



**Subsurface Data Supporting Release of Subarea F
Outside of the 2016 Proposed Licensed Area**

**Cimarron Environmental Response Trust
Cimarron Remediation Site**

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Table of Contents

EXECUTIVE SUMMARY	1
PROPOSED LICENSE AMENDMENT	3
SUBAREA F BACKGROUND.....	5
1991 RADIOLOGICAL SURVEYS.....	6
SUBAREA F FINAL STATUS SURVEY	7
1999 GROUNDWATER ASSESSMENT	9
2002 GROUNDWATER ASSESSMENT	10
GROUNDWATER DATA	11
CONCLUSION	13
REFERENCES.....	15

List of Tables

Table 1.....1991 Subsurface Soil Data

Table 2.....1997 Subsurface Soil Data

Table 3.....1999 Subsurface Soil Data

Table 4.....2002 Subsurface Soil Data

Table 5.....Groundwater Data for Subject Area Monitoring Wells

Table 6.....Groundwater Data for Border Monitoring Wells

List of Figures

Figure 1Cimarron Site With Subarea Designations

Figure 2Proposed Licensed Area in Burial Area #1

Figure 31991 and 1999 Subarea F Soil Boring Locations

Figure 41997 Subarea F Soil Boring Locations

Figure 5Monitoring Well Locations

EXECUTIVE SUMMARY

Environmental Properties Management, LLC (EPM) has proposed that License SNM-928 be amended to re-define the licensed site. Some portions of the Cimarron site which currently contain or will contain licensed material exceeding decommissioning criteria have been released from License SNM-928. The proposed amendment is intended to bring such property back under license.

Amending the license to include only the property which contains or will contain licensed material exceeding decommissioning criteria involves the release of a portion of the site which has not yet been released from the license. That property, which has not yet been released, but which the proposed amendment will exclude from the licensed site, is located in Subarea F (see Figure 1), and is referred to as the “Subject Area” in this report.

Subarea F includes four former burial trenches which were closed in place in 1970 and decommissioned in the 1980s. Subsurface soil samples were collected in 1991 for a final survey of the burial trenches. Oak Ridge Associated Universities (ORAU) performed a confirmatory survey in December 1991 which included the collection and analysis of subsurface soil samples. Additional subsurface soil samples were collected in 1997 to add subsurface data along potential pathways, to supplement subsurface data already collected. *Final Status Survey Report, Subarea F* (Nextep Environmental, August 2005) demonstrated that surface soil and subsurface soil throughout Subarea F comply with criteria for unrestricted release.

Subsurface soil samples were collected in 1999 and 2002 as part of the Burial Area #1 groundwater investigation. The investigations showed that groundwater exceeding decommissioning criteria extended from Subarea F into Subarea C. The area within which groundwater exceeds decommissioning criteria is referred to as Burial Area #1. Burial Area #1 is not a delineated area; it simply refers to the area in the northeastern portion of the site that required remediation to achieve license termination.

Subsurface Data Supporting Release of Subarea F
Outside of the 2016 Proposed Licensed Area
August 31, 2016

Data from these samples were not included in *Final Status Survey Report, Subarea F*, because there was little information on groundwater at that time. Only soil data, as required by the Nuclear Regulatory Commission (NRC) approved *Final Status Survey Plan for Phase II Areas* (Chase Environmental Group, July 1995), was reported.

In 2007, the 1991, 1997, 1999, and 2002 data was provided to NRC in *Burial Area #1 Subsurface Soil Assessment* (Cimarron Corporation, November 2007). Uranium activity for over 2,000 subsurface soil samples was reported. None of the samples yielded uranium activity exceeding the criteria for unrestricted release.

The NRC has requested that EPM provide the subset of the subsurface soil data submitted in 2007 which represents subsurface soil located within Subarea F, but outside of the proposed licensed area (referred to in this report as the “Subject Area”).

The 2005 *Final Status Survey Report, Subarea F* demonstrated that surface soil throughout Subarea F, including the Subject Area, complies with unrestricted release criteria. This report provides data which demonstrates that subsurface soil within the Subject Area is also releasable for unrestricted use.

Because groundwater sampling and analysis has continued in Subarea F, this report also contains groundwater data for monitoring wells located in or at the boundary of the Subject Area. This data, which extends from that reported in the 2005 *Final Status Survey Report, Subarea F* through the first quarter of 2016, demonstrates that groundwater also complies with its unrestricted release criterion.

PROPOSED LICENSE AMENDMENT

The NRC has released significant portions of the property owned by the Trust. The Site has been divided into sixteen Subareas, labeled Subareas A through O (there are two areas, both of which contained uranium waste ponds, designated Subarea O). Figure 1 shows the locations of these Subareas.

The release of portions of the Site (Subareas A, B, C, D, E, H, I, J, K, L, M, and O) was documented in Conditions 25, 28, 29, and 30 of License SNM-928. Two portions of the property have been demonstrated to comply with the decommissioning criteria for unrestricted use (Subareas G and N), but NRC will not release them until a decommissioning plan providing for the remediation of groundwater has been submitted.

Subsequent to the release of most of the Site, groundwater exceeding the release criteria for groundwater has been identified in some of the Subareas that had been released for unrestricted use. Portions of Subareas C, E, F, H, and M are underlain by groundwater exceeding the release criteria for uranium. These Subareas (excluding Subarea F) have been released from license SNM-928.

In Section 6.3 of *Facility Decommissioning Plan* (EPM, 2015), the licensee proposed that License SNM-928 be amended to include all property which contains or will contain licensed material exceeding decommissioning criteria. Figure 2 shows the proposed licensed area in Burial Area #1.

Several of the figures in this report show the locations of some of the groundwater remediation components and infrastructure that were included in *Facility Decommissioning Plan* (EPM, 2015) to show the relationship between planned infrastructure and the licensed and controlled areas, and the locations from which subsurface samples were obtained and analyzed. These components of groundwater remediation infrastructure include:

- Proposed groundwater extraction trenches, sumps, and wells, from which groundwater impacted with uranium and/or nitrate will be collected for treatment.
- Proposed water treatment facilities.

Subsurface Data Supporting Release of Subarea F
Outside of the 2016 Proposed Licensed Area
August 31, 2016

- Proposed treated water injection trenches, sumps, and wells into which treated water will be injected into the subsurface to flush contaminants to extraction components.
- Proposed trenches through which electrical power, impacted groundwater or treated water, and control wiring will be routed to the groundwater remediation components.

However, amending the license to include only the property shown in Figure 2 involves the release of most of Subarea F from the license. This report provides the subsurface soil and groundwater data needed to justify the release of the Subject Area.

SUBAREA F BACKGROUND

During the 1960's, Cimarron Corporation disposed of licensed material in Burial Ground #1, located in the northeastern portion of the Cimarron site. Figure 3 shows the location of the four former burial trenches. In 1970, the four trenches in Burial Ground #1 were closed and covered with several feet of clean soil.

The Cimarron facility ceased operation in 1975, and initiated decommissioning activities in 1976. Settlement of the material that had been placed in the trenches and the cover soils placed over the waste led to an investigation of the area in 1984. Analysis of groundwater from several monitoring wells installed in 1985 demonstrated that the licensed material in the trenches had impacted groundwater. Excavation of the trenches began in 1986 and was completed in 1988.

The NRC stipulated unrestricted release criteria for uranium in soil and groundwater in SNM-928, Amendment #15, issued August 23, 1999. The criterion for soil (stipulated in License Condition 27(c)) is 30 picoCuries per gram (pCi/g) total uranium (after subtracting background). The criterion for groundwater (stipulated in License Condition 27(b)) is 180 picoCuries per liter (pCi/L).

The vicinity surrounding Burial **Ground** #1 was designated Burial **Area** #1. This designation was developed to distinguish between the burial ground (i.e., the former trenches and a small area around them) and the larger surrounding area containing impacted groundwater. Continuing groundwater assessment in Subarea F included the installation of additional monitoring wells in 1999, 2000, and 2002.

1991 RADIOLOGICAL SURVEYS

After excavation of the trenches was completed in 1988, a verification survey was performed in and around the excavated trenches. The surveillance methodology used was similar to that later promulgated in draft regulatory guide NUREG/CR-5849, *Manual for Conducting Radiological Surveys in Support of License Termination* (Oak Ridge Associated Universities, June 1992).

Borings were advanced on a ten-meter grid in an area extending 170 meters north-south and 80 meters east-west. This grid extended beyond Burial Ground #1 into the Subject Area to the east, south, and west. Samples were collected at six inch intervals from the first foot of each boring, and then at one foot intervals to four feet in depth, or until the auger hit bedrock, whichever came first. All material that was identified as exceeding the 30 pCi/g Criteria was excavated.

The verification survey data, as well as data obtained after excavation based on the verification survey, was presented in *Decontamination and Final Survey Report for Cimarron Facility Contaminated Waste Burial Ground* (Cimarron Corporation, November 1991). Figure 3 shows the locations of the 1991 soil borings, the Subarea F boundary, and the proposed licensed area.

The location IDs for the 1991 soil borings were based on the number of meters north and east of a local origin established by the licensee as a local reference point. Uranium activity reported for the 1991 subsurface soil samples (samples collected from below the top six inches) from locations in the Subject Area are provided in Table 1. Data from the ORAU report, *Confirmatory Radiological Survey – Former Burial Ground* (ORAU, 1992) is shown in red italicized font.

A total of 308 subsurface soil samples from borings in the Subject Area were analyzed for uranium activity. The mean activity value was 6.5 pCi/g, the mean plus two standard deviations ($\bar{x} + 2\sigma$ - the 95% confidence level) was 11.6 pCi/g, and the maximum value for any sample was 21 pCi/g total uranium. Background was not subtracted from these gross activity results. The maximum net activity (gross minus background) is less than two-thirds of the 30 pCi/g decommissioning criterion for soil.

SUBAREA F FINAL STATUS SURVEY

Radiological Characterization Report for Cimarron Corporation's Former Nuclear Fuel Fabrication Facility (Chase Environmental Group, October 1994) divided the site into sixteen Subareas, which were grouped into three "phases". The "phases" represented areas with different potential for radiological impact. Phase I areas were unimpacted. Phase II areas were impacted areas which may not exceed decommissioning criteria. Phase III areas were impacted areas which were known to exceed decommissioning criteria. Subarea F, which includes Burial Ground #1, was identified as a Phase II area.

The licensee submitted *Final Status Survey Plan for Phase II Areas*, (Chase Environmental Group, July 1995), which included a final status survey plan for Subarea F. The final survey plan did not include subsurface sampling in Phase II areas because samples collected in 1991 by both the licensee and ORAU in Burial Area #1 demonstrated that licensed material and soils exceeding the 30 pCi/g criterion had been removed. In a letter dated October 31, 1996, the NRC commented on potential subsurface contamination in Phase II affected areas. In a January 28, 1997 letter, the licensee committed to perform subsurface soil sampling along the haul road extending from the former burial trenches to the former operating facility. The NRC approved this addition to the final status survey in a letter dated March 14, 1997.

Cimarron collected additional subsurface samples in 1997, in accordance with the NRC-approved plan. Samples were collected to a depth of four feet at 100-meter intervals in both the drainage leading from the pond spillway and along the site road extending from the trenches toward the east. The approximate sample locations are shown in Figure 4. The subsurface soil data was presented in *Final Status Survey Report, Subarea F* (Nextstep Environmental, August 2005).

Table 2 presents the data for subsurface soil collected during the 1997 final status survey for Subarea F. The mean activity value for the 12 samples collected from the drainage was 4.5 pCi/g, the $(\bar{x} + 2\sigma)$ value was 9.1 pCi/g, and the maximum value for any sample was 8 pCi/g total uranium. The mean activity value for the 20 samples collected from the roadway was 2.9

Subsurface Data Supporting Release of Subarea F
Outside of the 2016 Proposed Licensed Area
August 31, 2016

pCi/g, the $(\bar{x} + 2\sigma)$ value was 6.7 pCi/g, and the maximum value for any sample was 7 pCi/g total uranium.

All these results are a small fraction of the 30 pCi/g decommissioning criterion for soil.

1999 GROUNDWATER ASSESSMENT

In *Site Decommissioning Plan – Groundwater Evaluation Report* (Cimarron Corporation, July 1998), the licensee committed to additional assessment work in the area surrounding Burial Ground #1.

Soil samples were collected from 11 locations identified by geophysical anomalies, 27 borings advanced along lines across the former burial trenches, and 13 borings advanced to install Monitoring Wells TMW-01 through TMW-13. Although most of these locations are not within (or close to) the Subject Area, borings for Anomaly C, Borings B-10, B-11, and B-27, and Monitoring Wells TMW-05 and TMW-06 were advanced in or on the boundary of the Subject Area.

Soil samples were collected from borings at one-foot intervals as recovery allowed. Figure 3 shows the locations of borings in or bordering the Subject Area. Figure 5 shows the locations of Monitoring Wells in Subarea F. Table 3 lists the data for all soil samples collected from the Subject Area in 1999. The mean activity value for these 75 samples was 5.1 pCi/g, the $(\bar{x} + 2\sigma)$ value was 10.1 pCi/g, and the maximum value for any sample was 12 pCi/g total uranium. All these values are less than half of the 30 pCi/g decommissioning criterion for soil.

It should be noted that Monitoring Wells TMW-14 through TMW-25 were installed in 2000, after the initial groundwater assessment. These wells were installed solely to delineate the uranium plume in Burial Area #1, so soil samples were not collected for laboratory analysis.

2002 GROUNDWATER ASSESSMENT

Additional groundwater assessment was performed in 2002. During this assessment, 62 borings were advanced (labeled 02W01 through 02W62). Those installed in or near Subarea F are shown on Figure 5. Soil samples were collected at one foot intervals from surface to refusal in select borings. From most borings, one soil sample was collected from the unsaturated zone and one from the saturated zone. Most of the monitoring wells located in Subarea C not shown on Figure 5 because they are not relevant to this report. Monitoring Well 02W20 is located within the Subject Area.

Monitoring Wells 02W09, 02W10, 02W13, 02W26, 02W51, and 02W53 are located on the boundary of the proposed licensed area in Subarea F. Although these locations are not within the Subject Area; subsurface soil data from these locations was included in this report to provide the most complete data set which may be considered to demonstrate that the Subject Area complies with the decommissioning criterion.

Analytical results for the subsurface soil collected from the soil borings advanced for these monitoring wells are presented in Table 4. These data were initially submitted to NRC in *Burial Area #1 Groundwater Assessment Report* (Cimarron Corporation, January 2003).

The mean net activity value (background was subtracted) for these 38 samples was 2.2 pCi/g, the $(\bar{x} + 2\sigma)$ value was 3.7 pCi/g, and the maximum value for any sample was 4 pCi/g total uranium. All these values are a small fraction of the 30 pCi/g decommissioning criterion for soil.

GROUNDWATER DATA

Figure 5 shows the locations of all monitoring wells located in or near Subarea F, as well as the proposed licensed area. The following two monitoring wells are located within the Subject Area:

- 02W20
- TMW-06

Groundwater data from monitoring wells located in the Subject Area are presented in Table 5. The maximum total uranium activity (for the 10 samples for which isotopic activity was analyzed) was 3.20 pCi/L total uranium. All these values are a small fraction of the 180 pCi/L decommissioning criterion for groundwater, and are within the range of background for uranium in groundwater.

Figure 5 shows the following eleven monitoring wells located on the boundary of the licensed area (within Subarea F):

- 02W09
- 02W10
- 02W13
- 02W26
- 02W51
- 02W53
- TMW-05
- TMW-20
- TMW-21
- TMW-25
- 1316R

Groundwater samples from these eleven monitoring wells represent a mixture of groundwater from both the Subject Area and the proposed licensed area. Consequently, groundwater in the proposed licensed area (which may contain uranium exceeding the decommissioning criterion

Subsurface Data Supporting Release of Subarea F
Outside of the 2016 Proposed Licensed Area
August 31, 2016

for groundwater) contributes to the total uranium activity in groundwater collected from these wells. Groundwater data from these locations (presented in Table 6) was included in this report to provide the most complete data set.

Even with the contribution from groundwater within the proposed licensed area, groundwater from 6 of the 11 monitoring wells bordering the Subject Area (Monitoring Wells 02W09, 02W10, 02W26, 02W51, TMW-05, and TMW-20) have never exceeded one-tenth of the 180 pCi/L criterion for groundwater. Monitoring Wells 02W13, 02W53, and TMW-21 have never exceeded the criterion. Only Monitoring Wells TMW-25 and 1316R have ever exceeded 180 pCi/L, and not since 2002 and 2004, respectively.

CONCLUSION

Investigation of environmental media in Subarea F began with the excavation of the burial trenches in Burial Ground #1. Samples collected for final status survey effort in 1991 and 1997 provided data on subsurface soil in the Subject Area. Samples obtained during groundwater assessment performed in 1999 and 2002 yielded additional data for both subsurface soil and groundwater. Finally, groundwater sampling performed since 2000 provided additional data on groundwater both in and on the border of the Subject Area.

Soil Sample Results

The 1991 sampling effort included the collection of 308 samples from the Subject Area. The 1997 sampling effort yielded another 32 subsurface soil samples in the Subject Area. All 340 samples collected during these efforts were located in the Subject Area. Groundwater assessment activities performed in 1999 and 2002 yielded 75 and 38 subsurface soil samples, respectively, in or on the border of the Subject Area. Not one of those 453 samples yielded over 21 pCi/g (net), or approximately two-thirds of the decommissioning criterion for soil.

Groundwater Results

Since 2000, 10 groundwater samples were analyzed for uranium activity from the 2 monitoring wells located in the Subject Area. The maximum net activity in any of those samples was 3.20 pCi/L total uranium, a tiny fraction of the 180 pCi/L decommissioning criterion for uranium in groundwater.

Since 2001, a total of 62 groundwater samples were collected from 11 monitoring wells located on the border of the Subject Area. Only three of the 62 samples yielded uranium exceeding the 180 pCi/L decommissioning criterion for uranium in groundwater, and none have exceeded the criterion since 2004.

Conclusion

The Subject Area, consisting of the portion of Subarea F which lies outside of the area which is proposed to be licensed, has been demonstrated to comply with unrestricted release criteria for

Subsurface Data Supporting Release of Subarea F
Outside of the 2016 Proposed Licensed Area
August 31, 2016

surficial soil, subsurface soil, and groundwater. License SNM-928 should be amended to release these portions of Subarea F for unrestricted use.

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Subsurface Data Supporting Release of Subarea F
Outside of the 2016 Proposed Licensed Area
August 31, 2016

TABLES

Subsurface Data Supporting Release of Subarea F
Outside of the 2016 Proposed Licensed Area
August 31, 2016

FIGURES