon early detection of cross-contamination in the laboratory. All of the samples in set 7 that were suspected of contamination were repeated; those that were determined not to be contaminated were combined with set 6 and are supported by the blind result of set 6. Results of the above tests indicate good internal agreement and provide additional support to the conclusion that the results are reliable.

The replicate results, which form part of the basic data base for the calculation of inverse relaxation lengths and ratios, are summarized in Table C-4. In general, the replicate results were considered acceptable based on the acceptance test. Exceptions to that conclusion were in plutonium results for L19869 and L19873 and in ^{137}Cs for L20489. The initial samples provided to the REECo laboratory were lost during analysis of plutonium; new aliquots were later provided. Plutonium results for each subaliquot prepared by the REECo laboratory show a rather large degree of variability that may be attributed to the HPP. The discrepancy in the

^{137}Cs results for sample L20489 could not be resolved by submitting another aliquot because that sample contains a high level of plutonium relative to the other samples in this series. The analytical laboratory decided not to accept a second aliquot for fear of cross-contaminating other samples.

Results from the replicate samples indicate the precision of the analyses. The accuracy and reliability of the results is derived from the similarity of the REECo, Referee, and EAL results. Table C-5 summarizes the gamma and radiochemical results from the three laboratories. The results compare quite well except for two samples which are both from safety shot sites known to exhibit the HPP. An excellent example of the HPP is shown in sample L20489, with a 10-fold difference between the three 1-g aliquots of the same sample analyzed by the Referee. Americium-241 in sample L19965 reported by EAL appears to be high and no explanation for that discrepancy was found.

Table C-6 summarizes the results of ^{241}Am determinations on Sedan soil samples. Americium-241 determined by gamma assay of the 10-g soil sample is compared to the ^{241}Am measured by chemical separation and alpha spectrometry of an aliquot of the solution obtained by dissolving the same soil sample. Blind samples (L21037) and background samples (L21039) were included. Blind results compare very well, but gamma results from the Sedan soil samples show a high bias compared with the radiochemistry results. A least-squares fit (Prahl, 1981) of the log-transformed paired results resulted in the equation:

$$Y = 1.38X^{0.976}$$

with a coefficient of determination (r^2) of 0.994 and a geometric mean ratio for ^{241}Am-gamma to ^{241}Am-chem of 1.28. Apparently the spectrum reduction procedure used by REECo for ^{241}Am did not adequately correct for the ^{174}Lu-Yb X-ray interference on the 60-keV gamma peak of ^{241}Am.

With the exception of those few samples exhibiting the HPP, the two samples for which an explanation of the discrepancy was not available, and the bias detected in the Sedan 10-g ^{241}Am results, the gamma results reported for the bulk samples and the gamma and radiochemical results reported for the 10-g samples are considered a reliable and accurate representation of radioactivities in the samples tested.

REFERENCE

Prahl, W.H., 1981. Fitting linear equations to sets of experimental data. Chemical Engineering, August 10, 1981, pp 85-88.

TABLE C-1. GAMMA SPECTROMETRIC ANALYSES OF BULK SOIL SAMPLES AND 10-G ALIQUOTS BY REECO

Library No.	Sample Type	Concentration (pCi/g) and s.d. (%) ^{241}Am	^{137}Cs	^{60}Co
L19869	bulk[a]	93.0 (26)	64.7 (1)	7.75 (3)
	10-g[b]	69.6 (73)	70.8 (5)	6.30 (9)
L19873	bulk	5.89 (23)	61.0 (3)	16.3 (2)
	10-g	6.13 (63)	66.5 (3)	13.0 (7)
L19885	bulk	12.4 (16)	112. (2)	20.9 (2)
	10-g	13.7 (10)	112. (4)	15.2 (11)
L19893	bulk	29.7 (19)	139. (2)	20.6 (1)
	10-g	23.0 (8)	141. (1)	15.8 (5)
L20489	bulk	1.29E5 (19)	22.6 (14)	1.92 (11)
	10-g	1.34E5 (5)	44.8 (6)	2.44 (23)
L20493	bulk	728. (3)	53.2 (1)	5.28 (1)
	10-g	676. (10)	55.4 (3)	4.65 (8)
L20509	bulk	2.03E5 (18)	37.2 (8)	2.76 (10)
	10-g	2.33E5 (5)	56.0 (9)	3.18 (19)
L20517	bulk	3750. (22)	8.59 (4)	0.69 (5)
	10-g	399. (4)	8.87 (5)	0.68 (42)
L20525	bulk	429. (27)	53.3 (3)	6.27 (2)
	10-g	422. (25)	57.0 (6)	5.56 (8)
L19793	bulk	4.98 (21)	13.5 (4)	3.00 (2)
	10-g	4.82 (20)	13.2 (9)	2.48 (21)
L19801	bulk	9.28 (20)	8.55 (4)	0.61 (5)
	10-g	9.27 (14)	9.56 (6)	0.84 (32)
L19797	bulk	5.14 (22)	16.6 (2)	1.26 (4)
	10-g	4.50 (16)	17.2 (6)	1.07 (21)
L19953	bulk	11.3 (8)	7.09 (2)	0.76 (4)
	10-g	12.2 (17)	5.88 (8)	0.52 (22)
L19957	bulk	4.00 (22)	3.04 (9)	2.91 (3)
	10-g	4.45 (16)	3.46 (11)	2.66 (14)
L19961	bulk	52.8 (19)	13.0 (3)	4.00 (3)
	10-g	55.8 (3)	13.9 (4)	3.38 (16)
L19965	bulk	567. (19)	144. (3)	28.6 (1)
	10-g	557. (3)	150. (3)	21.8 (4)
L19972	bulk	34.0 (8)	3.71 (4)	2.42 (2)
	10-g	12.2 (9)	3.94 (13)	2.07 (17)
L20000	bulk	212. (19)	141. (1)	24.0 (2)
	10-g	206. (5)	136. (7)	17.3 (4)
L20012	bulk	87.1 (19)	60.3 (3)	22.6 (1)
	10-g	92.0 (5)	64.8 (1)	18.4 (4)
L20065	bulk	3.09 (9)	2.98 (2)	1.59 (3)
	10-g	2.97 (26)	3.33 (12)	1.33 (24)
L20073	bulk	6.76 (22)	28.8 (3)	8.52 (2)
	10-g	6.60 (14)	31.3 (4)	6.90 (8)
L20085	bulk	2.00 (23)	4.74 (3)	0.83 (5)
	10-g	1.85 (31)	5.05 (15)	0.80 (44)
L20093	bulk	3.61 (21)	3.98 (6)	0.89 (6)
	10-g	4.05 (16)	3.65 (9)	0.80 (28)
L20097	bulk	24.9 (15)	16.4 (4)	3.44 (3)
	10-g	25.3 (7)	17.7 (4)	2.77 (16)
L20105	bulk	6.52 (21)	20.3 (3)	7.03 (3)
	10-g	6.45 (14)	21.5 (4)	5.24 (9)
L20109	bulk	3.42 (11)	5.71 (6)	10.6 (1)
	10-g	3.75 (30)	5.45 (11)	7.48 (10)
L20121	bulk	4.60 (10)	4.59 (3)	0.69 (4)
	10-g	4.65 (27)	5.10 (8)	0.82 (34)
L20133	bulk	3.88 (20)	14.6 (3)	2.25 (6)
	10-g	3.02 (32)	16.2 (6)	2.04 (16)
L20141	bulk	39.6 (15)	5.67 (3)	0.63 (9)
	10-g	38.8 (16)	5.50 (20)	<
L20153	bulk	10.7 (21)	42.6 (2)	9.65 (2)
	10-g	9.60 (12)	43.7 (3)	7.69 (7)
L20137	bulk	4.00 (18)	3.11 (8)	0.65 (8)
	10-g	3.23 (41)	3.33 (12)	0.77 (36)

[a]Gamma spectra evaluated at LLNL using GAMANAL

[b]Results are averages of at least two replicates

TABLE C-2. GAMMA-SPECTROMETRIC ANALYSES OF BULK SOIL SAMPLES (REECO) AND 10-G ALIQUOTS (REFEREE, EAL)

Library No.	Labor- atory	Sample No.	Concentration (pCi/g) and s.d. (%)				
			^{241}Am	^{137}Cs	^{60}Cs	^{152}Eu	^{155}Eu
L20065	REECo[a]	62584	3.09 (9)	2.98 (2)	1.59 (3)	22.6 (1)	<
	Referee	64059	2.56 (11)	3.08 (11)	0.73 (53)	21.8 (8)	<
	EAL	64090	2.47 (5)	3.31 (6)	1.04 (15)	---	---
L20121	REECo	61780	4.60 (10)	4.59 (3)	0.69 (4)	6.37 (3)	0.67 (33)
	Referee	64063	4.92 (6)	5.06 (6)	0.76 (37)	6.58 (22)	<
L20153	REECo	62034	10.7 (21)	42.6 (2)	9.65 (2)	130. (1)	3.35 (12)
	Referee	64097	10.7 (5)	44.6 (6)	8.04 (9)	130. (7)	2.41 (22)
L19869	REECo	62052	93.0 (26)	64.7 (1)	7.75 (3)	13.8 (2)	2.40 (20)
	Referee	64046	53.1 (5)	73.1 (5)	6.57 (7)	14.7 (11)	1.79 (20)
L19965	REECo	62148	567. (19)	144. (3)	28.6 (1)	310. (1)	15.3 (28)
	Referee	64027	587. (5)	156. (5)	20.8 (6)	315. (5)	11.5 (7)
	EAL	64056	874. (7)	151. (3)	23.2 (4)	---	---
L20489	REECo	63271	1.29E5 (19)	22.6 (14)	1.92 (11)	3.62 (38)	<
	Referee	64051	2.45E5 (5)	37.9 (6)	2.75 (12)	4.80 (30)	<
	EAL	64079	1.47E5 (5)	35.3 (3)	2.24 (8)	---	---

[a]Gamma spectra evaluated at LLNL using GAMANAL

TABLE C-3. ANALYSES OF REFERENCE BLIND AND BACKGROUND SOILS BY REECO

Library No.	Sample No.	Set No.	Concentration (pCi/g) and s.d. (%) ^{241}Am	^{60}Co	^{137}Cs	^{239,240}Pu	^{238}Pu	^{90}Sr
L21037	64072	1	143. (3)	31.6 (5)	378. (3)	963. (10)	316. (10)	712. (6)
	64088	1	141. (2)	31.1 (2)	383. (3)	890. (9)	299. (8)	724. (5)
	63984	2	144. (1)	32.3 (2)	390. (1)	766. (13)	257. (13)	754. (5)
	64001	3	147. (1)	33.0 (2)	397. (2)	902. (13)	301. (13)	692. (3)
	64009	4	141. (2)	33.2 (4)	403. (0)	872. (11)	284. (12)	737. (5)
	64012	5	143. (4)	33.8 (2)	400. (2)	852. (12)	286. (12)	660. (6)
	64020	6	146. (3)	34.4 (2)	400. (1)	1230. (7)	318. (7)	770. (3)
	64028	7	144. (3)	31.1 (2)	383. (1)	952. (9)	308. (10)	692. (9)
	64036	8	145. (1)	32.5 (2)	383. (1)	831. (9)	276. (9)	732. (0)
	64041	9	143. (2)	33.3 (2)	390. (1)	872. (9)	281. (9)	730. (8)
	64050	10	137. (1)	32.1 (2)	384. (1)	861. (5)	280. (5)	734. (2)
	64058	11	141. (1)	33.0 (3)	385. (1)	956. (11)	310. (11)	754. (2)
	64066	12	148. (2)	33.1 (2)	392. (2)	978. (9)	322. (9)	740. (5)
	64068	13	142. (1)	31.8 (3)	383. (1)	884. (16)	293. (16)	734. (1)
	64069	14	144. (1)	33.0 (2)	387. (2)	919. (15)	299. (15)	734. (7)
	64073	15	142. (1)	31.9 (2)	392. (1)	---	---	---
	64450	16	152. (2)	33.0 (3)	422. (3)	983. (13)	322. (13)	803. (3)
	64451	17,18	---	---	---	894. (11)	294. (11)	---
L17835	64015	3	3.7 (23)	0.5 (25)	528. (0)	5.8 (17)	46.2 (15)	9.1 (8)
	64049	4	3.8 (21)	0.6 (21)	523. (1)	9.2 (13)	52.1 (12)	10.1 (7)
	63990	10	3.3 (23)	0.5 (25)	496. (2)	6.7 (7)	51.0 (6)	7.1 (39)
	63998	14	2.9 (23)	0.4 (38)	494. (1)	6.3 (15)	46.5 (13)	7.3 (14)
L21039	64098	2	0.9 (100)	0.2 (100)	0.4 (28)	0.9 (102)	0.3 (141)	0.4 (141)
	64099	4	<	0.3 (25)	<	0.5 (28)	0.1 (141)	1.6 (20)
	64100	6	<	<	<	<	<	<
	64449	16	<	<	<	0.6 (102)	0.3 (141)	1.1 (101)
	64101	9	<	<	0.3 (25)	1.8 (13)	0.1 (100)	1.1 (40)
	64102	13	<	<	0.5 (25)	1.2 (102)	0.8 (141)	0.8 (141)

TABLE C-4. GAMMA-SPECTROMETRIC AND RADIOCHEMICAL ANALYSES OF 10-G ALIQUOTS OF SOIL SAMPLES

Library No.	Sample No.	Set No.	Concentration (pCi/g) and s.d. (%) ^{241}Am	^{60}Co	^{137}Cs	$^{239,240}Pu$	^{238}Pu	^{90}Sr
L19269	63983	1	8.6 (17)	277. (2)	1470. (1)	30.4 (14)	4.5 (10)	296. (3)
	64011	3	9.6 (17)	283. (1)	1540. (1)	35.0 (12)	5.2 (23)	300. (1)
L19273	64070	1	2.8 (22)	29.1 (5)	141. (1)	---	2.2 (13)	41.8 (2)
	64456R[a]	17	---	---	---	8.2 (13)	2.1 (33)	---
	63985	2	1.9 (25)	27.3 (4)	137. (3)	10.8 (20)	2.5 (23)	42.3 (3)
L19281	64013	1	3.2 (25)	103. (3)	426. (4)	11.4 (10)	1.8 (13)	113. (4)
	64042	3	3.3 (25)	110. (4)	453. (5)	14.2 (14)	1.9 (19)	116. (2)
L19813	64071	1	10.1 (8)	6.5 (5)	32.7 (3)	41.9 (9)	8.4 (10)	25.9 (6)
	63986	2	10.0 (8)	6.6 (5)	33.0 (3)	46.0 (18)	9.3 (20)	24.6 (4)
L19829	64014	1	22.5 (4)	16.2 (3)	69.1 (1)	106. (10)	19.5 (10)	59.2 (2)
	64043	3	22.7 (4)	16.3 (3)	72.1 (2)	97.2 (12)	18.1 (13)	56.9 (3)
L19833	64074	2	26.9 (3)	19.0 (3)	62.9 (1)	96.5 (17)	17.5 (18)	50.8 (3)
	63987	3	27.6 (6)	20.0 (3)	65.1 (1)	120. (13)	22.5 (14)	50.7 (5)
L19837	63988	2	42.8 (2)	28.6 (2)	87.8 (1)	198. (17)	35.6 (18)	77.0 (2)
	64017	4	42.8 (2)	29.1 (4)	86.3 (1)	186. (14)	35.3 (15)	77.7 (4)
L19849	64045	2	25.2 (6)	18.4 (3)	52.1 (2)	127. (20)	24.7 (21)	45.7 (6)
	64075	3	26.3 (3)	18.8 (3)	56.2 (1)	110. (13)	20.4 (13)	46.2 (3)
L19869	63989	4,5	60.1 (20)	6.3 (5)	70.5 (5)	---	---	104. (1)
	64465R1	18	---	---	---	258. (12)	9.2 (14)	---
	64465R2	18	---	---	---	364. (12)	11. (14)	---
	64018	4,5	79.0 (62)	6.3 (7)	71.0 (1)	---	---	104. (4)
	64454R1	17	---	---	---	793. (13)	17.3 (16)	---
	64454R2	17	---	---	---	597. (17)	15.2 (18)	---
L19873	64077	4,5	6.2 (44)	12.5 (4)	66.0 (1)	---	---	214. (4)
	64466R1	18	---	---	---	54.5 (15)	5.0 (16)	---
	64466R2	18	---	---	---	28.2 (13)	---	---
	64229	6,7	5.4 (16)	13.8 (4)	66.2 (2)	---	6.1 (27)	---
	64455R	16	6.8 (39)	12.7 (4)	67.2 (1)	52.5 (27)	10.4 (49)	216. (3)
L19885	64078	4,5	13.3 (7)	15.3 (9)	113. (1)	---	---	362. (1)
	64467R	18	---	---	---	87.0 (11)	11.9 (10)	---
	63991	4	14.1 (7)	15.1 (6)	110. (4)	98.8 (12)	10.8 (13)	331. (3)
L19893	64019	4	22.9 (4)	15.8 (4)	141. (1)	170. (17)	16.4 (18)	311. (1)
	64047	6,7	23.1 (7)	15.7 (3)	141. (1)	---	---	316. (5)
	64453R	17	---	---	---	156. (38)	13.4 (19)	---
L20489	63992	15	134000. (2)	2.4 (23)	55.4 (1)	875000. (15)	---	---
	64021	6,7	135000. (5)	<	34.2 (8)	996000. (6)	18300. (11)	65.2 (3)
L20493	63993	4,5	651. (10)	4.5 (6)	56.4 (1)	---	---	87.1 (3)
	64462R	18	---	---	---	4635. (10)	85.2 (10)	---
	64022	6,7	702. (4)	4.8 (6)	54.4 (3)	---	---	82.0 (5)
	64461R	18	---	---	---	3960. (18)	72.1 (12)	---
L20509	64048	15	230000. (3)	3.2 (19)	55.4 (3)	1.36E6 (6)	---	---
	64080	6,7	236000. (4)	<	56.5 (9)	1.41E6 (5)	27800. (10)	88.2 (1)
L20517	63995	6,7	404. (3)	0.7 (37)	9.1 (3)	2825. (8)	46.0 (8)	13.0 (37)
	64023	6,7	394. (3)	0.7 (19)	8.6 (4)	2750. (8)	43.2 (8)	12.6 (17)
L20525	64052	6,7	438. (23)	5.4 (6)	56.4 (6)	---	---	119. (2)
	64463R	18	---	---	---	2665. (10)	53.4 (13)	---
	64082	6,7	406. (7)	5.7 (6)	57.7 (1)	3275. (11)	61.4 (11)	112. (9)
L19793	63996	6,7	5.1 (9)	2.2 (17)	13.3 (6)	---	---	---
	64464R	16	5.0 (11)	2.5 (10)	12.9 (3)	119. (10)	2.4 (15)	25.4 (4)
	64024	8	4.3 (15)	2.7 (9)	13.5 (5)	110. (10)	2.3 (21)	22.8 (9)
L19801	63997	6,7	9.2 (5)	0.8 (18)	9.8 (3)	---	---	---
	64468R	16	9.3 (8)	0.8 (18)	9.3 (3)	83.9 (15)	1.9 (21)	21.5 (6)
	64025	8	9.3 (10)	1.0 (19)	9.6 (4)	73.8 (14)	3.6 (13)	20.6 (3)

[a]R - repeat analysis

TABLE C-4. GAMMA-SPECTROMETRIC AND RADIOCHEMICAL ANALYSES OF 10-G ALIQUOTS OF SOIL SAMPLES (continued)

Library No.	Sample No.	Set No.	Concentration (pCi/g) and s.d. (%)					
			^{241}Am	^{60}Co	^{137}Cs	$^{239,240}Pu$	^{238}Pu	^{90}Sr
L19797	64053	8	3.9 (13)	1.1 (14)	17.3 (2)	146. (10)	3.6 (12)	29.1 (3)
	64083	9	5.0 (14)	1.0 (16)	17.0 (6)	138. (5)	3.3 (9)	26.1 (2)
L19953	64054	8	12.7 (4)	<	6.0 (5)	93.8 (11)	1.9 (16)	17.6 (3)
	64084	9	11.7 (17)	0.5 (22)	5.8 (6)	80.3 (36)	1.8 (17)	17.8 (10)
L19957	64085	8	4.4 (12)	2.8 (10)	3.6 (7)	31.6 (10)	0.6 (96)	7.5 (6)
	63999	10	4.5 (11)	2.5 (9)	3.3 (8)	46.8 (25)	1.3 (40)	6.6 (10)
L19961	64026	8	57.4 (2)	3.2 (14)	14.3 (3)	429. (10)	11.6 (13)	31.1 (5)
	64055	9	54.2 (2)	3.5 (8)	13.5 (3)	418. (8)	11.5 (8)	32.0 (2)
L19965	64087	9	540. (3)	21.6 (3)	146. (3)	4090. (10)	128. (10)	250. (3)
	64000	10	574. (1)	22.0 (3)	155. (1)	3975. (5)	126. (5)	271. (3)
L19972	64002	9	12.1 (5)	2.0 (14)	4.0 (11)	107. (17)	2.6 (34)	7.7 (18)
	64029	11	12.3 (8)	2.6 (10)	3.9 (7)	98.2 (18)	2.0 (20)	7.8 (9)
L20000	64057	10	210. (1)	17.9 (3)	140. (1)	1420. (6)	82.0 (6)	254. (3)
	64089	12	202. (5)	16.7 (3)	133. (7)	1505. (9)	76.0 (23)	256. (2)
L20012	64003	10	91.5 (5)	18.1 (3)	63.5 (1)	677. (6)	42.7 (6)	143. (6)
	64030	11	92.6 (2)	18.7 (3)	66.0 (1)	701. (17)	43.0 (22)	148. (2)
L20065	64004	10	3.0 (15)	1.2 (15)	3.0 (7)	34.5 (6)	1.9 (9)	8.0 (5)
	64469R	16	3.7 (12)	1.2 (15)	3.2 (8)	29.4 (13)	1.8 (28)	10.4 (21)
	64031	12	2.2 (21)	1.5 (12)	3.8 (6)	19.4 (22)	1.8 (17)	11.8 (21)
	64460R	18	---	---		31.4 (36)	1.4 (23)	---
L20073	64006	11	7.3 (9)	6.9 (6)	31.4 (2)	47.3 (30)	15.7 (11)	50.0 (2)
	64032	13	6.0 (11)	6.9 (5)	31.2 (4)	51.5 (25)	15.4 (26)	46.8 (7)
L20085	64060	11	1.7 (22)	0.8 (40)	5.0 (13)	18.2 (12)	1.3 (15)	29.7 (2)
	64091	12	2.0 (22)	0.9 (16)	5.1 (7)	16.6 (11)	1.1 (17)	26.8 (6)
L20093	64007	11	3.6 (13)	0.7 (24)	3.3 (7)	34.5 (10)	1.1 (17)	12.3 (9)
	64033	13	4.5 (10)	0.8 (18)	3.9 (6)	---	---	12.6 (6)
	64458R	17	---	---	---	29.3 (17)	0.9 (102)	---
L20097	64061	11	26.3 (3)	2.6 (11)	17.7 (3)	195. (9)	4.2 (11)	57.2 (3)
	64092	12	24.1 (6)	3.0 (11)	17.7 (3)	198. (12)	5.2 (14)	55.4 (3)
L20105	64008	12	7.0 (10)	5.3 (6)	21.1 (2)	58.8 (17)	10.9 (13)	44.6 (5)
	64034	13	5.9 (10)	5.2 (7)	21.9 (4)	63.9 (20)	11.2 (22)	44.7 (11)
L20109	64062	12	4.1 (21)	7.1 (5)	5.0 (8)	28.4 (18)	1.7 (14)	18.9 (4)
	64094	14	3.4 (22)	7.9 (8)	5.9 (7)	25.7 (24)	1.0 (26)	17.5 (5)
L20121	64010	13	4.4 (24)	0.9 (21)	5.0 (6)	---	---	21.1 (4)
	64459R	17	---	---	---	30.2 (14)	0.5 (102)	---
	64037	14	4.9 (14)	0.8 (24)	5.2 (5)	30.1 (13)	0.9 (28)	20.0 (5)
L20133	64035	13	3.7 (28)	1.8 (12)	15.4 (3)	---	---	46.2 (4)
	64457R	17	---	---	---	29.3 (12)	3.3 (17)	---
	64064	14	3.8 (18)	2.3 (11)	17.0 (5)	31.4 (14)	4.2 (33)	53.0 (4)
L20141	64065	14	41.0 (9)	<	5.3 (8)	266. (16)	4.4 (17)	12.0 (6)
	64096	15	36.6 (14)	<	5.7 (18)	274. (38)	5.4 (25)	15.8 (8)
L20153	64039	14	9.2 (9)	7.8 (5)	45.8 (2)	94.5 (14)	5.3 (21)	158. (2)
	64067	15	10.0 (8)	7.7 (5)	41.6 (2)	108. (15)	5.5 (19)	162. (2)
L20137	64095	15	2.6 (14)	0.7 (24)	3.5 (7)	20.2 (20)	1.7 (26)	10.6 (6)
	64038	15	3.3 (15)	0.7 (20)	3.2 (7)	---	---	
	64452R	16	3.9 (30)	0.9 (19)	3.3 (7)	28.6 (17)	1.8 (22)	10.7 (20)

TABLE C-5. ANALYTICAL RESULTS REPORTED BY REECO, EAL, AND THE REFEREE

Library No.	Labor-atory	Sample No.	Concentration (pCi/g) and s.d. (%) ^{241}Am	^{137}Cs	^{60}Cs	^{238}Pu	$^{239,240}Pu$	^{90}Sr
L21037	REECo	([a])..	144. (2)	391. (3)	32.6 (3)	297. (6)	918. (11)	731. (5)
	EAL	64076	138. (4)	401. (3)	35.9 (3)	294. (3)	910. (3)	766. (6)
		64081	172. (4)	380. (3)	32.4 (3)	312. (3)	946. (3)	734. (6)
	Referee	64086	161. (5)	424. (5)	38.8 (7)	273. (2)	899. (1)	888. (2)
		64093	155. (5)	413. (5)	34.5 (7)	276. (2)	896. (1)	880. (2)
L17835	REECo	([b])..	3.42 (12)	510. (4)	0.50 (20)	49.0 (6)	7.00 (21)	8.40 (17)
	EAL	([c])..	3.47 (16)	516. (8)	0.32 (21)	30.5 (9)	5.86 (12)	9.82 (4)
	Referee	64005	3.38 (17)	565. (5)	<	---	---	<
		63994	3.70 (15)	554. (5)	1.01 (26)	33.3 (3)	4.39 (11)	7.61 (39)
L19833	REECo	([d])..	27.9 (7)	63.0 (1)	19.6 (4)	20.0 (22)	108. (21)	50.8 (6)
	EAL	64044	23.5 (5)	62.6 (3)	18.5 (4)	21.1 (5)	112. (4)	46.8 (9)
	Referee	64016	20.1 (7)	65.3 (5)	18.2 (7)	---	---	51.4 (6)
L19965	REECo	([d])..	557. (3)	150. (3)	21.8 (4)	127. (11)	4030. (11)	260. (4)
	EAL	64056	874. (7)	151. (3)	23.2 (4)	148. (5)	4730. (4)	304. (6)
	Referee	64027	587. (5)	156. (5)	20.8 (6)	127. (4)	3750. (2)	300. (2)
L20065	REECo	([d])..	2.97 (26)	3.27 (12)	1.30 (24)	1.73 (40)	28.7 (45)	10.1 (33)
	EAL	64090	2.47 (5)	3.31 (6)	1.04 (15)	1.77 (5)	21.1 (4)	12.9 (6)
	Referee	64059	2.56 (11)	3.08 (11)	0.73 (53)	---	---	<
L20489	REECo	([d])..	1.36E5 (5)	47.1 (6)	2.60 (23)	1.83E4 (11)	9.36E5 (15)	65.2 (3)
	EAL	64079	1.47E5 (5)	35.3 (3)	2.24 (8)	1.96E4 (7)	1.15E6 (5)	---
	Referee	64051A	2.45E5 (5)	37.9 (6)	2.75 (12)	1.43E5 (3)	9.59E6 (1)	<
		64051B	---	---	---	1.23E4 (6)	1.00E6 (1)	<
		64051C	---	---	---	1.32E4 (6)	1.02E6 (1)	<
L19269	REECo	([d])..	9.00 (24)	1470. (1)	274. (2)	4.85 (26)	32.7 (18)	298. (3)
	Referee	64040	7.15 (14)	1510. (1)	280. (5)	---	---	357. (2)
L19869	REECo	([d])..	69.2 (73)	70.8 (5)	6.30 (9)	13.2 (28)	503. (48)	104. (5)
	Referee	64046	53.1 (5)	73.1 (5)	6.57 (7)	16.2 (8)	450. (2)	95.4 (11)
L20121	REECo	([d])..	4.65 (27)	5.09 (8)	0.80 (34)	0.9 (28)	30.2 (19)	20.6 (6)
	Referee	64063	4.92 (6)	5.06 (6)	0.76 (37)	---	---	23.9 (10)
L20153	REECo	([d])..	9.55 (12)	43.7 (3)	8.10 (7)	5.40 (28)	101. (21)	160. (3)
	Referee	64097	10.7 (5)	44.6 (6)	8.04 (9)	---	---	170. (2)

[a] Average results from 17 replicates

[b] Average results from 4 replicates

[c] Results from previous assay

[d] Average of replicate results

TABLE C-6. GAMMA-SPECTROMETRIC AND CHEMICAL ANALYSES FOR ^{241}Am IN SEDAN SOIL SAMPLES

Library No.	Sample No.	Concentration (pCi/g) and s.d. (%)	
		Gamma[a]	Chemistry
L21037[b]	63984	144. (1)	150. (22)
	64088	141. (2)	132. (10)
L21039[c]	64098	0.9 (100)[d]	0.4 (140)[d]
L19813	64071	10.1 (8)	7.7 (10)
	63986	10.1 (8)	8.2 (14)
L19829	64014	22.5 (4)	17.0 (12)
	64043	22.7 (4)	17.8 (18)
L19833	64074	26.9 (3)	22.4 (8)
	63987	27.6 (6)	20.0 (9)
L19837	63988	42.8 (2)	34.9 (7)
	64017	42.8 (2)	36.3 (7)
L19849	64045	25.2 (6)	20.7 (11)
	64075	26.3 (3)	20.1 (10)

[a]Gamma results not corrected for ^{174}Lu-Yb X-ray interference

[b]Reference blind sample

[c]Blank sample

[d]Not detectable

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