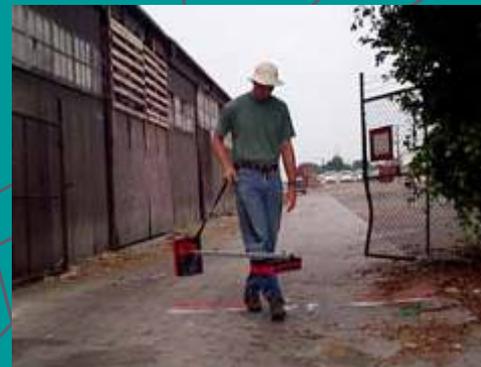


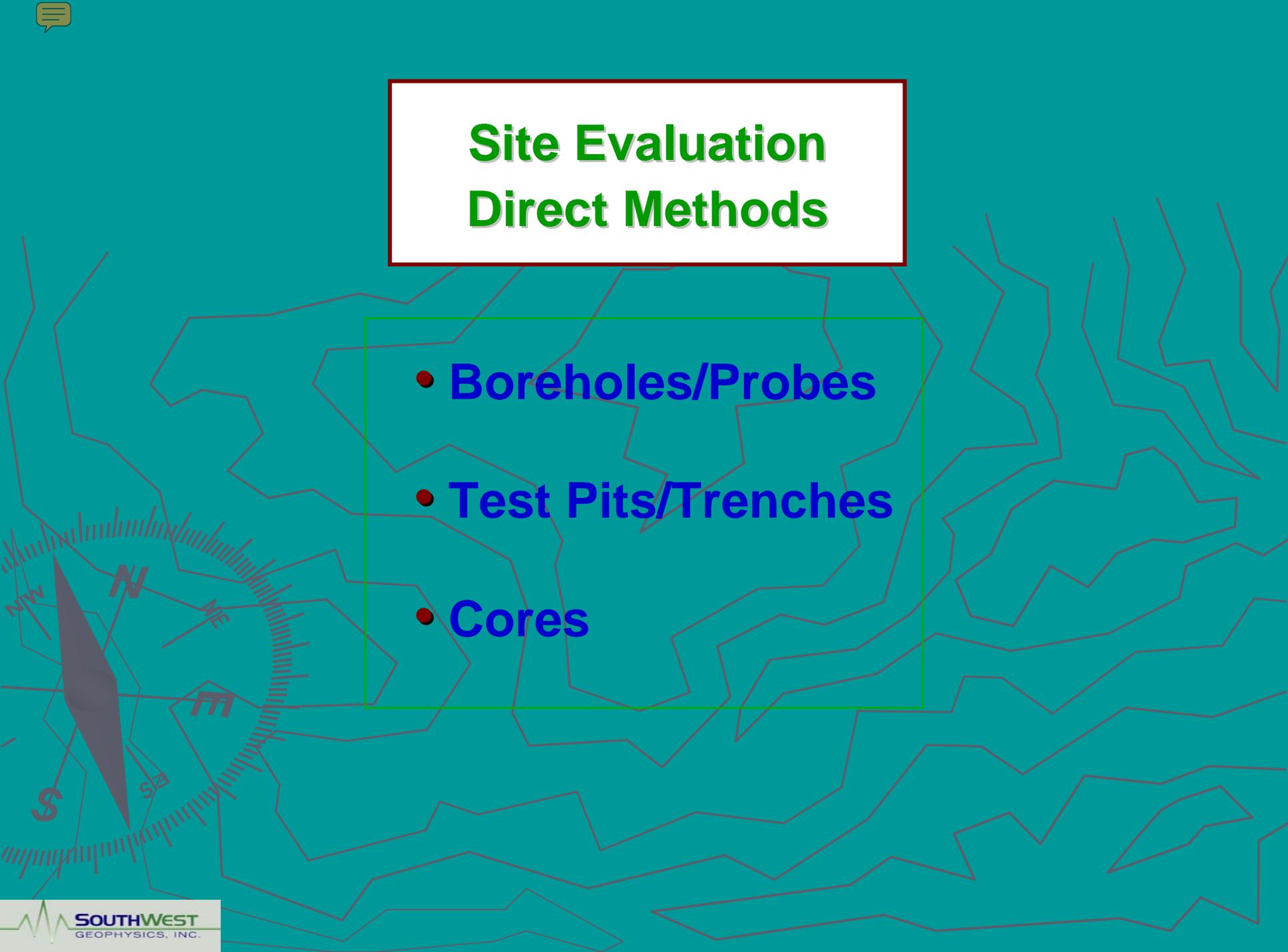
SOUTHWEST GEOPHYSICS

GEOPHYSICAL SERVICES



Presented By:
Hans van de Vrugt, CEG, RGp
Patrick F. Lehrmann, PG, RGp





Site Evaluation Direct Methods

- **Boreholes/Probes**
- **Test Pits/Trenches**
- **Cores**



Geophysical Techniques Indirect Methods

- **Ground Penetrating Radar (GPR)**
- **Electromagnetics (EM)**
- **Magnetics**
- **Utility Locating**
- **Seismics**
- **Electrical Resistivity**
- **Gravity**
- **Very Low Frequency (VLF)**





Geophysical Techniques Indirect Methods

Advantages:

- **Non-Destructive**
- **Cost Effective**
- **Provides Preliminary or Supplemental Information**



Geotechnical Applications

Geotechnical Studies	Seismic	Electrical Resistivity	GPR	Electro-Magnetics	Magnetics	Gravity
Character subsurface geology						
Evaluate depth to bedrock						
Evaluate depth to groundwater						
Determine shear modulus and poisson's ratio						
Locate faults						
Evaluate soil corrosivity						
Locate rebar in concrete						
Map shallow stratigraphic units						
Evaluate rippability						
Map underground utilities						
Locate voids						

Environmental Applications

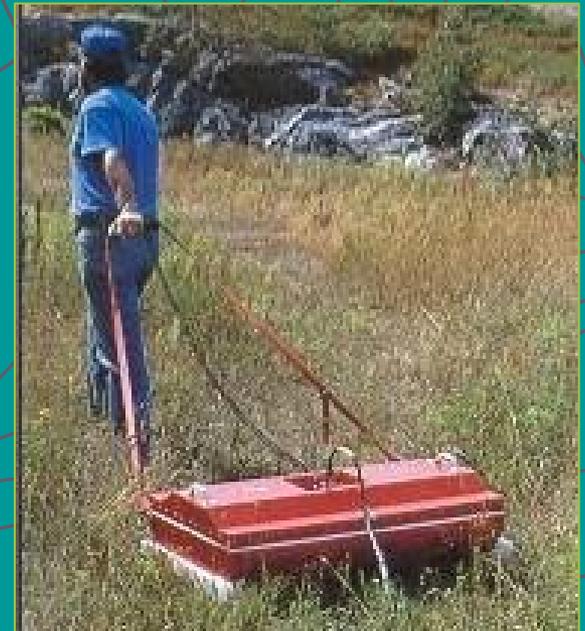
Environmental Studies	GPR	Seismic	Magnetics	Electro-Magnetics	Electrical Resistivity
Locate buried storage tanks	●		●	●	
Locate underground pipes	●		●	●	
Map land fill boundaries	●	●	●	●	●
Locate previously excavated areas	●	●		●	
Locate buried drums	●		●	●	
Locate buried ferromagnetic objects	●		●	●	
Locate buried non-ferrous objects	●			●	
Delineate drilling-mud pits	●			●	●
Map leachate plumes	●			●	●

Geophysical Methods

Ground Penetrating Radar System

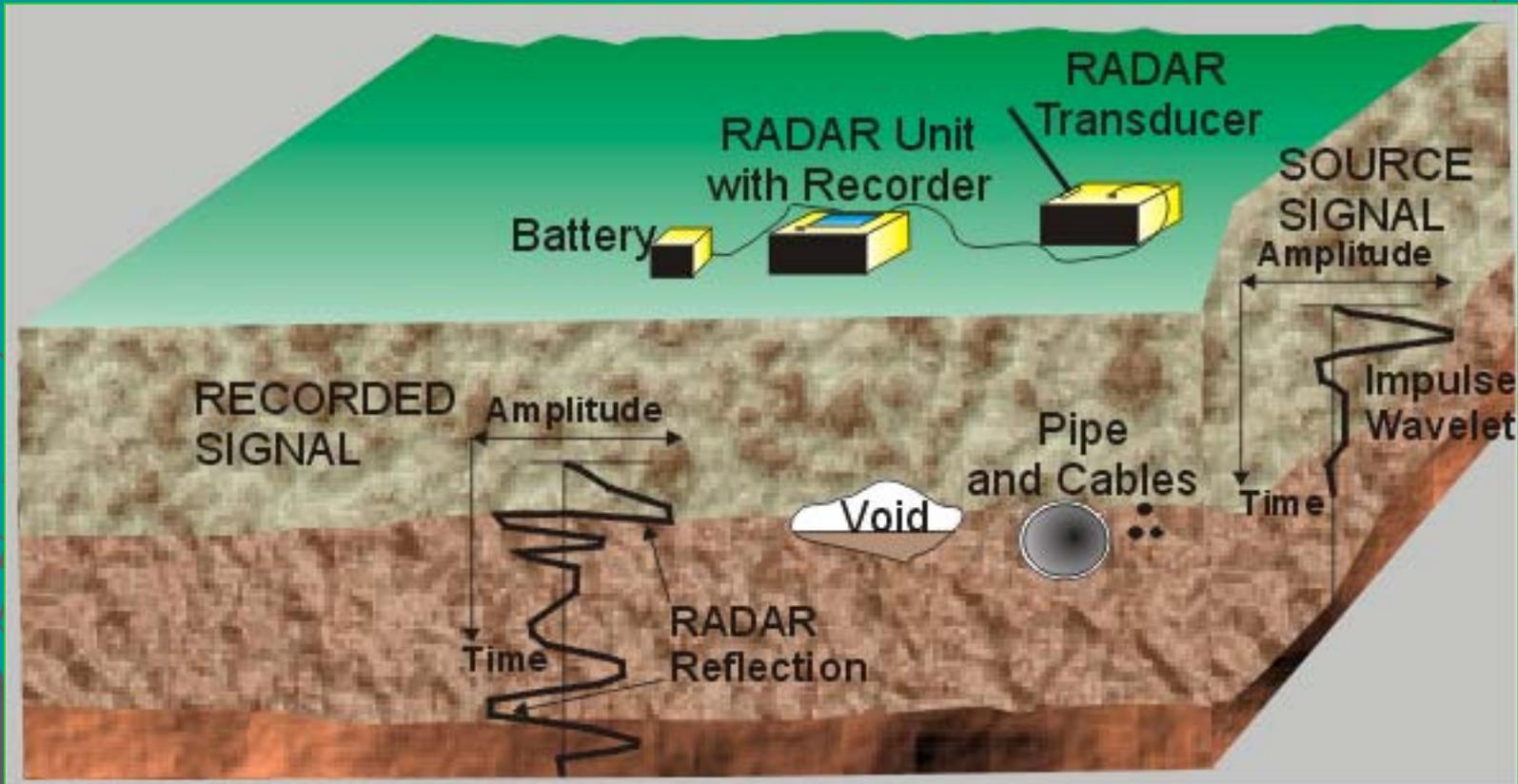


SIR 3000 – 400 MHz

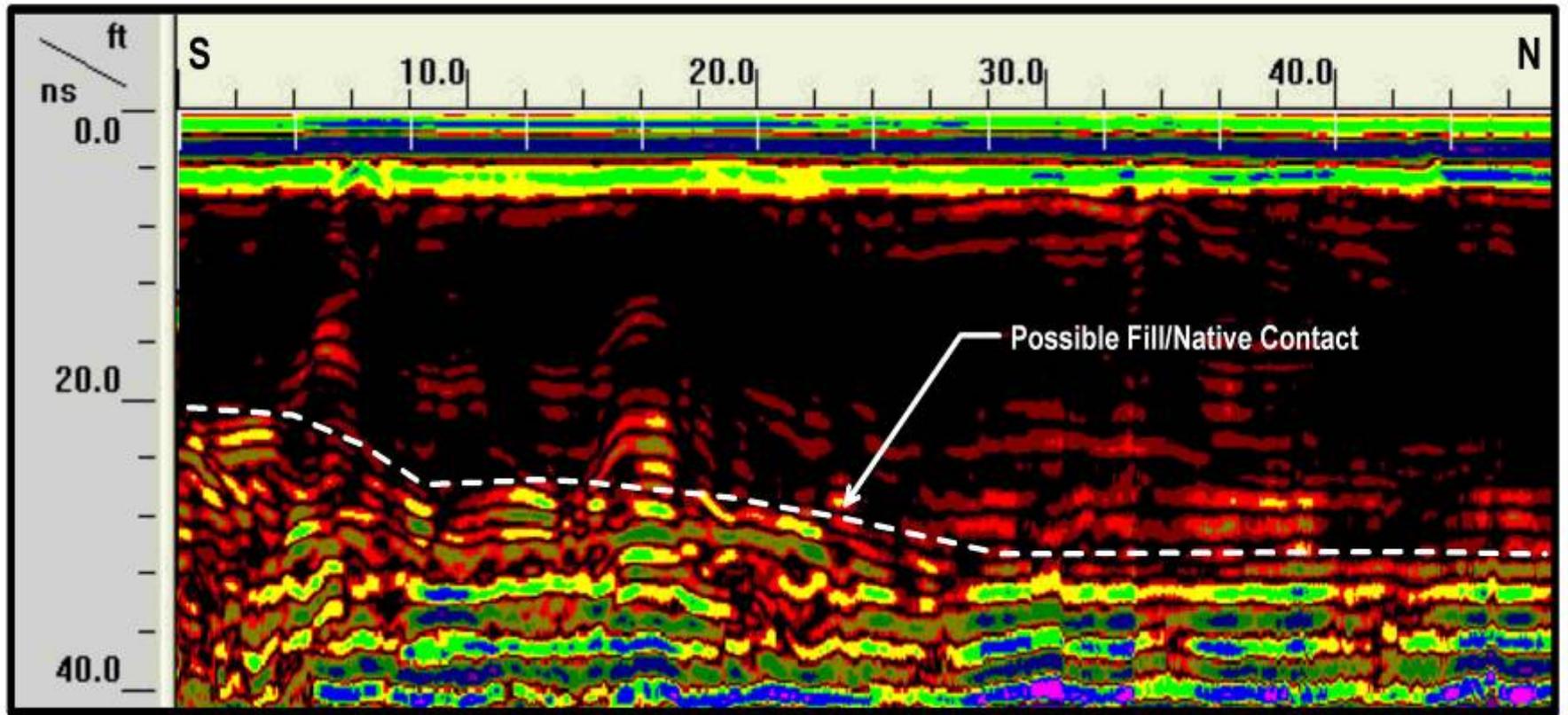


SIR 3000 – 100 MHz

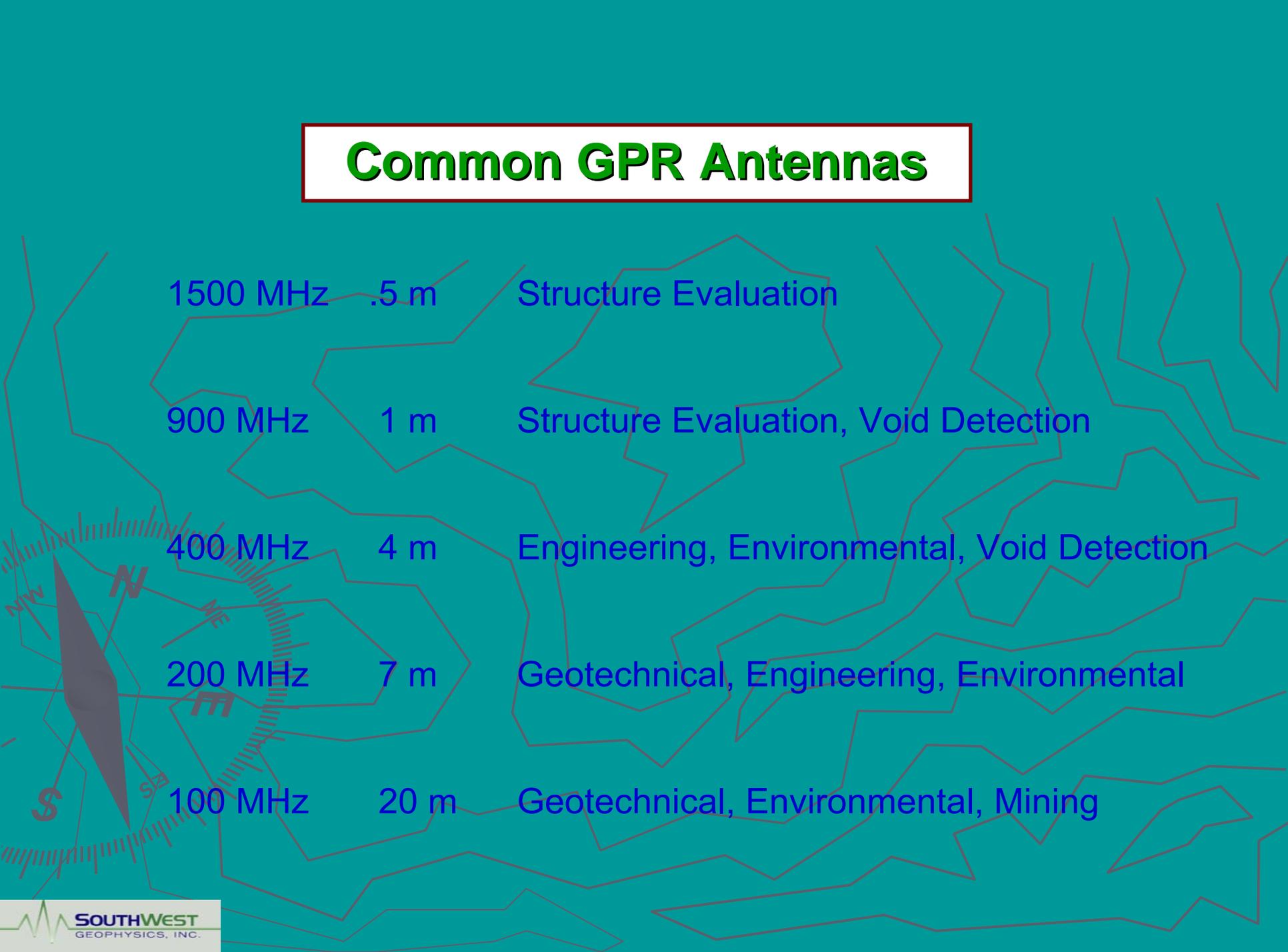
Ground Penetrating RADAR (GPR) Survey



Stratigraphy Survey GPR Data



Common GPR Antennas

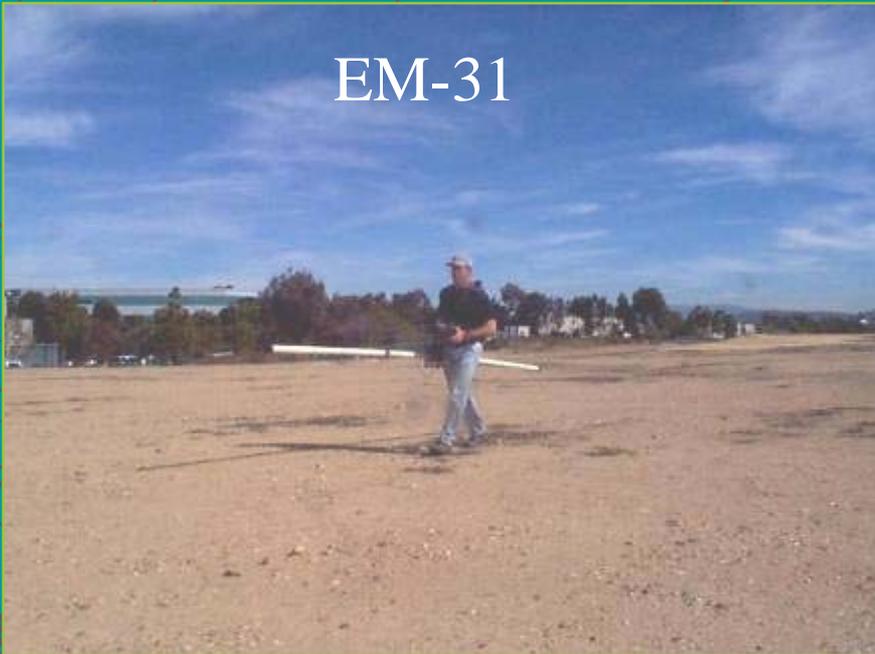


1500 MHz	.5 m	Structure Evaluation
900 MHz	1 m	Structure Evaluation, Void Detection
400 MHz	4 m	Engineering, Environmental, Void Detection
200 MHz	7 m	Geotechnical, Engineering, Environmental
100 MHz	20 m	Geotechnical, Environmental, Mining

Geophysical Methods

Electromagnetic Conductivity: EM-61 and EM-31 Field Survey Equipment

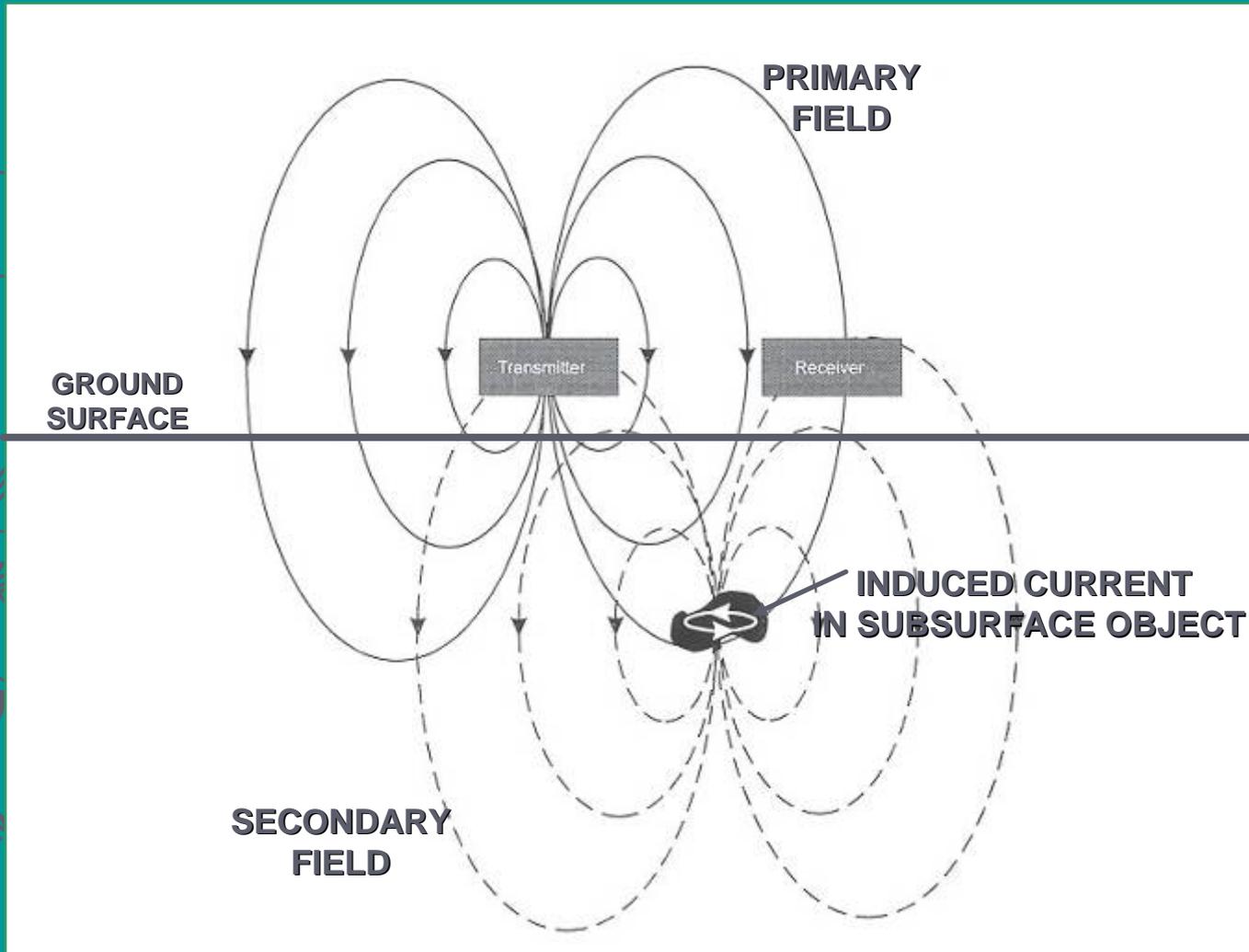
EM-31



EM-61

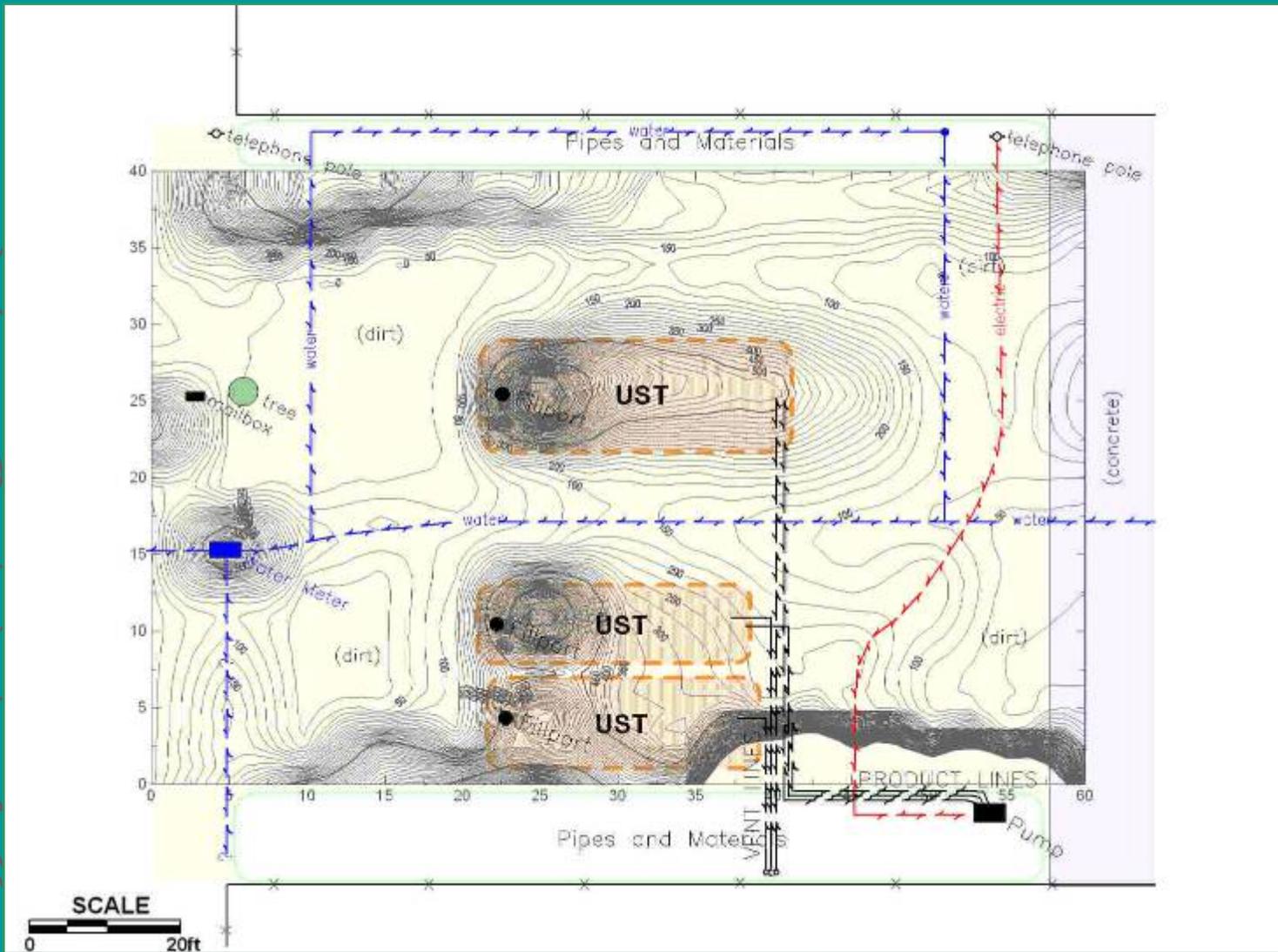


Electromagnetic Conductivity Survey



UST Search

Electromagnetic (EM61) Survey Data



Geophysical Methods

Magnetics - Magnetometer Equipment

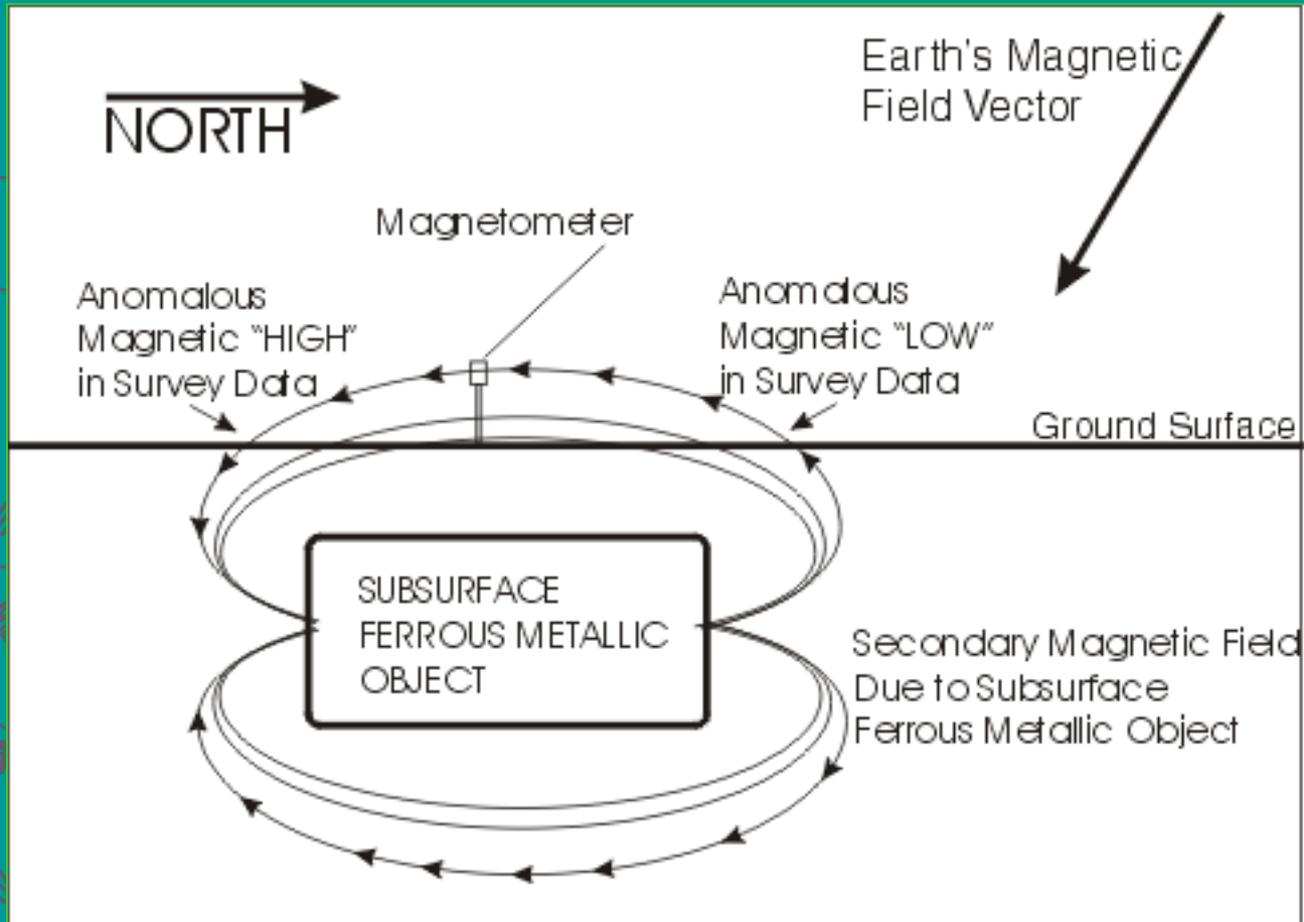
Magnetometer



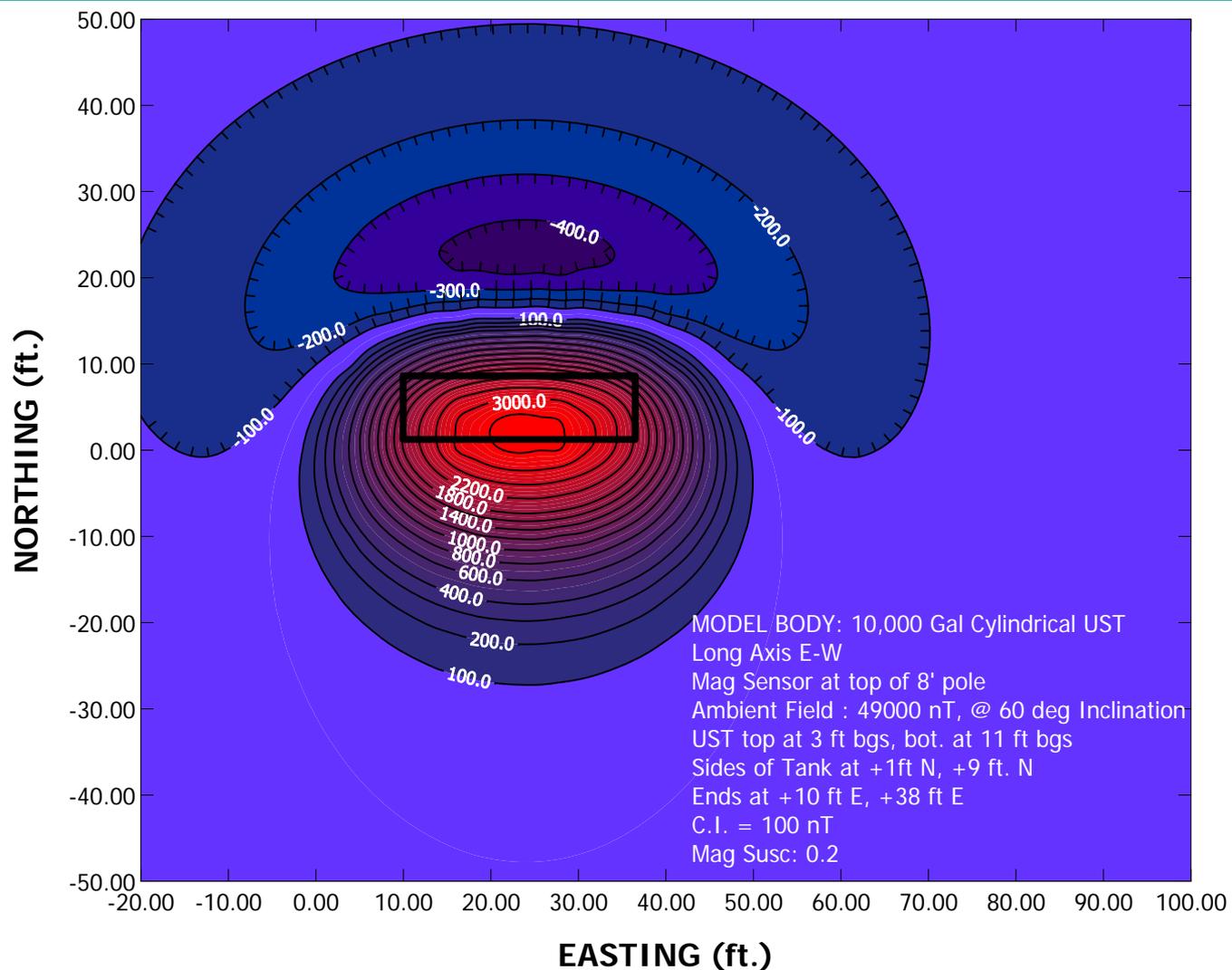
Gradiometer



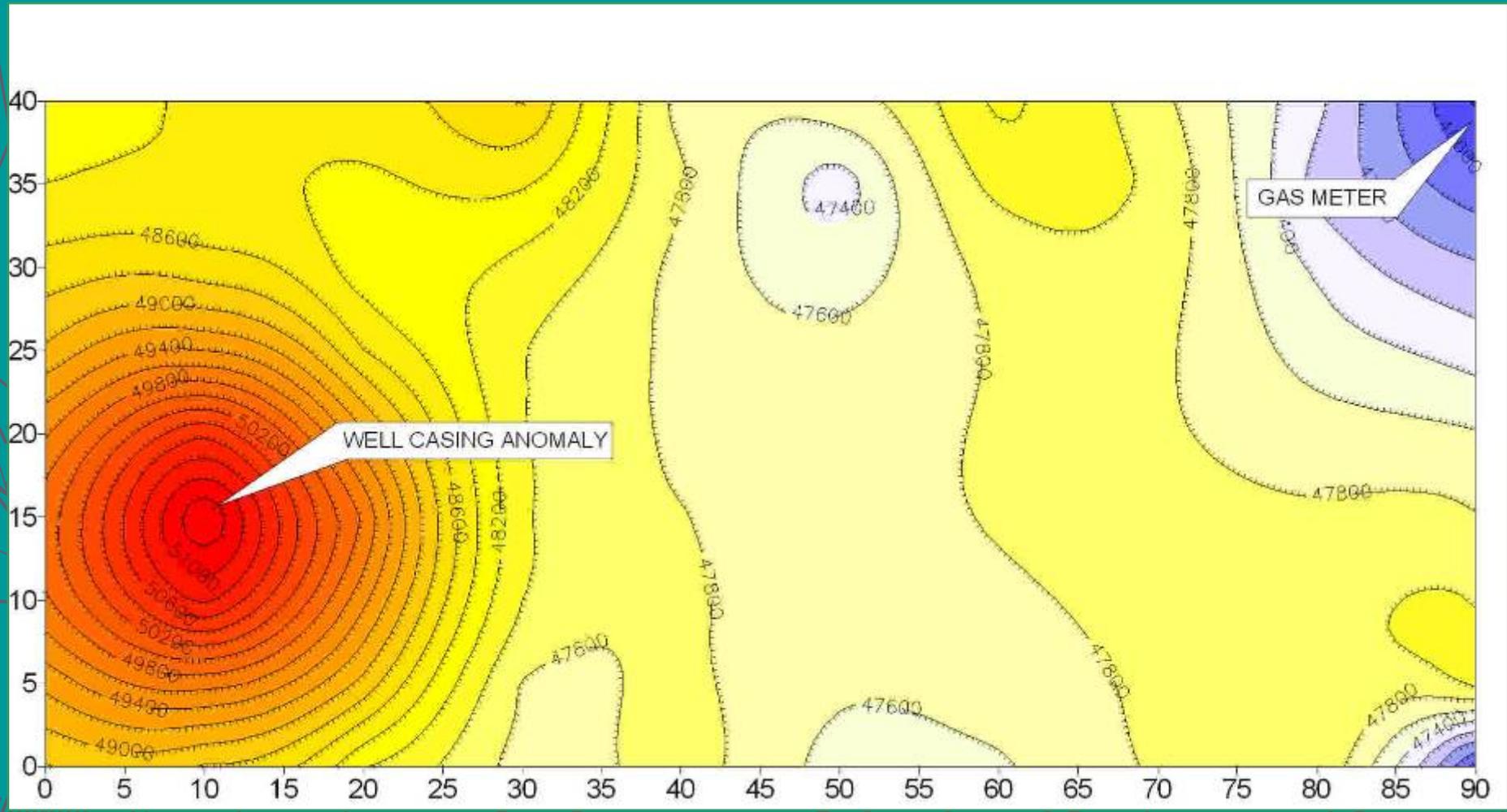
Magnetics Survey



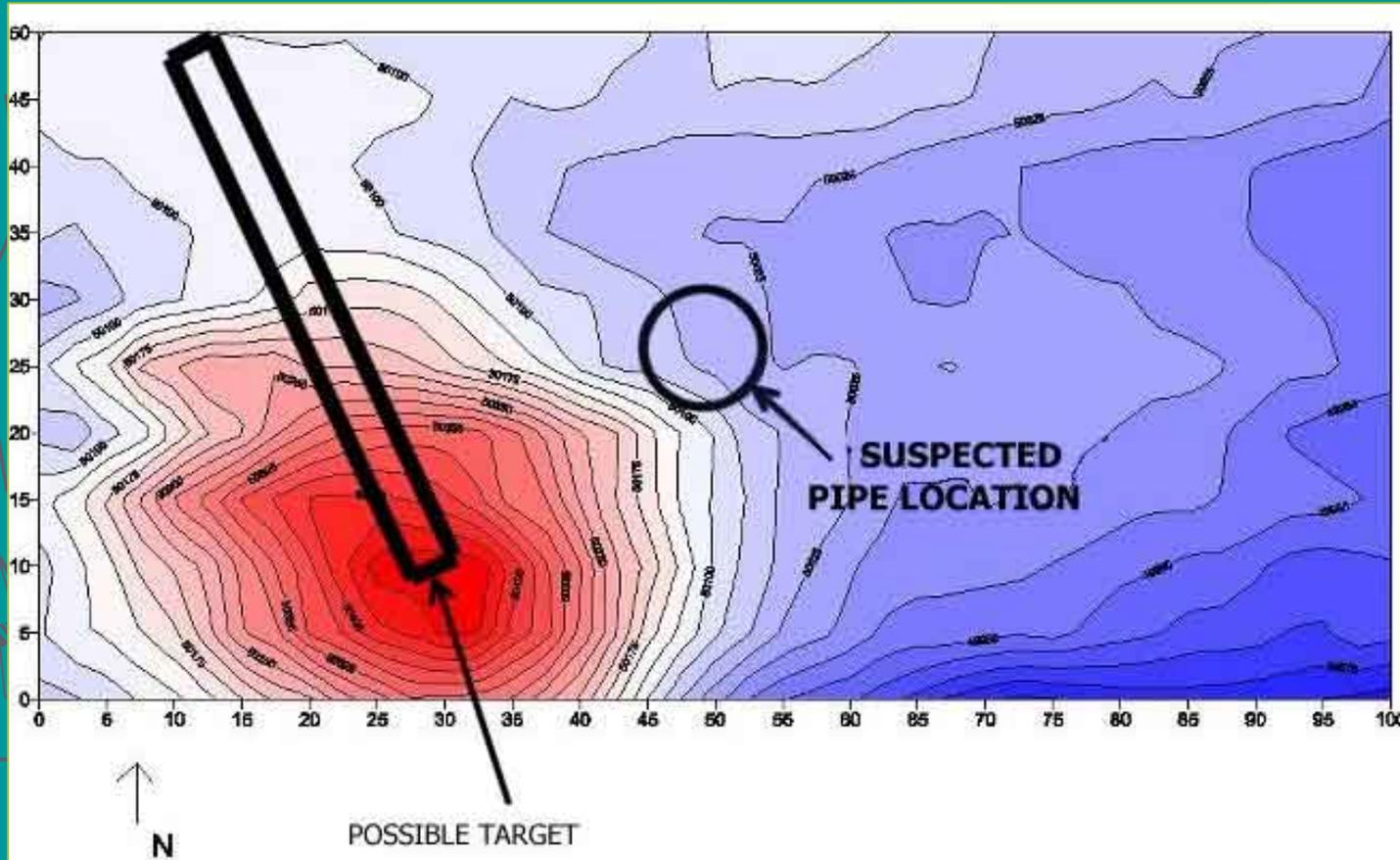
Magnetometer Survey Data 10,000 Gallon UST



Magnetometer Survey Data Abandoned Oil Well



Magnetometer Survey Data Lost Culvert

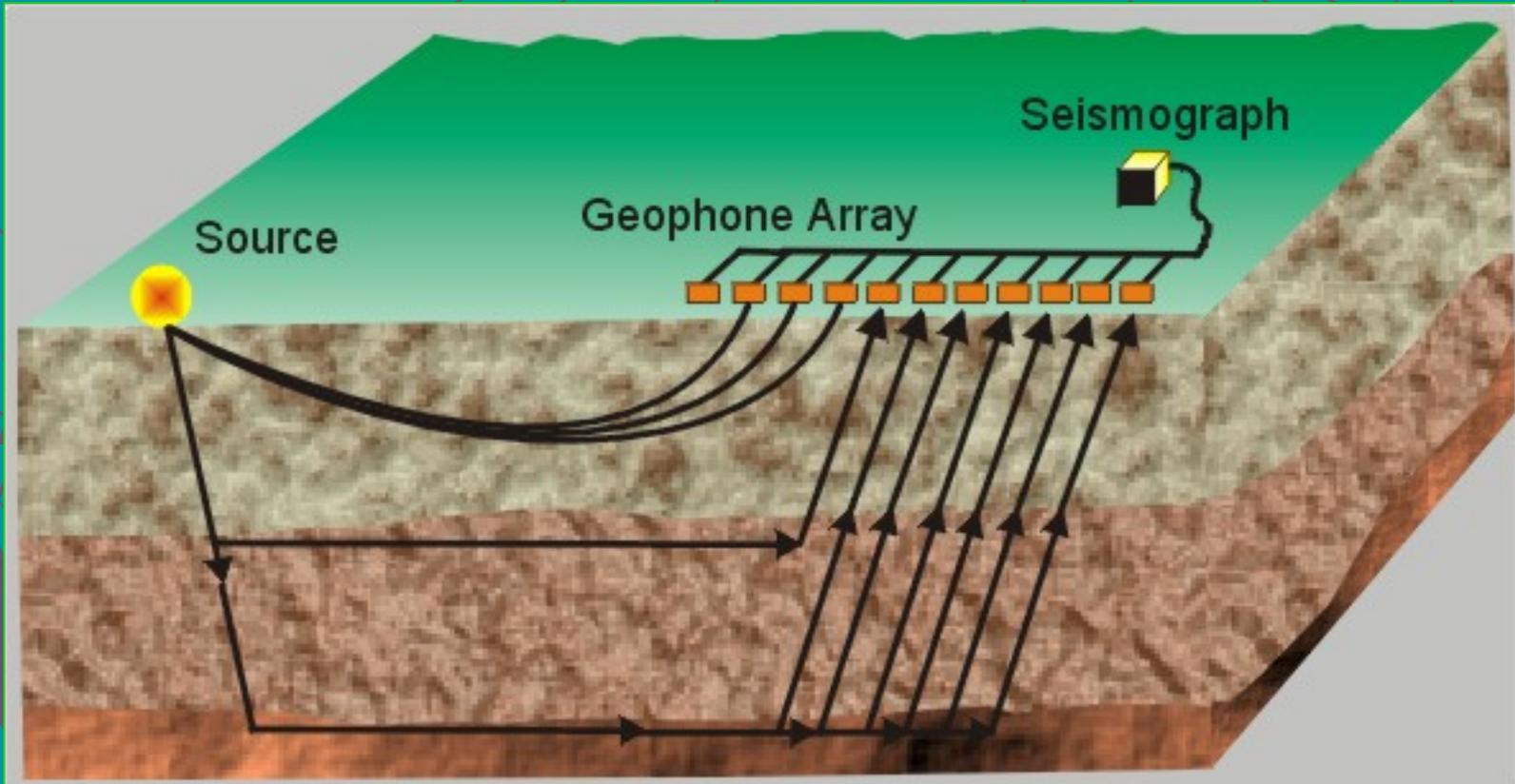


Geophysical Methods

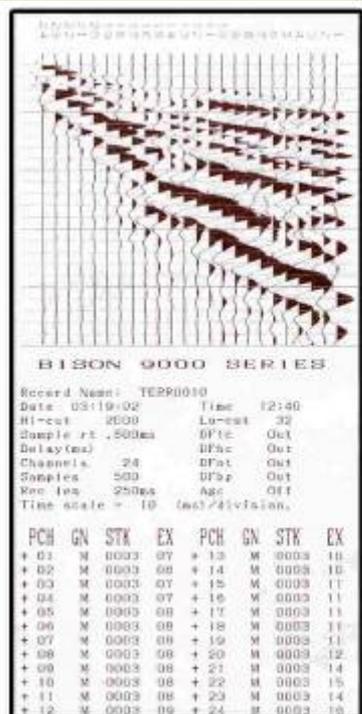
Seismic Refraction System



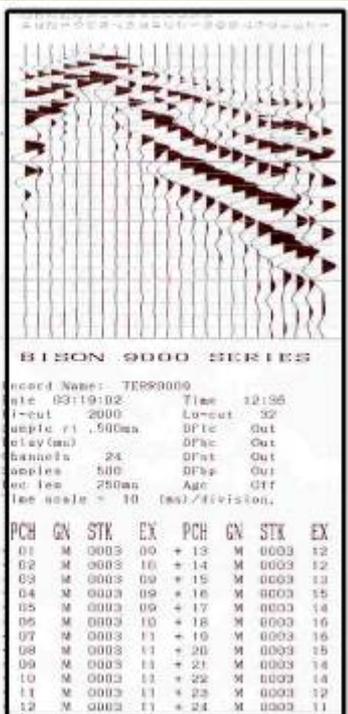
Seismic Refraction Survey



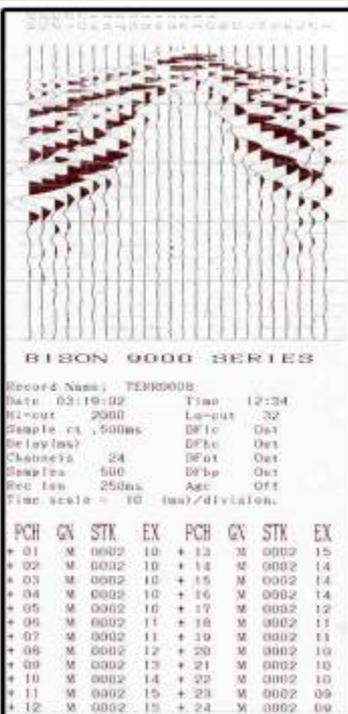
Seismic Refraction Survey Data



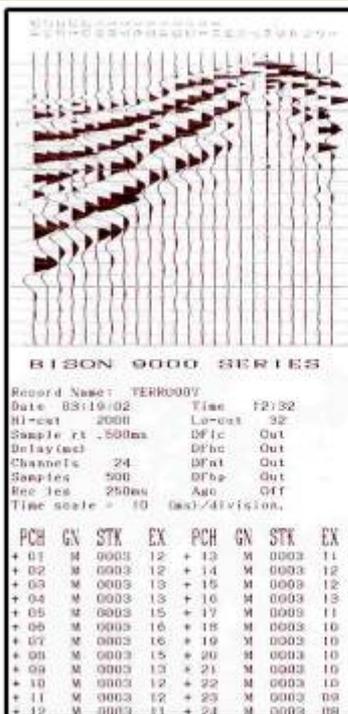
REVERSE



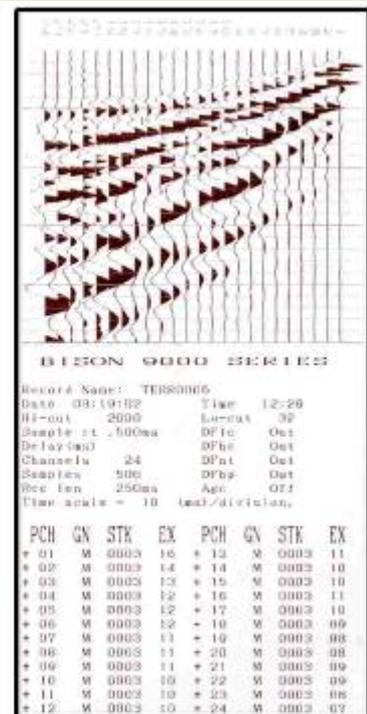
MID



MID

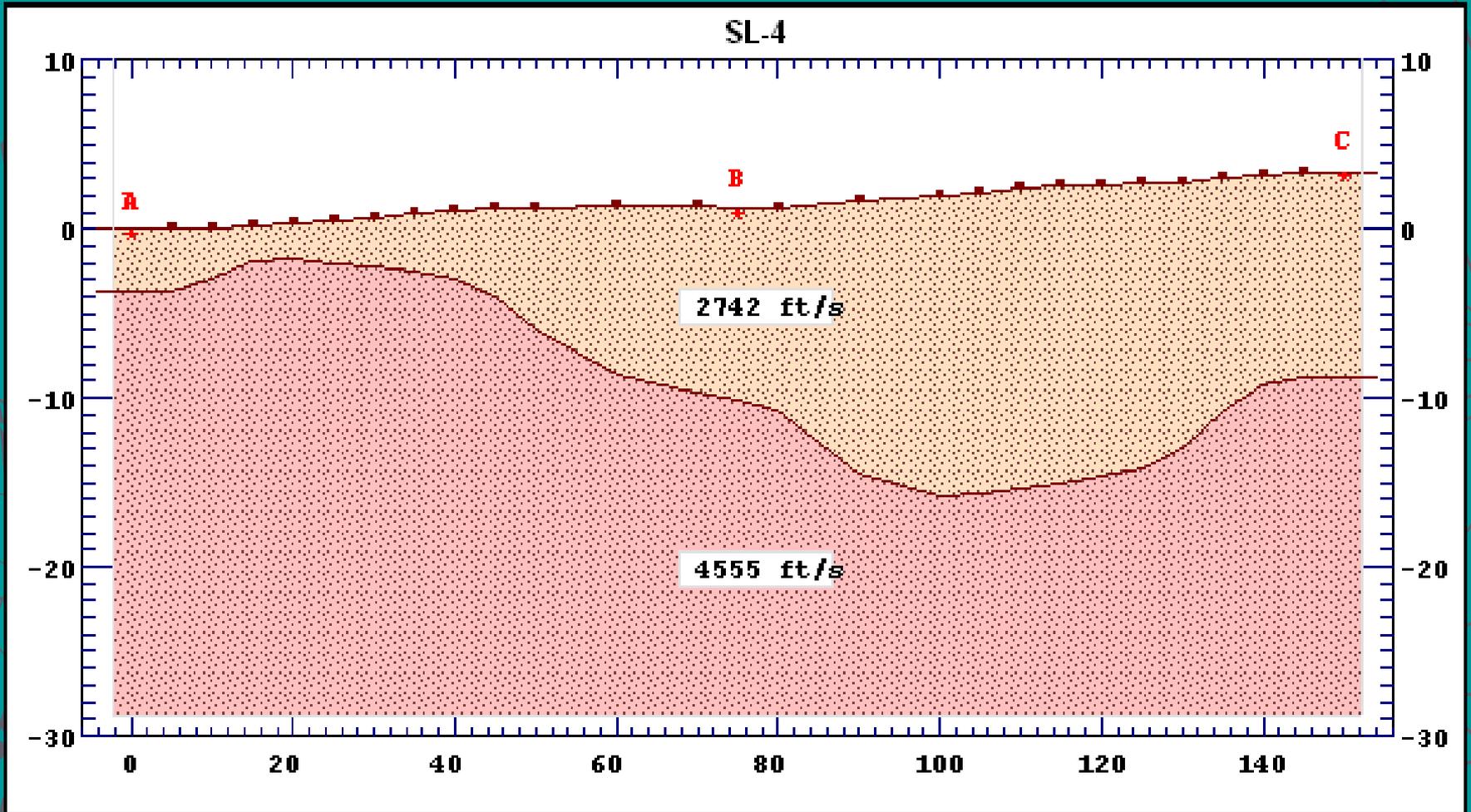


MID



FORWARD

Depth To Bedrock Study Seismic Refraction Velocity Model

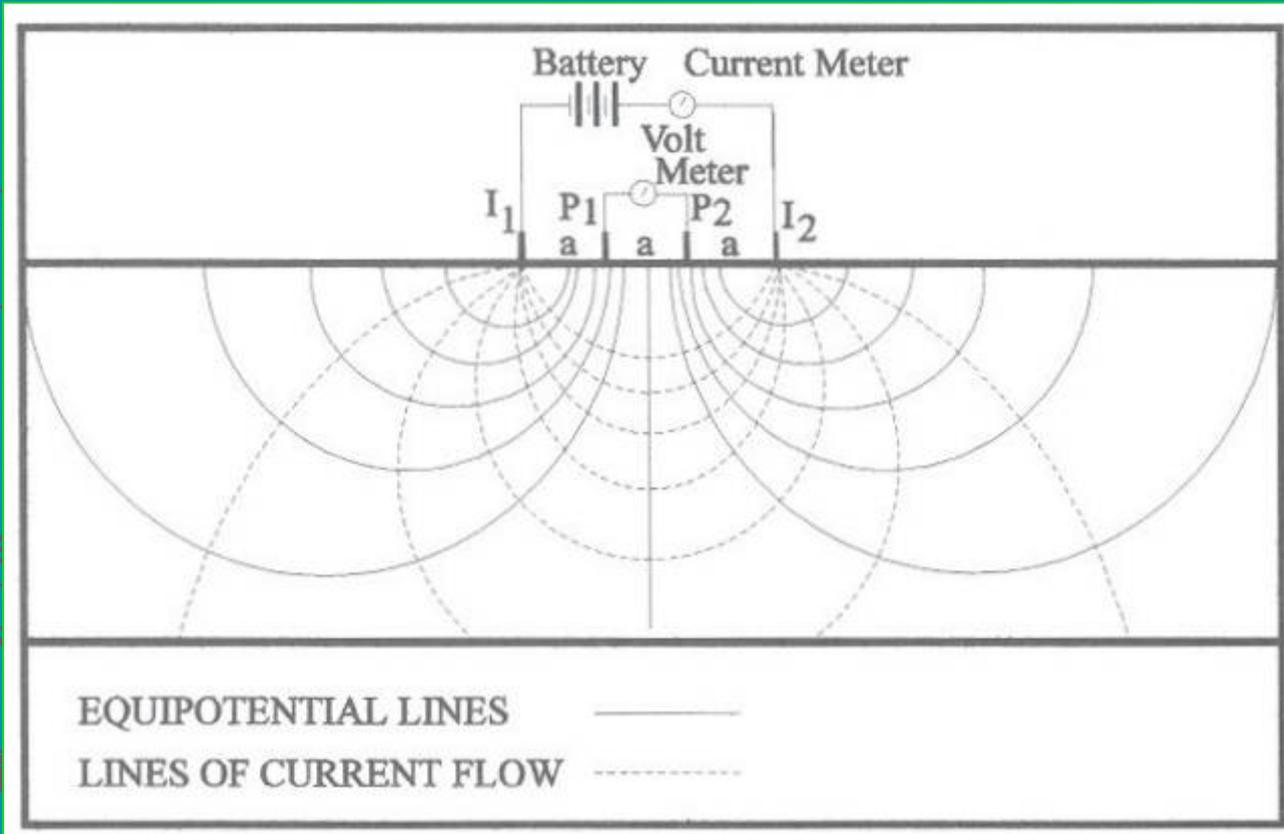


Geophysical Methods

Sting/Swift Earth Resistivity System



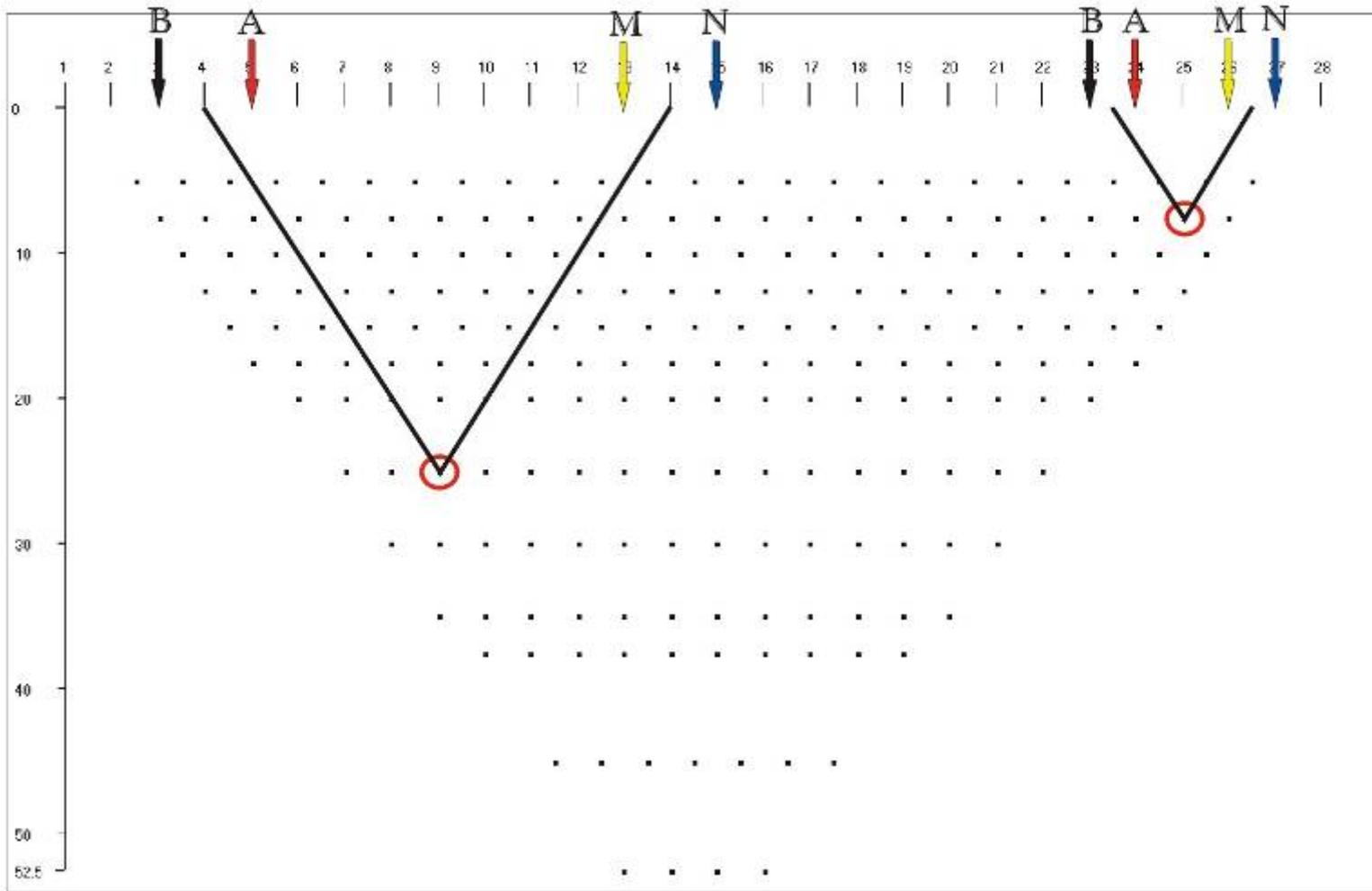
Resistivity: Wenner Array Survey



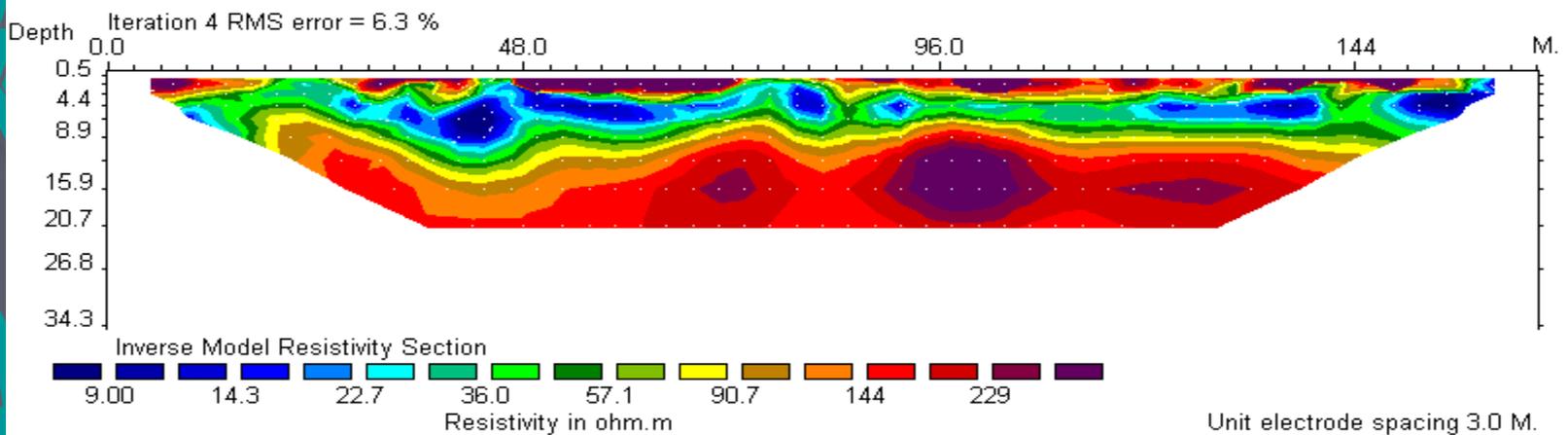
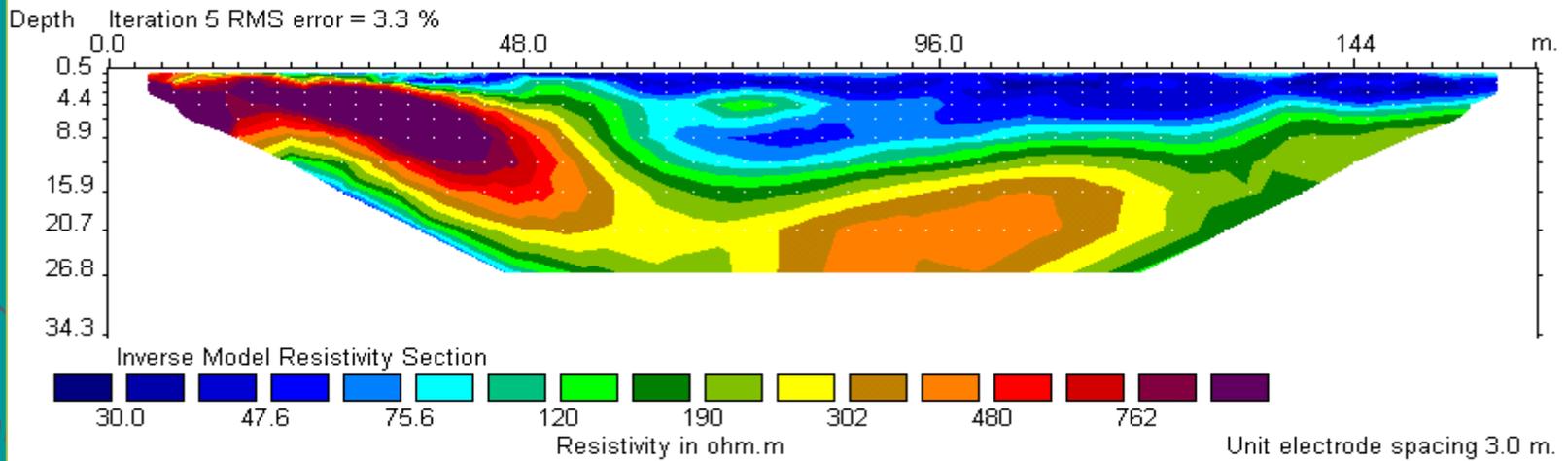
Sting Dipole-Dipole Array

Dipole size: 2 electrode spacings
 $n = 4$

Dipole size: 1 electrode spacing
 $n = 2$



Landfill Investigation Earth Resistivity Profiling

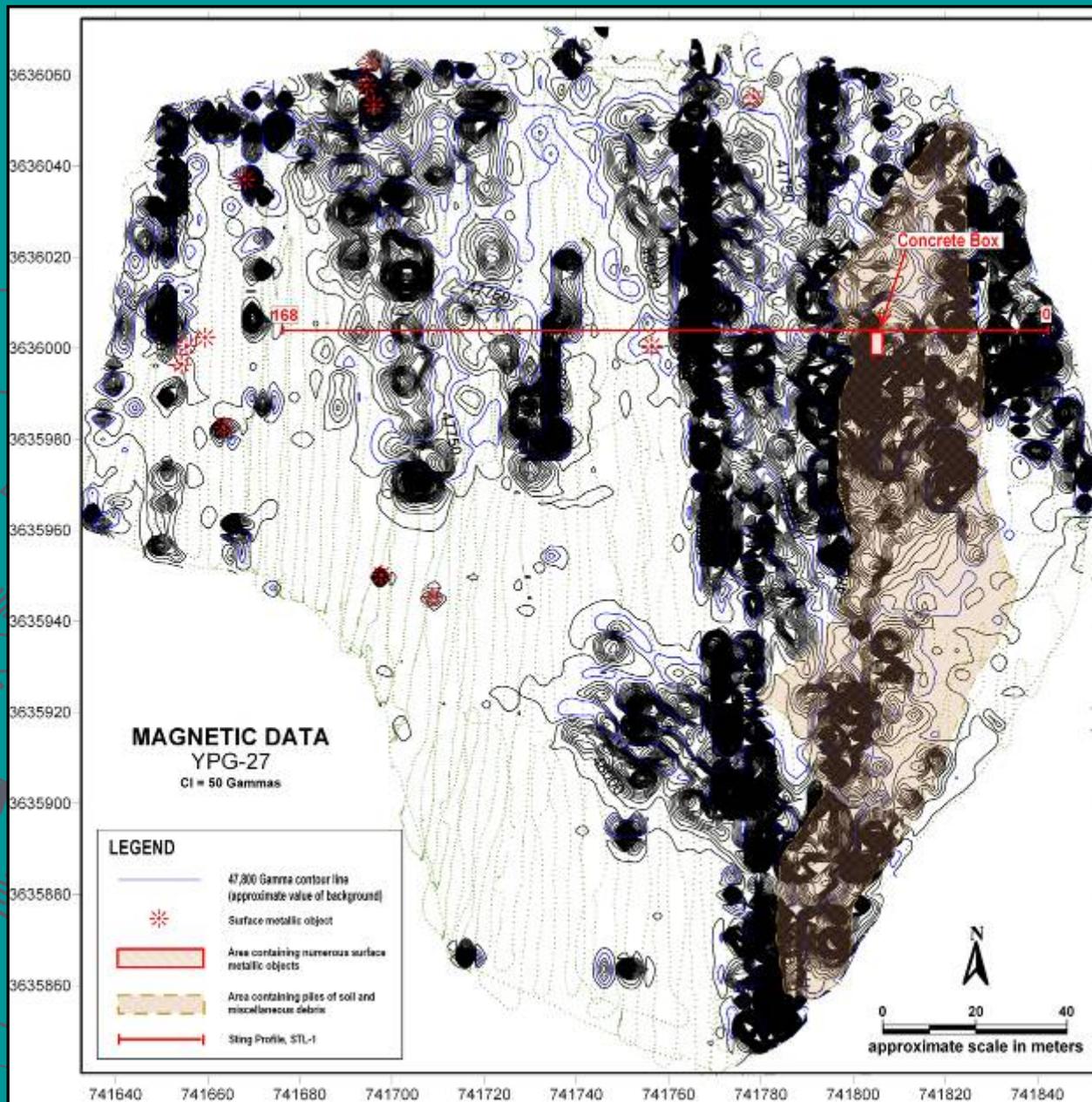




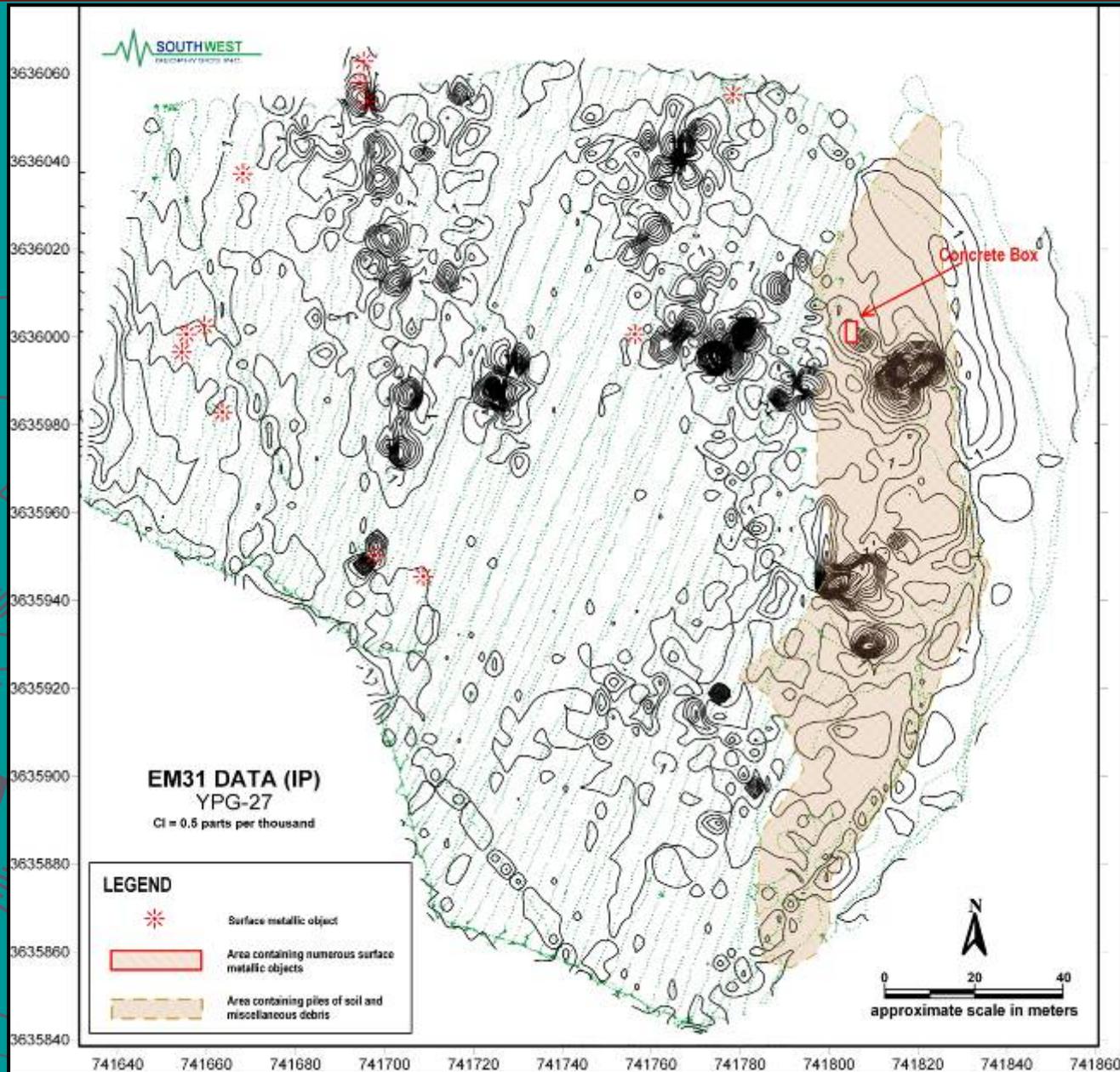
Case Studies



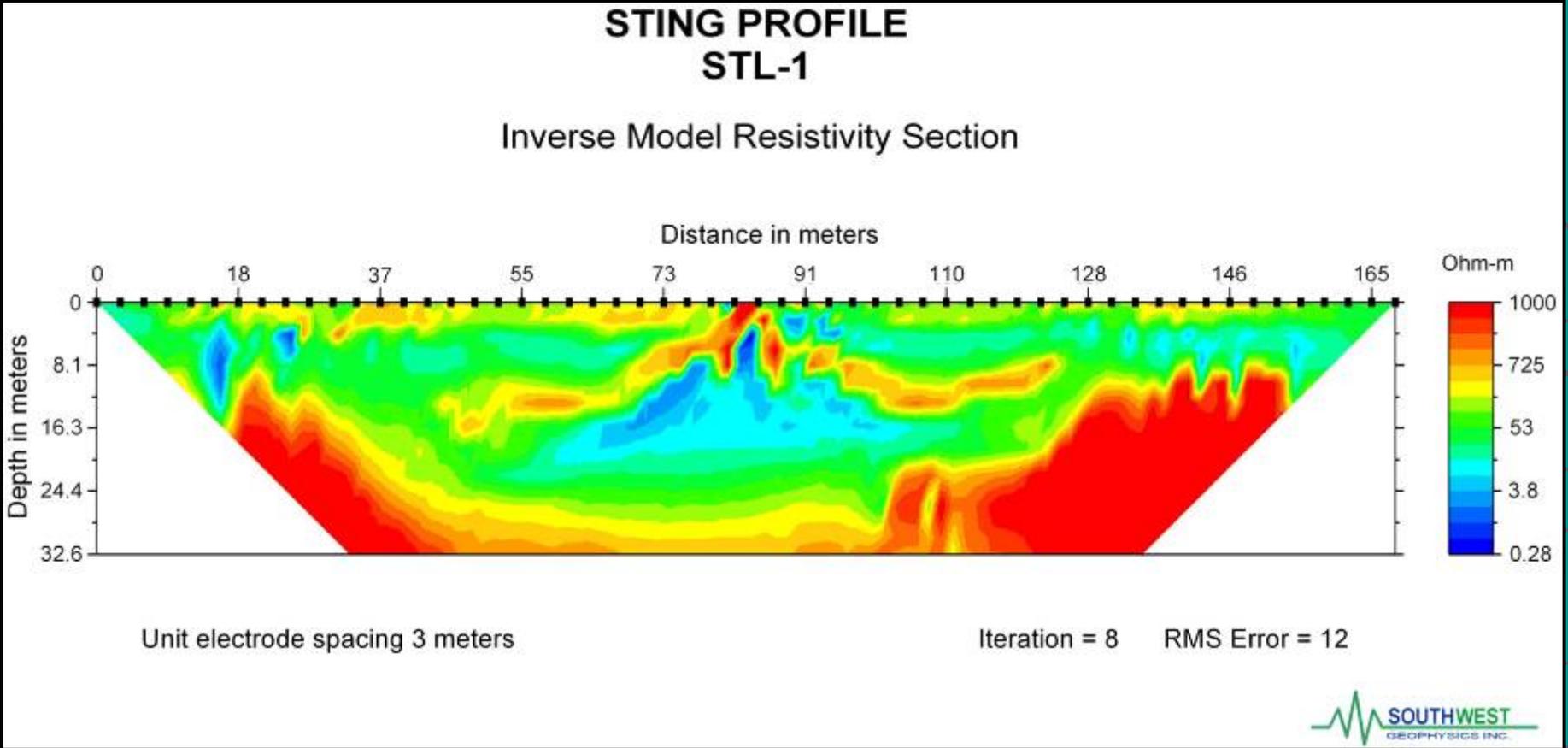
Former Landfill, Proving Grounds



Former Landfill, Proving Grounds



Former Landfill, Proving Grounds



Undocumented Landfill Survey



SITE
PHOTOGRAPHS

Project No.:

Date:

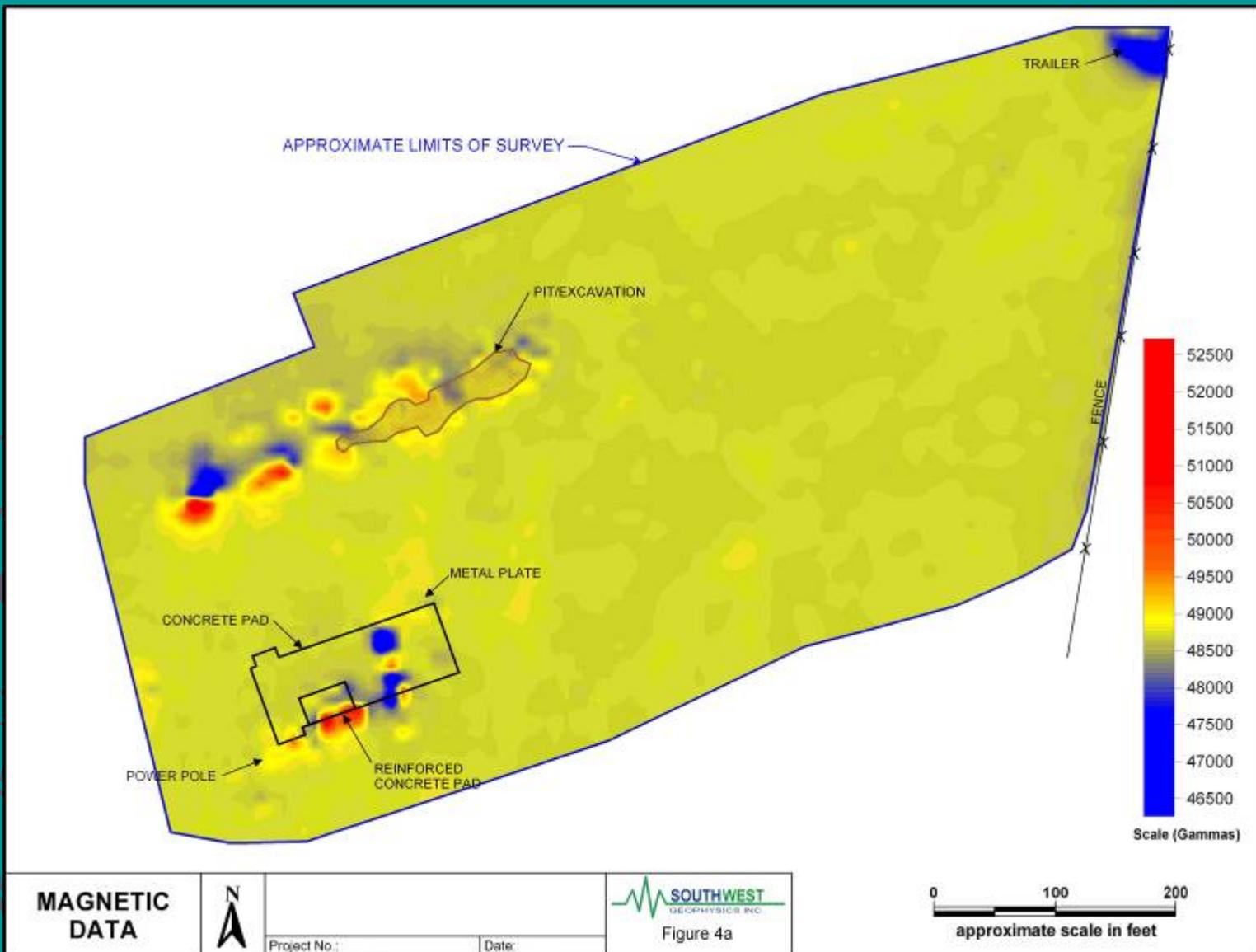


Figure 2b

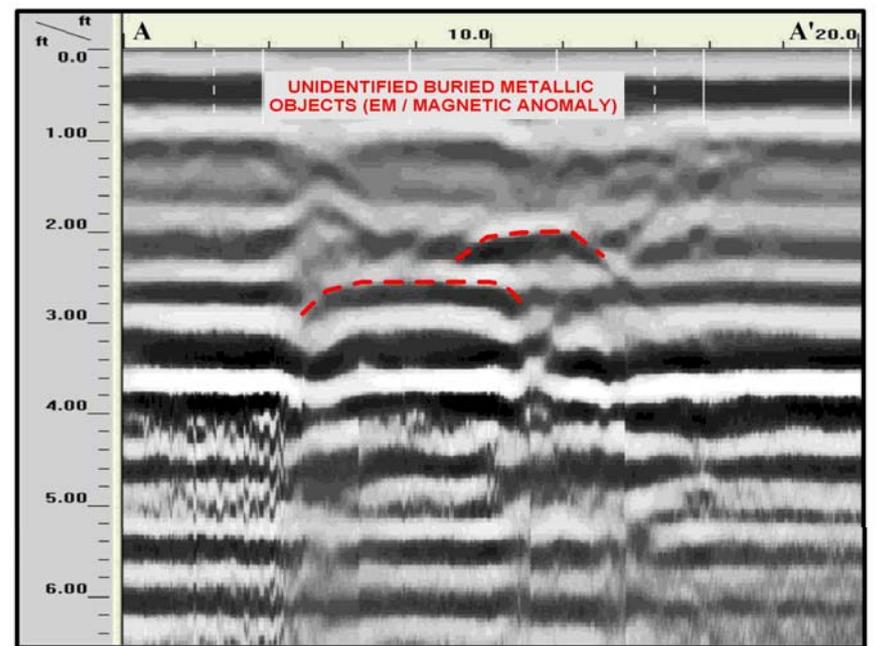
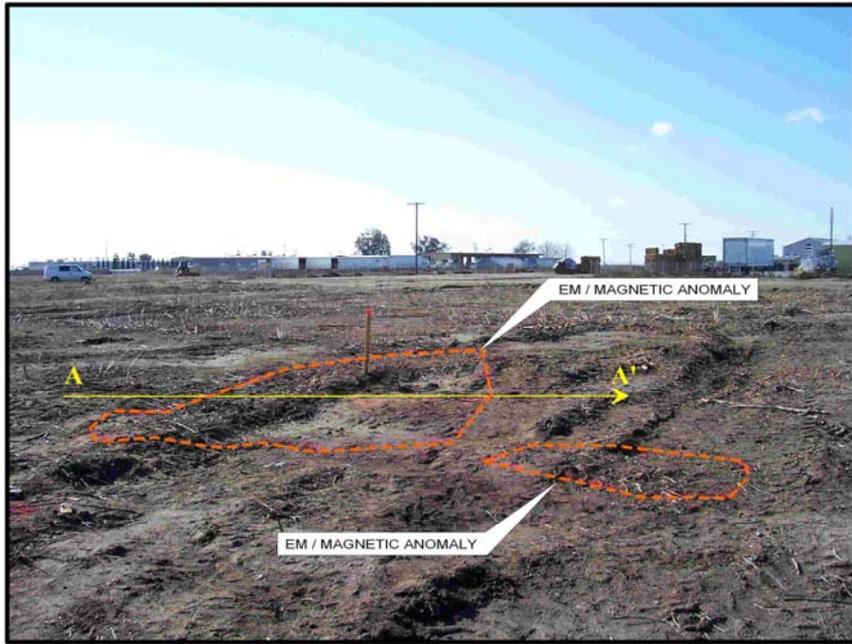
Undocumented Landfill Survey Data Points



Undocumented Landfill Survey



Undocumented Landfill Survey

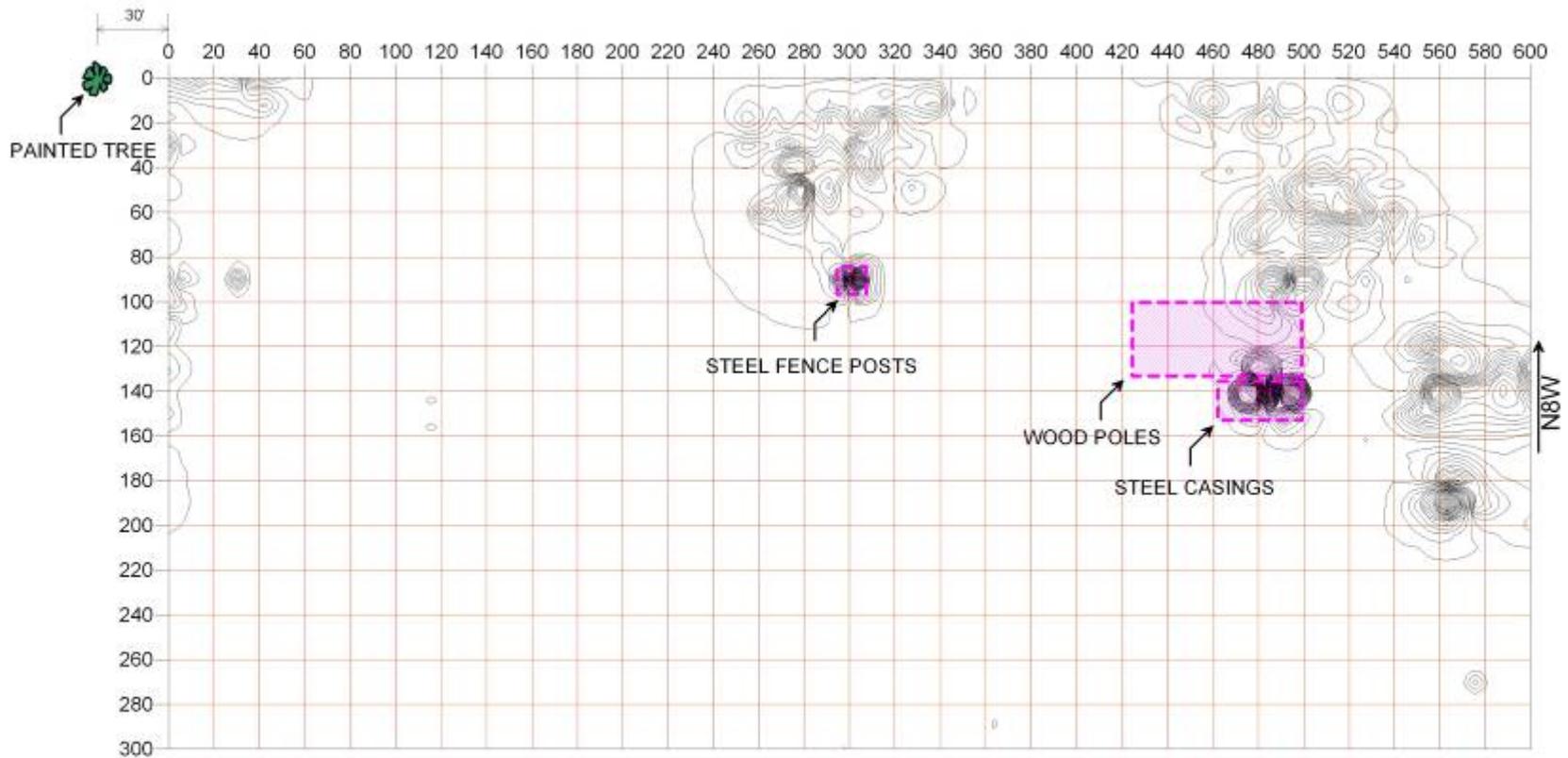


Magnetic Survey Undocumented Landfill



APPROXIMATE LANDFILL
SURVEY LIMITS

Magnetic Data Map



N82E →

0 80 160
approximate scale feet

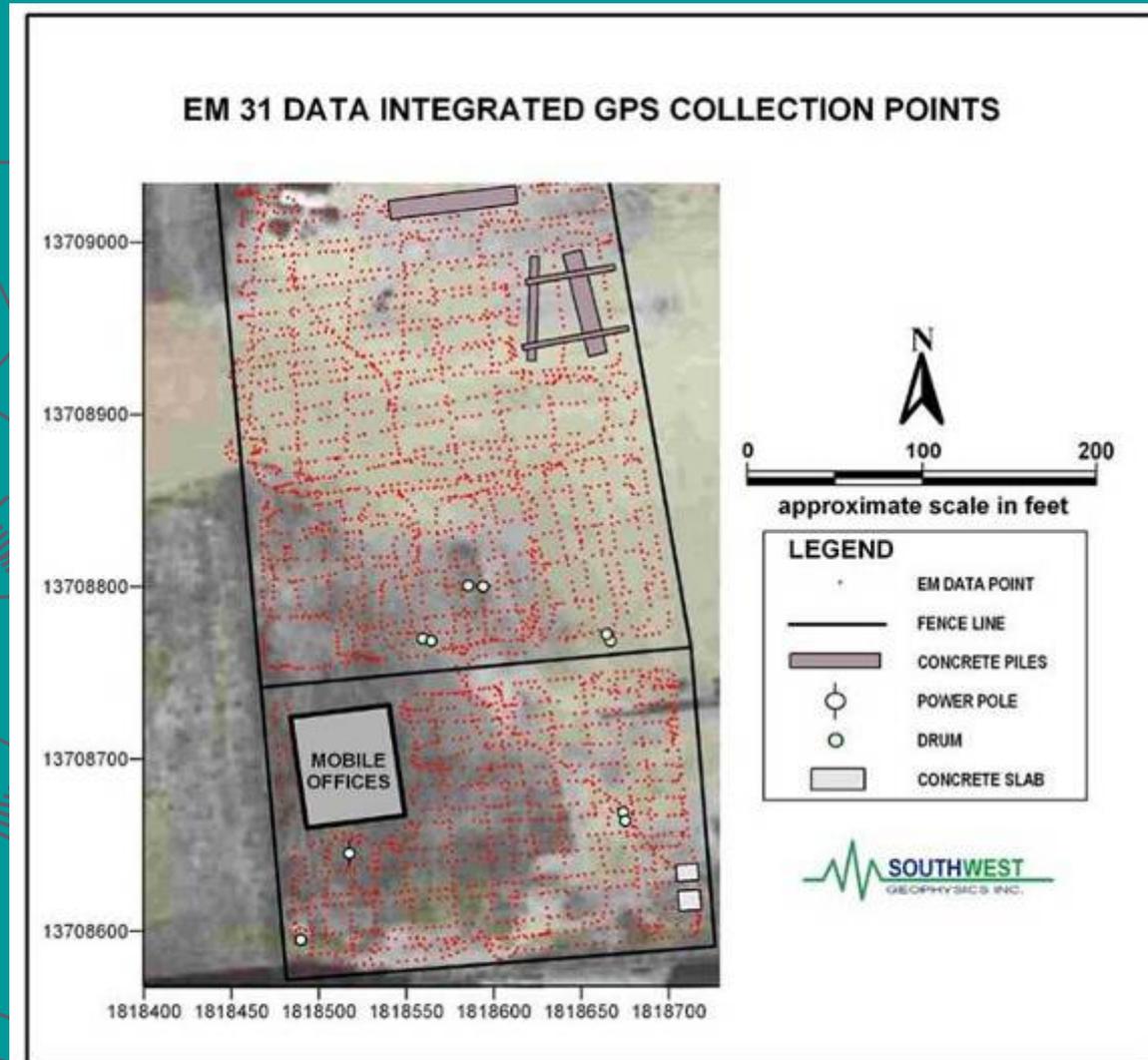
SITE DATA MAP
MAGNETIC DATA
CI = 100 gammas



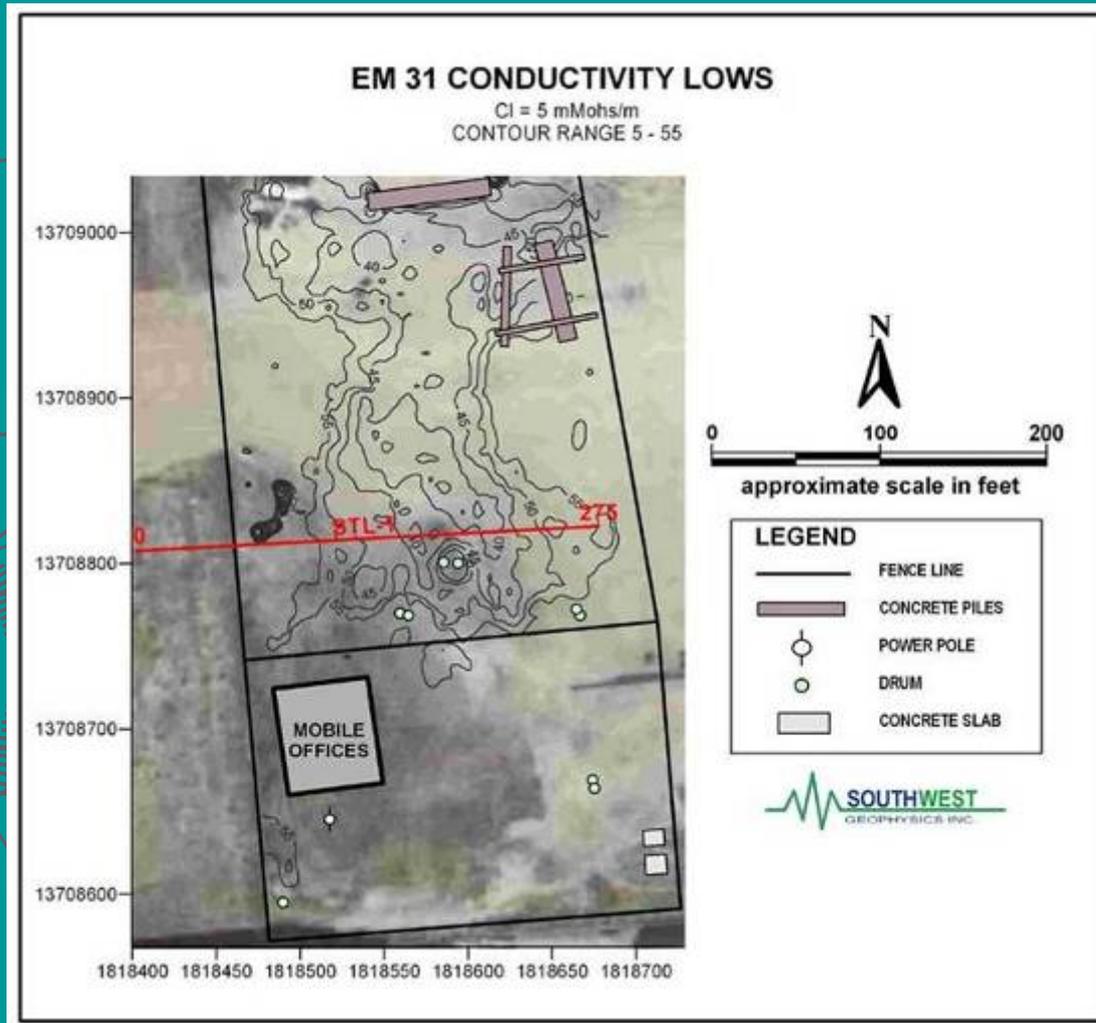
Proposed Power Plant Site



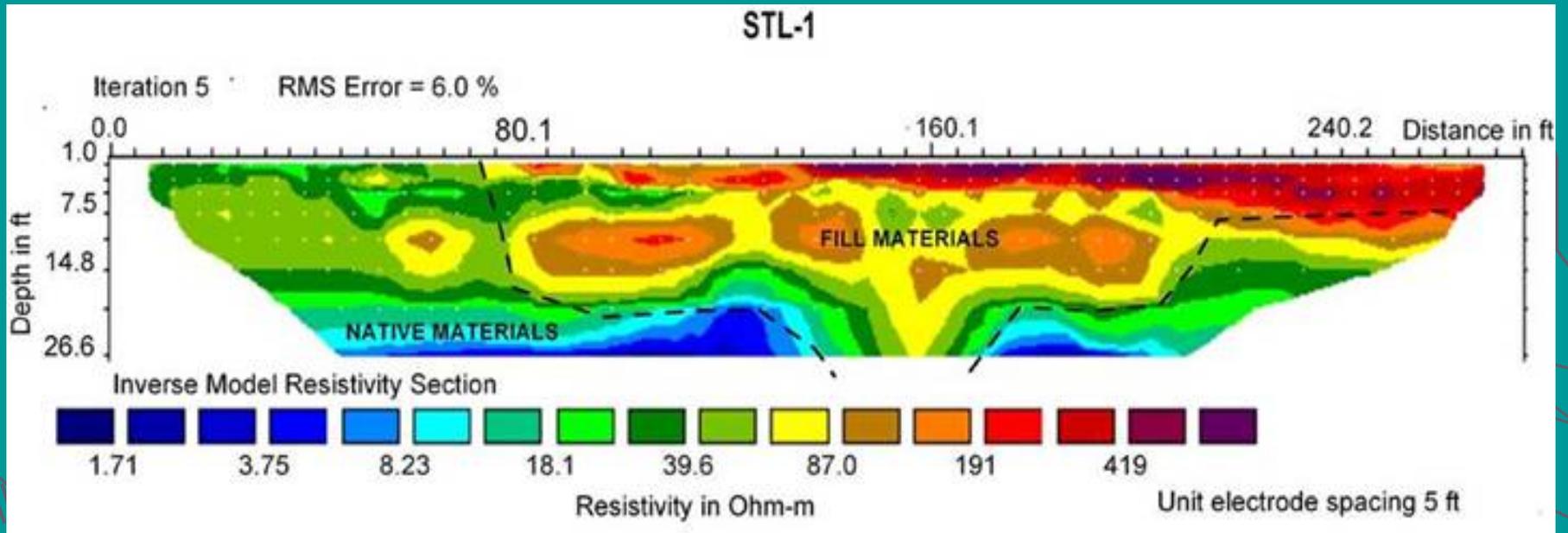
Terrain Conductivity (EM31) Survey



Terrain Conductivity (EM31) Survey (EM Low)



Sting Results



Instrument List

- ▶ Sir 3000 GPR W/ 400, 900 & 1600 MHz Antennas
- ▶ Geonics EM61 Time Domain EM Metal Detector
- ▶ Geonics EM31 Terrain Conductivity Meter
- ▶ Geometrics 858 Cesium Magnetometer
- ▶ Schonstedt GA 52 Magnetic Gradiometer
- ▶ RD4000, RD500 & Metrotech 9860 Utility Line Locators
- ▶ Fisher M-Scope TW-6 Pipe Locator
- ▶ Fisher M-Scope M-100 Rebar and Cable Locator
- ▶ Instantel Blastmate III Vibration Monitor
- ▶ Geometrics StrataView 24 Channel Seismograph
- ▶ AGI Super Sting R8 Resistivity Meter
- ▶ Trimble Pro XRS GPS



Advantages/Limitations

Advantages

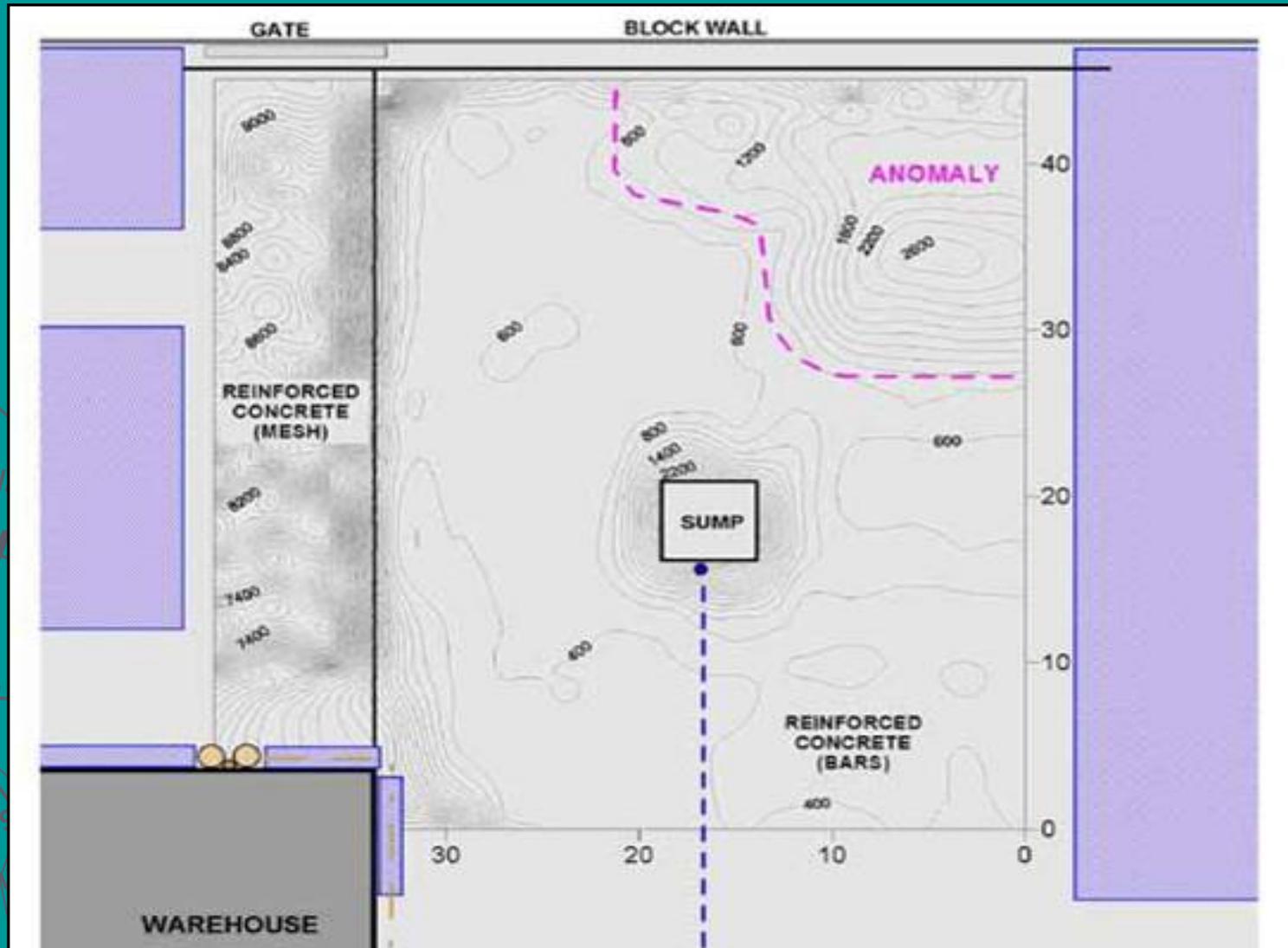
- **Non Destructive**
- **Quick Data Collection**
- **Cost Effective**

Limitations

- **Depth of Penetration v. Resolution**
- **Non Unique Solutions**
- **Undesirable Signals/Noise**

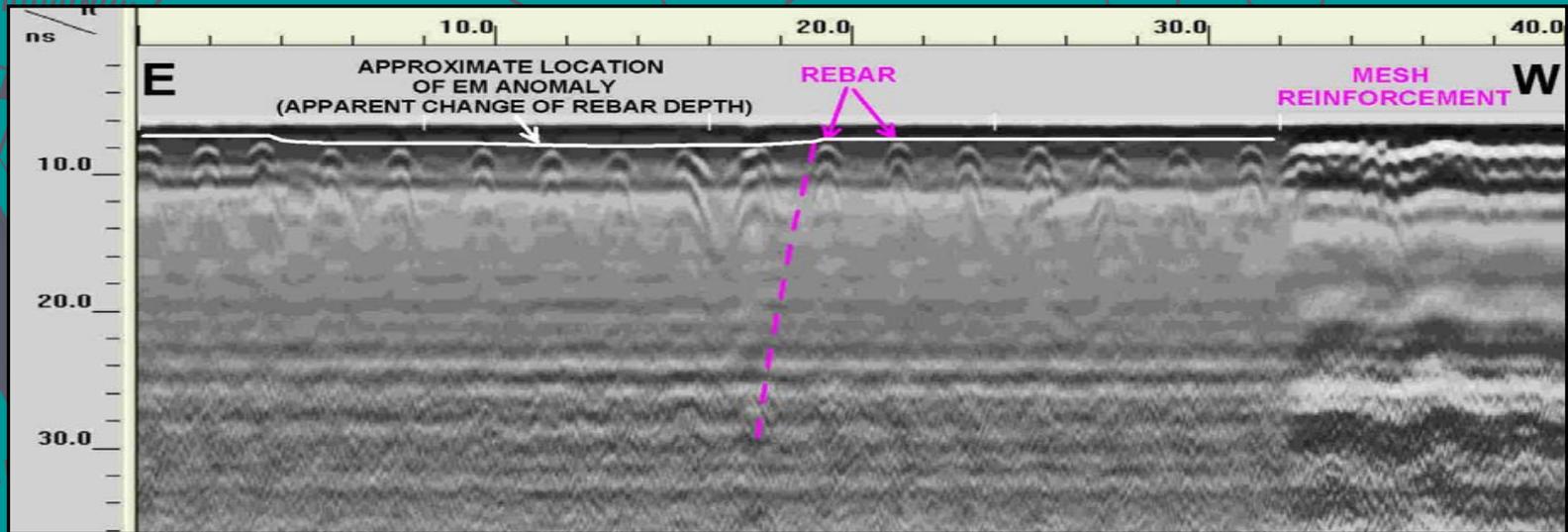
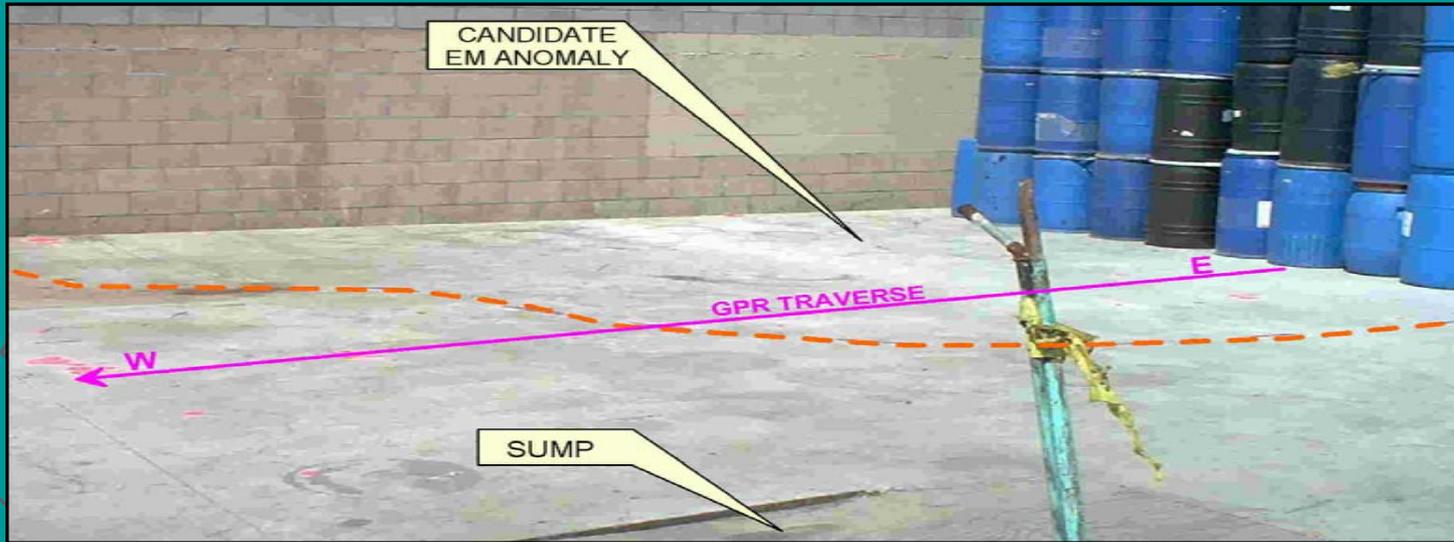
Illegal Drum Burial

EM61 Data



Illegal Drum Burial

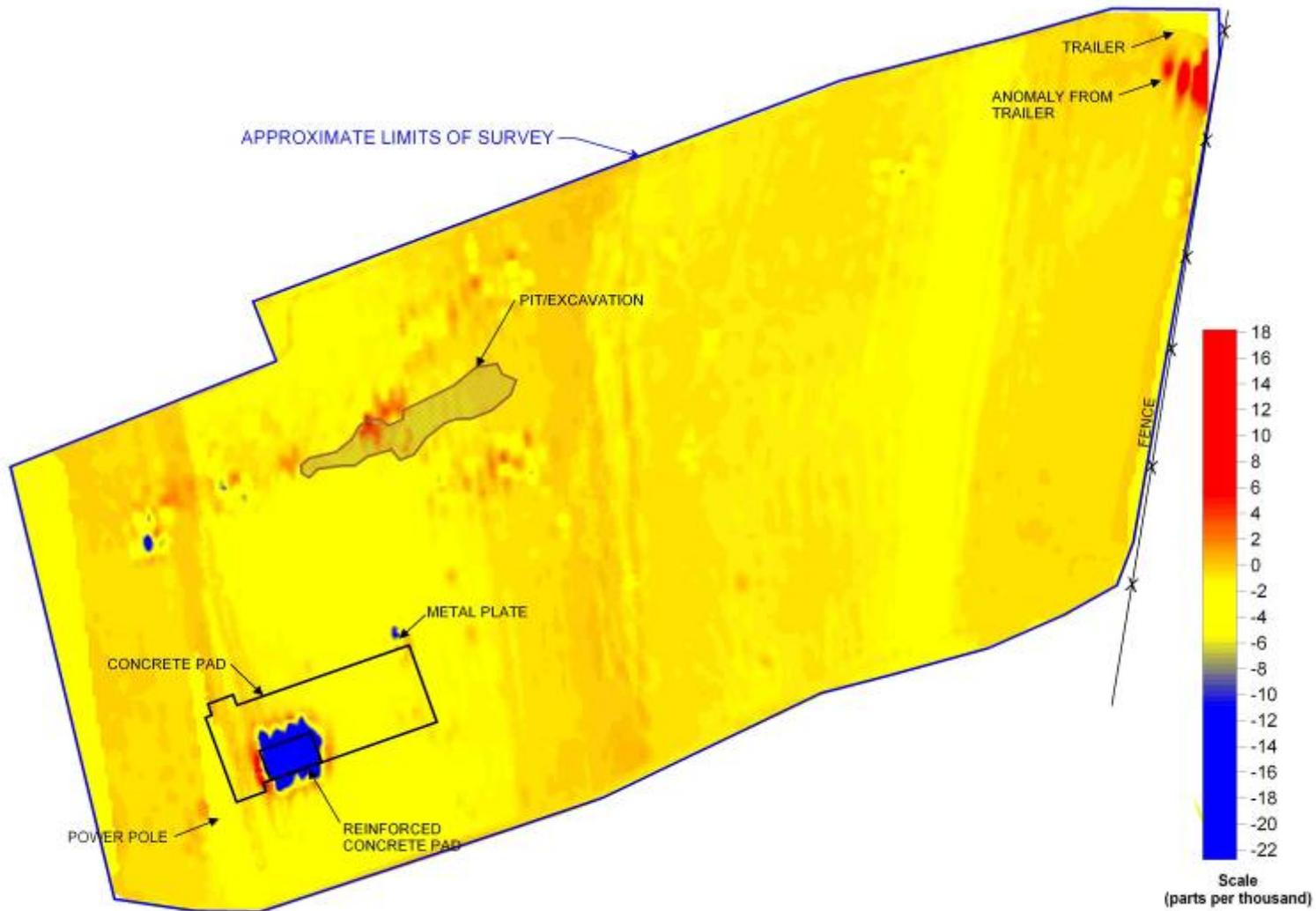
GPR Data



Illegal Drum Burial Pay Dirt



Undocumented Landfill Survey



EM31 DATA

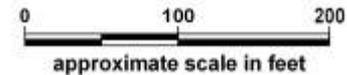


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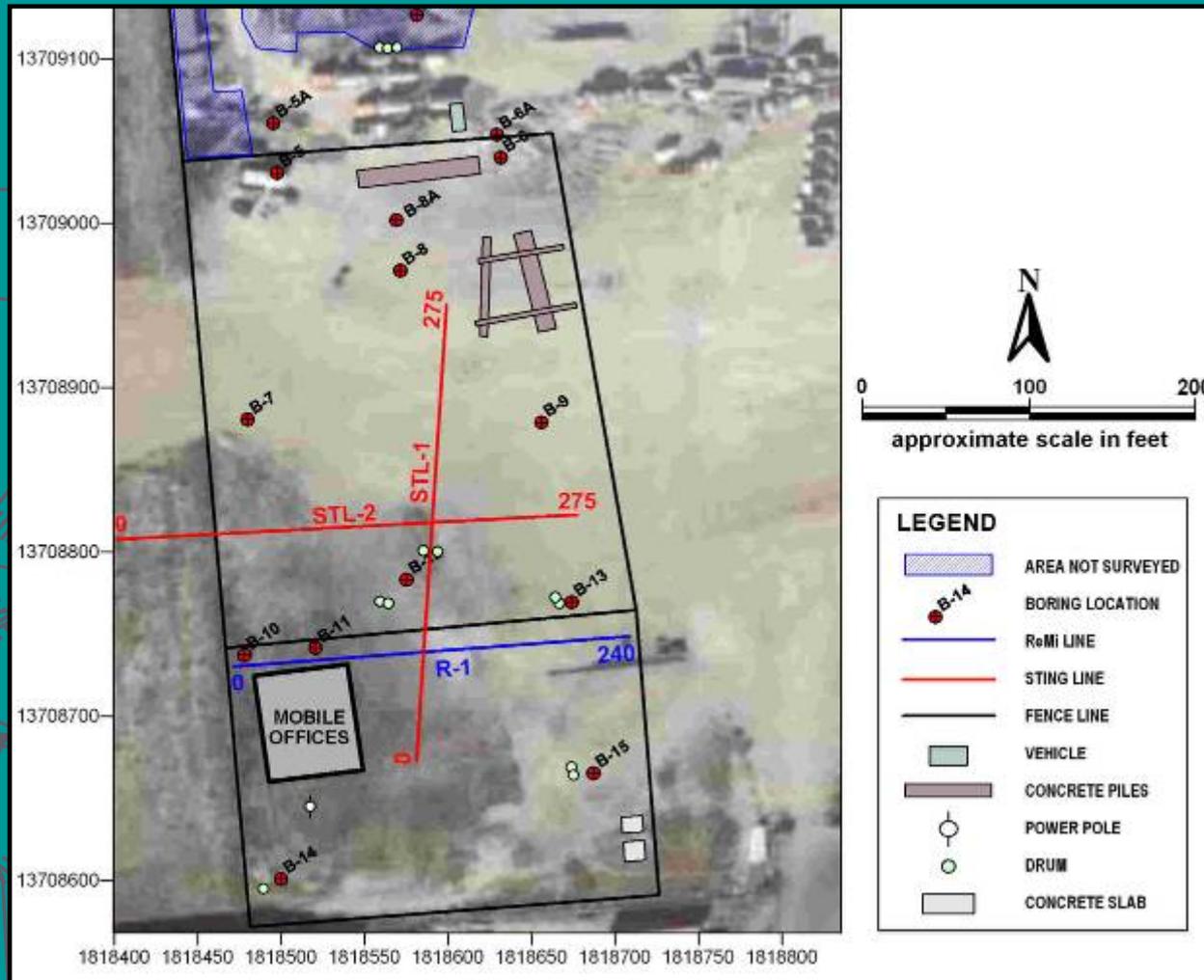
Date:



Figure 5a



Site Map



Time-Distance Plot

