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1994 Fernald Field Characterization Demonstration Program Data Report

C. A. Rautman, M. V. Cromer, G. C. Newman, D. A. Beiso

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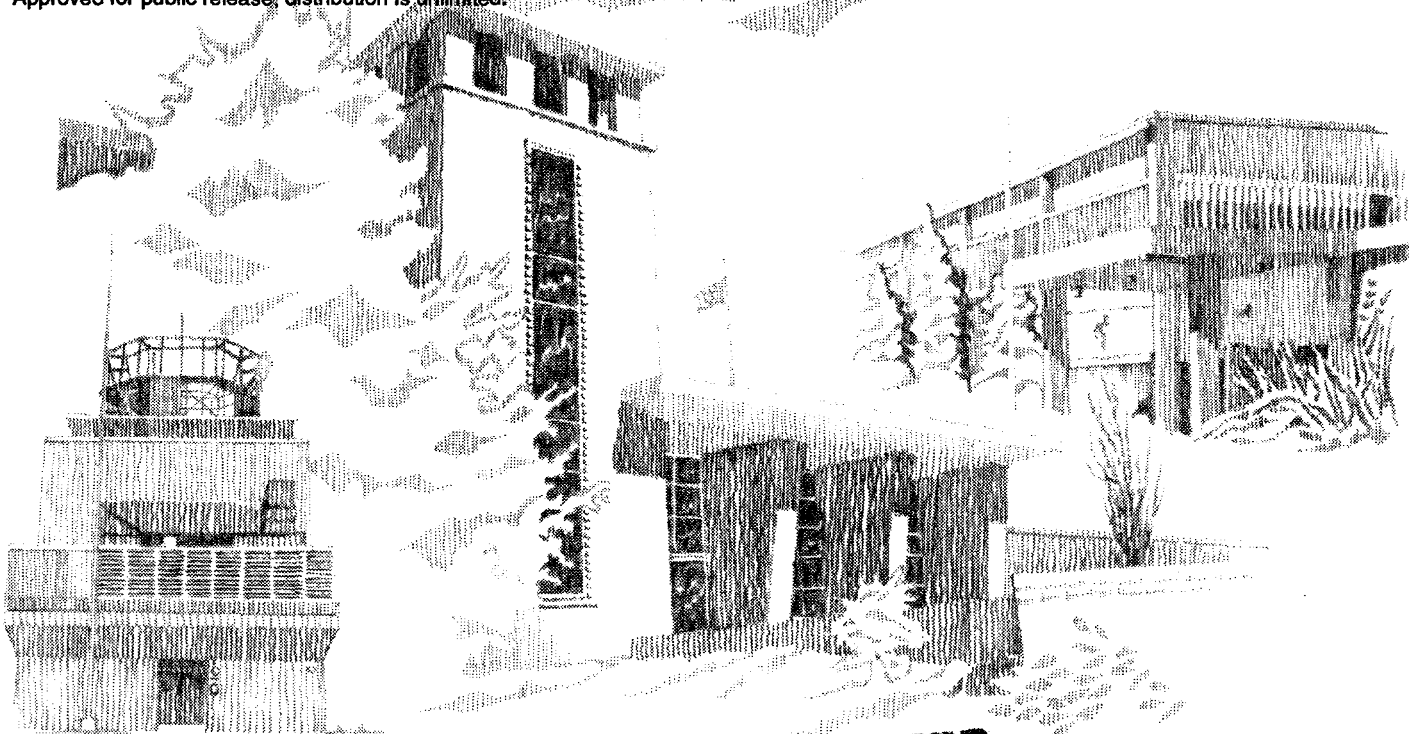

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1994 FERNALD FIELD CHARACTERIZATION DEMONSTRATION PROGRAM DATA REPORT

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Abstract

The 1994 Fernald field characterization demonstration program, hosted by Fernald Environmental Management Project, was established to investigate technologies that are applicable to the characterization and remediation of soils contaminated with uranium. An important part of this effort was evaluating field-screening tools potentially capable of acquiring high-resolution information on uranium contamination distribution in surface soils. Furthermore, the information needed to be obtained in a cost- and time-efficient manner. Seven advanced field-screening technologies were demonstrated at a uranium-contaminated site at Fernald, located 29 kilometers northwest of Cincinnati, Ohio. The seven technologies tested were: (1) alpha-track detectors, (2) a high-energy beta scintillometer, (3) electret ionization chambers, (4) and (5) two variants of gamma-ray spectrometry, (6) laser ablation-inductively coupled plasma-atomic emission spectroscopy, and (7) long-range alpha detection. The goals of this field demonstration were to evaluate the capabilities of the detectors and to demonstrate their utility within the U.S. Department of Energy's Environmental Restoration Program. Identical field studies were conducted using four industry-standard characterization tools: (1) a sodium-iodide scintillometer, (2) a low-energy FIDLER scintillometer, (3) a field-portable x-ray fluorescence detector, and (4) standard soil sampling coupled with laboratory analysis. Another important aspect of this program was the application of a cost/risk decision model to guide characterization of the site. This document is a compilation of raw data submitted by the technologies and converted total uranium data from the 1994 Fernald field characterization demonstration.

Acknowledgments

The authors thank the members of the Sandia Cost/Risk Performance Assessment team and the Fernald Environmental Management Project team: Kim Nuhfer (USID Coordinator), Rochelle Chernikoff (Field Data and Field Testing Coordinator), Jim Schwing (Project Engineer and Field Testing Coordinator), and Kevin Pylka (Project Engineer). The authors also thank all the Technology Principal Investigators for their professional expertise and contributions.

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1994 FERNALD FIELD CHARACTERIZATION DEMONSTRATION PROGRAM DATA REPORT

Introduction

One of the major problems facing the U.S. Department of Energy's Environmental Restoration Program is the characterization and remediation of uranium-contaminated soils. In response to this problem, the Office of Technology Development within U.S. Department of Energy sponsored the 1994 Fernald field characterization demonstration program. The program was designed to evaluate and compare the versatility, efficiency, and economics of various technologies for the characterization and remediation of uranium-contaminated soils. The Fernald Environmental Management Program site, located 29 kilometers northwest of Cincinnati, Ohio (figure 1), was selected as the location for the demonstration. Site selection was based on known environmental problems stemming from past production of uranium metal for defense-related applications. In support of the demonstration, a task group was appointed to design and administer a program that would address site characterization issues relative to uranium-contaminated soils, specifically the demonstration of alternative methods and instruments for obtaining rapid and cost-effective measurements of uranium activity. Cunnane and others (1993) and Tidwell and others (1993) presented a description of earlier activities leading to the 1994 Fernald field characterization demonstration program.

The demonstration was conducted from May through July 1994 at the Fernald Environment Management Program site. Seven proposed alternative field-screening technologies were demonstrated. These proposed technologies are (1) passive alpha-track detectors, (2) a high-energy beta scintillometer, (3) electret ionization chambers, (4) a high-mounted and (5) low-mounted gamma-ray spectrometer, (6) a field laser ablation-inductively coupled plasma-atomic emission spectrometer, and (7) a long-range alpha detector. Four other techniques that are considered to be current industry-standards were also demonstrated for comparison purposes. These standard technologies are (1) a sodium-iodide scintillometer, (2) a FIDLER low-energy scintillometer, (3) a field-portable x-ray fluorescence unit, and (4) conventional soil sampling coupled with laboratory chemical analysis.

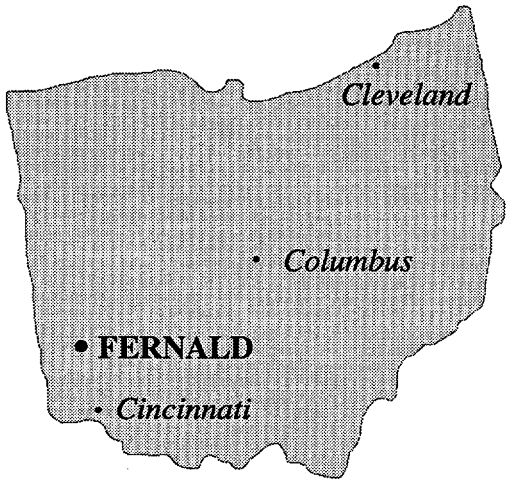

Figure 1. Index map showing location of the Fernald site in southwestern Ohio. Not to exact scale.

This report contains the basic measurement data and supporting information that were obtained during the 1994 Fernald field characterization demonstration program. It also provides a simple description of the operation and capabilities of the various characterization techniques and references to more comprehensive descriptions of the different methodologies. The data from the field demonstration program were to be evaluated economically through use of a cost-risk decision analysis. Additional evaluation of the field demonstration program and the results of the economic-decision analysis will be described in greater detail in future reports.

Methods

Demonstration of the various field-screening and industry-standard measurement techniques involved site preparation and measurement of the total uranium activity at a number of field survey locations. Uranium activity measurements were also obtained at a suite of plots containing known levels of uranium contamination similar in nature to in-situ Fernald soils for purposes of calibrating the technologies using a common, on-site reference. Additional replicate measurements were obtained at two standard sites, also located in the field adjacent to the base grid. The replicate measurements were to provide data for evaluating the accuracy and precision of the various alternative measurement technologies. Meteorologic observations (temperature, relative humidity, wind speed and direction, total daily rainfall) were obtained at episodic times throughout the course of the field demonstration to identify any effects of changes in local environmental conditions on the measurements reported by the alternative technologies. A more detailed description of planned activities constituting the 1994 Fernald field characterization demonstration program are presented in the original "project plan," which is reproduced as it existed at the beginning of the demonstration in Appendix A.

Site Selection and Preparation

The site selected for the 1994 Fernald field characterization demonstration program is adjacent to a region known as the incinerator area, located east of the main Fernald production area (figure 2). Uranium contamination in this region resulted principally from airborne emissions produced by the incineration of uranium-contaminated combustibles. The general magnitude of uranium activity in the incinerator area was thought to be suitable for demonstration of the various technologies, and the mode of contaminant deposition was believed to be relatively amenable to geostatistical evaluation as part of the cost-risk economic decision model.

A site comprising approximately 126,000 square feet or 2.9 acres (10,000 square meters) was identified for the actual field demonstration. The initially proposed survey grid, shown in figure 3(a), is a systematic sampling network designed specifically to focus on the spatial densities and scales needed to characterize the spatial-correlation structure among samples. Quantitative description of spatial continuity is fundamental to the geostatistical procedures used in the evaluation. Of the 89 sample locations that were originally proposed, 42 locations are located on a regular, 60-foot (18-m) grid; these gridded locations provide areal coverage of the entire site. Within this regularly gridded network, an additional 29 locations were defined on 30-foot (9-m) spacings to capture shorter-scale spatial relationships. Another 18 locations were selected to examine contaminant heterogeneity at a fine scale using 5-foot (1.5 m) sample spacing. Conflicts with existing cultural features, principally roads through the incinerator area, reduced the total number of actual sample locations to 85 and slightly modified the regularly gridded nature of the proposed design. The actual field survey grid is shown in figure 3(b).

Site preparation, including marking the site and restricting access once the field demonstration effort had begun, was the responsibility of Fernald Environmental Management Project personnel. Prior to taking field measurements, the base grid was staked and surveyed using the Ohio state plane coordinate system. For ease of reference, each grid location was assigned a unique letter-number

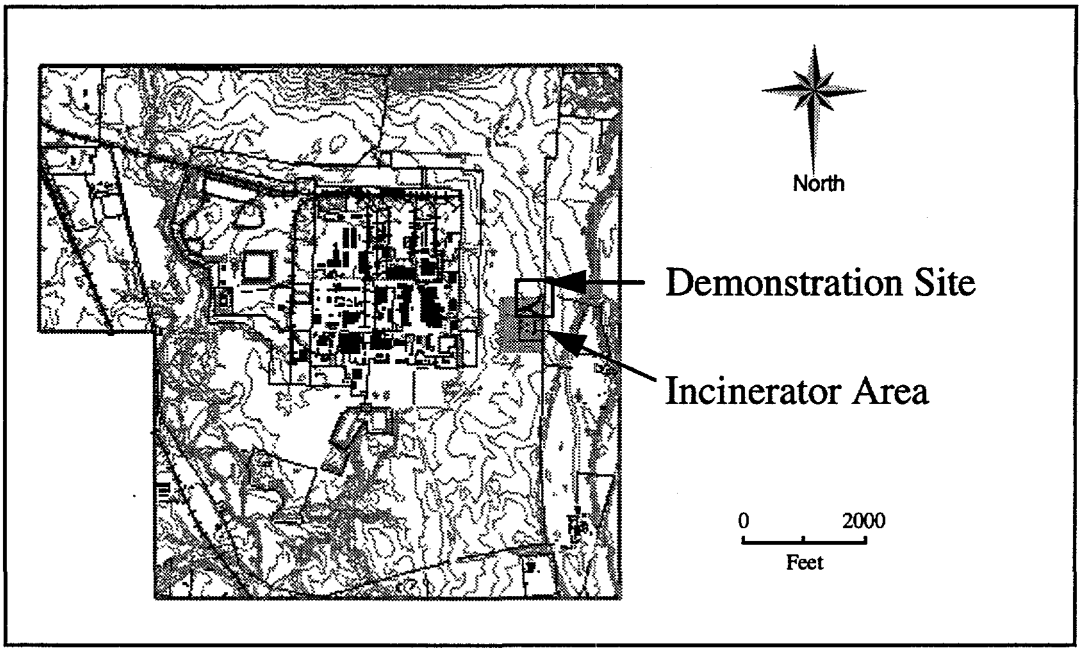

Figure 2. Map of the Fernald Environmental Management Project site showing the location of the incinerator area and the site selected for the 1994 Fernald field characterization demonstration program.

"geolocation" code based on a row-column numbering scheme, as indicated in figure 3(a). Grass at each measurement location was cropped and residual thatch was removed to reduce the influence of naturally occurring ground cover; only bare ground and short grass stubble were visible to the detectors. All technologies recorded their measurements at a location approximately 6 inches (15.2 cm) north of each staked geolocation. Each characterization technology surveyed the complete field grid, resulting in matched data sets to facilitate comparison.

Two standard sites, used to obtain replicate measurements by each technology of the same (standardized) uranium-contamination levels and identified as S1 and S2, were also staked and located in the field within the boundaries of the field grid [figure 3(b)]. Each of these sites were maintained and measured in the same manner as the sites constituting the general field survey grid.

Four calibration beds were prepared in the field to allow calibration of the alternative measurement techniques to a common reference. The calibration beds consisted of boxes 5.25 feet (1.6 m) square by 9 inches (22.5 cm) deep containing Fernald soils spiked with variable but known levels of uranium contamination. Soils composing the calibration beds were homogenized by mixing clean native soils with contaminated Fernald soils in a rotary mixer similar to that used to mix concrete. Ohio state plane coordinates are not applicable to these artificially constructed measurement locations. However, the calibration beds were located immediately adjacent to the survey grid; thus calibration data were taken under effectively the same environmental conditions as the routine field measurements.

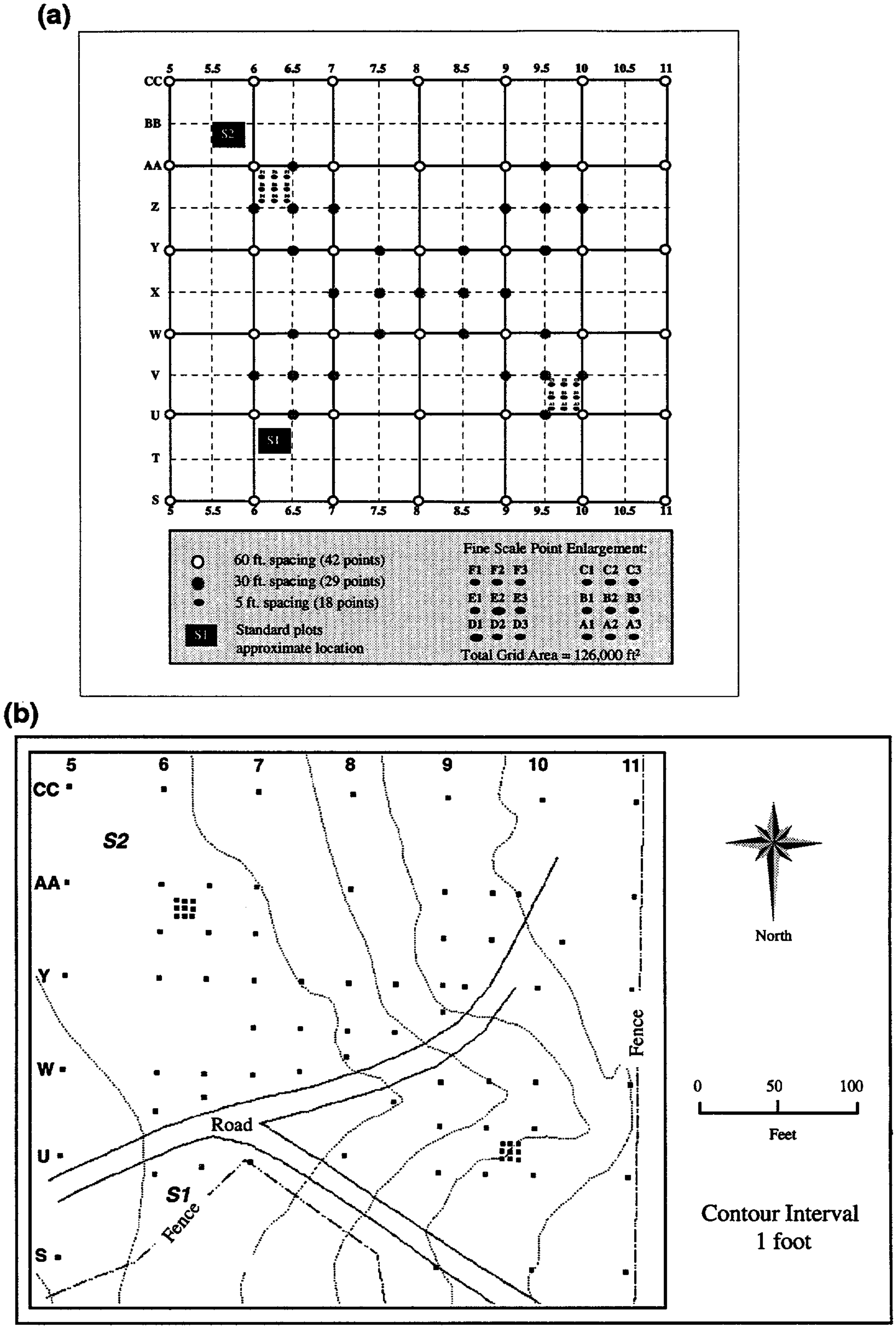

Figure 3. (a) Generalized plan showing the proposed baseline measurement grid and associated geolocation indexing scheme; (b) map showing the final sample-collection grid used in the 1994 Fernald field characterization demonstration program. *S1* and *S2* are actual locations of standard sites.

Field Screening Technologies

Seven proposed alternative field-screening technologies were tested during the 1994 Fernald field characterization demonstration program. These technologies are capable of measuring alpha, beta, or gamma radiation or, in some cases, a combination of radiation types. A listing of the seven technologies, the three-character identifier or abbreviation used in this data report and associated tables, and a brief tabulation of the detection principle(s) used, are given in table 1. The technologies themselves are described in some greater detail in the remainder of this section; the listing is in alphabetical order for convenience; see also Appendix A.

Alpha Track Detector

An alpha track detector (abbreviated ATD) is a passive, single-use device originally developed to measure indoor airborne alpha activity (Alter and Fleisher, 1981), principally from radon gas. Detection of alpha particles is through observation of damage tracks left in a proprietary polymer material (Lantrack®). Damage tracks within the plastic detector material are etched chemically for greater visibility and then counted. The density of tracks is proportional to the monitored alpha activity. The alpha track detector demonstrated in the field was a few square centimeters in size and is sensitive to total alpha radiation emitted from within 10 to 20 micrometers of the soil surface.

High-Energy Beta Scintillation Sensor

The high-energy beta scintillation sensor (BET) was developed to measure uranium concentrations in surface soils on a real-time basis (Schilk et al., 1993a). The system consists of multiple layers of plastic scintillating material designed to measure surficial uranium-238 (^{238}U) contamination by detecting the 2.29 MeV (million electron volts) maximum-energy beta particles from a ^{238}U daughter product, metastable protactinium-234 (^{234m}Pa). The system discriminates between high-energy beta particles and other interfering background radiation using coincidence-counting techniques. This technique identifies high-energy beta particles by the depth to which they penetrate into the scintillating-

Table 1: Classification and brief description of alternative characterization technologies demonstrated at the Fernald site

Abbreviation	Technology Name	Detection Principle	
	Proposed Alternative Field-Screening Technologies		
ATD	Alpha-track detector	passive	alpha particles
BET	Beta scintillometer	passive	beta particles
EIC	Electret ionization chamber	passive	alpha particles
GMH, GML	High-mount / low-mount gamma spectrometer	passive	gamma rays
ICP	Laser-ablation inductively coupled plasma-atomic emission spectrometry	active	visible and ultraviolet light
LRA	Long-range alpha detection	passive	alpha particles
	Industry-Standard Field-Screening Techniques		
FID	FIDLER scintillometer	passive	gamma rays
NAD	Sodium-iodide scintillometer	passive	gamma rays
LAB	Mass spectroscopy	active	ionized elements
XRF	X-ray fluorescence unit	active	photons

layer stack. The device used in the field tests monitored a surface area of approximately 0.2 square meters. Beta particles are detected from a depth of less than 1 centimeter in the surficial soil.

Electret Ionization Chamber

The electret ionization chamber (EIC) is similar to the alpha track detector in that both are small, passive devices originally developed to measure indoor alpha activity (Kotrappa and others, 1991, 1988). The EIC device consists of a positively charged piece of Teflon®, known as an "electret." The electret ionization chamber is activated by screwing the electret into a special conductive polymer holder that establishes a static electric field inside the chamber. Ionizing radiation, including alpha particles, passing through the sensitive volume of the detector creates electron showers that are attracted to the positively charged electret, thus neutralizing that charge in proportion to the radiation load. The charge remaining in the electret ionization chamber detector after a timed exposure can be measured and the known voltage drop converted to activity.

Because the electret ionization chambers are sensitive to all ionizing radiation, a pair of detectors is utilized in mixed radiation fields, such as exist at the Fernald site. An unshielded detector measures the effect of all ambient radiation, while another is shielded by Tyvek® plastic, which absorbs low-energy alpha particles before they reach the detector. Alpha activity is determined as the difference between the two readings. Electret ionization chambers measure uranium in the surficial soil to depths of 10 to 20 micrometers.

In-Situ Gamma-Ray Spectrometry

Field demonstration of the in-situ gamma-ray spectrometry system was conducted using two instrument configurations to monitor surface contamination; these are referred to as the high- (GMH) and low-mounted (GML) positions. Both configurations use the same special thallium-activated sodium-iodide crystal and measure the full gamma spectrum, using the 1.0 MeV maximum-energy gamma rays from ^{234m}Pa as the primary indicator of uranium activity (Schilk and others, 1993b).

The high-mount configuration of the in-situ gamma-ray spectrometer positions the detector crystal on a tripod about 3 feet (1 meter) above the ground surface. The unshielded device detects incoming radiation from all directions. The effective surface measurement area of the high-mount gamma detector is approximately 14,000 square feet (300 m^2), or a circle with a radius of approximately 30 feet (10 m). Because gamma radiation is penetrating, contaminants can be detected up to 6 to 9 inches (15 or 20 cm) in depth immediately beneath the spectrometer. The depth of detection in surficial soil decreases radially outward with increasing distance from the center of the detector.

The low-mount configuration of the in-situ gamma-ray spectrometer positions the detector crystal on a tripod somewhat less than a foot (a few cm) above ground level. In contrast with the high-mount gamma configuration, the field-of-view of the detector in the low-mounted position is collimated by the addition of a tungsten shield. This collimation effectively reduces the size of the region examined to approximately 30 square feet (10 m^2), or a circle with a radius of 10 feet (3 m). Depths of penetration of gamma rays within the soil are similar to those of the high-mount configuration.

Laser Ablation-Inductively Coupled Plasma-Atomic Emission Spectrometer

The laser ablation-inductively coupled plasma-atomic emission spectrometer technique (abbreviated more simply as ICP) is a standard laboratory analytical method modified for field application (Baldwin et al., 1993; D'Silva et al., 1992). A neodymium-yttrium-aluminum garnet laser is focused directly on the soil surface, and this laser beam ablates in-situ soil. As the laser ablates the soil, an argon gas stream entrains ablated sample particles and transports them directly into an inductively coupled plasma burner. The emitted-light spectrum is then transferred by fiber optics to a spectrometer for quantitative analysis of total elemental uranium. During the course of an individual measurement, the laser beam is rastered over an area of about 6.5 square centimeters, removing particles from only the upper 100 micrometers of soil.

Long-Range Alpha Detector

The long-range alpha detector (LRA) system detects alpha particles and other ionizing radiation by collecting and measuring the ions produced when alpha particles are stopped in air (Caress et al., 1993; MacArthur et al., 1992). Because the ambient air is the detector gas, the field long-range alpha detector system was configured to be placed directly on the ground. In this configuration, it detects the uranium in the surface soil by monitoring the air ionization near the soil surface produced by contaminants to a depth of approximately 10 to 20 micrometers. The long-range alpha detector system tested at the Fernald site was designed to monitor contamination present on a 1 square meter surface area.

Industry-Standard Technologies

Several standard measurement technologies in widespread industrial use were tested at the demonstration for comparison with the proposed alternative field-screening technologies.

FIDLER Detector

FIDLER is an acronym standing for "Field Instrument for Detecting Low-Energy Radiation." The FIDLER scintillometer (FID) uses a thallium-activated sodium-iodide crystal that converts passing gamma-ray photons to visible light, which is then detected by a photomultiplier tube and associated electronics. The detector crystal is only 1.5 millimeters thick. This relatively small detector volume reduces the probability that high-energy photons, such as cosmic radiation, will interact with the scintillating material and be detected. The device is sensitive principally to gamma rays in the energy range 10 to 200 KeV (thousand electron volts), which includes the primary gamma spectrum of the uranium decay chain. The FIDLER detector measures soil contamination present within a few centimeters of the soil surface (< 15-20 cm).

Soil Sampling and Laboratory Analysis

Soil samples were collected and submitted for laboratory analysis (LAB) to provide a means of comparison. Soil samples were analyzed in the laboratory using EPA-certified mass-spectrometry procedures (US EPA, 1992). Uranium measurements produced by this method are routinely accepted by regulatory agencies and thus serve as a basis for comparison among other detectors and measurement technologies. Both surface (maximum depth of 1 cm) and core samples [to a depth of 8 inches (20 cm)] were collected for analysis.

Sodium-Iodide Scintillometer

Sodium-iodide scintillometers (NAD) detect the total x-ray and gamma-radiation emitted from the soil. The scintillometer uses a thallium-activated sodium-iodide crystal that converts adsorbed gamma-ray photons to visible light, which is detected by a photomultiplier tube and associated electronics. A typical detector crystal is 5 centimeters in diameter and 5 centimeters in height. The sodium-iodide detector is sensitive to gamma radiation more energetic than about 60 KeV, which includes photons from sources other than the uranium decay chain. A thin lead shield may be placed around the detector to decrease sensitivity to very high-energy cosmic radiation. The sodium-iodide scintillometer is sensitive to contamination in the upper few centimeters of soil (< 15-20 cm).

Field X-Ray Fluorescence Detector

X-ray fluorescence detector (XRF) is an active nuclear technique in which one or more radioactive sources contained in an aluminum probe are used to excite the specific target elements. A mercuric iodide crystal is then used to detect and quantify the x-ray photons emitted by the excited atoms. The field-portable x-ray fluorescence unit used at the Fernald site was configured to detect uranium and thorium through a window of observation measuring approximately one inch (2.5 cm) square. The measurement technique is sensitive to uranium atoms that can be activated by x-radiation from the activation sources (depths of < 15-20 cm).

Field Data Collection and Data Management

A number of different data were collected during the course of the 1994 Fernald field characterization demonstration program. During field operations, developers and operators of each characterization technology recorded: (1) a sequential measurement number; (2) the date and time of each measurement; (3) the measurement type [field survey data (FLD), standard-site data (STD), calibration data (CAL)]; (4) the geolocation grid index or other location-specific identifier (calibration plot ID, standard site ID); and (5) the raw measurement value (instrument reading) in units appropriate for the specific technology. A small number of additional soil samples were collected for laboratory analysis as (6) location-specific duplicate (DUP) samples, and (7) as soil cores (COR) to assist in evaluating the depth distribution of uranium contamination.

Field environmental conditions were also recorded during the 1994 Fernald field characterization demonstration program. Meteorologic data consists of (1) date and time of reading; (2) temperature; (3) humidity; (4) wind speed and direction; and (5) total daily precipitation. (6) cloud cover and heights are available for some times. Most of the meteorologic data was recorded at the Fernald meteorology tower, which is located approximately one-third of a mile (one-half kilometer) northwest of the survey field site. Supplemental data were also recorded at the field site itself. In addition to daily readings, meteorologic measurements (excluding rainfall and cloud cover) were also recorded during the calibration-plot and standard-site measurements by the various technologies.

The diverse types and large quantity of data involved in the 1994 Fernald field characterization demonstration program, as well as the need to merge different data sets by date and time, required standardized procedures and a comprehensive computerized database. Data received during the field demonstration program were entered into a Microsoft Access® relational database management system. Copies of the resulting data tables were verified by the technology principal investigators. Ohio state plane coordinates were linked to geolocation codes, and the raw measurement values were converted to total uranium activities in picocuries per gram (pCi/g) using calibration information. All data used for visualization and analysis were retrieved from this database, which serves as a single source for both raw and reduced data from the1994 Fernald field characterization demonstration program. A copy of the data management plan used to design and implement the field demonstration is included as Appendix B for reference and historical purposes.

Results

A variety of data were collected during the 1994 Fernald field characterization demonstration program. These data include meteorologic information and geographic-location data for the gridded and supplemental surveyed locations, calibration data, replicate standard-site measurements, and instrument readings (both raw and calibrated) that result from the actual field measurements. Complete data tables containing all data obtained during the 1994 Fernald field characterization demonstration program are included as appendices to this report.

Location Data

The majority of the field measurements were taken at pre-marked locations coded to a geolocation grid system [figure 3(a)]. Grid and supplemental locations were surveyed by Fernald Environmental Management Project personnel and referenced to the Ohio state plane coordinate system in general use for environmental restoration purposes at the Fernald site. Coordinate values corresponding to each geolocation index are presented in Appendix C. Supplemental field survey points were measured by some of the demonstrated technologies after preliminary analysis of the completed survey grid to provide follow-up characterization in regions of significant uncertainty. These supplemental locations may be identified as lacking an alphanumeric geolocation code; they are referenced only by state plane coordinates in the composite data tables of the appendix.

Meteorologic Data

Field environmental conditions were measured and recorded by project engineers on a daily basis. Meteorologic data consists of daily and episodic measurements of temperature, precipitation, humidity, wind speed and direction, and cloud cover/height, plus daily rainfall totals. A complete listing of meteorologic data relevant to the 1994 Fernald field characterization demonstration program, including records from both the local field site and the meteorology tower, is provided in Appendix D. A simplified diagram showing changes in the major environmental variables measured during the field demonstration program is presented in figure 4.

Technology Calibration

The alternative characterization technologies tested at the 1994 field characterization demonstration program were calibrated to total uranium activity in picocuries per gram using a series of calibration beds with known activity. Uranium activities by isotope were measured using EPA-certified laboratory mass spectroscopy. Five calibration beds consisting of variably contaminated Fernald soils were available during the course of the field demonstration program. Replicate laboratory determinations of total uranium activity for these calibration beds are presented in table 2.

Four calibration beds were available at the beginning of the field program. These plots were numbered C0, C35, C100, and C200 in recognition of their intended approximate uranium activity. When it became apparent that the measured uranium activity levels were generally higher than originally anticipated (table 2), bed C200 was dismantled and diluted with clean Fernald soil to produce calibration bed CP. Plot CP occupied the same physical location as the defunct C200 plot. As a result of this reconstruction, not all of the technologies obtained calibration measurements at all five plots. The relative magnitudes and internal variability of uranium samples taken from the calibration beds are presented in figure 5. The internal homogeneity of calibration plot CP is markedly less [a coefficient of variation (C.V.) > 36 percent] than for the other calibration beds (C.V. < 10 percent).

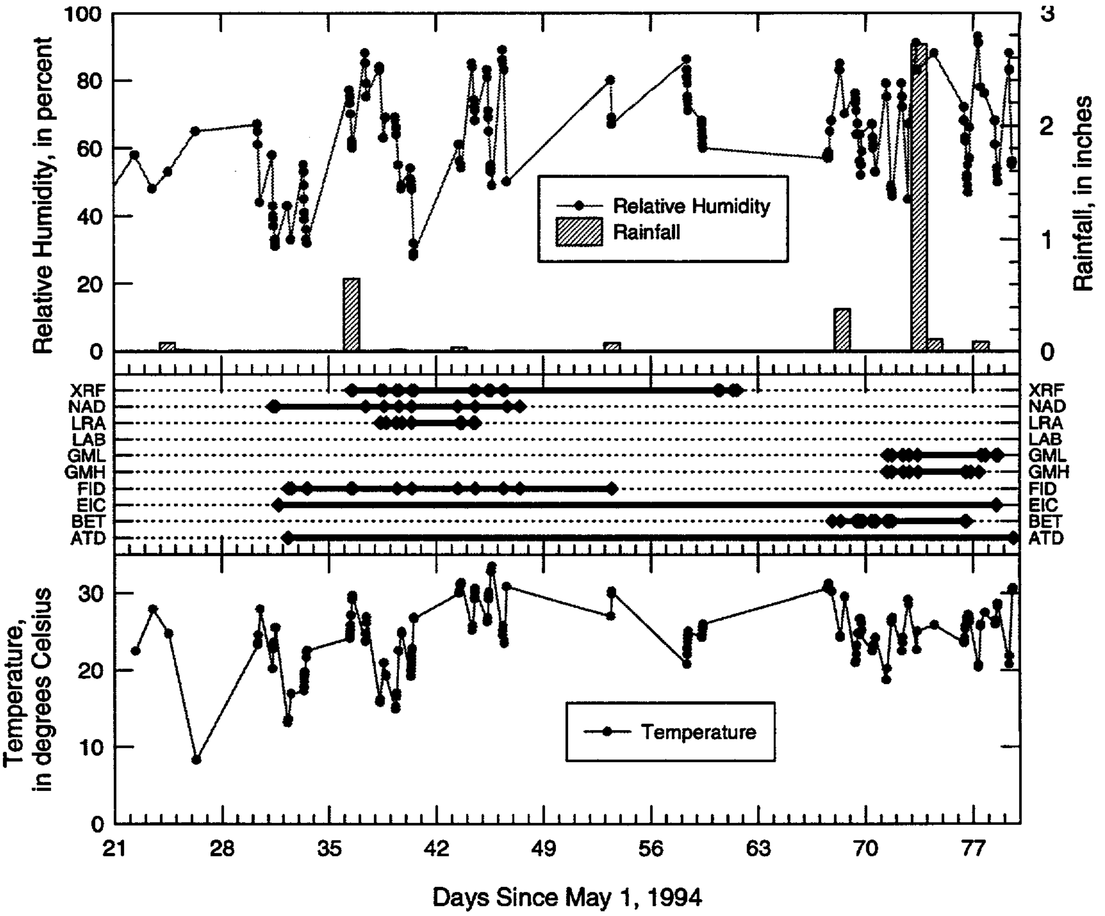

Figure 4. Variation in temperature, relative humidity, and total daily rainfall amounts with respect to the times field measurements were taken by the different characterization technologies (indicated by ♦ symbols along individual technology bars; many symbols overlap). Meteorological information from Appendix D.

The raw measurement values obtained for each calibration bed by each technology are tabulated in Appendix E. The individual characterization technologies were calibrated as follows: For each demonstrated technology, the individual measurement values were averaged (table 3) and plotted against the mean laboratory uranium activity taken from table 2. These cross plots are shown (alphabetically by technology abbreviation) in figures 6 and 7. Note that the number of raw measurement values varies markedly among the different technologies.

Visual inspection indicates that the measurement response of the technologies is essentially linear with increasing total uranium activity. A least-squares regression of the form

$$U_t = b_0 + b_1 X \qquad (1)$$

was fitted to the averaged data, where U_t is mean total uranium activity in picocuries per gram, b_0 and b_1 are the regression coefficients (intercept and slope, respectively), and X is the mean observed raw-measurement value (units vary). No attempt was made to force the regression equation through the origin. Table 4 presents the regression coefficients determined for the calibration data obtained by each technology demonstrated at the 1994 Fernald field characterization demonstration program. Coefficients of determination (r^2 values) associated with the regressions all exceed 0.9 (table 4).

Table 2: Laboratory measurements and statistical summary of uranium contamination for the five calibration beds

[Analyses by ICP mass spectroscopy; values are total uranium in picocuries per gram (except C.V and N). Std.Dev.: standard deviation; C.V.: coefficient of variation, defined as the standard deviation divided by the mean; N: number of samples. Leaders (--): not applicable]

	C0	C35	C100	C200	CP
	5.962	97.33	144.66	312.28	79.655
	5.962	92.84	153.71	303.0x	26.15
	5.612	92.65	141.91	331.0x	36.862
	6.450	84.26	158.78	380.4x	43.412
	5.272	95.11	150.40	364.4x	69.946
	5.612	97.25	128.54	315.7x	52.802
	5.262	90.72	145.19	322.15	48.837
	--	106.39	--	--	--
Mean	5.73	94.57	146.17	332.71	51.09
Std.Dev.	0.42	6.76	9.71	28.82	18.54
C.V. %	7.33	7.15	6.64	8.66	36.29
Minimum	5.26	84.26	128.54	303.01	26.15
Maximum	6.45	106.3	158.78	380.42	79.66
N	7	8	7	7	7

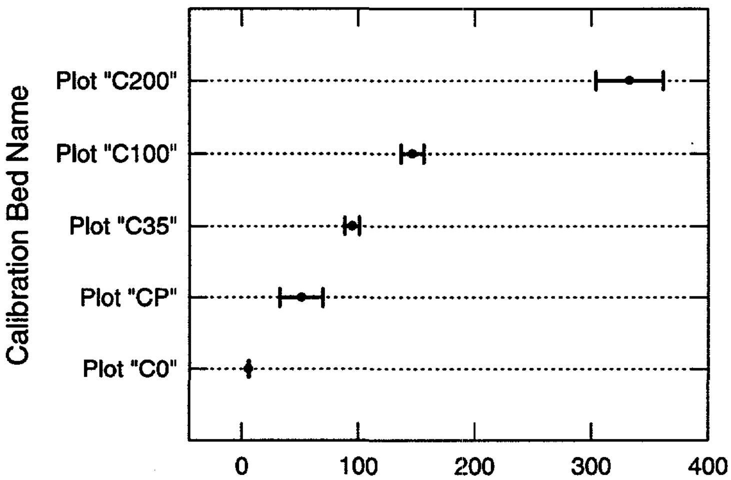

Figure 5. Diagram showing mean uranium concentration and variability of laboratory measurements of the five Fernald calibration beds. Error bars represent plus and minus one standard deviation.

Table 3: Statistical summary of raw measurement values at the calibration beds for 10 characterization technologies from the 1994 Fernald field characterization demonstration program

[Std.Dev.: standard deviation; N: number of samples; leaders (--): not measured or not applicable. Values are total uranium activity in picocuries per gram (except for N)]

	ATD	BET	EIC	FID	GMH	GML	ICP	LRA	NAD	XRF
Calibration Bed C0										
Mean	0.0648	6.67	2.16	457.85	1.94	2.24	0.00	6050	3723	4.92
Std.Dev.	0.0516	0.43	1.52	15.24	--	1.72	0.00	494.97	74.72	3.39
N	5	6	5	13	1	3	7	2	9	15
Calibration Bed C35										
Mean	0.1498	23.13	3.87	773.36	34.60	35.80	0.03	7700	5407	78.68
Std.Dev.	0.0567	2.94	1.74	20.68	--	1.73	0.01	141.42	107.76	9.51
N	5	6	5	14	1	3	16	2	10	15
Calibration Bed C100										
Mean	0.1851	31.17	7.80	927.38	46.00	49.33	0.05	9700	6280	126.02
Std.Dev.	0.0191	3.63	6.11	23.77	--	1.66	0.01	141.42	142.48	12.09
N	5	6	5	13	1	3	4	2	9	15
Calibration Bed C200										
Mean	0.3425	--	13.31	1577.60	--	--	--	19000	9979	342.17
Std.Dev.	0.0468	--	1.46	41.41	--	--	--	--	103.65	72.77
N	2	0	3	10	0	0	0	1	10	5
Calibration Bed CP										
Mean	0.0941	15.93	4.27	532.67	--	--	--	--	--	57.30
Std.Dev.	0.0069	0.18	2.80	19.04	--	--	--	--	--	12.13
N	2	2	2	3	0	0	0	0	0	10

The error bars shown on figures 6 and 7 represent plus and minus one standard deviation for the replicate calibration readings for both the laboratory values and technology measurements. However, the regressions [equation (1); table 4] are based solely upon the mean values indicated by the filled circles at the intersection of the error bars. The regression equations are fitted to these mean values only, and the r^2 values apply to the mean-versus-mean regression. Neither the regressions nor the coefficients of determination consider the variability of the individual measurements constituting those means. In some instances, this variability is rather large [for example, figure 6(c)] or the calibration may be based only on a single reading for a calibration bed [figure 6(e); see also table 3]. The indicated r^2 values may overstate the accuracy of the calibration for these technologies.

Table 4: Regression coefficients for equation relating raw measurement data to total uranium activity

Technology (Abbreviated)	b_0	b_1	r^2
ATD	-68.705	1164.4	0.996
BET	-36.06	5.7448	0.996
EIC	-50.42	28.09	0.965
FID	-115.70	0.2832	0.994
GMH	-2.696	3.084	0.986
GML	-2.828	2.918	0.992
ICP	-6.782	3425.7	0.997
LRA	-104	0.02344	0.966
NAD	-186.58	0.0522	0.999
XRF	8.66	0.964	0.991

Each technology developer was directed by the Data Management Plan (Appendix B) to measure the calibration bed soils at least three times: (1) prior to the field demonstration, (2) after completing the baseline survey, and (3) following completion of the project.

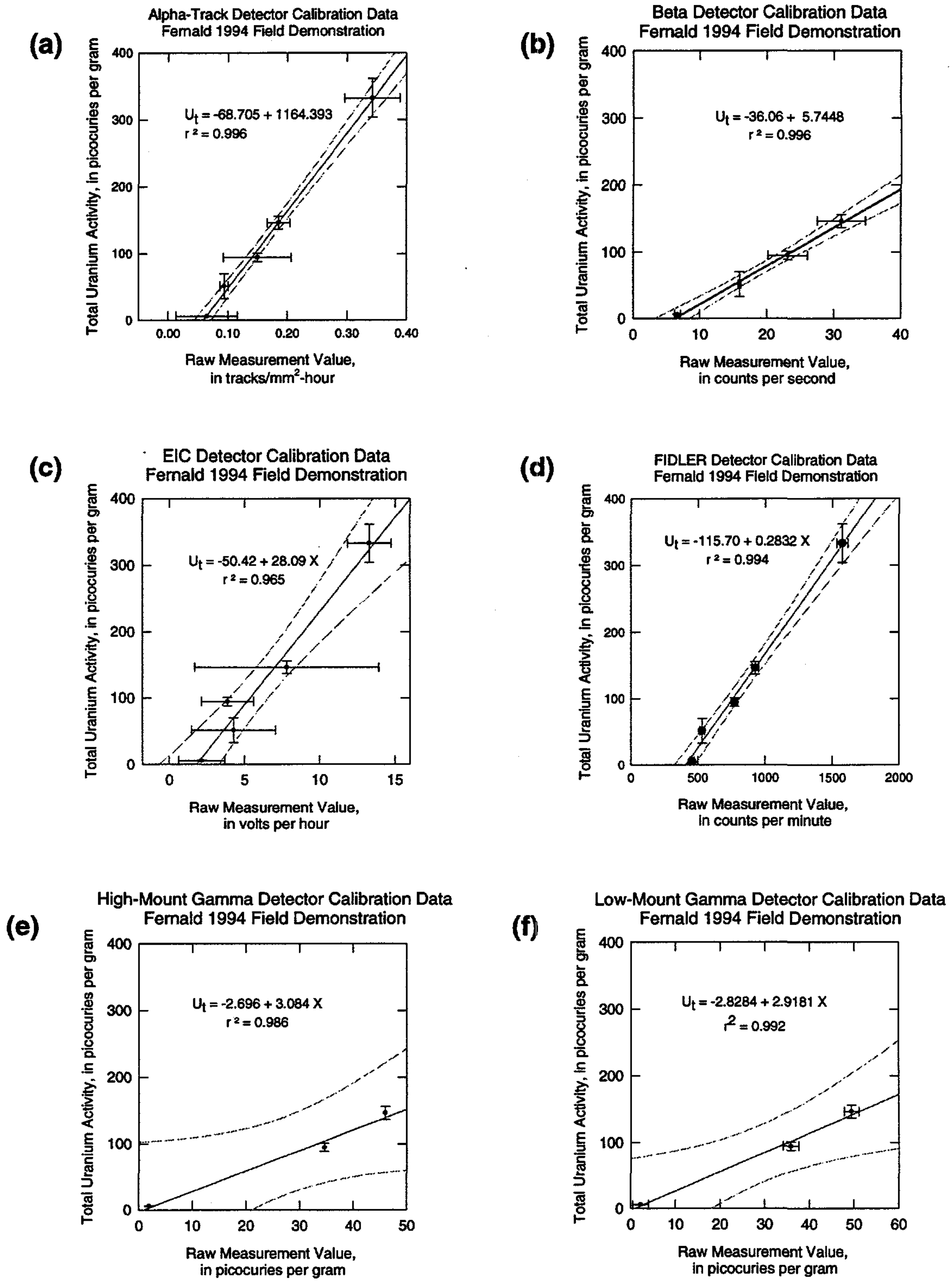

Figure 6. Cross plots of calibration data for (a) alpha-track detector, (b) beta scintillometer, (c) electret ionization chamber, (d) FIDLER scintillometer, (e) high-mount gamma-ray spectrometer, and (f) low-mount gamma-ray spectrometer. Error bars on calibration points represent plus and minus one standard deviation; dashed lines are 95-percent confidence limits on solid-line regression equation.

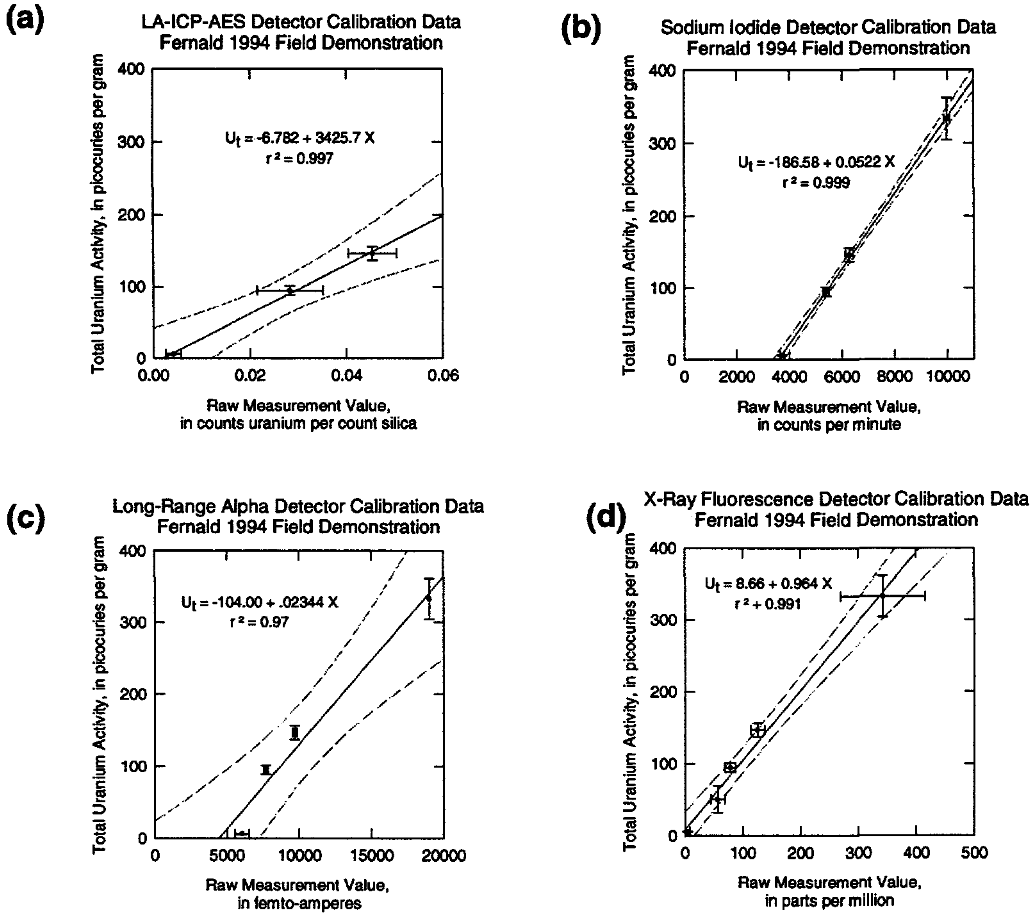

Figure 7. Cross plots of calibration data for (a) laser ablation-inductively coupled plasma-atomic emission spectrometer, (b) long-range alpha detector, (c) sodium-iodide scintillometer, and (d) field x-ray fluorescence unit. Error bars on calibration points represent plus and minus one standard deviation; dashed lines are 95-percent confidence limits on solid-line regression equation.

Field conditions also were to be recorded by project engineers at the time the various technology instruments measured the calibration beds. Not all technology developers followed these instructions exactly, leading to calibration datasets of variable quality and reliability

Standard-Sites Measurements

Two standard sites, identified as S1 and S2, were established on undisturbed native soils within the survey grid. The standards sites were used to make repeated detector measurements to quantify detector precision. These standard-sites data are tabulated in Appendix F, and a summary of the measurements is presented in table 5. The technologies were to take standard-site measurements twice daily (see Data Management Plan; Appendix B). All technologies took measurements at the S1 and S2 locations (table F-1) with the exception of the laser ablation-inductively coupled plasma-atomic emission spectrometer, which recorded somewhat equivalent, replicate "standard" measurements on calibration beds C0, C35, and CP (table 6; table F-2). The ICP technology developers took their replicate standardized soil measurements from the calibration beds ostensibly because the technology required removing soil for testing. This

Table 5: Statistical summary of measured uranium activities of the standard sites for all technologies except ICP

[Std.Dev.: standard deviation; C.V.: coefficient of variation, defined as the standard deviation divided by the mean, in percent; N: number of samples. Values are total uranium activity in picocuries per gram (except for C.V. and N)]

	ATD	BET	EIC	FID	GMH	GML	LAB	LRA	NAD	XRF
					Standard Site 1					
Mean	73.16	66.81	34.23	90.71	75.02	81.93	69.44	45.55	130.83	86.01
Std.Dev.	98.21	7.41	55.36	10.90	14.33	8.88	7.50	32.51	10.56	8.14
C.V. %	134	11	162	12	19	11	11	71	8	9
N	3	19	2	21	9	9	5	10	18	18
					Standard Site 2					
Mean	24.87	53.77	15.41	76.30	49.82	48.13	48.79	68.94	118.21	63.64
Std.Dev.	24.09	11.82	10.47	12.06	6.01	7.99	2.25	330.78	7.10	9.60
C.V. %	97	22	69	16	12	17	5	45	6	15
N	3	17	2	20	7	8	5	9	17	17

procedure ensured the standard plots surface soils remained undisturbed. Consequently, however, the ICP standard data cannot be compared directly to those reported for other techniques.

Table 6: Statistical summary of measured uranium activities of the standard sites by ICP technology

[Std.Dev.: standard deviation; C.V.: coefficient of variation, in percent; N: number of samples. Values are total uranium activity in picocuries per gram (except for C.V. and N)]

	CO	C35	CP
Mean	11.95	115.00	133.79
Std.Dev.	12.66	145.24	19.85
C.V. %	106	126	15
N	16	32	3

Soil-Moisture Correction Factors

Raw field measurement values obtained by the majority of the technologies demonstrated were converted directly to total uranium activities through straight-forward application of the appropriate calibration coefficients (table 4). However, three of the field-screening technologies adopted a modified approach to converting the raw measured readings in an effort to compensate for varying environmental conditions, specifically changes in soil-moisture levels. The data affected are those obtained by the beta scintillometer and the high-mount and low-mount gamma-ray spectrometer.

The modification involves the development of an empirical "soil-moisture correction factor." Measured values recorded for the affected technologies at the standard sites were observed (by the developers) to decrease markedly following heavy rain during the course of the 1994 Fernald field characterization demonstration program. These values were then observed to increase over somewhat extended periods of time to approximately the levels observed prior to the rainfall events. The developers of the beta scintillometer and gamma-ray spectrometer elected to make use of the concept that replicate measurements obtained from the standard sites should be approximately the same, all other conditions being equal. Soil moisture was inferred to have increased abruptly coincident with rainfall events and then to have decreased progressively to pre-rainfall levels over the course of several hours to a day or so. An empirical soil-moisture correction factor was obtained by distributing the observed drop and subsequent rebound in standard-site measurements over the interspersed field-survey measurements in proportion to the elapsed time associated with each individual measurement. Calculation of this time (measurement)-specific correction factor is illustrated schematically in figure 8, based on a sequence of control readings obtained from one of the two standard sites.

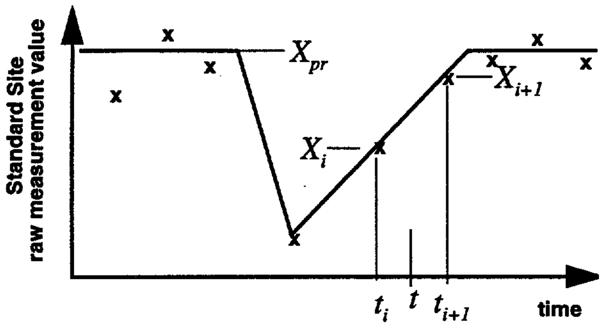

Figure 8. Schematic illustration of quantities involved in calculation of a linear soil-moisture correction factor for a field-survey measurement taken at time *t* from changes in repeated measurements at a standard site (x).

The soil-moisture correction factor, $F^*(t)$, at any arbitrary time, t, with $t_i \le t \le t_{i+1}$, is defined in a general sense as:

$$F^*(t) = \frac{X_{pr}}{X_i + (t - t_i) \cdot \dfrac{X_{i+1} - X_i}{t_{i+1} - t_i}}, \quad (2)$$

where X_{pr} is the average pre- (and post-) rainfall standard-site measurement value, X_i is the standard-site measurement obtained at time t_i, and X_{i+1} is the standard-site measurement obtained at a later time, t_{i+1}. In practice, a best-fit curve through the affected X_i values would be used if there were sufficient standard-site measurements that the response of the instrument readings to changes in soil-moisture content would be better represented by some possibly non-linear, temporally averaged rate of change, rather than by simple linear interpolation between individual standard-site measurements. Soil-moisture correction factors were provided directly by the technology developers.

The calibrated results for the three affected alternative technologies, the beta scintillometer and the high- and low-mounted gamma spectrometers, are given in Appendix G. The "baseline" results are indicated in the column labeled "Total U (pCi/g)" for consistency and comparison with the uranium activities reported by the other technologies. Additional columns provide the appropriate moisture-correction factors, F*, and the "adjusted total U" obtained by multiplying the otherwise calibrated reading [from equation (1)] by F*. The baseline uranium activities (without the soil-moisture factor correction) are used throughout the remainder of this report to facilitate direct comparison with the readings reported by the majority of the demonstrated technologies.

Field Survey Results

Measurements of uranium activity recorded for the baseline Fernald field grid by each different characterization technology are tabulated in Appendix G. Grid measurements are identified by "FLD" in the sample-type category. Calibration (CAL) and standard-site (STD) measurements are also included in these tables, which are organized by sample sequence number. Duplicate (DUP) soil samples, collected at selected grid locations, and a small number of core samples (COR) were submitted for standard laboratory analysis. The baseline field data from Appendix G are summarized in table 7, which presents a comparison of the final, calibrated, baseline uranium activities obtained by all technologies, organized in order by geolocation index. The timing of the field measurements for each technology with respect to major meteorological variables is shown in figure 4.

Maps showing the baseline calibrated measurements of uranium activity obtained for the field survey grid are shown in figures 9 and 10. Total uranium activities are represented by a small grey-scale-coded circle at the approximate x and y locations corresponding to the actual sample locations in the field.The grey-

Table 7: Composite tabulation of field survey results for geolocation grid

[All values are total uranium activity in picocuries per gram. Negative values are interpreted as below detection limit. Technology abbreviations from table 1. Leaders (--): not measured]

Geolocation Index	ATD	BET	EIC	FID	GMH	GML	ICP	LAB	LRA	NAD	XRF
A1	27.71	44.19	-50.42	67.81	51.27	47.36	79.55	63.36	83.52	95.30	72.29
A2	30.50	45.46	-2.67	64.42	48.81	46.49	57.62	56.58	95.24	95.30	60.25
A3	30.85	68.44	-45.08	75.46	46.65	51.45	94.96	65.60	95.24	110.96	61.87
AA5	0.81	41.72	16.74	72.06	53.12	50.86	32.27	39.41	60.08	124.01	61.10
AA6	-16.19	49.54	20.54	81.69	56.52	49.11	36.72	59.80	36.64	131.84	72.39
AA6.5	10.94	54.65	-31.71	88.49	58.37	53.49	52.48	52.99	76.49	105.74	47.90
AA7	-5.13	51.84	24.78	69.51	64.54	57.28	36.72	48.42	99.93	116.18	38.16
AA8	-5.48	49.65	-1.40	77.16	68.85	71.29	52.14	61.79	34.30	116.18	33.38
AA9	-1.64	45.57	25.20	75.74	62.99	58.45	41.18	54.20	67.11	105.74	83.75
AA9.5	6.98	57.70	-1.26	86.22	56.83	55.53	49.74	68.27	67.11	110.96	104.06
AA10	27.12	65.45	25.31	80.27	48.50	53.49	52.14	53.89	76.49	97.91	91.21
AA11	-14.79	32.76	156.94	72.34	45.41	55.83	54.54	51.54	88.21	87.99	74.23
B1	20.95	54.25	-40.31	69.80	46.96	45.32	86.05	46.80	106.96	97.91	50.71
B2	-30.51	56.26	15.87	58.75	44.49	49.41	41.18	71.08	48.36	105.74	54.16
B3	-12.93	53.85	-14.75	70.36	46.34	47.95	40.49	64.39	85.86	100.52	63.43
C1	1.04	62.69	-19.80	76.88	42.64	48.53	59.33	72.21	95.24	108.35	83.10
C2	41.45	50.97	25.98	74.04	45.41	45.03	52.14	61.84	60.08	97.91	61.97
C3	3.02	58.10	25.98	74.89	46.34	42.99	65.16	61.10	62.42	98.43	64.67
CC5	-8.04	33.16	-9.66	87.35	50.35	45.90	28.50	50.12	43.67	110.96	67.78
CC6	8.38	58.15	-13.34	90.19	55.90	60.20	39.81	59.33	53.05	121.40	77.82
CC7	3.95	56.72	12.39	96.70	56.83	58.16	32.27	52.48	78.83	124.01	65.85
CC8	15.83	57.58	-35.64	89.90	61.45	60.49	41.18	51.36	104.62	113.57	62.58
CC9	--	63.27	-20.87	92.45	46.65	68.67	40.84	61.59	109.30	113.57	82.48
CC10	0.81	46.89	19.64	86.22	46.03	47.65	43.58	60.74	31.95	113.57	54.89
CC11	22.00	32.71	51.27	74.61	20.13	29.27	16.51	31.41	36.64	95.30	42.44
D1	3.95	56.78	-9.69	82.82	48.50	45.61	60.36	64.89	92.90	110.96	71.69
D2	0.58	54.65	-45.64	89.62	47.26	52.03	80.23	53.81	64.77	108.35	68.26
D3	-17.59	53.16	-35.81	84.24	50.04	45.61	60.36	55.36	76.49	95.30	67.35
E1	-2.10	48.10	-30.20	87.07	45.72	41.53	56.94	56.83	76.49	105.74	54.14
E2	-0.24	45.11	-24.86	82.54	56.21	55.24	48.37	52.44	57.74	100.52	68.78
E3	20.37	58.61	-9.69	84.24	47.57	47.65	55.57	56.38	97.58	106.26	71.04
F1	5.58	58.56	-50.42	88.49	48.19	42.99	44.60	50.93	78.83	105.74	76.67
F2	10.59	56.49	-36.09	98.68	47.57	44.74	45.63	49.90	95.24	105.74	60.84
F3	-2.68	53.04	-35.25	85.94	46.34	42.40	51.80	52.56	92.90	105.74	63.71
S5	2.91	30.06	17.16	77.16	58.98	50.86	39.12	50.98	64.77	118.79	82.35
S9	81.85	72.63	-25.70	93.30	77.49	72.46	87.77	90.68	55.39	126.62	100.41
S10	47.15	61.08	39.81	78.01	42.95	46.49	47.69	71.75	20.23	95.30	71.23
S11	-1.05	41.49	38.88	57.05	26.29	21.39	78.52	39.21	60.08	78.60	25.02

Table 7: Composite tabulation of field survey results for geolocation grid (continued)
[All values are total uranium activity in picocuries per gram. Negative values are interpreted as below detection limit. Technology abbreviations from table 1. Leaders (--): not measured]

Geolocation Index	ATD	BET	EIC	FID	GMH	GML	ICP	LAB	LRA	NAD	XRF
U5	17.23	51.95	27.16	68.38	47.26	53.20	63.10	47.53	139.78	113.57	64.98
U6	31.78	45.46	-25.70	79.42	66.08	73.92	100.78	65.60	55.39	139.67	74.38
U6.5	33.99	55.63	66.27	85.66	82.73	87.92	105.24	82.55	71.80	137.06	84.24
U7	30.62	55.57	69.66	100.38	81.19	75.67	94.28	89.03	78.83	150.11	95.11
U8	23.86	64.13	84.61	106.33	89.82	97.85	88.11	105.50	132.74	147.50	88.94
U9	8.14	61.54	11.35	89.05	65.77	73.63	69.27	76.02	46.02	116.18	65.83
U9.5	32.25	46.67	49.75	70.65	49.42	53.49	47.34	52.16	95.24	100.52	78.16
U10	3.72	64.07	36.57	76.88	47.57	53.49	67.21	59.77	27.26	103.65	62.04
U11	29.80	65.39	41.88	81.69	38.94	48.24	87.42	58.04	88.21	103.13	66.61
V10	-9.44	59.36	24.16	67.81	42.95	40.65	66.53	53.72	83.52	97.91	66.58
V6	-32.14	59.48	-20.98	94.15	62.68	71.87	55.91	58.81	146.81	129.23	68.74
V6.5	11.41	75.39	18.79	107.18	73.79	80.05	54.54	86.46	151.50	150.11	92.91
V9	30.85	63.61	43.63	80.56	58.37	68.08	94.28	81.67	85.86	129.23	73.92
V9.5	-0.01	54.77	16.46	67.25	42.33	40.07	63.79	54.12	102.27	100.52	66.66
W5	25.96	56.78	45.79	87.35	50.97	56.70	26.10	61.86	118.68	131.84	69.90
W6	5.12	53.79	112.75	102.65	67.93	64.00	38.78	70.52	106.96	137.06	74.82
W6.5	10.24	65.62	25.59	104.63	76.87	79.46	36.72	74.04	111.65	137.06	76.34
W7	-9.55	73.72	98.68	96.98	80.88	78.59	42.21	79.11	88.21	144.89	87.23
W7.5	23.98	67.98	-17.95	103.21	72.25	80.05	56.94	77.83	76.49	139.67	83.94
W8	0.46	59.36	10.82	79.14	68.54	69.83	41.52	62.32	55.39	118.79	81.18
W8.5	-1.05	58.73	2.50	92.45	79.34	87.92	75.78	81.23	109.30	124.01	88.91
W9	-22.25	55.05	23.09	87.07	48.19	48.53	45.97	52.94	78.83	113.57	61.45
W9.5	7.33	48.33	25.06	78.86	45.72	41.82	65.50	51.20	99.93	108.35	59.76
W10	0.93	60.62	115.56	79.14	44.80	55.83	43.23	75.26	111.65	118.79	70.20
W11	15.48	65.28	25.62	94.43	40.79	51.45	56.25	82.98	113.99	116.18	67.24
X7	-12.81	61.66	99.24	86.79	70.70	74.21	73.38	68.76	74.14	134.45	83.95
X7.5	11.75	45.63	-4.41	72.91	71.32	63.41	72.69	62.73	60.08	124.01	64.19
X8	18.51	56.60	-38.06	81.97	74.10	73.33	52.14	62.24	46.02	126.62	81.27
X8.5	10.12	52.01	29.52	76.03	68.85	70.12	55.91	61.53	78.83	134.45	66.65
X9	15.71	60.51	58.63	91.89	67.62	75.08	56.59	78.12	69.46	126.62	78.99
Y5	-13.40	50.05	68.65	80.84	52.20	55.53	45.63	49.60	76.49	103.13	54.70
Y6	8.61	56.83	20.45	78.29	61.45	56.70	54.88	55.32	36.64	100.52	64.92
Y6.5	-7.92	59.94	54.05	68.95	60.53	64.58	74.06	60.17	43.67	100.52	68.34
Y7	16.06	55.51	46.72	87.92	69.47	65.75	70.98	57.33	46.02	108.35	72.54
Y7.5	12.34	55.51	5.59	103.21	72.25	80.92	98.04	76.00	43.67	118.79	65.17
Y8	-10.95	41.78	20.45	84.24	73.17	71.87	112.77	59.93	34.30	105.74	62.38
Y8.5	20.02	54.88	-5.62	82.26	73.48	76.54	97.02	68.69	69.46	110.96	85.20
Y9	24.56	46.67	73.18	88.77	71.94	70.42	101.13	62.19	67.11	103.13	85.75

Table 7: Composite tabulation of field survey results for geolocation grid (continued)
[All values are total uranium activity in picocuries per gram. Negative values are interpreted as below detection limit. Technology abbreviations from table 1. Leaders (--): not measured]

Geolocation Index	ATD	BET	EIC	FID	GMH	GML	ICP	LAB	LRA	NAD	XRF
Y9.5	14.20	55.68	33.23	69.80	49.73	46.49	86.74	60.78	67.11	113.57	60.08
Y10	-0.01	61.26	206.49	85.94	48.50	52.32	105.92	57.80	83.52	103.65	84.49
Y11	64.62	61.03	52.45	121.06	58.06	73.04	74.41	86.77	146.81	137.06	111.53
Z6	1.97	50.34	42.59	83.67	54.67	54.66	69.27	45.36	78.83	108.35	62.07
Z6.5	10.12	62.35	-24.35	93.87	59.29	64.29	97.36	56.85	74.14	108.35	65.66
Z7	5.58	51.43	10.31	77.16	61.76	56.99	80.23	49.57	67.11	116.18	56.75
Z9	-11.77	49.54	40.45	82.26	68.85	69.54	111.75	57.49	50.70	90.60	70.41
Z9.5	-12.35	65.97	29.07	85.66	50.35	60.20	123.05	67.36	78.83	105.74	73.88
Z10	6.40	53.39	73.82	72.06	47.57	50.28	72.35	58.82	78.83	103.13	60.12

scale coding varies from white (low uranium activities) to black (high values) as indicated by the shaded ramp scale on the figures; the scale boundaries are the same for all figures to facilitate comparison of the absolute magnitudes of the measurements obtained by the different technologies. Note that for presentation purposes only, the state plane coordinates indicated on the axes of figures 9 and 10 have been truncated to the right-most three or four digits. The full Ohio state plane coordinates are given in Appendix C.

An alternative presentation of the field survey results is given in figures 11 through 13. In these figures, the baseline, calibrated uranium activities are plotted in an arbitrary, but consistent, sequence of geolocations (effectively row by row). This mode of presentation allows direct visual comparison of nearby spatial measurements among the different technologies demonstrated at Fernald. The equivalent soil-geochemistry values (LAB) are also shown on each figure for comparison; soil geochemical determinations are generally accepted as the "true" uranium contamination level at each sample location. Note that in this set of figures, the total uranium activity scales have been modified so that the full range of variability exhibited by the measurements obtained by each individual technology is reflected.

Examination of the various parts of figures 9 through 13 can provide a first pass assessment of the degree to which the various technologies are measuring the same uranium activities. Figures 9 and 10 clearly indicate that the alpha-track detector and the electret-ionization chamber methods [figure 9(a) and 9(c), respectively] are producing markedly different results from the other technologies. Although there are definite differences, the remaining characterization techniques produced at least grossly similar spatial patterns of uranium contamination. Figures 11 through 13 emphasize the point-by-point comparisons of the different technologies. For example, compare the similar shapes of the paired curves for the low-mount gamma spectrometer (GML; figure 12(b)) and the sodium-iodide (NAD; figure 13(b)) detectors. The GML measurement curve both tracks and nearly overlies the "ground-truth" laboratory-analysis curve

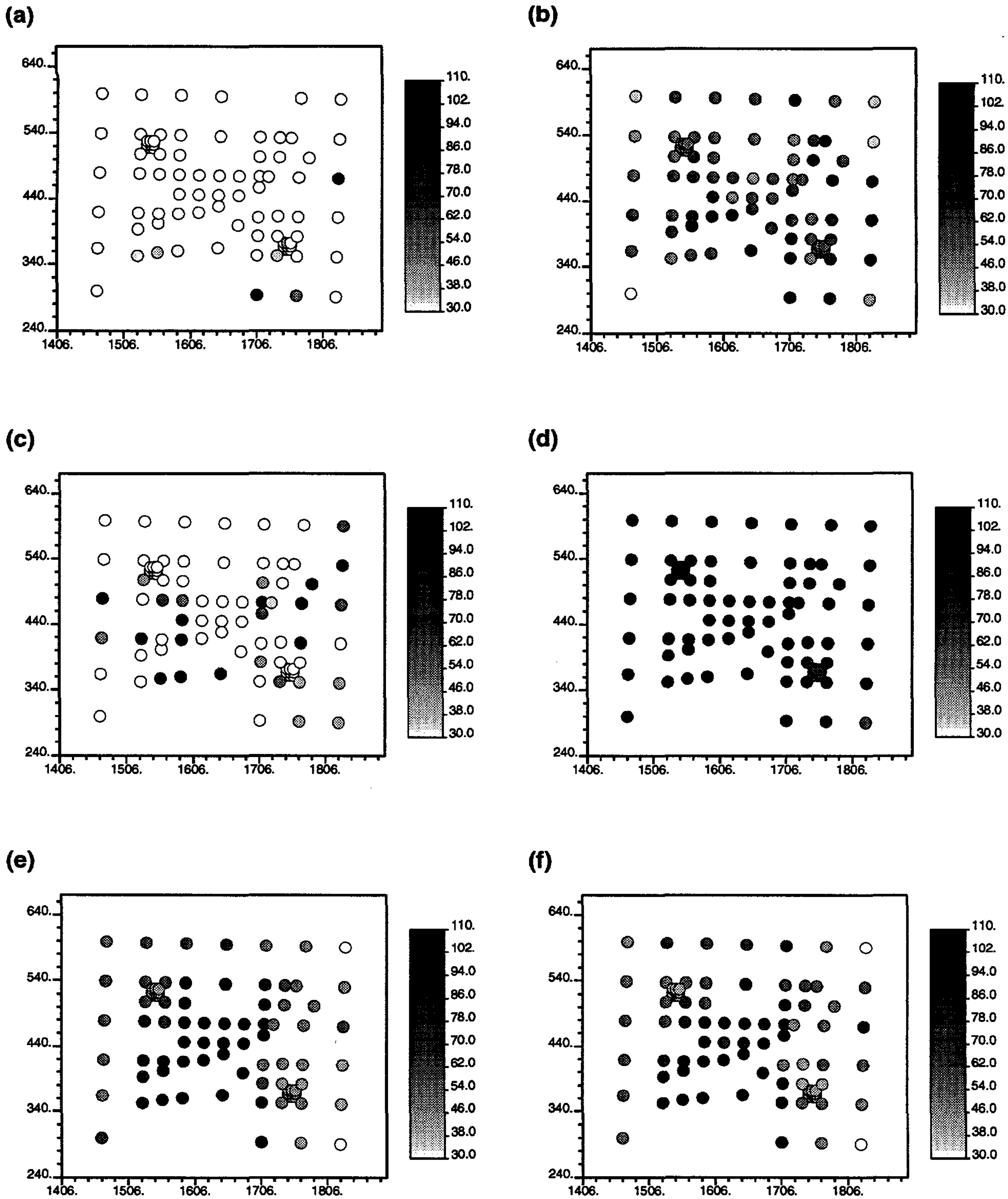

Figure 9. Grey-scale location maps showing uranium activities for the 1994 Fernald field characterization demonstration grid as measured by (a) alpha-track detectors, (b) beta scintillometer, (c) electret ionization chambers, (d) FIDLER detector, and (e) high-mount and (f) low-mount gamma spectrometer. Grey-scale bars indicate total uranium activity in picocuries per gram. *X*- and *Y*-axis values are truncated Ohio state plane coordinates in feet.

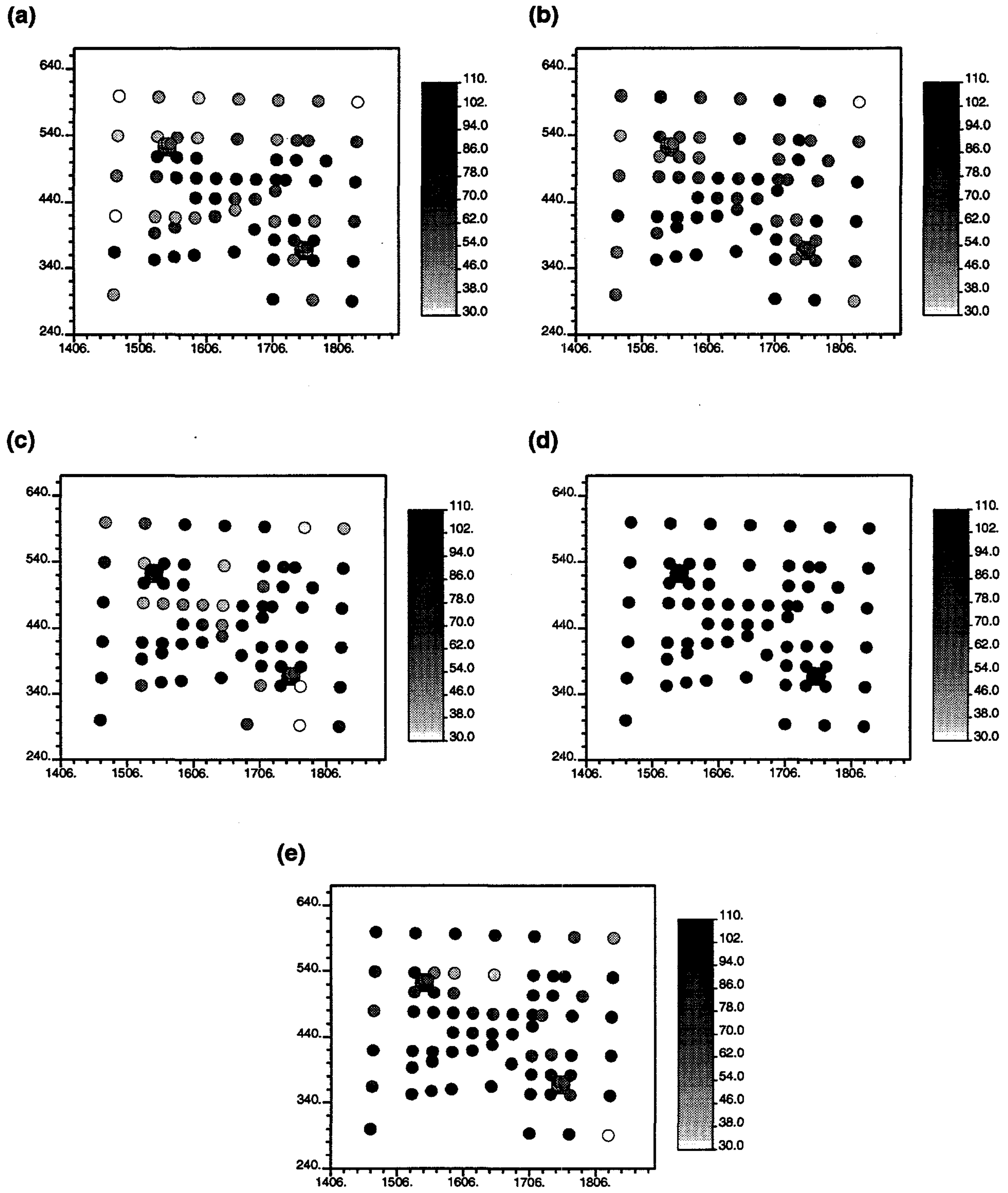

Figure 10. Grey-scale location maps showing uranium activities for the 1994 Fernald field characterization demonstration grid as measured by (a) laser ablation-inductively coupled plasma-atomic emission spectrometer, (b) long-range alpha detector, (c) soil sampling and laboratory analysis, (d) sodium-iodide scintillometer, and (d) x-ray fluorescence unit. Grey-scale bars indicate total uranium activity in picocuries per gram. *X*- and *Y*-axis values are truncated Ohio state plane coordinates in feet.

(a)

(b)

(c)

(d)

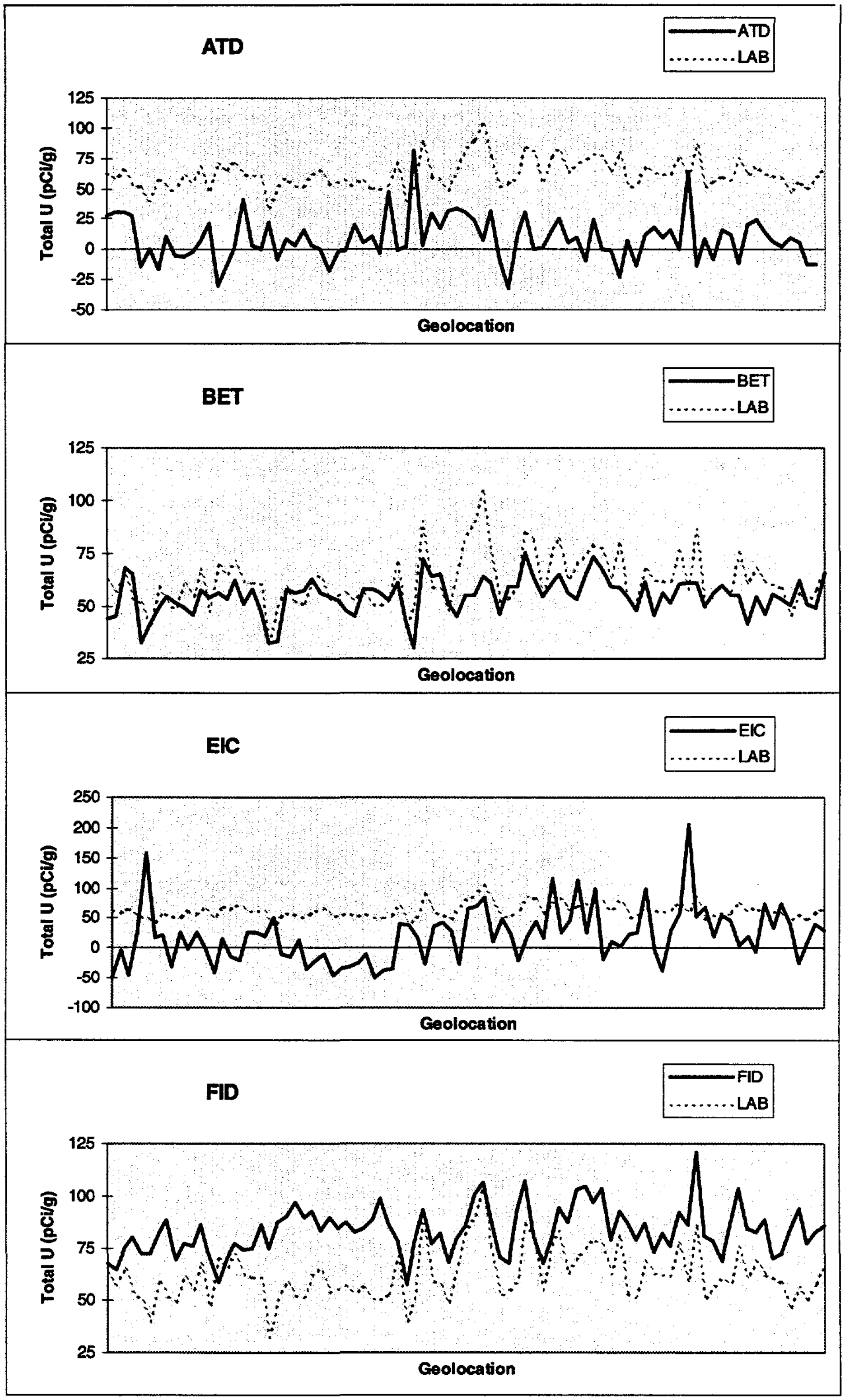

Figure 11. Field measurements of total uranium activity arranged sequentially by geolocation index code, as measured by (a) alpha-track detectors, (b) beta scintillometer, and (c) electret ionization chambers, and (d) FIDLER scintillometer.

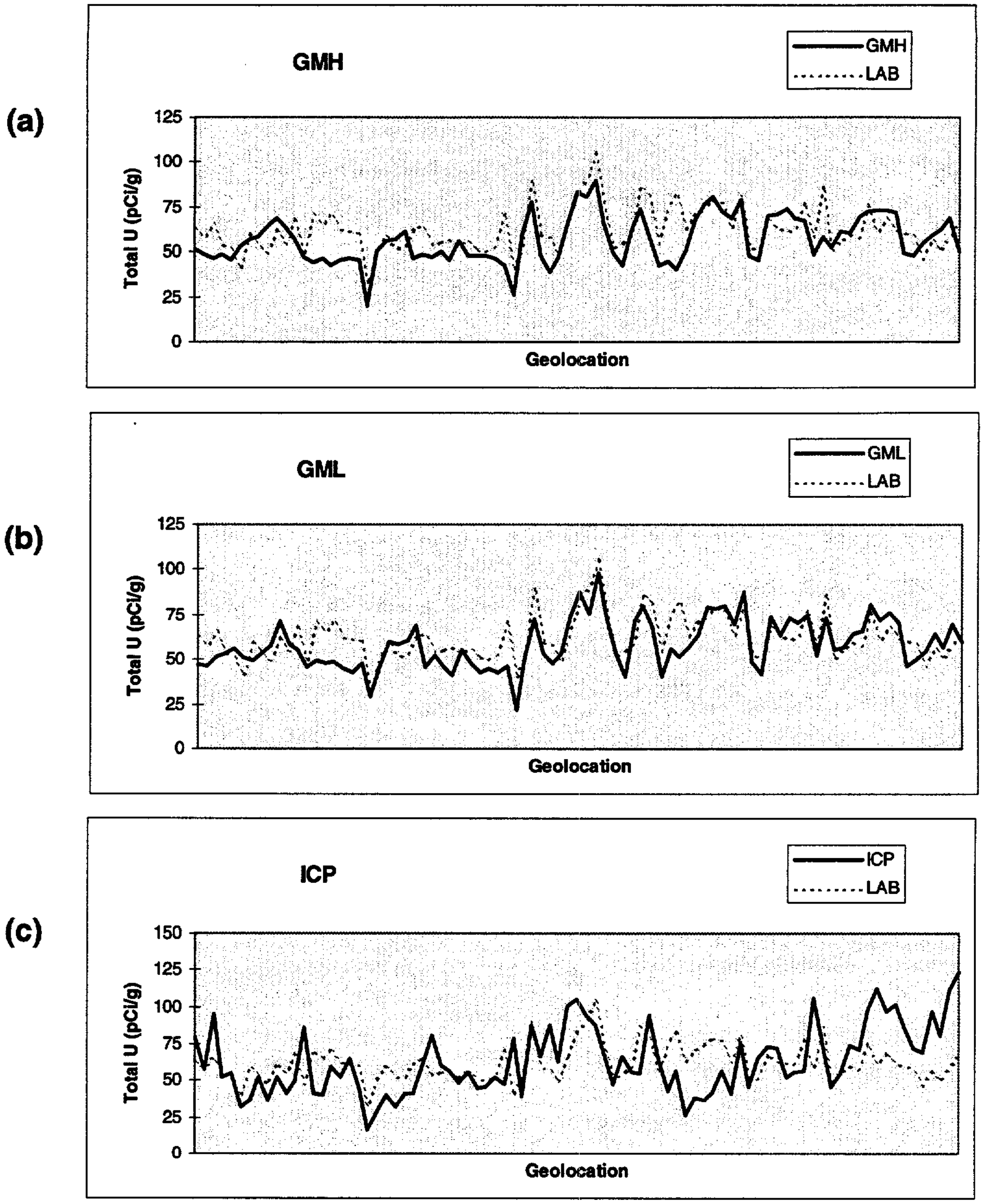

Figure 12. Field measurements of total uranium activity arranged sequentially by geolocation index code, as measured by (a) high-mount gamma spectrometer, (b) low-mount gamma spectrometer, and (c) laser ablation-inductively coupled plasma-atomic emission spectroscope.

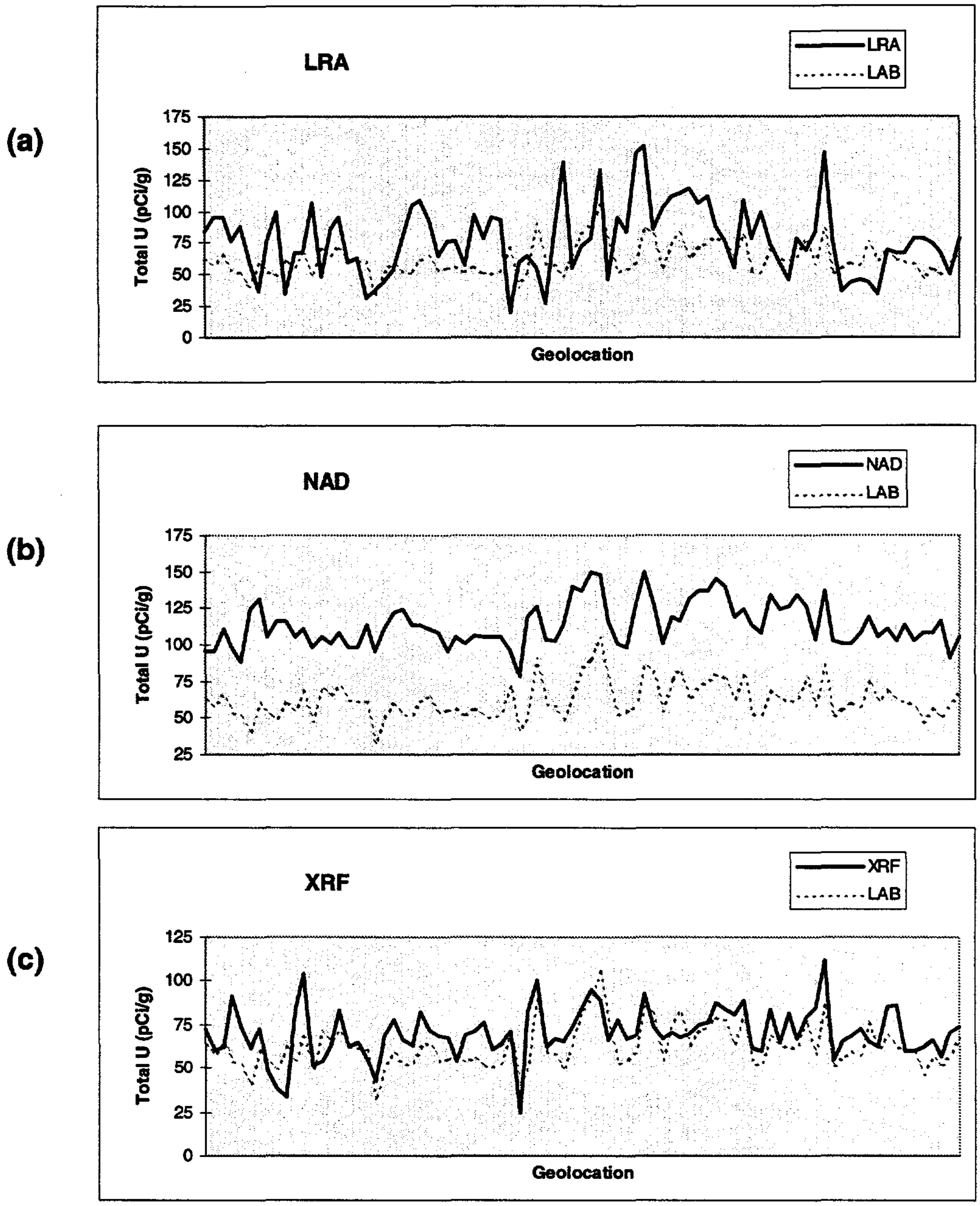

Figure 13. Field measurements of total uranium activity arranged sequentially by geolocation index code, as measured by (a) long-range alpha detector, (b) sodium-iodide scintillometer, and (c) field x-ray fluorescence unit.

(LAB) quite closely, whereas the NAD measurement curve tracks the *shape* of the LAB measurement curve but is vertically offset from it. In contrast, the measurement curve from the passive alpha-track detector [ATD; figure 11(a)] is both offset from the LAB measurement curve and sometimes indicates an *inverse* correlation with the relative high and low uranium activity peaks represented in the LAB data. Another notably different set of paired curves is represented by the electret-ionization chamber technology [EIC; figure 11(c)]. Here, the alternative technology appears to be generating a uranium "signal" far out of proportion to the actual signal contained in the laboratory analyses. Similar to the passive alpha-track measurements, there is a suggestion of an inverse correlation with conventional soil sampling in figure 11(c).

The field-survey data for some technologies (ATD, EIC) exhibit a large number of negative values, despite the excellent (high-r^2) regression fits of the field calibration readings to the laboratory calibration-plot activities (table 4). For purposes of this baseline data report, negative values are interpreted as "below the detection limit" of the instrument involved. The ultimate cause of these negative total uranium activities is unclear, although the immediate cause obviously is the negative intercept (b_0 coefficient) resulting from the least-squares regression. Forcing the regression curve to pass through the origin probably would not significantly reduce the number of negative calibrated measurements, as the difficulty does not appear to involve elevated background readings that could be subtracted from all the field readings. Had elevated background readings been the problem, the regression-fitting procedure simply would have generated an appropriate positive intercept, and the background readings would have been incorporated into the calibration automatically. More likely, some combination of field environmental and/or instrument conditions changed between the time the affected technologies obtained their calibration readings and the time the field survey(s) were conducted. The specific causes are uncertain; however, the overall effect is to have decreased field readings taken in a known contaminant field, relative to readings associated with the C0 (near zero uranium activity) calibration plot (table 2).

Depth Distribution of Uranium

Most of the uranium contamination at the incinerator area demonstration site, and at the Fernald site generally, is thought to be surficial in nature. A small number of soil-core samples were taken as part of the 1994 Fernald field characterization demonstration program to confirm this understanding for the demonstration data. A total of 15 eight-inch (20-cm) soil cores were collected. Five of these cores were sampled in two-inch (5-cm) increments to allow explicit evaluation of the depth distribution of uranium activity. The remaining ten cores were collected as one sample each. Core

Table 8: Uranium contamination measurements for selected depth intervals in soil cores

[Uranium measurements by ICP mass spectrometry; sample IDs are prefixed by "LAB." Data are total uranium values in picocuries per gram]

Depth, (inches)	AA7		AA9		W7		W9		Y8	
	ID	Total U	ID	Total U	ID	Total U	ID	Total U	ID	Total U
0–2	136	40.94	140	50.46	148	77.09	152	46.60	144	52.26
2–4	137	16.85	141	32.60	149	22.83	153	24.76	145	30.31
4–6	138	6.27	142	16.03	150	12.08	154	11.85	146	16.99
6–8	139	6.39	143	4.88	151	13.64	155	14.46	147	4.97

Table 9: Comparison of Total Uranium Activities for 8-inch Core Samples and Standard Field Grab Samples
[Uranium activities in picocuries per gram by ICP mass spectrometry]

Location Code	Core Activity	Field-Sample Activity	Location Code	Core Activity	Field-Sample Activity
AA10	22.25	53.89	U7	46.26	89.03
AA6	21.68	59.80	U8	57.75	105.50
AA8	29.87	61.79	U9	33.30	76.02
CC10	12.23	60.74	W10	30.50	75.26
CC6	25.81	59.33	W6	31.46	70.52
CC7	25.09	52.48	W8	22.08	62.32
CC8	21.35	51.36	Y10	15.10	57.80
CC9	18.19	61.59	Y6	18.46	55.32
U10	23.33	59.77	Y7	20.29	57.33
U6	45.80	65.60	Y9	22.42	62.19

samples were analyzed only by the standard laboratory analysis process.

The vertical distribution of uranium in two-inch (5-cm) soil-core segments taken from five separate spatial locations is given in table 8, and these data are displayed graphically in figure 14. These diagrams indicate that the majority of the uranium activity at the Fernald incinerator area is confined to the uppermost 2 inches (5 cm) of the soil and that the activity decreases markedly to a depth of at least 8 inches (20 cm) Schilk and others (1993a) have reported down-hole measurements of uranium activity, using a modification of the high-resolution gamma spectrometer technique, that are compatible with this conclusion of surficial concentration of uranium contaminants. Their measurements extended to depths of nearly 10 feet (3 m).

A somewhat less-definitive, but still instructive, evaluation of uranium activity with depth is possible by comparing composite 8-inch (20-cm) soil-core results (COR in table G-8) with the results of standard "grab" field sampling (FLD in table G-8) that represents soil from only the top inch (2.5 cm) or so. These data are presented in table 9 and the corresponding cross plot is illustrated in figure 15. Without exception, the 8-inch composite core activities are markedly lower than the corresponding field-sample activity. This relationship is compatible with the vertical activity profiles of figure 14, which suggest that high surficial activities are being mixed and diluted with less-contaminated subsurface materials.

Duplicate Field Sampling and Laboratory Analyses

A number of replicate soil samples were collected at selected field locations for duplicate laboratory analyses. These duplicated data are identified by a sample type of "DUP" in the Appendix (table G-8), and these specific values have been extracted and reproduced in table 10. These paired analyses are plotted in figure 16. These replicate values fall very close to the 1:1 line that would indicate perfect reproducibility. A least-squares regression equation fitted to these data produces coefficients that are indistinguishable from a perfect 45° line; the coefficient

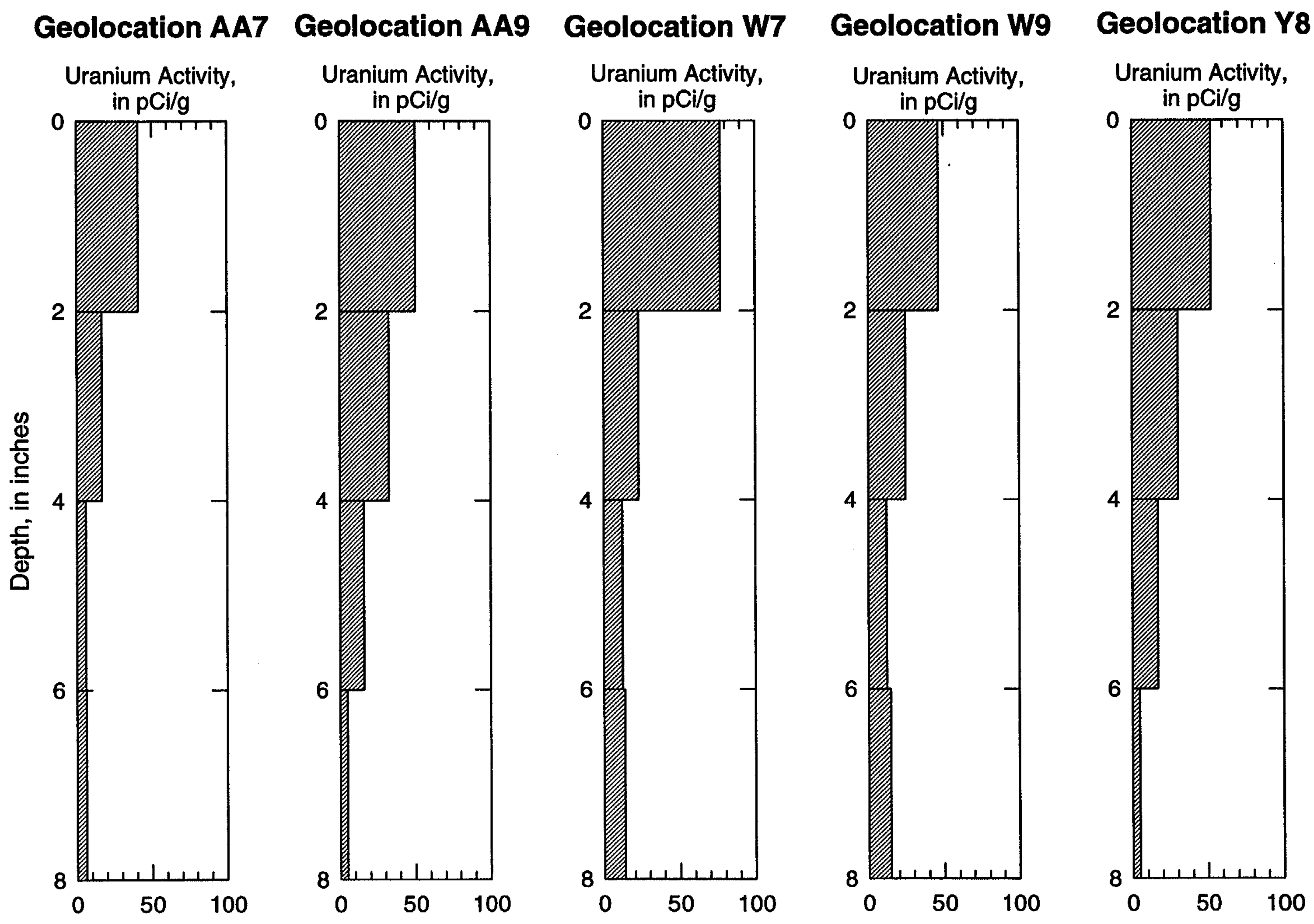

Figure 14. Depth profiles of total uranium activity for five 8-inch (20-cm) soil cores. Analyses by ICP mass spectrometry

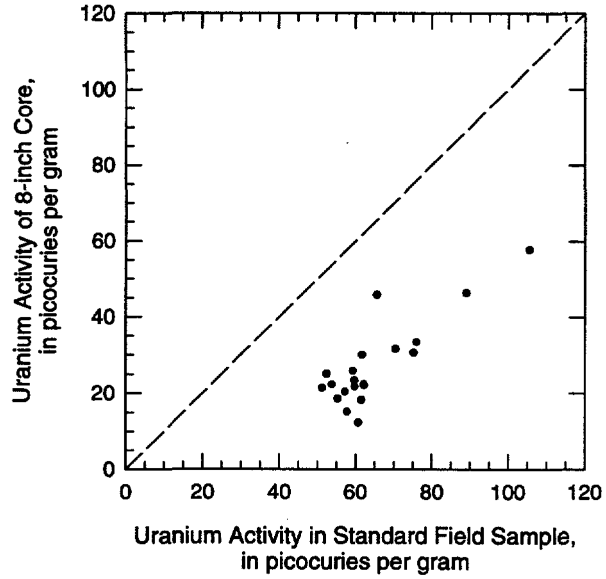

Figure 15. Cross plot showing total uranium activities of 8-inch composite soil core samples compared to the activity of standard "surficial" field (FLD) samples taken at the same spatial location. All sample pairs plot below the indicated 1:1 line (equal activities). Analyses by ICP mass spectrometry.

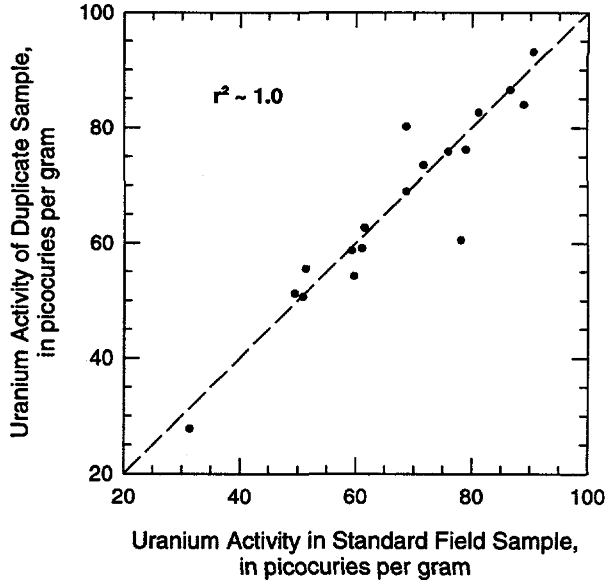

Figure 16. Cross plot comparing total uranium activities for replicate soil samples. Analyses by ICP mass spectrometry.

of determination for these paired samples is essentially equal to 1.0.

Although the total suite of replicate samples is too limited for large-scale generalizations, the 17 available replicate analyses do provide some confirmation that the distribution of surficial uranium in the soil is relatively uniform over the very small-scale physical distances involved in this replicate sampling process.

Further Analyses

Analysis of the baseline Fernald field-demonstration data, beyond presentation of simple location and value-comparison figures is beyond the scope of this data report. A future effort will evaluate the accuracy and precision of each demonstrated technology with respect to the replicate measurements of the two standard sites included as part of the demonstration. Preliminary results† suggest that some techniques are more precise than accurate, and vice-versa. Clearly, as indicated by the divergence between the paired curves representing the technology and laboratory geochemical uranium activities presented in figures 11 through 13, there are major questions of calibration accuracy represented by data from some of the different field methods.

The main set of field-survey data also will be evaluated separately, using statistical and geostatistical methods, such as those described by Rautman (1993) and by Rautman and others (1994). This latter evaluation will focus on the cost and risk decisions confronting a site operator: (1) What area(s) should be designated for remediation and which area(s) can be inferred to be "clean?" and (2) How should limited resources be allocated among additional characterization activities, treatment and remediation activities, and the potential costs of failure if all contaminated material is

†Rautman, C.A., in draft, Evaluation of standard-site measurements, 1994 Fernald field characterization demonstration program: being prepared as a Sandia Report, Sandia National Laboratories, Albuquerque, N. Mex.

Table 10: Replicate Soil Samples and Laboratory Analyses at Selected Grid Locations From Appendix Table G-8
[Measurements by ICP mass spectroscopy in pCi/g]

Geolocation Index	FLD Measurement	DUP Measurement
C3	61.1	59.02
CC11	31.41	27.73
CC6	59.33	58.62
CC8	51.36	55.49
S10	71.75	73.52
S5	50.98	50.58
U10	59.77	54.18
U7	89.03	83.88
U9	76.02	75.82
W7	79.11	76.11
W8.5	81.23	82.55
X7	68.76	80.17
X8.5	61.53	62.55
X9	60.46	57.80
Y11	86.77	86.51
Y8.5	68.69	68.95
Z7	49.57	51.11

not identified and remediated? (for example, Kaplan, 1993).

Conclusions

This data report contains the results of field demonstration of seven advanced-technology field-screening and four industry-standard methods for determining the total uranium activity of contaminated soils. The eleven individual data sets consist of raw field measurements at a number of manufactured calibration beds, two standard sites, and 85 field sample locations on a sequence of nested regular grids. The raw field measurements have been calibrated to laboratory measurements of total uranium activity obtained from a maximum of five calibration beds. A variety of meteorologic observations obtained episodically during the course of the field demonstration program are also included.

The data contained in this report will serve as the basis for future cost and performance evaluation of the eleven alternative characterization technologies demonstrated at the Fernald site. Preliminary comparison of simple graphical plots of results from the proposed alternatives to conventional soil sampling and laboratory measurement of uranium activity indicate that the beta scintillometer, the two mounting positions of gamma spectrometer, the laser ablation-inductively coupled plasma-atomic emission spectroscopy tool, and the field x-ray fluorescence technology performed best in terms of reproducing the laboratory data. The industry-standard FIDLER and sodium-iodide detectors plus the innovative long-range alpha detector appear to reproduce the spatial variability of the laboratory data, but exhibit varying degrees of difference in the actual magnitude of the laboratory uranium activities. In general, all three of these technologies were conservative, reporting higher field uranium activities than those resulting from laboratory measurement. The passive alpha techniques, alpha-track detectors and electret-ionization chambers, appear to have performed worst in terms of both failing to reproduce the spatial variability of the laboratory measurements and *under*estimating those uranium activities. This underestimation could result in leaving contaminated soil in place without remediation. These data are also available for additional study of issues related to: (1) calibration of the technologies as potential functions of changing environmental conditions, (2) the overall accuracy and precision of the various technologies as captured by replicate measurements taken at the two standard sites, and (3) evaluation of the uranium contamination for a portion of the Fernald site.

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Appendix A: Field Demonstration Project Plan

Project Plan

The "Field Demonstration Project Plan—Uranium in Soils Integrated Demonstration Program" dated May 1994 that follows was developed originally to document the various characterization technologies to be demonstrated during the 1994 Fernald Field Characterization Demonstration Program and to specify conduct of the actual field surveys. The plan is reproduced as it appeared at the beginning of field activities, with only those changes necessary to incorporate the plan into the overall report format. No editing or revisions has been done to modify this planning document to reflect in-field changes or grammatical errors.

Note that "Appendix F" of the project plan is duplicated by the Data Management Plan contained in Appendix B of this data report. The data management plan portion of the project plan has been omitted from this Appendix A to conserve space. The project plan continues with "Appendix G" of the original document. The original table of contents has also been omitted because those page numbers are no longer relevant.

FIELD DEMONSTRATION PROJECT PLAN

URANIUM IN SOILS INTEGRATED DEMONSTRATION PROGRAM

MAY 1994

Host Site:
Fernald Environmental Restoration Management Corporation
Fernald, Ohio

ABSTRACT

An Integrated Demonstration Program, hosted by the Fernald Environmental Restoration Management Corporation (FERMCO), has been established for investigating technologies applicable to the characterization and remediation of soils contaminated with uranium. An important part of this effort is the evaluation of field screening tools capable of acquiring high resolution information on the distribution of uranium contamination in surface soils in a cost-and-time efficient manner. Consistent with this need, five field screening technologies will be demonstrated at a uranium contaminated site at the FERMCO. The five technologies to be tested are gamma-ray spectrometry, beta scintillation counting, laser ablation-inductively coupled plasma-atomic emission spectroscopy (LA-ICP-AES), long-range alpha detection (LRAD), and passive radon monitoring. The goals of this field demonstration are to evaluate the capabilities of the five detectors and to demonstrate their utility within the Department of Energy's Environmental Restoration Program. To aid in the evaluation of detector performance similar field studies will be conducted using a sodium-iodide detector (NaI), a low-energy scintillation detector (FIDLER), an x-ray fluorescence detector, and soil sampling/laboratory analysis. This second suite of tools represent the industrial standards for characterizing soils contaminated with uranium and other radionuclides. Another important aspect of this program is the application of a cost/risk decision model to guide characterization of the site in real-time.

INTRODUCTION

One of the major problems facing the U.S. Department of Energy's (DOE) Environmental Restoration Program is the remediation of uranium-contaminated soils. In response to this problem the Office of Technology Development has initiated an Integrated Demonstration (ID) program to evaluate and compare the versatility, efficiency, and economics of various technologies that may be combined into systems for the characterization and remediation of uranium contaminated soils. The Fernald Environmental Restoration Management Corporation (FERMCO), located 29 kilometers northwest of Cincinnati, Ohio, has been selected as the host site for this ID program (DOE, 1991) based on known environmental problems stemming from past production of uranium metal for defense related applications. In support of the ID, a task group has been appointed to design and administer a program to address site characterization issues relative to uranium-contaminated soils.

Costs and schedules associated with the characterization of soils bearing radionuclide contamination represent a significant obstacle in the remediation of such sites. Difficulties arise because current field detectors (i.e., scintillation detectors, Geiger counters, alpha detectors) do not offer the necessary sensitivity, hence site characterization programs must rely heavily on soil sampling and laboratory analysis. However, a number of alternative technologies have recently been developed which appear to offer much better detection sensitivity (i.e., able to resolve contamination to a much lower concentration). These field screening technologies are gamma-ray spectrometry, beta scintillation counting, laser ablation-inductively coupled plasma-atomic emission spectroscopy (LA-ICP-AES), long-rang alpha detection (LRAD), and passive radon monitoring.

It is the interest of the ID program to evaluate the capabilities of each of these technologies and to demonstrate how these technologies might be integrated into the DOE's Environmental Restoration program. To meet these objectives a field demonstration program is scheduled for the spring of 1994. At this time each of these five technologies will be demonstrated at a uranium contaminated site at the FERMCO along with the current industrial standards (sodium-iodide detector [NaI], low-energy scintillation detector [FIDLER], x-ray fluorescence detector [XRF], and soil sampling). Real-time analysis employing a cost/risk decision model will also be demonstrated and the merits of such an approach evaluated.

In this field demonstration project plan we outline a program aimed at evaluating the capabilities of a suite of real-time radiation detectors and a cost/risk decision model. We begin with a brief overview of each of the technologies to be demonstrated. This is followed by a description of the field site and project schedule. Also included, is a description of the sampling strategy to be employed, details of how detector calibration will be conducted, and how the collected data will be analyzed and used in real-time to guide field demonstration activities. A Health and Safety Plan, Quality Assurance Plan, and Data Management Plan for the Field Demonstration are included as appendices to this document. Detailed descriptions of each of the technologies demonstrated as well as detailed operating procedures are also provided in the appendices.

MEASUREMENT AND ANALYSIS TECHNOLOGIES

Five real-time field screening technologies for delineating uranium contamination in surface and shallow sub-surface soils will be demonstrated along with the current industrial standards for soils characterization. It is important to note that each of these techniques measure uranium concentration in a different manner and each technique has a different window of observation, in an areal sense as well as in the effective depth to which the instrument is sensitive. In this section a brief description of each of the soil characterization technologies is given, along with a description of the cost/risk decision model used in the real-time analysis of the generated site characterization data.

Field demonstration of the gamma-ray spectrometry system will be conducted by personnel from the Pacific Northwest Laboratories (PNL) (Schilk et al., 1993). The system is based on the use of a germanium detector that may be collimated by specially shaped heavy metal shields. In the surface monitoring mode, an uncollimated detector is suspended one meter above the ground by a tripod. This orientation theoretically allows the detector to observe full 2¼ space. In this configuration, the spectrometer detects uranium in the exposed surface and subsurface soils to a maximum depth of approximately 15-20 cm to distances exceeding 10 m, but the sensitivity decreases with additional depth and radial distance due to gamma-ray attenuation. Other detector configurations will be investigated which yield data at a finer areal resolution. Although the full gamma spectrum is measured the 1.0 MeV gamma particles from protactinium-234m, a daughter product of uranium-238 decay, is used as the primary indicator of uranium concentration.

The beta scintillation counter was developed at PNL to measure uranium concentrations in surface soils on a real-time basis (Schilk et al., 1993). The system consists of multiple layers of plastic scintillating material for the measurement of beta particles from surficial soils (~ the top 1 cm). The plastic scintillating layers are designed to measure uranium-238 surface concentration by detecting the 2.29 MeV (maximum energy) beta particles from protactinium-234m. The system is designed to discriminate between high-energy beta particles and other interfering background radiation by using coincidence counting techniques, which identify high-energy beta particles by the depth to which they penetrate into the fluor layer stack. The device used in the field tests is designed to monitor a surface area of approximately 0.2 m^2.

The LA-ICP-AES technique is a proven laboratory analytical method that has been adapted by Ames Laboratory for field applications (Baldwin et al., 1993; D'Silva et al., 1992). A neodymium YAG laser is focused directly on the soil surface to ablate in-situ a small sample (~10's of g of soil), while an argon gas stream entrains the ablated sample particles and transports them directly into the ICP. The atomic emission from the ICP is transferred by fiber optics to a spectrometer for quantitative analysis of total elemental uranium. During the course of an individual measurement, the ablating laser beam is rastered over a sampling area of about 6.5 cm^2 affecting only the surficial layer of the soil (~100 μm).

LRAD system, which was developed at Los Alamos National Laboratory (LANL), detects alpha particles (and other ionizing radiation) by collecting and measuring the ions that are produced when alpha particles are stopped in air (Caress et al., 1993; McArthur et al., 1992). Because the ambient air is the "detector gas," the field LRAD system was configured to be placed directly on the ground. In this configuration, it detects the uranium in the surface soil by monitoring the air ionization near the soil surface (~10-20 μm). The LRAD system to be tested at FERMCO was designed to monitor contamination present on an ~1 m^2 surface.

Techniques currently available for the measurement of alpha activity in indoor air are being adapted for the task of screening soils contaminated with uranium. A group from Oak Ridge National Laboratory (ORNL) are evaluating commercially available passive radon monitors. Three types are being considered, electret ionization chambers, alpha track detectors, and thin-layer thermoluminescence detector arrays. The detectors, measuring a few square centimeters in size, are sensitive to total alpha radiation emitted from near the soil surface (~10-20 μm).

To provide a means of comparison, soil samples will be collected and submitted for laboratory analysis. The collected samples will be submitted to an independent laboratory for analysis. The method of analysis will be neutron activation.

The five field screening technologies under investigation will also be compared with those methods commonly employed in the field detection of radionuclide contaminated soils. Hand-held NaI, FIDLER, and XRF debtors will be employed as part of the field demonstration program. The NaI, and FIDLER detectors are scintillation counters. The detectors count the total x- and gamma-radiation emitted from the soil. The active detection window measures 10's of square centimeters in size and is sensitive to contamination in the upper few centimeters of the soil. The XRF is an active nuclear technique in which a radioactive source is used to excite the target element. A simple spectrometer is then used to detect and quantify the x-ray photons emitted by the excited atom. As such, the XRF is a point measurement technique sensitive to the total uranium concentration in the soil.

Also to be explored is how the real-time analysis of field data might be used to improve the site characterization process. As data is gathered by a field technique it will be analyzed and a cost/risk decision model (Kaplan, 1992) will be used to help answer such questions as; where should the next measurement be made, is the information worth of the next sample greater than its cost to be collected, how uncertain are the predictions of contaminant concentrations at unsampled locations. A framework of geological decision analysis has been adopted that quantifies the uncertainties inherent with sampling natural materials and propagates those uncertainties through a decision model (Rautman, 1993). In this model, geologic uncertainty is described using standard geostatistical techniques while decision analysis is approached through the optimization of a cost-risk-benefit objective function.

FIELD DEMONSTRATION SITE DESCRIPTION

A site with uranium contaminated soil located at the FERMCO has been selected for demonstration of the field screening technologies. The selected site is known as the incinerator area, which is located just to the east of the production area. The field demonstration will be performed on a subsection of the site measuring approximately 10,000 m^2. Uranium contamination levels are believed to range from background to approximately 80 pCi/g. Contamination at this site is primarily the result of emissions from the incineration of uranium-contaminated combustibles.

FIELD DEMONSTRATION SCHEDULE

The schedule for the field demonstration is contained in Table 1. The actual field demonstration is planned for May, June, and July 1994. It is expected that each detector technology will need to spend approximately three weeks at the FERMCO (about one week for training and mobilization/demobilization, and two weeks to make field measurements). Multiple technologies will be fielded at the same time in efforts to minimize the duration of the field demonstration. Some flexibility has been factored into this schedule; however, prolonged bad weather may cause the schedule to slide. As such the dates given here should only be viewed as approximate.

SITE INVESTIGATION PLAN

As previously noted the costs and schedules associated with the characterization of uranium contaminated soil present a significant problem to the DOE's Environmental Restoration program. Five field screening technologies, each of which are currently at various stages of development, have been identified that may help address this problem. Each of these technologies are of interest because of their potential to detect radionuclide concentration at levels lower than currently achievable with standard field detector methodologies. These detectors offer a number of advantages over the industrial standard for soils characterization; sampling and laboratory analysis. Probably the two most important are, 1) field detectors yield data in real-time as opposed to laboratory analysis which may take months to accomplish, and 2) field measurements can be made at very high spatial resolution (i.e., many more field measurements can be made than can feasibly be sampled). With the development of sensitive field detectors, soil sampling will no long have to be relied upon for site characterization but simply be used as a means of verifying the results of the detector surveys.

In the summer of 1992, each of the new field screening technologies were demonstrated at the FERMCO (Cunnane, 1993; Tidwell, 1993). Except for the gamma-ray spectrometry system, this was the first time that the field detectors had been tested under actual field conditions. Several

Table 1. Field Demonstration Schedule

Date	Activity
TBD	Meet with Regulators
January 28	Finalize Field Demonstration Site Selection
March 27	Finalize Field Demonstration Plan
March 22-23	Perform initial site walk-over survey using NaI detector and perform dry-run test of real-time decision modeling
April 18-May 6	Site preparation: survey initial grid, prepare calibration soils, locate on-site office space, kill grass, etc.
May 17-20	Perform passive radon monitor survey
May 23-June 3	Perform NaI detector survey
May 30-June 10	Perform FIDDLER survey
June 6-24	Perform LRAD survey
June 13-24	Perform ICP-AES survey
June 20-July 8	Perform gamma-ray spectrometry/beta detector survey, EG&G Spectrometer
July 5-15	Perform XRF survey, Perform passive radon monitor survey
July 11-22	Collect soil samples, Other
September 2	Complete soils analyses
September 20-22	Hold Field Demonstration Open-House

important findings resulted from the field investigation. The most important finding was that each of the detectors showed promise for soils characterization applications; however, the need to improve detector sensitivity was identified (achievable simply through refinement of the prototype detectors). Difficulties were also experienced in comparing data collected by the different measurement techniques. One reason is the vast difference in the scales of measurement. Each detector has a different window of observation in both an areal sense as well as depth of penetration. Also, each technique relies on different physical laws for measuring uranium concentrations in the soil. To account for these differences, particular care must be given to the methodology governing the application of the field detector to a particular site characterization problem. We also found that the site characterization process could be improved by developing the capability to perform real-time analysis of field data as well as involving regulators in the formulation of site characterization strategies.

A second field demonstration is scheduled for May, June, and July of 1994. The primary purpose of the study is to evaluate the capabilities of the refined field screening technologies and directly compare their performance with that of detectors currently used by the environmental industry (NaI, FIDLER, and XRF detectors). Also to be evaluated is the methodology governing the application of these technologies to the characterization of radionuclide contaminated soils. In particular, care will be given to the manner in which detectors are calibrated, data reduction is performed, and how the data are analyzed. These precautions are necessary to facilitate interpretation of data generated by means of multiple measurement techniques, including soil sampling. Another important aspect of this field demonstration will be the use of real time analysis coupled with a cost/ risk decision modeling to guide the site characterization process. Efforts are also currently being made to involve state and federal regulators in designing the field characterization strategies. In the following section, details concerning the field demonstration program are given.

Interview State and Local Regulators:

Efforts will be made by the ID characterization task group and performance assessment task group to meet with state and federal EPA representatives. The purpose of the meeting will be to gain an understanding of how compliance measures are routinely established for sites bearing soils contaminated with radionuclides. Regulatory decisions impacting the site characterization process include adoption of action levels, definition of the selective remediation unit (i.e., volume of soil associated with the action level), treatment of "hot-spots", averaging or compositing practices, and how verification measures are enforced.

Site Preparation:

Site preparation is the responsibility of FERMCO personnel. Site preparation will include marking the site and restricting access to the site once the field demonstration begins. Prior to the initiation of the field program a base grid is to be marked and surveyed (consisting of approximately 50-75 locations). "Standards" plots (to be explained later) are also to be marked and access restricted. Three standards plots are needed, each measuring approximately 1.0 by 1.0 meter in size. Average uranium concentration in each plot should be background, 35 pCi/g, and 100 pCi/g, respectively. Grass on approximately 80% of the site is to be removed, either by mowing (i.e., crop grass off close to the ground) or killed, using an EPA approved defoliant. As such, this will allow assessment of the effect of grass on detector response. Subsequent growth of grass should be prevented for the duration of the field demonstration.

Preparation of Calibration Soils:

In efforts to normalize detector response a suite of spiked soils will be made and used to calibrate each of the field detectors. Preparation of the spiked soils will be the responsibility of FERMCO personnel. Four calibration soils, using soil of similar characteristics that found at the field demonstration site, will be prepared. Soils are to be homogenized and spiked (with uranium contaminated soil from the Fernald site) to yield concentrations of near background, 35, 100, and 200 pCi/g. Soils will then be dried and stored in sealed, marked drums. Pans measuring 1.6 m on a side and 22.5 cm deep will be used to calibrate the detectors. To verify the soils, five samples will be collected from each soil and analyzed.

Site Investigation:

Site surveys will be conducted using a wide suite of detectors. These technologies and the party responsible for their demonstration include:

- gamma spectrometry, PNL
- beta detector, PNL
- long range alpha detector, LANL
- LA-ICP-AES, AMES
- passive radon monitors, ORNL
- NaI detector, FERMCO
- FIDLER detector, FERMCO
- XRF detector, FERMCO

- total station, FERMCO (for surveying, in real-time, measured locations)

To facilitate comparison among the different detector technologies, each detector survey is to be performed in exactly the same manner. Site surveys are to be performed according to the practices prescribed below. Any deviations to this program must first be approved by the ID characterization task group.

Detector calibration:

To improve comparability of the data derived by different measurement techniques, efforts are being made to assure consistency in the calibration of each detector. Consistency is achieved by calibrating each technique with the same soils, and by assuring that a consistent set of assumptions, coefficients, and parameters are used in reducing measurement counts to a consistent unit (for this study pCi/g of total U). As such, each detector will survey the calibration soils at least three times. These surveys will be conducted prior to the field demonstration, after completing the baseline survey, and following completion of the project. Prior to the field demonstration, PI's representing each of the detector technologies will be responsible for providing the ID characterization task group with a detailed description of how raw detector data is converted to pCi/g of total U. The characterization task group will then decide upon a consistent set of assumptions, etc. to be used in detector data reduction.

Quantification of Detector Precision:

To facilitate evaluation of the detectors, we also wish to standardize the way detector precision is quantified. This is accomplished by identifying plots of undisturbed soil, called standards plots, at the test site. These standards plots will be used for making repeated detector measurements. Twice each day the standards plots are to be surveyed by each detector being demonstrated. Environmental conditions at the time of the survey are also to be recorded. Hence, in addition to evaluating instrument precision, this data will also provide insight into the effects of the environment (i.e., humidity, rainfall, ambient temperature fluctuation) on detector performance.

Field Surveys:

Surveys of the field demonstration site will be accomplished using eight independent detector technologies. Each survey will begin by making measurements on a baseline grid marked prior to the field demonstration. Using this data and the cost/risk decision model additional measurement locations will be identified. Data will continue to be collected and analyzed until the information worth of additional samples is less than the cost to collect them.

Soil Sampling:

Soil samples will be collected for comparison with each of the detector technologies. Both soil cores, for comparison with the gamma-ray spectrometry system, and surface samples, for comparison with the other strictly surface sensitive techniques, will be collected. Soil cores will be collected with a hand auger, driven to a depth of 20 cm. A subset of these cores will be separated into 5 cm sections to provide insight into the distribution of uranium with depth. Surface samples will be collected with a hand spade to depths not exceeding one centimeter. The collected samples will be homogenized and a 500 g sample extracted for analysis. Rocks, organic material, etc. is not to be removed from the samples.

Samples will be collected on the same baseline grid used for the detector surveys (approximately 50-75 surface samples and 25 core samples). An additional 10 samples will be collected from each of the standards plots (5 surface samples and 5 core samples). Spiked samples, replicates, and blank samples are also to be analyzed. Four sets of blanks and spiked samples (35, 100 and 200 pCi/g) are to be analyzed and 10% of the samples collected will be split for duplicate analysis.

Also of interest is how few soil samples would be necessary to verify the results of the field detector surveys. To address this question, data collected by the various detector technologies will be used with the cost/risk decision model to locate verification soil sampling sites. Sampling will be performed and results compared to the baseline grid sampling as well as the detector survey data.

Measurement Support Effects:

One of the factors impacting the comparability of collected detector data is the vast difference in size of the soil surface area measured by each of the detector technologies. A number of methodologies have been developed in the mining industry to account for differences in the support size between core samples analyzed to determine ore grade and the support size of the selective mining unit. Similar methodologies will be applied here to determine whether such an approach will help explain differences in the collected detector data. In order to make the necessary calculations a limited number of samples need to be made on a very finely spaced grid. This will involve collecting nine closely spaced samples within a 3.3 m by 3.3 m area. Two sets of such data are to be collected. These fine scale grids will be incorporated into the larger baseline grid.

Gamma-ray Spectrometry Surveys:

Field surveys utilizing the gamma-ray spectrometry system will be performed in both a collimated and uncollimated mode. In the uncollimated mode the gamma-ray spectrometer functions as a large area detector (sampling >300 square meters in a single measurement), which is valuable for initial site surveys. However, more detailed site surveys can be performed with the same instrument by simply collimating the detector (i.e., narrowing the field of view of the detector). The desired size of the detection area, when operating in the collimated detector mode, will be 10 m^2 (the detection area is set equal to the size of the selective remediation unit).

The gamma-ray spectrometer will also be used to infer the depth distribution of uranium contamination at the site. The depth distribution can be determined directly by analyzing different energy photons and accounting for their differential absorption. The depth distribution can also be inferred through comparison of gamma-ray spectrometer data with data collected by detectors sensitive only to surface contamination.

<u>Data Analysis:</u>

Analysis of the field demonstration data will be the responsibility of the ID characterization and performance assessment task groups. Detector performance will be judged in part on the repeated data collected from the field standards plots as well as the repeatability of measurements made on the calibration soils. Data from the baseline grid, as collected by each of the measurement technologies, will be directly compared. Also to be compared are the final uranium isopleth maps generated by each of the measurement techniques. Where significant differences exist efforts will be made to identify physical reasons for the discrepancies. The product of the analysis will be a report documenting the findings of the field demonstration. In this report we will make recommendations concerning the use of these technologies in characterization programs as well as note the strengths and weaknesses of the different detector technologies. Evaluation of the cost benefits of the various detector technologies will be performed by the ID performance assessment task group.

Integrated Demonstration Open House:

As information and technology transfer are important aspects of this program, an open house will be hosted by the ID characterization task group to publicize the results of the field demonstration. The basic format for the open house will include time for presentations, question-and-answer secessions, and technology demonstrations. Those invited to attend will include DOE officials, representatives of Environmental Restoration programs from various national labs, EPA representatives, representatives of private consulting firms, technology vendors, and the local public. The open house is scheduled for late summer once the analysis of the field demonstration data is complete.

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APPENDIX A: FIELD DEMONSTRATION OF IN SITU GAMMA-RAY SPECTROMETER, AND HIGH-ENERGY BETA SCINTILLATION SENSOR

Alan Schilk (Pacific Northwest Laboratories)
Dick Perkins (Pacific Northwest Laboratories)

DETECTOR THEORY

In Situ Gamma-Ray Spectrometer:

In situ gamma-ray spectrometry has enjoyed widespread use around the world for the precise characterization of a multitude of radionuclides in the field due to its convenient transportability and rapid data-reduction capability. A high-purity germanium gamma-ray detector, suspended one meter from the ground in an uncollimated configuration, is sensitive to surface and shallow subsurface activity originating from hundreds of square meters, and effectively averages any horizontal heterogeneities that may exist within its field of view. Although in theory this type of system would monitor complete 2¼-space (i.e., from horizon to horizon), the actual depth and expanse of contamination detected is strictly a function of the photon energy due to geometry factors and attenuation in the soil and air.

In practice, photons (i.e., gammas and x-rays) that are incident upon the germanium crystal lead to ionizations and excitations of myriad germanium atoms, thereby leading to the generation of an equivalent number of oppositely-charged species, viz., electrons (negative) and electron "holes" (positive). These charge-carrying species are swept to opposing regions of the germanium crystal due to the presence of a strong electrical potential (generally on the order of a few thousand volts) where they are subsequently collected and quantified. The greater the amount of total energy deposited from an isolated event (i.e., due to the attenuation of a lone photon), the larger the total charge collected. Hence, by observing the magnitudes of individual charge pulses one may determine the various energies of the photons undergoing complete absorption in the crystal, and the specific photon energies serve as unique and immutable identifiers for various radionuclides of interest; e.g., 1.461-MeV gamma rays originate from the spontaneous decay of ^{40}K, 0.662-MeV gammas represent ^{137}Cs, and 1.001-MeV gammas are an indication of the presence of ^{234m}Pa (a daughter of ^{238}U). Furthermore, the total number of equivalent pulses per unit time is an indication of the actual amount of source material present.

The ^{238}U decay chain begins as follows:

^{238}U (4.47x10^9 y) → ^{234}Th (24.1 d) → ^{234m}Pa (1.18 m) → ^{234}U (2.45x10^5 y) ....

If secular equilibrium may be assumed, i.e., if no fractionation between U and Pa has occurred within the past six months, then the decay rate of ^{234m}Pa is essentially equivalent to that of ^{238}U. Consequently, one may utilize gamma-ray spectrometry to observe the rate of incidence of 1.001-MeV gammas from ^{234m}Pa to determine the decay rate (and, therefore, the total activity) of ^{238}U following system calibration.

An additional application of this technology is the ability to approximate the average uranium depth distribution in the soil volume viewed by comparing multiple photons from the uranium decay chain; viz., the 63-keV and 93-keV x-rays from ^{234}Th and the 1.001-MeV and 0.766-MeV gammas from ^{234m}Pa. Due to the differing attenuation properties of these photons, one may compare their observed intensities with those expected from various vertical distributions and determine, to a first-order, the behavior of the subsurficial contaminant.

High-Energy Beta Scintillation Sensor:

A traditional mechanism for detecting charged particles (e.g., betas) is one that utilizes a substance which scintillates, or emits light, upon passage of such species through the sensitive material. The resulting light may then be used to simply indicate the presence of these charged particles or, under certain conditions, their relative energies as well. In particular, polystyrene-based plastic fibers may be doped during their casting process with various fluorescent compounds that have been carefully selected to produce the desired scintillation, optical and radiation-resistance characteristics. The passage of charged particles through these individual fibers leads to the ionization and excitation of the fluorescent dopants, which subsequently de-excite via the emission of visible light. The resulting light pulses are then partially transmitted down the length of the fiber and may eventually be converted into electrical signals (the intensities of which are directly proportional to the total energy deposited per event) via a light-sensitive device such as a photomultiplier tube (PMT).

With regard to the characterization of ^{238}U contamination, PNL has developed a prototype scintillation sensor that targets the 2.29-MeV (maximum energy) beta particle from the decay of ^{234m}Pa (see above decay scheme). This is accomplished through (1) the construction of flat ribbons that are composed of numerous square fibers (0.25 mm^2 and 1.0 mm^2), (2) the stacking of these ribbons and the coupling of each bundled end to a PMT, and (3) utilizing custom-designed circuitry to interrogate the total number of scintillation events from each layer (as well as the coincident signals therefrom).

DETECTOR DESCRIPTION

In Situ Gamma-Ray Spectrometer:

The in situ spectrometry system is centered around a standard germanium-crystal-based gamma-ray sensor that was purchased from EG&G ORTEC (Oak Ridge, TN). This detector was specifically chosen for its enhanced sensitivity toward low-energy photons in order to facilitate the characterization of the 63-keV and 93-keV x-rays from ^{234}Th. The germanium crystal must be kept cold during normal operation to minimize the stray electronic noise inherent to this type of sensor, and such cooling is provided by the addition of liquid nitrogen (LN2) to a reservoir that is attached directly to the crystal housing. Hence, the overall sensor configuration consists of a cylindrical crystal housing (9-cm diameter x 28-cm length) surmounted by a reservoir of the same basic shape (22 cm x 28 cm). This package is mounted to a sturdy tripod, in a down-looking orientation, such that the detector endcap is suspended one meter above the soil surface. The total combined weight (including full LN2 capacity, approximately 3 liters), is somewhat less than 15 kg.

With regard to the supporting data-acquisition hardware, two individual options exist. In one, a remote package contains all of the electronic hardware necessary for proper detector operation; this unit requires external AC power and includes a bias supply for the detector, an amplifier to shape and amplify the detector output signal, an analog-to-digital converter to translate this signal into usable form, and a memory buffer for storing the acquired data. The overall dimensions are approximately 30 cm x 30 cm x 30 cm, and the unit is connected to the detector via a 10-m power-supply/signal cable. Data display, acquisition control, and data reduction are performed by a standard laptop PC, which receives output from the hardware unit and contains the necessary application-specific software (viz., Maestro-II from EG&G ORTEC). The second hardware option eliminates the need for external power, remote hardware and cable, and laptop PC. With this option (currently under joint development at PNL and Los Alamos National Laboratory), all of the aforementioned electronics are condensed into an 11-cm x 8-cm x 24-cm package that attaches directly to the LN2 reservoir and contains its own battery power. Data control and display are maintained by a local palmtop PC (e.g., a Hewlett-Packard [Corvallis, OR] HP100LX) and data reduction occurs ex situ at the operator's (or field supervisor's) convenience; acquired data is stored on convenient "flash-type" memory cards and transferred by hand as necessary.

High-Energy Beta Scintillation Sensor:

The beta sensor represents new technology developed at PNL for the real-time, in situ characterization of ^{238}U or ^{90}Sr in surface soils and, as such, is not available commercially. The scintillating fiber ribbons, PMTs, power supplies, and associated electronic hardware are enclosed in an aluminum box measuring approximately 120 cm x 35 cm x 12 cm and weighing less than 20 kg. This package is composed of welded box-tube and sheet aluminum, and contains separate compartments for the ribbons/PMTs and supporting hardware. The light-sensitive fiber ribbons are shielded from ambient light by a thin layer of opaque plastic, and the effective observation window, which is centered on the detector base, measures 30 cm x 60 cm. This unit requires clean AC power, although efforts to convert the system to a self-contained, battery-powered configuration are currently underway and may be available at the time of the subject demonstration.

Radiation-induced scintillations within the individual ribbon layers are converted to proportionate electrical pulses by the PMTs, and the resulting signals are subsequently processed as follows: (1) shaping and amplifying (first by a preamplifier and then by an amplification circuit), (2) filtering (to reduce the inherent electronic-noise contribution), (3) comparison with other contemporaneous PMT outputs (in order to establish intralayer and interlayer coincidences for mitigating individual PMT noise and determining relative beta-particle energy, respectively), and (4) transmission via a signal cable to a local laptop or palmtop PC for final display. Although the only parameter of direct interest in the real-time in situ characterization of ^{238}U is the total number of triple-coincidences per unit time (i.e., the rate of incidence of high-energy ^{234m}Pa beta particles), the logic circuitry developed for the performance of step (3), above, also indicates the number of signals in each individual layer and the coincidences between layers 1&2 and layers 2&3; this additional information is useful for diagnostic and evaluation purposes.

OPERATING PROCEDURE

In Situ Gamma-Ray Spectrometer:

The following describes the necessary steps for the proper and safe operation of the in situ gamma-ray spectrometry system:

- Remove the germanium-detector/reservoir unit (hereafter referred to as the "detector") from its shipping container and, using appropriate safety precautions, add LN2 to the fill port; a special funnel is supplied for this purpose. When handling LN2, long-sleeve shirts, long pants, gloves and a full face shield (as a minimum) are to be worn for protection against frostbite should spillage occur. This step is to be performed at least 8 hours prior to supplying power to the detector to ensure proper operation and preclude detector damage.

- Assemble detector tripod and attach detector to faceplate. Adjust tripod legs so that the detector endcap is 1 meter above the ground. This step may be performed during the detector cool-down process.

- When detector has reached normal operating temperature, connect the supporting electronics (remote or local unit) to the detector via the supplied cable; this includes the detector bias supply (SHV connector), preamplifier power supply (9-pin D-type connector), detector output (BNC connector), and bias shutdown signal (BNC connector). All cable connectors are clearly marked to prevent improper use.

- Connect appropriate PC to the supporting electronics via the requisite cable (laptop PC for remote unit or HP100LX for local unit).
- Provide power to the supporting electronic package and PC (clean AC power for the remote unit or battery power for the local unit).
- Test proper operation of the in situ gamma-ray spectrometry system by placing a radioactive source (e.g., a sealed ^{60}Co-^{137}Cs-^{241}Am source) near the detector endcap and acquiring a preliminary spectrum for approximately five minutes. Adjust the amplifier gain and zero-adjust, if necessary, to obtain a 1-keV/channel spectrum.
- Place uncollimated detector directly above each sampling point, ensure the endcap is located 1 meter above the surface, and initiate data acquisition via the controlling PC (this operation, and others, is performed by the accompanying software from EG&G ORTEC). Acquisition times will be chosen at the discretion of the field supervisor. A unique sample identifier will be requested upon initiation, and individual spectra will be automatically saved to magnetic medium for subsequent data reduction.
- Repeat above step following addition of tungsten or lead collimator.
- After cessation of data acquisition, move detector to next sample location and repeat the two previous steps. Repeat until complete.
- Through the course of, and following, each day of data collection, acquire additional sealed-source spectra as above and compare with previous to evaluate stability of electronics.
- Reduce data as convenient utilizing the accompanying software and provide results to FERMCO Site Engineer or ID Coordinator. This is to include hardcopy, magnetic medium, and photocopies of field notes.

High-Energy Beta Scintillation Sensor:

The following describes the necessary steps for the proper and safe operation of the beta sensor:

- Remove the sensor from its shipping container and place it on a sturdy surface.
- Connect the sensor to its PC via the accompanying cable and provide power to the system (either clean AC power or battery power, if the latter capability is available).
- Test the proper operation of the sensor by placing an extended, sealed source directly below the sensitive area and acquiring data for approximately ten minutes. Results are to be compared with previous laboratory runs to determine stability of sensor.
- Place the sensor directly on the ground (a thin plastic sheet may be used to protect the sensor from contamination) at each sample location and initiate data acquisition. A unique sample identifier will be assigned at each point and data will be automatically saved to the PC's hard drive.
- Move the sensor to the next sample location and repeat the previous step. Repeat until com-

plete.

- Through the course of, and following, each day of data collection, acquire additional sealed-source spectra as above and compare with previous to evaluate stability of electronics.

- Reduce data as convenient and provide results to FERMCO Site Engineer or ID Coordinator. This is to include hardcopy, magnetic medium, and photocopies of field notes.

CONVERSION OF FIELD DATA TO pCi/g TOTAL URANIUM

In Situ Gamma-Ray Spectrometer:

Prior to field deployment, the germanium gamma-ray detector must undergo a thorough calibration process involving the observation of multiple radioactive sources in various orientations. Sealed ^{60}Co, ^{137}Cs, ^{241}Am, and ^{152}Eu sources are placed 1 meter from the endcap at a number of angles from the detector normal (e.g., every 10 degrees, from directly in front of the detector to directly alongside), and the sources are slowly rotated around the detector axis to determine its angular response function. Total gamma-ray counts for each source/orientation combination are compared with actual source strengths, and detector efficiencies for each scenario are calculated. This detector-specific information is combined with tabulated data that indicates the expected gamma-ray fluxes originating from soils exhibiting various vertical distributions. These data are entirely independent of the actual detector to be calibrated, and are easily calculated using radiation theory (e.g., attenuation coefficients) and simple mathematics.

The end result of this detector-specific and -independent collaboration is the generation of unique "calibration factors", with units of (pCi/g)/(counts per second), for all energies (or radionuclides) of interest; n.b., this is strictly true only for uniform vertical distributions of contaminants, since the actual pCi/g for a non-uniform distribution (e.g., one that decreases exponentially with depth) is a direct function of the depth in question --conversely, one may "assume" a uniform distribution, despite evidence to the contrary, and obtain the "average" pCi/g for the soil volume viewed. As an example, to determine the specific activity of aged ^{238}U in soil one may obtain a gamma-ray spectrum (as above), determine the total number of counts in the 1.001-MeV ^{234m}Pa peak per unit time (i.e., the total counts per second), multiply this parameter by the unique calibration factor for this energy, and thereby obtain the total activity of ^{238}U per gram of soil. By doubling this value, one obtains the pCi/g of total uranium.

High-Energy Beta Scintillation Sensor:

The calibration process for the beta sensor is quite simple in relationship to the in situ gamma-ray spectrometer. In this case, the sensor is calibrated prior to field deployment by first monitoring a series of medium-grained sands that have been "spiked" with various amounts of ^{238}U (in nitrate form). These standard soils are (1) mixed thoroughly to ensure contaminant homogeneity, (2) slightly larger than the active area of the beta sensor, and (3) much thicker than the longest possible pathlength of a 2.29-MeV ^{234m}Pa beta particle originating from within the source.

Triple-coincidences (see above) resulting from the observation of the standard sources, which generally span the range of 5 pCi/g to 200 pCi/g of total uranium (i.e., 2.5 pCi/g to 100 pCi/g of ^{238}U), are plotted versus activity to obtain a calibration curve; laboratory experience shows that the sensor response in this range is quite linear. Consequently, when triple-coincidences are obtained in the field they are simply multiplied by the previously determined calibration constant to establish total uranium activity per gram of soil at the ground surface.

APPENDIX B: FIELD DEMONSTRATION OF THE LASER-ABLATION, INDUCTIVELY COUPLED PLASMA-ATOMIC EMISSION SPECTROMETER

Marvin Anderson (AMES Laboratory)

DETECTOR THEORY

Laser Ablation

The laser ablation (LA) technique is used for direct sampling of soils. Laser radiation focused on the soil generates sample particles that range up to a few 10s of microns (μm) in size. The ablated sample particles are entrained in argon gas that is flowing through the ablation cell, transported through a 20 meter tube, and introduced into the ICP for excitation. This technique eliminates the lengthy, approximately eight-hour sample dissolution and separation process needed to prepare a sample for analysis. Laser ablation has been successfully used for the direct sampling of metals and ceramics.

Inductively Coupled Plasma - Atomic Emission Spectroscopy

The Inductively Coupled Plasma-Atomic Emission Spectrometry (ICP-AES) technique is used to analyze soil samples generated by the laser ablation technique. The sample is introduced into the high temperature plasma, 8000 K, of the ICP torch where it is vaporized, atomized, and ionized. The intense light from the ICP plasma is transfered via a fiber optic cable and introduced into the atomic emission spectrometer where it is resolved into wavelengths and intensities. The ICP-AES is capable of rapidly detecting and quantitating several elements, up to 20 in the current configuration, simultaneously at the parts-per-million (ppm (μg/g)) level. This feature makes the ICP-AES a valuable tool for the rapid simultaneous detection of total uranium, total thorium, soil matrix elements, and other heavy metals.

DETECTOR DESCRIPTION

Apparatus

The LA-ICP-AES instrumentation used for laser sampling and rapid analysis of soil samples is located in the *mobile demonstration laboratory for environmental screening technologies* (MDLEST) which is completely self-contained. Computers and control systems, electrical power, water, gases, and other utilities required to operate the LA-ICP-AES instrumentation are supplied by the MDLEST. In addition, a newly acquired Global Positioning System (GPS) is installed in the MDLEST to supply real-time coordinate information for mapping in situ sampling sites. The instrumentation and equipment installed in the MDLEST is under computer-control for system monitoring and actuation, and data acquisition and reporting. Thus, the operators have a minimal number of "manual tasks" to perform during the sampling and analysis operation.

The laser used for ablation sampling (Continuum model NY81-30 Nd:YAG laser, 30 Hz repetition rate, and 1064 nm wavelength with frequency doubling and tripling capabilities) is located in the MDLEST. A fiber-optic cable (600 μm core diameter silica fiber, 25 meters in length -Polymicro Technologies model FVP-600660690) transmits the laser radiation (_5.5 mJ) to the sampling probe. The fiber-optic cable is one component in the 20 meter umbilical connecting the MDLEST and the sampling probe. The umbilical also contains the aerosol transport tube, the power and control wiring for the electronic systems in the sampling probe, and the GPS antenna wire. The sampling probe is equipped with a GPS antenna for locating in situ sampling sites, the ablation cell that is mechanically sealed to the soil surface, and the mechanism that focuses and rasters the laser beam over the soil surface. Argon gas flowing through the aerosol transport tube carries the ablated sample particles from the ablation cell to the remote ICP (RF Plasma Products model ICP- 36 L) which is connected by fiber-optic bundle to the AES (Thermo Jarrell Ash model ICAP 61-E Atomic Emission Spectrometer). The spectrometer is configured to detect and analyze 20-channels (elements) simultaneously, and is configured for the detection and analysis of uranium, thorium, and the soil matrix elements Si, Fe, Al, Ca, Na, K, Ti.

A *Global Positioning System* (GPS) (Ashtech model M-XII receiver and associated software) is installed in the MDLEST to supply real-time coordinate information for mapping in situ sampling sites. This mapping information is acquired during the sampling process, and can be directly plotted on site maps provided a common bench mark location is used. This feature allows off-grid locations to be sampled and the results plotted directly on the site map. This system will allow innovative sampling strategies to be tested.

A microwave oven (CEM model MDS-2100) in the MDLEST will be used for sample drying if necessary.

Safety Precautions

Laser

A Continuum Nd:YAG laser is utilized for the ablation sampling. The laser is capable of producing 100 mJ of 1064 nm laser light, 25 mJ of 532 nm second harmonic light, or 12 mJ of 355 nm third harmonic light in 10 nanosecond pulses at a 30 Hz repetition rate. These power, wavelength, and operating parameters define this as a class IV laser as defined in ANSI Z136.1-1986. A Class IV laser is capable of causing eye and skin damage through direct or specular reflection exposure, and is capable of igniting flammable materials. During the alignment of the Nd:YAG laser beam to the optical fiber, class IV laser operation, the access doors to the MDLEST are controlled, and only Ames Laboratory personnel wearing appropriate laser safety eye wear and possessing current laser safety training and eye exam will be allowed in the MDLEST. During normal sampling operations with the laser beam path in the MDLEST enclosed, the laser energy emitted from the end of the fiber optic cable in the sampling probe is defined as a class I laser. There is no exposed laser radiation when the sampling probe is seated in the ground seal ring.

ICP

The ICP requires high power levels at radio frequencies (RF) and high voltage for proper operation, and the torch emits intense ultraviolet and visible light. The operator is prevented from accessing the radio frequency and high voltage components during normal operation by safety interlocks and shielding. Additional installed shielding prevents eye injury from the intense ultraviolet and visible light being emitted from the ICP torch during operation.

Liquid Argon

A pressurized liquid argon dewar and manifold system distribute gas to the ICP, the sampling probe, and the spectrometer. This dewar and gas distribution system is equipped with pressure relief valves and gas regulators to prevent system over-pressurization. Cryogenic liquids are handled in accordance with safe handling practices to prevent skin and eye tissue contact that will result in burns.

Microwave Oven

The microwave oven will be used for soil sample drying if necessary. This microwave oven complies with the U.S. Code of Federal Regulations Title 21, part 1030 for microwave leakage, and is equipped with safety interlocks that prevent operation while the door is open.

Sample Handling

The MDLEST is designed to take LA-ICP-AES instrumentation into the field for in situ sampling of contaminated sites. The data acquisition occurs without the operator physically handling the sample. The sampling probe is set over the site to be sampled; laser radiation is delivered to acquire the sample; flowing argon gas transports the ablated sample material to the ICP; the emission generated in the ICP is imaged into the AES for analysis. The entire operation, in principle, can be performed by an operator in minimal contact with the contaminated site.

Decontaminating Equipment

The ground seal ring will be decontaminated by washing with water between successive sample sites. The ablation cell will be washed as needed. The flexible tubing connecting the ablation cell to the ICP will become contaminated during operation and will be cleaned or replaced as needed. The ICP torch box is fitted with a *high efficiency particulate air* (HEPA) filter, located on the MDLEST roof, to trap sample residue that passes through the ICP. The HEPA filters are in situ certified to be operating within specifications by the Ames Laboratory ES&H personnel. The HEPA filters will be surveyed before leaving the site, and if contaminated they will be removed and left at the site for disposal. The components of the Thermo Jarrell Ash ICAP-61E Spectrometer will not be exposed to radioactive material.

Geiger Counter

A Geiger counter (Aware Electronics model RM-70 or equivalent) is available in the MDLEST for radiation monitoring and surveying purposes.

OPERATING PROCEDURES

LA-ICP-AES Operation

There are two methods of introducing a sample into the LA system. The primary method is in situ, this is the direct placement of the sample probe over the location to be sampled. The second method involves digging _10 grams of sample and placing it in a polypropylene bottle. This bottle then is manually placed under the sample probe for sampling and analysis. The second method will be used if the soil to be sampled is too wet and will need to be dried before sampling and analysis.

The following steps outline the procedure for acquiring and analyzing an in situ sample:

° Position MDLEST near the location to be sampled
° Power "on" equipment and utilities
° Laser on shutter closed
° Prepare site by removing vegetation, tamping, and positioning the ground seal ring
° Set the sampling probe in the ground seal ring
° Initiate 'Control' computer programming that prompts the following steps:
° Initiate GPS position system
° Check the gas seal to the soil surface
° Adjust the argon gas flow through the ablation cell to the required level
° Ignite the ICP torch; set the operating power and acquire background emission data
° Initiate the automatic sampling sequence that performs the following steps

- Adjust the laser energy for the focus routine
- Open the laser shutter
- Focus the laser energy on the soil
- Close the laser shutter and adjust the laser energy for sample ablation
- Open the laser shutter
- Start the programmed raster of the laser energy across the soil surface
- Acquire and store the ICP-AES emission data
- Close the laser shutter

- Store GPS sample site location information
- Analyze ICP-AES emission data, print the results and save on optical disk
- Remove the ground seal ring, decontaminate, and place at the next sample location
- Repeat the sampling and analysis steps for multiple sites within reach of the umbilical
- Move the MDLEST to a new location and repeat the sampling and analysis steps

Microwave Drying

In situ soil samples that contain too much moisture will not produce enough sample material during the ablation sampling process to be quantitated with a high level of confidence. For this case, _10 grams of sample will be dug and placed into a polypropylene bottle and dried _8 minutes in the microwave oven. The bottle containing the dried sample will be placed in the calibration fixture for laser ablation sampling and analysis.

Interferences

Spectral interferences of analyte emission lines in ICP-AES result from the overlap of emission lines, unresolved lines or molecular band emission, background emission from the ICP, or stray light from strong emission lines of high concentration elements in the sample. Spectral overlap can be compensated for by measuring the concentration of interfering element(s). Unresolvable spectral interference requires the use of an alternate emission line for the element. Background and stray light can be compensated for by background corrections. The ICP-AES is tested to ensure that the detection channels for the elements of interest do not have any spectral interference from elements in the sample for which there are no detection channels.

Chemical interferences in ICP-AES include molecular compound formation and ionization effects that occur within the ICP, and are highly dependent on the matrix of the soil sample and the specific element being detected. These effects are normally insignificant; however, if chemical interferences are observed, they can be minimized by using soil standards that are matrix-matched.

Physical and chemical interferences can occur during the laser ablation sampling, particularly at low laser energy densities, where selective vaporization may occur. These interferences should be minimal since Fernald blank soil, with a matrix similar to the soils that will be analyzed on-site, was used to prepare the "artificial" soil standards for instrument calibration.

Standardization

The Fernald soil standards will be used to calibrate the LA-ICP-AES and for determining inter-element and background correction factors. Alternatively, NIST and NRM certified standard soils will be used.

The steps in the standardization procedure are:

° Start the system, using standard operating procedures
° Profile and calibrate the LA-ICP-AES response for uranium, thorium, and matrix elements by sampling and analyzing the soil standards
° 5 replicate measurements will be made on each sample from which the mean and standard deviation will be calculated
° Repeat the sampling and analysis of one soil standard sample after no more than five unknown site soil samples are analyzed. Use the results from the repeat soil standard to recalibrate the LA-ICP-AES response
° Report the instrument calibration in terms of the total U/Si ratio vs the activity in pCi/g

DERIVATION OF pCi/g

Calculation

An LA-ICP-AES calibration curve for the total U/Si ratio vs the activity in pCi/g will be determined using the Fernald soil standards. This calibration curve will then be used to quantitate the U activity in the Fernald soil samples analyzed. The concentrations of individual isotopes, if needed, will be calculated from their natural abundance percentages.

Alternative Method

Alternatively, the ICP-AES can be calibrated in terms of concentration (ppm (μg/g)) of total U. The resulting quantitation is reported in terms of the concentration that must be converted to activities (pCi/g) using the half life values of the particular radioisotope.

Precision and Accuracy

° Data averages and standard deviations will be calculated and reported for the elements of interest in terms of activities or alternatively in concentrations
° Matrix elements, e.g. Si, Al, and Fe, will be quantitated within 30%
° The accuracy of the quantitation of the total U is unknown at this time but will be determined in the field

REFERENCES

° Operation and Maintenance Manual for Continuum NY81-30 Nd:YAG Laser
° Operation and Maintenance Manual for Thermo Jarrell Ash ICAP-61E Simultaneous Spectrometer
° Operation and Maintenance Manual for CEM MDS-2100 microwave digestion system
° Laser-Induced Plasmas and Applications; L.J. Radziemski and D.A. Cremers (eds.); Marcel Dekker, Inc., New York, 1989
° Laser Microanalysis; L. Moenke-Blankenburg (ed.); John Wiley & Sons, Hew York, 1989
° Mobile Laboratory 5th Wheel Trailer Minimum Specification Summary, Ames Laboratory and Iowa State University

APPENDIX C: FIELD DEMONSTRATION OF THE LONG RANGE ALPHA DETECTOR

John Bounds (Los Alamos National Laboratories)
Duncan MacArthur (Los Alamos National Laboratories)

DETECTOR THEORY

Long-Range Alpha Detector (LRAD) technology relies on measuring radioactivity not by counting the radiation particles directly but by measuring the amount of air ionization caused by the radiation. In one type of LRAD, the ions created can be transported by an airflow and have been observed and measured at distances from a few centimeters to a few meters from the original alpha source. In another type of LRAD, an electrostatic field separates the ion pairs as they are formed. In both types of LRAD, the collected ions form an electrical current which can be measured. High sensitivities over extended areas can be obtained. Alpha radiation is preferentially detected, since although all radiation tends to ionize air; neutron, beta and gamma radiation tend to deposit less energy per unit distance in air per incident energy. Alpha radiation has both short range and high energy, creating many ions near the source of the radiation. The LRAD takes its name for its high sensitivity towards detecting alpha radiation and the relatively long distances at which the actual ion collection occurs from the source.

Uranium decays by alpha emission and so is an ideal candidate for detection by an LRAD.

DETECTOR DESCRIPTION

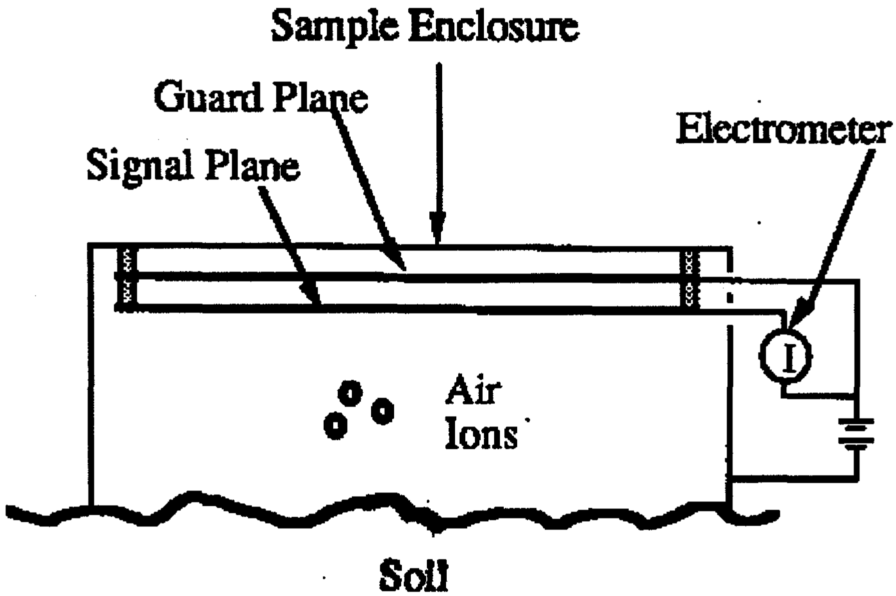
For monitoring soils in situ, the electrostatic LRAD was chosen over the airflow types for the electrostatic detector's lower power requirements, simpler and more rugged construction, and higher efficiency at monitoring flat surfaces - the applied electric field allows fewer radiation-produced ion pairs to recombine before being collected. Unlike traditional hand held probes, the LRADs have no mylar or thin wires to break. The LRADs use no special detection gases, the air itself is the medium for ion transport. The LRADs are so rugged, the largest measure one square meter and are mounted on the front end of a tractor, withstanding the beating obtained by driving over rough terrain and being placed on the ground with occasional hydraulic pressure. The figure shows the construction.

The LRAD soil surface monitor is essentially a large, flat box whose open end is placed on top of the soil to be measured. Inside the box, a signal plane of either copper or aluminum sheet is biased at 300 V and creates an electric field between itself and the soil. Ions created above the soil are collected by the field, resulting in an electrical current which is measured by the electrometer. Readings can be obtained directly from the electrometer or from an attached computer which averages the readings over thirty seconds and graphically displays the results. A guard plane between the signal plane and the detector box prevents leakage currents in and across the lexan standoffs from being misread as a signal. The entire unit, including computer, is powered in the field by its own car battery and dc to ac inverter.

All LRAD soil surface monitors with a four-inch signal plane to ground distance and 300 V bias have a response of one femtoamp (10^{-15} A) per 6 dpm of ^{239}Pu. For other alpha emitters the LRAD has a response which varies as the average energy of the alpha particle. Response linearity is excellent and has been measured from 100 dpm to 300,000 dpm. Linearity is expected to continue until space charge effects begin or until the current draw of the battery becomes a factor.

OPERATING PROCEDURE

The LRAD large soil surface monitor is mounted on a farm tractor. Experience has shown



that the detector operation can be learned in less than half an hour, including how to drive the tractor. The general procedure other than how to drive the tractor is as follows:

The tractor is operated only to move the detector and not while measurements are being made. The detector electronics are powered up at least the night before measurements are to be made to allow for thorough warm-up time. The electronics should be powered by supplied AC outlets and the detector's car battery should be recharged if necessary. The detector's 300 V battery should be checked on the first day and be not lower than 295 V. The detector should be on a reasonably clean (not spotless) aluminum plate to obtain an intrinsic background reading for the detector. An aluminum plate reading of 200 to 400 fA is normal. In the morning, the electronics should be switched from the overnight AC supply to self contained and recharged battery supply. As the first reading of the day, the reference spot should be re monitored, or one chosen if it is the first day of field work. Repeatability of background and the reference point is sufficient to show the detector is operating correctly and additional source checking is not required under normal operating conditions. Once the aluminum plate and reference spot readings are made, new monitoring may be performed.

To monitor a new spot, the spot should be four feet square and must be within a couple of inches of being planar. Its vegetation must be scalped as close to the ground as practical and clippings removed. This is typically accomplished with a WeedEater style cutter or with hand shears. Best results are obtained in two person operation, one to drive the tractor and one to direct placement of the detector on the cleared spot using prearranged hand signals. Since personnel often take turns driving the tractor, both should be wearing safety shoes to protect their toes during detector placement. The detector should be placed as nearly parallel to the ground as possible and pushed down slightly with the tractor hydraulics to assure a good seal. The tractor should be stopped and dismounted since vibrations will cause noisy signals. The detector has a four inch wide foam seal around the outside lower edge of the box -there should be few or no gaps between the foam and the soil (outside air contains about 10^7 ions per cm^3 during the day, a fA is only about 6000 electrons/sec). Once the detector is placed, computer acquisition is started and attention is paid to the initial readings to note any problems with the placement. A shorted signal plane or air leaks are the two most common problems and easy to notice; all problems ever encountered, their signs and solutions, are listed on a one page sheet which deploys with the tractor. With practice the person directing the placement can spot potential troubles before they occur and correct the situation before the detector is placed.

Once the detector is placed and data acquisition started, the data is allowed to collect for 8 to 15 minutes. This gives time for transient conditions to subside and usually results in data with a discernible plateau in readings. After at least 8 minutes and once a plateau is evident, the data may be saved to the computer hard disk and the plateau value manually recorded in a logbook. The computer acquisition is halted and the tractor is remounted to be moved to the next cleared spot.

At the end of the day or when desired, the reference spot should be re monitored. The detector should be returned to its aluminum background plate overnight and the electronics switched over to AC power. The battery should be recharged as needed. It is easiest to let the detector acquire data overnight so that it will be ready to take out the next morning without waiting the time for a new data set to be acquired.

It is desirable to make a contour plot of the day's data nightly to observe trends and catch unusual readings. In addition the plot gives a sense of accomplishment to those taking the data.

CONVERSION OF FIELD MEASUREMENTS

The LRAD soil surface monitor measures the ionization of air in its active volume. By using NIST-traceable sources, it has been determined that the monitor collects about 40% of the airborne ion pairs produced by an alpha source beneath it (less within 3 cm of the sides of the box). The current reading in the LRAD can then be directly converted from fA to roentgen per unit time since the latter is defined in terms of the rate of ion production in air. Unfortunately, alpha contamination has historically been described by activity rather than exposure rate: DOE order 5400.5 states contamination limits in the more common form of dpm/100 cm^2.

In order to make the LRAD readings more comprehensible to a wider audience, we prefer to report readings in dpm/100 cm^2. To convert to dpm/100 cm^2 we take the measured current, subtract the background reading of the detector on a clean aluminum plate (typically 350 fA), and multiply by the measured conversion rate of 6 dpm/fA to get total dpm. The conversion is precise for plutonium-239 (5.10 MeV average alpha energy) and is very nearly the same for the average alpha energy of each of the natural decay chains starting with ^{238}U, ^{235}U, and ^{232}Th (5.36, 6.08, and 6.14 MeV respectively). Fabricated ^{238}U metal has a lower average alpha energy of only 4.19 MeV. Since most sites that the LRAD have surveyed involved uranium contamination on natural background soil, the 6 dpm/fA corresponding to 5.10 MeV alphas has been chosen as the best compromise to cover the range of 4.19 to 6.14 MeV when converting to more common units. Dividing this total dpm measured over one square meter by 100 gives the reported dpm/100 cm^2.

Several groups prefer to know contamination levels in terms of pCi/g or ppm. The conversion from measured current to one of these units requires many assumptions. We do not like to make all of these assumptions because each assumption gives reason to cast doubt on the accuracy and value of the measurement. The LRAD monitors make very accurate readings of relative activity, but contain no spectroscopic information from which to obtain isotope ratios or absolute concentrations. In fact, all in situ measurements on soil must make assumptions about the soil composition and homogeneity in order to determine either isotope ratios or absolute concentrations. For completeness only, the LRAD conversion from current to pCi/g and ppm is included here and goes as follows. The range of alpha particles can be used to get an effective depth of soil from which all upwardly directed alphas are collected and below which none are collected. For typical soil densities this depth works out to be 36 mm. Multiplying by the one square meter surface area of the detector gives an effective volume of 36 cm^3. At 2.7 g/cm^3, this implies an effective 100% monitored mass of 100 g. Each pCi/g of ^{238}U equals 2.22 dpm/g of ^{238}U. Multiplying by the effective soil mass of 100 g gives 220 dpm in the detector per 1 pCi/g ^{238}U. Taking into account the lower energy of ^{238}U alphas compared to ^{239}Pu alphas then gives a conversion of 7.4 dpm/fA, and therefore 30 fA per pCi ^{238}U/g. Since in most cases ^{234}U is in equilibrium with the ^{238}U, the same steps must be followed and yield 34 fA per pCi ^{234}U/g. The detector will see both of these decays for a total of 64 fA per pCi /g of ^{238}U. The higher beta and gamma activity for uranium add to this number slightly. Once the pCi/g ^{238}U are determined, the total uranium ppm is obtained by multiplying by (3 ppm total U)/(pCi/g ^{238}U). This calculated conversion number of 64 fA per pCi /g of ^{238}U is smaller than what we have been using based on our original calculations and supported by the results at the Fernald STP area. In our previous derivations and reporting of results we obtained a value of 108 fA per pCi /g of ^{238}U and obtained reasonable agreement with core samples in the STP area. We determined empirically a total contribution of 2000 fA from the detector background on an aluminum plate plus the natural activity other than uranium at the STP area, i.e., this background, subtracted from the measured current, gave uranium concentrations consistent with background. At this point we cannot select between the empirical and theoretical calculations as to which is more accurate. We look forward to the proposed well characterized plots for the spring demo to settle the issue once and for all.

APPENDIX D: FIELD DEMONSTRATION OF PASSIVE ALPHA DETECTORS FOR CHARACTERIZATION OF URANIUM CONTAMINATION IN SOILS

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DETECTOR THEORY AND DETECTOR DESCRIPTION

Alpha Track Detector (ATD) Technology:

ATDs are the basis of a technology that can achieve large numbers of inexpensive surface and near-surface soil measurements that are both accurate and simple to make. Alter and Fleisher (Health Physics 40:693-702, 1981) described the application of ATDs to the measurement of indoor airborne alpha activity. The underlying principles of the measurement are that damage tracks in the plastic material are induced by the passage of alpha particles through the material, that the damage tracks can be subsequently enlarged by exposure to potassium hydroxide solution, that the enlarged tracks can be counted with a microscope, and that the density (per unit area) of tracks is proportional to the alpha activity. Plastic ATDs are about 70% efficient in detecting alpha rays while being almost completely insensitive to gamma and beta radiations. The technology has already been commercialized for the monitoring of environmental radon. Millions of detectors of the ATD type have been sold both to individual homeowners and to federal agencies mandated to screen their facilities for radon. The ATD technology has passed the stringent test criteria, blind testing, and quality assurance procedures set under EPA's Radon Measurement Proficiency Program.

ATDs are fabricated from LANTRACK® material, which is a polymer that has been cast using proprietary methods from an allyl diglycol carbonate monomer. Typically, the material is manufactured in 1mm thick sheets which are easily cut or formed to suit a particular application. The most frequently used detector format is small slabs, 1cmx2cm in size, that have an identification number laser-scribed on one face for chain-of-custody and tracking purposes.

Electret Ionization Chamber (EIC) Technology:

EICs provide another inexpensive measurement technique that is very easy to implement. Kotrappa and coworkers (Health Physics 41:35-46, 1981;Health Physics 54:47-56, 1988) have described the application of EICs to the measurement of indoor alpha activity. The underlying principle of the measurement is that ionizing particles that pass through the air in the sensitive volume of the detector create electron showers that are attracted to the positively charged face of the electret, neutralizing the charge. The rate at which the charge is neutralized is proportional to the activity concentration in the topmost centimeters of soil beneath the EIC. The technology has already been commercialized for the monitoring of environmental radon. Hundreds of thousands of detectors of the EIC type have been sold both to individual homeowners and to governmental agencies (principally school systems) mandated to screen their facilities for radon. The EIC technology has passed the stringent test criteria, blind testing, and quality assurance procedures set under EPA's Radon Measurement Proficiency Program.

EICs are passive ionization chambers that consist of a charged Teflon electret mounted in a holder constructed of a conducting polymer. The assembled detector stands 4cm tall and samples a $47cm^2$ area. The charge on the Teflon is uniform and very stable, resulting in a long detector shelf life. When the electret is screwed into its holder a static electric field is established. The chamber is then placed on the contaminated soil surface.

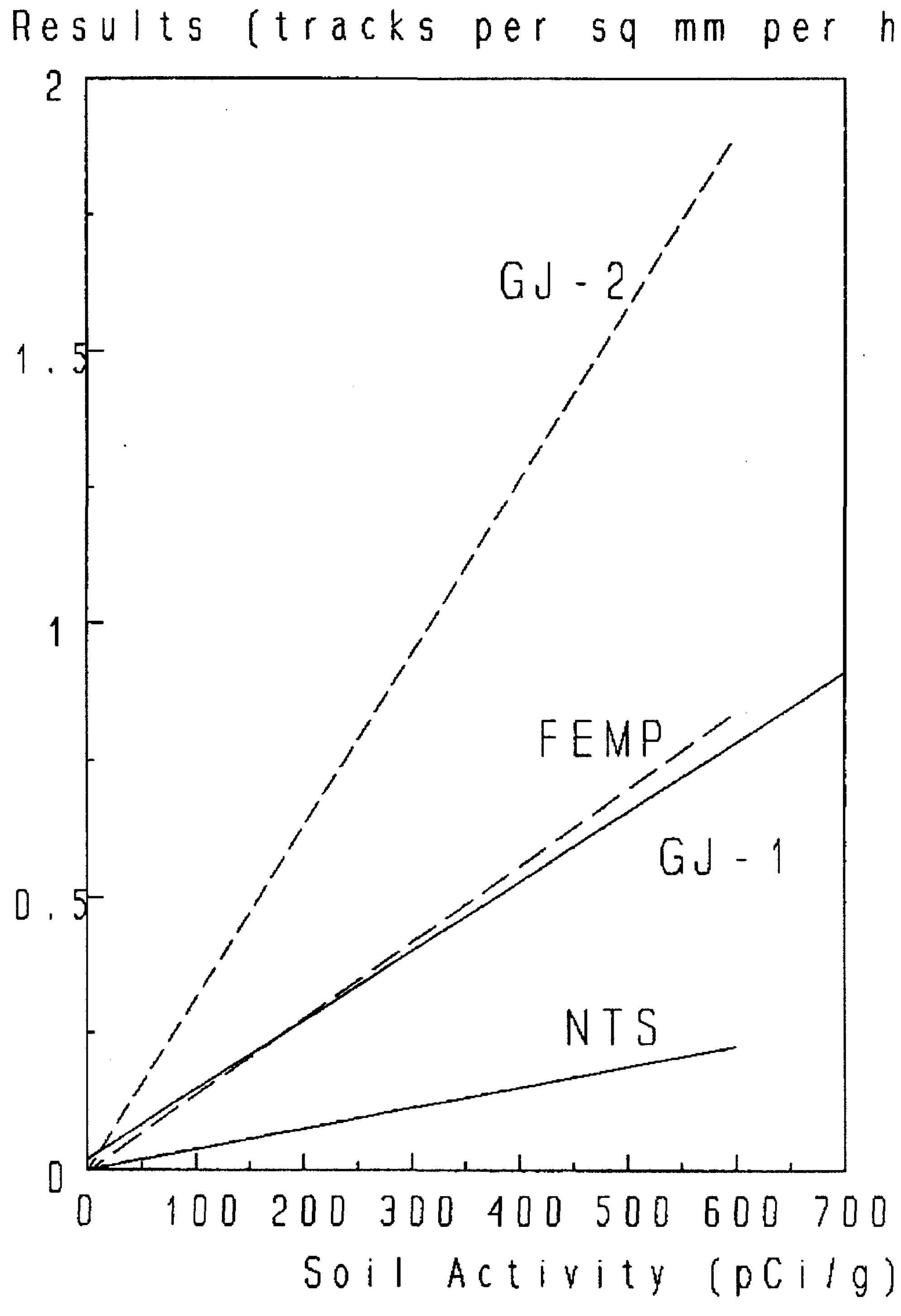


Figure 1. ATD calibration curves (determined by regression) are shown for soil sample sets from four different sites

OPERATING PROCEDURE

The protocol for deployment of ATDs on contaminated soil surfaces is:

1) Record detector number, deployment location, and time;
2) Open sealed Mylar bag; strip protective polyethylene films off of detector face and back; place detector (number side down) on the contaminated surface;
3) After desired exposure time (1min - 24hours), retrieve detector and record retrieval time;
4) Decontaminate detector (if necessary) by rinsing with clean water; allow to air-dry; return to Mylar bag; re-seal the bag;
5) Ship batch of detectors to Landauer, Inc. for analysis;
6) Convert tracks/mm^2/hour to soil activity concentration.

The detector face in proximity to the surface will measure alpha emission due the surface contamination plus environmental radon. The other, or distal, face will measure only alpha emission due to environmental radon. For most situations, Landauer Inc. can provide the results of detector analysis within 48 hours of receipt of the detectors. A prototype mobile field-deployable ATD processing/analysis system is being developed at ORNL for those applications which require more immediate data analysis.

Protocols have also been developed for the proper handling, deployment, and calibration of EICs and a brief summary will be given here. The recommended procedure is:

1) Remove protective electret cap; place electret in voltmeter; record initial voltage, detector number, deployment location, and time.
2) Screw electret into holder and place chamber on contaminated soil surface.
3) In mixed fields (radon, beta, and/or gamma), deploy a paired detector shielded with porous Tyvek material.
4) After the desired exposure time (1min - 24hours, depending on the contamination level), retrieve detector and record final electret voltage(s) and time(s).
5) Convert net rate of voltage drop to soil activity concentration.

The unscreened detector responds to surface alpha emission, environmental radon, and environmental beta and gamma radiations, while the screened detector responds to all of these except the surface alpha emission. Therefore taking the difference between the screened and unscreened readings yields the detector response due to the surface alpha contamination alone.

DATA REDUCTION PROCEDURES

Site-specific Calibration:

Preliminary results have shown that there is a generally linear relationship between EIC or ATD response and bulk soil activity (expressed in pCi/g) when the devices are exposed in the laboratory. As seen in Figure 1, there can be substantial variation among ATD responses to soils from different sites. Similar results have been obtained with EIC exposures. Therefore, a required element for data analysis is the collection of a set of soil samples from the measurement site. The set of samples should reflect a range of activity concentrations so that after radiochemical analysis is complete, site-specific calibration exposures can be performed in the laboratory.

Once a set of soil samples from the site are returned to the laboratory, the following steps are taken:

1). The samples are ground in a jar mill to a very fine powder, ensuring uniform distribution of radioactive species.

2). Petri dishes are filled to a depth of about one inch with ground soil from each sample. ATDs and EICs are exposed to each sample and the response recorded.

3). One or two aliquots from each ground sample is analyzed radiochemically.

4). The ATD responses are regressed (linearly) onto the radiochemical results to determine the linear relationship between ATD response and bulk soil activity. The EIC responses are regressed onto the radiochemical results in the same manner. Ongoing research is investigating why we find non-zero intercepts in some regression analyses.

<u>ATD Calculations</u>:

At the time of the field exposure, the following information must be recorded: the identification number of the ATD, the location of the measurement, and the times at which exposure began and ended. After laboratory processing, the average track density on the proximal (i.e., toward the soil surface) and distal faces must be recorded. The expression for the relationship between the ATD track density measurements and the bulk soil activity is:

$$\frac{\left(\frac{D - D_{back}}{T_f - T_i}\right) - b}{m} = (pCi/g)$$

where

D	= measurement track density (tr/mm^2) on proximal face
D_{back}	= background track density (tr/mm^2) on distal face
$T_f - T_i$	= elapsed exposure time (minutes)
b	= site-specific intercept (tr/mm^2 per minute)
m	= site-specific slope coefficient (tr/mm^2 per minute per pCi/g)

<u>EIC Calculations</u>:

At the time of the field exposure, the following information must be recorded: the identification number of the EIC, the location of the measurement, the electret voltages before and after exposure, and the times at which exposure began and ended. The expression for the relationship between the electret voltage readings and the source activity is:

$$\frac{\left(\left[\frac{V_f - Vi}{T_f - T_i}\right] \times NL_{open} - \left[\frac{V_f - Vi}{T_f - T_i}\right] \times NL_{shielded}\right) - b}{m} = (pCi/g)$$

where

open	= open electret measurement
shielded	= electret/Tyvek paper measurement
NL	= nonlinearity correction factor (dimensionless, see Table 1)
$T_f - T_i$ =	elapsed exposure time (minutes)
$V_f - V_i$ =	change in voltage during exposure (V)
b	= site-specific intercept (volts per minute)
m	= site-specific slope coefficient (volts per minute per pCi/g)

The mid-point voltage that is used in the nonlinearity correction factor reference table (Table 1) is given by:

$$V_{mpv} = \frac{V_f - V_i}{2}$$

The nonlinearity correction factors were estimated from experiments using a ^{239}Pu source with an activity of 7700 dpm (4¼). The correction derived here can be applied for any source. Thirteen electret voltage measurements were made at exposure time intervals of 5.5 minutes. The voltage drop for each time interval was plotted versus the mid-point voltage for each measurement. The measurements were then normalized to the measurement at V_{MPV} = 400V. This data was then fit with a polynomial curve of the form:

$$y = a + bx + cx^2 + dx^3 + ex^4 + fx^5$$

where:

$y = NL$
$x = V_{MPV}$

and the fitted coefficients were found to be: a = 1.9555, b = -0.0099419, c = 4.487317e-5, d = 1.03644e-7, e = 1.18166e-10, and f = -5.27881e-14.

Table 1. Nonlinearity Correction Factors

V_{MPV} (volts)	NL	V_{MPV} (volts)	NL	V_{MPV} (volts)	NL
100	1.3176	325	1.0331	550	0.9739
125	1.2387	350	1.0250	575	0.9704
150	1.1798	375	1.0172	600	0.9670
175	1.1366	400	1.0097	625	0.9360
200	1.1050	425	1.0025	650	0.9573
225	1.0820	450	0.9953	675	0.9482
250	1.0652	475	0.9888	700	0.9336
275	1.0523	500	0.9830	725	0.9110
300	1.0419	525	0.9781	750	0.8769

APPENDIX E: FIELD DEMONSTRATION OF THE NaI, FIDDLER, and XRF DETECTORS

Fernald Enviornmental Restoration Management Co.

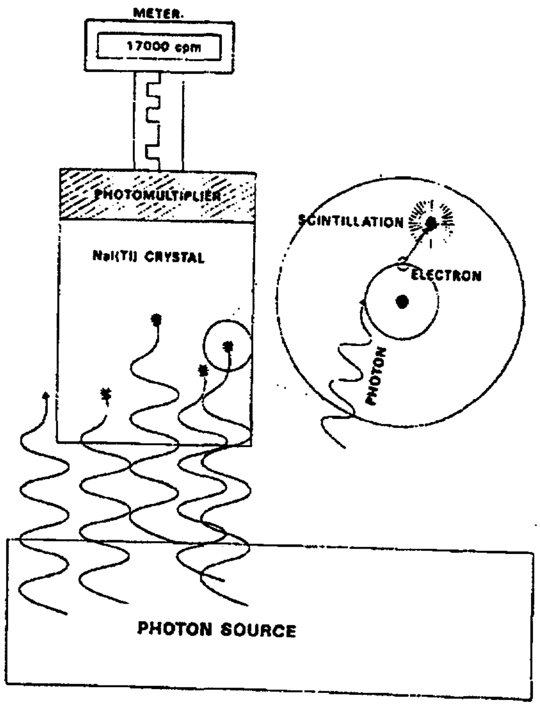
DISCUSSION OF DETECTOR THEORY

NaI and FIDDLER Detectors:

Thallium activated sodium iodide {NaI(Tl)} scintillation material has been used since the early 1950's and remains the most popular scintillation material used for photon detection. Scintillation detectors rely on the uncharged photon undergoing an interaction that transfers the photon energy to an electron in the absorbing material. The electron's kinetic energy is then converted to a detectable flash of light. The light or scintillation is detected by a photomultiplier tube. The photomultiplier tube is required to convert the light into an electrical pulse which can then be counted on an appropriate meter. A schematic exhibiting this theory is shown in Figure 1.

Although uranium is primarily an alpha emitter, it also emits characteristic γ-rays when it decays. These photons are of low energy, ranging from 48 keV to 205 keV, which may be attenuated by surface soils, limiting the depth at which the detector is effective.

Figure 1.



X-ay Fluoresence Detector:

The Spectrace 9000 X-ray fluorescence analyzer (XRF) is a field portable instrument capable of real-time in-situ qualitative and quantitative determination of elements above and including sulfur (with the exception of transuranics) in the periodic table, any of which may be present in a solid, liquid, or powder sample. The sample analysis quantifies the detected elements in parts per million (ppm) for the primary sample matrix applications. Parts per million of uranium can effectively be converted to picocuries per gram (pCi/g) by multiplying the value in ppm by 0.6757 .

During analysis, one or more of the three sources (^{55}Fe, ^{109}Cd, and ^{241}Am) may be exposed to the sample one at a time, thereby emitting x-radiation of sufficient energies to cause affected atoms to fluoresce or emit x-ray photons of characteristic energy. An x-ray photon striking the biased mercuric iodide crystal loses energy in the crystal through producing electron-hole pairs. The electric charge produced is collected and provides a current pulse that is directly proportional to the energy of the x-ray photon absorbed by the crystal. By analyzing this current, both the identity and the quantity of the elements present in the sample can be determined by the XRF electronics unit. The minimum detection limit (MDL) for most analytes falls between 50-100 ppm. Typically, the larger the atomic number (Z) the lower the MDL for the XRF. For example, the MDL for cobalt (Z=27) is 101 ppm, for thorium (Z=90) is 15 ppm, and for uranium (Z=92) is 10 ppm.

DETECTOR DESCRIPTION

NaI(Tl) 2 X 2 Detector

The NaI(Tl) 2 X 2 Detector is a NaI(Tl) crystal with the shape of a right cylinder 2 inches high by 2 inches in diameter. This crystal is optically coupled to a photomultiplier tube. The output of the photomultiplier is connected to a survey meter. This detector is small enough, 2 lbs (.91 kg), to be used as a portable detector. The specifications for the scintillation probe used for the survey are listed in Table 1.

The NaI(Tl) detector with the above dimensions is able to detect photons with energies ranging from 60 keV and above. This detector is limited in its ability to differentiate radiation sources. This detector will count all energies of γ-rays including cosmic radiation and shine. In order minimize the effect of shine and cosmic radiation on the gamma measurements, a 3/16" thick lead shield is placed around the circumference of the active portion of the detector.

FIDLER (Field Instrument for Detecting Low Energy Radiation)

The FIDLER operates with the same theory as the NaI(Tl) 2 X 2 detector with the exception of the NaI(Tl) crystal dimensions. The NaI(Tl) crystal used in the FIDLER is only .063" (1.6 mm) thick. This decreases the probability of a high energy photon from interacting in the scintillation material. This allows for the detector to count low energy photons without the unnecessary counting of high energy photons. The FIDLER radiation entrance window is 5" diameter. The specifications for the FIDLER probe are listed below:

The FIDLER is used in the same manner as the 2 X 2 detector. The difference is that the FIDLER can detect photons with energies as low as 10 keV. The efficiency of this detector decreases as the photon energy increases. This allows for increased detectability of uranium. The problems associated with the "shine" from surrounding radiation sources are not evident when the FIDLER is used due to the FIDLER being a thin crystal detector.

X-ay Fluoresence Detector:

The XRF is composed of two primary components including a probe and an electronics unit. The probe consists of a sealed aluminum enclosure containing a high resolution mercuric iodide detector and three sealed radioisotope x-ray excitation sources. Also included in the probe is a pre-amplifier and bias supply for the detector and a mechanism to move the radioisotope sources from their shielded location during analysis.

The electronics unit of the Spectrace 9000 provides data acquisition, processing, and display capabilities. The unit utilizes a fundamental parameter XRF calibration derived from theoretical considerations (as opposed to empirical data). The menu driven software supports multiple

Table 1.

	Model	Victoreen 489-120
	Type	Sodium iodide NaI(Tl) gamma scintillator optically coupled to a photomultiplier tube.
	Radiation Detected	Gamma above 60 keV
	Exposure Rate	Recovery time, approximately 3-4μ sec.
	Limitations (typical)	Saturates above 35 R/hr.
	Temperature Range	-40°F to +120°F (-40°C to +50°C) with temperature gradient no greater than 20°F/hr
	Humidity Range	0 - 95% Relative Humidity
	Operating Voltage	900 V
Detector Construc-tion	**Wall Material**	.04", 1 mm thick aluminum
	Type Crystal	Sodium Iodide NaI(Tl) crystal in cylindrical aluminum housing
	Window	108 mg/cm^2 aluminum
	Crystal Dimensions	2 in. dia. x 2 in. thick
	Sensitive Area	20 cm^2 (3.1 in^2)
	Tube	Photomultiplier in mu-metal shield
Overall Probe Dimensions	**Diameter**	2 in. (5.7 cm)
	Length	9 5/8 in. (24.4 cm)
	Nominal Weight	2 lbs. (.91 kg)

XRF calibrations called "Applications." Each Application is a complete analysis configuration including elements to be measured, interfering elements in the sample, and a set of fundamental parameter calibration coefficients. The Applications currently available on the XRF include "Soils with U and Th", "Asphalt", "Water", "PbK in Paint", and "Pb in Paint."

OPERATING PROCEDURE

Specific details for the operation of the NaI and Fiddler detectors are contained in FERMCO Procedure EP-REM-001, "Use of Victoreen Thyac V Survey Meter Model 190 with Communicator and NaI(Tl) Probes for use in Surface Soil Surveys."

Specific details for the operation of the X-ray Fluorescence Analyzer is contained in FERMCO Procedure EP-CRU3-006, "Operation of XRF Analyzer."

CONVERSION OF FIELD MEASUREMENTS

Table 2.

	Model	Rexon
	Type	Sodium iodide NaI(Tl) gamma scintillator optically coupled to a photomultiplier tube.
	Radiation Detected	Gamma and X-ray > 10 keV to approx. 200 keV
	Detectability	330 cpm/μCi/m^2 for 60 keV, and 640 cpm/μCi/m^2 for 17 keV
	Temperature Range	-40°F to 120°F (-40°C to 50°C)
	Operating Voltage	1200 V
Detector Construction	**Type Crystal**	Sodium Iodide NaI(Tl) crystal in cylindrical aluminum housing
	Crystal Dimensions	5" dia. x 0.060" thick
	Window	.002" aluminum
	Tube	Photomultiplier 3" dia. SRC#875801 or Equivalent
	Wall Material	Light shield mu-metal .040" thick
Overall Probe	**Diameter**	6 in.
Dimensions	**Length**	8 3/4 in.

In general, field measurements are converted to pCi/g total Uranium through detector calibration. Appropriate calibration curves will be developed using the calibration soils provided by the ID Demonstration Program.

APPENDIX F: DATA MANAGEMENT PLAN

(This section has been omitted from this data report; see Appendix B.)

APPENDIX G: GEOSTATISTICAL ANALYSIS AND PERFORMANCE ASSESSMENT

1.0 Sampling Plan

Randomization of sample information is necessary to make probability or confidence statements about the results of statistical analyses. Pure random sampling with a limited number of points faces the possibility of localized spatial clustering of points (purely by chance) that produces information redundancy. Yet, systematic sampling with a random initial point provides for a distribution of samples over the entire study area because the sample points follow a simple pattern and are separate by a fixed distance.

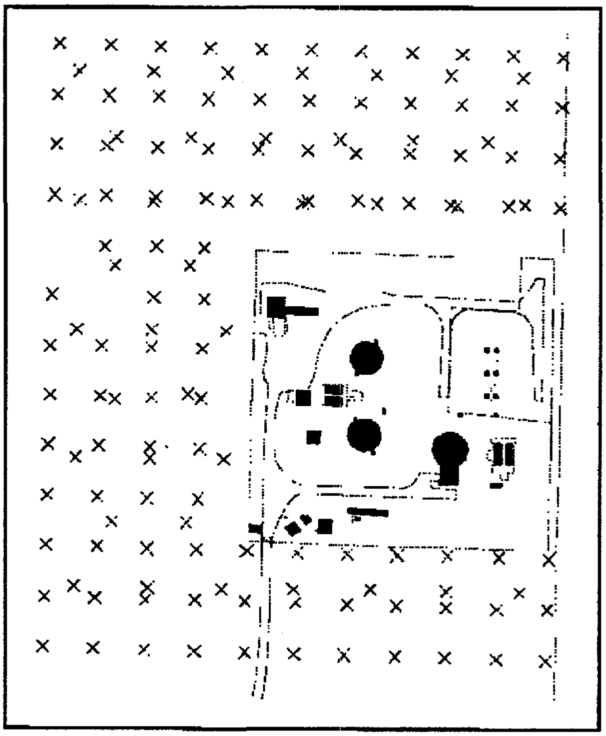


Figure 1.0 Sampling locations (example only)

Although "traditional" statistical approaches to sample analyses impose strict requirements pertaining to grid design and number of samples collected, this is not the case with the geostatistical/decision analysis approach proposed to be used during the USID. Althought, as an initial point of reference and to provide options for future "traditional" analyses, the sampling grid network proposed will follow a traditional, but modified, systematic sampling pattern. In this sense the number of *exploratory* sampling locations will be sufficient to provide a 95-percent probability that the maximum value sampled will equal or exceed the 95th percentile of the unknown underlying distribution, using a robust method presented by Barnes (1988). Of course, these are requirements that satisfy only one statistical test, but this test serves the purpose of investigating a site like Fernald where the point of the investigation is to determine the extreme values with some degree of confidence. These extreme values are considered to be associated with some degree of failure, such as exceeding a regulatory cutoff criteria. Of course, like most statistical tests, the samples that describe the system are assumed to be independent (uncorrelated), whereas previous work at Fernald (1993) has already identified spatial correlation among Uranium contaminated soil samples.

The systematic sampling network will be *modified* in the sense that specific spatial scales for sampling need to be examined to define the geostatistical variogram models used to characterize the correlational structure between samples. The number of exploratory samples required is currently anticipated to range from 50-70 samples for an area between 10-15 acres. It is anticipated that a sampling configuration similar to that shown in Figure 1.2 will be used to evaluate each technology at the exploratory level of this study. The results of the geostatistical/decision analysis will guide the collection of any subsequent samples, as required specifically by each technology to complete contaminate characterization of the site.

2.0 Data Analysis and Interpretation

All the geostatistical software packages mentioned earlier require structured ASCII data files, yet data are read without specific format criteria (*i.e. free-format, space delimited*). The basic required database line structure for each sample location, therefore, is as follows: x (easting) coordinate, y (northing) coordinate, attribute. The database may be developed in any convenient manner so that extracting this structure is a simple task.

SampleID	X-coord.	Y-coord.	Total U pCi/g
FS0011	1487256.13	532913.66	45.22
FS0012	1487356.34	533013.92	30.97
FS0013	1487456.65	533114.12	100.32

Figure 2.0 Required data format for geostatistical analysis

There are four field data components that must maintain a high level of precision and accuracy throughout the entire analysis process. First, the coordinate location of the field measurement must be verified and maintained throughout the analysis process. Corruption of this key component would be extremely detrimental due to the spatial emphasis of the analysis procedures. Secondly, the reported field measurements must be reduced to a consistent unit of measurement for direct comparison between sample locations and competing technologies. This plan assumes that all transformations/reductions in the field measurements required to meet these consistencies will be performed by the field technician and also that these values ate accurate, following verification of telecommunication transmission. Thirdly, each sample must be identified by a unique and distinguishing name that will have nomenclature that is conducive to database queries and general visual screening. Finally, if the technology used in sampling cannot be identified through the naming convention, then it must be indicated and maintained as a separate field for each sample collected.

Following the completion of the exploratory sampling for a given technology, sample results will be received and verified via a telecommunication link between the Fernald Site and SNL. Geostatistical analyses will then be performed on the data set.
This approach will typically involve developing univariate summary statistics and probability (histogram) plots from the raw information and evaluating any potential errant or outlier values. The data will then be transformed into normal-scores space to guarantee the gaussian (normal) distribution required for stochastic modeling of the areal distribution of contamination.

Depending upon the selected study site, the surficial soil contamination may have an anisotropic component to the spatial correlation of samples. Such characteristics may be attributed to such natural processes as prevailing wind directions or preferential erosional patterns. If this anisotropy is deemed to be significant, it will have to be characterized and incorporated into the spatial correlation (variogram) model for the specific technology under study.

Data analysis mentioned above will be accomplished using a number of geostatistical software and other specifically developed programs including EPA's GEO-EAS, FSS TOOLBOX, and GSLIB. Following the variogram model development, several stochastic models will be developed to reflect the areal distribution of contamination as defined by the exploratory sampling from the specific technology. Each stochastic model, or realization, will be developed using the Sequential Gaussian Simulation technique contained in the GSLIB software package and each will equally reflects the spatial and statistical attributes of the available data. Because each stochastic model is equiprobable, generating a large number of model outcomes allows for developing a probability frequency in the modeled outcome for any particular unsampled location within the study domain, thereby assessing the uncertainty resulting from the model given the current data representation.

Potentially 3 to 5 stochastic realizations will be mapped with accompanying summary statistics in the form of graphs, tables, and/or plots to provide validation of the simulation model for each technology. The resulting uncertainty assessment provided through post-processing of the stochastic modeling, as preveously mentioned, will be used to drive the decision analysis portion of the study and determine the need for additional sampling efforts and their optimal location for collection.

3.0 Performance Assessment/cost Risk Analysis

As discussed in Section 2.0, the data will be analyzed within a geostatistical framework to ultimately provide maps reflecting uncertainty in the modeling of surficial soil contamination. These maps will then be used in conjunction with decision analysis methodologies to determine optimal selection of additional samples, with the ultimate goal being a reduction in the risk of a wrong interpretation based on limited data.

The geostatistical component of this study requires fundamental statistical data analysis, an exercise in data transformation, and two levels of modeling. Summary statistics from the exploratory sampling information will be developed to evaluate basic behavior of the population characterized by the data. These summaries will reflect such things as the mean,

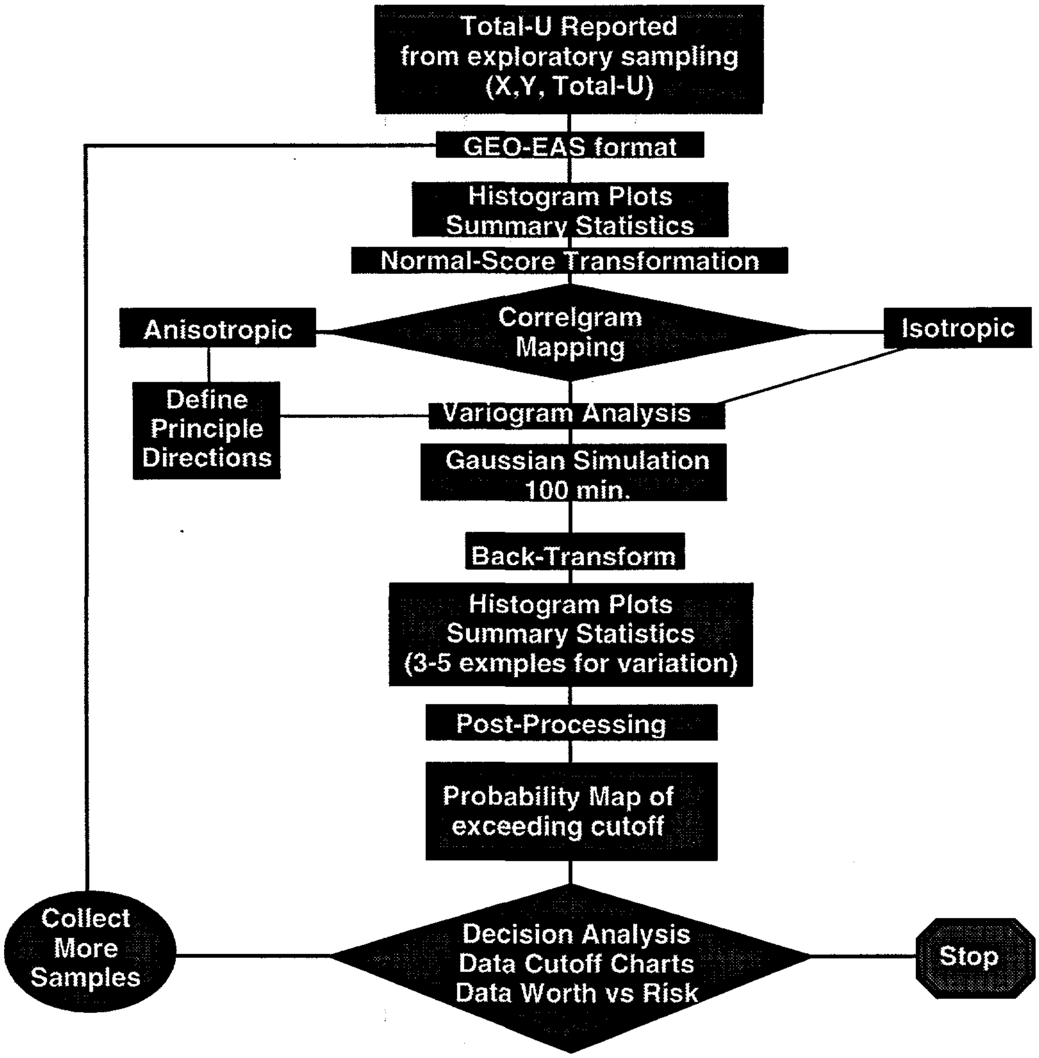


Figure 2.1 Geostatistical data analysis process flow

standard deviation, the sample frequency distribution (histogram) and it's behavior (skewness, quartile ranges, etc.). Figure 2.1 exhibits the geostatisitcal data analysis process flow.

The current intent is to employ a gaussian-related simulation algorithm to provide stochastic modeling of the sample data. This procedure requires that the population described by the data have a normal distribution. This normality will not likely be the case in the raw field data, but a simple transformation (normal-score) can insure the condition. The transformed data will then be subjected to an analysis of their spatial correlation (variography) to determine how the variance between all sample points can be expected to change as a function of their separational distance and direction. This information is analyzed graphically in the form of a variogram and subsequently a linear model is fit to the graph to reflect the variogram behavior.

The parameters that define the variogram model are then used to constrain the stochastic modeling (sequential gaussian simulation) of the areal distribution of contamination.

Currently a minimum of 100 simulations are proposed to model "reality" as presented by each competing technology. Each simulation is conditioned to the existing data and provides an equiprobable representation of spatial distribution of contamination.

Following back-transformation of the data, the suite of simulations will be processed to develop an understanding of the probability that any particular location could exceed a pre-determined cutoff (performance) criteria. It is this appreciation of uncertainty that will be used to optimize additional sampling efforts and also provide qualifying information on the performance of the technology via decision analysis methods.

4.0 Data Evaluation and Transfer to FERMCO

Following the evaluation of uncertainty in the exploratory sampling modeling results, additional data may be required by the field technology to complete the interpretation for a desired degree of confidence. In these instances, the performance assessment team will direct FERMCO as to the number and location of any subsequent sampling efforts. Locations for additional sampling will be provided through appropriate coordinates.

Sandia National Laboratories

Albuquerque, New Mexico 87185

date: April 1, 1994

from: V.C. Tidwell

to: distribution

subject: FY-94 Field Demonstration Project Plan

Enclosed you will find a copy of the FY-94 Field Demonstration Project Plan. The demonstration plan was developed based on our past discussions, meetings, and review comments. If there are questions or comments concerning the plan please contact me. I will be in contact with each of you as time nears for the demonstration.

copy to:

A. Armstrong (ORNL)
M. Anderson (Ames)
J. Bounds (LANL)
J. Cunnane (ANL)
C. Dudney (ORNL)
P. Kaplan (SNLA)
K. Nuhfer (FERMCO)
D. Morris (LANL)
S. Lee (ORNL)
D. Perry (LBL)
A. Schilk (PNL)

(Copy of original letter transmitting Project Plan to technology developers.)

Appendix B: Data Management Plan

Data Management Plan

The "Uranium in Soils Integrated Demonstration Field Characterization - Spring 1994 Data Management Plan" that follows was developed originally to guide the collection and transmission of data from the Fernald site to Sandia National Laboratories and back. The report is reproduced as it appeared at the beginning of the field characterization demonstration program. No editing or revisions have occurred to modify this planning document to reflect in-field changes or grammatical errors.

June 26, 1994

Uranium in Soils Integrated Demonstration
Field Characterization - Spring 1994
Draft Data Management Plan

Figure 1.1.1 Fernald Site.

1.0 Introduction

The Uranium in Soils Integrated Demonstration (USID) program was developed to help improve the detection and remediation of uranium contaminated soils by demonstrating reliability, effectiveness, cost savings, and applicability under various environmental conditions. How each technology performs influences the risk level, which will in turn influence how it is accepted by the public and the regulator.

The majority of data collected for the USID 1994 Field Characterization Demonstration will be directly from various technologies' field measurements of surface uranium concentrations. Other collected data will be based on laboratory analysis of soil samples. A description of the technologies and methodologies used to detect uranium in soil is contained in the *Measurement and Analysis Technologies* section of the *Field Demonstration Project Plan* (May 1994). The quality objective for data management of the USID Field Characterization program is to provide a framework for maintaining validated and verifiable information.

The collection and analysis of data from the field and laboratory needs to be scientifically accurate and legally defensible. This requires the development of a data base that maintains and links both raw and transformed data. The procedures and requirements for assuring data quality are outlined in this data management plan. The plan is drafted in accordance with the guidance contained in Appendix F of the DOE *Environmental Survey Manual* (DOE 1987).

1.1 Site Description

Fernald Environmental Management Project (FEMP) is located in southwestern Ohio approximately 18 miles northwest of Cincinnati near the communities of Miamitown and Ross. The site covers an area of 1050 acres of which 850 acres are in Hamilton County and 200 acres are in Butler County. Of the 1050 acres, 136 acres encompass the former processing plant area. Figure 1.1.1 is a 1988 aerial photo of the Fernald Site. Figure 1.1.2 is the approximate location of the USID Field Characterization Demonstration.

Fernald was built in the early 1950s' for the purpose of processing uranium and its compounds from natural ore for use in government defense programs. Full operation of the processing plant began in 1952 with peak production occurring in the early 1960s. By the mid-1960's production declined and by 1989 production of uranium ore stopped. Since 1991 the mission of Fernald has focused on waste management and environmental restoration of the site.

The majority of soils containing uranium exceeding 35 pCi/g are located within the top 1.5 feet of surficial material which consists predominantly of glacial till and includes sand, silt and clay. Approximately 50 percent of the production area soils contain contamination exceeding 35 pCi/g.

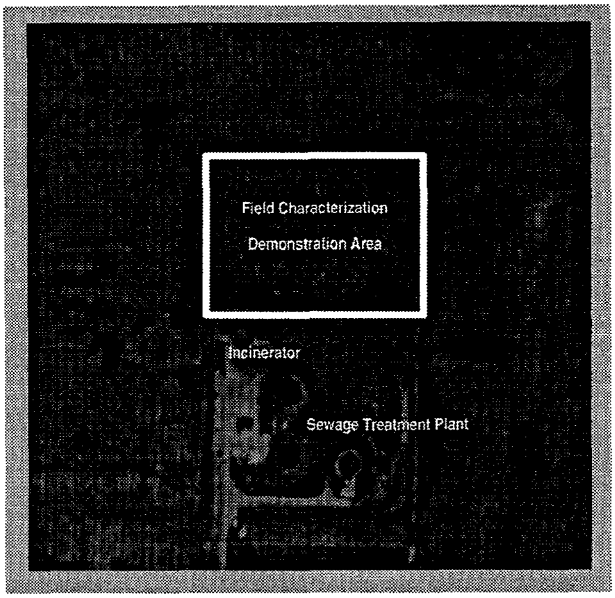


Figure 1.1.2 Field characterization location.

1.2 Sampling Plan

Randomization of sample information is necessary to make probability or confidence statements about the results of statistical analyses. Pure random sampling with a limited number of points faces the possibility of localized spatial clustering of points (purely by chance) that produces information redundancy. Yet, systematic sampling with a random initial point provides for a distribution of samples over the entire study area because the sample points follow a simple pattern and are separated by a fixed distance.

Although "traditional" statistical approaches to sample analyses impose strict requirements pertaining to grid design and number of samples collected, this is not the case with the geostatistical/decision analysis approach to be used during the USID. Although, as an initial point of reference and to provide options for future "traditional" analyses, the sampling grid network proposed will follow a traditional, but modified, systematic sampling pattern. In this sense the number of *exploratory* sampling locations will be sufficient to provide a 95-percent probability that the maximum value sampled will equal or exceed the 95th percentile of the unknown underlying distribution, using a robust method presented by Barnes (1988). These requirements satisfy only one statistical test, but this test serves the purpose of investigating a site like Fernald where the purpose of the investigation is to determine the extreme values with some degree of confidence.

These extreme values are considered to be associated with some degree of failure, such as exceeding a regulatory cutoff criteria. Like most statistical tests, the samples that describe the system are assumed to be independent (uncorrelated), whereas previous work at Fernald (1993) has already identified spatial correlation among uranium contaminated soil samples.

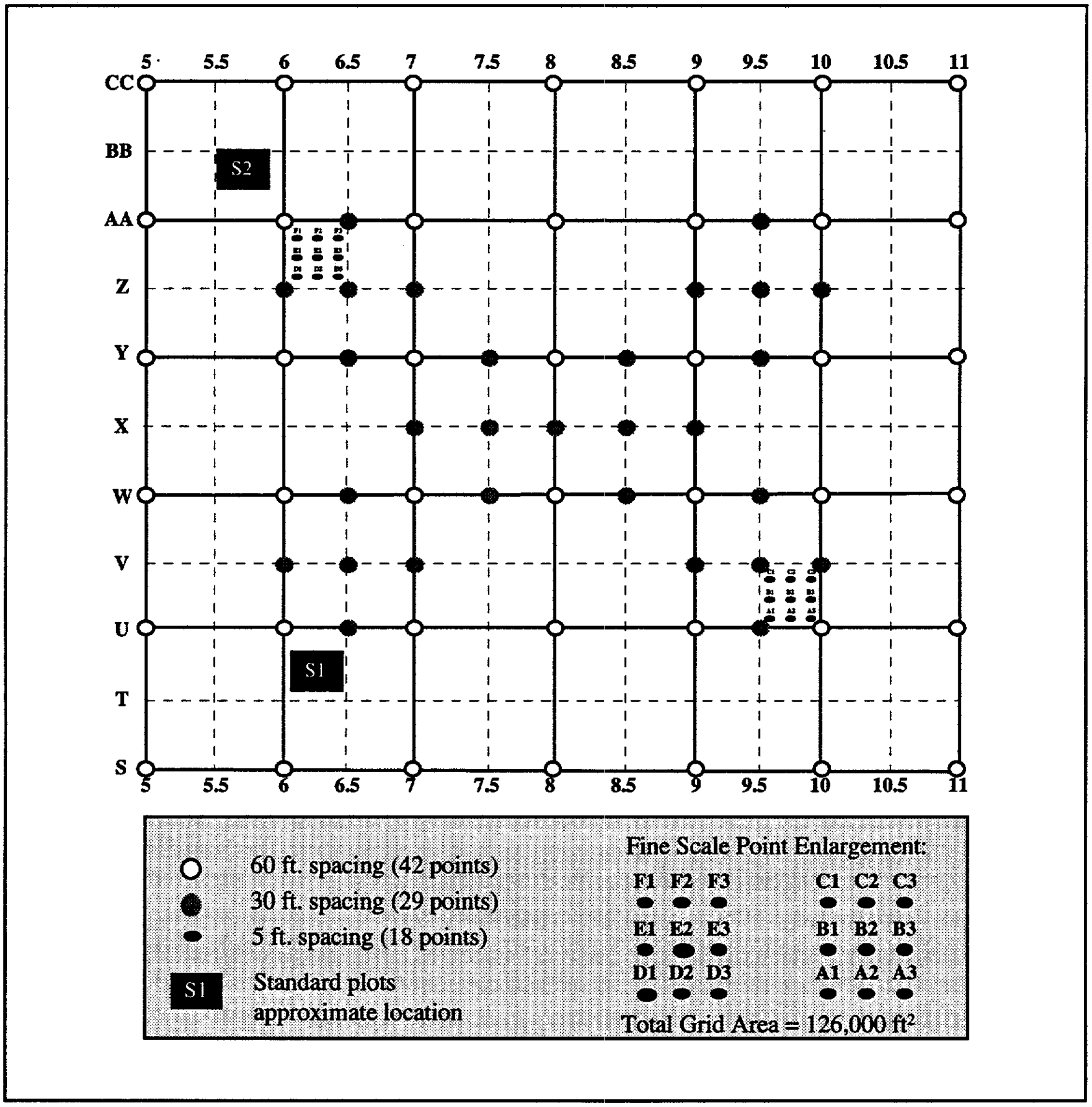


Figure 1.2 Field characterization measurement locations.

The systematic sampling network will be *modified* in the sense that specific spatial scales for sampling need to be examined to define the geostatistical variogram models used to characterize the correlational structure between samples. The number of exploratory measurements required is currently anticipated to 89 over an area approximately 2.9 acres. It is anticipated that a sampling configuration similar to that shown in Figure 1.2 will be used to evaluate each technology at the exploratory level of this study. The results of the geostatistical/decision analysis will guide the collection of any subsequent samples, as required for each technology to complete contaminate characterization of the site.

1.3 Field Data Collection Procedures

Field data will be collected from three separate instrument measurements (calibration of instruments, standards plots measurements and field (grid) measurements) and from field condition readings. Requirements for instrument measurement data collection, including a description of each data field, naming conventions, data units, data precision, and frequency of reporting are in *Appendix A. Specifications and Guidelines for Instrument Measurement Data Collection.*

Calibration bed measurements. First, data are collected during calibration of detectors. Calibration is necessary to improve comparability of data derived by different measurement techniques. Each detector will measure the four calibration bed soils at least three times during the course of the survey - 1) prior to field measurements, 2) after completing the baseline survey, and 3) following completion of the field characterization exercise. Figure 1.2 exhibits the general location of the four calibration beds.

It is very important that we know how the data is converted from the instrument counts to total uranium in pCi/g and how it is converted between total uranium and U-238. All data collected from calibration bed measurements must show formulae for any conversion applied to the raw data.
Field conditions will be recorded at the time calibration plots are measured. The following field condition data will be obtained by FERMCO staff from measurements routinely recorded at the FEMP meteorological tower: temperature, humidity, wind speed, wind direction, and time. Figure 1.3.1 summarizes the frequency of instrument measurements and field condition data associated with each measurement.

Standards plots measurements. The second instrument measurement will be from standards plots measurements recorded twice daily. The standards plots will be used for making repeated detector measurements, thus quantifying detector precision as affected by instrument drift and changing environmental conditions. Figure 1.2 exhibits the general location of the two standards plots.

It is very important that we know how the data is converted from the instrument counts to total uranium in pCi/g and how it is converted between total uranium and U-238. All data collected from standards plots measurements must show formulae for any conversion applied to the raw data.

Field conditions will be recorded at the time standards plots are measured. The following field condition data will be obtained by FERMCO staff from measurements routinely recorded at the FEMP meteorological tower: temperature, humidity, wind speed, wind direction, and time. Figure 1.3.1 summarizes the frequency of instrument measurements and field condition data associated with each measurement.

Field (grid) measurements. The third event where data will be generated is during the field (grid) measurements. Prior to initiation of field data collection a baseline grid will be marked and surveyed consisting of 89 measurement points. Field measurements will be taken on the 89 baseline grid points and will continue to be collected and analyzed until information worth of additional samples is less than cost to collect them.

Figure 1.2 exhibits the layout of the grid points and grid point names.

It is very important that we know how the data is converted from the instrument counts to total uranium in pCi/g and how it is converted between total uranium and U-238. All data collected from field measurements must show formulae for any conversion applied to the raw data.

SUMMARY OF DATA COLLECTION			
Measurement Type	**Data Type**	**Frequency**	**Field Conditions Recorded**
Calibration Beds	CAL	1) Prior to instrument measurements 2) After completing baseline grid measurements 3) At completion of field characterization exercise	Temperature Humidity Wind speed Wind direction Time
Standards Plots	STD	Twice each day	Temperature Humidity Wind speed Wind direction Time
Field (grid) Measurements	FLD	1) Continuously until baseline grid points are measured 2) Follow-on measurements as directed by SNL.	Linked to FEMP Meteor. tower field conditions
Local Field Conditions		Once each day	Grass Height Soil Moisture (qualitative) Precipitation Temperature Humidity Time
Meteor-ological tower field conditions		1) When Calibration Beds are measured 2) When Standards Plots are measured 3) When Local Field Conditions are measured	Temperature Humidity Wind speed Wind direction Time

Figure 1.3.1 Summary of data collection.

Field condition measurements. In addition to field condition data obtained during calibration bed measurements and standards plots measurements, grass height, soil moisture (qualitative), temperature, humidity, and precipitation (over a 24 hour period) will be measured locally at the field characterization site once each day by the Project Engineers. The Project Engineers will compile a list of times that correspond to these measurements so that field condition data can be related to instrument measurements. Figure 1.3.1 summarizes the frequency of instrument measurements and field condition data associated with each measurement. The technology developers are responsible for obtaining calibration plots measurements, standards plots measurements and field (grid) measurements. The Project Engineer is responsible for accurately recording field conditions at the specified intervals. Instrument measurement data and field condition data must be provided to the Field Data Coordinator at the end of each day on 3.25" diskette (high density or double density) in ASCII format and follow all requirements described in Appendix A. The Field Data Coordinator must verify the data files meet the required described in Appendix A. Figures 1.3.2 and 1.3.3 exhibit the data collection templates for instrument measurements and field conditions.

FILE HEADER			
Technology Name:	Radionuclide surface detector	First Measure ID:	RSD004
Submitter's Name:	J. Field	Last Measure ID:	RSD009
Date (MMM/DD/YY)	JUN/05/94	Conversion Formula:	C/71.45

DATA (for each point surveyed)

Measure ID	Measure Type	X Coord. (Easting)	Y Coord. (Northing)	Geo. Location	Raw Data Measure	Raw Units	Total U pCi/g	Conversion Formula	Time
RSD004	CAL			C35	2500.87	C/sec	35.0	Leave	1430
RSD005	FLD	1351466	480300		3278.41	C/sec	45.9	blank	1510
RSD006	FLD			W6	3144.20	C/sec	44.0	unless	1535
RSD007	FLD			Y6	2537.11	C/sec	35.5	differ-	1550
RSD008	FLD			Y6.5	3342.88	C/sec	46.8	ent from	1410
RSD009	STD			S2	3334.76	C/sec	46.7	header	1430
end									

Figure 1.3.2 Instrument measurement data collection template.

FIELD CONDITION DATA

Date:	Grass Height:	Soil Condition:	Precip.

LOCAL SITE FIELD CONDITION DATA

Time	Temp.	Humidity

FEMP METEOROLOGICAL TOWER DATA

Time	Temp.	Humidity	Wind Speed	Wind Direction
1245	69	80	15	NE
1500	78	100		

Figure 1.3.3 Field condition data collection template.

1.4 Data Transfer Procedures

Instrument measurement data will be provided at the end of each day to the Field Data Coordinator in the format specified in Appendix A. The data will then be transferred to Lane Yarrington at SNL via modem by the Field Data Coordinator at the FEMP. The field condition data will be transferred, as a single electronic file, once each week to SNL via modem. The communications software used to transfer the data from the field must be compatible with a 14.4K modem and *QModem Pro* for Windows software. Data will be transferred as follows:

The instrument measurement data and field condition data available at the end of each day will be transferred to Sandia National Laboratories by the Field Data Coordinator. The Sandia host computer will be left in HOST mode (acting as a Bulletin Board Service) so the data can be uploaded from a remote system. The phone number of the transfer host is (505) 848-0682. The login name and password will be provided separately to the Field Data Coordinator. Figure 1.4 exhibits the SNL data transfer HOST mode screen.

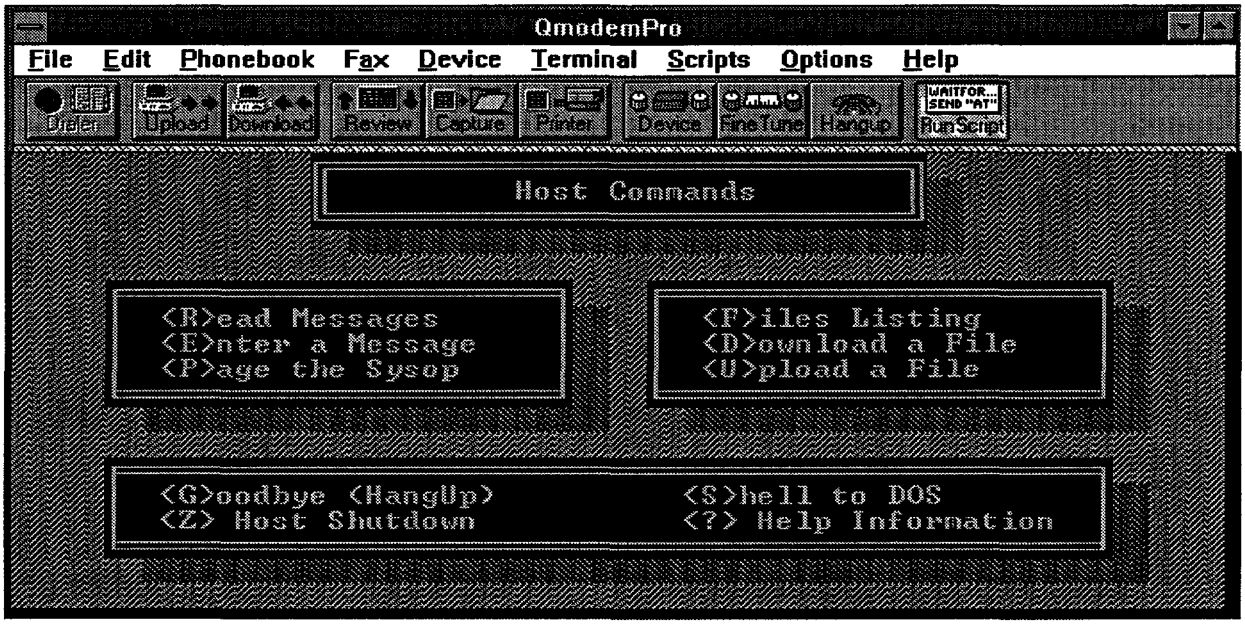


Figure 1.4. Data transfer procedures.

1.4.1 Data Verification Procedures

Once the instrument measurement and field condition data files have been uploaded to the SNL host computer, the data file shall be downloaded from the SNL data transfer host to the Fernald transfer host. An electronic file comparison shall be made using the automated 'packet checking' feature of the transfer communication software to ensure that data is not altered during transmission.

The Field Data Coordinator will provide hardcopies of instrument measurement data to the technology developers on the day following submittal of electronic data (e.g. electronic data submitted Monday will be will be provided in hardcopy format on Tuesday). The technology developers will be asked to sign a duplicate of the hardcopy (to acknowledging receipt of a hardcopy) and return to the Field Data Coordinator.

If the technology developers find discrepancies in the hardcopy data it will be their responsibility to notify the Field Data Coordinator within two working days.

1.4.2 Database Management

All data received from instrument calibrations, standards plots, and field measurements will be entered into *Microsoft ACCESS's* relational database management system. The database is being constructed and customized such that data can be entered, manipulated, updated, and retrieved using buttons, pull-down menus and point-and-click features. The database is being designed as a user-friendly tool making the data easily accessible to analysts, technicians, and managers.

All data required for analyses, visualization, and display will be retrieved from the USID *ACCESS* database. This will ensure data consistency and integrity.

Electronic instrument measurement data and field condition data will be continuously archived throughout the acquisition (instrument measurements and field condition data transferred to SNL), construction (ACCESS database format), and analysis (GSLIB output) processes.

Paper copies of the original instrument measurement and field condition data will be kept on file at the FEMP by the Field Data Coordinator. At the conclusion of the field characterization exercise a paper copy of will be forwarded to SNL by the Field Data Coordinator.

1.5 Geostatistical Analysis and Interpretation

All the geostatistical software packages mentioned earlier require structured ASCII data files, yet data are read without specific format criteria (*i.e. free-format, space delimited*). The basic required database line structure for each sample location, therefore, is as follows: X (easting) Coordinate, Y (northing) Coordinate, and Total U expressed in pCi/g. Figure 1.5 exhibits the required data format. The database may be developed in manner that allows for simple extraction of this data structure.

X Coord	Y Coord	Total U pCi/g
1487256.13	532913.66	45.22
1487456.65	533114.12	100.32
1487567.32	533259.06	103.76

Figure 1.5. Required data format for geostatistical analysis.

There are four field data components that must maintain a high level of precision and accuracy throughout the entire analysis process. First, the coordinate location of the field measurement must be verified and maintained throughout the analysis process. Corruption of this key component would be extremely detrimental due to the spatial emphasis of the analysis procedures. Secondly, the reported field measurements must be reduced to a consistent unit of measurement for direct comparison between sample locations and competing technologies. This plan assumes that all transformations/reductions in the field measurements required to meet these consistencies will be performed by the field technicians and also that these values are accurate, following verification of telecommunication transmission. Thirdly, each sample must be identified by a unique and distinguishing name that will have nomenclature that is conducive to database queries and general visual screening. Finally, if the technology used in sampling cannot be identified through the naming convention, then it must be indicated and maintained as a separate field for each sample collected.

Following the completion of the exploratory sampling for a given technology, sample results will be received and verified via a telecommunication link between the Fernald Site and SNL. Geostatistical analyses will then be performed on the data set.

This approach will typically involve developing univariate summary statistics and probability (histogram) plots from the raw information and evaluating any potential errant or outlier values. The data will then be transformed into normal-scores spaced to guarantee the gaussian (normal) distribution required for stochastic modeling of the areal distribution of contamination.

Depending upon the selected study site, the surficial soil contamination may have an anisotropic component to the spatial correlation of samples. Such characteristics may be attributed to such natural processes as prevailing wind directions or preferential erosional patterns. If this anisotropy is deemed to be significant, it will have to be characterized and incorporated into the spatial correlation (variogram) model for the specific technology under study.

Data analysis will be accomplished using a number of geostatistical software and other specifically developed programs including EPA's GEO-EAS, FSS TOOLBOX, and GSLIB. Following the variogram model development, several stochastic models will be developed to reflect the areal distribution of contamination as defined by the exploratory sampling from the specific technology. Each stochastic model, or realization, will be developed using the Sequential Gaussian Simulation technique contained in the GSLIB software package and each will equally reflects the spatial and statistical attributes of the available data. Because each stochastic model is equiprobable, generating a large number of model outcomes allows for developing a probability frequency in the modeled outcome for any particular unsampled location within the study domain, thereby assessing the uncertainty resulting from the model given the current data representation.

Potentially 3 to 5 stochastic realizations will be mapped with accompanying summary statistics in the form of graphs, tables, and/or plots to provide validation of the simulation model for each technology. The resulting uncertainty assessment provided through post-processing of the stochastic modeling, as previously mentioned, will be used to drive the decision analysis portion of the study and determine the need for additional sampling efforts and their optimal location for collection.

1.6 Performance Assessment/Cost Risk Analysis

As discussed in Section 1.5, the data will be analyzed within a geostatistical framework to ultimately provide maps reflecting uncertainty in the modeling of surficial soil contamination. These maps will then be used in conjunction with decision analysis methodologies to determine optimal selection of additional samples, with the ultimate goal being a reduction in the risk of a wrong interpretation based on limited data.

The geostatistical component of this study requires fundamental statistical data analysis, an exercise in data transformation, and two levels of modeling. Summary statistics from the exploratory sampling information will be developed to evaluate basic behavior of the population characterized by the data. These summaries will reflect such things as the mean, standard deviation, the sample frequency distribution (histogram) and it is behavior (skewness, quartile ranges, etc.). Figure 1.6 exhibits the geostatistical data analysis process flow.

The current intent is to employ a gaussian-related simulation algorithm to provide stochastic modeling of the sample data. This procedure requires that the population described by the data have a normal distribution. This normality will not likely be the case in the raw field data, but a simple transformation (normal-score) can insure the condition. The transformed data will then be subjected to an analysis of their spatial correlation (variography) to determine how the variance between all sample points can be expected to change as a function of their separational distance and direction. This information is analyzed graphically in the form of a variogram and subsequently a linear model is fit to the graph to reflect the variogram behavior.

The parameters that define the variogram model are then used to constrain the stochastic modeling (sequential gaussian simulation) of the areal distribution of contamination. Currently a minimum of 100 simulations are proposed to model "reality" as presented by each competing technology. Each simulation is conditioned to the existing data and provides an equiprobable representation of spatial distribution of contamination.

Following back-transformation of the data, the suite of simulations will be processed to develop an understanding of the probability that any particular location could exceed a pre-determined cutoff (performance) criteria. It is this appreciation of uncertainty that will be used to optimize additional sampling efforts and also provide qualifying information on the performance of the technology via decision analysis methods.

1.7 Data Evaluation and Transfer to FERMCO

Following the evaluation of uncertainty in the exploratory sampling modeling results, additional data may be required by the field technology to complete the interpretation for a desired degree of confidence. In these instances, the SNL Performance Assessment team will direct

FERMCO as to the number and location of any subsequent sampling efforts. Locations for additional sampling will be provided through appropriate coordinates.

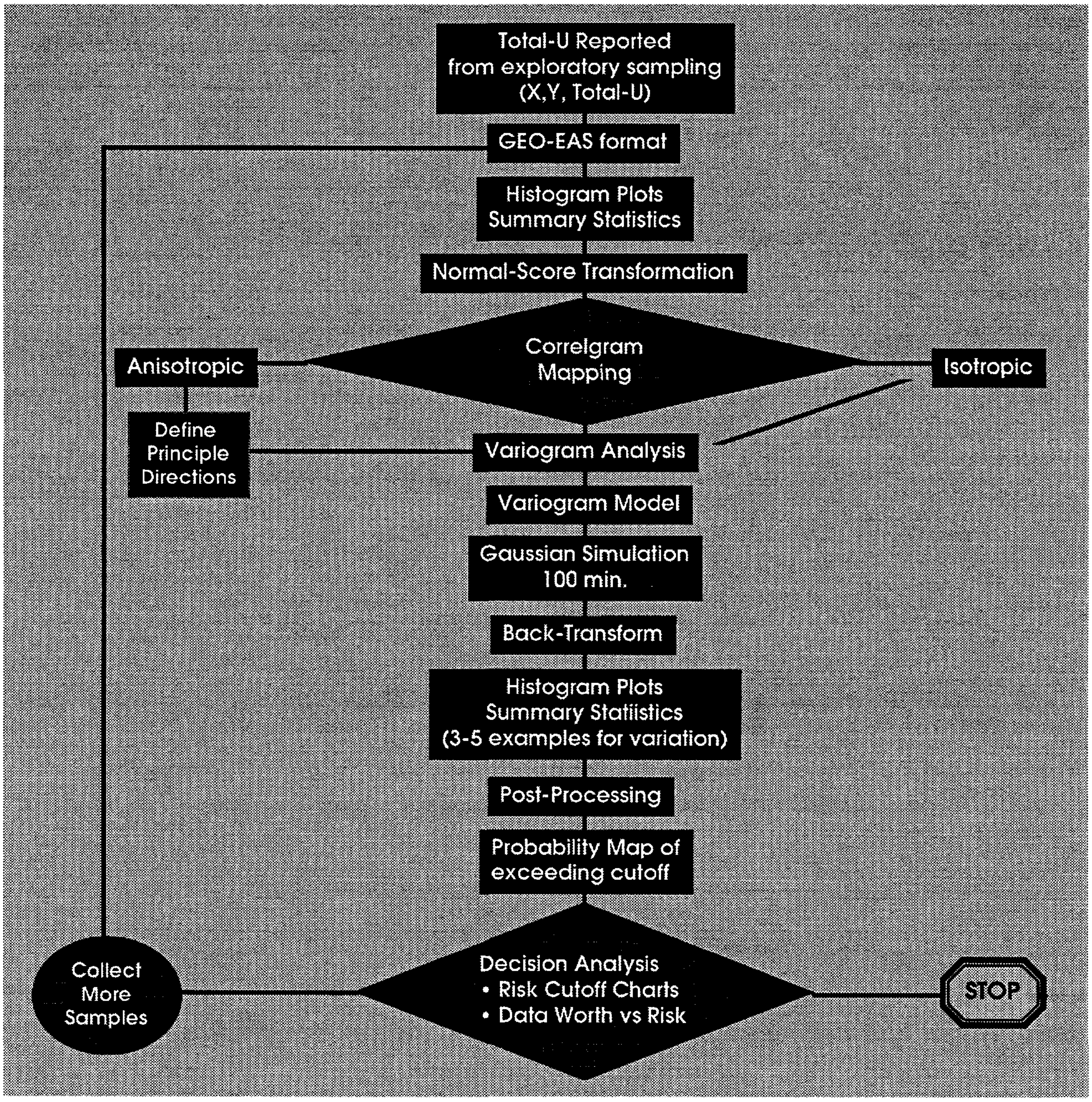


Figure 1.6. Conceptual data analysis process flow.

2.0 Project Organization and Responsibility

The following parties are responsible for the indicated tasks of the Spring 1994 USID Field Characterization program.

• *USID Coordinator - K. Nuhfer*
A FERMCO employee responsible for managing, coordinating and funding the USID.

• *Program Manager - V. Tidwell*
A Sandia National Laboratory member will serve as the principal manager for the USID Field Characterization program. The program manager is responsible for developing and implementing the field sampling and analysis effort. The manager is responsible for preparing the Work Plan which describes technical requirements for the field demonstration.

• *Project Engineers - J. Schwing and K. Pylka*
FERMCO employees who will provide USID Field Characterization engineering support. The Project Engineer will provide full-time on-site support for all field activities including preparation of calibration test beds and standards plots, and engineering/logistic support for all Field Characterization program requirements. The Project Engineer is also responsible for obtaining field condition data and maintaining a field notebook.

• *Field Data Coordinator - R. Chernikoff*
An FEMP employee will be responsible for the coordination of all data acquisition activities. This will include verifying instrument measurement locations, transferring instrument measurement and field condition data to SNL in electronic format, and assuring compliance with procedures outlined in this document and in the *Specifications and Guidelines for Instrument Measurement Data Collection.*

• *Database Management - (D. Beiso, G. Newman)*
The data manager is an SNL contractor responsible for developing and maintaining a data management plan which describes the process flow for the data received from the instrument measurements and field condition measurements. The data manager will develop a relational database repository for the data which will serve as the source for all calculations and analyses of the data.

• *Performance Assessment Analyst (M. Cromer)*
The performance assessment analyst is an SNL contract employee responsible for defining data specifications, ensuring data received from field measurements meets those specifications and for producing simulations of the data using the GSLIB software tools. The analyst is also responsible for data transferal back to the field.

• *Computer Support Engineer (L. Yarrington)*
The computer support engineer is a SNL employee responsible for performance assessment software development (automation) and maintenance, for establishing data transfer and verification procedures, and for establishing data tracking procedures such that information presented in the final report can be traced back to the original field data entry.

• *Computer Visualization Analyst (J. Flinn)*
The computer visualization analyst is a FERMCO employee responsible for generating graphical outputs of analyzed data using Intergraph software tools.

APPENDIX A.
URANIUM IN SOILS INTEGRATED DEMONSTRATION - FIELD CHARACTERIZATION SPECIFICATIONS AND GUIDELINES FOR INSTRUMENT MEASUREMENT DATA

General:

At the end of each day of field characterization the Technology Developers will provide instrument measurement data to the Field Data Coordinator on a DOS formatted 3.5" double or high density diskette. All measurement data for a given day must be included in a single ASCII comma-delimited file containing no hidden or special characters as illustrated in Figure 1.

The ASCII file name will be in accordance with the following convention: A three character technology abbreviation (abbreviation list contained in item #7), three character abbreviation for month, two digit character day, and a ".DAT" file extension. For example, the ASCII data file containing measurement data for the FIDLER survey on June 5 would be named FIDJUN05.DAT. The file name for Figure 1 would be RSDJUN05.DAT.

```
Technology Name: Radionuclide surface detector   First Measure ID:  RSD004
Submitters Name: J. Field                        Last Measure ID:  RSD009
Date: Jun/05/94

RSD004,CAL,,,C35,2500.9,C/sec.,35,C/71.45, 1430
RSD005,FLD,1351466,480300,,3278.4,C/sec.,45.9,C/71.46,1510
RSD006,FLD,,,W6,3144.2,C/sec.,44,C/71.47,1535
RSD007,FLD,,,Y6,2537.1,C/sec.,35.5,C/71.48,1550
RSD008,FLD,,,Y6.5,3342.9,C/sec.,46.8,C/71.49,1410
RSD009,STD,,,S2,3334.8,C/sec.,46.7,C/71.50,1430
end
```

Note: *Insert at least one blank line between header information and data. Blank fields are separated by commas.*

Figure 1. Comma delimited-ASCII data file format.

File Specifications:

The following defines the data items, naming conventions, data units, precision and frequency of reporting required for the instrument measurements data file. Figure 2 illustrates items 1-17 described below.

File Header: Items 1-5

The following information will be provided at the top of each data measurement file.

Field Name	Field Description
1. Technology Name	Name of the instrument from which data is obtained. Be consistent with the technology name, for example, if you chose Gamma-ray spectrometer do not later refer to the instrument as a Gamma spec.
2. Submitter's Name	Name of the individual(s) collecting and submitting data for that day.
3. Data	Date the data was collected in the following format: MMM/DD/YY (ex. MAY, JUN, JUL, AUG)
4. First Measure ID	The Measure ID (using the naming conventions described in item #7) of the first data point measured that day. This information will be used to verify that all information has not been lost.
5. Last Measure ID	The Measure ID using the naming conventions described in item #7) of the last data point measured that day.
6. Conversion Formula	Formula applied to convert raw data into total uranium in pCi/g. If the same formula is used to convert all measurements to Total U (pCi/g/.b) indicate the formula in the header portion of the file. If different formulae are used, provide the formula in column 15 for the corresponding measurement.

Data Point: Items 7-17

The following information will be captured with each instrument measurement.

7. Measure ID

A unique six character identification for each instrument measurement, including calibration plots, standards plots and field (grid) measurements. The naming convention for Measure ID is a three character (alpha) abbreviation of the technology followed by a three character sequential number. For example, the first measurement recorded by the Sodium Iodide Detector would be represented in the Measure ID field as follow: NAD001 followed by NAD002 and so on. Technology abbreviations have been assigned as follows:

ATD - Alpha Track Detector
BET - High Energy Beta Scintillation Sensor
EIC - Electret Ionization Chamber
FID - FIDLER Survey
GMH - In Situ High-Mounted Gamma-Ray Spectrometer
GML - In Situ Low-Mounted Gamma-Ray Spectrometer
ICP - Laser-Ablation, Inductively Coupled Plasma-Atomic Emission Spectrometer

LAB - Laboratory Analysis
LRA - Long Range Alpha Detector
NAD - Sodium Iodide Detector
XRF - X-Ray Fluorescence Detector

Note: Every measurement must have a unique Measure ID in order for the relational database links to be established. Each technology will use sequential numbering for Measure ID beginning with 001. The numbering will continue throughout the course of obtaining filed measurements. (Sequential numbering will no t begin with 001 each day. For example, if the Last Measure ID recorded on Monday is LRA067, the First Measure ID on Tuesday will begin with LRA068.) Therefore it is important to make a note of the Last Measure ID. The Field Data Coordinator is responsible for verifying this has been done correctly.

8. Measure Type

Indicate what type of measurement is being recorded using the following designators:

CAL - Calibration bed measurement. Each detector will measure the four calibration bed soils at least three times during the course of the survey - 1) prior to field measurements, 2) after completing the baseline survey, and 3) following completion of the field data measurements.

STD - Standards plots measurement. Standards plots measurements will be taken twice daily unless field conditions or other factors require additional measurements.

FLD - Field measurement (baseline grid and interstitial)

Note:

Do not include any “mistaken” measurements in the data file.

9. X Coord

NAD-83 Ohio State plane coordinate for the easting value of measurement location. State plane coordinates may be used when measurements are not taken on baseline (pre-assigned) grid locations. Coordinate values should not contain more than two digits after the decimal point.

10. Y Coord

NAD-83 Ohio State plane coordinate for the northing value of measurement location. State plane coordinates may be used when measurements are not taken on baseline (pre-assigned) grid locations. Coordinate values should not contain more than two digits after the decimal point.

11. Geolocation

A naming convention has been established to discriminate between the three measurement types and their pre-defined locations.

Figure 3 illustrates calibration beds, standards plots, and baseline grid measurement locations.

<u>**Calibration bed measurements**</u>
Measurements taken at the four calibration beds will have geolocation designations as follows:

C0 - Measurements from background calibration bed
C35 - Measurements from 35 pCi/g calibration bed
C100 - Measurements from 100 pCi/g calibration bed
C200 - Measurements from 200 pCi/g calibration bed

<u>**Standards plots measurements**</u>

S1 - Measurements from standard plot #1
S2 - Measurements from standard plot #2

<u>**Baseline grid and interstitial measurements**</u>
Measurements from the baseline grid will use the pre-assigned geolocation designations shown in Figure 3. Measurements taken <u>between</u> baseline grid points (that is, locations with no pre-assigned geolocation) record X Coord (as defined in item #9) and Y Coord (as defined in item #10) values instead of geolocation (item #11).

12. Raw Data Measure The measurement values as reported by the instrument prior to any conversions or transformations

13. Raw Units Customary units for the raw data.

14. Total U (pCi/g) Raw data converted to total uranium expressed in pCi/g. Single decimal place precision will be used for reporting total uranium.

15. Conversion Formula Formula applied to convert raw data in to total uranium in pCi/g. If the <u>same</u> formula is used to convert all measurements to Total U (pCi/g) indicate the formula in the header portion of the file. If <u>different</u> formulae are used, provide the formula in column 15 for the corresponding measurement.

16. Time Approximate time that measurement was taken expressed in 24 hour military time units (local Fernald time - EST). Example: 1430 is 2:30 pm.

17. End Text added to the end of the file to verify end of data.

FILE HEADER

Technology Name:	Radionuclide surface detector	First Measure ID:	RSD004
Submitter's Name:	J. Field	Last Measure ID:	RSD009
Date (MMM/DD/YY)	JUN/05/94	Conversion Formula:	C/71.45

DATA (for each point surveyed)

Measure ID	Measure Type	X Coord. (Easting)	Y Coord. (Northing)	Geo. Location	Raw Data Measure	Raw Units	Total U pCi/g	Conversion Formula	Time
RSD004	CAL			C35	2500.87	C/sec	35.0	Leave	1430
RSD005	FLD	1351466	480300		3278.41	C/sec	45.9	blank	1510
RSD006	FLD			W6	3144.20	C/sec	44.0	unless	1535
RSD007	FLD			Y6	2537.11	C/sec	35.5	differ-	1550
RSD008	FLD			Y6.5	3342.88	C/sec	46.8	ent from	1410
RSD009	STD			S2	3334.76	C/sec	46.7	header	1430
end									

Figure 2. Instrument measurement data fields.

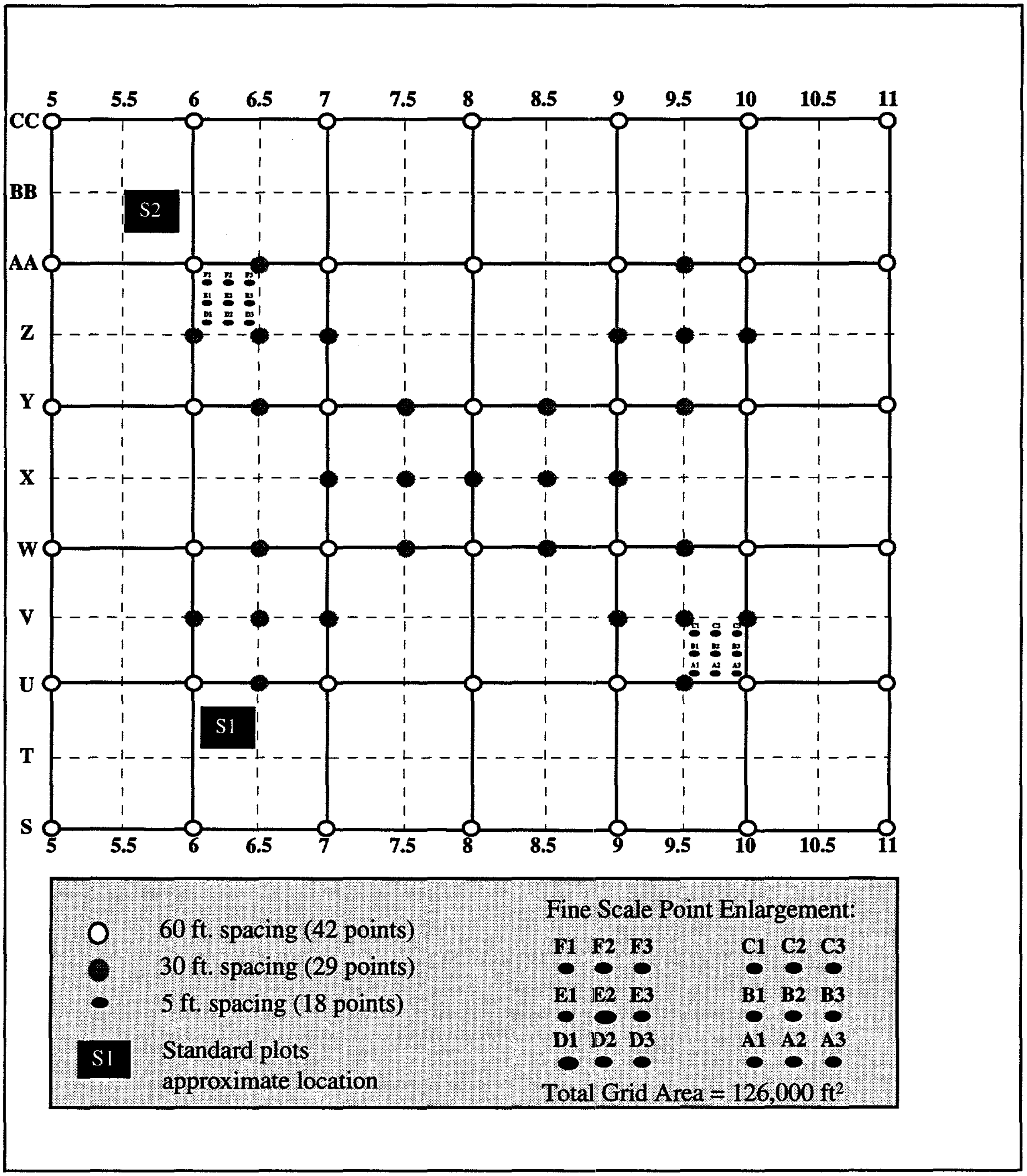


Figure 3. Geolocation references

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Appendix C: Ohio State Plane X-Y Coordinates for Geolocation Grid

Table C-1: Ohio State Plane X-Y Coordinates for Geolocation Grid

[Coordinate values in feet. Leaders (--) not applicable]

Geo Loc	X Coord	Y Coord	Geo Loc	X Coord	Y Coord	Geo Loc	X Coord	Y Coord	Geo Loc	X Coord	Y Coord
A1	1351748.16	480363.18	D1	1351542.09	480518.53	V6	1351528.87	480393.83	Y7	1351591.04	480477.26
A2	1351753.15	480363.05	D2	1351547.09	480518.40	V6.5	1351559.12	480403.06	Y7.5	1351621.03	480476.49
A3	1351758.15	480362.92	D3	1351552.09	480518.28	V7	1351588.72	480386.29	Y8	1351651.02	480475.71
AA5	1351472.63	480540.33	E1	1351542.22	480523.53	V9	1351708.68	480384.20	Y8.5	1351681.01	480474.94
AA6	1351532.61	480538.78	E2	1351547.22	480523.40	V9.5	1351738.67	480383.43	Y9	1351711.00	480474.17
AA6.5	1351562.60	480538.01	E3	1351552.21	480523.27	V10	1351768.66	480382.65	Y9.5	1351725.00	480473.81
AA7	1351592.59	480537.24	F1	1351542.35	480528.53	W5	1351469.54	480420.37	Y10	1351770.98	480472.62
AA8	1351652.57	480535.69	F2	1351547.34	480528.40	W6	1351529.52	480418.82	Y11	1351830.96	480471.08
AA9	1351712.55	480534.15	F3	1351552.34	480528.27	W6.5	1351559.51	480418.05	Z6	1351531.83	480508.79
AA9.5	1351742.54	480533.38	S5	1351466.45	480300.41	W7	1351589.50	480417.28	Z6.5	1351561.82	480508.02
AA10	1351759.53	480532.94	S6	1351526.43	480298.86	W7.5	1351619.56	480419.51	Z7	1351591.81	480507.25
AA11	1351832.51	480531.06	S7	1351586.41	480297.32	W8	1351649.81	480428.73	Z9	1351711.77	480504.16
B1	1351748.29	480368.17	S8	1351646.39	480295.77	W8.5	1351679.08	480399.97	Z9.5	1351741.76	480503.39
B2	1351753.28	480368.05	S9	1351706.37	480294.23	W9	1351709.41	480412.19	Z10	1351786.75	480502.23
B3	1351758.28	480367.92	S10	1351766.35	480292.68	W9.5	1351739.45	480413.42	--	--	--
C1	1351748.41	480373.17	S11	1351826.33	480291.14	W10	1351769.44	480412.64	--	--	--
C2	1351753.41	480373.04	U5	1351468.12	480365.39	W11	1351829.42	480411.10	--	--	--
C3	1351758.41	480372.91	U6	1351527.84	480353.85	X7	1351590.27	480447.27	--	--	--
CC5	1351474.17	480600.31	U6.5	1351557.96	480358.07	X7.5	1351620.26	480446.50	--	--	--
CC6	1351534.15	480598.76	U7	1351588.06	480361.30	X8	1351650.25	480445.72	--	--	--
CC7	1351594.13	480597.22	U8	1351648.19	480365.75	X8.5	1351680.24	480444.95	--	--	--
CC8	1351654.11	480595.67	U9	1351707.91	480354.21	X9	1351710.56	480457.17	--	--	--
CC9	1351714.09	480594.13	U9.5	1351737.90	480353.44	Y5	1351471.08	480480.35	--	--	--
CC10	1351774.07	480592.58	U10	1351767.89	480352.66	Y6	1351531.06	480478.80	--	--	--
CC11	1351834.05	480591.04	U11	1351827.87	480351.12	Y6.5	1351561.05	480478.03	--	--	--

Appendix D: Meteorologic Data

Table D-1: Meterologic Data for 1994 Fernald Field Characterization Demonstration Program

[EDT: Eastern Daylight Time; EST: Eastern Standard Time; est.: estimated; mph: miles per hour]

Date	LOCAL					TOWER							Weather/Cloud Height (100's ft.)
	Total Precipitation (inches)	Time (EDT)	Temperature (ºC)	Humidity (est. %)	Wind Speed (est. mph)	Time (EST)	Time (EDT)	Total Precipitation (inches)	Temperature (ºC)	Humidity (%)	Wind Speed (mph)	Wind Direction (from azimuth, º)	
05/01/94	0.00							0.00					
05/02/94	0.00	14:10	14.0	48	5	13:10	14:10	0.00	13.5	49	3.4	34	50 Sct 250 Sct
05/03/94	0.05	13:18	12.1	57	4	12:15	13:15	0.04	11.8	53	7.4	69	Vry lgt. rain; 35 Sct 60 Ovc
05/04/94	0.00	14:20	13.3	72	4	13:20	14:20	0.00	13.1	73	7.0		50 Ovc
05/05/94	0.00	07:55	6.8	100	3	07:00	08:00	0.00	6.2	100	2.1	267	Heavy fog w/ .13 mi visibility
05/06/94	0.28	07:49	11.0	98	1	06:49	07:49	0.27	10.8	100	2.7	349	Lgt. rain
05/07/94	1.05							1.03					
05/08/94	0.00							0.00					
05/09/94	0.00							0.00					
05/10/94	0.00	13:23	18.6	36	4	12:23	13:23	0.00	18.5	37	5.0	354	50 Sct
05/11/94	0.13	14:05	22.8	36	6	13:05	14:05	0.12	22.0	33	9.6	221	120 Sct 250 Bkn
05/12/94	0.05	09:08	13.3	66	7	08:08	09:08	0.04	12.9	70	4.8	298	60 Sct 250 Sct
05/13/94	0.00	14:48	20.8	35	5	14:00	15:00	0.00	19.6	39	5.0	95	60 Sct 200 Sct
05/14/94	0.35							0.37					
05/15/94	0.29							0.31					
05/16/94	0.00	11:00	16.6	74	6	10:00	11:00	0.00	15.6	65	11.2	323	45 Sct
05/17/94	0.00	13:45	18.5	57	9	12:45	13:45	0.00	17.3	49	10.9	29	
05/18/94	0.00	15:22	18.7	34	11	14:22	15:22	0.00	17.8	34	14.0	8	60 Sct
05/19/94	0.00	13:35	17.9	53	3	12:35	13:35	0.00	17.2	48	6.5	46	60 Sct
05/20/94	0.00	13:49	21.0	46	6	12:49	13:49	0.00	20.0	39	6.8	21	60 Sct 250 Sct
05/21/94	0.00							0.00					
05/22/94	0.00							0.00					
05/23/94	0.00	09:52	23.3	56	1	08:50	09:50	0.00	22.5	58	2.3	308	120 Sct
05/24/94	0.00	13:22	28.5	50	8.5	12:22	13:22	0.00	27.9	48	9.8	240	”60 Sct 200 Sct 250 -Bkn
05/25/94	0.08	13:25	25.7	52	4	12:54	13:54	0.08	24.7	53	7.5	250	60 Sct 120 Sct

Table D-1: Meterologic Data for 1994 Fernald Field Characterization Demonstration Program (continued)

[EDT: Eastern Daylight Time; EST: Eastern Standard Time; est.: estimated; mph: miles per hour]

Date	LOCAL					TOWER							Weather/Cloud Height (100's ft.)
	Total Precipitation (inches)	Time (EDT)	Temperature (°C)	Humidity (est. %)	Wind Speed (est. mph)	Time (EST)	Time (EDT)	Total Precipitation (inches)	Temperature (°C)	Humidity (%)	Wind Speed (mph)	Wind Direction (from azimuth, °)	
05/26/94	0.02							0.02					
05/27/94	0.00	08:25	9.3	67	6	07:25	08:25	0.00	8.3	65	7.9	31	60 Sct
05/28/94	0.00							0.00					
05/29/94	0.00							0.00					
05/30/94	0.00							0.00					
05/31/94	0.00	09:50				08:45	09:45	0.00	23.4	67	5.5	232	
05/31/94		10:14				9:00	10:00		23.7	65	7.5	219	
05/31/94		10:27				09:30	10:30		24.6	61	7.9	217	
05/31/94		13:20	28	46	8.5	12:20	13:20		27.9	44			
06/01/94	0.00	08:50				07:45	08:45	0.00	20.2	58	4.0	304	
06/01/94		08:59											
06/01/94		09:54				08:45	09:45		22.8	43	7.0	331	
06/01/94		10:01				09:00	10:00		22.9	40	6.5	325	
06/01/94		10:16				09:15	10:15		23.4	39	7.3	327	
06/01/94		10:27											
06/01/94		10:50				09:45	10:45		23.7	37	7.9	318	
06/01/94		10:57											
06/01/94		13:00				12:00	13:00		25.5	33	7.5	278	
06/01/94		13:17				12:15	13:15		25.5	32	8.9	287	
06/01/94		13:26											
06/01/94		13:31				12:30	13:30		25.5	31	10.5	304	
06/01/94		13:36											
06/01/94		13:39											
06/02/94	0.00	08:08				07:00	08:00	0.00	13.2	43	4.1	6	
06/02/94		08:10											

Table D-1: Meterologic Data for 1994 Fernald Field Characterization Demonstration Program (continued)

[EDT: Eastern Daylight Time; EST: Eastern Standard Time; est.: estimated; mph: miles per hour]

Date	LOCAL					TOWER							Weather/Cloud Height (100's ft.)
	Total Precipitation (inches)	Time (EDT)	Temperature (°C)	Humidity (est. %)	Wind Speed (est. mph)	Time (EST)	Time (EDT)	Total Precipitation (inches)	Temperature (°C)	Humidity (%)	Wind Speed (mph)	Wind Direction (from azimuth, °)	
06/02/94		08:14											
06/02/94		08:16				07:15	08:15		13.5	43	4.9	6	
06/02/94		08:19											
06/02/94		08:22											
06/02/94		08:24											
06/02/94		08:27											
06/02/94		08:29											
06/02/94		08:31				07:30	08:30		13.4	43	5.3	0	
06/02/94		09:00				08:00	09:00		13.6	43	4.9	359	
06/02/94		09:05											
06/02/94		13:21				12:15	13:15		16.9	33	5.1	9	
06/02/94		13:24											
06/03/94	0.00	09:50				08:45	09:45	0.00	17.3	55	4.2	74	
06/03/94		10:06				09:00	10:00		17.8	53	4.2	53	
06/03/94		10:16				09:15	10:15		18.5	49	4.1	66	
06/03/94		10:34				09:30	10:30		19.0	45	4.5	67	
06/03/94		10:46				09:45	10:45		19.5	41	5.6	83	
06/03/94		11:07				10:00	11:00		19.8	39	5.9	67	
06/03/94		13:21				12:15	13:15		21.7	33	5.7	27	
06/03/94		13:36	22.2	39	2	12:36	13:36		22.4	36			
06/03/94		14:51				13:45	14:45		22.6	32	4.9	67	
06/04/94	0.00							0.00					
06/05/94	0.00							0.00					
06/06/94	0.62	09:30				08:30	09:30	0.65	24.2	77	6.3	203	
06/06/94		09:45				08:45	09:45		24.6	77	6.5	202	

Table D-1: Meterologic Data for 1994 Fernald Field Characterization Demonstration Program (continued)

[EDT: Eastern Daylight Time; EST: Eastern Standard Time; est.: estimated; mph: miles per hour]

Date	LOCAL					TOWER							Weather/Cloud Height (100's ft.)
	Total Precipitation (inches)	Time (EDT)	Temperature (°C)	Humidity (est. %)	Wind Speed (est. mph)	Time (EST)	Time (EDT)	Total Precipitation (inches)	Temperature (°C)	Humidity (%)	Wind Speed (mph)	Wind Direction (from azimuth, °)	
06/06/94		10:28				09:15	10:15		25.2	75	7.4	199	
06/06/94		10:30				09:30	10:30		25.8	73	7.1	202	
06/06/94		11:16				10:15	11:15		27.1	70	7.2	198	
06/06/94		11:28											
06/06/94		13:28				12:15	13:15		29.2	62	8.1	196	
06/06/94		13:31				12:30	13:30		29.6	61	8.8	204	
06/06/94		13:40											
06/06/94		13:55				12:45	13:45		29.5	61	8.5	203	
06/06/94		14:01				13:00	14:00		29.6	60	9.5	201	
06/07/94	0.00	09:50	24.4	84	2.5	08:54	09:54	0.00	23.8	88	4.0	341	-X 250 -Bkn Haze
06/07/94		10:49				09:45	10:45		24.7	85	1.6	16	
06/07/94		11:30				10:30	11:30		26.2	79	3.1	86	
06/07/94		12:02				11:00	12:00		26.9	75	1.7	69	
06/08/94	0.01	08:55				07:45	08:45	0.01	15.8	84	7.9	16	
06/08/94		09:10				08:00	09:00		16.0	83	10.4	30	
06/08/94		09:29				08:15	09:15		16.2	83	10.5	33	
06/08/94		14:40				13:30	14:30		21.0	63	9.9	54	
06/08/94		14:43											
06/08/94		18:11				17:00	18:00		19.4	69	7.9	51	
06/08/94		18:23				17:15	18:15		19.2	69	7.3	65	
06/09/94	0.02	09:16				08:15	09:15	0.02	14.9	69	6.2	60	
06/09/94		09:32				08:30	09:30		15.0	69	4.9	44	
06/09/94		09:46				08:45	09:45		15.3	68	7.2	66	
06/09/94		09:58											
06/09/94		10:45	16.9	67	2.5	09:45	10:45		16.6	66	5.6	61	100 Bkn

Table D-1: Meterologic Data for 1994 Fernald Field Characterization Demonstration Program (continued)

[EDT: Eastern Daylight Time; EST: Eastern Standard Time; est.: estimated; mph: miles per hour]

Date	LOCAL					TOWER							Weather/Cloud Height (100's ft.)
	Total Precipitation (inches)	Time (EDT)	Temperature (°C)	Humidity (est. %)	Wind Speed (est. mph)	Time (EST)	Time (EDT)	Total Precipitation (inches)	Temperature (°C)	Humidity (%)	Wind Speed (mph)	Wind Direction (from azimuth, °)	
06/09/94		10:47											
06/09/94		11:07				10:00	11:00		17.0	64	7.1	56	
06/09/94		14:00				13:00	14:00		22.6	55	4.8	78	
06/09/94		14:10											
06/09/94		14:12											
06/09/94		14:16				13:15	14:15		22.5	55	3.0	42	
06/09/94		14:25											
06/09/94		18:30				17:30	18:30		25.0	48	4.3	41	
06/09/94		18:45				17:45	18:45		24.8	49	3.2	68	
06/10/94	0.00	09:22				08:15	09:15	0.00	19.2	54	3.8	59	
06/10/94		09:34				08:30	09:30		20.0	51	4.0	56	
06/10/94		09:36											
06/10/94		09:48				08:45	09:45		20.5	50	4.1	54	
06/10/94		09:50											
06/10/94		09:56											
06/10/94		09:58											
06/10/94		10:04				09:00	10:00		20.8	49	4.2	72	
06/10/94		10:13											
06/10/94		10:15				09:15	10:15		21.4	50	3.7	76	
06/10/94		10:17											
06/10/94		10:20											
06/10/94		10:26											
06/10/94		10:28											
06/10/94		10:30				09:30	10:30		22.0	48	3.5	91	
06/10/94		10:31											

Table D-1: Meterologic Data for 1994 Fernald Field Characterization Demonstration Program (continued)

[EDT: Eastern Daylight Time; EST: Eastern Standard Time; est.: estimated; mph: miles per hour]

Date	LOCAL					TOWER							Weather/Cloud Height (100's ft.)
	Total Precipitation (inches)	Time (EDT)	Temperature (°C)	Humidity (est. %)	Wind Speed (est. mph)	Time (EST)	Time (EDT)	Total Precipitation (inches)	Temperature (°C)	Humidity (%)	Wind Speed (mph)	Wind Direction (from azimuth, °)	
06/10/94		10:34											
06/10/94		10:36											
06/10/94		10:40											
06/10/94		10:42											
06/10/94		10:45				09:45	10:45		22.5	48	3.6	86	
06/10/94		10:47											
06/10/94		10:49											
06/10/94		10:53											
06/10/94		10:56											
06/10/94		10:58											
06/10/94		11:01				10:00	11:00		22.8	48	3.4	43	
06/10/94		11:03											
06/10/94		13:50	27.6	34	0.0	12:50	13:50		26.8	32	3.5	220	60 Sct 100 Sct 250 Sct
06/10/94		14:00				13:00	14:00		26.7	28	4.4	308	
06/10/94		14:15				13:15	14:15		26.7	29	5.0	341	
06/13/94	0.04	13:13				12:00	13:00	0.04	30	61	8.8	203	
06/13/94		13:30				12:30	13:30		30.3	61	12.2	185	
06/13/94		14:35				13:30	14:30		31.1	56	10.5	213	
06/13/94		16:08				15:00	16:00		31.1	55	10	200	
06/13/94		16:28				15:15	16:15		31.3	54	9.6	210	
06/14/94	0.00	09:37				08:30	09:30	0.00	25.2	85	7.5	202	
06/14/94		09:46				08:45	09:45		25.7	84	6.5	206	
06/14/94		10:11				09:00	10:00		25.7	84	7.2	187	
06/14/94		10:12											
06/14/94		12:56				11:45	12:45		29.3	72	6.1	201	

Table D-1: Meterologic Data for 1994 Fernald Field Characterization Demonstration Program (continued)

[EDT: Eastern Daylight Time; EST: Eastern Standard Time; est.: estimated; mph: miles per hour]

Date	LOCAL					TOWER							Weather/Cloud Height (100's ft.)
	Total Precipitation (inches)	Time (EDT)	Temperature (°C)	Humidity (est. %)	Wind Speed (est. mph)	Time (EST)	Time (EDT)	Total Precipitation (inches)	Temperature (°C)	Humidity (%)	Wind Speed (mph)	Wind Direction (from azimuth, °)	
06/14/94		13:08				12:00	13:00		29.4	74	6.5	181	
06/14/94		13:38				12:30	13:30		30.1	71	5.9	179	
06/14/94		13:55				12:45	13:45		30.5	68	6.6	194	
06/15/94	0.00	09:24				08:15	09:15	0.00	26.3	83	4.0	257	
06/15/94		09:38				08:30	09:30		26.8	81	3.9	238	
06/15/94		10:46				09:45	10:45		29.3	71	3	235	
06/15/94		11:01				10:00	11:00		29.7	69	3.9	233	
06/15/94		11:33				10:30	11:30		30.1	65	5.6	276	
06/15/94		11:44											
06/15/94		14:53				13:45	14:45		32.8	54	4.1	187	
06/15/94		15:08				14:00	15:00		32.7	53	3.9	176	
06/15/94		15:23				14:15	15:15		32.8	55	3.9	205	
06/15/94		15:41				14:30	15:30		33.3	53	4.5	171	
06/15/94		16:22				15:15	16:15		33.4	49	2.9	183	
06/16/94	0.01	09:00				08:00	09:00	0.01	24.5	89	0.7	249	
06/16/94		09:15				08:15	09:15		25.2	86	1.7	237	
06/16/94		09:20				08:15	09:15		25.2	86	1.7	237	
06/16/94		09:22											
06/16/94		09:24											
06/16/94		09:32				08:30	09:30		25.8	85	1.5	192	
06/16/94		09:34											
06/16/94		09:38											
06/16/94		11:25				10:15	11:15		23.8	83	11.1	123	
06/16/94		11:44				10:30	11:30		23.5	83	8.4	112	
06/16/94		15:15				14:15	15:15		30.8	50	4.1	184	

Table D-1: Meterologic Data for 1994 Fernald Field Characterization Demonstration Program (continued)

[EDT: Eastern Daylight Time; EST: Eastern Standard Time; est.: estimated; mph: miles per hour]

Date	LOCAL					TOWER							Weather/Cloud Height (100's ft.)
	Total Precipitation (inches)	Time (EDT)	Temperature (°C)	Humidity (est. %)	Wind Speed (est. mph)	Time (EST)	Time (EDT)	Total Precipitation (inches)	Temperature (°C)	Humidity (%)	Wind Speed (mph)	Wind Direction (from azimuth, °)	
06/16/94		15:17											
06/16/94		15:23											
06/16/94		15:25											
06/23/94	0.08	10:37				09:30	10:30	0.08	27.0	80	2.9	197	
06/23/94		10:42											
06/23/94		11:47				10:45	11:45		29.8	69	7.0	189	
06/23/94		11:51											
06/23/94		11:56											
06/23/94		11:58											
06/23/94		12:02				11:00	12:00		30.2	67	6.8	196	
06/23/94		12:04											
06/23/94		12:07											
06/23/94		12:09											
06/28/94	0.00	09:52				08:45	09:45	0.00	20.8	86	1.2	212	
06/28/94		10:04				09:00	10:00		22.1	83	2.5	219	
06/28/94		10:17				09:15	10:15		22.9	81	3.3	208	
06/28/94		10:26											
06/28/94		10:35				09:30	10:30		23.6	79	2.8	213	
06/28/94		10:45				09:45	10:45		24.2	75	4.1	212	
06/28/94		11:04				10:00	11:00		24.6	74	4.7	214	
06/28/94		11:13											
06/28/94		11:22				10:15	11:15		25.1	71	5.8	223	
06/28/94		11:44				10:30	11:30		25.0	73	5.4	223	
06/29/94	0.01	09:13				08:00	09:00	0.01	24.3	68	6.9	240	
06/29/94		09:22				08:15	09:15		24.6	67	7.1	237	

Table D-1: Meterologic Data for 1994 Fernald Field Characterization Demonstration Program (continued)

[EDT: Eastern Daylight Time; EST: Eastern Standard Time; est.: estimated; mph: miles per hour]

Date	LOCAL					TOWER							Weather/Cloud Height (100's ft.)
	Total Precipitation (inches)	Time (EDT)	Temperature (°C)	Humidity (est. %)	Wind Speed (est. mph)	Time (EST)	Time (EDT)	Total Precipitation (inches)	Temperature (°C)	Humidity (%)	Wind Speed (mph)	Wind Direction (from azimuth, °)	
06/29/94		09:32				08:30	09:30		25.0	65	7.4	235	
06/29/94		09:41											
06/29/94		09:53				08:45	09:45		25.2	64	8.3	240	
06/29/94		10:02				09:00	10:00		25.4	63	8.0	241	
06/29/94		10:11											
06/29/94		10:23				09:15	10:15		25.6	61	7.9	252	
06/29/94		10:32				09:30	10:30		26.0	60	8.2	231	
06/29/94		10:40											
07/07/94	0.00	13:30				12:30	13:30	0.00	30.6	57	5.2	211	
07/07/94		13:50				12:45	13:45		30.7	58	6.2	216	
07/07/94		14:15				13:15	14:15		30.9	58	6.7	210	
07/07/94		14:35				13:30	14:30		30.9	57	5.7	183	
07/07/94		15:00				14:00	15:00		31.2	59	5.6	169	
07/07/94		15:15				14:15	15:15		31.2	57	6.5	182	
07/07/94		15:35				14:30	15:30		31.0	58	4.9	209	
07/07/94		15:50				14:45	15:45		31.1	58	5.9	200	
07/07/94		17:25				16:15	17:15		30.4	65	3.7	203	
07/07/94		19:49				18:45	19:45		30.2	68	2.1	181	
07/08/94	0.41	08:56				07:45	08:45	0.38	24.4	83	7.2	201	
07/08/94		09:36				08:30	09:30		24.3	85	7.7	212	
07/08/94		16:06				15:00	16:00		29.5	70	9.0	188	
07/09/94	0.00	09:06				08:00	09:00	0.00	21.0	76	3.4	299	
07/09/94		09:31				08:30	09:30		21.3	73	3.5	274	
07/09/94		09:57				08:45	09:45		21.3	74	3.2	263	
07/09/94		10:21				09:15	10:15		22.1	71	3.1	243	

Table D-1: Meterologic Data for 1994 Fernald Field Characterization Demonstration Program (continued)

[EDT: Eastern Daylight Time; EST: Eastern Standard Time; est.: estimated; mph: miles per hour]

Date	LOCAL					TOWER							Weather/Cloud Height (100's ft.)
	Total Precipitation (inches)	Time (EDT)	Temperature (°C)	Humidity (est. %)	Wind Speed (est. mph)	Time (EST)	Time (EDT)	Total Precipitation (inches)	Temperature (°C)	Humidity (%)	Wind Speed (mph)	Wind Direction (from azimuth, °)	
07/09/94		11:13				10:00	11:00		23.2	64	5.4	242	
07/09/94		12:21				11:15	12:15		24.8	67	6.3	234	
07/09/94		15:48				14:45	15:45		26.6	56	8.9	253	
07/09/94		16:06				15:00	16:00		26.6	56	7.4	265	
07/09/94		17:35				16:30	17:30		26.6	52	8.3	256	
07/09/94		17:57				16:45	17:45		26.1	55	6.8	256	
07/09/94		19:43				18:30	19:30		25.2	59	4.6	246	
07/09/94		20:02				15:30	16:30		24.6	64	2.4	235	
07/10/94	0.00	11:25				10:15	11:15	0.00	22.5	67	5.5	315	
07/10/94		12:00				11:00	12:00		23.2	63	5.6	324	
07/10/94		12:31				11:30	12:30		23.1	60	6.1	321	
07/10/94		13:00				12:00	13:00		23.1	61	6.3	312	
07/10/94		16:15				15:15	16:15		24.2	53	6.7	311	
07/10/94		16:35				15:30	16:30		24.2	53	7.2	337	
07/11/94	0.00	09:30				08:30	09:30	0.00	18.7	79	2.6	75	
07/11/94		10:08				09:00	10:00		20.2	75	2.0	51	
07/11/94		16:34				15:30	16:30		26.2	49	5.4	264	
07/11/94		17:01				16:00	17:00		26.6	48	2.3	264	
07/11/94		18:21				17:15	18:15		26.5	47	2.9	278	
07/11/94		18:48				17:45	18:45		26.8	46	1.9	217	
07/12/94	0.00	09:54				08:45	09:45	0.00	22.5	79	2.6	189	
07/12/94		10:00				09:00	10:00		23.6	75	2.0	159	
07/12/94		10:20				09:15	10:15		24.2	72	3.2	206	
07/12/94		10:27											
07/12/94		19:28				18:15	19:15		29.1	45	2.5	221	

Table D-1: Meterologic Data for 1994 Fernald Field Characterization Demonstration Program (continued)

[EDT: Eastern Daylight Time; EST: Eastern Standard Time; est.: estimated; mph: miles per hour]

Date	LOCAL					TOWER							Weather/Cloud Height (100's ft.)
	Total Precipitation (inches)	Time (EDT)	Temperature (°C)	Humidity (est. %)	Wind Speed (est. mph)	Time (EST)	Time (EDT)	Total Precipitation (inches)	Temperature (°C)	Humidity (%)	Wind Speed (mph)	Wind Direction (from azimuth, °)	
07/12/94		19:50				18:45	19:45		28.5	67	1.1	258	
07/12/94		19:56											
07/13/94	2.40	08:51				07:45	08:45	2.72	22.7	91	2.0	230	
07/13/94		08:55											
07/13/94		09:38				08:30	09:30		25.1	83	6.1	182	
07/13/94		09:43											
07/14/94	0.11	12:07				11:00	12:00	0.11	25.9	88	4.8	196	
07/16/94	0.00	11:04				10:00	11:00	0.00	23.6	72	4.6	34	
07/16/94		11:15				10:15	11:15		23.9	68	4.6	55	
07/16/94		11:35				10:30	11:30		24.2	68	4.6	92	
07/16/94		11:39											
07/16/94		12:50				11:45	12:45		25.4	63	2.9	93	
07/16/94		13:07				12:00	13:00		25.7	62	3.3	140	
07/16/94		15:19				14:15	15:15		26.6	51	3.2	287	
07/16/94		15:30				14:30	15:30		26.8	52	3.6	323	
07/16/94		15:42											
07/16/94		16:25				15:15	16:15		26.6	55	4.1	294	
07/16/94		16:45				15:45	16:45		27.0	49	3.7	295	
07/16/94		17:00				16:00	17:00		27.2	47	1.8	11	
07/16/94		19:21				18:15	19:15		26.7	57	3.3	338	
07/16/94		19:33				18:30	19:30		26.3	66	2.6	325	
07/17/94	0.10	09:07				08:00	09:00	0.09	20.4	93	2.0	81	
07/17/94		09:19				08:15	09:15		20.7	91	1.2	4	
07/17/94		12:26				11:15	12:15		25.8	78	3.7	205	
07/17/94		12:43				11:30	12:30		26.0	78	2.5	203	

Table D-1: Meterologic Data for 1994 Fernald Field Characterization Demonstration Program (continued)

[EDT: Eastern Daylight Time; EST: Eastern Standard Time; est.: estimated; mph: miles per hour]

Date	LOCAL					TOWER							Weather/Cloud Height (100's ft.)
	Total Precipitation (inches)	Time (EDT)	Temperature (°C)	Humidity (est. %)	Wind Speed (est. mph)	Time (EST)	Time (EDT)	Total Precipitation (inches)	Temperature (°C)	Humidity (%)	Wind Speed (mph)	Wind Direction (from azimuth, °)	
07/17/94		19:02				18:00	19:00		27.5	76	3.9	224	
07/18/94	0.00	11:12				10:00	11:00	0.00	26.0	68	5.5	310	
07/18/94		11:31				10:30	11:30		26.5	61	5.3	303	
07/18/94		14:31				13:30	14:30		28.6	54	3.7	227	
07/18/94		14:43											
07/18/94		15:05				14:00	15:00		28.3	52	5.0	307	
07/18/94		15:17				14:15	15:15		28.6	50	4.4	274	
07/18/94		15:28											
07/19/94	0.00	09:04				08:00	09:00	0.00	20.8	88	1.9	101	
07/19/94		09:12											
07/19/94		09:16				08:15	09:15		21.9	83	1.3	108	
07/19/94		09:21											
07/19/94		09:29											
07/19/94		13:39				12:30	13:30		30.3	56	4.7	162	
07/19/94		13:50				12:45	13:45		30.3	55	4.8	178	
07/19/94		14:01				13:00	14:00		30.6	56	4.5	195	
07/19/94		15:00				14:00	14:10		30.6	56	5.3	233	

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Appendix E: Calibration Data

Table E-1: Calibration Measurements for Alternative Characterization Technologies

[Leaders (--): not applicable]

ID	Date	Time	Calibration Plot Name				
			C0	C35	C100	C200	CP
Alpha-Track Detector (units are tracks per mm^2 - hour)							
ATD167	01-Jun-94	16:00	0.1567	--	--	--	--
ATD168	01-Jun-94	16:00	--	--	0.1875	--	--
ATD170	01-Jun-94	16:00	--	0.2450	--	--	--
ATD222	02-Jun-94	08:30	0.0405	--	--	--	--
ATD223	02-Jun-94	09:00	--	--	0.1993	--	--
ATD224	02-Jun-94	09:00	--	--	-	0.3756	--
ATD225	02-Jun-94	09:00	--	0.1196	--	--	--
ATD226	02-Jun-94	15:00	0.0387	--	--	--	--
ATD227	02-Jun-94	15:00	--	--	0.2073	--	--
ATD228	02-Jun-94	15:00	--	0.0970	--	--	--
ATD229	02-Jun-94	15:00	--	--	--	0.3094	--
ATD321	18-Jul-94	13:41	0.0378	--	--	-	--
ATD322	18-Jul-94	13:41	--	0.1405	--	--	--
ATD323	18-Jul-94	13:55	--	--	0.1639	--	--
ATD324	18-Jul-94	13:55	--	--	--	--	0.0892
ATD401	19-Jul-94	09:07	0.0504	--	--	--	--
ATD402	19-Jul-94	09:07	--	--	0.1675	--	--
ATD403	19-Jul-94	09:07	--	0.1468	--	--	--
ATD407	19-Jul-94	09:07	--	--	--	--	0.0990
Beta Scintillometer (units are counts per second)							
BET001	07-Jul-94	13:28	5.98	--	--	--	--
BET002	07-Jul-94	13:48	6.30	--	--	--	--
BET003	07-Jul-94	14:15	--	18.78	--	--	--
BET004	07-Jul-94	14:34	--	20.14	--	--	--
BET005	07-Jul-94	14:54	--	--	26.37	--	--
BET006	07-Jul-94	15:14	--	--	26.75	--	--
BET007	07-Jul-94	15:34	--	--	--	--	16.06
BET008	07-Jul-94	15:50	--	--	--	--	15.80
BET127	11-Jul-94	17:56	7.03	--	--	--	--
BET128	11-Jul-94	18:12	6.91	--	--	--	--
BET129	11-Jul-94	18:50	--	24.68	--	--	--
BET130	11-Jul-94	19:06	--	25.62	--	--	--
BET131	11-Jul-94	19:24	--	--	34.41	--	--
BET132	11-Jul-94	19:41	--	--	32.42	--	--
BET144	16-Jul-94	15:19	6.97	--	--	--	--
BET145	16-Jul-94	15:30	6.85	--	--	--	--
BET146	16-Jul-94	15:42	--	23.98	--	--	--
BET147	16-Jul-94	16:25	--	25.60	--	--	--
BET148	16-Jul-94	16:45	--	--	33.27	--	--
BET149	16-Jul-94	17:00	--	--	33.80	--	--

Table E-1: Calibration Measurements for Alternative Characterization Technologies (continued)

[Leaders (--): not applicable]

ID	Date	Time	Calibration Plot Name				
			C0	C35	C100	C200	CP
Electret Ionization Chamber (units are volts per hour)							
EIC426	02-Jun-94	15:35	--	--	--	14.617	--
EIC427	02-Jun-94	08:13	--	--	--	13.559	--
EIC428	02-Jun-94	15:40	--	--	12.056	--	--
EIC429	01-Jun-94	15:57	--	--	8.591	--	--
EIC430	01-Jun-94	17:02	--	--	-	11.739	--
EIC435	02-Jun-94	08:12	--	--	15.134	--	--
EIC436	02-Jun-94	15:43	--	4.310	--	--	--
EIC437	02-Jun-94	08:11	--	3.834	--	--	--
EIC438	01-Jun-94	16:50	--	6.158	--	--	--
EIC439	02-Jun-94	08:10	2.834	--	--	--	--
EIC440	02-Jun-94	16:32	2.841	--	--	--	--
EIC441	01-Jun-94	16:42	3.988	--	--	--	--
EIC534	18-Jul-94	13:41	0.630	--	--	--	--
EIC535	18-Jul-94	13:41	0.520	--	--	--	--
EIC536	18-Jul-94	13:41	--	1.300	--	--	--
EIC537	18-Jul-94	13:41	--	3.750	--	--	--
EIC538	18-Jul-94	13:41	--	--	1.200	--	--
EIC539	18-Jul-94	13:41	--	--	2.030	--	--
EIC540	18-Jul-94	13:55	--	--	--	--	6.250
EIC541	18-Jul-94	13:55	--	--	--	--	2.290
FIDLER Scintillometer (units are counts per minute)							
FID006	02-Jun-94	08:08	469	--	--	--	--
FID007	02-Jun-94	08:10	440	--	--	--	--
FID008	02-Jun-94	08:12	440	--	--	--	--
FID009	02-Jun-94	08:14	--	808	--	--	--
FID010	02-Jun-94	08:16	--	783	--	--	--
FID011	02-Jun-94	08:18	--	782	--	--	--
FID012	02-Jun-94	08:20	--	--	918	--	--
FID013	02-Jun-94	08:22	--	--	940	--	--
FID014	02-Jun-94	08:24	--	--	969	--	--
FID015	02-Jun-94	08:26	--	--	--	1633	--
FID016	02-Jun-94	08:28	--	--	--	1622	--
FID017	02-Jun-94	08:30	--	--	--	1582	--
FID176	06-Jun-94	13:43	449	--	--	--	--
FID177	06-Jun-94	13:45	442	--	--	--	--
FID178	06-Jun-94	13:55	--	781	--	--	--
FID179	06-Jun-94	13:57	--	735	--	--	--
FID180	06-Jun-94	13:59	--	--	964	--	--
FID181	06-Jun-94	14:01	--	--	909	--	--
FID182	06-Jun-94	14:03	--	--	913	--	--
FID183	06-Jun-94	14:06	--	--	--	1519	--

Table E-1: Calibration Measurements for Alternative Characterization Technologies (continued)

[Leaders (--): not applicable]

ID	Date	Time	Calibration Plot Name				
			C0	C35	C100	C200	CP
FID184	06-Jun-94	14:08	--	--	--	1541	--
FID214	10-Jun-94	10:13	463	--	--	--	--
FID215	10-Jun-94	10:15	481	--	--	--	--
FID216	10-Jun-94	10:17	479	--	--	--	--
FID217	10-Jun-94	10:20	465	--	--	--	--
FID218	10-Jun-94	10:23	475	--	--	--	--
FID219	10-Jun-94	10:26	--	785	--	--	--
FID220	10-Jun-94	10:28	--	767	--	--	--
FID221	10-Jun-94	10:31	--	748	--	--	--
FID222	10-Jun-94	10:34	--	764	--	--	--
FID223	10-Jun-94	10:36	--	762	--	--	--
FID224	10-Jun-94	10:38	--	797	--	--	--
FID225	10-Jun-94	10:40	--	--	909	--	--
FID226	10-Jun-94	10:42	--	--	937	--	--
FID227	10-Jun-94	10:45	--	--	897	--	--
FID228	10-Jun-94	10:47	--	--	953	--	--
FID229	10-Jun-94	10:49	--	--	921	--	--
FID230	10-Jun-94	10:53	--	--	--	1556	--
FID231	10-Jun-94	10:56	--	--	--	1561	--
FID232	10-Jun-94	10:58	--	--	--	1638	--
FID233	10-Jun-94	11:01	--	--	--	1543	--
FID234	10-Jun-94	11:03	--	--	--	1581	--
FID303	23-Jun-94	11:47	454	--	--	--	--
FID304	23-Jun-94	11:49	440	--	--	--	--
FID305	23-Jun-94	11:51	455	--	--	--	--
FID306	23-Jun-94	11:56	--	748	--	--	--
FID307	23-Jun-94	11:58	--	794	--	--	--
FID308	23-Jun-94	12:00	--	773	--	--	--
FID309	23-Jun-94	12:02	--	--	898	--	--
FID310	23-Jun-94	12:04	--	--	928	--	--
FID311	23-Jun-94	12:07	--	--	--	--	551
FID312	23-Jun-94	12:09	--	--	--	--	513
FID313	23-Jun-94	12:11	--	--	--	--	534
High-Mount Gamma Spectrometer (units are picocuries per gram of ^{238}U)							
GMH001	10-Jul-94	11:25	1.94	--	--	--	--
GMH002	10-Jul-94	12:00	--	34.60	--	--	--
GMH003	10-Jul-94	12:31	--	--	46.00	--	--
Low Mount Gamma Spectrometer (units are picocuries per gram of ^{238}U)							
GML001	10-Jul-94	11:25	--	36.70	--	--	--
GML002	10-Jul-94	12:00	1.91	--	--	--	--
GML003	10-Jul-94	13:00	--	--	50.90	--	--
GML108	18-Jul-94	15:05	0.70	--	--	--	--

Table E-1: Calibration Measurements for Alternative Characterization Technologies (continued)

[Leaders (--): not applicable]

ID	Date	Time	Calibration Plot Name				
			C0	C35	C100	C200	CP
GML109	18-Jul-94	15:17	--	33.80	--	--	--
GML110	18-Jul-94	15:28	--	--	49.50	--	--
GML111	19-Jul-94	13:39	4.10	--	--	--	--
GML112	19-Jul-94	13:50	--	36.90	--	--	--
GML113	19-Jul-94	14:01	--	--	47.60	--	--
Laser Ablation-Inductively Coupled Plasma Spectrometer (units are counts of uranium per count of silicon)							
ICP001	15-Jun-94	11:20	.0051	--	--	--	--
ICP002	15-Jun-94	11:40	--	.0367	--	--	--
ICP003	15-Jun-94	12:02	--	--	.0508	--	--
ICP004	15-Jun-94	12:20	.0041	--	--	--	--
ICP005	15-Jun-94	12:34	--	.0397	--	--	--
ICP006	15-Jun-94	12:50	--	--	.0504	--	--
ICP007	15-Jun-94	13:06	.0046	--	--	--	--
ICP008	15-Jun-94	13:21	--	.0394	--	--	--
ICP009	15-Jun-94	13:35	--	--	.0502	--	--
ICP020	16-Jun-94	08:45	--	.0367	--	--	--
ICP034	17-Jun-94	10:50	--	.0341	--	--	--
ICP042	18-Jun-94	10:51	.0040	--	--	--	--
ICP043	18-Jun-94	11:00	--	.0247	--	--	--
ICP044	18-Jun-94	11:08	--	--	.0304	--	--
ICP055	18-Jun-94	14:38	--	.0211	--	--	--
ICP075	19-Jun-94	13:43	--	.0298	--	--	--
ICP096	19-Jun-94	09:12	--	.0221	--	--	--
ICP112	20-Jun-94	10:06	--	.0206	--	--	--
ICP125	20-Jun-94	11:16	--	.0265	--	--	--
ICP130	20-Jun-94	13:48	--	.0248	--	--	--
ICP141	20-Jun-94	07:27	--	.0248	--	--	--
ICP158	21-Jun-94	10:11	--	.0241	--	--	--
ICP159	21-Jun-94	10:23	.0068	--	--	--	--
ICP176	12-Oct-94	08:40	.0018	--	--	--	--
ICP177	12-Oct-94	08:51	--	.0212	--	--	--
ICP192	12-Oct-94	13:24	.0029	--	--	--	--
ICP193	12-Oct-94	13:35	--	.0264	--	--	--
Long-Range Alpha Detector (units are fempto-amperes)							
LRA001	07-Jun-94	10:49	5700	--	--	--	--
LRA002	07-Jun-94	11:30	--	7600	--	--	--
LRA003	07-Jun-94	11:44	--	--	9800	--	--
LRA004	07-Jun-94	12:02	--	--	--	19000	--
LRA101	10-Jun-94	10:11	--	--	9600	--	--
LRA102	10-Jun-94	10:27	6400	--	--	--	--
LRA103	10-Jun-94	10:41	--	7800	--	--	--

Table E-1: Calibration Measurements for Alternative Characterization Technologies (continued)

[Leaders (--): not applicable]

ID	Date	Time	Calibration Plot Name				
			C0	C35	C100	C200	CP
Sodium-Iodide Scintillometer (units are counts per minute)							
NAD006	31-May-94	10:50	3717	--	--	--	--
NAD007	31-May-94	10:52	3724	--	--	--	--
NAD008	31-May-94	10:55	--	5361	--	--	--
NAD009	31-May-94	10:57	--	5420	--	--	--
NAD010	31-May-94	10:59	--	5420	--	--	--
NAD011	31-May-94	11:02	--	--	6340	--	--
NAD012	31-May-94	11:04	--	--	6250	--	--
NAD013	31-May-94	11:07	--	--	--	9970	--
NAD014	31-May-94	11:09	--	--	--	9870	--
NAD119	01-Jun-94	13:17	3704	--	--	--	--
NAD120	01-Jun-94	13:26	3703	--	--	--	--
NAD121	01-Jun-94	13:28	--	5360	--	--	--
NAD122	01-Jun-94	13:31	--	5210	--	--	--
NAD123	01-Jun-94	13:34	--	--	6050	--	--
NAD124	01-Jun-94	13:36	--	--	6200	--	--
NAD125	01-Jun-94	13:39	--	--	--	9820	--
NAD126	01-Jun-94	13:41	--	--	--	10020	--
NAD127	01-Jun-94	13:43	--	--	--	9870	--
NAD138	03-Jun-94	10:00	3571	--	--	--	--
NAD139	03-Jun-94	10:04	3777	--	--	--	--
NAD140	03-Jun-94	10:06	3720	--	--	--	--
NAD141	03-Jun-94	10:09	3735	--	--	--	--
NAD142	03-Jun-94	10:14	3856	--	--	--	--
NAD143	03-Jun-94	10:16	--	5400	--	--	--
NAD144	03-Jun-94	10:19	--	5400	--	--	--
NAD145	03-Jun-94	10:21	--	5450	--	--	--
NAD146	03-Jun-94	10:25	--	5400	--	--	--
NAD147	03-Jun-94	10:27	--	5650	--	--	--
NAD148	03-Jun-94	10:30	--	--	6100	--	--
NAD149	03-Jun-94	10:34	--	--	6300	--	--
NAD150	03-Jun-94	10:36	--	--	6400	--	--
NAD151	03-Jun-94	10:40	--	--	6430	--	--
NAD152	03-Jun-94	10:43	--	--	6450	--	--
NAD153	03-Jun-94	10:46	--	--	--	10020	--
NAD154	03-Jun-94	09:45	--	--	--	9970	--
NAD155	03-Jun-94	09:50	--	--	--	10050	--
NAD156	03-Jun-94	09:55	--	--	--	10030	--
NAD157	03-Jun-94	09:58	--	--	--	10170	--
X-Ray Fluorescence Unit (units are parts per million)							
XRF001	03-Jun-94	10:08	1.5065	--	--	--	--
XRF002	03-Jun-94	10:18	7.1392	--	--	--	--

Table E-1: Calibration Measurements for Alternative Characterization Technologies (continued)

[Leaders (--): not applicable]

ID	Date	Time	Calibration Plot Name				
			C0	C35	C100	C200	CP
XRF003	03-Jun-94	10:28	2.4741	--	--	--	--
XRF004	03-Jun-94	10:38	5.0143	--	--	--	--
XRF005	03-Jun-94	10:48	-3.128	--	--	--	--
XRF006	03-Jun-94	10:59	--	87.620	--	--	--
XRF007	03-Jun-94	11:09	--	87.092	--	--	--
XRF008	03-Jun-94	11:21	--	83.774	--	--	--
XRF009	03-Jun-94	11:31	--	83.227	--	--	--
XRF010	03-Jun-94	11:41	--	80.580	--	--	--
XRF011	03-Jun-94	11:51	--	--	131.23	--	--
XRF012	03-Jun-94	12:01	--	--	130.38	--	--
XRF013	03-Jun-94	12:10	--	--	126.26	--	--
XRF014	03-Jun-94	12:20	--	--	134.51	--	--
XRF015	03-Jun-94	12:30	--	--	137.20	--	--
XRF016	03-Jun-94	12:41	--	--	--	297.76	--
XRF017	03-Jun-94	13:01	--	--	--	469.40	--
XRF018	03-Jun-94	09:57	--	--	--	330.44	--
XRF019	06-Jun-94	10:09	--	--	--	293.20	--
XRF020	06-Jun-94	09:58	--	--	--	320.06	--
XRF134	28-Jun-94	10:04	-.3322	--	--	--	--
XRF135	28-Jun-94	10:17	8.0806	--	--	--	--
XRF136	28-Jun-94	10:26	11.063	--	--	--	--
XRF137	28-Jun-94	10:35	.14989	--	--	--	--
XRF138	28-Jun-94	10:45	6.3455	--	--	--	--
XRF139	28-Jun-94	11:04	--	81.606	--	--	--
XRF140	28-Jun-94	11:13	--	60.776	--	--	--
XRF141	28-Jun-94	11:22	--	82.830	--	--	--
XRF142	28-Jun-94	11:44	--	72.294	--	--	--
XRF143	28-Jun-94	09:52	--	97.769	--	--	--
XRF144	29-Jun-94	10:02	--	--	150.49	--	--
XRF145	29-Jun-94	10:11	--	--	110	--	--
XRF146	29-Jun-94	10:23	--	--	107.17	--	--
XRF147	29-Jun-94	10:32	--	--	119.15	--	--
XRF148	29-Jun-94	10:40	--	--	133.93	--	--
XRF149	29-Jun-94	09:13	--	--	--	--	45.716
XRF150	29-Jun-94	09:22	--	--	--	--	62.459
XRF151	29-Jun-94	09:32	--	--	--	--	74.296
XRF152	29-Jun-94	09:41	--	--	--	--	56.234
XRF153	29-Jun-94	09:53	--	--	--	--	59.668
XRF173	01-Jul-94	10:03	5.1425	--	--	--	--
XRF174	01-Jul-94	10:12	9.5908	--	--	--	--
XRF175	01-Jul-94	10:23	1.9863	--	--	--	--
XRF176	01-Jul-94	10:33	8.0542	--	--	--	--
XRF177	01-Jul-94	10:44	3.7396	--	--	--	--
XRF178	01-Jul-94	10:56	--	78.945	--	--	--

Table E-1: Calibration Measurements for Alternative Characterization Technologies (continued)

[Leaders (--): not applicable]

ID	Date	Time	Calibration Plot Name				
			C0	C35	C100	C200	CP
XRF179	01-Jul-94	11:05	--	69.607	--	--	--
XRF180	01-Jul-94	13:02	--	66.563	--	--	--
XRF181	01-Jul-94	13:13	--	69.512	--	--	--
XRF182	01-Jul-94	13:21	--	78.027	--	--	--
XRF183	01-Jul-94	13:30	--	--	120.03	--	--
XRF184	01-Jul-94	13:40	--	--	113.09	--	--
XRF185	01-Jul-94	13:49	--	--	119.54	--	--
XRF186	01-Jul-94	13:59	--	--	118.09	--	--
XRF187	01-Jul-94	14:07	--	--	139.24	--	--
XRF188	01-Jul-94	14:18	--	--	--	--	43.615
XRF189	01-Jul-94	14:27	--	--	--	--	68.619
XRF190	01-Jul-94	09:32	--	--	--	--	71.211
XRF191	01-Jul-94	09:43	--	--	--	--	39.051
XRF192	01-Jul-94	09:53	--	--	--	--	52.116

Appendix F: Standard Sites Data

Table F-1: Standard-Sites Measurements by all Technologies Except ICP

[Times are Eastern Daylight Time; raw data measurement units vary by technology; total uranium in picocuries per gram. Leaders (--) indicate no data]

Standard Site 1					Standard Site 2				
Date	Time	ID	Raw Data	Total Uranium	Date	Time	ID	Raw Data	Total Uranium
Alpha-Track Detector (raw data units are tracks/mm^2-hour)									
02-Jun-94	07:55	ATD215	0.0752	18.86	02-Jun-94	07:57	ATD217	0.0747	18.28
18-Jul-94	12:00	ATD319	0.0711	14.08	18-Jul-94	12:00	ATD320	0.0631	4.77
19-Jul-94	14:10	ATD440	0.2192	186.53	19-Jul-94	14:10	ATD441	0.1033	51.58
Beta Scintillometer (raw data units are counts per second)									
07-Jul-94	19:49	BET016	19.82	77.80	07-Jul-94	17:25	BET009	16.30	57.58
08-Jul-94	08:56	BET017	20.58	82.17	08-Jul-94	09:36	BET018	18.11	67.98
09-Jul-94	09:06	BET050	16.78	60.34	08-Jul-94	16:06	BET042	16.39	58.10
09-Jul-94	09:57	BET052	16.11	56.49	09-Jul-94	09:31	BET051	14.17	45.34
09-Jul-94	11:13	BET054	16.82	60.57	09-Jul-94	10:21	BET053	13.96	44.14
09-Jul-94	12:21	BET058	16.00	55.86	09-Jul-94	16:06	BET070	16.12	56.55
09-Jul-94	14:04	BET063	16.69	59.82	09-Jul-94	17:35	BET075	16.53	58.90
09-Jul-94	15:48	BET069	18.79	71.88	09-Jul-94	20:02	BET083	16.04	56.09
09-Jul-94	17:57	BET076	18.63	70.97	10-Jul-94	09:37	BET085	14.62	47.93
09-Jul-94	19:43	BET082	18.82	72.06	10-Jul-94	11:24	BET091	16.24	57.24
10-Jul-94	09:16	BET084	18.10	67.92	10-Jul-94	12:55	BET096	15.49	52.93
10-Jul-94	13:29	BET097	18.03	67.52	10-Jul-94	16:21	BET106	15.67	53.96
10-Jul-94	15:59	BET105	18.86	72.29	11-Jul-94	10:35	BET109	21.33	86.48
11-Jul-94	09:17	BET107	18.53	70.39	11-Jul-94	13:25	BET118	15.20	51.26
11-Jul-94	10:09	BET108	18.53	70.39	11-Jul-94	16:56	BET125	14.52	47.35
11-Jul-94	13:00	BET117	18.42	69.76	16-Jul-94	11:39	BET134	12.89	37.99
11-Jul-94	17:26	BET126	17.48	64.36	16-Jul-94	12:50	BET139	12.23	34.20
16-Jul-94	11:04	BET133	17.22	62.87	--	--	--	--	--
16-Jul-94	13:07	BET140	16.03	56.03	--	--	--	--	--
Electret Ionization Chamber (raw data units are volts per hour)									
01-Jun-94	17:25	EIC363	4.41	73.37	01-Jun-94	17:28	EIC365	2.61	22.81
18-Jul-94	12:00	EIC518	1.62	-4.91	18-Jul-94	12:00	EIC519	2.08	8.01
FIDLER Detector (raw data units are counts per minute)									
02-Jun-94	09:00	FID018	775	103.78	02-Jun-94	09:05	FID020	674	75.18
02-Jun-94	09:02	FID019	752	97.27	02-Jun-94	09:07	FID021	755	98.12
02-Jun-94	13:24	FID083	740	93.87	02-Jun-94	13:27	FID084	698	81.97
03-Jun-94	13:21	FID095	752	97.27	03-Jun-94	13:26	FID096	729	90.75
03-Jun-94	14:51	FID124	751	96.98	03-Jun-94	14:57	FID126	676	75.74

Table F-1: Standard-Sites Measurements by all Technologies Except ICP (continued)
[Times are Eastern Daylight Time; raw data measurement units vary by technology; total uranium in picocuries per gram. Leaders (--) indicate no data]

Standard Site 1					Standard Site 2				
Date	Time	ID	Raw Data	Total Uranium	Date	Time	ID	Raw Data	Total Uranium
03-Jun-94	14:54	FID125	740	93.87	06-Jun-94	10:31	FID138	716	87.07
06-Jun-94	10:28	FID137	763	100.38	06-Jun-94	13:31	FID175	732	91.60
06-Jun-94	13:28	FID174	705	83.96	09-Jun-94	11:03	FID197	638	64.98
09-Jun-94	10:51	FID195	683	77.73	09-Jun-94	11:05	FID198	613	57.90
09-Jun-94	10:53	FID196	711	85.66	10-Jun-94	09:57	FID212	683	77.73
10-Jun-94	09:49	FID210	777	104.35	10-Jun-94	09:59	FID213	668	73.48
10-Jun-94	09:51	FID211	769	102.08	13-Jun-94	09:49	FID247	600	54.22
13-Jun-94	09:36	FID245	678	76.31	13-Jun-94	09:51	FID248	627	61.87
13-Jun-94	09:39	FID246	650	68.38	14-Jun-94	13:20	FID261	632	63.28
14-Jun-94	13:07	FID259	660	71.21	14-Jun-94	13:22	FID262	642	66.11
14-Jun-94	13:09	FID260	686	78.58	16-Jun-94	09:32	FID275	668	73.48
16-Jun-94	09:20	FID273	745	95.28	16-Jun-94	09:34	FID276	705	83.96
16-Jun-94	09:22	FID274	740	93.87	17-Jun-94	10:47	FID289	686	78.58
17-Jun-94	10:41	FID287	729	90.75	17-Jun-94	10:49	FID290	722	88.77
17-Jun-94	10:43	FID288	728	90.47	23-Jun-94	10:37	FID296	695	81.12
23-Jun-94	10:42	FID297	772	102.93	--	--	--	--	--
High-Mount Gamma Spectrometer (raw data units are picocuries per gram)									
11-Jul-94	09:30	GMH005	27.7	82.73	11-Jul-94	18:48	GMH023	17.9	52.51
11-Jul-94	16:34	GMH018	28.6	85.51	12-Jul-94	09:54	GMH026	18.5	54.36
12-Jul-94	10:20	GMH027	28.7	85.81	12-Jul-94	19:28	GMH045	18.7	54.97
12-Jul-94	19:50	GMH046	28.8	86.12	13-Jul-94	08:55	GMH047	19.1	56.21
13-Jul-94	09:43	GMH048	28.0	83.66	16-Jul-94	11:14	GMH060	14.9	43.26
16-Jul-94	12:07	GMH059	23.3	69.16	16-Jul-94	19:21	GMH094	14.6	42.33
16-Jul-94	11:35	GMH061	23.1	68.54	17-Jul-94	09:19	GMH097	15.5	45.11
16-Jul-94	19:33	GMH095	24.0	71.32	--	--	--	--	--
17-Jul-94	09:07	GMH096	14.6	42.33	--	--	--	--	--
Low Mount-Gamma Spectrometer (raw data units are picocuries per gram)									
11-Jul-94	10:08	GML006	29.9	84.42	11-Jul-94	18:21	GML023	19.0	52.62
11-Jul-94	17:01	GML020	32.2	91.13	12-Jul-94	10:27	GML028	20.0	55.53
12-Jul-94	10:00	GML027	31.3	88.51	12-Jul-94	19:56	GML046	20.2	56.12
12-Jul-94	19:35	GML045	31.7	89.68	13-Jul-94	09:38	GML048	20.0	55.53
13-Jul-94	08:51	GML047	32.5	92.01	17-Jul-94	12:43	GML061	15.1	41.23
17-Jul-94	12:26	GML060	25.6	71.87	18-Jul-94	11:12	GML094	13.4	36.27
17-Jul-94	19:02	GML093	25.8	72.46	18-Jul-94	14:43	GML107	14.7	40.07
18-Jul-94	11:31	GML095	26.8	75.38	19-Jul-94	15:00	GML114	17.3	47.65

Table F-1: Standard-Sites Measurements by all Technologies Except ICP (continued)
[Times are Eastern Daylight Time; raw data measurement units vary by technology; total uranium in picocuries per gram. Leaders (--) indicate no data]

Standard Site 1					Standard Site 2				
Date	Time	ID	Raw Data	Total Uranium	Date	Time	ID	Raw Data	Total Uranium
18-Jul-94	14:31	GML106	25.6	71.87	--	--	--	--	--
Long-Range Alpha Detector (raw data units are fempto amperes)									
08-Jun-94	08:55	LRA005	6400	46.02	08-Jun-94	09:10	LRA006	6800	55.39
08-Jun-94	18:11	LRA045	7700	76.49	08-Jun-94	18:23	LRA046	8700	99.93
09-Jun-94	09:32	LRA051	7300	67.11	09-Jun-94	09:16	LRA050	8400	92.90
09-Jun-94	18:44	LRA097	7800	78.83	09-Jun-94	18:33	LRA096	8700	99.93
10-Jun-94	09:19	LRA098	7700	76.49	10-Jun-94	09:41	LRA099	8500	95.24
13-Jun-94	13:13	LRA105	3900	-12.58	13-Jun-94	13:30	LRA106	5000	13.20
13-Jun-94	14:35	LRA111	4300	-3.21	13-Jun-94	16:08	LRA118	6000	36.64
13-Jun-94	16:21	LRA119	5700	29.61	14-Jun-94	09:46	LRA120	7200	64.77
14-Jun-94	10:11	LRA121	6500	48.36	14-Jun-94	12:56	LRA134	7100	62.42
14-Jun-94	13:08	LRA135	6500	48.36	--	--	--	--	--
Sodium-Iodide Scintillometer (raw data units are counts per minute)									
01-Jun-94	08:51	NAD073	6250	139.67	01-Jun-94	08:59	NAD074	6050	129.23
01-Jun-94	13:00	NAD116	6050	129.23	01-Jun-94	13:07	NAD118	5850	118.79
01-Jun-94	13:02	NAD117	6200	137.06	07-Jun-94	09:50	NAD169	5750	113.57
07-Jun-94	09:46	NAD168	6050	129.23	08-Jun-94	14:32	NAD180	5800	116.18
08-Jun-94	14:38	NAD182	6050	129.23	08-Jun-94	14:34	NAD181	5850	118.79
08-Jun-94	14:40	NAD183	6050	129.23	09-Jun-94	14:12	NAD191	5750	113.57
09-Jun-94	14:00	NAD189	5900	121.40	09-Jun-94	14:14	NAD192	5800	116.18
09-Jun-94	14:02	NAD190	5850	118.79	10-Jun-94	09:56	NAD205	6000	126.62
10-Jun-94	09:48	NAD203	6300	142.28	10-Jun-94	09:58	NAD206	6100	131.84
10-Jun-94	09:50	NAD204	6550	155.33	13-Jun-94	09:44	NAD219	5750	113.57
13-Jun-94	09:30	NAD217	5800	116.18	13-Jun-94	09:46	NAD220	5800	116.18
13-Jun-94	09:32	NAD218	5900	121.40	14-Jun-94	13:14	NAD233	5700	110.96
14-Jun-94	13:00	NAD231	5900	121.40	14-Jun-94	13:16	NAD234	5650	108.35
14-Jun-94	13:02	NAD232	6050	129.23	16-Jun-94	15:23	NAD247	5700	110.96
16-Jun-94	15:15	NAD245	6050	129.23	16-Jun-94	15:25	NAD248	5760	114.09
16-Jun-94	15:17	NAD246	5900	121.40	17-Jun-94	10:47	NAD261	6050	129.23
17-Jun-94	10:41	NAD259	6200	137.06	17-Jun-94	10:49	NAD262	5900	121.40
17-Jun-94	10:43	NAD260	6400	147.50	--	--	--	--	--
X-Ray Fluorescence Unit (raw data units are parts per million)									
06-Jun-94	11:21	XRF024	84.71	90.32	06-Jun-94	11:37	XRF025	31.00	38.54
06-Jun-94	13:43	XRF029	69.93	76.07	06-Jun-94	13:53	XRF030	70.52	76.64

Table F-1: Standard-Sites Measurements by all Technologies Except ICP (continued)

[Times are Eastern Daylight Time; raw data measurement units vary by technology; total uranium in picocuries per gram. Leaders (--) indicate no data]

Standard Site 1					Standard Site 2				
Date	Time	ID	Raw Data	Total Uranium	Date	Time	ID	Raw Data	Total Uranium
08-Jun-94	09:13	XRF031	68.70	74.89	08-Jun-94	09:29	XRF032	51.90	58.69
08-Jun-94	13:49	XRF047	83.80	89.45	08-Jun-94	14:01	XRF048	60.93	67.39
09-Jun-94	09:50	XRF049	70.54	76.66	09-Jun-94	10:01	XRF050	65.15	71.46
09-Jun-94	14:08	XRF068	68.48	74.68	09-Jun-94	14:22	XRF069	64.49	70.83
10-Jun-94	09:36	XRF071	72.19	78.25	10-Jun-94	10:06	XRF072	63.94	70.30
10-Jun-94	14:06	XRF086	85.19	90.79	10-Jun-94	14:17	XRF087	55.50	62.16
14-Jun-94	09:37	XRF088	80.61	86.36	14-Jun-94	10:12	XRF089	58.36	64.92
14-Jun-94	13:55	XRF104	77.62	83.48	14-Jun-94	13:38	XRF103	56.98	63.59
15-Jun-94	09:48	XRF105	83.66	89.30	15-Jun-94	10:05	XRF106	64.33	70.67
15-Jun-94	13:30	XRF119	80.09	85.87	15-Jun-94	13:17	XRF118	58.82	65.36
16-Jun-94	09:24	XRF120	73.25	79.28	16-Jun-94	09:38	XRF121	56.83	63.44
16-Jun-94	11:44	XRF133	98.53	103.64	16-Jun-94	11:33	XRF132	60.35	66.84
30-Jun-94	09:02	XRF154	80.82	86.57	30-Jun-94	09:13	XRF155	54.08	60.80
30-Jun-94	12:30	XRF169	89.53	94.97	01-Jul-94	08:54	XRF171	60.13	66.63
01-Jul-94	08:44	XRF170	87.64	93.14	01-Jul-94	15:07	XRF194	36.35	43.70
01-Jul-94	14:51	XRF193	88.98	94.44	--	--	--	--	--

Table F-2: Standard Sites Measurements by Laser Ablation-Inductively Coupled Plasma-Atomic Emission Spectroscopy Technology

[Raw data in counts uranium per count silicon; total uranium in picocuries per gram. Negative values interpreted as below detection limit]

Date (EDT)	Time	ID	Raw Data	Total Uranium
		Calibration Plot CP		
15-Jun-94	14:42	ICP012	0.0344	111.06
15-Jun-94	14:55	ICP013	0.0436	142.58
15-Jun-94	15:09	ICP014	0.0451	147.72
		Calibration Plot C0		
15-Jun-94	14:19	ICP011	0.0047	9.32
15-Jun-94	17:56	ICP018	0.0048	9.66
16-Jun-94	09:05	ICP021	0.0053	11.37
16-Jun-94	18:36	ICP032	0.0148	43.92
17-Jun-94	11:36	ICP036	0.0046	8.98
18-Jun-94	11:13	ICP045	0.0037	5.89
19-Jun-94	07:33	ICP067	0.0060	13.77
20-Jun-94	08:07	ICP115	0.0052	11.03
20-Jun-94	14:55	ICP147	0.0087	23.02
21-Jun-94	08:12	ICP149	0.0053	11.37
21-Jun-94	13:42	ICP174	0.0126	36.38
12-Oct-94	13:53	ICP179	0.0019	-0.27
12-Oct-94	16:16	ICP190	0.0026	2.12
12-Oct-94	17:15	ICP191	0.0012	-2.67
12-Oct-94	08:57	ICP194	0.0035	5.21
12-Oct-94	11:29	ICP205	0.0026	2.12
		Calibration Plot C35		
15-Jun-94	14:01	ICP010	0.0357	115.52
15-Jun-94	16:54	ICP015	0.0373	121.00
15-Jun-94	17:56	ICP019	0.0418	136.41
16-Jun-94	09:21	ICP022	0.0362	117.23
16-Jun-94	16:44	ICP029	0.2627	893.15
16-Jun-94	18:49	ICP033	0.0637	211.44
17-Jun-94	11:21	ICP035	0.0346	111.75
17-Jun-94	13:15	ICP041	0.0400	130.25
18-Jun-94	11:21	ICP046	0.0242	76.12
18-Jun-94	12:42	ICP054	0.0212	65.84
18-Jun-94	16:33	ICP065	0.0236	74.06
19-Jun-94	07:19	ICP066	0.0224	69.95
19-Jun-94	09:22	ICP076	0.0297	94.96
19-Jun-94	10:40	ICP083	0.0300	95.99

Table F-2: Standard Sites Measurements by Laser Ablation-Inductively Coupled Plasma-Atomic Emission Spectroscopy Technology (continued)

[Raw data in counts uranium per count silicon; total uranium in picocuries per gram. Negative values interpreted as below detection limit]

Date (EDT)	Time	ID	Raw Data	Total Uranium
19-Jun-94	12:18	ICP091	0.0297	94.96
19-Jun-94	16:06	ICP107	0.0228	71.32
19-Jun-94	17:00	ICP111	0.0225	70.30
20-Jun-94	07:44	ICP113	0.0188	57.62
20-Jun-94	07:55	ICP114	0.0211	65.50
20-Jun-94	11:49	ICP131	0.0224	69.95
20-Jun-94	14:45	ICP146	0.0275	87.42
21-Jun-94	07:58	ICP148	0.0221	68.93
21-Jun-94	09:31	ICP155	0.0232	72.69
21-Jun-94	12:30	ICP168	0.0234	73.38
21-Jun-94	13:30	ICP173	0.0272	86.40
21-Jun-94	13:54	ICP175	0.0329	105.92
12-Oct-94	13:40	ICP178	0.0214	66.53
12-Oct-94	14:46	ICP183	0.0267	84.68
12-Oct-94	15:59	ICP189	0.0266	84.34
12-Oct-94	09:08	ICP195	0.0233	73.04
12-Oct-94	10:06	ICP199	0.0216	67.21
12-Oct-94	01:14	ICP206	0.0213	66.19

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Appendix G: Technology Data

Table G-1: Composite Data Listing for Alpha-Track Detector Technology

[Negative total uranium values interpreted as below detection level. Leaders (--): not measured or not applicable]

Geo Loc	X Coord (feet)	Y Coord (feet)	ID	Type	Date	Time (EDT)	Raw Data (tracks per mm^2-hour)	Total U (pCi/g)
CC10	1351774	480593	ATD101	FLD	01-Jun-94	12:43	0.0597	0.81
AA9	1351713	480534	ATD102	FLD	01-Jun-94	12:44	0.0576	-1.64
Y8	1351651	480476	ATD103	FLD	01-Jun-94	12:46	0.0496	-10.95
X7.5	1351620	480447	ATD104	FLD	01-Jun-94	12:48	0.0691	11.75
W7	1351590	480417	ATD105	FLD	01-Jun-94	12:49	0.0508	-9.55
W6.5	1351560	480418	ATD106	FLD	01-Jun-94	12:50	0.0678	10.24
V6.5	1351559	480403	ATD107	FLD	01-Jun-94	12:51	0.0688	11.41
V6	1351529	480394	ATD108	FLD	01-Jun-94	12:57	0.0314	-32.14
U5	1351468	480365	ATD109	FLD	01-Jun-94	12:59	0.0738	17.23
W5	1351470	480420	ATD110	FLD	01-Jun-94	13:00	0.0813	25.96
Y5	1351471	480480	ATD111	FLD	01-Jun-94	13:02	0.0475	-13.40
AA5	1351473	480540	ATD112	FLD	01-Jun-94	13:03	0.0597	0.81
CC5	1351474	480600	ATD113	FLD	01-Jun-94	13:05	0.0521	-8.04
CC6	1351534	480599	ATD114	FLD	01-Jun-94	13:06	0.0662	8.38
CC7	1351594	480597	ATD115	FLD	01-Jun-94	13:08	0.0624	3.95
AA6	1351533	480539	ATD116	FLD	01-Jun-94	13:09	0.0451	-16.19
Z6	1351532	480509	ATD117	FLD	01-Jun-94	13:10	0.0607	1.97
Z6.5	1351562	480508	ATD118	FLD	01-Jun-94	13:14	0.0677	10.12
Y6	1351531	480479	ATD119	FLD	01-Jun-94	13:16	0.0664	8.61
W6	1351530	480419	ATD120	FLD	01-Jun-94	13:17	0.0634	5.12
Y6.5	1351561	480478	ATD121	FLD	01-Jun-94	13:19	0.0522	-7.92
F1	1351542	480529	ATD122	FLD	01-Jun-94	13:21	0.0638	5.58
F2	1351547	480528	ATD123	FLD	01-Jun-94	13:22	0.0681	10.59
F3	1351552	480528	ATD124	FLD	01-Jun-94	13:23	0.0567	-2.68
E1	1351542	480524	ATD125	FLD	01-Jun-94	13:24	0.0572	-2.10
E2	1351547	480523	ATD126	FLD	01-Jun-94	13:25	0.0588	-0.24
E3	1351552	480523	ATD127	FLD	01-Jun-94	13:26	0.0765	20.37
D1	1351542	480519	ATD128	FLD	01-Jun-94	13:27	0.0624	3.95
D2	1351547	480518	ATD129	FLD	01-Jun-94	13:28	0.0595	0.58
D3	1351552	480518	ATD130	FLD	01-Jun-94	13:29	0.0439	-17.59
AA7	1351593	480537	ATD131	FLD	01-Jun-94	13:30	0.0546	-5.13
Z7	1351592	480507	ATD132	FLD	01-Jun-94	13:32	0.0638	5.58
Y7	1351591	480477	ATD133	FLD	01-Jun-94	13:33	0.0728	16.06
W7.5	1351620	480420	ATD134	FLD	01-Jun-94	13:35	0.0796	23.98
Y7.5	1351621	480476	ATD135	FLD	01-Jun-94	13:37	0.0696	12.34
CC8	1351654	480596	ATD136	FLD	01-Jun-94	13:38	0.0726	15.83
X7	1351590	480447	ATD137	FLD	01-Jun-94	13:38	0.0480	-12.81

Table G-1: Composite Data Listing for Alpha-Track Detector Technology (continued)
[Negative total uranium values interpreted as below detection level. Leaders (--): not measured or not applicable]

Geo Loc	X Coord (feet)	Y Coord (feet)	ID	Type	Date	Time (EDT)	Raw Data (tracks per mm^2-hour)	Total U (pCi/g)
AA8	1351653	480536	ATD138	FLD	01-Jun-94	13:40	0.0543	-5.48
X8	1351650	480446	ATD139	FLD	01-Jun-94	13:41	0.0749	18.51
W8	1351650	480429	ATD140	FLD	01-Jun-94	13:43	0.0594	0.46
X8.5	1351680	480445	ATD141	FLD	01-Jun-94	13:44	0.0677	10.12
Y8.5	1351681	480475	ATD142	FLD	01-Jun-94	13:46	0.0762	20.02
W8.5	1351679	480400	ATD143	FLD	01-Jun-94	13:48	0.0581	-1.05
Z9	1351712	480504	ATD145	FLD	01-Jun-94	13:53	0.0489	-11.77
Y9	1351712	480474	ATD146	FLD	01-Jun-94	13:54	0.0801	24.56
X9	1351711	480457	ATD147	FLD	01-Jun-94	13:56	0.0725	15.71
W9	1351709	480412	ATD148	FLD	01-Jun-94	13:57	0.0399	-22.25
V9	1351709	480384	ATD149	FLD	01-Jun-94	13:59	0.0855	30.85
U9	1351708	480354	ATD150	FLD	01-Jun-94	14:00	0.0660	8.14
S9	1351706	480294	ATD151	FLD	01-Jun-94	14:01	0.1293	81.85
AA9.5	1351743	480533	ATD152	FLD	01-Jun-94	14:06	0.0650	6.98
Z9.5	1351742	480503	ATD153	FLD	01-Jun-94	14:07	0.0484	-12.35
W9.5	1351739	480413	ATD154	FLD	01-Jun-94	14:09	0.0653	7.33
V9.5	1351739	480383	ATD155	FLD	01-Jun-94	14:10	0.0590	-0.01
U9.5	1351738	480353	ATD156	FLD	01-Jun-94	14:11	0.0867	32.25
C1	1351748	480373	ATD157	FLD	01-Jun-94	14:12	0.0599	1.04
C2	1351753	480373	ATD158	FLD	01-Jun-94	14:13	0.0946	41.45
C3	1351758	480373	ATD159	FLD	01-Jun-94	14:14	0.0616	3.02
B1	1351748	480368	ATD160	FLD	01-Jun-94	14:15	0.0770	20.95
B2	1351753	480368	ATD161	FLD	01-Jun-94	14:16	0.0328	-30.51
B3	1351758	480368	ATD162	FLD	01-Jun-94	14:17	0.0479	-12.93
A1	1351748	480363	ATD163	FLD	01-Jun-94	14:18	0.0828	27.71
A2	1351753	480363	ATD164	FLD	01-Jun-94	14:19	0.0852	30.50
A3	1351758	480363	ATD165	FLD	01-Jun-94	14:20	0.0855	30.85
AA10	1351760	480533	ATD166	FLD	01-Jun-94	14:22	0.0823	27.12
C0	--	--	ATD167	CAL	01-Jun-94	16:00	0.1567	--
C100	--	--	ATD168	CAL	01-Jun-94	16:00	0.1875	--
C35	--	--	ATD170	CAL	01-Jun-94	16:00	0.2450	--
AA11	1351833	480531	ATD201	FLD	02-Jun-94	07:38	0.0463	-14.79
Y11	1351831	480471	ATD202	FLD	02-Jun-94	07:39	0.1145	64.62
W11	1351829	480411	ATD203	FLD	02-Jun-94	07:40	0.0723	15.48
U11	1351828	480351	ATD204	FLD	02-Jun-94	07:41	0.0846	29.80
S10	1351766	480293	ATD205	FLD	02-Jun-94	07:43	0.0995	47.15
S11	1351826	480291	ATD206	FLD	02-Jun-94	07:43	0.0581	-1.05
U10	1351768	480353	ATD207	FLD	02-Jun-94	07:45	0.0622	3.72

Table G-1: Composite Data Listing for Alpha-Track Detector Technology (continued)

[Negative total uranium values interpreted as below detection level. Leaders (--): not measured or not applicable]

Geo Loc	X Coord (feet)	Y Coord (feet)	ID	Type	Date	Time (EDT)	Raw Data (tracks per mm^2-hour)	Total U (pCi/g)
V10	1351769	480383	ATD208	FLD	02-Jun-94	07:45	0.0509	-9.44
W10	1351769	480413	ATD209	FLD	02-Jun-94	07:46	0.0598	0.93
Y10	1351771	480473	ATD210	FLD	02-Jun-94	07:47	0.0590	-0.01
CC11	1351834	480591	ATD211	FLD	02-Jun-94	07:49	0.0779	22.00
U7	1351588	480361	ATD212	FLD	02-Jun-94	07:51	0.0853	30.62
S5	1351466	480300	ATD214	FLD	02-Jun-94	07:53	0.0615	2.91
S1	1351541	480338	ATD215	STD	02-Jun-94	07:55	0.0752	18.86
AA6.5	1351563	480538	ATD216	FLD	02-Jun-94	07:56	0.0684	10.94
S2	1351508	480562	ATD217	STD	02-Jun-94	07:57	0.0747	18.28
U6.5	1351558	480358	ATD218	FLD	02-Jun-94	08:00	0.0882	33.99
U8	1351648	480366	ATD219	FLD	02-Jun-94	08:01	0.0795	23.86
Y9.5	1351725	480474	ATD220	FLD	02-Jun-94	08:03	0.0712	14.20
Z10	1351787	480502	ATD221	FLD	02-Jun-94	08:05	0.0645	6.40
C0	--	--	ATD222	CAL	02-Jun-94	08:30	0.0405	--
C100	--	--	ATD223	CAL	02-Jun-94	09:00	0.1993	--
C200	--	--	ATD224	CAL	02-Jun-94	09:00	0.3756	--
C35	--	--	ATD225	CAL	02-Jun-94	09:00	0.1196	--
C0	--	--	ATD226	CAL	02-Jun-94	15:00	0.0387	--
C100	--	--	ATD227	CAL	02-Jun-94	15:00	0.2073	--
C35	--	--	ATD228	CAL	02-Jun-94	15:00	0.0970	--
C200	--	--	ATD229	CAL	02-Jun-94	15:00	0.3094	--
S1	1351541	480338	ATD319	STD	18-Jul-94	12:00	0.0711	14.08
S2	1351508	480562	ATD320	STD	18-Jul-94	12:00	0.0631	4.77
C0	--	--	ATD321	CAL	18-Jul-94	13:41	0.0378	--
C35	--	--	ATD322	CAL	18-Jul-94	13:41	0.1405	--
C100	--	--	ATD323	CAL	18-Jul-94	13:55	0.1639	--
CP	--	--	ATD324	CAL	18-Jul-94	13:55	0.0892	--
C0	--	--	ATD401	CAL	19-Jul-94	09:07	0.0504	--
C100	--	--	ATD402	CAL	19-Jul-94	09:07	0.1675	--
C35	--	--	ATD403	CAL	19-Jul-94	09:07	0.1468	--
CP	--	--	ATD407	CAL	19-Jul-94	09:07	0.0990	--
U6	1351528	480354	ATD421	FLD	19-Jul-94	10:05	0.0863	31.78
--	1351465	480330	ATD428	FLD	19-Jul-94	13:55	0.0715	14.55
--	1351475	480320	ATD429	FLD	19-Jul-94	13:55	0.1226	74.05
--	1351473	480315	ATD430	FLD	19-Jul-94	14:10	0.1331	86.28
--	1351475	480310	ATD431	FLD	19-Jul-94	14:10	0.0954	42.38
--	1351480	480310	ATD432	FLD	19-Jul-94	14:10	0.1951	158.47

Table G-1: Composite Data Listing for Alpha-Track Detector Technology (continued)

[Negative total uranium values interpreted as below detection level. Leaders (--): not measured or not applicable]

Geo Loc	X Coord (feet)	Y Coord (feet)	ID	Type	Date	Time (EDT)	Raw Data (tracks per mm^2-hour)	Total U (pCi/g)
--	1351480	480315	ATD433	FLD	19-Jul-94	14:10	0.1602	117.83
--	1351480	480320	ATD434	FLD	19-Jul-94	14:10	0.1357	89.30
--	1351485	480310	ATD435	FLD	19-Jul-94	14:10	0.0753	18.97
--	1351485	480315	ATD436	FLD	19-Jul-94	14:10	0.0851	30.38
--	1351485	480320	ATD437	FLD	19-Jul-94	14:10	0.1473	102.81
--	1351495	480300	ATD438	FLD	19-Jul-94	14:10	0.0765	20.37
--	1351495	480330	ATD439	FLD	19-Jul-94	14:10	0.0822	27.01
S1	1351541	480338	ATD440	STD	19-Jul-94	14:10	0.2192	186.53
S2	1351508	480562	ATD441	STD	19-Jul-94	14:10	0.1033	51.58
--	1351800	480595	ATD442	FLD	19-Jul-94	14:53	0.0861	31.55
--	1351815	480575	ATD443	FLD	19-Jul-94	14:53	0.1095	58.80
--	1351815	480580	ATD444	FLD	19-Jul-94	14:53	0.0689	11.52
--	1351815	480585	ATD445	FLD	19-Jul-94	14:53	0.0450	-16.31
--	1351820	480575	ATD446	FLD	19-Jul-94	14:53	0.1116	61.24
--	1351820	480580	ATD447	FLD	19-Jul-94	14:53	0.2299	198.99
--	1351820	480585	ATD448	FLD	19-Jul-94	14:53	0.1222	73.58
--	1351830	480565	ATD449	FLD	19-Jul-94	14:53	0.0889	34.81

Table G-2: Composite Data Listing for Beta Scintillometer Technology

[F*: soil moisture correction factor (not applicable to sample type CAL); Adj.: adjusted (see text). Negative total uranium values interpreted as below detection level. Leaders (--): not measured or not applicable]

Geo Loc	X Coord (feet)	Y Coord (feet)	ID	Type	Date	Time (EDT)	Raw Data (counts per second)	Total U (pCi/g)	F*	Adj. Total U (pCi/g)
C0	--	--	BET001	CAL	07-Jul-94	13:28	5.98	--	--	--
C0	--	--	BET002	CAL	07-Jul-94	13:48	6.30	--	--	--
C35	--	--	BET003	CAL	07-Jul-94	14:15	18.78	--	--	--
C35	--	--	BET004	CAL	07-Jul-94	14:34	20.14	--	--	--
C100	--	--	BET005	CAL	07-Jul-94	14:54	26.37	--	--	--
C100	--	--	BET006	CAL	07-Jul-94	15:14	26.75	--	--	--
CP	--	--	BET007	CAL	07-Jul-94	15:34	16.06	--	--	--
CP	--	--	BET008	CAL	07-Jul-94	15:50	15.80	--	--	--
S2	1351508	480562	BET009	STD	07-Jul-94	17:25	16.30	57.58	1.000	57.58
CC6	1351534	480599	BET010	FLD	07-Jul-94	18:00	16.40	58.15	1.000	58.15
CC5	1351474	480600	BET012	FLD	07-Jul-94	18:36	12.05	33.16	1.000	33.16
AA5	1351473	480540	BET013	FLD	07-Jul-94	18:54	13.54	41.72	1.000	41.72
AA6	1351533	480539	BET014	FLD	07-Jul-94	19:11	14.90	49.54	1.000	49.54
Z6	1351532	480509	BET015	FLD	07-Jul-94	19:27	15.04	50.34	1.000	50.34
S1	1351541	480338	BET016	STD	07-Jul-94	19:49	19.82	77.80	1.000	77.80
S1	1351541	480338	BET017	STD	08-Jul-94	08:56	20.58	82.17	1.000	82.17
S2	1351508	480562	BET018	STD	08-Jul-94	09:36	18.11	67.98	1.000	67.98
F1	1351542	480529	BET019	FLD	08-Jul-94	09:53	16.47	58.56	1.000	58.56
F2	1351547	480528	BET020	FLD	08-Jul-94	10:09	16.11	56.49	1.000	56.49
F3	1351552	480528	BET021	FLD	08-Jul-94	10:25	15.51	53.04	1.000	53.04
E3	1351552	480523	BET022	FLD	08-Jul-94	10:41	16.48	58.61	1.000	58.61
E2	1351547	480523	BET023	FLD	08-Jul-94	10:57	14.13	45.11	1.000	45.11
E1	1351542	480524	BET024	FLD	08-Jul-94	11:12	14.65	48.10	1.000	48.10
D1	1351542	480519	BET025	FLD	08-Jul-94	11:28	16.16	56.78	1.000	56.78
D2	1351547	480518	BET026	FLD	08-Jul-94	11:44	15.79	54.65	1.000	54.65
D3	1351552	480518	BET027	FLD	08-Jul-94	12:00	15.53	53.16	1.000	53.16
AA6.5	1351563	480538	BET028	FLD	08-Jul-94	12:16	15.79	54.65	1.000	54.65
Z6.5	1351562	480508	BET029	FLD	08-Jul-94	12:31	17.13	62.35	1.000	62.35
Y6.5	1351561	480478	BET030	FLD	08-Jul-94	12:47	16.71	59.94	1.000	59.94
Y6	1351531	480479	BET031	FLD	08-Jul-94	13:03	16.17	56.83	1.000	56.83
Y5	1351471	480480	BET032	FLD	08-Jul-94	13:20	14.99	50.05	1.000	50.05
W5	1351470	480420	BET033	FLD	08-Jul-94	13:36	16.16	56.78	1.000	56.78
U5	1351468	480365	BET034	FLD	08-Jul-94	13:52	15.32	51.95	1.000	51.95
V6	1351529	480394	BET035	FLD	08-Jul-94	14:11	16.63	59.48	1.000	59.48
V6.5	1351559	480403	BET036	FLD	08-Jul-94	14:28	19.40	75.39	1.000	75.39
W6.5	1351560	480418	BET037	FLD	08-Jul-94	14:44	17.70	65.62	1.000	65.62
W6	1351530	480419	BET038	FLD	08-Jul-94	15:00	15.64	53.79	1.000	53.79
W7	1351590	480417	BET039	FLD	08-Jul-94	15:16	19.11	73.72	1.000	73.72
W7.5	1351620	480420	BET040	FLD	08-Jul-94	15:32	18.11	67.98	1.000	67.98

Table G-2: Composite Data Listing for Beta Scintillometer Technology (continued)

[F*: soil moisture correction factor (not applicable to sample type CAL); Adj.: adjusted (see text). Negative total uranium values interpreted as below detection level. Leaders (--): not measured or not applicable]

Geo Loc	X Coord (feet)	Y Coord (feet)	ID	Type	Date	Time (EDT)	Raw Data (counts per second)	Total U (pCi/g)	F*	Adj. Total U (pCi/g)
W8	1351650	480429	BET041	FLD	08-Jul-94	15:48	16.61	59.36	1.000	59.36
S2	1351508	480562	BET042	STD	08-Jul-94	16:06	16.39	58.10	1.000	58.10
CC7	1351594	480597	BET043	FLD	08-Jul-94	16:40	16.15	56.72	1.000	56.72
CC8	1351654	480596	BET044	FLD	08-Jul-94	17:00	16.30	57.58	1.000	57.58
AA8	1351653	480536	BET045	FLD	08-Jul-94	17:16	14.92	49.65	1.000	49.65
AA7	1351593	480537	BET046	FLD	08-Jul-94	17:33	15.30	51.84	1.000	51.84
Z7	1351592	480507	BET047	FLD	08-Jul-94	17:49	15.23	51.43	1.000	51.43
Y7	1351591	480477	BET048	FLD	08-Jul-94	18:05	15.94	55.51	1.000	55.51
X7	1351590	480447	BET049	FLD	08-Jul-94	18:22	17.01	61.66	1.000	61.66
S1	1351541	480338	BET050	STD	09-Jul-94	09:06	16.78	60.34	1.374	82.90
S2	1351508	480562	BET051	STD	09-Jul-94	09:31	14.17	45.34	1.374	62.30
S1	1351541	480338	BET052	STD	09-Jul-94	09:57	16.11	56.49	1.374	77.62
S2	1351508	480562	BET053	STD	09-Jul-94	10:21	13.96	44.14	1.374	60.64
S1	1351541	480338	BET054	STD	09-Jul-94	11:13	16.82	60.57	1.374	83.22
U6	1351528	480354	BET055	FLD	09-Jul-94	11:30	14.19	45.46	1.374	62.46
S5	1351466	480300	BET056	FLD	09-Jul-94	11:47	11.51	30.06	1.374	41.31
U6.5	1351558	480358	BET057	FLD	09-Jul-94	12:05	15.96	55.63	1.374	76.43
S1	1351541	480338	BET058	STD	09-Jul-94	12:21	16.00	55.86	1.374	76.75
U7	1351588	480361	BET059	FLD	09-Jul-94	12:39	15.95	55.57	1.374	76.35
U8	1351648	480366	BET060	FLD	09-Jul-94	12:57	17.44	64.13	1.374	88.11
U9	1351708	480354	BET061	FLD	09-Jul-94	13:13	16.99	61.54	1.374	84.56
S9	1351706	480294	BET062	FLD	09-Jul-94	13:29	18.92	72.63	1.374	99.80
S1	1351541	480338	BET063	STD	09-Jul-94	14:04	16.69	59.82	1.374	82.19
W8.5	1351679	480400	BET064	FLD	09-Jul-94	14:24	16.50	58.73	1.311	76.99
W9	1351709	480412	BET065	FLD	09-Jul-94	14:40	15.86	55.05	1.272	70.03
V9	1351709	480384	BET066	FLD	09-Jul-94	14:56	17.35	63.61	1.236	78.62
V9.5	1351739	480383	BET067	FLD	09-Jul-94	15:12	15.81	54.77	1.201	65.77
W9.5	1351739	480413	BET068	FLD	09-Jul-94	15:27	14.69	48.33	1.169	56.50
S1	1351541	480338	BET069	STD	09-Jul-94	15:48	18.79	71.88	1.109	79.72
S2	1351508	480562	BET070	STD	09-Jul-94	16:06	16.12	56.55	1.109	62.71
X7.5	1351620	480447	BET071	FLD	09-Jul-94	16:28	14.22	45.63	1.109	50.60
X8	1351650	480446	BET072	FLD	09-Jul-94	16:44	16.13	56.60	1.109	62.77
Y8	1351651	480476	BET073	FLD	09-Jul-94	17:00	13.55	41.78	1.109	46.34
Y7.5	1351621	480476	BET074	FLD	09-Jul-94	17:16	15.94	55.51	1.109	61.56
S2	1351508	480562	BET075	STD	09-Jul-94	17:35	16.53	58.90	1.109	65.32
S1	1351541	480338	BET076	STD	09-Jul-94	17:57	18.63	70.97	1.109	78.70
Y8.5	1351681	480475	BET077	FLD	09-Jul-94	18:19	15.83	54.88	1.109	60.86
Y9	1351711	480474	BET078	FLD	09-Jul-94	18:36	14.40	46.67	1.109	51.75
Y9.5	1351725	480474	BET079	FLD	09-Jul-94	18:52	15.97	55.68	1.109	61.75
X9	1351711	480457	BET080	FLD	09-Jul-94	19:08	16.81	60.51	1.109	67.11

Table G-2: Composite Data Listing for Beta Scintillometer Technology (continued)

[F*: soil moisture correction factor (not applicable to sample type CAL); Adj.: adjusted (see text). Negative total uranium values interpreted as below detection level. Leaders (--): not measured or not applicable]

Geo Loc	X Coord (feet)	Y Coord (feet)	ID	Type	Date	Time (EDT)	Raw Data (counts per second)	Total U (pCi/g)	F*	Adj. Total U (pCi/g)
X8.5	1351680	480445	BET081	FLD	09-Jul-94	19:24	15.33	52.01	1.109	57.68
S1	1351541	480338	BET082	STD	09-Jul-94	19:43	18.82	72.06	1.109	79.91
S2	1351508	480562	BET083	STD	09-Jul-94	20:02	16.04	56.09	1.109	62.20
S1	1351541	480338	BET084	STD	10-Jul-94	09:16	18.10	67.92	1.187	80.62
S2	1351508	480562	BET085	STD	10-Jul-94	09:37	14.62	47.93	1.187	56.89
CC9	1351714	480594	BET086	FLD	10-Jul-94	10:01	17.29	63.27	1.187	75.10
CC10	1351774	480593	BET087	FLD	10-Jul-94	10:18	14.44	46.89	1.187	55.66
AA10	1351760	480533	BET088	FLD	10-Jul-94	10:34	17.67	65.45	1.187	77.69
AA9.5	1351743	480533	BET089	FLD	10-Jul-94	10:50	16.32	57.70	1.187	68.48
AA9	1351713	480534	BET090	FLD	10-Jul-94	11:06	14.21	45.57	1.187	54.10
S2	1351508	480562	BET091	STD	10-Jul-94	11:24	16.24	57.24	1.187	67.94
Z9	1351712	480504	BET092	FLD	10-Jul-94	11:48	14.90	49.54	1.187	58.80
Z9.5	1351742	480503	BET093	FLD	10-Jul-94	12:04	17.76	65.97	1.187	78.30
Z10	1351787	480502	BET094	FLD	10-Jul-94	12:20	15.57	53.39	1.187	63.37
Y10	1351771	480473	BET095	FLD	10-Jul-94	12:36	16.94	61.26	1.187	72.71
S2	1351508	480562	BET096	STD	10-Jul-94	12:55	15.49	52.93	1.187	62.82
S1	1351541	480338	BET097	STD	10-Jul-94	13:29	18.03	67.52	1.187	80.14
W10	1351769	480413	BET098	FLD	10-Jul-94	13:39	16.83	60.62	1.187	71.96
W11	1351829	480411	BET099	FLD	10-Jul-94	14:06	17.64	65.28	1.187	77.49
Y11	1351831	480471	BET100	FLD	10-Jul-94	14:22	16.90	61.03	1.187	72.44
AA11	1351833	480531	BET101	FLD	10-Jul-94	14:39	11.98	32.76	1.187	38.89
S11	1351826	480291	BET102	FLD	10-Jul-94	14:58	13.50	41.49	1.187	49.25
U11	1351828	480351	BET103	FLD	10-Jul-94	15:19	17.66	65.39	1.187	77.62
U10	1351768	480353	BET104	FLD	10-Jul-94	15:39	17.43	64.07	1.187	76.05
S1	1351541	480338	BET105	STD	10-Jul-94	15:59	18.86	72.29	1.187	85.80
S2	1351508	480562	BET106	STD	10-Jul-94	16:21	15.67	53.96	1.187	64.05
S1	1351541	480338	BET107	STD	11-Jul-94	09:17	18.53	70.39	0.880	61.94
S1	1351541	480338	BET108	STD	11-Jul-94	10:09	18.53	70.39	0.880	61.94
S2	1351508	480562	BET109	STD	11-Jul-94	10:35	21.33	86.48	0.846	73.16
V10	1351769	480383	BET110	FLD	11-Jul-94	10:59	16.61	59.36	0.883	52.42
C3	1351758	480373	BET111	FLD	11-Jul-94	11:15	16.39	58.10	0.908	52.75
C2	1351753	480373	BET112	FLD	11-Jul-94	11:31	15.15	50.97	0.933	47.56
C1	1351748	480373	BET113	FLD	11-Jul-94	11:48	17.19	62.69	0.960	60.19
B1	1351748	480368	BET114	FLD	11-Jul-94	12:04	15.72	54.25	0.985	53.43
B2	1351753	480368	BET115	FLD	11-Jul-94	12:20	16.07	56.26	1.010	56.82
B3	1351758	480368	BET116	FLD	11-Jul-94	12:38	15.65	53.85	1.038	55.89
S1	1351541	480338	BET117	STD	11-Jul-94	13:00	18.42	69.76	1.073	74.85
S2	1351508	480562	BET118	STD	11-Jul-94	13:25	15.20	51.26	1.112	57.00
U9.5	1351738	480353	BET119	FLD	11-Jul-94	14:07	14.40	46.67	1.178	54.97
A1	1351748	480363	BET120	FLD	11-Jul-94	14:24	13.97	44.19	1.267	55.99

Table G-2: Composite Data Listing for Beta Scintillometer Technology (continued)

[F*: soil moisture correction factor (not applicable to sample type CAL); Adj.: adjusted (see text). Negative total uranium values interpreted as below detection level. Leaders (--): not measured or not applicable]

Geo Loc	X Coord (feet)	Y Coord (feet)	ID	Type	Date	Time (EDT)	Raw Data (counts per second)	Total U (pCi/g)	F*	Adj. Total U (pCi/g)
A2	1351753	480363	BET121	FLD	11-Jul-94	14:40	14.19	45.46	1.267	57.60
A3	1351758	480363	BET122	FLD	11-Jul-94	15:27	18.19	68.44	1.267	86.71
S10	1351766	480293	BET123	FLD	11-Jul-94	15:55	16.91	61.08	1.267	77.39
CC11	1351834	480591	BET124	FLD	11-Jul-94	16:17	11.97	32.71	1.267	41.44
S2	1351508	480562	BET125	STD	11-Jul-94	16:56	14.52	47.35	1.267	60.00
S1	1351541	480338	BET126	STD	11-Jul-94	17:26	17.48	64.36	1.267	81.54
C0	--	--	BET127	CAL	11-Jul-94	17:56	7.03	--	--	--
C0	--	--	BET128	CAL	11-Jul-94	18:12	6.91	--	--	--
C35	--	--	BET129	CAL	11-Jul-94	18:50	24.68	--	--	--
C35	--	--	BET130	CAL	11-Jul-94	19:06	25.62	--	--	--
C100	--	--	BET131	CAL	11-Jul-94	19:24	34.41	--	--	--
C100	--	--	BET132	CAL	11-Jul-94	19:41	32.42	--	--	--
S1	1351541	480338	BET133	STD	16-Jul-94	11:04	17.22	62.87	1.276	80.22
S2	1351508	480562	BET134	STD	16-Jul-94	11:39	12.89	37.99	1.580	60.02
--	1351488	480598	BET135	FLD	16-Jul-94	11:58	9.42	18.06	1.343	24.25
--	1351474	480571	BET136	FLD	16-Jul-94	12:11	10.45	23.97	1.359	32.58
--	1351487	480540	BET137	FLD	16-Jul-94	12:25	10.50	24.26	1.377	33.41
--	1351473	480523	BET138	FLD	16-Jul-94	12:38	10.52	24.38	1.393	33.95
S2	1351508	480562	BET139	STD	16-Jul-94	12:50	12.23	34.20	1.742	59.57
S1	1351541	480338	BET140	STD	16-Jul-94	13:07	16.03	56.03	1.425	79.84
--	1351485	480300	BET141	FLD	16-Jul-94	13:21	10.55	24.55	1.816	44.58
--	1351466	480312	BET142	FLD	16-Jul-94	13:33	8.69	13.86	1.844	25.56
--	1351831	480550	BET143	FLD	16-Jul-94	13:53	7.98	9.78	1.690	16.53
C0	--	--	BET144	CAL	16-Jul-94	15:19	6.97	--	--	--
C0	--	--	BET145	CAL	16-Jul-94	15:30	6.85	--	--	--
C35	--	--	BET146	CAL	16-Jul-94	15:42	23.98	--	--	--
C35	--	--	BET147	CAL	16-Jul-94	16:25	25.60	--	--	--
C100	--	--	BET148	CAL	16-Jul-94	16:45	33.27	--	--	--
C100	--	--	BET149	CAL	16-Jul-94	17:00	33.80	--	--	--

Table G-3: Composite Data Listing for Electret Ionization Chamber Technology

[Negative total uranium values interpreted as below detection level. Leaders (--): not measured or not applicable]

Geo Loc	X Coord (feet)	Y Coord (feet)	ID	Type	Date	Time (EDT)	Raw Data (volts/hr)	Total U (pCi/g)
AA11	1351833	480531	EIC349	FLD	01-Jun-94	15:53	7.3820	156.94
Y11	1351831	480471	EIC350	FLD	01-Jun-94	15:54	3.6620	52.45
W11	1351829	480411	EIC351	FLD	01-Jun-94	15:56	2.7070	25.62
U11	1351828	480351	EIC352	FLD	01-Jun-94	15:57	3.2860	41.88
S11	1351826	480291	EIC353	FLD	01-Jun-94	15:58	3.1790	38.88
S10	1351766	480293	EIC354	FLD	01-Jun-94	16:00	3.2120	39.81
U10	1351768	480353	EIC355	FLD	01-Jun-94	16:01	3.0970	36.57
V10	1351769	480383	EIC356	FLD	01-Jun-94	16:03	2.6550	24.16
W10	1351769	480413	EIC357	FLD	01-Jun-94	16:05	5.9090	115.56
Y10	1351771	480473	EIC358	FLD	01-Jun-94	16:05	9.1460	206.49
CC11	1351834	480591	EIC359	FLD	01-Jun-94	16:07	3.6200	51.27
U7	1351588	480361	EIC360	FLD	01-Jun-94	17:10	4.2750	69.66
V6	1351529	480394	EIC361	FLD	01-Jun-94	17:22	1.0480	-20.98
S5	1351466	480300	EIC362	FLD	01-Jun-94	17:24	2.4060	17.16
S1	1351541	480338	EIC363	STD	01-Jun-94	17:25	4.4070	73.37
S2	1351508	480562	EIC365	STD	01-Jun-94	17:28	2.6070	22.81
U6.5	1351558	480358	EIC366	FLD	01-Jun-94	17:30	4.1540	66.27
U8	1351648	480366	EIC367	FLD	01-Jun-94	17:31	4.8070	84.61
Y9.5	1351725	480474	EIC368	FLD	01-Jun-94	17:32	2.9780	33.23
Z10	1351787	480502	EIC369	FLD	01-Jun-94	17:33	4.4230	73.82
CC10	1351774	480593	EIC370	FLD	02-Jun-94	16:01	2.4940	19.64
CC9	1351714	480594	EIC371	FLD	02-Jun-94	16:02	1.0520	-20.87
CC8	1351654	480596	EIC372	FLD	02-Jun-94	16:03	0.5260	-35.64
CC7	1351594	480597	EIC373	FLD	02-Jun-94	16:05	2.2360	12.39
CC5	1351474	480600	EIC375	FLD	02-Jun-94	16:07	1.4510	-9.66
AA5	1351473	480540	EIC376	FLD	02-Jun-94	16:08	2.3910	16.74
AA6	1351533	480539	EIC377	FLD	02-Jun-94	16:09	2.5260	20.54
AA6.5	1351563	480538	EIC378	FLD	02-Jun-94	16:10	0.6660	-31.71
AA7	1351593	480537	EIC379	FLD	02-Jun-94	16:11	2.6770	24.78
AA8	1351653	480536	EIC380	FLD	02-Jun-94	16:12	1.7450	-1.40
AA9	1351713	480534	EIC381	FLD	02-Jun-94	16:13	2.6920	25.20
AA9.5	1351743	480533	EIC382	FLD	02-Jun-94	16:14	1.7500	-1.26
AA10	1351760	480533	EIC383	FLD	02-Jun-94	16:14	2.6960	25.31
Z9.5	1351742	480503	EIC384	FLD	02-Jun-94	16:16	2.8300	29.07
Z9	1351712	480504	EIC385	FLD	02-Jun-94	16:17	3.2350	40.45
Z7	1351592	480507	EIC386	FLD	02-Jun-94	16:18	2.1620	10.31
Z6.5	1351562	480508	EIC387	FLD	02-Jun-94	16:28	0.9280	-24.35

Table G-3: Composite Data Listing for Electret Ionization Chamber Technology (continued)

[Negative total uranium values interpreted as below detection level. Leaders (--): not measured or not applicable]

Geo Loc	X Coord (feet)	Y Coord (feet)	ID	Type	Date	Time (EDT)	Raw Data (volts/hr)	Total U (pCi/g)
Z6	1351532	480509	EIC388	FLD	02-Jun-94	16:29	3.3110	42.59
Y5	1351471	480480	EIC389	FLD	02-Jun-94	16:30	4.2390	68.65
Y6	1351531	480479	EIC390	FLD	02-Jun-94	16:31	2.5230	20.45
Y6.5	1351561	480478	EIC391	FLD	02-Jun-94	16:32	3.7190	54.05
Y7	1351591	480477	EIC392	FLD	02-Jun-94	16:33	3.4580	46.72
Y7.5	1351621	480476	EIC393	FLD	02-Jun-94	16:34	1.9940	5.59
Y8	1351651	480476	EIC394	FLD	02-Jun-94	16:36	2.5230	20.45
Y8.5	1351681	480475	EIC395	FLD	02-Jun-94	16:37	1.5950	-5.62
Y9	1351711	480474	EIC396	FLD	02-Jun-94	16:37	4.4000	73.18
Y9.5	1351725	480474	EIC397	DUP†	02-Jun-94	16:38	2.0060	5.93
X9	1351711	480457	EIC398	FLD	02-Jun-94	16:39	3.8820	58.63
X8.5	1351680	480445	EIC399	FLD	02-Jun-94	16:40	2.8460	29.52
X7.5	1351620	480447	EIC401	FLD	02-Jun-94	16:41	1.6380	-4.41
X7	1351590	480447	EIC402	FLD	02-Jun-94	16:42	5.3280	99.24
W5	1351470	480420	EIC403	FLD	02-Jun-94	16:43	3.4250	45.79
W6	1351530	480419	EIC404	FLD	02-Jun-94	16:43	5.8090	112.75
W6.5	1351560	480418	EIC405	FLD	02-Jun-94	16:44	2.7060	25.59
W7	1351590	480417	EIC406	FLD	02-Jun-94	16:45	5.3080	98.68
W7.5	1351620	480420	EIC407	FLD	02-Jun-94	16:45	1.1560	-17.95
W8	1351650	480429	EIC408	FLD	02-Jun-94	16:46	2.1800	10.82
V6.5	1351559	480403	EIC409	FLD	02-Jun-94	16:48	2.4640	18.79
V6	1351529	480394	EIC410	DUP†	02-Jun-94	16:49	1.3040	-13.79
U9	1351708	480354	EIC411	FLD	02-Jun-94	16:53	2.1990	11.35
U5	1351468	480365	EIC412	FLD	02-Jun-94	16:49	2.7620	27.16
U7	1351588	480361	EIC413	DUP†	02-Jun-94	16:51	2.7540	26.94
W8.5	1351679	480400	EIC414	FLD	02-Jun-94	16:54	1.8840	2.50
W9	1351709	480412	EIC415	FLD	02-Jun-94	16:55	2.6170	23.09
V9	1351709	480384	EIC416	FLD	02-Jun-94	16:55	3.3480	43.63
S10	1351766	480293	EIC417	DUP†	02-Jun-94	16:57	2.6670	24.50
U10	1351768	480353	EIC418	DUP†	02-Jun-94	16:58	2.5260	20.54
U9.5	1351738	480353	EIC419	FLD	02-Jun-94	16:59	3.5660	49.75
V9.5	1351739	480383	EIC420	FLD	02-Jun-94	17:00	2.3810	16.46
V10	1351769	480383	EIC421	DUP†	02-Jun-94	17:01	2.2320	12.28
W10	1351769	480413	EIC422	DUP†	02-Jun-94	17:01	4.1790	66.97
W9.5	1351739	480413	EIC423	FLD	02-Jun-94	17:02	2.6870	25.06
Y10	1351771	480473	EIC424	DUP†	02-Jun-94	17:03	1.7910	-0.11
Z10	1351787	480502	EIC425	DUP†	02-Jun-94	17:04	2.5370	20.84
C200	--	--	EIC426	CAL	02-Jun-94	15:35	14.6170	--

Table G-3: Composite Data Listing for Electret Ionization Chamber Technology (continued)

[Negative total uranium values interpreted as below detection level. Leaders (--): not measured or not applicable]

Geo Loc	X Coord (feet)	Y Coord (feet)	ID	Type	Date	Time (EDT)	Raw Data (volts/hr)	Total U (pCi/g)
C200	--	--	EIC427	CAL	02-Jun-94	8:13	13.5590	--
C100	--	--	EIC428	CAL	02-Jun-94	15:40	12.0560	--
C100	--	--	EIC429	CAL	01-Jun-94	15:57	8.5910	--
C200	--	--	EIC430	CAL	01-Jun-94	17:02	11.7390	--
C100	--	--	EIC435	CAL	02-Jun-94	8:12	15.1340	--
C35	--	--	EIC436	CAL	02-Jun-94	15:43	4.3100	--
C35	--	--	EIC437	CAL	02-Jun-94	8:11	3.8340	--
C35	--	--	EIC438	CAL	01-Jun-94	16:50	6.1580	--
C0	--	--	EIC439	CAL	02-Jun-94	8:10	2.8340	--
C0	--	--	EIC440	CAL	02-Jun-94	16:32	2.8410	--
C0	--	--	EIC441	CAL	01-Jun-94	16:42	3.9880	--
F1	1351542	480529	EIC500	FLD	18-Jul-94	9:36	0.0000	-50.42
F2	1351547	480528	EIC501	FLD	18-Jul-94	10:34	0.5100	-36.09
F3	1351552	480528	EIC502	FLD	18-Jul-94	10:34	0.5400	-35.25
E1	1351542	480524	EIC503	FLD	18-Jul-94	10:34	0.7200	-30.20
E2	1351547	480523	EIC504	FLD	18-Jul-94	10:34	0.9100	-24.86
E3	1351552	480523	EIC505	FLD	18-Jul-94	10:34	1.4500	-9.69
D1	1351542	480519	EIC506	FLD	18-Jul-94	10:34	1.4500	-9.69
D2	1351547	480518	EIC507	FLD	18-Jul-94	10:34	0.1700	-45.64
D3	1351552	480518	EIC508	FLD	18-Jul-94	10:34	0.5200	-35.81
C1	1351748	480373	EIC509	FLD	18-Jul-94	10:48	1.0900	-19.80
C2	1351753	480373	EIC510	FLD	18-Jul-94	10:48	2.7200	25.98
C3	1351758	480373	EIC511	FLD	18-Jul-94	10:48	2.7200	25.98
B1	1351748	480368	EIC512	FLD	18-Jul-94	10:48	0.3600	-40.31
B2	1351753	480368	EIC513	FLD	18-Jul-94	10:48	2.3600	15.87
B3	1351758	480368	EIC514	FLD	18-Jul-94	10:48	1.2700	-14.75
A1	1351748	480363	EIC515	FLD	18-Jul-94	11:02	0.0000	-50.42
A2	1351753	480363	EIC516	FLD	18-Jul-94	11:02	1.7000	-2.67
A3	1351758	480363	EIC517	FLD	18-Jul-94	11:02	0.1900	-45.08
S1	1351541	480338	EIC518	STD	18-Jul-94	12:00	1.6200	-4.91
S2	1351508	480562	EIC519	STD	18-Jul-94	12:00	2.0800	8.01
CC6	1351534	480599	EIC520	FLD	18-Jul-94	12:00	1.3200	-13.34
X8	1351650	480446	EIC521	FLD	18-Jul-94	12:00	0.4400	-38.06
U6	1351528	480354	EIC522	FLD	18-Jul-94	12:00	0.8800	-25.70
S9	1351706	480294	EIC523	FLD	18-Jul-94	12:00	0.8800	-25.70
--	1351727	480596	EIC524	FLD	18-Jul-94	12:00	0.0000	-50.42
--	1351725	480580	EIC525	FLD	18-Jul-94	12:43	2.0800	8.01
--	1351655	480577	EIC526	FLD	18-Jul-94	12:43	1.0400	-21.21

Table G-3: Composite Data Listing for Electret Ionization Chamber Technology (continued)

[Negative total uranium values interpreted as below detection level. Leaders (--): not measured or not applicable]

Geo Loc	X Coord (feet)	Y Coord (feet)	ID	Type	Date	Time (EDT)	Raw Data (volts/hr)	Total U (pCi/g)
--	1351635	480597	EIC527	FLD	18-Jul-94	12:43	0.2600	-43.12
--	1351632	480445	EIC528	FLD	18-Jul-94	12:43	2.6000	22.61
--	1351631	480419	EIC529	FLD	18-Jul-94	12:43	0.0000	-50.42
--	1351576	480507	EIC530	FLD	18-Jul-94	12:58	3.8900	58.85
--	1351576	480536	EIC531	FLD	18-Jul-94	12:58	3.0600	35.54
--	1351474	480565	EIC532	FLD	18-Jul-94	12:58	1.0400	-21.21
--	1351671	480474	EIC533	FLD	18-Jul-94	12:58	0.7800	-28.51
C0	--	--	EIC534	CAL	18-Jul-94	13:41	0.6300	--
C0	--	--	EIC535	CAL	18-Jul-94	13:41	0.5200	--
C35	--	--	EIC536	CAL	18-Jul-94	13:41	1.3000	--
C35	--	--	EIC537	CAL	18-Jul-94	13:41	3.7500	--
C100	--	--	EIC538	CAL	18-Jul-94	13:41	1.2000	--
C100	--	--	EIC539	CAL	18-Jul-94	13:41	2.0300	--
CP	--	--	EIC540	CAL	18-Jul-94	13:55	6.2500	--
CP	--	--	EIC541	CAL	18-Jul-94	13:55	2.2900	--

†. The designation, "DUP" is in the original data base. The geolocation code and the coordinates indicate that this is not a duplicate sample.

Table G-4: Composite Data Listing for FIDLER Scintillometer Technology

[Negative total uranium values interpreted as below detection level. Leaders (--): not measured or not applicable]

Geo Loc	X Coord (feet)	Y Coord (feet)	ID	Type	Date	Time (EDT)	Raw Data (counts per minute)	Total U (pCi/g)
C0	--	--	FID006	CAL	02-Jun-94	08:08	469	--
C0	--	--	FID007	CAL	02-Jun-94	08:10	440	--
C0	--	--	FID008	CAL	02-Jun-94	08:12	440	--
C35	--	--	FID009	CAL	02-Jun-94	08:14	808	--
C35	--	--	FID010	CAL	02-Jun-94	08:16	783	--
C35	--	--	FID011	CAL	02-Jun-94	08:18	782	--
C100	--	--	FID012	CAL	02-Jun-94	08:20	918	--
C100	--	--	FID013	CAL	02-Jun-94	08:22	940	--
C100	--	--	FID014	CAL	02-Jun-94	08:24	969	--
C200	--	--	FID015	CAL	02-Jun-94	08:26	1633	--
C200	--	--	FID016	CAL	02-Jun-94	08:28	1622	--
C200	--	--	FID017	CAL	02-Jun-94	08:30	1582	--
S1	1351541	480338	FID018	STD	02-Jun-94	09:00	775	103.78
S1	1351541	480338	FID019	STD	02-Jun-94	09:02	752	97.27
S2	1351508	480562	FID020	STD	02-Jun-94	09:05	674	75.18
S2	1351508	480562	FID021	STD	02-Jun-94	09:07	755	98.12
CC5	1351474	480600	FID022	FLD	02-Jun-94	09:10	717	87.35
CC6	1351534	480599	FID024	FLD	02-Jun-94	09:15	727	90.19
CC7	1351594	480597	FID027	FLD	02-Jun-94	09:23	750	96.70
CC8	1351654	480596	FID029	FLD	02-Jun-94	09:28	726	89.90
CC9	1351714	480594	FID031	FLD	02-Jun-94	09:34	735	92.45
CC10	1351774	480593	FID033	FLD	02-Jun-94	09:39	713	86.22
CC11	1351834	480591	FID035	FLD	02-Jun-94	09:46	672	74.61
AA5	1351473	480540	FID038	FLD	02-Jun-94	09:55	663	72.06
AA6	1351533	480539	FID040	FLD	02-Jun-94	09:59	697	81.69
F1	1351542	480529	FID042	FLD	02-Jun-94	10:04	721	88.49
F2	1351547	480528	FID044	FLD	02-Jun-94	10:09	757	98.68
F3	1351552	480528	FID046	FLD	02-Jun-94	10:15	712	85.94
E3	1351552	480523	FID048	FLD	02-Jun-94	10:19	706	84.24
E2	1351547	480523	FID051	FLD	02-Jun-94	10:26	700	82.54
E1	1351542	480524	FID053	FLD	02-Jun-94	10:30	716	87.07
D1	1351542	480519	FID055	FLD	02-Jun-94	10:35	701	82.82
D2	1351547	480518	FID059	FLD	02-Jun-94	10:42	725	89.62
D3	1351552	480518	FID061	FLD	02-Jun-94	10:47	706	84.24
AA6.5	1351563	480538	FID063	FLD	02-Jun-94	12:33	721	88.49
AA7	1351593	480537	FID065	FLD	02-Jun-94	12:38	654	69.51
AA8	1351653	480536	FID067	FLD	02-Jun-94	12:42	681	77.16

Table G-4: Composite Data Listing for FIDLER Scintillometer Technology (continued)

[Negative total uranium values interpreted as below detection level. Leaders (--): not measured or not applicable]

Geo Loc	X Coord (feet)	Y Coord (feet)	ID	Type	Date	Time (EDT)	Raw Data (counts per minute)	Total U (pCi/g)
AA9	1351713	480534	FID070	FLD	02-Jun-94	12:50	676	75.74
AA9.5	1351743	480533	FID072	FLD	02-Jun-94	12:55	713	86.22
AA10	1351760	480533	FID074	FLD	02-Jun-94	12:59	692	80.27
AA11	1351833	480531	FID076	FLD	02-Jun-94	13:04	664	72.34
Z10	1351787	480502	FID078	FLD	02-Jun-94	13:10	663	72.06
Z9.5	1351742	480503	FID081	FLD	02-Jun-94	13:18	711	85.66
Z9	1351712	480504	FID082	FLD	02-Jun-94	13:21	699	82.26
S1	1351541	480338	FID083	STD	02-Jun-94	13:24	740	93.87
S2	1351508	480562	FID084	STD	02-Jun-94	13:27	698	81.97
S1	1351541	480338	FID095	STD	03-Jun-94	13:21	752	97.27
S2	1351508	480562	FID096	STD	03-Jun-94	13:26	729	90.75
Z7	1351592	480507	FID097	FLD	03-Jun-94	13:30	681	77.16
Z6.5	1351562	480508	FID098	FLD	03-Jun-94	13:32	740	93.87
Z6	1351532	480509	FID099	FLD	03-Jun-94	13:35	704	83.67
Y5	1351471	480480	FID100	FLD	03-Jun-94	13:37	694	80.84
Y6	1351531	480479	FID101	FLD	03-Jun-94	13:40	685	78.29
Y6.5	1351561	480478	FID103	FLD	03-Jun-94	13:45	652	68.95
Y7	1351591	480477	FID104	FLD	03-Jun-94	13:47	719	87.92
Y7.5	1351621	480476	FID105	FLD	03-Jun-94	13:50	773	103.21
Y8	1351651	480476	FID106	FLD	03-Jun-94	13:54	706	84.24
Y8.5	1351681	480475	FID107	FLD	03-Jun-94	13:56	699	82.26
Y9	1351711	480474	FID108	FLD	03-Jun-94	13:59	722	88.77
Y9.5	1351725	480474	FID109	FLD	03-Jun-94	14:01	655	69.80
Y10	1351771	480473	FID110	FLD	03-Jun-94	14:04	712	85.94
Y11	1351831	480471	FID111	FLD	03-Jun-94	14:06	836	121.06
X7	1351590	480447	FID114	FLD	03-Jun-94	14:16	715	86.79
X7.5	1351620	480447	FID115	FLD	03-Jun-94	14:19	666	72.91
X8	1351650	480446	FID116	FLD	03-Jun-94	14:21	698	81.97
X8.5	1351680	480445	FID117	FLD	03-Jun-94	14:25	677	76.03
X9	1351711	480457	FID118	FLD	03-Jun-94	14:27	733	91.89
W11	1351829	480411	FID119	FLD	03-Jun-94	14:31	742	94.43
W10	1351769	480413	FID120	FLD	03-Jun-94	14:35	688	79.14
W9	1351709	480412	FID121	FLD	03-Jun-94	14:41	716	87.07
W8.5	1351679	480400	FID122	FLD	03-Jun-94	14:45	735	92.45
W8	1351650	480429	FID123	FLD	03-Jun-94	14:48	688	79.14
S1	1351541	480338	FID124	STD	03-Jun-94	14:51	751	96.98
S1	1351541	480338	FID125	STD	03-Jun-94	14:54	740	93.87
S2	1351508	480562	FID126	STD	03-Jun-94	14:57	676	75.74

Table G-4: Composite Data Listing for FIDLER Scintillometer Technology (continued)
[Negative total uranium values interpreted as below detection level. Leaders (--): not measured or not applicable]

Geo Loc	X Coord (feet)	Y Coord (feet)	ID	Type	Date	Time (EDT)	Raw Data (counts per minute)	Total U (pCi/g)
S1	1351541	480338	FID137	STD	06-Jun-94	10:28	763	100.38
S2	1351508	480562	FID138	STD	06-Jun-94	10:31	716	87.07
W7.5	1351620	480420	FID139	FLD	06-Jun-94	10:36	773	103.21
W7	1351590	480417	FID140	FLD	06-Jun-94	10:39	751	96.98
W6.5	1351560	480418	FID141	FLD	06-Jun-94	10:42	778	104.63
W6	1351530	480419	FID142	FLD	06-Jun-94	10:45	771	102.65
W5	1351470	480420	FID143	FLD	06-Jun-94	10:47	717	87.35
V6	1351529	480394	FID144	FLD	06-Jun-94	10:52	741	94.15
V6.5	1351559	480403	FID145	FLD	06-Jun-94	10:54	787	107.18
U5	1351468	480365	FID147	FLD	06-Jun-94	12:10	650	68.38
U6	1351528	480354	FID148	FLD	06-Jun-94	12:14	689	79.42
U6.5	1351558	480358	FID149	FLD	06-Jun-94	12:16	711	85.66
U7	1351588	480361	FID150	FLD	06-Jun-94	12:20	763	100.38
U8	1351648	480366	FID151	FLD	06-Jun-94	12:22	784	106.33
U9	1351708	480354	FID152	FLD	06-Jun-94	12:25	723	89.05
V9	1351709	480384	FID153	FLD	06-Jun-94	12:27	693	80.56
V9.5	1351739	480383	FID154	FLD	06-Jun-94	12:30	646	67.25
V10	1351769	480383	FID155	FLD	06-Jun-94	12:32	648	67.81
C1	1351748	480373	FID156	FLD	06-Jun-94	12:36	680	76.88
C2	1351753	480373	FID157	FLD	06-Jun-94	12:38	670	74.04
C3	1351758	480373	FID159	FLD	06-Jun-94	12:43	673	74.89
B3	1351758	480368	FID160	FLD	06-Jun-94	12:45	657	70.36
B2	1351753	480368	FID161	FLD	06-Jun-94	12:47	616	58.75
B1	1351748	480368	FID162	FLD	06-Jun-94	12:50	655	69.80
A1	1351748	480363	FID163	FLD	06-Jun-94	12:52	648	67.81
A2	1351753	480363	FID164	FLD	06-Jun-94	12:55	636	64.42
A3	1351758	480363	FID165	FLD	06-Jun-94	12:57	675	75.46
U9.5	1351738	480353	FID166	FLD	06-Jun-94	13:00	658	70.65
U10	1351768	480353	FID167	FLD	06-Jun-94	13:02	680	76.88
U11	1351828	480351	FID168	FLD	06-Jun-94	13:05	697	81.69
S11	1351826	480291	FID170	FLD	06-Jun-94	13:14	610	57.05
S10	1351766	480293	FID171	FLD	06-Jun-94	13:17	684	78.01
S9	1351706	480294	FID172	FLD	06-Jun-94	13:21	738	93.30
S5	1351466	480300	FID173	FLD	06-Jun-94	13:25	681	77.16
S1	1351541	480338	FID174	STD	06-Jun-94	13:28	705	83.96
S2	1351508	480562	FID175	STD	06-Jun-94	13:31	732	91.60
C0	--	--	FID176	CAL	06-Jun-94	13:43	449	--
C0	--	--	FID177	CAL	06-Jun-94	13:45	442	--

Table G-4: Composite Data Listing for FIDLER Scintillometer Technology (continued)
[Negative total uranium values interpreted as below detection level. Leaders (--): not measured or not applicable]

Geo Loc	X Coord (feet)	Y Coord (feet)	ID	Type	Date	Time (EDT)	Raw Data (counts per minute)	Total U (pCi/g)
C35	--	--	FID178	CAL	06-Jun-94	13:55	781	--
C35	--	--	FID179	CAL	06-Jun-94	13:57	735	--
C100	--	--	FID180	CAL	06-Jun-94	13:59	964	--
C100	--	--	FID181	CAL	06-Jun-94	14:01	909	--
C100	--	--	FID182	CAL	06-Jun-94	14:03	913	--
C200	--	--	FID183	CAL	06-Jun-94	14:06	1519	--
C200	--	--	FID184	CAL	06-Jun-94	14:08	1541	--
S1	1351541	480338	FID195	STD	09-Jun-94	10:51	683	77.73
S1	1351541	480338	FID196	STD	09-Jun-94	10:53	711	85.66
S2	1351508	480562	FID197	STD	09-Jun-94	11:03	638	64.98
S2	1351508	480562	FID198	STD	09-Jun-94	11:05	613	57.90
S1	1351541	480338	FID210	STD	10-Jun-94	09:49	777	104.35
S1	1351541	480338	FID211	STD	10-Jun-94	09:51	769	102.08
S2	1351508	480562	FID212	STD	10-Jun-94	09:57	683	77.73
S2	1351508	480562	FID213	STD	10-Jun-94	09:59	668	73.48
C0	--	--	FID214	CAL	10-Jun-94	10:13	463	--
C0	--	--	FID215	CAL	10-Jun-94	10:15	481	--
C0	--	--	FID216	CAL	10-Jun-94	10:17	479	--
C0	--	--	FID217	CAL	10-Jun-94	10:20	465	--
C0	--	--	FID218	CAL	10-Jun-94	10:23	475	--
C35	--	--	FID219	CAL	10-Jun-94	10:26	785	--
C35	--	--	FID220	CAL	10-Jun-94	10:28	767	--
C35	--	--	FID221	CAL	10-Jun-94	10:31	748	--
C35	--	--	FID222	CAL	10-Jun-94	10:34	764	--
C35	--	--	FID223	CAL	10-Jun-94	10:36	762	--
C35	--	--	FID224	CAL	10-Jun-94	10:38	797	--
C100	--	--	FID225	CAL	10-Jun-94	10:40	909	--
C100	--	--	FID226	CAL	10-Jun-94	10:42	937	--
C100	--	--	FID227	CAL	10-Jun-94	10:45	897	--
C100	--	--	FID228	CAL	10-Jun-94	10:47	953	--
C100	--	--	FID229	CAL	10-Jun-94	10:49	921	--
C200	--	--	FID230	CAL	10-Jun-94	10:53	1556	--
C200	--	--	FID231	CAL	10-Jun-94	10:56	1561	--
C200	--	--	FID232	CAL	10-Jun-94	10:58	1638	--
C200	--	--	FID233	CAL	10-Jun-94	11:01	1543	--
C200	--	--	FID234	CAL	10-Jun-94	11:03	1581	--
S1	1351541	480338	FID245	STD	13-Jun-94	09:36	678	76.31
S1	1351541	480338	FID246	STD	13-Jun-94	09:39	650	68.38

Table G-4: Composite Data Listing for FIDLER Scintillometer Technology (continued)

[Negative total uranium values interpreted as below detection level. Leaders (--): not measured or not applicable]

Geo Loc	X Coord (feet)	Y Coord (feet)	ID	Type	Date	Time (EDT)	Raw Data (counts per minute)	Total U (pCi/g)
S2	1351508	480562	FID247	STD	13-Jun-94	09:49	600	54.22
S2	1351508	480562	FID248	STD	13-Jun-94	09:51	627	61.87
S1	1351541	480338	FID259	STD	14-Jun-94	13:07	660	71.21
S1	1351541	480338	FID260	STD	14-Jun-94	13:09	686	78.58
S2	1351508	480562	FID261	STD	14-Jun-94	13:20	632	63.28
S2	1351508	480562	FID262	STD	14-Jun-94	13:22	642	66.11
S1	1351541	480338	FID273	STD	16-Jun-94	09:20	745	95.28
S1	1351541	480338	FID274	STD	16-Jun-94	09:22	740	93.87
S2	1351508	480562	FID275	STD	16-Jun-94	09:32	668	73.48
S2	1351508	480562	FID276	STD	16-Jun-94	09:34	705	83.96
S1	1351541	480338	FID287	STD	17-Jun-94	10:41	729	90.75
S1	1351541	480338	FID288	STD	17-Jun-94	10:43	728	90.47
S2	1351508	480562	FID289	STD	17-Jun-94	10:47	686	78.58
S2	1351508	480562	FID290	STD	17-Jun-94	10:49	722	88.77
S2	1351508	480562	FID296	STD	23-Jun-94	10:37	695	81.12
S1	1351541	480338	FID297	STD	23-Jun-94	10:42	772	102.93
W9.5	1351739	480413	FID298	FLD	23-Jun-94	10:47	687	78.86
--	1351811	480313	FID300	FLD	23-Jun-94	10:50	413	1.26
--	1351810	480293	FID301	FLD	23-Jun-94	10:53	372	-10.35
--	1351825	480314	FID302	FLD	23-Jun-94	10:56	609	56.77
C0	--	--	FID303	CAL	23-Jun-94	11:47	454	--
C0	--	--	FID304	CAL	23-Jun-94	11:49	440	--
C0	--	--	FID305	CAL	23-Jun-94	11:51	455	--
C35	--	--	FID306	CAL	23-Jun-94	11:56	748	--
C35	--	--	FID307	CAL	23-Jun-94	11:58	794	--
C35	--	--	FID308	CAL	23-Jun-94	12:00	773	--
C100	--	--	FID309	CAL	23-Jun-94	12:02	898	--
C100	--	--	FID310	CAL	23-Jun-94	12:04	928	--
CP	--	--	FID311	CAL	23-Jun-94	12:07	551	--
CP	--	--	FID312	CAL	23-Jun-94	12:09	513	--
CP	--	--	FID313	CAL	23-Jun-94	12:11	534	--

Table G-5: Composite Data Listing for High-Mount Gamma Spectrometer Technology

[F* - Soil moisture correction factor (not applicable to sample type CAL); Adj.: adjusted (see text). Leaders (--): not measured or not applicable]

GeoLoc	X Coord (feet)	Y Coord (feet)	ID	Type	Date	Time (EDT)	Raw U-238 (pCi/g)	Raw U-235 (pCi/g)	Total U (pCi/g)	F*	Adj. Total U (pCi/g)
C0	--	--	GMH001	CAL	10-Jul-94	11:25	1.94	0.09	--	--	--
C35	--	--	GMH002	CAL	10-Jul-94	12:00	34.60	1.67	--	--	--
C100	--	--	GMH003	CAL	10-Jul-94	12:31	46.00	2.26	--	--	--
AA8	1351653	480536	GMH004	DUP†	10-Jul-94	17:10	21.50	1.12	63.61	1.000	63.61
S1	1351541	480338	GMH005	STD	11-Jul-94	09:30	27.70	1.44	82.73	1.000	82.73
X7	1351590	480447	GMH006	FLD	11-Jul-94	10:44	23.80	1.19	70.70	1.000	70.70
Y7	1351591	480477	GMH007	FLD	11-Jul-94	11:17	23.40	1.20	69.47	1.000	69.47
Z7	1351592	480507	GMH008	FLD	11-Jul-94	11:37	20.90	1.04	61.76	1.000	61.76
AA7	1351593	480537	GMH009	FLD	11-Jul-94	12:00	21.80	1.04	64.54	1.000	64.54
CC7	1351594	480597	GMH010	FLD	11-Jul-94	12:22	19.30	0.96	56.83	1.000	56.83
CC6	1351534	480599	GMH011	FLD	11-Jul-94	12:43	19.00	0.85	55.90	1.000	55.90
AA6	1351533	480539	GMH012	FLD	11-Jul-94	13:03	19.20	0.92	56.52	1.000	56.52
Z6	1351532	480509	GMH013	FLD	11-Jul-94	14:18	18.60	0.94	54.67	1.000	54.67
Y6	1351531	480479	GMH014	FLD	11-Jul-94	14:40	20.80	1.03	61.45	1.000	61.45
W6	1351530	480419	GMH015	FLD	11-Jul-94	13:00	22.90	1.16	67.93	1.000	67.93
V6	1351529	480394	GMH016	FLD	11-Jul-94	15:23	21.20	1.05	62.68	1.000	62.68
U6	1351528	480354	GMH017	FLD	11-Jul-94	16:03	22.30	1.13	66.08	1.000	66.08
S1	1351541	480338	GMH018	STD	11-Jul-94	16:34	28.60	1.47	85.51	1.000	85.51
U6.5	1351558	480358	GMH019	FLD	11-Jul-94	16:56	27.70	1.46	82.73	1.000	82.73
U7	1351588	480361	GMH020	FLD	11-Jul-94	17:28	27.20	1.43	81.19	1.000	81.19
V6.5	1351559	480403	GMH021	FLD	11-Jul-94	18:00	24.80	1.18	73.79	1.000	73.79
CC5	1351474	480600	GMH022	FLD	11-Jul-94	18:23	17.20	0.81	50.35	1.000	50.35
S2	1351508	480562	GMH023	STD	11-Jul-94	18:48	17.90	0.94	52.51	1.000	52.51
AA5	1351473	480540	GMH024	FLD	11-Jul-94	19:08	18.10	0.88	53.12	1.000	53.12
Y5	1351471	480480	GMH025	FLD	11-Jul-94	19:32	17.80	0.85	52.20	1.000	52.20
S2	1351508	480562	GMH026	STD	12-Jul-94	09:54	18.50	0.91	54.36	1.000	54.36
S1	1351541	480338	GMH027	STD	12-Jul-94	10:20	28.70	1.51	85.81	1.000	85.81
S5	1351466	480300	GMH028	FLD	12-Jul-94	10:43	20.00	0.95	58.98	1.000	58.98
U5	1351468	480365	GMH029	FLD	12-Jul-94	11:06	16.20	0.87	47.26	1.000	47.26
W5	1351470	480420	GMH030	FLD	12-Jul-94	11:35	17.40	0.93	50.97	1.000	50.97
E2	1351547	480523	GMH031	FLD	12-Jul-94	12:13	19.10	0.96	56.21	1.000	56.21
Z6.5	1351562	480508	GMH032	FLD	12-Jul-94	14:02	20.10	1.12	59.29	1.000	59.29
AA6.5	1351563	480538	GMH033	FLD	12-Jul-94	14:34	19.80	1.00	58.37	1.000	58.37
W6.5	1351560	480418	GMH034	FLD	12-Jul-94	15:00	25.80	1.34	76.87	1.000	76.87
Y6.5	1351561	480478	GMH035	FLD	12-Jul-94	15:24	20.50	1.05	60.53	1.000	60.53
Y7.5	1351621	480476	GMH036	FLD	12-Jul-94	15:48	24.30	1.32	72.25	1.000	72.25
X7.5	1351620	480447	GMH037	FLD	12-Jul-94	16:10	24.00	1.18	71.32	1.000	71.32
W7.5	1351620	480420	GMH038	FLD	12-Jul-94	16:35	24.30	1.26	72.25	1.000	72.25
U8	1351648	480366	GMH039	FLD	12-Jul-94	16:56	30.00	1.49	89.82	1.000	89.82
W8	1351650	480429	GMH040	FLD	12-Jul-94	17:23	23.10	1.24	68.54	1.000	68.54
X8	1351650	480446	GMH041	FLD	12-Jul-94	17:45	24.90	1.28	74.10	1.000	74.10
Y8	1351651	480476	GMH042	FLD	12-Jul-94	18:12	24.60	1.32	73.17	1.000	73.17

Table G-5: Composite Data Listing for High-Mount Gamma Spectrometer Technology (continued)

[F* - Soil moisture correction factor (not applicable to sample type CAL); Adj.: adjusted (see text). Leaders (--): not measured or not applicable]

GeoLoc	X Coord (feet)	Y Coord (feet)	ID	Type	Date	Time (EDT)	Raw U-238 (pCi/g)	Raw U-235 (pCi/g)	Total U (pCi/g)	F*	Adj. Total U (pCi/g)
AA8	1351653	480536	GMH043	FLD	12-Jul-94	18:41	23.20	1.19	68.85	1.000	68.85
CC8	1351654	480596	GMH044	FLD	12-Jul-94	19:08	20.80	1.03	61.45	1.000	61.45
S2	1351508	480562	GMH045	STD	12-Jul-94	19:28	18.70	0.96	54.97	1.000	54.97
S1	1351541	480338	GMH046	STD	12-Jul-94	19:50	28.80	1.52	86.12	1.000	86.12
S2	1351508	480562	GMH047	STD	13-Jul-94	08:55	19.10	0.99	56.21	1.000	56.21
S1	1351541	480338	GMH048	STD	13-Jul-94	09:43	28.00	1.52	83.66	1.000	83.66
W7	1351590	480417	GMH049	FLD	13-Jul-94	10:06	27.10	1.34	80.88	1.000	80.88
Y8.5	1351681	480475	GMH050	FLD	13-Jul-94	10:25	24.70	1.26	73.48	1.000	73.48
X8.5	1351680	480445	GMH051	FLD	13-Jul-94	10:51	23.20	1.27	68.85	1.000	68.85
W8.5	1351679	480400	GMH052	FLD	13-Jul-94	11:11	26.60	1.39	79.34	1.000	79.34
X9	1351711	480457	GMH053	FLD	13-Jul-94	11:33	22.80	1.07	67.62	1.000	67.62
Y9	1351711	480474	GMH054	FLD	13-Jul-94	11:54	24.20	1.10	71.94	1.000	71.94
Z9	1351712	480504	GMH055	FLD	13-Jul-94	12:21	23.20	1.15	68.85	1.000	68.85
AA9	1351713	480534	GMH056	FLD	13-Jul-94	12:50	21.30	1.15	62.99	1.000	62.99
S9	1351706	480294	GMH057	FLD	13-Jul-94	16:27	26.00	1.30	77.49	1.000	77.49
U9	1351708	480354	GMH058	FLD	13-Jul-94	17:00	22.20	1.08	65.77	1.000	65.77
S1	1351541	480338	GMH059	STD	16-Jul-94	12:07	23.30	1.27	69.16	1.000	69.16
S2	1351508	480562	GMH060	STD	16-Jul-94	11:14	14.90	0.74	43.26	1.231	53.25
S1	1351541	480338	GMH061	STD	16-Jul-94	11:35	23.10	1.17	68.54	1.231	84.38
S11	1351826	480291	GMH062	FLD	16-Jul-94	11:55	9.40	0.50	26.29	1.231	32.37
S10	1351766	480293	GMH063	FLD	16-Jul-94	12:08	14.80	0.83	42.95	1.231	52.87
U10	1351768	480353	GMH064	FLD	16-Jul-94	12:20	16.30	0.91	47.57	1.231	58.56
U9.5	1351738	480353	GMH065	FLD	16-Jul-94	12:34	16.90	0.96	49.42	1.231	60.84
A1	1351748	480363	GMH066	FLD	16-Jul-94	12:46	17.50	0.76	51.27	1.231	63.12
A2	1351753	480363	GMH067	FLD	16-Jul-94	12:57	16.70	0.95	48.81	1.231	60.08
A3	1351758	480363	GMH068	FLD	16-Jul-94	13:09	16.00	0.91	46.65	1.231	57.42
B3	1351758	480368	GMH069	FLD	16-Jul-94	13:23	15.90	0.87	46.34	1.231	57.04
B2	1351753	480368	GMH070	FLD	16-Jul-94	13:38	15.30	0.88	44.49	1.231	54.77
B1	1351748	480368	GMH071	FLD	16-Jul-94	13:53	16.10	0.84	46.96	1.231	57.80
C1	1351748	480373	GMH072	FLD	16-Jul-94	14:07	14.70	0.78	42.64	1.231	52.49
C2	1351753	480373	GMH073	FLD	16-Jul-94	14:19	15.60	0.82	45.41	1.231	55.91
C3	1351758	480373	GMH074	DUP†	16-Jul-94	14:31	23.80	1.20	70.70	1.231	87.04
V10	1351769	480383	GMH075	FLD	16-Jul-94	15:04	14.80	0.74	42.95	1.231	52.87
U11	1351828	480351	GMH076	FLD	16-Jul-94	15:25	13.50	0.75	38.94	1.231	47.93
W11	1351829	480411	GMH077	FLD	16-Jul-94	15:36	14.10	0.68	40.79	1.231	50.21
W10	1351769	480413	GMH078	FLD	16-Jul-94	15:48	15.40	0.94	44.80	1.231	55.15
W9.5	1351739	480413	GMH079	FLD	16-Jul-94	16:03	15.70	0.98	45.72	1.231	56.28
W9	1351709	480412	GMH080	FLD	16-Jul-94	16:14	16.50	0.86	48.19	1.231	59.32
V9	1351709	480384	GMH081	FLD	16-Jul-94	16:30	19.80	1.15	58.37	1.231	71.85
V9.5	1351739	480383	GMH082	FLD	16-Jul-94	16:42	14.60	0.83	42.33	1.231	52.11
Y10	1351771	480473	GMH083	FLD	16-Jul-94	16:57	16.60	0.85	48.50	1.231	59.7
Y11	1351831	480471	GMH084	FLD	16-Jul-94	17:11	19.70	0.94	58.06	1.231	71.47
Z10	1351787	480502	GMH085	FLD	16-Jul-94	17:22	16.30	0.78	47.57	1.231	58.56

Table G-5: Composite Data Listing for High-Mount Gamma Spectrometer Technology (continued)

[F* - Soil moisture correction factor (not applicable to sample type CAL); Adj.: adjusted (see text). Leaders (--): not measured or not applicable]

GeoLoc	X Coord (feet)	Y Coord (feet)	ID	Type	Date	Time (EDT)	Raw U-238 (pCi/g)	Raw U-235 (pCi/g)	Total U (pCi/g)	F*	Adj. Total U (pCi/g)
AA11	1351833	480531	GMH086	FLD	16-Jul-94	17:38	15.60	0.65	45.41	1.231	55.91
CC11	1351834	480591	GMH087	FLD	16-Jul-94	17:54	7.40	0.37	20.13	1.231	24.77
CC10	1351774	480593	GMH088	FLD	16-Jul-94	18:08	15.80	0.89	46.03	1.231	56.66
CC9	1351714	480594	GMH089	FLD	16-Jul-94	18:22	16.00	0.87	46.65	1.231	57.42
AA9.5	1351743	480533	GMH090	FLD	16-Jul-94	18:33	19.30	0.92	56.83	1.231	69.95
AA10	1351760	480533	GMH091	FLD	16-Jul-94	18:45	16.60	0.92	48.50	1.231	59.70
Z9.5	1351742	480503	GMH092	FLD	16-Jul-94	18:56	17.20	0.93	50.35	1.231	61.98
Y9.5	1351725	480474	GMH093	FLD	16-Jul-94	19:08	17.00	0.96	49.73	1.231	61.22
S2	1351508	480562	GMH094	STD	16-Jul-94	19:21	14.60	0.68	42.33	1.231	52.11
S1	1351541	480338	GMH095	STD	16-Jul-94	19:33	24.00	1.23	71.32	1.231	87.79
S1	1351541	480338	GMH096	STD	17-Jul-94	09:07	14.60	0.65	42.33	1.254	53.08
S2	1351508	480562	GMH097	STD	17-Jul-94	09:19	15.50	0.74	45.11	1.254	56.56
F1	1351542	480529	GMH098	FLD	17-Jul-94	09:31	16.50	0.75	48.19	1.254	60.43
F2	1351547	480528	GMH099	FLD	17-Jul-94	09:48	16.30	0.76	47.57	1.254	59.66
F3	1351552	480528	GMH100	FLD	17-Jul-94	10:00	15.90	0.80	46.34	1.254	58.11
E3	1351552	480523	GMH101	FLD	17-Jul-94	10:17	16.30	0.80	47.57	1.254	59.66
D3	1351552	480518	GMH102	FLD	17-Jul-94	10:29	17.10	0.80	50.04	1.254	62.75
D2	1351547	480518	GMH103	FLD	17-Jul-94	10:41	16.20	0.85	47.26	1.254	59.27
D1	1351542	480519	GMH104	FLD	17-Jul-94	10:55	16.60	0.86	48.50	1.254	60.82
E1	1351542	480524	GMH105	FLD	17-Jul-94	11:19	15.70	0.69	45.72	1.254	57.34
C3	1351758	480373	GMH106	FLD	17-Jul-94	11:42	15.90	0.75	46.34	1.254	58.11

† The designation, "DUP" is in the original data base. The geolocation code and the coordinates indicate that this is not a duplicate sample.

Table G-6: Composite Data Listing for Low-Mount Gamma Spectrometer Technology

[F* - Soil moisture correction factor (not applicable to sample types CAL or STD); Adj.: adjusted (see text). Leaders (--): not measured or not applicable]

Geo Loc	X Coord (feet)	Y Coord (feet)	ID	Type	Date	Time (EDT)	Raw U238 (pCi/g)	Raw U235 (pCi/g)	Total U (pCi/g)	F*	Adj. Total U (pCi/g)
C35	--	--	GML001	CAL	10-Jul-94	11:25	36.70	1.82	--	--	--
C0	--	--	GML002	CAL	10-Jul-94	12:00	1.91	0.07	--	--	--
C100	--	--	GML003	CAL	10-Jul-94	13:00	50.90	2.55	--	--	--
AA9	1351713	480534	GML004	FLD	10-Jul-94	17:20	21.00	1.02	58.45	1.000	58.45
U6.5	1351558	480358	GML005	FLD	11-Jul-94	09:32	31.10	1.53	87.92	1.000	87.92
S1	1351541	480338	GML006	STD	11-Jul-94	10:08	29.90	1.60	84.42	1.000	84.42
W7	1351590	480417	GML007	FLD	11-Jul-94	10:37	27.90	1.47	78.59	1.000	78.59
X7	1351590	480447	GML008	FLD	11-Jul-94	11:20	26.40	1.37	74.21	1.000	74.21
Y7	1351591	480477	GML009	FLD	11-Jul-94	11:43	23.50	1.22	65.75	1.000	65.75
Z7	1351592	480507	GML010	FLD	11-Jul-94	12:04	20.50	1.09	56.99	1.000	56.99
AA7	1351593	480537	GML011	FLD	11-Jul-94	12:25	20.60	1.08	57.28	1.000	57.28
CC7	1351594	480597	GML012	FLD	11-Jul-94	12:47	20.90	1.08	58.16	1.000	58.16
CC6	1351534	480599	GML013	FLD	11-Jul-94	13:09	21.60	1.06	60.20	1.000	60.20
AA6	1351533	480539	GML014	FLD	11-Jul-94	14:22	17.80	0.89	49.11	1.000	49.11
Z6	1351532	480509	GML015	FLD	11-Jul-94	14:45	19.70	1.03	54.66	1.000	54.66
Y6	1351531	480479	GML016	FLD	11-Jul-94	15:04	20.40	1.11	56.70	1.000	56.70
W6	1351530	480419	GML017	FLD	11-Jul-94	15:28	22.90	1.29	64.00	1.000	64.00
V6	1351529	480394	GML018	FLD	11-Jul-94	16:04	25.60	1.31	71.87	1.000	71.87
U6	1351528	480354	GML019	FLD	11-Jul-94	16:37	26.30	1.23	73.92	1.000	73.92
S1	1351541	480338	GML020	STD	11-Jul-94	17:01	32.20	1.60	91.13	1.000	91.13
V6.5	1351559	480403	GML021	FLD	11-Jul-94	17:31	28.40	1.44	80.05	1.000	80.05
W6.5	1351560	480418	GML022	FLD	11-Jul-94	17:51	28.20	1.48	79.46	1.000	79.46
S2	1351508	480562	GML023	STD	11-Jul-94	18:21	19.00	1.03	52.62	1.000	52.62
CC5	1351474	480600	GML024	FLD	11-Jul-94	18:51	16.70	0.87	45.90	1.000	45.90
Y5	1351471	480480	GML025	FLD	11-Jul-94	19:12	20.00	0.91	55.53	1.000	55.53
AA5	1351473	480540	GML026	FLD	11-Jul-94	19:34	18.40	0.90	50.86	1.000	50.86
S1	1351541	480338	GML027	STD	12-Jul-94	10:00	31.30	1.70	88.51	1.000	88.51
S2	1351508	480562	GML028	STD	12-Jul-94	10:27	20.00	0.99	55.53	1.000	55.53
W5	1351470	480420	GML029	FLD	12-Jul-94	10:50	20.40	1.08	56.70	1.000	56.70
U5	1351468	480365	GML030	FLD	12-Jul-94	11:41	19.20	1.00	53.20	1.000	53.20
E2	1351547	480523	GML031	FLD	12-Jul-94	12:10	19.90	1.04	55.24	1.000	55.24
AA6.5	1351563	480538	GML032	FLD	12-Jul-94	13:56	19.30	1.06	53.49	1.000	53.49
Z6.5	1351562	480508	GML033	FLD	12-Jul-94	14:35	23.00	1.15	64.29	1.000	64.29
Y6.5	1351561	480478	GML034	FLD	12-Jul-94	15:04	23.10	1.12	64.58	1.000	64.58
U6.5	1351558	480358	GML035	DUP†	12-Jul-94	15:29	32.10	1.68	90.84	1.000	90.84
W7.5	1351620	480420	GML036	FLD	12-Jul-94	15:54	28.40	1.50	80.05	1.000	80.05
Y7.5	1351621	480476	GML037	FLD	12-Jul-94	16:16	28.70	1.42	80.92	1.000	80.92
X7.5	1351620	480447	GML038	FLD	12-Jul-94	16:39	22.70	1.13	63.41	1.000	63.41
W8	1351650	480429	GML039	FLD	12-Jul-94	17:00	24.90	1.31	69.83	1.000	69.83
U8	1351648	480366	GML040	FLD	12-Jul-94	17:28	34.50	1.76	97.85	1.000	97.85
Y8	1351651	480476	GML041	FLD	12-Jul-94	17:53	25.60	1.38	71.87	1.000	71.87
X8	1351650	480446	GML042	FLD	12-Jul-94	18:18	26.10	1.34	73.33	1.000	73.33

Table G-6: Composite Data Listing for Low-Mount Gamma Spectrometer Technology (continued)

[F* - Soil moisture correction factor (not applicable to sample types CAL or STD); Adj.: adjusted (see text). Leaders (--): not measured or not applicable]

Geo Loc	X Coord (feet)	Y Coord (feet)	ID	Type	Date	Time (EDT)	Raw U238 (pCi/g)	Raw U235 (pCi/g)	Total U (pCi/g)	F*	Adj. Total U (pCi/g)
CC8	1351654	480596	GML043	FLD	12-Jul-94	18:46	21.70	1.19	60.49	1.000	60.49
AA8	1351653	480536	GML044	FLD	12-Jul-94	19:11	25.40	1.32	71.29	1.000	71.29
S1	1351541	480338	GML045	STD	12-Jul-94	19:35	31.70	1.69	89.68	1.000	89.68
S2	1351508	480562	GML046	STD	12-Jul-94	19:56	20.20	1.12	56.12	1.000	56.12
S1	1351541	480338	GML047	STD	13-Jul-94	08:51	32.50	1.67	92.01	1.000	92.01
S2	1351508	480562	GML048	STD	13-Jul-94	09:38	20.00	1.11	55.53	1.000	55.53
Y8.5	1351681	480475	GML049	FLD	13-Jul-94	10:00	27.20	1.52	76.54	1.000	76.54
X8.5	1351680	480445	GML050	FLD	13-Jul-94	10:19	25.00	1.35	70.12	1.000	70.12
W8.5	1351679	480400	GML051	FLD	13-Jul-94	10:45	31.10	1.60	87.92	1.000	87.92
X9	1351711	480457	GML052	FLD	13-Jul-94	11:07	26.70	1.38	75.08	1.000	75.08
Y9	1351711	480474	GML053	FLD	13-Jul-94	11:27	25.10	1.29	70.42	1.000	70.42
Z9	1351712	480504	GML054	FLD	13-Jul-94	11:50	24.80	1.27	69.54	1.000	69.54
AA9	1351713	480534	GML055	DUP†	13-Jul-94	12:15	21.20	1.14	59.04	1.000	59.04
CC9	1351714	480594	GML056	FLD	13-Jul-94	12:44	24.50	1.27	68.67	1.000	68.67
U9	1351708	480354	GML057	FLD	13-Jul-94	14:26	26.20	1.37	73.63	1.000	73.63
V9	1351709	480384	GML058	FLD	13-Jul-94	16:25	24.30	1.32	68.08	1.000	68.08
S5	1351466	480300	GML059	FLD	17-Jul-94	12:02	18.40	0.87	50.86	1.217	61.90
S1	1351541	480338	GML060	STD	17-Jul-94	12:26	25.60	1.37	71.87	1.268	91.14
S2	1351508	480562	GML061	STD	17-Jul-94	12:43	15.10	0.84	41.23	1.268	52.29
F1	1351542	480529	GML062	FLD	17-Jul-94	12:54	15.70	0.83	42.99	1.268	54.51
F2	1351547	480528	GML063	FLD	17-Jul-94	13:06	16.30	0.67	44.74	1.268	56.73
F3	1351552	480528	GML064	FLD	17-Jul-94	13:17	15.50	0.82	42.40	1.268	53.77
E3	1351552	480523	GML065	FLD	17-Jul-94	13:28	17.30	0.82	47.65	1.268	60.43
E2	1351547	480523	GML066	DUP†	17-Jul-94	13:39	16.00	0.84	43.86	1.268	55.62
E1	1351542	480524	GML067	FLD	17-Jul-94	13:49	15.20	0.78	41.53	1.268	52.66
D1	1351542	480519	GML068	FLD	17-Jul-94	14:00	16.60	0.93	45.61	1.268	57.84
D2	1351547	480518	GML069	FLD	17-Jul-94	14:11	18.80	0.88	52.03	1.268	65.98
D3	1351552	480518	GML070	FLD	17-Jul-94	14:22	16.60	0.98	45.61	1.268	57.84
U7	1351588	480361	GML071	FLD	17-Jul-94	14:37	26.90	1.48	75.67	1.268	95.95
S9	1351706	480294	GML072	FLD	17-Jul-94	14:48	25.80	1.42	72.46	1.268	91.88
S10	1351766	480293	GML073	FLD	17-Jul-94	15:07	16.90	0.94	46.49	1.268	58.95
S11	1351826	480291	GML074	FLD	17-Jul-94	15:20	8.30	0.61	21.39	1.268	27.12
U11	1351828	480351	GML075	FLD	17-Jul-94	15:32	17.50	0.89	48.24	1.268	61.17
U10	1351768	480353	GML076	FLD	17-Jul-94	15:44	19.30	0.96	53.49	1.268	67.83
U9.5	1351738	480353	GML077	FLD	17-Jul-94	15:55	19.30	0.90	53.49	1.268	67.83
A1	1351748	480363	GML078	FLD	17-Jul-94	16:08	17.20	0.92	47.36	1.268	60.06
A2	1351753	480363	GML079	FLD	17-Jul-94	16:18	16.90	0.85	46.49	1.268	58.95
A3	1351758	480363	GML080	FLD	17-Jul-94	16:29	18.60	0.94	51.45	1.268	65.24
B3	1351758	480368	GML081	FLD	17-Jul-94	16:40	17.40	0.96	47.95	1.268	60.80
B2	1351753	480368	GML082	FLD	17-Jul-94	16:50	17.90	0.90	49.41	1.268	62.65
B1	1351748	480368	GML083	FLD	17-Jul-94	17:01	16.50	0.95	45.32	1.268	57.47
C1	1351748	480373	GML084	FLD	17-Jul-94	17:14	17.60	0.89	48.53	1.268	61.54
C2	1351753	480373	GML085	FLD	17-Jul-94	17:24	16.40	0.92	45.03	1.268	57.10

Table G-6: Composite Data Listing for Low-Mount Gamma Spectrometer Technology (continued)

[F* - Soil moisture correction factor (not applicable to sample types CAL or STD); Adj.: adjusted (see text). Leaders (--): not measured or not applicable]

Geo Loc	X Coord (feet)	Y Coord (feet)	ID	Type	Date	Time (EDT)	Raw U238 (pCi/g)	Raw U235 (pCi/g)	Total U (pCi/g)	F*	Adj. Total U (pCi/g)
C3	1351758	480373	GML086	FLD	17-Jul-94	17:35	15.70	0.93	42.99	1.268	54.51
V10	1351769	480383	GML087	FLD	17-Jul-94	17:45	14.90	0.82	40.65	1.268	51.55
V9.5	1351739	480383	GML088	FLD	17-Jul-94	17:57	14.70	0.84	40.07	1.268	50.81
W9	1351709	480412	GML089	FLD	17-Jul-94	18:09	17.60	0.90	48.53	1.268	61.54
W9.5	1351739	480413	GML090	FLD	17-Jul-94	18:21	15.30	0.86	41.82	1.268	53.03
W10	1351769	480413	GML091	FLD	17-Jul-94	18:33	20.10	1.10	55.83	1.268	70.79
W11	1351829	480411	GML092	FLD	17-Jul-94	18:45	18.60	0.97	51.45	1.268	65.24
S1	1351541	480338	GML093	STD	17-Jul-94	19:02	25.80	1.40	72.46	1.268	91.88
S2	1351508	480562	GML094	STD	18-Jul-94	11:12	13.40	0.65	36.27	1.305	47.34
S1	1351541	480338	GML095	STD	18-Jul-94	11:31	26.80	1.34	75.38	1.305	98.37
Y9.5	1351725	480474	GML096	FLD	18-Jul-94	11:44	16.90	0.91	46.49	1.305	60.67
Z9.5	1351742	480503	GML097	FLD	18-Jul-94	11:59	21.60	1.10	60.20	1.305	78.56
AA9.5	1351743	480533	GML098	FLD	18-Jul-94	12:21	20.00	1.06	55.53	1.305	72.47
AA10	1351760	480533	GML099	FLD	18-Jul-94	12:34	19.30	1.13	53.49	1.305	69.81
CC10	1351774	480593	GML100	FLD	18-Jul-94	12:48	17.30	0.89	47.65	1.305	62.19
CC11	1351834	480591	GML101	FLD	18-Jul-94	13:04	11.00	0.55	29.27	1.305	38.20
AA11	1351833	480531	GML102	FLD	18-Jul-94	13:29	20.10	0.77	55.83	1.305	72.85
Z10	1351787	480502	GML103	FLD	18-Jul-94	13:48	18.20	1.00	50.28	1.305	65.62
Y11	1351831	480471	GML104	FLD	18-Jul-94	14:02	26.00	1.21	73.04	1.305	95.32
Y10	1351771	480473	GML105	FLD	18-Jul-94	14:14	18.90	1.07	52.32	1.305	68.28
S1	1351541	480338	GML106	STD	18-Jul-94	14:31	25.60	1.37	71.87	1.305	93.80
S2	1351508	480562	GML107	STD	18-Jul-94	14:43	14.70	0.78	40.07	1.305	52.29
C0	--	--	GML108	CAL	18-Jul-94	15:05	0.70	0.00	-0.79	--	-0.79
C35	--	--	GML109	CAL	18-Jul-94	15:17	33.80	1.77	95.80	--	95.80
C100	--	--	GML110	CAL	18-Jul-94	15:28	49.50	2.42	141.62	--	141.62
C0	--	--	GML111	CAL	19-Jul-94	13:39	4.10	0.08	9.14	--	--
C35	--	--	GML112	CAL	19-Jul-94	13:50	36.90	1.80	104.85	--	9.14
C100	--	--	GML113	CAL	19-Jul-94	14:01	47.60	2.51	136.07	--	104.85
S2	1351508	480562	GML114	STD	19-Jul-94	15:00	17.30	0.89	47.65	1.145	136.07
--	1351629	480339	GML116	FLD	19-Jul-94	15:54	32.60	1.69	92.30	1.145	--
--	1351568	480366	GML117	FLD	19-Jul-94	16:17	28.00	1.40	78.88	1.145	54.56
--	1351685	480353	GML118	FLD	19-Jul-94	16:43	28.00	1.49	78.88	1.145	105.69
--	1351666	480383	GML119	FLD	19-Jul-94	16:31	27.90	1.51	78.59	1.145	90.32
--	1351683	480294	GML120	FLD	19-Jul-94	16:56	30.60	1.62	86.47	1.145	90.32
--	1351811	480469	GML121	FLD	19-Jul-94	17:11	4.40	0.24	10.01	1.145	89.98
--	1351829	480485	GML122	FLD	19-Jul-94	17:22	27.70	1.33	78.00	1.145	99.00

† The designation, "DUP" is in the original data base. The geolocation code and the coordinates indicate that this is not a duplicate sample.

Table G-7: Composite Data Listing for Laser Ablation-Inductively Coupled Plasma-Atomic Emission Spectrometer Technology

[Negative total uranium values interpreted as below detection level. Leaders (--): not measured or not applicable]

Geo Loc	X Coord (feet)	Y Coord (feet)	ID	Type	Date	Time (EDT)	Raw Data (counts U per count Si)	Total U (pCi/g)
C0	--	--	ICP001	CAL	15-Jun-94	11:20	0.0051	--
C35	--	--	ICP002	CAL	15-Jun-94	11:40	0.0367	--
C100	--	--	ICP003	CAL	15-Jun-94	12:02	0.0508	--
C0	--	--	ICP004	CAL	15-Jun-94	12:20	0.0041	--
C35	--	--	ICP005	CAL	15-Jun-94	12:34	0.0397	--
C100	--	--	ICP006	CAL	15-Jun-94	12:50	0.0504	--
C0	--	--	ICP007	CAL	15-Jun-94	13:06	0.0046	--
C35	--	--	ICP008	CAL	15-Jun-94	13:21	0.0394	--
C100	--	--	ICP009	CAL	15-Jun-94	13:35	0.0502	--
C35	--	--	ICP010	STD	15-Jun-94	14:01	0.0357	115.52
C0	--	--	ICP011	STD	15-Jun-94	14:19	0.0047	9.32
CP	--	--	ICP012	STD	15-Jun-94	14:42	0.0344	111.06
CP	--	--	ICP013	STD	15-Jun-94	14:55	0.0436	142.58
CP	--	--	ICP014	STD	15-Jun-94	15:09	0.0451	147.72
C35	--	--	ICP015	STD	15-Jun-94	16:54	0.0373	121.00
C0	--	--	ICP018	STD	15-Jun-94	17:56	0.0048	9.66
C35	--	--	ICP019	STD	15-Jun-94	17:56	0.0418	136.41
C35	--	--	ICP020	CAL	16-Jun-94	8:45	0.0367	118.94
C0	--	--	ICP021	STD	16-Jun-94	9:05	0.0053	11.37
C35	--	--	ICP022	STD	16-Jun-94	9:21	0.0362	117.23
C35	--	--	ICP029	STD	16-Jun-94	16:44	0.2627	893.15
C0	--	--	ICP032	STD	16-Jun-94	18:36	0.0148	43.92
C35	--	--	ICP033	STD	16-Jun-94	18:49	0.0637	211.44
C35	--	--	ICP034	CAL	17-Jun-94	10:50	0.0341	110.03
C35	--	--	ICP035	STD	17-Jun-94	11:21	0.0346	111.75
C0	--	--	ICP036	STD	17-Jun-94	11:36	0.0046	8.98
C35	--	--	ICP041	STD	17-Jun-94	13:15	0.0400	130.25
C0	--	--	ICP042	CAL	18-Jun-94	10:51	0.0040	6.92
C35	--	--	ICP043	CAL	18-Jun-94	11:00	0.0247	77.83
C100	--	--	ICP044	CAL	18-Jun-94	11:08	0.0304	97.36
C0	--	--	ICP045	STD	18-Jun-94	11:13	0.0037	5.89
C35	--	--	ICP046	STD	18-Jun-94	11:21	0.0242	76.12
CC5	1351474	480600	ICP047	FLD	18-Jun-94	11:30	0.0103	28.50
CC6	1351534	480599	ICP048	FLD	18-Jun-94	11:40	0.0136	39.81
CC7	1351594	480597	ICP049	FLD	18-Jun-94	11:51	0.0114	32.27
CC8	1351654	480596	ICP050	FLD	18-Jun-94	12:00	0.0140	41.18
CC9	1351714	480594	ICP051	FLD	18-Jun-94	12:11	0.0139	40.84
CC10	1351774	480593	ICP052	FLD	18-Jun-94	12:22	0.0147	43.58
CC11	1351834	480591	ICP053	FLD	18-Jun-94	12:31	0.0068	16.51
C35	--	--	ICP054	STD	18-Jun-94	12:42	0.0212	65.84
C35	--	--	ICP055	CAL	18-Jun-94	14:38	0.0211	--
AA5	1351473	480540	ICP056	FLD	18-Jun-94	14:49	0.0114	32.27

Table G-7: Composite Data Listing for Laser Ablation-Inductively Coupled Plasma-Atomic Emission Spectrometer Technology (continued)

[Negative total uranium values interpreted as below detection level. Leaders (--): not measured or not applicable]

Geo Loc	X Coord (feet)	Y Coord (feet)	ID	Type	Date	Time (EDT)	Raw Data (counts U per count Si)	Total U (pCi/g)
AA6	1351533	480539	ICP057	FLD	18-Jun-94	14:59	0.0127	36.72
AA6.5	1351563	480538	ICP058	FLD	18-Jun-94	15:10	0.0173	52.48
AA7	1351593	480537	ICP059	FLD	18-Jun-94	15:20	0.0127	36.72
AA8	1351653	480536	ICP060	FLD	18-Jun-94	15:32	0.0172	52.14
AA9	1351713	480534	ICP061	FLD	18-Jun-94	15:45	0.0140	41.18
AA9.5	1351743	480533	ICP062	FLD	18-Jun-94	15:57	0.0165	49.74
AA10	1351760	480533	ICP063	FLD	18-Jun-94	16:10	0.0172	52.14
AA11	1351833	480531	ICP064	FLD	18-Jun-94	16:22	0.0179	54.54
C35	--	--	ICP065	STD	18-Jun-94	16:33	0.0236	74.06
C35	--	--	ICP066	STD	19-Jun-94	7:19	0.0224	69.95
C0	--	--	ICP067	STD	19-Jun-94	7:33	0.0060	13.77
Y5	1351471	480480	ICP068	FLD	19-Jun-94	7:43	0.0153	45.63
Y6	1351531	480479	ICP069	FLD	19-Jun-94	7:57	0.0180	54.88
Y6.5	1351561	480478	ICP070	FLD	19-Jun-94	8:06	0.0236	74.06
Y7	1351591	480477	ICP071	FLD	19-Jun-94	8:19	0.0227	70.98
Y7.5	1351621	480476	ICP072	FLD	19-Jun-94	8:34	0.0306	98.04
C35	--	--	ICP075	CAL	19-Jun-94	9:12	0.0298	--
C35	--	--	ICP076	STD	19-Jun-94	9:22	0.0297	94.96
Y8	1351651	480476	ICP077	FLD	19-Jun-94	9:32	0.0349	112.77
Y8.5	1351681	480475	ICP079	FLD	19-Jun-94	9:54	0.0303	97.02
Y9	1351711	480474	ICP080	FLD	19-Jun-94	10:05	0.0315	101.13
Y9.5	1351725	480474	ICP081	FLD	19-Jun-94	10:15	0.0273	86.74
Y10	1351771	480473	ICP082	FLD	19-Jun-94	10:26	0.0329	105.92
C35	--	--	ICP083	STD	19-Jun-94	10:40	0.0300	95.99
Y11	1351831	480471	ICP084	FLD	19-Jun-94	10:53	0.0237	74.41
Z6	1351532	480509	ICP085	FLD	19-Jun-94	11:04	0.0222	69.27
Z6.5	1351562	480508	ICP086	FLD	19-Jun-94	11:13	0.0304	97.36
Z7	1351592	480507	ICP087	FLD	19-Jun-94	11:24	0.0254	80.23
Z9	1351712	480504	ICP088	FLD	19-Jun-94	11:34	0.0346	111.75
Z9.5	1351742	480503	ICP089	FLD	19-Jun-94	11:46	0.0379	123.05
Z10	1351787	480502	ICP090	FLD	19-Jun-94	12:07	0.0231	72.35
C35	--	--	ICP091	STD	19-Jun-94	12:18	0.0297	94.96
D1	1351542	480519	ICP092	FLD	19-Jun-94	12:31	0.0196	60.36
D2	1351547	480518	ICP093	FLD	19-Jun-94	12:42	0.0254	80.23
C35	--	--	ICP096	CAL	19-Jun-94	13:43	0.0221	--
D3	1351552	480518	ICP097	FLD	19-Jun-94	13:55	0.0196	60.36
F1	1351542	480529	ICP098	FLD	19-Jun-94	14:09	0.0150	44.60
F2	1351547	480528	ICP099	FLD	19-Jun-94	14:20	0.0153	45.63
F3	1351552	480528	ICP100	FLD	19-Jun-94	14:38	0.0171	51.80
E1	1351542	480524	ICP101	FLD	19-Jun-94	14:50	0.0186	56.94
E2	1351547	480523	ICP102	FLD	19-Jun-94	15:03	0.0161	48.37
E3	1351552	480523	ICP103	FLD	19-Jun-94	15:15	0.0182	55.57
X7	1351590	480447	ICP104	FLD	19-Jun-94	15:29	0.0234	73.38

Table G-7: Composite Data Listing for Laser Ablation-Inductively Coupled Plasma-Atomic Emission Spectrometer Technology (continued)

[Negative total uranium values interpreted as below detection level. Leaders (--): not measured or not applicable]

Geo Loc	X Coord (feet)	Y Coord (feet)	ID	Type	Date	Time (EDT)	Raw Data (counts U per count Si)	Total U (pCi/g)
X7.5	1351620	480447	ICP105	FLD	19-Jun-94	15:41	0.0232	72.69
C35	--	--	ICP107	STD	19-Jun-94	16:06	0.0228	71.32
X8.5	1351680	480445	ICP108	FLD	19-Jun-94	16:17	0.0183	55.91
X8	1351650	480446	ICP109	FLD	19-Jun-94	16:29	0.0172	52.14
X9	1351711	480457	ICP110	FLD	19-Jun-94	16:40	0.0185	56.59
C35	--	--	ICP111	STD	19-Jun-94	17:00	0.0225	70.30
C35	--	--	ICP112	CAL	20-Jun-94	7:27	0.0206	--
C35	--	--	ICP113	STD	20-Jun-94	7:44	0.0188	57.62
C35	--	--	ICP114	STD	20-Jun-94	7:55	0.0211	65.50
C0	--	--	ICP115	STD	20-Jun-94	8:07	0.0052	11.03
W5	1351470	480420	ICP116	FLD	20-Jun-94	8:20	0.0096	26.10
W6	1351530	480419	ICP117	FLD	20-Jun-94	8:32	0.0133	38.78
W6.5	1351560	480418	ICP118	FLD	20-Jun-94	8:43	0.0127	36.72
W7	1351590	480417	ICP119	FLD	20-Jun-94	8:52	0.0143	42.21
W7.5	1351620	480420	ICP120	FLD	20-Jun-94	9:03	0.0186	56.94
W9	1351709	480412	ICP121	FLD	20-Jun-94	9:15	0.0154	45.97
W9.5	1351739	480413	ICP122	FLD	20-Jun-94	9:27	0.0211	65.50
W10	1351769	480413	ICP123	FLD	20-Jun-94	9:41	0.0146	43.23
W11	1351829	480411	ICP124	FLD	20-Jun-94	9:51	0.0184	56.25
C35	--	--	ICP125	CAL	20-Jun-94	10:06	0.0265	--
V6	1351529	480394	ICP126	FLD	20-Jun-94	10:17	0.0183	55.91
V9	1351709	480384	ICP127	FLD	20-Jun-94	10:29	0.0295	94.28
C35	--	--	ICP130	CAL	20-Jun-94	11:16	0.0248	--
C35	--	--	ICP131	STD	20-Jun-94	11:49	0.0224	69.95
V9.5	1351739	480383	ICP134	FLD	20-Jun-94	12:15	0.0206	63.79
V10	1351769	480383	ICP135	FLD	20-Jun-94	12:29	0.0214	66.53
U8	1351648	480366	ICP136	FLD	20-Jun-94	12:41	0.0277	88.11
V6.5	1351559	480403	ICP139	FLD	20-Jun-94	13:19	0.0179	54.54
W8.5	1351679	480400	ICP140	FLD	20-Jun-94	13:30	0.0241	75.78
C35	--	--	ICP141	CAL	20-Jun-94	13:48	0.0248	--
A1	1351748	480363	ICP142	FLD	20-Jun-94	14:00	0.0252	79.55
A2	1351753	480363	ICP143	FLD	20-Jun-94	14:11	0.0188	57.62
A3	1351758	480363	ICP144	FLD	20-Jun-94	14:24	0.0297	94.96
B1	1351748	480368	ICP145	FLD	20-Jun-94	14:36	0.0271	86.05
C35	--	--	ICP146	STD	20-Jun-94	14:45	0.0275	87.42
C0	--	--	ICP147	STD	20-Jun-94	14:55	0.0087	23.02
C35	--	--	ICP148	STD	21-Jun-94	7:58	0.0221	68.93
C0	--	--	ICP149	STD	21-Jun-94	8:12	0.0053	11.37
B2	1351753	480368	ICP150	FLD	21-Jun-94	8:22	0.0140	41.18
B3	1351758	480368	ICP151	FLD	21-Jun-94	8:36	0.0138	40.49
C1	1351748	480373	ICP152	FLD	21-Jun-94	8:49	0.0193	59.33
C2	1351753	480373	ICP153	FLD	21-Jun-94	9:01	0.0172	52.14
C3	1351758	480373	ICP154	FLD	21-Jun-94	9:15	0.0210	65.16

Table G-7: Composite Data Listing for Laser Ablation-Inductively Coupled Plasma-Atomic Emission Spectrometer Technology (continued)

[Negative total uranium values interpreted as below detection level. Leaders (--): not measured or not applicable]

Geo Loc	X Coord (feet)	Y Coord (feet)	ID	Type	Date	Time (EDT)	Raw Data (counts U per count Si)	Total U (pCi/g)
C35	--	--	ICP155	STD	21-Jun-94	9:31	0.0232	72.69
U5	1351468	480365	ICP156	FLD	21-Jun-94	9:42	0.0204	63.10
C35	--	--	ICP158	CAL	21-Jun-94	10:11	0.0241	--
C0	--	--	ICP159	CAL	21-Jun-94	10:23	0.0068	--
U6	1351528	480354	ICP161	FLD	21-Jun-94	10:55	0.0314	100.78
U6.5	1351558	480358	ICP162	FLD	21-Jun-94	11:07	0.0327	105.24
U7	1351588	480361	ICP163	FLD	21-Jun-94	11:21	0.0295	94.28
U9	1351708	480354	ICP164	FLD	21-Jun-94	11:36	0.0222	69.27
U9.5	1351738	480353	ICP165	FLD	21-Jun-94	11:49	0.0158	47.34
U10	1351768	480353	ICP166	FLD	21-Jun-94	12:03	0.0216	67.21
U11	1351828	480351	ICP167	FLD	21-Jun-94	12:19	0.0275	87.42
C35	--	--	ICP168	STD	21-Jun-94	12:30	0.0234	73.38
S5	1351466	480300	ICP169	FLD	21-Jun-94	12:46	0.0134	39.12
S9	1351706	480294	ICP170	FLD	21-Jun-94	12:57	0.0276	87.77
S10	1351766	480293	ICP171	FLD	21-Jun-94	13:09	0.0159	47.69
S11	1351826	480291	ICP172	FLD	21-Jun-94	13:19	0.0249	78.52
C35	--	--	ICP173	STD	21-Jun-94	13:30	0.0272	86.40
C0	--	--	ICP174	STD	21-Jun-94	13:42	0.0126	36.38
C35	--	--	ICP175	STD	21-Jun-94	13:54	0.0329	105.92
C0	--	--	ICP176	CAL	12-Oct-94	13:24	0.0018	--
C35	--	--	ICP177	CAL	12-Oct-94	13:35	0.0212	--
C35	--	--	ICP178	STD	12-Oct-94	13:40	0.0214	66.53
C0	--	--	ICP179	STD	12-Oct-94	13:53	0.0019	-0.27
--	1351473	480509	ICP180	FLD	12-Oct-94	14:08	0.0095	25.76
--	1351471	480451	ICP181	FLD	12-Oct-94	14:21	0.0085	22.34
--	1351494	480454	ICP182	FLD	12-Oct-94	14:34	0.0095	25.76
C35	--	--	ICP183	STD	12-Oct-94	14:46	0.0267	84.68
--	1351500	480421	ICP184	FLD	12-Oct-94	15:00	0.0104	28.85
--	1351469	480393	ICP185	FLD	12-Oct-94	15:13	0.0100	27.48
--	1351469	480328	ICP186	FLD	12-Oct-94	15:26	0.0087	23.02
--	1351742	480295	ICP187	FLD	12-Oct-94	15:37	0.0128	37.07
--	1351711	480324	ICP188	FLD	12-Oct-94	15:48	0.0135	39.46
C35	--	--	ICP189	STD	12-Oct-94	15:59	0.0266	84.34
C0	--	--	ICP190	STD	12-Oct-94	16:16	0.0026	2.12
C0	--	--	ICP191	STD	12-Oct-94	17:15	0.0012	-2.67
C0	--	--	ICP192	CAL	12-Oct-94	8:40	0.0029	--
C35	--	--	ICP193	CAL	12-Oct-94	8:51	0.0264	--
C0	--	--	ICP194	STD	12-Oct-94	8:57	0.0035	5.21
C35	--	--	ICP195	STD	12-Oct-94	9:08	0.0233	73.04
--	1351801	480432	ICP196	FLD	12-Oct-94	9:20	0.0123	35.35
--	1351802	480474	ICP197	FLD	12-Oct-94	9:34	0.0101	27.82
--	1351744	480591	ICP198	FLD	12-Oct-94	9:52	0.0163	49.06
C35	--	--	ICP199	STD	12-Oct-94	10:06	0.0216	67.21

Table G-7: Composite Data Listing for Laser Ablation-Inductively Coupled Plasma-Atomic Emission Spectrometer Technology (continued)

[Negative total uranium values interpreted as below detection level. Leaders (--): not measured or not applicable]

Geo Loc	X Coord (feet)	Y Coord (feet)	ID	Type	Date	Time (EDT)	Raw Data (counts U per count Si)	Total U (pCi/g)
--	1351831	480562	ICP200	FLD	12-Oct-94	10:22	0.0069	16.86
W8	1351650	480429	ICP201	FLD	12-Oct-94	10:34	0.0141	41.52
--	1351473	480509	ICP202	DUP†	12-Oct-94	10:45	0.0090	24.05
--	1351494	480454	ICP203	DUP†	12-Oct-94	10:58	0.0093	25.08
--	1351469	480328	ICP204	DUP†	12-Oct-94	11:12	0.0081	20.97
C0	--	--	ICP205	STD	12-Oct-94	11:29	0.0026	2.12
C35	--	--	ICP206	STD	12-Oct-94	1:14	0.0213	66.19

† The designation, "DUP" is in the original data base. The geolocation code and the coordinates indicate that this is not a duplicate sample.

Table G-8: Composite Data Listing for Soil Sampling and Laboratory Geochemical Analysis Technology

[Additional sample types unique to this technology: COR: core sample, 1-8 inches depth; COR1: core sample, 0-2 inches; COR2: core sample, 2-4 inches; COR3: core sample, 4-6 inches; COR4: core sample, 6-8 inches]

Geo Loc	X Coord (feet)	Y Coord (feet)	ID	Type	Total U (pCi/g)
A1	1351748	480363	LAB082	FLD	63.36
A2	1351753	480363	LAB083	FLD	56.58
A3	1351758	480363	LAB084	FLD	65.60
AA10	1351760	480533	LAB018	FLD	53.89
AA10	1351760	480533	LAB121	COR	22.25
AA11	1351833	480531	LAB019	FLD	51.54
AA5	1351473	480540	LAB011	FLD	39.41
AA6	1351533	480539	LAB012	FLD	59.80
AA6	1351533	480539	LAB119	COR	21.68
AA6.5	1351563	480538	LAB013	FLD	52.99
AA7	1351593	480537	LAB014	FLD	48.42
AA7	1351593	480537	LAB136	COR1	40.94
AA7	1351593	480537	LAB137	COR2	16.85
AA7	1351593	480537	LAB138	COR3	6.27
AA7	1351593	480537	LAB139	COR4	6.39
AA8	1351653	480536	LAB015	FLD	61.79
AA8	1351653	480536	LAB120	COR	29.87
AA9	1351713	480534	LAB016	FLD	54.20
AA9	1351713	480534	LAB140	COR1	50.46
AA9	1351713	480534	LAB141	COR2	32.60
AA9	1351713	480534	LAB142	COR3	16.03
AA9	1351713	480534	LAB143	COR4	4.88
AA9.5	1351743	480533	LAB017	FLD	68.27
B1	1351748	480368	LAB079	FLD	46.80
B2	1351753	480368	LAB080	FLD	71.08
B3	1351758	480368	LAB081	FLD	64.39
C1	1351748	480373	LAB075	FLD	72.21
C2	1351753	480373	LAB076	FLD	61.84
C3	1351758	480373	LAB077	FLD	61.10
C3	1351758	480373	LAB078	DUP	59.02
CC10	1351774	480593	LAB008	FLD	60.74
CC10	1351774	480593	LAB118	COR	12.23
CC11	1351834	480591	LAB009	FLD	31.41
CC11	1351834	480591	LAB010	DUP	27.73
CC5	1351474	480600	LAB001	FLD	50.12
CC6	1351534	480599	LAB002	FLD	59.33
CC6	1351534	480599	LAB003	DUP	58.62
CC6	1351534	480599	LAB114	COR	25.81
CC7	1351594	480597	LAB004	FLD	52.48
CC7	1351594	480597	LAB115	COR	25.09
CC8	1351654	480596	LAB005	FLD	51.36
CC8	1351654	480596	LAB006	DUP	55.49

Table G-8: Composite Data Listing for Soil Sampling and Laboratory Geochemical Analysis Technology (continued)

[Additional sample types unique to this technology: COR: core sample, 1-8 inches depth; COR1: core sample, 0-2 inches; COR2: core sample, 2-4 inches; COR3: core sample, 4-6 inches; COR4: core sample, 6-8 inches]

Geo Loc	X Coord (feet)	Y Coord (feet)	ID	Type	Total U (pCi/g)
CC8	1351654	480596	LAB116	COR	21.35
CC9	1351714	480594	LAB007	FLD	61.59
CC9	1351714	480594	LAB117	COR	18.19
D1	1351542	480519	LAB033	FLD	64.89
D2	1351547	480518	LAB034	FLD	53.81
D3	1351552	480518	LAB035	FLD	55.36
E1	1351542	480524	LAB030	FLD	56.83
E2	1351547	480523	LAB031	FLD	52.44
E3	1351552	480523	LAB032	FLD	56.38
F1	1351542	480529	LAB027	FLD	50.93
F2	1351547	480528	LAB028	FLD	49.90
F3	1351552	480528	LAB029	FLD	52.56
S1	1351541	480338	LAB104	STD	74.82
S1	1351541	480338	LAB105	STD	57.30
S1	1351541	480338	LAB106	STD	68.18
S1	1351541	480338	LAB107	STD	76.19
S1	1351541	480338	LAB108	STD	70.70
S1	1351541	480338	LAB134	COR	32.60
S10	1351766	480293	LAB101	FLD	71.75
S10	1351766	480293	LAB102	DUP	73.52
S11	1351826	480291	LAB103	FLD	39.21
S2	1351508	480562	LAB109	STD	49.84
S2	1351508	480562	LAB110	STD	47.99
S2	1351508	480562	LAB111	STD	52.23
S2	1351508	480562	LAB112	STD	46.98
S2	1351508	480562	LAB113	STD	46.93
S2	1351508	480562	LAB135	COR	23.34
S5	1351466	480300	LAB097	FLD	50.98
S5	1351466	480300	LAB098	DUP	50.58
S9	1351706	480294	LAB099	FLD	90.68
S9	1351706	480294	LAB100	DUP	93.07
U10	1351768	480353	LAB094	FLD	59.77
U10	1351768	480353	LAB095	DUP	54.18
U10	1351768	480353	LAB133	COR	23.33
U11	1351828	480351	LAB096	FLD	58.04
U5	1351468	480365	LAB085	FLD	47.53
U6	1351528	480354	LAB086	FLD	65.60
U6	1351528	480354	LAB129	COR	45.80
U6.5	1351558	480358	LAB087	FLD	82.55
U7	1351588	480361	LAB088	FLD	89.03
U7	1351588	480361	LAB089	DUP	83.88
U7	1351588	480361	LAB130	COR	46.26
U8	1351648	480366	LAB090	FLD	105.50

Table G-8: Composite Data Listing for Soil Sampling and Laboratory Geochemical Analysis Technology (continued)

[Additional sample types unique to this technology: COR: core sample, 1-8 inches depth; COR1: core sample, 0-2 inches; COR2: core sample, 2-4 inches; COR3: core sample, 4-6 inches; COR4: core sample, 6-8 inches]

Geo Loc	X Coord (feet)	Y Coord (feet)	ID	Type	Total U (pCi/g)
U8	1351648	480366	LAB131	COR	57.75
U9	1351708	480354	LAB091	FLD	76.02
U9	1351708	480354	LAB092	DUP	75.82
U9	1351708	480354	LAB132	COR	33.30
U9.5	1351738	480353	LAB093	FLD	52.16
V10	1351769	480383	LAB074	FLD	53.72
V6	1351529	480394	LAB070	FLD	58.81
V6.5	1351559	480403	LAB071	FLD	86.46
V9	1351709	480384	LAB072	FLD	81.67
V9.5	1351739	480383	LAB073	FLD	54.12
W10	1351769	480413	LAB068	FLD	75.26
W10	1351769	480413	LAB128	COR	30.50
W11	1351829	480411	LAB069	FLD	82.98
W5	1351470	480420	LAB057	FLD	61.86
W6	1351530	480419	LAB058	FLD	70.52
W6	1351530	480419	LAB126	COR	31.46
W6.5	1351560	480418	LAB059	FLD	74.04
W7	1351590	480417	LAB060	FLD	79.11
W7	1351590	480417	LAB061	DUP	76.11
W7	1351590	480417	LAB148	COR1	77.09
W7	1351590	480417	LAB149	COR2	22.83
W7	1351590	480417	LAB150	COR3	12.08
W7	1351590	480417	LAB151	COR4	13.64
W7.5	1351620	480420	LAB062	FLD	77.83
W8	1351650	480429	LAB063	FLD	62.32
W8	1351650	480429	LAB127	COR	22.08
W8.5	1351679	480400	LAB064	FLD	81.23
W8.5	1351679	480400	LAB065	DUP	82.55
W9	1351709	480412	LAB066	FLD	52.94
W9	1351709	480412	LAB152	COR1	46.60
W9	1351709	480412	LAB153	COR2	24.76
W9	1351709	480412	LAB154	COR3	11.85
W9	1351709	480412	LAB155	COR4	14.46
W9.5	1351739	480413	LAB067	FLD	51.20
X7	1351590	480447	LAB049	FLD	68.76
X7	1351590	480447	LAB050	DUP	80.17
X7.5	1351620	480447	LAB051	FLD	62.73
X8	1351650	480446	LAB052	FLD	62.24
X8.5	1351680	480445	LAB053	FLD	61.53
X8.5	1351680	480445	LAB054	DUP	62.55
X9	1351711	480457	LAB055	FLD	78.12
X9	1351711	480457	LAB056	DUP	60.46
Y10	1351771	480473	LAB046	FLD	57.80

Table G-8: Composite Data Listing for Soil Sampling and Laboratory Geochemical Analysis Technology (continued)

[Additional sample types unique to this technology: COR: core sample, 1-8 inches depth; COR1: core sample, 0-2 inches; COR2: core sample, 2-4 inches; COR3: core sample, 4-6 inches; COR4: core sample, 6-8 inches]

Geo Loc	X Coord (feet)	Y Coord (feet)	ID	Type	Total U (pCi/g)
Y10	1351771	480473	LAB125	COR	15.10
Y11	1351831	480471	LAB047	FLD	86.77
Y11	1351831	480471	LAB048	DUP	86.51
Y5	1351471	480480	LAB036	FLD	49.60
Y6	1351531	480479	LAB037	FLD	55.32
Y6	1351531	480479	LAB122	COR	18.46
Y6.5	1351561	480478	LAB038	FLD	60.17
Y7	1351591	480477	LAB039	FLD	57.33
Y7	1351591	480477	LAB123	COR	20.29
Y7.5	1351621	480476	LAB040	FLD	76.00
Y8	1351651	480476	LAB041	FLD	59.93
Y8	1351651	480476	LAB144	COR1	52.26
Y8	1351651	480476	LAB145	COR2	30.31
Y8	1351651	480476	LAB146	COR3	16.99
Y8	1351651	480476	LAB147	COR4	4.97
Y8.5	1351681	480475	LAB042	FLD	68.69
Y8.5	1351681	480475	LAB043	DUP	68.95
Y9	1351711	480474	LAB044	FLD	62.19
Y9	1351711	480474	LAB124	COR	22.42
Y9.5	1351725	480474	LAB045	FLD	60.78
Z10	1351787	480502	LAB026	FLD	58.82
Z6	1351532	480509	LAB020	FLD	45.36
Z6.5	1351562	480508	LAB021	FLD	56.85
Z7	1351592	480507	LAB022	FLD	49.57
Z7	1351592	480507	LAB023	DUP	51.11
Z9	1351712	480504	LAB024	FLD	57.49
Z9.5	1351742	480503	LAB025	FLD	67.36

Table G-9: Composite Data Listing for Long-Range Alpha Detector Technology

[Negative total uranium values interpreted as below detection level. Leaders (--): not measured or not applicable]

Geo Loc	X Coord (feet)	Y Coord (feet)	ID	Type	Date	Time (EDT)	Raw Data (fempto-amperes)	Total U ((pCi/g)
C0	--	--	LRA001	CAL	07-Jun-94	10:49	5700	--
C35	--	--	LRA002	CAL	07-Jun-94	11:30	7600	--
C100	--	--	LRA003	CAL	07-Jun-94	11:44	9800	--
C200	--	--	LRA004	CAL	07-Jun-94	12:02	19000	--
S1	1351541	480338	LRA005	STD	08-Jun-94	8:55	6400	46.02
S2	1351508	480562	LRA006	STD	08-Jun-94	9:10	6800	55.39
CC5	1351474	480600	LRA007	FLD	08-Jun-94	9:29	6300	43.67
CC6	1351534	480599	LRA008	FLD	08-Jun-94	9:42	6700	53.05
CC7	1351594	480597	LRA009	FLD	08-Jun-94	9:54	7800	78.83
CC8	1351654	480596	LRA010	FLD	08-Jun-94	10:07	8900	104.62
AA8	1351653	480536	LRA011	FLD	08-Jun-94	10:21	5900	34.30
AA7	1351593	480537	LRA012	FLD	08-Jun-94	10:33	8700	99.93
AA6.5	1351563	480538	LRA013	FLD	08-Jun-94	11:17	7700	76.49
AA5	1351473	480540	LRA014	FLD	08-Jun-94	11:29	7000	60.08
Y5	1351471	480480	LRA015	FLD	08-Jun-94	11:50	7700	76.49
Y6	1351531	480479	LRA016	FLD	08-Jun-94	12:22	6000	36.64
AA6	1351533	480539	LRA017	FLD	08-Jun-94	12:33	6000	36.64
Y6.5	1351561	480478	LRA018	FLD	08-Jun-94	12:48	6300	43.67
Y7	1351591	480477	LRA019	FLD	08-Jun-94	13:00	6400	46.02
Y7.5	1351621	480476	LRA020	FLD	08-Jun-94	13:12	6300	43.67
Y8	1351651	480476	LRA021	FLD	08-Jun-94	13:24	5900	34.30
X8	1351650	480446	LRA022	FLD	08-Jun-94	13:35	6400	46.02
X7.5	1351620	480447	LRA023	FLD	08-Jun-94	13:46	7000	60.08
X7	1351590	480447	LRA024	FLD	08-Jun-94	13:57	7600	74.14
W6	1351530	480419	LRA025	FLD	08-Jun-94	14:08	9000	106.96
W6.5	1351560	480418	LRA026	FLD	08-Jun-94	14:27	9200	111.65
W7	1351590	480417	LRA027	FLD	08-Jun-94	14:37	8200	88.21
W7.5	1351620	480420	LRA028	FLD	08-Jun-94	14:48	7700	76.49
W8	1351650	480429	LRA029	FLD	08-Jun-94	14:58	6800	55.39
U5	1351468	480365	LRA030	FLD	08-Jun-94	15:10	10400	139.78
V6	1351529	480394	LRA031	FLD	08-Jun-94	15:21	10700	146.81
V6.5	1351559	480403	LRA032	FLD	08-Jun-94	15:50	10900	151.50
X8.5	1351680	480445	LRA033	FLD	08-Jun-94	16:01	7800	78.83
Y8.5	1351681	480475	LRA034	FLD	08-Jun-94	16:12	7400	69.46
X9	1351711	480457	LRA035	FLD	08-Jun-94	16:24	7400	69.46
Y9	1351711	480474	LRA036	FLD	08-Jun-94	16:35	7300	67.11
Z9	1351712	480504	LRA037	FLD	08-Jun-94	16:45	6600	50.70
AA9	1351713	480534	LRA038	FLD	08-Jun-94	16:55	7300	67.11
CC9	1351714	480594	LRA039	FLD	08-Jun-94	17:06	9100	109.30
CC10	1351774	480593	LRA040	FLD	08-Jun-94	17:17	5800	31.95
AA10	1351760	480533	LRA041	FLD	08-Jun-94	17:27	7700	76.49
AA9.5	1351743	480533	LRA042	FLD	08-Jun-94	17:38	7300	67.11
Z9.5	1351742	480503	LRA043	FLD	08-Jun-94	17:49	7800	78.83

Table G-9: Composite Data Listing for Long-Range Alpha Detector Technology (continued)

Geo Loc	X Coord (feet)	Y Coord (feet)	ID	Type	Date	Time (EDT)	Raw Data (fempto-amperes)	Total U ((pCi/g)
Y9.5	1351725	480474	LRA044	FLD	08-Jun-94	18:00	7300	67.11
S1	1351541	480338	LRA045	STD	08-Jun-94	18:11	7700	76.49
S2	1351508	480562	LRA046	STD	08-Jun-94	18:23	8700	99.93
Z6	1351532	480509	LRA047	FLD	08-Jun-94	18:35	7800	78.83
Z6.5	1351562	480508	LRA048	FLD	08-Jun-94	18:45	7600	74.14
Z7	1351592	480507	LRA049	FLD	08-Jun-94	18:56	7300	67.11
S2	1351508	480562	LRA050	STD	09-Jun-94	9:16	8400	92.90
S1	1351541	480338	LRA051	STD	09-Jun-94	9:32	7300	67.11
S5	1351466	480300	LRA052	FLD	09-Jun-94	9:46	7200	64.77
U6	1351528	480354	LRA053	FLD	09-Jun-94	10:00	6800	55.39
U6.5	1351558	480358	LRA054	FLD	09-Jun-94	10:10	7500	71.80
U8	1351648	480366	LRA055	FLD	09-Jun-94	10:33	10100	132.74
W8.5	1351679	480400	LRA056	FLD	09-Jun-94	10:48	9100	109.30
W9	1351709	480412	LRA057	FLD	09-Jun-94	10:58	7800	78.83
V9	1351709	480384	LRA058	FLD	09-Jun-94	11:09	8100	85.86
U9	1351708	480354	LRA059	FLD	09-Jun-94	11:20	6400	46.02
S9	1351687	480295	LRA060	FLD	09-Jun-94	11:31	6800	55.39
S10	1351766	480293	LRA061	FLD	09-Jun-94	11:42	5300	20.23
S11	1351826	480291	LRA062	FLD	09-Jun-94	11:53	7000	60.08
U11	1351828	480351	LRA063	FLD	09-Jun-94	12:11	8200	88.21
W11	1351829	480411	LRA064	FLD	09-Jun-94	12:21	9300	113.99
Y11	1351831	480471	LRA065	FLD	09-Jun-94	12:30	10700	146.81
AA11	1351833	480531	LRA066	FLD	09-Jun-94	12:44	8200	88.21
Z10	1351787	480502	LRA067	FLD	09-Jun-94	12:57	7800	78.83
Y10	1351771	480473	LRA068	FLD	09-Jun-94	13:08	8000	83.52
W10	1351769	480413	LRA069	FLD	09-Jun-94	13:21	9200	111.65
V10	1351769	480383	LRA070	FLD	09-Jun-94	13:34	8000	83.52
U10	1351768	480353	LRA071	FLD	09-Jun-94	13:45	5600	27.26
U9.5	1351738	480353	LRA072	FLD	09-Jun-94	13:59	8500	95.24
V9.5	1351739	480383	LRA073	FLD	09-Jun-94	14:10	8800	102.27
W9.5	1351739	480413	LRA074	FLD	09-Jun-94	14:21	8700	99.93
CC11	1351834	480591	LRA075	FLD	09-Jun-94	14:35	6000	36.64
A3	1351758	480363	LRA076	FLD	09-Jun-94	14:48	8500	95.24
A2	1351753	480363	LRA077	FLD	09-Jun-94	14:59	8500	95.24
A1	1351748	480363	LRA078	FLD	09-Jun-94	15:09	8000	83.52
B3	1351758	480368	LRA079	FLD	09-Jun-94	15:20	8100	85.86
B2	1351753	480368	LRA080	FLD	09-Jun-94	15:31	6500	48.36
B1	1351748	480368	LRA081	FLD	09-Jun-94	15:41	9000	106.96
C3	1351758	480373	LRA082	FLD	09-Jun-94	15:53	7100	62.42
C2	1351753	480373	LRA083	FLD	09-Jun-94	16:03	7000	60.08
C1	1351748	480373	LRA084	FLD	09-Jun-94	16:13	8500	95.24
U7	1351588	480361	LRA085	FLD	09-Jun-94	16:26	7800	78.83
W5	1351470	480420	LRA086	FLD	09-Jun-94	16:38	9500	118.68
D1	1351542	480519	LRA087	FLD	09-Jun-94	16:51	8400	92.90

Table G-9: Composite Data Listing for Long-Range Alpha Detector Technology (continued)

Geo Loc	X Coord (feet)	Y Coord (feet)	ID	Type	Date	Time (EDT)	Raw Data (fempto-amperes)	*Total U* ((pCi/g)
D2	1351547	480518	LRA088	FLD	09-Jun-94	17:02	7200	64.77
D3	1351552	480518	LRA089	FLD	09-Jun-94	17:13	7700	76.49
E1	1351542	480524	LRA090	FLD	09-Jun-94	17:23	7700	76.49
E2	1351547	480523	LRA091	FLD	09-Jun-94	17:35	6900	57.74
E3	1351552	480523	LRA092	FLD	09-Jun-94	17:46	8600	97.58
F1	1351542	480529	LRA093	FLD	09-Jun-94	17:58	7800	78.83
F2	1351547	480528	LRA094	FLD	09-Jun-94	18:11	8500	95.24
F3	1351552	480528	LRA095	FLD	09-Jun-94	18:22	8400	92.90
S2	1351508	480562	LRA096	STD	09-Jun-94	18:33	8700	99.93
S1	1351541	480338	LRA097	STD	09-Jun-94	18:44	7800	78.83
S1	1351541	480338	LRA098	STD	10-Jun-94	9:19	7700	76.49
S2	1351508	480562	LRA099	STD	10-Jun-94	9:41	8500	95.24
C100	--	--	LRA101	CAL	10-Jun-94	10:11	9600	121.02
C0	--	--	LRA102	CAL	10-Jun-94	10:27	6400	46.02
C35	--	--	LRA103	CAL	10-Jun-94	10:41	7800	78.83
S1	1351541	480338	LRA105	STD	13-Jun-94	13:13	3900	-12.58
S2	1351508	480562	LRA106	STD	13-Jun-94	13:30	5000	13.20
S1	1351541	480338	LRA111	STD	13-Jun-94	14:35	4300	-3.21
S2	1351508	480562	LRA118	STD	13-Jun-94	16:08	6000	36.64
S1	1351541	480338	LRA119	STD	13-Jun-94	16:21	5700	29.61
S2	1351508	480562	LRA120	STD	14-Jun-94	9:46	7200	64.77
S1	1351541	480338	LRA121	STD	14-Jun-94	10:11	6500	48.36
--	1351800	480564	LRA122	FLD	14-Jun-94	10:26	4000	-10.24
--	1351682	480505	LRA123	FLD	14-Jun-94	10:42	5400	22.58
--	1351651	480504	LRA124	FLD	14-Jun-94	10:52	5300	20.23
--	1351621	480504	LRA125	FLD	14-Jun-94	11:04	5500	24.92
--	1351561	480445	LRA130	FLD	14-Jun-94	12:09	5400	22.58
--	1351501	480524	LRA131	FLD	14-Jun-94	12:22	6300	43.67
--	1351503	480574	LRA132	FLD	14-Jun-94	12:34	6700	53.05
--	1351563	480573	LRA133	FLD	14-Jun-94	12:44	3600	-19.62
S2	1351508	480562	LRA134	STD	14-Jun-94	12:56	7100	62.42
S1	1351541	480338	LRA135	STD	14-Jun-94	13:08	6500	48.36
--	1351740	480315	LRA136	FLD	14-Jun-94	13:20	5200	17.89
--	1351801	480315	LRA137	FLD	14-Jun-94	13:47	3200	-28.99

Table G-10: Composite Data Listing for Sodium-Iodide Scintillometer Technology

[Leaders (--): not measured or not applicable]

Geo Loc	X Coord (feet)	Y Coord (feet)	ID	Type	Date	Time (EDT)	Raw Data (counts per minute)	Total U (pCi/g)
C0	--	--	NAD006	CAL	31-May-94	10:50	3717	--
C0	--	--	NAD007	CAL	31-May-94	10:52	3724	--
C35	--	--	NAD008	CAL	31-May-94	10:55	5361	--
C35	--	--	NAD009	CAL	31-May-94	10:57	5420	--
C35	--	--	NAD010	CAL	31-May-94	10:59	5420	--
C100	--	--	NAD011	CAL	31-May-94	11:02	6340	--
C100	--	--	NAD012	CAL	31-May-94	11:04	6250	--
C200	--	--	NAD013	CAL	31-May-94	11:07	9970	--
C200	--	--	NAD014	CAL	31-May-94	11:09	9870	--
CC11	1351834	480591	NAD015	FLD	31-May-94	11:25	5400	95.30
CC10	1351774	480593	NAD016	FLD	31-May-94	11:27	5750	113.57
CC9	1351714	480594	NAD017	FLD	31-May-94	11:29	5750	113.57
CC8	1351654	480596	NAD018	FLD	31-May-94	11:31	5750	113.57
CC7	1351594	480597	NAD019	FLD	31-May-94	11:33	5950	124.01
CC6	1351534	480599	NAD020	FLD	31-May-94	11:35	5900	121.40
CC5	1351474	480600	NAD021	FLD	31-May-94	11:37	5700	110.96
AA5	1351473	480540	NAD022	FLD	31-May-94	11:40	5950	124.01
AA6	1351533	480539	NAD023	FLD	31-May-94	11:42	6100	131.84
AA7	1351593	480537	NAD024	FLD	31-May-94	11:44	5800	116.18
AA8	1351653	480536	NAD025	FLD	31-May-94	11:46	5800	116.18
AA9	1351713	480534	NAD026	FLD	31-May-94	11:48	5600	105.74
AA9.5	1351743	480533	NAD027	FLD	31-May-94	11:50	5700	110.96
AA10	1351760	480533	NAD028	FLD	31-May-94	11:52	5450	97.91
AA11	1351833	480531	NAD029	FLD	31-May-94	11:54	5260	87.99
AA6.5	1351563	480538	NAD030	FLD	31-May-94	11:57	5600	105.74
Y11	1351831	480471	NAD031	FLD	31-May-94	13:57	6200	137.06
Y10	1351771	480473	NAD032	FLD	31-May-94	14:05	5560	103.65
Z10	1351787	480502	NAD033	FLD	31-May-94	14:07	5550	103.13
Z9.5	1351742	480503	NAD034	FLD	31-May-94	14:10	5600	105.74
Z9	1351712	480504	NAD035	FLD	31-May-94	14:12	5310	90.60
Y9.5	1351725	480474	NAD036	FLD	31-May-94	14:14	5750	113.57
Y9	1351711	480474	NAD037	FLD	31-May-94	14:16	5550	103.13
Y8.5	1351681	480475	NAD038	FLD	31-May-94	14:20	5700	110.96
Y8	1351651	480476	NAD039	FLD	31-May-94	14:22	5600	105.74
Y7.5	1351621	480476	NAD040	FLD	31-May-94	14:24	5850	118.79
Y7	1351591	480477	NAD041	FLD	31-May-94	14:26	5650	108.35
Z7	1351592	480507	NAD042	FLD	31-May-94	14:28	5800	116.18
Z6.5	1351562	480508	NAD043	FLD	31-May-94	14:31	5650	108.35
Z6	1351532	480509	NAD044	FLD	31-May-94	14:33	5650	108.35
Y6	1351531	480479	NAD045	FLD	31-May-94	14:35	5500	100.52
Y6.5	1351561	480478	NAD046	FLD	31-May-94	14:38	5500	100.52
Y5	1351471	480480	NAD047	FLD	31-May-94	14:40	5550	103.13
F1	1351542	480529	NAD048	FLD	31-May-94	14:44	5600	105.74

Table G-10: Composite Data Listing for Sodium-Iodide Scintillometer Technology (continued)

[Leaders (--): not measured or not applicable]

Geo Loc	X Coord (feet)	Y Coord (feet)	ID	Type	Date	Time (EDT)	Raw Data (counts per minute)	Total U (pCi/g)
F2	1351547	480528	NAD049	FLD	31-May-94	14:46	5600	105.74
F3	1351552	480528	NAD050	FLD	31-May-94	14:48	5600	105.74
E3	1351552	480523	NAD051	FLD	31-May-94	14:50	5610	106.26
E2	1351547	480523	NAD052	FLD	31-May-94	14:52	5500	100.52
E1	1351542	480524	NAD053	FLD	31-May-94	14:54	5600	105.74
D1	1351542	480519	NAD054	FLD	31-May-94	14:56	5700	110.96
D2	1351547	480518	NAD055	FLD	31-May-94	14:58	5650	108.35
D3	1351552	480518	NAD056	FLD	31-May-94	15:00	5400	95.30
X9	1351711	480457	NAD067	FLD	01-Jun-94	8:34	6000	126.62
X8.5	1351680	480445	NAD068	FLD	01-Jun-94	8:37	6150	134.45
X8	1351650	480446	NAD069	FLD	01-Jun-94	8:40	6000	126.62
X7.5	1351620	480447	NAD070	FLD	01-Jun-94	8:42	5950	124.01
X7	1351590	480447	NAD071	FLD	01-Jun-94	8:47	6150	134.45
S1	1351541	480338	NAD073	STD	01-Jun-94	8:51	6250	139.67
S2	1351508	480562	NAD074	STD	01-Jun-94	8:59	6050	129.23
W5	1351470	480420	NAD075	FLD	01-Jun-94	9:03	6100	131.84
W6	1351530	480419	NAD076	FLD	01-Jun-94	9:06	6200	137.06
W6.5	1351560	480418	NAD077	FLD	01-Jun-94	9:09	6200	137.06
W7	1351590	480417	NAD078	FLD	01-Jun-94	9:11	6350	144.89
W7.5	1351620	480420	NAD079	FLD	01-Jun-94	9:14	6250	139.67
W8	1351650	480429	NAD080	FLD	01-Jun-94	9:17	5850	118.79
W9	1351709	480412	NAD081	FLD	01-Jun-94	9:20	5750	113.57
W9.5	1351739	480413	NAD082	FLD	01-Jun-94	9:23	5650	108.35
W10	1351769	480413	NAD084	FLD	01-Jun-94	9:29	5850	118.79
W11	1351829	480411	NAD085	FLD	01-Jun-94	9:32	5800	116.18
U11	1351828	480351	NAD086	FLD	01-Jun-94	9:49	5550	103.13
U10	1351768	480353	NAD087	FLD	01-Jun-94	9:53	5560	103.65
V10	1351769	480383	NAD088	FLD	01-Jun-94	9:55	5450	97.91
C3	1351758	480373	NAD089	FLD	01-Jun-94	9:58	5460	98.43
C2	1351753	480373	NAD090	FLD	01-Jun-94	10:01	5450	97.91
C1	1351748	480373	NAD091	FLD	01-Jun-94	10:04	5650	108.35
B1	1351748	480368	NAD092	FLD	01-Jun-94	10:06	5450	97.91
B2	1351753	480368	NAD093	FLD	01-Jun-94	10:08	5600	105.74
B3	1351758	480368	NAD095	FLD	01-Jun-94	10:14	5500	100.52
A3	1351758	480363	NAD096	FLD	01-Jun-94	10:16	5700	110.96
A2	1351753	480363	NAD097	FLD	01-Jun-94	10:18	5400	95.30
A1	1351748	480363	NAD098	FLD	01-Jun-94	10:21	5400	95.30
V9.5	1351739	480383	NAD099	FLD	01-Jun-94	10:23	5500	100.52
U9.5	1351738	480353	NAD100	FLD	01-Jun-94	10:26	5500	100.52
U9	1351708	480354	NAD101	FLD	01-Jun-94	10:29	5800	116.18
V9	1351709	480384	NAD102	FLD	01-Jun-94	10:33	6050	129.23
W8.5	1351679	480400	NAD103	FLD	01-Jun-94	10:35	5950	124.01
U8	1351648	480366	NAD104	FLD	01-Jun-94	10:38	6400	147.50

Table G-10: Composite Data Listing for Sodium-Iodide Scintillometer Technology (continued)

[Leaders (--): not measured or not applicable]

Geo Loc	X Coord (feet)	Y Coord (feet)	ID	Type	Date	Time (EDT)	Raw Data (counts per minute)	Total U (pCi/g)
U7	1351588	480361	NAD105	FLD	01-Jun-94	10:45	6450	150.11
V6.5	1351559	480403	NAD107	FLD	01-Jun-94	12:29	6450	150.11
V6	1351529	480394	NAD108	FLD	01-Jun-94	12:33	6050	129.23
U5	1351468	480365	NAD109	FLD	01-Jun-94	12:36	5750	113.57
S5	1351466	480300	NAD110	FLD	01-Jun-94	12:39	5850	118.79
U6	1351528	480354	NAD111	FLD	01-Jun-94	12:42	6250	139.67
U6.5	1351558	480358	NAD112	FLD	01-Jun-94	12:44	6200	137.06
S9	1351706	480294	NAD113	FLD	01-Jun-94	12:49	6000	126.62
S10	1351766	480293	NAD114	FLD	01-Jun-94	12:53	5400	95.30
S11	1351826	480291	NAD115	FLD	01-Jun-94	12:56	5080	78.60
S1	1351541	480338	NAD116	STD	01-Jun-94	13:00	6050	129.23
S1	1351541	480338	NAD117	STD	01-Jun-94	13:02	6200	137.06
S2	1351508	480562	NAD118	STD	01-Jun-94	13:07	5850	118.79
C0	--	--	NAD119	CAL	01-Jun-94	13:17	3704	--
C0	--	--	NAD120	CAL	01-Jun-94	13:26	3703	--
C35	--	--	NAD121	CAL	01-Jun-94	13:28	5360	--
C35	--	--	NAD122	CAL	01-Jun-94	13:31	5210	--
C100	--	--	NAD123	CAL	01-Jun-94	13:34	6050	--
C100	--	--	NAD124	CAL	01-Jun-94	13:36	6200	--
C200	--	--	NAD125	CAL	01-Jun-94	13:39	9820	--
C200	--	--	NAD126	CAL	01-Jun-94	13:41	10020	--
C200	--	--	NAD127	CAL	01-Jun-94	13:43	9870	--
C0	--	--	NAD138	CAL	03-Jun-94	9:45	3571	--
C0	--	--	NAD139	CAL	03-Jun-94	9:50	3777	--
C0	--	--	NAD140	CAL	03-Jun-94	9:55	3720	--
C0	--	--	NAD141	CAL	03-Jun-94	9:58	3735	--
C0	--	--	NAD142	CAL	03-Jun-94	10:00	3856	--
C35	--	--	NAD143	CAL	03-Jun-94	10:04	5400	--
C35	--	--	NAD144	CAL	03-Jun-94	10:06	5400	--
C35	--	--	NAD145	CAL	03-Jun-94	10:09	5450	--
C35	--	--	NAD146	CAL	03-Jun-94	10:14	5400	--
C35	--	--	NAD147	CAL	03-Jun-94	10:16	5650	--
C100	--	--	NAD148	CAL	03-Jun-94	10:19	6100	--
C100	--	--	NAD149	CAL	03-Jun-94	10:21	6300	--
C100	--	--	NAD150	CAL	03-Jun-94	10:25	6400	--
C100	--	--	NAD151	CAL	03-Jun-94	10:27	6430	--
C100	--	--	NAD152	CAL	03-Jun-94	10:30	6450	--
C200	--	--	NAD153	CAL	03-Jun-94	10:34	10020	--
C200	--	--	NAD154	CAL	03-Jun-94	10:36	9970	--
C200	--	--	NAD155	CAL	03-Jun-94	10:40	10050	--
C200	--	--	NAD156	CAL	03-Jun-94	10:43	10030	--
C200	--	--	NAD157	CAL	03-Jun-94	10:46	10170	--
S1	1351541	480338	NAD168	STD	07-Jun-94	9:46	6050	129.23

Table G-10: Composite Data Listing for Sodium-Iodide Scintillometer Technology (continued)

[Leaders (--): not measured or not applicable]

Geo Loc	X Coord (feet)	Y Coord (feet)	ID	Type	Date	Time (EDT)	Raw Data (counts per minute)	Total U (pCi/g)
S2	1351508	480562	NAD169	STD	07-Jun-94	9:50	5750	113.57
S2	1351508	480562	NAD180	STD	08-Jun-94	14:32	5800	116.18
S2	1351508	480562	NAD181	STD	08-Jun-94	14:34	5850	118.79
S1	1351541	480338	NAD182	STD	08-Jun-94	14:38	6050	129.23
S1	1351541	480338	NAD183	STD	08-Jun-94	14:40	6050	129.23
S1	1351541	480338	NAD189	STD	09-Jun-94	14:00	5900	121.40
S1	1351541	480338	NAD190	STD	09-Jun-94	14:02	5850	118.79
S2	1351508	480562	NAD191	STD	09-Jun-94	14:12	5750	113.57
S2	1351508	480562	NAD192	STD	09-Jun-94	14:14	5800	116.18
S1	1351541	480338	NAD203	STD	10-Jun-94	9:48	6300	142.28
S1	1351541	480338	NAD204	STD	10-Jun-94	9:50	6550	155.33
S2	1351508	480562	NAD205	STD	10-Jun-94	9:56	6000	126.62
S2	1351508	480562	NAD206	STD	10-Jun-94	9:58	6100	131.84
S1	1351541	480338	NAD217	STD	13-Jun-94	9:30	5800	116.18
S1	1351541	480338	NAD218	STD	13-Jun-94	9:32	5900	121.40
S2	1351508	480562	NAD219	STD	13-Jun-94	9:44	5750	113.57
S2	1351508	480562	NAD220	STD	13-Jun-94	9:46	5800	116.18
S1	1351541	480338	NAD231	STD	14-Jun-94	13:00	5900	121.40
S1	1351541	480338	NAD232	STD	14-Jun-94	13:02	6050	129.23
S2	1351508	480562	NAD233	STD	14-Jun-94	13:14	5700	110.96
S2	1351508	480562	NAD234	STD	14-Jun-94	13:16	5650	108.35
S1	1351541	480338	NAD245	STD	16-Jun-94	15:15	6050	129.23
S1	1351541	480338	NAD246	STD	16-Jun-94	15:17	5900	121.40
S2	1351508	480562	NAD247	STD	16-Jun-94	15:23	5700	110.96
S2	1351508	480562	NAD248	STD	16-Jun-94	15:25	5760	114.09
S1	1351541	480338	NAD259	STD	17-Jun-94	10:41	6200	137.06
S1	1351541	480338	NAD260	STD	17-Jun-94	10:43	6400	147.50
S2	1351508	480562	NAD261	STD	17-Jun-94	10:47	6050	129.23
S2	1351508	480562	NAD262	STD	17-Jun-94	10:49	5900	121.40

Table G-11: Composite Data Listing for X-Ray Fluorescence Detector Technology

[Leaders (--): not measured or not applicable]

Geo Loc	X Coord (feet)	Y Coord (feet)	ID	Type	Date	Time (EDT	Raw Data (ppm)	Total U (pCi/g)
C0	--	--	XRF001	CAL	03-Jun-94	9:57	1.51	--
C0	--	--	XRF002	CAL	03-Jun-94	10:08	7.14	--
C0	--	--	XRF003	CAL	03-Jun-94	10:18	2.47	--
C0	--	--	XRF004	CAL	03-Jun-94	10:28	5.01	--
C0	--	--	XRF005	CAL	03-Jun-94	10:38	-3.13	--
C35	--	--	XRF006	CAL	03-Jun-94	10:48	87.62	--
C35	--	--	XRF007	CAL	03-Jun-94	10:59	87.09	--
C35	--	--	XRF008	CAL	03-Jun-94	11:09	83.77	--
C35	--	--	XRF009	CAL	03-Jun-94	11:21	83.23	--
C35	--	--	XRF010	CAL	03-Jun-94	11:31	80.58	--
C100	--	--	XRF011	CAL	03-Jun-94	11:41	131.24	--
C100	--	--	XRF012	CAL	03-Jun-94	11:51	130.38	--
C100	--	--	XRF013	CAL	03-Jun-94	12:01	126.27	--
C100	--	--	XRF014	CAL	03-Jun-94	12:10	134.51	--
C100	--	--	XRF015	CAL	03-Jun-94	12:20	137.21	--
C200	--	--	XRF016	CAL	03-Jun-94	12:30	297.77	--
C200	--	--	XRF017	CAL	03-Jun-94	12:41	469.40	--
C200	--	--	XRF018	CAL	03-Jun-94	13:01	330.44	--
C200	--	--	XRF019	CAL	06-Jun-94	9:58	293.20	--
C200	--	--	XRF020	CAL	06-Jun-94	10:09	320.07	--
CC11	1351834	480591	XRF021	FLD	06-Jun-94	10:37	35.04	42.44
AA11	1351833	480531	XRF022	FLD	06-Jun-94	10:51	68.02	74.23
Y11	1351831	480471	XRF023	FLD	06-Jun-94	11:04	106.71	111.53
S1	1351541	480338	XRF024	STD	06-Jun-94	11:21	84.71	90.32
S2	1351508	480562	XRF025	STD	06-Jun-94	11:37	31.00	38.54
W11	1351829	480411	XRF026	FLD	06-Jun-94	11:53	60.77	67.24
U11	1351828	480351	XRF027	FLD	06-Jun-94	13:14	60.12	66.61
S11	1351826	480291	XRF028	FLD	06-Jun-94	13:30	16.97	25.02
S1	1351541	480338	XRF029	STD	06-Jun-94	13:43	69.93	76.07
S2	1351508	480562	XRF030	STD	06-Jun-94	13:53	70.52	76.64
S1	1351541	480338	XRF031	STD	08-Jun-94	9:13	68.70	74.89
S2	1351508	480562	XRF032	STD	08-Jun-94	9:29	51.90	58.69
S10	1351766	480293	XRF033	FLD	08-Jun-94	9:45	64.91	71.23
U10	1351768	480353	XRF034	FLD	08-Jun-94	9:57	55.38	62.04
V10	1351769	480383	XRF035	FLD	08-Jun-94	10:07	60.08	66.58
W10	1351769	480413	XRF036	FLD	08-Jun-94	10:19	63.84	70.20
Y10	1351771	480473	XRF037	FLD	08-Jun-94	10:50	78.66	84.49
Z10	1351787	480502	XRF038	FLD	08-Jun-94	11:05	53.38	60.12
AA10	1351760	480533	XRF039	FLD	08-Jun-94	12:18	85.63	91.21
CC10	1351774	480593	XRF040	FLD	08-Jun-94	12:29	47.96	54.89
AA9.5	1351743	480533	XRF041	FLD	08-Jun-94	12:42	98.97	104.06
Z9.5	1351742	480503	XRF042	FLD	08-Jun-94	12:55	67.65	73.88
Y9.5	1351725	480474	XRF043	FLD	08-Jun-94	13:05	53.34	60.08

Table G-11: Composite Data Listing for X-Ray Fluorescence Detector Technology (continued)

[Leaders (--): not measured or not applicable]

Geo Loc	X Coord (feet)	Y Coord (feet)	ID	Type	Date	Time (EDT	Raw Data (ppm)	Total U (pCi/g)
W9.5	1351739	480413	XRF044	FLD	08-Jun-94	13:17	53.01	59.76
V9.5	1351739	480383	XRF045	FLD	08-Jun-94	13:29	60.17	66.66
U9.5	1351738	480353	XRF046	FLD	08-Jun-94	13:39	72.09	78.16
S1	1351541	480338	XRF047	STD	08-Jun-94	13:49	83.80	89.45
S2	1351508	480562	XRF048	STD	08-Jun-94	14:01	60.93	67.39
S1	1351541	480338	XRF049	STD	09-Jun-94	9:50	70.54	76.66
S2	1351508	480562	XRF050	STD	09-Jun-94	10:01	65.15	71.46
A1	1351748	480363	XRF051	FLD	09-Jun-94	10:17	66.01	72.29
A2	1351753	480363	XRF052	FLD	09-Jun-94	10:32	53.51	60.25
A3	1351758	480363	XRF053	FLD	09-Jun-94	10:47	55.19	61.87
B1	1351748	480368	XRF054	FLD	09-Jun-94	10:56	43.62	50.71
B2	1351753	480368	XRF055	FLD	09-Jun-94	11:06	47.20	54.16
B3	1351758	480368	XRF056	FLD	09-Jun-94	11:17	56.81	63.43
C1	1351748	480373	XRF057	FLD	09-Jun-94	11:32	77.22	83.10
C2	1351753	480373	XRF058	FLD	09-Jun-94	11:43	55.30	61.97
C3	1351758	480373	XRF059	FLD	09-Jun-94	11:53	58.10	64.67
S9	1351706	480294	XRF060	FLD	09-Jun-94	12:13	95.17	100.41
U9	1351708	480354	XRF061	FLD	09-Jun-94	12:24	59.30	65.83
V9	1351709	480384	XRF062	FLD	09-Jun-94	12:33	67.70	73.92
W9	1351709	480412	XRF063	FLD	09-Jun-94	12:52	54.77	61.45
X9	1351711	480457	XRF064	FLD	09-Jun-94	13:03	72.96	78.99
Y9	1351711	480474	XRF065	FLD	09-Jun-94	13:13	79.97	85.75
Z9	1351712	480504	XRF066	FLD	09-Jun-94	13:39	64.06	70.41
AA9	1351713	480534	XRF067	FLD	09-Jun-94	13:52	77.89	83.75
S1	1351541	480338	XRF068	STD	09-Jun-94	14:08	68.48	74.68
S2	1351508	480562	XRF069	STD	09-Jun-94	14:22	64.49	70.83
CC9	1351714	480594	XRF070	FLD	09-Jun-94	14:33	76.58	82.48
S1	1351541	480338	XRF071	STD	10-Jun-94	9:36	72.19	78.25
S2	1351508	480562	XRF072	STD	10-Jun-94	10:06	63.94	70.30
CC8	1351654	480596	XRF073	FLD	10-Jun-94	10:20	55.93	62.58
AA8	1351653	480536	XRF074	FLD	10-Jun-94	10:31	25.65	33.38
Y8	1351651	480476	XRF075	FLD	10-Jun-94	10:44	55.73	62.38
X8	1351650	480446	XRF076	FLD	10-Jun-94	10:57	75.32	81.27
W8	1351650	480429	XRF077	FLD	10-Jun-94	11:09	75.23	81.18
U8	1351648	480366	XRF078	FLD	10-Jun-94	11:35	83.28	88.94
W7.5	1351620	480420	XRF079	FLD	10-Jun-94	11:50	78.09	83.94
X7.5	1351620	480447	XRF080	FLD	10-Jun-94	12:10	57.61	64.19
Y7.5	1351621	480476	XRF081	FLD	10-Jun-94	12:21	58.62	65.17
U7	1351588	480361	XRF082	FLD	10-Jun-94	13:05	89.68	95.11
W7	1351590	480417	XRF083	FLD	10-Jun-94	13:16	81.50	87.23
X7	1351590	480447	XRF084	FLD	10-Jun-94	13:36	78.10	83.95
Y7	1351591	480477	XRF085	FLD	10-Jun-94	13:43	66.27	72.54
S1	1351541	480338	XRF086	STD	10-Jun-94	14:06	85.19	90.79
S2	1351508	480562	XRF087	STD	10-Jun-94	14:17	55.50	62.16

Table G-11: Composite Data Listing for X-Ray Fluorescence Detector Technology (continued)

[Leaders (--): not measured or not applicable]

Geo Loc	X Coord (feet)	Y Coord (feet)	ID	Type	Date	Time (EDT	Raw Data (ppm)	Total U (pCi/g)
S1	1351541	480338	XRF088	STD	14-Jun-94	9:37	80.61	86.36
S2	1351508	480562	XRF089	STD	14-Jun-94	10:12	58.36	64.92
Z7	1351592	480507	XRF090	FLD	14-Jun-94	10:26	49.89	56.75
AA7	1351593	480537	XRF091	FLD	14-Jun-94	10:38	30.60	38.16
CC7	1351594	480597	XRF092	FLD	14-Jun-94	10:49	59.32	65.85
Y8.5	1351681	480475	XRF093	FLD	14-Jun-94	11:02	79.40	85.20
X8.5	1351680	480445	XRF094	FLD	14-Jun-94	11:13	60.15	66.65
W8.5	1351679	480400	XRF095	FLD	14-Jun-94	11:26	83.25	88.91
U6.5	1351558	480358	XRF096	FLD	14-Jun-94	11:43	78.40	84.24
V6.5	1351559	480403	XRF097	FLD	14-Jun-94	11:54	87.40	92.91
W6.5	1351560	480418	XRF098	FLD	14-Jun-94	12:04	70.21	76.34
Y6.5	1351561	480478	XRF099	FLD	14-Jun-94	12:54	61.90	68.34
Z6.5	1351562	480508	XRF100	FLD	14-Jun-94	13:07	59.13	65.66
AA6.5	1351563	480538	XRF101	FLD	14-Jun-94	13:17	40.70	47.90
CC6	1351534	480599	XRF102	FLD	14-Jun-94	13:27	71.74	77.82
S2	1351508	480562	XRF103	STD	14-Jun-94	13:38	56.98	63.59
S1	1351541	480338	XRF104	STD	14-Jun-94	13:55	77.62	83.48
S1	1351541	480338	XRF105	STD	15-Jun-94	9:48	83.66	89.30
S2	1351508	480562	XRF106	STD	15-Jun-94	10:05	64.33	70.67
AA6	1351533	480539	XRF107	FLD	15-Jun-94	10:12	66.11	72.39
D1	1351542	480519	XRF108	FLD	15-Jun-94	10:25	65.39	71.69
D2	1351547	480518	XRF109	FLD	15-Jun-94	10:34	61.83	68.26
D3	1351552	480518	XRF110	FLD	15-Jun-94	10:44	60.88	67.35
E1	1351542	480524	XRF111	FLD	15-Jun-94	10:59	47.18	54.14
E2	1351547	480523	XRF112	FLD	15-Jun-94	11:10	62.36	68.78
E3	1351552	480523	XRF113	FLD	15-Jun-94	11:21	64.71	71.04
F1	1351542	480529	XRF114	FLD	15-Jun-94	11:31	70.55	76.67
F2	1351547	480528	XRF115	FLD	15-Jun-94	12:47	54.13	60.84
F3	1351552	480528	XRF116	FLD	15-Jun-94	12:59	57.10	63.71
Z6	1351532	480509	XRF117	FLD	15-Jun-94	13:08	55.40	62.07
S2	1351508	480562	XRF118	STD	15-Jun-94	13:17	58.82	65.36
S1	1351541	480338	XRF119	STD	15-Jun-94	13:30	80.09	85.87
S1	1351541	480338	XRF120	STD	16-Jun-94	9:24	73.25	79.28
S2	1351508	480562	XRF121	STD	16-Jun-94	9:38	56.83	63.44
Y6	1351531	480479	XRF122	FLD	16-Jun-94	9:50	58.37	64.92
W6	1351530	480419	XRF123	FLD	16-Jun-94	10:00	68.63	74.82
V6	1351529	480394	XRF124	FLD	16-Jun-94	10:12	62.32	68.74
U6	1351528	480354	XRF125	FLD	16-Jun-94	10:22	68.18	74.38
S5	1351466	480300	XRF126	FLD	16-Jun-94	10:33	76.44	82.35
U5	1351468	480365	XRF127	FLD	16-Jun-94	10:44	58.43	64.98
W5	1351470	480420	XRF128	FLD	16-Jun-94	10:55	63.53	69.90
Y5	1351471	480480	XRF129	FLD	16-Jun-94	11:05	47.76	54.70
AA5	1351473	480540	XRF130	FLD	16-Jun-94	11:15	54.40	61.10
CC5	1351474	480600	XRF131	FLD	16-Jun-94	11:24	61.33	67.78

Table G-11: Composite Data Listing for X-Ray Fluorescence Detector Technology (continued)

[Leaders (--): not measured or not applicable]

Geo Loc	X Coord (feet)	Y Coord (feet)	ID	Type	Date	Time (EDT	Raw Data (ppm)	Total U (pCi/g)
S2	1351508	480562	XRF132	STD	16-Jun-94	11:33	60.35	66.84
S1	1351541	480338	XRF133	STD	16-Jun-94	11:44	98.53	103.64
C0	--	--	XRF134	CAL	28-Jun-94	9:52	-0.33	--
C0	--	--	XRF135	CAL	28-Jun-94	10:04	8.08	--
C0	--	--	XRF136	CAL	28-Jun-94	10:17	11.06	--
C0	--	--	XRF137	CAL	28-Jun-94	10:26	0.15	--
C0	--	--	XRF138	CAL	28-Jun-94	10:35	6.35	--
C35	--	--	XRF139	CAL	28-Jun-94	10:45	81.61	--
C35	--	--	XRF140	CAL	28-Jun-94	11:04	60.78	--
C35	--	--	XRF141	CAL	28-Jun-94	11:13	82.83	--
C35	--	--	XRF142	CAL	28-Jun-94	11:22	72.29	--
C35	--	--	XRF143	CAL	28-Jun-94	11:44	97.77	--
C100	--	--	XRF144	CAL	29-Jun-94	9:13	150.49	--
C100	--	--	XRF145	CAL	29-Jun-94	9:22	110.00	--
C100	--	--	XRF146	CAL	29-Jun-94	9:32	107.17	--
C100	--	--	XRF147	CAL	29-Jun-94	9:41	119.16	--
C100	--	--	XRF148	CAL	29-Jun-94	9:53	133.94	--
CP	--	--	XRF149	CAL	29-Jun-94	10:02	45.72	--
CP	--	--	XRF150	CAL	29-Jun-94	10:11	62.46	--
CP	--	--	XRF151	CAL	29-Jun-94	10:23	74.30	--
CP	--	--	XRF152	CAL	29-Jun-94	10:32	56.23	--
CP	--	--	XRF153	CAL	29-Jun-94	10:40	59.67	--
S1	1351541	480338	XRF154	STD	30-Jun-94	9:02	80.82	86.57
S2	1351508	480562	XRF155	STD	30-Jun-94	9:13	54.08	60.80
--	1351683	480555	XRF156	FLD	30-Jun-94	9:34	58.36	64.92
--	1351651	480555	XRF157	FLD	30-Jun-94	9:48	73.97	79.96
--	1351621	480553	XRF158	FLD	30-Jun-94	9:59	83.85	89.50
--	1351591	480555	XRF159	FLD	30-Jun-94	10:08	53.77	60.50
--	1351620	480535	XRF160	FLD	30-Jun-94	10:18	59.82	66.33
--	1351685	480533	XRF161	FLD	30-Jun-94	10:28	49.09	55.98
--	1351650	480506	XRF162	FLD	30-Jun-94	10:38	68.56	74.75
--	1351620	480507	XRF163	FLD	30-Jun-94	10:49	49.65	56.52
--	1351504	480506	XRF164	FLD	30-Jun-94	11:02	45.38	52.41
--	1351472	480506	XRF165	FLD	30-Jun-94	11:16	47.75	54.69
--	1351825	480315	XRF166	FLD	30-Jun-94	11:40	31.67	39.19
--	1351801	480315	XRF167	FLD	30-Jun-94	11:52	37.15	44.47
--	1351800	480291	XRF168	FLD	30-Jun-94	12:02	56.05	62.69
S1	1351541	480338	XRF169	STD	30-Jun-94	12:30	89.53	94.97
S1	1351541	480338	XRF170	STD	01-Jul-94	8:44	87.64	93.14
S2	1351508	480562	XRF171	STD	01-Jul-94	8:54	60.13	66.63
--	1351786	480592	XRF172	FLD	01-Jul-94	9:09	63.00	69.39
C0	--	--	XRF173	CAL	01-Jul-94	9:32	5.14	--
C0	--	--	XRF174	CAL	01-Jul-94	9:43	9.59	--
C0	--	--	XRF175	CAL	01-Jul-94	9:53	1.99	--

Table G-11: Composite Data Listing for X-Ray Fluorescence Detector Technology (continued)

[Leaders (--): not measured or not applicable]

Geo Loc	X Coord (feet)	Y Coord (feet)	ID	Type	Date	Time (EDT	Raw Data (ppm)	Total U (pCi/g)
C0	--	--	XRF176	CAL	01-Jul-94	10:03	8.05	--
C0	--	--	XRF177	CAL	01-Jul-94	10:12	3.74	--
C35	--	--	XRF178	CAL	01-Jul-94	10:23	78.95	--
C35	--	--	XRF179	CAL	01-Jul-94	10:33	69.61	--
C35	--	--	XRF180	CAL	01-Jul-94	10:44	66.56	--
C35	--	--	XRF181	CAL	01-Jul-94	10:56	69.51	--
C35	--	--	XRF182	CAL	01-Jul-94	11:05	78.03	--
C100	--	--	XRF183	CAL	01-Jul-94	13:02	120.03	--
C100	--	--	XRF184	CAL	01-Jul-94	13:13	113.09	--
C100	--	--	XRF185	CAL	01-Jul-94	13:21	119.54	--
C100	--	--	XRF186	CAL	01-Jul-94	13:30	118.09	--
C100	--	--	XRF187	CAL	01-Jul-94	13:40	139.24	--
CP	--	--	XRF188	CAL	01-Jul-94	13:49	43.62	--
CP	--	--	XRF189	CAL	01-Jul-94	13:59	68.62	--
CP	--	--	XRF190	CAL	01-Jul-94	14:07	71.21	--
CP	--	--	XRF191	CAL	01-Jul-94	14:18	39.05	--
CP	--	--	XRF192	CAL	01-Jul-94	14:27	52.12	--
S1	1351541	480338	XRF193	STD	01-Jul-94	14:51	88.98	94.44
S2	1351508	480562	XRF194	STD	01-Jul-94	15:07	36.35	43.70

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