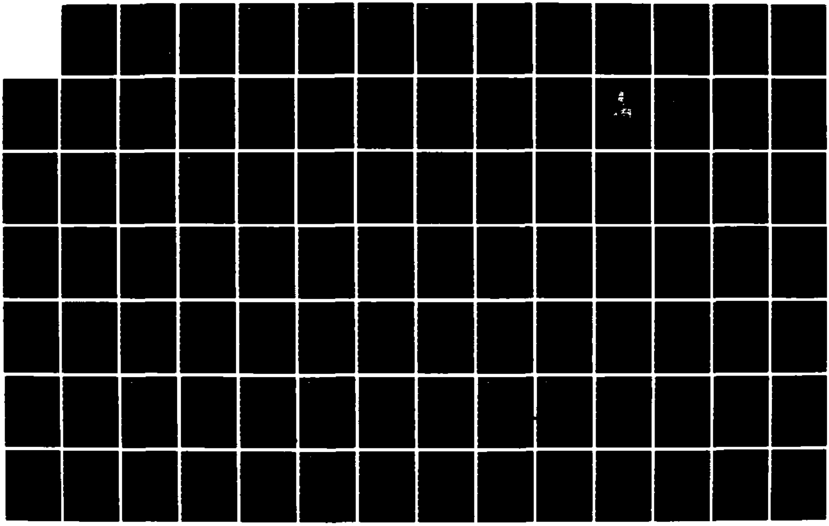
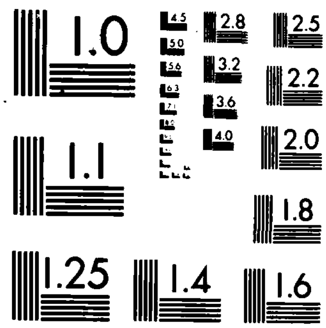
AD-A174 095 INSTALLATION RESTORATION PROGRAM PHASE II 1/4
CONFIRMATION/QUANTIFICATION STA..(U) RADIAN CORP AUSTIN
TX OCT 86 F33615-84-D-4402
UNCLASSIFIED F/G 13/2 NL





MICROCOPY RESOLUTION TEST CHART
NATIONAL BUREAU OF STANDARDS-1963-A

DCN 86-214-114-06-03

AD-A174 095

INSTALLATION RESTORATION PROGRAM
PHASE II - CONFIRMATION/QUANTIFICATION
STAGE 1

VOLUME 3 - APPENDICES B-L

FINAL REPORT FOR
CARSWELL AFB, TEXAS

HEADQUARTERS STRATEGIC AIR COMMAND
COMMAND SURGEON'S OFFICE (HQSAC/SGPB)
OFFUTT AFB, NEBRASKA 68113

OCTOBER 1986

PREPARED BY:
RADIAN CORPORATION
8501 MO-PAC BOULEVARD
POST OFFICE BOX 9948
AUSTIN, TEXAS 78766

USAF CONTRACT NO. F33615-84-D-4402, DELIVERY ORDER NO. 6
RADIAN CONTRACT NUMBER 214-114-06

APPROVED FOR PUBLIC RELEASE
DISTRIBUTION UNLIMITED

USAFOEHL TECHNICAL PROGRAM MANAGER
MAJOR GEORGE R. NEW
TECHNICAL SERVICES DIVISION (TS)

UNITED STATES AIR FORCE
OCCUPATIONAL AND ENVIRONMENTAL HEALTH LABORATORY (USAFOEHL)
TECHNICAL SERVICES DIVISION (TS)
BROOKS AIR FORCE BASE, TEXAS 78235-5000

RADIAN
CORPORATION

NOTICE

This report has been prepared for the United States Air Force by Radian Corporation, for the purpose of aiding in the implementation of the Air Force Installation Restoration Program. It is not an endorsement of any product. The views expressed herein are those of the contractor and do not necessarily reflect the official views of the publishing agency, the United States Air Force, nor the Department of Defense.

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Springfield, Virginia 22161

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Cameron Station
Alexandria, Virginia 22314

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The blank pages in this report were
intentionally left blank.
Per Major Carmichael, USAFOEHL/TSD

A1

RADIAN
CORPORATION

TABLE OF CONTENTS

APPENDIX B

Definitions, Nomenclature, and Units

RADIAN CORPORATION

APPENDIX B

Definitions, Nomenclature, and Units

- o AFB - Air Force Base
- o Aquifer - geologic unit capable of storing and transmitting significant quantities of water.
- o D.P.D.O. - Defense Property Disposal Office
- o DoD - Department of Defense
- o EMP - Electromagnetic Profiling
- o EPA - Environmental Protection Agency
- o GC - Gas Chromatography
- o GC-MS - Gas Chromatography-Mass Spectrometry
- o IRP - Installation Restoration Program
- o JP-4 - Jet Propulsion fuel
- o mg/L - Milligrams per liter
- o msl - mean sea level
- o O&G - Oil and Grease
- o PCE - tetrachlorethylene (perchloroethylene)
- o PD-680 - Petroleum distillate (aliphatic) used as a safety cleaning solvent
- o POL - Petroleum, oil, and lubricants
- o PVC - Polyvinyl Chloride
- o RCRA - Resource Conservation and Recovery Act
- o TCE - trichloroethene
- o TOC - Total Organic Carbon
- o TOX - Total Organic Halogens
- o ug/L - Micrograms per Liter
- o ug/ml - Micrograms per milliliter
- o ug/g - Micrograms per gram
- o USAF - United States Air Force
- o VES - Vertical electrical soundings, earth resistivity
- o VOC - Volatile organic compound
- o WSA - Weapons Storage Area

RADIAN CORPORATION

APPENDIX C

Scope of Work

REF 55X (jp)

CONTRACTOR'S COPY

55X

ORDER FOR SUPPLIES OR SERVICES

1. PAGE 1 OF 20

2. PROC INSTRUMENT ID NO. (PIIN)	3. CALL/ORDER NO.	4. DATE OF ORDER*	5. REQUISITION/PURCHASE REQUEST PROJECT NO.	6. CERTIFIED FOR NATIONAL DEFENSE UNDER BDC REG 2/DMS REG 1 RATING
F33615-84-D-4402 (Mark all packages & papers with this number.)	0006	84SEP24	FY7624-84-01839	DO-C9

7. ISSUED BY CODE FQ8419
DEPARTMENT OF THE AIR FORCE
AIR FORCE SYSTEMS COMMAND
AERONAUTICAL SYSTEMS DIV/PMRSC
WRIGHT-PATTERSON AFB OH 45433
BUYER: DIANE C. CARSELLO
PHONE: (513) 255-3042

8. ADMINISTERED BY CODE S4404A
DCASMA SAN ANTONIO
P.O. BOX 1040
615 EAST HOUSTON ST.
SAN ANTONIO, TX 78294

9. CONTRACTOR NAME AND ADDRESS CODE 3B126 FACILITY CODE
IF "9" FOR MULTIPLE FACILITIES SEE SECT "K"
RADIAN CORPORATION
8501 MO-PAC BLVD.
P.O. BOX 9948
AUSTIN, TX 78766
(TRAVIS COUNTY)
(512) 454-4797

MAILING DATE
SEP 29 1984
DUPLICATE ORIGINAL

10. MAIL INVOICES TO

11. DISCOUNT FOR PROMPT PAYMENT
NET DAYS
1ST N - DAYS
OTHER IF 9 SEE SECT "E"
2ND - DAYS
3RD - DAYS

12A. PURCHASE OFFICE POINT OF CONTACT
LQB/L58/LQB

12B. RESERVED FOR SERVICE/AGENCY USE

13. PAYMENT WILL BE MADE BY CODE S4403A IF "9" SEE SECT "K"
DCASR DALLAS
500 SOUTH ERVAY ST.
DALLAS, TX 75201

14. TYPE CONTRACTOR: A
15. SECURITY A. CLAS: U B. DATE OF DD 254

16. CONTRACT ADMINISTRATION DATA: A. FAST PAY; B. CONTRACT (1) KIND (2) TYPE: 0 Y; C. ABSTRACT RECIP ADP POINT; D. SPL CONT PROVISIONS; E. CONT ADMIN FUNC LMT
17. RESERVED
18. SVC AGENCY USE
19. SUR. CR: C
20. TOTAL AMOUNT: NOT-TO-EXCEED $ 401,816.28

21. APPROPRIATION AND ACCOUNTING DATA
A. ACCTG CLAS: U B. ACRN: AA C. APPROPRIATION: 9740810.200 D. LIMIT SUBHEAD E. SUPPLEMENTAL ACCOUNTING CLASSIFICATION: E74 4308 P820 503701
F. CPN RECIPIENT DODAAD G. OBLIGATION AMOUNT: 401,816.28 H. NON-CLIN ELIN PAYMENT PROV I. SVC AGENCY USE: FY7624-84-01839*

22A. TYPE OF ORDER
DELIVERY X
B. NON-DOD CONTRACT NO.
This delivery order is subject to instructions contained on this side of form only and is issued in accordance with and subject to terms and conditions of above numbered contract, or Non-DOD Contract No.

PURCHASE
Reference your ~~CONTRACT CATEGORY CODE: FAZ~~
Furnish the following on terms specified herein including, for U.S. purchases, General Provisions of Purchase Order on DD form 1155 ... is checked and ... special provisions ______ and delivery as indicated. This purchase is negotiated under authority of 10 USC 2304(a)( ) or as specified in the schedule if within the U.S., its possessions or Puerto Rico, if otherwise, under 2304(a)(6).
If checked Additional General Provisions apply, supplier shall sign Acceptance on DD form 1155r and return ... copies.

*If quantity accepted by the Government is same as quantity ordered, indicated by ✓ mark. If different enter actual quantity accepted below quantity ordered and encircle.

23. UNITED STATES OF AMERICA
Christopher D. Miller 84 Sep 25 (YYMMDD)
BY: CHRISTOPHER D. MILLER
NAME OF CONTRACTING ORDERING OFFICER AND DATE

24. TOTAL
28. DIFFERENCES

25. QUANTITY ORDERED HAS BEEN ☐ INSPECTED ☐ RECEIVED ☐ ACCEPTED, AND CONFORMS TO THE CONTRACT EXCEPT AS STATED
DATE SIGNATURE OF AUTHORIZED GOVERNMENT REPRESENTATIVE
26. SHIP NO. ☐ PARTIAL ☐ FINAL
27. D.O. VOUCHER NO.
29. INITIALS
31. PAID BY
32. Amount Verified Correct For
30. PAYMENT ☐ COMPLETE ☐ PARTIAL ☐ FINAL
33. CHECK NUMBER
34. BILL OF LADING NO.
35. I CERTIFY THIS AMOUNT IS CORRECT AND PROPER FOR PAYMENT
SIGNATURE AND TITLE OF CERTIFYING OFFICER

36. RECEIVED AT	37. RECEIVED BY	38. DATE RECEIVED	39. TOTAL CONTAINERS	40. S/R ACCOUNT NUMBER	41. S/R VOUCHER NO.

AFSC FORM 700 NOV 75 *When used as a formal contract this will be the effective date.

*1947 HSG/FMCF, Pentagon, Washington DC, 20330, #E70A84-03, Ch 4, DTD 84JUL20

PART I SECTION B OF THE SCHEDULE SUPPLIES LINE ITEM DATA	1. PROC INSTRUMENT ID NO. (PIIN) F33615-84-D-4402	2. SPIIN 0006	3. PAGE 2 OF 20

4. ITEM NO.	5. QUANTITY*	6. PURCH UNIT	7. UNIT PRICE	8. TOTAL ITEM AMOUNT*
0001	1	LO	$	$E146,937.94

9. SCTY CLAS	10. ACRN	11. NSN	12. FSCM AND PART NUMBER	13. CIRR
U	AA	N		

14. SITE CODES A.POA	B.ACP	C.FOB	15. NOUN	16. SVC/AGENCY USE
D	D	D	IRP/PHASE II/STAGE I CARSWELL AFB TX	

17. PR/MIPR DATA	18. AUTHORIZED RATE A.PROGRESS PAY	B.RECOUP	19. CONTRACT PERCENT FEE	20. SVC ID NO.	21. ITEM/PROJ MGR
FY7624-84-01839-0001	%	%	%		FY7624

22. 1ST DISCOUNT A.	B.DAYS	23. 2ND DISCOUNT A.	B.DAYS	24. 3RD DISCOUNT A.	B.DAYS	25. NET DAYS	26. QUANTITY VARIANCE A. OVER	B. UNDER	27. TYPE CONTRACT	28. OPR
%		%		%			%	%		

29. DESCRIPTIVE DATA

PERFORM FIELD SURVEY IN ACCORDANCE WITH THE TASK DESCRIPTION AS SET FORTH ON PAGES 4 THRU 19 HEREOF, AND SECTION C, DESCRIPTION/SPECIFICATIONS OF THE BASIC CONTRACT, AND SUBMIT DATA IN ACCORDANCE WITH ATTACHMENT #1, THE CONTRACT DATA REQUIREMENTS LIST, OF THE BASIC CONTRACT AS IMPLEMENTED ON PAGE 12 BY PARAGRAPH VI HEREOF.

IN NO EVENT SHALL THE AMOUNT PAID FOR THE NUMBER OF HOURS SPECIFIED EXCEED THE AMOUNT SPECIFIED IN BLOCK 8 ABOVE.

4. ITEM NO.	5. QUANTITY*	6. PURCH UNIT	7. UNIT PRICE	8. TOTAL ITEM AMOUNT*
0002	1	LO	$	$E232,397.17

9. SCTY CLAS	10. ACRN	11. NSN	12. FSCM AND PART NUMBER	13. CIRR
U	AA	N		

14. SITE CODES A.POA	B.ACP	C.FOB	15. NOUN	16. SVC/AGENCY USE
D	D	D	SUPPORT	

17. PR/MIPR DATA	18. AUTHORIZED RATE A.PROGRESS PAY	B.RECOUP	19. CONTRACT PERCENT FEE	20. SVC ID NO.	21. ITEM/PROJ MGR
FY7624-84-01839-0002	%	%	%		FY7624

22. 1ST DISCOUNT A.	B.DAYS	23. 2ND DISCOUNT A.	B.DAYS	24. 3RD DISCOUNT A.	B.DAYS	25. NET DAYS	26. QUANTITY VARIANCE A. OVER	B. UNDER	27. TYPE CONTRACT	28. OPR
%		%		%			%	%		

29. DESCRIPTIVE DATA

SUPPORT FOR ITEM 0001 ABOVE.

IN NO EVENT SHALL THE TOTAL AMOUNT PAID FOR THIS ITEM EXCEED THE AMOUNT AMOUNT SPECIFIED IN BLOCK 8 ABOVE.

*REPRESENTS NET AMOUNT OF INCREASE/DECREASE WHEN MODIFYING EXISTING ITEM NO.

N = NOT APPLICABLE
U = UNDEFINITIZED
NSP = NOT SEPARATELY PRICED

E = ESTIMATED
– (IN QTY AND $) = DECREASE
+ OR – (IN ITEM NO.) = ADDITION OR DELETION
CIRR: CONTROLLED ITEM RPT RQMT

SITE CODES: S = SOURCE, D = DESTINATION, O = INTERMEDIATE

PART I SECTION B OF THE SCHEDULE
SUPPLIES LINE ITEM DATA

1. PROC INSTRUMENT ID NO. (PIIN): F33615-84-D-4402
2. SPIIN: 0006
3. PAGE 3 OF 20

4. ITEM NO.	5. QUANTITY*	6. PURCH UNIT	7. UNIT PRICE	8. TOTAL ITEM AMOUNT*
0004	1	LO	$	$E22,481.17

9. SCTY CLAS	10. ACRN	11. NSN	12. FSCM AND PART NUMBER	13. CIRR
U	AA	N		

14. SITE CODES A. PQA	B. ACP	C. FOB	15. NOUN	16. SVC/AGENCY USE
D	D	D	CHEMICAL ANALYSIS	

17. PR/MIPR DATA	18. AUTHORIZED RATE A. PROGRESS PAY	B. RECOUP	19. CONTRACT PERCENT FEE	20. SVC ID NO.	21. ITEM/PROJ MGR
FY7624-84-01839-0004	%	%	%		FY7624

22. 1ST DISCOUNT A.	B. DAYS	23. 2ND DISCOUNT A.	B. DAYS	24. 3RD DISCOUNT A.	B. DAYS	25. NET DAYS	26. QUANTITY VARIANCE A. OVER	B. UNDER	27. TYPE CONTRACT	28. OPR
%		%		%			%	%		

29. DESCRIPTIVE DATA

PERFORM CHEMICAL ANALYSIS IN ACCORDANCE WITH THE TASK DESCRIPTION AS SET FORTH ON PAGES 4 THRU 19 HEREOF, AND SECTION C, DESCRIPTION/SPECIFICATIONS OF THE BASIC CONTRACT.

IN NO EVENT SHALL THE AMOUNT PAID FOR THE NUMBER OF HOURS SPECIFIED EXCEED THE AMOUNT SPECIFIED IN BLOCK 8 ABOVE.

4. ITEM NO.	5. QUANTITY*	6. PURCH UNIT	7. UNIT PRICE	8. TOTAL ITEM AMOUNT*
			$	$

9. SCTY CLAS	10. ACRN	11. NSN	12. FSCM AND PART NUMBER	13. CIRR

14. SITE CODES A. PQA	B. ACP	C. FOB	15. NOUN	16. SVC/AGENCY USE

17. PR/MIPR DATA	18. AUTHORIZED RATE A. PROGRESS PAY	B. RECOUP	19. CONTRACT PERCENT FEE	20. SVC ID NO.	21. ITEM/PROJ MGR
	%	%	%		

22. 1ST DISCOUNT A.	B. DAYS	23. 2ND DISCOUNT A.	B. DAYS	24. 3RD DISCOUNT A.	B. DAYS	25. NET DAYS	26. QUANTITY VARIANCE A. OVER	B. UNDER	27. TYPE CONTRACT	28. OPR
%		%		%			%	%		

29. DESCRIPTIVE DATA

*REPRESENTS NET AMOUNT OF INCREASE/DECREASE WHEN MODIFYING EXISTING ITEM NO.

N = NOT APPLICABLE
U = UNDEFINITIZED
NSP = NOT SEPARATELY PRICED

E = ESTIMATED
– (IN QTY AND $) = DECREASE
+ OR – (IN ITEM NO.) = ADDITION OR DELETION
CIRR: CONTROLLED ITEM RPT RQMT

SITE CODES: S = SOURCE, D = DESTINATION, O = INTERMEDIATE

AFSC FORM 705 JAN 80 PREVIOUS EDITION WILL BE USED. AFSC—Andrews AFB Md 1980

27 JUL 1984

INSTALLATION RESTORATION PROGRAM
PHASE II - CONFIRMATION/QUANTIFICATION
(STAGE 1) CARSWELL AFB TEXAS

I. DESCRIPTION OF WORK

The purpose of this task is to undertake a field survey at Carswell AFB TX to determine: (1) the presence or absence of contamination within the specified areas of the survey; (2) the potential for migration of identified contaminants in the various environmental media; (3) additional investigations necessary to define the magnitude, extent, direction and rate of migration of identified contaminants; and (4) potential environmental consequences and health risks of migrating contaminants.

The Phase I IRP report (mailed under separate cover) incorporates the background and description of the sites for this task. To accomplish this survey effort, the contractor shall take the following actions:

A. General

1. Well Installation:

a. Each borehole shall be drilled in accordance with ASTM procedures.

b. Install 33 boreholes for a total of 1440 linear feet. Twenty-four [illegible] boreholes shall be completed as ground-water monitoring wells for a total of 1280 linear feet.

c. Each well shall be developed as soon as practical after completion by blowing with air and pumping or by using a bailer. Well development shall proceed until the discharge water is clear and free of sediment to the fullest extent practical.

d. Field permeability tests shall be performed in accordance with ASTM procedures.

e. Hollow stem auger techniques shall be used to install boreholes and monitoring wells in the upper zone (alluvium) to allow the collection of split-samples. Split-spoon samples shall be collected, containerized, described and logged at 5 ft intervals or at stratum changes. Samples to be analyzed chemically (per para B.) shall be capped, frozen and package for overnight shipment to the appropriate laboratory. Two split-spoon samples from each well/borehole shall be selected based on color, odor, and organic vapor analysis (OVA) and analyzed per Table 2, Atch 3. The remaining samples shall be archived and analyzed only if contamination is found in the first samples.

f. Each ground-water monitoring well shall be screened over the entire saturated thickness.

g. Air rotary methods shall be used for drilling monitor wells into the Paluxy. Special precautions shall be taken to ensure that contaminants are not introduced into the Paluxy during drilling or as a result of migration around the borehole after well installation.

h. Schedule 40 PVC shall be used for upper zone wells and schedule 80 PVC for Paluxy wells and any well over 100 feet deep.

2. The contractor shall monitor all exploratory well drilling and borehole operations with an OVA instrument to identify potential generation of hazardous and/or toxic materials. In addition, the contractor shall monitor drill cuttings for discoloration and odor. During drilling operations, if soil cuttings are suspected to be hazardous (based on OVA measurement, odors, or discoloration), the contractor shall place them in proper containers and test them for EP Toxicity and Ignitibility. Results of this monitoring shall be included in boring logs.

3. Sampling and Analysis

a. All water samples collected shall be analyzed on site for pH, temperature, and the specific conductance. Sampling, maximum holding time, and preservation of samples shall strictly comply with the following references: Standard Methods for the Examination of Water and Wastewater, current edition; ASTM, Section 11, Water and Environmental Technology; Methods for Organic Chemical Analysis of Municipal and Industrial Wastewater, EPA-600/4-82-057; and Methods for Chemical Analysis of Waters and Wastes, EPA Manual 600/4-79-020. All chemical analyses (water, sediment and soil) shall meet the required limits of detection for the applicable EPA method identified in Table 1, Attachment 1.

b. Locations where water, soil, or sediment samples are taken shall be surveyed and marked where possible with a permanent marker, and the location documented on a project site map.

c. Split all water, sediment and soil samples as part of the contractor's specific Quality Assurance/Quality Control (QA/QC) protocols and procedures. One set of samples shall be analyzed by the contractor. The other set of samples shall be forwarded for analysis through overnight delivery to:

USAF OEHL/SA
Bldg 140
Brooks AFB TX 78235

The samples sent to the USAF OEHL/SA shall be accompanied by the following information:

(1) Purpose of sample (analyte)

(2) Installation name (base)

(3) Sample number (on containers)

(4) Source/location of sample

(5) Contract Task Numbers and Title of Project

(6) Method of collection (bailer, suction pump, air-lift pump etc.)

(7) Volumes removed before sample taken

(8) Special Conditions (use of surrogates, filtering, etc.)

(9) Preservatives used, especially any nonstandard types.

This information shall be forwarded with each sample by properly completing an AF Form 2752 (copy of form and instructions on proper completion mailed under separate cover). In addition, copies of field logs documenting sample collection parameters should accompany the samples.

Chain-of-custody records for all samples, field blanks, and quality control duplicates shall be maintained.

d. Water levels shall be measured at all monitoring wells to the nearest 0.01 feet.

e. All wells shall be purged prior to sampling to ensure that fresh formation water is collected. Purging shall proceed until at least three well volumes of water have been displaced or until pH, temperature, and specific conductance stabilize. If water flow to the well is too low or recharge too slow to meet the above conditions, the contractor shall document the number of volumes purged and sample in the most practical manner to get a representative sample. All sampling in the upper zone shall be conducted using 2-inch stainless steel Kemmerer sampler, teflon bailer, or PVC bailer. Sampling in the Paluxy shall be done with a dedicated pump installed in each well.

f. Second-column confirmation shall be required when detection limits exceed values identified in Attachment 1, for EPA Methods 601 and 602. Second column confirmation shall be conducted on a maximum of 50% of the samples collected for these analyses. Total number of samples for Method 601 and 602 in Attachment 2 include these confirmation analyses.

g. Ground-water elevations shall be measured at three points in time on all wells. One measurement shall be taken when the well is developed, a second when the sample is obtained and the third approximately one month after sampling. Measurements shall be referenced to an established, surveyed mark-point on the top of the well casing.

h. Flow conditions shall be documented for all surface-water sampling.

4. Field data collected for each site shall be plotted and mapped.The nature, magnitude, and potential for contaminant flow within each zone to receiving streams and groundwaters shall be estimated. Upon completion of each sampling and analysis effort, the data shall be tabulated in the next RβD Status report as specified in Item VI below.

5. Determine the areal extent of the sites by reviewing available aerial photos of the base, both historical and the most recent panchromatic infrared.

B. In addition to items delineated in A above, conduct the following specific actions at the indicated sites on Carswell AFB:

1. Site 13, Flightline Drainage Ditch

a. Hand auger six soil borings to a depth of 10 ft at locations as shown in Figure 1, Atch 2. Samples shall be collected at two foot intervals and analyzed as shown in Table 2, Atch 3.

b. Three sediment samples shall be collected at locations shown in Figure 1, Atch 2 and analyzed as shown in Table 2, Atch 3.

2. Site 12, Fire Department Training Area No. 2

a. Geologic conditions and plume existence shall be determined by a site geophysical survey (electromagnetics and electrical resistivity).

b. Three ground-water monitoring wells (one upgradient, two downgradient) shall be installed in the upper zone to an average depth of 40 ft (total of 120 linear ft) as shown in Figure 2, Atch 4. Collect split-spoon samples per A.1.e and analyze as shown in Table 2, Atch 3.

c. Collect two rounds of ground-water samples from each well (total of 6 samples) one month apart, and analyze for parameters shown in Table 2, Atch 3.

d. Collect two surface water samples (one month apart) from the small tributary to Farmers Branch north of the site and analyze for parameters shown in Table 2, Atch 3.

e. Hand auger one soil boring to a depth of ten feet. Collect 5 soil samples (2 ft intervals) and analyze per Table 2, Atch 3. Collect one ground-water sample and analyze per Table 2, Atch 3.

3. Site 17, POL Tank Farm

a. Eight soil borings (2 upgradient, 6 downgradient) shall be drilled to a maximum depth of 20 feet each (total of 160 linear ft) as shown in Figure 3, Atch 5. Analyze soil from each borehole for signs of fuels by observing odor, color, and OVA measurements.

b. Collect one water sample from each borehole (total of eight) and analyze per Table 2, Atch 3.

c. Collect split-spoon samples per A.1.e from each of the eight wells and analyze per Table 2, Atch 3.

4. Site 10, Waste Burial Area

a. Conduct a geophysical survey (electromagnetic, electrical resistivity, and magnetometer) to define the site geologic conditions, waste boundaries, and any plume present.

b. Install three upper zone monitor wells (Figure 2, Atch 4) to an average depth of 40 ft (total of 120 linear feet). One well shall be drilled upgradient and two downgradient. Collect split-spoon samples per A.1.e and analyze as shown in Table 2, Atch 3.

c. Collect two water samples (one month apart) from each well and analyze per Table 2, Atch 3.

5. Site 16, Unnamed Stream

a. Hand auger three soil borings to a maximum depth of 10 ft each (total of 30 linear feet) at locations shown in Figure 4, Atch 6. Collect samples at two foot intervals, a total of 15 soil samples. Analyze two soil samples from each borehole based on OVA, odor, or color per Table 2, Atch 3. Archive the remaining samples and analyze if the previous samples are found to be contaminated.

b. Collect two samples (one month apart) from the stream and analyze per Table 2, Atch 3.

c. Collect two water samples (one month apart) from the oil/water separator and analyze per Table 2, Atch 3.

d. Conduct a geophysical survey (magnetometer) in the vicinity of the abandoned gas station to determine if the tanks are still in place and to evaluate potential of the site as a source of contamination.

e. Drill three soil borings to an average depth of 40 ft (total of 120 linear feet) as shown in Figure 4, Atch 6. Analyze soils using an OVA. Collect three water samples and analyze for TOC, TOX, OβE, heavy metals and Purgeable Organics per Table 2, Atch 3.

6. Site 15, Entomology Dry Well

a. One sample from the entomology dry well shall be collected and analyzed for pesticides per Table 2, Atch 3.

b. Drill three wells (Figure 4, Atch 6), in the upper zone (two downgradient and one upgradient). The wells shall be drilled to an average depth of 40 ft (total of 120 linear feet). Each well shall be sampled twice (one month apart) and each sample analyzed for pesticides per Table 2, Atch 3. Split-spoon samples shall be collected per A.1.e. and analyzed as shown in Table 2, Atch 3.

7. Site 1, Landfill 1

a. Conduct geophysical surveys (electromagnetic, electrical resistivity, and magnetometer) to delineate waste boundaries and aid in selection of monitor well locations.

b. Drill four wells (one upgradient and three downgradient) into the upper zone at an average depth of 30 ft (total of 120 linear ft) at locations shown in Figure 5, Atch 7.

c. Collect two water samples (one month apart) from each well (total of 8 samples) and analyze as shown in Table 2, Atch 3. Split-spoon samples shall be collected per A.1.e. aud analyzed as shown in Table 2, Atch 3.

8. Site 4, Landfill 4

a. Conduct geophysical surveys (electromagnetic, electrical resistivity, and magnetometer) to define geological conditions and waste/plume boundaries in the upper zone.

b. Collect two grab samples (one month apart) of the surface water from the stream east of the site and analyze per Table 2, Atch 3.

c. Drill five boreholes (one upgradient and four downgradient) into the upper zone at an average depth of 40 ft each (total of 200 linear ft). Split-spoon samples shall be collected per A.1.e. and analyzed as shown in Tabel 2, Atch 3.

d. Each of the five boreholes shall be completed as a groundwater monitoring well. Two ground-water samples (one month apart) from each well shall be analyzed per Table 2, Atch 3.

e. Install one downgradient well to a depth of 200 ft into the upper Paluxy. Two ground-water samples (one month apart) shall be collected and analyzed per Table 2, Atch 3.

9. Site 5, Landfill No. 5

a. Conduct geophysical surveys (electromagnetic and electrical resistivity) to define geological conditions and waste boundaries in the upper zone.

b. Install three ground-water monitor wells (one upgradient and two downgradient) in the upper zone (total of 120 linear ft) as shown in Figure 2, Atch 4. Collect two ground-water samples (one month apart) and analyze per Table 2, Atch 3. Split-spoon samples shall be collected per A.1.e. and analyzed as shown in Table 2, Atch 3.

c. Install one upper Paluxy monitor well (200 linear ft) upgradient of this site. Collect two ground-water samples (one month apart) and analyze Table 2, Atch 3. Collect split-spoon samples per A.1.e and analyze as shown in Table 2, Atch 3.

d. Collect two surface water grab samples (one month apart) from the small stream that flows around the site. Analyze samples per Table 2, Atch 3.

10. Site 11, Fire Department Training Area No. 1

a. Drill two boreholes (one upgradient and one downgradient) to an average depth of 40 ft (total of 80 linear ft). Collect split-spoon samples per A.1.e. and analyze as shown in Table 2, Atch 3.

b. Complete the two boreholes as ground-water monitor wells. Collect and analyze two water samples per well (one month apart) per Table 2, Atch 3.

c. Hand auger one soil boring to a depth of 10 ft. Collect soil samples at two foot intervals (total of five) and analyze per Table 2, Atch 3.

11. Site 3, Landfill No. 3

Conduct geophysical surveys (electromagnetic and electrical resistivity) to define lateral and vertical boundaries of any contaminant plume.

12. Weapons Storage Area (WSA) Inspection Shop Site

a. Hand auger three soil borings to an average depth of five feet and spaced five feet apart.

b. Collect and analyze two soil samples from each boring for purgeable organics and oil and grease per Table 2, Atch 3.

c. Collect one ground-water sample from the on-site potable water well and analyze for radioisotopes per Table 2, Atch 3.

C. Well and Borehole Cleanup

All well and boring area drill cuttings shall be removed and the general area cleaned following the completion of each well and boring. Only those drill cuttings suspected as being a hazardous waste (based on discoloration, odor, or organic vapor analysis) shall be properly containerized (according to local civil engineering office requirements) by the contractor for eventual government disposal. The suspected hazardous waste shall be tested by the contractor for EP toxicity and Ignitibility. The contractor is not responsible for ultimate disposal of the drill cuttings. Disposal will be conducted by base personnel.

D. Data Review

Results of sampling and analysis shall be tabulated and incorporated in the Informal Technical Information Report (as specified in Item VI below) and forwarded to the USAF OEHL for review. Results shall also be forwarded as available in the next monthly R&D status report.

E. Reporting

1. A draft report delineating all findings of this field investigation shall be prepared and forwarded to the USAF OEHL (as specified in item VI below) for Air Force review and comment. This report shall include a discussion of the regional/site specific hydrogeology, well and boring logs, data from water level surveys, groundwater surface and gradient maps, water quality and soil analysis results, available geohydrologic cross sections, and laboratory quality assurance information. The report shall follow the USAF OEHL supplied format (mailed under separate cover).

2. The recommendation section shall address each site and list them by catagories. Catagory I shall include sites where no further action (including remedial action) is required. Data for these sites is considered sufficient to rule out unacceptable health or environmental risks. Category II sites are those requiring additional monitoring or work to quantify or further assess the extent of current or future contamination. Category III sites are sites that will require remedial actions (ready for IRP Phase IV actions). In each case, the contractor will summarize or present the results of field data, environmental or regulatory criteria, or other pertinent information supporting these conclusions.

F. Meetings

The contractor's project leader shall attend one meeting with Air Force headquarters and regulatory agency personnel to take place at a time to be specified by the USAF OEHL. The meeting shall take place at Carswell AFB for a duration of one day (eight hours).

II. SITE LOCATION AND DATES:

Carswell AFB TX
Date to be established

III. BASE SUPPORT: None

IV. GOVERNMENT FURNISHED PROPERTY: None

V. GOVERNMENT POINTS OF CONTACT:

1. Maj George R. New
USAF OEHL/TSS
Brooks AFB TX 78235
(512) 536-2158
AV 240-2158

2. Capt David R. Carpenter
USAF Regional Hosp Carswell/SGPB
Carswell AFB TX 76127
(817) 735-7111
AV 739-7111

2. Col Ronald D. Burnett
HQ SAC/SGPB
Offutt AFB NE 68113
(402) 294-4651
AV 271-4651

VI. In addition to sequence numbers 1, 5, and 10 in Attachment 1 to the contract, which are applicable to all orders, the sequence numbers listed below are applicable to this order. Also shown are data applicable to this order.

Sequence No.	Block 10	Block 11	Block 12	Block 13	Block 14
3	O/Time	*	*		
4	One/R	8 Mar 85	10 May 85	12 Jul 85	**

* Upon completion of analytical effort before submission of 1st draft report.

** Two draft reports will be required. After incorporating Air Force comments concerning the first draft report, the contractor shall supply the USAF OEHL with one copy of the second draft report. Upon acceptance of the second draft, the USAF OEHL will furnish a distribution list for the remaining 24 copies of the second draft. The contractor shall supply 50 copies plus the original camera ready copy of the final report.

Table 1 Analytical Detection Parameters

ANALYTE	METHOD	DETECTION LIMIT (µg/L)	QA/QC	NO. OF SAMPLES
Oil and Grease (IR)	EPA 413.2	100	17	179
Total Organic Carbon (TOC)*	EPA 415.1	1000	8	81
Total Organic Halogens (TOX)*	EPA 9020	5 (5 µg/g)	15	157
Purgeable Organics	EPA 601,602	**	51	153
pH	EPA 150.1	+0.1 unit		-
Specific Conductance	EPA 120.1	1 umho/cm		-
Lead	EPA		2	15
EP Toxicity	EPA 1310	***	4	39
Ignitability	EPA 1010	****	1	3
Phenols	EPA -	0.5 mg/Kg	9	93

* Detection limit for TOC must be 3 times the noise level of the instrument. Laboratory distilled water must show no response; if it shows a response, corrections of positive results must be made.

** Varies with compound. Refer to EPA method referenced above.

***

Metal	µg/L of solution
As	10
Ba	200
Cd	10
Cr	50
Pb	20
Hg	1
Se	10
Ag	10

**** Find if sample is ignitible at 140 degrees Farenheit or below. If so, it is a hazardous waste.

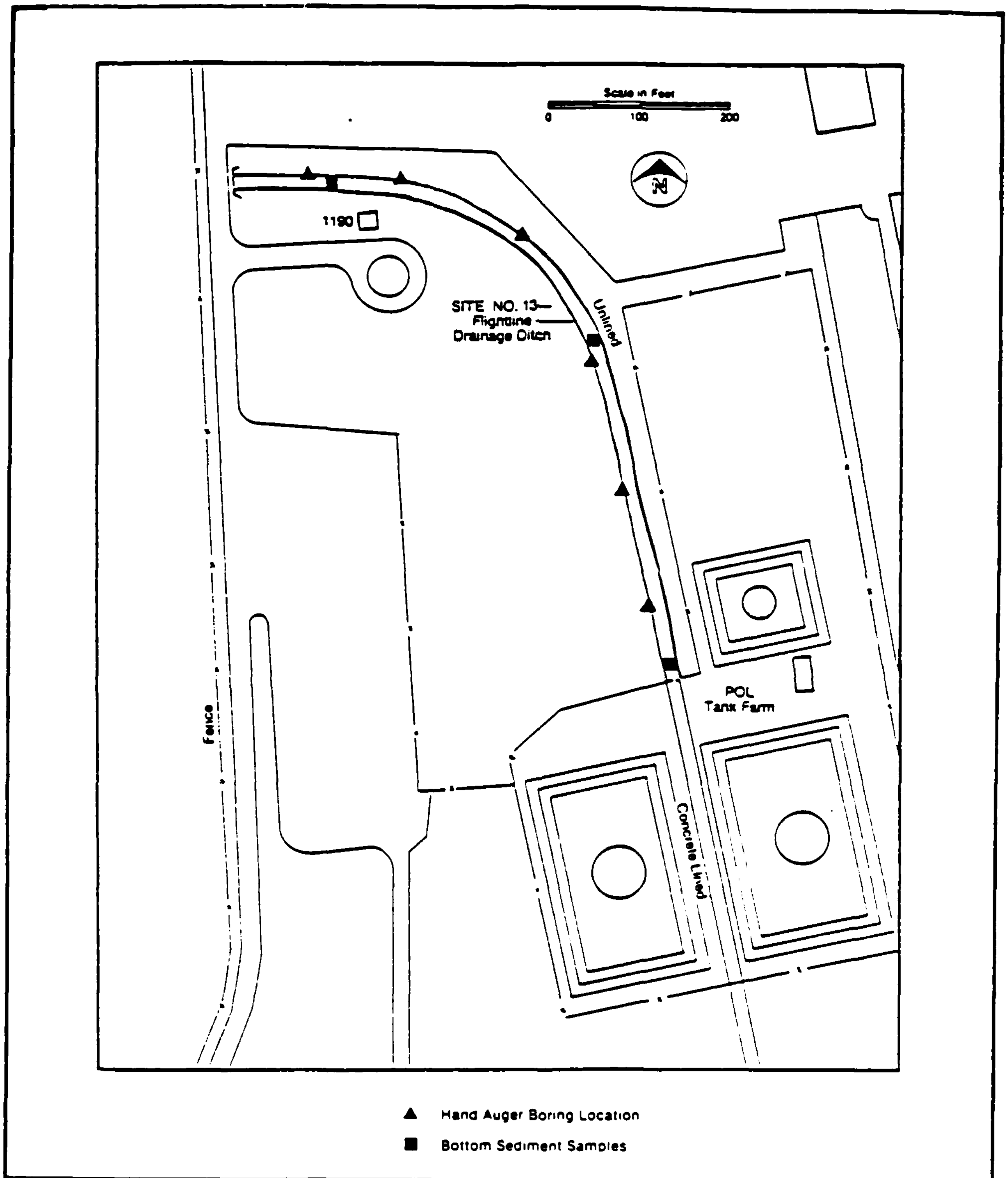


Figure 1 Phase II Stage 1 Program, Site No. 13

Table 2. IRP Phase II, Stage 1 Sampling Parameters

SAMPLING LOCATION

ANALYTE	#13	#12	#17	#10	#16	#15	#1	#4	#5	#11	WSA	OTHER	SUB TOTAL
TOC		7G 2W	8G	6G	3G 4W	7G	8G	2W 12G	2W 8G	4G			73
TOX	30S 3B	7G 2W 6S	8G 16S	6G 6S	3G 4W 6S		8G 8S		8G 8S	4G 9S			142
O&G	30S 3B	7G 2W 6S	8G 16S	6G 6S	3G 4W 6S		8G 8S	12G	8G 2W 8S	4G 9S	6S		162
Lead					3G 4W 6S								13
EP Toxicity	30S 3B											2	35
Pesticides						11 G 9 S	12 G 12 S	12 G 3 W	12 G 3 W 12 S	6 G 14 S			106
Phenols		7G 2W 6S					8G 8S	12G 12S	8G 8S	4G 9S			84
Primary Heavy Metals		11G 2W 6S					8G 8S	12G 12S	8G 8S	4G 9S			84
Purgeable Organics		11G 3W 17S		9 G 9S	5G 6W 9S		12 G 12 S	3 W 18 G	12 G 3 W 12 S	6 G 14 S	9S		170
COD								2W	2W				
Ignitability												2	2
Radiochemical											1G		1
No. Wells/ Boreholes	0	3	8	3	0	3	4	6	4	2		0	33
Total Depth of Wells/Boreholes	0	120	160	120	0	120	120	400	320	80		0	1440

G=Ground-water samples
S=Soil samples
W=Surface-water samples
B=Sediment samples
*Radiochemical: Gross A, Gross B, and Total Radium

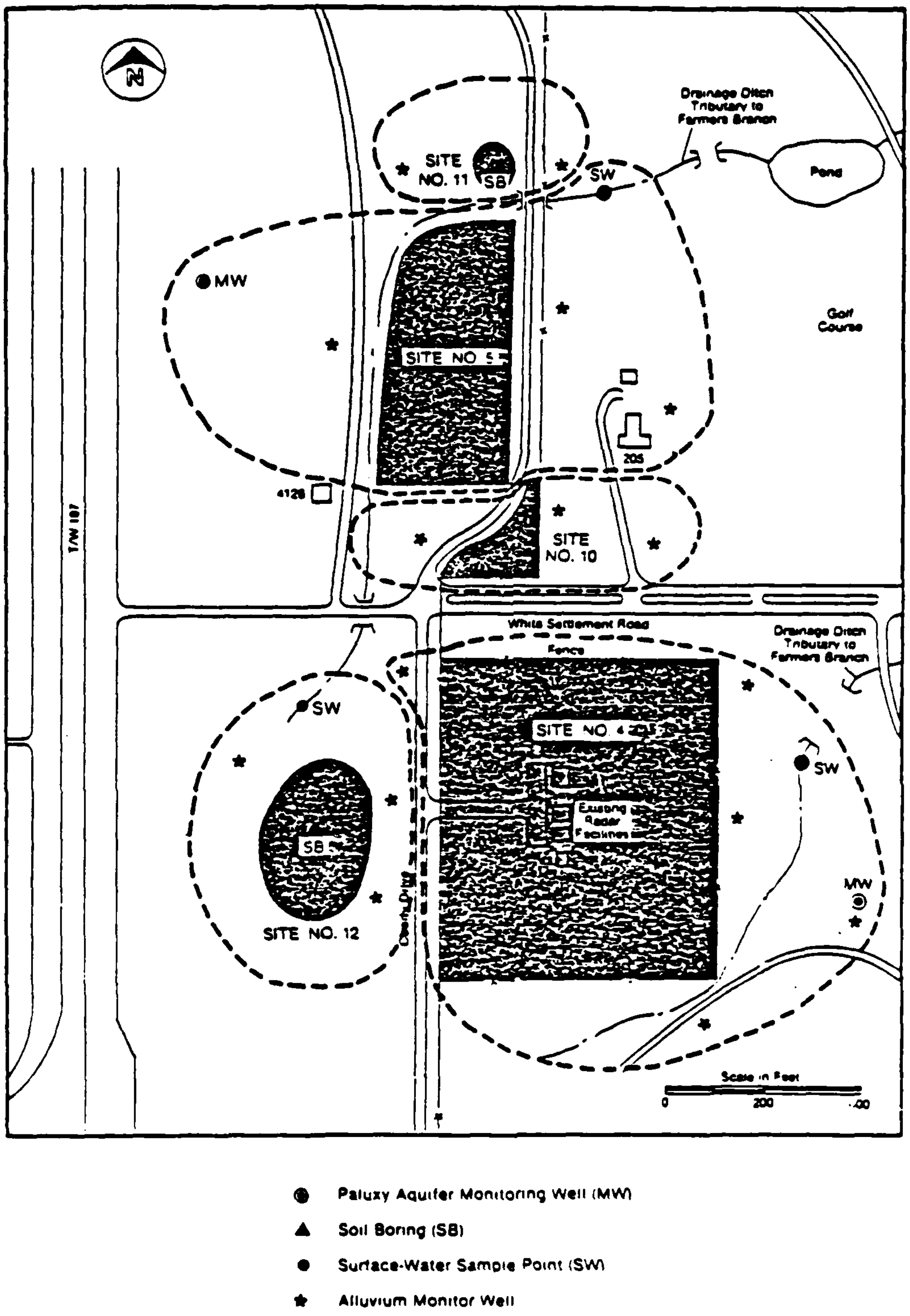


Figure 2 Phase II Stage 1 Program, Sites No. 4, 5, 10, 11, 12

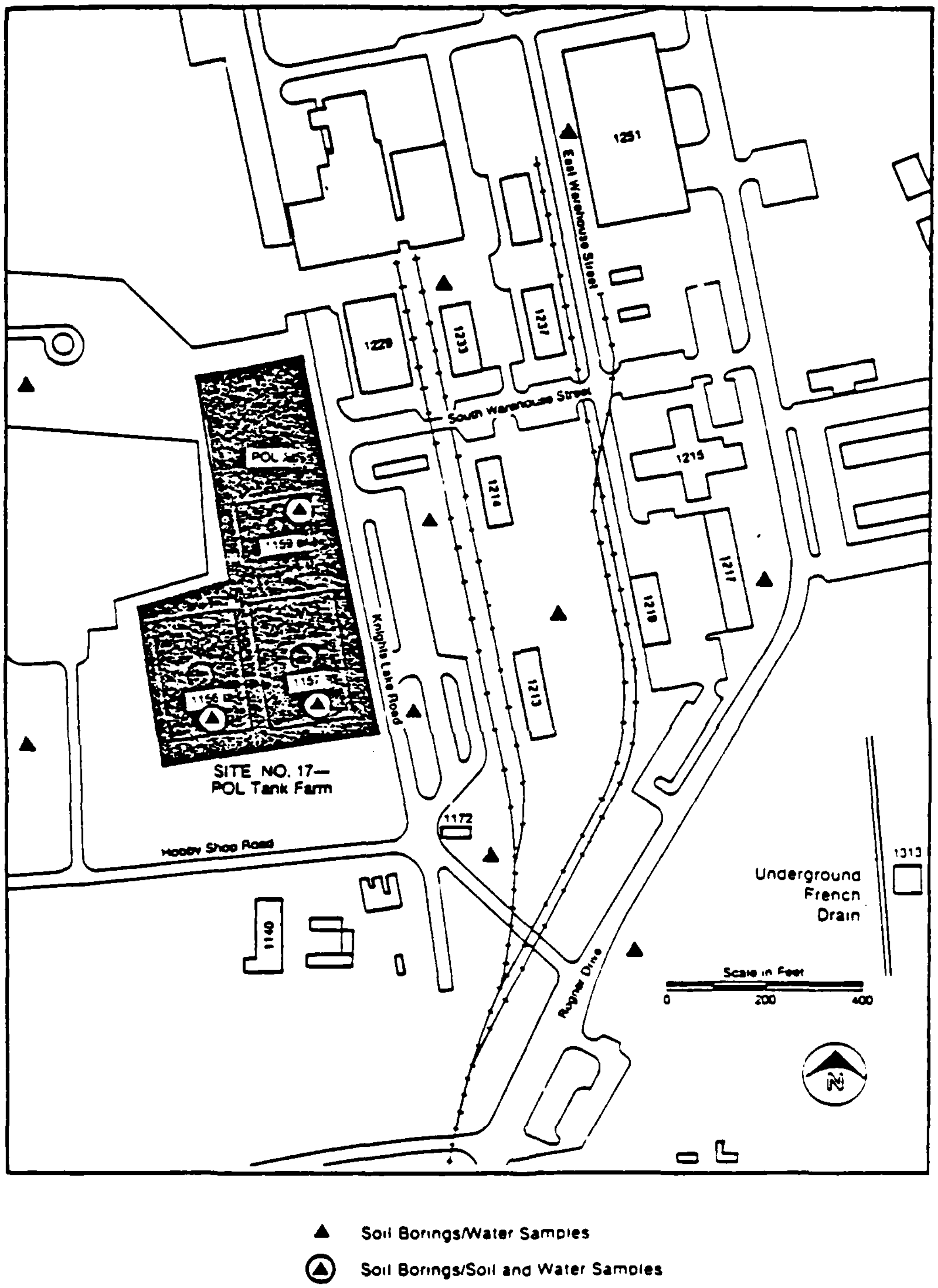
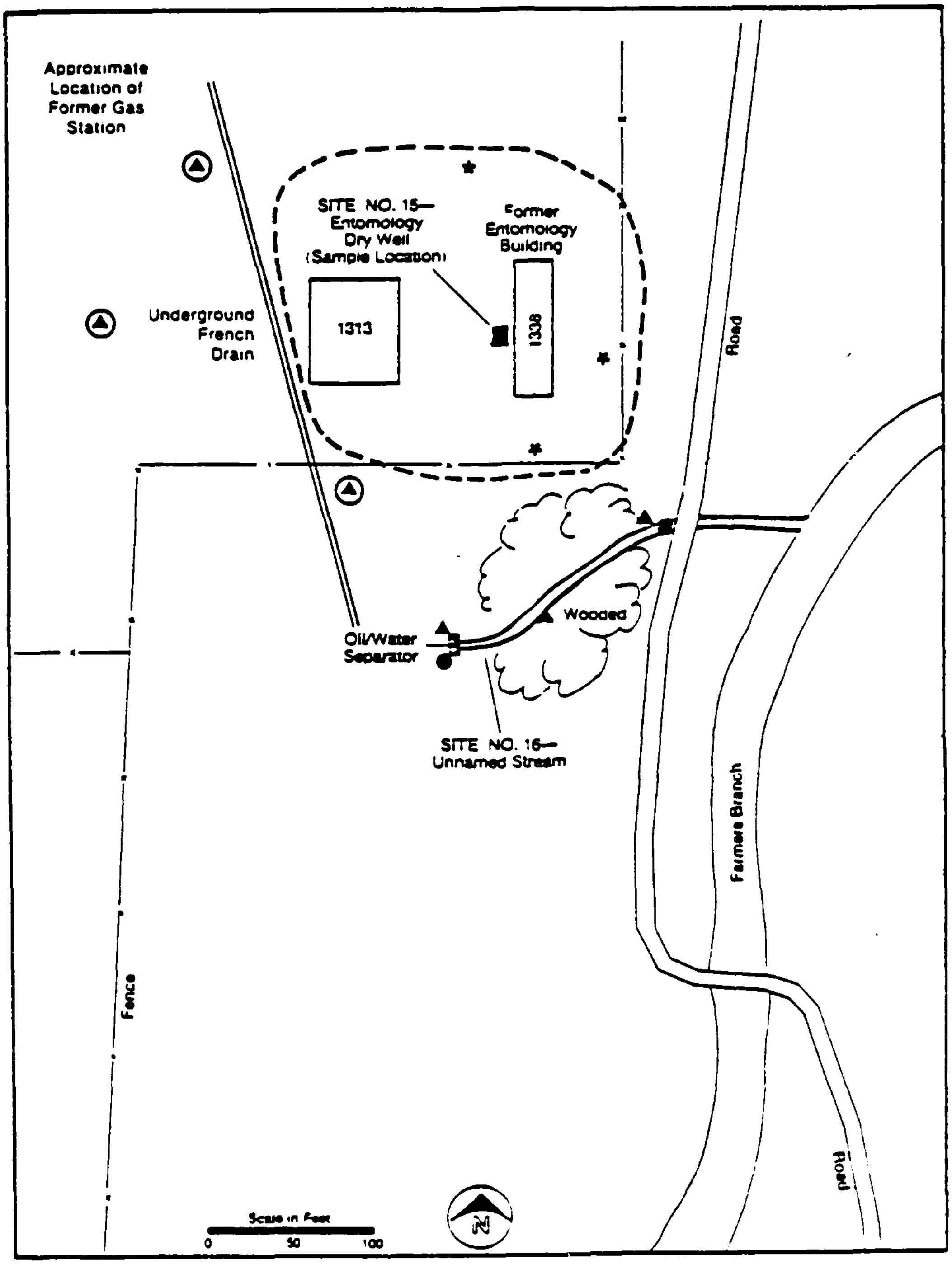


Figure 3 Phase II Stage 1 Program, Site No. 17



★ Alluvium Monitor Wells

● Surface Water Sampling Points

▲ Soil Borings

Ⓐ Soil Borings/Water Samples

Figure 4 Phase II Stage 1 Program, Sites No. 15 and 16

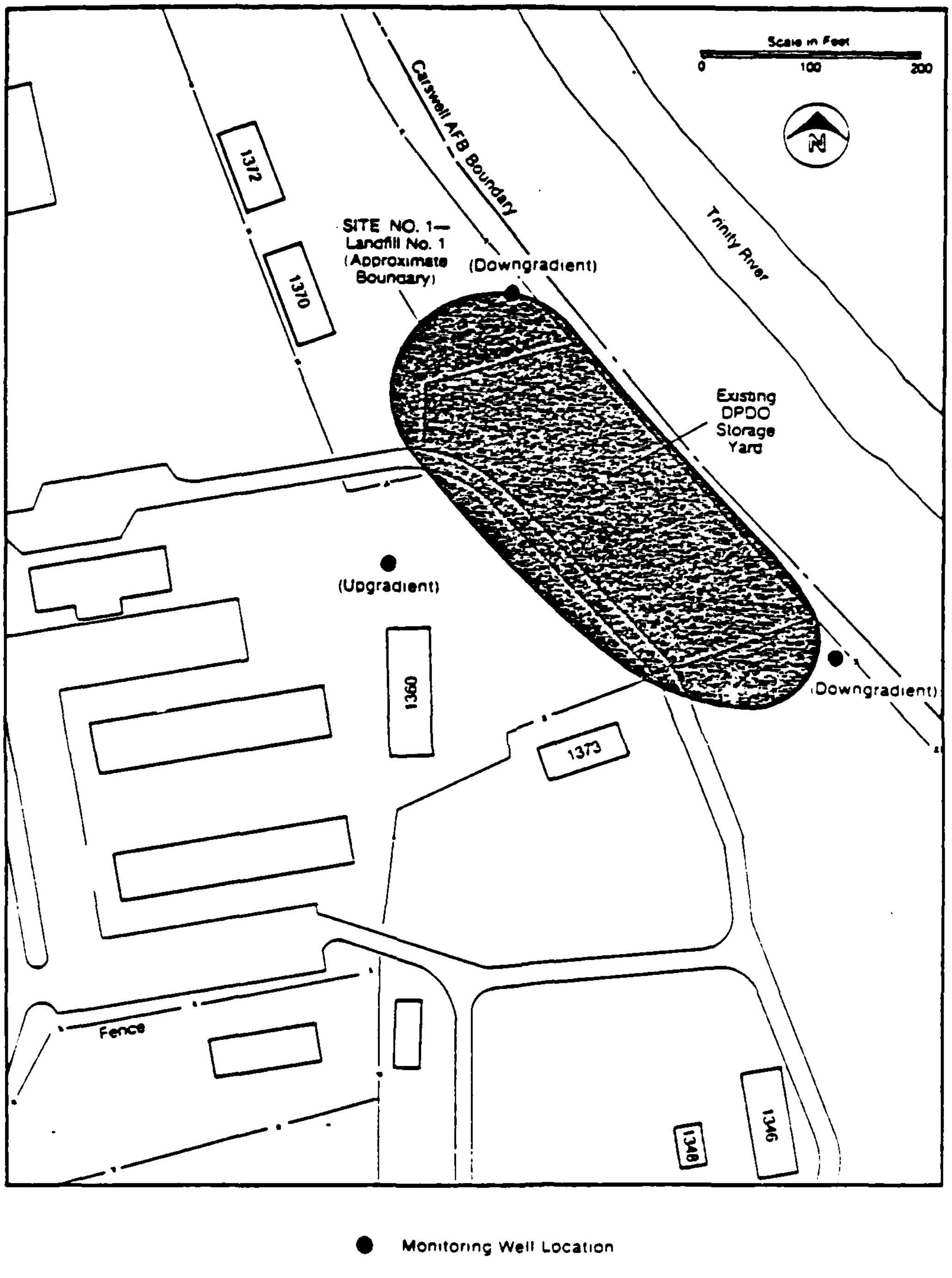


Figure 9 Phase II Stage 1 Program, Site No. 1

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APPENDIX D

Well Numbering System

APPENDIX D
Well Numbering System

The well and borings drilled at Carswell AFB during the Phase II investigation are identified by a two-part label. The label consists of a number followed by a letter of the alphabet. The number refers to the site at which the well or boring is located. The letter refers to the position of the well relative to the hydrogeology of the site. The letter A is assigned to the well believed to be upgradient from the site. The letter B, and those consecutive after it, are assigned to wells and borings that are downgradient of their respective sites.

An example is well 15A. The well is located at site No. 15, and is believed to be upgradient of any contamination that may be present at the site. Well 12C is located at site No. 12 and is believed to be downgradient of any contamination present at the site.

One boring not drilled during the Phase II investigation was included on the base-wide cross-section, A-A'. This boring was identified as #27 on the "Master Plan Soil Boring and Monument Data, Carswell AFB", prepared in June 1967. This plan was prepared by Carter and Burgess, Engineers, of Fort Worth, under contract AF 25(600)-4683.

APPENDIX E
Well Logs

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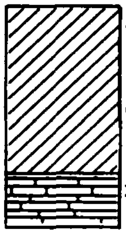
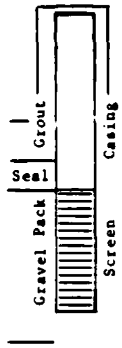
Log: Monitor Well 1A

Project Carswell AFB IRP
Location Outside of DPDO, to the West
Drilled by SWL (CME 75)
Logged by J.B. Chapman

Dates of Drilling/Well Completion 1/19/85
Elevations: Land Surface 566.62 Measuring Point 570.42
Total Depth 9 ft.
Drilling, Sampling Methods Hollow-stem auger; split-spoon

Depth (ft)	Sampling Record: Sample Type	Sampling Record: Blows per 6 inches	Sampling Record: Sample I.D.	Graphic Log	Geologic Description	Notes	Well Completion
+5							
0					CLAY; silty, black.		
5	SS	2-5	1A1 (850888)		CLAY; brown, moist; grades to gray clay with minor pebbles and sand just above 5 ft.		
					LIMESTONE.	Limestone at 7 feet.	
					End of boring: 9 feet.		
10							
15							
20							
25							
30							
35							
40							





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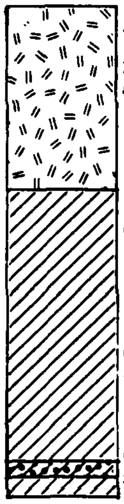
Log: Monitor Well 1B

Project Carswell AFB IRP
Location DPDO, North Yard
Drilled by SWL (CME 75)
Logged by J.B. Chapman

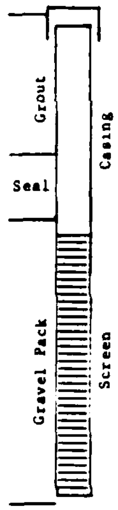
Dates of Drilling/Well Completion 1/19/85
Elevations: Land Surface 560.69 Measuring Point 560.24
Total Depth 20 ft.
Drilling, Sampling Methods Hollow-stem auger; split-spoon

Depth (ft)	Sampling Record: Sample Type	Sampling Record: Blows per 6 inches	Sampling Record: Sample I.D.	Geologic Description	Notes
+5					
0				ASPHALT.	
				FILL; contains pieces of concrete and tar.	
5	SS	10-9	1B1		
10	SS	3-4	1B2 (850886)	CLAY; dark gray to black; moist.	Water at 9 feet.
15	SS	7-9	1B3	CLAY; dark gray; cohesive; weathered shale.	
20	SS	4-6	1B4 (850887)	CLAY; brown; gravelly zone at 19.5 ft. containing pebbles over 1 in. in diameter, grading back into brown clay at 19.7 ft. End of boring: 20 feet.	
25					
30					
35					
40					

Graphic Log



Well Completion



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CORPORATION

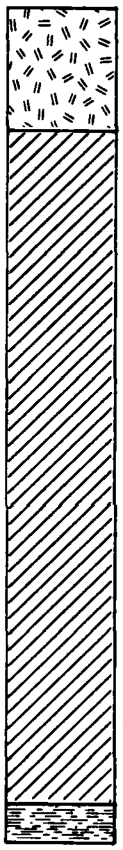
Log: Monitor Well 1C

Project Carswell AFB IRP
Location DPDO, South Yard
Drilled by SWL (CME 75)
Logged by J.B. Chapman

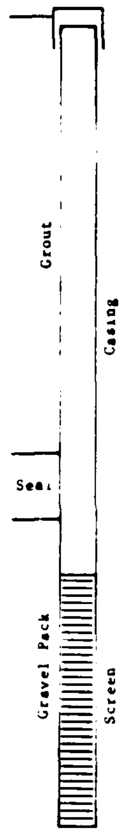
Dates of Drilling/Well Completion 1/19/85
Elevations: Land Surface 560.46 Measuring Point 560.03
Total Depth 34 ft.
Drilling, Sampling Methods Hollow-stem auger; split-spoon

Depth (ft)	Sampling Record: Sample Type	Sampling Record: Blows per 6 inches	Sampling Record: Sample I.D.	Geologic Description	Notes
+5-					
-					
0-				ASPHALT; cement, fill material.	
-					
	SS	31/14	1C1	FILL; contains concrete pieces.	
5-				CLAY; black; contains wood chips.	
-					
	SS	4/6	1C2		
10-					
-					
	SS	6/7	1C3 (850884)	CLAY; brown; contains minor pebbles and shell fragments.	Drager reaction.
15-					
-					
	SS	3/4	1C4	CLAY; brown to gray; minor sand and pebbles (up to 1.5 cm in diameter); moist.	
20-					
-					
	SS	3/4	1C5 (850885)	CLAY; brown to gray; contains pebbles and increasing sand with depth; wet.	Water.
25-					
-					
	SS	4/4	1C6	CLAY; brown to gray; contains sand, minor pebbles, and limestone fragments.	
30-					
-					
	SS	7/12	1C7	SHALE; bluish-gray; limonite staining; weathered. End of boring: 34 feet.	
35-					
-					
40-					
-					

Graphic Log



Well Completion



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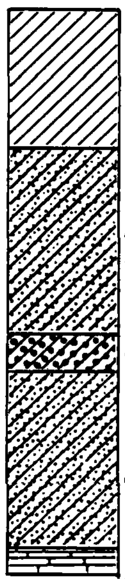
Log: Monitor Well 1D

Project: Carswell AFB IRP
Location: East of DPDO
Drilled by: SWL (CME 75)
Logged by: J.B. Chapman

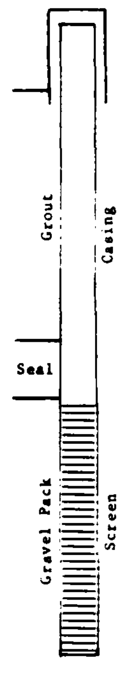
Dates of Drilling/Well Completion: 1/18/85
Elevations: Land Surface 560.46 Measuring Point 564.06
Total Depth: 24 ft.
Drilling, Sampling Methods: Hollow-stem auger; split-spoon

Depth (ft)	Sampling Record: Sample Type	Sampling Record: Blows per 6 inches	Sampling Record: Sample I.D.	Geologic Description	Notes
+5					
0				CLAY; dark brown to black, trace to some silt and fine sand, few gravel.	
5	SS	4-4	1D1		
10	SS	3-4	1D2 (850876)	Grades to tan color, increasing fine sand.	
15	SS	5-6	1D3	Thin gravel layer at 14 ft; clay is gray.	
20	SS	15-15	1D4 (850877)	Clay is moist.	Fuel odor at 19 ft; air sample reaction; cuttings damp, but no free water.
	SS	NA	1D5 (850878)	LIMESTONE; dry, hard. End of boring: 24 ft.	
25					
30					
35					
40					

Graphic Log



Well Completion



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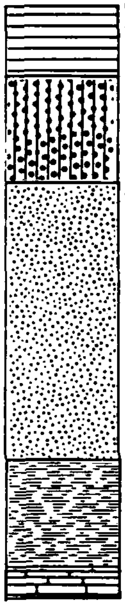
Log: Monitor Well 4A

Project Carswell AFB IRP
Location Southwest of Radar Facility
Drilled by SWL (CME 75)
Logged by L.N. French

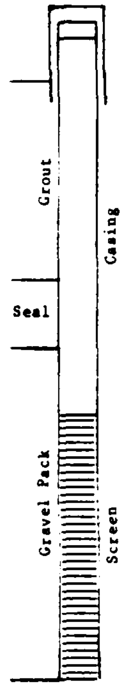
Dates of Drilling/Well Completion 1/14/85
Elevations: Land Surface 624.65 Measuring Point 625.84
Total Depth 24 ft.
Drilling, Sampling Methods Hollow-stem auger; split-spoon

Depth (ft)	Sampling Record: Sample Type	Blows per 6 inches	Sample I.D.	Geologic Description	Notes
+5-					
-					
0-				CLAY; silty, gray to black; increasing sand and gravel with depth; moist.	
-					
5-	SS	4-5	4A1		
-				SAND; fine to medium grained, tan to rust, dry; trace to some silt; trace fine gravel; moist.	No sample recovery
10-	SS	3-4	-		
-					Water at 13 ft.
15-	SS	5-3	4A2 (850806)		
-					
20-	SS	11-37	4A3	SHALE; bluish-gray; with interbedded limestone.	
-					Limestone at 23.5 ft
25-				End of boring: 24 ft.	
-					
30-					
-					
35-					
-					
40-					
-					

Graphic Log



Well Completion



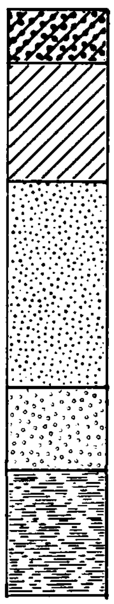
RADIAN CORPORATION

Log: Monitor Well 4B

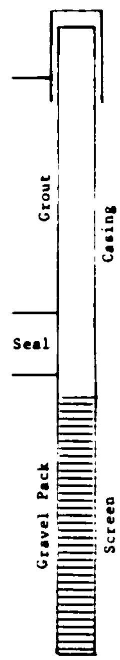
Project: Carswell AFB IRP	Dates of Drilling/Well Completion: 1/14/85
Location: Southeast of Radar Facility	Elevations: Land Surface 618.69 Measuring Point 620.02
Drilled by: SWL (CME 75)	Total Depth: 24 ft.
Logged by: L.N. French	Drilling, Sampling Methods: Hollow-stem auger; split-spoon

Depth (ft)	Sampling Record: Sample Type	Sampling Record: Blows per 6 inches	Sampling Record: Sample I.D.	Geologic Description	Notes
+5					
0				FILL; red to brown, clayey with variable amounts of fine to coarse sand, trace fine gravel.	
				CLAY; dark brown, moist; some silt. Grades to light brown, increasing silt.	
5	SS	5-8	4B1		
				SAND; fine to medium grained, tan, mostly quartz with some feldspar and mica, friable; occasional fine gravel.	
10					
15	SS	2-2	4B3 (850807)		Water at 16 ft.
				Increasing fine gravel.	
20	SS	10-40*	4B4 (850808)	SHALE; gray-blue with thin layers of limestone.	*for 5 1/2 in.
25				End of boring: 24 ft.	
30					
35					
40					

Graphic Log



Well Completion



RADIAN CORPORATION

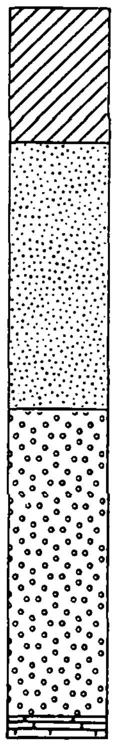
Log: Monitor Well 4C

Project: Carswell AFB IRP
Location: Golf Course-East of Radar Facility
Drilled by: SWL (CME 75)
Logged by: L.N. French

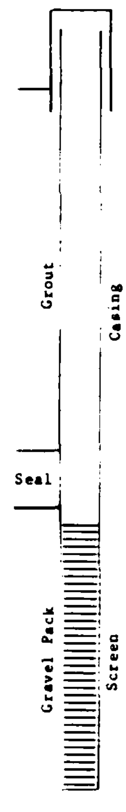
Dates of Drilling/Well Completion: 1/11/85
Elevations: Land Surface 610.82 Measuring Point 613.12
Total Depth: 29.5 ft.
Drilling, Sampling Methods: Hollow-stem auger

Depth (ft)	Sampling Record: Sample Type	Sampling Record: Blows per 6 inches	Sampling Record: Sample I.D.	Geologic Description	Notes
+5					
0				CLAY; dark brown, silty; grades to sandy clay, light tan, few fine gravel. Limestone gravel (1/2 in) at 4 ft.	
5	SS	3-4	4C1	SAND; fine to medium grained, red-brown, friable, dry; trace silt; few limestone and rock fragments.	
10	SS	6-7	4C2		
15	SS	23-2/*	4C3	Gravel and shell layer at 15 ft., increasing medium to coarse gravel interbedded with coarse tan sand.	*for 5 in. Water at 16 ft.
				GRAVEL; fine to coarse, rock fragments and shells; with SAND, stratified, medium to coarse grained.	
20	SS	16-23	4C4 (850804)		
25	SS	42-8*	4C5	Large limestone cobbles (4-5 in).	Air sample negative *for 0.25 in.
30	SS	-	4C6 (850805)	LIMESTONE: dark gray; hard.	Auger refusal.
				End of boring: 29.5 ft.	
35					
40					

Graphic Log



Well Completion



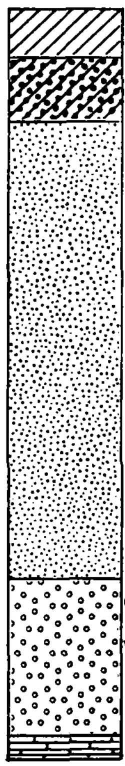
RADIAN
CORPORATION

Log: Monitor Well 4D

Project Carswell AFB IRP
Location Golf Course-East of Radar Facility
Drilled by SWL (CME 75)
Logged by L.N. French

Dates of Drilling/Well Completion 1/10/85
Elevations: Land Surface 613.15 Measuring Point 615.40
Total Depth 30.5 ft.
Drilling, Sampling Methods Hollow-stem auger; split-spoon

Depth (ft)	Sampling Record: Sample Type	Sampling Record: Blows per 6 inches	Sampling Record: Sample I.D.	Graphic Log	Geologic Description	Notes	Well Completion
+5–							
–							
0–					CLAY; dark brown, moist, some silt. Grades to tan, gravelly clay with decreasing moisture.		
–							
5–	SS	5–5	4D1		SAND, tan, fine to medium grained, quartz, dry.		
–							
10–	SS	5–6	4D2				
–							
15–	SS	9–13	4D3				
–						Water at 18 ft.	
20–	SS	17–10	4D4 (850802)		Increasing coarse sand, with gravel and cobbles.		
–							
25–	SS	13–18	4D5		GRAVEL; medium to coarse, rock fragments and shells; interbedded with coarse SAND, tan, stratified.	Air sample negative.	
–							
30–	SS	8–19	4D6 (850803)		LIMESTONE (?). End of boring: 30.5 ft.	Refusal at 30.5 ft.	
–							
35–							
–							
40–							
–							



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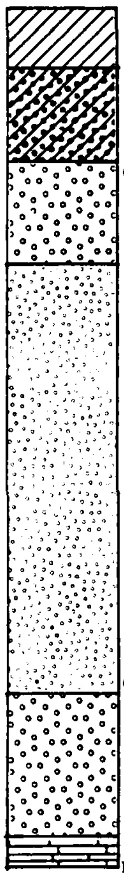
Log: Monitor Well 4E

Project Carswell AFB IRP
Location Northeast of Radar Facility
Drilled by SWL (CME 75)
Logged by L.N. French

Dates of Drilling/Well Completion 1/10/85
Elevations: Land Surface 617.45 Measuring Point 618.55
Total Depth 35 ft.
Drilling, Sampling Methods Hollow-stem auger; split-spoon



Depth (ft)	Sampling Record: Sample Type	Sampling Record: Blows per 6 inches	Sampling Record: Sample I.D.	Geologic Description	Notes
+5					
0				CLAY; dark brown, moist, with some silt and fine sand. Grades to light brown-tan with weathered limestone pebbles, increasing silt and sand.	
5	SS	10-13	4E1		
				GRAVEL; fine to medium, and SAND, medium to coarse grained, medium brown, stratified, friable, moist.	
10	SS	90-12	4E2	Decreasing gravel below 11 ft.	
15	SS	5-6	4E3		
20	SS	13-18	4E4		
25	SS	5-8	4E5 (850800)		Water at 24 ft.
				Gravel layer at 27.5 ft.	
30	SS	6-8	4E6 (850801)	Increasing gravel.	
					Air sample negative.
35	SS	24-26*	4E7 (850801)	LIMESTONE; dark gray, hard. End of boring: 35 ft.	*for 1.5 in. Refusal at 35 ft.
40					

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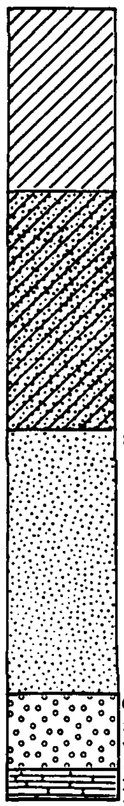
Log: Monitor Well 5A

Project Carswell AFB IRP
Location West of Landfill 5
Drilled by SWL (CME 75)
Logged by L.N. French

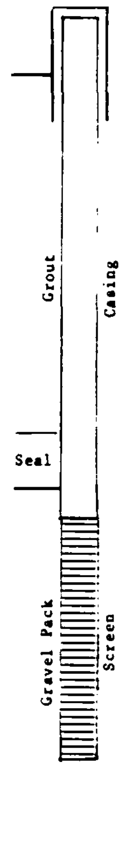
Dates of Drilling/Well Completion 1/16/85
Elevations: Land Surface 619.42 Measuring Point 623.22
Total Depth 32 ft.
Drilling, Sampling Methods Hollow-stem auger; split-spoon

Depth (ft)	Sampling Record: Sample Type	Sampling Record: Blows per 6 inches	Sampling Record: Sample I.D.	Geologic Description	Notes
+5					
0				CLAY; mottled reddish brown-tan, dry, some silt, trace sand and fine gravel.	
5	SS	8-11	5A1		
10	SS	4-8	5A2	Increasing fine sand, silt.	
15	SS	9-6	5A3		
20	SS	8-10	5A4	SAND; fine to medium grained, light tan, faintly laminated.	
25	SS	7-11	5A5 (850858)	Increasing fine gravel.	Water at 24 ft.
30	SS	13-29	5A6 (850859)	GRAVEL; medium to coarse, rock fragments and shell, interbedded with thin layers of medium to coarse sand. LIMESTONE (?). End of boring: 32 ft.	Refusal at 32 ft.
35					
40					

Graphic Log



Well Completion



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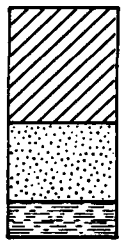
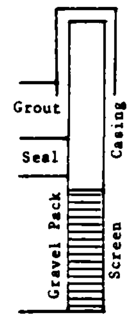
Log: Monitor Well 5B

Project Carswell AFB IRP
Location Northeast of Landfill 5 at Stream
Drilled by SWL (CME 75)
Logged by L.N. French

Dates of Drilling/Well Completion 1/15/85
Elevations: Land Surface 597.18 Measuring Point 600.48
Total Depth 9 ft.
Drilling, Sampling Methods Hollow-stem auger; split-spoon

Depth (ft)	Sampling Record: Sample Type	Sampling Record: Blows per 6 inches	Sampling Record: Sample I.D.	Graphic Log	Geologic Description	Notes	Well Completion
+5-							
-							
0-					CLAY; dark brown, with variable amounts of silt, sand and gravel; moist.		
-							
	SS	3-2	5B1 (850838)				
5-					SAND; fine to medium grained, orange-brown, trace silt and fine gravel.		
-					SHALE; gray-blue, hard, dry. End of boring: 9 ft.	Shale at 8 ft.	
	SS	50 (1 in)	5B2				
10-							
-							
15-							
-							
20-							
-							
25-							
-							
30-							
-							
35-							
-							
40-							
-							





RADIAN CORPORATION

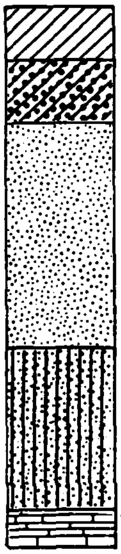
Log: Monitor Well 5C

Project Carswell AFB IRP
Location West of Landfill 5 at Goody Dr.
Drilled by SWL (CME 75)
Logged by L.N. French

Dates of Drilling/Well Completion 1/15/85
Elevations: Land Surface 606.63 Measuring Point 608.73
Total Depth 22 ft.
Drilling, Sampling Methods Hollow-stem auger; split-spoon

Depth (ft)	Sampling Record: Sample Type	Sampling Record: Blows per 6 inches	Sampling Record: Sample I.D.	Geologic Description	Notes
+5					
0				CLAY; medium brown; with some silt and fine to coarse sand, increasing gravel with depth.	
5	SS	3-7	5C1	SAND; fine to medium grained, orange-brown, dry; increasing moisture, few Mn stains.	
10	SS	7-10	5C2		Water at 12 ft.
15	SS	3-2	5C3 (850839)	Few layers and lenses of CLAY, reddish-brown, mottled with light tan, plastic; some silt.	Air sample negative.
20	SS	14-11	5C4 (850840)	LIMESTONE (?). End of boring: 22 ft.	
25					
30					
35					
40					

Graphic Log



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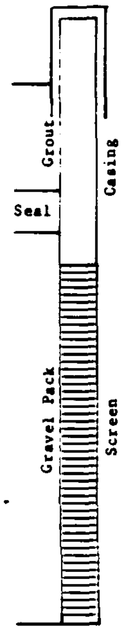

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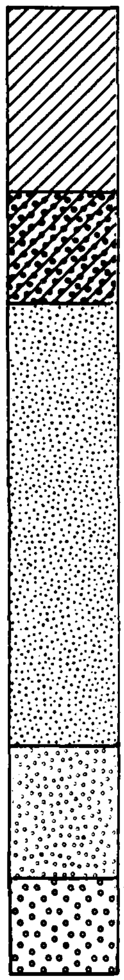
Log: Monitor Well 10A

Project Carswell AFB IRP
Location West of Waste Burial Area
Drilled by SWL (CME 75)
Logged by L.N. French

Dates of Drilling/Well Completion 1/15/85
Elevations: Land Surface 623.98 Measuring Point 626.68
Total Depth 39 ft.
Drilling, Sampling Methods Hollow-stem auger; split-spoon

Depth (ft)	Sampling Record: Sample Type	Sampling Record: Blows per 6 inches	Sampling Record: Sample I.D.	Geologic Description	Notes
+5					
0				CLAY; medium brown, dry, some silt; few limestone gravel.	
5	SS	15-17	10A1		
10	SS	16-29	10A2		
				SAND; fine to medium grained, orange-brown, dry.	
15	SS	6-7	10A3		
20	SS	12-19	10A4		
25	SS		10A5	Increasing moisture.	
					Water at 27 ft.
30	SS	6-13	10A6 (850860)		
				Increasing fine to medium gravel with shell fragments.	
35	SS	13-15	10A7		
				GRAVEL: medium to coarse grained, rock fragments and shell, interbedded with layers of SAND, fine to coarse grained, light tan, laminated.	
40	SS	N/A	10A8	End of boring: 39 feet.	

Graphic Log



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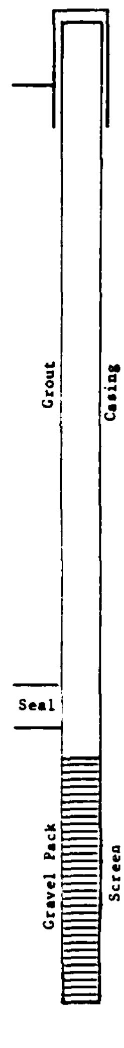

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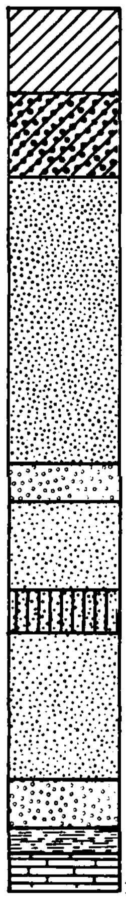
Log: Monitor Well 10B

Project Carswell AFB IRP
Location East of Waste Burial Area
Drilled by SWL (CME 75)
Logged by L.N. French

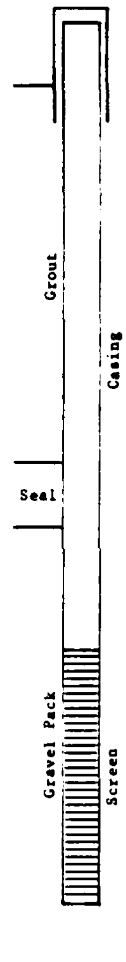
Dates of Drilling/Well Completion 1/14/85
Elevations: Land Surface 620.92 Measuring Point 624.42
Total Depth 36 ft.
Drilling, Sampling Methods Hollow-stem auger; split-spoon

Depth (ft)	Sampling Record: Sample Type	Sampling Record: Blows per 6 inches	Sampling Record: Sample I.D.	Geologic Description	Notes
+5-					
-					
0-				CLAY; dark brown, moist; some silt; grades to increasing fine to coarse grained sand with fine gravel.	
-					
	SS	10-13	10B1		
5-					
-				SAND; medium to coarse grained, tan-rust, dry; trace silt.	
	SS	5-4	10B2		
10-					
-					
	SS	7-9	10B3 (850809)		
15-					
-					
	SS	6-8	10B4	Few limestone gravel.	
20-					
-					
	SS	12-16	10B5	Few thin lenses and layers of red silty clay.	
25-					Water at 26.5 ft.
-					
	SS	6-16	10B6 (850810)		
30-					
-				Few zones of coarse sand and fine gravel.	
	SS	38-12*	10B7	SHALE; gray, hard.	*for 1 inch.
35-				LIMESTONE; gray. End of boring: 36 ft.	
-					
40-					
-					

Graphic Log



Well Completion



RADIAN CORPORATION

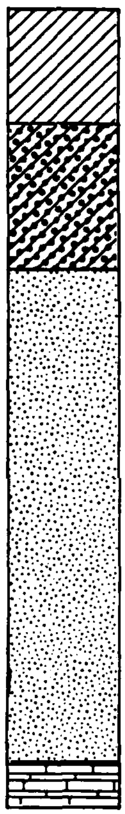
Log: Monitor Well 10C

Project: Carswell AFB IRP
Location: Northeast of Waste Burial Area
Drilled by: SWL (CME 75)
Logged by: L.M. French

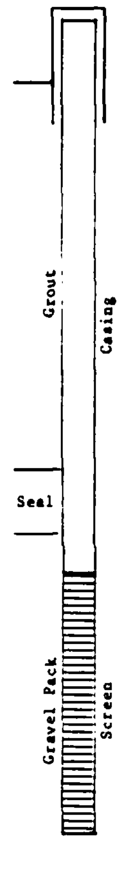
Dates of Drilling/Well Completion: 1/15/85
Elevations: Land Surface 615.16 Measuring Point 617.21
Total Depth: 32.5 ft.
Drilling, Sampling Methods: Hollow-stem auger; split-spoon

Depth (ft)	Sampling Record: Sample Type	Sampling Record: Blows per 6 inches	Sampling Record: Sample I.D.	Geologic Description	Notes
+5					
0				CLAY; dark brown, moist; some silt; trace fine to coarse sand; trace gravel grades to medium brown, dry clay.	
	SS	5-8	10C1		
5				Increasing gravel and coarse sand.	
	SS	17-20	10C2		
10				Gravelly zone at 11 feet. SAND; fine to medium grained, light tan, dry; some silt.	
	SS	25-25*	10C3		*for 5 1/2 in.
15					
	SS	NR	10C4	Increasing moisture.	Water at 22 ft.
20					
	SS	8-13	10C5 (850842)		
25					
	SS	5-7	10C6 (850837)		
30				LIMESTONE; hard, dry. End of boring: 32.5 feet.	
35					
40					

Graphic Log



Well Completion



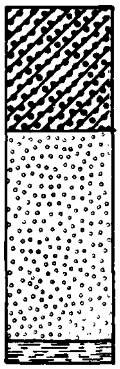
RADIAN CORPORATION

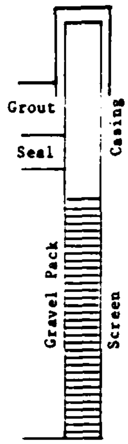
Log: Monitor Well 11A

Project Carswell AFB IRP
Location North of FTA 1
Drilled by SWL (CME 75)
Logged by L.N. French

Dates of Drilling/Well Completion 1/15/85
Elevations: Land Surface 604.75 Measuring Point 608.25
Total Depth 14.5 ft.
Drilling, Sampling Methods Hollow-stem auger; split-spoon

Depth (ft)	Sampling Record: Sample Type	Sampling Record: Blows per 6 inches	Sampling Record: Sample I.D.	Graphic Log	Geologic Description	Notes	Well Completion
+5						(11A destroyed on 1/23/85; replaced as shown at right)	
0					GRAVEL; limestone, coarse; and CLAY, dry, light brown; with some silt and fine to coarse grained sand.		
	SS	4-7	11A1				
5					SAND; medium to coarse grained, medium brown, stratified with thin gravel and shell layers.		
						Water at 8 ft.	
10	SS	3-4	11A2 (850841)				
	SS	13-28	11A3		SHALE; blue-gray, massive, hard. End of boring: 14.5 feet.		
15							
20							
25							
30							
35							
40							





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Log: Monitor Well 11B

Project Carswell AFB IRP

Location South of FTA 1

Drilled by SWL (CME 75)

Logged by L.N. French

Dates of Drilling/Well Completion 1/16/85

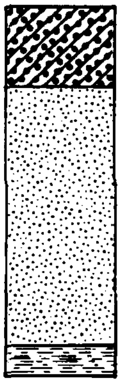
Elevations: Land Surface 603.56 Measuring Point 608.11

Total Depth 15 ft.

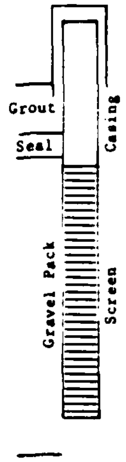
Drilling, Sampling Methods Hollow-stem auger; split-spoon

Depth (ft)	Sampling Record: Sample Type	Sampling Record: Blows per 6 inches	Sampling Record: Sample I.D.	Geologic Description	Notes
+5					
0				CLAY; dark brown to tan; with silt and fine sand. Trace fine gravel.	
	SS	4-5	11B1		
5				SAND; medium brown, medium to coarse grained; little silt.	Water at 7 ft. Air sample negative.
	SS	4-7	11B2 (850861)		
10					
	SS	13-25	11B3	SHALE, blue-gray, massive, hard.	
15				End of boring: 15 ft.	
20					
25					
30					
35					
40					

Graphic Log



Well Completion



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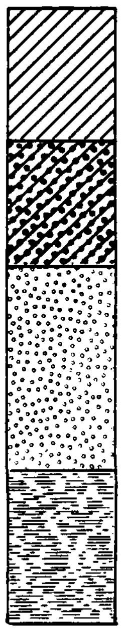
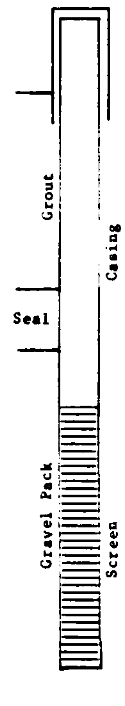
Log: Monitor Well 12A

Project Carswell AFB IRP
Location Southwest of FTA 2
Drilled by SWL (CME 75)
Logged by L.N. French

Dates of Drilling/Well Completion 1/17/85
Elevations: Land Surface 631.76 Measuring Point 635.66
Total Depth 25 ft.
Drilling, Sampling Methods Hollow-stem auger; split-spoon

Depth (ft)	Sampling Record: Sample Type	Sampling Record: Blows per 6 inches	Sampling Record: Sample I.D.	Graphic Log	Geologic Description	Notes	Well Completion
+5							
0					CLAY; tan-brown, dry; trace to some silt with depth; little fine sand.		
5	SS	6-8	12A1		Increasing coarse sand and fine gravel.		
10	SS	24-26	12A2		SAND; tan, fine to coarse grained, very moist; little silt; few fine gravel and pebbles.		
15	SS	6-7	12A3			Water at 16 ft.	
20	SS	10-12	12A4 (850869)		SHALE; weathered, mottled gray and brown. Increasing stiffness with depth.		
25	SS	12-32	12A5		End of boring: 25 ft.		
30							
35							
40							





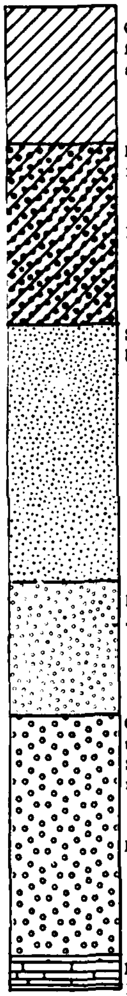
RADIAN CORPORATION

Log: Monitor Well 12B

Project: Carswell AFB IRP	Dates of Drilling/Well Completion: 1/17/85
Location: North of FTA 2	Elevations: Land Surface 625.56 Measuring Point 627.59
Drilled by: SWL (CME 75)	Total Depth 40 ft.
Logged by: L.N. French	Drilling, Sampling Methods: Hollow-stem auger; split-spoon

Depth (ft)	Sampling Record: Sample Type	Sampling Record: Blows per 6 inches	Sampling Record: Sample I.D.	Geologic Description	Notes
+5					
0				CLAY; dark brown to gray, organic fragments, slightly moist; some silt; trace fine sand.	
5	SS	3-7	12B1		
				Few gravel, color change to yellowish tan at 7 ft.	
10	SS	7-9	12B2 (850870)	Increasing gravel at 9 ft.	
				SAND; fine to medium grained, light brown, dry, friable; little silt.	
15	SS	8-10	12B3 (850871)		
20	SS	5-7	12B4		Hydrocarbon odor at 19 ft.
25	SS	13-18	12B5	Few gravel lenses with coarse sand at 24 ft.	
					Air sample reaction at 29 ft.
30	SS	27-33*	12B6	GRAVEL; shells and rock fragments, medium to coarse grained; and SAND; tan, fine to coarse, saturated, some silt and clay.	*for 3 inches.
35	SS	12-19	12B7 (850872)	Decreasing silt and clay.	
40				LIMESTONE; hard. End of boring: 40 ft.	Auger refusal at 40 ft.

Graphic Log



Well Completion

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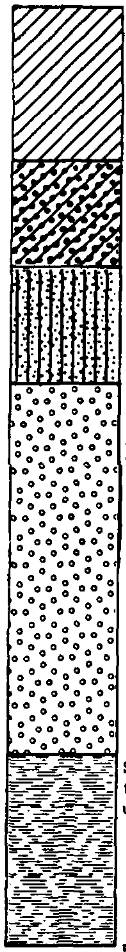
Log: Monitor Well 12C

Project: Carswell AFB IRP
Location: East of FTA 2
Drilled by: SWL (CME 75)
Logged by: L.N. French

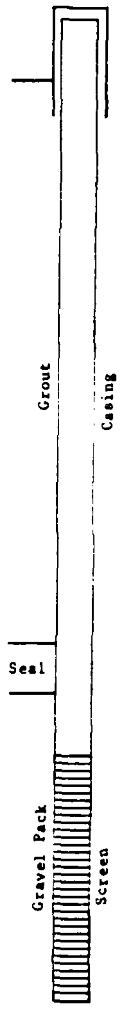
Dates of Drilling/Well Completion: 1/17/85
Elevations: Land Surface 625.44 Measuring Point 628.07
Total Depth: 38 ft.
Drilling, Sampling Methods: Hollow-stem auger; split-spoon

Depth (ft)	Sampling Record: Sample Type	Sampling Record: Blows per 6 inches	Sampling Record: Sample I.D.	Geologic Description	Notes
+5					
0				CLAY; dark brown, grading to medium brown; with silt; trace to few fine to coarse grained sand; trace gravel; dry.	
5	SS	7-11	12C1		
				Increasing gravel from 8 to 10 ft.	
10	SS	7-10	12C2	Grades to SILT; tan, gravelly, with lenses of fine sand.	
15	SS	5-7	12C3	SAND; light tan to orange, medium to coarse grained, slightly moist; and GRAVEL in layers and lenses, medium to coarse, dominantly limestone fragments.	
20	SS	6-7	12C4		
25	SS	31-19*	12C5 (850873)		*for 3 inches.
30	SS	12-10	12C6	SHALE; weathered, light brown to tan mottled, grades to gray-blue unweathered shale.	Water at 29 ft.
35	SS	12-14	12C7		
				End of boring: 38 ft.	
40					

Graphic Log



Well Completion



RADIAN CORPORATION

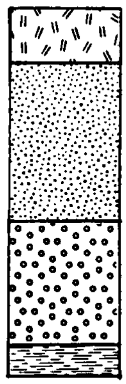
Log: Monitor Well 15A

Project: Carswell AFB IRP
Location: Northeast of Bldg. 1337
Drilled by: SWL (CME 75)
Logged by: L.N. French

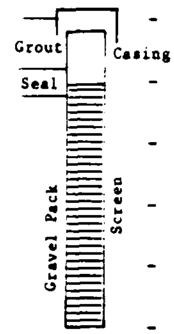
Dates of Drilling/Well Completion: 1/18/85
Elevations: Land Surface 570.62 Measuring Point 570.24
Total Depth: 15 ft.
Drilling, Sampling Methods: Hollow-stem auger; split-spoon

Depth (ft)	Sampling Record: Sample Type	Blows per 6 inches	Sample I.D.	Geologic Description	Notes
+5					
0				FILL; gravelly sand, clay.	
5	SS	5-5	15A1	SAND; fine to medium grained, brown-gray, dry; little silt and clay; trace fine gravel.	
10	SS	7-10	15A2 (850875)	Interbedded sand and gravel with rounded rock fragments.	Water at 9 ft.
15	SS	50*	15A3	SHALE; gray, weathered near upper contact; few limestone layers. End of boring: 15 ft.	*for 6 inches.
20					
25					
30					
35					
40					

Graphic Log



Well Completion



RADIAN
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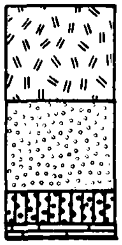
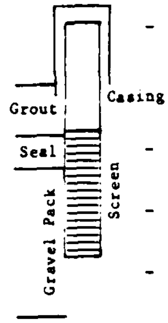
Log: Monitor Well 15B

Project Carswell AFB IRP
Location South of Bldg. 1337
Drilled by SWL (CME 75)
Logged by L.N. French

Dates of Drilling/Well Completion 1/18/85
Elevations: Land Surface 564.14 Measuring Point 568.09
Total Depth 9 ft.
Drilling, Sampling Methods Hollow-stem auger; split-spoon

Depth (ft)	Sampling Record: Sample Type	Sampling Record: Blows per 6 inches	Sampling Record: Sample I.D.	Graphic Log	Geologic Description	Notes	Well Completion
+5-							
-							
0-					FILL; tan, sandy clay, dry.		
-							
5-	SS	11-7	15B1		SAND; fine to coarse grained, orange-brown, moist; with silt and variable amount of fine to coarse gravel.		
-					Increasing gravel in clayey matrix.	Water at 9 feet.	
10-	SS	50*	15B2 (850874)		LIMESTONE; gray, hard, dry. End of boring: 9 ft.	*for 3/4 inch.	
-							
15-							
-							
20-							
-							
25-							
-							
30-							
-							
35-							
-							
40-							
-							





RADIAN
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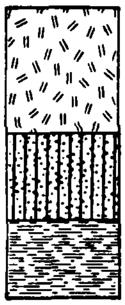
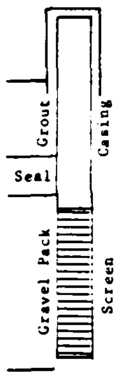
Log: Monitor Well 15C

Project Carswell AFB IRP
Location South of Bldg. 1337
Drilled by SWL (CME 75)
Logged by L.N. French

Dates of Drilling/Well Completion 1/18/85
Elevations: Land Surface 564.17 Measuring Point 567.87
Total Depth 12 ft.
Drilling, Sampling Methods Hollow-stem auger; split-spoon

Depth (ft)	Sampling Record: Sample Type	Sampling Record: Blows per 6 inches	Sampling Record: Sample I.D.	Graphic Log	Geologic Description	Notes	Well Completion
+5							
0					FILL; asphalt, concrete, sandy gravel, dry.		
	SS	2-2	15C1				
5					SILT; dark brown, moist; with SAND; fine to medium grained; trace fine gravel and clay.	Hard drilling at 8 ft.	
	SS	20-28	15C2		SHALE; light gray, dry, with Mn streaks and slightly mottled. End of boring: 12 ft.		
10							
15							
20							
25							
30							
35							
40							



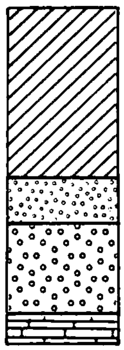


RADIAN
CORPORATION

Log: Boring 16A

Project Carswell AFB IRP
Location Near Abandoned Gas Station
Drilled by SWL (CME 75)
Logged by J.B. Chapman

Dates of Drilling/Well Completion 1/19/85
Elevations: Land Surface 568.44 Measuring Ponit 568.44
Total Depth 13.5 feet
Drilling, Sampling Methods Hollow-stem auger; split-spoon and bailer

Depth (ft)	Sampling Record Sample Type	Blows per 6 inches	Sample I.D.	Graphic Log	Geologic Description	Notes	Well Completion
+5-							Borehole filled in with grout.
-							
0-					CLAY; silty, black.		
-							
	SS	6-8	16A1		CLAY; sandy, gray to black.	Drager reaction.	
5-							
-					SAND and GRAVEL.		
	SS	8-13	16A2				
10-					GRAVEL.	Strong Drager reaction.	
-	BW	—	16A (850889)			Water sample. Limestone at 12.5 feet.	
					LIMESTONE. End of boring: 13.5 ft.		
15-							
-							
20-							
-							
25-							
-							
30-							
-							
35-							
-							
40-							
-							

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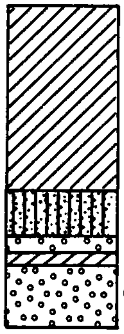
CORPORATION

Log: Boring 16B

Project Carswell AFB IRP
Location 100 ft. West of Bldg. 1337
Drilled by SWL (CME 75)
Logged by J.B. Chapman

Dates of Drilling/Well Completion 1/19/85
Elevations: Land Surface 569.67 Measuring Point 569.67
Total Depth 13 feet
Drilling, Sampling Methods Hollow-stem auger; split-spoon and bailer

Depth (ft)	Sampling Record: Sample Type	Blows per 6 inches	Sample I.D.	Graphic Log	Geologic Description	Notes	Well Completion
+5-							Borehole filled in with grout.
-							
0-					CLAY; sandy, brown; contains asphalt near the surface.		
-							
5-	SS	1-2	16B1			Drager reaction.	
-							
10-	SS	11-13	16B2		SAND; fine-grained, gray; grades downward into a GRAVEL lens, and then a CLAY containing many pebbles and sand.	Drager reaction.	
-	BW	--	16B (850890)		GRAVEL; sandy. End of boring: 13 feet.	Water sample. Limestone at 13 feet.	
15-							
-							
20-							
-							
25-							
-							
30-							
-							
35-							
-							
40-							
-							

RADIAN
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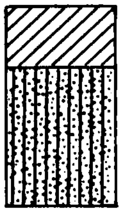
Log: Boring 16C

Project Carswell AFB IRP
Location 100 ft. SW of Bldg. 1337
Drilled by SWL (CME 75)
Logged by J.B. Chapman

Dates of Drilling/Well Completion 1/19/85
Elevations: Land Surface 565.35 Measuring Point 565.35
Total Depth 8 feet
Drilling, Sampling Methods Hollow-stem auger; split-spoon and bailer

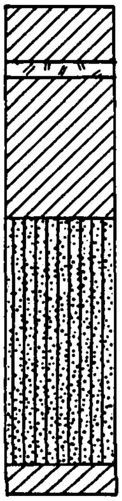
Depth (ft)	Sampling Record: Sample Type	Sampling Record: Blows per 6 inches	Sampling Record: Sample I.D.	Graphic Log	Geologic Description	Notes	Well Completion
+5-							Borehole filled in with grout.
-							
0-					CLAY; silty, black.		
-							
5-	SS	3-3	16C1		SAND; brown to gray, coarsening downward.		
-	BW	--	16C (850891)		End of boring: 8 feet.	Water sample has fuel odor. Limestone at 8 feet.	
10-							
-							
15-							
-							
20-							
-							
25-							
-							
30-							
-							
35-							
-							
40-							
-							

RADIAN
CORPORATION

Log: Boring 17A

Project Carswell AFB IRP
Location West of Tank 1156
Drilled by SWL (CME 75)
Logged by J.B. Chapman

Dates of Drilling/Well Completion 1/22/85
Elevations: Land Surface 580.13 Measuring Point 580.13
Total Depth 20 ft.
Drilling, Sampling Methods Hollow-stem auger; split-spoon and bailer

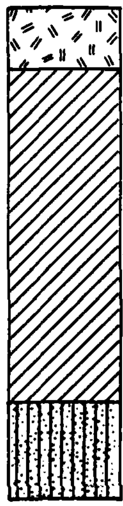
Depth (ft)	Sampling Record: Sample Type	Sampling Record: Blows per 6 inches	Sampling Record: Sample I.D.	Graphic Log	Geologic Description	Notes	Well Completion
+5-							Borehole filled with grout.
-							
0-					CLAY; black.		
-					HARDPAN LAYER; possibly cement.		
	SS	6-6	17A1		CLAY; reddish brown.		
5-							
-							
10-	SS	2-1	17A2 (850905)		SAND; fine-grained, clayey and silty; tan to pink.	Water at 9.5 ft.	
-							
15-	SS	See notes	17A3 (850906)		SAND; fine-grained matrix with medium-grained sand suspended.	Weight of hammer pushed sample.	
-					SAND; increasing clay with depth.		
20-	SS BW	See notes	17A3 17A (850908)		CLAY; tan to pink. End of boring: 20 feet.	Weight of hammer pushed sample. Water sample.	
-							
25-							
-							
30-							
-							
35-							
-							
40-							
-							

RADIAN
CORPORATION

Log: Boring 17B

Project Carswell AFB IRP
Location North of POL tank farm(Comm.ParkLot)
Drilled by SWL (CME 75)
Logged by J.B. Chapman

Dates of Drilling/Well Completion 1/21/85
Elevations: Land Surface 578.48 Measuring Point 578.48
Total Depth 20 ft.
Drilling, Sampling Methods Hollow-stem auger; split-spoon and bailer

Depth (ft)	Sampling Record: Sample Type	Sampling Record: Blows per 6 inches	Sampling Record: Sample I.D.	Graphic Log	Geologic Description	Notes	Well Completion
+5							Borehole filled with grout.
0					ASPHALT; gray clay fill.		
5	SS	6-8	17B1		CLAY; sandy; gray and brown.		
10	SS	2-2	17B2 (850889)		CLAY; sandy; tan with a pink tint; moist.		
15	SS	4-5	17B3		CLAY; dark gray; increasing sand with depth; damp.	Water at 16 feet.	
20	SS	2-5	17B4 (850890)		SAND; gray; contains fragments of limestone; wet.		
	BW		17B (850896)		End of boring: 20 feet.	Water sample.	
25							
30							
35							
40							

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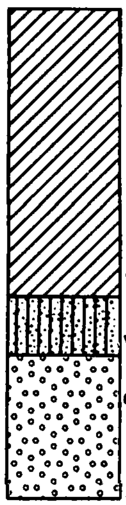
CORPORATION

Log: Boring 17C

Project Carswell AFB IRP
Location NE of Tank 1157; inside tank farm boundary
Drilled by SWL (CME 75)
Logged by J.B. Chapman

Dates of Drilling/Well Completion 1/21/85
Elevations: Land Surface 574.27 Measuring Point 574.27
Total Depth 20 ft.
Drilling, Sampling Methods Hollow-stem auger; split-spoon and bailer



Depth (ft)	Sampling Record: Sample Type	Sampling Record: Blows per 6 inches	Sampling Record: Sample I.D.	Geologic Description	Notes	Well Completion
+5						Borehole filled with grout.
0				CLAY; black to brown.		
5	SS	2-2	17C1	CLAY; gray; contains minor shell fragments.		
10	SS	2-3	17C2 (850891)	CLAY; gray with limonite staining; shells and pebbles increasing downward; moist.		
				SAND; gray; contains decayed wood; wet.	Water at 12 feet.	
15	SS	5-8	17C3 (850892)	GRAVEL and SAND.		
20	SS BW		17C4 17C (850897)	End of boring: 20 feet.	Small soil sample recovery (too wet). Water sample had an oil sheen.	
25						
30						
35						
40						

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Log: Boring 17D

Project Carswell AFB IRP
Location Inside Berm of tank 1157
Drilled by SWL (CME 75)
Logged by J.B. Chapman

Dates of Drilling/Well Completion 1/21/85
Elevations: Land Surface 573.05 Measuring Point 573.05
Total Depth 18 ft.
Drilling, Sampling Methods Hollow-stem auger; split-spoon and bailer

Depth (ft)	Sampling Record: Sample Type	Sampling Record: Blows per 6 inches	Sampling Record: Sample I.D.	Graphic Log	Geologic Description	Notes	Well Completion
+5-							Borehole filled with grout.
-							
0-					CLAY; black/gray.		
-							
5-	SS	2-3	17D1		CLAY; gray, featureless.		
-							
10-	SS	3-4	17D2		CLAY; gray with limonite staining; contains minor shell fragments, increasing in abundance downward.	Drager reaction.	
-						Water at 13 feet.	
15-	SS	7-13	17D3 (850893)		GRAVEL; pea size, fining downward.		
-							
20-	BW	--	17D (850898)		End of boring: 18 feet.	Water sample. Limestone at 18 feet.	
-							
25-							
-							
30-							
-							
35-							
-							
40-							
-							

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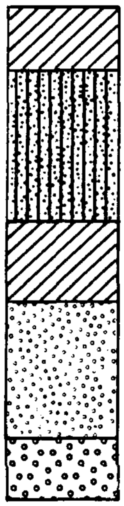
CORPORATION

Log: Boring 17E

Project Carswell AFB IRP
Location South of POL Tank Farm by Culvert
Drilled by SWL (CME 75)
Logged by J.B. Chapman

Dates of Drilling/Well Completion 1/22/85
Elevations: Land Surface 574.99 Measuring Point 574.99
Total Depth 20 ft.
Drilling, Sampling Methods Hollow-stem auger; split-spoon and bailer



Depth (ft)	Sampling Record: Sample Type	Sampling Record: Blows per 6 inches	Sampling Record: Sample I.D.	Geologic Description	Notes	Well Completion
+5-						Borehole filled with grout.
-						
0-				CLAY; black/brown.		
-						
5-	SS	2-3	17E1	SAND; silty, tan. Increasing clay content downward.		
-						
10-	SS	3-5	17E2 (850900)	CLAY; gray; contains minor sand and shell fragments.	Drager reaction.	
-				SAND; fine-grained; gray; wet.	Water at 12.5 feet.	
15-	SS	8-11	17E3 (850901)	SAND; fine-grained; brown; contains pebbles.		
-						
20-	SS BW	50 for 3.5"	17E4 17E (850903)	GRAVEL; 3 mm in diameter; contains limestone fragments. End of boring: 20 feet.	Water sample. Limestone at 20 feet.	
-						
25-						
-						
30-						
-						
35-						
-						
40-						
-						

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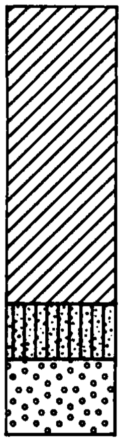
CORPORATION

Log: Boring 17F

Project Carswell AFB IRP
Location Between RR Track and Bldg. 1172
Drilled by SWL (CME 75)
Logged by J.B. Chapman

Dates of Drilling/Well Completion 1/22/85
Elevations: Land Surface 572.87 Measuring Point 572.87
Total Depth 17.5 ft.
Drilling, Sampling Methods Hollow-stem auger; split-spoon and bailer

Depth (ft)	Sampling Record: Sample Type	Sampling Record: Blows per 6 inches	Sampling Record: Sample I.D.	Graphic Log	Geologic Description	Notes	Well Completion
+5-							Borehole filled with grout.
-							
0-					CLAY; black.		
-							
5-	SS	6-9	17F1		CLAY; gray; contains minor pebbles and shell fragments.		
-							
10-	SS	4-6				No sample recovery.	
-					SAND; fine-grained; brown; wet.	Water at 12.5 feet.	
15-	SS	10-16	17F2 (850907)		GRAVEL; some pebbles up to 2.5 cm in diameter.		
	BW		17F (850909)			Water sample. Limestone at 17.5 feet.	
-					End of boring: 17.5 feet.		
20-							
-							
25-							
-							
30-							
-							
35-							
-							
40-							
-							

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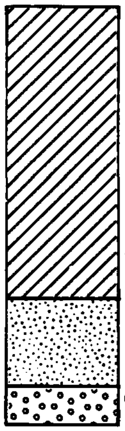
Log: Boring 17G

Project Carswell AFB IRP
Location Inside Pumping Station
Drilled by SWL (CME 75)
Logged by J.B. Chapman

Dates of Drilling/Well Completion 1/21/85
Elevations: Land Surface 573.20 Measuring Point 573.20
Total Depth 17 ft.
Drilling, Sampling Methods Hollow-stem auger; split-spoon and bailer



Depth (ft)	Sampling Record: Sample Type	Sampling Record: Blows per 6 inches	Sampling Record: Sample I.D.	Geologic Description	Notes	Well Completion
+5–						Borehole filled with grout.
–						
0–				CLAY; black.		
–						
5–	SS	4-4	17G1	CLAY; dark gray.		
–						
10–	SS	3-5	17G2 (850894)	CLAY; dark gray; contains a 1 cm thick gravel band stained with an organic black to dark brown oily material.	Drager reaction. Water at 12 feet.	
–				SAND; gravelly, increasing gravel with depth.		
15–	SS	5-6	17G3 (850895)			
	BW		17G (850899)	GRAVEL; pebbles over 2.5 cm in diameter. End of boring: 17 feet.	Water sample. Limestone at 17 feet.	
–						
20–						
–						
25–						
–						
30–						
–						
35–						
–						
40–						
–						

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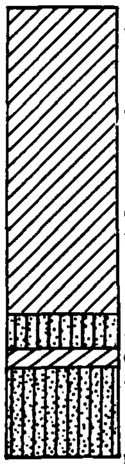
Log: Boring 17H

Project Carswell AFB IRP
Location S. of POL tanks by Knights Lake Rd.
Drilled by SWL (CME 75)
Logged by J.B. Chapman

Dates of Drilling/Well Completion 1/22/85
Elevations: Land Surface 573.66 Measuring Point 573.66
Total Depth 18.5 ft.
Drilling, Sampling Methods Hollow-stem auger; split-spoon and bailer

Depth (ft)	Sampling Record: Sample Type	Sampling Record: Blows per 6 inches	Sampling Record: Sample I.D.	Graphic Log	Geologic Description	Notes	Well Completion
+5							Borehole filled with grout.
0					CLAY; black/brown.		
5	SS	3-4	17H1		CLAY; sandy; tan.		
10	SS	4-6	17H2		CLAY; tan to light gray with limonite staining; contains minor shells.		
					SAND; silty; gray.	Water at 13 feet.	
15	SS	6-6	17H3 (850902)		CLAY; 10 cm thick lens. SAND; tan.		
	BW		17H (850904)		End of boring: 18.5 feet.	Water sample. Limestone at 18.5 feet.	
20							
25							
30							
35							
40							



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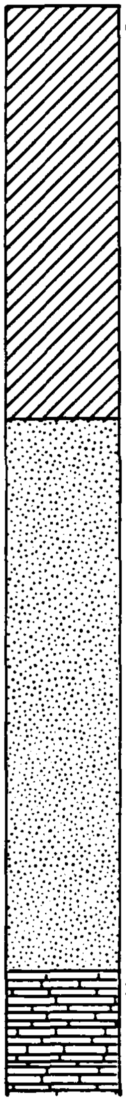
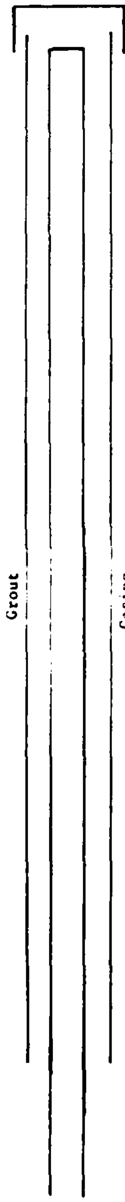
Log: Monitor Well Paluxy #1

Project Carswell AFB IRP
Location 100 yds. west of Bldg. 4127
Drilled by URM (Gardner Denver 1500)
Logged by L.N. French/J.B. Chapman

Dates of Drilling/Well Completion 2/26/85 - 3/1/85
Elevations: Land Surface 625.59 Measuring Point 628.19
Total Depth 109.4 feet
Drilling, Sampling Methods Air/Mud Rotary; Air/Mud Cuttings

Depth (ft)	Sampling Record: Sample Type	Sampling Record: Blows per 6 inches	Sampling Record: Sample I.D.	Graphic Log	Geologic Description	Notes	Well Completion
+5							
0	(Periodic grab samples)				CLAY; medium to dark brown; some silt; few small gravel.	6-in. pilot hole with tricone bit to 39 ft; reamed to 14-in. Install 10-in. steel casing and grout annular space.	
5							
10							
15							
					SAND; fine to medium grained, trace coarse sand, light brown to tan.	Increased drilling speed.	
20							
25							
					Increasing gravel with depth.		
30							
35							
40					LIMESTONE; medium gray; fossiliferous.	Goodland/Walnut Formation. Drilling with 6-in. tricone bit.	





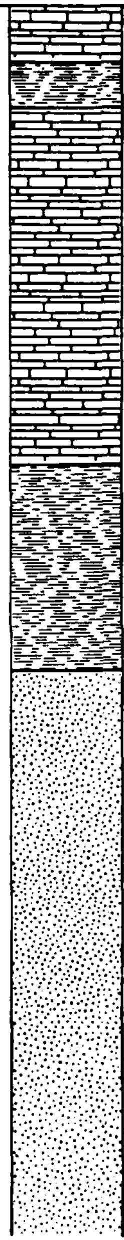
RADIAN CORPORATION

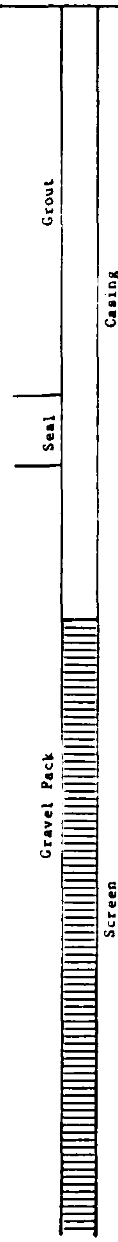
Log: Monitor Well Paluxy #1

Project: Carswell AFB IRP
Location: 100 yards West of Bldg. 4127
Drilled by: URM (Gardner Denver 1500)
Logged by: L.N. French/J.B. Chapman

Dates of Drilling/Well Completion: 2/25/85 - 3/1/85
Elevations: Land Surface 625.59 Measuring Point 628.19
Total Depth: 109.4 feet
Drilling, Sampling Methods: Air/Mud Rotary; Air/Mud Cuttings

Depth (ft)	Sampling Record: Sample Type	Blows per 6 inches	Sample I.D.	Graphic Log	Geologic Description	Notes	Well Completion
45							
-					SHALE lens.	Increase in drilling speed at 47 ft; decrease in drilling speed below 49 ft. Water noted in discharge to 60 ft; grout hole and redrill. Subsequent drilling under dry conditions to Paluxy Formation.	
50							
-							
55							
-							
60							
-					SHALE; dark gray, carbonaceous, soft.		
65							
-							
70							
-					SAND; white, medium to fine, dry.	Paluxy Formation.	
75							
-						Water noted in discharge. Drilling switched to mud rotary due to borehole instability.	
80					SANDSTONE; layers of cemented fine-grained sandstone composed of clean, white quartz alternate with softer, clayey layers.		
-							
85							
-							
90					Lignite and pyrite in clayey sand.		
-							





RADIAN
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Log: Monitor Well Paluxy #1

Project Carswell AFB IRP
Location 100 yds. West of Bldg. 4127
Drilled by URM (Gardner Denver 1500)
Logged by L.N. French/J.B. Chapman

Dates of Drilling/Well Completion 2/26/85 - 3/1/85
Elevations: Land Surface 625.59 Measuring Point 628.19
Total Depth 109.4 feet
Drilling, Sampling Methods Air/Mud Rotary; Air/Mud Cuttings

Depth (ft)	Sampling Record: Sample Type	Sampling Record: Blows per 6 inches	Sampling Record: Sample I.D.	Graphic Log	Geologic Description	Notes	Well Completion
95-							
-							
100-					Increasing clay content.		Gravel Pack; Screen
-							
105-					CLAY; light gray, soft.		
-							
110-					Total depth = 109.4 feet.		
-							
115-							
-							
120-							
-							
125-							
-							
130-							
-							
135-							
-							
140-							
-							

RADIAN
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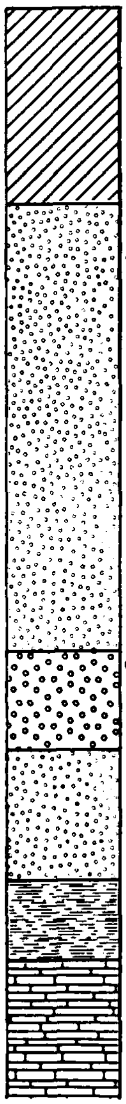
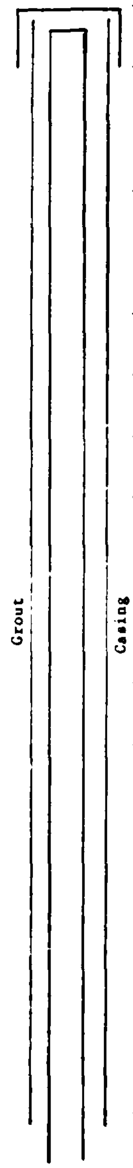
Log: Monitor Well Paluxy #2

Project Carswell AFB IRP
Location Between Radar Station & Golf Course
Drilled by URM (Gardner Denver 1500)
Logged by J.B. Chapman

Dates of Drilling/Well Completion 3/2/85 - 3/4/85
Elevations: Land Surface 615.79 Measuring Point 618.42
Total Depth 109.6 feet
Drilling, Sampling Methods Air/Mud Rotary; Air/Mud Cuttings





Depth (ft)	Sampling Record: Sample Type	Sampling Record: Blows per 6 inches	Sampling Record: Sample I.D.	Graphic Log	Geologic Description	Notes	Well Completion
+5							
-							
0	(Periodic grab samples)				CLAY; red to brown; contains pebbles.	6-in. pilot hole with tricone bit to 43 ft; reamed to 14-in. Install 10-in. steel casing and grout annular space.	
-							
5							
-							
10					SAND; coarse sand and gravel mix; grains between 2 mm and 1 cm diameter. Individual grains are flattened and disc-shaped.		
-							
15							
-							
20					SAND; fine-grained and silty; brown; composed of quartz grains. Increasing gravel with depth.		
-							
25							
-					GRAVEL; fine to coarse (some pieces up to 2 cm in diameter); contains pelecypod shell fragments and gastropod shells.		
30					SAND; as above.		
-							
35					SHALE; medium gray; cohesive (weathered limestone).	Goodland/Walnut Formation.	
-							
40					LIMESTONE; light to medium gray; fossiliferous (pelycypod shell fragments).		
-						Drilling with 6-in. tricone bit.	

RADIAN
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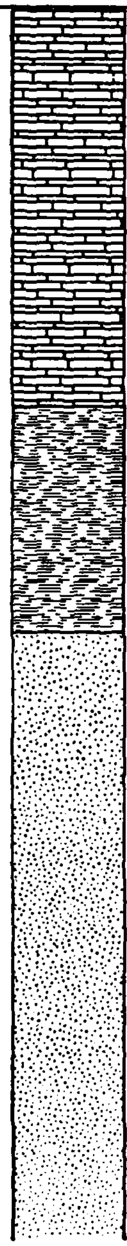
Log: Monitor Well Paluxy #2

Project Carswell AFB IRP
Location Between Radar Station & Golf Course
Drilled by UEM (Gardner Denver 1500)
Logged by J.B. Chapman

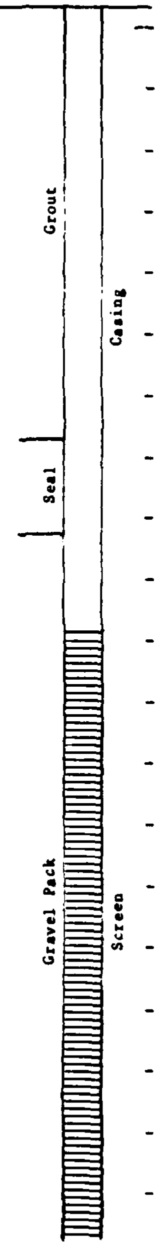
Dates of Drilling/Well Completion 3/2/85 - 3/4/85
Elevations: Land Surface 615.79 Measuring Point 618.42
Total Depth 109.6 feet
Drilling, Sampling Methods Air/Mud Rotary; Air/Mud Cuttings

Depth (ft)	Sampling Record: Sample Type	Sampling Record: Blows per 6 inches	Sampling Record: Sample I.D.	Geologic Description	Notes
45					
				Increased shale content for 1 ft. LIMESTONE; light gray; composed of 1 to 2 mm diameter shell fragments.	Increased drilling speed between 46 and 47 ft.
50				Between 50 and 57 ft., small shale stringers (1/2 to 1 ft. thick) abundant.	Periodic increases and decreases in drilling speed.
55					
60				SHALE; dark gray, carbonaceous, soft.	
65					
70				SAND; tan to gray; fine-grained, well-sorted quartz.	Paluxy Formation.
75					Water noted in discharge.
80					
85				Lignite pieces in sand.	
				Increase in shale content.	
90					

Graphic Log



Well Completion



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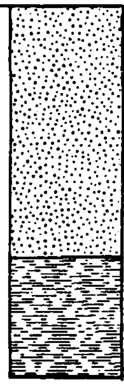
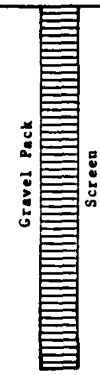
Log: Monitor Well Paluxy #2

Project Carswell AFB IRP
Location Between Radar Station & Golf Course
Drilled by URM (Gardner Denver 1500)
Logged by J.B. Chapman

Dates of Drilling/Well Completion 3/2/85 - 3/4/85
Elevations: Land Surface 615.79 Measuring Point 618.42
Total Depth 109.6 feet
Drilling, Sampling Methods Air/Mud Rotary; Air/Mud Cuttings

Depth (ft)	Sampling Record: Sample Type	Sampling Record: Blows per 6 inches	Sampling Record: Sample I.D.	Graphic Log	Geologic Description	Notes	Well Completion
95							
					SANDSTONE; cemented, fine-grained, clean, quartz sand. Soft white, weathered shell fragments in the sand.		
100							
					Increasing clay content.		
105					CLAY; medium gray; soft.		
					Total depth = 109.6 feet.		
110							
115							
120							
125							
130							
135							
140							

APPENDIX F

Raw Field Data

TABLE F-1. SUMMARY OF SOIL AND WATER FIELD SAMPLES

SAMPLE NUMBER	SAMPLE TYPE	SITE	WELL/ BORING	DEPTH (FEET)	DATE	COMMENT
4E1	SS	4	E	4-5	1-10-85	
4E2	SS	4	E	9-10		
4E3	SS	4	E	14-15		
4E4	SS	4	E	19-20		
GS-85-0800	SS	4	E	24-25	1-10-85	
4E6	SS	4	E	29-30	1-10-85	4E6 Sample composited with 0801 for chemical analysis.
GS-85-0801	SS	4	E	34-35	1-10-85	
4D1	SS	4	D	4-5		
4D2	SS	4	D	9-10		
4D3	SS	4	D	14-15		
GS-85-0802	SS	4	D	19-20	1-10-85	
4D5	SS	4	D	24-25		
GS-85-0803	SS	4	D	29-30	1-10-85	
4C1	SS	4	C	4-5	1-11-85	
4C2	SS	4	C	9-10		
4C3	SS	4	C	14-15		
GS-85-0804	SS	4	C	19-20	1-11-85	
4C5	SS	4	C	24-25		
GS-85-0805	SS	4	C	29-30	1-11-85	
4A1	SS	4	A	4-5	1-14-85	
GS-85-0806	SS	4	A	14-15	1-14-85	
4A3	SS	4	A	19-20	1-14-85	
4B1	SS	4	B	4-5	1-14-85	
4B2	SS	4	B	9-10	1-14-85	
GS-85-0807	SS	4	B	14-15	1-14-85	
GS-85-0808	SS	4	B	19-20	1-14-85	
10B1	SS	10	B	4-5	1-14-85	
10B2	SS	10	B	9-10		
GS-85-0809	SS	10	B	14-15	1-14-85	
10B4	SS	10	B	19-20		
10B5	SS	10	B	24-25		

[continued]

TABLE F-1 [continued]

SAMPLE NUMBER	SAMPLE TYPE	SITE	WELL/ BORING	DEPTH (FEET)	DATE	COMMENT
GS-85-0810	SS	10	B	29-30	1-14-85	
10B7	SS	10	B	34-35	1-14-85	
GS-85-0811	HA	13	A	0	1-14-85	
GS-85-0812	HA	13	B	0	1-14-85	
GS-85-0813	HA	13	B	2	1-14-85	
GS-85-0814	HA	13	B	4	1-14-85	
GS-85-0815	HA	13	C	0	1-14-85	
GS-85-0816	HA	13	C	2	1-14-85	
GS-85-0817	HA	13	C	4	1-14-85	
GS-85-0818	HA	13	C	6	1-14-85	
GS-85-0819	GS	13	G	0	1-15-85	Bottom sediment
GS-85-0820	GS	13	H	0	1-15-85	Bottom sediment
GS-85-0821	GS	13	I	0	1-15-85	Bottom sediment
GS-85-0822	HA	11	A	0	1-15-85	
GS-85-0823	HA	11	[illegible]	2	1-15-85	
GS-85-0824	HA	11	A	4	1-15-85	
GS-85-0825	HA	13	D	0	1-15-85	
GS-85-0826	HA	13	D	2	1-15-85	
GS-85-0827	HA	13	D	4	1-15-85	
GS-85-0828	HA	13	D	6	1-15-85	
GS-85-0829	HA	13	D	8	1-15-85	
GS-85-0830	HA	13	D	0	1-15-85	
GS-85-0831	HA	13	F	0	1-15-85	
GS-85-0832	HA	13	F	2	1-15-85	
GS-85-0833	HA	13	F	4	1-15-85	
GS-85-0834	HA	13	F	6	1-15-85	
GS-85-0835	HA	13	F	8	1-15-85	
GS-85-0836	HA	11	A	6	1-15-85	
10C1	SS	10	C	4-5		
10C2	SS	10	C	9-10		

[continued]

TABLE F-1 [continued]

SAMPLE NUMBER	SAMPLE TYPE	SITE	WELL/ BORING	DEPTH (FEET)	DATE	COMMENT
10C3	SS	10	C	14-15		
10C4	SS	10	C	19-20		
GS-85-0837	SS	10	C	29-30	1-15-85	
GS-85-0838	SS	5	B	4-5	1-15-85	
5B2	SS	5	B	9-10	1-15-85	
5C1	SS	5	C	4-5	1-15-85	
5C2	SS	5	C	9-10	1-15-85	
GS-85-0839	SS	5	C	14-15	1-15-85	
GS-85-0840	SS	5	C	19-20	1-15-85	
GS-85-0841	SS	11	A	9-10	1-15-85	
GS-85-0842	SS	10	C	24-25	1-15-85	
GS-85-0843	HA	13	A	0	1-16-85	
GS-85-0844	HA	13	B	0	1-16-85	
GS-85-0845	HA	13	B	2	1-16-85	
GS-85-0846	HA	13	B	2	1-15-85	
GS-85-0847	HA	13	B	4	1-16-85	
GS-85-0848	HA	13	C	0	1-16-85	
GS-85-0849	HA	13	C	2	1-16-85	
GS-85-0850	HA	13	C	4	1-16-85	
GS-85-0851	HA	13	D	0	1-16-85	
GS-85-0852	HA	13	D	2	1-16-85	
GS-85-0853	HA	13	D	4	1-16-85	
GS-85-0854	HA	13	D	6	1-16-85	
GS-85-0855	HA	13	D	8	1-16-85	
GS-85-0856	HA	13	E	0	1-16-85	
GS-85-0857	HA	13	D	2	1-16-85	
GS-85-0858	HA	13	D	4	1-16-85	
5A1	SS	5	A	4-5	1-16-85	
5A2	SS	5	A	9-10		
5A3	SS	5	A	14-15		
5A4	SS	5	A	19-20		

[continued]

TABLE F-1 [continued]

SAMPLE NUMBER	SAMPLE TYPE	SITE	WELL/ BORING	DEPTH (FEET)	DATE	COMMENT
GS-85-0858	SS	5	A	24-25	1-16-85	
GS-85-0859	SS	5	A	29-30	1-16-85	
10A1	SS	10	A	4-5		
10A2	SS	10	A	9-10		
10A3	SS	10	A	14-15		
10A4	SS	10	A	19-20		
10A5	SS	10	A	24-25		
GS-85-0860	SS	10	A	29-30	1-16-85	
10A7	SS	10	A	34-35		
10A8	SS	10	A	39-40		
11B1	SS	11	B	4-5		
GS-85-0861	SS	11	B	9-10	1-16-85	
11B3	SS	11	B	14-15		
GS-85-0862	HA	13	F	0	1-17-85	
GS-85-0863	HA	13	F	2	1-17-85	
GS-85-0864	SW	4			1-17-85	Strm so. of lndfl
GS-85-0865	SW	5			1-17-85	Strm no. of SB
GS-85-0866	SW	12			1-17-85	Drnge no. of site
GS-85-0867	SW	16			1-17-85	Oil/wtr separator
GS-85-0868	SW	16			1-17-85	Stream at bridge
12A1	SS	12	A	4-5		
12A2	SS	12	A	9-10		
12A3	SS	12	A	14-15		
GS-85-0869	SS	12	A	19-20	1-17-85	
12B1	SS	12	A	4-5		
GS-85-0870	SS	12	B	9-10	1-17-85	
GS-85-0871	SS	12	B	14-15	1-17-85	
12B4	SS	12	B	19-20		
12B5	SS	12	B	24-25		
12B6	SS	12	B	29-30		
12B7	SS	12	B	34-35		

[continued]

TABLE F-1 [continued]

SAMPLE NUMBER	SAMPLE TYPE	SITE	WELL/ BORING	DEPTH (FEET)	DATE	COMMENT
GS-85-0872	SS	12	B	34-35	1-17-85	
12C1	SS	12	C	4-5	1-17-85	
12C2	SS	12	C	9-10		
12C3	SS	12	C	14-15		
12C4	SS	12	C	19-20		
GS-85-0873	SS	12	C	24-25	1-17-85	
12C6	SS	12	C	29-30		
12C7	SS	12	C	34-35		
15B1	SS	15	B	4-5	1-18-85	
GS-85-0874	SS	15	B	9-10	1-18-85	
15C1	SS	15	C	4-5	1-18-85	
15C2	SS	15	C	9-10	1-18-85	
15A1	SS	15	A	4-5		
GS-85-0875	SS	15	A	9-10	1-18-85	
15A3	SS	15	A	14-15	1-18-85	
1D1	SS	1	D	4-5		
GS-85-0877	SS	1	D	9-10	1-18-85	
1D3	SS	1	D	14-15		
GS-85-0877	SS	1	D	19-20	1-18-85	
GS-85-0877	SS	1	D	19-20	1-18-85	Auger cuttings
GS-85-0878	SS	1	D	20	1-18-85	
GS-85-0879	HA	12	F	0	1-18-85	
GS-85-0880	HA	12	F	2	1-18-85	
GS-85-0881	HA	12	F	4	1-18-85	
GS-85-0882	HA	12	F	6	1-18-85	
GS-85-0883	HA	12	F	8	1-18-85	
1C1	SS	1	C	4-5	1-19-85	
1C2	SS	1	C	9-10	1-19-85	
GS-85-0884	SS	1	C	14-15	1-19-85	
1C4	SS	1	C	19-20	1-19-85	
GS-85-0885	SS	1	C	24-25	1-18-85	

[continued]

TABLE F-1 [continued]

SAMPLE NUMBER	SAMPLE TYPE	SITE	WELL/ BORING	DEPTH (FEET)	DATE	COMMENT
1C6	SS	1	C	29-30		
1C7	SS	1	C	34-35		
1B1	SS	1	B	4-5	1-19-85	
GS-85-0886	SS	1	B	9-10	1-19-85	
1B3	SS	1	B	14-15	1-19-85	
GS-85-0887	SS	1	B	19-20	1-19-85	
GS-85-0888	SS	1	A	4-5	1-19-85	
16A1	SS	16	A	4-5		
16A2	SS	16	A	9-10		
16A3	SS	16	A	14-15		
16B1	SS	16	B	4-5		
16B2	SS	16	B	9-10		
16A3	SS	16	A	14-15		
16B1	SS	16	B	4-5		
16B2	SS	16	B	9-10		
16B3	SS	16	B	14-15		
16C1	SS	16	C	4-5		
16C2	SS	16	C	9-10		
GN-85-0889	BW	16	A		1-19-85	
17B1	SS	17	B	4-5	1-21-85	
GN-85-0890	BW	16	B	9-10	1-21-85	
GS-85-0890	SS	17	B	19-20	1-21-85	
GN-85-0891	BW	16	C		1-19-85	
17C1	SS	17	C	4-5	1-21-85	
GS-85-0891	SS	17	C	9-10	1-21-85	
GS-85-0892	SS	17	C	14-15	1-21-85	
17C4	SS	17	C	19-20		
17D1	SS	17	D	4-5		
17D2	SS	17	D	9-10		
GS-85-0893	SS	17	D	14-15	1-21-85	
17G1	SS	17	G	4-5		

[continued]

TABLE F-1 [continued]

SAMPLE NUMBER	SAMPLE TYPE	SITE	WELL/ BORING	DEPTH (FEET)	DATE	PH	COMMENT COND	TEMP
GS-85-0894	SS	17	G	14-15	1-21-85			
GS-85-0895	SS	17	G		1-21-85			
GS-85-0896	BW	17	B		1-21-85			
GN-85-0897	BW	17	C		1-21-85			
GN-85-0898	BW	17	D		1-21-85			
GN-85-0899	BW	17	G		1-21-85			
17E1	SS	17	E	4-5	1-22-85			
GS-85-0900	SS	17	E	9-10	1-22-85			
GS-85-0901	SS	17	E	14-15	1-22-85			
17E4	SS	17	E	19-20				
17H1	SS	17	H	4-5				
17H2	SS	17	H	9-10				
GS-85-0902	SS	17	H	14-15	1-22-85			
GN-85-0903	BW	17	E		1-22-85			
GN-85-0904	BW	17	H		1-22-85			
17A1	SS	17	A	4-5	1-22-85			
GS-85-0905	SS	17	A	9-10	1-22-85			
GS-85-0906	SS	17	A	14-15	1-22-85			
17A4	SS	17	A	19-20				
17F1	SS	17	F	4-5				
GS-85-0907	SS	17	F	14-15				
GN-85-0908	BW	17	A		1-22-85			
GN-85-0909	BW	17	F		1-22-85			
GN-85-0910	BW	4	A		2-05-85	7.1	500	15
GN-85-0911	BW	4	B		2-05-85	7.2	500	13
GN-85-0912	BW	4	C		2-05-85	6.8	840	18
GN-85-0913	BW	4	D		2-05-85	7.0	680	19
GN-85-0914	BW	4	E		2-05-85	7.0	640	20
GN-85-0915	BW	10	B		2-06-85	6.7	680	19
GN-85-0916	BW	10	C		2-06-85	6.8	640	20
GN-85-0917	BW	5	B		2-06-85	6.8	730	13

[continued]

TABLE F-1 [continued]

SAMPLE NUMBER	SAMPLE TYPE	SITE	WELL/ BORING	DEPTH (FEET)	DATE	PH	COMMENT COND	TEMP
GN-85-0918	BW	1	A		2-06-85	7.1	660	14
GN-85-0919	BW	10	A		2-06-85	7.0	670	20
GN-85-0920	BW	5	A		2-06-85	7.1	650	20
GN-85-0921	BW	5	C		2-06-85	6.9	680	19
GN-85-0922	BW	11	B		2-06-85	6.8	1000	16
GN-85-0923	BW	11	A		2-07-85	6.7	680	17
GN-85-0924	BW	12	A		2-07-85	7.0	420	19
GN-85-0925	BW	12	B		2-07-85	6.9	610	20
GN-85-0926	BW	12	C		2-07-85	7.4	620	20
GN-85-0927	BW	15	A		2-07-85	7.1	680	17.5
GN-85-0928	BW	1	D		2-07-85	7.2	820	19
GN-85-0929	BW	1	B		2-08-85	(no sample)		
GN-85-0930	BW	1	C		2-08-85	6.8	880	22
GN-85-0931	BW	15	B		2-08-85	7.0	640	14
GN-85-0932	BW	15	C		2-08-85	6.9	610	14
GP-85-0933	W	WSA	Potable Well		2-19-85	6.8	460	17
GS-85-0934	HA	WSA	A		2-19-85			
GS-85-0935	HA	WSA	A	3.25	2-19-85			
GS-85-0936	HA	WSA	B	1.5	2-19-85			
GS-85-0937	HA	WSA	B	5	2-19-85			
GS-85-0938	HA	WSA	C	1.5	2-19-85			
GS-85-0939	HA	WSA	C	2.5	2-19-85			
GN-85-0940	SW	5	Stream north of site		2-19-85	6.5	690	15
GN-85-0941	SW	4	Stream south of site		2-19-85	6.0	490	16
GS-85-0942	HA	16	F	1	2-21-85			
GS-85-0943	HA	16	F	9	2-21-85			
GN-85-0944	SW	12	Drainage north of site		2-28-85		440	8
GN-85-0945	SW	16			2-28-85	Stream at bridge		
GS-85-0946	SW	16			2-28-85	Oil/water sep.		
GS-85-0947	HA	16	E	2	2-28-85			
GS-85-0948	HA	16	E	8	2-28-85			

[continued]

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TABLE F-1 [continued]

SAMPLE NUMBER	SAMPLE TYPE	SITE	WELL/ BORING	DEPTH (FEET)	DATE	PH	COMMENT COND	TEMP
GS-85-0949	GS	16			2-28-85	Sediment near sep.		
GS-85-0950	GS	16			2-28-85	Sediment near brdg		
GN-85-0951	BW	4	A		3-04-85		490	18
GN-85-0952	BW	4	A (QA)*		3-04-85			
GN-85-0953	BW	4	B		3-04-85		480	12
GN-85-0954	BW	4	B (QA)*		3-04-85			
GN-85-0955	BW	4	C		3-05-85			17
GN-85-0956	BW	4	C (QA)*		3-05-85			
GN-85-0957	BW	4	D		3-05-85			17
GN-85-0958	BW	4	D (QA)*		3-05-85			
GN-85-0959	BW	4	E		3-05-85			19
GN-85-0960	BW	4	E (QA)		3-05-85			
GN-85-0961	BW	10	B		3-05-85			19
GN-85-0962	BW	10	B (QA)		3-05-85			
GN-85-0963	BW	10	C		3-05-85			19
GN-85-0964	BW	10	C (QA)		3-05-85			
GN-85-0965	BW	5	B		3-05-85			15
GN-85-0966	BW	5	B (QA)		3-05-85			
GN-85-0967	BW	1	C		3-05-85			22
GN-85-0968	BW	1	C (QA)		3-05-85			
GN-85-0969	BW	1	A		3-05-85			15
GN-85-0970	BW	1	A (QA)		3-05-85			
GN-85-0971	BW	1	D		3-05-85			20
GN-85-0972	BW	1	D (QA)		3-05-85			
GN-85-0973	BW	15	C		3-06-85			15
GN-85-0974	BW	15	B		3-05-85			16
GN-85-0975	BW	15	A		3-06-85			17
GN-85-0976	BW	11	A		3-06-85			16
GN-85-0976**	BW	1	B		3-08-85			
GN-85-0977	BW	11	A (QA)		3-06-85			
GN-85-0978	BW	11	B		3-06-85			16

[continued]

TABLE F-1 [continued]

SAMPLE NUMBER	SAMPLE TYPE	SITE	WELL/ BORING	DEPTH (FEET)	DATE	PH	COMMENT COND	TEMP
GN-85-0979	BW	11	B (QA)		3-06-85			
GN-85-0980	BW	5	C		3-06-85			18
GN-85-0981	BW	5	C (QA)		3-06-85			
GN-85-0982	BW	5	A		3-06-85			19
GN-85-0983	BW	5	A (QA)		3-06-85			
GN-85-0984	BW	10	A		3-07-85			20
GN-85-0985	BW	10	A (QA)		3-07-85			
GN-85-0986	BW	12	C		3-07-85			18
GN-85-0987	BW	12	C (QA)		3-07-85			
GN-85-0988	BW	12	B		3-07-85			
GN-85-0989	BW	12	B (QA)		3-07-85			18
GN-85-0990	BW	12	A		3-07-85			
GN-85-0992	W	P1			3-07-85			20
GN-85-0993	W	P2			3-07-85			21
GN-85-0977*	W	P1			3-26-85			
GN-85-0978*	W	P2			3-26-85			

*Previous QA/QC samples were assigned OEHL numbers identical to the original sample.

**Mistakenly given a previously assigned number. The samples must be differentiated by the date of collection.

Notes:
- ha = hand-augered soil sample
- ss = split-spoon soil sample
- gs = grab sample of sediment
- sw = surface-water sample
- bw = bailed ground-water sample
- w = pumped ground-water sample

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TABLE F-2. SUMMARY OF SURVEYING DATA

SEMPCO, INC. SURVEYING — MAPPING — PLANNING — CONSULTANTS

Fred A. Barnett, R.S.
David A. Watson, R.S., L.S.L.S.
Don M. Wood, R.S.
David A. White, R.S.

James W. Bartlett, R.S.
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Louis M. Hawkins, R.S., L.S.L.S. - Consultant

March 11, 1985

Re: P.O. - H28994
(Radian Corporation)

TABLE LISTING SHOWING ELEVATION
of
MONITOR WELL INSTALLATIONS
and
SOIL BORINGS
located at
CARSWELL AIR FORCE BASE
Fort Worth, Texas

B.M. Finished Floor Building No. 1215 (Eng. Bldg.) - Elev. 576.00
(Carswell Base Datum)

T.B.M. Finished Floor Building No. 4127 (Storage) - Elev. 625.96
(Carswell Base Datum)

WELL	DESCRIPTION	ELEVATION
1-A	Existing Well Pipe	570.42
1-B	Meter Box (Flush Well)	560.24
1-C	Meter Box (Flush Well)	560.03
1-D	Existing Well Pipe	564.06
15-A	Meter Box (Flush Well)	570.24
15-B	Existing Well Pipe	568.09
15-C	Existing Well Pipe	567.87
16-A	Core Hole (Control Point)	568.44
16-B	Core Hole (Control Point)	569.67
16-C	Core Hole (Control Point)	565.35
17-A	Core Hole (Control Point)	580.13
17-B	Core Hole (Control Point)	578.48
17-C	Core Hole (Control Point)	574.27
17-D	Core Hole (Control Point)	573.05
17-E	Core Hole (Control Point)	574.99
17-F	Core Hole (Control Point)	572.87
17-G	Core Hole (Control Point)	573.20
17-H	Core Hole (Control Point)	573.66

3208 SOUTH MAIN STREET, FORT WORTH, TEXAS 76110 AREA CODE 817 PHONE 926-7876

WELL	DESCRIPTION	ELEVATION
5-A	Existing Well Pipe	623.22
5-B	Existing Well Pipe	600.48
5-C	Existing Well Pipe	608.73
11-A	Existing Well Pipe	608.25
11-B	Existing Well Pipe	608.11
10-A	Existing Well Pipe	626.68
10-B	Existing Well Pipe	624.42
10-C	Existing Well Pipe	617.21
12-A	Existing Well Pipe	635.66
12-B	Existing Well Pipe	627.59
12-C	Existing Well Pipe	628.07
4-A	Existing Well Pipe	625.84
4-B	Existing Well Pipe	620.02
4-C	Existing Well Pipe	613.12
4-D	Existing Well Pipe	615.40
4-E	Existing Well Pipe	618.55
P-1	Existing Well Pipe	628.19
P-2	Existing Well Pipe	618.42

NOTES:

1. All well pipe elevations taken on top of metal pipe, below cap.

2. All meter box (flush well) elevations taken on edge of box (painted).

3. All core hole (control point) elevations are natural ground.

TABLE F-3. PUMP TEST DATA - P1

Time, min	Water Level Below Measuring Pt.	Flow Q, GPM	Drawdown S
0	82.54	0	-
1.5	85.46	5	2.92
3	85.85		3.31
5	86.19		3.65
7	86.38		3.84
9	86.47	5	3.93
11	86.54		4.0
13	86.63		4.09
15	86.69		4.15
20	86.79		4.25
25	86.89		4.35
30	87.01		4.47
35	87.08		4.54
40	87.13		4.59
45	87.19		4.65
50	87.20		4.66
55	87.25		4.71
65	87.31	5	4.77
70	87.34		4.80

pump off @70 min.

TABLE F-4. RECOVERY TEST DATA - P1

Time, min	Water Level Below Measuring Pt.	Residual Drawdown S'	t/t'*
0	87.34	4.80	
.25	86.21	3.68	281
.67	85.25	2.70	105
1	84.85	2.31	71
1.5	84.42	1.87	48
2	84.21	1.67	36
3	83.98	1.43	24
4	83.81	1.27	18.5
5	83.69	1.16	15
6	83.63	1.08	12.7
7	83.57	1.02	11
8	83.54	0.99	9.75
10	83.47	0.92	8
13	83.41	0.86	6.38
18	83.29	0.74	4.89
24	83.23	0.68	3.92
31	83.14	0.59	3.26
41	83.08	0.53	2.71
55	83.0	0.45	2.27
90	82.85	0.31	1.78

*ratio of $\frac{\text{time since pumping began}}{\text{time since pumping stopped}}$

TABLE F-5. PUMP TEST DATA - P2

Time, min	Water Level Below Measuring Pt.	Flow Q, GPM	Drawdown S
0	75.69		-
.5	77.10	5 gpm	1.41
1	77.94		2.25
2	78.33		2.64
3	78.56		2.87
4	78.67		2.98
5	78.76		3.07
7	79.0		3.31
9	79.10		3.41
11	79.12		3.43
13	79.18		3.49
15	79.23		3.54
20	79.31		3.62
26.5	79.45		3.76
30	79.46		3.77
35	79.51		3.82
40	79.55		3.86
50	79.63		3.94
60	79.66		3.97
70	79.71		4.02
80	79.74		4.05
85 pump off	79.74		4.05

TABLE F-6. RECOVERY TEST DATA - P2

Time, min	Water Level Below Measuring Pt.	Residual Drawdown S'	t/t'*
0	79.74	4.05	-
.25	78.90	3.21	341
.67	78.17	2.48	128
1.17	77.67	1.98	74
1.75	77.25	1.56	50
2.5	76.93	1.24	35
3.5	76.72	1.03	25
5	76.56	0.87	18
7	76.41	0.72	13.14
9	76.31	0.62	10.44
11	76.29	0.60	8.73
15	76.19	0.50	6.67
20	76.10	0.32	3.83
30	76.01	0.32	3.83
40	75.98	0.29	3.13
50	75.91	0.22	2.70
60	75.90	0.21	2.42

*ratio of $\frac{\text{time since pumping began}}{\text{time since pumping stopped}}$

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APPENDIX G

Sampling and Analytical Procedures

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CARSWELL AFB IRP PHASE II STAGE 1
FIELD INVESTIGATION SAMPLING
QUALITY CONTROL PLAN

Prepared by:

Radian Corporation
8501 Mo-Pac Blvd.
Austin, Texas 78766

APPENDIX G

1.0 INTRODUCTION

Field investigations conducted at Carswell AFB will generate a large number of soil, sediment, and water samples for chemical analysis. The analytical results are an important source of information used to determine the impact of a disposal or spill site upon the local hydrogeologic system(s). Since the analyses form a foundation of interpretation, it is important that the samples analyzed be representative of the material.

The purpose of quality control (QC) plan is to provide guidance through which field samples can be obtained, preserved, and controlled. The QC plan helps ensure that the integrity of the sample is maintained. The QC plan for the Carswell AFB IRP Phase II Stage 1 investigation describes the general collection of soil, waste and water samples. In addition, methods of preservation, shipping and administrative controls are discussed.

2.0 QUALITY CONTROL PROCEDURES FOR SAMPLING

Based upon the sampling scheme as outlined in the Carswell IRP Description of Work, nearly 200 samples will be collected for chemical analysis. Other samples will be retained for possible future analytical work. The samples will be collected at the following sites:

- o Landfills 1, 4, 5;
- o Unnamed Stream;
- o Fire Protection Training Areas No. 1 and 2;
- o Entomology Dry Well;
- o Flightline Drainage Ditch;
- o POL Tank Farm;
- o Waste Burial Area; and
- o WSA Inspection Shop Site.

Field procedures and QC procedures using in the collection and analysis of the soil and water samples are summarized in the following paragraphs.

Collection of Soil Samples

Procedures to be used in the collection of soil samples are summarized in Table 2-1. QC procedures for soil and water sampling will be an integral part of the sampling methodology. These procedures will focus upon ensuring the collection of representative samples which are free from external contamination. Documentation and chain-of-custody procedures will also be an important part of the sample collection QC effort, which will include the following procedures:

- o Split-spoon and hand auger sampling will be used to obtain representative samples from depth specific points, as opposed to sample cuttings which may originate at different points in a borehole.

TABLE 2-1. PROCEDURES FOR SOIL SAMPLE COLLECTION

Analysis Required	Field Procedure
Purgeable Halocarbons and Aromatics	Prepare a homogeneous soil mixture and fill 2 each 40 ml VOA vials. (1 vial for RAS, 1 vial for OEHL.) Keep samples chilled to 4°C.
Pesticides	Prepare a homogeneous soil mixture and fill 2 each 40 ml VOA vials. (1 vial for RAS, 1 vial for OEHL.) Keep samples chilled to 4°C.
All other parameters	Prepare a homogeneous soil mixture and fill 2 each 1-quart glass jar (1 jar for RAS, 1 for OEHL.) <u>Note</u>: One jar provides RAS with sufficient soil to perform any or all requested analyes. Keep samples chilled to 4°C.

- During the drilling, the Supervising Geologist will describe the cuttings coming to the surface on the auger flights. This will serve as a general log to be confirmed by description of split-spoon samples.

- The split-spoon or hand auger sampler will be cleaned between each sampling to prevent cross-contamination of the samples.

- All soil and water samples for chemical analysis will be collected in duplicate (i.e., split samples). These samples will be split with OEHL.

- Also, soil and water samples will be analyzed in duplicate at a frequency of 10% for analytical quality control. Duplicates will be carried through the entire analytical scheme independently, including the extraction and digestion steps as applicable.

- After sample collection, each sample will be logged into a master sample logbook (bound, paginated, laboratory notebook) which as a minimum indicates the date and time of sample collection, sample type, and initials of the person who collected the sample.

- Soil samples will be frozen until analysis.

- Chain-of-custody forms (Figure 2-1) will be used to document all Radian and USAF transfers of sample possession from initial preparation of the sample container to final disposition of the sample.

- Additional information is required for samples shipped to OEHL. Table 2-2 shows a list of information, most of which will be provided on the sample container label.

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CHAIN OF CUSTODY RECORD

Field Sample No. ______________

Company Sampled/Address ______________

Sample Point Description ______________

Stream Characteristics:

Temperature ______________ Flow ______________ pH ______________

Visual Observations/Comments ______________

____

Collector's Name ______________ Date/Time Sampled ______________

Amount of Sample Collected ______________

Sample Description ______________

Store at: ☐ Ambient ☐ 5°C ☐ −10°C ☐ Other ______________

☐ Caution - No more sample available ☐ Return unused portion of sample ☐ Discard unused portions

Other Instructions - Special Handling - Hazards ______________

____

____

☐ Hazardous sample (see below) ☐ Non-hazardous sample

☐ Toxic
☐ Pyrophoric
☐ Acidic
☐ Caustic
☐ Skin irritant
☐ Lachrymator
☐ Biological
☐ Peroxide
☐ Flammable (FP< 40°C)
☐ Shock sensitive
☐ Carcinogenic - suspect
☐ Radioactive
☐ Other ______________

Sample Allocation/Chain of Possession:

Organization Name ______________

Received By ______________ Date Received ______________ Time ______________

Transported By ______________ Lab Sample No. ______________

Comments ______________

Inclusive Dates of Possession ______________

Organization Name ______________

Received By ______________ Date Received ______________ Time ______________

Transported By ______________ Lab Sample No. ______________

Comments ______________

Inclusive Dates of Possession ______________

Organization Name ______________

Received By ______________ Date Received ______________ Time ______________

Transported By ______________ Lab Sample No. ______________

Comments ______________

Inclusive Dates of Possession ______________

Figure 2-1. Chain-Of-Custody.

TABLE 2-2. INFORMATION TO ACCOMPANY SAMPLES FORWARDED TO OEHL

1. Installation name (base)
2. Purpose of sample (analyte)
3. Sample number (on containers)
4. Source/Location of sample
5. Contract Task Number and Title of Project
6. Method of collection (i.e., bailer, suction pump, air-lift pump, split spoon, etc.)
7. Volumes removed before sampling
8. Special conditions (use of surrogate standard, special nonstandard preservations, etc.)

Air Force Form 2752 (see Attachment) also needs to accompany the samples. Instructions for filling out AF Form 2752 are provided.

Collection of Water Samples

Field sampling procedures for ground water and surface water are summarized in Table 2-3. QC efforts associated with ground-water sampling are primarily procedural activities. These procedures focus upon ensuring that the samples are representative of ground water and as free as possible from external and/or cross-contamination. The QC steps for ground-water sampling include the following:

- Ground-water levels will be measured and recorded before sampling work begins.
- All wells will be developed by pumping or bailing in order to remove all fine sediment within the well.

AD-A174 095 INSTALLATION RESTORATION PROGRAM PHASE II CONFIRMATION/QUANTIFICATION STA..(U) RADIAN CORP AUSTIN TX OCT 86 F33615-84-D-4402 2/4

UNCLASSIFIED F/G 13/2 NL

1.0 1.1 1.25 1.4 1.6 1.8 2.0 2.2 2.5 2.8 3.2 3.6 4.0 4.5 5.0 5.6 6.3

MICROCOPY RESOLUTION TEST CHART

NATIONAL BUREAU OF STANDARDS-1963-A

TABLE 2-3. PROCEDURES FOR WATER SAMPLE COLLECTION

Analysis Required	Field Procedure
TOC and/or phenol	Collect sufficient water and fill 2 each 500 ml glass jars. Add 2 ml (1 plastic pipet full) of Sulfuric Acid to each jar. (1 jar for RAS, 1 for OEHL.) Keep samples chilled to 4°C.
Purgeable Halocarbons and Aromatics	Collect sufficient water and fill 4 each 40 ml VOA vials to the top (no air bubbles present). Cap and seal the vials. No air bubbles should be present. (2 vials for RAS, 2 for OEHL.) Keep samples chilled.
Lead, Primary Heavy Metals	Collect sufficient water and fill 2 each 500 ml plastic bottles. Add 2 ml (1 plastic pipet full) of Nitric Acid to each bottle (1 bottle for Ras, 1 for OEHL). Keep samples chilled.
Oil and Grease	Collect sufficient water and fill 2 each 1-quart glass bottle nearly to the top. Add 2 ml (1 plastic pipet full) of Sulfuric Acid to each bottle (1 bottle for RAS, 1 for OEHL). Keep samples chilled to 4°C.
TOX	Collect sufficient water and fill 2 each 500 ml glass bottles (1 bottle for RAS, 1 for OHEL). Keep samples chilled to 4°C.
Pesticides	Collect sufficient water and fill 2 each 1-liter glass bottles with teflon liners (1 bottle for RAS, 1 for OEHL). Keep samples chilled to 4°C.
Radiochemical	Collect sufficient water and fill 2 each 1-liter glass bottles (1 bottle for RAS, 1 for OEHL). Keep samples chilled to 4°C.

- All sampling equipment will be thoroughly cleaned before the start of work and between wells.

- Upgradient wells will be sampled first in order to further minimize possible transfer of contaminants, if present, among the wells.

- All wells will be purged with a PVC or Teflon bailer or a submersible bladder pump prior to sampling. Purging will continue until the pH and specific conductance of the water stabilizes or until at least three well volumes of water have been removed.

- Following purging, wells will be allowed to recover prior to sampling.

- Samples will be transferred to containers with a minimum of agitation and disturbance.

- A sufficient volume of ground water will be collected so that samples can be split with OEHL and a replicate of each retained for Radian Analytical Services.

- All samples will be refrigerated (i.e. iced) during transportation and storage.

- Blind duplicate samples will be prepared and submitted for analysis at a frequency of 20% to provide a measure of sampling and analytical variability (precision).

In addition to these procedures, chain of custody documentation (Figure 2-1) will accompany all samples. The chain of custody records will contain, at a minimum, the following information:

- Time, date, and location of sampling, and name of person performing sampling;
- Number, depth, and type of sample;
- Conditions encountered during well evacuation and water sample collection;
- The signature of the responsible on-site hydrogeologist and the time and date he relinquished the samples to either the field laboratory technician or the transporter who will deliver samples to the analytical laboratory.

3.0 QUALITY CONTROL PROCEDURES FOR ANALYSES

In addition to the sampling QC procedures described in Section 2.0, specific QC procedures and criteria will be associated with the various analyses. These QC procedures are project-specific and complement the ongoing QC program conducted routinely in the laboratory.

3.1 Analysis of Metals

Heavy metals will be determined after acid extraction in accordance with EPA methods. Determination for these metals will involve both inductively coupled plasma emission spectrometry (ICPES) and atomic absorption spectroscopy (AAS). The metals to be analyzed, the analytical method for each metal, and EPA method references are presented in Table 3-1. Calibration and QC procedures for metals analyses are discussed below. These procedures are based upon EPA recommended procedures for the 200 Series Methods.

Calibration curves will be generated daily for each metal species using a reagent blank and a minimum of three upscale concentrations. A calibration curve will be considered acceptable if the correlation coefficient is ≥ 0.995. A new calibration curve will be generated after analysis of no more than 20 samples. The new curve will be acceptable if it meets the linearity criterion above, <u>and</u> if the slope agrees with that of the previous curve within $\pm 10\%$.

3.2 Analysis of Purgeable Organics

Purgeable organics in water will be determined by EPA Methods 601 and 602 (Methods 8010 and 8020 for soil). Detection limits and holding times are provided in Table 3-1. QC procedures for these methods involve quadruplicate analyses of reagent water spiked with a "quality control check sample concentrate" and a "surrogate standard". Average percent recoveries and standard deviations are then calculated for each compound and compared to EPA values to determine acceptability. These data should be available for inspection, but the acceptability test need not be repeated specifically for this project.

TABLE 3-1. ANALYTICAL METHODS AND DETECTION LIMITS

Parameter	EPA Method	Detection Limit* (Water)	Detection Limit* (Soil)	Holding Time
COD	410.1/410.2	1.0 mg/L	NA	28 days
Oil and Grease	413.2	1.0 mg/L	10.0 u/g	28 days
Phenols	420.2	0.005 mg/L	0.1 ug/g	28 days
TOC	415.1	1.0 mg/L	NA	28 days
TOX	9020	0.01 mg/L	NA	14 days
Primary Heavy Metals				
Arsenic	200.7	0.060 mg/L	3.0 ug/g	6 months
Barium	200.7	ND	ND	6 months
Cadmium	200.7	0.002 mg/L	0.40 ug/g	6 months
Chromium	200.7	0.005 mg/L	ND	24 hours
Lead	200.7	0.080 mg/L	4.0 ug/g	6 months
Mercury	24.51	0.0002 mg/L	0.05 ug/g	28 days
Selenium	200.7	0.080 mg/L	4.0 ug/g	6 months
Silver	200.7	0.002 mg/L	0.020 ug/g	6 months
EP Toxicity: 1310				
Arsenic		NA	0.060 ug/ml	
Barium		NA	ND	
Cadmium		NA	0.002 ug/ml	
Chromium		NA	0.005 ug/ml	
Lead		NA	0.080 ug/ml	
Mercury		NA	0.0002 ug/ml	
Selenium		NA	0.080 ug/ml	
Silver		NA	0.002 ug/ml	
Pesticides: 608				7 days
Lindane		0.1 ug/L	0.1 ug/L	(extraction)
Endrin		0.1 ug/L	0.1 ug/L	40 days
Methoxychlor		1.0 ug/L	1.0 ug/L	(analysis)
Toxaphene		1.0 ug/L	1.0 ug/L	
Chlordane		1.0 ug/L	1.0 ug/L	
Herbicides: Standard Method 509B				
2,4-D		5.0 ug/L	0.2 ug/L	
2,4,5-TP (Silvex)		5.0 ug/L	0.2 ug/L	
2,4,5-T		5.0 ug/L	0.2 ug/L	

(Continued)

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TABLE 3-1. (Continued)

Parameter	EPA Method	Detection Limit* (Water)	Detection Limit* (Soil)	Holding Time
Purgeable Aromatics: 602				
Benzene		0.2 ug/L		14 days
Toluene		0.2 ug/L		14 days
Ethyl Benzene		0.2 ug/L		14 days
1,3-Dichlorobenzene		0.4 ug/L		14 days
1,2-Dichlorobenzene		0.4 ug/L		14 days
1,4-Dichlorobenzene		0.3 ug/L		14 days
Purgeable Halogens: 601				
Chloromethane		0.08 ug/L		14 days
Bromomethane		1.18 ug/L		14 days
Vinyl Chloride		0.18 ug/L		14 days
Chloroethane		0.52 ug/L		14 days
Methylene Chloride		0.25 ug/L		14 days
Trichlorofluoromethane		ND		14 days
1,1-Dichloroethene		0.13 ug/L		14 days
1,1-Dichloroethane		0.07 ug/L		14 days
trans-1,2-Dichloroethene		0.10 ug/L		14 days
Chloroform		0.05 ug/L		14 days
1,2-Dichloroethane		0.03 ug/L		14 days
1,1,1-Trichloroethane		0.03 ug/L		14 days
Carbon Tetrachloride		0.12 ug/L		14 days
Bromodichloromethane		0.10 ug/L		14 days
1,2-Dichloropropane		0.04 ug/L		14 days
trans-1,3-Dichloropropene		0.34 ug/L		14 days
Trichloroethene		0.12 ug/L		14 days
Dibromochloromethane		0.09 ug/L		14 days
1,1,2-Trichloroethane		0.02 ug/L		14 days
cis-1,3-Dichloropropene		0.20 ug/L		14 days
2-Chloroethylvinyl Ether		0.13 ug/L		14 days
Bromoform		0.20 ug/L		14 days
1,1,2,2-Tetrachloroethane		0.03 ug/L		14 days
Tetrachloroethylene		0.03 ug/L		14 days
Chlorobenzene		0.25 ug/L		14 days
1,3-Dichlorobenzene		0.32 ug/L		14 days
1,2-Dichlorobenzene		0.15 ug/L		14 days
1,4-Dichlorobenzene		0.24 ug/L		14 days
Radiochemical:				
gross A	900.0	ND		6 months
gross B	900.0	ND		6 months
Total Radium		ND		6 months

NOTES:

* Detection limits can vary upwards if the sample is diluted.
ND = Not determined
NA = Not applicable

SOURCES:

EPA, June 1982, "Test Methods for Organic Chemical Analysis of Municipal and Industrial Wastewater", EPA-600/4-82-057.

EPA, March 1983, "Methods for Chemical Analysis of Water and Wastes", EPA-600/4-79-020.

Carswell RAS Reports, Feb.-May 1985.

Duplicate samples will be analyzed at a frequency of 30% to provide a measure of samling and analytical variability. These will be blind duplicates submitted by the field sample custodian and will be subject to the complete analytical scheme.

Second gas chromatographic columns for Methods 601 and 602 are required for confirmation whenever the following values are exceeded:

Compound	Concentration (ug/L)
Benzene	0.7
Carbon Tetrachloride	4.0
Chloroform	10.0
Dichlorethane	0.1
Methylene Chloride	4.0
Tetrachloroethylene	4.0
Toluene	10.0
1,1,1-Trichloroethane	10.0
Trichloroethylene	1.0
Vinyl Chloride	1.0
Dichlorobenzene isomers	>10
Other organics	10

Tables 3-2 and 3-3 provide information on second column confirmation data for these methods.

TABLE 3-2. SECOND COLUMN CONFIRMATION DATA FOR EPA METHOD 601

Compound	Retention Times 1st Column*	2nd Column**
Chloromethane	2.09	4.58
Bromomethane	3.37	5.98
Vinyl chloride	4.14	4.58
Chloroethane	5.24	7.82
Methylene chloride	7.39	9.40
Trichlorofluoromethane	9.39	5.15
1,1-Dichloroethene	10.09	6.53
1,1-Dichloroethane	11.30	11.88
trans-1,2-Dichloroethene	12.08	8.44
Chloroform	12.54	11.40
1,2-Dichloroethane	13.32	15.37
1,1,1-Trichloroethane	14.59	12.17
Carbon tetrachloride	14.97	9.66
Bromodichloromethane	15.46	14.04
1,2-Dichloropropane	16.88	17.04
Trichloroethene	17.73	12.17
Dibromochlormethane	18.28	16.68
2-Chloroethylvinyl ether	19.56	ND
Bromoform	21.03	19.21
Tetrachloroethylene	23.52	14.04
Chlorobenzene	26.15	18.91
1,3-Dichlorobenzene	39.44	22.58
1,2-Dichlorobenzene	40.65	23.87
1,4-Dichlorobenzene	41.42	22.58

*1st Column: Packing: Carbopack B 60/80 mesh w/1% SP-1000 8' x 1/4" OD glass column
Carrier Gas: Helium @ 40 ml/min
Initial Temp: 45°C
Initial Hold: 3 min
Program rate: 8°C/min
Final temp: 200°C
Final hold: 15 min

**2nd Column: Packing: Porpak-C 1 w/120 mesh w/N-octane 6' x 1/4: OD glass column
Carrier Gas: Helium @ 40 ml/min
Initial Temp: 50°C
Initial Hold: 3 min
Program rate: 6°C/min
Final temp: 170°C
Final hold: 4 min

TABLE 3-3. SECOND COLUMN CONFIRMATION DATA FOR EPA METHOD 601

Compound	Retention Times	
	1st Column*	2nd Column**
Benzene	4.72	6.04
Toluene	7.54	8.93
Ethyl benzene	11.04	12.12
1,4-Dichlorobenzene	17.47	25.25
1,3-Dichlorobenzene	18.31	23.77
1,2-Dichlorobenzene	23.17	28.91

*1st Column: Packing: Supelcoport 100/120 mesh w/5% SR 1200 and 1.75 Bentone-34 6' x 1/4" glass column
Carrier Gas: Nitrogen @ 40 mL/min
Initial Temp: 50°C
Initial Hold: 5 min
Program rate: 8°C/min
Final temp: 90°C

**2nd Column: Packing: Chromasorb W-AW 60/80 mesh w/5% 1,2,3-tris(2-Cyanoethyoxy) propane 6' x 1/4" OD glass column
Carrier Gas: Nitrogen @ 40 mL/min
Initial Temp: 40°C
Initial Hold: 2 min
Program rate: 2°C/min
Final temp: 100°C

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ATTACHMENT

AF Form 2752 - Environmental Sampling Data

ENVIRONMENTAL SAMPLING DATA

OEHL USE ONLY

(Use this space for mechanical imprint)

SAMPLING SITE IDENTIFIER (AFR 19-7)

BASE WHERE SAMPLE COLLECTED

SAMPLING SITE DESCRIPTION

DATE COLLECTION BEGAN (YYMMDD)

TIME COLLECTION BEGAN (24 hour clock)

COLLECTION METHOD ☐ GRAB ☐ COMPOSITE _______ HOURS

MAIL REPORTS TO (circle if changed): ORIGINAL / COPY 1 / COPY 2

SAMPLE COLLECTED BY (Name,Grade,AFSC) | SIGNATURE | AUTOVON

REASON FOR SUBMISSION: A-ACCIDENT/INCIDENT; R-ROUTINE/PERIODIC; C-COMPLAINT; N-NPDES; F-FOLLOWUP/CLEANUP; O-OTHER (specify)

BASE SAMPLE NUMBER | OEHL PID

ANALYSES REQUESTED (check appropriate blocks)

GROUP A		Hardness	00900	Residue, Settleable	50086	GROUP T	
Ammonia	00610	Iron	01045	Residue, Volatile	00505	Bromoform	32104
Chemical Oxygen Demand	00340	Lead	01051	Silica	00955	Bromodichloromethane	32101
Kjeldahl Nitrogen	00625	Magnesium	00927	Specific Conductance	00095	Carbon Tetrachloride	32102
Nitrate	00620	Manganese	01055	Sulfate	00945	Chloroform	32106
Nitrite	00615	Mercury	71900	Sulfite	00740	Chloromethane	34418
Oil & Grease	00560	Nickel	01067	Surfactants -MBAS	38260	Dibromochloromethane	32105
Organic Carbon	00680	Potassium	00937	Turbidity	00076	Methylene Chloride	34423
Orthophosphate	00671	Selenium	01147			Tetrachloroethylene	34475
Phosphorus, Total	00665	Silver	01077			1,1,1-Trichloroethane	34506
		Sodium	00929	GROUP H		Trichloroethylene	39180
GROUP D		Thallium	01059	BHC Isomers	39340	Trihalomethanes	82080
Cyanide, Tot	00720	Zinc	01092	Chlordane	39350	PCBs	39516
Cyanide, Free	00722			DDT Isomers	39370		
				Dieldrin	39380		
GROUP E		GROUP G		Endrin	39390		
Phenols	32730	Acidity, Total	70508	Heptachlor	39410		
		Alkalinity, Total	00410	Heptachlor Epoxide	39420		
GROUP F		Alkalinity, Bicarbonate	00425	Lindane	39782		
Antimony	01097	Bromide	71870	Methoxychlor	39480		
Arsenic	01002	Carbon Dioxide	00405	Toxaphene	39400		
Barium	01007	Chloride	00940	2,4-D	39730	ON SITE ANALYSES	
Beryllium	01012	Color	00080	2,4,5-TP-Silvex	39760	Parameter	Value
Boron	01022	Fluoride	00951	2,4,5-T	39740	Flow 50050	mgd
Cadmium	01027	Iodide	71865			Chlorine, Total 50060	mg/l
Calcium	00916	Odor	00086			Dissolved Oxygen 00300	mg/l
Chromium, Total	01034	Residue, Total	00500			pH 00400	units
Chromium VI	01032	Residue Filterable (TDS)	70300	GROUP J		Temperature 00010	°C
Copper	01042	Residue, Nonfilterable	00530	Sulfides	00745		

COMMENTS

AF FORM JAN 81 2752

INSTRUCTIONS FOR COMPLETING AF FORM 2752,
ENVIRONMENTAL SAMPLING DATA

The purpose of this form is to record environmental and drinking water sampling information. The form will be used for submitting environmental and drinking water samples (except radiological samples) to the USAF Occupational and Environmental Health Laboratory (USAF OEHL). Use AF Form 2753 for radiological sampling data.

1. Identification Data. Plastic embossed cards for recording identification data may be used in lieu of the following handwritten entries:

a. Sampling Site Identifier. Enter code for Sampling Site Identifier (see page 3).

b. Base. Enter name of base where sample is collected.

c. Sampling Site Description. Enter name of sampling site.

2. Date Collection Began. Enter date sample collection began (e.g., if Jan 14, 1981, enter 81/01/14).

3. Time Collection Began. Enter time (24-hour clock) sample collection began.

4. Collection Method. Check whether sample was a grab sample or a composite sample. If a composite sample, enter number of hours from beginning to the completion of compositing.

5. Mail Reports To. Enter four-digit base code in small boxes (same code as first four digits of environmental identifier if same base). Enter mailing addresses where analysis results will be sent. Include unit designation, office symbol, base, state, and ZIP code.

6. Sample Collected By. Enter name (last name only), grade and AFSC of individual collecting sample.

7. Signature. Enter signature of individual collecting sample.

8. AUTOVON. Enter AUTOVON number of responsible individual who can answer questions from the laboratory concerning the sample.

9. Reasons for Submission. Enter code (in the box to the right of shaded "E") indicating reason for submitting sample.

10. Base Sample Number. Enter eight-digit coded base sample number for each sample. See pages 4-5.

11. OEHL PID. Leave blank.

12. Analysis Requested. Check the block to the left of the analyses desired. For parameters not listed, enter parameter name and number in the blank spaces provided under the appropriate preservation group. Continue in the Comments Section if required.

13. On-Site Analyses. Enter results of any on-site analyses. For parameters not listed, enter parameter name, number, value and unit in the blank spaces provided.

14. Preserve a one liter (one quart) sample as shown in page 7 for each group in which an analysis is requested.

15. Submit one copy of the completed form in a waterproof envelope with the sample to USAF OEHL/SA, Building 140, Brooks AFB TX 78235.

THE SAMPLING SITE IDENTIFIER

1. All environmental monitoring and drinking water sampling sites must be identified in a standardized manner. The sampling site identifier will be used for local identification purposes and will be the primary identifier for environmental data stored in a central Automatic Data Processing (ADP) repository.

2. The sampling site identifier is nine alphanumeric characters made up of the installation code, followed by the sampling site type code and the sampling location number.

a. Installation Code. The four-digit number now used for the film dosimetry program with a zero prefix (available from project monitor or base bioenvironmental engineer).

b. Sampling Site Type. A two-letter code to identify the source of the sample (see para 5 of this attachment for the complete list).

c. Sample Location Number. A three-digit number assigned locally.

3. The code formed when the three elements are combined is unique for a particular sampling point. If the sampling location is taken out of service, destroyed or no longer used, the code will not be reassigned to another sampling site nor used again.

4. The new code will look like this:

Installation Code	Sample Type	Sample Location
0 1 2 3	AB	4 5 6

5. Sample Type Codes:

Sampling Site Type	Code
Air	AO
Nonpotable water, source (effluent)	NS
Nonpotable water, process	NP
Nonpotable water, ambient	NA
Potable water, distribution system	PD
Potable water, ground water (untreated)	PG
Potable water, surface water (untreated)	PS
Potable water, other	PO
Solid	SO

CODED BASE SAMPLE NUMBER

This section contains accepted environmental sampling methods recommended by the USAF OEHL. The basis for any monitoring program rests upon information obtained from sampling. Improper sampling can negate even the most careful and accurate work performed by the remainder of the monitoring team. Therefore, the proper selection, collection, identification and shipment of environmental samples are paramount for a successful monitoring program. (General instructions for packaging and shipping samples are contained in Section V). Additional information can be obtained from:

USAF OEHL/ECA AUTOVON 240-2891 or (512) 536-2891
USAF OEHL/ECW AUTOVON 240-3305 or (512) 536-3305
USAF OEHL/ECE AUTOVON 240-3667 or (512) 536-3667

ASSIGNMENT OF BASE SAMPLE NUMBERS

Environmental samples that are collected at base level must be assigned a sample number, regardless of whether they are analyzed locally or at a central laboratory such as the USAF OEHL. This coded sample number will enable the analysis results to be ultimately stored in and retrieved from a central data repository. A sample number code consists of eight digits. The first two digits classify the sample as to the method and type of sample. The next two digits identify the calendar year that the sample was taken and the last four digits identify the locally assigned sample number, progressing in numerical sequence from sample number 0001 to sample number 9999. Sample number codes follow:

a. First 2 digits

(1) Digit #1 -

Sample Method	Code
Grab Sample	G
Composite Sample	C

(2) Digit #2 -

Sample Type	Code
Nonpotable	N
Potable Water	P
Residue (Incinerator Ash)	D
Sludge (Wet or Dry)	L
Soil	S
Unclassified	C
Vegetation	V

b. Next 2 digits - Code for sample year using last two numbers of calendar year in which sample was taken. Example: Code for CY 1981 is 81.

c. Last 4 digits - Code for locally assigned, numerically sequenced sample number. Example: Code for thirteenth sample taken during a calendar year is 0013.

Completed Base Sample Number. To illustrate a completed code, consider an environmental water sample taken to characterize storm water runoff. The sample was a grab sample taken from a storm drain. Eighty-six other samples had already been taken at the base that year (CY 1979). The sample would be:

Grab Sample
Nonpotable Water
Calendar Year 1979
Sample No. 87

GN 79 0087

USAF OEHL WORK CENTER CODES

	Analysis of Industrial Hygiene Samples
1XX	Liquid Media or Eluent for Tube Analysis
2XX	Liquid Media or Eluent for Pesticide Type Analysis
3XX	Eluent or Solvent for Metals Analysis
4XX	Collection Media Colorimetric Analysis
5XX	Media for Gravimetric/Physical Observations
6XX	Media for Volumetric/Electrometric AN
7XX	Media for Liquid Chromatography
9XX	Special Modification
1XXX	Special Analysis (Bulk Industrial Products)
9XXX	Analysis of Biological Materials
1XXXX	Analysis of Water or Soil (Environmental) Samples

10100-10199	A Preservation Group
10300-10399	D Preservation Group (Cyanides)
10400-10499	E Preservation Group (Phenols)
10500-10599	F Preservation Group (Metals)
10600-10699	G Preservation Group (Unpreserved)
10600	J Preservation Group (Sulfides)
10700-10799	H Preservation Group (Pesticides)
10800-10899	T Preservation Group (Trace Organics)

2XXXX	Radioassay of Materials

PRESERVATION METHODS*

NOTE: A preservative must be added immediately after collection unless the sample is to be analyzed for dissolved materials. For dissolved materials analysis, filter as soon as possible, and then add the preservative.

GROUP		DESCRIPTION
A	(A1XX)	Cool to 4°C; add sulfuric acid to pH <2; submit 1 liter in a polyethylene or glass container.
	(A2XX)	Same as Group A1XX except that a separate 1 liter individual sample must be submitted in a glass container.
D	(D1XX)	Cool to 4°C; add sodium hydroxide to pH >12; add sodium thiosulfate if residual chlorine exists in the sample. Submit 1 liter in a polyethylene or glass container.
E	(E1XX)	Cool to 4°C; add sulfuric acid to pH <2; submit 1 liter in a polyethylene or glass container.
F	(F1XX)	Add nitric acid to pH <2; submit 1 liter in a polyethylene or glass container.
	(F2XX)	This group is for boron. Do not add nitric acid to this group--no preservative is necessary. Do not, under any circumstances, submit sample in a glass container.
G	(G1XX)	Cool to 4°C; add no other preservative; submit 1 liter in a glass or polyethylene container.
	(G3XX)	This group is for asbestos. No other preservative is necessary.
H	(H1XX)	Cool to 4°C; add sodium thiosulfate if residual chlorine exists in sample; submit 1 liter in glass container with Teflon® lined cap.
	(H2XX)	These analytes degrade rapidly and it is generally not feasible to submit samples for this analyte. If it is necesary call USAF OEHL/SAN [AUTOVON 240-3626 or (512) 536-3626/Mr Nishioka].
J	(J1XX)	This sample is for sulfides. Cool to 4°C; add 2 ml of a 22% zinc acetate solution per liter of sample. Submit 1 liter in a glass or polyethylene container.
T	(T1XX)	Submit only in special containers obtained from USAF OEHL/SAN [AUTOVON 240-3626 or (512) 536-3626/Mr Rodriguez].
	(T4XX)	Cool to 4°C; add sodium thiosulfate if residual chlorine exists in sample; submit 1 liter in glass container with Teflon lined cap.

*These instructions supersede all previously issued preservation instructions.

RECOMMENDED ENVIRONMENTAL SAMPLING METHODS

STORET #	NAME	PRESERVATIVE WORK CENTER	NOTES	REF.
34205	ACENAPHTHENE	T4XX-10820	C	E610
34200	ACENAPHTHYLENE	T4XX-10820	C	E610
1001462AD	ACID EXTRACT. PRIORITY POLLUTANT	T4XX-10810	C	E625
00436	ACIDITY (MINERAL)	G1XX-10610	A	E305
70508	ACIDITY (TOTAL)	G1XX-10610	A	E305
34210	ACROLEIN	T4XX-10820	C	E603
34215	ACRYLONITRILE	T4XX-10820	C	E603
70312	AGGRESSIVE INDEX	G1XX-10000		
39330	ALDRIN	H1XX-10700	C	E608
00425	ALKALINITY (BICARBONATE)	G1XX-10610	A	A403
00430	ALKALINITY (CARBONATE)	G1XX-10610	A	A403
00420	ALKALINITY (HYDROXIDE)	G1XX-10610	A	A403
00415	ALKALINITY (PHENOLTHALEIN)	G1XX-10610	A	A403
00410	ALKALINITY (TOTAL)	G1XX-10610	A	A403
01106	ALUMINUM (DISSOLVED)	F1XX-10500	A	E202
01105	ALUMINUM (TOTAL)	F1XX-10500	A	E202
00610	AMMONIA (NITROGEN)	A1XX-10110	A	E350
34420	ANTHRACENE	T4XX-10820	C	E610
34556	DIBENZO(a,h)ANTHRACENE	T4XX-10820	C	E610
01095	ANTIMONY (DISSOLVED)	F1XX-10520	A	E204
01097	ANTIMONY (TOTAL)	F1XX-10510	A	E204
01000	ARSENIC (DISSOLVED)	F1XX-10520	A	E206

RECOMMENDED ENVIRONMENTAL SAMPLING METHODS

STORET #	NAME	PRESERVATIVE WORK CENTER	NOTES	REF.
01002	ARSENIC (TOTAL)	F1XX-10510	A	E206
34225	ASBESTOS	G3XX-10000	C	C
01005	BARIUM (DISSOLVED)	F1XX-10520	A	E208
01007	BARIUM (TOTAL)	F1XX-10510	A	E208
1001463BE	BASE/NEUTRAL EXTR. PRI. POLLUT.	T4XX-10820	C	E625
34030	BENZENE (OBTAIN SPECIAL CONTAINER FROM LAB)	T1XX-10850	F	E503
39120	BENZIDINE	T4XX-10820	C	E605
34526	BENZO(a)ANTHRACENE	T4XX-10820	C	E610
34230	BENZO(b)FLUORANTHENE	T4XX-10820	C	E610
34242	BENZO(k)FLUORANTHENE	T4XX-10820	C	E610
34247	BENZO(a)PYRENE	T4XX-10820	C	E610
34521	BENZO(ghi)PERYLENE	T4XX-10820	C	E610
01010	BERYLLIUM (DISSOLVED)	F1XX-10520	A	E210
01012	BERYLLIUM (TOTAL)	F1XX-10510	A	E210
39340	BHC ISOMERS	H1XX-10700	C	E608
39337	a-BHC	H1XX-10700	C	E608
39338	b-BHC	H1XX-10700	C	E608
34259	d-BHC	H1XX-10700	C	E608
00310	*BOD (BIOCHEMICAL OXYGEN DEMAND)	G1XX-10000	AX	
01020	BORON (DISSOLVED)	F1XX-10500	B	A404B
01022	BORON (TOTAL)	F1XX-10500	B	A404B

RECOMMENDED ENVIRONMENTAL SAMPLING METHODS

STORET #	NAME	PRESERVATIVE WORK CENTER	NOTES	REF.
71870	BROMIDES	G1XX-10630	A	A405
32101	BROMODICHLOROMETHANE (OBTAIN SPECIAL CONTAINER FROM LAB)	T1XX-10860	D	E501
32104	BROMOFORM (OBTAIN SPECIAL CONTAINER FROM LAB)	T1XX-10860	D	E501
34413	BROMOMETHANE (OBTAIN SPECIAL CONTAINER FROM LAB)	T1XX-10860	D	E501
01025	CADMIUM (DISSOLVED)	F1XX-10520	A	E213
01027	CADMIUM (TOTAL)	F1XX-10510	A	E213
00915	CALCIUM (DISSOLVED)	F1XX-10520	A	E215
00916	CALCIUM (TOTAL)	F1XX-10510	A	E215
00405	CARBON DIOXIDE (CALCULATED)	G1XX-10610	A	A406
32102	CARBON TETRACHLORIDE (OBTAIN SPECIAL CONTAINER FROM LAB)	T1XX-10860	D	E601
00340	CHEMICAL OXYGEN DEMAND (COD)	A1XX-10130	A	A508A
39350	CHLORDANE	H1XX-10700	C	A509
00940	CHLORIDES	G1XX-10630	A	E325
50064	*CHLORINE (FREE AVAILABLE)	G1XX-10000	X	
50066	*CHLORINE (COMBINED AVAILABLE)	G1XX-10000	X	
50060	*CHLORINE (TOTAL RESIDUAL)	G1XX-10000	X	
34301	CHLOROBENZENE (OBTAIN SPECIAL CONTAINER FROM LAB)	T1XX-10850	F	E601
32106	CHLOROFORM (OBTAIN SPECIAL CONTAINER FROM LAB)	T1XX-10800	D	E601

RECOMMENDED ENVIRONMENTAL SAMPLING METHODS

STORET #	NAME	PRESERVATIVE WORK CENTER	NOTES	REF.
34311	CHLOROETHANE (OBTAIN SPECIAL CONTAINER FROM LAB)	T1XX-10860	D	E601
34273	BIS(2-CHLOROETHYL) ETHER	T4XX-10820	C	E611
34278	BIS(2-CHLOROETHOXY)METHANE	T4XX-10820	C	E611
34283	BIS(2-CHLOROISOPROPYL)ETHER	T4XX-10820	C	E611
34576	CHLOROETHYLVINYL ETHER (OBTAIN SPECIAL CONTAINER FROM LAB)	T1XX-10860	D	E602
34418	CHLOROMETHANE (OBTAIN SPECIAL CONTAINER FROM LAB)	T1XX-10860	D	E602
34518	2-CHLORONAPHTHALENE	T4XX-10820	C	E612
01030	CHROMIUM (DISSOLVED)	F1XX-10520	A	E218
01032	CHROMIUM (HEXAVALENT)	F1XX-10510	AX	A312B
01034	CHROMIUM (TOTAL)	F1XX-10510	A	E218
34320	CHRYSENE	T4XX-10820	C	E610
01035	COBALT (DISSOLVED)	F1XX-10500	A	E219
01037	COBALT (TOTAL)	F1XX-10500	A	E219
31501	*COLIFORM (TOTAL)	G1XX-10000	X	
00080	COLOR	G1XX-10620	A	E110
01040	COPPER (DISSOLVED)	F1XX-10520	A	E220
01042	COPPER (TOTAL)	F1XX-10510	A	E220
00720	CYANIDES (TOTAL)	D1XX-10300	A	A412D
00722	CYANIDES (AMENABLE TO CHLORINE)	D1XX-10300	A	A412D
39730	2,4-D	H1XX-10700	C	A509

RECOMMENDED ENVIRONMENTAL SAMPLING METHODS

STORET #	NAME	PRESERVATIVE WORK CENTER	NOTES	REF.
39310	4,4'-DDD	H1XX-10700	C	E608
39320	4,4'-DDE	H1XX-10700	C	E608
39300	4,4'-DDT	H1XX-10700	C	E608
39370	DDT ISOMERS	H1XX-10700	C	A509
39570	DIAZINON	H2XX-10700	C	A509
32105	DIBROMOCHLOROMETHANE (OBTAIN SPECIAL CONTAINER FROM LAB)	T1XX-10860	D	E501
34536	1,2-DICHLOROBENZENE (ORTHO) (OBTAIN SPECIAL CONTAINER FROM LAB)	T1XX-10850	F	E602
34566	1,3-DICHLOROBENZENE (META) (OBTAIN SPECIAL CONTAINER FROM LAB)	T1XX-10850	F	E602
34571	1,4-DICHLOROBENZENE (PARA) (OBTAIN SPECIAL CONTAINER FROM LAB)	T1XX-10850	F	E602
34631	3,3'-DICHLOROBENZIDENE	T4XX-10820	C	E605
34668	DICHLORODIFLUOROMETHANE (OBTAIN SPECIAL CONTAINER FROM LAB)	T1XX-10860	D	E601
34496	1,1-DICHLOROETHANE (OBTAIN SPECIAL CONTAINER FROM LAB)	T1XX-10860	D	E601
32103	1,2-DICHLOROETHANE (OBTAIN SPECIAL CONTAINER FROM LAB)	T1XX-10860	D	E601
34501	1,1-DICHLOROETHENE (OBTAIN SPECIAL CONTAINER FROM LAB)	T1XX-10860	D	E601
34546	1,2-DICHLOROETHYLENE (OBTAIN SPECIAL CONTAINER FROM LAB)	T1XX-10860	D	E601
34423	DICHLOROMETHANE (OBTAIN SPECIAL CONTAINER FROM LAB)	T1XX-10860	D	E601

RECOMMENDED ENVIRONMENTAL SAMPLING METHODS

STORET #	NAME	PRESERVATIVE WORK CENTER	NOTES	REF.
34451	1,2-DICHLOROPROPANE (OBTAIN SPECIAL CONTAINER FROM LAB)	T1XX-10860	D	E601
34704	CIS-1,3-DICHLOROPROPENE (OBTAIN SPECIAL CONTAINER FROM LAB)	T1XX-10860	D	E601
34699	TRANS-1,3-DICHLOROPROPENE (OBTAIN SPECIAL CONTAINER FROM LAB)	T1XX-10860	D	E601
39380	DIELDRIN	H1XX-10700	C	E608
34611	2,4-DINITROTOLUENE	T4XX-10820	C	E609
34626	2,6-DINITROTOLUENE	T4XX-10820	C	E609
00300	*DISSOLVED OXYGEN	G1XX-10000	CX	
34641	DURSBAN	H1XX-10700	C	E611
34361	ENDOSULFAN I	H1XX-10700	C	E608
34356	ENDOSULFAN II	H1XX-10700	C	E608
34351	ENDOSULFAN SULFATE	H1XX-10700	C	E608
39390	ENDRIN	H1XX-10700	C	E608
34366	ENDRIN ALDEHYDE	H1XX-10700	C	E608
34371	ETHYLBENZENE (OBTAIN SPECIAL CONTAINER FROM LAB)	T1XX-10850	F	E602
31613	*FECAL COLIFORM	G1XX-10000	X	
31673	*FECAL STREPTOCOCCI	G1XX-10000	X	
34376	FLUOROANTHENE	T4XX-10820	C	E610
34381	FLUORENE	T4XX-10820	C	E610
00951	FLUORIDES	G1XX-10630	B	E340
38260	FOAMING AGENTS (SEE SURFACTANTS)	G1XX-10620	AX	E425

RECOMMENDED ENVIRONMENTAL SAMPLING METHODS

STORET #	NAME	PRESERVATIVE WORK CENTER	NOTES	REF.
00901	HARDNESS (CARBONATE)	G1XX-10600	A	A314A
00902	HARDNESS (NONCARBONATE)	G1XX-10600		
00900	HARDNESS (TOTAL)	F1XX-10510	A	A314A
39410	HEPTACHLOR	H1XX-10700	C	A509
39420	HEPTACHLOR EPOXIDE	H1XX-10700	C	E608
39700	HEXACHLOROBENZENE	T4XX-10820	C	E608
34391	HEXACHLOROBUTADIENE	T4XX-10820	C	E612
34386	HEXACHLOROCYCLOPENTADIENE	T4XX-10820	C	E612
34396	HEXACHLOROETHANE	T4XX-10820	C	E612
00400	*HYDROGEN ION (pH)	G1XX-10000	AX	E150
34403	INDENO(1,3-CD)PYRENE	T4XX-10820	C	E610
71865	IODIDES	G1XX-10630	AX	E345
01046	IRON (DISSOLVED)	F1XX-10520	A	E236
01045	IRON (TOTAL)	F1XX-10510	A	E236
34408	ISOPHORONE	T4XX-10820	C	E609
00625	KJELDAHL NITROGEN (TOTAL)	A1XX-10110	A	E351
70311	LANGLIER INDEX	G1XX-10000	A	A203
01049	LEAD (DISSOLVED)	F1XX-10520	A	E239
01051	LEAD (TOTAL)	F1XX-10510	A	E239
39782	LINDANE	H1XX-10700	C	E608
00925	MAGNESIUM (DISSOLVED)	F1XX-10520	A	E242
00927	MAGNESIUM (TOTAL)	F1XX-10510	A	E242

RECOMMENDED ENVIRONMENTAL SAMPLING METHODS

STORET #	NAME	PRESERVATIVE WORK CENTER	NOTES	REF.
01056	MANGANESE (DISSOLVED)	F1XX-10520	A	E243
01055	MANGANESE (TOTAL)	F1XX-10510	A	E243
1001465MT	MAXIMUM TRIHALOMETHANE POTENTIAL (OBTAIN SPECIAL CONTAINER FROM LAB)	T1XX-10830	E	E501
38260	MBAS (SEE SURFACTANTS)	G1XX-10620	AX	E425
71890	MERCURY (DISSOLVED)	F1XX-10520	A	E245
71900	MERCURY (TOTAL)	F1XX-10510	A	E245
39480	METHOXYCHLOR	H1XX-10700	C	E608
34423	METHYLENE CHLORIDE (OBTAIN SPECIAL CONTAINER FROM LAB)	T1XX-10800	D	E601
81595	METHYL ETHYL KETONE (OBTAIN SPECIAL CONTAINER FROM LAB)	T1XX-10850	D	E503
81596	METHYL ISOBUTYL KETONE (OBTAIN SPECIAL CONTAINER FROM LAB)	T1XX-10850	D	E503
01060	MOLYBDENUM (DISSOLVED)	F1XX-10500	A	E246
01062	MOLYBDENUM (TOTAL)	F1XX-10500	A	E246
34301	MONOCHLOROBENZENE (OBTAIN SPECIAL CONTAINER FROM LAB)	T1XX-10800	F	E602
34696	NAPHTHALENE	T4XX-10820	C	E610
01065	NICKEL (DISSOLVED)	F1XX-10520	A	E249
01067	NICKEL (TOTAL)	F1XX-10510	A	E249
00620	NITRATES (AS NITROGEN)	A1XX-10110	AX	E353
00630	NITRATES-NITRITES	A1XX-10100	AX	E353
00615	NITRITES (AS NITROGEN)	A1XX-10110	AX	E353

RECOMMENDED ENVIRONMENTAL SAMPLING METHODS

STORET #	NAME	PRESERVATIVE WORK CENTER	NOTES	REF.
34447	NITROBENZENE	T4XX-10820	C	E609
00625	NITROGEN (TOTAL KJELDAHL)	A1XX-10110	A	E351
34438	N-NITROSODIMETHYLAMINE	T4XX-10820	C	E607
34428	N-NITROSODI-N-PROPYLAMINE	T4XX-10820	C	E607
34433	N-NITROSODIPHENYLAMINE	T4XX-10820	C	E607
00086	*ODOR	G1XX-10620	X	
00560	OIL & GREASE	A2XX-10120	CJ	E413
00680	ORGANIC CARBON	A1XX-10130	A	E415
00671	ORTHO PHOSPHATE (DISSOLVED)	A1XX-10110	AX	E365
00300	*OXYGEN (DISSOLVED)	G1XX-10000	X	
39516	PCB (POLYCHLORINATED BIPHENYLS)	T4XX-10850	C	E608
00400	*pH (HYDROGEN ION)	G1XX-10000	X	
34461	PHENANTHRENE	T4XX-10820	C	E610
32730	PHENOLS	E1XX-10400	A	E420
34452	4-CHLORO-3-METHYLPHENOL	T4XX-10810	C	E604
34586	2-CHLOROPHENOL	T4XX-10810	C	E604
34601	2,4-DICHLOROPHENOL	T4XX-10810	C	E604
34606	2,4-DIMETHYLPHENOL	T4XX-10810	C	E604
34606	2,4-DINITROPHENOL	T4XX-10810	C	E604
34657	2-METHYL-4,6-DINITROPHENOL	T4XX-10810	C	E604
34591	2-NITROPHENOL	T4XX-10810	C	E604
34646	4-NITROPHENOL	T4XX-10810	C	E604

RECOMMENDED ENVIRONMENTAL SAMPLING METHODS

STORET #	NAME	PRESERVATIVE WORK CENTER	NOTES	REF.
34694	PENTACHLOROPHENOL	T4XX-10810	C	E604
34621	2,4,6-TRICHLOROPHENOL	T4XX-10810	C	E604
34636	4-BROMOPHENYL PHENYLETHER	T4XX-10820	C	E611
34641	4-CHLOROPHENYL PHENYLETHER	T4XX-10820	C	E611
00671	PHOSPHATES ORTHO (DISSOLVED)	A1XX-10110	AX	E365
70507	PHOSPHATES ORTHO (TOTAL)	A1XX-10100	A	E365
00665	PHOSPHORUS (TOTAL)	A1XX-10110	A	E365
1000069PH	PHTHALATE ESTER SCREEN	T4XX-10820	C	E606
39100	BIS(2-ETHYLHEXYL)PHTHALATE	T4XX-10820	C	E606
34292	BUTYLBENZYL PHTHALATE	T4XX-10820	C	E606
39110	DI-N-BUTYL PHTHALATE	T4XX-10820	C	E606
34336	DIETHYL PHTHALATE	T4XX-10820	C	E606
34341	DIMETHYL PHTHALATE	T4XX-10820	C	E606
34596	DI-N-OCTYL PHTHALATE	T4XX-10820	C	E606
31751	*PLATE COUNT, TOTAL	G1XX-10000	X	
00935	POTASSIUM (DISSOLVED)	F1XX-10520	A	E258
00937	POTASSIUM (TOTAL)	F1XX-10510	A	E258
1001462AE	PRIORITY POLLUTANT-ACID EXTR.	T4XX-10810	C	E625
1001463BE	PRIORITY POLLUTANT - BASE/NEUT. EXT	T4XX-10820	C	E625
1001465MT	PRIORITY POLLUTANT - MAX.TRIHALO.PO (OBTAIN SPECIAL CONTAINER FROM LAB)	T1XX-10830	E	E501
82080	PRIORITY POLLUTANT - TOT.TRIHALOMET (OBTAIN SPECIAL CONTAINER FROM LAB)	T1XX-10840	D	E501

RECOMMENDED ENVIRONMENTAL SAMPLING METHODS

STORET #	NAME	PRESERVATIVE WORK CENTER	NOTES	REF.
1001461PA	PRIORITY POLLUTANT - VOL. AROMATICS (OBTAIN SPECIAL CONTAINER FROM LAB)	T1XX-10850	F	E602
1001460PH	PRIORITY POLLUTANT-VOLATILE HALOCAR (OBTAIN SPECIAL CONTAINER FROM LAB)	T1XX-10860	D	E601
71220	*PSEUDOMONAS, AERUGINOSA	G1XX-10000	X	
34469	PYRENE	T4XX-10820	C	E610
00500	RESIDUE (TOTAL)	G1XX-10642	A	E160
70300	RESIDUE FILTERABLE [illegible] S)	G1XX-10640	AX	E160
00530	RESIDUE NON-FILTERABLE (SS)	G1XX-10640	AX	E160
50086	RESIDUE (SETTLEABLE)	G1XX-10600	A	E160
00520	RESIDUE (VOLATILE FILTERABLE)	G1XX-10600	AX	E160
00535	RESIDUE (VOLATILE NON-FILTERABLE)	G1XX-10600	AX	E160
00505	RESIDUE VOLATILE (TOTAL)	G1XX-10642	AX	E160
00480	SALINITY	G1XX-10600	A	A210A
01145	SELENIUM (DISSOLVED)	F1XX-10520	A	E270
01147	SELENIUM (TOTAL)	F1XX-10510	A	E270
39750	SEVIN	H2XX-10700	C	A509
00955	SILICA	G1XX-10600	B	E370
01075	SILVER (DISSOLVED)	F1XX-10520	A	E272
01077	SILVER (TOTAL)	F1XX-10510	A	E272
39760	SILVEX (2,4,5-TP)	H1XX-10700	C	A509
00930	SODIUM (DISSOLVED)	F1XX-10520	A	E273
00929	SODIUM (TOTAL)	F1XX-10510	A	E273

RECOMMENDED ENVIRONMENTAL SAMPLING METHODS

STORET #	NAME	PRESERVATIVE WORK CENTER	NOTES	REF.
00095	SPECIFIC CONDUCTANCE	G1XX-10620	A	E120
80110	SPECIFIC GRAVITY	G1XX-10600	A	A213
00945	SULFATES	G1XX-10630	A	E375
00745	SULFIDES	J1XX-10600	AX	E376
00740	SULFITES	G1XX-10600	AX	E377
38260	SURFACTANTS (MBAS AS LAS)	G1XX-10620	AX	E425
39740	2,4,5-T	H1XX-10700	C	A509
32240	TANNINS & LIGNINS	G1XX-10600	A	A513
00010	*TEMPERATURE (°C)	G1XX-10000	X	
34516	TETRACHLOROETHANE (OBTAIN SPECIAL CONTAINER FROM LAB)	T1XX-10860	D	E601
34475	TETRACHLOROETHYLENE (OBTAIN SPECIAL CONTAINER FROM LAB)	T1XX-10860	D	E601
00730	THIOCYANATES	D1XX-10300	A	A412K
01057	THALLIUM (DISSOLVED)	F1XX-10520	A	E279
01059	THALLIUM (TOTAL)	F1XX-10510	A	E279
01100	TIN (DISSOLVED)	F1XX-10500	A	E282
01102	TIN (TOTAL)	F1XX-10500	A	E282
01150	TITANIUM (DISSOLVED)	F1XX-10500	A	E283
34506	1,1,1-TRICHLOROETHANE (OBTAIN SPECIAL CONTAINER FROM LAB)	T1XX-1086	D	E601
34511	1,1,2-TRICHLOROETHANE (OBTAIN SPECIAL CONTAINER FROM LAB)	T1XX-10860	D	E601

RECOMMENDED ENVIRONMENTAL SAMPLING METHODS

STORET #	NAME	PRESERVATIVE WORK CENTER	NOTES	REF.
39180	TRICHLOROETHYLENE (OBTAIN SPECIAL CONTAINER FROM LAB)	T1XX-10860	D	E601
34488	TRICHLOROFLUOROMETHANE (OBTAIN SPECIAL CONTAINER FROM LAB)	T1XX-10860	D	E601
82080	TRIHALOMETHANES (TOTAL) (OBTAIN SPECIAL CONTAINER FROM LAB)	T1XX-10840	D	E501
00076	TURBIDITY	G1XX-10620	AX	E180
39175	VINYL CHLORIDE (OBTAIN SPECIAL CONTAINER FROM LAB)	T1XX-10860	D	E601
81710	M-XYLENE (OBTAIN SPECIAL CONTAINER FROM LAB)	T1XX-10850	F	E503
81711	O-XYLENE (OBTAIN SPECIAL CONTAINER FROM LAB)	T1XX-10850	F	E503
78132	P-XYLENE (OBTAIN SPECIAL CONTAINER FORM LAB)	T1XX-10850	F	E503
01090	ZINC (DISSOLVED)	F1XX-10500	A	E289
01092	ZINC (TOTAL)	F1XX-10510	A	E289

RADIAN
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Quality Assurance/Quality Control Program for Radian Analytical Services

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THE QUALITY ASSURANCE/QUALITY CONTROL PROGRAM
FOR RADIAN ANALYTICAL SERVICES

Radian Analytical Services' (RAS) objective is to provide high quality chemical analyses to all clients regardless of the size of the analytical task. To aid in achieving this goal, a strong quality assurance program and rigid quality control practices are integral parts of all analyses. This document describes these quality assurance/quality control protocols for the Radian Analytical Services laboratories.

The basic quality control program includes procedures for sample handling, calibration, spiking and replicate analyses, analysis of QC test samples, equipment maintenance, and supplies control. These procedures can be integrated with a client's additional requirements, such as spiking studies, analysis of replicate samples, linearity determinations, and stability studies.

The quality assurance program consists of the frequent submission of blind QA samples, duplicates, and spiked sample splits. Also included are personnel training, analytical methodologies, sample control procedures, data handling, and equipment maintenance and calibrations.

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1.0 QA Organization/Policy

The objective of Radian's quality assurance/quality control program is to assure, assess, and document the precision, accuracy, and adequacy of data obtained from chemical analysis and to assure the technical accuracy of the results obtained for all samples.

Radian has organized the quality assurance function within the company to allow complete independence of program review. Radian's Quality Assurance Director reports directly to the Vice President of the Technical Staff. This position provides independent reviews at all levels of the technical staff and laboratory organization and allows immediate access to Radian's top management on QA-related matters.

The QA Director's involvement may be limited to a review of quality control practices or as extensive as active development and implementation of quality control procedures and statistical data analysis. The QA Director may be asked to contribute expertise and assistance when a need is perceived by either the client, the technical staff, or the management staff.

Because of the large number of samples analyzed by RAS, a QA coordinator has been assigned to monitor and maintain an effective QA/QC program for these laboratories. The RAS Quality Assurance Coordinator, directly responsible to the Corporate QA Director, serves as an independent auditor of all RAS laboratories. The responsibilities of the RAS QA Coordinator are as follows:

- Monitor QA/QC within RAS laboratories,
- Supervise the preparation of blind audit samples,

- inform the Director of RAS and the corporate QA Director of quality assurance problems,
- summarize and report QA activities in the laboratories,
- document all QA and QC procedures within RAS,
- act as liaison between the corporate QA Director and RAS,
- provide QA data to the corporate QA Director for inclusion in the corporate QA reports.

The RAS laboratory managers function as the quality control coordinators in each particular analytical area. Their efforts are coordinated and monitored by the QA Coordinator.

Quality control coordinators serve as a focal point for all QC activities pertaining to each RAS laboratory. They work as a committee coordinated by the RAS Quality Assurance Coordinator. Their activities include the following:

- monitor the QA/QC activities of the laboratory area,
- inform the Director of Analytical Services and the QA coordinator of QC problems and needs.
- summarize, document, and report quality control activities and data generated in the laboratory,

- provide documentation of all QC procedures in the laboratory,

- maintains summaries of QC activities and data in a form suitable for client review upon request.

2.0 Quality Control for Laboratory Analyses

Radian Analytical Services has developed and implemented quality control procedures for all of the analyses performed in the laboratory. The laboratory quality control program provides an effective and efficient laboratory protocol for QC regardless of the size or scope of the analytical requirements. Approved analytical methods are used whenever available. When approved methods are not available, a method is developed by the Radian technical staff, and a technical note written describing the method. The quality control procedures are designed to insure that the standard operating procedures and quality control protocols are being followed and accurate results are obtained.

The general quality control program utilized in each laboratory includes consideration of the following areas:

- personnel training and certification,
- analytical methodology documentation,
- sample handling and control,
- laboratory facilities and equipment,
- calibration and standards,
- data handling and documentation,
- quality control check samples,

The general approach to quality control in each of these areas is discussed in the remainder of this section.

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2.1 Personnel Training and Certification

The successful implementation of any QA/QC program is determined by the training and dedication of the laboratory personnel. The quality and consistency of data should be independent of the analyst. With the proper training and supervision, an analyst will be able to obtain quality data by the use of proven methodology. Periodic assessment of training requirements and certification are performed to maintain a high level of laboratory awareness.

The training and certification methods employed in the RAS laboratories are briefly described below:

- study of laboratory standard operating procedures,
- study of QA manual,
- observation of experienced operators/analysts,
- study of operating manuals,
- instruction by the laboratory manager on all aspects of the analysis,
- perform the analysis under the direct supervision of the laboratory manager,
- perform analysis under supervision of experienced personnel,
- analysis of blind QC samples prepared by laboratory QC coordinator,
- participation in in-house seminars on laboratory methods and procedures.

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PERSONNEL TRAINING RECORD

Employee ____________

Employee Number ____________

Date of Employment ____________

Laboratory Orientation:

Upon completion of each phase of personnel training the employee and Laboratory Manager will initial and date the step completed.

- The RAS laboratory Standard Operating Procedures have been read and understood.

  Employee ______ Lab Mgr. ______ Date ______

- The RAS Quality Assurance manual has been read and the procedures for the laboratory in which the employee worker have been explained.

  Employee ______ Lab Mgr. ______ Date ______

- Operation manuals for instruments with which the employee performs analyses have been studied and the procedures for operation and maintenance are understood.

Instrument	Employee	Lab Mgr.	Date	Instrument	Employee	Lab Mgr.	Date

Figure 2-1.

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Test Specific Training:

Each specific test performed in the RAS laboratories involves procedures which may be unique. The steps involved in training an employee are:

- Instruction by the Laboratory Manager on all aspects of the analysis,
- Observation of experienced operators/analysts,
- Perform the analysis under supervision of the laboratory manager,
- Perform analysis of QA samples submitted by the QA coordinator, and
- Participation in in-house seminars on laboratory methods and procedures.

The following table is to be completed by dating and initialing by the employee and Laboratory Manager upon completion of each step.

Method	Instruction	Observation	Perform the Analysis	Analysis of QA samples	Seminars

Figure 2-1. (Cont'd)

All RAS personnel must complete a quality control training program. This system includes motivation toward producing data of acceptable quality and involves "practice work" by new employees. New personnel are made aware of the quality standards established by RAS and the reasons for those standards. They are made aware of the various ways of achieving and maintaining quality data. After an employee has been trained to use a method and the work validated by the laboratory manager, the employee is certified to perform the analysis. As these people progress to higher degrees of proficiency, their accomplishments are reviewed and then documented. Documentation of proficiency training is maintained by the QC Coordinator for each laboratory technician using the two-page form shown in Figure 2-1.

2.2 Analytical Methodologies

All analytical procedures followed in the RAS laboratories are documented in a methods manual for the specific laboratory. A set of standard operating procedures (SOP) has been established for each analysis to insure consistency. Most methods used are directly from an approved analytical manual, e.g., EPA methods, APHA Standard Methods for Water and Wastewater, ASTM, etc.

Methodologies may contain the following information:

- method title,
- scope of method,
- summary of interferences, and applications,
- concentration ranges and detection limits,
- safety precautions,
- required equipment and materials,
- standardization directions,
- detailed analytical procedure,
- calculations, with examples,
- reporting method,
- precision and accuracy statement,
- references.

2.3 Sample Control and Record Keeping

The Radian Analytical Services Sample Control Center is a controlled access area. Only employees of the Sample Control Center have access to sample receiving, sample storage, documentation files, and the computer terminals. Analysts check out samples under the supervision of the sample control personnel. All samples are stored in locked storage areas. Sample tracking is maintained by a computerized laboratory management system and a sample checkout logbook. The RAS Sacramento laboratory is linked to the central processing unit of the computer in Austin via a dedicated phone line. This insures that the laboratories are in constant communication. All sample information and data entries can be immediately accessed at either location.

Detailed record keeping and control of samples are essential for effective laboratory operation. All samples received for analysis in the Radian Analytical Service laboratories are processed through the Sample and Analysis Management System (SAM). Radian Corporation's SAM is a software and hardware system for controlling and handling information for the analytical laboratory. SAM provides a dynamic, easy-to-use method for tracking, scheduling, reporting, and laboratory management. The system has been designed to accommodate and promote good laboratory management practices by providing high visibility of the information laboratory managers need to make good decisions regarding schedules and priority. The system is designed around a Data General Nova-IV computer with a 64K-byte memory. It also includes a 65M-byte disk drive and a line printer with plotting capabilities. Data is entered via a TEC terminal and CRT. All data stored on the disk is backed up on magnetic tape to prevent loss in the event of a system malfunction. The system is designed so that an individual designated as the principal operator can process the required paperwork for a large laboratory with little difficulty. The approach centralizes information input and data retrieval, and provides the mechanism for organized, up-to-date laboratory performance monitoring.

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SAM maintains complete client information files, generates laboratory status reports, flags sampl analyses which are overdue, accepts analysis results manually or automatically, and generates reports and invoices.

The Sample Control Center and SAM have six basic functions:

- sample receipt and logging,
- sample storage and maintenance of sample integrity,
- laboratory status reporting,
- document control,
- data compilation and reporting, and
- invoicing

In order to assure the integrity of a sample and the accompanying documentation, a security plan has been established. This plan consists of three parts:

- chain or custody,
- secured refrigerated storage, and
- document control.

The progression of samples and documentation through the Sample Control Center and the analytical laboratories is presented in Figure 2-2. Detailed descriptions of each sample control function are presented below:

- Samples are received from the commercial carrier at Radian's shipping and receiving facilities by the receiving clerk.

- Within one hour of arrival, the samples are accepted by RAS sample control personnel.

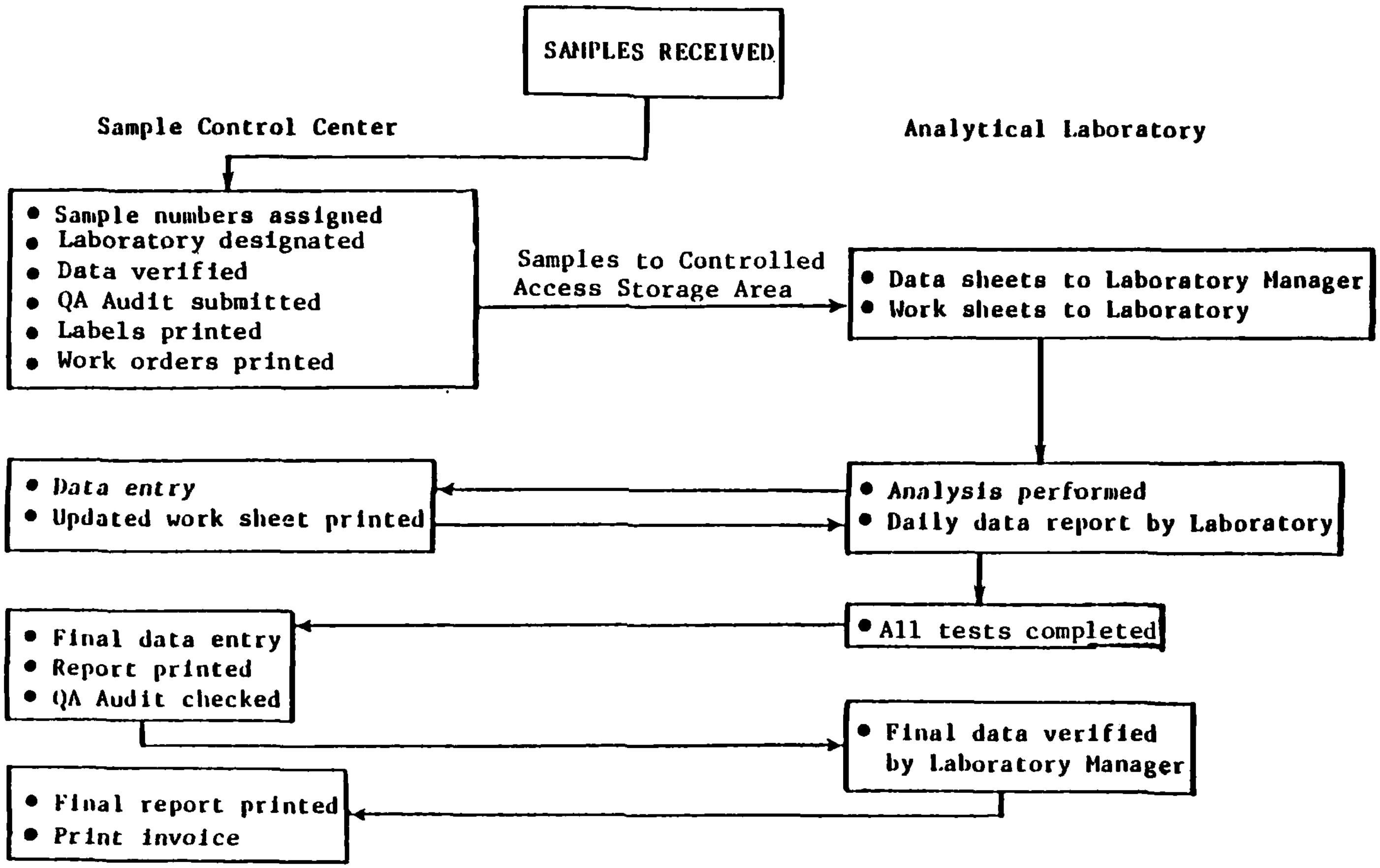

Figure 2-2. SAM Laboratory Management System

- All shipping containers and security seals, when appropriate, are inspected for physical damage or evidence of tampering.

- The samples are unpacked in the sample receiving area by the RAS sample custodian. The method of shipment, shipping container integrity, condition of samples, the number of samples/container, integrity of the security seal, and accompanying documentation are noted. Sample identification is verified against custody documents. The enclosed chain-of-custody forms, Figure 2-3, when required, are completed and filed with the shipping and receiving documentation. In the event that peculiarities are noted, the project officer or client is immediately advised of the irregularity.

- Samples are logged into a bound sample logbook, Figure 2-4. Again, sample identity is verified. All discrepancies are noted in the logbook.

- The handwritten logbook and all documentation are transferred to the Sample Control Center.

- The samples are logged into the SAM system. Each batch of samples is assigned a consecutive work order number by the system. Analytical requirements for each sample are entered into the computer.

- Hard copy of the work order and other information is printed and filed with the received documentation in the Sample Control Center.

- Labels are printed and secured to each sample. Label information includes sample number, identification, storage location, and analytical requirements.

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CHAIN OF CUSTODY RECORD

Field Sample No. ______________

Company Sampled/Address ______________
Sample Point Description ______________

Stream Characteristics:
Temperature ______________ Flow ______________ pH ______________
Visual Observations/Comments ______________

____

Collector's Name ______________ Date/Time Sampled ______________
Amount of Sample Collected ______________
Sample Description ______________
Store at: ☐ Ambient ☐ 5°C ☐ −10°C ☐ Other ______________

☐ Caution - No more sample available ☐ Return unused portion of sample ☐ Discard unused portions

Other Instructions - Special Handling - Hazards ______________

____

____

☐ Hazardous sample (see below) ☐ Non-hazardous sample

☐ Toxic ☐ Skin irritant ☐ Flammable (FP< 40°C)
☐ Pyrophoric ☐ Lachrymator ☐ Shock sensitive
☐ Acidic ☐ Biological ☐ Carcinogenic - suspect
☐ Caustic ☐ Peroxide ☐ Radioactive
☐ Other ______________

Sample Allocation/Chain of Possession:
Organization Name ______________
Received By ______________ Date Received ______________ Time ______________
Transported By ______________ Lab Sample No. ______________
Comments ______________
Inclusive Dates of Possession ______________

Organization Name ______________
Received By ______________ Date Received ______________ Time ______________
Transported By ______________ Lab Sample No. ______________
Comments ______________
Inclusive Dates of Possession ______________

Organization Name ______________
Received By ______________ Date Received ______________ Time ______________
Transported By ______________ Lab Sample No. ______________
Comments ______________
Inclusive Dates of Possession ______________

Figure 2-3. Chain or Custody Record

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Lab No. ______

Company ______	Quoted $ ______	Contact ______
Facility ______	Sample $ ______	Received ______
______	Misc $ ______	Date Due ______
Rep ______	Total $ ______	Samples ______
Phone ______	Inv by (CPR) ______	Keep for ______
Report ______	% Surcharge ______	Keep til ______
to ______	% Disc: All ______	Disp (RD) ______
______		
______	# Reports ______	# Invoices ______
Attn ______	Work ID ______	
Inv ______	Taken ______	
to ______	Trans ______	
______	Type ______	
______	Condition ______	
Attn ______	Comments:	
P.O. # ______		
Expires ______	Location: ______	

Dash No.	Sample Description	Analysis Required	QA

Figure 2-4. Sample Log Sheet

- Data sheets and work sheets are printed for each batch of samples and distributed to the appropriate laboratory managers. The work sheets list sample numbers, sample identification, storage location, and analytical requirements. Data sheets are for results and contain only the parameters to be determined by a given laboratory.

- Following sample logging, the samples are placed in the designated locked storage area.

- Subsequent sample custody is documented and all transactions witnessed by sample control personnel.

- The analyst retrieves the samples from the Sample Control Center by sample number and storage location.

- The Sample checkout log (Figure 2-5) is completed by the analyst, noting the laboratory to which the sample is being removed.

- After analysis, or when the required aliquot is removed, the sample is returned to the Sample Control Center and return is noted in the sample checkout log.

- The sample is returned to the designated storage location.

- When requested, addition chain-of-custody documentation can be provided using a SAM-generated document (Figure 2-6). This document can be retained by sample control to provide a more easily retrievable record of sample custody within the analytical laboratory.

- The sample is stored until the assigned time or written permission is given to either properly dispose of or return the sample to the client.

RAS SAMPLE CHECK OUT LOG

WORK ORDER	SPLITS REMOVED	CHECK-OUT INFORMATION				RETURN INFORMATION		
		DATE	TIME	DESTINATION	INITIALS	DATE	TIME	INITIALS

7S/196 (Water and Prep. Labs)

7S/194 (Extraction & Water Labs)

7S/180 (ICP and AA Labs)

7S/191 (TOX, TOC)

7S/195 (Technician)

7S/171 (GC)

Figure 2-5. Sample Checkout Log

PAGE 1 CORPORATION Analytical Serv CHAIN OF CUSTODY LAB # 83-02-A67

RCVD: 02/26/83 DUE: 03/19/83 04/21/83 09:56:49 KEEP: 05/09/83 DISP: D

DASH	SAMPLE IDENTIFICATION	LOCATION	TESTS						
01A-B	Number 001	Ref 2	CAUSTY	CO3_A	HARD_B	HCO3_A	MHO_A	ONG_A	PH_A
			PO4_B	SO3_TA	TANNIN				
02A	Number 002	Ref 2	ACFS						
02B	Number 002	Ref 2	ICP_40						
03A	Super soil	Ref 2	ANFS						
04A	Boiler scale 222	Ref 2	CA_E	CL_TA	CO3_A	FE_E	HCO3_A	MG_E	NA_E
			P_E	SO4_NA	S_E	ZN_E			
05A	Sample AV56	Shelf 13	B_MET	C_MET					
06A	Water #164	Ref. 023	AG_E	AS_HA	BA_E	CD_E	CR_E	FE_E	HG_CA
			MN_E	NA_E	PB_GA	SE_HA			
06B	Water #164	Ref. 023	CL_TA	F_SIEA	MHO_A	NO3_A	PH_A	SO4_NA	TDS_A
06C	Water #164	Ref. 023	H1RCRA	P1RCRA					
06D	Water #164	Ref. 023	ALPHA	BETA	RA_TOT				

RECEIVED BY	DATE	RETURNED TO	DATE	FRACTION NUMBERS.

Figure 2-6. Laboratory Chain of Custody

- All documentation, including shipping documents, field sampling documents, computer-generated log sheets, chain-of-custody forms, laboratory data sheets, final computer reports, and other documents, are maintained in the sample control area. All reports are kept in locked filing cabinets. As with the sample storage area, the document storage area is limited-access.

All storage areas are within the Sample Control Center and are locked when not in use. Access to the storage area is limited to sample control personnel or other RAS employees accompanied by sample control personnel. There are four storage locations that are used depending on the sample and the required analyses. They are:

- ambient storage for samples that do not require refrigeration,

- $4^{\circ}C$ storage for most samples requiring water quality analysis and extractable organics,

- $4^{\circ}C$ storage for samples requiring volatile organic analysis, and

- $-20^{\circ}C$ storage for extracts and samples that require freezing.

A temperature log is maintained to monitor the cold storage facilities.

2.4 Laboratory Facilities and Equipment

A clean well-lighted, and well maintained laboratory is essential for accurate analytical results. Each laboratory is well-lighted, air conditioned and equipped with chemical fume hoods. Instrumentation that may emit noxious odors is vented externally.

Quality Control of Equipment and Supplies

Each laboratory QC program includes detailed requirements for equipment and supplies. Reagents, solvents, and standards with specific levels of purity are used as specified by the analytical protocol. Specific GC column materials, glassware and sample handling equipment are also specified. The quality control procedures for equipment and supplies generally include the following items:

- operator checklists for required supplies,
- documentation and reporting of all deviations from specified instrument performance,
- procedures for testing for purity of reagents,
- tolerances for calibrated glassware where applicable,
- monitoring of refrigerated storage space,
- maintenance logbooks,
- service contracts on analytical instrumentation.

Quality control procedures during sample preparation include the preparation of reagent or solvent blanks. Additional quality control techniques implemented in sample preparation include:

- deionized water piped into all laboratories, monitored daily,
- purchasing high purity distilled-in-glass solvents in large quantities from a single lot,

- use of Ultrex acids in trace metal digestion,
- cleaning of organic glassware with chromic acid or firing in a kiln at 450°C,
- cleaning of trace metal glassware with nitric acid,
- use of organic-free water prepared at Radian by distillation over alkaline permanganate under nitrogen atomsphere in all-glass still,
- use of volatile-free water prepared by purging organic-free water with nitrogen,
- sample preparation performed by experienced technical personnel under the supervision of senior level analysts.

2.5 Quality Control for Standards and Calibration

The quality of all test results is greatly impacted by the calibration procedures used. Calibration procedures and standards should be specified for all equipment and supplies used in the test procedure. Traceability to common standards is essential for test procedures to be used in multiple laboratories. Quality control procedures for standards and calibrations include the following considerations:

- written, detailed calibration instructions,
- preparation procedures for secondary standards, when applicable,
- requirements for frequency of calibration,
- recordkeeping of all calibrations and standards used,

- quality control charts for recording results from multiple calibrations,
- evaluation of internal standards, and
- tolerances for calibration requirements.

All calibration standards are prepared from NBS-traceable, EPA certified, or primary standard materials. Daily logs are maintained to monitor instrument response to a given standard.

Quality Control Test Samples

Routine quality control samples to be analyzed concurrently with client samples are a significant portion of the RAS laboratory quality control programs. The purpose of these checks is twofold: 1) to assure that samples being analyzed satisfy predetermined standards of accuracy, and 2) to measure and document achieved levels of accuracy and precision.

There are many different types of quality control samples which could be used for these purposes. The correct combination of these will depend on the complexity of the test method and the desired degree of accuracy. The following quality control parameters are general considerations for Radian's quality control for test methods.

Interferences

The analytical results of a test method might be affected by interferences from the glassware, solvents, reagents, or the sample matrix. Blank samples which are subjected to conditions similar to samples being analyzed are used to evaluate the purity of laboratory reagents. The frequency of blank analysis is method dependent. For example, a laboratory or field blank is analyzed after each GC/MS volatile organic analysis with high levels for any of the pollutants. Ten percent of the samples from a given sample batch are spiked with a known standard. Spike recovery data are calculated to determine matrix interference.

Precision

The precision or repeatability of a test method is required for proper interpretation and weighting of the data. Replicate samples or standards are used to determine the precision on a regular basis. The precision of multiple analyses are compared against predetermined precision limits to determine their acceptability. The precision is usually reported as a standard deviation or repeatability statistic and often depends on the concentration of the parameters analyzed. Replicate analyses are defined as separate digestions or extractions of the same sample, when possible. The percentage difference or range between replicate analyses is also used to monitor precision.

Reproducibility

The reproducibility of a test method refers to the repeatability over a period of time. How well will analytical results repeated a month later agree with today's results? Reproducibility can be measured by the repeated analysis of samples from a previous time period or by analysis by more than one laboratory or laboratory technician.

Qualitative Specificity

In the analysis of complex sample matrices containing multiple components, the use of a single method can lead to misidentification of compounds. The misidentification can be detected by repeated analysis of standards containing the compounds of interest or by independent analysis by a more specific method. For example, mass spectral confirmation can be used to evaluate misidentification problems in the GC laboratory.

2.6 Documentation and Data Handling

Documentation of methods, procedures, and results is an essential aspect of a QA/QC program.

Adequate documentation is required for an instrument maintenance system. RAS laboratories use an individual logbook, which is kept at each instrument, to record all calibration and maintenance activities. This logbook gives a chronology of that instrument's installation, operation, calibrations, maintenance, malfunction, and repairs. An accompanying binder includes all pertinent manufacturing information, service manuals, and similar reference materials.

Directions for calibrations and maintenance, along with appropriate forms and checklists, are maintained in a manual accompanying the logbook. The directions specify the required frequency for calibrations and maintenance, the tolerances for calibrations, and the action to be taken when calibration requirements are not met.

In this system, there is a single source for reference purposes as well as record keeping. All the instrument logbooks are reviewed periodically by the quality assurance coordinator and laboratory manager. A record of these logbook checks is maintained by the QA coordinator.

Work sheets have been developed to insure consistent laboratory data entry for most parameters determined in the laboratories. These sheets are designed to organize the data in a clear and logical manner, and to simplify calculations. The work sheets are divided into various sections including a section for reporting calibration standards and blank values and a section for plotting calibration curves. These work sheets are usually a standard data entry form which the laboratory technician enters in his/her bound lab notebook. When automated calibration is not applicable, electronic calculators are available in the laboratories to generate calibration curves by the method of least squates. Thus errors in reading calibration curves and calculating data are minimized. After an analysis is completed and a data sheet filled out, the laboratory manager checks the data for completeness and approves the data sheet. After the data have been entered into the SAM system, an updated data sheet is issued to the laboratory manager. When the work is complete, a preliminary report is printed and distributed to the contributing laboratory managers for the final data check and approval. A final report is printed, certified by the laboratory manager, and forwarded to the client.

Proper documentation of quality assurance and quality control activities is an essential requirement. Documentation is needed to demonstrate that quality control activities were completed as scheduled and to communicate the results of the QC tests to laboratory managers and clients. Documentation of QA results is required to provide feedback for improvement of quality control programs.

Quality control documentation should be timely in order for feedback to occur. Daily reporting to laboratory managers is mandatory. Forms are designed to organize the QC data in a clear and logical manner, and to simplify calculations. Control charts are another excellent tool for summarizing quality control test results.

As part of Radian's QA audit program weekly reports summarizing audit results in the laboratories are prepared and distributed to QC coordinators.

3.0 Quality Assurance Audits

The quality assurance audit program of the RAS laboratories is conducted by the RAS QA Coordinator in conjunction with the corporate QA Director. The program consists of the following:

- QA standards are prepared using EPA certified standards, NBS standards, primary standard materials, and NBS-traceable compounds. All standards preparations are recorded in the QA Sample logbook (Figure 3-1).

RADIAN
CORPORATION

Standard No. QAS ______________

QA type ____________________________

Prep date ______________ Prepared by _________________ Verified by______________

Standard source ____

____

Sample matrix ____

Parameters

Preparation method Final vol______________

Figure 3-1. Standards preparation logbook

QAS ____________

Prep method (con't)

Calculations

Sample Distribution

Date	SAM No.	Client	Remarks

Figure 3-1. (Cont.)

- An inventory of stock standards is maintained within the limits of published stability data. This decreases the time required for daily standard preparation.

- Duplicate samples are requested from clients. These are blind to the laboratory and the client is not billed for the duplicate.

- Blind QA samples are submitted through the Sample Control Center to all laboratories. The parameters and concentration levels are selected by the RAS Quality Assurance Coordinator.

- Laboratory managers submit, via a "QA Alert Form" (Figure 3-2). a list of the types of QA samples needed the following week. This insures that the parameters with which there have been problems are included in the sample.

- Monthly reports are issued from the RAS QA Coordinator (Fig. 3-3). These are submitted to the corporate QA Director, laboratory managers and Director of RAS. Managers are notified immediately of major problems with the results of analysis of a QA sample.

- The results of the program are summarized on a quarterly basis for Radian's management.

In addition to the continuous audit program, provisions for third party review are made with each client's work. Radian Analytical Services welcomes onsite audits, performance samples, and independent evaluations.

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QA ALERT FORM

QA standard for the week of ____________

NPDES
- Form A water __
- Form B water __
  - metals __
- Form C water __
  - metals __
  - organics __

RCRA metals __
anions __

pesticide
OC __ OP __
herbicide __

EPA 601 __
602 __

624 __
625 __

B/N __ Acids __ A/N __

TOC __ TOX __

MS VOA __ GC VOA __

PCB __

Matrix requirements: ____________________________

Concentration requirements: ____________________________

Special Standards/Instructions	Individual Parameters

Date ____________ Mgr ____________________

Figure 3-2. QA alert form

ANALYTICAL SERVICES
MONTHLY QA REPORT

QA prep report for the month of ______________

Order No.	Lab	Parameter	Certified Value	Analyzed Value	% Recovery	Date Reported

Figure 3-3. Monthly QA Report

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3.1 Data Review and Validation

All analysis results are entered into the SAM computer system. Following completion of the analyses, a preliminary report is printed and returned to the appropriate laboratory manager for review and validation. A final report is printed after the certification by the manager. This report is signed and approved by the laboratory manager before being forwarded to the client. The following diagram (Fig. 3-4) illustrates the data flow for a typical sample analysis.

Upon completion of the analysis and before the final data are issued, the results of the QA audit samples are compared to the certified values. These results are plotted on control charts. Separate control charts are maintained for each analysis. If results are outside the accepted control limits, the analytical results are held until the problem is resolved.

3.2 Control Charts

Quality control charts are maintained for both accuracy and precision. Both charts are structured as shown in Figure 3-5. The main portions of the chart are the center line and the two control limits. The center line is the 100% or total recovery/total agreement of analytical results. The upper and lower control limits are calculated from historical data.

Control charts for accuracy are constructed as follows:

Precent recovery of standards (P_{ST}):

$$P_{ST} = 100 \times \frac{\text{analyzed value}}{\text{certified value}}$$

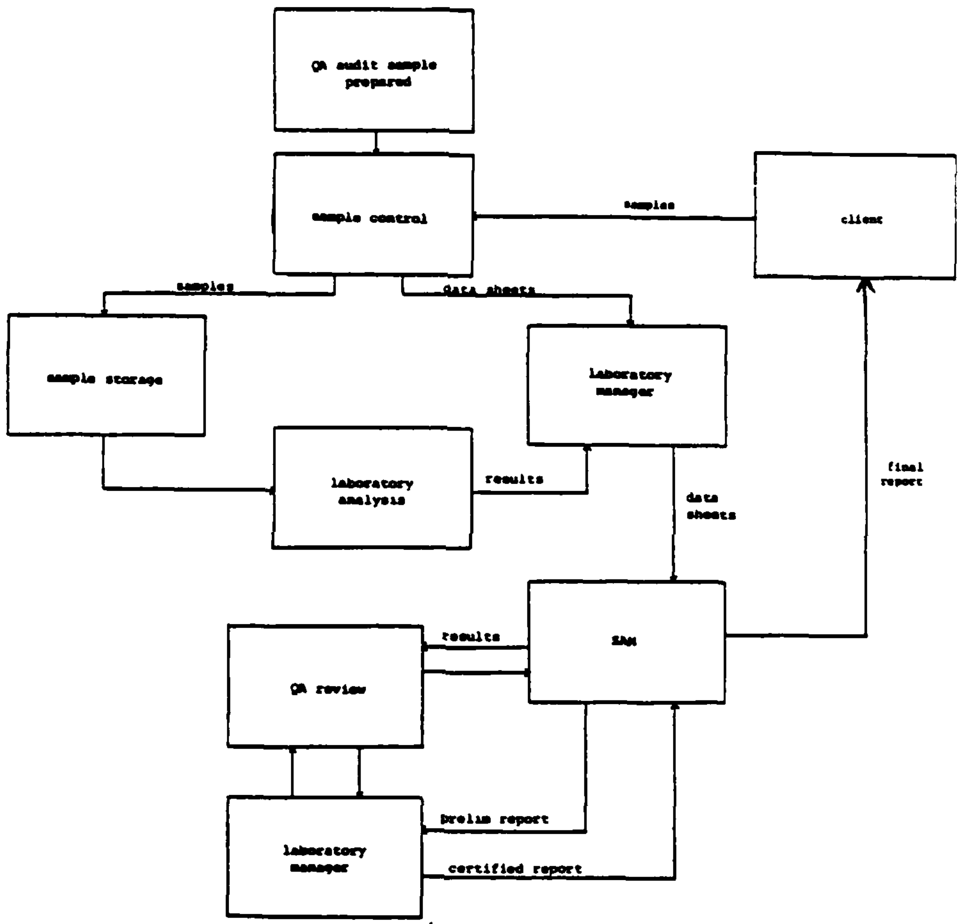

Figure 3-4. Data Flow

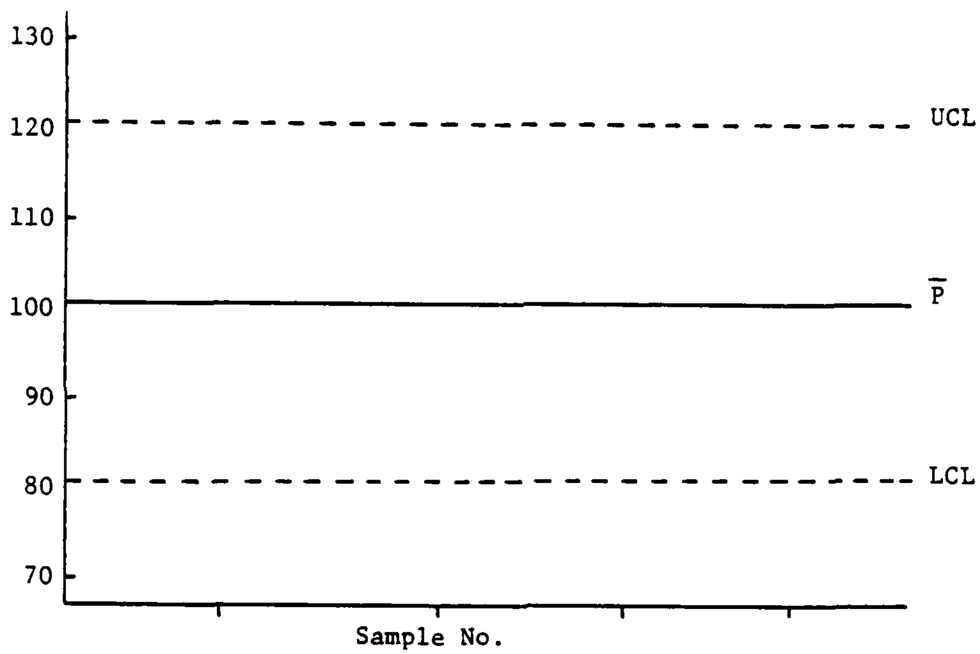

Figure 3-5. Control Chart

Percent recovery of spikes in samples (P_{SP}):

$$P_{SP} = 100 \times \frac{\text{analyzed value - background value}}{\text{spike}}$$

From a set of analyses, the average percent recovery ($\overline{P}$):

$$\overline{P} = \frac{\sum_{i=1}^{n} P_i}{n}$$

The standard deviation for percent recovery (S_R):

$$S_R = \sqrt{\frac{\sum_{i=1}^{n} P_i^2 - \left(\sum_{i=1}^{n} P_i\right)^2 \Big/ n}{n-1}}$$

The upper and lower control limits are therefore

$$UCL = \overline{P} + 3S_R$$
$$LCL = \overline{P} - 3S_R$$

An analysis is out of control when either of the two conditions apply:

1) Any results outside the control limits
2) Seven successive results on the same side of the control line.

Control charts for precision are also constructed. Precision is a function of the concentration range of the analyte. The closer the result is to the analytical detection limit, the more imprecise the data become on a percentage scale. Figure 3-6 illustrates the relationship between detection limit and precision for a typical methodology. Because of this concentration dependence, precision control charts need to be developed for specific concentration ranges for each analyte. For duplicate samples A and B, the ratio of the values of A and B are plotted.

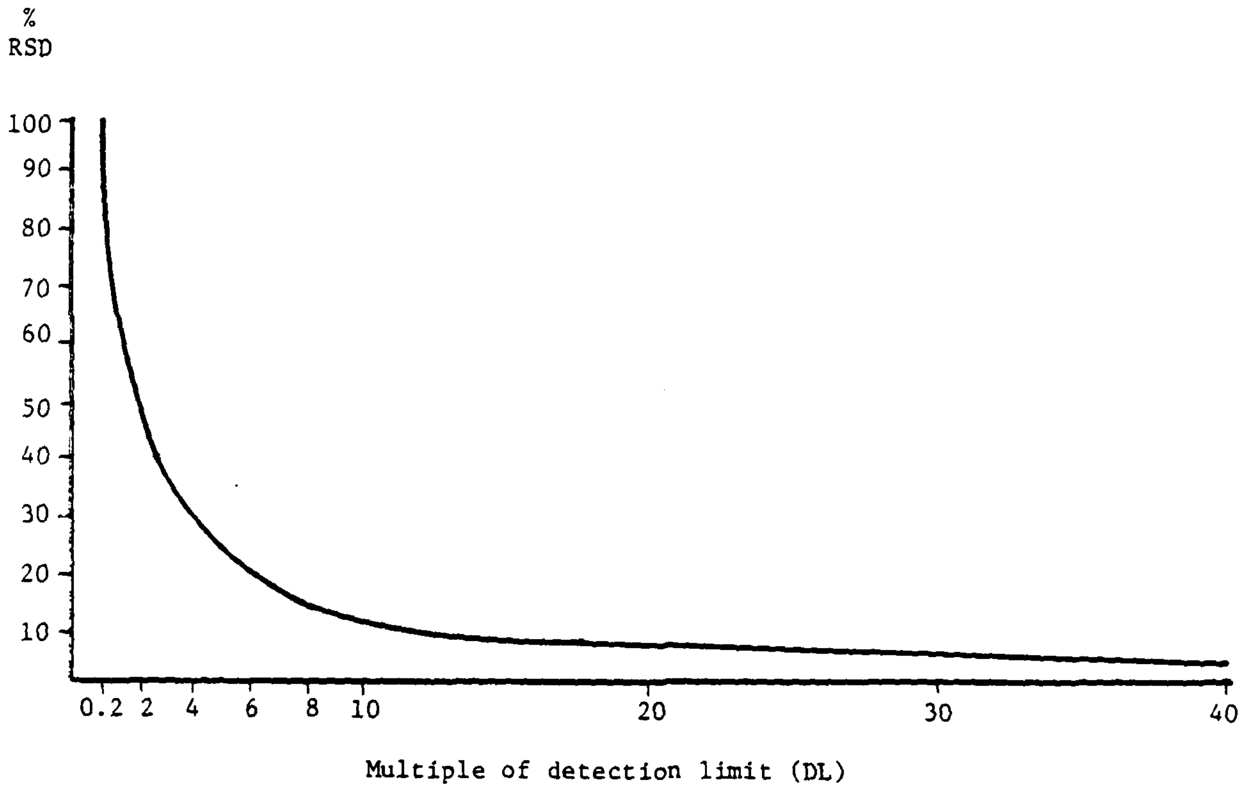

Figure 3-6. Relationship between Detection Limit and Precision

3.3 Concurrent Review

Upon review of analytical results of QA audit samples, the QA Coordinator will schedule a meeting with the laboratory manager if there are any tests out of control or which are deviant from an expected precision/accuracy norm. The purpose of this meeting is to:

- review raw data and determine if there is an explanation for the deviance.
- outline analyses of quality control and/or quality assurance samples to further define the problem and its solution.
- establish a schedule for monitoring the analysis after a solution is implemented, to assure that the problem does not recur.

Involvement of the laboratory manager in the problem assessment and solution is essential to a mutual committment to a quality analytical laboratory.

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APPENDIX H

Chain-of-Custody Forms

RADIAN CORPORATION

CHAIN OF CUSTODY RECORD

850800-850802, 850804-850810

Field Sample No. ______

Company Sampled/Address: Carswell AFB

Sample Point Description: Monitor Well Borings at Site 4,10

Stream Characteristics:

Temperature: / Flow: / pH: /

Visual Observations/Comments ______

Collector's Name: LN French Date/Time Sampled: 1/21/11, 1/14

Amount of Sample Collected ______

Sample Description: Soil

Store at: ☐ Ambient ☐ 5°C ☑ –10°C ☐ Other ______

☑ Caution - No more sample available ☐ Return unused portion of sample ☐ Discard unused portions

Other Instructions - Special Handling - Hazards: See program instructions for Carswell: Site 4: heavy metals, phenol Site 10: O+G, TOX, Purgeable Organics

☒ Hazardous sample (see below) ☐ Non-hazardous sample

☒ Toxic	☐ Skin irritant	☐ Flammable (FP< 40°C)
☐ Pyrophoric	☐ Lachrymator	☐ Shock sensitive
☐ Acidic	☐ Biological	☐ Carcinogenic - suspect
☐ Caustic	☐ Peroxide	☐ Radioactive
☐ Other		

presumed due to proximity to landfills

Sample Allocation/Chain of Possession:

Organization Name ______
Received By ______ Date Received ______ Time ______
Transported By ______ Lab Sample No. ______
Comments ______
Inclusive Dates of Possession ______

Organization Name ______
Received By ______ Date Received ______ Time ______
Transported By ______ Lab Sample No. ______
Comments ______
Inclusive Dates of Possession ______

Organization Name ______
Received By ______ Date Received ______ Time ______
Transported By ______ Lab Sample No. ______
Comments ______
Inclusive Dates of Possession ______

RADIAN
CORPORATION

CHAIN OF CUSTODY RECORD

850803 AND
850811 -
Field Sample Nos 850818

Company Sampled/Address CARSWELL AFB
Sample Point Description HAND AUGER SITE 13

Stream Characteristics: N/A
Temperature ______ **Flow** ______ **pH** ______
Visual Observations/Comments ______

Collector's Name PETER WATERREUS **Date/Time Sampled** 1/14/85
Amount of Sample Collected ______
Sample Description SOIL
Store at: ☐ Ambient ☐ 5°C ☒ −10°C ☐ Other ______

☒ Caution - No more sample available ☐ Return unused portion of sample ☐ Discard unused portions

Other Instructions - Special Handling - Hazards ANALYZE FOR OIL AND GREASE, TOTAL ORGANIC HALOGEN, E.P TOXICITY

☒ Hazardous sample (see below) ☐ Non-hazardous sample

☐ Toxic ☐ Skin irritant ☐ Flammable (FP< 40°C)
☐ Pyrophoric ☐ Lachrymator ☐ Shock sensitive
☐ Acidic ☐ Biological ☐ Carcinogenic - suspect
☐ Caustic ☐ Peroxide ☐ Radioactive
☐ Other ______

Sample Allocation/Chain of Possession:

Organization Name RAS
Received By [illegible signature] **Date Received** 1-15-85 **Time** 1100
Transported By Fed Ex **Lab Sample No.** 8501057 8501084
Comments ______
Inclusive Dates of Possession ______

Organization Name ______
Received By ______ **Date Received** ______ **Time** ______
Transported By ______ **Lab Sample No.** ______
Comments ______
Inclusive Dates of Possession ______

Organization Name ______
Received By ______ **Date Received** ______ **Time** ______
Transported By ______ **Lab Sample No.** ______
Comments ______
Inclusive Dates of Possession ______

RADIAN CORPORATION

CHAIN OF CUSTODY RECORD

850 829 →
850 836

Field Sample No. ______

Company Sampled/Address: Carswell AFB

Sample Point Description: Hand auger Site 11 (#?), Stream Sediment Site 13

Stream Characteristics:

Temperature ______ Flow ~0.05 cfs (Site 13) pH ______

Visual Observations/Comments ______

Collector's Name: J L Machin   Date/Time Sampled: 1-15-85

Amount of Sample Collected ______

Sample Description: Soil

Store at: ☐ Ambient ☐ 5°C ☒ −10°C ☐ Other ______

☒ Caution - No more sample available ☐ Return unused portion of sample ☐ Discard unused portions

Other Instructions - Special Handling - Hazards: Analyses: Site 11 – TOX, O+G, pesticides, phenols, primary heavy metals, purgeable organics. Site 13 – TOX, O+G, EP Toxicity

☒ Hazardous sample (see below) ☐ Non-hazardous sample

☒ Toxic	☐ Skin irritant	☐ Flammable (FP< 40°C)
☐ Pyrophoric	☐ Lachrymator	☐ Shock sensitive
☐ Acidic	☐ Biological	☐ Carcinogenic - suspect
☐ Caustic	☐ Peroxide	☐ Radioactive
☐ Other: Assumed		

Sample Allocation/Chain of Possession:

Organization Name: RTS
Received By: [illegible]   Date Received: 1-16-85   Time: [illegible]
Transported By: [illegible]   Lab Sample No. ______
Comments ______
Inclusive Dates of Possession ______

Organization Name ______
Received By ______ Date Received ______ Time ______
Transported By ______ Lab Sample No. ______
Comments ______
Inclusive Dates of Possession ______

Organization Name ______
Received By ______ Date Received ______ Time ______
Transported By ______ Lab Sample No. ______
Comments ______
Inclusive Dates of Possession ______

RADIAN
CORPORATION

CHAIN OF CUSTODY RECORD 850837-850857

Field Sample No. ______

Company Sampled/Address Carswell AFB

Sample Point Description Sites 5, 10, 11, 13

Stream Characteristics:

Temperature ______ Flow ______ pH ______

Visual Observations/Comments ______

Collector's Name LNF, PAW, JLM Date/Time Sampled 1/15/85 – 1/16/85

Amount of Sample Collected ______

Sample Description Soil

Store at: ☐ Ambient ☐ 5°C ☑ – 10°C ☐ Other ______

☑ Caution - No more sample available ☐ Return unused portion of sample ☐ Discard unused portions

Other Instructions - Special Handling - Hazards ______

☑ Hazardous sample (see below) ☐ Non-hazardous sample

☑ Toxic	☐ Skin irritant	☐ Flammable (FP< 40°C)
☐ Pyrophoric	☐ Lachrymator	☐ Shock sensitive
☐ Acidic	☐ Biological	☐ Carcinogenic - suspect
☐ Caustic	☐ Peroxide	☐ Radioactive
☐ Other ______		

Sample Allocation/Chain of Possession:

Organization Name RAS

Received By [illegible] Date Received 1-17-85 Time [illegible]

Transported By [illegible]

Lab Sample No. ______

Comments ______

Inclusive Dates of Possession ______

Organization Name ______

Received By ______ Date Received ______ Time ______

Transported By ______ Lab Sample No. ______

Comments ______

Inclusive Dates of Possession ______

Organization Name ______

Received By ______ Date Received ______ Time ______

Transported By ______ Lab Sample No. ______

Comments ______

Inclusive Dates of Possession ______

RADIAN
CORPORATION

850858-850863,
850869-850873

CHAIN OF CUSTODY RECORD

Field Sample No. ______

Company Sampled/Address Carswell AFB

Sample Point Description Soil Borings 5A, 10A, 11B, 12A, 12B, 12C, 13F

Stream Characteristics:

Temperature — Flow — pH —

Visual Observations/Comments ______

Collector's Name JLMachin, LNFrench Date/Time Sampled 1/16, 1/17/85

Amount of Sample Collected —

Sample Description Soil

Store at: ☐ Ambient ☐ 5°C ☒ −10°C ☐ Other ______

☒ Caution - No more sample available ☐ Return unused portion of sample ☐ Discard unused portions

Other Instructions - Special Handling - Hazards ______

☒ Hazardous sample (see below) ☐ Non-hazardous sample

☒ Toxic	☐ Skin irritant	☐ Flammable (FP< 40°C)
☐ Pyrophoric	☐ Lachrymator	☐ Shock sensitive
☐ Acidic	☐ Biological	☐ Carcinogenic - suspect
☐ Caustic	☐ Peroxide	☐ Radioactive
☐ Other ______		

Sample Allocation/Chain of Possession:

Organization Name RAS

Received By [illegible] Date Received 1-1-85 Time [illegible]

Transported By [illegible] Lab Sample No. ______

Comments ______

Inclusive Dates of Possession ______

Organization Name ______

Received By ______ Date Received ______ Time ______

Transported By ______ Lab Sample No. ______

Comments ______

Inclusive Dates of Possession ______

Organization Name ______

Received By ______ Date Received ______ Time ______

Transported By ______ Lab Sample No. ______

Comments ______

Inclusive Dates of Possession ______

RADIAN CORPORATION

CHAIN OF CUSTODY RECORD

850864 → 850868

Field Sample No. ______

Company Sampled/Address: Carswell AFB, TX

Sample Point Description: 4E, 5D, 12E, 16A, 16B

Stream Characteristics:

Temperature ______ Flow ______ pH ______

Visual Observations/Comments ______

Collector's Name: JL Machin Date/Time Sampled: 1-17-85

Amount of Sample Collected ______

Sample Description ______

Store at: ☐ Ambient [x] 5°C ☐ −10°C ☐ Other ______

[x] Caution - No more sample available ☐ Return unused portion of sample ☐ Discard unused portions

Other Instructions - Special Handling - Hazards ______

[x] Hazardous sample (see below) ☐ Non-hazardous sample

[x] Toxic ☐ Skin irritant ☐ Flammable (FP< 40°C)
☐ Pyrophoric ☐ Lachrymator ☐ Shock sensitive
☐ Acidic ☐ Biological ☐ Carcinogenic - suspect
☐ Caustic ☐ Peroxide ☐ Radioactive
☐ Other: presumed - IRP program

Sample Allocation/Chain of Possession:

Organization Name: [illegible]
Received By: [illegible] Date Received: [illegible] Time ______
Transported By: [illegible] Lab Sample No.: [illegible]
Comments ______
Inclusive Dates of Possession ______

Organization Name ______
Received By ______ Date Received ______ Time ______
Transported By ______ Lab Sample No. ______
Comments ______
Inclusive Dates of Possession ______

Organization Name ______
Received By ______ Date Received ______ Time ______
Transported By ______ Lab Sample No. ______
Comments ______
Inclusive Dates of Possession ______

RADIAN CORPORATION

850874 →
850883
and 850888

CHAIN OF CUSTODY RECORD

Field Sample No. ______

Company Sampled/Address Carswell AFB, TX

Sample Point Description 15B2, 15A2, 1D2, 1D4, 1D5, 12F 0', 2', 4', 6', 8', 1A1

Stream Characteristics:

Temperature ______ Flow ______ pH ______

Visual Observations/Comments ______

Collector's Name L. French/J. Machin/J. Chapman Date/Time Sampled 1-18-85, 1-19-85

Amount of Sample Collected ______

Sample Description Soil

Store at: ☐ Ambient ☒ 5°C ☐ −10°C ☐ Other ______

☒ Caution - No more sample available ☐ Return unused portion of sample ☐ Discard unused portions

Other Instructions - Special Handling - Hazards ______

☒ Hazardous sample (see below) ☐ Non-hazardous sample

☒ Toxic
☐ Pyrophoric
☐ Acidic
☐ Caustic
☐ Other presumed- IRP program

☐ Skin irritant
☐ Lachrymator
☐ Biological
☐ Peroxide

☐ Flammable (FP< 40°C)
☐ Shock sensitive
☐ Carcinogenic - suspect
☐ Radioactive

Sample Allocation/Chain of Possession:

Organization Name RAS

Received By [illegible] Date Received 1-23-85 Time [illegible]

Transported By [illegible] Lab Sample No. ______

Comments ______

Inclusive Dates of Possession ______

Organization Name ______

Received By ______ Date Received ______ Time ______

Transported By ______ Lab Sample No. ______

Comments ______

Inclusive Dates of Possession ______

Organization Name ______

Received By ______ Date Received ______ Time ______

Transported By ______ Lab Sample No. ______

Comments ______

Inclusive Dates of Possession ______

GS 85 0884 →
0887

GS 85 0889 →
0895

RADIAN
CORPORATION

CHAIN OF CUSTODY RECORD

Field Sample No. ______

Company Sampled/Address Carswell AFB
Sample Point Description 1B2,4; 1C3,5; 17B2,4; 17C2,3; 17D3; 17G2,3

Stream Characteristics:
Temperature ______ **Flow** ______ **pH** ______
Visual Observations/Comments ______

Collector's Name JB Chapman **Date/Time Sampled** 1/19/85 & 1/21/85
Amount of Sample Collected ______
Sample Description Soil
Store at: ☐ Ambient ☒ 5°C ☐ −10°C ☐ Other ______

☒ Caution - No more sample available ☐ Return unused portion of sample ☐ Discard unused portions

Other Instructions - Special Handling - Hazards ______

☒ Hazardous sample (see below) ☐ Non-hazardous sample

☒ Toxic — presumed - IRP program
☐ Pyrophoric
☐ Acidic
☐ Caustic
☐ Other ______
☐ Skin irritant
☐ Lachrymator
☐ Biological
☐ Peroxide
☐ Flammable (FP< 40°C)
☐ Shock sensitive
☐ Carcinogenic - suspect
☐ Radioactive

Sample Allocation/Chain of Possession:

Organization Name [illegible]
Received By [illegible] **Date Received** [illegible] **Time** [illegible]
Transported By [illegible] **Lab Sample No.** ______
Comments ______
Inclusive Dates of Possession ______

Organization Name ______
Received By ______ **Date Received** ______ **Time** ______
Transported By ______ **Lab Sample No.** ______
Comments ______
Inclusive Dates of Possession ______

Organization Name ______
Received By ______ **Date Received** ______ **Time** ______
Transported By ______ **Lab Sample No.** ______
Comments ______
Inclusive Dates of Possession ______

GN-85-0296 → GN-85-0399

RADIAN
CORPORATION

CHAIN OF CUSTODY RECORD

Field Sample No. ______________

Company Sampled/Address Carswell AFB

Sample Point Description iTB, C, D, G

Stream Characteristics:

Temperature ______________ **Flow** ______________ **pH** ______________

Visual Observations/Comments ______________

Collector's Name JB Chapman **Date/Time Sampled** 1-21-85

Amount of Sample Collected ______________

Sample Description water

Store at: ☐ Ambient ☒ 5°C ☐ −10°C ☐ Other ______________

☒ Caution · No more sample available ☐ Return unused portion of sample ☐ Discard unused portions

Other Instructions · Special Handling · Hazards ______________

☒ Hazardous sample (see below) ☐ Non-hazardous sample

☒ Toxic — assume IRP program
☐ Pyrophoric
☒ Acidic — treated samples
☐ Caustic
☐ Other ______________

☐ Skin irritant
☐ Lachrymator
☐ Biological
☐ Peroxide

☐ Flammable (FP< 40°C)
☐ Shock sensitive
☐ Carcinogenic · suspect
☐ Radioactive

Sample Allocation/Chain of Possession:

Organization Name [illegible]
Received By [illegible] **Date Received** [illegible] **Time** ______
Transported By [illegible] **Lab Sample No.** [illegible]
Comments ______________
Inclusive Dates of Possession ______________

Organization Name ______________
Received By ______________ **Date Received** ______________ **Time** ______
Transported By ______________ **Lab Sample No.** ______________
Comments ______________
Inclusive Dates of Possession ______________

Organization Name ______________
Received By ______________ **Date Received** ______________ **Time** ______
Transported By ______________ **Lab Sample No.** ______________
Comments ______________
Inclusive Dates of Possession ______________

RADIAN
CORPORATION

6N 85 0889 →
85 0891

CHAIN OF CUSTODY RECORD

Field Sample No. ____

Company Sampled/Address Carswell AFB, TX
Sample Point Description 16 A, B, C

Stream Characteristics:
Temperature ____ Flow ____ pH 6-7
Visual Observations/Comments ____

Collector's Name J Chapman Date/Time Sampled 1-19-85
Amount of Sample Collected ____
Sample Description water
Store at: ☐ Ambient ☒ 5°C ☐ −10°C ☐ Other ____

☒ Caution - No more sample available ☐ Return unused portion of sample ☐ Discard unused portions

Other Instructions - Special Handling - Hazards ____

☒ Hazardous sample (see below) ☐ Non-hazardous sample

☒ Toxic — presumed, IRP program ☐ Skin irritant ☐ Flammable (FP< 40°C)
☐ Pyrophoric ☐ Lachrymator ☐ Shock sensitive
☒ Acidic — treated samples ☐ Biological ☐ Carcinogenic - suspect
☐ Caustic ☐ Peroxide ☐ Radioactive
☐ Other ____

Sample Allocation/Chain of Possession:
Organization Name [illegible]
Received By [illegible] Date Received [illegible] Time [illegible]
Transported By [illegible] Lab Sample No. [illegible]
Comments ____
Inclusive Dates of Possession ____

Organization Name ____
Received By ____ Date Received ____ Time ____
Transported By ____ Lab Sample No. ____
Comments ____
Inclusive Dates of Possession ____

Organization Name ____
Received By ____ Date Received ____ Time ____
Transported By ____ Lab Sample No. ____
Comments ____
Inclusive Dates of Possession ____

SN85-903
-904
-908
-909

RADIAN CORPORATION

CHAIN OF CUSTODY RECORD

Field Sample No. -909

Company Sampled/Address Carswell AFB
Sample Point Description 17E, 17H, 17A, 17F

Stream Characteristics:
Temperature ______ Flow ______ pH ______
Visual Observations/Comments ______

Collector's Name JB Chapman Date/Time Sampled 1-22-85
Amount of Sample Collected ______
Sample Description water
Store at: ☐ Ambient ☒ 5°C ☐ −10°C ☐ Other ______

☒ Caution - No more sample available ☐ Return unused portion of sample ☐ Discard unused portions

Other Instructions - Special Handling - Hazards ______

☒ Hazardous sample (see below) ☐ Non-hazardous sample

☒ Toxic -assumed, IRP program ☐ Skin irritant ☐ Flammable (FP< 40°C)
☐ Pyrophoric ☐ Lachrymator ☐ Shock sensitive
☒ Acidic Treated Samples ☐ Biological ☐ Carcinogenic - suspect
☐ Caustic ☐ Peroxide ☐ Radioactive
☐ Other ______

Sample Allocation/Chain of Possession:
Organization Name [illegible]
Received By [illegible] Date Received 1-23-85 Time [illegible]
Transported By [illegible] Lab Sample No. [illegible]
Comments ______
Inclusive Dates of Possession ______

Organization Name ______
Received By ______ Date Received ______ Time ______
Transported By ______ Lab Sample No. ______
Comments ______
Inclusive Dates of Possession ______

Organization Name ______
Received By ______ Date Received ______ Time ______
Transported By ______ Lab Sample No. ______
Comments ______
Inclusive Dates of Possession ______

RADIAN
CORPORATION

6S 85-0900 →
0902

CHAIN OF CUSTODY RECORD

Field Sample No. 6S 85-0905 →
0907

Company Sampled/Address Carswell AFB

Sample Point Description 17E2, E3, H3, A2, A3, F2

Stream Characteristics:

Temperature ______ Flow ______ pH ______

Visual Observations/Comments ______

Collector's Name JB Chapman Date/Time Sampled 1-22-85

Amount of Sample Collected ______

Sample Description Soil

Store at: ☐ Ambient ☒ 5°C ☐ −10°C ☐ Other ______

☒ Caution - No more sample available ☐ Return unused portion of sample ☐ Discard unused portions

Other Instructions - Special Handling - Hazards ______

☒ Hazardous sample (see below) ☐ Non-hazardous sample

☒ Toxic — assumed, IRP program ☐ Skin irritant ☐ Flammable (FP< 40°C)
☐ Pyrophoric ☐ Lachrymator ☐ Shock sensitive
☐ Acidic ☐ Biological ☐ Carcinogenic - suspect
☐ Caustic ☐ Peroxide ☐ Radioactive
☐ Other ______

Sample Allocation/Chain of Possession:

Organization Name [illegible]
Received By [illegible] Date Received [illegible] Time [illegible]
Transported By [illegible] Lab Sample No. [illegible]
Comments ______
Inclusive Dates of Possession ______

Organization Name ______
Received By ______ Date Received ______ Time ______
Transported By ______ Lab Sample No. ______
Comments ______
Inclusive Dates of Possession ______

Organization Name ______
Received By ______ Date Received ______ Time ______
Transported By ______ Lab Sample No. ______
Comments ______
Inclusive Dates of Possession ______

RADIAN
CORPORATION

GN-85-0910

CHAIN OF CUSTODY RECORD

Field Sample No. 4A

Company Sampled/Address Carswell AFB
Sample Point Description 4A

Stream Characteristics:
Temperature 15 **Flow** —— **pH** 7.1
Visual Observations/Comments ______

Collector's Name DHG JBC **Date/Time Sampled** 2/5/85 0930
Amount of Sample Collected ______
Sample Description 1 x 1 g 1 x 500 ml plastic, 1 x mason, 4 x VOA, 1 x 500 ml glass
Store at: ☐ Ambient ☒ 5°C ☐ −10°C ☐ Other ______

☒ Caution - No more sample available ☐ Return unused portion of sample ☐ Discard unused portions

Other Instructions - Special Handling - Hazards ______

☒ Hazardous sample (see below) ☐ Non-hazardous sample

☒ Toxic Assumed — IRP	☐ Skin irritant	☐ Flammable (FP< 40°C)
☐ Pyrophoric	☐ Lachrymator	☐ Shock sensitive
☐ Acidic	☐ Biological	☐ Carcinogenic - suspect
☐ Caustic	☐ Peroxide	☐ Radioactive
☐ Other ______		

Sample Allocation/Chain of Possession:

Organization Name RAS
Received By [illegible] **Date Received** [illegible] **Time** [illegible]
Transported By [illegible] **Lab Sample No.** 5503637
Comments ______
Inclusive Dates of Possession ______

Organization Name ______
Received By ______ **Date Received** ______ **Time** ______
Transported By ______ **Lab Sample No.** ______
Comments ______
Inclusive Dates of Possession ______

Organization Name ______
Received By ______ **Date Received** ______ **Time** ______
Transported By ______ **Lab Sample No.** ______
Comments ______
Inclusive Dates of Possession ______

GN-85-0911

RADIAN
CORPORATION

CHAIN OF CUSTODY RECORD

Field Sample No. 4B

Company Sampled/Address Carswell AFB
Sample Point Description 4B

Stream Characteristics:
Temperature 13 Flow — pH 7.2
Visual Observations/Comments

Collector's Name JBC DHG Date/Time Sampled 2/5/85 1100
Amount of Sample Collected
Sample Description 1x 1l glass, 1x 500 ml plastic, 1x mason, 4x VOA, 1x 500 ml glass
Store at: ☐ Ambient ☒ 5°C ☐ −10°C ☐ Other

☒ Caution - No more sample available ☐ Return unused portion of sample ☐ Discard unused portions

Other Instructions - Special Handling - Hazards

☒ Hazardous sample (see below) ☐ Non-hazardous sample

☒ Toxic Assumed — IRP
☐ Pyrophoric
☐ Acidic
☐ Caustic
☐ Other

☐ Skin irritant
☐ Lachrymator
☐ Biological
☐ Peroxide

☐ Flammable (FP< 40°C)
☐ Shock sensitive
☐ Carcinogenic - suspect
☐ Radioactive

Sample Allocation/Chain of Possession:
Organization Name [illegible]
Received By [illegible] Date Received [illegible] Time [illegible]
Transported By [illegible] Lab Sample No. [illegible]
Comments
Inclusive Dates of Possession

Organization Name
Received By Date Received Time
Transported By Lab Sample No.
Comments
Inclusive Dates of Possession

Organization Name
Received By Date Received Time
Transported By Lab Sample No.
Comments
Inclusive Dates of Possession

RADIAN
CORPORATION

4C

CHAIN OF CUSTODY RECORD

Field Sample No. GN-85-0912

Company Sampled/Address Carswell AFB

Sample Point Description 4C

Stream Characteristics:

Temperature 18° C Flow — pH 6.8

Visual Observations/Comments

Collector's Name DHG/JBC Date/Time Sampled 2/5/85 - 1430

Amount of Sample Collected 2X 1 L, 2x 500 ml gl, 2x 500 ml plastic, 2x 1l mason

Sample Description 4X VOA

Store at: ☐ Ambient ☒ 5°C ☐ −10°C ☐ Other

☒ Caution - No more sample available ☐ Return unused portion of sample ☐ Discard unused portions

Other Instructions - Special Handling - Hazards

☒ Hazardous sample (see below) ☐ Non-hazardous sample

☒ Toxic Assumed – IRP program	☐ Skin irritant	☐ Flammable (FP< 40°C)
☐ Pyrophoric	☐ Lachrymator	☐ Shock sensitive
☐ Acidic	☐ Biological	☐ Carcinogenic - suspect
☐ Caustic	☐ Peroxide	☐ Radioactive
☐ Other		

Sample Allocation/Chain of Possession:

Organization Name [illegible] 2-6-85

Received By [illegible] Date Received [illegible] Time [illegible]

Transported By [illegible] Lab Sample No. [illegible]

Comments

Inclusive Dates of Possession

Organization Name

Received By Date Received Time

Transported By Lab Sample No.

Comments

Inclusive Dates of Possession

Organization Name

Received By Date Received Time

Transported By Lab Sample No.

Comments

Inclusive Dates of Possession

RADIAN
CORPORATION

CHAIN OF CUSTODY RECORD

Field Sample No. GW-85-0913

Company Sampled/Address: Carswell AFB
Sample Point Description: 4D

Stream Characteristics:
Temperature: 19 Flow: — pH: 7.0
Visual Observations/Comments:

Collector's Name: DHG/JBC Date/Time Sampled: 2/5/85 — 1530
Amount of Sample Collected: 500 ml glass, 500 ml plastic 4 x VOA
Sample Description:
Store at: ☐ Ambient ☒ 5°C ☐ −10°C ☐ Other

☒ Caution - No more sample available ☐ Return unused portion of sample ☐ Discard unused portions

Other Instructions - Special Handling - Hazards:

☒ Hazardous sample (see below) ☐ Non-hazardous sample

☒ Toxic Assumed – IRP program ☐ Skin irritant ☐ Flammable (FP< 40°C)
☐ Pyrophoric ☐ Lachrymator ☐ Shock sensitive
☐ Acidic ☐ Biological ☐ Carcinogenic - suspect
☐ Caustic ☐ Peroxide ☐ Radioactive
☐ Other

Sample Allocation/Chain of Possession:

Organization Name: [illegible] 3-6-85
Received By: [illegible] Date Received: [illegible] Time: [illegible]
Transported By: [illegible] Lab Sample No.: [illegible]
Comments:
Inclusive Dates of Possession:

Organization Name:
Received By: Date Received: Time:
Transported By: Lab Sample No.:
Comments:
Inclusive Dates of Possession:

Organization Name:
Received By: Date Received: Time:
Transported By: Lab Sample No.:
Comments:
Inclusive Dates of Possession:

RADIAN CORPORATION

GN-85-0913

CHAIN OF CUSTODY RECORD

Field Sample No. 4D

Company Sampled/Address Carswell AFB

Sample Point Description 4D

Stream Characteristics:

Temperature 19 Flow / pH 7.0

Visual Observations/Comments

Collector's Name JBC DHG Date/Time Sampled 2/5/85 1530

Amount of Sample Collected

Sample Description 1x 1e glass 1x mason

Store at: ☐ Ambient ☒ 5°C ☐ −10°C ☐ Other

☒ Caution - No more sample available ☐ Return unused portion of sample ☐ Discard unused portions

Other Instructions - Special Handling - Hazards

☒ Hazardous sample (see below) ☐ Non-hazardous sample

☒ Toxic Assumed - IRP
☐ Pyrophoric
☐ Acidic
☐ Caustic
☐ Other

☐ Skin irritant
☐ Lachrymator
☐ Biological
☐ Peroxide

☐ Flammable (FP< 40°C)
☐ Shock sensitive
☐ Carcinogenic - suspect
☐ Radioactive

Sample Allocation/Chain of Possession:

Organization Name RAS
Received By [illegible] Date Received 2-6-85 Time [illegible]
Transported By [illegible] Lab Sample No. 8502027
Comments
Inclusive Dates of Possession

Organization Name
Received By Date Received Time
Transported By Lab Sample No.
Comments
Inclusive Dates of Possession

Organization Name
Received By Date Received Time
Transported By Lab Sample No.
Comments
Inclusive Dates of Possession

RADIAN
CORPORATION

CHAIN OF CUSTODY RECORD

GN-85-0914

Field Sample No. 4

Company Sampled/Address Carswell AFB

Sample Point Description 4E

Stream Characteristics:

Temperature 20°C **Flow** — **pH** 7.0

Visual Observations/Comments ____________________

Collector's Name JBC/DHG **Date/Time Sampled** 2/5/85 / 1630

Amount of Sample Collected 500 ml glass, 500 ml plastic, 4x VOA

Sample Description ____________________

Store at: ☐ Ambient ☒ 5°C ☐ −10°C ☐ Other ____________________

☒ Caution - No more sample available ☐ Return unused portion of sample ☐ Discard unused portions

Other Instructions - Special Handling - Hazards ____________________

☒ Hazardous sample (see below) ☐ Non-hazardous sample

☒ Toxic Assume$ - IRP program	☐ Skin irritant	☐ Flammable (FP< 40°C)
☐ Pyrophoric	☐ Lachrymator	☐ Shock sensitive
☐ Acidic	☐ Biological	☐ Carcinogenic - suspect
☐ Caustic	☐ Peroxide	☐ Radioactive
☐ Other ____________________		

Sample Allocation/Chain of Possession:

Organization Name [illegible]

Received By [illegible] **Date Received** [illegible] **Time** [illegible]

Transported By [illegible] **Lab Sample No.** [illegible]

Comments ____________________

Inclusive Dates of Possession ____________________

Organization Name ____________________

Received By ____________________ **Date Received** ____________ **Time** ____________

Transported By ____________________ **Lab Sample No.** ____________________

Comments ____________________

Inclusive Dates of Possession ____________________

Organization Name ____________________

Received By ____________________ **Date Received** ____________ **Time** ____________

Transported By ____________________ **Lab Sample No.** ____________________

Comments ____________________

Inclusive Dates of Possession ____________________

RADIAN CORPORATION

GK-85-0914

CHAIN OF CUSTODY RECORD

Field Sample No. 4E

Company Sampled/Address USAF - Carswell AFB

Sample Point Description 4E

Stream Characteristics:

Temperature 20° Flow — pH 7.0

Visual Observations/Comments

Collector's Name DHG, JBC Date/Time Sampled 2/5/85 1630

Amount of Sample Collected

Sample Description 1 l glass, 1x mason

Store at: ☐ Ambient ☒ 5°C ☐ -10°C ☐ Other

☒ Caution - No more sample available ☐ Return unused portion of sample ☐ Discard unused portions

Other Instructions - Special Handling - Hazards

☒ Hazardous sample (see below) ☐ Non-hazardous sample

☒ Toxic Assumed - IRP	☐ Skin irritant	☐ Flammable (FP< 40°C)
☐ Pyrophoric	☐ Lachrymator	☐ Shock sensitive
☐ Acidic	☐ Biological	☐ Carcinogenic - suspect
☐ Caustic	☐ Peroxide	☐ Radioactive
☐ Other		

Sample Allocation/Chain of Possession:

Organization Name [illegible]

Received By [illegible] Date Received [illegible] Time

Transported By [illegible] Lab Sample No. [illegible]

Comments

Inclusive Dates of Possession

Organization Name

Received By Date Received Time

Transported By Lab Sample No.

Comments

Inclusive Dates of Possession

Organization Name

Received By Date Received Time

Transported By Lab Sample No.

Comments

Inclusive Dates of Possession

GN-85-0918
GN-85-0916

RADIAN
CORPORATION

CHAIN OF CUSTODY RECORD

Field Sample No. 1A, 10C

Company Sampled/Address Carswell AFB
Sample Point Description 1A = 3×500ml glass, 2×mason, 2×1l glass, 1×500ml plastic, 4×VOA
10C = 2×500ml glass, 1×mason, 4×VOA
Stream Characteristics:
Temperature ______ **Flow** ______ **pH** ______
Visual Observations/Comments ______

Collector's Name JB Chapman, DH Gancarz **Date/Time Sampled** 2-6-85
Amount of Sample Collected ______
Sample Description water well
Store at: ☐ Ambient ☒ 5°C ☐ −10°C ☐ Other ______

☒ Caution · No more sample available ☐ Return unused portion of sample ☐ Discard unused portions

Other Instructions · Special Handling · Hazards ______

☒ Hazardous sample (see below) ☐ Non-hazardous sample

☒ Toxic — assumed, IRP program ☐ Skin irritant ☐ Flammable (FP< 40°C)
☐ Pyrophoric ☐ Lachrymator ☐ Shock sensitive
☐ Acidic ☐ Biological ☐ Carcinogenic · suspect
☐ Caustic ☐ Peroxide ☐ Radioactive
☐ Other ______

Sample Allocation/Chain of Possession:
Organization Name RAS
Received By [illegible] **Date Received** 2-7-85 **Time** ______
Transported By [illegible] **Lab Sample No.** [illegible]
Comments ______
Inclusive Dates of Possession ______

Organization Name ______
Received By ______ **Date Received** ______ **Time** ______
Transported By ______ **Lab Sample No.** ______
Comments ______
Inclusive Dates of Possession ______

Organization Name ______
Received By ______ **Date Received** ______ **Time** ______
Transported By ______ **Lab Sample No.** ______
Comments ______
Inclusive Dates of Possession ______

GN-85-0922
GN-85-0921
GN-85-0919
GN-85-0915

RADIAN CORPORATION

CHAIN OF CUSTODY RECORD

Field Sample No. 11B, 5C, 10A, 10B

Company Sampled/Address Carswell AFB

Sample Point Description 10A & B = 4x500ml glass, 2x mason, 8VOA / 11B = 2x500ml glass, 1x mason, 1x1l gl, 1x500 plast, 4VOA
5C = 3x500ml glass, 4xVOA, 1x mason, 1x 1l glass, 1x500ml plastic

Stream Characteristics:

Temperature ______ **Flow** ______ **pH** ______

Visual Observations/Comments ______

Collector's Name JB Chapman DH Gancarz **Date/Time Sampled** 2-6-85

Amount of Sample Collected ______

Sample Description water well

Store at: ☐ Ambient ☒ 5°C ☐ −10°C ☐ Other ______

☒ Caution - No more sample available ☐ Return unused portion of sample ☐ Discard unused portions

Other Instructions - Special Handling - Hazards ______

☒ Hazardous sample (see below) ☐ Non-hazardous sample

☒ Toxic – assumed, IRP program
☐ Pyrophoric
☐ Acidic
☐ Caustic
☐ Other ______

☐ Skin irritant
☐ Lachrymator
☐ Biological
☐ Peroxide

☐ Flammable (FP< 40°C)
☐ Shock sensitive
☐ Carcinogenic - suspect
☐ Radioactive

Sample Allocation/Chain of Possession:

Organization Name RAS
Received By [illegible] **Date Received** 2-7-85 **Time** [illegible]
Transported By [illegible] **Lab Sample No.** [illegible]
Comments ______
Inclusive Dates of Possession ______

Organization Name ______
Received By ______ **Date Received** ______ **Time** ______
Transported By ______ **Lab Sample No.** ______
Comments ______
Inclusive Dates of Possession ______

Organization Name ______
Received By ______ **Date Received** ______ **Time** ______
Transported By ______ **Lab Sample No.** ______
Comments ______
Inclusive Dates of Possession ______

GN-85-0920
GN-85-0917

RADIAN CORPORATION

CHAIN OF CUSTODY RECORD

Field Sample No. 5A, 5B

Company Sampled/Address: Caswell AFB

Sample Point Description: 5A: 4×500ml glass, 2×mason, 4×VOA, 2×1l glass, 2×500ml plastic
5B: 3×500ml glass, 2×mason, 4×VOA, 1×1l glass, 1×500ml plastic

Stream Characteristics:

Temperature ______ Flow ______ pH ______

Visual Observations/Comments ______

Collector's Name: JB Chapman, DH Gancarz Date/Time Sampled: 2-6-85

Amount of Sample Collected ______

Sample Description: water well

Store at: ☐ Ambient ☒ 5°C ☐ −10°C ☐ Other ______

☒ Caution · No more sample available ☐ Return unused portion of sample ☐ Discard unused portions

Other Instructions · Special Handling · Hazards ______

☒ Hazardous sample (see below) ☐ Non-hazardous sample

☒ Toxic—assumed, IRP program
☐ Pyrophoric
☐ Acidic
☐ Caustic
☐ Other ______

☐ Skin irritant
☐ Lachrymator
☐ Biological
☐ Peroxide

☐ Flammable (FP< 40°C)
☐ Shock sensitive
☐ Carcinogenic · suspect
☐ Radioactive

Sample Allocation/Chain of Possession:

Organization Name: [illegible]
Received By: [illegible] Date Received: [illegible] Time: [illegible]
Transported By: [illegible] Lab Sample No.: [illegible]
Comments ______
Inclusive Dates of Possession ______

Organization Name ______
Received By ______ Date Received ______ Time ______
Transported By ______ Lab Sample No. ______
Comments ______
Inclusive Dates of Possession ______

Organization Name ______
Received By ______ Date Received ______ Time ______
Transported By ______ Lab Sample No. ______
Comments ______
Inclusive Dates of Possession ______

GN-85-0925
-0926
-0927

RADIAN
CORPORATION

CHAIN OF CUSTODY RECORD

Field Sample No. (12B, C & 15A)

Company Sampled/Address Carswell AFB
Sample Point Description 12B & C each have 2×500ml glass, 1×mason, 1×500ml plastic, 4×VOA
15A has 1×500ml glass, 1×1l glass
Stream Characteristics:
Temperature ______ **Flow** ______ **pH** ______
Visual Observations/Comments ______

Collector's Name JBC/DHG **Date/Time Sampled** 2-7-85
Amount of Sample Collected ______
Sample Description water well
Store at: ☐ Ambient ☒ 5°C ☐ −10°C ☐ Other ______

☒ Caution - No more sample available ☐ Return unused portion of sample ☐ Discard unused portions

Other Instructions - Special Handling - Hazards ______

☒ Hazardous sample (see below) ☐ Non-hazardous sample

☒ Toxic -assumed, IRP program	☐ Skin irritant	☐ Flammable (FP< 40°C)
☐ Pyrophoric	☐ Lachrymator	☐ Shock sensitive
☐ Acidic	☐ Biological	☐ Carcinogenic - suspect
☐ Caustic	☐ Peroxide	☐ Radioactive
☐ Other ______		

Sample Allocation/Chain of Possession:

Organization Name RAS
Received By [illegible] **Date Received** [illegible] 85 **Time** [illegible]
Transported By Fed Ex **Lab Sample No.** 5203143 -[illegible]
Comments ______
Inclusive Dates of Possession ______

Organization Name ______
Received By ______ **Date Received** ______ **Time** ______
Transported By ______ **Lab Sample No.** ______
Comments ______
Inclusive Dates of Possession ______

Organization Name ______
Received By ______ **Date Received** ______ **Time** ______
Transported By ______ **Lab Sample No.** ______
Comments ______
Inclusive Dates of Possession ______

GN-85-0923
&GN-85-0924

RADIAN CORPORATION

CHAIN OF CUSTODY RECORD

Field Sample No. (11&12A)

Company Sampled/Address Carswell AFB

Sample Point Description 11A = 3×500ml glass, 2×mason, 2×1l glass, 1×500ml plastic, 4×VOA
12A = 4×500ml glass, 2×mason, 2×500ml plastic, 4×VOA

Stream Characteristics:

Temperature ____ Flow ____ pH ____

Visual Observations/Comments ____

Collector's Name JBC/DHG Date/Time Sampled 2-7-85

Amount of Sample Collected ____

Sample Description water well

Store at: ☐ Ambient ☒ 5°C ☐ −10°C ☐ Other ____

☒ Caution · No more sample available ☐ Return unused portion of sample ☐ Discard unused portions

Other Instructions · Special Handling · Hazards ____

☒ Hazardous sample (see below) ☐ Non-hazardous sample

☒ Toxic – assumed, IRP program
☐ Pyrophoric
☐ Acidic
☐ Caustic
☐ Other ____
☐ Skin irritant
☐ Lachrymator
☐ Biological
☐ Peroxide
☐ Flammable (FP< 40°C)
☐ Shock sensitive
☐ Carcinogenic · suspect
☐ Radioactive

Sample Allocation/Chain of Possession:

Organization Name RAS

Received By [illegible] Date Received 2-8-85 Time 1:00

Transported By [illegible] Lab Sample No. 5C2043, 044

Comments ____

Inclusive Dates of Possession ____

Organization Name ____

Received By ____ Date Received ____ Time ____

Transported By ____ Lab Sample No. ____

Comments ____

Inclusive Dates of Possession ____

Organization Name ____

Received By ____ Date Received ____ Time ____

Transported By ____ Lab Sample No. ____

Comments ____

Inclusive Dates of Possession ____

RADIAN
CORPORATION

GN-85-0928

CHAIN OF CUSTODY RECORD

Field Sample No. (1D)

Company Sampled/Address Carswell AFB
Sample Point Description 1D = 4x 500ml glass, 2x mason, 2x 1l glass, 2x 500ml plastic, 4x VOA

Stream Characteristics:
Temperature ________ **Flow** ________ **pH** ________
Visual Observations/Comments ________

Collector's Name JBC/DHG **Date/Time Sampled** 2-7-85
Amount of Sample Collected ________
Sample Description water well
Store at: ☐ Ambient ☒ 5°C ☐ −10°C ☐ Other ________

☒ Caution · No more sample available ☐ Return unused portion of sample ☐ Discard unused portions

Other Instructions · Special Handling · Hazards ________

☒ Hazardous sample (see below) ☐ Non-hazardous sample

☒ Toxic — assumed, IRP program	☐ Skin irritant	☐ Flammable (FP< 40°C)
☐ Pyrophoric	☐ Lachrymator	☐ Shock sensitive
☐ Acidic	☐ Biological	☐ Carcinogenic · suspect
☐ Caustic	☐ Peroxide	☐ Radioactive
☐ Other ________		

Sample Allocation/Chain of Possession:

Organization Name SAS
Received By [illegible] **Date Received** 3-5-? **Time** [illegible]
Transported By [illegible] **Lab Sample No.** 5563044
Comments ________
Inclusive Dates of Possession ________

Organization Name ________
Received By ________ **Date Received** ________ **Time** ________
Transported By ________ **Lab Sample No.** ________
Comments ________
Inclusive Dates of Possession ________

Organization Name ________
Received By ________ **Date Received** ________ **Time** ________
Transported By ________ **Lab Sample No.** ________
Comments ________
Inclusive Dates of Possession ________

GN-85-0930→
0932

RADIAN
CORPORATION

CHAIN OF CUSTODY RECORD

Field Sample No. (1C, 15B, C)

Company Sampled/Address Caswell AFB

Sample Point Description 1C = 2×500 ml glass, 1×mason, 1×1 l glass, 1×500 ml plastic, 4×VOA

Stream Characteristics: 15B and C each have 1×500 ml glass, 1×1 l glass

Temperature ____ **Flow** ____ **pH** ____

Visual Observations/Comments ____

Collector's Name JBC/DHG **Date/Time Sampled** 2-8-85

Amount of Sample Collected ____

Sample Description water well

Store at: ☐ Ambient ☒ 5°C ☐ −10°C ☐ Other ____

☒ Caution · No more sample available ☐ Return unused portion of sample ☐ Discard unused portions

Other Instructions · Special Handling · Hazards ____

☒ Hazardous sample (see below) ☐ Non-hazardous sample

☒ Toxic — assumed, IRP program
☐ Pyrophoric
☐ Acidic
☐ Caustic
☐ Other ____

☐ Skin irritant
☐ Lachrymator
☐ Biological
☐ Peroxide

☐ Flammable (FP< 40°C)
☐ Shock sensitive
☐ Carcinogenic · suspect
☐ Radioactive

Sample Allocation/Chain of Possession:

Organization Name [illegible]
Received By [illegible] **Date Received** [illegible] **Time** [illegible]
Transported By [illegible] **Lab Sample No.** [illegible]
Comments ____
Inclusive Dates of Possession ____

Organization Name ____
Received By ____ **Date Received** ____ **Time** ____
Transported By ____ **Lab Sample No.** ____
Comments ____
Inclusive Dates of Possession ____

Organization Name ____
Received By ____ **Date Received** ____ **Time** ____
Transported By ____ **Lab Sample No.** ____
Comments ____
Inclusive Dates of Possession ____

RADIAN
CORPORATION

CHAIN OF CUSTODY RECORD

850933,
850940,
Field Sample No. ~~850941~~

Company Sampled/Address Carswell AFB
Sample Point Description WSA well, Streams at Sites 4,5

Stream Characteristics:
Temperature ______ Flow ______ pH ______
Visual Observations/Comments ______

Collector's Name LN French Date/Time Sampled 2/19/85
Amount of Sample Collected variable
Sample Description Water
Store at: ☐ Ambient ☒ 5°C ☐ −10°C ☐ Other ______

☒ Caution - No more sample available ☐ Return unused portion of sample ☐ Discard unused portions

Other Instructions - Special Handling - Hazards ______

☒ Hazardous sample (see below) ☐ Non-hazardous sample

☐ Toxic	☐ Skin irritant	☐ Flammable (FP< 40°C)
☐ Pyrophoric	☐ Lachrymator	☐ Shock sensitive
☐ Acidic	☐ Biological	☐ Carcinogenic - suspect
☐ Caustic	☐ Peroxide	☐ Radioactive

☐ Other from IRP

Sample Allocation/Chain of Possession:
Organization Name [illegible]
Received By [illegible] Date Received [illegible] Time [illegible]
Transported By [illegible] Lab Sample No. [illegible]
Comments ______
Inclusive Dates of Possession ______

Organization Name ______
Received By ______ Date Received ______ Time ______
Transported By ______ Lab Sample No. ______
Comments ______
Inclusive Dates of Possession ______

Organization Name ______
Received By ______ Date Received ______ Time ______
Transported By ______ Lab Sample No. ______
Comments ______
Inclusive Dates of Possession ______

RADIAN
CORPORATION

GS-85-C934 →
GS-85-C939,

CHAIN OF CUSTODY RECORD

Field Sample No. GS-85-C942,
GS-85-C943

Company Sampled/Address Carswell AFB

Sample Point Description Sites 16, WSA

Stream Characteristics:

Temperature — Flow — pH —

Visual Observations/Comments

Collector's Name C N French Date/Time Sampled 2/17, 21

Amount of Sample Collected quart mason jars

Sample Description Soil

Store at: ☐ Ambient ☐ 5°C ☒ −10°C ☐ Other

☒ Caution - No more sample available ☐ Return unused portion of sample ☐ Discard unused portions

Other Instructions - Special Handling - Hazards

☒ Hazardous sample (see below) ☐ Non-hazardous sample

☐ Toxic	☐ Skin irritant	☐ Flammable (FP< 40°C)
☐ Pyrophoric	☐ Lachrymator	☐ Shock sensitive
☐ Acidic	☐ Biological	☐ Carcinogenic - suspect
☐ Caustic	☐ Peroxide	☐ Radioactive
☐ Other IRP Site		

Sample Allocation/Chain of Possession:

Organization Name RAS

Received By [illegible] Date Received [illegible] Time [illegible]

Transported By LF Lab Sample No. [illegible]

Comments

Inclusive Dates of Possession

Organization Name

Received By Date Received Time

Transported By Lab Sample No.

Comments

Inclusive Dates of Possession

Organization Name

Received By Date Received Time

Transported By Lab Sample No.

Comments

Inclusive Dates of Possession

AD-A174 095 INSTALLATION RESTORATION PROGRAM PHASE II CONFIRMATION/QUANTIFICATION STA..(U) RADIAN CORP AUSTIN TX OCT 86 F33615-84-D-4402

3/4

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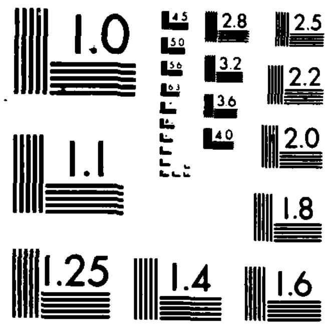

MICROCOPY RESOLUTION TEST CHART
NATIONAL BUREAU OF STANDARDS-1963-A

RADIAN
CORPORATION

CHAIN OF CUSTODY RECORD

GN85-0944, 0945, 0946

Field Sample No.

Company Sampled/Address Carswell AFB
Sample Point Description Surface Water, Sites 12+16

Stream Characteristics:
Temperature — **Flow** ______ **pH** ______
Visual Observations/Comments ______

Collector's Name CN French JB Chapman **Date/Time Sampled** 2/28/85
Amount of Sample Collected variable
Sample Description water
Store at: ☐ Ambient ☒ 5°C ☐ −10°C ☐ Other ______

☒ Caution - No more sample available ☐ Return unused portion of sample ☐ Discard unused portions

Other Instructions - Special Handling - Hazards ______

☒ Hazardous sample (see below) ☐ Non-hazardous sample

☐ Toxic
☐ Pyrophoric
☐ Acidic
☐ Caustic
☐ Other IRP Site
☐ Skin irritant
☐ Lachrymator
☐ Biological
☐ Peroxide
☐ Flammable (FP< 40°C)
☐ Shock sensitive
☐ Carcinogenic - suspect
☐ Radioactive

Sample Allocation/Chain of Possession:
Organization Name [illegible]
Received By [illegible] **Date Received** [illegible] **Time** [illegible]
Transported By [illegible] **Lab Sample No.** [illegible]
Comments ______
Inclusive Dates of Possession ______

Organization Name ______
Received By ______ **Date Received** ______ **Time** ______
Transported By ______ **Lab Sample No.** ______
Comments ______
Inclusive Dates of Possession ______

Organization Name ______
Received By ______ **Date Received** ______ **Time** ______
Transported By ______ **Lab Sample No.** ______
Comments ______
Inclusive Dates of Possession ______

RADIAN
CORPORATION

GS-85-0821
GS-85-0947, 0948, 0949, 0950

CHAIN OF CUSTODY RECORD

Field Sample No. GS-85-0821, GS-85-0947, 0948, 0949, 0950

Company Sampled/Address Carswell AFB
Sample Point Description Sites 13, 16

Stream Characteristics:
Temperature ______ Flow ______ pH ______
Visual Observations/Comments ______

Collector's Name LN French Date/Time Sampled 2/28/85
Amount of Sample Collected ______
Sample Description Soil
Store at: ☐ Ambient ☐ 5°C ☒ −10°C ☐ Other ______

☒ Caution - No more sample available ☐ Return unused portion of sample ☐ Discard unused portions
Other Instructions - Special Handling - Hazards ______

☒ Hazardous sample (see below) ☐ Non-hazardous sample

☐ Toxic ☐ Skin irritant ☐ Flammable (FP< 40°C)
☐ Pyrophoric ☐ Lachrymator ☐ Shock sensitive
☐ Acidic ☐ Biological ☐ Carcinogenic - suspect
☐ Caustic ☐ Peroxide ☐ Radioactive
☐ Other IRP Site

Sample Allocation/Chain of Possession:
Organization Name CAS
Received By [illegible] Date Received 3-1-85 Time [illegible]
Transported By Fed Ex Lab Sample No. 503007
Comments ______
Inclusive Dates of Possession ______

Organization Name ______
Received By ______ Date Received ______ Time ______
Transported By ______ Lab Sample No. ______
Comments ______
Inclusive Dates of Possession ______

Organization Name ______
Received By ______ Date Received ______ Time ______
Transported By ______ Lab Sample No. ______
Comments ______
Inclusive Dates of Possession ______

RADIAN
CORPORATION

CHAIN OF CUSTODY RECORD

850967
850970
Field Sample No. 850971

Company Sampled/Address CARSWELL AFB
Sample Point Description MONITOR WELLS
Stream Characteristics: N/A
Temperature ______ Flow ______ pH ______
Visual Observations/Comments ______

Collector's Name PETER A WATERREUS Date/Time Sampled 3/5/85
Amount of Sample Collected QUARTS, VOAS, 500ml glass and plastic, 1-liter glass
Sample Description WATER
Store at: ☐ Ambient ☐ 5°C ☐ −10°C ☒ Other 4°C

☒ Caution - No more sample available ☐ Return unused portion of sample ☐ Discard unused portions

Other Instructions - Special Handling - Hazards SUSPECTED HAZARDOUS MATERIAL

☐ Hazardous sample (see below) ☐ Non-hazardous sample

☐ Toxic ☐ Skin irritant ☐ Flammable (FP< 40°C)
☐ Pyrophoric ☐ Lachrymator ☐ Shock sensitive
☐ Acidic ☐ Biological ☐ Carcinogenic - suspect
☐ Caustic ☐ Peroxide ☐ Radioactive
☐ Other ______

Sample Allocation/Chain of Possession:

Organization Name KAS
Received By [illegible] Date Received 3-6-85 Time [illegible]
Transported By Fed Ex Lab Sample No. 850349
Comments ______
Inclusive Dates of Possession ______

Organization Name ______
Received By ______ Date Received ______ Time ______
Transported By ______ Lab Sample No. ______
Comments ______
Inclusive Dates of Possession ______

Organization Name ______
Received By ______ Date Received ______ Time ______
Transported By ______ Lab Sample No. ______
Comments ______
Inclusive Dates of Possession ______

RADIAN CORPORATION

CHAIN OF CUSTODY RECORD

850958
850957
850969
850972
850964
Field Sample No. 850966
850956
850955

Company Sampled/Address CARSWELL AFB

Sample Point Description MONITOR WELLS

Stream Characteristics: N/A

Temperature ______ Flow ______ pH ______

Visual Observations/Comments ______

Collector's Name PETER A WATERREUS Date/Time Sampled 3/5/85

Amount of Sample Collected QUARTS, VOAS, 500ml glass, 500 ml Plastic, 1-lite,

Sample Description WATER

Store at: ☐ Ambient ☐ 5°C ☐ −10°C ☒ Other 4°C

☒ Caution · No more sample available ☐ Return unused portion of sample ☐ Discard unused portions

Other Instructions · Special Handling · Hazards SUSPECTED HAZARDOUS MATERIAL

☐ Hazardous sample (see below) ☐ Non-hazardous sample

☐ Toxic ☐ Skin irritant ☐ Flammable (FP< 40°C)

☐ Pyrophoric ☐ Lachrymator ☐ Shock sensitive

☐ Acidic ☐ Biological ☐ Carcinogenic · suspect

☐ Caustic ☐ Peroxide ☐ Radioactive

☐ Other ______

Sample Allocation/Chain of Possession:

Organization Name RAS

Received By [illegible] Date Received 3 6 85 Time 0900

Transported By Fed Ex Lab Sample No. 8503041, 050, 051

Comments ______

Inclusive Dates of Possession ______

Organization Name ______

Received By ______ Date Received ______ Time ______

Transported By ______ Lab Sample No. ______

Comments ______

Inclusive Dates of Possession ______

Organization Name ______

Received By ______ Date Received ______ Time ______

Transported By ______ Lab Sample No. ______

Comments ______

Inclusive Dates of Possession ______

RADIAN
CORPORATION

850968
850952
850951

CHAIN OF CUSTODY RECORD

Field Sample No. 850953
850954

Company Sampled/Address CARSWELL AFB
Sample Point Description MONITOR WELLS
Stream Characteristics: N/A
Temperature ______ Flow ______ pH ______
Visual Observations/Comments ______

Collector's Name PETER A WATERREUS Date/Time Sampled 3/4/85 – 3/5/85
Amount of Sample Collected QUARTS, VOAS, 500ml glass, 500ml plastic, 1-liter
Sample Description WATER
Store at: ☐ Ambient ☐ 5°C ☐ –10°C ☒ Other 4°C

☒ Caution · No more sample available ☐ Return unused portion of sample ☐ Discard unused portions

Other Instructions · Special Handling · Hazards SUSPECTED HAZARDOUS MATERIAL

☐ Hazardous sample (see below) ☐ Non-hazardous sample

☐ Toxic	☐ Skin irritant	☐ Flammable (FP< 40°C)
☐ Pyrophoric	☐ Lachrymator	☐ Shock sensitive
☐ Acidic	☐ Biological	☐ Carcinogenic · suspect
☐ Caustic	☐ Peroxide	☐ Radioactive
☐ Other ______		

Sample Allocation/Chain of Possession:

Organization Name RAS
Received By [illegible signature] Date Received 3 6 85 Time 0900
Transported By Fed Ex Lab Sample No. 850349, 350
Comments ______
Inclusive Dates of Possession ______

Organization Name ______
Received By ______ Date Received ______ Time ______
Transported By ______ Lab Sample No. ______
Comments ______
Inclusive Dates of Possession ______

Organization Name ______
Received By ______ Date Received ______ Time ______
Transported By ______ Lab Sample No. ______
Comments ______
Inclusive Dates of Possession ______

RADIAN
CORPORATION

850962
850963
850965
850959

CHAIN OF CUSTODY RECORD

Field Sample No. 850961
850960

Company Sampled/Address CARSWELL AFB
Sample Point Description Monitor wells

Stream Characteristics: N/A
Temperature ______ Flow ______ pH ______
Visual Observations/Comments ______

Collector's Name PETER A WATERREUS Date/Time Sampled ______
Amount of Sample Collected QUARTS, VOAS, 500ml glass, 500ml plastic, 1-liter
Sample Description WATER
Store at: ☐ Ambient ☐ 5°C ☐ −10°C ☒ Other 4°C

☒ Caution - No more sample available ☐ Return unused portion of sample ☐ Discard unused portions

Other Instructions - Special Handling - Hazards SUSPECTED HAZARDOUS MATERIAL

☐ Hazardous sample (see below) ☐ Non-hazardous sample

☐ Toxic ☐ Skin irritant ☐ Flammable (FP< 40°C)
☐ Pyrophoric ☐ Lachrymator ☐ Shock sensitive
☐ Acidic ☐ Biological ☐ Carcinogenic - suspect
☐ Caustic ☐ Peroxide ☐ Radioactive
☐ Other ______

Sample Allocation/Chain of Possession:
Organization Name RAS -
Received By [illegible] Date Received 3-6-85 Time [illegible]
Transported By [illegible] Lab Sample No. 850 3051
Comments ______
Inclusive Dates of Possession ______

Organization Name ______
Received By ______ Date Received ______ Time ______
Transported By ______ Lab Sample No. ______
Comments ______
Inclusive Dates of Possession ______

Organization Name ______
Received By ______ Date Received ______ Time ______
Transported By ______ Lab Sample No. ______
Comments ______
Inclusive Dates of Possession ______

RADIAN CORPORATION

850973
850974
850975

CHAIN OF CUSTODY RECORD

Field Sample No. 850981

Company Sampled/Address CARSWELL AFB

Sample Point Description MONITOR WELLS

Stream Characteristics: N/A

Temperature ______ **Flow** ______ **pH** ______

Visual Observations/Comments ______

Collector's Name PETER A WATERREUS **Date/Time Sampled** 3/6/85

Amount of Sample Collected QUARTS, VOAS, 500 ml glass + plastic, 1-liter

Sample Description WATER

Store at: ☐ Ambient ☐ 5°C ☐ −10°C ☒ Other 4°C

☒ Caution - No more sample available ☐ Return unused portion of sample ☐ Discard unused portions

Other Instructions - Special Handling - Hazards ______

☐ Hazardous sample (see below) ☐ Non-hazardous sample

☐ Toxic	☐ Skin irritant	☐ Flammable (FP< 40°C)
☐ Pyrophoric	☐ Lachrymator	☐ Shock sensitive
☐ Acidic	☐ Biological	☐ Carcinogenic - suspect
☐ Caustic	☐ Peroxide	☐ Radioactive

☐ Other SUSPECTED HAZARDOUS MATERIAL

Sample Allocation/Chain of Possession:

Organization Name RAS
Received By [illegible] **Date Received** [illegible] **Time** [illegible]
Transported By [illegible] **Lab Sample No.** [illegible]
Comments ______
Inclusive Dates of Possession ______

Organization Name ______
Received By ______ **Date Received** ______ **Time** ______
Transported By ______ **Lab Sample No.** ______
Comments ______
Inclusive Dates of Possession ______

Organization Name ______
Received By ______ **Date Received** ______ **Time** ______
Transported By ______ **Lab Sample No.** ______
Comments ______
Inclusive Dates of Possession ______

RADIAN
CORPORATION

850977
850978
850979
850982

CHAIN OF CUSTODY RECORD

Field Sample No. 850983
850976

Company Sampled/Address CARSWELL AFB
Sample Point Description MONITOR WELLS
Stream Characteristics: N/A
Temperature ______ Flow ______ pH ______
Visual Observations/Comments ______

Collector's Name PETER A WATERREUS Date/Time Sampled 3/6/85
Amount of Sample Collected QUARTS, VOAS, 500ml glass + plastic, 1-liter
Sample Description WATER
Store at: ☐ Ambient ☐ 5°C ☐ −10°C ☒ Other 4°C

☒ Caution · No more sample available ☐ Return unused portion of sample ☐ Discard unused portions

Other Instructions · Special Handling · Hazards ______

☐ Hazardous sample (see below) ☐ Non-hazardous sample

☐ Toxic ☐ Skin irritant ☐ Flammable (FP< 40°C)
☐ Pyrophoric ☐ Lachrymator ☐ Shock sensitive
☐ Acidic ☐ Biological ☐ Carcinogenic · suspect
☐ Caustic ☐ Peroxide ☐ Radioactive
☐ Other SUSPECTED HAZARDOUS MATERIAL

Sample Allocation/Chain of Possession:
Organization Name [illegible]
Received By [illegible] Date Received 3 7 85 Time [illegible]
Transported By [illegible] Lab Sample No. [illegible]
Comments ______
Inclusive Dates of Possession ______

Organization Name ______
Received By ______ Date Received ______ Time ______
Transported By ______ Lab Sample No. ______
Comments ______
Inclusive Dates of Possession ______

Organization Name ______
Received By ______ Date Received ______ Time ______
Transported By ______ Lab Sample No. ______
Comments ______
Inclusive Dates of Possession ______

RADIAN CORPORATION

CHAIN OF CUSTODY RECORD

850992
850980
850943
Field Sample No. 350975

Company Sampled/Address CARSWELL AFB
Sample Point Description MONITOR WELLS (P1, 5C, P2, 15A)

Stream Characteristics: N/A
Temperature ______ Flow ______ pH ______
Visual Observations/Comments ______

Collector's Name PETER A WATERREUS Date/Time Sampled 3/1/85 - 3/2/85
Amount of Sample Collected QUARTS, VOAS, 500 ml glass + plastic, 1-liter
Sample Description WATER
Store at: ☐ Ambient ☐ 5°C ☐ −10°C ☒ Other 4°C

☒ Caution - No more sample available ☐ Return unused portion of sample ☐ Discard unused portions

Other Instructions - Special Handling - Hazards ______

☐ Hazardous sample (see below) ☐ Non-hazardous sample

☐ Toxic ☐ Skin irritant ☐ Flammable (FP< 40°C)
☐ Pyrophoric ☐ Lachrymator ☐ Shock sensitive
☐ Acidic ☐ Biological ☐ Carcinogenic - suspect
☐ Caustic ☐ Peroxide ☐ Radioactive
☐ Other SUSPECTED HAZARDOUS MATERIAL

Sample Allocation/Chain of Possession:
Organization Name [illegible]
Received By [illegible] Date Received [illegible] Time [illegible]
Transported By [illegible] Lab Sample No. [illegible]
Comments ______
Inclusive Dates of Possession ______

Organization Name ______
Received By ______ Date Received ______ Time ______
Transported By ______ Lab Sample No. ______
Comments ______
Inclusive Dates of Possession ______

Organization Name ______
Received By ______ Date Received ______ Time ______
Transported By ______ Lab Sample No. ______
Comments ______
Inclusive Dates of Possession ______

RADIAN
CORPORATION

CHAIN OF CUSTODY RECORD

850987
850991
850986
850988
850989
Field Sample No. 850774
850940
850985

Company Sampled/Address CARSWELL AFB
Sample Point Description MONITOR WELLS (12C, 12A, 12B, 10A)
Stream Characteristics: N/A
Temperature ______ **Flow** ______ **pH** ______
Visual Observations/Comments ______

Collector's Name PETER A WATERREUS **Date/Time Sampled** 3/7/85
Amount of Sample Collected QUARTS, VOAS, 500 ml glass + plastic, 1-liter glass
Sample Description water
Store at: ☐ Ambient ☐ 5°C ☐ −10°C ☒ Other 4°C

☒ Caution - No more sample available ☐ Return unused portion of sample ☐ Discard unused portions

Other Instructions - Special Handling - Hazards ______

☐ Hazardous sample (see below) ☐ Non-hazardous sample

☐ Toxic ☐ Skin irritant ☐ Flammable (FP< 40°C)
☐ Pyrophoric ☐ Lachrymator ☐ Shock sensitive
☐ Acidic ☐ Biological ☐ Carcinogenic - suspect
☐ Caustic ☐ Peroxide ☐ Radioactive
☐ Other SUSPECTED HAZARDOUS MATERIAL

Sample Allocation/Chain of Possession:

Organization Name [illegible]
Received By [illegible] **Date Received** 3-8-85 **Time** 0930
Transported By [illegible] **Lab Sample No.** [illegible]
Comments ______
Inclusive Dates of Possession ______

Organization Name ______
Received By ______ **Date Received** ______ **Time** ______
Transported By ______ **Lab Sample No.** ______
Comments ______
Inclusive Dates of Possession ______

Organization Name ______
Received By ______ **Date Received** ______ **Time** ______
Transported By ______ **Lab Sample No.** ______
Comments ______
Inclusive Dates of Possession ______

RADIAN
CORPORATION

CHAIN OF CUSTODY RECORD

Field Sample No. 850971

Company Sampled/Address CARSWELL AFB

Sample Point Description Monitor Well 1B

Stream Characteristics: N/A

Temperature ______ Flow ______ pH ______

Visual Observations/Comments ______

Collector's Name PETER A WATERREUS Date/Time Sampled 3/5/85

Amount of Sample Collected 1 ___ ml plastic, 2 VOAS

Sample Description WATER

Store at: ☐ Ambient ☐ 5°C ☐ −10°C ☒ Other 4°C

☒ Caution - No more sample available ☐ Return unused portion of sample ☐ Discard unused portions

Other Instructions - Special Handling - Hazards ______

☐ Hazardous sample (see below) ☐ Non-hazardous sample

☐ Toxic	☐ Skin irritant	☐ Flammable (FP< 40°C)
☐ Pyrophoric	☐ Lachrymator	☐ Shock sensitive
☐ Acidic	☐ Biological	☐ Carcinogenic - suspect
☐ Caustic	☐ Peroxide	☐ Radioactive

☐ Other SUSPECTED HAZARDOUS MATERIAL

Sample Allocation/Chain of Possession:

Organization Name [illegible]
Received By [illegible] Date Received [illegible] Time [illegible]
Transported By [illegible] Lab Sample No. [illegible]
Comments ______
Inclusive Dates of Possession ______

Organization Name ______
Received By ______ Date Received ______ Time ______
Transported By ______ Lab Sample No. ______
Comments ______
Inclusive Dates of Possession ______

Organization Name ______
Received By ______ Date Received ______ Time ______
Transported By ______ Lab Sample No. ______
Comments ______
Inclusive Dates of Possession ______

[illegible]

RADIAN
CORPORATION

CHAIN OF CUSTODY RECORD

Field Sample No. 850977, 850978

Company Sampled/Address Carswell AFB
Sample Point Description Pablizy wells

Stream Characteristics:
Temperature — Flow 5gpm pH —
Visual Observations/Comments No sed or turbidity

Collector's Name LN French Date/Time Sampled 3/26/85
Amount of Sample Collected as shipped
Sample Description ground water
Store at: ☐ Ambient ☒ 5°C ☐ −10°C ☐ Other

☒ Caution · No more sample available ☐ Return unused portion of sample ☐ Discard unused portions

Other Instructions · Special Handling · Hazards

☒ Hazardous sample (see below) ☐ Non-hazardous sample

☐ Toxic ☐ Skin irritant ☐ Flammable (FP< 40°C)
☐ Pyrophoric ☐ Lachrymator ☐ Shock sensitive
☐ Acidic ☐ Biological ☐ Carcinogenic · suspect
☐ Caustic ☐ Peroxide ☐ Radioactive
☐ Other IRP site

Sample Allocation/Chain of Possession:
Organization Name [illegible]
Received By [illegible] Date Received [illegible] Time [illegible]
Transported By [illegible] Lab Sample No. [illegible]
Comments
Inclusive Dates of Possession

Organization Name
Received By Date Received Time
Transported By Lab Sample No.
Comments
Inclusive Dates of Possession

Organization Name
Received By Date Received Time
Transported By Lab Sample No.
Comments
Inclusive Dates of Possession

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CORPORATION

APPENDIX I

References

RADIAN CORPORATION

APPENDIX I
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RADIAN CORPORATION

APPENDIX J

Biographies of Key Personnel

Thomas W. Grimshaw - Program Manager
Lawrence N. French - Project Director
Jenny B. Chapman - Supervising Geologist
James L. Machin - Soil Sampling
Peter A. Waterreus - Soil and Monitor Well Sampiling
David H. Gancarz - Monitor Well Sampling
Doug A. Orr - Monitor Well Sampling
Jill P. Rossi - Cartographer
Kevin Zonana - Cartographer Assistant
William M. Little - Technical Review

THOMAS W. GRIMSHAW

EDUCATION:

Ph.D., Geology, University of Texas at Austin, 1976.

M.S., Geology, University of Texas at Austin, 1970.

B.S., Geological Engineering, South Dakota School of Mines and Technology, 1967.

EXPERIENCE:

Program Manager, Radian Corporation, Austin, TX, 1984-Present.

Division Manager, Policy and Environmental Analysis Division, Radian Corporation, 1982-1984.

Department Head, Environmental Analysis Department, Radian Corporation, 1978-1982.

Group Leader, Radian Corporation, 1976-1978.

Teaching Assistant, The University of Texas at Austin, 1974.

Captain (R&D Coordinator), U.S. Army, 1970-1972.

Geologist, Junior Grade, Amoco Production Company, 1969-1970.

Geologic Field Assistant, Amoco Production Company, 1967.

Certification: AIPG Certified Professional Geologist No. 4425

FIELDS OF EXPERIENCE:

As Program Manager at Radian, Dr. Grimshaw has overall responsibility for the technical, fiscal, and schedule aspects of several solid/hazardous waste, ground-water, and other environmental projects. For these projects, he serves as the primary point of contact for the clients sponsoring the work. Dr. Grimshaw is also responsible for marketing and preparing proposals for Radian services in a variety of areas, including solid/hazardous waste site investigations, remedial action planning and implementation, ground-water contamination studies, multidisciplinary environmental studies, and reclamation investigations.

Most recently, Dr. Grimshaw has served as Program Manager (PM) for solid/hazardous waste disposal investigations at seven U.S. Air Force bases in Texas, Oklahoma, Louisiana, and New Mexico. These projects, which are being performed for the USAF Occupational and Environmental Health Laboratory, Brooks AFB, Texas, are an integral part of the Air Force Installation Restoration Program. Each investigation includes soil sampling and analysis, monitor well installation, and surface water sampling and analysis. The resulting data are interpreted in terms of degree of soils, ground-water, and surface-water impacts, and recommendations are made for investigations for defining remedial measures to be undertaken.

Also for the Air Force, Dr. Grimshaw is PM for wastewater investigations at Kelly AFB and Laughlin AFB, Texas. The study at Kelly AFB is to detemine the source and characteristics of industrial wastewater and other inflows to the storm sewer system and to make recommendations for redirecting these flows to the industrial wastewater treatment plant. The investigation at Laughlin AFB is a comprehensive evaluation of the effectiveness of the existing wastewater treatment system accompanied by recommendations for required changes to the system.

Dr. Grimshaw is also PM for an ongoing task order contract for a large IBM manufacturing plant in Austin, Texas. This contract is for sampling, analysis, and related services for ground-water monitor wells, wastewater streams, and other sources in the plant.

For a major law firm in Kansas City, Missouri, Dr. Grimshaw is serving as PM for a program to provide Expert Witness and corollary services related to a hazardous waste disposal site in Kansas City. A lawsuit has been filed against the four largest Potentially Responsible Party generators and the owner/operator by the U.S. Department of Justice (who received the case by referral from the U.S. Environmental Protection Agency). Radian is working with the law firm representing the former owner/operator of the site.

Expert support is being provided in the following areas: 1) oversight of Remedial Investigation and Feasibility Study activities by the U.S. EPA and the PRP generators; 2) review of depositions and recommendations for line of questioning by the attorneys; 3) support of automation of disposal records with the objective of developing a basis for allocation of investigation and clean-up costs ; 4) prepare and give technical presentations on the case to the attorneys involved; and 5) prepare and execute work plans to on-site technical studies to be undertaken at the site.

The Western Company of North America, Fort Worth, Texas is an oil field servicing firm whose operations generate hazardous wastes. Dr. Grimshaw is PM for a program being performed for the Western Company to achieve compliance with Texas Department of Water Resources regulations at three of their sites in Kermit, Odessa, and Rankin. Activities for this program to date have included preparation of a Plan of Action for obtaining compliance and a Waste Analysis plan, both of which have been submitted to TDWR for approval.

Thomas W. Grimshaw

Dr. Grimshaw is PM for a site investigation and remediation for a pesticide-contaminated site in Arizona owned by University Financial Investors Corporation. This project has included soil sampling and analysis for pesticides, remedial plan preparation, and presentations to state and EPA regulatory authorities.

Dr. Grimshaw has served as Technical Coordinator for over 40 risk assessment surveys for Environmental Impairment Liability (EIL) insurance policies. The purpose of these surveys is to provide EIL insurance underwriters the data needed for assessing the risks involved in providing insurance coverage for the facilities surveyed. Dr. Grimshaw also personally performed six EIL surveys involving facilities at more than 30 locations around the country. These facilities included a hazardous waste landfill, numerous industrial and municipal wastewater treatment plants, a municipal landfill, an aluminum forging plant and a casting plant, a magnet wire production facility, and several paper mills.

Dr. Grimshaw was Project Director for an investigation of an unpermitted disposal site located near Dallas, Texas. This project, which was performed for a major law firm in Dallas, included extensive waste and soil sampling and analysis, delineation of specific sites of disposal, and recommendations for disposition of the waste materials found. Several meetings were held with the regulatory agency, the Texas Department of Water Resources.

In another investigation for the same law firm, Dr. Grimshaw was Project Director for a soil sampling and analysis and ground-water monitoring project at a PCB disposal site. The area of contamination was defined by surface and shallow subsurface soil sampling on a modified grid pattern, and two monitor wells were installed. A recommendation involving soil removal, redepositing, and pavement was made to address the PCB contamination at the site.

For a large program conducted for International Paper Company, Dr. Grimshaw served as Technical Coordinator for developing Closure Plans for impoundments at wood treatment plants in three states. This program included a full complement of studies to define the existing situation and prepare a plan of remedial action for each plant. The initial activity was the sampling and analysis of pond supernatant and sludge, subsoil, and ground water. Bench-scale stabilization studies were performed on the sludge using a number of candidate commercial stabilizing compounds. Several closure alternatives were developed and screened, and a set of alternatives was selected for inclusion in conceptual plans. After the conceptual plans were approved by the client and the regulatory agencies, a detailed design was prepared and specifications developed.

For Tuloma Energies, Inc., Radian performed a program directed by Dr. Grimshaw for development of a commercial Hazardous Waste Management Facility in northeastern Oklahoma. During the initial phases of this project, a market analysis was performed to determine the sources at waste that could potentially use the new facility. Subsequently, a regional screening analysis was performed to identify areas most likely to have suitable sites for the new facility. This analysis included screening for several factors, including hydrologic, geologic, topographic, ecologic, and aerometric characteristics as well as population density. Dr. Grimshaw assisted Tuloma Energies in coordinating with the state regulatory agency (Oklahoma Department of Health) during the initial phases of the project.

Dr. Grimshaw was Project Director for two programs for International Paper Company to evaluate the potential risk of proposed solid waste management plans for paper mills in Arkansas and Mississippi. These programs included collection of waste, soil, and ground-water samples, analysis of the wastes, and batch extraction of the wastes followed by analysis of the leachates. In addition, leachates were generated and attenuated in waste and soil columns to evaluate the capacity of the subsoil to attenuate any leachate that might escape from the disposal site. A ground-water flow model was used to assess the rate and direction of contaminant movement if contaminants were to reach the water table.

Dr. Grimshaw was Technical Director for a generic environmental assessment of wastes from fluidized bed combustion for the U.S. Environmental Protection Agency (EPA). Emphasis was placed on potential hydrologic impacts. Both laboratory studies and field lysimeter tests were conducted in the study. The objectives were to identify and investigate key variables which determine the acceptability of FBC waste disposal and to establish a reliable empirical correlation between laboratory and field results so that better conclusions on field effects can be drawn on the basis of laboratory studies. Since the regulatory situation for FBC wastes was unclear during conduct of the program, provisions were made for both the eventuality that leachate migration will be allowed in the substrate below the landfill and that leachate escape will be controlled by liners. Interactions between leachate and representative disposal media and between leachate and several candidate liner materials were investigated in laboratory studies.

Dr. Grimshaw was also Technical Director for a program to investigate the ground-water impact of a spill of a coal-distillate liquid fuel at an SRC-II (Solvent Refined Coal) pilot plant at Fort Lewis Military Reservation near Tacoma, Pierce County, Washington. The study involved detailed coring to establish the location and extent of unsaturated zone con tamination and designing and constructing a set of ground-water monitoring wells to define the extent of ground-water contamination that had occurred. Analytical chemistry support was provided for Resource Conservation and Recovery Act (RCRA) Extraction Procedure testing of contaminated soils and for ground-water quality evaluation. A Remedial Measures Plan was formulated and implemented to remove contaminated material and to prevent the further spread of ground-water contamination. This program involved extensive coordination and interfacing with the states regulatory authority (Washington Department of Ecology).

In a follow-up program for which Dr. Grimshaw was again Technical Director, Radian evaluated the overall hydrogeologic impact of the entire SRC plant in addition to the spill area. This program again involved soil sampling, extraction, and analysis as well as water quality monitor well installation and sampling. A zone of contamination was identified, and a comprehensive Remedial Measures Plan was prepared to address the problem.

In a program for Utah International, Incorporated, Dr. Grimshaw was responsible for evaluating the implications of RCRA on the company's mining operations under various regulatory scenarios. Special reference was made to UI's proposed Springer Mine which is in Pershing County, Nevada. Several issues concerning the application of RCRA regulations to metal mines emerged, including the applicability of the procedure for classifying solid waste as hazardous or non-hazardous.

Dr. Grimshaw was Technical Director for a project to investigate the environmental feasibility of disposing of flue gas desulfurization (FGD) wastes, ash and sludge, from a mine mouth power plant by backfilling into the associated surface mine in northwestern Colorado. He also had major supervisory and hydrogeologic interpretation roles in the second phase of the program, which included extensive field studies. These field studies included infiltration tests of the mine floor and overburden, water balance investigations to estimate ground-water recharge, and emplacement of piezometers to ascertain the direction of ground-water flow. A major output of this program was a rating of the various parts of the large surface mine in terms of suitability for ash and sludge disposal.

Dr. Grimshaw was a Task Leader in a program for the EPA ground-water laboratory (Robert S. Kerr Environmental Research Laboratory) to investigate a technique for identifying sources of nitrate ions in ground waters and soils using stable nitrogen isotopes. The usefulness of nitrogen isotope ratios for differentiating sources of nitrate pollution (septic tanks, feedlots, barnyards, and lands receiving municipal waste waters) was evaluated. Standard statistical techniques were used to analyze the observed variations in nitrogen isotope values, with respect to several nitrate-ion sources and various environmental factors.

For a comprehensive environmental assessment for Shell's Milam Mine near Rockdale, Texas in Texas, Dr. Grimshaw prepared and conducted an aquifer test program. These efforts included design of the pump wells and piezometers, layout of the well configuration in the field, oversight of well drilling operations, conduct of the two pump tests, and interpretation of the results in terms of the basic aquifer parameters. In another project related to this mine,

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Thomas W. Grimshaw

Dr. Grimshaw was responsible for evaluating the potential effects on ground water resulting from disposal of ash and FGD solids from a power plant by emplacement of the wastes in the mine.

Dr. Grimshaw has directed or prepared parts of numerous multidisciplinary environmental investigations. The major projects of these type are as follows:

- EIS for Improvement of the City of San Antonio Wastewater Treatment System
- EIS for Upgrade of the City of Greensboro, NC Wastewater Treatment System
- EA for the Sandow Four Lignite-Fired Generating Station, Milam County, Texas
- Preliminary EA for a Proposed Lignite Mine in Henderson and Anderson Counties, Texas
- Hydrology-Related Regulatory Risks for Lignite Mining at the Deadwood-Shiloh Prospect, Texas and Louisiana
- EA for a Proposed Olefins Complex near Sweeney, Texas
- Environmental Audit of the Geokinetics In-Situ Oil Shale Operation, Uintah County, Utah
- Environmental Support Studies for a New Coal Gasification Facility at the Celanese Chemical Plant, Bishop, Texas
- Environmental and Reclamation Support Studies for a Proposed Lignite Mine in Freestone County, Texas

Prior to his employment by Radian Corporation, Dr. Grimshaw was employed as an oil and gas exploration geologist by Amoco Production Company, Denver, Colorado. Initially, he was a geologic field assistant near the coast of the Gulf of Alaska. This work entailed measuring, describing, and collecting stratigraphic sections in the Tertiary rocks in the vicinity of Cordova and Cape Yakataga, Alaska. Subsequently, Dr. Grimshaw was involved in a gas and petroleum exploration program in north central Montana. Most of the effort was in working out the stratigraphy and structural geology in the area of investigation, and he served for a time as well-site geologist on gas exploration wells. In addition, he launched a program of regional exploration in a much larger area in Montana. This work included study of down-hole geophysical logs, preparation of structural contour maps, and assembly of isopachous maps.

Thomas W. Grimshaw

HONORARY AND PROFESSIONAL SOCIETIES:

Sigma Xi, Phi Kappa Phi, Sigma Tau, Sigma Gamma Epsilon, Geological Society of America, American Association of Petroleum Geologists, Association of Engineering Geologists.

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LAWRENCE N. FRENCH

EDUCATION:

M.A., Geological Sciences, University of Texas at Austin, 1979.

B.S., Geological Sciences, University of California at Riverside, 1975.

EXPERIENCE:

Senior Geologist, Radian Corporation, Austin, TX, 1985-Present.

Staff Geologist, Radian Corporation, Austin, TX, 1979-1984.

Geologist, Sargent and Lundy Engineers, Chicago, IL, 1978-1979.

REGISTRATION/CERTIFICATION:

Registered Geologist No. 3804, California
American Institute of Professional Geologists, CPGS No. 6307

FIELDS OF EXPERIENCE:

At Radian, Mr. French is involved in a variety of hydrogeologic and geologic studies. His roles in these studies range from collecting and analyzing hydrogeologic data, interpreting and reporting results of investigations, to directing interdisciplinary programs.

A RCRA groundwater detection monitoring program was recently designed by Mr. French for a hazardous waste management area at a large petroleum refinery in Illinois. The groundwater program, a component of a Part B application, provided for sampling and analysis of groundwater at up-and-down gradient compliance monitoring points and specified monitoring parameters.

At Carswell AFB, Texas, Mr. French is directing an investigation to determine the effect of waste-disposal sites on soil, surface water, and groundwater. The program, part of the nationwide DOD Installation Restoration Program, involves installation of monitor wells, geophysical surveys, collection and analysis of environmental samples, and interpretation of data. Recommendations for appropriate future actions will be based on the findings of this investigation. Mr. French has also been responsible for field activities related to the USAF Installation Restoration Program at Tinker AFB, Oklahoma. At Tinker, electromagnetics surveys were performed at closed industrial waste impoundments and monitoring wells were installed near landfills. At England AFB, Louisiana, Mr. French developed a work plan for the field evaluation of waste disposal practices at the base.

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Lawrence N. French

Recently Mr. French served as Task Leader for the field portion of an environmental audit of a major DOE-owned research facility near San Francisco. This project involved a detailed look at the regulatory compliance status of the facility, which generates, stores, transports, and disposes of a wide variety of hazardous materials and wastes. The audit, which included contacts with nearly 1,000 people and visits to dozens of buildings, uncovered a number of areas needing upgrading in order to achieve regulatory compliance.

Mr. French has also been involved in various aspects of ground-water investigations at several hazardous waste disposal sites. He recently served as Project Director for a study of PCB-contaminated soils at an industrial site in North Texas. The study involved sampling and analysis of near-surface soils to define the extent of PCB contamination. Remedial measures options were also identified. Mr. French also developed a ground-water monitoring plan in accordance with the Compliance Agreement between the state and the property owner. As Ground-Water Task Leader, he supervised the installation of monitoring wells at an abandoned petroleum products waste dump in Southern California. He later co-authored a technical report on the occurrence and character of ground water at the site. Mr. French also prepared technical designs and specifications for a permanent, post-remedial action ground-water monitoring network.

As part of a comprehensive hydrogeologic evaluation of a solvent refined coal pilot plant in Washington, Mr. French supervised the installation of water quality monitoring wells and conducted pumping tests for the evaluation of aquifer characteristics. He also supervised soil coring and sampling efforts at the site of process fluid spill. Mr. French also served as Project Director for a pre-closure evaluation of two hazardous waste impoundments at a wood treatment plant in Washington. The plant had discharged wastewater containing creosote and pentachlorophenol to the unlined impoundments, which are located on floodplain sands and gravels of the Columbia River. A second site was also examined in terms of disposal practices and the character and volume of wastes. Results of the pre-closure survey were used for a definition of areas of concern requiring closure and for the selection of ground-water monitoring parameters based on the character and volume of wastes.

While employed by Sargent and Lundy Engineers, Mr. French was involved in detailed hydrologic and geologic studies for Preliminary and Final Safety Analysis Reports (PSAR and FSAR) for several nuclear power plants. The PSARs and FSARs involved detailed geologic mapping, inventory of water wells, analysis of subsurface flow, and reviews of regional geologic features. Mr. French also analyzed stratigraphic, structural, and hydrologic features at power plant sites in the Illinois Basin for a compressed air energy storage project. Mr. French directed an extensive hydrogeologic and geologic study of potential sites for a lignite-fired electric generation station in Walker County, Texas.

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Lawrence N. French

HONORARY AND PROFESSIONAL SOCIETIES:

Ground-Water Technology Division of the National Water Well Association; Geological Society of America.

PUBLICATIONS/REPORTS:

Radian Corporation, "Site and Compliance Profiles of a Major DOE Facility," August 1984 (author of hazardous waste sections).

Radian Corporation, "Installation Restoration Program Phase II - Field Evaluation, Stage 1, Tinker AFB, Oklahoma," report to Air Force Systems Command, November 1984.

French, L.N. and J.L. Machin, "Cumulative Hydrologic Impact Assessment for McKinley Mine," Radian Corporation, Austin, TX, January 1984.

Little, W.M. and L.N. French, "Hydrogeologic Aspects of the McColl Site, Fullerton, California," Radian Corporation, Austin, TX, November 1982.

French, L.N., "Pre-Closure Evaluation of the Treated Wood Products Facility and Site C, Longview, Washington," Radian Corporation, Austin, TX, May 1983.

Lacy, J.C., L.N. French, and T.W. Grimshaw, "Regulation of the Hydrologic Impacts of Underground Coal Gasification," in Proc. Sixth Underground Coal Conversion Symposium, Shangri-La, OK, pp. V-79 thru V-88, July 1980.

French, L.N., et al., "Environmental Constraint Analysis of the Proposed Coastal Bend Coal Gasification Project," Radian Corporation, Austin, TX, August 1981.

White, D.M. and L.N. French, "Evaluation, Screening, and Prioritization of Candidate Gulf Coast Lignite Resource Blocks," Radian Corporation, Austin, TX, April 1981.

French, L.N. and J.L. Machin, "Water Availability Appraisal for the Proposed Solvent Refined Coal-I Demonstration Plant, Daviess County, Kentucky," Radian Corporation, Austin, TX, December 1979.

U.S. Bureau of Land Management, "Proposed Camp Swift Lignite Leasing (Draft and Final EIS)," Radian Corporation, Austin, TX, September 1980.

French, L.N., "Compilation of Environmental Information for a Proposed Olefins Complex, Brazoria County, Texas," Radian Corporation, Austin, TX, July 1981 (author of Ground-Water Hydrology and Topography and Geology chapters).

02/21/85

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JENNY B. CHAPMAN

EDUCATION:

M.A., Geology, The University of Texas at Austin, Austin, TX, 1984.

B.S., Geology, Sul Ross State University, Alpine, TX, 1981.

EXPERIENCE:

Geologist, Radian Corporation, Austin, TX, 1984-Present.

Research Assistant, The University of Texas Bureau of Economic Geology, Austin, TX, 1982-1984.

FIELDS OF EXPERIENCE:

At Radian, Ms. Chapman is involved in hydrogeologic and geologic studies, especially as they relate to hazardous waste contamination. Her responsibilities range from collecting and analyzing hydrogeologic and geologic data and samples to interpreting and reporting on the results of investigations.

Ms. Chapman recently participated in a field study at Carswell AFB. She supervised the installation of monitor wells in both alluvial deposits and in the regional aquifer. Drilling methods used include hollow-stem auger, mud rotary, and air rotary. She also supervised geophysical crews and participated in soil and water sampling. She is one of the primary authors of the project report.

Other recent projects include a study funded by the Electric Power Research Institute to locate and collect limestone samples for use in experiments concerning stack scrubber systems. In addition to identifying and collecting the samples, Ms. Chapman participated in laboratory grindability and insoluble residue experiments. In another project, she performed field work at the Big Thicket National Preserve to assess the environmental impact of oil and gas well drilling. Activities included delineation and mapping of active and non-active gas and oil well sites as well as damaged areas adjacent to sites.

At the University of Texas Bureau of Economic Geology, Ms. Chapman wrote and edited contract reports for the West Texas Waste Isolation Project, studying the feasibility of storing high-level radioactive waste in Permian salt beds in the Texas Panhandle. She assisted in hydro- and geochemical research pertaining to WTWI, especially interpreting chemical analyses of water samples.

Ms. Chapman researched and wrote her master degree thesis on the hydrogeochemistry of the unsaturated zone. Her field work included the use of tensiometers, lysimeters, and neutron probes (moisture and density). Lab work included water and soil analysis using atomic absorption spectrophotometer, titration techniques, X-ray diffraction, and thin-section analysis.

04/29/85

Jenny B. Chapman

HONORARY & PROFESSIONAL/TECHNICAL SOCIETIES:

Sigma Gamma Epsilon, Alpha Chi.

PUBLICATIONS:

Chapman, J.B., "A Comparison of the Depositional Environmental of the San Andres Formation in the Palo Duro Basin to Recent Evaporitic Environments," The University of Texas at Austin, Bureau of Economic Geology, Open-file Report OF-WTWI-1984-1, 1984.

Kreitler, C.W., J.B. Chapman, and L.P. Knauth, "Chemical and Isotopic Composition of Waters from the Salina Ometepec, Baja, California," The University of Texas at Austin, Bureau of Economic Geology, Open-file Report, OF-WTWI-1981-41, 1984.

Chapman, J.E.B., "Hydrogeochemistry of a Salt Flat in Hudspeth County, Texas," The University of Texas at Austin, Master's Thesis, 1984.

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JAMES L. MACHIN, P.E.

EDUCATION:

M.S., Environmental Health Engineering, Civil Engineering Department, University of Texas at Austin, 1980.

M.B.A., University of Michigan, Ann Arbor, MI, 1974.

B.S.E., Engineering, Princeton University, Princeton, NJ, 1971.

EXPERIENCE:

Staff Engineer, Radian Corporation, Austin, TX, 1977-Present.

Hydrologist, Texas Department of Water Resources, Austin, TX, 1975-1977.

Manufacturing Engineer, Texas Instruments, Inc., Austin, TX, 1974.

Pipestress Analyst, C-E Lummus, G.m.b.H., Wiesbaden, Germany, 1971-1972.

FIELDS OF EXPERIENCE:

Mr. Machin has participated in and directed a variety of investigations at Radian. His work has focused on the areas of solid and hazardous waste management, environmental engineering and waste treatment, and water resources engineering and hydrology.

Mr. Machin was Project Director of a study to develop guidance for closure and remedial action at hazardous waste surface impoundments used in the wood treating industry in Florida. The complex regional combinations of hydrogeology, geology, soils, and surface-water hydrology were analyzed. Based on this analysis, treatment technologies and costs were developed for disposal of liquids, sludge, and contaminated soils in the various regions. Mr. Machin also performed an in-depth analysis of the applicability of biological degradation of these wastes by specialized bacteria.

For a major industrial client, Mr. Machin prepared a permit application including operating procedures for a solid waste disposal landfill. On two other projects, he prepared and costed closure plans for RCRA Part B permits for hazardous waste surface impoundments. He was also involved in the design and costing of remedial actions at a major abandoned hazardous waste disposal landfill in the densely populated Los Angeles area.

He also conducted a laboratory waste treatability evaluation. The project involved remedial measures for a hazardous waste site from which leachate containing chlorinated organics had migrated into the local ground water. For another hazardous waste site, he designed a stream bottom sediment analysis program to define extent and severity of waste migration.

02/10/84

James L. Machin

Mr. Machin performed a special analysis involving the reclamation of an abandoned hazardous waste disposal site for a proposed industrial facility. The waste contained residual, low-level radioactivity. A detailed investigation was made and calculations were performed for estimating the cover requirements to eliminate the potential health hazards of the site. At another hazardous waste site, he prepared a design for a permanent, paved cap. The site contained high levels of PCB surface contamination over a large area.

He was Project Director of a study to design and construct stream gaging stations and conduct a detailed surface-water field data collection program at a proposed surface mining site. He has been Project Director or Surface-Water Task Director for several comprehensive environmental assessments of proposed industrial, mining, and power generation sites in various regions of the country. These studies involved extensive field work and analyses in the areas of hydrology; water quality; design and implementation of water, sediment, and priority pollutant sampling programs; statistical data analysis; impact analysis; and mathematical modeling. He has also been Task Director on three site acceptability studies for proposed Department of Energy coal conversion facilities in Minnesota, Tennessee, and Kentucky. A major portion of these studies involved an analysis of the availability of local surface waters for water supply purposes.

As part of an assessment of the water-quality impacts of disposing of power plant wastes in a surface mine, Mr. Machin performed a special hydrologic study. This was done on a reach of the Yampa River in northwestern Colorado and involved a quantitative analysis of exchanges between the surface-water and ground-water systems.

For EPA, Mr. Machin served as Project Director for an Environmental Impact Statement for a proposed sewer interceptor in North Carolina. He participated in an intensive water quality survey of the affected area which included the municipal water supply. He also performed all engineering calculations and costing analyses for the alternatives under consideration. On another project for EPA, Mr. Machin performed a study evaluating the impacts of developing large-scale energy resources in eight western states. This included an analysis of using large quantities of water for coal, oil shale, uranium, and geothermal energy development.

Mr. Machin's work at the Texas Department of Water Resources was primarily within the areas of engineering and water quality analysis, waste treatment, and economic evaluations. He helped design and manage a water quality investigation for a major water supply reservoir for the City of Houston. Both point and nonpoint sources were significant, and both structural and nonstructural control measures were evaluated. A portion of the study involved a cost-benefit analysis of the effects of water quality alterations.

Upon graduation from Michigan Business School, Mr. Machin was employed by Texas Instrument's Digital Systems Division. He was responsible for control

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of all of the printed circuit boards and metal fabricated parts used in their Austin plant.

While at Lummus, Mr. Machin was involved in planning and design of industrial facilities. He was primarily responsible for computer stress analysis of high and low pressure piping systems.

PROFESSIONAL AFFILIATIONS:

Registered Professional Engineer, Texas No. 53349; American Water Resources Association; Water Pollution Control Federation; Texas Water Pollution Control Association.

HONORS:

1976 EPA Fellowship for Professional Development of an Agency Employee of the State of Texas.

PUBLICATIONS:

Machin, J.L. and D.L. Richmann, "Guidance for Closure and Remedial Action at Hazardous Waste Surface Impoundments--Wood Treatment Industry," Radian Corporation, Austin, TX, January 1984.

French, L.N. and J.L. Machin, "Cumulative Hydrologic Impact Assessment for McKinley Mine," Radian Corporation, Austin, TX, January 1984.

Machin, J.L., et al., "Presurvey, Inflow Study of Wastewater Conveyance System, Kelly AFB, TX," Radian Corporation, Austin, TX, December 1983.

Leonard, R.L., et al., "Permit Application Package: Administrative Completeness Review, McKinley Mine, NM," Radian Corporation, Austin, TX, November 1983.

Leonard, R.L., et al., "Western Water Scoping Study," Radian Corporation, Austin, TX, November 1983.

International Paper Co., Radian Corporation, and Law Engineering Testing Co., "RCRA Permit Application for Hazardous Waste Storage Impoundments at a Treated Wood Products Plant, Joplin, MO," International Paper Co., Dallas, TX, July 1983.

Machin, J.L. and C.M. Thompson, "Input Information for Ground-Water Modeling for the International Paper Wood Treatment Facility at Joplin, MO," Radian Corporation, Austin, TX, June 1983.

Machin, J.L., et al., "Capping of PCB-Affected Soils at an Industrial Site, Greenville, TX, Conceptual Design," Radian Corporation, Austin, TX, May 1983.

James L. Machin

Radian Staff, "Environmental Assessment of Remedial Action Alternatives for the McColl Site, Fullerton, CA," Radian Corporation, Austin, TX, April 1983.

Radian Staff, "Remedial Action Alternatives for the McColl Site, Fullerton, CA," Radian Corporation, Austin, TX, March 1983.

International Paper Co., Radian Corporation, and Law Engineering Testing Co., "Closure Plan for Surface Impoundments Regulated Under Louisiana Hazardous Waste Management Plan," International Paper Co., Dallas, TX, March 1983.

Machin, J.L., "Surface-Water Hydrology, Interim Task Report, Texas Gasification Project," Radian Corporation, Austin, TX, February 1983.

Machin, J.L., et al., "Adsorption Testing of Contaminated Ground Water, Waste Disposal Engineering, Inc. Landfill Site," Radian Corporation, Austin, TX, November 1982.

Machin, J.L., "Surface-Water Data Collection Program, Chacon Creek East Property, Zavala County, Texas, System Construction Report," Radian Corporation, Austin, TX, September 1982.

Radian Staff, "Pre-Survey Report for Kelly Air Force Base, San Antonio, Texas," Radian Corporation, Austin, TX, August 1982.

Radian Staff, "Environmental Assessment of Air Quality, Surface Water, and Noise Impact for the Proposed Milam Mine," Radian Corporation, Austin, TX, July 1982.

Machin, J.L. and J.C. Lippe, "Surface-Water Baseline Data Collection Program, Chacon Creek East, Zavala County, Texas, System Design Report," Radian Corporation, Austin, TX, May 1982.

Devine, Michael, et al., "Energy From the West," University of Oklahoma Press, Norman, OK, 1981.

Radian Staff, "Identification and Environmental Evaluation of Candidate Solid Waste Disposal Sites for Tri-State Synfuels Project," Radian Corporation, Austin, TX, October 1981.

Wallace, R.C., et al., "Preliminary Analysis of Impacts from Mine Depressurization Discharges of the Milam Mine," Radian Corporation, Austin, TX, September 1981.

Radian Staff, "Compilation of Environmental Information for Tri-State Synfuels Project," Tri-State Synfuels Company and Radian Corporation, Austin, TX, September 1981.

James L. Machin

Perino, J.V., et al., "Compilation of Environmental Information for a Proposed Olefins Complex, Brazoria County, Texas," Radian Corporation, Austin, TX, July 1981.

Beall, G.D., J.L. Machin, and K.L. Kelly, "Field Measurements of Environmental Impacts of Gypsum Pile Radioactivity," Radian Corporation, Austin, TX, June 1981.

Wolterink, T.W., et al., "Preliminary Analysis of Potential Environmental Constraints to the RTC/MEC In-Situ Gasification Project," Radian Corporation, Austin, TX, June 1981.

Belan, R.A., et al., "Environmental Constraint Screening of Mine Property and Surrounding Areas for Solid Waste Disposal Siting near Troup, Texas," Radian Corporation, Austin, TX, March 1981.

Lippe, J.C., J.L. Machin, and A.P. Covar, "Preliminary Study of Water Supply and Demand in Austin, Texas," Radian Corporation, Austin, TX, January 1981.

Hoskings, T.W., et al., "Review of Alternative Stormwater Treatment Systems for the SRC Pilot Plant, Fort Lewis, Washington," Radian Corporation, Austin, TX, December 1980.

Covar, A.P., et al., "Baseline Environmental Studies and Licensing Activities for a Cement Plant and Quarry in Comal County, Texas," Radian Corporation, Austin, TX, November 1980.

Grimshaw, T.W., et al., "Preliminary Evaluation of the Hydrologic Impacts of Utilizing the Trapper Mine for Disposal of Wastes from the Craig Station Power Plant, Moffat County, Colorado," Radian Corporation, Austin, TX, August 1978.

Wolterink, T.W., et al., "Environmental Assessment, Geothermal Direct Heat Project, Marlin, Texas," U.S. Department of Energy, Washington, DC, August 1980.

Machin, J.L., et al., "An Analysis of Environmental/Regulatory Considerations for the Yantis Project," Radian Corporation, Austin, TX, August 1980.

French, L.N. and J.L. Machin, "Water Availability Appraisal for the Proposed SRC-I Demonstration Plant, Daviess County, Kentucky," Radian Corporation, Austin, TX, May 1980.

Machin, J.L. and A.P. Covar, "Floodplain Modeling for Proposed Phillips Olefins Complex, Sweeny, Texas," Radian Corporation, Austin, TX, March 1980.

McCloskey, M.H., et al., "Preliminary Culvert Design, Phillips Olefins Complex, Sweeny, Texas," Radian Corporation, Austin, TX, March 1980.

RADIAN
CORPORATION

James L. Machin

Machin, J.L., "Environmental Inventory and Impact Analysis, Sparta Mine, Calhoun County, Arkansas: Surface-Water Hydrology," Radian Corporation, Austin, TX, March 1980.

Grimshaw, T.W., et al., "Hydrology-Related Regulatory Risk for a Proposed Lignite Mine in East Texas," Radian Corporation, Austin, TX, December 1979.

Machin, J.L., et al., "Greensboro-Guilford County, North Carolina, Horsepen Creek Interceptor (Draft and Final EIS)," Radian Corporation, Austin, TX, July 1979.

Machin, J.L., "An Investigation of Surface/Ground-Water Exchanges on the Yampa River near Craig, Colorado," Radian Corporation, Austin, TX, June 1979.

Sheffield, F.H., J.L. Machin, and T.W. Grimshaw, "Preliminary Evaluation of Hydrology-Related Regulatory Risks for Lignite Mining at the Deadwood-Shiloh Prospect, Panola County, Texas, and DeSoto Parish, Louisiana," Radian Corporation, Austin, TX, February 1979.

Radian Corporation and Oklahoma University Staff, "Energy from the West: Impact Analysis Report Volume II, Site-Specific and Regional Impact Analyses," Radian Corporation, Austin, TX, March 1979.

Radian Staff, "An Environmental Report for the Geothermal Direct Utilization Project at Navarro College and the Navarro County Memorial Hospital, Corsicana, Texas," Radian Corporation, Austin, TX, May 1979.

Machin, J.L., "Analysis of Radon Daughter and Radiation Problems Associated with the CAM Company Gypsum Pile, Texas City, Texas," Radian Corporation, Austin, TX, February 1979.

James, S.N., T.W. Grimshaw, and J.L. Machin, "Evaluation of Factors Affecting the Acceptability of the Proposed Site for the Erie Mining Company Industrial Fuel Gas Demonstration Plant," Radian Corporation, Austin, TX, August 1978.

Machin, J.L., T.W. Wolterink, and S.N. James, "Evaluation of Factors Affecting the Acceptability of the Proposed Site for the City of Memphis Medium BTU Coal Gasification Facility," Radian Corporation, Austin, TX, July 1978.

Grimshaw, T.W., J.L. Machin, T.W. Wolterink, and K.L. Choffel, "Surface-Water and Ground-Water Impacts of Selected Energy Development Operations in Eight Western States," Radian Corporation, Austin, TX, May 1978.

Grimshaw, T.W., J.L. Machin, and L.G. Michel, "An Evaluation of Factors Affecting Acceptability of the Proposed Site for the Conoco Coal Development Coal Company Coal Conversion Facility, Noble County, Ohio," Radian Corporation, Austin, TX, November 1977.

RADIAN
CORPORATION

James L. Machin

Machin, J.L. and T.W. Grimshaw, "Investigation of Water Quality Impacts Related to Development of the Horsepen Creek Basin, Guilford County, North Carolina," Radian Corporation, Austin, TX, October 1977.

Holland, W.F., et al., "Environmental Impact Statement for the Greensboro Guilford County, North Carolina, 201 Wastewater Treatment System (Draft and Final EIS)," Radian Corporation, Austin, TX, September 1977.

Machin, J.L., "An Estimation of Nutrient Sources to an Impoundment: Lake Livingston on the Trinity River, Texas," Texas Water Quality Board, Austin, TX, June 1976.

PETER ALEXANDER WATERREUS

EDUCATION:

B.S., Geology, The University of Texas at San Antonio, San Antonio, TX, 1984.

EXPERIENCE:

Geologist, Radian Corporation, Austin, TX, 1984-Present.

Mud Logger, Precision Well Logging, Houston, TX, 1984.

FIELDS OF EXPERIENCE:

Mr. Waterreus is currently involved in the investigation and determination of a JP-4 fuel leak from existing underground pipelines at Bergstrom AFB, Austin, Texas. As supervising geologist, activities include safety supervision, logging borings, collection of soil samples, installation of monitor wells, collection of water samples, and reporting.

Mr. Waterrus also is currently involved in the investigation of hazardous waste contamination at Sheppard AFB, Wichita Falls, Texas. As a supervising geologist, activities include safety supervision, logging borings, collection of soil samples, installation of monitor wells, collection of water samples, monitoring possible types of contamination by use of a photo-ionizer and drager tubes, and reporting.

Mr. Waterreus was involved in the investigation of environmental impact related to gas and oil production in the Big Thicket area of East Texas. Activities includes delineation and mapping of active and non-active gas and oil well sites as well as damaged areas outside the site area.

At Precision Well Logging, he performed analyses of rock cuttings with respect to lithology and oil content as well as gas monitoring and identification.

He has also been involved in field mapping and property investigation in Uvalde County, Texas.

PUBLICATIONS:

Waterreus, P.A. and R.A. Wooster, "A Feasibility Study of Inducing Artificial Recharge to the Edwards Aquifer by Diversion of Floodwaters in Uvalde County, Texas," on record at the Edwards Underground Water District, San Antonio, Texas.

HONORARY AND PROFESSIONAL SOCIETIES:

Geologic Society of America.
Association of Ground Water Scientists and Engineers.

02/26/85

RADIAN
CORPORATION

DAVID H. GANCARZ

EDUCATION:

Master of Engineering, Environmental Engineering (Hydrology), University of Florida, Gainesville, FL, 1984.

Bachelor of Arts (Biology), Grinnell College, Grinnell, IA, 1976.

EXPERIENCE:

Engineer, Radian Corporation, Austin, TX, 1984-Present.

Graduate Research Assistant, Department of Environmental Engineering, University of Florida, Gainesville, FL, 1983-1984.

Chemist I, Department of Food Science & Human Nutrition, University of Florida, Gainesville, FL, 1981-1982.

Laboratory Technologist I, Department of Soil Science and Department of Fruit Crops, University of Florida, Gainesville, FL, 1977-1981.

Graduate Teaching Assistant, Department of Botany, University of Florida, Gainesville, FL, 1976-1977.

FIELDS OF EXPERIENCE:

While an engineer at Radian, Mr. Gancarz has been a member of the project team designing hazardous waste landfarms and providing assistance with RCRA Part B permits to several oil companies. He played a key role in preparing the Facility Management and Post-Closure portions of these applications.

Mr. Gancarz was co-author and had a major role in a contract to study and provide recommendations for the separation of contaminated from uncontaminated inflows to a combined stormwater/industrial waste sewer system on a US Air Force base. A follow-up contract to provide a detailed design for this purpose is expected.

He took the lead role in researching and making recommendations to a Gulf Coast cattle feedlot operator for alternative feedlot waste disposal technologies. The purpose of the study was to provide the operator with the means to meet federal and state water quality regulations while remaining cost competitive.

Mr. Gancarz has had extensive experience in the sampling of hazardous waste contaminated water wells. He has provided such field support for several USAF Installation Restoration Program (IRP) studies.

11/12/84

RADIAN
CORPORATION

David H. Gancarz

As a Graduate Research Assistant, Mr. Gancarz was responsible for researching and writing a thorough literature review of the sources, effects, and regulations concerning ambient air flourides for the Florida Department of Environmental Regulation. A later project under the South West Florida Water Management District involved a study of the surface and subsurface hydrology around a 150 MGD wellfield in central Florida. The focus of the project was a modeling effort using the hydrologic models HSPF and PLASM. His graduate research was an adaptation of the Storage/Treatment block of the widely used urban stormwater runoff model SWMM to microcomputer.

Prior to his return to graduate school, Mr. Gancarz conducted analyses of pesticide residues in soil and tissue samples for the Institute of Food and Agricultural Sciences at the University of Florida. Various phases of this work involved sample preparation, gas chromatographic analysis, and radioisotope tracer techniques. While at the Department of Fruit Crops at the University of Florida, Mr. Gancarz developed an efficient assay for cellulase isozymes in citrus.

PUBLICATIONS:

Machin, J.L., et al., "Storm Sewer Inflow Study--Kelly Air Force Base, Texas," Radian Corporation, Austin, TX, November, 1984.

Gancarz, D.H. and W.C. Huber, "The USEPA Storm Water Management Model Storage/Treatment Block for the IBM Personal Computer," Paper presented at the Storm Water & Water Quality Model Users Group Conference, Hamilton, Ontario, Canada, September, 1984.

Gancarz, D.H. and J.L. Machin, "Evaluation of Alternative Feedlot Waste Disposal Technologies," Radian Corporation, Austin, TX, July, 1984.

Gancarz, D.H., et al., "Ambient Atmospheric Fluoride Pollution in Florida," Report to State of Florida Department of Environmental Regulation, 1983.

Huber, W.C., D.H. Gancarz, and R.E. Dickinson, "Apple SWMM, a Possibility?" Proceedings of Conference on Emerging Computer Techniques in Stormwater Management, Ontario, Canada, 1983.

Ou, L.T., et al., "Infuence of Soil Temperature and Soil Moisture on Degradation and Metabolism of Carbofuran in Soils," Journal of Environmental Quality, 11:293-298, 1982.

11/12/84

RADIAN CORPORATION

DOUGLAS A. ORR

EDUCATION:

B.S., Chemical Engineering, University of Wisconsin-Madison, Madison, WI, 1984.

EXPERIENCE:

Chemical Engineer, Radian Corporation, Austin, TX, 1985-Present.

FIELDS OF EXPERIENCE:

At Radian, Mr. Orr recently joined the Engineering Division and is involved in the work of the Process Engineering Department.

While in school Mr. Orr was a research assistant for a project with the University of Wisconsin Water Chemistry Department. He performed analytical lab work and gas chromatographic analyses to determine isotherms for the adsorption of various polychlorinated biphenyl (PCB) compounds onto particulates.

HONORARY AND PROFESSIONAL/TECHNICAL SOCIETIES:

AIChE

Tau Beta Pi

Phi Eta Sigma

04/30/85

RADIAN
CORPORATION

JILL P. ROSSI

EDUCATION:

B.A. Geography, The University of Minnesota at Minneapolis, 1972.

EXPERIENCE:

Geographer, Cartographer, Policy and Environmental Analysis Division, Radian Corporation, Austin, TX, 1980-Present.

Drafting and Graphics Assistant, Dam Safety Unit, Texas Department of Water Resources, Austin, TX, 1979-1980.

Cartographer, Continental Map Inc., Austin, TX, 1978-1979.

Teaching Assistant, University College-Geology, University of Minnesota at Minneapolis, 1972.

FIELDS OF EXPERIENCE:

At Radian, Ms. Rossi is responsible for producing maps and coordinating graphics for the Environmental Analysis Division. She utilizes data from a variety of technical disciplines (geology, hydrology, noise and air monitoring, sociology, soils, and hydrogeology) to create maps which clearly and concisely illustrate the written text. Ms. Rossi has been responsible for work in the following projects:

- Develop base maps and coordinate graphics throughout an Environmental Impact Statement prepared for the U.S. Bureau of Land Management for a central Texas lignite mine;

- Develop color overlay method of mapping for site selection process of commercial waste disposal sites in Texas and southeastern Oklahoma;

- Develop a series of figures used as illustrations in a manual for the Environmental Protection Agency on Remedial Actions at Uncontrolled Hazardous Waste Sites;

- Draft maps and coordinate the graphics for an Environmental Impact Statement for a synfuels plant in Tennessee;

- Create base and thematic maps for Air Force Installation Restoration Programs (Phase I and Phase II) for the following locations: Kelly AFB, Texas; Hill AFB, Utah; Bergstrom AFB, Texas; Cannon AFB, New Mexico; England AFB, Louisiana; Tinker AFB, Oklahoma; and Reese AFB, Texas; Carswell AFB, Texas; Sheppard AFB, Texas;

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Jill P. Rossi

- Map limestone deposits, lime plants, and limestone quarries in the United States by county in a series of regional maps for the Electric Power Research Institute;
- Map compliance/non-compliance with air pollution standards for all counties in the United States in a series of EPA regional maps;
- Map concentrations of selected air pollutants in the El Paso, Texas, area for a Texas Air Control Board study in a series of quarterly and annual reports;
- Prepare aerial photography history of a wood preserving plant for a commercial client which included extensive research of available aerial photography and interpretation of those photos to determine historical features of interest;
- Prepare complex permitting schedules for proposed mines, energy facilities, and hazardous waste handling facilities;
- Preparation of base and thematic maps for various feasibility studies, fatal flaw analyses, Environmental Information Documents, and Environmental Impact Statements;
- Identify, field verify, and map oil and gas development features within the Big Thicket National Preserve for the National Park Service; and
- Research of available map resources, aerial photography, remote sensing products, and mapping technologies as required by individual client needs.

While with the Texas Department of Water Resources, Ms. Rossi worked in the graphics section of the Dam Safety Unit, a federal grant program. She prepared maps and exhibits, and laid out phototypset text into camera-ready form according to standards, developed with her assistance, for the technical reports written by the engineering section.

During her employment with Continental Map Incorporated, Ms. Rossi was involved in all phases of four color map production. These included source information procurement and classification, imaging of base maps, scribing plates, cutting specialties, sizing and adhering type, designing customer copy panels, indexing streets and points of interest, photo-lab contact reproducing of base plates, and the final compositing of the four negative plates to be sent to the printer. These maps included large metroplex areas, counties, enlarged downtown sections, and simplified principle city thoroughfares.

Jill P. Rossi

While employed by the University of Minnesota as a Geology Teaching Assistant, Ms. Rossi taught geology laboratory sessions, prepared geology lab work materials, tutored students, and assisted the professors by preparing classroom presentations and grading and proctoring exams.

RADIAN
CORPORATION

KEVIN L. ZONANA

EDUCATION:

Presently pursuing M.A., Geography (Remote Sensing), The University of Texas at Austin.

B.S., Geology, The University of Texas at Austin, 1982.

EXPERIENCE:

Cartographer, Research Assistant, Engineering and Environmental Analysis Division, Radian Corporation, Austin, TX, 1984-Present.

Teaching Assistant, Austin Community College, Austin, TX, 1981-Present.

Lab Research Assistant, Bureau of Economic Geology, Well Sample Core Library, Balcones Research Center, Austin, TX, September-November 1984.

Student Assistant, Department of Geological Sciences, The University of Texas at Austin, September-December 1982.

Geology Field Assistant, Durango, CO, Summer 1980.

FIELDS OF EXPERIENCE:

At Radian, Mr. Zonana assists in producing maps, coordinating graphics, and researching various topics for the Engineering and Environmental Analysis Division. He has been responsible for work in the following projects:

- Draft maps of oil and gas development features within the Big Thicket National Preserve for the National Park Service;
- Draft a series of locator maps for Radian offices in Salt Lake City, Utah, and Sacramento and Santa Barbara, California;
- Develop a series of figures used as illustrations in a manual for the Civil Engineering Department of Kelly AFB, Texas for a Storm Sewer Inflow Study;
- Create base and thematic maps for Air Force Installation Restoration Programs (Phase I and Phase II) for the following locations: Kelly AFB, Texas; Bergstrom AFB, Texas; Cannon AFB, New Mexico; Tinker AFB, Oklahoma; Carswell AFB, Texas; Sheppard AFB, Texas;
- Prepare research material from Texas Air Control Board files for confidential clients.

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Kevin L. Zonana

At the Austin Community College Mr. Zonana works as a Geology Teaching Assistant. He is responsible for preparation, teaching, testing, and grading of all lab materials for courses in physical and historical geology.

While with the Bureau of Economic Geology, Mr. Zonana worked in the Well Sample Core Library where he prepared well core samples for study and admission to library collection.

As a student assistant to University of Texas geology professors, Mr. Zonana drafted geologic maps, charts, and illustrations for reports on depositional systems. He also performed administrative duties in the Geology Graduate Admissions Office.

As a geology field assistant to Dr. R.H. Blodgett of Ohio State University, Mr. Zonana's duties included all aspects of field work. He was specifically responsible for measuring and describing stratigraphic sections, and drilling oriented core samples for paleo magnetic analysis.

RADIAN
CORPORATION

WILLIAM M. LITTLE

EDUCATION:

M.S., Civil Engineering, University of California, Berkeley, 1974.

M.S., Hydrology, University of Arizona, Tucson, 1968.

B.S., Hydrology, University of Arizona, Tucson, 1967.

EXPERIENCE:

Senior Engineer and Group Leader, Radian Corporation, Austin, TX, 1982-Present.

Senior Engineer, Radian Corporation, Austin, TX, 1978-1982.

Hydrologist, U.S. Army Environmental Hygiene Agency, 1973-1978.

Research and Technical Operations Officer, U.S. Army Engineer Nuclear Cratering Group, 1969-1971.

Graduate Student in Research, University of Arizona, Tucson, 1968.

FIELDS OF EXPERIENCE:

Mr. Little is a Senior Engineer and Group Leader with a major technical specialty in ground-water pollution studies. He is currently the Project Director for hydrogeologic investigations of multiple waste disposal sites on Tinker Air Force Base, Oklahoma. He has recently completed a similar investigation for Kelly AFB, Texas. These investigations include monitoring well construction, ground-water sampling, and contaminant transport assessment. He is responsible for program design and execution, subcontractor selection, and managing and editing the final report. He is also providing technical consulting and expert witness services for a hazardous waste site cleanup case in Kansas City, Missouri.

Mr. Little has recently completed a hydrogeologic investigation of a Superfund site in western New York state. The project included monitoring well construction, definition of ground-water flow system, assessment of contaminant transport potential, and presentations to regulatory authorities. Mr. Little served as Project Director and principal investigator. He has also served as Project Director and field manager for a large, multidisciplinary characterization of an abandoned hazardous waste disposal site in southern California. The waste materials consist of acid petroleum refinery sludges. Major areas of investigation were: chemical characterization of wastes and geologic materials; quantification of sulfur dioxide and hydrocarbon emissions; and ground-water monitoring. Mr. Little was responsible for managing the field operations and supervising report preparation.

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RADIAN
CORPORATION

William M. Little

Mr. Little has served as assistant Project Director and field manager for an investigation of the ground-water quality impact of a spill of a coal-distillate liquid at an SRC pilot plant near Tacoma, Washington. The study involved detailed unsaturated zone coring and designing and constructing a series of ground-water monitoring wells A Remedial Measures Plan was formulated and adopted to remove contaminated materials and to prevent the further spread of ground-water contamination. Following the evaluation of the spill event, Mr. Little directed an expanded program to evaluate the ground-water quality effects of overall plant operations. The possible sources of contamination were identified and characterized. Mr. Little then developed a ground-water monitoring program and supervised the installation of the monitoring network. He designed and conducted aquifer pump tests to define aquifer performance and interpreted the results.

Mr. Little has also conducted a program to evaluate the extent of ground-water contamination by refinery operations and wastes at an oil refinery near Duncan, Oklahoma. The assessment was based on site reconnaissance, interviews with refinery personnel and a study of existing hydrogeologic and process data.

Mr. Little has recently completed two environmental/regulatory fatal flaw studies for lignite mines and associated power plants in East Texas. He was both Project Director, responsible for overall management and preparation of the final report, and hydrology task leader, responsible for assembling data on hydrologic conditions and assessing probable impacts. He has also recently served as task leader for regulations review, impact analysis and permit application preparation for a commercial-scale coal gasification facility in Wyoming and ground-water hydrology task leader for environmental analysis of a major lignite mine and associated synfuels plant in east Texas.

In another program, Mr. Little directed an evaluation of surface-water and ground-water availability in the vicinity of the proposed Solvent Refined Coal-II (SRC-II) demonstration plant and commercial facilities near Morgantown, West Virginia.

For a private industrial client, Mr. Little reviewed and evaluated the environmental monitoring data from the vicinity of an in situ coal gasification test in the Powder River Basin of Wyoming. The water quality impacts of the test burn were assessed, and a program of aquifer restoration and hydrologic testing recommended. Based on available hydrologic and geochemical data, a conceptual model of the test site was developed. He also developed a ground-water monitoring and contingency aquifer restoration program for a proposed future test. The program includes selection of well locations and parameters for monitoring and specification of restoration strategies.

Mr. Little has also participated in an assessment of the environmental behavior of fluidized bed combustion (FBC) waste for EPA, IERL. Mr. Little was responsible for the design, construction and operation of field cells for

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William M. Little

testing FBC waste disposal alternatives and for the development of a preliminary waste transport model. He has also been project director and hydrology task leader in the evaluation of the environmental suitability of an ash/scrubber sludge disposal site. He was responsible for the overall management of the program, evaluated the laboratory and hydrogeologic data and predicted contaminant migration.

As a hydrologist with the Water Quality Engineering Division, U.S. Army Environmental Hygiene Agency, Mr. Little served as a consultant to the Office of the Surgeon General and to major commands and installations on hydrologic aspects of water supply and wastewater disposal. He prepared design criteria for programs of effluent and receiving water monitoring at Army manufacturing and research facilities, evaluated ground-water pollution potential of waste disposal practices, and reviewed draft NPDES discharge permits issued to Army installations. He performed preliminary technical feasibility studies of land treatment of wastewater including field investigations and trial systems design. He conducted environmental impact statement data requirements review and prepared and reviewed portions of environmental impact statements. Mr. Little also managed the Army Medical Department's nationwide Drinking Water Surveillance Program.

With the Corps of Engineers, Mr. Little was assigned as a Research and Technical Operations Officer, U.S. Army Engineer Nuclear Cratering Group. There he conducted a general investigation of hydrologic transport of radionuclides from Plowshare application sites. This work included literature searches, computer simulation, experimental design and conceptual modeling of transport phenomena. He also participated in final preparation of a 1971 Corps of Engineers report on Wastewater Management in the San Francisco Bay Region.

While at the University of Arizona, Mr. Little was a member of the Operations Research Study Group on the Tucson Basin, gathering background hydrologic material, and conducting a literature and data file search. He directed and participated in preliminary adaptation of a two-dimensional, finite difference model of a large, heterogeneous ground-water basin.

HONORARY AND PROFESSIONAL SOCIETIES:

American Geophysical Union, American Water Resources Association, National Water Well Association, Sigma Xi.

CERTIFICATION:

AIPG Certified Professional Geological Scientist No. 6468.

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RADIAN
CORPORATION

William M. Little

PUBLICATIONS/REPORTS:

Numerous technical reports in the fields of water resources development, ground-water contaminant migration, occurrence of radionuclides in ground water, land treatment feasibility and receiving water monitoring, including:

Little, W.M., et al., "Installation Restoration Program, Phase II - Confirmation/Quantification, Stage 2, Tinker AFB, Oklahoma," Radian Corporation, Draft Report to U.S. Air Force, December 1984.

Little, W.M., et al., "Installation Restoration Program, Phase II - Field Evaluation, Stage 1, Tinker AFB, Oklahoma," Radian Corporation, Draft Final Report to U.S Air Force, November 1984.

Little, W.M., et al., "Installation Restoration Program, Phase II, Stage 1, Field Evaluation, Kelly AFB, Texas," Radian Corporation, Final Report to U.S. Air Force, July 1984.

Little, W.M., "Hydrogeologic Investigations, Facet Enterprises, Inc., Elmira, New York," Radian Corporation Final Report to Facet Enterprises, Inc., September 1983.

Little, W.M., et al., "McColl Site Investigation - Phase 1," Radian Corporation Report to the Participants Committee, November 1982.

Little, W.M., et al., "Environmental Considerations and Air Quality Modeling for the Freestone County Project," Radian Corporation Report to Tenneco Coal Company, March 1982.

Grimshaw, T.W., et al., "Assessment of Fluidized-Bed Combustion Solid Wastes for Land Disposal," Draft Final Report, Radian Corporation Report to EPA Industrial Environmental Research Laboratory, December 1982.

Little, W.M., et al., "Environmental Considerations and Air Quality Modeling for the Edgewood and Mustang Creek Prospects and Associated Energy Park," Radian Corporation Report to Tenneco Coal Company, November 1981.

Little, W.M., et al., "Ground-Water Impact of SRC Pilot Plant Activities Fort Lewis, Washington," Radian Corporation report to Gulf Mineral Resources Company, January 1981.

Little, W.M., et al., "Ground Water Modeling at an In-Situ Coal Gasification Test," Radian Corporation Report to confidential industrial client, September 1980.

Little, W.M. and H.J. Williamson, "Recommended Ground-Water Monitoring and Aquifer Restoration Programs, Future In-Situ Coal Gasification Test," Radian Corporation Report to confidential industrial client, September 1980.

02/08/85

RADIAN
CORPORATION

William M. Little

Little, W.M. and W.C. Micheletti, "Recommended Aquifer Restoration and Hydrologic Testing Program for an In-Situ Coal Gasification Test," Radian Corporation Report to confidential industrial client, August 1980.

Grimshaw, T.W. and W.M. Little, "Remedial Measures Plan for a Spill of Solvent Refined Coal Liquid at the SRC Pilot Plant, Fort Lewis, Washington," Radian Corporation Report to Gulf Mineral Resources Company, August 1980.

Little, W.M., et al., "Hydrologic Evaluation of a Combined Ash/FGD Sludge Storage Site, Craig Station," Radian Corporation Report to Colorado Ute Electric Association, July 1980.

Little, W.M., T.J. Wolterink, and M.H. McCloskey, "Water Availability Appraisal for the Proposed Solvent Refined Coal-II Demonstration Plant, Monongalia County, West Virginia," Radian Corporation Report to U.S. Department of Energy, February 1980.

Little, W.M., "Water Quality Geohydrologic Consultation No. 24-0286-77," Twin Cities Army Ammunition Plant, New Brighton, MN, 21-23 July 1976, U.S. Army Environmental Hygiene Agency, 11 January 1977 (six additional geohydrologic consultations).

Little, W.M., Drinking Water Consultation Visit No. 24-1301-77, Joliet Army Ammunition Plant, Illinois, 2-4 August 1976, USAEHA, 9 February 1977 (four additional drinking water consultations).

Little, W.M., Water Quality Geohydrologic Consultation No. 24-058-75/76, Land Disposal Feasibility Study, Fort Polk, Louisiana, 2-29 April and 9-29 October 1975, USAEHA, 19 August 1976 (three additional land treatment evaluations).

Little, W.M., Water Quality Monitoring Consultation No. 24-048-74/75, Aberdeen Proving Ground, Maryland, 25-27 February 1974, USAEHA, 17 December 1974 (three additional monitoring consultations).

Little, W.M., Water Quality Engineering Special Study No. 24-017-74, Mixing in Receiving Waters, 7 September-24 October 1973, USAEHA, 3 January 1974.

Little, W.M., Analysis of Hydrologic Transport of Tritium, U.S. Army Engineer Nuclear Cratering Group Technical Memorandum 70-7, Lawrence Radiation Laboratory, Livermore, CA, April 1971.

Little, W.M., An Engineering and Economic Feasibility Study for Diversion of Central Arizona Project Waters from Alternate Sites, M.S. Thesis, Department of Hydrology, University of Arizona, Tucson, AZ, 1968.

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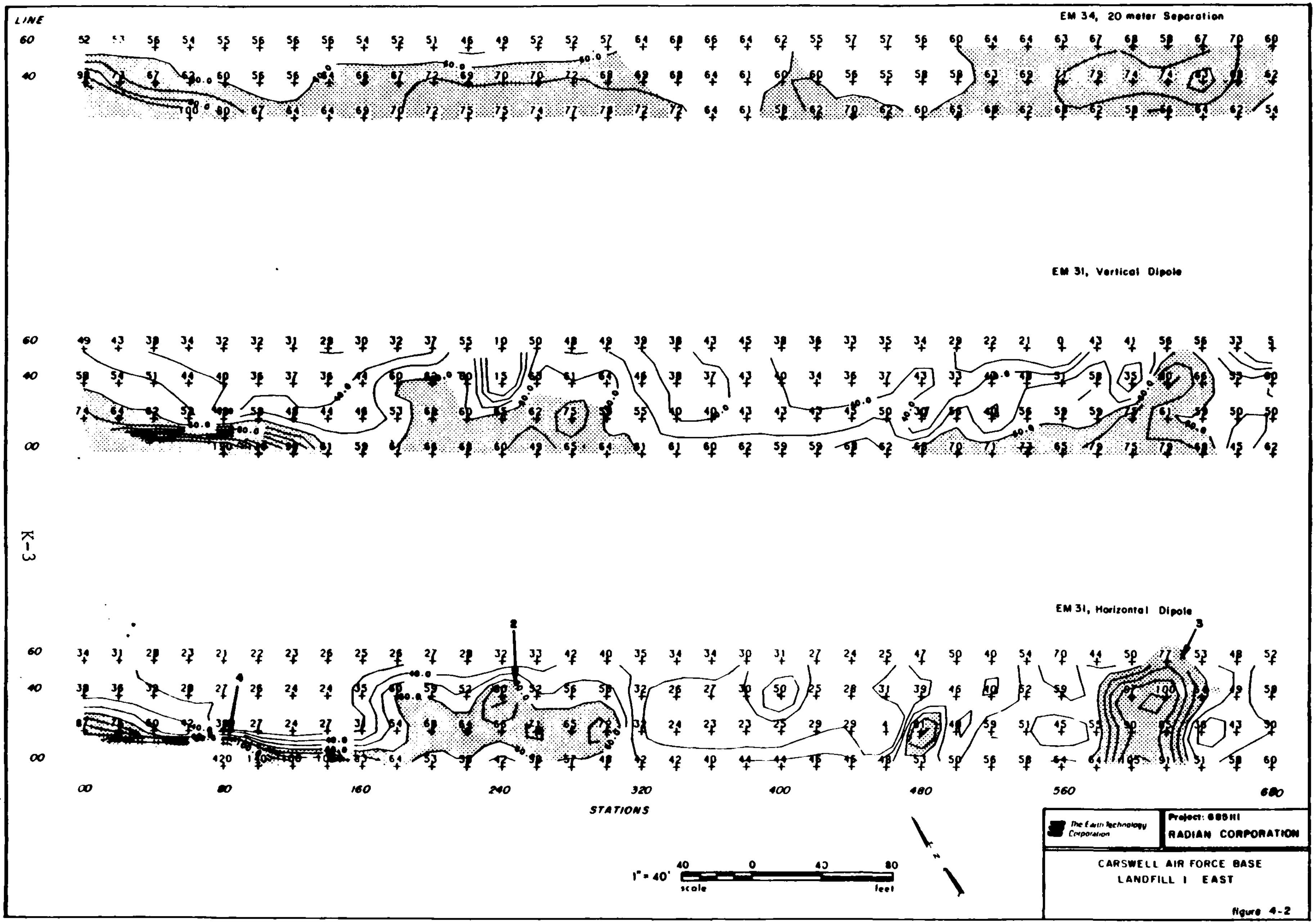
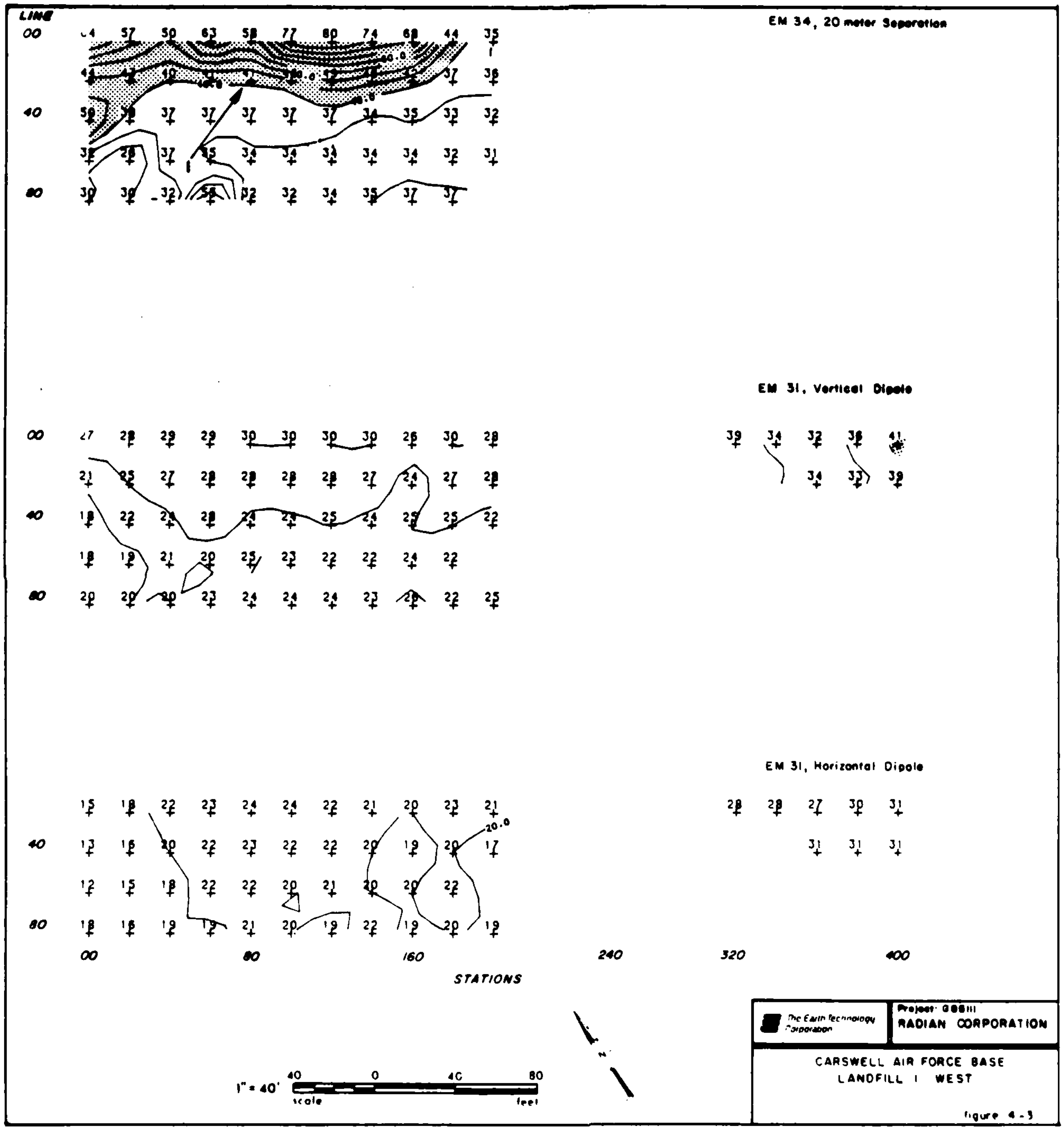
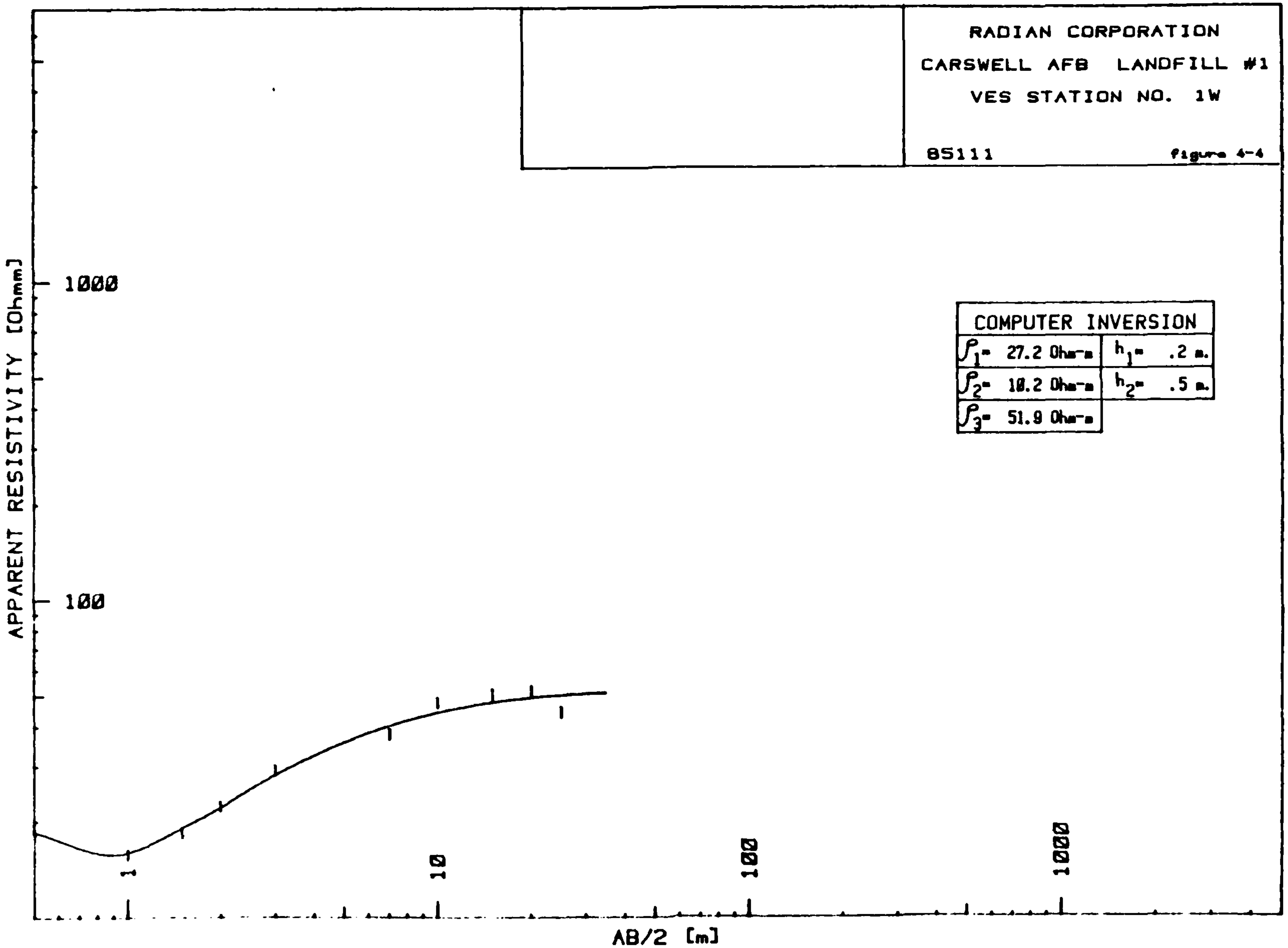
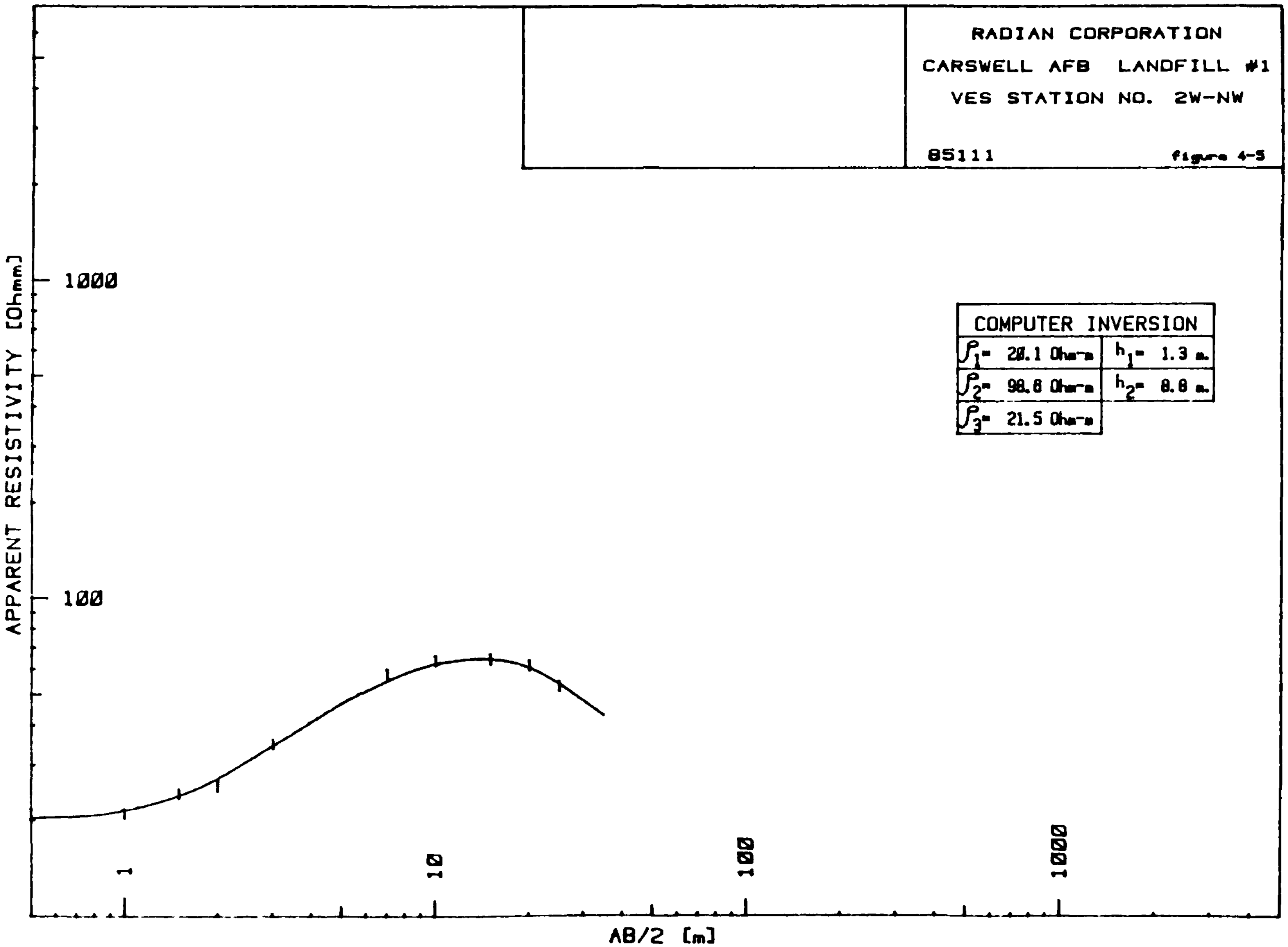
APPENDIX K

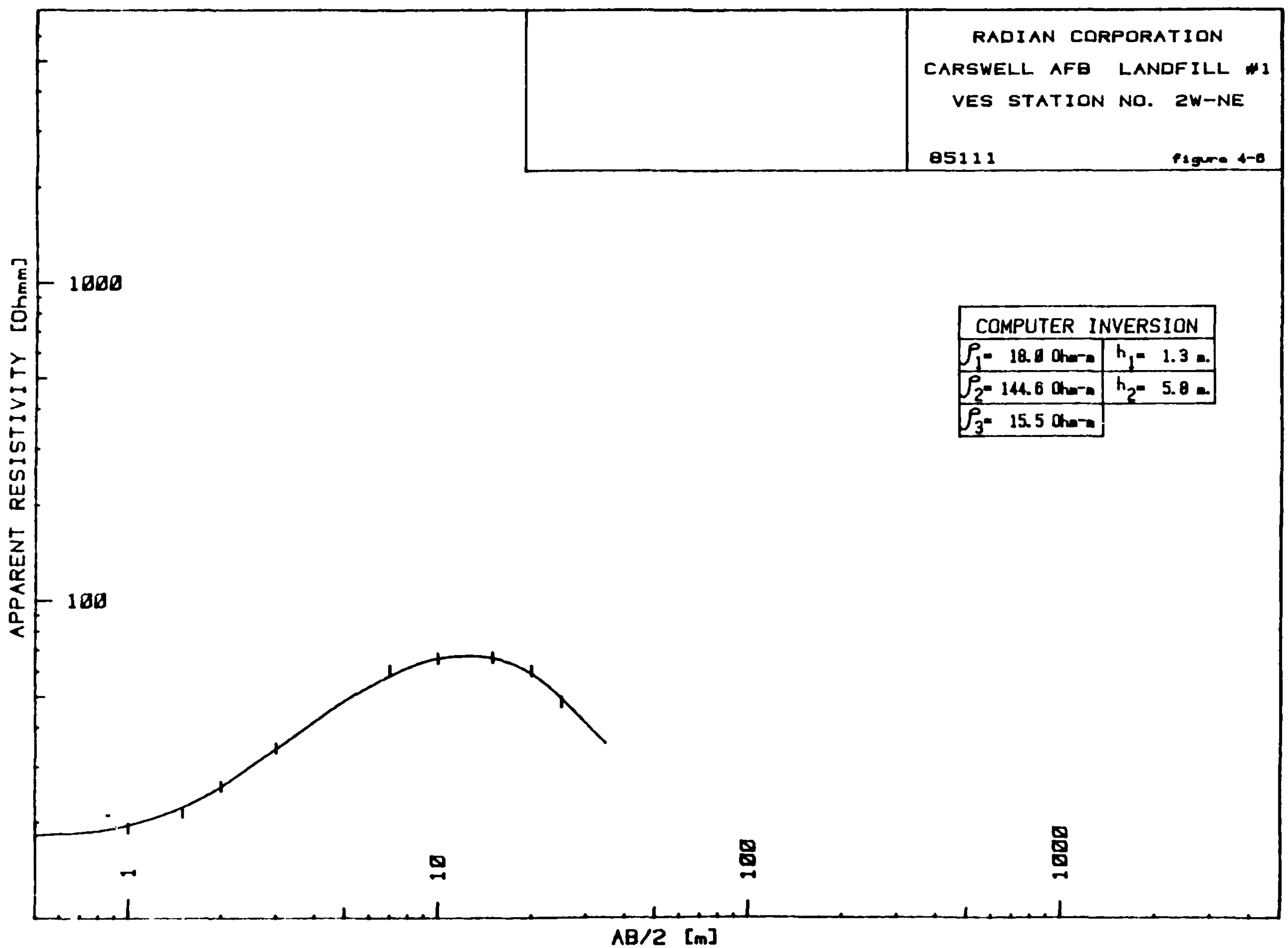
Geophysical Tracings

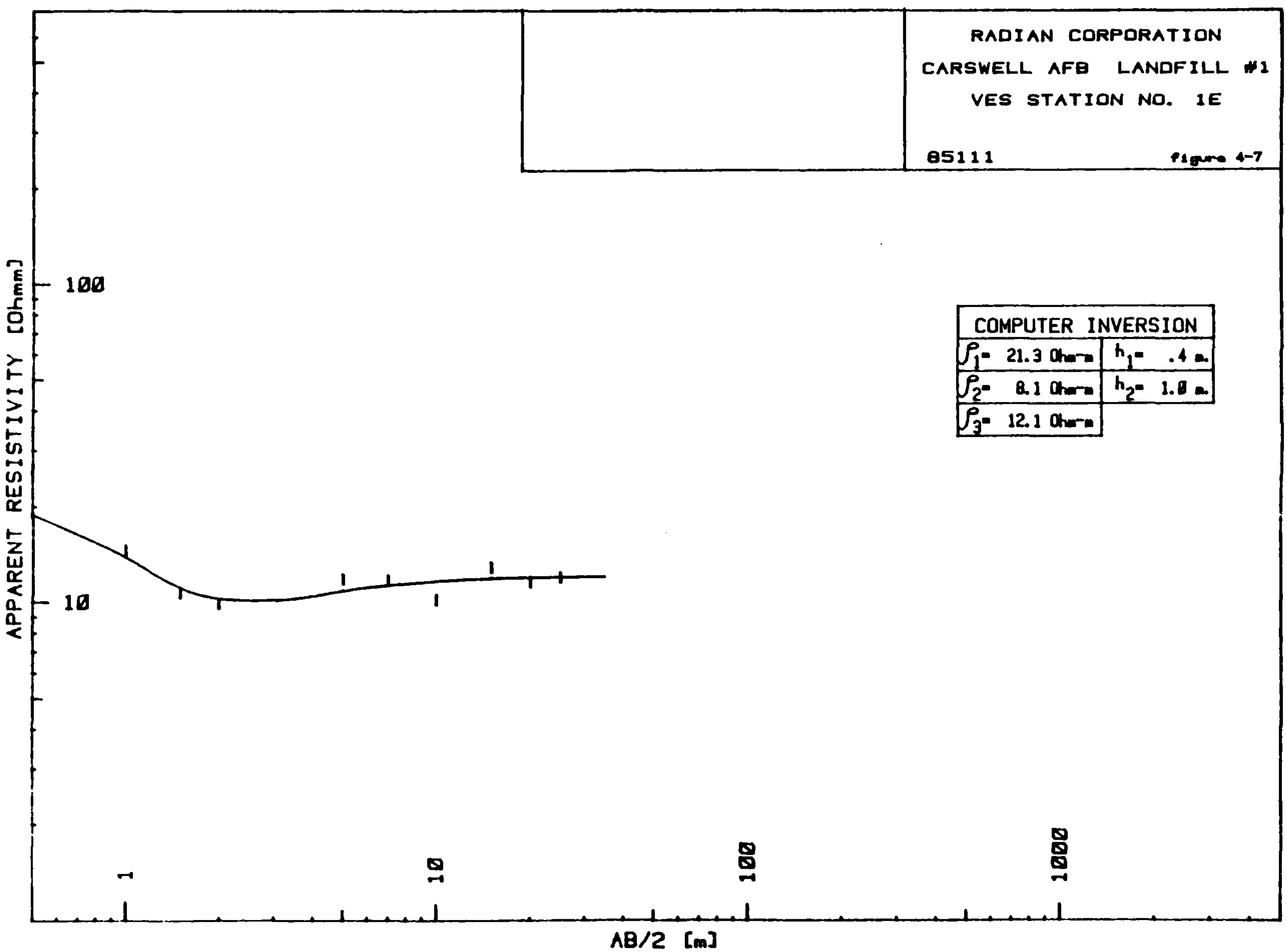

EM 34, 20 meter Separation
EM 31, Vertical Dipole
EM 31, Horizontal Dipole
LINE
STATIONS
1" = 40'
scale
feet
The Earth Technology Corporation
Project: 68811
RADIAN CORPORATION
CARSWELL AIR FORCE BASE
LANDFILL 1 EAST
figure 4-2

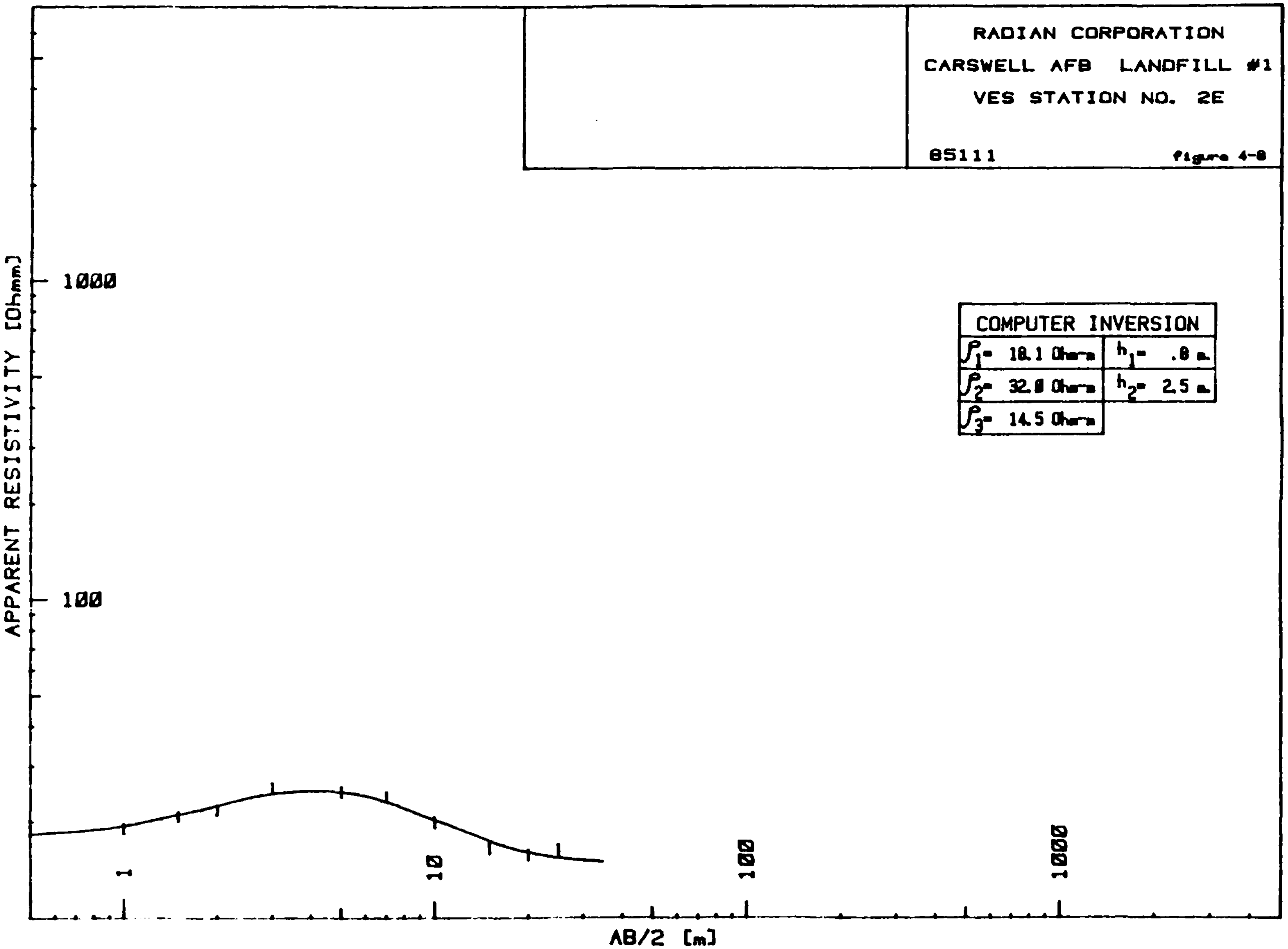

EM 34, 20 meter Separation
EM 31, Vertical Dipole
EM 31, Horizontal Dipole
LINE
STATIONS
1" = 40'
scale
feet
The Earth Technology Corporation
Project: 208111
RADIAN CORPORATION
CARSWELL AIR FORCE BASE
LANDFILL 1 WEST
figure 4-3

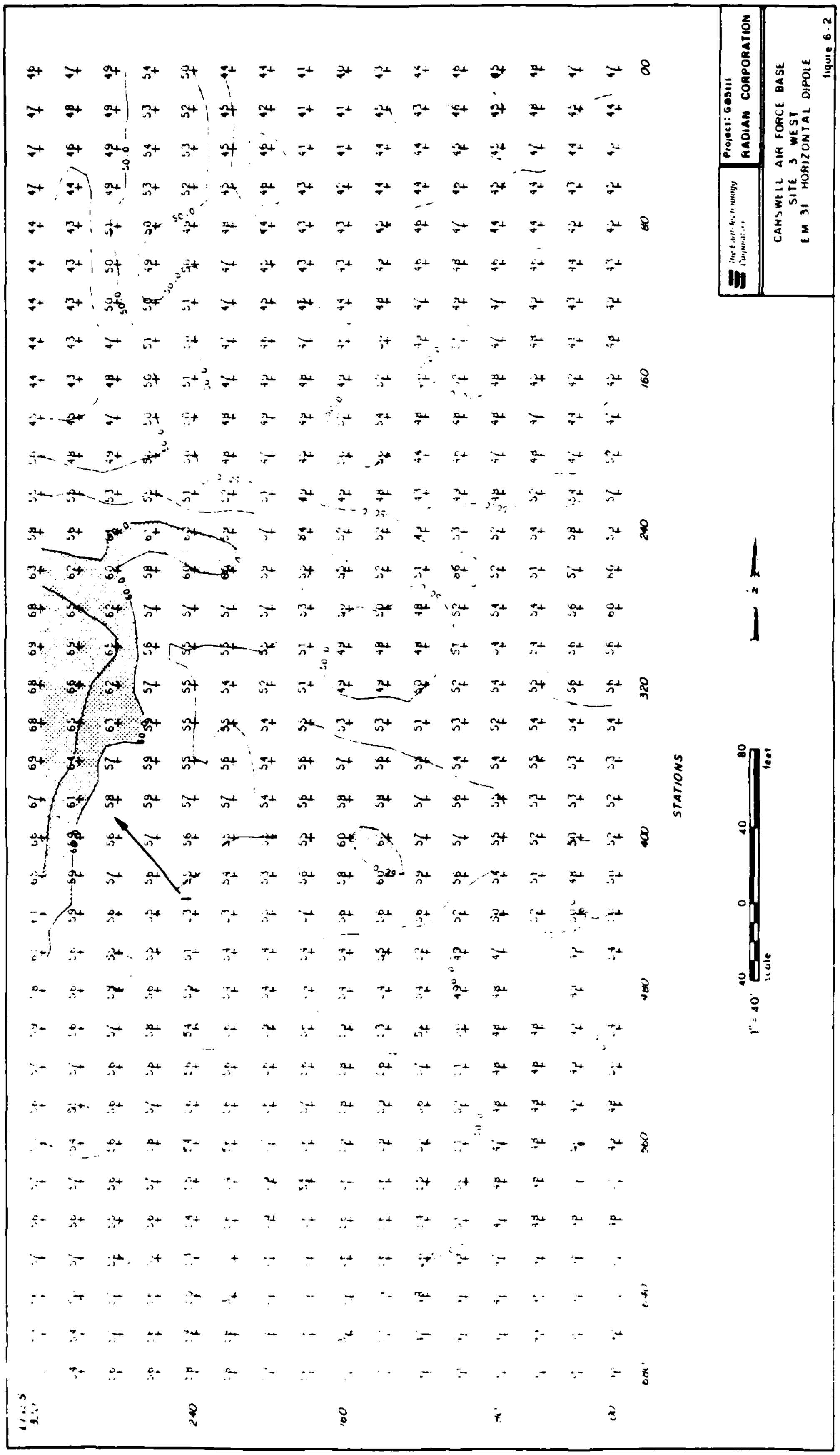

RADIAN CORPORATION
CARSWELL AFB LANDFILL #1
VES STATION NO. 1W
85111
figure 4-4
COMPUTER INVERSION
ρ1= 27.2 Ohm-m
h1= .2 m.
ρ2= 10.2 Ohm-m
h2= .5 m.
ρ3= 51.9 Ohm-m
APPARENT RESISTIVITY [Ohmm]
1000
100
1
10
100
1000
AB/2 [m]

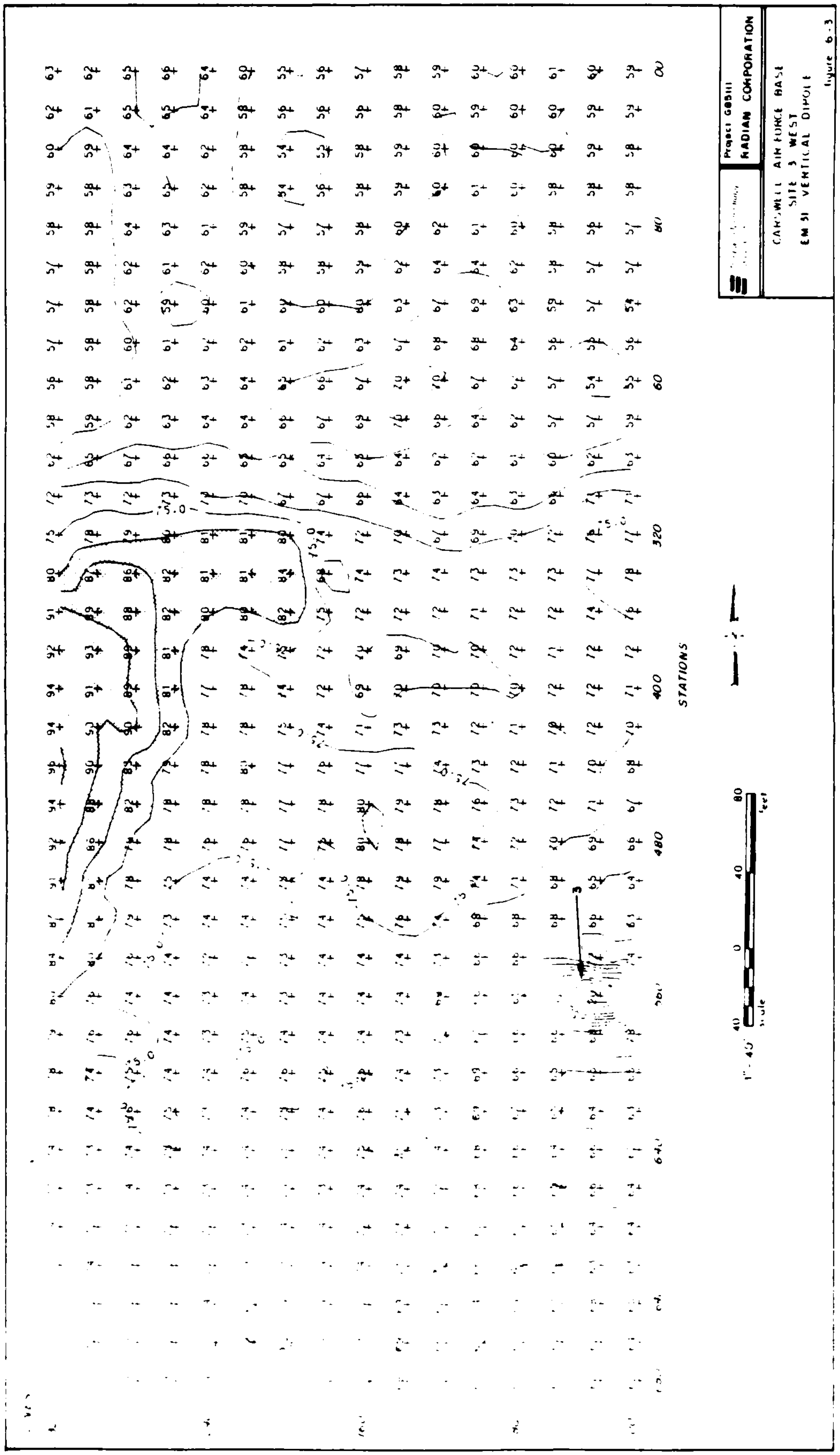

RADIAN CORPORATION
CARSWELL AFB LANDFILL #1
VES STATION NO. 2W-NW
85111
figure 4-5
COMPUTER INVERSION
ρ1= 20.1 Ohm-m
h1= 1.3 m.
ρ2= 98.8 Ohm-m
h2= 8.8 m.
ρ3= 21.5 Ohm-m
APPARENT RESISTIVITY [Ohmm]
1000
100
1
10
100
1000
AB/2 [m]

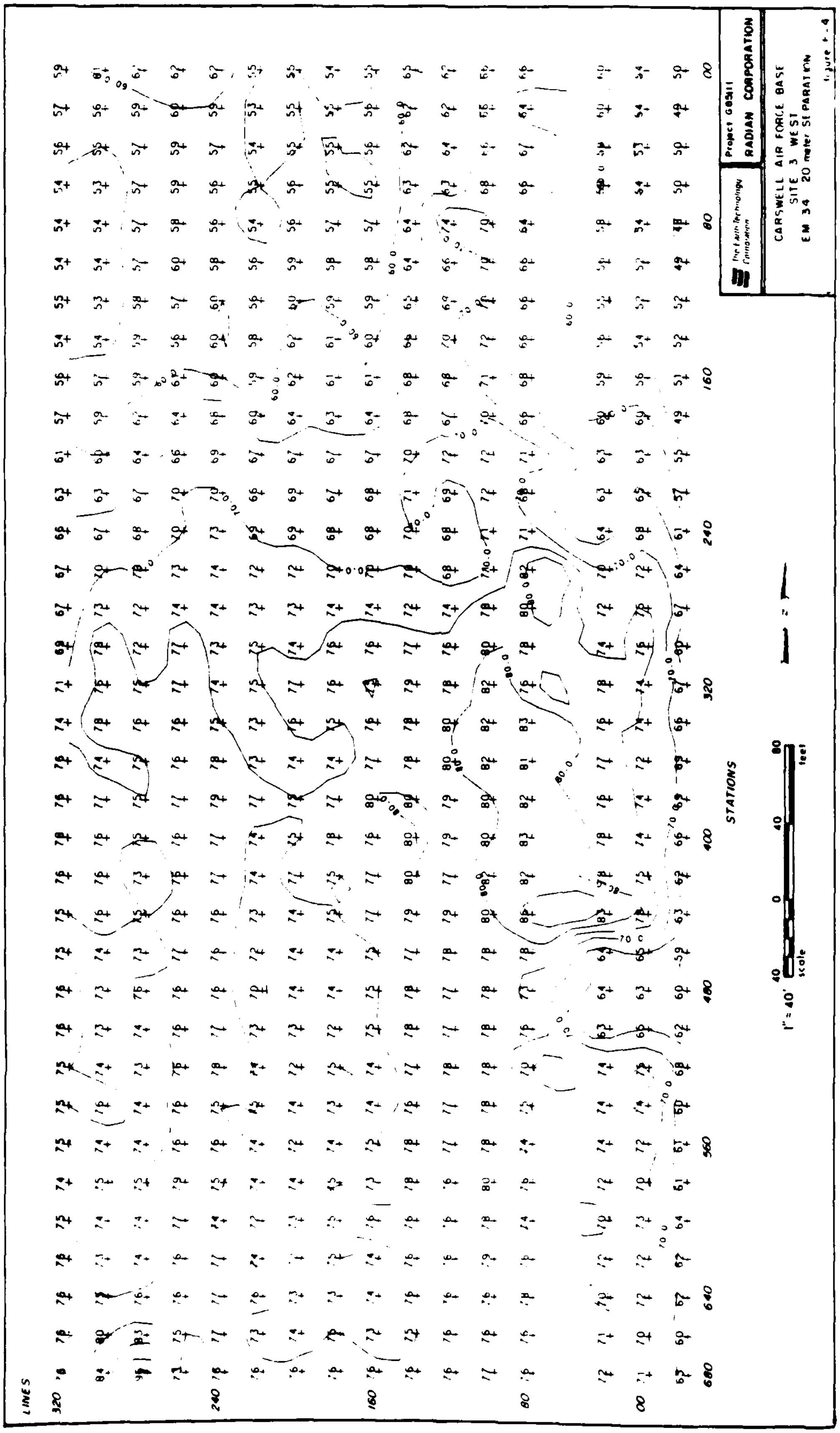

RADIAN CORPORATION
CARSWELL AFB LANDFILL #1
VES STATION NO. 2W-NE
85111
figure 4-8
COMPUTER INVERSION
ρ_1= 18.0 Ohm-m
h_1= 1.3 m.
ρ_2= 144.6 Ohm-m
h_2= 5.8 m.
ρ_3= 15.5 Ohm-m
APPARENT RESISTIVITY [Ohmm]
1000
100
1
10
100
1000
AB/2 [m]


RADIAN CORPORATION
CARSWELL AFB LANDFILL #1
VES STATION NO. 1E
85111
figure 4-7
COMPUTER INVERSION
ρ1= 21.3 Ohm-m
h1= .4 m.
ρ2= 8.1 Ohm-m
h2= 1.0 m.
ρ3= 12.1 Ohm-m
APPARENT RESISTIVITY [Ohmm]
100
10
1
10
100
1000
AB/2 [m]

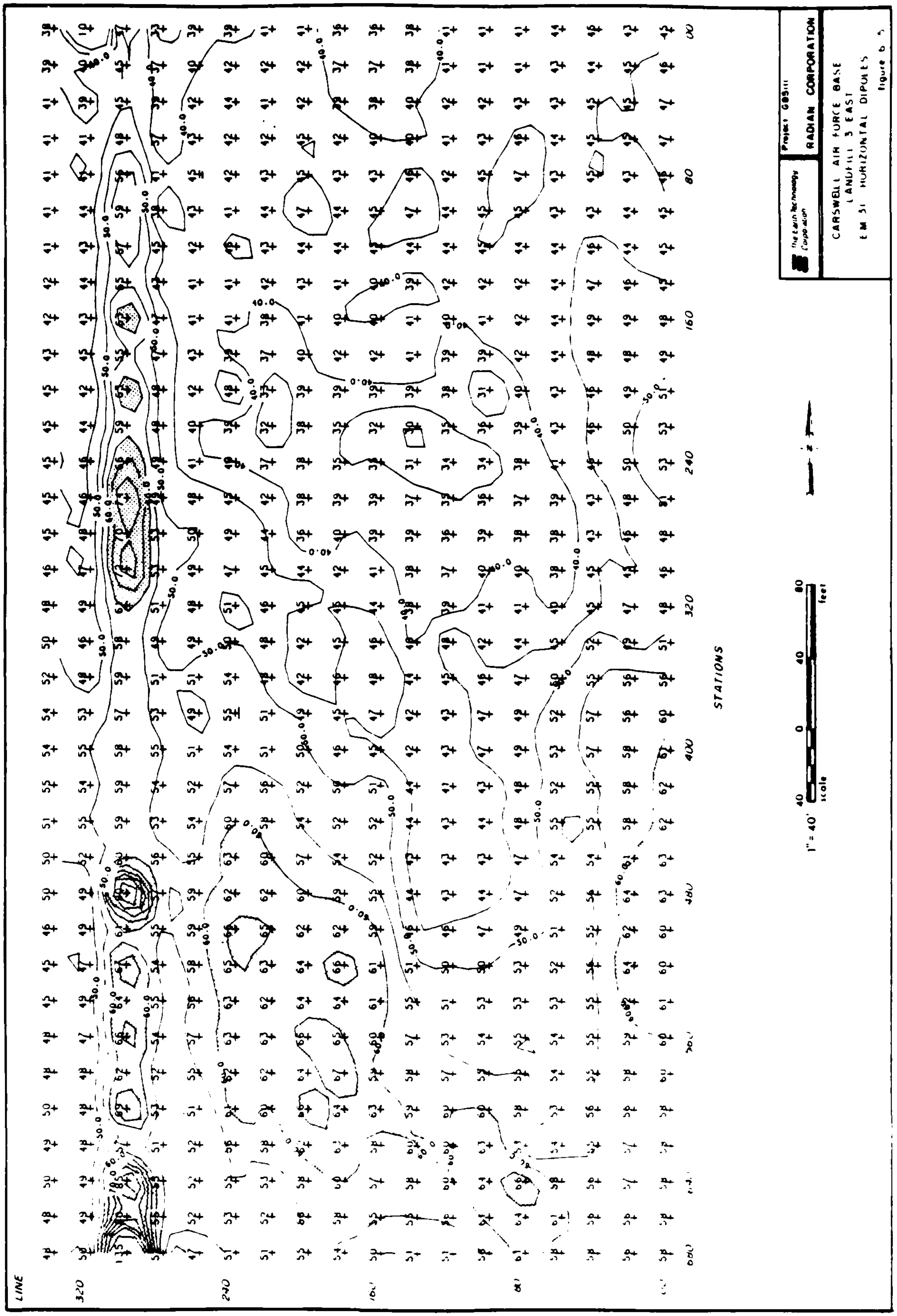

RADIAN CORPORATION
CARSWELL AFB LANDFILL #1
VES STATION NO. 2E
85111
figure 4-8
COMPUTER INVERSION
ρ1= 10.1 Ohm-m
h1= .8 m
ρ2= 32.0 Ohm-m
h2= 2.5 m
ρ3= 14.5 Ohm-m
APPARENT RESISTIVITY [Ohm-m]
1000
100
1
10
100
1000
AB/2 [m]

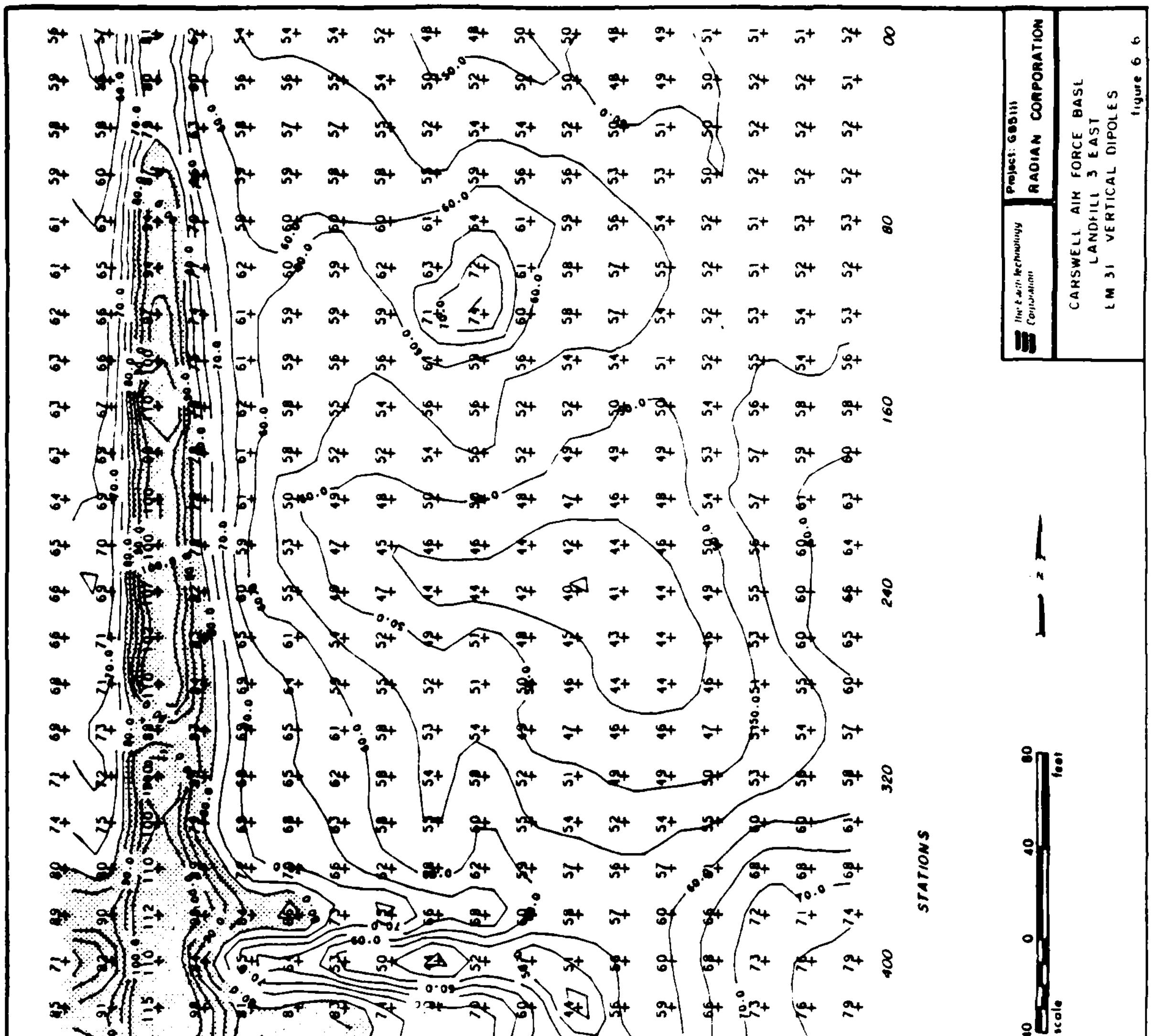

RADIAN CORPORATION
CARSWELL AIR FORCE BASE
SITE 3 WEST
EM 31 HORIZONTAL DIPOLE
figure 6-2
STATIONS
scale
feet
1" = 40'

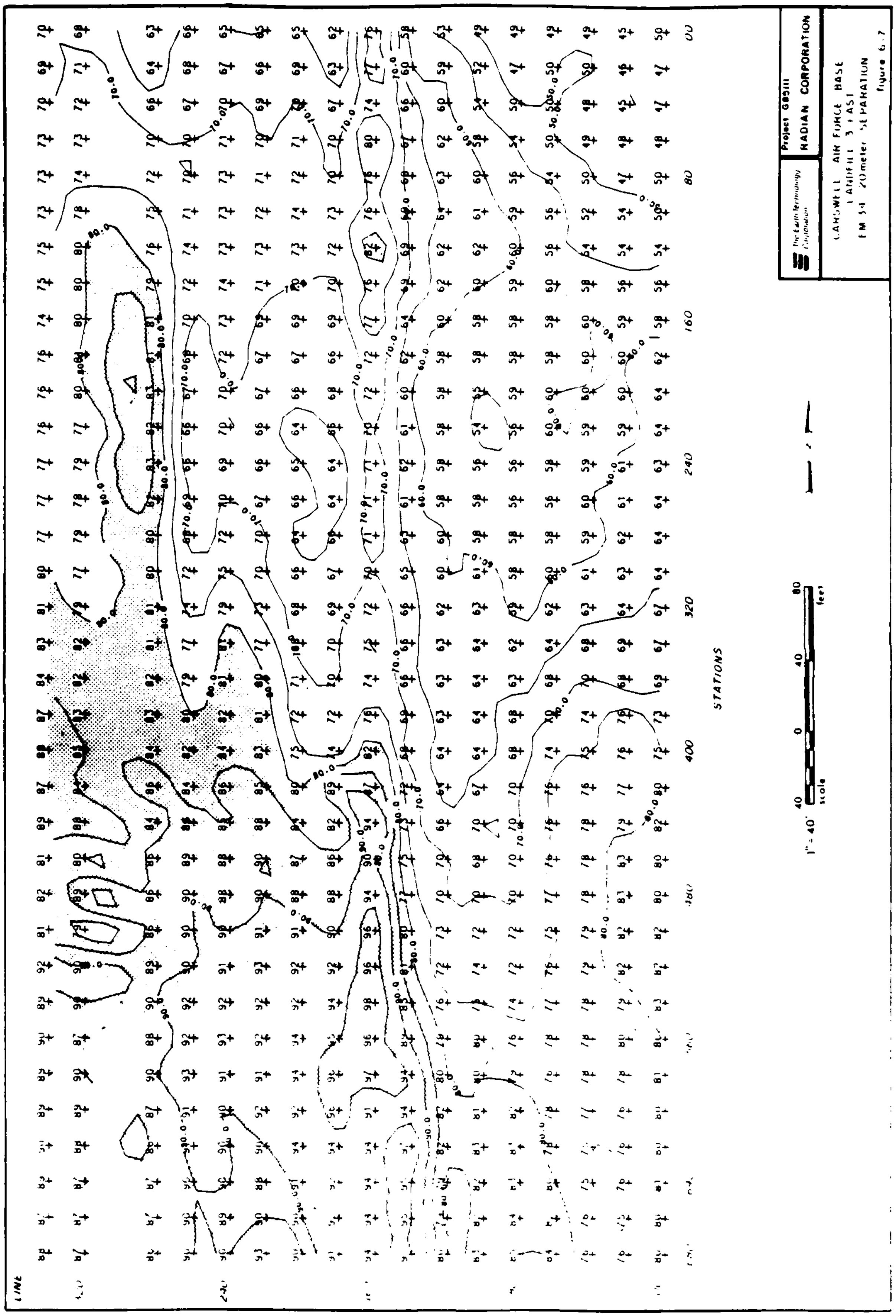

Project 608111
RADIAN CORPORATION
CARSWELL AIR FORCE BASE
SITE 3 WEST
EM 31 VERTICAL DIPOLE
Figure 6-3
STATIONS
scale
feet

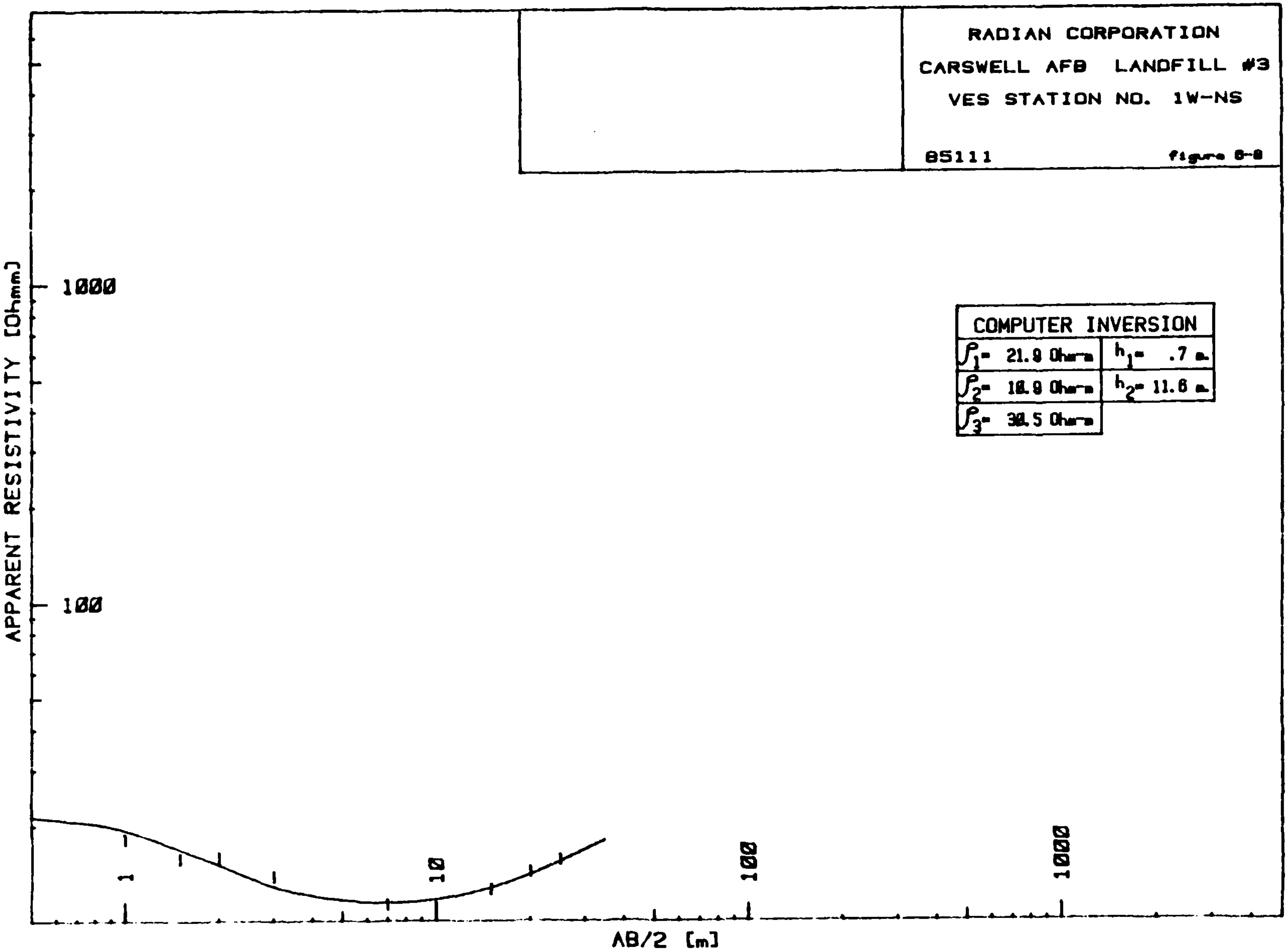


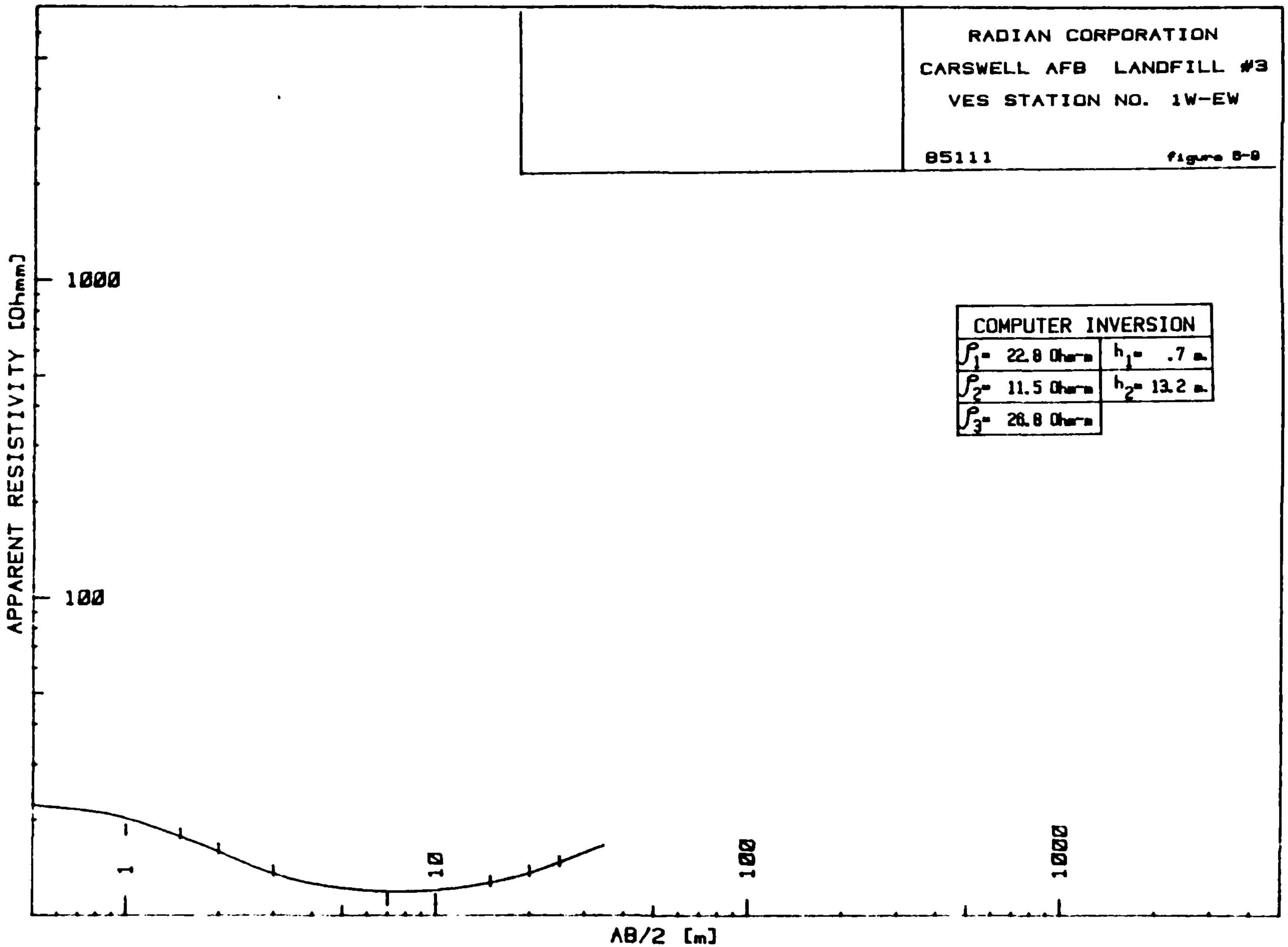
Project G0511
RADIAN CORPORATION
CARSWELL AIR FORCE BASE
SITE 3 WEST
EM 34 20 meter SEPARATION
STATIONS
LINES
1" = 40'
scale
feet

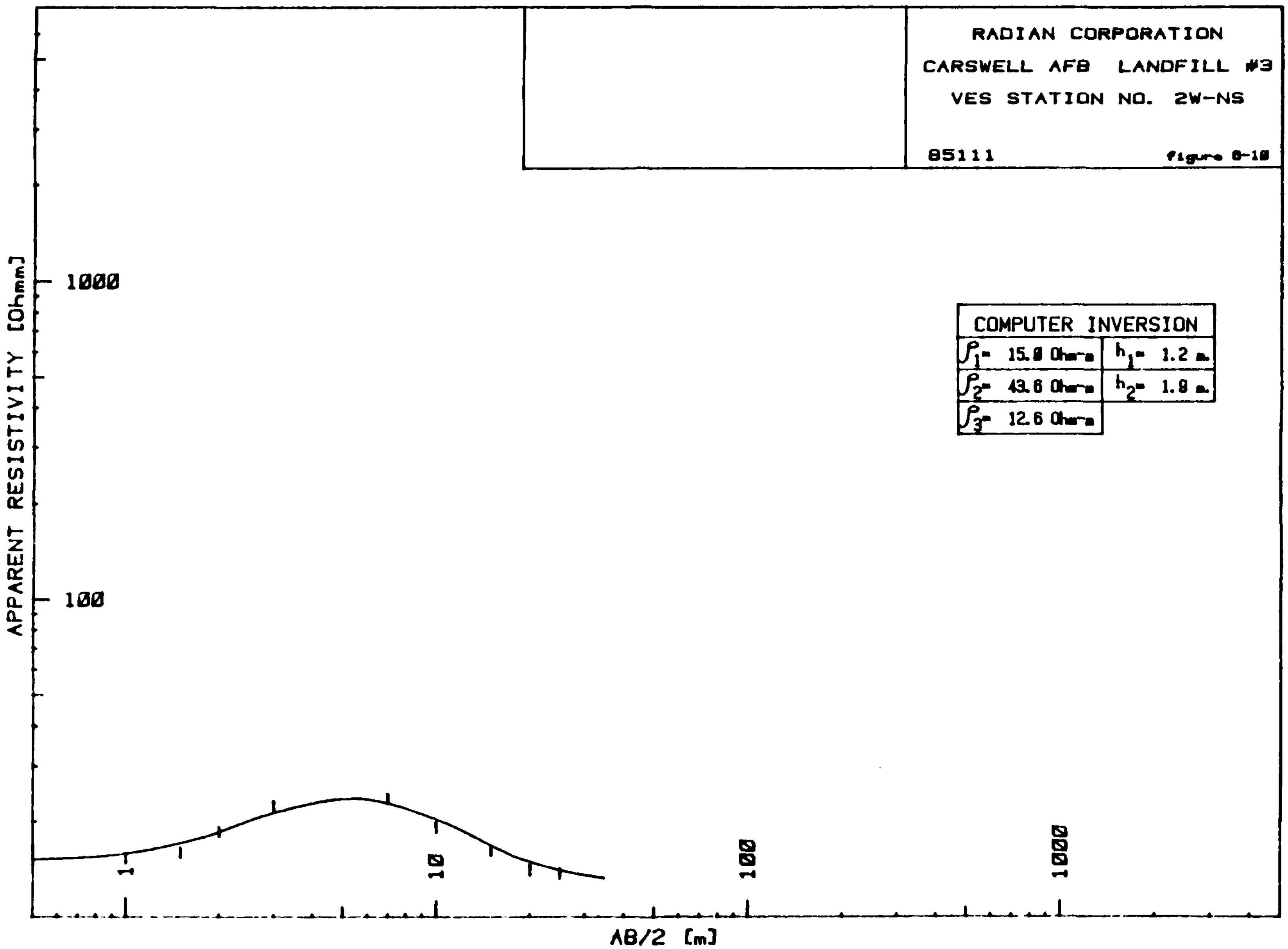

RADIAN CORPORATION
CARSWELL AIR FORCE BASE
LANDFILL 3 EAST
EM 31 HORIZONTAL DIPOLES
STATIONS
LINE
scale
feet
1" = 40'

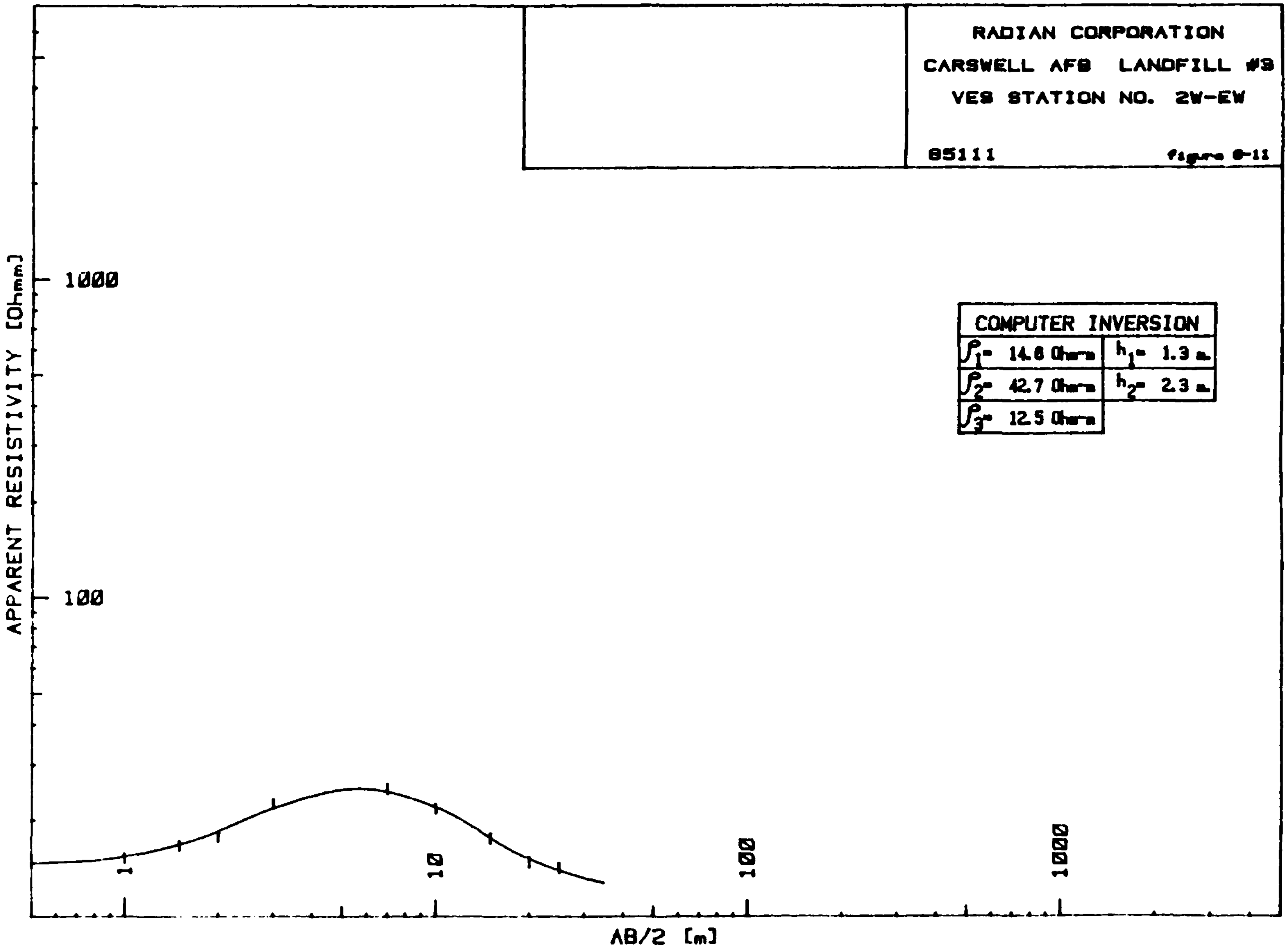

The Earth Technology Corporation
Project: GB5111
RADIAN CORPORATION
CARSWELL AIR FORCE BASE
LANDFILL 3 EAST
EM 31 VERTICAL DIPOLES
figure 6.6
1" = 40'
scale
feet
STATIONS
LINE


Project G8511
RADIAN CORPORATION
CARSWELL AIR FORCE BASE
LANDFILL 3 EAST
EM 34 20 meter SEPARATION
Figure 6.7
STATIONS
1" = 40'
scale
feet


RADIAN CORPORATION
CARSWELL AFB LANDFILL #3
VES STATION NO. 1W-NS
85111
figure 8-8
COMPUTER INVERSION
ρ1= 21.9 Ohm-m
h1= .7 m.
ρ2= 18.9 Ohm-m
h2= 11.6 m.
ρ3= 38.5 Ohm-m
APPARENT RESISTIVITY [Ohm-m]
1000
100
1
10
100
1000
AB/2 [m]

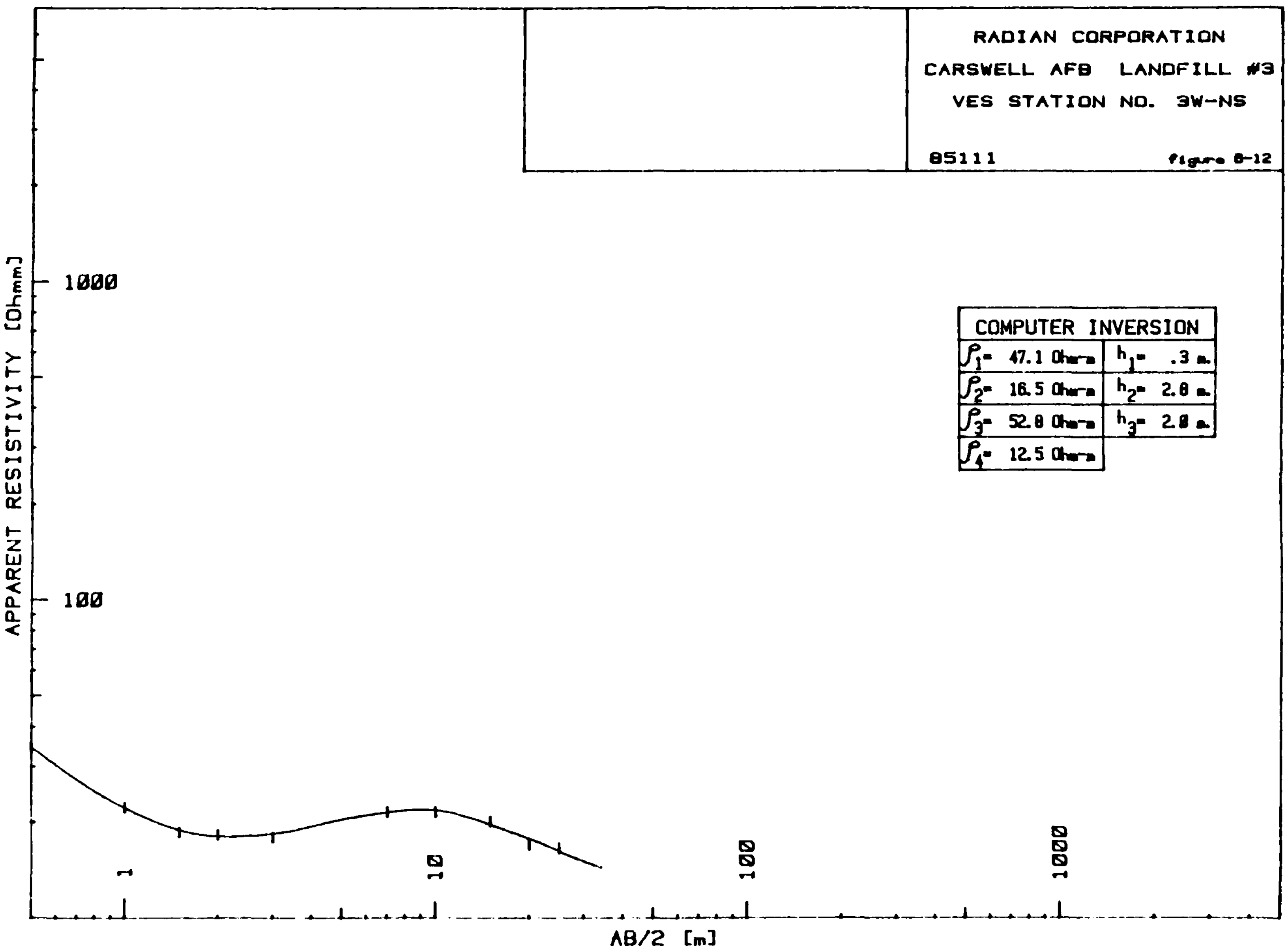

RADIAN CORPORATION
CARSWELL AFB LANDFILL #3
VES STATION NO. 1W-EW
85111
figure 8-9
COMPUTER INVERSION
ρ1= 22.8 Ohm-m
h1= .7 m.
ρ2= 11.5 Ohm-m
h2= 13.2 m.
ρ3= 26.8 Ohm-m
APPARENT RESISTIVITY [Ohmm]
1000
100
1
10
100
1000
AB/2 [m]

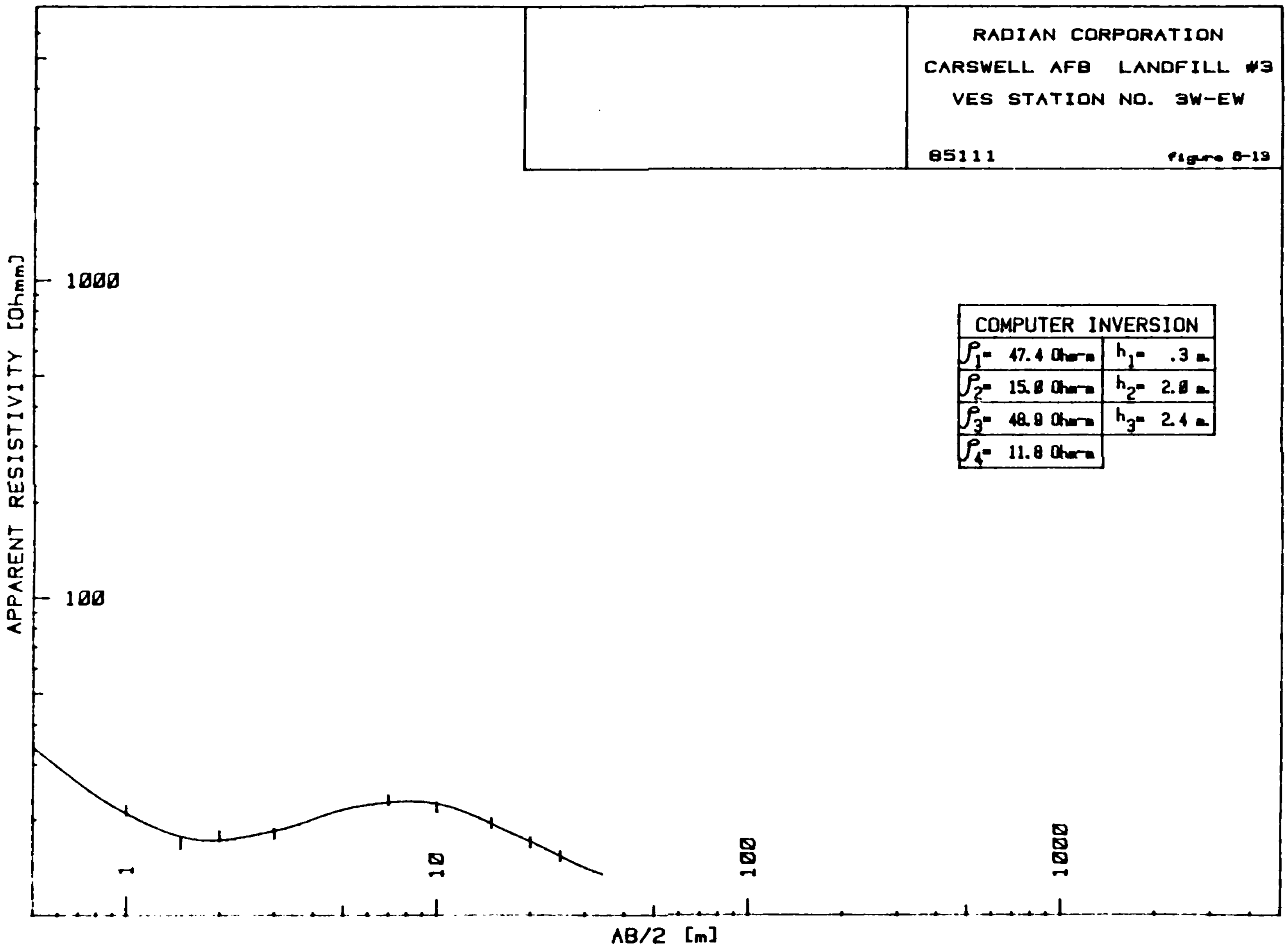

RADIAN CORPORATION
CARSWELL AFB LANDFILL #3
VES STATION NO. 2W-NS
85111
figure 8-18
COMPUTER INVERSION
ρ1= 15.0 Ohm-m
h1= 1.2 m.
ρ2= 43.6 Ohm-m
h2= 1.9 m.
ρ3= 12.6 Ohm-m
APPARENT RESISTIVITY [Ohmm]
1000
100
1
10
100
1000
AB/2 [m]



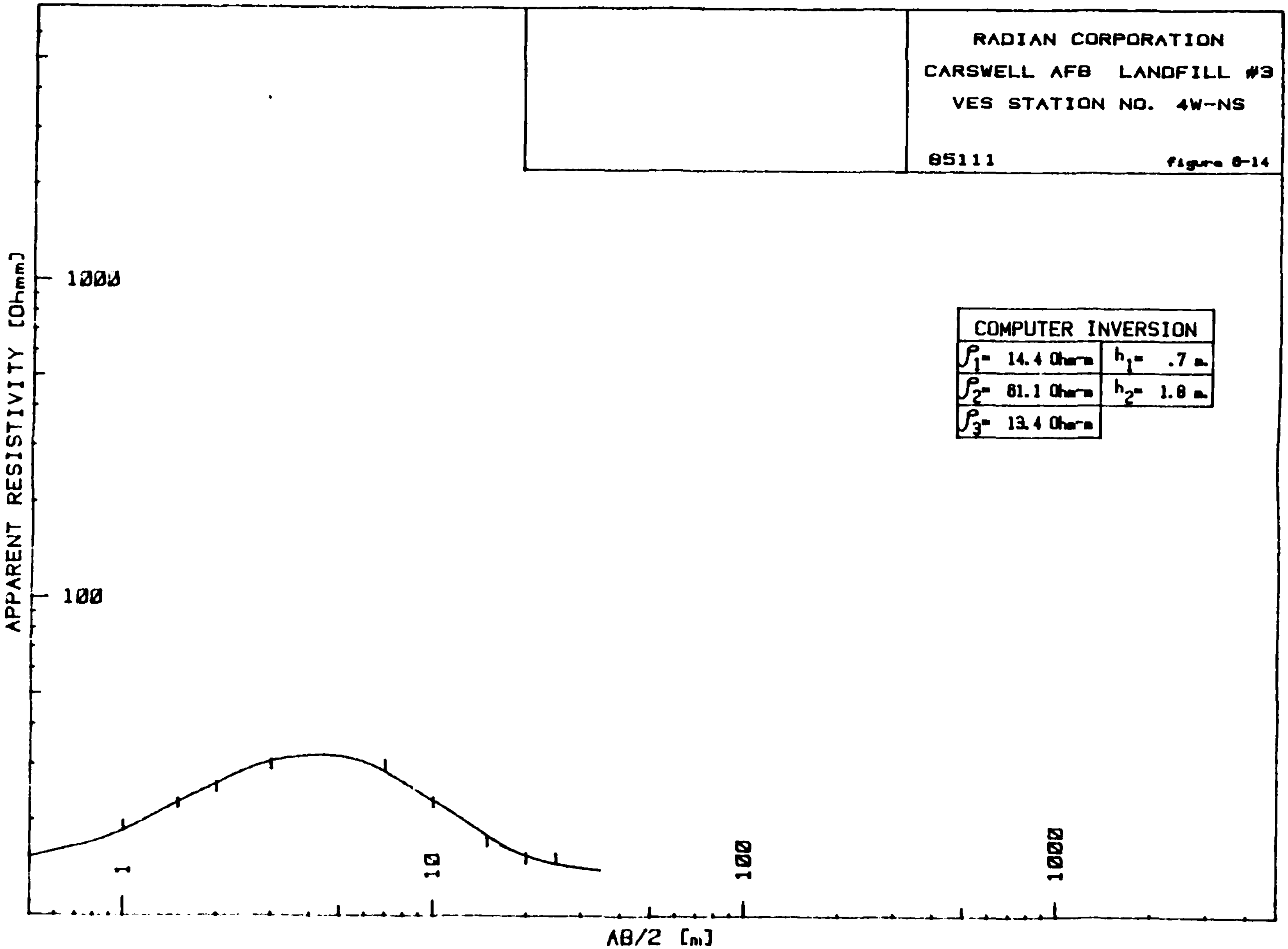
RADIAN CORPORATION
CARSWELL AFB LANDFILL #3
VES STATION NO. 2W-EW
85111
COMPUTER INVERSION
ρ1= 14.6 Ohm-m
h1= 1.3 m.
ρ2= 42.7 Ohm-m
h2= 2.3 m.
ρ3= 12.5 Ohm-m
APPARENT RESISTIVITY [Ohm-m]
1000
100
1
10
100
1000
AB/2 [m]

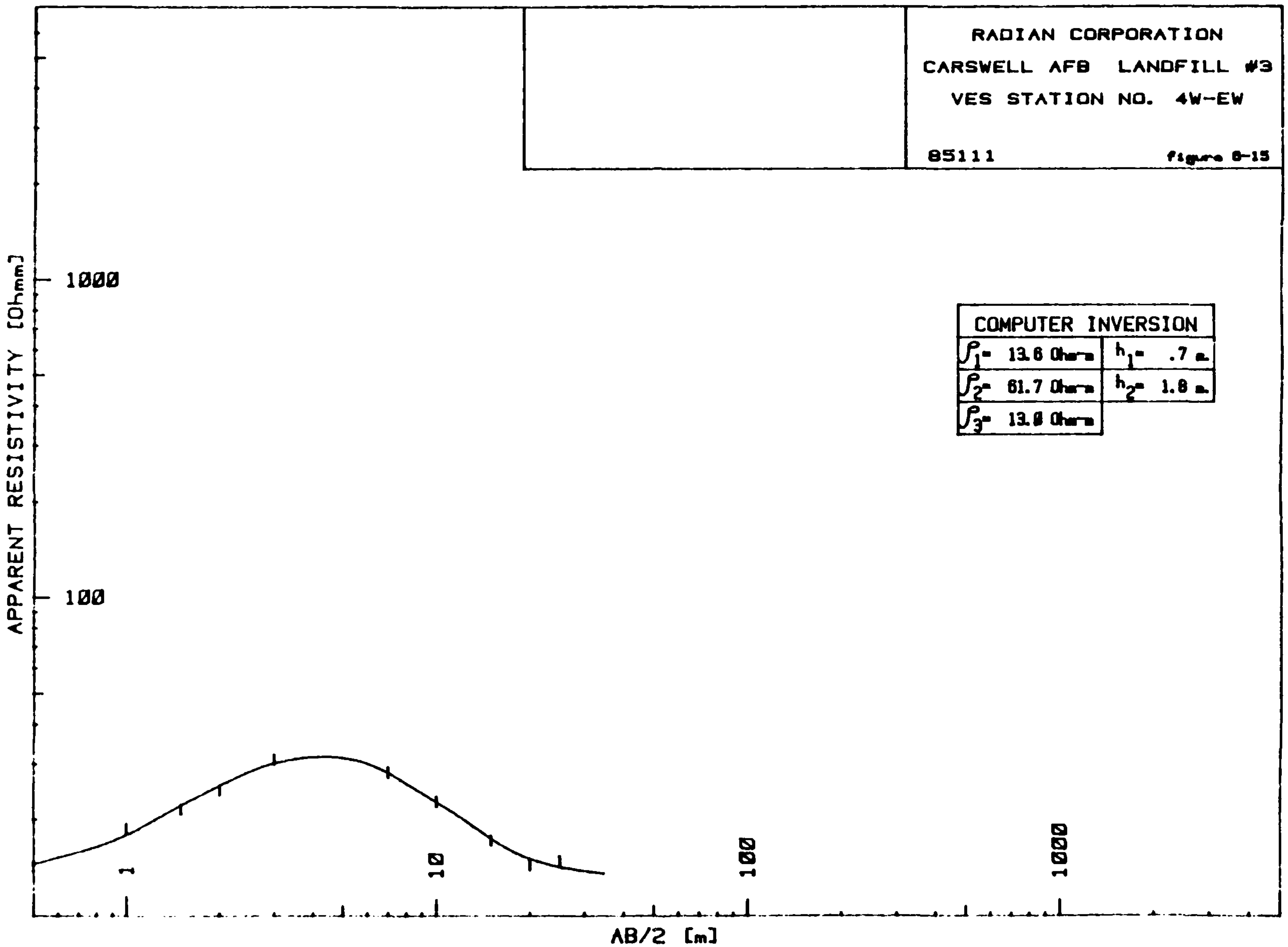
ALL R

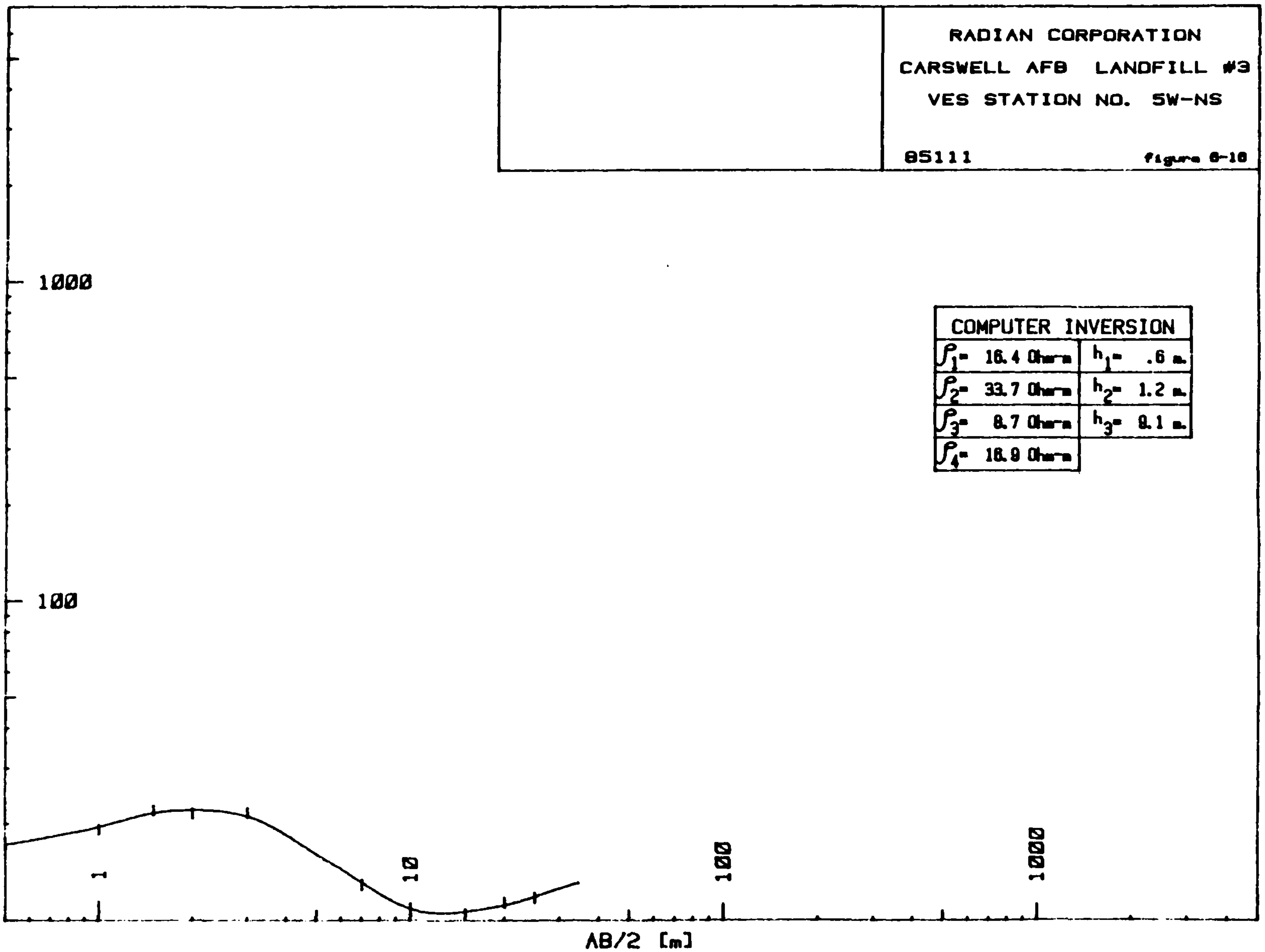

RADIAN CORPORATION
CARSWELL AFB LANDFILL #3
VES STATION NO. 3W-NS
85111
figure 8-12
COMPUTER INVERSION
ρ1= 47.1 Ohm-m
h1= .3 m.
ρ2= 16.5 Ohm-m
h2= 2.0 m.
ρ3= 52.0 Ohm-m
h3= 2.0 m.
ρ4= 12.5 Ohm-m
APPARENT RESISTIVITY [Ohmm]
1000
100
1
10
100
1000
AB/2 [m]

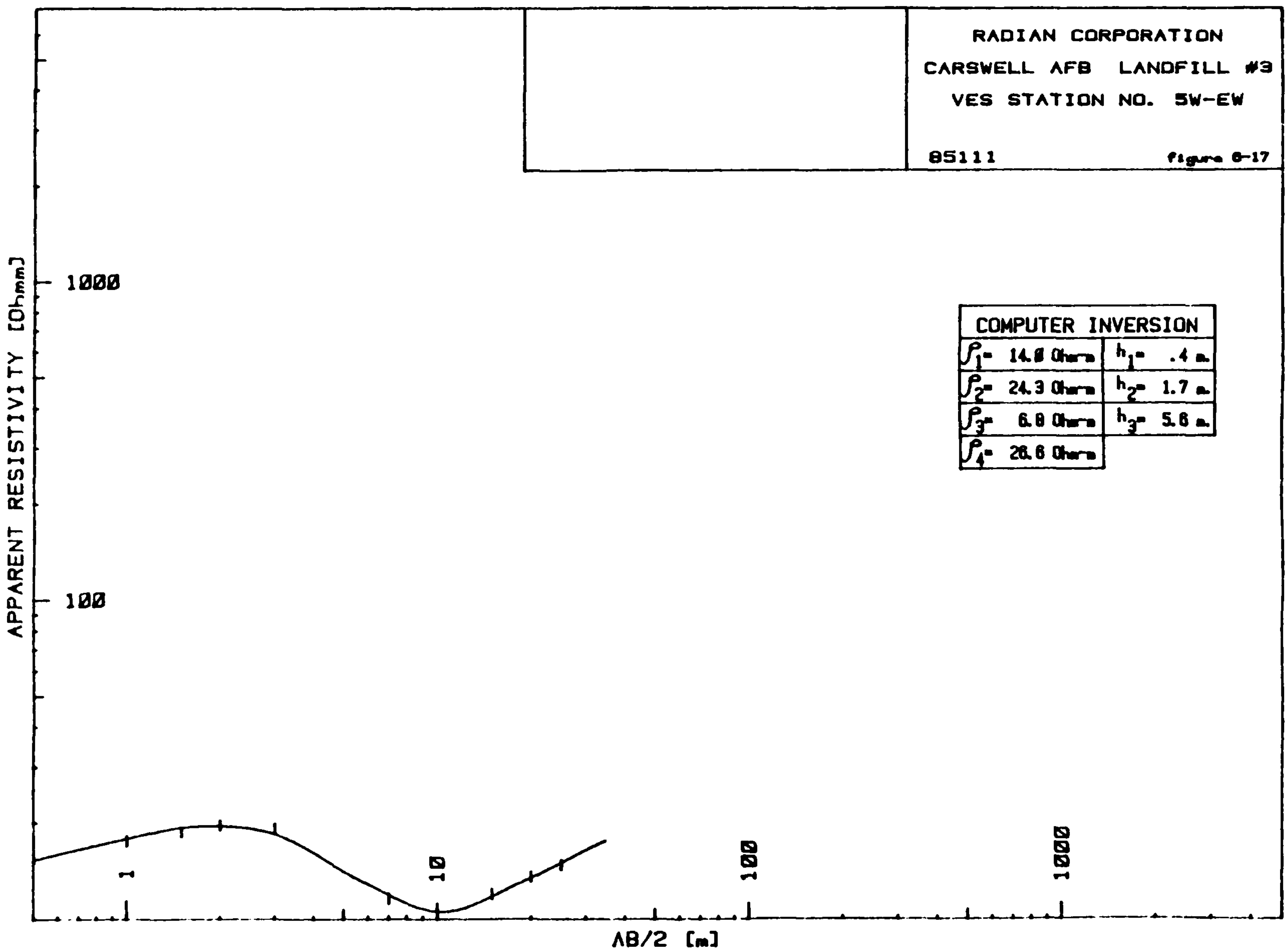


RADIAN CORPORATION
CARSWELL AFB LANDFILL #3
VES STATION NO. 3W-EW
85111
figure 8-13
COMPUTER INVERSION
ρ1= 47.4 Ohm-m
ρ2= 15.0 Ohm-m
ρ3= 48.9 Ohm-m
ρ4= 11.8 Ohm-m
h1= .3 m.
h2= 2.0 m.
h3= 2.4 m.
APPARENT RESISTIVITY [Ohmm]
1000
100
1
10
100
1000
AB/2 [m]

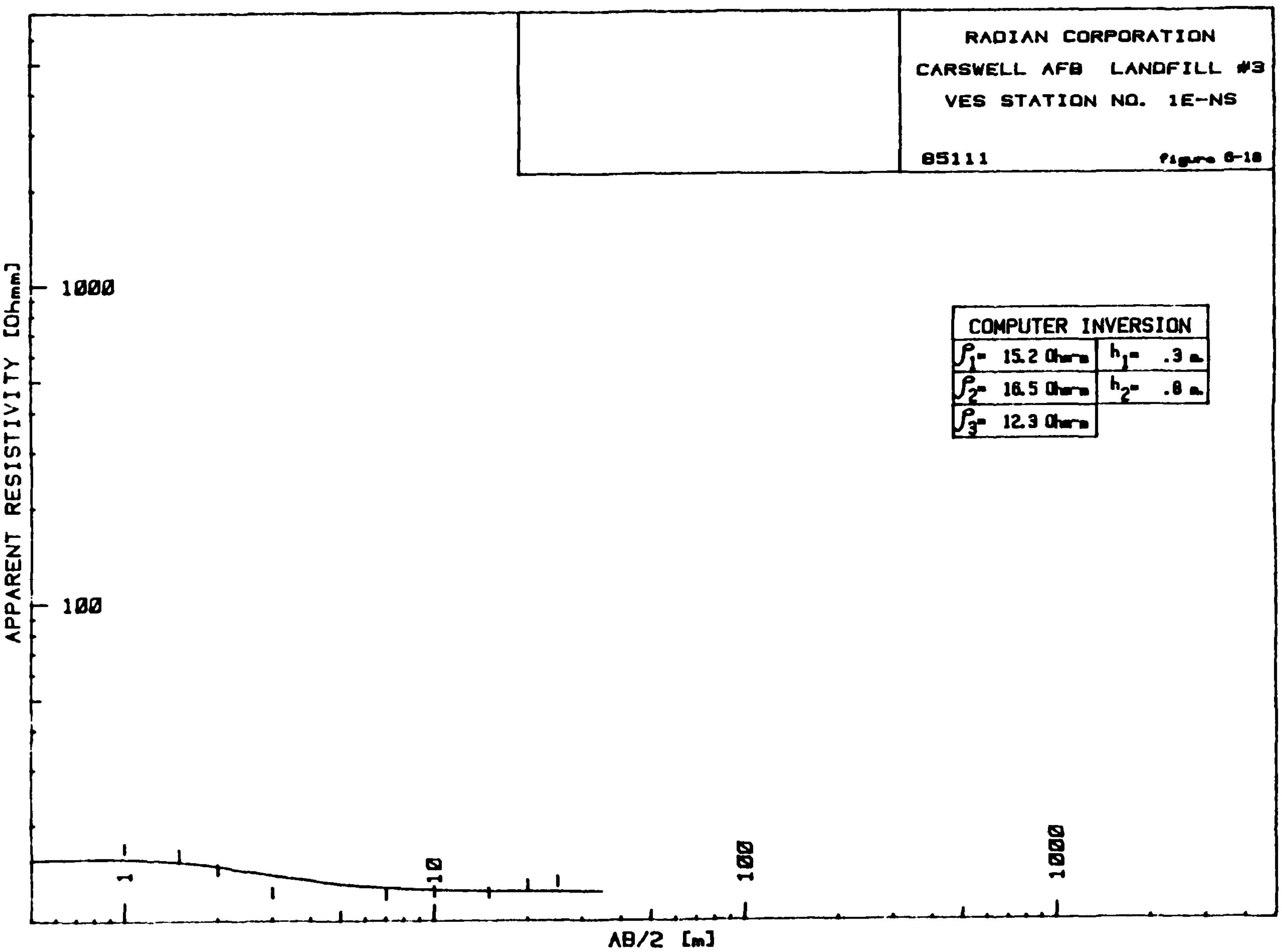

RADIAN CORPORATION
CARSWELL AFB LANDFILL #3
VES STATION NO. 4W-NS
85111
figure 8-14
COMPUTER INVERSION
ρ_1= 14.4 Ohm-m
h_1= .7 m.
ρ_2= 81.1 Ohm-m
h_2= 1.8 m.
ρ_3= 13.4 Ohm-m
APPARENT RESISTIVITY [Ohm-m]
1000
100
1
10
100
1000
AB/2 [m]

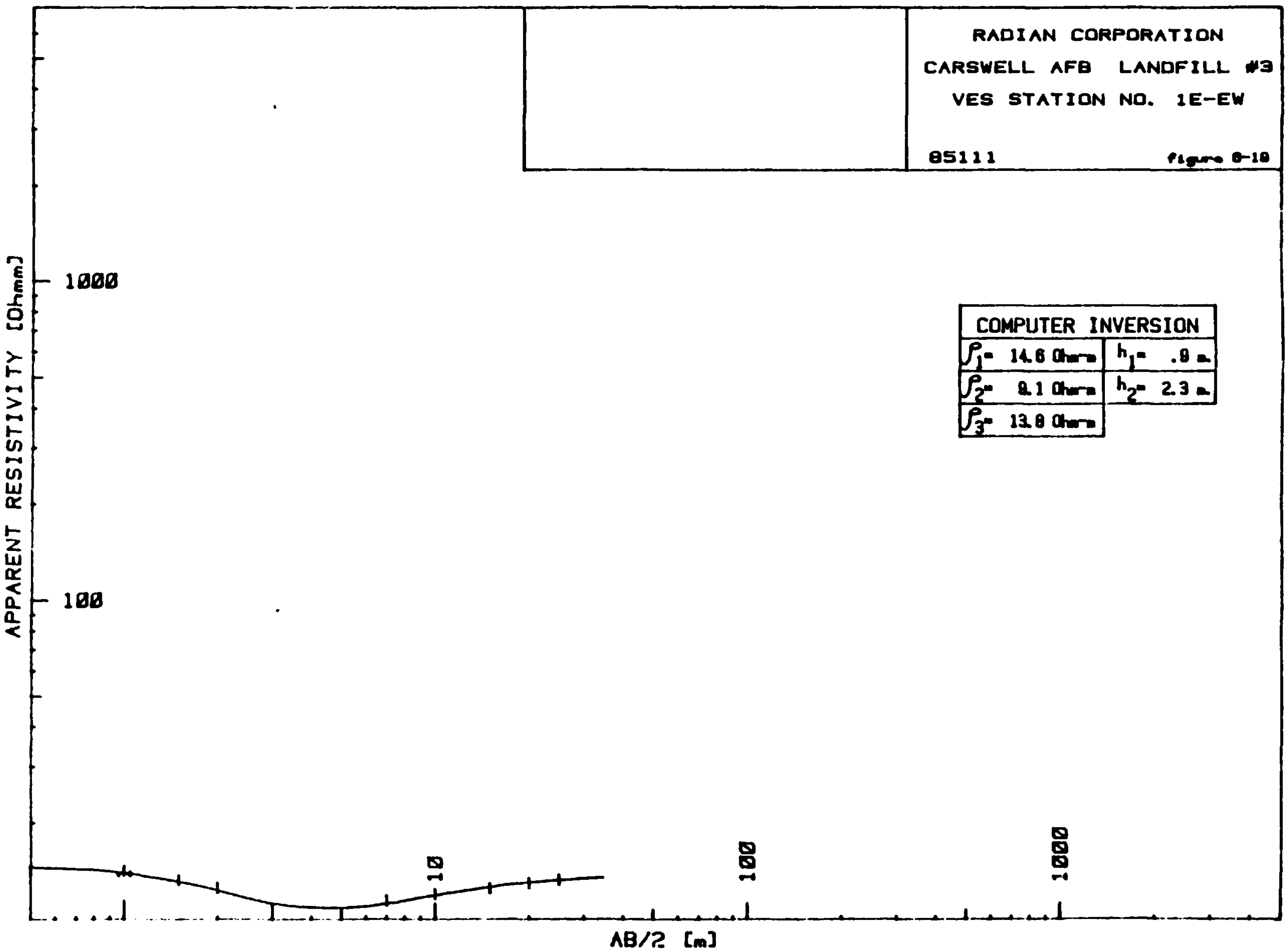

RADIAN CORPORATION
CARSWELL AFB LANDFILL #3
VES STATION NO. 4W-EW
85111
figure 8-15
COMPUTER INVERSION
ρ_1= 13.6 Ohm-m
h_1= .7 m.
ρ_2= 61.7 Ohm-m
h_2= 1.8 m.
ρ_3= 13.0 Ohm-m
APPARENT RESISTIVITY [Ohm-m]
1000
100
1
10
100
1000
AB/2 [m]

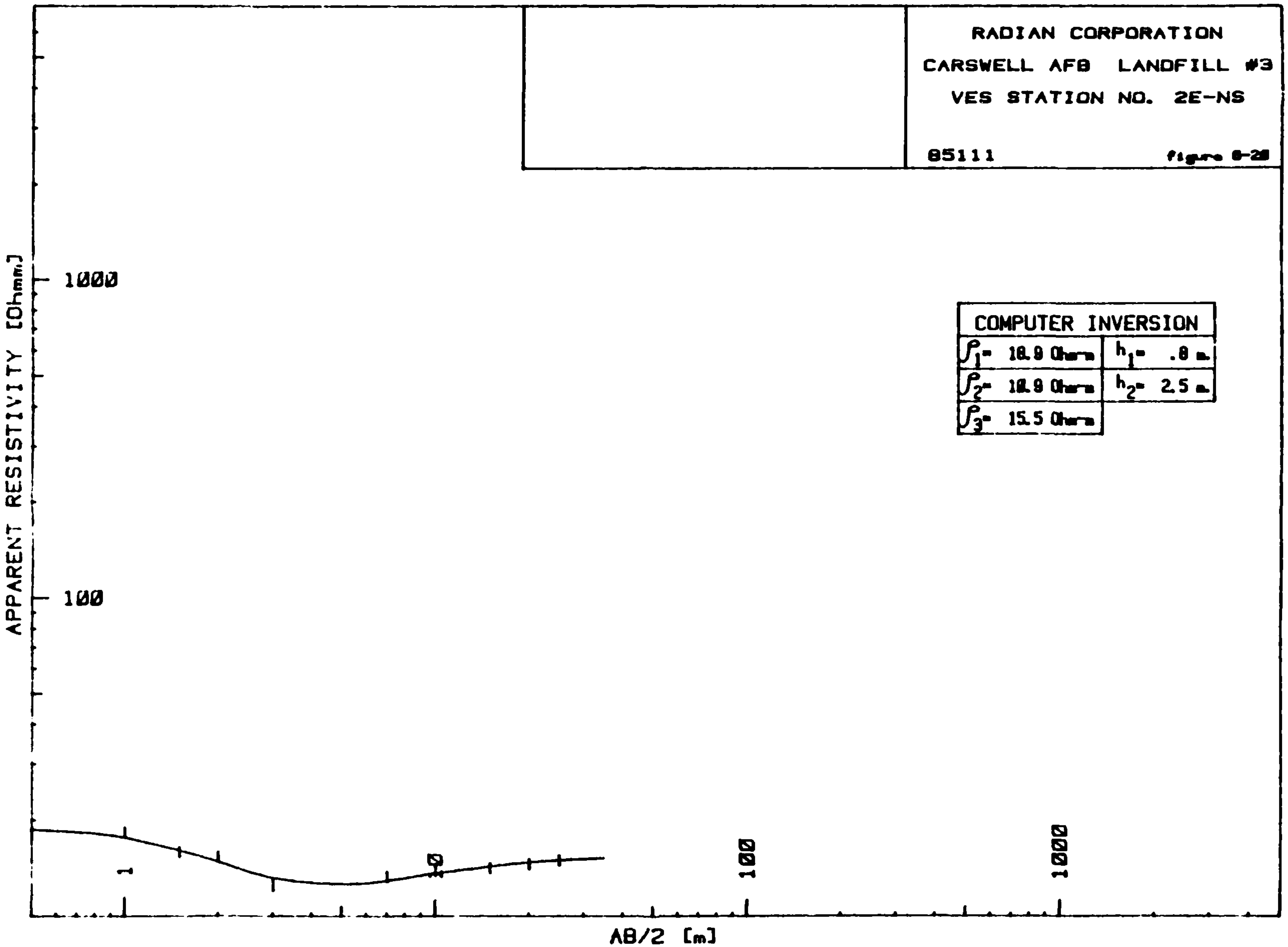

RADIAN CORPORATION
CARSWELL AFB LANDFILL #3
VES STATION NO. 5W-NS
85111
figure 6-10
COMPUTER INVERSION
ρ1= 16.4 Ohm-m
ρ2= 33.7 Ohm-m
ρ3= 8.7 Ohm-m
ρ4= 18.9 Ohm-m
h1= .6 m.
h2= 1.2 m.
h3= 9.1 m.
APPARENT RESISTIVITY [Ohmm]
1000
100
1
10
100
1000
AB/2 [m]



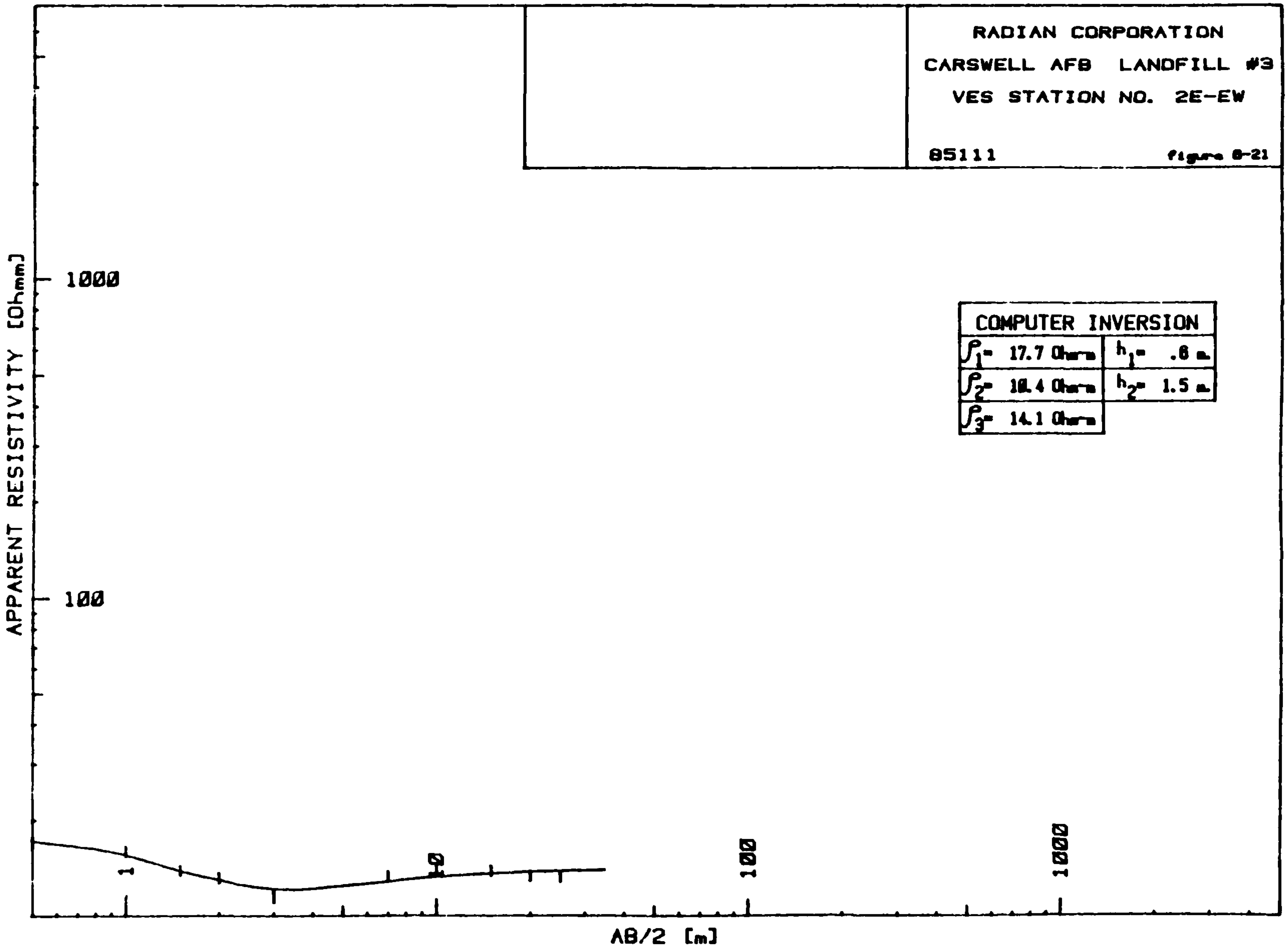
RADIAN CORPORATION
CARSWELL AFB LANDFILL #3
VES STATION NO. 5W-EW
85111
figure 6-17
COMPUTER INVERSION
ρ1= 14.0 Ohm-m
ρ2= 24.3 Ohm-m
ρ3= 6.0 Ohm-m
ρ4= 20.6 Ohm-m
h1= .4 m.
h2= 1.7 m.
h3= 5.6 m.
APPARENT RESISTIVITY [Ohm-m]
1000
100
1
10
100
1000
AB/2 [m]

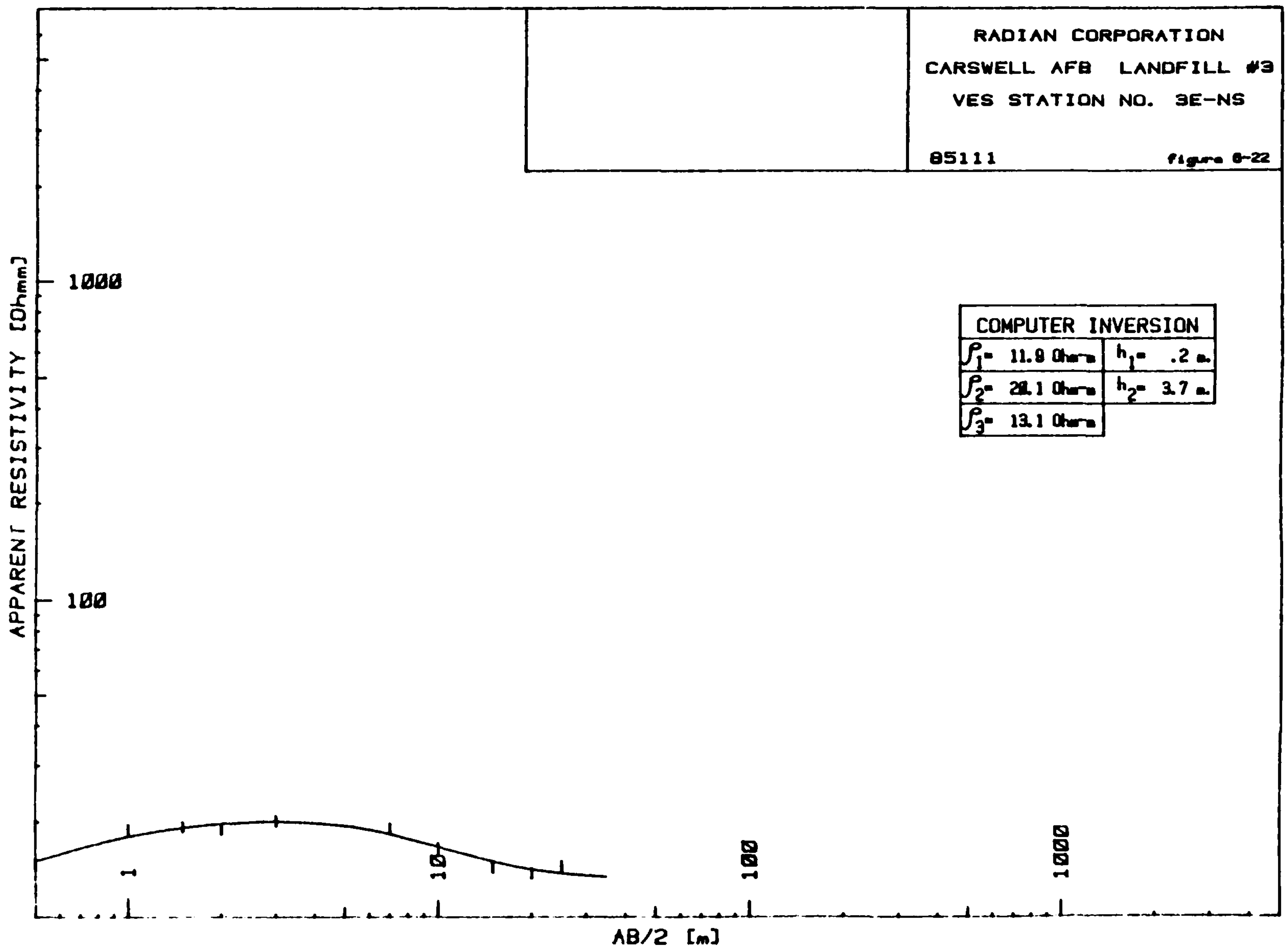

RADIAN CORPORATION
CARSWELL AFB LANDFILL #3
VES STATION NO. 1E-NS
85111
Figure 6-18
COMPUTER INVERSION
ρ_1= 15.2 Ohms
h_1= .3 m.
ρ_2= 16.5 Ohms
h_2= .8 m.
ρ_3= 12.3 Ohms
APPARENT RESISTIVITY [Ohmm]
1000
100
1
10
100
1000
AB/2 [m]

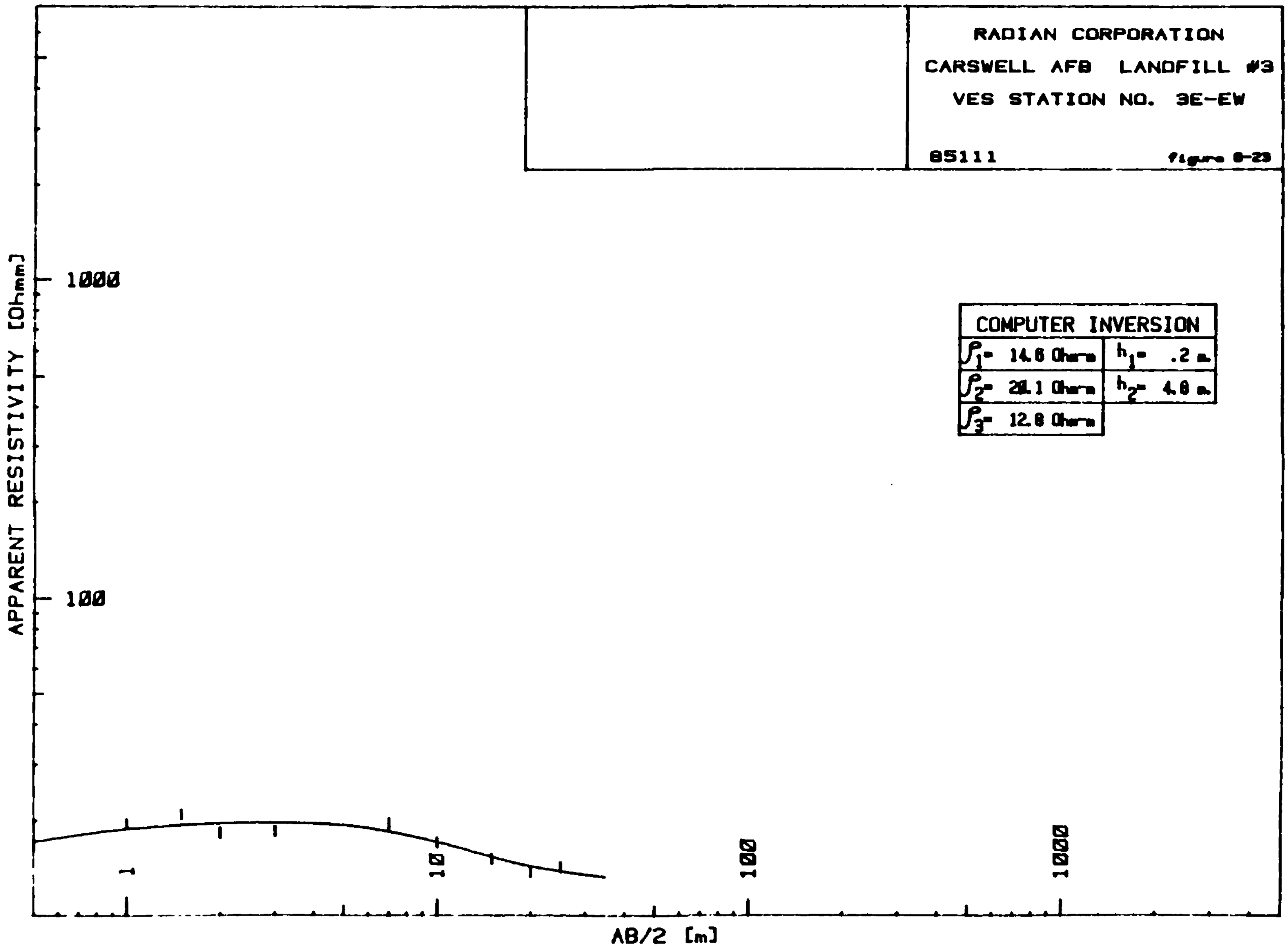

RADIAN CORPORATION
CARSWELL AFB LANDFILL #3
VES STATION NO. 1E-EW
85111
figure 8-10
COMPUTER INVERSION
ρ1= 14.6 Ohm-m
ρ2= 9.1 Ohm-m
ρ3= 13.8 Ohm-m
h1= .9 m.
h2= 2.3 m.
APPARENT RESISTIVITY [Ohm-m]
1000
100
10
AB/2 [m]

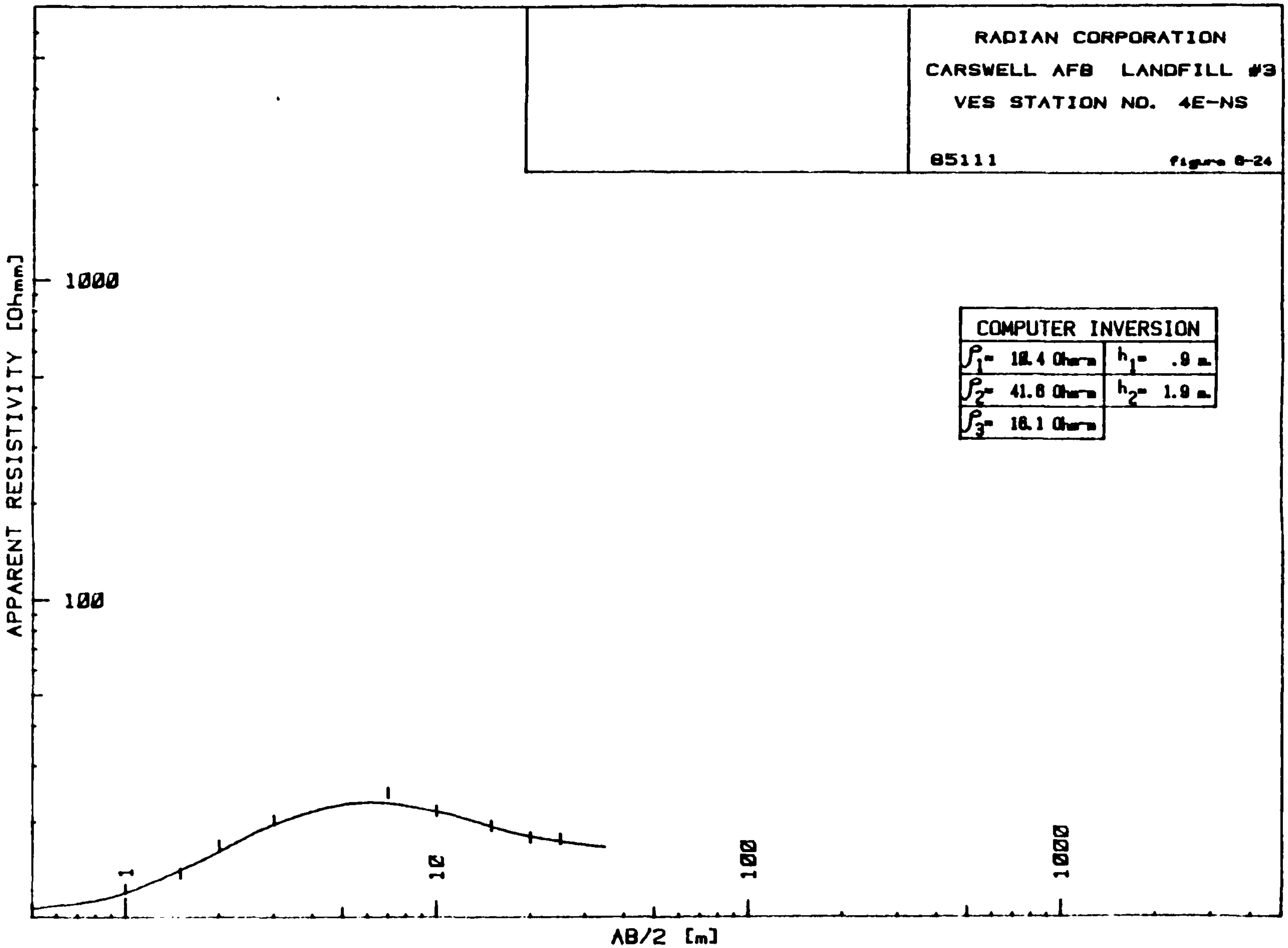


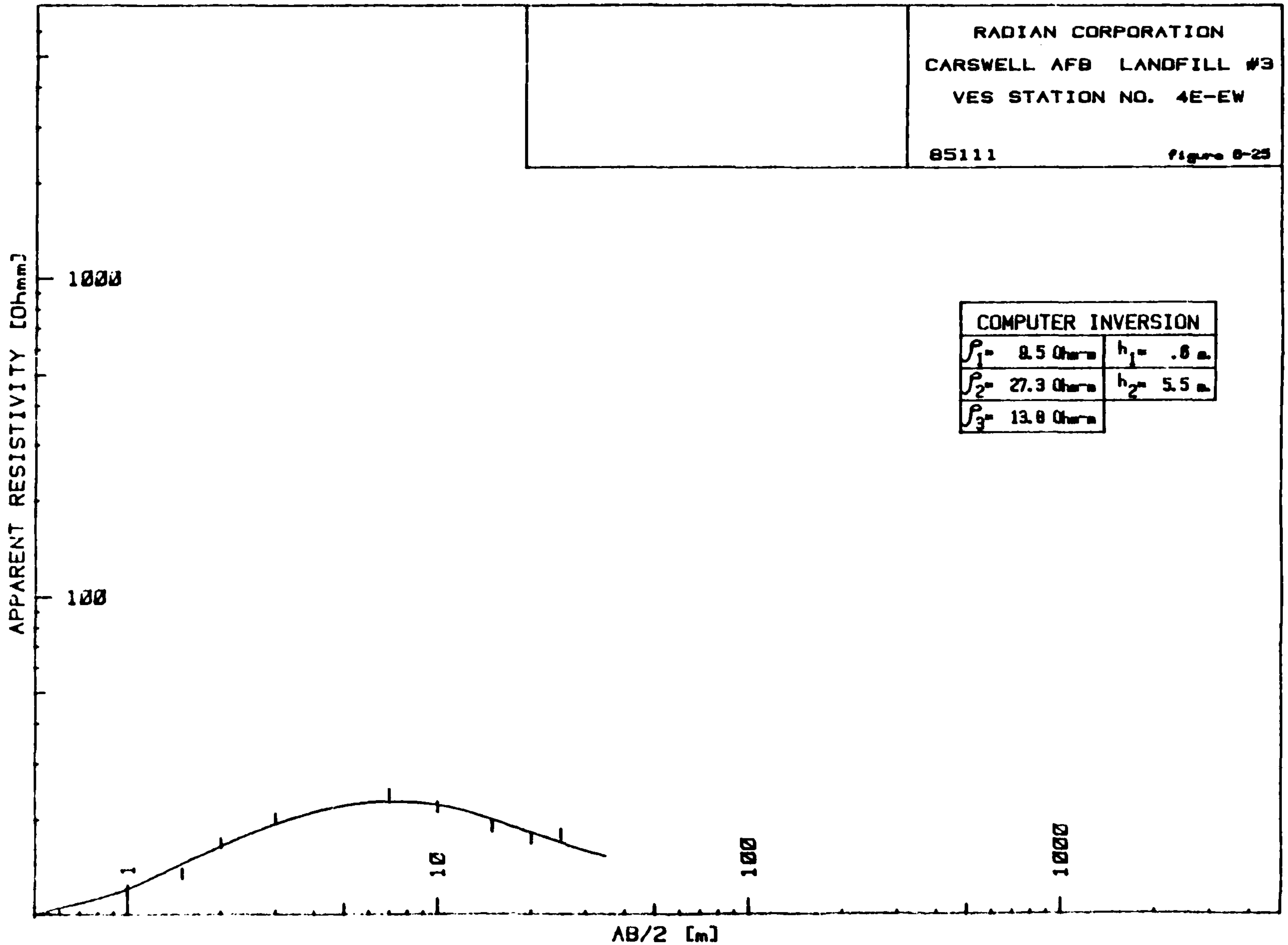
RADIAN CORPORATION
CARSWELL AFB LANDFILL #3
VES STATION NO. 2E-NS
85111
figure 8-28
COMPUTER INVERSION
ρ1= 10.9 Ohm-m
ρ2= 10.9 Ohm-m
ρ3= 15.5 Ohm-m
h1= .8 m.
h2= 2.5 m.
APPARENT RESISTIVITY [Ohm-m]
1000
100
1
10
100
1000
AB/2 [m]

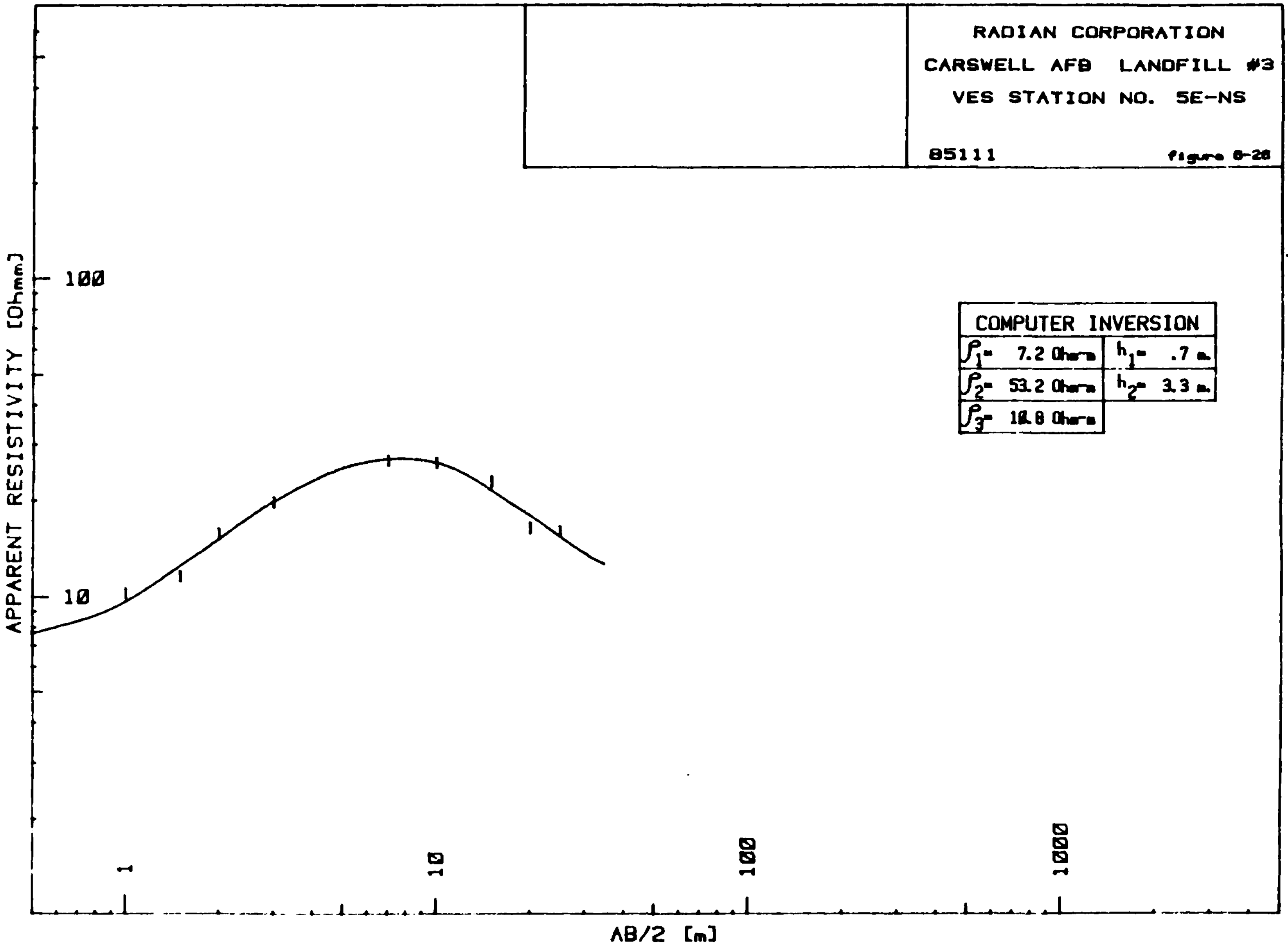

RADIAN CORPORATION
CARSWELL AFB LANDFILL #3
VES STATION NO. 2E-EW
85111
figure 8-21
COMPUTER INVERSION
ρ_1= 17.7 Ohm-m
h_1= .8 m.
ρ_2= 10.4 Ohm-m
h_2= 1.5 m.
ρ_3= 14.1 Ohm-m
APPARENT RESISTIVITY [Ohmm]
1000
100
1
10
100
1000
AB/2 [m]

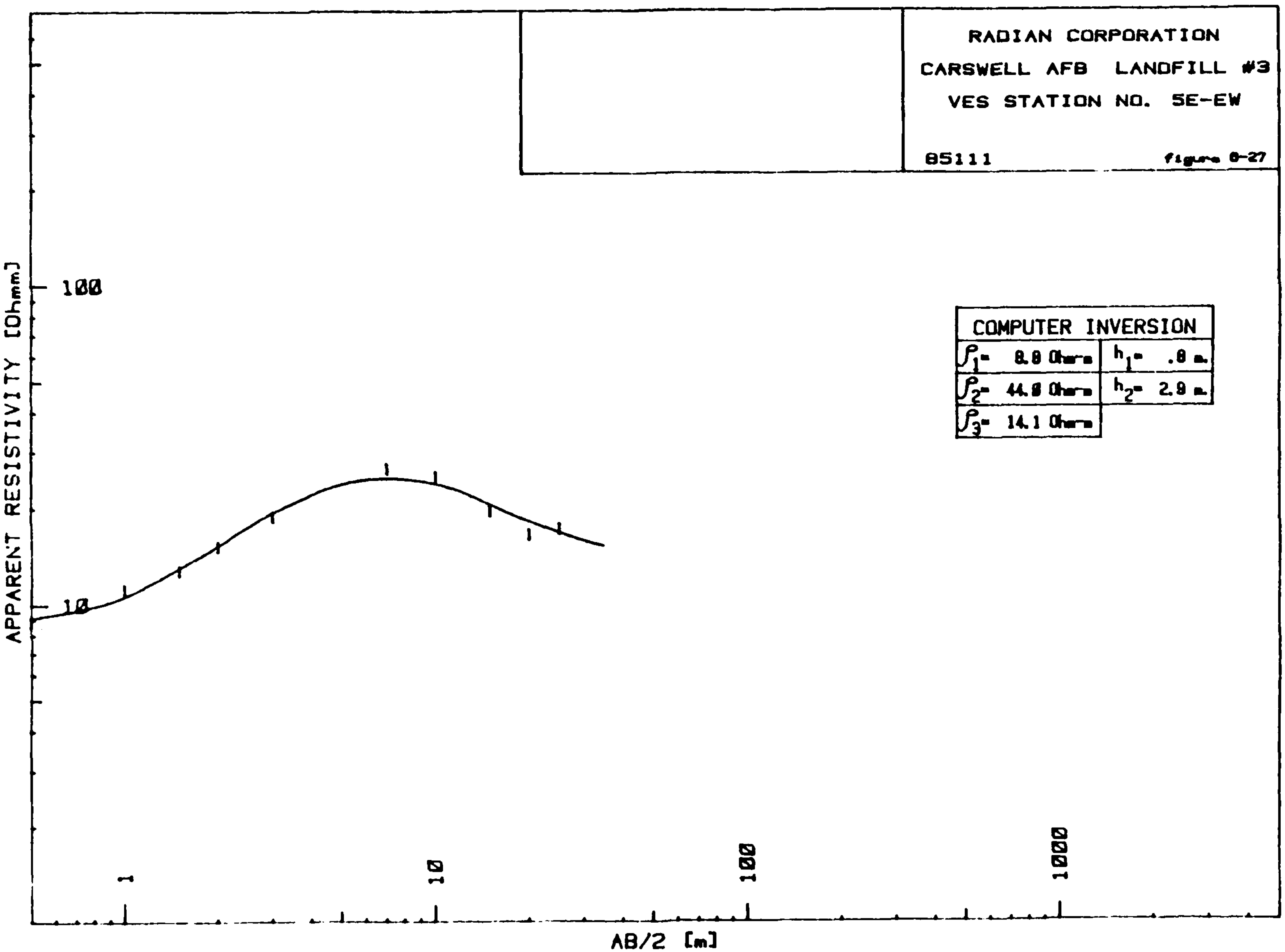

RADIAN CORPORATION
CARSWELL AFB LANDFILL #3
VES STATION NO. 3E-NS
85111
figure 8-22
COMPUTER INVERSION
ρ1= 11.9 Ohm-m
h1= .2 m.
ρ2= 28.1 Ohm-m
h2= 3.7 m.
ρ3= 13.1 Ohm-m
APPARENT RESISTIVITY [Ohmm]
1000
100
1
10
100
1000
AB/2 [m]

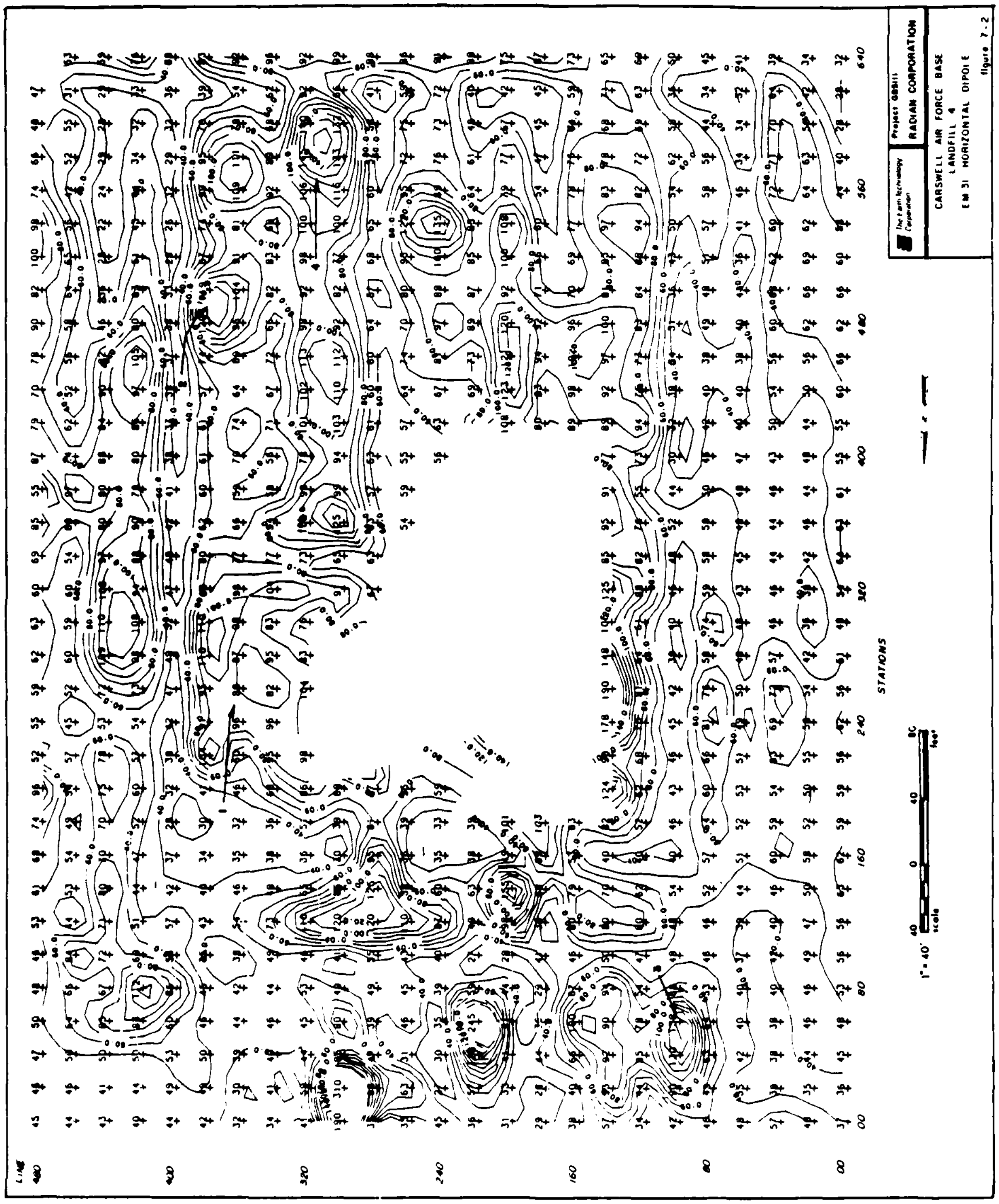

RADIAN CORPORATION
CARSWELL AFB LANDFILL #3
VES STATION NO. 3E-EW
85111
figure 8-23
COMPUTER INVERSION
ρ1= 14.6 Ohm-m
h1= .2 m
ρ2= 20.1 Ohm-m
h2= 4.0 m
ρ3= 12.0 Ohm-m
APPARENT RESISTIVITY [Ohmm]
1000
100
1
10
100
1000
AB/2 [m]

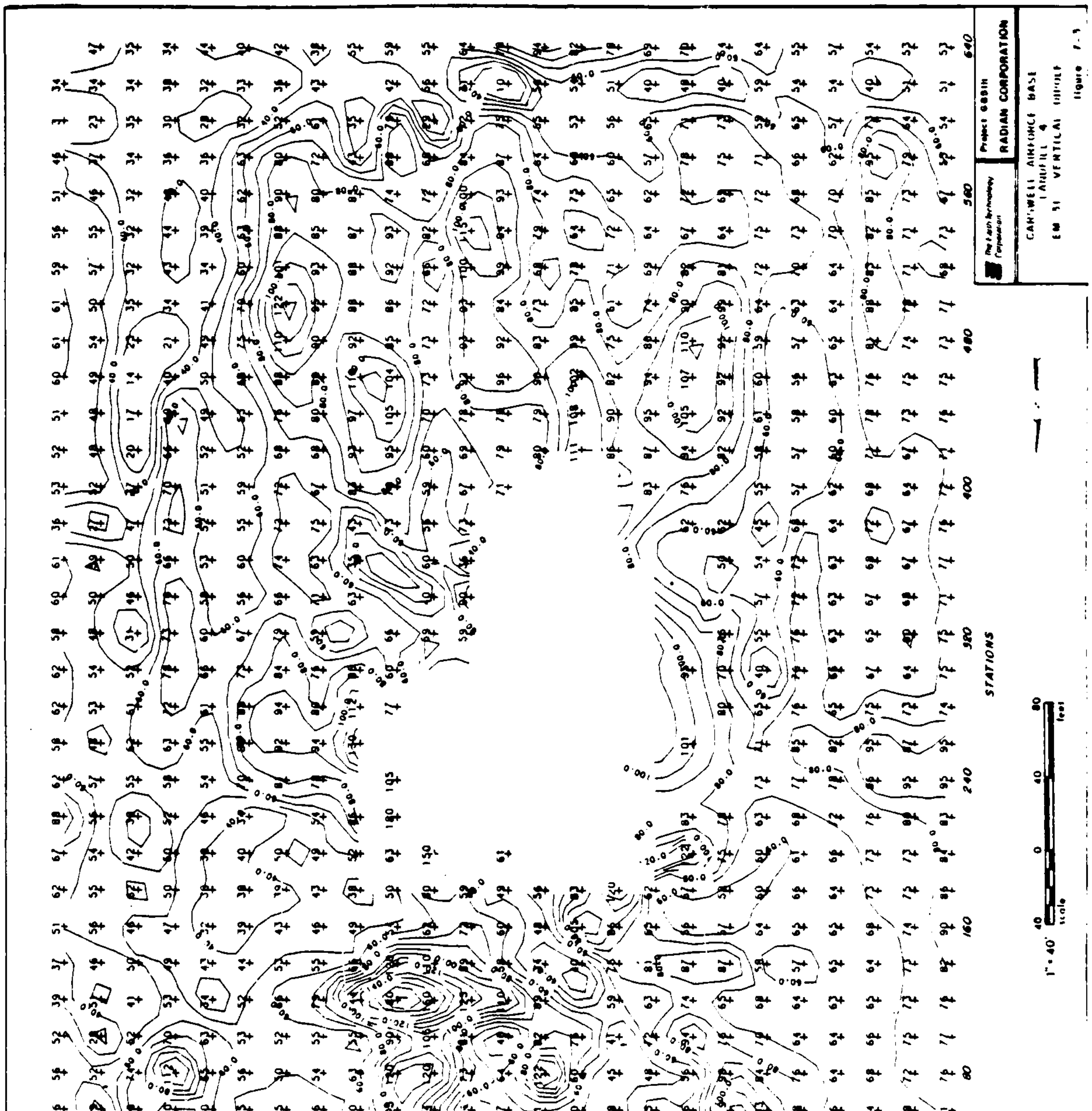

RADIAN CORPORATION
CARSWELL AFB LANDFILL #3
VES STATION NO. 4E-NS
85111
figure 8-24
COMPUTER INVERSION
ρ_1= 10.4 Ohm-m
h_1= .9 m.
ρ_2= 41.6 Ohm-m
h_2= 1.9 m.
ρ_3= 16.1 Ohm-m
APPARENT RESISTIVITY [Ohm-m]
1000
100
1
10
100
1000
AB/2 [m]

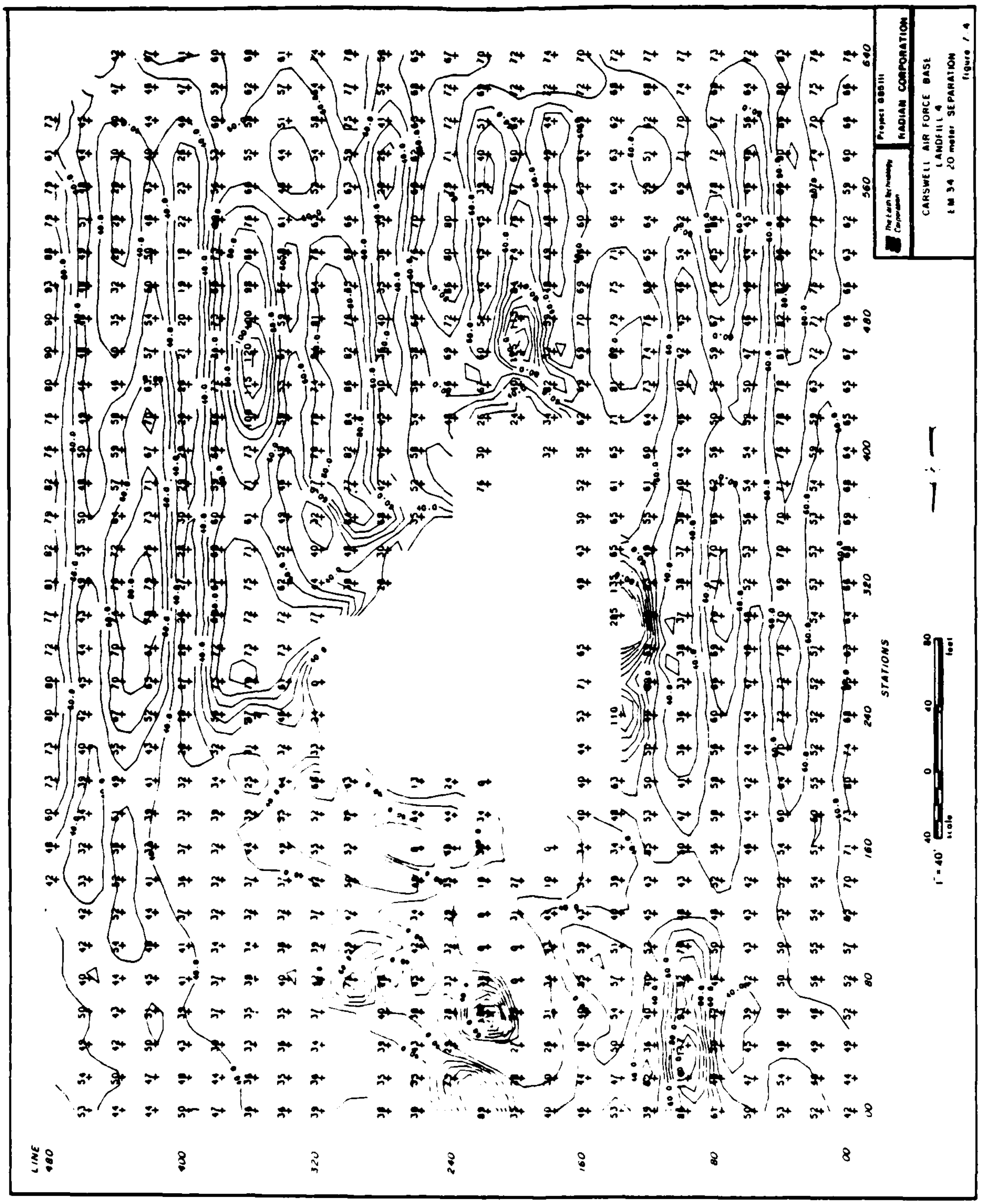

RADIAN CORPORATION
CARSWELL AFB LANDFILL #3
VES STATION NO. 4E-EW
85111
figure 8-25
COMPUTER INVERSION
ρ_1= 8.5 Ohm-m
h_1= .8 m.
ρ_2= 27.3 Ohm-m
h_2= 5.5 m.
ρ_3= 13.8 Ohm-m
APPARENT RESISTIVITY [Ohm-m]
1000
100
1
10
100
1000
AB/2 [m]

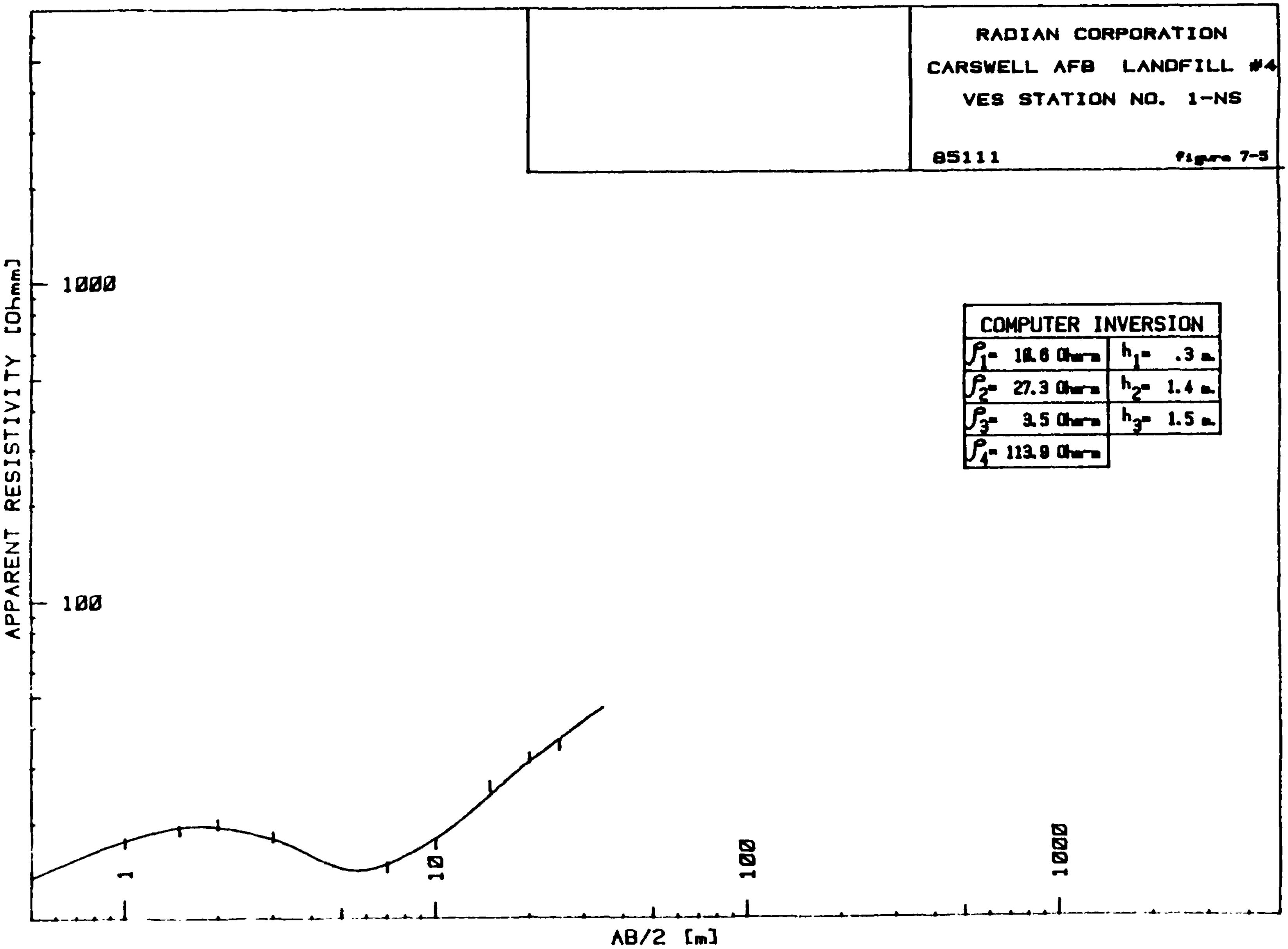

RADIAN CORPORATION
CARSWELL AFB LANDFILL #3
VES STATION NO. 5E-NS
85111
figure 6-28
COMPUTER INVERSION
ρ1= 7.2 Ohm-m
h1= .7 m.
ρ2= 53.2 Ohm-m
h2= 3.3 m.
ρ3= 10.8 Ohm-m
APPARENT RESISTIVITY [Ohmm]
100
10
1
10
100
1000
AB/2 [m]


RADIAN CORPORATION
CARSWELL AFB LANDFILL #3
VES STATION NO. 5E-EW
85111
figure 8-27
COMPUTER INVERSION
ρ1= 8.8 Ohm-m
h1= .8 m.
ρ2= 44.8 Ohm-m
h2= 2.9 m.
ρ3= 14.1 Ohm-m
APPARENT RESISTIVITY [Ohm-m]
100
10
1
10
100
1000
AB/2 [m]

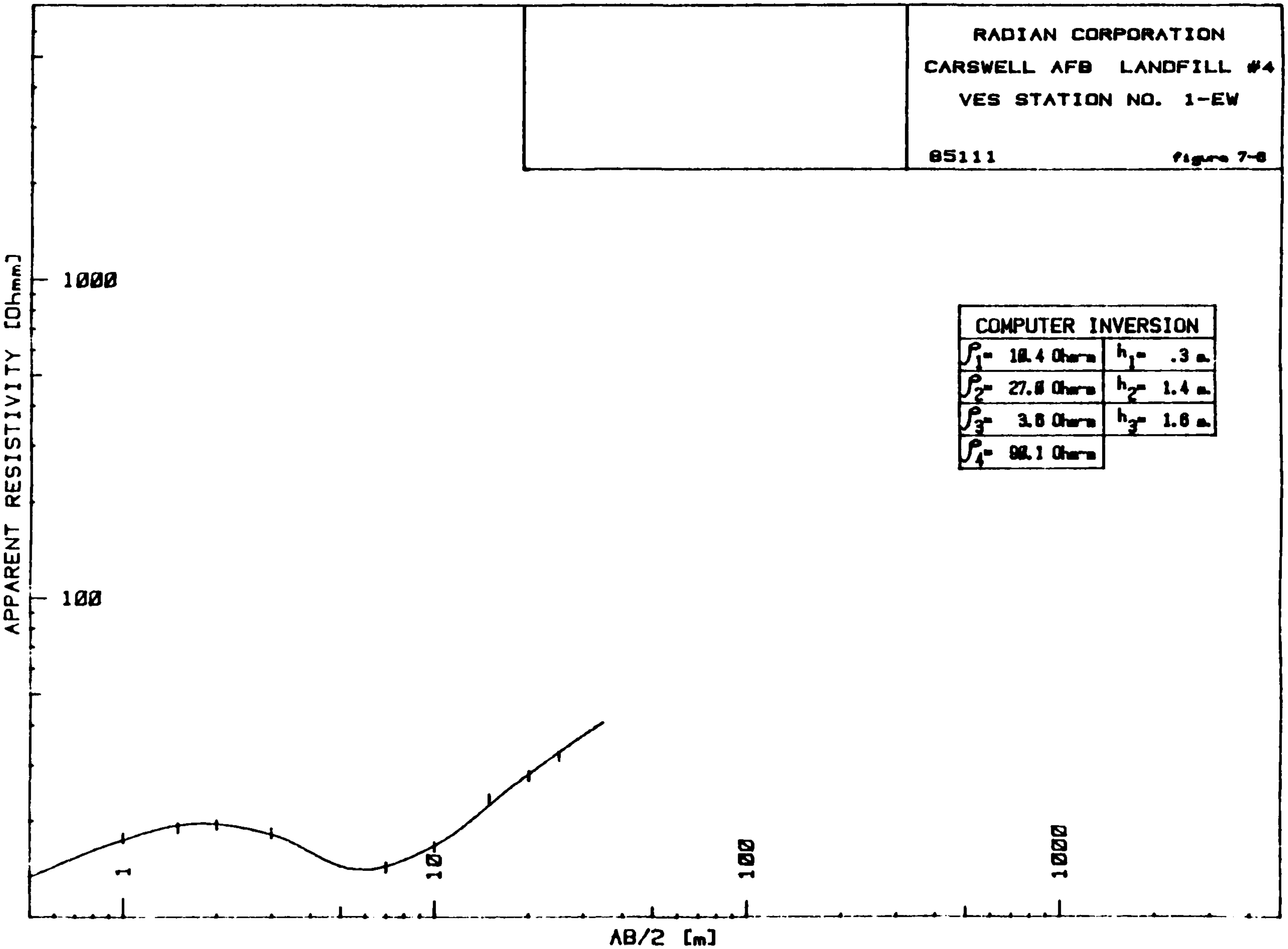

RADIAN CORPORATION
CARSWELL AIR FORCE BASE
LANDFILL 4
EM 31 HORIZONTAL DIPOLE
figure 7.2
STATIONS
LINE
scale
feet

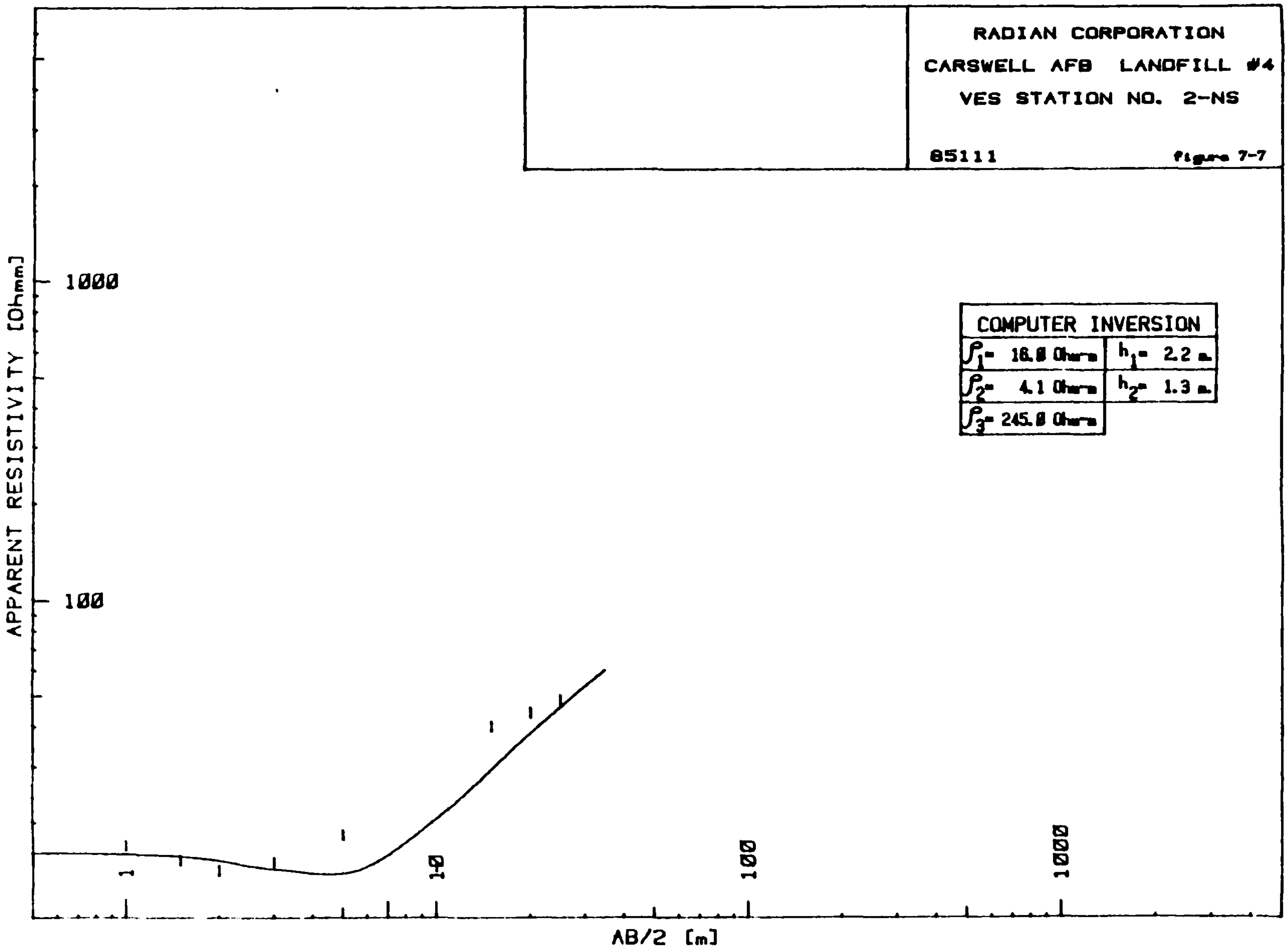

RADIAN CORPORATION
STATIONS
LINE
scale
feet

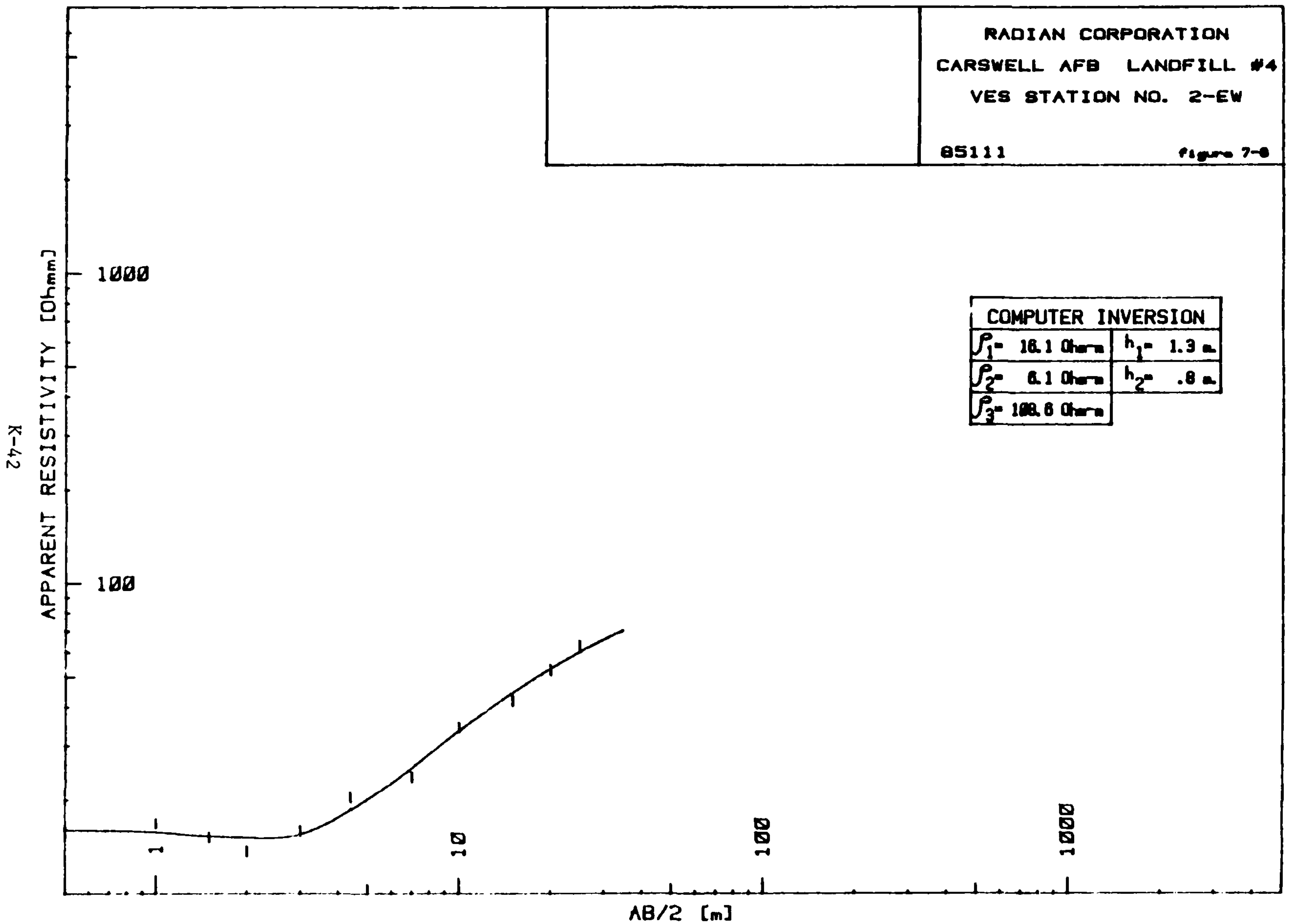

Project 688111
RADIAN CORPORATION
CARSWELL AIR FORCE BASE
LANDFILL 4
EM 34 20 meter SEPARATION
figure 14
STATIONS
LINE
1" = 40' scale
feet



RADIAN CORPORATION
CARSWELL AFB LANDFILL #4
VES STATION NO. 1-NS
85111
figure 7-5
COMPUTER INVERSION
ρ1= 10.6 Ohm-m
ρ2= 27.3 Ohm-m
ρ3= 3.5 Ohm-m
ρ4= 113.9 Ohm-m
h1= .3 m.
h2= 1.4 m.
h3= 1.5 m.
APPARENT RESISTIVITY [Ohmm]
1000
100
1
10
100
1000
AB/2 [m]

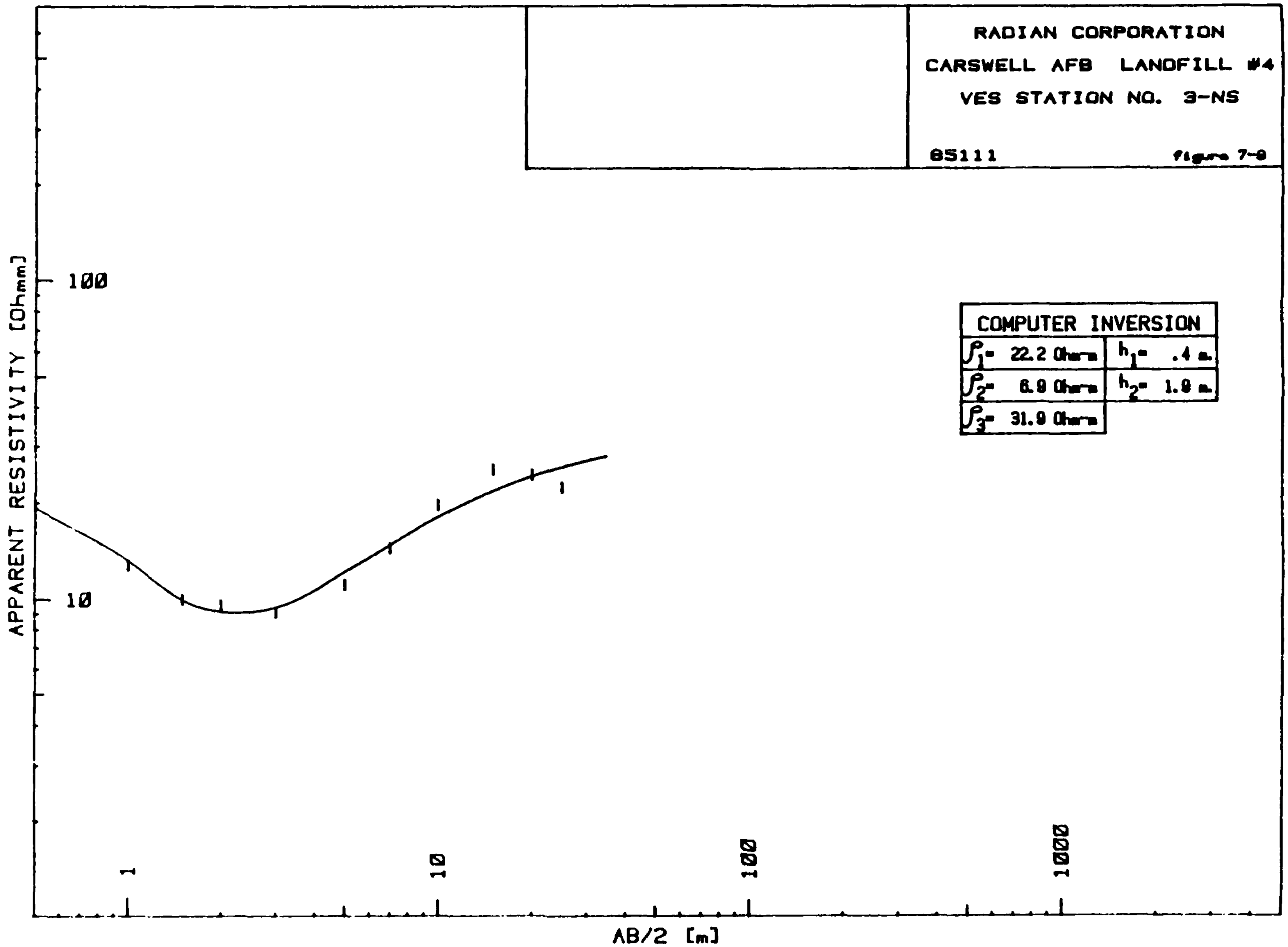

RADIAN CORPORATION
CARSWELL AFB LANDFILL #4
VES STATION NO. 1-EW
85111
figure 7-8
COMPUTER INVERSION
ρ1= 10.4 Ohm-m
h1= .3 m.
ρ2= 27.0 Ohm-m
h2= 1.4 m.
ρ3= 3.6 Ohm-m
h3= 1.6 m.
ρ4= 90.1 Ohm-m
APPARENT RESISTIVITY [Ohm-m]
1000
100
1
10
100
1000
AB/2 [m]

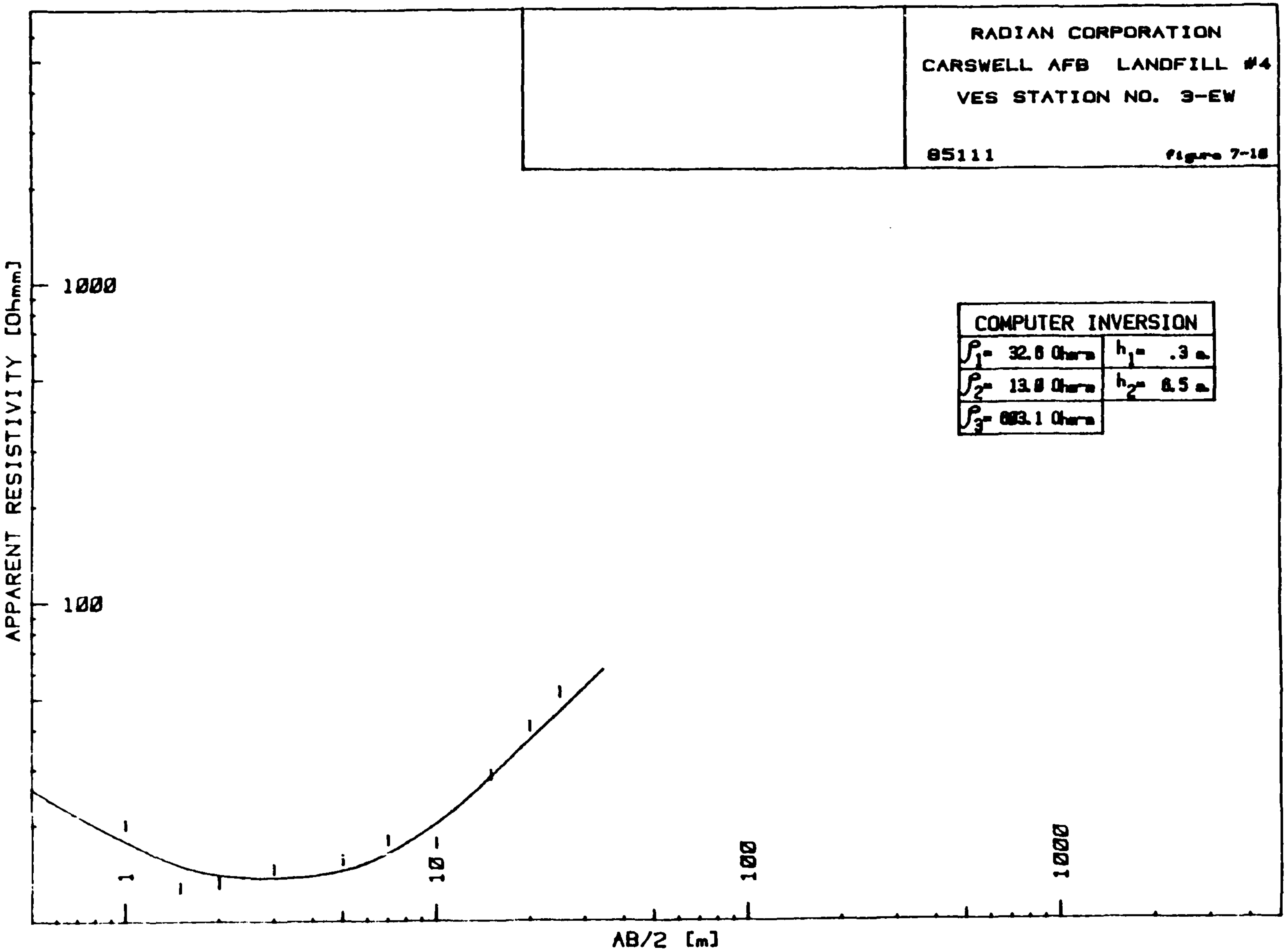

RADIAN CORPORATION
CARSWELL AFB LANDFILL #4
VES STATION NO. 2-NS
85111
figure 7-7
COMPUTER INVERSION
ρ_1= 16.0 Ohm-m
h_1= 2.2 m.
ρ_2= 4.1 Ohm-m
h_2= 1.3 m.
ρ_3= 245.0 Ohm-m
APPARENT RESISTIVITY [Ohm-m]
1000
100
1
10
100
1000
AB/2 [m]

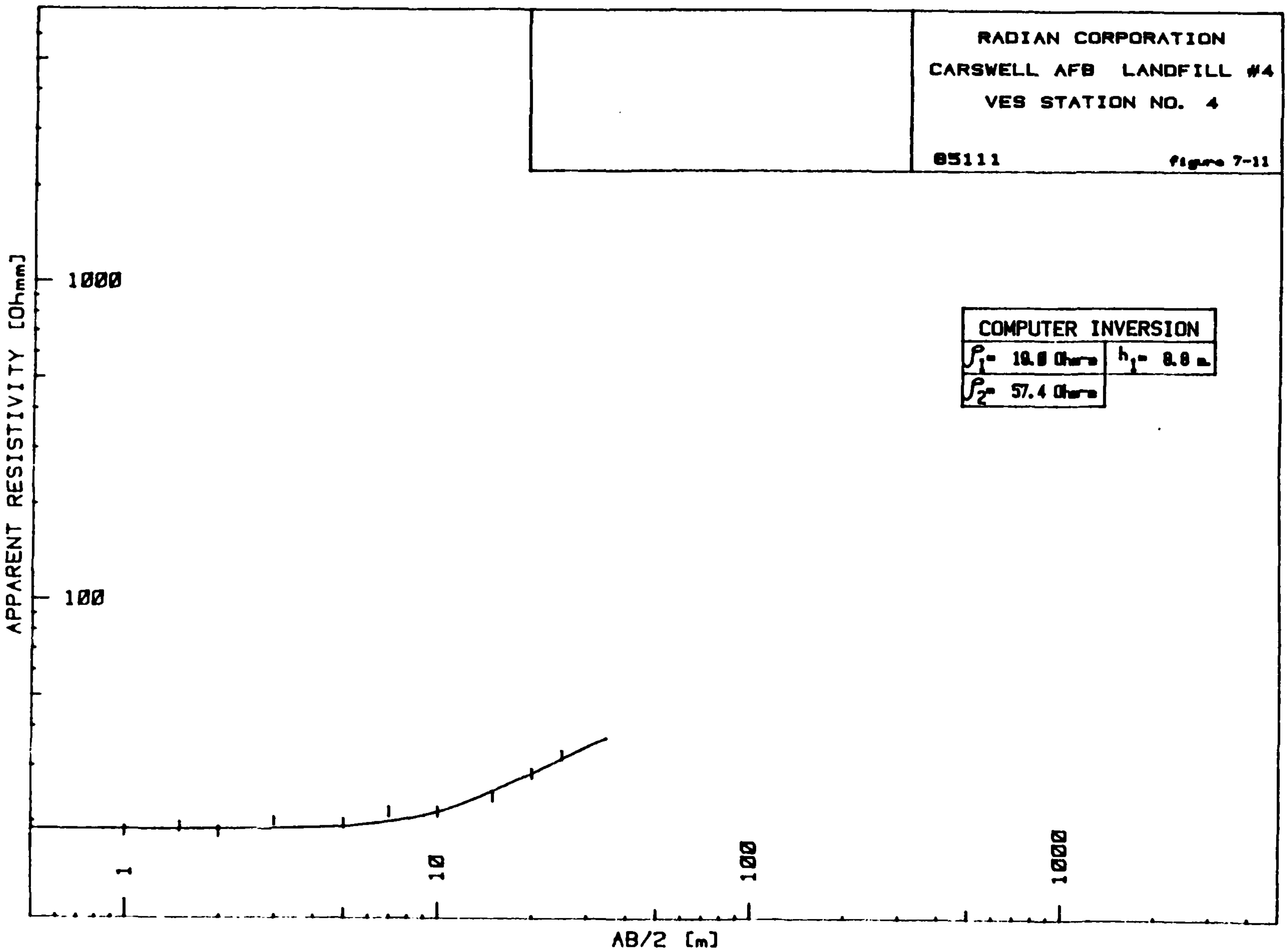


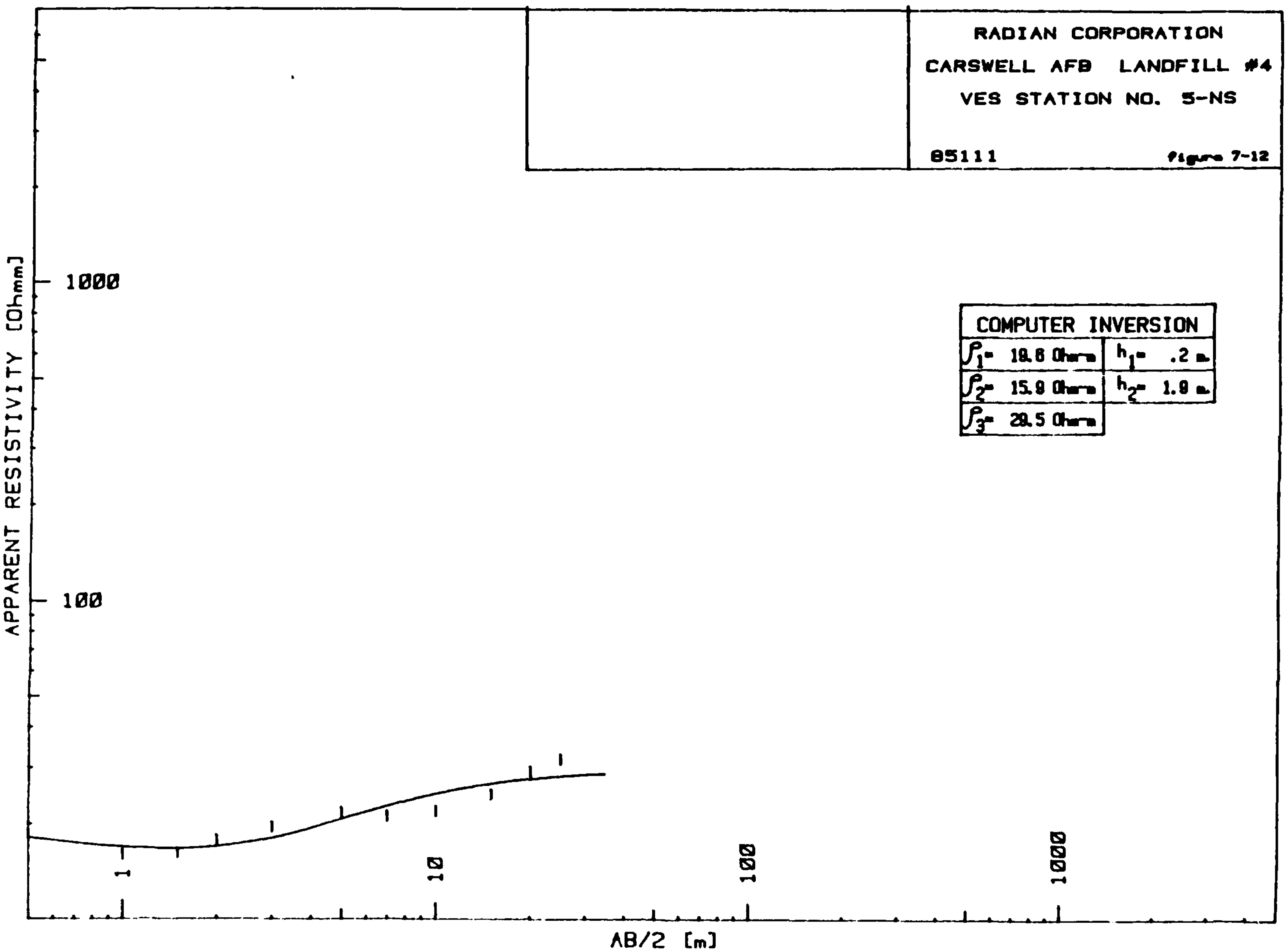
RADIAN CORPORATION
CARSWELL AFB LANDFILL #4
VES STATION NO. 2-EW
85111
figure 7-8
COMPUTER INVERSION
ρ1= 16.1 Ohm-m
h1= 1.3 m.
ρ2= 6.1 Ohm-m
h2= .8 m.
ρ3= 100.6 Ohm-m
1000
100
APPARENT RESISTIVITY [Ohmm]
1
10
100
1000
AB/2 [m]

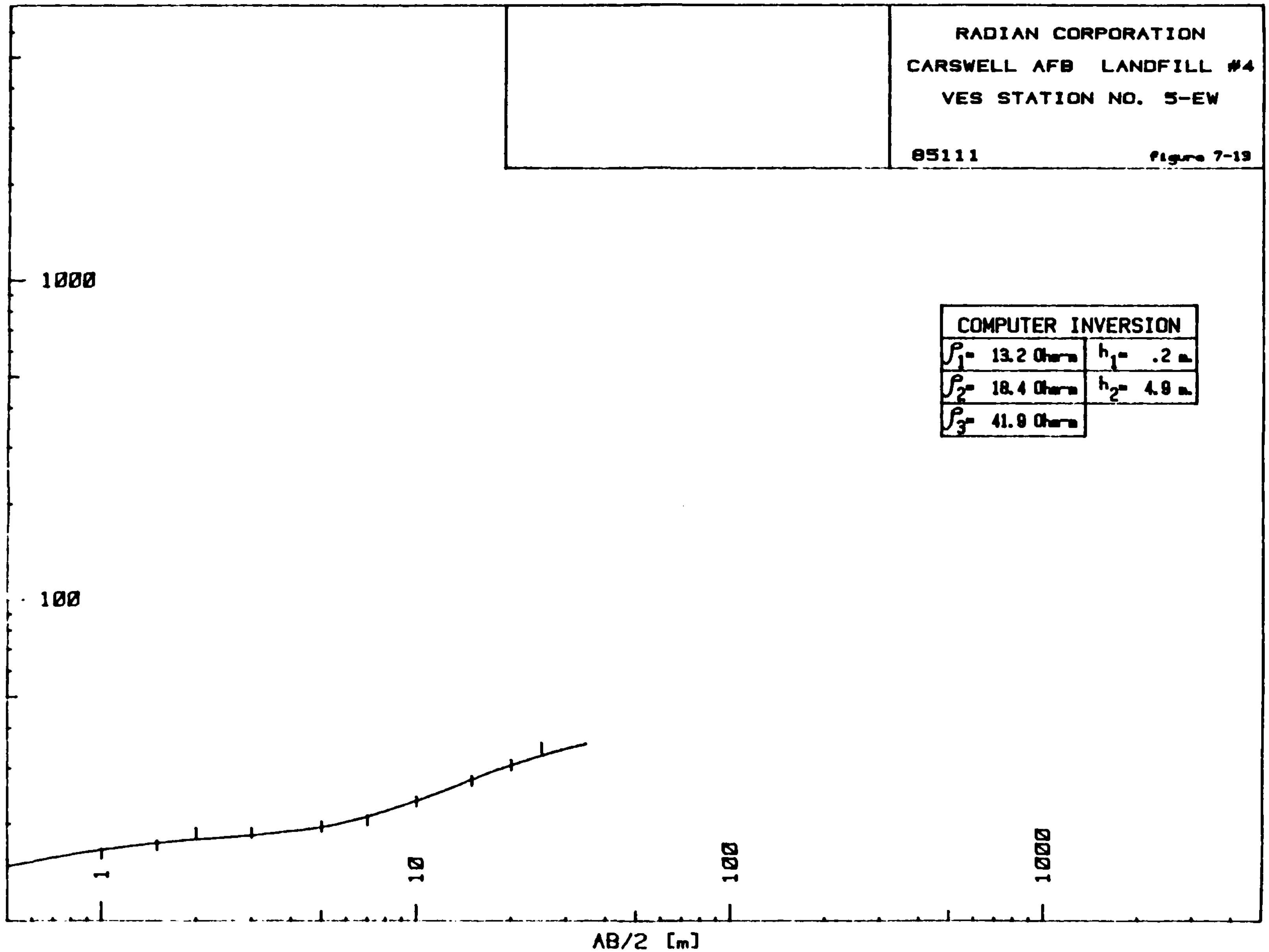
ALL R


RADIAN CORPORATION
CARSWELL AFB LANDFILL #4
VES STATION NO. 3-NS
85111
figure 7-9
COMPUTER INVERSION
ρ1= 22.2 Ohm-m
h1= .4 m.
ρ2= 6.9 Ohm-m
h2= 1.9 m.
ρ3= 31.9 Ohm-m
APPARENT RESISTIVITY [Ohm-m]
100
10
1
10
100
1000
AB/2 [m]

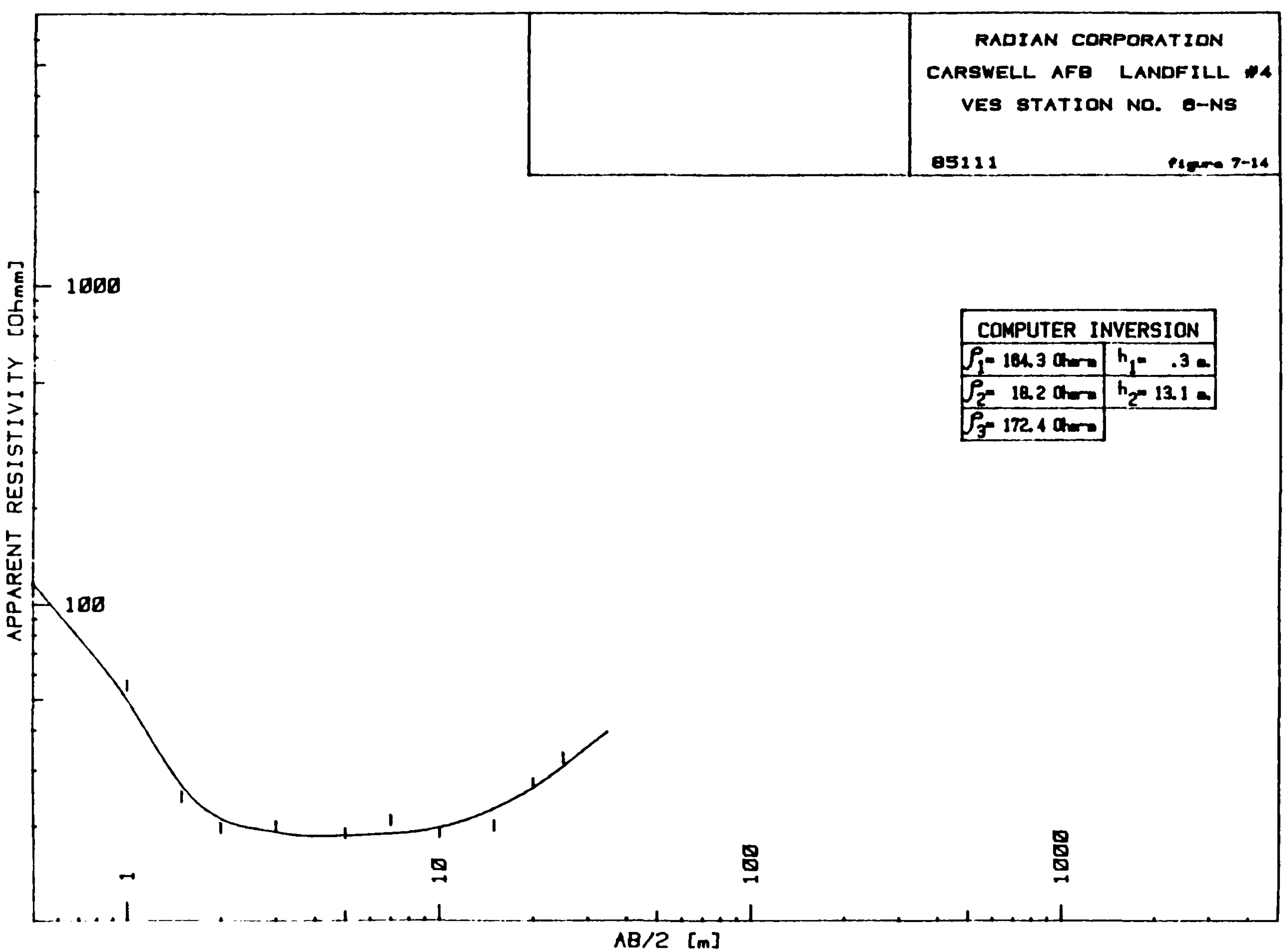

RADIAN CORPORATION
CARSWELL AFB LANDFILL #4
VES STATION NO. 3-EW
85111
figure 7-18
COMPUTER INVERSION
ρ1= 32.8 Ohm-m
ρ2= 13.8 Ohm-m
ρ3= 883.1 Ohm-m
h1= .3 m
h2= 8.5 m
APPARENT RESISTIVITY [Ohm-m]
1000
100
AB/2 [m]
1
10
100
1000

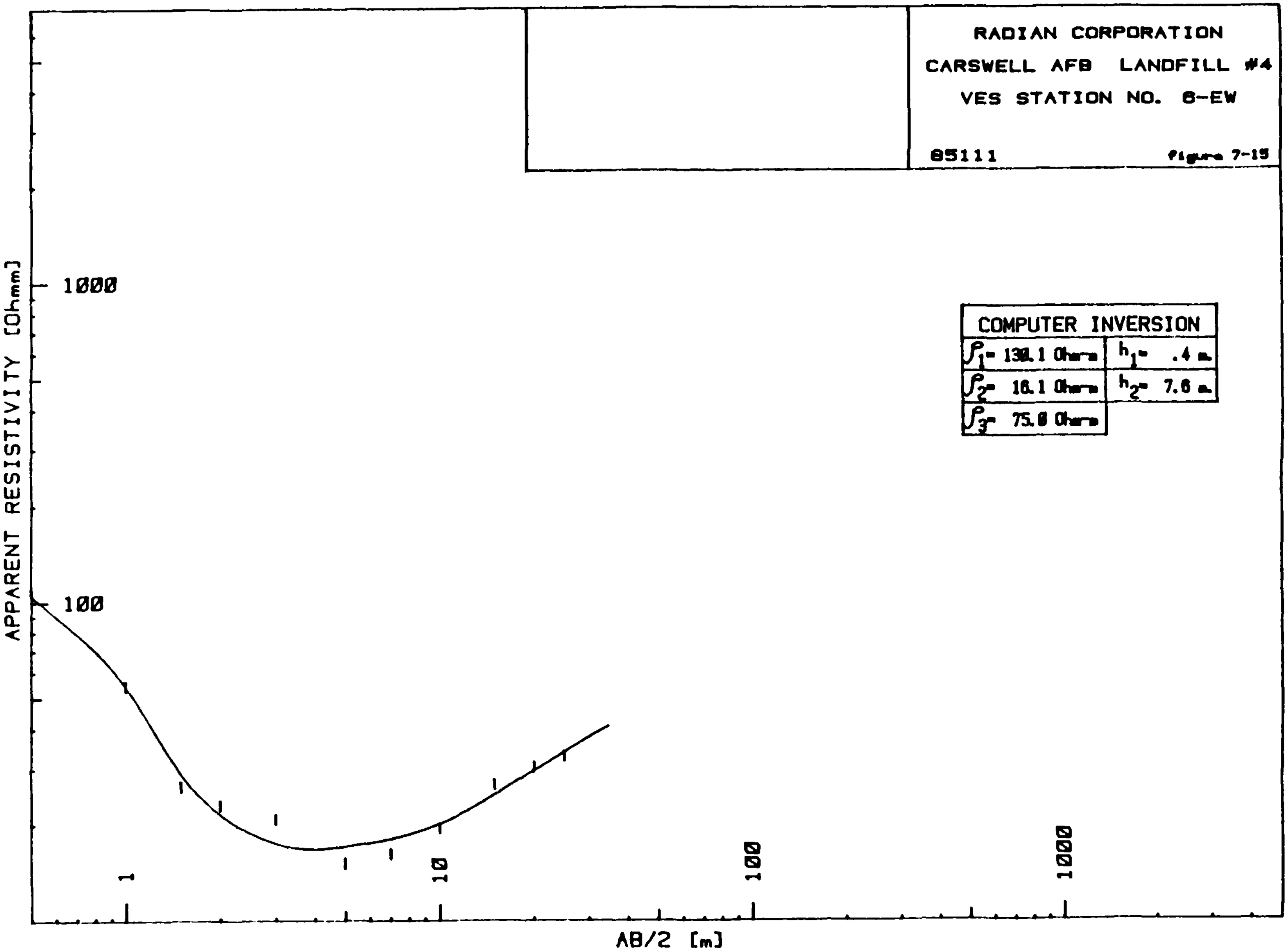

RADIAN CORPORATION
CARSWELL AFB LANDFILL #4
VES STATION NO. 4
85111
figure 7-11
COMPUTER INVERSION
ρ_2= 57.4 Ohm-m
APPARENT RESISTIVITY [Ohm-m]
1000
100
1
10
100
1000
AB/2 [m]


RADIAN CORPORATION
CARSWELL AFB LANDFILL #4
VES STATION NO. 5-NS
85111
figure 7-12
COMPUTER INVERSION
ρ1= 19.8 Ohm-m
h1= .2 m.
ρ2= 15.9 Ohm-m
h2= 1.9 m.
ρ3= 29.5 Ohm-m
APPARENT RESISTIVITY [Ohm-m]
1000
100
1
10
100
1000
AB/2 [m]



RADIAN CORPORATION
CARSWELL AFB LANDFILL #4
VES STATION NO. 5-EW
85111
figure 7-13
COMPUTER INVERSION
ρ_1= 13.2 Ohm-m
h_1= .2 m.
ρ_2= 18.4 Ohm-m
h_2= 4.9 m.
ρ_3= 41.9 Ohm-m
APPARENT RESISTIVITY [Ohmm]
1000
100
1
10
100
1000
AB/2 [m]


RADIAN CORPORATION
CARSWELL AFB LANDFILL #4
VES STATION NO. 8-NS
85111
figure 7-14
COMPUTER INVERSION
ρ_1= 184.3 Ohm-m
h_1= .3 m.
ρ_2= 18.2 Ohm-m
h_2= 13.1 m.
ρ_3= 172.4 Ohm-m
APPARENT RESISTIVITY [Ohm-m]
1000
100
1
10
100
1000
AB/2 [m]


RADIAN CORPORATION
CARSWELL AFB LANDFILL #4
VES STATION NO. 6-EW
85111
figure 7-15
COMPUTER INVERSION
ρ1= 130.1 Ohm-m
h1= .4 m.
ρ2= 16.1 Ohm-m
h2= 7.6 m.
ρ3= 75.0 Ohm-m
APPARENT RESISTIVITY [Ohm-m]
1000
100
1
10
100
1000
AB/2 [m]

AD-A174 095 INSTALLATION RESTORATION PROGRAM PHASE II CONFIRMATION/QUANTIFICATION STA..(U) RADIAN CORP AUSTIN TX OCT 86 F33615-84-D-4402

4/4

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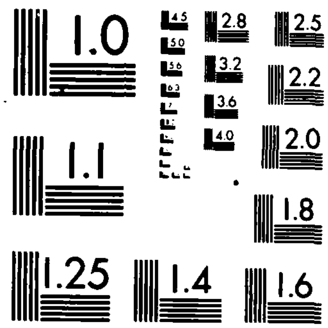
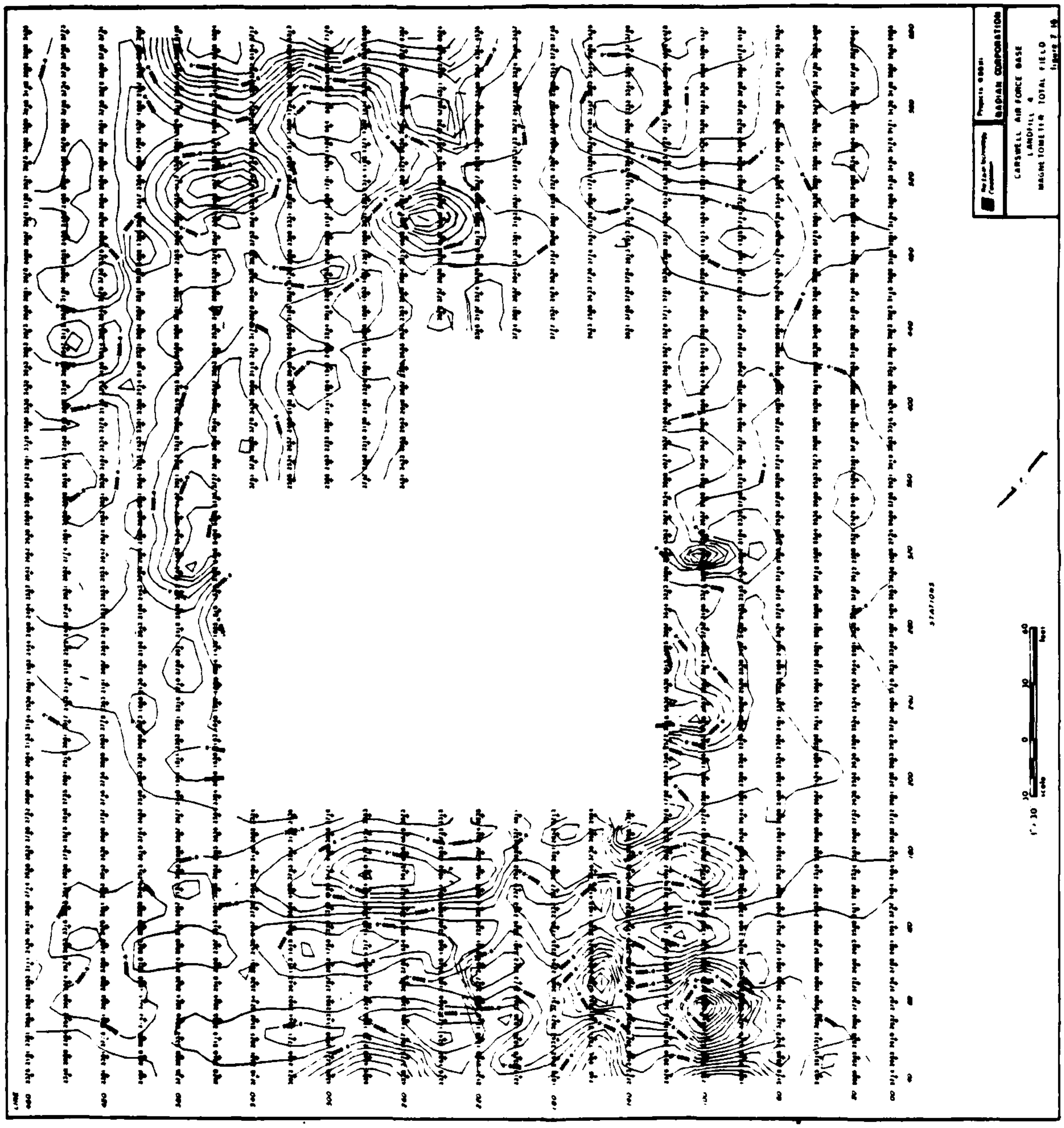
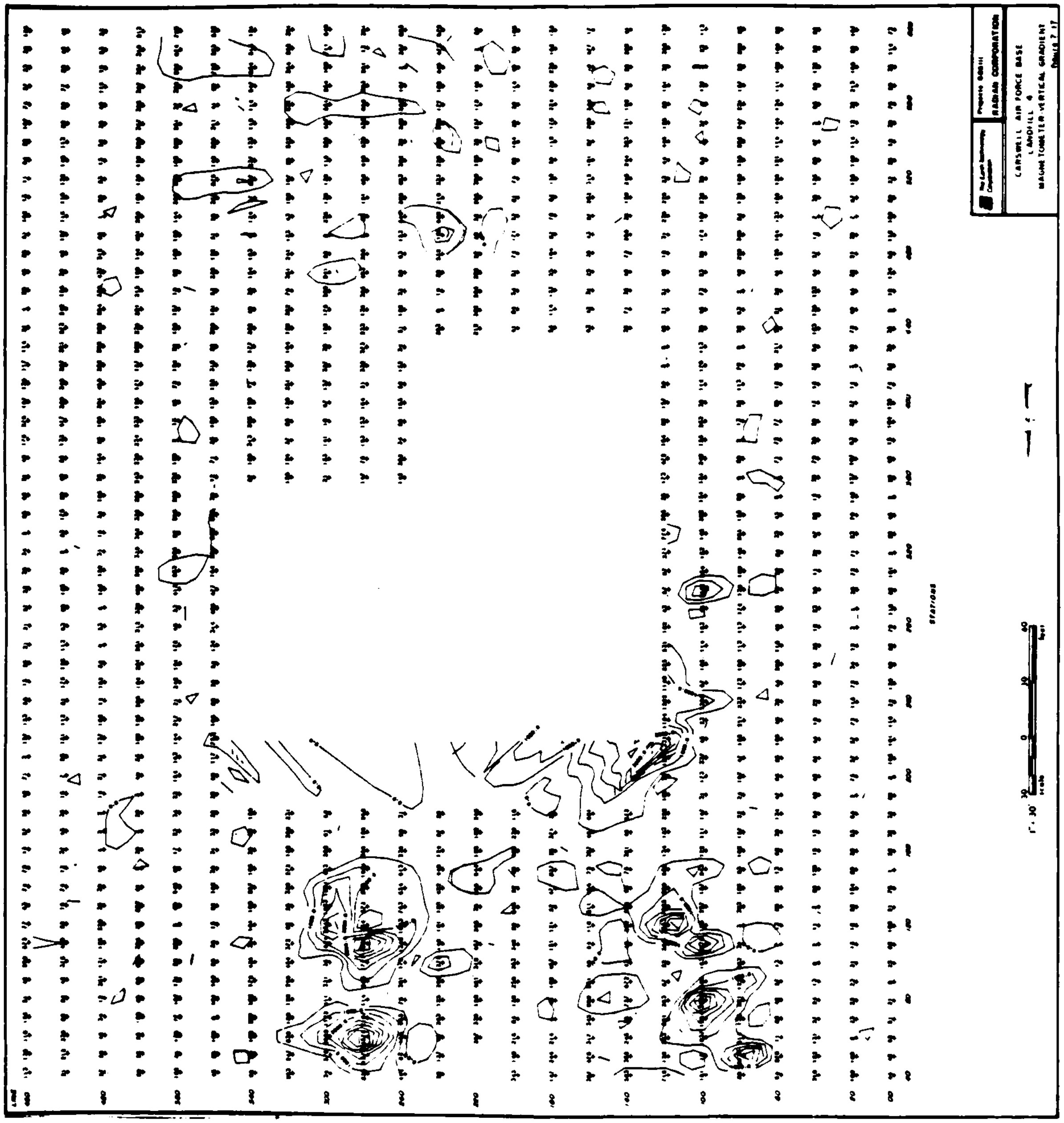
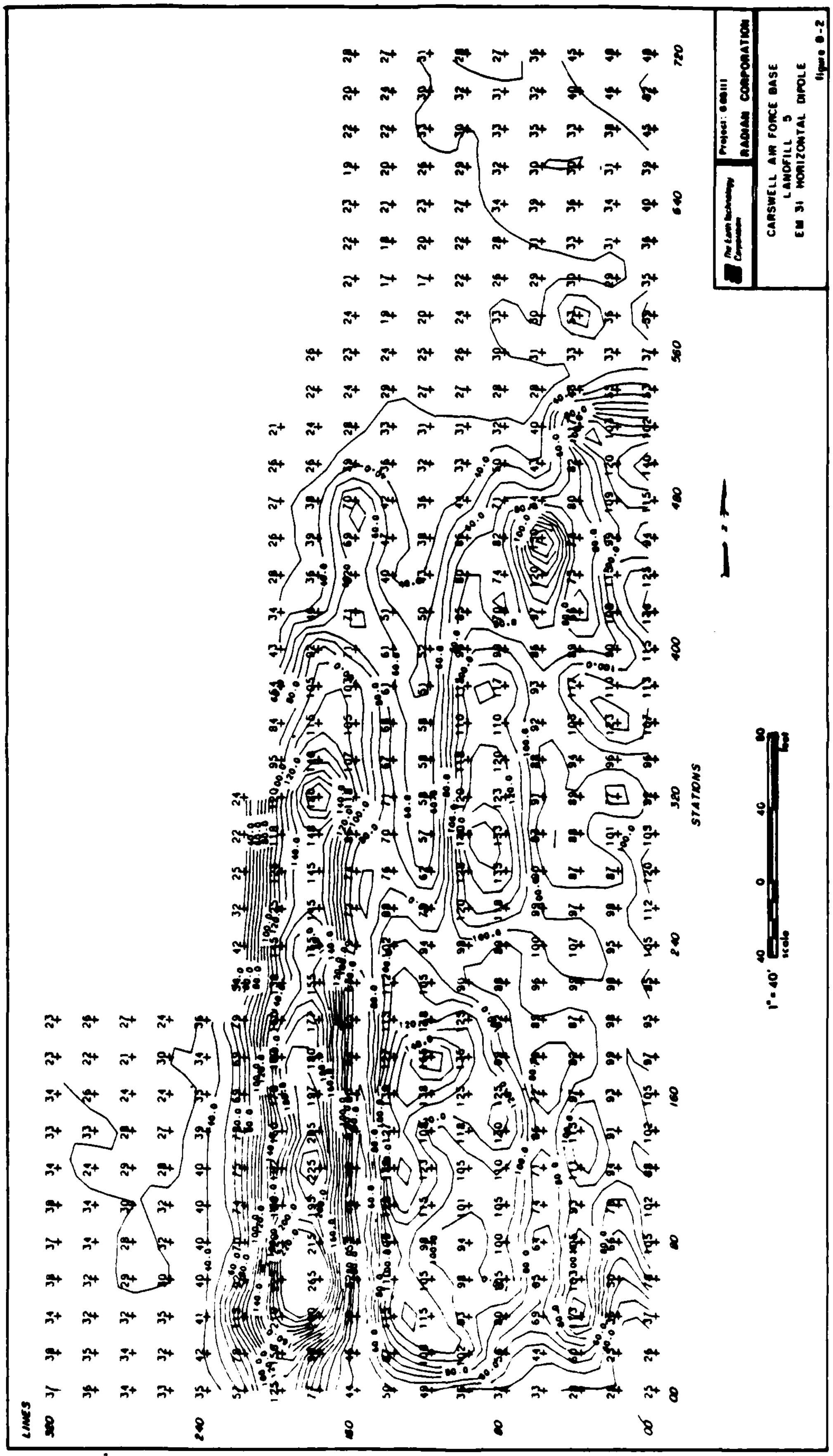
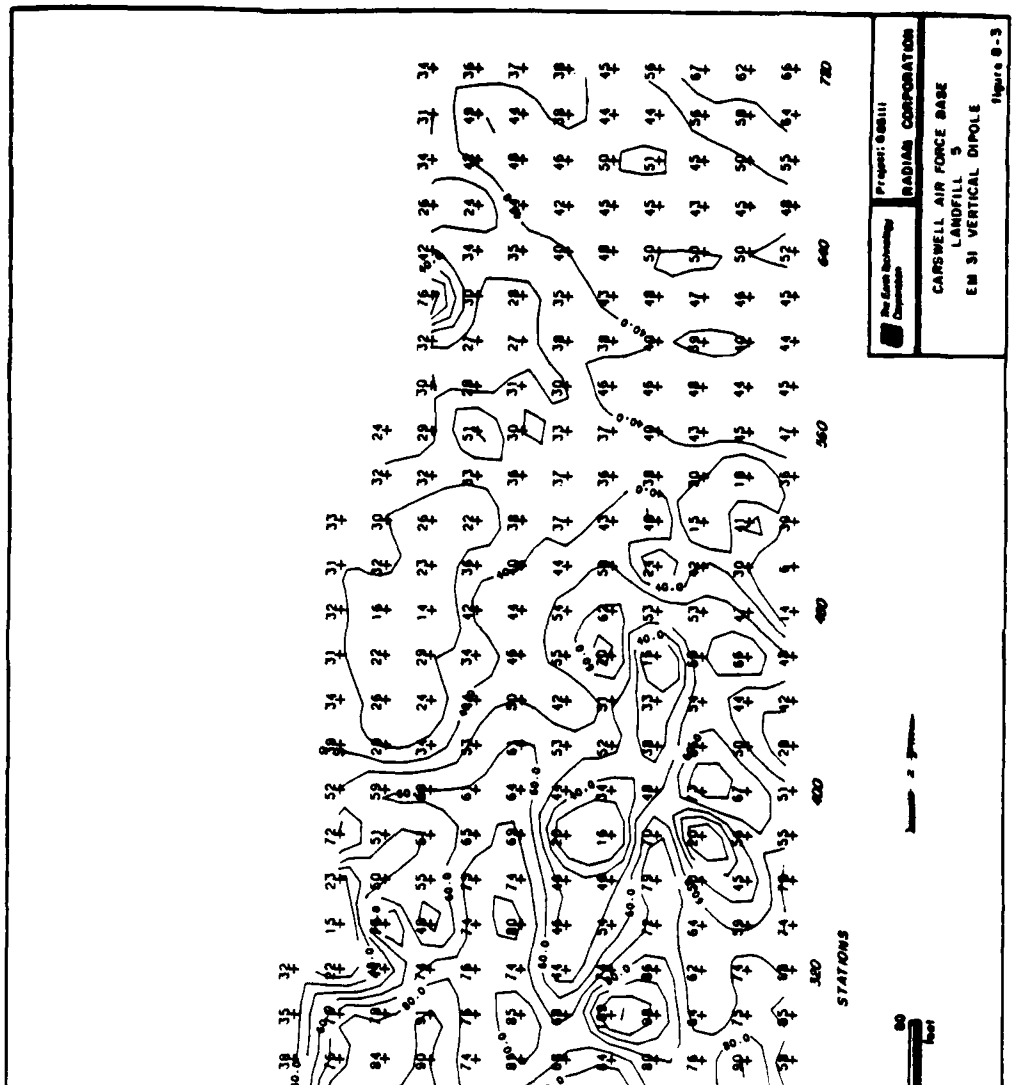


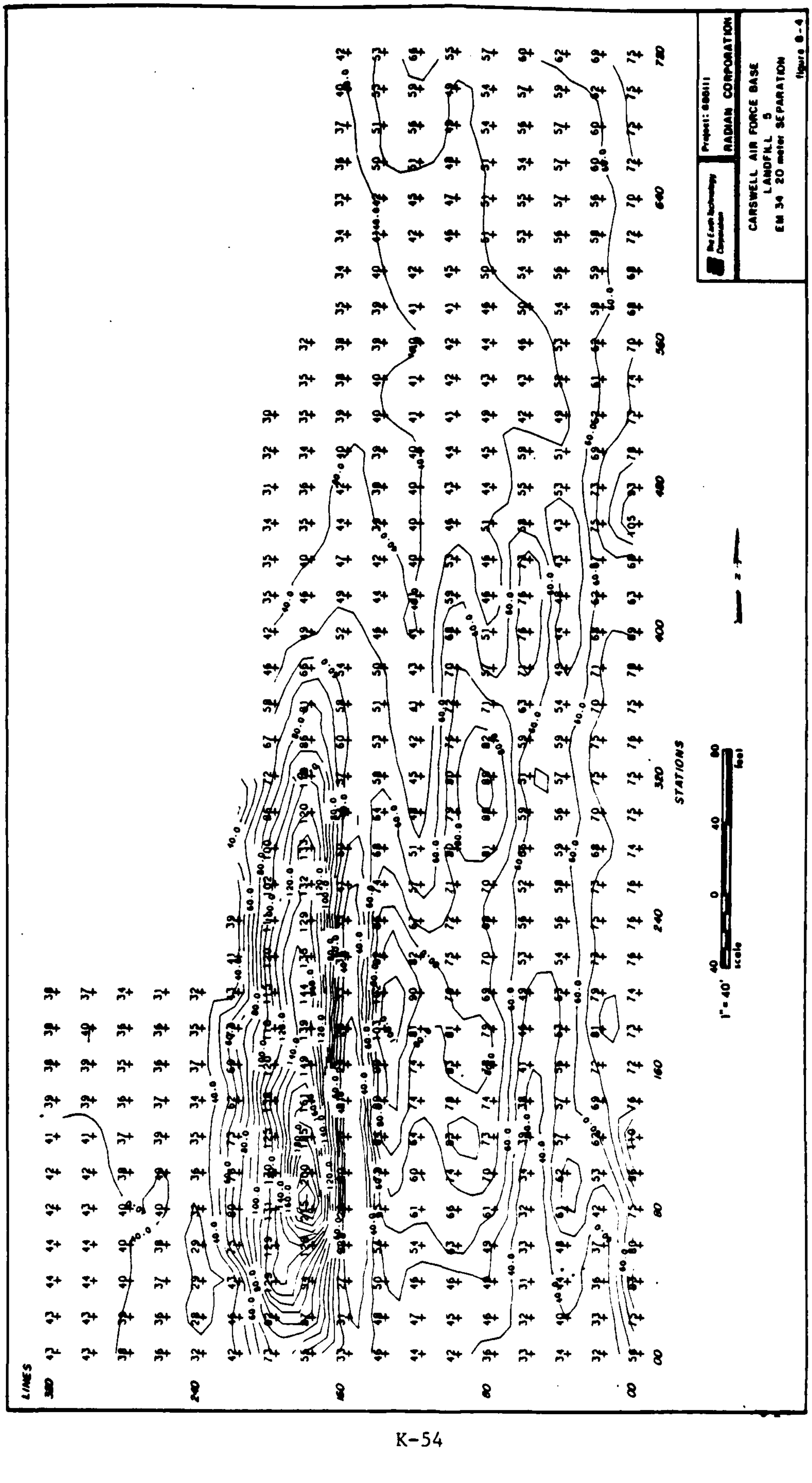
MICROCOPY RESOLUTION TEST CHART
NATIONAL BUREAU OF STANDARDS-1963-A

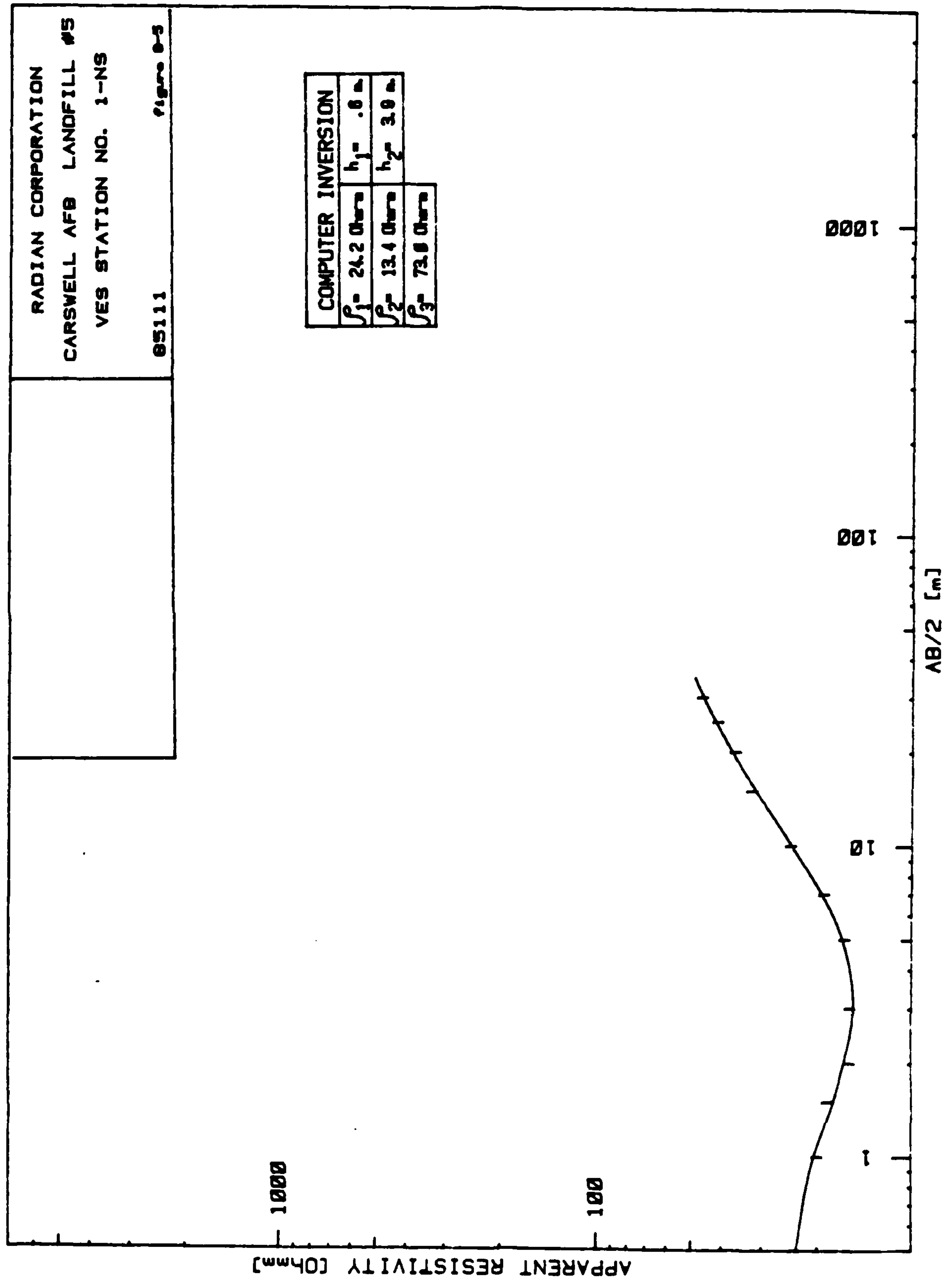

RADIAN CORPORATION
CARSWELL AIR FORCE BASE
LANDFILL 4
MAGNETOMETER TOTAL FIELD
STATIONS

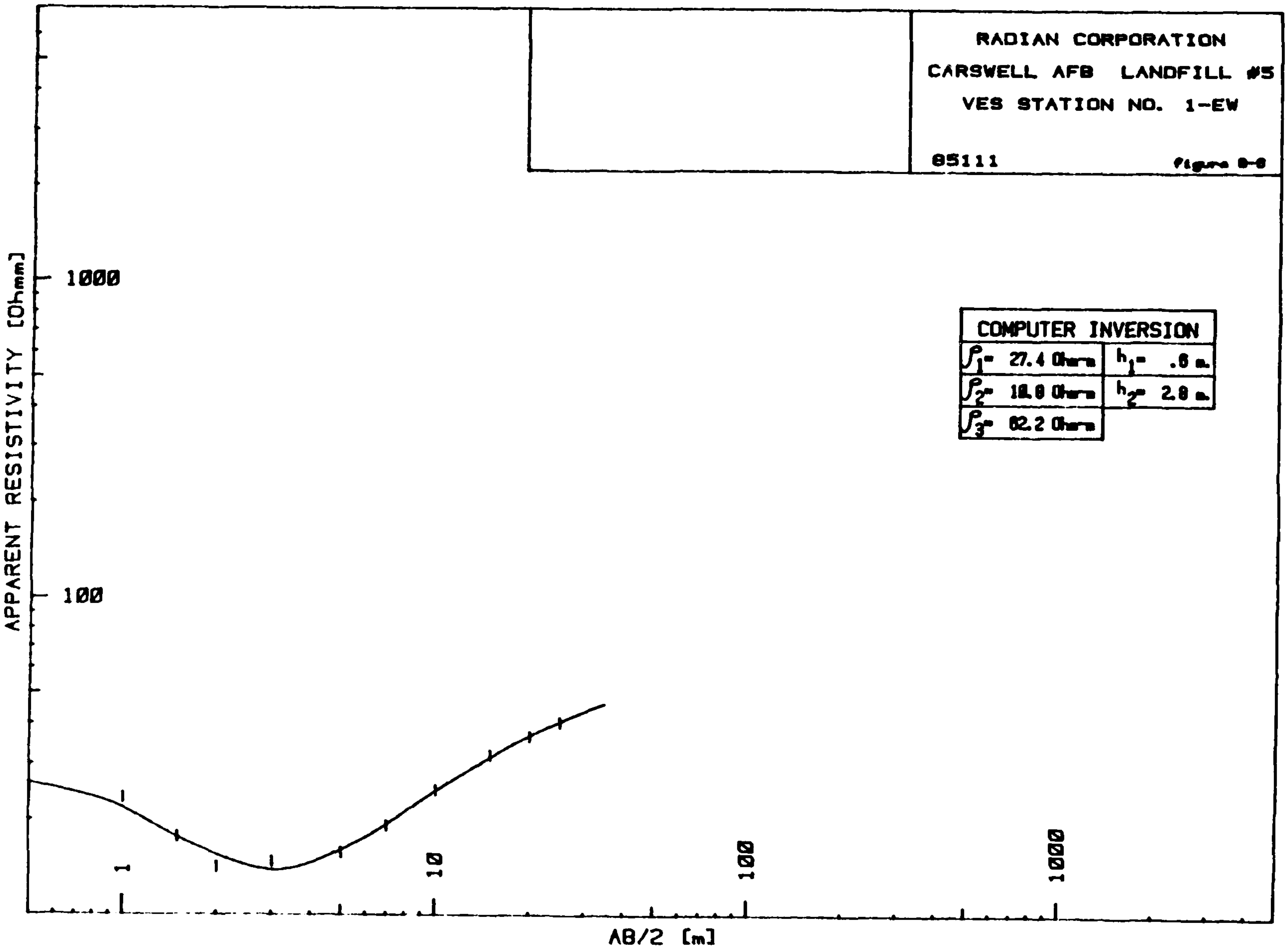

RADIAN CORPORATION
CARSWELL AIR FORCE BASE
LANDFILL 4
MAGNETOMETER-VERTICAL GRADIENT
STATIONS

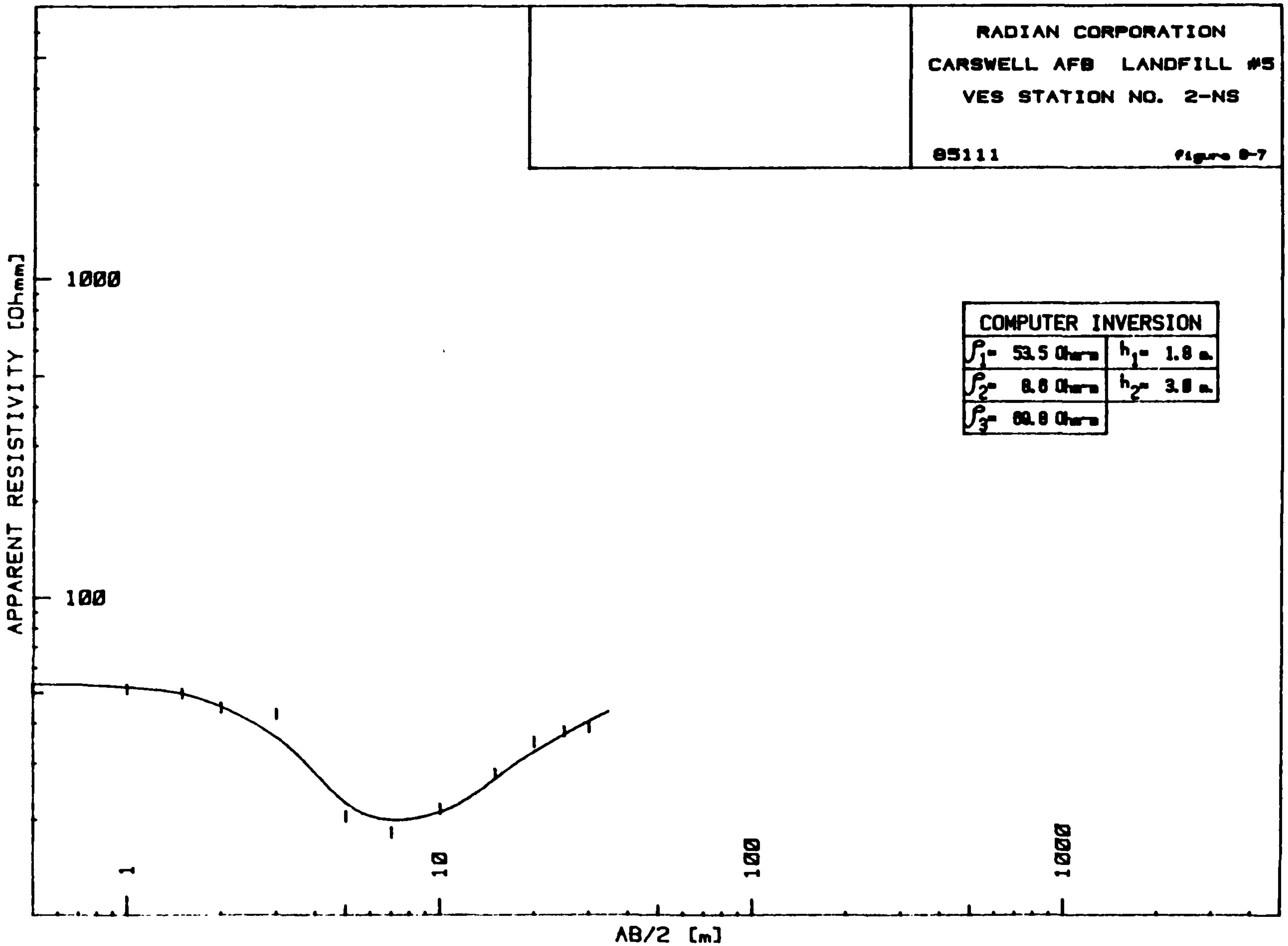

Radian Corporation
CARSWELL AIR FORCE BASE
LANDFILL 5
EM 31 HORIZONTAL DIPOLE
Figure B-2
STATIONS
LINES
1" = 40'
scale
feet

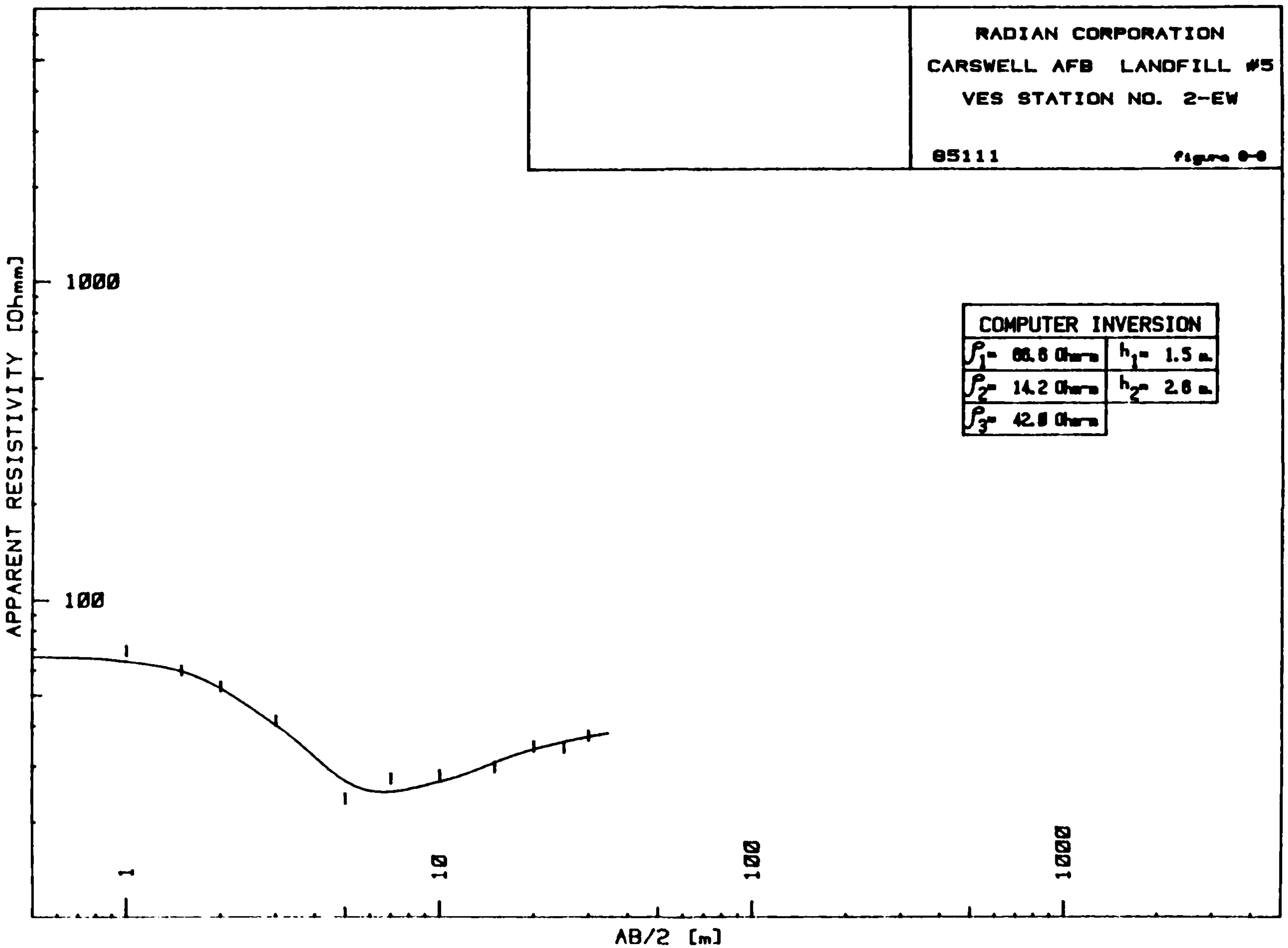

RADIAN CORPORATION
CARSWELL AIR FORCE BASE
LANDFILL 5
EM 31 VERTICAL DIPOLE
Figure B-3
STATIONS
LINES
1" = 40'
scale
feet

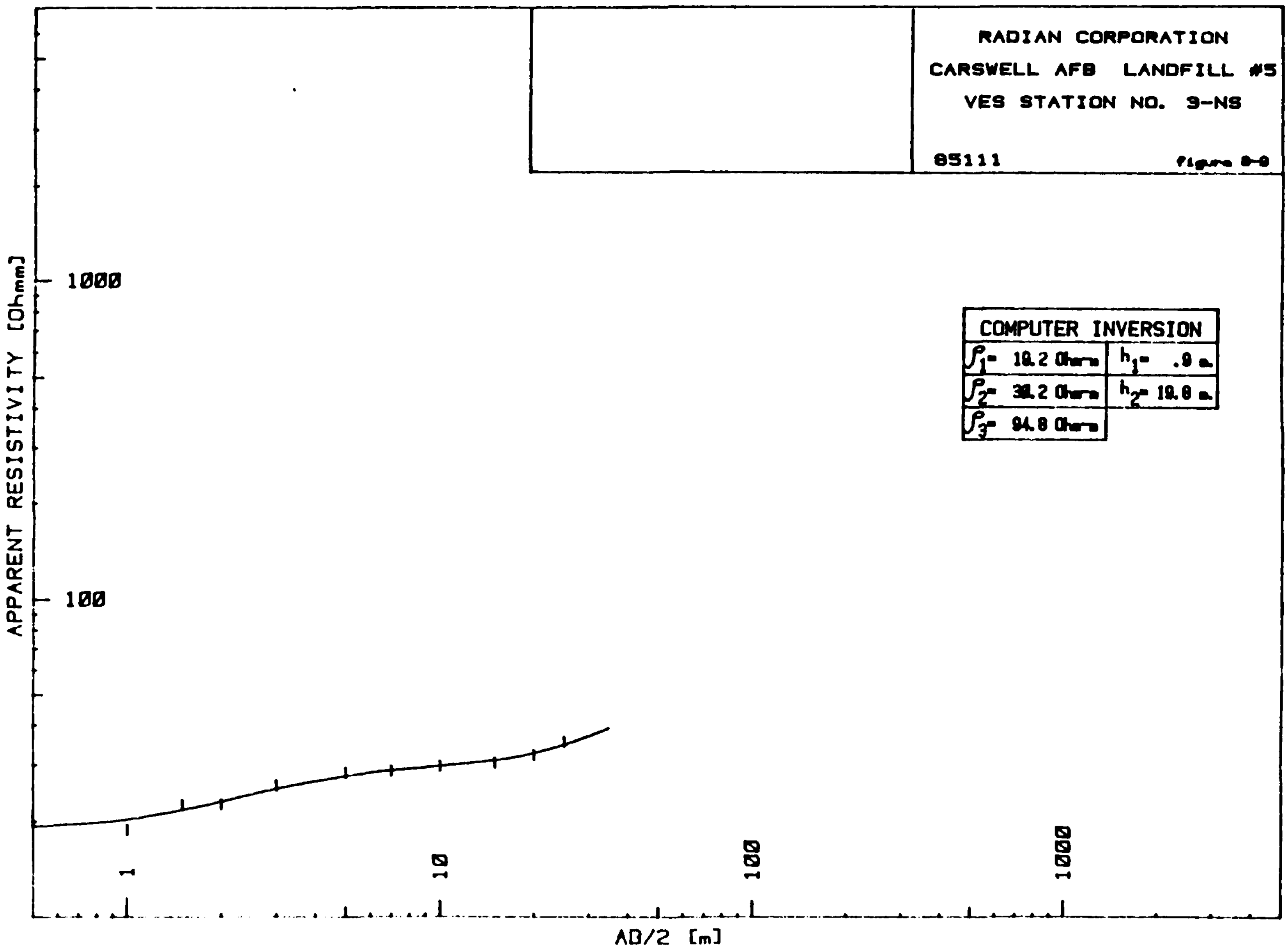

RADIAN CORPORATION
CARSWELL AIR FORCE BASE
LANDFILL 5
EM 34 20 meter SEPARATION
figure 6-4
STATIONS
LINES
1"=40'
scale
feet

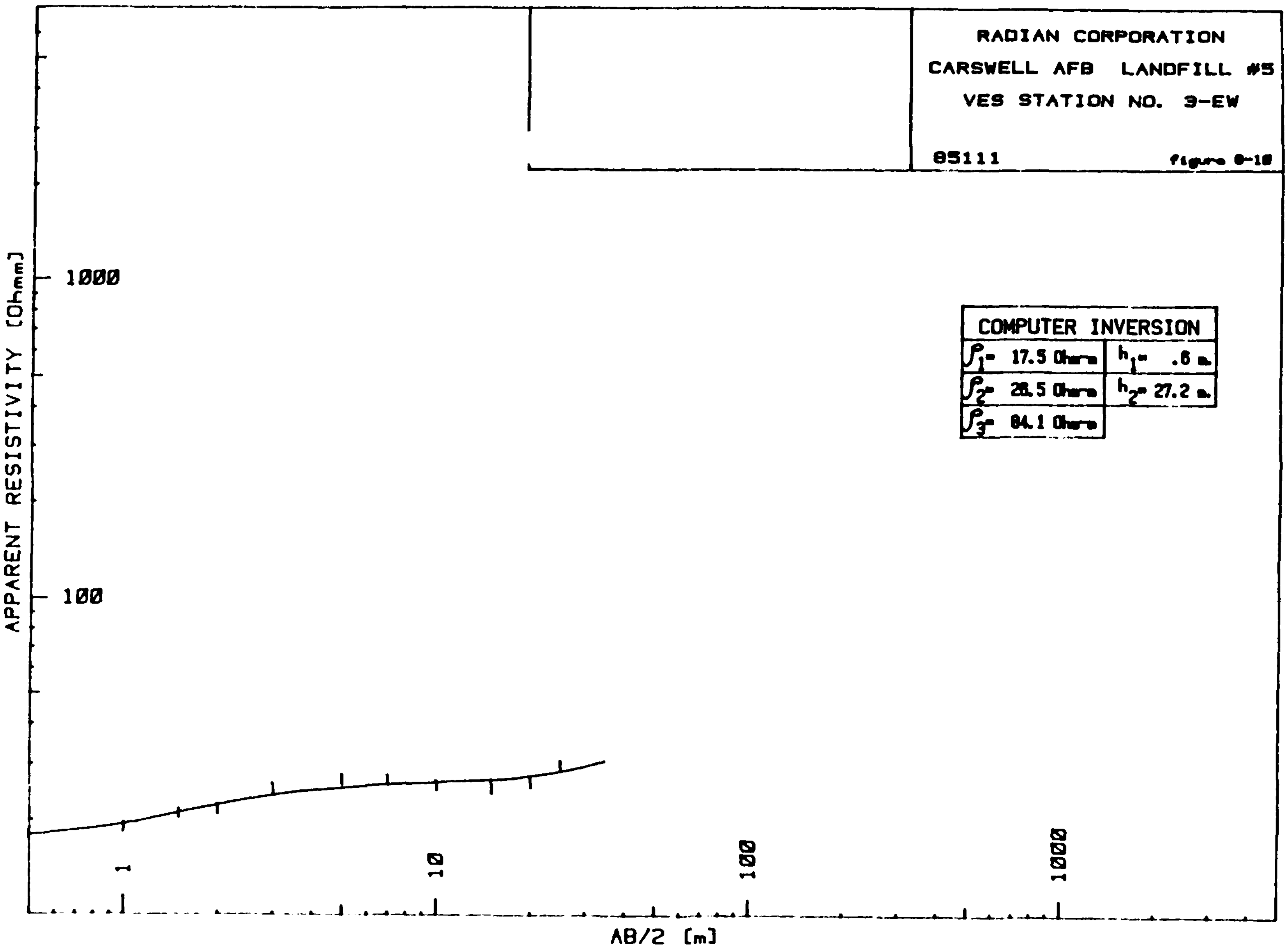

RADIAN CORPORATION
CARSWELL AFB LANDFILL #5
VES STATION NO. 1-NS
85111
COMPUTER INVERSION
ρ1= 24.2 Ohms
h1= .8 m
ρ2= 13.4 Ohms
h2= 3.0 m
ρ3= 73.0 Ohms
APPARENT RESISTIVITY [Ohm-m]
AB/2 [m]
1000
100
1
10
100
1000

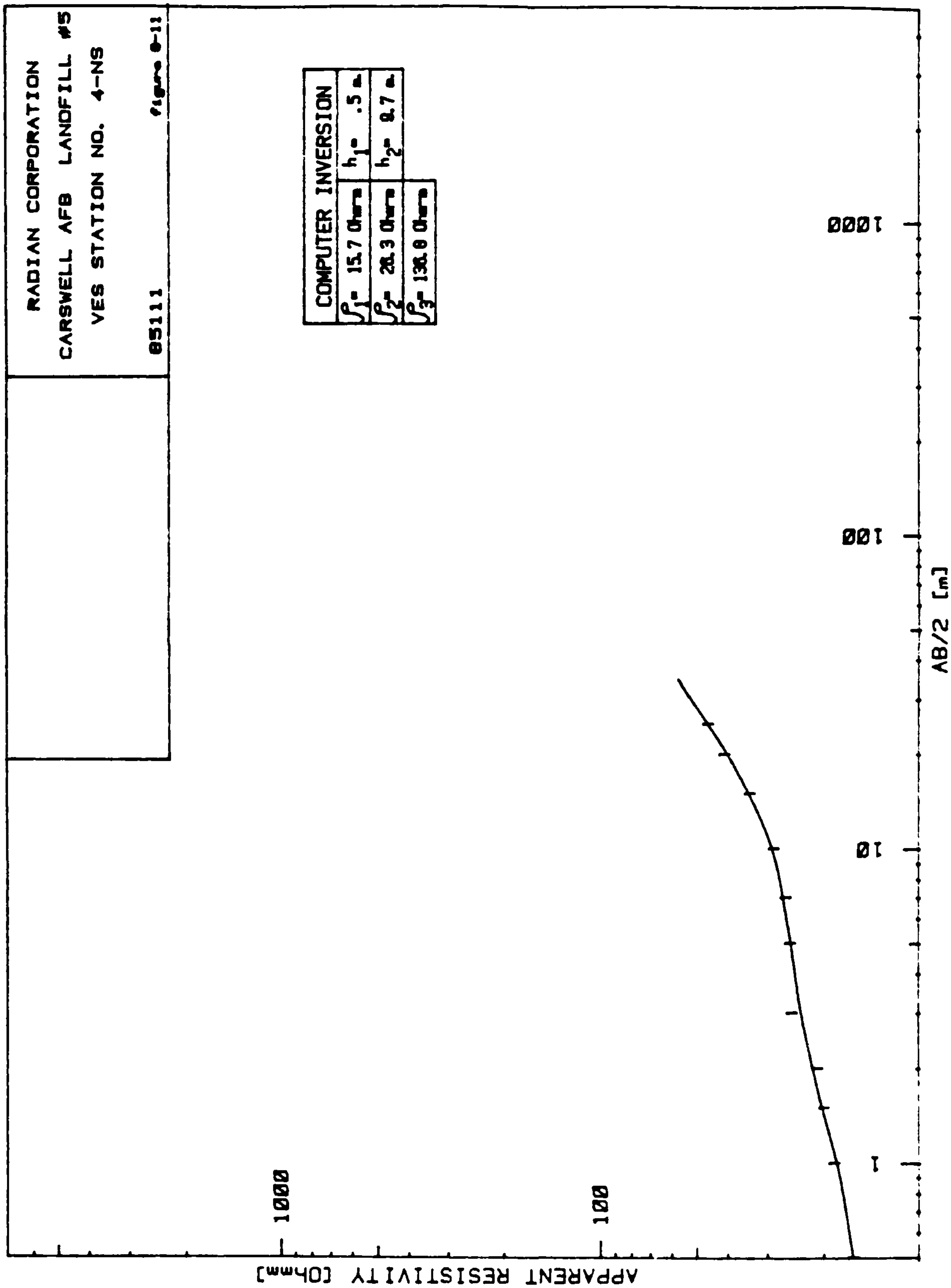

RADIAN CORPORATION
CARSWELL AFB LANDFILL #5
VES STATION NO. 1-EW
85111
Figure B-8
COMPUTER INVERSION
ρ1= 27.4 Ohm-m
h1= .8 m.
ρ2= 18.0 Ohm-m
h2= 2.8 m.
ρ3= 82.2 Ohm-m
APPARENT RESISTIVITY [Ohmm]
1000
100
1
10
100
1000
AB/2 [m]

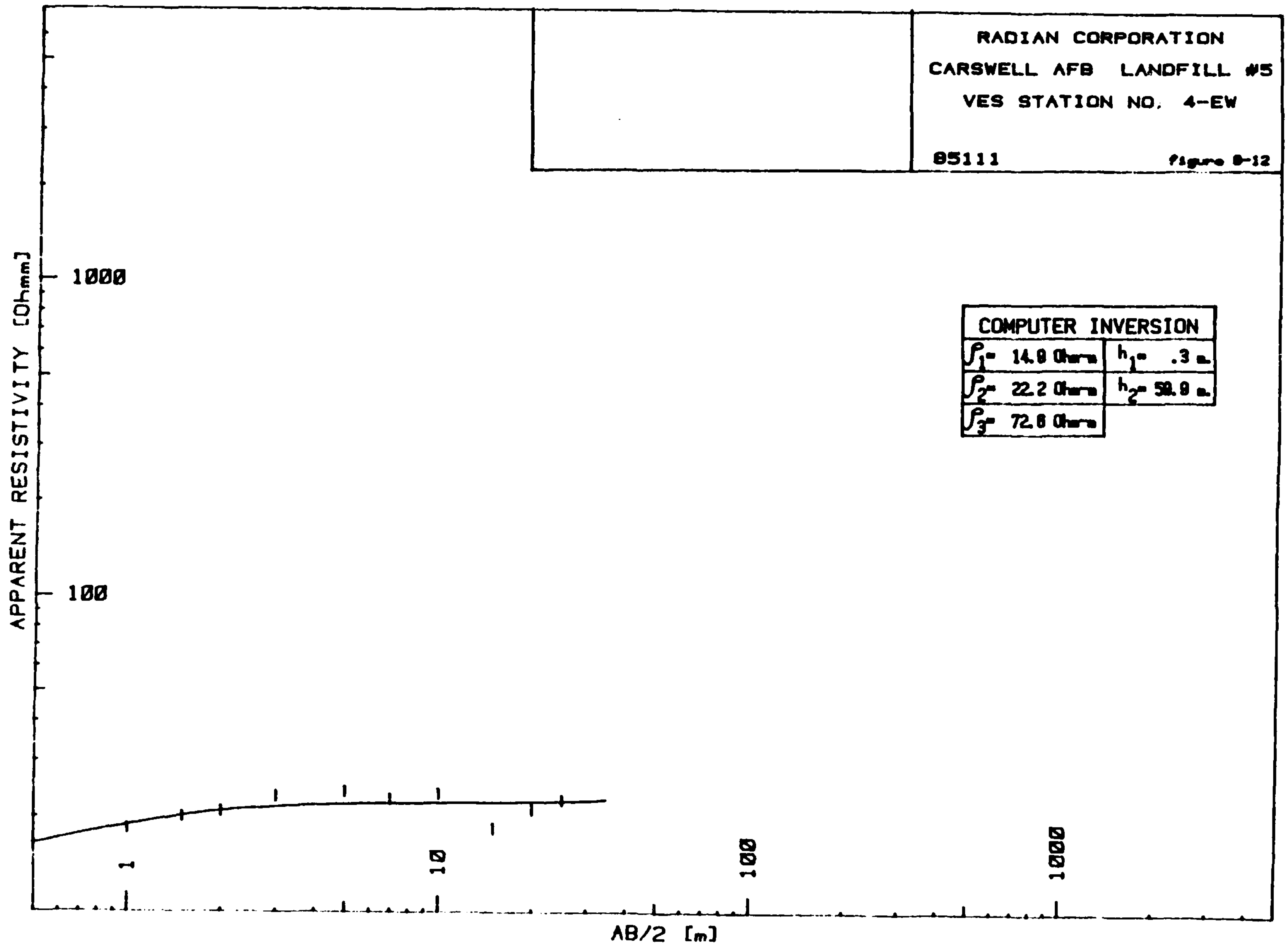

RADIAN CORPORATION
CARSWELL AFB LANDFILL #5
VES STATION NO. 2-NS
85111
COMPUTER INVERSION
ρ_1= 53.5
h_1= 1.8
ρ_2= 8.8
h_2= 3.8
ρ_3= 88.8
APPARENT RESISTIVITY [Ohmm]
1000
100
1
10
100
1000
AB/2 [m]

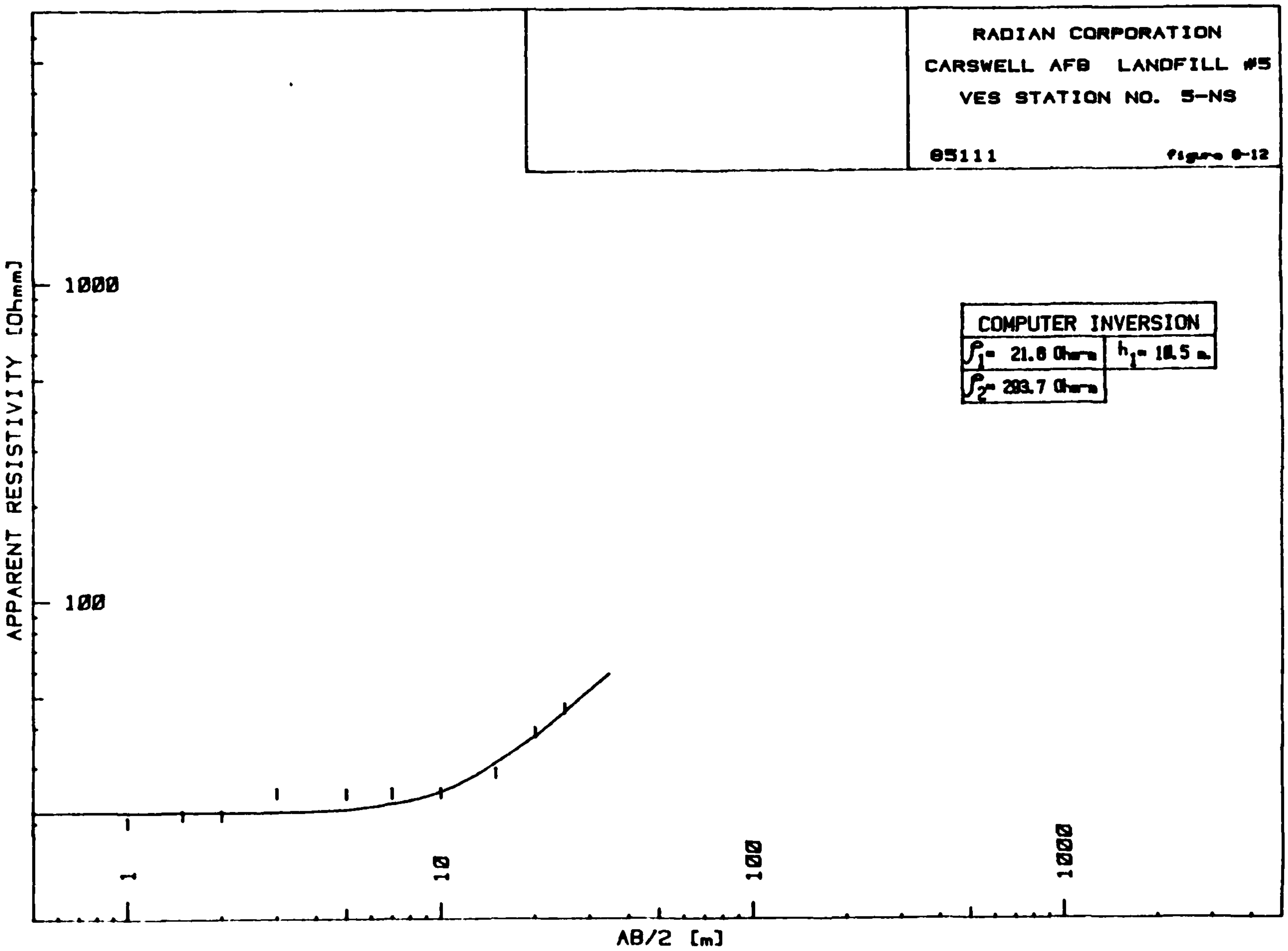

RADIAN CORPORATION
CARSWELL AFB LANDFILL #5
VES STATION NO. 2-EW
85111
COMPUTER INVERSION
h1= 1.5 m.
ρ2= 14.2 Ohms
APPARENT RESISTIVITY [Ohmm]
1000
100
1
10
100
1000
AB/2 [m]

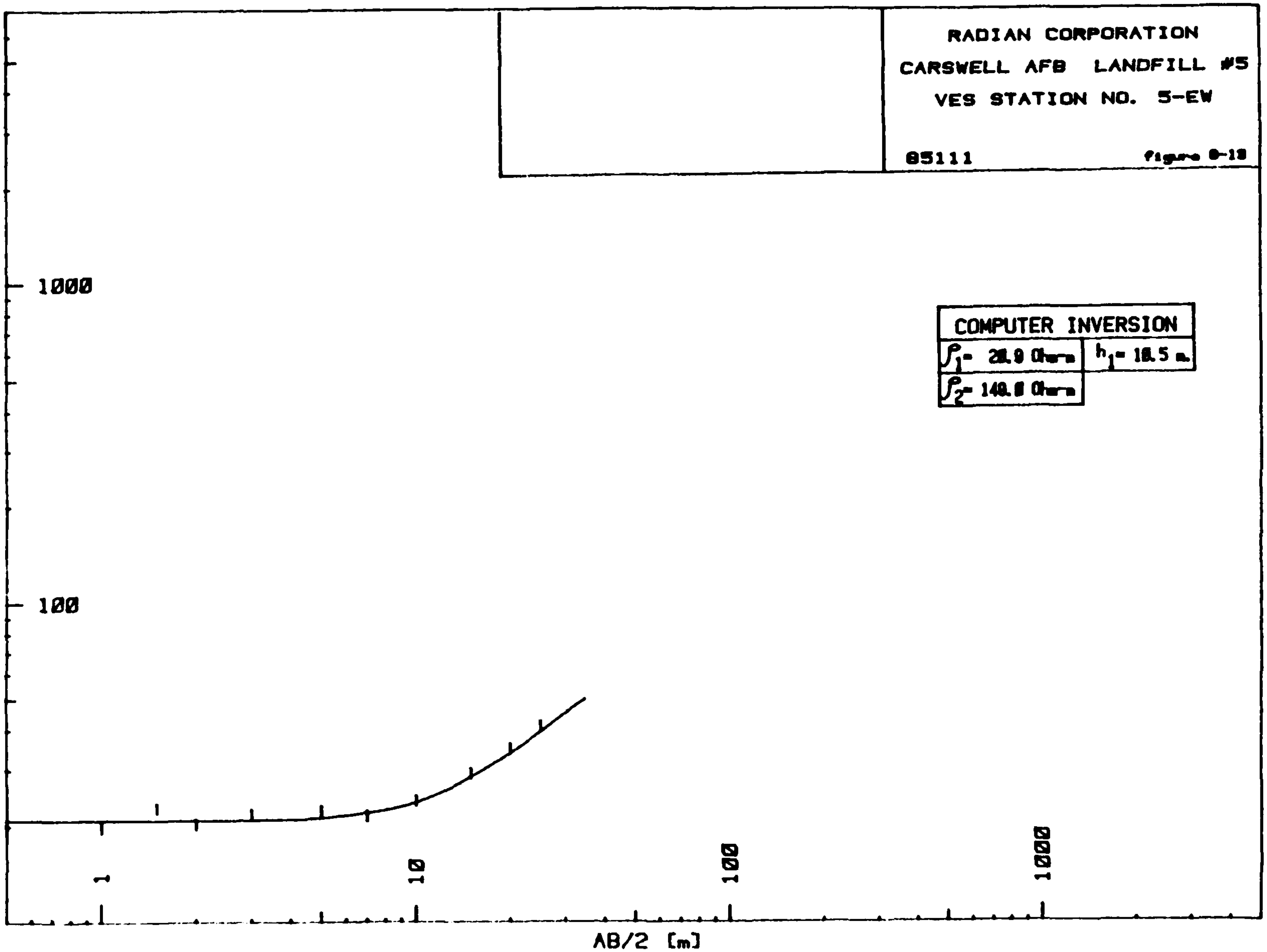

RADIAN CORPORATION
CARSWELL AFB LANDFILL #5
VES STATION NO. 3-NS
85111
COMPUTER INVERSION
ρ1= 10.2 Ohm-m
ρ2= 30.2 Ohm-m
ρ3= 94.8 Ohm-m
h1= .9 m
h2= 10.8 m
APPARENT RESISTIVITY [Ohm-m]
1000
100
1
10
100
1000
AB/2 [m]

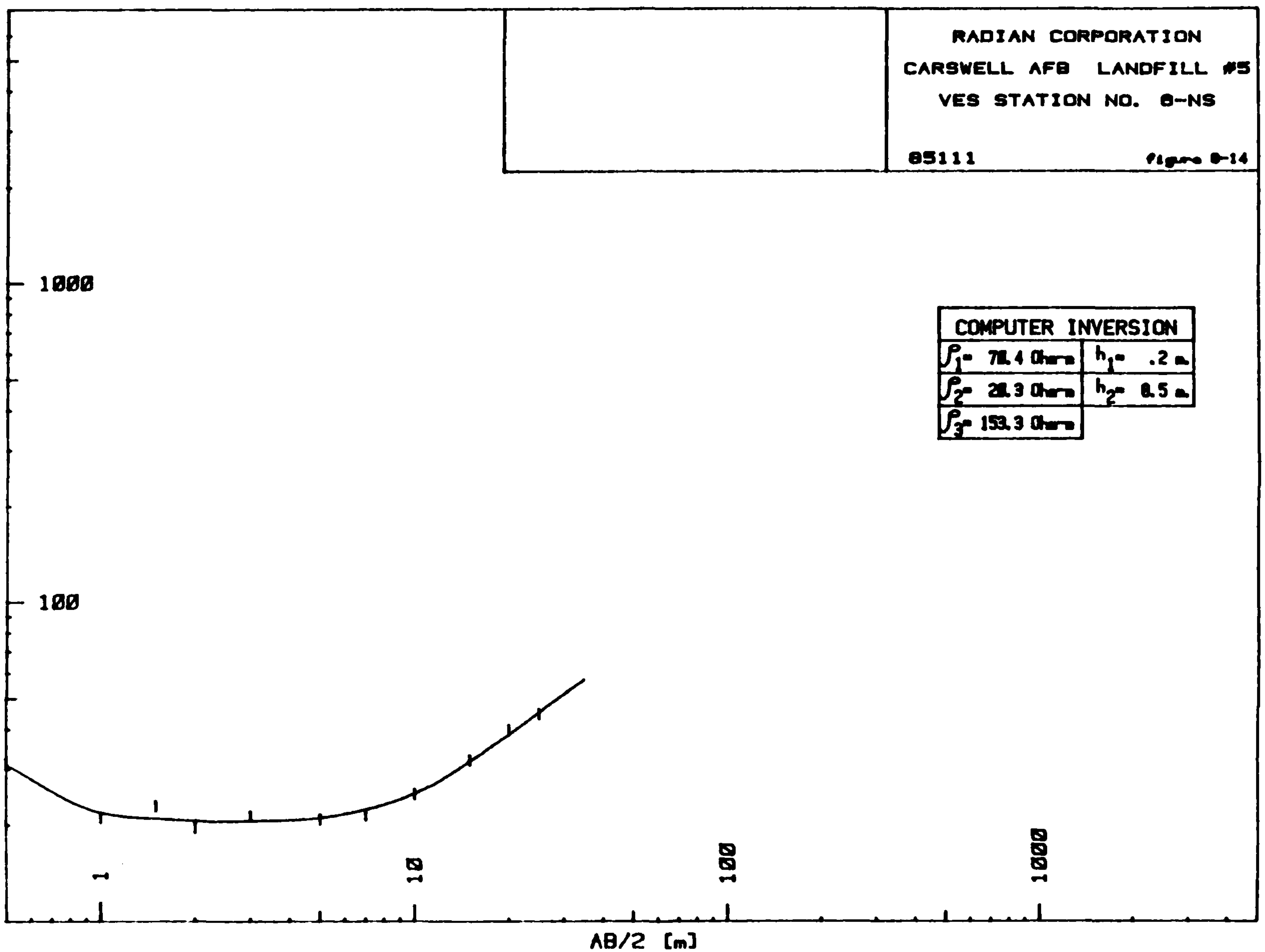

RADIAN CORPORATION
CARSWELL AFB LANDFILL #5
VES STATION NO. 3-EW
85111
figure 8-18
COMPUTER INVERSION
ρ_1= 17.5 Ohm-m
h_1= .6 m.
ρ_2= 28.5 Ohm-m
h_2= 27.2 m.
ρ_3= 84.1 Ohm-m
APPARENT RESISTIVITY [Ohm-m]
1000
100
1
10
100
1000
AB/2 [m]

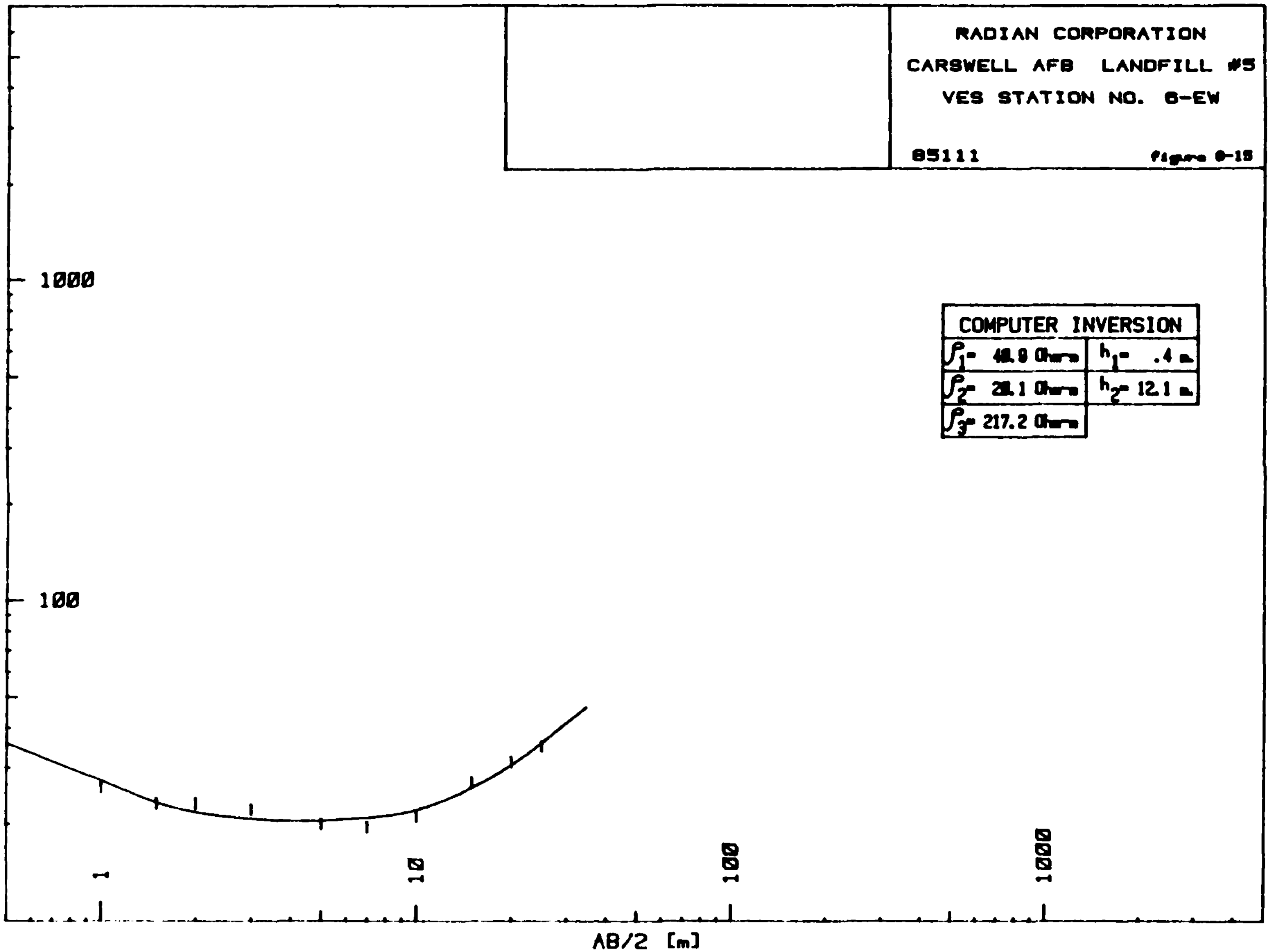

RADIAN CORPORATION
CARSWELL AFB LANDFILL #5
VES STATION NO. 4-NS
85111
Figure 8-11
COMPUTER INVERSION
ρ1= 15.7 Ohms
ρ2= 28.3 Ohms
ρ3= 136.0 Ohms
h1= .5 m
h2= 9.7 m
1000
100
10
1
AB/2 [m]
1000
100
APPARENT RESISTIVITY [Ohm-m]

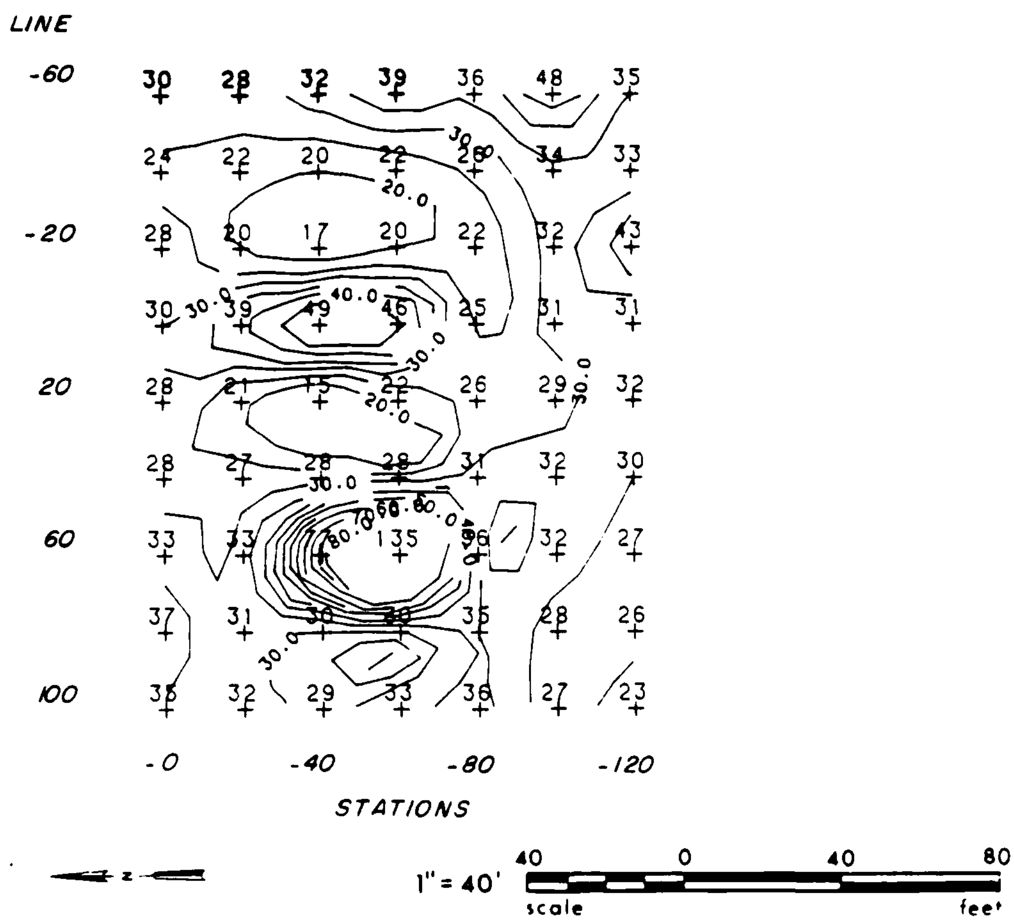

RADIAN CORPORATION
CARSWELL AFB LANDFILL #5
VES STATION NO. 4-EW
85111
figure 8-12
COMPUTER INVERSION
ρ_1= 14.8 Ohms
h_1= .3 m.
ρ_2= 22.2 Ohms
h_2= 58.8 m.
ρ_3= 72.8 Ohms
APPARENT RESISTIVITY [Ohmm]
1000
100
1
10
100
1000
AB/2 [m]


RADIAN CORPORATION
CARSWELL AFB LANDFILL #5
VES STATION NO. 5-NS
85111
Figure 8-12
COMPUTER INVERSION
ρ_1= 21.8 Ohm
h_1= 10.5 m
ρ_2= 283.7 Ohm
APPARENT RESISTIVITY [Ohmm]
1000
100
1
10
100
1000
AB/2 [m]


RADIAN CORPORATION
CARSWELL AFB LANDFILL #5
VES STATION NO. 5-EW
85111
figure 8-18
COMPUTER INVERSION
ρ_1= 2Ø.9 Ohm-m
h_1= 1Ø.5 m.
ρ_2= 14Ø.Ø Ohm-m
APPARENT RESISTIVITY [Ohm-m]
1ØØØ
1ØØ
1
1Ø
1ØØ
1ØØØ
AB/2 [m]


RADIAN CORPORATION
CARSWELL AFB LANDFILL #5
VES STATION NO. 8-NS
85111
figure 8-14
COMPUTER INVERSION
ρ_1= 70.4 Ohm
h_1= .2 m
ρ_2= 20.3 Ohm
h_2= 0.5 m
ρ_3= 153.3 Ohm
APPARENT RESISTIVITY [Ohmm]
1000
100
1
10
100
1000
AB/2 [m]


RADIAN CORPORATION
CARSWELL AFB LANDFILL #5
VES STATION NO. 6-EW
85111
figure 6-15
COMPUTER INVERSION
ρ_1= 48.9 Ohm-m
h_1= .4 m
ρ_2= 28.1 Ohm-m
h_2= 12.1 m
ρ_3= 217.2 Ohm-m
APPARENT RESISTIVITY [Ohmm]
1000
100
1
10
100
1000
AB/2 [m]



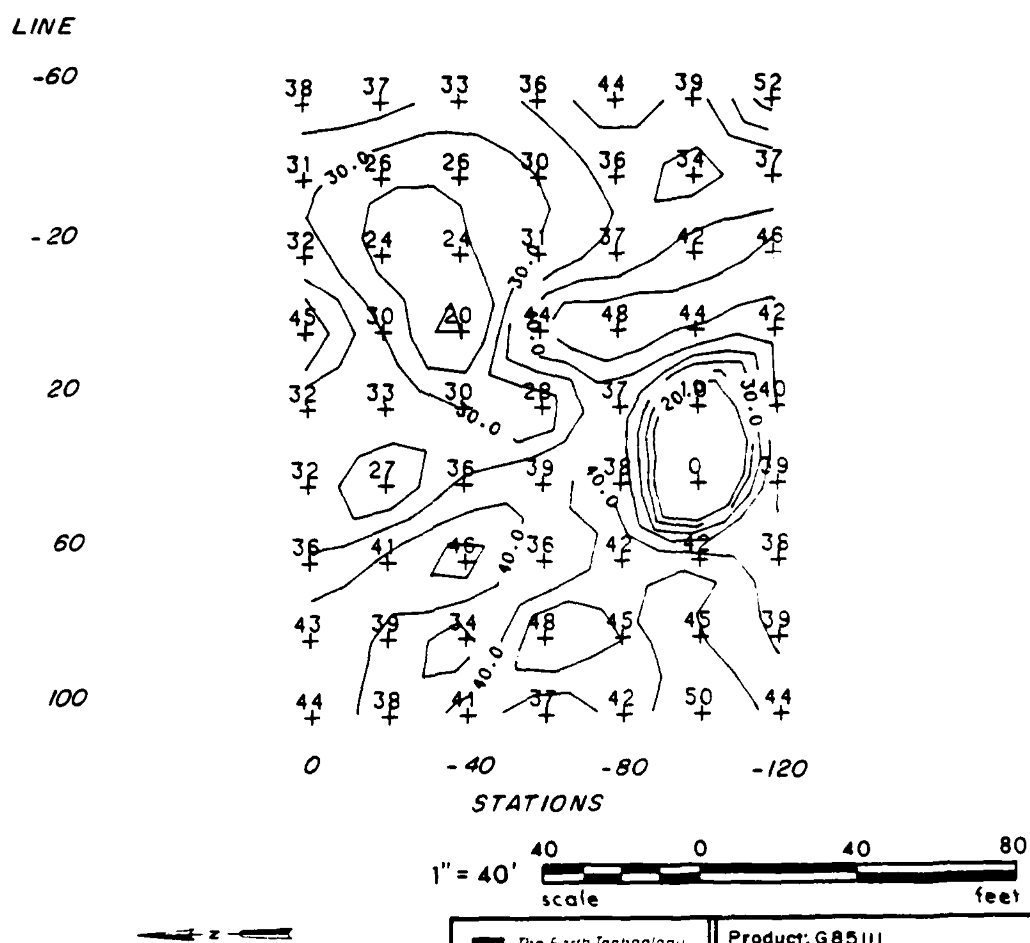
The Earth Technology Corporation

Product G85111

RADIAN CORPORATION

CARSWELL AIR FORCE BASE
WASTE BURIAL AREA
EM 31 HORIZONTAL DIPOLE

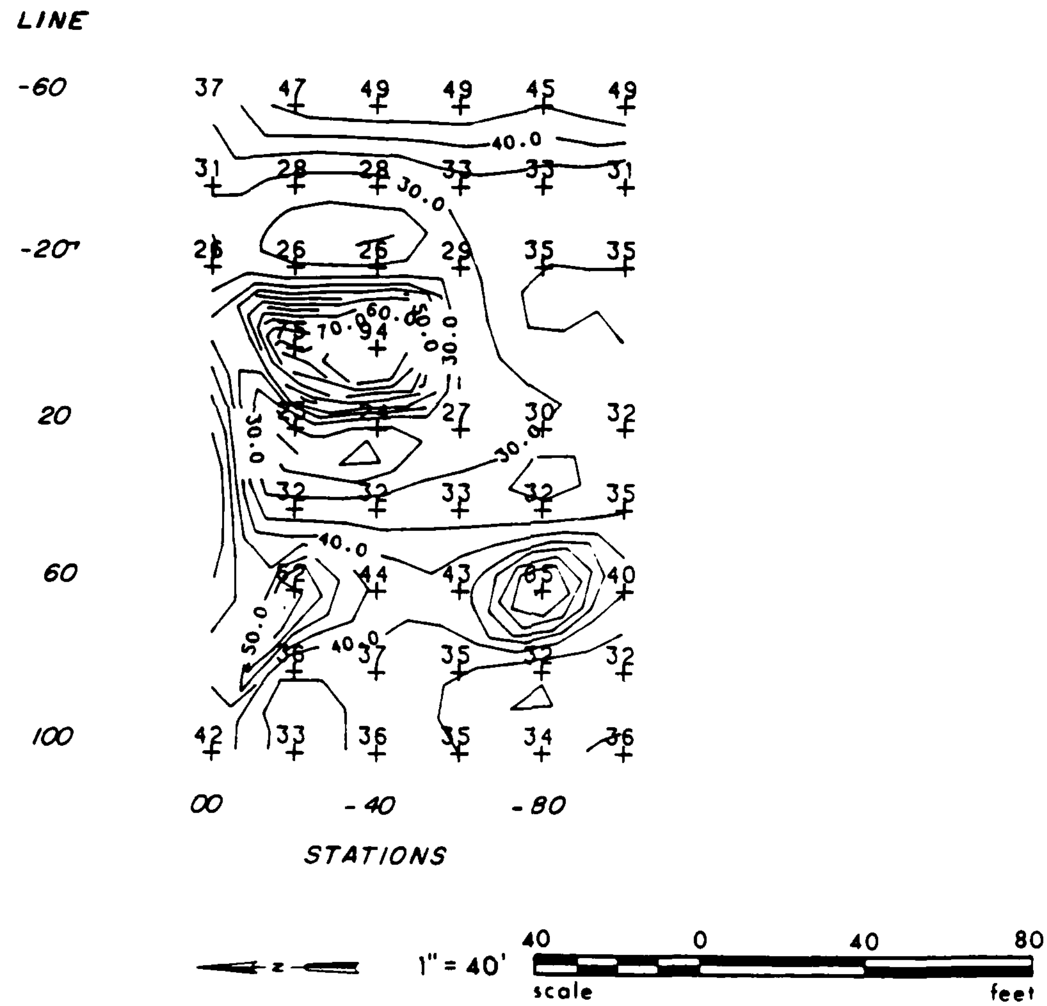
figure 9-3



The Earth Technology Corporation

Product: G85111
RADIAN CORPORATION

CARSWELL AIR FORCE BASE
WASTE BURIAL AREA
EM 31 VERTICAL DIPOLE
figure 9-4

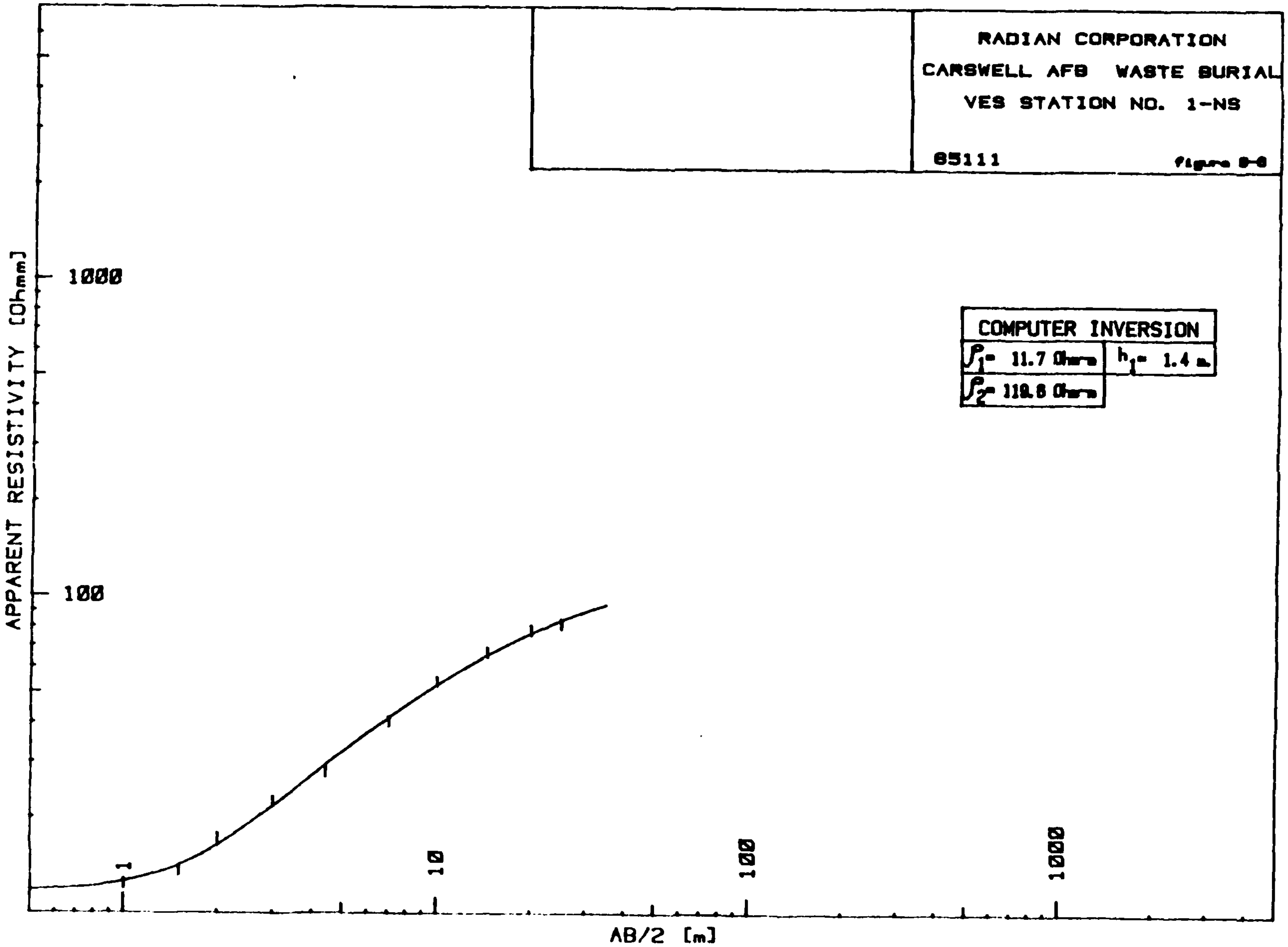


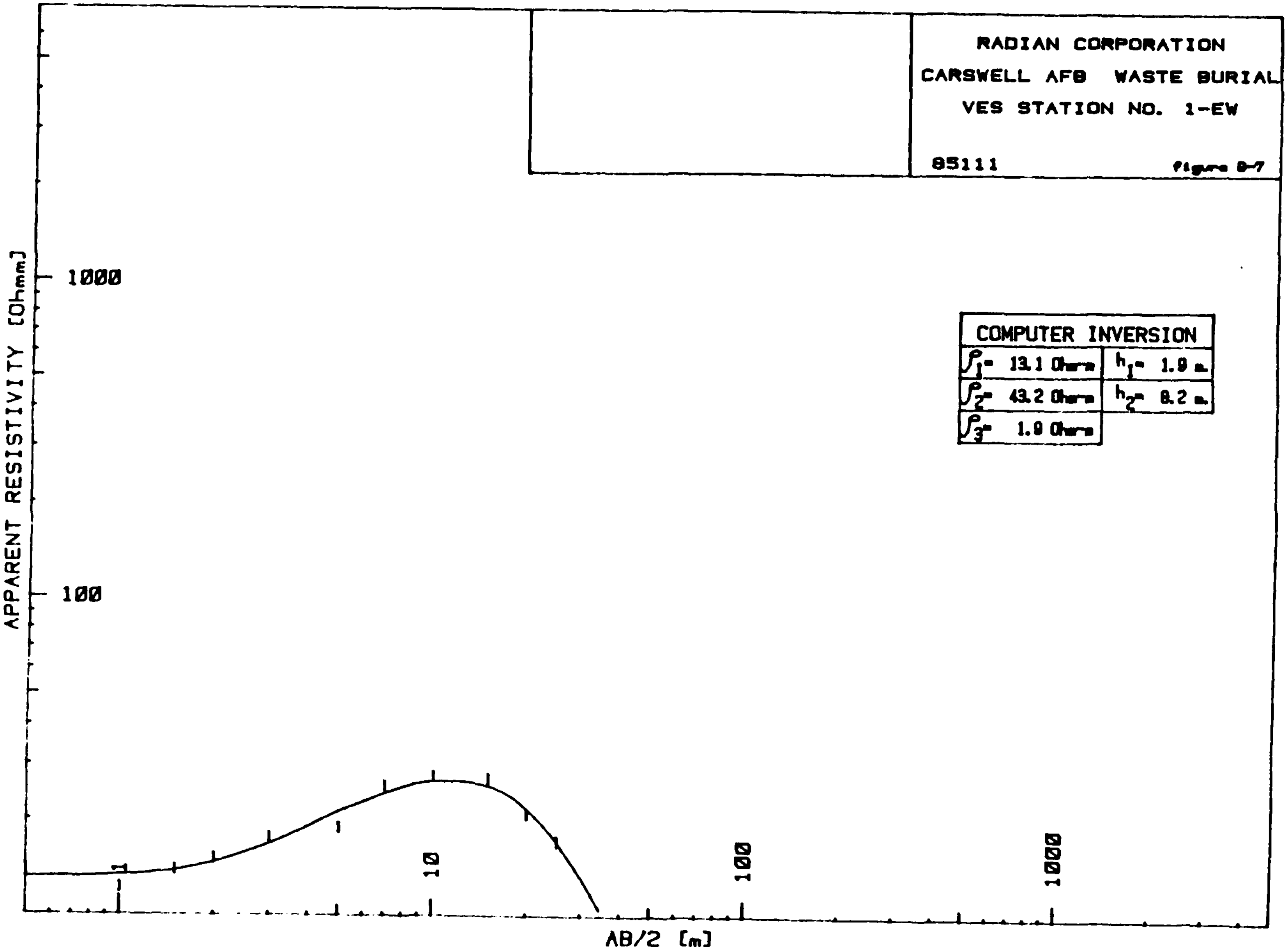
The Earth Technology Corporation

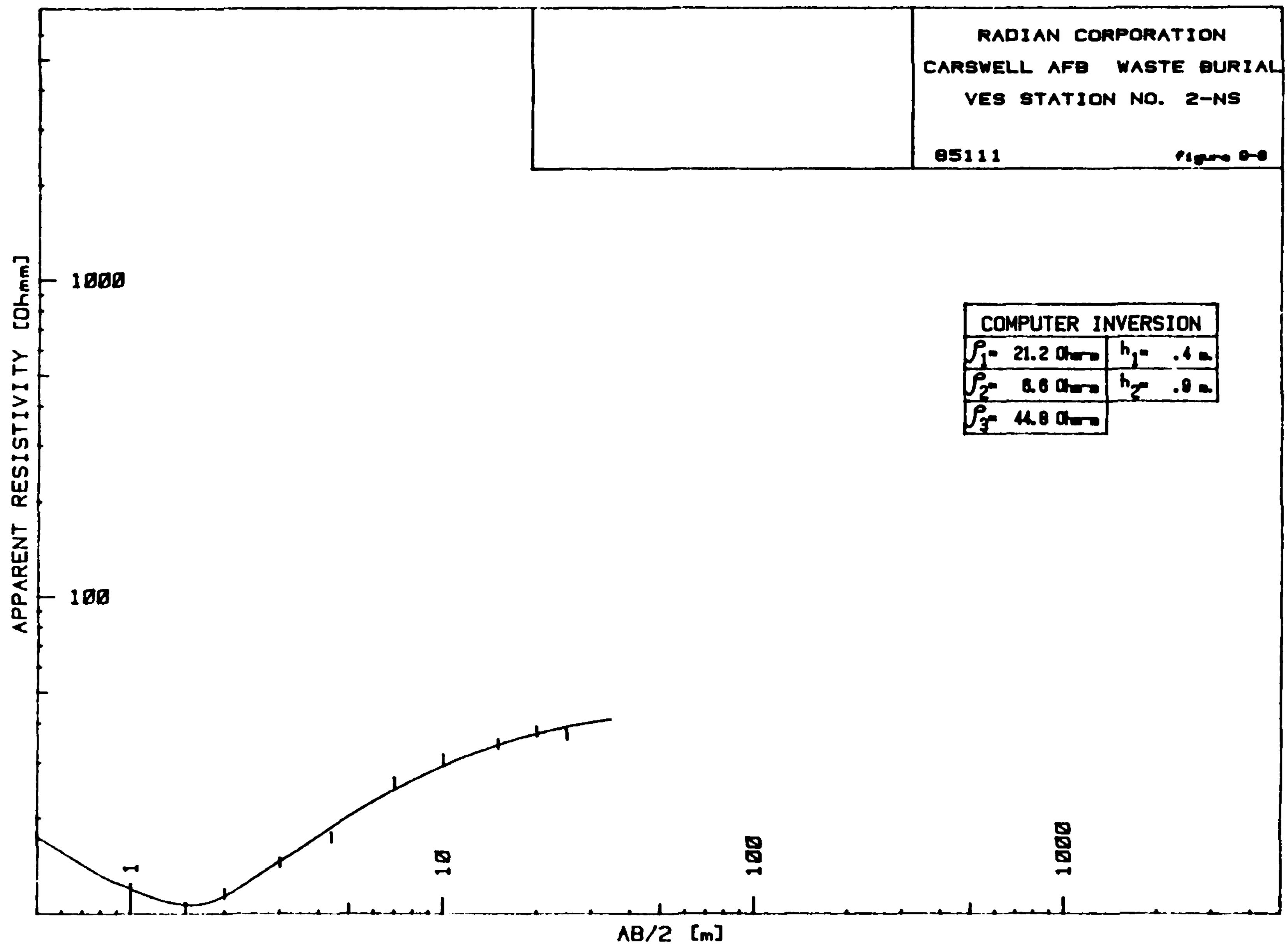
Project: G85111

RADIAN CORPORATION

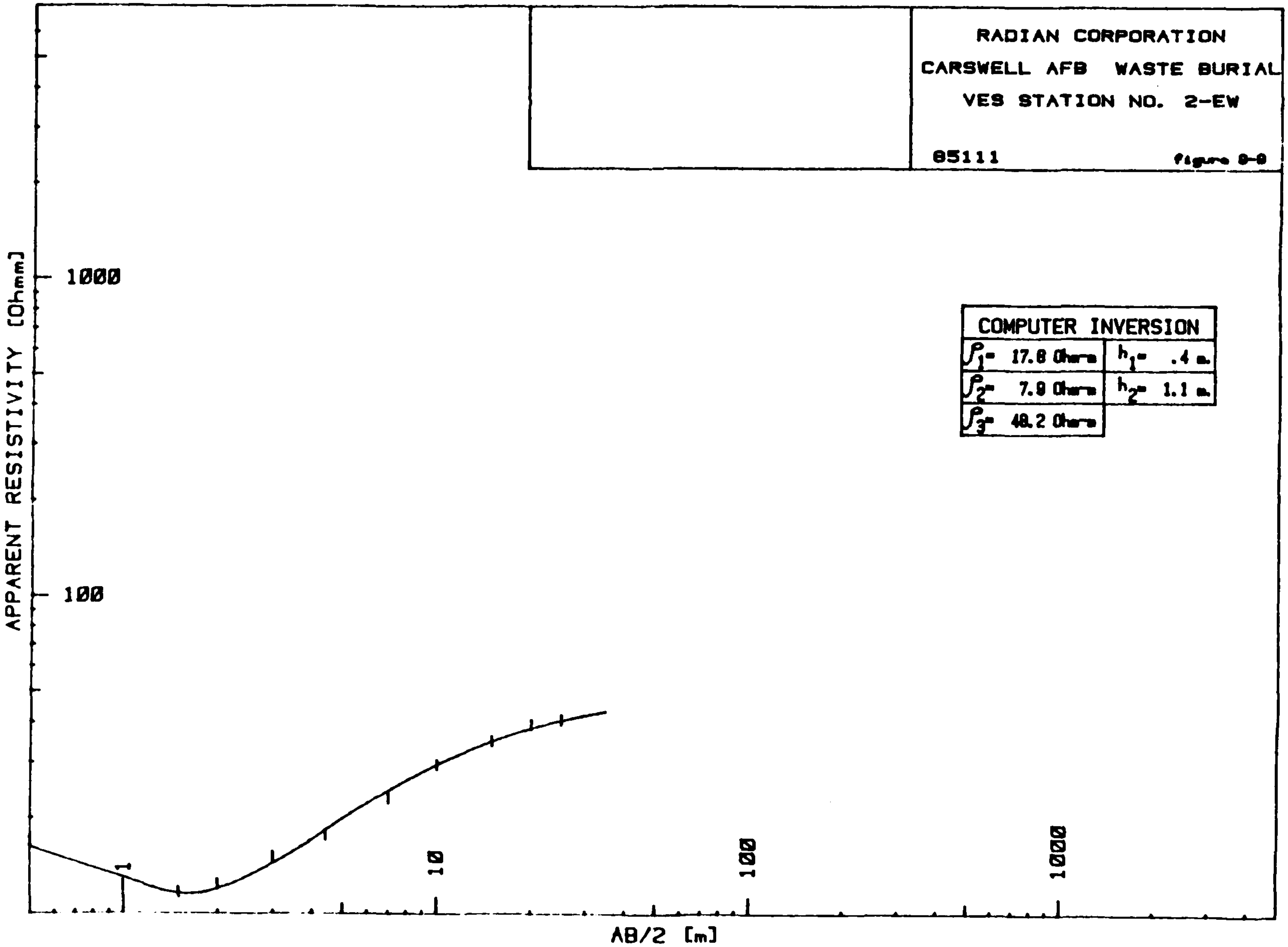
CARSWELL AIR FORCE BASE
WASTE BURIAL AREA
EM34 20 meter SEPARATION
figure 9-5

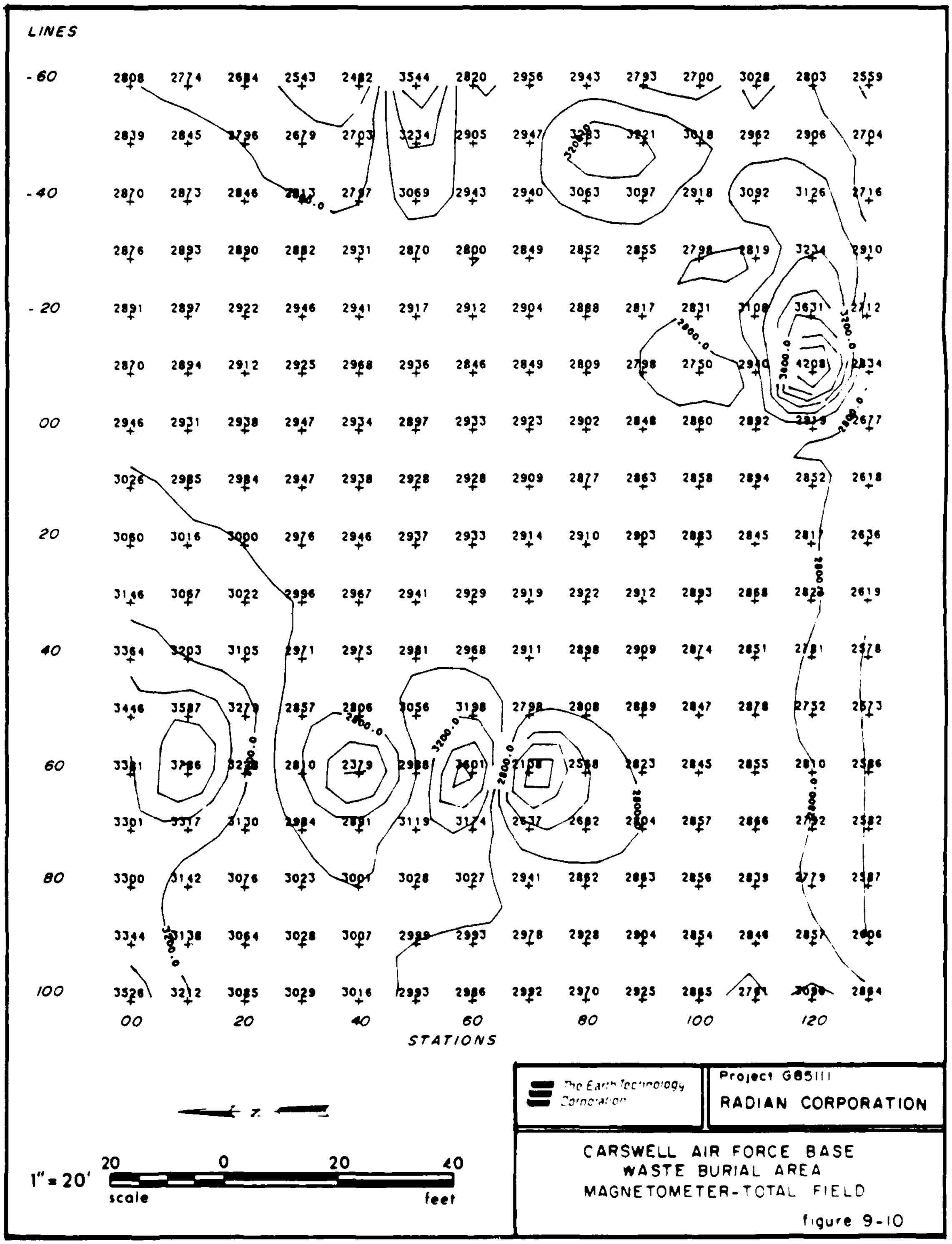

RADIAN CORPORATION
CARSWELL AFB WASTE BURIAL
VES STATION NO. 1-NS
85111
figure
COMPUTER INVERSION
ρ1= 11.7 Ohm-m
h1= 1.4 m
ρ2= 118.8 Ohm-m
APPARENT RESISTIVITY [Ohm-m]
1000
100
1
10
100
1000
AB/2 [m]


RADIAN CORPORATION
CARSWELL AFB WASTE BURIAL
VES STATION NO. 1-EW
85111
figure 8-7
COMPUTER INVERSION
ρ1= 13.1 Ohm-m
h1= 1.9 m.
ρ2= 43.2 Ohm-m
h2= 8.2 m.
ρ3= 1.9 Ohm-m
APPARENT RESISTIVITY [Ohm-m]
1000
100
1
10
100
1000
AB/2 [m]



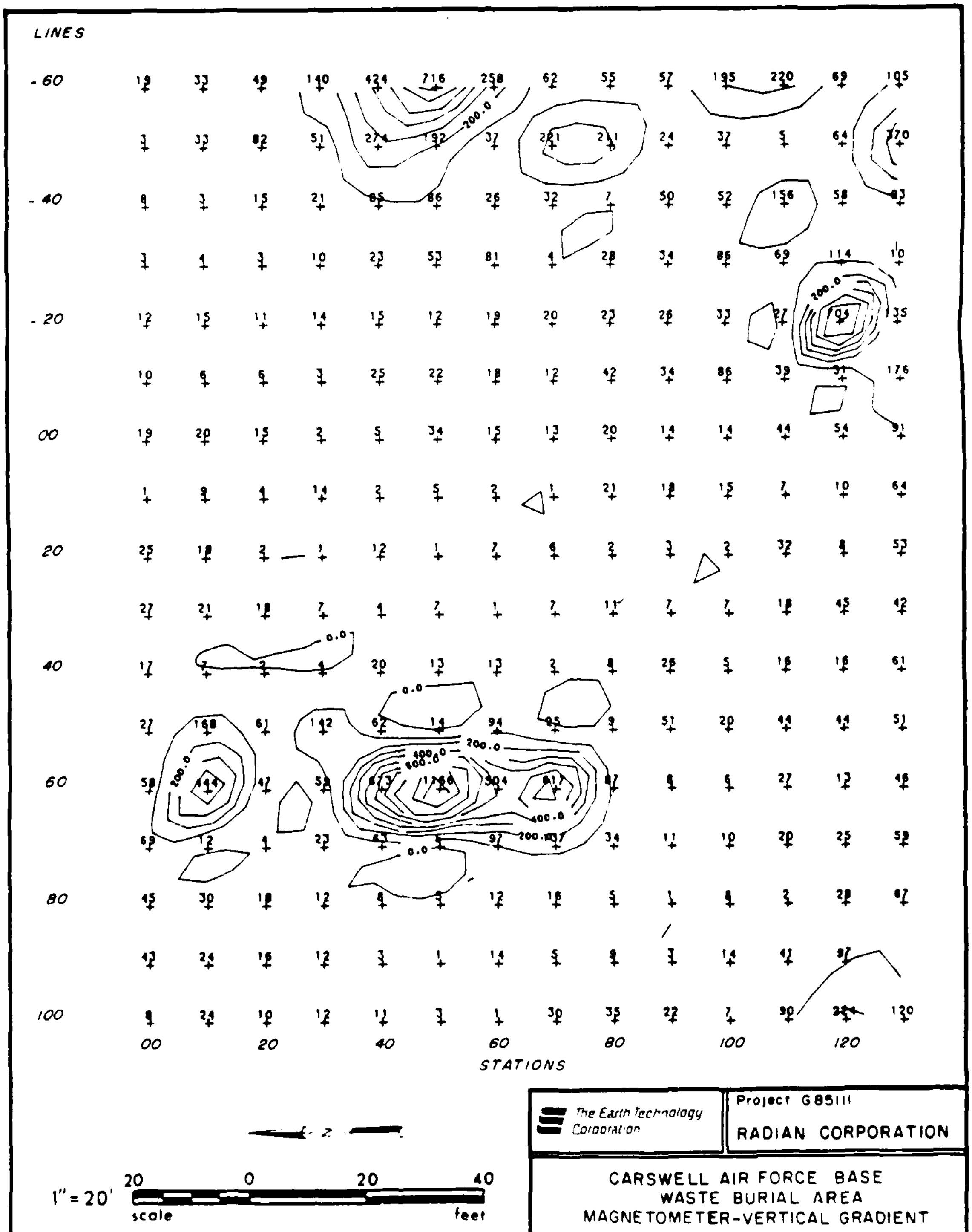
RADIAN CORPORATION
CARSWELL AFB WASTE BURIAL
VES STATION NO. 2-NS
85111
COMPUTER INVERSION
ρ1= 21.2 Ohm-m
h1= .4 m.
ρ2= 8.6 Ohm-m
h2= .9 m.
ρ3= 44.8 Ohm-m
APPARENT RESISTIVITY [Ohmm]
1000
100
1
10
100
1000
AB/2 [m]


RADIAN CORPORATION
CARSWELL AFB WASTE BURIAL
VES STATION NO. 2-EW
85111
figure
COMPUTER INVERSION
ρ1= 17.8 Ohms
ρ2= 7.9 Ohms
ρ3= 48.2 Ohms
h1= .4 m.
h2= 1.1 m.
APPARENT RESISTIVITY [Ohmm]
1000
100
1
10
100
1000
AB/2 [m]



CARSWELL AIR FORCE BASE
WASTE BURIAL AREA
MAGNETOMETER-TOTAL FIELD

figure 9-10



The Earth Technology Corporation

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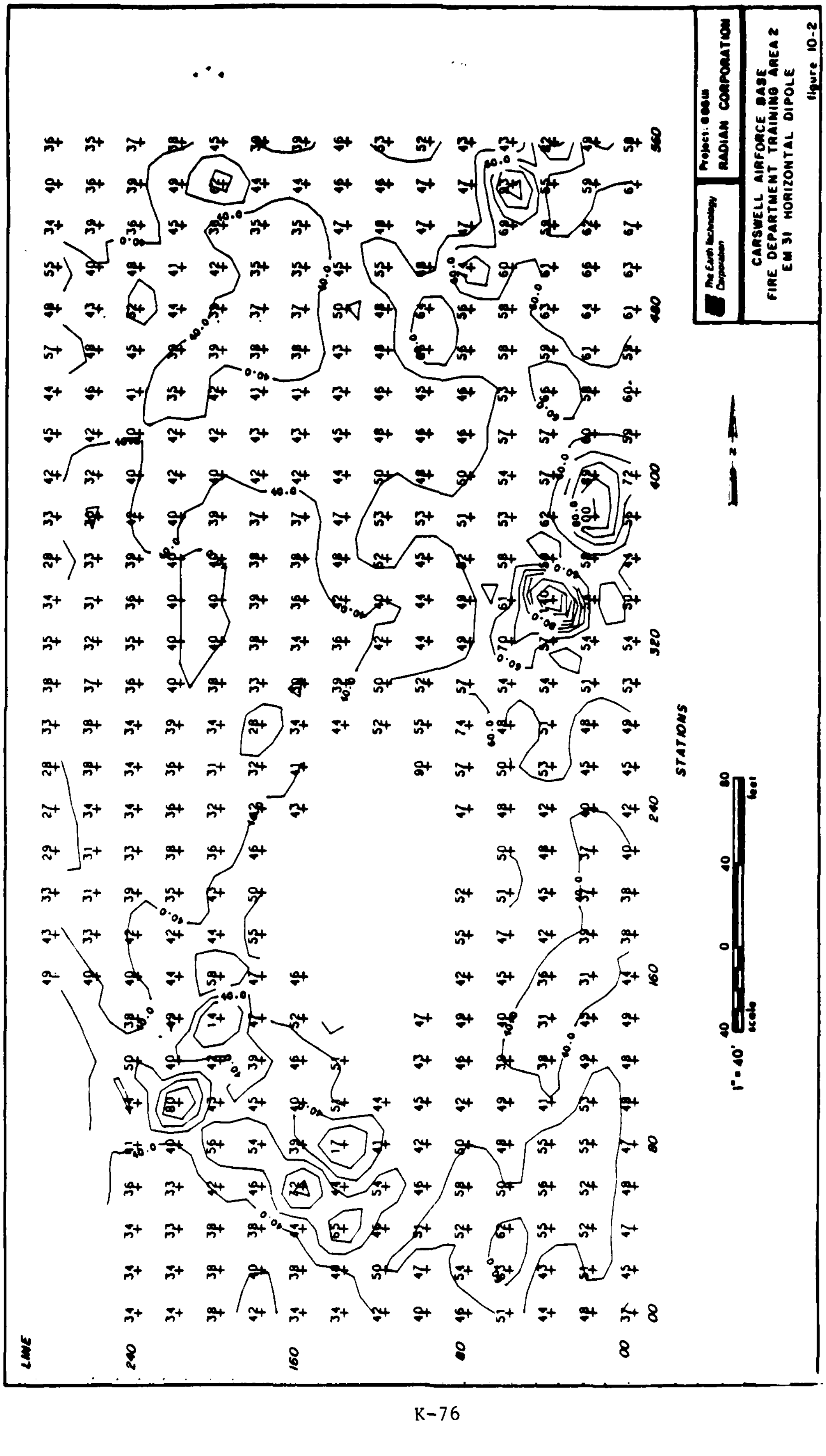
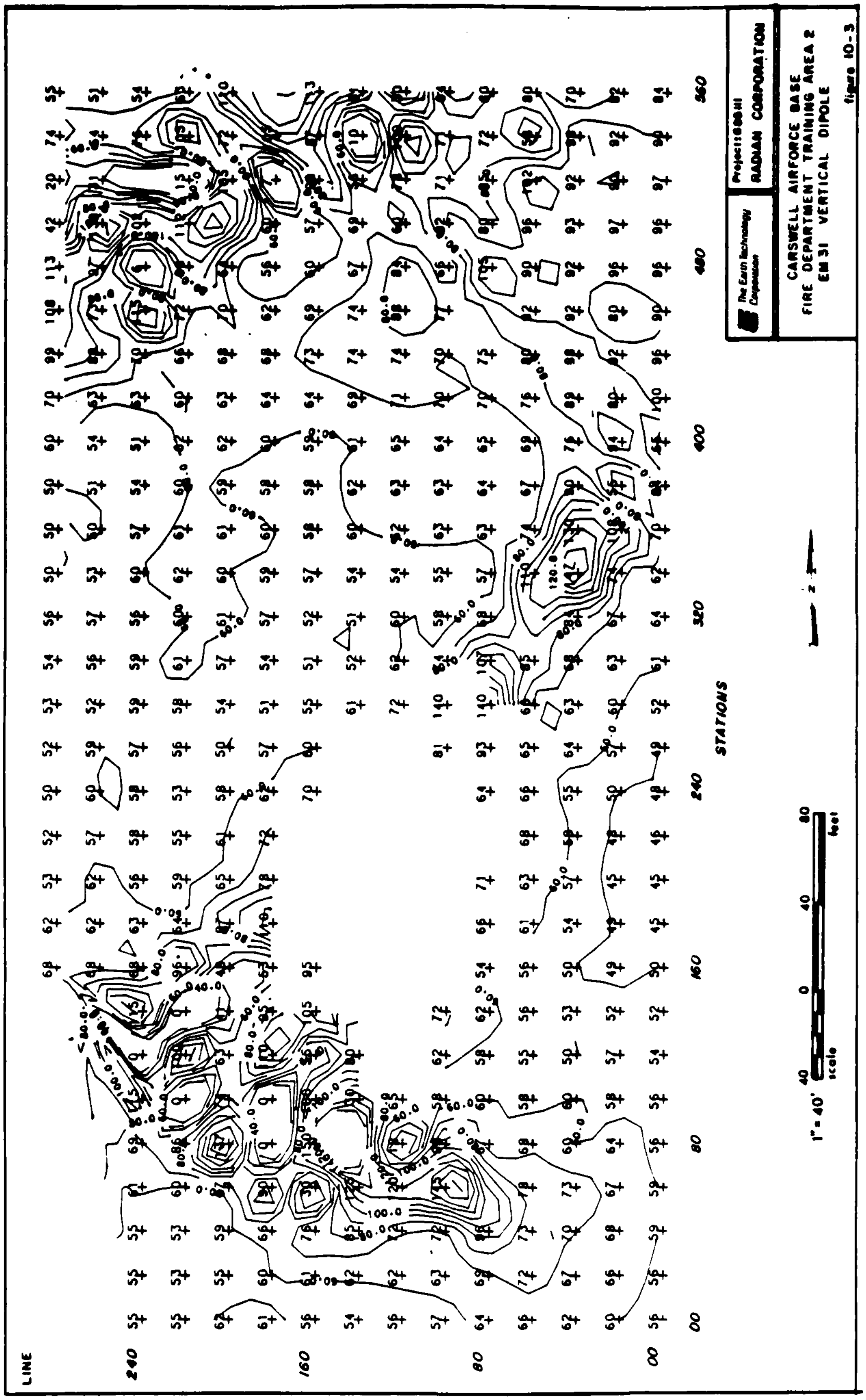
RADIAN CORPORATION

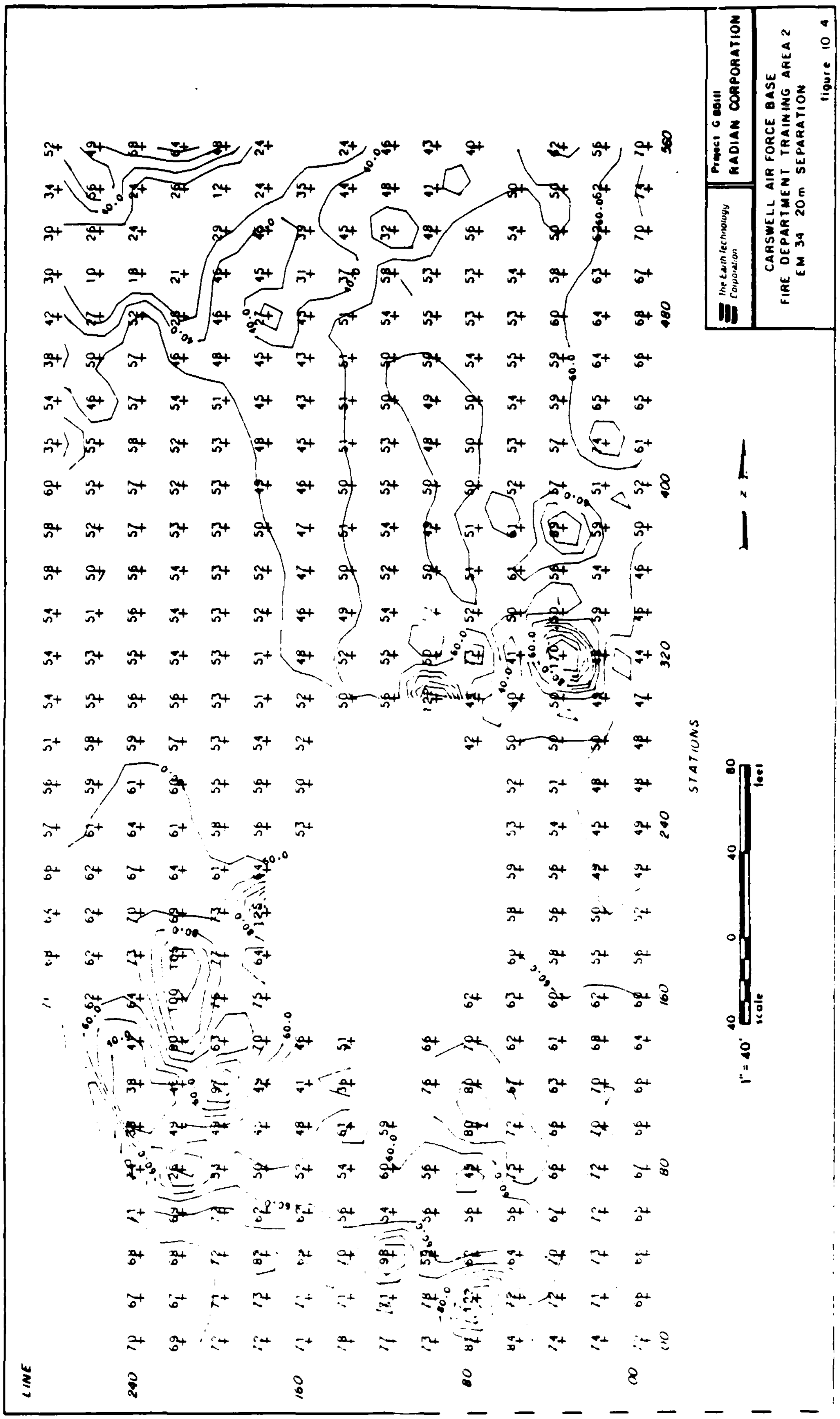
CARSWELL AIR FORCE BASE
WASTE BURIAL AREA
MAGNETOMETER-VERTICAL GRADIENT

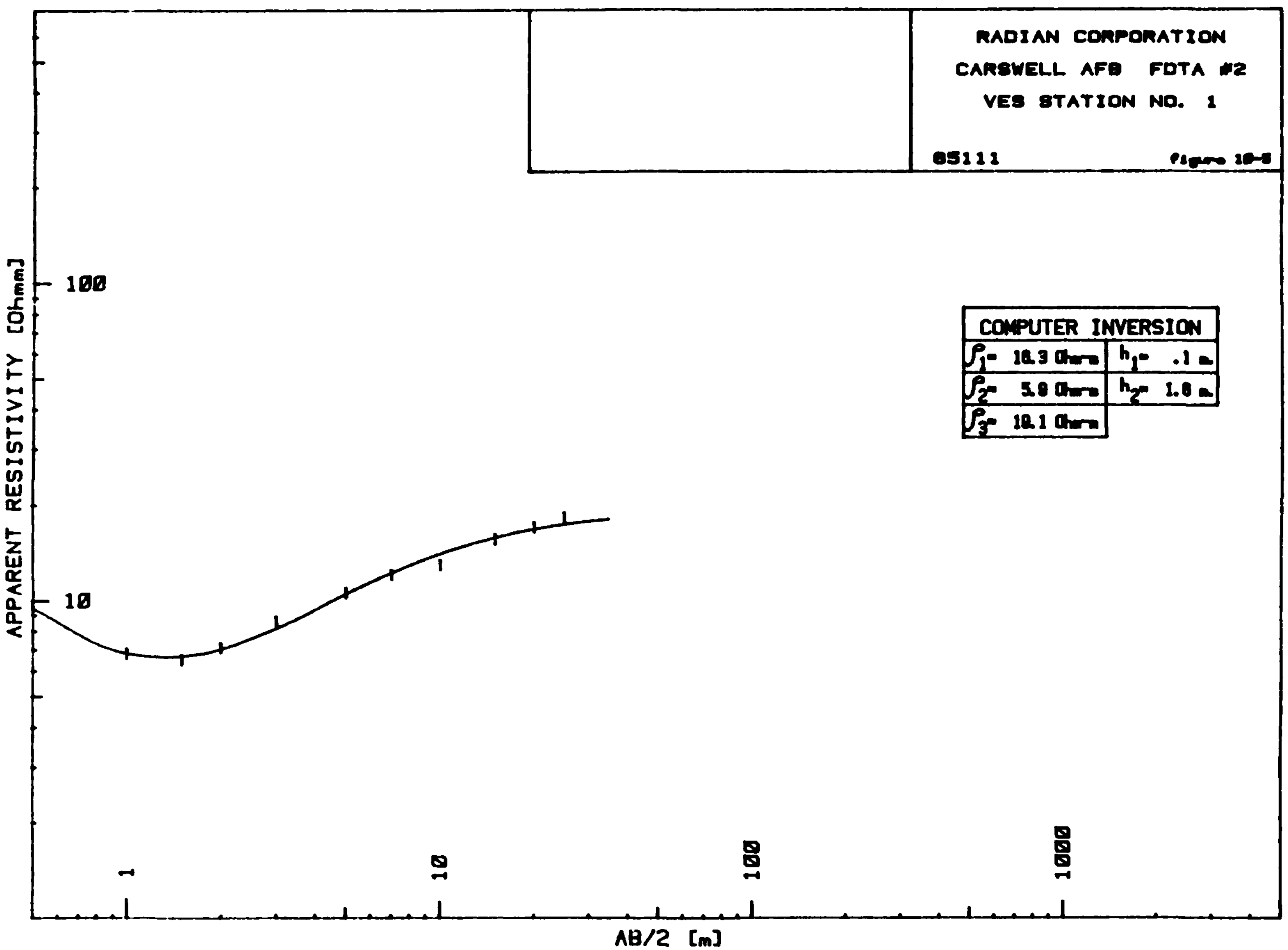
figure 9-11

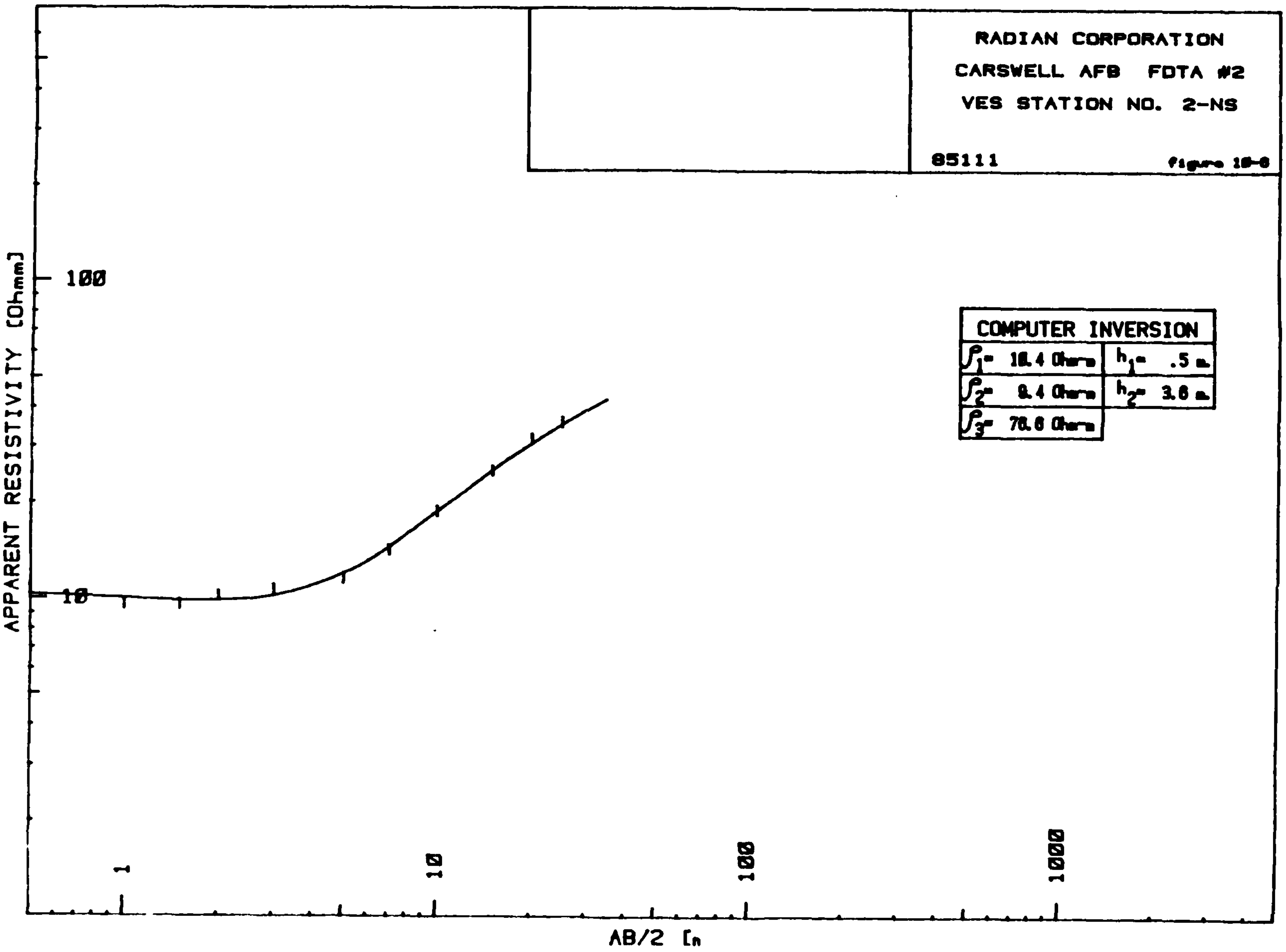


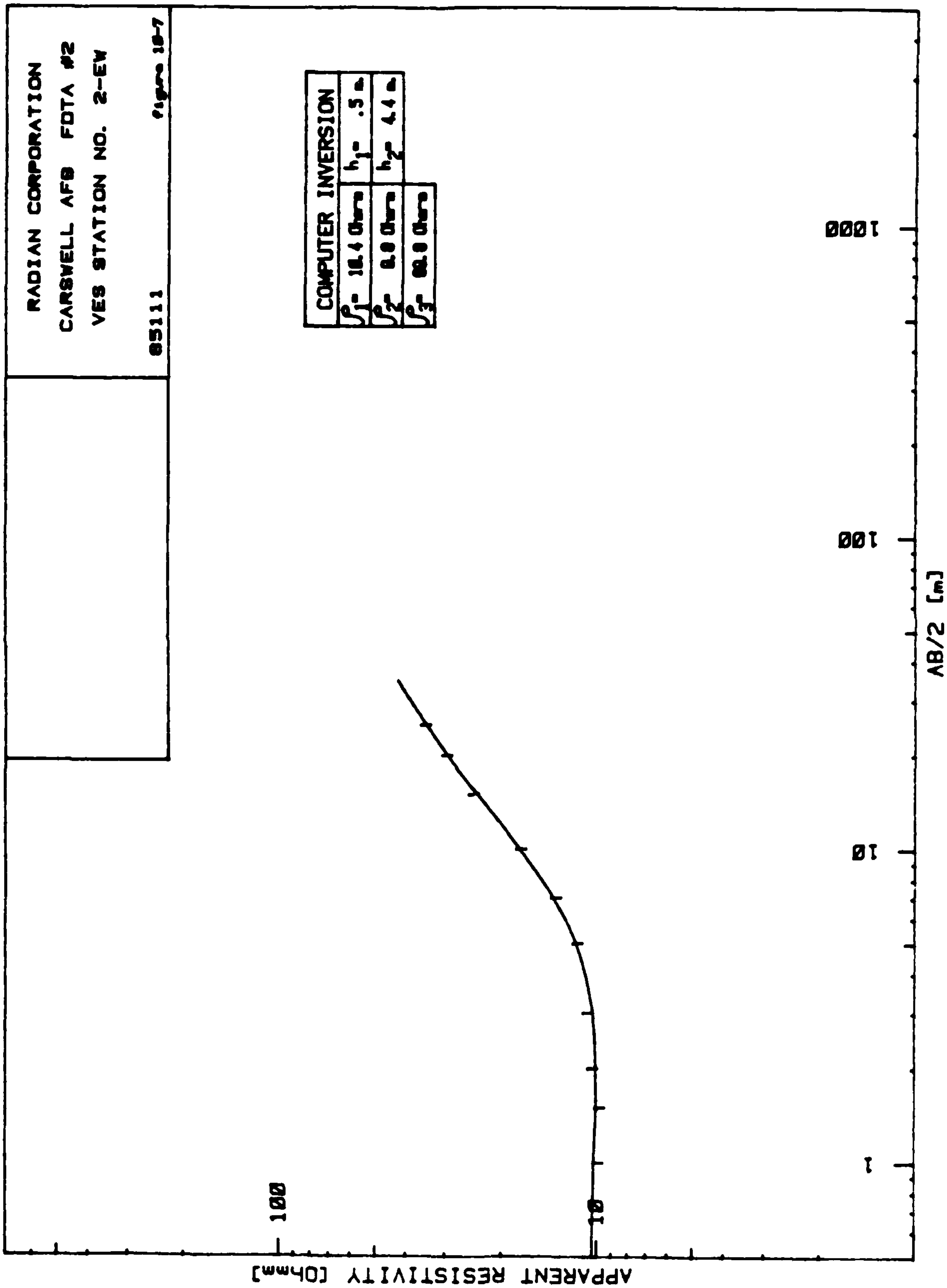
RADIAN CORPORATION
The Earth Technology Corporation
CARSWELL AIRFORCE BASE
FIRE DEPARTMENT TRAINING AREA 2
EM 31 HORIZONTAL DIPOLE
figure 10-2
STATIONS
LINE
N
1" = 40'
scale
feet

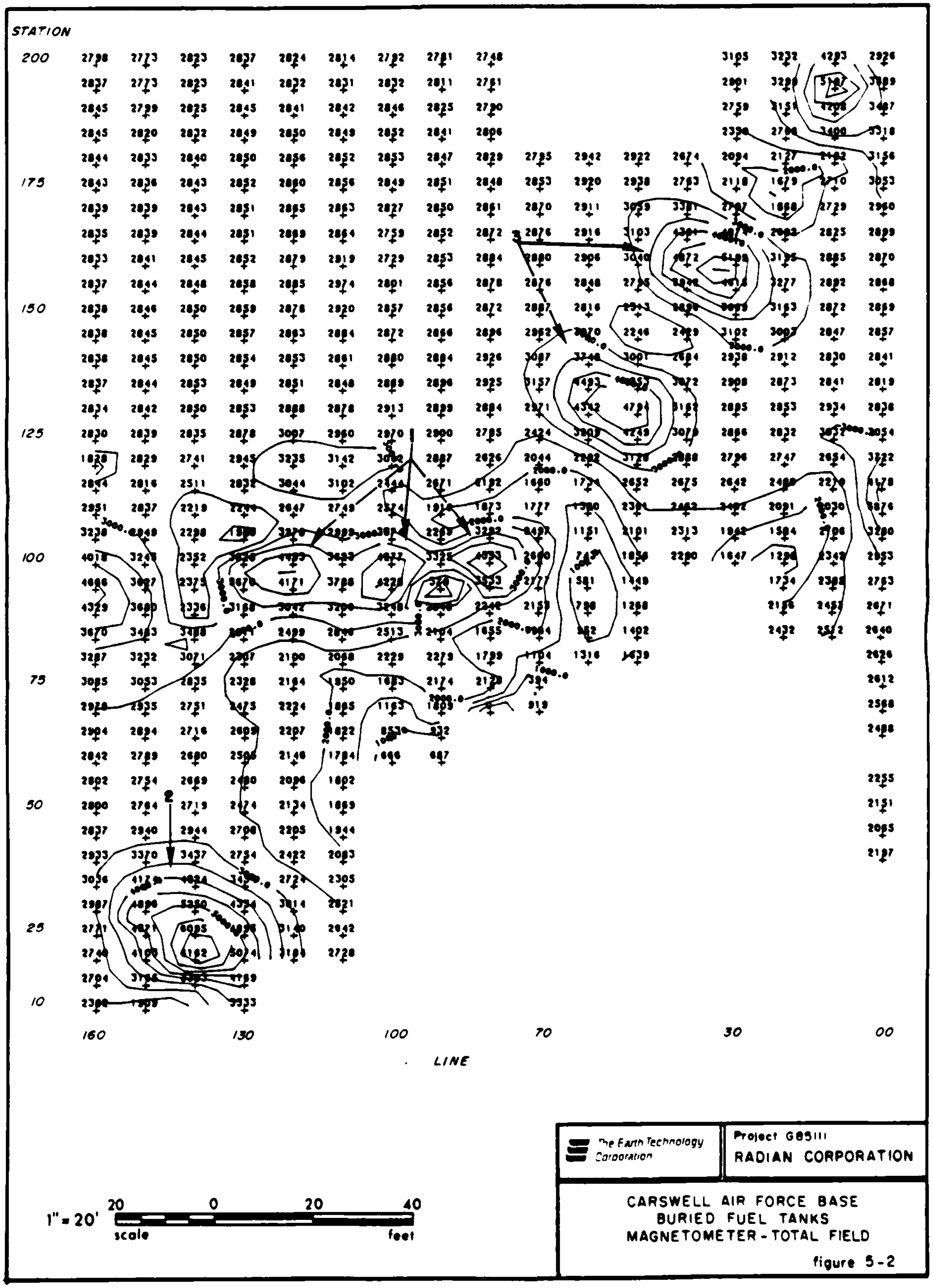

CARSWELL AIRFORCE BASE
FIRE DEPARTMENT TRAINING AREA 2
EM 31 VERTICAL DIPOLE
figure 10-3
RADIAN CORPORATION
The Earth Technology Corporation
STATIONS
LINE
1" = 40'
scale
feet

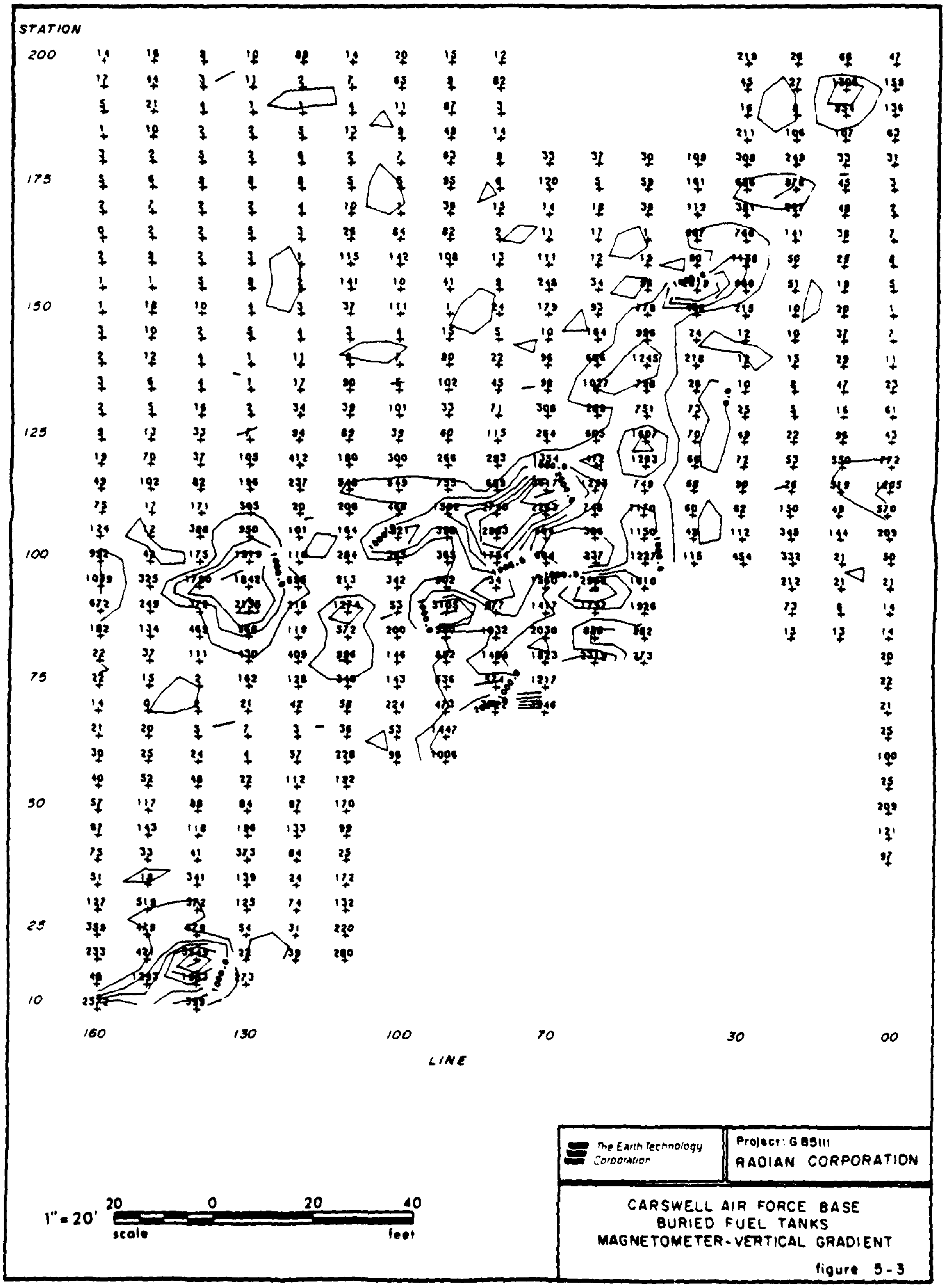

Project G 85111
RADIAN CORPORATION
The Earth Technology Corporation
CARSWELL AIR FORCE BASE
FIRE DEPARTMENT TRAINING AREA 2
EM 34 20m SEPARATION
figure 10 4
STATIONS
LINE
1" = 40'
scale
feet


RADIAN CORPORATION
CARSWELL AFB FDTA #2
VES STATION NO. 1
85111
figure 10-5
COMPUTER INVERSION
ρ_1= 10.3 Ohm-m
h_1= .1 m.
ρ_2= 5.9 Ohm-m
h_2= 1.8 m.
ρ_3= 10.1 Ohm-m
APPARENT RESISTIVITY [Ohmm]
100
10
1
10
100
1000
AB/2 [m]


RADIAN CORPORATION
CARSWELL AFB FDTA #2
VES STATION NO. 2-NS
85111
COMPUTER INVERSION
APPARENT RESISTIVITY [Ohmm]
100
10
1
10
100
1000
AB/2 [m


RADIAN CORPORATION
CARSWELL AFB FDTA #2
VES STATION NO. 2-EW
85111
figure 18-7
COMPUTER INVERSION
ρ1= 10.4 Ohm
ρ2= 8.0 Ohm
h1= .5 m
h2= 4.4 m
1
10
100
1000
AB/2 [m]
10
100
APPARENT RESISTIVITY [Ohm-m]


STATION
200
175
150
125
100
75
50
25
10
160
130
100
70
30
00
LINE
The Earth Technology Corporation
Project G85111
RADIAN CORPORATION
CARSWELL AIR FORCE BASE
BURIED FUEL TANKS
MAGNETOMETER - TOTAL FIELD
figure 5-2
1" = 20'
20 0 20 40
scale
feet



CARSWELL AIR FORCE BASE
BURIED FUEL TANKS
MAGNETOMETER-VERTICAL GRADIENT

figure 5-3

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APPENDIX L

Safety Plan

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CARSWELL AIR FORCE BASE

IRP PHASE II STAGE 1

Prepared by: Radian Corporation

December, 1984

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TABLE OF CONTENTS

1.0 INTRODUCTION

This plan describes the safety and health procedures and practices for the accomplishment of IRP Phase II Stage 1 Field Evaluation to be conducted at Carswell AFB, Texas. All Radian employees and subcontractors to Radian will follow this plan unless situations encountered in the field make changes necessary. These changes must be approved by the Supervising Geologist.

Major site activities will consist of monitoring well installation and development followed by collection of water samples.

The prime responsibility for employee safety will rest with: (1) Radian for it's own employees, (2) Radian subcontractors for their employees and (3) with other parties whose employees will work under Radian's technical direction.

Radian, it's subcontractors, and other parties participating in on-site work, will comply with all applicable requirements of the Occupational Safety and Health Administration.

2.0 FIELD ACTIVITIES/TEAM RESPONSIBILITIES

The activities planned for the investigation of Carswell AFB are presented below:

- o Performance of geophysical surveys at several waste disposal sites across the Base. These surveys do not involve any disturbance of the land surface.

- o Performance of hand augered borings in the vicinity of waste disposal areas and waste affected streams and drainageways. The maximum depth of the borings is to be ten feet. No waste is expected to be directly encountered. Samples of soil will be collected as the borehole is advanced.

- o Drilling eleven boreholes in the vicinity of waste storage or disposal sites using a hollow stem auger drilling rig. Split spoon samples will be collected at regular intervals from each of the borings.

- o Installation of twenty-three monitor wells to a maximum depth of 40 feet using a hollow stem auger drilling rig. Split spoon samples will be collected as the drilling proceeds.

- o Installation of two monitor wells in the Paluxy aquifer will be made to a maximum depth of 200 feet. An air rotary rig will be used to accomplish most of the drilling. Samples of soil will be continuously observed but not collected.

- o Collection of surface water samples at several locations.

- o Collection of ground water samples from the monitor wells.

2.1 Waste Description

The type of waste material that is known to be present on site is listed below:

- o fuels (MOGAS, JP-4);

- o solvents (PD-680 type II);

- o engine oils and hydraulic fluids;

- o waste paint cans;

- o discarded batteries; and

- o construction rubble.

2.2 Key Personnel

The Radian personnel who will be responsible for the safe operation of this project are:

- o Administration (Tom Grimshaw, Program Manager);
- o Supervising Geologist (Larry French, Project Director and on-site Safety Officer);
- o The Drilling Supervisor (subcontractor); and
- o Corporate Safety Office (Andrew Ellis).

Supervising Geologist (Mr.Larry French)

The Supervising Geologist will be responsible for executing the safety procedures that are described below:

- o Locate support facilities in an uncontaminated area.
- o Initiate contact with the Base Safety Officer and test the emergency phone numbers to ensure their accuracy.
- o Implement the site safety training program as described in this plan.
- o Observe site activities to ensure the proper use of personal protective equipment.
- o Initiate outside emergency phone calls when an injury or accident requires medical attention.
- o Ensure that work schedules , dependent on work levels and outside temperatures, are set each day and adhered to throughout the work day.
- o Ensure that the field team observes the work zone and decontamination procedures.
- o Ensure that safety equipment is maintained in a safe manner.
- o Report violation and compliance problems to the Corporate Safety Office in Austin (512-454-4797 ext. 5763, Andrew Ellis).

Drilling Supervisor (unknown at this time)

- o Drilling crew compliance with the health and safety plan.

- Enforcement of corrective action under the direction of the Supervising Geologist. Compliance problems will be brought to the attention of the Drilling Supervisor who will be expected to correct the safety problem through a series of reprimands, eventually resulting in the dismissal of the offending employee.

Corporate Safety Office

- Prepare a health and safety plan for the project.
- Perform a job safety analysis.
- Select appropriate personal protection equipment.
- Define appropriate workplace exposure monitoring procedures.
- Develop a contamination control program.
- Develop a plan to cope with anticipated emergencies.
- Ensure that the field team has undergone medical monitoring.

Field Team Members

- Read and understand this plan.
- Perform your work safely.
- Report any unsafe condition to your supervisor.
- Be aware and alert for signs and symptoms of exposure to site contaminants.

3.0 JOB SAFETY ANALYSIS

A preliminary job safety analysis (JSA) has been performed for each work function at the site. Additional job safety analyses will be performed by the Supervising Geologist to respond to site conditions and work activities that were not anticipated correctly.

3.1 Geophysical Survey

Geophysical surveys will be performed prior to selecting the location of well installation points. The surveys will not involve disturbance of the soils and the primary hazard to employees will be from contacting the waste material while walking on the site. Site survey personnel should take care to avoid obvious waste areas, and keep shoes and hands clean. If you or your articles of clothing or equipment become contaminated, wash them up with hot soap and water.

Personal Protective Equipment

- o Chemical resistant PVC or Neoprene safety boot with steel shank and toe;
- o Safety helmet;
- o Safety glasses;
- o Long sleeve shirt; and
- o PVC disposable gloves (worn when contact with the waste material is possible).

3.2 Monitor Well Installation

Installation of monitor wells using the hollow stem auger rig will expose the field team to respiratory, skin contact, ingestion and noise hazards. The personal protective equipment specified below has been selected to reduce the risk of exposure to site hazards.

Personal Protective Equipment

- o tyvek coveralls;
- o Gauntlet style, chemical resistant, neoprene gloves;
- o Chemical resistant, steel toed, steel shank, safety boots, (PVC or Neoprene);
- o Respirator, full face piece, air purifying, equipped with organic vapor cartridges and dust filters;

- o Safety helmet; and

- o Hearing protectors (rotary drilling rig).

Depending on site conditions and drilling conditions, other items may be used for supplemental protection. Such items may include:

- o PVC bib overalls and jacket (especially for drillers handling auger flights that have contacted waste material;

- o Respirator, half face piece, air purifying equipped with organic vapor cartridges and dust filters (used only when there are no eye irritating chemicals, splashes, or projectiles in the work environment) YOU MUST USE EYE PROTECTION WITH HALF FACE RESPIRATORS;

- o Chemical splash goggles when splash hazards exist (steam cleaning especially); and

- o PVC disposable gloves to be worn outside of the neoprene gloves for extra protection.

Air rotary drilling techniques will be used to install two of the monitoring wells. In addition to the hazards mentioned above, the field team will be exposed to noise hazards while operating the Air Rotary Drilling Rig.

Based on previous experience with similar operations, hearing protection will be required for the field team while operating the rotary drilling rig. Some tips to pay attention to when working around drilling rigs are given below:

- o Always wear the proper personal protection as required by the safety plan.

- o Always wear eye protection while working on site. Driving pins in drive chains, handling chemicals, breaking concrete, hammering or sledging, cutting wires, grinding, and or welding are all examples of work that is hazardous to your eyes.

- o Don't set or drop a heavy object on your foot.

- o Use the correct stance when lifting a heavy object.

- o Watch out for slippery surfaces or objects to trip on.

- o Always wear splash goggles when handling chemicals.

- o Keep your clothing out of spinning rig equipment.

- Always get treatment for even the most minor scratch or abrasion.

- Watch out for swinging equipment. Most drilling equipment will break a rib if it hits you.

3.3 Surface and Ground Water Sampling

The sampling team will be expected to contact potentially contaminated surface and ground water while they collect samples. This operation is to be conducted using the following personal protection:

- tyvek coveralls;

- Gauntlet style, chemical resistant, neoprene gloves;

- Chemical resistant, steel toed, steel shank, boots;

- Chemical splash goggles or safety spectacles with side shields; and

- Safety helmet.

3.4 Other Potential Hazards

The site may contain other hazards that are not described above. The Supervising Geologist will make an assessment of the site hazards prior to starting work and ensure that the field team is protected. Two hazards which may be encountered are:

- heat stress

- drilling into underground hazards (buried drums, cylinders, electrical cables, etc.)

Heat Stress

During work, the Supervising Geologist must be alert for the signs and symptoms of heat stress. A hazard exists when employees are required to work in warm temperatures while wearing impervious protective clothing. When ambient air temperatures at the site exceed 65 degrees F, heat stress may become a problem. If these conditions are encountered, the following precautions will be taken:

- The Supervising Geologist will regularly monitor the ambient air temperature;

- Field team members will be observed for the following signs and symptoms of heat stress:

- Dizziness
- Profuse sweating
- Skin color change
- Increased heart rate
- Abnormal body temperature as measured by fever detectors (forehead straps)
- vision problems

Any employee who exhibits any of these symptoms will be immediately removed from field work and requested to consume 2-4 pints of electrolyte fluid or cool water every hour while resting in a shaded area. The worker should not return to work until symptoms are no longer recognizable. If the symptoms worsen, seek immediate medical attention.

Drilling Into Buried Hazards

During the planning/mobilization phase, the Supervising Geologist should consult with base personnel about the location of utility lines. Prior to penetrating the soil, ask knowledgeble site employees about the possibility of buried drums or gas cylinders. If drilling cuttings indicate any signs of drums or cylinders, cease drilling immediately and close the borehole.

4.0 SAFETY TRAINING

Prior to starting the work, the Supervising Geologist will conduct a training session and ensure that each field team member understands his or her safety responsibilities.

All personnel assigned to drilling activities and water sampling efforts will be instructed regarding the potential health and safety hazards. Specifically, the following topics will be covered in the initial training session.

- Potential routes of contact with toxic and or corrosive materials, excessive noise, or physical site hazards.
  - skin contact/absorbtion
  - eye contact
  - inhalation
  - ingestion
  - hearing exposure

- Types, proper use, limitations and maintenance of applicable protective clothing and equipment.
  - safety helmet
  - eye protection
  - gloves
  - safety boots
  - tyvek coveralls
  - respirators

- Respiratory protection using full face or half face air purifying respirator equipped with organic vapor cartridges and dust filters
  - forms of respirators: air purifying, air supplied, and self contained
  - selection of respiratory protection based on the hazard
  - NIOSH certification of all equipment to be used on site
  - medical/physical fitness to wear respiratory protection
  - use, limitations and maintenance of full and half face respirators including qualitative fit testing, routine inspection, replacement of parts, cleaning, disinfection, decontamination, and storage requirements.

- Proper decontamination procedures and adherence to work zone boundaries.

- Reporting of accidents and availability of medical assistance.

4.1 Potential Routes of Exposure

Field team members can be exposed to a number of hazards on the site. Based on preliminary information, the following hazards and routes of exposure are known to be present.

- solvent waste: respiratory hazard, ingestion hazard;
- fuels: respiratory hazard, ingestion hazard;
- discarded batteries: respiratory, eye, skin, explosion hazards;
- waste paint cans: physical hazards (cuts, abrasions);
- construction rubble: physical, eye, body hazards;
- excessive noise: auditory hazard; and
- drilling rigs: physical, eye, head, hand hazards.

4.2 Personal Protective Clothing and Equipment

Workers on site will use protective clothing and equipment to reduce or eliminate the risk of exposure to the hazards mentioned above. Workers will be trained in the proper use of such clothing and equipment before starting work.

Clothing

Protective coveralls will reduce the chances of contacting the waste material. The Tyvek coverall will provide protection against splashes, and dusts. The coveralls are not to be considered "impervious" and should be quickly removed upon obvious contamination.

Gloves

Gloves provided for this project will protect the hands from contacting the waste material. The Gauntlet style neoprene glove is used for handling grossly contaminated equipment and soil samples. The PVC disposable glove is used for routine site work, and should be considered "light duty" gloves. The PVC gloves will not provide a high level of protection against contaminated ground or surface samples, and may only be used when the chance of contact with these materials is unlikely. They should be removed and disposed of immediately upon contamination.

Eye Protection

Several levels of eye protection are available for this project. The full facepiece respirator will provide eye protection against splashes and eye irritating gases and mists. Splash goggles will be used when steam cleaning equipment. Every team member will use proper safety glasses while on site.

Respiratory Protection

The respirators selected for this project will provide protection against anticipated levels of airborne gases, fumes, mists, and dusts. To ensure that the mask will perform as expected, the respirator must be inspected, fit tested, maintained, and stored properly, according to company policy and governmental regulations.

1. Inspection procedures:

   The facepiece (full or half) should be free of dust, dirt, rips, tears, and obvious contamination. The septa (three in the half facepiece, one in the full facepiece) should be present and in good shape, watch for rips or dirt.

2. Fit Testing Procedures:

   The first step in testing the fit of your respirator is called the negative pressure test. Block the inhalation valves (on the side of the mask) with the hands or plastic sheets and inhale slightly. You should feel the mask draw in on the face. Watch for air leakage around the facepiece indicating a poor facial fit. REMEMBER, NO FACIAL HAIR THAT INTERFERES WITH THE FIT OF THE MASK IS PERMITTED.

   The next test (positive pressure test) is done by blocking the exhalation valve (at the bottom of the mask) with the palm of your hand. Exhale gently and notice for air leaking around the facepiece of the mask, indicating a poor fit. If air is leaking out of the mask, retighten the straps and perform the negative and positive pressure tests again.

   The last test (qualitative testing) involves the use of an indicating odor that is passed around the mask fitted with ORGANIC VAPOR CARTRIDGES. The employee will be asked to position his or her head to the side, up and down to simulate normal working conditions. The detection of the odor indicates that the facial seal of the mask is inadequate. If the employee detects the smell, the trainer is allowed to tighten the straps and adjust the mask on the employee one time. If the odor test is unsucessful twice, another brand of mask should be fitted.

3. Maintenance of Respirators:

   Respirators will be maintained to ensure that they work properly. Replace any missing part of the mask or strap, clean the mask with hot soapy water after each use, and do not let others wear your mask without disinfection first.

4. Storage of Respirators:

   Respirators must be stored in a clean, safe, dry, environment (e.g. not near the working area or on the drilling rigs).

5. Use and limitations of Respirators:

   Respirators selected for this project should be used properly and within the limits for which they were designed. These air purifying respirators will be useful in concentrations well below the 1000 ppm filtration limit of the cartridges. Air monitoring will confirm that airborne contamination does not exceed the use limitations of the respirator. These masks do not provide oxygen and should not be used in confined spaces or oxygen deficient atmospheres.

4.3 Decontamination and Work Zone Procedures

Items that become contaminated must be cleaned up to prevent employee exposure and the spread of harmful materials. The field team will also be expected to establish work zones and comply with safety procedures and dress codes for each particular zone. Section 6 gives a description of the decontamination procedures that will be used for this project. The following information will be given to the field team.

- o Work zone definition and marking;
- o Dress codes for each work zone;
- o Decontamination procedures for personnel, equipment, and heavy equipment.

Exclusion Zone

The exclusion zone is the area immediately surrounding the work area where the waste is being disturbed. For Monitor Well installation (hollow stem and air rotary) the exclusion zone will comprise a circle extending 25 feet around the drilling rig. Proper personal protection consists of hand, foot, eye, respiratory, body, and head protection as listed in Section 3.2.

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Contamination Reduction Zone (CRZ)

The contamination reduction zone is the area where decontamination will occur. The idea is to have personnel remove contaminants from themselves and their equipment inside the CRZ. This practice will avoid the spread of contamination into the support area.

Support Zone

The support zone is intended as an area that remains free of contamination and is used for staging activities, breaks, and eating. It is extremely important to keep this area clean and free of contamination. Never bring contaminated equipment, articles or yourself into this area without going through the decontamination procedures first.

Decontamination Procedures

Personnel and equipment can become contaminated in a number of ways including:

- Contacting vapors, gases, mists, or particulates in the air.
- Being splashed by materials while sampling or opening containers.
- Walking through puddles of liquids or on contaminated soil.
- Using contaminated instruments or equipment.

Protective clothing and respirators help prevent the wearer from becoming contaminated or inhaling contaminants. Good work practices help reduce contamination of protective clothing, instruments, and equipment.

The employee needs to be aware of donning and doffing procedures for protective clothing and equipment. These procedures are easy to follow:

- Gloves go on your hands first when putting protective clothing on; and
- Gloves come off your hands last, when undressing.

These procedures will be supplemented by performing decontamination on personnel, equipment and heavy equipment. Decontamination procedures consist of physically removing contaminants from the person or equipment with:

- Steam cleaning equipment;
- Diesel fuel and brushes;

- o Acetone rinsing; and
- o Detergent washing.

The drilling rig will be steam cleaned following contact with waste/soil material. The rig will then be spray washed and detergent washed prior to leaving the CRZ. Diesel fuel brushing is only required in the event that the auger flights become covered with waste that the steam cleaning will not remove.

Respirators should be washed with detergent/disinfection solution to remove any contamination. Respirators must be washed at the end of each day or more often if they become grossly contaminated.

Emergency Procedures

Emergency procedures are presented in this manual to address the possible site emergencies given below:

- o Medical injuries;
- o Fire and explosions;
- o Excessive emissions from drilling activity;

Medical Injuries

Medical problems that can occur on site need to be handled competently and quickly. Each field team member should be aware of the instructions and information given below:

- o Write down and post the telephone numbers of the local Base and community ambulances and medical facilities.
- o Seek professional medical attention for personnel that are not breathing, bleeding severely, experiencing intense pain or are unconscious. Each member of the site team should know how to call for an ambulance (on Base and off Base).
- o If you get anything in your eyes (chemicals or dust), flood them with water for 15 minutes. Be sure to tell a supervisor. The Supervisor will make sure that the victim washes the eyes for the full 15 minutes.
- o Do not remove objects that are impaled (stuck) in the eye.
- o Always seek medical attention for eye injuries.
- o Stop bleeding with direct pressure. Place a bandage over the wound and press down with your hand. Use a tourniquet

only in extreme cases when you are not able to stop severe bleeding.

- If you contact the waste, wash the affected area with soap and water as soon as possible. If large amounts of waste come in contact with the body, you will be required to take a full body shower with soap immediately.

Fire and Explosion Response Procedures

Fires on site can be caused by the drilling rig activity and welding activity. The drilling rig will have a fire extinguisher on hand at all times. The procedure for using a fire extinguisher is to pull the safety pin, point the extinguisher at the base of the flames and discharge the extinguisher by sweeping the flames from a distance of six feet. Move in closer as the flames are being put out.

- Never use water on an electrical fire or a solvent fire. All extinguishers should be dry chemical and labeled "Class A, B, C".

- Never weld in dry grass and always keep an extinguisher nearby.

- Keep decontamination solvents well away from the steam cleaner.

Excessive Emissions Procedures

If the detector tube readings indicate that the drilling activity is producing excessive emissions (any emission approaching the TLV), the following action needs to be taken:

- Cease drilling and contain cuttings.

- If emissions are not controlled, remove auger flights and close the borehole. Continuous air monitoring will be conducted during this type of emergency.

- Be prepared to evacuate to an upwind site.

5.0 EMPLOYEE EXPOSURE MONITORING

The field team will be monitored for exposure to site hazards. The monitoring program planned for this project will consist of monitoring airborne vapor contamination, and employee exposure to heat stress, if temperatures exceed 70 degrees F. The following tables will summarize monitoring information:

Tables	Description
1	Detector tubes for monitoring air quality
2	Respirator protection factors

5.1 Air Monitoring

Ambient air monitoring will be performed using colorimetric indicator tubes to detect the presence of airborne contamination in vapor form. A Draeger kit with an assortment of indicator tubes will be used to obtain quick analyses of hazardous substances in the air.

Air samples will be collected in the following manner:

- Prior to starting any work at a drilling site, the Supervising Geologist will take one air sample using the "polytest" detector tube. This tube will show a positive reaction in the presence of:
  - ethyl acetate
  - benzene
  - acetone
  - alcohol
  - hydrocarbons

If a positive reaction does occur, more specific tests may be made using specific detector tubes. The results of the air samples will confirm that the respirators selected for this project will provide adequate protection under actual site conditions.

An example for confirming respiratory protection is provided below:

- The protection factor of a full facepiece respirator is 50.

- Suppose the detector tube reading for benzene is 1 ppm.
- The Threshold Limit Value (TLV) for benzene is 10 ppm, which means that with a protection factor of 50, you would be protected at a concentration of 50 time the TLV (or 500 ppm), leaving quite a large margin of safety when the detector tube reads 1 ppm.

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6.0 DECONTAMINATION PROCEDURES

To minimize the transfer of hazardous substances from the site, contamination control procedures are needed. Contaminants must be removed from people and equipment prior to relocation from a work zone.

6.1 Work Zones

The field team will prevent waste material from moving from the drilling site. The team will prevent migration of site contaminants by using work zones to control and decontaminate personnel and equipment. Protection levels in each work zone will be different and the workers should familiarize themselves with the special procedures and dress codes of each work zone. Presented below is a list of figures that will demonstrate how the work zones will be set up and the decontamination scheme for cleaning equipment and personnel.

Figure	Description
1	Monitor well work zones
2	Decontamination scheme for the drilling rig, auger flights, and split spoon samplers.
3	Decontamination procedures for personal protective equipment.

Exclusion Zone

A 25 foot circle around the drilling rig will be the "exclusion zone". This zone may contain potentially hazardous airborne and physical hazards to the workers. Full personal protection will be required in this area.

Contamination Reduction Zone

A corridor leading from the exclusion zone will be defined. This corridor should lead from the drilling rig to the break area. All decontamination activities will occur in this area. A waste container should be placed at the end of the corridor so contaminated disposable equipment can be dropped off. Personal protective equipment should be removed in the order given below before anyone enters the support area.

- first, remove any outer gloves or boot covers and drop them in the container provided;

- next, remove the tyvek coverall, save this coverall unless it is contaminated;

- next, remove your respirator;

- last, remove your inside gloves.

Reverse the order of the doffing procedure when you are ready to enter the exclusion zone.

Support Zone

A support zone must be defined for each well installation location. The zone should be at least 50 feet from the drilling rig and should be clean and free of contamination (surface and airborne). Air monitoring and visual inspection of the support zone location will confirm that the area is relatively clean.

Some general rules to obey when in the support zone are as follows:

- You must wash your hands and forearms with soap and water before eating, drinking, smoking, anything.

- You must wash your hands before using the toilet.

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