

CIMARRON CORPORATION

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June 21, 1995

S. JESS LARSEN
VICE PRESIDENT

Mr. Michael F. Weber
Chief, Low-Level Waste and Decommissioning
Projects Branch
Division of Waste Management
Office of Nuclear Material Safety and Safeguards
United States Nuclear Regulatory Commission
Washington, D.C. 20555-0001

Re: Docket No. 70-0295
License No. SNM-928
South Uranium Yard Decontamination
May 31, 1995 letter from Mr. Michael F. Weber to Mr. Jess Larsen

Dear Mr. Weber:

The purpose of this letter is to provide responses to the two issues identified in the above-referenced letter. The two issues were raised as a result of the April 24 and 25, 1995 ORISE confirmatory survey of the south uranium yard area located on the Cimarron site.

The enclosed attachment lists the two issues as they appear in the above-referenced letter followed by the Cimarron Corporation responses.

Please feel free to contact Joe Kegin at 405/282-6722 or me at 405/270-2288 if there are any additional questions or concerns.

Sincerely,



Jess Larsen
Vice-President

enclosure

NRC Comment #1: First, the ORISE borehole sample from location #1 (see Enclosure 1), at the 0-15 cm depth, indicated a total uranium concentration of 38.4 pCi/g. Since 38.4 pCi/g exceeds the enriched uranium limit of 30 pCi/g, additional samples should be collected to determine compliance with the hot-spot limit using the procedure that was applied in the November 1994 "Report on the South Yard Remediation at the Cimarron Facility," (South Yard Report). NRC believes that it would be more efficient for Kerr-McGee to collect and analyze the additional samples as opposed to sending ORISE back to the Cimarron site to perform the work. The results of the additional samples should be submitted to NRC.

Response: Cimarron has performed additional gamma scans of the area surrounding the 38.4 pCi/g hot-spot identified by ORISE. These scans were performed using a 3" x 0.5" lead shielded sodium iodide detector. The surface gamma scan indicated that the area of the hot-spot was defined by a 3m x 3m boundary for a total of 9m². The 38.4 pCi/g hot-spot area and the 100m² area used to determine compliance with the NUREG/CR-5849 hot-spot averaging criteria are shown in Figure 1.

Based on the surrounding gamma scans, Cimarron Corporation believes that additional soil samples from this area are not justified. The existing areal concentration data generated during characterization activities represents current concentrations of total uranium in soil. The sample data from locations surrounding the ORISE identified hot-spot are presented below in relation to the location sampled.

Location	Total U Concentration (pCi/g)
85E-55N	16
85E-60N	9
85E-65N	27
90E-55N	23
90E-60N	15
90E-65N	10
95E-55N	9
95E-60N	25
95E-65N	18
93E-65N	14
Total	166
Average	16.6

The 100m² area containing the 38.4 pCi/g hot-spot was evaluated based upon the criteria in NUREG/CR-5849. The hot-spot is less than three times the soil guideline value of 30 pCi/g total uranium. In addition, the calculation presented below shows that the average concentration is less than (100/A)^{1/2} times the guideline value of 30 pCi/g.

$$38.4 \text{ pCi/g} < (30) (100/A)^{1/2} = (30) (100/9)^{1/2} = 100 \text{ pCi/g}$$

CRITERIA SATISFIED

The average activity in the 100m² contiguous area containing the hot-spot was also determined. NUREG/CR-5849 specifies that the average activity in the 100m² area must be less than or equal to the guideline value (≤ 30 pCi/g). This calculation is performed using the ORISE hot-spot data and the Cimarron characterization data.

$$\bar{x}_w = 16.6 [1 - (9/100)] + 38.4 [9/100] = 18.6 \text{ pCi/g}$$
$$18.6 \text{ pCi/g} \leq 30 \text{ pCi/g}$$

CRITERIA SATISFIED

All criteria in NUREG/CR-5849 have been satisfactorily met. Therefore, the hot-spot identified by ORISE will not affect the conclusion that the South Uranium Yard meets all release criteria.

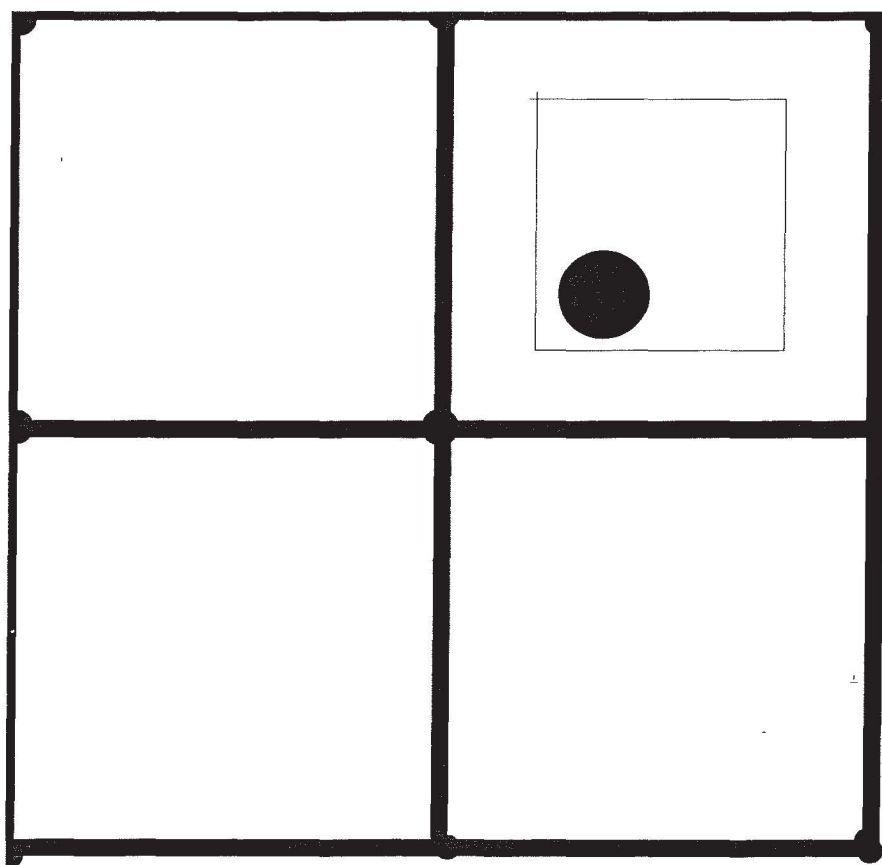
Figure 1

CIMARRON SOUTH U-YARD AREA

ORISE ELEVATED SAMPLE RESULTS
LOCATED AT 92E-62N
(38.4 pCi/g U)

85E-65N

95E-65N



85E-55N

95E-55N

NRC Comment #2: Second, during the confirmatory survey, ORISE collected six samples from the vicinity of the Cimarron site to assess background uranium concentrations. The ORISE results for background concentrations of total uranium range from 0.80 to 1.86 pCi/g. These values differ from the background concentration of 6 pCi/g total uranium reported in the South Yard Report (page 4). Please provide an explanation for this apparent discrepancy.

Response:

CIMARRON SITE BACKGROUND

Introduction

The Cimarron soil counter was designed in 1985 for use in the sorting of enriched uranium at concentrations of greater than 30 pCi/g (Option #2) from soils containing lower concentrations. This counting system uses a 4" by 4" by 16" NaI detector and a computer based multi-channel analysis system with spectrum analysis software. **The soil counter assumes an enrichment of 2.7 weight percent U-235, which has been established as the average enrichment for uranium in soils at Cimarron.** The soil counter efficiency is based upon the utilization of standards with activities ranging from background levels to approximately 300 pCi/g total uranium. All standards, as well as samples analyzed, have a mass of approximately 750 grams. The initial use of the Cimarron soil counter was for the segregation of soils greater than Option #1 (> 30 pCi/g) above background. This application was performed using a sample counting time of 5 minutes. The a priori minimum detectable concentration (i.e., per draft NUREG/CR-5849 equation 5-4) for the soil counter, based on a 5 minute count time, is approximately 10 pCi/g total uranium.

Numerous areas of the Cimarron Facility have been released using this counting system with confirmation from outside independent laboratories, including Oak Ridge Institute for Science and Education (ORISE, previously known as ORAU) and the Nuclear Regulatory Commission (NRC).

The Cimarron soil counter has recently been used for the purpose of determining concentrations of total uranium in unaffected areas of the site. Due to the lower concentrations of total uranium expected in unaffected areas, a 30 minute counting time for soil samples was selected to lower the a priori minimum detectable concentration to approximately 4 pCi/g.

Background soil samples have been collected and analyzed by Cimarron on the soil counter. In addition, ORISE has reported the results of background samples collected as part of their confirmatory process on behalf of the NRC. The data from these evaluations is presented below. In addition, recommendations and conclusions are presented regarding appropriate uses of background as it applies to release of areas within the Cimarron site, while also considering materials with total uranium concentrations greater than Option #1 (> 30 pCi/g).

Data Presentation and Evaluation

ORAU prepared a report, "Confirmatory Radiological Survey Former Burial Ground Cimarron Corporation Facility Crescent, Oklahoma, July, 1992", which included analysis of six background soil samples collected near the Cimarron facility. The sampling locations are shown in Figure 1. Table 1 summarizes the total uranium data from the ORAU report. Total uranium in the six background soil samples ranged from less than 1.2 pCi/g to 2.0 pCi/g, based upon calculations performed using the gamma spectroscopy data. The average concentration for the samples, assuming that the actual concentration for the two reported "less than" values are equal to the maximum possible values, was reported as 1.6 pCi/g.

In May, 1995, ORISE collected and analyzed an additional six off-site background samples at NRC request. Samples were analyzed by alpha pulse height analysis. Preliminary results from these samples are presented in Table 2. Total uranium results were calculated by summing the U-234, U-235, and U-238 results. Concentrations of total uranium ranged from $0.80 \pm 0.15(2\sigma)$ pCi/g to $1.86 \pm 0.23(2\sigma)$ pCi/g. The average total uranium concentration for the six samples was $1.33 \pm 0.84(2\sigma)$ pCi/g.

Cimarron personnel collected 30 site background surface soil samples from the perimeter of the Cimarron site during the first quarter of 1995. Figure 2 shows the sample locations. Locations were selected along the east and west boundaries as the prevailing wind directions at the facility are from the south, southeast, and the north. Sample results are presented in Table 3. Column B presents the five minute count data for the 30 samples. **Total uranium results for the 5 minute counts ranged from 2 pCi/g to 10 pCi/g, with an average of $6.7 \pm 3.5(2\sigma)$ pCi/g.** The 5 minute counting data are biased high due to several factors. The on-site soil counter reports certain results as "less than" a certain value. When "less than" values are reported by the counting system, the concentration of total uranium is calculated based upon the assumption that the sample contains uranium activity at the maximum possible concentration. Additionally, the reported concentrations assume an enrichment of 2.7 weight percent U-235, which results in an overestimate for total uranium in soil samples in which the actual U-235 enrichment is less than 2.7%.

NOTE: For samples at natural enrichment, this overestimate is equal to the factor 2.2, which is equal to the activity ratio of enriched uranium to natural uranium (i.e., $1.5 \text{ pCi}/\mu\text{g} \div 0.67 \text{ pCi}/\mu\text{g}$). However, the Cimarron soil counter provides results in terms of enriched uranium in order to provide a conservative estimate of soil sample activity.

Past remediation activities at the Cimarron facility have focused mainly upon the affected areas of the facility. More recent activities have involved the characterization of unaffected areas containing lower concentrations of total uranium in soil. Cimarron Corporation elected to increase the soil sample counting time to 30 minutes for samples collected in unaffected areas in order to lower the a priori minimum detectable concentration (MDC) for 2.7% enriched total

uranium to approximately 4 pCi/g. As demonstrated below, this MDC is consistent with total uranium in average background soils.

Column C of Table 3 provides results from 30 minute counts of 28 of the perimeter background soil samples. These results also assume an enrichment of 2.7 weight percent. **Total uranium ranged from 2.3 pCi/g to 6.6 pCi/g, with an average of $4.0 \pm 2.6(2\sigma)$ pCi/g.** Column D applies the correction factor of 0.67/1.5 to the Column C data, to provide results in terms of naturally enriched uranium. **Column D results range from 1.0 pCi/g to 2.9 pCi/g, with an average of $1.8 \pm 1.0(2\sigma)$ pCi/g.**

NOTE: The Cimarron soil counter results compare favorably to ORISE/ORAU results when corrections for enrichment are applied to the data.

The draft NUREG/CR-5849 provides criteria to be used in evaluation of the adequacy of background data relative to the guideline value. NUREG/CR-5849 states in section 8.6, "For the purposes of this Manual, the background has been considered to be insignificant if it is <10% of the guideline, although the licensee may use such background levels in determining net residual activity...".

NOTE: The average total uranium background [$1.8 \pm 1.0(2\sigma)$ pCi/g] is less than 10 percent of the guideline value for Option #1 material (30 pCi/g). Therefore, it can be stated that the average background is "insignificant" with respect to the Option #1 guideline value, in accordance with NUREG/CR-5849.

Based upon the measurements of background soils performed on the Cimarron soil counter, it can be stated that measurements of background soils should fall below 2.8 pCi/g 95% of the time, when results are reported in terms of natural enrichment. This concentration represents the upper 95 percent confidence interval for total uranium (naturally enriched) for the 28 background samples. The above statement can be interpreted with respect to Cimarron soil counter results reported in terms of 2.7% enriched activity. The conversion factor 1.5/0.67 can be applied to the upper 95 percent concentration interval value. **Application of the conversion factor results in a total uranium concentration of 6.2 pCi/g. This concentration represents the upper 95% confidence interval for total uranium in background soil samples reported as 2.7% enriched.**

Conclusions

Background samples were collected for the purpose of documenting the site background. Five minute counts of these samples on the Cimarron soil counter ranged from 2 pCi/g to 10 pCi/g total uranium, with an average of $6.7 \pm 3.5(2\sigma)$ pCi/g. These data are known to be biased high

due to the reporting of "less than" values at the maximum possible concentration and the assumption that the uranium is enriched at 2.7 weight percent.

Twenty eight of the 30 background soil samples were analyzed for a 30 minute counting time to achieve more accurate results. Total uranium concentration in the 28 samples ranged from 2.3 pCi/g to 6.6 pCi/g, with an average of $4.0 \pm 2.6(2\sigma)$ pCi/g. These results also assumed that the uranium was present at an enrichment of 2.7 percent.

A conversion factor was applied to the 30 minute background count data to obtain results in terms of natural enriched activity. The background concentration for total uranium in soil was calculated as $1.8 \pm 1.0(2\sigma)$ pCi/g. This value is in agreement with prior measurements reported by ORAU and ORISE. Cimarron has also established the upper 95% confidence interval for total uranium in background soils as 2.8 pCi/g.

Calculations presented above show that naturally occurring uranium activity will affect the results reported by the Cimarron soil counter. **The upper 95% confidence interval for background soil analyzed using the Cimarron soil counter is 6.2 pCi/g total uranium (assuming 2.7 % enrichment), which equates to 2.8 pCi/g natural uranium.** Therefore, samples with reported activity exceeding 6.2 pCi/g should contain activity due to naturally occurring uranium only 5% of the time.

Table 1

**Background Concentrations of Total Uranium in Soil
Former Burial Ground
Cimarron Corporation Facility
Crescent, Oklahoma**

Location	Total U (pCi/g)
1	1.5
2	1.3
3	<1.7
4	2.0
5	1.9
6	<1.2
Average	1.6

- Notes: 1) Refer to Figure 1 for sample locations.
2) Results based on gamma spectrometry analysis.
3) Results calculated based on natural activity ratios.

Reference: Confirmatory Radiological Survey Former Burial Ground Cimarron Corporation Facility Crescent, Oklahoma, B. M. Smith, Oak Ridge Associated Universities, Environmental Survey and Site Assessment Program, Report No. ORISE 92/G-57, July, 1992.

TABLE 2

**ISOTOPIC URANIUM CONCENTRATIONS
IN BACKGROUND SOIL SAMPLES
KERR-McGEE CORPORATION, CIMARRON FACILITY
CRESCENT, OKLAHOMA**

Location	Concentration (pCi/g)			
	U-238	U-235	U-234	Total U
1	0.41 ± 0.11	<0.07	0.55 ± 0.13	0.97 ± 0.18
2	0.38 ± 0.10	<0.08	0.42 ± 0.11	0.80 ± 0.15
3	0.49 ± 0.11	<0.07	0.57 ± 0.13	1.09 ± 0.18
4	0.79 ± 0.13	<0.06	0.90 ± 0.14	1.72 ± 0.19
5	0.90 ± 0.15	<0.11	0.91 ± 0.16	1.86 ± 0.23
6	0.71 ± 0.13	<0.06	0.59 ± 0.12	1.34 ± 0.19

- Notes: 1) Total Uranium calculated based on the sum of U-238, U-235, and U-234.
2) Uncertainties represent the 95% confidence level, based only on counting statistics.

Table 3

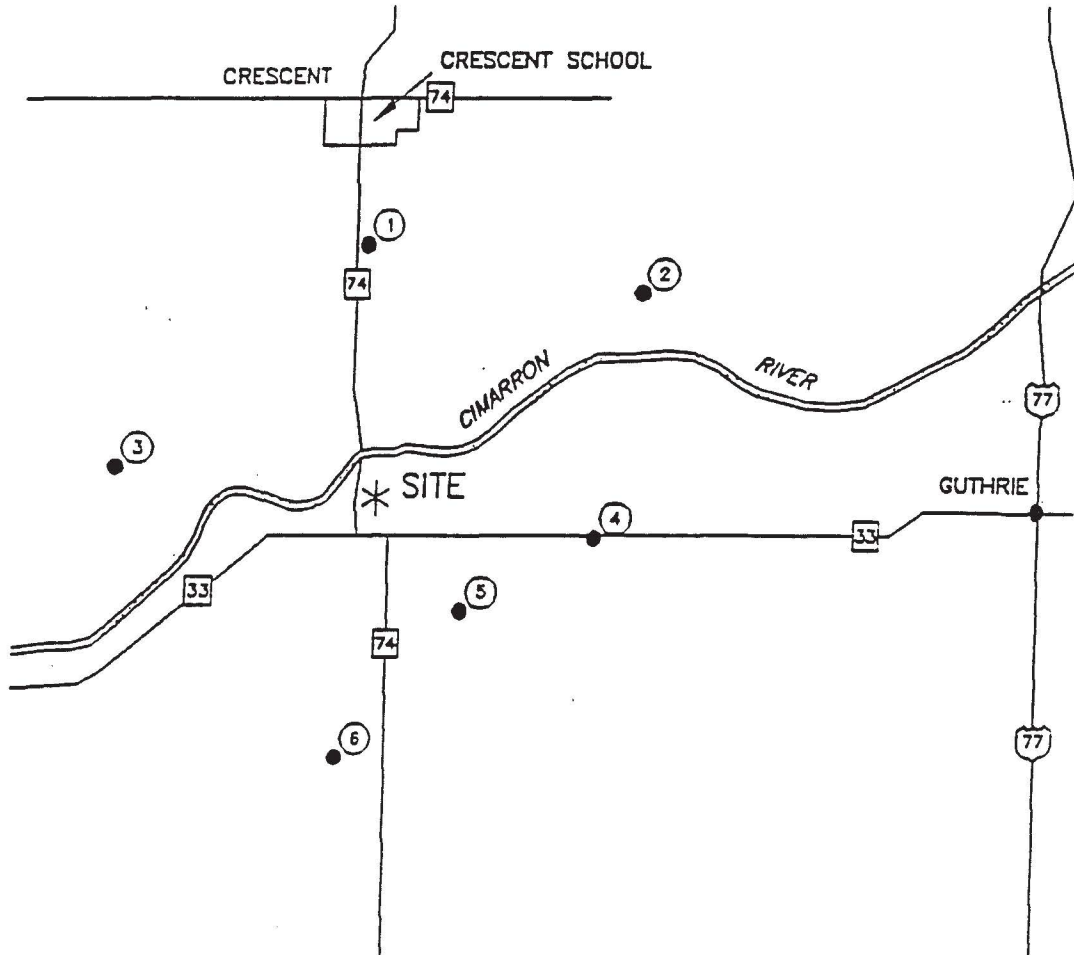
CIMARRON FACILITY BACKGROUND SOIL SAMPLE COUNTS

pCi/g Total U			
A UAF-BKG	B 5 MIN. COUNT <u>2.7% ENRICHED</u>	C 30 MIN. COUNT <u>2.7% ENRICHED</u>	D 30 MIN. COUNT <u>NATURAL ENRICHED</u>
1	7	6.3	2.8
2	8	-----NOT	ANALYZED-----
3	9	3.4	1.5
4	7	2.5	1.1
5	8	3.3	1.5
6	6	-----NOT	ANALYZED-----
7	7	2.3	1.0
8	5	2.8	1.3
9	7	3.2	1.4
10	6	3.4	1.5
11	2	3.0	1.3
12	5	3.3	1.5
13	7	5.0	2.2
14	7	4.3	1.9
15	4	6.1	2.7
16	9	4.7	2.1
17	10	6.0	2.7
18	9	4.4	2.0
19	6	3.6	1.6
20	8	6.6	2.9
21	8	4.8	2.1
22	5	3.2	1.4
23	6	2.3	1.0
24	4	2.9	1.3
25	7	3.3	1.5
26	6	2.3	1.0
27	5	4.5	2.0
28	7	4.3	1.9
29	8	5.9	2.6
30	7	4.8	2.1
AVERAGE	6.7 ± 3.5	4.0 ± 2.6	1.8 ± 1.0

NOTE: ERROR TERMS REPRESENT THE 95% CONFIDENCE INTERVAL.

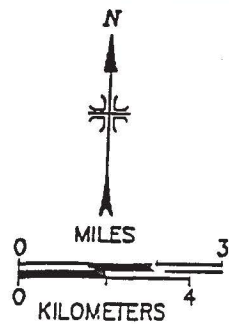
FIGURE 1

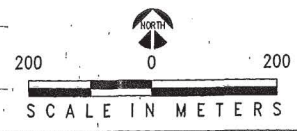
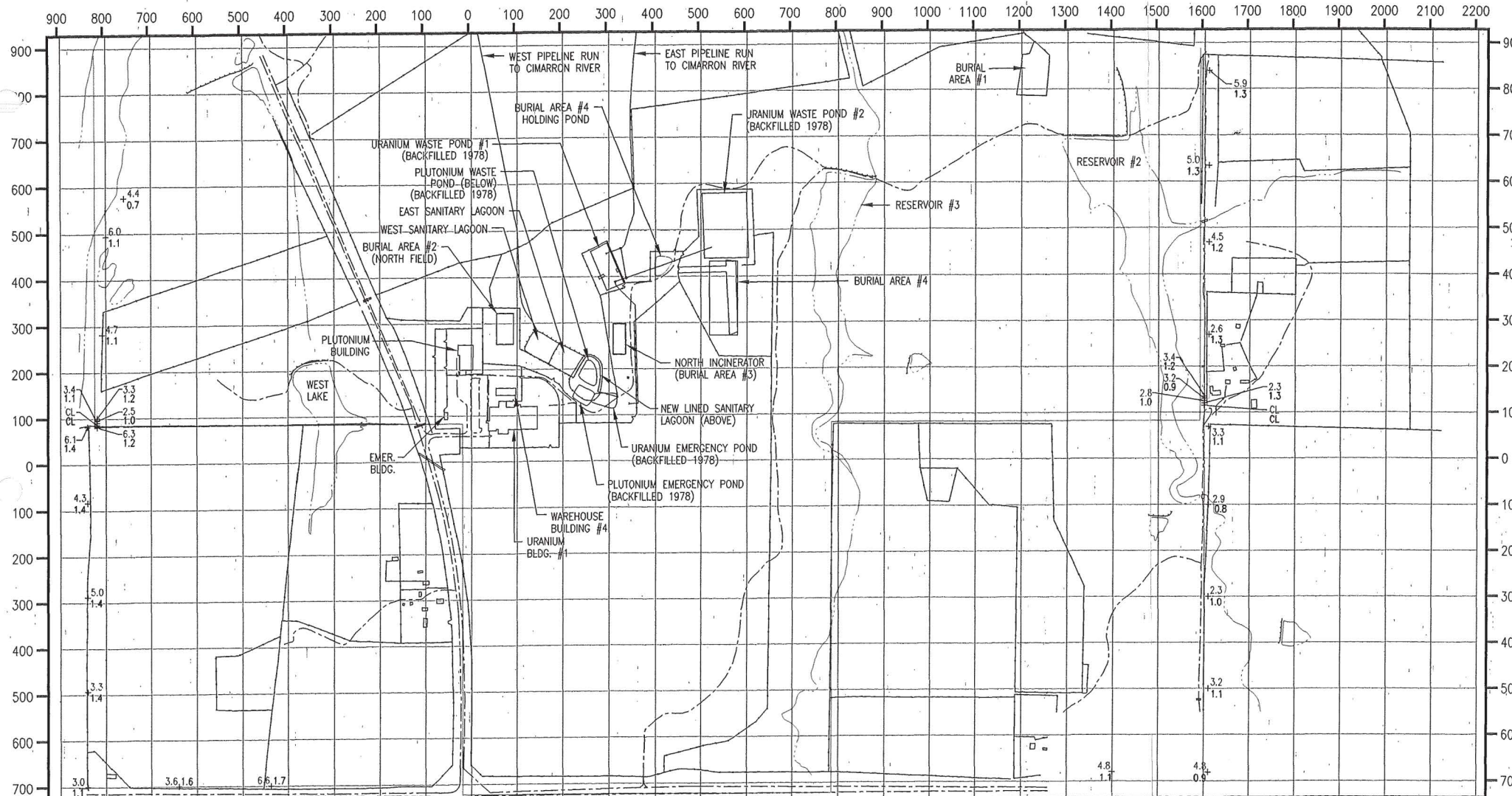
ORISE BACKGROUND SOIL SAMPLING LOCATIONS



MEASUREMENT/SAMPLING LOCATIONS

● # EXPOSURE RATE MEASUREMENT AND SOIL SAMPLE





SAMPLES ARE IN PICO-CURIES PER GRAM URANIUM (pCi/g U) AND THORIUM (pCi/g Th).
 CIMARRON GAMMA SPEC SOIL COUNTER.
 SITE SOIL BACKGROUND OF APPROX. 6 pCi/g U AND 1.5 pCi/g Th, NOT SUBTRACTED.

LEGEND
 □ URANIUM pCi/g
 ▽ THORIUM pCi/g

CIMARRON CORPORATION

FIGURE 2 CIMARRON FACILITY UNAFFECTED AREA BACKGROUND FINAL SOIL SAMPLES IN pCi/g (1995) AT LAND SURFACE

CLIENT DRAWING NO.

DRWN. BY JE	DATE 5/29/95	CHKD. BY KM	DATE 6/15/95	APP'D. BY JK	SCALE: AS SHOWN	JOB NO.	DRAWING NO. 95FIBKSS-0	REV.
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