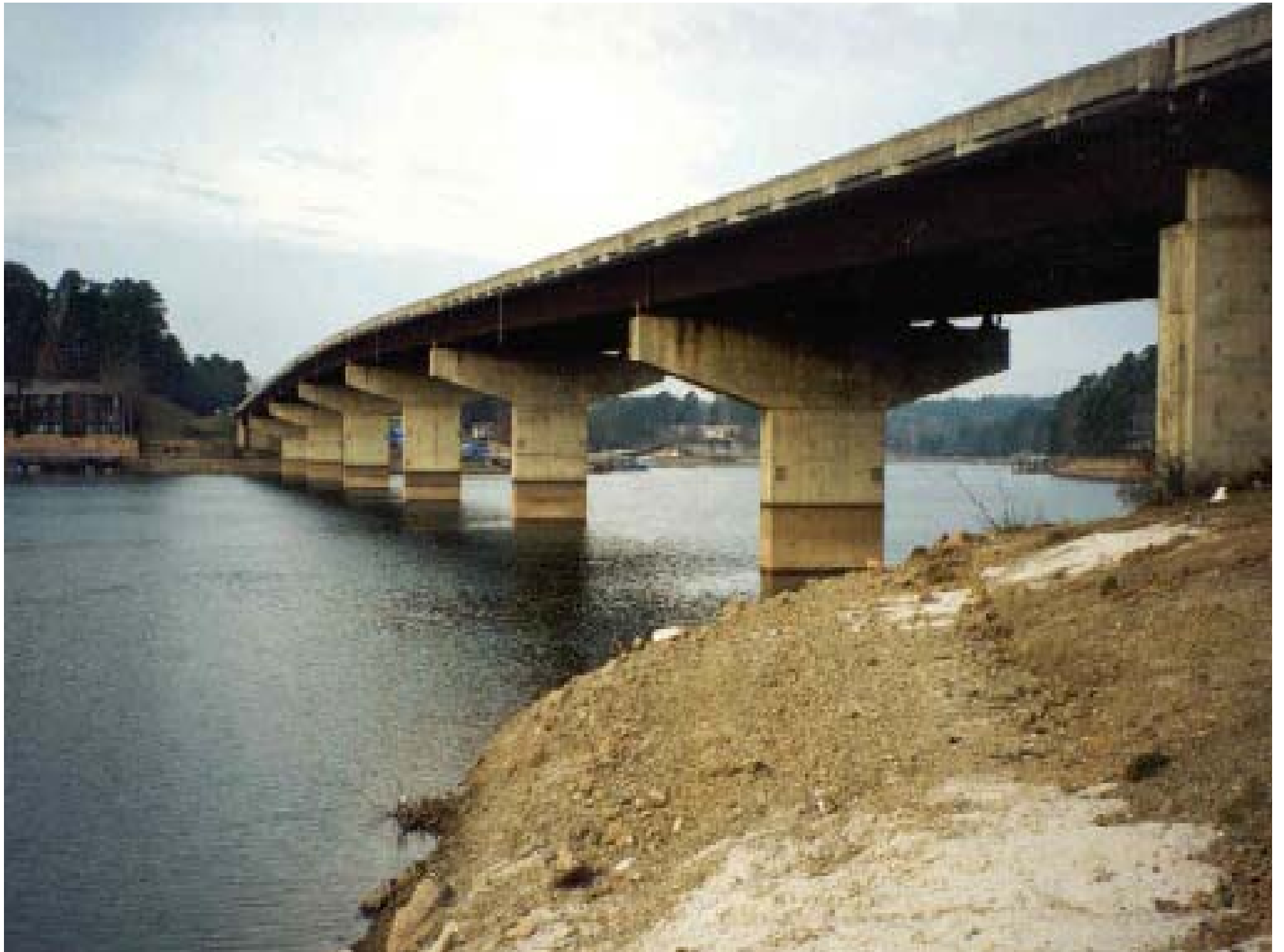


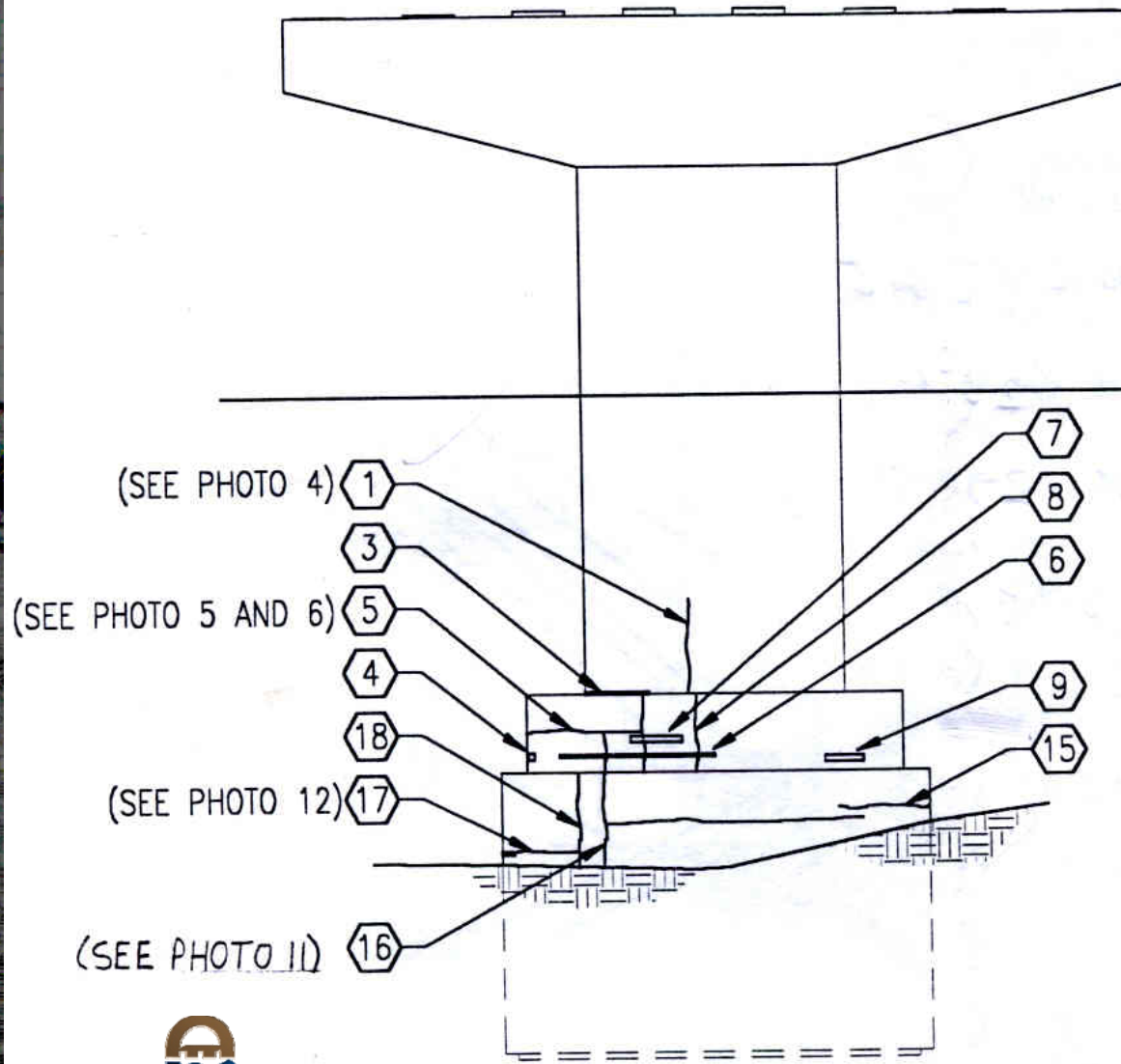


**INFRASTRUCTURE
ENGINEERS, INC.**

Advanced Technology in the Decision Making Process for Major Bridge Repairs

**David R. Reser, P.E.
Project Manager**





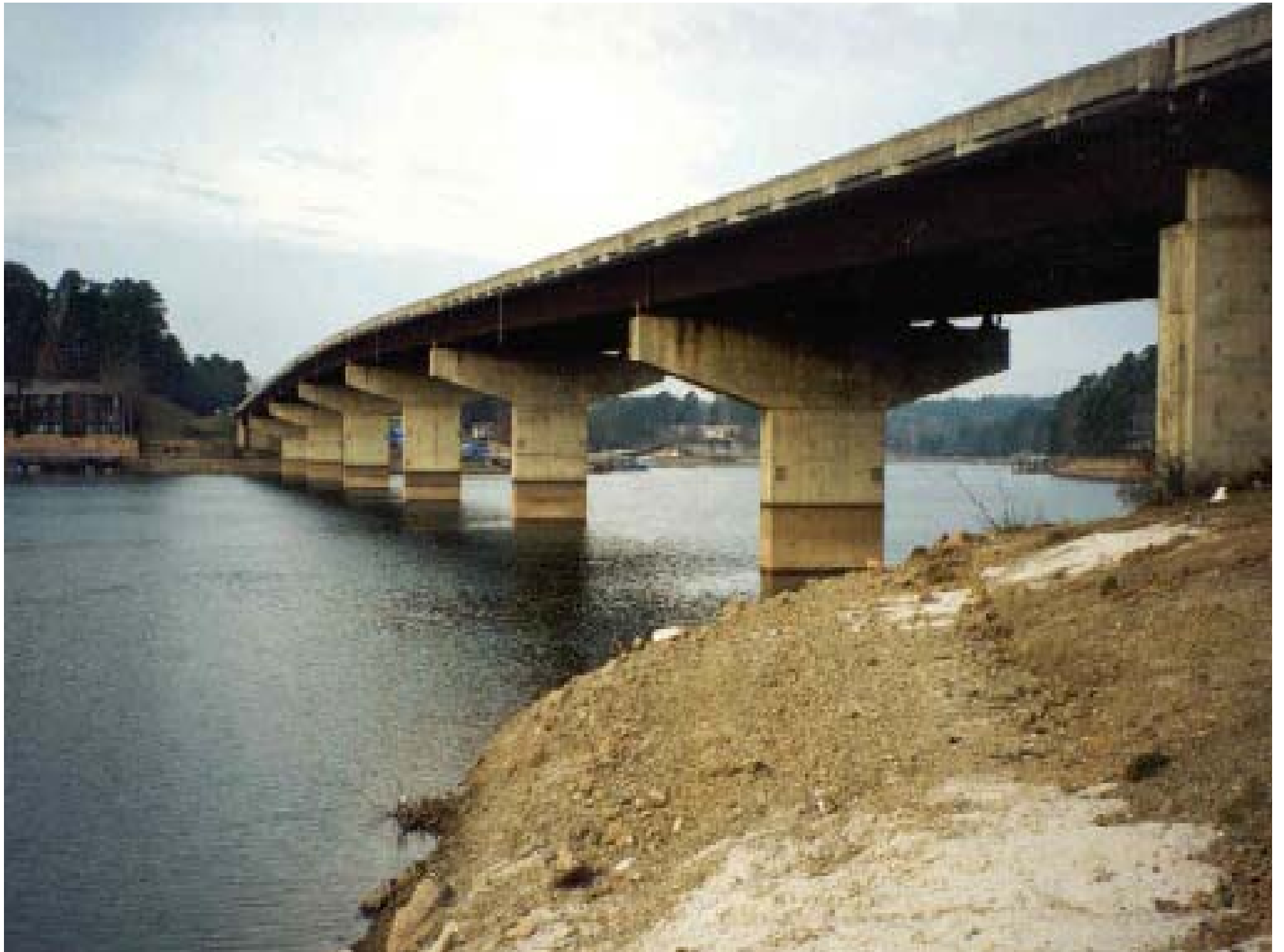












THE PROJECT PLAN

- Review Construction Documents
- Core Footings
 - Visual Inspection
 - In-situ Strength Determination
 - Petrographic Analysis
- Cross Hole Sonic Logging
 - Single Hole Sonic Logging
- Supplemental Underwater Inspection
- Repair Design Recommendation



REVIEW OF CONSTRUCTION DOCUMENTS

- Pier 7 seal failed after construction.
- Single tremie was stationary.
- Mix designs were verified.
- Contractor personnel inexperienced.
- Foundation rock highly fractured at several seal locations.

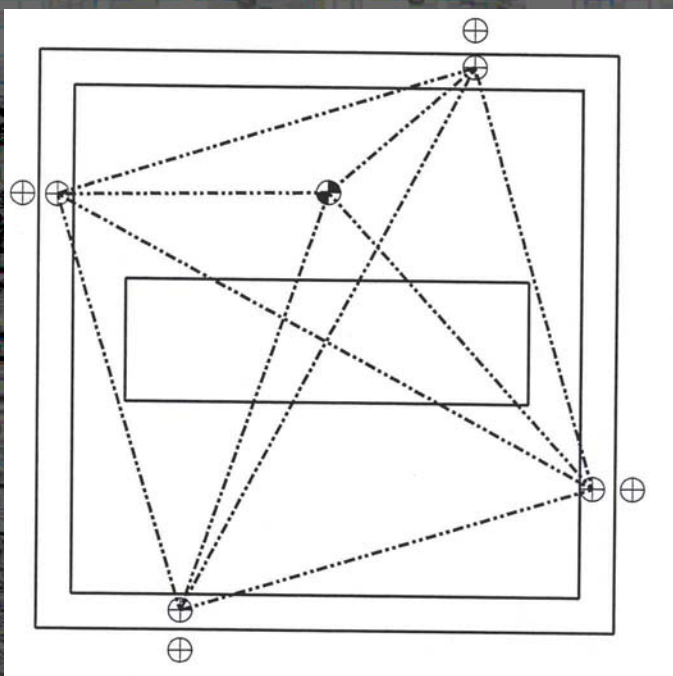


OTHER DOCUMENTS

- Similar bridge on SR 7 over Lake Hamilton in good condition.
- SR 7 bridge had different contractor and concrete supplier.
- Survey monitoring since 1998 reveals no settlement.



CORE PATTERN



CORING TECHNIQUE

- Truck mounted Simco 2400 Rotary-drilling rig from spud barge.
- Wireline system with 5ft long NQwl-size double-tube core barrel with diamond bit.
- RQD and Recovery Recorded
- Cores stored in waxed cardboard boxes for additional inspection as needed.



THE RESULTS



99-297
Grubbs, Hoskyn, Barton & Wyatt, Inc. Consulting Engineers
LOG OF BORING NO. 2-5
 US 70 Bridge over Ouachita River
 Hot Springs, Arkansas

TYPE: Core LOCATION: See Plate 1

DEPTH, FT	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT LBS/CU FT	COHESION, TON/SQ FT			- No. 200 %	% Recovery	% RCD
						PLASTIC LIMIT	WATER CONTENT	LIQUID LIMIT			
			SURF. EL: 375±								
5			Portland cement concrete (footing)								100/100
			- reinforcing steel at 5.8 ft (#11 Rebar)								
10			Portland cement concrete (seal concrete) - cold joint at 8.6 ft								100/100
			- discontinuity from 10.4 to 10.6 ft, bare aggregate								100/100
15			- soft zone at 14.3 to 14.4 ft								100/100
20											100/100
25											100/100
30			- soft zone at 28.9 to 29.1 ft								100/100
35			Medium hard dark gray shale w/occasional quartz seams. 4.5% dia. Note: Borehole depth referenced from top of footing.								100/0

COMPLETION DEPTH: 33.0 ft DEPTH TO WATER IN BORING: N/A DATE: 6-13-00 DATE: 8/13/2000

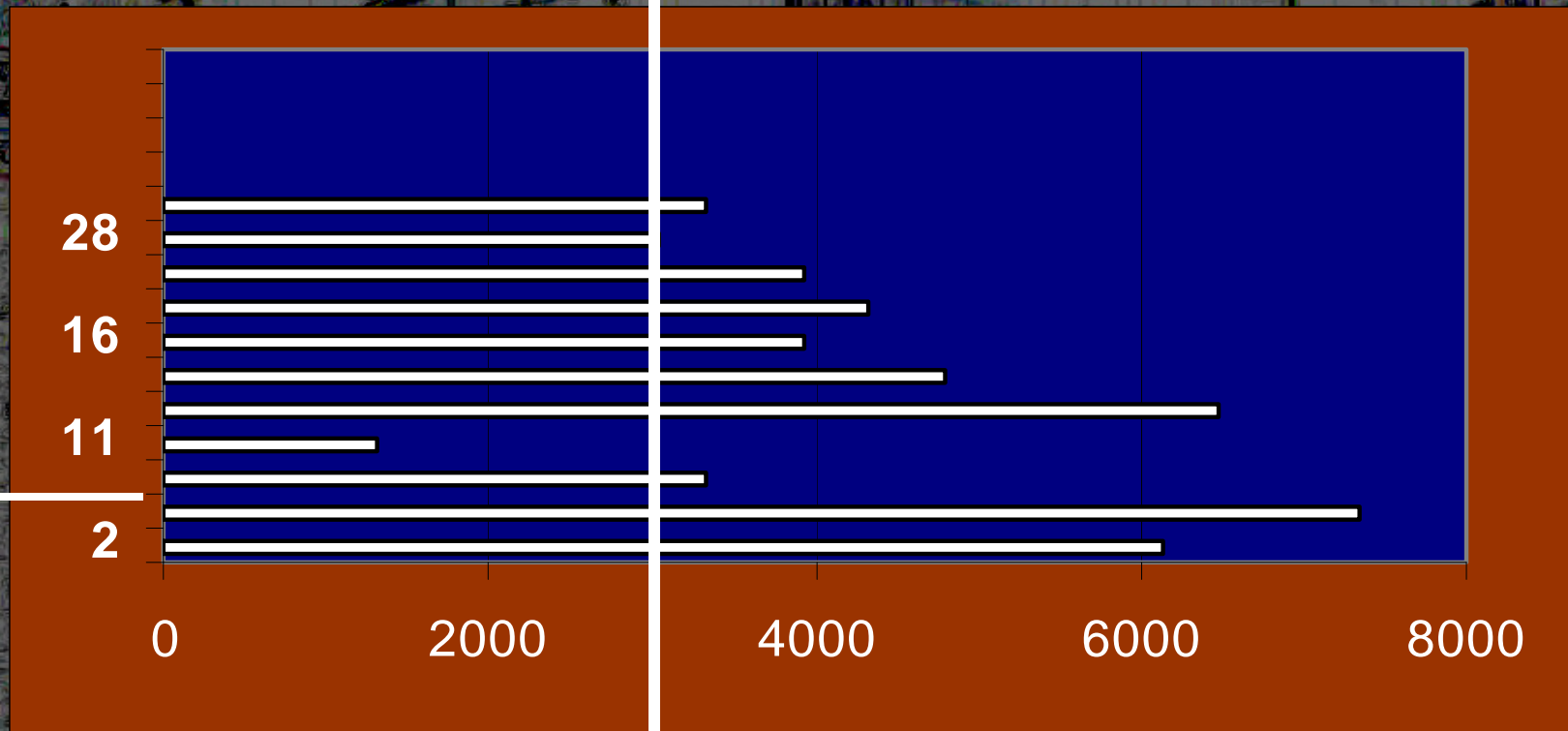
PLATE 14

VISUAL INSPECTION RESULTS

- All seals have seams of soft concrete with isolated areas of bare aggregate.
- Several vertical and horizontal cracks were bisected by the core barrel.
- The interface of the footing and seal concrete is generally good.
- Highly weathered and fractured foundation rock at Pier 2.

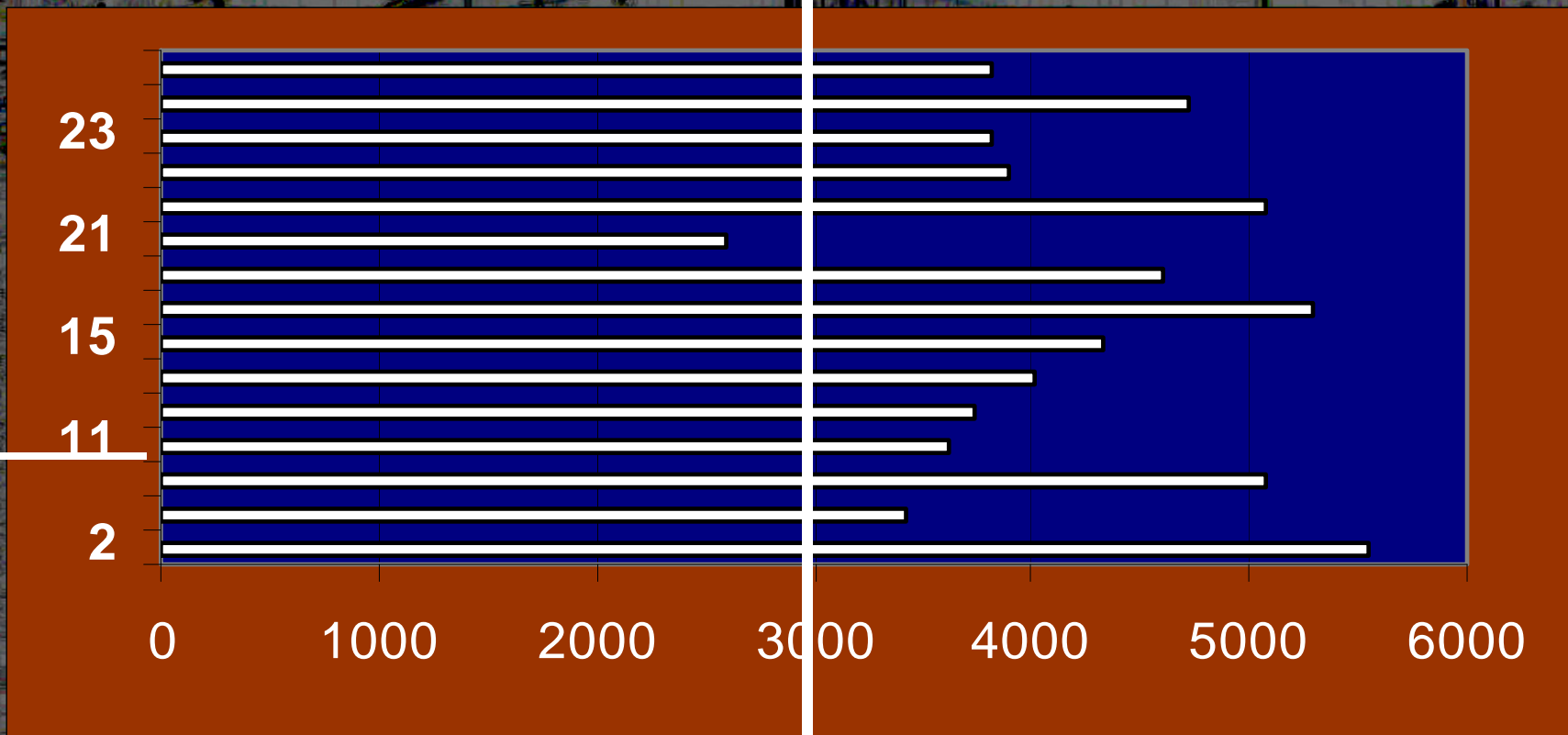
PIER 2 COMPRESSIVE STRENGTH ASTM C-39

3000



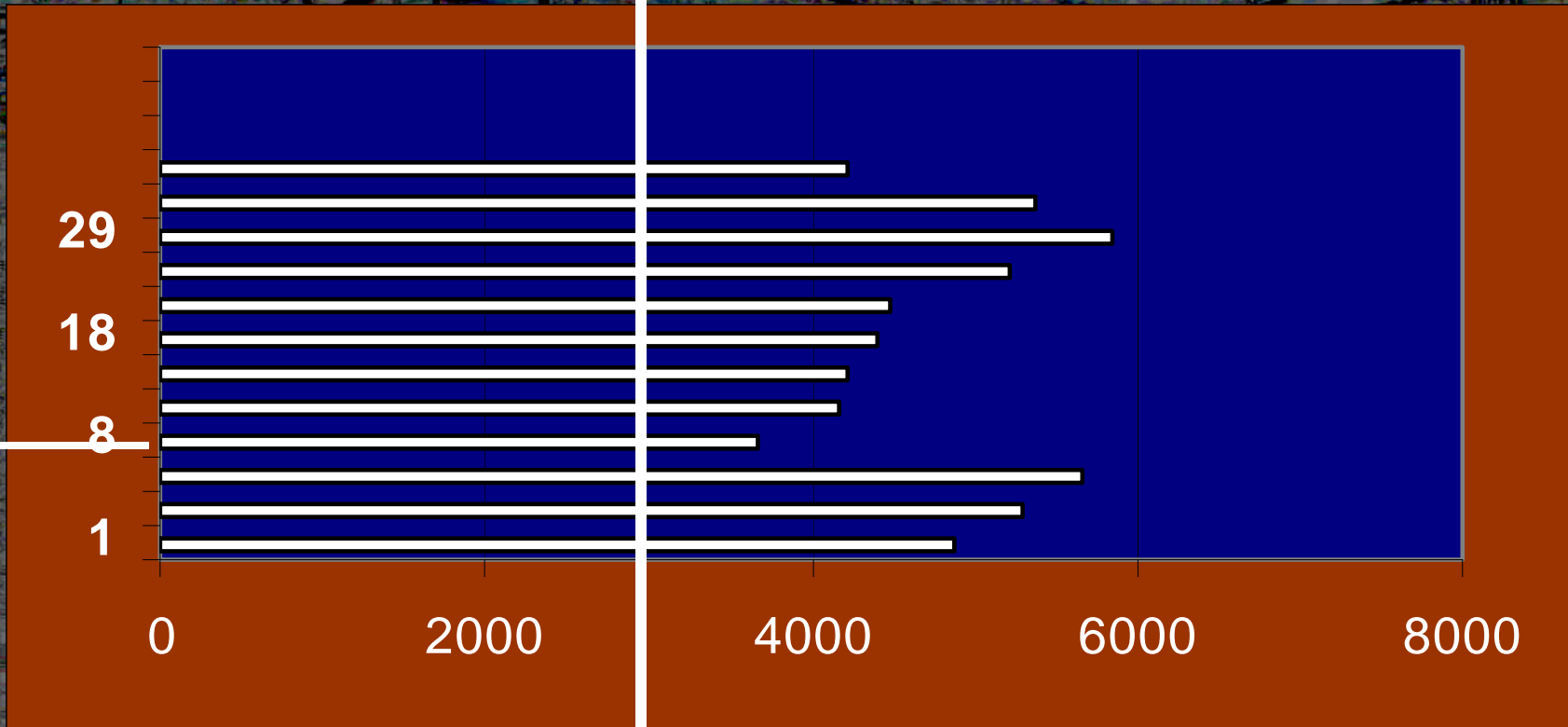
PIER 3 COMPRESSIVE STRENGTH ASTM C-39

3000



PIER 5 COMPRESSIVE STRENGTH ASTM C-39

3000

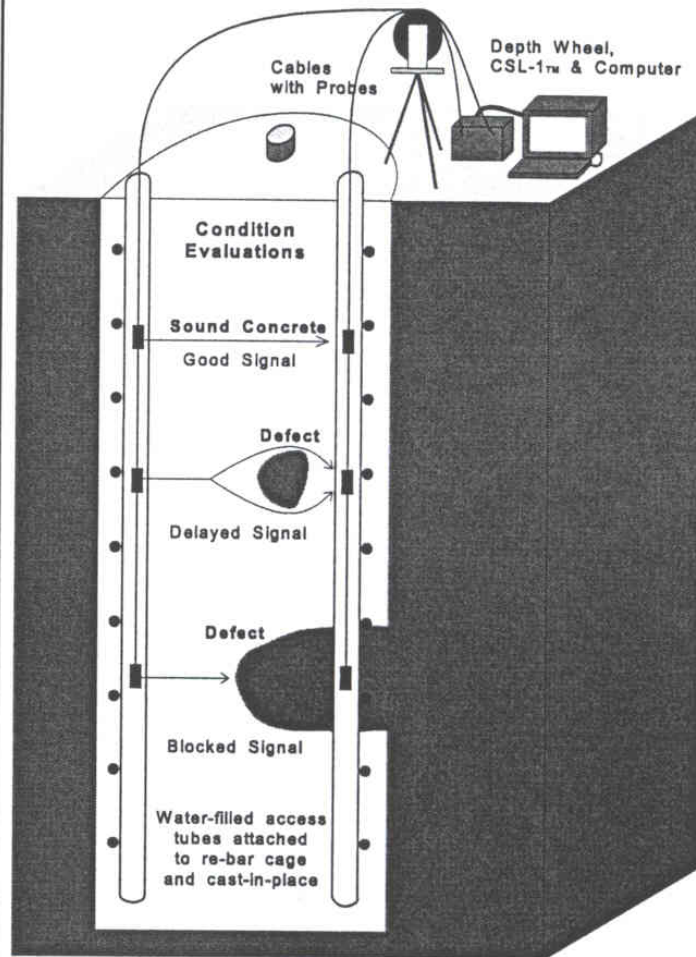


PETROGRAPHIC ANALYSIS

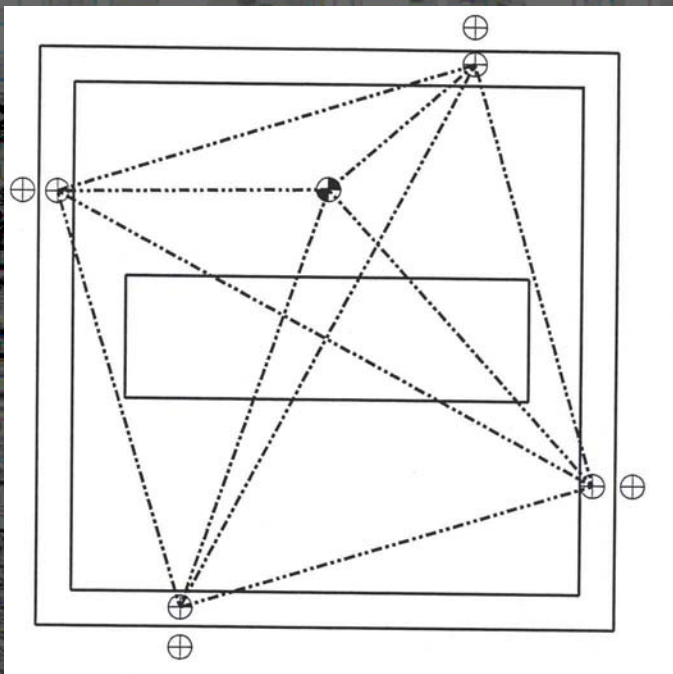
- Three samples at each pier.
- ASTM C856 - Petrographic Examination of Hardened Concrete
- No evidence of distress or abnormal reactions.
 - 5.6 to 6 bags cement/cu yd
 - 0 lbs fly ash
 - 0.42 to 0.45 W/C ratio
 - .5 to 1% air

CROSS HOLE SONIC LOGGING

CROSSHOLE SONIC LOGGING



CORE PATTERN

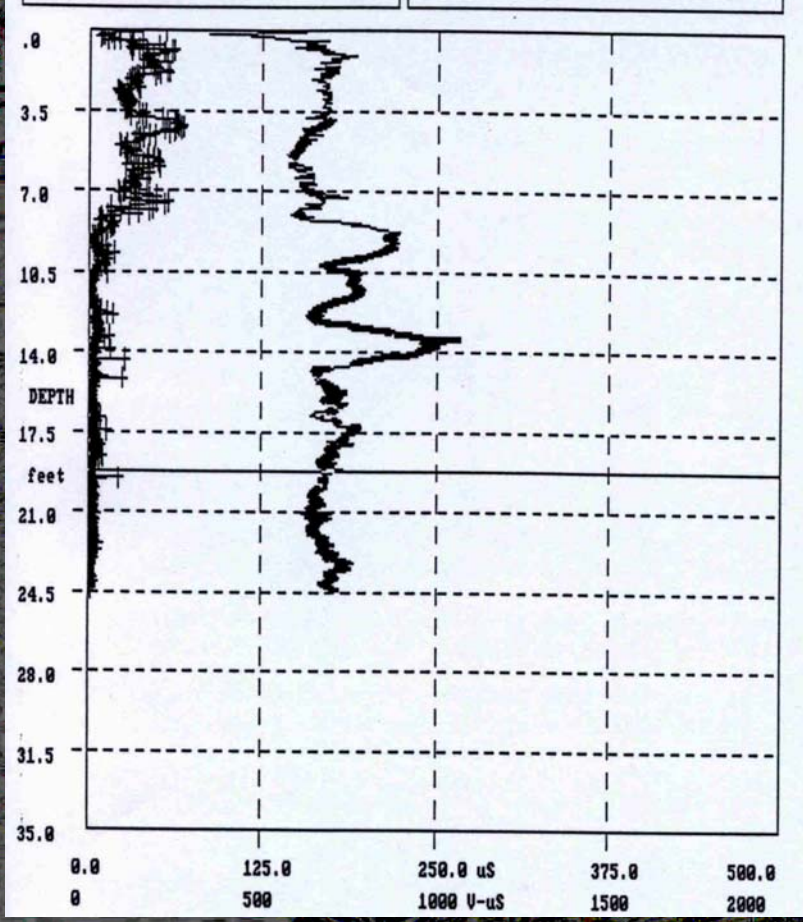


PIER 2 RESULTS

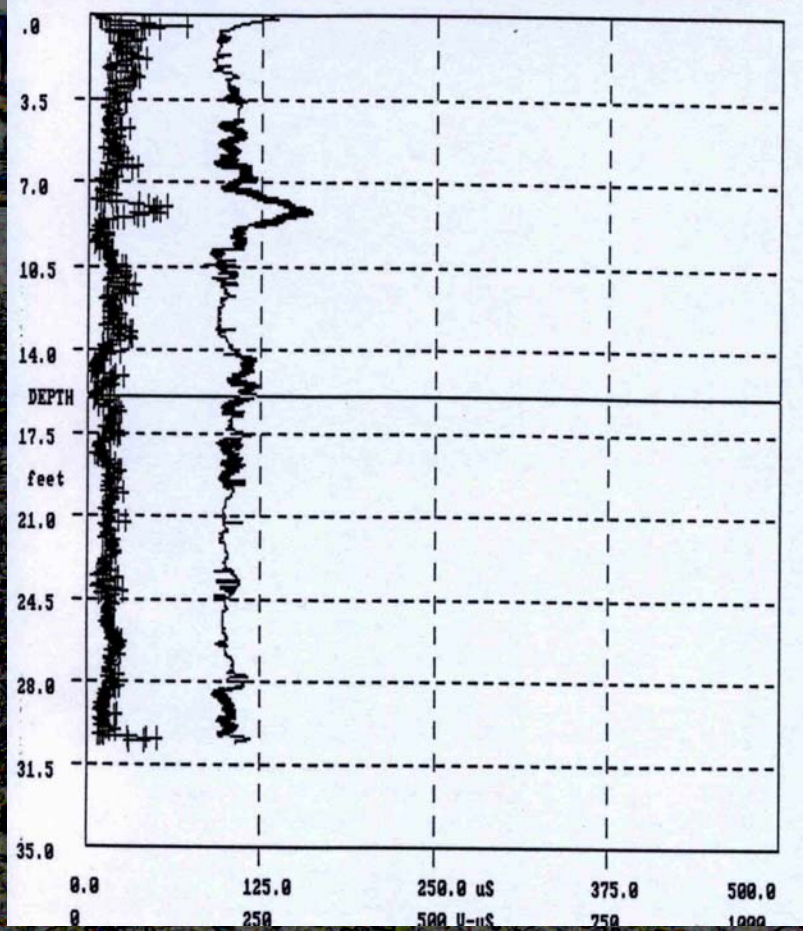
HOLE 2-3 (SEAL)

HOLE 2-1 (FTG)

JOB: 885A P2 LOG: p2ss3.pl2 THRESHOLDS: 4.5* PKnse FIG. A-4
TUBE PAIR: 2 - 3, CH. 1, SP.= 12.0 in RECORD: 114 DEPTH: 19.23 ft
DEPTH vs. THRESHOLD $T_t = -172 \text{ uS}$ $V_{pl} = -77 \text{ mV}$
DEPTH vs. TOT. ENERGY+++++++ $E_{sig} = 6 \text{ VuS}$ $E_{nse} = 0.00 \text{ VuS}$

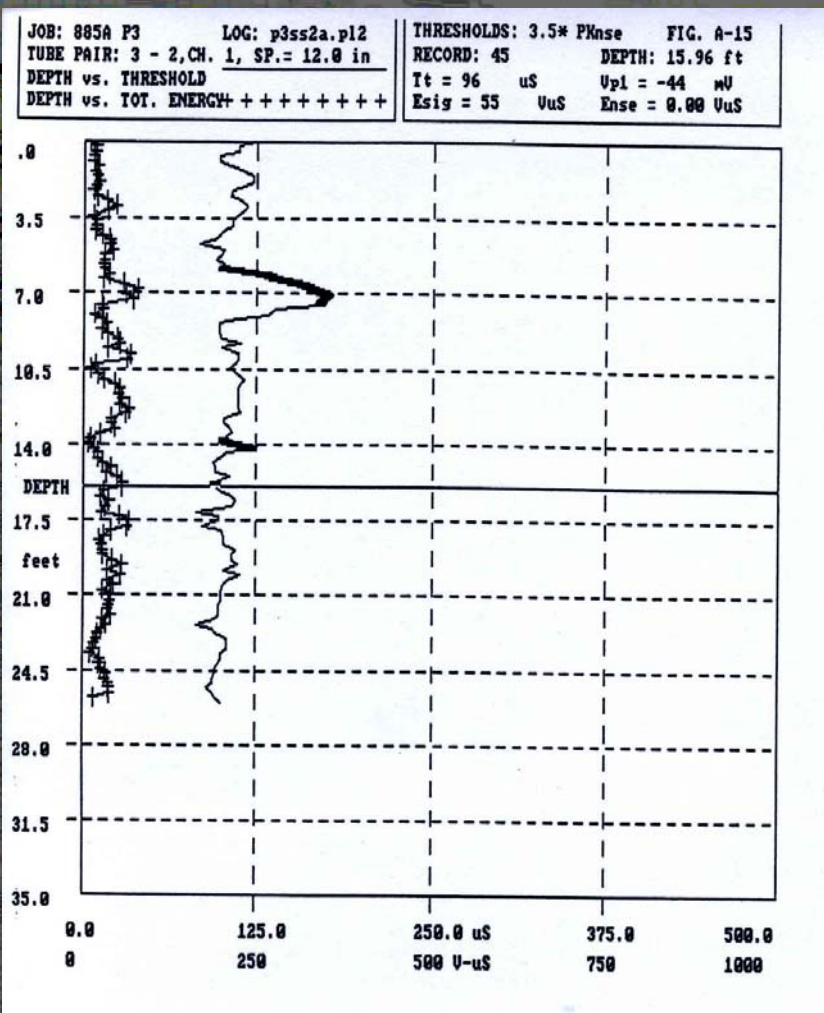


JOB: 885A P2 LOG: p2ss1.pl2 THRESHOLDS: 4.0* PKnse FIG. A-3
TUBE PAIR: 2 - 1, CH. 1, SP.= 12.0 in RECORD: 321 DEPTH: 15.94 ft
DEPTH vs. THRESHOLD $T_t = -118 \text{ uS}$ $V_{pl} = -63 \text{ mV}$
DEPTH vs. TOT. ENERGY+++++++ $E_{sig} = 11 \text{ VuS}$ $E_{nse} = 0.00 \text{ VuS}$

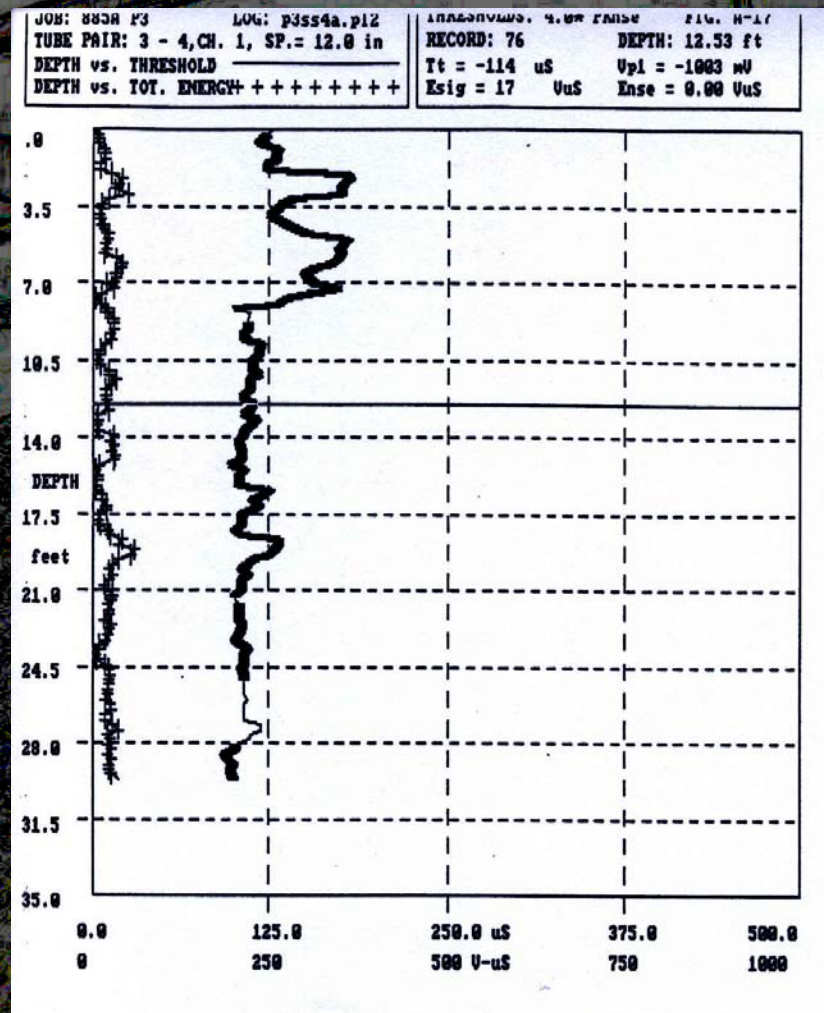


PIER 3 RESULTS

HOLE 3-2 (SEAL)



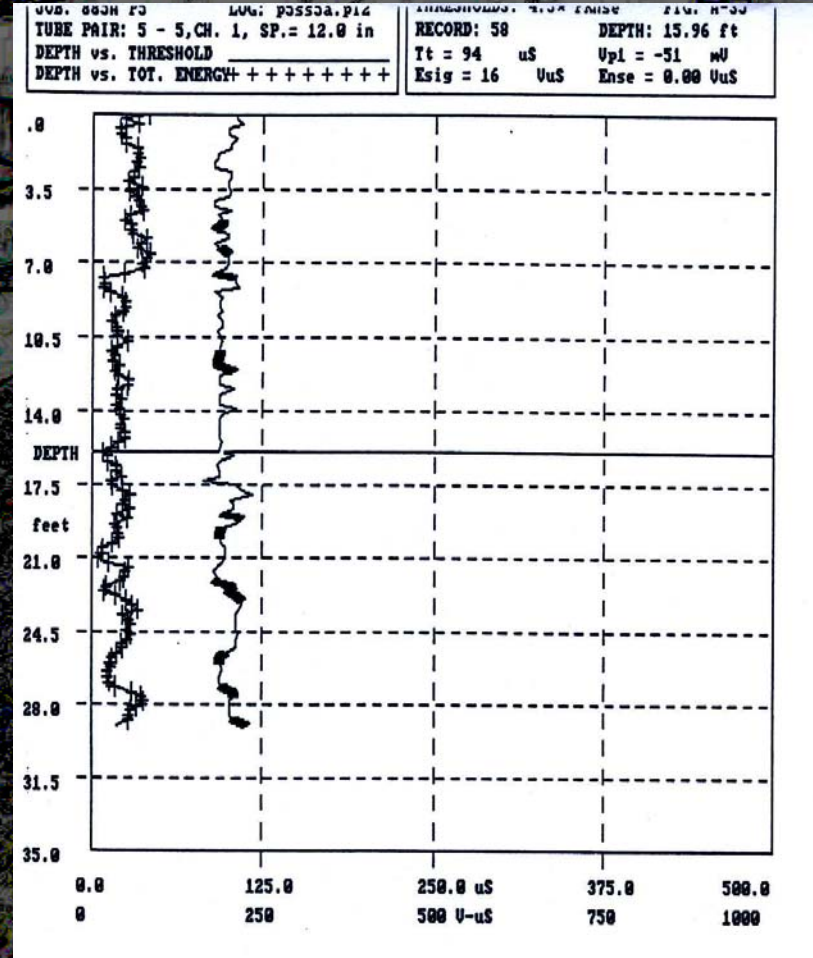
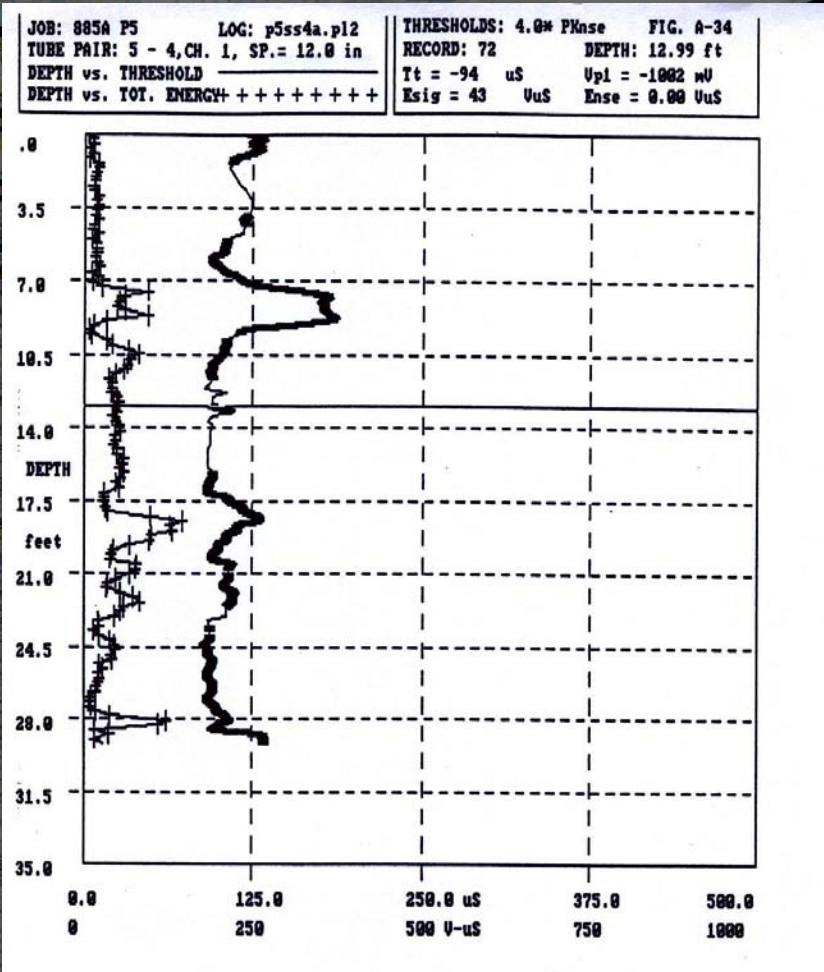
HOLE 3-4 (SEAL)



PIER 5 RESULTS

HOLE 5-4 (SEAL)

HOLE 5-5 (FTG)



DATA PRESENTATION

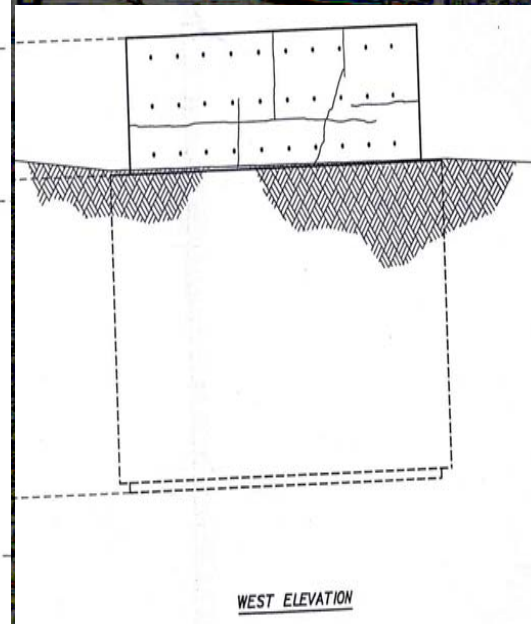
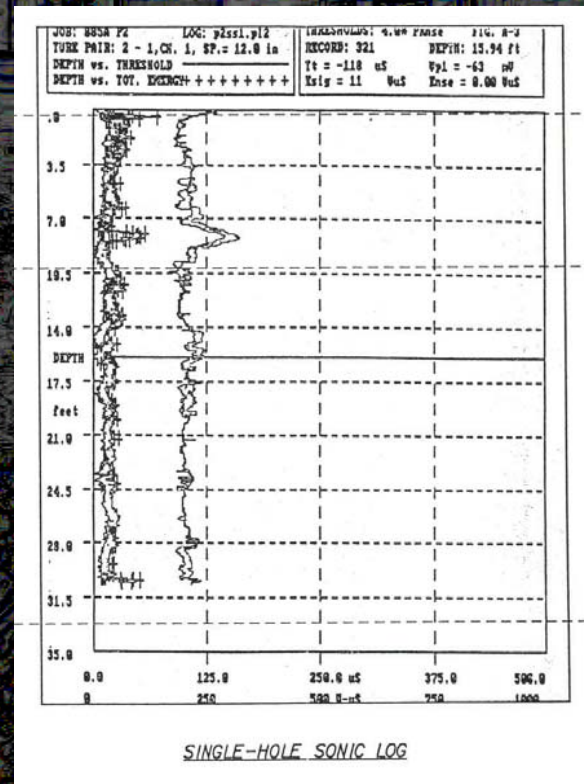
92-297
Grubbs, Hoskyn, Barton & Wylst, Inc.
 Consulting Engineers
LOG OF BORING NO. 2-1
 US 70 Bridge over Ouachita River
 Hot Springs, Arkansas

TYPE: Core LOCATION: See Plate 1

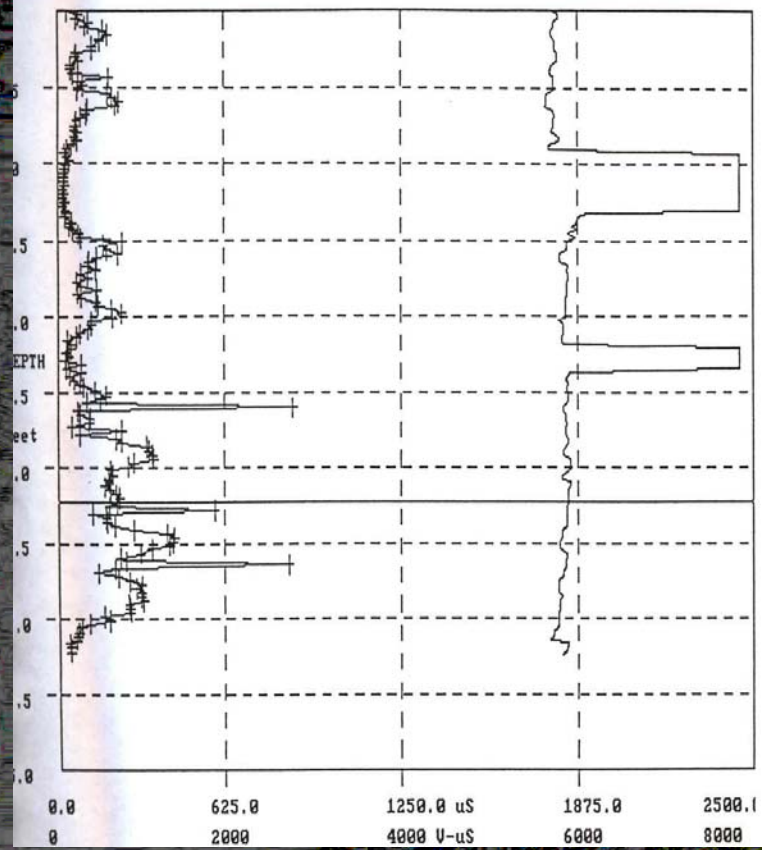
DEPTH FT	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNSATURATED SUCTIVITY	COHESION, TONS/50 FT				No. 200 %	% Fines	% SAND
						0.2	0.4	0.8	1.0			
0			SURF. EL: 378±									
5			Portland cement concrete (footing)									
5.7			- reinforcing steel at 5.7 ft									
5.8			- several soft zones between 5.8 and 10 ft									
10			Portland cement concrete (seal concrete)									
15			- bare sandstones at 15.5 to 15.8 ft, 16.2 to 16.8 ft and 16.8 to 17.8 ft									
18			- soft zone at 18 to 18.2 ft									
20			- soft seam at 20.5, 20.4, 22, 22.3, 23.8 and 29 ft									
25			- soft zones at 25.3 to 25.5 ft									
35			Hard dark gray fine-grained sandstone w/occasional quartz pebbles Note: Borehole depth referenced from top of footing.									

COMPLETION DEPTH: 34.0 ft DEPTH TO WATER IN BORING: N/A DATE: 6/13/2000
 DATE: 8-13-00

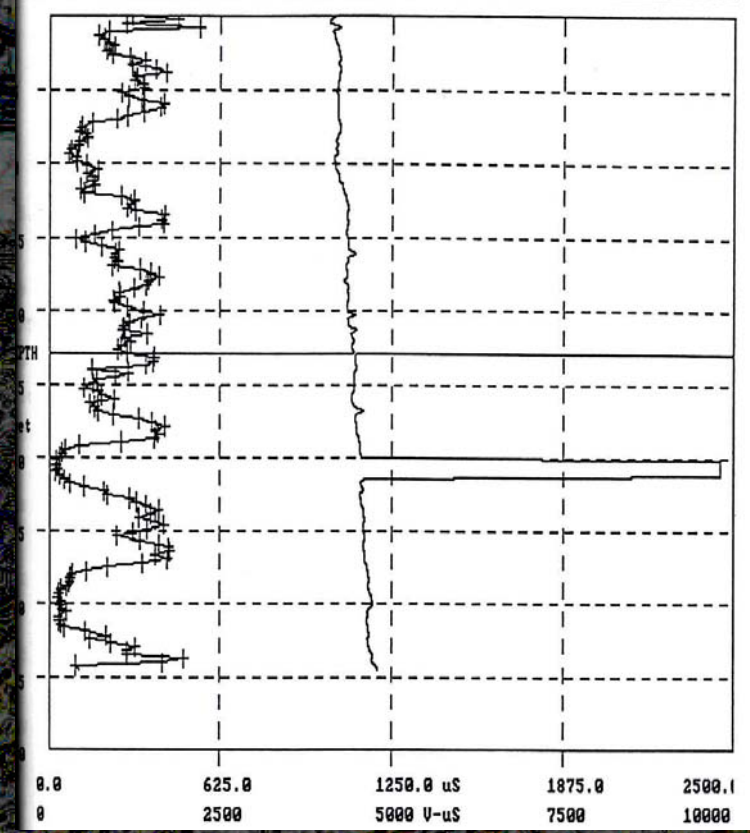
DATE: 6/13/2000
 PLATE 12



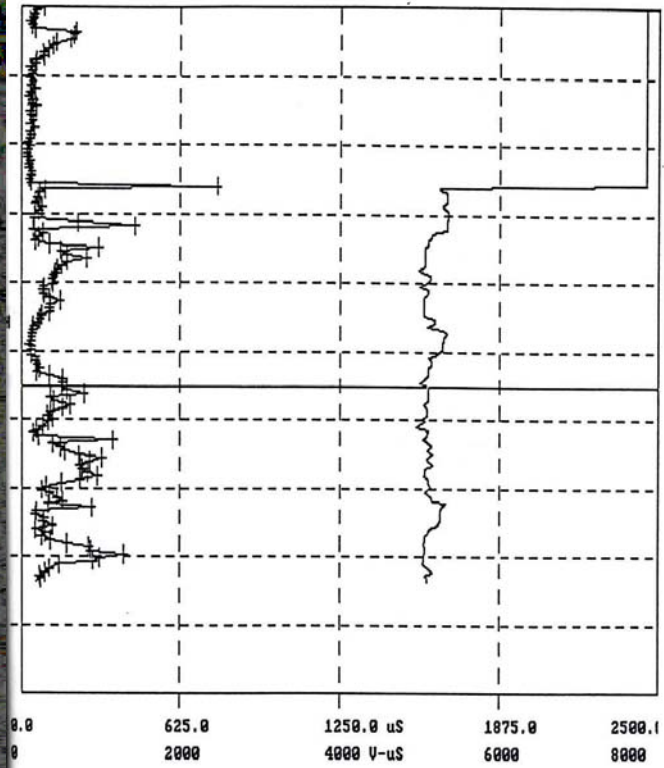
JOB: 885A P3 LOG: p323.p12 THRESHOLDS: 1.5* PKnse FIG. A-10
 WIRE PAIR: 3 - 3, CH. 1, SP.= 300.0 in RECORD: 40 DEPTH: 22.57 ft
 DEPTH vs. THRESHOLD It = 1842 uS Upl = 3170 mV
 DEPTH vs. TOT. ENERGY ++++++ Esig = 716 VuS Ense = 60 VuS



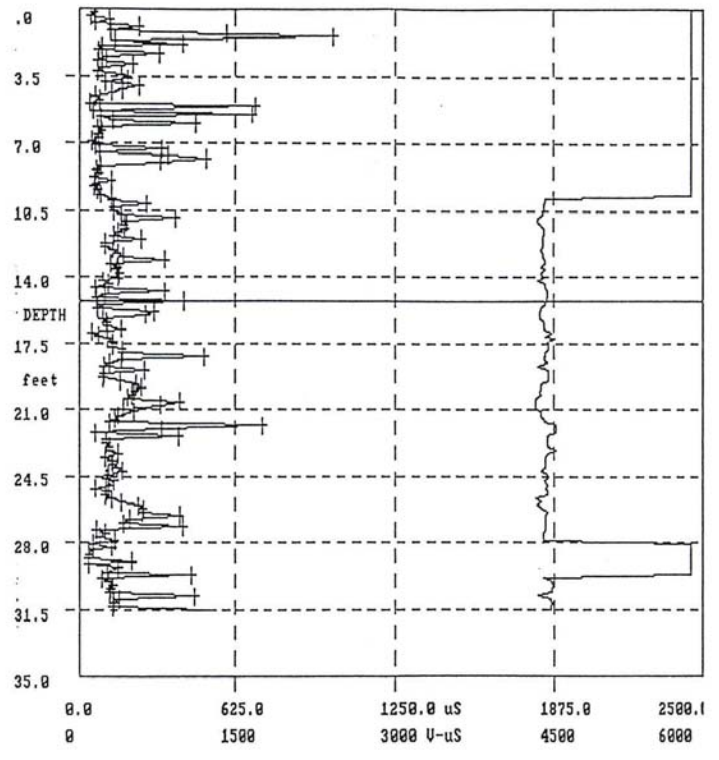
JOB: 885A P5 LOG: p515.p12 THRESHOLDS: 2.0* PKnse FIG. A-22
 WIRE PAIR: 1 - 5, CH. 1, SP.= 180.0 in RECORD: 84 DEPTH: 16.01 ft
 DEPTH vs. THRESHOLD It = -1110 uS Upl = 9231 mV
 DEPTH vs. TOT. ENERGY ++++++ Esig = 1157 VuS Ense = 106 VuS



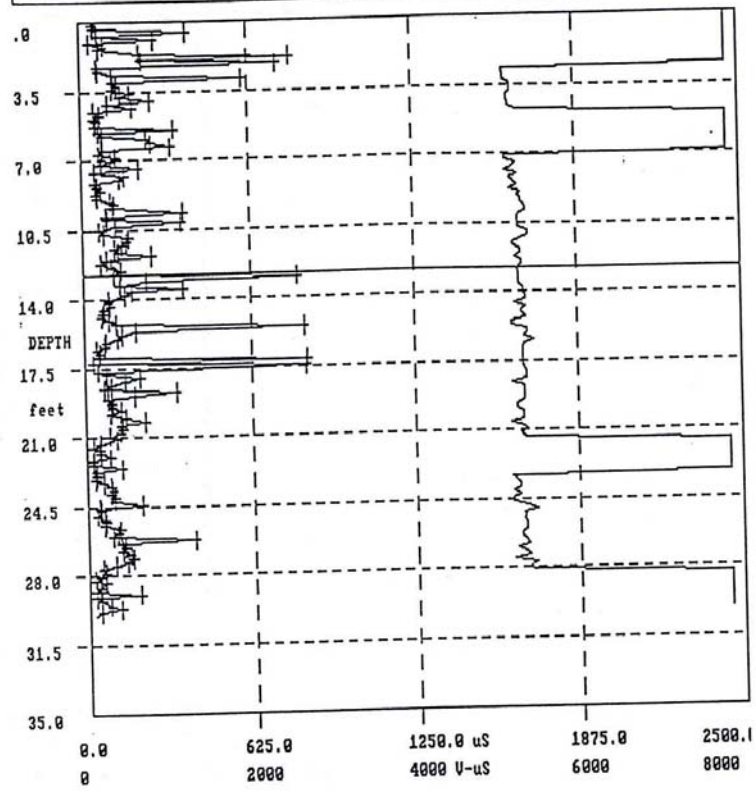
885A P3 LOG: p334.p12 THRESHOLDS: 1.0* PKnse FIG. A-11
 PAIR: 3 - 4, CH. 1, SP.= 258.0 in RECORD: 56 DEPTH: 19.30 ft
 vs. THRESHOLD It = -1596 uS Vpl = 2957 mV
 vs. TOT. ENERGY+++++++ Esig = 505 VuS Ense = 87 VuS



JOB: 885A P5 LOG: p525.p12 THRESHOLDS: 1.0* PKnse FIG. A-26
 TUBE PAIR: 2 - 5, CH. 1, SP.= 289.0 in RECORD: 90 DEPTH: 15.20 ft
 DEPTH vs. THRESHOLD It = -1842 uS Vpl = -9681 mV
 DEPTH vs. TOT. ENERGY+++++++ Esig = 999 VuS Ense = 976 VuS



JOB: 885A P5	LOG: p545.pl2	THRESHOLDS: 1.0* PKnse	FIG. A-25
TUBE PAIR: 4 - 5, CH. 1, SP.= 270.0 in	RECORD: 96	DEPTH: 12.74 ft	
DEPTH vs. THRESHOLD	It = 1650 uS	Vp1 = 2305 uV	
DEPTH vs. TOT. ENERGY+++++	Esig = 364 VuS	Ense = 86 VuS	





REPAIR RECOMMENDATIONS



**INFRASTRUCTURE
ENGINEERS, INC.**

**David R. Reser, P.E.
Project Manager**