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INFORMAL REPORT

Los Alamos Land Areas Environmental Radiation Survey 1972

los alamos
scientific laboratory
of the University of California
LOS ALAMOS, NEW MEXICO 87544

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ABSTRACT

The details of an environmental radiological evaluation on about 5,500 acres in eight parcels of land owned by the United States Atomic Energy Commission (USAEC) in Los Alamos County, New Mexico, are presented in this report. The environmental assessment of these real properties included a careful search of the administrative records of the Los Alamos Scientific Laboratory (LASL) to determine the extent the land might have been used or involved in the Laboratory's activities, extensive measurements of the radiation levels in the field, and radiochemical analysis of numerous soil and vegetation samples. A new portable radiation measurement instrument, designated as the Los Alamos Field Pulse Height Analyzer, was developed and used for this study. This analyzer proved to be valuable in documenting the low levels of radioactivity encountered. The results of the study showed that all measured values were comparable to reported worldwide levels. and that no radiation or radioactive contamination observations were encountered that are of radiological health or environmental concern. The study therefore supports the conclusion that no abnormal environmental hazard as a result of past Laboratory activities, exists on the surveyed parcels of land.

I. INTRODUCTION

At the request of the Los Alamos Area Office (LAAO), U. S. Atomic Energy Commission (USAEC), personnel of the Los Alamos Scientific Laboratory (LASL) conducted an environmental radiological evaluation on about 5,500 acres of USAEC-owned real property during June 1972. The land areas surveyed were entirely within Los Alamos County and near the boundaries of the LASL technical area. Nuclear research and development activities have been conducted at this locality since the early 1940's as a Manhattan District Project installation and later as directed by the University of California's Los Alamos Scientific Laboratory under the sponsorship of the USAEC. The objective of the survey was to determine the actual, potential or proximal involvement of the designated parcels of land in the site-associated work and to assess the environmental radiological status of this property in order that the suitability of the parcels of land for disposal by the USAEC may be established.

The land parcels surveyed and assessed are designated A, B, C, E, K, L, N, and PL (pipeline). The general location and relative size of each land area are shown in Fig. 1.

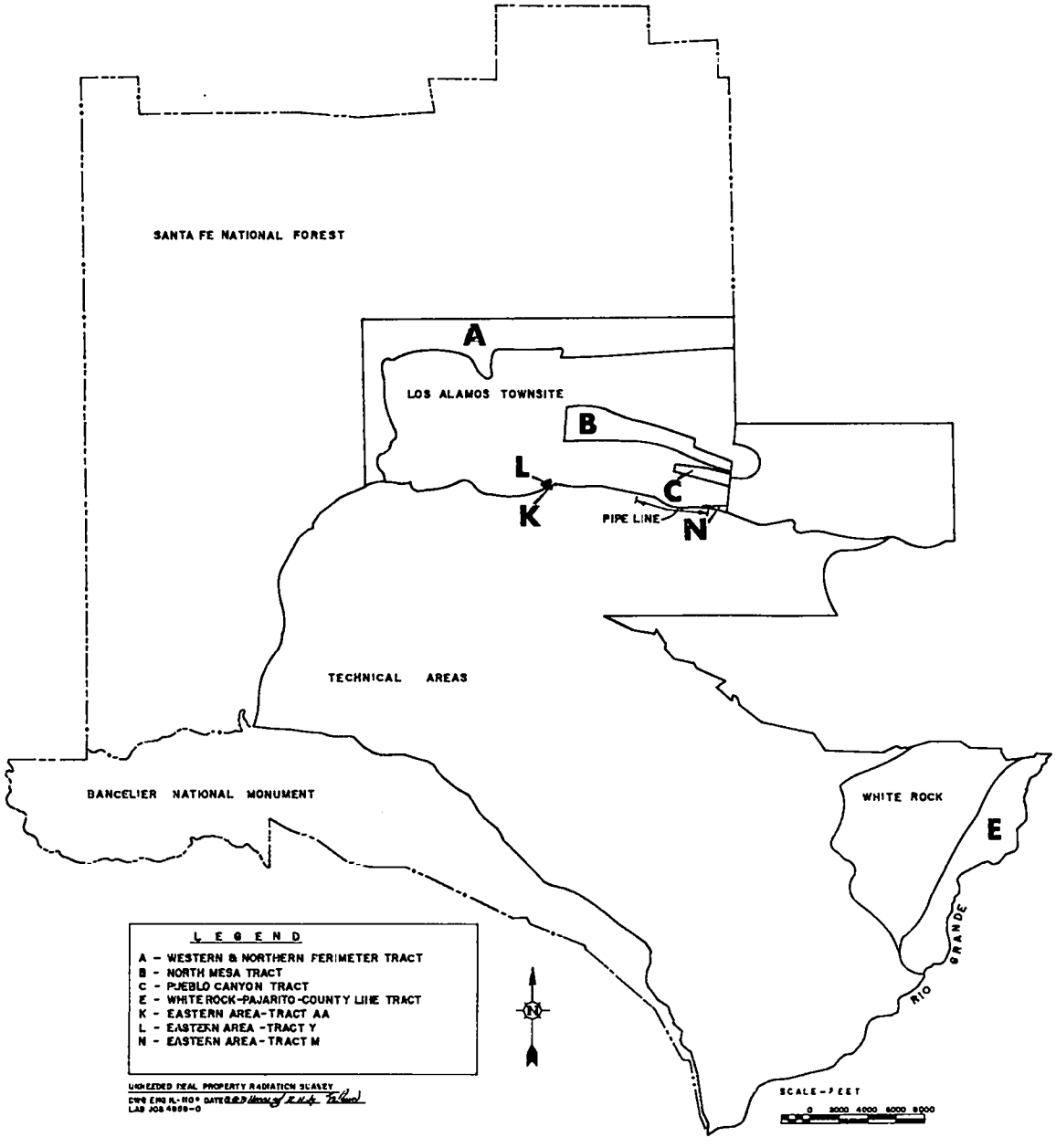


Fig. 1. Relative size and location of the Los Alamos land areas surveyed.

II. PROCEDURE

The environmental assessment of these real properties included a search of available records to determine historical land use by the Laboratory or its predecessor, radiation measurements in the field, and radiochemical analysis of soil and vegetation samples. During the course of the field work, attention was also given to a search for evidence of any possible non-radioactive hazards, i. e., explosives, chemicals, etc.

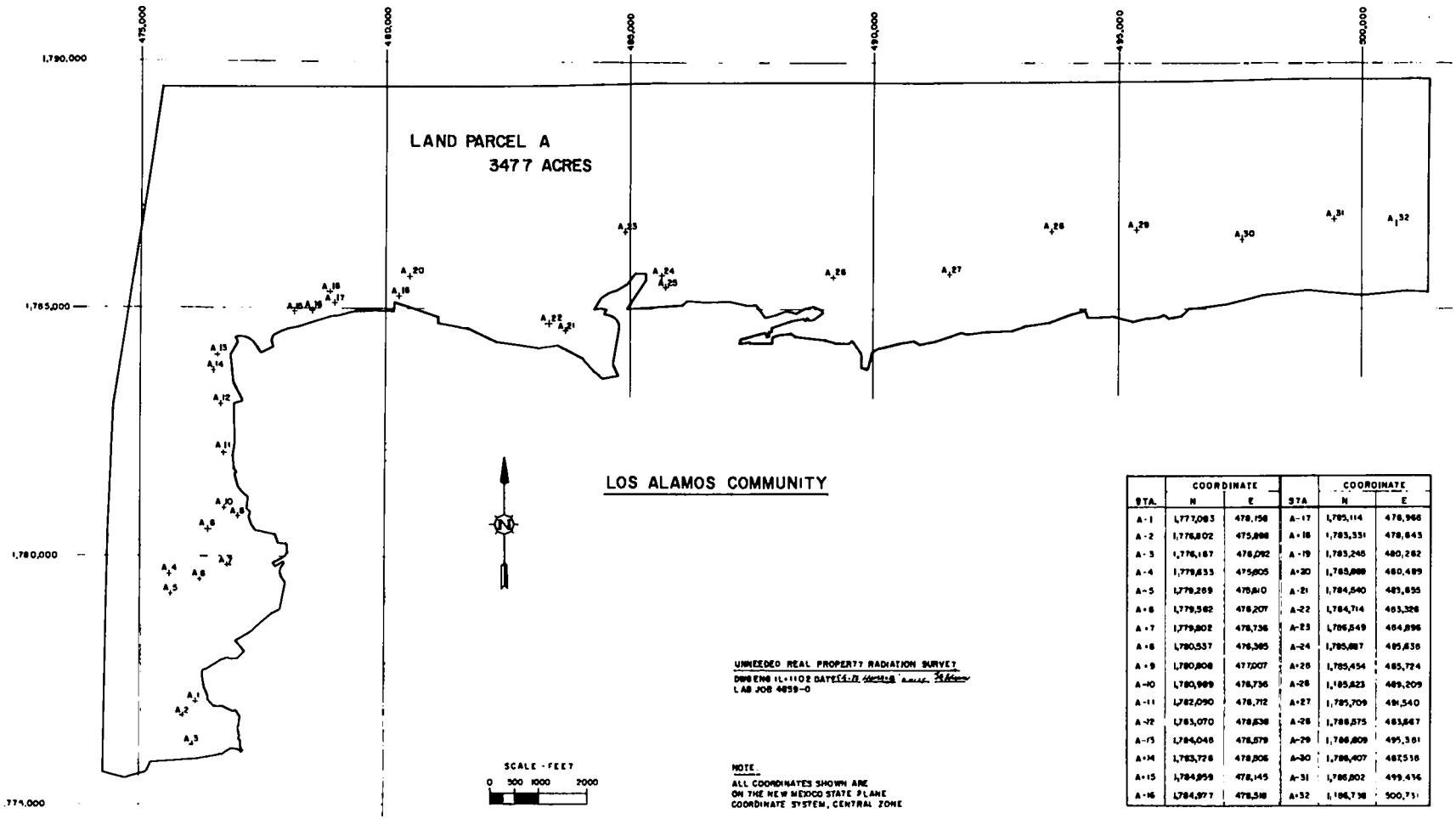
The potential for radioactive material disposal or deposition as a result of Laboratory work activities in each land area was determined by a review of Laboratory documents and records. Engineering and health physics files were searched for evidence that the land might have been used for structures, experimental activities, or waste disposal. In addition, personnel interviews were conducted with employees whose employment began in the early phases of the project to augment and substantiate available records.

The locations established for field measurement and sample collection were defined by an engineering survey crew. Stakes were used to mark each measurement and collection point in the field. This procedure allowed secondary readings or sample acquisitions at the same location where subsequent findings might indicate this need. Each sampling point was identified on maps using the New Mexico Plane Coordinate System. The number of assessment points within each land parcel were arbitrarily predetermined, based on acreage and on a weighed judgement that a high probability existed that none of the areas were ever involved in Laboratory activities. Thus, any contamination encountered would have resulted from airborne materials emitted by adjacent Laboratory facilities with a consequent relatively uniform deposition pattern. The location of a sampling point within a land parcel was influenced principally by physical terrain features which allowed access and the availability of engineering survey markers from which the sampling point coordinates were determined. The coordinates of each sampling point, its location within a parcel, and the area of each parcel are shown in Figs. 2 through 6.

In addition to the measurements and collections made on the real property described above, background measurements and collections were made at points 30 to 50 air miles north, south, east, and west of Los Alamos in north central New Mexico. These points were at locations designated as Cochiti, Ponderosa, Tesuque, Santa Cruz, and Taos and were near these respective geographical sites.

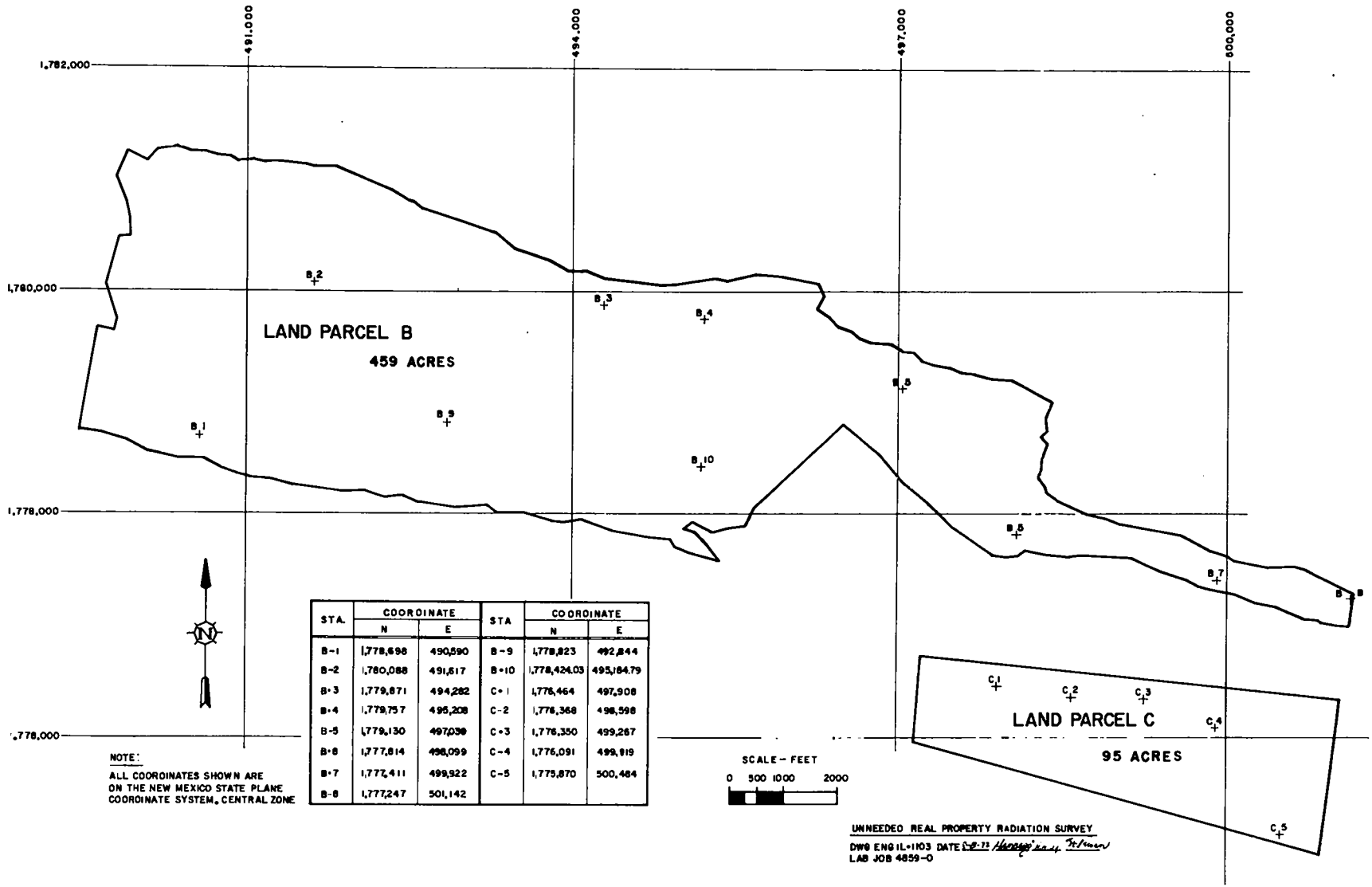
The problem of documenting very low radiation levels was identified early in the study as a major cause for concern. This concern lead to discussions with personnel from USAEC Headquarters - Division of Waste Management regarding the survey instrument of choice for this type of survey, i. e., measurement of radiation in the micro-Roentgen per hour (μR/h) range. As a result of these discussions, attempts were made to identify an instrument that had been used in another environmental survey. This investigation led, by way of discussions with personnel from the Oak Ridge National Laboratory and the instrument manufacturer, to the conclusion that the referenced instrument was not a stock item but rather an instrument modified in an unknown way, and to the fact that the Environmental Protection Agency's Western Environmental Research Laboratory (EPA-WERL) was a user of the modified instrument. WERL personnel, however, indicated that, for a variety of reasons, the instrument in question had been replaced in their work by the Ludlum Model 12S Count Rate Meter. This instrument is specially assembled by Ludlum and is not a stock item. Two of the instruments were purchased and calibrated for the survey.

The Ludlum Model 12S Count Rate Meter, which utilizes a NaI(Tl) scintillation detector, was used for in situ environmental radiation measure-



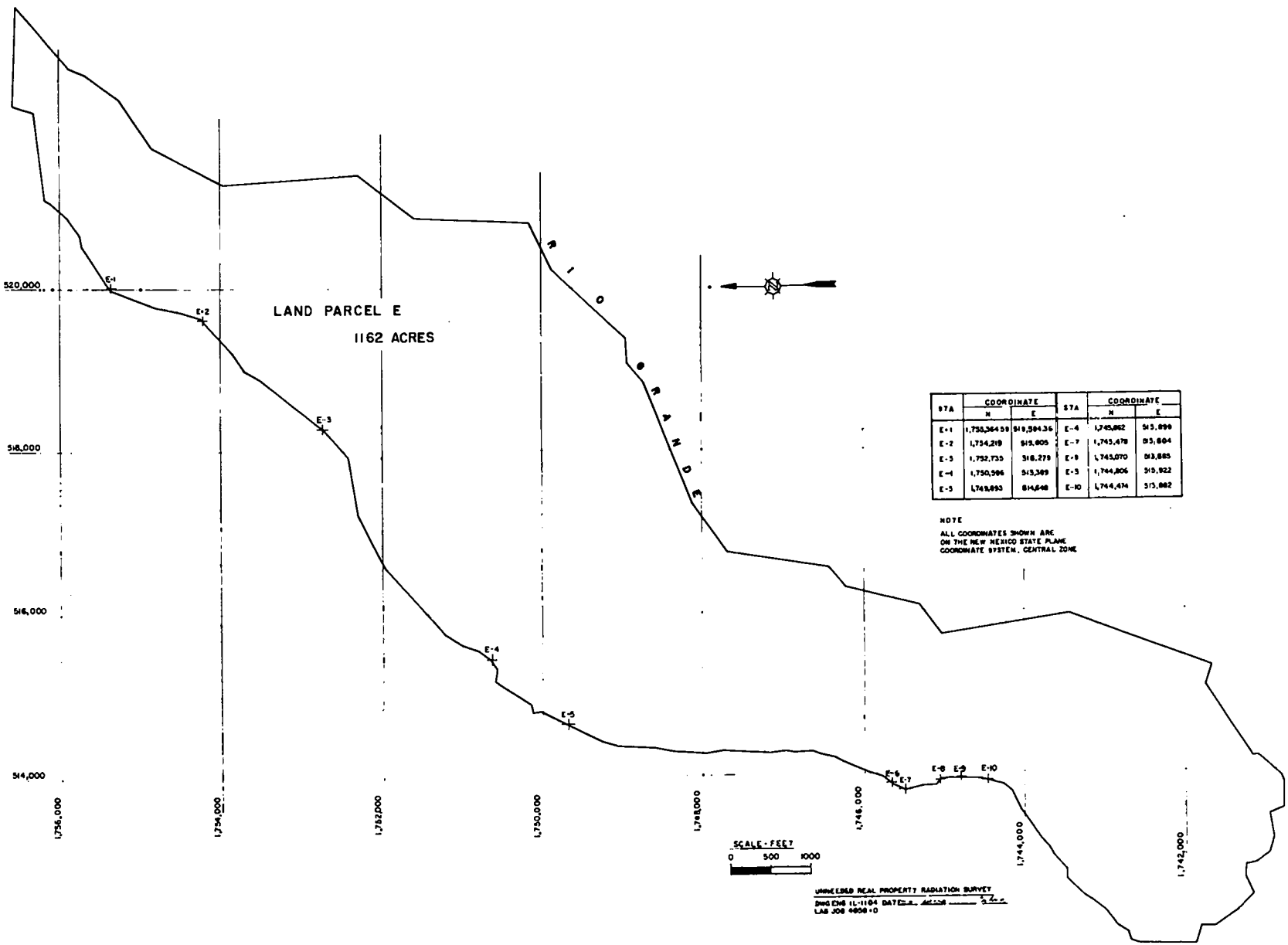
STA.	COORDINATE N	E	STA.	COORDINATE N	E
A-1	1,777,083	478,158	A-17	1,785,114	478,966
A-2	1,776,802	475,898	A-18	1,783,331	478,843
A-3	1,776,187	476,092	A-19	1,783,245	480,262
A-4	1,779,833	475,805	A-20	1,785,888	480,489
A-5	1,779,269	476,810	A-21	1,784,540	483,855
A-6	1,779,582	476,207	A-22	1,784,714	483,328
A-7	1,779,802	476,736	A-23	1,786,549	484,896
A-8	1,780,537	476,385	A-24	1,785,887	485,836
A-9	1,780,808	477,007	A-25	1,785,454	485,724
A-10	1,780,989	476,736	A-26	1,785,823	489,209
A-11	1,782,090	476,712	A-27	1,785,709	491,540
A-12	1,783,070	478,838	A-28	1,786,575	493,867
A-13	1,784,046	478,579	A-29	1,786,809	495,361
A-14	1,783,726	478,806	A-30	1,786,407	497,516
A-15	1,784,959	478,145	A-31	1,786,802	499,416
A-16	1,784,977	478,518	A-32	1,786,738	500,751

Fig. 2. Land parcel "A" measurement and sampling points, coordinates, and acreage.



STA.	COORDINATE N	COORDINATE E	STA	COORDINATE N	COORDINATE E
B-1	1,778,698	490,590	B-9	1,778,823	492,844
B-2	1,780,088	491,617	B-10	1,778,424.03	495,184.79
B-3	1,779,871	494,282	C-1	1,776,464	497,908
B-4	1,779,757	495,208	C-2	1,776,368	498,598
B-5	1,779,130	497,039	C-3	1,776,350	499,267
B-6	1,777,814	498,099	C-4	1,776,091	499,819
B-7	1,777,411	499,922	C-5	1,775,870	500,484
B-8	1,777,247	501,142			

Fig. 3. Land parcels "B" and "C" measurement and sampling points, coordinates, and acreage.



STA	COORDINATE N	COORDINATE E	STA	COORDINATE N	COORDINATE E
E-1	1,755,364.59	519,584.36	E-6	1,745,662	515,899
E-2	1,754,219	515,805	E-7	1,745,478	515,804
E-3	1,752,735	516,279	E-8	1,745,070	513,685
E-4	1,750,596	513,389	E-9	1,744,806	515,922
E-5	1,749,893	514,648	E-10	1,744,474	513,862

Fig. 4. Land parcel "E" measurement and sampling points, coordinates, and acreage.

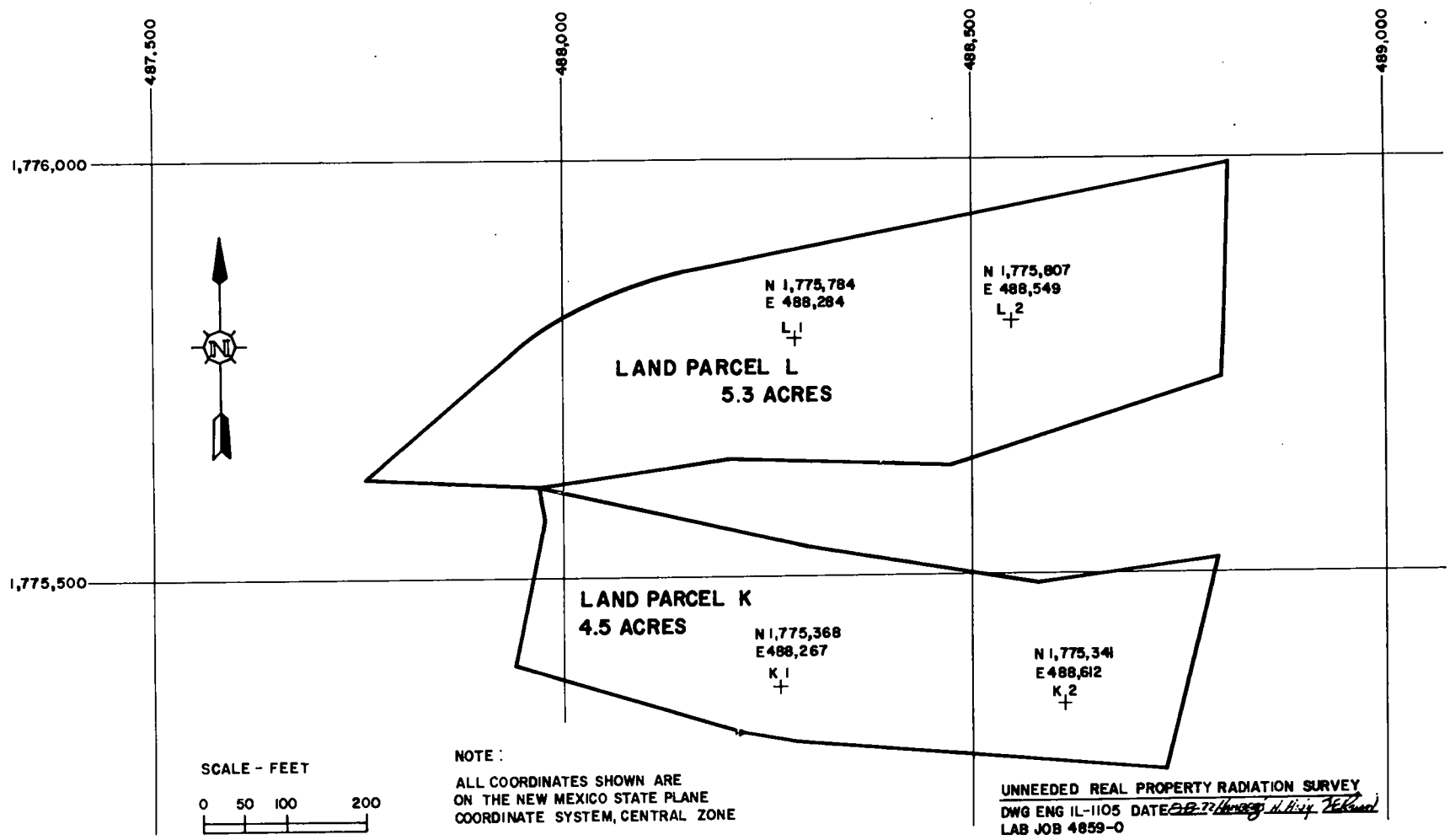
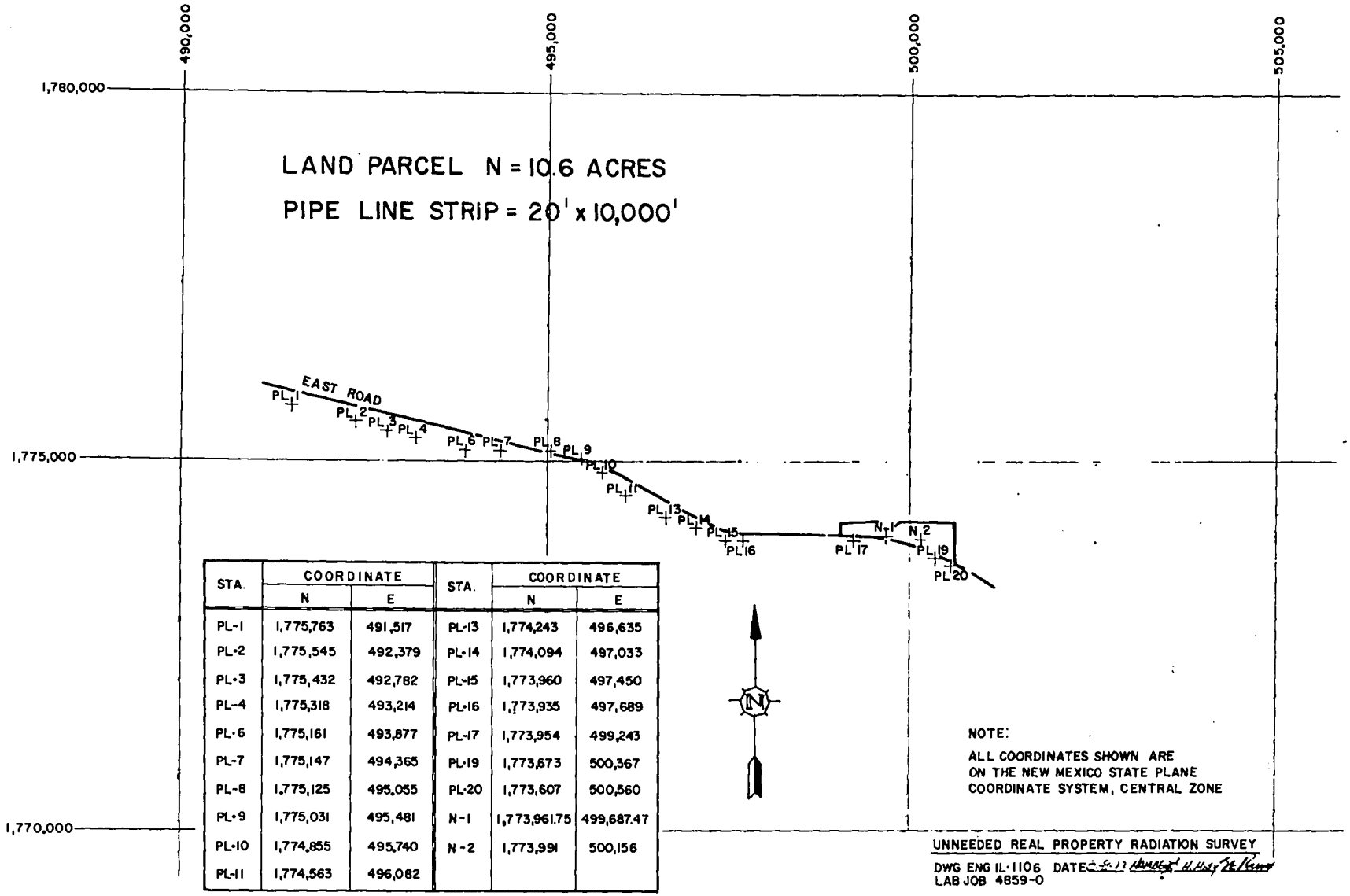


Fig. 5. Land parcels "K" and "L" measurement and sampling points, coordinates, and acreage.



STA.	COORDINATE		STA.	COORDINATE	
	N	E		N	E
PL-1	1,775,763	491,517	PL-13	1,774,243	496,635
PL-2	1,775,545	492,379	PL-14	1,774,094	497,033
PL-3	1,775,432	492,782	PL-15	1,773,960	497,450
PL-4	1,775,318	493,214	PL-16	1,773,935	497,689
PL-6	1,775,161	493,877	PL-17	1,773,954	499,243
PL-7	1,775,147	494,365	PL-19	1,773,673	500,367
PL-8	1,775,125	495,055	PL-20	1,773,607	500,560
PL-9	1,775,031	495,481	N-1	1,773,961.75	499,687.47
PL-10	1,774,855	495,740	N-2	1,773,991	500,156
PL-11	1,774,563	496,082			

Fig. 6. Land parcel "N" and the gas pipeline strip measurement and sampling points, coordinates, and acreage.

ments. This instrument's readout is indicated in "μR/h" and was calibrated to give a proper reading with ^{60}Co gamma rays. During the survey, the instrument was held at about 3-ft above the ground surface and the observed rate noted and recorded at the respective locations.

The response of the instrument as a function of photon energy was determined using monoenergetic x-ray and gamma-ray sources in the laboratory[1] and is shown in Fig. 7. Because of the inherent photon energy-dependent response, all readings obtained were normalized using 10 LASL environmental radiation dosimetry stations which utilize LiF thermoluminescent dosimeters (TLD) for background radiation measurements.[2,3] Dosimetric values obtained from these TLD materials have been shown to be essentially independent of radiation energy and, therefore, provided a basis for the correction or normalization of the Ludlum Model 12S meter readings. The normalization assumed uniform photon spectral distribution. The observed average ratio of TLD-determined exposure rates to the survey meter measurements was 0.70.

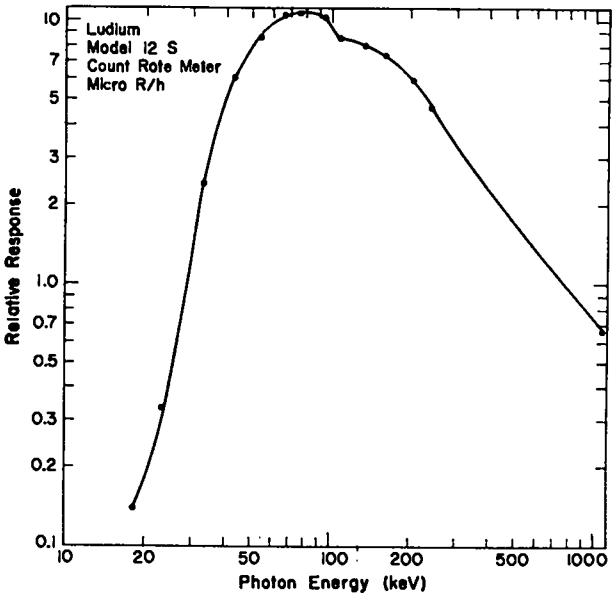


Fig. 7. Experimentally determined response curve of the Ludlum Model 12S Count Rate Meter detector as a function of photon energy.

Because of the LASL's past heavy metals research and development activities, measurement of environmental plutonium, americium, etc., was important. The principle emissions of these materials are alpha and low energy x rays or gamma rays. Measurement of alpha radiation with the emitters in environmental media such as soil or vegetation is difficult and lacking in needed sensitivity. The low energy photon emissions of the heavy metal materials are not efficiently detected by the "μR/h" survey meter as discussed above. The need for a system to provide field measurements for determining environmental levels of materials like plutonium resulted in an instrument design and development effort. The Los Alamos Field Pulse Height Analyzer (LAFPHA) described below was developed to aid in this project by the joint efforts of LASL Groups E-4 and H-8.

The second detection system utilized for field radiation measurements for gross indications of plutonium and americium contamination was the Los Alamos Field Pulse Height Analyzer (LAFPHA). The detector used was the Field Instrument for the Detection of Low Energy Radiation (FIDLER). The detector is 1/16-in. thick by 5-in. diam NaI(Tl) scintillation counter mounted with a 0.010-in. beryllium entrance window. The signal from this detector is received by the LAFPHA for sorting and counting. The LAFPHA's principle features are six individually settable windows or channels, a preset count time selection capability, a scaler for recording the number of individual pulses sensed, manually selectable and visually displayed count readout for each of the six channels, a count rate meter, an audio signal output, and several other operational features described in Ref. 4. The instrument is pictured in Fig. 8. In the present application, Channels 1 through 6 were set with respective energy bounds of: 4 to 10, 10 to 23, 23 to 34, 34 to 46, 46 to 68, and 68 to 84 keV. Channel 2 was set to

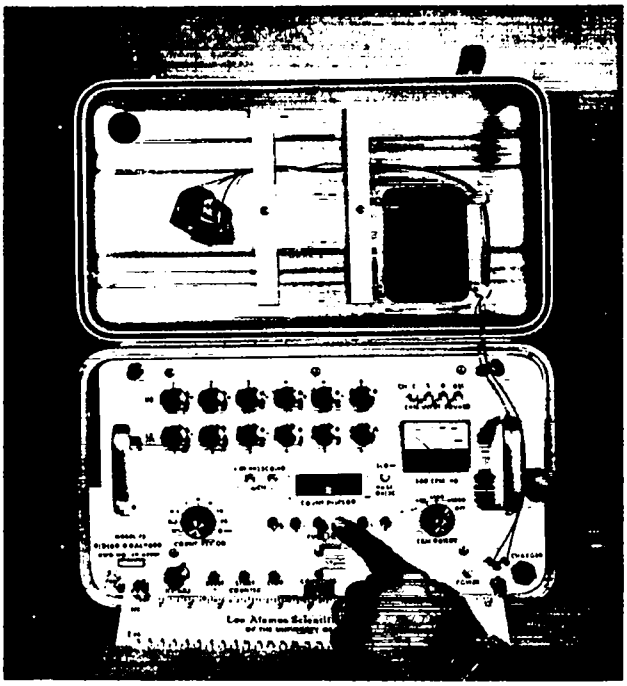


Fig. 8. The Los Alamos Field Pulse Height Analyzer (LAFPHA) front panel instrumentation controls.

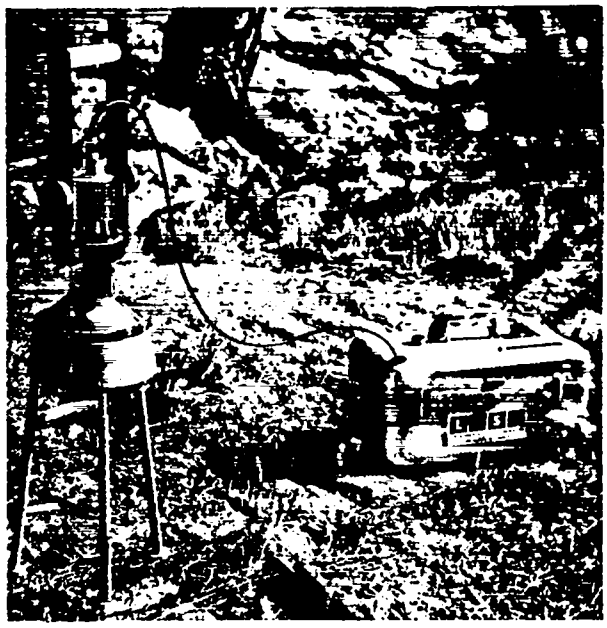


Fig. 9. Field setup of the FIDLER detector and the LAFPHA readout system.

detect the L-series x rays of uranium which occur following the alpha decay of plutonium and have an effective energy of about 17 keV and channel 5 was adjusted to detect the 59.5 keV gamma ray emission of ^{241}Am which is commonly associated with plutonium.

This detection system was calibrated to measure the presence of these radionuclides principally on or near the ground's surface. All measurements were taken during June because the ground was dry. The presence of moisture would interfere with the detection of low energy photons. The detector was positioned in a tripod 12-in. above the earth's surface, as depicted in Fig. 9. Measurement times of 20-min were selected on the LAFPHA for each measurement which proceeded as other measurements and collections were made.

Soil and vegetation samples were collected at each designated sampling point for radiochemical analyses. The soil samples consisted of a 3-in. diam by 2-in. deep core sample at the center and corners of a 33-ft square. These soil cores were composited to form a single soil sample representing a point within a land area. Ponderosa, piñon, and juniper needles were collected and analyzed. These predominate tree species were selected because they are perennial and may have adsorbed any airborne contaminants released.

Activity concentration determinations were made on soil and plant samples for:

1. Tritium (in the free moisture of plant tissues)
2. Gross beta emitters
3. Cesium-137
4. Plutonium-238, 239
5. Americium-241
6. Uranium (total)

Water from the vegetation samples was collected by a distillation technique. Four milliliters of the sample moisture were analyzed for tritium content by liquid scintillation counting. Following collection of the vegetation moisture, for tritium assay, each sample (sample mass

varied from 100 to about 400 g) was dry ashed at 500°C, dissolved in nitric acid, wet ashed with hydrogen peroxide, treated with hydrofluoric acid to dissolve any silicious residue and diluted to 500 ml for analysis.

The soil samples were manually blended in the plastic collection containers and 100 g aliquots of each were dry ashed at 500°C and leached with nitric and hydrofluoric acids. The filtered leachates were diluted to 500 ml for analysis. A complete library of individual vegetation and soil samples is presently available for potential use in replicate or special analyses.

Gross beta activities were determined by evaporating a 10 ml aliquot of the leached or dissolved sample on a stainless steel planchet and counting with a gas flow proportional counter. Cesium-137 activities were determined by direct gamma spectrometry on the dissolved sample with a NaI(Tl) scintillation detector system. Plutonium and americium concentrations were measured in a 50 ml aliquot of the sample by isolation of the elements on ion exchange columns, electrodeposition and alpha spectrometry. Total uranium concentrations were measured by extracting the uranium from a 10 ml aliquot of the leached or dissolved sample with ethyl acetate and measuring the fluoresence in a lithium fluoride matrix. Some sample solutions were composited, within land parcel sets, at the ion exchange step for actinide content determinations. Sample compositing within a given land area expedited completion of the analyses. The compositing procedure was judged to be technically feasible because of the uniform nature of any potential contaminant present as discussed above.

III. RESULTS

A complete listing of individual and composite measurements and analyses are given in the Appendix Tables. The "±" values listed are single standard deviations due to counting statistics. Composite sample results are listed in the Tables of the Appendix with identification notation ending with "C", e.g., E-1C.

No potential non-radioactive environmental hazards were observed during the course of this survey.

A. Record Search

A LASL records search together with personnel interviews did not reveal any indication of disposal, burial, or storage of radioactive materials on the real properties surveyed. The extent of the review and the findings are described in the Jordan/Meyer Memorandum as shown in Fig. A-1 on the last page of the Appendix.

B. Field Survey

The results of the gross gamma field radiation measurements are summarized in Table I. The exposure rates are those corrected in accordance with the procedure previously described. The background measurements obtained in northern New Mexico fluctuated over a wide range. The average gross gamma radiation measurements obtained on the designated land parcels were not significantly different from the measurements obtained at remote locations or what could be considered to be the natural background radiation levels for this north central New Mexico area. Measured values of radiation on the land parcels also fell within the range of 13-21 μR/h suggested by Cowan[6] as being normal for the Los Alamos elevation depending on the geological composition of the earth's crust.

TABLE I
GROSS GAMMA FIELD RADIATION MEASUREMENTS

Location	Range, μR/h	Average, μR/h
Northern New Mexico	11 - 20	15.1
Parcel A	16 - 25	18.1
Parcel B	16 - 19	17.6
Parcel C	19 - 27	21.8
Parcel E	8 - 13	10.9
Parcel K	16	16.
Parcel L	17 - 18	17.2
Parcel N	14	14.
Parcel PL	14 - 19	16.2

TABLE II

MEAN RATIOS AND 95% CONFIDENCE INTERVALS[a]

Parcel	Channel 2/Channel 1		Channel 2/Channel 3		Channel 2/Channel 6		Channel 5/Channel 4		Channel 5/Channel 6	
	Range	Average	Range	Average	Range	Average	Range	Average	Range	Average
Bkgd	0.61 - 1.03	0.82	0.85 - 1.16	1.01	0.15 - 0.24	0.19	2.60 - 4.48	3.54	0.85 - 0.97	0.91
A	0.71 - 1.07	0.89	0.89 - 1.13	1.01	0.16 - 0.20	0.18	3.64 - 4.24	3.94	0.90 - 0.99	0.96
B	0.87 - 1.01	0.94	0.98 - 1.09	1.04	0.17 - 0.19	0.18	3.59 - 3.99	3.79	0.88 - 1.04	0.96
C	0.99 - 1.13	1.06	0.99 - 1.05	1.02	0.16 - 0.18	0.17	3.77 - 3.99	3.88	0.94 - 1.02	0.98
E	0.56 - 0.82	0.69	0.17 - 1.33	0.75	0.20 - 0.24	0.22	3.20 - 3.90	3.55	0.83 - 0.99	0.91
K	0.75 - 0.97	0.86	0.92 - 1.20	1.06	0.17 - 0.19	0.18	3.93 - 3.99	3.96	0.96 - 0.98	0.97
L	0.87 - 0.97	0.92	1.08 - 1.10	1.09	0.17 - 0.19	0.18	3.68 - 3.96	3.82	0.92 - 1.02	0.95
N	0.78 - 0.92	0.85	0.98 - 1.04	1.01	0.17 - 0.19	0.18	3.86 - 3.88	3.87	0.93	0.93
PL	0.76 - 0.96	0.86	0.94 - 1.10	1.02	0.16 - 0.18	0.17	3.72 - 4.06	3.89	0.89 - 0.99	0.94

[a] Column headings show average channel reading ratios for each parcel and the 95% confidence interval for the respective average value.

The gross count rates observed in each of the LAFPHA's six channels are recorded in Table A-II. Ratios of the observed count rates in channels 2 and 5, the channels into which photons of 17 and 59.5 keV regions would fall, to surrounding channels were computed for each measurement point and appear in Table A-III. A summary of these ratios is shown in Table II. No statistically significant differences were observed at the 5% error level with the exception of Area E where lower ratios were observed (opposite of that expected where plutonium or americium are present). This anomally may be due to counting geometry circumstances discussed below.

Radioactive contamination was not identifiable above the natural radiation levels by use of field instrumentation. It was observed that some of the count rate variation, both the extreme low and high rates, derived from the counting geometry at the respective measurement locations. High count rates were observed where the measurement point was at the convergence of two or more slopes (in a valley or gully) or vertical protrusions making the effective surface area larger and, therefore, the observed count rate higher. Low values, such as some of those observed in Area E, occurred because the measurement point was near the edge of a mesa providing a reduced land surface area and, therefore, a lower overall geometry.

C. Laboratory Sample Analyses

The results of the tritium determinations on plant water are summarized in Table III. Compared to the background samples, the tritium in vegetation appears to be measureably higher on the land parcels surveyed. This finding is consistent with that reported [2,3] for the tritium activity measured in the atmospheric water near the Laboratory where the tritium concentration appears to be about twice the values observed at locations distant from the Laboratory. The average tritium concentration measured in these parcels is within the range of the values (0.2 to 6.4 pCi/ml) reported for vegetation in the Livermore Valley.[6] While standards for the tritium concentration in the moisture of vegetation have not been established, it is useful, as a frame of reference, to compare the observed concentrations with concentration guides listed in USAEC Manual Chapter 0524 for tritium in water in uncontrolled areas.

TABLE III

TRITIUM IN VEGETATION

Location	Range, pCi/ml	Average, pCi/ml
Northern New Mexico	<1.0	<1.0
Parcel A	<1.0 - 5.8	<2.8
Parcel B	1.1 - 3.7	2.5
Parcel C	1.3 - 2.8	1.7
Parcel E	<1.0 - 8.0	<3.0
Parcel K	4.6 - 5.8	5.2
Parcel L	5.6 - 5.8	5.7
Parcel N	4.7	4.7
Parcel PL	<1.0 - 9.6	4.1

TABLE IV

GROSS BETA ACTIVITY IN VEGETATION AND SOIL

Location	Soil, pCi/g Range	Soil, pCi/g Average	Vegetation, pCi/g Range	Vegetation, pCi/g Average
Northern New Mexico	16.2 - 31.7	21.4	4.2 - 5.1	4.6
Parcel A	13.1 - 31.6	23.8	2.1 - 6.0	4.5
Parcel B	20.0 - 26.3	22.8	4.4 - 6.0	5.3
Parcel C	20.9 - 26.9	24.2	3.7 - 6.7	5.0
Parcel E	13.4 - 19.7	15.3	3.5 - 13.4	5.4
Parcel K	16.4 - 21.5	19.0	2.7 - 6.2	4.5
Parcel L	16.6 - 26.5	21.6	3.8 - 4.7	4.3
Parcel N	37.6	37.6	3.2 - 15.7	9.5
Parcel PL	17.4 - 26.4	21.2	0.3 - 22.7	9.6

This guide is 3×10^{-3} μCi/ml. The values measured are about 0.1 percent of this value.

The observed gross beta concentrations in vegetation and soil and the summary tabulations of the ^{137}Cs activity concentrations in vegetation and soil are shown in Tables IV and V. The average ^{137}Cs values measured on the land parcels surveyed appear to be about equal to the background values for north central New Mexico. No large deviations from the average levels of ^{137}Cs were observed in either vegetation or soil samples. The gross beta activities of samples obtained from surveyed land parcels do not appear to be different from the samples obtained from remote areas. The single soil sample analyzed for Area N was somewhat higher than the average values observed for other areas. The higher gross beta activity reported for some vegetation samples is maybe due to the inclusion of a variable amount of associated soil,

Summary plutonium concentration values in vegetation samples are shown in Table VI. The average ^{238}Pu concentrations were not statistically significantly different due to the relatively large average standard deviation for these measurements. The chemical recovery values ranged from 10 to 80 percent which contributed to the relatively large standard deviations. The average concentration (wet weight) of ^{239}Pu for samples obtained from Parcels E and PL were significantly above worldwide fallout levels as indicated by the background samples obtained in north central New Mexico. An unknown amount of soil adsorbing to the plant samples may have accounted for the elevated concentrations observed. Plutonium activities in vegetation at points greater than 5 miles from the Rocky Flats Plant ranged from 0.036 to 0.045 pCi/g of vegetation dried at 120°F.[7] Assuming an 80-90% plant moisture content, the reported concentrations are comparable to those observed here.

The plutonium values measured in soil are summarized in Table VII for both the surveyed and the background areas. Individual samples ranged in activity up to an order of magnitude larger than the average background values measured. Due to the large uncertainty values associated with the Area C and E measurements, these numbers are not statistically different from zero at the 5% error level. Airborne effluent from a laboratory research facility near the pipeline strip appears to have elevated the soil's plutonium concentration in this area by an average factor of 2 to 3 over worldwide fallout levels. The average plutonium concentration values for the other land areas surveyed do not appear to be significantly different from the observed background measurements nor from reported plutonium in soil concentrations due principally to worldwide fallout.[6,8] The values reported in the foregoing references range from 0.001 to 0.20 pCi/g.

TABLE V

^{137}Cs IN VEGETATION AND SOIL

Location	Soil, pCi/g Range	Soil, pCi/g Average	Vegetation, pCi/g Range	Vegetation, pCi/g Average
Northern New Mexico	1.2 - 5.7	3.6	0.5 - 2.4	1.6
Parcel A	0.9 - 9.2	4.0	0.5 - 6.7	1.4
Parcel B	1.9 - 4.0	2.9	0.5 - 6.1	2.2
Parcel C	2.4 - 3.6	3.0	0.5 - 3.0	1.3
Parcel E	0.9 - 2.1	1.6	0.5 - 1.7	1.2
Parcel K	2.3 - 3.5	2.9	0.3 - 6.4	3.3
Parcel L	3.1 - 3.9	3.5	0.7 - 1.5	1.1
Parcel N	1.6	1.6	3.7 - 9.8	6.7
Parcel PL	1.1 - 4.3	2.5	0.1 - 5.6	2.3

TABLE VI

PLUTONIUM IN VEGETATION

Location	^{238}Pu, pCi/g Range	^{238}Pu, pCi/g Average	^{239}Pu, pCi/g Range	^{239}Pu, pCi/g Average
Northern New Mexico	0.002 - 0.005	0.004	<0.001 - 0.003	0.002
Parcel A	<0.001 - 0.004	0.002	0.003 - 0.012	0.006
Parcel B	0.005 - 0.007	0.006	0.005 - 0.006	0.005
Parcel C	<0.001	<0.001	0.002	0.002
Parcel E	0.003 - 0.03	0.016	0.002 - 0.034	0.018
Parcel K	0.002	0.002	0.002	0.002
Parcel L	<0.001	<0.001	0.004	0.004
Parcel N	0.001	0.001	0.008	0.008
Parcel PL	<0.001 - 0.005	0.003	0.012 - 0.058	0.026

TABLE VII

PLUTONIUM IN SOIL

Location	^{238}Pu, pCi/g Range	^{238}Pu, pCi/g Average	^{239}Pu, pCi/g Range	^{239}Pu, pCi/g Average
Northern New Mexico	0.01 - 0.50	0.13	0.02 - 0.11	0.048
Parcel A	<0.01 - 0.6	<0.17	0.01 - 0.22	0.08
Parcel B	<0.01 - 0.2	<0.11	0.01 - 0.08	0.05
Parcel C	0.30	0.30	0.12	0.12
Parcel E	<0.01 - 1.2	0.49	<0.01 - 1.0	0.44
Parcel K	0.05	0.05	0.02	0.02
Parcel L	0.01	0.01	0.04	0.04
Parcel N	0.01	0.007	0.04	0.04
Parcel PL	<0.01 - 0.05	0.02	0.04 - 0.39	0.12

The range and average ^{241}Am concentrations observed in the samples collected on the land parcels and from localities in north central New Mexico are listed in Table VIII. The observed chemical recovery values ranged from 10 to 80 percent for the americium analyses. The measured concentration of ^{241}Am for samples obtained from the land parcels appear to be identical to values from background areas with the exception of the vegetation samples in the PL Area. No reports of background values for americium in soil or vegetation were available in the literature for comparison with our measured values.

A summary of the measurements of the uranium concentration in soil and vegetation samples is shown in Table IX. Values of 0.03 to 3.0 μg/g in soil and 0.1 to 20 μg/g of vegetation have been reported [2,3,6,9] at locations remote from nuclear facilities. The observed values fall within these reported ranges.

IV. CONCLUSIONS

The results of the radiation survey indicate that only low radiation levels are associated with the land parcels included in this study. No abnormal in situ field radiation measurements were observed in total gamma radiation measurements or from readings for low energy photons obtained with the newly developed Los Alamos Field Pulse Height Analyzer. Measurements of gross beta, ^{137}Cs, ^{238,239}Pu, ^{241}Am and total uranium in soil and vegetation samples obtained on the land areas monitored indicate, in general, concentrations similar to those measured at locations undisturbed by nuclear energy installations. Tritium concentrations in general and Pu and Am concentrations at a few points appeared to be above that expected from past weapons testing fallout.

TABLE VIII

AMERICIUM IN SOIL AND VEGETATION

Location	Soil ^{241}Am, pCi/g Range	Soil ^{241}Am, pCi/g Average	Vegetation ^{241}Am, pCi/g Range	Vegetation ^{241}Am, pCi/g Average
Northern New Mexico	0.03 - 0.09	0.06	0.003 - 0.012	0.007
Parcel A	<0.01 - 0.90	<0.04	0.004 - 0.14	0.016
Parcel B	0.01 - 0.14	0.10	0.006 - 0.012	0.009
Parcel C	0.05	0.05	0.004	0.004
Parcel E	<0.01 - 0.08	<0.03	0.007 - 0.029	0.018
Parcel K	0.03	0.03	0.006	0.006
Parcel L	0.04	0.04	0.006	0.006
Parcel N	0.03	0.03	0.016	0.016
Parcel PL	<0.01 - 0.07	<0.04	0.010 - 0.057	0.034

TABLE IX

URANIUM IN SOIL AND VEGETATION

Location	Total U in Soil, μg/g Range	Total U in Soil, μg/g Average	Total U in Vegetation, μg/g Range	Total U in Vegetation, μg/g Average
Northern New Mexico	0.16 - 1.24	0.58	<0.02 - 0.05	<0.03
Parcel A	0.28 - 1.50	0.83	0.04 - 0.27	0.10
Parcel B	0.71 - 1.13	0.92	0.10 - 0.12	0.11
Parcel C	0.65	0.65	0.07	0.07
Parcel E	0.39 - 0.65	0.49	0.04 - 0.38	0.21
Parcel K	0.65	0.65	0.02	0.02
Parcel L	0.60	0.60	0.07	0.07
Parcel N	0.75	0.75	0.15	0.15
Parcel PL	0.37 - 0.56	0.42	0.05 - 0.20	0.12

All results generated by this study confirm and are in substantial agreement with the generally low levels of radiation and radioactive contaminants in the Los Alamos environs noted in the reports of the LASL environmental surveillance program.[2,3]

No environmental standards exist for radionuclides in soil or vegetation and therefore the measured values have been compared to reported worldwide levels. No radiation or radiocontamination observations were encountered which are of radiological or environmental concern. As a result of this study, therefore, it is reasonable to conclude that no abnormal environmental hazards exist on the designated parcels of land.

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APPENDIX

TABLE A-I

GROSS GAMMA FIELD RADIATION MEASUREMENTS

Ludlum Model 12S NaI(Tl) Survey Meter

Survey Point	μR/h	Survey Point	μR/h	Survey Point	μR/h	Survey Point	μR/h
Cochiti-1	15	A-17	17	B- 8	18	L- 1	17
Cochiti-2	16	A-18	17	B- 9	18	L- 2	18
Ponderosa	20	A-19	18	B-10	18		
Tesuque	18	A-20	19			N- 1	14
Santa Cruz	13	A-21	18	C- 1	21	N- 2	14
Taos-1	11	A-22	17	C- 2	27		
Taos-2	13	A-23	19	C- 3	21	PL- 1	16
		A-24	25	C- 4	22	PL- 2	18
A- 1	18	A-25	20	C- 5	19	PL- 3	19
A- 2	20	A-26	19			PL- 4	17
A- 3	18	A-27	17	E- 1	13	PL- 6	18
A- 4	18	A-28	18	E- 2	13	PL- 7	18
A- 5	19	A-29	16	E- 3	11	PL- 8	17
A- 6	19	A-30	17	E- 4	11	PL- 9	17
A- 7	18	A-31	15	E- 5	11	PL-10	16
A- 8	18	A-32	16	E- 6	10	PL-11	15
A- 9	18			E- 7	9	PL-13	15
A-10	20	B- 1	17	E- 8	8	PL-14	16
A-11	19	B- 2	16	E- 9	8	PL-15	15
A-12	18	B- 3	19	E-10	8	PL-16	14
A-13	18	B- 4	19			PL-17	15
A-14	18	B- 5	17	K- 1	16	PL-19	15
A-15	18	B- 6	18	K- 2	16	PL-20	15
A-16	17	B- 7					

TABLE A-II

LOW ENERGY FIELD RADIATION MEASUREMENTS

Survey Point	Gross Counts Per Minute					
	Channel 1	Channel 2	Channel 3	Channel 4	Channel 5	Channel 6
Cochiti - 1	561	467	445	630	2287	2619
Cochiti - 2	672	581	569	814	3027	3283
Ponderosa	833	803	796	1199	2938	3350
Tesuque	644	612	613	898	3361	3512
Santa Cruz	489	357	333	470	1789	1927
Taos - 1	504	349	417	435	1600	1805
Taos - 2	555	410	386	541	2016	2265
A- 1	622	551	549	766	3117	3219
A- 2	697	646	593	831	3328	3451
A- 3	678	590	586	811	3332	3399
A- 4	660	616	610	898	3617	3646
A- 5	662	590	566	815	3403	3535
A- 6	677	614	566	827	3348	3502
A- 7	667	544	504	728	2948	3119
A- 8	743	606	600	810	3129	3201
A- 9	744	575	561	774	3182	3466
A-10	764	586	554	758	3168	3489
A-11	743	587	568	746	2985	3237
A-12	725	526	503	679	2776	3088
A-13	694	550	522	724	2971	3206
A-14	723	596	586	823	3290	3523
A-15	611	584	587	847	3225	3155
A-16	636	591	580	845	3301	3330
A-17	641	566	574	806	3270	3390
A-18	614	558	562	807	3150	3195
A-19	693	591	570	814	3204	3408
A-20	711	582	560	855	3372	3645
A-21	680	581	575	779	3056	3202
A-22	663	573	570	791	3086	3144
A-23	586	635	662	956	3710	3660
A-24	605	685	962	1016	4155	4375
A-25	584	560	544	807	3084	3226
A-26	599	609	599	878	3330	3446
A-27	586	617	616	895	3331	3343
A-28	631	605	604	842	3194	3327
A-29	592	525	502	712	2756	2982
A-30	601	602	623	878	3119	3170
A-31	550	456	454	640	2377	2482
A-32	584	536	523	765	2810	2807
B- 1	531	529	530	789	3113	3136
B- 2	530	508	492	755	2948	3008
B- 3	620	623	629	932	3526	3547
B- 4	601	569	550	839	3184	3323
B- 5	595	549	510	777	2965	3164
B- 6	663	592	567	839	3143	3379
B- 7	637	583	555	818	3021	3232
B- 8	613	584	558	810	3091	3314
B- 9	615	561	522	774	2940	3220
B-10	614	563	546	852	3062	2956

TABLE A-II (continued)

Survey Point	Gross Counts Per Minute					
	Channel 1	Channel 2	Channel 3	Channel 4	Channel 5	Channel 6
C- 1	593	657	656	1033	4039	3998
C- 2	640	688	666	1034	4076	4137
C- 3	605	637	615	968	3752	3846
C- 4	642	675	665	1017	3850	3946
C- 5	591	594	576	872	3367	3524
E- 1	420	320	262	373	1396	1491
E- 2	386	283	487	320	1145	1214
E- 3	383	274	465	312	1165	1244
E- 4	400	282	436	326	1181	1245
E- 5	433	342	295	416	1582	1660
E- 6	372	242	470	288	1012	1169
E- 7	428	281	480	307	1031	1210
E- 8	453	293	269	363	1204	1347
E- 9	418	237	452	263	934	1071
E-10	422	272	499	316	1051	1238
K- 1	543	491	469	707	2796	2868
K- 2	583	478	452	642	2546	2663
L- 1	634	571	526	788	3049	3278
L- 2	634	595	551	828	3122	3232
N- 1	596	491	489	688	2664	2865
N- 2	587	510	502	696	2685	2878
PL- 1	618	492	437	666	2569	2799
PL- 2	653	567	519	794	3026	3230
PL- 3	592	543	530	791	3171	3226
PL- 4	542	497	486	725	2836	2893
PL- 6	598	527	527	755	3016	3112
PL- 7	623	514	510	728	2901	3080
PL- 8	564	538	532	764	3103	3124
PL- 9	568	530	517	754	2956	3109
PL-10	577	513	502	722	2795	2993
PL-11	606	517	511	716	2784	2991
PL-13	601	535	525	733	2818	3052
PL-14	591	509	515	700	2705	2930
PL-15	579	473	477	658	2557	2802
PL-16	540	426	426	609	2292	2474
PL-17	578	477	489	675	2572	2754
PL-19	604	516	514	734	2740	2979
PL-20	616	501	527	717	2768	3003

TABLE A-III

LAFPHA DATA RATIOS

Survey Point	Ratios of Observed Count Rates				
	Ch 2/Ch 1	Ch 2/Ch 3	Ch 2/Ch 6	Ch 5/Ch 4	Ch 5/Ch 6
Cochiti - 1	0.83	1.05	0.18	3.63	0.87
Cochiti - 2	0.86	1.02	0.18	3.72	0.92
Ponderosa	0.96	1.01	0.24	2.45	0.88
Tesuque	0.95	1.00	0.17	3.74	0.96
Santa Cruz	0.73	1.07	0.19	3.81	0.93
Taos - 1	0.69	0.84	0.19	3.68	0.89
Taos - 2	0.74	1.06	0.18	3.73	0.89
A- 1	0.89	1.00	0.17	4.07	0.97
A- 2	0.93	1.09	0.19	4.00	0.96
A- 3	0.87	1.01	0.17	4.11	0.98
A- 4	0.93	1.01	0.17	4.03	0.99
A- 5	0.89	1.04	0.17	4.18	0.96
A- 6	0.91	1.08	0.18	4.05	0.96
A- 7	0.82	1.08	0.17	4.05	0.95
A- 8	0.82	1.01	0.19	3.86	0.98
A- 9	0.77	1.02	0.17	4.11	0.92
A-10	0.77	1.06	0.17	4.18	0.91
A-11	0.79	1.03	0.18	4.00	0.92
A-12	0.73	1.05	0.17	4.09	0.90
A-13	0.79	1.05	0.17	4.10	0.93
A-14	0.82	1.02	0.17	4.00	0.93
A-15	0.96	0.99	0.19	3.81	1.02
A-16	0.93	1.02	0.18	3.91	0.99
A-17	0.88	0.99	0.17	4.06	0.96
A-18	0.91	0.99	0.17	3.90	0.99
A-19	0.85	1.04	0.17	3.94	0.94
A-20	0.82	1.04	0.16	3.94	0.93
A-21	0.85	1.01	0.18	3.92	0.95
A-22	0.86	1.01	0.18	3.90	0.98
A-23	1.08	0.96	0.17	3.88	1.01
A-24	1.13	0.71	0.16	4.09	0.95
A-25	0.96	1.03	0.17	3.82	0.96
A-26	1.02	1.02	0.18	3.79	0.97
A-27	1.05	1.00	0.18	3.72	1.00
A-28	0.96	1.00	0.18	3.79	0.96
A-29	0.89	1.05	0.18	3.87	0.92
A-30	1.00	0.97	0.19	3.55	0.98
A-31	0.83	1.00	0.18	3.71	0.96
A-32	0.92	1.02	0.19	3.67	1.00
B- 1	1.00	1.00	0.17	3.95	0.99
B- 2	0.96	1.03	0.17	3.90	0.98
B- 3	1.00	0.99	0.18	3.78	0.99
B- 4	0.95	1.03	0.17	3.79	0.96
B- 5	0.92	1.08	0.17	3.82	0.94
B- 6	0.89	1.04	0.18	3.75	0.93
B- 7	0.92	1.05	0.18	3.69	0.93
B- 8	0.95	1.05	0.18	3.82	0.93
B- 9	0.91	1.07	0.17	3.80	0.91
B-10	0.92	1.03	0.19	3.59	1.04

TABLE A-III (continued)

Survey Point	Ratios of Observed Count Rates				
	Ch 2/Ch 1	Ch 2/Ch 3	Ch 2/Ch 6	Ch 5/Ch 4	Ch 5/Ch 6
C- 1	1.11	1.00	0.16	3.91	1.01
C- 2	1.08	1.03	0.17	3.94	0.99
C- 3	1.05	1.04	0.17	3.88	0.98
C- 4	1.05	1.02	0.17	3.79	0.98
C- 5	1.01	1.03	0.17	3.86	0.96
E- 1	0.76	1.22	0.21	3.74	0.94
E- 2	0.73	0.58	0.23	3.58	0.94
E- 3	0.72	0.59	0.22	3.73	0.94
E- 4	0.71	0.65	0.23	3.62	0.95
E- 5	0.79	1.16	0.21	3.80	0.95
E- 6	0.65	0.51	0.21	3.51	0.87
E- 7	0.66	0.59	0.23	3.36	0.85
E- 8	0.65	1.09	0.22	3.32	0.89
E- 9	0.57	0.52	0.22	3.55	0.87
E-10	0.64	0.55	0.22	3.33	0.85
K- 1	0.90	1.05	0.17	3.95	0.97
K- 2	0.82	1.06	0.18	3.97	0.96
L- 1	0.90	1.09	0.17	3.87	0.93
L- 2	0.94	1.08	0.18	3.77	0.97
N- 1	0.82	1.00	0.17	3.87	0.93
N- 2	0.87	1.02	0.18	3.86	0.93
PL- 1	0.80	1.13	0.18	3.86	0.92
PL- 2	0.86	1.09	0.18	3.81	0.94
PL- 3	0.92	1.02	0.17	4.01	0.98
PL- 4	0.92	1.02	0.17	3.91	0.98
PL- 6	0.88	1.00	0.17	3.99	0.97
PL- 7	0.83	1.01	0.17	3.98	0.94
PL- 8	0.95	1.01	0.17	4.06	0.99
PL- 9	0.93	1.03	0.17	3.92	0.95
PL-10	0.89	1.02	0.17	3.87	0.93
PL-11	0.85	1.01	0.17	3.89	0.93
PL-13	0.89	1.02	0.18	3.84	0.92
PL-14	0.86	0.99	0.17	3.86	0.92
PL-15	0.82	0.99	0.17	3.89	0.91
PL-16	0.79	1.00	0.17	3.76	0.93
PL-17	0.83	0.98	0.17	3.81	0.93
PL-19	0.85	1.00	0.17	3.73	0.92
PL-20	0.81	0.95	0.17	3.86	0.92

TABLE A-IV

^{137}CESIUM, AND GROSS BETA ACTIVITIES IN SOIL

Sample Location	^{137}Cs, pCi/g	Gross β, pCi/g
Taos	1.2 ± 0.7	16.2 ± 0.5
Ponderosa	5.7 ± 0.8	31.7 ± 0.7
Cochiti	4.3 ± 0,8	19.1 ± 0.6
Santa Cruz	3.0 ± 0.8	17.5 ± 0.6
Tesuque	4.0 ± 0.8	22.6 ± 0.6
A- 1	6.8 ± 0.8	27.2 ± 0.7
A- 2	3.3 ± 0.8	26.7 ± 0.7
A- 3	4.4 ± 0.8	25.1 ± 0.6
A- 4	3.6 ± 0.8	31.6 ± 0.7
A- 5	3.0 ± 0.8	28.2 ± 0.7
A- 6	3.1 ± 0.8	28.2 ± 0.7
A- 7	2.8 ± 0.8	20.3 ± 0.6
A- 8	4.3 ± 0.8	24.8 ± 0.6
A- 9	3.6 ± 0.8	28.4 ± 0.7
A-10	3.9 ± 0.8	25.3 ± 0.6
A-11	2.8 ± 0.8	25.1 ± 0.6
A-12	3.7 ± 0.8	18.3 ± 0.6
A-13	9.2 ± 0.8	27.0 ± 0.7
A-14	5.9 ± 0.8	30.0 ± 0.7
A-15	5.9 ± 0.8	19.4 ± 0.6
A-16	6.2 ± 0.8	19.4 ± 0.6
A-17	5.0 ± 0.8	23.6 ± 0.6
A-18	6.9 ± 0.8	23.8 ± 0.6
A-19	2.9 ± 0.8	26.7 ± 0.7
A-20	3.2 ± 0.8	24.4 ± 0.6
A-21	5.3 ± 0.8	23.3 ± 0.6
A-22	-- lost	--
A-23	5.0 ± 0.8	23.8 ± 0.6
A-24	3.4 ± 0.8	20.9 ± 0.6
A-25	3.4 ± 0.8	18.8 ± 0.6
A-26	2.4 ± 0.8	26.0 ± 0.7
A-27	3.3 ± 0.8	27.5 ± 0.7
A-28	4.2 ± 0.8	23.7 ± 0.6
A-29	2.2 ± 0.8	17.4 ± 0.6
A-30	3.1 ± 0.8	22.2 ± 0.6
A-31	0.9 ± 0.7	13.1 ± 0.5
A-32	1.9 ± 0.8	16.8 ± 0.5
B- 1	-- lost	--
B- 2	1.9 ± 0.8	20.6 ± 0.6
B- 3	2.4 ± 0.8	26.3 ± 0.7
B- 4	4.0 ± 0.8	20.9 ± 0.6
B- 5	2.5 ± 0.8	20.6 ± 0.6
B- 6	2.5 ± 0.8	20.0 ± 0.6
B- 7	2.1 ± 0.8	24.8 ± 0.6
B- 8	3.4 ± 0.8	23.1 ± 0.6
B- 9	4.0 ± 0.8	25.0 ± 0.6
B-10	3.5 ± 0.8	24.2 ± 0.6

Sample Location	^{137}Cs, pCi/g	Gross β, pCi/g
C- 1	2.9 ± 0.8	26.6 ± 0.7
C- 2	3.6 ± 0.8	26.9 ± 0.7
C- 3	2.5 ± 0.8	20.9 ± 0.6
C- 4	2.4 ± 0.8	23.6 ± 0.6
C- 5	3.5 ± 0.8	23.0 ± 0.6
E- 1	2.2 ± 0.8	19.7 ± 0.6
E- 2	1.4 ± 0.8	17.6 ± 0.6
E- 3	1.7 ± 0.8	16.0 ± 0.5
E- 4	-- lost	--
E- 5	2.1 ± 0.8	15.8 ± 0.5
E- 6	0.9 ± 0.7	14.1 ± 0.6
E- 7	1.3 ± 0.8	13.6 ± 0.6
E- 8	1.0 ± 0.7	13.4 ± 0.6
E- 9	1.5 ± 0.8	13.6 ± 0.6
E-10	2.1 ± 0.8	13.5 ± 0.6
K- 1	3.5 ± 0.8	21.5 ± 0.7
K- 2	2.3 ± 0.8	16.4 ± 0.7
L- 1	3.1 ± 0.8	16.6 ± 0.7
L- 2	3.9 ± 0.8	26.5 ± 0.8
N- 1	-- lost	--
N- 2	1.6 ± 0.5	37.6 ± 0.8
PL- 1	2.0 ± 0.8	18.6 ± 0.6
PL- 2	2.6 ± 0.8	23.5 ± 0.6
PL- 3	2.4 ± 0.8	18.7 ± 0.6
PL- 4	1.5 ± 0.8	20.0 ± 0.6
PL- 6	2.8 ± 0.8	22.7 ± 0.6
PL- 7	2.3 ± 0.8	20.8 ± 0.6
PL- 8	2.2 ± 0.8	20.3 ± 0.6
PL- 9	3.0 ± 0.8	26.4 ± 0.6
PL-10	2.9 ± 0.8	22.2 ± 0.6
PL-11	2.2 ± 0.8	21.6 ± 0.6
PL-13	2.4 ± 0.8	20.4 ± 0.6
PL-14	4.3 ± 0.8	25.4 ± 0.6
PL-15	4.0 ± 0.8	24.0 ± 0.6
PL-16	2.1 ± 0.8	19.0 ± 0.6
PL-17	1.8 ± 0.8	20.1 ± 0.6
PL-19	1.1 ± 0.7	17.4 ± 0.6
PL-20	2.4 ± 0.8	20.0 ± 0.6

TABLE A-V

PLUTONIUM AND AMERICIUM ACTIVITIES IN SOIL

Sample Location(s)[a]	^{239}Pu, pCi/g	^{238}Pu, pCi/g	^{241}Am, pCi/g
Taos	0.02 ± 0.01	0.04 ± 0.03	0.09 ± 0.08
Ponderosa	0.03 ± 0.01	0.01 ± 0.01	0.09 ± 0.03
Cochiti	0.07 ± 0.08	0.50 ± 0.40	0.04 ± 0.02
Santa Cruz	0.03 ± 0.02	0.06 ± 0.04	0.04 ± 0.02
Tesuque	0.11 ± 0.02	0.05 ± 0.02	0.03 ± 0.02
A-1	0.04 ± 0.01	<0.01 ± 0.01	0.06 ± 0.02
A-2	0.01 ± 0.01	<0.01 ± 0.01	0.09 ± 0.03
A-1C	0.10 ± 0.03	0.19 ± 0.08	0.90 ± 0.30
A-2C	0.22 ± 0.16	0.60 ± 0.40	<0.01
A-12	0.01 ± 0.01	<0.01 ± 0.01	0.09 ± 0.02
A-3C	0.09 ± 0.06	0.30 ± 0.20	0.03 ± 0.02
A-15	0.03 ± 0.01	<0.01 ± 0.01	0.04 ± 0.02
A-16	0.04 ± 0.01	<0.01 ± 0.01	0.04 ± 0.02
A-17	0.03 ± 0.01	<0.01 ± 0.01	0.02 ± 0.02
A-18	0.03 ± 0.01	<0.01 ± 0.01	0.06 ± 0.01
A-21	0.03 ± 0.01	<0.01 ± 0.01	0.03 ± 0.02
A-23	0.04 ± 0.01	<0.01 ± 0.01	0.04 ± 0.01
A-24	0.01 ± 0.01	<0.01 ± 0.01	<0.01 ± 0.01
A-4C	0.06 ± 0.02	0.01 ± 0.01	0.25 ± 0.09
A-29	0.04 ± 0.01	<0.01 ± 0.01	0.04 ± 0.01
A-5C	0.06 ± 0.03	0.03 ± 0.03	0.06 ± 0.02
A-31	0.02 ± 0.01	<0.01 ± 0.01	0.03 ± 0.02
B-1C	0.08 ± 0.05	0.20 ± 0.14	0.12 ± 0.06
B-4	0.04 ± 0.01	0.01 ± 0.004	0.15 ± 0.07
B-5	0.02 ± 0.01	<0.01 ± 0.01	0.01 ± 0.01
B-6	0.01 ± 0.01	0.01 ± 0.002	0.16 ± 0.09
B-8	0.01 ± 0.01	<0.01 ± 0.01	0.04 ± 0.03
C-1C	0.12 ± 0.07	0.30 ± 0.20	0.05 ± 0.02
E-1C	1.00 ± 0.60	1.20 ± 1.00	0.06 ± 0.02
E-2C	<0.01 ± 0.01	<0.01 ± 0.01	0.08 ± 0.04
E-3C	0.60 ± 0.30	0.40 ± 0.30	<0.01 ± 0.01
K-1C	0.02 ± 0.01	0.05 ± 0.02	0.03 ± 0.02
L-1C	0.04 ± 0.02	0.01 ± 0.01	0.04 ± 0.02
N-1C	0.04 ± 0.04	0.01 ± 0.01	0.03 ± 0.01
PL-1C	0.15 ± 0.04	<0.01 ± 0.01	0.04 ± 0.02
PL-2C	0.27 ± 0.04	0.02 ± 0.01	<0.01 ± 0.01
PL-3C	0.05 ± 0.02	0.01 ± 0.01	0.03 ± 0.01
PL-4C	0.39 ± 0.14	0.05 ± 0.04	0.07 ± 0.02
PL-5C	0.04 ± 0.02	<0.01 ± 0.01	0.05 ± 0.01

[a] Sample location notation with an alpha character followed by a number indicates an individual sample; e.g., A-1; where the number is followed by the alpha character "C"; e.g., A-1C, a composite of individual samples is indicated.

TABLE A-VI

URANIUM MEASUREMENTS IN SOIL

Composited & Individual Sample Location(s)	Total Uranium µg/g of Sample[a]	Composited & Individual Sample Location(s)	Total Uranium µg/g of Sample[a]
A-1 C	0.28	K-1 C	0.65
A-2 C	1.50	L-1 C	0.60
A-3 C	1.06	N-1 C	0.75
A-4 C	0.52	PL-1 C	0.56
A-5 C	1.20	PL-2 C	0.39
A-6 C	0.61	PL-3 C	0.39
A-7 C	0.33	PL-4 C	0.37
B-1 C	1.13	PL-5 C	0.41
B-2 C	0.71	Taos	0.16
C-1 C	0.65	Ponderosa	1.24
E-1 C	0.58	Cochiti	0.18
E-2 C	0.65	Santa Cruz	0.65
E-3 C	0.39	Tesuque	0.65

[a] Estimated single standard deviation due to measurement, 0.04 µg/g.

TABLE A-VII

TRITIUM, ^{137}CESIUM, AND GROSS BETA ACTIVITIES IN VEGETATION

Sample Location	^{3}H, pCi/ml	^{137}Cs, pCi/g	Gross β, pCi/g
Taos	< 1.0 ± 0.3	2.4 ± 0.3	4.6 ± 0.2
Ponderosa	< 1.0 ± 0.3	2.3 ± 0.4	4.3 ± 0.2
Cochiti	< 1.0 ± 0.3	1.3 ± 0.3	4.2 ± 0.2
Santa Cruz	< 1.0 ± 0.3	0.5 ± 0.4	5.0 ± 0.2
Tesuque	< 1.0 ± 0.3	1.7 ± 0.5	5.1 ± 0.2
A- 1	4.9 ± 0.3	0.8 ± 0.4	4.6 ± 0.3
A- 2	-- lost	--	--
A- 3	5.8 ± 0.3	1.5 ± 0.5	4.3 ± 0.3
A- 4	2.8 ± 0.3	1.1 ± 0.3	4.1 ± 0.2
A- 5	3.8 ± 0.3	3.4 ± 0.4	5.7 ± 0.3
A- 6	2.5 ± 0.3	1.4 ± 0.3	4.4 ± 0.2
A- 7	3.5 ± 0.3	2.2 ± 0.4	4.7 ± 0.3
A- 8	2.8 ± 0.3	1.4 ± 0.3	4.7 ± 0.2
A- 9	4.1 ± 0.3	0.5 ± 0.4	4.9 ± 0.3
A-10	4.1 ± 0.3	1.7 ± 0.5	4.4 ± 0.3
A-11	1.8 ± 0.3	0.9 ± 0.6	4.1 ± 0.4
A-12	3.4 ± 0.3	1.2 ± 0.5	4.3 ± 0.3
A-13	3.7 ± 0.3	0.7 ± 0.5	4.2 ± 0.3
A-14	3.5 ± 0.3	1.0 ± 0.4	2.1 ± 0.2
A-15	2.9 ± 0.3	0.5 ± 0.5	3.0 ± 0.3
A-16	3.8 ± 0.3	1.2 ± 0.5	4.0 ± 0.3
A-17	1.5 ± 0.3	1.4 ± 0.6	3.9 ± 0.3
A-18	2.8 ± 0.3	1.8 ± 0.5	2.3 ± 0.2
A-19	2.0 ± 0.3	1.6 ± 0.5	5.7 ± 0.3
A-20	2.4 ± 0.3	0.9 ± 0.6	4.4 ± 0.3
A-21	1.9 ± 0.3	6.7 ± 1.3	6.0 ± 0.6
A-22	3.4 ± 0.3	1.3 ± 0.8	5.1 ± 0.4
A-23	1.5 ± 0.3	2.1 ± 0.8	5.7 ± 0.4
A-24	< 1.0 ± 0.3	1.6 ± 0.7	5.9 ± 0.4
A-25	3.7 ± 0.3	3.7 ± 0.8	5.8 ± 0.4
A-26	1.7 ± 0.3	1.2 ± 0.6	4.9 ± 0.3
A-27	1.7 ± 0.3	1.0 ± 0.4	4.2 ± 0.2

TABLE A-VII (continued)

Sample Location	^{3}H, pCi/ml		^{137}Cs, pCi/g	Gross β, pCi/g
A-28	2.0 ± 0.3		1.7 ± 0.5	4.7 ± 0.3
A-29	2.0 ± 0.3		0.9 ± 0.4	3.5 ± 0.2
A-30	1.6 ± 0.3		1.0 ± 0.4	3.5 ± 0.2
A-31	1.7 ± 0.3		3.3 ± 0.4	5.2 ± 0.2
A-32	<1.0 ± 0.3		1.3 ± 0.3	5.2 ± 0.3
B- 1	3.1 ± 0.3		3.1 ± 0.4	6.0 ± 0.3
B- 2	1.3 ± 0.3		1.0 ± 0.3	5.0 ± 0.2
B- 3	1.2 ± 0.3		2.2 ± 0.4	4.4 ± 0.2
B- 4	1.1 ± 0.3		1.4 ± 0.5	5.9 ± 0.3
B- 5	3.5 ± 0.3		1.2 ± 0.4	5.8 ± 0.3
B- 6	3.5 ± 0.3		2.5 ± 0.6	5.8 ± 0.3
B- 7	3.5 ± 0.3		2.1 ± 0.5	4.5 ± 0.3
B- 8	3.7 ± 0.3		0.5 ± 0.5	5.6 ± 0.3
B- 9	1.2 ± 0.3		6.1 ± 0.4	4.7 ± 0.2
B-10	2.8 ± 0.3		1.5 ± 0.5	5.0 ± 0.3
C-1	1.3 ± 0.3		3.0 ± 0.4	6.7 ± 0.3
C-2	2.8 ± 0.3		0.8 ± 0.4	4.3 ± 0.2
C-3	1.3 ± 0.3		0.5 ± 0.5	5.1 ± 0.3
C-4	1.6 ± 0.3		1.1 ± 0.5	5.0 ± 0.4
C-5	1.3 ± 0.3		1.3 ± 0.4	3.7 ± 0.3
E- 1	1.4 ± 0.3		1.7 ± 0.5	4.0 ± 0.2
E- 2	8.0 ± 0.3		0.6 ± 0.3	3.8 ± 0.2
E- 3	1.3 ± 0.3		1.0 ± 0.3	4.2 ± 0.2
E- 4	2.4 ± 0.3		0.5 ± 0.4	3.8 ± 0.2
E- 5	1.7 ± 0.3		1.2 ± 0.6	3.5 ± 0.3
E- 6	<1.0 ± 0.3		0.8 ± 0.3	4.3 ± 0.2
E- 7	<1.0 ± 0.3		1.3 ± 0.3	13.4 ± 0.4
E- 8	1.3 ± 0.3		1.7 ± 0.4	6.5 ± 0.3
E- 9	1.9 ± 0.3		1.1 ± 0.2	5.3 ± 0.2
E-10	1.7 ± 0.3		1.2 ± 0.4	5.4 ± 0.3
K-1	4.6 ± 0.3		6.4 ± 0.9	6.2 ± 0.5
K-2	5.8 ± 0.3		0.3 ± 0.4	2.7 ± 0.2
L-1	5.8 ± 0.3		0.7 ± 0.3	4.7 ± 0.3
L-2	5.6 ± 0.3		1.5 ± 0.5	3.8 ± 0.3
N-1	4.7 ± 0.3		9.8 ± 0.9	15.7 ± 0.4
N-2	lost		3.7 ± 0.6	3.2 ± 0.2
PL- 1	4.3 ± 0.3		0.6 ± 0.4	5.0 ± 0.3
PL- 2	9.6 ± 0.3		0.8 ± 0.6	3.0 ± 0.3
PL- 3	6.9 ± 0.3		1.8 ± 0.3	3.9 ± 0.2
PL- 4	--	lost	--	--
PL- 6	8.1 ± 0.3		1.3 ± 0.3	3.8 ± 0.2
PL- 7	5.5 ± 0.3		3.7 ± 1.2	20.7 ± 0.9
PL- 8	2.4 ± 0.3		1.3 ± 0.4	4.2 ± 0.3
PL- 9	2.8 ± 0.3		5.6 ± 1.0	19.4 ± 0.9
PL-10	2.8 ± 0.3		0.7 ± 0.3	2.9 ± 0.2
PL-11	4.6 ± 0.3		2.3 ± 0.7	17.0 ± 0.6
PL-13	5.2 ± 0.3		2.5 ± 0.4	5.6 ± 0.3
PL-14	3.6 ± 0.3		4.1 ± 0.9	21.4 ± 0.7
PL-15	3.5 ± 0.3		0.1 ± 0.4	4.7 ± 0.2
PL-16	<1.0 ± 0.3		5.2 ± 1.2	22.7 ± 0.8
PL-17	<1.0 ± 0.3		0.7 ± 0.3	5.0 ± 0.2
PL-19	2.5 ± 0.3		0.5 ± 0.4	0.3 ± 0.1
PL-20	2.4 ± 0.3		3.6 ± 0.8	14.5 ± 0.5

TABLE A-VIII

PLUTONIUM AND AMERICIUM ACTIVITIES IN VEGETATION

Composited & Individual Sample Location(s)	^{238}Pu, pCi/g	^{238}Pu, pCi/g	^{241}Am, pCi/g
A-1C	0.005 ± 0.002	0.004 ± 0.002	0.140 ± 0.030
A-2C	0.004 ± 0,001	0.003 ± 0.001	0.006 ± 0.001
A-3C	0.009 ± 0.001	0.003 ± 0.001	0.004 ± 0.001
A-4C	0.012 ± 0.004	0.003 ± 0.002	0.007 ± 0,002
A-5C	0.004 ± 0.001	<0.001 ± 0.001	0.009 ± 0.004
A-6C	0.003 ± 0.001	0.003 ± 0.001	0.008 ± 0.002
A-7C	0.004 ± 0.001	<0.001 ± 0.001	0.010 ± 0.003
A-8C	0.006 ± 0.001	<0.001 ± 0.001	0.021 ± 0.009
B-1C	0.006 ± 0.001	0.007 ± 0.003	0.006 ± 0.001
B-2C	0.005 ± 0.002	0.005 ± 0.004	0.012 ± 0.002
C-1C	0.002 ± 0.001	<0.001 ± 0.001	0.004 ± 0.001
E-1C	0.002 ± 0.001	0.003 ± 0.002	0.007 ± 0,001
E-2C	0.034 ± 0.015	0.030 ± 0.020	0.029 ± 0.007
K-1C	0.002 ± 0.001	0.002 ± 0.001	0.006 ± 0.002
L-1C	0.004 ± 0.001	<0.001 ± 0.001	0.006 ± 0.002
N-1C	0.008 ± 0.006	0.001 ± 0.001	0.016 ± 0.003
PL-1C	0.017 ± 0.002	0.003 ± 0.001	0.010 ± 0.003
PL-2C	0.016 ± 0.002	0.003 ± 0.001	0.031 ± 0.008
PL-3C	0.058 ± 0.007	<0.001 ± 0.001	0.057 ± 0.011
PL-4C	0.012 ± 0.005	0.005 ± 0.003	0.032 ± 0.007
Taos	0.002 ± 0.001	0.005 ± 0.002	0.011 ± 0.003
Ponderosa	<0.001 ± 0.001	0.004 ± 0.002	0.012 ± 0.005
Cochiti	0.003 ± 0.001	0.002 ± 0.001	0.003 ± 0.001
Santa Cruz	0.003 ± 0.001	0.004 ± 0.002	0.003 ± 0.001
Tesuque	0.002 ± 0.001	0.004 ± 0.002	0.009 ± 0.003

TABLE A-IX

URANIUM MEASUREMENTS IN VEGETATION

Composited & Individual Sample Location(s)	Total Uranium µg/g of Sample[a]	Composited & Individual Sample Location(s)	Total Uranium µg/g of Sample
A-1C	0.10	K-1C	0.02
A-2C	0.27	L-1C	0.07
A-3C	0.10	N-1C	0.15
A-4C	0.07	PL-1C	0.05
A-5C	0.07	PL-2C	0.11
A-6C	0.07	PL-3C	0.10
A-7C	0.04	PL-4C	0.20
A-8C	0.12		
B-1C	0.12	Taos	0.02
B-2C	0.10	Ponderosa	<0.02
C-1C	0.07	Cochiti	0.05
E-1C	0.04	Tesuque	0.04
E-2C	0.38	Santa Cruz	lost

[a] Estimated single standard deviation due to measurement, 0.04 µg/g.

LOS ALAMOS SCIENTIFIC LABORATORY
UNIVERSITY OF CALIFORNIA
LOS ALAMOS, NEW MEXICO 87544

OFFICE MEMORANDUM

TO : Harry S. Jordan, Group Leader, H-8 DATE: Aug. 22, 1972

FROM : Dean D. Meyer, Group Leader, H-1

SUBJECT: RECORDS SEARCH: CONTAMINATION REPORT, UNNEEDED REAL PROPERTY

SYMBOL : H-1-72-225

A records search was made to determine the radioactive contamination history of the parcels of land A, B, C, E, L, K, and N listed in the request from Blackwell to Agnew, dated March 25, 1971.

In this search, records in Group H-1 were examined and Mail and Records was requested to provide records which the Laboratory had originated on the subject.

The following files were obtained from Mail and Records:

"Acreage Boundaries"
"Demolition of Buildings"
"Demolition of Abandoned Lab Structures" (safety relating to)
"Contaminated Dumps and Waste Disposal"
"Transfer of Real Property or Land"
"Perimeter Safety Surveys".

In addition, the following H-Division records were consulted:

LA-4562, "Plutonium and Strontium in Soil in Los Alamos, Espanola, and Santa Fe, New Mexico, Areas"

Pueblo Canyon Test Wells, Metes and Bounds, Description and Access Easements, Zia Company drawing Z-4226, two sheets, dated 8-11-66

LA-4561, "Plutonium in Stream Channel Alluvium in Los Alamos Area, New Mexico".

The records search indicated that with the exception of Area C, no detectable radioactive contamination (portable survey instruments) was present. Area C has a stream bed into which treated waste water was discharged for a number of years. The Laboratory has an easement on the channel and this should be retained.

The findings of the record search are supported by the personal experience of several members of Group H-1 who have been with the Laboratory up to 27 years and they are sure that the areas in question were not laboratory sites and that burial sites were not established in any of the areas.

DDM/eh

Fig. A-1.

CM;391(100)