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JUL 08 1994 (11)

Station # 12

ENGINEERING DATA TRANSMITTAL

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15. DATA TRANSMITTED

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1	WHC-SD-EN-TI-210		0	Geophysical Investigation of the "Thimble", 100 H Area	~~4~~ N/A	1/2	1	

16. KEY

Impact Level (F)	Reason for Transmittal (G)	Disposition (H) & (I)
1, 2, 3, or 4 (see MRP 5.43)	1. Approval 2. Release 3. Information 4. Review 5. Post-Review 6. Dist. (Receipt Acknow. Required)	1. Approved 2. Approved w/comment 3. Disapproved w/comment 4. Reviewed no/comment 5. Reviewed w/comment 6. Receipt acknowledged

17. SIGNATURE/DISTRIBUTION (See Impact Level for required signatures)

(G) Reason	(H) Disp.	(J) Name (K) Signature (L) Date (M) MSIN	(J) Name (K) Signature (L) Date (M) MSIN	(G) Reason	(H) Disp.
~~4~~ 1/2	1/2	Cog.Eng. K. A. Bergstrom H6-06 K.A. Bergstrom 1-27-94	EPIC (2) H6-08	3	
~~4~~ 1/2	1/2	Cog. Mgr. J. W. Fassett H6-06 J.W. Fassett 1-31-94	J. M. Ayers H6-02	3	
		QA	N. A. Holman H6-02	3	
		Safety	IRA (2) H4-17	3	
		Env.			
3		Geophysical Files (2) H6-06			
3		Central Files (2) L8-04			

18.	19.	20.	21. DOE APPROVAL (if required)
K.A. Bergstrom 1-28-94 K.A.Bergstrom Signature of EDT Originator Date	Authorized Representative Date for Receiving Organization	J. W. Fassett J.W. Fassett 1-31-94 Cognizant/Project Engineer's Manager Date	Ltr. No. [] Approved [] Approved w/comments [] Disapproved w/comments

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Date Received: 7-1-94 LS

INFORMATION RELEASE REQUEST

Reference: WHC-CM-3-4

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Purpose		ID Number (include revision, volume, etc.)
[] Speech or Presentation	[] Reference	WHC-SD-EN-TI-210, Rev. 0
[] Full Paper (Check only one suffix)	[X] Technical Report	List attachments.
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[] Visual Aid	[] Brochure/Flier	
[] Speakers Bureau	[] Software/Database	Date Release Required
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[] Videotape	[] Other	

Title: Geophysical Investigation of the "Thimble," 100-H Area

Unclassified Category UC- 630

Impact Level N/A

New or novel (patentable) subject matter? [X] No [] Yes If "Yes", has disclosure been submitted by WHC or other company?
[] No [] Yes Disclosure No(s).

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Title of Journal: N/A

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Information conforms to all applicable requirements. The above information is certified to be correct.

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References Available to Intended Audience	[X]	[]
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Author/Requestor (Printed/Signature) Date

for K. A. Bergstrom J. W. Fassett 6/30/94

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J. W. Fassett J. W. Fassett 6/30/94

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7-1-94

Date Cancelled

Date Disapproved

SUPPORTING DOCUMENT

1. Total Pages 8

2. Title

Geophysical Investigation of the "Thimble," 100-H Area

3. Number

WHC-SD-EN-TI-210

4. Rev No.

0

5. Key Words

radar, GPR, geophysics

APPROVED FOR PUBLIC RELEASE

7-1-94 D. Solis

6. Author

Name: K. A. Bergstrom

J. W. Fassett

Signature

Organization/Charge Code

8C540/PE2AA

7. Abstract

WHC, 1994, Bergstrom, K. A. and T. H. Mitchell, *Geophysical Investigation of the "Thimble," 100-H Area, WHC-SD-EN-TI-210, Rev. 0*, WHC-SD-EN-TI-213, Rev. 0, Westinghouse Hanford Company, Richland, Washington."

9. Impact Level N/A

10. RELEASE STAMP

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DATE JUL 08 1994

Station #12

A-6400-073 (11/91) (EF) WEF124

1.0 INTRODUCTION

This report summarizes the results of the geophysical investigations conducted as part of the characterization of the buried "Thimble" site. The site is locate just south of the 116-H-2 Crib and is in the 100-HR-2 Operable Unit. Available documentation has it located between, and at the convergence of, two railroad spurs that run north-south (Figure 1). A concrete monument is believed to mark the site. The burial ground is suspected of containing a vertical safety rod thimble that is reportedly 40 ft long (DOE-RL 1993).

Ground-penetrating radar (GPR) and electromagnetic induction (EMI) were the two techniques used in the investigation. The methods were selected because they are non-intrusive, relatively fast, economical, and have been used successfully in other similar investigations on the Hanford Site.

2.0 OBJECTIVES

The objective of the investigation was to locate the buried thimble.

3.0 METHODOLOGY

GPR and EMI were the two techniques used in the investigation. The GPR system used for this work utilized a 300-megahertz antenna to transmit the electromagnetic (EM) energy into the ground. The transmitted energy is reflected back to a receiving antenna where variations in the return signal are recorded during a time window of 100 nanoseconds. Common reflectors include natural geologic conditions such as bedding, cementation, moisture, and clay, or man-made objects such as pipes, barrels, foundations, and buried wire.

Depth of investigation is limited by transmit power, receiver sensitivity, and attenuation of the transmitted energy. Depth of investigation is also influenced by highly conductive material, such as clay and fly-ash. The method is limited to how far it can "see" below such layers. It is believed that the depth of penetration was less than 5 ft for most of the site because of an abundance of fly-ash that appears to be throughout the site. Figure 2 shows the effect of fly-ash of the GPR signal.

Display and interpretation of the data are similar to that of seismic reflection data. In some areas interpretations can be straightforward, but often unknown parameters, with a highly variable subsurface, yield complex data.

Data for these surveys were collected with a Geophysical Survey Systems Inc. (GSSI) Subsurface Interface Radar (SIR) [a trademark of Geophysical Survey Systems Inc. (GSSI)] System 8, model 4800 and digitally stored on a GSSI DT6000A tape drive.

EMI are used to determine the electrical conductivity of the subsurface soil, rock, and groundwater. They are generally used for shallow investigations. The method is based on a transmitting coil radiating an electromagnetic field which induces eddy currents in the earth. A resulting secondary electromagnetic field is measured at a receiving coil as a voltage which is linearly related to the subsurface conductivity.

Terrain or ground conductivity is a function of the natural soil matrix and pore fluid electrical conductivity. The depth of investigation is dependent upon the electrical conductivity of the subsurface, the distance between the transmitting and receiving coils, and the sensitivity of equipment and power of the source. The conductivity value resulting from a measurement is a composite representing the combined effects of thickness, depth and conductivity of the stratigraphic layers, and any man-made conductive objects that may be present such as metal objects. Metallic objects generally overwhelm the natural conductivity of the ground.

A Geonics' EM-31D (a trademark of Geonics Limited) ground conductivity meter was used for the survey and has a maximum depth of penetration of approximately 18 ft. Two measurements were collected, the quadrature and in-phase components. The inphase component is more sensitive to highly conductive material such as metal.

4.0 SURVEY GRID PARAMETERS

The survey boundary is a trapezoid with only two parallel sides, measuring approximately 60 ft by 125 ft (Figure 3). The long axis of the survey strikes north-south.

GPR profiles were collected in both east-west and north-south directions with the profiles spaced at 5 ft intervals. EMI data were collected along east-west profiles, spaced again at 5 ft with data recordings every 2.5 ft along each profile. The EM-31 instrument used for the survey was placed on the ground for all recording. All distances were measured and posted in feet. The southwest corner of the grid is designated E100/N100 and serves as the "origin". The letters "E" and "N" refer to a direction that trends generally east and north, respectively. The number refers to a distance in feet. For example, E120/N130 is 20 ft east and 30 ft north of E100/N100. A summary of the parameters for the survey are shown in Figure 4.

5.0 RESULTS

Fly-ash was observed on the surface throughout the site. Fly-ash, which acts as a strong reflector of the GPR signal, limited the effective depth of GPR to only a few feet (Figure 2). Because of GPR's inability to see deeper than a few feet, it is unlikely that the thimble would be detected with GPR even if the thimble were present.

A 40-ft-long metal rod should be readily detected with EMI if it is within 10 to 15 ft of the surface, provided that there are no surface or buried metallic features that "disguise" its response.

The EMI data shows a highly variable conductivity in the subsurface. With the absence of effective GPR data, this conductive variability cannot be qualified and interpreted. The in-phase response was not as variable as the quadrature mode. This gives indications that there are significant amounts of conductive debris buried throughout the site, but much of it may not be metallic. The debris is prevalent in the northern half of the grid. The buried debris could be masking the signature of the thimble rod. A roughly north-south trending linear anomaly extends from N160 to N220 between E85 and E100 (Figure 3). It is the only feature that has any resemblance to the expected EMI signature. Further study is required to verify the marginal linear.

The possibility that the thimble is not within the survey boundary should be considered. It is also possible that the thimble is buried deeper than the techniques can "see" or that the geophysical signature of the thimble was not recognized in the data.

6.0 REFERENCE

DOE-RL, 1993, *RCRA Facility Investigation/Corrective Measures Study Work Plan for the 100-DR-2 Operable Unit, Hanford Site, Richland, Washington*, DOE/RL-93-46, Draft A, U.S. Department of Energy, Richland Operations Office, Richland, Washington.

Figure 1. Location Map.

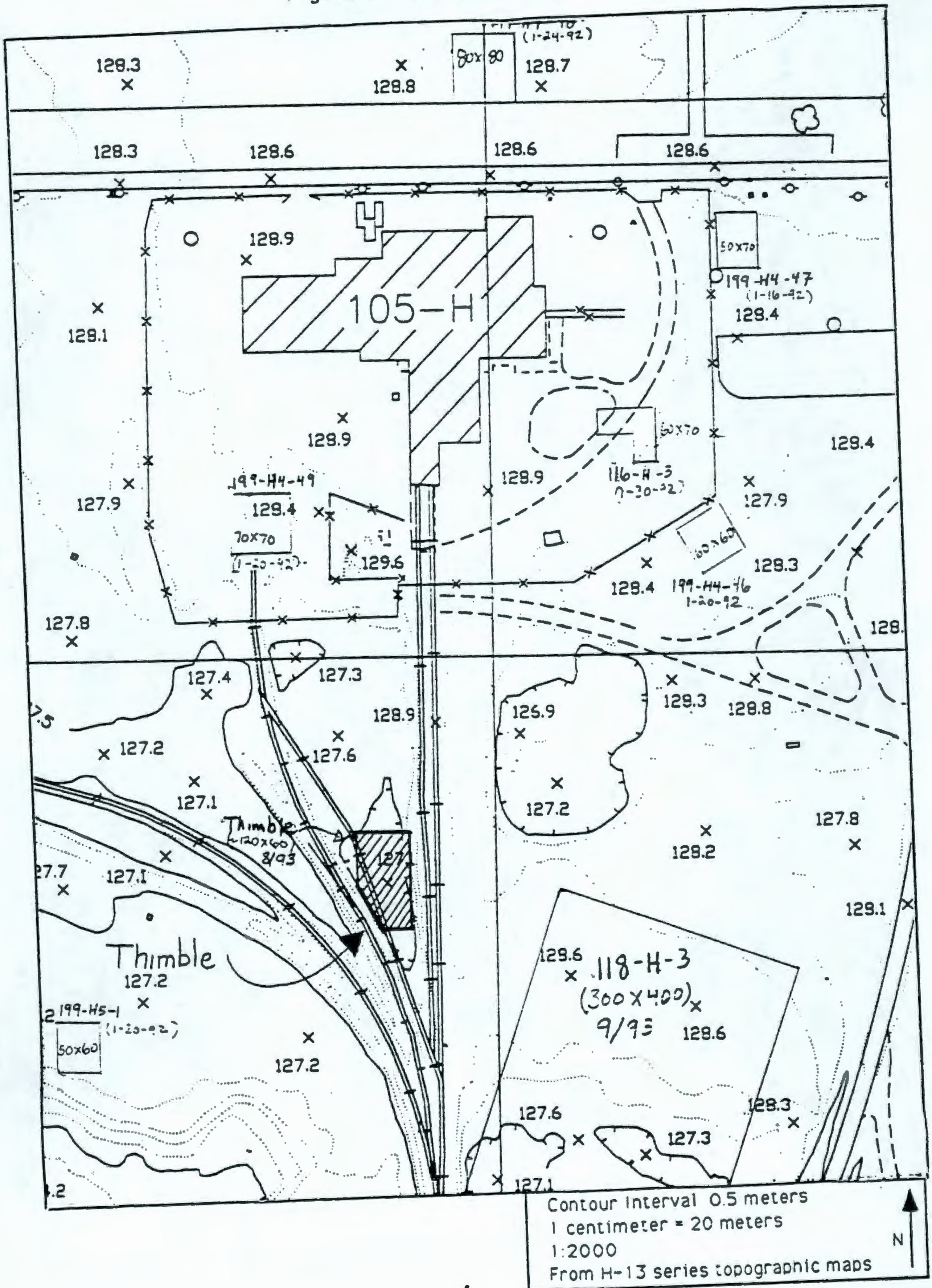

Figure 2. GPR Profile E85 Showing the Effects of Fly-Ash.

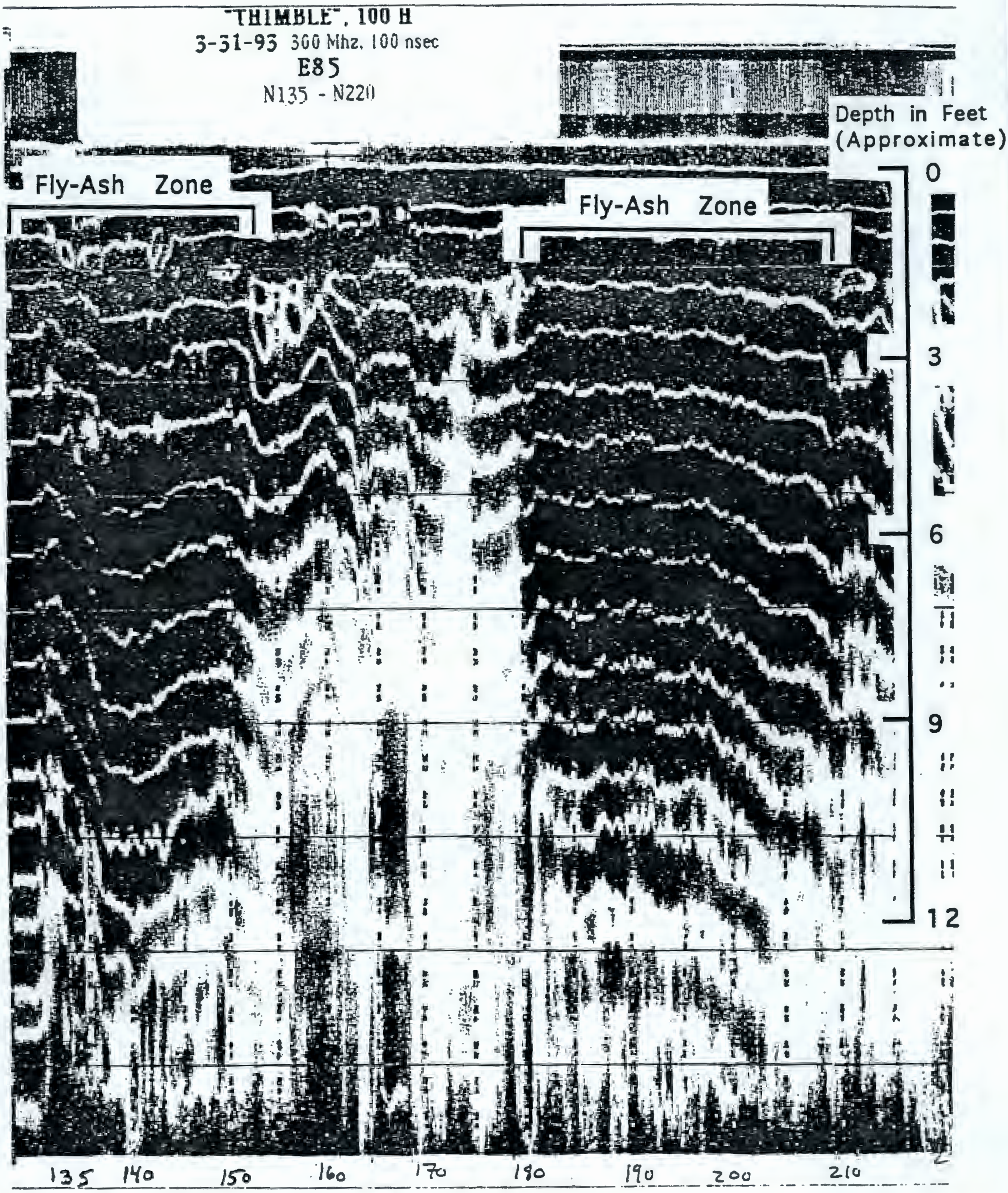

Figure 3. EMI Contour Map.

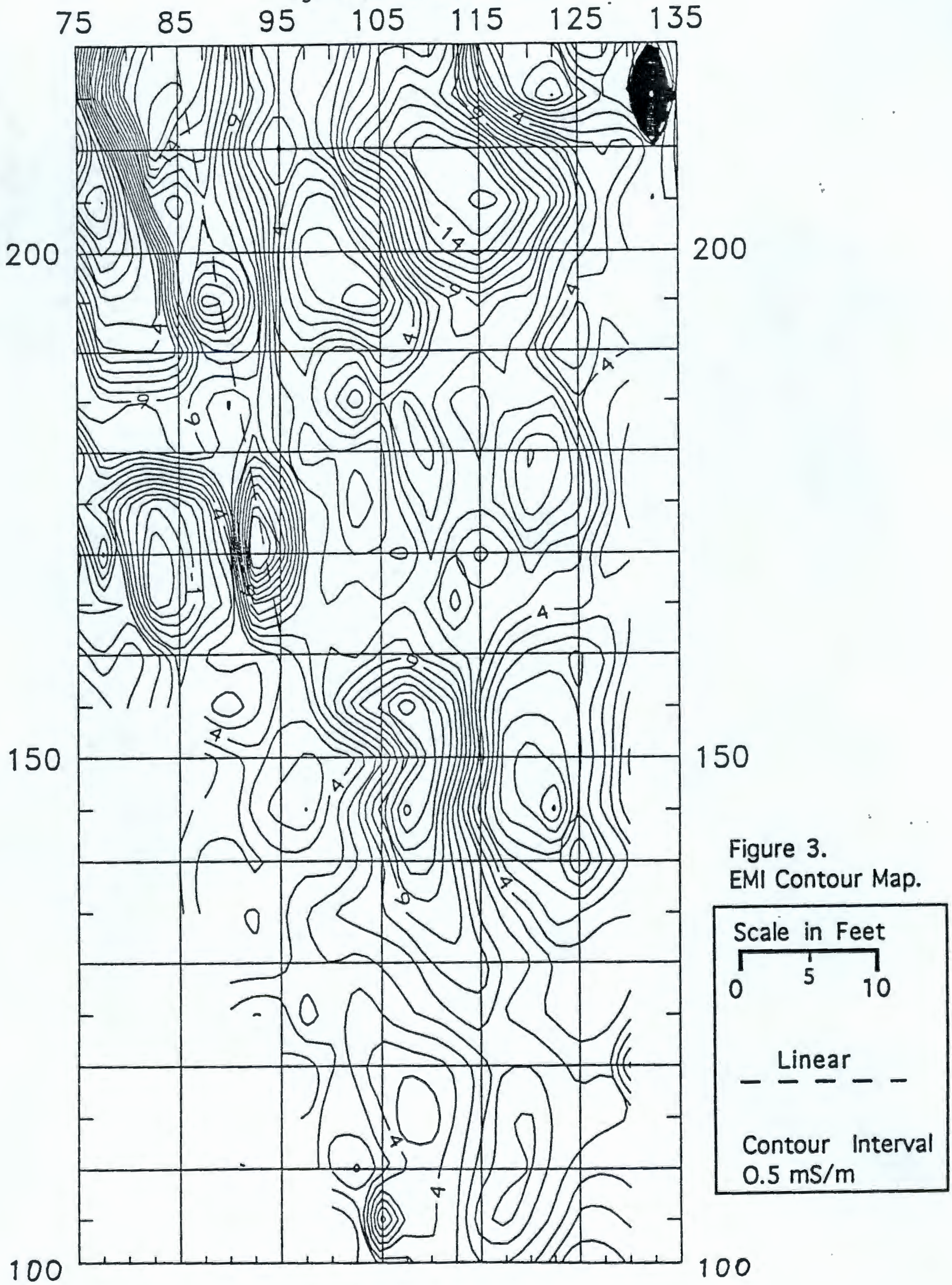

Figure 4. GPR and EMI Parameters for Thimble Site.

GROUND PENETRATING RADAR (GPR) and ELECTROMAGNETIC (EMI) SURVEY

Geophysics Group, Westinghouse Hanford Operations

TITLE: 100 H Thimble	DATE: 3/31/93
LOCATION: South of 100 H reactor building.	
CLIENT:	DATA COLLECTED BY K.A. Bergstrom & J.P. Kiesler
EQUIPMENT USED: GSSI System 8, model 4800 Calibrator Model P731 Digital Tape Recoder DT6000A	ANTENNA(S) USED: 100 ____ 300 _XX_ 100 BISTATIC ____ LOG BOOK: EFL1028 TIME WINDOW (NS): 100
PROCEDURES FOLLOWED: WHC-CM-7-7 EII 11.2, REV. 3	
GRID : 50x110 trapezoid NO. OF PROFILES: 50 TOTAL FOOTAGE COLLECTED: ~3000 PARAMETERS: Two sets of perpendicular profiles; five feet between north-south and east-west profiles.	
DATA TAPE NO.: 93-11 RECORDS LOCATION: Geophysical field files TAPE ADDRESS : 0-24300 CALIBRATION ADDRESS: 23496-24300	
INTERPRETED BY : K.A. Bergstrom REVIEWED BY : T. H. Mitchell	
OBJECTIVE(S): To locate 40-foot long thimble.	
NOTES: Antenna pulled by hand at 1-2 mph. 30 meter cable. EMI also collected along profiles five feet apart with a reading every 2.5 feet. Boom was placed on ground. File name HTHIMBA. Geonics model EM-31D used with data stored on Plycorder 516 GE-64-A. Both in-phase and quadrature collected.	