Documents Discussion

Return To Library > Records 2 > ERID-109000 Through ERID-109499 > **ERID-109161 1) GEOPHYSICAL INVESTIGATION OF MATERIAL DISPOSAL AREA B, 2) ATTACHED CD**

Created By:	Aurelia A. Martinez/USERS/LANL
File name:	Master-Media Target.pdf
Version:	1.0
Document Type:	RPF Record
Description:	SUBMITTED BY BRITTANY DONNELLY, NORTHWIND INC

Document Details:

Title:	ERID-109161 1) GEOPHYSICAL INVESTIGATION OF MATERIAL DISPOSAL AREA B, 2) ATTACHED CD
ERID Number.StartPage:	109161
Office of Record:	Waste & Environmental Support - Waste Acceptance
Date Received:	04/28/2010
Official Use Only:	N
Page Count:	67
Record Type:	Letter
Document Date:	02/20/2010
To:(Addressees - Organization)	N/A
From:(Senders - Organization)	N/A
Other Document Number(s):	PKG-1831
TA:	N/A

October 22nd, 2009

*** Denotes Fields that are mandatory.**

To download this file, right mouse click on the file and select 'Save to Disk' or 'Save Target as'

Master-Media Target.pdf <-- This link points to this version.

To check-out and/or edit this file, select Edit Document or Check Out Document from the Document menu above.

File Cabinet: Records 2

Binder Category: ERID-100000 Through ERID-109999

Binder: ERID-109000 Through ERID-109499

33633

M. Goldberg

Geophysical Investigation of Material Disposal Area B

Los Alamos National Laboratory, Los Alamos, New Mexico

ARM Project No.: 08351

February 20, 2009

Prepared for:

Portage

Portage Environmental, Inc.
146B Eastgate Drive
Los Alamos, NM 87544

Prepared by:

ARM GEOPHYSICS

1129 West Governor Road
Hershey, PA 17033-0797
(717) 533-8600

EXECUTIVE SUMMARY

ARM Geophysics (ARM) performed a non-intrusive geophysical investigation at the Los Alamos National Laboratory (LANL), Materials Disposal Area B (MDA B) during October 27 through November 7, 2008. MDA B was one of the first solid waste burial sites used by LANL. The area comprises 6 fenced acres where the pits were allegedly excavated to a depth of 12 feet into the overlying soil and tuff.

The objectives of the investigation were to delineate the lateral extent and estimate the depth of disposal pits. To achieve these objectives, an integrated geophysical investigation was performed using high-sensitivity metal detector (EM61), terrain conductivity (EM31), and ground penetrating radar (GPR) geophysical techniques. Figure presents a base map showing the location of the survey area.

The results of this investigation successfully achieved the project objectives by delineating the lateral extent and estimating the vertical extent of the pits contained in MDA B. While the lateral extent of these pits are defined with a reasonable degree of certainty, the vertical extent is less well defined. The interpreted average depth of the pits ranged from 7 to 11 feet. It is possible that greater depths exists but could not be observed in the GPR data due to insufficient penetration.

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF APPENDICES

1 INTRODUCTION AND SCOPE

ARM Geophysics (ARM) performed a non-intrusive geophysical investigation at the Los Alamos National Laboratory (LANL), Materials Disposal Area B (MDA B) during October 27 through November 7, 2008. MDA B was one of the first solid waste burial sites used by LANL. The area comprises 6 fenced acres where the pits were allegedly excavated to a depth of 12 feet into the overlying soil and tuff. Based on historical information, approximately 90% of the waste consisted of paper, rags, rubber gloves, glassware, and small metal apparatus. The remainder of the material consisted of scrap metal and large metal equipment. Historical documents further suggest as many as six pits were dug at MDA B.

The objectives of the investigation were to delineate the lateral extent and estimate the depth of disposal pits. To achieve these objectives, an integrated geophysical investigation was performed using high-sensitivity metal detector (EM61), terrain conductivity (EM31), and ground penetrating radar (GPR) geophysical techniques. Figure presents a base map showing the location of the survey area.

This report details the methods of the investigation in Section 2. A discussion of the results is presented in Section 3. Finally, the conclusions of the investigation can be found in Section 4.

2 METHODOLOGY

2.1 Geodetic Positioning

All geophysical instruments were integrated with a differential global positioning system (GPS) to allow real-time navigation along planned survey routes, to provide accurate location of geophysical measurements, to eliminate the need to establish a local reference grid, and to allow direct data integration with LANL's geographic information system (GIS). The geographic positions of all measurement points were acquired at less than 1-s intervals as the geophysical data were collected. The rectangular coordinate system used for all map projections in this report is New Mexico State Plane, North American Datum 1983, Central Zone, US survey feet (sft).

The GPS data were acquired using a Leica 1200 Real Time Kinematic (RTK) Global Positioning System. RTK allowed positions to be determined with centimeter accuracy as the geophysical data are collected. The Leica base station was set up over control monument TA21-DEM1, located within TA 21 approximately 525 feet southeast of MDA B (NORTHING: 1774729.401 sft, EASTING: 1631935.386 sft). The Leica rover receiver was centered over the measurement point of each geophysical instrument.

As the differentially corrected data were acquired, they were sent in NMEA-0183 Standard format to the geophysical instrument's data logger. The data are initially stored in the data logger in geographic latitude/longitude format and subsequently converted to a rectangular coordinate system for processing and mapping.

Quality control and functional test were performed at the beginning and ending of each survey day. In conjunction with geophysical instruments tests, GPS measurements were taken at the geophysical reference station (NORTHING: 1775094.414 sft, EASTING: 1629144.077 sft) to verify repeatability and document proper functioning. Variation in positioning measurements averaged less than 0.16 cm at the base station.

Further documentation to verify proper coordinate transformation procedures throughout the geophysical data processing and mapping is made by comparing the pin flag locations established by Portage's geodetic survey and the processed EM61 anomalies produced by the wire pin flags. Portage Inc. performed a stakeout survey of select nodes along the site 10 ft x 10 ft reference grid to provide ARM personnel visual guidance during instrument transects. Physical marking of these grid nodes in the field ensured proper alignment of geophysical instruments and full measurement coverage of MDA B. Nodes were delineated using spray paint in the paved western portion of the MDA and metal pin flags in the unpaved eastern portion. The comparison in Figure 2 shows the good correlation between coordinates surveyed by Portage and the coordinates used to acquired the geophysical data and construct the map.

2.2 High-Sensitivity Metal Detector (EM61)

The metal detector survey was performed using a Geonics EM61-MK2 High-Sensitivity Metal Detector. The EM61 is a time domain electromagnetic (EM) system that can discriminate between conductive soils and metal objects. It has numerous advantages over other commonly used metal detection devices. It is significantly less sensitive to cultural interference caused by above ground metal objects and power lines than the magnetometer or terrain conductivity meter.

The EM61 generates rapid electromagnetic pulses and measures the subsurface response between pulses. Secondary EM fields are generated in the ground after each pulse. These fields dissipate rapidly in earth materials but remain for a longer time in buried metal objects. The EM61 measures the prolonged metal response only after the earth response has dissipated. This response is measured and displayed in millivolts (mV).

For this investigation, data were collected at less than 1 ft intervals along lines spaced approximately 5-ft apart. Geodetic coordinates were recorded at 1-s intervals using the integrated RTK GPS so each measurement point could be located with centimeter accuracy. A geophysical reference station free from cultural interference was occupied at the beginning and end of each survey day to calibrate the instrument and perform system functional tests. During these the instrument was nulled and system calibration and sensitivity checks were performed.

2.3 Terrain Conductivity

The EM31 method uses the principle of electromagnetic induction to measure the electrical conductivity of the ground. Lateral changes in terrain conductivity can indicate the presence of disturbed ground, disposal areas, buried metallic and non-metallic waste, and impacted ground water. The method can also be useful in detecting linear metal objects such as utilities.

A Geonics EM31-MK2 was used to conduct the survey. The EM31 operates in accordance with the theory of operation at low induction numbers. An alternating current is passed through a transmitter coil to induce eddy currents into the ground below the instrument. These eddy currents generate a secondary magnetic field. The quadrature-phase component of the induced secondary magnetic field is detected by a receiver coil and measured by the instrument. The measured response is linearly related to the terrain conductivity. The instrument converts the measured signal and displays it as terrain conductivity in millisiemens per meter (mS/m).

The in-phase component of the resulting magnetic field is also measured by the instrument and displayed in parts per thousand (ppt) of the primary magnetic field. These data are more sensitive to the strong response from buried metal objects than the quadrature phase component or terrain conductivity.

For this investigation, EM31 data were recorded at less than 1-ft intervals along lines spaced approximately 5-ft apart. Geodetic coordinates were recorded at 1-s intervals using an integrated RTK GPS. A geophysical reference station free from cultural interference such as aboveground metal objects and overhead power lines was occupied at the beginning and end of each survey day to calibrate the instrument and perform system functional tests. During these tests, battery, phasing, and sensitivity checks were performed.

2.4 Ground Penetrating Radar (GPR)

The GPR technique uses the transmission and reflection of radio waves to image objects beneath the ground surface. The technique responds to changes in the electrical properties (specifically, the dielectric constant and conductivity) of the earth or buried materials. A GPR target must possess electrical characteristics that are different from the surrounding media in order to be detected. When the transmitted wave encounters an anomalous object or layer, the wave is reflected back to the surface where it is recorded and analyzed. The waves are transmitted rapidly such that a continuous subsurface image is generated as the transmitter is pulled along the ground surface.

The GPR survey was performed using a digital SIR-3000 Subsurface Interface Radar System, manufactured by Geophysical Survey Systems, Inc. Line locations were strategically chosen based on the results of the EM31 end EM61 surveys. Data were digitally recorded, displayed, and analyzed during acquisition to allow real-time interpretation.

Following detailed analysis of data collected using both a 200 and 400 MHz antenna, the 400 MHz transducer data was chosen for final analysis and interpretation. Hyperbolic fitting was performed by computer to calculate signal travel time and more accurately estimate target depths.

The following processing steps were applied to the raw data:

1. Marker interpolation
2. Background removal
3. Header gain removal
4. Energy decay filter
5. Butterworth bandpass filter
6. FK filters

3 RESULTS AND DISCUSSION

3.1 High-Sensitivity Metal Detector (EM61) Survey

Figure 3 presents a plan map of the EM61 data. The EM61 is designed to measure only the prolonged response created by metal objects. Therefore, any anomalies shown on the map are attributed to metal objects. The amplitude of any anomaly is a function of the distance (depth) to the object and the amount of metal present. Several data channels are recorded at each measurement point in millivolts (mV). The presence of buried metal will produce elevated responses from background.

The data set presented in Figure 3 was processed to enhance buried metal responses and represents 187,877 measurement locations along a total line distance of 8.1 miles. The most salient features in this data set are the series linear anomalies are observed throughout the survey area. The high amplitude and sharp boundaries of the anomalies suggest the presence of buried metal materials in linear disposal pits.

Figure 4 presents the interpreted pit locations based on the EM61 data. A long and narrow pit is observed in the western leg of the survey area. The approximate dimensions of this interpreted pit are 1070 ft long by 40 ft wide. The discontinuous nature of the anomalies is likely due to the variations in the concentration of metal objects as opposed to the existence of a multiple pits. Two notable deviations from this linear anomaly trend are observed on both the northern and southern side. These may be related to a widening of the trench instead of the existence of separate pits. The ground penetrating radar data (discussed below) corroborates this interpretation.

The eastern leg of the survey area also contains linear pits. The main pit is wider on the western end. This portion of the pit contains the greatest concentration of metal objects. Again, a discontinuous nature is observed in the anomaly on the eastern end, which may be due to variations in the concentration of metal objects. Four clusters of anomalies are also observed in the southeastern portion of the eastern leg. Although these anomalies are faint, the systematic arrangement of the subtle anomalies suggest the presence of four pits approximately 40 ft wide by 60 ft long. It is also possible that these four clusters of metal objects are contained within one continuous pit but separated by nonmetallic materials. A linear arrangements of anomalies within these smaller pits appear to be linear metal objects approximately 25 feet long.

Figure 5 presents a map of the EM61 data processed to highlight the larger metallic objects or greater concentration of metal. This map shows the greatest concentration of metal objects occurs within the wide portion of the pit in the eastern leg of the survey area.

3.2 Terrain Conductivity (EM31)

Terrain conductivity (EM31) data are commonly used to map the lateral changes in electrical conductivity that can indicate the presence of disturbed ground and both metallic and nonmetallic buried waste. The character of EM anomalies can be complex when produced by buried metal objects. Anomalies can be positive, negative, or both depending upon the depth, location, and orientation of the object with respect to the instrument orientation. If sufficient lateral resolution is achieved, shallow anomalies caused by large metal objects typically produce a negative anomaly directly over the object that is surrounded by a "halo" of elevated conductivity.

A contour map of the in-phase EM31 data are presented in Figure 6. This map was constructed using the EM31 data recorded at 120,151 locations along a total line distance of 8.1 miles. The location of the linear EM31 anomalies are consistent with the boundaries interpreted from the EM61 data. Deviations from the these boundaries are attributed to the lower lateral resolution of the EM31. The EM31 data more clearly shows the interpreted pit in the eastern leg of this survey area. It's continuous nature suggests the is one pit instead of a series of smaller ones.

Figure 7 is a map of the terrain conductivity component of the EM31 data. These data show no additional information related to the configuration of the pits. The terrain conductivity would be more useful in a more humid environment where the increased porosity associated with an excavation may also be associated with an increase in moisture content.

3.3 Ground Penetrating Radar (GPR)

The GPR technique responds to changes in the electrical properties of the earth or buried materials. A GPR target must possess electrical characteristics that are different from the surrounding media in order to be detected. In this investigation, significant electrical contrasts exist between many types of buried waste and the cover materials and bedrock. Poor electrical contrasts exist between the crushed tuff cover materials and tuff bedrock. Nevertheless, the base of the cover materials was interpreted along most lines. In some areas, structures beneath this interface and objects within the pits were observed as well.

GPR data acquisition involves measuring the travel time of a reflected electromagnetic pulse from the subsurface target. The travel time can vary depending upon the electrical characteristics of the subsurface materials through which the pulse travels. The travel time is usually converted to depth to produce meaningful results. This time-to-depth conversion is accomplished in several ways. Most often, the conversion is made using published travel time data for the appropriate sediment or rock types. For this investigation, more representative conversions were made by computer using hyperbolic fitting of point source reflections.

The locations of GPR lines are shown in Figure 8. GPR data were acquired continuously along 44 lines, resulting in 4,010 feet of detailed coverage. The interpreted GPR profiles are presented in Attachment A.

In general, there was excellent correlation between the pit boundaries interpreted from the EM data and those observed in the GPR profiles. The depth of penetration varied laterally due to changes in the physical properties of surficial materials. For this reason, pit boundaries were not clearly observed in all areas where GPR lines cross them.

Example GPR profiles are presented in Figures 9 through 12. The numbers along the X-axis represent line distance, which corresponds to the downline distances shown in Figure 8. The y-axis on the left shows the travel time of the radar signal that is converted to estimated depth, which is shown on the right y-axis. Figure 9 presents a GPR profile along Line 41. The disposal pits are characterized by strong chaotic reflections from randomly scattered buried materials. Undisturbed conditions exhibit lateral homogeneity and typically more horizontal layering. Line 41 crosses over the main trench in the western leg and into one of the anomalous globes observed in the EM61 data that extend outside of the main trench. This radar profile suggests these deviations from the main trench relate to areas where the trench was widened.

Finally, the GPR profile shown in Figure 12 suggest the presence of a shallow pit that was not observed in either the EM61 or in the EM31 data. The depth of this interpreted pit is only a few feet but the configuration dipping interfaces and chaotic reflections indicate this area had been disturbed. However, no buried objects are observed in the radar profile and no metal was detected with the EM61 in this area.

4 CONCLUSIONS

Each technique used in this investigation measures different physical properties of the subsurface. The results from the three geophysical techniques used at this site are consistent in terms of the interpreted pit boundaries. Some lateral variations within interpreted pit boundaries were observed but these are explained by the heterogeneity of buried materials.

While the lateral extent of these pits are defined with a reasonable degree of certainty, the vertical extent is less well defined. The interpreted average depth of the pits ranged from 7 to 12 feet. It is possible that greater depths exists but could not be observed in the GPR data due to insufficient penetration. Pit depth estimates were made by calculating the depth of the deepest chaotic reflection that is attributed to buried materials. In a few places, a flat interface was observed that may be the base of the trench. However this layer was intermittent and inconsistent in character.

In conclusion, the results of this investigation successfully achieved the project objectives by delineating the lateral extent and estimating the vertical extent of the pits contained in MDA B. Since these data may be used to locate exploratory borings near potentially hazardous materials, it is important to recognize that geophysical methods are indirect techniques. The correlation of geophysical responses with probable subsurface features is based on inferences made from the physical properties of buried materials. These physical properties are usually not definitive in terms of identification of the material or object and some ambiguities in interpretation may exist.

5 REFERENCES

Spatial Data Sources:

Dirt Road Arcs; Los Alamos National Laboratory, KSL Site Support Services, Planning, Locating and Mapping Section; 06 January 2004; as published 15 October 2008.

Hypsography, 2 Foot Contour Interval; Los Alamos National Laboratory, ENV Environmental Remediation and Surveillance Program; 1991.

Hypsography, 10 Foot Contour Interval; Los Alamos National Laboratory, ENV Environmental Remediation and Surveillance Program; 1991.

Hypsography, 20 Foot Contour Interval; Los Alamos National Laboratory, ENV Environmental Remediation and Surveillance Program; 1991.

Hypsography, 100 Foot Contour Interval; Los Alamos National Laboratory, ENV Environmental Remediation and Surveillance Program; 1991.

LANL Areas Used and Occupied; Los Alamos National Laboratory, Site Planning & Project Initiation Group, Infrastructure Planning Office; 19 September 2007; as published 04 December 2008.

Orthophotography, Los Alamos National Laboratory Site, 2005; Los Alamos National Laboratory, Site Planning and Project Initiation Group, Space and Site Management Office; LA-UR-05-9035, 17 October 2005.

Paved Road Arcs; Los Alamos National Laboratory, KSL Site Support Services, Planning, Locating and Mapping Section; 06 January 2004; as published 15 October 2008.

Security and Industrial Fences and Gates; Los Alamos National Laboratory, KSL Site Support Services, Planning, Locating and Mapping Section; 06 January 2004; as published 15 October 2008.

Structures; County of Los Alamos, Information Services; as published 29 October 2007.

Structures; Los Alamos National Laboratory, KSL Site Support Services, Planning, Locating and Mapping Section; 06 January 2004; as published 15 October 2008.

Technical Area Boundaries; Los Alamos National Laboratory, Site Planning & Project Initiation Group, Infrastructure Planning Office; September 2007; as published 04 December 2008.

FIGURES

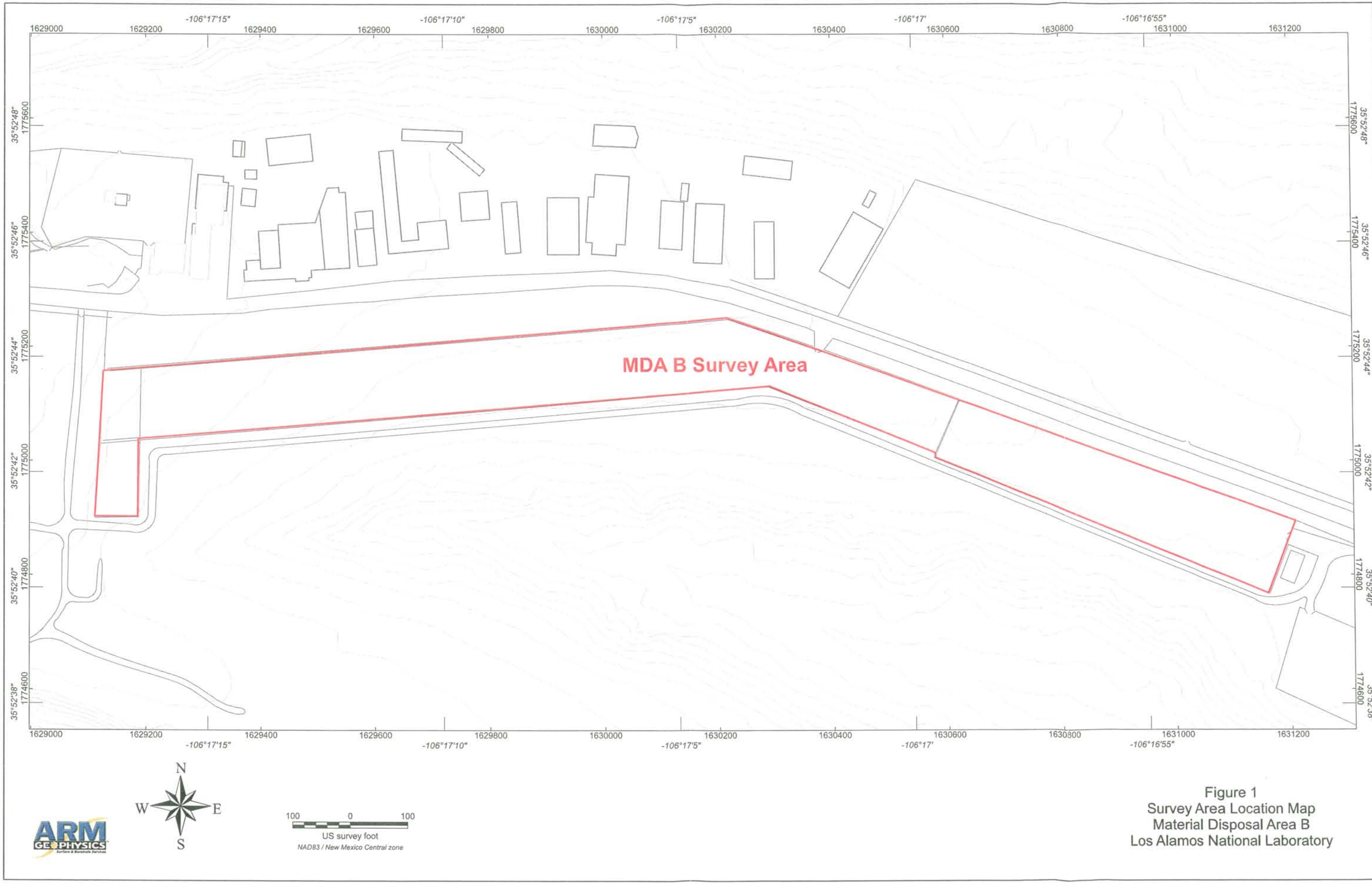


Figure 1
Survey Area Location Map
Material Disposal Area B
Los Alamos National Laboratory

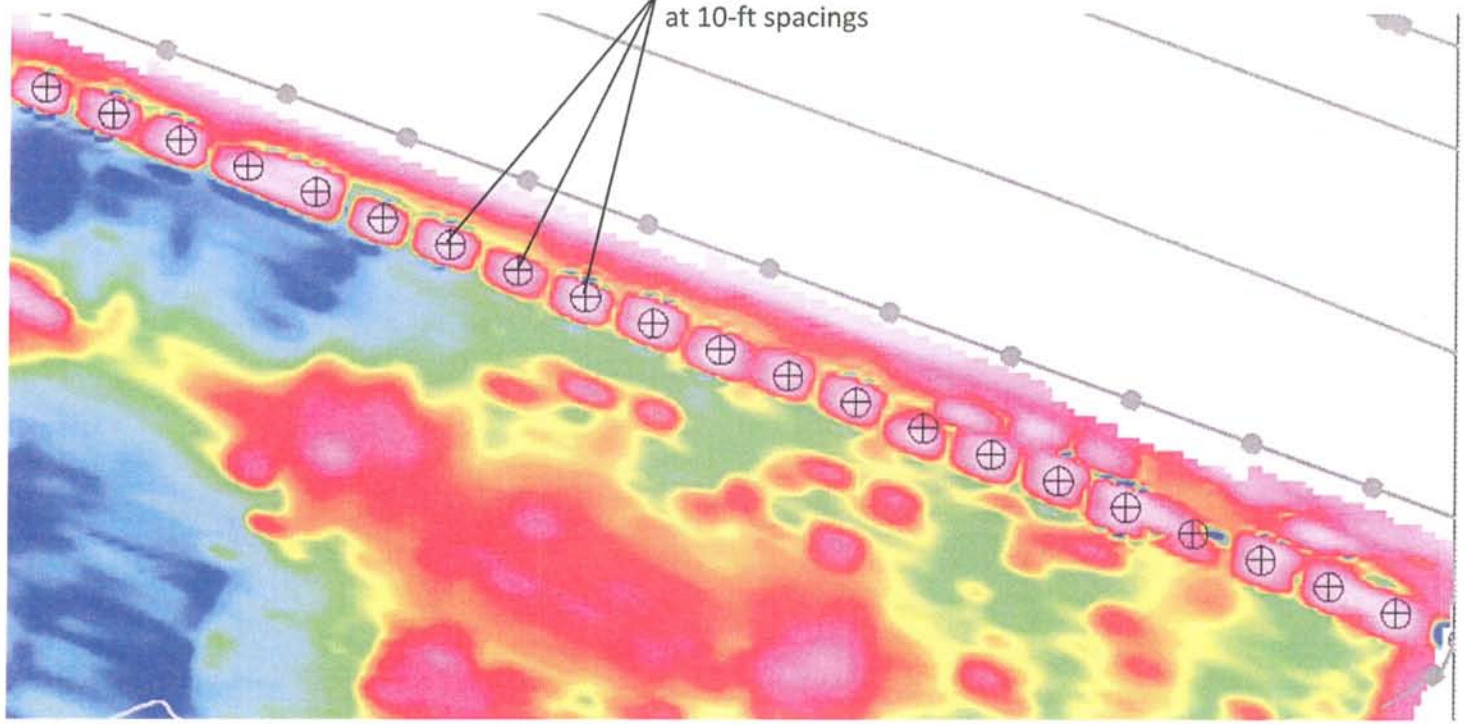


Figure 2
Overlay of Portage Pin Flag Coordinates
and ARM EM61 Anomalies Produced by Pin Flags
Material Disposal Area B
Los Alamos National Laboratory

ARM GEOPHYSICS

Figure 3
EM61 Buried Metal Anomaly Map
Material Disposal Area B
Los Alamos National Laboratory

Figure 4
Interpreted Pit Locations Based on EM61 Data
Material Disposal Area B
Los Alamos National Laboratory

Figure 5
EM61 Buried Metal Anomaly Map
Enhanced to Highlight Greater Concentrations of Metal Objects
Material Disposal Area B
Los Alamos National Laboratory

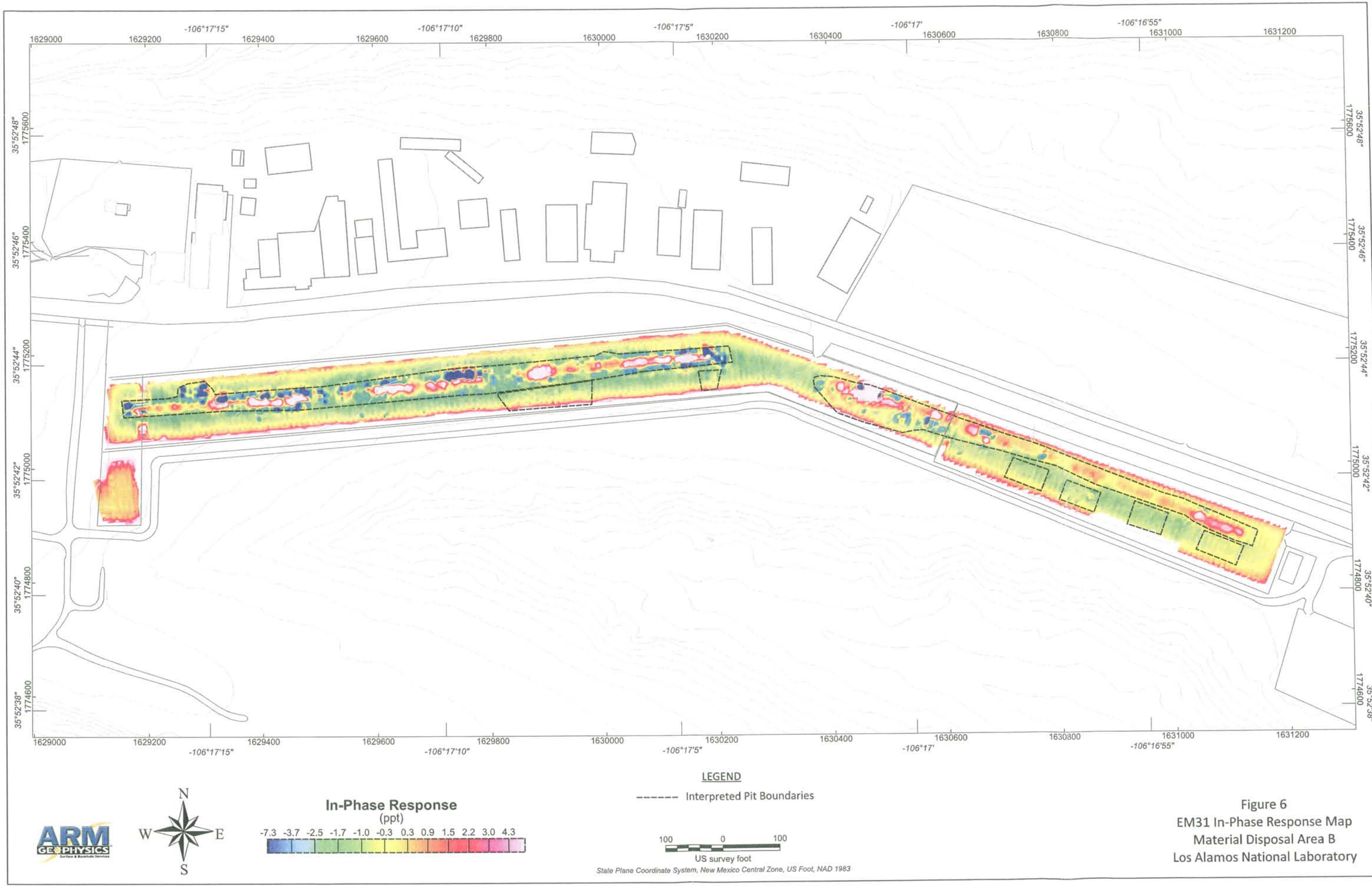


Figure 6
EM31 In-Phase Response Map
Material Disposal Area B
Los Alamos National Laboratory

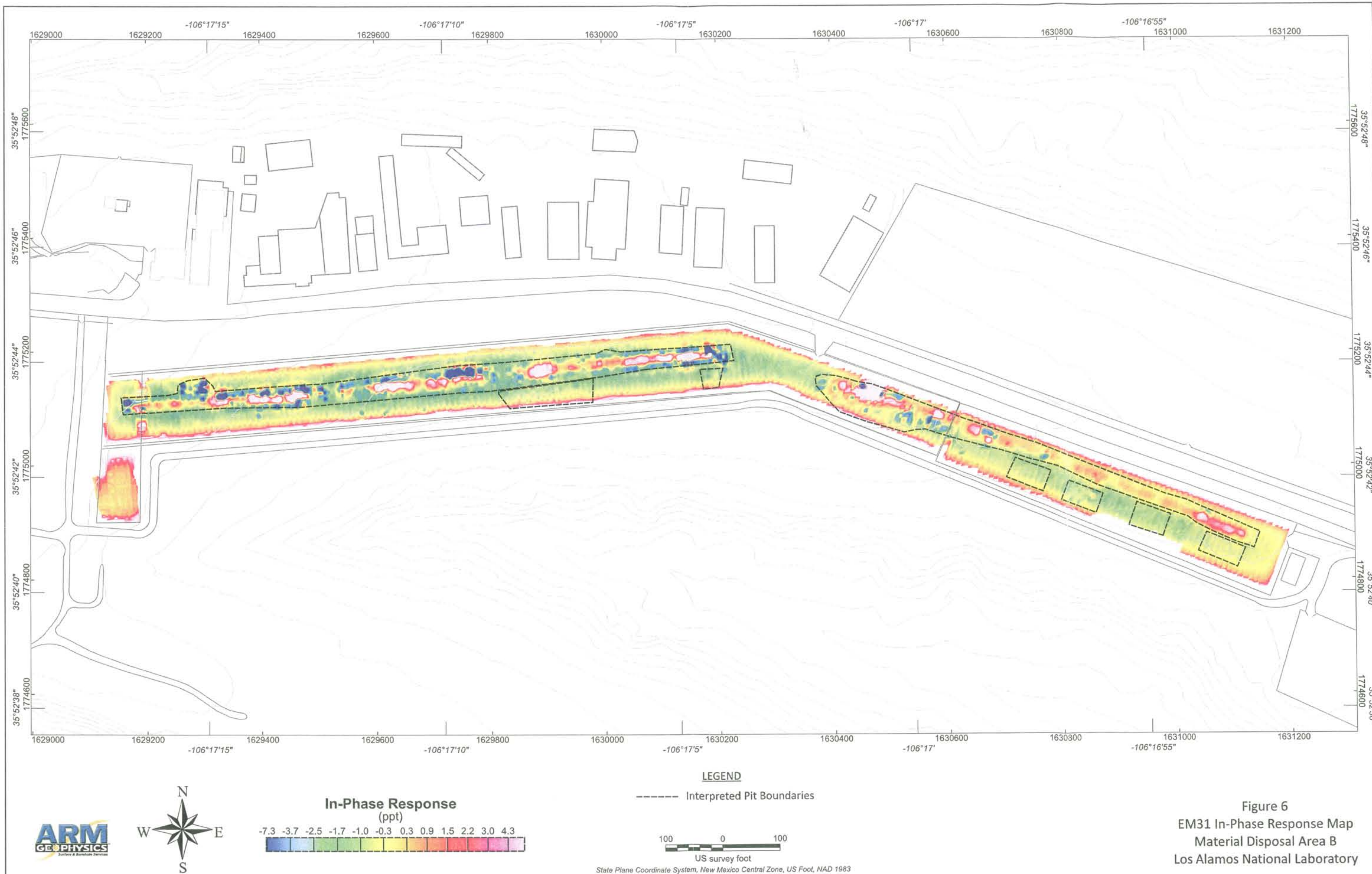


Figure 6
EM31 In-Phase Response Map
Material Disposal Area B
Los Alamos National Laboratory

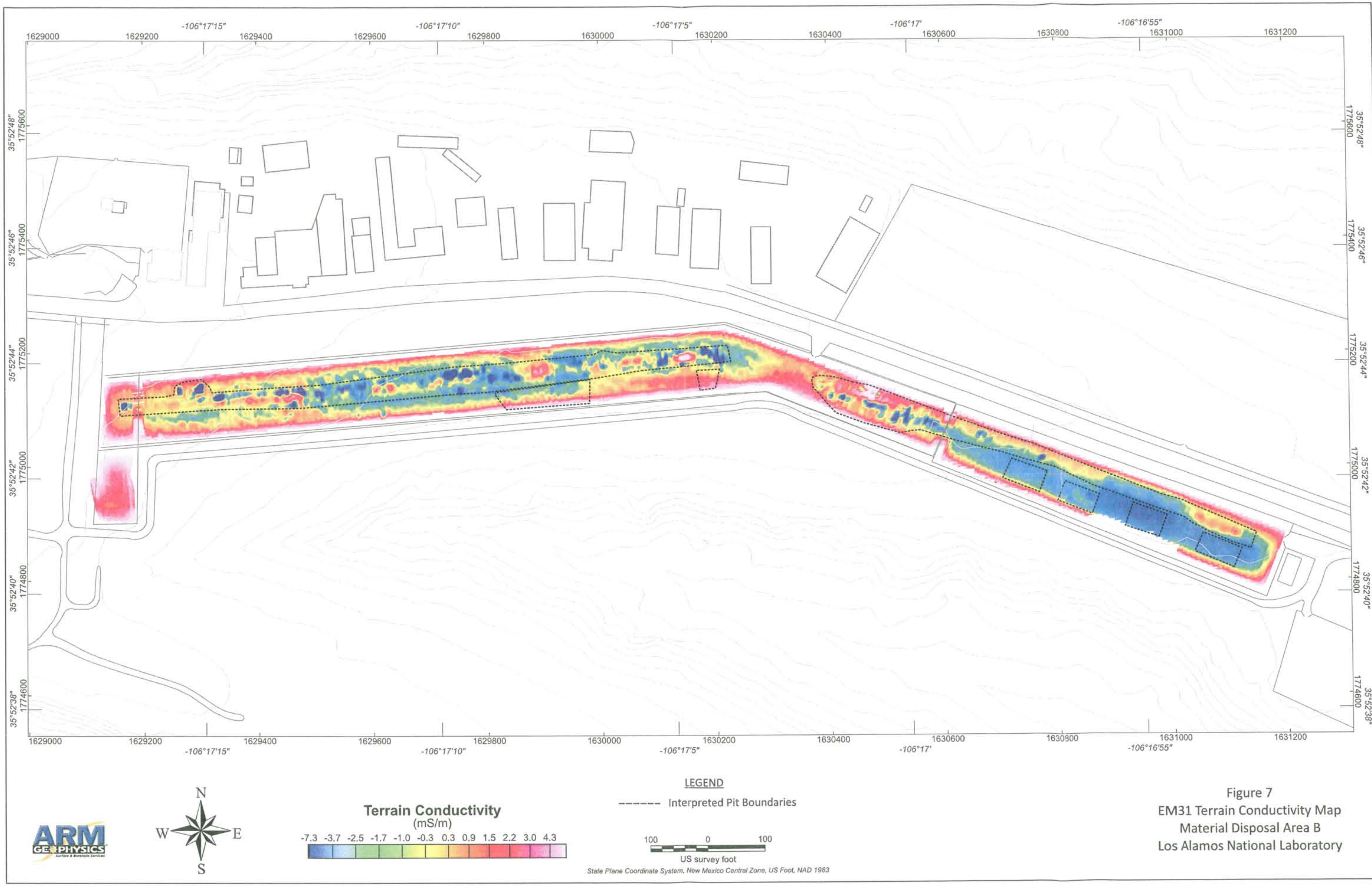


Figure 7
EM31 Terrain Conductivity Map
Material Disposal Area B
Los Alamos National Laboratory

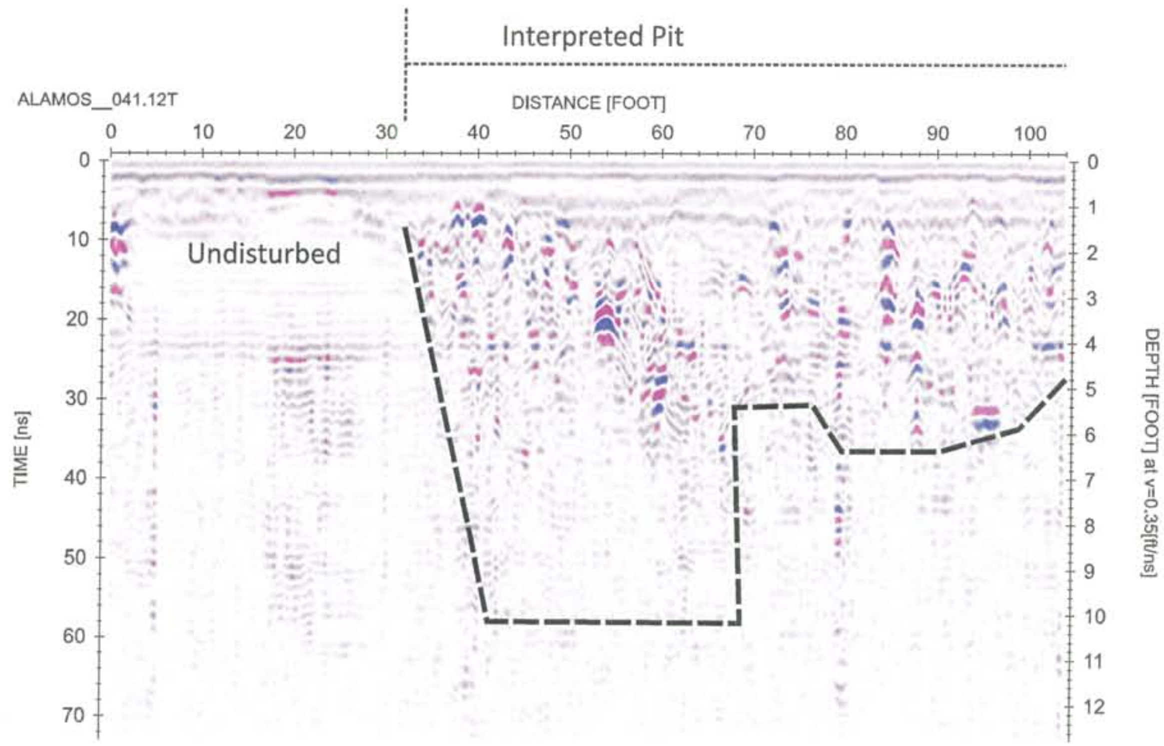


Figure 9
GPR Profile - Line 41
Material Disposal Area B
Los Alamos National Laboratory

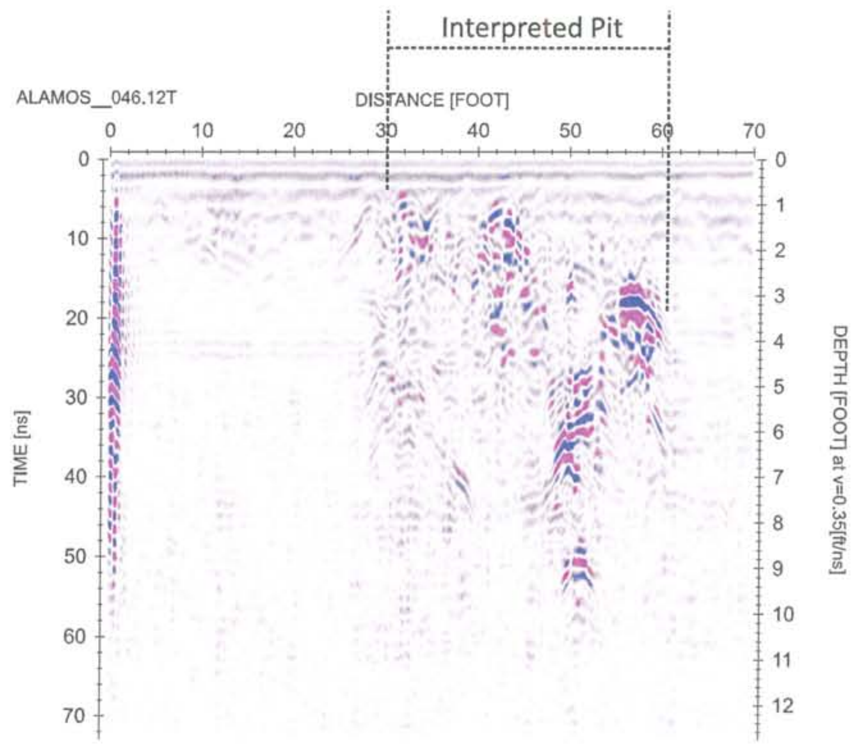


Figure 10
GPR Profile - Line 46
Material Disposal Area B
Los Alamos National Laboratory

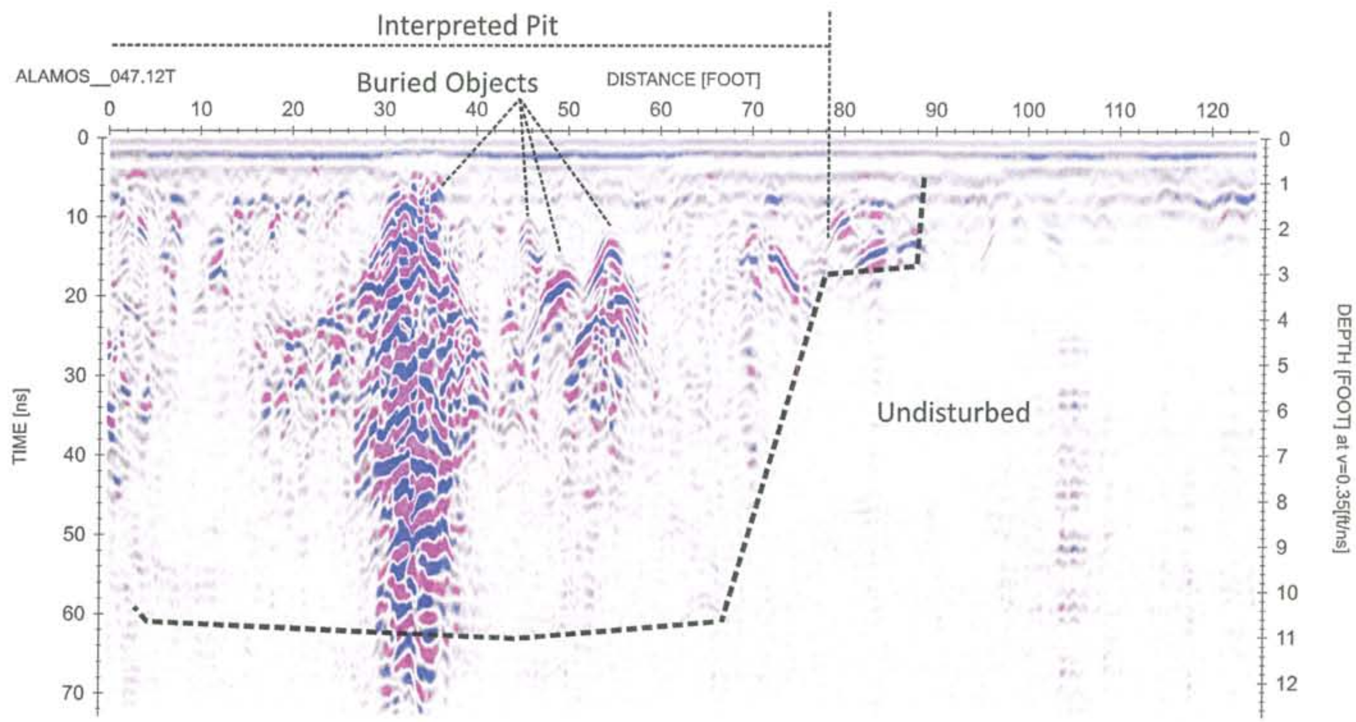


Figure 11
GPR Profile - Line 47
Material Disposal Area B
Los Alamos National Laboratory

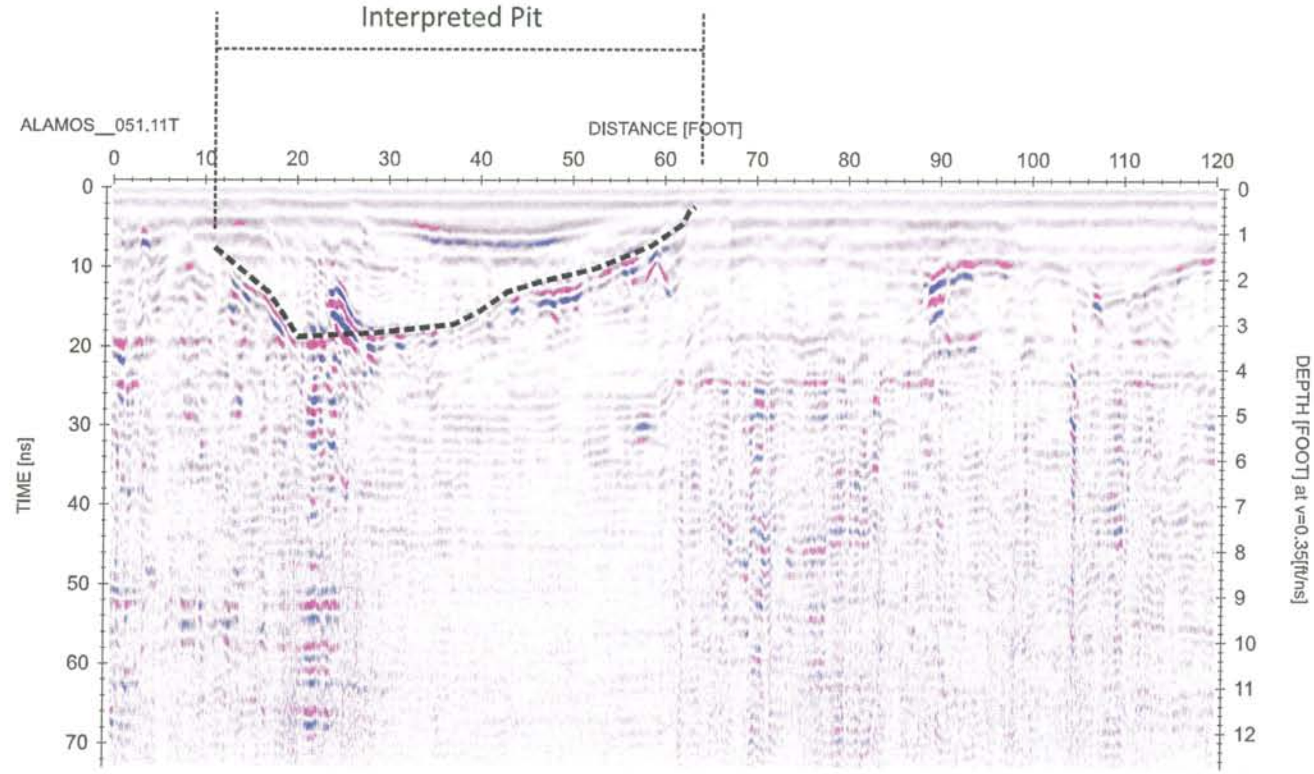
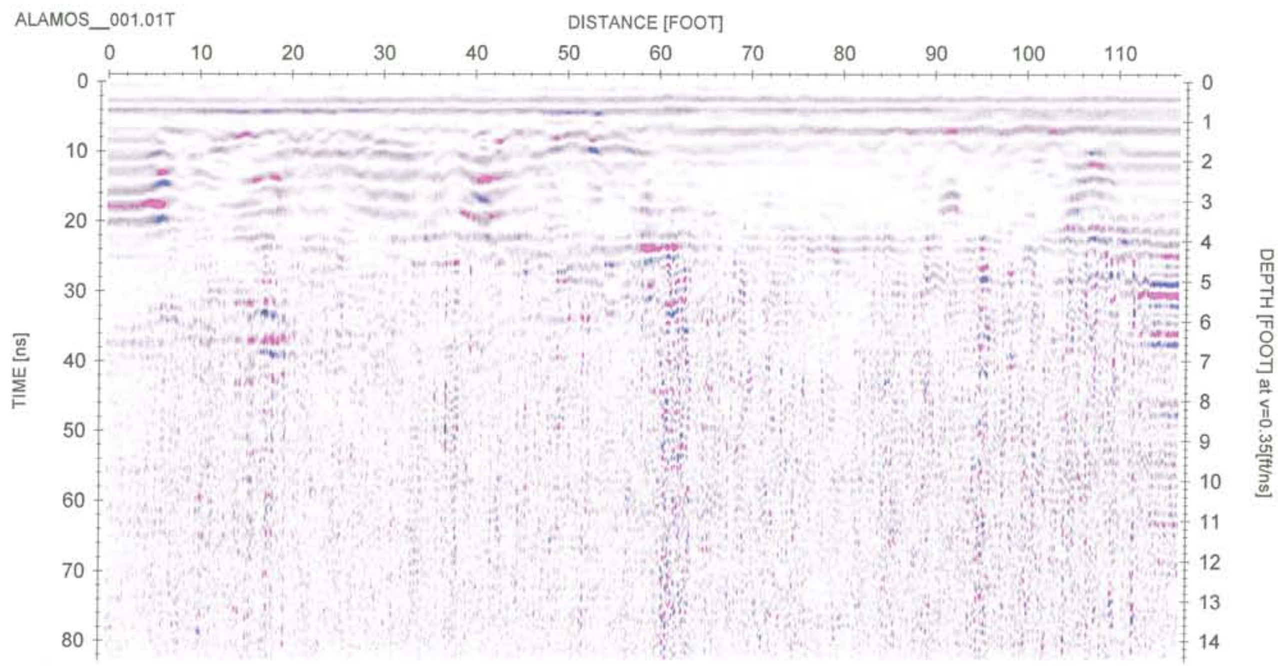
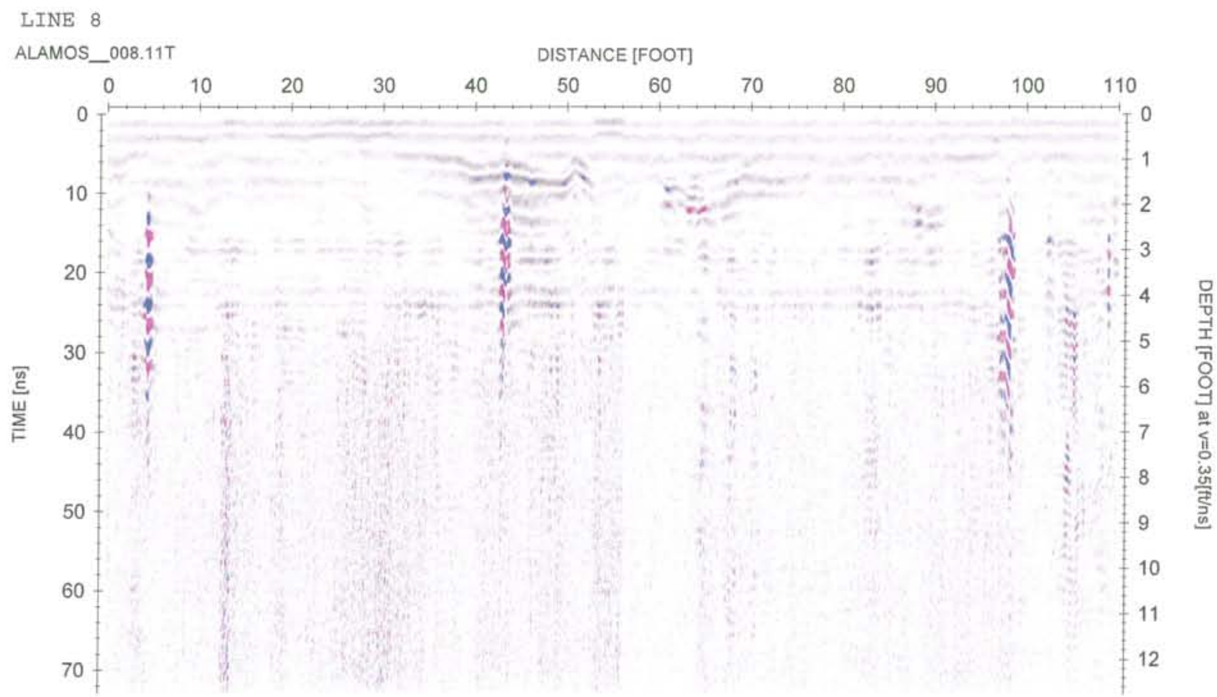
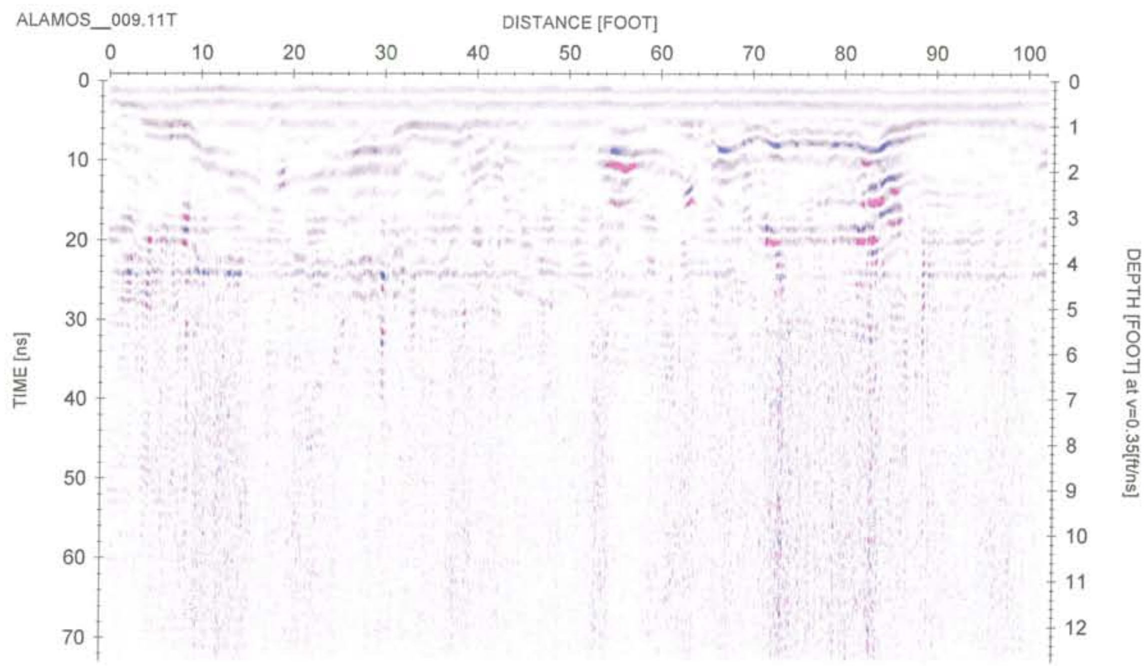


Figure 12
GPR Profile - Line 51
Material Disposal Area B
Los Alamos National Laboratory

APPENDIX A
GPR DATA

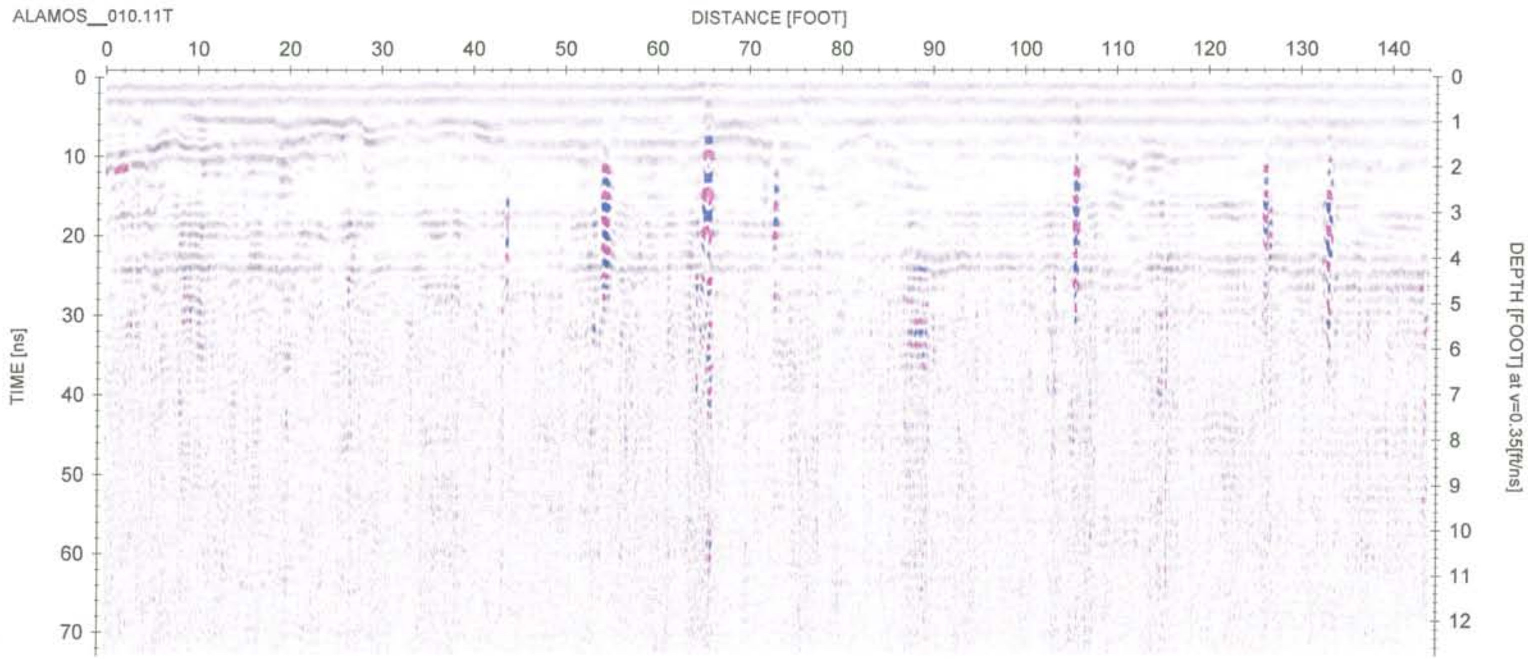

ALAMOS__001.01T
DISTANCE [FOOT]
0 10 20 30 40 50 60 70 80 90 100 110
TIME [ns]
0 10 20 30 40 50 60 70 80
DEPTH [FOOT] at v=0.35[ft/ns]
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14


LINE 8
ALAMOS__008.11T
DISTANCE [FOOT]
TIME [ns]
DEPTH [FOOT] at v=0.35[ft/ns]

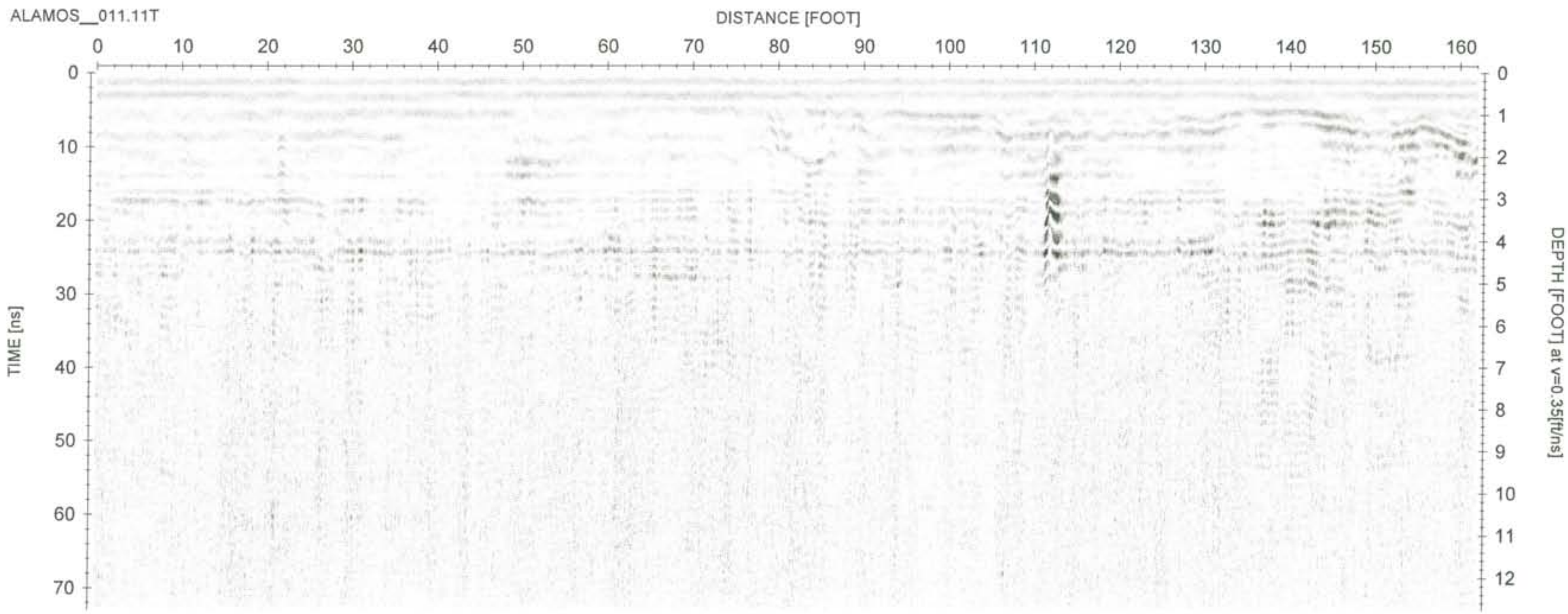


ALAMOS__009.11T
DISTANCE [FOOT]
TIME [ns]
DEPTH [FOOT] at v=0.35[ft/ns]

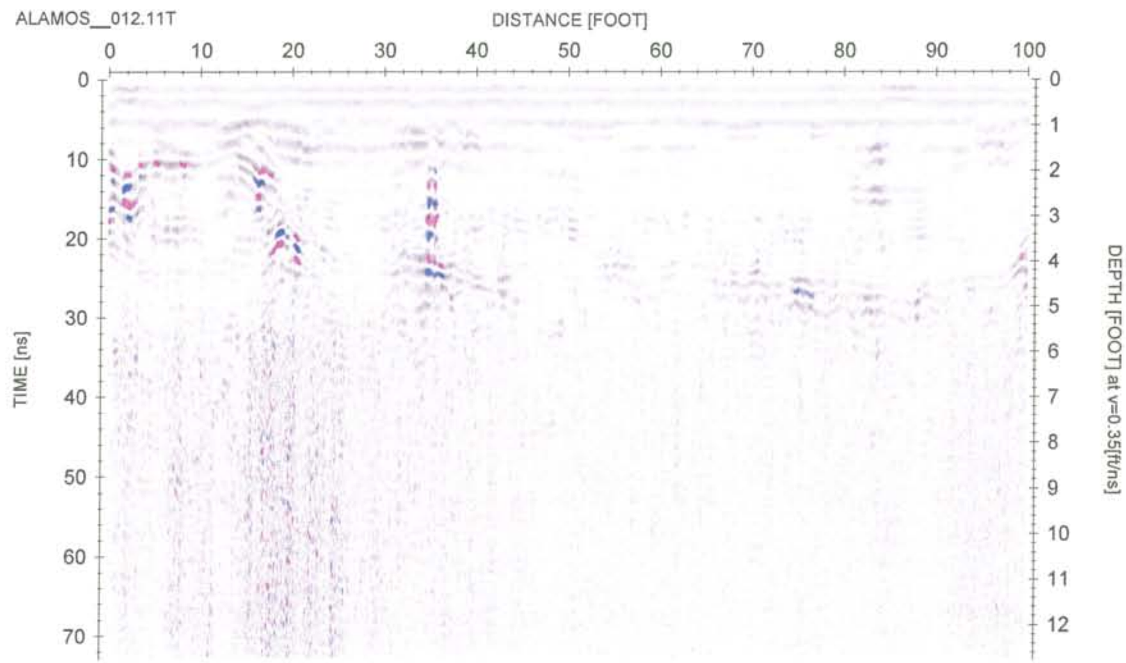
LINE 10
ALAMOS__010.11T



LINE 11

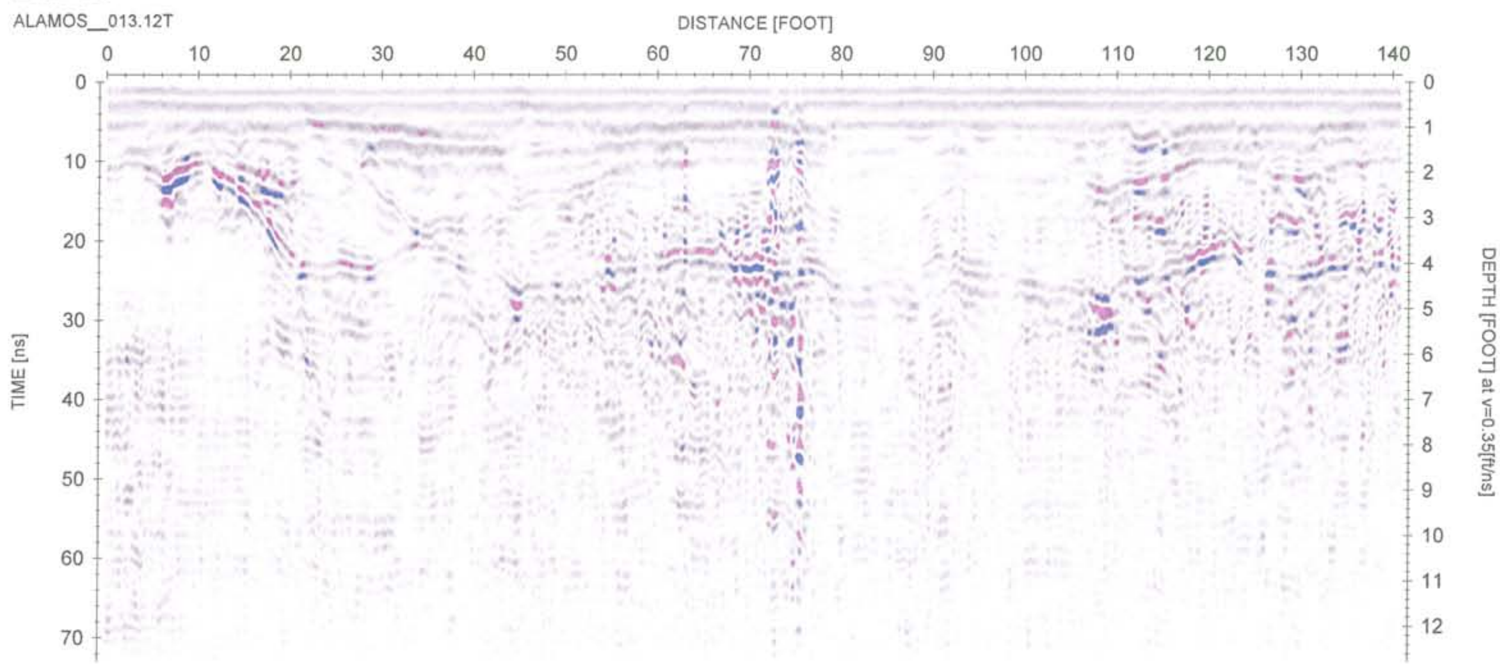

ALAMOS__011.11T
DISTANCE [FOOT]
TIME [ns]
DEPTH [FOOT] at v=0.35[ft/ns]
0
10
20
30
40
50
60
70
80
90
100
110
120
130
140
150
160
1
2
3
4
5
6
7
8
9
11
12

LINE 12



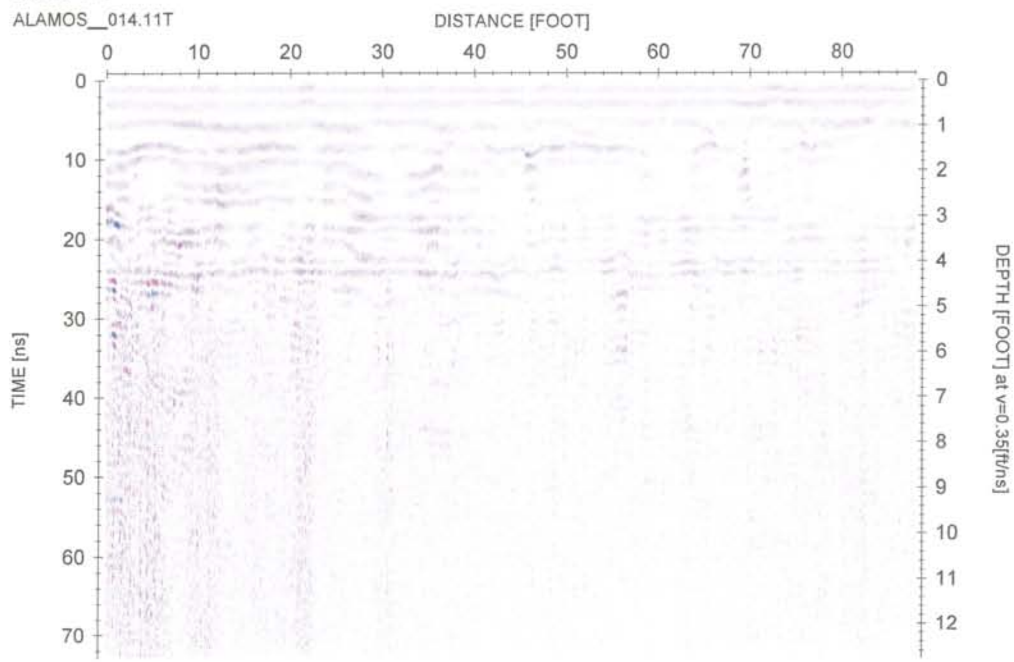
ALAMOS__012.11T
DISTANCE [FOOT]
0
10
20
30
40
50
60
70
80
90
100
TIME [ns]
DEPTH [FOOT] at v=0.35[ft/ns]
0
1
2
3
4
5
6
7
8
9
10
11
12

LINE 13



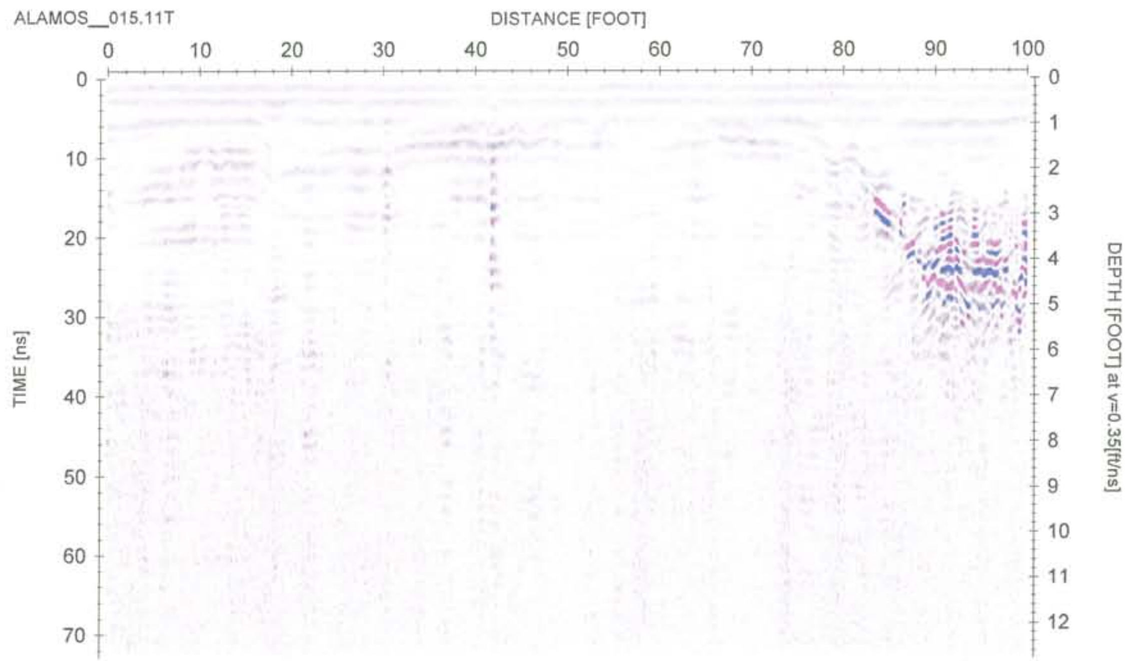
LINE 14

ALAMOS__014.11T

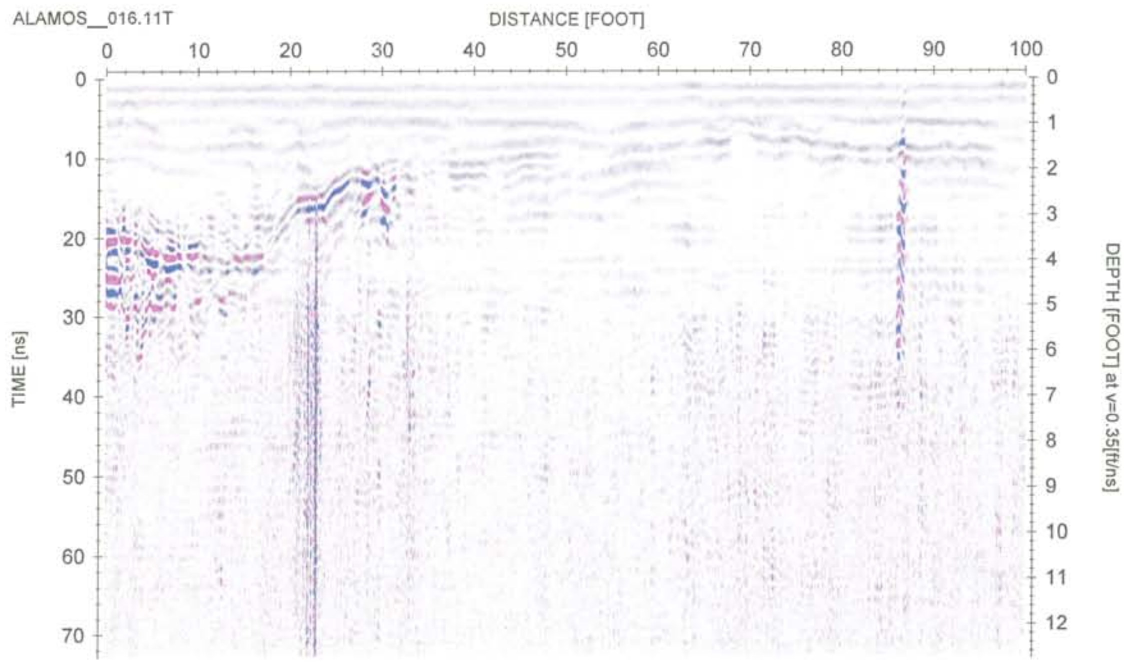


LINE 15

ALAMOS__015.11T

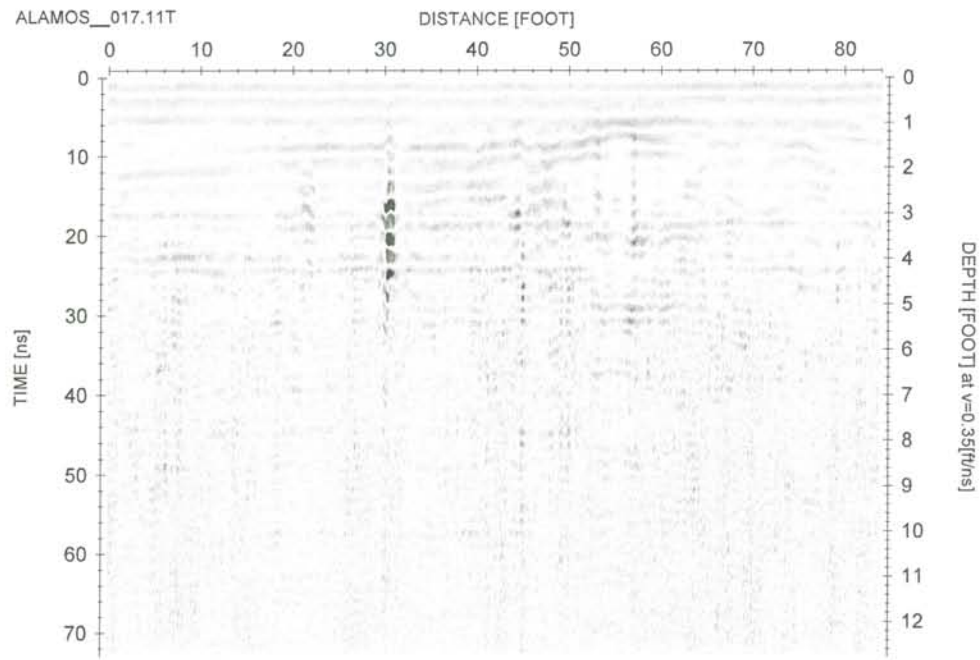


LINE 16

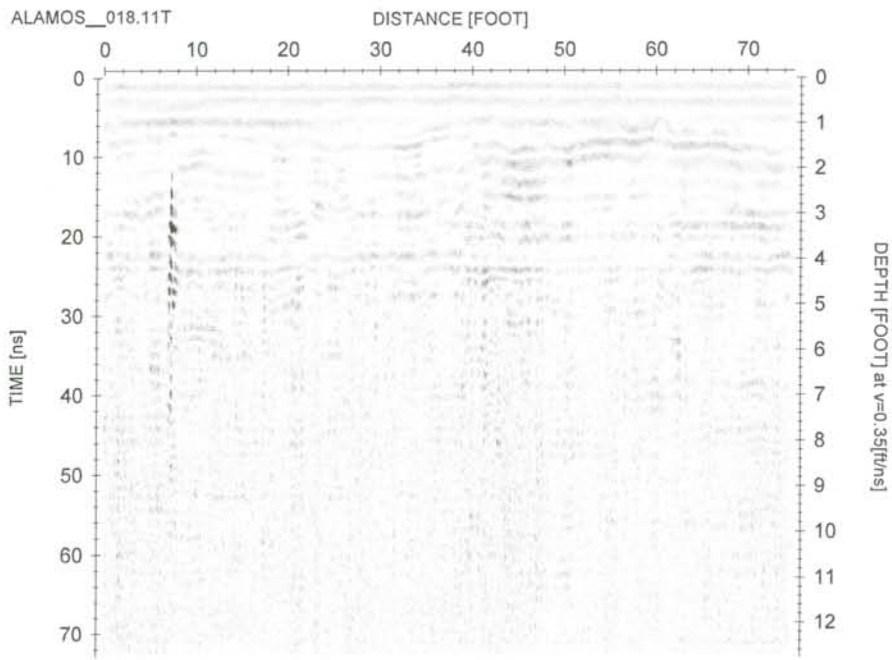


ALAMOS__016.11T
DISTANCE [FOOT]
0
10
20
30
40
50
60
70
80
90
100
TIME [ns]
DEPTH [FOOT] at v=0.35[ft/ns]
1
2
3
4
5
6
7
8
9
10
11
12

LINE 17
ALAMOS__017.11T

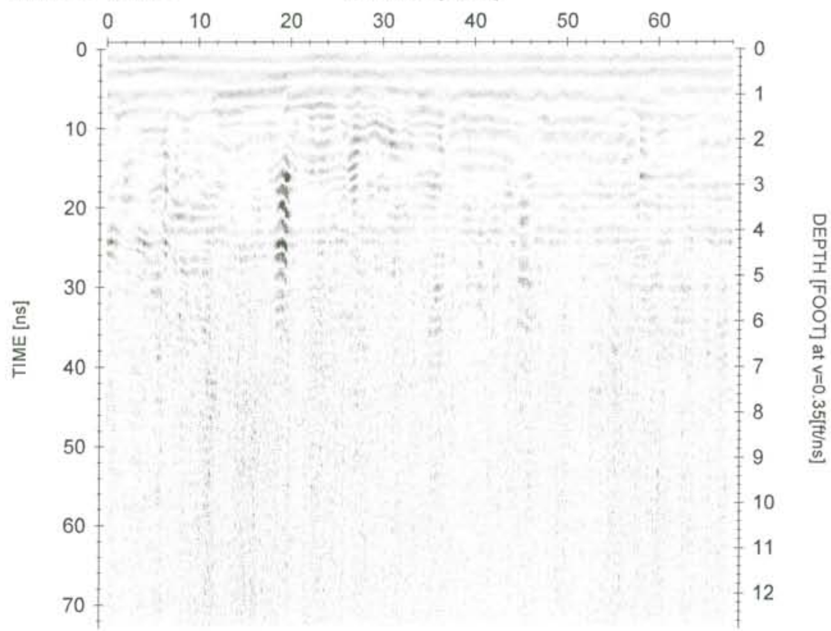


LINE 18


ALAMOS__018.11T
DISTANCE [FOOT]
0 10 20 30 40 50 60 70
TIME [ns]
0 10 20 30 40 50 60 70
DEPTH [FOOT] at v=0.35[ft/ns]
0 1 2 3 4 5 6 7 8 9 10 11 12

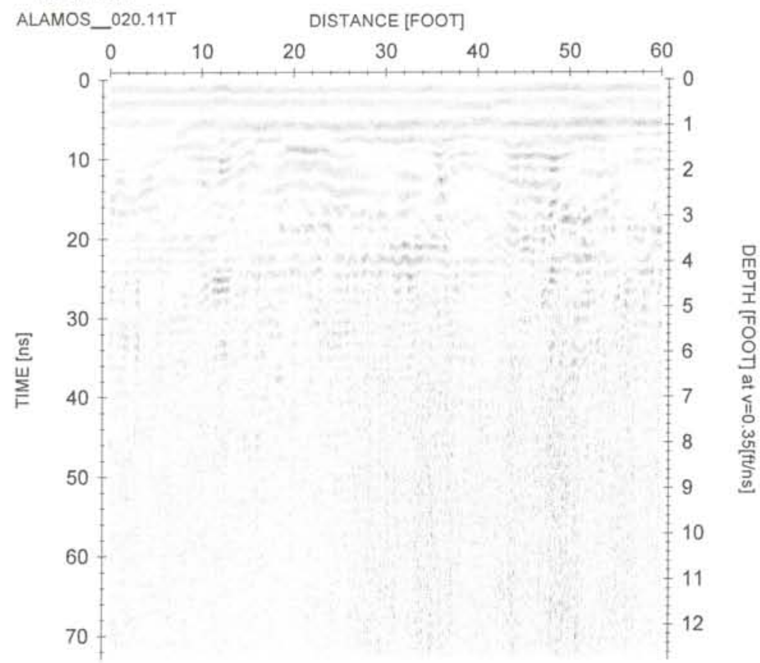
LINE 19

ALAMOS__019.11T

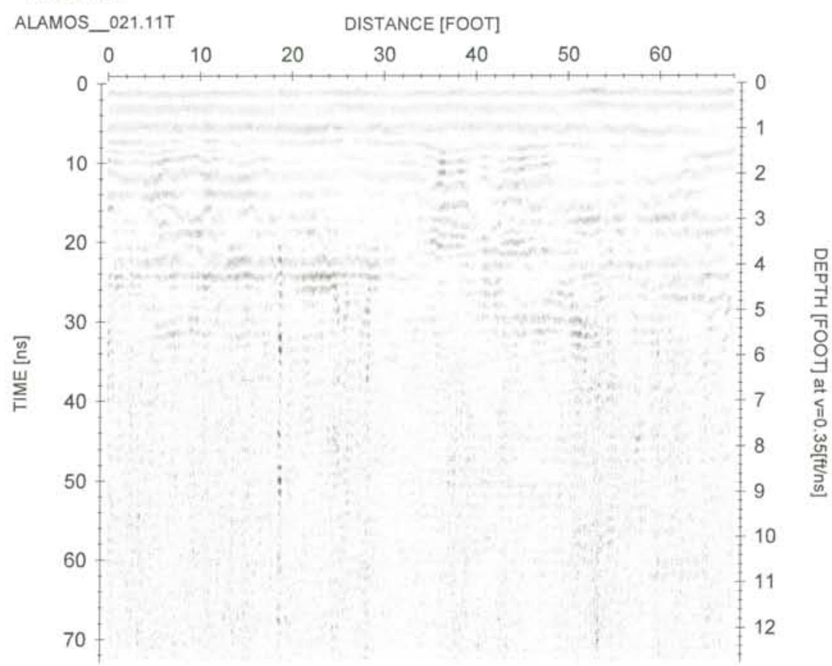


LINE 20

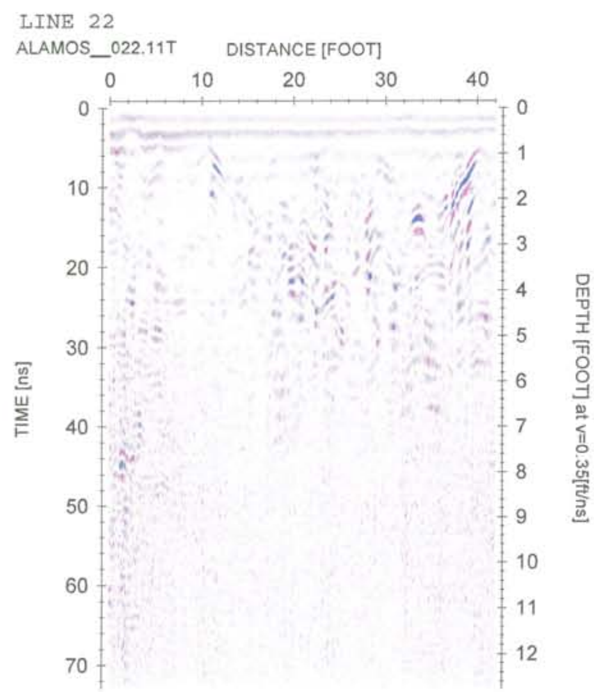
ALAMOS__020.11T



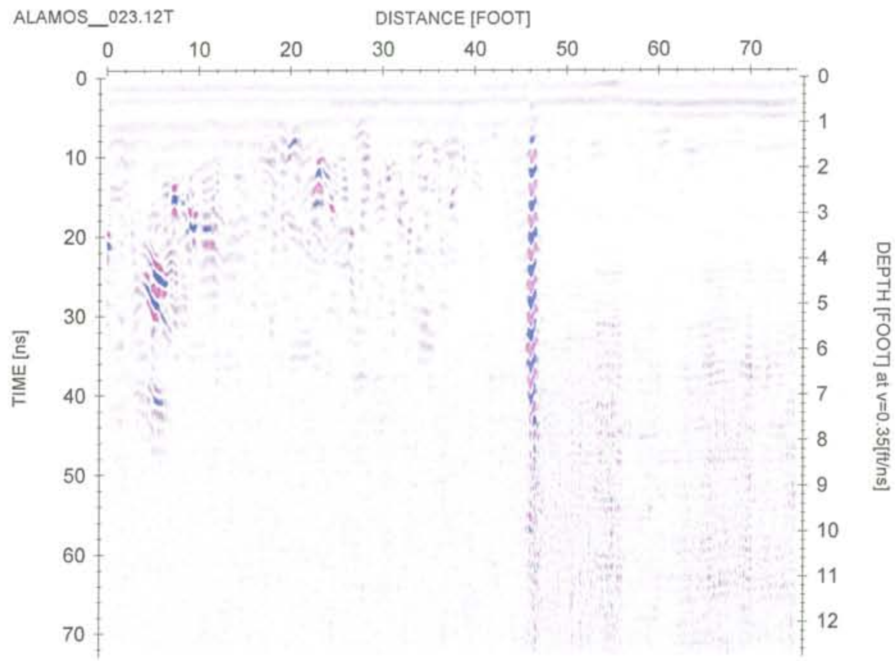
LINE 21



ALAMOS__021.11T
DISTANCE [FOOT]
0
10
20
30
40
50
60
TIME [ns]
0
10
20
30
40
50
60
70
DEPTH [FOOT] at v=0.35[ft/ns]
0
1
2
3
4
5
6
7
8
9
10
11
12

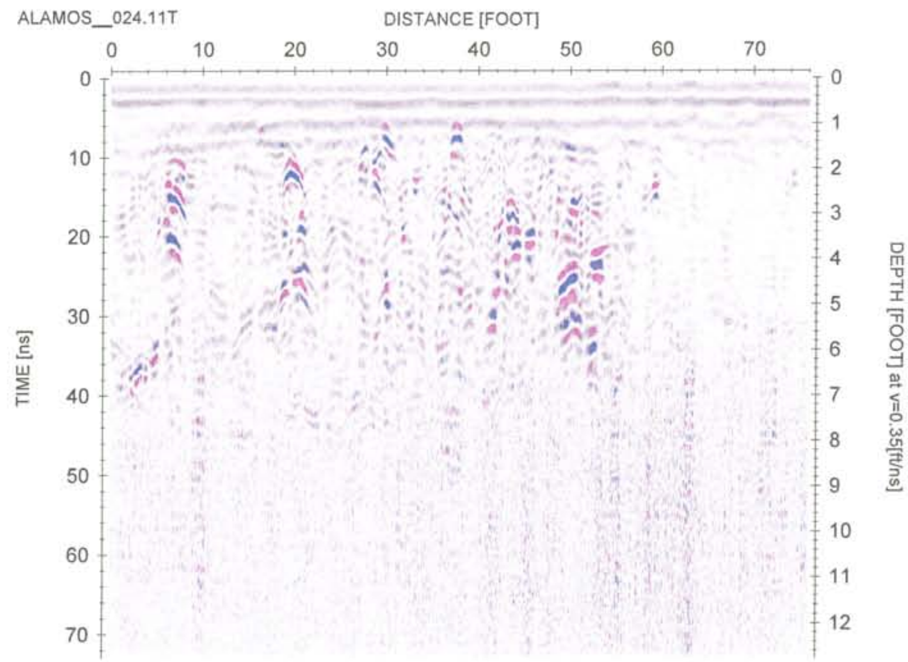

LINE 22
ALAMOS__022.11T
DISTANCE [FOOT]
TIME [ns]
DEPTH [FOOT] at v=0.35[ft/ns]

LINE 23
ALAMOS__023.12T

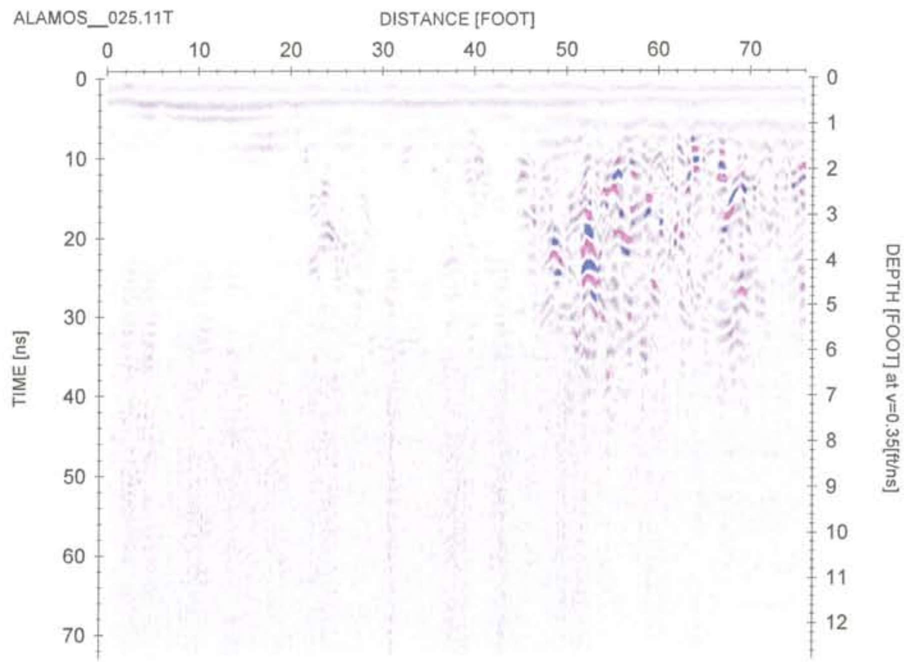


LINE 24

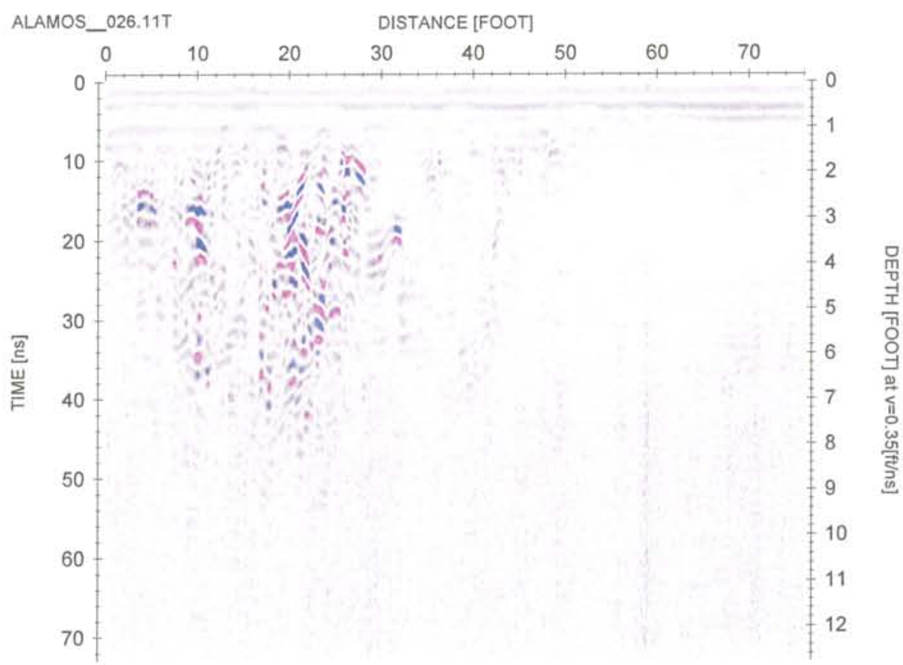
ALAMOS__024.11T



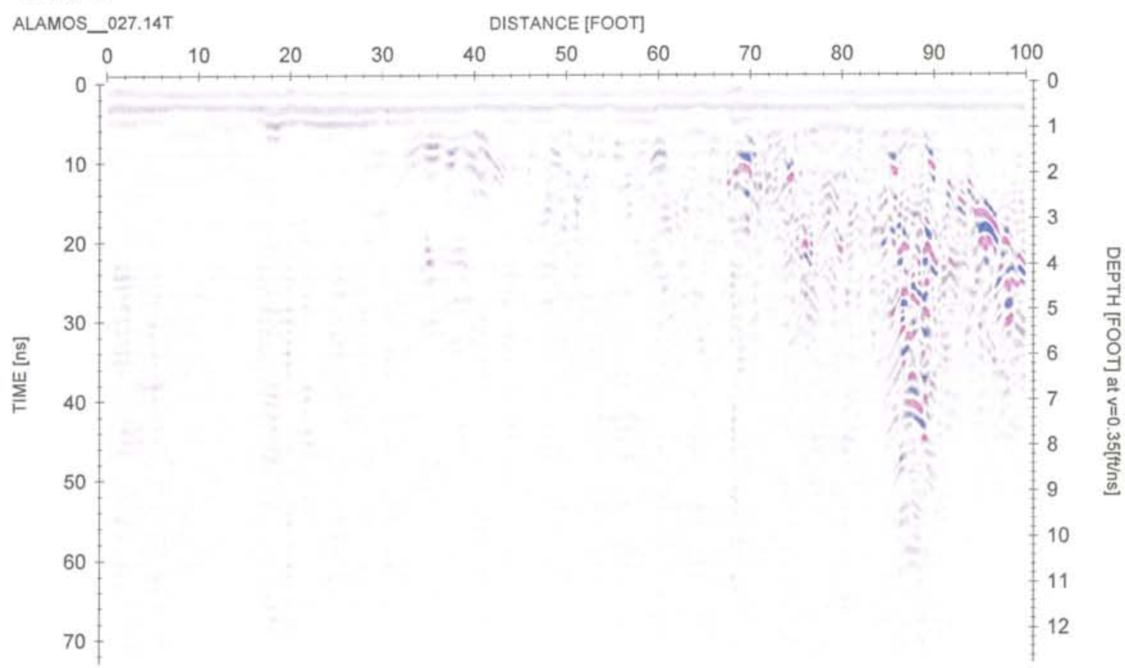
LINE 25



LINE 26



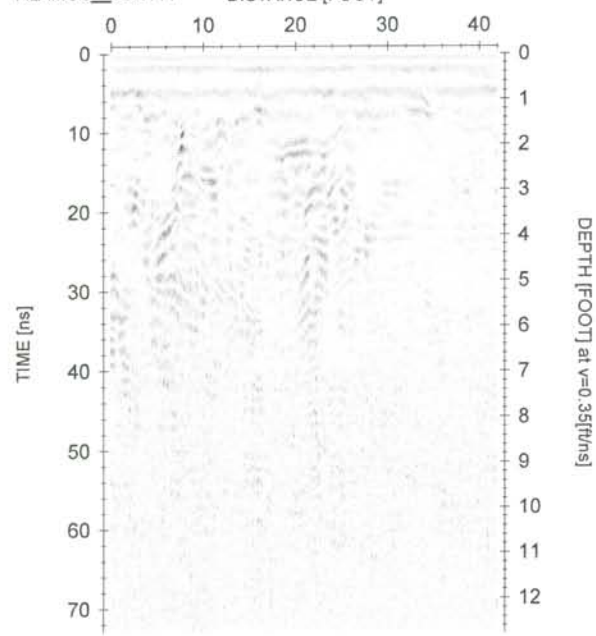
LINE 27



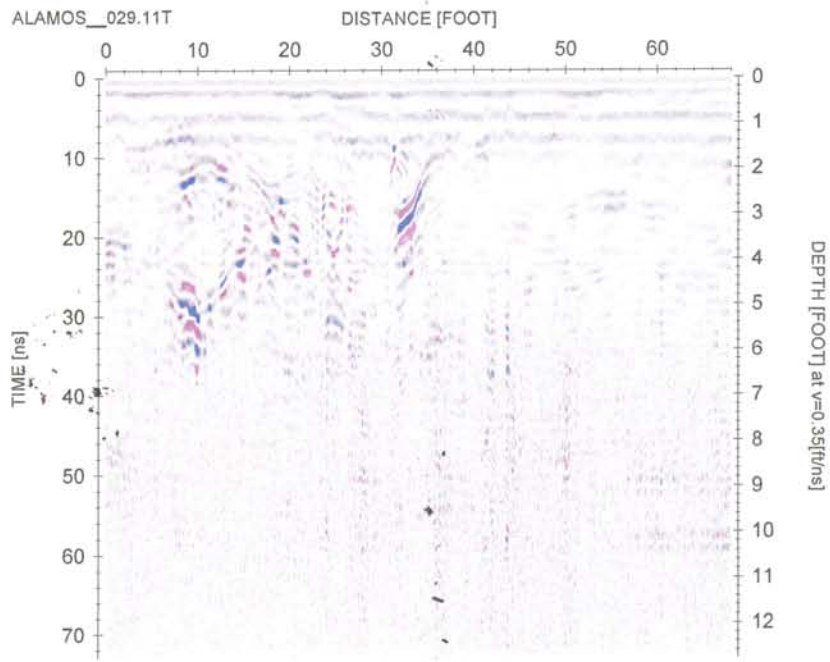
ALAMOS__027.14T
DISTANCE [FOOT]
0 10 20 30 40 50 60 70 80 90 100
TIME [ns]
0 10 20 30 40 50 60 70
DEPTH [FOOT] at v=0.35[ft/ns]
0 1 2 3 4 5 6 7 8 9 10 11 12

LINE 28

ALAMOS__028.11T

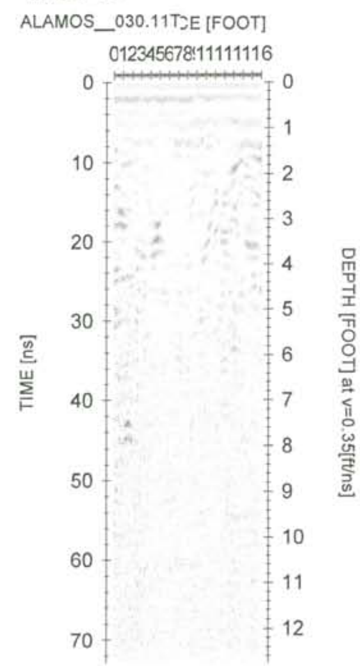


LINE 29



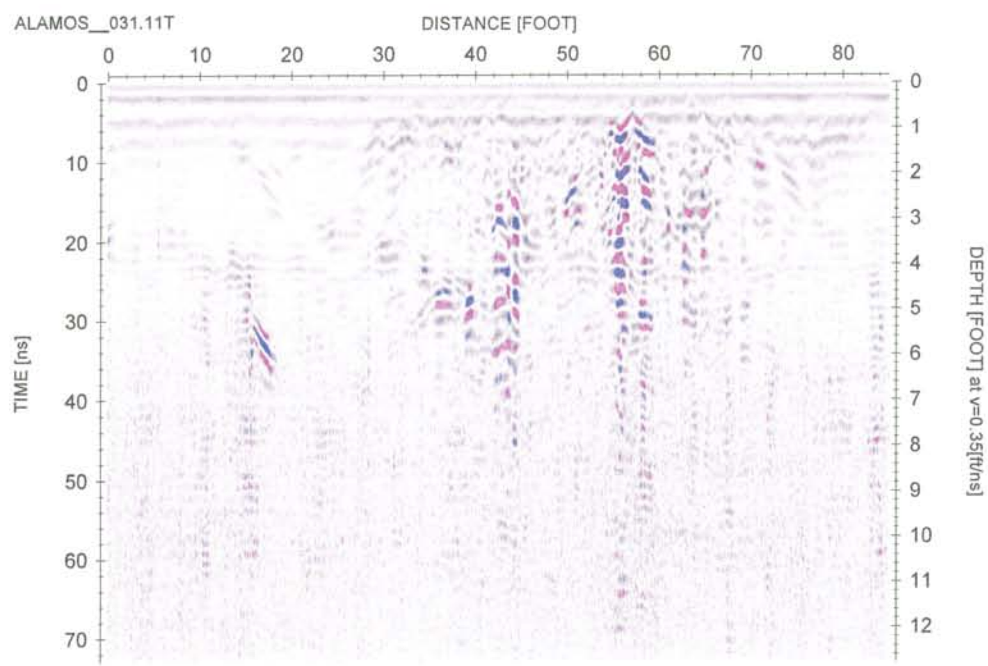
ALAMOS__029.11T
DISTANCE [FOOT]
0 10 20 30 40 50 60
TIME [ns]
0 10 20 30 40 50 60 70
DEPTH [FOOT] at v=0.35[ft/ns]
0 1 2 3 4 5 6 7 8 9 10 11 12

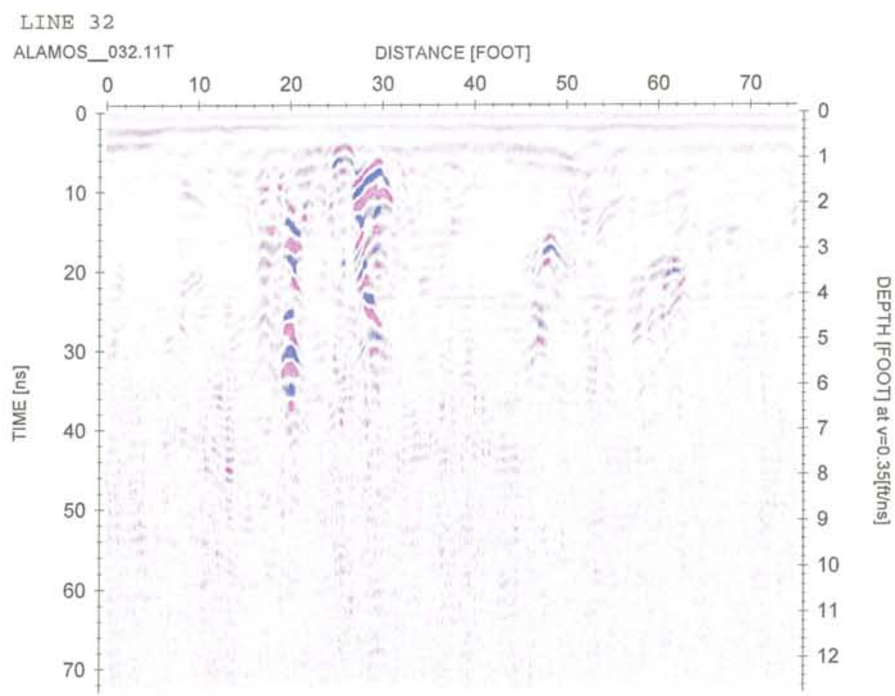
LINE 30



ALAMOS__030.11T_E [FOOT]
012345678111111116
TIME [ns]
0
10
20
30
40
50
60
70
DEPTH [FOOT] at v=0.35[ft/ns]
0
1
2
3
4
5
6
7
8
9
10
11
12

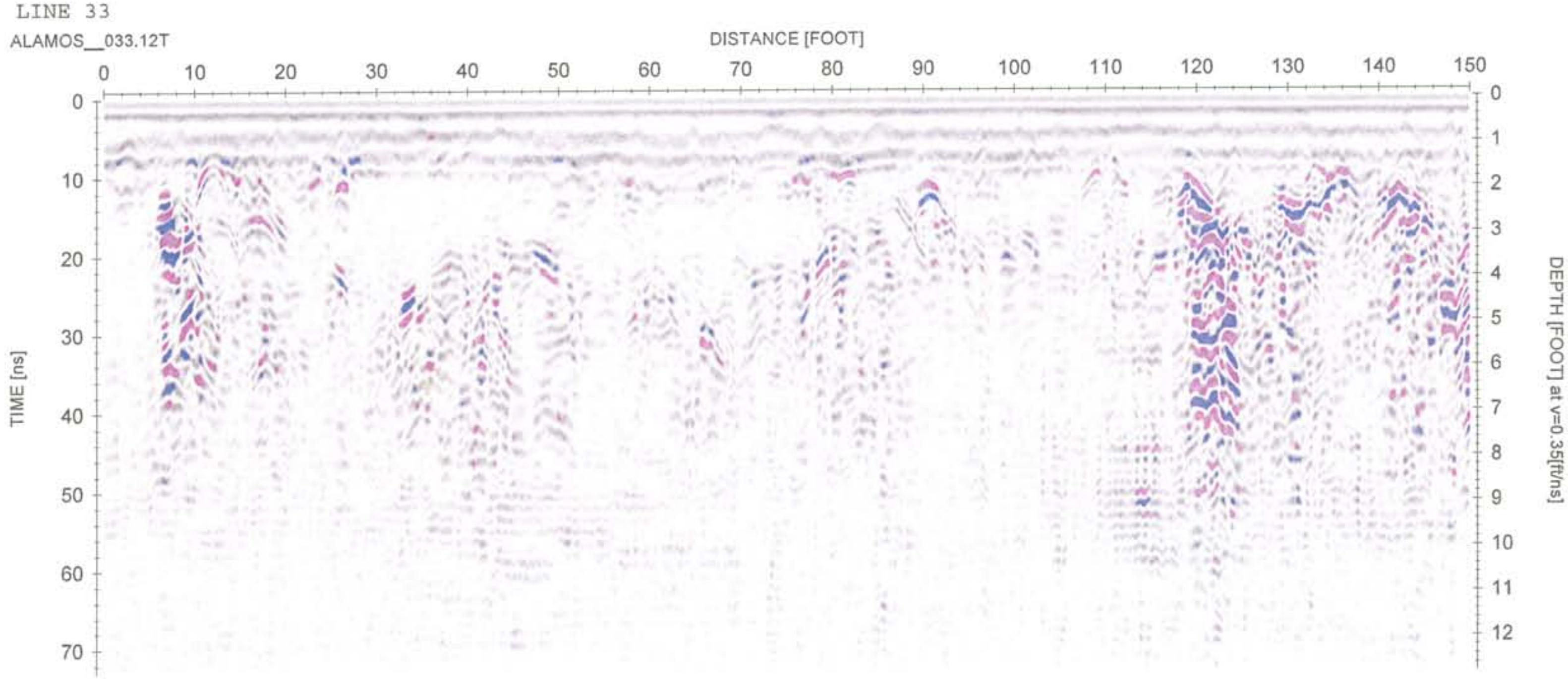
LINE 31

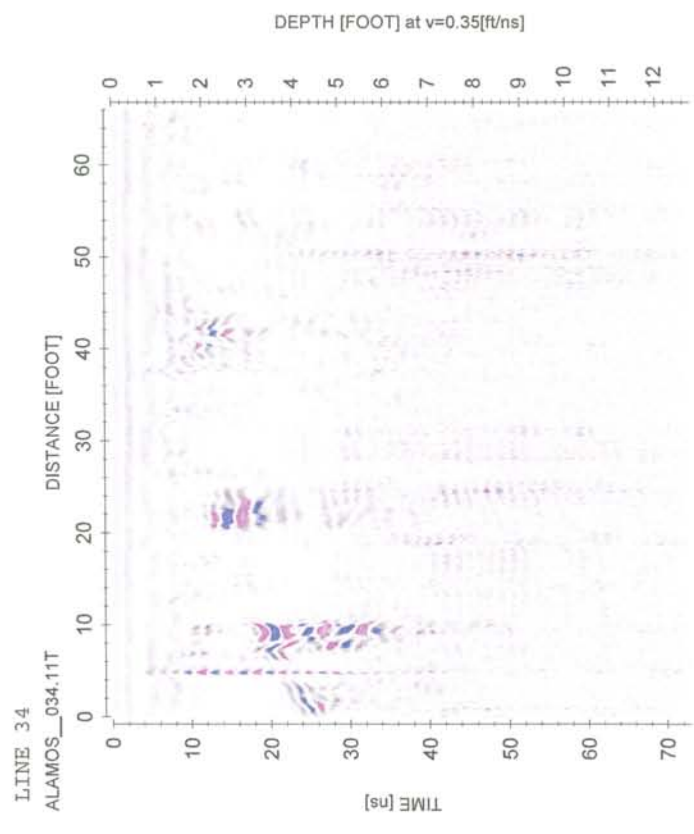

ALAMOS__031.11T
DISTANCE [FOOT]
0 10 20 30 40 50 60 70 80
TIME [ns]
0 10 20 30 40 50 60 70
DEPTH [FOOT] at v=0.35[ft/ns]
0 1 2 3 4 5 6 7 8 9 10 11 12


LINE 32
ALAMOS__032.11T
DISTANCE [FOOT]
0 10 20 30 40 50 60 70
TIME [ns]
0 10 20 30 40 50 60 70
DEPTH [FOOT] at v=0.35[ft/ns]
0 1 2 3 4 5 6 7 8 9 10 11 12

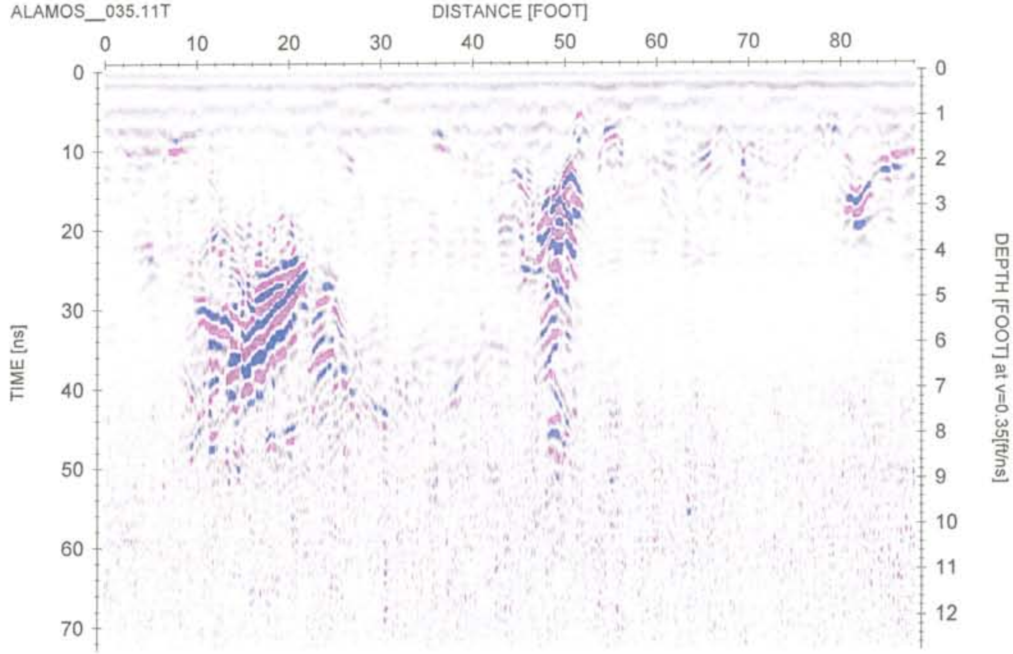
LINE 33

ALAMOS__033.12T

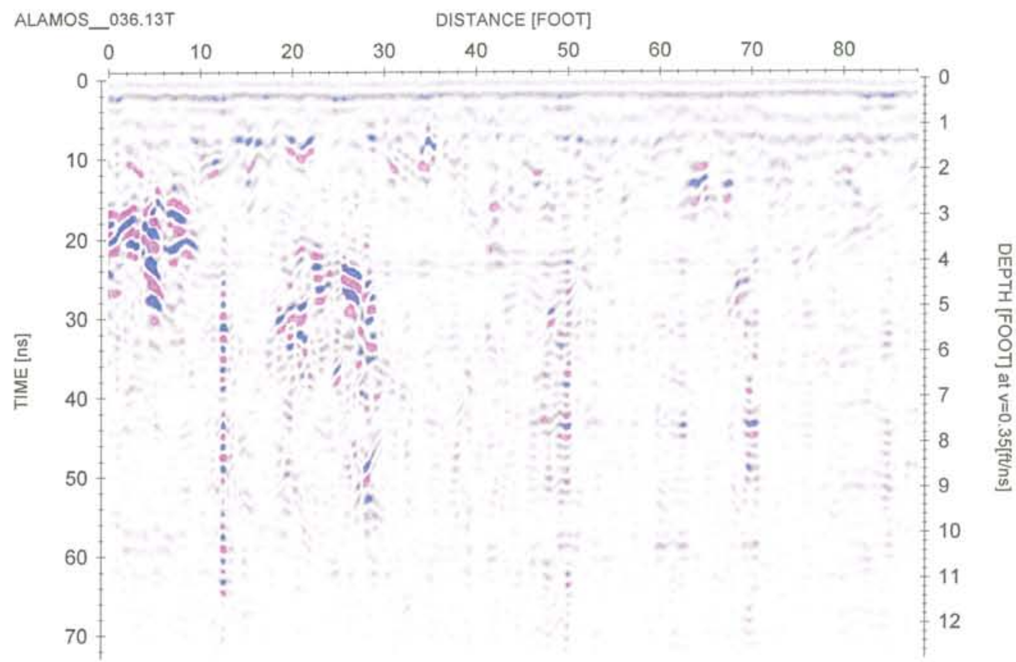


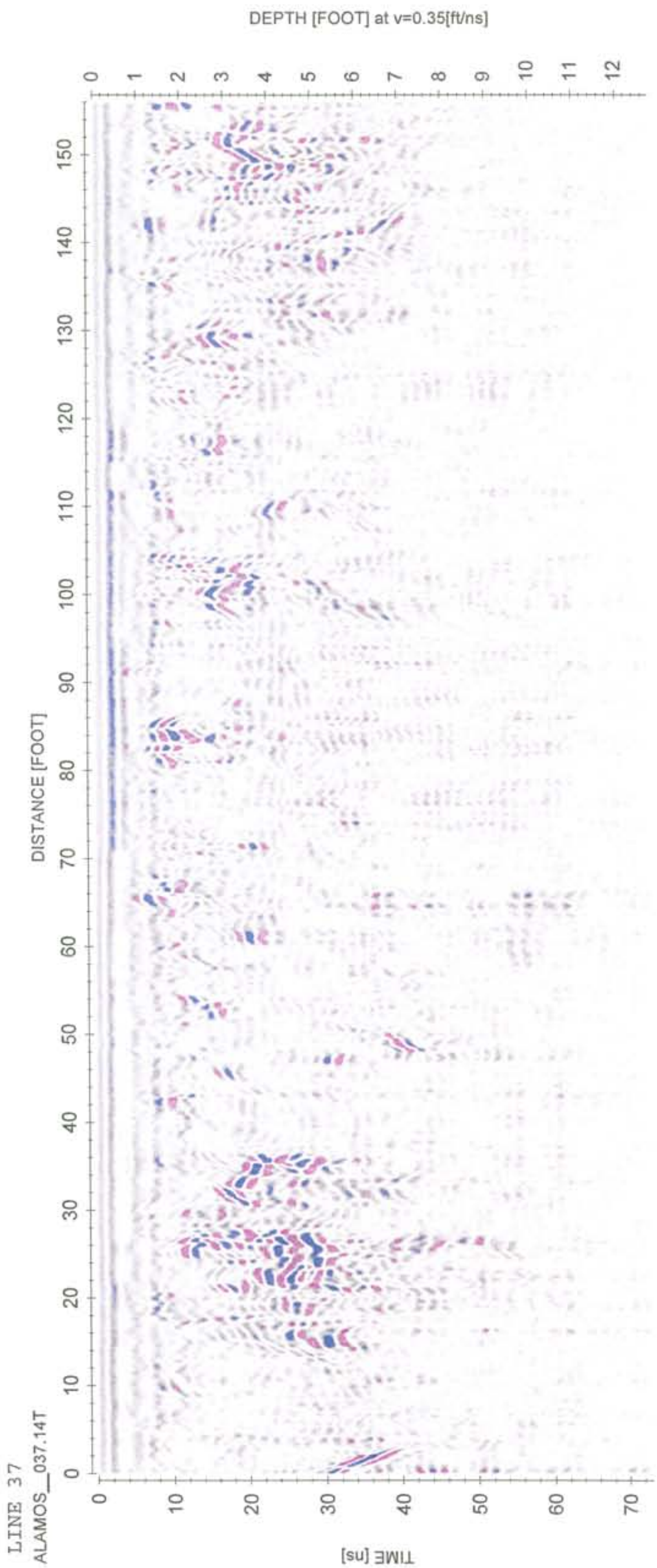

DEPTH [FOOT] at v=0.35[ft/ns]
DISTANCE [FOOT]
TIME [ns]
LINE 34
ALAMOS__034.11T

LINE 35
ALAMOS__035.11T



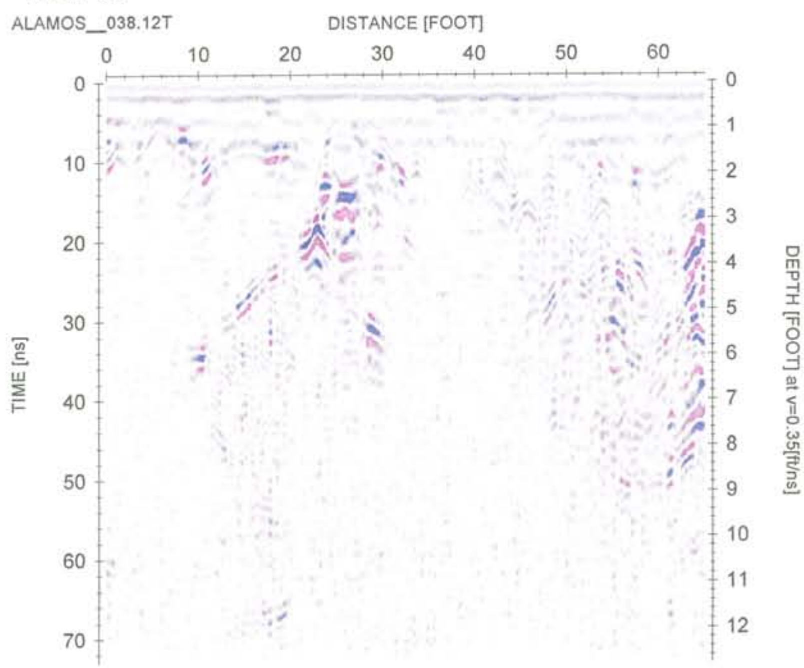
LINE 36





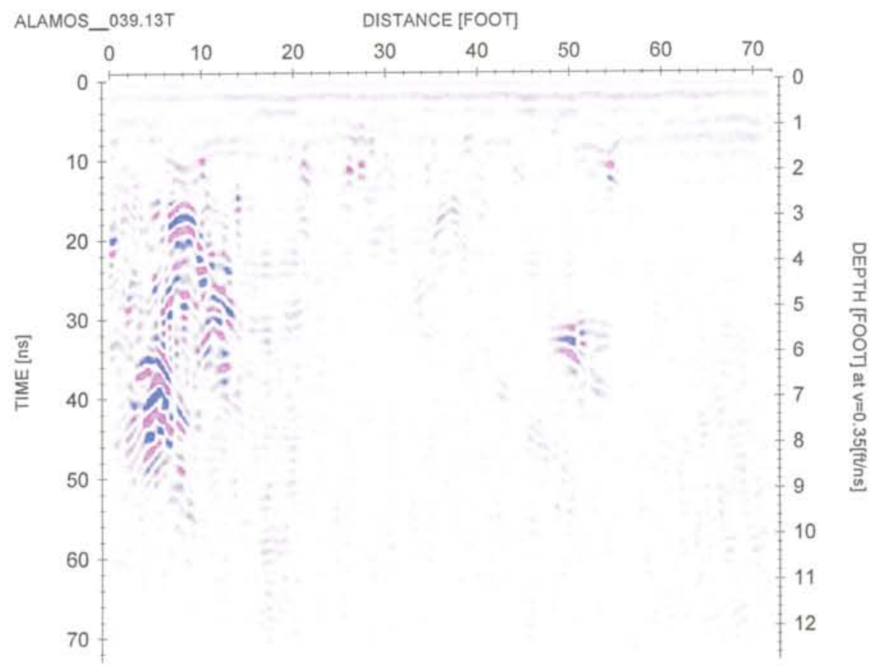
DEPTH [FOOT] at v=0.35[ft/ns]
DISTANCE [FOOT]
LINE 37
ALAMOS__037.14T
TIME [ns]

LINE 38



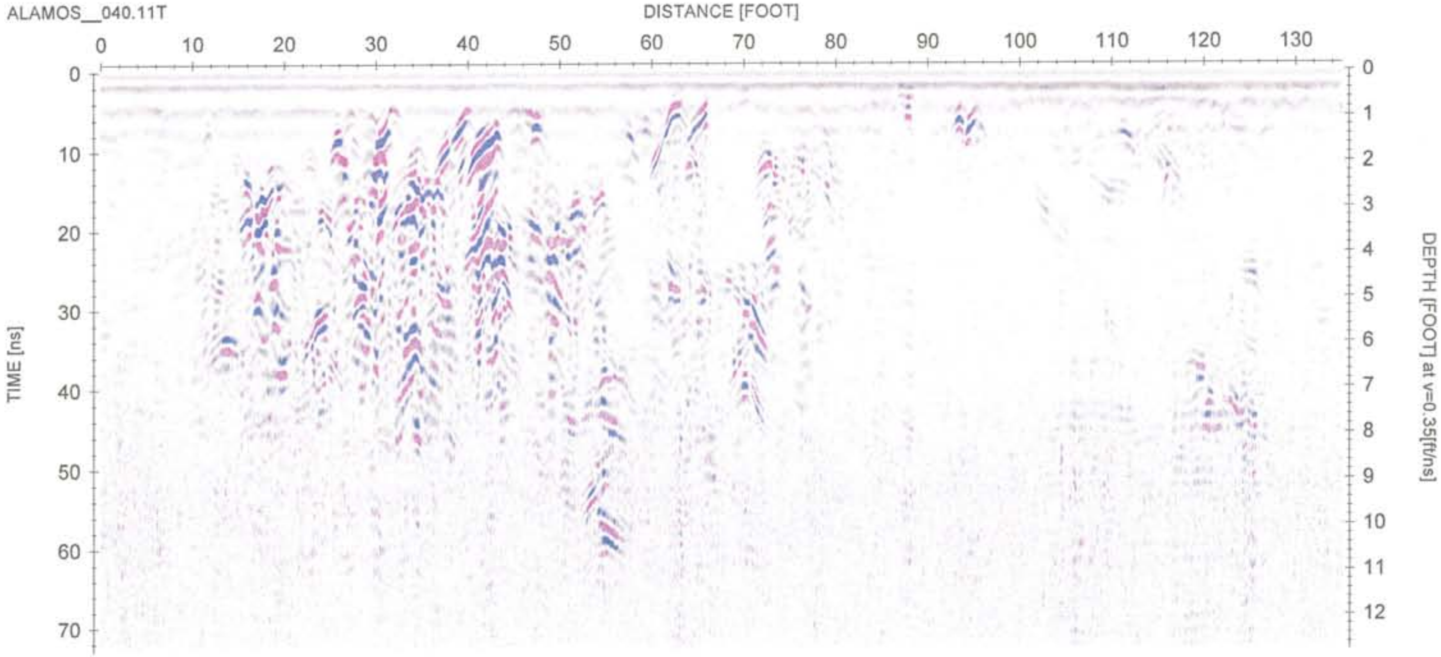
ALAMOS__038.12T
DISTANCE [FOOT]
0
10
20
30
40
50
60
TIME [ns]
0
10
20
30
40
50
60
70
DEPTH [FOOT] at v=0.35[ft/ns]
0
1
2
3
4
5
6
7
8
9
10
11
12

LINE 39



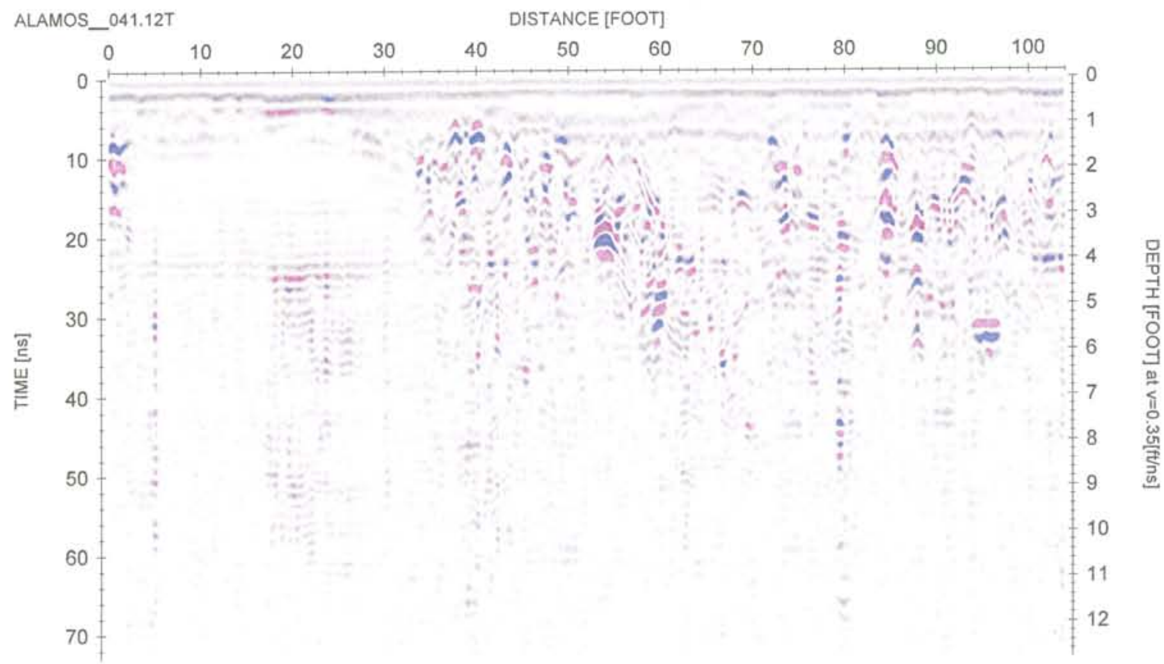
LINE 40

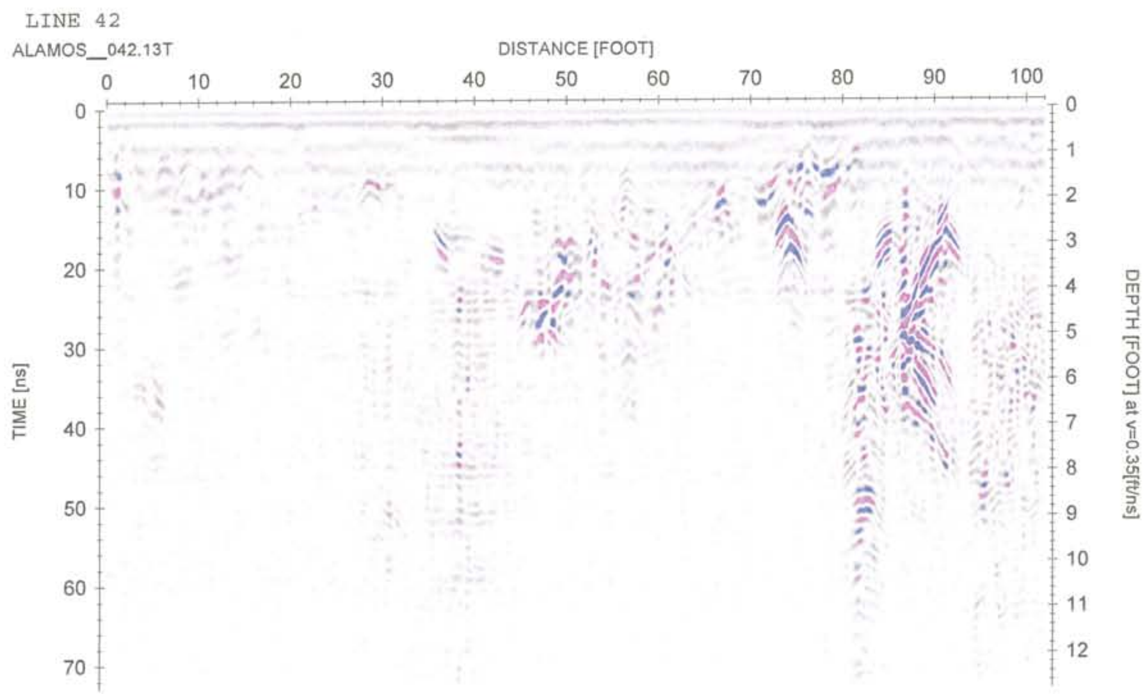
ALAMOS__040.11T



LINE 41

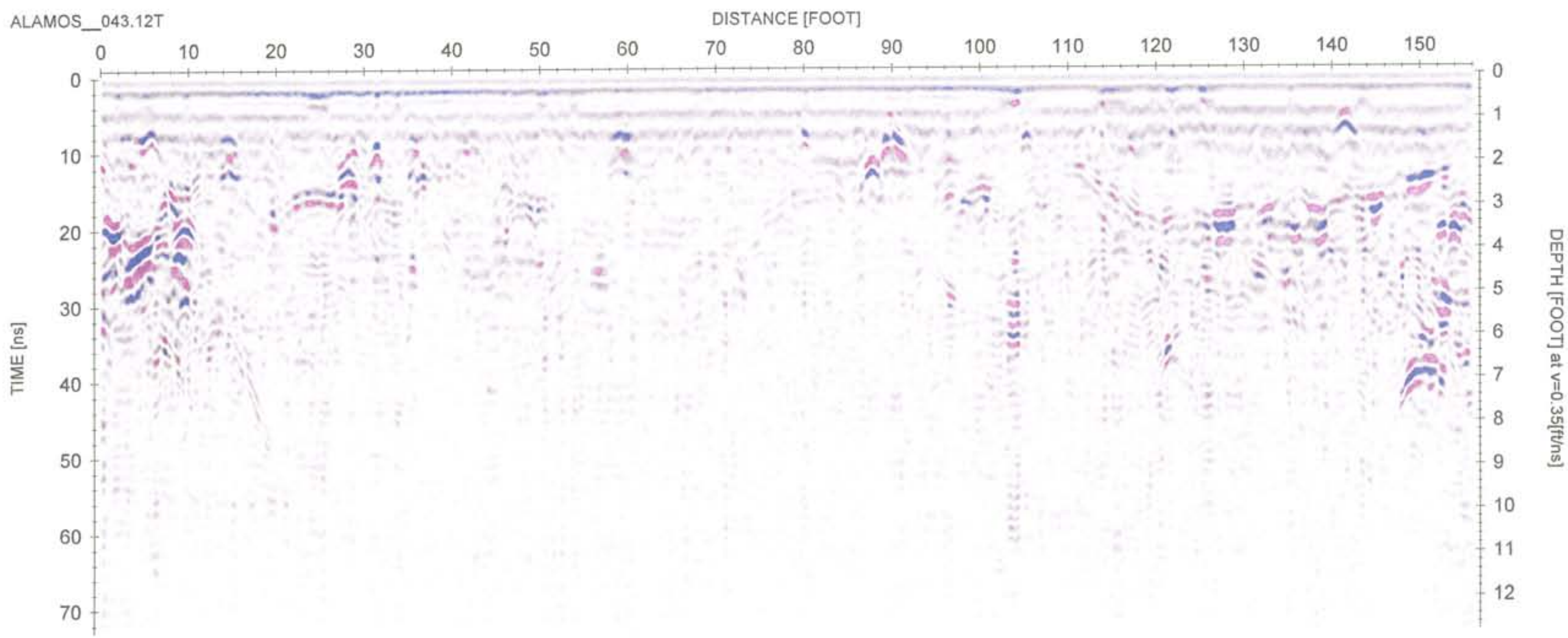
ALAMOS__041.12T

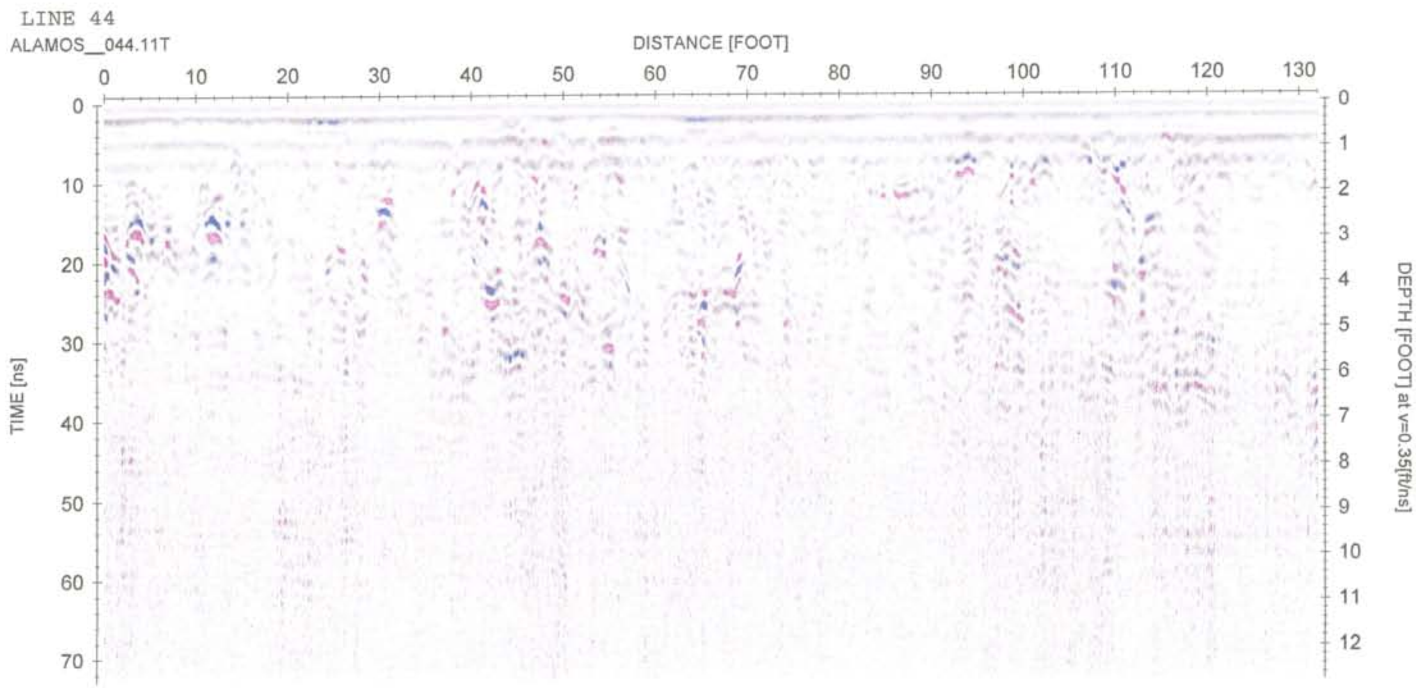



LINE 42
ALAMOS__042.13T
DISTANCE [FOOT]
TIME [ns]
DEPTH [FOOT] at v=0.35[ft/ns]

LINE 43

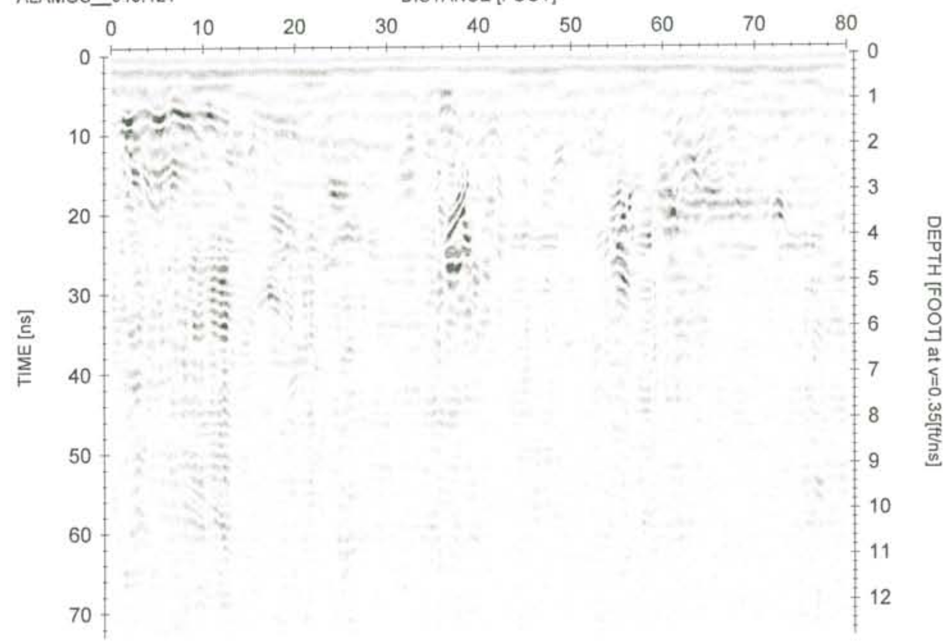
ALAMOS__043.12T





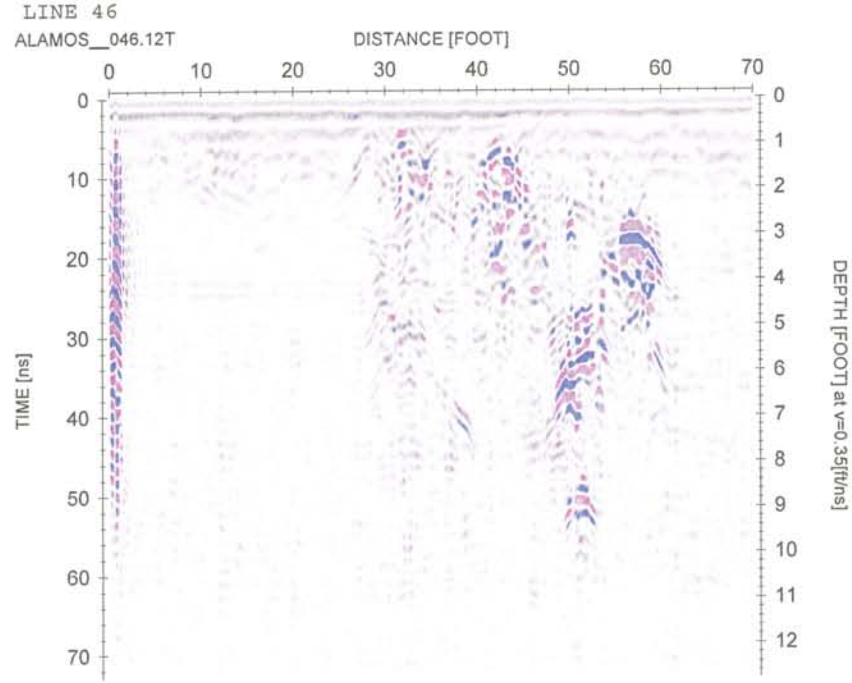
LINE 44
ALAMOS__044.11T
DISTANCE [FOOT]
TIME [ns]
DEPTH [FOOT] at v=0.35[ft/ns]

LINE 45
ALAMOS__045.12T



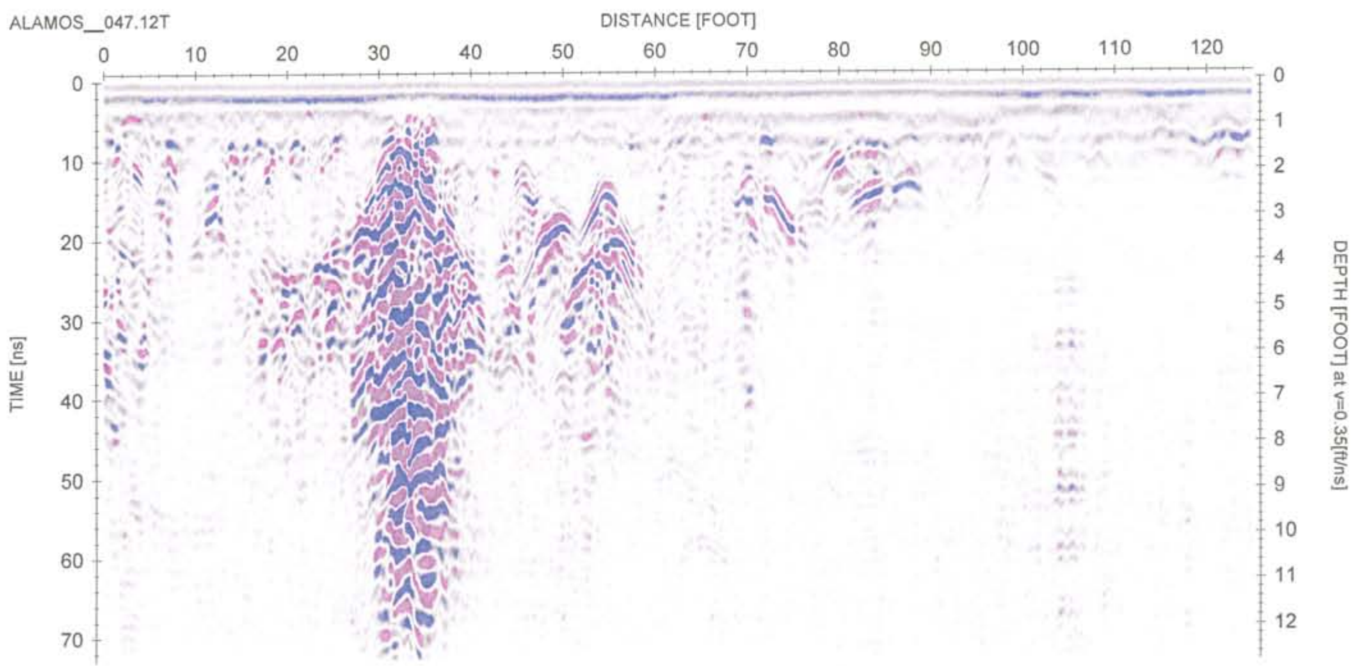
LINE 46

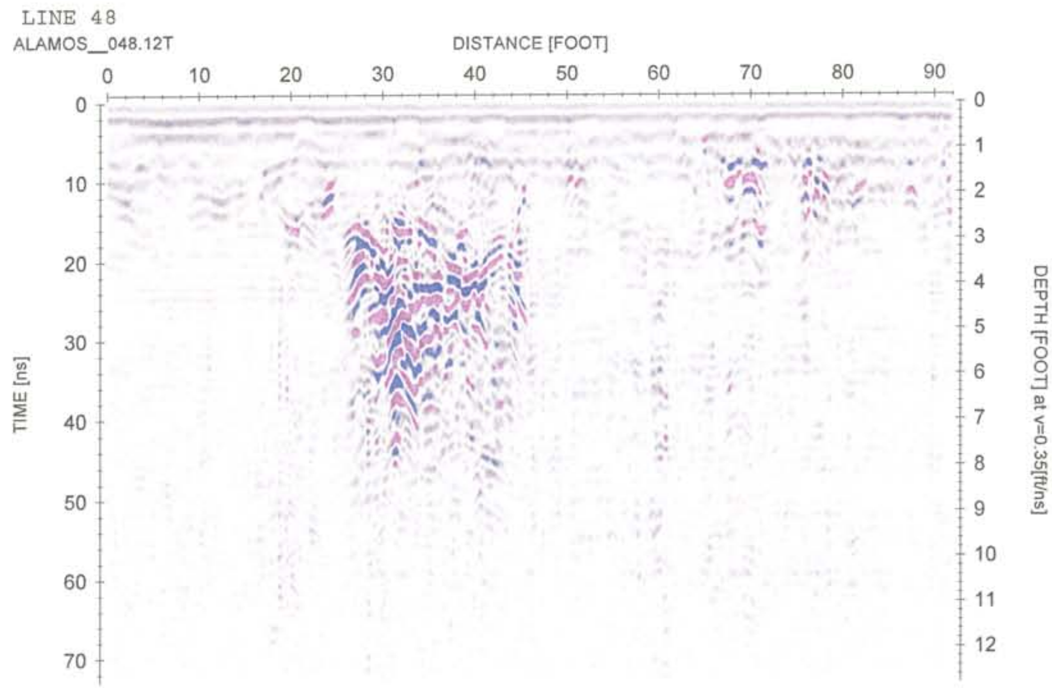
ALAMOS__046.12T



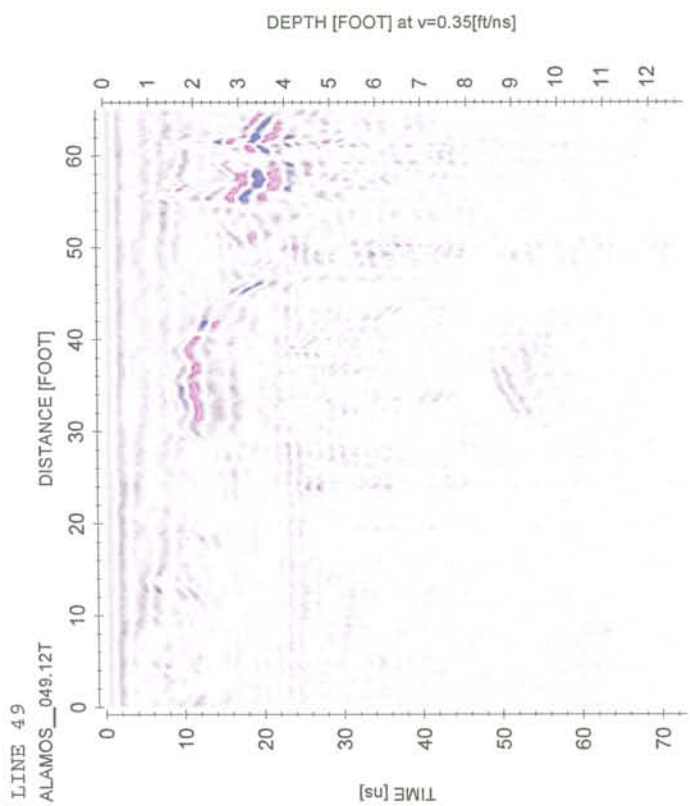
LINE 47

ALAMOS__047.12T

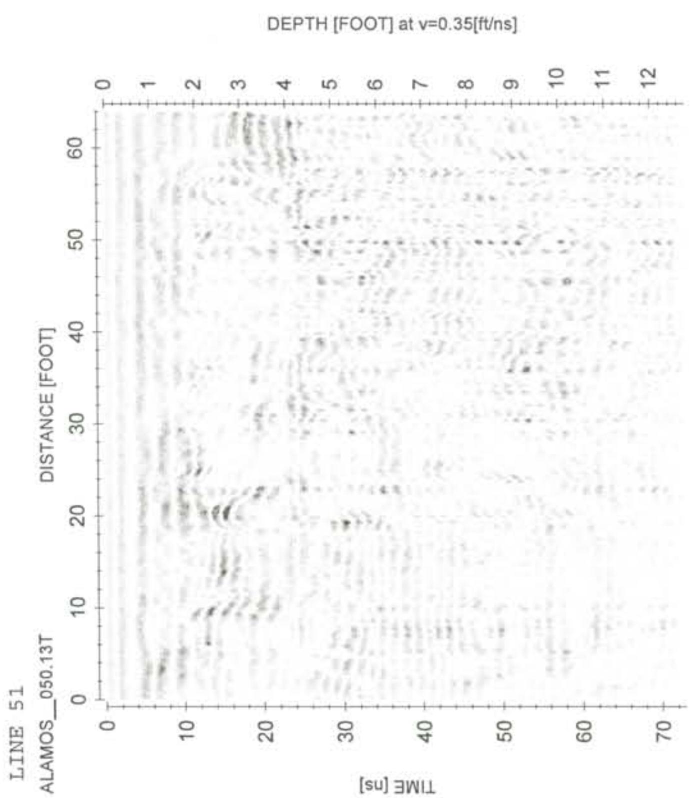




LINE 48
ALAMOS__048.12T
DISTANCE [FOOT]
0
10
20
30
40
50
60
70
80
90
TIME [ns]
DEPTH [FOOT] at v=0.35[ft/ns]

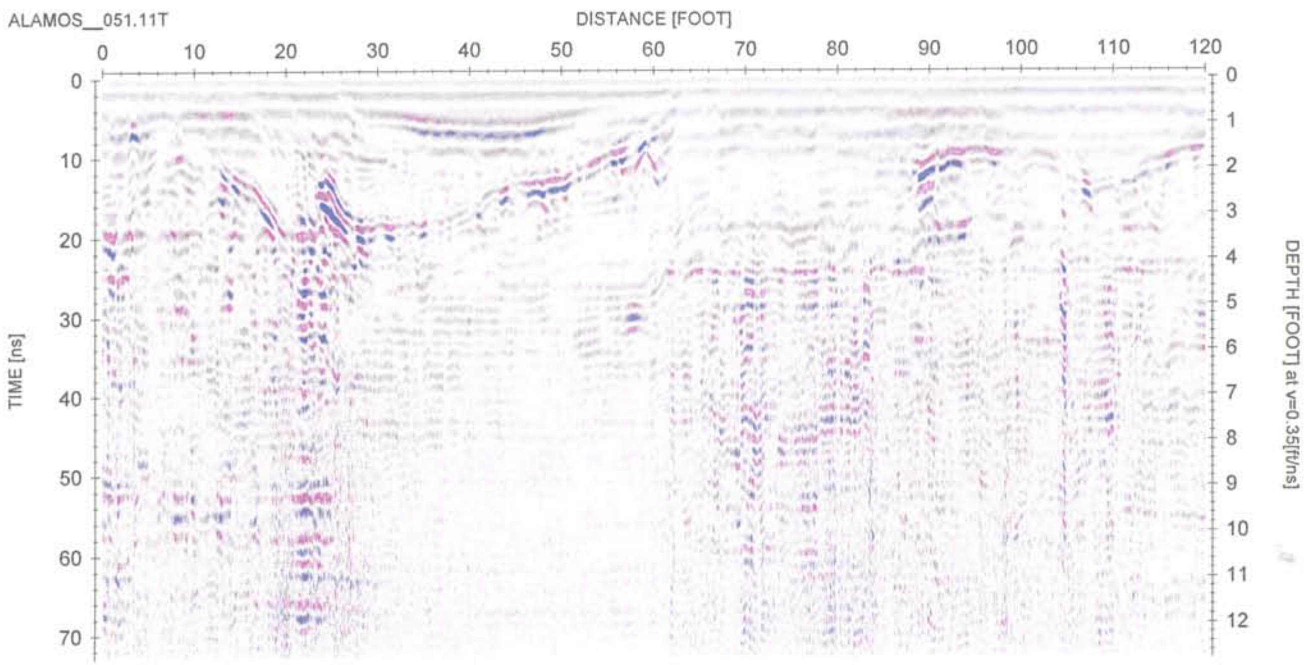


DEPTH [FOOT] at v=0.35[ft/ns]
0 1 2 3 4 5 6 7 8 9 10 11 12
DISTANCE [FOOT]
0 10 20 30 40 50 60
TIME [ns]
0 10 20 30 40 50 60 70
LINE 49
ALAMOS_049.12T


DEPTH [FOOT] at v=0.35[ft/ns]
DISTANCE [FOOT]
TIME [ns]
LINE 51
ALAMOS__050.13T

LINE 51

ALAMOS__051.11T



661-4290

LANL Environmental Programs (EP) Directorate, Record Transmittal Form

PRINT

To complete this form, see instructions on following pages. Use continuation version of form to list more records. See EP-DIR-SOP-4004 for more information.

Transmittal date: 04/21/2010 Priority Processing? Yes [✓] No [ ] Official Use Only? Yes [ ] No [ ] UCNI? Yes [ ] No [✓] Page 1 of 1

Reference Cited in NMED Deliverables? Yes [✓] No [ ] **Receipt Acknowledgement:** Do you need this form returned to you? Yes [✓] No [ ]

Transmitter Information

Z # : 236992 Name: Brittany Donnelly E-mail: bdonnelly@northwind-in Transmitters Organization: North Wind, Inc

Contamination Potential

[✓] To the best of my knowledge, the record(s) has no *radioactive* contamination. Signature: Brittany Donnelly

Record Type: Individual Record (no package) [✓] New package [ ] E-mail [ ] Add to existing package (fill in # and title below) [ ] Resubmitted/superseded record (record #) [ ]

Package(s) # : Package title(s):

Reference/Retrieval Information

Organization: TA-21 Closure Project: MDA B- PKG # 1831

Record (Package) Contents

Record Title	Media Type	Document Date	Author/Originator	Other Doc. # (e.g. Doc. Catalog #)	Page Count	ERID (RPF only)
TA-21-MDAB-Plan-00012-R0-Areas 9 & 10, Excavation Control Plan	CD	02/18/2010	LANL	N/A	6	109158
LANL- Notebook Control Information- MDAB- Areas 9 & 10	CD	02/19/2010	LANL	N/A	19	109159
Direct Push Technology Investigation Final Report (MDA-B-RPT-7001, Rev 0)	CD	04/06/2010	LANL	N/a	41	109160
Geophysical Investigation of Material Disposal Area B, LANL	CD	02/20/2010	LANL	N/A	67	109161

RPF Use Only: (names and dates)

Accepted | Entered AM 4-21-10 | Scanned 05/03/10 Presley M. Salay | QC: PS

Click here for Continuation Form