DEPARTMENT OF THE ARMY
U.S. ARMY WHITE SANDS MISSILE RANGE
WHITE SANDS MISSILE RANGE, NEW MEXICO 88002-5048

REPLY TO ATTENTION OF

May 12, 1992

Environmental Services Division

Mr. Benito J. Garcia
Bureau Chief
Hazardous and Radioactive Materials Bureau
New Mexico Environmental Department
525 Camino do los Marquez
P.O. Box 26110
Santa Fe, New Mexico 87502

Dear Mr. Garcia:

Enclosed for your review are the closure plans for Red Rio and Oscura Landfills. These two sites are identified on the Part B Permit Application as inactive interim status hazardous waste disposal facilities. Subpart G of the RCRA Regulations 40 CFR 265 requires the preparation of closure plans in accordance with section 265.111.

Through informal discussion with Mr. Herb Grover and Mr. Mark Sides, of your staff, WSMR understands your department may not be able to review our closure plans until FY 93. If so, it would be mutually advantageous to close these units in FY 93. The results of the investigation completed, indicate no contamination is present and consequently, no remediation is planned for these units. For planning purposes, WSMR would appreciate your cooperation regarding this matter.

If you agree, please contact Mr. Javier Mendoza, (505) 678-2415.

Sincerely,

Thomas A. Ladd

Thomas A. Ladd
Major, U.S. Army
Director, Environment
and Safety

Enclosures

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Site Evaluation Report and Closure Plans for the Oscura and Red Rio Practice Bomb Disposal Areas White Sands Missile Range, New Mexico

March 1992

Prepared for U.S. Army Toxic and
Hazardous Waste Materials Agency
Aberdeen Proving Grounds, Maryland
U.S. Department of the Army,
White Sands Missile Range, New Mexico

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for Environmental Management Operations
under a Related Services Agreement
with the U.S. Department of Energy

Environmental Management Operations
Richland, Washington 99352

EXECUTIVE SUMMARY

The Oscura and Red Rio Practice Bomb Disposal Areas are two inactive, interim status RCRA sites located on White Sands Missile Range, New Mexico. Both sites are located adjacent to active bombing and gunnery ranges and were previously used for detonation, burning, and burial of wastes generated on these ranges. This report presents the methods and results of investigations of the nature and extent of hazardous materials and environmental contamination at these sites. Formal RCRA closure plans are presented in following report conclusions.

Investigation results document the absence of hazardous wastes at both sites. Minor residual soil contamination by hazardous waste constituents is determined to present no unacceptable risks to human health. The potential for migration of hazardous waste constituents from the sites is shown to be extremely low.

The report recommends additional site closure activities to ensure consistency with the intent of RCRA Subtitle D and the New Mexico Solid Waste Management Regulations in effect at the time disposal operations ceased. The RCRA closure plans request a determination from the New Mexico Environment Department under 40 CFR Part 270.1(c)(5) that post-closure permits are not required for the Oscura and Red Rio Practice Bomb Disposal Areas. The date of receipt of notification of this determination will be considered to be the date of completion of closure for the sites.

TABLE OF CONTENTS

SECTION	PAGE
EXECUTIVE SUMMARY	ii
TABLE OF CONTENTS	iii
LIST OF FIGURES	vi
LIST OF TABLES	vii
1.0 INTRODUCTION	1.1
1.1 SITE BACKGROUND	1.2
1.2 RCRA STATUS	1.4
1.3 OBJECTIVES OF THE SITE EVALUATIONS	1.4
2.0 SITE FEATURES AND HISTORY	2.1
2.1 SITE DESCRIPTION	2.1
2.1.1 Climate	2.3
2.1.2 Geology	2.3
2.1.3 Hydrology	2.4
2.1.4 Biota	2.6
2.1.5 Land Use	2.7
2.2 SITE USAGE AND OPERATIONS	2.7
2.2.1 Summary of Disposal Practices	2.9
2.2.2 Possible Waste Types	2.10
2.2.3 Potential Migration Pathways	2.12
2.3 PREVIOUS INVESTIGATIONS	2.12
3.0 FIELD INVESTIGATION	3.1
3.1 METHODS	3.2
3.1.1 Topographic Surveys	3.2
3.1.2 Geophysical Surveys	3.3
3.1.3 Surface Soil Sampling Program	3.4
3.1.4 Subsurface Soil Sampling Program	3.7
3.2 RESULTS	3.11
3.2.1 Geophysical Investigation	3.11
3.2.2 Surface Soil Sample Results	3.14
3.2.3 Subsurface Soil Sampling Results	3.23
4.0 QUALITY ASSURANCE/QUALITY CONTROL	4.1
4.1 FIELD ACTIVITIES QA/QC	4.2
4.2 FIELD QC SAMPLING DATA	4.2
4.2.1 Split and Co-Located QA/QC Analyses	4.3
4.2.2 Decontamination Rinsate Samples	4.8
4.3 ANALYTICAL LABORATORY DATA VALIDATION	4.10

TABLE OF CONTENTS (cont)

SECTION PAGE

5.0 RISK ASSESSMENT 5.1
5.1 INTRODUCTION 5.1
5.2 SELECTION OF CONTAMINANTS OF CONCERN 5.1
5.2.1 Oscura Site 5.3
5.2.2 Red Rio 5.5
5.3 EXPOSURE ASSESSMENT 5.6
5.3.1 Site Receptors 5.6
5.3.2 Pathway Identification 5.9
5.3.3 Exposure Scenarios 5.9
5.3.4 Ingestion 5.10
5.4 METHODS OF RISK CHARACTERIZATION 5.11
5.5 NONCARCINOGENIC RISK CHARACTERIZATION 5.11
5.6 CARCINOGENIC RISK CHARACTERIZATION 5.12
5.7 RISK CHARACTERIZATION 5.14
5.7.1 Oscura Site 5.14
5.7.2 Red Rio Site 5.14
5.8 LEVEL OF UNCERTAINTY 5.16
5.9 RISK ASSESSMENT CONCLUSIONS 5.16

6.0 SUMMARY OF FINDINGS 6.1
6.1 DISCUSSION 6.1
6.2 CONCLUSIONS AND RECOMMENDATIONS 6.3

7.0 CLOSURE PLANS 7.1

7.1 CLOSURE PLAN FOR THE OSCURA PRACTICE BOMB DISPOSAL AREA 7.1
7.1.1 Introduction 7.1
7.1.2 Site Description and History 7.2
7.1.3 Waste Description and Investigation Results 7.3
7.1.4 Closure Plan 7.4
7.1.5 Closure Certification 7.4
7.1.6 Partial Closure 7.5
7.1.7 Financial Assurance Requirements 7.5
7.1.8 Closure Performance Standard 7.5
7.1.9 Anticipated Life of the Facility 7.5
7.1.10 Waste Inventory 7.5
7.1.11 Post-Closure Care Requirements 7.6
7.1.12 Closure 7.6

TABLE OF CONTENTS (cont)

SECTION PAGE

7.1.13 Dispute Resolution 7.7
7.1.14 Request for an Equivalency Determination 7.8

7.2 CLOSURE PLAN FOR THE RED RIO PRACTICE BOMB DISPOSAL AREA 7.9
7.2.1 Introduction 7.9
7.2.2 Site Description and History 7.10
7.2.3 Waste Description and Investigation Results 7.11
7.2.4 Closure Plan 7.12
7.2.5 Closure Certification 7.12
7.2.6 Partial Closure 7.13
7.2.7 Financial Assurance Requirements 7.13
7.2.8 Closure Performance Standard 7.13
7.2.9 Anticipated Life of the Facility 7.13
7.2.10 Waste Inventory 7.13
7.2.11 Post-Closure Care Requirements 7.14
7.2.12 Closure 7.14
7.2.13 Dispute Resolution 7.15
7.2.14 Request for an Equivalency Determination 7.16

8.0 REFERENCES 8.1

APPENDICES

A Geophysical Surveys at the Oscura Site
B Geophysical Surveys at the Red Rio Site
C Subsurface Logs, Oscura and Red Rio Sites
D Field Surveillance and Laboratory Audit Reports
E Field and Laboratory QA/QC
F Field Notes
G Supplemental Risk Assessment Information

LIST OF FIGURES

FIGURE		PAGE
1.1	Location of White Sands Missile Range, New Mexico	1.3
2.1	Location of the Oscura and Red Rio Practice Bomb Disposal Areas.	2.2
Plate 1	Topographic Map of the Oscura Site	(Following Text)
Plate 2	Topographic Map of the Red Rio Site	(Following Text)
Plate 3	Surface Soil Sampling Locations, Oscura Site	(Following Text)
Plate 4	Surface Soil Sampling Locations, Red Rio	(Following Text)
Plate 5	Subsurface Soil Sampling Location, Oscura Site	(Following Text)
Plate 6	Subsurface Soil Sampling Location, Red Rio Site	(Following Text)

LIST OF TABLES

TABLE		PAGE
2.1	Observed Fauna at the Oscura site, February 1991	2.8
2.2	Observed Fauna at the Red Rio site, February 1991	2.8
2.3	Individuals Interviewed for Site History Information	2.9
2.4	Analytical results for "Burn Pit Soil" samples collected at the Oscura and Red Rio practice bomb disposal areas, 1985 USAEHA Investigation	2.9
3.1	Summary of Analytical Methods for Surface and Subsurface Soil Samples.	3.8
3.2	Estimated Volumes Encompassing Buried Wastes at the Oscura and Red Rio sites.	3.13
3.3	Detection Limits Achieved for Explosive Compounds (USATHAMA Methods) in Soil and Water Samples.	3.15
3.4	Summary of Semivolatile Organic Compounds Above Detection Limits in Oscura Surface Soil Samples, May 1991.	3.16
3.5	Range of Detection Limits Achieved for Semivolatile Organic Compounds (EPA Methods) in Water Samples.	3.17
3.6	Typical Metals Concentrations in Soils of the Western United States	3.18
3.7	Surface Soil Metals Concentrations at the Oscura Site, May 1991.	3.19
3.8	Summary of Semivolatile Organic Compounds Above Detection Limits in Red Rio Surface Soil Samples, April 1991	3.21
3.9	Surface Soil Metals Concentrations at the Red Rio Site, April 1991	3.22
3.10	Summary of Semivolatile Organic Compounds Above Detection Limits in Oscura Subsurface Soil Samples, May 1991	3.25
3.11	Subsurface Soil Metals Concentrations at the Oscura Site, May 1991	3.27
3.12	Summary of Semivolatile Organic Compounds Above Detection Limits in Red Rio Subsurface Soil Samples, April 1991	3.32
3.13	Subsurface Soil Metals Concentrations at the Red Rio Site, April 1991	3.33
4.1	Soil Split Samples with Relative Percent Difference Values Exceeding 35 Percent	4.5
4.2	Soil Co-located Samples with Relative Percent Difference Values Exceeding 35 Percent	4.7
5.1	Summary of Contaminant of Concern Selection Criteria for Analyzed Constituents in Oscura Surface Soil Samples.	5.4
5.2	Summary of Contaminant of Concern Selection Criteria for Analyzed Constituents in Red Rio Surface Soil Samples	5.7
5.3	Exposure Assessment Pathways	5.8
5.5	Carcinogenic Weight of Evidence Classification	5.13
5.6	Noncarcinogenic Characterization of Risks for Oscura Surface Soils	5.15
5.7	Carcinogenic Characterization of Risk for Oscura Surface Soils	5.15
5.8	Noncarcenogenic Characterization of Risks for Red Rio Surface Soils.	5.16

1.0 INTRODUCTION

The U.S. Department of the Army, White Sands Missile Range (WSMR), New Mexico is responsible for operation, maintenance, and closure of Resource Conservation and Recovery Act (RCRA) hazardous waste sites at WSMR. The Director of Engineering, Housing, and Logistics at WSMR has selected two, inactive disposal sites for evaluation of closure options. Both sites were identified on a Part A RCRA permit application and are therefore regulated as interim status RCRA sites. The two sites, the Oscura and Red Rio practice bomb disposal areas, are located in the northeast portion of WSMR. Both sites are located adjacent to active bombing and gunnery ranges and were previously used for detonation, burning, and burial of wastes generated on these ranges.

Previous to this site evaluation, little was known about the nature and extent of contamination, if any, at either of the practice bomb disposal areas. As a result, detailed site evaluations were required before closure plans could be prepared. In early to mid 1991, field investigations consisting of topographic and geophysical surveys as well as surface and subsurface soil sampling were conducted at both the Oscura and Red Rio sites. The objective of the investigations was to collect sufficient data regarding possible site contamination, to describe the current and potential risks associated with the sites, and to develop an approach to their closure.

This report summarizes the site evaluation activities at both the Oscura and Red Rio practice bomb disposal areas. Section 1 details the purpose and scope of the investigations, site background, and RCRA status of each disposal unit. A profile of site features and history is provided in Section 2. Section 3 discusses the methods used to conduct the field investigation and the results obtained. Quality assurance issues relevant to the investigation are discussed in Section 4. An assessment of the potential human health risks posed by the sites is described in Section 5. The findings and conclusions of the investigations are summarized in Section 6. Formal RCRA Closure Plans are presented in Section 7. References are furnished in Section 8.

1.1 SITE BACKGROUND

Located in South-Central New Mexico, WSMR was established in 1945 as the White Sands Proving Ground, with command and operational responsibilities assigned to the Ordnance Corps, Department of the Army (Figure 1.1). In 1958 the installation's name was changed to WSMR and in 1961 WSMR was classified by the Department of Defense as a National Range, to be available to all U.S. Government users on a common basis. In 1962, the range was placed under the command jurisdiction of the U.S. Army Materiel Command (U.S. Army Corps of Engineers, USACOE 1985).

Exact dates of initiation of use of the Oscura and Red Rio practice bomb disposal sites are not known. A representative of Holloman Air Force Base, which is located adjacent to WSMR, and is currently responsible for operating the two ranges, reports that the Oscura site opened in 1960 or 1961 and that Red Rio began operations in 1963 (Hoppes 1990, personal communication). Analysis of U.S. Geological Survey aerial photographs taken in 1973 suggest the presence of linear pits at both sites, possibly used for open burning, detonation, and burial of practice bombs, small arms ammunition, and other wastes generated on bombing and gunnery ranges located adjacent to the sites. A report produced by the U.S. Army Environmental Hygiene Agency (USAEHA 1988) indicates that disposal was occurring at the Red Rio site as recently as 1987. The same investigation found that although one disposal unit was still open at the Oscura site in 1987, disposal operations had ceased at the site. Holloman Air Force Base personnel report that disposal operations ceased at both sites in October, 1988 (Hoppes 1990, personal communication). Since this time, wastes generated onsite have been taken to Holloman for recycling (Broka 1990, personal communication).

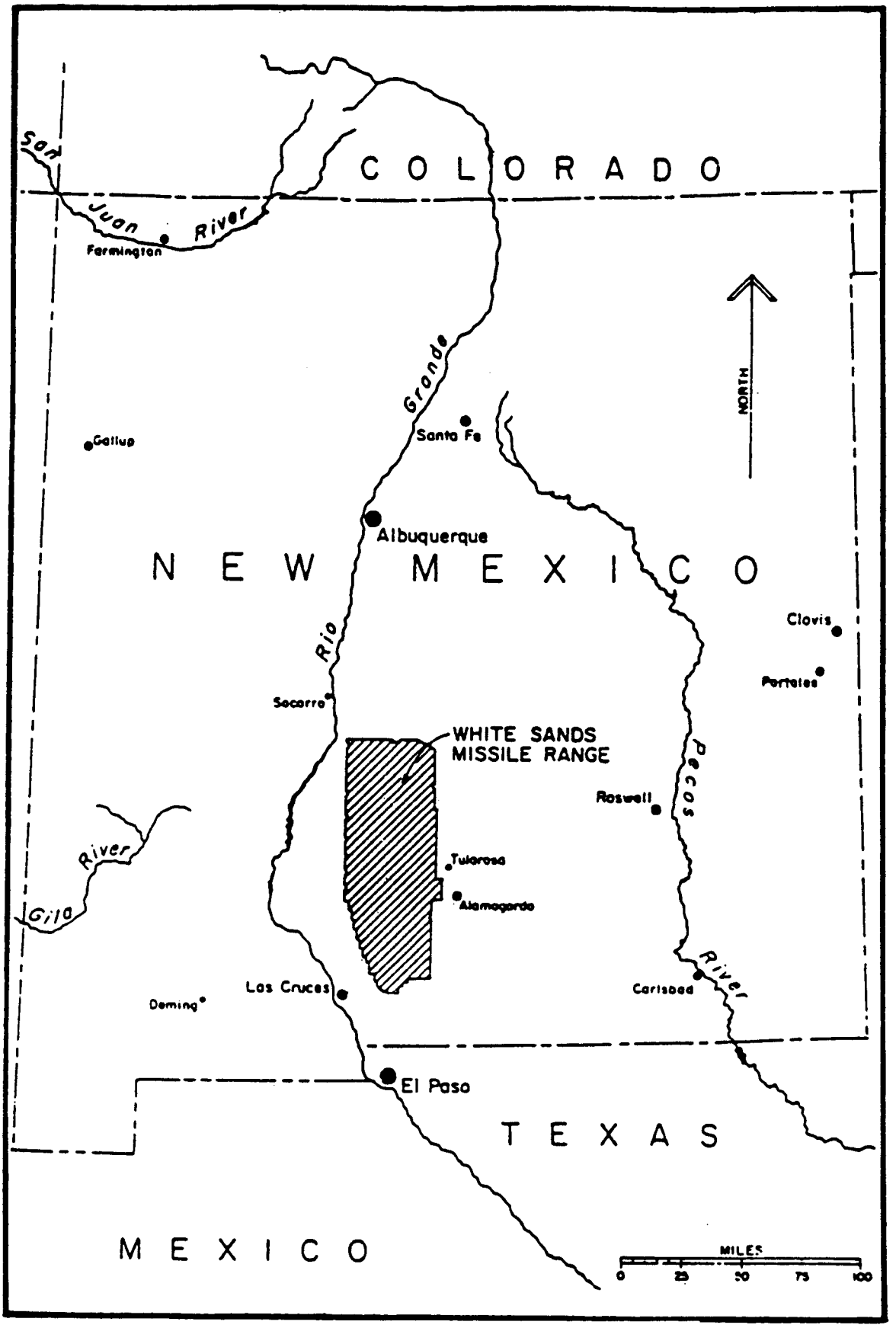

FIGURE 1.1. Location of White Sands Missile Range, New Mexico
Source: USAEHA 1988

1.2 RCRA STATUS

WSMR has submitted an application to the State of New Mexico for a RCRA Part A permit to operate hazardous waste facilities. The Oscura and Red Rio sites are identified on the Part A permit application as inactive interim status hazardous waste disposal facilities. Subpart G of the RCRA regulations as adopted by the State of New Mexico (NM HWMR-6, Part VI, 40 CFR Part 265) requires the preparation of closure plans describing how these facilities will be closed in accordance with Section 265.111. Closure plans have not been specifically requested by the regulatory agencies for the Oscura or Red Rio sites. However, WSMR is acting in advance of any such request by evaluating options for the closure of these two sites.

1.3 OBJECTIVES OF THE SITE EVALUATIONS

The objective of the site evaluations was to collect sufficient data regarding possible site contamination to describe the current and potential risks associated with the sites and for the purpose of developing an approach to their closure. Sufficient data were not available prior to the site evaluations to accomplish this task. Specific objectives of the field investigations included:

- Develop the necessary baseline maps to display the information obtained from the field investigation.
- Locate and delineate buried wastes at each practice bomb disposal site.
- Determine the presence or absence of site-related contaminants in surface soils at each site.
- Provide information regarding the distribution and concentrations of contaminants in surface soils, if present.
- Obtain information regarding subsurface conditions at each site.

- Investigate the presence or absence of site related contaminants in subsurface soils adjacent to and beneath buried waste.

- Provide information regarding the distribution and concentrations of contaminants in subsurface soils, if present.

The accomplishment of these objectives provided the data necessary to prepare closure plans for the two practice bomb disposal areas. Investigation into potential migration pathways for contaminants at the surface (e.g. windblown contaminated soil or surface water runoff) and in the subsurface (e.g. leaching to groundwater) would be recommended as part of closure, if appropriate.

2.0 SITE FEATURES AND HISTORY

2.1 SITE DESCRIPTION

The Oscura and Red Rio practice bomb disposal areas are located in the northeast portion of WSMR, approximately 15 mi apart (Figure 2.1). Despite their proximity, the two sites are characterized by differences in topography, geology, and vegetation.

The Oscura Bombing and Gunnery Range is located near longitude 106°13'; latitude 33°32' (T9S, R7E, Section 9) in Lincoln County, New Mexico, at an elevation of about 4700 ft. The Oscura Range is roughly 10.5 mi long and 4 mi wide consisting of 26,400 ac. The local topography is relatively flat and slopes gently to the south-southeast. The site itself occupies an area of about 10 ac and, in addition to the disposal activities, has been used periodically as a storage area for cars, trucks, helicopters, and other equipment used as bombing and gunnery targets.[1] The site is partially surrounded by berms and mounds of dirt installed, presumably, to prevent erosion of the site and to redirect any surface water flow to a pond west of the site. There are several signs around the site which read: "Munitions Residue Burial Site."

The Red Rio Bombing and Gunnery Range is located near longitude 106°15'; latitude 33°45' (T6S, R7E, Sections 20 and 29) in Socorro County, New Mexico, at an elevation of about 6300 ft. The range is oval-shaped and approximately 9 mi long and 6 mi wide consisting of 29,500 ac. The local topography consists of hills and valleys with up to 700-800 ft of relief. The hills represent outcrops of sandstone and limestone while the valleys have been formed by erosion of less resistent geologic units.[2] The disposal site lies within a small valley and is about 1.5 ac in size. A sign at the site reads: "DANGER: Munitions Burial Area."

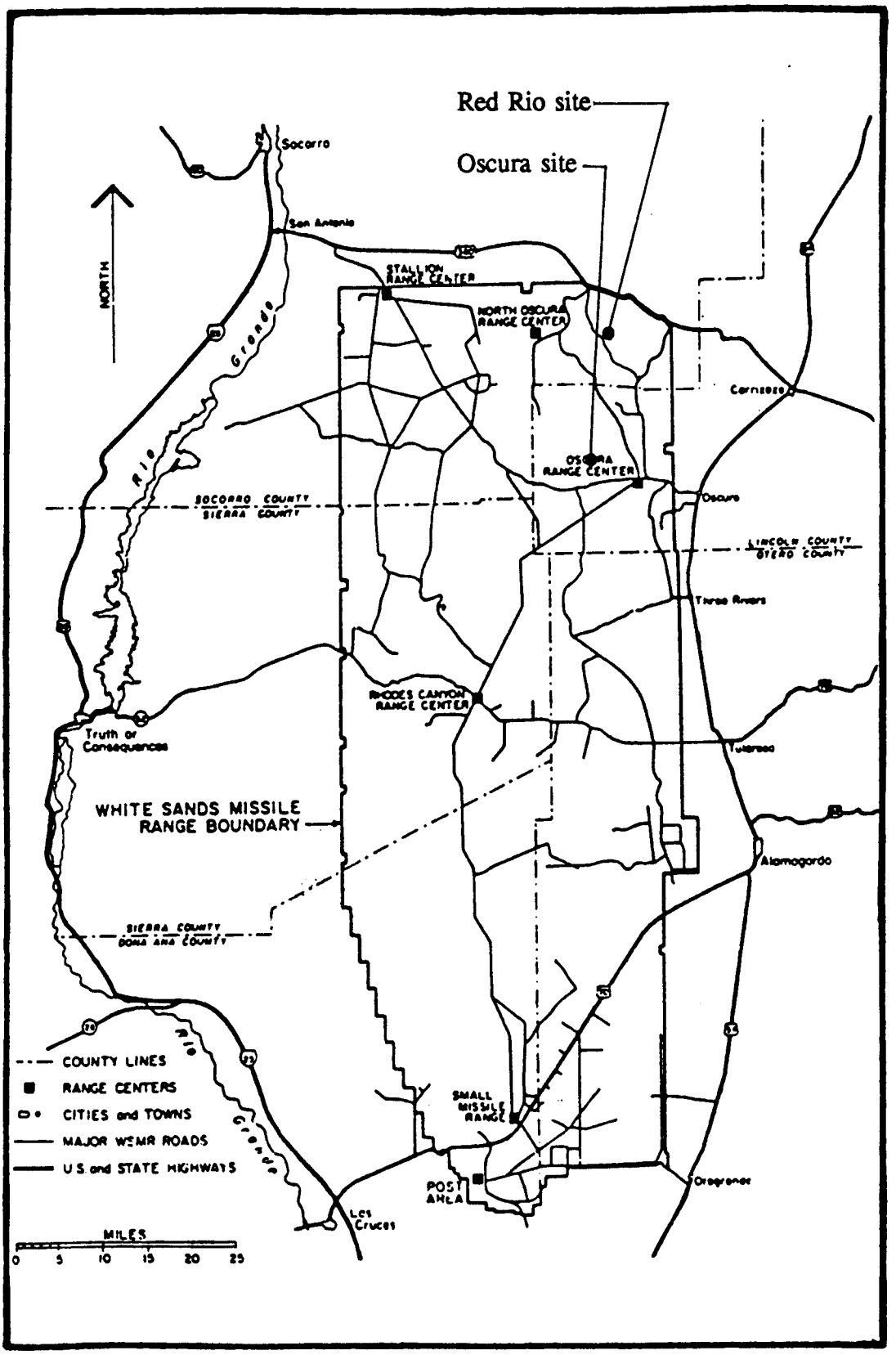

FIGURE 2.1. Location of the Oscura and Red Rio Practice Bomb Disposal Areas. Source: USAEHA 1988 and edited for this document.

2.1.1 Climate

Both the Red Rio and Oscura sites have climates typical of the desert southwest. The average temperatures in summer for lower elevation portions of WSMR, such as the Oscura site, range from highs of 35°C (95°F) to lows of 17°C (67°F) at night, while winter temperatures average highs of 14°C (57°F) in the day to -4°C (25°F) at night (USACOE 1985). Temperatures at the Red Rio site probably differ slightly, being on average a few degrees cooler than Oscura, because it is about 1,600 ft higher in elevation. Weather conditions at the two sites are typically dry with humidities averaging 35 percent. Precipitation is highest in the summer with over 50 percent of the 7 to 13-in. annual rainfall occurring in the summer months. During this time of year weather from the southeast brings moisture from the Gulf of Mexico, increasing rainfall. During fall, winter, and spring WSMR experiences westerly winds averaging 7 mph but exceeding 34 mph during stormy weather (USACOE 1985).

2.1.2 Geology

The Oscura and Red Rio sites lie at the north end of the Tularosa Basin, a north-south oriented structural trough tectonically related to the late-Cenozoic Rio Grande Rift to the west. The northern Tularosa Basin is bordered by the San Andres and Oscura Mountains to the west and the Sacramento Mountains to the east.

The Oscura site lies about 3 to 4 mi southeast of the Oscura Mountains and rests on alluvial fan deposits derived from this range. Geologic formations exposed deposits in the Oscura Mountains consist primarily of Permian age sandstones, limestones, shales, conglomerates, siltstones, and some evaporates. The fan deposits slope slightly to the southeast, grading toward the center of the Tularosa Basin. The total thickness of the alluvial deposits is not known, but could be upwards of several thousand feet (McLean 1970).

According to a soil survey of WSMR [U.S. Department of Agriculture Soil Conservation Service (USDA SCS) 1976], soils in the Oscura site are mapped as the Sotim-Russler association. This unit consists of about 60 percent Sotim clay loam and 25 percent Russler silt loam. Both soil types develop on nearly level to gently sloping surfaces on old alluvial fans. Runoff is medium and the potential for water erosion is severe. Soil blowing potential is moderate. Permeability ranges from moderately low to moderately high and the risk of corrosion to uncoated steel is considered high due to the presence of salts. Soil pH ranges from 7.4 to 8.4.

The Red Rio site, located about 15 mi north of the Oscura site, is in a area of eroded Permian bedrock and discontinuous, thin, unconsolidated deposits. Exposed in the Red Rio area are the Permian Abo, Yeso, and San Andres formations. These deposits dip gently eastward at less than 6 deg (Weir 1965). Sandstone, gypsum, siltstone, and limestone of the Yeso Formation are the most prominently exposed around the site. The sandstone and limestone are more competent than the gypsum and siltstone beds which tend to form slopes. The Red Rio practice bomb disposal area lies within a small valley formed as a result of erosion of the Yeso Formation. Alluvium is present as a thin fill in the valley and is probably less than 50 ft thick.

Soils at and around the Red Rio site have been mapped as "rock land" and the La Fonda association. The La Fonda association is the dominant soil type at the Red Rio Site. The unit consists primarily of the La Fonda Loam, a soil described as moderately permeable with a high potential for water erosion and a low potential for soil blowing. The risk of corrosion to uncoated steel is considered moderate and soil pH ranges from 6.6 to 8.4 (USDA SCS 1976).

2.1.3 Hydrology

Very little site-specific information is available for either the Oscura or Red Rio sites regarding ground water conditions. General information, however, is available in Weir (1965), McLean (1970), and various annual water-resources reviews, such as Cruz (1983).

In the Tularosa Basin, ground water moves generally southward and toward the axis of the basin, away from areas of recharge on alluvial sediments adjacent to the mountains and hills. In the northern part of the Basin, much ground water is discharged into Salt Creek, at Mound Springs (T10S, R6E, Section 23), and at Malpais Spring (T12S, R7E, Section 8). Ground-water gradients range from about 100-200 ft/mi near the margin of the basin to about 20 ft/mi in the central part of the basin (Weir 1965).

Alluvium contains large quantities of ground water throughout most of the central part of the Tularosa Basin, although nearly all of this water is of poor quality due to high concentrations of dissolved solids. The depths to water in the Basin alluvium range from zero, near Salt Creek, to approximately 330 ft below the land surface.

As discussed earlier, the Oscura site is located on alluvial fan deposits derived from the Oscura Mountains. Ground water beneath the site probably occurs under unconfined conditions. The depth to ground water is not precisely known, but a well located in the same section, apparently near the site with a field designation "New Mills" (T9S, R7E, Section 9), indicates that ground water was about 200 ft below the surface in 1955. The exact location of this well is not known. Water quality analysis conducted at that time show the water to be nonpotable due to high sulfate content (Weir 1965). More recent sampling at the Oscura Range Center (approximately 4 miles to the southeast of the site, T9S, R7E, Section 5) in 1982 confirmed poor ground water quality, relegating this water for use only in fire fighting and other applications for which non-potable water is appropriate (Cruz 1983).

Surface water at the Oscura site exists intermittently as overland flow resulting from intense local rainfall and/or rapidly melting snow. Berms constructed to the north and west of the site generally direct surface flow to the man-made pond west of the site. The pond contains water when the inflow exceeds seepage and evaporation, and therefore contains standing water only periodically during the year. Historical aerial photographs suggest the pond was constructed for stock watering purposes while the land was under private ownership.

Less information exists concerning ground-water conditions at the Red Rio site. As mentioned earlier, the site is located in a small valley containing a thin veneer of alluvium. Ground water may be present in this alluvium or, more likely, in the bedrock below it. A stock well, designated "Little Robinson's", is located approximately 1.5 mi to the west of the Red Rio site. Because it was drilled in an area of slightly different geologic conditions, extrapolation of hydrogeologic data is tenuous. Sampled in 1954 and 1956, water in this well was reported to be at a depth of about 315 feet and of potable quality (Weir 1965).

There are no surface water bodies located near the Red Rio site. Surface water exists only as overland flow during intense local rainfall and/or rapid snowmelt. There is an arroyo several hundred yards to the north but the flow in it is largely dispersed and infiltrated before reaching the site. A man-made channel about two feet wide diverts some of the remaining surface flow toward the disposal area. During the 1991 field work, however, there was little evidence of recent flow in the channel.

2.1.4 Biota

Vegetation at the Oscura site is sparse due to the low precipitation, high evaporation, and unfavorable soil conditions. Vegetation consists primarily of desert bunch grasses, such as grama and burrograss, which tend to grow in clumps, leaving large areas of barren soil. Ground cover vegetation also noted include mesquite, prickly pear cactus, yucca, cholla

cactus, and creosote bush. Where surface water flows intermittently, such as the area around the pond, vegetation is more dense.

Vegetation at the Red Rio site is somewhat less sparse than at the Oscura site probably due to slightly greater precipitation, cooler temperatures, and more favorable soil conditions. The area around the site is dominated by grama and muhly grasses, creosote, prickly pear and cholla cactus, mesquite, and juniper.

Fauna at the two sites are similar. Tables 2.1 and 2.2 list the fauna observed or in evidence during the February 1991 site visits. Other mammals not observed but likely to be present near the sites include coyote, kangaroo rats, cottontail rabbits, pocket gophers, prairie dogs, skunks, and porcupines. Additionally, bird species likely include varieties of dove, quail, warblers, falcons, and hawks. Reptiles include several varieties of lizards, such as whiptails, horned toads, and snakes, such as rattlesnakes and bullsnakes.

2.1.5 Land Use

The Oscura and Red Rio bombing and gunnery ranges are located within WSMR and are under the control of the U.S. Army Test and Evaluation Command. Both sites are used on a daily basis by aircraft and helicopters from all branches of U.S Armed Forces as practice air-to-ground gunnery, strafing, and bombing ranges. These ranges are located away from population centers and public land use areas, making them well suited for this purpose.

2.2 SITE USAGE AND OPERATIONS

This section summarizes burning, detonation, and burial operations at the Oscura and Red Rio practice bomb disposal sites. This information was determined from documents on file with WSMR, on-site interviews with staff of WSMR, Holloman Air Force Base, and

TABLE 2.1. Observed Fauna at the Oscura site, February 1991

Common Name	Genus Species
Antelope	Antilocapra Americana
Badger	Taxides taxus
Mule deer (tracks/scats)	Odocoileus hemionus
Wild Horses	
Ring Tailed Cat (tracks)	Bassaricus astutus
Black Tailed Jack Rabbit	Lepus californicus
Great Horned Owl (pellets)	Buba virginianus
Mexican Duck	Anas platyrhynchos
Lesser Scaup	Aythya affinis
Ash Throated Flycatcher	Mylarchus cinerascens
Black Throated Sparrow	Amphispiza bilineata
Western Kingbird	Tyrannus verticalis

TABLE 2.2. Observed Fauna at the Red Rio site, February 1991

Common Name	Genus Species
Antelope	Antilicapra americana
Ash Throated Flycatcher	Myiarchus cinerascens
Badger	Taxides taxus
House Wren	Troglodytes aedon
Says Phoebe	Sayornis saya
Gemsbok	Oryx gazella
Mule Deer (tracks/scats)	Odocoileus hemionus
Kill Deer	Charadrius vociferous
Mountain Plover	Chardadrius montanus
Blacktail Jack Rabbit (tracks)	Lepus californicus
Black Throated Sparrow	Amphispiza bilineata
Mouse	Peromyscus

Loral Aerospace (formerly Ford Aerospace), and subsequent telephone conversations. Table 2.3 lists the personnel interviewed. Background data identified to date for these sites are limited. However, several USAEHA documents were useful in providing general site information.

The U.S. Air Force uses several areas at WSMR for bombing and gunnery practice including the Oscura and Red Rio Ranges. Both of these sites are currently operated by Loral Aerospace under contract to Holloman Air Force Base. The Oscura site is used by training and tactical fighter aircraft for air-to-ground gunnery and strafing practice and for bombing practice.

TABLE 2.3. Individuals Interviewed for Site History Information.

Individual Interviewed	Affiliation	Date Interviewed*
D. Broka	Loral Aerospace	6/7
B. Andreoli	White Sands Missile Range	6/7-6/8, 8/16
L. Hoppes	Holloman Air Force Base	6/7-6/8
J. Kochefko	Holloman Air Force Base	8/16

*All interviews conducted in calendar year 1990.

The Red Rio Range is used by the U.S. Air Force for air-to-ground gunnery, bombing, and maneuver practice under simulated combat conditions. Both sites are utilized by the U.S. Air National Guard but to a lesser extent than the U.S. Air Force. Loral Aerospace and U.S. Air Force and Army personnel periodically police both sites for unexploded ordnance (UXO) and scrap metal. Historically, these materials were then brought to the practice bomb disposal areas for burning, detonation, and burial. Since 1988, these materials have been removed from the range and recycled (Broka 1990, personal communication).

2.2.1 Summary of Disposal Practices

Disposal pits utilized at the Oscura and Red Rio sites are elongate features, approximately 50 to 100 ft long, 15 to 30 ft wide, and from 10 to 15 ft deep (A.T. Kearney 1988; USAEHA 1988). The pits were probably excavated by bulldozer or front-end loader.

Disposal operations at both sites appear to have been similar. U.S. Air Force and Army Explosive Ordnance Disposal (EOD) personnel and range operations contractors periodically removed spent practice bombs, small arms ammunition, and scrap metal from the bombing ranges. Practice bombs with undetonated spotting charges and ammunition were placed in a pit at the disposal area and then detonated or burned (A.T. Kearney 1988; USAEHA 1988; Hoppes 1990, personal communication). In addition, it is possible that some live practice bombs and/or ammunition may have been detonated and burned at the surface prior to placement in a pit (USAEHA 1988). During the course of sample collection efforts, it was learned from EOD personnel that more recently, primer cord or other similar explosive was used to ensure that the spotting charges in the tips of practice bombs had detonated prior to removal from the range. The burned debris and residue as well as other wastes collected from the bombing ranges were placed in the pits then covered with approximately four inches of fill. Disposal operations were conducted in a progressive manner of layering until the pit was filled, at which time a new disposal pit was dug.

A Holloman Air Force Base staff member with experience at other open burning/open detonation pits claims that Air Force personnel may have used diesel fuel, kerosene, or other petroleum product and/or scrap wood to facilitate burning (Kochefko 1990, personal communication).

2.2.2 Possible Waste Types

Most of the material disposed at the two sites consisted of scrap metal from targets and practice bombs with white or red phosphorus spotting charges (A.T. Kearney 1988; USAEHA 1988; Hoppes 1990, personal communication). Additionally, air-to-ground rockets and small arms ammunition may have been buried. Wastes disposed probably included the following:

- Miscellaneous debris such as steel, aluminum, plastic, rubber, etc. from targets.
- Large, inert practice bombs consisting of a cast-iron jacket and concrete (BDU-500s).
- Smaller practice bombs consisting of steel bodies and plastic or aluminum fins with white or red phosphorus spotting charges (BDU-33 and -50, and Mark 82, 83, 84, 106, or 117).
- Two and three-quarter (2-3/4) inch rockets, composed of aluminum and steel, possibly containing propellent, and white phosphorus charges.
- Small arms ammunition (20 mm and 50 caliber).

Of the possible wastes listed above, BDU-33 and -500, Mark 106, and small arms ammunition were positively identified during the field investigation. At Oscura, a variety of miscellaneous debris from old helicopters, aircraft, and vehicles was also observed scattered around the site. At Red Rio, various ordnance-related debris, such as bomb retardation fins, was found.

Based on the above waste types, the following potential site contaminants were anticipated:

- Semivolatile organic compounds - as munitions constituents, byproducts of munitions burning, and as petroleum fuels possibly used to facilitate burning.

- Heavy metals - derived from practice bomb and other munitions construction materials. Also, heavy metals are constituents in some explosive compounds.

- Explosive organic compounds - possibly used in rockets, bombs, missiles, small arms ammunition, and in explosives used to detonate scrap practice bombs.

In addition, phosphorus used in spotting charges on practice bombs was considered to be a potential physical hazard.

2.2.3 Potential Migration Pathways

Contaminants, if present at the Oscura and Red Rio sites, could migrate from the sites via several pathways. If surface soil contamination exists, transportation from the site as windblown dust or by surface water flow is possible. Subsurface contaminants could be transported by the same means if erosion of pit cover material exposed waste materials. Surface or subsurface contaminants could also be leached and transported by meteoric water moving through these materials.

2.3 PREVIOUS INVESTIGATIONS

At least one and apparently two previous investigations have been performed at the Oscura and Red Rio practice bomb disposal areas. The first documented investigation of the Oscura and Red Rio sites was conducted in 1983 by USAEHA (1984, 1988). This investigation was part of a larger project to evaluate environmental impacts of open burning/open detonation sites at U.S. Army facilities nationwide. During this investigation, soil samples were collected at each of the two sites. Samples characterized as "burn pit soil" samples were apparently collected from active open burning/open detonation pits. Table 2.4 summarizes USAEHA's sample results.

Sample No. and Description		EP Toxicity*								Explosives†‡					
		As	Ba	Cd	Cr	Hg	Pb	Se	Ag	HMX	RDX	Tetryl	2,4,6-TNT	2,6-DNT	2,4-DNT
	Oscura														
4927-019	Burn Pit Soil	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
4729-020	Burn Pit Soil	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
4729-021	Burn Pit Soil	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
4729-022	Burn Pit Soil	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
4729-023	Burn Pit Soil	ND	ND	ND	ND	ND	ND	ND	ND	ND	4.7	ND	ND	ND	ND
4729-024	Burn Pit Soil	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
4729-025	Burn Pit Soil	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
4729-026	Burn Pit Soil	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
4729-027	Burn Pit Soil	ND	ND	ND	ND	ND	ND	ND	ND	ND	3.8	ND	ND	ND	ND
4729-029	Burn Pit Soil	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
4729-030	Burn Pit Soil	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	2.2
	Red Rio														
4729-031	Burn Pit Soil	ND	ND	ND	ND	ND	ND	ND	ND	ND	3.5	ND	ND	ND	ND
4729-032	Burn Pit Soil	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
4729-033	Burn Pit Soil	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
4729-034		ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
4729-035	Burn Pit Soil	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
4729-036	Burn Pit Soil	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
4729-037	Burn Pit Soil	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
4729-038	Burn Pit Soil	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
4729-039	Burn Pit Soil	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
4729-040	Burn Pit Soil	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
4729-041	Burn Pit Soil	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
4729-042	Burn Pit Soil	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND

ANALYTICAL LIMITS*

	As	Ba	Cd	Cr	Hg	Pb	Se	Ag
Detection Limit	0.5	10	0.1	0.5	0.02	0.5	0.1	0.5
RCRA Criteria Limit	5.0	100	1.0	5.0	0.2	5.0	1.0	5.0

* All units in mg/L
† All units in ug/g
‡ Detection limit for all explosives was 1.0 ug/g.
ND - not detected

TABLE 2.4. Analytical results for "Burn Pit Soil" samples collected at the Oscura and Red Rio practice bomb disposal areas, 1983 USAEHA investigation. Source: USAEHA 1984.

Reference to a second site investigation is made by an U.S. Environmental Protection Agency contractor in a RCRA Facility Assessment Report (A.T. Kearney 1988). The report makes reference to the soil sampling cited in the USAEHA (1988) evaluation which indicated elevated levels of barium at both sites based on EP Toxicity Protocol. Concentrations of barium reported were 2.4 ppm and 5.2 ppm at the Oscura and Red Rio sites, respectively. No other sampling or additional information regarding this investigation were provided. However, the reported concentrations of barium are well below the EP Toxicity standard of 100 ppm.

3.0 FIELD INVESTIGATION

The field activities in support of Oscura and Red Rio site evaluations took place in February through May 1991. The objectives of these evaluations are described in Section 1.3. Field activities at both sites included topographic and geophysical surveys, and surface and subsurface soil sampling. The topographic surveys were performed first and provided base maps from which site features could be accurately located. The geophysical surveys were used to locate buried wastes, and based on this information, the surface and subsurface soil sampling strategies were developed. Subsurface soil samples were collected from trenches excavated by backhoe.

Four project planning documents were prepared by CDM Federal Programs Corporation (FPC) prior to the start of field activities. Field investigations were performed in accordance with procedures and requirements described in these documents. Deviations from these procedures are described in Section 4.0. The Work Plan provides a description of the overall project approach. The Sampling and Analysis Plan contains specific, detailed protocol descriptions for field activities including equipment decontamination, sampling, sample labeling, sample handling, and documentation, as well as laboratory analytical methods and protocol. The Field Activity Quality Assurance Project Plan presents Quality Assurance/Quality Control requirements including procedures for ensuring precision, accuracy, representativeness, comparability, and completeness of data collected, as well as other elements designed to foster quality work. Finally, a Health and Safety Plan, included as an appendix to the Sampling and Analysis Plan, was developed to ensure protection of personnel present during the performance of the site investigations.

3.1 METHODS

3.1.1 Topographic Surveys

Following the delineation of the survey area boundaries and the establishment of horizontal and vertical control, aerial photographs of the Oscura and Red Rio practice bomb disposal areas were taken from which topographic maps could be prepared. The primary objectives for conducting topographic surveys of the sites were to provide horizontal and vertical control for locating features (e.g. buried waste and sampling locations) and to develop topographic base maps for use in the field and reporting of investigation results. Surveying, aerial photography, and preparation of topographic maps were tasked to Scanlon White, Inc., Las Cruces, New Mexico.

On February 25, 1991, FPC and Scanlon White Inc. personnel visited both sites. The survey area boundaries, as well as vertical and horizontal control points, were determined. Ground control targets were set in preparation for site overflight and aerial photography. The final boundaries of the survey were chosen to enclose all suspected waste burial locations. Evidence such as topographic mounds or depressions, disturbed soil and vegetation, reported locations of waste disposal pits, and analysis of historical aerial photographs were used to locate suspected waste burial areas.

Topographic base maps, at a scale of 1 in. = 50 ft were produced for each site (Plates 1 and 2). These maps were then used by FPC to illustrate the suspected locations of buried wastes, sampling trench locations, and other site features. Survey corner markers and various site landmarks were used to accurately locate these features.

3.1.2 Geophysical Surveys

Following the development of topographic base maps for the Oscura and Red Rio sites, geophysical surveys were conducted in late March and early April, 1991. The goal of the geophysical investigations was to locate and delineate buried wastes. Detailed geophysical surveys were necessary because of the lack of data available regarding the number, location, and sizes of pits used for burning or detonation and burial of practice bombs, small arms ammunition, and other wastes generated at the ranges. Information provided by this phase of the investigation aided in selection of sampling trench locations, calculation of estimated waste volumes, and evaluation of alternatives for site closure. Execution of the geophysical surveys, interpretation, and reporting of the results were tasked to Blackhawk Geosciences, Inc., Golden, Colorado. Geophysical investigations were conducted using two independent methods to provide confirmation of results. The first method used was electromagnetic profiling which measured the apparent differences in conductivity between metallics in the disposal trenches and the surrounding soils. The second method employed magnetic field measurements in which the presence of ferrous materials in the trenches affected the total magnetic field. Greater detail of these methods is provided in the individual geophysical reports for the Oscura and Red Rio sites prepared by Blackhawk Geosciences (Appendices A and B).

The total area surveyed by geophysical methods was greater at the Oscura site. Based on historical and physical evidence at Oscura, several separate waste burial locations were anticipated. Therefore, one large geophysical survey grid was employed (see Figure 1-1, Appendix A). One known trench existed at the Red Rio site and a geophysical survey grid was established over it. The Red Rio site also contained numerous smaller areas which exhibited disturbed soils and/or vegetation. These areas were also incorporated into the geophysical survey (see Figure 1-1, Appendix B). The grids laid out at each site established a uniform set of "stations" at which geophysical measurements were taken. Each grid was laid out using a compass and 300 ft fiberglass tape. North-south points were marked at 30 ft intervals and east-west points were marked at 50 ft intervals with labeled wooden stakes.

Intermediate measurement points at 10 ft intervals were marked on the ground with a spot by orange spray paint. Smaller areas at Red Rio suspected of having buried wastes had geophysical survey stations marked along a single grid line with perpendicular transects as necessary to accommodate the shape of the disturbances. All areas at Red Rio and the single large grid at Oscura had one or more grid nodes located with an auto-level and fiberglass tape by FPC personnel to link topographic and geophysical surveys to a single datum.

With the grids in place, Blackhawk personnel could begin the geophysical surveys. Electromagnetic profiling was performed with a portable Geonics EM-31 and magnetic field measurements were taken with a portable Geometrics 856. Readings were taken at each 10 foot grid node, and the data collected was periodically transferred to a portable computer. The computer's software was able to compile and contour the data such that burial locations could be determined on-site, if necessary.

Once the data were collected, all areas on the survey grids interpreted to be disposal pits were staked and marked with flagging by Blackhawk and FPC personnel. At each suspect area, the Geonics EM-31 in-phase component was measured at the interpreted boundary of the disposal pit, and when a significant anomaly was encountered, the interpreted boundary of the disposal pit was staked at that location.

3.1.3 Surface Soil Sampling Program

The objectives of the surface soil sampling program at the Oscura and Red Rio practice bomb disposal areas ~~was~~ were to determine the presence or absence of site-related contaminants in surface soils, and to provide preliminary information regarding the distribution and concentrations of contaminants, if present. This information is necessary to evaluate contaminant migration via wind and water erosion processes, contaminant leaching potential, potential risks to human health and the environment, and to determine site closure alternatives.

For the purpose of surface soil sample collection, each site was divided into four quadrants of equal area. The placement and dimensions of these quadrants was dependent upon the location of the buried wastes as determined by the geophysical investigations. The quadrants were defined relative to the existing geophysical survey grid and encompassed all suspected disposal pits at each site.

One composite surface soil sample was collected within each quadrant. Eight sub-areas were established within each quadrant with aliquots collected near the center of each sub-area. Aliquots were collected from the upper 0 to 2 inches of the soil. In addition, a single discrete sample was collected from a randomly selected sub-area within each quadrant. Plates 3 and 4 show the surface soil sampling quadrants. In keeping with the goal of identifying any contamination present, if suspected contaminated soil was identified based on visual evidence, odor, PID reading or other field criteria, grab samples were to be collected as necessary to augment the planned composite and discrete sample for that quadrant. During the surface sampling activities, however, no samples were collected based on those criteria.

In addition to surface soil samples collected, three grab samples representative of background conditions were collected near each site. Background sample locations were topographically higher than the practice bomb disposal areas and were located away from any suspected buried waste areas. Efforts were made to select a sampling location with a similar soil type as quadrant samples.

Each surface soil sample was assigned a sample identification number using a unique code which indicates the site, the investigation subtask (sampling media), sample location, and sample depth. An example sample identification code for a composite surface soil sample is shown below:

WSOR-SUR-Q1-0-2"

In this example, WSOR indicates the White Sands Oscura Range, SUR refers to a surface soil sample, Q1 identifies quadrant number one, and 0-2" refers to sampling depth. A discrete surface soil sample might be labeled:

WSOR-SUR-Q1/6-0-2"

Here, the "/6" indicates the sub-area from which the discrete sample was drawn.

Quality control samples represented at least 10% of all samples collected. In all, 13 surface soil samples were submitted for analysis from each site (26 total). Of these 13, one split and one co-located sample was collected at each site for quality control. A quality control sample might be labeled as follows:

WSOR-SUR-Q1/C-0-2"

In this example, the "/C" descriptor indicates that this is a co-located sample. A "/S" descriptor indicates that the sample is a split.

Background surface soil samples at both the Oscura and Red Rio sites are marked as quadrant "Q5" as shown below:

WSRR-SUR-Q5/2-0-2"

All three background surface soil samples collected at each site were collected as discrete samples. In this case the "/2" descriptor indicates a unique discrete sampling point.

Each surface soil composite subsample or aliquot was collected using a decontaminated stainless steel trowel. Aliquots of approximately equal volume for each composite sample were placed in a stainless steel mixing bowl. The stainless steel trowel was used to break up and mix the composite sample until homogenous. The soil was then spread evenly in the

bottom of the mixing bowl and one-liter, wide-mouth, glass sample jars were filled using the trowel. The sample label was attached and the jar placed on ice for shipment to the analytical laboratory under chain of custody.

The mixing bowl and trowels were decontaminated prior to use to minimize the chance of cross-contamination. This equipment was placed in a galvanized steel tub filled halfway with a laboratory-grade detergent and tap water solution and scrubbed with a brush and sponge. Another galvanized tub with plain tap water was used to rinse the equipment. A 55 gal drum with a dish rack suspended in it was used for final rinsing. Two plastic laboratory bottles, one filled with deionized water and the other filled with reagent-grade methanol, were used for final rinsing. A double deionized water rinse was followed by a methanol rinse and the equipment allowed to dry. Each piece was then covered with aluminum foil to indicate it as clean.

Surface soil samples were analyzed by the team subcontract laboratory, Thermo Analytical Inc. (TMA), using Environmental Protection Agency (EPA) method 8270 for RCRA semivolatile organic compounds, EPA methods 6010, 7060, 7471, and 7740, for RCRA metals, and U.S. Army Toxic and Hazardous Materials Agency (USATHAMA) methods LW17 and UW21 for explosive compounds. A summary of the analytical methods used is found in Table 3.1.

3.1.4 Subsurface Soil Sampling Program

The objective of subsurface soil sampling was to obtain and analyze geologic material from known depths in order to:

- Evaluate site subsurface conditions.
- Investigate the presence or absence of contaminants and, if present, the vertical extent.

TABLE 3.1. Summary of Analytical Methods for Surface and Subsurface Soil Samples.

Parameter	Sample Analysis Method
Metals	
Antimony	6010[1]
Arsenic	7060[1]
Barium	6010[1]
Cadmium	6010[1]
Chromium	6010[1]
Copper	6010[1]
Lead	6010[1]
Mercury	7471[1]
Nickel	6010[1]
Selenium	7740[1]
Silver	6010[1]
Thallium	6010[1]
Zinc	6010[1]
Semivolatile Organics	
All Target Compound List Analytes	8270[1]
Explosives	
2,4-Dinitrotoluene	LW17[2]
2,6-Dinitrotoluene	LW17[2]
HMX	LW17[2]
RDX	LW17[2]
Tetryl	LW17[2]
2,4,6-Trinitrotoluene	LW17[2]

References:

[1]U.S. EPA 1986. Office of Solid Waste Management, Test Methods for Evaluating Solid Wastes, SW-846, 3rd Edition. Washington, D.C.

[2]U.S. Army Toxic and Hazardous Materials Agency (USATHAMA), Aberdeen Proving Ground, MD 21010.

- Determine the potential for contaminant migration.

Subsurface samples were collected from trenches excavated adjacent to buried wastes. The potential for encountering unexploded ordnance (UXO) prevented deliberate excavation of uncharacterized waste materials. However, during excavation of several trenches, buried wastes were encountered. Trenches were excavated using a backhoe with composite sampling typically from the surface to a depth of 15 feet. A discrete sample was also collected at a depth of 15 feet or if wastes were encountered. Excavation equipment and operators were provided by WSMR EOD. Lithologic logging and sampling were conducted by FPC personnel.

Locations for the sampling trenches were selected based on the geophysical investigations. Trenches were generally excavated one or two feet outside the flagging demarcating a burial location. If buried wastes were encountered during excavation, the trench would be relocated several feet away.

Background and geophysical data indicated that more burning or detonation and disposal pits were used at the Oscura site than at the Red Rio location. In all, 16 suspected burial locations were identified within an area of about 10 acres at the Oscura site. Only one location was identified at the Red Rio site, although wastes are buried over an area of slightly more than one acre. Thirteen sampling trenches were excavated at Oscura and six at Red Rio, including a trench in a background location at each site. The existing geophysical survey grid was used to record the location of sampling trenches. Plates 5 and 6 show the subsurface soil sampling locations.

Samples were collected using a backhoe with individual samples usually composited over 0-10 and 11-15 foot intervals. At the base of each trench, a single discrete sample was collected. In keeping with the goal of identifying any contamination present, grab samples were collected of any suspected contaminated soil identified based on visual evidence, odor, PID reading, or other field criteria. On two occasions at Red Rio and once at Oscura, grab

samples were collected when buried wastes or other suspect materials were uncovered. Three background subsurface soil samples were collected as grab samples at depths of 5, 10, and 15 ft from a single trench excavated away from each site. The background trenches were excavated in a topographically higher location in an area representative of the surrounding soil conditions.

Each sample was designated using a unique code which indicates the site, sampling media, sample location, and sample depth. An example identification code for a subsurface soil sample is shown below:

WSRR-SUB-04-0-10'

WSRR indicates the White Sands Red Rio site, SUB refers to a subsurface soil sample, 04 refers to a sampling trench number, and 0-10' indicates the depth over which the sample was composited. A discrete sample is collected at a specific depth and might be labeled:

WSRR-SUB-02-15'

Here, the "15'" discriptor indicates discrete sample collection at a depth of 15 feet. Co-located and split samples use "/C" and "/S" descriptors, respectively, in the same manner as the surface soil samples.

Five aliquots collected at predetermined depths made up a composite sample. In the 0-10 foot interval, aliquots were collected every two feet and for the 11-15 foot interval, aliquots were taken every one foot of depth excavated. Aliquots were drawn with a stainless steel trowel directly from the backhoe bucket into the stainless mixing bowl. Care was exercised to ensure that the soil had not contacted excavating machinery and were representative of the desired depth. Trench depth was measured by EOD personnel during excavation using a fiberglass tape.

Decontamination procedures for the sampling equipment was identical to those used for surface soil sampling (Section 3.1.3). The backhoe bucket was decontaminated after each composite or discrete sample was collected. A lined evaporation pond and decontamination pad was constructed at each site. Decontamination began by spraying the backhoe bucket with a portable kerosene-heated steam cleaner. A water truck and tap water were provided by WSMR. A portable stainless steel, pressurized sprayer was then used to apply a laboratory-grade detergent and deionized water solution to the bucket. A stiff, long-handled brush was used to scrub the bucket. This was followed by another steam cleaning then a final rinse with deionized water from a plastic pressurized sprayer. Subsurface soil samples were analyzed for the same parameters as the surface soil samples by TMA (Table 3.1).

3.2 RESULTS

3.2.1 Geophysical Investigation

Oscura Site

As noted earlier in Section 3.1.2, two separate geophysical methods were used to locate buried wastes. Electromagnetic profiling measured both ground conductivity and the in-phase component and magnetic field measurements gauged variations in the total magnetic field. Contour maps of the data collected are available in the Blackhawk report prepared for the Oscura site (Appendix A). The interpreted buried waste locations are most clearly seen on contour maps of the in-phase component and total magnetic field, however, results of all three methods agreed well. Features on the ground conductivity contour map were less clearly defined possibly because this method is more affected by variations in soil properties (e.g. between disturbed and undisturbed soils).

At the Oscura site, sixteen separate areas were interpreted by Blackhawk Geosciences to be suspected waste burial locations (Appendix A, Figure 1-1). One of these areas, a square area of anomalous response on geophysical instruments (defined by 10E 450N, 10E 570N, 130E 570N, 130E 450N), is located near the center of the site. This area did not elicit the

same response on the geophysical instruments used as the other suspect locations. According to the Blackhawk report, the geophysical signature encountered in this area may be due to a different kind of buried waste, such as construction debris, or it may indicate similar waste as encountered elsewhere on site, but at a greater depth.

The volume encompassing buried wastes at the Oscura site is estimated to be 16,294 cu yds. Volume calculations are presented in Table 3.2. This estimate was based on the following assumptions:

1. The area covered by the buried wastes was assumed to be that staked during the geophysical survey. In actuality, staked areas slightly overestimate the area of buried waste due to the geophysical methods and approach used to identify buried waste areas.

2. Layers of wastes and intervening fill material were assumed to be about 8 ft thick and distributed uniformly within each staked area. This assumption is based on the areal extent of the buried wastes and the practical depth limits achievable with a bull dozer.

The geophysical investigation provided information used to select surface and subsurface sampling locations. The four surface soil sampling quadrants and thirteen subsurface sampling trench locations were selected based on the positions of the suspected buried wastes (Plates 3 and 5).

Red Rio Site

Although eleven suspect areas at the Red Rio site were investigated with geophysical methods, only one area proved to contain buried metallic wastes (Appendix B, Figure 1-1). Area 1 contains a single large trench about 100 x 500 ft whose existence was known prior to this investigation. All electromagnetic and magnetic field contour maps show clearly defined anomalies caused by buried wastes. Other anomalies noted at the site were attributed

TABLE 3.2. Estimated Volumes Encompassing Buried Wastes at the Oscura and Red Rio sites.

Waste Location	Approximate Area (ft^2)	Thickness (ft)	Volume (ft^3)	Volume (yd^3)
Oscura				
A	9,600	8	76,800	2,844
B	1,500	8	12,000	444
C	5,700	8	45,600	1,689
D	8,000	8	64,000	2,370
E	4,300	8	34,400	1,274
F	2,500	8	20,000	741
G	2,900	8	23,200	859
H	1,600	8	12,800	474
I	700	8	5,600	207
J	2,000	8	16,000	593
K	1,100	8	8,800	326
L	8,500	8	68,000	2,518
M	1,800	8	14,400	533
N	4,000	8	32,000	1,185
O	800	8	6,400	237
Subtotal	55,000		440,000	16,294
Anomalous Area	14,400	8	115,200	4,267
Total	69,400		555,200	20,561
Red Rio				
Large Disposal Trench	19,400	8	155,200	5,748

to buried wires, above ground electrical junction boxes, or guy wires attached to wooden poles.

The volume encompassing buried wastes at the Red Rio site is approximately 5,748 cu yds. This estimate was based on the same assumptions used for the Oscura site and the calculations are presented in Table 3.2.

The four surface soil sampling quadrants and six subsurface soil sampling trenches were selected based on the suspected location of wastes determined by the geophysical investigation, (Plates 4 and 6).

3.2.2 Surface Soil Sample Results

All samples collected were analyzed using EPA methods for metals and semivolatile organics and USATHAMA methods for explosives (Table 3.1). Since metals constitute a majority of the wastes disposed and are present in some explosives compounds, surface contamination by metals was considered to be a possibility. Analysis for semivolatile organic compounds was performed based on the suggestion that diesel or other similar fuel may have been used to facilitate the burning of wastes. Semivolatile compounds are also constituents of some munitions-related explosives. Explosive compounds were considered potential contaminants because they could be associated with some of the wastes disposed on-site or with materials used to detonate wastes.

Oscura Site

Of the six explosive compounds for which USATHAMA standard method analyses were performed, none were detected. The detection limits for explosive compounds are presented in Table 3.3. However, 1200 μg/kg of 2,4-dinitrotoluene (2,4-DNT) was identified in a single sample, WSOR-SUR-Q3/C-0-2" using Method 8270 for EPA Target Compound List (TCL) semivolatile organic compound analysis. WSOR-SUR-Q3/C-0-2" is a co-located sample with WSOR-SUR-Q3-0-2" and WSOR-SUR-Q3/S-0-2" was taken as a split sample.

TABLE 3.3. Detection Limits Achieved for Explosive Compounds (USATHAMA Methods) in Soil and Water Samples.

Parameter	Detection Limits (μg/kg)	
	Soil Samples	Water Samples
2,4-Dinitrotoluene	400	6.0
2,6-Dinitrotoluene	400	6.0
HMX	500	4.0
RDX	250	2.0
Tetryl	10,000	4.0
2,4,6-Trinitrotoluene	400	1.0

Neither of these field QC samples, however, contained detectable levels of 2-4-DNT, perhaps indicating that this compound is not widely dispersed but exists only in a discrete area or areas in the Q3 surface soil quadrant.

Three other TCL compounds, determined to be laboratory contaminants, were identified in the Oscura surface soil samples, as shown in Table 3.4. Typical detection limits achieved for all TCL compounds are presented in Table 3.5. The three compounds identified as laboratory contaminants are used as accelerators or plasticizers in rubber processing (Sax and Lewis 1987), and according to TMA, the analytical laboratory for this project, the compounds listed in Table 3.4 can occur as a result of sample or glassware contact with rubber products. These contaminants were also detected in laboratory blanks. The presence of these contaminants did not compromise the results for the other TCL compounds.

Table 3.6 is a listing of typical metal concentrations in soils of the western United States (Shacklette and Boerngen 1984). Table 3.7 presents the metal concentration results from the surface soil sampling at Oscura site. The mean of analytical results for background surface samples (labeled "Q5") were used to determine a ratio, R, comparing these background values to the metals concentration present in each sample. For all sample concentrations below detection limits, a value of one-half the detection limit for that sample was used to determine the R value.

TABLE 3.4. Summary of Semivolatile Organic Compounds Above Detection Limits in Oscura Surface Soil Samples, May 1991. Results in $\mu g/kg$. Detection limits are presented in Table 3.5.

Sample I.D.	Sample Date	N-Nitrosodiphenylamine	Di-n-Butylphthalate	bis(2-Ethylhexyl)Phthalate	Butylbenzylphthalate
WSOR-SUR-Q1-0-2"	05/07/91	----	470	85	----
WSOR-SUR-Q1/7-0-2"	05/07/91	----	1300	200	----
WSOR-SUR-Q2-0-2"	05/07/91	----	940	130	----
WSOR-SUR-Q2/4-0-2"	05/07/91	----	970	200	----
WSOR-SUR-Q3-0-2"	05/07/91	----	870	110	----
WSOR-SUR-Q3/3-0-2"	05/07/91	----	2100	180	----
WSOR-SUR-Q3/S-0-2"	05/07/91	----	370	93	----
WSOR-SUR-Q3/C-0-2"†	05/07/91	45[1]	1500	100	----
WSOR-SUR-Q4-0-2"	05/07/91	----	870	170	----
WSOR-SUR-Q4/5-0-2"	05/07/91	----	720	84	----
WSOR-SUR-Q5/1-0-2"	05/07/91	----	670	280	----
WSOR-SUR-Q5/2-0-2"	05/07/91	----	1700	3000	----
WSOR-SUR-Q5/3-0-2"	05/07/91	----	34	5J	----
WSOR-PND-6-8"	05/16/91	----	220	86	----

[1] Compound was not detected in laboratory blanks for this sample group but was detected in other sample group blanks.

† A concentration of 1,200 $\mu g/kg$ 2,4-dinitrotoluene was detected in this sample. This compound was not found in any other surface or subsurface sample.

J Estimated value, analyte detected below the sample quantitation limit

TABLE 3.5. Range of Detection Limits Achieved for Semivolatile Organic Compounds (EPA Methods) in Soil and Water Samples.

Compound	Range of Detection Limit Achieved		Compound	Range of Detection Limit Achieved		Compound	Range of Detection Limit Achieved	
	Soil Sample (µg/kg) ppb	Water Samples (µg/l) ppb		Soil Samples (µg/kg)	Water Samples (µg/l)		Soil Samples (µg/kg)	Water Samples (µg/l)
Phenol	30 - 35	10	4-Chloroaniline	30 - 35	10	4,6-Dinitro-2-methylphenol	200 - 240	50
Aniline	30 - 35	10	Hexachlorobutadiene	30 - 35	10	N-Nitrosodiphenylamine	30 - 35	50
bis(2-Chloroethyl)Ether	30 - 35	10	4-Chloro-3-methylphenol	30 - 35	10	4-Bromophenyl-phenylether	30 - 35	10
2-Chlorophenol	30 - 35	10	2-Methylnaphthalene	30 - 35	10	Hexachlorobenzene	30 - 35	10
1,3-Dichlorobenzene	30 - 35	10	Hexachlorocyclopentadiene	30 - 35	10	Pentachlorophenol	30 - 35	10 - 50
1,4-Dichlorobenzene	30 - 35	10	2,4,6-Trichlorophenol	30 - 35	10	Phenanthrene	30 - 35	10
Benzyl Alcohol	30 - 35	10	2,4,5-Trichlorophenol	30 - 35	10 - 50	Anthracene	30 - 35	10
1,2-Dichlorobenzene	30 - 35	10	2-Chloronaphthalene	30 - 35	10 - 50	Di-n-Butylphthalate	*	10
2-Methylphenol	30 - 35	10	2-Nitroaniline	30 - 35	10	Fluoranthene	30 - 35	10
bis(2-Chloroisopropyl)Ether	30 - 35	10	Dimethyl Phthalate	30 - 35	10 - 50	Pyrene	30 - 35	10
4-Methylphenol	30 - 35	10	Acenaphthylene	30 - 35	10	Butylbenzylphthalate	30 - 35	10
N-Nitroso-Di-n-Propylamine	30 - 35	10	3-Nitroaniline	200 - 240	50	3,3'-Dichlorobenzidine	61 - 71	20
Hexachloroethane	30 - 35	10	Acenaphthene	30 - 35	10	Benzo(a)anthracene	30 - 35	10
Nitrobenzene	30 - 35	10	2,4-Dinitrophenol	200 - 240	50	bis(2-Ethylhexyl)Phthalate	*	*
Isophorone	30 - 35	10	4-Nitrophenol	200 - 240	50	Chrysene	30 - 35	10
2-Nitrophenol	30 - 35	10	Dibenzofuran	30 - 35	10	Di-n-Octyl Phthalate	30 - 35	10
2,4-Dimethylphenol	30 - 35	10	2,4-Dinitrotoluene	30 - 35	10	Benzo(b)fluoranthene	30 - 35	10
Benzoic Acid	200 - 250	50	2,6-Dinitrotoluene	30 - 35	10	Benzo(k)fluoranthene	30 - 35	10
bis(2-Chloroethoxy)Methane	30 - 35	10	Diethylphthalate	30 - 35	10	Benzo(a)pyrene	30 - 35	10
2,4-Dichlorophenol	30 - 35	10	4-Chlorophenyl-phenylether	30 - 35	10	Indeno(1,2,3-cd)Pyrene	30 - 35	10
1,2,4-Trichlorobenzene	30 - 35	10	Fluorene	30 - 35	10	Dibenz(a,h)Anthracene	30 - 35	10
Naphthalene	30 - 35	10	4-Nitroaniline	200 - 240	10	Benzo(g,h,i)perylene	30 - 35	10

* Compound detected in all samples analyzed.

1 gal = 3783 gm = 3.785 l
1 l = 1000 gm = 1 kg

TABLE 3.6. Typical Metals Concentrations in Soils of the Western United States (mg/kg).

Element		Range	Mean
Aluminum	Al	5,000 - >100,000	74,000
Antimony	Sb	<1 - 2.6	0.62
Arsenic	As	<0.10 - 97	7.0
Barium	Ba	70 - 5,000	670
Beryllium	Be	<1 - 15	0.97
Cadmium	Cd	---	<1
Calcium	Ca	600 - 320,000	33,000
Chromium	Cr	3 - 2,000	56
Cobalt	Co	<3 - 50	9.0
Copper	Cu	2 - 300	27
Iron	Fe	1,000 - >100,000	26,000
Lead	Pb	<10 - 700	20
Magnesium	Mg	300 - >100,000	10,000
Manganese	Mn	30 - 5,000	480
Mercury	Hg	<0.01 - 4.6	0.065
Nickel	Ni	<5 - 700	19
Selenium	Se	<0.1 - 4.3	0.34
Silver	Ag	---	<1
Thallium	Tl	---	<50
Tin	Sn	<0.1 - 7.4	1.2
Uranium	U	0.68 - 7.9	2.7
Vanadium	Va	7 - 500	88
Zinc	Zn	10 - 2,100	65

SOURCE:

Shacklette, H.T., and Boerngen, J.G. 1984. *Element Concentrations in Soils and Other Surface Materials of the Conterminous United States*. U.S. Geological Survey, Professional Paper 1270.

TABLE 3.7. Surface Soil Metals Concentrations at the Oscura Site, May 1991. Results in mg/kg.

Sample I.D.	Sample Date	Antimony []	Antimony R	Arsenic []	Arsenic R	Barium []	Barium R	Cadmium []	Cadmium R	Chromium []	Chromium R	Copper []	Copper R	Lead []	Lead R
WSOR-SUR-Q1-0-2"	05/07/91	<4.07N	1.0	3.05	1.1	232.96	1.1	<0.41	1.0	15.56	1.1	27.26	1.1	26.25	1.7
WSOR-SUR-Q1/7-0-2"	05/07/91	11.21N	5.4	2.85	1.0	151.89	0.7	<0.41	1.0	7.75	0.5	11.72	0.5	16.11	1.0
WSOR-SUR-Q2-0-2"	05/07/91	6.13N	3.0	3.17	1.2	313.59	1.5	<0.41	1.0	14.40	1.0	16.34	0.6	13.38	0.9
WSOR-SUR-Q2/4-0-2"	05/07/91	<4.09N	1.0	2.66	1.0	221.88	1.0	<0.41	1.0	13.80	1.0	16.97	0.7	16.16	1.1
WSOR-SUR-Q3-0-2"	05/07/91	<4.09N	1.0	2.76	1.0	200.20	0.9	<0.41	1.0	11.44	0.8	14.71	0.6	11.34	0.7
WSOR-SUR-Q3/3-0-2"	05/07/91	6.13N	3.0	2.86	1.1	193.05	0.9	<0.41	1.0	12.97	0.9	15.93	0.6	13.79	0.9
WSOR-SUR-Q3/S-0-2"	05/07/91	9.15N	4.4	3.35	1.2	196.14	0.9	<0.41	1.0	12.91	0.9	19.00	0.7	11.89	0.8
WSOR-SUR-Q3/C-0-2"	05/07/91	15.29N	7.4	2.75	1.0	223.24	1.0	<0.41	1.0	15.19	1.1	14.98	0.6	11.93	0.8
WSOR-SUR-Q4-0-2"	05/07/91	7.07N	3.4	4.55	1.7	381.82	1.8	<0.51	1.2	22.53	1.6	33.84	1.3	25.66	1.7
WSOR-SUR-Q4/5-0-2"	05/07/91	7.07N	3.4	3.23	1.2	196.97	0.9	0.61	2.9	11.62	0.8	11.52	0.4	18.89	1.2
WSOR-PND-6-8"	05/16/91	6.83N	3.3	2.73	1.0	218.43N	1.0	<0.46	1.1	17.86	1.2	17.29	0.7	15.47	1.0
Background Sample Results															
WSOR-SUR-Q5/1-0-2"	05/07/91	<4.13N	1.0	2.89	1.1	213.84	1.0	<0.41	1.0	13.53	0.9	22.73	0.9	13.43	0.9
WSOR-SUR-Q5/2-0-2"	05/07/91	<4.16N	1.0	2.49	0.9	194.39	0.9	<0.42	1.0	11.33	0.8	29.11	1.1	14.86	1.0
WSOR-SUR-Q5/3-0-2"	05/07/91	<4.12N	1.0	2.78	1.0	240.21	1.1	<0.41	1.0	18.45	1.3	25.57	1.0	17.84	1.2
Mean Background/Std. Deviation		2.07/NA		2.72/0.21		216.15/23.0		0.21/NA		14.44/3.65		25.80/3.20		15.38/2.25	

Sample I.D.	Mercury []	Mercury R	Nickel []	Nickel R	Selenium []	Selenium R	Silver []	Silver R	Thallium []	Thallium R	Zinc []	Zinc R
WSOR-SUR-Q1-0-2"	0.027	1.4	28.48	0.8	<0.20	0.9	<0.51N	1.0	<0.20	0.9	60.63	0.9
WSOR-SUR-Q1/7-0-2"	0.027	1.4	16.31	0.5	<0.20	0.9	<0.51N	1.0	<0.20	0.9	37.10	0.6
WSOR-SUR-Q2-0-2"	0.025	1.3	30.64	0.9	<0.20	0.9	<0.51N	1.0	<0.20	0.9	50.36	0.8
WSOR-SUR-Q2/4-0-2"	0.032	1.6	25.56	0.7	<0.20	0.9	<0.51N	1.0	<0.20	0.9	50.92	0.8
WSOR-SUR-Q3-0-2"	0.023	1.2	26.56	0.8	<0.20	0.9	<0.51N	1.0	<0.20	0.9	47.29	0.7
WSOR-SUR-Q3/3-0-2"	0.025	1.3	26.56	0.8	<0.20	0.9	<0.50N	1.0	<0.20	0.9	50.46	0.8
WSOR-SUR-Q3/S-0-2"	0.023	1.2	25.41	0.7	<0.20	0.9	<0.51N	1.0	<0.20	0.9	47.97	0.7
WSOR-SUR-Q3/C-0-2"	0.019	1.0	26.50	0.8	<0.20	0.9	<0.51N	1.0	<0.20	0.9	51.38	0.8
WSOR-SUR-Q4-0-2"	0.019	1.0	41.41	1.2	<0.20	0.9	<0.51N	1.0	<0.20	0.9	213.13	3.2
WSOR-SUR-Q4/5-0-2"	0.015	0.8	15.15	0.4	<0.20	0.9	<0.51N	1.0	<0.20	0.9	412.12	6.2
WSOR-PND-6-8"	0.018	0.9	34.13	1.0	<0.23N	1.1	<0.57	1.1	<0.23N	1.1	59.50	0.9
Background Sample Results												
WSOR-SUR-Q5/1-0-2"	0.025	1.3	40.60	1.2	<0.21	1.0	<0.52N	1.0	<0.21	1.0	64.46	1.0
WSOR-SUR-Q5/2-0-2"	0.021	1.1	27.03	0.8	<0.21	1.0	<0.52N	1.0	<0.21	1.0	63.83	1.0
WSOR-SUR-Q5/3-0-2"	0.016	0.8	36.08	1.0	<0.21	1.0	<0.52N	1.0	<0.21	1.0	69.69	1.1
Mean Background/Std. Deviation	0.02/0.0045		34.57/6.91		0.11/NA		0.26/NA		0.11/NA		65.99/3.22	

[ ] Sample analyte concentration in mg/kg.
R Ratio of sample analyte concentration to average background levels (one-half of detection limit if not detected).
NA Standard deviation not calculated because analyte was undetected in at least one sample.
/ N Estimated value, spiked analyte recovery below control limits.

1 There were no surface soil metal concentrations at the Oscura site which exceeded ten times background, as shown in Table 3.7. Antimony values exceeded two times background in seven of ten samples and were above five times background in two of the ten. Cadmium exceeded two times average background only once. Background levels of antimony and cadmium, however, were all below detection limits, and since half the detection limit was used for the R calculations, the R values may be over- or underestimated. Zinc was present in two samples at concentrations exceeding two times background. In one of these samples zinc was present at a concentration greater than five times background. 2 All values for the metals analyzed, except antimony, were within the typical metals concentrations in soils of the western United States (Table 3.7).

3 In addition to the surface soil samples, a single sediment sample was collected in the dry pond west of the site. The metals concentrations in the sediments were within the ranges obtained for the surface soils at the site. Compared to the average surface soil background concentrations, only antimony was found to exceed two times background in this sediment sample. All other R values were closer to one.

Red Rio Site

Of the six explosive compounds for which analysis was performed, none were detected. Detection limits for explosives are presented in Table 3.3. As shown in Table 3.8, three TCL semivolatile compounds were identified in the Red Rio surface samples, but as with Oscura, the presence of these compounds is believed to be the result of contact with plastic or rubber tools or materials in the laboratory.

None of the surface soil samples collected at Red Rio contained greater than ten times average background for the metals analyzed, as shown in Table 3.9. Antimony, barium, lead, and selenium were found in one or more samples, at or slightly exceeding two times average background. Cadmium equaled or exceeded two times average background in six of 10 samples with two of these in excess of five times average background. Of the constituents analyzed, antimony and cadmium were found to exceed typical metals concentrations in soils of the western United States (Table 3.6).

TABLE 3.8. Summary of Semivolatile Organic Compounds Above Detection Limits in Red Rio Surface Soil Samples, April 1991. Results in μg/kg. Detection limits are presented in Table 3.5.

Sample I.D.	Sample Date	N-Nitrosodiphenylamine	Di-n-Butylphthalate	bis(2-Ethylhexyl)Phthalate	Butylbenzylphthalate
WSRR-SUR-Q1-0-2"	04/22/91	160	810	45	----
WSRR-SUR-Q1/7-0-2"	04/22/91	81	1600	44	----
WSRR-SUR-Q1/S-0-2"	04/22/91	----	----	46	----
WSRR-SUR-Q1/C-0-2"	04/22/91	----	62	25J	----
WSRR-SUR-Q2-0-2"	04/23/91	----	150	42	----
WSRR-SUR-Q2/1-0-2"	04/23/91	----	320	52	----
WSRR-SUR-Q3-0-2"	04/23/91	----	200	31	----
WSRR-SUR-Q3/5-0-2"	04/23/91	----	47	2400	----
WSRR-SUR-Q4-0-2"	04/23/91	35	180	250	----
WSRR-SUR-Q4/2-0-2"	04/23/91	----	170	47	----
WSRR-SUR-Q5/1-0-2"	04/22/91	34	360	81	----
WSRR-SUR-Q5/2-0-2"	04/22/91	35	290	59	----
WSRR-SUR-Q5/3-0-2"	04/22/91	----	390	77	----

J Estimated value, analyte detected below the sample quantitation limit

TABLE 3.9. Surface Soil Metals Concentrations at the Red Rio Site, April 1991. Results in mg/kg.

Sample I.D.	Sample Date	Antimony []	Antimony R	Arsenic []	Arsenic R	Barium []	Barium R	Cadmium []	Cadmium R	Chromium []	Chromium R	Copper []	Copper R	Lead []	Lead R
WSRR-SUR-Q1-0-2"	04/22/91	<4.17N	0.5	5.10	0.8	92.60	1.1	1.25	6.0	6.98	1.0	4.69	0.5	9.06	0.9
WSRR-SUR-Q1/7-0-2"	04/22/91	5.10N	1.2	4.18	0.7	83.08	1.0	1.22	5.8	6.22	0.9	4.99	0.5	16.00	1.7
WSRR-SUR-Q1/S-0-2"	04/22/91	8.34N	2.0	4.07	0.7	91.76	1.1	<0.42	1.0	6.47	1.0	4.59	0.5	22.0	2.3
WSRR-SUR-Q1/C-0-2"	04/22/91	8.32N	2.0	4.27	0.7	89.59	1.1	0.42	2.0	6.56	1.0	4.06	0.4	11.03	1.1
WSRR-SUR-Q2-0-2"	04/23/91	7.22N	1.7	5.26	0.9	102.06	1.2	0.41	2.0	7.22	1.1	3.09	0.3	7.32	0.8
WSRR-SUR-Q2/1-0-2"	04/23/91	4.12N	1.0	4.02	0.7	102.99	1.2	0.41	2.0	7.52	1.1	3.81	0.4	6.28	0.7
WSRR-SUR-Q3-0-2"	04/23/91	5.09N	1.2	4.58	0.8	101.73	1.2	<0.41	1.0	7.94	1.2	4.79	0.5	9.98	1.0
WSRR-SUR-Q3/5-0-2"	04/23/91	5.12N	1.2	4.1	0.7	98.77	1.2	0.41	2.0	7.27	1.1	4.92	0.5	7.99	0.8
WSRR-SUR-Q4-0-2"	04/23/91	<4.08N	0.5	5.40	0.9	127.42	1.5	<0.41	1.0	6.73	1.0	6.12	0.6	8.56	0.9
WSRR-SUR-Q4/2-0-2"	04/23/91	7.22N	1.7	5.68	0.9	202.27	2.4	<0.41	1.0	7.33	1.1	4.13	0.4	7.33	0.8
Background Sample Results															
WSRR-SUR-Q5/1-0-2"	04/22/91	<4.22N	0.5	6.55	1.1	78.78	1.0	<0.42	1.0	5.81	0.9	8.13	0.8	6.86	0.7
WSRR-SUR-Q5/2-0-2"	04/22/91	<4.07N	0.5	6.71	1.1	100.10	1.2	<0.41	1.0	8.65	1.3	12.00	1.2	16.58	1.7
WSRR-SUR-Q5/3-0-2"	04/22/91	8.34N	2.0	4.80	0.8	69.76	0.8	<0.42	1.0	5.74	0.9	10.22	1.0	5.42	0.6
Mean Background/Std. Deviation		4.16/NA		6.02/1.06		82.88/15.58		0.21/NA		6.73/1.66		10.12/1.94		9.62/6.07	

Sample I.D.	Mercury []	Mercury R	Nickel []	Nickel R	Selenium []	Selenium R	Silver []	Silver R	Thallium []	Thallium R	Zinc []	Zinc R
WSRR-SUR-Q1-0-2"	0.010	0.5	12.50	0.9	<0.21N	1.1	<0.52N	0.6	<0.21	0.4	30.94	0.9
WSRR-SUR-Q1/7-0-2"	0.007	0.4	13.25	0.9	<0.20N	1.0	<0.51N	0.6	<0.20	0.4	31.60	0.9
WSRR-SUR-Q1/S-0-2"	0.007	0.4	14.6	1.0	<0.21N	1.1	<0.52N	0.6	<0.21	0.4	30.97	0.9
WSRR-SUR-Q1/C-0-2"	0.012	0.6	11.45	0.8	<0.21N	1.1	<0.52N	0.6	<0.21	0.4	27.68	0.8
WSRR-SUR-Q2-0-2"	0.008	0.4	12.37	0.9	0.21N	2.1	0.52N	1.2	0.21	0.9	27.11	0.8
WSRR-SUR-Q2/1-0-2"	0.018	0.9	11.33	0.8	0.21N	2.1	0.51N	1.1	0.21	0.9	26.36	0.7
WSRR-SUR-Q3-0-2"	0.011	0.6	11.20	0.8	<0.20N	1.0	<0.51N	0.6	<0.20	0.4	30.45	0.9
WSRR-SUR-Q3/5-0-2"	0.010	0.5	11.27	0.8	<0.20N	1.0	<0.51N	0.6	<0.20	0.4	26.84	0.8
WSRR-SUR-Q4-0-2"	0.010	0.5	11.21	0.8	<0.20N	1.0	<0.51N	0.6	<0.20	0.4	27.32	0.8
WSRR-SUR-Q4/2-0-2"	0.019	1.0	11.35	0.8	<0.21N	1.1	<0.52N	0.6	<0.21	0.4	30.13	0.8
Background Sample Results												
WSRR-SUR-Q5/1-0-2"	0.018	0.9	12.67	0.9	<0.21N	1.1	0.84N	1.9	<0.21	0.4	32.52	0.9
WSRR-SUR-Q5/2-0-2"	0.022	1.1	18.31	1.3	<0.20N	1.0	<0.51N	0.6	0.31	1.3	47.81	1.3
WSRR-SUR-Q5/3-0-2"	0.011	0.6	11.47	0.8	<0.21N	1.1	<0.52N	0.6	<0.63	1.3	26.49	0.7
Mean Background/Std. Deviation	0.02/0.0056		14.15/3.65		0.10/NA		0.45/NA		0.24/NA		35.61/10.99	

[ ] Sample analyte concentration in mg/kg.
R Ratio of sample analyte concentration to average background concentration (one-half detection limit used for undetected analytes).
NA Standard deviation not calculated because analyte was undetected in at least one sample.
N Estimated value, spike recovery less than control limits.

All three background values for cadmium and selenium and two of three background values for antimony were below the limits of detection. Since R values were calculated using one-half the detection limit, the R values for these constituents may be over- or underestimated.

3.2.3 Subsurface Soil Sampling Results

All subsurface samples collected were analyzed for the same constituents using the same methods as those for the surface soil sampling. Subsurface lithology was recorded every 2 ft of depth when subsamples were collected. These descriptions are provided in Appendix C.

Oscura Site

Plate 5 shows the 13 sample trench locations at the Oscura site. Composite samples were collected over intervals of 0-10 ft and 11-15 ft and a discrete sample collected at 15 ft. Aliquots were taken at 2 ft and 1 ft intervals, respectively, for the 0-10 ft and 11-15 ft composite samples. In Trench 4, buried waste materials were discovered at a depth of 2 ft and a discrete sample taken.

As each aliquot was collected, a description of the soil encountered at that depth was recorded (see Appendix C). Typically, the upper 5 ft consisted of a brown clayey silt loam frequently containing roots and calcareous deposits such as nodules or stringers. Soil horizon development, even in what appeared to be undisturbed soils, was weak. The absence of calcareous features, however, seemed to be a good indicator as to whether a soil had been disturbed by site activities. From 5 to 10 ft the soils generally were a clayey silt which could contain varying amounts of sand as well as minor amounts of gravel (usually <5%). Calcareous features such as nodules and stringers or disseminated carbonate were common suggesting undisturbed soils. Below 10 ft, limestone pebbles and occasional cobbles became the predominant feature, varying from about 5% to 60% of the soil.

Table 3.10 lists the TCL semivolatile organic compounds found above detection limits in the Oscura subsurface samples. As with the surface soil samples, three semivolatile organic compounds associated with laboratory contamination were identified. The presence of these contaminants did not affect the results for the other TCL compounds. None of the explosive compounds for which analysis was performed were detected. The limits of detection for explosive compounds can be found in Table 3.3.

Metals concentrations detected in subsurface soil samples from the Oscura site can be found in Table 3.11. Two of the 42 samples contained silver concentrations in excess of ten times average background. Silver was also present in one sample between five and ten times background and in two samples between two and five times background. No silver concentrations exceeded the typical concentration for western U.S. soils and all were present at concentrations near the detection limit. Cadmium was detected in one sample at five times background but nine samples contained cadmium between two and five times average background. One sample contained cadmium slightly exceeding 1 mg/kg. All background concentrations obtained for both silver and cadmium, however, were below detection limits. The R values for these elements may be overestimated since this parameter was calculated using one-half the detection limit. Antimony and arsenic were found between two and three times average background in one sample each. Arsenic concentrations were well within the typical range for western U.S. soils. Most antimony concentrations, however, exceeded the typical range.

Red Rio Site

Subsurface lithologic logs for the Red Rio site are found in Appendix C. Soils at Red Rio were generally loamy in texture and medium or dark brown in color with some calcareous filaments and nodules. Soil horizons were poorly developed. Limestone gravel, less than 5 to 10%, was somewhat common at all depths.

TABLE 3.10. Summary of Semivolatile Organic Compounds Above Detection Limits in Oscura Subsurface Soil Samples, May 1991. Results in μg/kg. Detection limits are presented in Table 3.5.

Sample I.D.	Sample Date	N-Nitrosodiphenylamine	Di-n-Butylphthalate	bis(2-Ethylhexyl)Phthalate	Butylbenzylphahalate
WSOR-SUB-01-0-10'	05/08/91	----	1600	190	----
WSOR-SUB-01-11-15'	05/08/91	----	1100	150	----
WSOR-SUB-01-15'	05/08/91	----	1400	170	----
WSOR-SUB-02-0-10'	05/09/91	----	450	150	----
WSOR-SUB-02-11-15'	05/09/91	----	650	200	95
WSOR-SUB-02-15'	05/09/91	----	1000	320	220
WSOR-SUB-03-0-10'	05/09/91	----	330	160	270
WSOR-SUB-03-11-15'	05/09/91	----	660	210	420
WSOR-SUB-03-3-15'	05/09/91	----	----	160	----
WSOR-SUB-04-2'	05/10/91	----	2400	230	390
WSOR-SUB-04-0-10'	05/10/91	----	790	140	190
WSOR-SUB-04/S-0-10'	05/10/91	----	1200	300	770
WSOR-SUB-04/C-0-10'	05/10/91	----	540	190	580
WSOR-SUB-04-11-15'	05/10/91	----	490	140	510
WSOR-SUB-04-15'	05/10/91	----	1000	180	810
WSOR-SUB-05-5'	05/08/91	----	1900	340	----
WSOR-SUB-05-10'	05/08/91	----	850	110	----
WSOR-SUB-05-15'	05/08/91	----	720	83	----
WSOR-SUB-06-0-10'	05/10/91	----	----	240	----
WSOR-SUB-06-11-15'	05/10/91	----	960	170	65
WSOR-SUB-06-15'	05/10/91	----	750	430	91
WSOR-SUB-07-0-10'	05/13/91	----	650	110	----
WSOR-SUB-07-11-15'	05/13/91	----	620	83	----
WSOR-SUB-07-15'	05/13/91	----	560	150	----

TABLE 3.10. Summary of Semivolatile Organic Compounds Above Detection Limits in Oscura Subsurface Soil Samples, May 1991. Results in μg/kg. (continued)

Sample I.D.	Sample Date	N-Nitrosodiphenylamine	Di-n-Butylphthalate	bis(2-Ethylhexyl)Phthalate	Butylbenzylphahalate
WSOR-SUB-08-0-10'	05/14/91	----	380[2]	----	70[1,2]
WSOR-SUB-08-11-15'	05/14/91	----	870	340	----
WSOR-SUB-08/S-11-15'	05/14/91	----	530	73	----
WSOR-SUB-08/C-11-15'	05/14/91	----	570	170	----
WSOR-SUB-08-15'	05/14/91	----	500	110	----
WSOR-SUB-09-0-10'	05/14/91	----	1100	120	----
WSOR-SUB-09-11-15'	05/14/91	----	580	86	----
WSOR-SUB-09-15'	05/14/91	----	800	35	----
WSOR-SUB-10-0-10'	05/14/91	----	1000	150	----
WSOR-SUB-10-15'	05/15/91	----	150	----	----
WSOR-SUB-10-15'	05/15/91	----	270	86	----
WSOR-SUB-11-0-10'	05/15/91	----	310	63	----
WSOR-SUB-11-15'	05/15/91	----	230	----	----
WSOR-SUB-11-15'	05/15/91	----	340	49	----
WSOR-SUB-12-0-10'	05/15/91	----	270	58	----
WSOR-SUB-12/S-0-10'	05/15/91	----	280	40	----
WSOR-SUB-12-11-15'	05/16/91	----	290	110	----
WSOR-SUB-12-15'	05/16/91	----	360	110	----
WSOR-SUB-13-0-10'	05/16/91	----	160	51	----
WSOR-SUB-13-15'	05/16/91	----	630	57	----
WSOR-SUB-13-15'	05/16/91	----	700	110	----
WSOR-RIN-04*	05/10/91	----	----	3J	----

[1] - Compound was not detected in laboratory blanks of this sample group but was detected in other sample group blanks.
[2] - Estimated value, sample was extracted beyond maximum allowable holding times.
J - Estimated value, analyte detected below the sample quantitation limit.
*Rinsate water sample, results in μg/l.

TABLE 3.11. Subsurface Soil Metals Concentrations at the Oscura Site, May 1991. Results in mg/kg.

Sample I.D.	Sample Date	Antimony []	Antimony R	Arsenic []	Arsenic R	Barium []	Barium R	Cadmium []	Cadmium R	Chromium []	Chromium R	Copper []	Copper R	Lead []	Lead R
WSOR-SUB-01-0-10'	05/08/91	6.41N	0.8	2.46	0.9	170.94	0.7	<0.43	1.0	11.00	1.0	19.55	1.5	9.06	0.9
WSOR-SUB-01-11-15'	05/08/91	8.47N	1.0	2.75	1.0	200.21	0.9	<0.42	1.0	5.83	0.5	8.79	0.7	7.73	0.8
WSOR-SUB-01-15'	05/08/91	11.63N	1.4	3.38	1.3	299.15	1.3	<0.42	1.0	10.15	0.9	12.05	0.9	10.78	1.1
WSOR-SUB-02-0-10'	05/09/91	<4.31N	0.3	2.26	0.8	163.79	0.7	0.65	3.1	8.19	0.7	14.66	1.1	11.96	1.2
WSOR-SUB-02-11-15'	05/09/91	<4.18N	0.2	1.99	0.7	123.43	0.5	<0.42	1.0	6.49	0.6	8.47	0.6	7.64	0.8
WSOR-SUB-02-15'	05/09/91	<4.12N	0.2	1.44	0.5	142.27	0.6	<0.41	1.0	4.23	0.4	7.11	0.5	7.11	0.7
WSOR-SUB-03-0-10'	05/09/91	<4.21N	0.2	2.11	0.8	168.42	0.7	<0.42	1.0	7.37	0.6	8.32	0.6	8.53	0.9
WSOR-SUB-03-11-15'	05/09/91	<4.28N	0.3	1.82	0.7	231.02	1.0	0.86	4.1	5.13	0.5	7.06	0.5	8.13	0.9
WSOR-SUB-03-15'	05/09/91	<4.44N	0.3	1.56	0.6	183.33	0.8	<0.44	1.0	4.89	0.4	7.44	0.6	6.44	0.7
WSOR-SUB-04-2'	05/10/91	<4.37N	0.3	2.18	0.8	203.06	0.9	<0.44	1.0	13.10	1.2	14.30	1.1	13.54	1.4
WSOR-SUB-04-0-10'	05/10/91	9.77N	1.1	2.71	1.0	162.87	0.7	<0.43	1.0	7.60	0.7	9.34	0.7	7.93	0.8
WSOR-SUB-04/S-0-10'	05/10/91	<4.36N	0.3	2.83	1.1	161.22	0.7	<0.44	1.0	8.61	0.8	8.61	0.6	8.50	0.9
WSOR-SUB-04/C-0-10'	05/10/91	<4.31N	0.3	2.48	0.9	165.95	0.7	0.65	3.1	7.65	0.7	8.06	0.6	6.25	0.7
WSOR-SUB-04-11-15'	05/10/91	<4.46N	0.3	3.24	1.2	232.14	1.0	<0.45	1.1	7.92	0.7	7.92	0.6	7.48	0.8
WSOR-SUB-04-15'	05/10/91	<4.37N	0.3	2.19	0.8	154.10	0.7	<0.44	1.0	7.54	0.7	6.01	0.5	6.56	0.7
WSOR-SUB-06-0-10'	05/10/91	7.65N	0.9	2.73	1.0	229.51	1.0	<0.44	1.0	13.88	1.2	12.13	0.9	12.46	1.3
WSOR-SUB-06-11-15'	05/10/91	7.63N	0.9	2.83	1.1	122.0	0.5	<0.44	1.0	11.11	1.0	10.02	0.8	8.50	0.9
WSOR-SUB-06-15'	05/10/91	<4.36N	0.3	2.07	0.8	98.15	0.4	<0.44	1.0	5.78	0.5	7.31	0.6	7.20	0.7
WSOR-SUB-07-0-10'	05/13/91	12.44N	1.5	2.07	0.8	182.38N	0.8	<0.41	1.0	5.70	0.5	4.35	0.3	6.53N	0.7
WSOR-SUB-07-11-15'	05/13/91	11.48N	1.3	4.38	1.6	139.87N	0.6	1.04	5.0	5.95	0.5	6.37	0.5	7.10N	0.7
WSOR-SUB-07-15'	05/13/91	13.83N	1.6	1.81	0.7	126.60N	0.6	0.53	2.5	4.68	0.4	4.04	0.3	5.96N	0.6
Background Sample Results															
WSOR-SUB-05-5'	05/08/91	10.78N	1.3	3.66	1.4	233.84	1.0	<0.43	1.0	17.89	1.6	21.66	1.6	11.85	1.2
WSOR-SUB-05-10'	05/08/91	12.70N	1.5	2.22	0.8	172.49	0.8	<0.42	1.0	11.11	1.0	10.69	0.8	8.15	0.8
WSOR-SUB-05-15'	05/08/91	<4.11N	0.2	2.16	0.8	279.26	1.2	<0.41	1.0	5.13	0.5	7.39	0.6	8.83	0.9
Mean Background/Std. Deviation		8.51/NA		2.68/0.85		228.53/53.58		0.21/NA		11.38/6.38		13.25/7.47		9.61/1.97	

[ ] Sample analyte concentration in mg/kg.
R Ratio of sample analyte concentration to average background levels (one-half of detection limit used if analyte not detected).
NA Standard deviation not calculated because analyte was not detected in at least one sample.
N Estimated value, spiked analyte recovery below control limits.

TABLE 3.11. Subsurface Soil Metals Concentrations at the Oscura Site, May 1991. Results in mg/kg. (continued)

Sample I.D.	Mercury []	Mercury R	Nickel []	Nickel R	Selenium []	Selenium R	Silver []	Silver R	Thallium []	Thallium R	Zinc []	Zinc R
WSOR-SUB-01-0-10'	0.012	1.2	17.09	0.8	<0.21	1.0	<0.53N	1.0	<0.21	1.0	38.14	0.9
WSOR-SUB-01-11-15'	0.007	0.7	12.71	0.6	<0.21	1.0	1.59N	6.1	<0.21	1.0	23.20	0.6
WSOR-SUB-01-15'	0.013	1.3	17.97	0.8	<0.21	1.0	<0.53N	1.0	<0.21	1.0	36.26	09
WSOR-SUB-02-0-10'	0.016	1.6	23.71	1.1	<0.21N	1.0	<0.54N	1.0	<0.22	1.0	49.89	1.2
WSOR-SUB-02-11-15'	0.008	0.8	12.55	0.6	<0.21N	1.0	<0.52N	1.0	<0.21	1.0	53.35	1.3
WSOR-SUB-02-15'	0.008	0.8	8.25	0.4	<0.21N	1.0	<0.52N	1.0	<0.21	1.0	50.93	1.3
WSOR-SUB-03-0-10'	0.012	1.2	10.95	0.5	<0.21N	1.0	3.26N	12.5	<0.21	1.0	55.47	1.4
WSOR-SUB-03-11-15'	<0.005	0.3	10.70	0.5	<0.21N	1.0	<0.53N	1.0	<0.21	1.0	32.41	0.8
WSOR-SUB-03-15'	0.010	1.0	11.11	0.5	<0.22N	1.0	<0.56N	1.1	<0.22	1.0	47.56	1.2
WSOR-SUB-04-2'	<0.005	0.3	24.02	1.1	<0.22N	1.0	<0.55N	1.1	<0.22	1.0	48.14	1.2
WSOR-SUB-04-0-10'	<0.005	0.3	13.79	0.6	<0.22N	1.0	<0.54N	1.0	<0.22	1.0	53.53	1.3
WSOR-SUB-04/S-0-10'	0.009	0.9	14.16	0.6	<0.22N	1.0	<0.54N	1.0	<0.22	1.0	32.35	0.8
WSOR-SUB-04/C-0-10'	0.010	1.0	19.40	0.9	<0.22N	1.0	<0.54N	1.0	<0.22	1.0	23.81	0.6
WSOR-SUB-04-11-15'	0.013	1.3	14.51	0.7	<0.22N	1.0	<0.56N	1.1	<0.22	1.0	26.90	0.7
WSOR-SUB-04-15'	0.013	1.3	12.02	0.5	<0.22N	1.0	<0.55N	1.1	<0.22	1.0	24.81	0.6
WSOR-SUB-06-0-10'	0.014	1.4	25.14	1.2	<0.22N	1.0	<0.55N	1.1	<0.22	1.0	50.49	1.2
WSOR-SUB-06-11-15'	0.013	1.3	19.93	0.9	<0.22N	1.0	1.20N	4.6	<0.22	1.0	47.49	1.2
WSOR-SUB-06-15'	0.011	1.1	12.54	0.6	<0.22N	1.0	<0.55N	1.1	<0.22	1.0	23.88	0.6
WSOR-SUB-07-0-10'	0.009	0.9	12.44	0.6	<0.21N	1.0	<0.52N	1.0	<0.21	1.0	24.66	0.6
WSOR-SUB-07-11-15'	0.008	0.8	9.39	0.4	<0.21N	1.0	<0.52N	1.0	<0.21	1.0	20.46	0.5
WSOR-SUB-07-15'	0.013	1.3	9.57	0.4	<0.21N	1.0	<0.53N	1.0	<0.21	1.0	19.89	0.5
Background Sample Results												
WSOR-SUB-05-5'	0.017	1.7	30.17	1.4	<0.22	1.0	<0.54N	1.0	<0.22	1.0	56.57	1.4
WSOR-SUB-05-10'	0.016	1.6	16.93	0.8	<0.21	1.0	<0.53N	1.0	<0.21	1.0	35.24	0.9
WSOR-SUB-05-15'	0.009	0.9	18.48	0.8	<0.21	1.0	<0.51N	1.0	<0.21	1.0	30.18	0.7
Mean Background/Std. Deviation	0.01/0.0044		21.86/7.24		0.11/NA		0.26/NA		0.11/NA		40.66/14.01	

[ ] Sample analyte concentration in mg/kg.
R Ratio of sample analyte concentration to average background levels (one-half of detection limit used if analyte not detected).
NA Standard deviation not calculated because analyte was not detected in at least one sample.
N Estimated value, spiked analyte recovery below control limits.

TABLE 3.11. Subsurface Soil Metals Concentrations at the Oscura Site, May 1991. Results in mg/kg. (continued)

Sample I.D.	Sample Date	Antimony []	Antimony R	Arsenic []	Arsenic R	Barium []	Barium R	Cadmium []	Cadmium R	Chromium []	Chromium R	Copper []	Copper R	Lead []	Lead R
WSOR-SUB-08-0-10'	05/14/91	<4.26N	0.3	2.13	0.8	141.79N	0.6	<0.43	1.0	8.10	0.7	7.68	0.6	7.68N	0.8
WSOR-SUB-08-11-15'	05/14/91	20.06N	2.4	2.96	1.1	228.09N	1.0	<0.42	1.0	9.93	0.9	9.82	0.7	8.03N	0.8
WSOR-SUB-08/S-11-15	05/14/91	8.44N	1.0	5.70	2.1	173.0N	0.8	0.84	4.0	6.43	0.6	5.59	0.4	8.02N	0.8
WSOR-SUB-08/C-11-15	05/14/91	12.79N	1.5	2.35	0.9	147.12N	0.6	0.85	4.0	6.82	0.6	5.65	0.4	8.21N	0.9
WSOR-SUB-08-15'	05/14/91	11.70N	1.4	1.70	0.6	127.66N	0.6	<0.43	1.0	5.96	0.5	5.00	0.4	6.81N	0.7
WSOR-SUB-09-0-10'	05/14/91	11.62N	1.4	2.22	0.8	161.56N	0.7	<0.42	1.0	7.92	0.7	5.60	0.4	8.87N	0.9
WSOR-SUB-09-11-15'	05/14/91	11.46N	1.3	2.50	0.9	129.17N	0.6	<0.42	1.0	5.21	0.5	3.65	0.3	8.13N	0.8
WSOR-SUB-09-15'	05/14/91	12.97N	1.5	2.16	0.8	123.24N	0.5	<0.43	1.0	8.00	0.7	4.86	0.4	7.35N	0.8
WSOR-SUB-10-0-10'	05/14/91	7.62N	0.9	2.83	1.1	199.13N	0.9	<0.44	1.0	7.83	0.7	6.64	0.5	7.73N	0.8
WSOR-SUB-10-11-15'	05/15/91	12.17N	1.4	2.10	0.8	127.21N	0.6	<0.44	1.0	6.19	0.5	6.64	0.5	6.08N	0.6
WSOR-SUB-10-15'	05/15/91	11.04N	1.3	2.76	1.0	144.59N	0.6	0.55	2.6	9.16	0.8	16.78	1.3	7.40N	0.8
WSOR-SUB-11-0-10'	05/15/91	9.89N	1.2	2.75	1.0	150.55N	0.7	<0.44	1.0	11.76	1.0	12.86	1.0	9.67N	1.0
WSOR-SUB-11-11-15'	05/15/91	9.79N	1.2	2.61	1.0	139.28N	0.6	0.76	3.6	8.81	0.8	9.68	0.7	8.27N	0.9
WSOR-SUB-11-15'	05/15/91	9.86N	1.2	2.41	0.9	185.10N	0.8	<0.44	1.0	9.20	0.8	11.06	0.8	8.43N	0.9
WSOR-SUB-12-0-10'	05/15/91	7.50N	0.9	2.47	0.9	212.22N	09	<0.43	1.0	9.43	0.8	7.93	0.6	8.36N	0.9
WSOR-SUB-12/S-0-10'	05/15/91	8.57N	1.0	2.57	1.0	263.38N	1.2	<0.43	1.0	10.28	0.9	8.14	0.6	8.46N	0.9
WSOR-SUB-12-11-15'	05/16/91	15.12N	1.8	2.38	0.9	147.95N	0.6	<0.43	1.0	10.69	0.9	7.02	0.5	6.70	0.7
WSOR-SUB-12-15'	05/16/91	14.24N	1.7	1.97	0.7	254.11N	1.1	0.77	3.7	8.11	0.7	6.79	0.5	6.46	0.7
WSOR-SUB-13-0-10'	05/16/91	12.06N	1.4	2.63	1.0	166.67N	0.7	<0.44	1.0	13.38	1.2	12.28	0.9	10.09	1.0
WSOR-SUB-13-11-15'	05/16/91	11.60N	1.4	2.0	0.7	125.53N	0.5	<0.42	1.0	10.02	0.9	7.49	0.6	7.17	0.7
WSOR-SUB-13-15'	05/16/91	9.79N	1.2	2.18	0.8	161.04N	0.7	<0.44	1.0	7.73	0.7	8.27	0.6	8.38	0.9
WSOR-RIN-04*	05/10/91	<40		<1		5		<4		<7		68		125	
Mean Background		8.51		2.68		228.53		0.21		11.38		13.25		9.61	

*Rinsate water sample—results in mg/l
[ ] Sample analyte concentration in mg/kg.
R Ratio of sample analyte concentration to average background levels (one—half of detection limit used if analyte not detected).
N Estimated value, spiked analyte recovery below control limits.

TABLE 3.11. Subsurface Soil Metals Concentrations at the Oscura Site, May 1991. Results in mg/kg. (continued)

Sample I.D.	Mercury []	Mercury R	Nickel []	Nickel R	Selenium []	Selenium R	Silver []	Silver R	Thallium []	Thallium R	Zinc []	Zinc R
WSOR-SUB-08-0-10'	0.014	1.4	17.06	0.8	<0.21N	1.0	<0.53N	1.0	<0.21	1.0	31.66	0.8
WSOR-SUB-08-11-15'	<0.005	0.3	19.43	0.9	<0.21N	1.0	<0.53N	1.0	<0.21	1.0	37.06	0.9
WSOR-SUB-08/S-11-15'	<0.005	0.3	14.77	0.7	<0.21N	1.0	<0.53N	1.0	<0.21	1.0	26.90	0.7
WSOR-SUB-08/C-11-15'	<0.005	0.3	13.86	0.6	<0.21N	1.0	<0.53N	1.0	<0.21	1.0	28.14	0.7
WSOR-SUB-08-15'	<0.005	0.3	12.77	0.6	<0.21N	1.0	<0.53N	1.0	<0.21	1.0	23.40	0.6
WSOR-SUB-09-0-10'	<0.005	0.3	17.95	0.8	<0.21N	1.0	<0.53N	1.0	<0.21	1.0	36.85	0.9
WSOR-SUB-09-11-15'	0.005	0.5	11.46	0.5	<0.21N	1.0	<0.52N	1.0	<0.21	1.0	22.92	0.6
WSOR-SUB-09-15'	<0.005	0.3	14.05	0.6	<0.22N	1.0	<0.54N	1.0	<0.22	1.0	30.05	0.7
WSOR-SUB-10-0-10'	<0.005	0.3	19.59	0.9	<0.22N	1.0	<0.54N	1.0	<0.22	1.0	28.62	0.7
WSOR-SUB-10-11-15'	0.011	1.1	15.49	0.7	<0.22N	1.0	<0.55N	1.1	<0.22	1.0	24.12	0.6
WSOR-SUB-10-15'	0.009	0.9	15.45	0.7	<0.22N	1.0	<0.55N	1.1	<0.22	1.0	29.36	0.7
WSOR-SUB-11-0-10'	0.013	1.3	18.68	0.9	<0.22N	1.0	<0.55N	1.1	<0.22	1.0	40.0	1.0
WSOR-SUB-11-11-15'	<0.005	0.3	16.32	0.7	<0.22N	1.0	<0.54N	1.0	<0.22	1.0	33.51	0.8
WSOR-SUB-11-15'	0.007	0.7	18.62	0.9	<0.22N	1.0	<0.55N	1.1	<0.22	1.0	32.97	0.8
WSOR-SUB-12-0-10'	<0.005	0.3	16.08	0.7	<0.21N	1.0	0.86N	3.3	<0.21	1.0	29.9	0.7
WSOR-SUB-12/S-0-10'	<0.005	0.3	13.92	0.6	<0.21N	1.0	3.0N	11.5	<0.21	1.0	29.55	0.7
WSOR-SUB-12-11-15'	<0.005	0.3	14.04	0.6	<0.22NI	1.0	<0.54	1.0	<0.22N	1.0	26.13	0.6
WSOR-SUB-12-15'	<0.005	0.3	13.14	0.6	<0.22N	1.0	<0.55	1.1	<0.22N	1.0	27.38	0.7
WSOR-SUB-13-0-10'	0.006	0.8	19.74	0.9	<0.22N	1.0	<0.55	1.1	<0.22N	1.0	40.57	1.0
WSOR-SUB-13-11-15'	<0.005	0.3	16.88	0.8	<0.21N	1.0	<0.53	1.0	<0.21N	1.0	29.43	0.7
WSOR-SUB-13-15'	<0.005	0.3	16.32	0.7	<0.22N	1.0	<0.54	1.0	<0.22N	1.0	29.71	0.7
WSOR-RIN-04*	0.3		<20		<2		<5		<2		71	
Mean Background	0.01		21.86		0.11		0.26		0.11		40.66	

*Rinsate water sample—results in mg/l
[ ] Sample analyte concentration in mg/kg.
R Ratio of sample analyte concentration to average background levels (one-half of detection limit used if analyte not detected).
N Estimated value, spiked analyte recovery below control limits.

Plate 6 shows the location of sample trenches at Red Rio. In all, six trenches were excavated with composite samples typically taken over intervals of 0-10 ft and 11-15 ft and a discrete sample collected at 15 ft. While excavating Trench 2, a critical weld on the backhoe broke forcing an interruption in sampling. As a result, composite samples were collected over intervals 0-6 ft and 8-10 ft. Buried waste materials were encountered at 3 ft and 7 ft in Trench 3 and, as a precaution, excavation was stopped. One 0-6 ft composite sample as well as discrete samples at 3 ft and 7 ft were collected. The material exposed at 3 ft appeared to be a metal fin of a practice bomb and soil discolored by the oxidizing metal. According to the EOD personnel on-site, this feature has been observed at other munitions burial sites. At a depth of 7 ft, blackened and rusted BDU-33 practice bombs and what appeared to be fins from a larger bomb, possibly a BDU-500, were uncovered.

As before, no explosive compounds were found above detection limits. These limits of detection are noted in Table 3.3. Table 3.12 lists the TCL semivolatile organic compounds found above detection limits in the Red Rio subsurface samples. As described earlier, these compounds occurred as a result of laboratory contamination and did not affect the results for the other TCL compounds for which analysis was performed.

Table 3.13 lists the metals concentrations for the Red Rio subsurface samples. All 18 subsurface samples contained copper concentrations exceeding two times average background. Similarly, lead exceeded two times background in 15 of 18 samples with two of these exceeding five times but none exceeding ten times background. Zinc was present in one sample greater than ten times background and in one sample between two and five times background. Chromium was found in one sample between five and ten times background. With the exception of antimony concentrations in a few samples, none of the metal and arsenic concentrations exceeded typical ranges for western U.S. soils.

TABLE 3.12. Summary of Semivolatile Organic Compounds Above Detection Limits in Red Rio Subsurface Soil Samples, April 1991. Results in μg/kg. Detection limits are presented in Table 3.5.

Sample I.D.	Sample Date	N-Nitrosodiphenylamine	Di-n-Butylphthalate	bis(2-Ethylhexyl)Phthalate	Butylbenzylphthalate
WSRR-SUB-01-0-10"	04/24/91	----	730	43	----
WSRR-SUB-01-11-15"	04/24/91	----	----	35	----
WSRR-SUB-01-15"	04/24/91	----	780	54	----
WSRR-SUB-02-0-6"	04/24/91	----	1400	56	----
WSRR-SUB-02/S-0-6"	04/24/91	----	1000	56	----
WSRR-SUB-02/C-0-6"	04/24/91	----	1700	94	----
WSRR-SUB-02-8-10"	04/26/91	----	240	75	----
WSRR-SUB-02-15"	04/26/91	----	----	----	----
WSRR-SUB-02-11-15"	04/26/91	----	180	34	----
WSRR-SUB-03-3"	04/26/91	----	280	64	----
WSRR-SUB-03-7"	04/26/91	----	350	77	----
WSRR-SUB-03-0-6"	04/26/91	----	320	150	----
WSRR-SUB-04-0-10"	04/26/91	----	290	110	----
WSRR-SUB-04-11-15"	04/26/91	----	230	62	----
WSRR-SUB-04-15"	04/26/91	----	180	65	----
WSRR-SUB-05-5"	04/23/91	51	160	34	----
WSRR-SUB-05-10"	04/23/91	70	370	59	----
WSRR-SUB-05-15"	04/23/91	----	190	56	----
WSRR-SUB-06-0-10"	04/27/91	----	200	83	----
WSRR-SUB-06-11-15"	04/27/91	----	----	----	----
WSRR-SUB-06-15"	04/27/91	----	110	----	----
WSRR-RIN-03*	04/26/91	----	14	2J	----

J - Estimated values, analyte detected below the sample quantitation limit
*Rinsate water sample-results in μg/l

TABLE 3.13. Subsurface Soil Metals Concentrations at the Red Rio Site, April 1991. Results in mg/kg.

Sample I.D.	Sample Date	Antimony []	Antimony R	Arsenic []	Arsenic R	Barium []	Barium R	Cadmium []	Cadmium R	Chromium []	Chromium R	Copper []	Copper R	Lead []	Lead R
WSRR-SUB-01-0-10'	04/24/91	<4.33N	0.3	2.92	0.8	98.92	1.5	<0.43	0.8	5.41	0.8	5.63	3.5	5.30	2.0
WSRR-SUB-01-11-15'	04/24/91	<4.43N	0.3	4.87	1.4	115.17	1.7	<0.44	0.8	5.20	0.8	10.74	6.6	8.86	3.4
WSRR-SUB-01-15'**	04/24/91	<4.46N	0.3	3.24	0.9	121.65	1.8	<0.45	0.8	6.25	1.0	8.82	5.4	8.59	3.3
WSRR-SUB-02-0-6'	04/24/91	<4.45N	0.3	4.45	1.3	123.61	1.8	<0.45	0.8	6.68	1.0	6.01	3.7	6.79	2.6
WSRR-SUB-02/S-0-6'	04/24/91	<4.51N	0.3	3.49	1.0	120.63	1.8	<0.45	0.8	7.33	1.1	6.54	4.0	6.31	2.4
WSRR-SUB-02/C-0-6'	04/24/91	6.726N	0.9	3.59	1.0	130.04	1.9	<0.45	0.8	6.39	1.0	8.74	5.4	6.84	2.6
WSRR-SUB-02-8-10'	04/26/91	5.49N	0.7	2.64	0.8	118.68	1.8	<0.44	0.8	6.81	1.0	9.56	5.9	18.79	7.2
WSRR-SUB-02-11-15'	04/26/91	6.51N	0.8	2.82	0.8	126.90	1.9	<0.43	0.8	6.40	1.0	7.48	4.6	8.68	3.3
WSRR-SUB-02-15'	04/26/91	<4.33N	0.3	2.71	0.8	139.76	2.1	0.65	2.3	5.96	0.9	13.76	8.5	10.08	3.8
WSRR-SUB-03-3'	04/26/91	<4.72N	0.3	2.24	0.6	87.97	1.3	<0.47	0.8	38.44	5.9	242.92	150.0	7.67	2.9
WSRR-SUB-03-7'	04/26/91	<4.71N	0.3	2.36	0.7	87.75	1.3	<0.47	0.8	6.36	1.0	12.49	7.7	20.97	8.0
WSRR-SUB-03-0-6'	04/26/91	<4.65N	0.3	2.67	0.8	103.26	1.5	<0.47	0.8	7.67	1.2	13.14	8.1	10.81	4.1
WSRR-SUB-04-0-10'	04/26/91	6.86N	0.9	2.06	0.6	78.97	1.2	<0.46	0.8	5.94	0.9	6.74	4.2	5.60	2.1
WSRR-SUB-04-11-15'	04/26/91	6.80N	0.9	1.93	0.6	65.87	1.0	<0.45	0.8	4.76	0.7	6.80	4.2	5.22	2.0
WSRR-SUB-04-15'	04/26/91	<4.56N	0.3	2.39	0.7	71.95	1.1	<0.46	0.8	5.47	0.8	5.93	3.7	4.45	1.7
WSRR-SUB-06-0-10'	04/27/91	5.72N	0.7	2.40	0.7	102.17	1.5	<0.46	0.8	6.75	1.0	8.12	5.0	6.41	2.4
WSRR-SUB-06-11-15'	04/27/91	6.97N	0.9	2.21	0.6	86.18	1.3	<0.46	0.8	6.62	1.0	15.80	9.8	4.60	1.8
WSRR-SUB-06-15'	04/27/91	8.06N	1.0	2.42	0.7	92.28	1.4	<0.46	0.8	6.34	1.0	7.60	4.7	4.03	1.5
WSRR-RIN-03*	04/26/91	<40N		<1		<1		<4		<7		21		<5	
Background Sample Results															
WSRR-SUB-05-5'	04/23/91	7.47N	1.0	3.09	0.9	48.24	0.7	0.43	1.5	4.70	0.7	0.53	0.3	1.81	0.7
WSRR-SUB-05-10'	04/23/91	8.49N	1.1	3.50	1.0	76.75	1.1	<0.42	0.8	6.90	1.1	1.80	1.1	2.76	1.1
WSRR-SUB-05-15'	04/23/91	7.41N	1.0	3.81	1.1	78.31	1.2	<0.42	0.8	8.04	1.2	2.54	1.6	3.28	1.3
Mean Background/Std. Deviation		7.79/0.61		3.47/0.36		67.77/16.93		0.28/NA		6.55/1.70		1.62/1.02		2.62/0.75	

* Rinsate Water Sample, Results in ug/l.
[ ] Sample analyte concentration, in mg/kg.
R Ratio of sample analyte concentration to average background level (one-half of the detection limit used for undetected sample analyte).
NA Standard deviation not calculated because analyte was not detected in at least one sample.
N Estimated value, spike recovery below control limits.

TABLE 3.13. Subsurface Soil Metals Concentrations at the Red Rio Site, April 1991. Results in mg/kg. (continued)

Sample I.D.	Mercury []	Mercury R	Nickel []	Nickel R	Selenium []	Selenium R	Silver []	Silver R	Thallium []	Thallium R	Zinc []	Zinc R
WSRR-SUB-01-0-10'	0.006	0.8	11.90	1.1	<0.22N	1.0	<0.54N	1.0	<0.22	1.0	23.38	1.1
WSRR-SUB-01-11-15'	0.010	1.3	12.18	1.1	<0.22N	1.0	<0.55N	1.0	<0.22	1.0	29.24	1.4
WSRR-SUB-01-15'**	0.006	0.8	12.28	1.1	<0.22N	1.0	<0.56N	1.0	<0.22	1.0	31.58	1.5
WSRR-SUB-02-0-6'	0.007	0.9	13.36	1.2	<0.22N	1.0	<0.56N	1.0	<0.22	1.0	31.85	1.5
WSRR-SUB-02/S-0-6'	0.006	0.8	23.68	2.1	<0.23N	1.0	<0.56N	1.0	<0.23	1.0	32.47	1.5
WSRR-SUB-02/C-0-6'	0.006	0.8	15.70	1.4	<0.22N	1.0	<0.56N	1.0	<0.22	1.0	31.73	1.5
WSRR-SUB-02-8-10'	<0.005	0.3	31.87N	2.8	<0.22N	1.0	<0.55	1.0	<0.22	1.0	28.90	1.3
WSRR-SUB-02-11-15'	<0.005	0.3	11.93N	1.1	<0.22N	1.0	<0.54	1.0	<0.22	1.0	28.09	1.3
WSRR-SUB-02-15'	<0.005	0.3	13.00N	1.1	<0.22N	1.0	<0.54	1.0	<0.22	1.0	29.58	1.4
WSRR-SUB-03-3'	<0.006	0.4	17.69N	1.6	<0.24N	1.0	<0.59	1.1	<0.24	1.1	942.22	43.6
WSRR-SUB-03-7'	<0.006	0.4	14.13N	1.2	<0.24N	1.0	<0.59	1.1	<0.24	1.1	36.51	1.7
WSRR-SUB-03-0-6'	<0.006	0.4	22.09N	1.9	<0.23N	1.0	<0.58	1.1	<0.23	1.0	46.63	2.2
WSRR-SUB-04-0-10'	<0.006	0.4	11.43N	1.0	<0.23N	1.0	<0.57	1.1	<0.23	1.0	20.80	1.0
WSRR-SUB-04-11-15'	<0.006	0.4	11.34N	1.0	<0.23N	1.0	<0.57	1.1	<0.23	1.0	21.32	1.0
WSRR-SUB-04-15'	<0.006	0.4	21.66N	1.9	<0.23N	1.0	<0.57	1.1	<0.23	1.0	19.38	0.9
WSRR-SUB-06-0-10'	<0.006	0.4	12.59N	1.1	<0.23N	1.0	<0.57	1.0	<0.23	1.0	25.63	1.2
WSRR-SUB-06-11-15'	<0.006	0.4	9.29N	0.8	<0.23N	1.0	<0.58	1.0	<0.23	1.0	16.30	0.8
WSRR-SUB-06-15'	<0.006	0.4	12.67N	1.1	<0.23N	1.0	<0.58	1.0	<0.23	1.0	19.24	0.9
WSRR-RIN-03*	<0.2		380		<2		<5		<2		100	
Background Sample Results												
WSRR-SUB-05-5'	0.005	0.3	8.54	0.8	<0.21N	1.0	<0.53N	1.0	<0.21	1.0	16.86	0.8
WSRR-SUB-05-10'	0.007	0.9	12.74	1.1	<0.21N	1.0	<0.53N	1.0	<0.21	1.0	23.25	1.1
WSRR-SUB-05-15'	0.015	1.9	12.70	1.1	<0.21N	1.0	<0.53N	1.0	<0.21	1.0	24.76	1.1
Mean Background/Std. Deviation	0.008/0.0053		11.33/2.41		0.11/NA		0.27/NA		0.11/NA		21.62/4.19	

* Rinsate Water Sample, Results in ug/l.
[ ] Sample analyte concentration, in mg/kg.
R Ratio of sample analyte concentration to average background level (one-half of the detection limit used for undetected sample analyte).
NA Standard deviation not calculated because analyte was not detected in at least one sample.
N Estimated value, spike recovery below control limits.

The highest concentrations of chromium (38.4 ppm), copper (150.0 ppm), and zinc (942.2 ppm) were found in WSRR-SUB-03-3'. As mentioned earlier, waste material including oxidized metal, was incorporated into this sample. The aforementioned is the likely source of the elevated chromium, copper, and zinc in this sample.

While no direct comparison can be made between surface and subsurface sample results a review of the data suggests that the average subsurface background metals concentrations may be unrepresentative of site conditions because they are unusually low and the average surface background may be relatively high. All the subsurface samples contained copper and most contained lead at least two times above the average background levels. In the surface soil samples, however, R values for all copper and seven of ten of the lead values were less than one. These data suggest natural variability in the background concentrations of copper and lead may account for the results obtained.

4.0 QUALITY ASSURANCE/QUALITY CONTROL

All work associated with the investigation and reporting for the Oscura and Red Rio sites was conducted according to quality assurance procedures outlined in the Quality Assurance Project Plan (QAPjP) (FPC, August 1990), the Field Activities Quality Assurance Project Plan (FAQAPjP) (FPC, February 1991), and the FPC EMO Quality Assurance Program Plan (QAPP) (FPC, June 1990). Procedures specific to sampling and laboratory analysis are described in the Sampling and Analysis Plan (SAP) (FPC, February 1991).

All quality assurance/quality control (QA/QC) activities were conducted under the direction of the FPC Quality Assurance Manager. Documents which describe procedures as well as those which govern quality assurance have been subject to QA review and approval. All documents generated have received technical review and approval.

Quality assurance field surveillances were conducted by both FPC and EMO staff during sampling activities at the Red Rio site. These surveillances resulted in recommendations for minor changes to field procedures which were immediately implemented. No formal corrective actions were necessary. Surveillance reports are included in Appendix D.

A quality assurance audit was conducted by FPC QA staff on each of TMA's laboratories conducting samples analyses. TMA's facilities, staff, and procedures were found to be generally acceptable. Copies of the audit reports and completion notices are presented in Appendix D.

Laboratory data review and validation were conducted by FPC in accordance with procedures described in the FAQAPjP. Data validation checklists have been provided under separate cover with the raw analytical data. Findings and resulting actions are summarized in this section.

4.1 FIELD ACTIVITIES QA/QC

Quality assurance and quality control procedures for field activities are described in the above referenced governing documents. These documents describe project team organization, operation and calibration of field instruments, sampling and analytical procedures, data quality objectives, and other issues relevant to the conduct of field work at the Oscura and Red Rio practice bomb disposal sites. Any deviations from the procedures prescribed in the governing documents were documented in the field notebook. These exceptions are described in Appendix E.

Data quality objectives (DQOs) for field work, established in the FAQAPjP were met or exceeded in all cases. Topographic surveying resulted in site maps with a one-foot control interval for both sites. Data produced during geophysical investigations, as well as experience gained during subsurface investigations, suggest a horizontal resolution of geophysical survey data meeting or exceeding the five-foot objective (i.e., waste locations were identified with a resolution of five feet or less). In several sampling trenches waste materials were encountered near the waste boundary located by geophysical methods.

4.2 FIELD QC SAMPLING DATA

Field QC samples consisting of sample splits, co-located samples, and decontamination rinsate samples were collected at a minimum frequency of one in every 10 samples (per matrix). Sample splits were collected at a frequency of one in every 20 samples or greater (per matrix). Co-located samples were collected at a frequency of nearly one in every 20 samples (per matrix). The FAQAPjP stated one decontamination rinsate sample would be collected at the Oscura site and one at the Red Rio site. This requirement was satisfied.

Split samples allowed a check on laboratory methods of analysis, taking into account natural variability in the sampled medium. Splits were collected by splitting a single sample into two parts after thorough mixing. Sample mixing was accomplished using a decontaminated stainless steel bowl and trowel. The material was then placed into appropriately labeled sample jars.

Co-located samples provided information to evaluate the cumulative effects of the precision of the field sampling method (sampling variability), the heterogeneity of the sample matrix at a sampling location, and the precision of laboratory methods of analysis. Co-located samples were collected concurrently and at locations adjacent to the original samplings. At least one co-located sample was collected during surface and subsurface soil sampling at each the Oscura and Red Rio sites.

Decontamination rinsate samples consisted of rinsate water (deionized) from the final stage of decontamination of the sampling trowels, mixing bowls, and backhoe bucket. Rinsate samples were collected during the subsurface soil sampling program. At least one decontamination rinsate sample was collected during sampling at each the Oscura and Red Rio sites. Analytical results from decontamination rinsate samples allowed a determination of the effectiveness of decontamination procedures.

4.2.1 Split and Co-Located QA/QC Analyses

The split and co-located sample data were analyzed for field and laboratory technique precision and sample homogeneity using relative percent difference (RPD). RPD is calculated using the following formula:

$$\mathbf{RPD} = \frac{D_1 - D_2}{(D_1 + D_2)/2} \times 100$$

Where RPD = relative percent difference
D_1 = the larger of the two values
D_2 = the smaller of the two values

To calculate RPD values for samples that had parameter concentrations reported as undetected, a value of one-half the detection limit was used in the equation.

A control limit of 35% RPD was used to evaluate split and co-located samples. Split samples with parameter RPD values greater than 35% may indicate significant soil heterogeneity or that values reported for this parameter on other samples collected and analyzed within the same batch are uncertain due to low precision in laboratory methods. Co-located samples with RPD values greater than 35% could result from a significant degree of non-homogeneity (heterogeneity) of the material at the sample location or variability in sampling or laboratory methods.

Split Samples

A total of six soil samples were collected as split samples (2 surface and 4 subsurface). Each sample was analyzed for RCRA metals, explosives, and semivolatile organic compounds (Table 3.1). Neither explosive compounds nor semivolatile compounds (except confirmed laboratory contaminants described in Section 3.2) were detected in split samples or the original samples from which they were derived. Therefore, analysis of laboratory analytical data for split samples is limited to the 13 RCRA metals.

Analytical results for a total of 78 parameters (13 metals for each of 6 split samples) were evaluated with respect to a RPD control limit of 35%. This control limit value was exceeded in 14 of the 78 tests for a success rate of 82% (Table 4.1). This value is considered to be acceptable considering the inherent heterogeneity of soil samples and the laboratory duplicate control limit of 35%. Additionally, it should be noted that in 6 of the 14 tests outside the control limit, the analyte was detected at a concentration near the detection limit in either the original or split sample and was reported as undetected in the other (split or original sample, respectively). In these cases one half of the detection limit was used to calculate RPD. If these cases are disregarded the success rate is actually higher

TABLE 4.1. Soil Split Samples with Relative Percent Difference Values Exceeding 35 Percent

Sample ID	Analyte	RPD
WSRR-SUR-Q1-0-2"	Antimony†	120
	Cadmium†	142
	Lead	83
WSRR-SUB-02-0-6'	Nickel	56
WSOR-SUR-Q3-0-2"	Antimony†	127
WSOR-SUB-04-0-10'	Antimony†	127
	Mercury	113
	Zinc	49
WSOR-SUB-08-11-15'	Antimony†	82
	Arsenic	63
	Cadmium†	120
	Chromium	43
	Copper	55
WSOR-SUB-12-0-10'	Silver	111

† Either split or original sample reported an undetected value while the other sample reported a detected value. For evaluation purposes, ½ the detection limit was used.

than 82%. In those cases where the analyte was detected in both the original and split samples, the RPD exceeded 85% (a value which can reasonably be explained by variability in the soil matrix) in only one case, a silver analysis. With the exception of silver and antimony, no other parameters appear to have persistent precision problems. Silver was not a contaminant of concern at these sites and the inclusion of antimony as a contaminant of concern did not materially affect the assessment of risks (Section 5).

Co-located Samples

A total of five soil samples (2 surface and 3 subsurface) were collected as co-located samples. Each sample was analyzed for the same parameters as original and split samples. Except for confirmed laboratory contaminants, only one organic compound, 2,4-dinitrotoluene, was identified in the co-located and original samples. The occurrence of this organic compound, as well as the concentrations of metals, were evaluated for co-located and original samples.

The control limit of 35% RPD was applied to the 65 reported values for metals analyses (13 metals for each of 5 samples). The control limit was exceeded in 14 of the 65 cases for a success rate of 78% (Table 4.2). Seven cases in which the RPD exceeded the control limit were instances where the analyte was not detected in one of the samples but was quantified at a concentration near the detection level of the other. For undetected analytes, one half of the detection limit was used to evaluate RPD. In those cases where the analyte was detected in both the original and co-located sample, the RPD never exceeded 99%. Soil matrix variability can be expected to result in greater differences between original and co-located samples due to the fact that these samples are collected and analyzed independently. Again, antimony appears to have persistent precision problems near the detection level. However, the inclusion of antimony as a contaminant of concern did not significantly affect the outcome of the risk assessment (Section 5).

TABLE 4.2. Soil Co-located Samples with Relative Percent Difference Values Exceeding 35 Percent

Sample ID	Analyte	RPD
WSRR-SUR-Q1-0-2"	Antimony†	120
	Cadmium	99
WSRR-SUB-02-0-6'	Antimony†	101
	Copper	37
WSOR-SUR-Q3-0-2"	Antimony†	127
WSOR-SUB-04-0-10'	Antimony†	128
	Cadmium†	101
	Mercury†	120
	Zinc	77
WSOR-SUB-08-11-15'	Antimony	44
	Barium	43
	Cadmium†	121
	Chromium	37
	Copper	54

† Either the co-located or original sample reported an undetected value while the other sample reported a detected value. For evaluation purposes, ½ of the detection limit was used.

The only organic compound detected in samples from the White Sands sites which has not been confirmed as a laboratory contaminant is 2,4-dinitrotoluene (2,4-DNT). This compound, detected through EPA Method 8270, was quantified for the sample WSOR-SUR-Q3/C-0-2" at 1.2 mg/kg. This compound was not detected in the same sample using USATHAMA explosives analyses which have a detection level of 0.4 mg/kg for 2,4-DNT. Nor was this compound detected by EPA or USATHAMA methods in the original or split sample collected at the same locations. Due to field sampling procedures, subsamples submitted for analyses under EPA Method 8270 and USATHAMA methods are essentially splits of sample WSOR-SUR-Q3/C-0-2". Given laboratory quality control data including spike recoveries, it must be deduced that 2,4-DNT was present only in the subsample of WSOR-SUR-Q3/C-0-2" which was analyzed by EPA Method 8270. Accepting this, the evidence suggests that the 2,4-DNT detected is not widespread but is present in relatively low concentrations in one or more isolated locations within the Q3 surface soil sampling quadrant at the Oscura site.

4.2.2 Decontamination Rinsate Samples

Three decontamination rinsate samples were collected during the investigations at the Oscura and Red Rio sites. The governing documents called for the collection of a single decontamination rinsate sample at each site. However, because a sample bottle broke during shipment to the laboratory, a second rinsate sample was collected at the Oscura site for explosives analysis only. Decontamination rinsate samples were collected by filling each bottle approximately half-full with deionized water rinsate from stainless steel sampling equipment and filling the remainder with rinsate from the backhoe bucket. The stainless steel sampling equipment was rinsed using a laboratory squirt bottle and the backhoe bucket was rinsed using a spray of deionized water from a pressurized sprayer. Rinsate water was collected by placing the sampling bottle directly beneath the stream of water running off the sampling equipment or backhoe bucket.

Results of metals analyses for decontamination rinsate samples are provided in Tables 3.10 and 3.12. No explosive compounds or semivolatile compounds were detected in theses samples except for confirmed laboratory contaminants. Metals, including copper and zinc, were detected in both decontamination rinsate samples analyzed for metals. The rinsate sample from the Oscura site also contained detectable concentrations of barium, lead, and mercury. Nickel was the only other metal detected in the Red Rio decontamination rinsate sample.

Identification of these metals in the decontamination rinsate samples raises issue regarding the potential for cross-contamination in site environmental samples. However, there is little correlation between the metals detected and the concentrations of those metals in samples collected prior to or immediately following the collection of the rinsate samples. It should be noted that decontamination rinsates did not contain visible suspended or settled solids. Given the concentrations of the metals in the soils sampled immediately prior to rinsate collection, one gram of soil per liter or more would be necessary to account for the concentrations identified in the decontamination rinsate samples. One exception would be the decontamination rinsate sample collected at the Red Rio site (WSRR-RIN-03). A waste sample with relatively high concentrations of copper and zinc (WSRR-SUB-03-3') was collected prior to the rinsate sample collection. Analysis of subsequent soil samples failed to determine any significantly elevated concentrations of these metals; indicating that decontamination procedures were adequate to prevent cross-contamination.

Other potential sources existed for elevated metals concentrations detected in the decontamination rinsate samples. The pressurized sprayers used for soap solutions and deionized water for the backhoe bucket decontamination used some metal parts, including a brass air pump to generate pressure, and brass nozzles and spraying wands. The pump parts are brazed with an alloy containing lead and other metals. These metal parts could also be a source of copper. Welding rods used in the construction of the backhoe bucket and in

forming hardened beads on the surface and edges of the bucket contain a variety of metals including nickel, barium, and zinc. Finally, the paint used on the backhoe bucket may contain metals such as lead and zinc.

In summary, decontamination blanks contained elevated levels of some metals including copper, zinc, lead, and nickel. These metals bear little correlation to metals identified in related soil samples. Other potential sources for these metals exist, particularly the construction materials used in the pressurized sprayers and the backhoe bucket.

4.3 ANALYTICAL LABORATORY DATA VALIDATION

Soil and water (decontamination rinsate) samples collected at the Oscura and Red Rio sites were subject to analysis for metals, explosive compounds, and semivolatile organic compounds according to standard EPA and USATHAMA methods included in Appendix A of the SAP. Laboratory analyses were conducted by ThermoAnalytical Inc. in their Monrovia, California and Ann Arbor, Michigan facilities. The laboratory was required to conduct an internal validation of the generated data and flag all data not complying with the QC requirements of the EPA and USATHAMA methods used or those specified in the FAQAPjP. FPC also performed a validation of laboratory analytical data consisting of a spot check of compliance with holding times, calculations, data transcriptions, initial and continuing calibration checks, spike recoveries, and duplicate analyses. Findings of these efforts are included on data validation checklists provided with raw analytical data under separate cover and are summarized in this section.

Documentation of laboratory QC analyses provided with each data package formed the basis of FPC's data validation review. A checklist identifying validation criteria for each type of analysis (metals, explosive compounds, semivolatile compounds) was completed for each package. If spot checks of the data provided identified any inconsistencies, the

validation criteria in question was applied to the entire data package for that analysis. The analytical laboratory, Thermo Analytical, Inc., was then requested to provide corrected information and backup documentation, as appropriate, to resolve the inconsistencies.

In general, laboratory data quality met specified QA/QC criteria. Problems identified during FPC's data validation can be divided into three general categories: 1) transcription and calculation errors, 2) missing information, and 3) missed holding times. Each of these problems was satisfactorily resolved by the laboratory. A discussion of these problems as well as an evaluation of the data are presented in Appendix E.

5.0 RISK ASSESSMENT

5.1 INTRODUCTION

The objective of this Risk Assessment (RA) is to determine whether or not contaminants present at the Oscura and Red Rio sites present a potential human health risk. Contaminants at the two sites include organic compounds which do not occur naturally and inorganic substances which are present at concentrations significantly elevated above background levels. Contaminants have been identified in surface and subsurface soils at each site. The primary concern of this RA is the evaluation of potential carcinogenic and noncarcinogenic health risks associated with exposure to contaminated surface soils at each site. These sites are extremely remote and have no current or anticipated future use other than temporary storage of scrap metal. Based on current and anticipated land uses as well as overall low contaminant concentrations, subsurface contamination is not believed to present a significant threat to human health. The potential for contaminant migration to ground or surface water is discussed in Section 6.0.

5.2 SELECTION OF CONTAMINANTS OF CONCERN

As discussed in Section 3, all surface and subsurface soils at both sites were analyzed for certain explosives, semivolatile organic compounds, and metals. Although none of the explosives analyses showed the presence of explosives compounds above detection limits, 2,4-DNT was identified in one surface soil sample from the Oscura site during semivolatile organics analysis. In addition, several metals were found above background concentrations. Sample analytical results are presented in Section 3.0. An evaluation of data quality is provided in Section 4.0.

In order to identify only those contaminants which may significantly contribute to the potential health risks posed by the sites, all contaminants found at the sites were considered to be potential contaminants of concern (COCs). Certain contaminants were eliminated from consideration as COCs based on the following criteria:

1. Explosives analyzed for by USATHAMA methods were not detected in any samples and were withdrawn from the RA.

2. Target Compound List (TCL) semivolatile organic compounds not detected in any site samples were withdrawn from the RA.

3. Several TCL compounds detected in site samples and laboratory blanks have been identified as laboratory contaminants (see Section 3.2.2.). These compounds were withdrawn from the RA.

4. All inorganics analyzed for, but not detected in site samples, were withdrawn from the RA.

5. Inorganic elements present in site samples at concentrations less than three times average background concentrations were eliminated from the RA. Background values used are presented in Section 3.2.2.

In order to evaluate only those inorganic constituents which were detected significantly above background concentrations, any inorganic constituent present in concentrations greater than three times background concentrations was incorporated into the RA.[3] This approach is similar to that used to identify an "observed release" in 40 CFR Part 300, the EPA's Hazard Ranking System (HRS) (55 FR 51532). However, the HRS criteria include as an "observed release" sample measurements which equal or exceed the detection limit when the background concentration is below detection limits. For the purpose of this RA, the use of

this criteria to select COCs was not employed since many sample measurements were near detection limits and detection limits achieved in this investigation were commonly below typical concentrations for soils of the western U.S. In cases where inorganic constituents were not detected in background or site samples, a value of one-half the detection limit was used to evaluate relative concentrations. This approach, in combination with the COC selection criteria of three times average background, provided a quantitative criteria by which inorganic constituents could be selected as a COC. The final selection of COCs pertaining to each site is described in greater detail in the sections that follow.

5.2.1 Oscura Site

In the surface soils at the Oscura site, three contaminants were identified as COCs. These COCs are:

- 2,4-Dinitrotoluene
- Antimony
- Zinc

The basis for the selection of these COCs is summarized in Table 5.1 and described below.

The contaminant 2,4-DNT was included in the RA because it was detected in a site sample. A concentration of 1200 μg/kg of 2,4-DNT was detected in the sample WSOR-SUR-Q3/C-0-2". The presence of this compound in a single surface soil sample may be attributed to the practice of using primer cord, or other explosive, to destroy undetonated phosphorous spotting charges on practice bombs (Colson 1991, personal communication).

TABLE 5.1. Summary of Contaminant of Concern Selection Criteria for Analyzed Constituents in Oscura Surface Soil Samples.

PARAMETER	SELECTED FOR RA	JUSTIFICATION
Explosives	No	A
Semivolatile Organics		
2,4-Dinitrotoluene	Yes	B
N-Nitrosoldipenylamine	No	C
Di-n-Butylthalate	No	C
bis(2-Ethylhexyl)Phthalate	No	C
Metals		
Antimony	Yes	D
Arsenic	No	E
Barium	No	E
Cadmium	No	E
Chromium	No	E
Copper	No	E
Lead	No	E
Mercury	No	E
Nickel	No	E
Selenium	No	E
Silver	No	E
Thallium	No	E
Zinc	Yes	F

Justification:

A. All explosives compounds analyzed for were below detection limits.

B. Besides laboratory contaminants, 2,4-DNT was the only TCL semivolatile organic compound found above detection limits.

C. Identified as a laboratory contaminant. Compound was detected in laboratory blank samples at similar concentrations.

D. Seven of ten samples were at or above three times average background.

E. All sample concentrations for this constituent were below three times average background.

F. Two of ten samples exceeded three times average background.

Antimony was incorporated into the RA since 7 of 10 surface soil samples contained this constituent at or above three times average background concentrations. All three background samples had antimony concentrations less than detection limits and thus, one-half the detection limit was used to calculate mean background values. Antimony is used in a variety of applications including use as a hardening agent in lead alloys and as an ingredient in pyrotechnics (Sax and Lewis 1987). Potential sources of antimony at the Oscura site include lead batteries and cable sheaths from various targets (non-serviceable vehicles, helicopters, etc.) stored at the site and illuminating flares or munitions with tracer rounds possibly destroyed at the site. These possible sources, however, could not be verified.

Zinc was identified in two of 10 samples at concentrations of three times background concentrations or greater and was included in the RA. Both of these results occurred in surface sampling Quadrant 4. The suspected source of the zinc is galvanized metal or alloys from the various targets stored at the site or sample tool contamination from galvanized tubs used for decontamination. During the course of the investigation, a helicopter and at least one truck were temporarily stored and then removed from Quadrant 4.

All other metals analyzed were not detected or were present at concentrations less than three times background.

5.2.2 Red Rio

In surface samples at Red Rio, no explosives were found above detection limits and the three semivolatile organic compounds detected were determined to be laboratory contaminants. Thus, all explosive and semivolatile organic compounds were withdrawn from the RA.

Table 5.2 presents the criteria used to select the only contaminant of concern, cadmium, in the surface soils at Red Rio. Cadmium was detected above three times average background concentration in 2 of 10 surface soil samples. All three background samples had cadmium concentrations less than detection limits, thus the average background value was calculated based on one-half of reported detection limits. A possible source of cadmium, other than natural occurrence in geologic materials, may be its use in alloys disposed at the site.

5.3 EXPOSURE ASSESSMENT

An exposure assessment has been conducted for the contaminated surficial soil at the Red Rio and Oscura sites and is summarized on Table 5.3. The exposure assessment identifies the potentially exposed populations, describes potential exposure pathways, defines expected exposure scenarios, and calculates the chronic daily intake through exposure via incidental ingestion of surface soil.

5.3.1 Site Receptors

The Oscura and Red Rio Sites are remote, isolated sites. No residential areas exist within 10 mi or more of the site study. The closest military buildings are the Oscura range spotting tower and support buildings approximately 1 mi south of the Oscura site and the Red Canyon Range Camp about 5 mi east of the Red Rio site. The only potential receptors are those involved in site maintenance activities and patrol as well as trespassers and/or occasional permitted hunters who may visit the sites. These receptors are categorized below:

- Maintenance (civilian/military personnel).
- Recreationist (trespassers/hunters).

TABLE 5.2. Summary of Contaminant of Concern Selection Criteria for Analyzed Constituents in Red Rio Surface Soil Samples.

PARAMETER	SELECTED FOR RA	JUSTIFICATION
Explosives	No	A
Semivolatile Organics		
N-Nitrosoldipenylamine	No	B
Di-n-Butylphthalate	No	B
bis(2-Ethylhexyl)Phthalate	No	B
Metals		
Antimony	No	C
Arsenic	No	C
Barium	No	C
Cadmium	Yes	D
Chromium	No	C
Copper	No	C
Lead	No	C
Mercury	No	C
Nickel	No	C
Selenium	No	C
Silver	No	C
Thallium	No	C
Zinc	No	C

Justification:

A. All explosives compounds analyzed for were below detection limits.

B. Identified as a laboratory contaminant. Compound was detected in laboratory blank samples at similar concentrations.

C. All sample concentrations for this constituent were less than three times average background.

D. Two of 10 samples exceeded three times average background.

Table 5.3. Exposure Assessment Pathways

Surveyed Media	Scenario	Potential Receptors (1)	Probability (2)	Frequency	Comment
Surface Soil	Incidental Ingestion	Maintenance Recreationist	Maintenance personnel and recreationist have high probability for soil contact	Infrequent	Incidental ingestion of soil would represent the most likely exposure route for current and future receptors
	Inhalation	Maintenance Recreationist	Inhalation of wind entrained particulate may occur during high wind events only	Rare	High wind events represent only a small fraction of overall exposure frequency
	Dermal Absorbance	Maintenance Recreationist	Probability is low as potential receptors would have most skin area covered	Infrequent	Dermal absorbance does not represent a significant exposure pathway as absorbance of metals is minimal and receptors likely to be onsite have most skin area covered

[1] (Receptors) Receptors may be exposed to the media. The Frequency is dependent on receptor activity.
Maintenance personnel: 1 day/week
Recreationist: Permitted hunters or trespassers may access the site 0.5 day/week
The facility is a restricted area, remote from residential housing and development. Receptors who visit this area include maintenance (civilian/military personnel), and recreationist (trespassers/hunters).

[2] (Probability) The likelihood of exposure that may lead to adverse health effects.

5.3.2 Pathway Identification

The site contaminants will only present a risk to potential receptors if there is a means of exposure or a pathway. An exposure pathway is comprised of a contaminant source (such as a chemical spill), a transport medium (such as surface soil), a potential for human contact, and a means for exposure. [1]The Oscura and Red Rio sites are isolated and provide little opportunity for receptor exposure, however.

The primary pathway for exposure by maintenance personnel and recreationist is contact with contaminated surface soil through incidental ingestion. This pathway represents a reasonable worst case exposure for the WSMR receptors. [2]The inhalation scenario was not selected, as exposure to receptors would be limited to a small fraction of overall exposure frequency when winds are high. The dermal absorption pathway is not considered an important pathway because potential receptors would have most skin areas covered. [3]The subsurface soil contaminant exposure is considered an unlikely pathway for exposure for persons described previously.

5.3.3 Exposure Scenarios

The exposure scenarios have been modeled to quantify potential risk to site receptors. Two slightly different scenarios were developed for maintenance personnel and recreationists:

- The adult worker maintenance/military personnel: The adult worker is exposed for 52 days a year for nine years. The adult worker activities include area patrol and maintenance activities such as the removal of old targets and debris.

- The adult recreationist/trespasser scenario: The recreationist or trespasser is exposed for 26 days a year for nine years, 26 days represent a conservative, worst case scenario.

5.3.4 Ingestion

The exposure scenarios, assume that a certain amount of contaminated soil will be ingested as a result of maintenance or recreationist activities at the sites. The method and values for calculating the chronic daily intake (CDI) appears below:

$$\text{CDI (mg/kg-day)} = \frac{\text{CS x IR x CF x EF x ED}}{\text{BW x AT}}$$

Where:

CS = maximum Concentration in surface Soil (mg/kg)
IR = Ingestion Rate - 100 mg/day
CF = Conversion Factor (10^{-6} kg/mg)
EF = Exposure Frequency - 52 days/year (maintenance workers and military personnel) or 26 days/year (recreationist)
ED = Exposure Duration - 9 years
BW = Body Weight - 70 kg (adult, average)
AT = Average Time - pathway-specific period of exposure for noncarcinogenic effects is 9 years (i.e., ED X 365 days/year), and 70 year lifetime for carcinogenic effects (i.e., 70 years X 365 days/year).

To determine the potential hazard associated with soil exposure, this USEPA formula was selected (USEPA 1989). The formula is designed to quantify the CDI of the contamination so that a hazard index and slope factor analysis can be completed.

Certain assumptions are made to calculate a CDI for a contaminant of concern. For example, the soil ingestion rate assumes that 100 mg/day of contaminated soil is ingested through normal hand-to-mouth contact. The exposure frequency and duration were estimates of the number of days of exposure for maintenance personnel and recreationist per year. Once a CDI is determined, the potential health risks of a contaminant of concern can be evaluated.

5.4 METHODS OF RISK CHARACTERIZATION

The objective of this risk assessment is to determine the potential health hazards associated with exposure to surface soils. The carcinogenic and noncarcinogenic health risks associated with the contaminants of concern have been characterized using currently accepted exposure scenarios (USEPA 1989). These scenarios were selected to characterize the risks associated with exposure to surface soil through ingestion. Only chronic and subchronic exposure scenarios were considered because they would represent a reasonable scenario of exposure.

5.5 NONCARCINOGENIC RISK CHARACTERIZATION

A USEPA-developed hazard index (USEPA 1989) was used to characterize surface soil, in an effort to quantify the potential noncarcinogenic hazards associated with exposure to the site surface soil contaminants. This quantification utilizes the CDI and the chronic reference dose (RfD) for a particular contaminant of concern. The RfDs and other information for the COC's at the Oscura and Red Rio sites can be found in Appendix G, Supplemental Risk Assessment Information.

The RfD is an estimate (with uncertainty spanning perhaps an order of magnitude or greater) of a daily exposure level for the human population, including sensitive subpopulations, that is likely to be without an appreciable risk of deleterious effects during a lifetime. Chronic RfDs are specifically developed to be protective for long-term exposure to a compound.

The chronic hazard index or hazard quotient, is developed by dividing the CDI by the RfD. The CDI was calculated using the maximum concentration of the COC found in the site media to represent a worst case scenario. A resultant hazard quotient of less than 1.00 using this methodology indicates that the exposure does not present appreciable risk of

adverse noncarcinogenic effects to human receptors. The hazard quotient for each COC are then summed for additive effects as described below:

$$\frac{\text{Chronic Noncancer Hazard Index}}{\text{Chronic Additive Hazard Index } (=CDI1/RfD1 + CDI2/RfD2 + \ldots CDIi/RfDi)}$$

where:

CDIi = chronic daily intake for the ith toxicant in mg/kg/day, and

RfDi = chronic reference dose for the ith toxicant in mg/kg/day.

The summation of hazard quotients is used to prevent underestimation of the site risk due to potential compound synergism. This summation approach is carried out across the contaminants and exposure scenarios to quantify noncarcinogen site risk.

5.6 CARCINOGENIC RISK CHARACTERIZATION

The COC was screened for potential carcinogenic effects using the IRIS data base and Health Effects Assessment Summary Tables (HEAST 1991).

Only those compounds which have been classified as possible human carcinogens (as defined in Table 5.5) and that have a slope factor with current IRIS or HEAST verification were included in the carcinogenic assessment. This conservative approach was used in an effort to reduce the level of uncertainty in the risk assessment. The verified carcinogenic COC was 2,4-dinitrotoluene and further information on this compound, including the slope factor, can be found in Appendix G, Supplemental Risk Assessment Information.

The USEPA assessment methodology was used to assess the potential carcinogenic effects of the carcinogenic contaminants (USEPA 1986). The CDI was calculated using a maximum surveyed contaminant concentration found in the site media. This factor is multiplied by the slope factor (SF). The resultant sum yields a specific "risk" factor or the

TABLE 5.5 Carcinogenic Weight of Evidence Classification.*

The USEPA classifies substances according to their potential to promote cancer. The five classification categories are described below:

Group A -	Human Carcinogen (sufficient evidence of carcinogenicity in humans).
Group B -	Probable Human Carcinogen (B1 - limited evidence of carcinogenicity in humans; B2 - Sufficient evidence of carcinogenicity in animals with inadequate or lack of evidence in humans.
Group C -	Possible Human Carcinogen (limited evidence of carcinogenicity in animals and inadequate or lack of human data).
Group D -	Not classifiable as to Human Carcinogenicity (inadequate or no evidence).
Group E -	Evidence of Non-carcinogenicity for Human (no evidence of carcinogenicity in adequate studies).

* *Risk Assessment Guidance for Superfund Volume I Human Health Evaluation Manual* (OWSER Directive 9285.7-10A)

"probability of developing cancer". The specific risk factors are summed across compounds and exposure scenarios. The summation of specific risk factors aids in preventing underestimation of site-specific risks.

5.7 RISK CHARACTERIZATION

The WSMR risk assessment analyzed the risks associated with human exposure to surface soils. The results of the risk characterization appear below.

5.7.1 Oscura Site

The potential health risk for antimony and zinc proved to be negligible. A hazard quotient (HQ) that reaches a value greater than one (1) may ~~e~~affect human health. The HQ for surface soil exposure for maintenance workers and military personnel was 0.01. The HQ for recreationist was 0.00 (Table 5.6).

The potential carcinogenic associated risk with incidental ingestion of 2,4-DNT in surface soil for maintenance and military personnel does not exceed the EPA recommended risk range of (1×10^{-4} to 1×10^{-6}) (Table 5-7). The potential risk associated with ingestion of 2,4-DNT in surface soil for recreationist was less than that for maintenance personnel.

5.7.2 Red Rio Site

No carcinogens were identified as COCs at the Red Rio site. The potential noncarcinogenic risk for cadmium proved to be insignificant, in that the HQ for surface soil exposure for both maintenance workers and military personnel was 0.00, and the HQ for recreationist was also 0.00 (Table 5.8).

TABLE 5.6. Noncarcinogenic Characterization of Risks for Oscura Surface Soils

RECEPTOR	SUBSTANCE	MAXIMUM SURVEYED CONCENTRATION mg/kg	CDI (mg/kg/day)	RfD (mg/kg/day)	HQ
Maintenance	Antimony	15.29	3.1×10^{-6}	4.0×10^{-4}	0.01
	Zinc	412.12	8.4×10^{-5}	2.0×10^{-2}	0.00
				Total HQ 0.01	
Recreationist	Antimony	15.29	1.6×10^{-6}	4.0×10^{-4}	0.00
	Zinc	412.12	4.2×10^{-5}	2.0×10^{-2}	0.00
				Total HQ 0.00	

RfD - The toxic value for evaluating non carcinogenic effects (IRIS 1991)

Hazard Quotient (HQ) - A numerical indicator that stipulates whether a COC presents an applicable risk of deleterious effects where HQ = CDI/RfD

TABLE 5.7. Carcinogenic Characterization of Risk for Oscura Surface Soils.

RECEPTOR	SUBSTANCE	MAXIMUM SURVEYED CONCENTRATION mg/kg	CDI (mg/kg/day)	SPECIFIC RISK
Maintenance	2,4-Dinitrotoluene	1.2	3.1×10^{-8}	2×10^{-8}
Recreationist	2,4-Dinitrotoluene	1.2	1.6×10^{-8}	1×10^{-8}

Specific Risk = CDI x Slope Factor (SF)

SF converts estimated daily intakes averaged over a lifetime of exposure to incremental risk of an individual developing cancer

2,4-DNT (SF) = 6.8×10^{-1} (HEAST 1991)

TABLE 5.8. Noncarcenogenic Characterization of Risks for Red Rio Surface Soils.

RECEPTOR	MAXIMUM SURVEYED CADMIUM CONCENTRATION mg/kg	CDI (mg/kg/day)	RfD (mg/kg/day)	HQ
Maintenance/Military	1.22	2.5×10^{-7}	1.0×10^{-3}	0.00
Recreationist	1.22	1.25×10^{-7}	1.0×10^{-3}	0.00

RfD The toxicity value for evaluating noncarcinogenic effects (IRIS 09/91)

Hazard Quotient (HQ) A numerical indicator that stipulates whether a chemical of concern presents an appreciable risk of deleterious effects.

5.8 LEVEL OF UNCERTAINTY

The performance of a risk assessment is based on several assumptions including:

- Sufficient data was collected to accurately represent site conditions.
- Current toxicological data used to identify and estimate the risk associated with exposure to low doses of contaminants are valid.
- Modeled receptor exposure scenarios adequately predict potential exposures.

These assumptions and inherent uncertainties are common to all risk assessments and may affect the estimation of risk either by underestimating or overestimating the risk associated with a site. To compensate for the uncertainties and the potential for underestimating the risk, only the most conservative concentration factors (i.e. maximum concentrations) were used to assess the risk.

5.9 RISK ASSESSMENT CONCLUSIONS

This risk assessment (RA) addressed the area of human health exposure from ingestion of chemicals in surface soil at the Red Rio and Oscura practice bomb disposal sites located in WSMR.

The objective of the RA for Red Rio and Oscura was to characterize the potential risk associated with ingestion of chemicals in surface soil by maintenance workers, military personnel and recreationists (hunters and trespassers).

The maximum concentrations at the site were used to determine the potential noncarcinogenic and carcinogenic risk. The COCs were selected on the criteria that the site sample concentrations exceeded three times the average background concentrations. The results of this RA are described below:

Non-Carcinogenic Risk

A hazard quotient (HQ) is used to determine the potential risk from exposure to contaminants. A hazard quotient which meets or exceeds a value of 1.0 may represent risk from exposure. The hazard quotient for maintenance workers, military personnel, and recreationist did not exceed 1.0 for either the Oscura or Red Rio sites.

Carcinogenic Risk

The EPA has identified a range of acceptable risk to carcinogenic substances of 1×10^{-4} to 1×10^{-6}. The estimated risk for carcinogenic effects to maintenance workers, military personnel, and recreationist did not exceed this estimated risk range at either site.

6.0 SUMMARY OF FINDINGS

The sources and areas of environmental contamination at the Oscura and Red Rio practice bomb disposal areas have been defined. These definitions are based on disposal practice evaluation, anticipated and encountered waste types, findings from a previous study, and results of this site evaluation.

6.1 DISCUSSION

Information on waste types present at the Oscura and Red Rio sites was obtained through interviews with U.S. Army, U.S. Air Force, and civilian personnel familiar with site operations, review of WSMR files, and direct observation in the field. All evidence indicates that wastes consist of the burned or detonated practice bombs, scrap metal from vehicles and aircraft used as targets, and spent casings and projectiles (bullets) from small arms ammunition. These wastes are composed almost exclusively of metals and metal alloys, plastic, and concrete. No evidence exists that hazardous wastes are present in significant quantities at either site, as described below.

Locations of buried metallic wastes were determined by geophysical methods. A single burial area was identified at the Red Rio site containing a volume of approximately 5700 yds^3 which encompass buried wastes. Multiple burial areas at the Oscura site contain a volume of approximately 16,300 yds^3 which encompass buried wastes. An additional burial area at the Oscura site is interpreted to contain construction debris and/or buried wastes buried at a greater depth and has an approximate volume of 4300 yds^3.

Surface soil samples collected at both sites demonstrate the presence of several metals at concentrations slightly elevated above background. Additionally, one surface soil sample out of 13 collected at the Oscura site contained an organic contaminant, 2,4-DNT, at 1200 μg/kg. Metals detected in surface soil samples with concentrations two times

background levels or higher were antimony, cadmium, and zinc at the Oscura site and antimony, barium, lead, and selenium at the Red Rio site. Bits of scrap metal from detonation and handling of wastes are scattered around the surface of both sites and probably account for some of these elevated metals concentrations. In nearly all cases, surface soil metals concentrations fall within typical metals concentrations for soils of the western United States.

A risk assessment was conducted to evaluate potential human health threats posed by the elevated metals and the single occurrence of 2,4-DNT in surface soils. All exposure scenarios evaluated revealed no significant risks associated with surface soil contaminants at either site.

Forty-five subsurface soil samples were collected at the Oscura site and 21 at the Red Rio site. Several metals were detected at concentrations exceeding two times background levels at each site. Concentrations of these metals were typically only slightly elevated and can be attributed to soil variability and instrument sensitivity at or near detection levels. Copper, chromium, and zinc were present at significantly elevated levels in a single subsurface sample from the Red Rio site. However, this was a biased sample containing buried wastes including fragments of metallic waste encountered during an excavation.

The site evaluation failed to demonstrate substantial quantities of any hazardous constituents at the Oscura site. As described in Section 2.1.3, groundwater at the Oscura site is non-potable and occurs at a depth of about 200 ft below the surface. Berms around the site divert any surface water flow away from the buried wastes. Precipitation rates are low and evaporation rates are high. Had hazardous wastes been identified at the site it is unlikely that they would have any potential for impacting surface or groundwater quality.

Similarly, no evidence exists that hazardous wastes were disposed of at the Red Rio site. Depth to groundwater at this site is unknown although the nearest well, an abandoned stock watering well located 1.5 miles west, has a reported depth to water of 315 ft. Water from this well is described as potable. No domestic or other use of groundwater is known to exist or is anticipated within 5 mi of the site. Precipitation is low and evaporation relatively high at this site. Some limited surface water flow may enter the site during heavy precipitation events or snow melt. Low metals concentrations and lack of organic contaminants in surface soils minimize the potential for surface water impacts. Groundwater impacts are also considered unlikely given the low metals concentrations in subsurface soils, arid climate, and the inferred great depth to water.

6.2 CONCLUSIONS AND RECOMMENDATIONS

As documented in this site evaluation report there is no evidence that listed or characteristic hazardous wastes are present above trace levels at either the Oscura or Red Rio sites. Furthermore, it has been demonstrated that metallic wastes and trace surface soil contamination by 2,4-DNT (Oscura site only) present no significant or unacceptable human health risk. Based on these findings, it is concluded that no further closure activities are required under RCRA Subtitle C at either site. Formal RCRA closure plans for each site are presented in Section 7.0.

In keeping with RCRA Subtitle D and New Mexico Solid Waste Management Regulations in effect when disposal operations ceased at the sites the following recommendations are made:

- Divert surface drainage away from buried wastes through the construction of berms, diversion channels, or other means.
- Determine the thickness of cover material above wastes at both sites and provide additional cover to maintain a depth of burial of at least 2 ft.

- Cover materials should be graded to facilitate runoff without puddling or erosion.
- Place signs at the perimeter of each site indicating waste burial areas.
- Conduct periodic inspections of each site to ensure the integrity of cover materials and maintain drainage diversions.

7.0 CLOSURE PLANS

7.1 CLOSURE PLAN FOR THE OSCURA PRACTICE BOMB DISPOSAL AREA

7.1.1 Introduction

The Oscura Practice Bomb Disposal Site is located in the northeast portion of White Sands Missile Range (WSMR), south central New Mexico. The site is located in a remote area of the facility adjacent to a practice bombing and gunnery range. The Oscura disposal site was used from about 1960 until 1988 for open burning and detonation of practice bombs and small arms ammunition. Scrap metal and other residual waste materials were then buried in a series of trenches at the site.

In April 1988, WSMR submitted a Resource Conservation and Recovery Act (RCRA) Part A permit application to the State of New Mexico. The Oscura site was identified on this permit application for interim status. The RCRA regulations, as adopted by the State of New Mexico require the preparation of a closure plan describing how this unit will be closed (NM HWMR-6, Part V, 40 CFR Part 265, Subpart G). This closure plan has been written to fulfill these requirements.

Prior to development of this closure plan, a detailed site investigation was conducted to collect data regarding possible hazardous wastes or environmental contamination on site. The site investigation consisted of background data collection and evaluation, topographic and geophysical surveys, and comprehensive surface and subsurface soil sampling. The methods and results of the site investigation are discussed in detail in the preceding Site Evaluation Report and are summarized in this closure plan. The conclusion of the Site Evaluation Report is that no hazardous wastes and only minimal residual contamination are present onsite. Low level residual organic compound contamination was detected in 1 of the

69 samples collected. Elevated metals detected in surface and subsurface soil samples were close to background concentrations except in instances where biased grab samples contained metallic waste fragments.

Based on information summarized above, it is concluded that this site meets the requirements of clean closure (closure by removal or decontamination) referenced in 40 CFR, Part 270.1. Although the conclusions and recommendations section of the Site Evaluation Report contains recommendations for additional site closure activities under RCRA Subtitle D, no further closure is necessary under RCRA Subtitle C. This closure plan requests a determination, on the part of the New Mexico Environment Department (NMED), that standards for closure by removal or decontamination have been met.

7.1.2 Site Description and History

The Oscura site is located near longitude 106°13'; latitude 33°32', in Lincoln County, New Mexico at an elevation of about 4,700 ft. The site occupies an area of about 10 ac. The local topography is relatively flat and slopes gently to the south-southeast toward the center of the Tularosa Basin. Climate is typical of the desert southwest with an annual precipitation of 7 to 13 in.

The Oscura site lies about 3 to 4 mi southeast of the Oscura Mountains on alluvial fan deposits derived from this range. The total thickness of the alluvial deposits at the site is unknown, but may be several thousand feet. Ground water beneath the site probably occurs under unconfined conditions. The depth to water is not precisely known but is approximately 200 ft. A well used as a fire protection water supply at the Oscura Range Center, approximately four miles to the southeast, confirms poor ground-water quality in the area due to high concentrations of sulfate and total dissolved solids.

Surface water is present only intermittently near the Oscura site, resulting from intense local rainfall and/or rapidly melting snow. An abandoned stock pond located just southwest of the site contains water periodically during the year. Vegetation is sparse due to the low precipitation, high evaporation rate, and high salt content of soils near the Oscura site.

Prior to federal government control in 1945, the site was used as range land for grazing cattle. From 1945 to 1960 the Oscura site was unused. Since 1960 the Oscura site has been used for burning, detonation and burial of live practice bombs and scrap metal, and for storage of bombing targets (primarily decommissioned military vehicles). Burning, detonation, and burial of waste materials ceased in 1988. The Army has no current or planned uses for the site other than temporary storage of used bombing targets.

7.1.3 Waste Description and Investigation Results

Open burning, detonation, and burial of wastes at the Oscura site utilized elongate trenches approximately 50 to 100 ft long, 15 to 30 ft wide, and 10 to 15 ft deep. Practice bombs with undetonated spotting charges and small arms ammunition were placed in the trenches and detonated or burned to ensure destruction of reactive materials. Burned debris as well as other wastes collected on the bombing range (i.e. scrap metal) were then covered with approximately 4 in. of fill. Disposal operations were conducted in a progressive manner of layering until each pit was filled.

The areal extent of wastes at the Oscura site was determined using geophysical methods. Based on these determinations and an assumed waste burial thickness of 8 ft, a maximum waste volume was calculated. The calculated volume containing wastes (and interlayered fill) is approximately 16,294 cu yds.

Site investigations included comprehensive surface and subsurface soil sampling. Surface soil samples were collected over an area encompassing all buried wastes. Subsurface soil samples were collected during excavation of 13 trenches adjacent to buried wastes.

Trenches were excavated to a depth of 15 ft. In several instances trenches were excavated into buried wastes and samples collected of the combined soil and waste material. All samples were analyzed for possible hazardous waste constituents including explosives, semivolatile organic compounds, and heavy metals.

Residual contamination detected in surface and subsurface soil samples was minimal. The only organic hazardous waste constituent identified was 1.2 mg/kg of 2,4-dinitrotoluene in a single surface soil sample. A few metals were detected in surface and subsurface samples at concentrations elevated slightly above background. Most of these can likely be attributed to scrap metal fragments in samples. Nearly all metals concentrations were within a typical range for western U.S. soils.

7.1.4 Closure Plan

This closure plan for the Oscura Practice Bomb Disposal Area was prepared in accordance with the NMED requirements set forth in the NM Hazardous Waste Management Regulations (HWMR-6), Part VI, 40 CFR Part 265, Subpart G. Any amendment to this closure plan will be made in compliance with the requirements of 40 CFR Part 265.112(c). The effective date of this closure plan will be the date of receipt of approval from NMED.

7.1.5 Closure Certification

Upon receipt of notification from the NMED that a clean closure equivalency determination has been made, the Oscura Practice Bomb Disposal Area will be considered to have completed final closure. Within 60 days of this date, WSMR will submit two certifications, one signed by the Commanding General of White Sands Missile Range and the other signed by an independent qualified registered professional engineer, each attesting that the Oscura Practice Bomb Disposal Area has been closed in accordance with this closure plan. Certification of closure will be as required in 40 CFR Part 270.11(d).

7.1.6 Partial Closure

Partial closure is not planned for the Oscura Practice Bomb Disposal Area.

7.1.7 Financial Assurance Requirements

Financial assurance requirements of 40 CFR Part 265.143 for closure and of 40 CFR Part 265.145 for post-closure care are not applicable to federally-owned facilities.

7.1.8 Closure Performance Standard

This closure complies with the performance standards set forth in 40 CFR Part 265, Subpart G.

7.1.9 Anticipated Life of the Facility

Upon receipt of notification from NMED that a clean closure equivalency determination has been made (as provided for in 40 CFR Part 270.1(c)(5)), the Oscura Practice Bomb Disposal Area will be considered to have completed final closure. Any additional closure activities at the site will be conducted under RCRA Subtitle D and the New Mexico Solid Waste Management Regulations and will not be subject to the terms of this closure plan.

7.1.10 Waste Inventory

Historical information for the Oscura site indicates that no hazardous wastes were disposed on site. Review of site records and interviews with individuals knowledgeable of site history confirm that the site was used for open burning and open detonation of practice bombs and small arms ammunition. Prior to burning or detonation, some of these materials may have been characteristic hazardous wastes due to reactivity. During burning and

detonation these wastes were converted to inert, non-hazardous materials. The areal extent of wastes at the Oscura site was determined using geophysical methods. Based on the determinations and an assumed waste burial thickness of 8 ft, maximum waste volume was calculated. The calculated volume containing wastes (and interlayered fill) is approximately 20,561 cu yds.

7.1.11 Post-Closure Care Requirements

Site investigations described in the preceding site evaluation report demonstrated the absence of hazardous wastes at the Oscura Practice Bomb Disposal Area. Therefore, post-closure care requirements of 40 CFR Parts 265.117 through 264.120 are not applicable to this unit.

7.1.12 Closure

The interim status closure and post-closure regulations require that the owner or operator close a facility in a manner that "controls, minimizes or eliminates, to the extent necessary to protect human health and the environment, post-closure escape of hazardous waste, hazardous waste constituents, leachate, contaminated rainfall or waste decomposition products to the ground or surface waters or the atmosphere" (40 CFR 265.111). The cited requirements have been accomplished at the Oscura site.

Extensive sampling of surface soils, subsurface soils, and waste materials at the Oscura Practice Bomb Disposal Area have confirmed the absence of hazardous waste constituents at concentrations which present a significant health risk. Based on these sampling results no removal or decontamination of soils or waste materials is needed to meet the criteria for clean closure. The results of surface and subsurface sampling are discussed in detail in Sections 3.2.2 and 3.2.3 of the Site Evaluation Report, respectively. A risk assessment based on sampling results is presented in Section 5 of the Site Evaluation Report.

Ground-water monitoring is not necessary at the Oscura site for several reasons. Sample results for surface and subsurface soils as well as waste samples demonstrate minimal residual contamination by hazardous waste constituents. Annual precipitation is relatively low (7 to 13 in.) and because no liquid wastes were disposed, there is little hydraulic head driving contaminants to ground water. Further, ground water is known to be of poor quality and at a significant depth (approximately 200 ft). Other than development as a nonpotable water supply, no ground-water uses are known to exist within 10 mi of the site. Ground-water conditions at the Oscura site are discussed in more detail in Section 2.1.3 of the Site Evaluation Report.

Surface water run-on and run-off control is not required under RCRA for sites where clean closure criteria are met. Section 6.2 of the Site Evaluation Report contains recommendations for run-on and run-off control. These recommendations are made to ensure that site closure is consistent with intent of RCRA Subtitle D and the New Mexico Solid Waste Management Requirements in place at the time disposal operations ceased.

7.1.13 Dispute Resolution

The parties shall use their best efforts to informally and in good faith resolve all disputes or differences of opinion. If, however, disputes arise concerning the approved closure plan which the parties are unable to resolve informally, including but not limited to, disputes over implementation of workplans, approval of documents, scheduling of any work, selection, performance, or completion of any closure actions, or any other obligation assumed hereunder, WSMR shall present a written notice of such dispute and the basis for the objections to NMED within ten business days of the receipt of the disapproval, decision, or directive. The notice shall set forth the specific points of the dispute, the position WSMR maintains should be adopted as consistent with closure requirements, the basis therefore, and any matters which it considers necessary for the NMED's proper determination. NMED shall provide to WSMR a written statement of its decision on the pending dispute, which shall be

incorporated into the final closure plan unless WSMR requests an opportunity for a conference in accordance with the following paragraph. The existence of a dispute as defined herein, and the consideration of such matters which are placed into dispute shall not excuse, toll, or otherwise suspend any compliance obligation or deadline while the dispute resolution process is pending.

If WSMR objects to any NMED determination regarding any requirement by NMED that WSMR perform work, WSMR shall, within ten days of its receipt of NMED's decision pursuant to the previous paragraph, notify NMED in writing of its objections, and may request that the Division Director convene an informal conference. The Director shall state in writing the final decision regarding the resolution of the dispute and shall be implemented immediately by WSMR according to the schedule contained therein.

7.1.14 Request for an Equivalency Determination

Based on information provided in this closure plan and in the preceding Site Evaluation Report, White Sands Missile Range requests a determination from the New Mexico Environment Department under 40 CFR Part 270.1(c)(5) that a post-closure permit is not required for the Oscura Practice Bomb Disposal Area. The date of receipt of notification of this determination will be considered to be the date of completion of closure for the site.

7.2 CLOSURE PLAN FOR THE RED RIO PRACTICE BOMB DISPOSAL AREA

7.2.1 Introduction

The Red Rio Practice Bomb Disposal Site is located in the northeast portion of White Sands Missile Range (WSMR), south central New Mexico. The site is located in a remote area of the facility adjacent to a practice bombing and gunnery range. The Red Rio disposal site was used from about 1963 until 1988 for open burning and detonation of practice bombs and small arms ammunition. Scrap metal and other residual waste materials were then buried in a series of trenches at the site.

In April 1988, WSMR submitted a Resource Conservation and Recovery Act (RCRA) Part A permit application to the State of New Mexico. The Red Rio site was identified on this permit application for interim status. The RCRA regulations, as adopted by the State of New Mexico require the preparation of a closure plan describing how this unit will be closed (NM HWMR-6, Part VI, 40 CFR Part 265, Subpart G). This closure plan has been written to fulfill these requirements.

Prior to development of this closure plan, a detailed site investigation was conducted to collect data regarding possible hazardous wastes or environmental contamination on site. The site investigation consisted of background data collection and evaluation, topographic and geophysical surveys, and comprehensive surface and subsurface soil sampling. The methods and results of the site investigation are discussed in detail in the preceding Site Evaluation Report and are summarized in this closure plan. The conclusion of the Site Evaluation Report is that no hazardous wastes and only minimal residual contamination are present onsite. Elevated metals detected in surface and subsurface soil samples were close to background concentrations except in instances where biased grab samples contained metallic waste fragments.

Based on information summarized above it is concluded that this Site meets the requirements of clean closure (closure by removal or decontamination) referenced in 40 CFR, Part 270.1. Although the conclusions and recommendations section of the site Evaluation Report contains recommendations for additional site closure activities under RCRA Subtitle D, no further closure is necessary under RCRA Subtitle C. This closure plan requests a determination, on the part of the New Mexico Environment Department (NMED), that standards for closure by removal or decontamination have been met.

7.2.2 Site Description and History

The Red Rio site is located near longitude 106°15'; latitude 33°45', in Socorro County, New Mexico at an elevation of about 6,300 ft. The site occupies an area of about 1.5 ac. The local topography consists of hills and valleys with up to 800 ft of relief. Site drainage is to the southwest, eventually draining to the Tularosa Basin. Climate is typical of the desert southwest with an mean annual precipitation of about 14 in.

The Red Rio site is located about 7 mi east of the Oscura Mountains in an area of eroded Permian Bedrock and discontinuous, thin, unconsolidated deposits. Permian bedrock units consist of sandstones, siltstones, limestones, and gypsum, and dip gently eastward. The Red Rio disposal site lies in a small valley eroded into siltstones of the Yeso Formation. Alluvium is present as a thin fill in the valley and is probably less than 50 ft thick. Ground water may be present in this alluvium or, more likely, in the bedrock below it. Depth to water in an abandoned stock well located approximately 1.5 mi to the west is about 315 ft. Water from this well is considered potable.

There are no surface water bodies located near the Red Rio site. Surface water exists only as overland flow during intense local rainfall and/or rapid snowmelt. There is an arroyo several hundred yards to the north but the flow in it is largely dispersed and infiltrated before reaching the site. A man-made channel about 2 ft wide diverts some of the

remaining surface flow toward the disposal area. Vegetation near the Red Rio site consists primarily of grasses and juniper. Plants adapted to drier conditions such as creosote bush, and prickly pear and cholla cactus are also present.

Prior to federal government control in 1945, the site was used as range land for grazing cattle. From 1945 to 1963 the Red Rio site was unused. Since 1963 the Red Rio site has been used for burning, detonation and burial of live practice bombs and scrap metal. Burning, detonation, and burial of waste materials ceased in 1988. The Army has no current or planned uses for the site.

7.2.3 Waste Description and Investigation Results

Open burning, detonation, and burial of wastes at the Red Rio site utilized a single elongate trench approximately 550 ft long, 80 ft wide, and 10 to 15 ft deep. Practice bombs with undetonated spotting charges and small arms ammunition were placed in the trench and detonated or burned to ensure destruction of reactive materials. Burned debris as well as other wastes collected on the bombing range (i.e. scrap metal) were then covered with approximately 4 in. of fill. Disposal operations were conducted in a progressive manner of layering.

The areal extent of wastes at the Red Rio site was confirmed using geophysical methods. Based on these determinations and an assumed waste burial thickness of 8 ft, maximum waste volume was calculated. The calculated volume containing wastes (and interlayered fill) is approximately 5,748 cu yds.

Site investigations included comprehensive surface and subsurface soil sampling. Surface soil samples were collected over an area encompassing all buried wastes. Subsurface soil samples were collected during excavation of 6 trenches adjacent to buried wastes.

Trenches were excavated to a depth of 15 ft. In several instances trenches were excavated into buried wastes and samples collected of the combined soil and waste material. All samples were analyzed for possible hazardous waste constituents including explosives, semivolatile organic compounds, and heavy metals.

Residual contamination detected in surface and subsurface soil samples was minimal. No organic contaminants were detected in surface and subsurface soil samples. A few metals were detected in surface and subsurface samples at concentrations elevated slightly above background. Most of these can likely be attributed to scrap metal fragments in samples. Nearly all metals concentrations were within a typical range for western U.S. soils.

7.2.4 Closure Plan

This closure plan for the Red Rio Practice Bomb Disposal Area was prepared in accordance with the NMED requirements set forth in the NM Hazardous Waste Management Regulations (HWMR-6), Part VI, 40 CFR Part 265, Subpart G. Any amendment to this closure plan will be made in compliance with the requirements of 40 CFR Part 265.112(c). The effective date of this closure plan will be the date of receipt of approval from NMED.

7.2.5 Closure Certification

Upon receipt of notification from the NMED that a clean closure equivalency determination has been made, the Red Rio Practice Bomb Disposal Area will be considered to have completed final closure. Within 60 days of this date, WSMR will submit two certifications, one signed by the Commanding General of White Sands Missile Range and the other signed by an independent qualified registered professional engineer, each attesting that the Red Rio Practice Bomb Disposal Area has been closed in accordance with this closure plan. Certification of closure will be as required in 40 CFR Part 270.11(d).

7.2.6 Partial Closure

Partial closure is not planned for the Red Rio Practice Bomb Disposal Area.

7.2.7 Financial Assurance Requirements

Financial assurance requirements of 40 CFR Part 265.143 for closure and of 40 CFR Part 265.145 for post-closure care are not applicable to federally-owned facilities.

7.2.8 Closure Performance Standard

This closure complies with the performance standards set forth in 40 CFR Part 265, Subpart G.

7.2.9 Anticipated Life of the Facility

Upon receipt of notification from NMED that a clean closure equivalency determination has been made (as provided for in 40 CFR Part 270.1(c)(5)), the Red Rio Practice Bomb Disposal Area will be considered to have completed final closure. Any additional closure activities at the site will be conducted under RCRA Subtitle D and the New Mexico Solid Waste Management Regulations and will not be subject to the terms of this closure plan.

7.2.10 Waste Inventory

Historical information for the Red Rio site indicates that no hazardous wastes were disposed on site. Review of site records and interviews with individuals knowledgeable of site history confirm that the site was used for open burning and open detonation of practice bombs and small arms ammunition. Prior to burning or detonation, some of these materials

may have been characteristic hazardous wastes due to reactivity. During burning and detonation these wastes were converted to inert, non-hazardous materials. The areal extent of wastes at the Red Rio site was determined using geophysical methods. Based on the determinations and an assumed waste burial thickness of 8 ft, maximum waste volume was calculated. The calculated volume containing wastes (and interlayered fill) is approximately 5,748 cu yds.

7.2.11 Post-Closure Care Requirements

Site investigations described in the preceding site evaluation report demonstrated the absence of hazardous wastes at the Red Rio Practice Bomb Disposal Area. Therefore, post-closure care requirements of 40 CFR Parts 265.117 through 264.120 are not applicable to this unit.

7.2.12 Closure

The interim status closure and post-closure regulations require that the owner or operator close a facility in a manner that "controls, minimizes or eliminates, to the extent necessary to protect human health and the environment, post-closure escape of hazardous waste, hazardous waste constituents, leachate, contaminated rainfall or waste decomposition products to the ground or surface waters or the atmosphere" (40 CFR 265.111). The cited requirements have been accomplished at the Red Rio site.

Extensive sampling of surface soils, subsurface soils, and waste materials at the Red Rio Practice Bomb Disposal Area have confirmed the absence of hazardous waste constituents at concentrations which present a significant health risk. Based on these sampling results no removal or decontamination of soils or waste materials is needed to meet the criteria for clean closure. The results of surface and subsurface sampling are discussed in detail in Sections 3.2.2 and 3.2.3 of the site evaluation report, respectively. A risk assessment based on sampling results is presented in Section 5 of the Site Evaluation Report.

Ground-water monitoring is not necessary at the Red Rio site for several reasons. Sample results for surface and subsurface soils as well as waste samples demonstrate minimal contamination by hazardous waste constituents. Annual precipitation is relatively low (approximately 14 in.) and because no liquid wastes were disposed, there is little hydraulic head driving contaminants to ground water. Further, current information indicates that ground water is present only at a significant depth (approximately 300 ft). Finally, no ground-water uses are known to exist within 5 mi of the site. Ground-water conditions at the Red Rio site are discussed in more detail in Section 2.1.3 of the Site Evaluation Report.

Surface water run-on and run-off control is not required under RCRA for sites where clean closure criteria are met. Section 6.2 of the Site Evaluation Report contains recommendations for run-on and run-off control. These recommendations are made to ensure that site closure is consistent with intent of RCRA Subtitle D and the New Mexico Solid Waste Management Requirements in place at the time disposal operations ceased.

7.2.13 Dispute Resolution

The parties shall use their best efforts to informally and in good faith resolve all disputes or differences of opinion. If, however, disputes arise concerning the approved closure plan which the parties are unable to resolve informally, including but not limited to, disputes over implementation of workplans, approval of documents, scheduling of any work, selection, performance, or completion of any closure actions, or any other obligation assumed hereunder, WSMR shall present a written notice of such dispute and the basis for the objections to NMED within ten business days of the receipt of the disapproval, decision, or directive. The notice shall set forth the specific points of the dispute, the position WSMR maintains should be adopted as consistent with closure requirements, the basis therefore, and any matters which it considers necessary for the NMED's proper determination. NMED shall provide to WSMR a written statement of its decision on the pending dispute, which shall be

incorporated into the final closure plan unless WSMR requests an opportunity for a conference in accordance with the following paragraph. The existence of a dispute as defined herein, and the consideration of such matters which are placed into dispute shall not excuse, toll, or otherwise suspend any compliance obligation or deadline while the dispute resolution process is pending.

If WSMR objects to any NMED determination regarding any requirement by NMED that WSMR perform work, WSMR shall, within ten days of its receipt of NMED's decision pursuant to the previous paragraph, notify NMED in writing of its objections, and may request that the Division Director convene an informal conference. The Director shall state in writing the final decision regarding the resolution of the dispute and shall be implemented immediately by WSMR according to the schedule contained therein.

7.2.14 Request for an Equivalency Determination

Based on information provided in this closure plan and in the preceding Site Evaluation Report, White Sands Missile Range requests a determination from the New Mexico Environment Department under 40 CFR Part 270.1(c)(5) that a post-closure permit is not required for the Red Rio Practice Bomb Disposal Area. The date of receipt of notification of this determination will be considered to be the date of completion of closure for the site.

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APPENDIX A

GEOPHYSICAL SURVEYS AT THE OSCURA SITE

GEOPHYSICAL SURVEYS
AT THE OSCURA SITE
WHITE SANDS MISSILE RANGE

GEOPHYSICAL SURVEYS
AT THE OSCURA SITE
WHITE SANDS MISSILE RANGE

Prepared For:

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April 23, 1991

Table of Contents

		Page
1.0	INTRODUCTION	1
2.0	DATA ACQUISITION	2
2.1	GENERAL	2
2.2	ELECTROMAGNETIC CONDUCTIVITY PROFILING	2
2.3	MAGNETIC FIELD MEASUREMENTS	3
3.0	RESULTS	5
4.0	CONCLUSIONS	6

List of Tables and Figures

Table 2-1	Daily log of field activities at Oscura
Figure 1-1	Survey Location Map - Oscura Site
Figure 2-1	Example of Magnetic Field Over a Body
Figure 3-1	Total Magnetic Field (Gammas)
Figure 3-1a	Total Magnetic Field (Gammas)
Figure 3-2	EM-31 Ground Conductivity (mmhos/m)
Figure 3-2a	EM-31 Ground Conductivity (mmhos/m)
Figure 3-3	EM-31 Inphase Component (ppt)
Figure 3-3a	EM-31 Inphase Component (ppt)

1.0 INTRODUCTION

This report contains the results of a geophysical survey conducted at the Oscura Practice Bomb Disposal Site at White Sands Missile Range. This survey was performed by Blackhawk Geosciences, Inc. (BGI) for CDM Federal Programs Corporation (CDMFPC) on March 26-28 and April 3, 1991.

The objective of the survey was to delineate the location of disposal trenches once used for open burning, detonation, and burial of practice bombs, small arms ammunition, and other wastes generated on bombing and gunnery ranges located adjacent to the site. A site map showing cultural features and survey coverage is shown on Figure 1-1.

Two geophysical methods were utilized. These methods were:

(1) Electromagnetic (EM) profiling with the Geonics EM-31. The apparent conductivity of metallics in the disposal trenches will differ sharply from that of the surrounding soils.

(2) Magnetic field measurements with the Geometrics 856. Ferrous materials in the disposal trenches will affect the total magnetic field.

2.0 DATA ACQUISITION

2.1 GENERAL

The boundaries of the Oscura survey area were staked in the field by CDMFPC personnel and two BGI geophysical engineers. Within the boundaries of the survey area, a grid was laid out using a 30 ft line spacing with a 10 ft station interval. All survey lines are shown in Figure 1-1.

A daily log of field activities is given in Table 2-1.

Table 2-1. Daily log of field activities at Oscura

Date (1991)	Activity
March 25	Mobilize to Carrizozo, NM. Obtain badges and vehicle passes.
March 26	Begin layout of survey grid. Work halted at 11:15 A.M. by CDMFPC because of visible dust in the air.
March 27	Finish laying out survey grid. Collect EM-31 data. Begin data collection with magnetometer. Work halted at 3:00 P.M. because of visible dust in the air.
March 28	Finish data collection with magnetometer. Dump magnetometer data to portable computers at observation tower. Demobilize to Denver.
April 2	Mobilize to Socorro, NM.
April 3	Obtain vehicle pass and stake disposal pits at survey area.
April 4	Perform geophysical surveys at Red Rio Site.
April 5	Perform geophysical surveys at Red Rio Site. Demobilize crew and equipment to Denver.

2.2 ELECTROMAGNETIC CONDUCTIVITY PROFILING

In electromagnetic conductivity profiling the lateral and vertical variation in earth conductivity (geoelectric section) is measured. The conductivity is determined from measuring the resistance to flow of electrical current. Current flow (eddy currents) is generated in the subsurface by the primary electromotive induction of the time-varying current driven through the transmitter. ~~The intensity of the eddy currents~~

~~through the transmitter~~. The intensity of the eddy currents created in the subsurface are a function of ground conductivity. The ground eddy currents in turn cause a time-varying secondary magnetic field that is measured as a voltage in a receiver.

It has been shown that for the instrument parameters of the EM-31, there is a linear relation between quadrature phase component of voltage and ground conductivity. Thus, the EM-31 gives a direct reading of apparent conductivity to an effective exploration depth of about 10 ft.

The in-phase component of the induced magnetic field is more sensitive to large metallic objects than the quadrature phase component used for ground conductivity measurements. In-phase measurements are presented as the ratio of the induced secondary magnetic field to the primary magnetic field.

Buried metallic objects cause an anomalous spatial behavior in the apparent conductivities measured. Over metallic objects the linear relation between the quadrature phase component of voltage and conductivity is no longer valid, and even negative values can be observed. Thus, in addition to measuring ground conductivity, the EM-31 also can be effective in locating metallic objects.

The EM-31 was calibrated each field day prior to data acquisition. The Geonics EM-31 was operated by one BGI employee. At each measurement station the ground conductivity and the in-phase component are automatically entered into an Omnidata Data Logger. Along with these measurements, Line #, Station # and any comments are also stored. At the end of each day the data in the data logger was downloaded to a portable computer, and the data was examined. By examination of the data, anomalous trends and suspect data values can be identified, and any problems which may arise can be rectified during the next field day.

2.3 MAGNETIC FIELD MEASUREMENTS

The signals in a magnetic survey are partially the result of, and strongly influenced by, the ambient earth magnetic field. The net magnetization is the vector sum of induced plus remanent magnetizations. Remanent magnetization is a permanent magnetic moment per unit volume, and induced magnetization is magnetization fluctuating with the earth's magnetic field. The Geometrics 856 measures the maximum intensity of this vector field. The net magnetic field measured with a magnetometer is the vector sum of the field due to local magnetized materials and the ambient field of the earth. Figure 2-1 shows the total field intensity due to a simple magnetic dipole, the ambient field of the earth, and the total-intensity of an anomaly. In this case the magnetization is parallel to the earth's magnetic field. There is a magnetic low to the north of the center of the body

and a high to the south (Barrows, 1988). The steel present in the practice bombs should produce a magnetic signature similar to that shown in Figure 2-1.

Diurnal variations in the geomagnetic field can be removed from the survey data by taking base station measurements. This procedure is used in magnetic surveys for geologic features with large spatial wavelength. In surveying for buried metallic objects of short spatial wavelength, the anomalies are measured in a brief period of time, and correction of diurnal variation is not necessary. However, during this survey, base station measurements were recorded at regular intervals, and these were used to remove diurnal variations from the magnetometer data. Corrections for diurnal variations assisted in drawing the background contour map, but did not effect the short spatial wavelength anomalies of buried objects.

A Geometrics 856 proton precession magnetometer was used to record the total magnetic field at each station. Prior to daily data acquisition, the magnetometer was tested and calibrated according to the instructions in the user's manual. All measurements were taken with the sensor placed on an 8 ft staff to eliminate near surface noise.

The magnetometer data logger stores the measurements and station location automatically after each reading. Again the menu of the data logger assures entering all relevant data at each station. The data is then downloaded after each field day and contoured on a portable computer.

Reference

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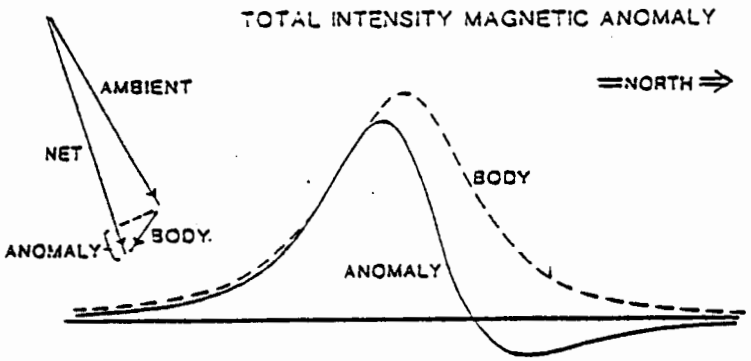
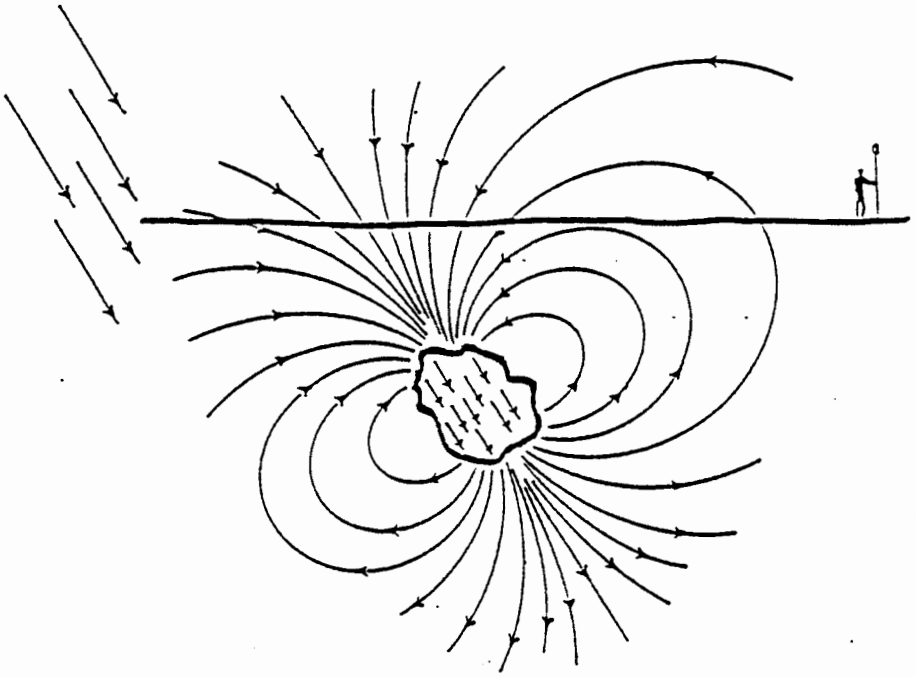




Magnetic effect of an isolated body magnetized in the direction of the earth's ambient field. The measured total magnetic intensity is the vector sum of the ambient field plus the field due to the body.

BLACKHAWK GEOSCIENCES, INC.

EXAMPLE OF MAGNETIC FIELD
OVER A BODY
OSCURA SITE
WHITE SANDS MISSILE RANGE
CDM FEDERAL PROGRAMS

PROJECT NO: 91017

Figure 2-1

3.0 RESULTS

The geophysical survey at the Oscura Site was performed on March 26, 1991 through March 28, 1991. The geophysical data sets were then contoured and interpreted. The three different geophysical methods performed at the Oscura Site were

- Total Magnetic Field (Figs. 3-1, 3-1a)
- EM-31 Ground Conductivity (Figs. 3-2, 3-2a), and
- EM-31 In-Phase Component (Figs. 3-3, 3-3a).

The interpreted disposal pits are readily apparent by anomalies in contoured data on both the total magnetic field (Fig. 3-1a) and EM-31 in-phase component (Fig. 3-3a). While these features can also be recognized in the ground conductivity contour map (Fig. 3-2a) some anomalies appear to be more clearly defined on the total magnetic field and EM-31 in-phase contour map. This may be because conductivity data can be affected by changes in soil type, and soil type cannot be assumed to remain constant over a landfill area.

On April 3, 1991 all areas on the survey grid interpreted to be disposal pits were staked by BGI and CDMFPC personnel. At each suspect area, the EM-31 in-phase component was measured at the interpreted boundary of the disposal pit, and when a significant anomaly was encountered, the interpreted boundary of the disposal pit was staked at that location. Fifteen separate pits were inferred to be present and staked. The approximate boundaries of all pits were outlined on a field map by CDMFPC and are shown in Figure 1-1.

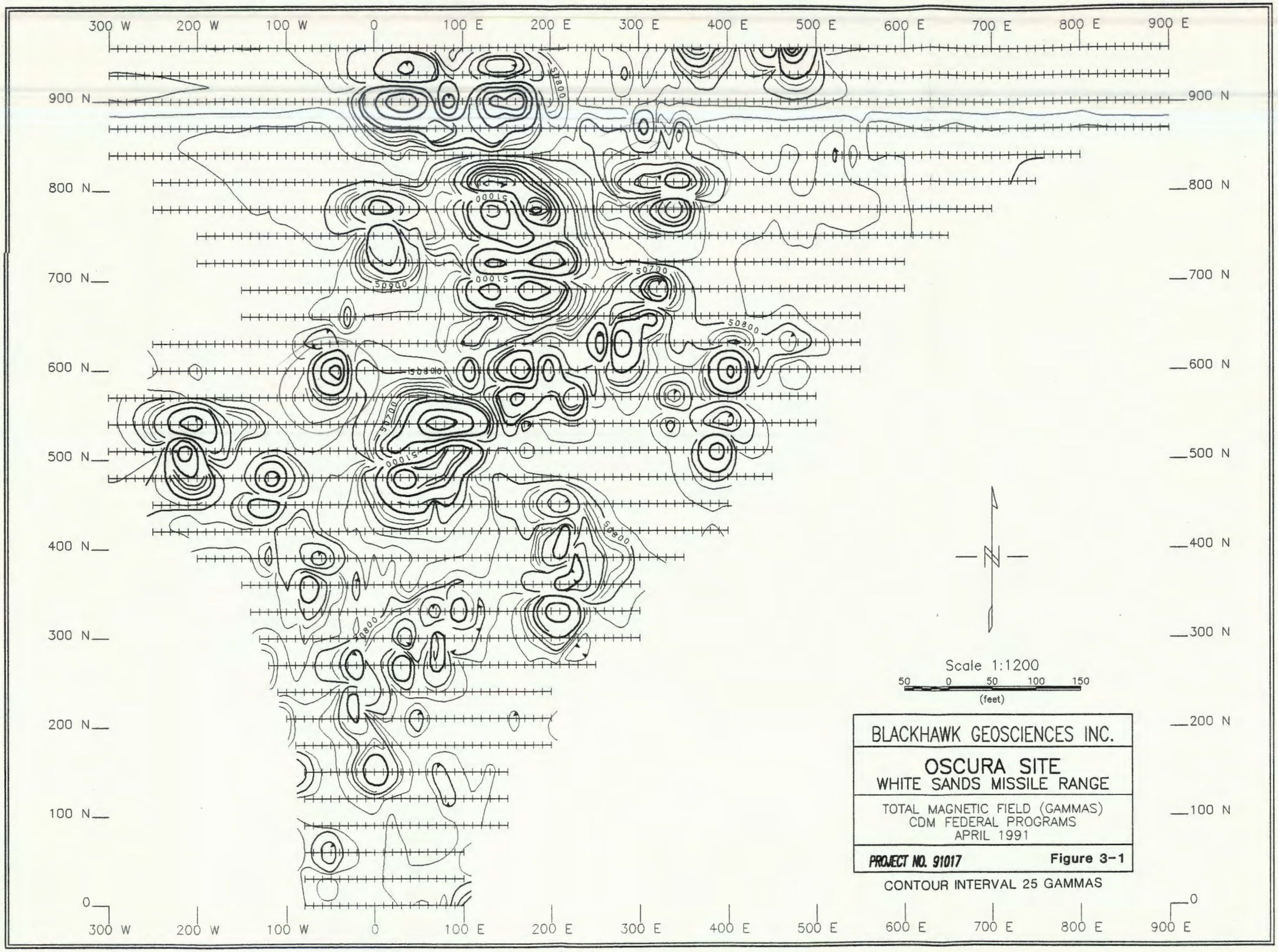
Near the center of the survey grid an area of anomalous readings was encountered on lines in the square defined by 10E 450N, 10E 570N, 130E 570N, 130E 450N. The geophysical behavior of the anomaly in this area was gradual and of low magnitude, which made definition of a boundary difficult. This area was staked and is identified on Figure 1-1. The geophysical behavior encountered in this area may be due to a different kind of buried waste (garbage or construction trash) than in the staked areas, or it may be similar waste as encountered elsewhere but buried deeper.

An anomaly can be seen at 40W, 600N on all contour maps. This anomaly is interpreted to be caused by a missile (approximately 10 ft long and 2 ft in diameter) that was visible in the berm. This area was not staked. A slightly anomalous area is present near 340E, 800N. The magnitudes of this anomaly were so low that this area is expected to contain a very small amount of metallics, such as construction trash. This area was not staked.

4.0 CONCLUSIONS

The interpretation of the geophysical surveys at the Oscura Site at the White Sands Missile Range showed 15 likely disposal pits. These pits were staked in the field by BGI and CDMPFC personnel.

An anomalous area centered at 70E 510N was encountered. The geophysical signatures of this anomaly showed a gradual boundary, and an area 120 ft by 120 ft square was staked to be certain the entire anomaly was encompassed.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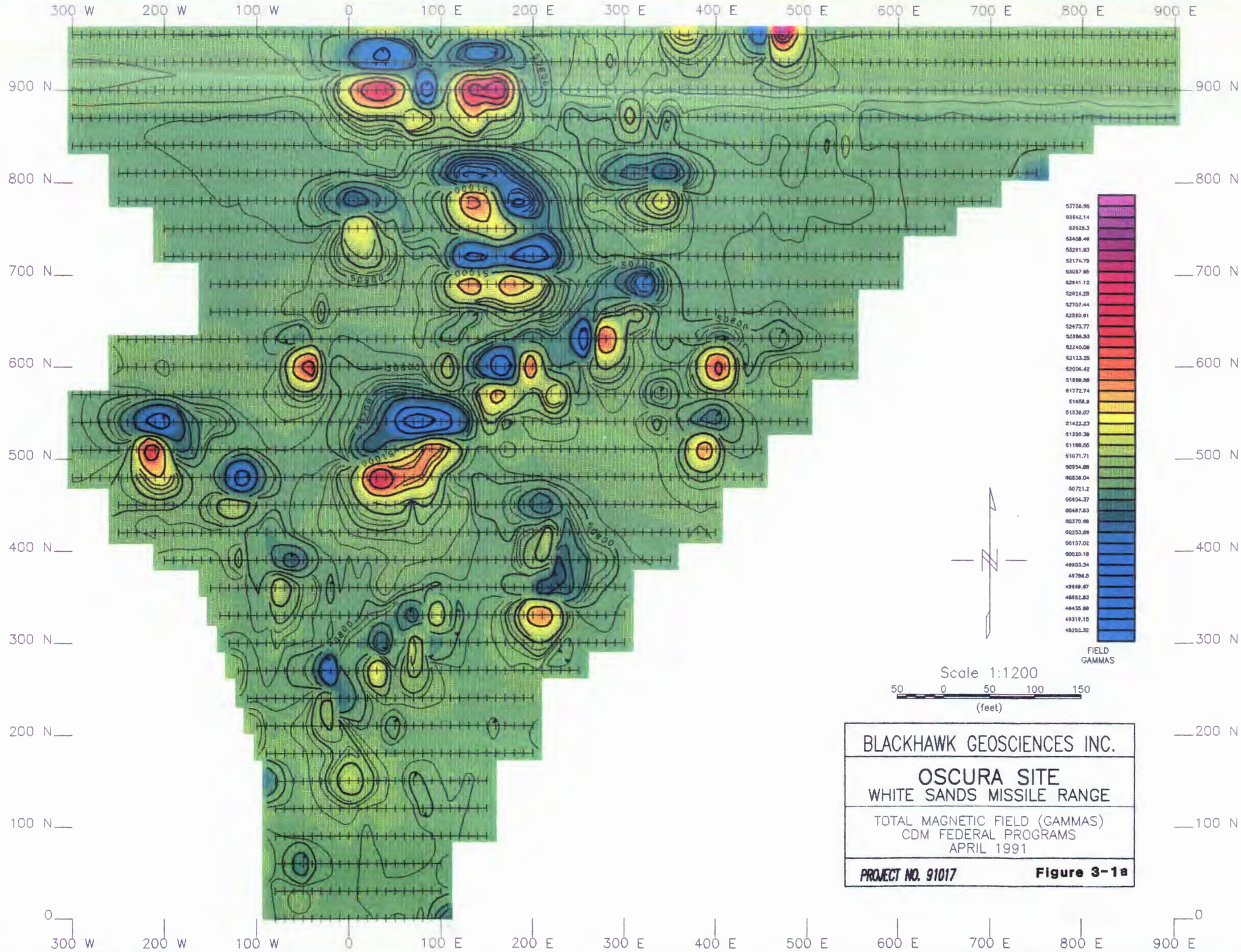
(feet)
BLACKHAWK GEOSCIENCES INC.
OSCURA SITE
WHITE SANDS MISSILE RANGE
TOTAL MAGNETIC FIELD (GAMMAS)
CDM FEDERAL PROGRAMS
APRIL 1991
PROJECT NO. 91017
Figure 3-1
CONTOUR INTERVAL 25 GAMMAS



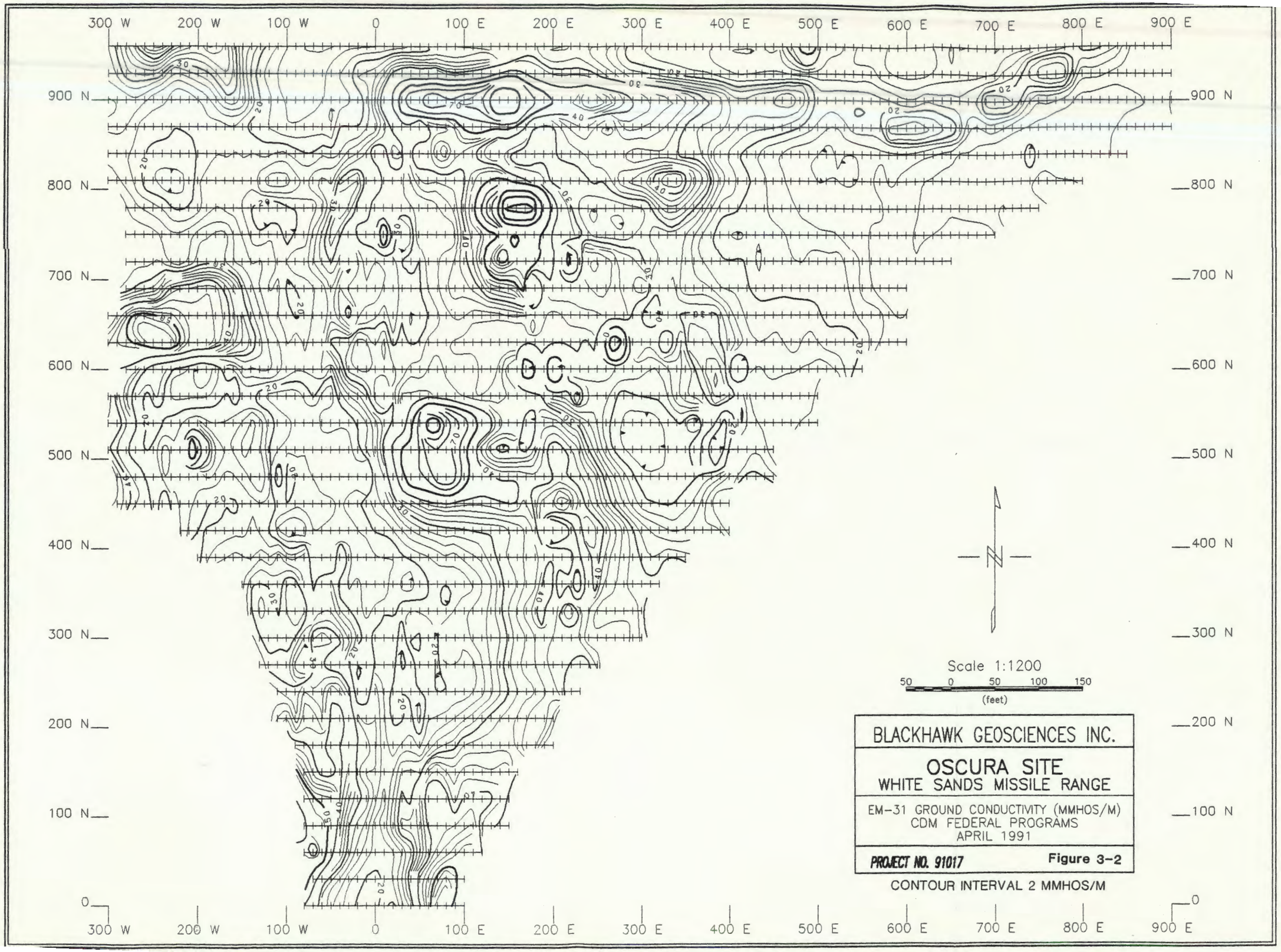
BLACKHAWK GEOSCIENCES INC.

OSCURA SITE
WHITE SANDS MISSILE RANGE

TOTAL MAGNETIC FIELD (GAMMAS)
CDM FEDERAL PROGRAMS
APRIL 1991

PROJECT NO. 91017

Figure 3-1a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200 N
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N
Scale 1:1200
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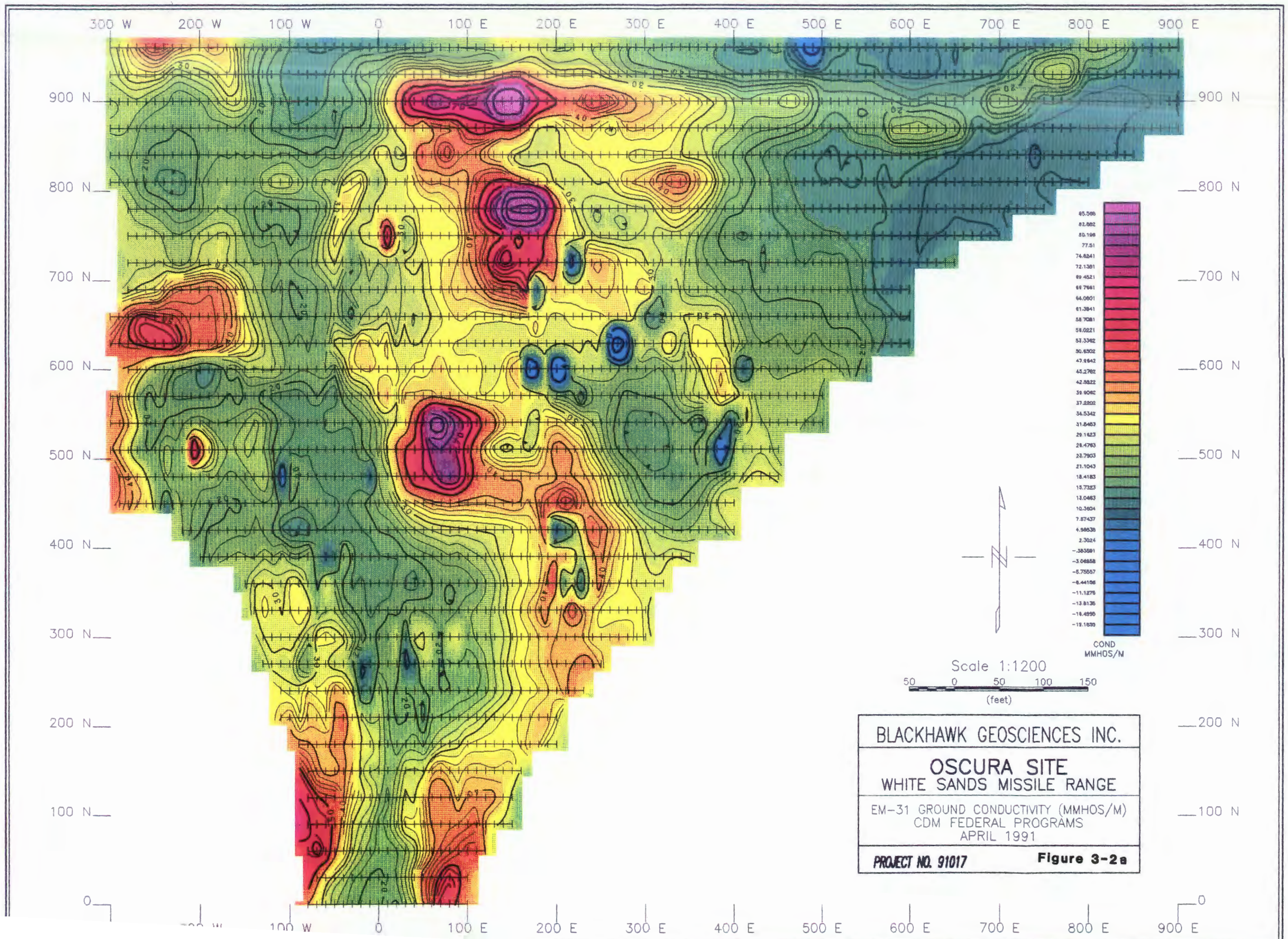
(feet)
BLACKHAWK GEOSCIENCES INC.
OSCURA SITE
WHITE SANDS MISSILE RANGE
EM-31 GROUND CONDUCTIVITY (MMHOS/M)
CDM FEDERAL PROGRAMS
APRIL 1991
PROJECT NO. 91017
Figure 3-2
CONTOUR INTERVAL 2 MMHOS/M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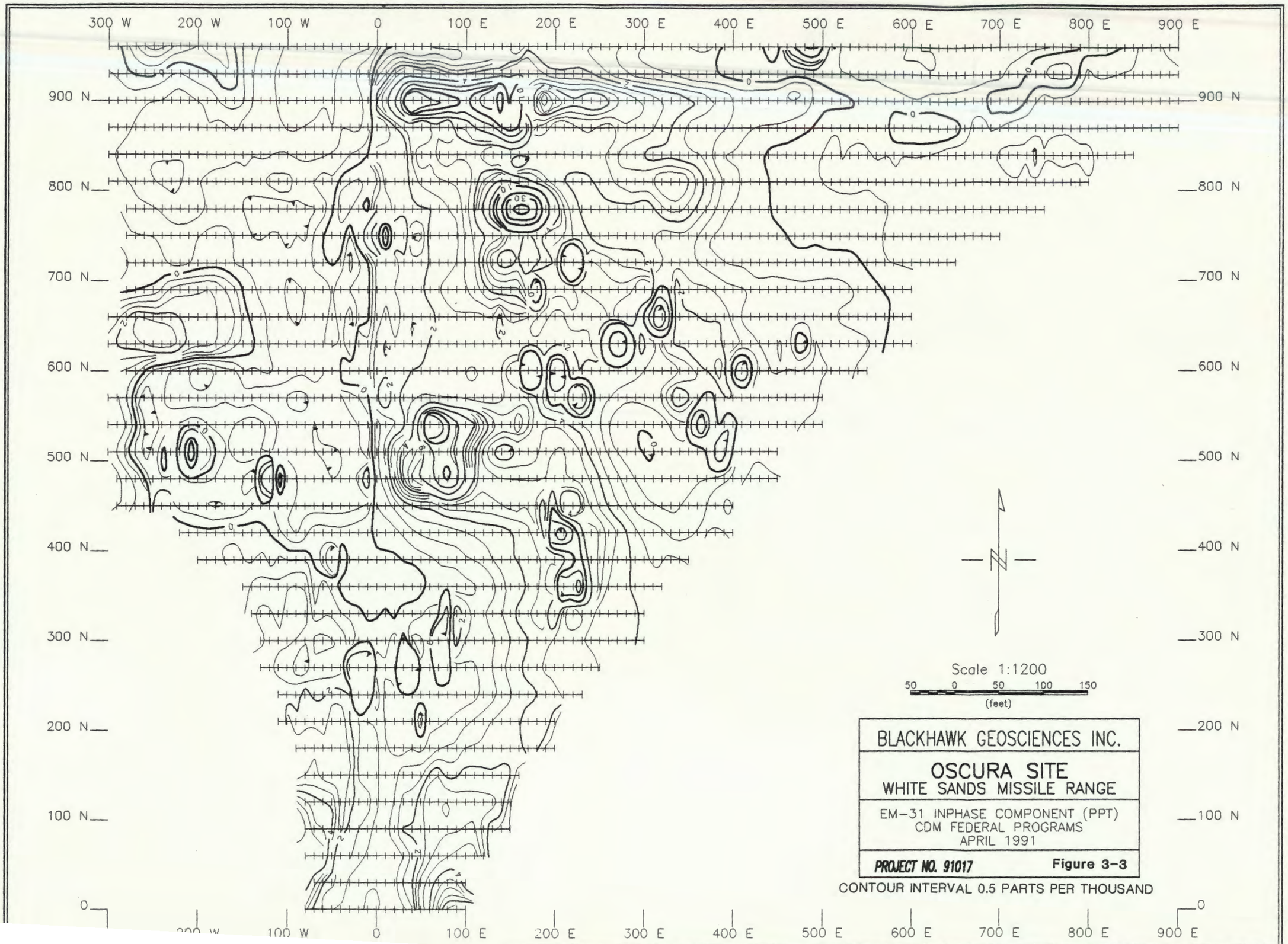
(feet)
BLACKHAWK GEOSCIENCES INC.
OSCURA SITE
WHITE SANDS MISSILE RANGE
EM-31 GROUND CONDUCTIVITY (MMHOS/M)
CDM FEDERAL PROGRAMS
APRIL 1991
PROJECT NO. 91017
Figure 3-2a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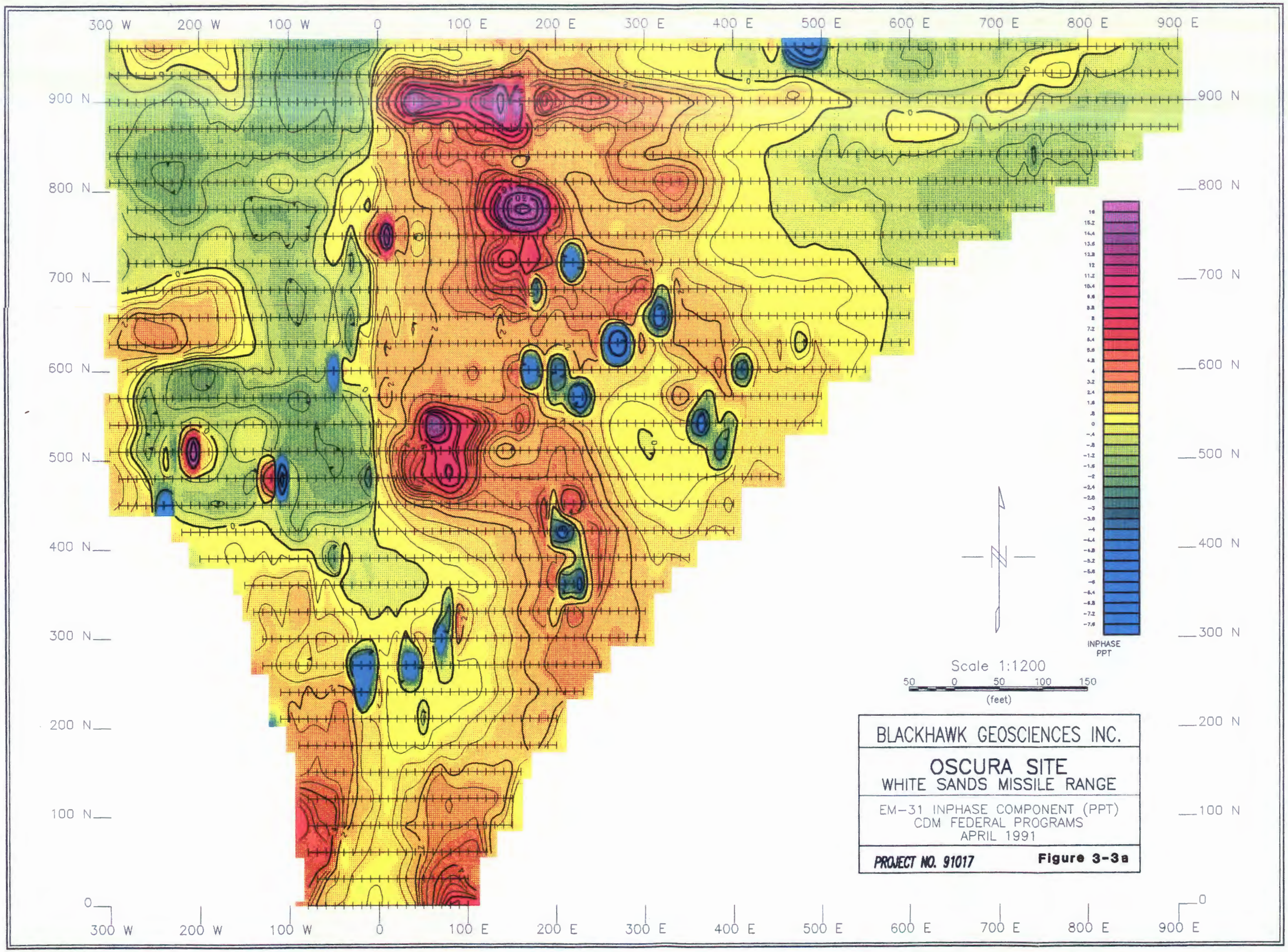
50 0 50 100 150
(feet)
BLACKHAWK GEOSCIENCES INC.
OSCURA SITE
WHITE SANDS MISSILE RANGE
EM-31 INPHASE COMPONENT (PPT)
CDM FEDERAL PROGRAMS
APRIL 1991
PROJECT NO. 91017
Figure 3-3
CONTOUR INTERVAL 0.5 PARTS PER THOUSAND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800 E
900 E
900 N
800 N
700 N
600 N
500 N
400 N
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200 N
100 N
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INPHASE
PPT
Scale 1:1200
50 0 50 100 150
(feet)
BLACKHAWK GEOSCIENCES INC.
OSCURA SITE
WHITE SANDS MISSILE RANGE
EM-31 INPHASE COMPONENT (PPT)
CDM FEDERAL PROGRAMS
APRIL 1991
PROJECT NO. 91017
Figure 3-3a

TO VIEW THE MAP AND/OR MAPS WITH THIS DOCUMENT, PLEASE CALL THE HAZARDOUS WASTE BUREAU AT 505-476-6000 TO MAKE AN APPOINTMENT

APPENDIX B

GEOPHYSICAL SURVEYS AT THE RED RIO SITE

GEOPHYSICAL SURVEYS
AT THE RED RIO SITE
WHITE SANDS MISSILE RANGE

GEOPHYSICAL SURVEYS
AT THE RED RIO SITE
WHITE SANDS MISSILE RANGE

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(Project #91017)

April 16, 1991

Table of Contents

		Page
1.0	INTRODUCTION	1
2.0	DATA ACQUISITION	2
2.1	GENERAL	2
2.2	ELECTROMAGNETIC CONDUCTIVITY PROFILING	2
2.3	MAGNETIC FIELD MEASUREMENTS	3
3.0	RESULTS	5
3.1	AREA 1	5
3.2	AREA 2	6
3.3	AREA 3	6
3.4	AREA 4	6
3.5	AREA 5	7
3.6	AREAS 6 THROUGH 11	7
4.0	CONCLUSIONS	8

List of Tables and Figures

Table 2-1 Daily log of field activities at Red Rio

Figure 1-1 Survey Location Map - Red Rio Site

Figure 2-1 Example of magnetic field over a body

(Red Rio Area 1)
Figure 3-1 Total Magnetic Field (gammas)
Figure 3-1a Total Magnetic Field (gammas)
Figure 3-2 Ground Conductivity (mmhos/m)
Figure 3-2a Ground Conductivity (mmhos/m)
Figure 3-3 EM-31 Inphase (ppt)
Figure 3-3a EM-31 Inphase (ppt)
Figure 3-4 Geophysical Data Sets

(Red Rio Area 2)
Figure 3-5 Total Magnetic Field (Gammas)
Figure 3-5a Total Magnetic Field (Gammas)
Figure 3-6 Ground Conductivity (mmhos/m)
Figure 3-6a Ground Conductivity (mmhos/m)
Figure 3-7 EM-31 Inphase (ppt)
Figure 3-7a EM-31 Inphase (ppt)

Figure 3-8 Red Rio Area 3. Geophysical Data Sets
Figure 3-9 Red Rio Area 4. Geophysical Data Sets
Figure 3-10 Red Rio Area 5. Geophysical Data Sets
Figure 3-11 Red Rio Area 5. Geophysical Data Sets
Figure 3-12 Red Rio Area 6. Geophysical Data Sets
Figure 3-13 Red Rio Area 7. Geophysical Data Sets
Figure 3-14 Red Rio Area 8. Geophysical Data Sets
Figure 3-15 Red Rio Area 9. Geophysical Data Sets
Figure 3-16 Red Rio Area 10. Geophysical Data Sets
Figure 3-17 Red Rio Area 11. Geophysical Data Sets

1.0 INTRODUCTION

A geophysical survey was conducted at the Red Rio Practice Bomb Disposal Site at White Sands Missile Range during April 4 and 5, 1991. This survey was performed by Blackhawk Geosciences, Inc. (BGI) for CDM-Federal Programs Corporation (CDMFPC).

The objective of the survey was to delineate the location of disposal trenches once used for open burning, detonation, and burial of practice bombs, small arms ammunition, and other wastes generated on bombing and gunnery ranges located adjacent to the site. A site map showing cultural features and survey coverage is shown on Figure 1-1.

Two geophysical methods were utilized. These methods were:

(1) Electromagnetic (EM) profiling with the Geonics EM-31. The apparent conductivity of metallics in the disposal trenches will differ sharply from that of the surrounding soils.

(2) Magnetic field measurements with the Geometrics 856. Ferrous materials in the disposal trenches will affect the total magnetic field.

2.0 DATA ACQUISITION

2.1 GENERAL

The geophysical survey at the Red Rio Site was conducted by a BGI crew consisting of two geophysical engineers. The survey areas were staked in the field by CDMFPC and BGI personnel. At Area 1 the survey grid was laid out at a 30 ft line spacing with measurement stations every 10 ft along each line. The grid was centered over an excavation in such a manner that the survey lines extended well beyond the excavated area (see Fig. 1-1).

The survey grid at Area 2 also used a 30 ft line spacing and 10 ft station spacing. Areas 3 and 6 through 11 were surveyed using two perpendicular lines, each 100 ft long, and intersecting at their centers. Area 4 consisted of a 100 ft line with one perpendicular line of 50 ft extending from its center. Area 5 had one 50 ft, one 150 ft, and one 200 ft line arranged in an irregular geometry (see Fig. 1-1). The station spacing used for all lines in Areas 3-11 was 10 ft.

A daily log of field activities is given in Table 2-1.

Table 2-1. Daily log of field activities at Red Rio

Date (1991)	Activity
April 2	Mobilize to Socorro, NM.
April 3	Obtain vehicle passes and perform geophysical surveys at Oscura site.
April 4	Layout survey grid at Areas 1 through 9. Collect EM-31 data and magnetometer data at Areas 1 and 2.
April 5	Stake disposal trenches at Area 1. Layout survey grid at Area 10. Collect EM-31 and magnetometer data at Areas 3-10. Layout survey grid at Area 11. Collect EM-31 and magnetometer data at Area 11. Dump all data to portable computer and make field interpretation of Areas 3-11. Demobilize to Denver, CO.

2.2 ELECTROMAGNETIC CONDUCTIVITY PROFILING

In electromagnetic conductivity profiling the lateral and vertical variation in earth conductivity (geoelectric section) is measured. The conductivity is determined from measuring the resistance to flow of electrical current. Current flow (eddy currents) is generated in the subsurface by the primary

created in the subsurface are a function of ground conductivity. The ground eddy currents in turn cause a time-varying secondary magnetic field that is measured as a voltage in a receiver.

It has been shown that for the instrument parameters of the EM-31, there is a linear relation between quadrature phase component of voltage and ground conductivity. Thus, the EM-31 gives a direct reading of apparent conductivity to an effective exploration depth of about 10 ft.

The in-phase component of the induced magnetic field is more sensitive to large metallic objects than the quadrature phase component used for ground conductivity measurements. In-phase measurements are presented as the ratio of the induced secondary magnetic field to the primary magnetic field.

Buried metallic objects cause an anomalous spatial behavior in the apparent conductivities measured. Over metallic objects the linear relation between the quadrature phase component of voltage and conductivity is no longer valid, and even negative values can be observed. Thus, in addition to measuring ground conductivity, the EM-31 also can be effective in locating metallic objects.

The EM-31 was calibrated each field day prior to data acquisition. The Geonics EM-31 was operated by one BGI employee. At each measurement station the ground conductivity and the in-phase component are automatically entered into an Omnidata Data Logger. Along with these measurements, Line #, Station # and any comments are also stored. At the end of each day the data in the data logger was downloaded to a portable computer, and the data was examined. By examination of the data, anomalous trends and suspect data values can be identified, and any problems which may arise can be rectified during the next field day.

2.3 MAGNETIC FIELD MEASUREMENTS

The signals in a magnetic survey are partially the result of, and strongly influenced by, the ambient earth magnetic field. The net magnetization is the vector sum of induced plus remanent magnetizations. Remanent magnetization is a permanent magnetic moment per unit volume, and induced magnetization is magnetization fluctuating with the earth's magnetic field. The Geometrics 856 measures the maximum intensity of this vector field. The net magnetic field measured with a magnetometer is the vector sum of the field due to local magnetized materials and the ambient field of the earth. Figure 2-1 shows the total field intensity due to a simple magnetic dipole, the ambient field of the earth, and the total-intensity of an anomaly. In this case the magnetization is parallel to the earth's magnetic field. There is a magnetic low to the north of the center of the body and a high to the south (Barrows, 1988). The steel present in

the practice bombs should produce a magnetic signature similar to that shown in Figure 2-1.

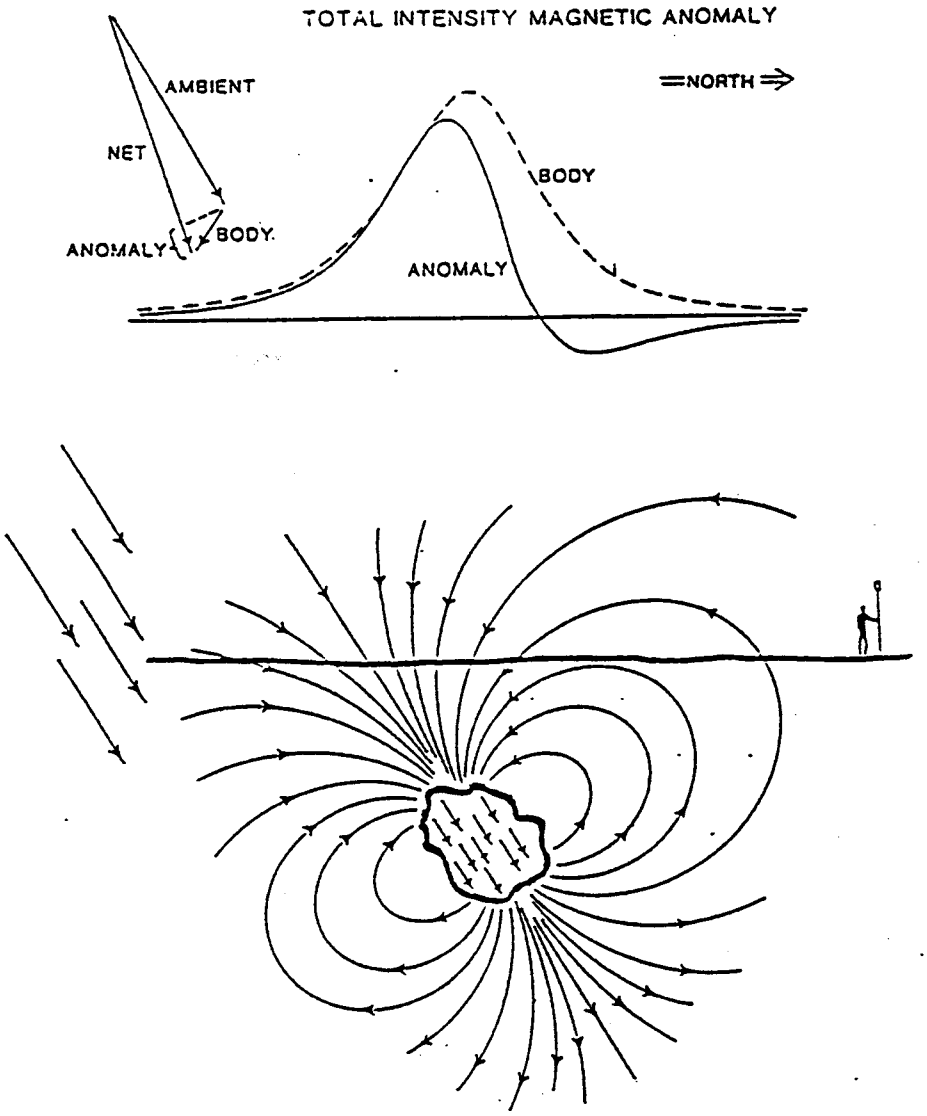
Diurnal variations in the geomagnetic field can be removed from the survey data by taking base station measurements. This procedure is used in magnetic surveys for geologic features with large spatial wavelength. In surveying for buried metallic objects of short spatial wavelength, the anomalies are measured in a brief period of time, and correction of diurnal variation is not necessary. However, during this survey, base station measurements were recorded at regular intervals, and these were used to remove diurnal variations from the magnetometer data. Corrections for diurnal variations assisted in drawing the background contour map, but did not effect the short spatial wavelength anomalies of buried objects.

A Geometrics 856 proton precession magnetometer was used to record the total magnetic field at each station. Prior to daily data acquisition, the magnetometer was tested and calibrated according to the instructions in the user's manual. All measurements were taken with the sensor placed on an 8 ft staff to eliminate near surface noise.

The magnetometer data logger stores the measurements and station location automatically after each reading. Again the menu of the data logger assures entering all relevant data at each station. The data is then downloaded after each field day and contoured on a portable computer.

Reference

Barrows, Larry, 1988. Magnetic surveying for hazardous waste site investigations, Earth Science and Engineering, Inc.



Magnetic effect of an isolated body magnetized in the direction of the earth's ambient field. The measured total magnetic intensity is the vector sum of the ambient field plus the field due to the body.

BLACKHAWK GEOSCIENCES, INC.

EXAMPLE OF MAGNETIC FIELD
OVER A BODY
RED RIO SITE
WHITE SANDS MISSILE RANGE
CDM FEDERAL PROGRAMS

PROJECT NO: 91017

Figure 2-1

3.0 RESULTS

3.1 AREA 1

Area 1 is situated over an excavation that was made in an existing drainage at the Red Rio Site. There are practice bombs visible on the surface in the excavated area, and some practice bombs were observed scattered around the perimeter of the excavation.

The results of three geophysical survey methods performed at Area 1 are shown in contour map and color contour form. These methods were total magnetic field (Figs. 3-1, 3-1a), EM-31 ground conductivity (Figs. 3-2, 3-2a), and EM-31 in-phase component (Figs. 3-3, 3-3a). A steep embankment in Area 1 made geophysical measurements impossible at some stations. The stations where no data were collected were blanked, and appear as rectangles with no contouring present on the color contour and contour maps (Figs. 3-1 through 3-3 and 3-1a through 3-3a). All three methods exhibited an elongated area showing highly anomalous values in the survey grid. This feature extends from roughly 0N to 510N on the surveyed area. The lateral extent of the anomalous area varies from survey line to survey line, but background values were encountered on each end of all survey lines.

A profile plot of survey line 330 in Area 1 is given in Figure 3-4. The magnitude of the anomaly on this line is roughly 1/4 of the total magnitude of the anomaly measured across Area 1. The lateral limits of the anomalous areas can be discerned by examination of the data sets on Figure 3-4.

After a field interpretation of the data sets for Area 1, the EM-31 in-phase component was measured at the interpreted boundary of the disposal pit, and when a significant anomaly was encountered, the interpreted boundary of the disposal pit was staked by BGI and CDMFPC personnel. This approximate boundary was outlined on a field map by CDMFPC and is shown in Figure 1-1.

An area of anomalous readings was encountered on lines 0N through 90N, but the geophysical behavior of the anomaly in this area was gradual and of low magnitude, which made definition of a boundary difficult. This area was not staked, but it is identified on Figure 1-1. The geophysical behavior encountered in this area may be due to a different kind of buried waste (garbage or construction trash) than in the staked areas, or the same waste buried deeper. This area should be avoided during excavation.

3.2 AREA 2

The survey grid for Area 2 lies west of the large mound on the left edge of Figure 1-1. Survey lines 210N and 240N were extended to cover the disturbed area pit.

The contour maps and color contour plots for Area 2 are total magnetic field (Figs. 3-5, 3-5a), EM-31 ground conductivity (Figs. 3-6, 3-6a), and EM-31 in-phase component (Figs. 3-7, 3-7a). The contour interval for the contour maps for Area 2 was independently determined, but the color scale used for the color contour maps was the same as determined for Area 1. This was done to give a visual comparison of the magnitude of the anomalies at Areas 1 and 2. A comparison of Figures 3-1a and 3-5a show that the magnetic anomaly measured at Area 2 is an order of magnitude less than that measured at Area 1.

The EM-31 ground conductivity and in-phase component show a linear anomaly of low magnitude extending from 360N, 50E through 240N, 80W to 210N, 250W. The total magnetic field shows no such feature, but shows an isolated magnetic high at line 240N, 80W. At this location there is a post (indicated on Fig. 1-1) with several metal junction boxes connected to a series of buried cables.

The lack of response from total magnetic field over the linear anomaly on the EM-31 data suggests that the anomaly is due to a non-ferrous buried metallic, such as copper or aluminum wire. The post located on the linear anomaly with buried cables connected to it helps to substantiate this interpretation. This linear anomaly is denoted on the map in Figure 1-1 as an anomaly not interpreted to be associated with disposal trenches.

3.3 AREA 3

The geophysical data collected at Area 3 (Fig. 3-8) shows little variation in the geophysical methods across the survey lines. Figure 3-8 plotted at the same scale as Figure 3-4 (line 330N, Area 1) to show the type of anomaly expected across a disposal trench filled with practice bombs. Because the profile on Figure 3-8 is flat, no anomalies associated with disposal pits were interpreted at Area 3.

3.4 AREA 4

The geophysical data is shown in Figure 3-9. The small deflection in the magnetic data at station 100 is interpreted as the effect of steel guy wires protruding from the ground at this location, connected to nearby poles (Fig. 1-1). A small area has been denoted on Figure 1-1 where this anomaly is present. Because the geophysical profiles are flat, no anomalies associated with disposal pits were interpreted at Area 4.

3.5 AREA 5

The geophysical data collected at this area is presented in profile form in Figures 3-10 and 3-11. Because the geophysical profiles are flat, no anomalies associated with disposal pits were interpreted at Area 5.

3.6 AREAS 6 THROUGH 11

The geophysical data collected at these areas is presented in profile form in Figures 3-12 (Area 6), 3-13 (Area 7), 3-14 (Area 8), 3-15 (Area 9), 3-16 (Area 10) and 3-17 (Area 11). Because the geophysical profiles are flat, no anomalies associated with disposal pits were interpreted at these areas.

4.0 CONCLUSIONS

The geophysical surveys conducted at the Red Rio Site at the White Sands Missile Range yielded the following results.

Area 1

An interpretation was made defining the boundary of an elongated disposal trench. This trench was staked by BGI and CDMFPC personnel in the field. An anomalous area on lines 0N through 90N with a gradual boundary in geophysical signatures was identified, but not staked due to an indefinite boundary. This area should be avoided during excavation.

Area 2

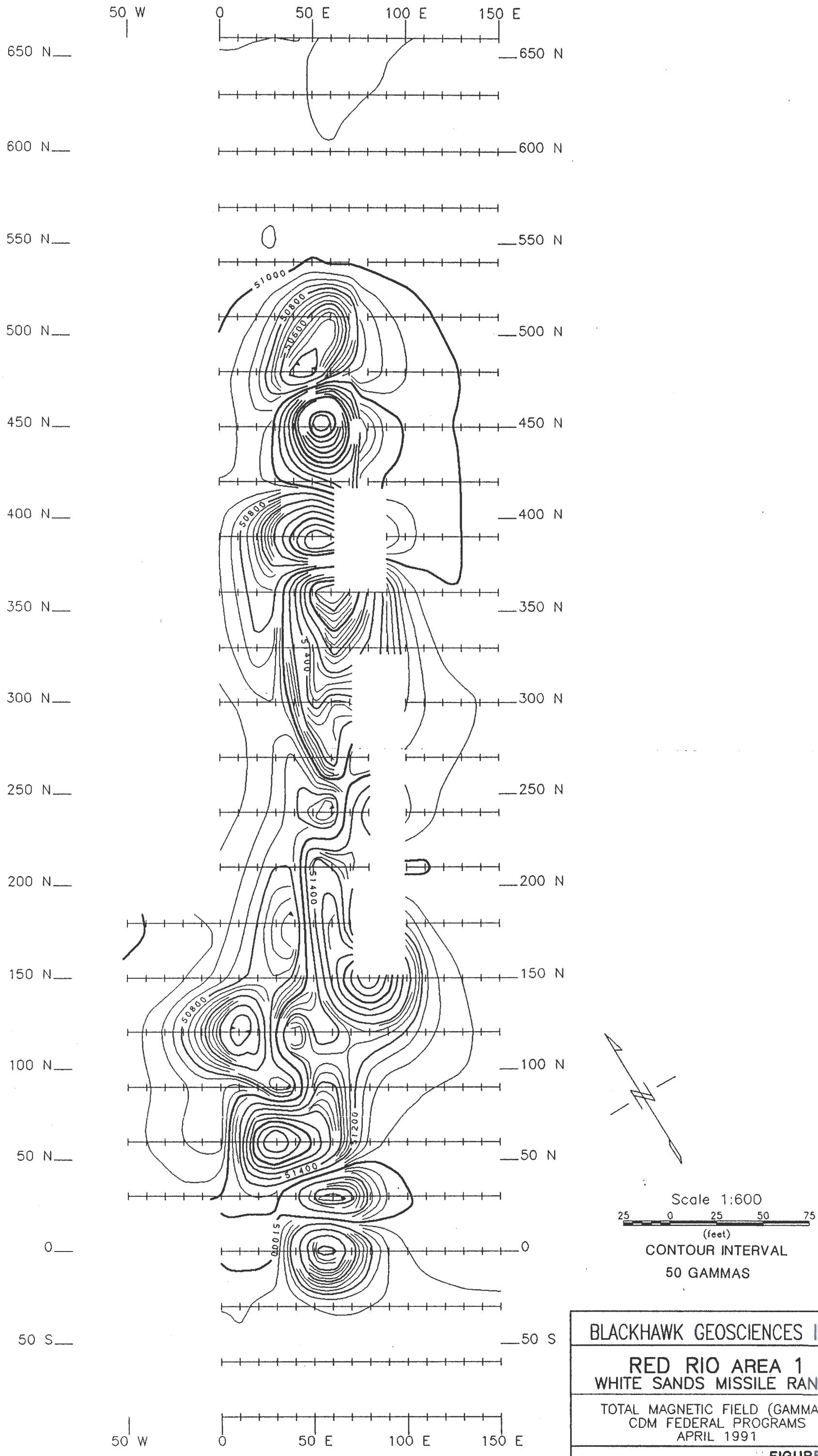
An anomalous linear trend was identified, but this linear feature is interpreted to be buried cables. No disposal pits were interpreted at this area.

Area 4

A small magnetic anomaly is present at Area 4, and is interpreted to be the magnetic response to a guy wire located on the line. No disposal pits were interpreted at this area.

Areas 3 and 5 through 11

No disposal pits were interpreted at these areas.



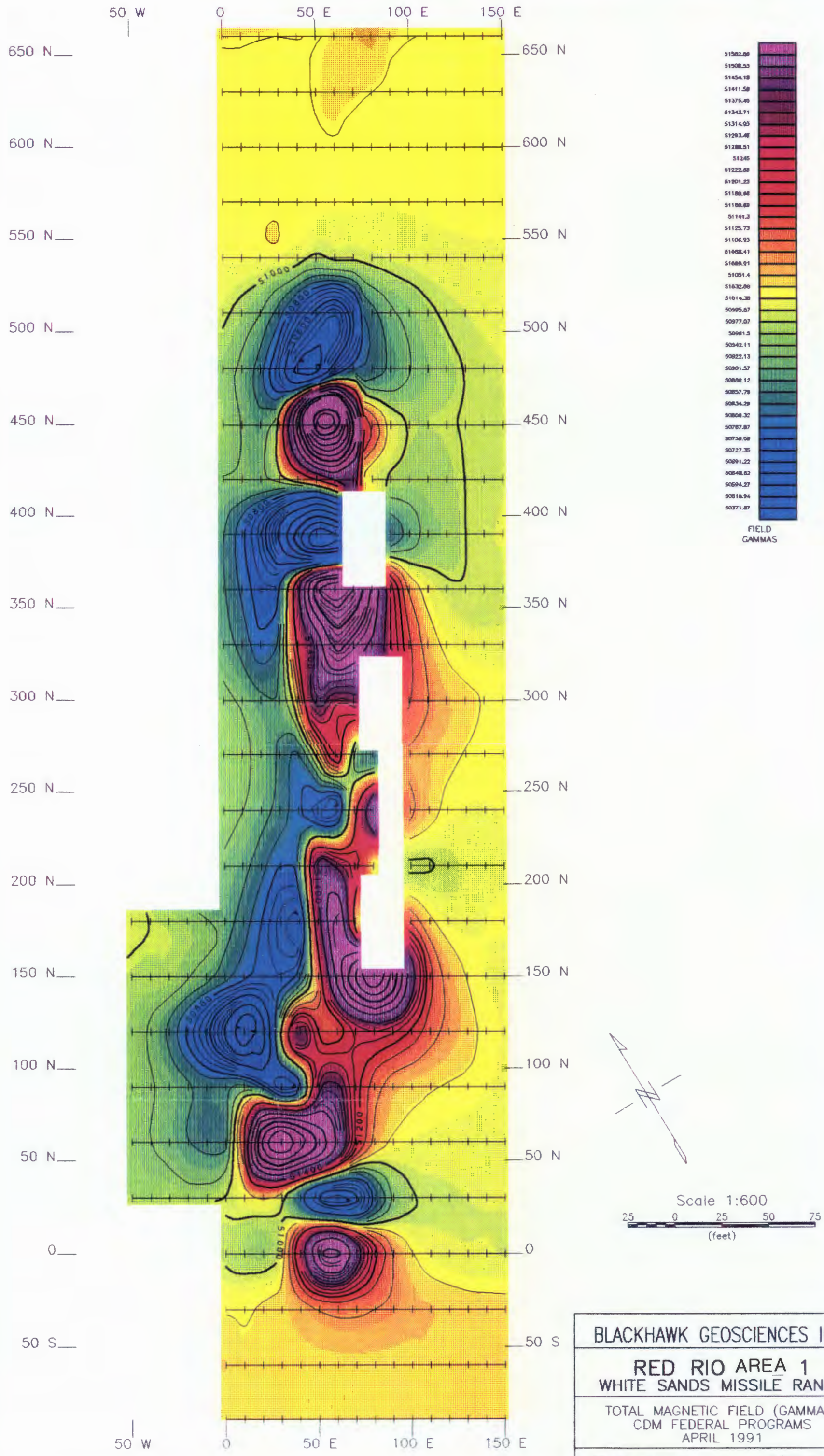
BLACKHAWK GEOSCIENCES INC.

RED RIO AREA 1
WHITE SANDS MISSILE RANGE

TOTAL MAGNETIC FIELD (GAMMAS)
CDM FEDERAL PROGRAMS
APRIL 1991

PROJECT NO. 91017

FIGURE 3-1



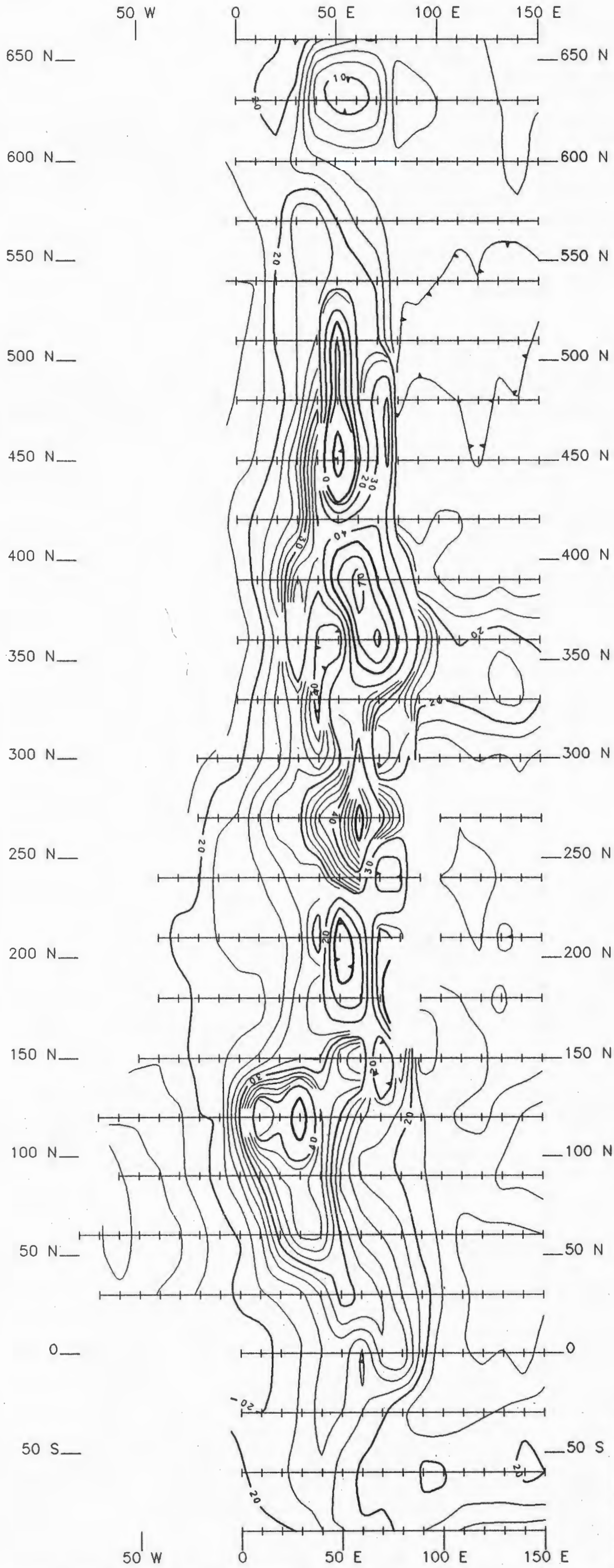
BLACKHAWK GEOSCIENCES INC.

RED RIO AREA 1
WHITE SANDS MISSILE RANGE

TOTAL MAGNETIC FIELD (GAMMAS)
CDM FEDERAL PROGRAMS
APRIL 1991

PROJECT NO. 91017

Figure 3-1a



Scale 1:600

25 0 25 50 75

(feet)

CONTOUR INTERVAL

2 MMHOS/M

BLACKHAWK GEOSCIENCES INC.

RED RIO AREA 1

WHITE SANDS MISSILE RANGE

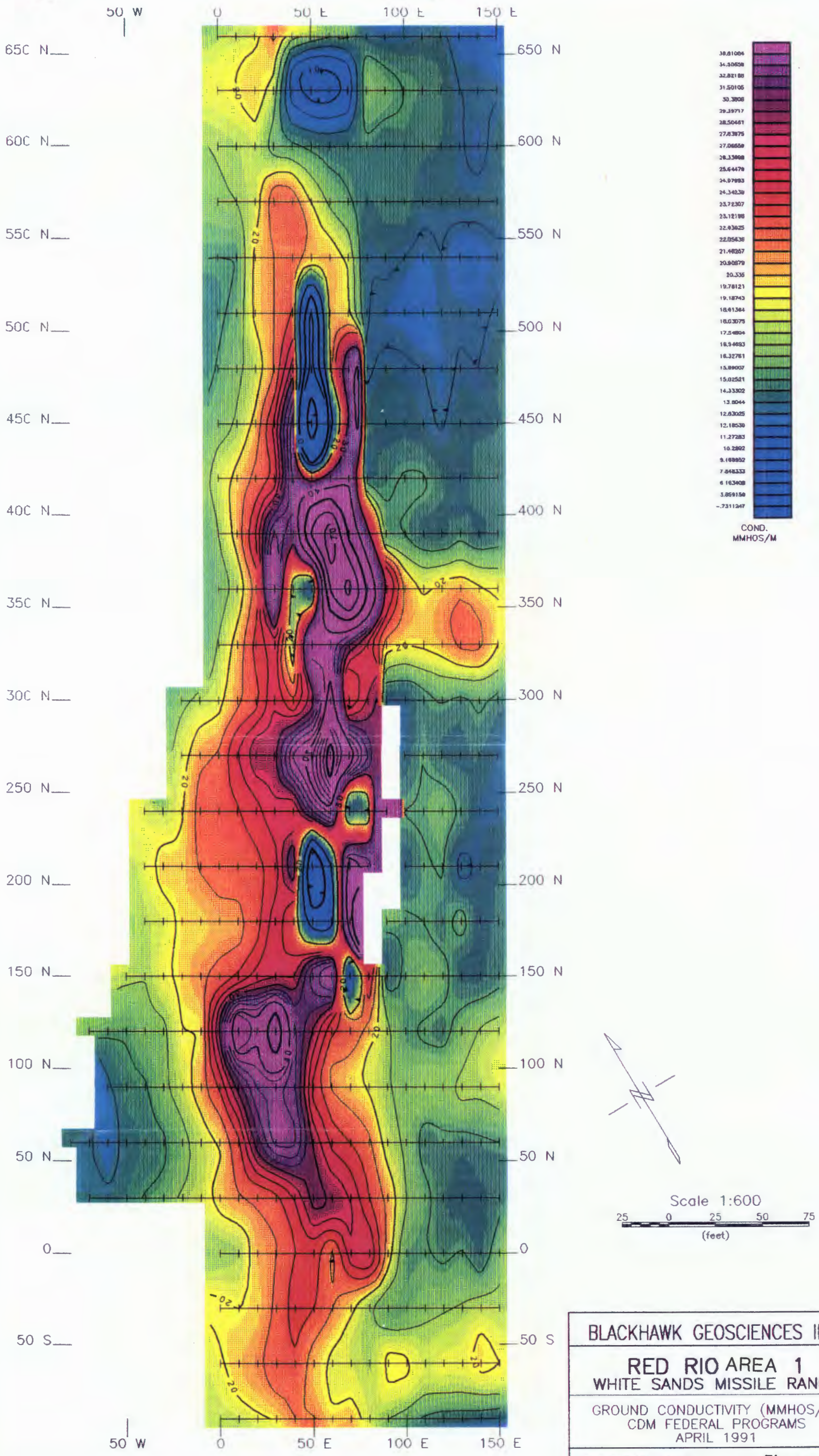
GROUND CONDUCTIVITY (MMHOS/M)

CDM FEDERAL PROGRAMS

APRIL 1991

PROJECT NO. 91017

FIGURE 3-2



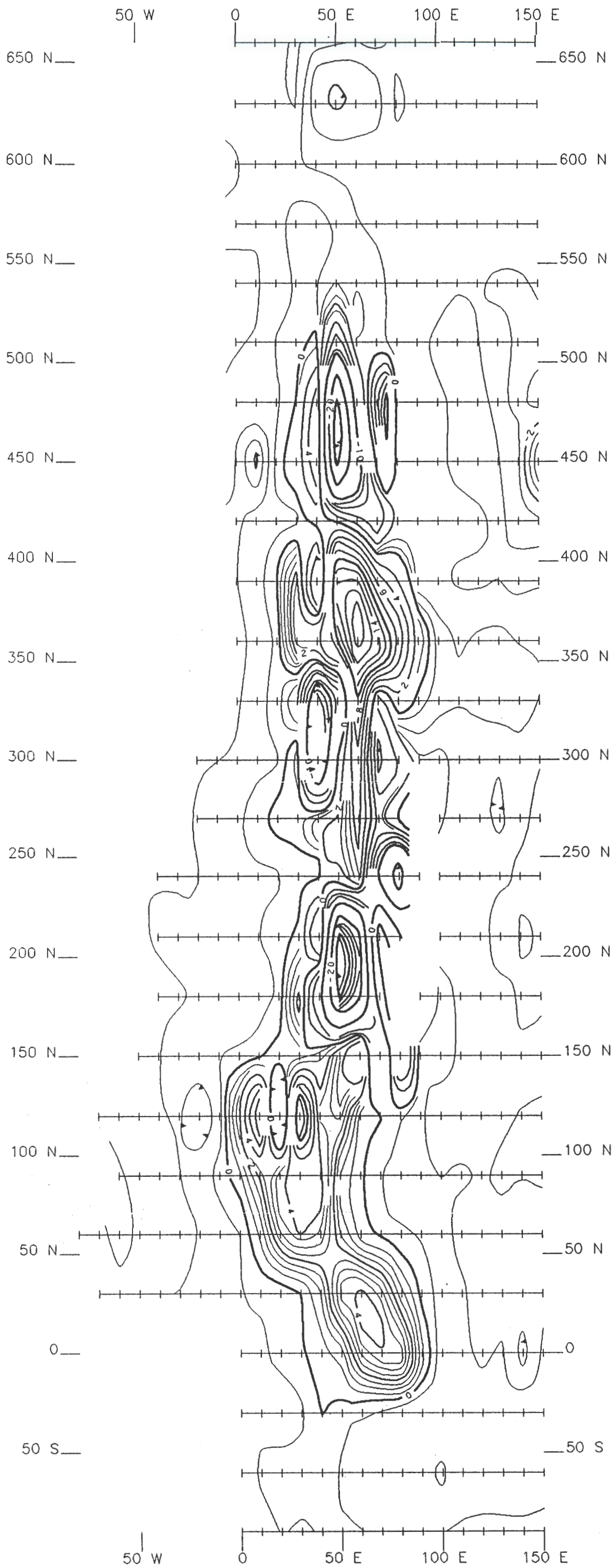
BLACKHAWK GEOSCIENCES INC.

RED RIO AREA 1
WHITE SANDS MISSILE RANGE

GROUND CONDUCTIVITY (MMHOS/M)
CDM FEDERAL PROGRAMS
APRIL 1991

PROJECT NO. 91017

Figure 3-2a



Scale 1:600

25 0 25 50 75

(feet)

CONTOUR INTERVAL

2 PPT

BLACKHAWK GEOSCIENCES INC.

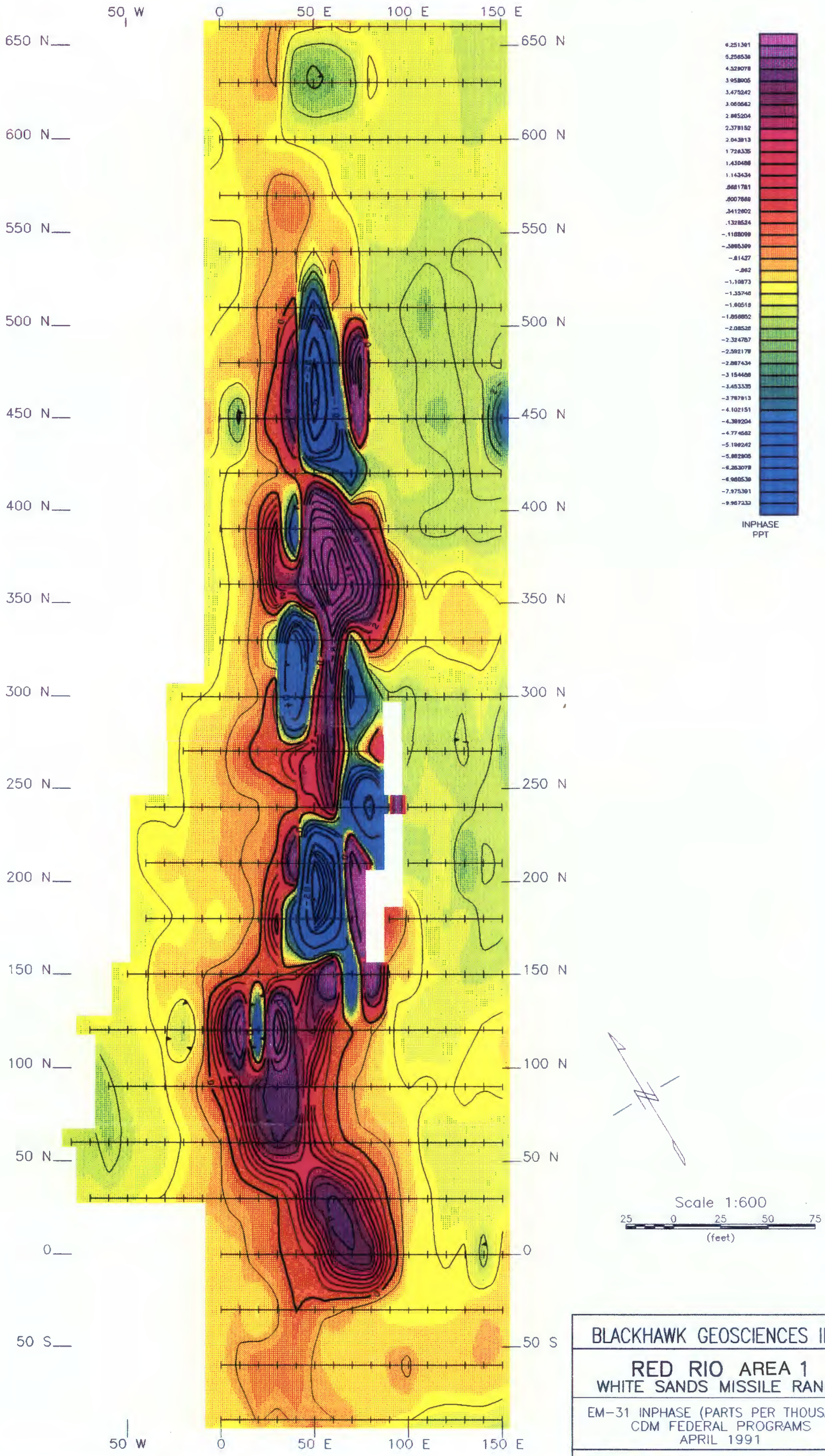
RED RIO AREA 1

WHITE SANDS MISSILE RANGE

EM-31 INPHASE (PARTS PER THOUSAND)
CDM FEDERAL PROGRAMS
APRIL 1991

PROJECT NO. 91017

FIGURE 3-3



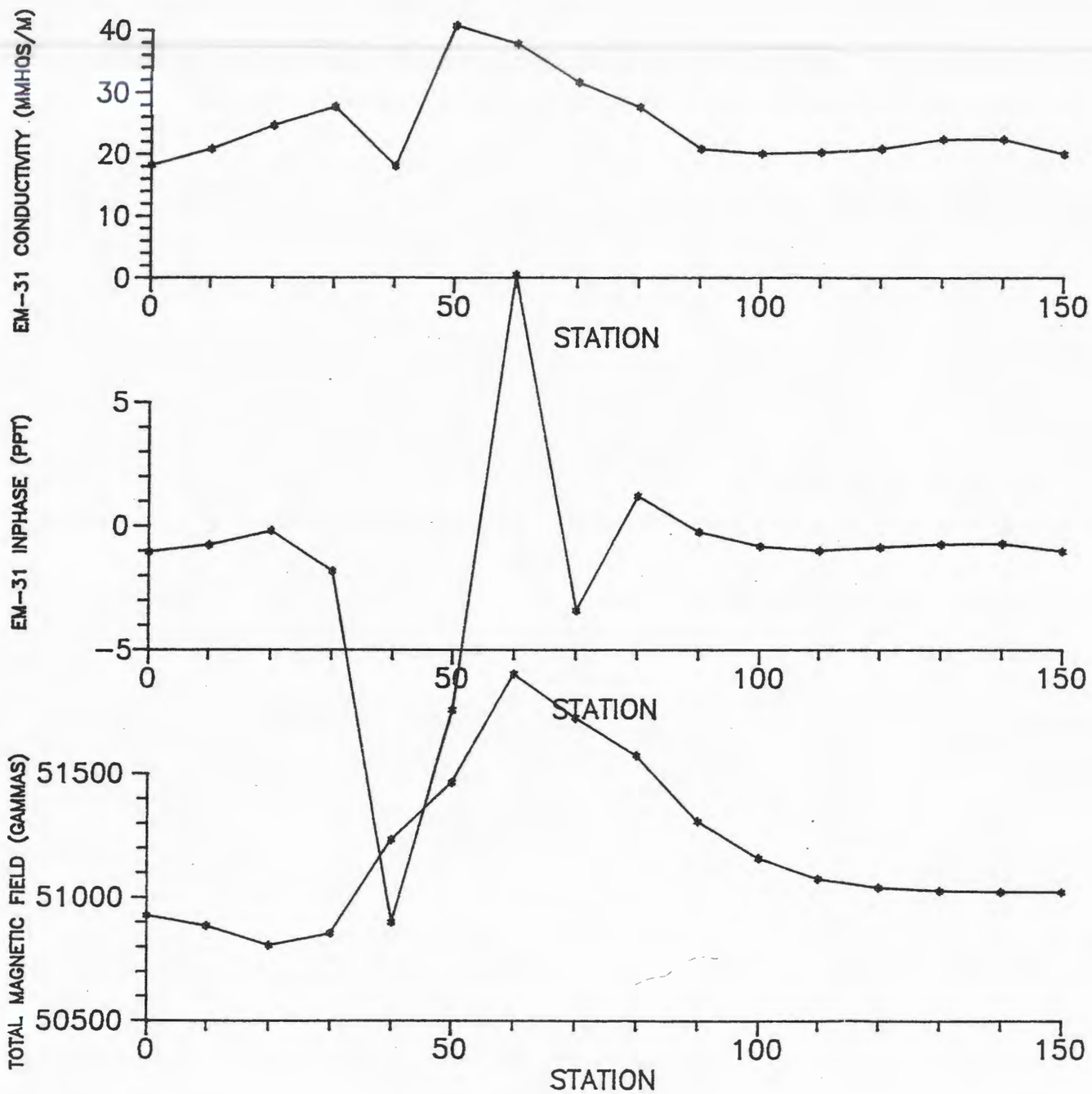
BLACKHAWK GEOSCIENCES INC.

RED RIO AREA 1
WHITE SANDS MISSILE RANGE

EM-31 INPHASE (PARTS PER THOUSAND)
CDM FEDERAL PROGRAMS
APRIL 1991

PROJECT NO. 91017

Figure 3-3a

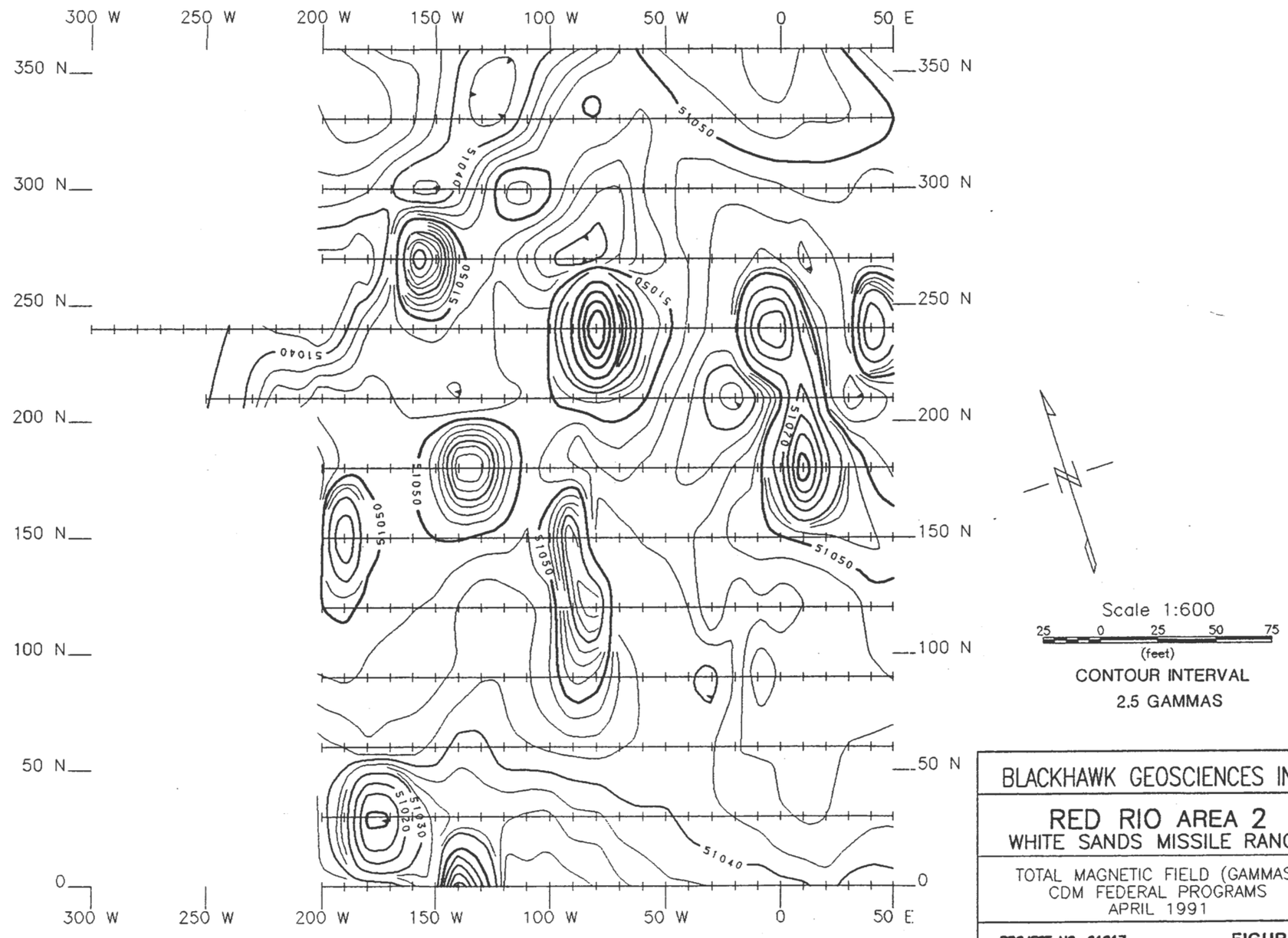


LINE 330

BLACKHAWK GEOSCIENCES, INC.

GEOPHYSICAL DATA SETS
AREA 1 - RED RIO
WHITE SANDS MISSILE RANGE
CDM FEDERAL PROGRAMS

PROJECT NO: 91017 Figure 3-4



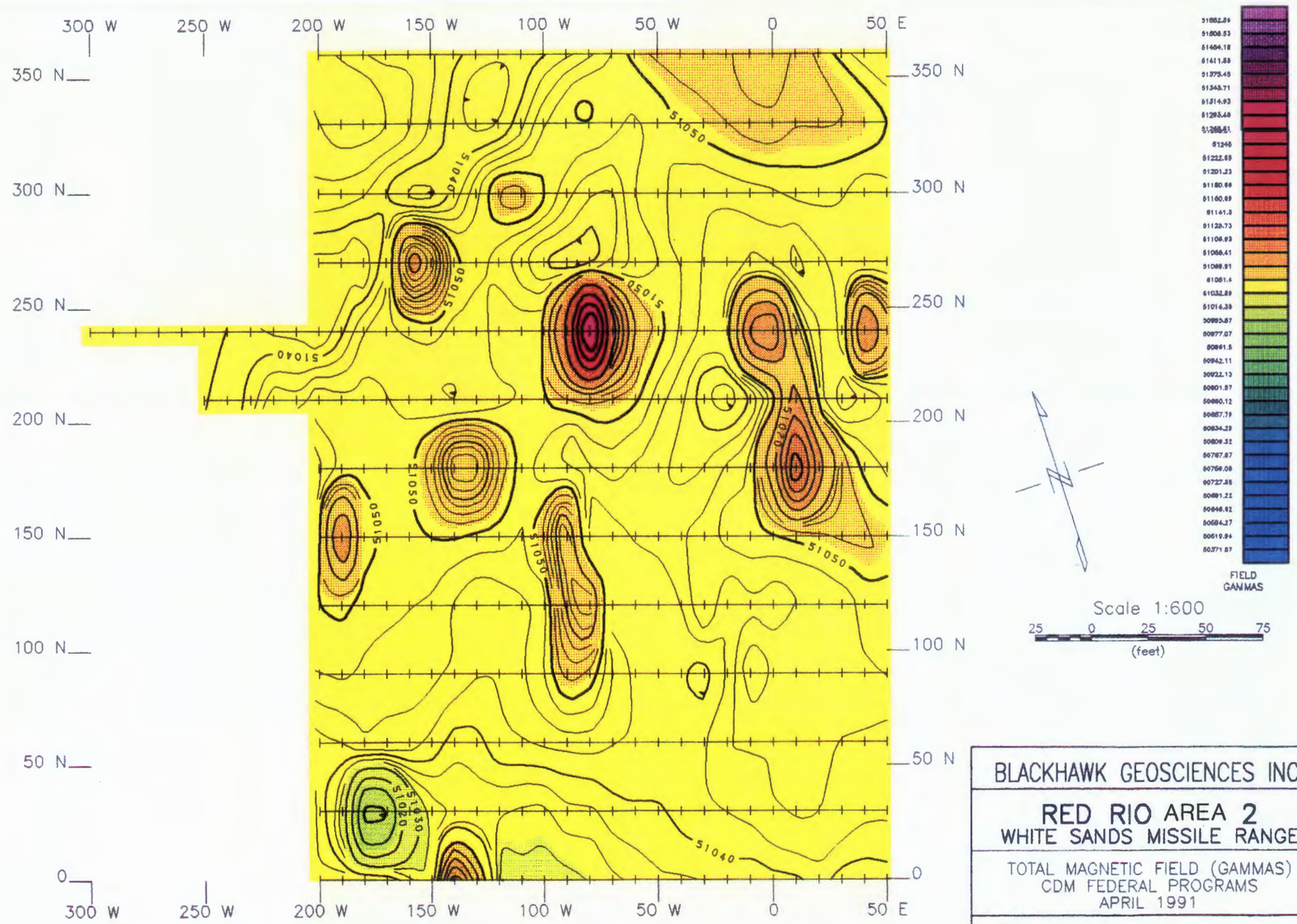
BLACKHAWK GEOSCIENCES INC.

RED RIO AREA 2
WHITE SANDS MISSILE RANGE

TOTAL MAGNETIC FIELD (GAMMAS)
CDM FEDERAL PROGRAMS
APRIL 1991

PROJECT NO. 91017

FIGURE 3-5



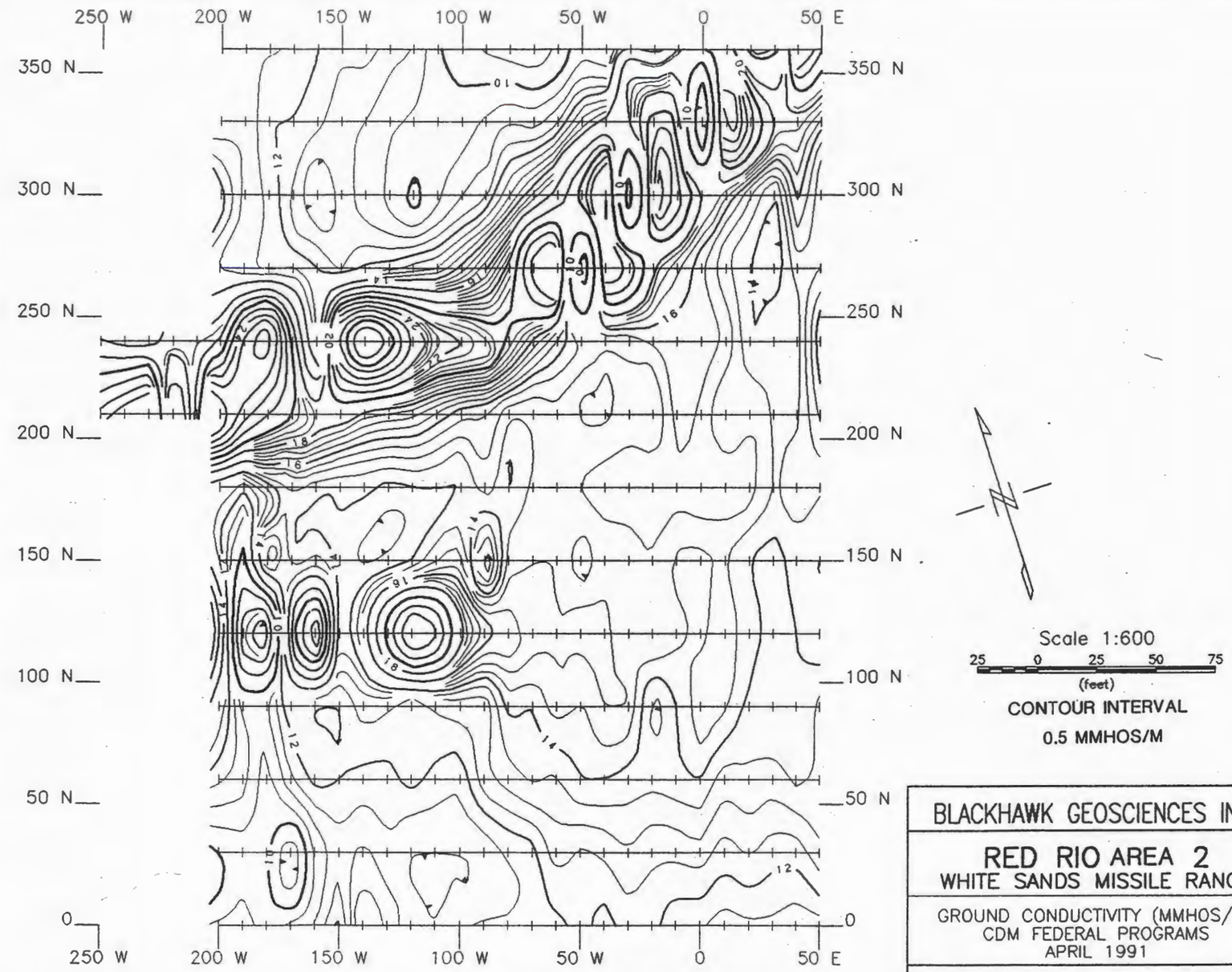
BLACKHAWK GEOSCIENCES INC.

RED RIO AREA 2
WHITE SANDS MISSILE RANGE

TOTAL MAGNETIC FIELD (GAMMAS)
CDM FEDERAL PROGRAMS
APRIL 1991

PROJECT NO. 91017

Figure 3-5a

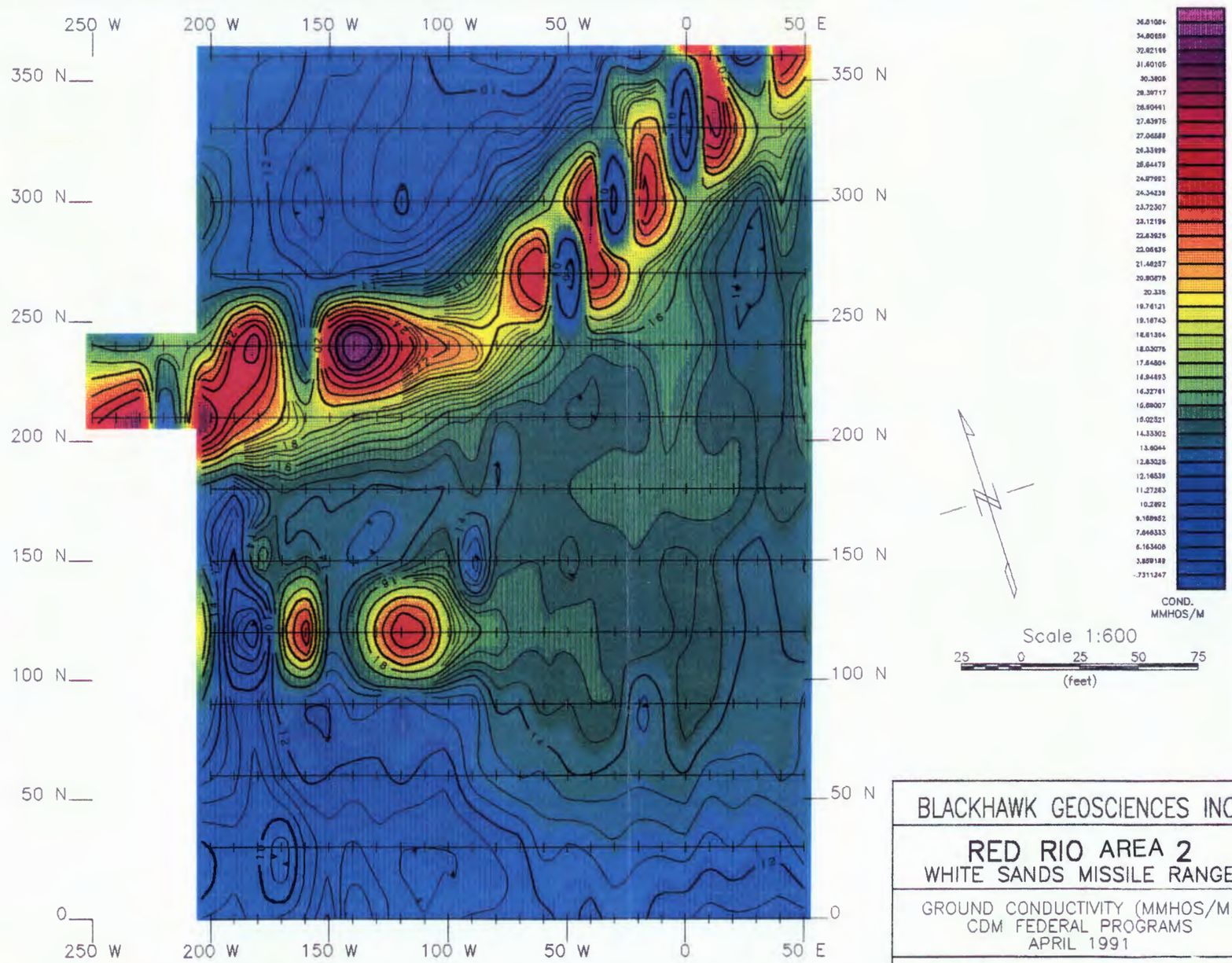


BLACKHAWK GEOSCIENCES INC.

RED RIO AREA 2
WHITE SANDS MISSILE RANGE

GROUND CONDUCTIVITY (MMHOS/M)
CDM FEDERAL PROGRAMS
APRIL 1991

PROJECT NO. 91017 FIGURE 3-6



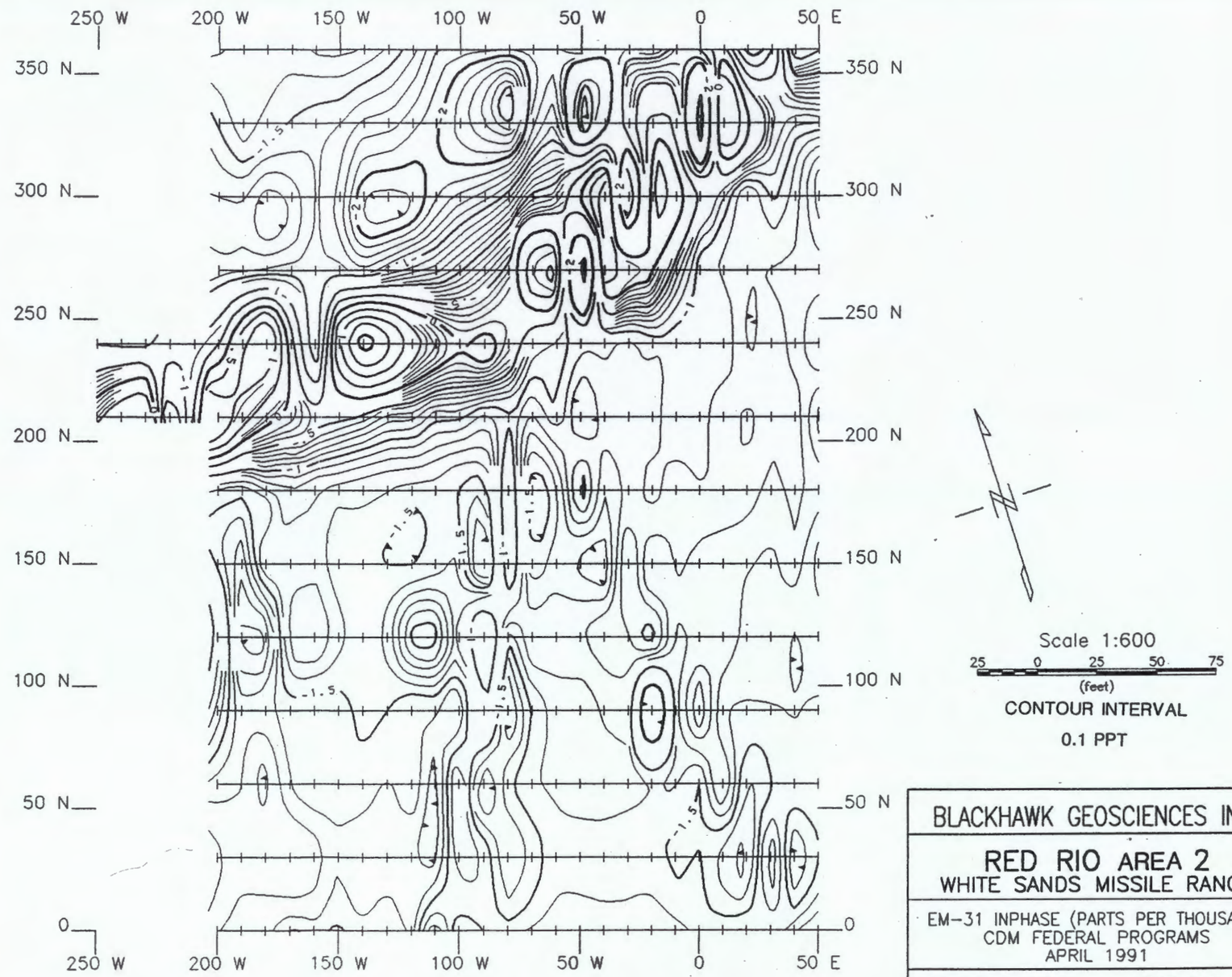
BLACKHAWK GEOSCIENCES INC.

RED RIO AREA 2
WHITE SANDS MISSILE RANGE

GROUND CONDUCTIVITY (MMHOS/M)
CDM FEDERAL PROGRAMS
APRIL 1991

PROJECT NO. 91017

Figure 3-6a



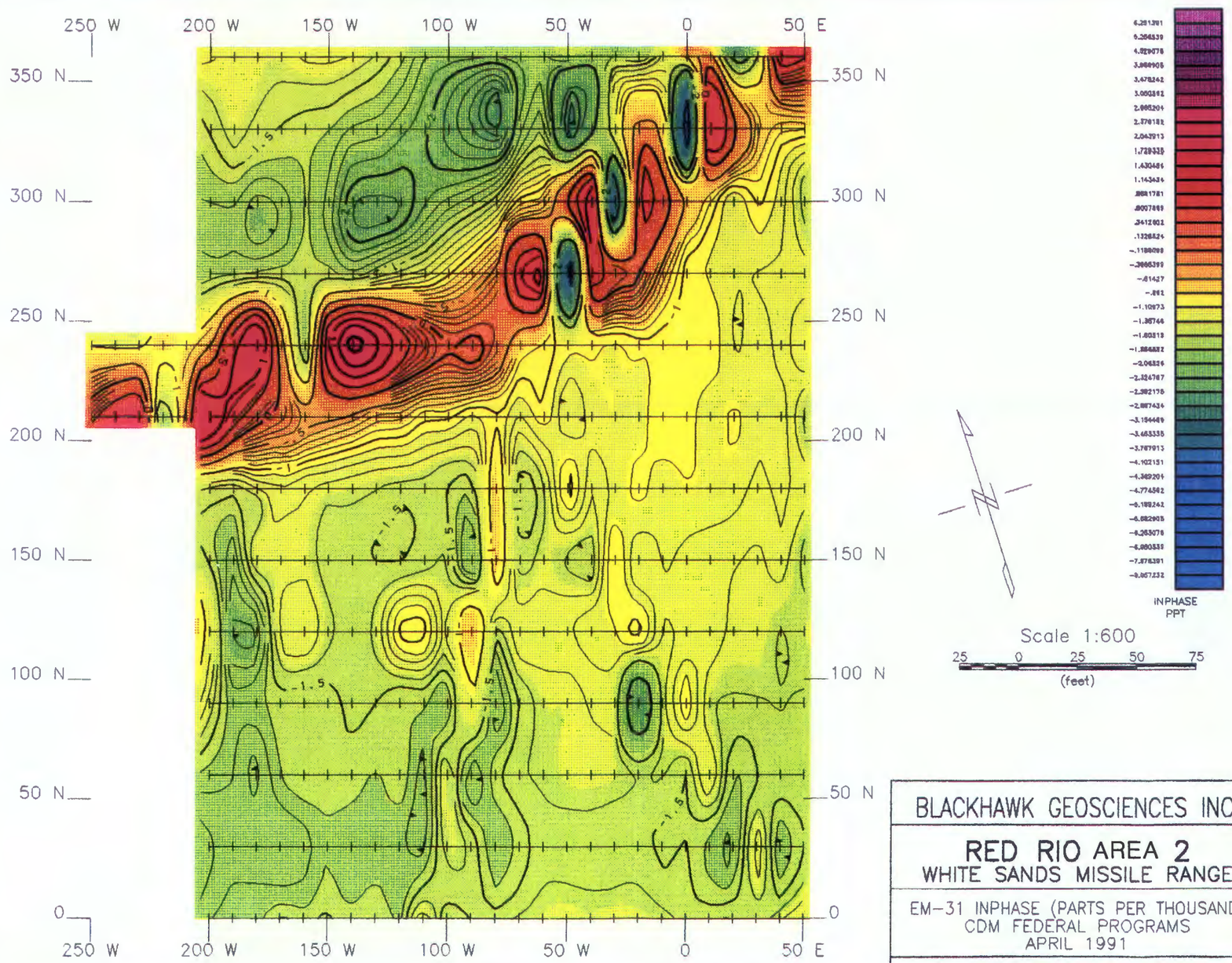
BLACKHAWK GEOSCIENCES INC.

RED RIO AREA 2
WHITE SANDS MISSILE RANGE

EM-31 INPHASE (PARTS PER THOUSAND)
CDM FEDERAL PROGRAMS
APRIL 1991

PROJECT NO. 91017

FIGURE 3-7



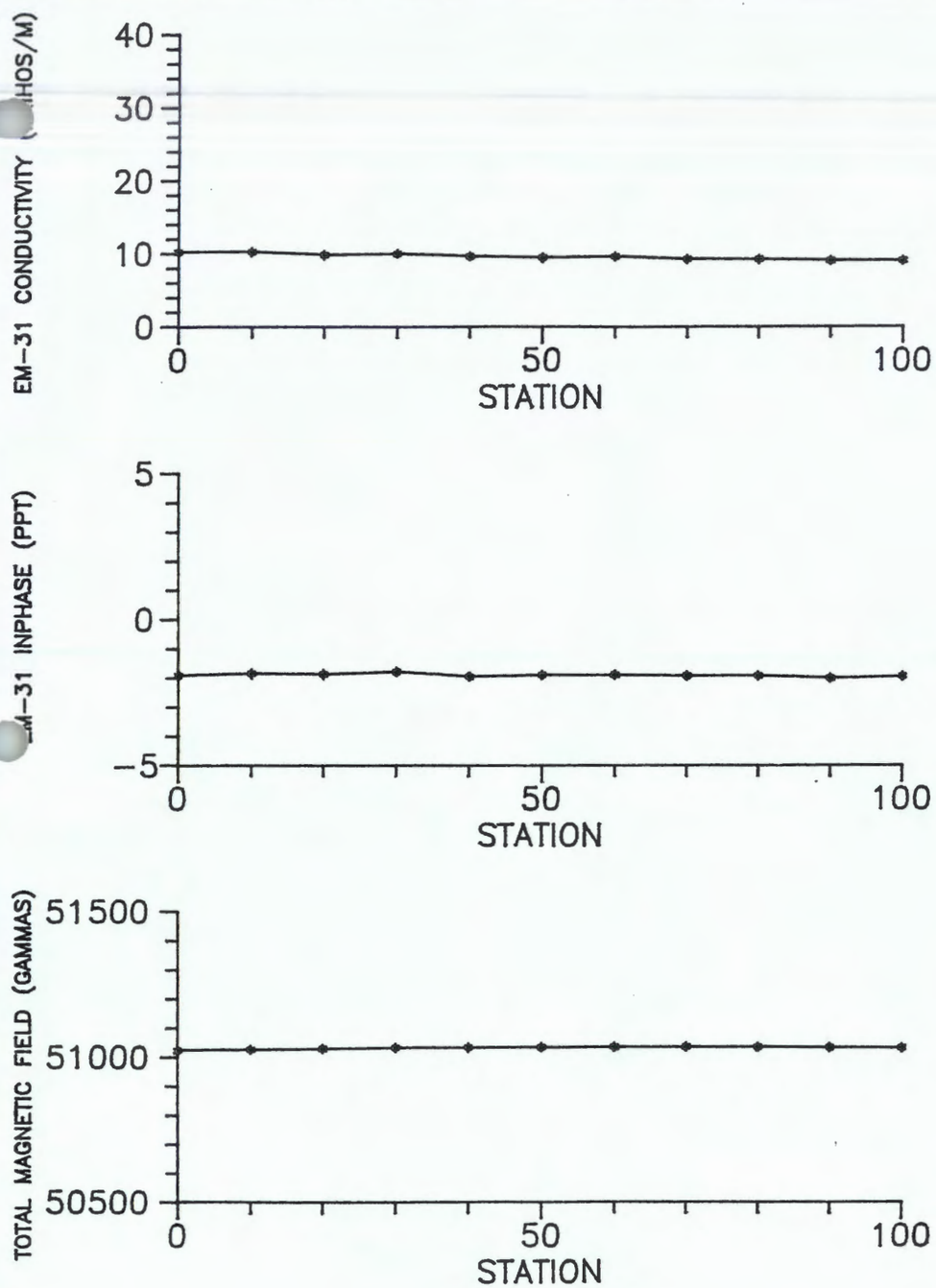
BLACKHAWK GEOSCIENCES INC.

RED RIO AREA 2
WHITE SANDS MISSILE RANGE

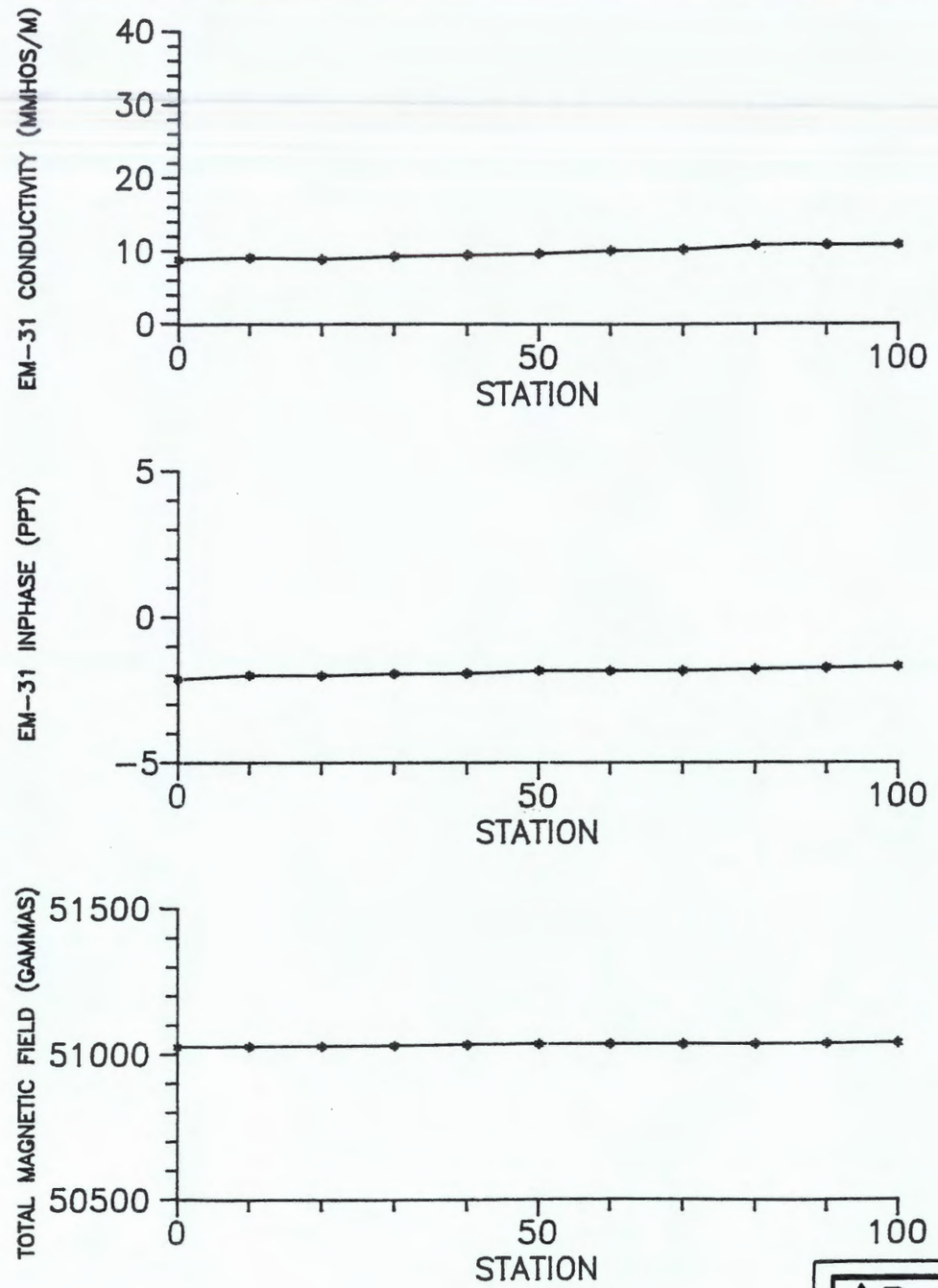
EM-31 INPHASE (PARTS PER THOUSAND)
CDM FEDERAL PROGRAMS
APRIL 1991

PROJECT NO. 91017

Figure 3-7a



LINE 301

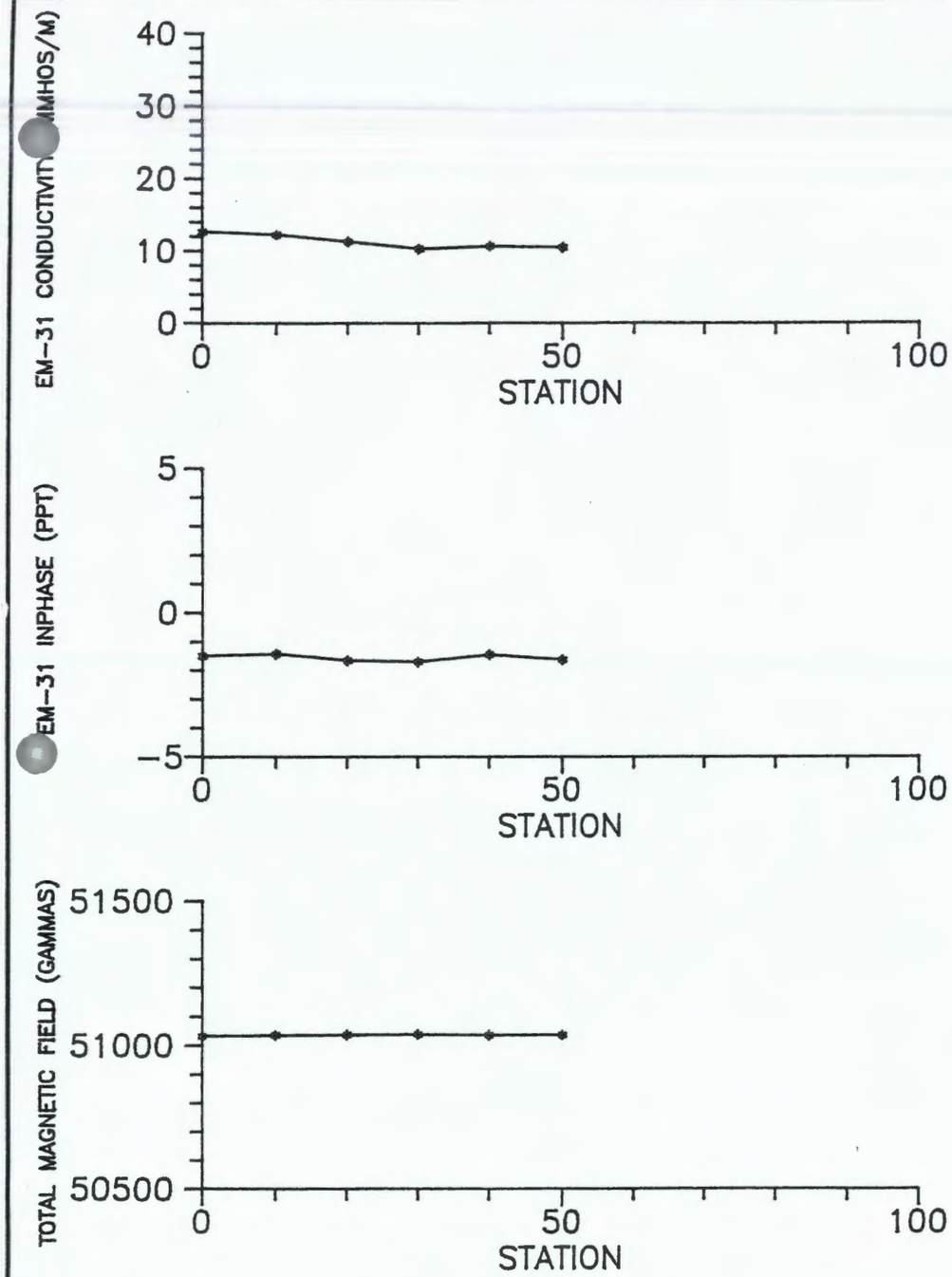


LINE 302

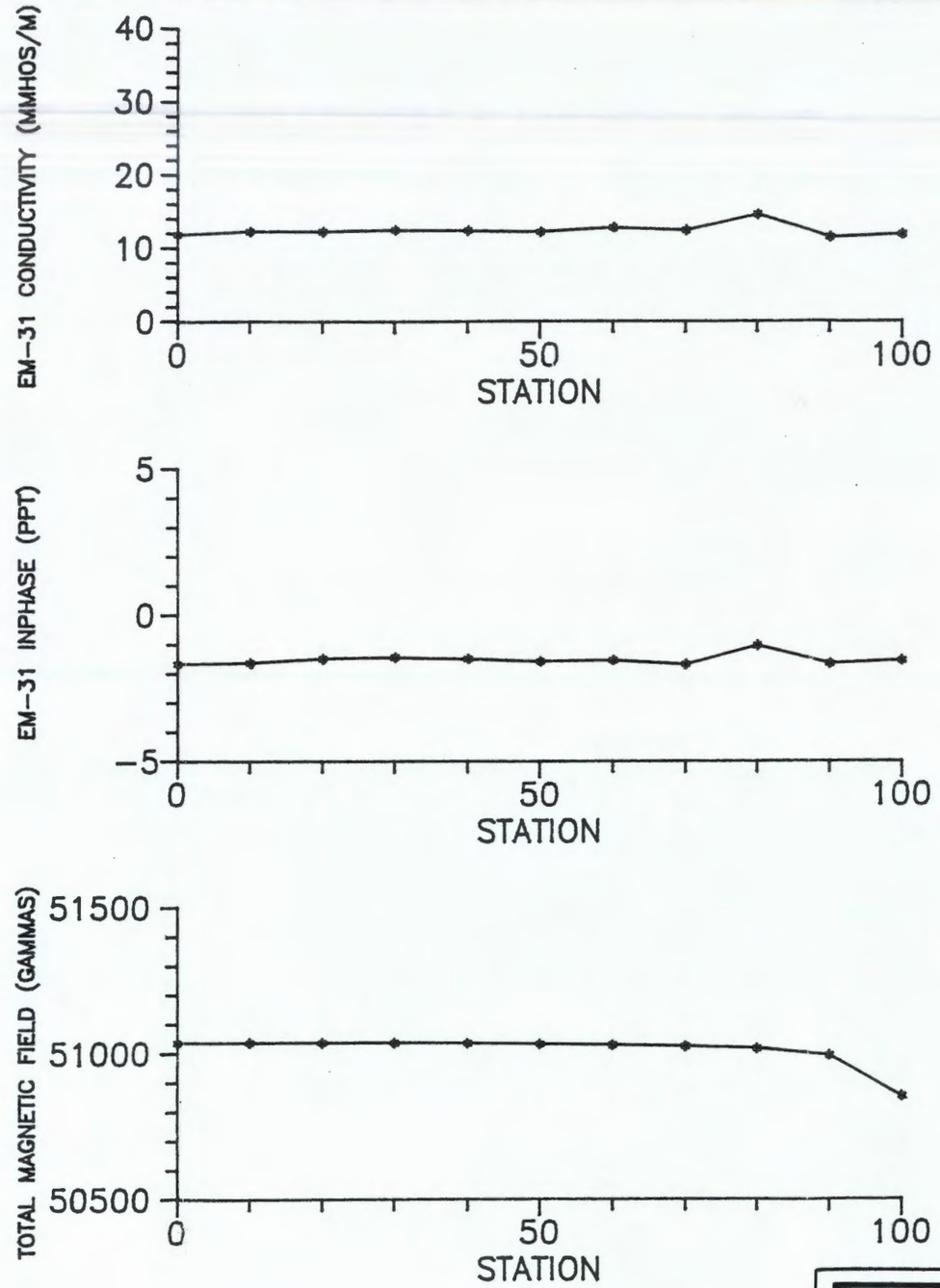
BLACKHAWK GEOSCIENCES, INC.

GEOPHYSICAL DATA SETS
AREA 3 - RED RIO
WHITE SANDS MISSILE RANGE
CDM FEDERAL PROGRAMS

PROJECT NO: 91017 Figure 3-8



LINE 401



LINE 402

BLACKHAWK GEOSCIENCES, INC.

GEOPHYSICAL DATA SETS

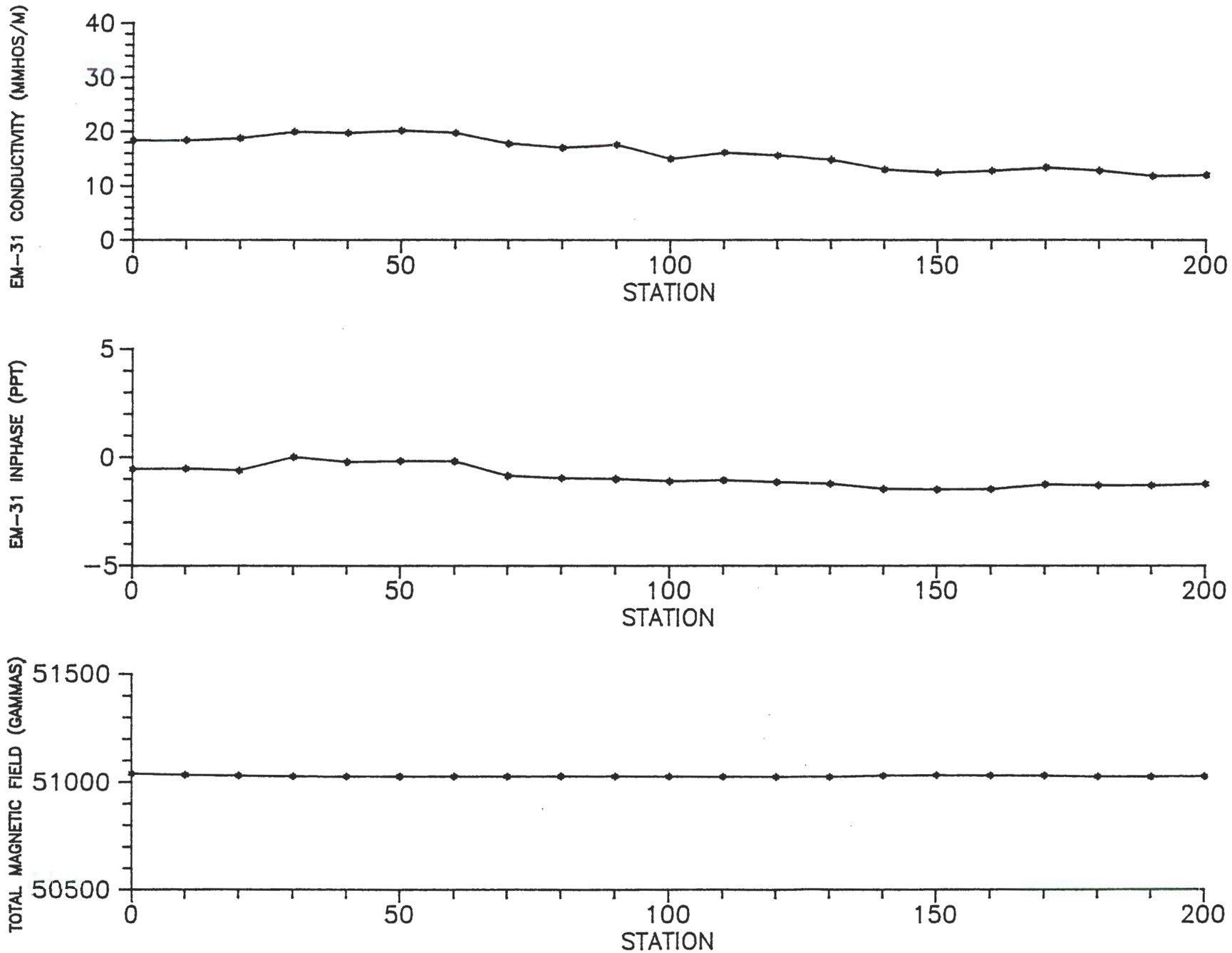
AREA 4 - RED RIO

WHITE SANDS MISSILE RANGE

CDM FEDERAL PROGRAMS

PROJECT NO: 91017

Figure 3-9



LINE 502

BLACKHAWK GEOSCIENCES, INC.

GEOPHYSICAL DATA SETS

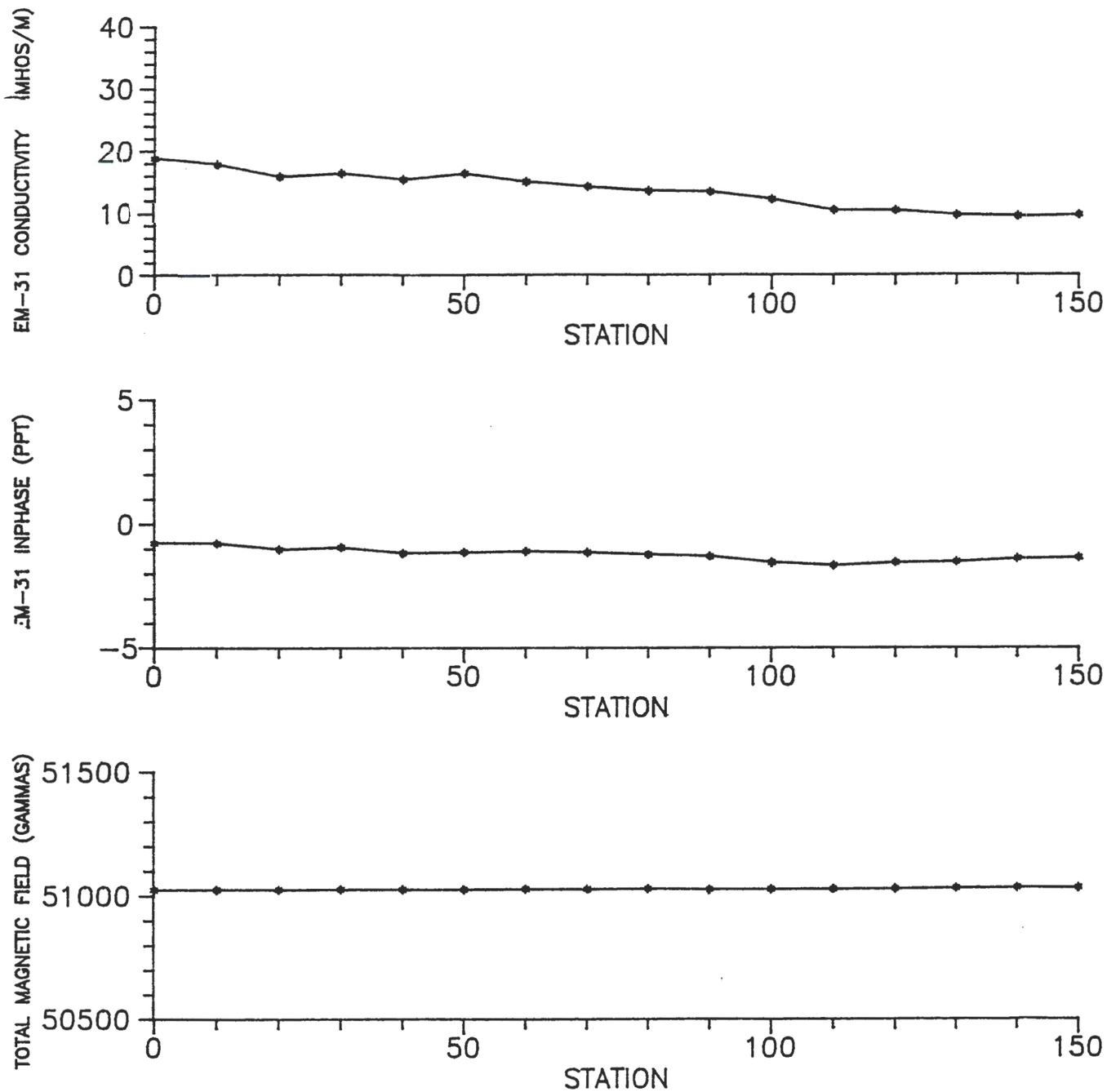
AREA 5 - RED RIO

WHITE SANDS MISSILE RANGE

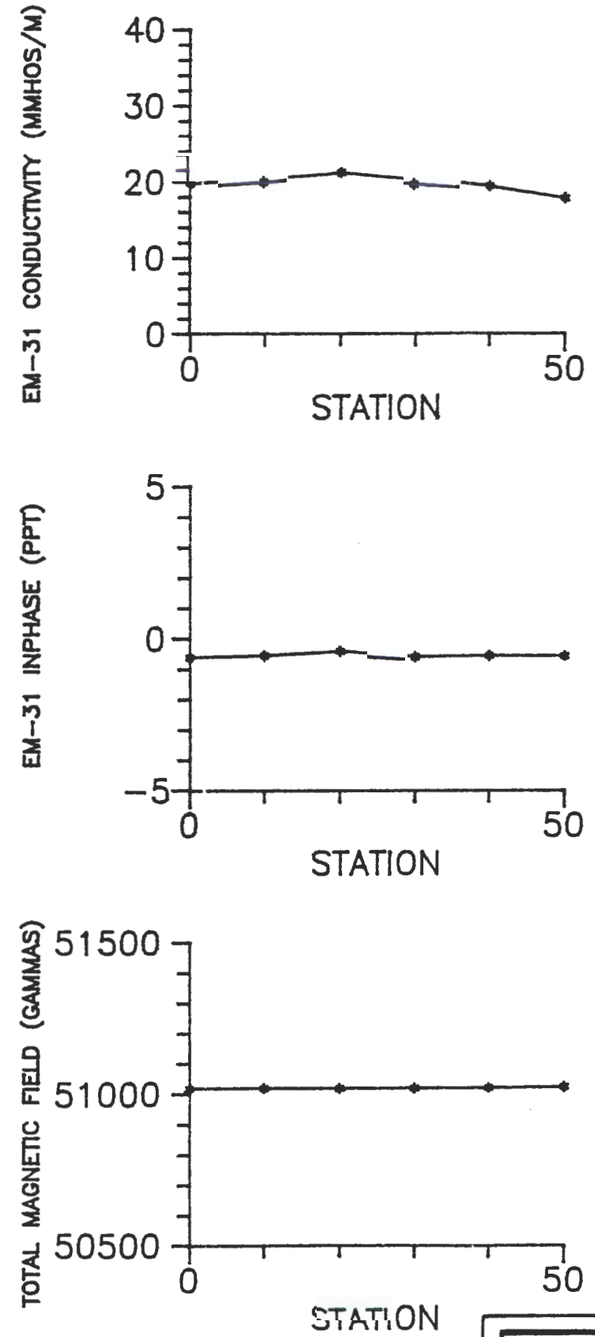
CDM FEDERAL PROGRAMS

PROJECT NO: 91017

Figure 3-10



LINE 501



LINE 503

BLACKHAWK GEOSCIENCES, INC.

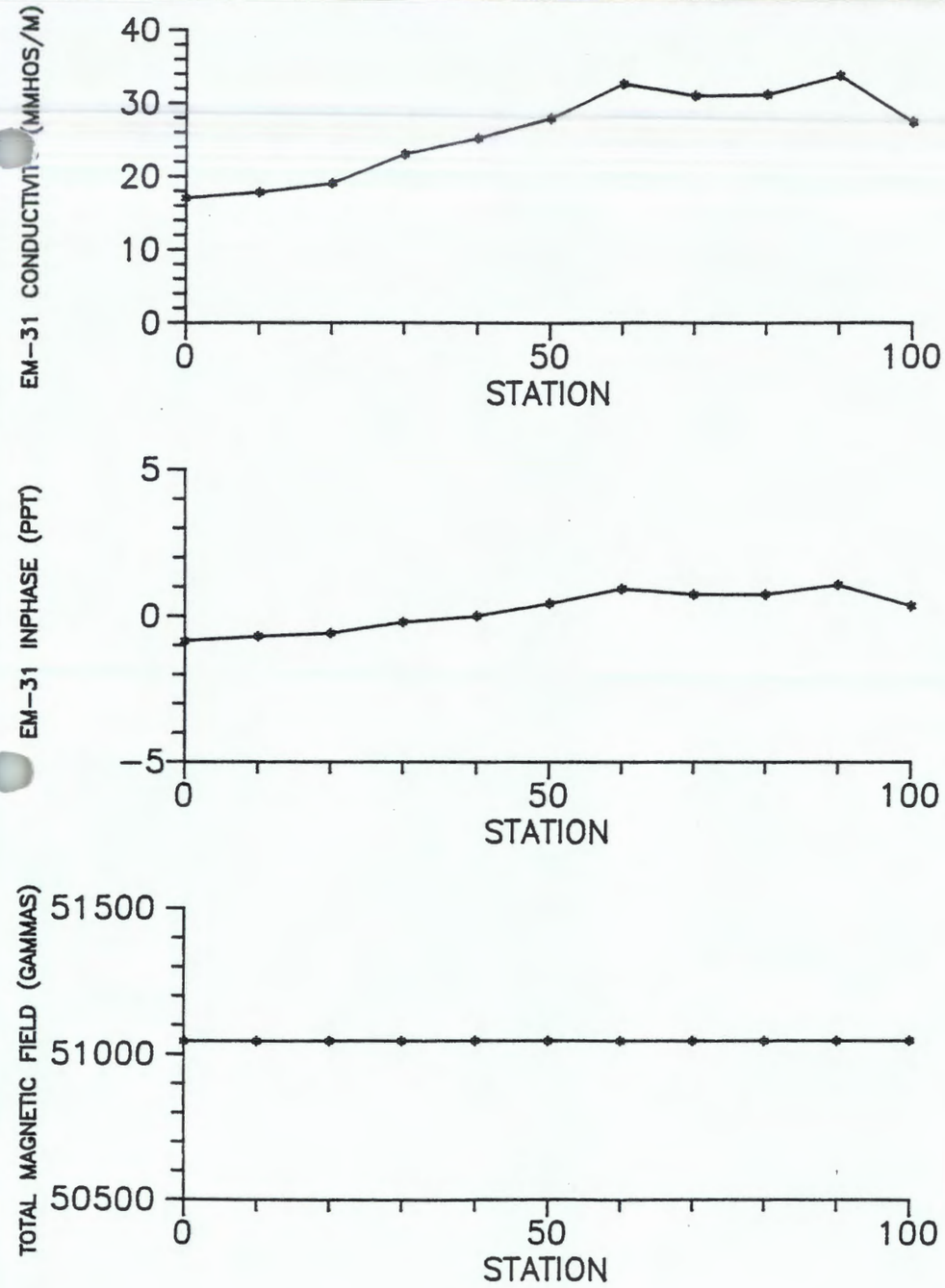
GEOPHYSICAL DATA SETS

AREA 5 - RED RIO

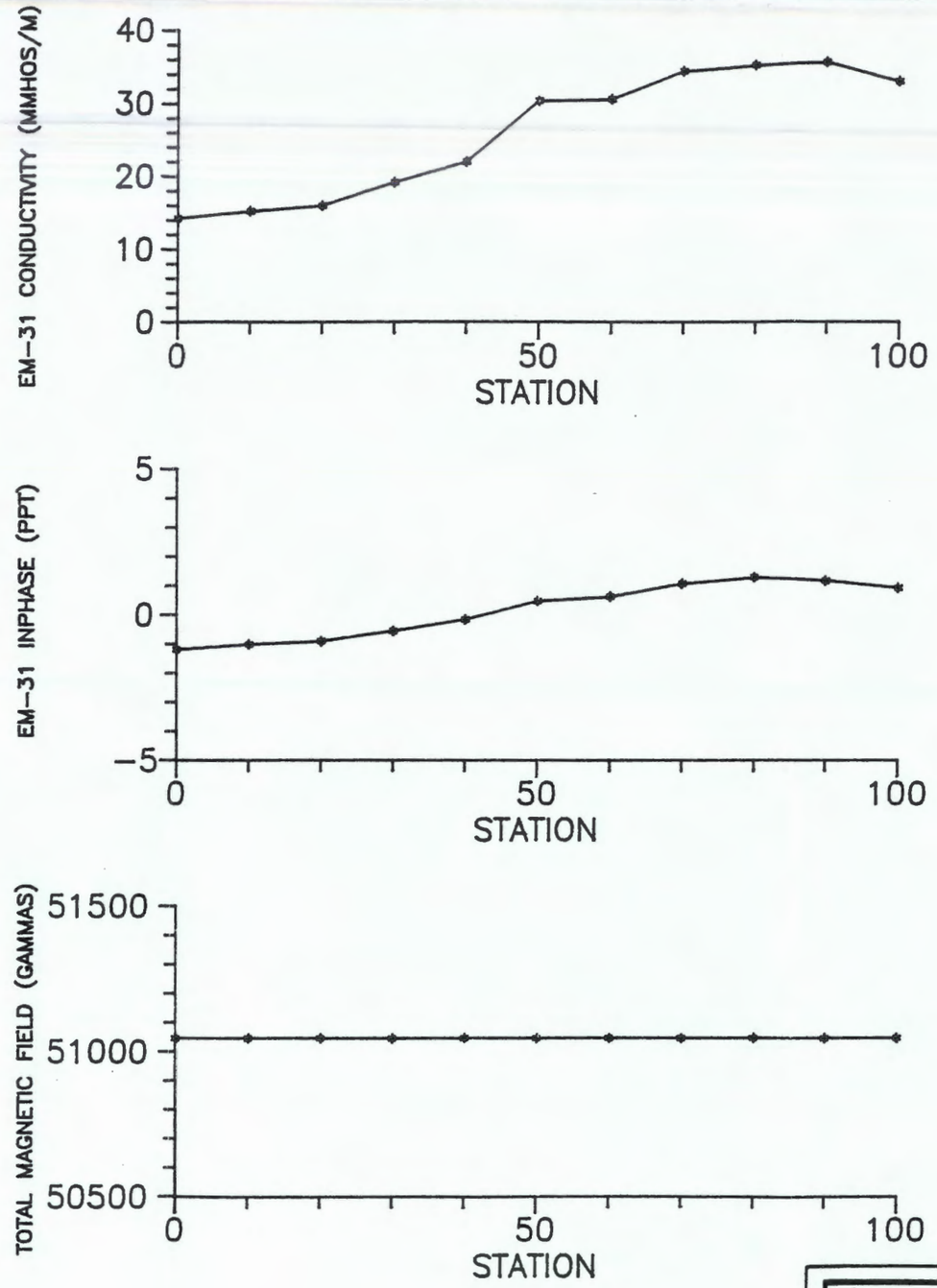
WHITE SANDS MISSILE RANGE

CDM FEDERAL PROGRAMS

PROJECT NO: 91017 Figure 3-11



LINE 601



LINE 602

BLACKHAWK GEOSCIENCES, INC.

GEOPHYSICAL DATA SETS

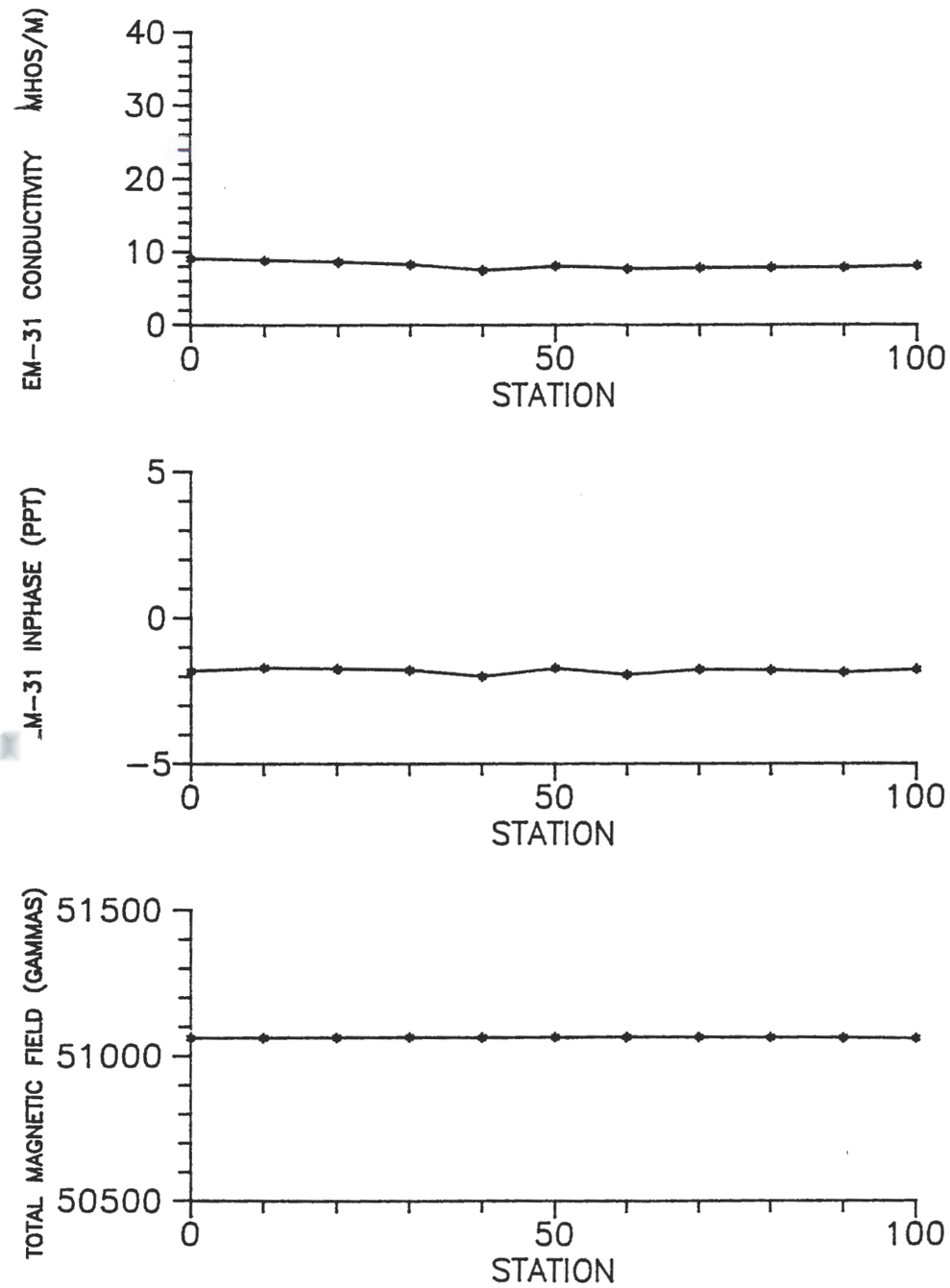
AREA 6 - RED RIO

WHITE SANDS MISSILE RANGE

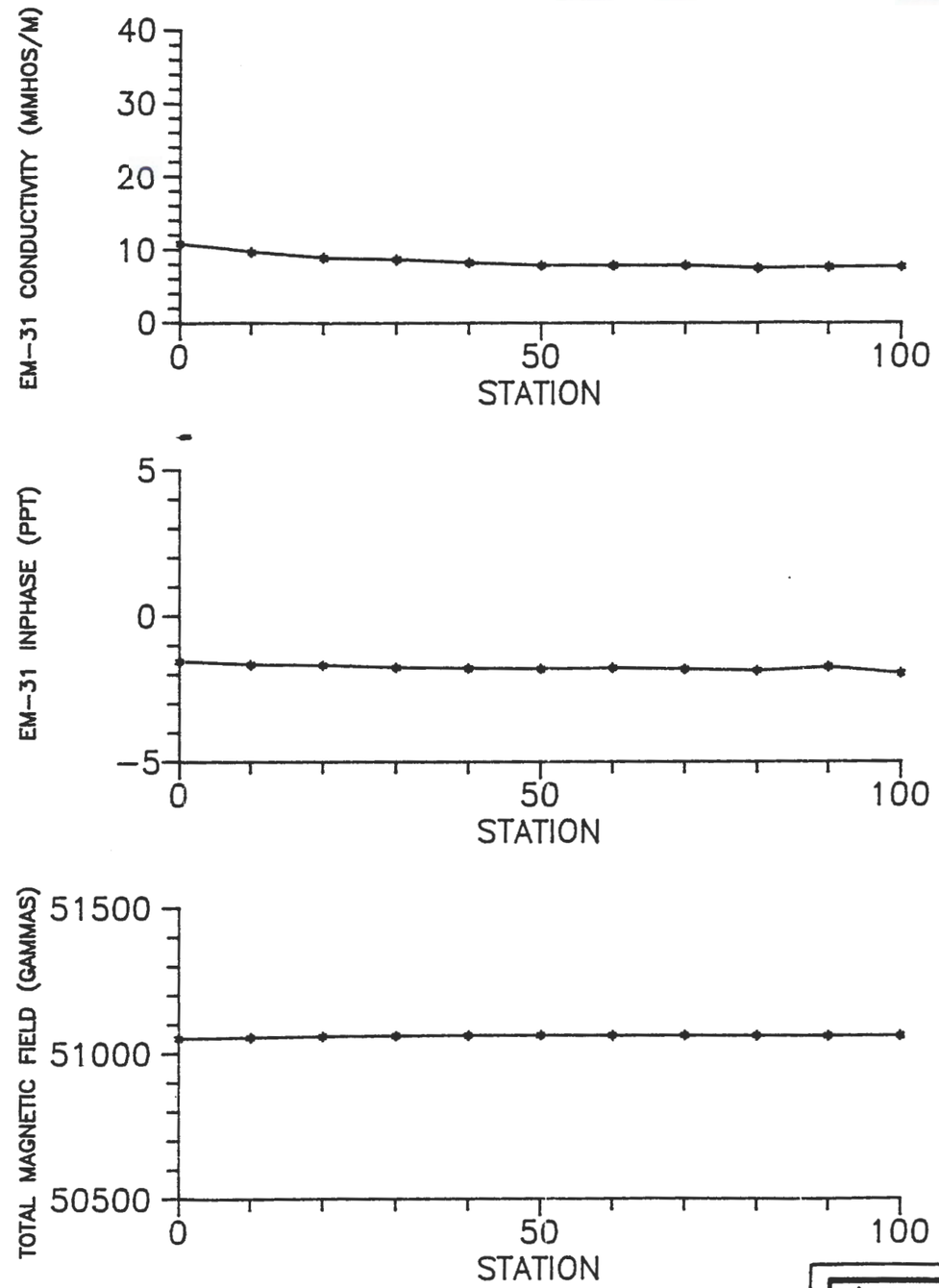
CDM FEDERAL PROGRAMS

PROJECT NO: 91017

Figure 3-12



LINE 701

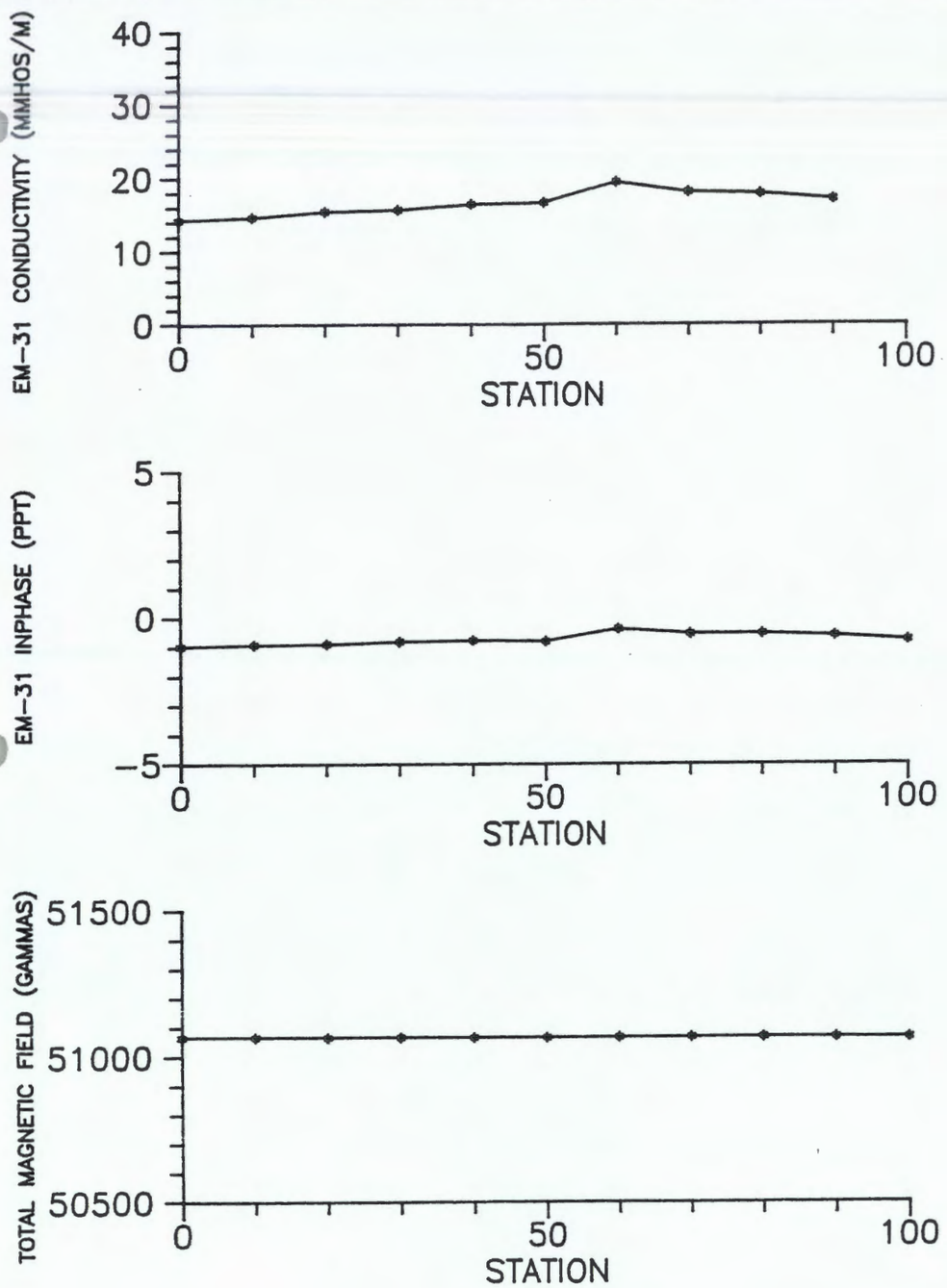


LINE 702

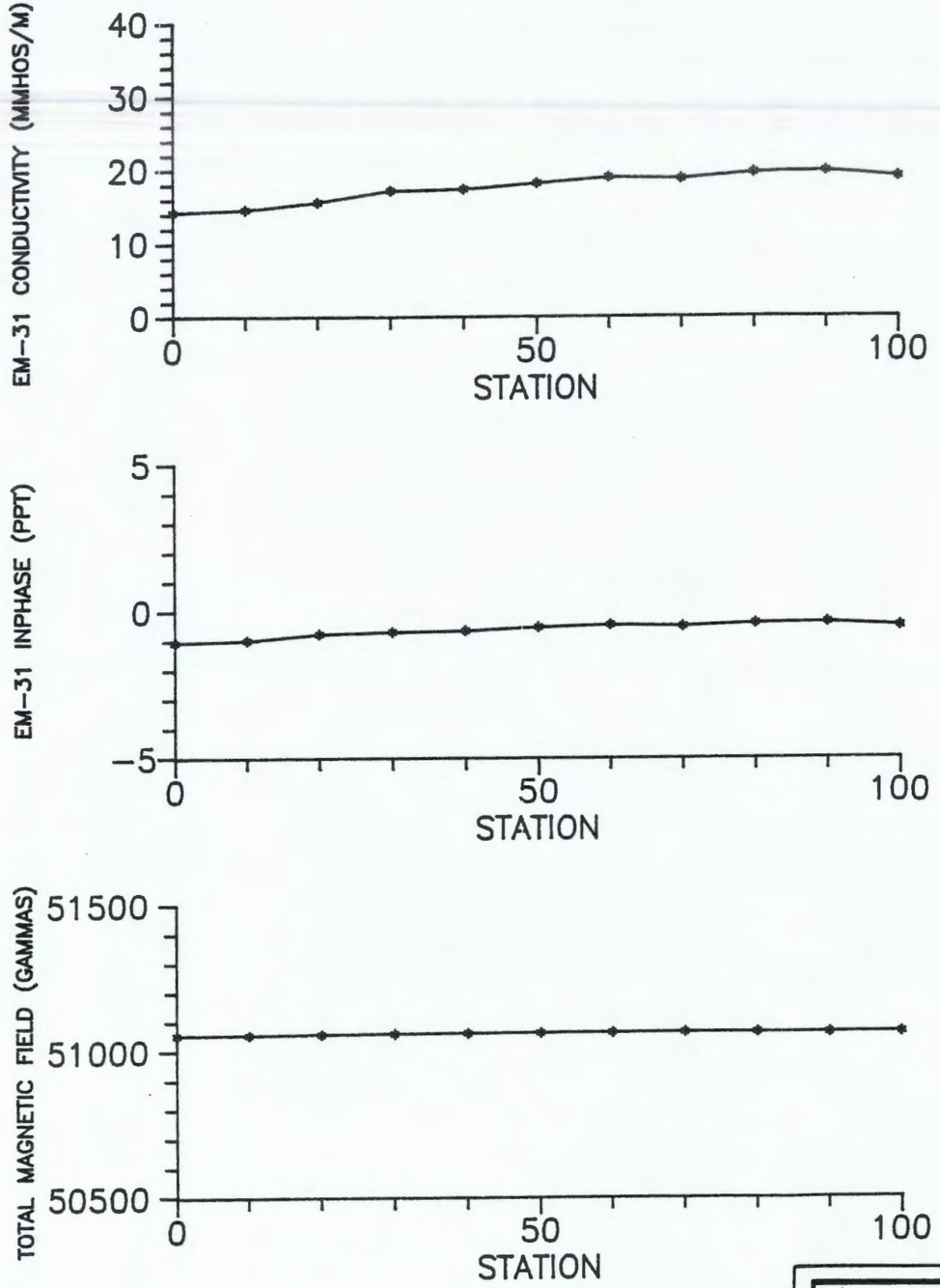
BLACKHAWK GEOSCIENCES, INC.

GEOPHYSICAL DATA SETS
AREA 7 - RED RIO
WHITE SANDS MISSILE RANGE
CDM FEDERAL PROGRAMS

PROJECT NO: 91017 Figure 3-13



LINE 801

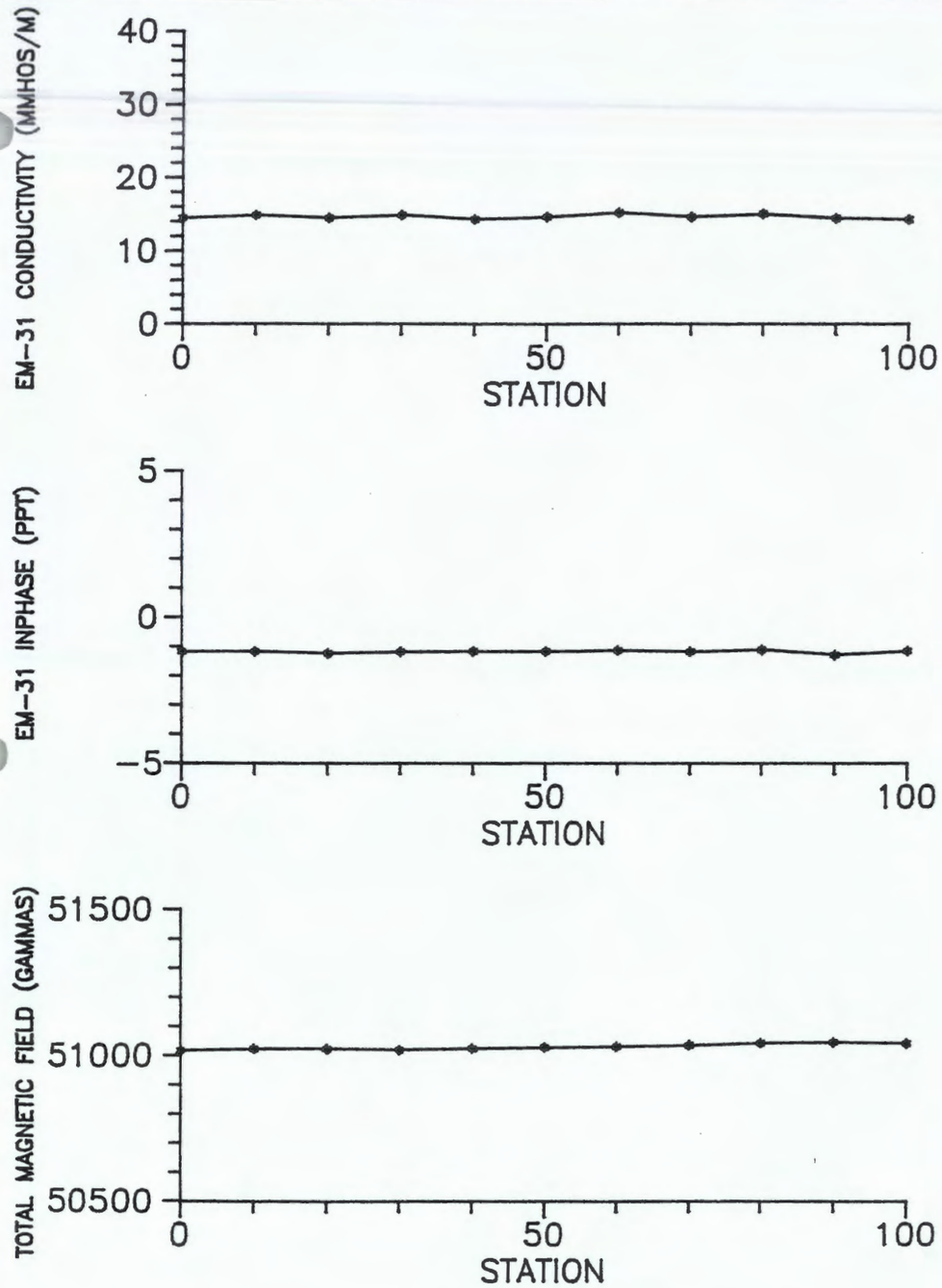


LINE 802

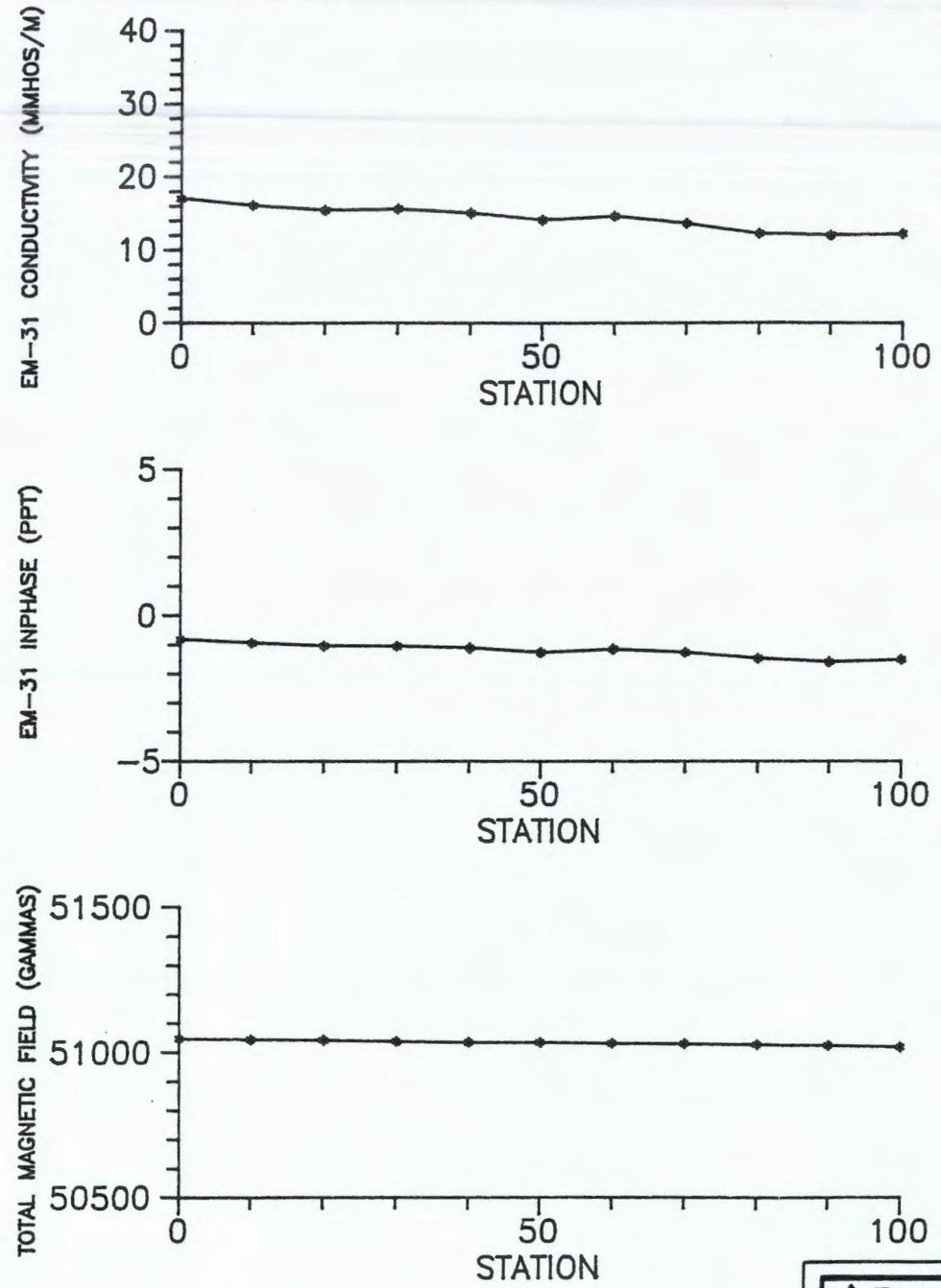
BLACKHAWK GEOSCIENCES, INC.

GEOPHYSICAL DATA SETS
AREA 8 - RED RIO
WHITE SANDS MISSILE RANGE
CDM FEDERAL PROGRAMS

PROJECT NO: 91017 Figure 3-14



LINE 901

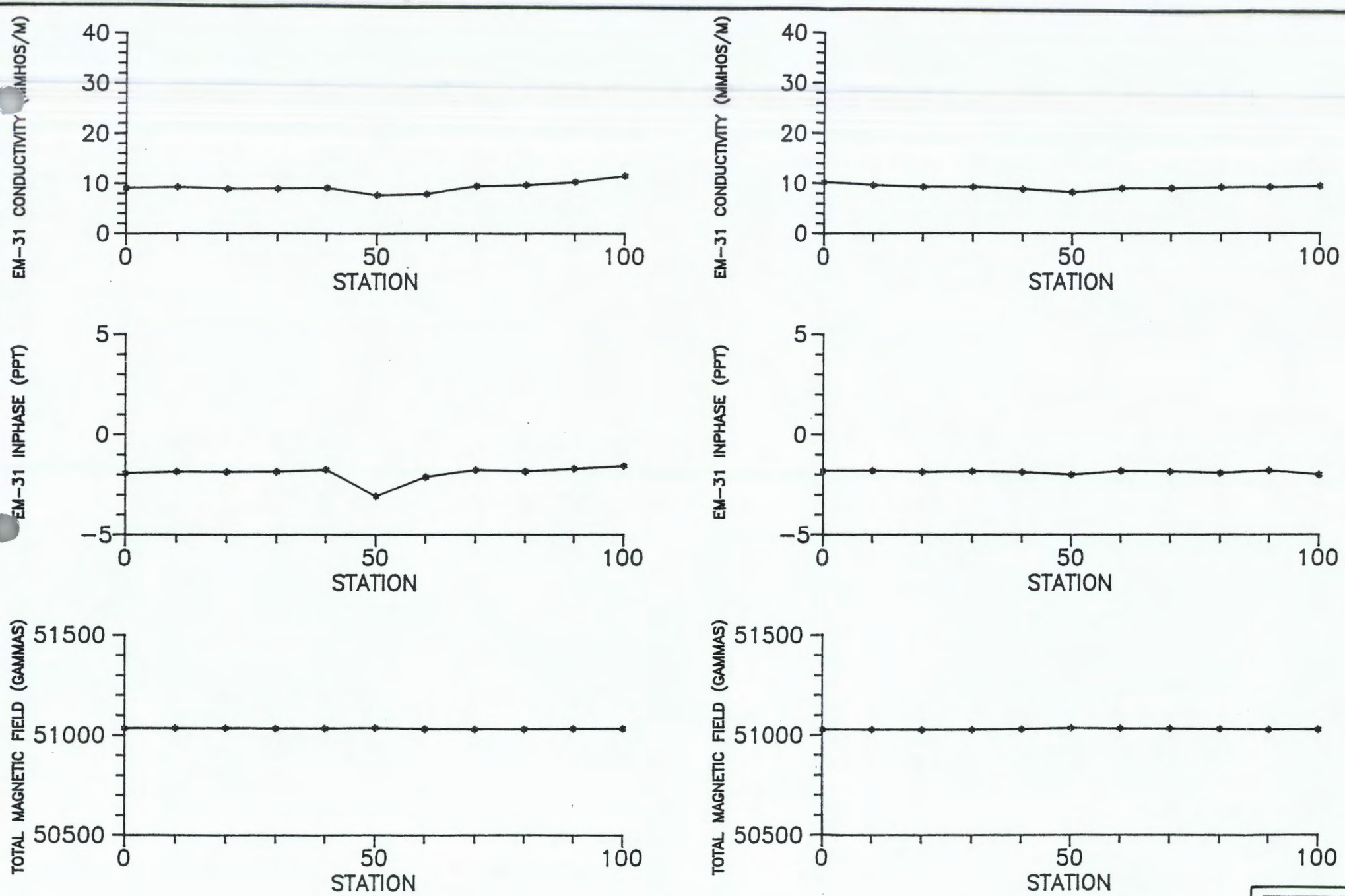


LINE 902

BLACKHAWK GEOSCIENCES, INC.

GEOPHYSICAL DATA SETS
AREA 9 - RED RIO
WHITE SANDS MISSILE RANGE
CDM FEDERAL PROGRAMS

PROJECT NO: 91017 Figure 3-15

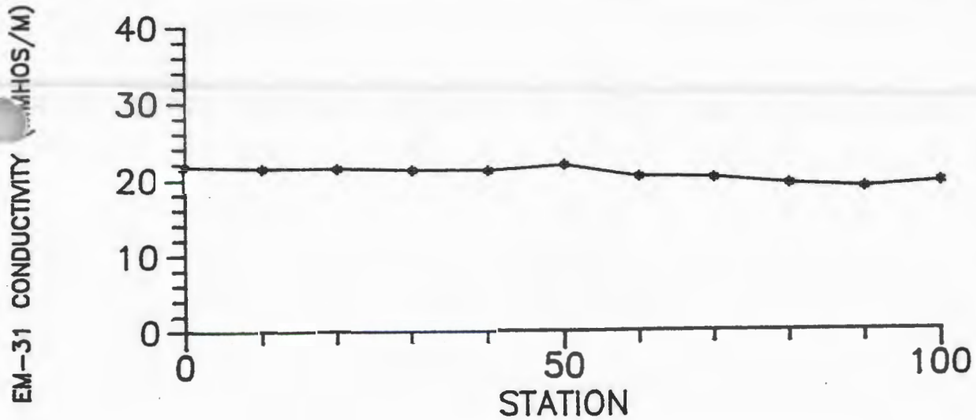


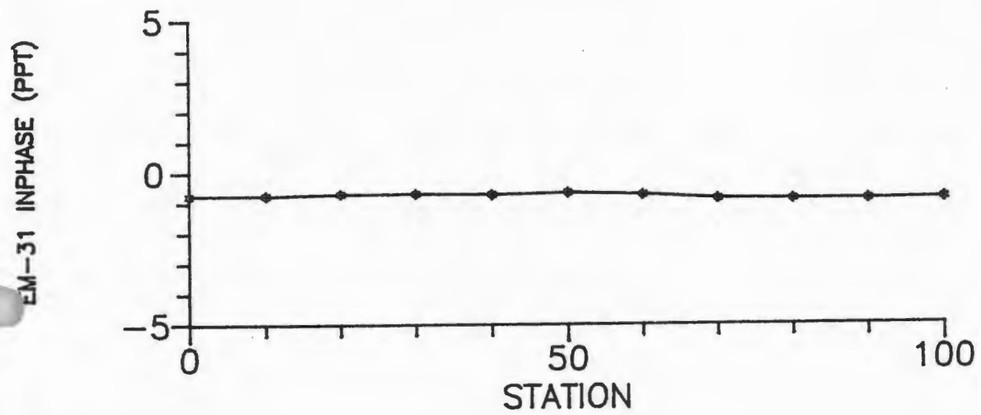
BLACKHAWK GEOSCIENCES, INC.

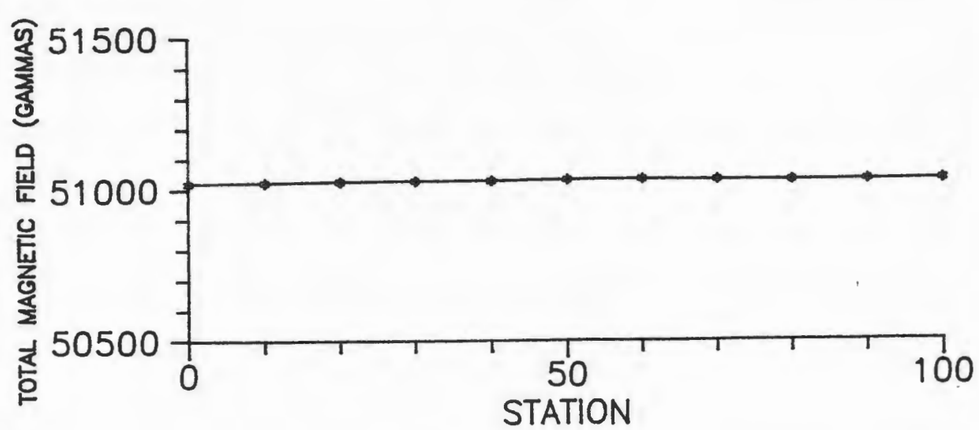
GEOPHYSICAL DATA SETS
AREA 10 - RED RIO
WHITE SANDS MISSILE RANGE
CDM FEDERAL PROGRAMS

PROJECT NO: 91017

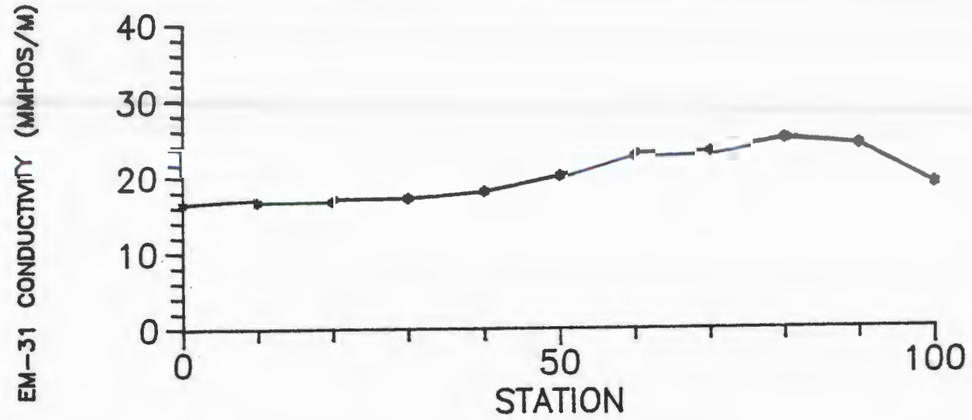
Figure 3-16

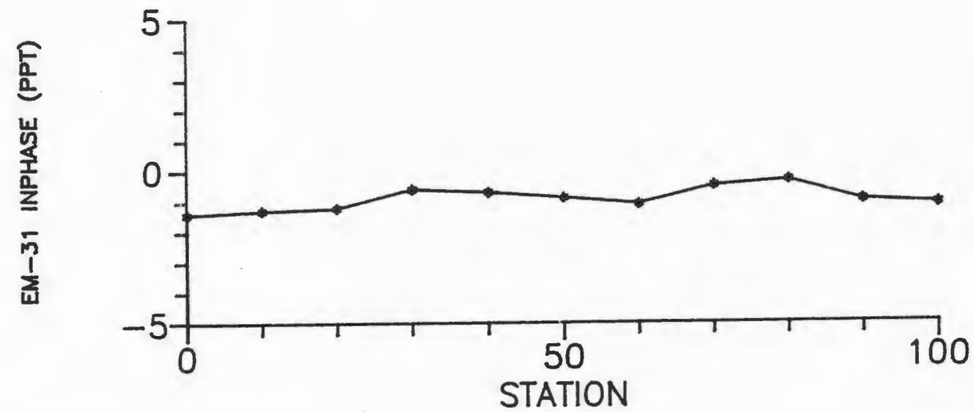


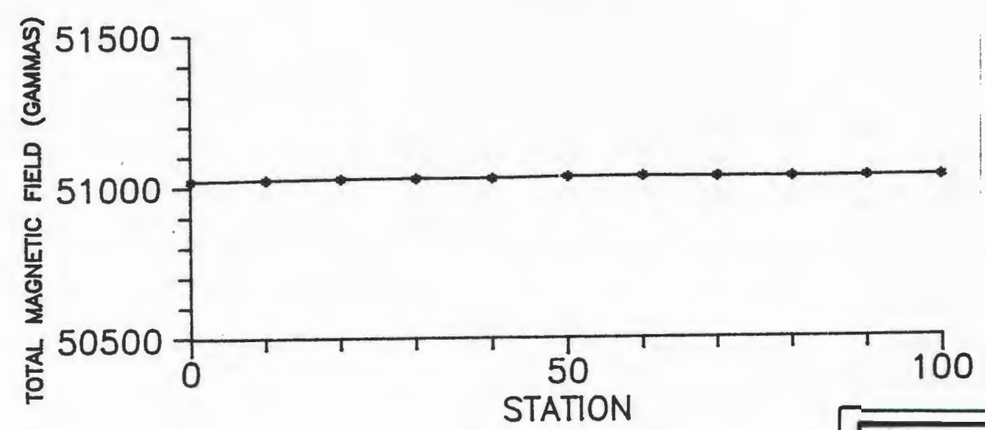




LINE 11







LINE 12

BLACKHAWK GEOSCIENCES, INC.

GEOPHYSICAL DATA SETS
AREA 11 - RED RIO
WHITE SANDS MISSILE RANGE
CDM FEDERAL PROGRAMS

PROJECT NO: 91017 Figure 3-17

APPENDIX C

SUBSURFACE LOGS, OSCURA AND RED RIO SITES

SUBSURFACE LOGS - Red Rio Site

TRENCH 1

Depth	Soil Description	PID	Remarks
2'	med brown silt loam	0	No evidence of soil development.
4'	med-dark brown loam w/carb filaments	0	
6'	lt brown loam	0	More sand than previous samples.
8'	lt brown sandy loam, 20% ls gravel (1-10 mm)	0	
10'	lt brown sandy loam, <5% ls pebbles	≈1	WSRR-SUB-01-0-10' collected.
11'	lt brown sandy loam, <5% ls pebbles	3	
12'	silt loam	--	PID reading not recorded.
13'	no data collected	0	
14'	no data collected	2	Jar headspace 8 ppm above background.
15'	brown sandy loam, carb nodules	0-1	WSRR-SUB-01-11-15' & WSRR-SUB-01-15' collected.

TRENCH 2

Depth	Soil Description	PID	Remarks
2'	dark-med brown loam, <1% gravel	0	
4'	dark-med brown loam, <1% gravel, thin carb filaments	0	
6'	dark brown loam, more carb filaments than at 4'	0	Backhoe broken. WSRR-SUB-02-0-6', -SUB-02/S-0-6', & -SUB-02/C-0-6'collected.
8'	lt brown loam, disseminated carb	0	
10'	lt brown loam, about 5% ls pebbles (5-15 mm)	0	WSRR-SUB-02-8-10' collected.
11'	lt brown loam, some carb filaments	0	
12'	lt brown loam, some carb filaments	0	
13'	med brown sandy loam w/carb nodules	0	
14'	lt brown loam w/carb filaments and disseminated carb	0	
15'	med brown sandy loam, 40% ls pebbles (5-15 mm), slightly moist	0	WSRR-SUB-02-11-15' & WSRR-SUB-02-15' collected.

SUBSURFACE LOGS - Red Rio Site

TRENCH 3

Depth	Soil Description	PID	Remarks
2'	dark brown silt loam, moist	0	Portion of golf ball sized mottled ash-like grey/white material included in sample.
3'	dark brown silt loam, moist	0	More of mottled material above and small bomb fins(?). WSRR-SUB-03-3' collected.
4'	med red-brown clay loam/dark brown loam, <5% pebbles, moist	0	Metal or rock contacted--trench moved slightly to south and east.
6'	dark brown loam w/<5% gravel	0	Baseball sized pieces burned wood found. WSRR-SUB-03-0-6' collected after hit at 7'.
7'	dark brown loam, 10% pebbles, stained w/black ash	1	Jar headspace 9-10 ppm. BDU-33s and bomb fins found. WSRR-SUB-O3-7' collected.

TRENCH 4

Depth	Soil Description	PID	Remarks
2'	med brown loam, <5% ls pebbles	0	Piece of scrap metal found in backhoe bucket.
4'	med brown loam, 10% gravel (5-10 mm)	0	
6'	med brown silt loam, 5% ls gravel (5-20 mm), moist	0	
8'	lt brown loam, calc filaments, 10% pebbles (10-20 mm)	0	Good ped development.
10'	med red-brown silt loam, <5% gravel, carb filaments, moist	2-3	WSRR-SUB-04-0-10' collected.
11'	clayey silt loam, <5% pebbles, carb filaments	<1	
12'	med-lt brown clay loam, dissem carb and carb nodules	0	Soil drier than that above.
13'	med brown clay loam, carb filaments	0	
14'	weathered shale, nearly all clay	0	White zones in soil may be secondary sedimentary structure.
15'	bedrock(?)	0	Operator reports hard digging. WSRR-SUB-04-11-15' & WSRR-SUB-04-15' collected.

SUBSURFACE LOGS - Red Rio Site

TRENCH 5 (Background)

Depth	Soil Description	PID	Remarks
			PID inoperative.
5'	brown silt loam	--	WSRR-SUB-05-5' collected.
7'			Soil lighter color below due to higher $CaCO_3$ content. Limited soil development above.
10'	lt brown silt loam	--	WSRR-SUB-05-10' collected.
15'	lt brown silt loam	--	WSRR-SUB-05-15' collected.

TRENCH 6

Depth	Soil Description	PID	Remarks
2'	med-dark brown silty loam, <5% ls pebbles (10-15 mm), moist	0	Minimal carbonate filaments.
4'	med-dark brown silty loam, <5% ls pebbles (10-15 mm), moist	0	
6'	med red-brown clay loam, moist	0	
8'	med red-brown clay loam, carb filaments	0	
10'	med red-brown clay loam, <5% ls pebbles (2-10 mm), carb string	0	WSRR-SUB-06-0-10' collected.
11'	med red-brown clay or silt loam, 5% ls gravel (2-10 mm)	0	
12'	med red-brown clay loam, few thick carb filaments and coatings	0	
13'	med red-brown clay loam, few thick carb filaments and coatings	0	
14'	med red-brown clay loam, few thick carb filaments and coatings	0	
15'	med red-brown clay loam, few thick carb filaments and coatings	0	WSRR-SUB-06-11-15' and WSRR-SUB-06-15' collected.

SUBSURFACE LOGS - Oscura Site

TRENCH 1

Depth	Soil Description	PID	Remarks
2'		0	Soil description not recorded.
4'	med brown clayey silt	0	
6'	med brown loam w/calc specks	0	
8'	sandy clay w/calc nodules, minor gravel, moist	0	
10'	gravelly sand w/clasts up to 1"	0	WSOR-SUB-01-0-10' collected.
11'	sand loam, 40% gravel (5-30 mm)	0	
12'	gravelly loamy sand, 40% gravel (5-30 mm), slightly moist	0	
13'	med brown loam, <5% pebbles	0	
14'	gravelly sandy loam, 20% gravel	0	
15'	sandy gravelly loam	0	WSOR-SUB-01-11-15' and WSOR-SUB-01-15' collected.

TRENCH 2

Depth	Soil Description	PID	Remarks
2'	silty clay w/roots and organic material	0	
4'	silty clay w/less roots than 2'	0	
6'	silty clay	0	
8'	silty clay w/minor amounts of gravel, calc specks	0	No organic matter.
10'	silty clay w/minor amounts of gravel, calc specks	0	WSOR-SUB-02-0-10' collected.
11'	lt brown silt loam, few carb nodules, very little fine gravel	0	
12'	lt brown silt-clay loam, many carb nodules	0	Soil very hard and dry.
13'	gravelly clay loam, 60% ls gravel (5-30 mm), dissem carb & nods	0	Operator reports hard digging.
14'	red-brown clay loam, <5% gravel, carb filaments & nodules	0	Soil dry, very hard.
15'	sandy loam, 50% ls gravel, no evidence of carb	0	Soil still very dry. WSOR-SUB-02-11-15' and WSOR-SUB-02-15' collected.

TRENCH 3

Depth	Soil Description	PID	Remarks
2'	uniform brown silt loam, 15% gravel, few roots	0	
4'	lt brown silt loam, <5% gravel, dissem carb, few roots	0	Fair ped development.
6'	lt brown silt loam, <5% pebbles, dissem carb and nodules	0	
8'	sandy loam, 25% gravel (5-15 mm)	0	
10'	dark red-brown sandy loam, 30% ls gravel	0	WSOR-SUB-03-0-10' collected.
11'	sandy gravel, 75% ls gravel (most 20-50 mm, some to 150 mm)	0	Soil looks moister.
12'	sandy gravel, 80% gravel	0	Sand portion moist.
13'	dark reddish-brown loam, <10% gravel, moist	0	
14'	dark reddish-brown loam, <10% gravel, moist	0	
15'	med red-brown gravelly sand	0	WSOR-SUB-03-11-15' and WSOR-SUB-03-15' collected.

TRENCH 4

Depth	Soil Description	PID	Remarks
2'	med brown loam, 15% gravel (5-15 mm)	0	2 orange Mk 106s uncovered, not weathered or burned. WSOR-SUB-04-2' collected.
2'	mixed lt brown loam and silt loam w/carb nodules	0	Trench relocated 18" SE of original excavation. Soil looks like fill material.
4'	lt brown silt loam w/dissem carb & nods, 10% gravel (5-15 mm)	0	Definite gravel zone between 2' and 2.5'. Soils below <u>may</u> be undisturbed.
6'	lt brown silt loam w/dissem carb & nods, 10% gravel (5-15 mm)	0	
8'	med brown loam, 20% large ls gravel (15-200 mm), slightly moist	0	Gravel also has carbonate coatings.
10'	med brown loam, less large gravel than 8'	0	WSOR-SUB-04-0-10', WSOR-SUB-04/S-0-10', & WSOR-SUB-04/C-0-10' collected.
11'	red brown clay loam, 15% gravel (<10 mm), carb filaments/coats	0	Abundant carbonate filaments and coatings.
12'	red brown clay loam, 15% gravel (<10 mm), less carb than 11'	0	
13'	lt brown gravelly clay loam, carb in matrix and clasts	0	Soils are still fairly dry.
14'	lt brown gravelly clay loam, carb in matrix and clasts	0	
15'	lt brown gravelly clay loam, carb in matrix and clasts	0	WSOR-SUB-04-11-15' and WSOR-SUB-04-15' collected.

TRENCH 5 (Background)

Depth	Soil Description	PID	Remarks
5'	uniform med brown silt loam, abundant roots	0	Some ped development. WSOR-SUB-05-5' collected. Screen w/rad meter negative.
10'	uniform red-brown loam, <5% ls pebbles (2-15 mm up to 5 cm)	0	WSOR-SUB-05-10' collected.
15'	gravelly sand w/ls clasts (1-2 cm up to 20 cm)	0	Operator reports gravelly sand hit at 12'. WSOR-SUB-05-15' collected.

TRENCH 6

Depth	Soil Description	PID	Remarks
2'	med brown silt loam, some carb	0	
3'			Bomb fins or sheet metal found, not weathered or burned. Trench widened to SE.
4'	med brown silt loam, some carb	0	Piece of angle iron and wire visible in trench. No sign of stained soil or burning.
5'			Backhoe contacts object which can't be pulled up. Trench moved a little to south.
6'	med brown calc silt loam w/nodules and filaments, roots present	0	May be undisturbed earth.
8'	med brown loam, 10% gravel and cobbles, few carb filaments	0	
10'	med brown sand loam	0	Soil slightly more moist than that above. WSOR-SUB-06-0-10' collected.
11'	med brown sand loam	0	
12'	med red-brown loam w/carb nodules, <5% gravel, slightly moist	0	
13'	med red-brown loam w/carb nodules, <5% gravel, slightly moist	0	
14'	brown gravelly sand, 40% ls gravel (5-20 up to 100 mm), moist	0	
15'	brown gravelly sand, 40% ls gravel (5-20 up to 100 mm), moist	0	WSOR-SUB-06-11-15' and WSOR-SUB-06-15' collected.

TRENCH 7

Depth	Soil Description	PID	Remarks
2'	med brown clay loam w/roots and calc stringers, very dry	0	
4'	med brown clay loam, less roots and calc stringers than 2'	0	
6'	med brown clay loam	0	
8'	clayey silt, 15% gravel (1-5 cm)	0	
10'	clayey silt w/ls rocks (1-20 cm)	0	WSOR-SUB-07-0-10' collected.
11'	gravelly clayey silt, 40% gravel (1-10 cm)	0	
12'	soil very rocky, 60% with cobbles up to 25 cm	0	Soil appears to be undisturbed thus far.
13'	soil very rocky, 60% with cobbles up to 25 cm	0	
14'	silty matrix, gravel size smaller than previous (1-5 cm)	0	
15'	gravel about 60% (1-8 cm)	0	WSOR-SUB-07-11-15' and WSOR-SUB-07-15' collected.

TRENCH 8

Depth	Soil Description	PID	Remarks
2'	med brown clay loam w/some calc nodules, roots, dry	0	
4'	med brown clay loam w/some calc nodules, less roots than at 2'	0	
6'	med brown clay loam w/some calc nodules	0	
8'	med brown clay loam w/some calc nodules	0	
10'	med brown clay loam w/some calc nodules	0	WSOR-SUB-08-0-10' collected.
11'	med brown clay loam, dry	0	Soils <u>may</u> be disturbed based on consistency of stratigraphy.
12'	med brown clay loam, <5% gravels (1-5 cm)	0	
13'	clayey silt, 5-10% cobbles	0	
14'	clayey silt, 5% gravels (1-3 cm)	0	
15'	clayey silt, 5-10% gravels (ls), still dry	0	WSOR-SUB-08-11-15', -08/S-11-15', -08/C-11-15', & WSOR-SUB-08-15' collected.

TRENCH 9

Depth	Soil Description	PID	Remarks
2'	clayey silt w/roots	0	
4'	med brown clayey silt w/some roots	0	
6'	clayey silt, 1-2% gravel (up to 1 cm)	0	
8'	clayey silt, 1-2% gravel (up to 2 cm)	0	
10'	clayey silt, 1-2% gravel (up to 2 cm)	0	WSOR-SUB-09-0-10' collected.
11'	clayey silt w/some sand	0	
12'	clayey silt w/some sand, few cobbles up to 15 cm	0	
13'	clayey silt, 30% ls gravel (1-5 cm)	0	
14'	clayey silt, 1-2% gravel (1-5 cm)	0	
15'	sandy silt, 70% gravel (1-2 cm)	0	WSOR-SUB-09-11-15' and WSOR-SUB-09-15' collected.

TRENCH 10

Depth	Soil Description	PID	Remarks
2'	clayey silt	0	Soil typical of those found in upper layers around the site.
4'	clayey silt, some calc nodules	0	
6'	clayey silt, some calc nodules	0	
8'	clayey silt, some calc nodules	0	
10'	clayey silt, more calc nodules than 8'	0	WSOR-SUB-10-0-10' collected.
11'	silty sand w/calc nodules	0	
12'	silty sand, <5% gravel (1-5 cm)	0	
13'	silty sand, less gravel than 12'	0	
14'	silty sand, more sand than 13'	0	
15'	silty sand, more sand than 13'	0	WSOR-SUB-10-11-15' and WSOR-SUB-10-15' collected.

TRENCH 11

Depth	Soil Description	PID	Remarks
2'	clayey silt	0	
4'	clayey silt	0	
6'	clayey silt	0	
8'	clayey silt, 1-2% (1-10 cm)	0	
10'	clayey silt, 5% gravel (0.5-3 cm)	0	WSOR-SUB-11-0-10' collected.
11'	clayey silt, 10% gravel (1-3 cm)	0	
12'	clayey silt, 10% gravel (1-3 cm)	0	
13'	clayey silt, 10% gravel (1-3 cm)	0	
14'	clayey silt, 10% gravel (0.5-3 cm)	0	
15'	clayey silt, 10% gravel (0.5-3 cm)	0	WSOR-SUB-11-11-15' and WSOR-SUB-11-15' collected.

TRENCH 12

Depth	Soil Description	PID	Remarks
2'	clayey silt w/roots	0	
4'	clayey silt w/roots, calc stringers	0	
6'	clayey silt, 5% gravel (0.5-2 cm)	0	
8'	clayey silt, 5% gravel (0.5-2 cm)	0	
10'	clayey silt, 5% gravel (0.5-2 cm)	0	WSOR-SUB-12-0-10' and WSOR-SUB-12/S-0-10' collected.
11'	clayey silt, numerous calc nodules	0	
12'	clayey silt, 10% gravel (0.3-3 cm)	0	
13'	sandy silt, 10% gravel (0.3-3 cm)	0	
14'	sandy silt, 10% gravel (0.3-3 cm)	0	
15'	sandy silt, 10% gravel (0.3-3 cm)	0	WSOR-SUB-12-11-15' and WSOR-SUB-12-15' collected.

TRENCH 13

Depth	Soil Description	PID	Remarks
2'	clayey silt w/some roots	0	
4'	clayey silt w/some roots	0	
6'	clayey silt w/some roots, calc nodules	0	
8'	clayey silt, 15% gravel (1-3 cm)	0	
10'	clayey silt, 15% gravel (1-5 cm)	0	WSOR-SUB-13-0-10' collected.
11'	clayey silt, 30% gravel (1-5 cm)	0	
12'	clayey silt, 30% gravel (1-5 cm)	0	
13'	clayey silt, 10% gravel	0	
14'	clayey silt, 10% gravel	0	
15'	clayey silt, 10% gravel	0	WSOR-SUB-13-11-15' and WSOR-SUB-13-15' collected.

APPENDIX D

FIELD SURVEILLANCE AND LABORATORY AUDIT REPORTS

FILE: 7902-002
P. Karas FIELD SURVEILLANCE

EXHIBIT A
Surveillance Report

DCN: 7902-002-RT-BCNV Date of Report: 4/29/91

Contract/Task No./Title: Battelle EMO/7902-002-RT-IVST

Organization: CDM Federal Programs Corporation

Date Performed: 4/23/91 Location: White Sands - Red Rio Site

Personnel Contacted: Paul Karas, Randy Reddick, and Bob Alexander

Controlling Documents/Procedures: QAPP, Sampling & Analysis Plan, Field Activity Quality Assurance Project Plan, and Work Plan

Specific Sections Applicable to Surveillance:

QAPP 15	Work Plan 5.2.3	
SAP 2,2.1,2.2,2.3		
FAQAPjP 4,5,6,9,10,13		

Activities/Documentation Reviewed: Surface soil sampling, sub-surface soil sampling, sample handling, sample preservation, field documentation, and equipment decontamination

Positive Findings: Field activities were found to be very well organized and in compliance with controlling documents/procedures. However, there are two minor observations.

EXHIBIT A (Continued)

Deficiencies and Observations: No major deficiencies were identified. The surveillance did identify two observations, which are explained below:

1). Currently two people are making entries into one logbook. It is important that there be a way to differentiate between whom is making the entries.

2). The FAQAPjP requires that the sample label be signed. The field personnel were signing the custody seal instead.

Corrective Action (CA) Taken to Address Each Deficiency/Observation. Describe Objective Evidence Observed or Reviewed that Demonstrates CA was Implemented:

1). The observation was accepted and the field personnel immediately began logging in and out of the field logbook.

2). This observation was also accepted and the field personnel immediately began signing all sample labels as required.

Both corrective actions were observed during the surveillance.

Further Corrective Action Required for Uncorrected Deficiencies? (Y / (N))
If yes, attach CAR form.

==========

Prepared by: Craig J Wood

Approved by: David O. Johnson for FPC QA Manager

Copies to - fill in names:

Task Manager: Paul A. Karas

Branch/Div. Manager: Linda J. Brown

QA Manager: R. Ellersick

QA Coordinator: Bob Thielke

Doc. Control File: 7902-002-SURV

Fairfax QA File: S. Searcy

7902-002-RT-BCRL

FILE 7902-002
CORRES

Battelle
Environmental Management Operations
P.O. Box 999
Richland, Washington U.S.A. 99352
Telephone (509) 376-1000

Telex 15-2874
Facsimile (509) 376-8105

May 6, 1991

Mr. Paul Karas
CDM Federal Programs Corp.
6400 Uptown Blvd. N.E., Suite 581-W
Albuquerque, NM 87110

Dear Mr. Karas:

MASTER AGREEMENT 071910-A-D3, TASK ORDER 110737, ENVIRONMENTAL MANAGEMENT OPERATIONS QUALITY ASSURANCE SURVEILLANCE REPORT SR-91-019

Thank you for your cooperation during the on-site surveillance of sampling activities at the White Sands Project on April 23 and 24, 1991. The EMO QA Surveillance Report, SR-91-019 is enclosed for your information.

If you have any questions, please contact SL English on 509/376-0634.

Sincerely,

Jan H. Slater

Jan H. Slater
Sr. Contract Specialist

JHS:sys

Enclosure

EMO QUALITY ASSURANCE DEPARTMENT
SOURCE SURVEILLANCE REPORT
Surveillance Report No: SR-91-019

PLANNING:
Project/Activity Title: White Sands RCRA Closure & Solid Waste Investigation

Subcontractor: CDM-FPC

QA Plan No: EMO QA Plan No. 010, Rev. 0

Other Applicable Documents: Field Activity QA Project Plan, Rev. 0, Feb. 15, 1991
Work Plan: SAmpling & Analysis Plan and Appendices Revision 0, February 15, 1991

Source of Requirements: See attached checklist

Purpose/Scope: The purpose is to observe field activities (sample collection) and verify comformance to the requirements of the project plans.

PERFORMANCE
Date initiated: April 23, 1991 Location: White Sands AFB, New Mexico

Contacts: Paul Karas

RESULTS
Main Statement: No major deficiencies. A few minor improvements were made in daily operations. Ex: signed custody seals, discontinued tamping down soil samples, initiated sign in and sign out in field log.

Summary: See attached checklist for specific details of what was observed.

Describe attachments:_3 page checklist_

CORRECTIVE ACTION
[ ] None Required [X] Completed at the site
[ ] Reference Follow-Up Source Surveillance Deficiency Response Form:

REPORTING
QA Trend Codes: NA

Distribution: RM Smith(Cog. Mgr.) SL English
CDM-FPC Paul Karas (w/o attachment) CDM-FPC Dave Johnson (QA) (w/o attachment)

Surveillance performed by: _JV Mohatt_ JV Mohatt Date 5-3-91

FILE: 7902-002
TMA AUDITS

CDM FEDERAL PROGRAMS CORPORATION

MEMORANDUM

TO: Project File - 7902-002

FROM: Robert Thielke

PROJECT: EMO Master Agreement 071910-A-D3

DATE: May 28, 1991

DCN: 7902-002-QA-BCNJ

SUBJECT: TMA/ARLI Laboratory Audit Report

INTRODUCTION

This EMO project includes field and laboratory work designed to aid in the development of closure plans for two practice bomb disposal areas at White Sands Missile Range. At the time of audit, soil sampling and laboratory analyses were in progress. Laboratory analysis is being performed by the subcontractor laboratory, ThermoAnalytical, Inc (TMA). Three TMA facilities are involved: TMA/Norcal of Richmond, CA is responsible for sample management; TMA/ARLI of Monrovia, CA is performing metals and semivolatiles analysis; and TMA/ERG of Ann Arbor, MI is performing explosives analysis.

This report documents the laboratory system audit of TMA/ARLI work conducted at the TMA/ARLI facility in Monrovia, California on May 9-10, 1991. The auditor reviewed TMA/ARLI operations, facilities, and personnel; related sample handling and documentation procedures were also reviewed.

This audit checked on adherence to the analytical methods, standard operating procedures, and QA/QC procedures defined in the White Sands Field Activity QA Project Plan, Laboratory Subcontract Statement of Work, Test Methods for Evaluating Solid Waste - Physical/Chemical Methods (EPA SW-846), and the TMA/ARLI QA Manual in the performance of this work. The laboratory audit checklist used during the audit is attached to this report.

The audit was conducted by Robert Thielke. Personnel contacted during the audit were:

- Dennis Wells — Laboratory Manager
- David Kohlenberger — QA Manager
- Mark Hudnall — Program Manager
- Craig Weed — GC/MS Operator
- Wida Ang — GC/MS Supervisor
- Robert Mazurek — ICP Operator
- Robert Ferguson — AA Operator/Metals section Supervisor.

AUDIT FINDINGS

The audit focused on the areas listed below; pertinent sections of the documents governing field work are cited in parentheses. The auditor checked on adherence to the requirements in these documents as noted below.

Availability of Relevant Documents

The appropriate SW-846 methods were available to all analysts and technicians. Copies of the White Sands Field Activities QA Plan and Laboratory Statement of Work were available to the Project Manager.

Personnel And Training

The auditor reviewed TMA/ARLI's personnel files, training files, and interviewed key analysts and technicians. All personnel appeared to have adequate education, experience, and training to perform their duties.

Training files were maintained for each employee that outlined each task that was necessary to complete training and the date that each training task was completed.

Document Control And Standard Operating Procedures (Subcontract SOW, Item #5)

TMA/ARLI has an established and approved set of standard operating procedures (SOPs) that address all activities that will be performed in conjunction with EMO sample analyses. Appropriate SOPs were available to all personnel.

SOPs have been approved by TMA/ARLI management and are issued as controlled documents with distribution lists.

Chain of Custody And Sample Traceability (Subcontract SOW, Item #2)

The auditor observed and examined all laboratory operations to determine if all laboratory activities were adequately documented and that the chain of custody of the samples are traceable from sample collection to sample disposal (including all preparation and analyses). The laboratory operations that were observed included:

- Sample Receipt
- Reagent and standards storage and preparation
- Sample storage
- Sample preparation
- Sample analysis
- Quality control
- Data package assembly
- Sample and records disposition.

The laboratory has two entrances which are locked or monitored at all times. The auditor was required to sign in and was escorted at all times. Samples are stored in locked refrigerators and transfer of custody into and

out of storage is maintained in an internal transfer log. The laboratory is a secure facility.

All laboratory operations and activities are adequately performed and documented with the following exceptions:

- Original chain of custody records for samples received at TMA/Norcal were not forwarded to TMA/ARLI. However, facsimile copies were available and reviewed by the auditor. The original chain of custody records will be forwarded to TMA/ARLI. Only early shipments of samples were sent to TMA/Norcal; subsequent samples were sent directly to TMA/ARLI.

- Regular review of logbooks by supervisory and QA personnel was not adequately documented; this finding requires corrective action.

Logbook pages, instrument printouts, chain of custody, and other documentation associated with the preparation and analysis of samples will be maintained in locked file cabinets. The locked files are located in the file storage room and will be maintained for a minimum of two years.

Sample Receipt and Storage (Subcontract SOW, Item #2)

Samples are received at the receiving door adjacent to the sample receipt area. The Sample Custodian determines the following upon receipt of samples:

- Condition of coolers and custody seals,
- Condition of samples and sample containers,
- Accuracy of chain of custody information in comparison to contents of coolers.

Sample receipt information is documented on the sample processing form. If discrepancies are found, the FPC project manager will be contacted to determine an resolution. Depending upon the severity of the discrepancy, the resolution will be documented on the sample processing form or on a telephone conversation form. The samples are logged into the Laboratory Sample Analytical Management (SAM) system and laboratory identification numbers are assigned. The laboratory and field identification numbers are cross-referenced.

Samples are stored in refrigerators located in the sample receipt area. Volatiles are stored in an upright refrigerator, sample extracts are stored in a different upright refrigerator, metal digestates are stored on shelves in the metals laboratory, and all other samples are stored in a large walk in cooler in the sample receipt area.

Sample receipt and storage facilities and procedures are adequate with the following observations:

- The auditor recommended that absorbent pads covering bench space in the sample receipt area should be replaced.

- An old reagent bottle of NaOH with no label was found during the audit; the bottle was identified with an ink marker. The bottle was immediately removed from use by TMA/ARLI.

Sample Preparation and Analysis (Subcontractor SOW, Item #6)

EMO samples are prepared and analyzed using the SW-846 methods specified in the FPC Laboratory Statement of Work. All analytical instruments are properly maintained and operated for the prescribed analytical methods.

Semi-Volatile analysis is performed by GC/MS using Method 8270. TMA/ARLI has two GC/MS instruments dedicated for Semi-Volatile analysis.

Most metals analysis is performed by Inductively Coupled Argon Plasma (ICP) using Method 6010. Mercury analysis is performed by cold vapor atomic absorption (AA) using Method 7471, and Arsenic and Selenium analyses are performed by AA using Methods 7060 and 7740 respectively. The metals section has only one ICP, one AA, and one cold vapor AA. Although the capacity for metals analyses may be limited, the capacity appears adequate for the sample load anticipated under the EMO White Sands task.

Calibration (Subcontract SOW, Item #6)

All observed instrument calibration procedures were compatible with the appropriate SW-846 methods. All calibration records are maintained in instrument specific calibration logbooks.

Standards are directly traceable to NIST or EPA certificates of analysis. Standards logbooks and certificates of Analysis logbooks are maintained for all analyses, although some organic certificates of analysis were not maintained in the certificates of analysis logbook.

Quality Control (Subcontractor SOW, Items #2 and #6)

Analytical Quality Control is maintained by analyzing Quality Control samples, maintaining calibration and Tune records, and maintaining control charts for all analyses.

The auditor noted that the specific conductivity of the deionized water system was not recorded on a daily basis, and a logbook was not maintained to document this information. This deficiency requires corrective action.

Analytical results are subject to review by each section supervisor to determine if Quality Control criteria were met, if the analysis was performed correctly, and that all data was correctly transcribed. Draft reports for metals analysis will be maintained in the project files to document that manual data entry was verified against the raw data.

CONCLUSION

In general, the laboratory appears acceptable for performing analytical work related to the EMO contract. Certain deficiencies noted in the Audit Findings section require further corrective action. Corrective Action

Request forms listing these deficiencies are attached.

The TMA/ARLI Program Manager is responsible for taking appropriate corrective action, briefly describing it on the Corrective Action Request form, and returning the completed form to Robert Thielke by the date indicated. An Audit Completion Notice will be issued when the corrective action taken is deemed acceptable by the FPC QA Director.

Prepared by:

Robert Thielke, Auditor

Approved by:

for RoseMary Ellersick, QA Director

Attachments

cc: S. English, EMO
L. Brown
J. Curtis
R. Ellersick
P. Karas
M. Malloy
R. Fox, TMA/Norcal
M. Hudnall, TMA/ARLI
Fairfax QA Files
Document Control

FILE: 7902-0
TMA AUDIT

CDM FEDERAL PROGRAMS CORPORATION

MEMORANDUM

TO: Project File - 7902-002

FROM: David Johnson

PROJECT: EMO Master Agreement 0710910-A-D3

DATE: June 6, 1991

DCN: 7902-002-QA-BCRD

SUBJECT: TMA/ERG Laboratory Audit Report

INTRODUCTION

This EMO project includes field and laboratory work designed to aid in the development of closure plans for two practice bomb disposal areas at White Sands Missile Range. At the time of audit, soil sampling and laboratory analyses were in progress. Laboratory analysis is being performed by the subcontractor laboratory, ThermoAnalytical, Inc (TMA). Three TMA facilities are involved: TMA/Norcal of Richmond, CA is responsible for sample management; TMA/ARLI of Monrovia, CA is performing metals and semivolatiles preparation and analysis; and TMA/ERG of Ann Arbor, MI is performing explosives analysis. Audits were conducted at the TMA Monrovia and Ann Arbor facilities; TMA/Norcal was not audited because no sample preparation or analysis was conducted by this facility.

This report documents the laboratory audit of TMA/ERG work conducted at the facility in Ann Arbor, MI on May 2-3, 1991. The auditor reviewed TMA/ERG operations, facilities, and personnel; related sample handling, documentation, and analytical procedures were also reviewed.

This audit checked on adherence to the analytical methods, standard operating procedures, and QA/QC procedures defined in the White Sands Field Activity QA Project Plan, the Laboratory Subcontract Statement of Work, the USATHAMA analytical methods, and the TMA/ERG QA Manual (June 16, 1990) in the performance of this work. The laboratory audit checklist used during the audit is attached to this report.

The audit was conducted by David Johnson. Personnel contacted during the audit were:

- Art Czabaniuk — Laboratory Manager
- Mark Ruve — QA Manager
- Michael Dew — Operations Manager
- Gerry Hughes — HPLC Operator
- Barbara Scribner — Inorganics Supervisor.

AUDIT FINDINGS

The audit focused on the areas listed below; pertinent sections of the documents governing work are cited in parentheses. The auditor checked on adherence to the requirements in these documents as noted below.

Availability of Relevant Documents

The White Sands Field Activities QA Plan, the TMA/ERG QA Manual, and copies of the USATHAMA analytical methods were available at the workplace. However, the subcontract statement of work (SOW) governing the White Sands analyses had not been forwarded to TMA/ERG from TMA/Norcal. The auditor provided an unofficial copy of the SOW to the Laboratory Manager and requested that he obtain an executed copy from TMA/Norcal, when available.

Personnel And Training (TMA/ERG QA Manual, Sect. 9)

The auditor reviewed TMA/ERG training files, and interviewed key analysts and technicians. All personnel appeared to have adequate education, experience, and training to perform their duties. The laboratory appears adequately staffed to handle the current sample load. The laboratory has a full-time QA Manager who reports directly to the Laboratory Manager.

Training files were maintained for each employee that outlined each task that was necessary to complete training and the date that each training task was completed.

Facilities and Equipment (Subcontract, Part II)

The facilities and equipment appeared adequate for performing the required work. No concerns were noted.

Standard Operating Procedures (Subcontract SOW, Item #5; TMA QA Manual, Sect. 7.2)

The TMA/ERG QA Manual (Section 7.2) states that routine procedures are contained in various Procedure Manuals. Although numerous standalone procedures were available, the auditor observed that the procedures were not consolidated in manuals. The auditor recommended that this discrepancy be clarified.

Sample Receipt and Storage (Subcontract SOW, Item #2)

The auditor reviewed sample receipt and storage procedures as stated in TMA/ERG SOP 8820. Samples are received at a sample receipt area. Based on a review of documentation for the White Sands task, the Sample Custodian examined the contents of the coolers, verified chain of custody information in comparison to contents of coolers, and signed the chain of custody form. However, the following sample receipt requirements specified in the SOW were not performed:

- Temperature of shipping coolers must be recorded.
- The general condition of the coolers and sample containers, and any problems must be recorded on a sample log-in form.

These deficiencies require corrective action.

Samples were stored in a walk-in cooler located in the sample receipt area. Sample extracts for explosives were stored in an upright refrigerator.

Chain of Custody And Sample Traceability (Subcontract SOW, Item #2)

The auditor observed and examined laboratory operations to determine if all laboratory activities were adequately documented and if the chain of custody of the samples is traceable from sample collection to sample disposal (including all preparation and analyses).

The auditor verified that the chain of custody form is signed and a copy placed in the data files; the laboratory will return the original to CDM FPC. The laboratory assigns a unique identification number to each sample; this number is used to track samples. This number is entered into a computer system and a project worksheet is generated.

Samples were stored in a locked cooler and transfer of custody into and out of storage was maintained in an internal transfer log. All laboratory custody procedures were adequately performed and documented with the following exception:

- There is no provision for recording the signatures/dates of personnel accepting or relinquishing the custody of explosives extracts from the upright refrigerator.

- Instrument run logs do not contain sufficient information concerning time of analysis and discussion of routine analytical problems and associated corrective action (e.g., re-analysis of QC samples when acceptance criteria are not met.)

These two findings require corrective action.

Laboratory records, including raw data and printouts, are maintained in locked file cabinets in a secure file room for two years. The auditor verified that adequate records are maintained and are traceable. According to the QA Manager, after two years, records are moved and archived at an offsite storage area.

The laboratory is a secure facility. The auditor was required to sign in and was escorted at all times.

Explosives Analysis (Subcontract SOW, Item #6)

The auditor discussed the analytical requirements with laboratory staff. Extractions are performed as required; the auditor reviewed documentation and verified that the seven-day holding time for extraction was being met. Although analysis of extracts had not been initiated at the time of the audit, the auditor discussed the USATHAMA methods (UW-21 for water and LW-17 for soil) with laboratory staff. Based on these discussions, all significant method requirements are planned for implementation by TMA:

- An 8-point calibration will be performed daily and method acceptance criteria applied.
- A method blank will be run daily and contamination monitored.
- A high-level matrix spike/matrix spike duplicate and a low-level matrix spike will be analyzed daily. Spiking solutions will be prepared independently of the calibration standards.
- Calibration check standards will be run before and after the spiked samples.
- A weekly control spike solution will be run to check the stability of stock solutions.

The auditor also reviewed documentation from explosives analyses performed for the USEPA's Special Analytical Request (SAS) program. Although different analytical protocols were specified, TMA/ERG was able to implement the analytical and QC requirements specified by EPA.

Metals Analysis (Subcontract SOW, Item #6)

Although TMA/ERG is not performing metals analysis for the White Sands task, the auditor reviewed metals operations with the inorganic supervisor. Based on a review of instrument run logs and data sheets, the section appears capable of performing metals analysis by SW-846 protocols. The data sheets provided evidence that SW-846 calibration, quality control, and acceptance criteria were implemented. The laboratory is currently installing software to produce CLP data packages and is planning to provide metals analysis by CLP protocols.

Calibration (Subcontract SOW, Item #6)

Based on discussions with laboratory staff, all USATHAMA method calibration requirements will be implemented for explosives. The metals section implements SW-846 and CLP calibration requirements. Calibrations are recorded in instrument run logs dedicated to each instrument.

The auditor examined logbooks for stock and working standards. Standards are labeled and tracked with a unique serial number. The auditor verified that explosive standards are traceable to USATHAMA standard analytical reference materials (SARMs); the other standards are traceable to EPA or NIST.

The auditor verified that the temperature of coolers, refrigerators, and ovens is measured and recorded daily. The thermometer is calibrated annually with a NIST-traceable thermometer.

The auditor reviewed the log used to record calibration checks of laboratory balances. The auditor noted that the calibration of balances was not consistently performed and recorded on a daily basis. Also, there was no documentation available demonstrating that the weights used to check the balances are Class S grade. These deficiencies concerning routine calibration of balances requires corrective action.

Internal Data Review (Subcontract SOW, Item #2)

According to the Operations Manager, it is TMA/ERG's standard policy that analytical results, including raw data and calculations, are spot-checked by the section supervisor and QA Manager. Although evidence of checks such as signed routing sheets and initials/dates on data packages was in the files, there was not a current written procedure describing the frequency, extent, and documentation requirements for internal data review. This finding requires corrective action.

The QA Manager maintains precision and accuracy control charts for major parameters and a corrective action log. The auditor reviewed several examples of control charts and completed corrective actions. No concerns were noted.

CONCLUSION

In general, the laboratory appears acceptable for performing analytical work related to the EMO contract. All key staff have been employed by TMA/ERG for several years and are very knowledgeable of laboratory operations and the importance of quality assurance. Certain deficiencies noted in the Audit Findings section require further corrective action. During the debriefing, the auditor discussed these deficiencies with the laboratory staff. The Laboratory Manager accepted the findings and agreed to take corrective action.

Corrective Action Request forms listing these deficiencies are attached. The TMA/ERG Laboratory Manager is responsible for taking appropriate corrective action, briefly describing it on the Corrective Action Request form, and returning the completed form to the auditor by the date indicated. Evidence that the corrective action has been implemented should be attached to the forms. An Audit Completion Notice will be issued when the corrective action taken is deemed acceptable by the FPC QA Director.

Prepared by:

David O. Johnson

David O. Johnson, Auditor

Approved by:

Rose Mary Ellersick

RoseMary Ellersick, QA Director

Attachments

cc: S. English, EMO
L. Brown
J. Curtis
R. Ellersick
P. Karas
M. Malloy
A. Czabaniuk, TMA/ERG
R. Fox, TMA/Norcal
Fairfax QA Files
Document Control

7902-002
LAB AUDIT

CDM FEDERAL PROGRAMS CORPORATION

MEMORANDUM

TO: Task File

FROM: David O. Johnson DOJ

PROJECT: EMO Master Agreement 071910, Task 02

DATE: August 2, 1991

DOCUMENT NO. 7902-002-QA-BDFT

SUBJECT: Audit Completion Notice - TMA/ARLI Laboratory

A laboratory audit was conducted at the ThermoAnalytical (TMA)/ARLI facility in Monrovia, CA on May 9-10, 1991, by Robert Thielke, FPC QA Specialist. The audit checked on adherence to the analytical methods, standard operating procedures, and QA/QC procedures defined in the White Sands Field Activity QA Project Plan, Laboratory Subcontract Statement of Work, the EPA analytical methods, and the TMA/ARLI QA Manual.

Deficiencies concerning documentation of laboratory water quality and internal data review were found as noted on the attached Corrective Action Request forms. The corrective actions taken and noted on the forms are acceptable.

This Audit Completion Notice documents the satisfactory completion of this audit.

Attachments (2)

cc: S. English, EMO
L. Brown
J. Curtis
R. Ellersick
P. Karas
M. Malloy
D. Kohlenberger, TMA/ARLI
R. Fox, TMA/Norcal
Fairfax QA Files
Document Control

CAR No. 1 of 2

EXHIBIT A

--- CORRECTIVE ACTION REQUEST ---

[To be completed by corrective action request originator.]

Name: White Sands TMA - Norcal Lab Audit Date: 05/28/91

Contract/Task No: EMO/ 7902-002 Task Manager: Paul Karas

Description of problem and date identified: The specific conductivity of the Deionized water system was not recorded on a daily basis, and a logbook was not maintained to document this information - 05/09/91.

Submit this form to task manager and QA Manager immediately.

[To be completed by QA Manager.]
Significant Condition Adverse to Quality? Yes / (No)

Responsible for Action: Mark Hudnall / DW Kellenberger, QA Mgr. Response Due: 06/27/91

[To be completed by the responsible person. Attach additional pages as required. Include evidence that corrective action has been implemented]

Corrective Action Taken or Planned and Date: TMA/ARLT Corrective Action A91-06 Report shows SOP written and data book pages are also attached showing recording of conductivity daily with use.

State root cause of problem (required for all significant conditions adverse to quality):

Signature: DW Kellenberger Date: 7/31/91

[To be completed by QA Manager.]

Corrective Action Accepted: David O. Johnson Date: 8/1/91

Follow-up Dates:

* CA Verified By: David O. Johnson Date: 8/1/91

cc: ORIGINATOR: see distribution list QA COORDINATOR:
TASK MANAGER: QA MANAGER:
PROGRAM MANAGER:

* TMA SOP and data book pages indicate that corrective action was implemented.
DOJ

CAR No. 2 of 2

EXHIBIT A

— CORRECTIVE ACTION REQUEST —

[To be completed by corrective action request originator.]

Name: White Sands TMA - Norcal Lab Audit Date: 05/28/91

Contract/Task No: EMO/ 7902-002 Task Manager: Paul Karas

Description of problem and date identified: Supervisory and QA review was not adequately documented - 05/09/91

Submit this form to task manager and QA Manager immediately.

[To be completed by QA Manager.]
Significant Condition Adverse to Quality? Yes / (No)

Responsible for Action: Mark Hudnall Ole Kohlenberger, QA Mgr. Response Due: 06/27/91

[To be completed by the responsible person. Attach additional pages as required. Include evidence that corrective action has been implemented]

Corrective Action Taken or Planned and Date: Extraction data sheet and ICP data sheets show initials verifying QA review.

State root cause of problem (required for all significant conditions adverse to quality):

Signature: Ole Kohlenberger Date: 7/31/91

[To be completed by QA Manager.]

Corrective Action Accepted: David O. Johnson Date: 8/1/91

Follow-up Dates:

* CA Verified By: David O. Johnson Date: 8/1/91

cc: ORIGINATOR: see distribution list QA COORDINATOR:
TASK MANAGER: QA MANAGER:
PROGRAM MANAGER:

*TMA data sheets indicate corrective action was implemented. DOJ

CDM FEDERAL PROGRAMS CORPORATION

MEMORANDUM

TO: Task File

FROM: David O. Johnson DOJ

PROJECT: EMO Master Agreement 071910, Task 02

DATE: July 31, 1991

DOCUMENT NO. 7902-002-QA-BDFD

SUBJECT: Audit Completion Notice - TMA/ERG Laboratory

A laboratory audit was conducted at the ThermoAnalytical (TMA)/ERG facility in Ann Arbor, MI on May 2-3, 1991, by David O. Johnson, FPC Deputy QA Director. The audit checked on adherence to the analytical methods, standard operating procedures, and QA/QC procedures defined in the White Sands Field Activity QA Project Plan, Laboratory Subcontract Statement of Work, the USATHAMA analytical methods, and the TMA/ERG QA Manual.

Deficiencies in the areas of sample receipt, internal custody, documentation of analyses, calibration of balances, and written procedures for internal data review were found as noted on the attached Corrective Action Request forms. The corrective actions taken and noted on the forms are acceptable.

This Audit Completion Notice documents the satisfactory completion of this audit.

Attachments (5)

cc: S. English, EMO
L. Brown
J. Curtis
R. Ellersick
P. Karas
M. Malloy
A. Czabaniuk, TMA/ERG
Fairfax QA Files
Document Control

EXHIBIT A
--- CORRECTIVE ACTION REQUEST ---

[To be completed by corrective action request originator.]

Name: White Sands TMA/ERG Audit Date: 06/04/91

Contract/Task No: EMO/White Sands Task Manager: P. Karas

Description of problem and date identified: Temperature of sample coolers and general condition of coolers, sample containers, and any problems are not recorded. (05/02/91)

Submit this form to task manager and QA Manager immediately.

[To be completed by QA Manager.]
Significant Condition Adverse to Quality? Yes / (No)

Responsible for Action: A. Czabaniuk / TMA Response Due: 06/27/91

[To be completed by the responsible person. Attach additional pages as required. Include evidence that corrective action has been implemented]

* Corrective Action Taken or Planned and Date: Log-in technician instructed to note on ~~Chain of Custody~~ Wash sample log in form form the general condition of coolers samples and any discrepancies. Temperature of cooler will also be noted and recorded.

State root cause of problem (required for all significant conditions adverse to quality):

Signature: [signature] Date: 6/25/91

[To be completed by QA Manager.]

Corrective Action Accepted: David O. Johnson Date: 7/31/91

Follow-up Dates:

CA Verified By: David O. Johnson Date: 7/31/91

cc: ORIGINATOR: see distribution list QA COORDINATOR:
TASK MANAGER: QA MANAGER:
PROGRAM MANAGER:

* Instruction memorandum received 6/27/91.
DOJ

CAR No. 2 of 5

EXHIBIT A
--- CORRECTIVE ACTION REQUEST ---

[To be completed by corrective action request originator.]

Name: White Sands TMA/ERG Audit Date: 06/04/91

Contract/Task No: EMO/White Sands Task Manager: P. Karas

Description of problem and date identified: No provision for recording the signatures/dates of personnel accepting/relinquishing the custody of explosives extracts. (05/02/91)

Submit this form to task manager and QA Manager immediately.

[To be completed by QA Manager.]
Significant Condition Adverse to Quality? Yes / (No)

Responsible for Action: A. Czabaniauk / TMA Response Due: 06/27/91

[To be completed by the responsible person. Attach additional pages as required. Include evidence that corrective action has been implemented]

* Corrective Action Taken or Planned and Date: a chain of custody procedure for explosives is currently being devised and is expected to be completed and implemented by 7/12/91

State root cause of problem (required for all significant conditions adverse to quality):

Signature: [signature] Date: 6-25-91

[To be completed by QA Manager.]

Corrective Action Accepted: David O. Johnson Date: 7/31/91

Follow-up Dates:

CA Verified By: David O. Johnson Date: 7/31/91

cc: ORIGINATOR: see distribution list QA COORDINATOR:
TASK MANAGER: QA MANAGER:
PROGRAM MANAGER:

* Custody procedure for extracts received 7/30/91
DOJ

CAR No. 3 of 5

EXHIBIT A
--- CORRECTIVE ACTION REQUEST ---

[To be completed by corrective action request originator.]

Name: White Sands TMA/ERG Audit Date: 06/04/91

Contract/Task No: EMO/White Sands Task Manager: P. Karas

Description of problem and date identified: Instrument run logs do not contain sufficient information concerning time of analysis and discussion of problems and corrective actions. (05/02/91)

Submit this form to task manager and QA Manager immediately.

[To be completed by QA Manager.]
Significant Condition Adverse to Quality? Yes / (No)

Responsible for Action: A. Czabaniuk Response Due: 06/27/91

[To be completed by the responsible person. Attach additional pages as required. Include evidence that corrective action has been implemented]

* Corrective Action Taken or Planned and Date: Instrument logs will contain sufficient information concerning time of analysis and discussion of problems for explosives analyses.

State root cause of problem (required for all significant conditions adverse to quality):

Signature: [signature] Date: 6-25-91

[To be completed by QA Manager.]

Corrective Action Accepted: David O. Johnson Date: 7/31/91

Follow-up Dates:

CA Verified By: David O. Johnson Date: 7/31/91

cc: ORIGINATOR: see distribution list QA COORDINATOR:
TASK MANAGER: QA MANAGER:
PROGRAM MANAGER:

* Objective evidence (copies of run log pages) received 7/30/91. DOJ

CAR No. 4 of 5

EXHIBIT A
--- CORRECTIVE ACTION REQUEST ---

[To be completed by corrective action request originator.]

Name: White Sands TMA/ERG Audit Date: 06/04/91

Contract/Task No: EMO/White Sands Task Manager: P. Karas

Description of problem and date identified: Balances not calibrated daily.

No documentation that weights are "Class S". (05/02/91)

Submit this form to task manager and QA Manager immediately.

[To be completed by QA Manager.]
Significant Condition Adverse to Quality? Yes / (No)

Responsible for Action: A. Czabaniuk Response Due: 06/27/91

[To be completed by the responsible person. Attach additional pages as required. Include evidence that corrective action has been implemented]

* Corrective Action Taken or Planned and Date: Balances are now being calibrated daily. Class S weights are ordered.

State root cause of problem (required for all significant conditions adverse to quality):

Signature: [signature] Date: 6/25/91

[To be completed by QA Manager.]

Corrective Action Accepted: [signature] Date: 7/31/91

Follow-up Dates:

CA Verified By: [signature] Date: 7/31/91

cc: ORIGINATOR: see distribution list QA COORDINATOR:
TASK MANAGER: QA MANAGER:
PROGRAM MANAGER:

* Objective evidence (copies of calibration logs) received 7/30/91. DOJ

CAR No. 5 of 5

EXHIBIT A
--- CORRECTIVE ACTION REQUEST ---

[To be completed by corrective action request originator.]

Name: White Sands TMA/ERG Audit Date: 06/04/91

Contract/Task No: EMO/White Sands Task Manager: P. Karas

Description of problem and date identified: No current written procedure describing the frequency, extent, and documentation requirements for internal data review. (05/02/91)

Submit this form to task manager and QA Manager immediately.

[To be completed by QA Manager.]
Significant Condition Adverse to Quality? Yes / (No)

Responsible for Action: A. Czabaniuk Response Due: 06/27/91

[To be completed by the responsible person. Attach additional pages as required. Include evidence that corrective action has been implemented.]

Corrective Action Taken or Planned and Date: A standard operating for data review was in the draft stage as of the audit date and has been completed. (1) copy enclosed.

State root cause of problem (required for all significant conditions adverse to quality):

Signature: [signature] Date: 6-25-91

[To be completed by QA Manager.]

Corrective Action Accepted: [signature] Date: 7/31/91

Follow-up Dates:

CA Verified By: [signature] Date: 7/31/91

cc: ORIGINATOR: see distribution list QA COORDINATOR:
TASK MANAGER: QA MANAGER:
PROGRAM MANAGER:

APPENDIX E

FIELD AND LABORATORY QA/QC

APPENDIX E

FIELD AND LABORATORY QA/QC

Field and laboratory QA/QC procedures followed the requirements of the following governing documents:

- Quality Assurance Project Plan (QAPjP) FPC, August 1990
- Field Activities Quality Assurance Project Plan (FAQAPjP) FPC, February 1991
- FPC EMO Quality Asssurance Program Plan (QAPP) FPC, June 1990
- Sampling and Analysis Plan (SAP) FPC, February 1991

Deviations from procedures outlined in these documents were recorded in field or lab notebooks and are discussed in this appendix.

E.1 FIELD ACTIVITIES QA/QC

Several minor changes for deviations were made from procedures defined in the governing documents for field activities. These changes did not materially effect the results or reliability of data generated.

Instruments utilized in the field during investigations at the two sites included survey equipment used by Scanlon White Associates staff (FPC's subcontractor for topographic survey work), geophysical instruments used by personnel from Blackhawk Geosciences Inc. (FPC's subcontractor for geophysical investigations), and monitoring equipment operated by FPC field personnel. Subcontractors to FPC were required to maintain and calibrate their equipment according to manufacturer's recommendations. Maintenance and calibration procedures for equipment operated by FPC staff were provided in Appendix A of the SAP.

Guidelines for instrument use and calibration were followed with the exception of one case. The HNU PI-101 photo ionization detector (PID) experienced a malfunction during the start up of work at the Red Rio site (April 23, 1991). The SAP and Health and Safety Plan required periodic monitoring of working levels for volatile organic compounds and soil sample screening during subsurface excavations using the HNU PID. It was decided, in consultation with EMO and USATHAMA representatives on-site, to deviate from the procedures outlined in the governing documents. This change was documented in the field notes. Trench WSRR-05 was excavated in a background location without the benefit of HNU PID monitoring. Special precautions were taken to ensure the safety of site personnel. EOD personnel were instructed to immediately cease excavation activities if any unusual odor or material was noted. The instrument was repaired the same evening and approved written procedures for use and calibration of the HNU PID were implemented on the following day.

Sampling QC procedures were implemented as described in the governing documents with one clarification. The SAP stated that sampling equipment would be decontaminated before and after use. This statement would, in effect, require double decontamination of sampling equipment, which was not the intent of the document. In the field, it was determined that a single decontamination step following the collection of each sample would be adequate. This determination was made in consultation with EMO staff on-site and documented in the field notes. Equipment was wrapped in aluminum foil to indicate that it had been cleaned, with the exception of the backhoe bucket. The backhoe bucket was decontaminated following sampling and left at the decontamination pad until needed.

Sampling locations were selected as described in the SAP with one exception. The SAP indicates that background sampling locations will be 1,000 feet from the nearest suspected buried wastes. Satisfying this requirement in the field proved difficult because of access restrictions to background locations. Topography and vegetation limited access by the backhoe to sampling sites meeting the stated criteria. Background sampling locations selected at the Oscura and Red Rio sites were placed at approximate distances of 200 feet and 350 feet, respectively, from the nearest buried wastes.

E.2 LABORATORY QA/QC

Several issues pertinent to laboratory QA/QC for this project are discussed in this section. These issues are: (1) changes made to laboratory data quality objectives (DQOs), (2) problems identified during data validation, and (3) precision, accuracy, representativeness and comparability of the data.

E.2.1 Laboratory DQOs

Several changes were made to the DQO tables in the FAQPjP to improve consistency with the standard EPA and USATHAMA methods. These changes included the following:

- Moving the precision and accuracy criteria from hexachlorobenzene to pentachlorophenol under semivolatile compound analyses. These values were entered on the wrong line during development of the DQO table.
- Spike recovery control limits for metals analyses were actually 75-125% in the respective EPA methods rather than the 75-100% range established in the DQO table.
- Relative percent difference and spike recovery limits for explosives analyses were 25% and 60-130%, respectively, for both water and soil samples. Spike recovery limits presented in the DQO table were appropriate only for analysis of laboratory certification samples.

E.2.2 Data Quality

In general, laboratory data quality met specified QA/QC criteria. Problems identified during FPC's data validation can be divided into three general categories: 1) transcription and calculation errors, 2) missing information, and 3) missed holding times. Each of these problems was satisfactorily resolved by the laboratory. A discussion of these problems as well as an evaluation of the data are discussed in this section.

Transcription errors were noted in sample identification cross-referenced tables for metals and semivolatile analyses and on explosives analyses reports. Examples include substitution of the letter S for the number five (5) and replacement of the inches notation for (") with that for feet ('). Due to the fact that each sample is also designated by a unique date and time, no ambiguity exists in the identification of sample results. As a result the laboratory has provided corrected sample identification cross-referenced tables for the metals and semivolatile analyses data package. Corrections to the explosives analysis reports were made by hand by FPC data validation staff.

Calculation errors were identified in the laboratory determination of values for percent recovery and relative percent differences. Recalculation of these values had a limited impact on the number of analytes with QC analyses results outside control limits. The laboratory provided corrected data sheets where these problems occurred.

Some information necessary for data validation was missing from several data packages. Missing information included date of analysis for metals analyses and lacking discussion regarding QC analyses outside control limits in the case narratives. All information missing from the laboratory analysis packages was provided by the laboratory.

Maximum sample holding times specified in the standard laboratory methods were exceeded in only one semivolatile sample analysis. Subsurface soil sample WSOR-SUB-08-0-10' was subject to the extraction procedure 24 days after collection. The laboratory method specifies a maximum holding time of 14 days prior to extraction. Analytical results from this sample were consistent with other subsurface soil samples collected at the same location. All three subsurface soil samples from Trench 07 were reanalyzed for semivolatiles after spiked compound recoveries were detected at higher concentrations than expected. The data from the reanalyses, analyzed after holding times had expired, generally agreed with the original numbers.

E.2.3 Precision

Precision of laboratory analytical methods was evaluated as part of FPC data validation efforts. Within each sample group or data package, precision was quantitatively determined for each analysis type (metals, explosives, semivolatile). RPD values for matrix spikes and matrix spike duplicates were checked against control limits established in DQO tables in the QAPjP (see discussion of laboratory analysis DQOs earlier in this section). Findings for these evaluations are presented in this section.

Most RPD values for metals analyses were within control limits. Isolated precision problems were experienced with antimony (3 sample groups of 6 outside control limits) thallium (2 sample groups of 6), as well as nickel, barium, lead, and selenium (1 sample group of 6 outside control limits for each analyte). All other RPD values for matrix spike duplicates were acceptable. Laboratory duplicates of unspiked site samples also occasionally exceeded matrix spike RPD limits. Examples include copper (2 cases), and chromium, nickel, lead, zinc, barium, and silver (1 case each). Concentrations of these metals in site samples were closer to detection limits than in spike samples and sample variability probably had a greater impact on RPD values.

Precision values were all within control limits for explosives analysis of soil samples. USATHAMA methods for explosives require matrix spike duplicates for high level (40-100 mg/kg) spikes only. Precision of low level spikes cannot be evaluated. Water sample analyses, in contrast, experienced numerous precision problems. RPD values for high level spikes of HMX and RDX in water exceeded control limits in both samples (decontamination rinsate samples). In one sample group, all six explosives analytes had RPD values outside control limits. However, precision of these water analyses is not considered critical as explosives were detected in only one soil sample from the Oscura site. The purpose of decontamination rinsate samples is to evaluate the potential for cross-contamination between samples. No site sample data for explosives suggest the possibility of cross-contamination.

Precision of semivolatile analyses was generally acceptable. RPD values for each of six analytes (pentachlorophenol, 1,4-dichlorobenzene, 1,2,4-trichlorobenzene, acenaphthalene, 4-nitrophenol, and 4-chloro-3-methylphenol), exceeded control limits in 1 sample group out of 6. None of these analytes were detected in site samples.

E.2.4 Accuracy

Accuracy of laboratory analytical methods was assessed for each analysis type in each sample group. Calculated percent recovery for each analyte in matrix spike samples was evaluated against established DQOs. Control limits for percent recovery values were presented in the QAPjP and discussed earlier in Section 4.0. Compliance with these control limits is discussed in this section.

Metals analyses experienced isolated accuracy problems with a few analytes and more persistent problems with several others. Percent recovery of nickel, lead, and thallium from matrix spike samples were each out of control limits once in the six sample groups. Barium had similar accuracy problems on two occasions. Examples of analytes with more persistent accuracy problems include antimony (outside QC limits in 6 of 6 cases) selenium (5 of 6 sample groups), and silver (5 of 6 samples groups). Accuracy problems for each of the analytes listed above were the result of low spike recovery values. In each case a "post-extraction" spike was analyzed, typically with more acceptable results. Data for the post-extraction spikes suggested that a matrix interference was occurring during the extraction process. Some spiked metals appeared to be retained in the sample matrix rather than partitioning to the digestate, possibly due to complexing with matrix ions. However, given the consistency of percent recovery in matrix spikes, and the acceptable precision values for these metals, the analytical data are still considered usable. In each case where accuracy criteria were not met, reported concentrations of those metals were flagged as estimated values within this report.

Accuracy of explosives analyses in soils met required QC criteria in all sample groups. For water analyses, the low concentration matrix spike of a single analyte, tetryl, had a low recovery value. As the only water samples analyzed were decontamination rinsate samples, this isolated accuracy problem is not considered significant.

Semivolatile organic analyses met accuracy criteria in all but two cases. In a matrix spike of a soil sample, recovery for pentachlorophenol was just below control limits. In a separate sample group, a water sample spike had low recovery values for 1,4-dichlorobenzene and 1,2,4-trichlorobenzene. In both instances, matrix spike duplicates had similar recoveries suggesting a possible matrix effect.

E.2.5 Representativeness and Comparability

Representativeness and comparability can be described in qualitative terms only. Use of standardized field and laboratory procedures was required by the FAQAPjP and SAP. In this way, representativeness and comparability of each data set was maximized.

Sampling method and sample locations were designated to ensure that representative data was collected. Surface soil samples were collected based on a grid system to provide random, unbiased data in an area of potential contamination. Subsurface soil samples were collected at predetermined depths to provide unbiased information on potential contamination in these areas. Biased grab samples were collected when waste materials were encountered according to predetermined criteria. These biased samples provided data representative of materials most likely to contain contaminants.

Representativeness can be assessed by the evaluation of co-located sample results. Co-located samples results are summarized in Section 4.2.1. In general, these sample results indicated that sample data was representative of conditions at a single sample point (discrete samples), or of areas sampled (composite samples). The identification of 2,4-DNT in one co-located sample and not the original sample from the Oscura site suggested a possible

problem with representativeness. However, based on the fact that 2,4-DNT was not detected in any other site samples, it was likely that this contaminant was present only in one or more isolated locations at the Oscura site. Accepting this hypothesis, both the original and co-located samples were representative of site conditions within the area sampled.

Comparability of the data collected at the two White Sands sites was considered to be satisfactory. This assessment of comparability was based on the consistency of method used for field and laboratory procedures and the similar levels of accuracy and precision achieved throughout the project.

APPENDIX F

FIELD NOTES

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DT-0659

Projects WHITE SANDS MISSILE RANGE

INVESTIGATIONS TO COLLECT DATA FOR DEVELOPMENT OF RCRA CLOSURE PLANS FOR THE OSCURA AND RED RIO PRACTICE BOMB DISPOSAL AREAS

[FIELD NOTEBOOK # 1]

PAGE RIPPED ON ORIGINAL OPENING OF BOOK. NO NOTES LOST

ELAN Publ

Projects (continued) .....

TABLE OF CONTENTS

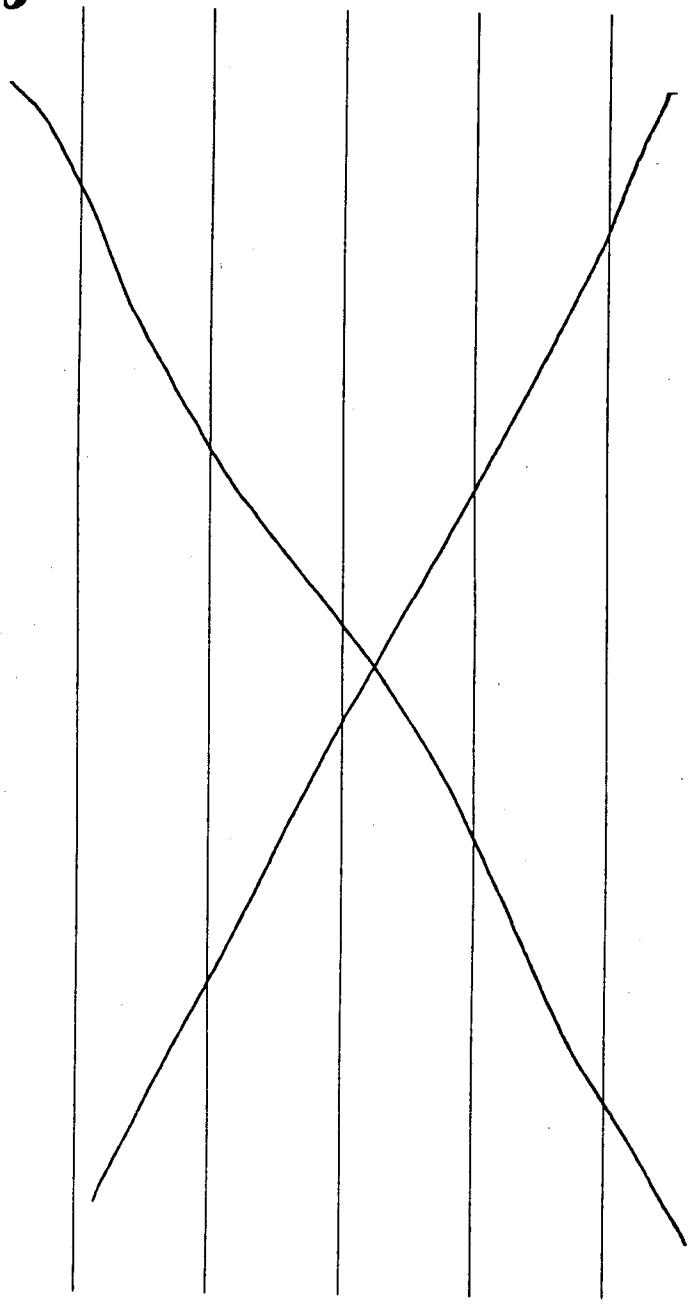
DESCRIPTION	PAGE
RESERVED FOR T.O.C.	1-9
RED RIO SURVEY TRIP (2/25/91)	10
OSCURA SURVEY TRIP (2/25/91)	12
OSCURA GEOPHYSICS (3/25/91)	14
OSCURA - STAKING TRENCHES (4/3/91)	25
RED RIO GEOPHYSICS (4/4/91)	34
RED RIO STAKE TRENCH (4/5/91)	45
RED RIO SAMPLING TRIP (4/22/91)	47
WSRR-SUR-QS/1-0-2" "	50
WSRR-SUR-QS/2-0-2" "	50
WSRR-SUR-QS/3-0-2" "	50
WSRR-SUR-Q1/7-0-2" "	51
WSRR-SUR-Q1-0-2" "	52
WSRR-SUR-Q1/S-0-2" "	52
WSRR-SUR-Q1/C-0-2" "	52
WSRR-SUR-Q2/1-0-2" (4/23/91)	54
WSRR-SUR-Q2-0-2" "	54
WSRR-SUR-Q3/5-0-2" (4/23/91)	55
WSRR-SUR-Q3-0-2" "	55
WSRR-SUR-Q4/2-0-2" "	55
WSRR-SUR-Q4-0-2" "	55
WSRR-SUB-OS-5' "	58
WSRR-SUB-OS-10' "	59
WSRR-SUB-OS-15' "	60

DESCRIPTION		PAGE
RED RIO SAMPLING		
WSRR-SUB-01-0-10'	(4/24/91)	67
WSRR-SUB-01-11-15'	(4/24/91)	70
WSRR-SUB-01-15'	"	71
WSRR-SUB-02-0-6'	"	74
WSRR-SUB-02/50-6'	"	74
WSRR-SUB-02/C-0-6'	"	74
WSRR-SUB-02-8-10'	(4/26/91)	82
WSRR-SUB-02-11-15'	"	85
WSRR-SUB-02-15'	"	86
WSRR-SUB-03-3'	"	~~86~~ 87
WSRR-SUB-03-7'	"	90
WSRR-SUB-03-0-6'	"	90
WSRR-RIN-03	"	91
WSRR-SUB-04-0-10'	"	95
WSRR-SUB-04-11-15'	"	97
WSRR-SUB-04-15'	"	97
WSRR-SUB-06-0-10'	(4/27/91)	102
WSRR-SUB-06-11-15'	"	103
WSRR-SUB-06-15'	"	104
OSCURA SAMPLING	(5/6/91)	107
WSOR-SUR-Q5/1-0-2"	(5/7/91)	112
WSOR-SUR-Q5/2-0-2"	"	113
WSOR-SUR-Q5/3-0-2"	"	113

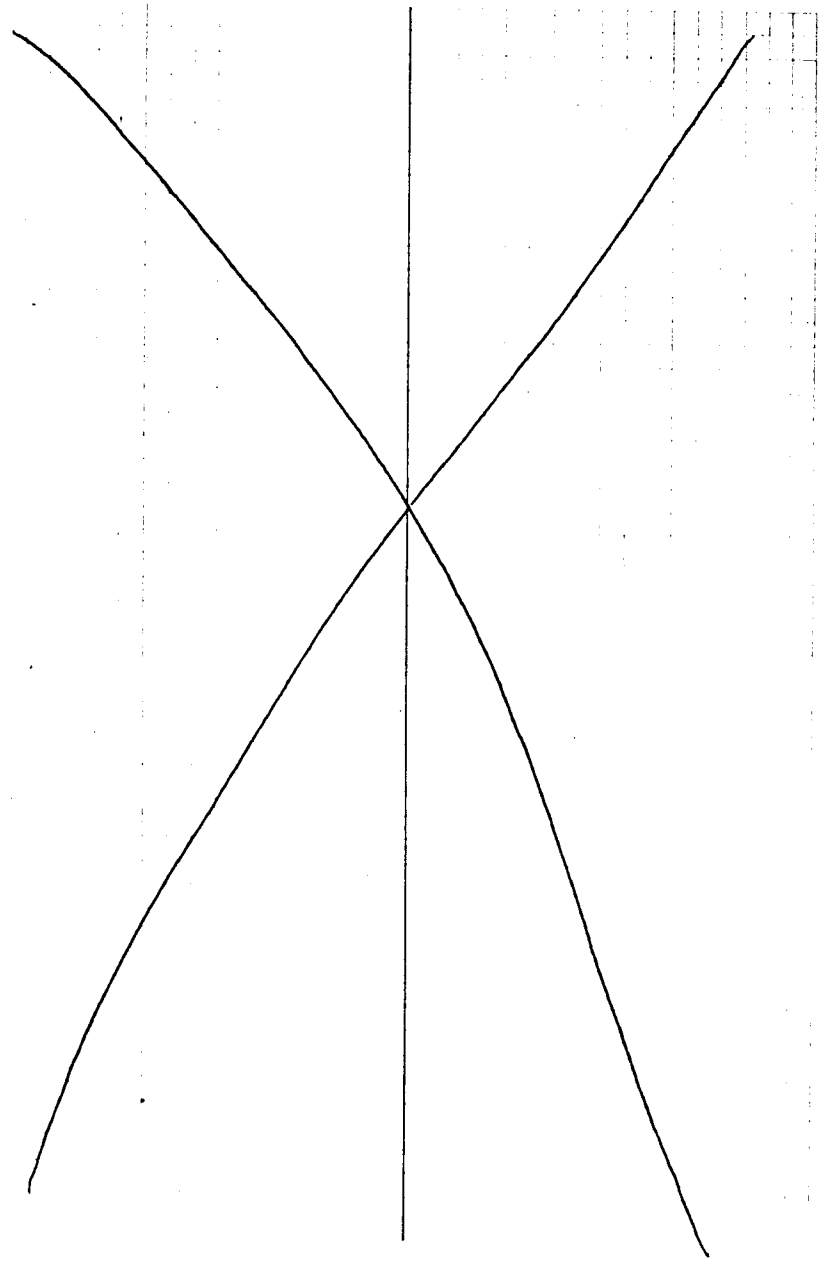
DESCRIPTION		PAGE
OSCURA SAMPLING		
WSOR-SUR-Q1/7-0-2"	(5/7/91)	114
WSOR-SUR-Q1-0-2"	"	115
WSOR-SUR-Q2/4-0-2"	"	116
WSOR-SUR-Q2-0-2"	"	117
WSOR-SUR-Q3/3-0-2"	"	117
WSOR-SUR-Q3-0-2"	"	117
WSOR-SUR-Q3/9-0-2"	"	117
WSOR-SUR-Q3/C-0-2"	"	117
WSOR-SUR-Q4/5-0-2"	"	118
WSOR-SUR-Q4-0-2"	"	118
WSOR-SUB-05-5'	(5/8/91)	122
WSOR-SUB-05-10'	"	123
WSOR-SUB-05-15'	"	124
WSOR-SUB-01-0-10'	"	126
WSOR-SUB-01-11-15'	"	129
WSOR-SUB-01-15'	"	129
WSOR-SUB-02-0-10'	(5/9/91)	132
WSOR-SUB-02-11-15'	"	135
WSOR-SUB-02-15'	"	136
WSOR-SUB-03-0-10'	"	138
WSOR-SUB-03-11-15'	"	140
WSOR-SUB-03-15'	"	141
WSOR-SUB-04-2'	(5/10/91)	142

DESCRIPTION		PAGE
WSOR-SUB-04-0-10'	(5/10/91)	145
WSOR-SUB-04/S-0-10'	"	145
WSOR-SUB-04/C-0-10'	"	145
WSOR-SUB-04-11-15'	"	148
WSOR-SUB-04-15'	"	149
WSOR-SUB-~~04~~ PAK 06-0-10'	"	153
WSOR-SUB-06-11-15'	"	155
WSOR-SUB-07-0-10'	(5/13/91)	158
WSOR-SUB-07-11-15'	"	159
WSOR-SUB-07-15'	"	159
END OF NOTES		159

6



7



2/25/91 Paul A Karas Robert R. Alexander

0900 arrived at 9:00 am and met Steve Sandoval and Ted Scanlon of Scanlon-White, Inc., and Larry Hoppes of Holloman AFB. Paul Karas, Rory Barnett and Bob Alexander represented CDM FPC

Paul Karas conducted a health and safety briefing covering items outlined in his log bookdated 2/25/91.

~~0910~~ Red Rio

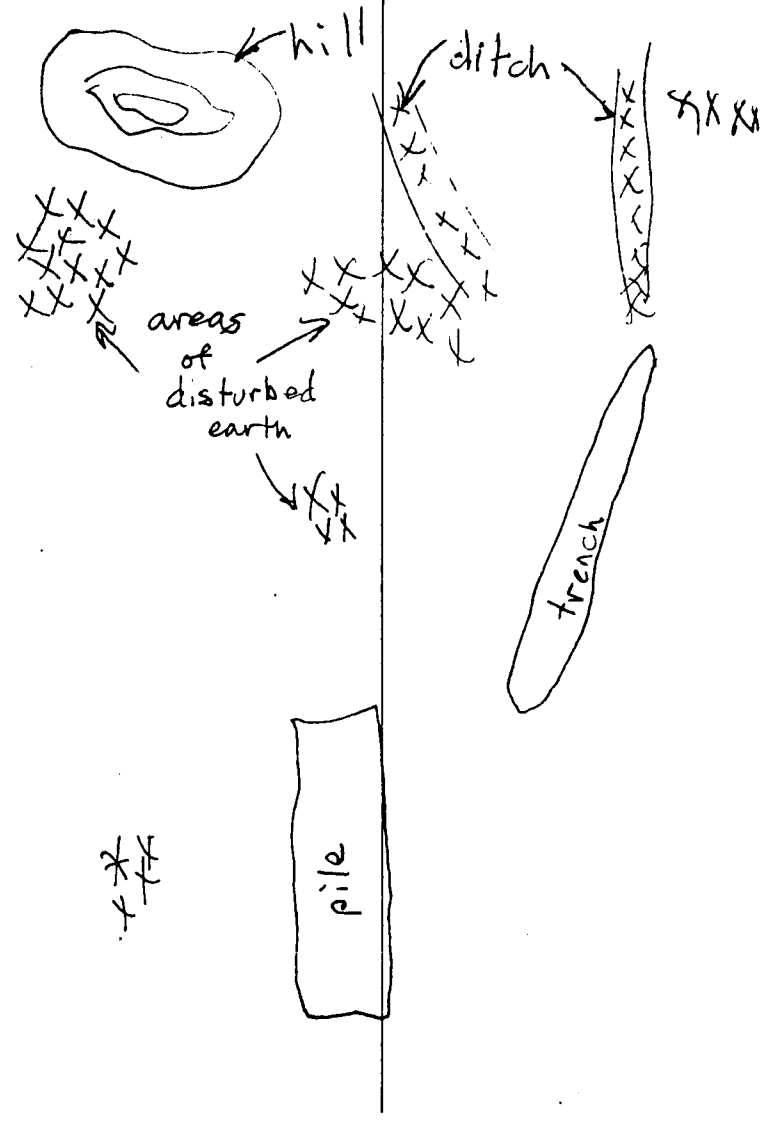
0920 arrived at site under escort of Larry Hoppes

0930 Began to stake out survey area, Ted, Steve, Paul, and Bob. During this process, several suspect areas were encountered which changed the shape of the planned survey area. See Sketch →

1054 weather this a.m. has been clear and cool with slight breeze

Paul A Karas Robert R. Alexander 2/25/91

Not to scale



2/25/91 Paul A Vance Robert R. Alexander

1111 North of pit there is evidence of water flow into main disposal pit from the man-made diversion ditch

1210 Scanlon - White completed their work

Oscura

1330 arrived oscura. Clear, warm, w/ slight breeze.

Paul and ~~Tony~~ Tony noted that most of the debris, vehicles, etc had been removed from the site

There is evidence of recent ~~field~~ earth work around the ponds.

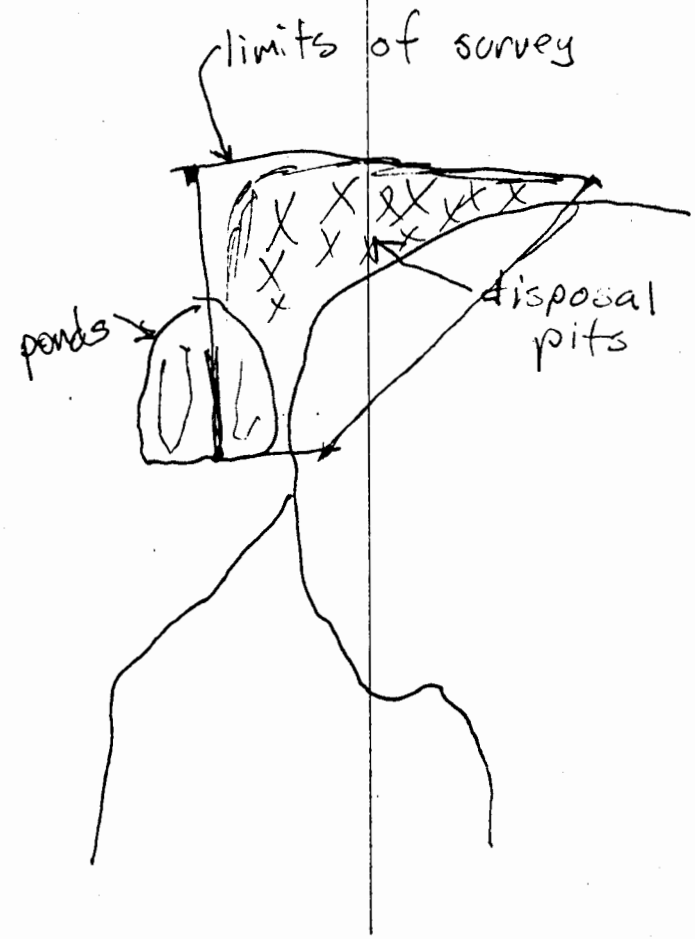
1500 Poly suggested that water samples from the ponds and muck samples be taken.

Quantity of disposal pits is much more difficult to see visually compared to Red Rio.

2/25/91 Paul A Vance Robert R. Alexander

Not to Scale

N



3/25/91 - VISIT FOR GEOPHYSICAL INVESTIGATIONS AT OSCURA FROM CDM FPC: PAUL KARAS AND BOB ALEXANDER.

09:30 ARRIVED AT OSCURA SIGNED IN LOG BOOK.
- PARTLY CLOUDY, TEMP 66°F WIND 11 KNOTS w/ GUSTS TO ~~18 KNOTS~~ PAK 16.5 KNOTS
- INFORMED BY STAFF THAT TWO MISSIONS WILL BE RUN TOMORROW, ONE AT 8:30 ONE AT 12:40. WILL HAVE TO SPEND 1/2 HR AT RANGE CAMP OR SPOTTING TOWER AT THAT TIME.

0940 - EOD STAFF ARRIVED SGT COLSON + SGT KERN (WES + RICK).
READ EOD'S SOP w/ SAFETY + HEALTH OPERATIONS GUIDELINES. WILL GET A COPY FROM

Paul Karas Robert R. Alexander

3/25/91 Paul Karas Robert R. Alexander

THEM.
- 1000 PROCEEDED TO OSCURA SITE. WIND IS STRONG BUT NO VISIBLE DUST. BEGAN WORK TO LAYOUT GRID CORNERS.

12:30 HAVE LOCATED CORNERS ABC. WIND HAS PICKED UP A LITTLE. STILL VERY LITTLE BLOWING DUST EVIDENT. NOW MOSTLY CLOUDY.

1:35pm Departed site

16. 3/25/91 Paul Marez Robert R. Alexander

Set up "X" — located 15.1' SE of southern most corner of corral in line with the W and S corners

Setup	to	∠°
X	3	94.7
X	Range tower	112.3°
X	A	120.0°

∠3XA = 120.0 − 94.7 = 25.3°

distance XA = 351.3 ft.

X	2	11.2
X	B	8.4

∠2XB = 11.2 − 8.4 = 2.8°

DISTANCE XB = 1,063.4

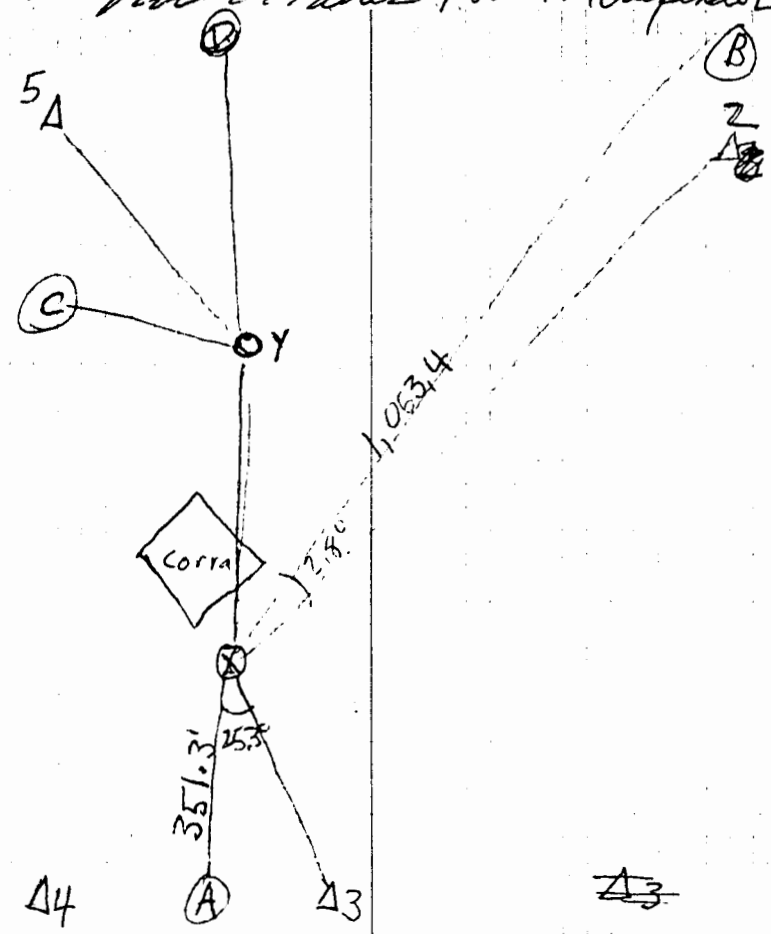
SET UP	TO	∠°
Y	X	136.8°
Y	C	210.5°

∠XYC = 210.5 − 136.8 =

DISTANCE YC = 359.0

11:30 pm 71°F, winds 192° @ 20 to 27 Kts.

3/25/91 Paul Marez Robert R. Alexander 17



SET UP	TO	∠°
Y	D	327.4
Y	5	260.4
Y	2	31.6

∠5YD = 327.4 − 260.4 = 67.0

DISTANCE YD = 344.2

Y	B	26.7

Paul O'Karas Robert R. Alexander

3/26/91 ARRIVED AT OSCRA SPOTTING TOWER

PRESENT: PAUL KARAS FPC
BOB ALEXANDER FPC
SGT MES COLSON EOD
SGT RICK KERN EOD
DAVE PHILLIPS BLACKHAWK
PAK RAYE LAHTI BLACKHAWK

07:50 ~~8:50~~ SIGNED IN LOG BOOK
WEATHER 56° F, PARTLY CLOUDY, WIND 10 KNOTS FROM 201°

08:00 PROCEEDED TO DISPOSAL SITE. BEGAN H+S BRIEFING (OUTLINED IN B. ALEXANDER'S LOG BOOK)

08:10 COMPLETED H+S BRIEFING + BEGAN SHOWING BLACKHAWK STAFF CORNERS OF AREA TO BE INVESTIGATED.

0900 Blackhawk set up a north south baseline using Silva compass

BA & PAK set up at "X" to locate set up "Y"

3/26/91 Paul O'Karas Robert R. Alexander

11:00am It was decided that the wind was too strong to continue work. Wisps of dust were noted which lead to this decision.

1107 BACK AT OSCRA SPOTTING TOWER.
WINDS FROM 198° AT 23 KNOTS, GUSTING TO 35 KNOTS.
FORECAST IS FOR WINDS GUSTING 30-49 KNOTS FROM 10:30 THROUGH 11:00 PM AND FROM 50-55 KNOTS FROM 2:00pm - 6:00pm.

1145 CHECKED WIND CONDITIONS.
WIND FROM 194 @ 21 KNOTS WITH GUSTS TO 35.5

1200 LEFT SITE DUE TO WEATHER

Paul O'Brien Robert R. Alexander

3/26/91

Locating Set Up "Y"

Setup	to	∠°	
X	3	2.9°	∠3XY=224.9-2.9
X	2	279.8°	
X	Y	224.9°	
X	5	197.6	
5	X	88.2	
5	Y	59.2	∠X5Y=88.2-59.2=29.0
Locating "B"			
2	B	102.7	
distance 2B=105.3'			
2	X	315.9	
2	3	293.8	

∠32B=293.8-102.7=
∠3XB=315.9-102.7=213.2

3/27/91 Paul O'Brien Robert R. Alexander

0645- ARRIVED AT OSCURA SPOTTING TOWER. SAME FIELD STAFF AS ON 3/26/91.
WEATHER - CLEAR SKY
TEMP 37°F, WINDS FROM 94° AT 3-4 KNOTS
PEAK GUSTS AT 4.9 KNOTS

0655- DROVE UP TO OSCURA SITE. GEOPHYSICISTS RESUME MARKING SURVEY GRID.

08:00 RETURNED TO SPOTTING TOWER TO CALL FEDEX. LEFT FEDEX PACKAGE AT FOUR WINDS THIS MORNING.
TEMP 46°F WIND FROM 124° AT 5 KNOTS, GUSTING TO 8.0 KNOTS

12:30 COMPLETED SETTING UP GEOPHYSICAL SURVEY GRID. WENT BACK TO SPOTTING TOWER FOR LUNCH
TEMP 56°F
WIND FROM 171 AT 6 KNOTS
PEAK WINDS 17.0 KNOTS

3/27/91 Robert R. Alexander

1300 FINISHED LUNCH AND RETURNED TO OSCURA SITE. SKY MOSTLY CLEAR TEMP IS ~ 60°F. WINDS FROM SOUTH AT ABOUT 10 KNOTS. RAY LAHTI, BLACKHAWK RESUMED EM MEASUREMENTS. DAVE PHILLIPS BEGAN WORK WITH MAGNETICS EQUIP.

1500 Recon of areas north and west of site outside of existing known Oscura site boundaries revealed evidence of at least two more disposal trenches. The trench to the west is approx. 10 feet wide and at least 100 feet long. The trench toward the north is about 15 feet wide and about 150 feet long and has berms approx 7-8 feet high built up around it. BTU-33 debris is present around both locations. The trench to the north has several acres of ground which appears to have been disturbed in the past.

3/27/91 Robert R. Alexander

1530 WIND IS BEGINNING TO GET STRONG. WISPS OF DUST HAVE BEEN NOTED NEAR THE GROUND. RAY LAHTI IS DONE WITH EM SURVEY, DAVE HAS 2½ LINES RUN w/MAG. EQUIPMENT (NORTH END, LONGEST LINES). ASKED D.P. TO FINISH THE CURRENT LINE AND WRAP IT UP FOR TODAY.

~~1545~~ 1545 Left Oscura site due to windy conditions. Weather conditions Oscura Spotting tower were temperature = 63.0°F Winds 18 to 27 kts. Weather report indicates a chance of precipitation and winds until approx. 11:00am 3/28/91. Will monitor conditions tomorrow to see if work will be possible.

03/28/91 Paul A. Mayer Robert R. Alexander

0830 ARRIVED AT OSCURA SPOTTING TOWER. PRESENT ARE SGTS COLSON + KERN, P. KARAS + R. ALEXANDER. GEOPHYSICISTS ARE TO ARRIVE IN APPROXIMATELY 1/2 HOUR. WEATHER CONDITIONS: CLOUDY, LIGHT SNOW NO ACCUMULATION. WINDS 11 KNOTS, PEAK 14.9 KNOTS FROM SOUTH. WILL SEE IF GEOPHYSICISTS CAN WORK IN LIGHT SNOW.

0950 BLACKHAWK STAFF ARRIVED WINDS ABOUT 10 KNOTS FROM THE WEST, CLOUDY, SCATTERED SNOW SHOWERS. LEFT FOR OSCURA SITE AFTER SIGNING IN.

1100 WEATHER IS UNCHANGED, SCATTERED SNOW WINDS 10-20 KNOTS FROM WEST. SUN BREAKING THROUGH CLOUDS OCCASIONALLY. D. PHILLIPS + R. LAHTI ARE COLLECTING STATION DATA WITH MAG. UNITS

3/28/91 Paul A. Mayer Robert R. Alexander

~~1:15~~ 13:15 DP + RL ARE FINISHED COLLECTING DATA LEFT SITE FOR SPOTTING TOWER

~~200~~ 1400 ALL LEFT SPOTTING TOWER FOR HOME. TEMP = 46°F, WIND 14 KNOTS FROM 264, GUSTING TO 21K. BLACKHAWK LEFT EQUIPMENT AT SPOTTING TOWER FACILITY FOR NEXT WEEK

4/3/91 RETURN TRIP TO OSCURA RANGE TO STAKE TRENCHES AS IDENTIFIED BY GEOPHYSICS.

13:50 ARRIVED AT SPOTTING TOWER AND SIGNED IN. WAS INFORMED THAT RANGE IS CLOSED TOMORROW UNTIL 8:00 AM. CALLED J. MENDOZA TO GET GATE COMBINATION FOR HUNTER'S LODGE GATE. LEFT MENDOZA A MESSAGE.

14:10: ARRIVED ON OSCURA SITE. PRESENT: B. ALEXANDER, P. KARAS, SGT. LARRY ALLEN, SGT CARL FUNK, DAVE PHILLIPS + RAY LAHTI.

Paul A. Mayer

4/3/91 Robert A. Alexander

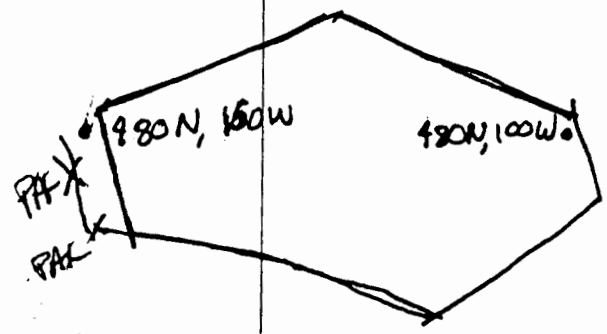
WEATHER AT SPOTTING TOWER. WIND FROM 150° AT 5 KNOTS, GUSTING TO 10 KNOTS, TEMP. 75°F

1430: REVIEWED CONTOURED DATA FROM BLACKHAWK. D.P. SHOWED GOOD CORRELATION BETWEEN EM-31, IN-PHASE READINGS AND MAGNETICS DATA. CONDUCTIVITY READINGS ON EM INCLUDE SOME NOISE RELATED TO SOIL TYPES, ETC. DP + RL USING EM-31 TO DEFINE TRENCH BOUNDARIES. USING SPRAY PAINT TO DELINEATE IRREGULAR AREAS. PK + RA WILL STAKE CORNERS + PROBABLY FLAG PRIOR TO SAMPLING.

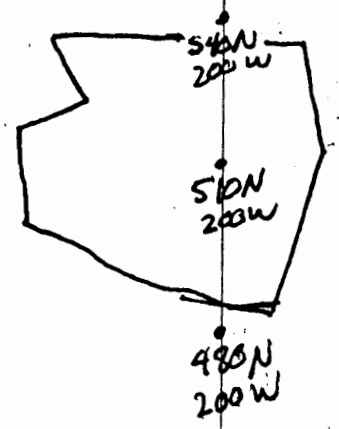
1500 BEGAN STAKING PIT LOCATIONS, LABELING BY NEAREST MARKED GRID NODE. FIRST AREA IS LOCATED AT 480N, 100W.

4/3/91 Robert A. Alexander

A SECOND GRID POINT, 480N, 150W IS JUST OUTSIDE MARKED AREA



1530 MARKED SECOND AREA WEST OF FIRST

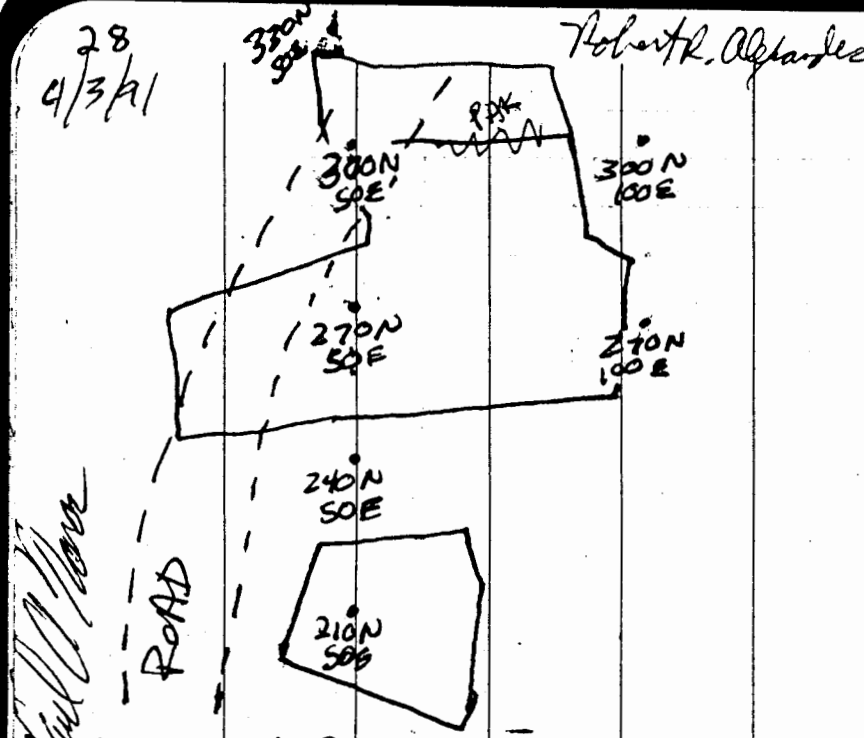


1542 STAKED ANOTHER AREA EAST OF ROAD.

28

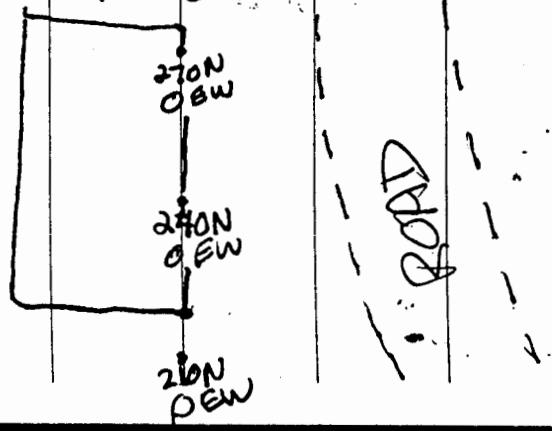
4/3/91

Robert R. Alexander



15:45 MARKED AN AREA JUST SOUTH OF LAST AREA

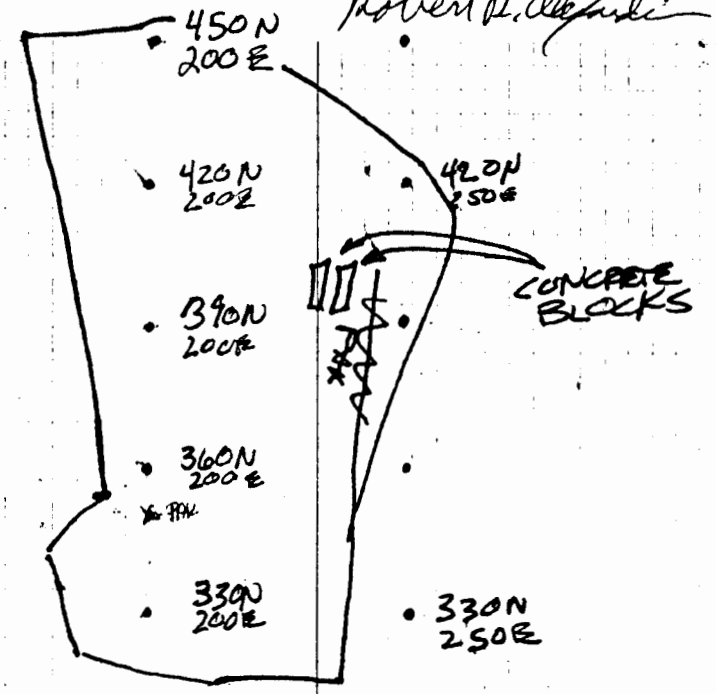
15:55 MARKED AREA JUST WEST OF ROAD



29

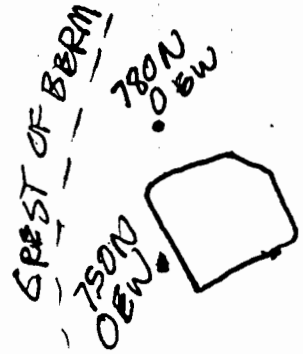
4/3/91

Robert R. Alexander



1610 MARKED LARGE AREA WHICH INCLUDES CEMENT BLOCKS

1625 MARKED SMALL AREA NEAR BERM AT 750N, 0EW



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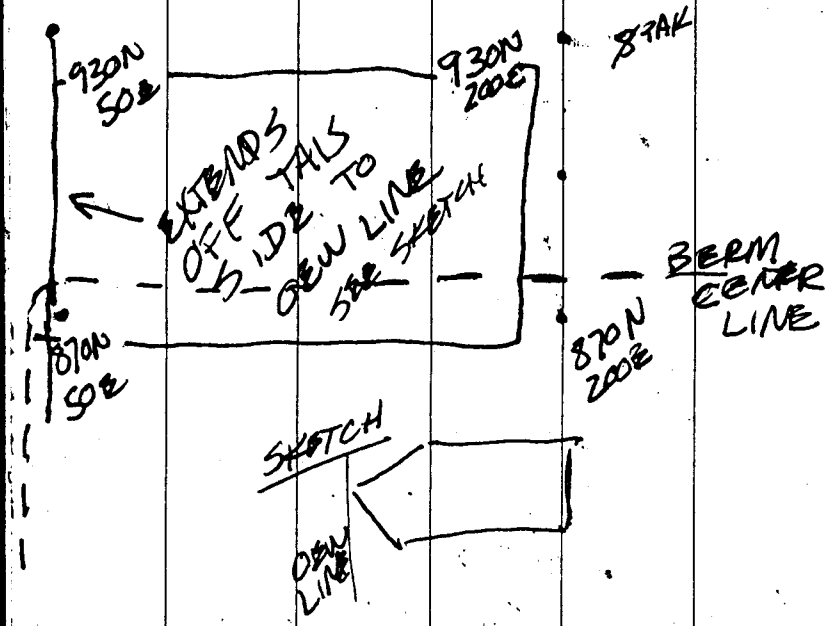
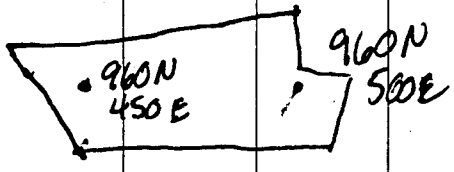
1637: MARKED LARGE AREA ALONG NORTH BERM.



1658 MARKED SMALL AREA NORTH OF BERM NEAR 960N, 500E



1655: WEATHER: CLEAR SKY TEMP ~70°F, WIND ~5

4/3/91 Robert R. Alexander

KNOTS FROM SSW.

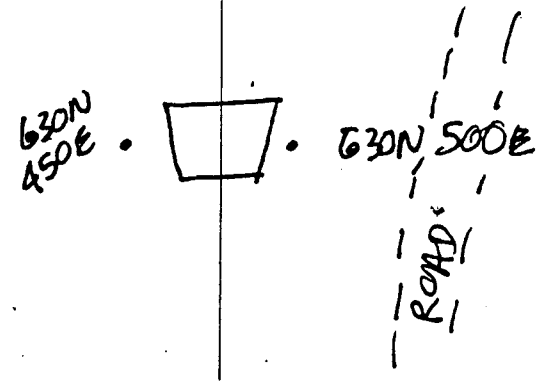
17:05 - D.P. MARKED AN AREA WHICH SHOWED UP ON EM-31 IN PHASE SURVEY

450N, 10W
570N, 10W
570N, 130W
450N, 130W

} COORDINATES.

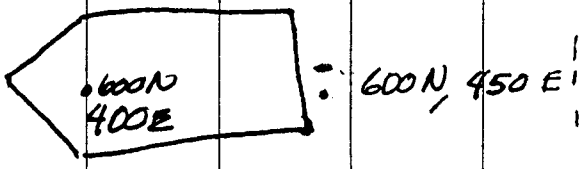
LIMITS OF THIS AREA VERY DIFICULT TO DEFINE BY EM. 4 STAKES MARKED "AREA OF INDEFINITE POSITIVE".

17:10 - MARKED SMALL AREA NEAR 630N, 500E

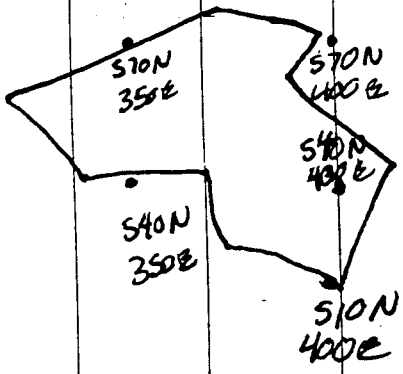


4/3/91 Paul A. Vance Robert R. Alexander

1715 MARKED A SMALL-MEDIUM AREA NEAR 600N, 400E

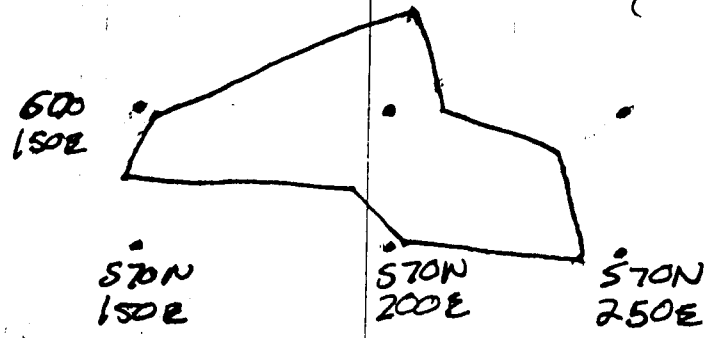


1725 MARKED ANOTHER MEDIUM AREA AROUND 570N, 350E

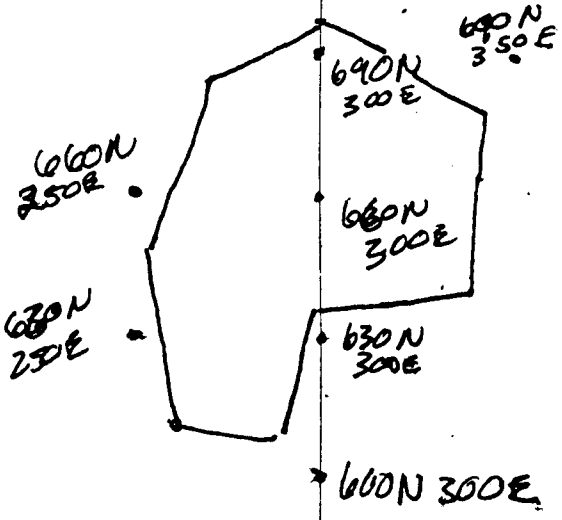


1735 LARGE IRREGULAR AREA NEAR 570N 200E

4/3/91 Paul A. Vance Robert R. Alexander

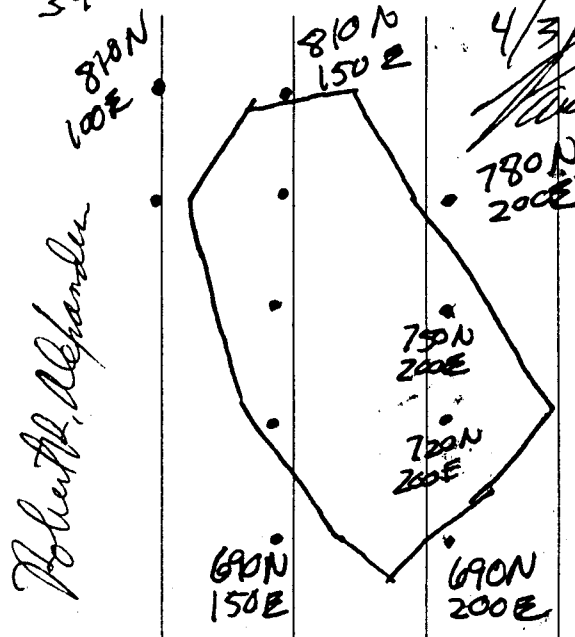


1745 MARKED A LARGE AREA



1755 MARKED LAST AREA AROUND 690N, 150E

4/3/91

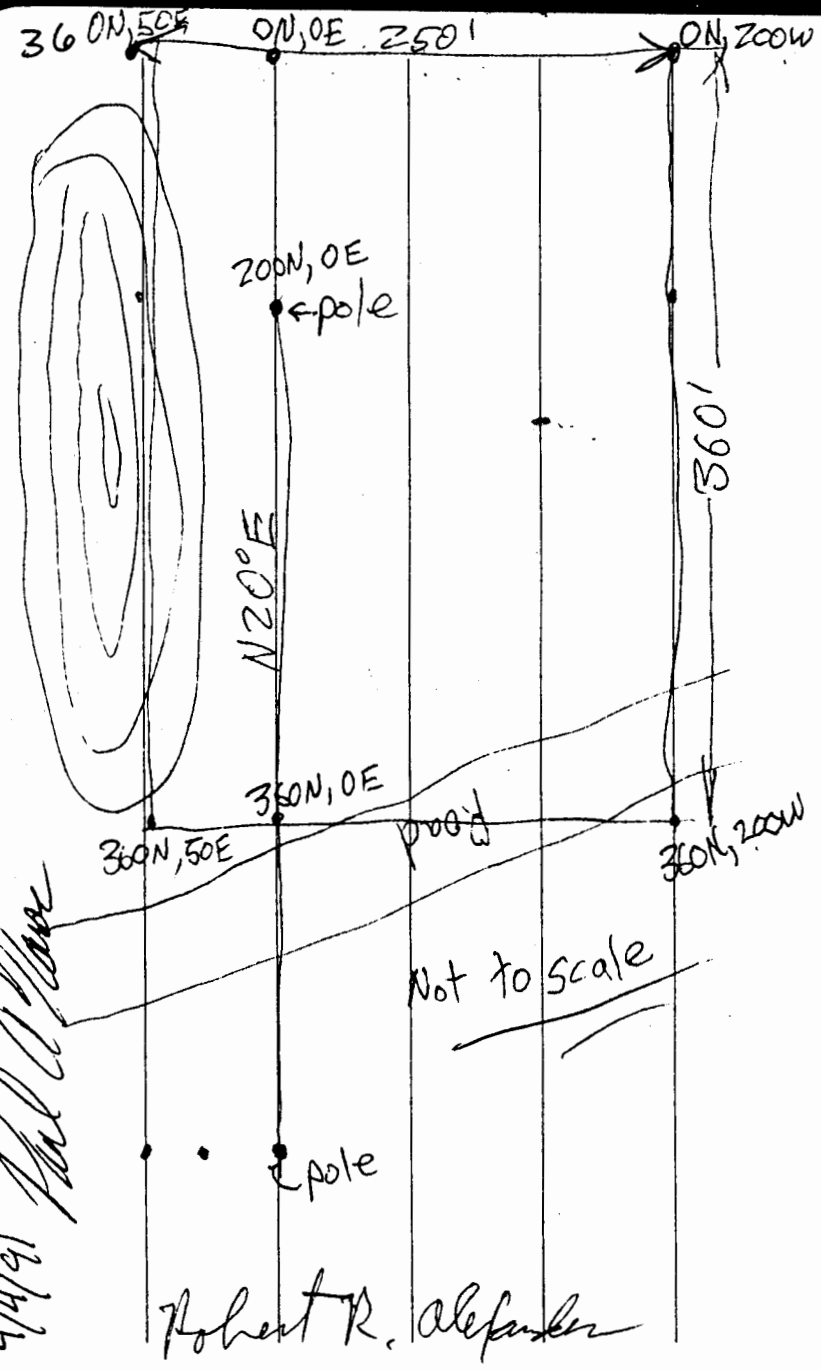


1802 LEFT SITE.

4/4/91 TRIP TO RED RIO FOR GEOPHYSICAL WORK
8:15 ARRIVED AT HUNTER'S LODGE GATE.
PRESENT: P. KARAS, R ALEXANDER, SGT. L. ALLEN, SGT. C. FUNK, D. PHILLIPS, R. LAHTI.
- DROVE TO RED RIO SITE
8:30 ARRIVED AT RED RIO. FPG/EOD CONDUCTED

4/4/91
A HEALTH + SAFETY BRIEFING.
WEATHER: ~55° F WIND ~5-10 MPH FROM SE.
8:45: D.P + RL BEGAN LAYING A SURVEY GRID ALONG LARGE TRENCH. PRIMARY LINE ORIENTED N30E.
9:20 IDENTIFIED ANOTHER SUSPICIOUS AREA JUST NORTH WEST OF THE HAWK-MISSILE DIRT MOUND.
10:35 WEATHER, TEMP ~64°F WIND ~10-12 MPH FROM EAST SOUTHEAST.

11:00 set up grid west of large mound. A Baseline measured from pole west of mound to western most of the three poles north of mound was N20°E. See sketch on next page. Area of this grid is 360' X 250.'



4/4/91 Robert R. Alexander

4/4/91 Robert R. Alexander

14.45 BEGAN STAKING SUSPICIOUS AREAS AROUND THE RED RIOW SITE. PLAN IS TO MAKE A CROSS OR "X" ON EACH AREA. BLACKHAWK WILL RUN EM + MAGNETICS PROFILES OF "X" PATTER ON 10 FT STATIONS.

1450 MARKED "AREA 3", ~75 FT SW OF 3 PHONE POLES IN CENTER OF AREA.

1500: NEARBY THUNDER + LIGHTNING CAUSED A CESSATION OF WORK.

1515: RAIN BEGAN. MODERATE TO HEAVY RAINFALL. LIGHT WINDS (~5 MPH) FROM NW. TEMP ~ 70°F

1532 STILL RAINING, THUNDER AND LIGHTNING HAVE ENDED. WIND SHIFTED, ~5-8 MPH FROM NE. DP RESUMED MAGNETIC SURVEY OF AREA 1

1545: RAIN STOPPED, RESUMED STAKING AREAS FOR GEOPHYSICAL SURVEY

Robert R. Alexander

4/4/91 Paul Karas Robert R. Alexander

1605: MARKED A "T" AT AN AREA OF DISTURBED EARTH IMMEDIATELY EAST OF 3 POLES. BASE ~EW 100 FT LONG W/ NS 50 FT LINE TO NORTH AT 40' MARK LABELED AREA 4

1630 MARKED SCRAPES ON NW CORNER OF RED RIO SITE. RAN A 200 FT LINE ROUGHLY NS WITH CROSS LINES AT 100 AND 0 FT. LABELED AREA 5

1645 MARKED SCRAPE AT NORTH CORNER OF RED RIO SITE LABELED AREA 6

1655 MARKED SCRAPE PARALLEL TO NE SIDE OF AREA. AREA 7.

1705 MARKED SOUTHEASTERN CONTINUATION OF AREA 7 AND LABELED AREA 8.

4/4/91 Paul Karas Robert R. Alexander

1715: MARKED SMALL AREA JUST NORTH OF EAST END OF TURN-AROUND LOOP AREA 9.

17:30: RAN 3 MORE E/W LINES OF SOUTH SIDE OF AREA 1 BECAUSE OF POSITIVE RESPONSE (ANOMALY) ON 0 NORTH LINE W/ MAG

18:00 Climbed hill SE of Area 1, identified one additional suspect feature south of area 2.

18:10 Reported site.

4/5/91 GEOPHYSICAL WORK AT RED RIO.

0815 ARRIVED AT RED RIO SITE. PRESENT: P. KARAS, R. ALEXANDER, L. ALLEN, C. FUNK, D. PHILLIPS, R. LAHTI. WEATHER ~ 60° F, WINDS 2-4 MPH FROM SW.

0830 D.P. IS RUNNING MAG

Paul Karas

4/5/91 Robert A. Alexander

INSTRUMENT ON AREAS 3-9. RL IS STAKING HOT AREAS USING EM-31

0900 MARKED ANOTHER DISTURBED AREA, AREA 10. BASELINE STARTS AT ZERO NORTH, ZERO EAST/WEST OF AREA 2 & CONTINUES ALONG TREND 100 FT SOUTH. X - CENTERED ON 50 SOUTH

0910 BEGAN SURVEYING LOCATIONS OF EACH AREA.

SET UP ON SCAMONS POINT 2 MEASURED FOLLOWING ANGLES:

2 TO POLE W OF MOUND 0°

2 TO WEST POLE OF 3 POLE SET 30.2°

2 TO Ø NORTH STAKE OF AREA 1 43.2°

DISTANCE PT 2 TO Ø NORTH STAKE, AREA 1 372.8'

0930 SET UP LEVEL ON SCAMONS POINT 3.

4/5/91 Robert P. Alexander

ANGLES & DISTANCES AS FOLLOWS

∡3 TO 660N, 150E OF AREA 1 15 5.0°

∡3 TO POLE WEST OF BERM 0°

POINT 3 TO 660N, 150E 180.5'

∡3 TO 660N, Ø E OF AREA 1 IS 32.8° DISTANCE = 286'

∡3 TO CENTER POINT AREA 8 PAC 50.9°, 164.7'

TYPICAL 100' X 100' "X" WITH ONE LINE BEARING N80W

0950 ∡3 TO CENTER POINT AREA 7 55.5°, & PAC 320'

TYPICAL 100' X 100' "X" WITH ONE LINE BEARING N72°W

∡3 TO WEST POLE OF 3, 16.1°

1015 SET UP ON SCAMONS POINT 4

∡4 TO WEST POLE OF 3 0°

∡4 TO CENTER POINT AREA 6, 16.9°

DISTANCE 4 TO CP 6 113.3'

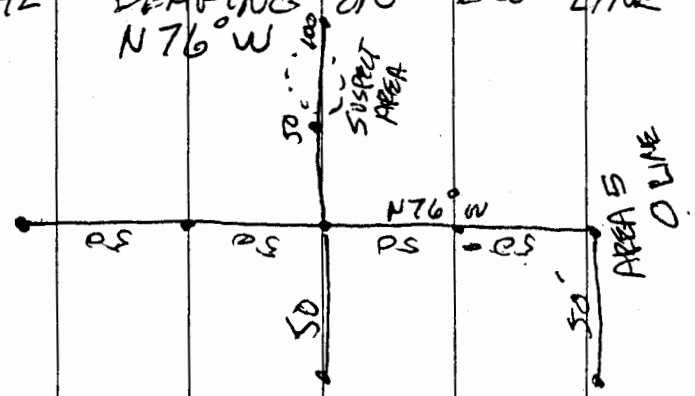
TYPICAL 100' X 100' "X" WITH ONE LINE BEARING N23E

4/5/91 Paul [illegible] Robert R. Alexander

1035 SETUP LEVEL ON "POST" LOCATED AT NORTH WEST CORNER OF AREA 2.

* POST TO POLE WEST OF MOUND 0°
* POST TO SCAMON POINT 1 IS 87.6°
* POST TO EASTERN MOST POINT ON AREA 5 (OPA) IS 226.8°
  DISTANCE IS 169.0'

1042 BEARING ON "EW" LINE N76°W



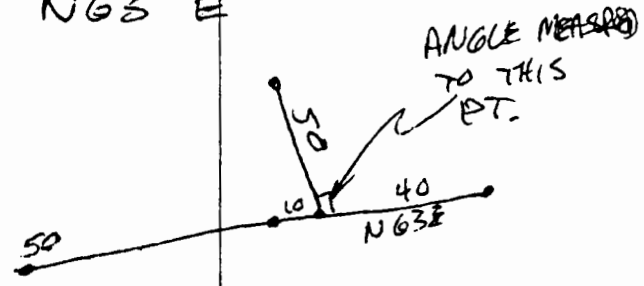
1057 SET UP LEVEL ON A POINT MIDWAY BETWEEN EAST POST AND CENTER POST OF 3.

* POST SETUP TO POLE WEST OF MOUND 0°

4/5/91 Paul [illegible] Robert R. Alexander PAK

~~* AREA 4 (~~

* POST SETUP TO AREA 4 STAKE 10E (10' EAST OF CENTER ON LONG LINE).
  ANGLE IS 247.9°
  DISTANCE IS 82.8'
  BEARING OF LONG LINE, AREA 4 IS N63°E



1107: * POST SET UP TO CENTER POINT AREA 9 IS 226.6°
  DISTANCE 276'
  BEARING OF ONE LINE IS N65W
  TYPICAL 100'x100' CROSS

* POST SETUP TO CENTER POST AREA 3 IS 47.1°
  DISTANCE IS 135.8'
  100'x100', BEARING N46W
* POST SETUP TO SCAMON POINT 2 IS 326.5°

4/5/91 Robert R. Oldham

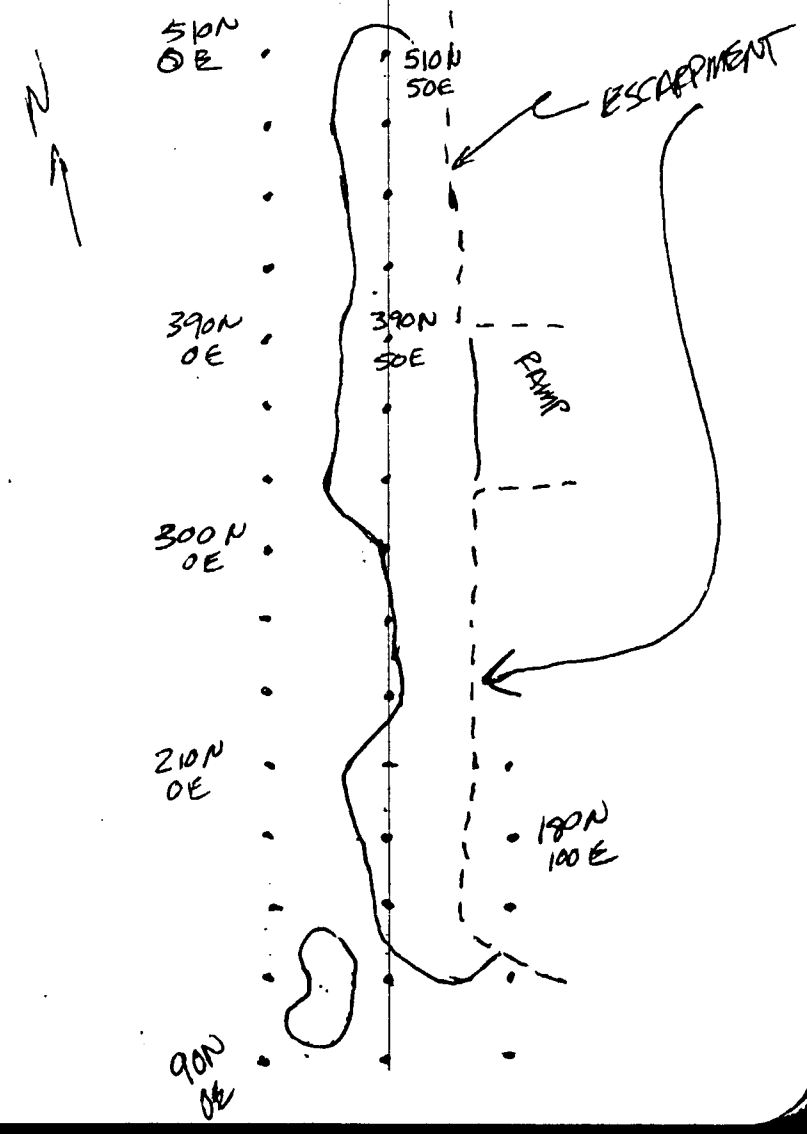
1150: MARKED ONE ADDITIONAL AREA SOUTH OF AREA 1 AND LABELED AREA 11.
SET UP LEVEL ON SCAMCN POINT 2
∢2 TO POLE WEST OF MOUND 0°
∢2 TO CENTER POINT, AREA 11 - 36.8°
DISTANCE 2-CP 11 179.5'
TYPICAL 100' x 100' "X"
BEARING OF 1 LINE N 2° E

1210 - IN-FIELD DATA REDUCTION BY BLACKHAWK REVEALED NO EVIDENCE FOR BURIED METALLIC WASTES OUTSIDE OF AREA 1.
BLACKHAWK STAFF MARKED TWO AREAS WITHIN AREA 1. BLACK HAWK STAFF LEFT SITE W/ EOD ESCORT TO GATE.

1313 STAKED OUT AREA 1 AREAS WHICH BLACKHAWK INDICATED CONTAIN METAL

4/5/91 2851 Robert R. Oldham

USED YELLOW FLAGGING. BEGAN SKETCHING SHAPE + ORIENTATION



4/5/91 Paul A. Karas

1340 Left Site

Robert R. Alexander

FLY TO HUNTER'S LODGE

NOTE: CHANNEL 3 IS EMERG CHANNEL. CALL RHODES MEDIC CALL AS RED RIO EOD REPORT INCIDENT

4/22/91 Paul A. Karas Randy T. Reddick

VISIT TO RED RIO SITE FOR SURFACE AND SUBSURFACE SOIL SAMPLING.

PRESENT: TRACYE REILAND USATHAMA
VIVIAN GRAHAM, USATHAMA
SGT SCOTT STARGARDT, WSMR
SGT. DON FENGENSER, WSMR
JOHN COTTMAN, WSMR
PAUL KARAS, FPC
RANDY REDDICK, FPC

10:00 ARRIVED ONSITE

10:15 TK GAVE H+S BRIEFING AS OUTLINED ON PAGE 69 OF PAUL KARAS' LOG BOOK.

10:30: SGT STARGARDT GAVE AN EOD H+S BRIEFING

10:35: WATER TRUCK ARRIVED. PARKED AS PER FIELD PLANNING MAP

10:40 J. COTTMAN BEGAN EXCAVATION OF DECON PIT, AS PER FIELD PLANNING MAP.

Randy F. Reddick
4/22/91

1100: LARRY HOPPES ARRIVED ONSITE
1120: PK TOOK VG + TR ON A SHORT TOUR OF R.R. SITE. RANDY REDDICK WORKED ON SETTING UP SAMPLE PREP. AREA
1200 RETURNED FROM SITE TOUR PK ASSISTED IN SAMPLE PREP. SETUP + FLAGGED OFF SAFE AREAS
12:30 WASHED UP + ATE LUNCH
1300: COMPLETED LUNCH AND CONDUCTED LOTTERY TO SELECT RANDOM LOCATIONS FOR SURFACE SOIL GRAB SAMPLES. NUMBERED PIECES OF BUSINESS CARD AND DREW FROM A BAG

Q1 - 7
Q2 - 1
Q3 - 5
Q4 - 2

4/22/91 Randy F. Reddick

1425: WEATHER: ~78° F, CLEAR SKIES, HIGH CLOUDS NEAR HORIZON. WINDS ~ 5-15 MPH FROM WEST. WEATHER HAS BEEN ABOUT THE SAME ALL DAY, SLOW WARMING. HAVE COMPLETED SETTING UP DECON AREA. STARTING TO PREPARE SAMPLE BOTTLES
1525. COMPLETED SAMPLE BOTTLE LABELS FOR SURFACE SOIL SAMPLES, DRESSED IN MODIFIED LEVEL D FOR SAMPLING AS PER HSP.
1545 DECONNING STAINLESS BOWLS + SHOVELS (SCOOPS)
1ST ALCONOX WASH
2ND TAP WATER RINSE (WATER TRUCK)
3RD TRIPLE DI WATER RINSE (USING "SIMPLY WATER" R.O. PURIFIED WATER FROM "WATER STORE" 1817 SAN MATEO NE ALBUQ, NM 87110
4TH METHANOL RINSE

Randy F. Redbird

4/22/91 Paul C. Vance

1600 COLLECTED SAMPLE AT Q5/1 LOCATION. MARKED LOCATION WITH A WOODEN STAKE. LOCATION IS ABOUT 50 FT N20°W OF NORTH STAKE, AREA B.
COLLECTED:
1 x 8oz JAR (METALS)
1 x 8oz AMBER JAR (SEMI VOA)
1 x 1 l AMBER JAR (USATHAMA EXPLOSIVES)

1610 COLLECTED SAMPLE AT Q5/2 LOCATION ~20 FT EAST OF Q5/1 ALONG A LINE BEARING N70°W

1630 CLEANED SAMPLE BOTTLES FOR Q5/1 + Q5/2 W/DEIONIZED WATER + A PAPER TOWEL. COMPLETED LABELS + PACKED ON ICE.

1635 V.G + T.R. LEFT SITE

1640 COLLECTED SAMPLES AT Q5/3 LOCATION. 20' WEST FROM STAKE

Randy F. Redbird

4/22/91 Paul C. Vance

SET AT 1600.

1645 DECONNED SHOVEL + PREPARED TO COLLECT ALL Q1 SAMPLES. ALL Q5 SAMPLES COLLECTED IN A GRASSY AREA ~60-75% GRASS COVER. NO SHRUBS AT SITE BUT SOME NEARBY.

1700 BEGAN COLLECTING SAMPLES Q1, Q1/C + Q1/S. USING TWO BOWLS. COLLECTING 4 SCOOPS AT EACH SUB-SAMPLE LOC IN Q1 + Q1/S BOWL, 2 SCOOPS AT Q1/C BOWL.
PACING OUT LOCATION OF EACH SUB-SAMPLE, FROM EXISTING MARKERS, 15' S, 25' EAST.

1712 COLLECTED GRAB SAMPLE Q1/7 AT SUB SAMPLE LOCATION #7. LOCATION IS ~8 FT WEST OF BURIED WASTES AS INDICATED BY GEOPHYSICS.

1717 COLLECTED SUB SAMPLE #8

Randy Lee Reddick

4/22/91 [signature]

FOR THIS + OTHER SUB-SAMPLES, IF PACR BROUGHT US UP TO TRENCH WALL, SAMPLE WAS COLLECTED AT THE BASE.

1720 COLLECTED SAMPLE Q1

1725 COLLECTED SAMPLE Q1/S

1730 COLLECTED SAMPLE Q1/C

1745 CLEANED SAMPLE BOTTLES FOR Q5/3, Q1/7, Q1, Q1/S, + Q1/C + PACKED THEM ON ICE.

1755 PACKED UP GEAR

1800 LEFT SITE

Randy Lee Reddick [signature]

4/23/91 FED EX CONF # FOR 4/22

SAMPLES: ROW #3. LEFT 2 COOLERS IN OFFICE OF 4-WINDS MOTEL.

0745: ARRIVED ONSITE. EOD REP. (FIGENSER) + COTTMAN LEFT SITE TO PICK UP DIESEL AT RED RIO RANGE (FROM L. HOPPES). SGT. STARGARDT IS ONSITE. NO SIGN OF RANDY REDDICK. HE MUST HAVE MISSED GATE. P. KARAS AND ROBERT ALEXANDER RETURNED TO HUNTERS LODGE (NOP) GATE TO WAIT FOR RANDY REDDICK.

0820 STILL NO SIGN OF RR AT GATE. WEATHER: TEMP ~ 50°F, WINDS ~5 MPH FROM WEST. HIGH CLOUDS.

0825 - LET T. REILAND, V. GRAHAM AND R. REDDICK IN GATE. PROCEDED TO SITE.

0845 R. REDDICK + R. ALEXANDER SUITED UP IN MODIFIED LEVEL D TO COLLECT REMAINING SURFACE SOIL SAMPLES

54

4/23/91

Robert R. Alexander, Paul A. Karas, Randy F. Reddick

09:00 am R. Reddick decorated the sampling bowls and scoops in preparation for surface Q2 sampling

09:15am Began sampling ~~Q2~~ (RRA) Q2 accompanied by Sgt. Figenser. Began at Section 1 and collected the grab sample

→ at Section 2, soil was noticeably moister than that in Section 1

09:30am R. Reddick mixed soil and placed composite samples in jars.

09:45am R. Alexander completed DI, H_2O wipe of sample jars and placed them in cooler. x Robert R. Alexander

0950 EMO + FRC STAFF ARRIVED ONSITE.
NOW PRESENT:
T. REILAND, V. GRAHAM
RON SMITH, JIM MOHATT,
P. KARAS, C. WOOD,
R. ALEXANDER, R. REDDICK

4/23/91

Robert R. Alexander, Paul A. Karas, Randy F. Reddick SS

S. STARGARDT, J. COTTMAN,
TOD FIGENSER.

10:10 am Began collecting Q3 samples.

10:18 R. Reddick collected grab sample in Section 5

10:30 Composite Q3 samples collected.

10:40 P. Karas cleaned the Q3 samplers and prepared for shipment.

11:00 Began collection of Q4 samples, collected grab sample at Section 2, x Robert R. Alexander

11:10 Q4 composite sample collected

11:45 JAVIER MENDOZA ARRIVED ONSITE WITH A PHOTOGRAPHER GEORGE BAIRD.

 4/23/91 Paul Karas Robert P. Olafson Randy F. Reddock

11:47 COMPLETED CONSTRUCTION OF DECON PIT WITH 23 MIL LINER

1200 BREAK FOR LUNCH.

12:30 STARTED TO PREPARE DECON STATION FOR CLEANING BACKHOE BUCKET. PROVIDED J. MENDOZA + 6 BAIRD W/ H+S BRIEFING DURING LUNCH. NOTE: CONDUCTED H+S BRIEFING FOR ALL FIELD PERSONNEL AT 9:30 AM.

12:50 CHANGED DECON WATER + ALCONOX SOLN. B. ALEXANDER DECONNING SPRAY CONTAINERS. J. LOTMAN MOVED BACKHOE TO POSITION BUCKET OVER DECON PAD.

1310 PHOTOGRAPHER BEGAN TAKING PHOTOS OF SITE.

1320 PORTABLE TOILETS ARRIVED

1322 B. ALEXANDER SUITED

 4/23/91 Paul Karas Robert P. Olafson Randy F. Reddock

UP FOR BACKHOE BUCKET DECON.

1325 CALIBRATED HNU. PAUL KARAS RENTED HNU FROM UNITED STATES ANALYTICAL INSTRUMENTS SAN CARLOS, CA 1(800) 458-9641 INSTRUMENT # 501241 (BLUE TAG ON FACE) PROBE # 501241A.

BATTERY CHECK OK, BUT NO FAN MOTOR NOISE. SEEMS FAN IS NON OPERABLE. NO RESPONSE TO SHARPIE MARKER.

1355 DISCUSSED NON FUNCTIONING HNU WITH V. GRAHAM, T. PELLAND, R. SMITH. DECIDED THAT IT WOULD BE O.K. TO GO AHEAD + DO BACKGROUND TRENCH W/O HNU. R. SMITH SAID HE + JM. CONCURR.

X Paul Karas

4/23/91 Paul [illegible] Robert R. Alexander Randy F. Reddick

1430 activities at site temporarily halted due to transfer of med-evac helicopter to a new location. P. Karas left site to call US. Analytical Instruments and order a new HNU for tomorrow. Decon of backhoe bucket complete. Hot water sprayer working very well.

1520 Showed EOD personnel background trench location. Grab samples will be collected at 5', 10', and 15'.

1545 Collected grab WSRR-SUB-05-5' by Alexander/Reddick

PAK 17 NOTES ABOVE AUTHORED BY

x Robert R. Alexander

1700 BACKHOE WAS DECONTAMINATED & DIGGING RESUMED AT ~~10~~ PAK 16:10. RADIO REPORT FROM EOD THAT THE

4/23/91 Paul [illegible] Robert R. Alexander Randy F. Reddick

OPERATOR WAS HAVING TROUBLE WITH DIGGING THROUGH HARD-PACKED EARTH. TOOK LONGER THAN EXPECTED TO EXCAVATE.

1705 COLLECTED SAMPLE WSRR-SUB-05-10'. SOIL IN LOWER PORTION OF EXCAVATION IS SAME TEXTURE (SILT LOAM) AS UPPER PORTION OF TRENCH BUT HAS HIGHER CALCIUM CARBONATE CONTENT AS EVIDENCED BY LIGHTER COLOR. COLOR BREAK IS AT ABOUT 7 FT. UPPER 7 FT HAS VERY LIMITED SOIL DEVELOPMENT, VERY HOMOGENEOUS, PROBABLY A VERY YOUNG DEPOSIT.

17:45 BACKHOE HAS BEEN DECONNED AND DIGGING RESUMED. EOD REPORTS WE HAVE PERMISSION TO EXTEND FIELD ACTIVITIES BEYOND 6:00 pm FROM MED-EVAC TEAM

4/23/91 Robert A. Alexander / Randy F. Redrick

1815: STILL WAITING ON BACKHOE EXCAVATION TO REACH THE 15' SAMPLING DEPTH.
WEATHER: ~ 72° F, CLEAR SKIES, HIGH CLOUDS ON NW HORIZON. WINDS 5-10 MPH FROM SW.
STAFF AT SAMPLE PREP. AREA
T. REILAND
V. GRAHAM
R. SMITH
J. MCHATT
R. REDDICK
R. ALEXANDER
P. KARAS
T. FIGENSER
AT BACKHOE:
S. STARGARDT
J. COTTMAN

18:30 COLLECTED SAMPLE WSRP-SUB-05-15
SOIL FROM TRENCH IS SAME IN APPEARANCE AS PREVIOUS SAMPLE.

19:00 LEFT SITE

4/23/91 Robert A. Alexander / Randy F. Redrick

2300: NOTES ON DEVIATIONS FROM FAQAPjP + SAP FOR THIS PROJECT.

① → SAP, pg 2-3, ¶ 2 STATES "ALL SAMPLING EQUIPMENT WILL BE DECONTAMINATED PRIOR TO USE AND AFTER EACH USE...." ACTUAL DECON IS OCCURING EITHER BEFORE OR AFTER USE. IF NOT USED IMMEDIATELY, EQUIPMENT IS WRAPPED IN FOIL AND MARKED AS CLEAN AS PER LAST SENTENCE IN 1st SAME ¶ OF SAP.

② → QAPjP - pg 9-2, 2nd SENTENCE, STATES "THE PERSON WHO PHYSICALLY COLLECTS THE SAMPLE IS THE SAMPLER AND WILL SIGN IT." SAMPLE LABELS HAVE BEEN SUBSTITUTED FOR SAMPLE TAGS, AS ALLOWED BY THE LAST SENTENCE ON pg 9-1, NO SIGNATURE LINE IS PROVIDED ON THE LABELS. SAMPLER DOES, HOWEVER, SIGN A CUSTODY SEAL MARKED WITH SAMPLE DATE AND TIME, WHICH IS AFFIXED TO THE BOTTLE LID PRIOR TO PACKING AND SHIPPING.

4/23/91 Robert R. Alexander
Randy F. Redlich

(3) → SAP - pg 2-6, ¶ 2, LAST SENTENCE, TO CLARIFY BACKGROUND SAMPLING, ORIGINAL INTENT AND ACTUAL SAMPLING, THREE GRAB SAMPLES WERE COLLECTED FROM BACKGROUND EXCAVATION (OS) AT DEPTHS OF 5', 10', + 15'. NO COMPOSITE SAMPLES WERE INTENDED OR COLLECTED.

2330 REPAIRED HNU BY DISASSEMBLING PROBE AND "JUMP STARTING" FAN MOTOR FROM BATTERY AS PER RECOMMENDATION FROM RENTAL COMPANY REP "PATRICK".
CALIBRATED AS FOLLOWS:
INSTRUMENT # 501241
PROBE # 501241A (501241A ?)
INITIAL SPAN SETTING 5.6
FINAL SPAN SETTING 5.24
TO REACH 66 PPM */11.7
PROBE LAMP. USING HNU CAL GAS, ISOBUTYLENE @ 100 PPM
GAS LOT #32959

NOTES ABOVE AUTHORED BY

4/24/91 Robert R. Alexander
Randy F. Redlich

GOT CONF # FROM FED EX ROWA #2 SAMPLE SHIPMENT (4/23 PM SPLS) LEFT AT FT. DESK, FOUR WINDS MOTEL.

0745 - LEFT SITE OF MOTEL FOR REP EIO. S. ALEXANDER TO DRIVE RENTAL TRUCK TO TULAROSA TO GET DIESEL WILL BE AT SITE LATER TODAY.

0835 ARRIVED ONSITE.
PERSONNEL ONSITE:
P. ILARAS
R. REDDICK
T. REILAND
V. GRAHAM
R. SMITH
J. MOHAT
G. BAIRD
S. STARGARDT
T. FIGENSER
J. COTTMAN

WEATHER: TEMP ~ 52-53°F, LIGHT BREEZES FROM SW (< 5 MPH). MOSTLY CLEAR SKIES

9/24/91: Paul C. Karas, Robert R. Alexander, Randy F. Reddrick

0852: R.REDDRICK SUITED UP FOR SAMPLING, P. KARAS SUITED UP FOR ~~AUG~~ PAF BACK HOE BUCKET DECON.

0900: RECEIVED CLEARANCE FROM SGT STARGARDT THAT MEDIVAC HELICOPTOR IS READY TO PROVIDE ASSISTANCE AS NEEDED.

0905 BEGAN DECON OF BACK HOE BUCKET

0930 DIRECTED J. COTTMAN + SGT STARGARDT TO EXCAVATE TRENCH #1 AT ~~EAST END~~ PAF NORTH-EAST END OF DISPOSAL TRENCH.

0945 COLLECTED FIRST SUBSAMPLE FOR WSRR-SUB-01-0-10' SOIL IN FIRST 2 FT OF TRENCH IS A MEDIUM BROWN SILT LOAM, FEW PEBBLES, NO EVIDENCE OF PEDOGENSIS OR SOIL DEVELOPMENT.

Paul C. Karas, Robert R. Alexander, Randy F. Reddrick 9/24/91

1000: CALIBRATED HNU, SAME PROBE + INSTRUMENT # + GAS LOT # (CYLINDER) AS LAST NIGHT. (PAUL KARAS)

INITIAL SPAN: 5.24

FINAL SPAN: 5.88

POSITIVE RESPONSE TO SHARPIE MARKER

BACKGROUND HNU READING AT SAMPLE PREP IS 2.4 WITH SETTING ON 0-20 PPM

1010 COLLECTED SECOND (4') SUBSAMPLE. SOIL AT THIS DEPTH IS MED-DK BROWN WITH CARBONATE FILIMENTS INDICATING SOIL DEVELOPMENT (UNDISTURBED) (NO HNU RDG > B.G.)

1015: J. MOHAT DID A H+S DEBRIEFING (+ QA)

- H+S BRIEFING NEED TO BETTER DEFINE WHERE PEOPLE CAN + CAN'T GO.
- COC SEAL, NO SPL #.
- 4°C - USING STD PRACTICE

4/24/91 Randy F. Reddick

- PROBLEM WITH LOGGING IN AND LOGGING OUT OF NOTEBOOK - CORRECTED
- RECOMMEND A SECOND HNU FOR BACK UP

1025: R. SMITH + J MOHAT LEFT SITE

1030: COLLECTED 6' SUB SAMPLE, TRENCH #01. NO HNU RESPONSE ABOVE BACKGROUND SOIL IS LIGHT BROWN LOAM, MORE SAND THAN PREVIOUSLY NOTED IN SAMPLES

1040 NOTE: COMPOSITE SAMPLING BOWL IS BEING STORED IN A RUBBERMAID "ROUGHNECK" TUB WITH 8 lbs OF ICE. SAMPLE BOWL IS COVERED BETWEEN SUB-SAMPLES WITH FOIL + TUB IS COVERED

1045: NO HNU READING ABOVE BACKGROUND (~ 1.0 ppm now) COLLECTED 8' SUB SAMPLE

Randy F. Reddick 4/24/91

SOIL AT THE 8' DEPTH WAS ~~ASPAK~~ LIGHT BROWN LOOSE SANDY LOAM WITH ~20% MEDIUM LIMESTONE GRAVEL (1-10 mm DIA).

1050 WEATHER: TEMP ~70°F WINDS 5-15 MPH FROM WEST, CLEAR SKIES.

1115: HNU READING AT BUCKET FOR 10' COMPOSITE SUB SAMPLE WAS WAVERING ~1 ppm ABOVE BACKGROUND OR A TOTAL OF ABOUT 3 ppm ON 1-20 DIAL SETTING. NO VISUAL EVIDENCE OF CONTAMINATION. SOIL LOOKS LIKE LAST SAMPLE BUT < 5% PEBBLES

1120 COLLECTED COMPOSITE ~~SUB PAK~~ SAMPLE WSRR-SUB-01-0-10'

11:40 B ALEXANDER ARRIVED ON SITE + JAVIER MENDOZA + ART MARTINEZ (NSMR STUDENT INTERN)

11:50 COMPLETED DECONNING BACKHOE BUCKET.

9/24/91 Robert R. Alexander
Randy F. Reddick

1200 INSTRUCTED STARGARDT + COTTMAN TO EXCAVATE TRENCH #01 TO 11 FT + WE WILL DO SUBSAMPLE. STRESSED IMPORTANCE OF SAMPLES REPRESENTING A UNIQUE DEPTH INTERVAL

1210 WINDS PICKING UP TO ~ 10-20 MPH FROM WEST TEMP ~ 74°F, CLEAR SKIES. NOTE: RANDY REDDICK HAS BEEN DOING ALL SUBSURFACE SAMPLING TO THIS POINT.

1220 HNU READING AT 11 FT INTERVAL IS 3 ppm. BACKGROUND READING 20 FT FROM BUCKET IS ~1 ppm. APPEARS TO HAVE POSITIVE RESPONSE AS PROBE IS LOWERED INTO BUCKET "HEADSPACE".

1225 COLLECTED 11' SUB SAMPLE FROM TRENCH #01 SOIL LOOKS LIKE 10' SPL.

1230 R. ALEXANDER RECALIBRATED HNU.
INITIAL SPAN READING: ~~5~~ 5.88 PAK

Robert R. Alexander
Randy F. Reddick 9/24/91

FINAL SPAN SETTING: 6.11

1245 Collected 12' subsample.

NOTES TO HERE AUTHORED BY PAUL KARAS

Soil clumps of loam, silt-loam, with medium pebbles.

12:55 Bump HNU probe and recalibrated
Initial span: 6.11
Final span: 6.82

1305 Collected 13' subsample, HNU reading showed no response above background.

1322 Collected 14' subsample, HNU reading 2 ppm above background. Also collected a sample in an 8 oz. jar for headspace analysis. Jar filled halfway w/ soil and allowed to sit in the sun

1342 Note: at approx. 12:55, T. Reiland, V. Graham, J. Mendoza, A. Hartnett, and L. Hopper departed site. Also, 2 additional EOD personnel arrived at about this time.

79

4/24/91 [signature] Robert R. Alexander / Randy F. Reddick

1352 Jar headspace analysis showed a concentration 8 ppm above background. Also, V. Graham and T. Reilard have returned.

1359 Collected 15' subsample. HNU reading did not change from background.

~~1407~~ RRA 1407 Notes on headspace analysis: Jar was filled halfway with soil, covered with aluminum foil, and lid holding aluminum foil. Jar sat in sun for about 15+20 minutes, then probe punctured aluminum foil and reading taken.

1445 Note: Composite for 11-15' interval of Trench 01 collected at 1400 by R. Reddick. Depth measurements being performed by EOD personnel

1510 Just received clearance from Med-Evac to continue work after a short delay which started at about 1440. Winds gusts of short duration may be a concern. Gusts are about 30-35 kts occasionally, then more calm with winds about 10-15 kts. EOD

4/24/91 NOTES TO HERE AUTHORED BY [signature] Robert R. Alexander / Randy F. Reddick 76

personnel advised to stay upwind of breezes. Breezes heading toward NE and haven't shifted much.

1517: HNU READING OF 2 PPM (1 PPM ABOVE BACKGROUND) IN BACKHOE BUCKET. DEPTH OF TRENCH 01 IS 15' (PLUS A COUPLE OF INCHES) SOIL LOOKS LIKE A BROWN SANDY LOAM WITH SMALL CALCIUM CARBONATE NODULES.

1520 COLLECTED 15' GRAB IN TRENCH #01 WSRR-SUB-01-15'

1540 B. ALEXANDER DECONNED BACKHOE BUCKET AFTER TRENCH 01 WAS FILLED IN. PREPARED TO COLLECT TRENCH 02 SAMPLES AS FOLLOWS:

WSRR-SUB-02/C-0-10'
WSRR-SUB-02-0-10'
WSRR-SUB-02/S-0-10'

[signature] Robert R. Alexander

4/24/91 Paul Olson Robert R. Christian Randy F. Reddick

WILL HAVE TO STOP EXCAVATION AT 10' TO MEET 6:00 pM MEDEVAC DEADLINE.
LOCATED TRENCH 02 ON FIELD PLANNING MAP, OFFICIAL FIELD COPY.

1555: HNU READING AT BACKHOE BUCKET, 2' DEPTH, TRENCH 02, NO READING ABOVE BG.

1557 R. REDDICK COLLECTED SUBSAMPLES 6 SCOOPS INTO ONE BOWL (FOR COLOCATE) AND 12 INTO ANOTHER (FOR SPLIT + COMPOSITE) USING RUBBER-MAID BINS + ICE (+ FOIL COVERS)
SOIL APPEARS DK-MED BROWN, ~~LOAMY~~ SAC LOAM WITH LITTLE CARBONATE OR PEBBLES (<1% GRAVEL)

1608 HNU READING AT BUCKET. NO READING ABOVE BG. DEPTH IS 4', TRENCH #02

1610 COLLECTED SUBSAMPLE

4/24/91 Paul Olson Robert R. Christian Randy F. Reddick

AT 4' DEPTH. SOIL APPEARS SIMILAR TO 2' INTERVAL BUT SOME THIN CARBONATE FILIMENTS ON SOIL PEDS. UNCONCLUSIVE AS TO WHETHER SOILS TO THIS DEPTH ARE DISTURBED OR NOT.

1620 WEATHER: WINDS HAVE LIGHTENED UP SOME, TEMP ~ 80°F, WIND 5-10 MPH FROM SOUTHWEST. SKIES CLEAR

1626 TOOK HNU READING AT BACKHOE BUCKET, NO READING ABOVE BACKGROUND.

1630 COLLECTED SAMPLE AT 6'. SOIL IS SLIGHTLY DARKER IN COLOR, SAME LOAM TEXTURE, SOMEWHAT MORE CARBONATE FILIMENTS THAN PREVIOUS SAMPLE DEPTH

1645: SGT FIGENSER INFORMS THAT A WELD HAS BROKEN ON THE BACKHOE ARM. MUST CEASE WORK

4/24/91 Robert B. Alexander Randy F. Reddock

FOR THE DAY. DECIDED TO BOTTLE UP SAMPLES WE NOW HAVE REPRESENTING A 0-6' INTERVAL. EOD STAFF TRYING TO ARRANGE FOR A WELDER OR NEW BACKHOE FOR TOMORROW MORNING

PAK 1655 ~~1455~~ COLLECTED SAMPLE WSRR-SUB-02-0-6'

PAK 1657 ~~1459~~ COLLECTED SAMPLE WSRR-SUB-02/S-0-6'

PAK 1659 ~~1459~~ COLLECTED SAMPLE WSRR-SUB-02/C-0-6"

17:30 LEFT SITE

NOTES ABOVE AUTHORED BY:

4/25/91 CALLED FED EX FOR PICKUP OF 4/24 SAMPLES, ROW A #7 IS CONF # FOR PICKUP AT 4 WINDS MOTEL.

4/25/91 P. KARAS PHONED MIKE BRAMM, TMA TO INFORM HIM OF SAMPLES SENT.

4/25/91 RED RIO SITE: EXCAVATION / SAMPLING

0815 ARRIVED ONSITE, MET EOD (T. FLGENSER, S. STARGART, + J. COTTMAN) AT H.L. GATE. TRACYE REILAND + V. GRAHAM HAVE GONE W/ L. HOPPES TO OSCURA SITE. FRL STAFF ONSITE: R. REDDICK, R. ALEXANDER, D. STATLER.

0830 ENTERED GATE. WEATHER: SUNNY, ~60° F WINDS LIGHT (<5 MPH) FROM WEST.

0900 MOVED BACKHOE TO SOUTH SIDE OF MOUND TO SET UP FOR REPAIR ~~WET~~ PAK WINDS PICKING UP TO ~ 10-15 MPH FROM SW.

0930 WENT TO HL GATE

Robert B. Alexander

7.6 4/25/91 Robert R. Alexander
Randy F. Rilbock

TO MAKE PHONE CALL TO R. SMITH + WAIT FOR WELDERS + EQUIP FOR BACKHOE REPAIR FROM STALLION. SEE P. KARAS W.S. LOGBOOK FOR TBLECON NOTES.

0945: STALLION STAFF ARRIVED TO DO BACKHOE REPAIR.

~~0945~~ PAK

1015 MECHANICS FROM STALLION REMOVED BROKEN PARTS + LEFT TO RETURN TO STALLION FOR REPAIR OF EQUIP.

1030 BEGAN SECURING EQUIPMENT, TARPS, ETC AT SITE. WINDS ~ 20-25 MPH FROM SW. ASKED EOD TO CHECK INTO ABILITY TO GO TO LEVEL C FOR WORK IF WINDY + TO ARRANGE FOR MEDIVAC THROUGH TUES.

4/25/91 Robert R. Alexander 77
Randy F. Rilbock

11:25 P. KARAS + SGT FIGENSER TO ~~STALLION~~ PAK H.L. GATE TO MAKE PHONE CALLS

12:15 PK + TF RETURN TO SITE

12:30 L. HOPPES, T. REILAND + V. GRAHAM RETURNED TO SITE. DISCUSSED RESPIRATOR USE. VIVIAN SAID SHE HAD NO PROBLEMS WITH OUR PLANS. V.G. SAID THAT ARMY STAFF IS QUALIFIED TO WORK IN RESPIRATORS NO AUTHORIZATION IS REQUIRED

12:35: LARRY HOPPES LEFT SITE.

12:45: STALLION MECHANICS RETURNED TO REPAIR BACKHOE. WEATHER: SUNNY, ~74°F, WINDS ~15-25 MPH FROM SSW.

B15 GOT BACKHOE UP + WORKING AGAIN. J. COTTMAN BROUGHT BACKHOE BACK TO DECON PAD.

1330 DECIDED TO END OPERATIONS FOR THE DAY

4/25/91 [signature] Robert R. Alexander Randy F. Reddick

1340 LEFT THE SITE.

NOTES ABOVE AUTHORIZED BY [signature]

1445 Called TMA in Ann Arbor, MI, to let them know we would be shipping on Saturday, 4/27/91, as well as Friday, 4/26/91. Arrangements for samples arriving on 4/27/91 were not completed during this call, but Carolina and Art of TMA said that it would probably be OK and to call them Friday am. (4/26/91) to make sure. Also, R. Alexander reminded them of the 7 day holding time requirement for US ATHAMA Explosive methods and samples taken on Saturday, 4/27/91, would not arrive to them until until Tuesday, 4/30/91.

1515 Called TMA in Richmond, CA. Spoke to Fernit Blunts to let him know that samples would be forthcoming to them on Saturday, 4/27/91 and Tuesday, 4/30/91. He acknowledged receiving samples on Tuesday, 4/23/91, and Wednesday, 4/24/91.

Above Notes by Robert R. Alexander

[signature] Robert R. Alexander Randy F. Reddick

4/26/91 RED RIO EXCAVATION AND SAMPLING

0730 ARRIVED ONSITE.

PRESENT: P. KARAS
R. REDDICK
R. ALEXANDER
S. STARGARDT
T. FIGENSER
J. COTTMAN

WEATHER ~ 50° F, PARTLY CLOUDY, MOSTLY CLEAR, WINDS ~ 10-15 MPH FROM WEST.

- RECIEVED AUTHORIZATION FOR LEVEL C RESPIRATORY PROTECTION FROM DUST, IF NEEDED, FROM GENE CZENSKI. ECD STAFF SECURED EQUIPMENT FOR LEVEL C WORK ALSO.

BEGAN SETTING UP FOR DECON + SAMPLING.

MEDEVAC WILL BE AVAILABLE AS OF 0800

0820 DECON OF BACKHOE BUCKET COMPLETE.

4/26/91 [signature] Robert H. Clarke [signature] Randy F. Reddick

P. KARAS + R. REDDICK DRESSED UP IN TYVEK, RUBBER OVERBOOTS, INNER + OUTER GLOVES + FULL FACE RESPIRATORS, GMC-H CARTRIDGES.
B. ALEXANDER IS IN A 1/2 FACE RESPIRATOR FOR DECON OF BUCKET + SAMPLING EQUIP.

0830 CALIBRATED HNU (SAME INSTRUMENT + PROBE (PAK) + GAS AS PREVIOUSLY)
INITIAL SPAN: 6.82
FINAL SPAN: ~~5.68~~ 5.69 PAK
USING ISOBUTYLENE W/ 66 PPM RESPONSE.

- BOP + RECOVERY AT SITE OF TRENCH 02 EXCAVATING TO A DEPTH OF 8' FOR A COMPOSITE SUB SAMPLE.

0837 - BACKHOE AT 8' IN TRENCH #02. HNU BACKGROUND IS 4 PPM. NO READING ABOVE BG.

0840 COLLECTED 8' SUBSAMPLE

4/26/91 [signature] Robert H. Clarke [signature] Randy F. Reddick

FOR WSRR-~~02~~ PAK-SUB-02-8-10'
SOIL AT THIS DEPTH IS LIGHT BROWN LOAM, DISEMINATED CARBONATE, NO GRAVEL VISABLE.

0845 DETERMINED HNU PROBE WAS ASSEMBLED LAST NIGHT W/ NOSE PIECE CROOKED. CORRECTED + RECALIBRATED.
INITIAL SPAN SETTING: 5.69
FINAL SPAN SETTING: 2.45
"SHARPIE TEST" POSITIVE

0903 HNU READING AT BUCKET, DEPTH OF 10', TRENCH 02 NO HNU READING ABOVE BACKGROUND (1 PPM)

0905 R. REDDICK COLLECTED SUB SAMPLE AT 10'. SOIL AT THIS DEPTH IS SAME AS 8' BUT ~5% LS PEBBLES 5-15 MM.
TOOK SUBSAMPLES IN BOWL W/ FOIL COVER, ON ICE IN RUBBERMAID TUB, BAK TO

4/26/91 Robert R. Alexander Randy B. Reddick

"SAMPLE COLLECTION AREA".
THIS AREA IS THE
CAB-END OF THE FLATBED
TRUCK COVERED ON TOP
& TWO SIDES BY A
12'x16' TARP.

0908 HNU BACKGROUND IN
"SPL COLL. AREA" IS
1 PPM. CHECKED AIR
OVER SOIL IN BOWL,
NO READING ABOVE
BACKGROUND.

0910 R. REDDICK HOMOGENIZED
SAMPLE WSRR SUB-02-8-10'
AND FILLED SAMPLE
BOTTLES:
1 x 1l AMBER GLASS
FOR EXPLOSIVES
1 x 8 oz AMBER GLASS
FOR SEMI VOAS
1 x 8 oz GLAS FOR METALS.
R. ALEXANDER DECONNING
BACKHOE IN PREPARATION
FOR 11'-15' ~~SUB~~ PAK
COMPOSITE SAMPLE.

4/26/91 Robert R. Alexander Randy B. Reddick

0930: DECON OF BUCKET
COMPLETE, EXCAVATION OF
TRENCH 02 RESUMES
WEATHER: ~65° F CLEAR
SKIES WIND ~ 10-20 MPH
FROM SW.

0940 BACKHOE BUCKET IS
READY FOR 11' SUB SAMPLE.
HNU READING AT BUCKET
IS 0 ABOVE A BACKGROUND
OF 1 PPM. SOIL AS AT
10' BUT WITH SOME (FEW)
CARBONATE FILAMENTS.

0942 COLLECTED SUB SAMPLE
AT 11', TRENCH # 02.
DEPTH OF COLLECTION IN
THIS AND ALL OTHER
TRENCHES IS BEING
MEASURED BY S. STARGARDT
WITH A FIBERGLASS TAPE.

0958 BACKHOE AT 12', HNU
READING AT BUCKET IS
0 ABOVE BACKGROUND. SOIL
APPEARS AS ABOVE

1000 RANDY COLLECTED 12' SUBSAMPLE
TRENCH #02

4/26/91 [signature] Robert R. Alexander Randy F. Reddick

1012 - BACKHOE AT 13, TRENCH 02. NO HNU READING ABOVE BACKGROUND. SOIL IS SANDY LOAM, MED BROWN WITH CARBONATE NODULES. NO PEBBLES OBSERVED

1014 R. REDDICK COLLECTED SUB SAMPLE @ 13'

1016 "SHARPIE TEST" ON HNU POSITIVE.

1020 BACKHOE @ 14', NO HNU READING ABOVE BG. SOIL LT BROWN w/CARBONATE FILIMENTS & DISSEMINATED CARBONATE, NO PEBBLES.

1022 COLLECTED 14' SUBSAMPLE

1040 BACKHOE AT 15', NO HNU READING ABOVE BACKGROUND. SOIL IS SANDY LOAM, MED BROWN, ~40% LS PEBBLES 5-15 MM. SLIGHTLY MOIST.

1042 COLLECTED 15' SUBSAMPLE TRENCH #02.

4/26/91 [signature] Robert R. Alexander Randy F. Reddick

1043: DROVE IN TWO STAKES LABELED "TRENCH 01" ON EITHER END OF TRENCH 01 LOCATION.

1045 R. REDDICK HOMOGENIZED AND COLLECTED SAMPLE WSPR-SUB-02-11-15'. R. ALEXANDER BEGAN DECONNING ~~AUG~~ PAK BACKHOE BUCKET.

1055 WEATHER: PARTLY CLOUDY SKIES, ~65°F, WIND 15-30 FROM WSW. R. REDDICK COMPLETING SAMPLE LABELS, CUSTODY SEALS ETC. R. ALEXANDER COMPLETING BACKHOE BUCKET DECON.

1112 BACKHOE OPERATOR CLEANED UP BOTTOM OF TRENCH AND COLLECTED A BUCKET FROM ~15 FT DEPTH. SOIL APPEARS AS BEFORE BUT ~30% GRAVEL. NO HNU READING ABOVE BACKGROUND (1 PPM).

1115 RANDY REDDICK COLLECTED

4/26/91 Robert R. Allendorf
Randy F. Reddick

15' GRAB SAMPLE FROM BUCKET WITH DECONNED SHOVEL DIRECTLY INTO BOTTLES.

1135 BROKE FOR LUNCH, EOD/RECOVERY REFUELING BACKHOE

1150 R. REDDICK DECONNING BACKHOE BUCKET

1210 READY TO BEGIN TRENCH #03.

1215 DIRECTED BACKHOE TO A LOCATION IMMEDIATELY WEST OF BURIED WASTE AREA AND JUST SOUTH OF 300N LINE. SGT. STARGARDT MOVED A BDU-33 OUT OF PATH OF BACKHOE PRIOR TO DIGGING TRENCH #03

1225 BUCKET CONTAINS SAMPLE FROM 2' AT TRENCH #03 NO HNU RESPONSE ABOVE BACKGROUND. SOIL IS MOIST DARK BROWN

4/26/91 Robert R. Allendorf
Randy F. Reddick

SILT LOAM, NO PEBBLES, MAY BE DISTURBED. MASS OF GREY/WHITE MOTTLED ASH-LIKE MATERIAL ABOUT THE SIZE OF A GOLF BALL. INCLUDED A PORTION OF IT IN COMPOSITE SUBSAMPLE.

1228 COLLECTED SUB SAMPLE AT 2'

1240 CALLED TO BACKHOE BY EOD. SUSPICIOUS-LOOKING MATERIAL WAS BROUGHT UP IN BACKHOE BUCKET. MORE OF GREY/BLUE + WHITE MOTTLED MATERIAL. NO HNU READING ABOVE BG. RIGHT AT SUSPICIOUS MATERIAL. DECIDED TO COLLECT A GRAB SAMPLE. SMALL METALLIC PIECE (FIN-SHAPED) PROTRUDING FROM MATERIAL.

1244 COLLECTED GRAB SAMPLE WSRR-SUB-03-~~03~~ BK. STARGARDT SAYS THE MATERIAL LOOKS

4/26/91 Robert R. Alexander
Randy G. Rollock

LIKE CORROSION OR OXIDIZED MATERIAL HE'S SEEN ON OLD BURIED ORDNANCE. STARGARDT IS COMFORTABLE CONTINUING THIS TRENCH BUT WILL STOP IF ANY OTHER WASTE-LIKE MATERIAL IS ENCOUNTERED.

1255 CALLED UP TO BACKHOE BY EOD. BACKHOE OPERATOR DETECTED SOMETHING IN THE BOTTOM OF THE TRENCH. MAY BE METAL MAY BE ROCK. DECIDED TO MOVE TRENCH (WIDEN IT) SLIGHTLY TO THE SOUTH AND WEST. NEW LOCATION IS AN EXTENSION OF EXISTING TRENCH #03

1310 BACKHOE AT 4' IN WIDENED TRENCH #03. NO HNU READING ABOVE BG. SOILS VERY MOIST, MEDIUM REDDISH-BROWN CLAY

4/26/91 Robert R. Alexander
Randy G. Rollock

LOAM & DK BROWN LOAM, MIXED, < 5% PEBBLES.

1314 COLLECTED 4' SAMPLE IN TRENCH #03.

1324 BACKHOE AT 6', NO HNU READING ABOVE BACKGROUND SOIL IS MOIST DK BROWN LOAM WITH <5% GRAVEL. SOME LARGE PIECES (~BASEBALL-SIZED) OF WHAT APPEARS TO BE BURNED WOOD.

1330: CHECKED CALIBRATION OF HNU. PRIOR & FINAL SPAN IS 2.45 w/66 PPM POSITIVE "SHARPIE TEST".

1345 CALLED TO TRENCH #03 BY EOD BECAUSE OF DISCOVERY OF BURIED ORDNANCE AT 7'. HNU READING OF 1 PPM ABOVE BACKGROUND JUST ABOVE STAINED SOIL. SOIL APPEARS AS ABOVE BUT LARGE AREAS OF BLACK ASH + SOIL. ~10% PEBBLES. ON SPOIL PILE

90 4/20/91 [redacted] Robert A. Alexander
Randy F. Reddick

ARE PIECES OF SEVERAL BDU-33's, FIN ASSEMBLY FROM LARGER BOMBS (500's?) ALL BLACKENED AND RUSTED. DECIDED TO COLLECT A GRAB SAMPLE AND CONDUCT AN INFORMAL HNU HEADSPACE ANALYSIS

1350 FILLED JARS FOR SAMPLE WSRR-SUB-03-7' AS FOLLOWS:

1 x 1 l EXPLOSIVES
1 x 8 oz SEMI VOA
1 x 8 oz METALS
1 x 8 oz HEADSPACE.

1400 RANDY HOMOGENIZED AND COLLECTED COMPOSITE SAMPLE WSRR-SUB-03-0-6'. CLEANED UP JARS, COMPLETED LABELS + ICED SAMPLES.

1405 CALL FROM MEDEVAC. WILL HAVE TO CEASE EXCAVATION FOR ~45 MINUTES WHILE HELECOPTER MOVES TO + FROM HOLLOMAN.

4/20/91 [redacted] Robert A. Alexander 91
Randy F. Reddick

1430 WEATHER: TEMP ~65 F, MOSTLY CLOUDY, WIND ~5 TO 15 FROM WEST. B. ALEXANDER, SHSC ANNOUNCED THAT USE OF MASKS (RESPIRATORS) WILL BE OPTIONAL UNTIL WIND PICKS UP AGAIN AND/OR DUST BECOMES A PROBLEM.

1435 - R. ALEXANDER DECONNING BACKHOE BUCKET.

1500 P. KARAS BEGAN COLLECTING RINSATE SAMPLE FROM DECONNED EQUIPMENT. SAMPLE NO. WSRR-RIN-03.
FILLED DECONNED BOWL 1/2 FULL W/ DI WATER + STIRRED WITH DECONNED SCOOP.
FILLED FOLLOWING BOTTLES 1/2 WAY:

PAK 1 x 1 l USATHAMA EXPLOSIVES
VAK 2 x 1 l RCRA SEMI VOAs
1 x 1 l POLY BOTTLE RCRA METALS

FILLED BOTTLES REMAINDER WITH DI WATER FROM SPRAYER

92 4/26/91 Robert R. Clark Randy F. Riddick

DRIBBLING OFF OF DECONNED BACKHOE BUCKET.

1510 ACIDIFIED 1L SAMPLE IN POLY BOTTLE (RCRA METALS) TO pH < 2.0. COMPLETED LABELS AND ICED

1515: GOT APPROVAL TO CONTINUE EXCAVATIONS FROM MEDEVAC. DIRECTED BACKHOE TO DIG ANOTHER TRENCH (TRENCH #04) IMMEDIATELY SW OF SMALL IRREGULAR WASTE AREA ON SOUTH END OF TRENCH (WASTE TRENCH).

1520 HNU READING FROM BUCKET WITH 2' SAMPLE WAS Ø ABOVE BACKGROUND OF 1 PPM. SOIL IS UNIFORM LOAM < 5% PEBBLES (LS.) MED BROWN. A PIECE OF "SCRAP METAL" PROTRUDING FROM DIRT IN BUCKET NO SOIL DISCOLORATION

93 4/26/91 Robert R. Clark Randy F. Riddick

1521 COLLECTED SUBSAMPLE AT 2' TRENCH 04.

1526 BACKGROUND READING W/ HNU IS 1.0 PPM, NO READING ABOVE B.G. AT BUCKET WITH 4' SAMPLE. SOIL APPEARANCE AS ~~BELOW~~ PAC BEFORE BUT ~10% GRAVEL .5-10 MM.

1527 COLLECTED 4' SUBSAMPLE, AT TRENCH 04.

1535 NO HNU READING ABOVE BACKGROUND, AT BUCKET. BUCKET CONTAINS SOIL FROM 6'. SOIL IS MOIST MEDIUM BROWN SILT LOAM ~ 5% GRAVEL 5-20 MM. (LS).

1537 COLLECTED 8' SUBSAMPLE.

1543 BACKHOE AT A DEPTH OF 8', NO HNU READING ABOVE BACKGROUND. SOIL IS LT BROWN WITH GOOD PED DEVELOPMENT, CALCAREOUS FILIMENTS. PEBBLES ~ 10% 10-20 MM.

4/26/91 Robert [illegible] Randy R. Reddick

1545 COLLECTED 10' SUBSAMPLE FROM TRENCH #04

NOTE: AT ABOUT 1415 WE ANALYZED HEADSPACE OF 8 OZ JAR COLLECTED AT TRENCH #03 - 7' DEPTH, COLLECTED FOR THAT PURPOSE. HNU READING WAS 10 PPM OR 9 PPM ABOVE BACKGROUND. SOIL WAS VISIBLY STAINED BLACK, PROBABLY FROM PETROLEUM OR BURNING OR BOTH.

1558 - BACKHOE IS AT 10' HNU READING IS 2-3 PPM ABOVE BACKGROUND IN BUCKET IMMEDIATELY ABOVE SOIL. SOIL IS MEDIUM RED-BROWN SILT LOAM < 5% GRAVEL, GOOD DEVELOPMENT OF CARBONATE FILIMENTS, MOIST. NO EVIDENCE OF STAINING.

1600 COLLECTED 10' SUBSAMPLE

4/26/91 Robert [illegible] Randy R. Reddick

1605 R. REDDICK HOMOGENIZED SAMPLE AND COLLECTED WSRR-SUB-04-0-10' IN JARS. MOVED BACKHOE TO DECON PAD.

1630 BEGAN EXCAVATION AGAIN AT TRENCH #04.

1642 BACKHOE AT 11', HNU READING OF < 1 PPM ABOVE BACKGROUND. SOIL CLAYEY SILT LOAM, < 5% PEBBLES, WELL DEVELOPED CARBONATE FILIMENTS.

1644 COLLECTED 11' SUBSAMPLE, TRENCH #04

1655 BACKHOE IS AT 12'. NO HNU READING ABOVE BACKGROUND. SOIL IS CLAY BAR LOAM, MED-LT BROWN, DISSEMINATED CARBONATE AND CARBONATE NODULES. DRYER THAN SHALLOWER SOILS.

1657 COLLECTED 12' SUBSAMPLE, TRENCH #04. WEATHER: CLOUDY, ~65° F WIND ~2-10 MPH FROM SW.

4/26/91 Paul A. Flanz — Robert K. Alexander, Randy F. Redlock

1713 BACKHOE AT 13', NO HNU READING ABOVE BACKGROUND. SOIL IS MED BROWN SILTY LOAM WITH NO VISIBLE PEBBLES, NO CARBONATE NODULES, BUT FAIRLY WELL DEVELOPED FILIMENTS.

1715 COLLECTED 13' SUBSAMPLE. FROM TRENCH #04

1725 BACKHOE IS AT 14' NO HNU READING ABOVE BACKGROUND. SOIL APPEARS TO BE WEATHERED SHALE, ALMOST ALL CLAY, LARGE WHITE ZONES MAY BE SECONDARY SEDIMENTARY STRUCTURE.

1727 - COLLECTED 14' SUBSAMPLE, TRENCH #04

1735 - BACKHOE AT 15' NO HNU READING ABOVE B.G. SOIL AS AT 14' OPERATOR SAYS EARTH IS VERY HARD AT THIS DEPTH.

4/26/91 Paul A. Flanz — Robert K. Alexander, Randy F. Redlock

1740 COLLECTED 15 SUBSAMPLE IN TRENCH #04.

1745 B. ALEXANDER DECONNING BACKHOE BUCKET. COLLECTED COMPOSITE SAMPLE WSRR-SUB-04 ~~#~~ PAK, 11-15

1755 BACKHOE BEGAN EXCAVATING AGAIN.

1800: COLLECTED GRAB SAMPLE ~~WSRR-04~~ PAK WSRR-SUB-04-15'. SOILS APPEAR AS ~~USUAL~~ PAK NOTED AT 1735.

1815: STRAIGHTENED UP SITE, COMPLETED SAMPLE LABELS AND ICED SAMPLES.

1830 LEFT SITE.

ABOVE NOTES AUTHORED BY Paul A. Flanz

4/27/91 RED RIO EXCAVATION AND SAMPLING.

GENERAL FIELD NOTES

- CHANGES TO FIELD PROCEDURES LISTED ON P61 OF THIS LOGBOOK HAVE BEEN RESOLVED AS FOLLOWS:

→ CHANGE # 2 AS OF 4/24/91 SAMPLER BEGAN SIGNING SAMPLE LABEL IN ADDITION TO CUSTODY SEAL. ALSO STARTING ENTERING SAMPLE # ON CUSTODY SEAL ON 4/24/91.

→ PAGE 66 OF THIS BOOK, J. MOHATT'S FINDING OF LOG BOOK CONTROL. AUTHORS OF ANY FIELD NOTES NOW LOG OUT OF BOOK W/SIGNATURE BEFORE ANY OTHER TEAM MEMBER BEGINS ENTERING NOTES INTO HIS HAND.

4/27/91 ARRIVED ONSITE AT 0745 - PERSONNEL PRESENT:

P. KARAS
R. ALEXANDER
S. STARGARDT
T. FIGENSER
J. COTTMAN

SENT R. REDDICK BACK TO ABQ BY BUS LAST NIGHT TO SHIP 4/26 SAMPLES BY FED EX.

0750 WEATHER: TEMP ~ 48°F, CLEAR SKIES, BREEZE ~ 5-10 MPH FROM WEST.

0830 FINISHED DECONNING BACKHOE BUCKET, BOWLS + SCOOPS. DIRECTED BACKHOE TO LOCATION FOR TRENCH #06 WILL BE EXCAVATED AT 30 SOUTH BETWEEN 20 + 30 EAST USING GEOPHYSICAL GRID ON "AREA 1".

0835 CALIBRATED HNU.
INITAL SPAN: 2.45
FINAL SPAN: 3.26
SAME HNU, PROBE + GAS AS PREVIOUSLY

100 4/27/91 [signature] Tolbert, Alexander

0840 BACKHOE AT 2'. NO HNU READING ABOVE 1ppm BACKGROUND. SOME DIESEL EXHAUST SMELL AT BUCKET (FROM BACKHOE). SOIL IS MOIST SILTY LOAM, MED-DARK BROWN <5% 10-15 mm PEBBLES, (LIMESTONE). MINIMAL CARBONATE FILIMENTS

0842 COLLECTED 2' SUBSAMPLE, TRENCH # 06

0852 BACKHOE AT 4', NO HNU READING ABOVE 1ppm BACKGROUND. ASKED OPERATOR TO SWING BUCKET TO OPPOSITE SIDE NEXT TIME TO AVOID DIESEL EXHAUST NEAR SAMPLING. SOIL APPEARS AS AT 2'

0855 COLLECTED 4' SUBSAMPLE, TRENCH # 06.

0859 BACKHOE AT 6', NO HNU READING ABOVE BACKGROUND. SOIL IS MEDIUM RED BROWN

4/27/91 [signature] Tolbert, Alexander

CLAY LOAM, MOIST, NO VISIBLE PEBBLES, OR CARBONATE.

0900 COLLECTED 6' SUBSAMPLE, TRENCH 06.

0910 BACKHOE AT 8', NO HNU READING ABOVE BACKGROUND SOIL IS MED RED-BROWN CLAY LOAM WITH WELL DEVELOPED CARBONATE FILIMENTS. NO PEBBLES.

0912 COLLECTED 8' SUBSAMPLE TRENCH # 06.

WEATHER: ~50° F, CLEAR SKIES, WIND ~ 8-10 MPH FROM WEST NORTHWEST.

0923 BACKHOE IS AT 10', NO HNU READING ABOVE BACKGROUND. SOIL IS MED RED BROWN CLAY LOAM, <5% 2-10 MM PEBBLES (LS), FEW CARBONATE STRINGERS

0925 COLLECTED 10' SUBSAMPLE, TRENCH # 06

0930 R. ALEXANDER HOMOGENIZED

AND COLLECTED SAMPLE:
WSRR-SUB-06-0-10'.

0935: R. ALEXANDER BEGAN DECONTAMINATING BACKHOE BUCKET.

NOTE: TRENCH MEASUREMENTS ARE BEING CONDUCTED BY T FIGENSER TODAY. S STARGARDT IS MANNING THE RADIO.

0950 RESUMED EXCAVATION OF TRENCH #06.

0958 BACKHOE AT 11', NO HNU READING ABOVE B.G. SOIL IS MED RED-BROWN CLAY OR SILT LOAM, ~5% GRAVEL (LS) 2-10 MM. VERY LITTLE CARBONATE EVIDENT.

PAK ~~04~~

1000 COLLECTED SUBSAMPLE AT 11', TRENCH #06

1011 - BACKHOE AT 12', NO HNU READING ABOVE B.G. SOIL IS MED RED BROWN

CLAY LOAM NO PEBBLES OBSERVED, FEW THICK CARBONATE FILIMENTS + COATINGS.

1012 COLLECTED 12' SUBSAMPLE TRENCH #06

1022 BACKHOE AT 13', NO HNU READING ABOVE BACKGROUND SOIL AS AT ~~12~~ PAK 12'.

1024 COLLECTED 13' SUBSAMPLE FROM TRENCH #06.

1040 BACKHOE AT 14', NO HNU READING ABOVE BACKGROUND. SOIL AS AT 12' + 13'

1042 COLLECTED 14' SUBSAMPLE FROM TRENCH #06

1055 BACKHOE AT 15', NO HNU READING ABOVE BACKGROUND. SOIL AS ABOVE

1057 - COLLECTED 15' SUBSAMPLE TRENCH ~~#04~~ PAK #06.

1100 R. ALEXANDER ~~DEC~~ PAK HOMOGENIZED + COLLECTED COMPOSITE SAMPLE:
WSRR-SUB-06-11-15'

104: 4/27/91 [signature] [signature]

1105 R. ALEXANDER DECONTAMINATE BACK HOE BUCKET. P. KARAS COMPLETING SAMPLE LABELS, PACKING + ICING. PREPARING TO DEMOB FROM SITE AFTER GRAB SAMPLE FROM 15' TRENCH #06 COLLECTED.

1120 EXCAVATION CONTINUES

1135 COLLECTED GRAB SAMPLE WSRP-SUB-06-15'

1150 COMPLETED LABELS, PACKED + ICED SAMPLES

1205: BEGAN RECORDING LOCATIONS OF TRENCHES EACH TRENCH MARKED WITH A STAKE (LABELED) AT EACH END.

12:08. TRENCH #05 IS 97.2' FROM CENTER STAKE OF AREA 8. BEARING N12°E TO EASTERN END OF TRENCH. TRENCH BEARING IS N84°W LENGTH 21.1'

4/27/91 [signature] [signature]

1214 DISTANCE FROM S10N, 0E TO WEST STAKE OF TRENCH #01 IS 37.3', BEARING N56°W. TRENCH #01 IS 14.4', BEARING N79°E

1218 DISTANCE FROM N390, 0E TO SOUTH END OF TRENCH #02 IS 34.3', BEARING: N39°W TRENCH #02 IS 12.4', BEARING N30°E

1223 DISTANCE FROM N300, 0E TO N END OF TRENCH #03 IS 51.7' BEARING: N55°W TRENCH #03 IS 16.0' BEARING N46°W

1229 DISTANCE FROM N90, 0E TO WEST STAKE OF TRENCH #04 IS 13.8 FT BEARING: N78W TRENCH #04 IS 10.1' BEARING: N84E

1234 DISTANCE FROM S30, 0E TO WEST END OF TRENCH #06 IS 26.0'

106 4/27/91 [signature] Roberts, [illegible]

BEARING: N 76 W
TRENCH #06 PS. 20.8'
BEARING S 84 E

800 PRESSURE WASHED BACKHOE + DECON TUBS + SPRAYERS, ETC.

1357 LEFT SITE.

NOTES ABOVE AUTHORED BY [signature]

[signature] Roberts, [illegible] 07

5/6/91 - SAMPLING TRIP TO OSCURA SITE. SURFACE + SUBSURFACE SAMPLING.

0940 ARRIVED AT SPOTTING TOWER + SIGNED IN. EOD/RECOVERY STAFF NOT PRESENT. PHONED SGT DOWNS. NOT IN OFFICE SPOKE W/SGT AYERS HE SAID TEAM WENT UP TO RED RIO. CONTACTED THEM BY RADIO AND TOLD THEM TO REDIRECT TO OSCURA SITE

0950 BEGAN MAKING UP SAMPLE LABELS (BASIC INFO ONLY) FOR SURFACE SOIL SAMPLING. FPC STAFF PRESENT:
P. KARAS
R. ALEXANDER
R. STATLER

PAK ~~09~~ 1030: SELECTED GRID NODES FOR RANDOM GRAB SAMPLES BY PUTTING #'S 1-8 ON SCRAPS OF [signature]

Robert R. Alexander

PAPER AND DRAWING
BLIND FROM A CUP.
GRABS AS FOLLOWS:
Q1 - 7
Q2 - 4
Q3 - 3
Q4 - 5

1200 STILL WAITING FOR
EOD + RECOVERY.
WEATHER: 71° F
- WIND 13 KNOTS FROM
207°
- 18 KNOTS PEAK

1300: WATER TRUCK ARRIVED.
BROUGHT IT OUT TO
SITE. DISCOVERED
WATER TRUCK HAS A
LEAK. OPERATOR TOOK
TRUCK BACK TO QRC.
TO TRANSFER WATER
TO A NON-LEAKING
TRUCK. A LARGE
QUANTITY OF SCRAP
METAL FROM RED RIO
SITE HAS BEEN

Robert R. Alexander

PILED UP ON SOUTH
END OF OSCURA SITE
BETWEEN THE GEOPHS.
SURVEY BASELINE +
POND BERM. SCRAP
INCLUDES HELECOPTER
BODIES, LATRINE "BOXES"
(PORTABLE) AND OTHER
SHOT-UP SCRAP.

1345 WEATHER PARTLY CLOUDY
HIGH CLOUDS, WINDS 13 KNOTS
FROM 205° PEAK
WINDS AT 20 KNOTS,
TEMP 76 F.

1515 EOD + VIVIAN GRAHAM
ARRIVE.
EOD STAFF.
STAFF SGT. GARY DESIMONE
SGT CURTIS JOHNSON
SPECIALIST JOHN COTTMANN
DISCUSSED PROJECT

1550 P. KARAS PHONED
RANGE CONTROL

1600 DROVE TO SITE. BEGAN
H+S BRIEFING.

1610 G. DISIMONE CALLED EOD SOP

1170

1615: EMERGENCY WORD USE CHANNEL 4. GARY DESIMONE WILL PUT EMERGENCY INSTRUCTIONS ON ~~TELEPHONE~~ RADIO.

1630 WENT UP ON BERM OF STOCK POND + DISCUSSED PLANS FOR EXCAVATIONS, ETC.

1640 BEGAN SETTING UP DECON AREAS, SAMPLE PREP, ETC.

1730 LEFT SITE.

NOTE: NO WATER IS PRESENT IN STOCK POND, JUST DRIED MUD W/ DESICATION CRACKS.

ABOVE NOTES FROM

Robert R. Alexander

111

5/7/91 OSCURA SAMPLING TRIP.

0700 ARRIVED AT SPOTTING TOWER. CLEAR SKIES, WINDS 2 KNOTS FROM 54°, TEMP 55°F. SIGNED IN. PRESENT AT TOWER:

FPC - P. KARAS
D. STATLER

EOD - G. DESIMONE
C. JOHNSON
J. COTTMAN

0720 CALLED RANGE CONTROL TOLD THEM 5 PEOPLE, 2 VEHICLES, 1 BACKHOE

0730 ARRIVED AT SITE BEGAN SETTING UP SAMPLE PREP. + DECON AREAS.

0830: B. ALEXANDER ARRIVED ONSITE. BA + DS BEGAN SUITING UP IN MODIFIED LEVEL D (TYVEK, RUBBER BOOT COVERS, LATEX GLOVES PLUS BUTYL GLOVES FOR SAMPLER) IN PREPARATION FOR SURFACE SOIL SAMPLING

1.1.2

Robert R. Alexander

0855 P. KARAS LEFT TO RETURN TO SPOTTING TOWER TO PHONE RANGE CONTROL + ABQ FPC OFFICE

ABOVE NOTES GATHERED BY

0915 D. Slatter and R. Alexander departed safe area escorted by Sgt. Desimone to collect background samples.

0920 began collecting WSOR-SUR-Q5/1-0-2". This sample is located approx. 120' north of 960N of baseline. Soil dry, light brown color, with little decomposed organic matter in it. Natural grasses growing at this location and had to be pushed aside to get to the soil.

0928 WSOR-SUR-Q5/1-0-2" collection complete.

0930 located WSOR-SUR-Q5/2-0-2" approx. 10' to the east of Q5/1 sample. Pounded in stake identifying Q5/1 sample location.

Robert R. Alexander 113

0938 completed collection of WSOR-SUR-Q5/2-0-2". Pounded in stake identifying this location

0946 arrived at safe area. The lot #'s for the Q5/1 and Q5/2 samples are:

1 liter bottles: X1023010
Clear wide-mouth: F1048010
8 oz. amber: U1008030

1007 Wind 15 kts @ 200°. Temp about 70°F, skies clear.

1014 Left safe area to sample Q5/3 and Q1.

1020 arrived at Q5/3, located approx. 10' west of Q5/1. Had to change location 3-4' to north to avoid a horse manure pile.

1026 completed collection of WSOR-SUB-Q5/3-0-2"

1037 Q1 surface sampling:
→ Collected subsample 5

1041 collected subsample 6

1044 Aborted sampling for Q1 composite due to lack of time before evacuation

Robert R. Alexander

1107 All EOD, FPC, and V. Graham personnel left site for the evacuation. ~~called~~ R. Karas called range control to let them know we left site. During evac period, sample cooler was left in shade under the table.

12:21 Left to return to site from Oscura entry/exit gate.

1230 R. Karas contacted Range Control to let them know 5 vehicles and 8 people returned to Oscura site.

1245 EOD obtained med-evac clearance. all EOD, FPC personnel as well as V. Graham and George Beard (photographer) returned to Oscura site. Mr. Beard will photograph site activities this p.m.

1305 R. Karas began marking the areas identified by geophysics. D. Statler and R. Alexander began to sample Q1.

1320 Subsample 5 collected for Q1 composite.

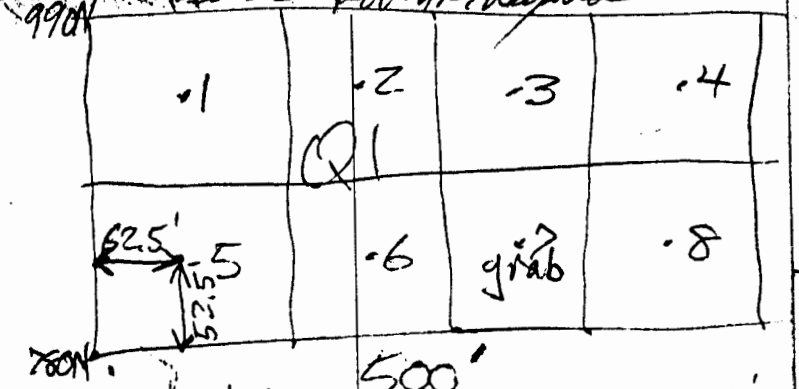
1325 " 6 "

1327 " 7 "

1330 Random grab sample at node #7 ~~collected~~ collected (HPA)

1336 Subsample 8 collected.

Robert R. Alexander



Sketch of Q1 surface sampling area.

1344 Subsample 1 collected for Q1 composite

1346 " 2 " " " "

1349 " 3 " " " "

1352 " 4 " " " "

Node locating procedure: a 100 foot fiberglass tape was used to find the nodes by measuring from ~~from~~ RHA known field grid locations. The same grid was used from the geophysical ~~location~~ investigation.

1358 D. Statler mixed soil in the bowl and filled sample jars.

1455 all personnel left site due to A-7 mission at 1510.

Notes above by Robert R. Alexander

Robert R. Alexander

1600 RETURNED FROM SPOTTING TOWER. PHONED RANGE CONTROL ON ARRIVAL + DEPARTURE FROM TOWER. PRIOR TO GOING TO TOWER, INSTALLED LINER IN DECON PIT. BACK AT TOWER U. GRAHAM PHONED ENVIRONMENTAL OFFICE AND ARRANGED FOR RESPIRATORS FOR EOD STAFF.

1615 COLLECTED GRAB SAMPLE WSOR-SUR-Q2/4-0-2"
SAMPLER: DAN STATLER
LOT #'s:

SEMI VOA	U 1008030
METALS	F 1048010
EXPLOSIVES	X 1023010

NOTE ALL BOTTLES USED TODAY CAME FROM SAME CASE, AND HAD IDENTICAL LOT #'s
CONTINUED TO COLLECT REMAINING SUBSAMPLES

Robert R. Alexander

1625 COLLECTED COMPOSITE SAMPLE WSOR-SUR-Q2-0-2"
1650 B. ALEXANDER COMPLETING SAMPLE LABELS. P. KARAS DECONNED SHOVEL + BOWL
WEATHER: ~ 86°F WIND ~ 10-15 KNOTS FROM NW. CLEAR SKIES.
1655 BEGAN COLLECTING COMPOSITE SPLIT, COLOCATE + GRAB SAMPLES, Q3.
1700 COLLECTED GRAB SAMPLE WSOR-SUR-Q3/3-0-2".
1715 COLLECTED COMPOSITE SAMPLE WSOR-SUR-Q3-0-2"
1717 COLLECTED SPLIT OF ABOVE SAMPLE AND LABELED WSOR-SUR-Q3/S-0-2". SPLIT COLLECTED FROM SAME BOWL OF HOMOGENIZED SAMPLE. ALL LOT #'s AS LISTED FOR SAMPLE COLLECTED AT 1615
1723 COLLECTED WSOR-SUR-Q3/C-02"

Robert A. Alexander

1735: COLLECTED GRAB SAMPLE WSOR-SIR-Q4/5-0-2" LOT #s
USATHAMA BX: X 1034030
SEMI VOA: V 100 8030
METALS: F104 8010

1737 CONTINUED TO COLLECT Q4 SUBSAMPLES

1748 COLLECTED COMPOSITE SAMPLE WSOR-SIR-Q4-0-2" BOTTLE LOT #s:
USATHAMA BX X023010
SEMI VOA: V 100 8030
METALS: F104 8010

1800 STOWED GEAR AND PREPARED TO LEAVE SITE.

18:30 LEFT SITE.

ABOVE NOTES AUTHORED BY:

5/8/91 Robert A. Alexander

0655 Called Fed. Ex. and obtained the confirmation #ROWA #5. Put three coolers in motel office - 2 are RRA ~~going~~ going to TMA in annarbor and one is going to TMA in Monrovia, CA.

ABOVE NOTES AUTHORED BY:
Robert A. Alexander

0740 ARRIVED AT SPOTTING TOWER TOLD BY STAFF WE DO NOT NEED TO SIGN LOG BOOK EVERY DAY.
CALLED RANGE CONTROL TO TELL THEM 3 VEHICLES AND 6 PEOPLE GOING ON SITE. GIVEN NEW CALL NAME OF "KILO DELTA".

0745 ARRIVED AT SITE PREPARED TO DECON BACKHOE BUCKET.
WEATHER: CLEAR SKIES SOME HIGH THIN CLOUDS ~55° F, WIND ~ 5 KNOTS FROM NORTHEAST

Robert A. Alexander

0820 HAVING SOME TROUBLE WITH GENERATOR/SPRAYER. SPRAYER WORKS INTERMITTENTLY DUE TO A SLOW SUPPLY OF WATER FROM GRAVITY LINE OF WATER TRUCK. WILL TRY TO DECON BUCKET AT LEAST ONCE WITHOUT ANY MODIFICATION TO TRUCK.

0830 SPRAYER SEEMS TO BE WORKING OK WITH A SIPHON LINE RUNNING OUT OF TOP OF WATER TRUCK. BURNER ON SPRAYER SMOKES A LITTLE WHEN SPRAY IS CUT OFF.

0850 SENT BACKHOE UP TO BACKGROUND SOIL SAMPLING LOCATION TO BEGIN

0900 CALIBRATED HNU INSTRUMENT # 501241 PROBE # 501241A

Robert A. Alexander

CALL GAS, 100 PPM ISOBUTYLENE LOT # 32959
INITIAL SPAN 3.26
FINAL SPAN 3.09.

0910 BACKHOE IS AT 2' WENT OUT TO MISTAKENLY COLLECT A COMPOSITE SUB SAMPLE. AT THIS BACKGROUND LOCATION WE SHOULD COLLECT GRAB SAMPLES AT 5, 10 + 15 FEET.

APPROACHED BACKHOE FROM UPWIND NO HNU READING ABOVE BACKGROUND (BG IS 1 PPM OR LESS).

SAMPLING STAFF (P. KAPAS + D. STATLER) IS GETTING TO + FROM SAMPLING SITE BY PICKUP ALONG A ROUTE CLEARED BY EOD. FRONT SEAT IS COVERED BY A PLASTIC SHEET TO REDUCE CONTAMINATION.

Robert R. Alexander

0925 BACKHOE IS AT 5' IN BACKGROUND LOCATION (TRENCH #05) NO HNU READING ABOVE BACKGROUND. SOIL FROM 0-5' IS UNIFORM MEDIUM BROWN SILT LOAM. NO PEBBLES VISIBLE, LOTS OF ROOTS SOME PED DEVELOPMENT BUT LITTLE OTHER EVIDENCE OF PEDOGENISIS.

0930 COLLECTED GRAB SAMPLE WSOR-SB-05-5' INSTRUCTED BACKHOE TO RETURN FOR DECON.

LOT #s:
USATHAMA : X 1034030
SEMIVOA : U 1008030
METALS : F 1048010

0935 WHEN WE RETURNED TO SAFE AREA, SGT JOHNSON SCREENED SAMPLES WITH A RAD METER. NO RESPONSE

Robert R. Alexander

0955: COMPLETED SAMPLE LABELS, SEALS & PLACED ON ICE. B ALEXANDER DID DECON OF BACKHOE BUCKET, BACKHOE RETURNED TO SITE OF TRENCH 05 TO GET TO 10 ft.

NOTE: GEORGE BAIRD WSMR PHOTOGRAPHER ARRIVED ONSITE AT ABOUT 0830.

WEATHER: ~72° F, CLEAR SKIES, LIGHT BREEZE, (~3 KNOTS) FROM EAST

1025 BACKHOE IS AT 10' NO HNU READING ABOVE BG. IN BREATHING ZONE OR OVER SOIL. SOIL IS A UNIFORM RED BROWN ~~SANDY~~ LOAM FEW PEBBLES (<5%) APPARENTLY LIMESTONE, 2-15 MM OCCASIONALLY UP TO 5 CM.

1030 COLLECTED GRAB SAMPLE WSOR-SUB-05-10' BACKHOE RETURNED FOR DECON

Robert R. Alexander

1045 COMPLETED SAMPLE LABELS + PUT SAMPLES ON ICE. BOB IS DECONNING BUCKET. NOTE: D. STATLER IS CONTINUEING AS SAMPLER. LOT #'S FOR ALL 10' SAMPLES SAME AS 5'

1055 SENT BACKHOE BACK TO TRENCH 05 TO GO TO ~~10' DEP~~ PAK 15'

1130 BACKHOE AT 15' NO HNU READING ABOVE BACKGROUND. SOIL IS GRAVELLY SAND. BACKHOE OPERATOR SAID HE HIT THE GRAVELLY SAND AT 12'. GRAVEL IS LIMESTONE CLASTS TYPICALLY 1-2 CM BUT SOME COBBLES UP TO 20 CM.

NOTE: ~10% GRAVEL PAK

1135 ~~1130~~ PAK COLLECTED GRAB SAMPLE WSOR-SUB-05-15'. INSTRUCTED BACKHOE OPERATOR TO FILL HOLE BACK IN.

Robert R. Alexander

1145 JAVIER MENDOZA AND JEANENE ONDRIK WSMR ENVIRONMENTAL OFFICE ARRIVED ON SITE. GARY DESIMONE LEFT FOR SPOTTING TOWER. BOB ALEXANDER BEGAN DECONNING BUCKET.

NOTES ABOVE AUTHORED BY

1223 Showed Sgt. Desimone & Spec. Cottman location of Trench #1.

1236 Collected 2' subsample. PID did not rise above background.

1249 Collected 4' subsample. PID did not rise above background. Soil medium brown, clayey silt.

Note: D. Statler is collecting subsamples and R. Alexander is operating PID.

1258 Collected 6' subsample. Soil has more sediment w/ calcareous specks. PID reading remained at background.

1305 A forklift and truck arrived at east side of pond and began removing salvage.

1316 Collected 8' subsample. Soil more moist and is sandy clay w/ calcareous nodules and minor amounts of gravel. No PID response above background.

Robert R. Alexander

Also, forklift and truck of left the area.

1333 Advised by EOD personnel that that pel-end would not be available for thirty minutes

1339 collected 10' subsample. Soil was a gravelly sand with clasts as large as 1." PID did not read above background

1342 D. Statler placed with composite soil into WSDR-SUB-01-0-10' jars.

ABOVE NOTES AUTHORED BY

x Robert R. Alexander

1400: B. ALEXANDER COMPLETED DECONNING BUCKET.
P. KARAS COMPLETED SAMPLE LABELS AND PUT SAMPLES ON ICE.

1425 STILL WAITING FOR MEDEVAC AVAILABILITY.
MEDIC IS DRIVING FROM "RHODES WIT" TO HOLLOMAN AFB. NO RADIO CONTACT WHILE HE'S IN TRANSIT

Robert R. Alexander

1435 DECIDED TO EVACUATE TO SPOTTING TOWER DUE TO REQUIRED EVACUATION AT 1500.

1530: RETURNED TO SITE. MISSION HAS ENDED. C.D. + JC. RETURNED TO BACKHOE AT TRENCH 01

1538 BACKHOE AT 11'. NO HNU READING ABOVE BACKGROUND SOIL IS SAND LOAM WITH ~40% GRAVEL 5-30 MM.

1540 COLLECTED SUBSAMPLE AT 11', TRENCH 01.

1547 B. ALEXANDER CALIBRATED HNU. INITIAL SPAN = 3.09
FINAL SPAN = 2.55

1553 BACKHOE AT 12'. NO HNU READING ABOVE BG. SOIL IS GRAVELLY LOAMY SAND ~40% GRAVEL 5-30 MM. SLIGHTLY MOIST.

1556 COLLECTED 12' SUBSAMPLE, TRENCH 01

Robert R. Alexander

1610 BACKHOE IS AT 13
NO HNU READING
ABOVE BACKGROUND OF
1 ppm. SOIL AT THIS
DEPTH IS LOAM, MED
BROWN, FEW (< 5%)
PEBBLES.
1612 COLLECTED 13'
SUBSAMPLE TRENCH 01
1620 BACKHOE IS AT 14'
SOIL IS SANDIER AGAIN
~20% GRAVEL, SANDY
LOAM, MOISTER
NO ~~BA~~ PAK HNU READING
ABOVE BACKGROUND.
1624 COLLECTED 14'
SUBSAMPLE, TRENCH 01.
WEATHER: CLEAR SKIES,
~ 68° F WIND ~ 5-10
KNOTS FROM WEST.
1650 BACKHOE IS AT
15' SOIL IS SANDY
GRAVELLY LOAM. NO
HNU READING ABOVE
BACKGROUND.

Robert R. Alexander

1655 D. STATLER HOMOGENIZED
SAMPLE AND COLLECTED
INTO JARS, 01-
WSOR-SUB-11-15'
1 PAK.

BACKHOE RETURNED TO
DECON PAD FOR CLEANING.
1710 COMPLETED SAMPLE
LABELS, PLACED SAMPLES
ON ICE
NOTE ALL TRENCH 01
SAMPLES ARE IN BOTTLES
WITH SAME LOT #s AS
TRENCH 05 SAMPLE
COLLECTED AT 0930
1727 BACKHOE AT 15'
NO HNU READING ABOVE
BACKGROUND. COLLECTED
SAMPLE WSOR-SUB-01-15'
1740 BACK AT SAFE ZONE,
GOT RADIO CALL THAT
BACKHOE IS STUCK
AT TRENCH 01 LOC.
HAD TO LEAVE BACKHOE
UNTIL TOMORROW.

Robert R. Alexander

1755 CLEANED OUT GALVINIZED WASH TUBS FILLED WITH WATER AND PLACED INFRONT OF DECON POND IN AN ATTEMPT TO LURE ANIMALS AWAY FROM THE POND.

18:15 LEFT SITE.

ABOVE NOTES AUTHORED BY

5/9/91 - CALLED FED EX TO ARRANGE PICK UP OF SAMPLES COLLECTED 5/8/91 AND A FED EX LETTER TO L. BROWN

CONC # ROW A 5

RRA Robert R. Alexander

0714 ~~Left~~ D. Statler & R. Alexander left motel for site. P. Karas to follow in about an hour.

0810 arrived at site. Personnel Present:
Spec. Cottman
Sgt. Desimone
D. Statler
R. Alexander and George Baird

0816 Sgt. Johnson arrived on site.

0830 R. Alexander deconned bucket

0841 Bucket decon complete.

0851 R. Alexander showed Spec. Cottman and Sgt. Desimone location of trench #2.

0855 weather calm, partly cloudy, temp. about 68°

0858 calibrated HNU PID:
Initial Span: 2.55
Final Span: 3.22

0906 Collected WSOR-SUB-02-~~R~~ RRA 2' subsample
No PID response above background.
Soil a silty clay w/roots and organic material in it.

R Statler

Robert R. Alexander

0916 Collected 4' subsample for SUB-02. Soil similar to 2', but with less roots. PID showed no response above background

0927 Collected 6' subsample for SUB-02. Soil very similar in appearance to to 4' subsample. PID showed no response above background.

0944 collected 8' subsample. Soil has minor gravel, silty clay, and calcareous specs, no organic matter noted. PID showed no response above background.

1000 collected WSOR-SUB-02-0-10'. PID showed no response above background. Soil similar in appearance to 8' subsample. D. Statler wiped sample before placing in jars

1008 PO Kolar arrived on site.

1015 B. Alexander decomned bucket

1025 Med-evac support lost until 1145 and work activities have ceased.

1037 weather w/breeze at about 0-5 kts from southwest. Temperature about 75°F.

1045 Note: Stallion range control was contacted about 7:50 am. Our new call sign is "Kilo Kilo".

Captain Bob (RRA) Robert R. Alexander

1050 Capt. Schuster and Lt. Scott Anderson arrived on site to observe site activities.

1130 Capt. Schuster & Lt. Anderson departed site. Capt. Schuster approved a change in EOD SOP, the EOD team can now decide whether or not to continue a (RRA) trench when med-evac is not available.

1140 Sgt. Desimone & Spec. Cottman began trenching at #2 again

1147 winds have picked up a little to 10-15 kts, still from southwest.

Above notes by Robert R. Alexander

1150 AT ~1145 BACKHOE AT 11'. NO HNU READING ABOVE BACKGROUND. SOIL IS LT BROWN SILT LOAM, FEW CARBONATE NODULES, VERY LITTLE FINE GRAVEL AT ~1147 D. STATLER COLLECTED 11' SUB SAMPLE, TRENCH #2.

1204 BACKHOE IS AT 12'. NO HNU READING ABOVE BG.

Robert R. Alexander

SOIL AT THIS DEPTH IS LT BROWN SILT-CLAY LOAM, VERY HARD + DRY, MANY CARBONATE NODULES.

1206 COLLECTED 12' SUBSAMPLE AT TRENCH 02

1220 ~~BACKGROUND BAC~~ BACKHOE IS AT 13', SOIL IS GRAVELLY CLAY LOAM, ~60% GRAVEL (LS.) 5-30 MM. BACKHOE OPERATOR SAYS IT'S VERY HARD. CARBONATE DISSEMINATED THROUGH MATRIX AND IN NODULES.

1222 COLLECTED 13' SUB SAMPLE, TRENCH #02

1233 BACKHOE IS AT 14' NO HNU READING ABOVE BG. SOIL AT THIS DEPTH IS RED-BROWN CLAY LOAM, DRY, VERY HARD, <5% GRAVEL CARBONATE FILIMENTS AND NODULES

Robert R. Alexander

1235 COLLECTED 14 SUBSAMPLE TRENCH #02.

WEATHER: WIND IS 20-25 MPH FROM SW. FEW HIGH CLOUDS. REDUCED VISIBILITY (~50 MI) BECAUSE OF DUST IN AIR. DUST ONLY APPEARS TO BE BLOWING OFF OF ROAD SURFACES WITHIN SITE. BACKHOE OPERATOR + EOD STAFF STAYING UPWIND OF TRENCH + PILE

1246 BACKHOE IS AT 15' NO HNU READING ABOVE BG. SOIL AT THIS DEPTH IS SANDY LOAM w/50% GRAVEL (LIMESTONE). STILL VERY DRY. NO EVIDENCE OF CARBONATE

1248 D. STATLER HOMOGENIZED AND COLLECTED SAMPLE WSOR-SUB-02-11-15' LAT #5 AS FOLLOWS

Paul Mason Robert H. Alexander

USATHAMA Ex: X 1034030
SEMI VOAS: U 1008030
METALS: F 1048010
BROUGHT BACKHOE BACK TO DECON PAD FOR CLEANING.
1303 COMPLETED LABELS, PACKED 1-15' SAMPLES ON ICE. B. ALEXANDER DECONNED BUCKET.
1325 BACKHOE IS BACK AT TRENCH GETTING A 15' SAMPLE
1330 COLLECTED GRAB SAMPLE WSOR-SUB-02-15'
1350 B. ALEXANDER FINISHED DECONNING BUCKET.
1355 DIRECTED BACKHOE TO LOCATION OF TRENCH #03 AS INDICATED ON THE OFFICAL SITE MAP.
1410 BACKHOE IS AT 2' SOIL IS UNIFORM BROWN SILT LOAM ~15% GRAVEL. FEW ROOTS. NO HNU READING ABOVE B.G.

Paul Mason Robert H. Alexander

1412 D. STATLER COLLECTED 2' SUBSAMPLE, TRENCH #03. WEATHER: ~84°F, WIND 15-20 MPH FROM SW. HIGH, THIN CLOUDS. SELECTED LOCATION OF TRENCH #03 TO PLACE BACKHOE OPERATOR, EOD + FPC SAMPLING PERSONNEL UPWIND OF ANY POTENTIAL WASTE AREAS.
1423 BACKHOE IS AT 4' IN TRENCH #03. NO HNU READING ABOVE BACKGROUND SOIL IS SILT LOAM, LT BROWN, DISEMINATED CARBONATE FEW ROOTS FAIR PED DEVELOPMENT <5% GRAVEL.
1425 D. STATLER COLLECTED 4' SUBSAMPLE, TRENCH #03
1434 BACKHOE IS AT 6', TRENCH #03 SOIL IS LT BROWN SILT LOAM

Robert R. Alexander

DISSEMINATED CARBONATE + NODULES. FEW PEBBLES (< 5%)

1435 COLLECTED 6' SUBSAMPLE FROM TRENCH #03 NO HNU READING ABOVE B.G.

1444 BACKHOE IS AT 8'. NO HNU READING ABOVE 0.5 PPM BACKGROUND. SOIL IS SANDY LOAM ~25% GRAVEL 5-15 mm.

1446 COLLECTED 8' SUBSAMPLE, TRENCH #03

1458 BACKHOE IS AT 10', NO HNU READING ABOVE BACKGROUND. SOIL IS A DARK RED BROWN SAND LOAM. ~30% GRAVEL. (LIMESTONE)

1500 HOMOGENIZED AND COLLECTED WSOR-SUB-03-0-10'

1520 COMPLETED LABELS + PACKED SAMPLES W/ ICE. B. ALEXANDER

Robert R. Alexander

DECONNED BUCKET. AT 7 PM 1520 ALL FIELD PERSONNEL LEFT FOR SPOTTING TOWER BECAUSE OF AN A-7 MISSION.

1600 RETURNED TO SITE. BACKHOE RETURNED TO TRENCH #03 TO GO TO 11'. WEATHER: 85°F, WIND 17 KNOTS FROM SOUTH WEST, GUSTING TO 22 KNOTS. HIGH THIN CLOUDS.

1616 BACKHOE IS AT 11', NO HNU READING ABOVE B.G. SOIL IS SANDY GRAVEL ~75% GRAVEL (LS) MOST 20-50 mm, SOME UP TO 150 mm. SOIL LOOKS MOISTER.

1618 COLLECTED 11' SUBSAMPLE

1625 BACKHOE IS AT 12' IN TRENCH #03. NO HNU READING ABOVE BACKGROUND.

1626 COLLECTED 12' SUBSAMPLE SOIL IS SANDY GRAVEL

Robert A. Alexander

ABOUT 80% GRAVEL, SAND PORTION IS MOIST.

1632 BACKHOE IS AT 13', NO HNU READING ABOVE BACKGROUND. SOIL AT THIS DEPTH IS DARK REDDISH BROWN ~~CLAY~~ LOAM, QUITE MOIST. LITTLE GRAVEL < 10%

1638 BACKHOE IS AT 14' NO HNU READING ABOVE BG.

1640 COLLECTED 14' SUBSAMPLE TRENCH #03, SOIL IS AS LAST SAMPLE (13').

1646 BACKHOE IS AT 15' NO HNU READING ABOVE BACKGROUND. SOIL IS MED RED BROWN GRAVELLY SAND.

1650 HOMOGENIZED AND COLLECTED SAMPLE WSOR-SUB-03-11-15' BROUGHT BACKHOE BACK FOR DECON.

Robert A. Alexander

1715 BACKHOE HAS A GRAB SAMPLE FROM 15'. D. STATLER COLLECTED A SAMPLE FROM BUCKET WSOR-SUB-03-15'

1730 PACKED UP SITE

1740 LEFT SITE.

Notes above by X

5/10/91 OSWRAA Sampling Continued

0710 Arrived on site w/ D. Statler and B. Alexander. P. Karas is contacting Range control at the Range Tower. EOD personnel present:

Spec. Cottman
Sgt. Beginnes
Sgt. Johnson

0722 P. Karas arrived on site.

0733 P. Karas Calibrated HNU PID. No Span adjustment was necessary.

ABOVE NOTES AUTHORED BY: Robert A. Alexander

0755 P. KARAS DIRECTED BACKHOE OPER TO LOCATION FOR TRENCH #04. PIT

Robert R. Alexander

THIS TRENCH AT SE SIDE OF LARGE WASTE AREA NW CORNER OF BERMED AREA. LOCATION DEPICTED ON SITE MAP D. STATLER HAS DECONNED THE BACKHOE BUCKET.

0805 EOD CALLED US OVER. BACKHOE IS AT 2 FT. TWO MK 106s CAME UP IN BUCKET AT 2 FT SAMPLE. NO HNU READING ABOVE BACKGROUND. MK 106s ARE ORANGE NO WEATHERING OR BURNING EVIDENT ON PAINT. SOIL IS MED BROWN LOAM ~15% GRAVEL (5-15 mm).

0810 DIRECTED DESIMONE & COTTMAN TO MOVE OVER 2 FT & CONTINUE TRENCH (AWAY FROM WASTES). COLLECTED A GRAB SAMPLE WSOR-SUB-04-2'

Robert R. Alexander

0818 GEORGE BAIRD ARRIVES ON SITE. R. ALEXANDER IS DECONNING SHOVEL USED FOR GRAB SAMPLE FOR USE ON COMPOSITE.

0825: BACKHOE IS AT 2' IN TRENCH #04 RELOCATED ~18" TO SE OF ORIGINAL LOCATION OF EXCAVATION. SOIL IS MIXED LT BROWN LOAM + SILT LOAM WITH CARBONATE NODULES. LOOKS LIKE FILL MATERIAL. NO HNU READING ABOVE BG.

0828 COLLECTED 2' SUBSAMPLE, TRENCH #04. COLLECTED SIX SCOOPS INTO ONE BOWL (FOR COLOCATE) + 12 INTO THE OTHER (FOR COMPOSITE + SPLIT).

0838 BACKHOE IS AT 4', NO HNU READING ABOVE BG. SOIL IS LT BROWN SILT LOAM w/ CARBONATE NODULES + DISSEMINATED CARBONATE. ~10% GRAVEL (5-15 mm) LOOKING

Paul A. Vance Robert R. Alexander

IN TRENCH THERE IS A DEFINITE GRAVEL ZONE BETWEEN 2' + 2.5'. BELOW THIS LEVEL SOILS MAY BE UNDISTURBED.

0848 BACKHOE IS AT 6'. SOILS APPEAR AS AT 4'. NO HNU READING ABOVE BG.

0850 COLLECTED 6' SUBSAMPLE AS BEFORE (6 SCOOPS IN ONE BOWL, 12 IN OTHER).

0900 BACKHOE AT 8' NO HNU READING ABOVE BG. COLLECTED 8' SUBSAMPLE IN TRENCH # 04. SOIL IS SLIGHTLY MOIST RED BROWN LOAM WITH ~20% LARGE GRAVEL (LIMESTONE) ~50-200 mm WITH CARBONATE COATINGS

0920 BACKHOE IS AT 10' IN TRENCH #04. SOIL IS AS AT 8' BUT LESS LARGE GRAVELS

RSH

Paul A. Vance Robert R. Alexander

0923 COLLECTED 8' SUBSAMPLE. B. ALEXANDER IS DOING SOIL SAMPLING SO FAR THIS MORNING. BROUGHT BOWLS BACK TO DECON AREA TO HOMOGENIZE AND COLLECT 0-10' COMPOSITE SAMPLES.

0930 BOB HOMOGENIZED AND COLLECTED COMPOSITE SAMPLE WSOR-SUB-04 ~~0-10'~~ PAK -0-10'

0932 COLLECTED SPLIT SAMPLE WSOR-SUB-04 ~~0-10'/S~~ PAK /S-0-10'

0935 COLLECTED COLOCATE SAMPLE WSOR-SUB-04 ~~0-10'/C~~ /C-0-10' PAK

WEATHER: TEMP ~ 74°F, WIND 15-25 MPH FROM SOUTH, PARTLY CLOUDY

0940 D. STATLER DECONNED BUCKET. LOT #s FOR 0-10' SAMPLES, TRENCH #04

USATHAMA EX	X1054030
SEMI VOAs	U1008030
RCRA METALS	F1048010

RSH

1000 P. KARAS COLLECTED RINSATE SAMPLE. ½ FROM DI RINSE OF BUCKET, ½ FROM DI WATER PLACED IN STEEL BOWL + STIRRED.
COLLECTED:
2x 1 l AMBER GLASS - SEMI VOA
1x 1 l AMBER GLASS - OS ATHAMA EX
1x 1 l PLASTIC - METALS
LOT #'S
GLASS: H1059010
PLASTIC: C1026020

1020 BACKHOE RETURNED TO TRENCH # 04.

1035 BACKHOE IS AT 11'. NO HNU READING ABOVE BACKGROUND. SOIL IS RED BROWN CLAY LOAM, ABUNDANT CARBONATE FILIMENTS + COATINGS. ~15% GRAVEL < 10 MM.

1037 COLLECTED 11' SUB-SAMPLE IN TRENCH #04.

1045 BACKHOE IS AT 12'

NO HNU READING ABOVE BACKGROUND. SOIL IS AS AT 11' BUT SLIGHTLY LESS CARBONATE.

1046 COLLECTED 12' SUBSAMPLE, TRENCH #04.

1050 WIND IS PICKING UP. DUST IS VISIBLE BLOWING OFF SITE. FPC STAFF + ECD STAFF TO DON RESPIRATORS.

1053 P. KARAS + B. ALEXANDER DON RESPIRATORS.
WEATHER: TEMP ~ 78° F
WIND ~ 20-30 MPH FROM SOUTHWEST. DECON/SAMPLE PREP AREAS ARE UPWIND OF SITE AND STAFF ARE NOT DONNING MASKS
SGT DESIMONE + SPC COTTMAN HAVE DONNED MASKS ALSO

1058 BACKHOE IS AT 13'. SOILS ARE STILL FAIRLY DRY, GRAVELLY CLAY LOAM

Robert R. Alexander

LIGHT BROWN, CARBONATE IN MATRIX AND ON CLASTS. NO HNU READING ABOVE BACKGROUND.

1100 COLLECTED 13' SUBSAMPLE FROM TRENCH #04

1115 BACKHOE IS AT 14' NO HNU READING ABOVE BACKGROUND. SOIL IS AS DESCRIBED FOR 13'.

1117 COLLECTED 14' SUBSAMPLE TRENCH #04.

1125 GEORGE BAIRD WILL BE LEAVING SITE WHEN WE GO IN FOR 15' SAMPLE.

1130: BACKHOE IS AT 15 NO HNU READING ABOVE BACKGROUND. SOIL IS AS DESCRIBED LAST.

1132 COLLECTED 15' SUBSAMPLE TRENCH #04.

1135 B. ALEXANDER HOMOGENIZED AND COLLECTED SAMPLE WSOR-SUB-04-11-15'

LOT #'s SAME AS 0940.

Robert R. Alexander

1200 BACKHOE BACK AT TRENCH #04 SITE AFTER DECON BY D. STATLER. B. ALEXANDER COLLECTED 15' GRAB SAMPLE: WSOR-SUB-04-15'

LOT #'s SAME AS 0940.

1210 FILLED TRENCH & BROUGHT BACKHOE BACK FOR DECON. EOD STAFF LEFT FOR SPOTTING TOWER TO MAKE CALLS

1250 EOD STAFF RETURNS

1300 P. KARAS WENT TO SPOTTING TOWER TO MAKE CALLS. CALLED L. BROWN & J. MENDOZA. MENDOZA SAID ALL ARRANGE-MENTS MADE FOR NEXT WEEK'S FIELD WORK.

1315 P. KARAS RETURNS TO SITE. & ALEXANDER HAS SHOWN EOD WHERE TO EXCAVATE NEXT TRENCH. TRENCH #06 IS SE OF

Paul C. Marx Robert R. Alexander

SMALLEST WASTE AREA
NW PART OF BERMED
AREA.
1325 BACKHOE IS AT 2'.
NO HNU READING ABOVE
BACKGROUND. SOIL IS
MEDIUM BROWN SILT
LOAM SOME CARBONATE.
1340 CALLED TO TRENCH BY
EOD. BACKHOE IS AT 3'
ORDNANCE IS PRESENT IN
THE BOTTOM OF THE TRENCH.
LOOKS LIKE OLIVE-DRAB
BOMB FINS OR OTHER
"SHEET" TYPE METAL.
NO EVIDENCE OF STAINING,
WEATHERING OR BURNING.
INSTRUCTED OPERATOR TO
WIDEN TRENCH TO THE
SOUTHEAST AWAY FROM
THE BURIED WASTES.
WILL CONTINUE THE
COMPOSITE AT 4' IF
NO ADDITIONAL ORDNANCE
IS FOUND

Paul C. Marx Robert R. Alexander

1350 BACKHOE IS AT 4'. NO
HNU READING ABOVE BACKGROUND
SOIL IS SAME AS AT 2'
A PIECE OF ANGLE IRON + SOME
WIRE ARE VISIBLE IN THE
BOTTOM OF THE TRENCH.
SGT GARY DESIMONE SAID
HE IS WILLING TO CONTINUE
EXCAVATION. NO SIGN OF
STAINED SOIL OR BURNING.
1352 COLLECTED 4' SUBSAMPLE
FROM TRENCH #06.
1355 INFORMED BY EOD
THAT THEY HIT SOMETHING
THE BACKHOE WILL NOT
PULL UP. P.K INSTRUCTED
THEM TO MOVE SOUTH A
LITTLE MORE + CONTINUE
TO 6' IF POSSIBLE.
1417 BACKHOE AT 6', NO
METAL OR OTHER WASTES
IDENTIFIED. NO HNU READINGS
ABOVE BACKGROUND. SOIL IS
MEDIUM BROWN CALCAREOUS
SILT-LOAM. ROOTS,

Robert R. Alexander

NODULES + FILIMENTS PRESENT. ~~H~~ PAT MAY BE UNDISTURBED EARTH.

1420 COLLECTED 6' SUBSAMPLE 6' DEPTH, TRENCH #06.

1422 CALIBRATED HNU.
INITIAL 3.22 SPAN
FINAL 3.08 SPAN
R. ALEXANDER DID CALIBRATION.

1428 BACKHOE IS AT 8' IN TRENCH #06. SOIL IS MEDIUM BROWN LOAM. SOME GRAVEL + COBBLES (~10%). FEW CARBONATE FILIMENTS. NO HNU RDG.

1430 SUBSAMPLE COLLECTED 8' TRENCH #06.

1445 BACKHOE IS AT 10' NO HNU READING ABOVE BACKGROUND. SOIL IS MEDIUM BROWN SANDY LOAM. SLIGHTLY MORE MOIST THAN PREVIOUS

Robert R. Alexander

SUBSAMPLES.

1447 COLLECT SUBSAMPLE AT 10' IN TRENCH #06.

1448 B. ALEXANDER HOMOGENIZED AND COLLECTED SAMPLE WSCR-SUB-06-0-10'
BACKHOE RETURNED TO DECON PAD FOR CLEANING.
WEATHER: TEMP ~ 85°F, WIND ~ 15-30 MPH FROM SOUTH, MOSTLY CLEAR SKIES.

1510 EXCAVATION RESUMED ON TRENCH #06.

1520 BACKHOE IS AT 11'. NO HNU READING ABOVE BACKGROUND.

1522 COLLECTED 11' SUBSAMPLE FROM TRENCH #06. SOIL APPEARANCE IS AS AT 10'

1532 BACKHOE IS AT 12' SOIL IS MED RED-BROWN LOAM W/ CARBONATE NODULES. VERY SLIGHTLY MOIST. VERY LITTLE GRAVEL (<5%)

154

Paul Vance / Robert R. Alexander

1535 COLLECTED 12 SUBSAMPLE IN TRENCH #06 NO HNU READING ABOVE BG.

1541 BACKHOE IS AT 13'. NO HNU READING ABOVE BACKGROUND. SOIL SAME AS AT 12'

1542 COLLECTED 13' SUBSAMPLE FROM TRENCH #06

1555 BACKHOE IS AT 14' NO HNU READING ABOVE BACKGROUND. SOIL IS A BROWN GRAVELLY SAND ~ 40% GRAVEL MOSTLY 5-20mm BUT SOME 100 mm. ALL SEEM TO BE LIMESTONE. ALSO FAIRLY MOIST.

1557 COLLECTED ~~14~~ 14' SUBSAMPLE FROM TRENCH #06.

1605 BACKHOE IS AT 15'. NO HNU READING. SOIL IS AS BEFORE

1606 COLLECTED 15'

R Statler

Paul Vance / Robert R. Alexander

SUBSAMPLE, TRENCH #06.

1610 B. ALEXANDER HOMOGENIZED AND COLLECTED COMPOSITE SAMPLE WSCR-SUB-06-11-15' BROUGHT BACKHOE BACK TO DECON PAD, D. STATLER CLEANED IT

1625 EXCAVATION RESUMED

1635 COLLECTED GRAB SAMPLE WSOR-SUB-06-15'. ALL LOT #s SAME FOR THIS & LAST SAMPLE AS FOR 0940 SPL.

1640 FILLED TRENCH #06 IN AND BROUGHT BACKHOE BACK TO DECON. HOSED OFF BUCKET.

1650 DECONNED INTERIOR OF PICKUP TRUCK USING WATER SPONGE + BRUSH

Above notes by X Paul Vance

R Statler

5/13/94 Robert P. Alexander
Zone. HAR

0925 Arrived at Oscura Range Tower, FPC personnel: R. Alexander & T. Hart EOD personnel getting fuel at Oscura Range Camp. Told by Total personnel that we must evacuate from 11:00 to 1300.

0940 EOD personnel arrive at Range Tower and party goes to the site.

0950 Conducted orientation for T. Hart covering vehicles, routes of egress, emergency procedures, etc. Sgts. Johnson & Desimone discussed EOD safety and evac procedures

1030 FPC & EOD personnel bug-out due to missile launch.

1245 Return and wait at Oscura gate.

1320 Left Oscura gate for range tower.

1327 Arrived at Range tower. Wind at 191° at 12-18 kts. Temperature 81°

1420 Finally got all equipment setup. B. Alexander showed T. Hart the proper decon procedures for the bucket, bowls, and shovels

1430 T. Hart decontaminating bucket. B. Alexander decontaminated bowls and shovels.

Robert P. Alexander / Zone. HAR

1450 Showed Sgt. Desimone the location of trench ~~HAR~~ RFA #7.

1455 Calibrated HNU PID - no adjustment was necessary. Soil a clay loam with roots and red brown color. Soil very dry.

1500 2' subsample for WSOR-SVB-07 collected

1510 4' subsample collected. Soil clay loam, but with less roots and calcareous stringers. PID reading for 2' and 4' not above background.

1520 Collected 6' subsample. Soil similar to that in 4'. PID had no response above background.

1542 Collected 8' subsample, Soil a clayey silt with about 15% gravel ranging in size from 1cm to 5cm in diameter. PID had no response above background.

1558 10' subsample collected. Soil very rocky (limestone) about 1cm to 20cm in diameter. No PID response above background.

Robert R. Alexander — Troy & Hart

1602 T. Hart mixed soil together and collected WSOR-SUB-07-0-10'.

1620 T. Hart deconned bucket.
Lot #'s for WSOR-SUB-07-0-10'
BATHAMA Explosives: X1034030
RCRA Metals: F1048010
Semi-Vol: U1008030

1640 11' subsample for WSOR-SUB-07-11-15' collected. Soil very gravelly with rock ranging from 1cm to 10cm about 40%, matrix clayey silt, PID showed no response above background.

1648 12' subsample collected. Soil very rocky (60%) with cobbles as large as 25cm. All subsamples collected thus far appeared from undisturbed soil. ~~to be~~ RRA
PID had no response above background

1656 13' subsample collected. Soil similar to that from 12'. PID showed

1704 14' subsample collected. Gravel size much smaller now, ~~about~~ RRA about 1-5cm. Silty matrix. PID showed no response above background.

Robert R. Alexander — Troy & Hart

1710 collected 15' subsample. Gravel about 60%, 1-8cm in size. PID showed no response above background.

1715 T. Hart mixed soil and collected WSOR-SUB-07-11-15'

1720 T. Hart deconning bucket.

1732 T. Hart finishes bucket decon.
Note: Bottle Numbers for WSOR-SUB-07-11-15' same as 0-10'
weather breezy w/winds 10-15 kts from SW, temperture about 80°
Note: Trench #7 located near 600N 450E

1745 T. Hart collects the grab sample WSOR-SUB-07-15'

1815 Secured equipment and left site

160

CURVE TABLES

HOW TO USE CURVE TABLES

Table I. contains Tangents and Externals to a 1° curve. Tan. and Ext. to any other radius may be found nearly enough, by dividing the Tan. or Ext. opposite the given Central Angle by the given degree of curve.

To find Deg. of Curve, having the Central Angle and Tangent: Divide Tan. opposite the given Central Angle by the given Tangent.

To find Deg. of Curve, having the Central Angle and External: Divide Ext. opposite the given Central Angle by the given External.

To find Nat. Tan. and Nat. Ex. Sec. for any angle by Table I.: Tan. or Ext. of twice the given angle divided by the radius of a 1° curve will be the Nat. Tan. or Nat. Ex. Sec.

EXAMPLE

Wanted a Curve with an Ext. of about 12 ft. Angle of Intersection or I. P. = 23° 20′ to the R. at Station 542+72.

Ext. in Tab. I opposite 23° 20′ = 120.87
120.87 ÷ 12 = 10.07. Say a 10° Curve.

Tan. in Tab. I opp. 23° 20′ = 1183.1
1183.1 ÷ 10 = 118.31.

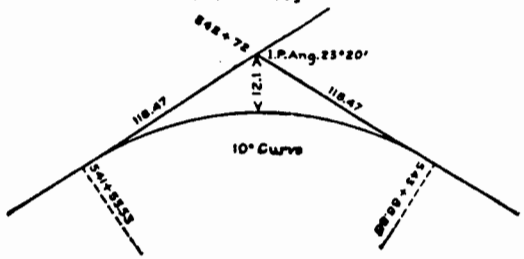
Correction for A. 23° 20′ for a 10° Cur. = 0.16
118.31 + 0.16 = 118.47 = corrected Tangent.

(If corrected Ext. is required find in same way)
Ang. 23° 20′ = 23.33° ÷ 10 = 2.3333 = L. C.

2° 19½′ = def. for sta.	542	I. P. = sta.	542+72
4° 49½′ = " " "	+50	Tan. =	1 .18.47
7° 19½′ = " " "	543	B. C. = sta.	541+53.53
9° 49½′ = " " "	+50	L. C. =	2 .33.33
11° 40′ = " " "	543+		
	86.86	E. C. = Sta.	543+86.86

100 − 53.53 = 46.47 × 3′ (def. for 1 ft. of 10° Cur.) = 139.41′ =
2° 19½′ = def. for sta. 542.

Def. for 50 ft. = 2° 30′ for a 10° Curve.
Def. for 36.86 ft. = 1° 50½′ for a 10° Curve.



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Projects
WHITE SANDS MISSILE RANGE

INVESTIGATIONS TO COLLECT DATA FOR DEVELOPMENT OF RCRA CLOSURE PLANS FOR THE OSCURA AND RED RIO PRACTICE BOMB DISPOSAL AREAS

[FIELD NOTEBOOK #2]

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DT-0659

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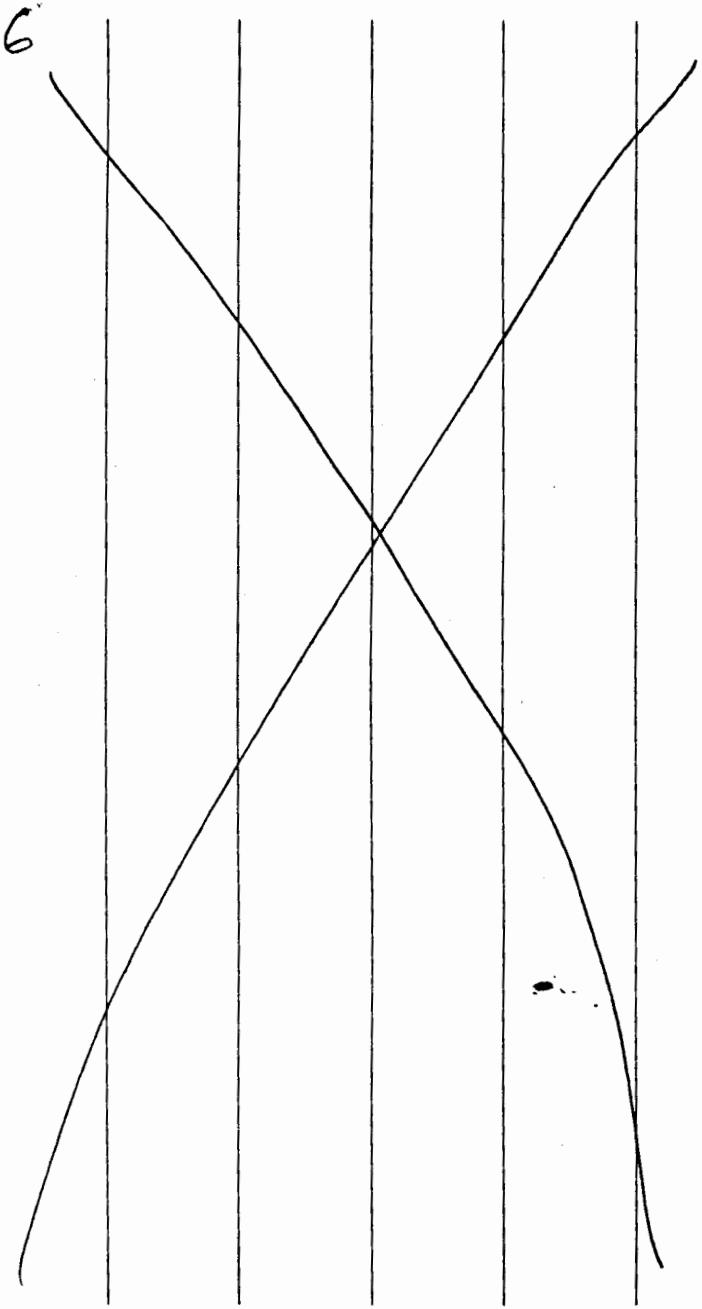
Projects (continued) .....

TABLE OF CONTENTS

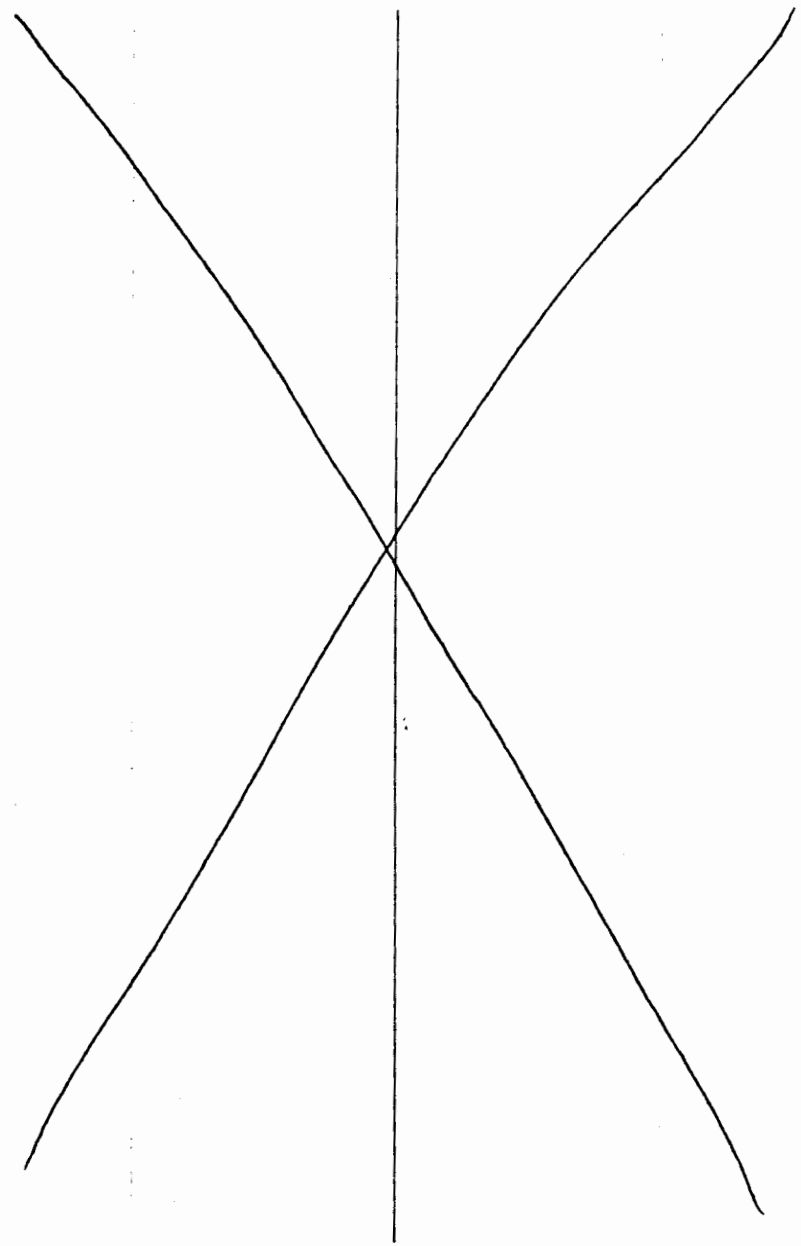
DESCRIPTION		PAGE
RESERVED FOR TOC		1-9
OSCURA SITE SAMPLING		
WSOR-SUB-08-0-10'	(5/14/91)	11
WSOR-SUB-08/C-11-15'	(5/14/91)	12
WSOR-SUB-~~08/PAH~~ 08-11-15'	"	12
WSOR-SUB-08/S-11-15'	"	12
WSOR-SUB-08-15'	"	12
WSOR-SUB-09-0-10'	"	14
WSOR-SUB-09-11-15'	"	14
WSOR-SUB-09-15'	"	15
WSOR-SUB-10-0-10'	"	16
WSOR-RIN-10	(5/15/91)	17
WSOR-SUB-10-11-15'	"	18
WSOR-SUB-10-15'	"	19
WSOR-SUB-11-0-10'	"	20
WSOR-SUB-11-11-15'	"	21
WSOR-SUB-11-15'	"	21
WSOR-SUB-12/S-0-10'	"	23
WSOR-SUB-12-0-10'	"	23
WSOR-SUB-12-11-15'	(5/16/91)	25
WSOR-SUB-12-15'	"	25
WSOR-SUB-13-0-10'	"	26
WSOR-SUB-13-11-15'	"	27
WSOR-SUB-13-15'	"	28

DESCRIPTION	PAGE
WSOR-PND-6-8" (5/16/91)	28
OSCURA TRENCH LOCATIONS (5/17/91)	30
END OF NOTES	31

6



7



8

9

10 5/14/91 Robert R. Alexander

0700 arrived on site after contacting Stallion Range Control. Personnel present: Spec. Cottman
Sgt. Desimone
Sgt. Johnson
Troy Hart
Bob Alexander

0720 T. Hart deconing bucket and B. Alexander labeling sample bottles

0745 Showed Sgt. Desimone location of trench #8. Trench #8 located between 570N, 150E and 570N, 200E approximately 10 ft. north of this line

0750 George Baird arrived on site

0800 T. Hart calibrated HNU PID
I.S. – 3.09
F.S. – 3.57

0804 2' subsample for WSOR-SUB-08-0-10' collected. Soil a clay loam, med. brown color, dry, w/some calcareous nodules. PID showed no response above background.

0807 weather calm, clear, ~70°F

0812 4' subsample collected. Soil similar to 2', but with less roots. PID showed no response above background.

Robert R. Alexander

0822 6' subsample collected. Soil similar to that in 4'. PID showed no response above background.

0834 8' subsample collected. No PID response

0844 10' subsample collected. Soil similar in appearance to that in other subsamples. No PID response above background.

0847 T. Hart mixed soil together and collected WSMR-SUB-08-0-10'

0908 Decon. of bucket and hand trowel complete. WSOR-08-11'-15 shall have a split and colocate collected.

0915 11' subsample collected. 12 scoops for split and 6 for colocate. Soil similar to others collected, dry, and of same color. PID had no response above background. Soils, based on consistent stratigraphy, may be disturbed.

0927 12' subsample collected. Soil now contains gravels < 50% 1cm to 5cm in diameter. Matrix similar to other samples, but calcareous materials absent. PID showed no response above background.

Robert R. Alexander

0940 13' foot subsample collected. Much larger cobbles are present, but make up still only 5-10% of total. Matrix a clayey silt, with little sand. PID had no response above background.

0951 14' subsample collected. Gravels present about 5%, about 1-3cm in diameter. PID had no response above background.

1002 15' subsample collected. Gravels about 5-10% (limestone). PID had no response above background. Soil still quite dry

1004 T. Hart mixed the samples and collected WSOR-SUB-08/C-11-15'

1005 Weather breezy with winds from SW at about 5-10 kts. Temperature about 75°F. 11-15' RRA

1008 WSOR-SUB-08 ~~0-10'~~ collected.

1010 WSOR-SUB-08/S-~~8~~11-15' collected. RRA

1040 WSOR-SUB-08-15' collected by T. Hart

1055 T. Hart begins bucket decon after Spec. Cottman filled in trench ~~#9~~ #8. Weather breezy, 15-20 kts from SW. Temperature approx. 80°F. RRA

Robert R. Alexander

1101 Note: Lot #'s for samples taken so far today:
USATHAMA Ex: X1034030
RCRA Metals: F1048010
Semi-Vol: V1008030

1110 Bucket decon complete.

1115 Showed Sgt. Desimone location of trench #9. Trench #9 is located west of 510N, 400E.

1123 2' subsample for WSOR-SUB-09-0-10' collected. Soil clayey silt w/roots. PID showed no response above background.

1132 4' subsample collected. Soil like 2' med. brown, some roots. No PID response above background.

1141 6' subsample collected. 1-2% gravels up to 1cm in size, matrix clayey silt. No PID response above background.

1151 8' subsample collected. No PID response.

1201 10' subsample collected. Soil similar to that at 8' level. 1-2% gravel up to 2cm in size. No PID response above background.

Robert R. Alexander — Trace Hart

1204 T. Hart mixed soil in bowl and collected WSOR-SUB-09-0-10'

1250 T. Hart began bucket decon after lunch break.

1300 B. Alexander calibrated HNU PID
I.S. = 3.57 (RRA)
F.S. = 2.92 (RRA)
Notes above by R. Alexander

1330 T. Hart collected soil at 11' level
Soil similar to 10' sample - Sand present.
No PID response above background.

1340 12' soil (TH) collected - No PID response
Some aggregate 6" diameter - similar soil to 11'.
Above notes by X T. Hart

1346 13' subsample collected. Soil 30% limestone gravels 1-10cm in size, clayey silt matrix, No PID response above background.

1354 14' subsample collected. Soil a silty clayey silt w/ 1-2% gravels 1-5cm in size (N/A)
PID showed no response above background.

1403 15' subsample collected. Soil 70% gravel 1mm.-2cm. in size. Matrix a sandy silt. PID showed no response above background.

1404 T. Hart mixed soil and collected sample WSOR-SUB-09-11-15'

Robert R. Alexander — Trace Hart

1415 T. Hart Decorning bucket.

1427 T. Hart completes decon of bucket. Spec. Cottman & Sgt. Johnson head back to trench #9 for grab.

1431 WSOR-SUB-09-15' collected.

1500 Decon of bucket complete.

1516 Collected 2' subsample for WSOR-SUB-10-0-10'. Soil clayey silt typical of upper layers of site. PID elicited no response above background.

1524 collected 4' subsample. Soil similar to 2', except for development of some calcareous nodules. PID had no response above background

Note: Trench #10 located between 330N, 200E and 330N, 250E and 10' South and parallel to to the line

1535 Collected 6' subsample. Soil similar to that in 4' sample. PID had no response above background.

Robert H. Alexander

1545 Collected 8' subsample. Soil same as in previous, PID radio response above background.

1554 Collected 10' subsample. Soil same appearance as that in 8', except a few more calcareous nodules.

1557 T. Hart wiped soil and collected WSOR-SUB-10-0-10'.

1615 Began securing equipment for the night. All samples had the same lot numbers for each type today. Weather breezy and warm, 10-20 kts from south

1645 Left site

0800 Called Federal Express to pick up 2 coolers for explosives ~~OERA~~ and 1 cooler of metals and semivol. Confirmation # ROWA#17.

0945 arrived at Range Tower

0956 arrive on site. Personnel present:

Spec. Cottman
Sgt. Johnson
Sgt. Desrosiers
George Baird
Troy Hart
Bob Alexander

1010 B. Alexander and T. Hart setting up equipment for the day's activities

1020 T. Hart begins bucket decon and B. Alexander labels sample jars

1035 Bucket decon complete

1036 Weather clear, breezes 0-5 kts from west, about 70°F.

1049 WSOR-RIN-10 for USATHAMA Explosives collected to replace the sample that was broken, a goat unavoidably flew into the water while being poured and maybe in the bottles →

Robert K. Alexander

1/2 the water was collected from ~~sanita~~ (PPA) runoff from the bowl and trowel and 1/2 from spraying the backhoe bucket and letting it drip into the bowl. Lot number for this sample is: H1059010

1100 Calibrated HNU PID by B. Alexander
I.S.: 2.94 F.S.: 3.46

1103 11' subsample for WSOR-SUB-10-11'-15' collected. Soil a silty sand with calcareous nodules. PID showed no response above background.

1110 12' subsample collected. Soils now have gravel <5%, 1-5 cm in size. PID showed no response above background

1115 13' subsample collected, Soils have slightly less gravel. Still a silty sand. PID showed no response above background.

1123 14' subsample collected. Soil a little more sandy. PID showed no response above background

1133 15' subsample collected. Soil same as in 14'. PID had no response above background

1136 T. Hart mixed soil in bowl and collected WSOR-SUB-10-11-15'

Tony Hart

Robert K. Alexander

1143 T. Hart decontaminating bucket. B. Alexander decontaminated trowel

1154 Spec. Cottman heads out to collect grab in Trench #10.

1200 T. Hart collects grab WSOR-SUB-10-15' (10-15') (PPA)

1205 Spec. Cottman filling in hole.

1215 T. Hart decontaminating bucket.

1220 Broke for lunch. ~~but~~ (PPA) Weather still nice, clear, winds 0-5 kts from west, about 75°F

1310 Showed Sgt. ~~Sgt.~~ PPA Desimone location of trench #11. Trench #11 is located just south of the indefinite positive area, along line heading east of ~~PPA~~ 450N.

1324 2' subsample for WSOR-SUB-11-0-10' collected. Soil the clayey silt typical of upper layers here at the site. PID showed no response above background

1331 4' subsample collected. Soil similar to last subsample. PID showed no response above background.

1339 6' subsample collected. Soil similar in appearance to previous subsamples. PID had no response above background.

Robert R. Alexander — Tour 21

Lot numbers for samples collected thus far today, including this one are:
USATHAMA Exp: X103403O
RCRA metals: F104801O
Semi-Vol: V008030

1349 8' subsample collected. Soil still a clayey silt with about 1-2% gravels of 1-10cm size. PID showed no response above background.

1402 10' subsample collected. Soil now has more gravels (5%) of 5mm to 3cm in size. PID had no response above background.

1404 T. Hart homogenized soil in bowl and collected WSOR-SUB-11-0-10'.

1411 T. Hart decorning bucket.

1423 T. Hart completes bucket decon. Spec. Cottman left a few minutes earlier to make a phone call at the range tower. Sgt. Desimone also went with Cottman.

1439 Cottman and Desimone still gone.

1452 Cottman and Desimone return.

1503 11' subsample for WSOR-SUB-11-11-15' collected. Soil about 10% gravels of 1-3cm in size. PID showed no response above background.

Robert R. Alexander — Tour 21

1508 Calibrated HNPID by B. Alexander. I.S. = 3.46 F.S. = 3.00

1512 12' subsample collected. Soil similar to that at 11'. PID had no response above background.

1518 13' subsample collected. Soil similar to previous — a silty matrix with about 10% gravels. PID showed no response above background.

1525 14' subsample collected. Soil similar to previous, except larger size range of gravels — 5mm — 3cm. PID showed no response above background.

1530 Winds increased to 10-15 blow from west-southwest, temperature about 80°F.

1535 15' subsample collected. Soil similar to that in 14'. PID had no response above background.

1538 T. Hart mixed soil in bowl and collected WSOR-SUB-11-11-15'.

1555 T. Hart completes bucket decon. Backhoe returns to Trench 11.

1605 WSOR-SUB-11-15' collected.

Robert H. Alexander

Tony Hart

1615 T. Hart begins bucket decon. All samples taken thus far have had the same lot numbers as noted at 1339.

1635 Showed Sgt. Desimone location of Trench #12. Trench #12 is parallel to the ~~the~~ PRA line made between 600N, 250E and 600N, 300E and about 5' to the north. ~~the~~

1645 2' subsample collected for WSOR-SUB-12-0-10' and WSOR-SUB-12S-0-10'. Soil clayey silt typical of other locations. PID showed ~~no~~ PRA no response above background.

1651 4' subsample collected. Soil similar to that at 2', roots still present and some calcareous stringers present. PID response not above background.

1701 6' subsample collected. Soil contains about 5% gravels 5mm to 2cm in size. PID had no response above background.

1709 8' subsample collected. Soil similar to that at 6'. PID had no response above background.

Robert H. Alexander

Tony Hart

1723 10' subsample collected. Soil similar to that in 8'. No PID response above background.

1725 T. Hart mixed soil together in bowl and collected WSOR-SUB-12S-0-10'

1728 WSOR-SUB-12-0-10' collected

1755 Secured equipment and left site.

5/16/91 Robert A. Alexander (From o Here)

0700 Contacted Federal Express for sample shipment pick-up: Conservation ROWA#4

0815 arrived on-site. Personnel present:
Spec. Cottman
Sgt. Desimone
Sgt. Johnson
George Baird
Troy Hart
Bob Alexander
Weather calm, clear, about 65°F.

0820 Began setting up for the days activities. T. Hart began decon of bucket @ 0825.

0838 HNU PID calibrated by B. Alexander
I.S. = 3.00 F.S. = 3.575

0840 bucket decon complete.

0855 11' subsample for WSOR-SUB-12-11-15' collected. Soil a clayey silt with numerous calcareous nodules. PID had no response above background.

0904 12' subsample collected. Soil now contains about 10% gravel, 3mm-3cm in size. PID had no response above background.

Robert A. Alexander (From o Here)

0915 13' subsample collected. Soil now a sandy silt with some amount of gravel ~~in~~ PPA as in the 12' subsample. PID showed no response above background.

0924 14' subsample collected. Soil similar to that at 13'. PID showed no response above background.

0933 15' subsample collected. Soil similar to that at 14'. PID showed no response above background.

0935 T. Hart homogenized soil in bowl and collected WSOR-SUB-12-11-15'

0950 T. Hart deconing bucket.

0956 Lot numbers for WSOR-SUB-12-11-15':
USATHAMA Explosives: X1034030
RCRA Metals: F1048010
Semi-Volatiles: V1008030

1006 T. Hart collected WSOR-SUB-12-15'

1040 T. Hart finishes bucket decon. Bottles prepared by B. Alexander. Weather about 75°F, winds about 0-5 ~~knots~~ PPA knots from NW, clear.

1045 Lot numbers for WSOR-SUB-12-15' same as for the 11-15' composite sample also. Sgts Johnson and Desimone left to make phone calls.

Robert A. Alexander

Front Hard

1100 Desimone & Johnson return

1105 B. Alexander shows Sgt. Desimone location of trench #13. Trench #13 is located about 15' NE of 240N, 50E.

1110 2' subsample for WSOR-SUB-13-0-10' collected. Soil clay silt typical of other locations near surface, have rootlets. PID had no response above background.

1120 4' subsample collected. Soil same as at 2'. PID had no response above background.

1127 6' subsample collected. Soil same as at 4', except w/ calcareous nodules. PID had no response above background

1136 8' subsample collected. Soil now has about 15% gravel in it (PPA), 1-3cm in size. PID had no response above background. (PPA)

1149 10' subsample collected. Soil similar to that at 8', but with larger gravels (up to 5cm). PID showed no response above background.

1151 T. Hart homogenized soil in bowl and collected WSOR-SUB-13-0-10'.

1201 Broke for lunch. (PPA)

Robert A. Alexander

Front Hard

1236 Winds now coming from SW at 5-10 kts, temperature about 75°F. T. Hart deconning bucket.

1249 Decon of bucket complete. Sgt. Johnson and Spec. Cottman head out to resume trenching.

1257 11' subsample collected. Soil about 30% gravel, 1cm to 5cm in size, matrix silty. PID showed no response above background.

1305 12' subsample collected. Soil similar to that in 11'. PID had no response above background. (PPA)

1320 13' subsample collected. Soil has less gravel in it (10%) and a silty matrix. PID had no response above background.

1327 14' subsample collected. Soil similar to that at 13'. PID had no response above background.

1338 15' subsample collected. Soil similar to that found at 14'. PID had no response ~~above~~ (PPA) above background

1340 WSOR-SUB-13-11-15' collected after mixing of soil by T. Hart.

Robert R. Alexander

From ~~Hart~~

1347 T. Hart in the process of deconing backhoe bucket.

1400 ~~Decon of~~ (RRA) Decon of bucket complete. Cottman and Johnson headout to collect grab WSOR-SUB-13-15.

1405 WSOR-SUB-13-15 grab sample collected.

1414 T. Hart deconing shovel and trowel in preparation for collecting pond sample.

1420 B. Alexander located location in pond for collection of a sediment sample. Pond is dry, with large mud cracks stiff enough to walk on. Animal tracks are common.

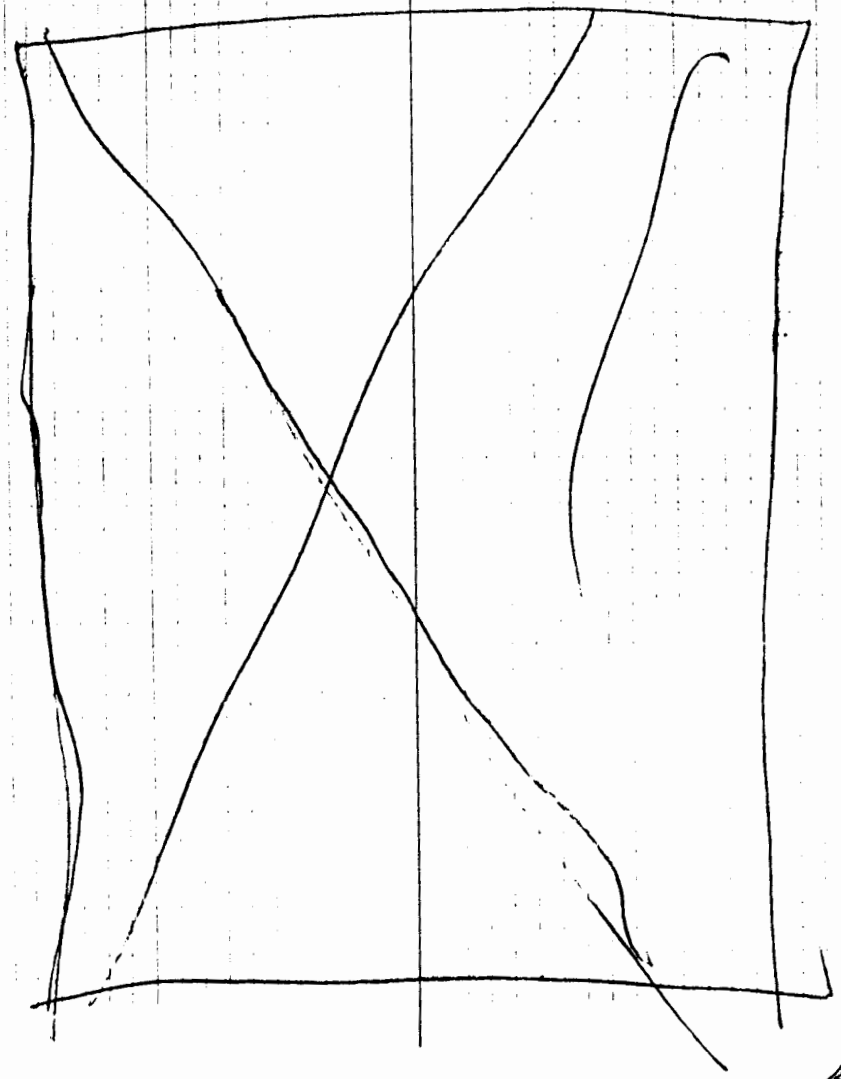
1435 WSOR-PND-6-8" collected in east pond in the center, location picked where there were no animal tracks. The pond sediment is nearly 100% clay, probably a montmorillonite, given the large cracking due to dessication.

1500 Began cleaning and picking up equipment

Robert R. Alexander

From ~~Hart~~

1715 Finally got equipment packed up — will return tomorrow to locate trenches. Left site.



30 5/17/91 Robert R. Alexander Zone Hunt

0930 arrived on site. Personnel present:
Spec. Cottman
Sgt. Johnson
Sgt. Dedinger
Pfcs. Hart
Robert Alexander

0950 French ~~Loca~~ #1 located at 902 N, 11E and 887N, 23E.

0957 French #05 located at 1090N, 0E and 1073N, 0E

1006 ~~French~~ RRA French #02 located at 943 N, 450E and 944N, 468E.

1016 French #07 located at 600N, 433E and 615N, 435E.

1023 French #09 located at 508N, 316E and 509N, 382E

1039 French #12 located at 613N, 287E and 613N, 273E.

RRA ~~RE~~ 1044 French ~~#08~~ located at 518N, ~~RE~~ RRA 187E and 583N, 175E

1059 French #04 located at 685N, 202E and 698N, 209E.

Robert R. Alexander Zone Hunt 31

1106 French #06 located at ~~7~~ RRA 738N, 11E and ~~739N~~ RRA 739N, 28E.

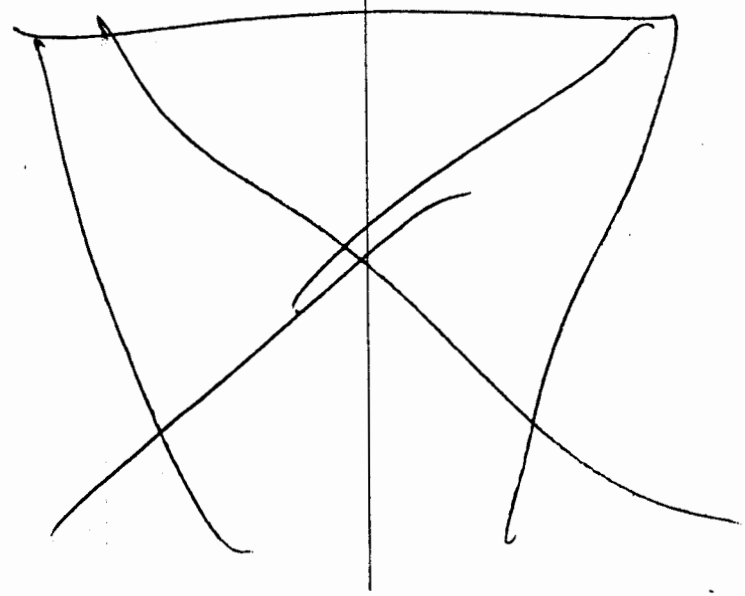
1120 French #11 located at 438N, 42E and 438N, 56E

1128 French #33 located at 440N, 206W and 493N, 218W.

1137 French #13 located at ~~25N~~ RRA 251N, 76E and 255N, 89E

1143 French #10 located at 313N, 235E 313N, 220E

1200 Departed site.



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PPA

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APPENDIX G

SUPPLEMENTAL RISK ASSESSMENT INFORMATION

APPENDIX G

SUPPLEMENTAL RISK ASSESSMENT INFORMATION

G.1 TOXICITY PROFILES

The contaminants of concern are selected to provide a focus for the assessment of risk and to identify the principal chemicals contributing to risk at the sites. To assess the risk associated with exposure to the contaminants of concern, it is necessary to determine the hazards that are unique to these substances. The IRIS Data Base and Hazardous Substance data base (HSDB 1991) were used as resources to define potential human health hazards of these substances. The toxicity profiles in this section provide a summary of those hazards for the following contaminants.

- Antimony.
- Cadmium.
- Zinc.
- 2,4-Dinitrotoluene

G.1.1 Antimony

Chemical and Physical Properties

Chemical Name: Antimony

CAS Registry Number: 7440-36-0

Boiling Point: 1750° C

Melting Point: 630.7° C

Molecule Symbol: Sb

Molecular Weight: 121.75 units

Water Solubility: Insoluble

Introduction

Antimony is used in alloys of metals and in the manufacturing of fireproofing chemicals, ceramics, glassware, and pigments.

Metabolism

Antimony is absorbed in the respiratory and gastrointestinal tracts. Upon absorption, trivalent antimony concentrates in the liver and the red blood cells. Pentavalent antimony concentrates in the plasma. Both forms are excreted in feces and urine, with trivalent antimony at greater concentrations in the urine and pentavalent antimony at greater concentrations in the feces.

Toxicity

Ingestion of antimony may result in severe gastrointestinitis including vomiting and diarrhea. Inhalation of dust containing antimony compounds can result in inflammation of the nasal passages and pulmonary edema, cardiovascular changes may also occur with exposure to antimony, tri- or pentavalent antimonial compounds. Observations of cardiac edema, myocardial fibrosis, and other signs of myocardial damage indicates that antimony exposure may produce permanent myocardial damage in humans (Clement Assoc. 1985).

Chronic exposure to antimony compounds can result in inflammation of the nasal passages, pharyngitis, tracheitis, and over the long term, bronchitis and eventually obstructive lung disease and emphysema (Doull et. al. 1986). Antimony production has been associated with an increase in lung cancer in exposed workers.

The USEPA Reference Dose (RfD) values is based on a study performed by Schroeder (1970). Subjects were dosed with potassium antimony at a concentration of 5 ppm. Growth rates were not affected but treated males and females survived 106 and 107 fewer days, respectively, than controls. Cholesterol levels in both treated sexes were altered and glucose levels and mean Heart weight decreased in treated males. No increase in tumors was seen as a result of treatment. Since only one dose was administered a No Observed Adverse Effect

Level (NOAEL) was not established but the Lowest Observed Adverse Effect Level (LOAEL) was determined to be 0.35 mg/kg/day (IRIS 1991). As a result of this study, an RfD value of 4E-4 mg/kg/day was established (IRIS 1991).

Carcinogenicity

Antimony is classified as a Class D compound.

Mutagenicity

Increased chromosome defects were observed when human lymphocytes are incubated with soluble antimony salt (Doull et. al. 1986). Several studies in bacterial test systems report that some antimony compounds including trioxide and tri- and pentachloride may be mutagenic (Clement Associates 1985).

Teratogenicity

Clement Associates (1985) reported that impairment to the female reproductive system has been associated with exposure to antimonial compounds. Female workers exposed to metallic antimony dust, antimony tri- and pentaoxide had increased incidence of gynecological disorders and late spontaneous abortions. Antimony was found in the breast milk, placental tissue, amniotic fluid, and blood of the umbilical cord in exposed workers. Decreased weight gain was also observed in children of workers exposed to antimony. Similar effects were shown in animal studies with treated rats (Doull et. al. 1986).

G.1.2 Cadmium

Chemical and Physical Properties

CAS Registry Number: 7440-43-9

Molecule Symbol: Cd

Molecular Weight: 112.41 units

Boiling Point: 765° C

Melting Point: 320° C

Water Solubility: Slightly Soluble

Introduction

Cadmium is a naturally occurring element which is used in electroplating, as a color pigment in paints and as a minor ingredient in fertilizers. Cadmium occurs naturally in ground and surface waters at concentrations ranging from 1 to 10 μg/l (NAS 1977). The compound is readily absorbed by plant and animal life.

Metabolism

Cadmium is absorbed by the gastrointestinal tract at a concentration rate of 5 to 8% (Flanagan et al. 1978) while the pulmonary absorption rate has been estimated to between 15 and 30% (Dorn 1976).

Absorbed cadmium is transported in blood bound to the red blood cells and in plasma proteins such as albumin. (Doull et al. 1986). A minimal fraction is said to be transported in the blood by metallothione (Doull et al. 1986). The principal fraction of absorbed cadmium is stored in the kidney and liver for periods of up to 30 years (Doull et al. 1986).

Toxicity

Cadmium salts are highly toxic. Inhalation of dust or fumes may cause upper respiratory irritation, headaches, nausea, vomiting, pneumonitis, and death. Ingestion may cause nausea, vomiting, abdominal pain, renal dysfunction, and anemia.

Acute inhalatory exposure of cadmium fumes at concentrations which range from 0.5 to 2.5 mg/m^3 have been reported to effect transitory pneumonitis (Lauwerys et al. 1974). Fatalities have been reported at concentrations of 9 mg/m^3 after one hour exposure.

In addition to pulmonary involvement, cadmium has significant effects on the kidney. Renal tubular neuropathy is widely reported to occur when the cadmium concentration reaches a level of 200 mg/g in the kidney (Lauwerys et al. 1974; Friberg et al. 1974).

The estimated LOAEL is 200 mg Cd/g tissue (level for evidence of renal dysfunction).

The EPA has estimated the LOAEL for cadmium to be 228 mg/day. The EPA findings were based on Friberg (USEPA 1984) observations of humans who had been exposed to cadmium at concentrations of 228 mg/day to 350 mg for periods from 50 years to a lifetime. The subjects symptoms included dizziness and renal dysfunction. The USEPA has established a Oral RfD value of 5.0E-04 for cadmium (IRIS 1991).

Carcinogenicity

Chronic feeding studies with cadmium sulfate were performed by Levy et al. (1975). Fifty Swiss male mice were administered cadmium doses of 0.44, 0.88 or 1.75 mg/kg for a period of 18 months. No significant differences were observed in tumor incidence between treated and control subjects.

Additional feeding studies were performed by Schroeder et al., (1965) and Levy and Clark (1975) with CB Hooded and Long-Evans rats. No significant differences were observed in total tumor incidence rate between treated and control groups.

Inhalation studies were performed by Takenaka et al. (1983). The male Wistar rats were exposed to cadmium concentrations of 50.8, 25.7 and/or 13.4 $\mu g/m^3$ for a period of 18 months. Subjects were kept an additional period of thirteen months before sacrifice. A dose related increase in lung tumors was observed.

The USEPA (1984) evaluated the animal data and classified cadmium as a Group B1 probable human carcinogenic via inhalation.

Mutagenicity

Cadmium has been tested extensively for metagenetic potential. The results are very mixed (USEPA 1984). The results of studies using plant species have been generally positive with observed chromosomal aberrations (USEPA 1984). Human exposures however have produced equivocal results (USEPA 1984).

Teratogenicity

Rats were administered 0.1 mg/l cadmium in water for 90 days. No reproductive effects were observed (Dixon et al. 1976). Studies by Schroeder and Mitchner (1971) at dose levels of 10 mg/l cadmium did effect teratogenic and reproduction responses with the subject rodent. The subjects exhibited decreased fertility, decreased growth, young deaths and caused deformity in a three generation study.

G.1.3 Zinc

Chemical and Physical Properties of Zinc

CAS Registry Number: 7440-66-6

Molecule Symbol: Zn

Molecular Weight: 65.38 g/mol

Boiling Point: 907° C

Melting Point: 419.6° C

Water Solubility: Insoluble

Introduction

Zinc is a malleable, flexible metal and a good conductor of electricity. Zinc is also essential to human health in small amounts.

Metabolism

Absorption of zinc by the gastrointestinal (GI) tract is variable in animals and poor in humans. Zinc is absorbed primarily in the duodenum. Clayton et al. (1981; 1982) reported that only a small amount of zinc is absorbed and stored in tissues of animals. The primary sites of storage are in the liver and pancreas. Osol and Hamilton (IRIS 1991) reported that zinc can readily bind to groups of proteins, amino acids and other organic molecules. Friberg et al. (1986) reported that regulation of zinc input and output takes place in the intestine. Animal studies suggest that metallothionein, a cytoplasmic metalloprotein, has a

role in maintaining zinc equilibrium in the body. Inhalation of zinc fumes may result in a transient accumulation in the lungs before absorption into the blood. Zinc is primarily excreted in the feces, in an amount approximately equal to the amount administered.

Toxicity

Metal fume fever is the most significant effect of inhalation of zinc oxide fumes. Attacks usually begin 4 to 8 hours after exposure. Symptoms include chills and fever, profuse sweating and weakness. Attacks usually only last 24 to 48 hours after exposure.

Zinc salts are corrosive to the skin, and irritating to the GI tract. Ingestion of zinc salts induces nausea and vomiting. Bai et al. (1980) administered zinc phosphide at doses of 0, 50, 100, 200 and 500 ppm to female rats. In rats dosed at 200 or 500 ppm there was approximately 8 and 83% mortality, respectively. Histopathological lesions accompanied with increased liver, kidney and brain weights were only observed in rats in the 200 and 500 ppm doses. Food intake and bodily weight significantly decreased in all exposed rats, indicating a dose-response susceptibility to zinc phosphide dosed at 50 and 100 ppm. Extensive hair loss was seen in those rats exposed to 50 and 100 ppm doses. Hair growth returned to normal after week 6 in those rats exposed to the 50 ppm dose. Therefore, 50 ppm (3.48 mg/kg/day) is considered the LOAEL.

Carcinogenicity

The USEPA has classified zinc as a Group D compound.

Mutagenicity

There are no data to support the mutagenic potential of zinc.

Teratogenicity

There are no data to support the teratogenetic potential of zinc.

G.1.4 2,4-Dinitrotoluene

Chemical and Physical Properties

CAS Registry Number: 121-14-2

Molecule Symbol: 2,4-DNT

Molecular Weight: 182.1 units

Boiling Point: 270° C

Melting Point: 70° C

Water Solubility: Insoluble

Introduction

2,4-Dinitrotoluene (2,4-DNT) is used in the manufacturing of azo dyes, plasticizers, explosives, and as a propellant additive.

Metabolism

Absorption of 2,4-DNT is primarily in the blood, liver and cardiovascular system. 2,4-DNT can affect the body if it is inhaled, comes in contact with the eyes or skin, ingested, or is readily absorbed through the skin.

Toxicity

2,4-DNT absorption, whether from inhalation of the vapor or absorption of the solid through skin, causes anoxia due to the formation of methemoglobin. Jaundice and anemia have been reported. Signs and symptoms of overexposure are due to the loss of oxygen carrying capacity of the blood. At methemoglobin concentrations of over 40% their usually is weakness and dizziness; at up to 70% concentrations there may be ataxia, dyspnea on mild exertion, tachycardia, nausea, vomiting and drowsiness (HSDB 1991).

Carcinogenicity

2,4-DNT is a class B2 probable human carcinogen.

The United States Army set a drinking water limit of 1.1 μg/L for DNT in response to groundwater contamination resulting from practices at two Army munitions plants (Rosenblatt and Small 1988). The chronic Lowest Observed Effect Level (LOEL) for 2,4-DNT designed to protect aquatic life is 230 μg/L (EPA 1986). The USEPA established an oral cancer potency slope factor for 2,4-DNT of 6.8 X 10-1 (mg/kg/day) (HEAST 1991).

Mutagenicity

Data is insufficient to determine mutagenetic potential of 2,4-DNT.

Tetratogenicity

NIOSH recommends that 2,4-DNT be regarded as a potential human carcinogen and a possible inducer of adverse reproductive effects (HSDB 1991).

G.2 ENVIRONMENTAL FATE AND TRANSPORT

Fate and transport profiles have been provided on the selected COC. The profiles serve as a tool to predict the persistence of the COC within the surveyed medium, and to predict the future migration of these contaminants to air, subsurface soil, and groundwater.

Antimony is a naturally occurring element which is found in the environment in four different valance states: -3, 0, +3, and +5 (Clement Assoc. 1985). The substance is soluble in natural water as antimonide, a soluble oxide. The substance is normally quite mobile, but is known to readily sorb to clays and minerals. Antimony adsorbs to sediments in a reducing environment and will remobilize to the aqueous medium under oxidizing conditions.

Cadmium is a naturally occurring element which is used in the plating industry, paint and coating industry, and in fungicide production. Cadmium is somewhat soluble in the aquatic environment and is removed from the aquatic medium by organic and inorganic complexes. Information on cadmium migration in soil is limited; however, cadmium is expected to move slowly through sandy soils but has the tendency to readily sorb to organic matter.

Zinc is a naturally occurring element which is found in both suspended and dissolved forms. Zinc is an essential nutrient for human metabolism and is readily bioaccumulated in both animal and plant tissue. The substance is used as a component of lubricating oils and pesticide products.

The fate of zinc in an aerobic aquatic system includes sorption to clay and organic material. Zinc tends to adsorb in waters with higher pHs while it desorbs in acidic aquatic conditions. Zinc compounds are, for the most part, soluble in surface water conditions with neutral or acidic pHs and in low organic content soils (Clement Assoc. 1985).

2,4-Dinitrotoluene (2,4-DNT) is used as a propellant additive and in explosives and may also occur in the environment as an intermediate product in the degradation of trinitrotoluene. In soil, 2,4-DNT will be slightly mobile based on aqueous biodegradation tests. 2,4-DNT may biodegrade in both aerobic and anaerobic zones of soil. 2,4-DNT in water will not bioconcentrate significantly and will have a slight tendency to partition to suspended and sediment organic matter (HSDB 1991).