Walkover Radiological Survey Report

Fort McClellan
Calhoun County, Alabama

Prepared for:

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Task Order CK10
Contract No. DACA21-96-D-0018
IT Project No. 796887

October 2002

Revision 0

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1.0 Introduction

IT conducted an airborne radiological survey in October 2001, over selected areas on the Main Post and Pelham Range at Fort McClellan in Calhoun County, Alabama. The survey used an array of detectors to measure the gamma emitting radioactive materials in the soil. During the airborne survey, several areas of elevated radioactivity (i.e., anomalies), shown on Figures 1 and 2, were identified at Pelham Range. Two of the identified anomalies (P1 and P2 on Figure 1, Rideout Field) were a radioactive waste disposal site undergoing remediation. This site contained cesium 137 (Cs-137) and cobalt 60 (Co-60) sources that had been used in training exercises. Remediation of this area has since been completed and the remediation contractor performed a final status survey. However, radiation "shine" from the uncovered waste masked the area surrounding the remediation site so that it could not be properly characterized during the airborne survey. The area included in the final status survey at Rideout Field is also shown in Figure 1. The other Pelham Range anomalies (P3 through P10) are areas where the elevated counts could not be definitely attributable to naturally occurring radioactive materials. Two anomalies were identified at the Main Post (M1 and M2) and one of these has subsequently been investigated (M1). The anomalies at the Main Post are shown on Figure 3.

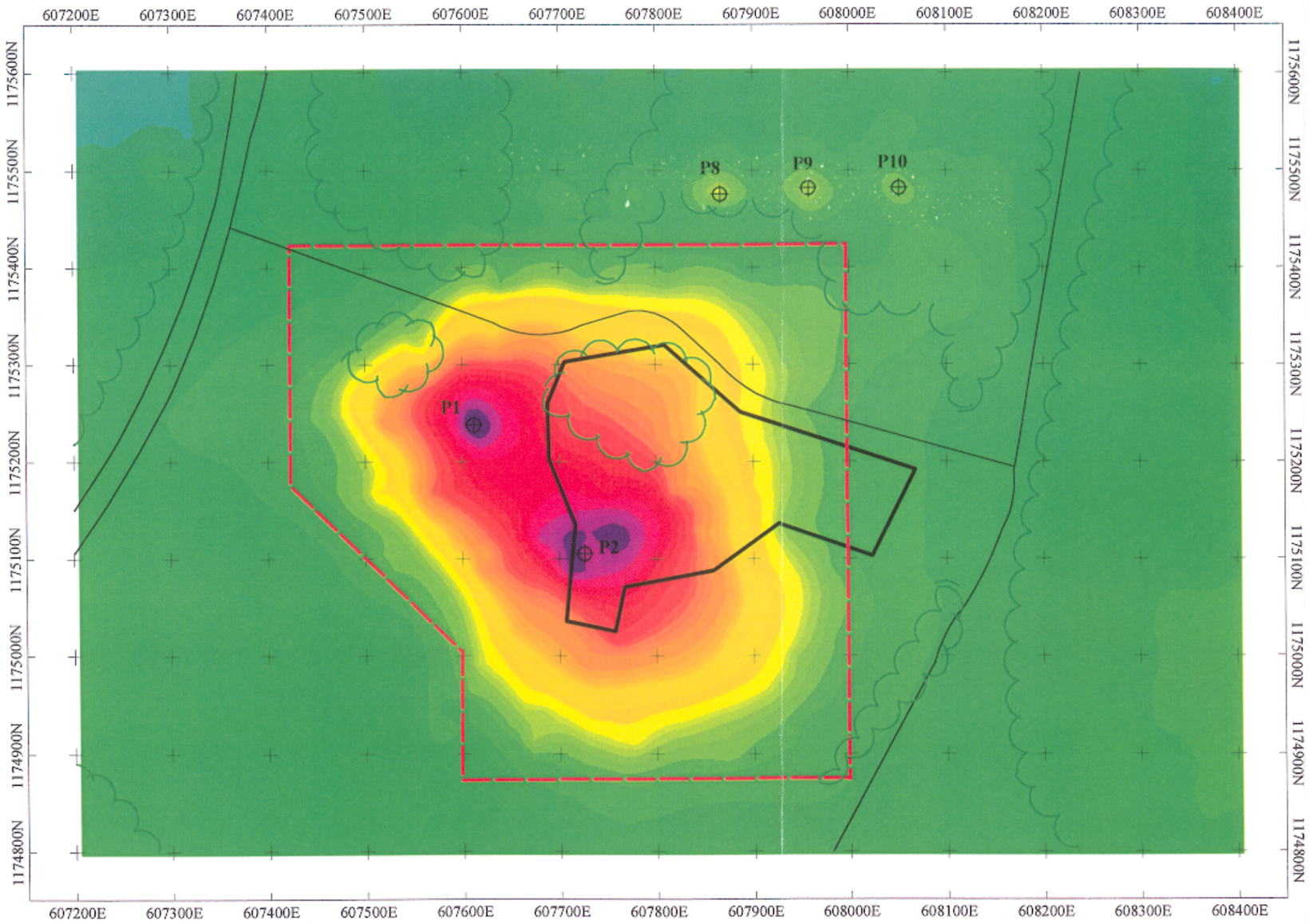
IT conducted further investigations on August 26 through 29, 2002, to complete the survey of the area surrounding the Rideout Field anomalies and to determine the nature of the radiological anomalies at Pelham Range and the one on the Main Post. The methods used to complete these investigations and the results are presented in the following sections.

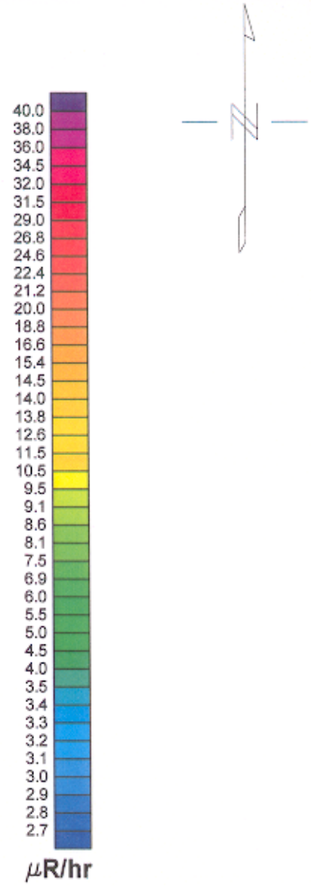
2.0 Completion of Radiological Survey at Rideout Field

This section describes the survey area and the field procedures and instruments used to complete the radiological investigation at Rideout Field, including survey area and control, data acquisition, and field verification of radiological anomalies identified during the course of this survey.

2.1 Survey Area

One area that contained anomalies (P1 and P2) identified during the airborne survey was a radioactive waste disposal site that was undergoing remediation (Rideout Field). The remediation contractor has since completed remediation and has performed a final status survey





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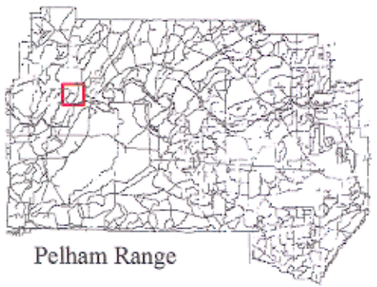
feet



Pelham Range

LEGEND

- ATG Final Status Survey Boundary determined from surveyed ATG stake locations
- Gridded Survey Area
- ⊕ Follow-up Survey Location
- Road
- Treeline

Note: The survey area is approximately 240650 sq. ft.
This does not include previous survey area as documented by ATG.
Coordinate System is NAD83, Alabama East State Plane.

FIGURE 1

RIDEOUT FIELD ANOMALY
PELHAM RANGE
FORT McCLELLAN

AIRBORNE TOTAL EXPOSURE RATE DATA

U.S. ARMY CORPS OF ENGINEERS
MOBILE DISTRICT
FORT McCLELLAN
CALHOUN COUNTY, ALABAMA
Contract No. DACA21-96-D-0018

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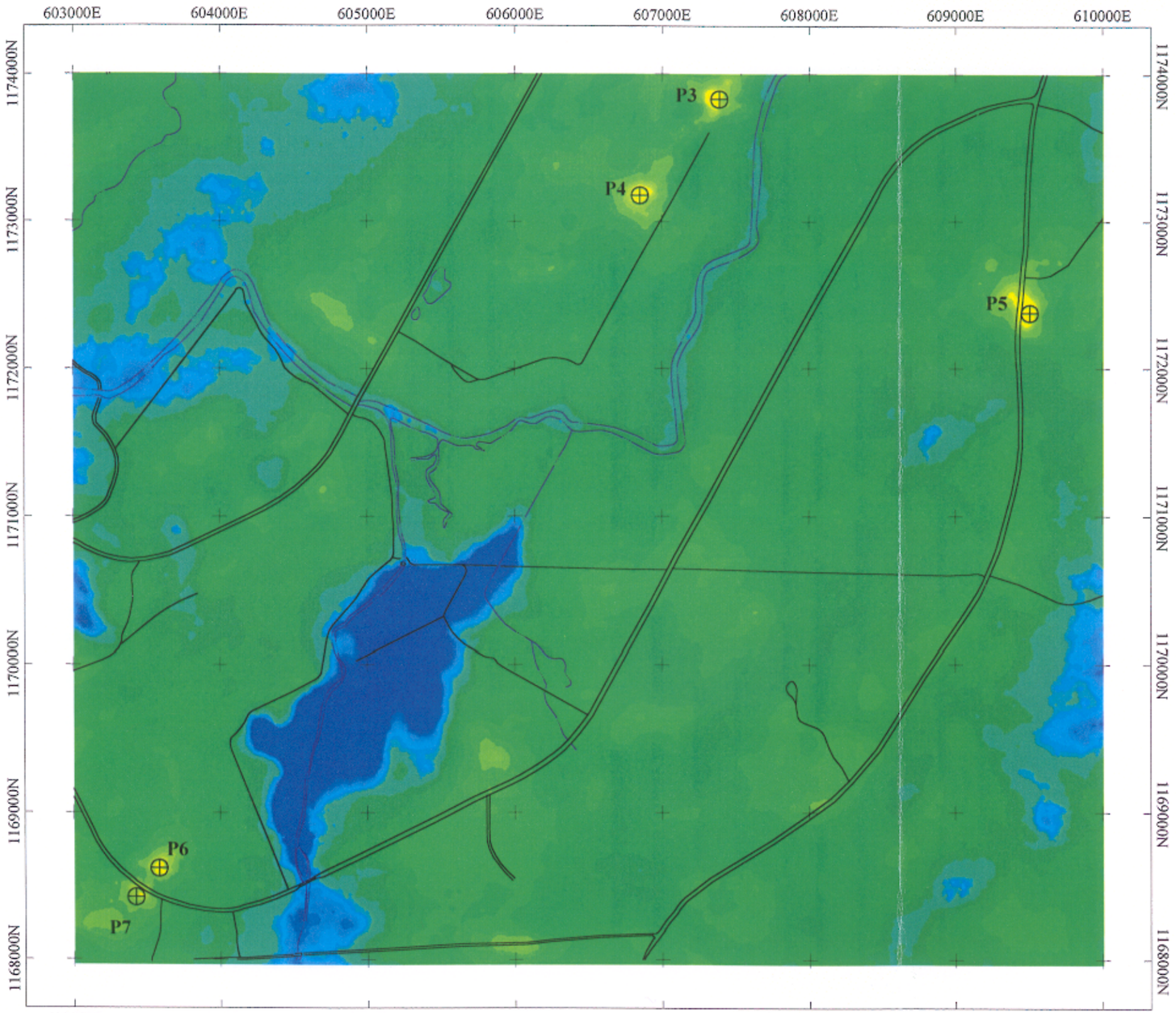

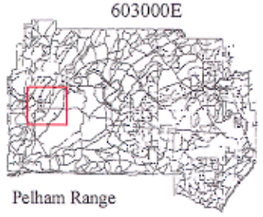

LEGEND

⊕ Follow-up Survey Location

Road

River

Note: Coordinate System is NAD83, Alabama East State Plane.

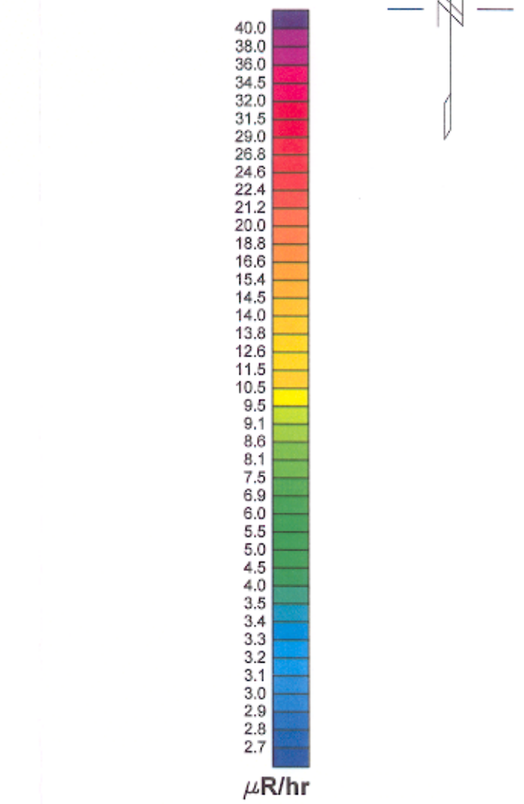

FIGURE 2

PELHAM RANGE ANOMALIES
PELHAM RANGE
FORT McCLELLAN

AIRBORNE TOTAL EXPOSURE RATE DATA

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MOBILE DISTRICT
FORT McCLELLAN
CALHOUN COUNTY, ALABAMA
Contract No. DACA21-96-D-0018

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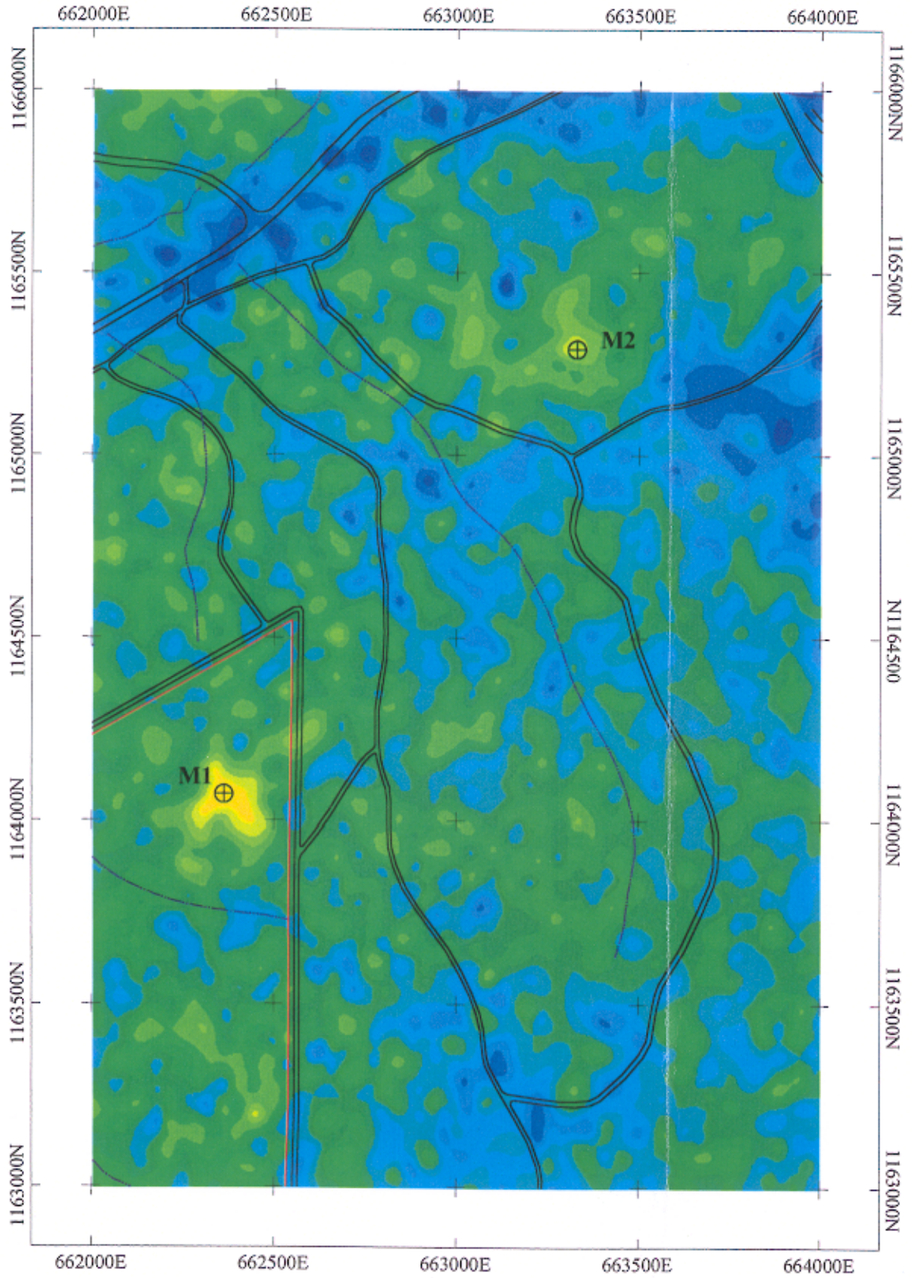

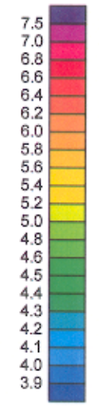

Scale 1:5000

250 0 250 500 750 1000

feet

Main Post

LEGEND

⊕ Follow-up Survey Location

Road

River

Main Post Boundary

Note: Coordinate System is NAD83, Alabama East State Plane.

FIGURE 3

MAIN POST ANOMALIES
MAIN POST
FORT McCLELLAN

AIRBORNE LOW ENERGY/ HIGH ENERGY RATIO DATA

U.S. ARMY CORPS OF ENGINEERS
MOBILE DISTRICT
FORT McCLELLAN
CALHOUN COUNTY, ALABAMA
Contract No. DACA21-96-D-0018

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to document that the site should be released from radiological controls. When the final status survey boundary is superimposed on the airborne survey map (Figure 1), it can be seen that the area containing the apparent anomalies is larger than the area remediated and included in the final status survey. This is expected due to "shine" from the radioactive sources uncovered during remediation of the site. In order to complete the radiological characterization of Rideout Field, a survey was performed outside the final status survey boundary and extending beyond the area affected by shine from the radioactive sources. The survey area is also shown on Figure 1.

2.2 Survey Control

Prior to conducting the radiological survey, the boundary of the proposed survey area was located and marked using caution tape. A Trimble GPS Pathfinder® Pro XR unit was coupled to the radiological detector during data collection and provided the spatial control required for the investigation. GPS data were collected using the Alabama East State Plane Coordinate System, North American Datum 1983 (NAD83). In order to provide reasonable line of sight navigation during the radiological data collection, marks were made on the ground using surveyor's paint down the line the surveyor walked during the data collection process. Paint marks were placed along the outside edge of the Ludlum 2221 rate meter detector swath in order to provide alignment for the adjacent survey line. A known surveyed location (monitor well) was used to check GPS accuracy daily.

2.3 Radiological Surveys

The radiation detection system used during the investigation consisted of a Ludlum 2221 scaler/ratemeter with a Ludlum 44-10 2" x 2" sodium iodide (NaI) detector sensitive to gamma radiation. Prior to collecting radiological data, the Ludlum 2221/44-10 instruments were background and response checked using a known source and the readings recorded in a logbook.

The Ludlum 2221/44-10 was then coupled with a Trimble GPS Pathfinder® Pro XR unit so that the data from the rate meter were logged in real-time by the GPS data logger. The survey was performed by holding the detector close to the ground surface and swinging the detector in a "S"-shaped pattern while walking at approximately 0.5 meters per second (m/s). One member of the survey team followed the operator with surveyor's paint and made marks on the ground to provide visual indicators of the survey path.

Prior to beginning the survey of the Rideout Field anomalies, a reference area (approximately 10 meters by 10 meters) within the boundary of the final status survey was selected and surveyed

using the methods described above (see Figure 1). This reference area was selected because of similar geological makeup to the survey area. In addition, a final status survey has been completed in this area in support of license termination; therefore, survey results in this area should represent acceptable radiation levels for Rideout Field. An additional reference area was surveyed in an unimpacted area at Main Post (Figure 4). This area was selected to provide data for comparison to surveys conducted at the Main Post where the geological makeup of the soils is different from the soils at the Rideout Field area of Pelham Range. This reference area was at the intersection of Diamond Drive and Realm Street.

The survey data were collected at 1-second intervals (approximately 0.5- to 1.0- meter (m) intervals) along roughly north-south (N-S) oriented survey lines spaced approximately 1 meter apart for most of the survey area. Data were collected in random directions in areas that were less accessible due to either thick brush or tree cover. The survey data were downloaded to a laptop computer at midday and at day's end to verify that the data were recorded properly and that there were no data gaps in the survey coverage. The survey data were backed up on compact disc (CD) and are retained in project files.

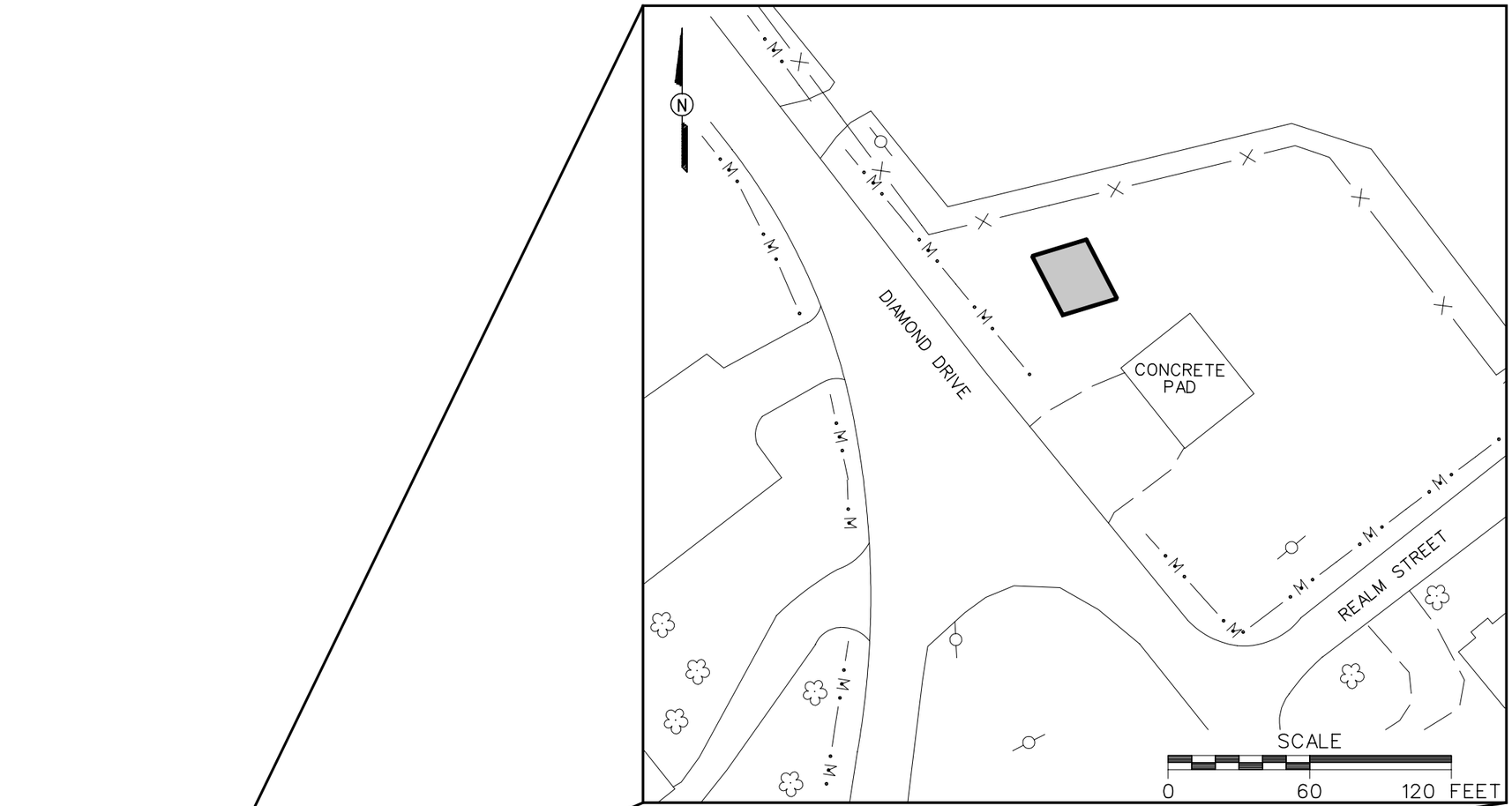
2.4 Anomaly Verification

Following the field survey, preliminary color-contour maps of the radiological data were generated and field-checked. Anomalies caused by topographic features (e.g., gullies) were labeled as such on the field data maps.

2.5 Data Processing

Contour maps of radiological data were generated using OASIS Montaj® data processing and analysis system from Geosoft, Inc. These maps were color-enhanced to aid with interpreting subtle anomalies. Select contour maps are presented as Figures 5 through 7.

A series of data processing steps were required to generate the contour maps of radiological data. Initially, field positional and radiological data were downloaded from the TDC1 GPS data logger to a laptop computer using Trimble Pathfinder® Office. Using Trimble Pathfinder® Office, the data were exported in an ASCII-format. GPS base station data provided by Intergraph Corporation were used to differentially correct the positional data. Preliminary data processing included assessing the ASCII-format data files for correct line and station ranges, removing unwanted characters and incomplete data records, and assessing overall data quality. Data file names were recorded on data file tracking forms.



LEGEND

- UNIMPROVED ROADS AND PARKING
- PAVED ROADS AND PARKING
- CONCRETE PAD
- TREES
- REFERENCE AREA
- MANMADE SURFACE DRAINAGE FEATURE
- FENCE
- UTILITY POLE

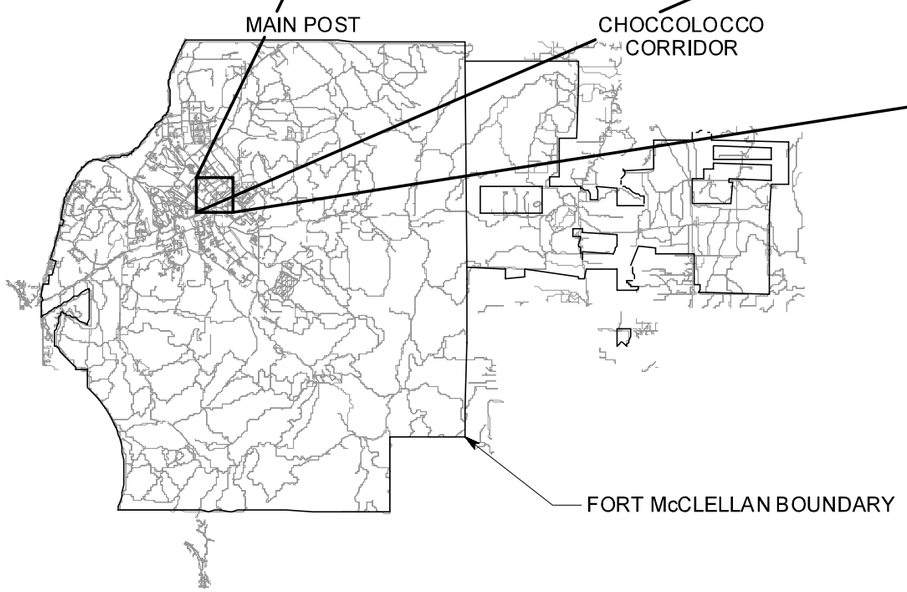


FIGURE 4
MAIN POST REFERENCE AREA

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MOBILE DISTRICT
FORT McCLELLAN
CALHOUN COUNTY, ALABAMA
Contract No. DACA21-96-D-0018

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ENGR. CHCK. BY: S. MORAN
INITIATOR: R. GREENE
PROJ. MGR.: J. YACOUB
DWG. NO.: ...\796887es.594
PROJ. NO.: 796887
DATE LAST REV.:
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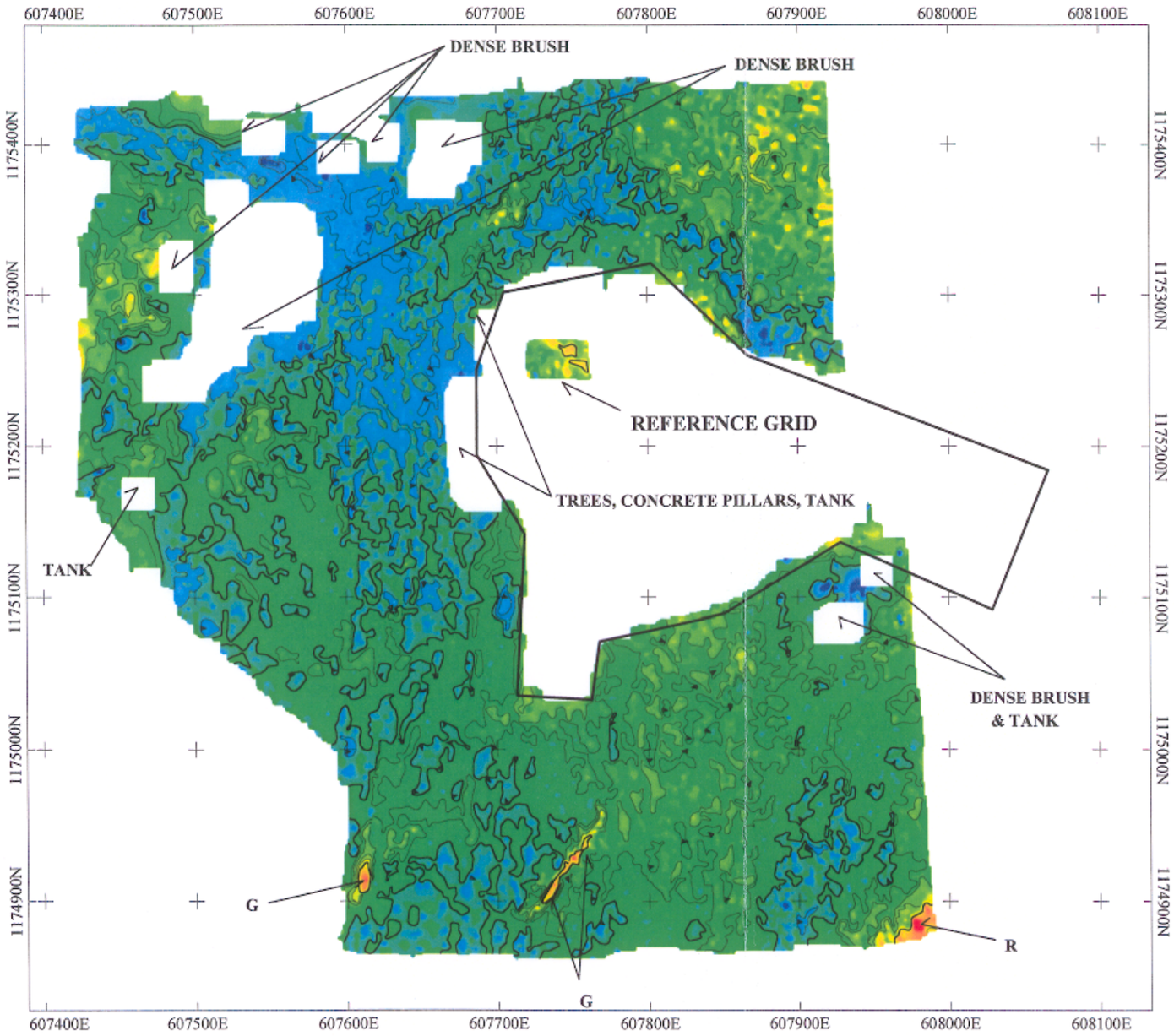

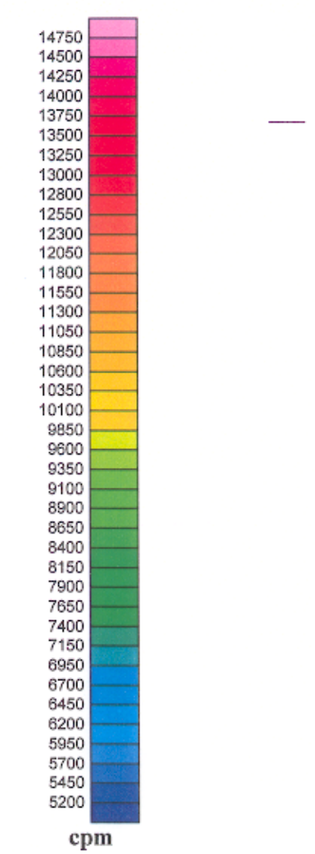

Scale 1:1020

50 0 50 100 150 200

foot

MINIMUM CONTOUR INTERVAL: 500 counts per minute

NOTE: Coordinate system is NAD83, Alabama East State Plane

LEGEND

	ATG Final Status Survey Boundary
R	Anomaly caused by a gravel road
G	Anomaly caused by a gully

NAME:	DATE:
Nicholas Muloshi	September 11, 2001
PROJECT NUMBER	LOCATION:
796887	c:\ITprojects\ftmc\modified.map

FIGURE 5

RIDEOUT FIELD RADIOLOGICAL SURVEY
PELHAM RANGE
FORT McCLELLAN

TOTAL COUNT MAP

U.S. ARMY CORPS OF ENGINEERS
MOBILE DISTRICT
FORT McCLELLAN
CALHOUN COUNTY, ALABAMA
Contract No. DACA21-96-D-0018

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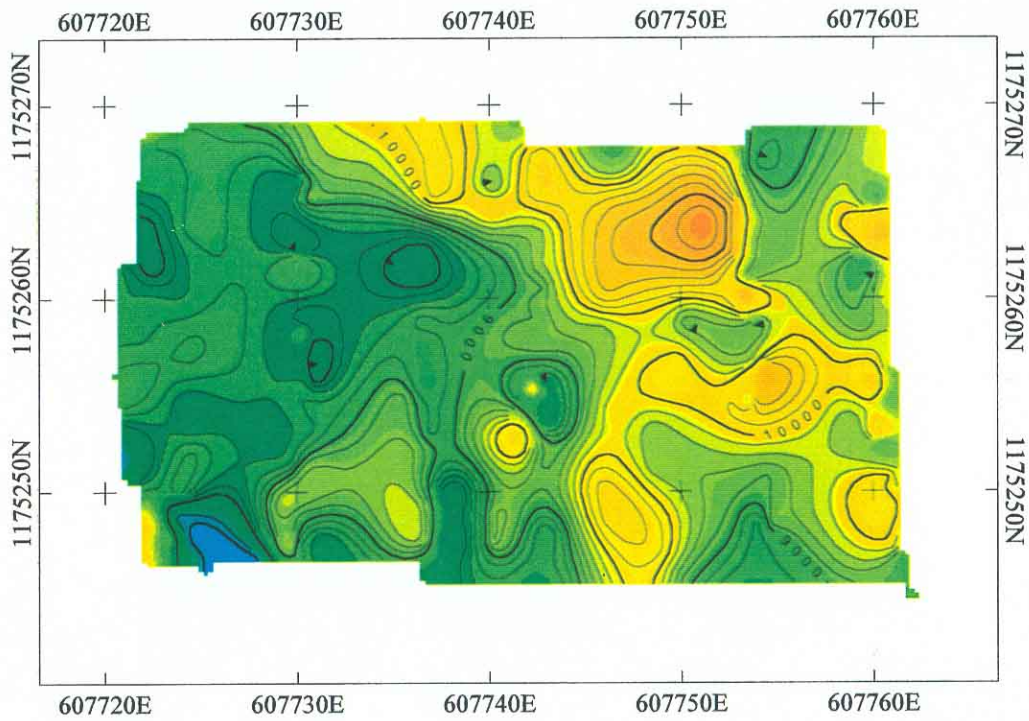

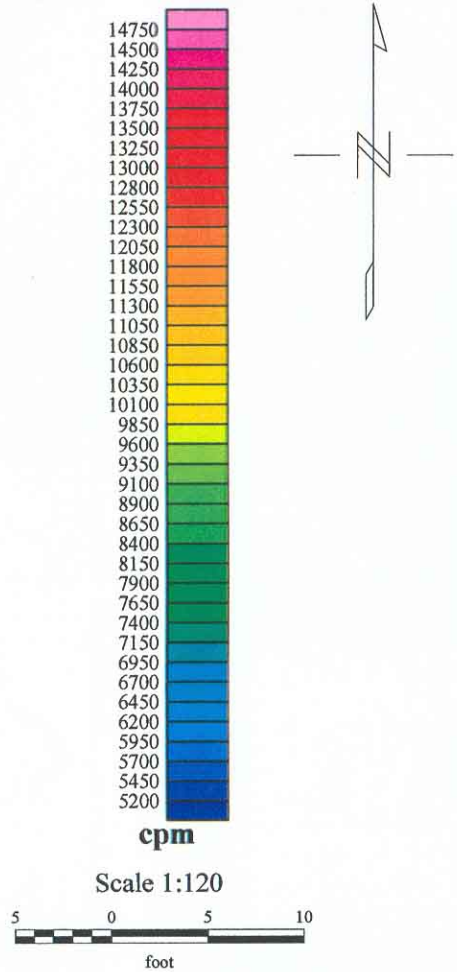

FIGURE 6

RIDEOUT FIELD RADIOLOGICAL SURVEY
PELHAM RANGE (Reference Grid)
FORT McCLELLAN

TOTAL COUNT MAP

U.S. ARMY CORPS OF ENGINEERS
MOBILE DISTRICT
FORT McCLELLAN
CALHOUN COUNTY, ALABAMA
Contract No. DACA21-96-D-0018

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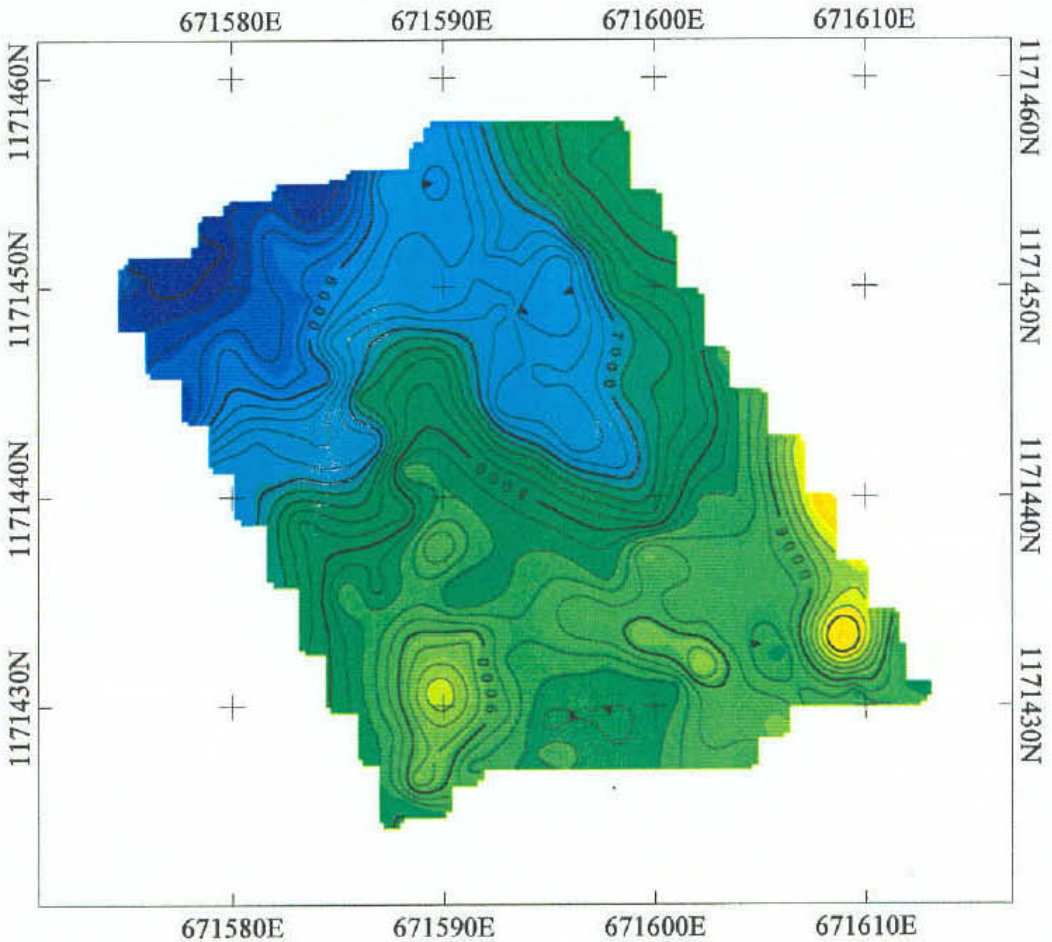
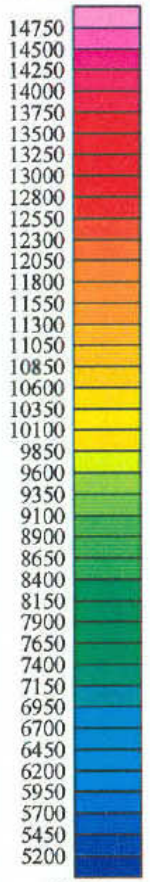
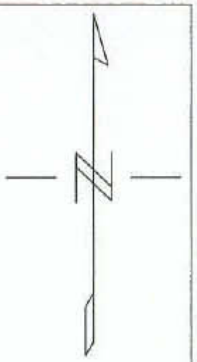
NAME:	DATE:
Nicholas Muloshi	September 11, 2001
PROJECT NUMBER	LOCATION:
796887	c:\ITprojects\ftmc\pelhamRF.map

Note: Coordinate system is NAD83, Alabama East State Plane







Scale 1:120

5 0 5 10

foot

MINIMUM CONTOUR INTERVAL: 200 counts per minute

FIGURE 7

RADIOLOGICAL SURVEY
MAIN POST (Reference Grid)
FORT McCLELLAN

TOTAL COUNT MAP

U.S. ARMY CORPS OF ENGINEERS
MOBILE DISTRICT
FORT McCLELLAN
CALHOUN COUNTY, ALABAMA
Contract No. DACA21-96-D-0018

NAME:	DATE:
Nicholas Muloshi	September 11, 2001
PROJECT NUMBER	LOCATION:
796887	c:\ITprojects\ftmc\mainpost_RF.map

Note: Coordinate system is NAD83, Alabama East State Plane

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Final, edited ASCII-format data files containing Alabama East State Plane, NAD83 coordinates (X, Y) and the radiological measurement (Z) were converted to OASIS Montaj® format and imported into the data processing and analysis software. Data in the OASIS Montaj® database were reviewed in profile form to verify completeness of data editing. Since two detectors were used for surveying, the count rates were adjusted to a common base level. This correction was determined from the source check and reference grid data. The data were then gridded with the minimum curvature gridding module using an Akima spline. The grid cell size for the radiological data was chosen to be 0.30 meters. A color contouring scale was selected to enhance data anomalies of interest to this investigation. The names of files generated and processing parameters used were recorded on data processing forms. Final processed map names are shown in the data processing box found in the lower left corner of each contour map presented. The processed radiological data and the completed radiological data quality control forms are retained in project files.

2.6 Results

Results of the surveys conducted at Rideout Field and the two reference areas are found on Figures 5 through 7. Results for the survey area are within expected ranges for the type of soil at Pelham Range. These results are comparable to the results measured for the Rideout Field and Main Post reference areas. Anomalies identified during the course of this survey can be attributed to the makeup of the soils and the geometry of the measurement. For example, clay soils typically have a higher natural radiation background than sandy soils. Surveys performed in a gully will be higher for a given soil type since the detector is surrounded by the source material thus allowing more of the gamma rays to interact in the detector resulting in a higher count rate. These anomalies are identified on Figure 5 as either a gully or gravel road. Blank spaces on the survey map represent areas than were inaccessible due to obstructions such as concrete pillars, army tanks, or dense brush. There is no indication that radiological anomalies exist in these inaccessible areas (i.e., no elevated counts near these areas).

2.7 Conclusions

The radiological investigation at Rideout Field was completed by performing a walkover survey using a Ludlum 2221/44-10 gamma scintillation detector. Accessible areas outside the boundary of the final status survey and extending into the area unaffected by radiation shine from the waste disposal site were surveyed. Survey results were within the expected range for naturally occurring radioactive materials in soil. Anomalies identified during the course of the survey

were due to variability in soil types and measurement conditions (i.e., geometry). There is no indication that radiological anomalies were present in inaccessible areas.

3.0 Investigation of Radioactive Anomalies

This section describes the selection and location of radioactive anomalies identified from the results of the airborne survey and the methods used for investigation.

3.1 Selection of Radioactive Anomalies

Radioactive anomalies were identified from the results of the airborne survey at Pelham Range and Main Post. Two of the anomalies at Pelham Range were due to the ongoing remediation of a radioactive waste site during the course of the survey. The remediation contractor has since completed remediation and has performed a final status survey of the affected area. Eight anomalies at Pelham Range (P3 through P10) were selected for further investigation based on elevated exposure rates measured during the airborne survey and on historical land use (see Figures 1 and 2).

Two anomalies at the Main Post (M1 and M2) were selected for further investigation (Figure 3) based on the results of the airborne survey. One of these was selected because of the presence of elevated counts in the Cs-137 region and the other was selected because of an elevated Low-E:High-E ratio. The Low-E:High-E ratio is an analysis tool used to help identify potential locations of man-made radiation since the low-energy portion of the spectrum contains the energy from the man-made sources of interest and the high-energy portion of the spectrum is dominated by natural radiation.

IT investigated the Cs-137 anomaly (M1) on February 1, 2002 using a Ludlum Model 19 microR meter and a Ludlum 2221 with a Ludlum 44-10 NaI detector. Subsequent sampling and gamma spectroscopy analysis confirmed the presence of Cs-137.

3.2 Investigative Method

The radioactive anomalies on the Main Post and Pelham Range were investigated using an Exploranium Gr-135 Identifier portable gamma spectrometer. The GR-135 is used to search for, locate, and identify gamma-emitting radioactive materials. The instrument contains a 4 cubic inch NaI detector and associated analysis software for identification of radioactive material using the built in gamma-ray library.

The GR-135 was stabilized each morning prior to use and again at the end of each day. The instrument was stabilized by placing it in the docking station that contained a small Cs-137 check source. Stabilization "fine-tunes" the system by adjusting the internal gain and aligning the spectrometer with the Cs-137 peak.

Reference spectra were collected at the Rideout Field and the Main Post Reference areas (Figures 8 and 9). These spectra were used for comparison to the spectra collected at the Pelham Range and Main Post anomalies, respectively.

Each anomaly was located and staked using the coordinates from the airborne survey. Initially, the area around each stake was surveyed with a Ludlum 2221/44-10 NaI detector (as described in Section 2.3) to identify the area in the vicinity of the anomaly with the highest count rate. After the highest count rate area was identified, the portable gamma spectrometer was used to identify the radiological contaminants at the location by placing the instrument on the ground and collecting a spectrum for 30 minutes. The GR-135 was used in the "Identify" mode. In this mode the instrument collects a spectrum for the preset time and, at the conclusion of the count, automatically performs spectrum analysis to identify the nuclides in the spectrum based on the reference library. The spectrum analysis indicates the nuclide type (i.e. Industrial, Special Nuclear Material, or Medical), isotope, and relative size for each identified nuclide. Each spectrum collected was stored for download to a PC.

In addition to the spectrometer measurements, exposure rate measurements were made at the ground surface and at 1 meter above ground surface using a microR meter. Gamma spectrometer and exposure rate readings were also collected within the final status survey reference area and the Main Post reference area. The gamma spectroscopy measurement locations were marked with surveyor's paint unless the highest reading was found at the location of the stake.

3.3 Data Processing

Spectra collected in the reference areas and at each of the anomalies were downloaded to a PC using the Exploranium Identiview software. The spectra were also converted to a text file and imported to an Excel spreadsheet for inspection and graphical presentation of the data. Use of the Identiview software and Excel enabled the data from the reference areas to be viewed with the anomalies for direct comparison of the spectra.

Figure 8
Pelham Range Anomalies and Reference Area
Pelham Range
Fort McClellan

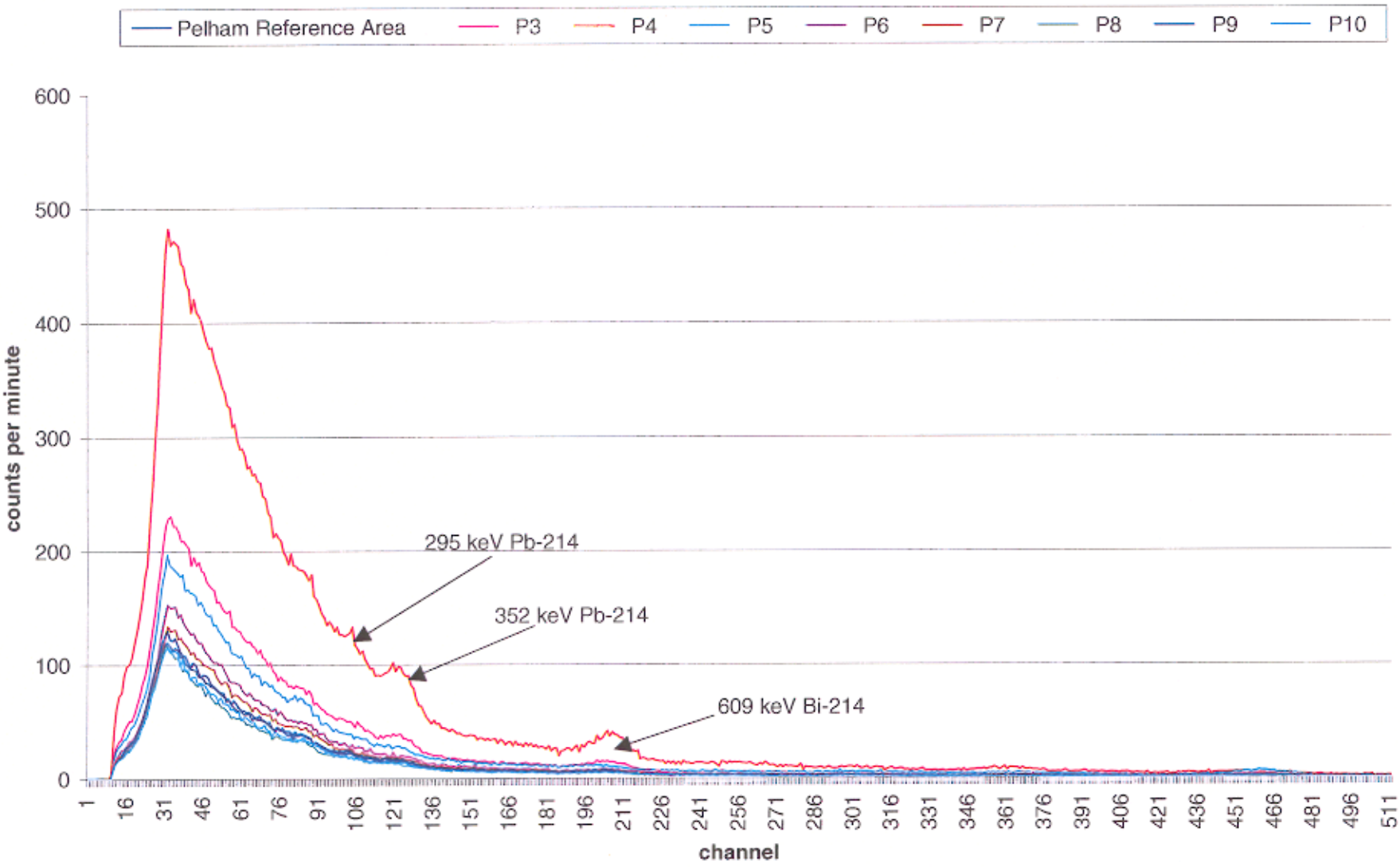
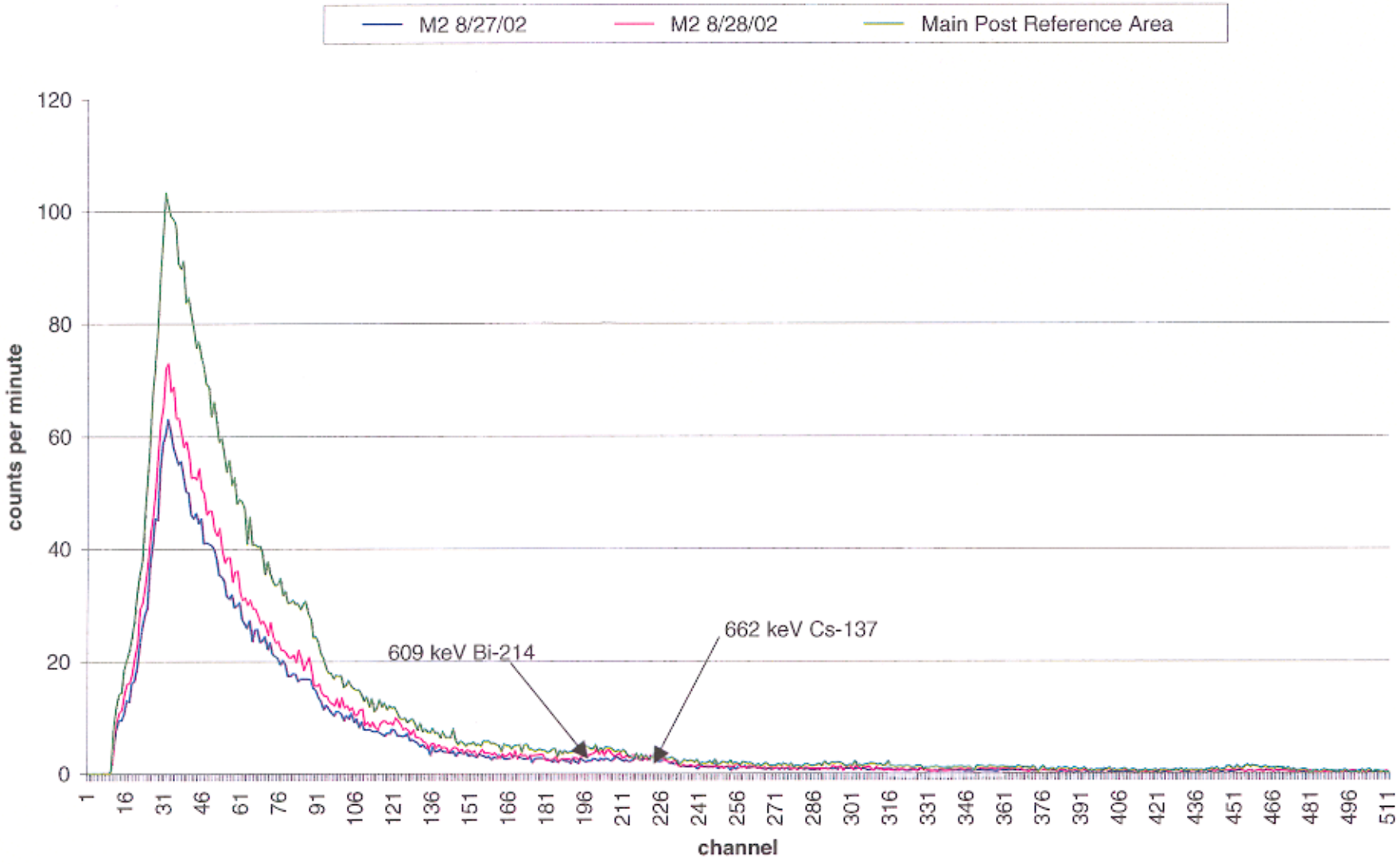


Figure 9
Main Post Anomaly and Reference Area
Main Post
Fort McClellan



3.4 Results

Gamma spectra collected at the eight Pelham Range anomalies and the Rideout Field reference area are shown on Figure 8. The only nuclides identified in these spectra were naturally occurring uranium series radionuclides (Pb-214, Bi-214) and potassium 40 (K-40). In some cases, the elevated exposure rates were attributable to visible shale outcroppings or clayey soil. Surface exposure rates ranged from 8 microroentgens per hour (μR/hr) for the reference area to 42 μR/hr at Anomaly P4. Relevant comments regarding the Pelham Range anomalies are provided in Table 1.

As mentioned previously, the Main Post Anomaly was selected from the results of the airborne survey because of a high Low-E:High-E ratio. A spectrum was collected at the Main Post Anomaly on August 27. This anomaly is located on a topographic high and had a low exposure rate. No elevated count rate areas were found in the vicinity of the stake that marked the anomaly therefore the measurement was made at the stake. Upon completion of the count, the GR-135 identified Cs-137 in the spectrum. There was some concern that the apparent Cs-137 peak had been misidentified due to thermal drift of the detector (i.e., that the 609 keV Bi-214 peak had been identified as the 662 keV Cs-137 peak). A decision was made to repeat the measurement on August 28 after stabilization of the instrument.

A spectrum was collected at the same location (Main Post Anomaly) during the morning of August 28. No nuclides were identified in this spectrum. A spectrum was also collected at the Main Post Reference Area on August 28.

3.5 Conclusions

Eight Pelham Range anomalies were investigated due to elevated exposure rates determined during the airborne survey and based on historical use of the site. The investigations were conducted using an Exploranium GR-135 portable gamma spectrometer. Only naturally occurring radioactive materials (uranium series radionuclides and potassium) were identified in any of these spectra. Elevated count rate areas were associated with clayey soil and visible shale outcroppings. No further radiological investigation of these anomalies is needed.

The Main Post Anomaly (M2) was selected for further investigation due to a high Low-E:High-E ratio. A high ratio for this parameter could be indicative of the presence of man-made radioactive materials such as Cs-137 or Co-60. However, the counts in the Co-60 and Cs-137 channels were low, as was the total exposure rate; therefore, the high Low-E:High-E ratio was probably an

Table 1

Pelham Range Anomalies
Fort McClellan, Calhoun County, Alabama

Anomaly Number	Surface Exposure Rate (μR/hr)	1-meter Exposure Rate (μR/hr)	Comments
P1	8	8	Anomalies P1 and P2 have been remediated. These measurements were made at the Pelham range reference area.
P2	8	8	
P3	17	13	Visible shale outcropping.
P4	42	21	Extensive shale outcropping. Measurement made on shale.
P5	16	12	Shale outcropping. Readings taken in washout gully.
P6	12	10	Kudzu field.
P7	11	9	Clay.
P8	6.5	5.5	
P9	8	7.5	
P10	8	5	

Measurements were made with a Ludlum Model 19 MicroR meter.
μR/hr – Microroentgens per hour.

artifact due to the low natural exposure rate. A higher natural exposure rate would have increased the counts in the 609 keV Bi-214 peak and would have masked the low levels of Cs-137 that are present in soils due to fallout from nuclear weapons testing. Figure 9 shows the spectrum from the Main Post Reference Area and the two spectra collected at the Main Post Anomaly M-2. It is concluded that the identification of Cs-137 at the Main Post anomaly was due to thermal drift of the detector and/or the low natural exposure rate at that location. Regardless of the reason, it can be seen on Figure 9 that the counts in the overall spectrum are lower at the anomaly than at the reference area. Therefore, further radiological investigation of this anomaly is not recommended.