Use of Radar in Pavement Evaluation and Forensics

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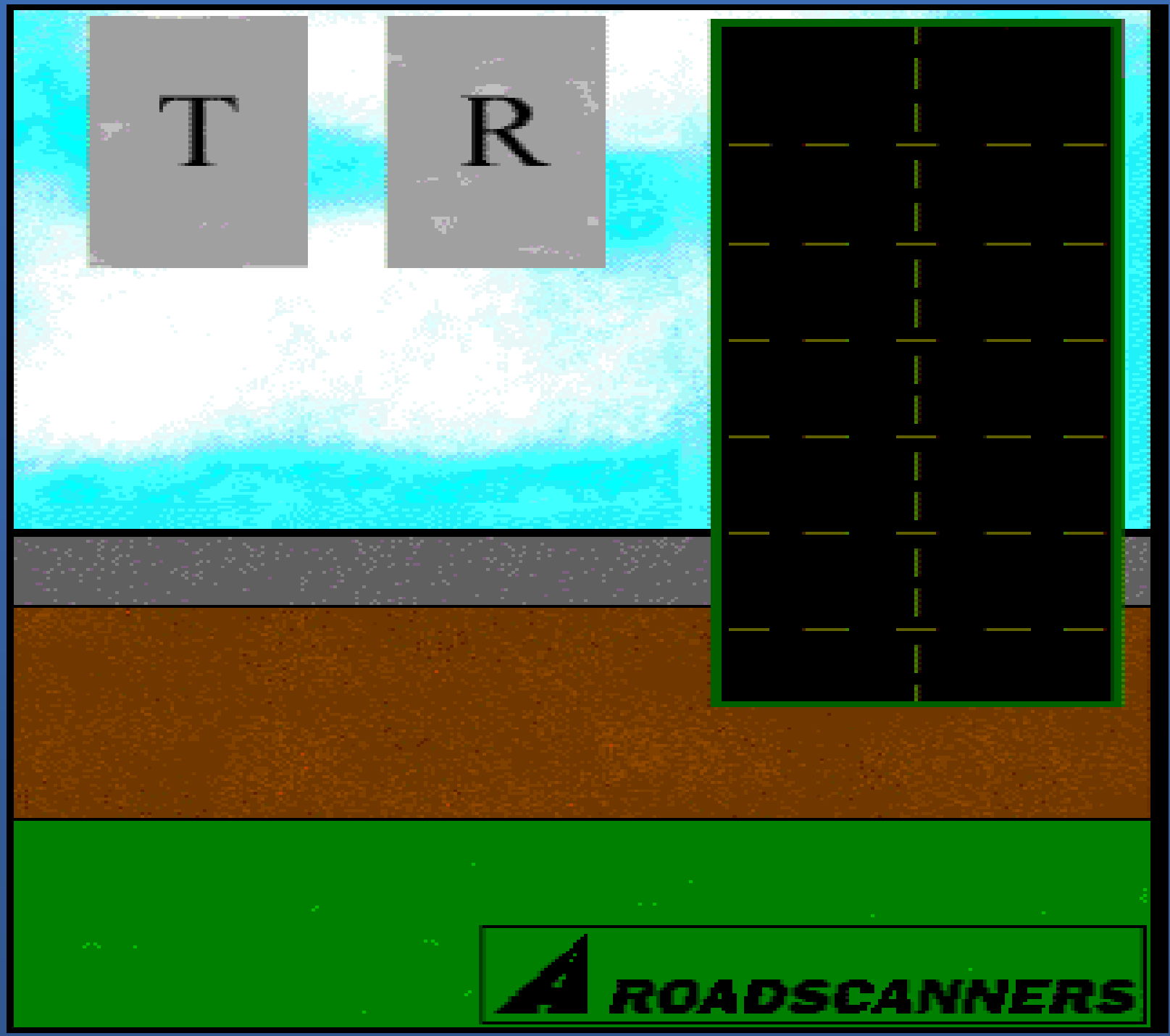
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This is the most

enjoyable

presentation of the day!

Introduction

- Ground Penetrating Radar (GPR) Development
- Applications
- Case Studies

Texas Ground Penetrating Radar (GPR) Development

Radar Systems Development

- Research Project 930
  - 1991, SHRP site layer thickness determination
- Research Project 1923
  - 1992, Influence of surface on layer thickness
- Research Project 1233
  - 1992 (Rev 1994), “Implementation of the Texas Ground Penetrating Radar”

TxDOT's GPR Development Effort

- 87 - 88 GPR first demonstrated to TxDOT
- 89 - 90 Evaluation + Specification Development
- 90 - 99 Software Development- Research system purchased - numerous research studies
- 95 – 96 TxDOT purchases first system
- 96 – 04 Training schools
- 96 - 04 Pavement design, Forensic Investigations
- 00 – 02 Buy additional units
- 02 – 04 Integrating GPR and FWD
- 00 – 04 Quality Control Studies
- 02 – XX Fighting with Feds

This was the most enjoyable presentation of the day!

Radar Systems Development

- Texas Ground Penetrating Radar (GPR)
  - TTI, Texas A&M (1 unit)
  - TxDOT, Construction Division (4 units)
- Ground Coupled radar systems
  - GSSI

GPR Characteristics

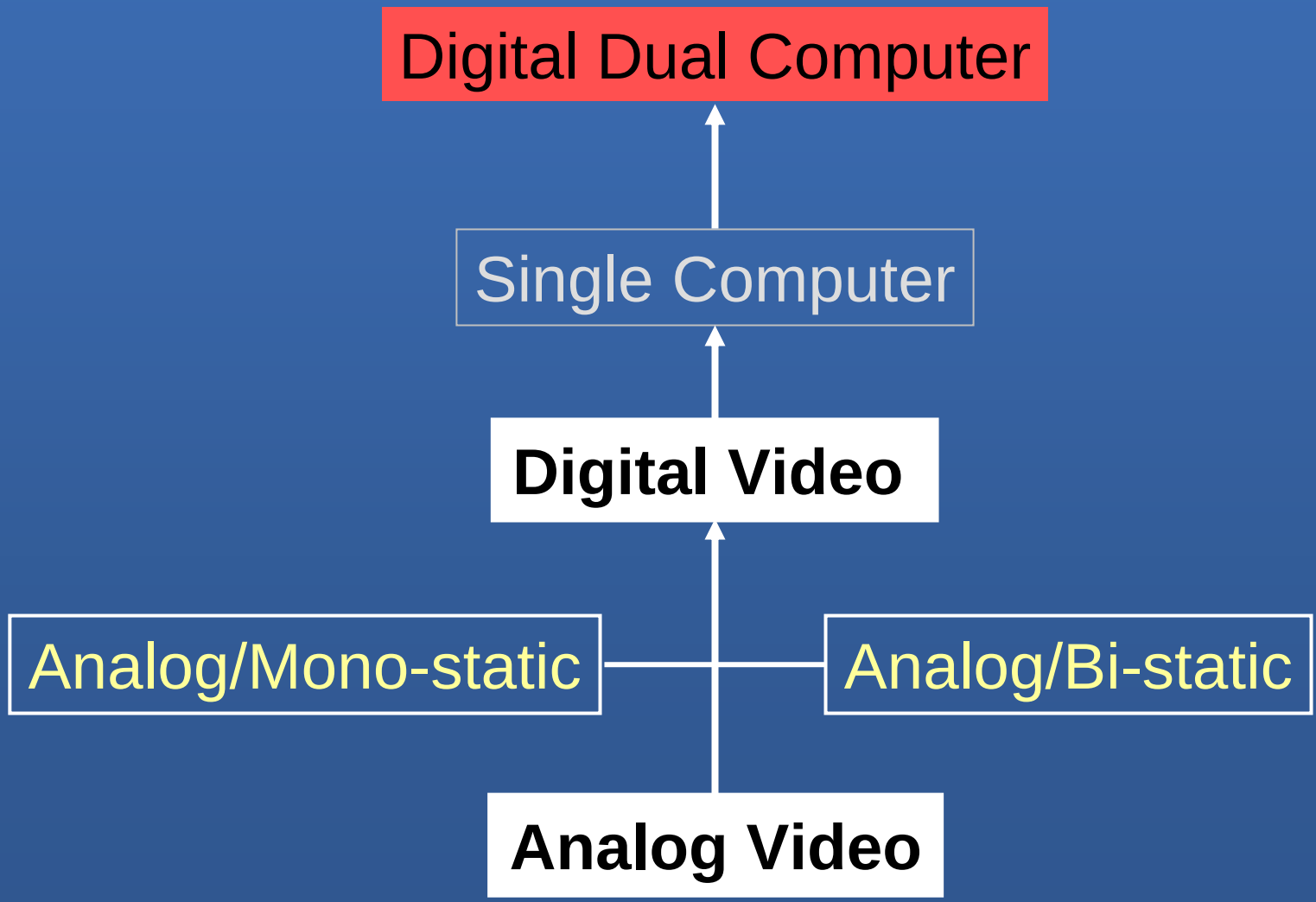
GPR Characteristics

- Air Coupled
  - Up to highway speeds (65 mph)
  - Long distances
  - Readily analyzed
  - Low traffic exposure
- Ground Coupled
  - Creep speed
  - Specific area investigations
  - Needs more intensive analysis

GPR Characteristics

- Air Coupled
  - 24” depth
- Ground Coupled
  - 1GHz -- 24”
  - 500 MHz -- 15 ft
  - 200 MHz -- 30 ft
  - 100 MHz -- 100 ft

Air Coupled Systems Development

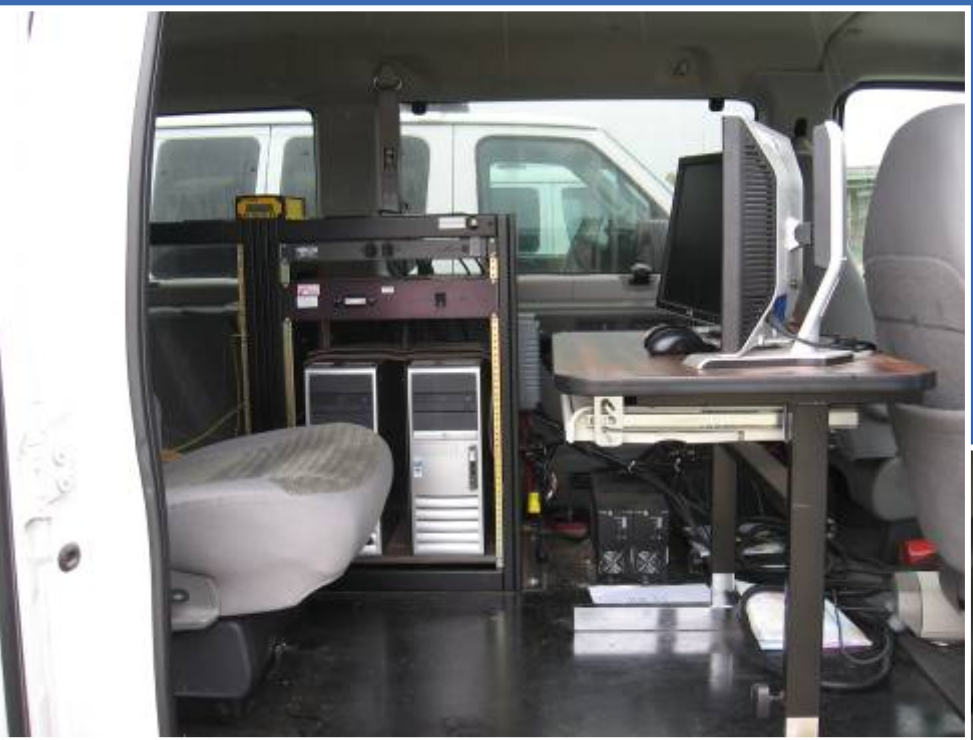


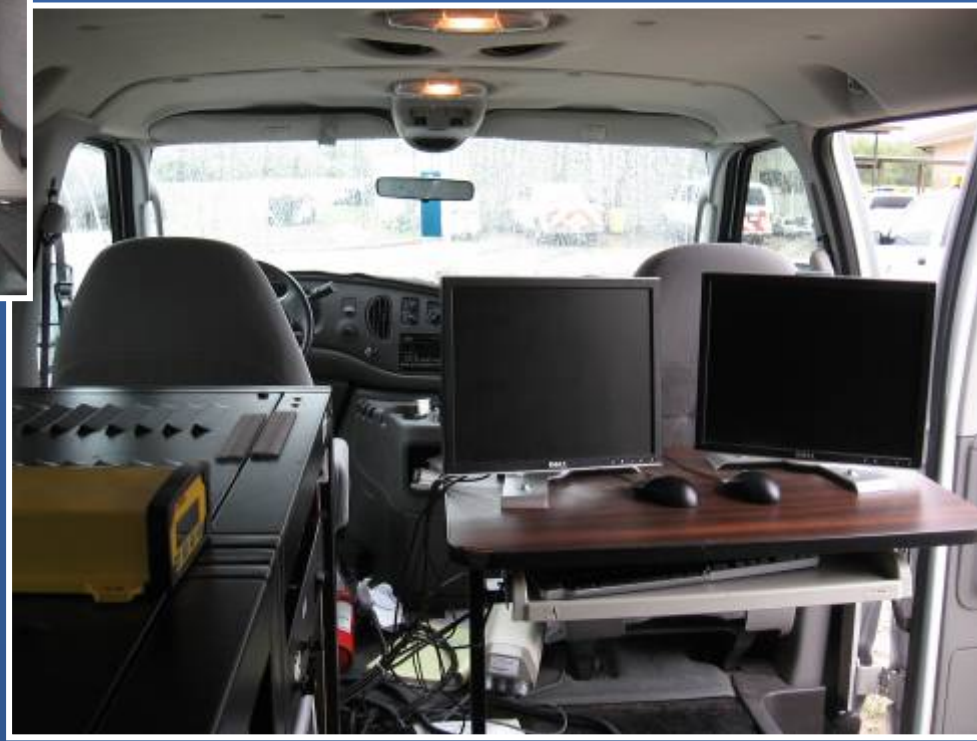
Digital Dual Computer System

- GPR Collection System
  - Controller
  - Antenna
- Video Collection System
  - Computer
  - Camera
- Ancillary
  - Distance Measurement
  - GPS

Air Coupled GPR System

Digital Dual Computer System



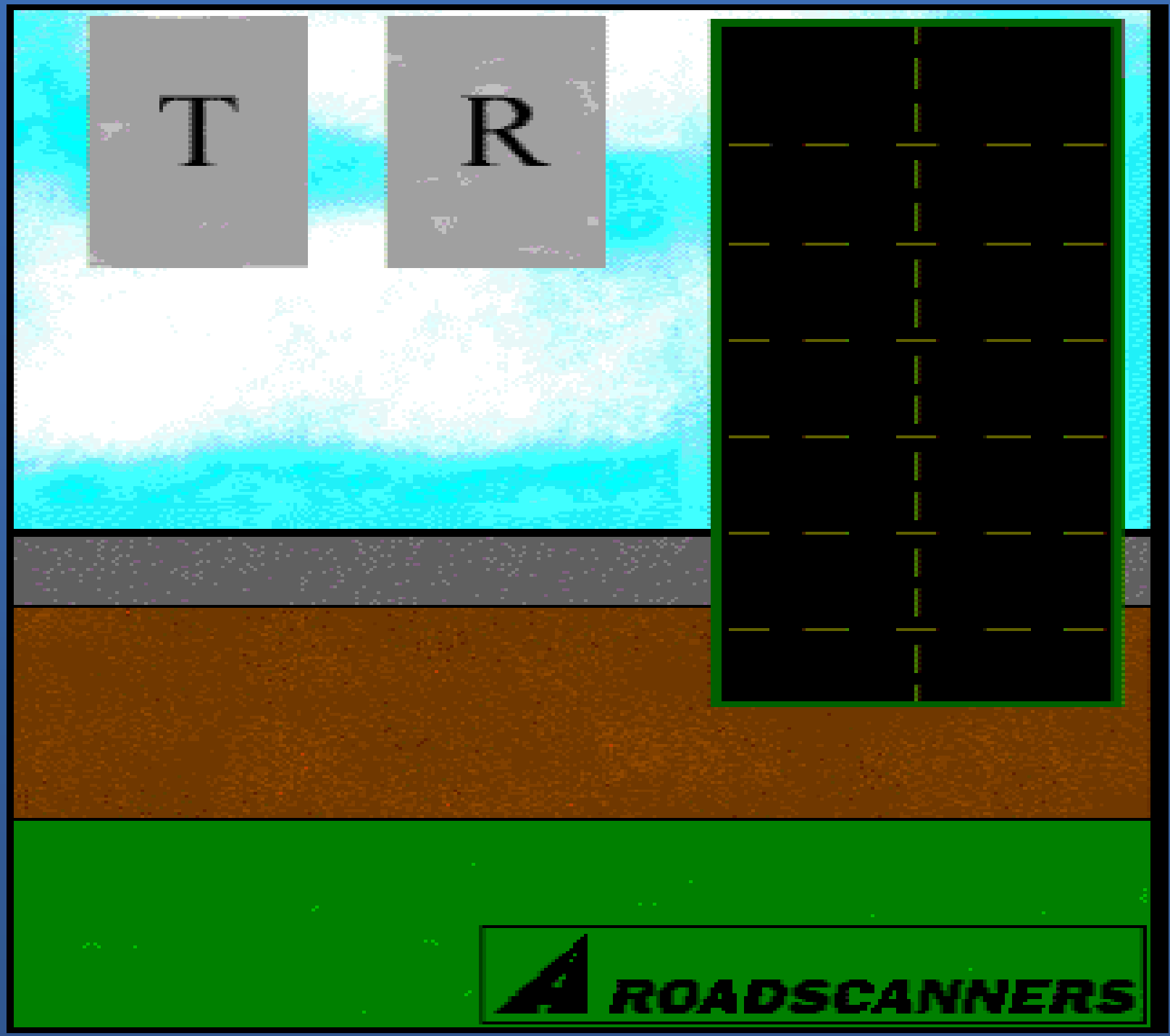


Ground Coupled GPR System

This was the most enjoyable presentation of the day!

USE IT

- GPR Signal
- GPR Representation
- Applications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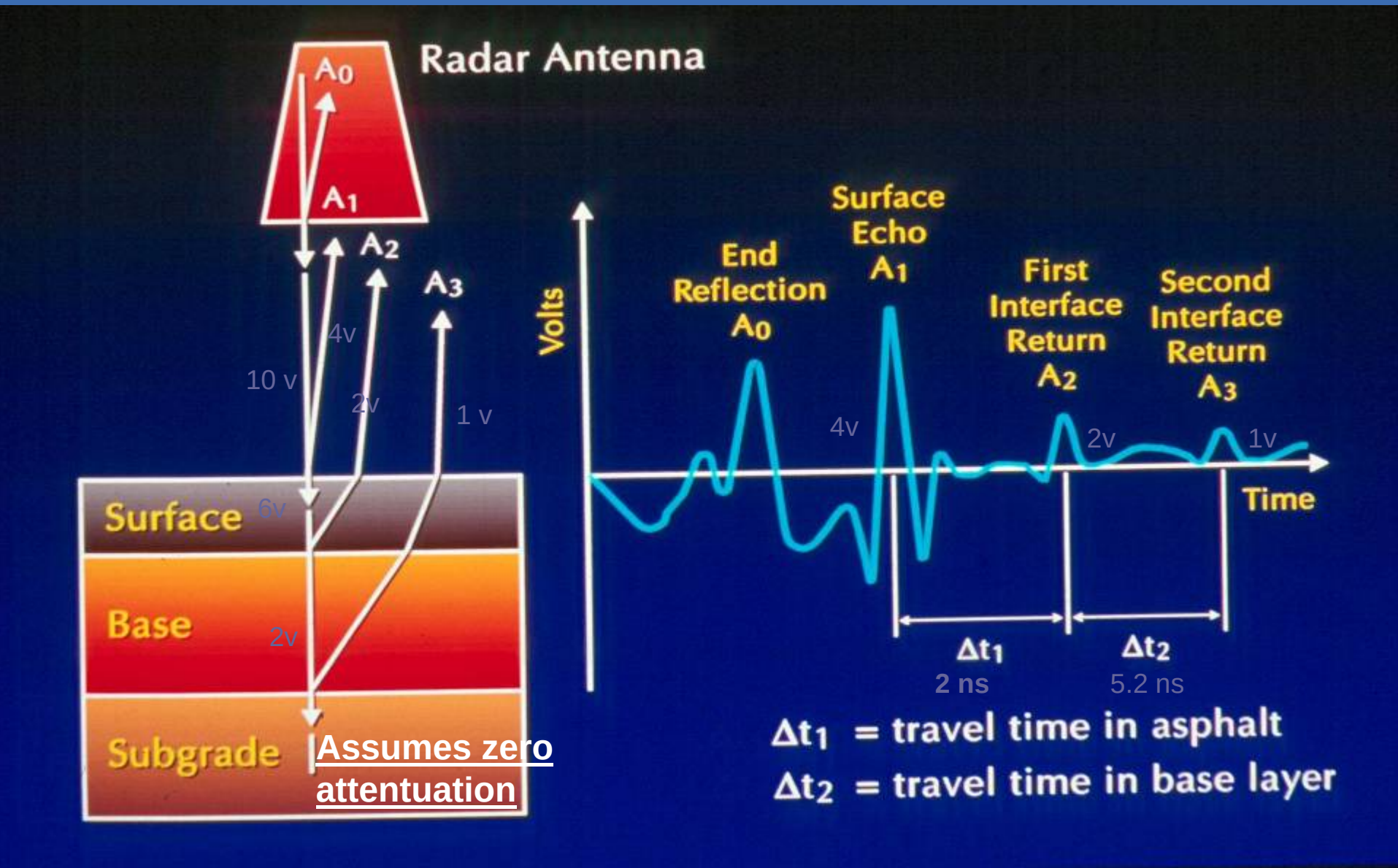
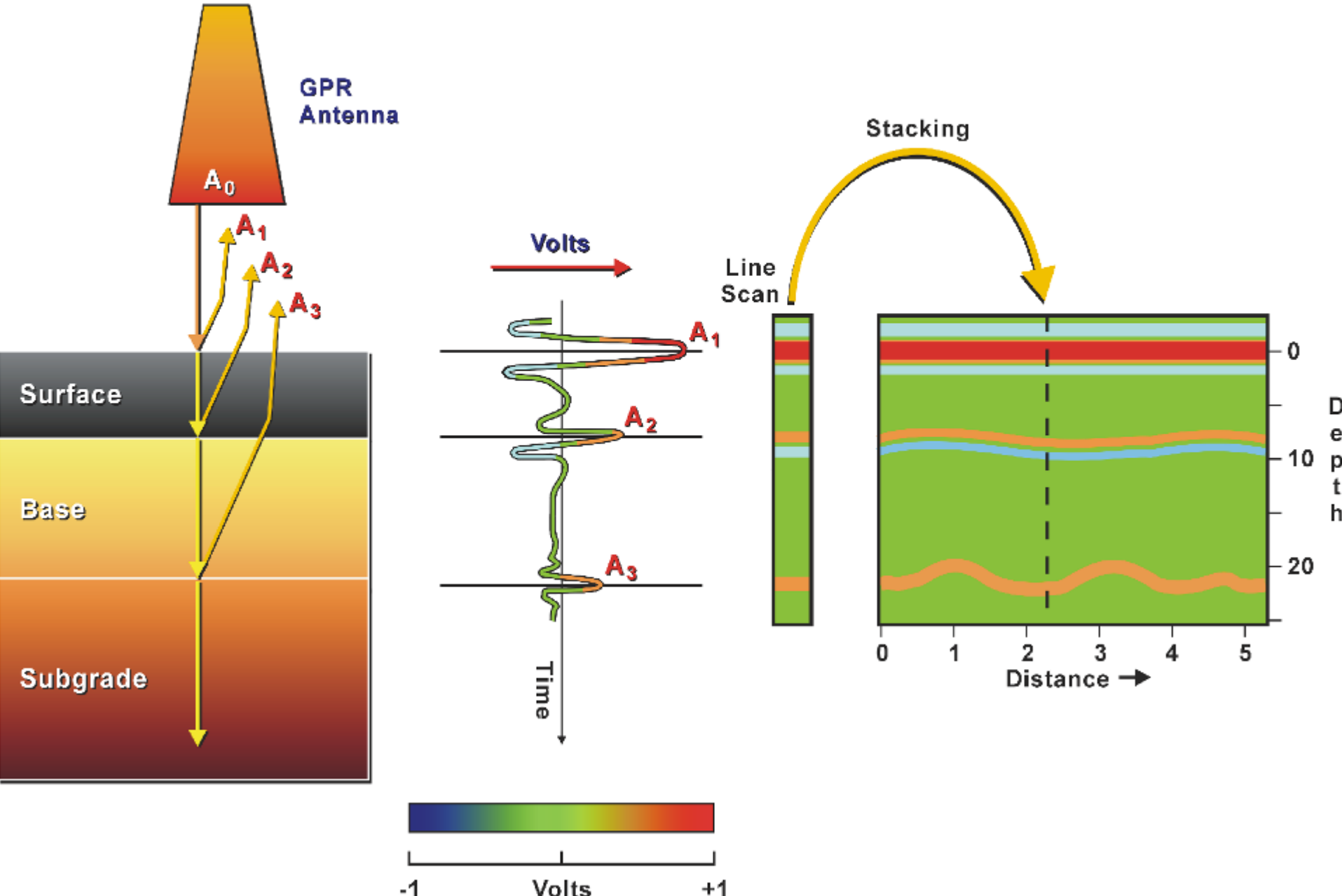
Inside the Bi-static antenna

- Two Tapered horns
- Pulse Generator (transmit antenna)
- Sampler (receive antenna)

Basics of GPR



Principles of Ground Penetrating Radar



Dielectric Measurements

- Air
- Water

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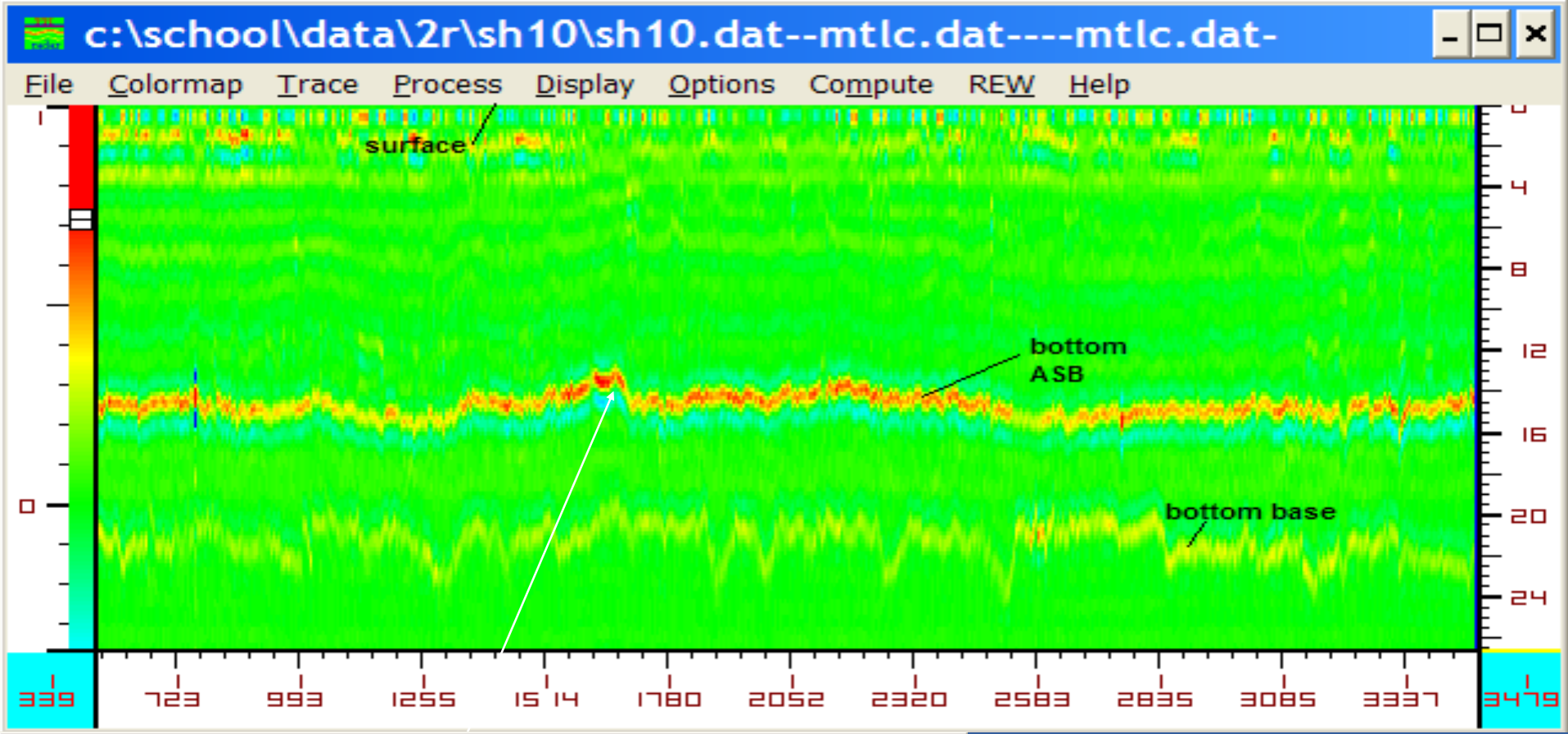
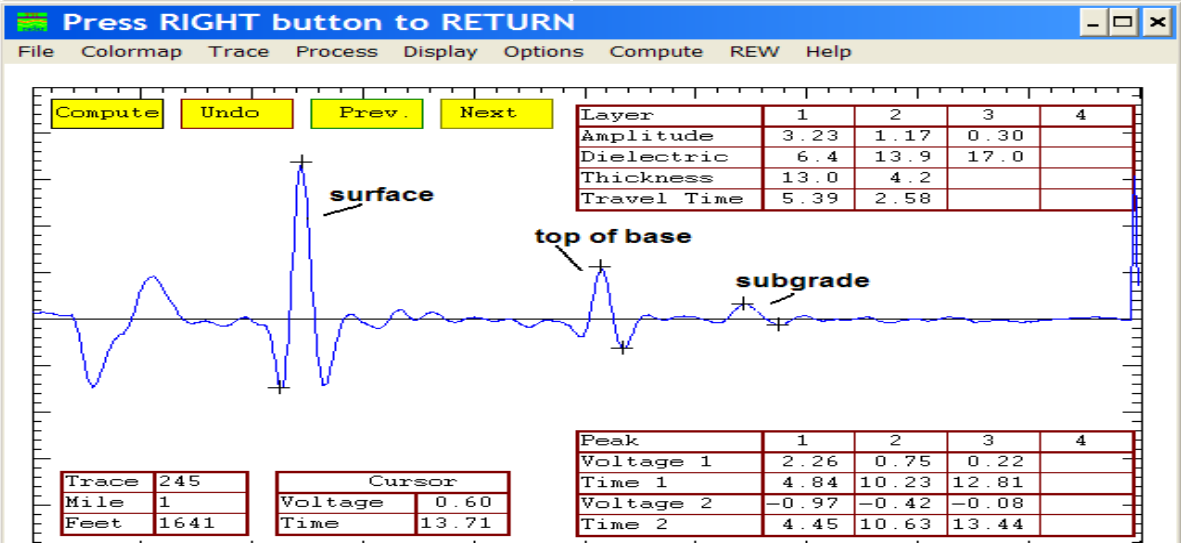




COLORMAP

GPR data from a thick Hot Mix section with no defects

So,

What can it do?

Successful GPR Applications

- Thickness of Pavement Layers
- Changes in structure
- Defects in Base (Wet areas)
- Defects in Hot Mix layers (stripping, trapped moisture)
- Segregation and poor joint density
- Deteriorated bridge deck overlays
- Base wash-outs
- Water filled voids under PCC

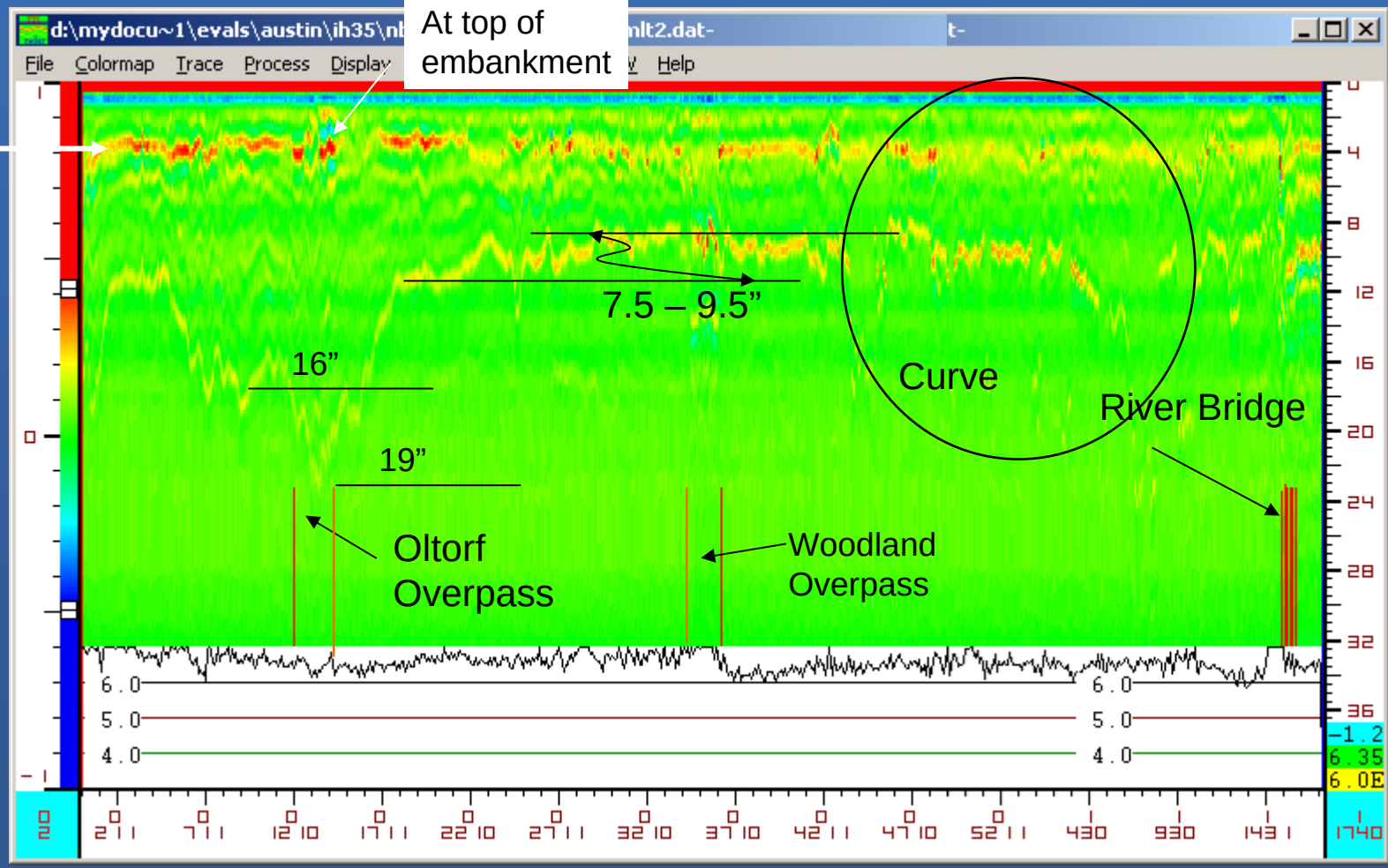
Exotic GPR Applications

- Location of sink holes
- Abandoned tanks
- Buried Rt 66 Signs
- Overlayed manhole covers
- Retaining wall integrity
- Utility pipe bursts
- Grave sites

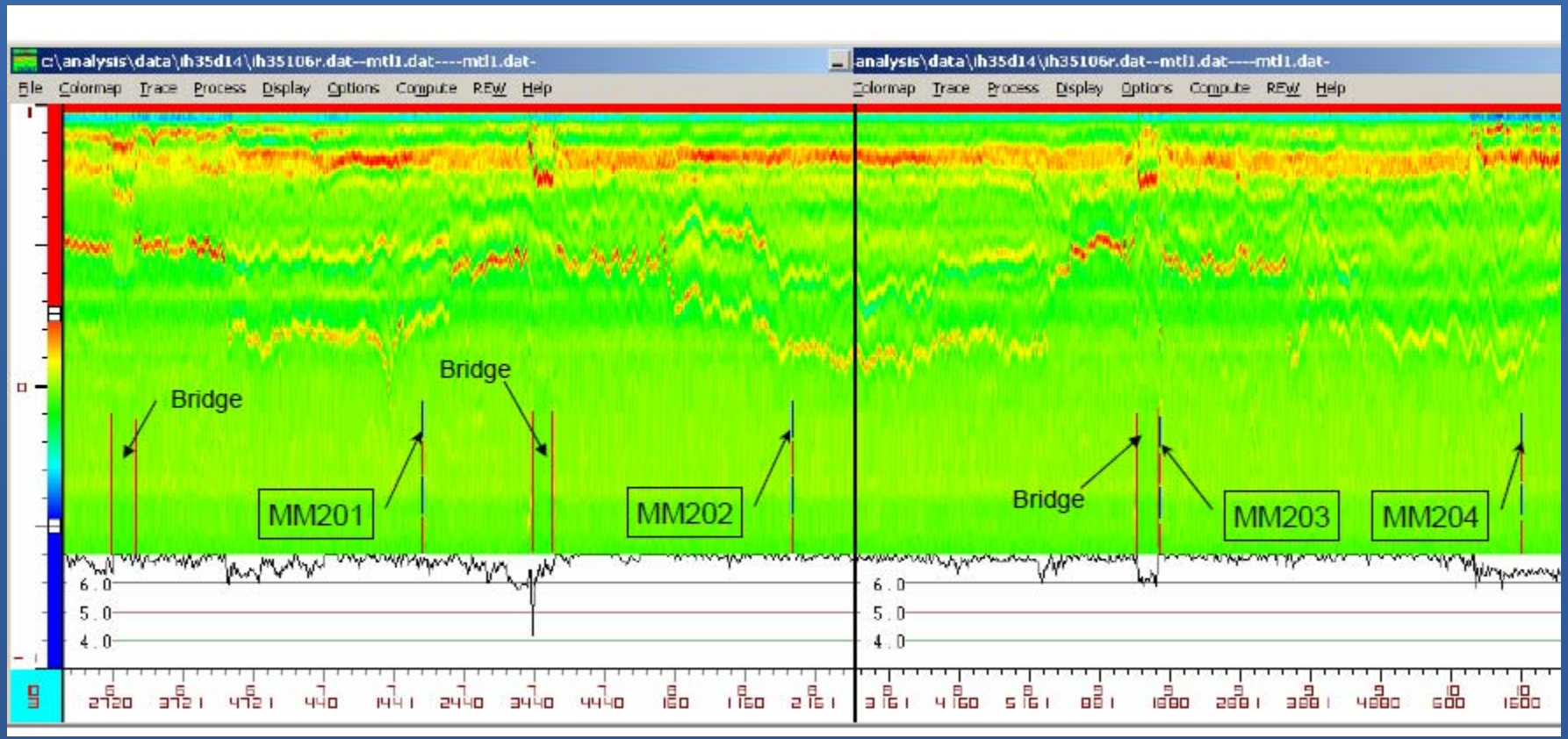
Thickness Determinations

Outside Lane

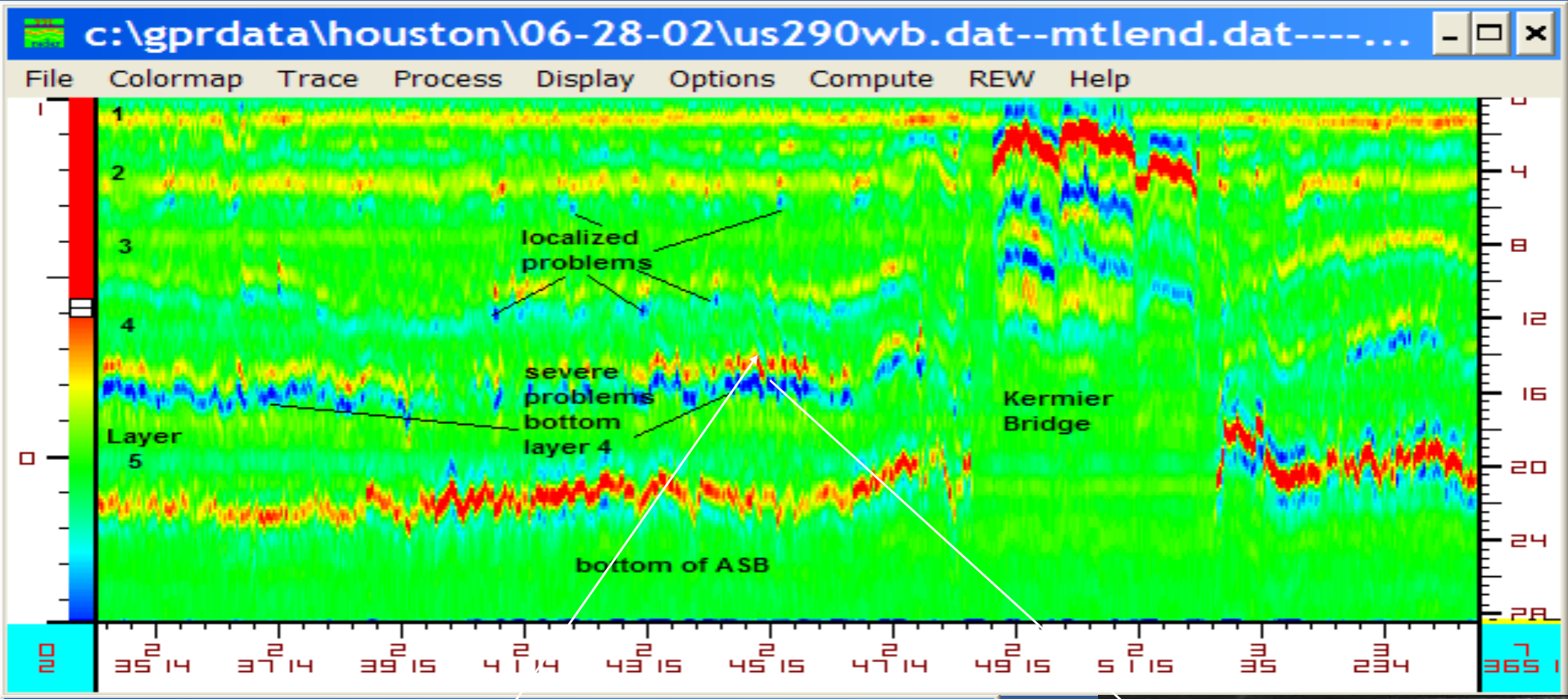
Approx 4in

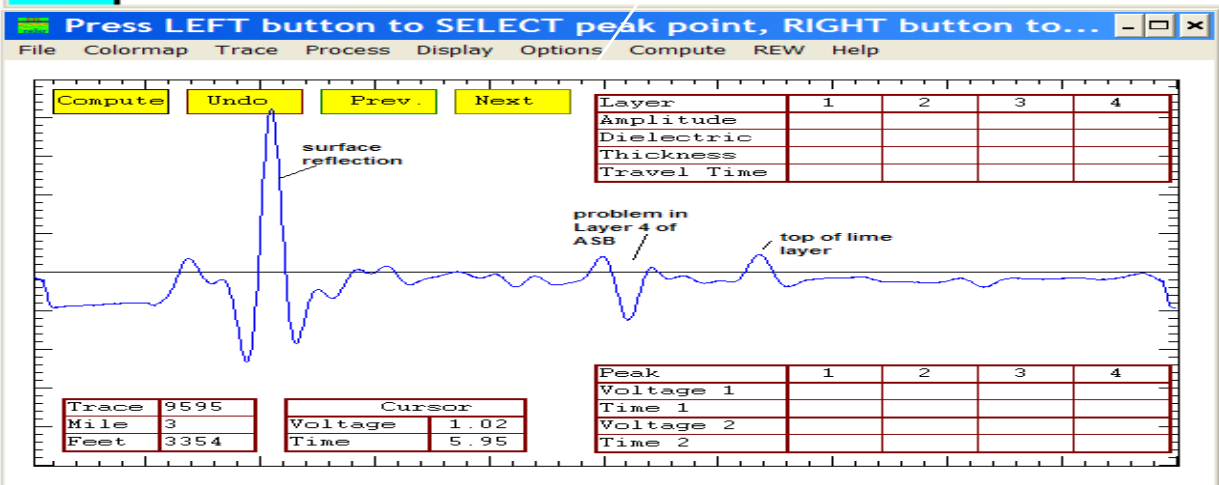


Section Breaks



GPR data from thick HMA section with subsurface damage

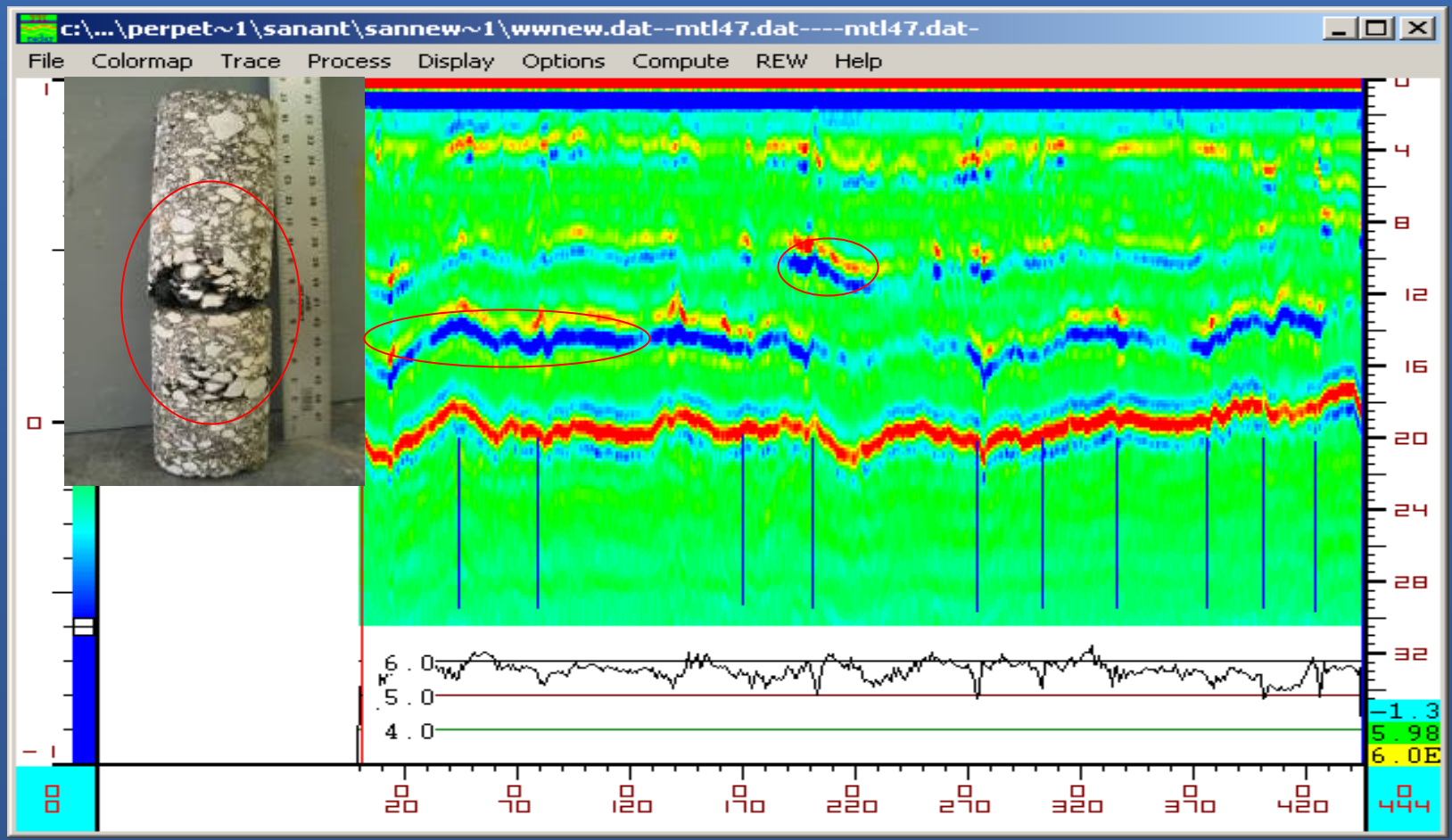




Low density & debonding

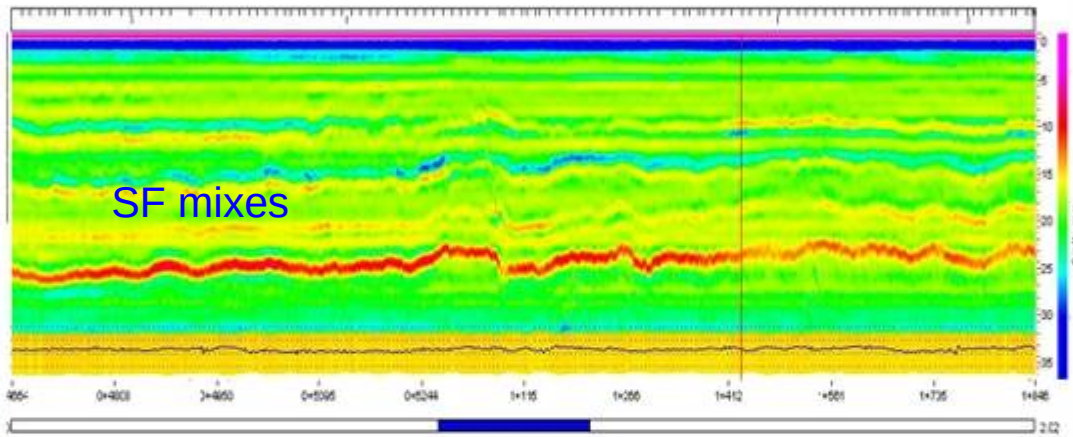
Voided areas, vertical segregation, & debonding

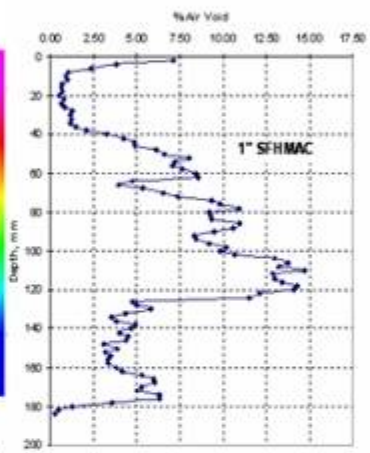
IH 35 San Antonio

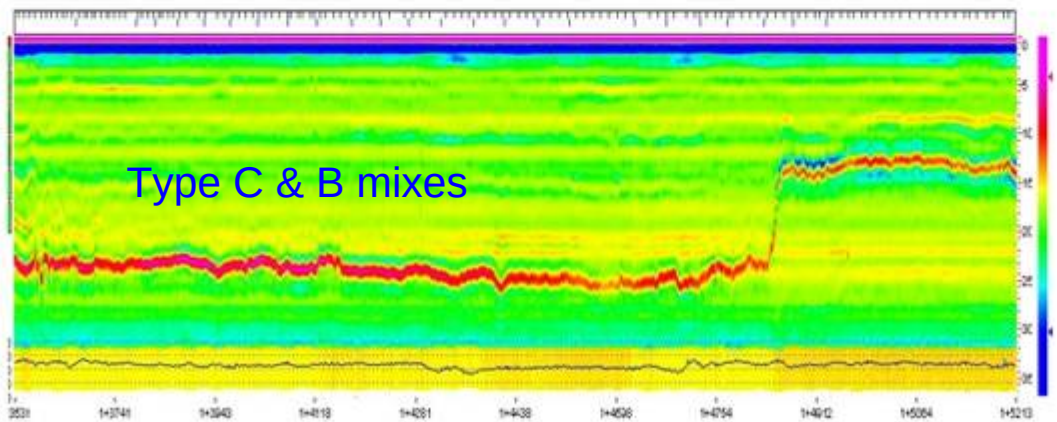


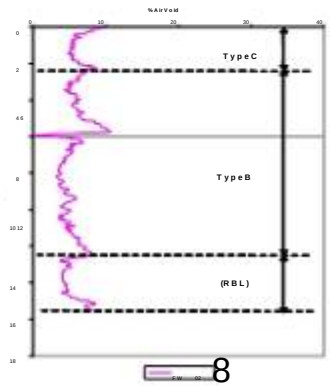
SH 114 Fort Worth..

GPR & AV comparisons

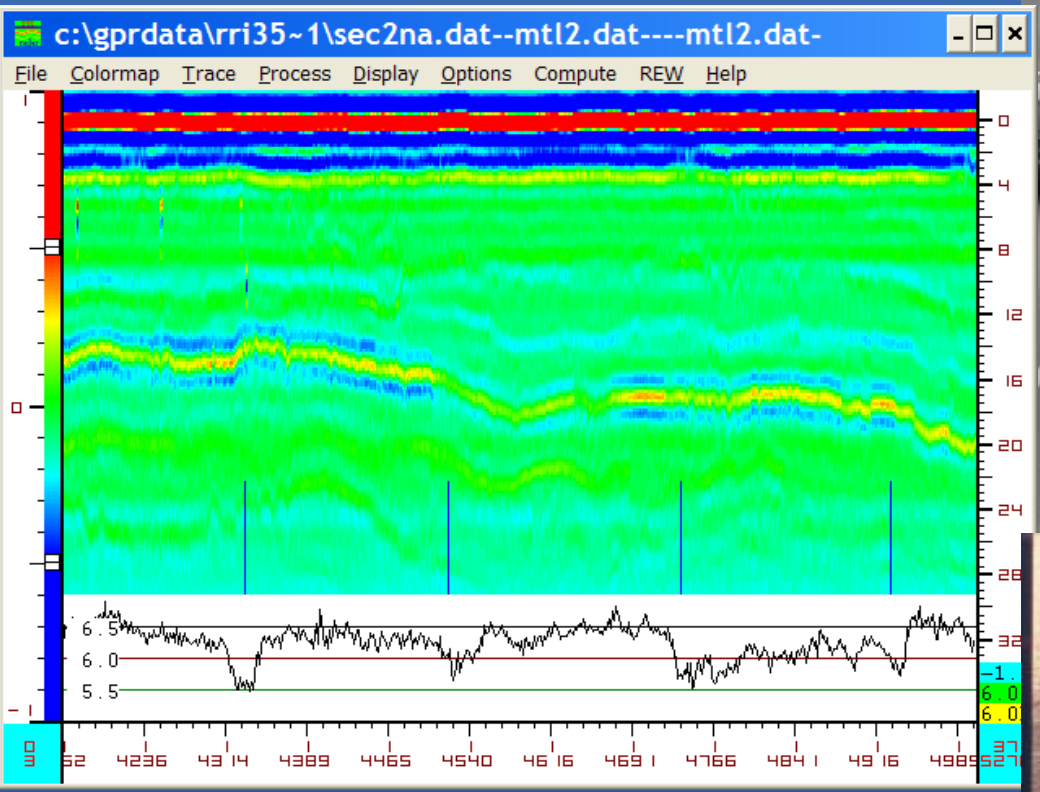


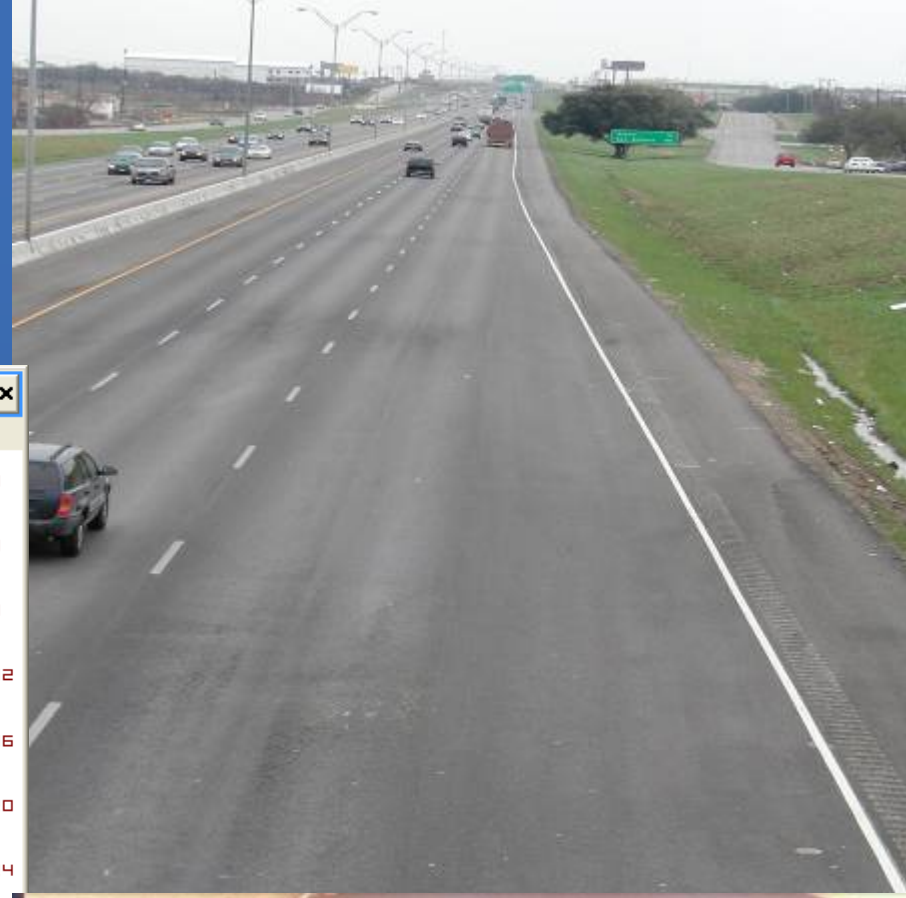






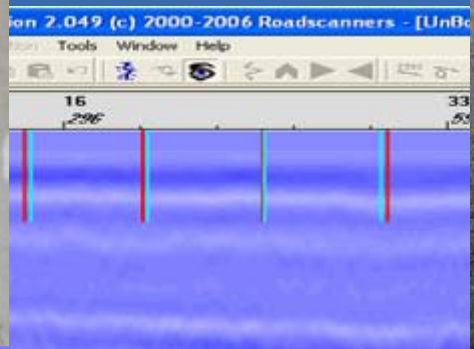
Use of GPR to detect Segregation





Water Line Rupture

TTI Radar Systems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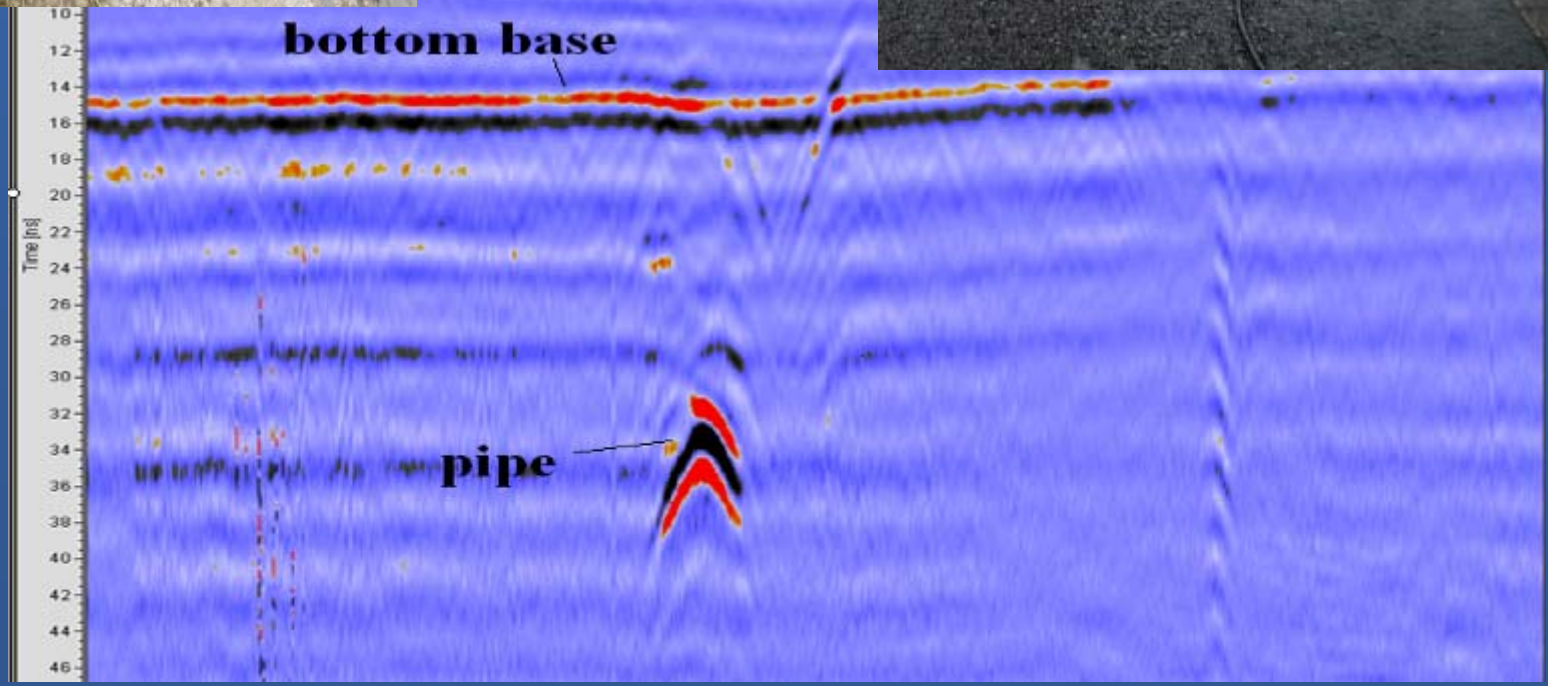
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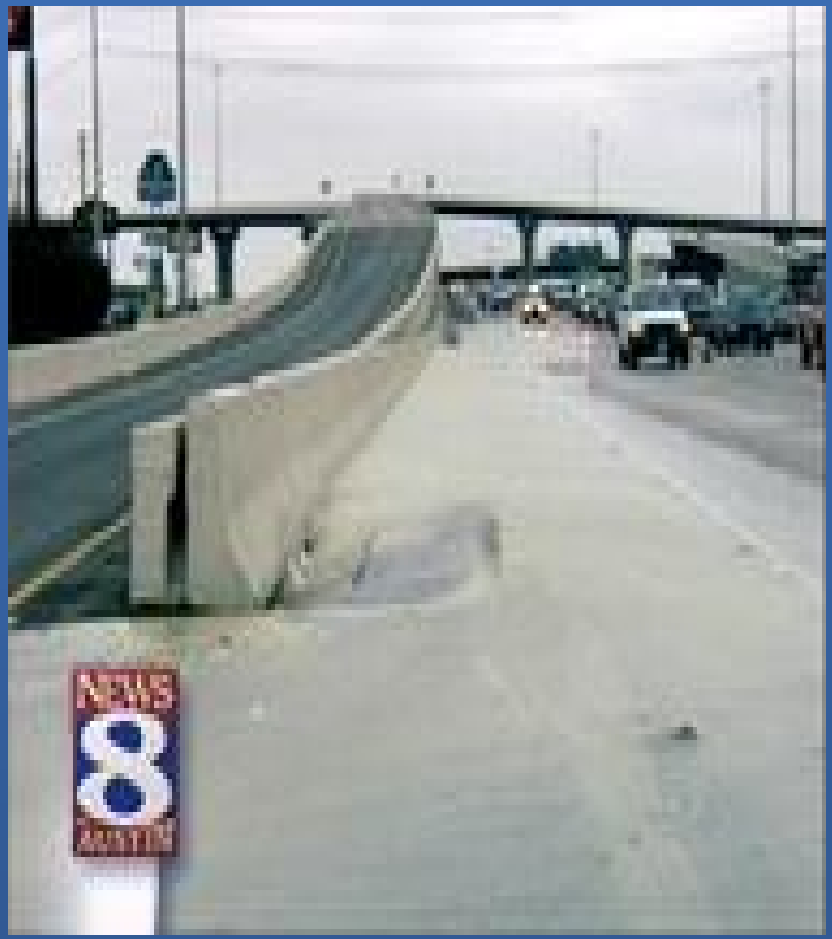
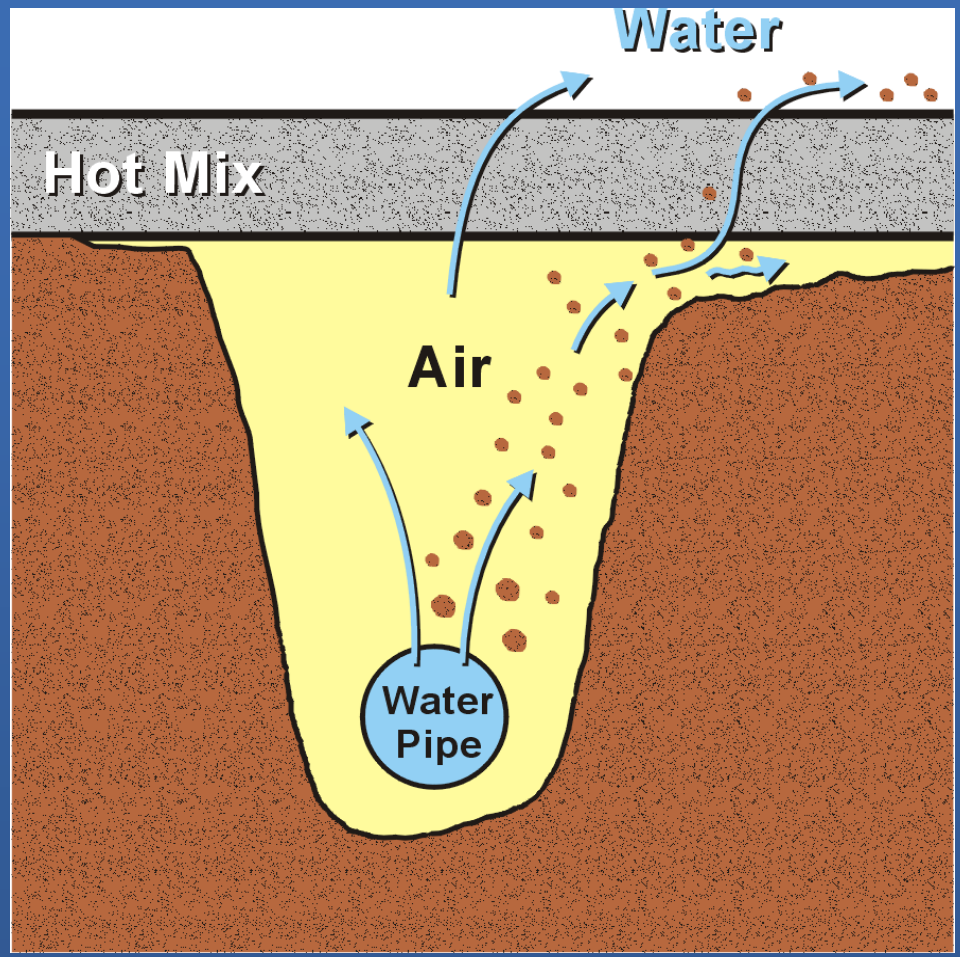
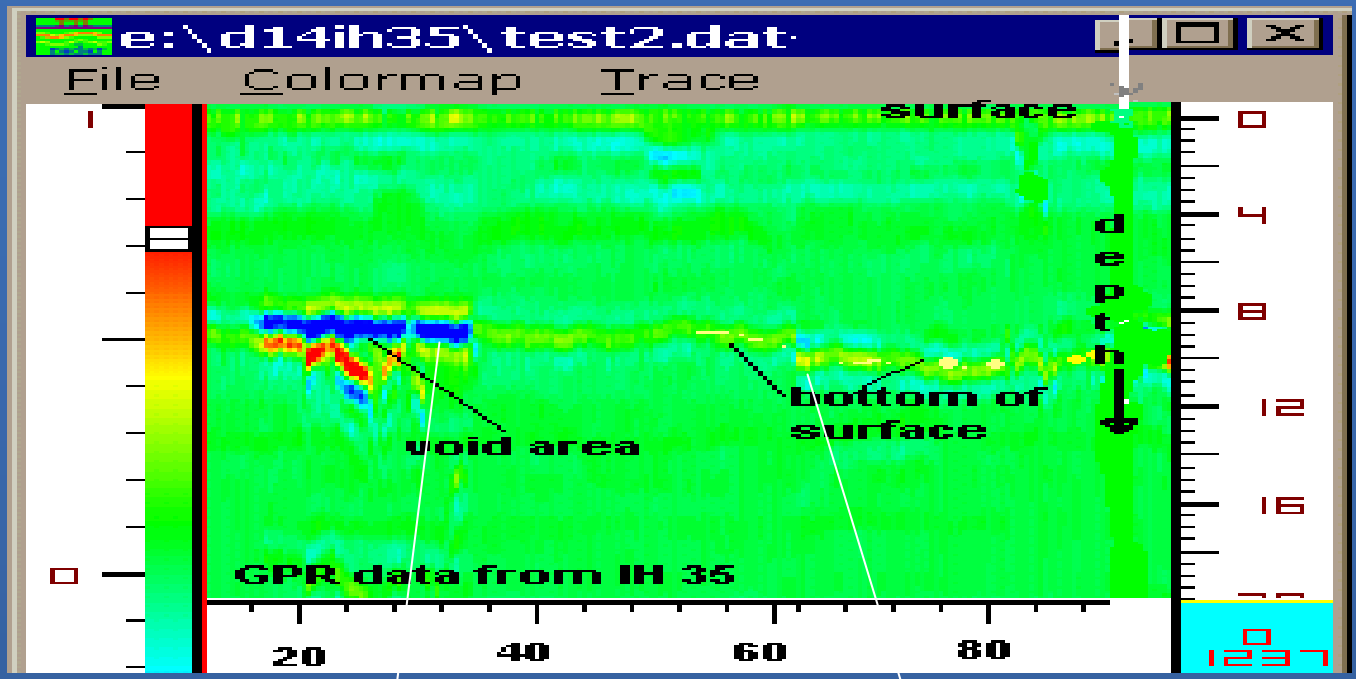
Water Line Blow Outs

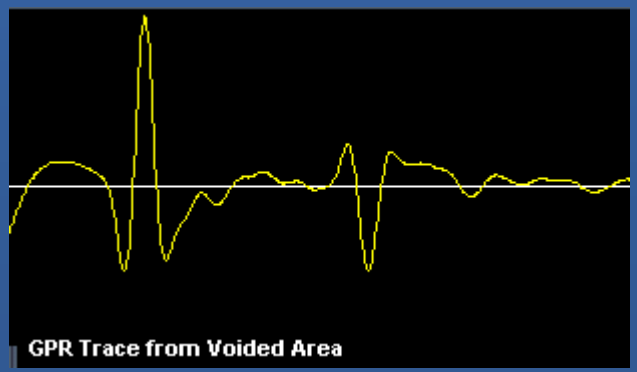


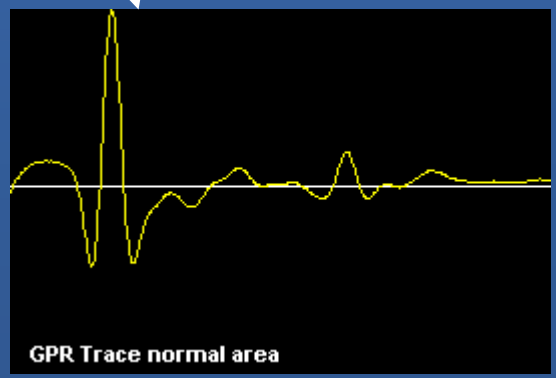
TV Video



Pipe 10 ft deep







Void location

Normal

IH 35 Austin

Easter 2002

TV Video

Overnight collapse of main lanes

VIDEO

Best of the day!