Los Alamos

Los Alamos National Laboratory
Los Alamos, New Mexico 87545

memorandum

TO: Tony Grieggs, ESH-8, MS K490

DATE: May 26, 1994

FROM: Phil Fresquez, ESH-8

MAIL STOP/TELEPHONE: K490/7-0815

SYMBOL: ESH-8/EFM-94-111

SUBJECT: **RESULTS OF THE SOIL SAMPLING SURVEY CONDUCTED OVER ACTIVE RCRA FIRING SITE TA-15-184 (PHERMEX)**

On April 7, 1993, the Environmental Protection Group (ESH-8) collected over 20 soil surface samples over active RCRA firing site TA-15-184 for the Corrective Activities Program (Phil Fresquez, "Sampling Plan for the Characterization of Active RCRA Firing Site TA-15-184 (PHERMEX)," Los Alamos National Laboratory memorandum EM-8:93-250, to Tony Grieggs).

Soil samples were collected at the 0 to 3-inch-depth along the length (0, 20, 40, 80, 160 and 200 feet) of each of four transects radiating outward from the center of the detonation area towards the NE, E, SE and SSE (Figure 1). Also, two sediment samples were collected from drainage channels located near the detonation site; one was located approximately 240-feet NE of the detonation pad and the other was located approximately 200-feet S of the detonation pad. These samples were collected downgradient from the firing pad where the potential for deposition of sediments was most likely (inside bends, ponding areas, etc.).

The last sample (rinsate) was collected from the scattered surface debris from around the firing site. Glass, plastics, metals and wood materials were collected around the site, rinsed with distilled water and the rinsate collected.

All soil and sediment samples were screened for gross alpha, beta and gamma radioactivity before they were submitted under chain-of-custody documentation to the Environmental Chemistry Group (EM-9). Soil, sediment and water samples were analyzed for Toxicity Characteristic Leaching Procedure (TCLP) metals (Ag, As, Ba, Cd, Cr, Pb, Hg and Se), total Be, Ga, Hg, Pb, Th, and U, Semivolatile Organic Compounds (SVOC's), and high Explosive (HE) residues (HMX [1,3,5,7-tetranitro-1,3,5,7-tetraazacyclooctane], RDX [1,3,5-trinitrohexahydro-1,3,5-triazine], TETRYL [2,4,6-trinitrophenylmethylnitramine], TNT [2,4,6-trintrotoluene], and 2,4-DNT [2,4-dinitrotoluene]). HE residues were analyzed by the Explosives Technology Group (M-1).

Most TCLP metals in soil surface samples were detected below proposed Environmental Protection Agency (EPA) action levels. Two soil samples (NE-20 and SSE-160) contained TCLP-Pb above EPA action levels of 5 ppm. No sediment or water samples, however, contained TCLP metals above EPA action levels.

Total Be, Ga, Hg, Pb and Th in soil surface samples ranged in concentration from 0.2 to 218 ppm, 0.8 to 5.8 ppm, <10 to 20 ppb, 2.9 to 230 ppm, and 1.2 to 5.5 ppm, respectively. Most Be levels were above EPA action levels (i.e., >0.2 ppm) and above upper limit background concentrations (mean + 2SD) reported for the Los Alamos area (i.e., >2.88 ppm). Hg levels in all soil, sediment and water samples were below EPA action levels (i.e., <20 ppm); no action levels exist for Ga, Pb or Th. Background concentrations around the Los Alamos area for Ga is 21.1 ppm, for Pb it is 28.4 ppm

3895

and for Th it is 16 ppm. All sediment samples contained levels of Be, Ga, Hg, Pb and Th within background.

The area contained 21 SVOC's: acenaphthene (<1700 ppb), anthracene (<2100 ppb), benzo (a) anthracene (<2400 ppb), benzo (a) pyrene (<2400 ppb), benzo (b) fluoranthene (<2800 ppb), benzo (g,h,i) perylene (<1200 ppb), benzo (k) fluoranthene (<1600 ppb), bis-2-ethylhexylphthalate (<5600 ppb), chrysene (<2600 ppb), di-n-butlylphthalate (<980 ppb), dibenzofuran (<830 ppb), dibenzo (a,h) anthracene (<360 ppb), fluoranthene (<5100 ppb), fluorene (<1600 ppb), indeno-1,2,3,-(cd)-pyrene (<1300 ppb), 4-methylphenol (<640 ppb), 2-methylnaphthalene (<570 ppb), naphthalene (<1700 ppb), phenanthrene (<5200 ppb), phenol (<500 ppb), and pyrene (<5300 ppb). Soil sample SSE-80 contained the most (17 compounds) and highest amounts of SVOC's. Also, the two sediment samples contained SVOC's; the one located at the northeastern portion of the firing site, in particular, contained seven SVOC's alone.

No traces of HE materials were detected in either of the soils, sediments or water samples.

Total U in soil samples ranged in concentration from 0.8 ppm in sample SSE-200 to 13,398 ppm in sample SSE-40. The NE transect averaged 451 ppm, the E transect averaged 825 ppm, the SE transect averaged 403 ppm, the SSE transect averaged 3,611 ppm, and the average concentration over the entire site was 1,210 ppm. The upper limit background concentrations for total U around the Los Alamos area is 3.4 ppm. The sediment sample collected from the drainage channel located on the northeastern side of the detonation area contained 105 ppm of total U, whereas, the drainage channel located on the southern side contained only 11.5 ppm total U..

A preliminary sampling study conducted by HSE-8 over the PHERMEX site in May of 1987 showed levels of total uranium up to 3,593 ppm (the average concentration over the entire site was 432 [±647] ppm) and beryllium up to 470 ppm (the average concentration over the entire site was 31.7 [±83] ppm).

All sample locations were surveyed (by the New Mexico State Plane coordinate system) and located on a FIMAD map for future reference. Similarly, all records associated with this sampling effort are enclosed for your records.

PF:RC/ja

Linda Sovijinski

Attach: a/s

Cy: M. Christian M-4, w/enc., MS P940
S. Kinkead, INC-1, w/enc., MS J534
S. Rae, EM-8, w/o enc., MS K490
D. Griechen, M-DO, w/enc., MS P915
J. Dallman, M-1, w/o enc., MS C920
B. Baron, NWT, w/o enc., MS C918
A. Ogard, INC-7, w/enc., MS J514
J. Armstrong, M-4, w/o enc., MS P942
P. Shanley, ESH-8, w/enc., MS K490
D. Armstrong, ESH-8, w/o enc., MS K490
ESH-8 Reading File

LAUR-94-400 February 1994

The Use of the Long-Range Alpha Detector (LRAD) for Alpha Emission Surveys at Active and Inactive Firing Sites

Los Alamos

Los Alamos National Laboratory is operated by the University of California for the United States Department of Energy under contract W-7405-ENG-36.

LAUR-94-400

THE USE OF THE LONG-RANGE ALPHA DETECTOR (LRAD) FOR ALPHA EMISSION SURVEYS AT ACTIVE AND INACTIVE FIRING SITES.

C. F. V. Mason, K.S. Allander, J. A. Bounds, S. E. Garner,
Los Alamos National Laboratory, Los Alamos, New Mexico 87545
and K. J. Walter,
Brown & Root Environmental, Albuquerque, New Mexico 87106

ABSTRACT

Surveys were carried out at five different firing sites at Los Alamos National Laboratory to measure residual alpha emissions in earth contaminated with natural and depleted uranium. This contamination is caused by controlled experimental explosions during testing of the non fissile components of nuclear weapons. Two conclusions were reached: the first is that post shot clearing of the experimental areas is effective at removing contamination and the second is that the diminution of alpha emissions due to aging is small.

INTRODUCTION

The technical area, TA-15, (Operable Unit 1086) at Los Alamos National Laboratory comprises 1200 acres of mesa tops, intersected and bounded by canyons, shown in Figure 1. Since the 1940s this area has been used for the explosive testing of non-fissile components of nuclear weapons at locations called firing sites. Over the years, twelve such sites have been developed and two are currently in use. Many large explosive tests have taken place with the concomitant scattering of large amounts of natural or depleted uranium (the replacement for the fissile component) and to a lesser extent, beryllium and lead.

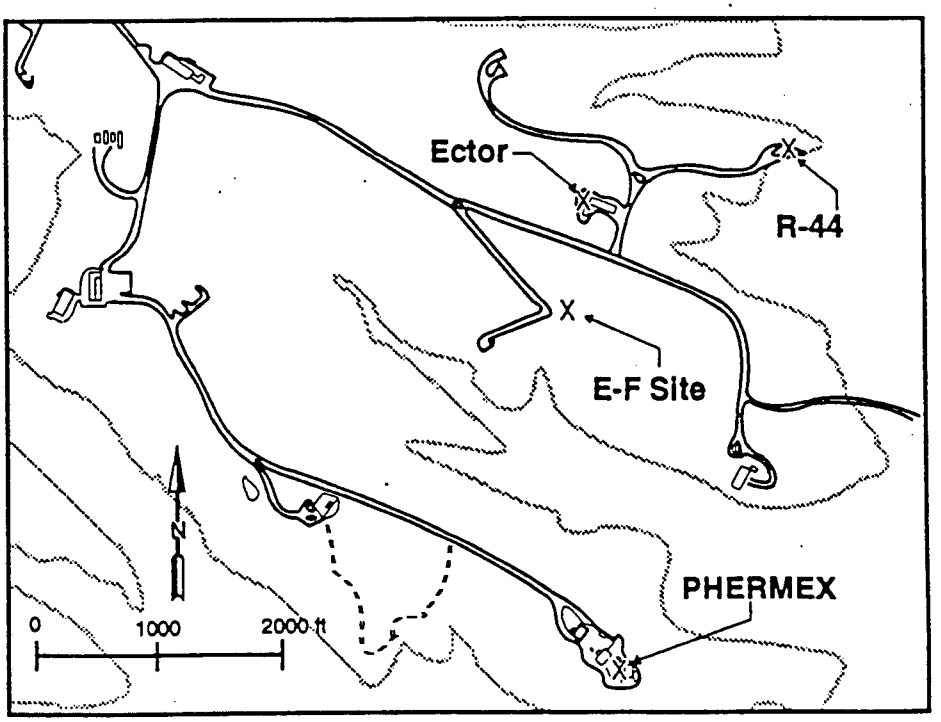


Figure 1 Map of Technical Area 15 at Los Alamos National Laboratory showing major firing sites (sampled by LRAD).

Recently there has been increasing concern over the build up of contaminants from these explosions in the surrounding areas, especially in the soil and the associated possible natural pathways for the spread of the contaminants. These concerns are driven by two different interests, the first being the safety of the workers at the active sites and the second being remediation so the mesa tops can eventually be made available for uses other than testing.

During the summer of 1993, five firing sites were surveyed for alpha emissions over a four week period by a two person crew. Figure 1 shows a map of the major firing sites surveyed at TA-15. The sites chosen were the two active firing sites for health monitoring reasons and two of the inactive firing sites (the areas of the largest explosions) for the environmental restoration program. In addition a fifth site, not at TA-15, was monitored, which although officially prepared for uranium firing site experiments, was mainly used for handling small amounts of high explosives.

The surveys were carried out using the Long-Range Alpha Detector (LRAD)[1] which monitors alpha emissions, in this case from the decay chains of uranium-238 and -235. The decay chains of concern are shown in Figure 2.

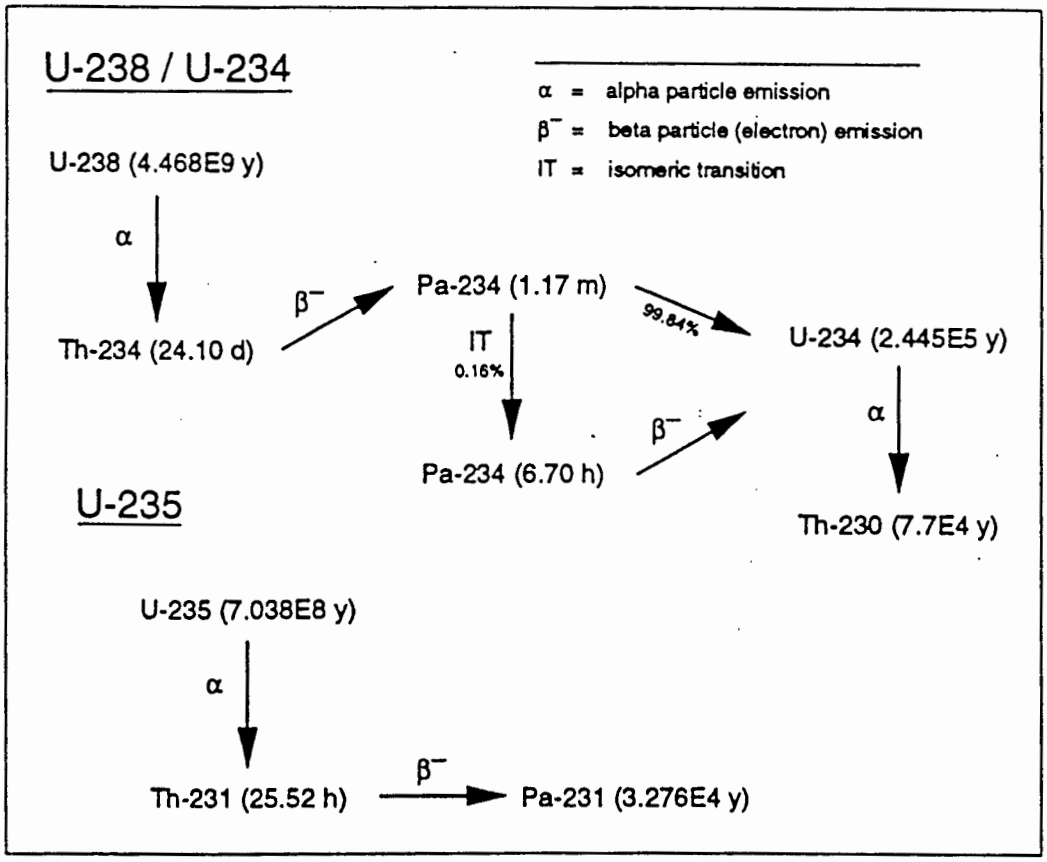


Figure 2 Decay chains for Uranuim -238 and -235.

EQUIPMENT

The LRAD has been described in detail elsewhere [2] and is schematically shown in Figure 3. The alpha particles generated in the contaminated soil create ions in air. In the presence of the electric field (created by a battery between the soil and the signal plane), these ions migrate up or down, depending on their polarity, until they encounter the signal

plane or the soil respectively. The ions cause a current to register on the electrometer; a DC current of a few femtoamps (10^{-15}A). This current reading can be converted directly to roentgen per unit time since the latter is defined in terms of rate of ion production in air. However alpha contamination has historically been described by activity rather than by exposure rate : DOE order 5400.5 states contamination limits in the more common form of disintegrations per minute/unit area, dpm/100cm^2. To convert to dpm/100cm^2 the background reading is subtracted from the measured current and multiplied by the conversion rate of 6dpm/fA to get total dpm. This conversion is precise for 5.10 MeV average alpha energy (that from plutonium-239) and very nearly the same for the alphas from the uranium decay chains (between 4.19 and 6.14 MeV). Converting these readings to ppm or pCi/g requires several assumptions such as the depth of soil penetration of the alphas as well as soil density, composition and homogeneity.

The detector is an open bottomed box that is placed face down on the soil to be monitored and is calibrated using a set of NIST (National Institutes of Standards and Technology) traceable alpha sources. It weighs about 300 lb. and is mounted on the front loader of a small tractor. The electronics are permanently running so the set up time consists of bringing the trailer to the test location. The response time for the detector is between eight and fifteen minutes per measurement. A weed-eater was used to clear the vegetation from the spot to be monitored. Vegetation interferes with measurements in two ways: a blade of grass can cause a short circuit between the signal plane and the soil, creating currents orders of magnitude greater than those due to alpha particles, and vegetation can shield the detector from the alpha-emitter activity beneath it. The advantages of this method for alpha detection include being fast, reliable and non intrusive. The major disadvantage is that it only measures the surface layer (36μm).

The instrument is currently being manufactured by Eberline Instruments Corporation (after development at Los Alamos National Lab.) and is also available in a hand held model.

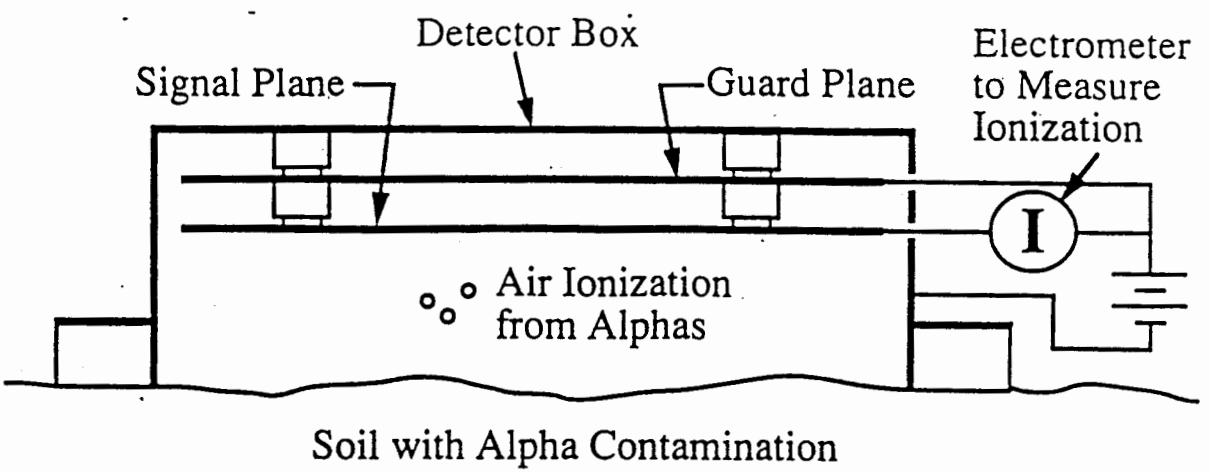


Figure 3 LRAD Soil Surface Monitor

DISCUSSION OF FIRING SITE DATA

Experiments at all of the firing sites spread uranium (and other contaminants) radially from the explosive point except when physical barriers, such as berms and walls, intercepted the debris. The alpha emissions data collected were used to create the charts shown in Figures 4-8.

Active Firing Sites

PHERMEX (Pulsed, High-Energy, Radiographic, Machine Emitting X-Rays)

For the past three decades, the PHERMEX facility has been used to examine the performance of weapon designs. In dynamic radiography, PHERMEX is used to produce extremely short duration bursts of x-rays. After passing through the test object during the explosion, the x-rays are recorded on film as an image of the test device at a preselected time. PHERMEX continues in operation although the amounts of uranium used now is less than 1000 kg per year. In a previous radiological survey [3] in 1982 PHERMEX was estimated to have about one-seventh of the radioactive material found at E-F site (an inactive site discussed later). As at all firing sites, there are pieces of depleted uranium near the firing point. The data collected at PHERMEX is shown in Figure 4.

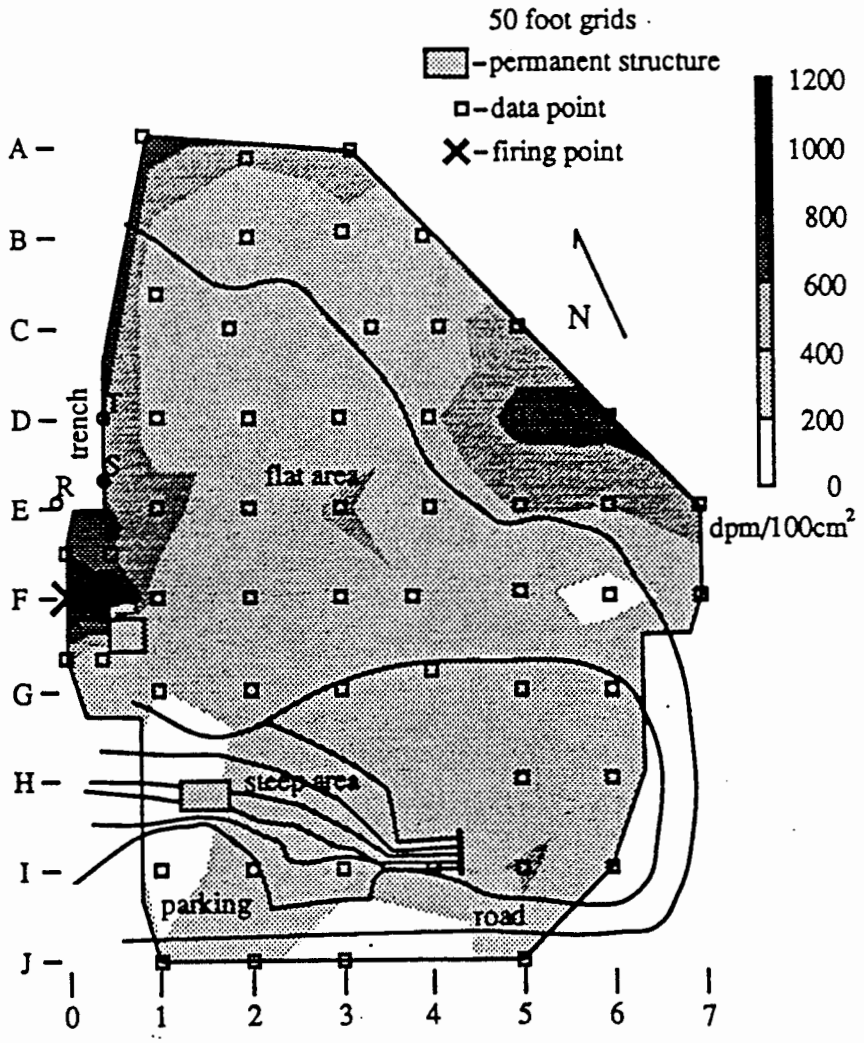


Figure 4 LRAD Monitoring at PHERMEX Site

The data shows lack of heavy contamination near the firing site. This is due to the extensive removal of contaminated soil after each shot, leaving the area adjacent to the firing point less contaminated than further away. There is one hot spot at PHERMEX where the detector saw very elevated readings, the level being about 10,000dpm/100cm^2 which coincides with the firing point. This point was not included in the interpolation of the data since the contamination is from a point source and not uniform soil distribution. There is contamination along the northern border of the monitored area where vegetation is present, showing the limits of post shot clearance. There is no clear radial distribution, due to the soil removal after the shots.

ECTOR

Ector has been used from the mid-1980s to the present time for dynamic radiography of explosion driven weapons components in a similar manner to PHERMEXbut not as extensively. After larger tests, the dirt nearest the firing point is removed and "clean" soil fill is put in its place. This is done to keep the soil contamination levels around the firing point at or near background. The site is approximately 250 feet by 150 feet with terrain varying from flat with no vegetation near the firing point to broken with heavy vegetation around the western and southern perimeters. The data collected is shown in Figure 5.

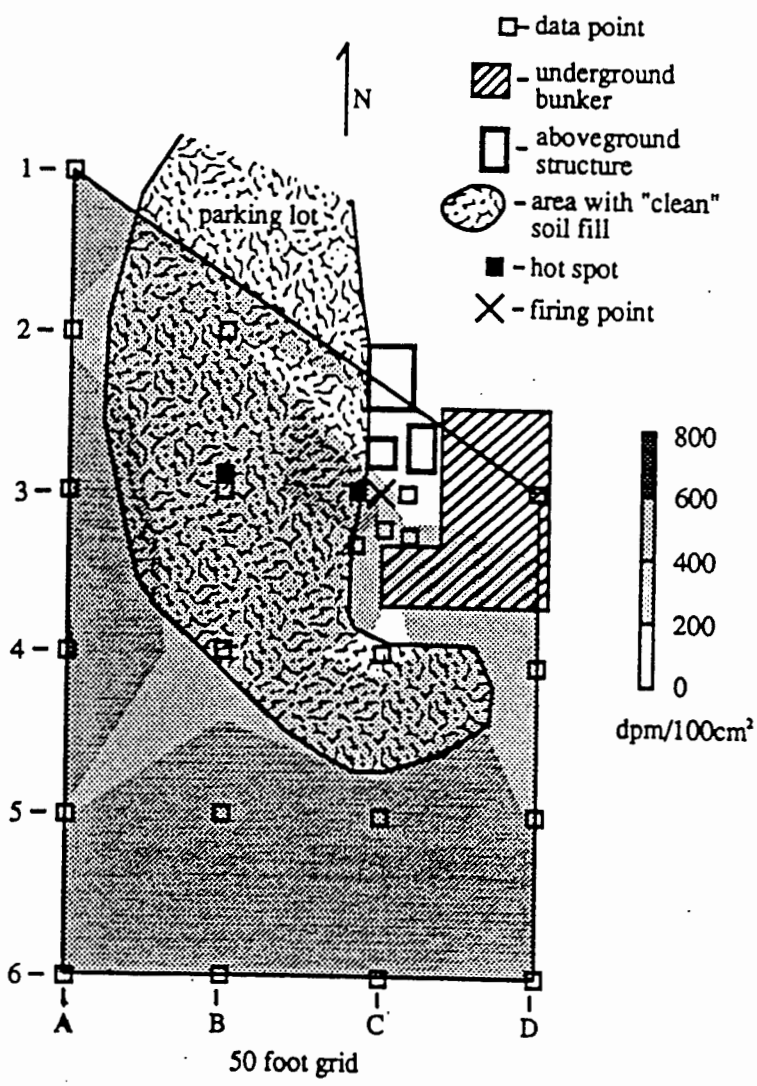


Figure 5 LRAD Monitoring at Ector Site

As can be seen in Figure 5, there are several spots which were considerably more contaminated than the surrounding soil. These isolated spots were not included in the interpolation because, if they were, unrealistically high levels of contamination would be found. As expected the imported soil is at or near background levels. The boundary between the indigenous and fresh soil was drawn before the data was collected but follows the edge of the hot zone well. Two hot spots were found; the one adjacent to the firing site gave a reading of 600dpm/100cm^2 and the one due west of the firing site was caused by a lump of uranium embedded in the soil surface (1150dpm/100cm^2).

Inactive Firing Sites

FIRING SITE E-F

Firing site E-F is now inactive but was the most extensively used firing site at Los Alamos, both in terms of length of active use (1947 - 1981) and the size of the individual explosions (up to 2500 lb). Initially, natural uranium was used but after 1957,was replaced by depleted uranium. In totality about 43,000 kg of natural uranium and 20,000 kg of depleted uranium were utilized here. Most of this uranium is thought to be still located in the soil since the main pathways for uranium to be removed (aerosolization and hydrologic runoff) are fairly minor. Because the sizes of the shots were so much bigger than at any other site, the size of the area potentially contaminated is much greater 800,000 ft^2 and therefore a larger area was surveyed. The results are shown in Figure 6.

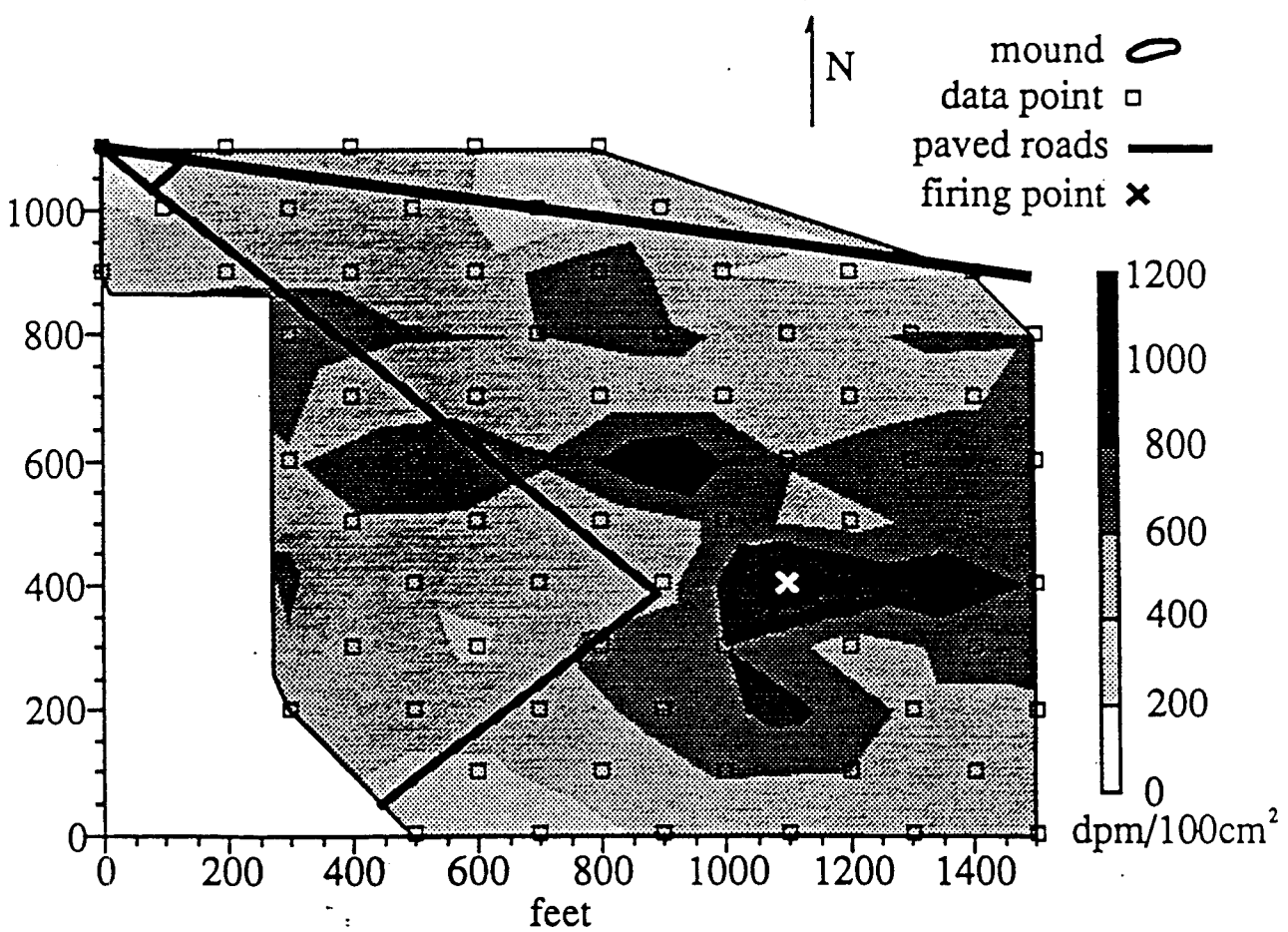


Figure 6 LRAD Monitoring at E-F Site

The results clearly show much higher activity than at the active sites, despite the time the area has been left to weather. Apparently there has been little migration of uranium, although the area to the north west shows elevated uranium due to a shallow drainage ditch. The relative high and constant values are confirmed by soil samples taken from this drainage channel where the values of uranium concentration have been found to be 6495.4 ppm (s.d.= 2839.4). [4] The firing point has mounds of earth to the north and south resulting in lower contamination immediately to the north and south. Little contamination reaches the canyon edge to the south, due to the barrier mound between the edge and the firing point.

FIRING SITE R-44

The second inactive firing site to be surveyed is located at the area designated R-44. This firing site was built in 1951 and was used extensively from 1956 to 1978 for diagnostic tests for weapons components. Approximately 7000 kg of depleted uranium were consumed here. Since the two currently active sites were put into operation R-44 has only been used for small experiments. This area is approximately 600 ft from the canyon wall so after each shot the debris were pushed to the edge of the canyon and some fell down the canyon wall. It is considerably smaller than the E-F site (6000 ft^2 versus 800,000 ft^2). The data is shown in Figure 7.

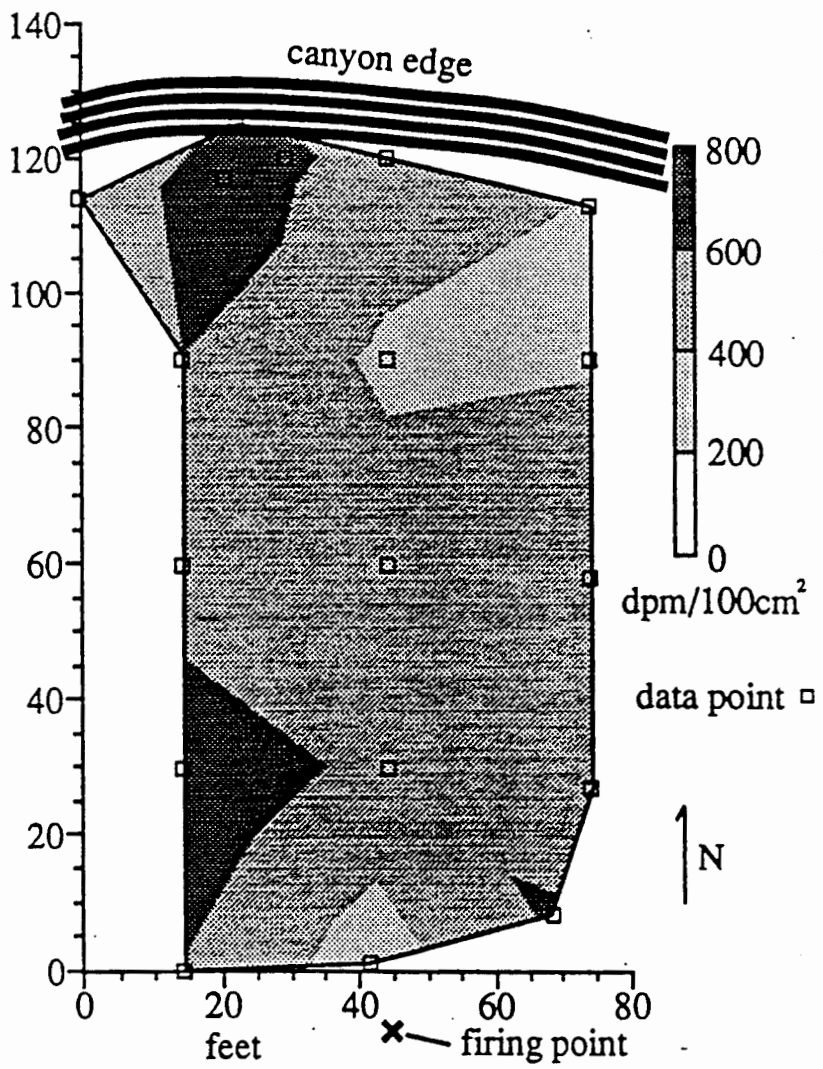


Figure 7 LRAD Monitoring at R-44

R-44 shows patterns more similar to Ector and PHERMEX than to E-F site, reflecting the smaller shots. The area immediately adjacent to the firing site has low alpha readings since the earth was pushed to the canyon edge and into the canyon. Yellow lumps of uranium (yellow cake) were seen on the surface but readings were not taken over them.

Minimally Used Firing Site

TA-40, CHAMBER 4

The area known as TA-40, Chamber 4 is a small blasting area, (7000 ft^2) designed to handle up to 25 lb of high explosive. There are reports of very limited uranium use in the distant past. The chamber is on an outcropping of a canyon wall, with the southern edge dropping off into the canyon. The soil is a sand/gravel mixture that does not appear to have been there before the existence of the site. The results are shown in Figure 8.

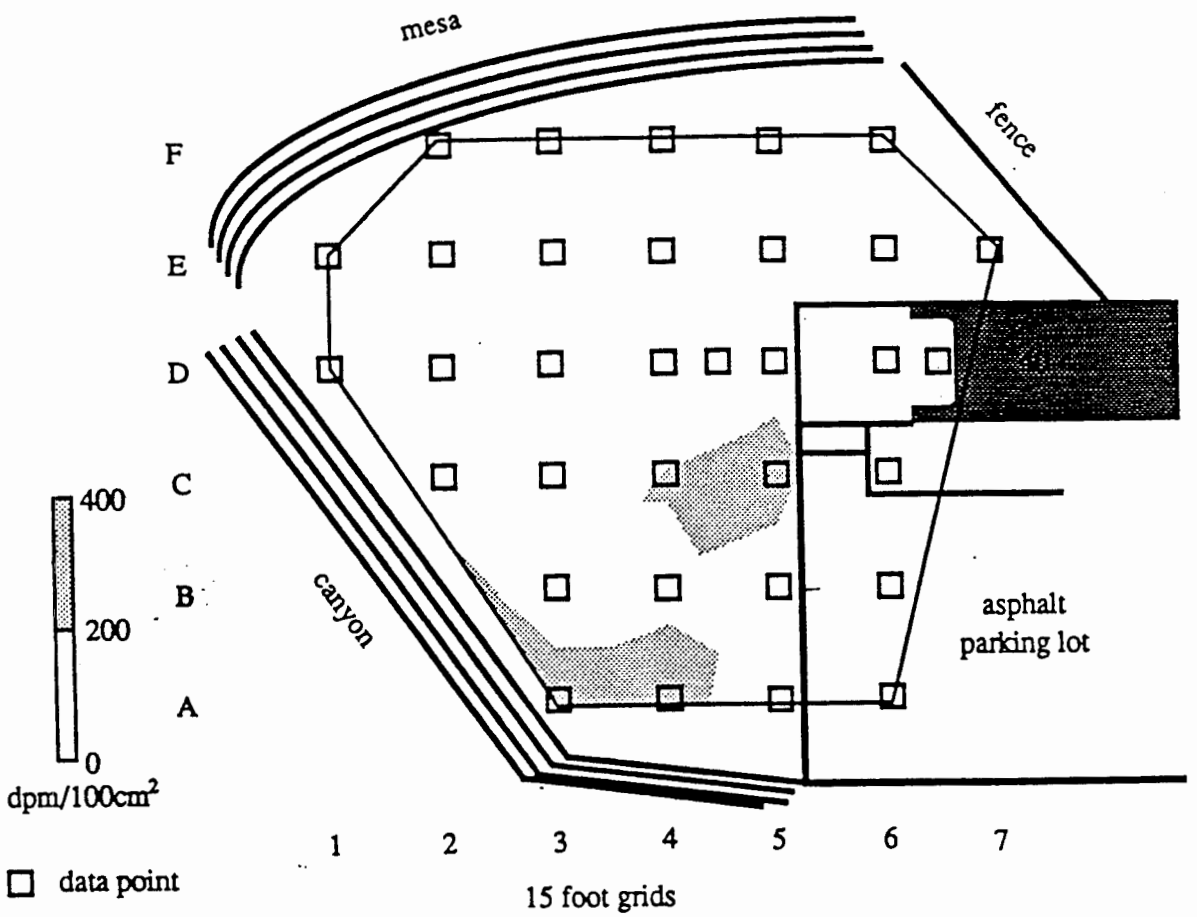


Figure 8 LRAD Monitoring at TA-40, Chamber 4

Chamber 4 although used for explosive tests has probably never been used with uranium with the possible exception of a few small shots many years ago. This is supported by the low contamination (at or below background of about 200dpm/100cm^2) measured at every data point at this site. The detector measured lower levels of alpha activity on asphalt than on the normal soil background, which is in keeping with results from other sites.

COMPARISON OF DATA.

Comparison between the active and inactive sites shows clearly the effectiveness of post shot clearing. None of the sites show radial distribution of alpha activity due either to post shot clearing and/or weathering. At E-F the higher alpha levels in the north-east follow the drainage channels and show there is some hydrologic draining away of uranium. At the other sites the overall levels of contamination and the intermittent cleaning operations result in low activity and indistinguishable drainage pathways . All the sites exhibit "hot spots" due to large pieces of depleted uranium which may skew the calculation of the overall soil contamination.

CONCLUSIONS AND FUTURE DIRECTIONS

Examination of the data show low levels of contamination at all four sites and remarkably little effects of aging and weathering at the two inactive sites which have not been used for twenty years. Post-shot clearing of the experimental areas has been effective at removing alpha contamination sources.

In the summer of 1994, extensive soil sampling will be undertaken at E-F site and R-44 to further define the extent (both surface and subsurface) of contamination and to prepare for remediation.

ACKNOWLEDGMENTS

Data from PHERMEX and Ector used by kind permission of Peter Veverka, HS-1. Funding provided by the Environmental Restoration Program, DOE/EM-40.

REFERENCES

1. D. W. MACARTHUR, K. S. ALLANDER, J. A. BOUNDS, M. M. CATLETT, J. L. MCATEE, "Long-Range Alpha Detector (LRAD) for Contamination Monitoring", IEEE Transactions on Nuclear Science, Vol. 39, No. 4, p. 952-957 (1992).

2. D. W. MACARTHUR, K. S. ALLANDER, J. A. BOUNDS, R. W. CARESS, M. M. CATLETT, D. A. RUTHERFORD, "LRAD Surface Monitors", LA-12524-MS (February 1993).

3. A. E. FRITZSCHE, "An Aerial Radiological Survey of Technical Area 15 and Surroundings, Los Alamos National Laboratory", EGG-10282-1095 (September 1984).

4. M. H. EBINGER, "E-F-Site Soil Samples", Internal LANL memo,(October 21 1993).

1-4-85

TO: FIRING SITE PROJECT FILE

FROM: E.J. COKAL AND JOHN RODGERS

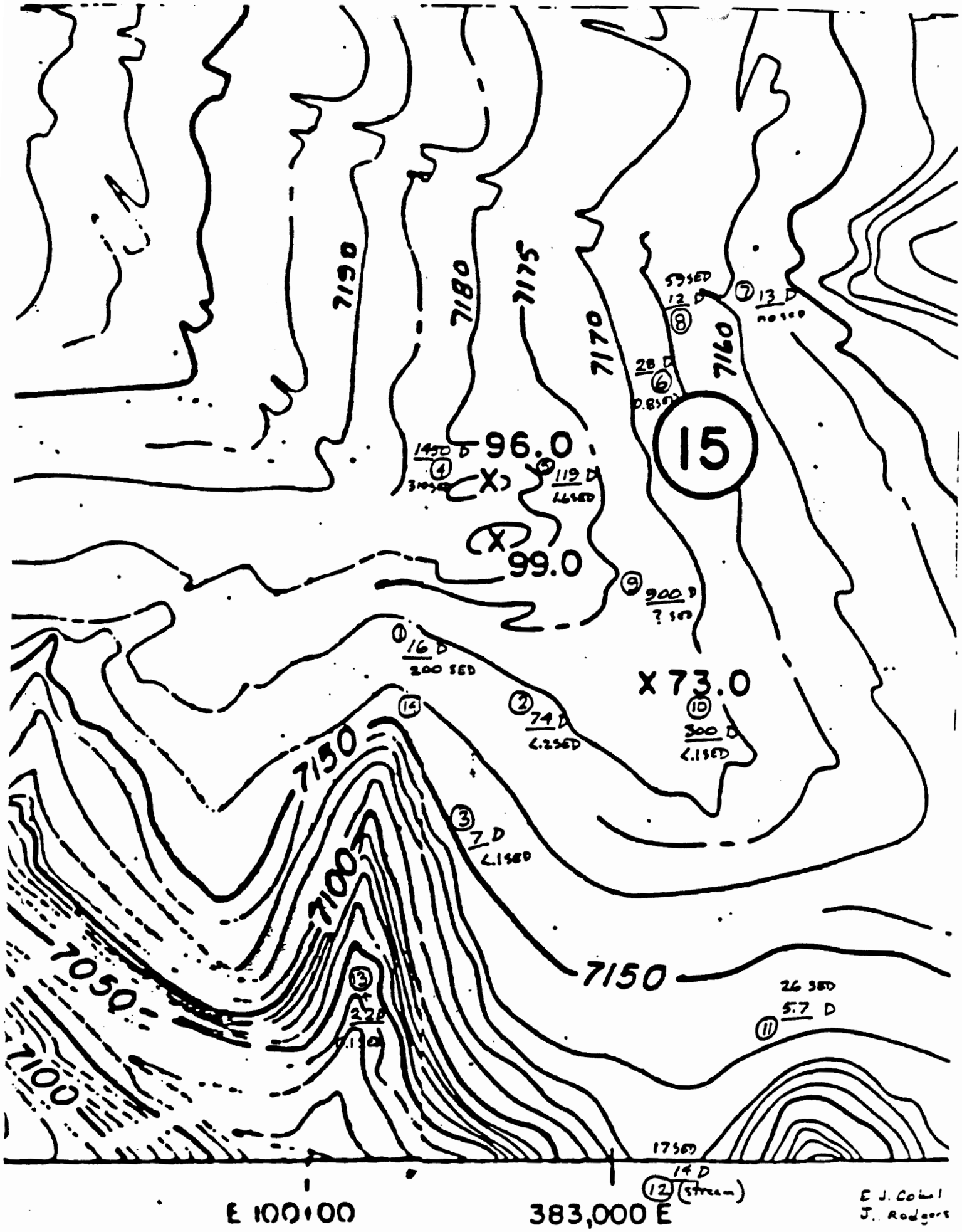
SUBJECT: URANIUM IN E-F SITE WATER SAMPLES COLLECTED 4 MARCH 1985

On the afternoon of March 4, 1985, thirteen water samples and one snow sample were collected from the area surrounding the E-F firing point. The intent was to establish (roughly) the amounts of soluble and suspended (presumably colloidal and adsorbed) uranium present in ponded snowmelt and surface runoff from the site. The ambient temperature was slightly above freezing. The soil was found to be frozen below a depth of approximately 10-15 cm; the soil above the frost level was saturated with meltwater. The soil surface was approximately 80% free of snow cover, and the remaining snow was actively melting to yield noticable surface runoff. Because of the soil saturation, numerous small surface ponds (up to ca. 3 cm depth) were present.

The samples were collected by decantation from the upper layers of water, but without any rigorous attempt to exclude sediment. The intention was to separate the water from the suspended colloidal material, and analyze the fractions separately. The samples were thus collected in 50 ml conventional polyethylene centrifuge tubes, capped, and transported back to the laboratory.

On the morning of 5 March, the samples were filtered through 0.4 micron Nucleopore membrane filters in all-plastic filter apparatus. The water fractions were then acidified with 1 ml of sub-boiling distilled nitric acid, and returned to the centrifuge tubes for storage. The sediment fractions were dissolved in the sub-boiling nitric acid and Ultrex hydrofluoric acid, and restored to volumes equal to the original water volume collected. In this way, the colloidal silica (apparently coated with hydrous iron oxide) was dissolved to yield the adsorbed heavy metals, while the coarse sediment consisting of tuff particles was left largely intact.

The dissolved uranium was determined by evaporating a 5 ml aliquot of each solution with 0.5 ml of uranium-free phosphoric acid, to remove chloride and destroy organic matter. The resulting clear globule of phosphoric acid was then diluted with 5 ml of reagent water to restore the original concentration. The concentration of uranium was then determined fluorimetrically using the Scintrex UA-3 fluorimeter. The standard addition technique was used to ensure that no fluoresence quenching interference occured. In all cases involving the water phase samples, no interferences were noted and the full spike recovery was obtained. The dissolved sediments contained some residual quenchers, but the measurements were completed satisfactorily.



SOLUBLE URANIUM SURFACE WATER SAMPLE LOCATIONS 4 MARCH 3[illegible]

TABLE V

NEW MEXICO GROUND WATER STANDARDS

A - Standards for Human Health

Constituent	Symbol	Allowed Concentration	
Arsenic	As	.1	mg/l
Barium	Ba	1.0	mg/l
Cadmium	Cd	.01	mg/l
Chromium	Cr	.05	mg/l
Cyanide	CN	.2	mg/l
Fluoride	F	1.6	mg/l
Lead	Pb	.05	mg/l
Mercury	Hg (total)	.002	mg/l
Nitrate (as Nitrogen)	NO_3 as N	10.0	mg/l
Selenium	Se	.05	mg/l
Silver	Ag	.05	mg/l
Uranium	U	5.0	mg/l
Radium	Ra-226 plus Ra-228	30.0	pCi/l

B - Other Standards for Domestic Water Supply

Constituent	Symbol	Allowed Concentration	
Chloride	Cl	250	mg/l
Copper	Cu	1.0	mg/l
Iron	Fe	1.0	mg/l
Manganese	Mn	.2	mg/l
Phenols		.005	mg/l
Sulfate	SO_4	600	mg/l
Total Dissolved Solids	TDS	1000	mg/l
Zinc	Zn	10	mg/l
	pH	between 6 and 9	

C - Standards for Irrigation

Constituent	Symbol	Allowed Concentration	
Aluminum	Al	5	mg/l
Boron	B	.75	mg/l
Cobalt	Co	.05	mg/l
Molybdenum	Mo	1.0	mg/l
Nickel	Ni	.2	mg/l

TO: FIRING SITE PROJECT FILE 11 March 1985

FROM: E.J. COKAL AND JOHN RODGERS

SUBJECT: BERYLLIUM IN E-F SITE WATER SAMPLES COLLECTED 4 MARCH 1985

Beryllium was determined in the solution and suspended matter fractions of the water samples collected 4 March from the E-F site and environs. Inductively coupled plasma spectrometry was used for these measurements. The detection limit for these measurements was approximately 1 ppb. As with the uranium measurements, the intent was to establish the order of magnitude of the concentration present, and no attempt was made to attain the ultimate in accuracy or precision.

The expected level of beryllium in U.S. drinking water supplies is in the range 0.01 to 0.7 ppb, according to U.S.P.H.S. water quality network data. It is expected from the chemistry of beryllium that the major part of any Be present should be adsorbed upon the solid phase associated with the water. This expectation was confirmed by our data.

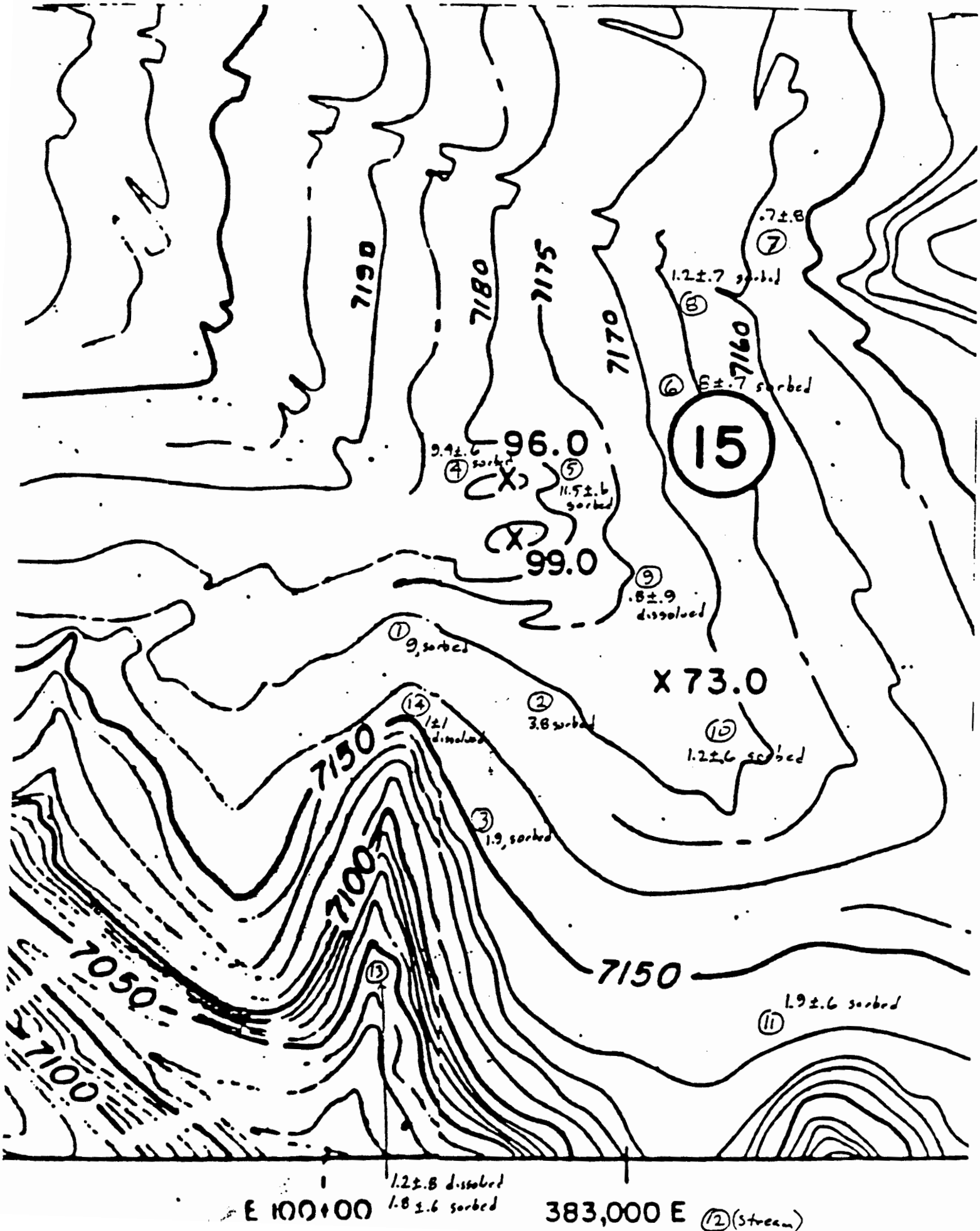
Beryllium is not listed among the U.S.P.H.S., WHO, EPA, or New Mexico Drinking Water Standard controlled elements. However, beryllium is known to be toxic to plants, and the National Academy of Sciences 1972 recommendation for limits of impurities in irrigation water is a maximum of 0.1 ppm (100 ppb) of beryllium. F.R. Robinson cites EPA aquatic life standards for Be in "Toxicology of Beryllium and Beryllium Containing Compounds" in BNL 51118 (1980). The standard is said to be 11 ppb in soft freshwater and 1100 ppb in hard fresh water. Reeves (in Drury et al,ORNL/EIS-87 (1978)) suggests that no biological effect should be apparent at the 100 ppb level, and proposes a standard of 50 ppb as providing an adequate margin of safety. Thus, no evidence is at hand to indicate that beryllium in the samples tested is of present environmental concern. For a recent review of the environmental quality aspects of beryllium, consult D.R. Dreesen's 1984 review of the subject. (Los Alamos report, draft available at this writing.)

The data for the samples collected on 4 March are tabulated on the following page.

E-F SITE SURFACE WATER SAMPLES COLLECTED 4 MARCH 1985

SAMPLE	DESCRIPTION	Be (sol'n, ppb)	Be(sorbed,ppb)
#1,	Stake #1, channel	<1	9 +/- 3
#2	S Berm, channel	.8 +/- .8	3.8 +/-.6
#3	Snowmelt puddle	<1	1.9 +/-.6
#4	Standing water	<2	9.4 +/-.6
#5	Standing Water	<1	11.5 +/-.6
#6	Standing Water	<1	8 +/-.7
#7	Stream, top of arroyo	.7 +/-.8	
#8	W. of road, standing	.7 +/-.9	1.2 +/-.7
#9	Standing Water	.8 +/-.9	
#10	Standing Water	<1	1.2 +/-.6
#11	Rock depression	<2	1.9 +/-.6
#12	Flowing stream, Potrillo C.	1 +/- 1	1.3 +/-.6
#13	Confluence, side arroyo	1.2+/-.8	1.8 +/-.6
#14	Snow, in shade	1 +/- 1	

Sample analyses by Ellen A. Stallings, 7 March 1985. E.J.C.


7190
7180
7175
7170
7160
7150
7100
7050
7100
7150
15
96.0
99.0
X 73.0
.7±.8
7
1.2±.7 sorbed
8
6
8±.7 sorbed
9.4±.6
4 sorbed
5
11.5±.6 sorbed
9
.8±.9 dissolved
1
9, sorbed
2
3.8 sorbed
14
1±1 dissolved
10
1.2±.6 sorbed
3
1.9, sorbed
13
1.9±.6 sorbed
11
1.2±.8 dissolved
1.8±.6 sorbed
E 100+00
383,000 E
12 (Stream)

TO: FIRING SITE PROJECT FILE 18 March 85

FROM: E.J. COKAL AND JOHN RODGERS

SUBJECT: LEAD IN E-F SITE SURFACE WATER COLLECTED 4 MARCH 85

Lead was measured in the dissolved and suspended sediment fractions of the surface waters collected on March 4, 1985. The measurements were done by graphite furnace atomic absorption spectrophotometry using the standard addition technique.

The dissolved, or "less than 0.2 micron" fraction was less than 5 ppb in all cases. No evidence was obtained that soluble lead is present in the waters. On the other hand, the suspended sediment fraction contained lead in measurable amounts, in some cases exceeding the accepted drinking water standards for this element.

These facts are in accord with the known adsorption behavior of lead in natural waters containing sediments, and in the vicinity of pH = 8, as is the present case. Lead is known to be strongly adsorbed to sediments above pH = 6. For reference, consult Schindler et al., J. Colloid and Interfacial Science 55, 469 (1976).

There is general agreement among water quality standards organizations that 0.05 ppm (50 ppb) consitutes the acceptable upper limit for lead in potable water. The corresponding National Academy of Science Irrigation Water Standard is 5 ppm. Thus, waters too contaminated for direct human use are still acceptable from an agricultural standpoint. Lead may be found in contaminated soils at levels of approximately 35 ppm.

Land plants contain lead in the range $1<Pb<13$ ppm. Lichens are lead accumulators. Waters containing lead in the range $3<Pb<20$ ppm are considered toxic to plants.

LEAD IN E-F SITE SURFACE WATER SAMPLES COLLECTED 4 MARCH

SAMPLE DESCRIPTION	Pb, ppb IN SEDIMENT
#1, Stake 1, channel	71+/-20
#2 S berm, channel	66+/-30
#3 Snowmelt puddle	51+/-14
#4 Standing Water	144+/-32
#5 Standing Water	255+/-41
#6 Standing Water	132+/-26
#7 Stream, top of arroyo	no sediment
#8 W. of road, standing	79+/-46
#9 Standing water	contam. with soil
#10 Standing water	19+/-12
#11 Rock depression	19+/-5
#12 Flowing stream, Potrillo Canyon	14+/-9
#13 Confluence, side arroyo	18+/-12
#14 Snow, in shade	no sediment

Sample analyses by Ellen Stallings. E.J.C.