LTPP Seasonal Monitoring Program

Site Installation and Initial Data Collection
Section 281802, Laurel, Mississippi

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16. Abstract

This report contains a description of the instrumentation installation activities and initial data collection for test section 281802, which is a part of the LTPP Core Seasonal Monitoring Program. This asphalt concrete surfaced pavement test section, which is located on US-84 in the eastbound lanes, approximately 2.41 km west of the Kovington/Jones County line, was instrumented on 19-20 July 1995. The instrumentation installed included time domain reflectometry probes for moisture content, thermistor probe for temperature, tipping-bucket rain gauge, a piezometer observation well to monitor the ground water table, and an on-site data logger. Initial data collection was performed on 19-20 July 1995, which consisted of deflection measurements with a Falling Weight Deflectometer (FWD), elevation measurements, temperature measurements and TDR measurements. The report contains a description of the test site and its location, the instruments installed at the site and their locations, characteristics of the installed instruments and probes, problems encountered during installation, specific site circumstances and deviations from the standard guidelines, and a summary of the initial data collection.

17. Key Words Pavement, Highway, Instrumentation, Monitoring, Time Domain Reflectometry, Thermistor, Piezometer Observation Well, Test Equipment, Field Tests.		18. Distribution Statement	
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SEASONAL INSTRUMENTATION STUDY
INSTRUMENTATION INSTALLATION
MISSISSIPPI SECTION 281802/28SA

I. Introduction

The seasonal instrumentation installation of Section 281802 was performed on 19-20 July 1995.

The GPS-1 test section resides in Seasonal Cell 14 and is located in a wet-no freeze zone. The site (see Figure A-1) is in the eastbound lanes on US-84, approximately 2.41 km west of the Covington/Jones County line.

The average maximum daily temperature for the months of June through August is 32°C and the average minimum daily temperature for the months of December through February is 3.4°C. The average annual precipitation is 1582 mm.

The pavement is a flexible structure consisting of approximately 220 mm of asphalt concrete over 51 mm of silty sand base. The subgrade is classified as a clayey sand. The typical soil profile under the pavement is illustrated in Figure A-2. This information was obtained from bore holes drilled during the GPS material sampling and testing. The dry densities of the unbound layers are given in Table 1.

Table 1. Layer Thicknesses and Dry Densities of the Unbound Layers

Material	Layer Thickness (mm)	In Situ Dry Density (kg/m^3)
Asphalt Concrete	220	- - -
Base	51	2032
Subgrade	---	1965

The annual average daily traffic (AADT) in the GPS lane is almost 1000, of which 30.6% is truck traffic. The estimated annual ESALs on the GPS lane were 74,500. This information is based on traffic data collected on site.

Installation of the instrumentation was completed through the cooperative efforts of the Mississippi Department of Transportation (Mississippi DOT), and Southern Region Coordination Office (SRCO) staff from Brent Rauhut Engineering Inc. (BRE), with guidance and training previously provided by the Federal Highway Administration Long Term Pavement Performance office (FHWA-LTPP) and its Technical Assistance Contractor (TAC).

The following is a list of the personnel who participated in the installation:

Larry Peirce	SRCO, Brent Rauhut Engineering
Jon Peacock	SRCO, Brent Rauhut Engineering
Steve Davis	SRCO, Brent Rauhut Engineering
Robin Belt	SRCO, Brent Rauhut Engineering
Hunter Estes	SRCO, Brent Rauhut Engineering
Dan McMinn	Mississippi DOT
Gary Browning	Mississippi DOT
Reggie Jenkins	Mississippi DOT
Vernell Flemming	Mississippi DOT
Marvin Smith	Mississippi DOT

II. Instrumentation Installation

Pre-Installation Activities

A pre-installation meeting was held at the Mississippi DOT Office of Research on 18 May 1995. The meeting agenda appears in Appendix B. The participants at the meeting were personnel from the Mississippi DOT, FHWA and SRCO. At the planning meeting, roles and responsibilities for all the various tasks to be performed during installation were assigned. A slide presentation was given, highlighting the order of operations for the installations in Delta, Colorado, Grand Rapids, Minnesota and various Texas installations.

A site inspection and a manual distress survey were performed on 19 July 1995 by Larry Peirce (SRCO). Deflection testing was conducted on 20 July 1995. The 5+10 end of the test section was selected for instrumentation, based on the amount of distress present and uniformity of the deflection profile. Both the deflection plots and distress survey data can be found in Appendix A.

Equipment Installed

The equipment installed at the test site included instrumentation for measuring air and subsurface temperature, rainfall and subsurface moisture contents. An equipment cabinet was installed to house the cable leads from the instrumentation, the data logger and the battery pack. In addition, a piezometer observation well was set to measure the depth to the water table. A list of the equipment installed, with the respective serial numbers, is in Table 2.

Table 2. Equipment Installed

Equipment	Quantity	Serial [3].
Instrument Hole		
MRC Thermistor Probe	1	210 (28AT)
TDR Sensors	10	28A01-28A10
Equipment Cabinet		
CR10 Data Logger	1	16520
Battery Package	1	Gel Cell
Weather Station		
Tipping-Bucket Rain Gauge	1	12073-693
Air Temperature Probe	1	421316
Piezometer Observation Well	1	N/A

Equipment Check/Calibration

Prior to installation, all instrumentation was checked or calibrated. The CR10 Data Logger was wired according to the Guidelines and the air temperature probe and thermistor probe were connected and monitored over a period of several hours to ensure that the sensors were working. The tipping-bucket was also connected to the data logger and the calibration was checked according to the method recommended by the manufacturer. These tests indicated that the air temperature probe and thermistor probe were working properly and that the tipping-bucket measurement was within the manufacturer's specifications. The TDR probes were also calibrated using an "in-air" test and "in-water" test for accuracy, the results of which can be found in Appendix B.

In addition to the above tests, the distances between sensors in the thermistor were measured and are presented in Table 3.

Table 3. Sensor Spacing in MRC Thermistor Probe

Unit	Channel №.	Distance from Top of Unit (mm)	Remarks
1	1	Not Measured	This unit was installed in the AC layer.
	2	Not Measured	
	3	Not Measured	
2	4	23	This unit was installed in the base and subgrade.
	5	97	
	6	173	
	7	248	
	8	324	
	9	477	
	10	630	
	11	783	
	12	934	
	13	1087	
	14	1239	
	15	1393	
	16	1545	
	17	1696	
	18	1857	

Location of Instrumentation

The instrumentation was installed at Station 5+10 of the test section. Approximately 850 mm from the lane edge, in the outside wheel path, a 305 mm core was removed from the pavement and a 254 mm diameter hole, 2.09 m deep, was drilled to install the thermistor probe and TDR sensors. Cables from the instrumentation were placed in a 51 mm diameter flexible conduit and buried in a 102 mm wide trench leading to the equipment cabinet located approximately 7.90 m from the lane edge.

The piezometer observation well was installed at Station 4+00 of the test section approximately 4.04 m from the lane edge. The piezometer observation well also serves as the swell-free benchmark for this project.

Installation

Installation of the monitoring equipment was begun on 19 July 1995 and was completed the following day. The Mississippi DOT provided all coring, drilling and sawing equipment and manpower for the instrumentation activities. The monitoring equipment and cabinet installation was performed by the SRCO staff. Traffic control was also provided by the Mississippi DOT.

The first day of operations included traffic control; site layout and marking; installation of the thermistor probe, TDR probes, air temperature probe and rain gauge; and wiring of the cabinet. The installation of all equipment was performed according to the procedures outlined in the "LTPP Seasonal Monitoring Program: Instrumentation and Data Collection Guidelines."

To ensure functioning of the TDR sensors during installation, the 1502B cable tester was connected to each sensor as backfilling of the instrumentation hole was performed. If a reasonable trace was displayed, it was assumed the sensor was functioning properly. The trace was printed for each TDR and the moisture content was determined using Topp's equation. The field moisture content was also measured by drying the soil on a propane stove. The TDR moisture contents, position of the TDR sensors and field moisture contents appear in Table 4. Both the field moisture contents and the field printed traces appear in Appendix C. Table 5 shows the distance from the top of the pavement to each of the individual thermistor sensors.

In addition, a single field density (one-point Proctor) test was performed on material taken at a depth of 1.24 m. The results from this test appear in Appendix C, Figure C-2.

When backfilling of the instrumentation hole was completed, the pavement core was repaired and replaced using PC-7 Epoxy and Dow 890 crack sealant. The overcuts from the pavement sawing operation (including the groove for the temperature probe) were also sealed with Dow-Corning 890 crack sealant.

Upon completion of the installation, the ONSITE program was downloaded to the onsite CR10 Data Logger and data from the air temperature probe, rain gauge and thermistor probe were collected overnight and evaluated the second day.

The second day activities included traffic control setup, evaluation of the data collected the previous night, monitoring of the TDR sensors, deflection testing and elevation surveys. The following sections describe these operations.

Table 4. Location of TDR Sensors and Measured Moisture Contents

Sensor №.	Sensor Depth (mm)	TDR Moisture Content (%, by wt)	Measured Moisture Content (%, by wt)
28A01	370	6.3	6.8
28A02	523	4.2	10.7
28A03	675	4.5	14.1
28A04	826	5.7	13.5
28A05	977	6.9	16.6
28A06	1130	7.2	12.0
28A07	1255	8.5	10.4
28A08	1435	11.1	14.2
28A09	1730	8.8	14.2
28A10	2050	15.6	19.8

Table 5. Thermistor Sensor Locations

Unit	Channel №.	Depth from Pavement Surface (mm)	Remarks
1	1	25	This unit was installed in the AC layer.
	2	110	
	3	172	
2	4	287	This unit was installed in the base and subgrade.
	5	361	
	6	437	
	7	512	
	8	588	
	9	741	
	10	899	
	11	1047	
	12	1198	
	13	1351	
	14	1503	
	15	1657	
	16	1809	
	17	1960	
	18	2121	

III. Initial Data Collection

Onsite Data Logger

The air temperature, subsurface temperatures and rainfall data were collected by the onsite CR10 Data Logger. The version of the ONSITE program used reads the thermistor probe (18 sensors) every minute. The average temperatures for the first five sensors are recorded hourly and the average temperature for every sensor is saved daily. The maximum and minimum temperature for all sensors are also saved on a daily basis.

The air temperature is read every minute by the ONSITE program and the average temperature is saved both daily and hourly. The maximum and minimum temperatures are saved daily. The precipitation is recorded on both an hourly and daily basis.

Figure D-1 shows the average hourly ambient air temperatures which were collected the night of 19 July 1995. Figure D-2 shows hourly average subsurface temperatures for the first five sensors for the same data collection period. Figure D-3 shows the measured average subsurface temperatures for all 18 sensors during the initial data collection.

Moisture Content Measurement by TDR Sensors

TDR data were collected using the mobile data logging system provided by the FHWA. The mobile system consists of a CR10 Data Logger, battery pack and two multiplexors for TDR data collection.

To begin data collection using the mobile system the TDR cable leads and 1502B cable reader were connected to the proper channels and the MOBILE program was downloaded from the notebook computer to the CR10 Data Logger. After approximately five minutes, the cable reader was triggered by the MOBILE program and the TDR traces were displayed. The data collection process was completed in approximately five minutes and was automatically repeated four hours later. The data were then uploaded to the notebook computer. Traces displayed on the cable reader indicated that the sensors were working properly. Figures D-4 through D-13 show the plots of the TDR traces obtained approximately 24 hours after installation. It should be noted that initial TDR readings yielded very low moisture contents, but have since stabilized.

Deflection Measurements

Deflection measurements were made according to the procedures outlined in the "LTPP Seasonal Monitoring Program: Instrumentation Installation and Data Collection Guidelines." At this time no analysis has been performed on this data.

Elevation Surveys

The elevation of the benchmark was assumed to be 0.000 meters and surface elevations were measured following the guidelines. These elevations were measured using a Spectra-Physics Laser Plane 350 level and Lenker rod, and were converted to the SI system using soft conversion factors. The elevations are contained in Appendix D.

IV. Summary

The instrumentation installation on Section 281802 (28SA) was completed on 20 July 1995 and initial data collection was completed on 20 July 1995. Instrumentation and equipment currently at the site includes time domain reflectometry probes for moisture content measurements; a thermistor probe for monitoring temperature gradient changes in the pavement, base and subgrade layers; a tipping-bucket rain gauge; an air temperature probe; a piezometer observation well to monitor ground water table movements and serve as a permanent swell and frost-free benchmark; and an on-site data logger and battery pack. Photos from the installation day appear in Appendix E.

At the time of this report, all of the equipment installed on-site appears to be functioning properly. The installation of the instrumentation at this site went fairly smoothly and all of the equipment appears to be functioning properly.

APPENDIX A

Test Section Background Information

Appendix A contains the following information:

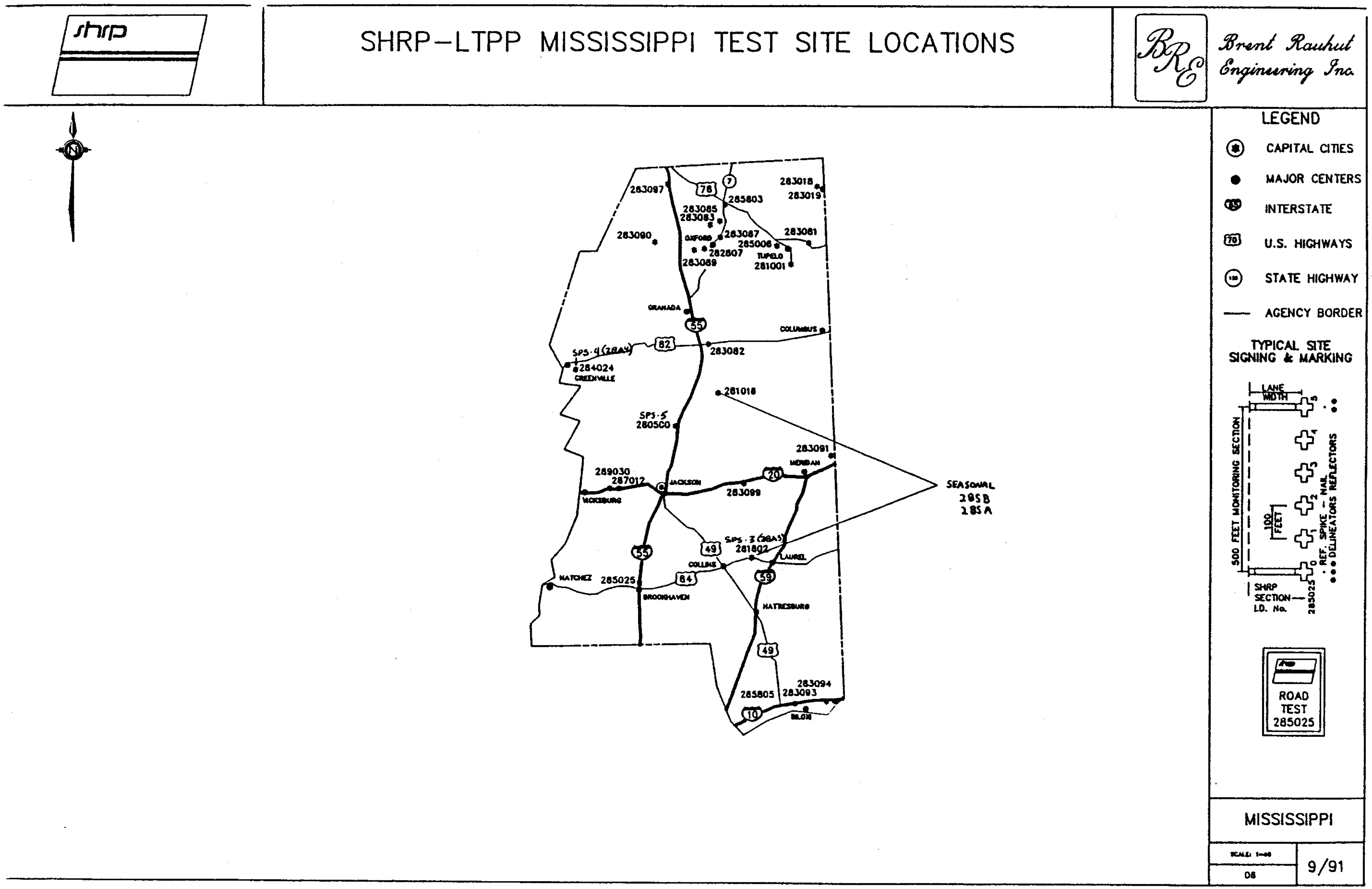


Figure A-1. Location of Test Site, GPS Test Section 281802

LTPP Seasonal Monitoring Program Data Sheet SMP-I04 Log of Instrumentation Hole	Agency Code 28SA [28] LTPP Section ID [1802]

Operator: DAN McMINN Equipment Used: Telephone auger ALTEC

Location: Station: 5+10 Offset: +0.85 m (from lane edge)

Bore Hole Diameter: 254. mm

Scale (m)	Strata Change[1] (m)	Material Description	Material Code[2]
0.10 – 0.20	0.22	AC	700
0.30 – 0.50	0.59	Red Sand	57
0.60 – 0.90	0.92	Red/Brownish Sand	57
1.00 – 1.50	1.50	Gray Sandy Clay	52
1.60 – 2.10	2.15	Gray/Tan Clay	51
2.20 – 2.50		Bottom	

[1] Format: _.___ m; [2] Format: ___

Prepared by: L. PEIRCE / S. DAVIS Employer: B R E

Date (dd/mm/yy): 20/07/95

Data Sheet SMP-I04: Log of Instrumentation Hole

Figure A-2. Profile of Test Section Layers

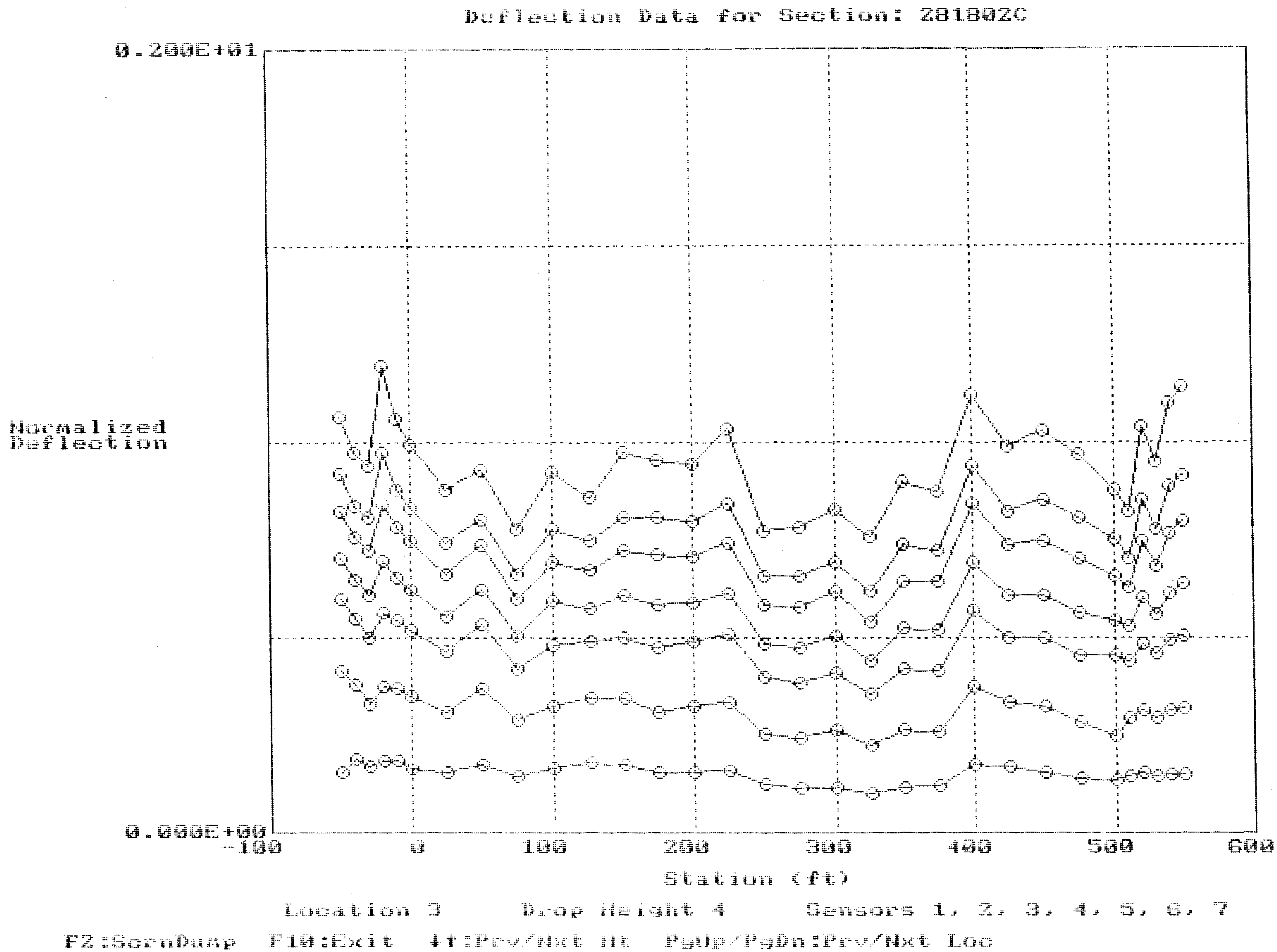


Figure A-3. Deflection Profiles from FWDCHECK

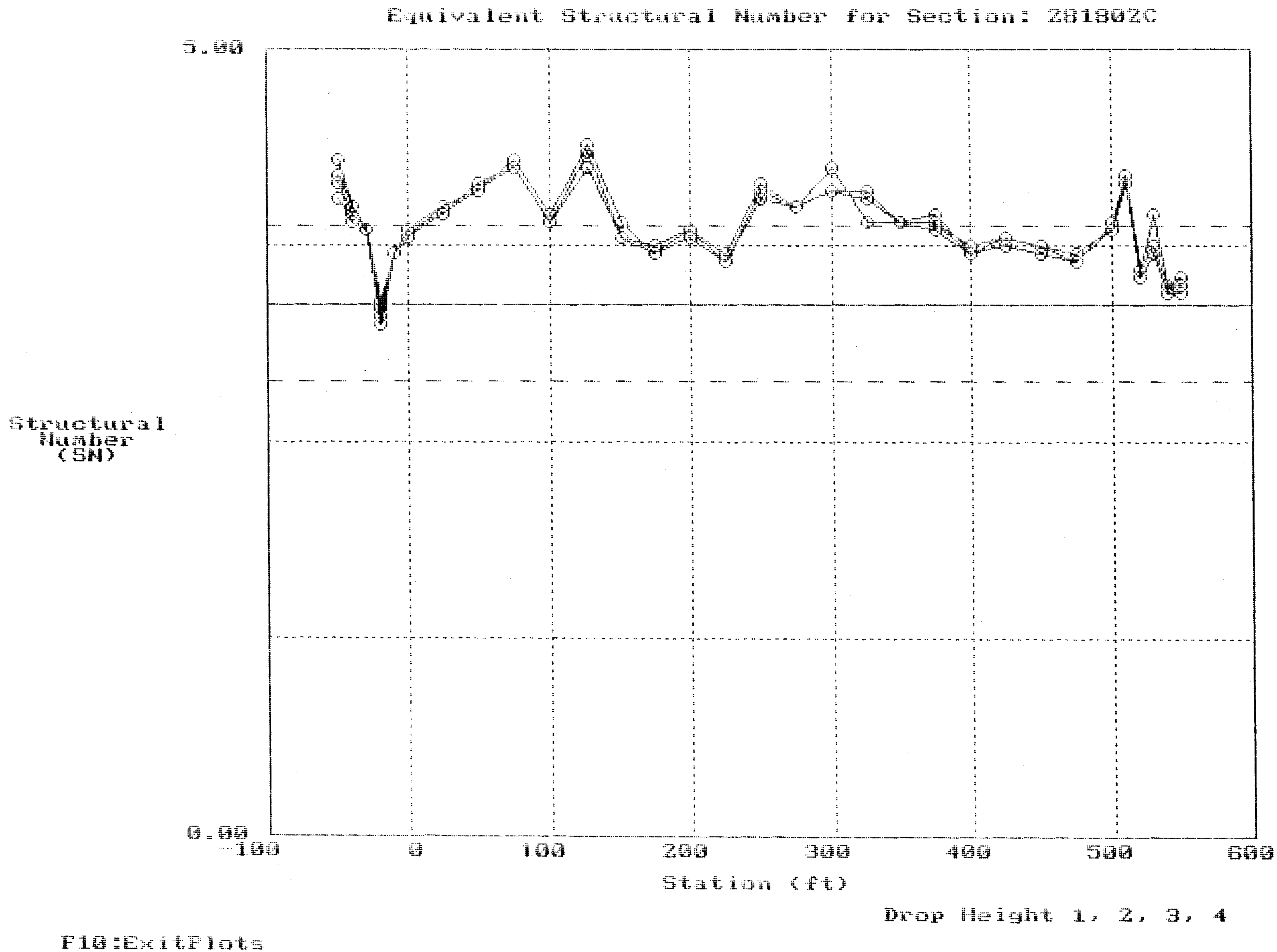


Figure A-4. Structural Number Profiles from FWDCHECK

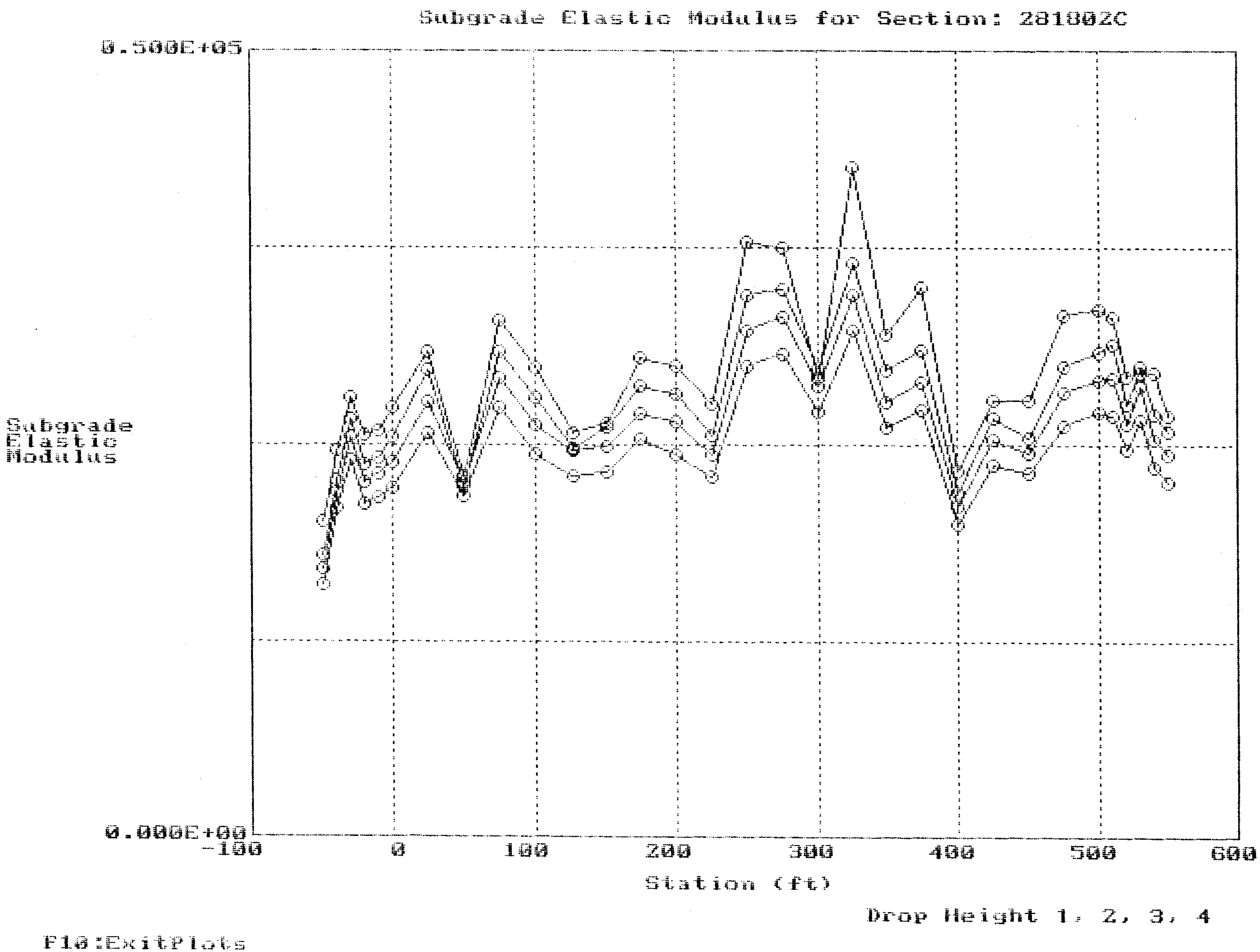


Figure A-5. Subgrade Modulus Profiles from FWDCHECK

RECEIVED SEP - 6 1995

Revised December 1, 1992

SHEET 1

DISTRESS SURVEY

LTPP PROGRAM

STATE ASSIGNED ID _ _ _ _

STATE CODE 28

SHRP SECTION ID 1802

DISTRESS SURVEY FOR PAVEMENTS WITH ASPHALT CONCRETE SURFACES

DATE OF DISTRESS SURVEY (MONTH/DAY/YEAR) 07/19/95

SURVEYORS: LLP, RAB PHOTOS, VIDEO, OR BOTH WITH SURVEY (P V B) XN As per LP 9/6/95

PAVEMENT SURFACE TEMP - BEFORE 43°C; AFTER 43°C 110°F

DISTRESS TYPE	SEVERITY LEVEL LOW	MODERATE	HIGH
CRACKING			
1. FATIGUE CRACKING (Square Meters)	34.9	0.0	0.0
2. BLOCK CRACKING (Square Meters)	0.0	0.0	0.0
3. EDGE CRACKING (Meters)	0.0	0.0	0.0
4. LONGITUDINAL CRACKING (Meters)			
4a. Wheel Path	13.7	19.1	0.0
Length Sealed (Meters)	0.0	0.0	0.0
4b. Non-Wheel Path	0.0	0.0	0.0
Length Sealed (Meters)	0.0	0.0	0.0
5. REFLECTION CRACKING AT JOINTS Number of Transverse Cracks	00	0	0
Transverse Cracking (Meters)	0.0	0.0	0.0
Length Sealed (Meters)	0.0	0.0	0.0
Longitudinal Cracking (Meters)	0.0	0.0	0.0
Length Sealed (Meters)	0.0	0.0	0.0
6. TRANSVERSE CRACKING Number of Cracks	11	12	5
Length (Meters)	16.	30.3	18.5
Length Sealed (Meters)			
PATCHING AND POTHOLES			
7. PATCH/PATCH DETERIORATION (Number)	0	0	0
(Square Meters)	0.0	0.0	0.0
8. Potholes (Number)	0	0	0
(Square Meters)	0.0	0.0	0.0

Figure A-9. Distress Survey Data

Revised December 1, 1992

SHEET 2

DISTRESS SURVEY

LTPP PROGRAM

STATE ASSIGNED ID _ _ _ _

STATE CODE 28

SHRP SECTION ID 1802

DATE OF DISTRESS SURVEY (MONTH/DAY/YEAR) 07/19/95

SURVEYORS: LLP, RAB

DISTRESS SURVEY FOR PAVEMENTS WITH ASPHALT CONCRETE SURFACES (CONTINUED)

DISTRESS TYPE	SEVERITY LEVEL LOW	MODERATE	HIGH
SURFACE DEFORMATION			
9. RUTTING - REFER TO SHEET 3 FOR SPS-3 OR Form S1 from Dipstick Manual			
10. SHOVING (Number) (Square Meters)			0 _ _ 0.0
SURFACE DEFECTS			
11. BLEEDING (Square Meters)	_ _ 0.0	_ _ 0.0	_ _ 0.0
12. POLISHED AGGREGATE (Square Meters)			_ _ _.0
13. RAVELING (Square Meters)	_ _ 0.0	_ _ 0.0	_ _ 0.0
MISCELLANEOUS DISTRESSES			
14. LANE-TO-SHOULDER DROPOFF - REFER TO SHEET 3			
15. WATER BLEEDING AND PUMPING (Number) Length of Affected Pavement (Meters)			_ _ 0 _ _ 0.0
16. OTHER (Describe) ____			

Figure A-9 (Continued). Distress Survey Data

Revised May 29, 1992

SHEET 3	STATE ASSIGNED ID _ _ _ _
DISTRESS SURVEY	STATE CODE 2 8
LTPP PROGRAM	SHRP SECTION ID 1 8 0 2

DATE OF DISTRESS SURVEY (MONTH/DAY/YEAR) 07/19/95

SURVEYORS: LLP, RAB

DISTRESS SURVEY FOR PAVEMENTS WITH ASPHALT CONCRETE SURFACES (CONTINUED)

9. RUTTING (FOR SPS-3 SITE SURVEYS)

INNER WHEEL PATH Point No.	Point Distance[1] (Meters)	Rut Depth (mm)	OUTER WHEEL PATH Point No.	Point Distance[1] (Meters)	Rut Depth (mm)
1	0.	_ _ 2.	1	0.	_ _ 3.
2	15.25	_ _ 3.	2	15.25	_ _ 2.
3	30.5	_ _ 5.	3	30.5	_ _ 3.
4	45.75	_ _ 7.	4	45.75	_ _ 5.
5	61.	_ _ 8.	5	61.	_ _ 4.
6	76.25	_ _ 2.	6	76.25	_ _ 2.
7	91.5	_ _ 0.	7	91.5	_ _ 0.
8	106.75	_ _ 5.	8	106.75	_ _ 3.
9	122.	_ _ 3.	9	122.	_ _ 5.
10	137.25	_ _ 3.	10	137.25	_ _ 2.
11	152.5	_ _ 3.	11	152.5	_ _ 4.

14. LANE-TO-SHOULDER DROPOFF

Point No.	Point Distance[1] Meters	Lane-to-Shoulder Dropoff (mm)
1	0.	_ _ _.
2	15.25	_ _ _.
3	30.5	_ _ _.
4	45.75	_ _ _.
5	61.	_ _ _.
6	76.25	_ _ _.
7	91.5	_ _ _.
8	106.75	_ _ _.
9	122.	_ _ _.
10	137.25	_ _ _.
11	152.5	_ _ _.

Note 1: "Point Distance" is the distance in meters from the start of the test section to the point where the measurement was made. The values shown are SI equivalents of the 50 ft spacing used in previous surveys.

Figure A-9 (Continued). Distress Survey Data

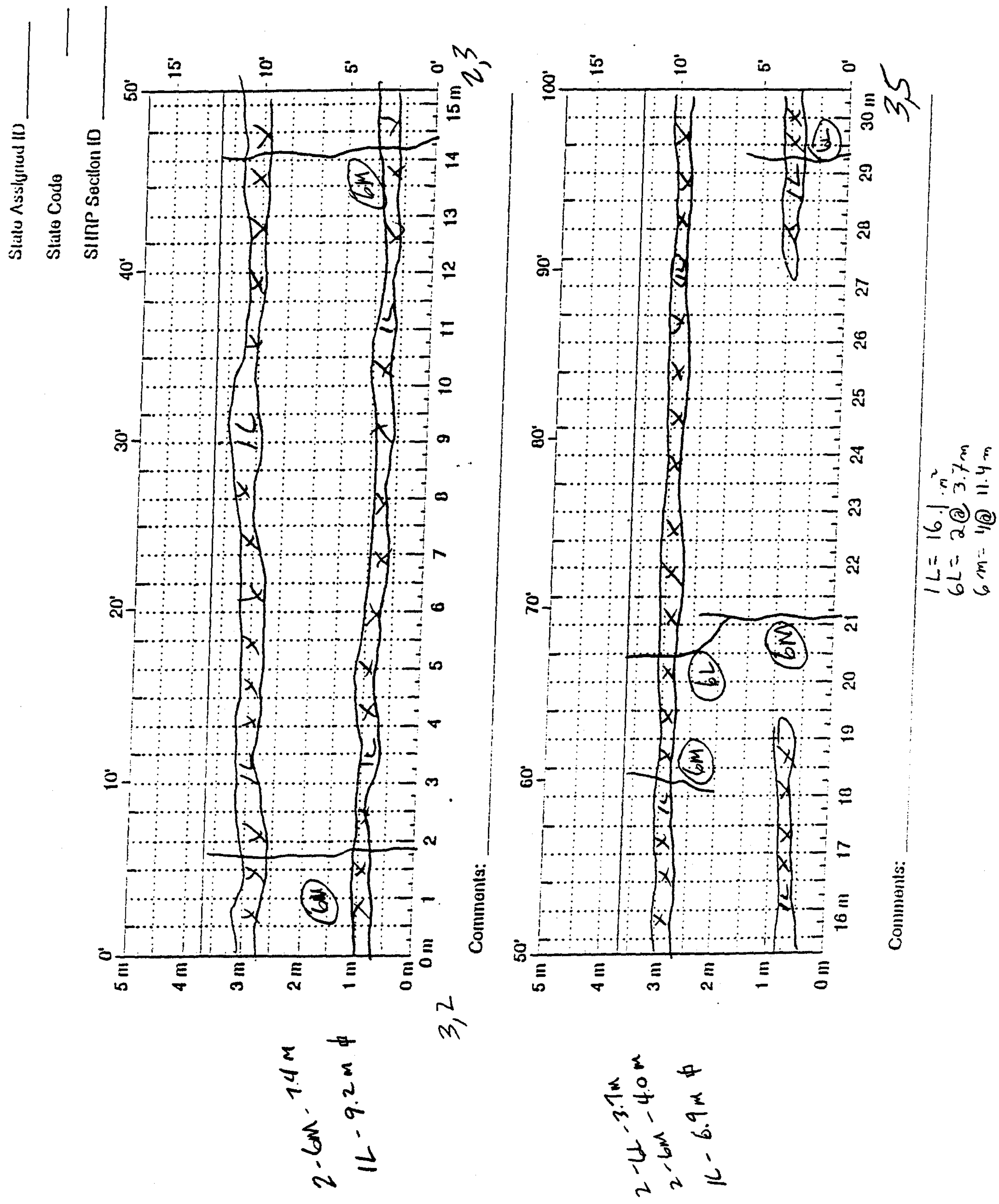


Figure A-9 (Continued). Distress Survey Data

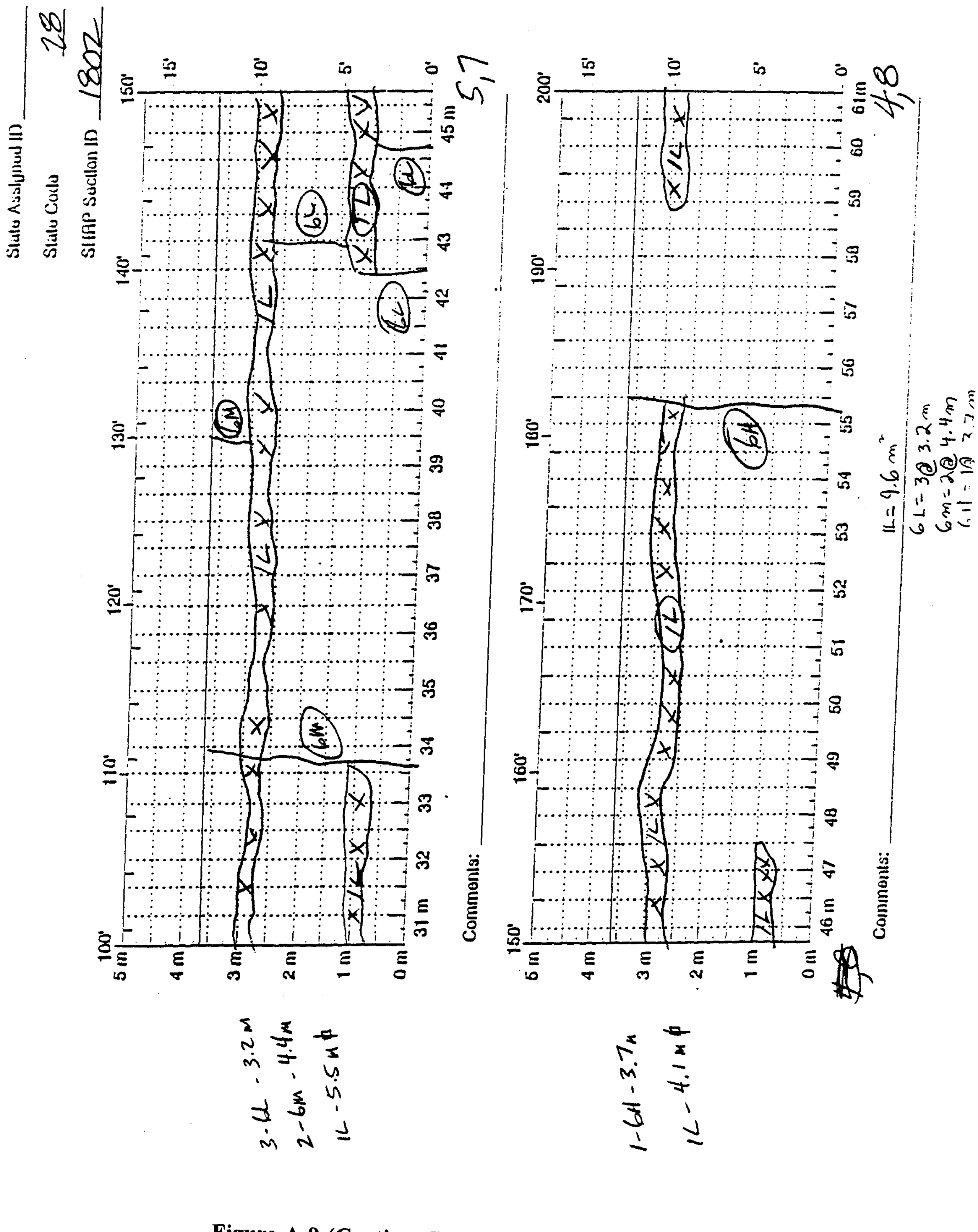


Figure A-9 (Continued). Distress Survey Data

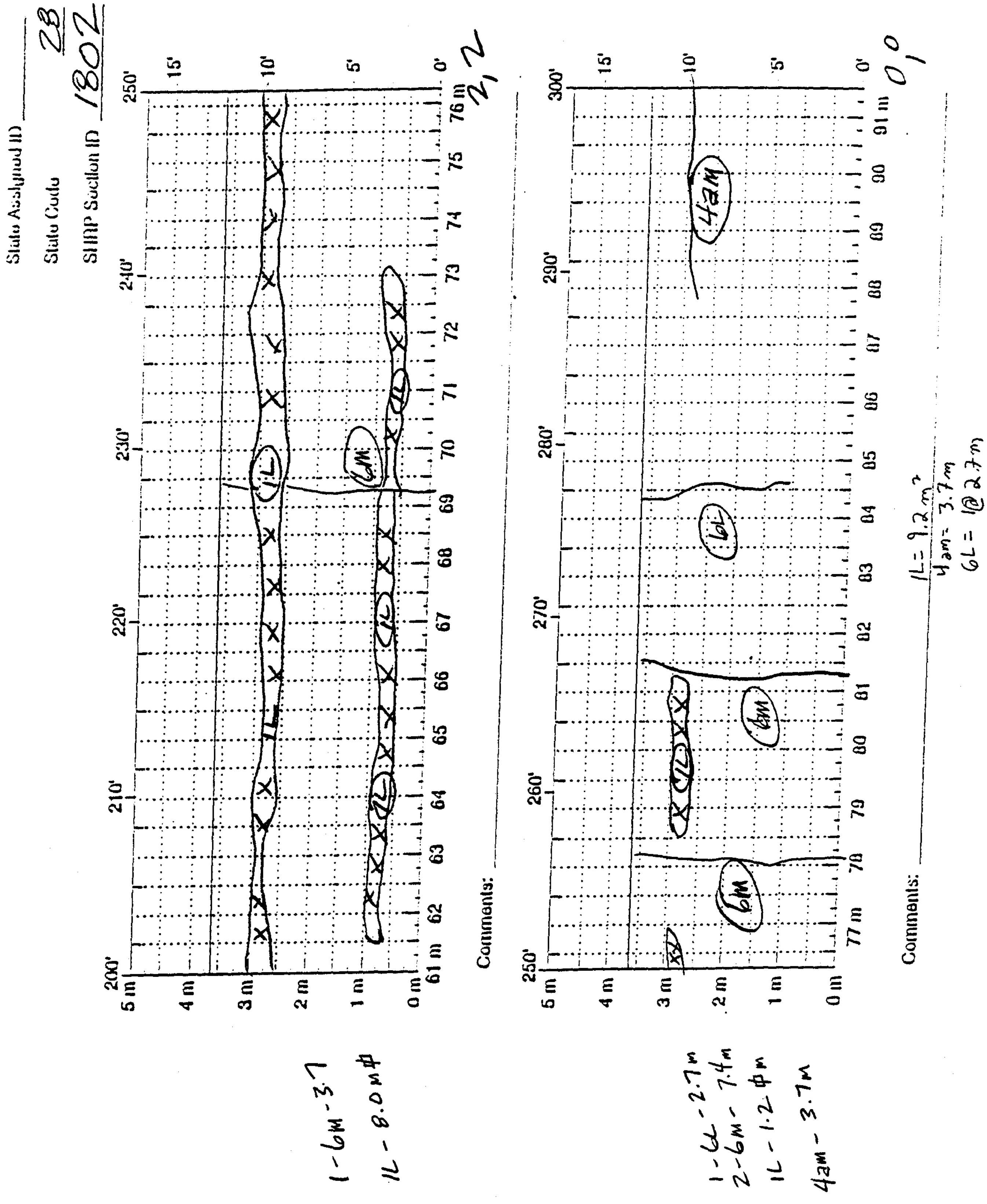


Figure A-9 (Continued). Distress Survey Data

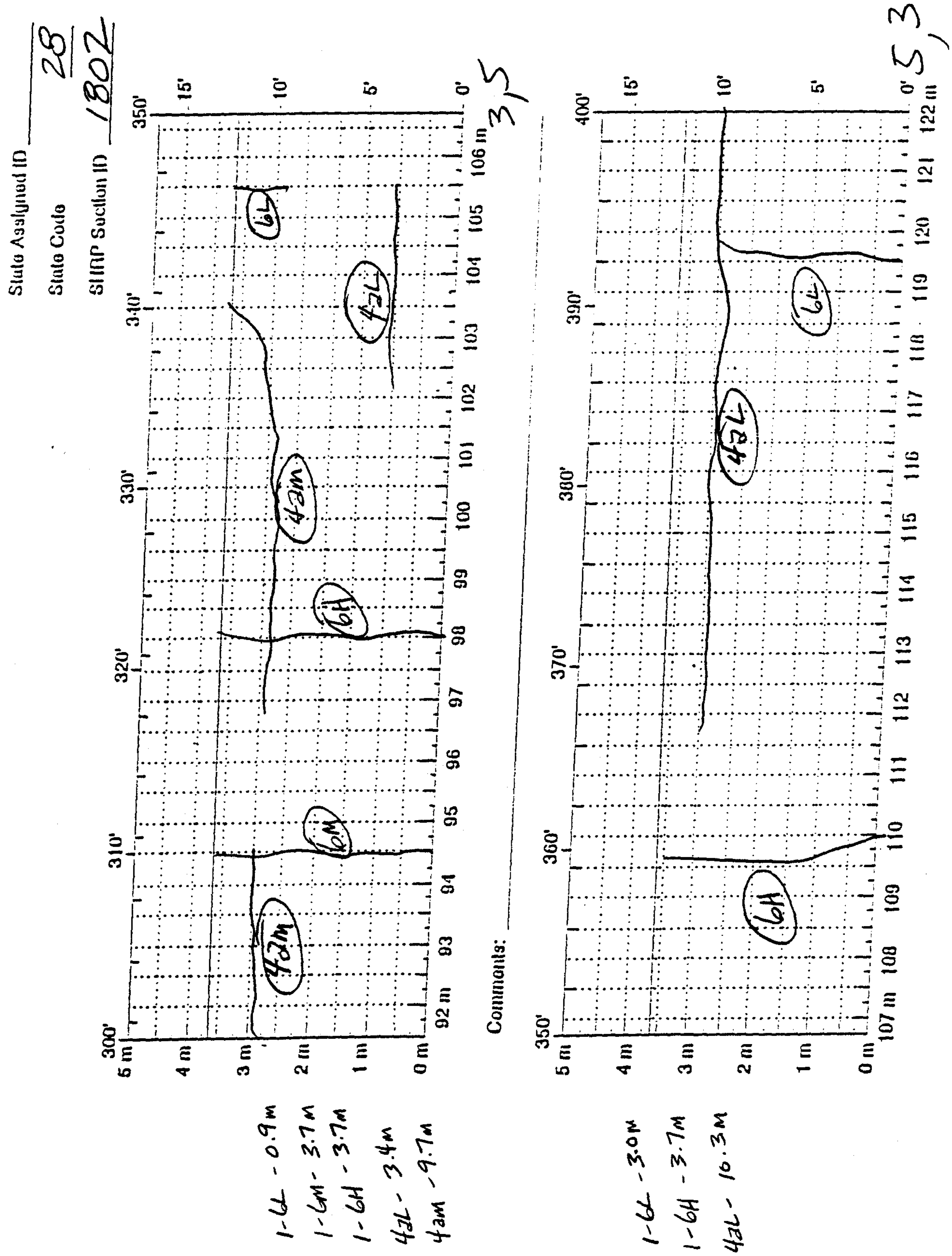


Figure A-9 (Continued). Distress Survey Data

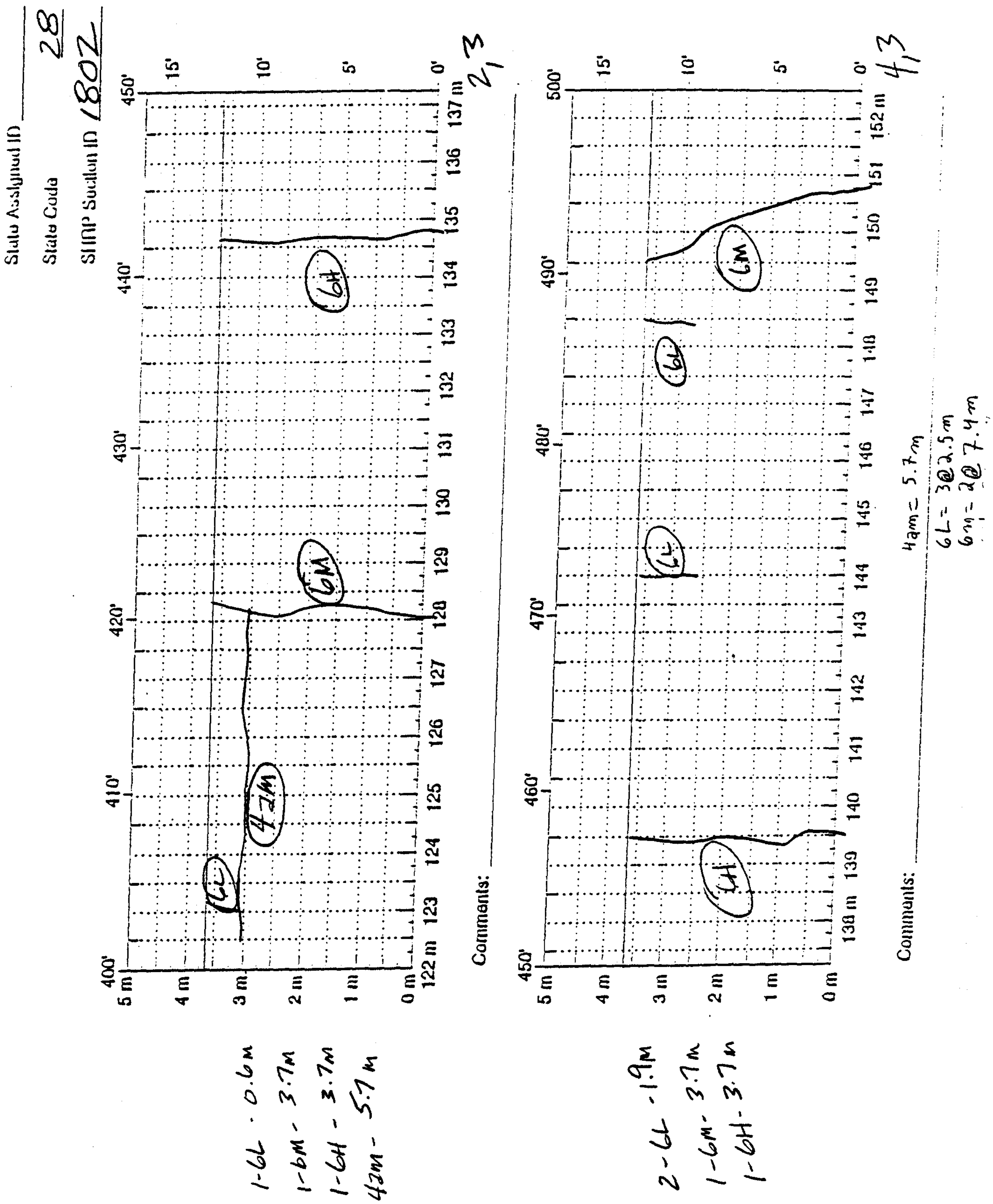


Figure A-9 (Continued). Distress Survey Data

APPENDIX B

Pre-installation Activities

Appendix B contains the following information:

Seasonal Monitoring Meeting Agenda

Seasonal Site Information

Figure B-1. TDR Traces Obtained During Calibration

AGENDA

Seasonal Monitoring Meeting

18 May 1995

I. Introductions

II. Brief Overview of the Seasonal Program

III. Roles & Responsibilities

IV. Activities on Site - Day 1

    A. Arrival
    B. Traffic Control
    C. Marking Section
    D. FWD Testing
    E. Sawing/Coring
    F. Observation Well
    G. Instrumentation Hole
    H. Weather Station
    I. Hook-up all Electronics
    J. Patching/Clean-up

V. Activities on Site - Day 2

    A. Instrumentation Check
    B. Data Collection

        1. FWD Testing
        2. Rod/Level Elevations
        3. Download Instrumentation Data

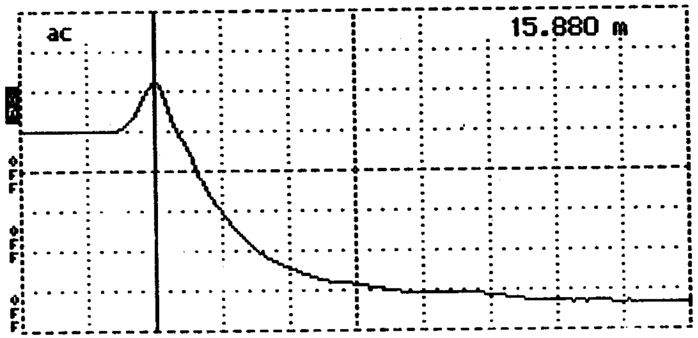
VI. Questions/Discussion

MISSISSIPPI SEASONAL SITE INFORMATION

Type	SHRP ID	Hwy №.	Location of Test Section
AC over Granular Base	281802	US-84, Covington Co. Eastbound	2.41 km W. of the Covington/ Jones Co. line.
AC over Granular Base	281016	SH-35, Attala Co. Northbound	2.25 km N. of the Natchez Trail.

LTPP Seasonal Monitoring Program Data Sheet SMP-C01 (Page 1) TDR Probe Check	Agency Code [28] LTPP Section ID [_A01]

Cursor .... 15.880 m
Distance/Div ..... .25 m/div
Vertical Scale.... 158 mρ/div
Vp 0.99
Noise Filter ...... 1 avg
Power .... ac

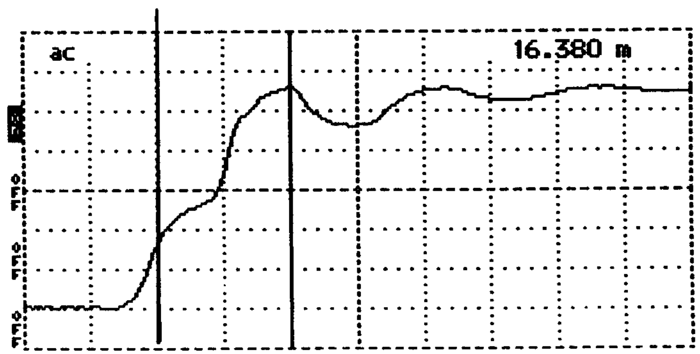


Tektronix 1502B TDR
Date 2/21/94
Cable 28A01
Notes SHORTED

Input Trace JP.
Stored Trace
Difference Trace

TDR Trace	Apparent Length, (m)	Dielectric Constant
"Shorted at Start"	_ . _ _	_ _ . _ _

Cursor .... 16.380 m
Distance/Div ..... .25 m/div
Vertical Scale.... 158 mρ/div
Vp 0.99
Noise Filter ...... 1 avg
Power .... ac



Tektronix 1502B TDR
Date 2/21/94
Cable 28A01
Notes AIR

Input Trace J.P.
Stored Trace
Difference Trace

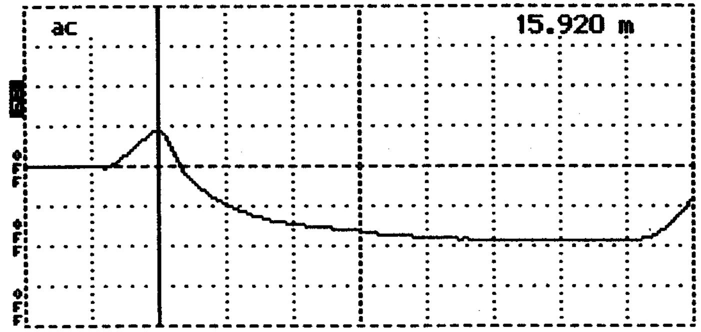
TDR Trace	Apparent Length, (m)	Dielectric Constant[1]
"In Air"	0.25	_1.54

Data Sheet SMP-C01: TDR Probe Check

Figure B-1. TDR Traces Obtained During Calibration

LTPP Seasonal Monitoring Program Data Sheet SMP-C01 (Page 2) TDR Probe Check	Agency Code [28] LTPP Section ID [_A01]

Cursor .... 15.920 m
Distance/Div..... .25 m/div
Vertical Scale.... 158 mρ/div
Vp 0.99
Noise Filter...... 1 avg
Power............ ac



Tektronix 1502B TDR
Date 2/21/94
Cable 28A01
Notes WATER
68°F

Input Trace J.P.
Stored Trace
Difference Trace

TDR Trace	Apparent Length, (m)	Dielectric Constant[2]
"In Water"	1.77	77.57

[1] If dielectric constant not between 0.75 and 2.0, contact FHWA LTPP Division
[2] If dielectric constant not between 76 and 84, contact FHWA LTPP Division

Note: Dielectric constant is determined as follows:

$$\varepsilon = \left[\frac{(L_a)}{(L)(V_p)}\right]^2 = \left[\frac{(D_2 - D_1)}{(L)(V_p)}\right]^2$$

where ε = dielectric constant; L_a = apparent length of probe, m; L = actual length of probe units (= 0.203 m (8 in) for FHWA probes); V_p = phase velocity setting (= 0.99).

TDR Probe Serial Number: 28A01 TDR Probe Length, L: 0.203 m Length of Coax Cable: 12.2 m

Comments:

Prepared by: Mark 7 Cd Employer: BKE

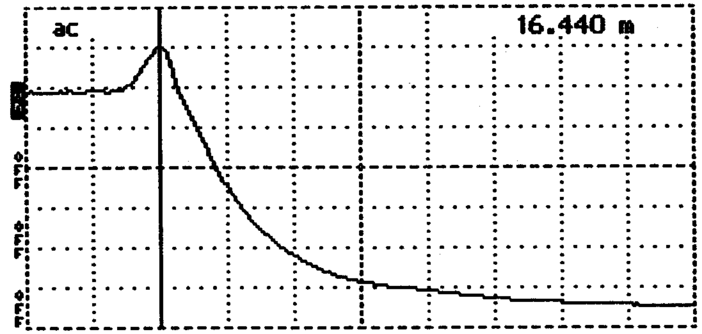
Date (dd/mmm/yy): 28/__7/95

Data Sheet SMP-C01: TDR Probe Check (Continued)

Figure B-1 (Continued). TDR Traces Obtained During Calibration

LTPP Seasonal Monitoring Program Data Sheet SMP-C01 (Page 1) TDR Probe Check	Agency Code [2 8] LTPP Section ID [_ A 0 2]

Cursor .... 16.440 m
Distance/Div ..... .25 m/div
Vertical Scale.... 158 mρ/div
Vp 0.99
Noise Filter ...... 1 avs
Power .... ac

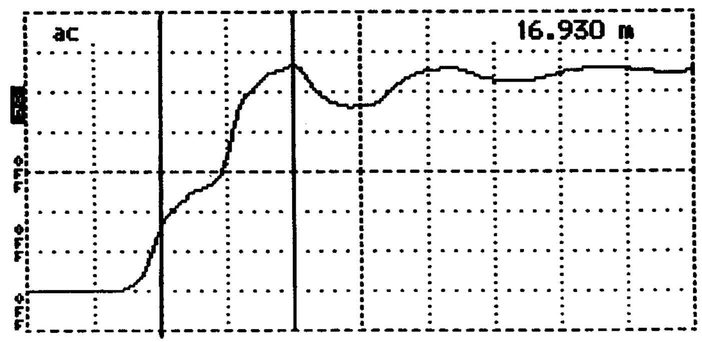


Tektronix 1502B TDR
Date 2/21/94
Cable 28A02
Notes SHORTED

Input Trace J.P.
Stored Trace
Difference Trace

TDR Trace	Apparent Length, (m)	Dielectric Constant
"Shorted at Start"	_ . _ _	_ _ . _ _

Cursor .... 16.930 m
Distance/Div ..... .25 m/div
Vertical Scale.... 158 mρ/div
Vp 0.99
Noise Filter ...... 1 avs
Power .... ac



Tektronix 1502B TDR
Date 2/21/94
Cable 28A02
Notes AIR

Input Trace J.P.
Stored Trace
Difference Trace

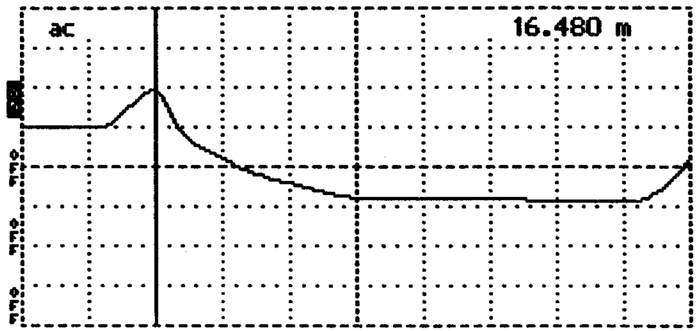
TDR Trace	Apparent Length, (m)	Dielectric Constant[1]
"In Air"	0.24	1.43

Data Sheet SMP-C01: TDR Probe Check

Figure B-1 (Continued). TDR Traces Obtained During Calibration

LTPP Seasonal Monitoring Program Data Sheet SMP-C01 (Page 2) TDR Probe Check	Agency Code [28] LTPP Section ID [_A02]

Cursor .... 16.480 m
Distance/Div..... .25 m/div
Vertical Scale.... 158 mρ/div
VP 0.99
Noise Filter...... 1 avg
Power........... ac



Tektronix 1502B TDR
Date 2/21/94
Cable 28A02
Notes WATER
69°F

Input Trace J.P.
Stored Trace
Difference Trace

TDR Trace	Apparent Length, (m)[1]	Dielectric Constant[2]
"In Water"	1.77	77.57

[1] If dielectric constant not between 0.75 and 2.0, contact FHWA LTPP Division
[2] If dielectric constant not between 76 and 84, contact FHWA LTPP Division

Note: Dielectric constant is determined as follows:

$$\varepsilon = \left[\frac{(L_a)}{(L)(V_p)}\right]^2 = \left[\frac{(D_2 - D_1)}{(L)(V_p)}\right]^2$$

where ε = dielectric constant; L_a = apparent length of probe, m; L = actual length of probe units (= 0.203 m (8 in) for FHWA probes); V_p = phase velocity setting (= 0.99).

TDR Probe Serial Number: 28A02 TDR Probe Length, L: 0.203 m Length of Coax Cable: 12.2 m

Comments: ____

Prepared by: [illegible] Employer: BRE

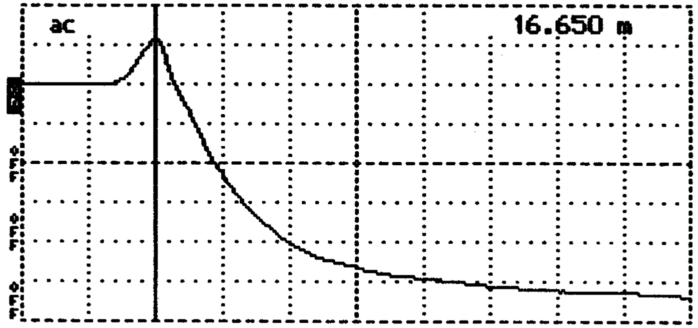
Date (dd/mmm/yy): 28/__/7/95

Data Sheet SMP-C01: TDR Probe Check (Continued)

Figure B-1 (Continued). TDR Traces Obtained During Calibration

LTPP Seasonal Monitoring Program Data Sheet SMP-C01 (Page 1) TDR Probe Check	Agency Code [2 8] LTPP Section ID [_ A 0 3]

Cursor .... 16.650 m
Distance/Div..... .25 m/div
Vertical Scale.... 158 mρ/div
VP 0.99
Noise Filter...... 1 avs
Power............ ac

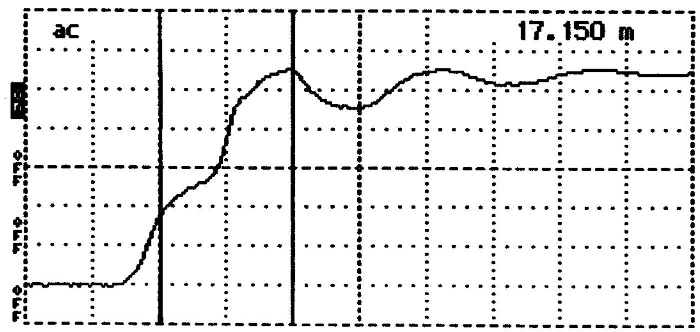


Tektronix 1502B TDR
Date 2/21/94
Cable 28A03
Notes ~~WATE~~
SHORTED

Input Trace J.P.
Stored Trace
Difference Trace

TDR Trace	Apparent Length, (m)	Dielectric Constant
"Shorted at Start"	_ . _ _	_ _ . _ _

Cursor .... 17.150 m
Distance/Div..... .25 m/div
Vertical Scale.... 158 mρ/div
VP 0.99
Noise Filter...... 1 avs
Power............ ac



Tektronix 1502B TDR
Date 2/21/94
Cable 28A03
Notes AIR

Input Trace J.P.
Stored Trace
Difference Trace

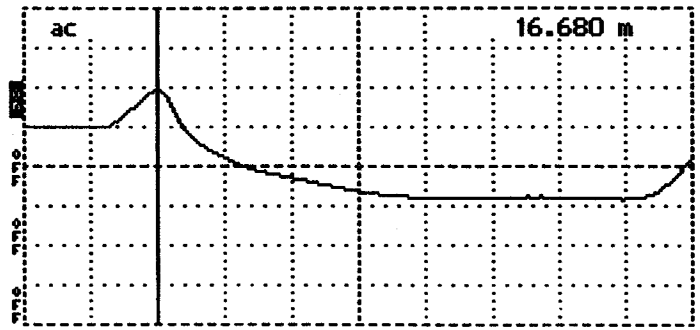
TDR Trace	Apparent Length, (m)	Dielectric Constant[1]
"In Air"	0.24	_1.43

Data Sheet SMP-C01: TDR Probe Check

Figure B-1 (Continued). TDR Traces Obtained During Calibration

LTPP Seasonal Monitoring Program Data Sheet SMP-C01 (Page 2) TDR Probe Check	Agency Code [28] LTPP Section ID [_A03]

Cursor .... 16.680 m
Distance/Div..... .25 m/div
Vertical Scale.... 158 mρ/div
Vp 0.99
Noise Filter...... 1 avg
Power........... ac



Tektronix 1502B TDR
Date 2/21/94
Cable 28A03
Notes WATER
70°F

Input Trace J.P.
Stored Trace
Difference Trace

TDR Trace	Apparent Length, (m)	Dielectric Constant[2]
"In Water"	1.77	77.57

[1] If dielectric constant not between 0.75 and 2.0, contact FHWA LTPP Division
[2] If dielectric constant not between 76 and 84, contact FHWA LTPP Division

Note: Dielectric constant is determined as follows:

$$\varepsilon = \left[\frac{(L_a)}{(L)(V_p)}\right]^2 = \left[\frac{(D_2 - D_1)}{(L)(V_p)}\right]^2$$

where ε = dielectric constant; L_a = apparent length of probe, m; L = actual length of probe units (= 0.203 m (8 in) for FHWA probes); V_p = phase velocity setting (= 0.99).

TDR Probe Serial Number: 28A03 TDR Probe Length, L: 0.203 m Length of Coax Cable: 12.2 m

Comments:

Prepared by: Mark 7. Cal Employer: BRE

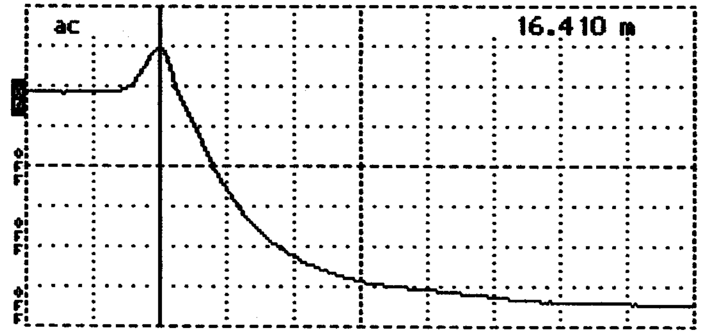
Date (dd/mmm/yy): 28/ __ 7/ 95

Data Sheet SMP-C01: TDR Probe Check (Continued)

Figure B-1 (Continued). TDR Traces Obtained During Calibration

LTPP Seasonal Monitoring Program Data Sheet SMP-C01 (Page 1) TDR Probe Check	Agency Code [28] LTPP Section ID [A04]

Cursor .... 16.410 m
Distance/Div..... .25 m/div
Vertical Scale.... 158 mρ/div
VP 0.99
Noise Filter...... 1 avg
Power........... ac

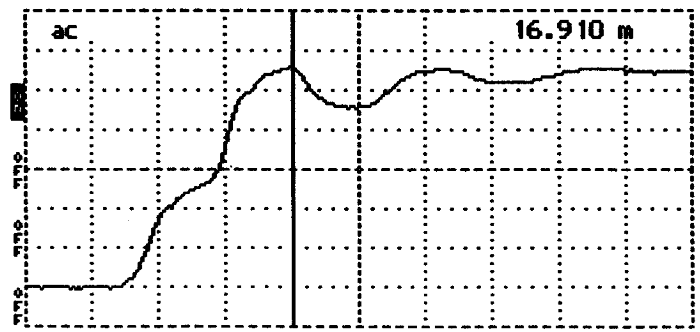


Tektronix 1502B TDR
Date 2/21/94
Cable 28A04
Notes SHORTED

Input Trace S.P.
Stored Trace
Difference Trace

TDR Trace	Apparent Length, (m)	Dielectric Constant
"Shorted at Start"	_ . _ _	_ _ . _ _

Cursor .... 16.910 m
Distance/Div..... .25 m/div
Vertical Scale.... 158 mρ/div
VP 0.99
Noise Filter...... 1 avg
Power........... ac



Tektronix 1502B TDR
Date 2/21/94
Cable 28A04
Notes AIR

Input Trace S.P
Stored Trace
Difference Trace

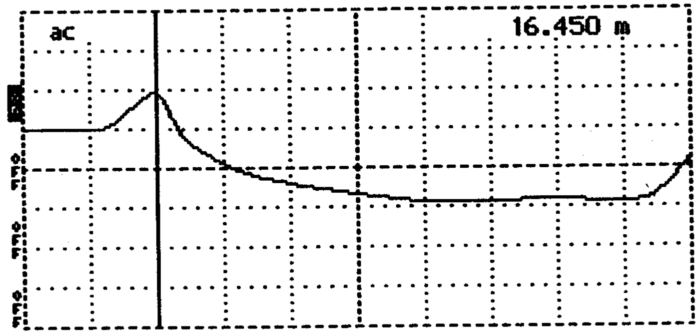
TDR Trace	Apparent Length, (m)	Dielectric Constant[1]
"In Air"	0.24	_ 1.43

Data Sheet SMP-C01: TDR Probe Check

Figure B-1 (Continued). TDR Traces Obtained During Calibration

LTPP Seasonal Monitoring Program Data Sheet SMP-C01 (Page 2) TDR Probe Check	Agency Code [2 8] LTPP Section ID [_ A 0 4]

Cursor .... 16.450 m
Distance/Div ..... .25 m/div
Vertical Scale.... 158 mρ/div
Vp 0.99
Noise Filter ...... 1 avg
Power .... ac



Tektronix 1502B TDR
Date 2/21/94
Cable 28A04
Notes WATER
68°F

Input Trace J.P
Stored Trace
Difference Trace

TDR Trace	Apparent Length, (m)	Dielectric Constant[2]
"In Water"	1.77	77.57

[1] If dielectric constant not between 0.75 and 2.0, contact FHWA LTPP Division
[2] If dielectric constant not between 76 and 84, contact FHWA LTPP Division

Note: Dielectric constant is determined as follows:

$$\varepsilon = \left[\frac{(L_a)}{(L)(V_p)}\right]^2 = \left[\frac{(D_2 - D_1)}{(L)(V_p)}\right]^2$$

where ε = dielectric constant; L_a = apparent length of probe, m; L = actual length of probe units (= 0.203 m (8 in) for FHWA probes); V_p = phase velocity setting (= 0.99).

TDR Probe Serial Number: 28A04 TDR Probe Length, L: 0.203 m Length of Coax Cable: 12.2 m

Comments: ______

Prepared by: Mark 7 Gl Employer: BRE

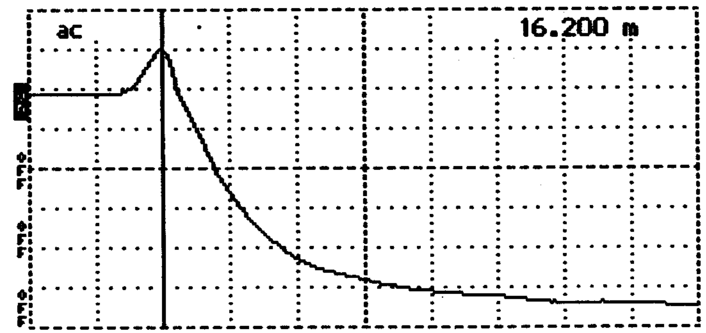
Date (dd/mmm/yy): 28/__7/95

Data Sheet SMP-C01: TDR Probe Check (Continued)

Figure B-1 (Continued). TDR Traces Obtained During Calibration

LTPP Seasonal Monitoring Program Data Sheet SMP-C01 (Page 1) TDR Probe Check	Agency Code [28] LTPP Section ID [_A05]

Cursor .... 16.200 m
Distance/Div..... .25 m/div
Vertical Scale.... 158 mρ/div
Vp 0.99
Noise Filter...... 1 avg
Power........... ac

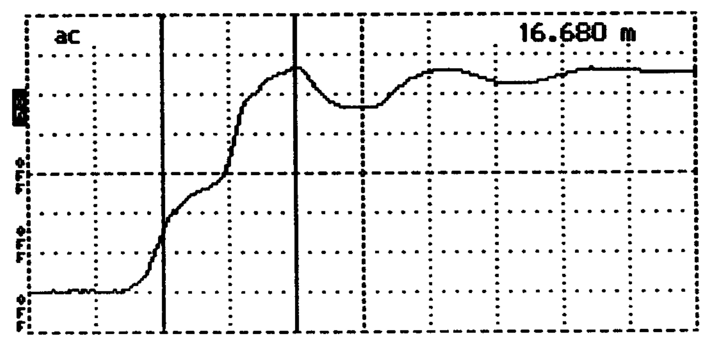


Tektronix 1502B TDR
Date 2/21/94
Cable 28A05
Notes SHORTED

Input Trace
Stored Trace
Difference Trace

TDR Trace	Apparent Length, (m)	Dielectric Constant
"Shorted at Start"	_ . _ _	_ _ . _ _

Cursor .... 16.680 m
Distance/Div..... .25 m/div
Vertical Scale.... 158 mρ/div
Vp 0.99
Noise Filter...... 1 avg
Power........... ac



Tektronix 1502B TDR
Date 2/21/94
Cable 28A05
Notes AIR

Input Trace JP
Stored Trace
Difference Trace

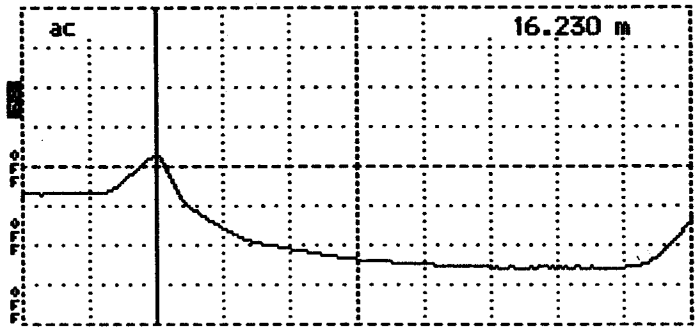
TDR Trace	Apparent Length, (m)	Dielectric Constant[1]
"In Air"	0.24	_ 1.43

Data Sheet SMP-C01: TDR Probe Check

Figure B-1 (Continued). TDR Traces Obtained During Calibration

LTPP Seasonal Monitoring Program Data Sheet SMP-C01 (Page 2) TDR Probe Check	Agency Code [28] LTPP Section ID [_A05]

Cursor .... 16.230 m
Distance/Div..... .25 m/div
Vertical Scale.... 158 mρ/div
Vp 0.99
Noise Filter...... 1 avg
Power........... ac



Tektronix 1502B TDR
Date 2/21/94
Cable 28A05
Notes WATER 69°F

Input Trace JP
Stored Trace ---
Difference Trace ---

TDR Trace	Apparent Length, (m)	Dielectric Constant[2]
"In Water"	1.77	77.57

[1] If dielectric constant not between 0.75 and 2.0, contact FHWA LTPP Division
[2] If dielectric constant not between 76 and 84, contact FHWA LTPP Division

Note: Dielectric constant is determined as follows:

$$\varepsilon = \left[\frac{(L_a)}{(L)(V_p)}\right]^2 = \left[\frac{(D_2 - D_1)}{(L)(V_p)}\right]^2$$

where ε = dielectric constant; L_a = apparent length of probe, m; L = actual length of probe units (= 0.203 m (8 in) for FHWA probes); V_p = phase velocity setting (= 0.99).

TDR Probe Serial Number: 28A05 TDR Probe Length, L: 0.203 m Length of Coax Cable: 12.2 m

Comments: ______

Prepared by: Mark ? Cil Employer: BRE

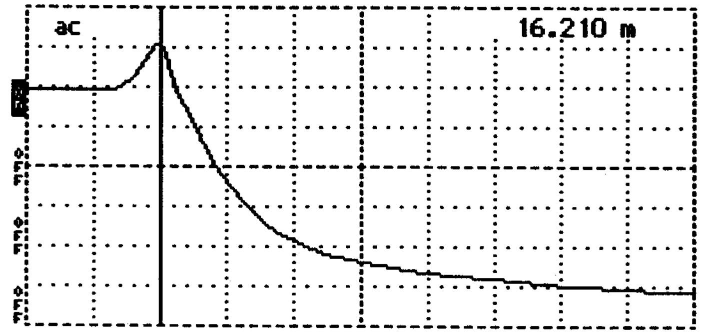
Date (dd/mmm/yy): 28/__7/95

Data Sheet SMP-C01: TDR Probe Check (Continued)

Figure B-1 (Continued). TDR Traces Obtained During Calibration

LTPP Seasonal Monitoring Program Data Sheet SMP-C01 (Page 1) TDR Probe Check	Agency Code [28] LTPP Section ID [_A06]

Cursor .... 16.210 m
Distance/Div ..... .25 m/div
Vertical Scale.... 158 mρ/div
Vp 0.99
Noise Filter...... 1 avg
Power .... ac

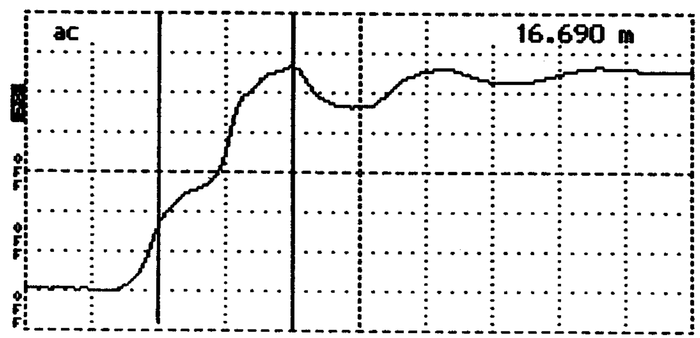


Tektronix 1502B TDR
Date 2/21/94
Cable 28A06
Notes
SHORTED

Input Trace JP
Stored Trace
Difference Trace

TDR Trace	Apparent Length, (m)	Dielectric Constant
"Shorted at Start"	_ . _ _	_ _ . _ _

Cursor .... 16.690 m
Distance/Div ..... .25 m/div
Vertical Scale.... 158 mρ/div
Vp 0.99
Noise Filter...... 1 avg
Power .... ac



Tektronix 1502B TDR
Date 2/21/94
Cable 28A06
Notes
AIR

Input Trace JP
Stored Trace
Difference Trace

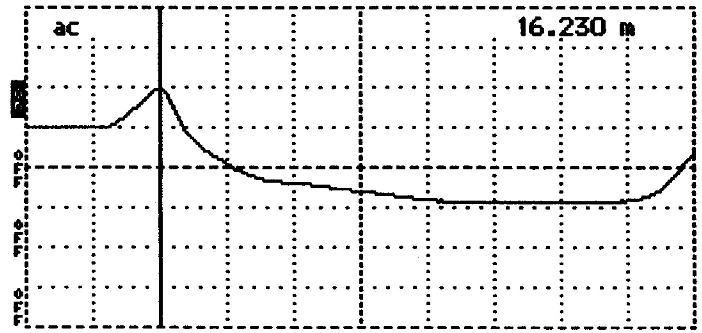
TDR Trace	Apparent Length, (m)	Dielectric Constant[1]
"In Air"	0.24	_1.43

Data Sheet SMP-C01: TDR Probe Check

Figure B-1 (Continued). TDR Traces Obtained During Calibration

LTPP Seasonal Monitoring Program Data Sheet SMP-C01 (Page 2) TDR Probe Check	Agency Code [28] LTPP Section ID [_A06]

Cursor .... 16.230 m
Distance/Div ..... .25 m/div
Vertical Scale.... 158 mρ/div
VP 0.99
Noise Filter ...... 1 avg
Power .... ac



Tektronix 1502B TDR
Date 2/21/94
Cable 28A06
Notes WATER
70°F

Input Trace J.P.
Stored Trace ....
Difference Trace ....

TDR Trace	Apparent Length, (m)	Dielectric Constant[2]
"In Water"	1.76	76.69

[1] If dielectric constant not between 0.75 and 2.0, contact FHWA LTPP Division
[2] If dielectric constant not between 76 and 84, contact FHWA LTPP Division

Note: Dielectric constant is determined as follows:

$$\varepsilon = \left[\frac{(L_a)}{(L)(V_p)}\right]^2 = \left[\frac{(D_2 - D_1)}{(L)(V_p)}\right]^2$$

where ε = dielectric constant; L_a = apparent length of probe, m; L = actual length of probe units (= 0.203 m (8 in) for FHWA probes); V_p = phase velocity setting (= 0.99).

TDR Probe Serial Number: 28A06 TDR Probe Length, L: 0.203 m Length of Coax Cable: 12.2 m

Comments: ____________________

Prepared by: Mark 7.C. Employer: BRE

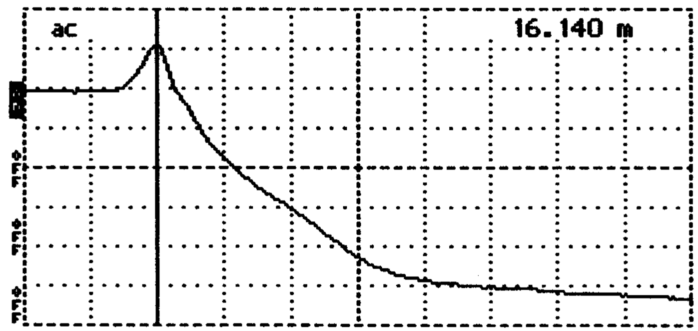
Date (dd/mmm/yy): 28/__7/95

Data Sheet SMP-C01: TDR Probe Check (Continued)

Figure B-1 (Continued). TDR Traces Obtained During Calibration

LTPP Seasonal Monitoring Program Data Sheet SMP-C01 (Page 1) TDR Probe Check	Agency Code [28] LTPP Section ID [A07]

Cursor .... 16.140 m
Distance/Div..... .25 m/div
Vertical Scale.... 158 mρ/div
Vp 0.99
Noise Filter...... 1 avg
Power........... ac

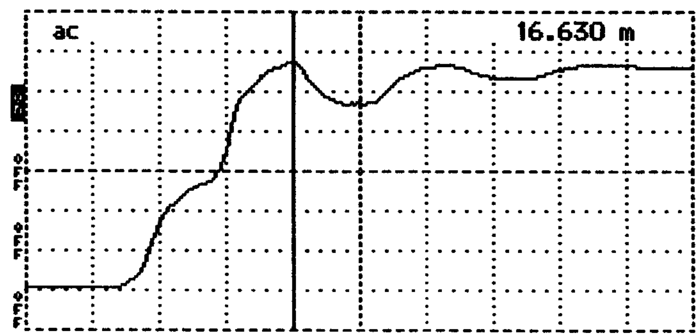


Tektronix 1502B TDR
Date 2/21/94
Cable 28A07
Notes SHORTED

Input Trace J.P.
Stored Trace ....
Difference Trace ....

TDR Trace	Apparent Length, (m)	Dielectric Constant
"Shorted at Start"	_ . _ _	_ _ . _ _

Cursor .... 16.630 m
Distance/Div..... .25 m/div
Vertical Scale.... 158 mρ/div
Vp 0.99
Noise Filter...... 1 avg
Power........... ac



Tektronix 1502B TDR
Date 2/21/94
Cable 28A07
Notes AIR

Input Trace J.P.
Stored Trace ....
Difference Trace ....

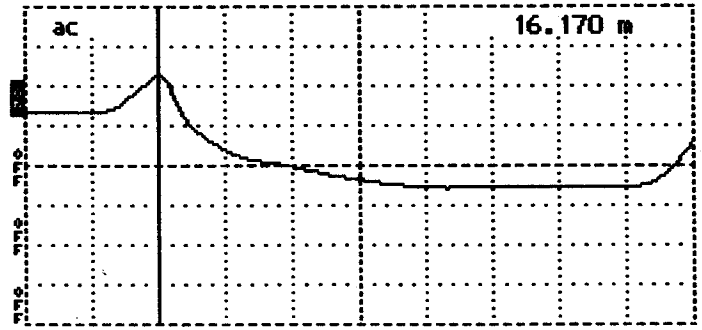
TDR Trace	Apparent Length, (m)	Dielectric Constant[1]
"In Air"	0.24	1.43

Data Sheet SMP-C01: TDR Probe Check

Figure B-1 (Continued). TDR Traces Obtained During Calibration

LTPP Seasonal Monitoring Program Data Sheet SMP-C01 (Page 2) TDR Probe Check	Agency Code [28] LTPP Section ID [_A07]

Cursor .... 16.170 m
Distance/Div..... .25 m/div
Vertical Scale.... 158 mρ/div
VP 0.99
Noise Filter...... 1 avg
Power........... ac



Tektronix 1502B TDR
Date 7/21/94
Cable 28A07
Notes WATER
68°F

Input Trace J.P.
Stored Trace
Difference Trace

TDR Trace	Apparent Length, (m)	Dielectric Constant[2]
"In Water"	1.84	83.88

[1] If dielectric constant not between 0.75 and 2.0, contact FHWA LTPP Division
[2] If dielectric constant not between 76 and 84, contact FHWA LTPP Division

Note: Dielectric constant is determined as follows:

$$\varepsilon = \left[\frac{(L_a)}{(L)(V_p)}\right]^2 = \left[\frac{(D_2 - D_1)}{(L)(V_p)}\right]^2$$

where ε = dielectric constant; L_a = apparent length of probe, m; L = actual length of probe units (= 0.203 m (8 in) for FHWA probes); V_p = phase velocity setting (= 0.99).

TDR Probe Serial Number: 28A07 TDR Probe Length, L: 0.203 m Length of Coax Cable: 12.2 m

Comments:

Prepared by: Mat 7 Cl Employer: BRE

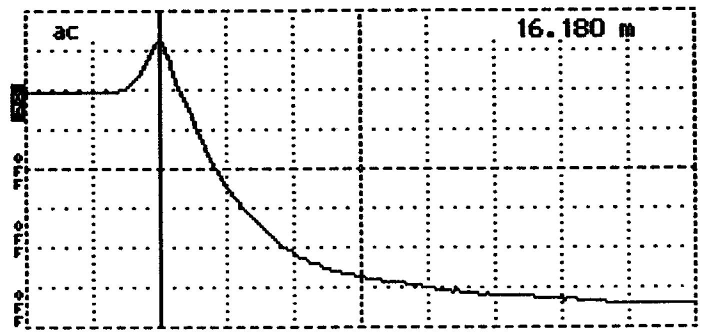
Date (dd/mmm/yy): 28/ 7/95

Data Sheet SMP-C01: TDR Probe Check (Continued)

Figure B-1 (Continued). TDR Traces Obtained During Calibration

LTPP Seasonal Monitoring Program Data Sheet SMP-C01 (Page 1) TDR Probe Check	Agency Code [28] LTPP Section ID [_ A 0 8]

Cursor .... 16.180 m
Distance/Div..... .25 m/div
Vertical Scale.... 158 mρ/div
Vp 0.99
Noise Filter...... 1 avg
Power........... ac

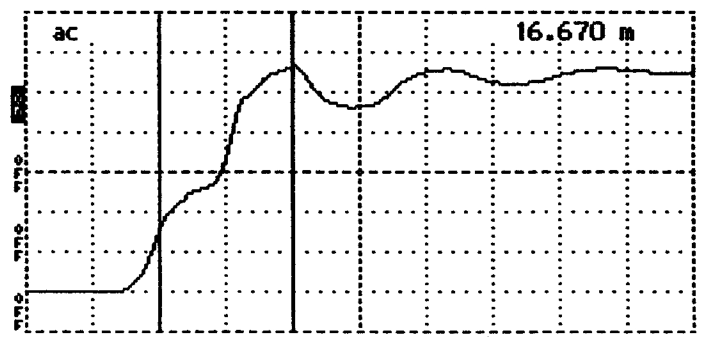


Tektronix 1502B TDR
Date 2/21/94
Cable 28A08
Notes SHORTED

Input Trace J.P.
Stored Trace
Difference Trace

TDR Trace	Apparent Length, (m)	Dielectric Constant
"Shorted at Start"	_ . _ _	_ _ . _ _

Cursor .... 16.670 m
Distance/Div..... .25 m/div
Vertical Scale.... 158 mρ/div
Vp 0.99
Noise Filter...... 1 avg
Power........... ac



Tektronix 1502B TDR
Date 2/21/94
Cable 28A08
Notes AIR

Input Trace J.P
Stored Trace
Difference Trace

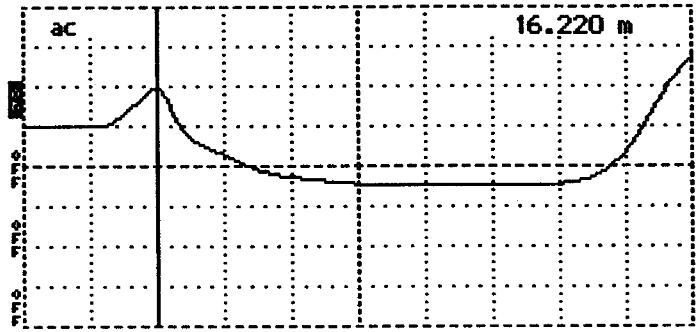
TDR Trace	Apparent Length, (m)	Dielectric Constant[1]
"In Air"	0.24	1.43

Data Sheet SMP-C01: TDR Probe Check

Figure B-1 (Continued). TDR Traces Obtained During Calibration

LTPP Seasonal Monitoring Program Data Sheet SMP-C01 (Page 2) TDR Probe Check	Agency Code [2 8] LTPP Section ID [_ A 0 8]

Cursor .... 16.220 m
Distance/Div..... .25 m/div
Vertical Scale.... 158 mρ/div
Vp 0.99
Noise Filter...... 1 avg
Power........... ac



Tektronix 1502B TDR
Date 2/21/94
Cable 28A08
Notes WATER
70°F

Input Trace J.P.
Stored Trace
Difference Trace

TDR Trace	Apparent Length, (m)	Dielectric Constant[2]
"In Water"	1 70	71.62

[1] If dielectric constant not between 0.75 and 2.0, contact FHWA LTPP Division
[2] If dielectric constant not between 76 and 84, contact FHWA LTPP Division

Note: Dielectric constant is determined as follows:

$$\varepsilon = \left[\frac{(L_a)}{(L)(V_p)}\right]^2 = \left[\frac{(D_2 - D_1)}{(L)(V_p)}\right]^2$$

where ε = dielectric constant; L_a = apparent length of probe, m; L = actual length of probe units (= 0.203 m (8 in) for FHWA probes); V_p = phase velocity setting (= 0.99).

TDR Probe Serial Number: 28A08 TDR Probe Length, L: 0.203 m Length of Coax Cable: 12.2 m

Comments: ____

Prepared by: Mat T. W Employer: BRE

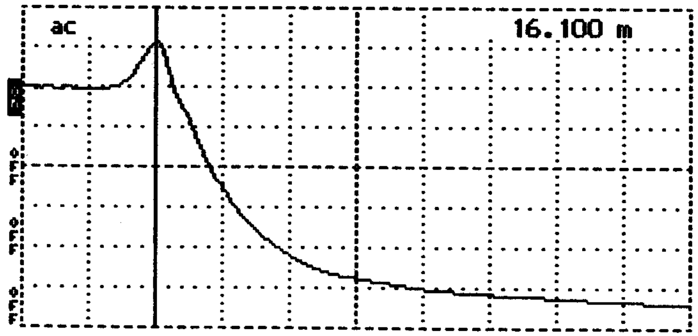
Date (dd/mmm/yy): 28/007/95

Data Sheet SMP-C01: TDR Probe Check (Continued)

Figure B-1 (Continued). TDR Traces Obtained During Calibration

LTPP Seasonal Monitoring Program Data Sheet SMP-C01 (Page 1) TDR Probe Check	Agency Code [28] LTPP Section ID [_A09]

Cursor .... 16.100 m
Distance/Div..... .25 m/div
Vertical Scale.... 158 mρ/div
VP 0.99
Noise Filter...... 1 avg
Power .... ac

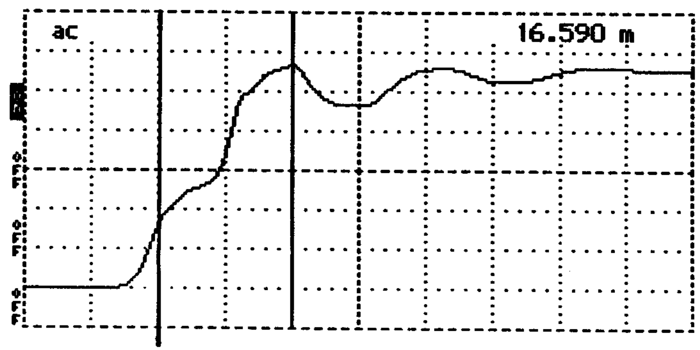


Tektronix 1502B TDR
Date 2/21/94
Cable 28A09
Notes SHORTED

Input Trace J.P.
Stored Trace
Difference Trace

TDR Trace	Apparent Length, (m)	Dielectric Constant
"Shorted at Start"	_ . _ _	_ _ . _ _

Cursor .... 16.590 m
Distance/Div..... .25 m/div
Vertical Scale.... 158 mρ/div
VP 0.99
Noise Filter...... 1 avg
Power .... ac



Tektronix 1502B TDR
Date 2/21/94
Cable 28A09
Notes AIR

Input Trace J.P.
Stored Trace
Difference Trace

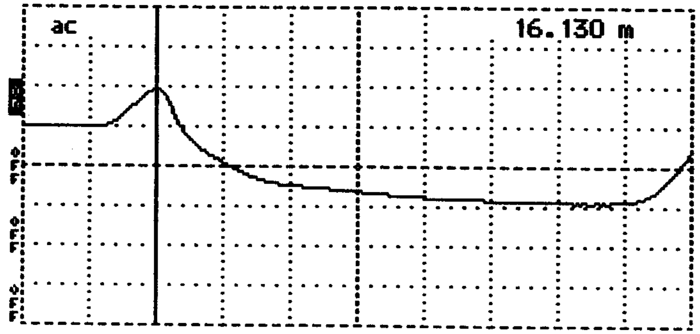
TDR Trace	Apparent Length, (m)	Dielectric Constant[1]
"In Air"	0.24	1.43

Data Sheet SMP-C01: TDR Probe Check

Figure B-1 (Continued). TDR Traces Obtained During Calibration

LTPP Seasonal Monitoring Program Data Sheet SMP-C01 (Page 2) TDR Probe Check	Agency Code [28] LTPP Section ID [A09]

Cursor .... 16.130 m
Distance/Div..... .25 m/div
Vertical Scale.... 158 mρ/div
Vp 0.99
Noise Filter...... 1 avg
Power........... ac



Tektronix 1502B TDR
Date 2/21/94
Cable 28A09
Notes WATER
70°F

Input Trace J.P.
Stored Trace
Difference Trace

TDR Trace	Apparent Length, (m)	Dielectric Constant[2]
"In Water"	1.80	80.28

[1] If dielectric constant not between 0.75 and 2.0, contact FHWA LTPP Division
[2] If dielectric constant not between 76 and 84, contact FHWA LTPP Division

Note: Dielectric constant is determined as follows:

$$\varepsilon = \left[\frac{(L_a)}{(L)(V_p)}\right]^2 = \left[\frac{(D_2 - D_1)}{(L)(V_p)}\right]^2$$

where ε = dielectric constant; L_a = apparent length of probe, m; L = actual length of probe units (= 0.203 m (8 in) for FHWA probes); V_p = phase velocity setting (= 0.99).

TDR Probe Serial Number: 28A09 TDR Probe Length, L: 0.203 m Length of Coax Cable: 12.2 m

Comments:

Prepared by: Mark 7. Wl Employer: BRE

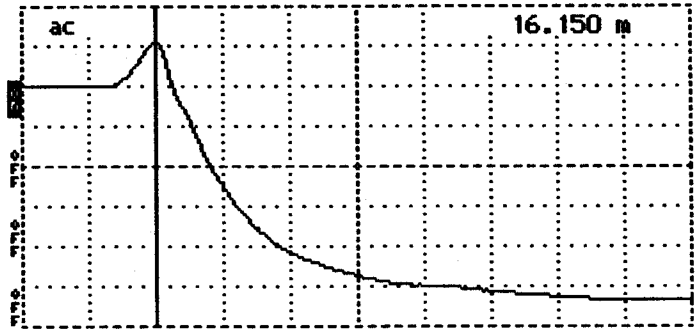
Date (dd/mmm/yy): 28/OCT/95

Data Sheet SMP-C01: TDR Probe Check (Continued)

Figure B-1 (Continued). TDR Traces Obtained During Calibration

LTPP Seasonal Monitoring Program Data Sheet SMP-C01 (Page 1) TDR Probe Check	Agency Code [28] LTPP Section ID [_A10]

Cursor .... 16.150 m
Distance/Div..... .25 m/div
Vertical Scale.... 158 mρ/div
Vp 0.99
Noise Filter...... 1 avg
Power.......... ac

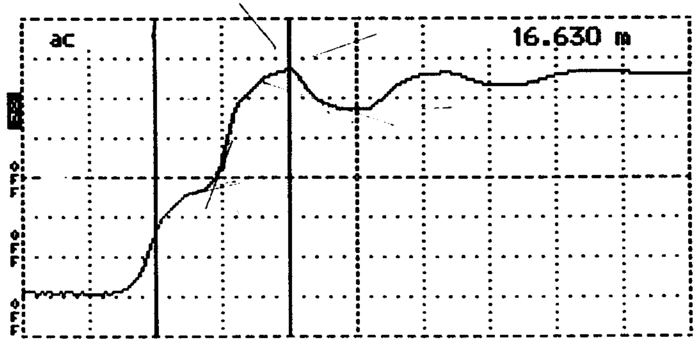


Tektronix 1502B TDR
Date 2/21/94
Cable 28A10
Notes SHORTED

Input Trace J.P.
Stored Trace
Difference Trace

TDR Trace	Apparent Length, (m)	Dielectric Constant
"Shorted at Start"	_._ _	_ _._ _

Cursor .... 16.630 m
Distance/Div..... .25 m/div
Vertical Scale.... 158 mρ/div
Vp 0.99
Noise Filter...... 1 avg
Power.......... ac



Tektronix 1502B TDR
Date 2/21/94
Cable 28A10
Notes AIR

Input Trace J.P
Stored Trace
Difference Trace

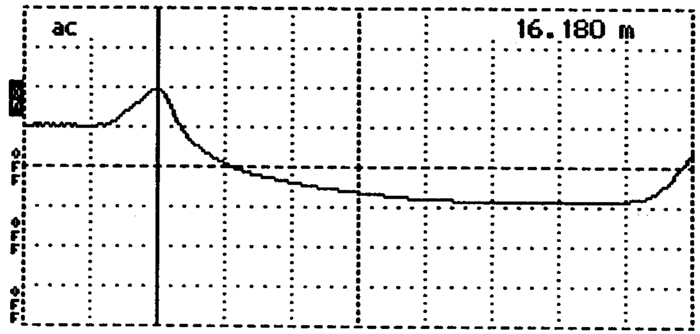
TDR Trace	Apparent Length, (m)	Dielectric Constant[1]
"In Air"	0.24	_1.43

Data Sheet SMP-C01: TDR Probe Check

Figure B-1 (Continued). TDR Traces Obtained During Calibration

LTPP Seasonal Monitoring Program Data Sheet SMP-C01 (Page 2) TDR Probe Check	Agency Code [2 8] LTPP Section ID [_ A 1 0]

Cursor .... 16.180 m
Distance/Div ..... .25 m/div
Vertical Scale.... 158 mρ/div
Vp 0.99
Noise Filter...... 1 avg
Power .... ac



Tektronix 1502B TDR
Date 2/21/94
Cable 28A10
Notes WATER
70°F

Input Trace J.P.
Stored Trace ....
Difference Trace ....

TDR Trace	Apparent Length, (m)	Dielectric Constant[2]
"In Water"	1.84	83.88

[1] If dielectric constant not between 0.75 and 2.0, contact FHWA LTPP Division
[2] If dielectric constant not between 76 and 84, contact FHWA LTPP Division

Note: Dielectric constant is determined as follows:

$$\varepsilon = \left[\frac{(L_a)}{(L)(V_p)}\right]^2 = \left[\frac{(D_2 - D_1)}{(L)(V_p)}\right]^2$$

where ε = dielectric constant; L_a = apparent length of probe, m; L = actual length of probe units (= 0.203 m (8 in) for FHWA probes); V_p = phase velocity setting (= 0.99).

TDR Probe Serial Number: 28A10 TDR Probe Length, L: 0.203 m Length of Coax Cable: 12.2 m

Comments: ____________________

Prepared by: Mark 7.W Employer: BRE

Date (dd/mmm/yy): 28/__7/95

Data Sheet SMP-C01: TDR Probe Check (Continued)

Figure B-1 (Continued). TDR Traces Obtained During Calibration

APPENDIX C

Instrumentation Installation Information

Appendix C contains the following information:

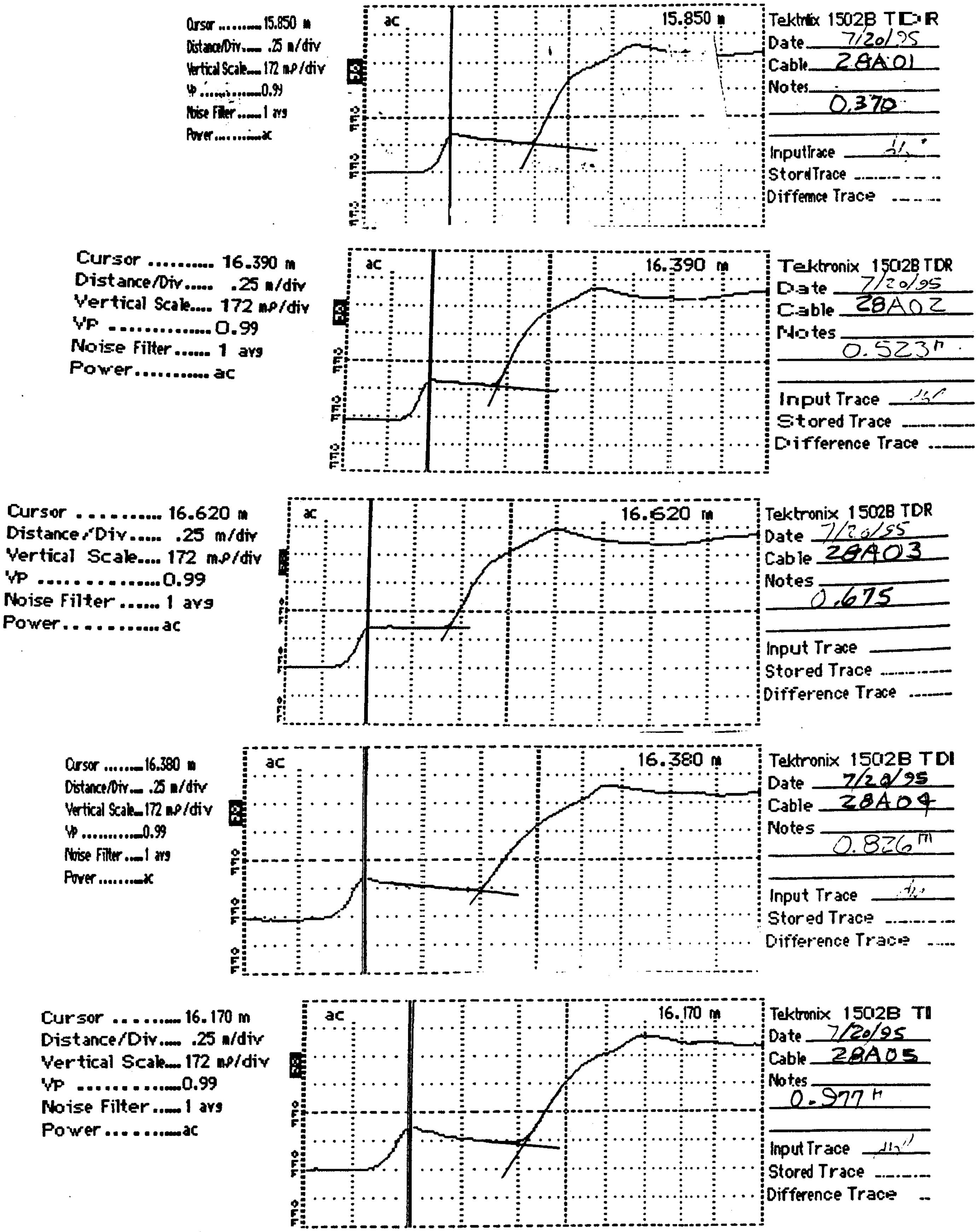
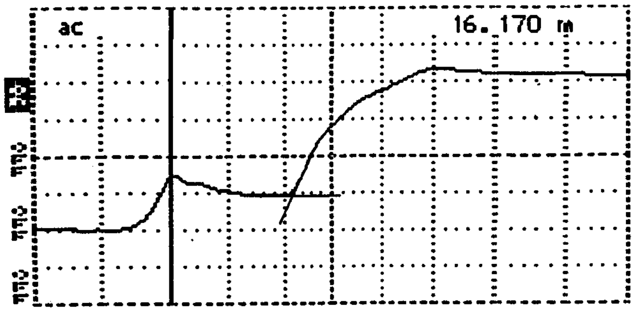


Figure C-1. TDR Traces During Installation

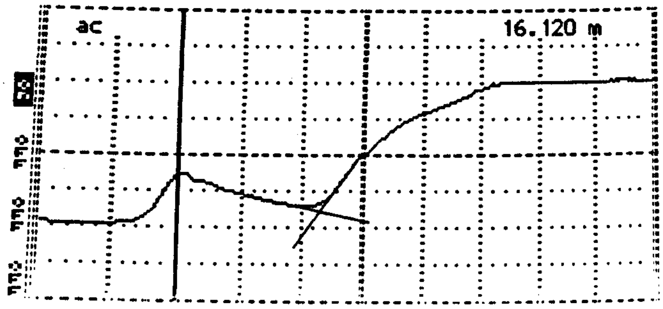
Cursor .... 16.170 m
Distance/Div..... .25 m/div
Vertical Scale.... 172 mρ/div
VP 0.99
Noise Filter...... 1 avg
Power .... ac



Tektronix 1502B TDR
Date 7/20/95
Cable 28A06
Notes
1.130 m

Input Trace dlp
Stored Trace ......
Difference Trace —

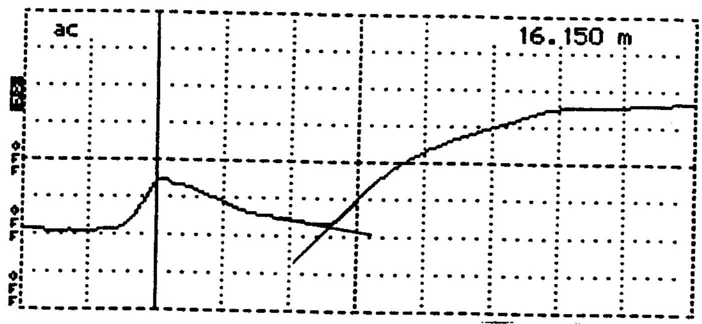
Cursor .... 16.120 m
Distance/Div..... .25 m/div
Vertical Scale.... 172 mρ/div
VP 0.99
Noise Filter...... 1 avg
Power .... ac



Tektronix 1502B TDR
Date 7/20/95
Cable 28A07
Notes
1.255 m

Input Trace dlp
Stored Trace ......
Difference Trace —

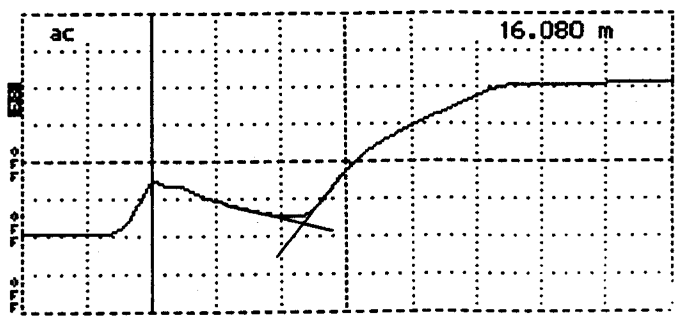
Cursor .... 16.150 m
Distance/Div..... .25 m/div
Vertical Scale.... 172 mρ/div
VP 0.99
Noise Filter...... 1 avg
Power .... ac



Tektronix 1502B TDR
Date 7/20/95
Cable 28A08
Notes
1.435 m

Input Trace dlp
Stored Trace ......
Difference Trace —

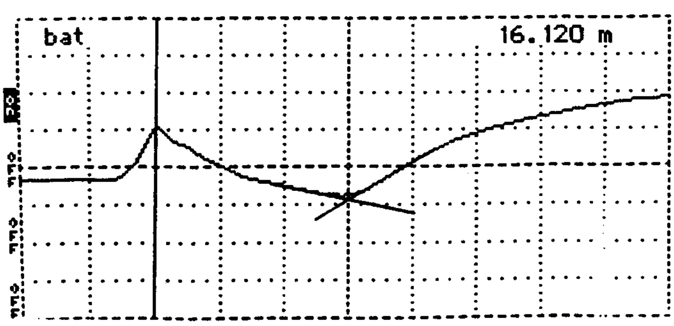
Cursor .... 16.080 m
Distance/Div..... .25 m/div
Vertical Scale.... 172 mρ/div
VP 0.99
Noise Filter...... 1 avg
Power .... ac



Tektronix 1502B TDR
Date 7/20/95
Cable 28A09
Notes
1.730 m

Input Trace dlp
Stored Trace ......
Difference Trace ......

Cursor .... 16.120 m
Distance/Div..... .25 m/div
Vertical Scale.... 172 mρ/div
VP 0.99
Noise Filter...... 1 avg
Power .... bat



Tektronix 1502B TDR
Date 7/20/95
Cable 28A10
Notes
2.05 m

Input Trace dlp
Stored Trace ......
Difference Trace ......

Figure C-1 (Continued). TDR Traces During Installation

Table C-1. Field Measured Moisture Contents

SITE NO. 281802 7/20/95

MOISTURE CONTENTS FOR TDR

TDR #	WT. OF PAN(g)	(WET) PAN & SOIL(g)	(DRY) PAN & SOIL(g)	M.C. (%)
28A10	174.5	332.6	307.4	19.0%
28A09	181.1	311.2	295.0	14.2%
28A08	149.7	287.2	270.1	14.2%
28A07	172.0	313.3	300.0	10.4%
28A06	151.0	294.1	278.8	12.0%
28A05	202.6	349.6	328.7	16.6%
28A04	148.5	259.8	246.6	13.5%
28A03	181.1	270.3	259.3	14.1%
28A02	170.0	262.4	253.5	10.7%
28A01	151.6	236.3	230.9	6.8%

LTPP Seasonal Monitoring Program Data Sheet SMP-I07 Representative Dry Density	Agency Code		[2 8]
	LTPP Section ID	28SA	[1 8 0 2]

Depth of Representative Sample (from pavement surface): 1 . 2 2 m

Dry Density Determination:

a.	Tare Weight of Empty Mold:	4 1 0 1 g (9 . 0 2 lb)
b.	Weight of Mold and Compacted Soil:	6 1 3 5 g (13 . 5 0 lb)
c.	Weight of Compacted Soil (b - a):	2 0 3 4 g (4 . 4 2 lb)
d.	Unit Weight of Compacted Soil = (c / 943.0) =	2 . 1 6 g/cm³
	([c / (1 / 30)] =	1 3 4 . 2 lb/ft³)
e.	Dry Density of Compacted Soil = [d / (1 + r/100)] =	1 . 9 0 g/cm³
		(1 1 8 . 3 lb/ft³)

Moisture Content Determination:

m.	Tare Weight of Pan:	1 7 1 . 8 g
n.	Weight of Pan and Moisture Sample:	3 7 7 . 5 g
o.	Weight of Pan and Dry Sample:	3 5 3 . 0 g
p.	Weight of Moisture (n - o):	2 4 . 5 g
q.	Weight of Dry Sample (o - m):	1 8 1 . 2 g
r.	Moisture Content by Weight = [(p / q) * 100] =	1 3 . 5 %

Comments: Soil was a sandy reddish-brown color, with a high content of clay. Very few if any rocks found in soil. Soil was difficult to turn to base state, and may have caused some error

Prepared by: Hunter Estes Employer: BRE

Date (dd/mmm/yy): 20 / JUL / 95

Data Sheet SMP-I07: Representative Dry Density

Figure C-2. Field Proctor Test

APPENDIX D

Initial Data Collection

Appendix D contains the following support information:

Table D-1. Raw Data from the On-Site Data Logger During Initial Data Collection

```
5,1995,202,100,12.08,23.47,0
6,1995,202,100,33,35,36.49,37.01,36.96
5,1995,202,200,12.08,22.97,0
6,1995,202,200,32.35,34.37,35.97,36.65,36.74
5,1995,202,300,12.08,22.52,0
6,1995,202,300,31.76,33.8,35.49,36.3,36.5
5,1995,202,400,12.08,22.24,0
6,1995,202,400,31.23,33.28,35.02,35.95,36.25
5,1995,202,500,12.07,22.39,0
6,1995,202,500,30.75,32.8,34.59,35.6,35.98
5,1995,202,600,12.07,23.69,0
6,1995,202,600,30.47,32.4,34.19,35.27,35.73
5,1995,202,700,12.07,24.7,0
6,1995,202,700,30.28,32.09,33.84,34.95,35.46
5,1995,202,800,12.07,25.48,0
6,1995,202,800,30.51,31.94,33.54,34.66,35.22
5,1995,202,900,12.08,27.65,0
6,1995,202,900,32.44,32.3,33.39,34.42,34.99
5,1995,202,1000,12.08,29.68,0
6,1995,202,1000,36.37,33.96,33.67,34.28,34.8
5,1995,202,1100,12.09,31.41,0
6,1995,202,1100,40.46,36.34,34.5,34.39,34.72
5,1995,202,1200,12.09,32.89,0
6,1995,202,1200,44.5,38.89,35.71,34.81,34.81
5,1995,202,1300,12.09,33.85,0
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5,1995,202,2000,12.08,25.43,.4
6,1995,202,2000,35.74,39.26,40.59,40.19,38.98
5,1995,202,2100,12.08,24.65,0
6,1995,202,2100,33.98,37.27,39.25,39.65,38.93
5,1995,202,2200,12.07,24.29,0
6,1995,202,2200,33.71,36.17,38.15,38.97,38.64
5,1995,202,2300,12.07,23.93,0
6,1995,202,2300,33.25,35.5,37.35,38.32,38.26
1,1995,202,2400,12.08,12.1,1438,12.06,2307,27.14,36.65,1605,22.06,357,4.8,4067
2,1995,202,2400,38.06,37.7,37.22,36.92,36.61,36.3,35.93,35.76,35.08,34.55,33.92,33.36,32.77,32.14,31.51,30.73,30.14,29.51
3,1995,202,2400,53.37,1419,48.01,1640,42.89,1705,40.4,1846,39.04,1950,37.93,2055,37.02,2156,36.5,2312,35.34,2358,34.76,1202,34.11,1149,33.54,1359,32.95,1222,32.3,1355,31.68,1402,31.06,1149,30.49,1551,29.86,1652
4,1995,202,2400,30.24,634,31.94,706,33.35,832,34.26,926,34.67,1025,34.84,1622,34.49,1622,33.93,1622,33.34,1622,32.78,1622,32.12,1622,31.5,1622,31.07,1622,30.32,1622,29.71,1622,-225.9,1622,-225.9,1622,-225.9,1622
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6,1995,202,2400,32.78,34.9,36.7,37.76,37.86
```

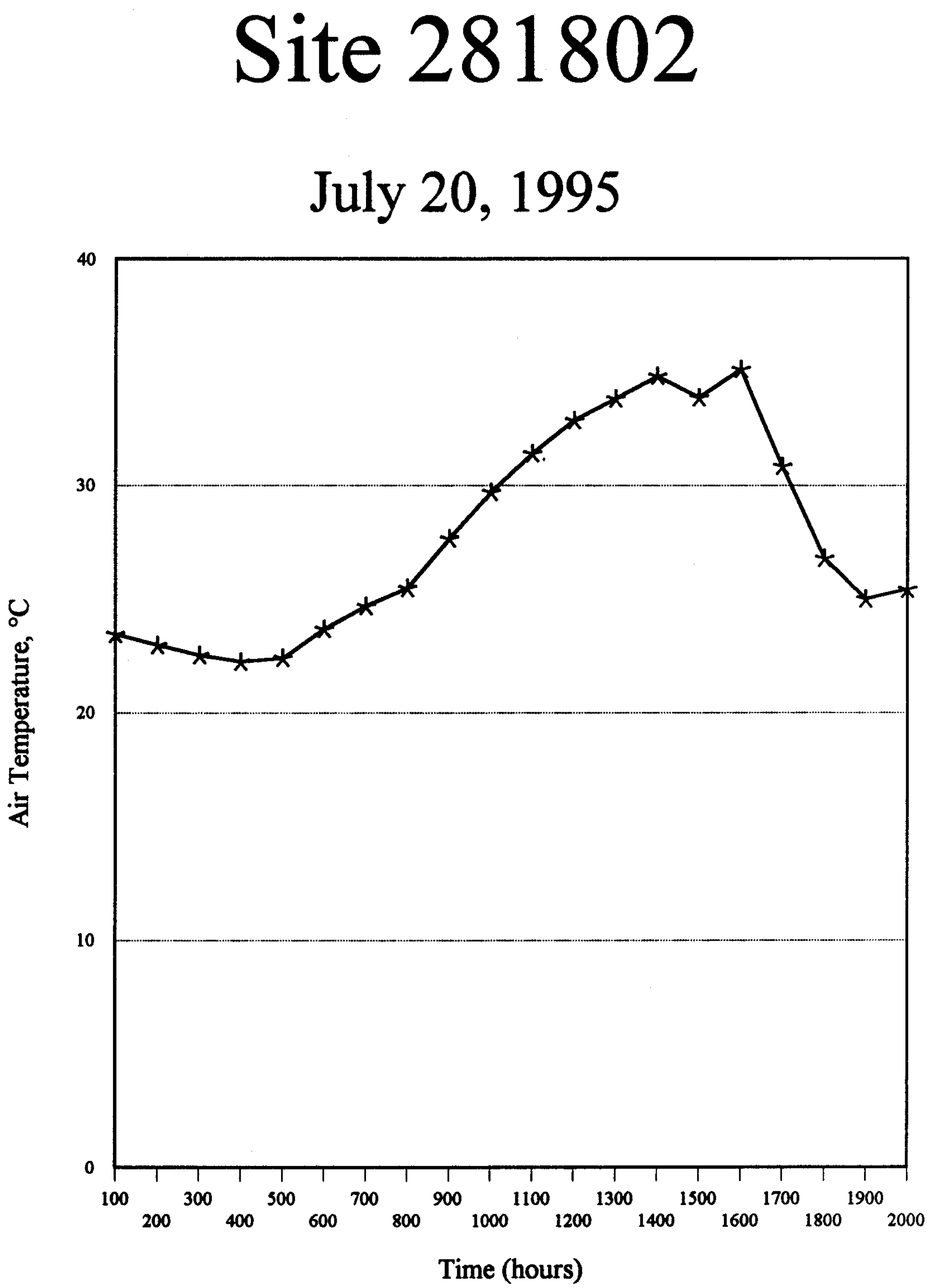


Figure D-1. Measured Air Temperature During July Data Collection.

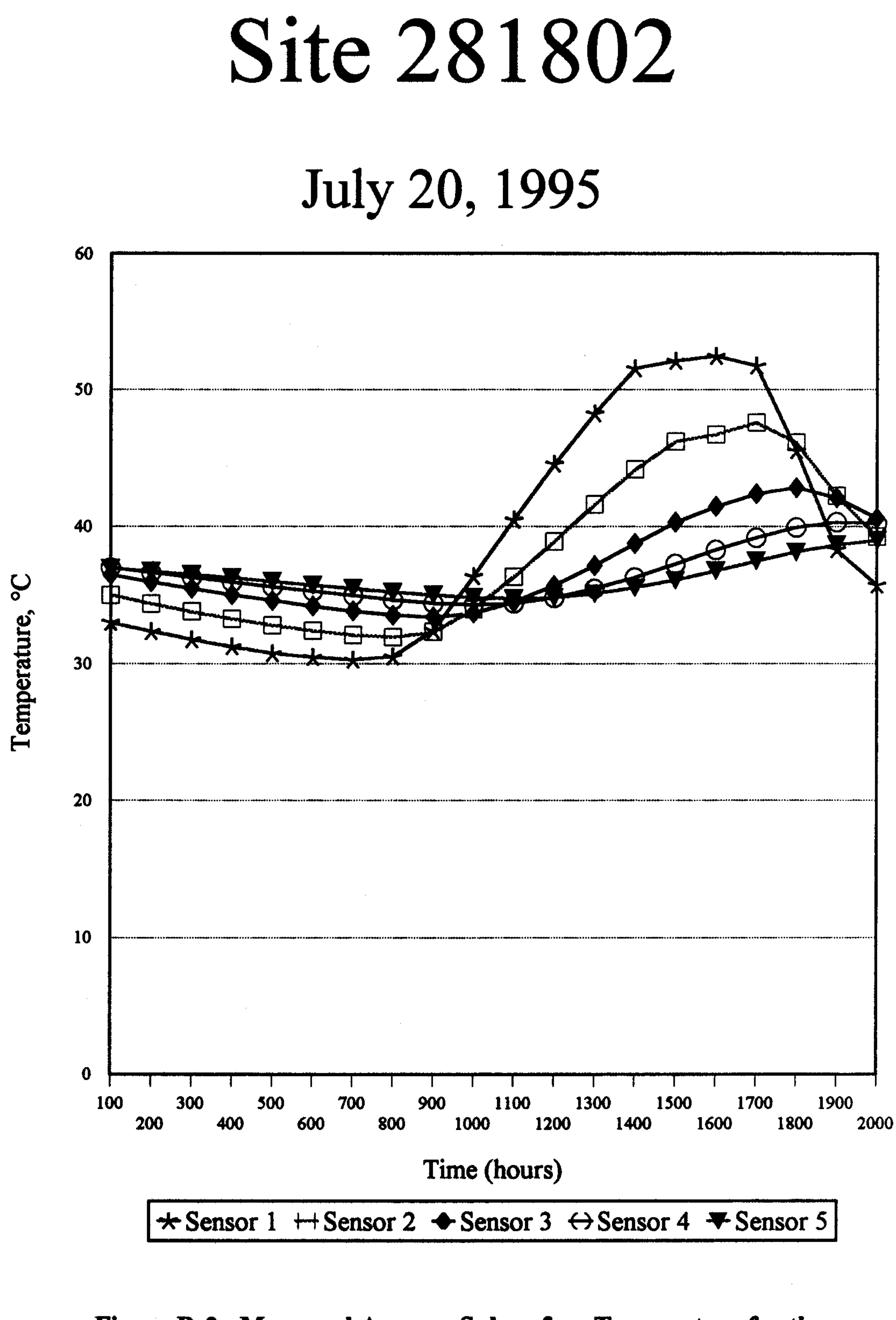


Figure D-2. Measured Average Subsurface Temperature for the First 5 Sensors During July Data Collection.

Site 281802

July 20, 1995

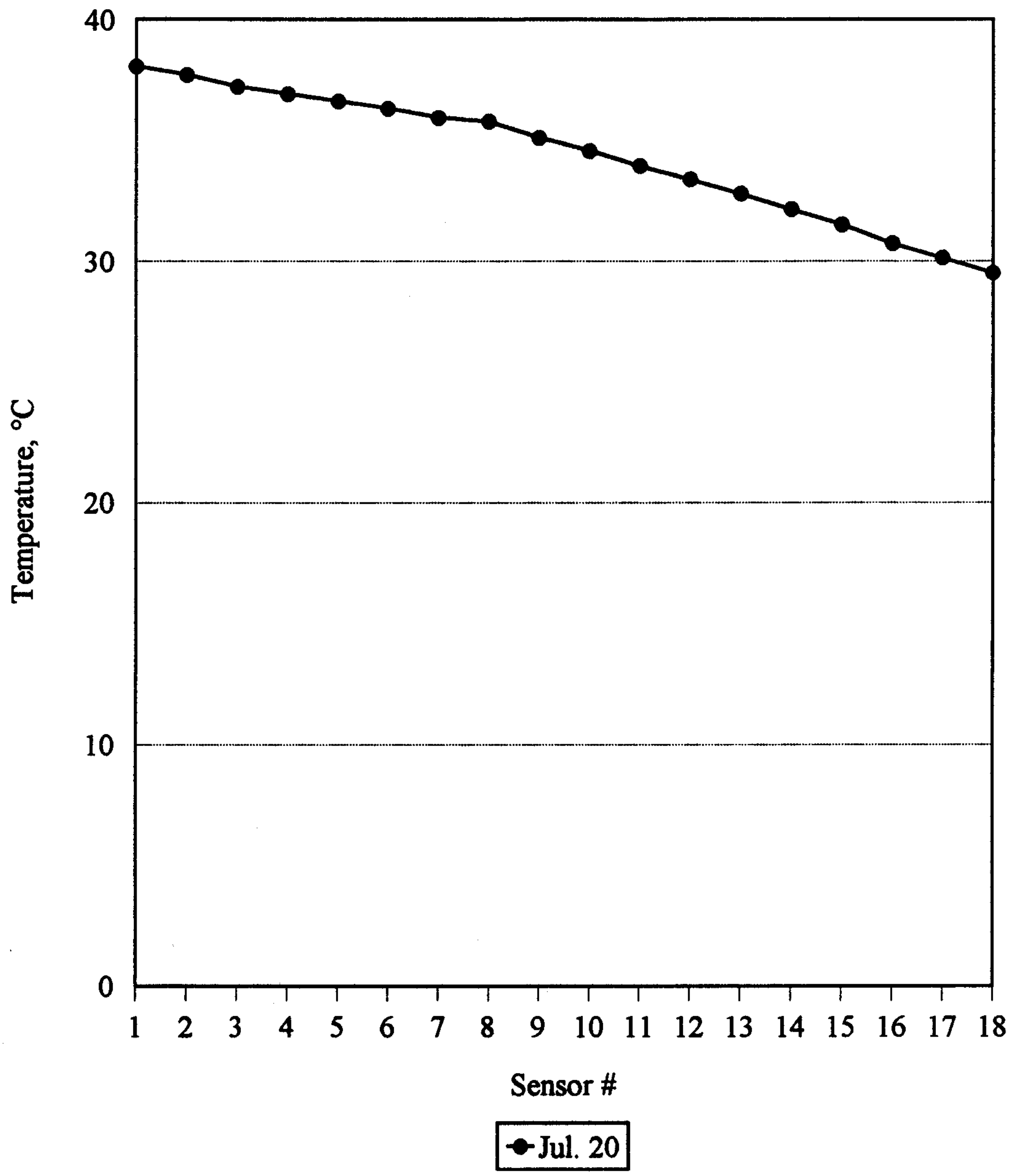


Figure D-3. Measured Average Subsurface Temperature for all 18 Sensors on July 20th.

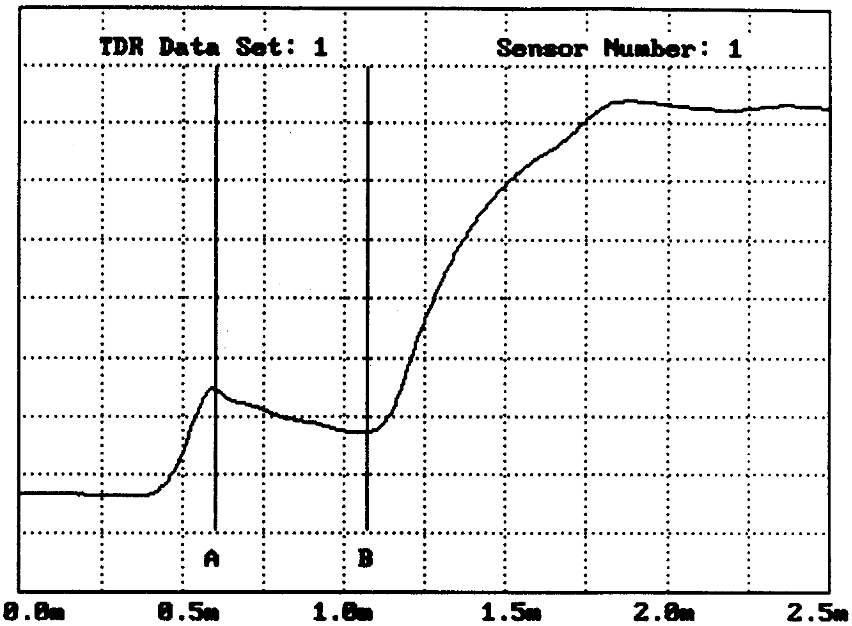
TDR RESULTS

File: 28SA95AG.MOB

Date: Jul 20, 1995
Time of Day: 13:34
Dist → Curs (m): 10.0
Dist btn WvFm (m):.01
Gain: 60
Offset: 53113
Sample No: 1

A (m) = 0.60
B (m) = 1.07
Trace Length (m)=0.47
Diele. Const.= 5.5
Volumetr MC (%)= 9.1

Total 2 Set Data



Esc=Menu; ↑ ↓; Ctr+PgU/Ctr+PgD=Prior/Next Set; F5=Res Data; F2=PrnScn; F8=A,F9=B

Figure D-4. Trace from TDR Sensor 1

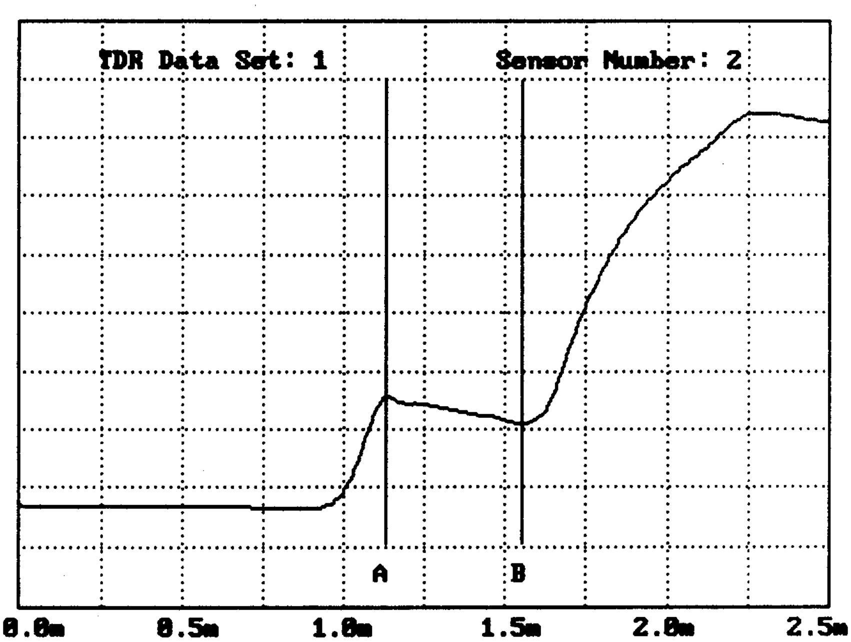
TDR RESULTS

File: 28SA95AG.MOB

Date: Jul 20, 1995
Time of Day: 13:35
Dist → Curs (m): 10.0
Dist btn WvFm (m):.01
Gain: 59
Offset: 53135
Sample No: 1

A (m) = 1.13
B (m) = 1.55
Trace Length (m)=0.42
Diele. Const.= 4.4
Volumetr MC (%)= 6.4

Total 2 Set Data



Esc=Menu; ↑ ↓; Ctr+PgU/Ctr+PgD=Prior/Next Set; F5=Res Data; F2=PrnScn; F8=A,F9=B

Figure D-5. Trace from TDR Sensor 2

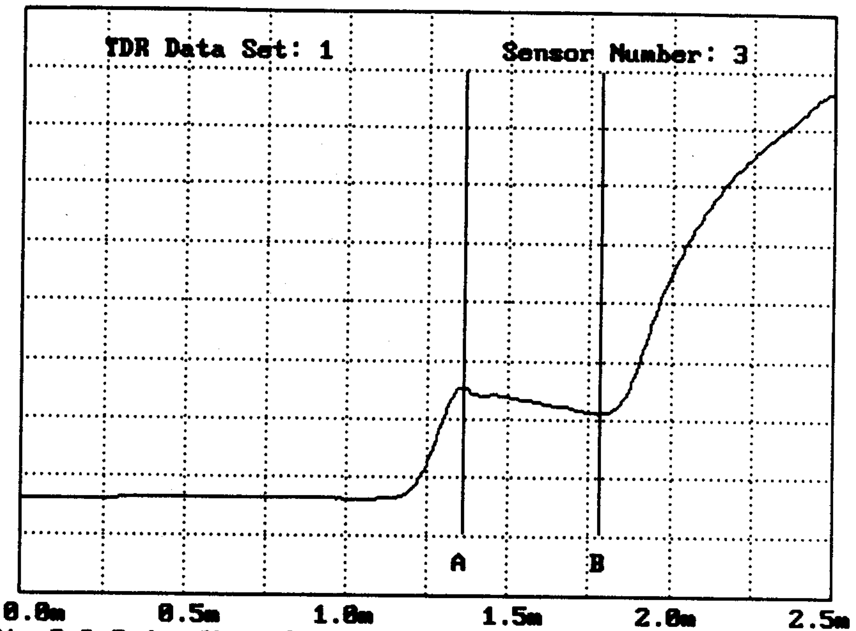
TDR RESULTS

File: 28SA95AG.MOB

Date: Jul 28, 1995
Time of Day: 13:35
Dist → Curs (m): 18.8
Dist btn WvFm (m):.81
Gain: 68
Offset: 53175
Sample No: 1

A (m) = 1.36
B (m) = 1.78
Trace Length (m)=8.42
Diele. Const.= 4.4
Volumetr MC (%)= 6.4

Total 2 Set Data



Esc=Menu; ↑ ↓; Ctr+PgU/Ctr+PgD=Prior/Next Set; F5=Res Data; F2=PrnScn; F8=A,F9=B

Figure D-6. Trace from TDR Sensor 3

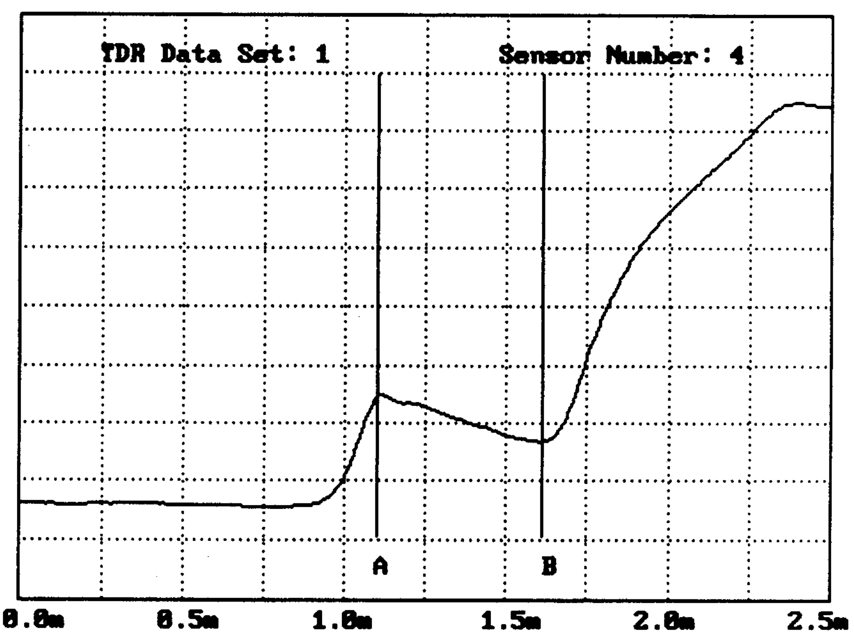
TDR RESULTS

File: 28SA95AG.MOB

Date: Jul 28, 1995
Time of Day: 13:36
Dist → Curs (m): 18.8
Dist btn WvFm (m):.81
Gain: 68
Offset: 53134
Sample No: 1

A (m) = 1.18
B (m) = 1.61
Trace Length (m)=8.51
Diele. Const.= 6.4
Volumetr MC (%)= 11.3

Total 2 Set Data



Esc=Menu; ↑ ↓; Ctr+PgU/Ctr+PgD=Prior/Next Set; F5=Res Data; F2=PrnScn; F8=A,F9=B

Figure D-7. Trace from TDR Sensor 4

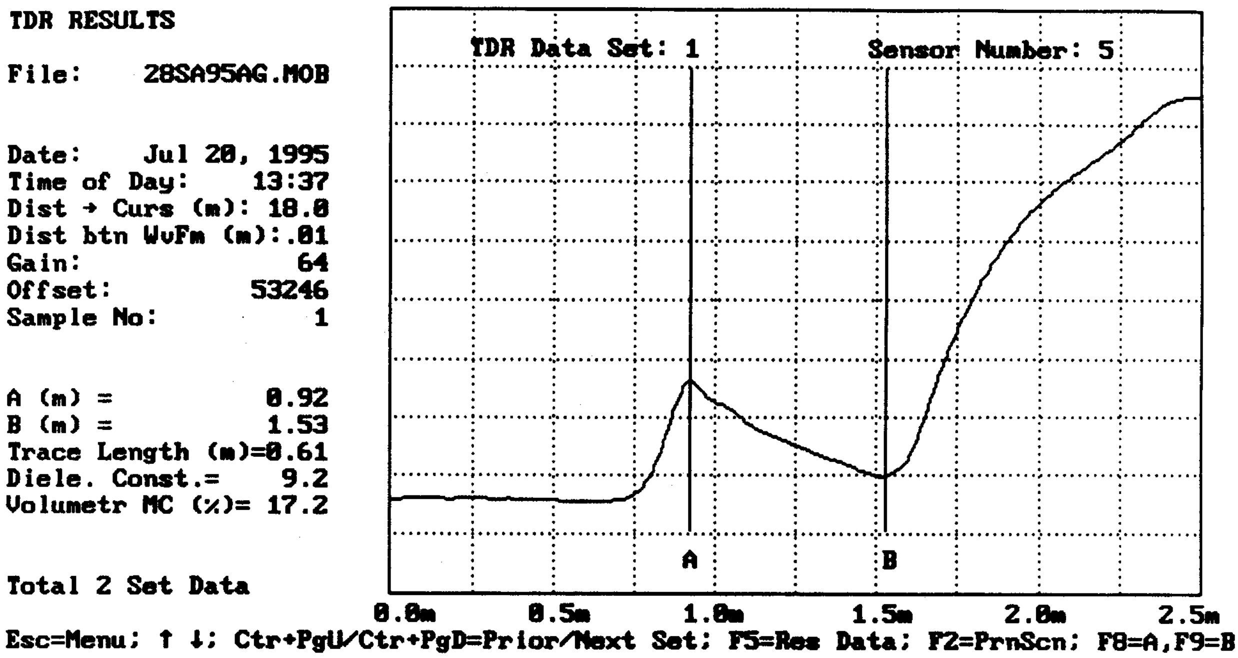


Figure D-8. Trace from TDR Sensor 5

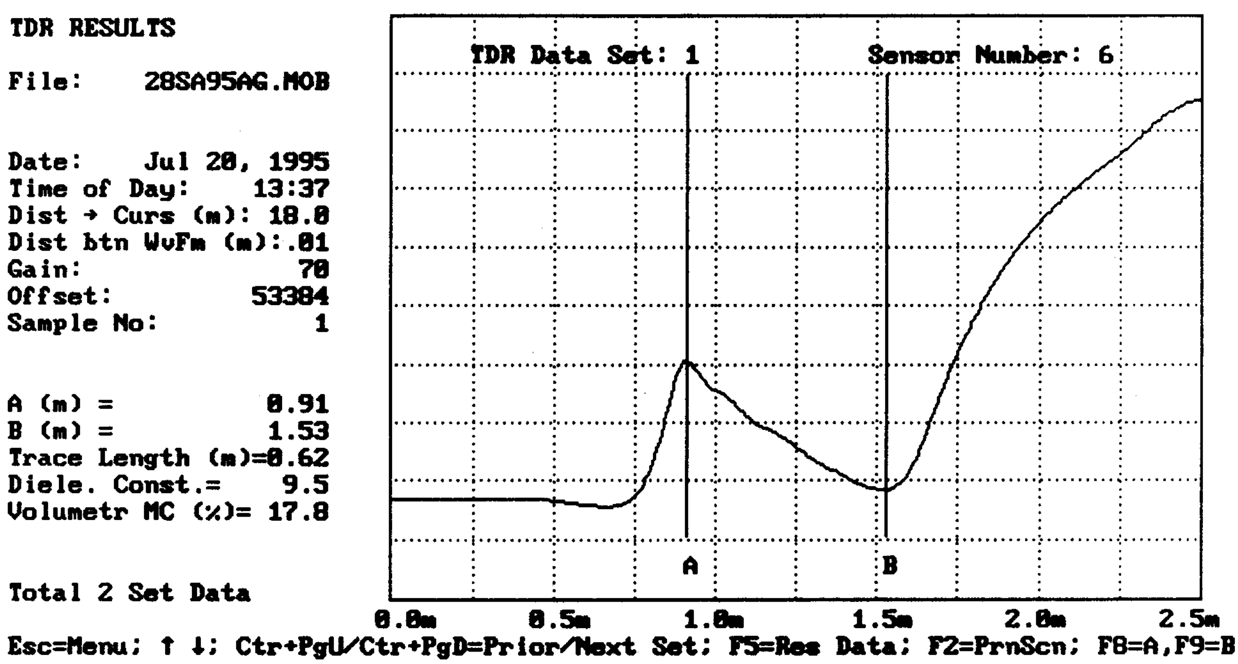


Figure D-9. Trace from TDR Sensor 6

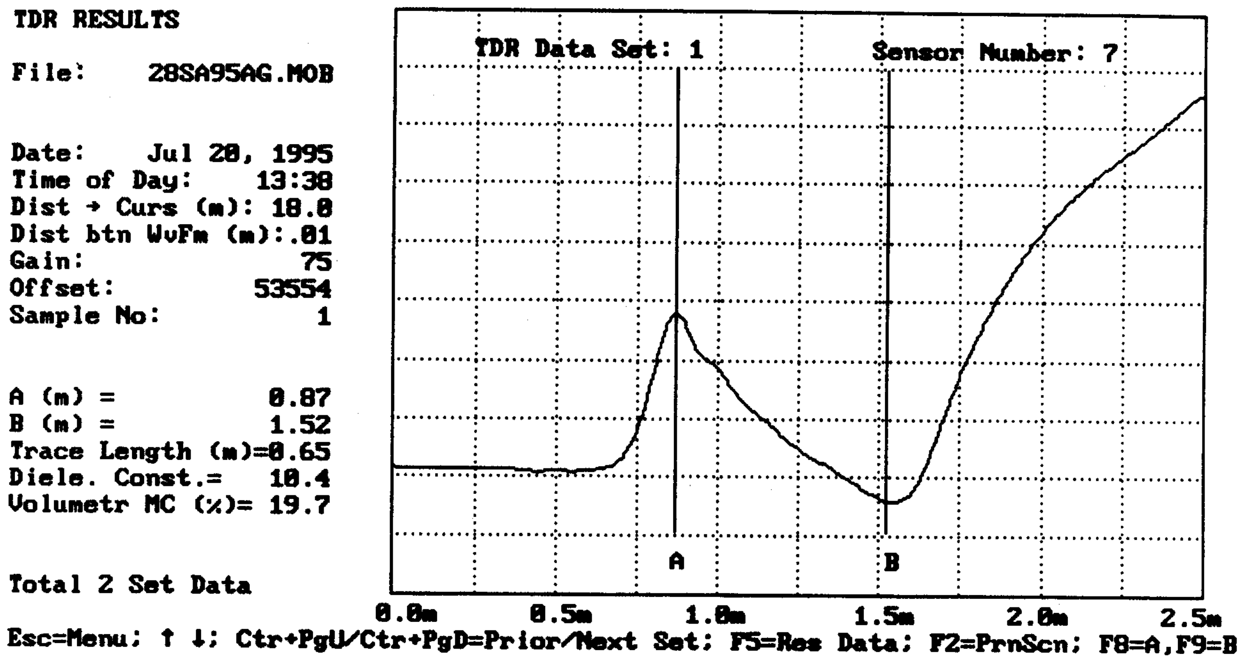


Figure D-10. Trace from TDR Sensor 7

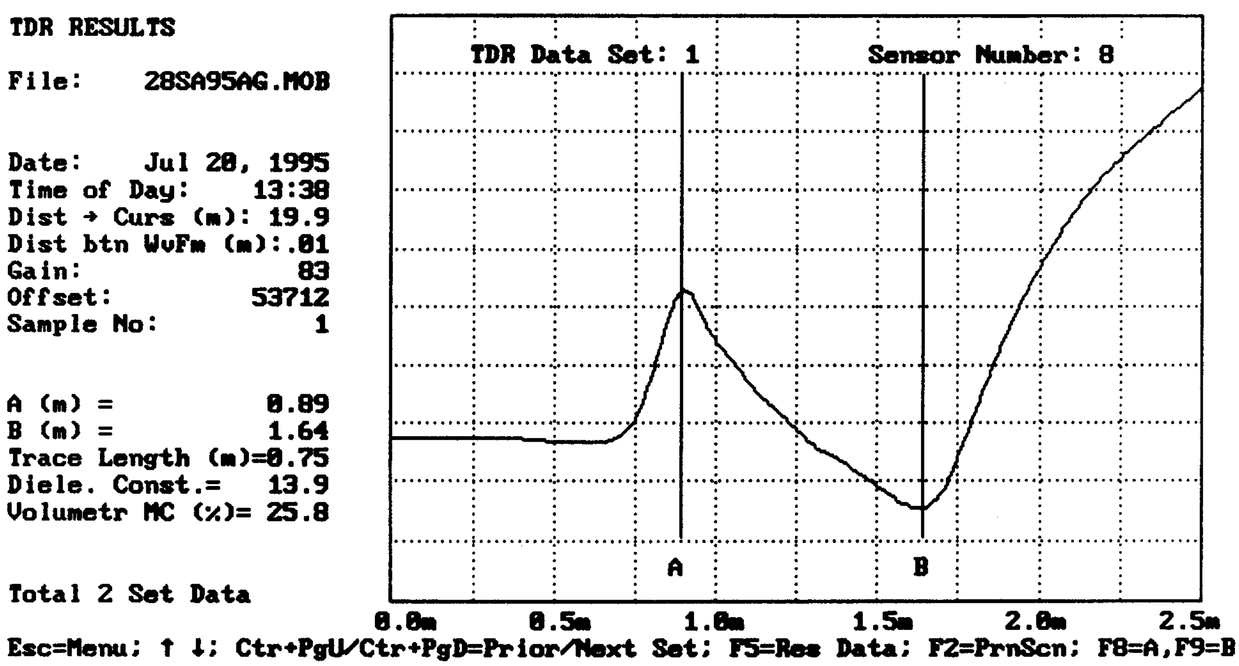


Figure D-11. Trace from TDR Sensor 8

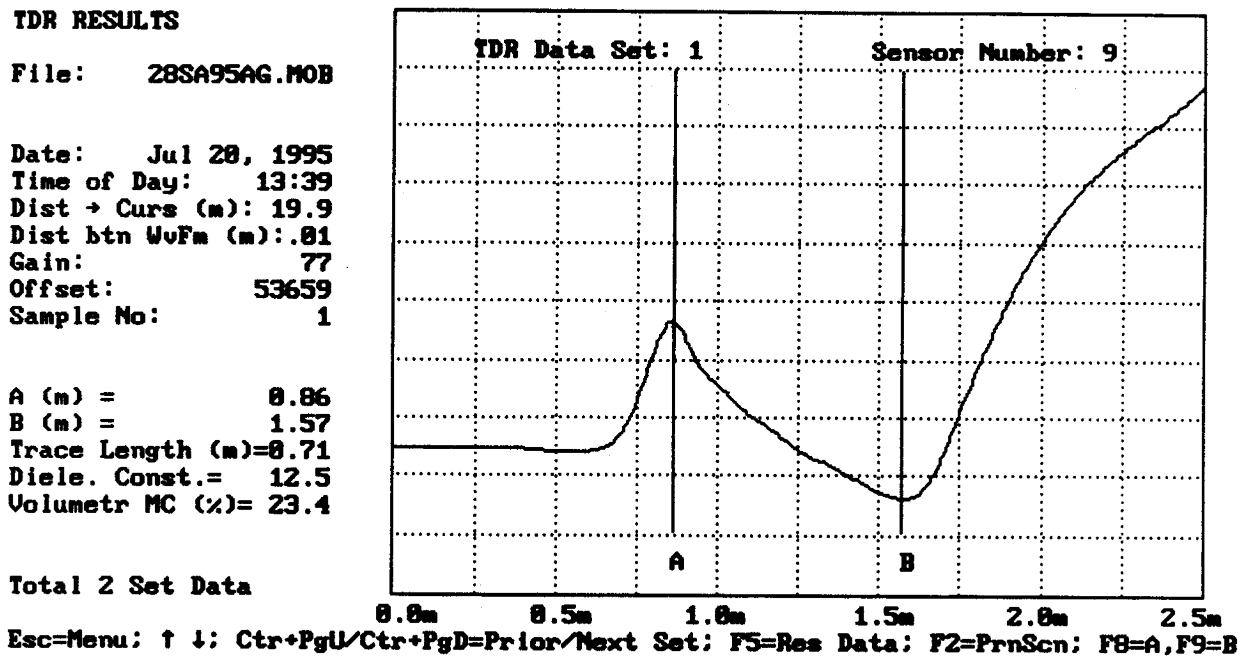


Figure D-12. Trace from TDR Sensor 9

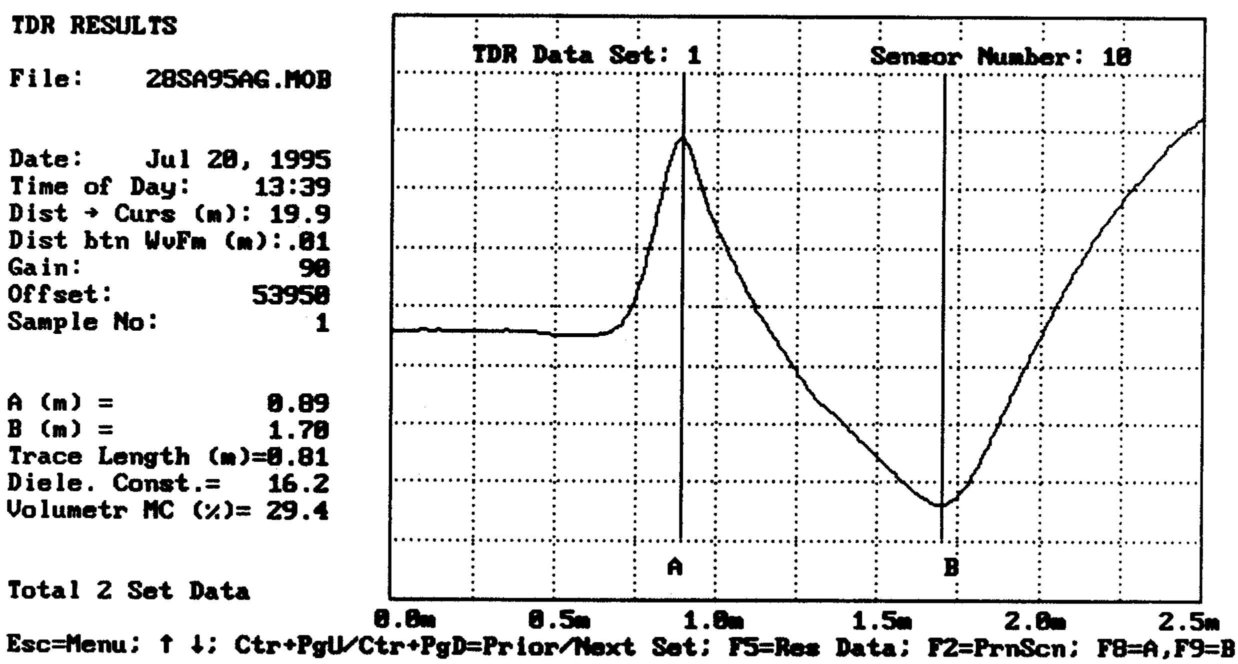


Figure D-13. Trace from TDR Sensor 10

Table D-2. Elevation Measurements Data Sheet - AC

SEASONAL MONITORING
"FLEX" TRANSVERSE ELEVATION MEASUREMENTS[1] 28SA

Station	Outside Edge		OWP		ML		IWP		Inside Edge	
	O/S	Elev.	O/S	Elev.	O/S	Elev.	O/S	Elev.	O/S	Elev.
3+00	.15m	10.702	.90m	10.709	1.90	10.723	2.70m	10.728	3.60m	10.735
3+25	"	10.583	"	10.593	"	10.606	"	10.610	"	10.618
3+50	"	10.473	"	10.481	"	10.494	"	10.498	"	10.504
3+75	"	10.360	"	10.368	"	10.381	"	10.385	"	10.390
4+00	"	10.245	"	10.251	"	10.265	"	10.269	"	10.275
4+25	"	10.131	"	10.138	"	10.150	"	10.157	"	10.165
4+50	"	10.020	"	10.026	"	10.039	"	10.046	"	10.053
4+75	"	9.903	"	9.910	"	9.924	"	9.929	"	9.935
5+00	.15m	9.786	.90m	9.790	1.90m	9.804	2.70	9.809	3.60m	9.318
5+10		INSTRUMENTATION								
5+20			.90m	9.700	1.90m	9.713				
5+30			.90m	9.653						

Bench Mark :

BM. STA. 4+00, RT. 14' : TOP OF 1" WELL PIPE. ASSUMED ELEV. 10.000 M

TBM Sta 3+54 - 32' Rt - Chiseled/scratched "+" on end of culvert Pipe

Elev. (9.846 m)

Comments: 3.70 P.K. NAIL TO P.K. NAIL, LANE CONTROL

INST. @ 4+12 ON SHOULDER

P. CLOUDY, HOT, HUMID

TIE IN - ✓

Test Section No.	281802	Date (dd,mm,yy)	19/07/95
Start Time (Military)	14.38	Device Used	LASER LEVEL
Recorded By	JLP, SD.	Employer	BRE

[1] OWP and ML readings to be taken at FWD test locations

07/11/95

APPENDIX E

Photographs

Appendix E contains the following photographs:

Photo E-1. FWD Testing Prior to Installation

Photo E-2. Augering of Instrumentation Hole

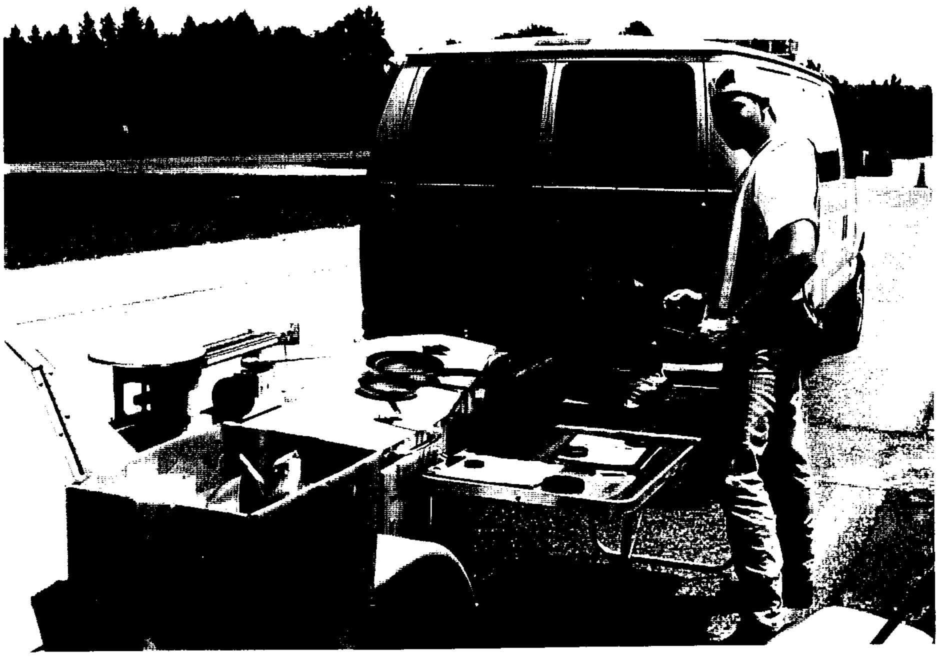


Photo E-3. Field Moisture Content Measurements

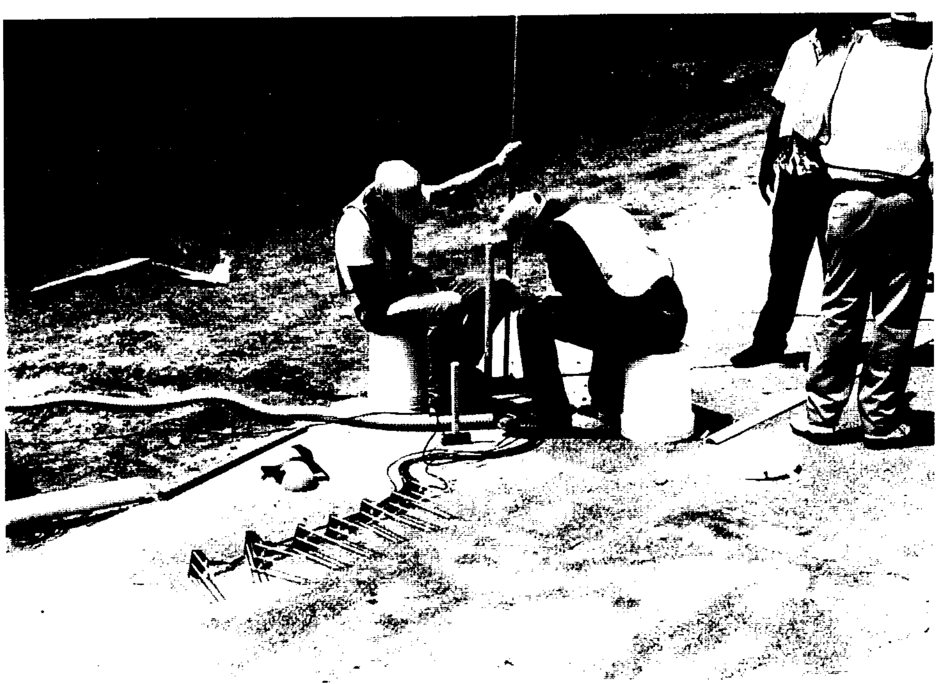


Photo E-4. Placement of TDRs During Backfilling of Soil

Photo E-5. Preparation of Core Prior to Replacement

Photo E-6. Location of Weather Station and Equipment Cabinet