AD NO. _____
DTC PROJECT NO. 8-CO-160-UXO-021
REPORT NO. ATC-8675

STANDARDIZED

UXO TECHNOLOGY DEMONSTRATION SITE

OPEN FIELD SCORING RECORD NO. 38

SITE LOCATION:
ABERDEEN PROVING GROUND

DEMONSTRATOR:
ZONGE ENGINEERING AND RESEARCH
ORGANIZATION, INC.
3322 E. FORT LOWELL RD
TUCSON, AZ 85716

TECHNOLOGY TYPE/PLATFORM:
4-DTEM/PUSHCART

PREPARED BY:
U.S. ARMY ABERDEEN TEST CENTER
ABERDEEN PROVING GROUND, MD 21005-5059

MARCH 2004

Prepared for:
U.S. ARMY ENVIRONMENTAL CENTER
ABERDEEN PROVING GROUND, MD 21010-5401

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ABERDEEN PROVING GROUND, MD 21005-5055

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14. ABSTRACT
This scoring record documents the efforts of Zonge, Inc. to detect and discriminate inert unexploded ordnance (UXO) utilizing the APG Standardized UXO Technology Demonstration Site Open Field. The scoring record was written by Larry Overbay utilizing methodology coordinated with the Standardized UXO Technology Demonstration Site Program Scoring Committee. Organizations on the committee include the U.S. Army Corps of Engineers, the Environmental Security Technology Certification Program, the Strategic Environmental Research and Development Program, the Institute for Defense Analysis, the U.S. Army Environmental Center, and the U.S. Army Aberdeen Test Center.

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SECTION 1. GENERAL INFORMATION

1.1 BACKGROUND

Technologies under development for the detection and discrimination of unexploded ordnance (UXO) require testing so that their performance can be characterized. To that end, Standardized Test Sites have been developed at Aberdeen Proving Ground (APG), Maryland and U.S. Army Yuma Proving Ground (YPG), Arizona. These test sites provide a diversity of geology, climate, terrain, and weather as well as diversity in ordnance and clutter. Testing at these sites is independently administered and analyzed by the government for the purposes of characterizing technologies, tracking performance with system development, comparing performance of different systems, and comparing performance in different environments.

The Standardized UXO Technology Demonstration Site Program is a multi-agency program spearheaded by the U.S. Army Environmental Center (AEC). The U.S. Army Aberdeen Test Center (ATC) and the U.S. Army Corps of Engineers Engineering Research and Development Center (ERDC) provide programmatic support. The program is being funded and supported by the Environmental Security Technology Certification Program (ESTCP), the Strategic Environmental Research and Development Program (SERDP) and the Army Environmental Quality Technology Program (EQT).

1.2 SCORING OBJECTIVES

The objective in the Standardized UXO Technology Demonstration Site Program is to evaluate the detection and discrimination capabilities of a given technology under various field and soil conditions. Inert munitions and clutter items are positioned in various orientations and depths in the ground.

The evaluation objectives are as follows:

a. To determine detection and discrimination effectiveness under realistic scenarios that vary targets, geology, clutter, topography, and vegetation.

b. To determine cost, time, and manpower requirements to operate the technology.

c. To determine demonstrator's ability to analyze survey data in a timely manner and provide prioritized "Target Lists" with associated confidence levels.

d. To provide independent site management to enable the collection of high quality, ground-truth, geo-referenced data for post-demonstration analysis.

1.2.1 Scoring Methodology

a. The scoring of the demonstrator's performance is conducted in two stages. These two stages are termed the RESPONSE STAGE and DISCRIMINATION STAGE. For both stages, the probability of detection (P_d) and the false alarms are reported as receiver-operating

characteristic (ROC) curves. False alarms are divided into those anomalies that correspond to emplaced clutter items, measuring the probability of false positive (P_{fp}), and those that do not correspond to any known item, termed background alarms.

b. The RESPONSE STAGE scoring evaluates the ability of the system to detect emplaced targets without regard to ability to discriminate ordnance from other anomalies. For the open field RESPONSE STAGE, the demonstrator provides the scoring committee with the field location and signal strength of all anomalies that the demonstrator has deemed sufficient to warrant further investigation and/or processing as potential emplaced ordnance items. This list is generated with minimal processing and will only include signals that are above the system noise level.

c. The DISCRIMINATION STAGE evaluates the demonstrator's ability to correctly identify ordnance as such and to reject clutter. For the same field locations as in the RESPONSE STAGE anomaly list, the DISCRIMINATION STAGE list contains the output of the algorithms applied in the discrimination-stage processing. This list is prioritized based on the demonstrator's determination that an anomaly location is likely to contain ordnance. Thus, higher output values are indicative of higher confidence that an ordnance item is present at the specified location. For digital signal processing, priority ranking is based on algorithm output. For other discrimination approaches, priority ranking is based on human (subjective) judgment. The demonstrator also specifies the threshold in the prioritized ranking that provides optimum performance termed the Discrimination Stage Threshold (i.e. that is expected to retain all detected ordnance and reject the maximum amount of clutter).

d. The demonstrator is also scored on EFFICIENCY and REJECTION RATIO, which measure the effectiveness of the discrimination stage processing. The goal of discrimination is to retain the greatest number of ordnance detections from the anomaly list, while rejecting the maximum number of anomalies arising from non-ordnance items. EFFICIENCY measures the fraction of detected ordnance retained after discrimination, while the REJECTION RATIO measures the fraction of false alarms rejected. Both measures are defined relative to the entire response stage anomaly list, i.e., the maximum ordnance detectable by the sensor and its accompanying false positive rate or background alarm rate.

e. Based on configuration of the ground truth at the standardized sites and the defined scoring methodology, there exists the possibility of having anomalies within overlapping halos and/or multiple anomalies within halos. In these cases, the following scoring logic is implemented:

(1) In situations where multiple anomalies exist within a single R_{halo}, the anomaly with the strongest response or highest ranking will be assigned to that particular ground truth item.

(2) For overlapping R_{halo} situations, ordnance has precedence over clutter. The anomaly with the strongest response or highest ranking that is closest to the center of a particular ground truth item gets assigned to that item. Remaining anomalies are retained until all matching is complete.

(3) Anomalies located within any R_{halo} that do not get associated with a particular ground truth item are thrown out and are not considered in the analysis.

f. All scoring factors are generated utilizing the Standardized UXO Probability and Plot Program, version 3.1.1.

1.2.2 Scoring Factors

Factors to be measured and evaluated as part of this demonstration include:

a. Response Stage ROC curves:

(1) Probability of Detection (P_d^{res}).

(2) Probability of False Positive (P_{fp}^{res}).

(3) Background Alarm Rate (BAR^{res}) or Probability of Background Alarm (P_{BA}^{res}).

b. Discrimination Stage ROC curves:

(1) Probability of Detection (P_d^{disc}).

(2) Probability of False Positive (P_{fp}^{disc}).

(3) Background Alarm Rate (BAR^{disc}) or Probability of Background Alarm (P_{BA}^{disc}).

c. Metrics:

(1) Efficiency (E).

(2) False Positive Rejection Rate (R_{fp}).

(3) Background Alarm Rejection Rate (R_{BA}).

d. Other:

(1) Probability of Detection by Size and Depth.

(2) Classification by type (i.e., 20-, 40-, 105-mm, etc.).

(3) Location accuracy.

(4) Equipment setup, calibration time and corresponding man-hour requirements.

(5) Survey time and corresponding man-hour requirements.

(6) Reacquisition/resurvey time and man-hour requirements (if any).

(7) Downtime due to system malfunctions and maintenance requirements.

1.3 STANDARD AND NONSTANDARD INERT ORDNANCE TARGETS

The standard and nonstandard ordnance items emplaced in the test areas are listed in Table 1. Standardized targets are members of a set of specific ordnance items that have identical properties to all other items in the set (caliber, configuration, size, weight, aspect ratio, material, filler, magnetic remanence, and nomenclature). Nonstandard targets are inert ordnance items having properties that differ from those in the set of standardized targets.

TABLE 1. INERT ORDNANCE TARGETS

Standard Type	Nonstandard (NS)
20-mm Projectile M55	20-mm Projectile M55
	20-mm Projectile M97
40-mm Grenades M385	40-mm Grenades M385
40-mm Projectile MKII Bodies	40-mm Projectile M813
BDU-28 Submunition	
BLU-26 Submunition	
M42 Submunition	
57-mm Projectile APC M86	
60-mm Mortar M49A3	60-mm Mortar (JPG)
	60-mm Mortar M49
2.75-inch Rocket M230	2.75-inch Rocket M230
	2.75-inch Rocket XM229
MK 118 ROCKEYE	
81-mm Mortar M374	81-mm Mortar (JPG)
	81-mm Mortar M374
105-mm Heat Rounds M456	
105-mm Projectile M60	105-mm Projectile M60
155-mm Projectile M483A1	155-mm Projectile M483A
	500-lb Bomb

JPG = Jefferson Proving Ground

SECTION 2. DEMONSTRATION

2.1 DEMONSTRATOR INFORMATION

2.1.1 Demonstrator Point of Contact and Address

Address: Zonge Engineering and Research Organization, Inc.
3322 E. Fort Lowell Road
Tucson, AZ 22202
520) 327-5501

2.1.2 System Description (Provided by Demonstrator)

Figure 1 shows an annotated photograph (without block diagram). The basic 4-D TEM acquisition system consists of three major hardware subsystems:

a. GDP-32II Transceiver Subsystem (not shown in photograph). The GDP-32II transceiver subsystem consists of a 3-channel high-speed digital data acquisition system together with a circuit board level fast switching NanoTEM transmitter (NT-32). The instrument transmits a bipolar current waveform at a pulse repetition frequency of 32 Hz. The transmitter is designed for rapid shutoff of current when working into relatively low inductance loads. With the antenna array that will be deployed at APG, the current shutoff time is approximately 5 μs. Secondary transients produced by nearby conductors illuminated by the transmitter field are sampled at a rate of 800 kHz and composited into 31 time windows over the time interval $1 \leq t \leq 2000$ μs.

b. Antenna Cart Subsystem. The cart-mounted antenna array consists of a single horizontal transmitter loop with an area of approximately 1 m^2 mounted together with three mutually orthogonal receiver loops. Cart attitude (heading, pitch, and roll) is transduced with a digital compass/tiltmeter.

c. GPS Navigation Subsystem. Local positioning and geo-referencing of the Zonge NanoTEM system is accomplished using a Leica SR530 real time kinematic (RTK) GPS system. The Leica system consists of two dual-frequency geodetic quality receivers that are in radio communication with each other. A roving GPS antenna is mounted on the NanoTEM antenna cart.

The operator carries the controller along with the GDP-32II instrument package. The antenna has been located in a position where it does not measurably affect the TEM measurements.

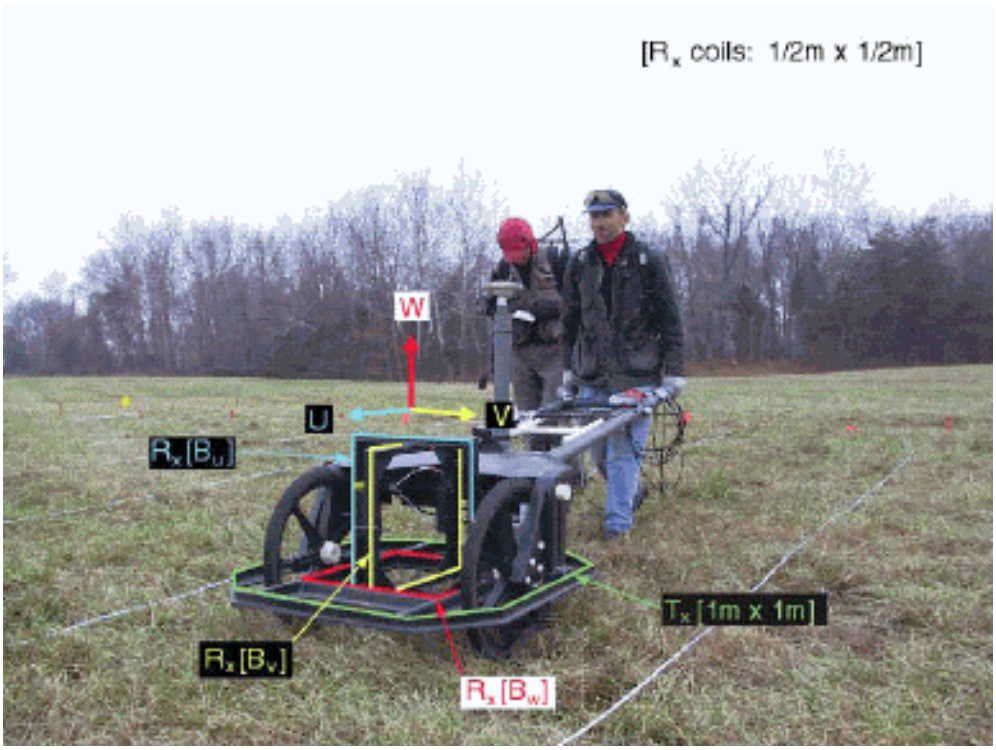

Figure 1. Demonstrator's system.

2.1.3 Data Processing Description (Provided by Demonstrator)

DNT Data Processing Subsystem. The data recorded by the GDP-32II, the compass subsystem, and the Leica GPS system are processed using a software system designed around Geosoft's Oasis Montaj™. The data sets are merged based on time-stamps recorded in each data set. Raw data files are imported into Oasis Montaj™ through a proprietary preprocessing program (DNT Reduce). This program performs basic corrections for cart geometry (e.g., GPS antenna offsets), antenna parameters (e.g., transmitter moment, and effective receiver area), and merges the data with the GPS positions if available. DNT Reduce can act as a stand-alone program or can be executed from within Oasis. In either case, the program generates both text based files (CSV) and/or a binary file that can be immediately imported by Oasis Montaj™ . The files output by Oasis Montaj™ meet the requirements as the raw sensor data that must be delivered at end of the field demonstration. After importation into Oasis Montaj™ , standard features of Oasis Montaj™ together with custom Geosoft executable (GX) modules will be used to perform the following processing steps on the data acquired as a result of activities at APG.

(1) Component rotation from cart-fixed to geographic coordinate system (Custom Oasis GX).

(2) Generation of composite time windows (Custom GX).

(3) Background removal or leveling.

(4) Map generation (Oasis).

(5) Target picking (Oasis/UXO).

(6) Target parameterization (DNT/Model).

(7) Target classification (DNT/Classify).

2.1.4 Data Submission Format

Data was submitted for scoring in accordance with data submission protocols outlined in the Standardized UXO Technology Demonstration Site Handbook (app E, ref 1). This data is not included in this report in order to protect ground truth information.

2.1.5 Demonstrator Quality Assurance (QA) and Quality Control (QC) (Provided by Demonstrator)

Overall data quality is controlled and documented by means of a series of tests that are run two or more times daily depending on the tests. There are three standard QC checks that will made two or more times for every field day:

(1) Standard Check. Measure instrument response from a standard target (e.g., 3-in. steel sphere).

(2) Position Check. Check GPS cart position at a specified station.

(3) Latency Check. Check to see that a target anomaly is recorded at the same position when crossed with the cart from opposite directions.

(4) Timing Check. Check for timing drift between GPS time and GDP-32II time.

The first three checks listed above are combined into a calibration ball check procedure. We locate and mark a station that is conveniently adjacent to the area to be surveyed. We place the calibration target at this point and mark the end points of a 10- to 15-meter line that traverses over the calibration target and the position base. The test procedure consists of a slow survey over the calibration target to the end of the calibration line. The cart is then turned around and a second slow traverse is made over the target in the opposite direction. Finally, the cart is slowly backed up from the beginning of the calibration ball line until it is centered directly over the target. We continue to record data for a short period (10 to 30 sec) while the cart remains in a static position over the target. At the end of the data recording, we record the GPS position of the cart as a static way point that can be compared with previously recorded positions. The calibration ball check procedure can be used not only to make the first three checks (i.e., standard, position, and latency) but also to document any timing drift of offset. The position of the target is precisely known and, hence, we can check for a time offset indicated by the difference in time between where the target peak occurs and where the GPS indicates that the

cart arrives at the true target position. The real time clock in the GDP-32II is also checked using a custom program together with the SynPaq GPS satellite timing system we use to synchronize the real time clock to GPS time.

The principal objective of the fieldwork to be conducted under this demonstration plan will be to acquire high quality dynamic data sets over the 43- by 27-meter Calibration Lanes and the 43- by 43-meter Blind Test Grid. The Calibration Lanes will be surveyed in one direction with a lane spacing of 1/2 m. The survey will be repeated at a higher speed (e.g., 60 to 80 m/min) in order to assess the degradation in data quality as a function of survey speed. The blind test grid will be surveyed in two orthogonal directions each with lane spacings of 1/2 meter. The remainder of the time will be spent in surveying the Open Field Site.

2.1.6 Additional Records

The following record(s) of this demonstrator's field activities can be accessed via the Internet as PDF files at www.uxotestsites.org.

Addendum 1, Zonge Blind Grid Scoring Record No. 37, dated October 2003. Record is published.

2.2 APG SITE INFORMATION

2.2.1 Location

The APG Standardized Test Site is located within a secured range area of the Aberdeen Area. The Aberdeen Area of APG is located approximately 30 miles northeast of Baltimore at the northern end of the Chesapeake Bay. The Standardized Test Site encompasses 17 acres of upland and lowland flats, woods and wetlands.

2.2.2 Soil Type

According to the soils survey conducted for the entire area of APG in 1998, the test site consists primarily of Elkton Series type soil (ref 2). The Elkton Series consist of very deep, slowly permeable, poorly drained soils. These soils formed in silty aeolin sediments and the underlying loamy alluvial and marine sediments. They are on upland and lowland flats and in depressions of the Mid-Atlantic Coastal Plain. Slopes range from 0 to 2 percent.

ERDC conducted a site-specific analysis in May of 2002 (ref 3). The results basically matched the soil survey mentioned above. Seventy percent of the samples taken were classified as silty loam. The majority (77 percent) of the soil samples had a measured water content between 15- and 30-percent with the water content decreasing slightly with depth.

For more details concerning the soil properties at the APG test site, go to www.uxotestsites.org on the web to view the entire soils description report.

2.2.3 Test Areas

A description of the test site areas at APG is included in Table 2.

TABLE 2. TEST SITE AREAS

Area	Description
Calibration Grid	Contains 14 standard ordnance items buried in six positions at various angles and depths to allow demonstrator to calibrate their equipment.
Blind Test Grid	Contains 400 grid cells in a 0.2-hectare (0.5 acre) site. The center of each grid cell contains ordnance, clutter or nothing.
Open Field	A 4-hectare (10-acre) site containing open areas, dips, ruts and obstructions that challenge platform systems or hand held detectors. The challenges include a gravel road, wet areas and trees. The vegetation height varies from 15 to 25 cm.

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SECTION 3. FIELD DATA

3.1 DATE OF FIELD ACTIVITIES (19 AUGUST TO 2 SEPTEMBER 2002)

3.2 AREAS TESTED/NUMBER OF HOURS

Areas tested and number of hours operated at each site are summarized in Table 3.

TABLE 3. AREAS TESTED AND NUMBER OF HOURS

Area	Number of Hours
Calibration Lanes	5.0
Blind Test Grid	3.2
Open Field	108.7

3.3 TEST CONDITIONS

3.3.1 Weather Conditions

An ATC weather station located approximately 2 miles west of the test site was used to record average temperature and precipitation on an hourly basis for each day of operation. The temperatures listed in Table 4 represent the average temperature during field operations from 0700 through 1700 hours while the precipitation data represents a daily total amount of rainfall. Hourly weather logs used to generate this summary are provided in Appendix B.

TABLE 4. TEMPERATURE/PRECIPITATION DATA SUMMARY

Date, 2002	Average Temperature, ^{o}F	Total Daily Precipitation, in.
19 August	87.0	0.00
20 August	84.2	0.00
21 August	81.6	0.00
22 August	82.2	0.00
23 August	80.8	0.07
24 August	78.0	0.84
25 August	80.2	0.00
26 August	78.1	0.00
27 August	79.6	0.00
28 August	71.2	0.64
29 August	65.2	0.20
30 August	67.5	0.00
31 August	74.3	0.00
01 September	64.1	0.92
02 September	70.5	0.00

3.3.2 Field Conditions

Zonge surveyed the open field from 20 August to 2 September 2002. The field was mostly dry throughout the survey. On 1 and 2 September 2002, the field became muddy due to rain that occurred on 1 September 2002.

3.3.3 Soil Moisture

The soil moisture logs are included in Appendix C. Three soil probes were placed at various locations of the site to capture soil moisture data: open field, open field lowland (wet) and open field scenario No. 1 wooded area. Measurements were collected in percent moisture and were taken twice daily (morning and afternoon) from five different soil layers (0 to 6 in., 6 to 12 in., 12 to 24 in., 24 to 36 in. and 36 to 48 in.) from each probe.

The soil moisture data collected are summarized in Table 5. The average moisture content was calculated by averaging the morning and afternoon measurements for each layer of each probe for the duration of the field operations in the Blind Grid.

TABLE 5. SOIL MOISTURE DATA SUMMARY

Layer, in.	Average Moisture Content, %	Standard Deviation, %
OPEN FIELD PROBE		
0 to 6	13.50	9.79
6 to 12	9.60	4.33
12 to 24	1.87	0.23
24 to 36	4.43	1.21
36 to 48	0.17	0.15
WET PROBE		
0 to 6	19.88	8.98
6 to 12	12.15	3.55
12 to 24	12.47	1.75
24 to 36	31.79	9.90
36 to 48	35.20	6.33

3.4 FIELD ACTIVITIES

3.4.1 Setup/Mobilization

These activities included initial mobilization and daily equipment preparation and breakdown. A crew of three people took 4 hours and 50 minutes to perform the initial setup and mobilization. Each day, 29 minutes to 2 hours and 25 minutes were spent preparing the equipment before beginning the field survey and 10 to 25 minutes spent breaking down equipment for the day. Daily start/stop activities totaled 17 hours and 42 minutes.

3.4.2 Calibration

In addition to spending 4 hours and 31 minutes in the calibration lanes, the equipment was calibrated before each data run using either a calibration ball or the GPS. On two occasions, the equipment was calibrated after the data run. Each of the 58 in-field calibrations took approximately 30 seconds (29 min total) for a total calibration time of 5 hours 0 minutes.

3.4.3 Downtime Occasions

Occasions of downtime are grouped into five categories: equipment/data checks or equipment maintenance, equipment failure and repair, weather, Demonstration Site issues, or breaks/lunch. All downtime is included for the purposes of calculating labor costs (section 5) except for downtime due to Demonstration Site issues. Demonstration Site issues, while noted in the Daily Log, are considered non-chargeable downtime for the purposes of calculating labor costs and are not discussed. Breaks and lunches are not discussed either.

3.4.3.1 Equipment/data checks, maintenance. Equipment and data were initially checked to verify data was being recorded and that the GPS was functioning. Frequent additional stops were made to download data, change batteries, or prepare for the next data run. The total time spent checking equipment or data and doing maintenance was 21 hours and 9 minutes. On 22 August 2002 software issues caused a 5-minute stoppage followed by a lunch break.

3.4.3.2 Equipment failure or repair. Zonge had several minor problems associated with their equipment including: a broken wheel yoke, GPS base receiver failure, a broken antenna assembly, and software glitches. Some data runs had to be resurveyed due to these equipment failures. Total downtime due to equipment failures: 6 hours and 24 minutes.

3.4.3.3 Weather. One 15-minute rain delay was recorded on 28 August 2002.

3.4.4 Data Collection

The demonstrator spent 57 hours and 44 minutes collecting data. This time excludes break/lunches and downtimes described in section 3.4.3.

3.4.5 Demobilization

A crew of two people took 1 hour and 45 minutes to breakdown and pack up equipment for demobilization.

3.5 PROCESSING TIME

Data was submitted for scoring within the 30-day period. Since this Demonstrator was the first to use the site, issues outside of the Demonstrator's control required data to be resubmitted on a total of four separate occasions. On each occasion, the Demonstrator was responsive and timely.

3.6 DEMONSTRATOR'S FIELD PERSONNEL

Section deleted for public release.

3.7 DEMONSTRATOR'S FIELD SURVEYING METHOD

Zonge Engineering began surveying in the northeast corner of the field continuing in a north/south direction. Zonge utilized radio frequency telemetry between a base station GPS unit and their hand-pushed cart. They utilized 100-meter tapes separated approximately 1 meter apart to cover all of the intended areas.

3.8 SUMMARY OF DAILY LOGS

Detailed daily activity logs are included as Appendix D. Other than the issues mentioned in section 3.4, the only other issue was that Zonge Engineering requested to drive wooden stakes into the ground in the open field to lay out measuring tapes and mark grids. This request was denied in order to protect the integrity of the site. Zonge did use cones and non-intrusive anchoring points as stakes to lay out their measuring tapes and mark grids. The use of these is noted in Appendix D.

SECTION 4. TECHNICAL PERFORMANCE RESULTS

4.1 ROC CURVES USING ALL ORDNANCE CATEGORIES

Figure 2 shows the probability of detection for the response stage (P_d^{res}) and the discrimination stage (P_d^{disc}) versus their respective probability of false positive. Figure 3 shows both probabilities plotted against their respective background alarm rate. Both figures use a horizontal line to illustrate the performance of the demonstrator at the demonstrator's recommended discrimination stage threshold level, which defines the subset of targets the demonstrator would recommend digging based on discrimination. Note that all points have been rounded to protect the ground truth.

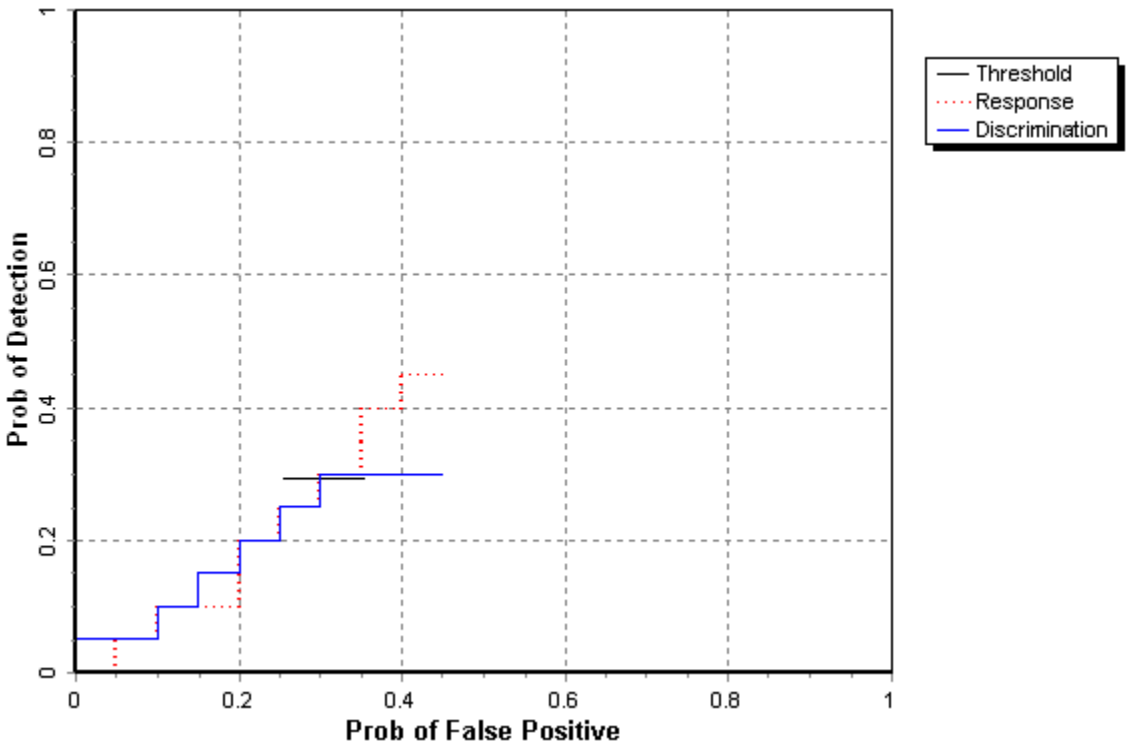

Figure 2. 4-D TEM open field probability of detection for response and discrimination stages versus their respective probability of false positive over all ordnance categories combined.

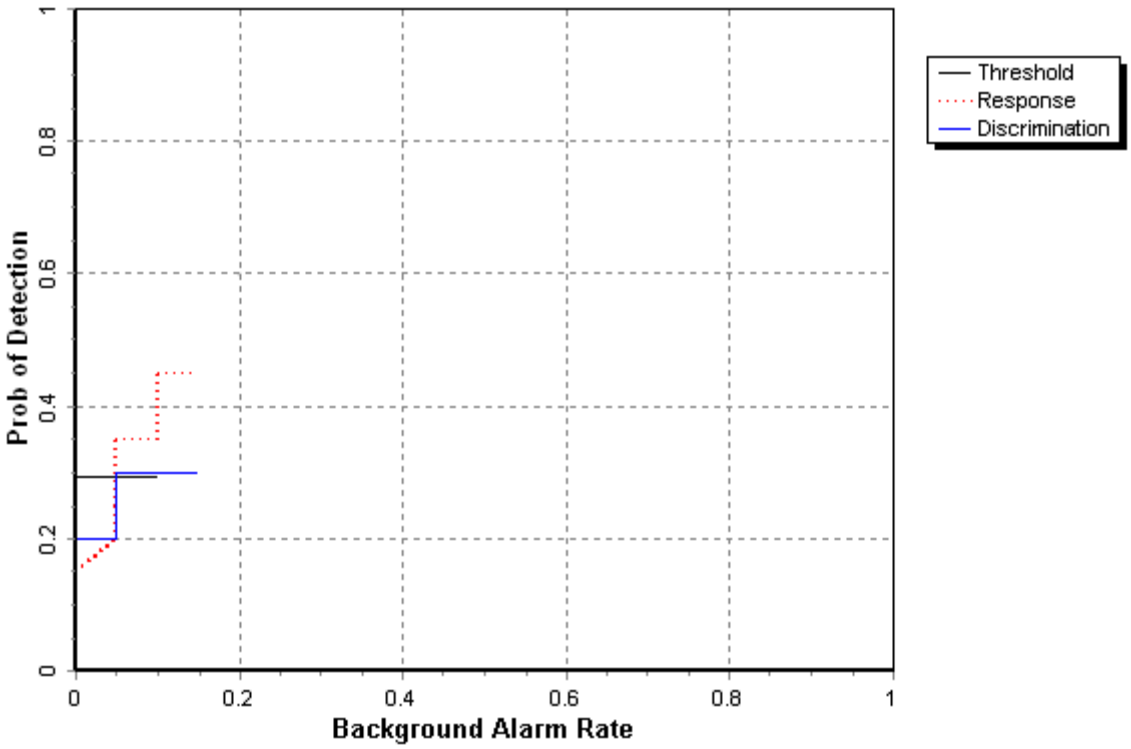

Figure 3. 4-D TEM open field probability of detection for response and discrimination stages versus their respective background alarm rate over all ordnance categories combined.

4.2 ROC CURVES USING ORDNANCE LARGER THAN 20 MM

Figure 4 shows the probability of detection for the response stage (P_d^{res}) and the discrimination stage (P_d^{disc}) versus their respective probability of false positive when only targets larger than 20 mm are scored. Figure 5 shows both probabilities plotted against their respective background alarm rate. Both figures use a horizontal line to illustrate the performance of the demonstrator at the demonstrator's recommended discrimination stage threshold level, which defines the subset of targets the demonstrator would recommend digging based on discrimination. Note that all points have been rounded to protect the ground truth.

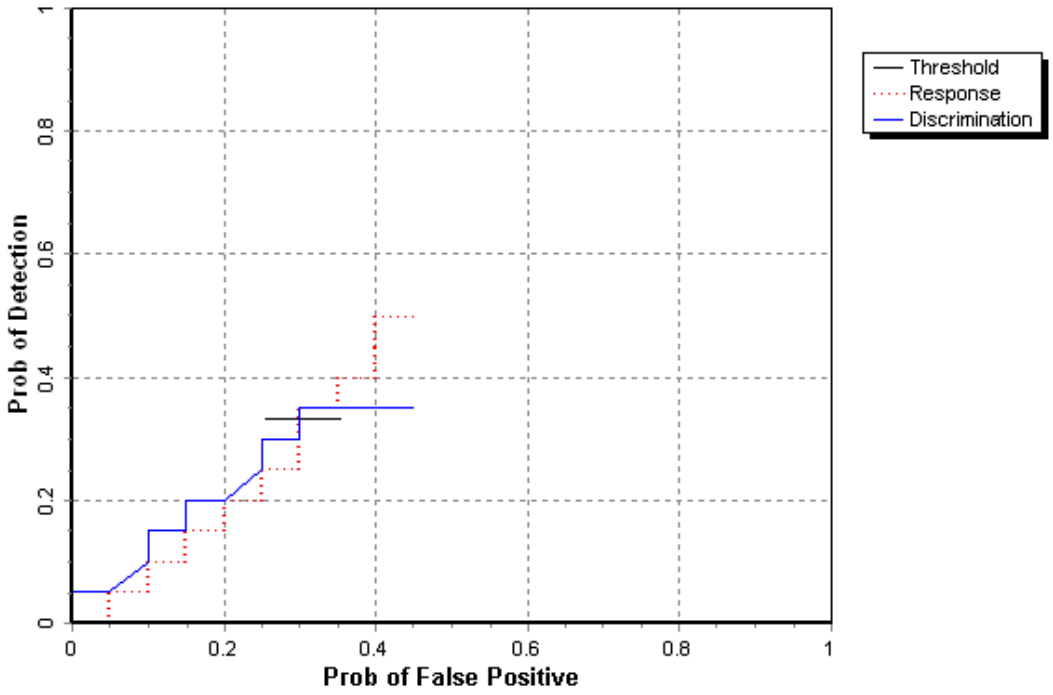

Figure 4. 4-D TEM open field probability of detection for response and discrimination stages versus their respective probability of false positive for all ordnance larger than 20 mm.

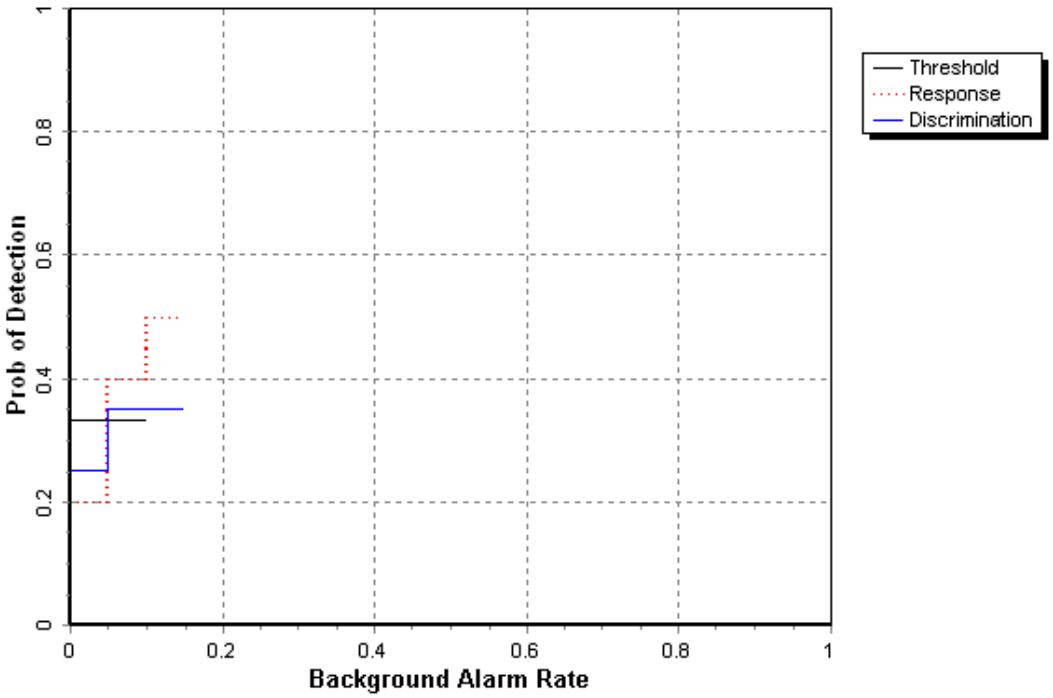

Figure 5. 4-D TEM open field probability of detection for response and discrimination stages versus their respective background alarm rate for all ordnance larger than 20 mm.

4.3 PERFORMANCE SUMMARIES

Results for the Open field test broken out by size, depth and nonstandard ordnance are presented in Table 6. (For cost results, see section 5.) Results by size and depth include both standard and nonstandard ordnance. The results by size show how well the demonstrator did at detecting/discriminating ordnance of a certain caliber range. (See app A for size definitions.) The results are relative to the number of ordnance items emplaced. Depth is measured from the closest point of anomaly to the ground surface.

The RESPONSE STAGE results are derived from the list of anomalies above the demonstrator-provided noise level. The results for the DISCRIMINATION STAGE are derived from the demonstrator's recommended threshold for optimizing UXO field cleanup by minimizing false digs and maximizing ordnance recovery. The lower 90 percent confidence limit on probability of detection and probability of false positive was calculated assuming that the number of detections and false positives are binomially distributed random variables. All results in Table 6 have been rounded to protect the ground truth. However, lower confidence limits were calculated using actual results.

TABLE 6. SUMMARY OF OPEN FIELD RESULTS FOR 4-D TEM

				By Size			By Depth, m		
Metric	**Overall**	**Standard**	**Non-Standard**	**Small**	**Medium**	**Large**	**< 0.3**	**0.3 to <1**	**>= 1**
RESPONSE STAGE									
P_d	0.45	0.50	0.40	0.40	0.55	0.50	0.60	0.45	0.05
P_d Low 90% Conf	0.43	0.47	0.33	0.33	0.49	0.41	0.57	0.41	0.03
P_{fp}	0.45	-	-	-	-	-	0.40	0.45	0.25
P_{fp} Low 90% Conf	0.41	-	-	-	-	-	0.39	0.42	0.11
BAR	0.15	-	-	-	-	-	-	-	-
DISCRIMINATION STAGE									
P_d	0.30	0.35	0.25	0.15	0.40	0.35	0.35	0.35	0.05
P_d Low 90% Conf	0.26	0.28	0.20	0.12	0.36	0.29	0.30	0.29	0.01
P_{fp}	0.30	-	-	-	-	-	0.30	0.30	0.20
P_{fp} Low 90% Conf	0.29	-	-	-	-	-	0.27	0.29	0.07
BAR	0.05	-	-	-	-	-	-	-	-

Recommended Discrimination Stage Threshold: 50.00

Note: The recommended discrimination stage threshold values are provided by the demonstrator.

4.4 EFFICIENCY, REJECTION RATES, AND TYPE CLASSIFICATION

Efficiency and rejection rates are calculated to quantify the discrimination ability at specific points of interest on the ROC curve: (1) at the point where no decrease in P_d is suffered (i.e., the efficiency is by definition equal to one) and (2) at the operator selected threshold. These values are reported in Table 7.

TABLE 7. EFFICIENCY AND REJECTION RATES FOR 4-D TEM

	Efficiency (E)	False Positive Rejection Rate	Background Alarm Rejection Rate
At Operating Point	0.63	0.29	0.69
With No Loss of P_d	1.00	0.00	1.00

At the demonstrator's recommended setting, the ordnance items that were detected and correctly discriminated were further scored on whether their correct type could be identified (table 8). Correct type examples include "20-mm projectile, 105-mm HEAT Projectile, and 2.75-inch Rocket". A list of the standard type declaration required for each ordnance item was provided to demonstrators prior to testing. For example, the standard type for the three example items are 20mmP, 105H, and 2.75in, respectively.

TABLE 8. CORRECT TYPE CLASSIFICATION OF TARGETS CORRECTLY DISCRIMINATED AS UXO

Size	% Correct
Small	8.7
Medium	33.3
Large	11.1
Overall	21.8

4.5 LOCATION ACCURACY

The mean and standard deviations of location accuracy are presented in Table 9 for each of the three dimensions of location. Location accuracy was calculated for those ordnance items correctly identified in the discrimination stage. Note that depth is measured from the closest point of the ordnance to the surface.

TABLE 9. MEAN LOCATION ACCURACY AND STANDARD DEVIATION (M) FOR 4-D TEM

	Mean	Standard Deviation
Northing	-0.16	0.12
Easting	-0.03	0.12
Depth	0.04	0.20

SECTION 5. ON-SITE LABOR COSTS

A standardized estimate for labor costs associated with this effort was calculated as follows: the first person at the test site was designated "supervisor", the second person was designated "data analyst", and the third and following personnel were considered "field support". Standardized hourly labor rates were charged by title: supervisor at $95.00/hour, data analyst at $57.00/hour, and field support at $28.50/hour.

Government representatives monitored on-site activity. All on site activities were grouped into one of ten categories: initial setup/mobilization, daily setup/stop, calibration, collecting data, downtime due to break/lunch, downtime due to equipment failure, downtime due to equipment/data checks or maintenance, downtime due to weather, downtime due to demonstration site issue, or demobilization. See Appendix D for the daily activity log. See section 3.4 for a summary of field activities.

The standardized cost estimate associated with the labor needed to perform the field activities is presented in Table 10. Note that calibration time includes time spent in the Calibration Lanes as well as field calibrations. "Site survey time" includes daily setup/stop time, collecting data, breaks/lunch, downtime due to equipment/data checks or maintenance, downtime due to failure, and downtime due to weather.

TABLE 10. ON-SITE LABOR COSTS

	No. People	Hourly Wage	Hours	Cost
INITIAL SETUP				
Supervisor	1	$95.00	4.83	$458.85
Data Analyst	1	57.00	4.83	$275.31
Field Support	1	28.50	4.83	$137.66
Subtotal				**$871.82**
CALIBRATION				
Supervisor	1	$95.00	5.00	$475.00
Data Analyst	1	57.00	5.00	$285.00
Field Support	1	28.50	5.00	$142.50
Subtotal				**$902.50**
SITE SURVEY				
Supervisor	1	$95.00	108.7	$10,326.50
Data Analyst	1	57.00	108.7	$6195.90
Field Support	1.25	28.50	108.7	$3872.44
Subtotal				**$20,394.84**

See notes at end of table.

TABLE 10 (CONT'D)

	No. People	Hourly Wage	Hours	Cost
DEMOBILIZATION				
Supervisor	1	$95.00	1.75	$166.25
Data Analyst	1	57.00	1.75	$99.75
Field Support	0	28.50	0.00	$0.00
Subtotal				**$266.00**
Total				**$22,435.16**

Notes: Calibration time includes time spent in the Calibration Lanes as well as calibration before each data run.

Site Survey time includes daily setup/stop time, collecting data, breaks/lunch, downtime due to system maintenance, failure, and weather.

SECTION 6. COMPARISON OF RESULTS TO BLIND GRID DEMONSTRATION

6.1 SUMMARY OF RESULTS FROM BLIND GRID DEMONSTRATION

Table 11 shows the results from Blind Grid survey conducted prior to surveying the open field during the same site visit in August of 2003. For more details on the Blind Grid survey results reference section 2.1.6.

TABLE 11. SUMMARY OF BLIND GRID RESULTS FOR 4-D TEM

				By Size			By Depth, m		
Metric	**Overall**	**Standard**	**Non-Standard**	**Small**	**Medium**	**Large**	**< 0.3**	**0.3 to <1**	**>= 1**
RESPONSE STAGE									
P_d	0.80	0.85	0.70	0.90	0.65	0.80	1.00	0.75	0.00
P_d Low 90% Conf	0.71	0.77	0.56	0.79	0.51	0.55	0.95	0.61	0.00
P_{fp}	0.90	-	-	-	-	-	0.87	0.90	1.00
P_{fp} Low 90% Conf	0.84	-	-	-	-	-	0.79	0.82	0.63
P_{ba}	0.40	-	-	-	-	-	-	-	-
DISCRIMINATION STAGE									
P_d	0.45	0.45	0.40	0.45	0.40	0.50	0.60	0.35	0.00
P_d Low 90% Conf	0.36	0.36	0.29	0.32	0.30	0.27	0.48	0.24	0.00
P_{fp}	0.40	-	-	-	-	-	0.40	0.40	0.40
P_{fp} Low 90% Conf	0.34	-	-	-	-	-	0.31	0.30	0.11
P_{ba}	0.00	-	-	-	-	-	-	-	-

6.2 COMPARISON OF ROC CURVES USING ALL ORDNANCE CATEGORIES

Figure 6 shows the probability of detection for the response stages versus the respective probability of false positives over all ordnance categories. Figure 7 shows probability of detection for the discrimination stages versus their respective probability of false positive over all ordnance categories. Figure 7 uses horizontal lines to illustrate the performance of the demonstrator at the recommended discrimination threshold levels, defining the subset of targets the demonstrator would recommend digging based on discrimination.

6.3 COMPARISON OF ROC CURVES USING ORDNANCE LARGER THAN 20 MM

Figure 8 shows the probability of detection for the response stages versus the respective probability of false positives over ordnance larger than 20 mm. Figure 9 shows probability of detection for the discrimination stages versus the respective probability of false positive over ordnance larger than 20 mm. Figure 9 uses horizontal lines to illustrate the performance of the demonstrator at the recommended discrimination threshold levels, defining the subset of targets the demonstrator would recommend digging based on discrimination.

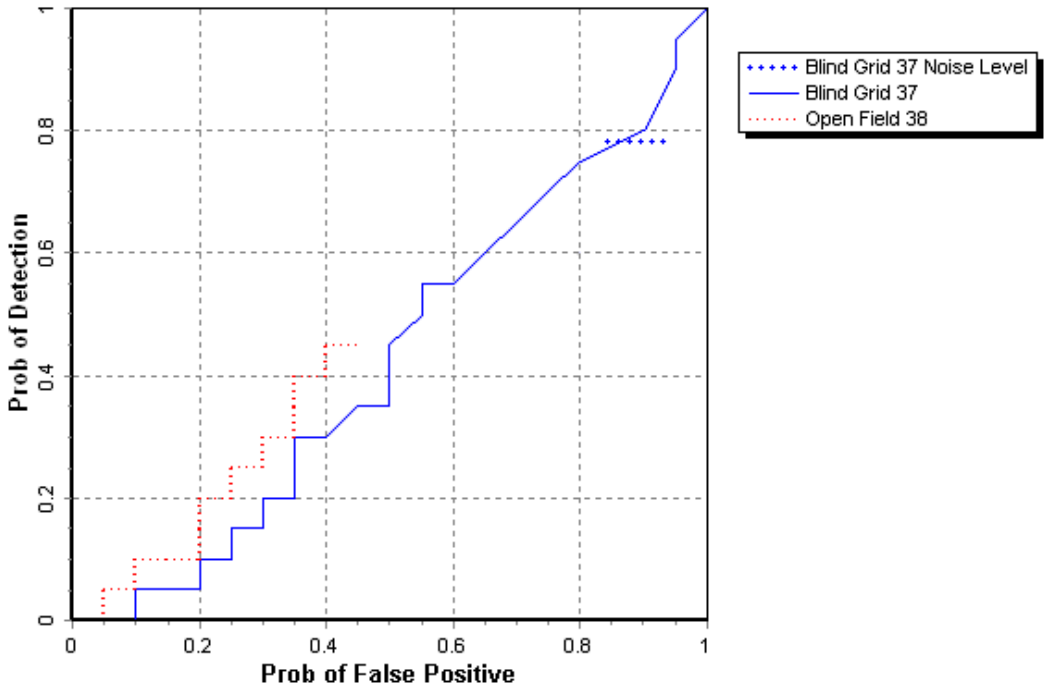

Figure 6. 4-D TEM probability of detection for response stages versus the respective probability of false positives over all ordnance categories combined.

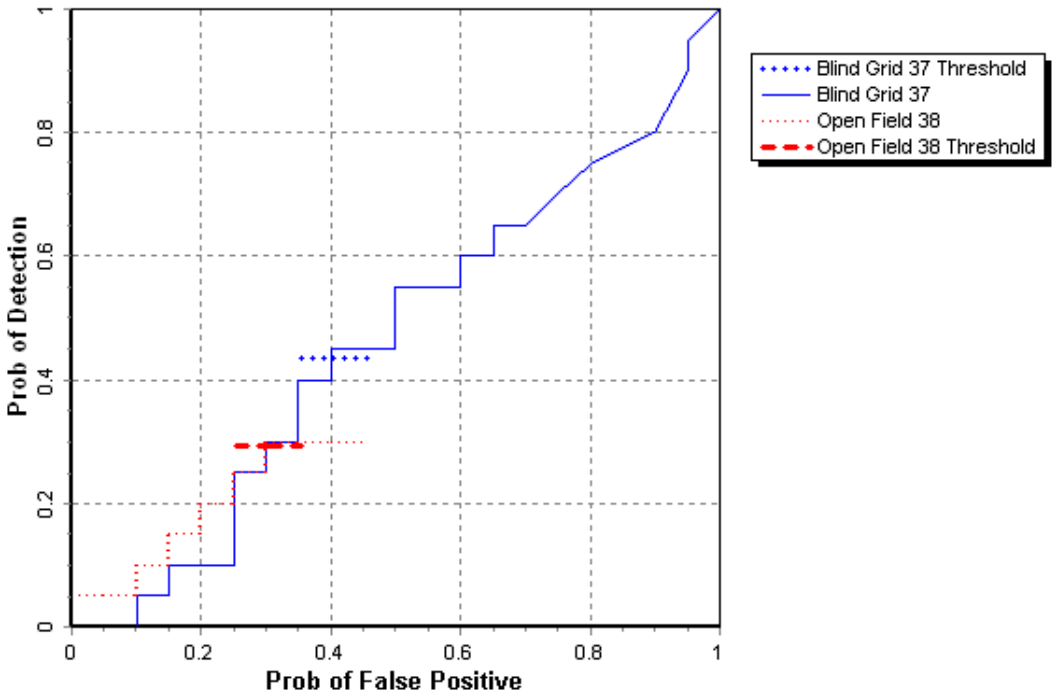

Figure 7. 4-D TEM probability of detection for discrimination stages versus the respective probability of false positive over all ordnance categories combined.

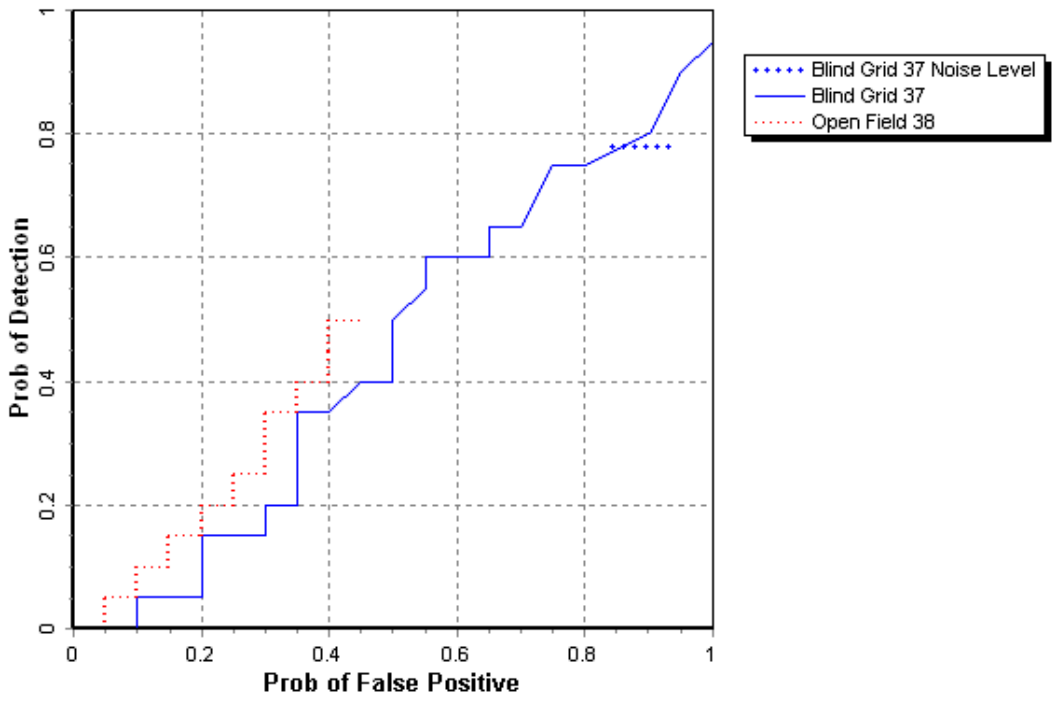

Figure 8. 4-D TEM probability of detection for response stages versus the respective probability of false positives for ordnance larger than 20 mm.

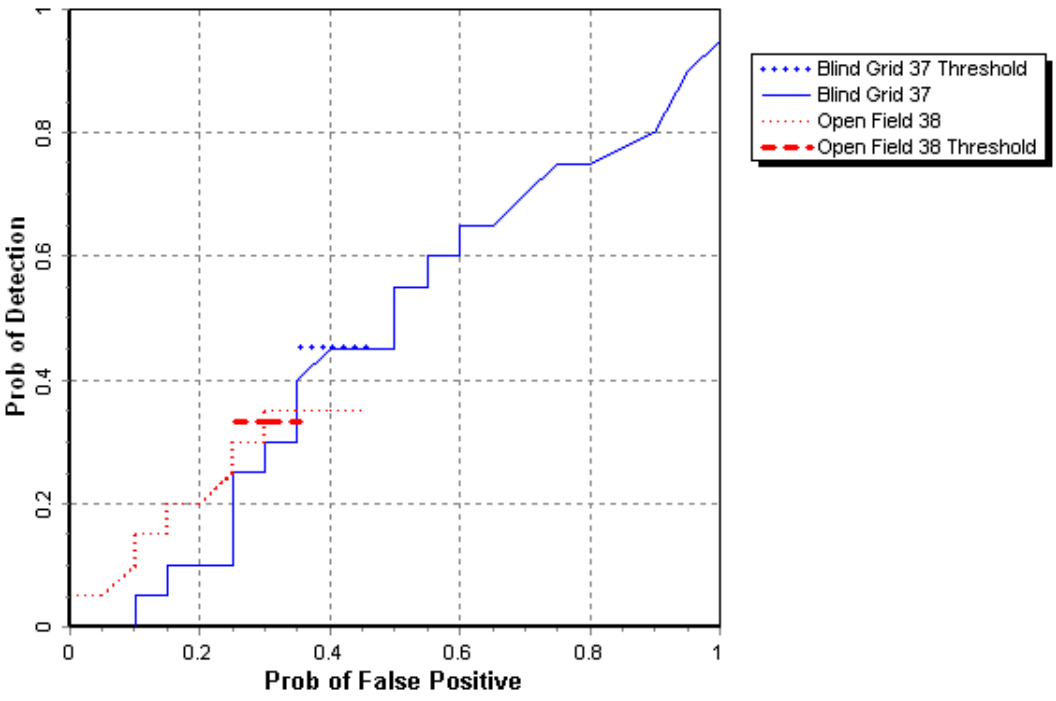

Figure 9. 4-D TEM probability of detection for discrimination stages versus the respective probability of false positive for ordnance larger than 20 mm.

6.4 STATISTICAL COMPARISONS

Statistical Chi-square significance tests were used to compare results between the Blind Grid and Open Field scenarios. The intent of the comparison is to determine if the feature introduced in each scenario has degrading effect on the performance of the sensor system. However, any modifications in the UXO sensor system during the test, like changes in the processing or changes in the selection of the operating threshold, will also contribute to performance differences.

The Chi-square test for comparison between ratios was used at a significance level of 0.05 to compare Blind Grid to Open Field with regard to P_d^{res}, P_d^{disc}, P_{fp}^{res} and P_{fp}^{disc}, Efficiency and Rejection Rate. These results are presented in Table 12. A detailed explanation and example of the Chi-square application is located in Appendix A.

TABLE 12. CHI-SQUARE RESULTS - BLIND GRID VERSUS OPEN FIELD

Metric	Small	Medium	Large	Overall
P_d^{res}	Significant	Not significant	Not significant	Significant
P_d^{disc}	Significant	Not significant	Not significant	Significant
P_{fp}^{res}	-	-	-	Significant
P_{fp}^{disc}	-	-	-	Significant

SECTION 7. APPENDIXES

APPENDIX A. TERMS AND DEFINITIONS

GENERAL DEFINITIONS

Anomaly: Location of a system response deemed to warrant further investigation by the demonstrator for consideration as an emplaced ordnance item.

Detection: An anomaly location that is within R_{halo} of an emplaced ordnance item.

Emplaced Ordnance: An ordnance item buried by the government at a specified location in the test site.

Emplaced Clutter: A clutter item (i.e., non-ordnance item) buried by the government at a specified location in the test site.

R_{halo}: A pre-determined radius about the periphery of an emplaced item (clutter or ordnance) within which a location identified by the demonstrator as being of interest is considered to be a response from that item. For the purpose of this program, a circular halo 0.5 meters in radius will be placed around the center of the object for all clutter and ordnance items less than 0.6 meters in length. When ordnance items are longer than 0.6 meters, the halo becomes an ellipse where the minor axis remains 1 meter and the major axis is equal to the projected length of the ordnance onto the ground plane plus 1 meter.

Small Ordnance: Caliber of ordnance less than or equal to 40 mm (includes 20-mm projectile, 40-mm projectile, submunitions BLU-26, BLU-63, and M42).

Medium Ordnance: Caliber of ordnance greater than 40 mm and less than or equal to 81 mm (includes 57-mm projectile, 60-mm mortar, 2.75 inch Rocket, MK118 Rockeye, 81-mm mortar).

Large Ordnance: Caliber of ordnance greater than 81 mm (includes 105-mm HEAT, 105-mm projectile, 155-mm projectile, 500-lb bomb).

Shallow: Items buried less than 0.3 meters below ground surface.

Medium: Items buried greater than or equal to 0.3 meters and less than 1 meter below ground surface.

Deep: Items buried greater than or equal to 1 meter below ground surface.

Response Stage Noise Level: The level that represents the point below which anomalies are not considered detectable. Demonstrators are required to provide the recommended noise level for the Blind Grid test area.

Discrimination Stage Threshold: The demonstrator selected threshold level that they believe provides optimum performance of the system by retaining all detectable ordnance and rejecting the maximum amount of clutter. This level defines the subset of anomalies the demonstrator would recommend digging based on discrimination.

Binomially Distributed Random Variable: A random variable of the type which has only two possible outcomes, say success and failure, is repeated for n independent trials with the probability p of success and the probability 1-p of failure being the same for each trial. The number of successes x observed in the n trials is an estimate of p and is considered to be a binomially distributed random variable.

RESPONSE AND DISCRIMINATION STAGE DATA

The scoring of the demonstrator's performance is conducted in two stages. These two stages are termed the RESPONSE STAGE and DISCRIMINATION STAGE. For both stages, the probability of detection (P_d) and the false alarms are reported as receiver-operating characteristic (ROC) curves. False alarms are divided into those anomalies that correspond to emplaced clutter items, measuring the probability of false positive (P_{fp}) and those that do not correspond to any known item, termed background alarms.

The RESPONSE STAGE scoring evaluates the ability of the system to detect emplaced targets without regard to ability to discriminate ordnance from other anomalies. For the RESPONSE STAGE, the demonstrator provides the scoring committee with the location and signal strength of all anomalies that the demonstrator has deemed sufficient to warrant further investigation and/or processing as potential emplaced ordnance items. This list is generated with minimal processing (e.g., this list will include all signals above the system noise threshold). As such, it represents the most inclusive list of anomalies.

The DISCRIMINATION STAGE evaluates the demonstrator's ability to correctly identify ordnance as such, and to reject clutter. For the same locations as in the RESPONSE STAGE anomaly list, the DISCRIMINATION STAGE list contains the output of the algorithms applied in the discrimination-stage processing. This list is prioritized based on the demonstrator's determination that an anomaly location is likely to contain ordnance. Thus, higher output values are indicative of higher confidence that an ordnance item is present at the specified location. For electronic signal processing, priority ranking is based on algorithm output. For other systems, priority ranking is based on human judgment. The demonstrator also selects the threshold that the demonstrator believes will provide "optimum" system performance, (i.e., that retains all the detected ordnance and rejects the maximum amount of clutter).

Note: The two lists provided by the demonstrator contain identical numbers of potential target locations. They differ only in the priority ranking of the declarations.

RESPONSE STAGE DEFINITIONS

Response Stage Probability of Detection (P_d^{res}): P_d^{res} = (No. of response-stage detections)/ (No.of emplaced ordnance in the test site).

Response Stage False Positive (fp^{res}): An anomaly location that is within R_{halo} of an emplaced clutter item.

Response Stage Probability of False Positive (P_{fp}^{res}): P_{fp}^{res} = (No. of response-stage false positives)/(No. of emplaced clutter items).

Response Stage Background Alarm: An anomaly in a blind grid cell that contains neither emplaced ordnance nor an emplaced clutter item. An anomaly location in the open field or scenarios that is outside R_{halo} of any emplaced ordnance or emplaced clutter item.

Response Stage Probability of Background Alarm (P_{ba}^{res}): Blind Grid only: P_{ba}^{res} = (No. of response-stage background alarms)/(No. of empty grid locations).

Response Stage Background Alarm Rate (BAR^{res}): Open Field only: BAR^{res} = (No. of response-stage background alarms)/(arbitrary constant).

Note that the quantities P_d^{res}, P_{fp}^{res}, P_{ba}^{res}, and BAR^{res} are functions of t^{res}, the threshold applied to the response-stage signal strength. These quantities can therefore be written as $P_d^{res}(t^{res})$, $P_{fp}^{res}(t^{res})$, $P_{ba}^{res}(t^{res})$, and $BAR^{res}(t^{res})$.

DISCRIMINATION STAGE DEFINITIONS

Discrimination: The application of a signal processing algorithm or human judgment to response-stage data that discriminates ordnance from clutter. Discrimination should identify anomalies that the demonstrator has high confidence correspond to ordnance, as well as those that the demonstrator has high confidence correspond to nonordnance or background returns. The former should be ranked with highest priority and the latter with lowest.

Discrimination Stage Probability of Detection (P_d^{disc}): P_d^{disc} = (No. of discrimination-stage detections)/(No. of emplaced ordnance in the test site).

Discrimination Stage False Positive (fp^{disc}): An anomaly location that is within R_{halo} of an emplaced clutter item.

Discrimination Stage Probability of False Positive (P_{fp}^{disc}): P_{fp}^{disc} = (No. of discrimination stage false positives)/(No. of emplaced clutter items).

Discrimination Stage Background Alarm: An anomaly in a blind grid cell that contains neither emplaced ordnance nor an emplaced clutter item. An anomaly location in the open field or scenarios that is outside R_{halo} of any emplaced ordnance or emplaced clutter item.

Discrimination Stage Probability of Background Alarm (P_{ba}^{disc}): P_{ba}^{disc} = (No. of discrimination-stage background alarms)/(No. of empty grid locations).

Discrimination Stage Background Alarm Rate (BAR^{disc}): BAR^{disc} = (No. of discrimination-stage background alarms)/(arbitrary constant).

Note that the quantities P_d^{disc}, P_{fp}^{disc}, P_{ba}^{disc}, and BAR^{disc} are functions of t^{disc}, the threshold applied to the discrimination-stage signal strength. These quantities can therefore be written as $P_d^{disc}(t^{disc})$, $P_{fp}^{disc}(t^{disc})$, $P_{ba}^{disc}(t^{disc})$, and $BAR^{disc}(t^{disc})$.

RECEIVER-OPERATING CHARACERISTIC (ROC) CURVES

ROC curves at both the response and discrimination stages can be constructed based on the above definitions. The ROC curves plot the relationship between P_d vs. P_{fp} and P_d vs. BAR or P_{ba} as the threshold applied to the signal strength is varied from its minimum (t_{min}) to its maximum (t_{max}) value.[1] Figure A-1 shows how P_d vs. P_{fp} and P_d versus BAR are combined into ROC curves. Note that the "res" and "disc" superscripts have been suppressed from all the variables for clarity.

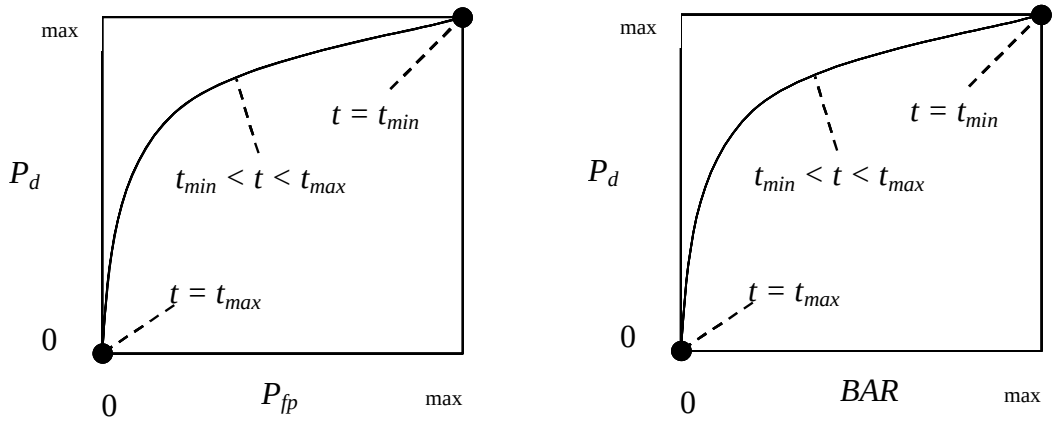

Figure A-1. ROC curves for open-field testing. Each curve applies to both the response and discrimination stages.

[1]Strictly speaking, ROC curves plot the P_d versus P_{ba} over a pre-determined and fixed number of detection opportunities (some of the opportunities are located over ordnance and others are located over clutter or blank spots). In an open field scenario, each system suppresses its signal strength reports until some bare-minimum signal response is received by the system. Consequently, the open field ROC curves do not have information from low signal-output locations, and, furthermore, different contractors report their signals over a different set of locations on the ground. These ROC curves are thus not true to the strict definition of ROC curves as defined in textbooks on detection theory. Note, however, that the ROC curves obtained in the Blind Grid test sites are true ROC curves.

METRICS TO CHARACTERIZE THE DISCRIMINATION STAGE

The demonstrator is also scored on efficiency and rejection ratio, which measure the effectiveness of the discrimination stage processing. The goal of discrimination is to retain the greatest number of ordnance detections from the anomaly list, while rejecting the maximum number of anomalies arising from nonordnance items. The efficiency measures the amount of detected ordnance retained by the discrimination, while the rejection ratio measures the fraction of false alarms rejected. Both measures are defined relative to the entire response list, i.e., the maximum ordnance detectable by the sensor and its accompanying false positive rate or background alarm rate.

Efficiency (E): $E = P_d^{disc}(t^{disc})/P_d^{res}(t_{min}^{res})$; Measures (at a threshold of interest), the degree to which the maximum theoretical detection performance of the sensor system (as determined by the response stage tmin) is preserved after application of discrimination techniques. Efficiency is a number between 0 and 1. An efficiency of 1 implies that all of the ordnance initially detected in the response stage was retained at the specified threshold in the discrimination stage, t^{disc}.

False Positive Rejection Rate (R_{fp}): $R_{fp} = 1 - [P_{fp}^{disc}(t^{disc})/P_{fp}^{res}(t_{min}^{res})]$; Measures (at a threshold of interest), the degree to which the sensor system's false positive performance is improved over the maximum false positive performance (as determined by the response stage tmin). The rejection rate is a number between 0 and 1. A rejection rate of 1 implies that all emplaced clutter initially detected in the response stage were correctly rejected at the specified threshold in the discrimination stage.

Background Alarm Rejection Rate (R_{ba}):

Blind Grid: $R_{ba} = 1 - [P_{ba}^{disc}(t^{disc})/P_{ba}^{res}(t_{min}^{res})]$
Open Field: $R_{ba} = 1 - [BAR^{disc}(t^{disc})/BAR^{res}(t_{min}^{res})])$

Measures the degree to which the discrimination stage correctly rejects background alarms initially detected in the response stage. The rejection rate is a number between 0 and 1. A rejection rate of 1 implies that all background alarms initially detected in the response stage were rejected at the specified threshold in the discrimination stage.

CHI-SQUARE COMPARISON EXPLANATION:

The Chi-square test for differences in probabilities (or 2 x 2 contingency table) is used to analyze two samples drawn from two different populations to see if both populations have the same or different proportions of elements in a certain category. More specifically, two random samples are drawn, one from each population, to test the null hypothesis that the probability of event A (some specified event) is the same for both populations (ref 4).

A 2 x 2 contingency table is used in the Standardized UXO Technology Demonstration Site Program to determine if there is reason to believe that the proportion of ordnance correctly detected/discriminated by demonstrator X's system is significantly degraded by the more

challenging terrain feature introduced. The test statistic of the 2 x 2 contingency table is the Chi-square distribution with one degree of freedom. Since an association between the more challenging terrain feature and relatively degraded performance is sought, a one-sided test is performed. A significance level of 0.05 is chosen which sets a critical decision limit of 2.71 from the Chi-square distribution with one degree of freedom. It is a critical decision limit because if the test statistic calculated from the data exceeds this value, the two proportions tested will be considered significantly different. If the test statistic calculated from the data is less than this value, the two proportions tested will be considered not significantly different.

An exception must be applied when either a 0 or 100 percent success rate occurs in the sample data. The Chi-square test cannot be used in these instances. Instead, Fischer's test is used and the critical decision limit for one-sided tests is the chosen significance level, which in this case is 0.05. With Fischer's test, if the test statistic is less than the critical value, the proportions are considered to be significantly different.

Standardized UXO Technology Demonstration Site examples, where blind grid results are compared to those from the open field and open field results are compared to those from one of the scenarios, follow. It should be noted that a significant result does not prove a cause and effect relationship exists between the two populations of interest; however, it does serve as a tool to indicate that one data set has experienced a degradation in system performance at a large enough level than can be accounted for merely by chance or random variation. Note also that a result that is not significant indicates that there is not enough evidence to declare that anything more than chance or random variation within the same population is at work between the two data sets being compared.

Demonstrator X achieves the following overall results after surveying each of the three progressively more difficult areas using the same system (results indicate the number of ordnance detected divided by the number of ordnance emplaced):

	Blind Grid	Open Field	Moguls
P_d^{res}	100/100 = 1.0	8/10 = .80	20/33 = .61
P_d^{disc}	80/100 = 0.80	6/10 = .60	8/33 = .24

P_d^{res}: BLIND GRID versus OPEN FIELD. Using the example data above to compare probabilities of detection in the response stage, all 100 ordnance out of 100 emplaced ordnance items were detected in the blind grid while 8 ordnance out of 10 emplaced were detected in the open field. Fischer's test must be used since a 100 percent success rate occurs in the data. Fischer's test uses the four input values to calculate a test statistic of 0.0075 that is compared against the critical value of 0.05. Since the test statistic is less than the critical value, the smaller response stage detection rate (0.80) is considered to be significantly less at the 0.05 level of significance. While a significant result does not prove a cause and effect relationship exists between the change in survey area and degradation in performance, it does indicate that the detection ability of demonstrator X's system seems to have been degraded in the open field relative to results from the blind grid using the same system.

P_d^{disc}: BLIND GRID versus OPEN FIELD. Using the example data above to compare probabilities of detection in the discrimination stage, 80 ordnance out of 100 emplaced ordnance items were correctly discriminated as ordnance in blind grid testing while 6 ordnance out of 10 emplaced were correctly discriminated as such in open field testing. Those four values are used to calculate a test statistic of 1.12. Since the test statistic is less than the critical value of 2.71, the two discrimination stage detection rates are considered to be not significantly different at the 0.05 level of significance.

P_d^{res}: OPEN FIELD versus MOGULS. Using the example data above to compare probabilities of detection in the response stage, 8 out of 10 and 20 out of 33 are used to calculate a test statistic of 0.56. Since the test statistic is less than the critical value of 2.71, the two response stage detection rates are considered to be not significantly different at the 0.05 level of significance.

P_d^{disc}: OPEN FIELD versus MOGULS. Using the example data above to compare probabilities of detection in the discrimination stage, 6 out of 10 and 8 out of 33 are used to calculate a test statistic of 2.98. Since the test statistic is greater than the critical value of 2.71, the smaller discrimination stage detection rate is considered to be significantly less at the 0.05 level of significance. While a significant result does not prove a cause and effect relationship exists between the change in survey area and degradation in performance, it does indicate that the ability of demonstrator X to correctly discriminate seems to have been degraded by the mogul terrain relative to results from the flat open field using the same system.

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APPENDIX B. DAILY WEATHER LOGS

TABLE B-1. WEATHER LOG

DCP 7 Data from Phillips Airfield							
Date	Time, EDST	Average Temperature, °F	Maximum Temperature, °F	Minimum Temperature, °F	RH, %	Station Pressure, MB	Precipitation, in.
19-Aug-02	2:00	80.1	81.4	79.1	77	29.81	0.00
19-Aug-02	3:00	81.6	82.5	80.6	66	29.81	0.00
19-Aug-02	4:00	79.7	81.9	77.5	71	29.82	0.00
19-Aug-02	5:00	77.7	81.5	74.5	77	29.82	0.00
19-Aug-02	6:00	74.0	75.8	72.7	87	29.83	0.00
19-Aug-02	7:00	73.3	74.3	72.7	88	29.84	0.00
19-Aug-02	8:00	78.0	80.7	74.0	76	29.84	0.00
19-Aug-02	9:00	82.1	83.8	80.6	65	29.86	0.00
19-Aug-02	10:00	84.8	87.2	83.1	59	29.87	0.00
19-Aug-02	11:00	86.9	88.4	85.6	56	29.89	0.00
19-Aug-02	12:00	89.4	91.3	87.9	52	29.89	0.00
19-Aug-02	13:00	89.8	91.4	88.0	52	29.87	0.00
19-Aug-02	14:00	91.3	93.2	89.1	49	29.85	0.00
19-Aug-02	15:00	93.4	94.7	92.6	44	29.84	0.00
19-Aug-02	16:00	94.0	95.1	93.0	43	29.82	0.00
19-Aug-02	17:00	93.8	94.8	92.7	43	29.79	0.00
19-Aug-02	18:00	92.3	93.3	91.2	46	29.77	0.00
19-Aug-02	19:00	91.9	92.4	91.2	47	29.76	0.00
19-Aug-02	20:00	89.3	91.8	86.4	52	29.76	0.00
19-Aug-02	21:00	85.7	88.1	82.9	60	29.77	0.00
19-Aug-02	22:00	81.3	83.3	80.3	73	29.79	0.00
19-Aug-02	23:00	79.3	80.5	78.4	79	29.79	0.00
19-Aug-02	23:59	77.5	79.0	76.5	85	29.80	0.00
20-Aug-02	1:00	76.7	77.6	75.9	87	29.80	0.00
20-Aug-02	2:00	76.4	77.6	75.7	89	29.80	0.00
20-Aug-02	3:00	77.8	81.2	76.6	90	29.79	0.00
20-Aug-02	4:00	79.8	81.8	78.7	73	29.81	0.00
20-Aug-02	5:00	77.6	78.8	76.7	78	29.80	0.00
20-Aug-02	6:00	75.6	77.0	74.2	84	29.83	0.00
20-Aug-02	7:00	74.8	75.6	74.1	87	29.85	0.00
20-Aug-02	8:00	76.8	78.0	75.1	82	29.88	0.00
20-Aug-02	9:00	78.7	80.9	77.2	76	29.89	0.00
20-Aug-02	10:00	82.4	83.9	80.6	68	29.90	0.00
20-Aug-02	11:00	83.3	85.7	82.1	63	29.92	0.00
20-Aug-02	12:00	85.7	87.8	83.5	57	29.93	0.00
20-Aug-02	13:00	87.3	89.1	86.3	52	29.93	0.00
20-Aug-02	14:00	88.2	89.1	87.1	48	29.92	0.00
20-Aug-02	15:00	88.9	91.5	86.7	46	29.92	0.00
20-Aug-02	16:00	90.4	92.6	88.8	42	29.92	0.00
20-Aug-02	17:00	89.7	91.4	88.5	43	29.92	0.00
20-Aug-02	18:00	89.2	89.8	88.5	44	29.93	0.00
20-Aug-02	19:00	87.6	88.9	86.6	45	29.94	0.00

TABLE B-1 (CONT'D)

DCP 7 Data from Phillips Airfield							
Date	Time, EDST	Average Temperature, °F	Maximum Temperature, °F	Minimum Temperature, °F	RH, %	Station Pressure, MB	Precipitation, in.
20-Aug-02	20:00	85.3	87.0	83.6	46	29.97	0.00
20-Aug-02	21:00	82.3	84.0	81.1	50	29.99	0.00
20-Aug-02	22:00	80.5	81.5	79.4	51	30.02	0.00
20-Aug-02	23:00	78.9	79.8	78.2	53	30.03	0.00
20-Aug-02	0:00	78.1	79.6	76.4	55	30.05	0.00
21-Aug-02	0:59	78.1	80.0	76.6	64	30.07	0.00
21-Aug-02	2:00	75.7	77.0	74.2	81	30.07	0.00
21-Aug-02	3:00	74.6	75.4	74.0	83	30.09	0.00
21-Aug-02	4:00	73.9	75.0	72.3	85	30.11	0.00
21-Aug-02	5:00	72.1	73.3	70.5	90	30.11	0.00
21-Aug-02	6:00	69.9	71.0	67.8	93	30.13	0.00
21-Aug-02	7:00	68.5	70.2	67.2	95	30.15	0.00
21-Aug-02	8:00	73.0	75.7	69.9	85	30.17	0.00
21-Aug-02	9:00	77.1	78.5	75.5	74	30.19	0.00
21-Aug-02	10:00	79.6	80.8	78.3	64	30.19	0.00
21-Aug-02	11:00	81.6	82.7	80.1	55	30.20	0.00
21-Aug-02	12:00	83.6	85.3	82.0	49	30.20	0.00
21-Aug-02	13:00	85.6	87.0	84.3	42	30.19	0.00
21-Aug-02	14:00	85.4	87.2	84.1	40	30.19	0.00
21-Aug-02	15:00	87.2	89.4	85.3	37	30.17	0.00
21-Aug-02	16:00	87.9	89.9	85.4	34	30.15	0.00
21-Aug-02	17:00	88.4	89.5	87.6	31	30.13	0.00
21-Aug-02	18:00	88.0	88.6	87.5	31	30.13	0.00
21-Aug-02	19:00	86.9	88.1	84.2	36	30.13	0.00
21-Aug-02	20:00	82.0	84.3	79.6	53	30.14	0.00
21-Aug-02	21:00	78.6	79.9	77.2	57	30.16	0.00
21-Aug-02	22:00	76.5	77.7	75.1	59	30.18	0.00
21-Aug-02	23:00	74.9	75.8	74.0	71	30.18	0.00
21-Aug-02	0:00	73.9	74.5	73.2	74	30.18	0.00
22-Aug-02	0:59	73.3	73.9	72.8	75	30.18	0.00
22-Aug-02	2:00	73.3	73.9	72.6	76	30.18	0.00
22-Aug-02	3:00	72.4	73.7	71.7	78	30.17	0.00
22-Aug-02	4:00	72.6	73.3	71.9	79	30.16	0.00
22-Aug-02	5:00	72.1	72.7	71.4	81	30.15	0.00
22-Aug-02	6:00	72.7	73.4	71.5	78	30.15	0.00
22-Aug-02	7:00	71.5	72.5	70.9	78	30.15	0.00
22-Aug-02	8:00	74.1	75.8	71.8	75	30.15	0.00
22-Aug-02	9:00	77.0	78.4	75.5	71	30.15	0.00
22-Aug-02	10:00	79.4	81.9	77.6	67	30.14	0.00
22-Aug-02	11:00	82.2	83.1	81.3	57	30.13	0.00
22-Aug-02	12:00	83.1	86.0	81.5	55	30.11	0.00
22-Aug-02	13:00	85.2	86.5	84.0	51	30.08	0.00
22-Aug-02	14:00	86.0	87.6	84.7	54	30.06	0.00
22-Aug-02	15:00	87.5	89.7	85.7	52	30.02	0.00
22-Aug-02	16:00	88.4	89.6	87.3	51	29.99	0.00

TABLE B-1 (CONT'D)

DCP 7 Data from Phillips Airfield							
Date	Time, EDST	Average Temperature, °F	Maximum Temperature, °F	Minimum Temperature, °F	RH, %	Station Pressure, MB	Precipitation, in.
22-Aug-02	17:00	90.0	91.3	88.8	49	29.96	0.00
22-Aug-02	18:00	89.2	91.0	88.4	52	29.94	0.00
22-Aug-02	19:00	87.8	89.4	86.4	57	29.92	0.00
22-Aug-02	20:00	85.6	86.7	84.5	64	29.90	0.00
22-Aug-02	21:00	83.5	84.8	81.9	68	29.90	0.00
22-Aug-02	22:00	82.3	83.2	81.2	69	29.91	0.00
22-Aug-02	23:00	82.1	82.6	81.5	74	29.90	0.00
22-Aug-02	23:59	82.1	82.5	81.6	80	29.89	0.00
23-Aug-02	1:00	79.7	82.2	77.9	89	29.90	0.00
23-Aug-02	2:00	77.6	78.6	76.5	94	29.90	0.07
23-Aug-02	3:00	76.3	77.1	75.3	93	29.89	0.00
23-Aug-02	4:00	75.0	75.8	74.2	97	29.87	0.00
23-Aug-02	5:00	74.4	74.9	73.9	98	29.87	0.00
23-Aug-02	6:00	74.8	75.3	74.4	97	29.87	0.00
23-Aug-02	7:00	74.3	75.0	73.7	97	29.87	0.00
23-Aug-02	8:00	76.5	78.2	74.6	92	29.88	0.00
23-Aug-02	9:00	78.0	78.5	77.5	87	29.90	0.00
23-Aug-02	10:00	78.8	80.0	77.9	85	29.91	0.00
23-Aug-02	11:00	80.3	80.9	79.7	80	29.92	0.00
23-Aug-02	12:00	81.9	83.2	80.5	72	29.92	0.00
23-Aug-02	13:00	83.2	84.3	82.4	69	29.91	0.00
23-Aug-02	14:00	83.9	84.8	82.9	67	29.91	0.00
23-Aug-02	15:00	83.6	84.5	82.8	70	29.89	0.00
23-Aug-02	16:00	83.8	84.8	83.0	69	29.87	0.00
23-Aug-02	17:00	84.3	85.1	83.8	66	29.87	0.00
23-Aug-02	18:00	83.7	84.5	83.0	67	29.86	0.00
23-Aug-02	19:00	83.9	84.8	82.9	67	29.85	0.00
23-Aug-02	20:00	81.9	83.4	79.6	71	29.85	0.00
23-Aug-02	21:00	79.1	80.4	77.8	81	29.85	0.00
23-Aug-02	22:00	77.3	78.2	76.0	85	29.87	0.00
23-Aug-02	23:00	75.7	76.4	75.3	88	29.88	0.00
23-Aug-02	0:00	75.4	75.8	75.1	85	29.88	0.00
24-Aug-02	0:59	75.3	75.7	74.9	86	29.88	0.00
24-Aug-02	2:00	75.1	75.5	74.2	86	29.87	0.00
24-Aug-02	3:00	74.6	74.9	74.2	87	29.85	0.00
24-Aug-02	4:00	74.0	74.8	73.1	89	29.83	0.00
24-Aug-02	5:00	73.4	73.9	72.6	91	29.82	0.03
24-Aug-02	6:00	73.1	74.0	72.3	92	29.81	0.00
24-Aug-02	7:00	72.0	73.4	71.4	97	29.83	0.21
24-Aug-02	8:00	71.7	72.2	71.4	99	29.84	0.18
24-Aug-02	9:00	71.8	72.3	71.4	100	29.82	0.10
24-Aug-02	10:00	72.8	74.4	71.9	98	29.80	0.03
24-Aug-02	11:00	75.5	77.7	73.9	93	29.79	0.00
24-Aug-02	12:00	77.1	77.8	76.0	86	29.79	0.00
24-Aug-02	13:00	78.7	80.6	76.4	83	29.77	0.00

TABLE B-1 (CONT'D)

DCP 7 Data from Phillips Airfield							
Date	Time, EDST	Average Temperature, °F	Maximum Temperature, °F	Minimum Temperature, °F	RH, %	Station Pressure, MB	Precipitation, in.
24-Aug-02	14:00	81.0	83.3	79.5	77	29.76	0.00
24-Aug-02	15:00	83.7	85.7	82.2	75	29.74	0.00
24-Aug-02	16:00	86.5	88.1	84.8	68	29.70	0.00
24-Aug-02	17:00	87.1	88.3	85.8	66	29.67	0.00
24-Aug-02	18:00	86.8	88.1	85.7	69	29.67	0.00
24-Aug-02	19:00	85.4	86.5	84.5	72	29.67	0.00
24-Aug-02	20:00	79.1	84.7	74.6	83	29.66	0.29
24-Aug-02	21:00	74.7	75.8	73.1	92	29.70	0.00
24-Aug-02	22:00	75.0	75.8	74.5	94	29.72	0.00
24-Aug-02	23:00	74.2	74.8	73.9	97	29.73	0.00
24-Aug-02	0:00	73.2	74.2	72.1	98	29.74	0.00
25-Aug-02	0:59	72.5	73.1	71.6	99	29.75	0.00
25-Aug-02	2:00	72.1	73.1	71.4	98	29.76	0.00
25-Aug-02	3:00	72.2	73.1	71.5	94	29.75	0.00
25-Aug-02	4:00	72.4	73.0	71.6	93	29.75	0.00
25-Aug-02	5:00	71.7	72.4	70.9	95	29.75	0.00
25-Aug-02	6:00	71.0	72.1	69.8	96	29.77	0.00
25-Aug-02	7:00	70.1	71.5	69.4	98	29.79	0.00
25-Aug-02	8:00	72.8	74.6	71.2	88	29.81	0.00
25-Aug-02	9:00	75.3	76.4	74.1	78	29.82	0.00
25-Aug-02	10:00	77.5	78.4	76.0	71	29.84	0.00
25-Aug-02	11:00	79.5	81.3	78.2	65	29.84	0.00
25-Aug-02	12:00	81.3	82.7	79.7	58	29.84	0.00
25-Aug-02	13:00	83.3	85.3	82.0	52	29.84	0.00
25-Aug-02	14:00	84.1	85.2	83.0	47	29.84	0.00
25-Aug-02	15:00	85.3	87.0	83.6	45	29.83	0.00
25-Aug-02	16:00	86.4	87.7	85.3	42	29.82	0.00
25-Aug-02	17:00	86.3	87.7	84.7	41	29.82	0.00
25-Aug-02	18:00	86.7	87.9	85.6	39	29.83	0.00
25-Aug-02	19:00	84.6	86.0	83.5	43	29.83	0.00
25-Aug-02	20:00	81.0	84.0	78.4	54	29.85	0.00
25-Aug-02	21:00	76.4	78.6	74.8	68	29.86	0.00
25-Aug-02	22:00	73.3	75.3	72.1	78	29.88	0.00
25-Aug-02	23:00	71.4	72.7	69.8	84	29.88	0.00
25-Aug-02	23:59	69.8	71.4	68.8	86	29.89	0.00
26-Aug-02	1:00	68.4	69.6	67.2	91	29.89	0.00
26-Aug-02	2:00	66.6	67.7	65.3	93	29.89	0.00
26-Aug-02	3:00	65.8	66.5	64.9	94	29.89	0.00
26-Aug-02	4:00	65.3	66.0	64.7	96	29.89	0.00
26-Aug-02	5:00	65.6	66.4	64.4	96	29.91	0.00
26-Aug-02	6:00	66.1	66.4	65.6	97	29.92	0.00
26-Aug-02	7:00	68.1	69.0	66.0	90	29.92	0.00
26-Aug-02	8:00	70.8	73.5	68.5	88	29.94	0.00
26-Aug-02	9:00	74.2	75.2	72.8	86	29.95	0.00
26-Aug-02	10:00	75.6	76.5	74.6	81	29.95	0.00

TABLE B-1 (CONT'D)

DCP 7 Data from Phillips Airfield							
Date	Time, EDST	Average Temperature, °F	Maximum Temperature, °F	Minimum Temperature, °F	RH, %	Station Pressure, MB	Precipitation, in.
26-Aug-02	11:00	77.8	79.8	76.3	78	29.95	0.00
26-Aug-02	12:00	80.0	80.8	79.3	75	29.94	0.00
26-Aug-02	13:00	80.4	81.5	79.7	71	29.94	0.00
26-Aug-02	14:00	82.0	83.0	81.0	63	29.93	0.00
26-Aug-02	15:00	82.7	83.3	82.1	60	29.92	0.00
26-Aug-02	16:00	83.4	84.2	82.4	58	29.90	0.00
26-Aug-02	17:00	83.8	85.6	82.4	50	29.89	0.00
26-Aug-02	18:00	84.0	85.2	82.8	43	29.89	0.00
26-Aug-02	19:00	82.0	83.3	80.4	58	29.89	0.00
26-Aug-02	20:00	77.9	80.8	75.5	72	29.90	0.00
26-Aug-02	21:00	74.7	75.8	73.4	81	29.92	0.00
26-Aug-02	22:00	71.9	73.8	70.4	88	29.93	0.00
26-Aug-02	23:00	71.4	71.9	70.4	90	29.94	0.00
26-Aug-02	0:00	70.3	72.0	68.5	91	29.94	0.00
27-Aug-02	0:59	68.6	69.3	67.8	96	29.94	0.00
27-Aug-02	2:00	67.8	68.3	67.2	97	29.94	0.00
27-Aug-02	3:00	67.3	67.7	66.6	98	29.94	0.00
27-Aug-02	4:00	66.4	67.1	65.7	99	29.94	0.00
27-Aug-02	5:00	65.6	66.5	64.8	100	29.94	0.00
27-Aug-02	6:00	65.2	65.7	64.7	100	29.95	0.00
27-Aug-02	7:00	64.9	65.4	64.4	100	29.97	0.00
27-Aug-02	8:00	67.6	72.3	64.6	97	29.99	0.00
27-Aug-02	9:00	74.4	76.8	72.0	83	29.99	0.00
27-Aug-02	10:00	78.3	80.1	76.5	70	30.01	0.00
27-Aug-02	11:00	81.4	83.0	79.7	58	30.02	0.00
27-Aug-02	12:00	84.5	86.5	82.6	48	30.01	0.00
27-Aug-02	13:00	85.7	86.9	84.0	44	30.01	0.00
27-Aug-02	14:00	85.3	86.1	84.3	46	30.01	0.00
27-Aug-02	15:00	85.6	86.3	84.8	44	30.00	0.00
27-Aug-02	16:00	84.2	85.2	83.5	49	30.00	0.00
27-Aug-02	17:00	83.9	84.3	83.4	50	30.01	0.00
27-Aug-02	18:00	82.8	83.8	81.4	57	30.02	0.00
27-Aug-02	19:00	81.2	81.9	80.3	60	30.02	0.00
27-Aug-02	20:00	79.9	81.0	79.0	61	30.03	0.00
27-Aug-02	21:00	77.7	79.4	76.1	66	30.05	0.00
27-Aug-02	22:00	77.8	78.5	76.0	65	30.06	0.00
27-Aug-02	23:00	77.1	78.2	75.8	65	30.09	0.00
27-Aug-02	0:00	75.2	76.9	73.1	72	30.09	0.00
28-Aug-02	0:59	72.3	73.5	71.4	82	30.09	0.00
28-Aug-02	2:00	72.4	73.4	71.5	83	30.09	0.00
28-Aug-02	3:00	73.8	74.7	72.9	85	30.09	0.00
28-Aug-02	4:00	74.5	75.0	74.0	86	30.09	0.00
28-Aug-02	5:00	74.1	75.1	73.3	84	30.10	0.00
28-Aug-02	6:00	74.0	74.5	73.7	84	30.10	0.00
28-Aug-02	7:00	73.9	74.6	73.2	83	30.12	0.00

TABLE B-1 (CONT'D)

DCP 7 Data from Phillips Airfield							
Date	Time, EDST	Average Temperature, °F	Maximum Temperature, °F	Minimum Temperature, °F	RH, %	Station Pressure, MB	Precipitation, in.
28-Aug-02	8:00	72.7	73.5	72.2	89	30.14	0.00
28-Aug-02	9:00	72.6	73.2	72.0	85	30.14	0.00
28-Aug-02	10:00	72.1	73.0	71.5	90	30.15	0.00
28-Aug-02	11:00	72.6	73.2	71.7	87	30.15	0.00
28-Aug-02	12:00	71.5	72.1	70.8	84	30.15	0.00
28-Aug-02	13:00	70.9	71.3	70.4	86	30.15	0.00
28-Aug-02	14:00	71.2	71.8	70.4	86	30.15	0.00
28-Aug-02	15:00	69.6	70.8	68.2	88	30.15	0.10
28-Aug-02	16:00	68.4	69.1	67.9	90	30.15	0.04
28-Aug-02	17:00	68.1	68.6	67.6	93	30.15	0.04
28-Aug-02	18:00	68.2	68.9	67.6	93	30.16	0.02
28-Aug-02	19:00	67.4	68.7	66.4	92	30.16	0.04
28-Aug-02	20:00	65.9	66.6	64.9	92	30.17	0.07
28-Aug-02	21:00	64.0	65.3	62.7	88	30.17	0.07
28-Aug-02	22:00	62.1	62.9	61.3	92	30.17	0.10
28-Aug-02	23:00	60.8	61.7	60.2	94	30.15	0.10
28-Aug-02	23:59	60.5	61.2	60.2	95	30.13	0.06
29-Aug-02	1:00	61.2	61.8	60.5	96	30.12	0.05
29-Aug-02	2:00	62.1	62.7	61.4	95	30.09	0.03
29-Aug-02	3:00	62.6	63.1	62.2	95	30.07	0.01
29-Aug-02	4:00	62.6	62.9	62.2	95	30.05	0.03
29-Aug-02	5:00	63.0	63.5	62.2	95	30.04	0.03
29-Aug-02	6:00	62.6	63.3	62.0	95	30.04	0.03
29-Aug-02	7:00	61.9	62.5	61.5	95	30.03	0.02
29-Aug-02	8:00	61.9	62.2	61.5	95	30.05	0.00
29-Aug-02	9:00	62.3	63.1	61.7	94	30.06	0.00
29-Aug-02	10:00	63.4	63.9	62.7	91	30.07	0.00
29-Aug-02	11:00	64.3	64.8	63.4	89	30.07	0.00
29-Aug-02	12:00	64.9	65.6	64.2	87	30.06	0.00
29-Aug-02	13:00	65.8	66.9	65.1	85	30.06	0.00
29-Aug-02	14:00	67.3	68.9	66.5	82	30.05	0.00
29-Aug-02	15:00	68.3	69.1	67.8	81	30.06	0.00
29-Aug-02	16:00	68.4	69.4	67.8	81	30.06	0.00
29-Aug-02	17:00	68.6	69.2	68.1	81	30.06	0.00
29-Aug-02	18:00	69.0	69.8	68.4	80	30.05	0.00
29-Aug-02	19:00	68.6	69.1	68.2	80	30.06	0.00
29-Aug-02	20:00	68.0	68.5	67.2	83	30.06	0.00
29-Aug-02	21:00	67.3	67.8	66.6	86	30.08	0.00
29-Aug-02	22:00	66.6	67.0	66.3	90	30.09	0.00
29-Aug-02	23:00	66.6	67.2	65.9	89	30.09	0.00
29-Aug-02	0:00	66.6	67.1	66.1	87	30.10	0.00
30-Aug-02	0:59	66.4	66.7	66.0	87	30.09	0.00
30-Aug-02	2:00	66.1	66.5	65.8	87	30.09	0.00
30-Aug-02	3:00	65.8	66.3	65.4	87	30.09	0.00
30-Aug-02	4:00	65.6	66.1	65.2	87	30.09	0.00

TABLE B-1 (CONT'D)

DCP 7 Data from Phillips Airfield							
Date	Time, EDST	Average Temperature, °F	Maximum Temperature, °F	Minimum Temperature, °F	RH, %	Station Pressure, MB	Precipitation, in.
30-Aug-02	5:00	65.3	65.8	64.9	88	30.10	0.00
30-Aug-02	6:00	65.0	65.4	64.6	89	30.12	0.00
30-Aug-02	7:00	65.1	65.4	64.7	88	30.13	0.00
30-Aug-02	8:00	65.5	66.1	65.1	87	30.15	0.00
30-Aug-02	9:00	66.3	67.0	65.8	85	30.17	0.00
30-Aug-02	10:00	66.8	67.2	66.4	80	30.17	0.00
30-Aug-02	11:00	66.7	67.2	66.3	77	30.18	0.00
30-Aug-02	12:00	67.5	68.2	66.7	76	30.19	0.00
30-Aug-02	13:00	68.1	68.8	67.7	76	30.19	0.00
30-Aug-02	14:00	68.8	69.4	68.3	74	30.19	0.00
30-Aug-02	15:00	69.1	69.6	68.6	74	30.19	0.00
30-Aug-02	16:00	69.2	69.7	68.7	73	30.19	0.00
30-Aug-02	17:00	69.5	70.3	68.6	73	30.20	0.00
30-Aug-02	18:00	69.7	70.2	69.2	72	30.20	0.00
30-Aug-02	19:00	69.6	70.3	68.8	72	30.20	0.00
30-Aug-02	20:00	67.1	69.1	64.3	80	30.21	0.00
30-Aug-02	21:00	63.2	64.6	61.7	93	30.22	0.00
30-Aug-02	22:00	62.5	63.4	61.6	95	30.23	0.00
30-Aug-02	23:00	61.5	62.2	61.0	98	30.24	0.00
30-Aug-02	0:00	60.9	61.4	60.5	99	30.24	0.00
31-Aug-02	0:59	60.7	61.3	60.2	99	30.25	0.00
31-Aug-02	2:00	60.5	60.9	60.1	100	30.26	0.00
31-Aug-02	3:00	60.5	61.0	60.1	100	30.26	0.00
31-Aug-02	4:00	61.8	63.4	60.4	98	30.25	0.00
31-Aug-02	5:00	63.2	63.7	62.8	96	30.25	0.00
31-Aug-02	6:00	62.4	63.5	61.3	97	30.26	0.00
31-Aug-02	7:00	61.2	63.3	60.4	98	30.28	0.00
31-Aug-02	8:00	63.8	67.0	62.6	92	30.30	0.00
31-Aug-02	9:00	69.0	71.2	66.7	83	30.31	0.00
31-Aug-02	10:00	72.4	73.7	70.8	75	30.32	0.00
31-Aug-02	11:00	74.5	76.2	73.2	69	30.33	0.00
31-Aug-02	12:00	77.4	78.6	75.8	57	30.33	0.00
31-Aug-02	13:00	78.1	79.4	77.1	56	30.33	0.00
31-Aug-02	14:00	79.5	81.3	77.8	55	30.33	0.00
31-Aug-02	15:00	81.2	82.3	79.9	48	30.32	0.00
31-Aug-02	16:00	80.2	81.7	79.0	50	30.32	0.00
31-Aug-02	17:00	79.7	81.0	78.9	51	30.33	0.00
31-Aug-02	18:00	77.7	79.1	76.1	55	30.32	0.00
31-Aug-02	19:00	75.1	76.6	73.7	64	30.33	0.00
31-Aug-02	20:00	71.9	74.0	70.0	75	30.35	0.00
31-Aug-02	21:00	68.8	70.4	68.0	87	30.36	0.00
31-Aug-02	22:00	67.7	68.4	67.2	92	30.35	0.00
31-Aug-02	23:00	68.3	69.0	67.6	87	30.35	0.00
31-Aug-02	23:59	66.8	67.7	66.0	87	30.34	0.00
01-Sep-02	1:00	65.3	66.5	64.5	88	30.33	0.02

TABLE B-1 (CONT'D)

DCP 7 Data from Phillips Airfield							
Date	Time, EDST	Average Temperature, °F	Maximum Temperature, °F	Minimum Temperature, °F	RH, %	Station Pressure, MB	Precipitation, in.
01-Sep-02	2:00	63.9	65.6	62.5	91	30.31	0.03
01-Sep-02	3:00	62.4	63.0	62.0	96	30.29	0.05
01-Sep-02	4:00	61.6	62.3	60.9	96	30.27	0.15
01-Sep-02	5:00	61.2	61.5	60.8	97	30.26	0.11
01-Sep-02	6:00	61.3	61.6	61.0	97	30.25	0.09
01-Sep-02	7:00	61.1	61.5	60.7	97	30.26	0.09
01-Sep-02	8:00	60.9	61.4	60.7	96	30.26	0.05
01-Sep-02	9:00	61.5	62.0	60.9	96	30.25	0.10
01-Sep-02	10:00	62.1	62.8	61.5	97	30.25	0.11
01-Sep-02	11:00	63.4	64.5	62.3	96	30.23	0.02
01-Sep-02	12:00	64.5	65.0	64.0	96	30.21	0.02
01-Sep-02	13:00	64.5	65.1	64.0	96	30.20	0.04
01-Sep-02	14:00	65.6	66.6	64.6	95	30.20	0.02
01-Sep-02	15:00	66.8	67.2	66.0	95	30.18	0.00
01-Sep-02	16:00	67.2	67.6	66.6	95	30.15	0.02
01-Sep-02	17:00	67.7	68.2	67.2	95	30.13	0.00
01-Sep-02	18:00	67.7	68.2	67.3	95	30.13	0.00
01-Sep-02	19:00	68.0	68.4	67.6	94	30.12	0.00
01-Sep-02	20:00	67.9	68.3	67.5	94	30.11	0.00
01-Sep-02	21:00	67.7	68.1	67.2	92	30.11	0.00
01-Sep-02	22:00	67.2	67.7	66.9	92	30.12	0.00
01-Sep-02	23:00	66.8	67.2	66.4	91	30.11	0.00
01-Sep-02	23:59	66.3	66.9	65.8	91	30.10	0.00
02-Sep-02	1:00	66.3	66.6	65.9	91	30.10	0.00
02-Sep-02	2:00	66.0	66.4	65.6	91	30.09	0.00
02-Sep-02	3:00	65.7	66.0	65.2	91	30.07	0.00
02-Sep-02	4:00	65.3	65.8	64.9	91	30.05	0.00
02-Sep-02	5:00	65.1	65.4	64.7	90	30.04	0.00
02-Sep-02	6:00	64.9	65.2	64.6	91	30.05	0.00
02-Sep-02	7:00	64.9	65.2	64.6	91	30.06	0.00
02-Sep-02	8:00	64.9	65.3	64.6	90	30.07	0.00
02-Sep-02	9:00	65.7	66.7	64.9	88	30.07	0.00
02-Sep-02	10:00	67.5	69.0	66.1	84	30.06	0.00
02-Sep-02	11:00	69.5	71.0	68.3	80	30.05	0.00
02-Sep-02	12:00	71.1	72.3	70.2	78	30.04	0.00
02-Sep-02	13:00	72.4	74.1	71.0	76	30.02	0.00
02-Sep-02	14:00	73.7	74.8	72.8	73	30.01	0.00
02-Sep-02	15:00	75.1	76.6	74.2	71	29.99	0.00
02-Sep-02	16:00	75.2	76.4	74.4	72	29.97	0.00
02-Sep-02	17:00	75.3	75.9	74.4	72	29.97	0.00
02-Sep-02	18:00	74.7	75.9	74.1	74	29.97	0.00
02-Sep-02	19:00	74.3	74.8	73.8	75	29.97	0.00
02-Sep-02	20:00	73.4	74.1	72.7	78	29.97	0.00
02-Sep-02	21:00	72.3	73.0	71.6	82	29.98	0.00

TABLE B-1 (CONT'D)

DCP 7 Data from Phillips Airfield							
Date	Time, EDST	Average Temperature, °F	Maximum Temperature, °F	Minimum Temperature, °F	RH, %	Station Pressure, MB	Precipitation, in.
02-Sep-02	22:00	70.3	72.3	67.9	88	29.98	0.00
02-Sep-02	23:00	66.9	68.2	65.2	96	29.98	0.00
02-Sep-02	23:59	64.6	66.0	63.6	99	29.98	0.00
							2.67

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APPENDIX C. SOIL MOISTURE

UXO SOIL MOISTURE PROBES DATA

DEPTH KEY: 1 = 1-6 inches, 2 = 6-12 inches, 3 = 12-24 inches
4 = 24-36 inches, 5 = 36-48 inches

Rec#: 2

1. Item ID (Vender) ZONGE 2. Date: 08/19/2002

3. Start Time: 1018 4. Stop Time 1515

5. Data Collectors Name

---------- REPEAT SECTION ----------

	Morning % Moisture		Afternoon % Moisture	
Wet Area	Time:	1018	Time:	1500
1		10.8		10.8
2		10.8		10.6
3		12.6		12.6
4		32.8		32.6
5		37.1		37.1
WOODED AREA	Time:	1026	Time:	1508
1		5.4		6.0
2		4.3		4.3
3		5.1		5.1
4		4.2		4.2
5		1.7		1.6
Open Field	Time:	1035	Time:	1515
1		3.7		3.3
2		4.6		4.3
3		2.1		2.2
4		5.1		4.8
5		0.1		0.2

UXO SOIL MOISTURE PROBES DATA

Rec#: 3

1. Item ID (Vender) ZONGE 2. Date: 08/20/2002

3. Start Time: 724 4. Stop Time 1617

5. Data Collectors Name

---------- REPEAT SECTION ----------

	Morning % Moisture	Afternoon % Moisture
Wet Area	Time: 930	Time: 1617
1	10.8	10.2
2	10.6	10.3
3	12.3	12.2
4	32.2	32.4
5	37.0	37.1
WOODED AREA	Time: 732	Time: 1610
1	6.0	5.4
2	4.0	4.0
3	4.9	4.9
4	4.4	4.1
5	1.6	1.7
Open Field	Time: 724	Time: 1600
1	4.0	4.0
2	4.3	4.3
3	1.8	1.3
4	4.8	1.5
5	0.5	0.1

UXO SOIL MOISTURE PROBES DATA

Rec#: 4

1. Item ID (Vender) ZONGE 2. Date: 08/21/2002

3. Start Time: 713 4. Stop Time 1520

5. Data Collectors Name

---------- REPEAT SECTION ----------

	Morning % Moisture	Afternoon % Moisture
Wet Area	Time: 730	Time: 1530
1	10.5	10.5
2	10.3	10.0
3	12.2	11.9
4	32.4	32.4
5	36.7	37.0
WOODED AREA	Time: 722	Time: 1510

1	5.7	5.7
2	4.0	4.0
3	4.9	5.2
4	4.5	4.4
5	1.7	1.7
Open Field	Time: 713	Time: 1500
1	3.7	3.7
2	5.4	4.3
3	2.0	2.1
4	1.4	5.1
5	0.5	0.2

UXO SOIL MOISTURE PROBES DATA

Rec#: 5

1. Item ID (Vender) ZONGE 2. Date: 08/22/2002

3. Start Time: 750 4. Stop Time 1458

5. Data Collectors Name

---------- REPEAT SECTION ----------

	Morning % Moisture	Afternoon % Moisture
Wet Area	Time: 807	Time: 1458
1	10.0	10.8
2	10.0	9.7
3	11.6	11.9
4	31.8	31.8
5	37.0	37.0
WOODED AREA	Time: 759	Time: 1450
1	6.0	5.4
2	4.0	3.7
3	5.1	4.9
4	4.4	4.2
5	1.7	1.9
Open Field	Time: 750	Time: 1440
1	3.4	4.0
2	4.3	4.3
3	2.1	1.5
4	4.9	1.5
5	0.2	0.4

UXO SOIL MOISTURE PROBES DATA

Rec#: 6

1. Item ID (Vender) ZONGE 2. Date: 08/23/2002

3. Start Time: 720 4. Stop Time 1427

5. Data Collectors Name

---------- REPEAT SECTION ----------

	Morning % Moisture	Afternoon % Moisture
Wet Area	Time: 739	Time: 1427
1	11.9	11.4
2	9.1	9.1
3	11.3	11.8
4	31.7	31.8
5	36.8	37.0
WOODED AREA	Time: 730	Time: 1420
1	6.0	5.7
2	4.0	3.4
3	4.9	4.9
4	4.4	4.5
5	1.9	1.9
Open Field	Time: 720	Time: 1408
1	5.1	4.3
2	4.0	3.7
3	1.8	1.9
4	2.1	4.8
5	0.4	0.1

UXO SOIL MOISTURE PROBES DATA

Rec#: 10

1. Item ID (Vender) ZONGE 2. Date: 08/25/2002

3. Start Time: 721 4. Stop Time 1436

5. Data Collectors Name

---------- REPEAT SECTION ----------

	Morning % Moisture	Afternoon % Moisture
Wet Area	Time: 740	Time: 1436

1	24.7	21.6
2	9.1	9.7
3	11.8	11.0
4	31.4	18.0
5	36.7	28.7
WOODED AREA	Time: 732	Time: 1429
1	18.5	14.2
2	14.5	12.3
3	16.0	13.0
4	4.1	4.2
5	2.3	2.2
Open Field	Time: 721	Time: 1419
1	18.8	15.6
2	2.3	3.1
3	1.9	1.9
4	5.2	5.1
5	0.0	0.1

UXO SOIL MOISTURE PROBES DATA

Rec#: 19

1. Item ID (Vender) ZONGE 2. Date: 08/26/2002

3. Start Time: 737 4. Stop Time 1438

5. Data Collectors Name

---------- REPEAT SECTION ----------

	Morning % Moisture	Afternoon % Moisture
Wet Area	Time: 753	Time: 1438
1	19.0	17.9
2	10.0	10.8
3	11.6	11.6
4	31.7	31.3
5	36.7	37.0
WOODED AREA	Time: 745	Time: 1432
1	13.1	10.0
2	10.8	10.8
3	10.7	10.0
4	4.5	4.1
5	2.0	2.4
Open Field	Time: 737	Time: 1423

1	13.4	11.1
2	4.3	4.8
3	2.2	1.8
4	4.8	4.9
5	0.1	0.0

UXO SOIL MOISTURE PROBES DATA

Rec#: 20

1. Item ID (Vender) ZONGE 2. Date: 08/27/2002

3. Start Time: 730 4. Stop Time 1500

5. Data Collectors Name

---------- REPEAT SECTION ----------

	Morning % Moisture	Afternoon % Moisture
Wet Area	Time: 730	Time: 1440
1	10.8	10.8
2	4.3	4.3
3	1.8	1.8
4	4.8	4.8
5	0.1	0.1
WOODED AREA	Time: 740	Time: 1450
1	10.5	10.3
2	9.7	9.4
3	8.4	8.7
4	4.4	4.1
5	2.0	1.9
Open Field	Time: 750	Time: 1500
1	17.3	16.8
2	10.6	11.0
3	11.6	11.9
4	31.4	31.5
5	36.6	36.6

UXO SOIL MOISTURE PROBES DATA

Rec#: 29

1. Item ID (Vender) ZONGE 2. Date: 08/28/2002

3. Start Time: 745 4. Stop Time 1449

5. Data Collectors Name

---------- REPEAT SECTION ----------

	Morning % Moisture	Afternoon % Moisture
Wet Area	Time: 815	Time: 1449
1	17.1	20.8
2	10.6	9.7
3	11.5	11.6
4	31.1	31.4
5	36.3	36.7
WOODED AREA	Time: 800	Time: 1442
1	13.2	10.0
2	10.9	8.3
3	7.6	7.4
4	4.5	4.5
5	2.3	2.0
Open Field	Time: 745	Time: 1435
1	19.1	12.8
2	10.2	4.3
3	2.1	1.8
4	4.8	4.8
5	0.2	0.0

UXO SOIL MOISTURE PROBES DATA

Rec#: 30

1. Item ID (Vender) ZONGE 2. Date: 08/29/2002

3. Start Time: 719 4. Stop Time 1429

5. Data Collectors Name

---------- REPEAT SECTION ----------

	Morning % Moisture	Afternoon % Moisture
Wet Area	Time: 734	Time: 1429
1	34.1	32.7
2	12.3	13.4
3	11.5	12.3
4	31.4	31.4
5	36.7	36.4
WOODED AREA	Time: 726	Time: 1422

1	33.8	30.7
2	29.1	16.5
3	46.6	40.9
4	3.3	4.1
5	4.9	3.1
Open Field	Time: 719	Time: 1412
1	27.3	23.3
2	8.6	8.0
3	1.6	1.6
4	5.2	4.9
5	0.0	0.1

UXO SOIL MOISTURE PROBES DATA

Rec#: 31

1. Item ID (Vender) ZONGE 2. Date: 08/30/2002

3. Start Time: 720 4. Stop Time 1340

5. Data Collectors Name

---------- REPEAT SECTION ----------

	Morning % Moisture	Afternoon % Moisture
Wet Area	Time: 740	Time: 1340
1	29.0	27.3
2	14.5	15.1
3	12.3	12.3
4	31.1	31.7
5	36.4	36.6
WOODED AREA	Time: 730	Time: 1330
1	25.0	22.7
2	13.4	12.3
3	26.1	24.2
4	4.0	4.2
5	2.3	2.7
Open Field	Time: 720	Time: 1320
1	18.5	17.1
2	7.4	7.4
3	1.9	1.6
4	5.1	4.8
5	0.1	0.2

UXO SOIL MOISTURE PROBES DATA

Rec#: 32

1. Item ID (Vender) ZONGE 2. Date: 08/31/2002

3. Start Time: 707 4. Stop Time 1349

5. Data Collectors Name

---------- REPEAT SECTION ----------

	Morning % Moisture	Afternoon % Moisture
Wet Area	Time: 725	Time: 1349
1	25.0	22.2
2	14.8	15.1
3	12.5	12.6
4	30.9	4.5
5	36.4	4.6
WOODED AREA	Time: 715	Time: 1342
1	20.5	18.2
2	11.4	10.8
3	22.1	21.2
4	4.1	4.0
5	2.4	2.4
Open Field	Time: 707	Time: 1434
1	16.5	14.2
2	8.3	8.0
3	1.8	1.9
4	4.9	4.8
5	0.4	0.1

UXO SOIL MOISTURE PROBES DATA

Rec#: 33

1. Item ID (Vender) ZONGE 2. Date: 09/01/2002

3. Start Time: 723 4. Stop Time 1255

5. Data Collectors Name

---------- REPEAT SECTION ----------

	Morning % Moisture	Afternoon % Moisture
Wet Area	Time: 750	Time: 1245

1	33.8	37.2
2	17.4	20.8
3	13.9	17.8
4	31.7	71.8
5	36.4	36.0
WOODED AREA	Time: 740	Time: 1255
1	39.5	45.7
2	65.1	65.6
3	33.8	33.8
4	4.0	4.1
5	2.6	2.6
Open Field	Time: 723	Time: 1235
1	37.7	33.8
2	14.3	20.8
3	1.9	2.2
4	4.9	4.8
5	0.2	0.2

UXO SOIL MOISTURE PROBES DATA

Rec#: 34

1. Item ID (Vender) ZONGE
2. Date: 09/02/2002
3. Start Time: 817
4. Stop Time 834
5. Data Collectors Name

---------- REPEAT SECTION ----------

	Morning % Moisture	Afternoon % Moisture
Wet Area	Time: 834	Time: 0
1	33.3	0.0
2	22.8	0.0
3	18.6	0.0
4	34.3	0.0
5	37.4	0.0
WOODED AREA	Time: 826	Time: 0
1	27.3	0.0
2	29.6	0.0
3	35.0	0.0
4	4.5	0.0
5	2.3	0.0
Open Field	Time: 817	Time: 0

1	25.9	0.0
2	16.3	0.0
3	0.0	0.0
4	5.1	0.0
5	0.1	0.0

UXO SOIL MOISTURE PROBES DATA

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APPENDIX D. DAILY ACTIVITY LOGS

Date	No. of People	Area Tested	Status Start Time	Status Stop Time	Duration min.	Operational Status	Operational Status - Comments	Track Method	Track Method=Other Explain	Pattern	Field Conditions		No. of People
20020819	3.00	NA	700	1150	290	INITIAL SET-UP	SET-UP/MOBILIZATION	GPS	NA	NA	HOT/HUMID	DRY	3
20020819	3.00	CALIBRATION LANES	1150	1205	15	COLLECTING DATA		GPS	NA	LINEAR	HOT/HUMID	DRY	3
20020819	3.00	CALIBRATION LANES	1205	1255	50	DOWNTIME DUE TO EQUIP MAINT/CHECK	VERIFIED DATA WAS BEING RECORDED	GPS	NA	NA	HOT/HUMID	DRY	3
20020819	3.00	CALIBRATION LANES	1255	1325	30	COLLECTING DATA		GPS	NA	LINEAR	HOT/HUMID	DRY	3
20020819	3.00	CALIBRATION LANES	1325	1451	86	DOWNTIME DUE TO EQUIP MAINT/CHECK	THE DATA WAS DOWNLOADED TO VERIFY THE GPS WAS FUNCTIONING	GPS	NA	NA	HOT/HUMID	DRY	3
20020819	3.00	CALIBRATION LANES	1451	1621	90	COLLECTING DATA		GPS	NA	LINEAR	HOT/HUMID	DRY	3
20020820	3.00	BLIND TEST GRID	700	805	65	DAILY START, STOP	START OF DAILY OPERATIONS / EQUIPMENT PREPERATIONS	OTHER	NA	NA	HOT/HUMID	DRY	3
20020820	3.00	BLIND TEST GRID	805	1014	129	COLLECTING DATA	EQUIPMENT WAS CALIBRATED BEFORE DATA RUN USING CAL BALL	OTHER	TAPES / STAKES	LINEAR	HOT/HUMID	DRY	3
20020820	3.00	OPEN FIELD	1014	1035	21	DOWNTIME DUE TO EQUIP MAINT/CHECK	CHANGED BATTERIES	OTHER	NA	NA	HOT/HUMID	DRY	3
20020820	3.00	OPEN FIELD	1035	1113	38	COLLECTING DATA	EQUIPMENT WAS CALIBRATED BEFORE DATA RUN USING CAL BALL	OTHER	TAPES	LINEAR	HOT/HUMID	DRY	3
20020820	3.00	MINE GRID	1113	1135	22	COLLECTING DATA	EQUIPMENT WAS CALIBRATED BEFORE DATA RUN USING CAL BALL	OTHER	TAPES	LINEAR	HOT/HUMID	DRY	3
20020820	3.00	OPEN FIELD	1135	1200	25	DOWNTIME DUE TO EQUIP MAINT/CHECK	PREPARING FOR NEXT RUN	OTHER	NA	NA	HOT/HUMID	DRY	3
20020820	3.00	OPEN FIELD	1200	1306	66	COLLECTING DATA	EQUIPMENT WAS CALIBRATED BEFORE DATA RUN USING CAL BALL	OTHER	TAPES / STAKES	LINEAR	HOT/HUMID	DRY	3
20020820	3.00	OPEN FIELD	1306	1341	35	BREAK/LUNCH	BREAK	OTHER	NA	NA	HOT/HUMID	DRY	3

Date	No. of People	Area Tested	Status Start Time	Status Stop Time	Duration min.	Operational Status	Operational Status - Comments	Track Method	Track Method=Other Explain	Pattern	Field Conditions		No. of People
20020820	3	OPEN FIELD	1341	1655	194	COLLECTING DATA	EQUIPMENT WAS CALIBRATED BEFORE DATA RUN USING CAL BALL	OTHER	TAPES/ STAKES	LINEAR	HOT/HUMID	DRY	3
20020820	3	OPEN FIELD	1655	1715	20	DAILY START, STOP	END OF DAILY OPERATIONS/ EQUIPMENT BREAKDOWN	OTHER	NA	NA	HOT/HUMID	DRY	3
20020821	3	OPEN FIELD	700	802	62	DAILY START, STOP	START OF DAILY OPERATIONS/ EQUIPMENT PREPERATIONS	NA	NA	NA	HOT/HUMID	DRY	3
20020821	3	OPEN FIELD	802	850	48	COLLECTING DATA	EQUIPMENT WAS CALIBRATED BEFORE DATA RUN USING CAL BALL	GPS	NA	LINEAR	HOT/HUMID	DRY	3
20020821	3	OPEN FIELD	850	930	40	DOWNTIME DUE TO EQUIP MAINT/CHECK	DOWNLOADING DATA	GPS	NA	NA	HOT/HUMID	DRY	3
20020821	3	OPEN FIELD	930	935	5	DOWNTIME DUE TO EQUIP MAINT/CHECK	PREPARING FOR NEXT RUN	GPS	NA	NA	HOT/HUMID	DRY	3
20020821	3	OPEN FIELD	935	951	16	COLLECTING DATA	EQUIPMENT WAS CALIBRATED BEFORE DATA RUN USING CAL BALL	OTHER	TAPES / STAKES	LINEAR	HOT/HUMID	DRY	3
20020821	3	OPEN FIELD	951	1030	39	BREAK/LUNCH	BREAK	NA	NA	NA	HOT/HUMID	DRY	3
20020821	3	OPEN FIELD	1030	1120	50	COLLECTING DATA	EQUIPMENT WAS CALIBRATED BEFORE DATA RUN USING CAL BALL	OTHER	TAPES / STAKES	LINEAR	HOT/HUMID	DRY	3
20020821	3	OPEN FIELD	1120	1150	30	BREAK/LUNCH	LUNCH	NA	NA	NA	HOT/HUMID	DRY	3
20020821	3	OPEN FIELD	1150	1240	50	COLLECTING DATA	EQUIPMENT WAS CALIBRATED BEFORE DATA RUN USING CAL BALL	OTHER	TAPES / STAKES	LINEAR	HOT/HUMID	DRY	3
20020821	3	OPEN FIELD	1240	1300	20	BREAK/LUNCH	BREAK	NA	NA	NA	HOT/HUMID	DRY	3
20020821	3	OPEN FIELD	1300	1340	40	DOWNTIME DUE TO EQUIP MAINT/CHECK	DOWNLOADING DATA	NA	NA	NA	HOT/HUMID	DRY	3
20020821	3	OPEN FIELD	1340	1350	10	DOWNTIME DUE TO EQUIP MAINT/CHECK	PREPARING FOR NEXT RUN	NA	NA	NA	HOT/HUMID	DRY	3

Date	No. of People	Area Tested	Status Start Time	Status Stop Time	Duration min.	Operational Status	Operational Status - Comments	Track Method	Track Method=Other Explain	Pattern	Field Conditions	
20020821	3	OPEN FIELD	1350	1455	65	COLLECTING DATA	EQUIPMENT WAS CALIBRATED BEFORE DATA RUN USING CAL BALL	OTHER	TAPES	LINEAR	HOT/HUMID	DRY
20020821	3	OPEN FIELD	1455	1530	35	DAILY START, STOP	END OF DAILY OPERATION/ EQUIPMENT BREAKDOWN	NA	NA	NA	HOT/HUMID	DRY
20020822	3	OPEN FIELD	700	810	70	DAILY START, STOP	START OF DAILY OPERATIONS/ EQUIPMENT PREPERATIONS	NA	NA	NA	HOT/HUMID	DRY
20020822	3	OPEN FIELD	810	930	80	COLLECTING DATA	EQUIPMENT WAS CALIBRATED AFTER DATA RUN USING CAL BALL	OTHER	TAPES/ STAKES	LINEAR	HOT/HUMID	DRY
20020822	3	OPEN FIELD	930	940	10	BREAK/LUNCH	BREAK	NA	NA	NA	HOT/HUMID	DRY
20020822	3	OPEN FIELD	940	950	10	DOWNTIME DUE TO EQUIP MAINT/CHECK	DOWNLOADING DATA	NA	NA	NA	HOT/HUMID	DRY
20020822	3	OPEN FIELD	950	1050	60	COLLECTING DATA	EQUIPMENT WAS CALIBRATED AFTER DATA RUN USING CAL BALL	OTHER	TAPES / STAKES	LINEAR	HOT/HUMID	DRY
20020822	3	OPEN FIELD	1050	1112	22	DOWNTIME DUE TO EQUIP MAINT/CHECK	DOWNLOADING DATA	NA	NA	NA	HOT/HUMID	DRY
20020822	3	OPEN FIELD	1112	1120	8	DOWNTIME DUE TO EQUIP MAINT/CHECK	CHANGED BATTERIES	NA	NA	NA	HOT/HUMID	DRY
20020822	3	OPEN FIELD	1120	1230	70	COLLECTING DATA	EQUIPMENT WAS CALIBRATED BEFORE DATA RUN USING CAL BALL	OTHER	TAPES / STAKES	LINEAR	HOT/HUMID	DRY
20020822	3	OPEN FIELD	1230	1235	5	DOWNTIME DUE TO EQUIP MAINT/CHECK	THE SOFTWARE WAS RESET	NA	NA	NA	HOT/HUMID	DRY
20020822	3	OPEN FIELD	1235	1250	15	BREAK/LUNCH	LUNCH	NA	NA	NA	HOT/HUMID	DRY
20020822	3	OPEN FIELD	1250	1305	15	DOWNTIME DUE TO EQUIP MAINT/CHECK	DOWNLOADING DATA	NA	NA	NA	HOT/HUMID	DRY
20020822	3	OPEN FIELD	1305	1315	10	DOWNTIME DUE TO EQUIP MAINT/CHECK	PREPARING FOR NEXT RUN	NA	NA	NA	HOT/HUMID	DRY

Date	No. of People	Area Tested	Status Start Time	Status Stop Time	Duration min.	Operational Status	Operational Status - Comments	Track Method	Track Method=Other Explain	Pattern	Field Conditions	
20020822	3	OPEN FIELD	1315	1408	53	COLLECTING DATA	EQUIPMENT WAS CALIBRATED BEFORE DATA RUN USING CAL BALL	OTHER	TAPES/ STAKES	LINEAR	HOT/HUMID	DRY
20020822	3	OPEN FIELD	1408	1415	7	DOWNTIME DUE TO EQUIPMENT FAILURE	WHEEL YOKE SUPPORT WAS REINFORCED USING TAPE AND A WOODEN STICK	NA	NA	NA	HOT/HUMID	DRY
20020822	3	OPEN FIELD	1415	1430	15	DOWNTIME DUE TO EQUIP MAINT/CHECK	DOWNLOADING DATA	NA	NA	NA	HOT/HUMID	DRY
20020822	3	OPEN FIELD	1430	1436	6	DOWNTIME DUE TO EQUIP MAINT/CHECK	PREPARING FOR NEXT RUN	NA	NA	NA	HOT/HUMID	DRY
20020822	3	OPEN FIELD	1436	1540	64	COLLECTING DATA	EQUIPMENT WAS CALIBRATED BEFORE DATA RUN USING CAL BALL	OTHER	TAPES/ STAKES	LINEAR	HOT/HUMID	DRY
20020822	3	OPEN FIELD	1540	1550	10	DOWNTIME DUE TO EQUIP MAINT/CHECK	DOWNLOADING DATA	NA	NA	NA	HOT/HUMID	DRY
20020822	3	OPEN FIELD	1550	1605	15	DAILY START, STOP	END OF DAILY OPERATIONS/ EQUIPMENT BREAK DOWN	NA	NA	NA	HOT/HUMID	DRY
20020823	3	OPEN FIELD	700	810	70	DAILY START, STOP	START OF DAILY OPERATIONS/ EQUIPMENT PREPARATIONS	NA	NA	NA	HOT/HUMID	DRY
20020823	3	OPEN FIELD	810	830	20	COLLECTING DATA	EQUIPMENT WAS CALIBRATED BEFORE DATA RUN USING CAL BALL	OTHER	TAPES/ STAKES	LINEAR	HOT/HUMID	WET
20020823	3	OPEN FIELD	830	930	60	DOWNTIME DUE TO EQUIPMENT FAILURE	UNABLE TO KEEP LOCK ON GPS DUE TO BASE RECIEVER FAILURE	NA	NA	NA	HOT/HUMID	DRY
20020823	3	OPEN FIELD	930	1030	60	COLLECTING DATA	EQUIPMENT WAS CALIBRATED BEFORE DATA RUN USING CAL BALL	OTHER	TAPES / STAKES	LINEAR	HOT/HUMID	WET

Date	No. of People	Area Tested	Status Start Time	Status Stop Time	Duration min.	Operational Status	Operational Status - Comments	Track Method	Track Method=Other Explain	Pattern	Field Conditions	
20020824	3	OPEN FIELD	1700	1800	60	COLLECTING DATA	EQUIPMENT WAS CALIBRATED BEFORE DATA RUN USING CAL BALL	OTHER	TAPES/ STAKES	LINEAR	HOT/HUMID	WET
20020824	3	OPEN FIELD	1800	1815	15	DOWNTIME DUE TO EQUIP MAINT/CHECK	DOWNLOADING DATA	NA	NA	NA	HOT/HUMID	WET
20020824	3	OPEN FIELD	1815	1830	15	DAILY START, STOP	END OF DAILY OPERATIONS/ EQUIPMENT BREAKDOWN	NA	NA	NA	HOT/HUMID	WET
20020825	3	OPEN FIELD	700	741	41	DAILY START, STOP	START OF DAILY OPERATIONS/ EQUIPMENT PREPERATIONS	NA	NA	NA	CLEAR/UNLIMITED	WET
20020825	3	OPEN FIELD	741	841	60	COLLECTING DATA	EQUIPMENT WAS CALIBRATED USING GPS BEFORE DATA RUN	OTHER	TAPES/ STAKES	LINEAR	CLEAR/UNLIMITED	WET
20020825	3	OPEN FIELD	841	849	8	DOWNTIME DUE TO EQUIP MAINT/CHECK	DOWNLOADING DATA	NA	NA	NA	NA	NA
20020825	3	OPEN FIELD	849	858	9	BREAK/LUNCH	BREAK	NA	NA	NA	CLEAR/UNLIMITED	WET
20020825	3	OPEN FIELD	858	1002	64	COLLECTING DATA	EQUIPMENT WAS CALIBRATED BEFORE DATA RUN USING CAL BALL	OTHER	TAPES/ STAKES	LINEAR	HOT	WET
20020825	3	OPEN FIELD	1002	1017	15	BREAK/LUNCH	BREAK	NA	NA	NA	NA	NA
20020825	3	OPEN FIELD	1017	1027	10	DOWNTIME DUE TO EQUIP MAINT/CHECK	DOWNLOADING DATA	NA	NA	NA	NA	NA
20020825	3	OPEN FIELD	1027	1141	74	COLLECTING DATA	EQUIPMENT WAS CALIBRATED BEFORE DATA RUN USING CAL BALL	OTHER	TAPES/ STAKES	LINEAR	HOT	WET
20020825	3	OPEN FIELD	1141	1146	5	DOWNTIME DUE TO EQUIP MAINT/CHECK	DOWNLOADING DATA	NA	NA	NA	NA	NA
20020825	3	OPEN FIELD	1146	1206	20	BREAK/LUNCH	LUNCH	NA	NA	NA	NA	NA
20020825	3	OPEN FIELD	1206	1241	35	DOWNTIME DUE TO EQUIP MAINT/CHECK	CHANGED BATTERIES	NA	NA	NA	HOT/HUMID	NA

Date	No. of People	Area Tested	Status Start Time	Status Stop Time	Duration min.	Operational Status	Operational Status - Comments	Track Method	Track Method=Other Explain	Pattern	Field Conditions	
20020825	3	OPEN FIELD	1241	1313	32	COLLECTING DATA	EQUIPMENT WAS CALIBRATED BEFORE DATA RUN USING CAL BALL	OTHER	TAPES/ STAKES	LINEAR	HOT/HUMID	DRY
20020825	3	OPEN FIELD	1313	1318	5	DOWNTIME DUE TO EQUIP MAINT/CHECK	DOWNLOADING DATA	NA	NA	NA	NA	NA
20020825	3	OPEN FIELD	1318	1336	18	BREAK/LUNCH	BREAK	NA	NA	NA	NA	NA
20020825	3	OPEN FIELD	1336	1350	14	DOWNTIME DUE TO EQUIP MAINT/CHECK	PREPARING FOR NEXT RUN	NA	NA	NA	NA	NA
20020825	3	OPEN FIELD	1350	1433	43	COLLECTING DATA	EQUIPMENT WAS CALIBRATED BEFEORE DATA RUN USING CAL BALL	OTHER	TAPES/ STAKES	LINEAR	HOT/HUMID	DRY
20020825	3	OPEN FIELD	1433	1449	16	DOWNTIME DUE TO EQUIPMENT FAILURE	LEFT BRACE SUPPORT FOR ANTENNA ASSEMBLY BROKE	NA	NA	NA	NA	NA
20020825	3	OPEN FIELD	1449	1457	8	DOWNTIME DUE TO EQUIP MAINT/CHECK	DOWNLOADING DATA	NA	NA	NA	NA	NA
20020825	3	OPEN FIELD	1457	1504	7	DOWNTIME DUE TO EQUIP MAINT/CHECK	PREPARING FOR NEXT RUN	NA	NA	NA	NA	NA
20020825	3	OPEN FIELD	1504	1605	61	COLLECTING DATA	EQUIPMENT WAS CALIBRATED BEFORE DATA RUN USING CAL BALL	OTHER	TAPES/ STAKES	LINEAR	HOT/HUMID	DRY
20020825	3	OPEN FIELD	1605	1615	10	DAILY START, STOP	END OF DAILY OPERATIONS/ EQUIPMENT BREAKDOWN	NA	NA	NA	NA	NA
20020826	3	OPEN FIELD	700	730	30	DEMONSTRATION SITE ISSUE	SECURITY BADGES NEED TO BE RENEWED	NA	NA	NA	NA	NA
20020826	3	OPEN FIELD	730	815	45	DAILY START, STOP	START OF DAILY OPERATIONS/ EQUIPMENT PREPERATIONS	NA	NA	NA	NA	NA
20020826	3	OPEN FIELD	815	940	85	COLLECTING DATA	EQUIPMENT WAS CALIBRATED BEFORE RUN USING CAL BALL	CONES	TAPES	LINEAR	NA	NA

Date	No. of People	Area Tested	Status Start Time	Status Stop Time	Duration min.	Operational Status	Operational Status - Comments	Track Method	Track Method=Other Explain	Pattern	Field Conditions	
20020826	3	OPEN FIELD	940	950	10	DOWNTIME DUE TO EQUIP MAINT/CHECK	DOWNLOADING DATA	NA	NA	NA	NA	NA
20020826	3	OPEN FIELD	950	1000	10	DOWNTIME DUE TO EQUIP MAINT/CHECK	PREPARING FOR NEXT RUN	NA	NA	NA	NA	NA
20020826	3	OPEN FIELD	1000	1050	50	COLLECTING DATA	EQUIPMENT WAS CALIBRATED BEFORE DATA RUN USING CAL BALL	CONES	TAPES	LINEAR	HOT/HUMID	DRY
20020826	3	OPEN FIELD	1050	1110	20	DOWNTIME DUE TO EQUIP MAINT/CHECK	DOWNLOADING DATA	NA	NA	NA	NA	NA
20020826	3	OPEN FIELD	1110	1125	15	DOWNTIME DUE TO EQUIP MAINT/CHECK	CHANGED BATTERIES	NA	NA	NA	NA	NA
20020826	3	OPEN FIELD	1125	1230	65	COLLECTING DATA	EQUIPMENT WAS CALIBRATED BEFORE DATA RUN USING CAL BALL	CONES	TAPES	LINEAR	HOT/HUMID	NA
20020826	3	OPEN FIELD	1230	1240	10	DOWNTIME DUE TO EQUIP MAINT/CHECK	DOWNLOADING DATA	NA	NA	NA	NA	NA
20020826	3	OPEN FIELD	1240	1300	20	BREAK/LUNCH	LUNCH	NA	NA	NA	NA	NA
20020826	3	OPEN FIELD	1300	1310	10	DOWNTIME DUE TO EQUIP MAINT/CHECK	PREPARING FOR NEXT RUN	NA	NA	NA	NA	NA
20020826	3	OPEN FIELD	1310	1410	60	COLLECTING DATA	EQUIPMENT WAS CALBRATED BEFORE DATA RUN USING CAL BALL	CONES	TAPES	LINEAR	HOT/HUMID	DRY
20020826	3	OPEN FIELD	1410	1420	10	BREAK/LUNCH	BREAK	NA	NA	NA	NA	NA
20020826	3	OPEN FIELD	1420	1430	10	DOWNTIME DUE TO EQUIP MAINT/CHECK	DOWNLOADING DATA	NA	NA	NA	NA	NA
20020826	3	OPEN FIELD	1430	1440	10	DOWNTIME DUE TO EQUIP MAINT/CHECK	PREPARING FOR NEXT RUN	NA	NA	NA	NA	NA
20020826	3	OPEN FIELD	1440	1550	70	COLLECTING DATA	EQUIPMENT WAS CALIBRATED BEFORE DATA RUN USING CAL BALL	CONES	TAPES	LINEAR	HOT/HUMID	DRY

Date	No. of People	Area Tested	Status Start Time	Status Stop Time	Duration min.	Operational Status	Operational Status - Comments	Track Method	Track Method=Other Explain	Pattern	Field Conditions	
20020826	3	OPEN FIELD	1550	1610	20	DOWNTIME DUE TO EQUIP MAINT/CHECK	DOWNLOADING DATA	NA	NA	NA	NA	NA
20020826	3	OPEN FIELD	1610	1620	10	DAILY START, STOP	END OF DAILY OPERATIONS/ EQUIPMENT BREAKDOWN	NA	NA	NA	NA	NA
20020827	3	OPEN FIELD	700	729	29	DAILY START, STOP	START OF DAILY OPERATIONS/ EQUIPMENT PREPERATIONS	NA	NA	NA	NA	NA
20020827	3	OPEN FIELD	729	845	76	COLLECTING DATA	EQUIPMENT WAS CALIBRATED BEFORE DATA RUN USING CAL BALL	CONES	TAPES	LINEAR	HOT/HUMID	DRY
20020827	3	OPEN FIELD	845	900	15	DOWNTIME DUE TO EQUIP MAINT/CHECK	DOWNLOADING DATA	NA	NA	NA	NA	NA
20020827	3	OPEN FIELD	900	905	5	BREAK/LUNCH	BREAK	NA	NA	NA	NA	NA
20020827	3	OPEN FIELD	905	915	10	DOWNTIME DUE TO EQUIP MAINT/CHECK	PREPARING FOR NEXT RUN	NA	NA	NA	NA	NA
20020827	3	OPEN FIELD	915	1010	55	COLLECTING DATA	EQIPMENT WAS CALIBRATED BEFORE DATA RUN USING CAL BALL	CONES	TAPES	LINEAR	HOT/HUMID	DRY
20020827	3	OPEN FIELD	1010	1020	10	DOWNTIME DUE TO EQUIP MAINT/CHECK	DOWNLOADING DATA	NA	NA	NA	NA	NA
20020827	3	OPEN FIELD	1020	1040	20	DOWNTIME DUE TO EQUIP MAINT/CHECK	PREPARING FOR NEXT RUN	NA	NA	NA	NA	NA
20020827	3	OPEN FIELD	1040	1125	45	COLLECTING DATA	EQUIPMENT WAS CALIBRATED BEFORE DATA RUN USING CAL BALL	CONES	TAPES	LINEAR	HOT/HUMID	DRY
20020827	3	OPEN FIELD	1125	1135	10	DOWNTIME DUE TO EQUIP MAINT/CHECK	DOWNLOADING DATA	NA	NA	NA	NA	NA
20020827	3	OPEN FIELD	1135	1155	20	BREAK/LUNCH	LUNCH	NA	NA	NA	NA	NA
20020827	3	OPEN FIELD	1155	1210	15	DOWNTIME DUE TO EQUIP MAINT/CHECK	PREPARING FOR NEXT RUN	NA	NA	NA	NA	NA

Date	No. of People	Area Tested	Status Start Time	Status Stop Time	Duration min.	Operational Status	Operational Status - Comments	Track Method	Track Method=Other Explain	Pattern	Field Conditions	
20020827	3	OPEN FIELD	1210	1300	50	COLLECTING DATA	EQUIPMENT WAS CALIBRATED BEFORE DATA RUN USING CAL BALL	CONES	TAPES	LINEAR	HOT/HUMID	DRY
20020827	3	OPEN FIELD	1300	1320	20	DOWNTIME DUE TO EQUIP MAINT/CHECK	DOWNLOADING DATA	NA	NA	NA	NA	NA
20020827	3	OPEN FIELD	1320	1340	20	DOWNTIME DUE TO EQUIP MAINT/CHECK	PREPARING FOR NEXT RUN	NA	NA	NA	NA	NA
20020827	3	OPEN FIELD	1340	1440	60	COLLECTING DATA	EQUIPMENT WAS CALIBRATED BEFORE DATA RUN USING CAL BALL	CONES	TAPES	LINEAR	HOT/HUMID	DRY
20020827	3	OPEN FIELD	1440	1450	10	DOWNTIME DUE TO EQUIP MAINT/CHECK	DOWNLOADING DATA	NA	NA	NA	HOT/HUMID	DRY
20020827	3	OPEN FIELD	1450	1500	10	DOWNTIME DUE TO EQUIP MAINT/CHECK	PREPARING FOR NEXT RUN	NA	NA	NA	HOT/HUMID	DRY
20020827	3	OPEN FIELD	1500	1535	35	COLLECTING DATA	EQUIPMENT WAS CALIBRATED BEFORE DATA RUN USING CAL BALL	CONES	TAPES	LINEAR	HOT/HUMID	DRY
20020827	3	OPEN FIELD	1535	1540	5	DOWNTIME DUE TO EQUIPMENT FAILURE	GPS COMMUNICATIONS	NA	NA	NA	HOT/HUMID	DRY
20020827	3	OPEN FIELD	1540	1604	24	COLLECTING DATA	RESTART AFTER FAILURE TO COMMUNICATE WITH GPS	CONES	TAPES	LINEAR	HOT/HUMID	DRY
20020827	3	OPEN FIELD	1604	1610	6	DOWNTIME DUE TO EQUIP MAINT/CHECK	DOWNLOADING DATA	NA	NA	NA	NA	NA
20020827	3	OPEN FIELD	1610	1620	10	DAILY START, STOP	END OF DAILY OPERATIONS/ EQUIPMENT BREAKDOWN	NA	NA	NA	NA	NA
20020828	4	OPEN FIELD	700	815	75	DAILY START, STOP	START OF DAILY OPERATIONS/ EQUIPMENT PREPARATIONS	NA	NA	NA	NA	NA

Date	No. of People	Area Tested	Status Start Time	Status Stop Time	Duration min.	Operational Status	Operational Status - Comments	Track Method	Track Method=Other Explain	Pattern	Field Conditions	
20020828	4	OPEN FIELD	815	920	65	COLLECTING DATA	EQUIPMENT WAS CALIBRATED BEFORE DATA RUN USING CAL BALL	CONES	TAPES	LINEAR	RAIN/LIMITED	WET
20020828	4	OPEN FIELD	920	930	10	DOWNTIME DUE TO EQUIP MAINT/CHECK	DOWNLOADING DATA	NA	NA	NA	NA	NA
20020828	4	OPEN FIELD	930	945	15	WEATHER ISSUE	RAIN DELAY	NA	NA	NA	RAIN/LIMITED	WET
20020828	4	OPEN FIELD	945	950	5	DOWNTIME DUE TO EQUIP MAINT/CHECK	PREPARING FOR NEXT RUN	NA	NA	NA	NA	NA
20020828	4	OPEN FIELD	950	1050	60	COLLECTING DATA	EQUIPMENT WAS CALIBRATED BEFORE DATA RUN USING CAL BALL	CONES	STAKES	LINEAR	RAIN/LIMITED	WET
20020828	4	OPEN FIELD	1050	1100	10	DOWNTIME DUE TO EQUIP MAINT/CHECK	DOWNLOADING DATA	NA	NA	NA	NA	NA
20020828	4	OPEN FIELD	1100	1115	15	DOWNTIME DUE TO EQUIP MAINT/CHECK	PREPARING FOR NEXT RUN	NA	NA	NA	NA	NA
20020828	4	OPEN FIELD	1115	1215	60	COLLECTING DATA	EQUIPMENT WAS CALIBRATED BEFORE DATA RUN USING CAL BALL	CONES	TAPES	LINEAR	RAIN/LIMITED	WET
20020828	4	OPEN FIELD	1215	1225	10	DOWNTIME DUE TO EQUIP MAINT/CHECK	CHANGED BATTERIES	NA	NA	NA	NA	NA
20020828	4	OPEN FIELD	1225	1330	65	DOWNTIME DUE TO EQUIP MAINT/CHECK	ROUTINE CHECK OF BASE RADIO RECIEVER/NEED NEW BATTERY	NA	NA	NA	NA	NA
20020828	4	OPEN FIELD	1330	1340	10	DOWNTIME DUE TO EQUIP MAINT/CHECK	PREPARING FOR NEXT RUN	NA	NA	NA	RAIN/LIMITED	WET
20020828	4	OPEN FIELD	1340	1445	65	COLLECTING DATA	EQUIPMENT WAS CALIBRATED BEFORE DATA RUN USING CAL BALL	CONES	TAPES	LINEAR	RAIN/LIMITED	WET
20020828	4	OPEN FIELD	1445	1500	15	DOWNTIME DUE TO EQUIP MAINT/CHECK	DOWNLOADING DATA	NA	NA	NA	NA	NA

Date	No. of People	Area Tested	Status Start Time	Status Stop Time	Duration min.	Operational Status	Operational Status - Comments	Track Method	Track Method=Other Explain	Pattern	Field Conditions	
20020828	4	OPEN FIELD	1500	1515	15	DAILY START, STOP	END OF DAILY OPERATIONS/ EQUIPMENT BREAKDOWN	NA	NA	NA	NA	NA
20020829	4	OPEN FIELD	700	800	60	DAILY START, STOP	START OF DAILY OPERATIONS/ EQUIPMENT PREPARATIONS	NA	NA	NA	NA	NA
20020829	4	OPEN FIELD	800	810	10	COLLECTING DATA	EQUIPMENT WAS CALIBRATED BEFORE DATA RUN USING CAL BALL	CONES	STAKES	LINEAR	RAIN/LIMITED	WET
20020829	4	OPEN FIELD	810	910	60	DOWNTIME DUE TO EQUIPMENT FAILURE	STRESS CRACK ON WHEEL YOKE BASE BRACKET; REPAIRED	NA	NA	NA	NA	NA
20020829	4	OPEN FIELD	910	925	15	DOWNTIME DUE TO EQUIP MAINT/CHECK	NO DATA WAS DOWNLOADED	NA	NA	NA	NA	NA
20020829	4	OPEN FIELD	925	1030	65	COLLECTING DATA	EQUIPMENT WAS CALIBRATED BEFORE DATA RUN USING CAL BALL	CONES	STAKES	LINEAR	RAIN & HAZE/LIMITED	WET
20020829	4	OPEN FIELD	1030	1050	20	DOWNTIME DUE TO EQUIP MAINT/CHECK	NO DATA WAS DOWNLOADED	NA	NA	NA	NA	NA
20020829	4	OPEN FIELD	1050	1130	40	COLLECTING DATA	EQUIPMENT WAS CALIBRATED BEFORE DATA RUN USING CAL BALL	CONES	STAKES	LINEAR	RAIN & HAZE/LIMITED	WET
20020829	4	OPEN FIELD	1130	1150	20	DOWNTIME DUE TO EQUIP MAINT/CHECK	EQUIPMENT DATA CHECK	NA	NA	NA	NA	NA
20020829	4	OPEN FIELD	1150	1215	25	COLLECTING DATA	EQUIPMENT WAS CALBRATED BEFORE DATA RUN / RESUMED TESTING	CONES	STAKES	LINEAR	RAIN & HAZE/LIMITED	WET
20020829	4	OPEN FIELD	1215	1230	15	DOWNTIME DUE TO EQUIP MAINT/CHECK	CHANGED BATTERIES	NA	NA	NA	HOT/HUMID	NA
20020829	4	OPEN FIELD	1230	1240	10	BREAK/LUNCH	LUNCH	NA	NA	NA	NA	NA
20020829	4	OPEN FIELD	1240	1250	10	DOWNTIME DUE TO EQUIP MAINT/CHECK	PREPARING FOR NEXT RUN	NA	NA	NA	NA	NA

Date	No. of People	Area Tested	Status Start Time	Status Stop Time	Duration min.	Operational Status	Operational Status - Comments	Track Method	Track Method=Other Explain	Pattern	Field Conditions	
20020829	4.00	OPEN FIELD	1250	1350	60	COLLECTING DATA	EQUIPMENT WAS DOWNLOADED BEFORE RUN/START OF NEW GRID	CONES	TAPES	LINEAR	RAIN & HAZE/LIMITED	WET
20020829	4.00	OPEN FIELD	1350	1405	15	DOWNTIME DUE TO EQUIP MAINT/CHECK	NO DATA WAS DOWNLOADED	NA	NA	NA	NA	NA
20020829	4	OPEN FIELD	1405	1505	60	COLLECTING DATA	EQUIPMENT WAS CALIBRATED BEFORE DATA RUN USING CAL BALL	CONES	TAPES	LINEAR	RAIN & HAZE/LIMITED	WET
20020829	4	OPEN FIELD	1505	1540	35	DOWNTIME DUE TO EQUIP MAINT/CHECK	NO DATA DOWNLOADED	NA	NA	NA	NA	NA
20020829	4	OPEN FIELD	1540	1640	60	COLLECTING DATA	EQUIPMENT WAS CALIBRATED BEFORE DATA RUN USING CAL BALL	CONES	TAPES	LINEAR	RAIN & HAZE/LIMITED	WET
20020829	4	OPEN FIELD	1640	1650	10	DOWNTIME DUE TO EQUIP MAINT/CHECK	DOWNLOADING DATA	NA	NA	NA	NA	NA
20020829	4	OPEN FIELD	1650	1700	10	DAILY START, STOP	END OF DAILY OPERATIONS/ EQUIPMENT BRREAKDOWN	NA	NA	NA	NA	NA
20020830	4	OPEN FIELD	700	925	145	DAILY START, STOP	START OF DAILY OPERATIONS/ EQUIPMENT PREPARATIONS	NA	NA	NA	NA	NA
20020830	4	OPEN FIELD	925	1025	60	COLLECTING DATA	EQUIPMENT WAS CALIBRATED BEFORE DATA RUN USING CAL BALL	CONES	TAPES	LINEAR	CLEAR/UNLIMITED	WET
20020830	4	OPEN FIELD	1025	1040	15	DOWNTIME DUE TO EQUIP MAINT/CHECK	EQUIPMENT CHECK/ NO DATA WAS DOWNLOADED	NA	NA	NA	NA	NA
20020830	4	OPEN FIELD	1040	1055	15	DOWNTIME DUE TO EQUIP MAINT/CHECK	PREPARING FOR NEXT RUN	NA	NA	NA	NA	NA
20020830	4	OPEN FIELD	1055	1155	60	COLLECTING DATA	EQUIPMENT WAS CALIBRATED BEFORE DATA RUN USING CAL BALL	CONES	TAPES	LINEAR	CLEAR/UNLIMITED	WET

Date	No. of People	Area Tested	Status Start Time	Status Stop Time	Duration min.	Operational Status	Operational Status - Comments	Track Method	Track Method=Other Explain	Pattern	Field Conditions	
20020830	4	OPEN FIELD	1155	1215	20	DOWNTIME DUE TO EQUIP MAINT/CHECK	DOWNLOADING DATA	NA	NA	NA	NA	NA
20020830	4	OPEN FIELD	1215	1225	10	DOWNTIME DUE TO EQUIP MAINT/CHECK	CHANGED BATTERIES	NA	NA	NA	NA	NA
20020830	4	OPEN FIELD	1225	1325	60	COLLECTING DATA	EQUIPMENT WAS CALIBRATED BEFORE DATA RUN USING CAL BALL	CONES	TAPES	LINEAR	CLEAR/UNLIMITED	WET
20020830	4	OPEN FIELD	1325	1338	13	DOWNTIME DUE TO EQUIP MAINT/CHECK	DOWNLOADING DATA	NA	NA	NA	NA	NA
20020830	4	OPEN FIELD	1338	1345	7	DOWNTIME DUE TO EQUIPMENT FAILURE	LEFT SIDE WHEEL YOKE ASSY. BASE CRACKED / REPAIRED WITH EPOXY	NA	NA	NA	NA	NA
20020830	4	OPEN FIELD	1345	1351	6	DOWNTIME DUE TO EQUIP MAINT/CHECK	PREPARING FOR NEXT RUN	NA	NA	NA	NA	NA
20020830	4	OPEN FIELD	1351	1500	69	COLLECTING DATA	EQUIPMENT CALIBRATED/SECOND PASSDUE TO EQUIP. FAILURE, LOST DATA	CONES	TAPES	LINEAR	CLEAR/UNLIMITED	WET
20020830	4	OPEN FIELD	1500	1520	20	DOWNTIME DUE TO EQUIP MAINT/CHECK	DOWNLOADING DATA	NA	NA	NA	NA	NA
20020830	4	OPEN FIELD	1520	1545	25	DAILY START, STOP	END OF DAILY OPERATIONS/ EQUIPMENT BREAKDOWN	NA	NA	NA	NA	NA
20020831	3	OPEN FIELD	700	810	70	DAILY START, STOP	START OF DAILY OPERATIONS/ EQUIPMENT PREPARATIONS	NA	NA	NA	NA	NA
20020831	3	OPEN FIELD	810	900	50	COLLECTING DATA	EQUIPMENT WAS CALIBRATED BEFORE DATA RUN USING CAL BALL	CONES	TAPES	LINEAR	CLEAR/UNLIMITED	DRY
20020831	3	OPEN FIELD	900	910	10	DOWNTIME DUE TO EQUIP MAINT/CHECK	DOWNLOADING DATA	NA	NA	NA	NA	NA
20020831	3	OPEN FIELD	910	920	10	DOWNTIME DUE TO EQUIP MAINT/CHECK	CHANGED BATTERIES	NA	NA	NA	NA	NA

Date	No. of People	Area Tested	Status Start Time	Status Stop Time	Duration min.	Operational Status	Operational Status - Comments	Track Method	Track Method=Other Explain	Pattern	Field Conditions	
20020831	3	OPEN FIELD	920	1045	85	COLLECTING DATA		CONES	TAPES	LINEAR	CLEAR/UNLIMITED	DRY
20020831	3	OPEN FIELD	1045	1100	15	DOWNTIME DUE TO EQUIP MAINT/CHECK	DOWNLOADING DATA	NA	NA	NA	NA	NA
20020831	3	OPEN FIELD	1100	1120	20	BREAK/LUNCH	BREAK	NA	NA	NA	NA	NA
20020831	3	OPEN FIELD	1120	1205	45	DOWNTIME DUE TO EQUIP MAINT/CHECK	PREPARING FOR NEXT RUN	NA	NA	NA	NA	NA
20020831	3	OPEN FIELD	1205	1305	60	COLLECTING DATA	EQUIP CALIBRATED BEFORE DATA RUN/ INCLUDES FENCE CHALLENGE AREA	CONES	TAPES	LIEAR	CLEAR/UNLIMITED	DRY
20020831	3	OPEN FIELD	1305	1320	15	DOWNTIME DUE TO EQUIP MAINT/CHECK	DOWNLOADING DATA	NA	NA	NA	NA	NA
20020831	3	OPEN FIELD	1320	1330	10	DOWNTIME DUE TO EQUIP MAINT/CHECK	PREPARING FOR NEXT RUN	NA	NA	NA	NA	NA
20020831	3	OPEN FIELD	1330	1440	70	COLLECTING DATA	EQUIPMENT WAS CALIBRATED BEFORE DATA RUN USING CAL BALL	CONES	TAPES	LINEAR	CLEAR/UNLIMITED	DRY
20020831	3	OPEN FIELD	1440	1450	10	DOWNTIME DUE TO EQUIP MAINT/CHECK	DOWNLOADING DATA	NA	NA	NA	NA	NA
20020831	3	OPEN FIELD	1450	1500	10	DOWNTIME DUE TO EQUIP MAINT/CHECK	PREPARING FOR NEXT RUN	NA	NA	NA	NA	NA
20020831	3	OPEN FIELD	1500	1600	60	COLLECTING DATA	EQUIPMENT WAS CALIBRATED BEFORE DATA RUN USING CAL BALL	CONES	STAKES	LINEAR	CLEAR/UNLIMITED	DRY
20020831	3	OPEN FIELD	1600	1610	10	DOWNTIME DUE TO EQUIP MAINT/CHECK	DOWNLOADING DATA	NA	NA	NA	NA	NA
20020831	3	OPEN FIELD	1610	1630	20	DAILY START, STOP	END OF DAILY OPERATIONS/ EQUIPMENT BREAKDOWN	NA	NA	NA	NA	NA
20020901	3	OPEN FIELD	700	800	60	DAILY START, STOP	START OF DAILY OPERATIONS/ EQUIPMENT PREPARATIONS	NA	NA	NA	NA	NA

Date	No. of People	Area Tested	Status Start Time	Status Stop Time	Duration min.	Operational Status	Operational Status - Comments	Track Method	Track Method=Other Explain	Pattern	Field Conditions	
20020901	3	OPEN FIELD	800	900	60	COLLECTING DATA	EQUIPMENT WAS CALIBRATED/RUN INCLUDES GRAVEL CHALLENGE AREA	CONES	STAKES	LINEAR	RAIN & HAZE/LIMITED	WET
20020901	3	OPEN FIELD	900	920	20	DOWNTIME DUE TO EQUIP MAINT/CHECK	DOWNLOADING DATA	NA	NA	NA	NA	LIGHT MUD
20020901	3	OPEN FIELD	920	940	20	DOWNTIME DUE TO EQUIP MAINT/CHECK	PREPARING FOR NEXT RUN	NA	NA	NA	NA	NA
20020901	3	OPEN FIELD	940	1040	60	COLLECTING DATA	EQUIPMENT WAS CALIBRATED BEFORE DATA RUN USING CAL BALL	CONES	TAPES	LINEAR	RAIN & HAZE/LIMITED	WET
20020901	3	OPEN FIELD	1040	1050	10	DOWNTIME DUE TO EQUIP MAINT/CHECK	DOWNLOADING DATA	NA	NA	NA	NA	NA
20020901	3	OPEN FIELD	1050	1105	15	DOWNTIME DUE TO EQUIP MAINT/CHECK	PREPARING FOR NEXT RUN	NA	NA	NA	NA	NA
20020901	3	OPEN FIELD	1105	1205	60	COLLECTING DATA	EQUIPMENT CALIBRATED/ FENCE CHALLENGE AREA	CONES	TAPES	LINEAR	RAIN & HAZE/LIMITED	WET
20020901	3	OPEN FIELD	1205	1210	5	BREAK/LUNCH	BREAK	NA	NA	NA	NA	NA
20020901	3	OPEN FIELD	1210	1235	25	DOWNTIME DUE TO EQUIP MAINT/CHECK	CHANGED BATTERIES	NA	NA	NA	RAIN/LIMITED	WET
20020901	3	OPEN FIELD	1235	1335	60	COLLECTING DATA	SECOND PASS/ RECAPTURE LOST DATA	CONES	TAPES	LINEAR	RAIN/LIMITED	WET
20020901	3	OPEN FIELD	1335	1340	5	DOWNTIME DUE TO EQUIP MAINT/CHECK	DOWNLOADING DATA	NA	NA	NA	NA	NA
20020901	3	OPEN FIELD	1340	1350	10	DAILY START, STOP	END OF DAILY OPERATIONS/ EQUIPMENT BREAKDOWN	NA	NA	NA	NA	NA
20020902	2	OPEN FIELD	800	905	65	DAILY START, STOP	START OF DAILY OPERATIONS/ EQUIPMENT PREP/ CHECK BASE STATION	NA	NA	NA	NA	NA

Date	No. of People	Area Tested	Status Start Time	Status Stop Time	Duration min.	Operational Status	Operational Status - Comments	Track Method	Track Method=Other Explain	Pattern	Field Conditions	
20020902	2	OPEN FIELD	905	1000	55	COLLECTING DATA	EQUIPMENT WAS CALIBRATED BEFORE DATA RUN USING CAL BALL	CONES	TAPES	LINEAR	CLEAR/UNLIMITED	DRY
20020902	2	OPEN FIELD	1000	1015	15	DOWNTIME DUE TO EQUIP MAINT/CHECK	DOWNLOADING DATA	NA	NA	NA	NA	NA
20020902	2	NA	1015	1200	105	DEMOBILIZATION	END OF TESTING OPERATIONS/ FINAL EQUIPMENT BREAKDOWN	NA	NA	NA	NA	NA

APPENDIX E. REFERENCES

1. Standardized UXO Technology Demonstration Site Handbook, DTC Project No. 8-CO-160-000-473, Report No. ATC-8349, March 2002.

2. Aberdeen Proving Ground Soil Survey Report, October 1998.

3. Data Summary, UXO Standardized Test Site: APG Soils Description, May 2002.

4. Practical Nonparametric Statistics; W.J. Conover; John Wiley & Sons; 1980; pp144-151.

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APPENDIX F. ABBREVIATIONS

AEC	=	U.S. Army Environmental Center
APG	=	Aberdeen Proving Ground
ATC	=	U.S. Army Aberdeen Test Center
CAD	=	computer-aided design
ERDC	=	U.S. Army Corp of Engineers Engineering, Research and Development Center
ESTCP	=	Environmental Security Technology Certification Program
EQT	=	Army Environmental Quality Technology Program
GPR	=	ground-penetrating radar
GPS	=	Global Positioning System
GX	=	Geosoft executable
MS	=	Microsoft
POC	=	point of contact
PVC	=	polyvinyl chloride
QC	=	quality control
ROC	=	receiver-operating characteristic
RTK	=	real time kinematic
SAR	=	synthetic-aperture radar
SERDP	=	Strategic Environmental Research and Development Program
UXO	=	unexploded ordnance

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