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DRAFT

GEOPHYSICAL SURVEY

THE ARMY CREMATOR DISPOSAL AREA (SITE 5)

NAVAL STATION, ROOSEVELT ROADS, PUERTO RICO

CONTRACT TASK ORDER 0007

Prepared For:

DEPARTMENT OF THE NAVY
ATLANTIC DIVISION
NAVAL FACILITIES
ENGINEERING COMMAND
Norfolk, Virginia

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4.B.1.0 INTRODUCTION AND OBJECTIVES

A multidisciplinary geophysical survey was undertaken at Naval Station, Roosevelt Roads to characterize subsurface conditions at the Army Cremator Disposal Area (Site 5). The purpose of the survey was to delineate disposal features (three suspected trenches) and to locate buried metal objects. Electromagnetic (EM) terrain conductivity and magnetometry were used to achieve these objectives. On site interpretation of the geophysical data was used to help finalize the siting of soil sampling stations. The survey was conducted in November of 1992.

4.B.2.0 METHODS OF INVESTIGATION

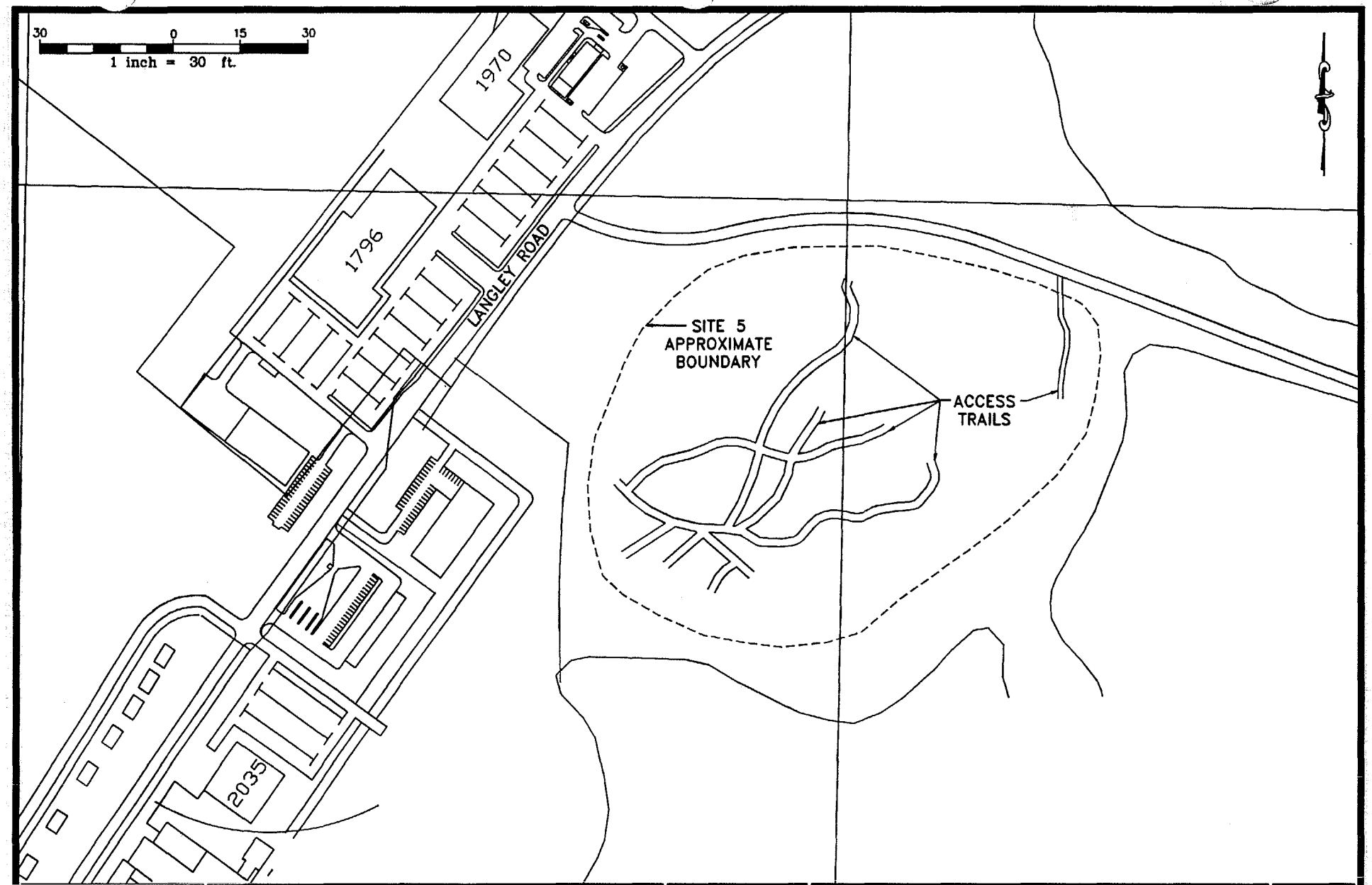
2.1 Survey Control

The initial geophysical investigation followed access lanes selected by Baker Environmental. The Navy Public Works Office provided an operator and heavy equipment necessary to clear the dense vegetation. Based on preliminary data interpretation, additional lines of coverage were added to better define lateral disposal boundaries. This additional coverage was limited by local geological and topographic features such as near-vertical rock outcrop and steep-sloping ravines. A Global Positioning System (GPS) navigation receiver was utilized to reference the survey area to local cultural features (Figure 4.B.1) and locate the geophysical lines of coverage (Figure 4.B.2).

2.2 Electromagnetic Terrain Conductivity

The conductivity of subsurface materials is determined by measuring the response to an induced electromagnetic field. Factors affecting in-situ conductivity include porosity, moisture content, clay content, and the conductivity of subsurface fluids and materials. Former excavations and landfills are often identified by recognizing lateral changes in soil conductivity. This method may also be used to infer the presence of buried metal objects such as drums, tanks or utilities.

Electromagnetic (EM) terrain conductivity profiling was performed at Site 5 to delineate buried debris and locate metal objects. Instrumentation used during this survey was a Geonics model EM-31 coupled with an Omnidata polycorder. The EM-31 is a fixed-coil device with a maximum investigation depth of approximately 15 feet. The polycorder acts as an



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SITE LOCATION MAP
SITE 5
ARMY CREMATOR DISPOSAL SITE

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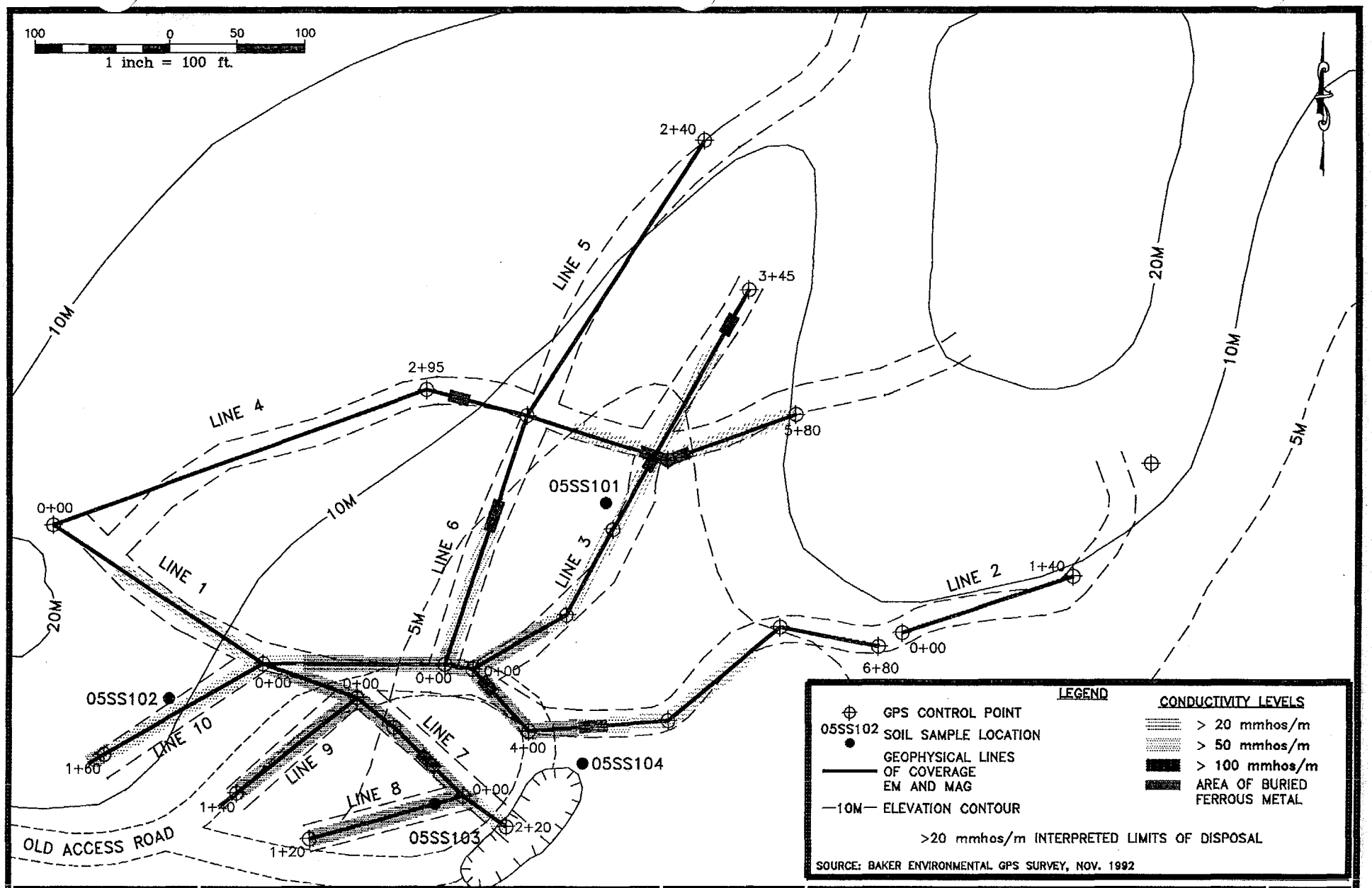
FIGURE
4.B.1



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GEOPHYSICAL COVERAGE AND RESULTS
SITE 5
ARMY CREMATOR DISPOSAL SITE

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FIGURE
4.B.2

electronic notebook that digitally records the data for future playback. EM-31 data were acquired in the vertical dipole mode (VDM) at 5-foot intervals along each traverse.

Both quadrature-phase (conductivity) and in-phase measurements of the EM field were performed at each station to more confidently distinguish metallic objects from nonmetallic objects or earth materials with high electrical properties. The quadrature-phase component provides a measurement of soil conductivity in units of millimhos/meter (mmhos/m), while the in-phase component is measured in parts per thousand (ppt) of the primary magnetic field.

Both conductivity and in-phase data were downloaded to a laptop computer and profiled prior to interpretation (Figures 4.B.3 through 4.B-8).

2.3 Magnetometry

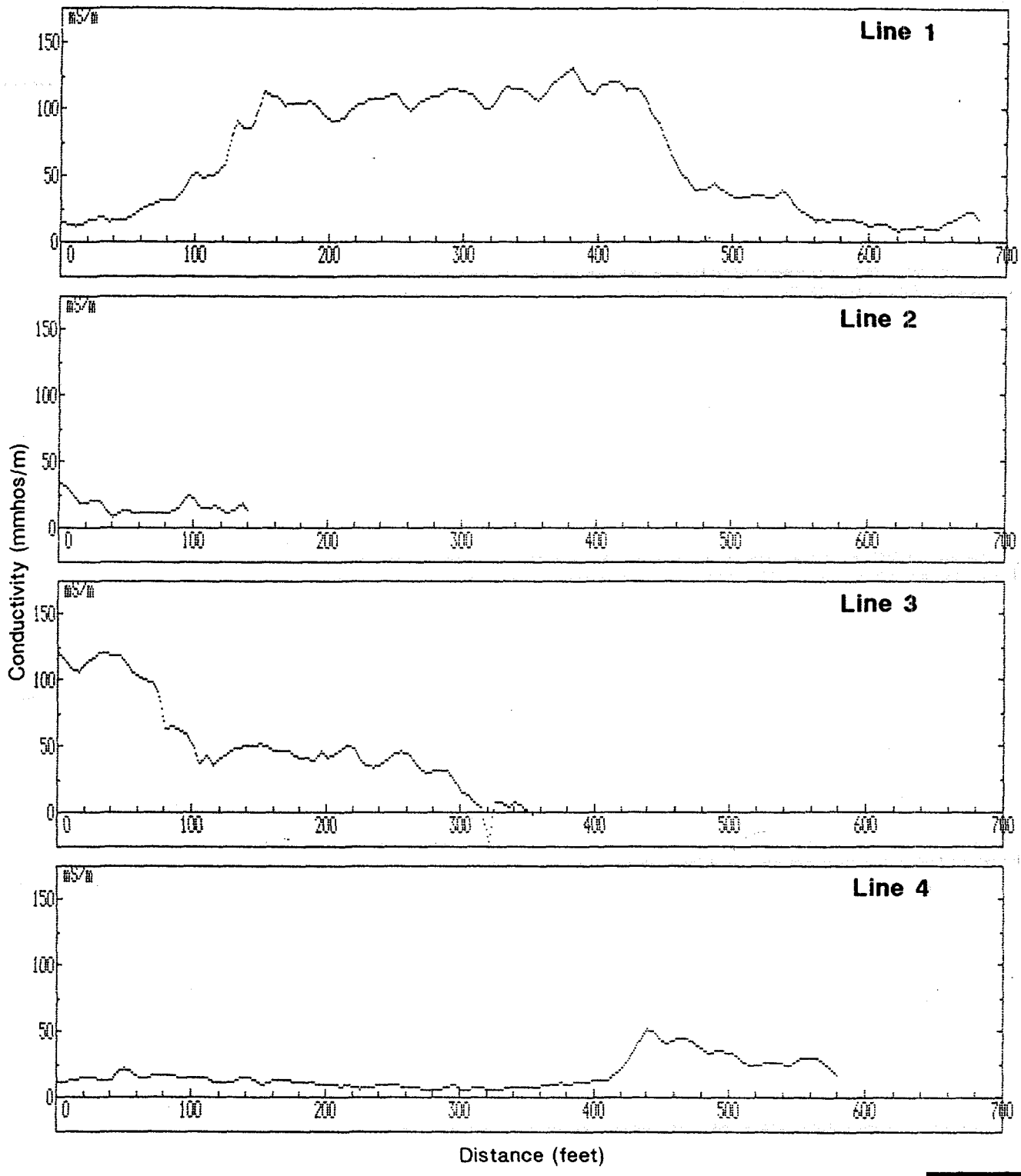
Magnetic profiling was performed to complement the interpretation of subsurface debris and objects within Site 5. A total-field digital proton precession magnetometer, Geometrics model G-856X was utilized during this survey. Magnetic data were acquired at 10-foot intervals along survey lines duplicating the EM-31 coverage. A magnetic base station was reoccupied at approximately one hour intervals during the survey to facilitate adjustment of data for natural daily variations in the magnetic field due to solar activities. Perturbations to the ambient magnetic field are indicative of localized ferrous metal, the magnitudes of which are a function of the mass of the objects and their depth.

The magnetic data were downloaded to a computer, corrected for diurnal drift, and profiled prior to interpretation (Figures 4.B.9 through 4.B.13). The magnetic profiles were then compared to the EM conductivity and in-phase profiles to determine whether specific EM anomalies were caused by ferrous or nonferrous buried objects or fill.

4.B.3.0 RESULTS

3.1 Electromagnetic Terrain Conductivity

EM terrain conductivity measurements were conducted along the traverses (Lines 1-10) shown on Figure 4.B.2 to map the lateral extent of disposal. Conductivity levels above background (>20mmhos/m) were interpreted to be indicative of buried debris and used to define the limits of the landfill boundaries. East and west disposal limits were determined by



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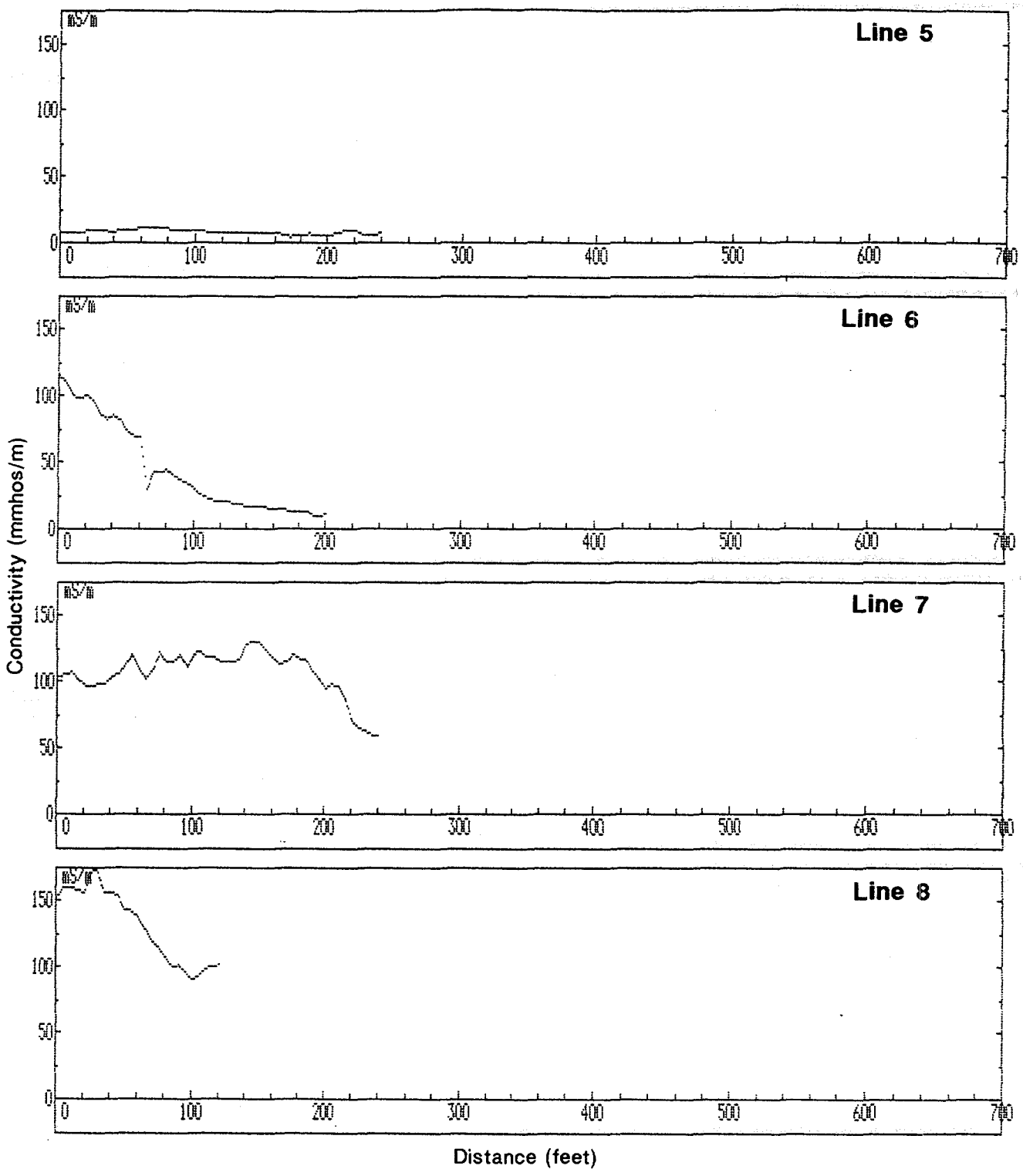
Geophysical Investigation Naval Station Roosevelt Roads Ceiba, Puerto Rico	**EM Conductivity Profiles (VDM)** **Lines 1 - 4**
WESTON GEOPHYSICAL CORP. Coraopolis, Pennsylvania	Date 7/93 — Figure No. 4.B.3



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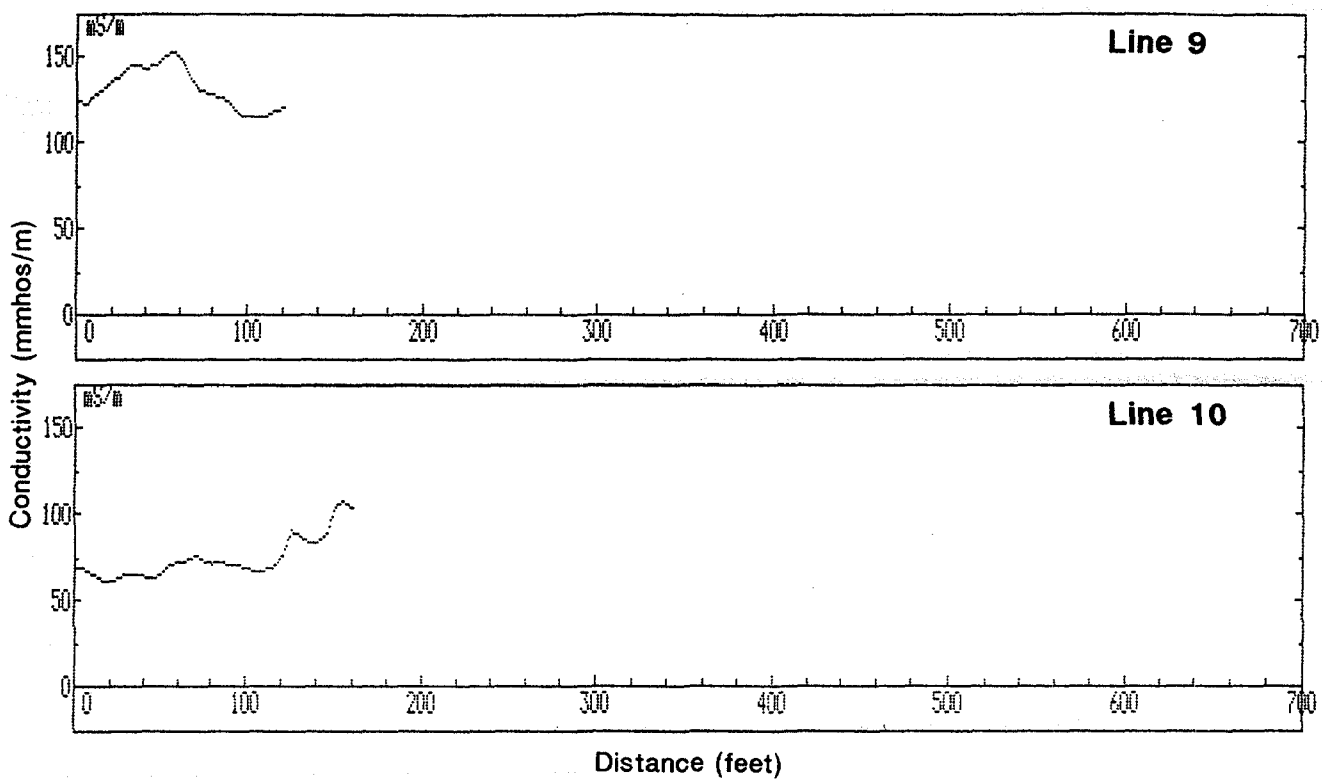
EM Conductivity Profiles (VDM)
Lines 5 - 8

WESTON GEOPHYSICAL CORP.
Coraopolis, Pennsylvania

Date 7/93

Figure No. 4.B.4



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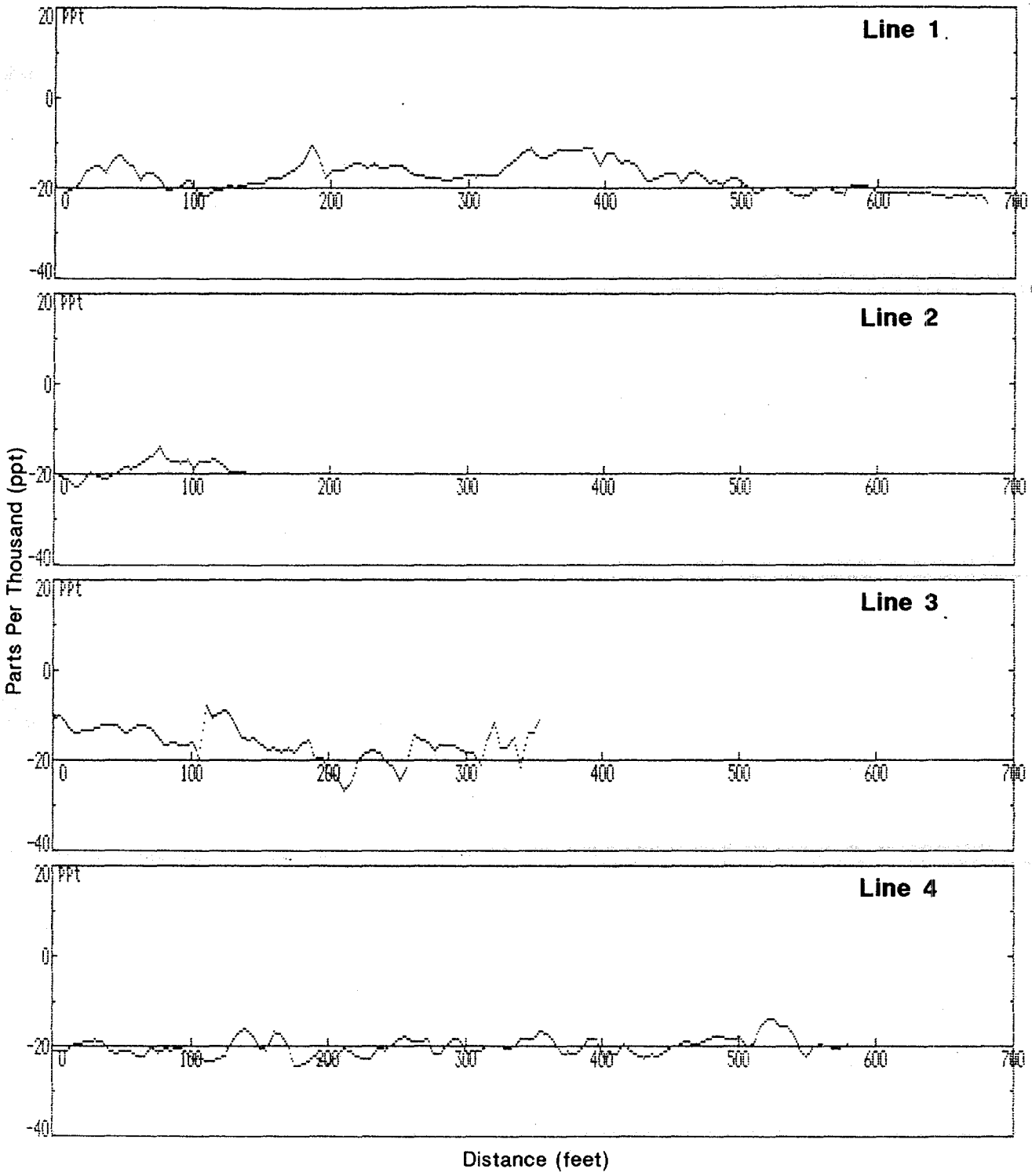
Geophysical Investigation Naval Station Roosevelt Roads Ceiba, Puerto Rico	**EM Conductivity Profiles (VDM)** **Lines 9 &10**
WESTON GEOPHYSICAL CORP. Coraopolis, Pennsylvania	Date 7/93 — Figure No. 4.B.5



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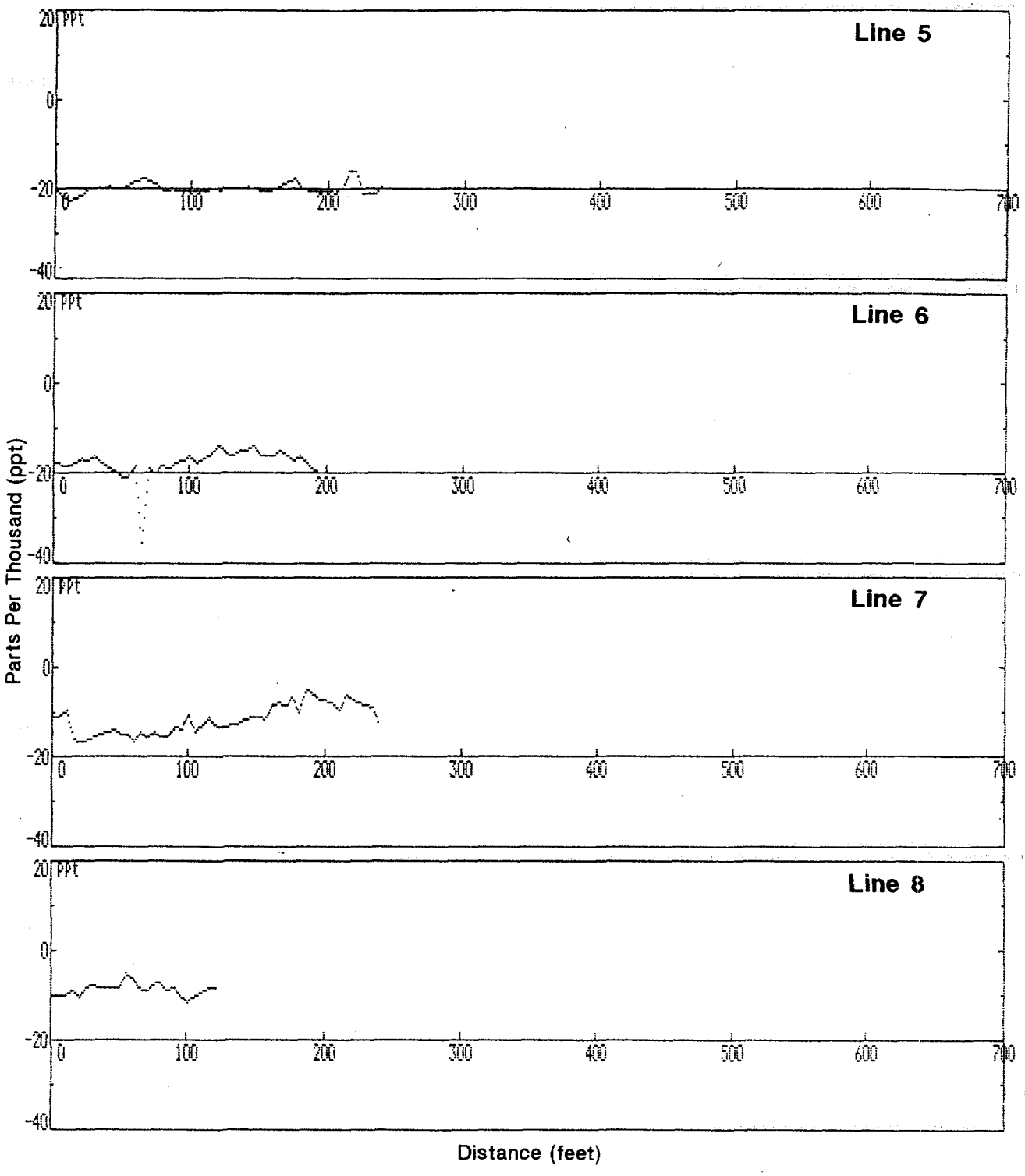
Geophysical Investigation Naval Station Roosevelt Roads Ceiba, Puerto Rico	**EM In-Phase Profiles** **Lines 1 - 4**
WESTON GEOPHYSICAL CORP. Coraopolis, Pennsylvania	Date 7/93 — Figure No. 4.B.6



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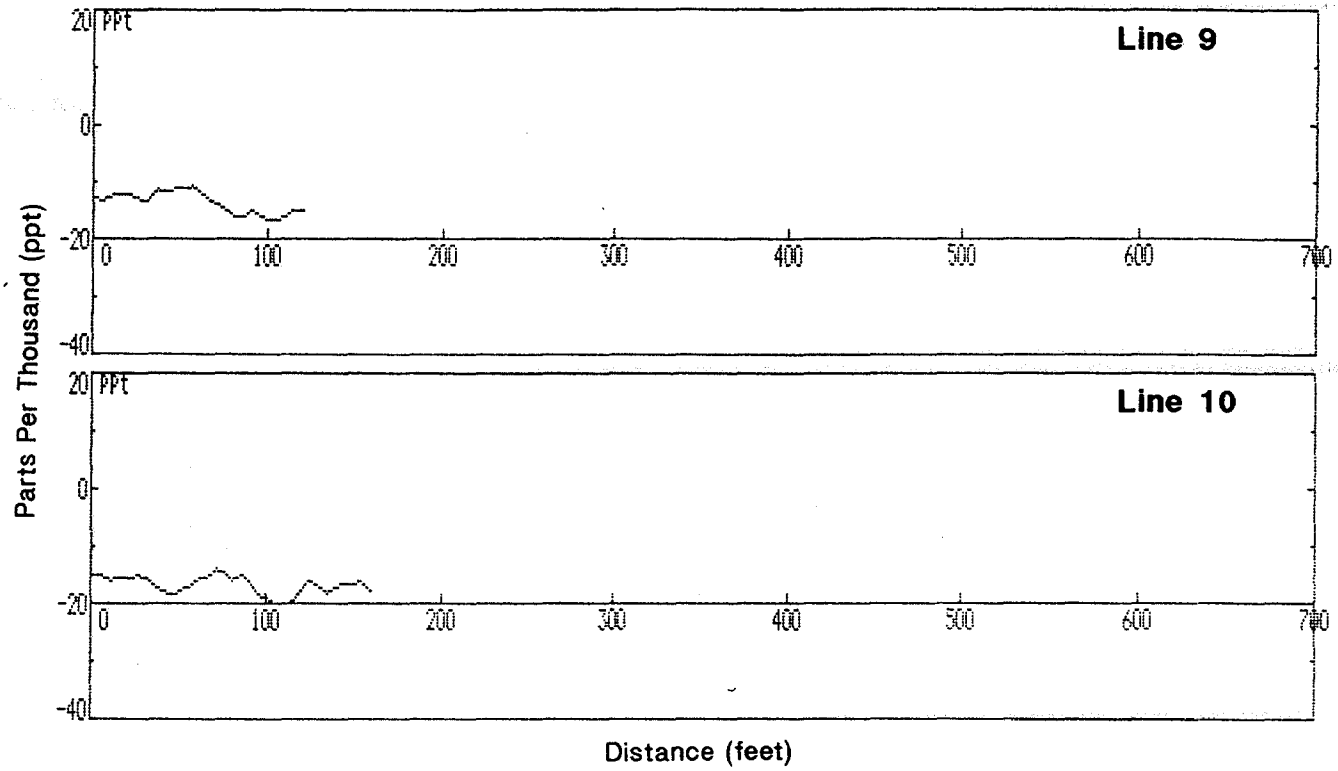
Geophysical Investigation Naval Station Roosevelt Roads Ceiba, Puerto Rico	**EM In-Phase Profiles** **Lines 5 - 8**
WESTON GEOPHYSICAL CORP. Coraopolis, Pennsylvania	Date 7/93 — Figure No. 4.B.7



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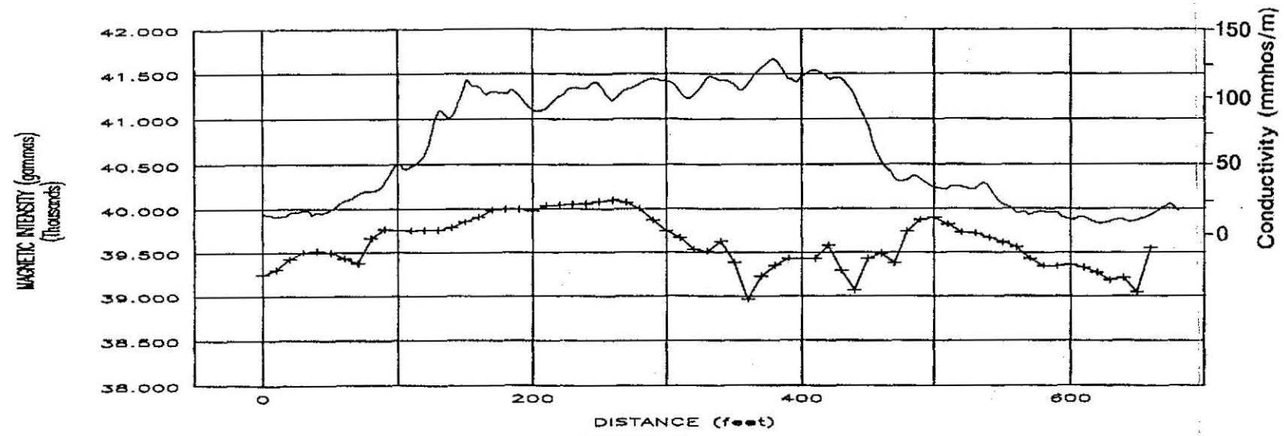
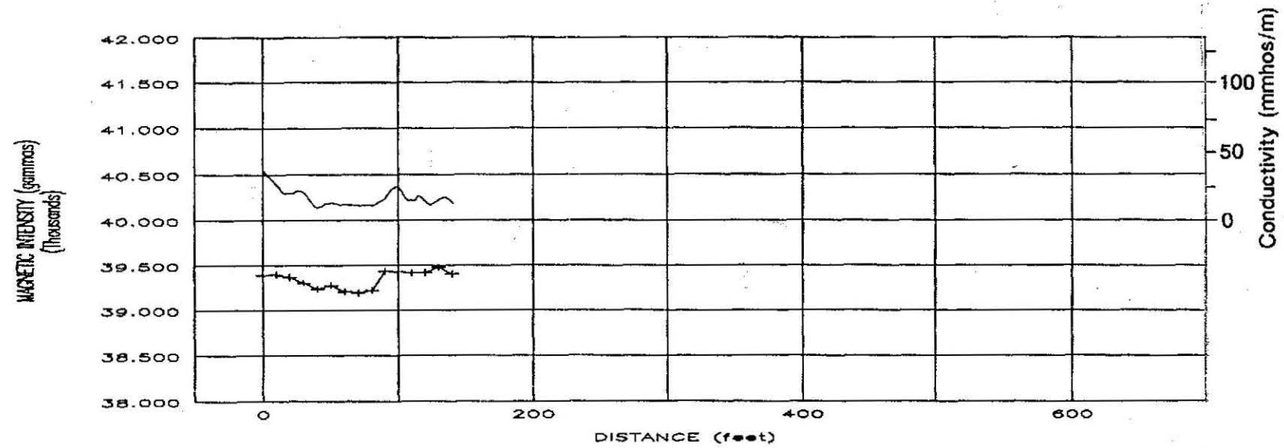
Geophysical Investigation Naval Station Roosevelt Roads Ceiba, Puerto Rico	**EM In-Phase Profiles** **Lines 9 &10**
WESTON GEOPHYSICAL CORP. Coraopolis, Pennsylvania	Date 7/93 — Figure No. 4.B.8



LINE NO. 1



LINE NO. 2

Magnetometry Profile EM Profile

REVISIONS	DATE SCALE DRAWN DM REVIEWED TJS S.O.# 19007-70-SRN CADD#	Geophysical Investigation Naval Station Roosevelt Roads Ceiba, Puerto Rico	Baker Baker Environmental, Inc.	EM Conductivity (VDM) & Magnetometry Profiles Lines 1 & 2	FIGURE NO.
WESTON GEOPHYSICAL CORP. IS A WHOLLY OWNED SUBSIDIARY OF BAKER ENVIRONMENTAL, INC.		WESTON GEOPHYSICAL CORP. Coraopolis, Pennsylvania		SCALE / DATE 7/93	4.B.9

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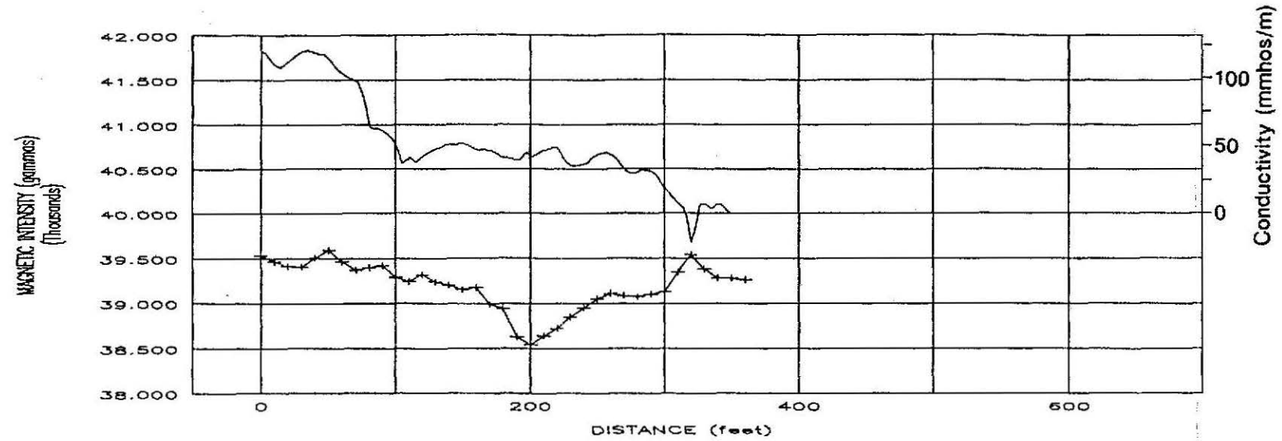
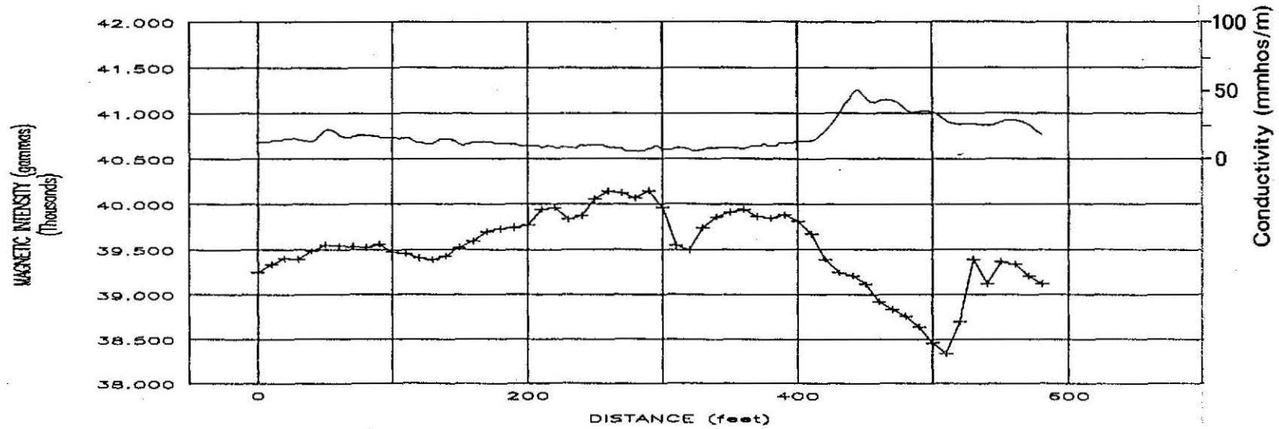


LINE NO. 3



LINE NO. 4

Magnetometry Profile EM Profile

REVISIONS	DATE SCALE DRAWN DM REVIEWED TJS S.O.# 19007-70-SRN CADD#	Geophysical Investigation Naval Station Roosevelt Roads Ceiba, Puerto Rico	Baker Baker Environmental, Inc.	EM Conductivity (VDM) & Magnetometry Profiles Lines 3 & 4	FIGURE NO.
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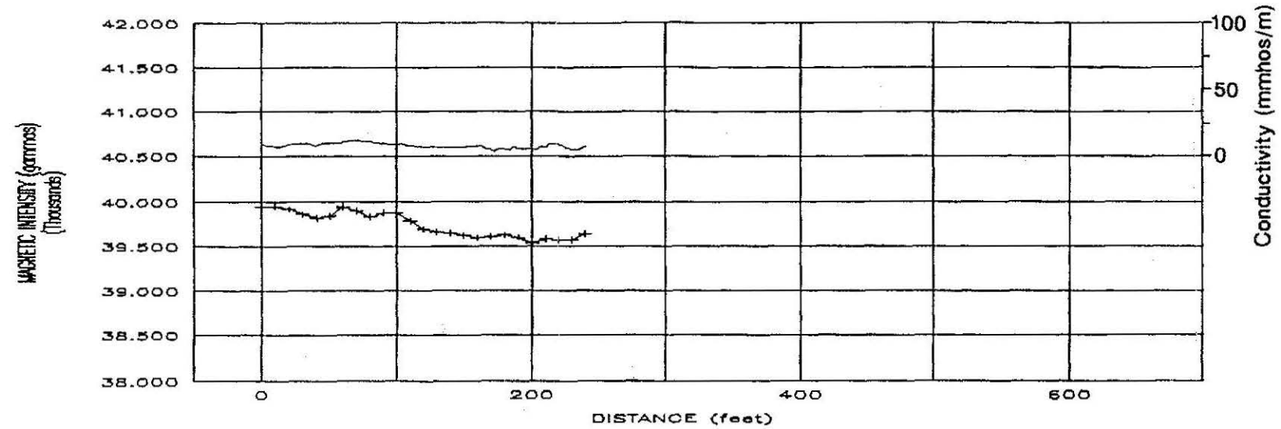
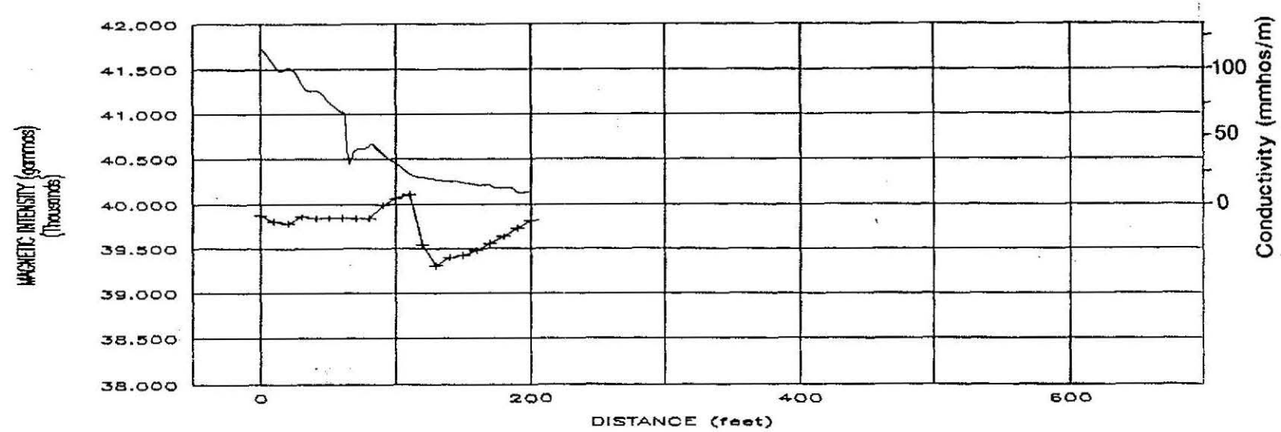


LINE NO. 5



LINE NO. 6

Magnetometry Profile EM Profile

REVISIONS	DATE SCALE DRAWN DM REVIEWED TJS S.O.# 19007-70-SRN CADD#	Geophysical Investigation Naval Station Roosevelt Roads Ceiba, Puerto Rico	Baker Baker Environmental, Inc.	EM Conductivity (VDM) & Magnetometry Profiles Lines 5 & 6	FIGURE NO. 4.B.11
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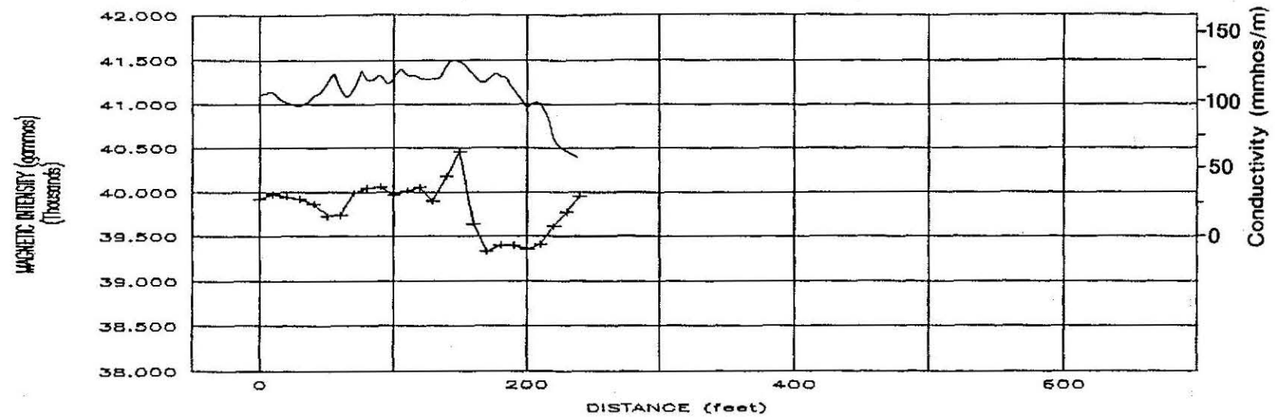
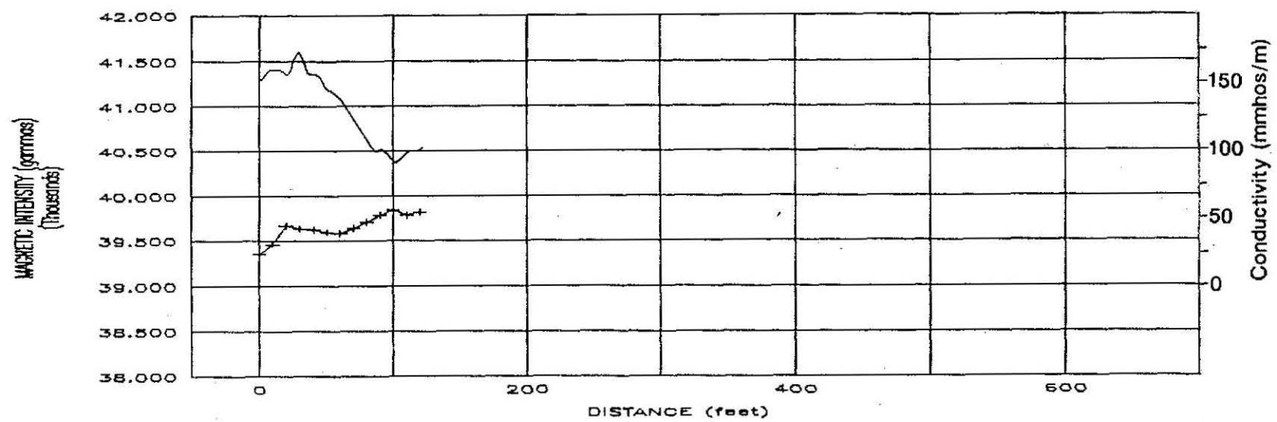


LINE NO. 7



LINE NO. 8

Magnetometry Profile EM Profile

REVISIONS	DATE SCALE DRAWN DM REVIEWED TJS S.O.# 19007-70-SRN CADD#	Geophysical Investigation Naval Station Roosevelt Roads Ceiba, Puerto Rico	Baker Baker Environmental, Inc.	EM Conductivity (VDM) & Magnetometry Profiles Lines 7 & 8	FIGURE NO.
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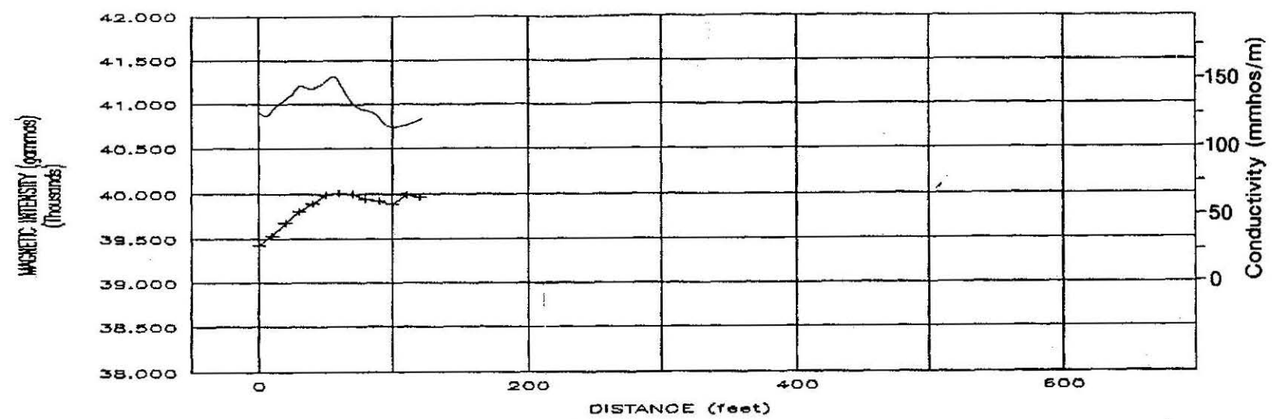
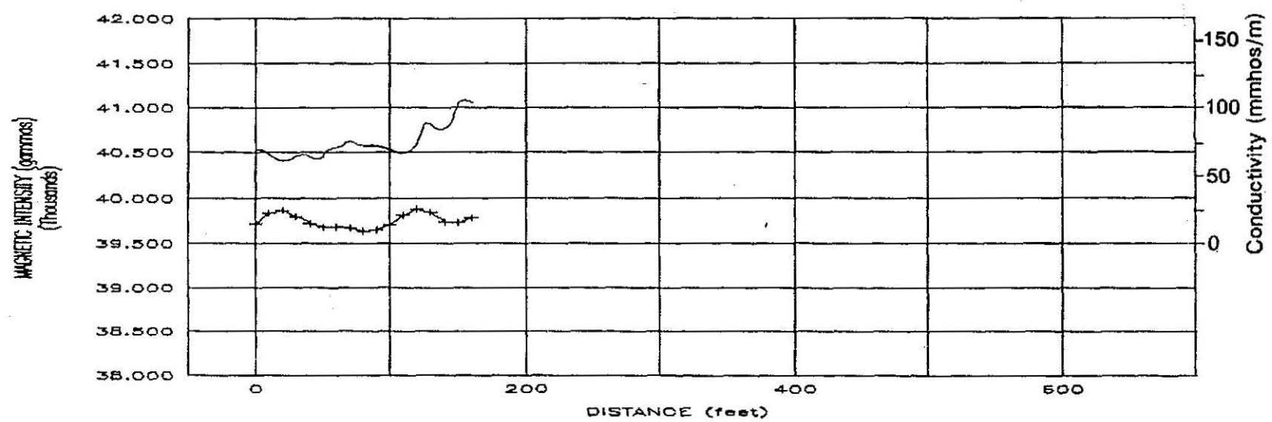


LINE NO. 9



LINE NO. 10

Magnetometry Profile EM Profile

REVISIONS	DATE	Geophysical Investigation Naval Station Roosevelt Roads Ceiba, Puerto Rico	Baker Baker Environmental, Inc.	EM Conductivity (VDM) & Magnetometry Profiles Lines 9 & 10	FIGURE NO.
	SCALE				4.B.13
	DRAWN DM				
	REVIEWED TJS				
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	CADD#				

conductivity values above background on Line 1 and 4. The northern boundary was similarly defined by Lines 3-6 along with an abrupt increase in topography near the ends of Lines 3 and 4.

The highest EM readings (>100 mmhos/m) were measured on Lines 1, 7, 8 and 9, and may correlate with more centralized burial of debris. This zone of anomalously high conductivity appears to agree with the suspected trench locations and debris stockpiles defined by historical airphoto analysis made by Geo Decisions, Inc. (Appendix 4.A).

Topographic features that could not be negotiated by the clearing equipment prevented the delineation of the southern limits of disposal.

3.2 Magnetometry

Magnetometry measurements were taken along the traverses (Lines 1-10) shown on Figure 4.B.2 to complement the EM survey. Magnetic intensities ranged between 39,500 and 40,000 gammas, and exhibited only minimal fluctuations. Several locations of buried ferrous metal have been identified on Figure 4.B.2. Most of these are within the limits of disposal defined by the EM survey. Locations identified beyond the disposal limits may represent miscellaneous scrap metal rather than widespread disposal.

4.B.4.0 SUMMARY AND CONCLUSIONS

EM data defined limits of disposal to the north, west and east. Geologic, topographic and equipment constraints prevented delineation of the southern disposal boundaries.

Disposal boundaries were defined as areas with conductivity values above background (>20mmhos/m) levels.

The highest conductivity values (>100 mmohs/m) and locations of buried ferrous metal coincide with an old access road, debris stock piles and trenches that were identified on historical photos by Geo Decisions, Inc.

Although the high conductivity levels and presence of buried ferrous metal indicate previous disposal on site, a higher resolution geophysical survey with an orthogonal grid would be

required to map actual trench locations completely; however, the identified disposal locations and trends generally agree with the photo-interpretation.