LTPP Seasonal Monitoring Program

Site Installation and Initial Data Collection
Section 133019, Gainesville, Georgia

Prepared by

Brent Rauhut Engineering Inc.
8240 Mopac, Suite 220
Austin, Texas 78759

Prepared for

Federal Highway Administration
LTPP Division, HNR-40
Turner-Fairbanks Highway Research Center
6300 Georgetown Pike
McLean, Virginia 22101

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16. Abstract

This report contains a description of the instrumentation installation activities and initial data collection for test section 133019, which is a part of the LTPP Core Seasonal Monitoring Program. This jointed plain concrete surfaced pavement test section, which is located on US-23 in the southbound lanes, approximately 9.66 km north of Gainesville, was instrumented on 31 July-1 August 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 1 August 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		18. Distribution Statement	
Pavement, Highway, Instrumentation, Monitoring, Time Domain Reflectometry, Thermistor, Piezometer Observation Well, Test Equipment, Field Tests.			
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Table of Contents

List of Tables

SEASONAL INSTRUMENTATION STUDY
INSTRUMENTATION INSTALLATION
GEORGIA SECTION 133019/13SA

I. Introduction

The seasonal instrumentation installation of Section 133019 was performed on 31 July-1 August 1995.

The GPS-3 test section resides in Seasonal Cell 18 and is located in a wet-no freeze zone. The site (see Figure A-1) is in the southbound lanes on US-23, approximately 9.66 km north of Gainesville.

The average maximum daily temperature for the months of June through August is 30°C and the average minimum daily temperature for the months of December through February is 0°C. The average annual precipitation is 1367 mm.

The pavement is a jointed plain concrete structure consisting of approximately 227 mm of portland cement concrete (PCC) over 255 mm of crushed stone 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)
Portland Cement Concrete	227	- - -
Base	255	2163
Subgrade	---	N/A

For the jointed plain concrete pavement, a test pit section was not cut from the concrete; therefore the in situe dry density was not tested for the subgrade material.

The annual average daily traffic (AADT) in the GPS lane is almost 4600, of which 12.8% is truck traffic. The estimated annual ESALs on the GPS lane were 226,000. This information is based on traffic data collected on site.

Installation of the instrumentation was completed through the cooperative efforts of the Georgia Department of Transportation (Georgia 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:

Jon Peacock	SRCO, Brent Rauhut Engineering
Steve Davis	SRCO, Brent Rauhut Engineering
Robin Belt	SRCO, Brent Rauhut Engineering
Hunter Estes	SRCO, Brent Rauhut Engineering
Dennis Richardson	Georgia DOT
Clyde Blaine	Georgia DOT
Ricky Kilgore	Georgia DOT
Don Montgomery	Georgia DOT

II. Instrumentation Installation

Pre-Installation Activities

A pre-installation meeting was held at the Georgia DOT office of Materials and Research on 25 May 1995. The meeting agenda appears in Appendix B. The participants at the meeting were Dennis Richardson, Lamar Caylor and Larry Peirce. 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 1 August 1995 by Jon Peacock and Hunter Estes (SRCO). Deflection testing was conducted on 1 August 1995. The 0-21 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 №.
Instrument Hole		
MRC Thermistor Probe	1	286 (13AT)
TDR Sensors	10	13A01-13A10
Equipment Cabinet		
CR10 Data Logger	1	16522
Battery Package	1	Gel Cell
Weather Station		
Tipping-Bucket Rain Gauge	1	12077-693
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 JCP layer.
	2	Not Measured	
	3	Not Measured	
2	4	20	This unit was installed in the base and subgrade.
	5	93	
	6	172	
	7	244	
	8	321	
	9	474	
	10	626	
	11	779	
	12	931	
	13	1082	
	14	1239	
	15	1387	
	16	1541	
	17	1695	
	18	1842	

Location of Instrumentation

The instrumentation was installed at Station 0-21 of the test section. Approximately 900 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, 2.22 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 7.60 m from the lane edge.

The piezometer observation well was installed at Station 0+71 of the test section approximately 4.9 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 31 July 1995 and was completed the following day. The Georgia 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 Georgia 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 a Set-45 concrete mixture. The overcuts from the pavement sawing operation (including the groove for the temperature probe) were also sealed with Dow-Corning 888 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. Snap rings for measuring joint movement were also installed on 22 January 1996. 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)
13A01	310	16.3	13.6
13A02	465	15.9	19.9
13A03	615	15.1	20.6
13A04	767	15.5	20.2
13A05	923	19.6	22.3
13A06	1073	18.0	24.7
13A07	1225	20.4	22.4
13A08	1370	20.8	23.5
13A09	1675	18.0	19.0
13A10	1970	18.4	28.0

Table 5. Thermistor Sensor Locations

Unit	Channel №.	Depth from Pavement Surface (mm)	Remarks
1	1	25	This unit was installed in the JCP layer.
	2	114	
	3	210	
2	4	305	This unit was installed in the base and subgrade.
	5	378	
	6	457	
	7	529	
	8	606	
	9	759	
	10	911	
	11	1064	
	12	1216	
	13	1367	
	14	1524	
	15	1672	
	16	1826	
	17	1980	
	18	2127	

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 31 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.

Joint Movement Measurements

For measuring joint movement, snap rings were set into the pavement itself. These rings were installed on 22 January 1996 by Robin Belt and Jon Peacock (SRCO). The rings were placed at distances of 0.3, 1.8 and 3.4 m from the outside pavement edge and 64 mm from the joint center on both sides. Holes (13 mm diameter and 13 mm deep) were drilled at these locations using a template to prevent bit wander and depth control, and the snap rings were sealed into place. These thin metal rings provide sharp edges for caliper jaw readings, resulting in high measurement accuracy of joint movement. Initial measurements can be found in Table D-3.

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 133019 (13SA) was completed on 31 July 1995 and initial data collection was completed on 1 August 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. Installation of snap rings for measuring changes in joint width was completed in January 1996.

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:

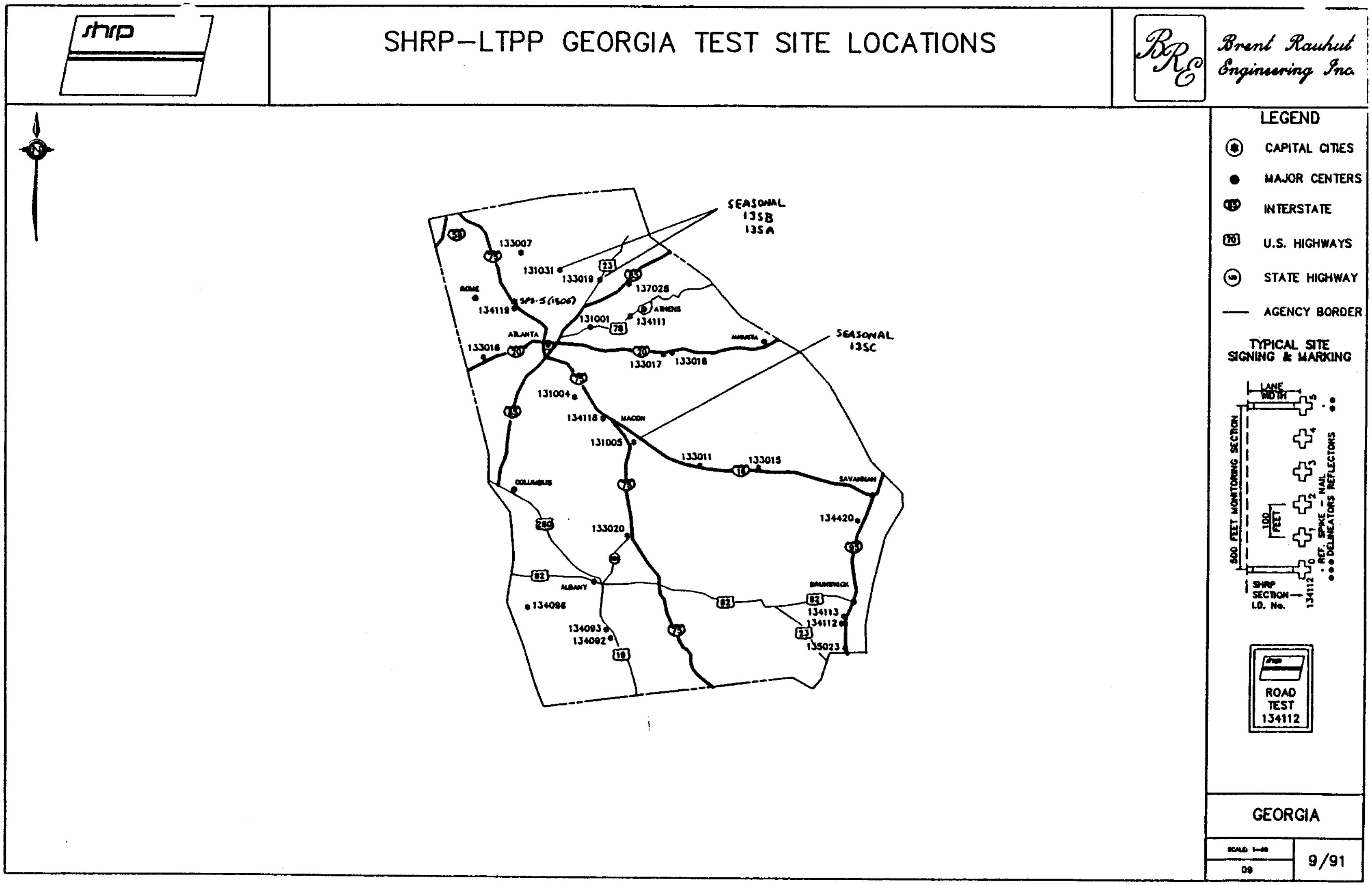


Figure A-1. Location of Test Site, GPS Test Section 133019

LTPP Seasonal Monitoring Program Data Sheet SMP-I04 Log of Instrumentation Hole	Agency Code 13SA [1 3] LTPP Section ID [3 0 1 9]

Operator: CLYDE Equipment Used: CME 750

Location: Station: 0 - 2 1 6 Offset: 0 . 9 0 m (from lane edge)

Bore Hole Diameter: 3 0 . mm

Scale (m)	Strata Change[1] (m)	Material Description	Material Code[2]
0.10		PCP	
0.20	0.227		
0.30		GRAY CRUSHED STONE (GRANITE)	23
0.40	0.482		
0.50			
0.60			
0.70			
0.80			
0.90			
1.00			
1.10			
1.20			
1.30			
1.40			
1.50			
1.60			
1.70			
1.80			
1.90	1.984	T.D.	
2.00			
2.10			
2.20			
2.30			
2.40			
2.50			

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

Prepared by: S. DAVIS Employer: BRE

Date (dd/mm/yy): 31/07/95

Data Sheet SMP-I04: Log of Instrumentation Hole

Figure A-2. Profile of Test Section Layers

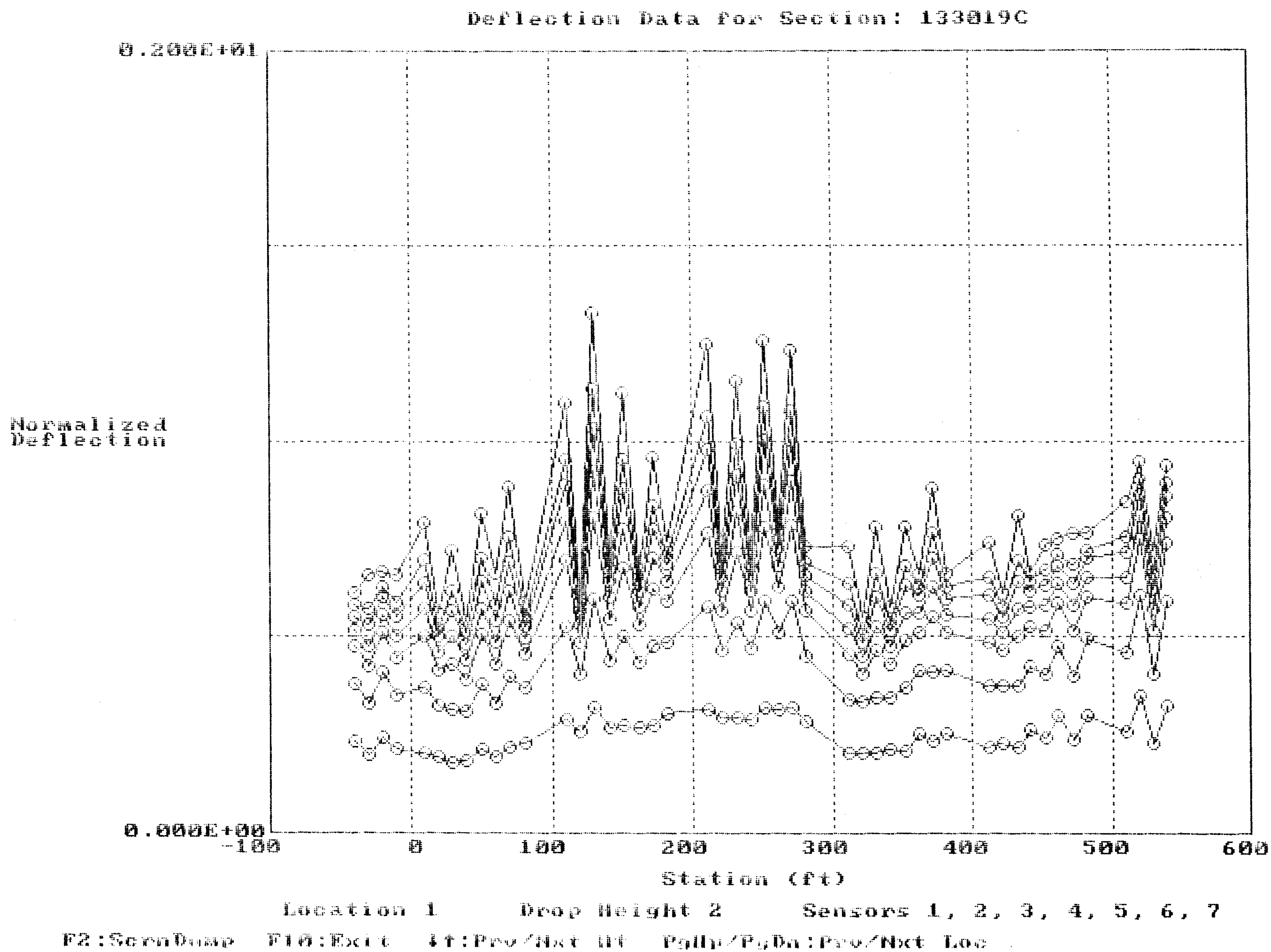


Figure A-3. Deflection Profiles from FWDCHECK for Mid-Slab

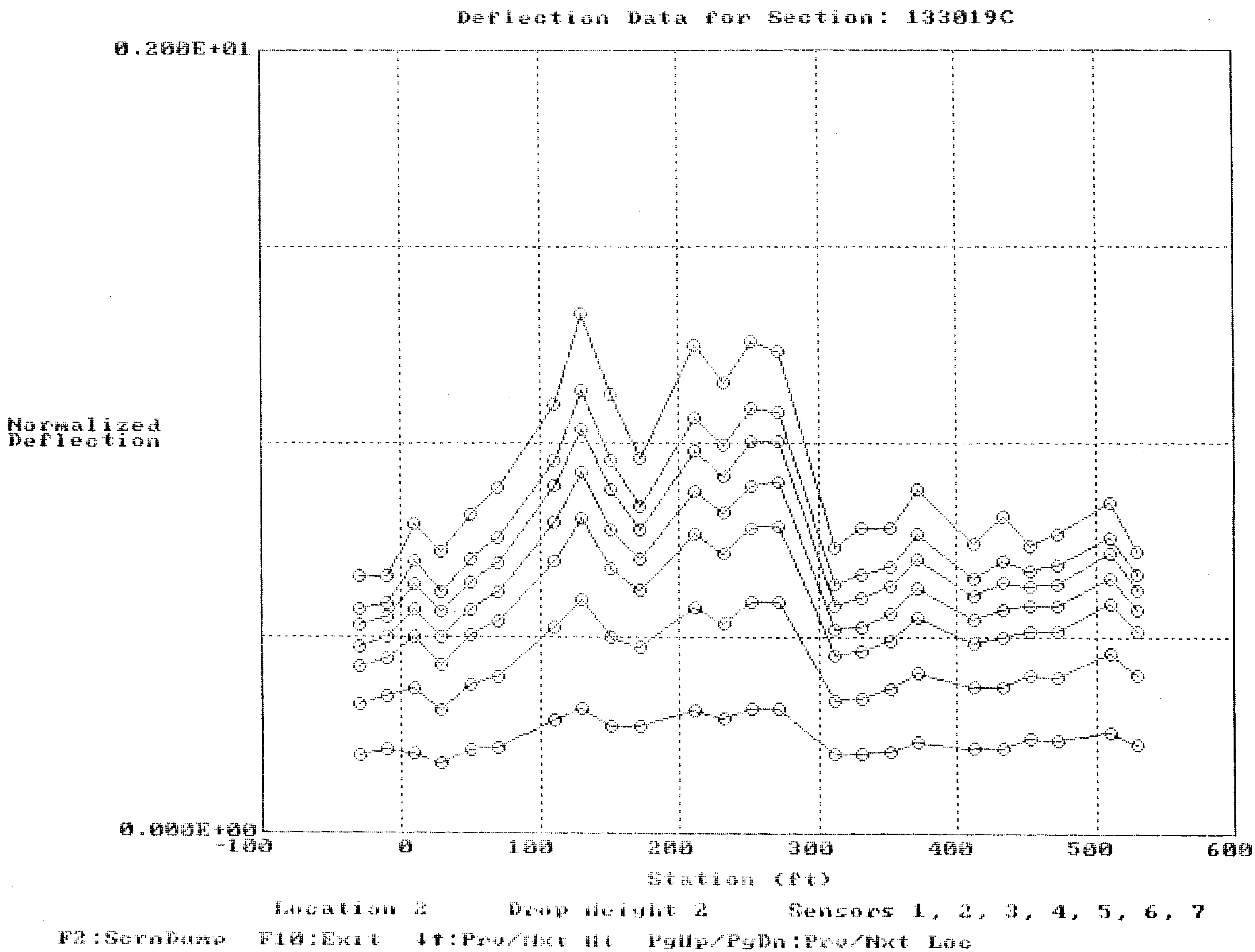


Figure A-4. Deflection Profiles from FWDCHECK for Corner

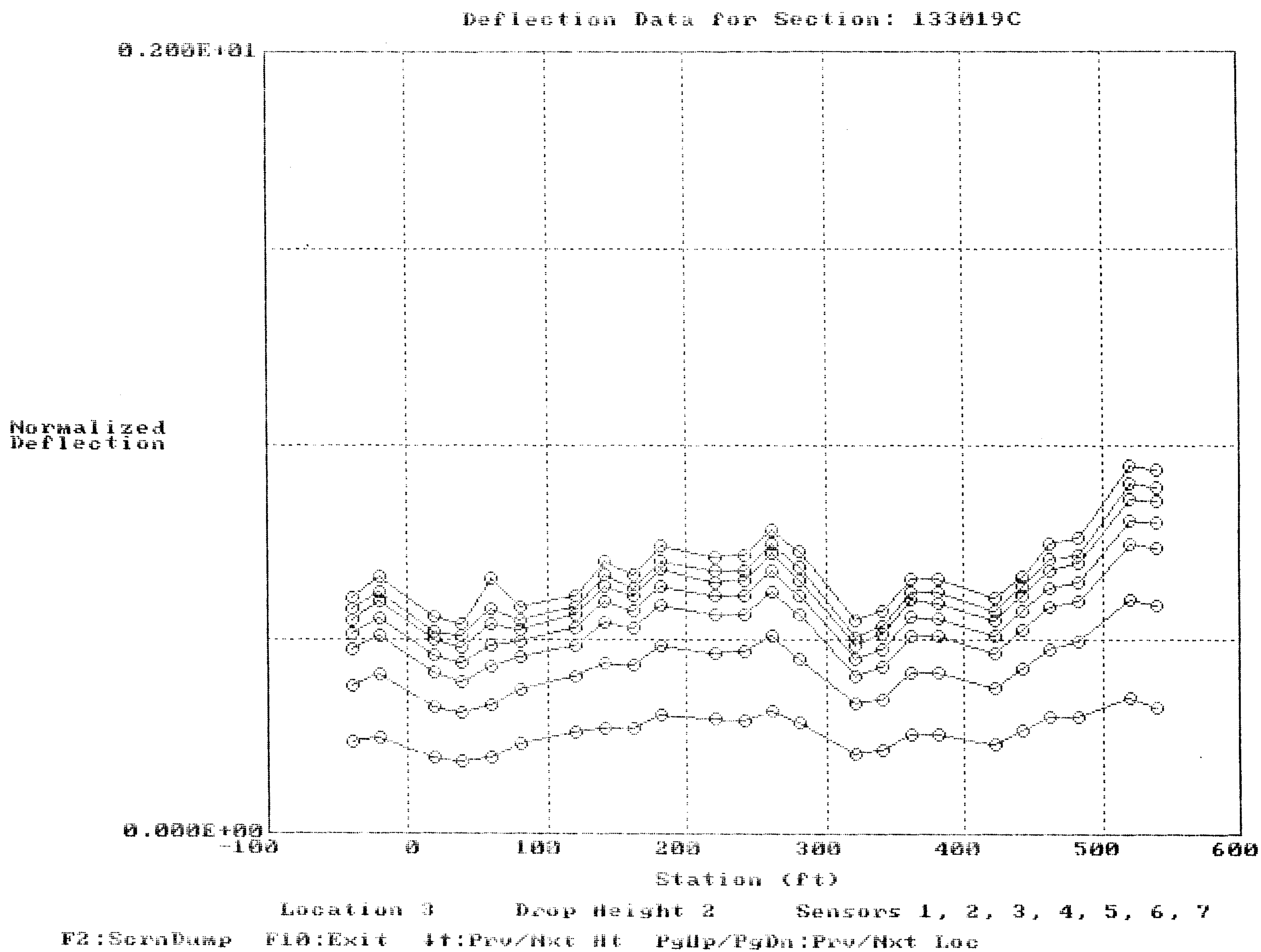


Figure A-5. Deflection Profiles from FWDCHECK for Edge

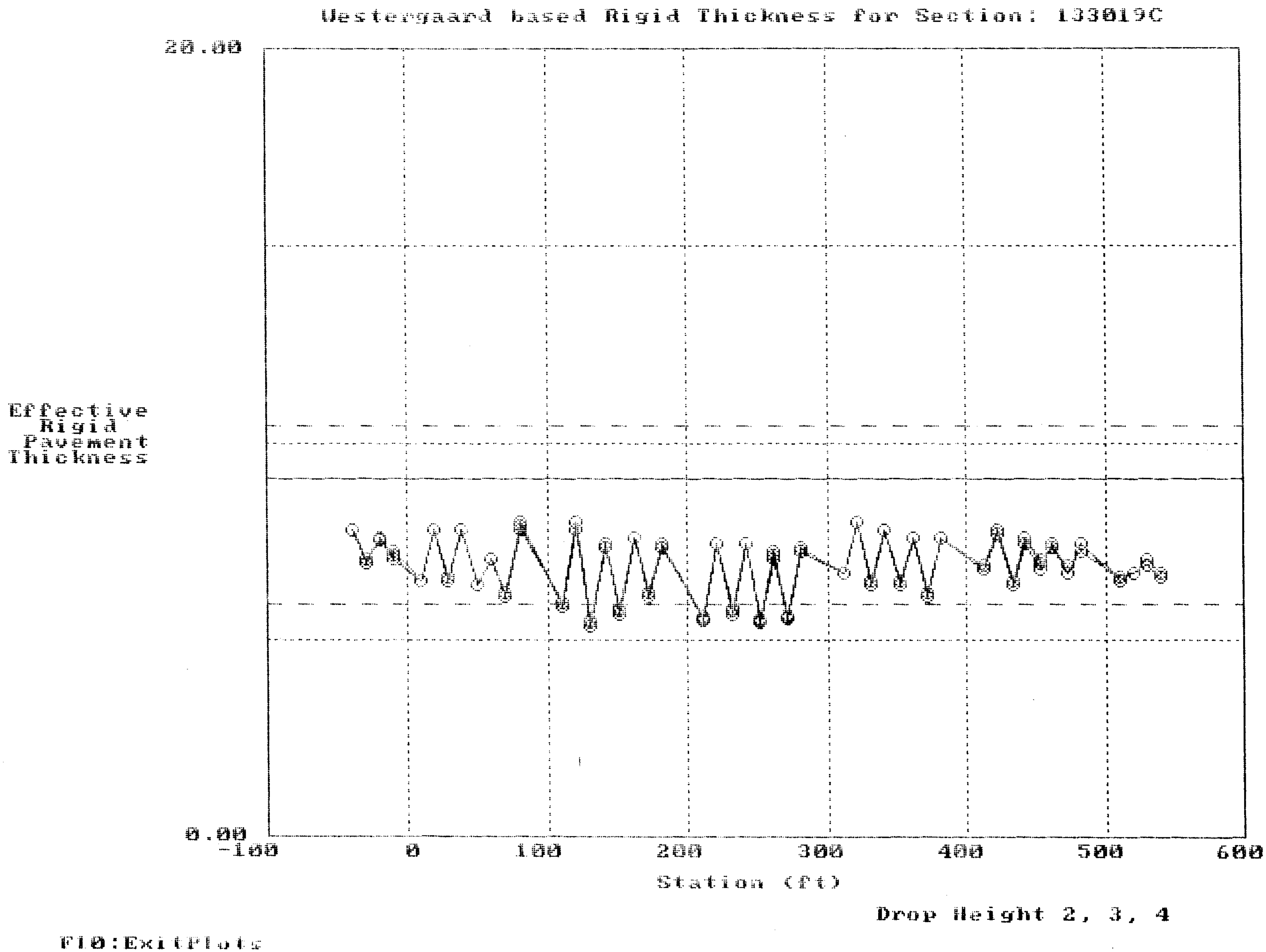


Figure A-6. Rigid Thickness Plot from FWDCHECK

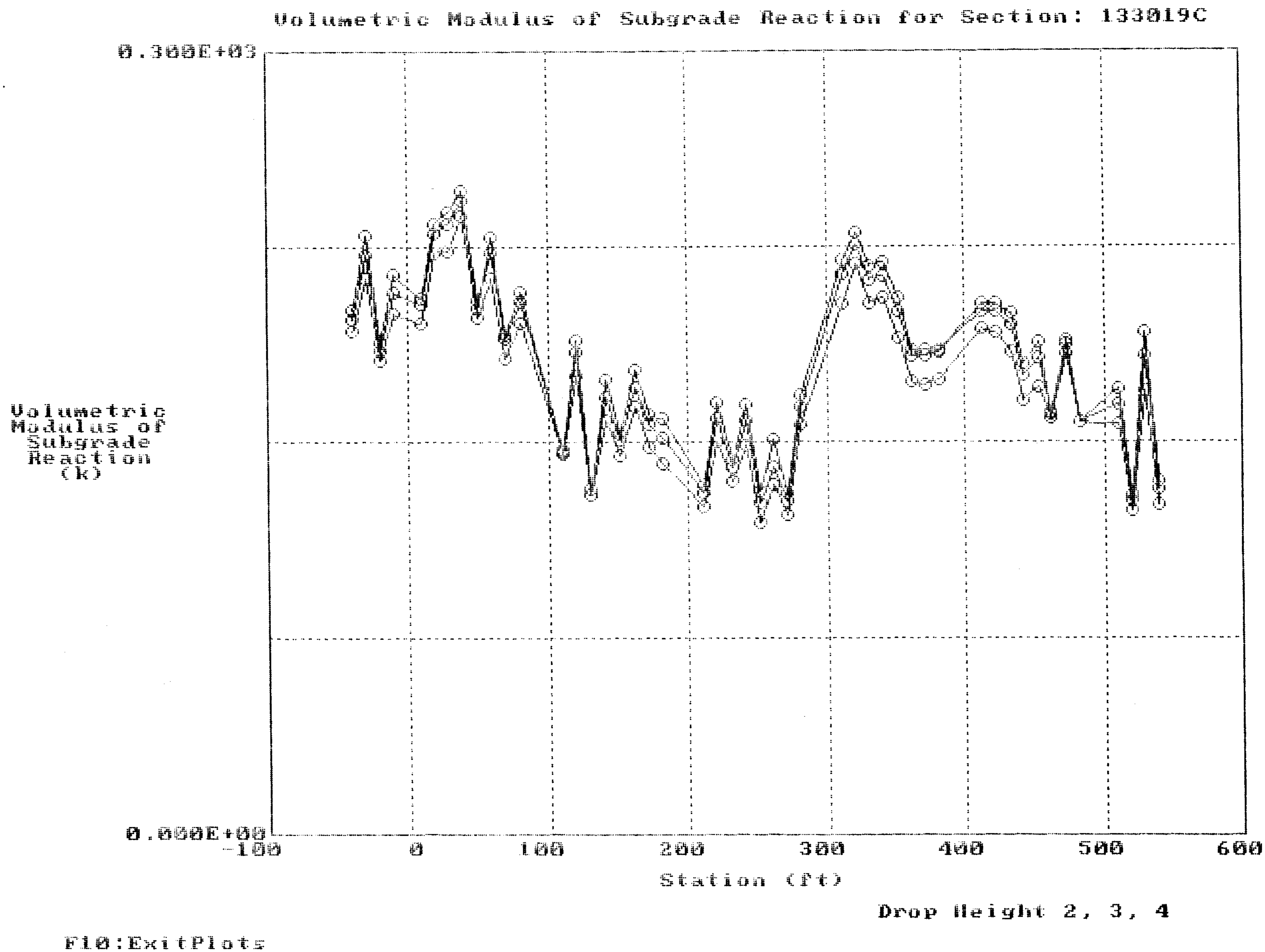


Figure A-7. Volumetric Modulus of Subgrade Reaction from FWDCHECK

Revised May 29, 1992

135A

STATE ASSIGNED ID _ _ _ _

SHEET 4

DISTRESS SURVEY

LTPP PROGRAM

STATE CODE 13

SHRP SECTION ID 3019

DISTRESS SURVEY FOR PAVEMENTS WITH JOINTED PORTLAND CEMENT CONCRETE SURFACES

DATE OF DISTRESS SURVEY (MONTH/DAY/YEAR) 08/01/95

SURVEYORS: JCP, HE, _ _ _

PAVEMENT SURFACE TEMP - BEFORE _ _ ~ _°C; AFTER ~ _ _ _°C

PHOTOS, VIDEO, OR BOTH WITH SURVEY (P, V, B) P

DISTRESS TYPE	SEVERITY LEVEL: LOW	MODERATE	HIGH
CRACKING			
1. CORNER BREAKS (Number)	0	0	0
2. DURABILITY "D" CRACKING (Number of Affected Slabs)	0	0	0
AREA AFFECTED (Square Meters)	0._	0._	0._
3. LONGITUDINAL CRACKING (Meters)	2.1	0._	0._
Length Sealed (Meters)	0._	0._	0._
4. TRANSVERSE CRACKING (Number of Cracks)	0	0	0
(Meters)	0._	0._	0._
Length Sealed (Meters)	0._	0._	0._
JOINT DEFICIENCIES			
5a. TRANSVERSE JOINT SEAL DAMAGE Sealed? (Y, N)			Y
If "Y" Number of Joints	25	0	0
5b. LONGITUDINAL JOINT SEAL DAMAGE Number of Longitudinal Joints that have been sealed (0, 1, or 2)			2
Length of Damaged Sealant (Meters)			0._
6. SPALLING OF LONGITUDINAL JOINTS (Meters)	0._	0._	0._
7. SPALLING OF TRANSVERSE JOINTS Number of Affected Joints	0	0	0
Length Spalled (Meters)	0._	0._	0._

Figure A-9. Distress Survey Data

Revised May 29, 1992

SHEET 5

DISTRESS SURVEY

LTPP PROGRAM

STATE ASSIGNED ID _ _ _ _

STATE CODE 1 3

SHRP SECTION ID 3 0 1 9

DATE OF DISTRESS SURVEY (MONTH/DAY/YEAR) 0 8 / 0 1 / 9 5
SURVEYORS: d L P , H C

DISTRESS SURVEY FOR PAVEMENTS WITH JOINTED PORTLAND CEMENT CONCRETE SURFACES (CONTINUED)

DISTRESS TYPE		SEVERITY LEVEL LOW	MODERATE	HIGH
SURFACE DEFORMATION				
8a.	MAP CRACKING (Number)	SEE PHOTOS		_ _ ?
	(Square Meters)			_ _ _ . _
8b.	SCALING (Number)			_ _ 0
	(Square Meters)			_ _ _ . 0
9.	POLISHED AGGREGATE (Square Meters)			_ _ 0 . _
10.	POPOUTS (Number per Square Meter)			_ _ 0 _
MISCELLANEOUS DISTRESSES				
11.	BLOWUPS (Number)			_ _ 0
12.	FAULTING OF TRANSVERSE JOINTS AND CRACKS - REFER TO SHEET 6			
13.	LANE-TO-SHOULDER DROPOFF - REFER TO SHEET 7			
14.	LANE-TO-SHOULDER SEPARATION - REFER TO SHEET 7			
15.	PATCH/PATCH DETERIORATION			
	Flexible (Number)	_ _ 0	_ _ 0	_ _ 0
	(Square Meters)	_ _ 0 . _	_ _ 0 . _	_ _ 0 . _
	Rigid (Number)	_ _ 0	_ _ 0	_ _ 0
	(Square Meters)	_ _ 0 . _	_ _ 0 . _	_ _ 0 . _
16.	WATER BLEEDING AND PUMPING (Number of Occurrences)			_ _ 0
	Length Affected (Meters)			_ _ 0 . _
17.	OTHER (Describe) ____________________			

Figure A-9 (Continued). Distress Survey Data

Revised April 23, 1993

SHEET 6

DISTRESS SURVEY

LTPP PROGRAM

STATE ASSIGNED ID _ _ _ _

STATE CODE 13

SHRP SECTION ID 3019

DATE OF DISTRESS SURVEY (MONTH/DAY/YEAR) 08/01/95
SURVEYORS: JLR, HE

DISTRESS SURVEY FOR PAVEMENTS WITH JOINTED PORTLAND CEMENT CONCRETE SURFACES (CONTINUED)

12. FAULTING OF TRANSVERSE JOINTS AND CRACKS

Page 1 of 1

MEASURED WITH 31' METRIC TAPE

Point[1] Distance (Meters)	Joint or Crack (J/C)	Crack Length (Meters)	Well Sealed (Y/N)	Length of Joint Spalling, m L	M	H	Faulting[2], mm 0.3m	0.75m
2.7	J		Y	0	0	0	0	0
8.8	J		Y	0	0	0	0	1
14.9	J		Y	0	0	0	2	0
21.0	J		Y	0	0	0	0	0
27.1	J		Y	0	0	0	2	2
33.2	J		Y	0	0	0	1	1
39.3	J		Y	0	0	0	2	1
45.4	J		Y	0	0	0	1	0
51.5	J		Y	0	0	0	1	1
57.6	J		Y	0	0	0	0	0
63.6	J		Y	0	0	0	1	0
69.7	J		Y	0	0	0	0	1
75.8	J		Y	0	0	0	0	1
81.9	J		Y	0	0	0	1	0
88.0	J		Y	0	0	0	0	0
94.1	J		Y	0	0	0	0	0
100.2	J		Y	0	0	0	1	0
106.3	J		Y	0	0	0	0	1
112.4	J		Y	0	0	0	1	0
118.5	J		Y	0	0	0	1	1
124.6	J		Y	0	0	0	1	1
130.7	J		Y	0	0	0	0	0
136.8	J		Y	0	0	0	1	1
142.9	J		Y	0	0	0	0	0
149.0	J		Y	0	0	0	1	0

Note 1. Point Distance is from the start of the test section to the measurement location.

Note 2. If the "approach" slab is higher than the "departure" slab, faulting is recorded as positive (+ or 0); if the "approach" slab is lower, record faulting as negative (-) and the minus sign must be used.

Figure A-9 (Continued). Distress Survey Data

Revised May 29, 1992

SHEET 7

DISTRESS SURVEY

LTPP PROGRAM

STATE ASSIGNED ID _ _ _ _

STATE CODE 1 3

SHRP SECTION ID 3 0 1 9

DATE OF DISTRESS SURVEY (MONTH/DAY/YEAR) 08/01/95
SURVEYORS: LLL, HE

DISTRESS SURVEY FOR PAVEMENTS WITH JOINTED
PORTLAND CEMENT CONCRETE SURFACES
(CONTINUED)

13. LANE-TO-SHOULDER DROPOFF

14. LANE-TO-SHOULDER SEPARATION

Point No.	Point[1] Distance (meters)	Lane-to-shoulder[2] Dropoff (mm)	Lane-to-shoulder Separation (mm)	Well Sealed (Y/N)
1.	0.	5.	0.	Y
2.	15.25	16.	0.	Y
3.	30.5	13.	0.	Y
4.	45.75	12.	0.	Y
5.	61.	6.	0.	Y
6.	76.25	8.	0.	Y
7.	91.5	15.	0.	Y
8.	106.75	13.	0	Y
9.	122.	17.	0.	Y
10.	137.25	13.	0.	Y
11.	152.5	5.	0.	Y

Note 1. Point Distance is from the start of the test section to the measurement location. The values shown are SI equivalents of the 50 ft spacing used in previous surveys.

Note 2. If heave of the shoulder occurs (upward movement), record as a negative (-) value. Do not record (+) signs, positive values are assumed.

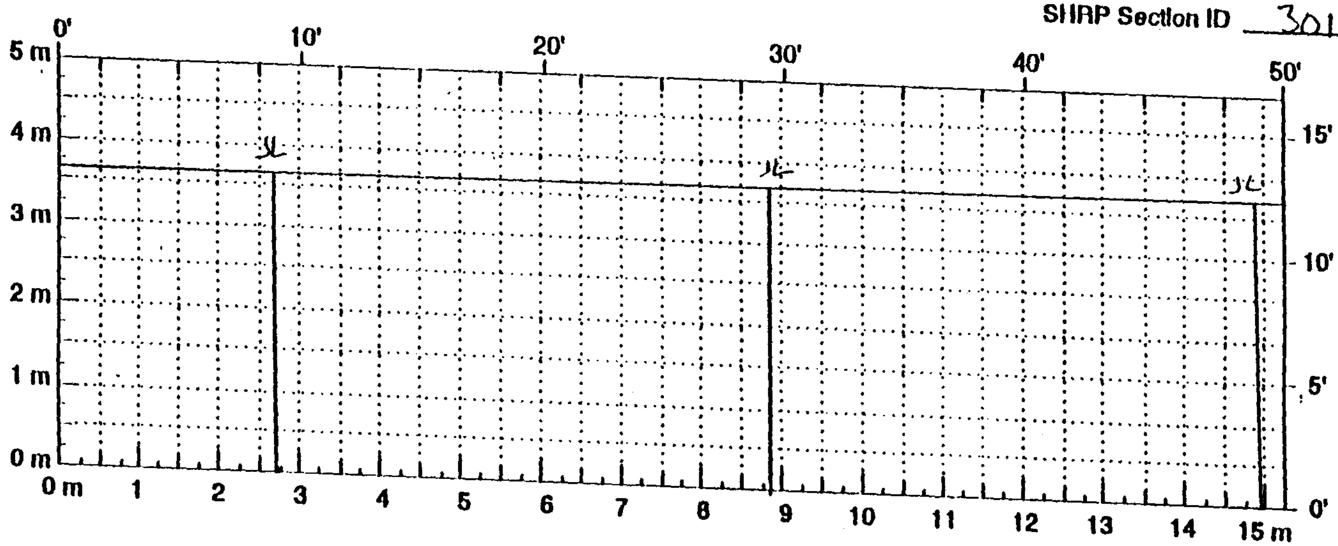
Figure A-9 (Continued). Distress Survey Data

KLP/HE
08/01/95

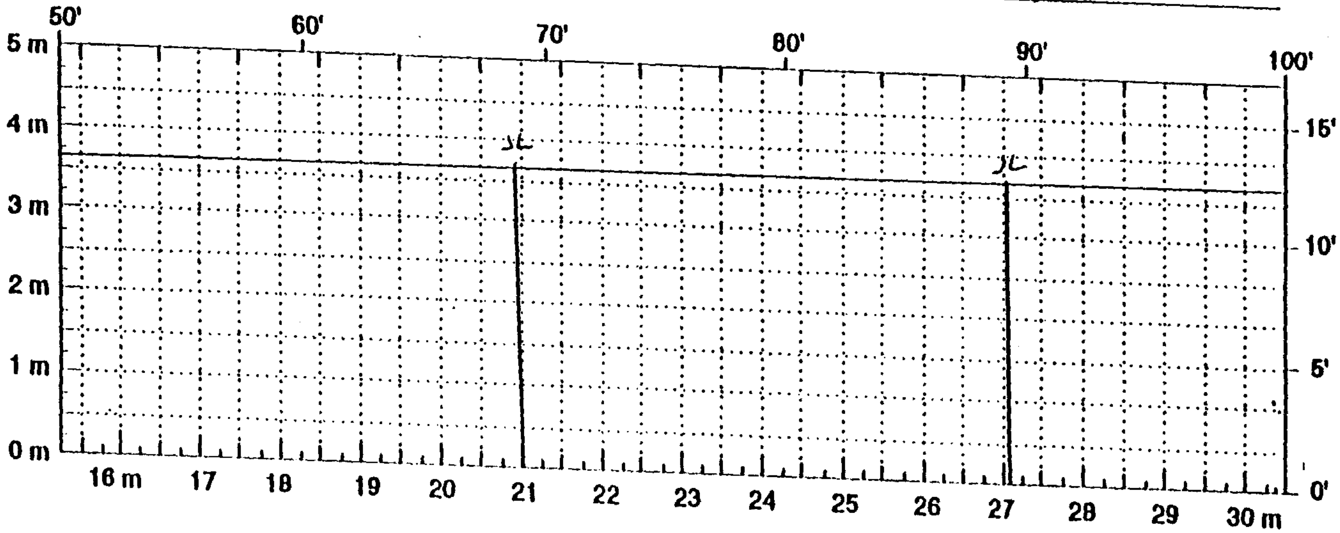
State Assigned ID ____________

State Code 13

SHRP Section ID 3019



Comments: No Distress   Micro Surface Cracks



Comments: ____________

Figure A-9 (Continued). Distress Survey Data

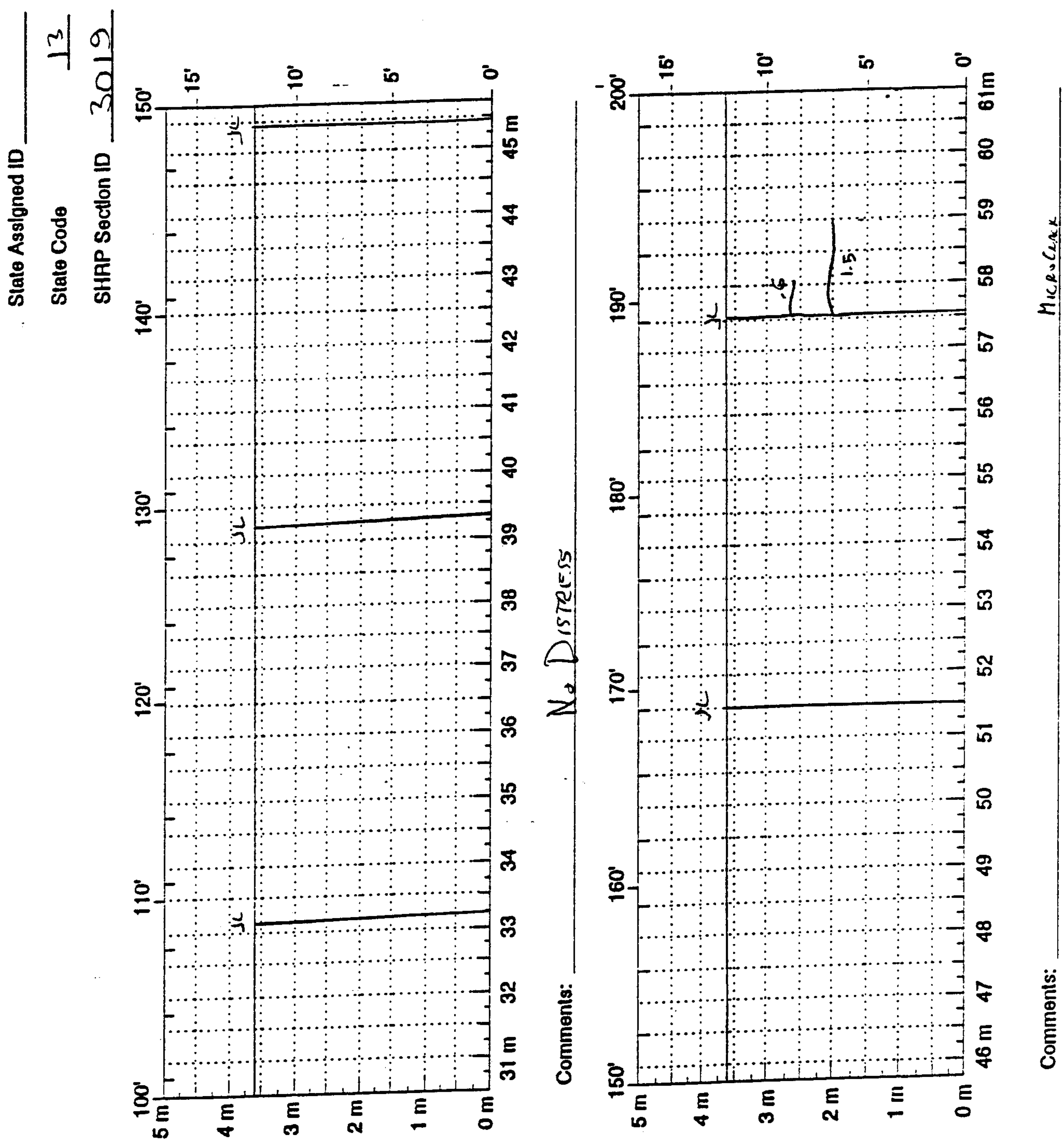


Figure A-9 (Continued). Distress Survey Data

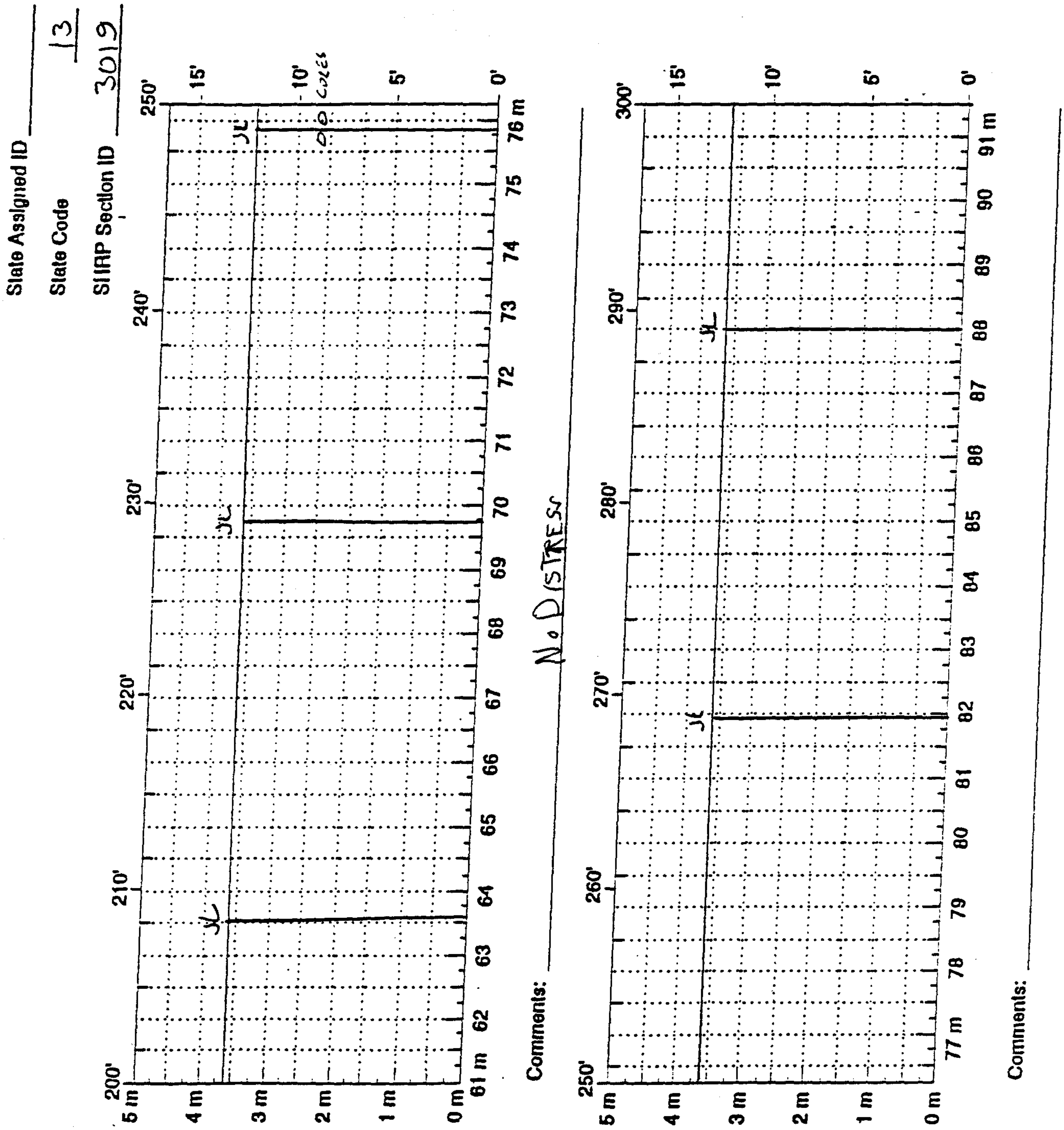


Figure A-9 (Continued). Distress Survey Data

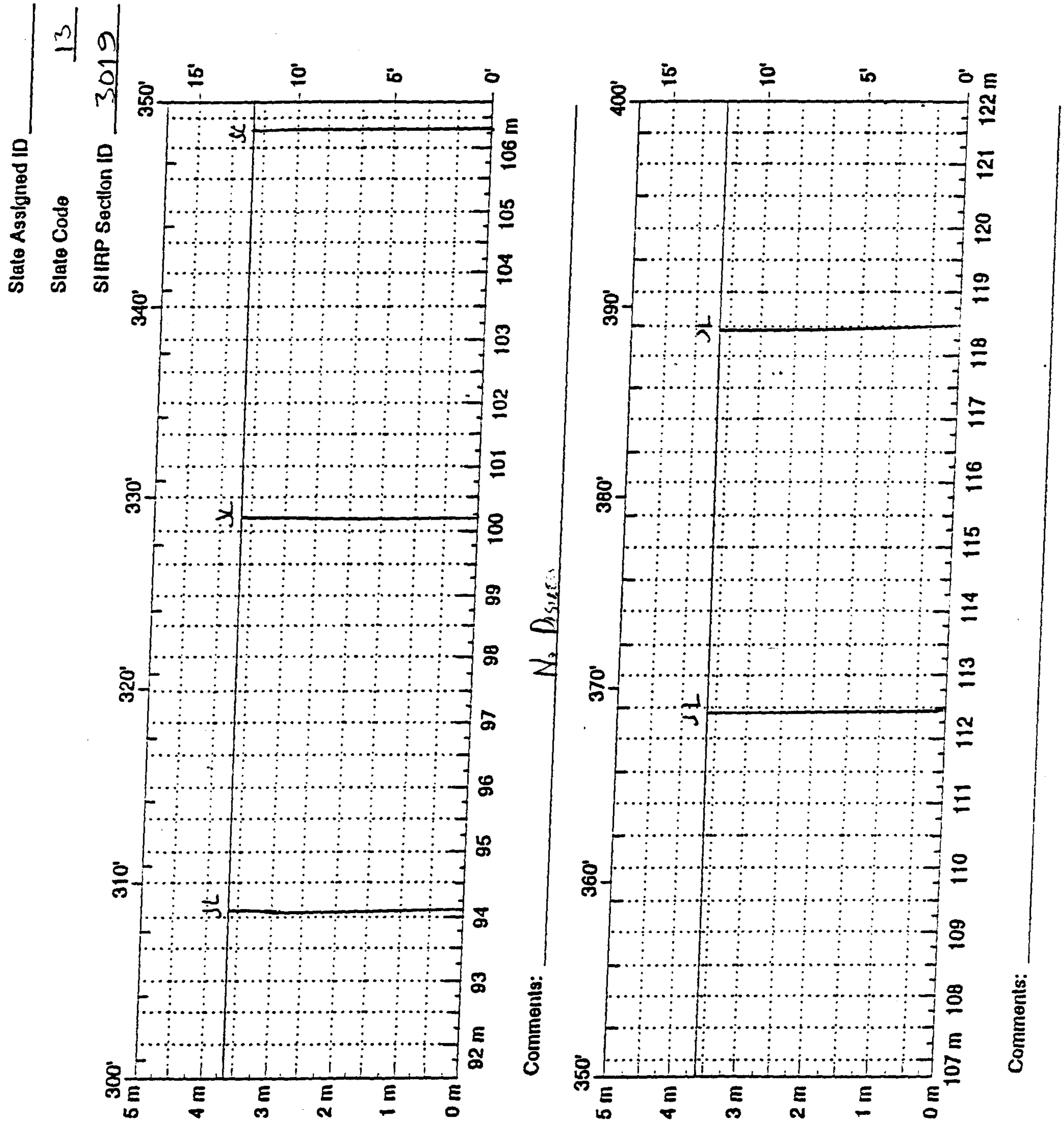


Figure A-9 (Continued). Distress Survey Data

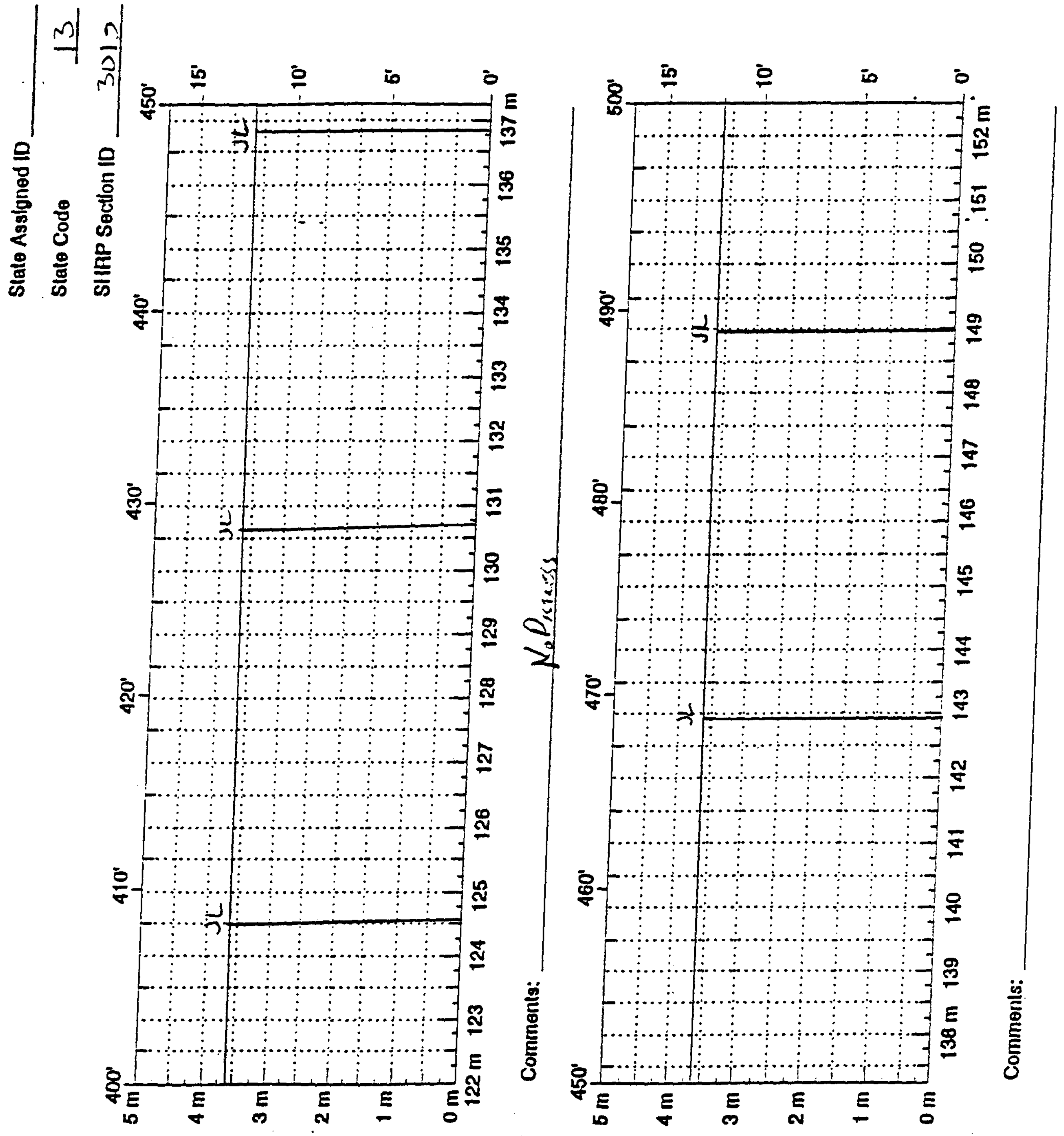


Figure A-9 (Continued). Distress Survey Data

APPENDIX B

Pre-installation Activities

Appendix B contains the following information:

AGENDA

Seasonal Monitoring Meeting

25 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

GEORGIA SEASONAL SITE INFORMATION

Type	SHRP ID	Hwy №.	Location of Test Section
JPC	133019	US-23, Hall Co. Southbound	9.66 km N. of Gainesville.
AC over Granular Base	131031	US-19, Dawson Co. Westbound	5.64 km N. of GA-53.
AC over Granular Base	131005	SH-247, Houston Co. Eastbound	1.77 km E. of the Peach/Houston Co. Line.

LTPP Seasonal Monitoring Program Data Sheet SMP-C01 (Page 1) TDR Probe Check	Agency Code [_ 3] LTPP Section ID [SA01]

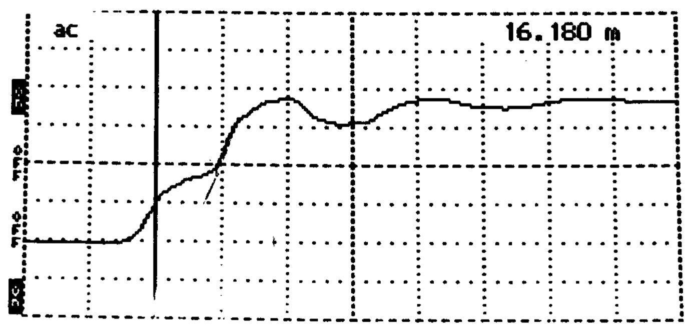
Cursor .... 16.180 m
Distance/Div..... .25 m/div
Vertical Scale.... 230 mρ/div
Vp 0.99
Noise Filter...... 1 avg
Power........... ac

Tektronix 1502B TDR
Date 06/29/95
Cable 13A01
Notes Shorted V.O.

Input Trace
Stored Trace
Difference Trace

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

Cursor .... 16.180 m
Distance/Div..... .25 m/div
Vertical Scale.... 230 mρ/div
Vp 0.99
Noise Filter...... 1 avg
Power........... ac



Tektronix 1502B TDR
Date 06/29/95
Cable 13A01
Notes IN AIR V.O.

Input Trace
Stored Trace
Difference Trace

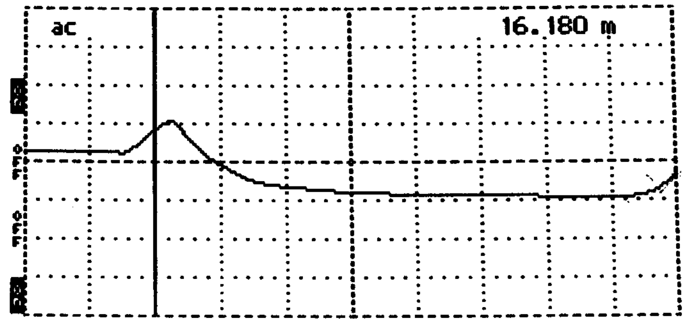
TDR Trace	Apparent Length, (m)	Dielectric Constant[1]
"In Air"	0.24	1.43

Data Sheet SMP-C01: TDR Probe Check

Figure B-1. TDR Traces Obtained During Calibration

LTPP Seasonal Monitoring Program Data Sheet SMP-C01 (Page 2) TDR Probe Check	Agency Code [13] LTPP Section ID [SA01]

Cursor .... 16.180 m
Distance/Div..... .25 m/div
Vertical Scale.... 230 mρ/div
Vp 0.99
Noise Filter...... 1 avg
Power........... ac



Tektronix 1502B TDR
Date 06/29/95
Cable 13A01
Notes IN WATER 4.0

Input Trace
Stored Trace
Difference Trace

TDR Trace	Apparent Length, (m)	Dielectric Constant[2]
"In Water"	1.80	80.21

[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: 1 3 A 0 1 TDR Probe Length, L: 0 . 2 0 3 m Length of Coax Cable: 1 2 . 2 m

Comments: __________

Prepared by: [illegible] Employer: BRE

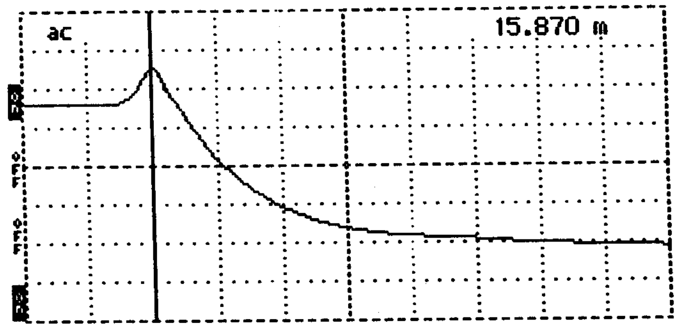
Date (dd/mmm/yy): 28/ __ 7/95

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 [_1_ _3_] LTPP Section ID [_ _A_ _0_ _2_]

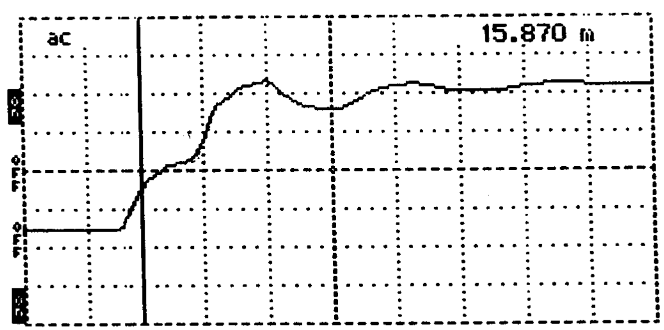
Cursor .... 15.870 m
Distance/Div ..... .25 m/div
Vertical Scale.... 230 mρ/div
Vp 0.99
Noise Filter ...... 1 avg
Power .... ac



Tektronix 1502B TDR
Date 06/29/95
Cable 13A02
Notes Shorted S.D.

Input Trace
Stored Trace
Difference Trace

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



Tektronix 1502B TDR
Date 06/29/95
Cable 13A02
Notes IN AIR S.D.

Input Trace
Stored Trace
Difference Trace

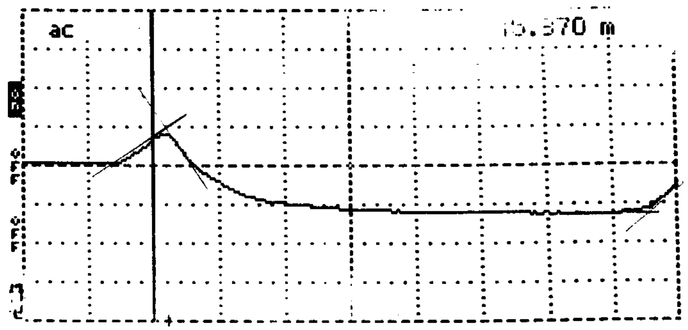
TDR Trace	Apparent Length, (m)	Dielectric Constant[1]
"In Air"	0.23	_1.31

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 [L 3] LTPP Section ID [_ A 0 2]

Cursor .... 15.870 m
Distance/Div..... .25 m/div
Vertical Scale.... 230 mρ/div
Vp 0.99
Noise Filter...... 1 avg
Power........... ac



Date 06/29/95
Cable 13A02
Notes IN WATER 1.0

Input Trace
Stored Trace
Difference Tra...

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: 13A02 TDR Probe Length, L: 0.203 m Length of Coax Cable: 12.2 m

Comments: ______

Prepared by: Mark 7 C Employer: BKE

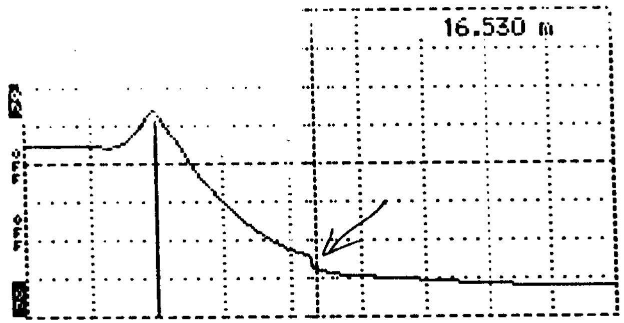
Date (dd/mmm/yy): 28/__7/95

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 [13] LTPP Section ID [SA03]

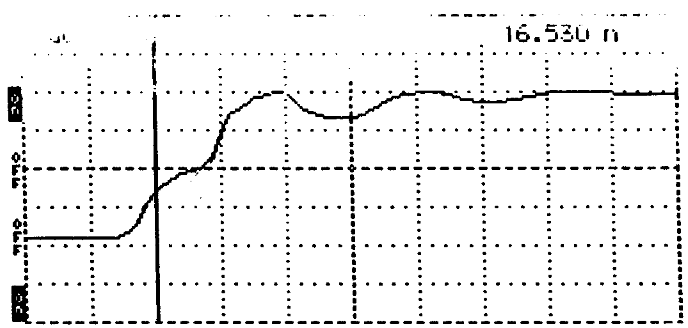
Cursor ....
Distance/Div ..... .25 m/div
Vertical Scale.... 230 mρ/div
VP 0.99
Noise Filter ...... 1 avg
Power .... ac



Tektronix 1502B TDR
Date 06/29/95
Cable 13SA03
Notes shorted AD
FAULT IN PRINTER FEED
Input Trace
Stored Trace
Difference Trace

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

Cursor .... 16.530 m
Distance/Div ..... .25 m/div
Vertical Scale.... 230 mρ/div
VP 0.99
Noise Filter ...... 1 avg
Power .... ac



Tektronix 1502B
Date 06/29/95
Cable 13A03
Notes IN AIR AD
Input Trace
Stored Trace
Difference Trace

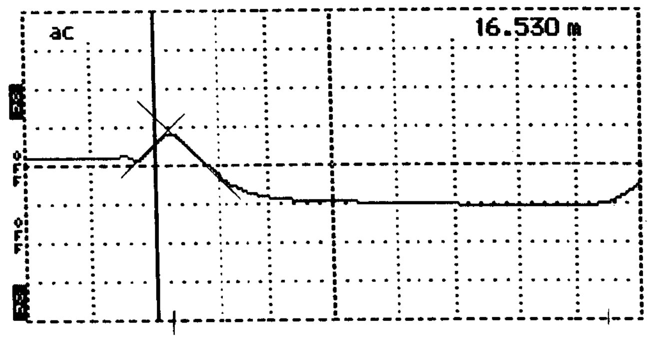
TDR Trace	Apparent Length, (m)	Dielectric Constant[1]
"In Air"	0.23	1.31

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 [13] LTPP Section ID [SA03]

Cursor .... 16.530 m
Distance/Div ..... .25 m/div
Vertical Scale.... 230 mρ/div
Vp 0.99
Noise Filter...... 1 avg
Power........... ac



Tektronix 1502B TDR
Date 06-29-95
Cable 13A03
Notes 1" WATER 10

Input Trace
Stored Trace
Difference Trace

TDR Trace	Apparent Length, (m)	Dielectric Constant[2]
"In Water"	1.82	82.07

[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

<u>Note</u>: 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: 13A03 TDR Probe Length, L: 0.203 m Length of Coax Cable: 12.2 m

Comments: __________

Prepared by: Mark 7. Gl Employer: BRE

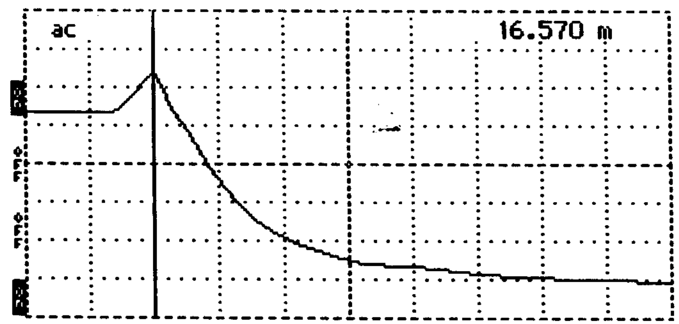
Date (dd/mmm/yy): 28/ 7/95

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 [/ 3] LTPP Section ID [A 0 4]

Cursor .... 16.570 m
Distance/Div..... .25 m/div
Vertical Scale.... 193 mρ/div
VP 0.99
Noise Filter...... 1 avg
Power........... ac

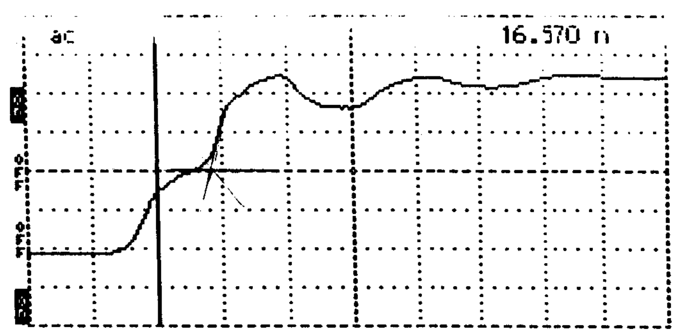


Tektronix 1502B TDR
Date 06-29-95
Cable 13A04
Notes shorted Y O.

Input Trace
Stored Trace
Difference Trace

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

Cursor .... 16.570 m
Distance/Div..... .25 m/div
Vertical Scale.... 193 mρ/div
VP 0.99
Noise Filter...... 1 avg
Power........... ac



Tektronix
Date 6/29/95
Cable 13A04
Notes
IN AIR
Y O

Input Tra
Stored Tr
Differenc

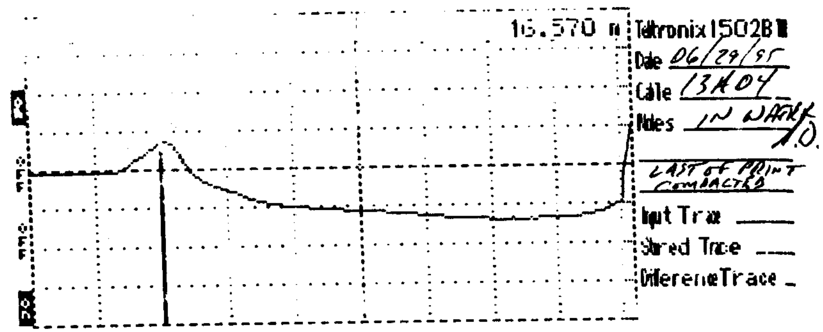
TDR Trace	Apparent Length, (m)	Dielectric Constant[1]
"In Air"	0.20	0.99

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 [1 3] LTPP Section ID [SA 04]

Distance/Div ..... .25 m/div
Vertical Scale.... 193 mρ/div
VP 0.99
Noise Filter ...... 1 avg
Power .... ac



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

[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

<u>Note</u>: 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: 13A04 TDR Probe Length, L: 0.203 m Length of Coax Cable: 12.2 m

Comments: ______________________________

Prepared by: Ai ?Cl Employer: BKE

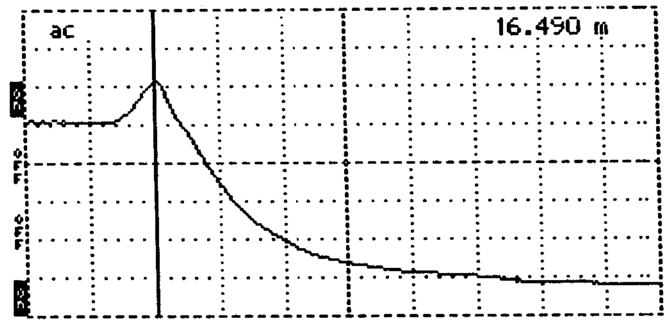
Date (dd/mmm/yy): 28/ _ _ 7/95

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 13 LTPP Section ID 5A05

Cursor .... 16.490 m
Distance/Div..... .25 m/div
Vertical Scale.... 193 mρ/div
VP 0.99
Noise Filter...... 1 avg
Power........... ac

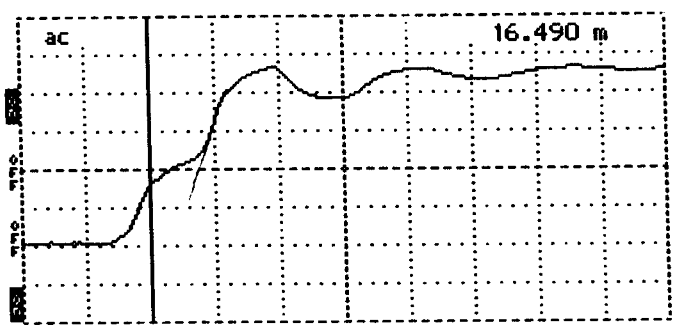


Tektronix 1502B TDR
Date 06-29-95
Cable 13A05
Notes SHORTED

Input Trace
Stored Trace
Difference Trace

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

Cursor .... 16.490 m
Distance/Div..... .25 m/div
Vertical Scale.... 193 mρ/div
VP 0.99
Noise Filter...... 1 avg
Power........... ac



Tektronix 1502B TDR
Date 06-29-95
Cable 13A05
Notes IN AIR

Input Trace
Stored Trace
Difference Trace

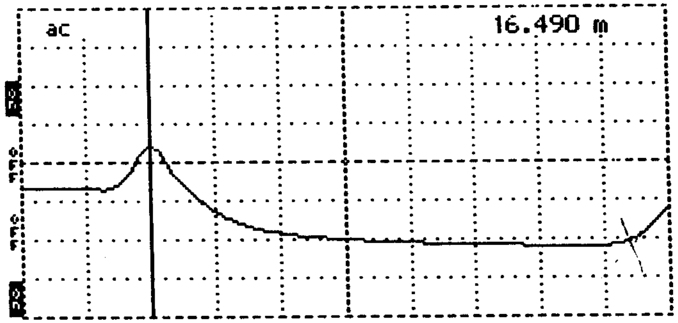
TDR Trace	Apparent Length, (m)	Dielectric Constant[1]
"In Air"	0.20	0.99

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 [13] LTPP Section ID [SA05]

Cursor .... 16.490 m
Distance/Div ..... .25 m/div
Vertical Scale.... 193 mρ/div
Vp 0.99
Noise Filter ...... 1 avg
Power .... ac



Tektronix 1502B TDR
Date 06-29-95
Cable 13A05
Notes IN WATER N.D

Input Trace
Stored Trace
Difference Trace

TDR Trace	Apparent Length, (m)	Dielectric Constant[2]
"In Water"	1.85	84.74

[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: 13A05 TDR Probe Length, L: 0.203 m Length of Coax Cable: 12.2 m

Comments: ______

Prepared by: Mark C Employer: BRE

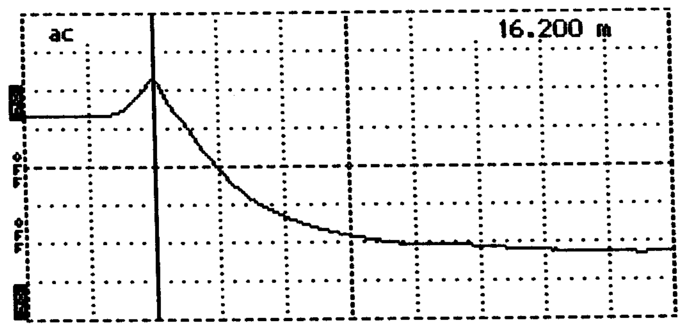
Date (dd/mmm/yy): 28/ 7/95

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 [13] LTPP Section ID [5A06]

Cursor .... 16.200 m
Distance/Div ..... .25 m/div
Vertical Scale.... 230 mρ/div
Vp 0.99
Noise Filter ...... 1 avg
Power .... ac

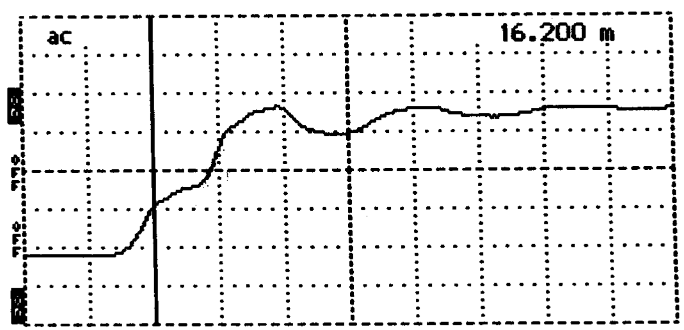


Tektronix 1502B TDR
Date 06/29/95
Cable 13A06
Notes Shorted tb.

Input Trace
Stored Trace
Difference Trace

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

Cursor .... 16.200 m
Distance/Div ..... .25 m/div
Vertical Scale.... 230 mρ/div
Vp 0.99
Noise Filter ...... 1 avg
Power .... ac



Tektronix 1502B TDR
Date 06/29/95
Cable 13A06
Notes IN AIR

Input Trace
Stored Trace
Difference Trace

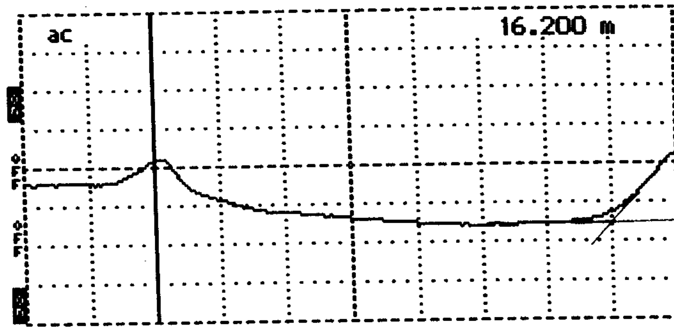
TDR Trace	Apparent Length, (m)	Dielectric Constant[1]
"In Air"	0.20	_ 0.99

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 [13] LTPP Section ID [SA06]

Cursor .... 16.200 m
Distance/Div ..... .25 m/div
Vertical Scale.... 230 mρ/div
VP 0.99
Noise Filter ...... 1 avg
Power .... ac



Tektronix 1502B TDR
Date 06/29/95
Cable 13A06
Notes IN WATER
Input Trace
Stored Trace
Difference Trace

TDR Trace	Apparent Length, (m)	Dielectric Constant[2]
"In Water"	1.75	15 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: 13A06   TDR Probe Length, L: 0.203 m   Length of Coax Cable: 12.2 m

Comments: ______

Prepared by: Matt ? W   Employer: BRE

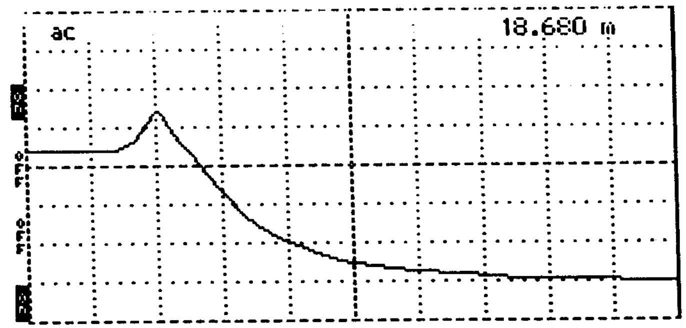
Date (dd/mmm/yy): 28/ __ 7/95

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

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

LTPP Seasonal Monitoring Program Data Sheet SMP-C01 (Page 1) TDR Probe Check	Agency Code [13] LTPP Section ID [5A07]

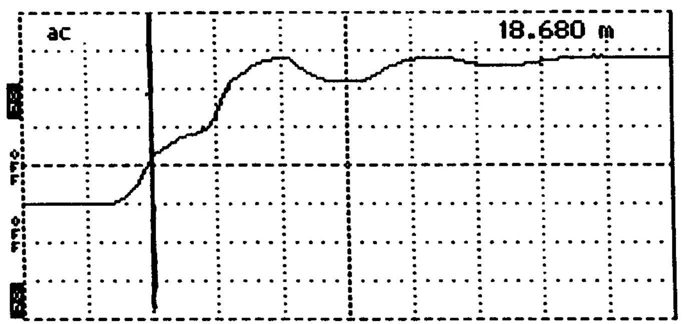
Cursor .... 18.680 m
Distance/Div ..... .25 m/div
Vertical Scale.... 230 mρ/div
VP 0.99
Noise Filter ...... 1 avg
Power .... ac



Tektronix 1502B TDR
Date 06/29/95
Cable 13A07
Notes Shorted S.O.
taken from wounded 8
Input Trace
Stored Trace
Difference Trace

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

Cursor .... 18.680 m
Distance/Div ..... .25 m/div
Vertical Scale.... 230 mρ/div
VP 0.99
Noise Filter ...... 1 avg
Power .... ac



Tektronix 1502B TDR
Date 06/29/95
Cable 13A07
Notes IN AIR
seem to be fluctuation
Input Trace
Stored Trace
Difference Trace

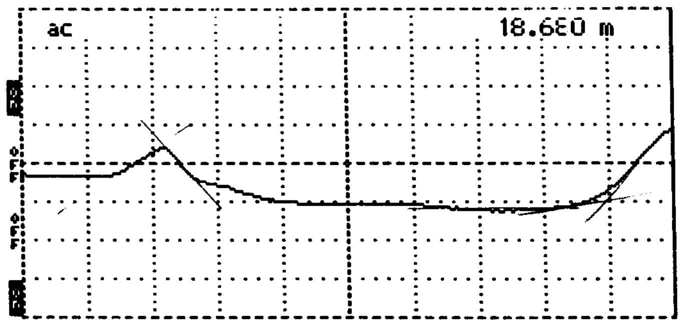
TDR Trace	Apparent Length, (m)	Dielectric Constant[1]
"In Air"	0.24	_1.43

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 [13] LTPP Section ID [5A07]

Cursor .... .680 m
Distance/Div..... .25 m/div
Vertical Scale.... 230 mρ/div
VP 0.99
Noise Filter...... 1 avg
Power............ ac



Tektronix 1502B TDR
Date 06/29/95
Cable 13A07
Notes IN WATER 1.0
some fluctuation
from wounded 8
Input Trace
Stored Trace
Difference Trace

TDR Trace	Apparent Length, (m)	Dielectric Constant[2]
"In Water"	1.70	71.55

[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: 13A07 TDR Probe Length, L: 0.203 m Length of Coax Cable: 12.2 m

Comments:

Prepared by: Mark 7.60 Employer: BRE

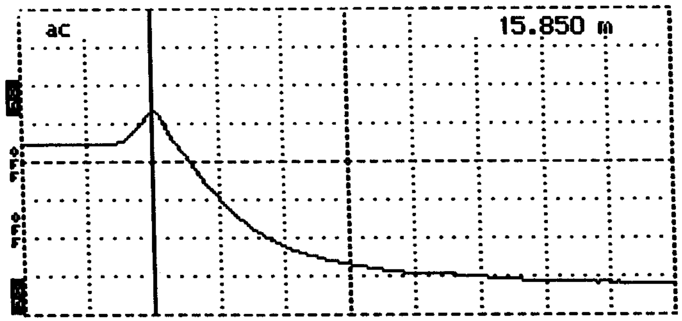
Date (dd/mmm/yy): 28/ 7/95

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 [1 3] LTPP Section ID [5 A 0 8]

Cursor .... 15.850 m
Distance/Div..... .25 m/div
Vertical Scale.... 230 mρ/div
VP 0.99
Noise Filter...... 1 avg
Power........... ac

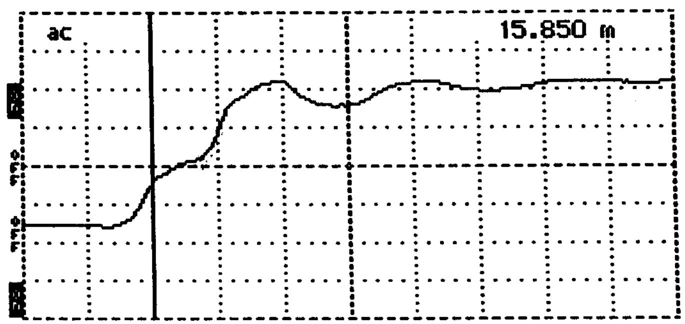


Tektronix 1502B TDR
Date 06/29/95
Cable 13A08
Notes Shorted AD

Input Trace
Stored Trace
Difference Trace

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

Cursor .... 15.850 m
Distance/Div..... .25 m/div
Vertical Scale.... 230 mρ/div
VP 0.99
Noise Filter...... 1 avg
Power........... ac



Tektronix 1502B TDR
Date 06-29-95
Cable 13A08
Notes IN AIR AD

Input Trace
Stored Trace
Difference Trace

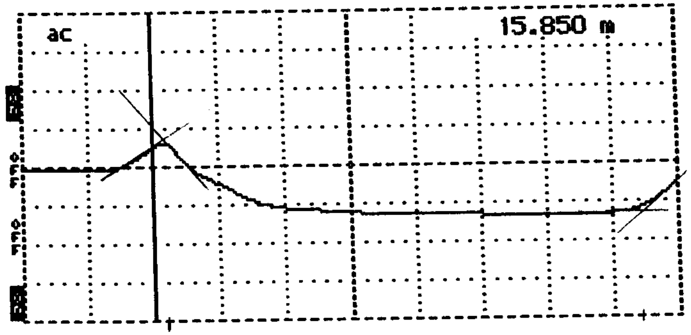
TDR Trace	Apparent Length, (m)	Dielectric Constant[1]
"In Air"	0.23	_ 1.31

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 [13] LTPP Section ID [5A08]

Cursor .... 15.850 m
Distance/Div ..... .25 m/div
Vertical Scale.... 230 mρ/div
VP 0.99
Noise Filter ...... 1 avg
Power .... ac



Tektronix 1501
Date 06/29/95
Cable 13A8
Notes IN WATER

Input Trace ——
Stored Trace ......
Difference Trac.....

TDR Trace	Apparent Length, (m)	Dielectric Constant[2]
"In Water"	1.81	81.17

[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: 13A08 TDR Probe Length, L: 0.203 m Length of Coax Cable: 12.2 m

Comments: ______

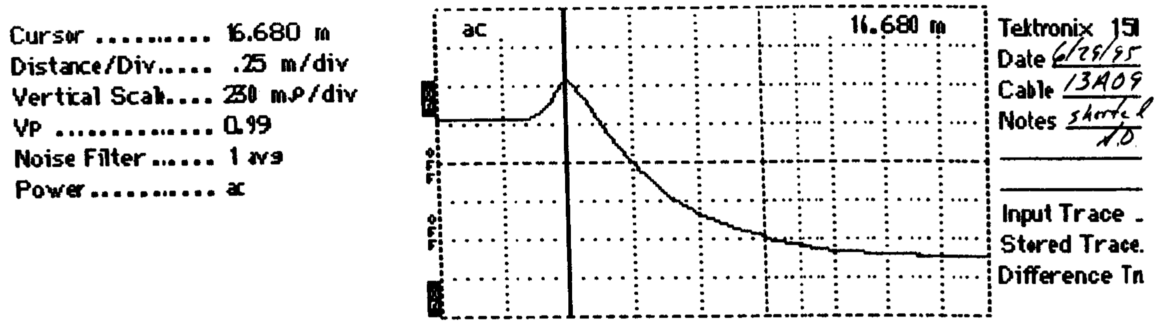
Prepared by: Mat'l W Employer: BRE

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

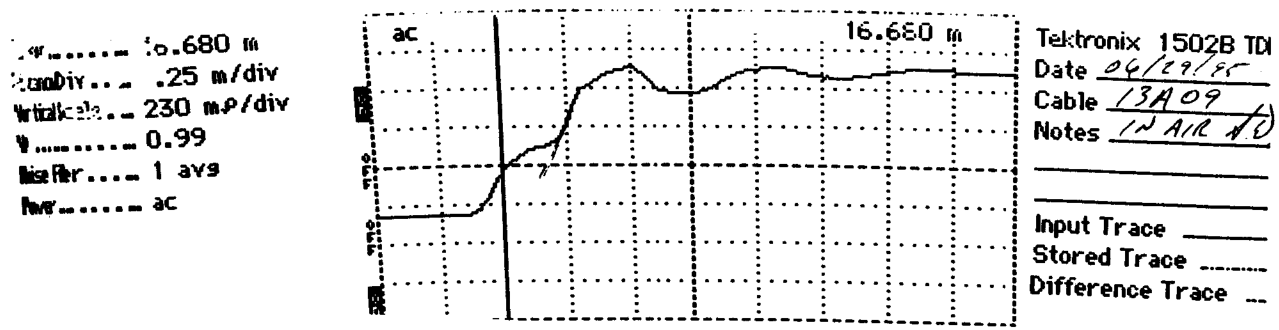
Data Sheet SMP-C01: TDR Probe Check (Continued)

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

LTPP Seasonal Monitoring Program Data Sheet SMP-C01 (Page 1) TDR Probe Check	Agency Code [13] LTPP Section ID [5A09]



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



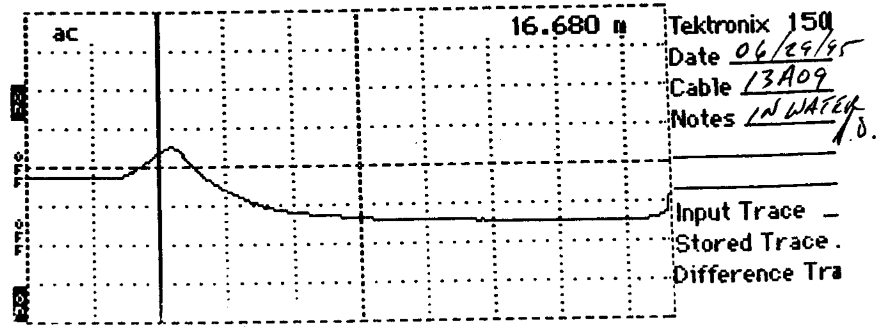
TDR Trace	Apparent Length, (m)	Dielectric Constant[1]
"In Air"	0.21	1.09

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 [13] LTPP Section ID [SA09]

Cursor .... 16.680 m
Distance/Div ..... .25 m/div
Vertical Scale.... 230 mρ/div
VP 0.99
Noise Filter...... 1 avg
Power........... ac



TDR Trace	Apparent Length, (m)	Dielectric Constant[2]
"In Water"	1.85	84.74

[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: 13A09 TDR Probe Length, L: 0.203 m Length of Coax Cable: 12.2 m

Comments: ______

Prepared by: Mark 7. Cl Employer: BRE

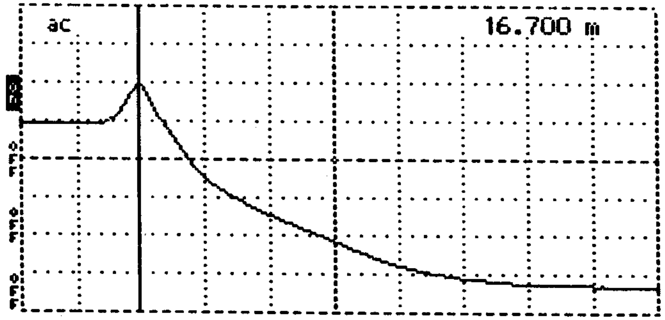
Date (dd/mmm/yy): 28/ 7/95

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 [1 3] LTPP Section ID [E A 1 0]

Cursor .... 16.700 m
Distance/Div..... .25 m/div
Vertical Scale.... 193 mρ/div
Vp 0.99
Noise Filter...... 1 avg
Power........... ac

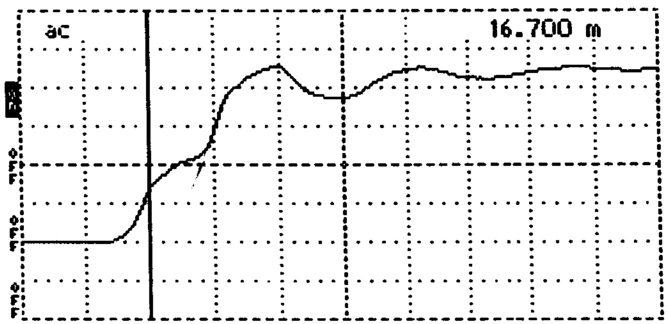


Tektronix 1502B TDR
Date 06/29/95
Cable 13A10
Notes SHORTED

Input Trace
Stored Trace
Difference Trace

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

Cursor .... 16.700 m
Distance/Div..... .25 m/div
Vertical Scale.... 193 mρ/div
Vp 0.99
Noise Filter...... 1 avg
Power........... ac



Tektronix 1502B TDR
Date 06/29/95
Cable 13A10
Notes AIR

Input Trace
Stored Trace
Difference Trace

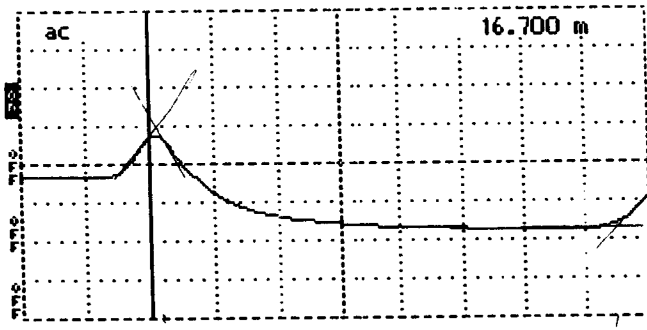
TDR Trace	Apparent Length, (m)	Dielectric Constant[1]
"In Air"	0.20	_ 0.99

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 [13] LTPP Section ID [SA10]

Cursor .... 16.700 m
Distance/Div ..... .25 m/div
Vertical Scale.... 193 mρ/div
VP 0.99
Noise Filter ...... 1 avg
Power .... ac



Tektronix 1502B TDR
Date 06/29/95
Cable 13A10
Notes IN WATER

Input Trace
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: _ _ _ _ _ TDR Probe Length, L: 0.203 m Length of Coax Cable: 12.2 m

Comments:

Prepared by: Mark T.Ll 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:

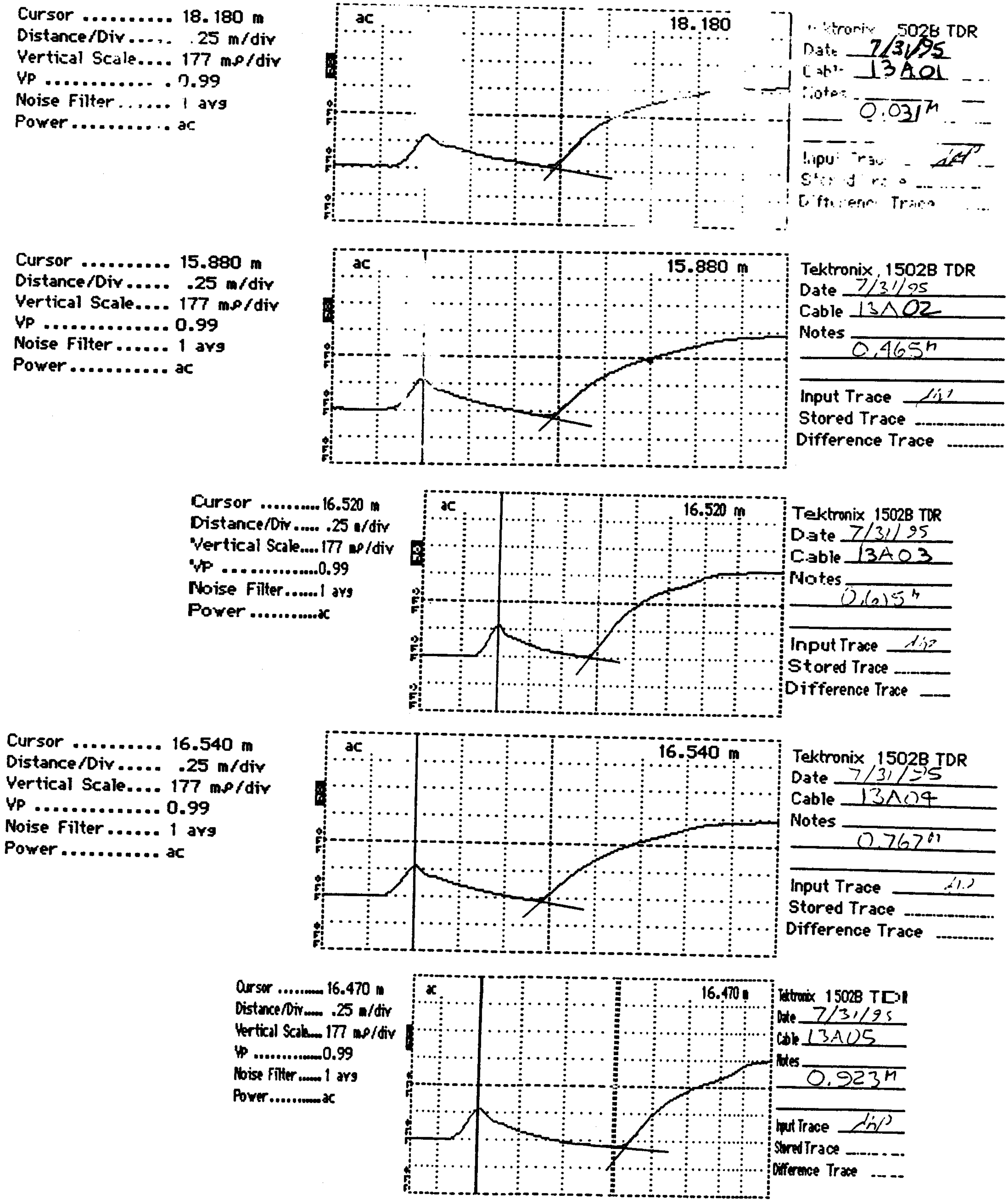
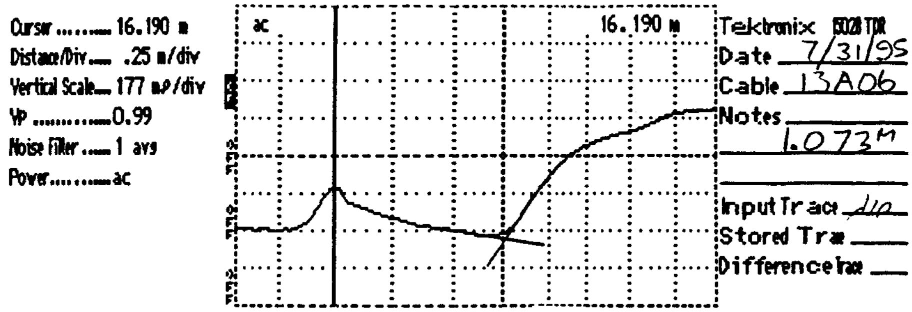
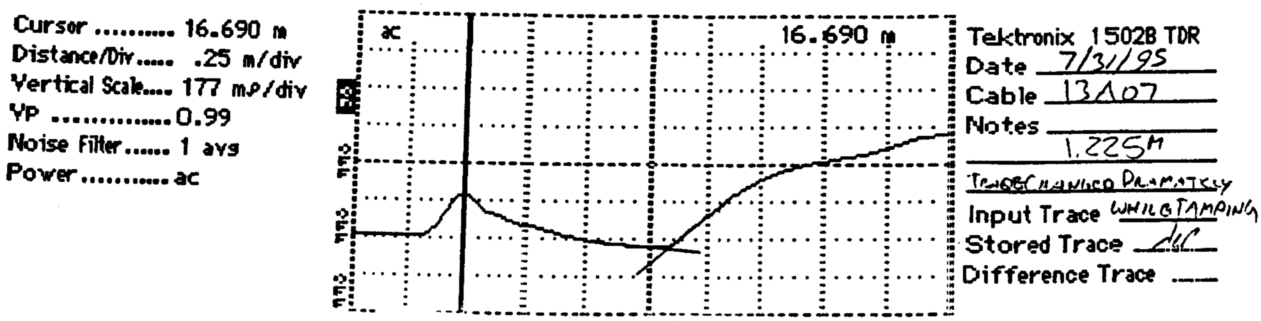
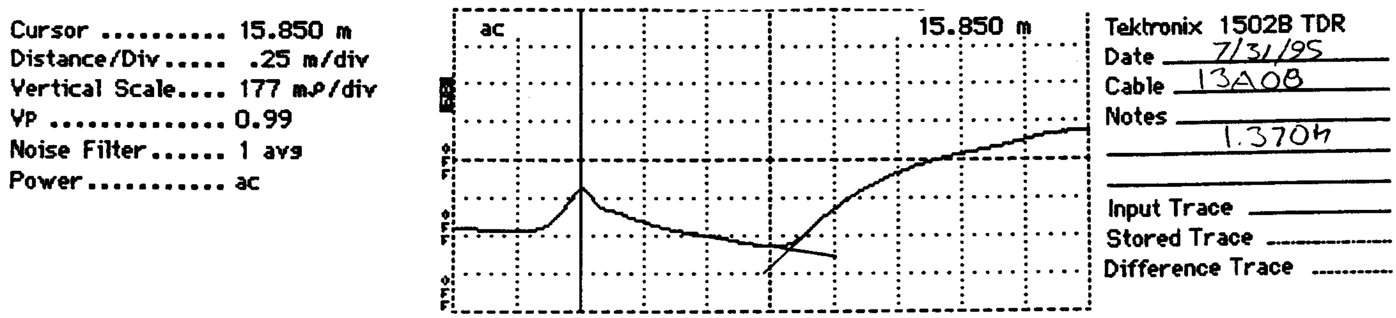
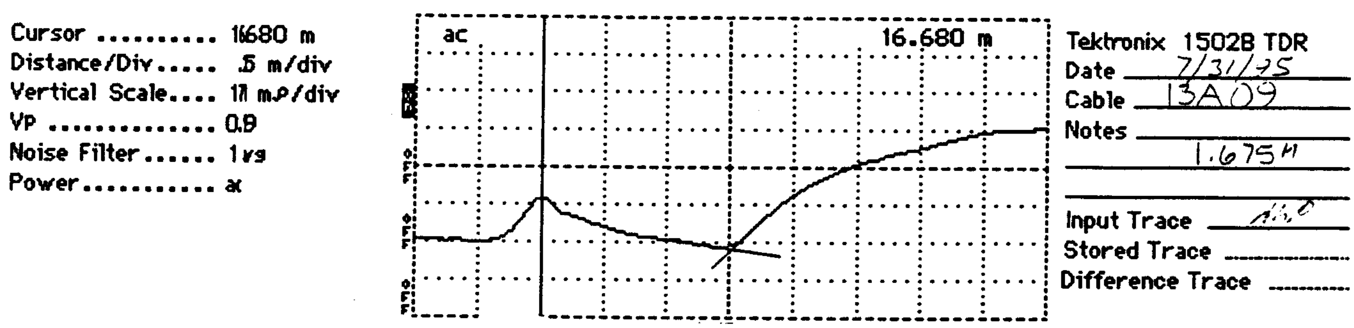


Figure C-1. TDR Traces During Installation









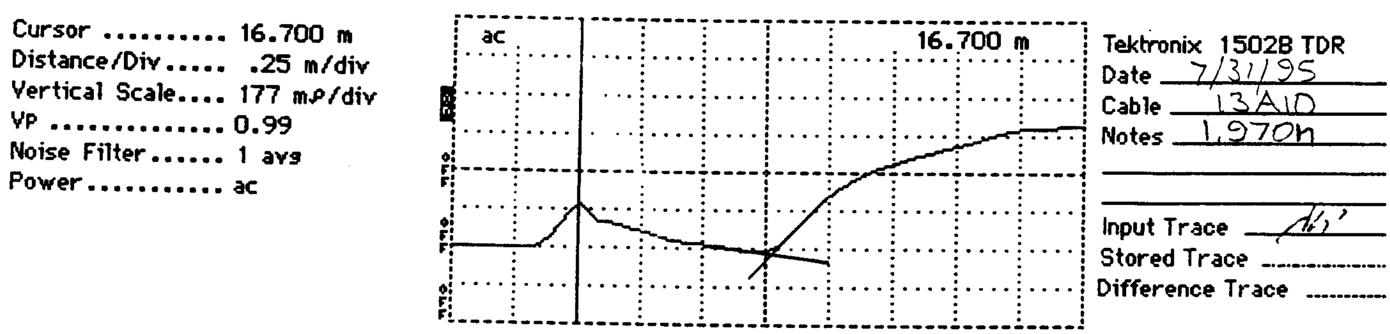


Figure C-1 (Continued). TDR Traces During Installation

Table C-1. Field Measured Moisture Contents

SITE NO. 133019 8/01/95

MOISTURE CONTENTS FOR TDR

TDR #	WT. OF PAN(g)	(WET) PAN & SOIL(g)	(DRY) PAN & SOIL(g)	M.C. (%)
13A10	152.0	265.8	240.9	28.0%
13A09	172.3	285.9	267.8	19.0%
13A08	204.6	314.0	293.2	23.5%
13A07	181.0	280.9	262.6	22.4%
13A06	150.1	258.7	237.2	24.7%
13A05	171.9	271.1	253.0	22.3%
13A04	204.0	318.9	299.6	20.2%
13A03	180.2	281.6	264.3	20.6%
13A02	150.2	255.2	237.8	19.9%
13A01	149.0	251.2	239.0	13.6%

LTPP Seasonal Monitoring Program Data Sheet SMP-I07 Representative Dry Density	Agency Code		[13]
	LTPP Section ID	13SA	[3019]

Depth of Representative Sample (from pavement surface): 1.22 m

Dry Density Determination:

a.	Tare Weight of Empty Mold:	4099 g	(9.02 lb)
b.	Weight of Mold and Compacted Soil:	5956 g	(13.10 lb)
c.	Weight of Compacted Soil (b - a):	1857 g	(4.09 lb)
d.	Unit Weight of Compacted Soil = (c / 943.0) =		1.97 g/cm³
	([c / (1 / 30)] =		(122.7 lb/ft³)
e.	Dry Density of Compacted Soil = [d / (1 + r/100)] =		1.48 g/cm³
			(92.2 lb/ft³)

Moisture Content Determination:

m.	Tare Weight of Pan:	149.8 g
n.	Weight of Pan and Moisture Sample:	258.5 g
o.	Weight of Pan and Dry Sample:	231.5 g
p.	Weight of Moisture (n - o):	27.0 g
q.	Weight of Dry Sample (o - m):	81.7 g
r.	Moisture Content by Weight = [(p / q) * 100] =	33.0 %

Comments: Brownish-red soil Some clay and rocks of varying size present. Depth of soil given by Robin Self. Sil fairly moist and compacts easily

Prepared by: Hunter Estes Employer: BRE

Date (dd/mmm/yy): 31/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
Figure D-1.	Measured Air Temperature During September Data Collection
Figure D-2.	Measured Average Subsurface Temperature for the First 5 Sensors During September Data Collection
Figure D-3.	Measured Average Subsurface Temperature for all 18 Sensors on September 19th Collection
Figure D-4 thru Figure D13.	Traces from TDR Sensor
Table D-2.	Elevation Measurements Data Sheet - PCC
Table D-3.	Snap Ring Joint Measurement Data Sheet

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

```
5,1995,262,100,12.42,17.88,0
6,1995,262,100,23.96,26.06,27.08,27.4,27.15
5,1995,262,200,12.42,19.54,0
6,1995,262,200,23.61,25.51,26.63,27.19,27.08
5,1995,262,300,12.42,19.67,0
6,1995,262,300,23.1,25.09,26.24,26.97,26.97
5,1995,262,400,12.42,19.2,0
6,1995,262,400,22.6,24.64,25.88,26.75,26.84
5,1995,262,500,12.41,18.44,0
6,1995,262,500,21.94,24.18,25.52,26.52,26.7
5,1995,262,600,12.41,18.2,0
6,1995,262,600,21.4,23.7,25.17,26.3,26.55
5,1995,262,700,12.41,18.6,0
6,1995,262,700,21.35,23.31,24.8,26.06,26.4
5,1995,262,800,12.41,18.92,0
6,1995,262,800,21.55,23.15,24.51,25.83,26.23
5,1995,262,900,12.41,19.23,0
6,1995,262,900,21.97,23.1,24.3,25.61,26.07
5,1995,262,1000,12.41,20.2,0
6,1995,262,1000,23.6,23.38,24.2,25.43,25.91
5,1995,262,1100,12.41,21.36,0
6,1995,262,1100,26.49,24.26,24.32,25.3,25.77
5,1995,262,1200,12.42,22.2,0
6,1995,262,1200,29.05,25.62,24.75,25.24,25.66
5,1995,262,1300,12.42,22.77,0
6,1995,262,1300,31.89,27.22,25.46,25.33,25.61
5,1995,262,1400,12.42,23.48,0
6,1995,262,1400,35.01,28.98,26.31,25.54,25.64
5,1995,262,1500,12.42,23.95,0
6,1995,262,1500,34.76,30.24,27.3,25.87,25.74
5,1995,262,1600,12.41,24.67,0
6,1995,262,1600,36.83,31.3,28.1,26.28,25.92
5,1995,262,1700,12.41,24.13,0
6,1995,262,1700,35.69,32.06,28.88,26.72,26.16
5,1995,262,1800,12.41,23.81,0
6,1995,262,1800,34.13,31.93,29.4,27.17,26.44
5,1995,262,1900,12.4,22.13,0
6,1995,262,1900,31.63,31.29,29.51,27.51,26.68
5,1995,262,2000,12.39,18.97,0
6,1995,262,2000,20.61,24.83,26.14,26.1,25.52
5,1995,262,2100,12.38,17.04,0
6,1995,262,2100,18.86,23.61,25.45,25.88,25.59
5,1995,262,2200,12.37,15.81,0
6,1995,262,2200,16.98,21.92,24.17,25.1,25.23
5,1995,262,2300,12.37,15.08,0
6,1995,262,2300,15.96,20.96,23.39,24.6,25.02
1,1995,262,2400,12.41,12.43,17,12.36,2258,19.98,25.43,1646,13.97,2358,0,4067
2,1995,262,2400,25.34,25.68,25.84,26.03,26.06,26.02,25.88,25.72,25.48,25.18,25,24.81,24.63,24.38,24.15,24.02,23.72,23.43
3,1995,262,2400,37.18,1549,32.22,1638,29.66,1842,27.77,1852,27.24,4,26.78,47,26.49,307,26.29,1048,26.06,1036,25.68,1037,25.52,1206,25.33,1011,25.15,1018,24.9,1106,24.65,1032,24.54,1128,24.21,1016,23.93,1022
4,1995,262,2400,13.24,0,18.7,0,21.4,0,22.98,0,23.76,0,24.07,0,23.81,1900,23.5,1929,23.1,1900,22.91,1915,22.68,1929,22.48,1915,22.28,1915,22.05,1915,21.79,1915,21.58,1929,21.43,1915,21.28,1929
5,1995,262,2400,12.37,14.37,0
6,1995,262,2400,15.14,20.07,22.56,23.98,24.61
```

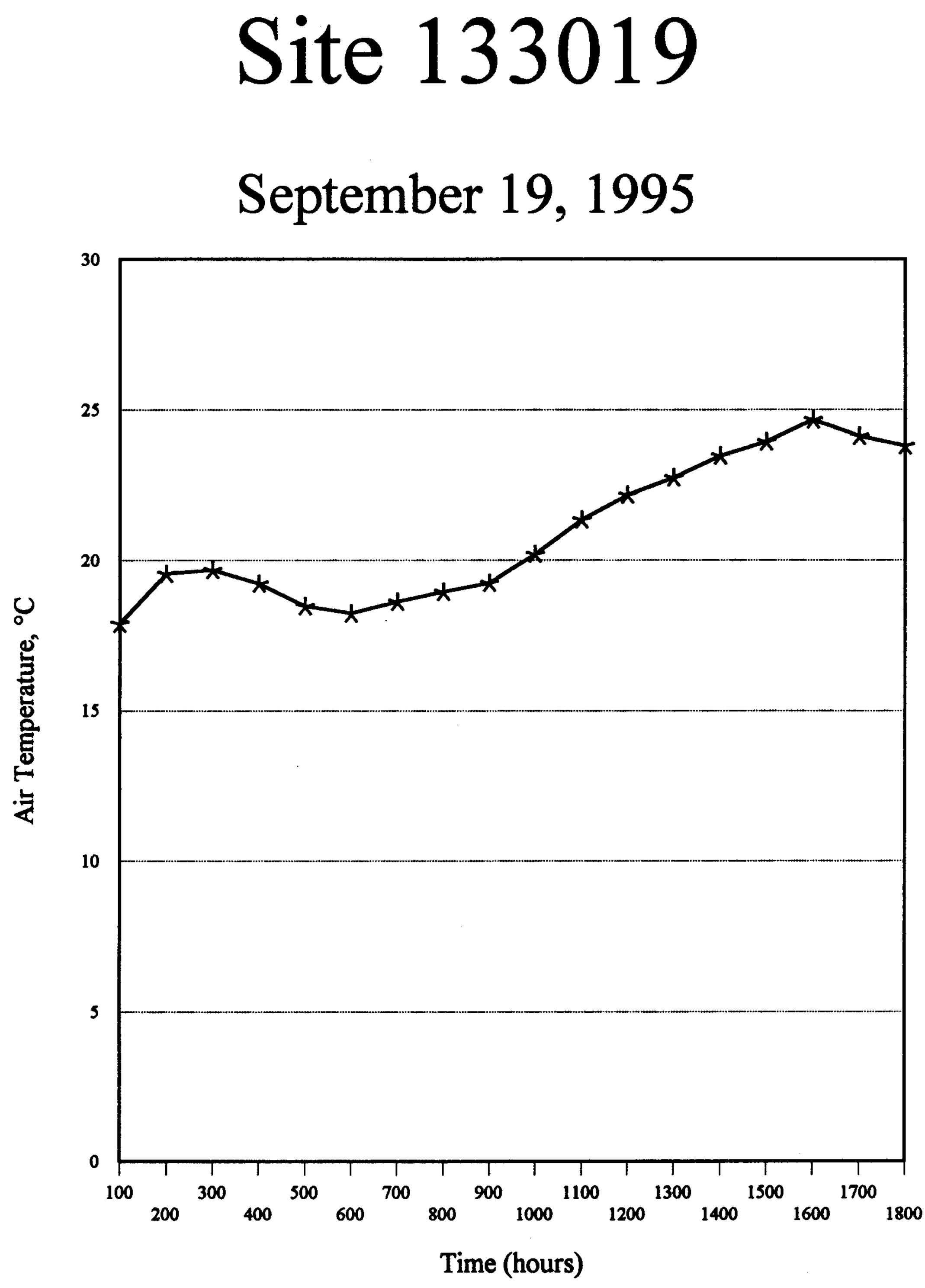


Figure D-1. Measured Air Temperature During September Data Collection. (Data shown not collected on installation date due to problems collecting data on datalogger)

Site 133019

September 19, 1995

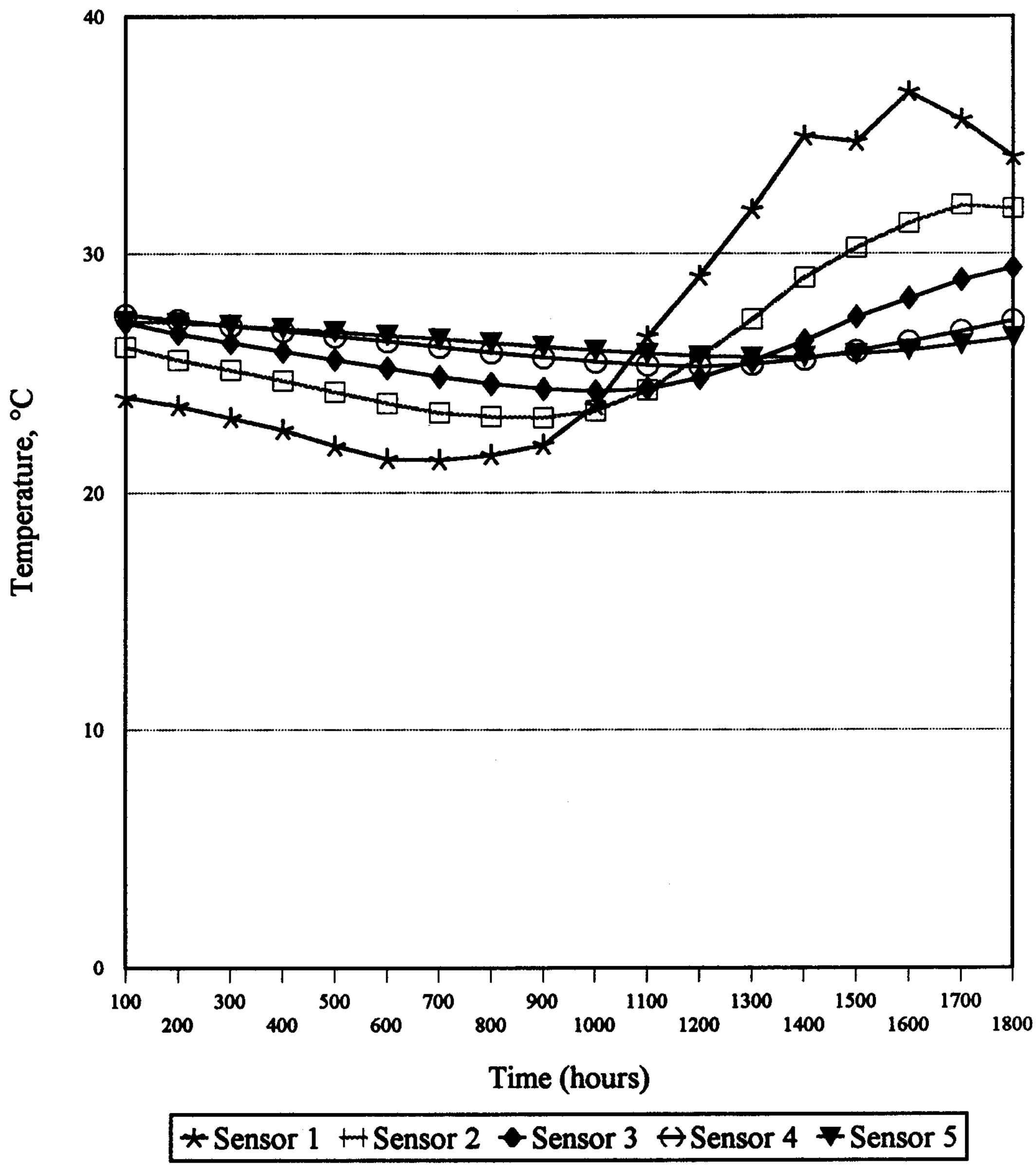


Figure D-2. Measured Average Subsurface Temperature for the First 5 Sensors During September Data Collection. (Data shown not collected on installation date due to problems collecting data on datalogger)

Site 133019

September 19, 1995

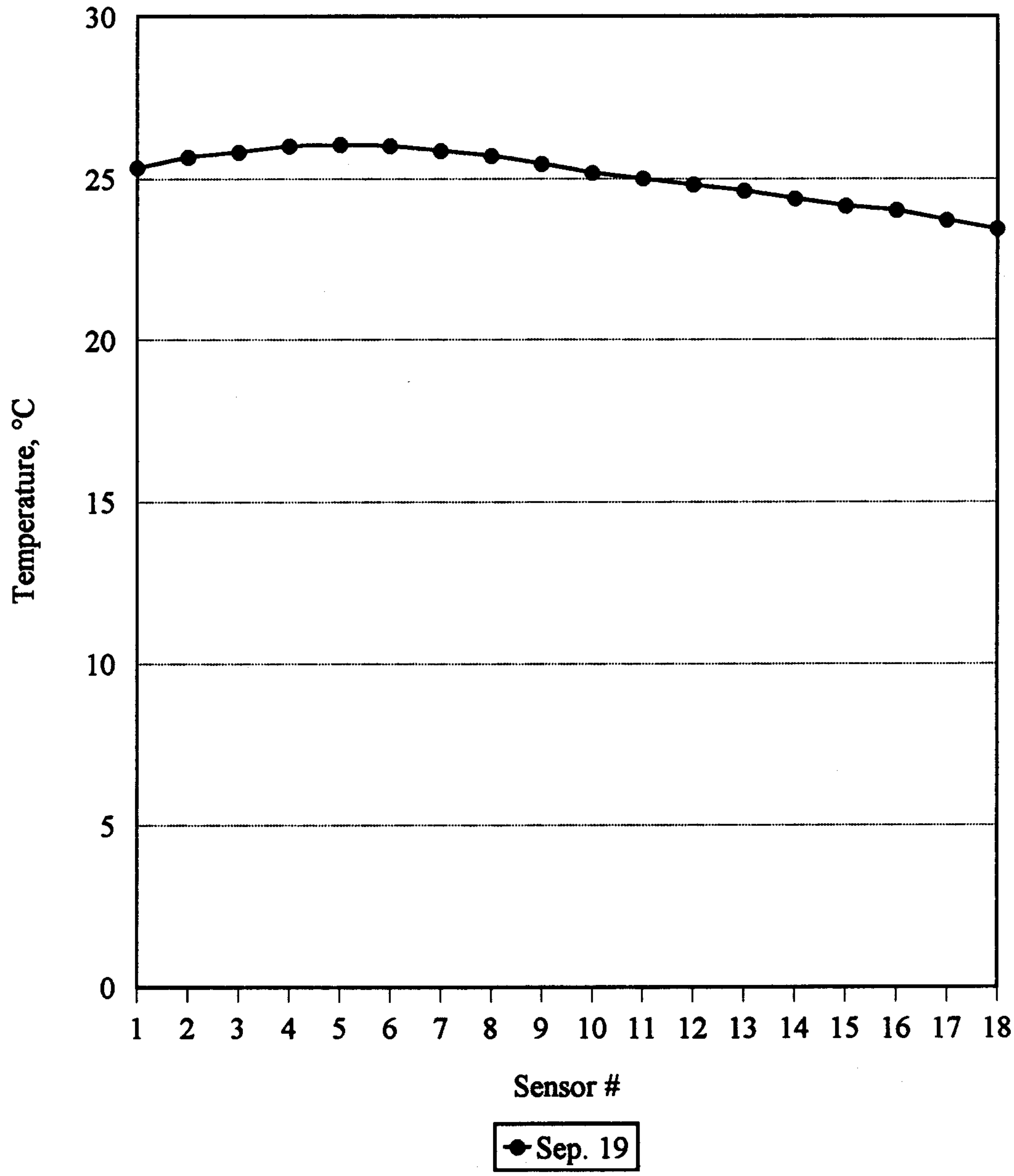


Figure D.3. Measured Average Subsurface Temperature for all 18 Sensors on September 19th.(Data shown not collected on installation date due to problems collecting data on datalogger)

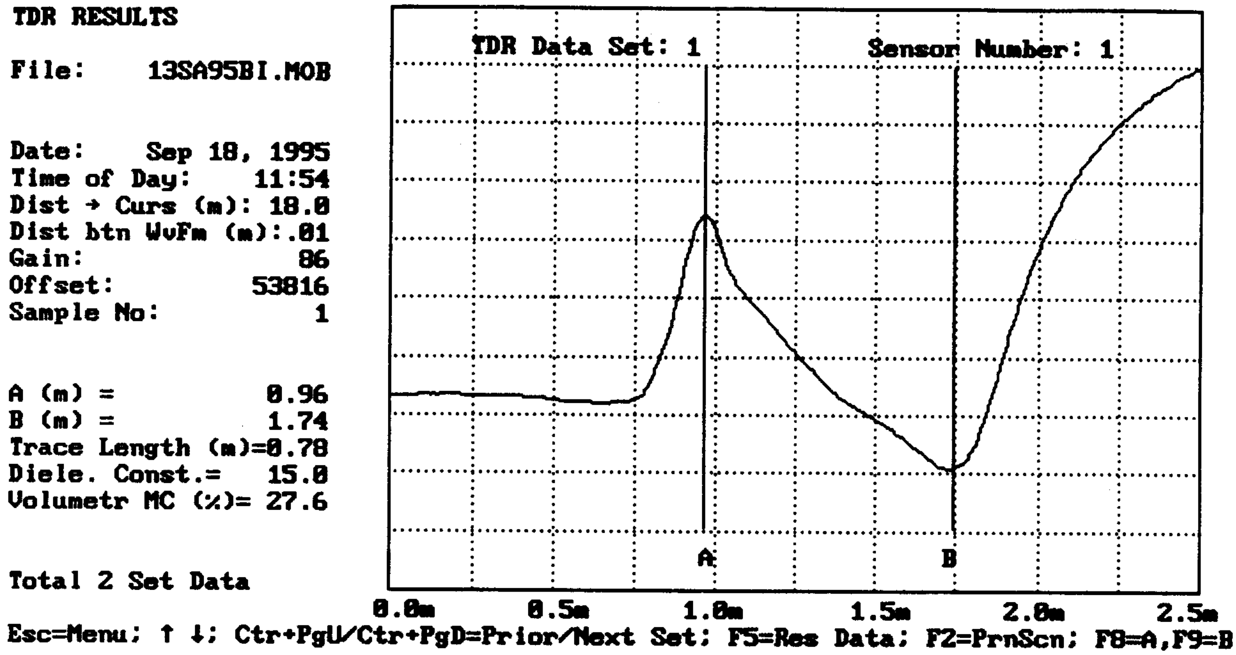


Figure D-4. Trace from TDR Sensor 1

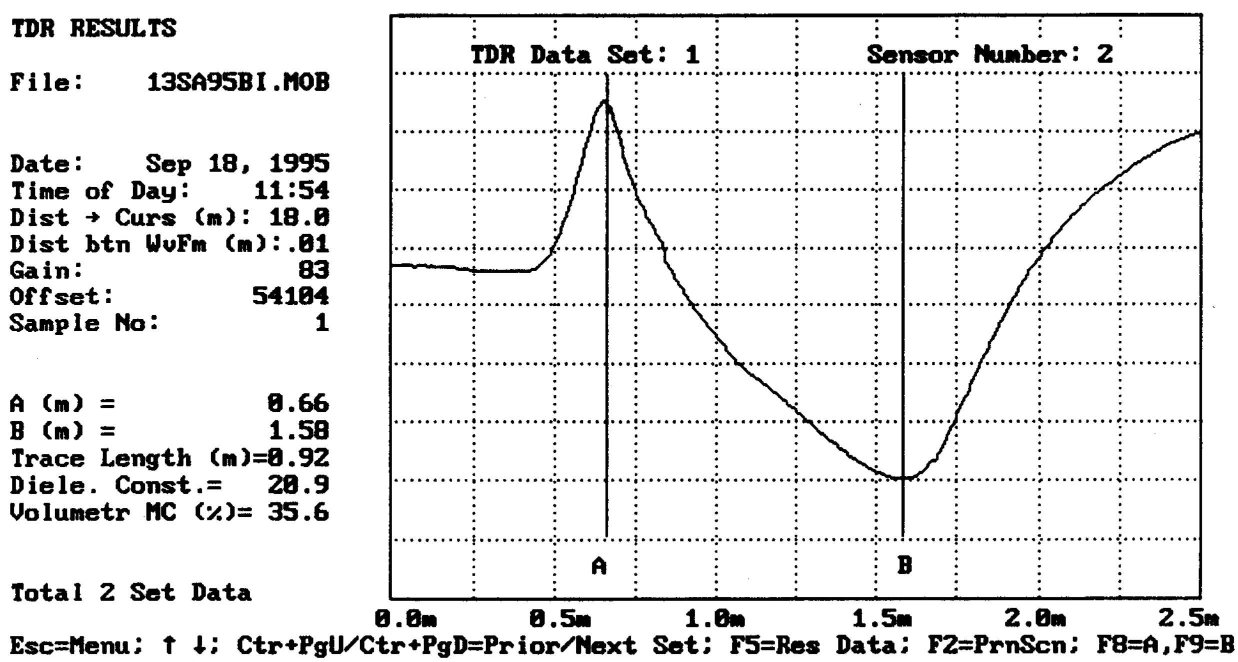


Figure D-5. Trace from TDR Sensor 2

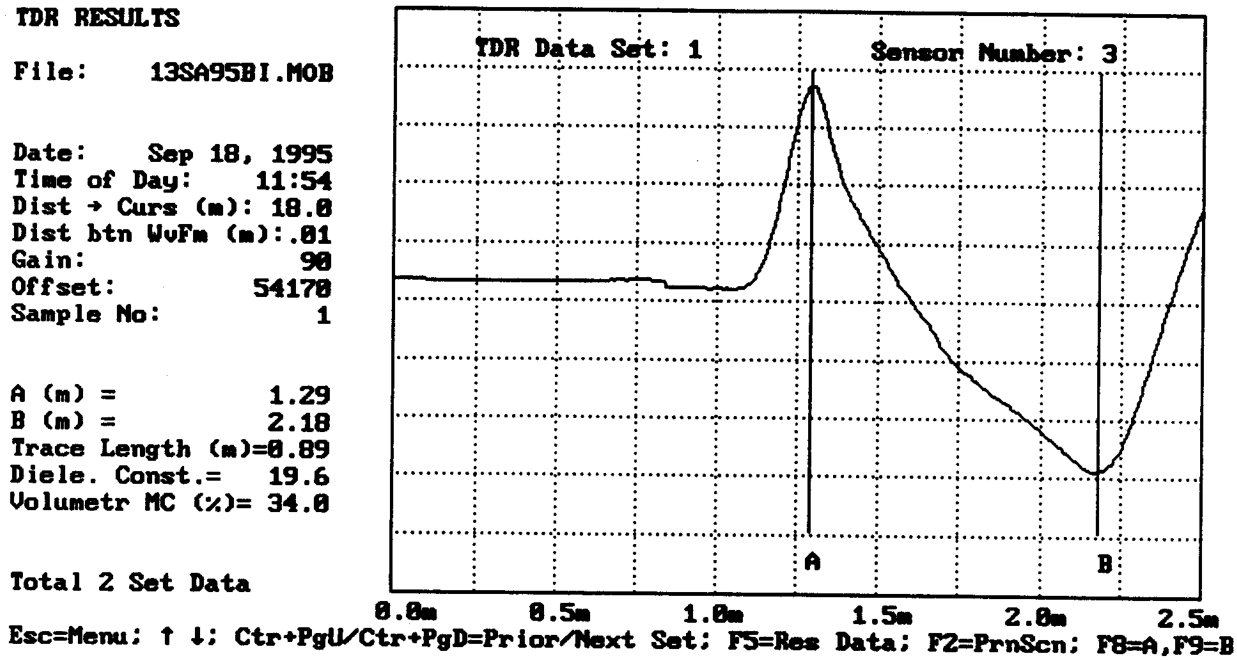


Figure D-6. Trace from TDR Sensor 3

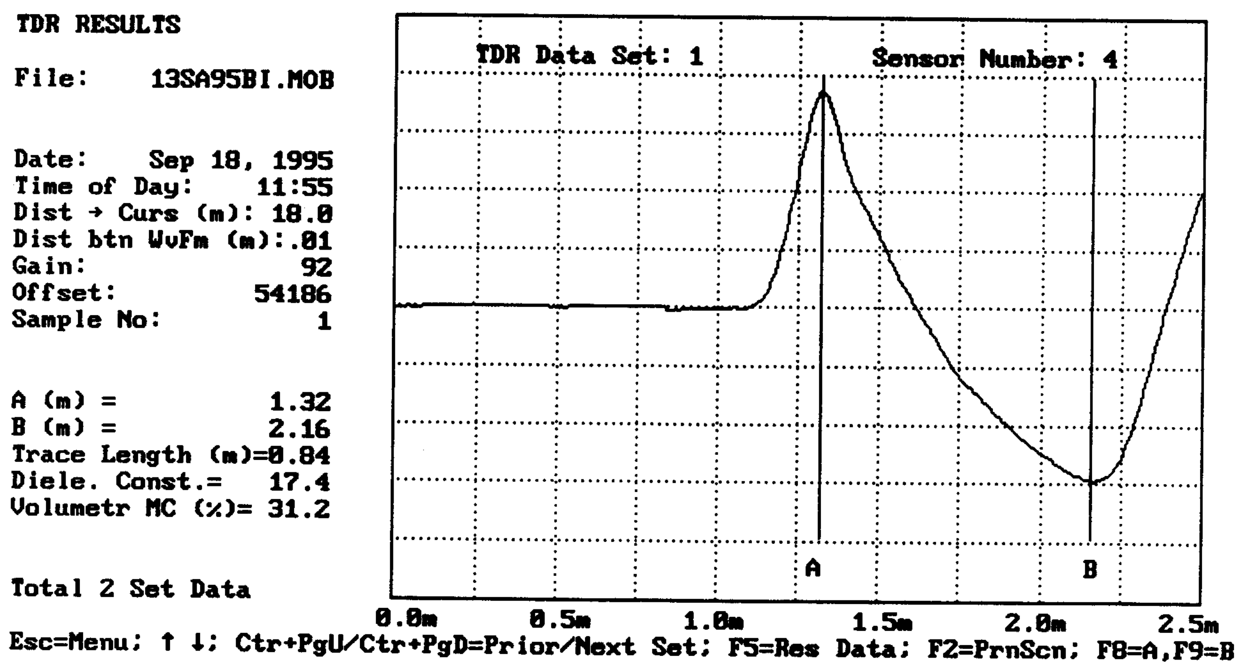


Figure D-7. Trace from TDR Sensor 4

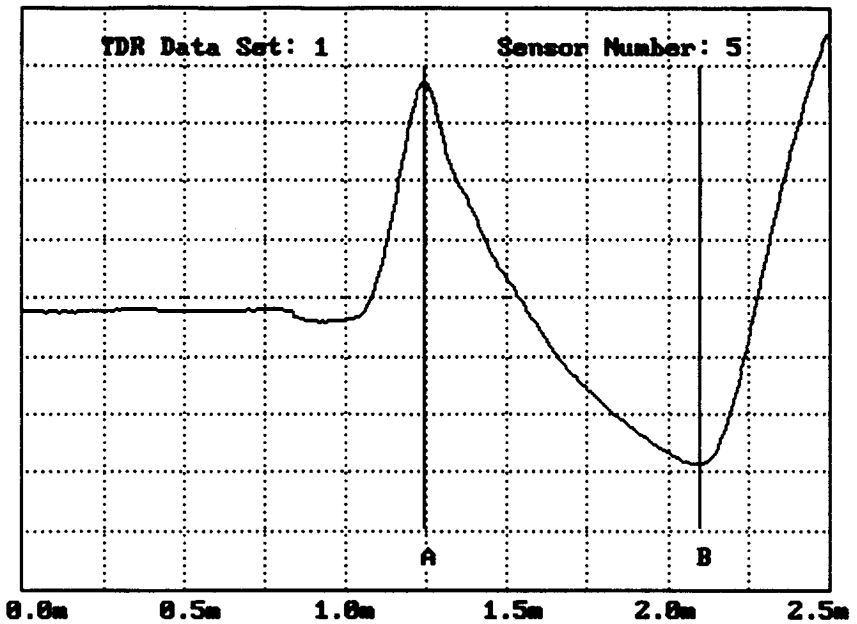
TDR RESULTS

```
File:     13SA95BI.MOB

Date:     Sep 18, 1995
Time of Day:     11:55
Dist → Curs (m): 18.0
Dist btn WvFm (m):.01
Gain:               94
Offset:          54191
Sample No:           1

A (m) =           1.24
B (m) =           2.10
Trace Length (m)=0.86
Diele. Const.=    18.3
Volumetr MC (%)= 32.3

Total 2 Set Data
```



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

Figure D-8. Trace from TDR Sensor 5

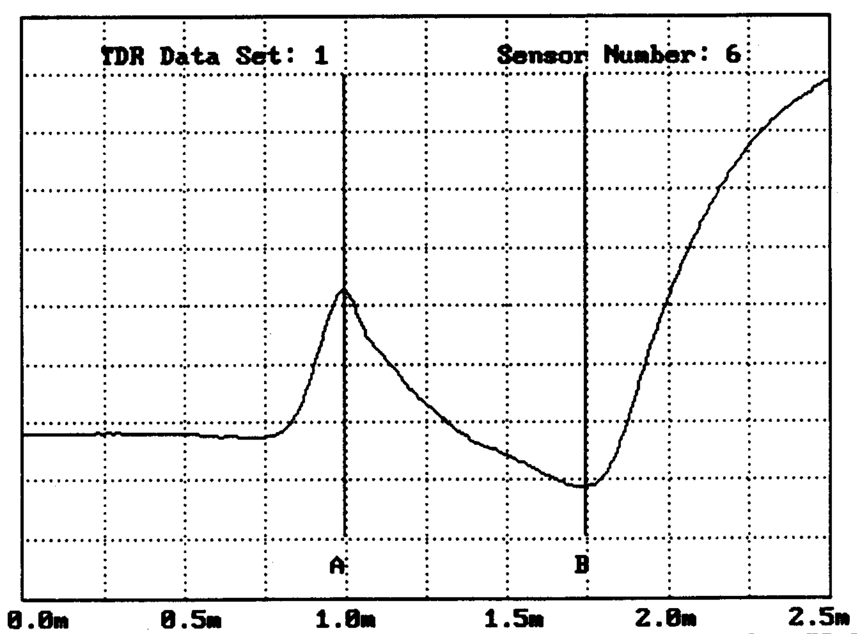
TDR RESULTS

```
File:     13SA95BI.MOB

Date:     Sep 18, 1995
Time of Day:     11:55
Dist → Curs (m): 18.0
Dist btn WvFm (m):.01
Gain:               76
Offset:          53771
Sample No:           1

A (m) =           0.99
B (m) =           1.74
Trace Length (m)=0.75
Diele. Const.=    13.9
Volumetr MC (%)= 25.8

Total 2 Set Data
```



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

Figure D-9. Trace from TDR Sensor 6

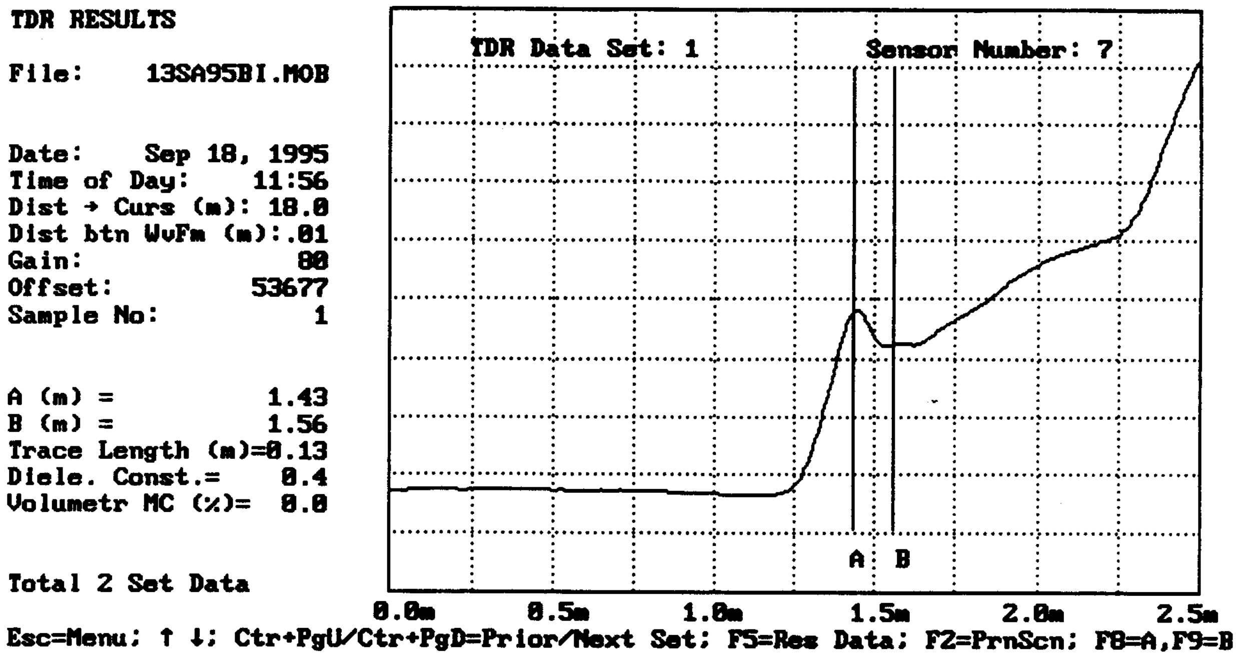


Figure D-10. Trace from TDR Sensor 7

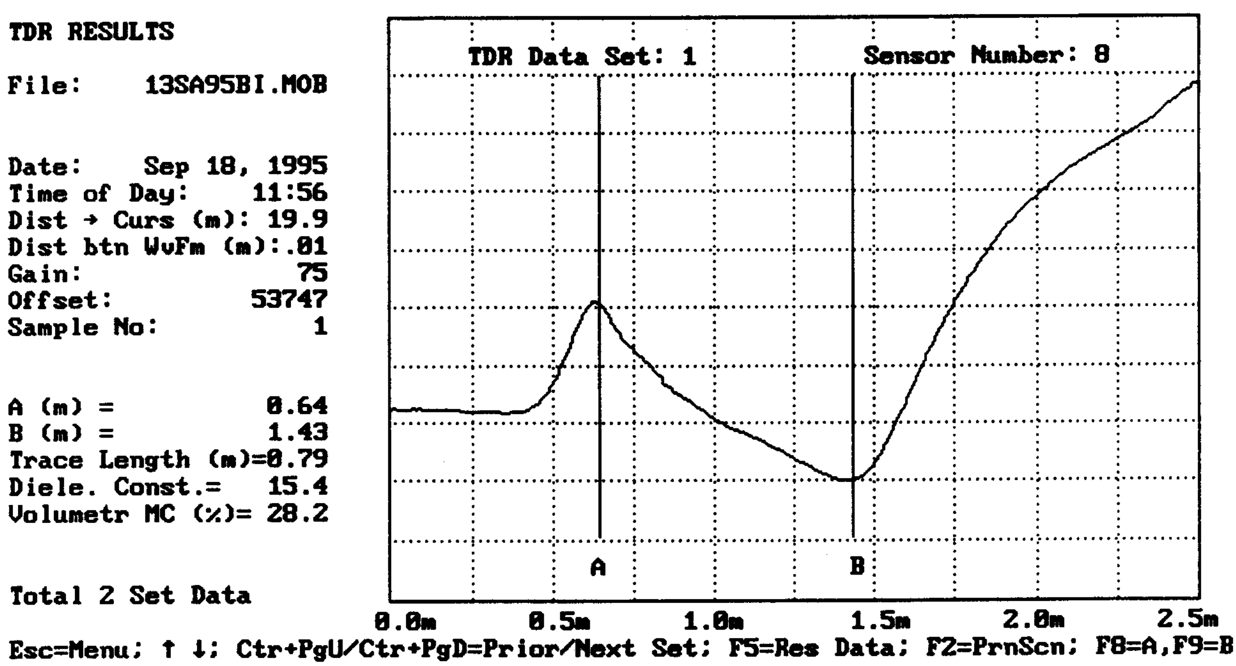


Figure D-11. Trace from TDR Sensor 8

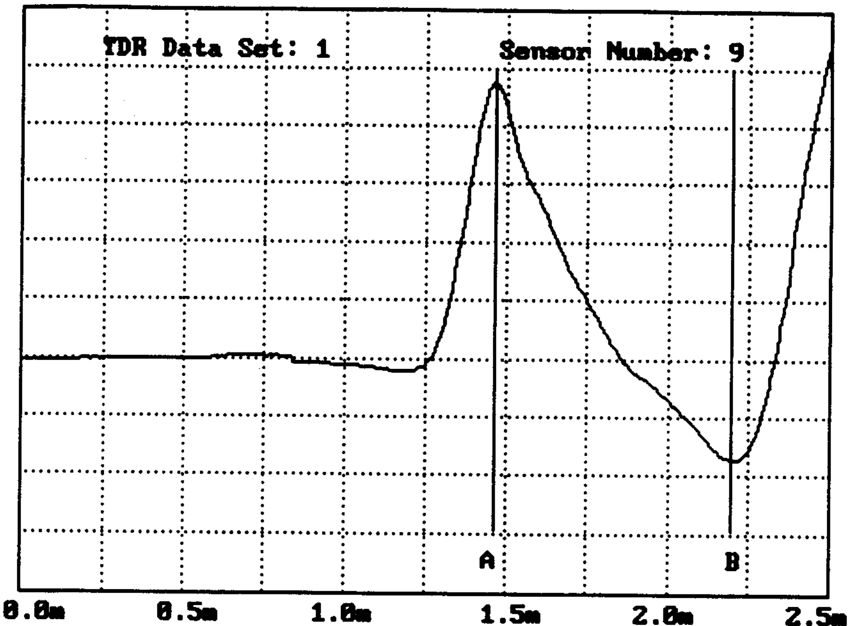
TDR RESULTS

File: 13SA95BI.MOB

Date: Sep 18, 1995
Time of Day: 11:56
Dist → Curs (m): 19.9
Dist btn WvFm (m):.01
Gain: 103
Offset: 54160
Sample No: 1

A (m) = 1.46
B (m) = 2.20
Trace Length (m)=0.74
Diele. Const.= 13.5
Volumetr MC (%)= 25.2

Total 2 Set Data



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

Figure D-12. Trace from TDR Sensor 9

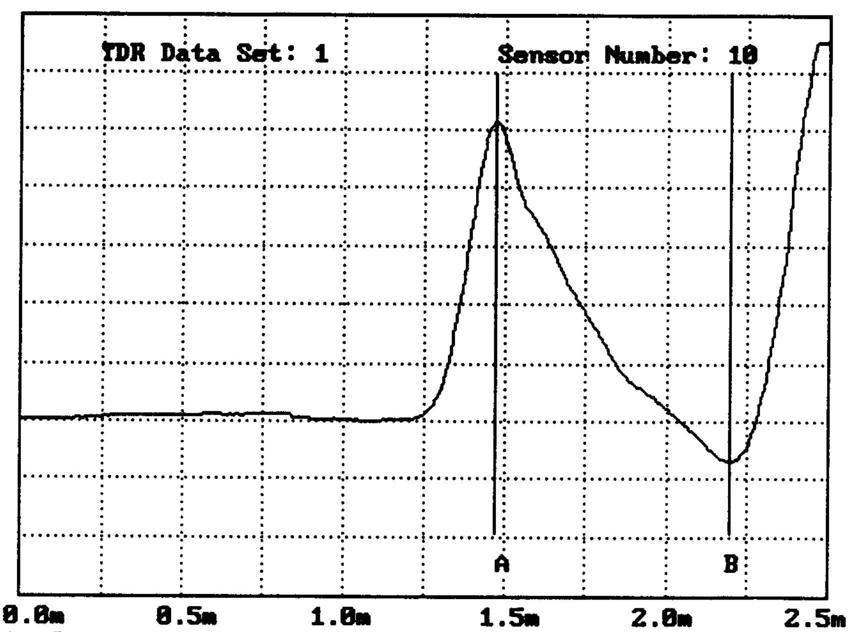
TDR RESULTS

File: 13SA95BI.MOB

Date: Sep 18, 1995
Time of Day: 11:57
Dist → Curs (m): 19.9
Dist btn WvFm (m):.01
Gain: 104
Offset: 54120
Sample No: 1

A (m) = 1.47
B (m) = 2.20
Trace Length (m)=0.73
Diele. Const.= 13.2
Volumetr MC (%)= 24.6

Total 2 Set Data



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

Figure D-13. Trace from TDR Sensor 10

Table D-2. Elevation Measurements Data Sheet - PCC

SEASONAL MONITORING
"RIGID" TRANSVERSE ELEVATION MEASUREMENTS[1]

13SA

	Station		Outside Edge		ML		Inside Edge	
			O/S	Elev.	O/S	Elev.	O/S	Elev.
J	0-31.1	L	0.3m	10.364	1.85m	10.385	3.4m	10.407
	0-21.1	M	"	INST.	"	10.386	"	10.408
J	0-11.1	A	"	10.360	"	10.385	"	10.406
J	0+08.9'	A	"	10.364	"	10.389	"	10.407
	"	L	"	10.364	"	10.388	"	10.407
	0+17.8'	M	"	10.365	"	10.391	"	10.412
J	0+28.9'	A	"	10.369	"	10.397	"	10.417
	"	L	"	10.369	"	10.396	"	10.417
	0+38.8'	M	"	10.373	"	10.403	"	10.424
J	0+48.7	A	"	10.380	"	10.407	"	10.428
	"	L	"	10.379	"	10.406	"	10.428
	0+58.8	M	"	10.387	"	10.415	"	10.437
J	0+69.9	A	"	10.395	"	10.423	"	10.443
	"	L	"	10.394	"	10.422	"	10.442
	0+78.9	M	"	10.399	"	10.430	"	10.450
J	0+88.8	A	"	10.409	"	10.435	"	10.454

Bench Mark : TOP OF 1" MONITOR WELL PIPE, STA. 0+71, 16.0' (4.87m) RT.
ASSUMED ELEV. 10.000 METERS
T.B.M. CHISELED '+' (PLUS) ON N. END OF CONC. CATCH BASIN IN ℄ MEDIAN STA. 0+37
ELEV. 9.652

Comments: 3.70 M. SLAB WIDTH; SNAP RINGS NOT SET YET, APPROACH & LEAVE LOCATIONS SHOT @ PROPOSED SNAP RING LOCATION

CLEAR BREEZY TIE IN ✓

Test Section No. 133019
Start Time (Military)
Recorded By [illegible] / HE

Date (dd,mm,yy) 01/08/95 AUG
Device Used LASERPLANE LEVEL
Employer BRE

(1) ML readings to be taken at FWD test locations, A = Approach Joint, L = Leave Joint, M = Mid Lane. Stations are at slab joint.

07/11/95

Table D-3. Snap Ring Joint Measurement Data Sheet

LTPP Seasonal Monitoring Program Data Sheet SMP-D06 Joint Opening Measurement	Agency Code 13SA96A [13] LTPP Section ID [3019]

Station	Time (military)	Joint Opening (mm) Offset (PE): 0.30 m	Offset (ML): 1.85 m	Offset (ILE): 3.40 m	Joint Width (mm)
0-31	08:10	116.75	116.99	116.56	12.
		116.78	116.97	116.53	
		116.73	116.90	116.57	
	12:30	116.66	116.68	116.20	10.
	16:20	116.61	116.59	116.51	~~4~~ 10
0+08	08:13	115.57	117.39	116.50	10.
		115.51	117.36	116.45	
		115.55	117.38	116.44	
	12:35	115.22	117.04	116.28	11.
	16:25	115.23	116.84	116.07	09.
0+28	0817	116.76	116.53	117.04	11.
		116.71	116.50	116.96	
		116.76	116.48	116.94	
	12:38	116.53	116.78	116.66	11.
	16:30	116.50	116.07	116.56	08.
0+48	08:21	118.33	116.96	116.43	09.
		118.28	116.99	116.71	
		118.32	116.01	116.50	
	12:40	117.93	116.68	116.12	09.
	16:35	117.85	116.61	115.96	08.
0+69	08:25	116.75	116.58	116.76	10.
		116.77	116.61	116.71	
		116.77	116.66	116.75	
	12:44	116.43	116.33	116.44	09.
	16:40	116.39	116.17	116.44	09.
0+88	08:30	117.05	117.69	117.86	10.
		117.11	117.70	117.89	
		117.15	117.75	117.90	
	12:48	116.75	117.24	117.47	09.
	16:45	116.53	117.22	117.51	09.

Comments:

Prepared by: Robin BELT Employer: BRENT Rauhut Eng.

Date (dd/mm/yy): 22/01/96

Data Sheet SMP-D06: Joint Opening Measurements

APPENDIX E

Photographs

Appendix E contains the following photographs:

Photo E-1. General Photo of Test Section

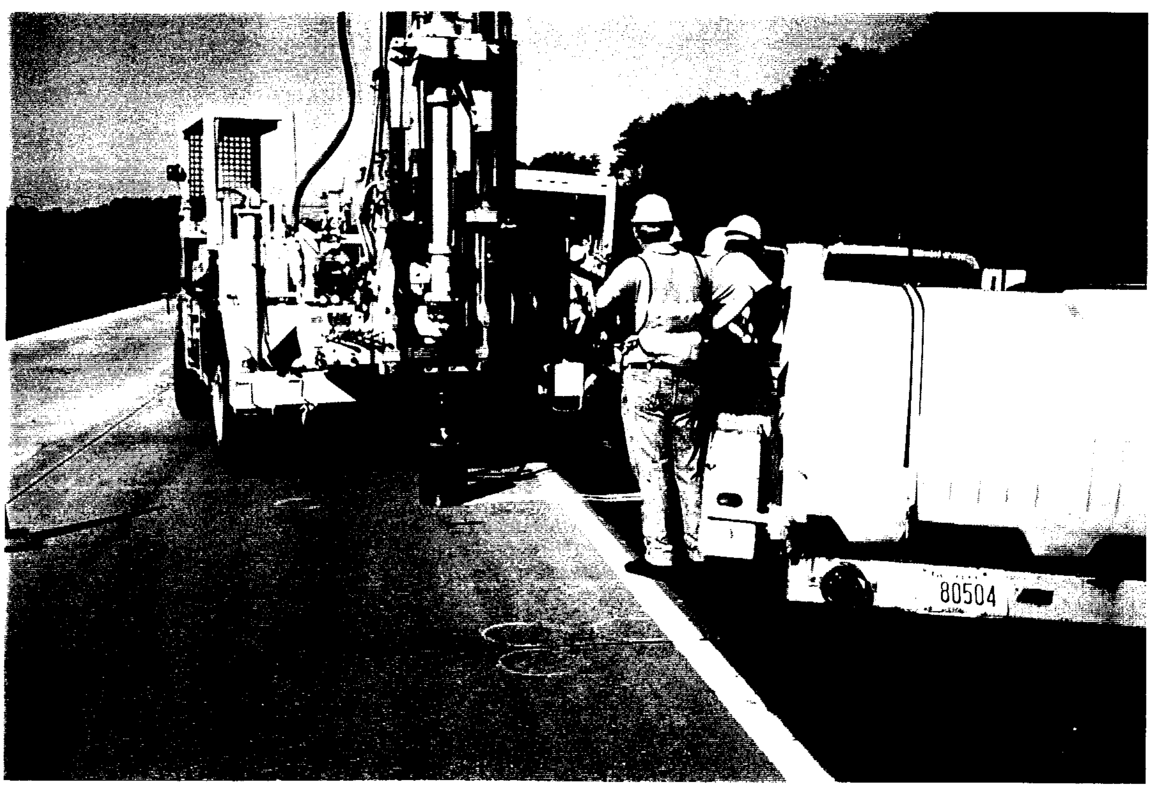


Photo E-2. Removal of Pavement Core

Photo E-3. Installation of Piezometer Observation Well

Photo E-4. Preparing for Instrumentation Installation