NOTICE

All drawings located at the end of the document.

RF/ER-96-0036

Field Sampling Plan for Delineation of The 903 Pad, Lip Area, and Surrounding Surface Soil Radioactive Areas

Final

June 1996

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Field Sampling Plan for Delineation of The 903 Pad, Lip Area, and Surrounding Surface Soil Radioactive Areas

Rocky Mountain Remediation Services, L.L.C.

Environmental Restoration/
Waste Management Sitewide Actions

June 1996

Revision 0

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ACRONYMS, ABBREVIATIONS, AND INITIALISMS

FSP	Field Sampling Plan
IHSS	Individual Hazardous Substance Site
RFETS	Rocky Flats Environmental Technology Site
RCRA	Resource Conservation and Recovery Act
RFI/RI	RCRA Facility Investigation/Remedial Investigation
VOC	volatile organic compounds
HPGe	high purity germanium
FIDLER	Field Instrument for Detection of Low Energy Radiation
FOV	field-of-view
DQO	data quality objective
PAM	Proposed Action Memorandum
MDA	minimum detectable activity
GPS	Global Positioning System
GIS	Geographic Information System
OU	Operable Unit

1.0 INTRODUCTION

The purpose of this Field Sampling Plan (FSP) is to identify and delineate the areal extent of a portion of the radiologically contaminated surficial soil at the Rocky Flats Environmental Technology Site (RFETS) to plan remedial actions. Implementation of the FSP will provide better definition of the extent of contamination requiring remedial action at the Individual Hazardous Substance Site (IHSS) 112 – 903 Drum Storage Site (the 903 Pad), the IHSS 155 – 903 Pad Lip Area (the Lip Area) and surrounding areas, and is expected to identify isolated surficial soil hot spots that may be suitable for remediation through accelerated actions.

The FSP summarizes the existing data, and describes the scope of work required to define the plutonium and americium radioactive contamination in surface soils located at the 903 Pad, the Lip Area, and surrounding areas at RFETS.

1.1 BACKGROUND

The 903 Pad and Lip Area are located southeast of the RFETS industrial area and are the primary sources of radiological contamination in the surficial soil in this part of RFETS (see Figure 1-1). This area has been characterized as part of the Operable Unit (OU) 2 Phase II Resource Conservation and Recovery Act (RCRA) Facility Investigation/Remedial Investigation (RFI/RI) (DOE 1995) and the following information was derived from that report.

Drums that contained radiologically contaminated oils and volatile organic compounds (VOCs) were stored at this location from the summer of 1958 to January 1967. Approximately three fourths of the drums contained plutonium-contaminated liquids, while most of the remaining drums contained uranium-contaminated liquids. Of the drums containing plutonium, the liquid comprised primarily lathe coolant and carbon tetrachloride in varying proportions. Also stored in the drums were hydraulic oils, vacuum pump oils, trichloroethylene, perchloroethylene, silicone oils, and acetone still bottoms.

Leaking drums were noted in 1964 during routine handling operations. The contents of the leaking drums were transferred to new drums, and the area was fenced to restrict access. When cleanup operations began in 1967, a total of 5,237 drums were at the drum storage site at the 903 Pad. Of the 5,237, approximately 420 drums had leaked to some degree. Of these, an estimated 50 drums were empty, having leaked their entire contents. The total amount of leaked material was estimated at around 5,000 gallons of contaminated liquid containing approximately 86 grams of plutonium.

From 1968 through 1978, approximately 1,300 cubic yards of the radiologically contaminated material was removed, the surrounding area was regraded, and much of the area was covered by clean road base and an asphalt cap.

During drum removal and cleanup activities, wind and rain spread plutonium to the east and southeast from the 903 Pad area creating the IHSS 155 – 903 Pad Lip Area (see Figure 1-1). Although several limited excavations have removed some of the plutonium contaminated soils from the Lip Area, recent sampling and analysis confirms that radiologically contaminated soils remain.

Surface soils to the east and southeast of the Lip Area also exhibit elevated plutonium and americium values (see Figure 1-1 for an overview of sampling locations). This contamination is primarily attributed to wind dispersion from the 903 Pad with a possible contribution from historical fires and stack effluent.

1.2 SITE CONCEPTUAL MODEL

The surficial geology in this area consists of Quaternary alluvium, colluvium, and slump deposits along with artificial fill, soil and debris deposits, and disturbed soil. The surficial deposits overlie bedrock consisting of weathered claystone and minor bedrock sandstones of the Cretaceous Arapahoe and Laramie Formations. Surficial deposits consist of sandy clay and clayey gravel. Soil developed over the alluvium is rocky and sandy in contrast to the clayey soils developed over the claystone bedrock.

The surficial soil contaminants of concern are plutonium and americium. The plutonium is relatively insoluble and tends to agglomerate with soil grains. While there is a tendency for plutonium and americium concentrations to decrease with increasing distance from the source areas, several areas outside of the 903 Pad and Lip Area show higher concentrations. These variances from typical wind-dispersed contamination reflect the influences of several factors including surface water runoff from rain or snow melt, past cleanup efforts, and biological activity. Numerous earthworms and ant colonies have been observed in the area which may result in the upper transport of actinides (Litaor, et al., 1994).

The data will be evaluated and isolated areas where concentrations of plutonium and americium are elevated above the concentrations in the surrounding surficial soils will be evaluated for potential remediation. If these are limited in areal extent, these may be removed as hot spots. In addition, the survey results will be compared to the vertical samples to determine if there is a correlation between subsurface and surface soil activities.

2.0 PROJECT AND DATA QUALITY OBJECTIVES

The objective of this FSP is to characterize the 903 Pad, Lip Area, and surrounding area actinide concentrations in surficial soils sufficiently for planning future remedial actions. A two-staged approach is planned. Truck and/or tripod-mounted high purity germanium (HPGe) detectors will be used to provide a better-defined radiological survey of the entire study area, followed by closer-spaced, hand-held Field Instrument for Detection of Low Energy Radiation (FIDLER) surveying as required to obtain additional detail and to identify potential hot spots. Neither laboratory analyses of soil samples nor removal of soil hot spots are planned as part of these field activities.

The data collected under this FSP will identify and delineate the areas with contaminated soil to plan hot spot removals where appropriate, and to assist with determining the volume and most appropriate remedial action for the remaining radioactive soils. Refining the identified areas before the start of remediation will reduce the areal extent of the action, and the resulting impact to the environment can be reduced. Further defining the areal extent of surficial soils requiring a remedial action will result in appropriate planning, identification of the appropriate method to perform the remedial action, and determination of the volume of impacted soil.

2.1 PREVIOUS DATA ADEQUACY

Previous surface soil investigations were broad in scope and did not adequately define the source areas for the purpose of conducting hot spot removals or remedial actions. Radiological analyses of composite soil samples from plots of 12,100 square yards or larger were obtained, and radiological surveys were performed at the 903 Pad, Lip Area, and surrounding area as part of the OU 2 Phase II RFI/RI activities (DOE 1995). Surface soils with concentrations of plutonium and americium well above proposed action levels were found at three plots situated near but outside of the 903 Pad and Lip Area (see Figure 1-1).

A truck-mounted HPGe survey was conducted in June 1994. The HPGe survey measured the average concentrations of actinides over a specific field-of-view (FOV), which, for the 1994 survey, was 150 ft in diameter. The FOV is optimized to obtain the specified sensitivity for the results. For example, a large FOV will provide less sensitive results than a smaller FOV. The 1994 survey was conducted over part of the Americium Zone east of the 903 Pad and Lip Area. This survey identified 35 FOV locations, many which are contiguous, where estimated americium-241 activities were above 10 pCi/g (see Figure 2-1). Smaller FOV readings were taken in a few areas. These are also shown on the map, but values were not posted. The three soil sample plots with elevated plutonium activities identified during surficial soils sampling (above) occur within the elevated areas determined by the HPGe survey but do not correspond directly with any one particular FOV measurement.

2.2 DATA QUALITY OBJECTIVES (DQOs)

Data quality objectives are set forth to optimize sample collection with respect to accomplishing the ultimate remediation objectives. The DQO methodology ensures a minimization of costs, while collecting sufficient data to decide, with a stated level of scientific confidence, whether the project objectives have been accomplished. The method is consistent with the latest EPA guidance (EPA 1994, "EOA QA/G-4").

The DQOs are to characterize the 903 Pad, Lip Area, and surrounding area actinide concentrations for future remedial actions. The previous surficial soil sampling program obtained data by compositing samples over at least 12,100 square yard plots. The previous HPGe survey analyzed activities in a 150-ft FOV. Isolated, higher concentrations would be averaged when composited over these areas. Therefore, sampling on the smaller grid spacing will allow definition of the limit of contamination sufficient to implement remedial actions, and better define the extent of higher concentrations of plutonium and americium. Table 2-1 shows the DQOs for this project.

Table 2-1 Data Quality Objectives for the Field Sampling Plan

DQOs	How Achieved
Characterize the actinide concentrations for the 903 Pad, Lip Area, and surrounding areas sufficiently to plan remedial actions.	A HPGe survey will be conducted with a FOV (diameter of measured area) of 39.4 ft (12 m). This survey will further delineate the area of contaminated soil that must be addressed by remedial actions. The grid spacing and FOV will ensure 100% coverage of the area.
Identify areas of discontinuous contamination that may be appropriate for potential hot spot removals.	FIDLER surveys will be conducted for specific FOVs where HPGe measurements exceed 100 pCi/g for plutonium-239, but at least two neighboring FOVs are below this level.

Follow-on remedial actions are not a part of this FSP and will be performed through either IM/IRA or Proposed Action Memorandum (PAM) documents.

3.0 DATA COLLECTION

Nonintrusive field activities were chosen to cost-effectively and adequately define the actinide concentrations in the 903 Pad, Lip Area, and surrounding area. Traditional sampling and analysis approaches are not capable of effectively isolating small areas with elevated actinide contamination over the large surface area investigated for this project (207,778 square yards). The field program will be conducted using a phased approach through surveying using the truck and/or tripod-mounted HPGe detectors, followed by FIDLER survey as required. The HPGe detector was chosen because it can detect low levels of plutonium-239 and americium-241 on a real-time basis, eliminating the time and expense of laboratory analyses.

There are limitations to the HPGe equipment. While RFCA defines surface soil as the upper 15 cm of soil, the detectors can only detect radiological contamination within the upper 3 cm of soil at the surface. Therefore, the detectors can accurately determine the average concentrations of radionuclides over the FOV at the surface, but higher concentrations at depth will not be detected. However, the objective is to define areas of radiological contamination (above action levels) to protect surface water. Contamination at depth does not pose a threat to surface water. Soil samples taken from within the FOV may have higher plutonium and americium values due to the averaging effect using the HPGe. However, the results of the HPGe survey will be sufficient to identify and delineate the areal extent of radiologically contaminated soil that will require remediation, either as hot spot removals, or during remediation of the 903 Pad, Lip Area, and surrounding areas.

The HPGe radiation detection instrument is designed to detect gamma rays produced by the decay of radioactive isotopes. For the radioactive isotopes that emit gamma rays, each isotope decays according to a unique decay series and produces gamma rays of characteristic energy levels. The HPGe sensors are calibrated using a known source which contains a mixture of the radioactive isotopes expected at RFETS. For equal concentrations of americium and plutonium, americium will emit a larger number of gamma rays per disintegration than plutonium. Therefore, the HPGe equipment is more effective in detecting americium than plutonium. However, because americium is a decay product of plutonium, the amount of americium present in a sample is dependent on the amount of plutonium present in the sample. The ratio of americium to plutonium in a sample changes depending on the age of the plutonium. Because the surface contamination in the study area results from plutonium of approximately the same age, the values for plutonium can be reliably extrapolated from the americium values detected by the HPGe unit. The americium values for samples at RFETS are typically 18 percent of the plutonium value (Ibrahim, et al. 1996).

Action levels for radiological contaminants have not yet been decided, therefore, the minimum detectable activity (MDA) of the HPGe detector will be set to provide effective data anticipated to be below the new action levels and to minimize data acquisition time. An activity level of 18 pCi/g americium was established, which equates to an activity level of 100 pCi/g plutonium-239, has been chosen for the MDA. This can be obtained by a HPGe detector height setting of one meter with a FOV of about 39.4 ft (12 meters). If activities above the 100 pCi/g plutonium level are detected within a FOV, a FIDLER survey may be performed to further define the distribution of soils with higher concentrations. The MDA established meets the recently negotiated, Tier II action level for unrestricted release which will be presented for public comment.

3.1 FIELD PREPARATION

Before data collection begins, reference stakes for the HPGe grid-layout will be located in the field using a Global Positioning System (GPS). GPS is an advanced positioning system which can be used for locating environmental data points. To locate a point, a base point is established for reference, then a receiver is placed at the base point, and at the environmental data point to be located. The signals from the GPS satellites are intercepted by both receivers. These data are processed to obtain state plane coordinates, which are then verified, and incorporated into GIS. Data are collected per the Ashtech XII GPS Receiver Operating Manual (Version 7). From these stakes, the HPGe survey grid will be laid out using tape and compass methods, at the spacing specified in Section 3.2. Each measurement point will be staked, flagged, and numbered for reference by the HPGe crew. When required, a grid will be established on 4-ft centers for any required FIDLER surveys.

3.2 HPGe SURVEY

The HPGe survey will focus on the 903 Pad, Lip Area, and Americium Zone. The survey area will include the surface soils with elevated concentrations of plutonium and americium identified during the OU 2 RFI/RI activities, the 35 original HPGe 150-ft FOV plots that exhibit elevated americium activities as described in Section 2.1, and the area directly below the culvert that drains out of the 903 Pad and Lip Area where sediments were deposited during surface runoff events (see Figure 3-1).

The HPGe grid-spacing will result in 100 percent coverage of the area using a FOV of 12 meters. An equilateral triangular grid pattern having row spacing of 33 ft between centers and a column spacing of 29 ft has been chosen as the most efficient grid system for the field survey. This grid spacing translates to 33 HPGe measurements for complete coverage of a 150 x 150 ft square area. Figure 3-2 shows the configuration of the sampling grid. Each center will be assigned a sequential number.

To obtain the MDA of 100 pCi/g for plutonium-239, truck- and/or tripod-mounted detectors will be set at a one meter height above ground surface at each sampling point. Complete coverage of the survey area is estimated to require 2,742 measurements. If three tripods and the truck-mounted HPGe are used, this project is expected to require over seven weeks to complete. Actual project completion time for the field project will depend on the type and number of detectors used.

HPGe measurements will be made at each survey location in accordance with Radiological Engineering Procedures 4-61100-REP-1401, *Operation of Gamma Ray Spectroscopy Systems*, and 4-R29-REP-1402, *Routine Characterization of HPGe Detectors*, to a MDA that meets or exceeds the specified plutonium-239 threshold criteria of 100 pCi/g. All HPGe detectors will be calibrated from the same source to ensure comparable results, and all detectors will be positioned at the same height with the same FOV. For safety and logistical reasons, truck-mounted HPGe measurements will be limited to flat ground in the east and northeast Americium Zone areas. HPGe data from all instruments will be processed and converted to equivalent plutonium-239 activity units, then plotted to permit field evaluation of surface soil plutonium-239 activity trends.

In areas lacking previous HPGe coverage (e.g., south of the 903 Pad), the field HPGe data plot will be used by the HPGe field crews to continue the survey beyond the limits shown in Figure 3-1, if necessary. Plotting data during the survey will enable a graded approach. Field crews will curtail surveying after two rows of measurements are below 100 pCi/g for plutonium-239.

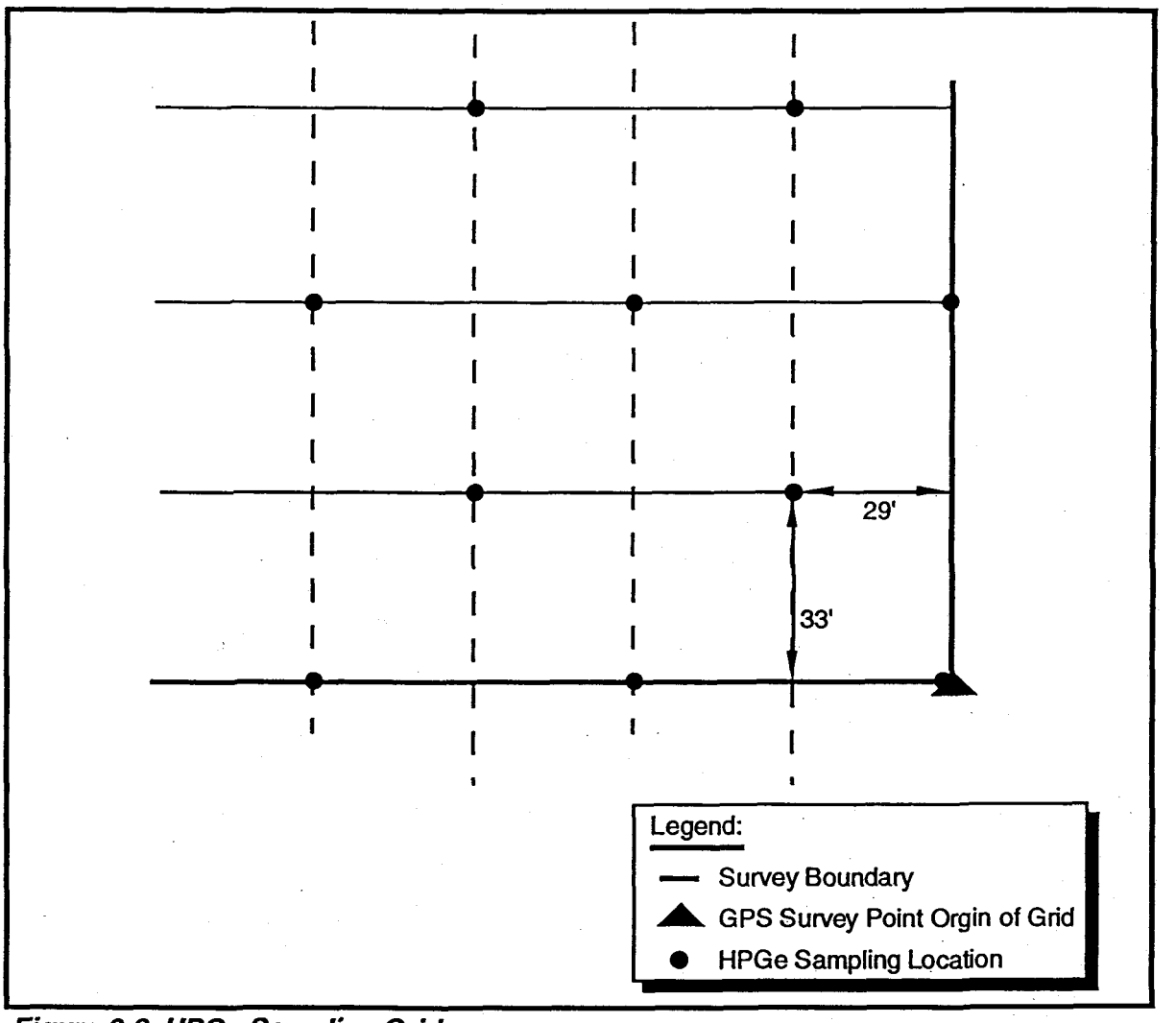


Figure 3-2 HPGe Sampling Grid

3.3 FIDLER SURVEYS

Where the individual HPGe measurements exceed the 100 pCi/g MDA threshold value, a follow-on FIDLER survey may be conducted. An evaluation of the nature of the exceedances will be conducted to determine if detailed FIDLER surveys are required. If it is determined that a FIDLER survey is needed, a grid with 4-ft spacing will be staked in the field and located using GPS. While all available data will be used to determine whether a FIDLER survey is required, it is anticipated that FIDLER surveys will only be conducted where there are no continuous, adjacent FOV measurements above 100 pCi/g for plutonium-239. This would indicate the potential presence of isolated small areas with elevated actinide soil contamination.

FIDLER surveys will be conducted in accordance with the *Radiological Operating Instructions Manual, 4-H58-ROI-06.6, Use of Bicron FIDLER*. Readings will be taken and recorded for each of the 4-ft grid nodes. When walking between grid nodes, the operators will slowly swing their instruments. If a sharp increase above local background in the reading is seen between grid nodes, the surrounding area will be investigated. The boundaries of the localized areas with at least 100 pCi/g

plutonium-239 which are above local background readings outside of the Lip Area will be determined and mapped as potential hot spots. A visual inspection and 9-point survey will be conducted if warranted to further define the contaminated area. This information will be recorded in field notebooks and transmitted to GIS. Potential hot spots and areas of higher concentrations identified during the hand-held FIDLER survey will then be staked, surveyed, and numbered for future evaluation.

4.0 DATA MANAGEMENT

A controlled field notebook will be created and maintained for the project by the project manager or designee. This will be used in conjunction with the appropriate field data forms required by the operating procedures (see Table 4-1) governing the field activities occurring during this project. It is not necessary to duplicate items recorded on field data forms in the field notebook, but if additional clarification of entries on the forms is required, they should be recorded in the field notebook. The field notebook should include time and date information concerning the field activities and a sketch map of actual sample locations. Information not specifically required by the field data forms should be recorded in the field notebook. Data will be collected and managed according to procedures including:

- 14-61100-REP-1401 – Operation of Gamma Ray Spectroscopy Systems
- 14-R29-REP-1402 – Routine Characterization of HPGe Detectors
- 13-21000-ADM-17.01 – Quality Assurance Records Requirements

These procedures will ensure that data are collected, entered, and stored in a secure, controlled, and retrievable environment.

Table 4-1 Applicable Field and Administrative Standard Operating Procedures

Number	Procedure Title
5-21000-OPS-FO.3	General Equipment Decontamination
5-21000-OPS-FO.6	Handling of Personal Protective Equipment
5-21000-OPS-FO.11	Field Communications
5-21000-OPS-FO.14	Field Data Management
5-21000-OPS-FO.16	Field Radiological Measurements
1-5000-ADM-12.01	Control of Measuring and Test Equipment
4-61100-REP-1401	Operation of Gamma Ray Spectroscopy Systems
4-R29-REP-1402	Routine Characterization of HPGe Detectors

4.1 PROJECT COMPLETION

The field results will be compiled into a brief report and map. These data will be electronically entered, verified by project personnel, and stored in the Graphical Information System (GIS) files. At the end of the project, all records and field documentation will be turned over to the records center.

5.0 PROJECT ORGANIZATION

The project organization chart is shown in Figure 5-1. The Sitewide Actions Group is responsible for management and coordination of resources dedicated to the project. Other organizations assisting with the implementation of this project are: RMRS Health and Safety, RMRS Quality Assurance, and Kaiser-Hill Radiological Engineering.

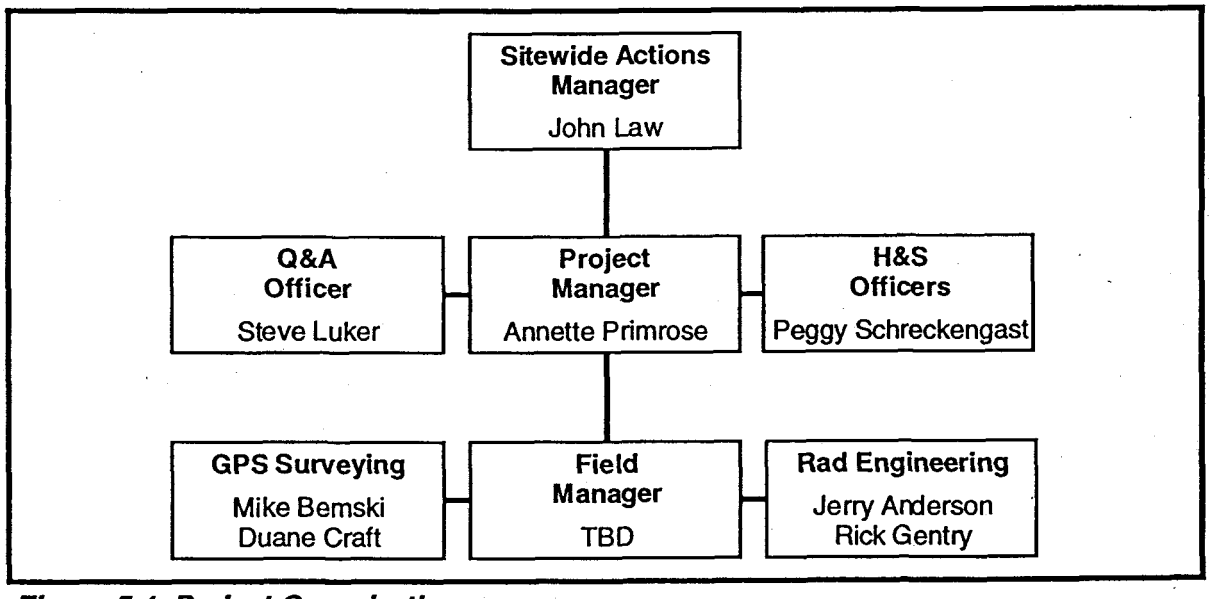


Figure 5-1 Project Organization

6.0 REFERENCES

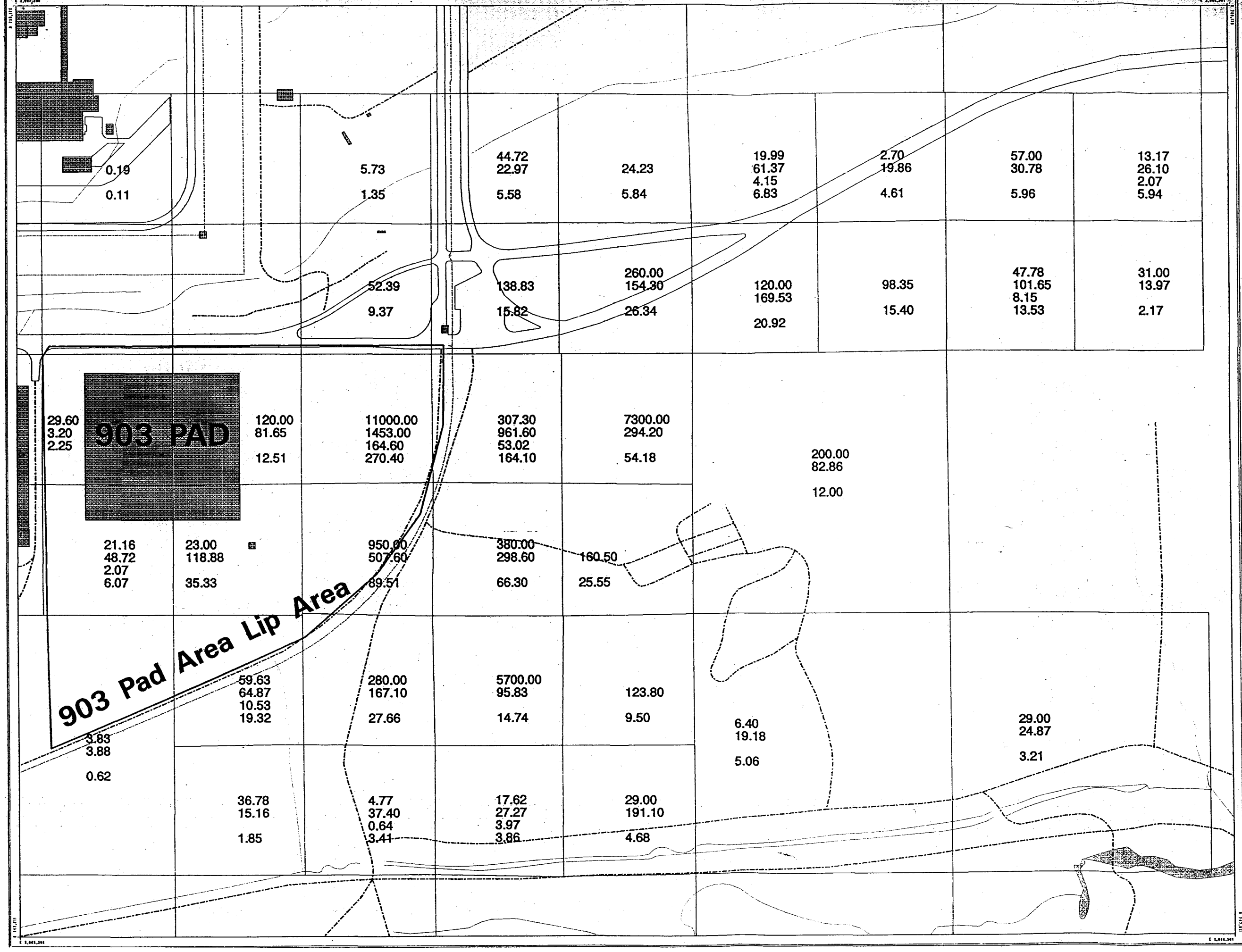
DOE, 1995, *Final Phase II RFI/RI Report, 903 Pad, Mound, East Trenches Area, Operable Unit No. 2*, RF/ER-95-0079.UN.

Ibrahim, S. A., M. J. Schierman, and F. W. Whicker 1996, "Comparative Distribution of ^{241}Am and ^{239,240}Pu in Soils around the Rocky Flats Environmental Technology Site" Health Physics, 70, 4, April.

Litaor, M. I., M. L. Thompson, G. R. Barth, and P. C. Molzer 1994, "Plutonium-239 + 240 and Americium -241 in Soils East of Rocky Flats, Colorado", Journal of Environmental Quality, Vol 23, No. 6 November – December.

Rocky Flats Surface Soil Sampling Plot Locations Around the 903 Pad

Figure 1-1
Surface Soil Sampling Locations



Explanation

1st Number - Pu 239 +240 RFP Result
2nd Number - Pu 239 +240 CDH Result
3rd Number - Am 241 RFP Result
4th Number - Am 241 CDH Result

- Buildings or other structures
- Lakes and ponds
- Streams, ditches, or other drainage features
- Fences
- Rocky Flats boundary
- Paved roads
- Dirt roads

Scale = 1 : 2760
1 inch represents 230 feet

50 0 100 200ft

State Plane Coordinate Projection
Colorado Central Zone
Datum: NAD27

U.S. Department of Energy
Rocky Flats Environmental Technology Site

Prepared by:
RMRS Rocky Mountain Remediation Services, L.L.C.
Geographic Information Systems Group
Rocky Flats Environmental Technology Site
P.O. Box 464
Golden, CO 80402-0464

MAP ID: ***Draft***

May 23, 1996

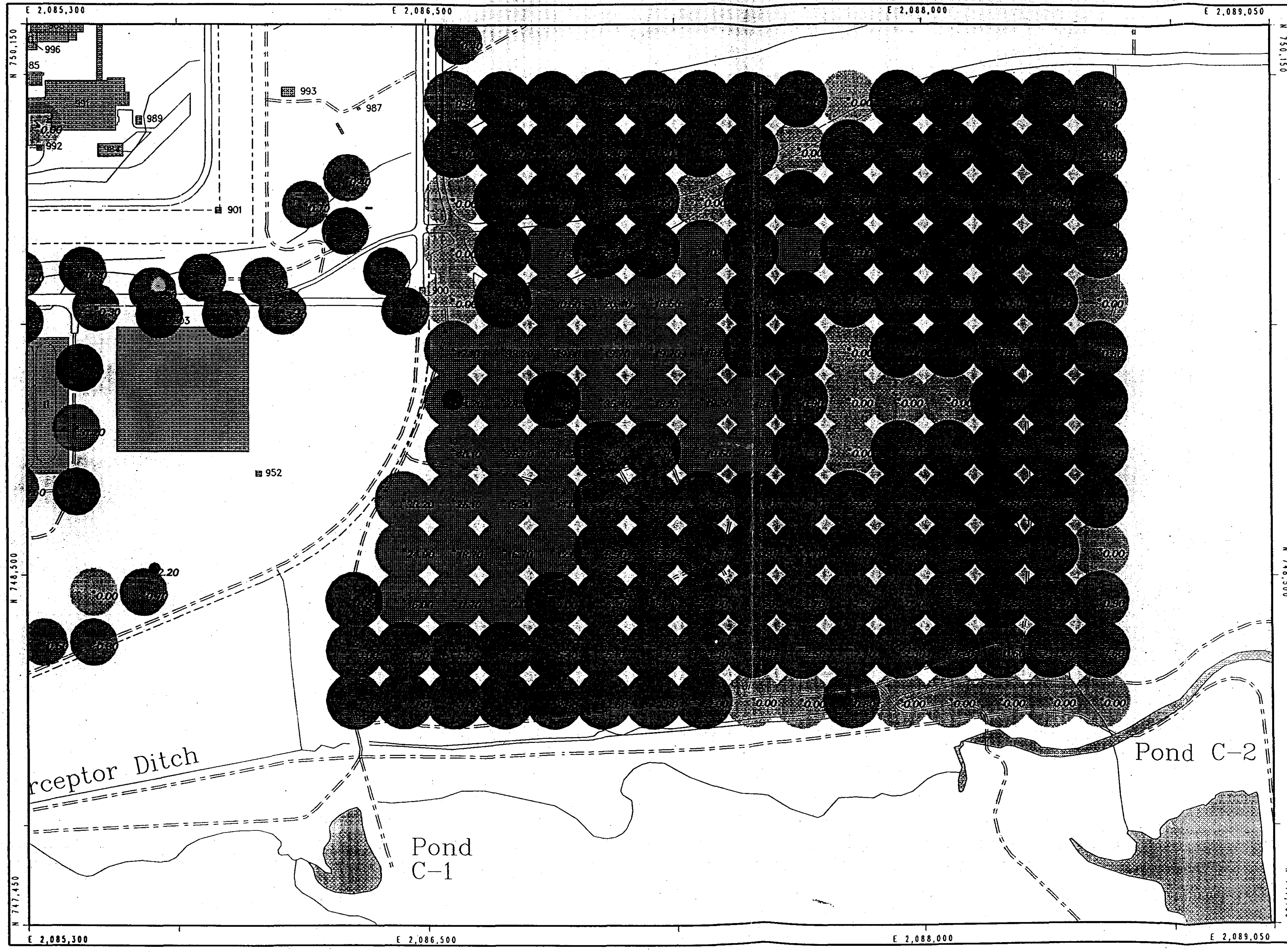


Figure 2-1

HPGe Data for Americium 241 (pCi/g)

(for a Field of View of 150 feet)

HPGe Data Ranges–

- 0.0 - 0.1
- 0.1 - 1
- 1 - 10
- 10 - 100
- 100 - 1000
- 1000 - 10000

Standard Map Features–

- Buildings or other structures
- Lakes and ponds
- Streams, ditches, or other drainage features
- Fences
- Rocky Flats boundary
- Paved roads
- Dirt roads

NOTE:
The HPGe field of view (FOV) or radius of influence, assumes a homogeneous surface distribution. The FOV represents a circle where 90% of the flux originates. The radius, for each HPGe sampling location, is based on the height of the detector above the ground.

The FOV for the majority of the points is 150 feet; however, two of the survey locations have a FOV of less than 150 feet.

DATA SOURCE:
HPGe data from Ron Reiman, Gamma Survey Group, Safeguard Measurements, EG&G Rocky Flats, Inc. June 1994
Buildings, roads, and fences provided by Facilities Engr., EG&G Rocky Flats, Inc. - 1991.
Hydrology provided by USGS - (date unknown)

150 0 300ft

U.S. Department of Energy
Rocky Flats Environmental Technology Site

Prepared by:
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Golden, CO 80402-0464

MAP ID: HPGe-OU2 May 06, 1996

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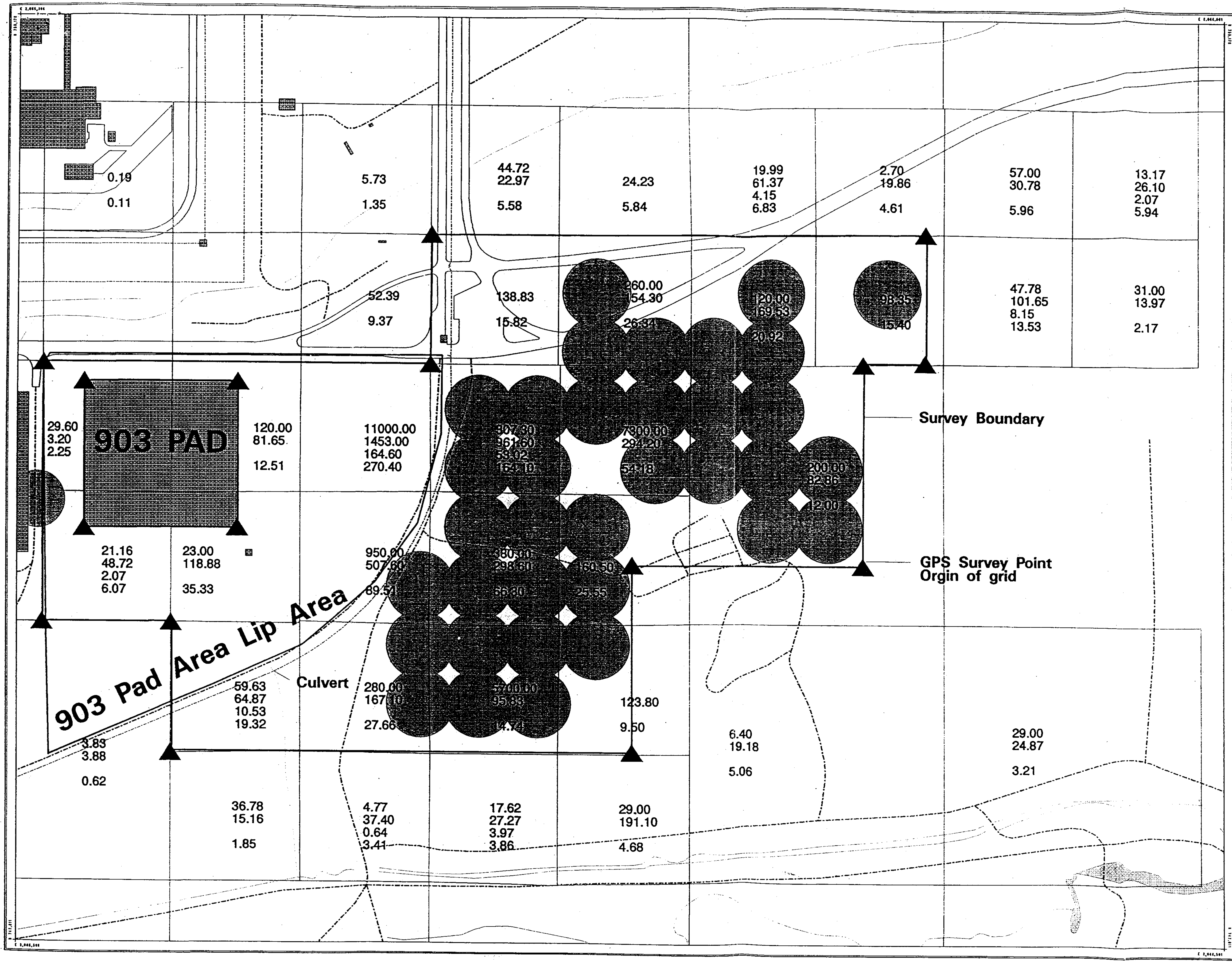

Rocky Flats Surface Soil Sampling Plot Locations Around the 903 Pad

Figure 3-1
HPGe Survey Area

Explanation

- HPGe 150 foot FOV Circles (above 10pCi/g Am-241)
- ▲ Proposed GPS Survey Point

1st Number - Pu 239 +240 RFP Result
2nd Number - Pu 239 +240 CDH Result
3rd Number - Am 241 RFP Result
4th Number - Am 241 CDH Result

- Buildings or other structures
- Lakes and ponds
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Scale = 1 : 2760
1 inch represents 230 feet

State Plane Coordinate Projection
Colorado Central Zone
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