FINAL DATA REPORT
Revision 0
GEOTECHNICAL EXPLORATION AND TESTING
SUPPLEMENT 2
DOMINION POWER
NORTH ANNA NUCLEAR POWER STATION
NORTH ANNA 3 PROJECT
MINERAL, LOUISA COUNTY, VIRGINIA

December 16, 2009

VOLUME 1

APPENDIX B.2
SPT Energy Measurement Reports

Prepared By:

MACTEC ENGINEERING AND CONSULTING, INC.
RALEIGH, NORTH CAROLINA

MACTEC PROJECT No. 6468-09-2473

Prepared For:

Bechtel Power Corporation
Subcontractor No. 25161-500-HC4-CY00-00001

North Anna 3 Project

MACTEC Project: 6468-09-2473

SPT Energy Report – Vendor A (supplement 2 – 29 borings) Dated Nov 16 and Dec 2 2009

MACTEC

Engineering and constructing a better tomorrow

November 16, 2009

For Jon Honeycutt With Permission

From: Jon Honeycutt, Staff Professional LC

Reviewed By: Steve Kiser, Principal Professional

Subject: **Report of SPT Energy – MACTEC CME-550x ATV**
Hammer Serial No. MEC-05 Automatic Hammer
WORK INSTRUCTION No. 8 (DCN:NAP-077)
North Anna 3 Project
Louisa County, Virginia
MACTEC Project No. 6468-09-2473

Jonathan Honeycutt, of MACTEC Engineering and Consulting, Inc. (MACTEC), performed energy measurements on the drill rig at the subject site per the referenced Work Instructions. This memorandum summarizes the field testing activities and presents the results of the energy measurements.

SPT Energy Field Measurements

SPT energy measurements were made on September 2, 2009, during drilling of Boring M-9 at the referenced site. The testing was performed by Jonathan Honeycutt from approximately 8:30 AM to 10:00 AM on September 2 under clear skies with a temperature of about 65 degrees Fahrenheit. The boring was drilled by MACTEC personnel using equipment from the MACTEC Atlanta office. The drilling equipment consisted of a CME-550x model ATV drill rig with an SPT automatic hammer. The drilling tools consisted of AW-J-sized drilling rods and a 2-foot long split-barrel sampler. Mud rotary drilling techniques were used to advance the boring at the time of energy testing. The drill rig operator during sampling was Mr. Ruben Landeros. Energy measurements were recorded during sampling at the depth intervals shown in Table 1.

The energy measurements were performed with a Pile Driving Analyzer (PDA) model PAX (Serial No. 3622L), and calibrated accelerometers (Serial Nos. K983 and K0686) and strain gages (Serial Nos. AW#75/1 and AW#75/2). A steel drill rod, 2 feet long and instrumented with dedicated strain gages, was inserted at the top of the drill rod string immediately below the automatic SPT hammer. The inserted rod was also instrumented with two piezoresistive accelerometers that were bolted to the outside of the rod. The instrumented rod was two feet below the hammer impact point and had a cross-sectional area of approximately 1.22 square inches and an outside diameter of approximately 1.75 inches at the gage location. The drill rods included in the drill rod string were hollow rods in 5 to 10 foot long sections, with an outside and inside diameter of approximately 1.75 and 1.375 inches, respectively. The recommended operation rate of the hammer is not known. Due to the closed hammer system, the hammer lubrication condition and anvil dimensions could not be observed.

18 Pages Total

MACTEC Engineering and Consulting, Inc.
2801 Yorkmont Road, Suite 100 • Charlotte, NC 28208 • Phone: 704.357.8600

www.mactec.com

Calibration Records

The calibration records for all the above are filed in DCN NAP-223.

Calculations for EFV

The work was done in accordance with ASTM D 4633-05. The strain and acceleration signals were converted to force and velocity by the PDA. The maximum energy transmitted to the drill rod string (EFV), as measured at the location of the strain gages and accelerometers, was calculated by the PDA using the equation shown below:

$$EFV = \int F(t) * V(t) * dt$$

Where: EFV = Transferred energy (EFV equation), or Energy of FV
F(t) = Calculated force at time t
V(t) = Calculated velocity at time t

As recommended by ASTM D4633-05, the force-velocity method of energy calculation was used. The equation shown above for calculating EFV, integrated over the complete wave event, measures the total energy content of the event using both force and velocity measurements. The EFV values associated with each blow analyzed are tabulated in the attached PDIPLOT tables and are also shown graphically in the PDIPLOT charts.

Calculations for ETR

The ratio of the measured transferred energy (EFV) to the theoretical potential energy of the SPT system (140 lb weight with the specified 30 inch fall) is the ETR. The ETR values (as percent of the theoretical value) are shown in Table 1.

Comparison of ETR to Typical Energy Transfer Ratio Range

Based on a research report published by the Florida Department of Transportation (FDOT) (Report WPI No. 0510859, 1999), the average ETR measured for automatic hammers is 79.6%. The standard deviation was 7.9%; therefore, the range of ETRs within one standard deviation of the average was reported to be 71.7% to 87.5%. This range of ETRs was also consistent with other research that was cited in the FDOT research paper; however, maximum and minimum ETR values of up to 98% and 56%, respectively, were reported in the literature. The ETR values shown in Table 1 are generally within the range of typical values for automatic hammers as reported in the literature.

Discussion

Based on the field testing results, observations from the SPT energy measurements are summarized below:

- The data obtained by the PDA are generally consistent between individual hammer blows and between the sample depths tested. In general, the first and last one (and sometimes two or more) hammer blow records recorded by the PDA produced poor quality data (which is relatively common) and, as such, the record(s) was(were) not

used in the data reduction. This may result in more or less hammer blows evaluated for ETR than what is shown on the boring logs.

- The average energy transferred from the hammer to the drill rods for each individual depth interval using the EFV method ranged from 280 foot-pounds to 298 foot-pounds. These average energy transfers correspond to energy transfer ratios (ETR) of 80.0% to 85.1% of the theoretical energy (350 foot-pounds) of the SPT hammer.

- The average at each depth interval was calculated as the transferred energy for each analyzed blow of the depth intervals divided by the total number of hammer blows analyzed. The overall average energy transfer of the SPT system (for all the depth intervals tested) was 291.2 foot-pounds, with an average ETR of 83.2%.

Attachments: Page 4 Table 1 - Summary of SPT Energy Measurements – 1 Page
Pages 5 – 6 Work Instruction No. 8 DCN:NAP 077 – 2 Pages (without attachments)
Page 7 Record of SPT Energy Measurement – 1 Page
Pages 8 – 17 PDIPLOT Output – 10 Pages
Page 18 Force-Velocity Plot – 1 Page

TABLE 1
SUMMARY OF SPT ENERGY MEASUREMENTS (ASTM D4633-05)

North Anna 3 Project
Louisa County, Virginia
MACTEC Project No. 6468-09-2473

Automatic Hammer Serial Number and Rig Model	Rig Owner	Rig Operator	Boring No. Tested	Date Tested	Drill Rod Size	Sample Depth (feet)	SPT Blow Count (blows per six inches)	No. of Blows Analyzed	Average Measured Energy (Average EFV)[a] (ft-lbs)	Energy Transfer Ratio (%)[b] (Average ETR)
MEC-05 (CME-550x ATV)	MACTEC Atlanta	Ruben Landeros	M-9	9/2/2009	AW-J	15.4 - 16.9	4 - 5 - 4	16	290	82.9%
						17.9 - 19.4	5 - 6 - 6	17	295	84.3%
						22.9 - 24.4	5 - 6 - 6	19	295	84.3%
						27.8 - 29.3	5 - 7 - 7	19	298	85.1%
						32.8 - 34.3	5 - 8 - 8	22	280	80.0%
							Average for Rig:		**291.2**	**83.2%**

[a]Measured Energy is energy based on the EFV method, as outlined in ASTM D4633-05, for each blow recorded by the PDA. In some cases, the initial and final one to two blows produced poor quality data, and were not used to calculate the Average Measured Energy. This may result in more or less blows evaluated for ETR than what is shown on the boring logs.

EFV = EMX * 1000 lbs/kip, where EMX equals the maximum transferred energy measured by the PDA (see attached PDA data).

[b]Energy Transfer Ratio is the Measured Energy divided by the theoretical SPT energy of 350 foot-pounds (140 pound hammer falling 2.5 feet).

The average EFV and ETR values may differ slightly and insignificantly from those in the PDIPLOT tables due to roundoff.

Prepared By: LC	Date: 11-16-09		Checked By: SLW	Date: 11-16-09

For Jon Honeycutt
With Permission

Work Instruction No. 8
North Anna 3 Project
MACTEC Engineering and Consulting, Inc.
Project Number: 6468-09-2473

Issued To: Jonathan Honeycutt, Steve Kiser Rev. No. 0

Issued By: D. Steven Copley, P.E. DSC 8-31-09 Date: August 31, 2009

Valid From: August 31, 2009 To: August 31, 2010

Task Description: Perform SPT Energy Measurements

Applicable Technical Procedures or Plans, or other reference:

1. Geotechnical Work Plan (complete copy of current revision available at Field Office), Section 4.2 and Attachment 2 – Drilling and Sampling Procedures (attached)
2. Engineering Specification for Subsurface Investigation and Laboratory Testing, No. 25161-500-3PS-CY00-Q0001, Rev. 000, Issued for use August 21, 2009, Section 3.3 Drilling Equipment (attached)
3. ASTM D 4633-05 (attached)

Specific Instructions (note attachments where necessary): Perform energy measurements for each drill rig on site in general accordance with ASTM D 4633-05. Consult with Site Manager as to schedule for performing the measurements. Hammer weights have been checked, and records will be available on site. All rigs are using automatic hammer systems. Confirm that automatic hammer system is being operated within manufacturer's recommendations or in a typical operating fashion as observed from watching one or two SPT measurements prior to measuring energy. Check each drill rig using all hammer/rod combinations that it will be using. Depths for measurements should be coordinated with the Site Manager. See Site Manager for current boring logs of holes drilled, if available, and use these to plan most effective field measurement program. Submit copies of calibration records for equipment to Principal Professional for review prior to beginning work on site.

Confirm with Site Manager that approval of equipment calibration records have been received prior to beginning field testing. If unexpected conditions are encountered that affect measurements, contact Site Manager or Principal Professional immediately.

Report Format: Prepare standard report in accordance with ASTM D 4633-05 requirements.

Specific Quality Assurance Procedures Applicable: 10CFR21; NQAP 16-01 Procedure For Conforming To Federal Regulation 10CFR21; QAP 20-1; QAP 25-1; Section 306 of the Energy Reorganization Act of 1974. Current revisions apply; copies available in Field Office.

Hold Points or Witness Points: None

Records: All records generated shall be considered QA Records.

Reviewed and Approved By (Note: Only one signature required for issuance):

Project Manager: ________________________________ Date: ____________________

Principal Professional: D. Aaron Copley ________________ Date: 8-31-09

Site Manager: ________________________________ Date: ____________________

No. of Pages: 15

DCN: NAP077

QA Form 24-1 Revised 8/12/2009

MACTEC

2801 YORKMONT ROAD, SUITE 100 □ CHARLOTTE, NC 28208
Telephone: (704) 357-8600 / Facsimile: (704) 357-8638

RECORD OF SPT ENERGY MEASUREMENT

GENERAL INFORMATION		DRILL RIG DATA	
PROJECT:	North Anna 3 Project	MAKE:	CME
LOCATION:	Virginia	MODEL:	550X ATV
PROJECT NO.:	6468-09-2473	SERIAL NO.:	MEC-05
DATE:	9/2/2009	HAMMER TYPE:	AUTO
WEATHER:	65°F SUNNY	ROPE CONDITION:	N/A
INSPECTOR:	JNH	ROD SIZE:	AW-J
DRILLING COMPANY:	MACTEC -	NO. OF SHEAVES:	N/A

BORING DATA

BORING NUMBER:	M-9		
DEPTH DRILLED:	Various		
TIME DRIVEN:	8:30 AM — 10:00 AM		
RIG OPERATOR:	R. LANDERS		
HAMMER OPERATOR:	N/A		
PDA PAK SERIAL NO.:	3622L		
INSTR. ROD AREA:	1.22 in2		
ACCEL. SERIAL NOS.:	A1-K983 A2-K0686		
STRAIN SERIAL NOS.:	75 AW # 1/2		

SAMPLE DEPTH (feet)	SPT N-VALUE (bpf)
15.4-16.9	4-5-4
17.9-19.4	5-6-6
22.9-24.4	5-6-6
27.8-29.3	5-7-7
32.8-34.3	5-8-8

REMARKS: Testing performed in accordance with ASTM D 4633-05

Reviewed By:

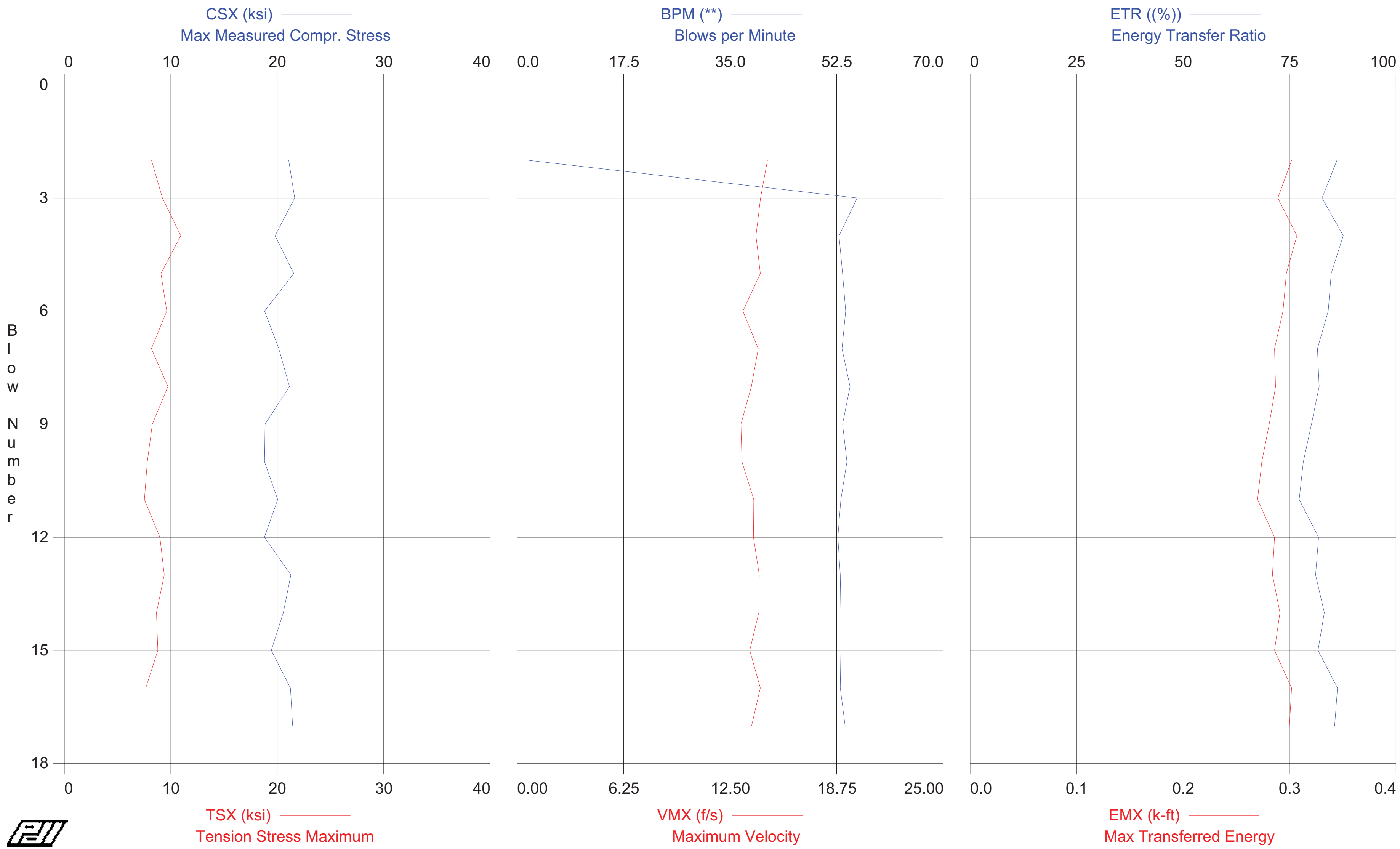
REV. 0

PDIPLOT Ver. 2008.2 - Printed: 5-Oct-2009

MACTEC Engineering and Consulting, Inc. - Case Method Results

Test date: 2-Sep-2009

NORTH ANNA 3 Project - BORING M9 (15.4' - 16.9' sample)



NORTH ANNA 3 Project - BORING M9 (15.4' - 16.9' sample)
OP: JNH

Rig Serial No. MEC-05; CME 550 X (R.Landerous)
Test date: 2-Sep-2009

AR: 1.22 in^2
LE: 21.00 ft
WS: 16,807.9 f/s

SP: 0.492 k/ft3
EM: 30,000 ksi
JC: 0.70

CSX: Max Measured Compr. Stress
TSX: Tension Stress Maximum
VMX: Maximum Velocity
FMX: Maximum Force
FVP: Force/Velocity proportionality

BPM: Blows per Minute
EF2: Energy of F^2
ETR: Energy Transfer Ratio
EMX: Max Transferred Energy

BL#	CSX	TSX	VMX	FMX	FVP	BPM	EF2	ETR	EMX
	ksi	ksi	f/s	kips	[]	**	k-ft	(%)	k-ft
2	21.1	8.2	14.7	26	0.8	1.9	0.219	86.2	0.302
3	21.6	9.2	14.3	26	0.8	55.9	0.199	82.6	0.289
4	19.8	10.9	14.0	24	0.8	52.9	0.206	87.6	0.307
5	21.6	9.1	14.3	26	0.8	53.5	0.203	84.8	0.297
6	18.8	9.6	13.3	23	0.8	54.0	0.204	84.1	0.294
7	20.1	8.2	14.1	25	0.8	53.4	0.199	81.6	0.286
8	21.1	9.7	13.7	26	0.9	54.7	0.194	82.0	0.287
9	18.9	8.3	13.1	23	0.8	53.5	0.196	80.2	0.281
10	18.8	7.8	13.2	23	0.8	54.2	0.196	78.3	0.274
11	20.0	7.5	13.9	24	0.8	53.2	0.196	77.3	0.270
12	18.8	9.0	13.9	23	0.8	52.7	0.200	81.8	0.286
13	21.3	9.4	14.2	26	0.8	53.1	0.199	81.1	0.284
14	20.6	8.7	14.2	25	0.8	53.2	0.198	83.2	0.291
15	19.4	8.8	13.7	24	0.8	53.2	0.198	81.7	0.286
16	21.2	7.6	14.3	26	0.8	53.1	0.201	86.3	0.302
17	21.4	7.7	13.8	26	0.9	53.9	0.200	85.6	0.300
Average	20.3	8.7	13.9	25	0.8	50.4	0.200	82.8	0.290

Total number of blows analyzed: 16

Time Summary

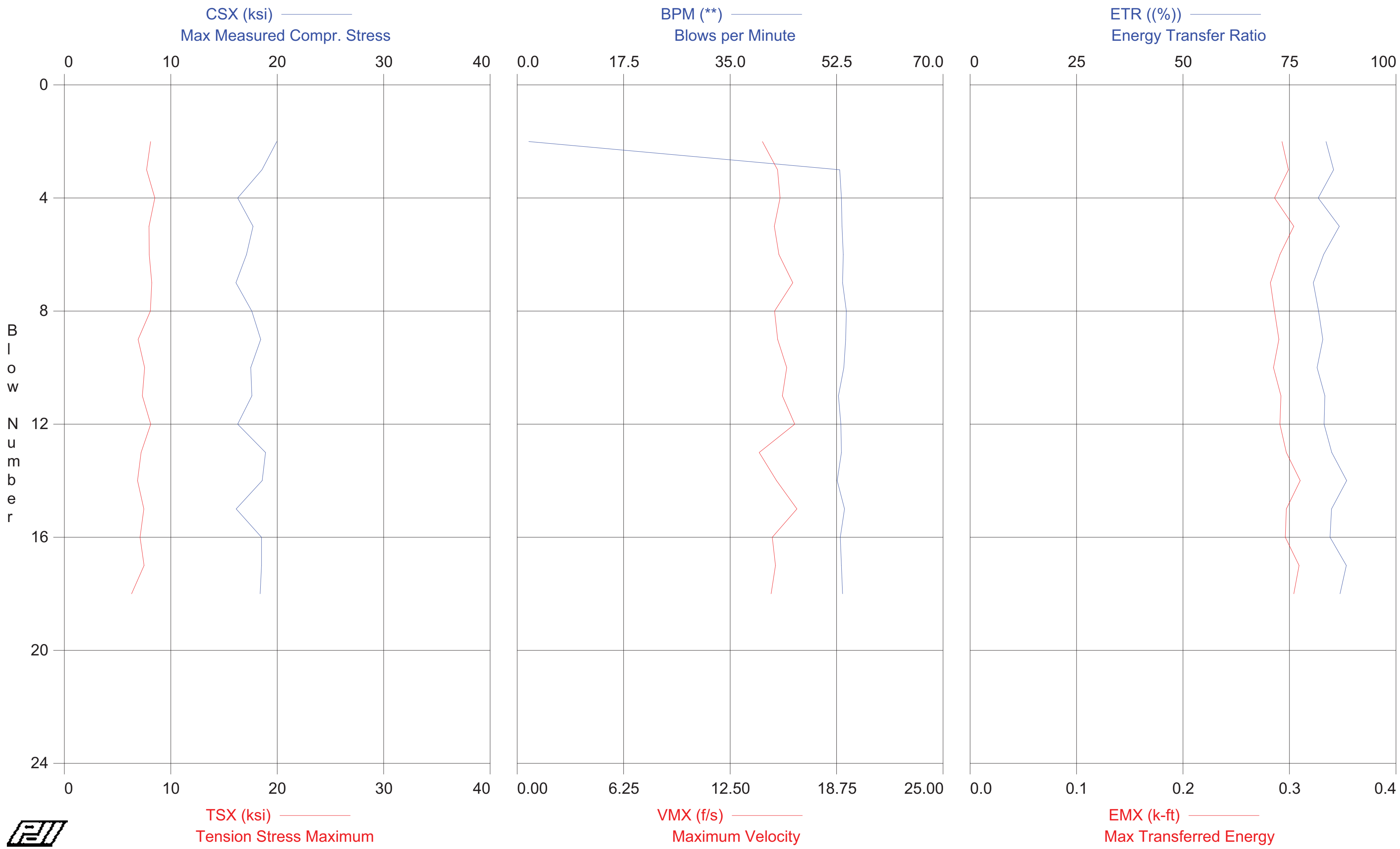
Drive 42 seconds 8:49:27 AM - 8:50:09 AM (9/2/2009) BN 1 - 17

MACTEC Engineering and Consulting, Inc. - Case Method Results

PDIPLOT Ver. 2008.2 - Printed: 5-Oct-2009

Test date: 2-Sep-2009

NORTH ANNA 3 Project - BORING M9 (17.9' - 19.4' sample)



NORTH ANNA 3 Project - BORING M9 (17.9' - 19.4' sample)
OP: JNH

Rig Serial No. MEC-425; CME 550 X (R.Landerous)
Test date: 2-Sep-2009

AR: 1.22 in^2
LE: 23.40 ft
WS: 16,807.9 f/s

SP: 0.492 k/ft3
EM: 30,000 ksi
JC: 0.70

CSX: Max Measured Compr. Stress
TSX: Tension Stress Maximum
VMX: Maximum Velocity
FMX: Maximum Force
FVP: Force/Velocity proportionality

BPM: Blows per Minute
EF2: Energy of F^2
ETR: Energy Transfer Ratio
EMX: Max Transferred Energy

BL#	CSX	TSX	VMX	FMX	FVP	BPM	EF2	ETR	EMX
	ksi	ksi	f/s	kips	[]	**	k-ft	(%)	k-ft
2	20.0	8.1	14.4	24	0.5	1.9	0.198	83.6	0.293
3	18.6	7.7	15.3	23	0.7	53.0	0.190	85.4	0.299
4	16.3	8.5	15.4	20	0.6	53.3	0.189	81.7	0.286
5	17.7	8.0	15.1	22	0.5	53.4	0.198	86.7	0.304
6	17.1	8.0	15.4	21	0.5	53.6	0.194	83.0	0.291
7	16.1	8.2	16.2	20	0.6	53.5	0.190	80.6	0.282
8	17.6	8.1	15.1	21	0.7	54.1	0.184	81.9	0.286
9	18.5	6.9	15.3	23	0.5	54.0	0.191	82.8	0.290
10	17.5	7.5	15.8	21	0.5	53.7	0.187	81.5	0.285
11	17.6	7.3	15.6	22	0.5	52.8	0.190	83.3	0.292
12	16.3	8.1	16.3	20	0.6	53.2	0.184	83.1	0.291
13	18.9	7.2	14.2	23	0.7	53.3	0.191	84.9	0.297
14	18.6	6.9	15.2	23	0.5	52.6	0.195	88.4	0.310
15	16.1	7.5	16.4	20	0.5	53.8	0.190	84.9	0.297
16	18.5	7.1	15.0	23	0.5	53.1	0.193	84.5	0.296
17	18.5	7.5	15.2	23	0.7	53.3	0.189	88.3	0.309
18	18.4	6.3	14.9	22	0.5	53.5	0.188	86.9	0.304
Average	17.8	7.6	15.3	22	0.6	50.4	0.191	84.2	0.295

Total number of blows analyzed: 17

Time Summary

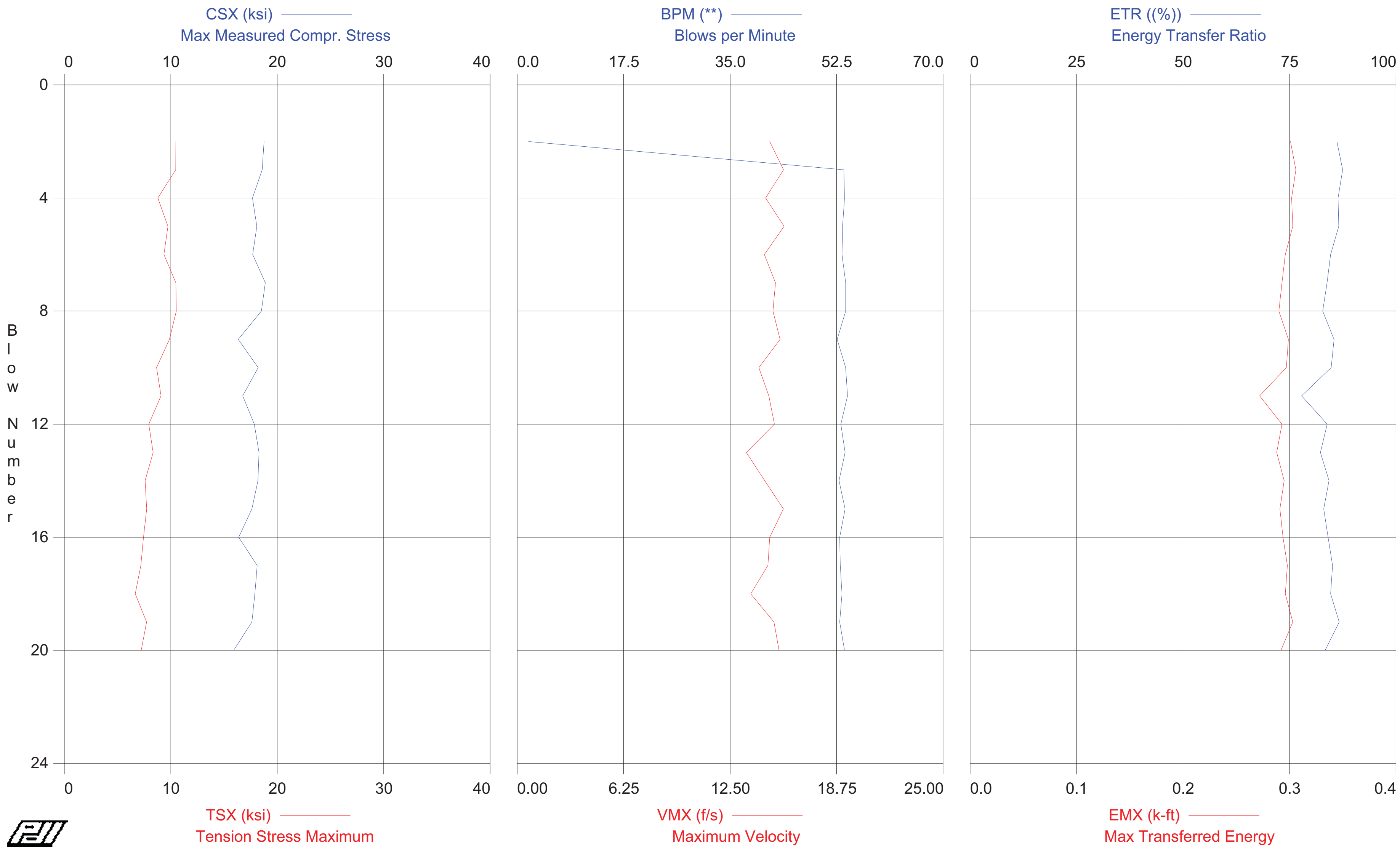
Drive 26 seconds 9:04:01 AM - 9:04:27 AM (9/2/2009) BN 1 - 18

MACTEC Engineering and Consulting, Inc. - Case Method Results

PDIPLOT Ver. 2008.2 - Printed: 5-Oct-2009

Test date: 2-Sep-2009

NORTH ANNA 3 Project - BORING M9 (22.9' - 24.4' sample)



NORTH ANNA 3 Project - BORING M9 (22.9' - 24.4' sample) Rig Serial No. MEC-05; CME 550 X (R.Landerous)
OP: JNH Test date: 2-Sep-2009

AR: 1.22 in^2 SP: 0.492 k/ft3
LE: 28.40 ft EM: 30,000 ksi
WS: 16,807.9 f/s JC: 0.70

CSX: Max Measured Compr. Stress
TSX: Tension Stress Maximum
VMX: Maximum Velocity
FMX: Maximum Force
FVP: Force/Velocity proportionality

BPM: Blows per Minute
EF2: Energy of F^2
ETR: Energy Transfer Ratio
EMX: Max Transferred Energy

BL#	CSX	TSX	VMX	FMX	FVP	BPM	EF2	ETR	EMX
	ksi	ksi	f/s	kips	[]	**	k-ft	(%)	k-ft
2	18.8	10.5	14.8	23	0.6	1.9	0.218	86.1	0.301
3	18.6	10.5	15.6	23	0.7	53.7	0.214	87.5	0.306
4	17.7	8.8	14.6	22	0.6	53.8	0.214	86.4	0.302
5	18.1	9.7	15.7	22	0.6	53.5	0.208	86.6	0.303
6	17.7	9.4	14.5	22	0.6	53.4	0.215	84.7	0.296
7	18.9	10.5	15.2	23	0.7	54.0	0.210	83.8	0.293
8	18.5	10.5	15.0	23	0.7	54.0	0.203	82.8	0.290
9	16.3	9.9	15.4	20	0.6	52.6	0.214	85.5	0.299
10	18.2	8.7	14.2	22	0.6	54.0	0.210	84.8	0.297
11	16.8	9.1	14.8	20	0.6	54.3	0.197	77.8	0.272
12	17.8	7.9	15.1	22	0.7	53.2	0.199	83.8	0.293
13	18.3	8.3	13.5	22	0.6	53.9	0.202	82.3	0.288
14	18.2	7.6	14.5	22	0.7	52.9	0.199	84.3	0.295
15	17.6	7.7	15.6	21	0.6	53.9	0.199	83.0	0.291
16	16.4	7.4	14.8	20	0.6	53.0	0.205	84.1	0.294
17	18.1	7.2	14.7	22	0.7	53.1	0.201	85.1	0.298
18	17.9	6.7	13.7	22	0.6	53.4	0.205	84.6	0.296
19	17.6	7.7	15.1	21	0.5	53.0	0.211	86.7	0.303
20	15.9	7.2	15.4	19	0.6	53.8	0.200	83.4	0.292
Average	17.8	8.7	14.9	22	0.6	50.8	0.207	84.4	0.295

Total number of blows analyzed: 19

Time Summary

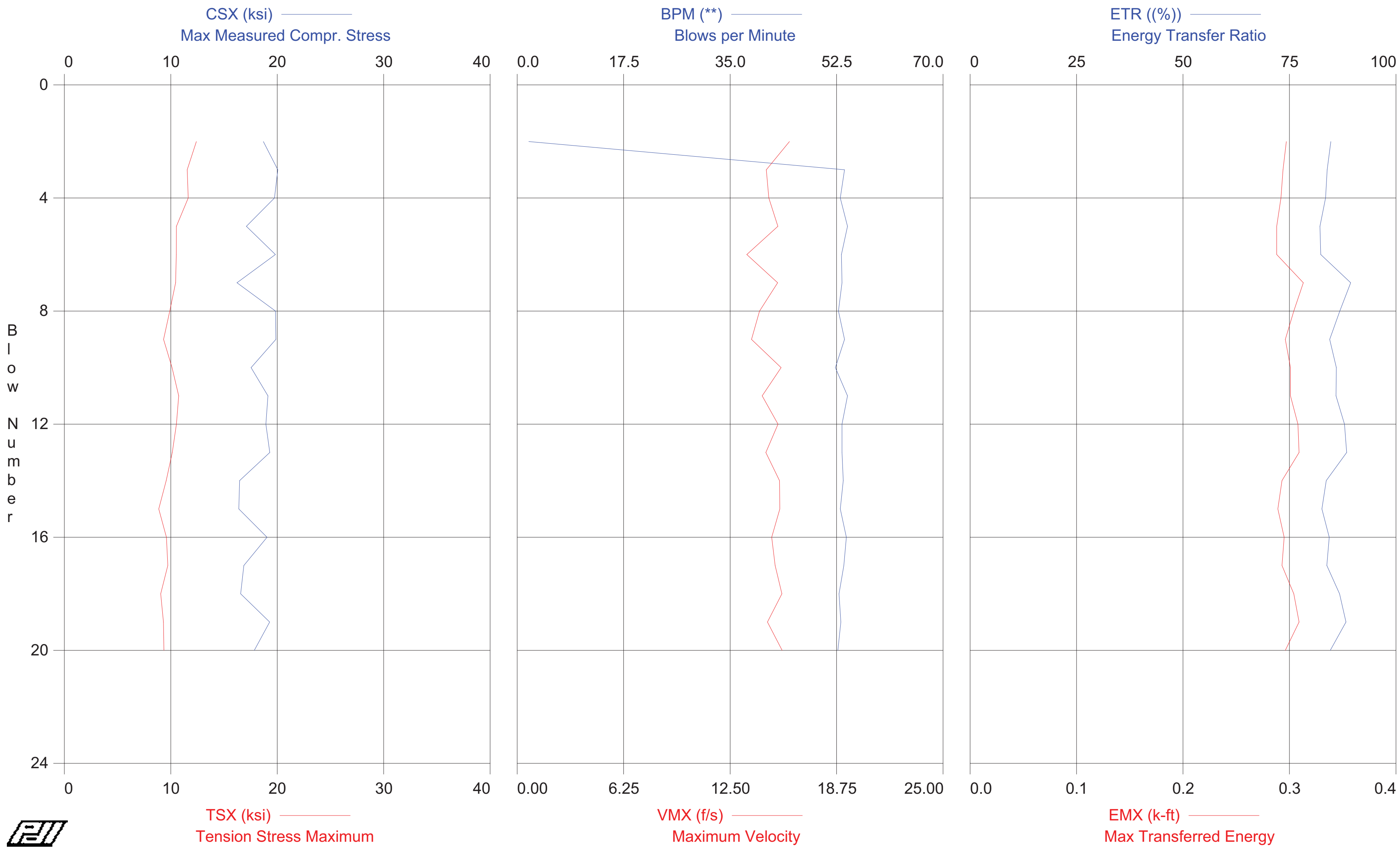
Drive 31 seconds 9:20:31 AM - 9:21:02 AM (9/2/2009) BN 1 - 20

MACTEC Engineering and Consulting, Inc. - Case Method Results

PDIPLOT Ver. 2008.2 - Printed: 5-Oct-2009

Test date: 2-Sep-2009

NORTH ANNA 3 Project - BORING M9 (27.8' - 29.3' sample)



NORTH ANNA 3 Project - BORING M9 (27.8' - 29.3' sample) Rig Serial No. MEC-05; CME 550 X (R.Landerous)
OP: JNH Test date: 2-Sep-2009

AR: 1.22 in^2 SP: 0.492 k/ft3
LE: 34.40 ft EM: 30,000 ksi
WS: 16,807.9 f/s JC: 0.70

CSX: Max Measured Compr. Stress
TSX: Tension Stress Maximum
VMX: Maximum Velocity
FMX: Maximum Force
FVP: Force/Velocity proportionality
BPM: Blows per Minute
EF2: Energy of F^2
ETR: Energy Transfer Ratio
EMX: Max Transferred Energy

BL#	CSX	TSX	VMX	FMX	FVP	BPM	EF2	ETR	EMX
	ksi	ksi	f/s	kips	[]	**	k-ft	(%)	k-ft
2	18.7	12.4	16.0	23	0.6	1.9	0.224	84.7	0.297
3	20.1	11.5	14.6	24	0.8	53.8	0.222	83.9	0.294
4	19.7	11.6	14.8	24	0.7	53.1	0.218	83.5	0.292
5	17.1	10.5	15.3	21	0.6	54.3	0.209	82.2	0.288
6	19.8	10.5	13.5	24	0.8	53.3	0.217	82.3	0.288
7	16.2	10.5	15.3	20	0.6	53.4	0.213	89.4	0.313
8	19.8	9.9	14.2	24	0.5	52.8	0.223	86.8	0.304
9	19.9	9.3	13.8	24	0.8	53.8	0.218	84.4	0.296
10	17.5	10.1	15.5	21	0.6	52.3	0.221	86.0	0.301
11	19.1	10.7	14.4	23	0.5	54.3	0.218	85.9	0.301
12	18.9	10.5	15.3	23	0.7	53.4	0.215	87.9	0.308
13	19.3	10.1	14.6	24	0.5	53.4	0.217	88.4	0.309
14	16.5	9.6	15.4	20	0.6	53.6	0.212	83.6	0.293
15	16.4	8.9	15.4	20	0.6	53.1	0.213	82.6	0.289
16	19.0	9.6	14.9	23	0.7	54.1	0.210	84.3	0.295
17	16.9	9.7	15.1	21	0.6	53.7	0.212	83.8	0.293
18	16.6	9.1	15.5	20	0.6	52.9	0.213	86.8	0.304
19	19.3	9.3	14.7	24	0.7	53.2	0.213	88.3	0.309
20	17.9	9.4	15.6	22	0.6	52.7	0.214	84.6	0.296
Average	18.4	10.2	14.9	22	0.6	50.7	0.216	85.2	0.298

Total number of blows analyzed: 19

Time Summary

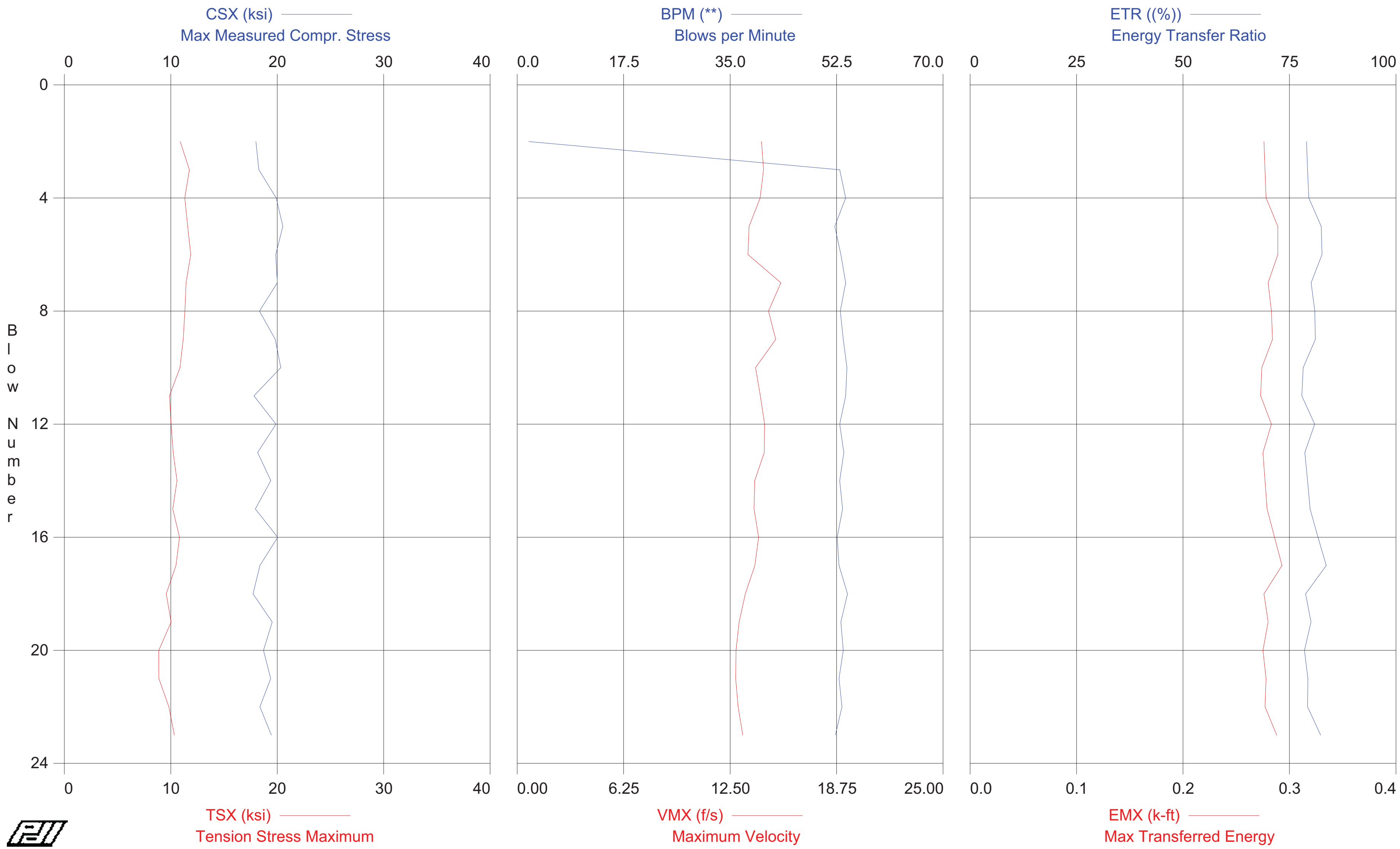
Drive 44 seconds 9:36:26 AM - 9:37:10 AM (9/2/2009) BN 1 - 21

MACTEC Engineering and Consulting, Inc. - Case Method Results

PDIPLOT Ver. 2008.2 - Printed: 5-Oct-2009

Test date: 2-Sep-2009

NORTH ANNA 3 Project - BORING M9 (32.8' - 34.3' sample)



MACTEC Engineering and Consulting, Inc.
Case Method Results PDIPLOT Ver. 2008.2 - Printed: 5-Oct-2009

NORTH ANNA 3 Project - BORING M9 (32.8' - 34.3' sample) Rig Serial No. MEC-05; CME 550 X (R.Landerous)
OP: JNH Test date: 2-Sep-2009

AR: 1.22 in^2 SP: 0.492 k/ft3
LE: 38.30 ft EM: 30,000 ksi
WS: 16,807.9 f/s JC: 0.70

CSX: Max Measured Compr. Stress
TSX: Tension Stress Maximum
VMX: Maximum Velocity
FMX: Maximum Force
FVP: Force/Velocity proportionality
BPM: Blows per Minute
EF2: Energy of F^2
ETR: Energy Transfer Ratio
EMX: Max Transferred Energy

BL#	CSX	TSX	VMX	FMX	FVP	BPM	EF2	ETR	EMX
	ksi	ksi	f/s	kips	[]	**	k-ft	(%)	k-ft
2	18.0	10.9	14.3	22	0.8	1.9	0.222	79.0	0.276
3	18.3	11.7	14.5	22	0.8	53.0	0.231	79.2	0.277
4	19.9	11.3	14.3	24	1.0	54.0	0.230	79.6	0.278
5	20.5	11.6	13.6	25	0.9	52.2	0.238	82.4	0.289
6	19.9	11.9	13.5	24	0.9	53.2	0.241	82.7	0.289
7	20.0	11.4	15.5	24	0.9	54.0	0.234	80.1	0.280
8	18.3	11.3	14.7	22	0.9	53.1	0.240	80.9	0.283
9	19.8	11.2	15.2	24	0.9	53.6	0.236	81.1	0.284
10	20.3	10.9	14.0	25	1.0	54.2	0.235	78.2	0.274
11	17.8	9.9	14.3	22	0.9	54.0	0.231	77.9	0.273
12	19.9	10.0	14.5	24	1.0	53.0	0.235	80.9	0.283
13	18.2	10.2	14.5	22	0.8	53.7	0.236	78.6	0.275
14	19.4	10.6	13.9	24	0.9	53.0	0.231	79.2	0.277
15	17.9	10.2	13.9	22	0.8	53.5	0.228	79.8	0.279
16	20.0	10.8	14.2	24	1.0	52.6	0.238	81.7	0.286
17	18.4	10.5	14.0	22	0.9	52.9	0.235	83.6	0.293
18	17.7	9.6	13.4	22	0.8	54.3	0.231	78.8	0.276
19	19.5	10.0	13.0	24	1.0	53.2	0.230	80.0	0.280
20	18.7	8.9	12.9	23	0.8	53.6	0.229	78.5	0.275
21	19.4	8.9	12.8	24	1.0	52.9	0.232	79.3	0.278
22	18.4	9.8	13.0	22	0.8	53.4	0.228	79.2	0.277
23	19.5	10.3	13.2	24	0.9	52.3	0.232	82.3	0.288
Average	19.1	10.5	14.0	23	0.9	51.0	0.233	80.1	0.280

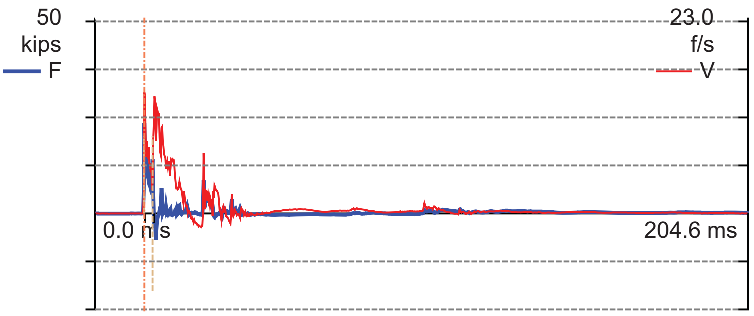
Total number of blows analyzed: 22

Time Summary

Drive 36 seconds 9:50:03 AM - 9:50:39 AM (9/2/2009) BN 1 - 23

Project: NORTH ANNA 3
Pile: BORING M9(17.9-19.4) - Description: CME 550X(R.LANDEROUS)
Operator: JNH

BN 13
9/2/2009 9:04:21 AM



LP	0.00	ft	LE	23.40	ft
CSX	18.9	ksi	AR	1.22	in^2
CSI	19.5	ksi	EM	30,000.0	ksi
TSX	7.2	ksi	SP	0.492	k/ft3
EMX	0.3	k-ft	WS	16,807.9	f/s
STK	4.80	ft	WC	16,807.9	f/s
FVP	0.75	[]	JC	0.70	[]
SFR	3	kips	2L/c	2.78	ms
RX5	8	kips	EA/c	2.2	ksec/ft
RMX	6	kips	FR	5.000	kHz

MACTEC

Engineering and constructing a better tomorrow

November 16, 2009

For Jon Honeycutt With Permission

From: Jon Honeycutt, Staff Professional L. C.

Reviewed By: Steve Kiser, Principal Professional SK

Subject: **Report of SPT Energy – MACTEC CME-45c Track Hammer Serial No. MEC-12 Automatic Hammer WORK INSTRUCTION No. 8 (DCN:NAP-077)**
North Anna 3 Project
Louisa County, Virginia
MACTEC Project No. 6468-09-2473

Jonathan Honeycutt, of MACTEC Engineering and Consulting, Inc. (MACTEC), performed energy measurements on the drill rig at the subject site per the referenced Work Instructions. This memorandum summarizes the field testing activities and presents the results of the energy measurements.

SPT Energy Field Measurements

SPT energy measurements were made on September 2, 2009, during drilling of Boring M-8 at the referenced site. The testing was performed by Jonathan Honeycutt from approximately 11:20 AM to 12:50 PM on September 2 under clear skies with a temperature of about 65 degrees Fahrenheit. The boring was drilled by MACTEC personnel using equipment from the MACTEC Raleigh office. The drilling equipment consisted of a CME 45c model track drill rig with an SPT automatic hammer. The drilling tools consisted of AW-J-sized drilling rods and a 2-foot long split-barrel sampler. Mud rotary drilling techniques were used to advance the boring at the time of energy testing. The drill rig operator during sampling was Mr. Donnie Rhodes. Energy measurements were recorded during sampling at the depth intervals shown in Table 1.

The energy measurements were performed with a Pile Driving Analyzer (PDA) model PAX (Serial No. 3622L), and calibrated accelerometers (Serial Nos. K983 and K0686) and strain gages (Serial Nos. AW#75/1 and AW#75/2). A steel drill rod, 2 feet long and instrumented with dedicated strain gages, was inserted at the top of the drill rod string immediately below the SPT hammer. The inserted rod was also instrumented with two piezoresistive accelerometers that were bolted to the outside of the rod. The instrumented rod was two feet below the hammer impact point and had a cross-sectional area of approximately 1.22 square inches and an outside diameter of approximately 1.75 inches at the gage location. The drill rods included in the drill rod string were hollow rods in 5 to 10 foot long sections, with an outside and inside diameter of approximately 1.75 and 1.375 inches, respectively. The recommended operation rate of the hammer is not known. Due to the closed hammer system, the hammer lubrication condition and anvil dimensions could not be observed.

18 Pages Total

MACTEC Engineering and Consulting, Inc.
2801 Yorkmont Road, Suite 100 • Charlotte, NC 28208 • Phone: 704.357.8600

www.mactec.com

Calibration Records

The calibration records for all the above are filed in DCN NAP-223.

Calculations for EFV

The work was done in accordance with ASTM D 4633-05. The strain and acceleration signals were converted to force and velocity by the PDA. The maximum energy transmitted to the drill rod string (EFV), as measured at the location of the strain gages and accelerometers, was calculated by the PDA using the equation shown below:

$$EFV = \int F(t) * V(t) * dt$$

Where: EFV = Transferred energy (EFV equation), or Energy of FV
F(t) = Calculated force at time t
V(t) = Calculated velocity at time t

As recommended by ASTM D4633-05, the force-velocity method of energy calculation was used. The equation shown above for calculating EFV, integrated over the complete wave event, measures the total energy content of the event using both force and velocity measurements. The EFV values associated with each blow analyzed are tabulated in the attached PDIPLOT tables and are also shown graphically in the PDIPLOT charts.

Calculations for ETR

The ratio of the measured transferred energy (EFV) to the theoretical potential energy of the SPT system (140 lb weight with the specified 30 inch fall) is the ETR. The ETR values (as percent of the theoretical value) are shown in Table 1.

Comparison of ETR to Typical Energy Transfer Ratio Range

Based on a research report published by the Florida Department of Transportation (FDOT) (Report WPI No. 0510859, 1999), the average ETR measured for automatic hammers is 79.6%. The standard deviation was 7.9%; therefore, the range of ETRs within one standard deviation of the average was reported to be 71.7% to 87.5%. This range of ETRs was also consistent with other research that was cited in the FDOT research paper; however, maximum and minimum ETR values of up to 98% and 56%, respectively, were reported in the literature. The ETR values shown in Table 1 are generally within the range of typical values for automatic hammers as reported in the literature.

Discussion

Based on the field testing results, observations from the SPT energy measurements are summarized below:

- The data obtained by the PDA are generally consistent between individual hammer blows and between the sample depths tested. In general, the first and last one (and sometimes two or more) hammer blow records recorded by the PDA produced poor quality data (which is relatively common) and, as such, the record(s) was(were) not

used in the data reduction. This may result in more or less hammer blows evaluated for ETR than what is shown on the boring logs.

- The average energy transferred from the hammer to the drill rods for each individual depth interval using the EFV method ranged from 292 foot-pounds to 305 foot-pounds. These average energy transfers correspond to energy transfer ratios (ETR) of 83.4% to 87.1% of the theoretical energy (350 foot-pounds) of the SPT hammer.

- The average at each depth interval was calculated as the transferred energy for each analyzed blow of the depth intervals divided by the total number of hammer blows analyzed. The overall average energy transfer of the SPT system (for all the depth intervals tested) was 297.1 foot-pounds, with an average ETR of 84.9%.

Attachments: Page 4 Table 1 - Summary of SPT Energy Measurements – 1 Page
Pages 5 - 6 Work Instruction No. 8 DCN:NAP 077– 2 Pages (without attachments)
Page 7 Record of SPT Energy Measurement – 1 Page
Pages 8 – 17 PDIPLOT Output – 10 Pages
Page 18 Force-Velocity Plot – 1 Page

TABLE 1
SUMMARY OF SPT ENERGY MEASUREMENTS (ASTM D4633-05)
North Anna 3 Project
Louisa County, Virginia
MACTEC Project No. 6468-09-2473

Automatic Hammer Serial Number and Rig Model	Rig Owner	Rig Operator	Boring No. Tested	Date Tested	Drill Rod Size	Sample Depth (feet)	SPT Blow Count (blows per six inches)	No. of Blows Analyzed	Average Measured Energy (Average EFV) (ft-lbs)[a]	Energy Transfer Ratio (%)[b] (Average ETR)
MEC-12 (CME-45c Track)	MACTEC Raleigh	Donnie Rhodes	M-8	9/2/2009	AW-J	23.7 - 25.2	19 - 17 - 16	52	293	83.7%
						28.7 - 30.2	4 - 6 - 11	21	292	83.4%
						33.7 - 35.2	4 - 7 - 7	18	293	83.7%
						38.7 - 40.2	5 - 8 - 11	24	300	85.7%
						43.7 - 45.2	13 - 14 - 15	41	305	87.1%
								Average for Rig:	**297.1**	**84.9%**

[a]Measured Energy is energy based on the EFV method, as outlined in ASTM D4633-05, for each blow recorded by the PDA. In some cases, the initial and final one to two blows produced poor quality data, and were not used to calculate the Average Measured Energy. This may result in more or less blows evaluated for ETR than what is shown on the boring logs.

EFV = EMX * 1000 lbs/kip, where EMX equals the maximum transferred energy measured by the PDA (see attached PDA data).

[b]Energy Transfer Ratio is the Measured Energy divided by the theoretical SPT energy of 350 foot-pounds (140 pound hammer falling 2.5 feet).

The average EFV and ETR values may differ slightly and insignificantly from those in the PDIPLOT tables due to roundoff.

Prepared By: L C.	Date: 11-16-09	Checked By: [signature]	Date: 11-16-09

For Jon Honeycutt
With Permission

Work Instruction No. 8
North Anna 3 Project
MACTEC Engineering and Consulting, Inc.
Project Number: 6468-09-2473

Issued To: Jonathan Honeycutt, Steve Kiser Rev. No. 0

Issued By: D. Steven Copley, P.E. DSC 8-31-09 Date: August 31, 2009

Valid From: August 31, 2009 To: August 31, 2010

Task Description: Perform SPT Energy Measurements

Applicable Technical Procedures or Plans, or other reference:

1. Geotechnical Work Plan (complete copy of current revision available at Field Office), Section 4.2 and Attachment 2 – Drilling and Sampling Procedures (attached)
2. Engineering Specification for Subsurface Investigation and Laboratory Testing, No. 25161-500-3PS-CY00-Q0001, Rev. 000, Issued for use August 21, 2009, Section 3.3 Drilling Equipment (attached)
3. ASTM D 4633-05 (attached)

Specific Instructions (note attachments where necessary): Perform energy measurements for each drill rig on site in general accordance with ASTM D 4633-05. Consult with Site Manager as to schedule for performing the measurements. Hammer weights have been checked, and records will be available on site. All rigs are using automatic hammer systems. Confirm that automatic hammer system is being operated within manufacturer's recommendations or in a typical operating fashion as observed from watching one or two SPT measurements prior to measuring energy. Check each drill rig using all hammer/rod combinations that it will be using. Depths for measurements should be coordinated with the Site Manager. See Site Manager for current boring logs of holes drilled, if available, and use these to plan most effective field measurement program. Submit copies of calibration records for equipment to Principal Professional for review prior to beginning work on site.

Confirm with Site Manager that approval of equipment calibration records have been received prior to beginning field testing. If unexpected conditions are encountered that affect measurements, contact Site Manager or Principal Professional immediately.

Report Format: Prepare standard report in accordance with ASTM D 4633-05 requirements.

Specific Quality Assurance Procedures Applicable: 10CFR21; NQAP 16-01 Procedure For Conforming To Federal Regulation 10CFR21; QAP 20-1; QAP 25-1; Section 306 of the Energy Reorganization Act of 1974. Current revisions apply; copies available in Field Office.

Hold Points or Witness Points: None

Records: All records generated shall be considered QA Records.

Reviewed and Approved By (Note: Only one signature required for issuance):

Project Manager: ______________________ Date: ______________

Principal Professional: D. Aaron Copley Date: 8-31-09

Site Manager: ______________________ Date: ______________

No. of Pages: 15 DCN: NAP077

QA Form 24-1 Revised 8/12/2009

MACTEC

2801 YORKMONT ROAD, SUITE 100 □ CHARLOTTE, NC 28208
Telephone: (704) 357-8600 / Facsimile: (704) 357-8638

RECORD OF SPT ENERGY MEASUREMENT

GENERAL INFORMATION		DRILL RIG DATA	
PROJECT:	North Anna 3 Project	MAKE:	CME
LOCATION:	Virginia	MODEL:	45C TRACK
PROJECT NO.:	6468-09-2473	SERIAL NO.:	MEC-~~13~~ 12 SK 11-16-09
DATE:	9/2/2009	HAMMER TYPE:	Auto
WEATHER:	Sunny 65°F	ROPE CONDITION:	N/A
INSPECTOR:	JNH	ROD SIZE:	AW-J
DRILLING COMPANY:	MACTEC - Raleigh	NO. OF SHEAVES:	N/A

BORING DATA

BORING NUMBER:	M-8		
DEPTH DRILLED:	Various		
TIME DRIVEN:	11:20 AM - 12:50 PM		
RIG OPERATOR:	D. RHODES		
HAMMER OPERATOR:	N/A		
PDA PAK SERIAL NO.:	3622L		
INSTR. ROD AREA:	1.22 in2		
ACCEL. SERIAL NOS.:	A1-K983 : A2-K0686		
STRAIN SERIAL NOS.:	75AW #1/2		

SAMPLE DEPTH (feet)	SPT N-VALUE (bpf)								
23.7-25.2	19-17-16								
28.7-30.2	4-6-11								
33.7-35.2	4-7-7								
38.7-40.2	5-8-11								
43.7-45.2	13-14-15								

REMARKS: Testing performed in accordance with ASTM D 4633-05

Reviewed By:

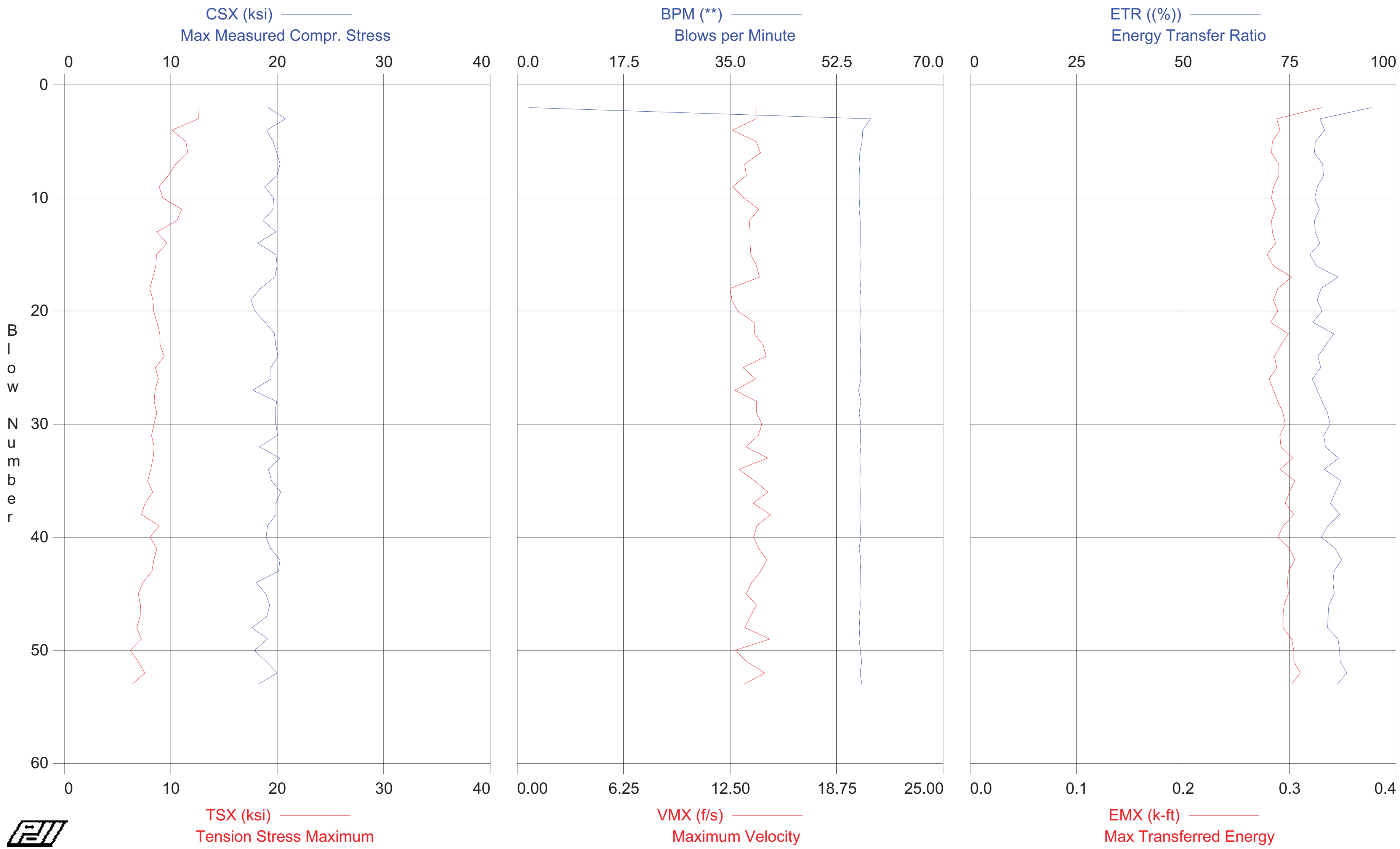
REV. 0

PDIPLOT Ver. 2008.1 - Printed: 16-Nov-2009

MACTEC Engineering and Consulting, Inc. - Case Method Results

Test date: 2-Sep-2009

NORTH ANNA 3 Project - BORING M-8 (23.7' - 25.2' sample)



NORTH ANNA 3 Project - BORING M-8 (23.7' - 25.2' sample) Rig Serial No. MEC-12; CME-45c Track (D. RHODES)
OP: JNH Test date: 2-Sep-2009

AR: 1.22 in^2 SP: 0.492 k/ft3
LE: 29.20 ft EM: 30,000 ksi
WS: 16,807.9 f/s JC: 0.70

CSX: Max Measured Compr. Stress
TSX: Tension Stress Maximum
VMX: Maximum Velocity
FMX: Maximum Force
FVP: Force/Velocity proportionality
BPM: Blows per Minute
EF2: Energy of F^2
ETR: Energy Transfer Ratio
EMX: Max Transferred Energy

BL#	CSX	TSX	VMX	FMX	FVP	BPM	EF2	ETR	EMX
	ksi	ksi	f/s	kips	[]	**	k-ft	(%)	k-ft
2	19.2	12.6	14.0	23	0.8	1.9	0.291	94.2	0.330
3	20.8	12.6	14.0	25	0.8	58.1	0.277	82.2	0.288
4	19.0	10.1	12.6	23	0.8	56.8	0.273	83.3	0.291
5	19.6	11.4	14.0	24	0.8	56.7	0.267	81.1	0.284
6	20.0	11.6	14.3	24	0.8	56.3	0.267	80.8	0.283
7	20.3	10.5	13.4	25	0.9	56.2	0.272	82.8	0.290
8	20.0	9.8	13.5	24	0.8	56.3	0.272	83.0	0.290
9	18.8	8.9	12.6	23	0.8	56.3	0.268	81.5	0.285
10	19.6	9.3	13.3	24	0.8	56.3	0.270	80.9	0.283
11	19.6	11.0	14.2	24	0.8	56.2	0.266	82.0	0.287
12	18.7	10.6	13.6	23	0.8	56.4	0.267	80.9	0.283
13	19.9	8.7	13.7	24	0.8	56.4	0.266	81.1	0.284
14	18.2	9.7	13.7	22	0.7	56.4	0.264	82.1	0.287
15	19.9	8.6	13.7	24	0.8	56.3	0.267	79.8	0.279
16	20.0	8.6	14.0	24	0.8	56.4	0.270	81.4	0.285
17	19.8	8.3	14.2	24	0.8	56.3	0.266	86.4	0.302
18	18.4	8.0	12.5	22	0.8	56.5	0.266	82.4	0.289
19	17.5	8.3	12.6	21	0.8	56.3	0.270	81.5	0.285
20	17.9	8.4	12.9	22	0.8	56.4	0.264	82.6	0.289
21	18.9	8.7	13.9	23	0.8	56.3	0.268	80.5	0.282
22	19.7	9.0	13.9	24	0.8	56.4	0.265	85.4	0.299
23	19.9	9.0	14.4	24	0.8	56.5	0.263	83.5	0.292
24	20.1	9.4	14.6	24	0.8	56.4	0.266	81.7	0.286
25	19.4	8.6	13.3	24	0.8	56.4	0.269	82.3	0.288
26	19.4	8.8	14.0	24	0.8	56.5	0.263	80.4	0.281
27	17.7	8.5	12.8	22	0.8	56.1	0.272	81.5	0.285
28	19.9	8.4	14.1	24	0.8	56.5	0.268	82.7	0.289
29	19.8	8.7	14.1	24	0.8	56.2	0.267	83.9	0.294
30	19.9	8.4	14.4	24	0.8	56.5	0.266	84.6	0.296
31	20.0	8.2	14.2	24	0.8	56.4	0.270	83.0	0.291
32	18.3	8.4	13.4	22	0.8	56.5	0.265	83.4	0.292
33	20.2	8.3	14.7	25	0.8	56.3	0.267	86.5	0.303
34	19.2	8.1	13.0	23	0.8	56.4	0.268	83.1	0.291
35	19.5	7.8	13.9	24	0.8	56.3	0.266	87.1	0.305
36	20.3	8.3	14.7	25	0.8	56.4	0.268	85.8	0.300
37	19.9	7.6	13.9	24	0.8	56.4	0.272	84.6	0.296
38	19.9	7.3	14.9	24	0.8	56.3	0.265	86.8	0.304
39	19.1	8.9	14.1	23	0.8	56.4	0.271	84.0	0.294
40	19.0	8.0	13.9	23	0.8	56.5	0.268	82.4	0.289
41	19.4	8.7	14.2	24	0.8	56.2	0.268	85.7	0.300
42	20.3	8.4	14.7	25	0.8	56.5	0.271	87.2	0.305
43	20.1	8.2	14.3	25	0.8	56.4	0.274	85.5	0.299
44	18.0	7.4	13.8	22	0.7	56.4	0.264	85.2	0.298
45	18.9	7.0	13.4	23	0.8	56.3	0.277	85.5	0.299
46	19.3	7.1	14.0	24	0.8	56.4	0.272	84.2	0.295
47	19.0	7.1	13.7	23	0.8	56.2	0.271	84.1	0.294
48	17.6	6.8	13.4	21	0.7	56.3	0.268	83.9	0.294
49	19.1	7.2	14.8	23	0.7	56.2	0.267	86.4	0.302
50	17.9	6.2	12.8	22	0.8	56.4	0.273	86.8	0.304
51	19.0	6.9	13.5	23	0.8	56.6	0.273	86.9	0.304
52	20.0	7.6	14.5	24	0.8	56.4	0.272	88.5	0.310
53	18.2	6.4	13.3	22	0.8	56.6	0.268	86.2	0.302
Average	19.3	8.7	13.8	24	0.8	55.4	0.269	83.8	0.293

Total number of blows analyzed: 52

Time Summary

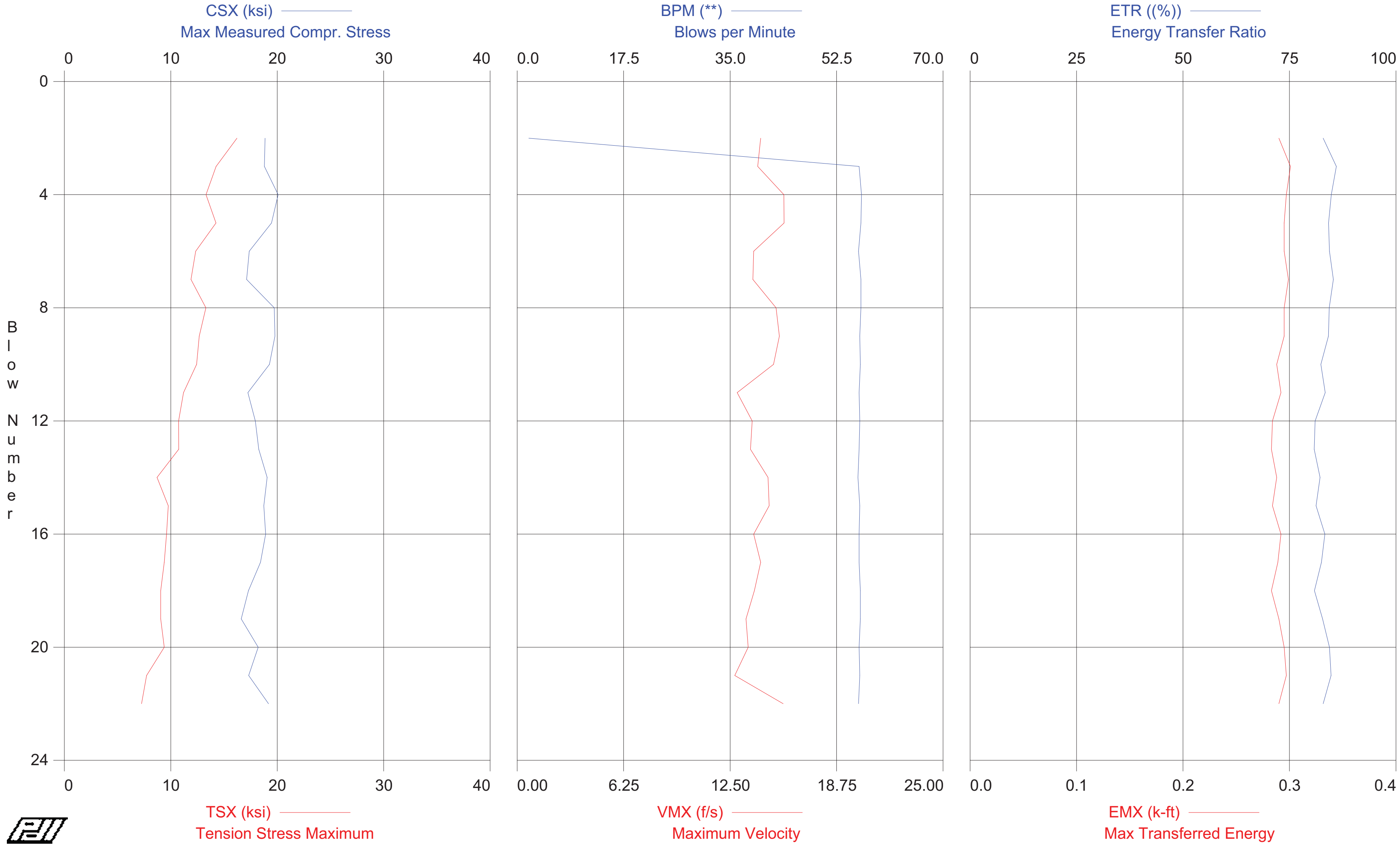
Drive 1 minute 25 seconds 11:23:35 AM - 11:25:00 AM (9/2/2009) BN 1 - 53

MACTEC Engineering and Consulting, Inc. - Case Method Results

PDIPLOT Ver. 2008.1 - Printed: 16-Nov-2009

Test date: 2-Sep-2009

NORTH ANNA 3 Project - BORING M-8 (28.7' - 30.2' sample)



NORTH ANNA 3 Project - BORING M-8 (28.7' - 30.2' sample) Rig Serial No. MEC-12; CME-45c Track (D.Rhodes)
OP: JNH Test date: 2-Sep-2009

AR: 1.22 in^2 SP: 0.492 k/ft3
LE: 34.20 ft EM: 30,000 ksi
WS: 16,807.9 f/s JC: 0.70

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EMX: Max Transferred Energy

BL#	CSX	TSX	VMX	FMX	FVP	BPM	EF2	ETR	EMX
	ksi	ksi	f/s	kips	[]	**	k-ft	(%)	k-ft
2	18.9	16.2	14.3	23	0.8	1.9	0.274	82.9	0.290
3	18.8	14.3	14.1	23	0.8	56.2	0.273	86.0	0.301
4	20.1	13.3	15.7	25	0.7	56.6	0.272	84.8	0.297
5	19.5	14.2	15.7	24	0.7	56.5	0.263	84.2	0.295
6	17.4	12.3	13.9	21	0.7	56.1	0.263	84.4	0.295
7	17.1	11.9	13.8	21	0.7	56.5	0.259	85.3	0.299
8	19.7	13.3	15.2	24	0.7	56.5	0.267	84.3	0.295
9	19.8	12.7	15.4	24	0.7	56.3	0.268	84.1	0.295
10	19.3	12.4	15.1	24	0.7	56.4	0.258	82.4	0.288
11	17.2	11.2	12.9	21	0.8	56.2	0.259	83.4	0.292
12	17.9	10.7	13.8	22	0.7	56.3	0.261	81.0	0.284
13	18.3	10.7	13.7	22	0.7	56.2	0.260	80.8	0.283
14	19.0	8.7	14.7	23	0.7	56.0	0.256	82.2	0.288
15	18.7	9.8	14.8	23	0.7	56.3	0.258	81.2	0.284
16	18.9	9.6	13.9	23	0.8	56.2	0.255	83.3	0.292
17	18.4	9.4	14.3	22	0.7	56.2	0.256	82.5	0.289
18	17.3	9.1	13.9	21	0.7	56.4	0.254	80.9	0.283
19	16.6	9.0	13.4	20	0.7	56.4	0.255	82.8	0.290
20	18.2	9.4	13.6	22	0.8	56.2	0.256	84.4	0.295
21	17.3	7.7	12.8	21	0.7	56.3	0.259	84.8	0.297
22	19.2	7.3	15.6	23	0.7	56.1	0.254	82.9	0.290
Average	18.5	11.1	14.3	23	0.7	53.7	0.261	83.3	0.292

Total number of blows analyzed: 21

Time Summary

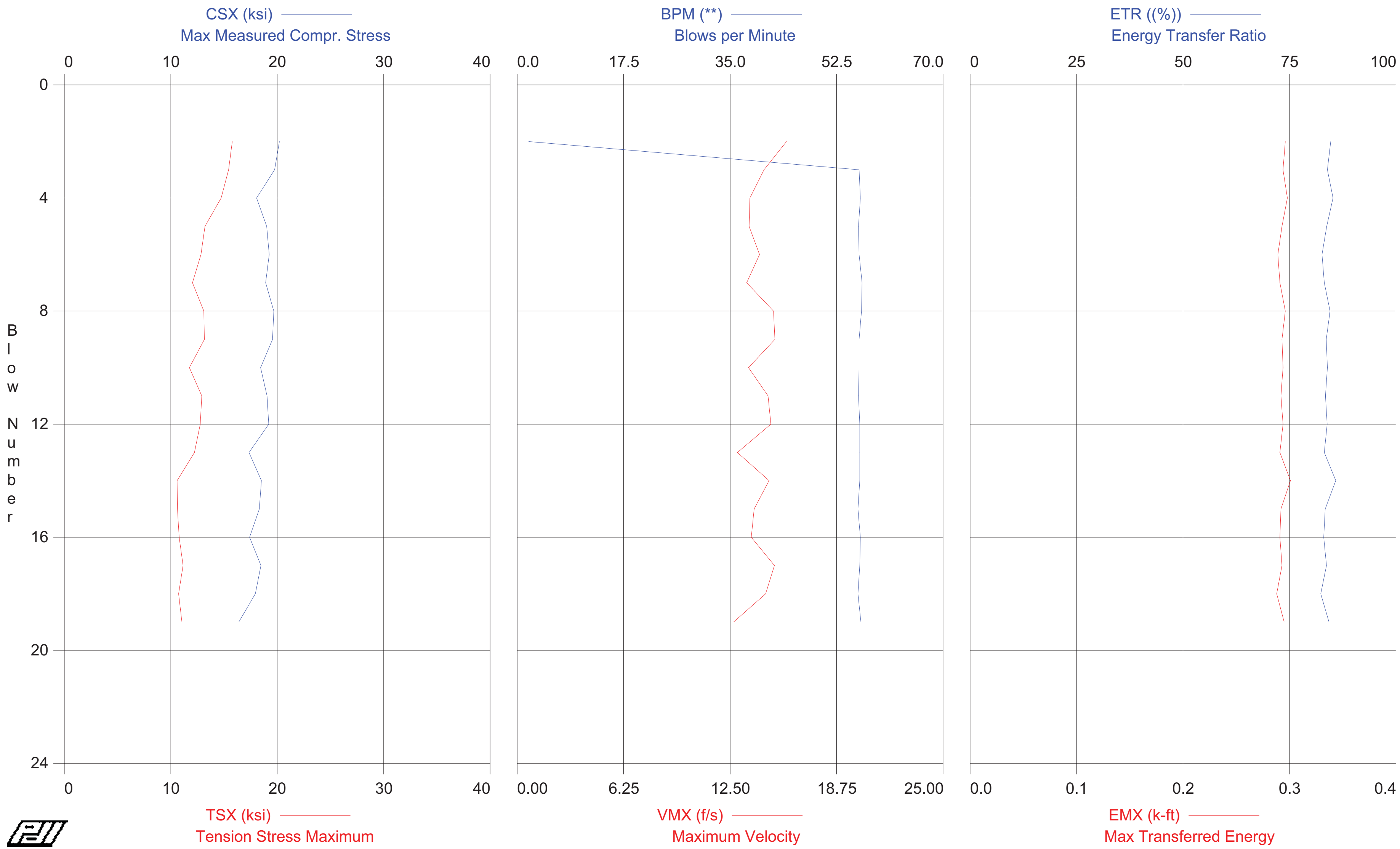
Drive 35 seconds 11:47:18 AM - 11:47:53 AM (9/2/2009) BN 1 - 22

MACTEC Engineering and Consulting, Inc. - Case Method Results

PDIPLOT Ver. 2008.1 - Printed: 16-Nov-2009

Test date: 2-Sep-2009

NORTH ANNA 3 Project - BORING M-8 (33.7' - 35.2' sample)



NORTH ANNA 3 Project - BORING M-8 (33.7' - 35.2' sample) Rig Serial No. MEC-12; CME-45c Track (D.Rhodes)
OP: JNH Test date: 2-Sep-2009

AR: 1.22 in^2 SP: 0.492 k/ft3
LE: 39.20 ft EM: 30,000 ksi
WS: 16,807.9 f/s JC: 0.70

CSX: Max Measured Compr. Stress
TSX: Tension Stress Maximum
VMX: Maximum Velocity
FMX: Maximum Force
FVP: Force/Velocity proportionality
BPM: Blows per Minute
EF2: Energy of F^2
ETR: Energy Transfer Ratio
EMX: Max Transferred Energy

BL#	CSX	TSX	VMX	FMX	FVP	BPM	EF2	ETR	EMX
	ksi	ksi	f/s	kips	[]	**	k-ft	(%)	k-ft
2	20.2	15.8	15.8	25	0.7	1.9	0.262	84.7	0.296
3	19.8	15.4	14.5	24	0.8	56.2	0.267	83.9	0.294
4	18.1	14.7	13.7	22	0.8	56.4	0.268	85.2	0.298
5	19.0	13.2	13.6	23	0.8	56.1	0.266	83.8	0.293
6	19.2	12.8	14.2	23	0.8	56.2	0.261	82.6	0.289
7	18.9	12.0	13.5	23	0.8	56.7	0.260	83.2	0.291
8	19.7	13.1	15.0	24	0.7	56.6	0.262	84.5	0.296
9	19.6	13.2	15.1	24	0.7	56.2	0.260	83.6	0.293
10	18.4	11.7	13.6	23	0.8	56.2	0.257	83.9	0.294
11	19.0	12.9	14.7	23	0.7	56.1	0.260	83.4	0.292
12	19.2	12.8	14.9	23	0.7	56.3	0.259	83.9	0.294
13	17.3	12.2	12.9	21	0.7	56.3	0.261	83.2	0.291
14	18.5	10.6	14.8	23	0.7	56.3	0.256	85.9	0.301
15	18.3	10.6	13.9	22	0.7	56.0	0.257	83.4	0.292
16	17.4	10.8	13.7	21	0.7	56.4	0.255	83.0	0.291
17	18.5	11.2	15.1	23	0.7	56.3	0.252	83.7	0.293
18	17.9	10.7	14.6	22	0.7	56.0	0.253	82.3	0.288
19	16.4	11.0	12.7	20	0.7	56.5	0.262	84.3	0.295
Average	18.6	12.5	14.2	23	0.7	53.3	0.260	83.8	0.293

Total number of blows analyzed: 18

Time Summary

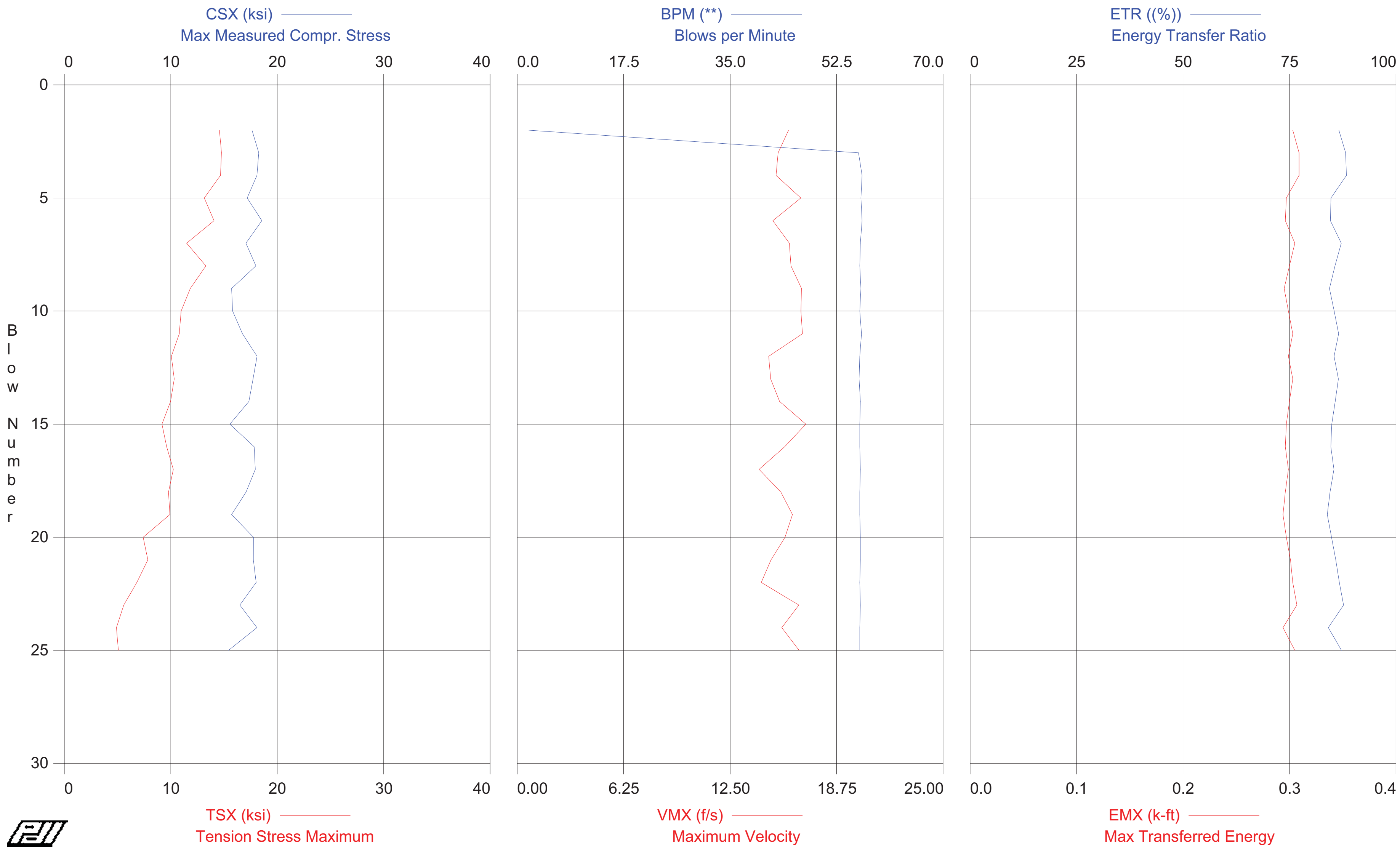
Drive 4 minutes 56 seconds 11:55:59 AM - 12:00:55 PM (9/2/2009) BN 1 - 20

MACTEC Engineering and Consulting, Inc. - Case Method Results

PDIPLOT Ver. 2008.1 - Printed: 16-Nov-2009

Test date: 2-Sep-2009

NORTH ANNA 3 Project - BORING M-8 (38.7' - 40.2' sample)



NORTH ANNA 3 Project - BORING M-8 (38.7' - 40.2' sample) Rig Serial No. MEC-12; CME-45c Track (D. Rhodes)
OP: JNH Test date: 2-Sep-2009

AR: 1.22 in^2 SP: 0.492 k/ft3
LE: 44.20 ft EM: 30,000 ksi
WS: 16,807.9 f/s JC: 0.70

CSX: Max Measured Compr. Stress
TSX: Tension Stress Maximum
VMX: Maximum Velocity
FMX: Maximum Force
FVP: Force/Velocity proportionality
BPM: Blows per Minute
EF2: Energy of F^2
ETR: Energy Transfer Ratio
EMX: Max Transferred Energy

BL#	CSX	TSX	VMX	FMX	FVP	BPM	EF2	ETR	EMX
	ksi	ksi	f/s	kips	[]	**	k-ft	(%)	k-ft
2	17.6	14.6	15.9	22	0.6	1.9	0.274	86.6	0.303
3	18.3	14.8	15.3	22	0.5	56.1	0.274	88.2	0.309
4	18.1	14.7	15.2	22	0.5	56.7	0.269	88.4	0.309
5	17.2	13.1	16.7	21	0.6	56.5	0.258	84.7	0.297
6	18.6	14.1	15.0	23	0.7	56.7	0.260	84.6	0.296
7	17.1	11.5	16.0	21	0.5	56.4	0.255	87.2	0.305
8	18.0	13.3	16.1	22	0.6	56.3	0.258	85.7	0.300
9	15.7	11.8	16.7	19	0.5	56.5	0.253	84.4	0.295
10	15.8	11.0	16.7	19	0.5	56.3	0.257	85.5	0.299
11	16.7	10.8	16.7	20	0.6	56.6	0.253	86.5	0.303
12	18.1	10.1	14.8	22	0.7	56.3	0.257	85.5	0.299
13	17.7	10.3	14.9	22	0.7	56.2	0.253	86.5	0.303
14	17.3	10.0	15.4	21	0.5	56.4	0.257	85.7	0.300
15	15.6	9.2	16.9	19	0.5	56.3	0.251	84.9	0.297
16	17.8	9.6	15.7	22	0.6	56.3	0.248	84.7	0.296
17	17.9	10.2	14.2	22	0.5	56.4	0.252	85.4	0.299
18	17.1	9.8	15.5	21	0.5	56.3	0.253	84.5	0.296
19	15.7	9.9	16.2	19	0.5	56.3	0.250	83.9	0.294
20	17.8	7.4	15.7	22	0.6	56.4	0.247	84.9	0.297
21	17.8	7.8	14.9	22	0.7	56.4	0.250	85.9	0.301
22	18.0	6.8	14.3	22	0.5	56.3	0.250	86.7	0.303
23	16.5	5.6	16.5	20	0.5	56.4	0.248	87.7	0.307
24	18.1	4.9	15.5	22	0.6	56.3	0.247	84.1	0.294
25	15.4	5.1	16.6	19	0.5	56.3	0.247	87.2	0.305
Average	17.2	10.3	15.7	21	0.6	54.1	0.255	85.8	0.300

Total number of blows analyzed: 24

Time Summary

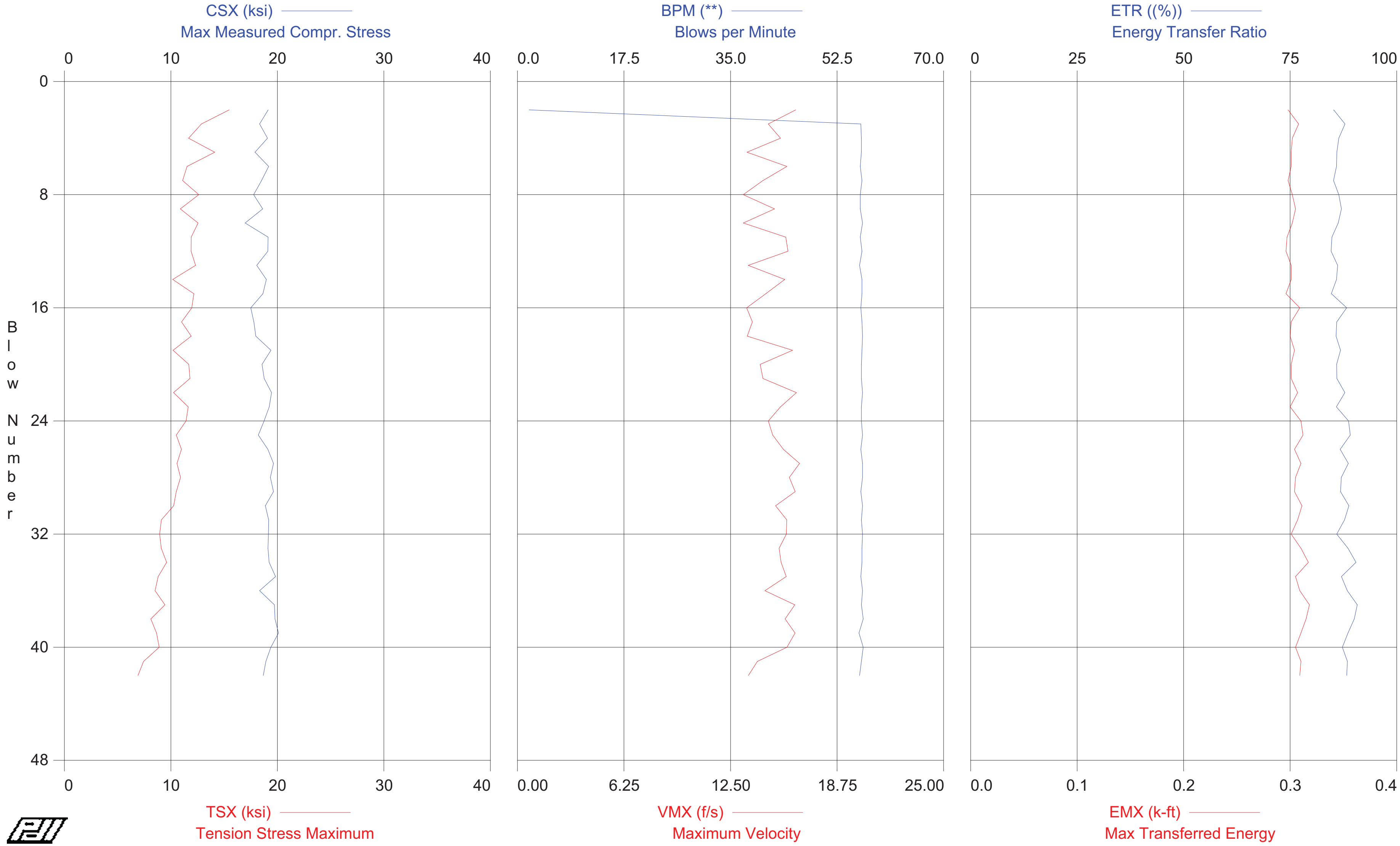
Drive 4 minutes 22 seconds 12:10:11 PM - 12:14:33 PM (9/2/2009) BN 1 - 26

MACTEC Engineering and Consulting, Inc. - Case Method Results

PDIPLOT Ver. 2008.1 - Printed: 16-Nov-2009

Test date: 2-Sep-2009

NORTH ANNA 3 Project - BORING M-8 (43.7' - 45.2' sample)



NORTH ANNA 3 Project - BORING M-8 (43.7' - 45.2' sample) Rig Serial No. MEC-12; CME-45c Track (D. Rhodes)
OP: JNH Test date: 2-Sep-2009

AR: 1.22 in^2 SP: 0.492 k/ft3
LE: 49.20 ft EM: 30,000 ksi
WS: 16,807.9 f/s JC: 0.70

CSX: Max Measured Compr. Stress
TSX: Tension Stress Maximum
VMX: Maximum Velocity
FMX: Maximum Force
FVP: Force/Velocity proportionality
BPM: Blows per Minute
EF2: Energy of F^2
ETR: Energy Transfer Ratio
EMX: Max Transferred Energy

BL#	CSX	TSX	VMX	FMX	FVP	BPM	EF2	ETR	EMX
	ksi	ksi	f/s	kips	[]	**	k-ft	(%)	k-ft
2	19.1	15.5	16.3	23	0.7	1.9	0.254	85.2	0.298
3	18.3	12.9	14.7	22	0.7	56.4	0.268	87.9	0.308
4	19.1	11.7	15.4	23	0.7	56.5	0.261	86.4	0.302
5	17.9	14.1	13.5	22	0.8	56.5	0.260	86.0	0.301
6	19.2	11.5	15.8	23	0.7	56.3	0.261	85.9	0.301
7	18.5	11.1	14.4	23	0.7	56.6	0.262	85.2	0.298
8	17.8	12.6	13.2	22	0.7	56.3	0.261	86.4	0.302
9	18.6	10.9	15.1	23	0.7	56.3	0.259	87.0	0.305
10	17.0	12.6	13.3	21	0.7	56.7	0.258	86.3	0.302
11	19.1	11.9	15.7	23	0.7	56.3	0.258	84.8	0.297
12	19.1	11.9	15.9	23	0.7	56.6	0.259	84.6	0.296
13	18.1	12.3	13.5	22	0.7	56.2	0.261	86.1	0.301
14	19.0	10.2	15.7	23	0.7	56.6	0.261	85.9	0.301
15	18.7	12.2	14.6	23	0.7	56.6	0.256	84.7	0.296
16	17.5	12.0	13.4	21	0.7	56.4	0.261	88.3	0.309
17	17.8	11.0	13.8	22	0.7	56.6	0.264	85.9	0.301
18	18.0	11.9	13.5	22	0.7	56.7	0.264	85.8	0.300
19	19.4	10.2	16.1	24	0.7	56.6	0.264	86.8	0.304
20	18.6	11.7	14.2	23	0.7	56.5	0.266	85.9	0.301
21	18.8	11.8	14.4	23	0.7	56.5	0.263	86.0	0.301
22	19.4	10.3	16.4	24	0.7	56.7	0.265	87.8	0.307
23	19.2	11.6	15.4	23	0.7	56.5	0.261	85.8	0.300
24	18.8	11.4	14.7	23	0.7	56.5	0.260	88.7	0.310
25	18.2	10.5	15.0	22	0.7	56.7	0.262	89.1	0.312
26	19.1	11.0	15.6	23	0.7	56.4	0.262	86.7	0.304
27	19.6	10.6	16.6	24	0.7	56.7	0.265	88.6	0.310
28	19.4	10.9	16.0	24	0.7	56.7	0.258	87.0	0.305
29	19.6	10.5	16.3	24	0.7	56.4	0.265	86.8	0.304
30	18.9	10.3	15.1	23	0.7	56.7	0.269	88.8	0.311
31	19.2	9.1	15.8	23	0.7	56.5	0.261	87.8	0.307
32	19.2	9.0	15.8	23	0.7	56.7	0.262	85.9	0.301
33	19.1	9.1	15.3	23	0.7	56.6	0.263	88.6	0.310
34	19.2	9.6	15.5	23	0.7	56.6	0.264	90.4	0.317
35	19.8	8.8	15.8	24	0.7	56.4	0.260	87.0	0.305
36	18.3	8.5	14.5	22	0.7	56.7	0.261	88.4	0.309
37	19.7	9.4	16.3	24	0.7	56.5	0.265	90.8	0.318
38	19.8	8.1	15.7	24	0.7	56.8	0.263	90.1	0.315
39	20.1	8.7	16.3	25	0.7	56.1	0.262	88.6	0.310
40	19.4	8.9	15.8	24	0.7	56.8	0.263	87.2	0.305
41	18.9	7.4	14.1	23	0.8	56.5	0.259	88.4	0.310
42	18.7	6.9	13.5	23	0.8	56.2	0.265	88.3	0.309
Average	18.9	10.7	15.1	23	0.7	55.2	0.262	87.1	0.305

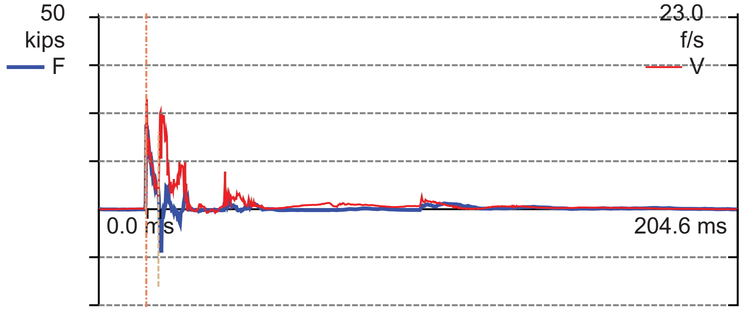
Total number of blows analyzed: 41

Time Summary

Drive 1 minute 47 seconds 12:24:49 PM - 12:26:36 PM (9/2/2009) BN 1 - 42

Project: NORTH ANNA 3
Pile: BORING M8 (28.7-30.2) - Description: CME 45C TRACK(D. RHODES)
Operator: JNH

BN 11
9/2/2009 11:47:41 AM



LP	0.00	ft	LE	34.20	ft
CSX	17.2	ksi	AR	1.22	in^2
CSI	18.0	ksi	EM	30,000.0	ksi
TSX	11.2	ksi	SP	0.492	k/ft3
EMX	0.3	k-ft	WS	16,807.9	f/s
STK	4.28	ft	WC	16,807.9	f/s
FVP	0.75	[]	JC	0.70	[]
SFR	0	kips	2L/c	4.07	ms
RX5	4	kips	EA/c	2.2	ksec/ft
RMX	3	kips	FR	5.000	kHz

MACTEC

Engineering and constructing a better tomorrow

November 16, 2009

For Jon Honeycutt W/ Permission

From: Jon Honeycutt, Staff Professional L.C.

Reviewed By: Steve Kiser, Principal Professional SK

Subject: **Report of SPT Energy – MACTEC CME 55 Track (RAL)**
Hammer Serial No. MEC-21 Automatic Hammer
WORK INSTRUCTION No. 8 (DCN:NAP-077)
North Anna 3 Project
Louisa County, Virginia
MACTEC Project No. 6468-09-2473

Jonathan Honeycutt, of MACTEC Engineering and Consulting, Inc. (MACTEC), performed energy measurements on the drill rig at the subject site per the referenced Work Instructions. This memorandum summarizes the field testing activities and presents the results of the energy measurements.

SPT Energy Field Measurements

SPT energy measurements were made on September 1, 2009, during drilling of Boring M-30(DH) at the referenced site. The testing was performed by Jonathan Honeycutt from approximately 4:05 PM to 4:45 PM on September 1 under clear skies with a temperature of about 75 degrees Fahrenheit. The boring was drilled by MACTEC personnel using equipment from the MACTEC Raleigh office. The drilling equipment consisted of a CME 55 model track drill rig with an SPT automatic hammer. The drilling tools consisted of AW-J-sized drilling rods and a 2-foot long split-barrel sampler. Mud rotary drilling techniques were used to advance the boring at the time of energy testing. The drill rig operator during sampling was Mr. Thomas Hahn. Energy measurements were recorded during sampling at the depth intervals shown in Table 1.

The energy measurements were performed with a Pile Driving Analyzer (PDA) model PAX (Serial No. 3622L), and calibrated accelerometers (Serial Nos. K983 and K0686) and strain gages (Serial Nos. AW#75/1 and AW#75/2). A steel drill rod, 2 feet long and instrumented with dedicated strain gages, was inserted at the top of the drill rod string immediately below the SPT hammer. The inserted rod was also instrumented with two piezoresistive accelerometers that were bolted to the outside of the rod. The instrumented rod insert had a cross-sectional area of approximately 1.22 square inches and an outside diameter of approximately 1.75 inches at the gage location. The drill rods included in the drill rod string were hollow rods in 5 to 10 foot long sections, with an outside and inside diameter of approximately 1.75 and 1.375 inches, respectively. The recommended operation rate of the hammer is not known. Due to the closed hammer system, the hammer lubrication condition and anvil dimensions could not be observed.

18 Pages Total

MACTEC Engineering and Consulting, Inc.
2801 Yorkmont Road, Suite 100 • Charlotte, NC 28208 • Phone: 704.357.8600

www.mactec.com

Calibration Records

The calibration records for all the above are filed in DCN NAP-223.

Calculations for EFV

The work was done in accordance with ASTM D 4633-05. The strain and acceleration signals were converted to force and velocity by the PDA. The maximum energy transmitted to the drill rod string (EFV), as measured at the location of the strain gages and accelerometers, was calculated by the PDA using the equation shown below:

$$EFV = \int F(t) * V(t) * dt$$

Where: EFV = Transferred energy (EFV equation), or Energy of FV
F(t) = Calculated force at time t
V(t) = Calculated velocity at time t

As recommended by ASTM D4633-05, the force-velocity method of energy calculation was used. The equation shown above for calculating EFV, integrated over the complete wave event, measures the total energy content of the event using both force and velocity measurements. The EFV values associated with each blow analyzed are tabulated in the attached PDIPLOT tables and are also shown graphically in the PDIPLOT charts.

Calculations for ETR

The ratio of the measured transferred energy (EFV) to the theoretical potential energy of the SPT system (140 lb weight with the specified 30 inch fall) is the ETR. The ETR values (as percent of the theoretical value) are shown in Table 1.

Comparison of ETR to Typical Energy Transfer Ratio Range

Based on a research report published by the Florida Department of Transportation (FDOT) (Report WPI No. 0510859, 1999), the average ETR measured for automatic hammers is 79.6%. The standard deviation was 7.9%; therefore, the range of ETRs within one standard deviation of the average was reported to be 71.7% to 87.5%. This range of ETRs was also consistent with other research that was cited in the FDOT research paper; however, maximum and minimum ETR values of up to 98% and 56%, respectively, were reported in the literature. The ETR values shown in Table 1 are generally within the range of typical values for automatic hammers as reported in the literature.

Discussion

Based on the field testing results, observations from the SPT energy measurements are summarized below:

- The data obtained by the PDA are generally consistent between individual hammer blows and between the sample depths tested. In general, the first and last one (and sometimes two or more) hammer blow records recorded by the PDA produced poor quality data (which is relatively common) and, as such, the record(s) was(were) not

used in the data reduction. This may result in more or less hammer blows evaluated for ETR than what is shown on the boring logs.

- The average energy transferred from the hammer to the drill rods for each individual depth interval using the EFV method ranged from 302 foot-pounds to 317 foot-pounds. These average energy transfers correspond to energy transfer ratios (ETR) of 86.3% to 90.6% of the theoretical energy (350 foot-pounds) of the SPT hammer.

- The average at each depth interval was calculated as the transferred energy for each analyzed blow of the depth intervals divided by the total number of hammer blows analyzed. The overall average energy transfer of the SPT system (for all the depth intervals tested) was 306.1 foot-pounds, with an average ETR of 87.4%.

Attachments: Page 4 Table 1 - Summary of SPT Energy Measurements – 1 Page
Page 5 - 6 Work Instruction No. 8 DCN:NAP 077– 2 Pages (without attachments)
Pages 7 Record of SPT Energy Measurement – 1 Page
Pages 8 – 17 PDIPLOT Output – 10 Pages
Page 18 Force-Velocity Plot – 1 Page

TABLE 1
SUMMARY OF SPT ENERGY MEASUREMENTS (ASTM D4633-05)
North Anna 3 Project
Louisa County, Virginia
MACTEC Project No. 6468-09-2473

Automatic Hammer Serial Number and Rig Model	Rig Owner	Rig Operator	Boring No. Tested	Date Tested	Drill Rod Size	Sample Depth (feet)	SPT Blow Count (blows per six inches)	No. of Blows Analyzed	Average Measured Energy (Average EFV) (ft-lbs)[a]	Energy Transfer Ratio (%)[b] (Average ETR)
MEC-21 (CME 55 Track)	MACTEC Raleigh	Thomas Hahn	M-30 (DH)	9/1/2009	AW-J	11.1 - 12.6	4 - 6 - 6	16	304	86.9%
						13.7 - 15.2	4 - 7 - 7	19	302	86.3%
						18.7 - 20.2	6 - 7 - 6	19	317	90.6%
						23.7 - 25.2	7 - 8 - 10	25	307	87.7%
						28.7 - 30.2	11 - 14 - 15	40	303	86.6%
							Average for Rig:		**306.1**	**87.4%**

[a]Measured Energy is energy based on the EFV method, as outlined in ASTM D4633-05, for each blow recorded by the PDA. In some cases, the initial and final one to two blows produced poor quality data, and were not used to calculate the Average Measured Energy. This may result in more or less blows evaluated for ETR than what is shown on the boring logs.

EFV = EMX * 1000 lbs/kip, where EMX equals the maximum transferred energy measured by the PDA (see attached PDA data).

[b]Energy Transfer Ratio is the Measured Energy divided by the theoretical SPT energy of 350 foot-pounds (140 pound hammer falling 2.5 feet).

The average EFV and ETR values may differ slightly and insignificantly from those in the PDIPLOT tables due to roundoff.

Prepared By: J. C.	Date: 11-16-09		Checked By: [signature]	Date: 11-16-09

For Jon Honeycutt
With Permission

Work Instruction No. 8
North Anna 3 Project
MACTEC Engineering and Consulting, Inc.
Project Number: 6468-09-2473

Issued To: Jonathan Honeycutt, Steve Kiser Rev. No. 0

Issued By: D. Steven Copley, P.E. DSC 8-31-09 Date: August 31, 2009

Valid From: August 31, 2009 To: August 31, 2010

Task Description: Perform SPT Energy Measurements

Applicable Technical Procedures or Plans, or other reference:

1. Geotechnical Work Plan (complete copy of current revision available at Field Office), Section 4.2 and Attachment 2 – Drilling and Sampling Procedures (attached)
2. Engineering Specification for Subsurface Investigation and Laboratory Testing, No. 25161-500-3PS-CY00-Q0001, Rev. 000, Issued for use August 21, 2009, Section 3.3 Drilling Equipment (attached)
3. ASTM D 4633-05 (attached)

Specific Instructions (note attachments where necessary): Perform energy measurements for each drill rig on site in general accordance with ASTM D 4633-05. Consult with Site Manager as to schedule for performing the measurements. Hammer weights have been checked, and records will be available on site. All rigs are using automatic hammer systems. Confirm that automatic hammer system is being operated within manufacturer's recommendations or in a typical operating fashion as observed from watching one or two SPT measurements prior to measuring energy. Check each drill rig using all hammer/rod combinations that it will be using. Depths for measurements should be coordinated with the Site Manager. See Site Manager for current boring logs of holes drilled, if available, and use these to plan most effective field measurement program. Submit copies of calibration records for equipment to Principal Professional for review prior to beginning work on site.

Confirm with Site Manager that approval of equipment calibration records have been received prior to beginning field testing. If unexpected conditions are encountered that affect measurements, contact Site Manager or Principal Professional immediately.

Report Format: Prepare standard report in accordance with ASTM D 4633-05 requirements.

Specific Quality Assurance Procedures Applicable: 10CFR21; NQAP 16-01 Procedure For Conforming To Federal Regulation 10CFR21; QAP 20-1; QAP 25-1; Section 306 of the Energy Reorganization Act of 1974. Current revisions apply; copies available in Field Office.

Hold Points or Witness Points: None

Records: All records generated shall be considered QA Records.

Reviewed and Approved By (Note: Only one signature required for issuance):

Project Manager: ______________________ Date: ______________

Principal Professional: D. Aaron Copley Date: 8-31-09

Site Manager: ______________________ Date: ______________

No. of Pages: 15 DCN: NAP077

QA Form 24-1 Revised 8/12/2009

MACTEC

2801 YORKMONT ROAD, SUITE 100 □ CHARLOTTE, NC 28208
Telephone: (704) 357-8600 / Facsimile: (704) 357-8638

RECORD OF SPT ENERGY MEASUREMENT

GENERAL INFORMATION		DRILL RIG DATA	
PROJECT:	North Anna 3 Project	MAKE:	CME
LOCATION:	Virginia	MODEL:	55 Track
PROJECT NO.:	6468-09-2473	SERIAL NO.:	MEC-21
DATE:	9/1/2009	HAMMER TYPE:	Auto
WEATHER:	Sunny 75°F	ROPE CONDITION:	N/A
INSPECTOR:	JNH	ROD SIZE:	AW-J
DRILLING COMPANY:	MACTEC - Raleigh	NO. OF SHEAVES:	N/A

BORING DATA

BORING NUMBER:	M-30(DH)		
DEPTH DRILLED:	Various		
TIME DRIVEN:	4:05 pm - 4:45 pm		
RIG OPERATOR:	T. HAHN		
HAMMER OPERATOR:	N/A		
PDA PAK SERIAL NO.:	3622L		
INSTR. ROD AREA:	1.22 in2		
ACCEL. SERIAL NOS.:	A1-K983 : A2-K0686		
STRAIN SERIAL NOS.:	75AW #1/2		

SAMPLE DEPTH (feet)	SPT N-VALUE (bpf)							
11.1-12.6	4-6-6							
13.7-15.2	4-7-7							
18.7-20.2	6-7-6							
23.7-25.2	7-8-10							
28.7-30.2	11-14-15							

REMARKS: Testing performed in accordance with ASTM D 4633-05

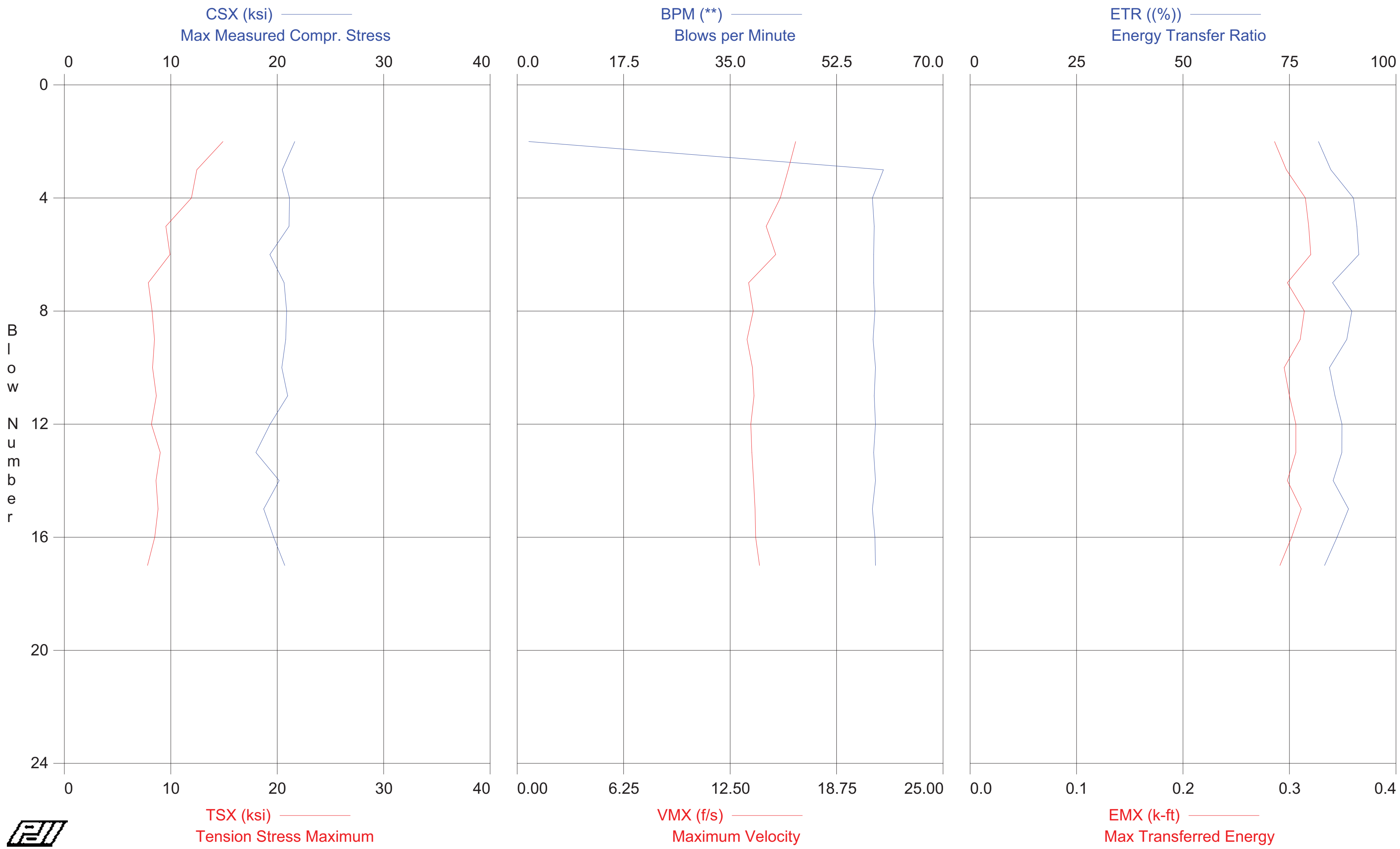
Reviewed By:

MACTEC Engineering and Consulting, Inc. - Case Method Results

PDIPLOT Ver. 2008.1 - Printed: 16-Nov-2009

Test date: 1-Sep-2009

NORTH ANNA 3 Project - BORING M-30(DH) (11.1' - 12.6' sample)



MACTEC Engineering and Consulting, Inc.
Case Method Results

PDIPLOT Ver. 2008.1 - Printed: 16-Nov-2009

NORTH ANNA 3 Project - BORING M-30(DH) (11.1' - 12.6' sample)
OP: JNH

Rig Serial No. MEC-21; CME 55 (T.Hahn)
Test date: 1-Sep-2009

AR: 1.22 in^2
LE: 16.60 ft
WS: 16,807.9 f/s

SP: 0.492 k/ft3
EM: 30,000 ksi
JC: 0.70

CSX: Max Measured Compr. Stress
TSX: Tension Stress Maximum
VMX: Maximum Velocity
FMX: Maximum Force
FVP: Force/Velocity proportionality

BPM: Blows per Minute
EF2: Energy of F^2
ETR: Energy Transfer Ratio
EMX: Max Transferred Energy

BL#	CSX	TSX	VMX	FMX	FVP	BPM	EF2	ETR	EMX
	ksi	ksi	f/s	kips	[]	**	k-ft	(%)	k-ft
2	21.6	14.9	16.3	26	0.8	1.9	0.251	81.8	0.286
3	20.5	12.4	15.9	25	0.8	60.2	0.246	84.7	0.297
4	21.2	11.9	15.4	26	0.9	58.4	0.243	90.0	0.315
5	21.1	9.5	14.6	26	0.9	58.7	0.244	90.8	0.318
6	19.3	9.9	15.2	24	0.8	58.6	0.242	91.3	0.320
7	20.6	7.9	13.6	25	0.9	58.6	0.236	85.1	0.298
8	20.9	8.2	13.9	25	0.9	58.8	0.235	89.6	0.314
9	20.8	8.5	13.5	25	0.9	58.5	0.234	88.5	0.310
10	20.4	8.3	13.8	25	0.8	58.9	0.233	84.4	0.295
11	21.0	8.6	13.9	26	0.8	58.7	0.234	85.7	0.300
12	19.3	8.2	13.7	24	0.8	58.9	0.235	87.3	0.306
13	18.0	9.0	13.8	22	0.8	58.6	0.235	87.3	0.306
14	20.2	8.6	13.9	25	0.8	58.9	0.228	85.3	0.298
15	18.7	8.8	14.0	23	0.8	58.4	0.235	88.9	0.311
16	19.7	8.5	14.0	24	0.8	58.8	0.231	86.2	0.302
17	20.7	7.8	14.2	25	0.8	58.9	0.230	83.2	0.291
Average	20.3	9.5	14.4	25	0.8	55.2	0.237	86.9	0.304

Total number of blows analyzed: 16

Time Summary

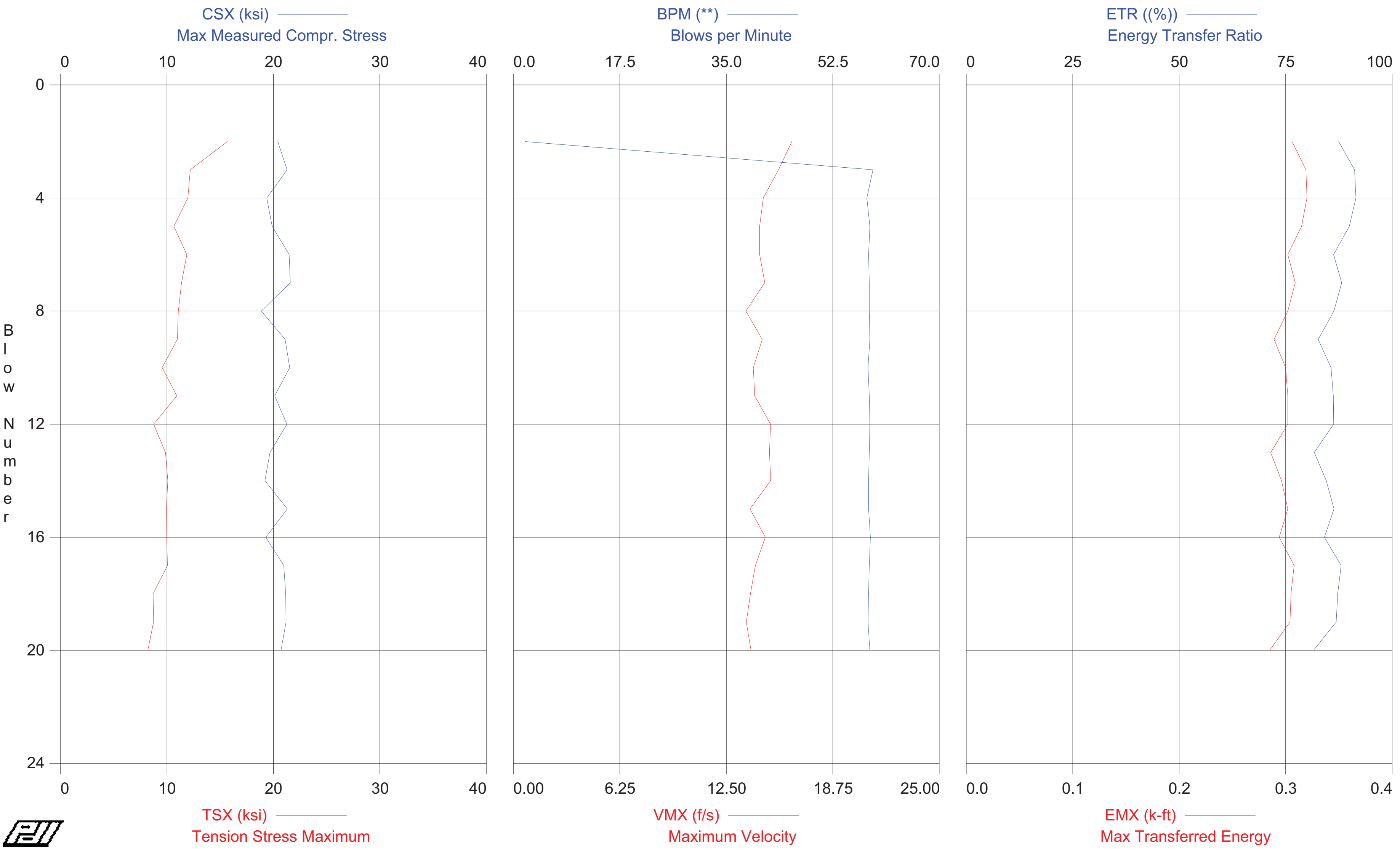
Drive 1 minute 44 seconds 3:54:35 PM - 3:56:19 PM (9/1/2009) BN 1 - 18

MACTEC Engineering and Consulting, Inc. - Case Method Results

PDIPLOT Ver. 2008.1 - Printed: 16-Nov-2009

Test date: 1-Sep-2009

NORTH ANNA 3 Project - BORING M-30(DH) (13.7' - 15.2' sample)



NORTH ANNA 3 Project - BORING M-30(DH) (13.7' - 15.2' sample) Rig Serial No. MEC-21; CME 55 (T.Hahn)
OP: JNH Test date: 1-Sep-2009

AR: 1.22 in^2 SP: 0.492 k/ft3
LE: 19.20 ft EM: 30,000 ksi
WS: 16,807.9 f/s JC: 0.70

CSX: Max Measured Compr. Stress
TSX: Tension Stress Maximum
VMX: Maximum Velocity
FMX: Maximum Force
FVP: Force/Velocity proportionality
BPM: Blows per Minute
EF2: Energy of F^2
ETR: Energy Transfer Ratio
EMX: Max Transferred Energy

BL#	CSX	TSX	VMX	FMX	FVP	BPM	EF2	ETR	EMX
	ksi	ksi	f/s	kips	[]	**	k-ft	(%)	k-ft
2	20.4	15.7	16.4	25	0.8	1.9	0.273	87.4	0.306
3	21.3	12.2	15.6	26	0.8	59.1	0.257	91.2	0.319
4	19.4	12.0	14.7	24	0.8	58.1	0.265	91.5	0.320
5	19.9	10.7	14.5	24	0.8	58.6	0.264	89.9	0.315
6	21.5	11.9	14.5	26	0.9	58.4	0.261	86.3	0.302
7	21.6	11.4	14.8	26	0.9	58.5	0.260	88.2	0.309
8	18.9	11.1	13.6	23	0.8	58.5	0.257	86.3	0.302
9	21.1	11.0	14.6	26	0.9	58.6	0.251	82.6	0.289
10	21.5	9.6	14.1	26	1.0	58.3	0.261	85.7	0.300
11	20.1	10.9	14.2	25	0.8	58.5	0.260	86.2	0.302
12	21.3	8.8	15.1	26	0.9	58.6	0.252	86.3	0.302
13	19.7	9.9	15.0	24	0.9	58.5	0.247	81.7	0.286
14	19.2	10.1	15.1	23	0.8	58.4	0.250	84.5	0.296
15	21.3	9.9	13.9	26	1.0	58.4	0.253	86.4	0.302
16	19.3	10.0	14.8	24	0.8	58.7	0.253	84.1	0.294
17	21.0	10.1	14.2	26	0.8	58.5	0.255	88.0	0.308
18	21.2	8.7	13.9	26	0.9	58.4	0.250	87.2	0.305
19	21.2	8.7	13.7	26	0.9	58.3	0.253	86.9	0.304
20	20.7	8.2	14.0	25	0.8	58.6	0.253	81.5	0.285
Average	20.5	10.6	14.5	25	0.9	55.5	0.257	86.4	0.302

Total number of blows analyzed: 19

Time Summary

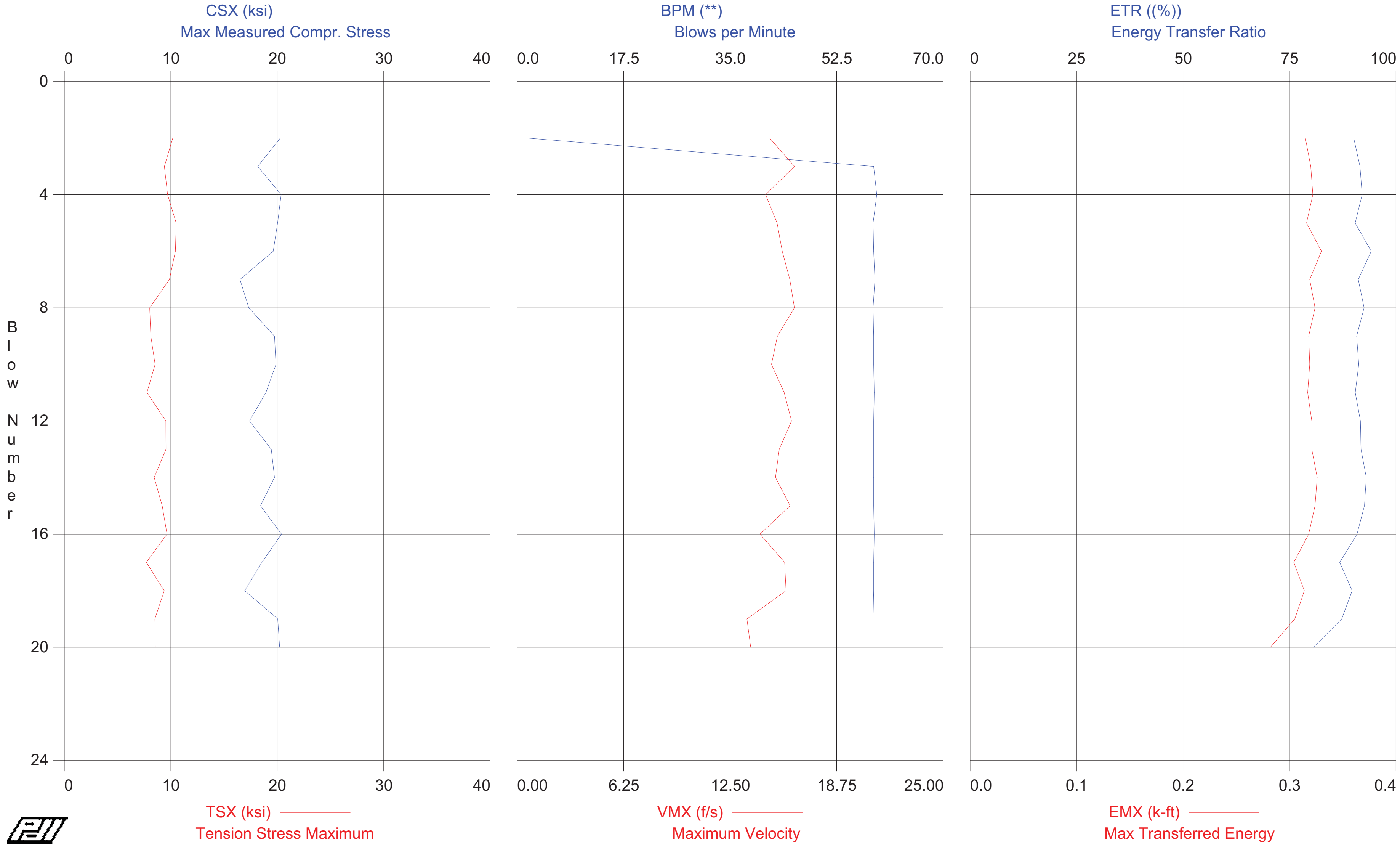
Drive 34 seconds 4:05:23 PM - 4:05:57 PM (9/1/2009) BN 1 - 20

MACTEC Engineering and Consulting, Inc. - Case Method Results

PDIPLOT Ver. 2008.1 - Printed: 16-Nov-2009

Test date: 1-Sep-2009

NORTH ANNA 3 Project - BORING M-30(DH) (18.7' - 20.2' sample)



NORTH ANNA 3 Project - BORING M-30(DH) (18.7' - 20.2' sample) Rig Serial No. MEC-21; CME 55 (T.Hahn)
OP: JNH Test date: 1-Sep-2009

AR: 1.22 in^2 SP: 0.492 k/ft3
LE: 24.20 ft EM: 30,000 ksi
WS: 16,807.9 f/s JC: 0.70

CSX: Max Measured Compr. Stress
TSX: Tension Stress Maximum
VMX: Maximum Velocity
FMX: Maximum Force
FVP: Force/Velocity proportionality
BPM: Blows per Minute
EF2: Energy of F^2
ETR: Energy Transfer Ratio
EMX: Max Transferred Energy

BL#	CSX	TSX	VMX	FMX	FVP	BPM	EF2	ETR	EMX
	ksi	ksi	f/s	kips	[]	**	k-ft	(%)	k-ft
2	20.3	10.2	14.8	25	0.5	1.9	0.239	90.1	0.315
3	18.2	9.4	16.3	22	0.6	58.6	0.234	91.6	0.320
4	20.4	9.7	14.6	25	0.8	59.1	0.237	92.0	0.322
5	20.0	10.5	15.3	24	0.5	58.5	0.241	90.4	0.316
6	19.6	10.4	15.6	24	0.7	58.6	0.234	94.2	0.330
7	16.5	9.9	16.0	20	0.6	58.8	0.235	91.2	0.319
8	17.3	8.0	16.3	21	0.6	58.5	0.230	92.5	0.324
9	19.7	8.1	15.3	24	0.7	58.6	0.234	90.8	0.318
10	19.9	8.5	14.9	24	0.5	58.6	0.233	91.3	0.319
11	18.9	7.8	15.7	23	0.5	58.7	0.233	90.4	0.317
12	17.4	9.5	16.1	21	0.6	58.6	0.234	91.7	0.321
13	19.4	9.6	15.4	24	0.5	58.6	0.237	91.8	0.321
14	19.7	8.4	15.2	24	0.7	58.6	0.230	93.0	0.326
15	18.4	9.2	16.0	22	0.6	58.6	0.232	92.6	0.324
16	20.4	9.6	14.3	25	0.5	58.7	0.235	90.9	0.318
17	18.6	7.7	15.7	23	0.7	58.6	0.228	86.8	0.304
18	16.9	9.4	15.8	21	0.6	58.6	0.231	89.7	0.314
19	20.0	8.5	13.5	24	0.8	58.5	0.227	87.3	0.305
20	20.2	8.5	13.7	25	0.8	58.5	0.228	80.6	0.282
Average	19.1	9.1	15.3	23	0.6	55.6	0.233	90.5	0.317

Total number of blows analyzed: 19

Time Summary

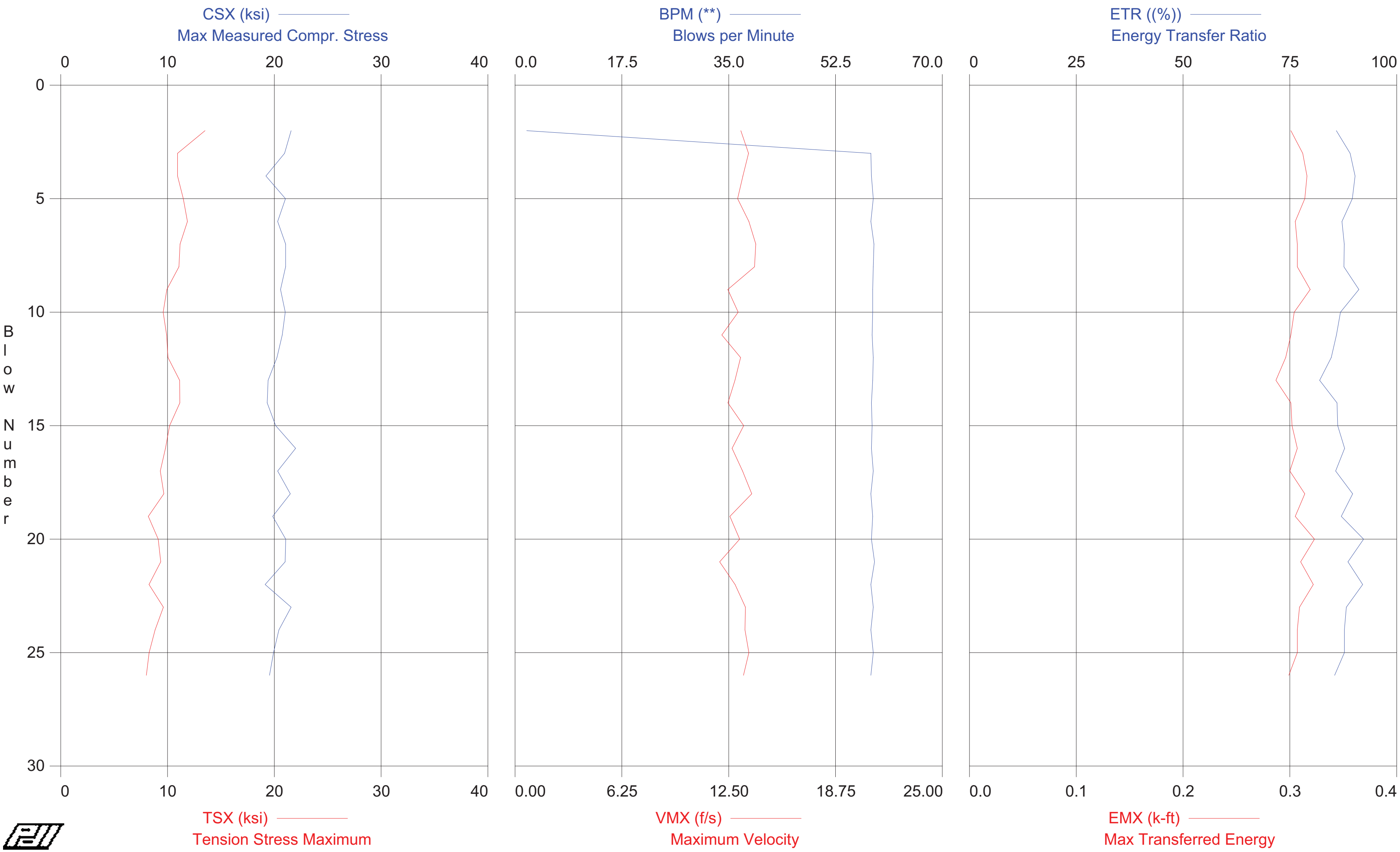
Drive 31 seconds 4:15:08 PM - 4:15:39 PM (9/1/2009) BN 1 - 20

MACTEC Engineering and Consulting, Inc. - Case Method Results

PDIPLOT Ver. 2008.1 - Printed: 16-Nov-2009

Test date: 1-Sep-2009

NORTH ANNA 3 Project - BORING M-30(DH) (23.7' - 25.2' sample)



NORTH ANNA 3 Project - BORING M-30(DH) (23.7' - 25.2' sample) Rig Serial No. MEC-21; CME 55 (T.Hahn)
OP: JNH Test date: 1-Sep-2009

AR: 1.22 in^2 SP: 0.492 k/ft3
LE: 29.20 ft EM: 30,000 ksi
WS: 16,807.9 f/s JC: 0.70

CSX: Max Measured Compr. Stress
TSX: Tension Stress Maximum
VMX: Maximum Velocity
FMX: Maximum Force
FVP: Force/Velocity proportionality
BPM: Blows per Minute
EF2: Energy of F^2
ETR: Energy Transfer Ratio
EMX: Max Transferred Energy

BL#	CSX	TSX	VMX	FMX	FVP	BPM	EF2	ETR	EMX
	ksi	ksi	f/s	kips	[]	**	k-ft	(%)	k-ft
2	21.6	13.5	13.2	26	0.9	1.9	0.249	85.9	0.301
3	21.0	10.9	13.7	26	0.9	58.3	0.251	89.1	0.312
4	19.2	10.9	13.3	23	0.8	58.4	0.256	90.3	0.316
5	21.0	11.5	13.0	26	0.9	58.7	0.255	89.6	0.314
6	20.3	11.9	13.7	25	0.8	58.3	0.254	87.2	0.305
7	21.0	11.2	14.1	26	0.8	58.8	0.251	87.7	0.307
8	21.1	11.1	14.0	26	0.8	58.7	0.255	87.7	0.307
9	20.6	9.9	12.5	25	0.9	58.6	0.254	91.2	0.319
10	21.0	9.6	13.1	26	0.9	58.6	0.253	86.8	0.304
11	20.7	9.9	12.1	25	1.0	58.5	0.252	85.9	0.301
12	20.2	10.0	13.2	25	0.9	58.7	0.249	84.7	0.296
13	19.4	11.1	12.9	24	0.8	58.6	0.255	82.0	0.287
14	19.3	11.2	12.5	24	0.8	58.4	0.252	86.0	0.301
15	20.1	10.2	13.4	25	0.8	58.5	0.257	86.2	0.302
16	22.0	9.8	12.7	27	1.0	58.4	0.257	87.8	0.307
17	20.3	9.3	13.3	25	0.9	58.7	0.252	85.7	0.300
18	21.5	9.7	13.9	26	0.9	58.3	0.258	89.7	0.314
19	19.9	8.2	12.6	24	0.8	58.6	0.261	87.0	0.305
20	21.1	9.1	13.1	26	0.9	58.4	0.251	92.3	0.323
21	21.0	9.4	12.0	26	0.8	58.9	0.255	88.6	0.310
22	19.1	8.3	12.9	23	0.8	58.3	0.257	92.0	0.322
23	21.6	9.6	13.5	26	0.9	58.7	0.254	88.2	0.309
24	20.4	8.8	13.5	25	0.8	58.3	0.260	87.7	0.307
25	19.9	8.3	13.7	24	0.8	58.7	0.257	87.8	0.307
26	19.5	8.0	13.4	24	0.8	58.3	0.259	85.5	0.299
Average	20.5	10.1	13.2	25	0.9	56.3	0.255	87.7	0.307

Total number of blows analyzed: 25

Time Summary

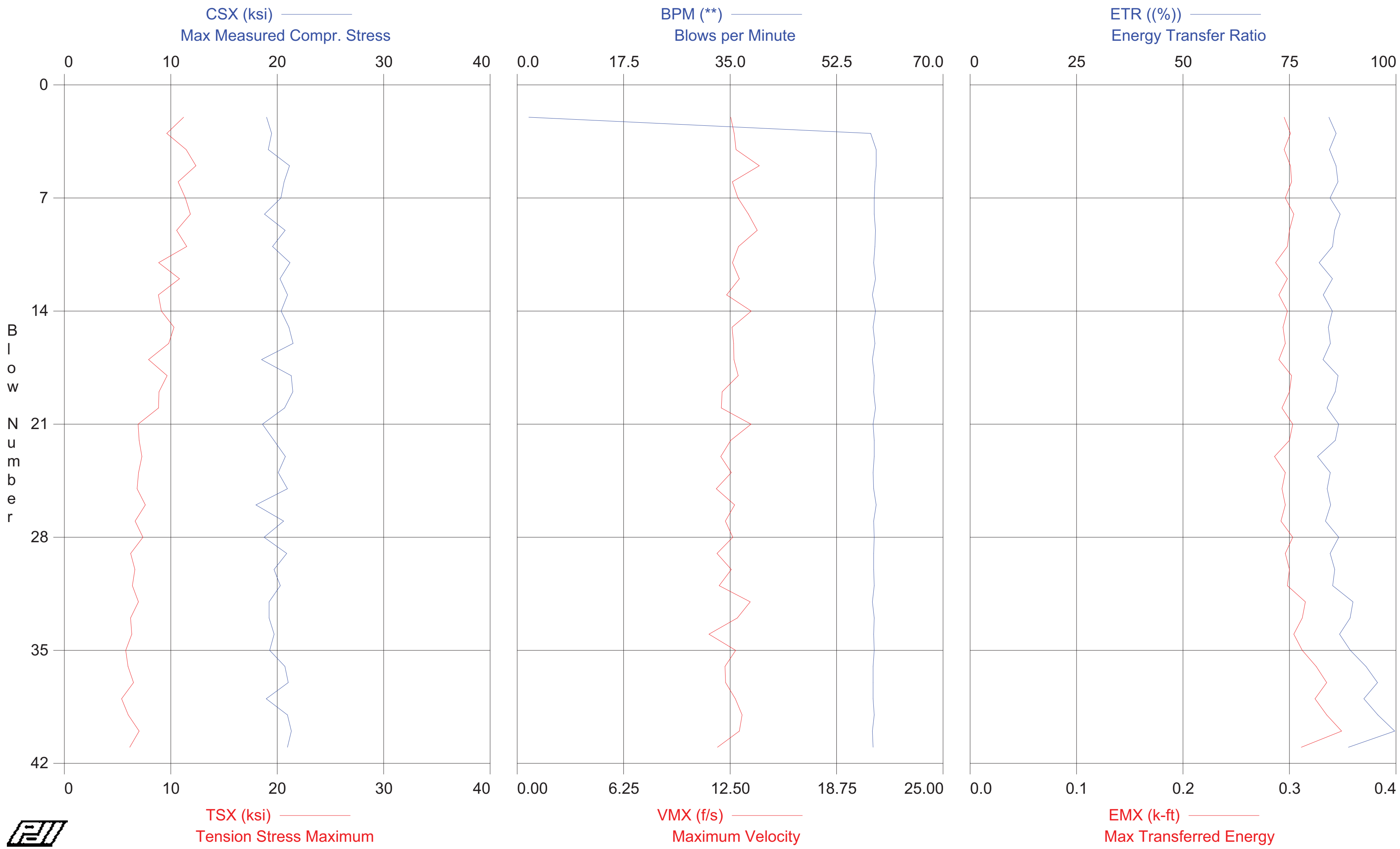
Drive 50 seconds 4:23:26 PM - 4:24:16 PM (9/1/2009) BN 1 - 27

MACTEC Engineering and Consulting, Inc. - Case Method Results

PDIPLOT Ver. 2008.1 - Printed: 16-Nov-2009

Test date: 1-Sep-2009

NORTH ANNA 3 Project - BORING M-30(DH) (28.7' - 30.2' sample)



NORTH ANNA 3 Project - BORING M-30(DH) (28.7' - 30.2' sample) Rig Serial No. MEC-21; CME 55 (T.Hahn)
OP: JNH Test date: 1-Sep-2009

AR: 1.22 in^2 SP: 0.492 k/ft3
LE: 34.20 ft EM: 30,000 ksi
WS: 16,807.9 f/s JC: 0.70

CSX: Max Measured Compr. Stress
TSX: Tension Stress Maximum
VMX: Maximum Velocity
FMX: Maximum Force
FVP: Force/Velocity proportionality
BPM: Blows per Minute
EF2: Energy of F^2
ETR: Energy Transfer Ratio
EMX: Max Transferred Energy

BL#	CSX	TSX	VMX	FMX	FVP	BPM	EF2	ETR	EMX
	ksi	ksi	f/s	kips	[]	**	k-ft	(%)	k-ft
2	19.0	11.2	12.5	23	0.8	1.9	0.273	84.2	0.295
3	19.5	9.6	12.7	24	0.8	58.1	0.285	85.9	0.301
4	19.2	11.4	12.8	23	0.8	59.0	0.285	84.4	0.295
5	21.1	12.4	14.2	26	0.8	59.0	0.273	85.9	0.301
6	20.6	10.7	12.6	25	0.8	58.8	0.279	86.4	0.302
7	20.3	11.4	13.0	25	0.9	58.7	0.275	84.5	0.296
8	18.8	11.8	13.6	23	0.8	58.7	0.277	86.9	0.304
9	20.7	10.5	14.1	25	0.8	58.9	0.272	85.6	0.300
10	19.6	11.5	13.0	24	0.8	58.8	0.276	85.1	0.298
11	21.2	8.9	12.6	26	0.9	58.6	0.271	82.0	0.287
12	20.3	10.8	13.0	25	0.8	58.9	0.273	85.1	0.298
13	21.0	8.8	12.3	26	1.0	58.4	0.274	82.9	0.290
14	20.4	9.1	13.7	25	0.8	58.9	0.267	85.1	0.298
15	21.1	10.3	12.6	26	0.9	58.5	0.269	84.1	0.294
16	21.5	9.8	12.7	26	0.9	58.8	0.273	84.6	0.296
17	18.5	7.9	12.7	23	0.8	58.4	0.277	82.9	0.290
18	21.3	9.7	13.0	26	0.9	58.7	0.270	86.4	0.302
19	21.5	8.9	12.0	26	0.8	58.6	0.272	85.7	0.300
20	20.7	8.9	12.0	25	1.0	58.9	0.266	83.8	0.293
21	18.6	6.9	13.7	23	0.8	58.5	0.270	86.5	0.303
22	19.7	7.0	12.5	24	0.8	58.7	0.270	85.8	0.300
23	20.8	7.3	11.9	25	0.8	58.7	0.272	81.6	0.286
24	20.1	7.0	12.6	25	0.7	58.5	0.268	84.6	0.296
25	21.0	6.8	11.7	26	0.7	58.6	0.270	83.8	0.293
26	18.0	7.6	12.8	22	0.8	59.0	0.269	84.6	0.296
27	20.6	6.7	12.2	25	0.9	58.6	0.262	83.5	0.292
28	18.8	7.4	12.7	23	0.8	58.7	0.273	86.6	0.303
29	20.9	6.2	11.7	25	1.0	58.6	0.266	84.6	0.296
30	19.7	6.6	12.6	24	0.9	58.6	0.266	85.6	0.300
31	20.3	6.4	11.9	25	1.0	58.7	0.263	85.1	0.298
32	19.2	7.0	13.7	23	0.8	58.4	0.269	89.9	0.315
33	19.2	6.2	12.9	23	0.8	58.7	0.270	89.2	0.312
34	19.7	6.3	11.3	24	1.0	58.6	0.263	86.7	0.304
35	19.3	5.8	12.8	24	0.8	58.7	0.266	89.3	0.312
36	20.7	6.0	12.2	25	0.7	58.5	0.262	93.0	0.325
37	21.0	6.5	12.2	26	0.7	58.5	0.264	95.7	0.335
38	19.0	5.4	12.8	23	0.8	58.5	0.266	92.5	0.324
39	21.0	6.0	13.2	26	0.7	58.7	0.264	95.8	0.335
40	21.3	7.0	13.0	26	0.7	58.4	0.270	99.7	0.349
41	21.0	6.1	11.8	26	0.8	58.5	0.269	88.8	0.311
Average	20.2	8.3	12.7	25	0.8	57.2	0.270	86.6	0.303

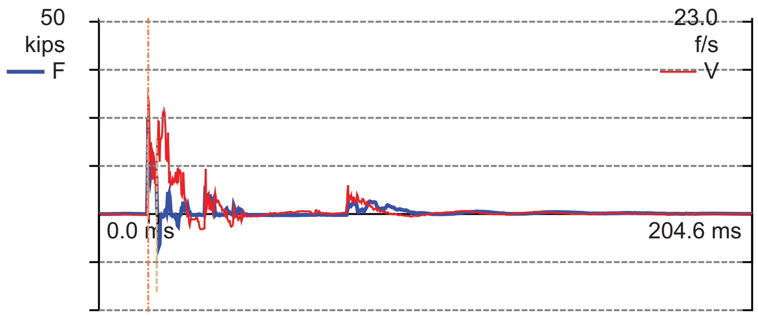
Total number of blows analyzed: 40

Time Summary

Drive 2 minutes 41 seconds 4:32:18 PM - 4:34:59 PM (9/1/2009) BN 1 - 41

Project: NORTH ANNA 3
Pile: BORING M30-DH(18.7-20.2) - Description: CME 55 (T.HAHN)
Operator: JNH

BN 19
9/1/2009 4:15:38 PM



LP	0.00	ft	LE	24.20	ft
CSX	20.0	ksi	AR	1.22	in^2
CSI	20.4	ksi	EM	30,000.0	ksi
TSX	8.5	ksi	SP	0.492	k/ft3
EMX	0.3	k-ft	WS	16,807.9	f/s
STK	3.93	ft	WC	16,807.9	f/s
FVP	0.83	[]	JC	0.70	[]
SFR	1	kips	2L/c	2.88	ms
RX5	5	kips	EA/c	2.2	ksec/ft
RMX	5	kips	FR	5.000	kHz

MACTEC

Engineering and constructing a better tomorrow

December 2, 2009

From: Jon Honeycutt, Staff Professional JNH 12/2/09

Reviewed By: Steve Kiser, Principal Professional SK 12-2-09

Subject: **Report of SPT Energy – MACTEC CME-55 Trailer (RAL)**
Hammer Serial No. MEC-425 Automatic Hammer
WORK INSTRUCTION No. 8 (DCN:NAP-077)
North Anna 3 Project
Louisa County, Virginia
MACTEC Project No. 6468-09-2473

Jonathan Honeycutt, of MACTEC Engineering and Consulting, Inc. (MACTEC), performed energy measurements on the drill rig at the subject site per the referenced Work Instructions. This memorandum summarizes the field testing activities and presents the results of the energy measurements.

SPT Energy Field Measurements

SPT energy measurements were made on September 2, 2009, during drilling of Boring M-11 at the referenced site. The testing was performed by Jonathan Honeycutt from approximately 10:05 AM to 11:15 AM on September 2 under clear skies with a temperature of about 65 degrees Fahrenheit. The boring was drilled by MACTEC personnel using equipment from the MACTEC Raleigh office. The drilling equipment consisted of a CME-55 model trailer-mounted drill rig with an SPT automatic hammer. The drilling tools consisted of AW-J-sized drilling rods and a 2-foot long split-barrel sampler. Mud rotary drilling techniques were used to advance the boring at the time of energy testing. The drill rig operator during sampling was Mr. Phil Pitts. Energy measurements were recorded during sampling at the depth intervals shown in Table 1.

The energy measurements were performed with a Pile Driving Analyzer (PDA) model PAX (Serial No. 3622L), and calibrated accelerometers (Serial Nos. K983 and K0686) and strain gages (Serial Nos. AW#75/1 and AW#75/2). A steel drill rod, 2 feet long and instrumented with dedicated strain gages, was inserted at the top of the drill rod string immediately below the SPT hammer. The inserted rod was also instrumented with two piezoresistive accelerometers that were bolted to the outside of the rod. The instrumented rod was two feet below the hammer impact point and had a cross-sectional area of approximately 1.22 square inches and an outside diameter of approximately 1.75 inches at the gage location. The drill rods included in the drill rod string were hollow rods in 5 to 10 foot long sections, with an outside and inside diameter of approximately 1.75 and 1.375 inches, respectively. The recommended operation rate of the hammer is not known. Due to the closed hammer system, the hammer lubrication condition and anvil dimensions could not be observed.

14 Pages Total

MACTEC Engineering and Consulting, Inc.
2801 Yorkmont Road, Suite 100 • Charlotte, NC 28208 • Phone: 704.357.8600

www.mactec.com

Calibration Records

The calibration records for all the above are filed in DCN NAP-223

Calculations for EFV

The work was done in accordance with ASTM D 4633-05. The strain and acceleration signals were converted to force and velocity by the PDA. The maximum energy transmitted to the drill rod string (EFV), as measured at the location of the strain gages and accelerometers, was calculated by the PDA using the equation shown below:

$$EFV = \int F(t) * V(t) * dt$$

Where: EFV = Transferred energy (EFV equation), or Energy of FV
F(t) = Calculated force at time t
V(t) = Calculated velocity at time t

As recommended by ASTM D4633-05, the force-velocity method of energy calculation was used. The equation shown above for calculating EFV, integrated over the complete wave event, measures the total energy content of the event using both force and velocity measurements. The EFV values associated with each blow analyzed are tabulated in the attached PDIPLOT tables and are also shown graphically in the PDIPLOT charts.

Calculations for ETR

The ratio of the measured transferred energy (EFV) to the theoretical potential energy of the SPT system (140 lb weight with the specified 30 inch fall) is the ETR. The ETR values (as percent of the theoretical value) are shown in Table 1.

Comparison of ETR to Typical Energy Transfer Ratio Range

Based on a research report published by the Florida Department of Transportation (FDOT) (Report WPI No. 0510859, 1999), the average ETR measured for automatic hammers is 79.6%. The standard deviation was 7.9%; therefore, the range of ETRs within one standard deviation of the average was reported to be 71.7% to 87.5%. This range of ETRs was also consistent with other research that was cited in the FDOT research paper; however, maximum and minimum ETR values of up to 98% and 56%, respectively, were reported in the literature. The ETR values shown in Table 1 are generally within the range of typical values for automatic hammers as reported in the literature.

Discussion

Based on the field testing results, observations from the SPT energy measurements are summarized below:

- The data obtained by the PDA are generally consistent between individual hammer blows and between the sample depths tested. In general, the first and last one (and sometimes two or more) hammer blow records recorded by the PDA produced poor quality data (which is relatively common) and, as such, the record(s) was(were) not

used in the data reduction. This may result in more or less blows evaluated for ETR than what is shown on the boring logs. The test results collected at depths of 23.9 and 28.9 feet were not used in the determination of the ETR due to inconsistency in transferred energy between successive hammer blows.

- The average energy transferred from the hammer to the drill rods for each individual depth interval using the EFV method ranged from 278 foot-pounds to 310 foot-pounds. These average energy transfers correspond to energy transfer ratios (ETR) of 79.4% to 88.6% of the theoretical energy (350 foot-pounds) of the SPT hammer.

- The average at each depth interval was calculated as the transferred energy for each analyzed blow of the depth intervals divided by the total number of hammer blows analyzed. The overall average energy transfer of the SPT system (for all the depth intervals tested) was 298.6 foot-pounds, with an average ETR of 85.3%.

Attachments: Page 4 Table 1 - Summary of SPT Energy Measurements – 1 Page
Pages 5-6 Work Instruction No. 8 – DCN:NAP-077 – 2 Pages (without attachments)
Page 7 Record of SPT Energy Measurement – 1 Page
Pages 8 – 13 PDIPLOT Output – 6 Pages
Page 14 Force-Velocity Plot – 1 Page

TABLE 1
SUMMARY OF SPT ENERGY MEASUREMENTS (ASTM D4633-05)
North Anna 3 Project
Louisa County, Virginia
MACTEC Project No. 6468-09-2473

Automatic Hammer Serial Number and Rig Model	Rig Owner	Rig Operator	Boring No. Tested	Date Tested	Drill Rod Size	Sample Depth (feet)	SPT Blow Count (blows per six inches)	No. of Blows Analyzed	Average Measured Energy (Average EFV)[a] (ft-lbs)	Energy Transfer Ratio (%)[b] (Average ETR)
MEC-425 (CME 55 Trailer)	MACTEC Raleigh	Phil Pitts	M-11	9/2/2009	AW-J	33.9 - 35.4	5 - 6 - 6	17	278	79.4%
						38.9 - 40.4	4 - 7 - 8	20	304	86.9%
						43.9 - 45.4	6 - 7 - 8	21	310	88.6%
							Average for Rig:		**298.6**	**85.3%**

[a]Measured Energy is energy based on the EFV method, as outlined in ASTM D4633-05, for each blow recorded by the PDA. In some cases, the initial and final one to two blows produced poor quality data, and were not used to calculate the Average Measured Energy. This may result in more or less blows evaluated for ETR than what is shown on the boring logs.

EFV = EMX * 1000 lbs/kip, where EMX equals the maximum transferred energy measured by the PDA (see attached PDA data).

[b]Energy Transfer Ratio is the Measured Energy divided by the theoretical SPT energy of 350 foot-pounds (140 pound hammer falling 2.5 feet).

The average EFV and ETR values may differ slightly and insignificantly from those in the PDIPLOT tables due to roundoff.

Prepared By: JNH	Date: 12/2/09		Checked By: [signature]	Date: 12-2-09

Work Instruction No. 8
North Anna 3 Project
MACTEC Engineering and Consulting, Inc.
Project Number: 6468-09-2473

Issued To: Jonathan Honeycutt, Steve Kiser Rev. No. 0

Issued By: D. Steven Copley, P.E. DSC 8-31-09 Date: August 31, 2009

Valid From: August 31, 2009 To: August 31, 2010

Task Description: Perform SPT Energy Measurements

Applicable Technical Procedures or Plans, or other reference:

1. Geotechnical Work Plan (complete copy of current revision available at Field Office), Section 4.2 and Attachment 2 – Drilling and Sampling Procedures (attached)
2. Engineering Specification for Subsurface Investigation and Laboratory Testing, No. 25161-500-3PS-CY00-Q0001, Rev. 000, Issued for use August 21, 2009, Section 3.3 Drilling Equipment (attached)
3. ASTM D 4633-05 (attached)

Specific Instructions (note attachments where necessary): Perform energy measurements for each drill rig on site in general accordance with ASTM D 4633-05. Consult with Site Manager as to schedule for performing the measurements. Hammer weights have been checked, and records will be available on site. All rigs are using automatic hammer systems. Confirm that automatic hammer system is being operated within manufacturer's recommendations or in a typical operating fashion as observed from watching one or two SPT measurements prior to measuring energy. Check each drill rig using all hammer/rod combinations that it will be using. Depths for measurements should be coordinated with the Site Manager. See Site Manager for current boring logs of holes drilled, if available, and use these to plan most effective field measurement program. Submit copies of calibration records for equipment to Principal Professional for review prior to beginning work on site.

Confirm with Site Manager that approval of equipment calibration records have been received prior to beginning field testing. If unexpected conditions are encountered that affect measurements, contact Site Manager or Principal Professional immediately.

Report Format: Prepare standard report in accordance with ASTM D 4633-05 requirements.

Specific Quality Assurance Procedures Applicable: 10CFR21; NQAP 16-01 Procedure For Conforming To Federal Regulation 10CFR21; QAP 20-1; QAP 25-1; Section 306 of the Energy Reorganization Act of 1974. Current revisions apply; copies available in Field Office.

Hold Points or Witness Points: None

Records: All records generated shall be considered QA Records.

Reviewed and Approved By (Note: Only one signature required for issuance):

Project Manager: ______________________ Date: ______________

Principal Professional: D. Aaron Copley Date: 8-31-09

Site Manager: ______________________ Date: ______________

No. of Pages: 15 DCN: NAP077

QA Form 24-1 Revised 8/12/2009

MACTEC

2801 YORKMONT ROAD, SUITE 100 □ CHARLOTTE, NC 28208
Telephone: (704) 357-8600 / Facsimile: (704) 357-8638

RECORD OF SPT ENERGY MEASUREMENT

GENERAL INFORMATION		DRILL RIG DATA	
PROJECT:	North Anna 3 Project	MAKE:	CME
LOCATION:	Virginia	MODEL:	55-trailer mounted
PROJECT NO.:	6468-09-2473	SERIAL NO.:	MEC 425
DATE:	9/2/2009	HAMMER TYPE:	Auto
WEATHER:	Sunny 65°F	ROPE CONDITION:	N/A
INSPECTOR:	JNH	ROD SIZE:	AW-J
DRILLING COMPANY:	MACTEC - Raleigh	NO. OF SHEAVES:	N/A

BORING DATA

BORING NUMBER:	M-11		
DEPTH DRILLED:	Various		
TIME DRIVEN:	10:05 AM - 11:15 AM		
RIG OPERATOR:	P. Pitts		
HAMMER OPERATOR:	N/A		
PDA PAK SERIAL NO.:	3622L		
INSTR. ROD AREA:	1.22 in²		
ACCEL. SERIAL NOS.:	A1-K983 : A2-K0686		
STRAIN SERIAL NOS.:	75AW#1/2		

SAMPLE DEPTH (feet)	SPT N-VALUE (bpf)
23.9-25.4	6-8-8
28.9-30.4	6-11-12
33.9-35.4	5-6-6
~~38.4~~ 38.9' -40.4	4-7-8
43.9-45.4	6-7-8

JNH 9/2/09

REMARKS: Testing performed in accordance with ASTM D 4633-05

Reviewed By:

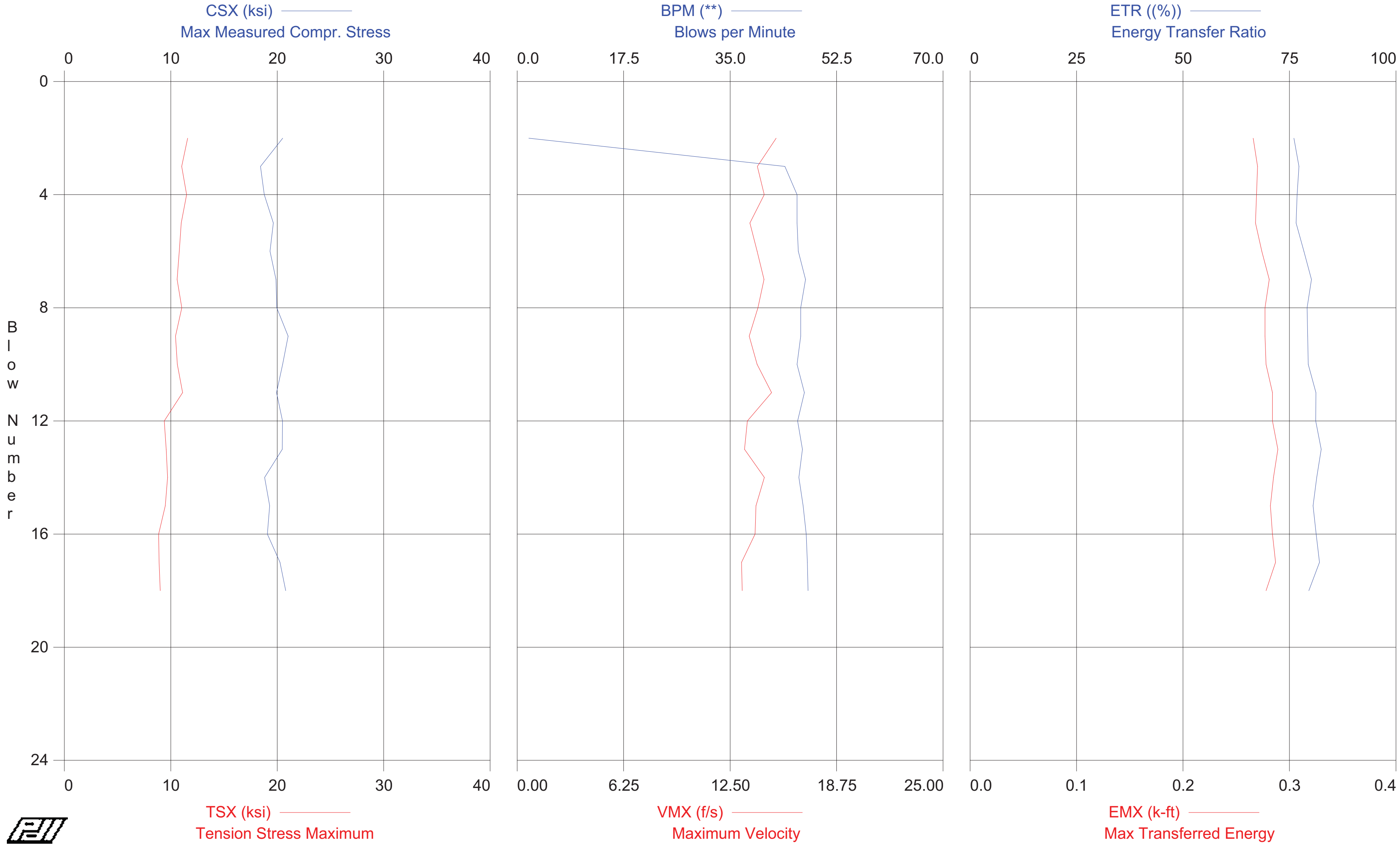
REV. 0

MACTEC Engineering and Consulting, Inc. - Case Method Results

PDIPLOT Ver. 2008.1 - Printed: 2-Dec-2009

Test date: 2-Sep-2009

NORTH ANNA 3 Project - BORING M-11 (33.9' - 35.4' sample))



NORTH ANNA 3 Project - BORING M-11 (33.9' - 35.4' sample)) — Rig Serial No. MEC-425; CME 55 TRAILER (RAL) (P.Pitts)
OP: JNH — Test date: 2-Sep-2009

AR: 1.22 in^2 — SP: 0.492 k/ft3
LE: 39.40 ft — EM: 30,000 ksi
WS: 16,807.9 f/s — JC: 0.70

CSX: Max Measured Compr. Stress
TSX: Tension Stress Maximum
VMX: Maximum Velocity
FMX: Maximum Force
FVP: Force/Velocity proportionality
BPM: Blows per Minute
EF2: Energy of F^2
ETR: Energy Transfer Ratio
EMX: Max Transferred Energy

BL#	CSX	TSX	VMX	FMX	FVP	BPM	EF2	ETR	EMX
	ksi	ksi	f/s	kips	[]	**	k-ft	(%)	k-ft
2	20.5	11.6	15.2	25	0.9	1.9	0.217	76.1	0.266
3	18.4	11.0	14.1	22	0.8	44.0	0.221	77.2	0.270
4	18.8	11.5	14.5	23	0.8	46.0	0.217	76.8	0.269
5	19.6	11.0	13.7	24	0.8	46.0	0.221	76.5	0.268
6	19.3	10.8	14.1	24	0.8	46.2	0.224	78.4	0.274
7	19.9	10.6	14.5	24	0.8	47.4	0.219	80.2	0.281
8	20.0	11.0	14.1	24	0.8	46.6	0.219	79.1	0.277
9	21.0	10.4	13.6	26	0.9	46.6	0.221	79.3	0.277
10	20.5	10.6	14.1	25	0.8	46.0	0.220	79.4	0.278
11	19.9	11.1	14.9	24	0.7	47.2	0.221	81.2	0.284
12	20.5	9.4	13.5	25	0.9	46.1	0.220	81.2	0.284
13	20.5	9.6	13.3	25	0.9	46.9	0.222	82.4	0.289
14	18.8	9.7	14.5	23	0.7	46.3	0.224	81.4	0.285
15	19.3	9.5	14.0	24	0.8	47.0	0.224	80.5	0.282
16	19.1	8.9	14.0	23	0.7	47.5	0.228	81.3	0.284
17	20.3	8.9	13.2	25	0.7	47.7	0.224	82.0	0.287
18	20.8	9.0	13.2	25	0.9	47.8	0.222	79.5	0.278
Average	19.8	10.3	14.0	24	0.8	44.0	0.221	79.6	0.278

Total number of blows analyzed: 17

Time Summary

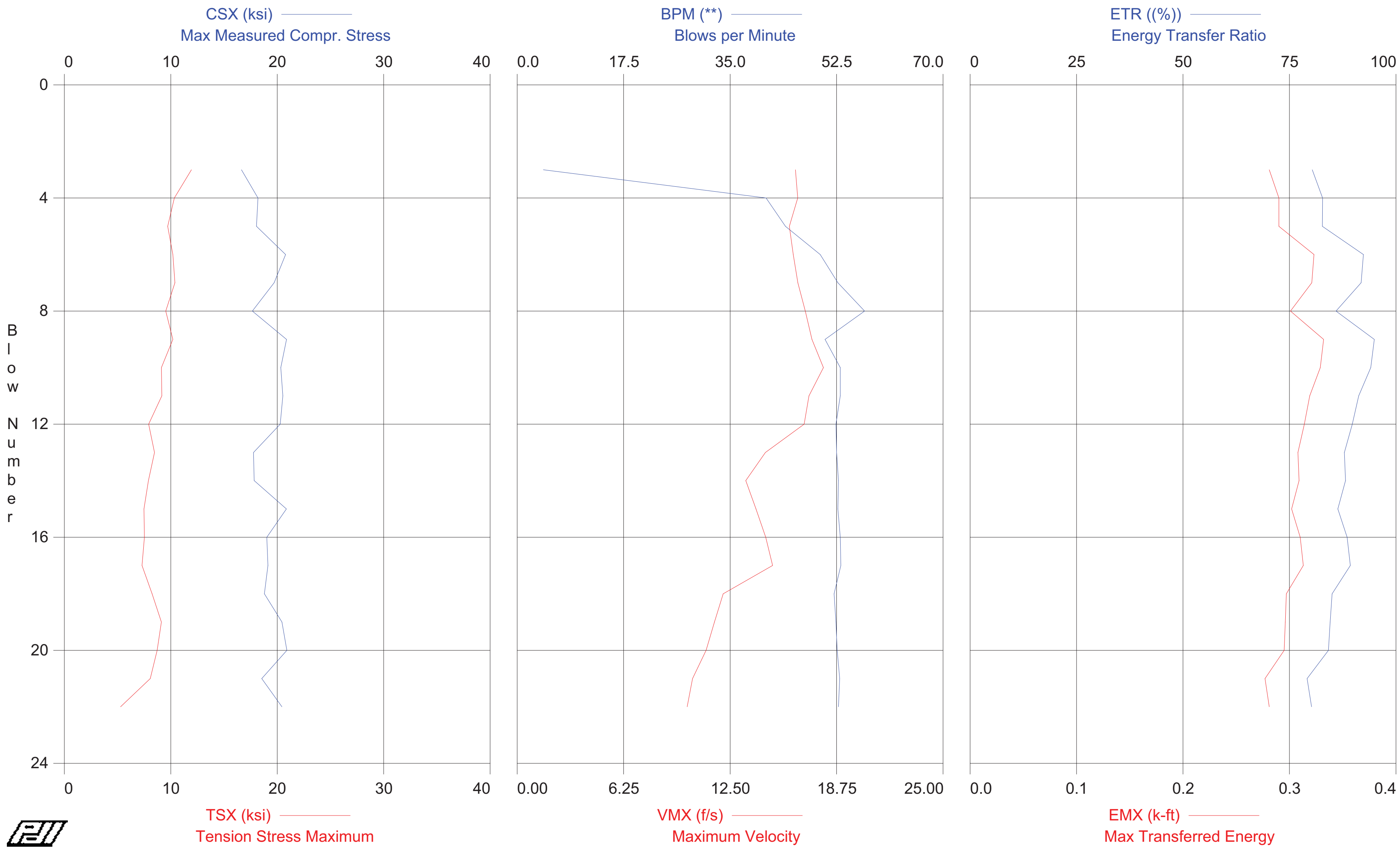
Drive 27 seconds 10:44:52 AM - 10:45:19 AM (9/2/2009) BN 1 - 18

PDIPLOT Ver. 2008.1 - Printed: 2-Dec-2009

MACTEC Engineering and Consulting, Inc. - Case Method Results

Test date: 2-Sep-2009

NORTH ANNA 3 Project - BORING M-11 (38.9' - 40.4' sample)



NORTH ANNA 3 Project - BORING M-11 (38.9' - 40.4' sample) Rig Serial No. MEC-425; CME 55 TRAILER (RAL) (P.Pitts)
OP: JNH Test date: 2-Sep-2009

AR: 1.22 in^2 SP: 0.492 k/ft3
LE: 44.40 ft EM: 30,000 ksi
WS: 16,807.9 f/s JC: 0.70

CSX: Max Measured Compr. Stress
TSX: Tension Stress Maximum
VMX: Maximum Velocity
FMX: Maximum Force
FVP: Force/Velocity proportionality
BPM: Blows per Minute
EF2: Energy of F^2
ETR: Energy Transfer Ratio
EMX: Max Transferred Energy

BL#	CSX	TSX	VMX	FMX	FVP	BPM	EF2	ETR	EMX
	ksi	ksi	f/s	kips	[]	**	k-ft	(%)	k-ft
3	16.6	11.9	16.3	20	0.6	4.3	0.202	80.4	0.281
4	18.2	10.3	16.5	22	0.6	40.9	0.203	82.8	0.290
5	18.1	9.7	16.0	22	0.6	44.1	0.207	82.7	0.290
6	20.8	10.2	16.2	25	0.4	49.8	0.233	92.4	0.323
7	19.7	10.4	16.5	24	0.7	52.7	0.227	91.8	0.321
8	17.7	9.5	16.9	22	0.6	57.1	0.212	85.9	0.301
9	20.9	10.2	17.3	25	0.4	50.6	0.231	94.9	0.332
10	20.3	9.1	18.0	25	0.5	53.1	0.230	94.1	0.329
11	20.5	9.2	17.1	25	0.4	53.1	0.228	91.3	0.319
12	20.3	7.9	16.8	25	0.5	52.4	0.229	89.7	0.314
13	17.8	8.5	14.6	22	0.7	52.5	0.226	87.9	0.308
14	17.8	7.9	13.4	22	0.4	52.8	0.227	88.2	0.309
15	20.9	7.5	14.0	25	0.5	52.7	0.229	86.3	0.302
16	19.0	7.5	14.6	23	0.4	53.1	0.222	88.5	0.310
17	19.1	7.3	15.0	23	0.4	53.2	0.220	89.3	0.313
18	18.8	8.2	12.1	23	0.5	52.1	0.224	85.0	0.297
19	20.4	9.1	11.6	25	0.6	52.4	0.227	84.6	0.296
20	20.9	8.7	11.1	26	0.6	52.6	0.229	84.2	0.295
21	18.5	8.1	10.3	23	0.5	53.0	0.217	79.2	0.277
22	20.4	5.3	10.0	25	0.7	52.8	0.212	80.2	0.281
Average	19.3	8.8	14.7	24	0.5	49.3	0.222	87.0	0.304

Total number of blows analyzed: 20

Time Summary

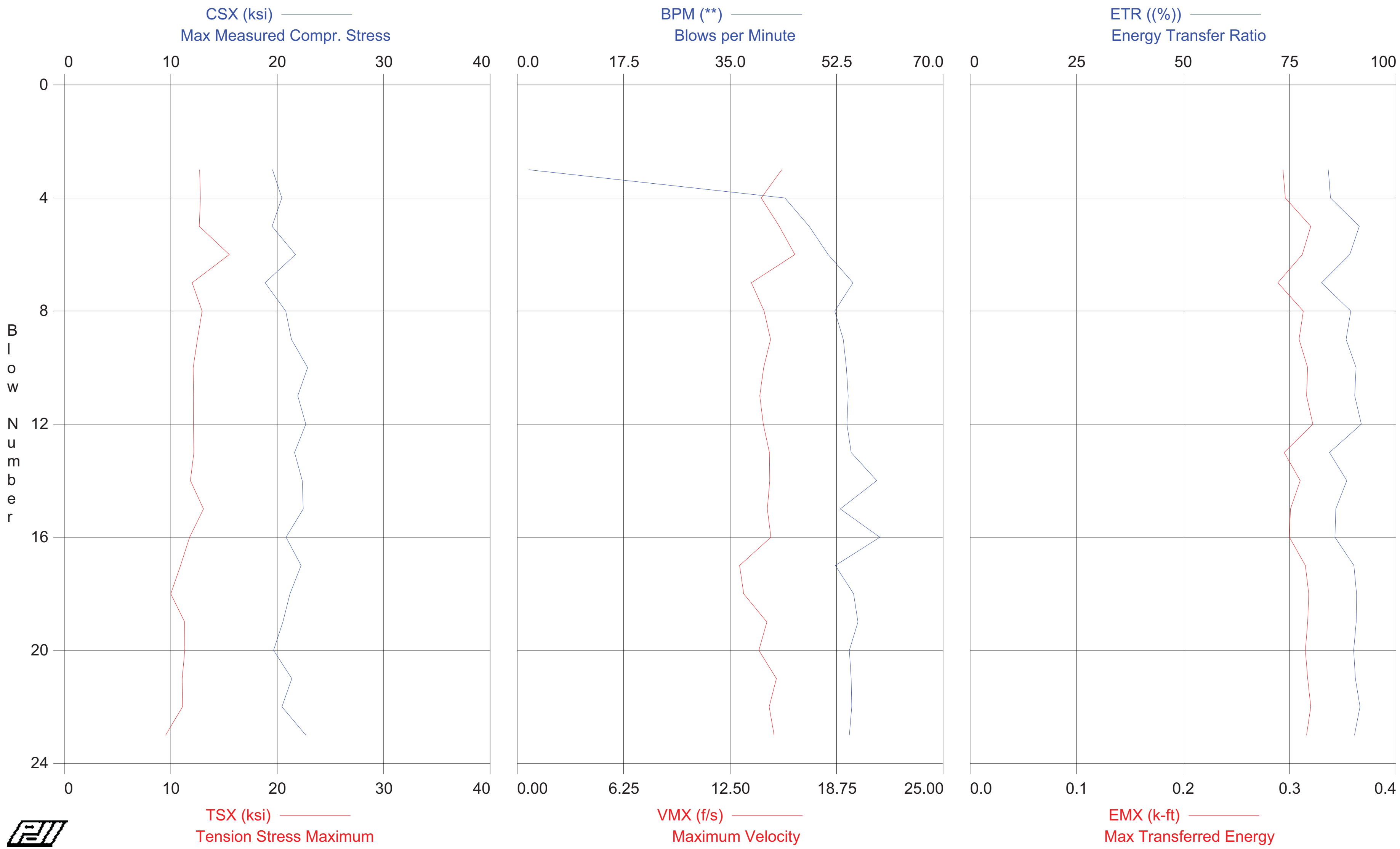
Drive 1 minute 24 seconds 10:54:32 AM - 10:55:56 AM (9/2/2009) BN 1 - 22

Volume 1, Revision 0

Page 254 of 542

DCN NAP307

NORTH ANNA 3 Project - BORING M-11 (43.9' - 45.4' sample)



NORTH ANNA 3 Project - BORING M-11 (43.9' - 45.4' sample)
OP: JNH
Rig Serial No. MEC-425; CME 55 TRAILER (RAL) (P.Pitts)
Test date: 2-Sep-2009

AR: 1.22 in^2
LE: 49.40 ft
WS: 16,807.9 f/s
SP: 0.492 k/ft3
EM: 30,000 ksi
JC: 0.70

CSX: Max Measured Compr. Stress
TSX: Tension Stress Maximum
VMX: Maximum Velocity
FMX: Maximum Force
FVP: Force/Velocity proportionality
BPM: Blows per Minute
EF2: Energy of F^2
ETR: Energy Transfer Ratio
EMX: Max Transferred Energy

BL#	CSX	TSX	VMX	FMX	FVP	BPM	EF2	ETR	EMX
	ksi	ksi	f/s	kips	[]	**	k-ft	(%)	k-ft
3	19.6	12.7	15.5	24	0.8	1.9	0.237	84.1	0.294
4	20.4	12.8	14.3	25	0.8	44.0	0.235	84.6	0.296
5	19.5	12.7	15.4	24	0.8	48.0	0.259	91.4	0.320
6	21.7	15.5	16.3	26	0.9	51.1	0.245	89.2	0.312
7	18.9	12.0	13.7	23	0.8	55.2	0.234	82.5	0.289
8	20.8	12.9	14.5	25	0.8	52.2	0.255	89.4	0.313
9	21.3	12.5	14.9	26	0.8	53.6	0.252	88.3	0.309
10	22.9	12.1	14.5	28	0.9	54.1	0.259	90.6	0.317
11	21.9	12.1	14.2	27	0.9	54.4	0.259	90.3	0.316
12	22.7	12.1	14.4	28	0.9	54.2	0.259	91.9	0.322
13	21.6	12.2	14.8	26	0.8	54.9	0.244	84.4	0.295
14	22.3	11.8	14.8	27	0.8	59.1	0.255	88.5	0.310
15	22.4	13.1	14.7	27	0.9	53.1	0.242	85.9	0.301
16	20.8	11.8	14.9	25	0.8	59.6	0.241	85.7	0.300
17	22.2	10.9	13.1	27	1.0	52.3	0.257	90.1	0.315
18	21.2	10.0	13.3	26	0.8	55.3	0.256	90.8	0.318
19	20.5	11.3	14.7	25	0.8	56.0	0.257	90.7	0.317
20	19.7	11.3	14.2	24	0.8	54.6	0.251	90.1	0.315
21	21.4	11.1	15.2	26	0.8	54.9	0.249	90.5	0.317
22	20.4	11.1	14.8	25	0.8	55.0	0.257	91.6	0.320
23	22.7	9.5	15.1	28	0.8	54.6	0.259	90.3	0.316
Average	21.2	12.0	14.6	26	0.8	51.3	0.251	88.6	0.310

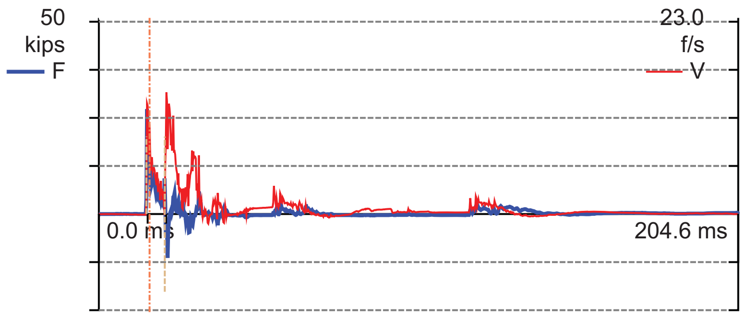
Total number of blows analyzed: 21

Time Summary

Drive 1 minute 7 seconds 11:05:53 AM - 11:07:00 AM (9/2/2009) BN 1 - 23

Project: NORTH ANNA 3
Pile: BORING M-11 (43.9-45.4) - Description: CME 55 TRAILER(P.PITTS)
Operator: JNH

BN 11
9/2/2009 11:06:47 AM



LP	0.00	ft	LE	49.40	ft
CSX	21.9	ksi	AR	1.22	in^2
CSI	22.6	ksi	EM	30,000.0	ksi
TSX	12.1	ksi	SP	0.492	k/ft3
EMX	0.316	k-ft	WS	16,807.9	f/s
STK	4.59	ft	WC	16,807.9	f/s
FVP	0.94	[]	JC	0.70	[]
SFR	1	kips	2L/c	5.88	ms
RX5	6	kips	EA/c	2.2	ksec/ft
RMX	4	kips	FR	5.000	kHz

MACTEC

Engineering and constructing a better tomorrow

December 2, 2009

From: Jon Honeycutt, Staff Professional JNH 12/2/09

Reviewed By: Steve Kiser, Principal Professional SK 12-2-09

Subject: **Report of SPT Energy – MACTEC CME 55-LC Track (RAL)**
Hammer Serial No. MEC-02 Automatic Hammer
WORK INSTRUCTION No. 8 (DCN:NAP-077)
North Anna 3 Project
Louisa County, Virginia
MACTEC Project No. 6468-09-2473

Jonathan Honeycutt, of MACTEC Engineering and Consulting, Inc. (MACTEC), performed energy measurements on the drill rig at the subject site per the referenced Work Instructions. This memorandum summarizes the field testing activities and presents the results of the energy measurements.

SPT Energy Field Measurements

SPT energy measurements were made on September 1, 2009, during drilling of Boring M-10(DH) at the referenced site. The testing was performed by Jonathan Honeycutt from approximately 2:30 PM to 4:00 PM on September 1 under clear skies with a temperature of about 75 degrees Fahrenheit. The boring was drilled by MACTEC personnel using equipment from the MACTEC Raleigh office. The drilling equipment consisted of a CME 55-LC model track drill rig with an SPT automatic hammer. The drilling tools consisted of AW-J-sized drilling rods and a 2-foot long split-barrel sampler. Mud rotary drilling techniques were used to advance the boring at the time of energy testing. The drill rig operator during sampling was Mr. David White. Energy measurements were recorded during sampling at the depth intervals shown in Table 1.

The energy measurements were performed with a Pile Driving Analyzer (PDA) model PAX (Serial No. 3622L), and calibrated accelerometers (Serial Nos. K983 and K0686) and strain gages (Serial Nos. AW#75/1 and AW#75/2). A steel drill rod, 2 feet long and instrumented with dedicated strain gages, was inserted at the top of the drill rod string immediately below the SPT hammer. The inserted rod was also instrumented with two piezoresistive accelerometers that were bolted to the outside of the rod. The instrumented rod was two feet below the hammer impact point and had a cross-sectional area of approximately 1.22 square inches and an outside diameter of approximately 1.75 inches at the gage location. The drill rods included in the drill rod string were hollow rods in 5 to 10 foot long sections, with an outside and inside diameter of approximately 1.75 and 1.375 inches, respectively. The recommended operation rate of the hammer is not known. Due to the closed hammer system, the hammer lubrication condition and anvil dimensions could not be observed.

18 Pages Total

MACTEC Engineering and Consulting, Inc.
2801 Yorkmont Road, Suite 100 • Charlotte, NC 28208 • Phone: 704.357.8600

www.mactec.com

Calibration Records

The calibration records for all the above are filed in DCN NAP-223.

Calculations for EFV

The work was done in accordance with ASTM D 4633-05. The strain and acceleration signals were converted to force and velocity by the PDA. The maximum energy transmitted to the drill rod string (EFV), as measured at the location of the strain gages and accelerometers, was calculated by the PDA using the equation shown below:

$$EFV = \int F(t) * V(t) * dt$$

Where: EFV = Transferred energy (EFV equation), or Energy of FV
F(t) = Calculated force at time t
V(t) = Calculated velocity at time t

As recommended by ASTM D4633-05, the force-velocity method of energy calculation was used. The equation shown above for calculating EFV, integrated over the complete wave event, measures the total energy content of the event using both force and velocity measurements. The EFV values associated with each blow analyzed are tabulated in the attached PDIPLOT tables and are also shown graphically in the PDIPLOT charts.

Calculations for ETR

The ratio of the measured transferred energy (EFV) to the theoretical potential energy of the SPT system (140 lb weight with the specified 30 inch fall) is the ETR. The ETR values (as percent of the theoretical value) are shown in Table 1.

Comparison of ETR to Typical Energy Transfer Ratio Range

Based on a research report published by the Florida Department of Transportation (FDOT) (Report WPI No. 0510859, 1999), the average ETR measured for automatic hammers is 79.6%. The standard deviation was 7.9%; therefore, the range of ETRs within one standard deviation of the average was reported to be 71.7% to 87.5%. This range of ETRs was also consistent with other research that was cited in the FDOT research paper; however, maximum and minimum ETR values of up to 98% and 56%, respectively, were reported in the literature. The ETR values shown in Table 1 are generally within the range of typical values for automatic hammers as reported in the literature.

Discussion

Based on the field testing results, observations from the SPT energy measurements are summarized below:

- The data obtained by the PDA are generally consistent between individual hammer blows and between the sample depths tested. In general, the first and last one (and sometimes two or more) hammer blow records recorded by the PDA produced poor quality data (which is relatively common) and, as such, the record(s) was(were) not

used in the data reduction. This may result in more or less hammer blows evaluated for ETR than what is shown on the boring logs.

- The average energy transferred from the hammer to the drill rods for each individual depth interval using the EFV method ranged from 275 foot-pounds to 302 foot-pounds. These average energy transfers correspond to energy transfer ratios (ETR) of 78.6% to 86.3% of the theoretical energy (350 foot-pounds) of the SPT hammer.

- The average at each depth interval was calculated as the transferred energy for each analyzed blow of the depth intervals divided by the total number of hammer blows analyzed. The overall average energy transfer of the SPT system (for all the depth intervals tested) was 283.6 foot-pounds, with an average ETR of 81.0%.

Attachments: Page 4 Table 1 - Summary of SPT Energy Measurements – 1 Page
Page 5 - 6 Work Instruction No. 8 DCN:NAP 077– 2 Pages (without attachments)
Pages 7 Record of SPT Energy Measurement – 1 Page
Pages 8 – 17 PDIPLOT Output – 10 Pages
Page 18 Force-Velocity Plot – 1 Page

TABLE 1

SUMMARY OF SPT ENERGY MEASUREMENTS (ASTM D4633-05)

North Anna 3 Project

Louisa County, Virginia

MACTEC Project No. 6468-09-2473

Automatic Hammer Serial Number and Rig Model	Rig Owner	Rig Operator	Boring No. Tested	Date Tested	Drill Rod Size	Sample Depth (feet)	SPT Blow Count (blows per six inches)	No. of Blows Analyzed	Average Measured Energy (Average EFV)[a] (ft-lbs)	Energy Transfer Ratio (%)[b] (Average ETR)
MEC-02 (CME 55-LC Track)	MACTEC Raleigh	David White	M-10 (DH)	9/1/2009	AW-J	11.7 - 13.2	3 - 4 - 5	9	302	86.3%
						14.3 - 15.8	4 - 3 - 5	12	280	80.0%
						19.2 - 20.7	4 - 4 - 5	13	275	78.6%
						24.2 - 25.7	2 - 3 - 4	9	280	80.0%
						29.2 - 30.7	2 - 3 - 5	10	286	81.7%
								Average for Rig:	**283.6**	**81.0%**

[a]Measured Energy is energy based on the EFV method, as outlined in ASTM D4633-05, for each blow recorded by the PDA. In some cases, the initial and final one to two blows produced poor quality data, and were not used to calculate the Average Measured Energy. This may result in more or less blows evaluated for ETR than what is shown on the boring logs.

EFV = EMX * 1000 lbs/kip, where EMX equals the maximum transferred energy measured by the PDA (see attached PDA data).

[b]Energy Transfer Ratio is the Measured Energy divided by the theoretical SPT energy of 350 foot-pounds (140 pound hammer falling 2.5 feet).

The average EFV and ETR values may differ slightly and insignificantly from those in the PDIPLOT tables due to roundoff.

Prepared By: JWH	Date: 12/2/09		Checked By: SLW	Date: 12-2-09

Work Instruction No. 8
North Anna 3 Project
MACTEC Engineering and Consulting, Inc.
Project Number: 6468-09-2473

Issued To: Jonathan Honeycutt, Steve Kiser Rev. No. 0

Issued By: D. Steven Copley, P.E. DSC 8-31-09 Date: August 31, 2009

Valid From: August 31, 2009 To: August 31, 2010

Task Description: Perform SPT Energy Measurements

Applicable Technical Procedures or Plans, or other reference:

1. Geotechnical Work Plan (complete copy of current revision available at Field Office), Section 4.2 and Attachment 2 – Drilling and Sampling Procedures (attached)
2. Engineering Specification for Subsurface Investigation and Laboratory Testing, No. 25161-500-3PS-CY00-Q0001, Rev. 000, Issued for use August 21, 2009, Section 3.3 Drilling Equipment (attached)
3. ASTM D 4633-05 (attached)

Specific Instructions (note attachments where necessary): Perform energy measurements for each drill rig on site in general accordance with ASTM D 4633-05. Consult with Site Manager as to schedule for performing the measurements. Hammer weights have been checked, and records will be available on site. All rigs are using automatic hammer systems. Confirm that automatic hammer system is being operated within manufacturer's recommendations or in a typical operating fashion as observed from watching one or two SPT measurements prior to measuring energy. Check each drill rig using all hammer/rod combinations that it will be using. Depths for measurements should be coordinated with the Site Manager. See Site Manager for current boring logs of holes drilled, if available, and use these to plan most effective field measurement program. Submit copies of calibration records for equipment to Principal Professional for review prior to beginning work on site.

Confirm with Site Manager that approval of equipment calibration records have been received prior to beginning field testing. If unexpected conditions are encountered that affect measurements, contact Site Manager or Principal Professional immediately.

Report Format: Prepare standard report in accordance with ASTM D 4633-05 requirements.

Specific Quality Assurance Procedures Applicable: 10CFR21; NQAP 16-01 Procedure For Conforming To Federal Regulation 10CFR21; QAP 20-1; QAP 25-1; Section 306 of the Energy Reorganization Act of 1974. Current revisions apply; copies available in Field Office.

Hold Points or Witness Points: None

Records: All records generated shall be considered QA Records.

Reviewed and Approved By (Note: Only one signature required for issuance):

Project Manager: ______________________ Date: ______________________

Principal Professional: D. Aaron Copley Date: 8-31-09

Site Manager: ______________________ Date: ______________________

No. of Pages: 15

DCN: NAP077

QA Form 24-1 Revised 8/12/2009

MACTEC

2801 YORKMONT ROAD, SUITE 100 □ CHARLOTTE, NC 28208
Telephone: (704) 357-8600 / Facsimile: (704) 357-8638

RECORD OF SPT ENERGY MEASUREMENT

GENERAL INFORMATION		DRILL RIG DATA	
PROJECT:	North Anna 3 Project	MAKE:	CME
LOCATION:	Virginia	MODEL:	55LC TRACK
PROJECT NO.:	6468-09-2473	SERIAL NO.:	MEC-02
DATE:	9/1/2009	HAMMER TYPE:	Auto
WEATHER:	Sunny 75°F	ROPE CONDITION:	N/A
INSPECTOR:	JNH	ROD SIZE:	AW-J
DRILLING COMPANY:	MACTEC - Raleigh	NO. OF SHEAVES:	N/A

BORING DATA

BORING NUMBER:	M-10 (DH)										
DEPTH DRILLED:	Various										
TIME DRIVEN:	2:30pm - 4:00pm										
RIG OPERATOR:	D. WHITE										
HAMMER OPERATOR:	N/A										
PDA PAK SERIAL NO.:	3622L										
INSTR. ROD AREA:	1.22 IN²										
ACCEL. SERIAL NOS.:	A1-K983 ; A2-K0686										
STRAIN SERIAL NOS.:	75AW #1/2										
	SAMPLE DEPTH (feet)	SPT N-VALUE (bpf)									
	11.7-13.2	3-4-5									
	14.3-15.8	4-3-5									
	19.2-20.7	4-4-5									
	24.2-25.7	2-3-4									
	29.2-30.7	2-3-5									

REMARKS: Testing performed in accordance with ASTM D 4633-05

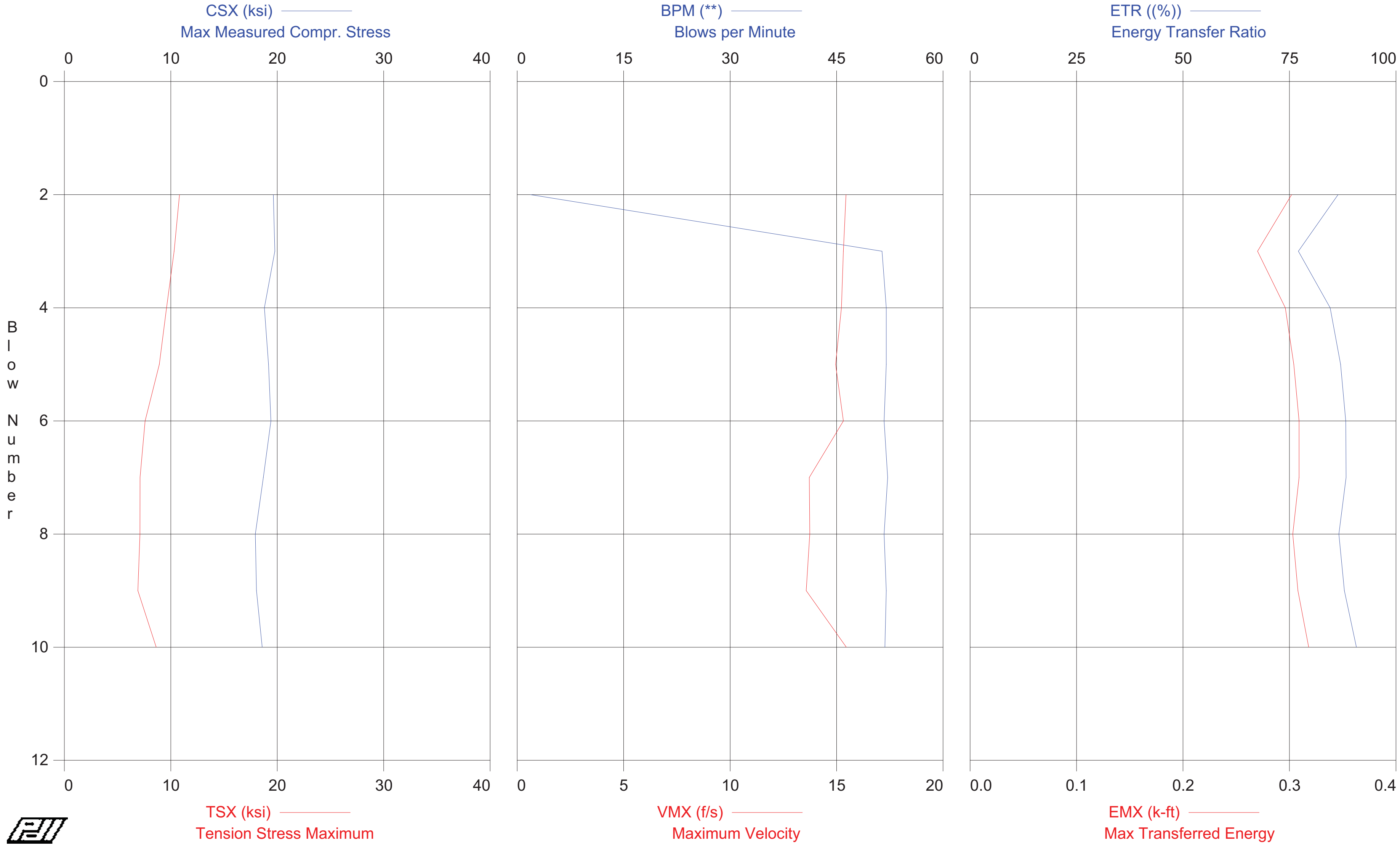
Reviewed By:

MACTEC Engineering and Consulting, Inc. - Case Method Results

PDIPLOT Ver. 2008.1 - Printed: 2-Dec-2009

Test date: 1-Sep-2009

NORTH ANNA 3 Project - Boring M-10(DH) (11.7' - 13.2' sample)



NORTH ANNA 3 Project - Boring M-10(DH) (11.7' - 13.2' sample)
OP: JNH

Rig Serial No. MEC-02; CME 55LC (RAL) (D.White)
Test date: 1-Sep-2009

AR: 1.22 in^2
LE: 17.50 ft
WS: 16,807.9 f/s

SP: 0.492 k/ft3
EM: 30,000 ksi
JC: 0.70

CSX: Max Measured Compr. Stress
TSX: Tension Stress Maximum
VMX: Maximum Velocity
FMX: Maximum Force
FVP: Force/Velocity proportionality

BPM: Blows per Minute
EF2: Energy of F^2
ETR: Energy Transfer Ratio
EMX: Max Transferred Energy

BL#	CSX	TSX	VMX	FMX	FVP	BPM	EF2	ETR	EMX
	ksi	ksi	f/s	kips	[]	**	k-ft	(%)	k-ft
2	19.6	10.8	15.4	24	0.8	1.9	0.226	86.4	0.302
3	19.8	10.3	15.3	24	0.7	51.4	0.219	77.1	0.270
4	18.8	9.6	15.2	23	0.7	52.0	0.224	84.6	0.296
5	19.2	8.9	15.0	23	0.7	52.0	0.224	87.0	0.304
6	19.4	7.6	15.3	24	0.7	51.7	0.220	88.2	0.309
7	18.7	7.1	13.7	23	0.7	52.2	0.213	88.3	0.309
8	17.9	7.1	13.7	22	0.7	51.7	0.210	86.6	0.303
9	18.1	6.9	13.6	22	0.7	52.0	0.208	87.9	0.308
10	18.6	8.6	15.5	23	0.7	51.8	0.215	90.7	0.318
Average	18.9	8.6	14.7	23	0.7	46.3	0.218	86.3	0.302

Total number of blows analyzed: 9

Time Summary

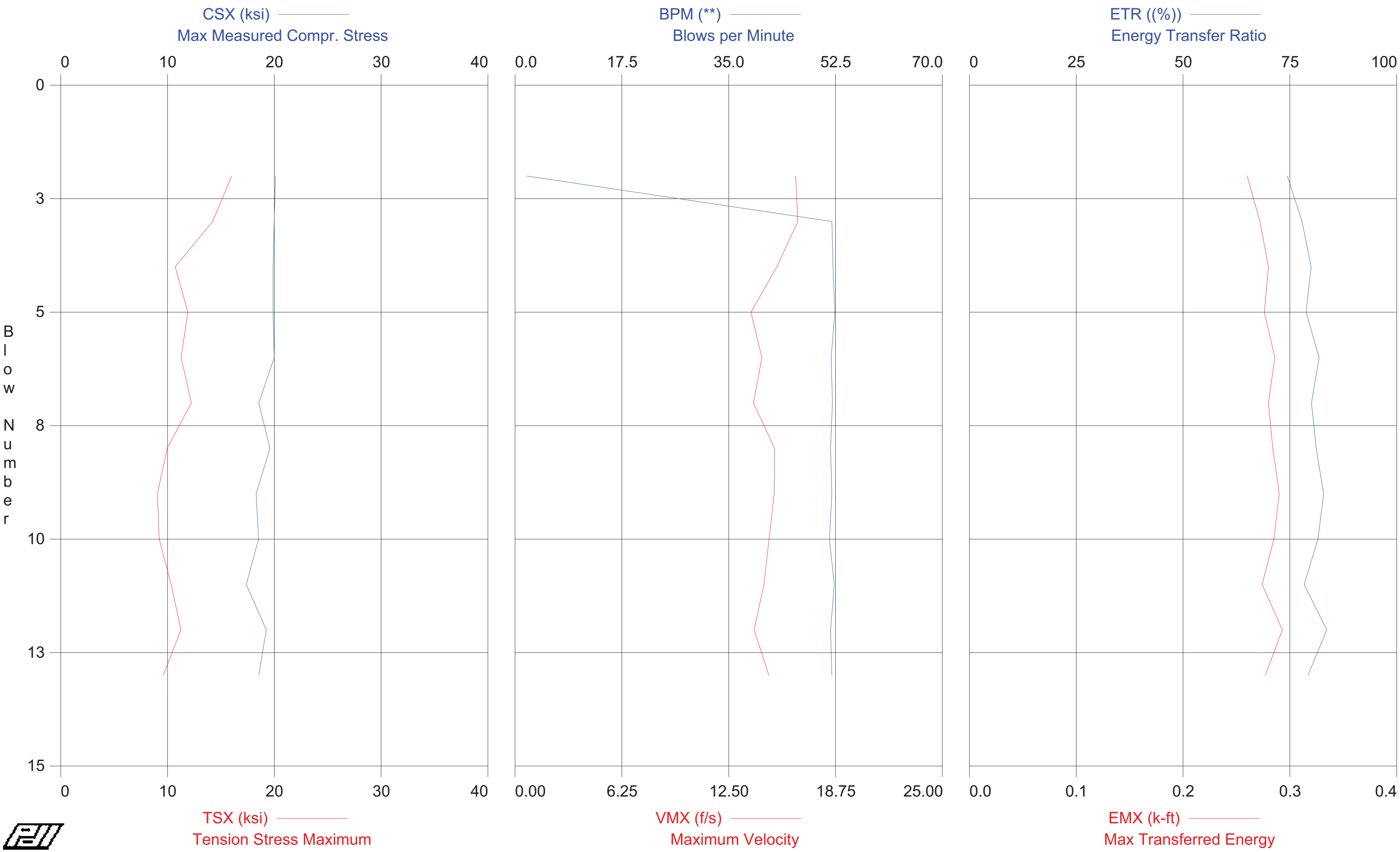
Drive 56 seconds 2:38:44 PM - 2:39:40 PM (9/1/2009) BN 1 - 10

MACTEC Engineering and Consulting, Inc. - Case Method Results

PDIPLOT Ver. 2008.1 - Printed: 2-Dec-2009

Test date: 1-Sep-2009

NORTH ANNA 3 Project - Boring M-10(DH) (14.3' - 15.8' sample)



Case Method Results PDIPLOT Ver. 2008.1 - Printed: 2-Dec-2009

NORTH ANNA 3 Project - Boring M-10(DH) (14.3' - 15.8' sample) Rig Serial No. MEC-02; CME 55LC (RAL) (D.White)
OP: JNH Test date: 1-Sep-2009

AR: 1.22 in^2 SP: 0.492 k/ft3
LE: 19.50 ft EM: 30,000 ksi
WS: 16,807.9 f/s JC: 0.70

CSX: Max Measured Compr. Stress
TSX: Tension Stress Maximum
VMX: Maximum Velocity
FMX: Maximum Force
FVP: Force/Velocity proportionality
BPM: Blows per Minute
EF2: Energy of F^2
ETR: Energy Transfer Ratio
EMX: Max Transferred Energy

BL#	CSX	TSX	VMX	FMX	FVP	BPM	EF2	ETR	EMX
	ksi	ksi	f/s	kips	[]	**	k-ft	(%)	k-ft
2	20.1	16.0	16.4	25	0.8	1.9	0.234	74.4	0.260
3	20.0	14.2	16.5	24	0.9	51.9	0.244	77.8	0.272
4	19.9	10.7	15.3	24	0.7	52.1	0.239	80.0	0.280
5	19.9	11.9	13.8	24	0.8	52.4	0.240	78.8	0.276
6	20.0	11.3	14.4	24	0.8	51.8	0.238	81.8	0.286
7	18.6	12.2	14.0	23	0.7	52.0	0.237	80.0	0.280
8	19.6	10.0	15.2	24	0.7	51.7	0.239	81.1	0.284
9	18.3	9.0	15.2	22	0.7	51.9	0.239	82.9	0.290
10	18.5	9.2	14.9	23	0.7	51.5	0.232	81.5	0.285
11	17.4	10.3	14.6	21	0.7	52.3	0.222	78.3	0.274
12	19.2	11.3	14.0	23	0.7	51.7	0.238	83.6	0.293
13	18.5	9.6	14.8	23	0.7	51.9	0.224	79.2	0.277
Average	19.2	11.3	14.9	23	0.7	47.8	0.235	80.0	0.280

Total number of blows analyzed: 12

Time Summary

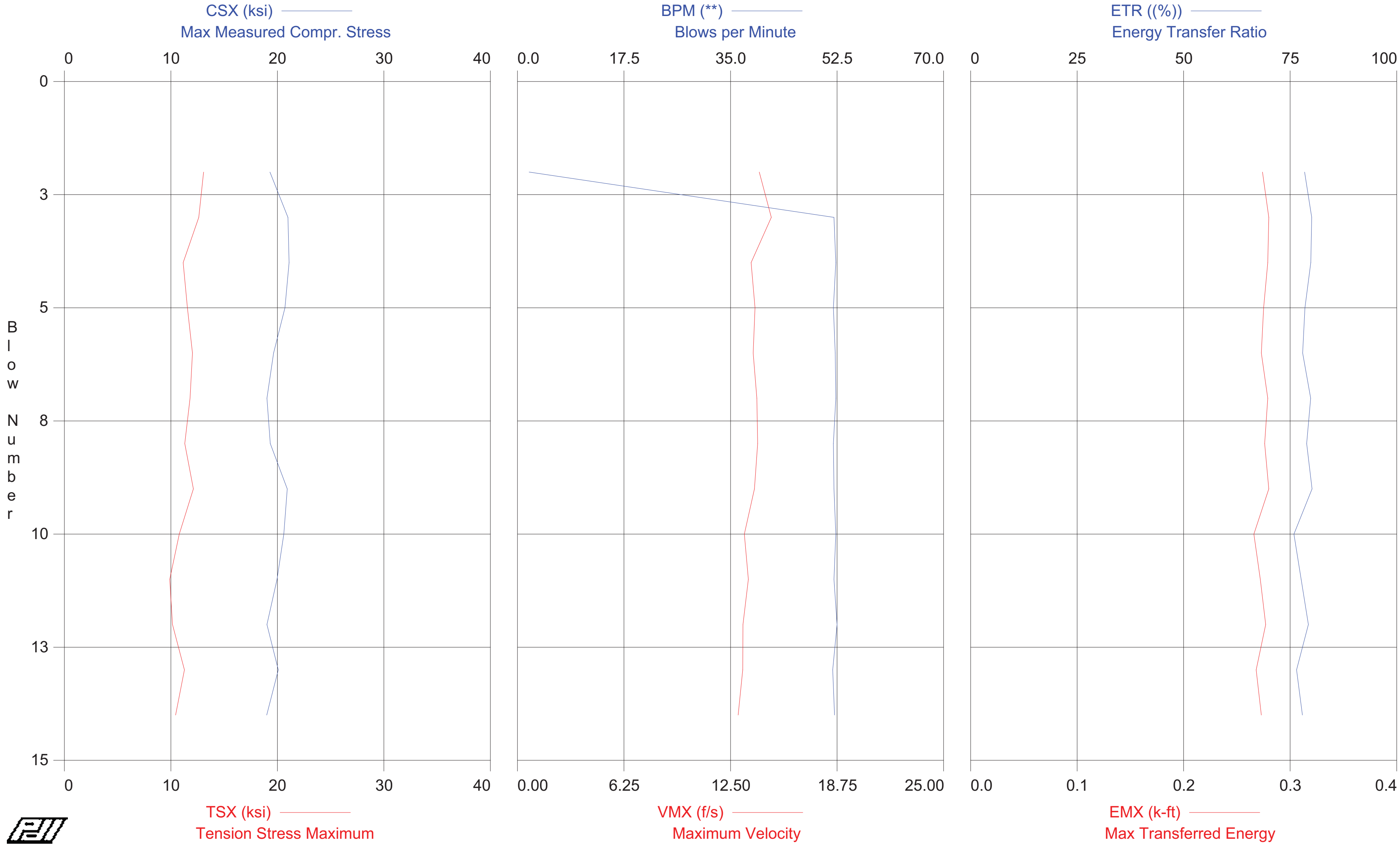
Drive 36 seconds 2:52:26 PM - 2:53:02 PM (9/1/2009) BN 1 - 13

MACTEC Engineering and Consulting, Inc. - Case Method Results

PDIPLOT Ver. 2008.1 - Printed: 2-Dec-2009

Test date: 1-Sep-2009

NORTH ANNA 3 Project - Boring M-10(DH) (19.2' - 20.7' sample)



NORTH ANNA 3 Project - Boring M-10(DH) (19.2' - 20.7' sample)
Rig Serial No. MEC-02; CME 55LC (RAL) (D.White)
OP: JNH
Test date: 1-Sep-2009

AR: 1.22 in^2
SP: 0.492 k/ft3
LE: 24.70 ft
EM: 30,000 ksi
WS: 16,807.9 f/s
JC: 0.70

CSX: Max Measured Compr. Stress
TSX: Tension Stress Maximum
VMX: Maximum Velocity
FMX: Maximum Force
FVP: Force/Velocity proportionality
BPM: Blows per Minute
EF2: Energy of F^2
ETR: Energy Transfer Ratio
EMX: Max Transferred Energy

BL#	CSX	TSX	VMX	FMX	FVP	BPM	EF2	ETR	EMX
	ksi	ksi	f/s	kips	[]	**	k-ft	(%)	k-ft
2	19.3	13.1	14.2	24	0.8	1.9	0.261	78.4	0.274
3	21.0	12.6	14.9	26	0.8	52.0	0.263	80.1	0.280
4	21.1	11.2	13.7	26	0.9	52.3	0.259	79.8	0.279
5	20.7	11.6	13.9	25	0.8	51.9	0.254	78.5	0.275
6	19.6	12.0	13.8	24	0.8	52.2	0.264	77.9	0.273
7	19.0	11.8	14.0	23	0.8	52.3	0.268	79.8	0.279
8	19.3	11.3	14.1	24	0.8	51.9	0.261	78.9	0.276
9	20.9	12.1	13.9	26	0.9	52.0	0.273	80.1	0.280
10	20.6	10.8	13.3	25	0.9	52.3	0.257	75.9	0.266
11	20.0	9.9	13.6	24	0.8	52.0	0.253	77.6	0.272
12	19.0	10.2	13.2	23	0.8	52.5	0.257	79.3	0.277
13	20.1	11.3	13.2	25	0.9	51.8	0.256	76.5	0.268
14	19.0	10.4	13.0	23	0.8	52.1	0.258	77.9	0.273
Average	20.0	11.4	13.8	24	0.8	48.2	0.260	78.5	0.275

Total number of blows analyzed: 13

Time Summary

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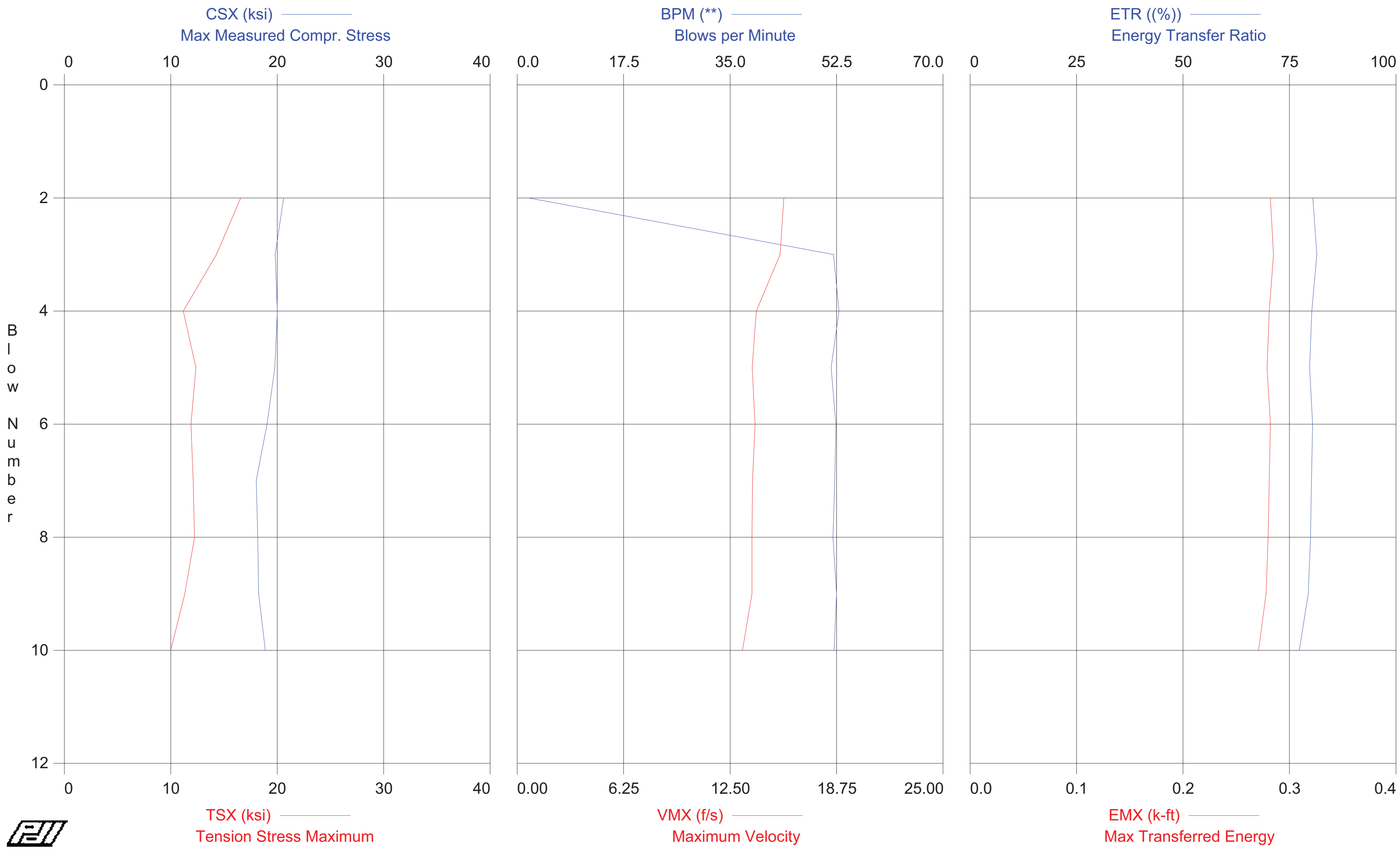
MACTEC Engineering and Consulting, Inc. - Case Method Results

PDIPLOT Ver. 2008.1 - Printed: 2-Dec-2009

Test date: 1-Sep-2009

NORTH ANNA 3 Project - Boring M-10(DH) (24.2' - 25.7' sample)



NORTH ANNA 3 Project - Boring M-10(DH) (24.2' - 25.7' sample) Rig Serial No. MEC-02; CME 55LC (RAL) (D.White)
OP: JNH Test date: 1-Sep-2009

AR: 1.22 in^2 SP: 0.492 k/ft3
LE: 29.70 ft EM: 30,000 ksi
WS: 16,807.9 f/s JC: 0.70

CSX: Max Measured Compr. Stress
TSX: Tension Stress Maximum
VMX: Maximum Velocity
FMX: Maximum Force
FVP: Force/Velocity proportionality
BPM: Blows per Minute
EF2: Energy of F^2
ETR: Energy Transfer Ratio
EMX: Max Transferred Energy

BL#	CSX	TSX	VMX	FMX	FVP	BPM	EF2	ETR	EMX
	ksi	ksi	f/s	kips	[]	**	k-ft	(%)	k-ft
2	20.6	16.6	15.7	25	0.8	1.9	0.261	80.5	0.282
3	19.8	14.3	15.4	24	0.8	52.0	0.257	81.4	0.285
4	20.0	11.2	14.0	24	0.8	52.9	0.257	80.3	0.281
5	19.8	12.4	13.8	24	0.8	51.6	0.267	79.7	0.279
6	19.0	11.9	14.0	23	0.8	52.4	0.257	80.4	0.282
7	18.0	12.1	13.8	22	0.8	52.2	0.263	80.2	0.281
8	18.2	12.2	13.8	22	0.8	51.9	0.260	79.9	0.280
9	18.3	11.3	13.8	22	0.8	52.5	0.256	79.4	0.278
10	18.9	10.0	13.2	23	0.8	52.1	0.250	77.3	0.271
Average	19.2	12.4	14.2	23	0.8	46.6	0.259	79.9	0.280

Total number of blows analyzed: 9

Time Summary

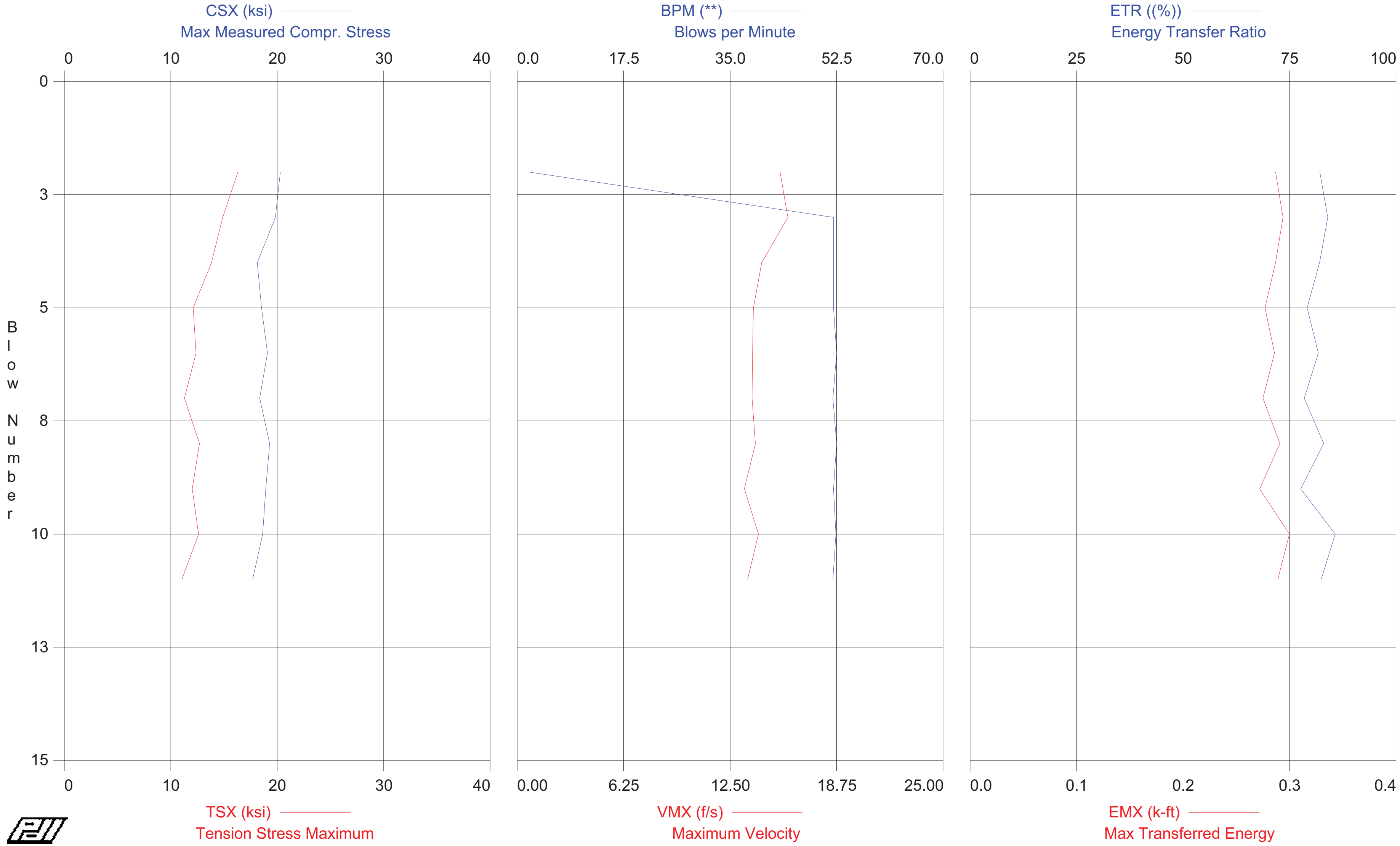
Drive 24 seconds 3:19:54 PM - 3:20:18 PM (9/1/2009) BN 1 - 10

PDIPLOT Ver. 2008.1 - Printed: 2-Dec-2009

MACTEC Engineering and Consulting, Inc. - Case Method Results

Test date: 1-Sep-2009

NORTH ANNA 3 Project - Boring M-10(DH) (29.2' - 30.7' sample)



NORTH ANNA 3 Project - Boring M-10(DH) (29.2' - 30.7' sample)
OP: JNH
Rig Serial No. MEC-02; CME 55LC (RAL) (D.White)
Test date: 1-Sep-2009

AR: 1.22 in^2
LE: 34.70 ft
WS: 16,807.9 f/s
SP: 0.492 k/ft3
EM: 30,000 ksi
JC: 0.70

CSX: Max Measured Compr. Stress
TSX: Tension Stress Maximum
VMX: Maximum Velocity
FMX: Maximum Force
FVP: Force/Velocity proportionality
BPM: Blows per Minute
EF2: Energy of F^2
ETR: Energy Transfer Ratio
EMX: Max Transferred Energy

BL#	CSX	TSX	VMX	FMX	FVP	BPM	EF2	ETR	EMX
	ksi	ksi	f/s	kips	[]	**	k-ft	(%)	k-ft
2	20.3	16.3	15.4	25	0.8	1.9	0.262	82.1	0.287
3	19.8	14.9	15.9	24	0.8	52.0	0.265	84.0	0.294
4	18.1	13.8	14.4	22	0.8	52.0	0.263	82.1	0.287
5	18.5	12.1	13.9	23	0.7	52.0	0.248	79.2	0.277
6	19.1	12.4	13.8	23	0.8	52.5	0.255	81.8	0.286
7	18.4	11.3	13.8	22	0.7	51.9	0.247	78.5	0.275
8	19.3	12.7	14.0	24	0.8	52.5	0.263	83.1	0.291
9	18.9	12.0	13.3	23	0.8	52.0	0.257	77.6	0.272
10	18.6	12.6	14.2	23	0.7	52.4	0.258	85.7	0.300
11	17.7	11.0	13.5	22	0.7	51.9	0.261	82.5	0.289
Average	18.9	12.9	14.2	23	0.8	47.1	0.258	81.7	0.286

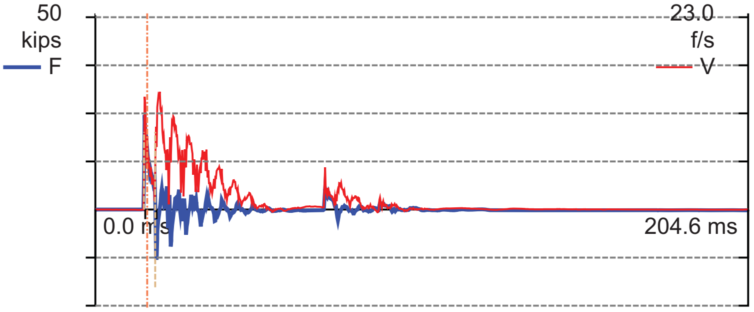
Total number of blows analyzed: 10

Time Summary

Drive 1 minute 25 seconds 3:29:07 PM - 3:30:32 PM (9/1/2009) BN 1 - 11

Project: NORTH ANNA 3
Pile: BORING M-10(DH) (24.2-25.7) - Description: CME 55LC DAVID WHITE
Operator: JNH

BN 5
9/1/2009 3:20:12 PM



LP	0.00	ft	LE	29.70	ft
CSX	19.8	ksi	AR	1.22	in^2
CSI	20.0	ksi	EM	30,000.0	ksi
TSX	12.4	ksi	SP	0.492	k/ft3
EMX	0.279	k-ft	WS	16,807.9	f/s
STK	5.14	ft	WC	16,807.9	f/s
FVP	0.84	[]	JC	0.70	[]
SFR	2	kips	2L/c	3.53	ms
RX5	4	kips	EA/c	2.2	ksec/ft
RMX	2	kips	FR	5.000	kHz

FINAL DATA REPORT
Revision 0
GEOTECHNICAL EXPLORATION AND TESTING
SUPPLEMENT 2
DOMINION POWER
NORTH ANNA NUCLEAR POWER STATION
NORTH ANNA 3 PROJECT
MINERAL, LOUISA COUNTY, VIRGINIA

December 16, 2009

VOLUME 1

APPENDIX C.1
Geovision Downhole and P-S Logging Report

Prepared By:

MACTEC ENGINEERING AND CONSULTING, INC.
RALEIGH, NORTH CAROLINA

MACTEC PROJECT No. 6468-09-2473

Prepared For:

Bechtel Power Corporation
Subcontractor No. 25161-500-HC4-CY00-00001

MACTEC

DOCUMENTATION OF TECHNICAL REVIEW
SUBCONTRACTOR WORK PRODUCT

Project Name: NORTH ANNA 3 PROJECT

Project Number: 6468-09-2473

Project Manager: Steve Criscenzo

Project Principals: Al Tice and Steve Copley

The report described below has been prepared by the named subcontractor retained in accordance with the MACTEC QAPD. The work and report have been reviewed by a MACTEC technically qualified person. Comments on the work or report, if any, have been satisfactorily addressed by the subcontractor. The attached report is approved in accordance with section QS-7 of MACTEC's QAPD

The information and date contained in the attached report are hereby released by MACTEC for project use.

REPORT :
North Anna Project 3 GEOVision Report, Revision 0 11-3-2009

SUBCONTRACTOR: GEOVision Geophysical Services

DATE OF ACCEPTANCE: 11-4-09

TECHNICAL REVIEWER: Michael B. L—

PROJECT PRINCIPAL Allan Tice

DCN – NAP274

MACTEC
3301 Atlantic Avenue, Raleigh, NC 27604

FINAL REPORT

BORING GEOPHYSICS
BORINGS M-10DH AND M-30DH

NORTH ANNA 3 PROJECT
NORTH ANNA NUCLEAR STATION

Report 9333-01 rev 0

November 3, 2009

FINAL REPORT

BORING GEOPHYSICS
BORINGS M-10DH AND M-30DH

NORTH ANNA 3 PROJECT
NORTH ANNA NUCLEAR STATION

Report 9333-01 rev 0

November 3, 2009

Prepared for:

MACTEC Engineering and Consulting, Inc.
3301 Atlantic Avenue
Raleigh, N. C. 27604
919-876-0416
MACTEC Job number 6468-09-2473

Prepared by

GEOVision Geophysical Services
1124 Olympic Drive
Corona, California 92881
(951) 549-1234

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APPENDICES

INTRODUCTION

Boring geophysical measurements were collected in two uncased borings located at the North Anna Nuclear Power Station, located in Louisa County, Virginia. Geophysical data acquisition was performed between September 15 and 17, 2009 by Charles Carter and Victor Gonzalez of **GEO***Vision*. Data analysis and report preparation were performed by Robert Steller and reviewed by John Diehl of **GEO***Vision*. The work was performed under subcontract with MACTEC Engineering and Consulting, Inc., (MACTEC) with J. Allan Tice serving as the point of contact for MACTEC.

This report describes the field measurements, data analysis, and results of this work.

SCOPE OF WORK

This report presents the results of boring geophysical measurements collected between September 15 and 17, 2009, in two uncased borings, as detailed in Table 1. The purpose of these studies was to supplement stratigraphic information obtained during MACTEC's soil and rock sampling program and to acquire shear wave velocities and compressional wave velocities as a function of depth.

The OYO Suspension PS Logging System was used to obtain in-situ horizontal shear and compressional wave velocity measurements at 1.6 foot intervals. The acquired data were analyzed and a profile of velocity versus depth was produced for both compressional and horizontally polarized shear waves.

A Robertson Geologging 3ACS 3-arm mechanical caliper probe was used to collect boring diameter and natural gamma data at 0.05 foot intervals.

A Robertson Geologging ELXG probe was used to collect long and short normal resistivity, single point resistance, self potential, and natural gamma data at 0.05 foot intervals.

A Robertson Geologging High Resolution Acoustic Televiewer (HiRAT) probe was used to collect Acoustic televiewer images of the boring walls, and boring deviation data, at 0.008 foot intervals.

A detailed reference for the velocity measurement techniques used in this study is:

> Guidelines for Determining Design Basis Ground Motions, Report TR-102293, Electric Power Research Institute, Palo Alto, California, November 1993, Sections 7 and 8.

INSTRUMENTATION

Suspension Instrumentation

Suspension soil and rock velocity measurements were performed using the suspension PS logging system, manufactured by OYO Corporation. This system directly determines the average in-situ horizontal shear and compressional wave velocity measurements of a 3.3 foot high segment of the rock and soil column surrounding the boring of interest by measuring the elapsed time between arrivals of a wave propagating upward through the rock and soil column. The receivers that detect the wave, and the source that generates the wave, are moved as a unit in the boring producing relatively constant amplitude signals at all depths.

The suspension system probe consists of a combined reversible polarity solenoid horizontal shear-wave source (S_H) and compressional-wave source (P), joined to two biaxial receivers by a flexible isolation cylinder, as shown in Figure 1. The separation of the two receivers is 3.3 feet, allowing average wave velocity in the region between the receivers to be determined by inversion of the wave travel time between the two receivers. The total length of the probe as used in these surveys is 19 feet, with the center point of the receiver pair 12.1 feet above the bottom end of the probe.

The probe receives control signals from, and sends the digitized receiver signals to, instrumentation on the surface via an armored 4 conductor cable. The cable is wound onto the drum of a winch and is used to support the probe. Cable travel is measured to provide probe depth data, using a 3.28 foot circumference sheave fitted with a digital rotary encoder.

The entire probe is suspended in the boring by the cable, therefore, source motion is not coupled directly to the boring walls; rather, the source motion creates a horizontally propagating impulsive pressure wave in the fluid filling the boring and surrounding the source. This pressure wave is converted to P and S_H-waves in the surrounding soil and rock as it impinges upon the wall of the boring. These waves propagate through the soil and rock surrounding the boring, in turn causing a pressure wave to be generated in the fluid surrounding the receivers as the soil waves pass their location. Separation of the P and S_H-waves at the receivers is performed using the following steps:

1. Orientation of the horizontal receivers is maintained parallel to the axis of the source, maximizing the amplitude of the recorded S_H -wave signals.
2. At each depth, S_H-wave signals are recorded with the source actuated in opposite directions, producing S_H-wave signals of opposite polarity, providing a characteristic S_H-wave signature distinct from the P-wave signal.
3. The 6.3 foot separation of source and receiver 1 permits the P-wave signal to pass and damp significantly before the slower S_H-wave signal arrives at the receiver. In faster soils or rock, the isolation cylinder is extended to allow greater separation of the P- and S_H-wave signals.
4. In saturated soils, the received P-wave signal is typically of much higher frequency than the received S_H-wave signal, permitting additional separation of the two signals by low pass filtering.
5. Direct arrival of the original pressure pulse in the fluid is not detected at the receivers because the wavelength of the pressure pulse in fluid is significantly greater than the dimension of the fluid annulus surrounding the probe (meter versus centimeter scale), preventing significant energy transmission through the fluid medium.

In operation, a distinct, repeatable pattern of impulses is generated at each depth as follows:

1. The source is fired in one direction producing dominantly horizontal shear with some vertical compression, and the signals from the horizontal receivers situated parallel to the axis of motion of the source are recorded.
2. The source is fired again in the opposite direction and the horizontal receiver signals are recorded.
3. The source is fired again and the vertical receiver signals are recorded. The repeated source pattern facilitates the picking of the P and S_H-wave arrivals; reversal of the source changes the polarity of the S_H-wave pattern but not the P-wave pattern.

The data from each receiver during each source activation are recorded as a different channel on the recording system. The Suspension PS system has six channels (two simultaneous recording channels), each with a 1024 sample record. The recorded data are displayed as six channels with a common time scale. Data are stored on disk for further processing. Up to 8 sampling sequences can be summed to improve the signal to noise ratio of the signals.

Review of the displayed data on the recorder or computer screen allows the operator to set the gains, filters, delay time, pulse length (energy), sample rate, and summing number to optimize the quality of the data before recording. Verification of the calibration of the Suspension PS digital recorder is performed every twelve months using a NIST traceable frequency source and counter, as outlined in Appendix D. An additional post-project calibration was performed following the field work, and is included in Appendix D.

Caliper / Natural Gamma Instrumentation

Caliper and natural gamma data were collected using a Model 3ACS 3-leg caliper probe, serial number 6621, manufactured by Robertson Geologging, Ltd. With the short arm configuration used in these surveys, the probes permitted measurement of boring diameters between 1.6 and 12 inches. With this tool, caliper measurements were collected concurrent with measurement of natural gamma emission from the boring walls. The probe was 6.82 feet long, and 1.5 inches in diameter.

This probe is useful in the following studies:

- Measurement of boring diameter and volume
- Location of hard and soft formations
- Location of fissures, caving, pinching and casing damage
- Bed boundary identification
- Strata correlation between borings

The probe receives control signals from, and sends the digitized measurement values to, a Robertson Micrologger II on the surface via an armored 4 conductor cable. The cable is wound onto the drum of a winch and is used to support the probe. Cable travel is measured to provide probe depth data, using a 3.28 foot circumference sheave fitted with a digital rotary encoder. The probe and depth data are transmitted by USB link from the Micrologger unit to a laptop computer where it is displayed and stored on hard disk.

The caliper consists of three arms, each with a toothed quadrant at their base, pivoted in the lower probe body. A toothed rack engages with each quadrant, thus constraining the arms to move together. Linear movement of the rack is converted to opening and closing of the arms. Springs hold the arms open in the operating position. A motor drive is provided to retract the arms, allowing the probe to be lowered into the boring. The rack is coupled to a potentiometer which converts movement into a voltage sensed by the probe's microprocessor.

Natural gamma measurements rely upon small quantities of radioactive material contained in all rocks to emit gamma radiation as they decay. Trace amounts of Uranium and Thorium are present in a few minerals, whereas potassium-bearing minerals such as feldspar, mica and clays will include traces of a radioactive isotope of Potassium. These emit gamma radiation as they decay with an extremely long half-life. This radiation is detected by scintillation - the production of a tiny flash of light when gamma rays strike a crystal of sodium iodide. The light is converted into an electrical pulse by a photomultiplier tube. Pulses above a threshold value of 60 KeV are counted by the probe's microprocessor. The measurement is useful because the radioactive elements are concentrated in certain rock types e.g. clay or shales, and depleted in others e.g. sandstone or coal.

Resistivity / Spontaneous Potential / Natural Gamma Instrumentation

Resistivity, spontaneous potential and natural gamma data were collected using a Model ELXG electric log probe, S/N 5490, manufactured by Robertson Geologging, Ltd. This probe measures Single Point Resistance (SPR), short normal (16") resistivity, long normal (64") resistivity, Spontaneous Potential (SP) and natural gamma. The probe is 8.20 feet long, and 1.73 inches in diameter.

This probe is useful in the following studies:

- Bed boundary identification
- Strata correlation between borings
- Strata geometry and type (shale indication)

The probe receives control signals from, and sends the digitized measurement values to, a Robertson Micrologger II on the surface via an armored 4 conductor cable. The cable is wound onto the drum of a winch and is used to support the probe. Cable travel is measured to provide probe depth data, using a 3.28 foot circumference sheave fitted with a digital rotary encoder. The probe and depth data are transmitted by USB link from the Micrologger unit to a laptop computer where they are displayed and stored on hard disk.

The resistivity section of the probe operates by driving an alternating current into the formation from the central SPR/DRIVE electrode. The current returns via the logging cable armor. To ensure adequate penetration of the formation the logging cable is insulated for approximately 30 feet from the cablehead. Voltages are measured between the 16" and 64" electrodes and the remote earth connection at surface, as noted below:

- Single Point Resistance (SPR): The current flowing to the cable armor is measured along with the voltage at the SPR electrode. The voltage divided by current gives resistance.

- Self Potential (SP): This is the DC bias of the 16" electrode with respect to the voltage return at the surface (ground stake).

Data quality is dependant upon good grounding at the surface. This is achieved with a metal stake driven into the mud-pit or the soil adjacent to the boring.

Acoustic Televiewer / Boring Deviation Instrumentation

An acoustic image and boring deviation data were collected in all three borings using a High Resolution Acoustic Televiewer probe (HiRAT), serial number 6641, manufactured by Robertson Geologging, Ltd. The probe is 7.58 feet long, and 1.9 inches in diameter, and is fitted with upper and lower four-band centralizers.

In this application, this probe is useful in the following studies:

- Measurement of boring inclination and deviation from vertical
- Determination of need to correct soil and geophysical log depths to true vertical depths
- Acoustic imaging of the boring wall to identify fractures, dikes, and weathered zones, and determine dip and azimuth of these features

The probe receives control signals from, and sends the digitized measurement values to, a Robertson Micrologger II on the surface via an armored 4 conductor cable. The cable is wound onto the drum of a winch and is used to support the probe. Cable travel is measured to provide probe depth data, using a 3.28 foot circumference sheave fitted with a digital rotary encoder. The probe and depth data are transmitted by USB link from the Micrologger unit to a laptop computer where it is displayed and stored on hard disk.

This system produces images of the boring wall based upon the amplitude and travel time of an ultrasonic beam reflected from the formation wall. The ultrasonic energy is generated by a piezoelectric transducer at a frequency of 1.4 MHz. A periodic acoustic energy wave is emitted by the transducer and travels through the acoustic head and boring fluid until it reaches the interface between the boring fluid and the boring wall. Here a portion of the energy is reflected back to the transducer, the remainder continuing on into the formation. By careful time sequencing, the piezoelectric transducer acts as both the transmitter of the ultrasonic pulse and receiver of the reflected wave. The travel time of the energy wave is the period between transmission of the source energy pulse and the return of the reflected wave measured at the point of maximum wave amplitude. The magnitude of the wave energy is measured in dB, a unit-less ratio of the detected echo wave amplitude divided by the amplitude of the transmitted wave. The strength of the reflected signal depends primarily upon the impedance contrast of the boring fluid and the boring wall formation. In these rock borings, the contrast between the clear water filling the boring and the rock formation generally provides high contrast. The changes in contrast between native rock and dikes provide imaging of fracture fillings.

The acoustic wave propagates along the axis of the probe and then is reflected perpendicular to this axis by a reflector that focuses the beam to a 0.1-inch diameter spot about 2 inches from the central axis of the probe. This reflector is mounted on the shaft of a stepper motor enabling the position of the measurement to be rotated through 360°. Sampling rates of 90, 180 and 360 measured points per revolution are available. During these surveys, data were collected at 360 samples per revolution. It should be noted that during logging the probe is moving in the boring, so that the measured points describe a very fine pitch spiral.

The probe contains a fluxgate magnetometer to monitor magnetic north, and all raw televiewer data are referenced to magnetic north. Also, a three-axis accelerometer is enclosed in the probe, and boring deviation data are recorded during the logging runs, to permit correction of structure dip angle from apparent dip, (referenced to boring axis), to true dip (referenced to a vertical axis) in non-vertical borings.

The data are presented on a computer screen for operator review during the logging run, and stored on hard disk for later processing.

MEASUREMENT PROCEDURES

Suspension Measurement Procedures

The borings were filled with bentonite or polymer based drilling mud and logged from the bottom of the surface casing down to the bottom of the boring, as listed in Table 2. 4-inch steel casing placed in the top 44 to 90 feet of softer soils above bedrock contact during the measurements in the lower rock portion of the borings. The casing was then removed, and measurements were performed in the upper soil portion of the borings, as indicated in Table 2. Measurements followed the **GEO***Vision* Procedure for P-S Suspension Seismic Velocity Logging, revision 1.4, as presented in Appendix F. This procedure was supplied to and approved by MACTEC in advance of the work. In each boring, the probe was positioned with the top of the probe at the top of the casing, and the electronic depth counter was set to the specified length of the probe, minus the height of the casing stick-up, as verified with a tape measure, and recorded on the field logs. The probe was lowered to the bottom of the boring, stopping at 1.6 foot intervals to collect data, as summarized in Table 2.

At each measurement depth the measurement sequence of two opposite horizontal records and one vertical record was performed, and the gains were adjusted as required. The data from each depth was reviewed on the computer display, and recorded on disk before moving to the next depth.

Upon completion of the measurements, the probe zero depth indication at the depth reference point was verified prior to removal from the boring, and the after survey depth error (ASDE) was calculated, as summarized in Table 3.

Calibration procedures and records for the suspension PS measurement system are presented in Appendix D. **GEO***Vision* standard field log sheets for all borings are reproduced in Appendix E and **GEO***Vision* standard field procedures are reproduced in Appendix F.

Caliper / Natural Gamma Measurement Procedures

The borings were filled with bentonite or polymer based drilling mud and logged from the bottom of the boring up until the caliper entered the bottom of the surface casing, as listed in Table 2. Measurements followed ASTM D6167-97 (Re-approved 2004) Conducting Borehole Geophysical Logging – Mechanical Caliper.

Prior to and following each logging run, the caliper tool was verified, using the manufacturer's supplied three point calibration jig, and a PVC coupling provided by MACTEC with an inside diameter traceable to NIST. The three point jig is a circular plate with a series of holes in the top surface into which the tips of the caliper arms fit. This has circles of diameters from 2 to 12 inches. The calibration jig is placed over a bucket with the probe standing upright with its nose section passing through the jig's central hole. The caliper probe arms are opened under program control, and a log is recorded as the tips of the arms are placed in the holes on the calibration jig and inside the PVC coupling. The measured dimensions, as displayed on the recording computer screen was recorded on the field log sheet, as well as in the digital files, and compared with the calibration jig dimensions. These files are presented in LAS 2.0 format in the boring specific sub-directories of the data disk (CD-R) labeled Report 9333-02 that accompanies this report. If the verification records did not fall within +/- 0.05 inches of the calibration jig values, the caliper tool was re-calibrated, using the three point calibration jig, and the log repeated. As with the verification, the tips of the caliper arms are placed in the holes marked with the required diameter. During calibration, the value of the current calibration point, as stamped on the jig, is entered via the control computer. The system counts for 15 seconds to make an average of the response. The procedure is repeated for the second and third required openings.

The computation and generation of the calibration coefficient file is entirely automatic. The calibration file is simply the set of coefficients of a quadratic curve which fits the three data points. Figure 2 shows the response of a caliper probe using data gathered during calibration.

Natural gamma was not calibrated in the field, as it is a qualitative measurement, not a quantitative value, and is used only to assist in picking transitions between stratigraphic units, as described in ASTM D6274-98 (Re-approved 2004), Conducting Borehole Geophysical Logging - Gamma.

In each boring, the probe was positioned with the top of the probe at the top of the casing, and the electronic depth counter was set to the specified length of the probe, minus the height of the casing stick-up, as verified with a tape measure, and recorded on the field logs. The probe was lowered to the bottom of the boring, where the caliper legs were opened, and data collection begun. The probe was then returned to the surface at 10 feet/minute, collecting data continuously at 0.05 foot spacing, as summarized in Table 2.

Upon completion of the measurements, the probe zero depth indication at the depth reference point was verified prior to removal from the boring, and the after survey depth error (ASDE) was calculated, as summarized in Table 3.

Resistivity / Spontaneous Potential Measurement Procedures

The borings were filled with bentonite or polymer based drilling mud and logged from the bottom of the boring up until the yoke electrode cleared the surface of the drilling mud at nominal 39 foot depth, or the probe entered the surface casing, as summarized in Table 2. The probe was connected to the logging cable using a 32.8 foot long insulating cable section or "yoke". The probe head was insulated by wrapping all exposed metal of the cablehead and probe with self-amalgamating insulation tape. The 32.8 foot insulating yoke was checked for any damage, and repaired with self-amalgamating insulation tape as needed.

The reference ground stake was driven firmly into the mud pit, and connected to the ground socket on the winch switch box.

This sonde was not calibrated in the field, as it is used to provide qualitative measurements, not quantitative values, and is used only to assist in picking transitions between stratigraphic units, as described in ASTM D5753-05, Planning and Conducting Borehole Geophysical Surveys. A functional test is performed prior to each logging run by applying fixed resistance values across the probe electrodes, as well as a 100 millivolt signal across the SP electrodes, and recording the resultant output of the system. These functional checks are presented in LAS 2.0 format in the boring specific sub-directories of the data directory on the data disk (CD-R) labeled Report 9333-02 that accompanies this report.

Natural gamma was not calibrated in the field, as it is a qualitative measurement, not a quantitative value, and is used only to assist in picking transitions between stratigraphic units, as described in ASTM D6274-98 (Re-approved 2004), Conducting Borehole Geophysical Logging - Gamma.

In each boring, the probe was positioned with the top of the yoke electrode at the top of the casing, and the electronic depth counter was set to the specified length of the probe and yoke, minus the height of the casing stick-up, as verified with a tape measure, and recorded in the field logs. The probe was lowered to the bottom of the boring, where data collection was begun. The probe was then returned to the surface at 10 feet/minute, collecting data continuously at 0.05 foot spacing, until the yoke electrode cleared the surface of the drilling mud at nominal 39 foot depth, or the probe entered the surface casing, as summarized in Table 2. The natural gamma data collected in these logs is redundant with the data collected in the caliper / natural gamma logs, and the caliper / natural data may be used to verify the natural gamma data collected in these logs.

Upon completion of the measurements, the probe zero depth indication at the depth reference point was verified prior to removal from the boring, and the after survey depth error (ASDE) was calculated, as summarized in Table 3.

Acoustic Televiewer / Boring Deviation Measurement Procedures

The borings were filled with bentonite or polymer based drilling mud and logged from the bottom of the boring up to the surface, as listed in Table 2. Measurements followed the **GEO***Vision* Hi-RAT Field Procedure, revision 1.0, as presented in Appendix F. This procedure was supplied to and approved by MACTEC in advance of the work.

Prior to use, the HiRAT probe tiltmeter and compass functions were checked by comparison with a Brunton surveyors' compass, and the results recorded on the field logs.

In each boring, the televiewer probe was positioned with the top of the probe at the top of the casing, and the electronic depth counter was set to the specified length of the probe, minus the height of the casing stick-up, as verified with a tape measure, and recorded on the field logs. The probe was lowered to the bottom of the boring, and data collection begun. The probe was then returned to the surface at 3.0 feet/minute, collecting data continuously at 0.008 foot intervals, as summarized in Table 2.

Upon completion of the measurements, the probe zero depth indication at grade was verified prior to removal from the boring and the after survey depth error (ASDE) was calculated, as summarized in Table 3.

DATA ANALYSIS

Suspension Analysis

Using the proprietary OYO program PSLOG.EXE version 1.0, included on the data disk (CD-R) labeled Report 9333-02 that accompanies this report, the recorded digital waveforms were analyzed to locate the most prominent first minima, first maxima, or first break on the vertical axis records, indicating the arrival of P-wave energy. The difference in travel time between receiver 1 and receiver 2 (R1-R2) arrivals was used to calculate the P-wave velocity for that 3.3 foot segment of the soil column. When observable, P-wave arrivals on the horizontal axis records were used to verify the velocities determined from the vertical axis data. The time picks were then transferred into an EXCEL template (EXCEL version 2003 SP2) to complete the velocity calculations based upon the arrival time picks made in PSLOG. The PSLOG pick files and the EXCEL analysis files are included in the boring specific directories on the data disk (CD-R) labeled Report 9333-02 that accompanies this report.

The P-wave velocity over the 6.3 foot interval from source to receiver 1 (S-R1) was also picked using PSLOG, and calculated and plotted in EXCEL, for comparison with the velocity derived from the travel time between receivers. In this analysis, the depth values as recorded were increased by 4.8 feet to correspond to the mid-point of the 6.3 foot S-R1 interval. Travel times were obtained by picking the first break of the P-wave signal at receiver 1 and subtracting 0.3 milliseconds, the calculated and experimentally verified delay from source trigger pulse (beginning of record) to source impact. This delay corresponds to the duration of acceleration of the solenoid before impact.

As with the P-wave records, using PSLOG, the recorded digital waveforms were analyzed to locate the presence of clear S_H-wave pulses, as indicated by the presence of opposite polarity pulses on each pair of horizontal records. Ideally, the S_H-wave signals from the 'normal' and 'reverse' source pulses are very nearly inverted images of each other. Digital FFT - IFFT lowpass filtering was used to remove the higher frequency P-wave signal from the S_H-wave signal. Different filter cutoffs were used to separate P- and S_H-waves at different depths, ranging from 600 Hz in the slowest zones to 4000 Hz in the regions of highest velocity. At each depth, the filter frequency was selected to be at least twice the fundamental frequency of the S_H-wave signal being filtered.

Generally, the first maxima were picked for the 'normal' signals and the first minima for the 'reverse' signals, although other points on the waveform were used if the first pulse was distorted. The absolute arrival time of the 'normal' and 'reverse' signals may vary by +/- 0.2 milliseconds, due to differences in the actuation time of the solenoid source caused by constant mechanical bias in the source or by boring inclination. This variation does not affect the R1-R2 velocity determinations, as the differential time is measured between arrivals of waves created by the same source actuation. The final velocity value is the average of the values obtained from the 'normal' and 'reverse' source actuations.

As with the P-wave data, S_H-wave velocity calculated from the travel time over the 6.3 foot interval from source to receiver 1 was calculated and plotted for comparison with the velocity derived from the travel time between receivers. In this analysis, the depth values were increased by 4.8 foot to correspond to the mid-point of the 6.3 foot S-R1 interval. Travel times were obtained by picking the first break of the S_H-wave signal at the near receiver and subtracting 0.3 milliseconds, the calculated and experimentally verified delay from the beginning of the record at the source trigger pulse to source impact.

Independent review of these data and analysis were performed by John Diehl of **GEO***Vision*.

Figure 3 shows an example of R1 - R2 measurements on a sample filtered suspension record. In Figure 3, the time difference over the 3.3 foot interval of 1.88 milliseconds for the horizontal signals is equivalent to an S_H-wave velocity of 1745 feet/second. Whenever possible, time differences were determined from several phase points on the S_H-waveform records to verify the data obtained from the first arrival of the S_H-wave pulse. Figure 4 displays the same record before filtering of the S_H-waveform record with a 1400 Hz FFT - IFFT digital lowpass filter, illustrating the presence of higher frequency P-wave energy at the beginning of the record, and distortion of the lower frequency S_H-wave by residual P-wave signal.

Caliper / Natural Gamma Analysis

No analysis is required with the caliper or natural gamma data, however depths to identifiable boring features were compared to verify compatible depth readings on all logs. Using WellCAD software version 4.3, these data were combined with the resistivity, ELOG based natural gamma and spontaneous potential (SP) logs, and converted to LAS and PDF formats for transmittal to the client.

Resistivity / Natural Gamma / Spontaneous Potential Analysis

No analysis is required with the resistivity, natural gamma or spontaneous potential data, however depths to identifiable boring features were compared to verify compatible depth readings on all logs. Using WellCAD software version 4.3, these data were combined with the caliper and caliper-based natural gamma logs, and converted to LAS and PDF formats for transmittal to the client.

Acoustic Televiewer / Boring Deviation Analysis

The collected Acoustic Televiewer data was processed with Robertson Geologging's RGLDIP program, version 6.2, to identify boring features and to extract the deviation data and produce an ASCII file and plots of deviation data.

Sinusoidal projections of both open and hairline fractures in the boring walls were interactively picked on the acoustic reflection image or acoustic travel time image, and are presented on the logs as red sinusoids superimposed over the televiewer images. Bedrock contact, and other bedding planes, when visible, were picked on the same images and are presented on the logs as green sinusoids. The sinusoidal projections were processed to correct for the plunge of the borings using the recorded data from the accelerometers located in the probe, and presented graphically, in what is referred to as "tadpole", or "arrow" format, with true dip indicated by the position of the arrow head on the plot. Direction of dip (not strike) is indicated by the direction of the arrow tail, with true north being "up". These values are presented numerically in columns to the left of the arrow graphic plots. These depth and dip data of the joints and foliation are also presented as .txt files in the boring specific sub-directories on the data disk (CD-R) labeled Report 9333-02 that accompanies this report, and summarized in Table 4.

The televiewer images were processed to create a simulated core image of the borings. It should be considered that the pseudo-core represents a core that would have the full 3.8-inch diameter of the boring, not the 2.5-inch diameter of the cores removed during drilling, so that direct comparison is not possible. Also, the unwrapped image is viewed from the perspective of an observer in the center of the boring looking outward. The simulated core image is viewed from the "outside" of the boring looking inward, so there is a reversal of the position of east and west relative to north between the two images.

RESULTS

Suspension Results

Suspension R1-R2 P- and S_H-wave velocities are plotted in Figures 5 and 8. The suspension velocity data presented in these figures are presented in Tables 5 and 6. The PSLOG and EXCEL analysis files for each boring are included in the boring specific directories on the data disk (CD-R) labeled Report 9333-02 that accompanies this report, along with the raw and filtered waveforms.

P- and S_H-wave velocity data from R1-R2 and S-R1 analysis, as discussed in the "Suspension Analysis" section of this report, are plotted together in Figures A-1 and A-2 to aid in visual comparison. It must be noted that R1-R2 data is an average velocity over a 3.3 foot segment of the soil column; S-R1 data is an average over 6.3 feet, creating a significant smoothing relative to the R1-R2 plots. S-R1 data are presented in Tables A-1 and A-2, and included in the EXCEL analysis files for each boring on the data disk (CD-R) labeled Report 9333-02 that accompanies this report.

Calibration procedures and records for the suspension measurement system are presented in Appendix D.

The **GEO***Vision* standard field log sheets for all borings are reproduced in Appendix E.

The **GEO***Vision* standard field procedures are reproduced in Appendix F.

Caliper/ Natural Gamma Results

Caliper and natural gamma data are presented in combined log plots with resistivity and spontaneous potential as single page logs in Figures 6 and 9, as well as multi-page logs in Appendix B. LAS 2.0 data and Acrobat files of the plots for each boring are included in the boring specific sub-directories on the data disk (CD-R) labeled Report 9333-02 that accompanies this report.

Resistivity / Spontaneous Potential Results

Resistivity and spontaneous potential data is presented in combined log plots with caliper and natural gamma data as single page logs in Figures 6 and 9, as well as multi-page logs in Appendix B. LAS 2.0 data and Acrobat files of the plots for each boring are included in the boring specific sub-directories on the data disk (CD-R) labeled Report 9333-02 that accompanies this report.

Acoustic Televiewer / Boring Deviation Results

Acoustic televiewer amplitude images and simulated core images are presented in Appendix C, with identified features super-imposed on the images. Features were picked as hairline fractures and bedding planes (as identified as features only present on the amplitude display) and open fractures (as identified as features present on both amplitude and travel-time displays). The same logs are presented in .pdf format in the boring specific sub-directories on the data disk (CD-R) labeled Report 9333-02 that accompanies this report. Fracture and planar feature depth, dip angle and azimuth of dip data are provided numerically on the log sheets, as well as in text format on the data CD-R.

Boring deviation data is presented graphically in Figures 7 and 10, and summarized in Table 4. Deviation data plots in Acrobat format and deviation data at 1.0 foot stations are presented in text format in the boring specific sub-directories of the data disk (CD-R) labeled Report 9333-02 that accompanies this report.

SUMMARY

Discussion of Suspension Results

Suspension PS velocity data are ideally collected in an uncased fluid filled boring, drilled with rotary mud (rotary wash) methods. The lower portions of the borings at this site were ideal for collection of suspension PS velocity data.

Suspension PS velocity data quality is judged based upon 5 criteria:

1. Consistent data between receiver to receiver (R1 – R2) and source to receiver (S – R1) data.
2. Consistent relationship between P-wave and S_H -wave (excluding transition to saturated soils)
3. Consistency between data from adjacent depth intervals.
4. Clarity of P-wave and S_H-wave onset, as well as damping of later oscillations.
5. Consistency of profile between adjacent borings, if available.

M-10DH: These data show excellent correlation between R1 – R2 and S – R1 data, as well as excellent correlation between P-wave and S_H-wave velocities. S_H-wave onsets are generally clear, and later oscillations are well damped. P-wave arrivals are weak, as is generally the case in hard rock borings, and above water table in soil. In the hard rock, low velocity regions correspond well with fracture zones identified on the acoustic televiewer logs. This is an excellent rock velocity data set, with good soil velocity data.

M-30DH: These data show excellent correlation between R1 – R2 and S – R1 data, as well as excellent correlation between P-wave and S_H-wave velocities. S_H-wave onsets are generally clear, and later oscillations are well damped. P-wave arrivals are weak, as is generally the case in hard rock borings, and above water table in soil. In the hard rock, low velocity regions correspond well with fracture zones identified on the acoustic televiewer logs. This is an excellent rock velocity data set, with good soil velocity data.

Discussion of Caliper / Natural Gamma Results

Caliper and natural gamma data was collected for the entire depth of each boring. The caliper logs for all these borings show very consistent gauge in competent rock, with minor tapering downhole due to bit wear. Some fracturing is noted, but below the rock contact, the borings are generally tight. Natural gamma was collected with this tool in all the borings, as well as with the ELOG probe, and the comparison between the two data sets provides an almost exact match, verifying the performance of the natural gamma measuring systems.

Discussion of Resistivity / Spontaneous Potential Results

Both long and short normal resistivity and single point resistance provide clear delineation of different lithologic units and changes within the bedrock, showing drops in resistivity at weathered zones that correspond with changes in natural gamma and velocity data. The electrical data is not valid above 40 feet, as the upper yoke electrode moves out of the boring fluid at this depth. The natural gamma data agrees well with the natural gamma data collected with the caliper probe. The comparison between the two data sets provides an almost exact match, verifying the performance of the natural gamma measuring systems.

Discussion of Acoustic Televiewer / Boring Deviation Results

The acoustic televiewer data quality in the rock section of both borings is very good, providing clear images of a number of fractures and beading planes. Many of the borings exhibit diagonal banding (zebra striping) caused by rapid reaming down the boring with new core bits that are slightly larger than the gauge of the original boring. This creates a spiral wear pattern in the boring that alters the characteristic smooth surface of diamond cored borings. This wear pattern can have a significant impact on acoustic televiewer image quality, and in these borings may conceal smaller features. It will not conceal fractures, however.

Location of fractures and weathered zones on the televiewer logs correspond precisely with increases in caliper log diameter and suspension PS velocity drops.

The borings were inclined at 3.9 degrees, or less, from vertical, and the maximum error in depth value was 0.5 feet in 200 ft, or less than 0.3 percent, as presented in Table 4. This error is less than depth errors from other causes, and no adjustment of log depth is indicated.

Quality Assurance

These boring geophysical measurements were performed using industry-standard or better methods for measurements and analyses. All work was performed under **GEO***Vision* data collection and processing procedures, which include:

- Use of NIST-traceable calibrations, where applicable, for field and laboratory instrumentation
- Use of standard field data logs
- Use of independent verification of velocity data by comparison of receiver-to-receiver and source-to-receiver velocities
- Independent review of calculations and results by a registered professional engineer, geologist, or geophysicist.

Suspension Data Reliability

P- and S_H-wave velocity measurement using the Suspension Method gives average velocities over a 3.3 foot interval of depth. This high resolution results in the scatter of values shown in the graphs. Individual measurements are very reliable with estimated precision of +/- 5%. Standardized field procedures and comparison checks contribute to the reliability of these data.

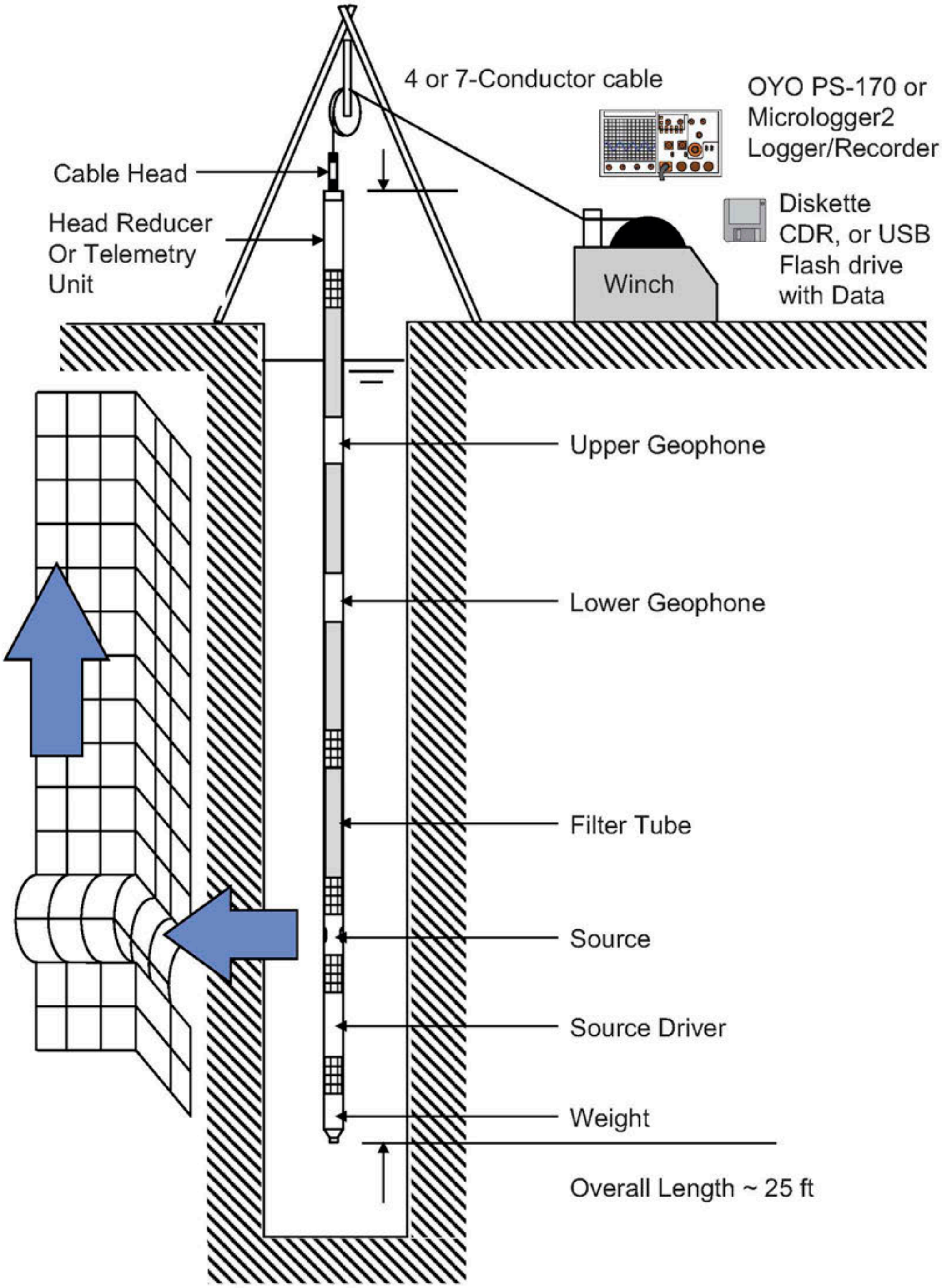


Figure 1: Concept illustration of P-S logging system

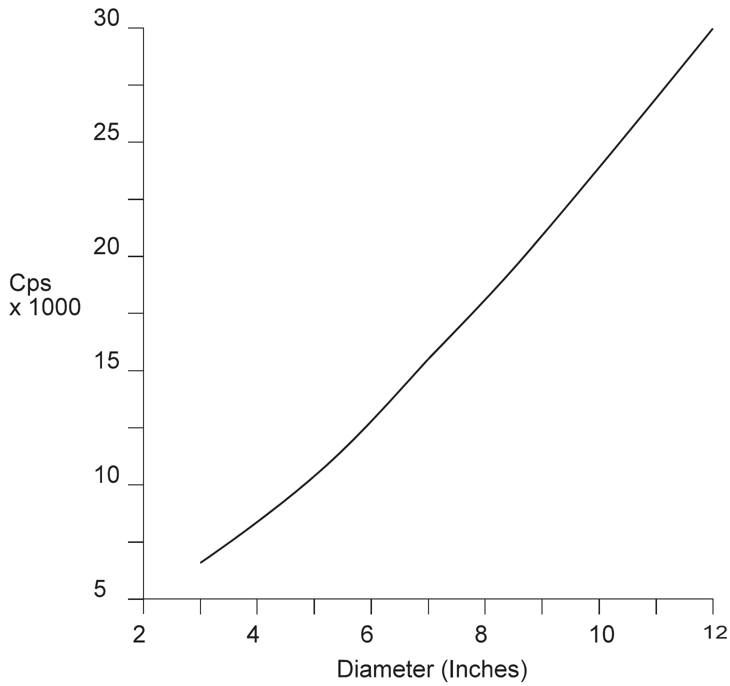


Figure 2. Example Calibration Curve for Caliper Probe

BORING DESIGNATION	DATES LOGGED	ELEVATION*	COORDINATES* - FEET	
			NORTH (Y)	EAST (X)
M-10DH	9/16-17/2009	323.61	3909243.32	11685945.83
M-30DH	9/15-17/2009	313.34	3909694.92	11685381.66

* All points referenced to Control Monument 7 and adjusted to reflect the following Datums
Horizontal – VSPCS South Zone, NAD 83(CORS96)(EPOCH:2002)
Elevation - NAVD88 (Geoid03)
Survey data provided by MACTEC

Table 1 Boring locations and logging dates

BORING NUMBER	TOOL AND RUN NUMBER	DEPTH RANGE (FEET)	OPEN HOLE (FEET)	DEPTH TO BOTTOM OF CASING (FEET)	SAMPLE INTERVAL (FEET)	DATE LOGGED
M-10DH	ELOG/GAMMA 1	200.1 – 86.0	200.1	89.8 STEEL	0.05	9/16/2009
M-10DH	SUSPENSION 1	91.9 – 187.0	-	89.8 STEEL	1.6	9/16/2009
M-10DH	ACOUSTIC TELEVIEWER 1	196.9 - 86.9	-	89.8 STEEL	0.008	9/16/2009
M-10DH	CALIPER/GAMMA 1	198.8 - 84.0	-	89.8 STEEL	0.05	9/16/2009
M-10DH	ELOG/GAMMA 2	105.6 – 36.6	-	7.0 STEEL	0.05	9/16/2009
M-10DH	SUSPENSION 2	8.2 – 98.4	-	7.0 STEEL	1.6	9/17/2009
M-10DH	CALIPER/GAMMA 2	100.9 – 3.9	-	7.0 STEEL	0.05	9/17/2009
M-10DH	ACOUSTIC TELEVIEWER 2	99.4 – 2.8	-	7.0 STEEL	0.008	9/18/2009
M-30DH	ELOG/GAMMA 1	200.5 – 39.6	200.5	44.0 STEEL	0.05	9/15/2009
M-30DH	ELOG/GAMMA 2	75.0 – 39.9	-	44.0 STEEL	0.05	9/15/2009
M-30DH	SUSPENSION 1	45.9 – 187.0	-	44.0 STEEL	1.6	9/15/2009
M-30DH	ACOUSTIC TELEVIEWER 1	200.2 – 40.2	-	44.0 STEEL	0.008	9/16/2009
M-30DH	ACOUSTIC TELEVIEWER 2	55.4 – 41.8	-	44.0 STEEL	0.008	9/16/2009
M-30DH	CALIPER/GAMMA 1	200.1 – 33.2	-	44.0 STEEL	0.05	9/16/2009
M-30DH	ELOG/GAMMA 3	65.4 – 34.3	-	7.0 STEEL	0.05	9/17/2009
M-30DH	SUSPENSION 2	8.2 – 52.5	-	7.0 STEEL	1.6	9/17/2009
M-30DH	ACOUSTIC TELEVIEWER 3	45.9 – 5.9	-	7.0 STEEL	0.008	9/17/2009
M-30DH	CALIPER/GAMMA 2	50.7 – 3.3	-	7.0 STEEL	0.05	9/17/2009

- PROBE DID NOT TOUCH BOTTOM OF BORING

Table 2. Logging dates and depth ranges

BORING NUMBER	TOOL AND RUN NUMBER	TOOL HIT BOTTOM DEPTH (FEET)	DRILLER DEPTH (FEET)	STARTING DEPTH REF. (FEET)	ENDING DEPTH REF. (FEET)	ASDE (FEET)
M-10DH	ELOG/GAMMA 1	201.1	201.9	39.5	39.5	0
M-10DH	SUSPENSION 1	-		6.7	6.7	0
M-10DH	ACOUSTIC TELEVIEWER 1	-		3.2	3.2	0
M-10DH	CALIPER/GAMMA 1	-		5.3	5.3	0
M-10DH	ELOG/GAMMA 2	-		32.2	32.2	0
M-10DH	SUSPENSION 2	-		5.4	5.4	0
M-10DH	CALIPER/GAMMA 2	-		4.0	4.0	0
M-10DH	ACOUSTIC TELEVIEWER 2	-		2.8	2.7	0.1
M-30DH	ELOG/GAMMA 1	200.5	201.7	39.9	39.6	0.3
M-30DH	ELOG/GAMMA 2	-		39.9	40.0	0.1
M-30DH	SUSPENSION 1	-		7.1	7.1	0
M-30DH	ACOUSTIC TELEVIEWER 1	-		3.6	3.6	0
M-30DH	ACOUSTIC TELEVIEWER 2	-		3.6	3.6	0
M-30DH	CALIPER/GAMMA 1	-		5.7	5.7	0
M-30DH	ELOG/GAMMA 3	-		37.7	37.8	0.1
M-30DH	SUSPENSION 2	-		4.9	4.9	0
M-30DH	ACOUSTIC TELEVIEWER 3	-		1.4	1.4	0
M-30DH	CALIPER/GAMMA 2	-		3.5	3.5	0

- PROBE DID NOT TOUCH BOTTOM OF BORING

Table 3. Boring Bottom Depths and After Survey Depth Error (ASDE)

BORING NUMBER	MEAN DEVIATION AND AZIMUTH (DEGREES)	SURVEY DEPTH (FEET)	VERTICAL DEPTH (FEET)	DEPTH ERROR (FEET)	HORIZONTAL OFFSET (FEET)
M-10DH	3.9 – N328	196.9	196.4	0.5	13.3
M-30DH	1.6 – N159	200.2	200.2	0	5.5

Table 4. Boring Deviation Data Summary

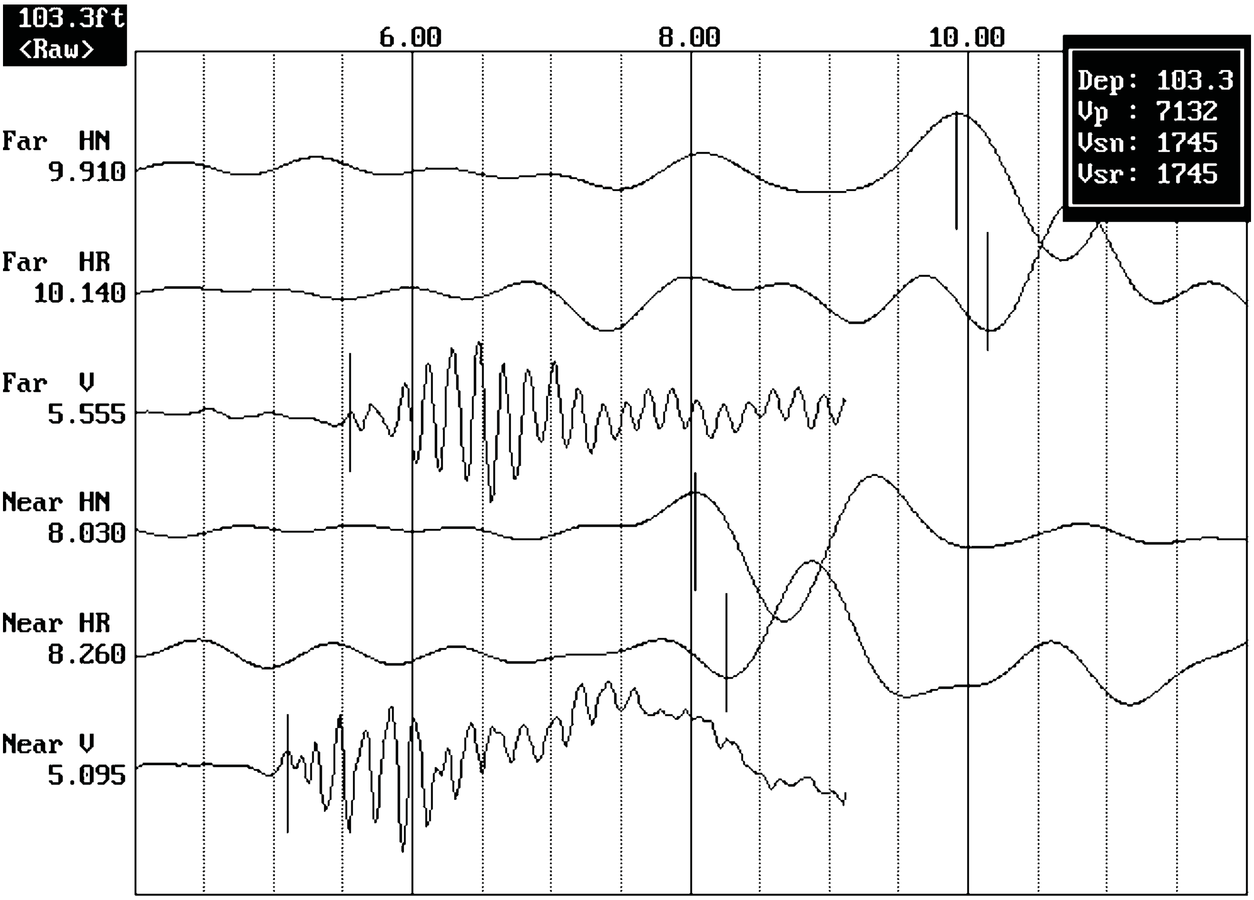


Figure 3: Example of filtered (1400 Hz lowpass) record

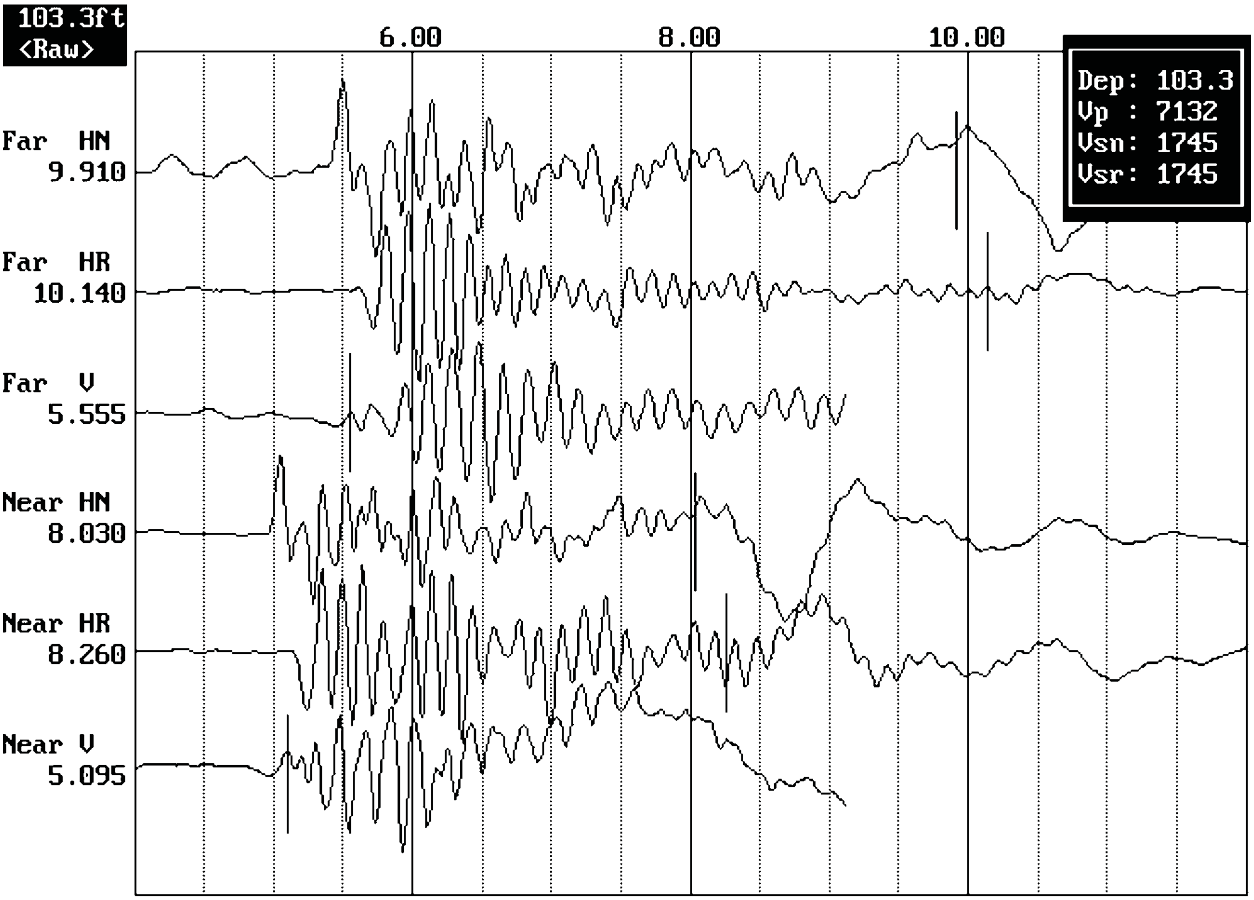


Figure 4. Example of unfiltered record

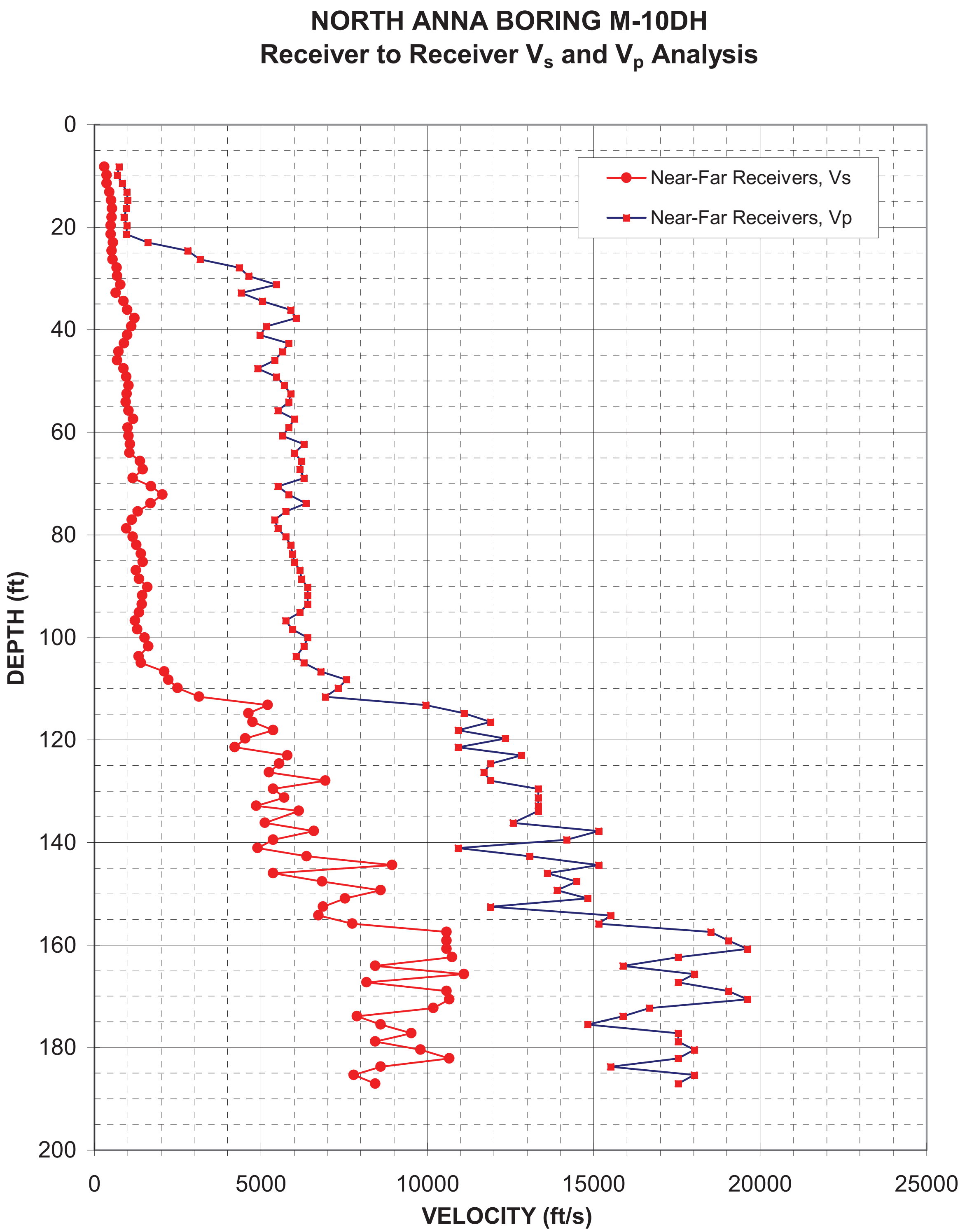


Figure 5: Boring M-10DH, Suspension R1-R2 P- and S_H-wave velocities

Table 5. Boring M-10DH, Suspension R1-R2 depths and P- and S_H-wave velocities

Summary of Compressional Wave Velocity, Shear Wave Velocity, and Poisson's Ratio Based on Receiver-to-Receiver Travel Time Data - Borehole M-10DH

American Units				Metric Units			
Depth at Midpoint Between Receivers	Velocity		Poisson's Ratio	Depth at Midpoint Between Receivers	Velocity		Poisson's Ratio
	V_s	V_p			V_s	V_p	
(ft)	(ft/s)	(ft/s)		(m)	(m/s)	(m/s)	
8.2	300	740	0.40	2.5	90	230	0.40
9.8	370	690	0.29	3.0	110	210	0.29
11.5	370	840	0.38	3.5	110	250	0.38
13.1	460	970	0.36	4.0	140	300	0.36
14.8	510	1010	0.33	4.5	160	310	0.33
16.4	530	960	0.28	5.0	160	290	0.28
18.0	520	890	0.24	5.5	160	270	0.24
19.7	500	980	0.32	6.0	150	300	0.32
21.3	490	960	0.32	6.5	150	290	0.32
23.0	560	1610	0.43	7.0	170	490	0.43
24.6	520	2800	0.48	7.5	160	850	0.48
26.3	550	3170	0.48	8.0	170	970	0.48
27.9	670	4360	0.49	8.5	200	1330	0.49
29.5	690	4630	0.49	9.0	210	1410	0.49
31.2	790	5460	0.49	9.5	240	1670	0.49
32.8	650	4420	0.49	10.0	200	1350	0.49
34.5	880	5050	0.48	10.5	270	1540	0.48
36.1	1000	5900	0.49	11.0	300	1800	0.49
37.7	1210	6060	0.48	11.5	370	1850	0.48
39.4	1110	5170	0.48	12.0	340	1580	0.48
41.0	1000	4980	0.48	12.5	300	1520	0.48
42.7	890	5850	0.49	13.0	270	1780	0.49
44.3	730	5650	0.49	13.5	220	1720	0.49
45.9	690	5420	0.49	14.0	210	1650	0.49
47.6	880	4900	0.48	14.5	270	1490	0.48
49.2	970	5460	0.48	15.0	290	1670	0.48
50.9	1030	5700	0.48	15.5	310	1740	0.48
52.5	980	5900	0.49	16.0	300	1800	0.49
54.1	960	5850	0.49	16.5	290	1780	0.49
55.8	1030	5510	0.48	17.0	310	1680	0.48
57.4	1170	6010	0.48	17.5	360	1830	0.48
59.1	1000	5850	0.49	18.0	300	1780	0.49
60.7	1030	5650	0.48	18.5	310	1720	0.48
62.3	1070	6290	0.49	19.0	330	1920	0.49
64.0	1060	6010	0.48	19.5	320	1830	0.48
65.6	1370	6230	0.47	20.0	420	1900	0.47

Summary of Compressional Wave Velocity, Shear Wave Velocity, and Poisson's Ratio Based on Receiver-to-Receiver Travel Time Data - Borehole M-10DH

American Units			
Depth at Midpoint Between Receivers	Velocity		Poisson's Ratio
	V_s	V_p	
(ft)	(ft/s)	(ft/s)	
67.3	1460	6170	0.47
68.9	1150	6290	0.48
70.5	1710	5510	0.45
72.2	2040	5850	0.43
73.8	1690	6350	0.46
75.5	1310	5750	0.47
77.1	1130	5420	0.48
78.7	970	5510	0.48
80.4	1150	5750	0.48
82.0	1260	5900	0.48
83.7	1410	5950	0.47
85.3	1460	6010	0.47
86.9	1250	6170	0.48
88.6	1340	6230	0.48
90.2	1590	6410	0.47
91.9	1450	6410	0.47
93.5	1420	6410	0.47
95.1	1350	6170	0.47
96.8	1230	5750	0.48
98.4	1290	5950	0.48
100.1	1520	6410	0.47
101.7	1620	6290	0.46
103.7	1340	6060	0.47
105.0	1400	6290	0.47
106.6	2100	6800	0.45
108.3	2220	7580	0.45
109.9	2500	7330	0.43
111.6	3140	6940	0.37
113.2	5210	9950	0.31
114.8	4630	11110	0.39
116.5	4760	11900	0.40
118.1	5380	10930	0.34
119.8	4540	12350	0.42
121.4	4220	10930	0.41
123.0	5800	12820	0.37
124.7	5560	11900	0.36
126.3	5250	11700	0.37
128.0	6940	11900	0.24
129.6	5380	13330	0.40

Metric Units			
Depth at Midpoint Between Receivers	Velocity		Poisson's Ratio
	V_s	V_p	
(m)	(m/s)	(m/s)	
20.5	450	1880	0.47
21.0	350	1920	0.48
21.5	520	1680	0.45
22.0	620	1780	0.43
22.5	520	1940	0.46
23.0	400	1750	0.47
23.5	340	1650	0.48
24.0	290	1680	0.48
24.5	350	1750	0.48
25.0	380	1800	0.48
25.5	430	1810	0.47
26.0	440	1830	0.47
26.5	380	1880	0.48
27.0	410	1900	0.48
27.5	490	1950	0.47
28.0	440	1950	0.47
28.5	430	1950	0.47
29.0	410	1880	0.47
29.5	370	1750	0.48
30.0	390	1810	0.48
30.5	460	1950	0.47
31.0	490	1920	0.46
31.6	410	1850	0.47
32.0	430	1920	0.47
32.5	640	2070	0.45
33.0	680	2310	0.45
33.5	760	2230	0.43
34.0	960	2120	0.37
34.5	1590	3030	0.31
35.0	1410	3390	0.39
35.5	1450	3630	0.40
36.0	1640	3330	0.34
36.5	1380	3760	0.42
37.0	1290	3330	0.41
37.5	1770	3910	0.37
38.0	1690	3630	0.36
38.5	1600	3560	0.37
39.0	2120	3630	0.24
39.5	1640	4060	0.40

Summary of Compressional Wave Velocity, Shear Wave Velocity, and Poisson's Ratio Based on Receiver-to-Receiver Travel Time Data - Borehole M-10DH

American Units				Metric Units			
Depth at Midpoint Between Receivers	Velocity		Poisson's Ratio	Depth at Midpoint Between Receivers	Velocity		Poisson's Ratio
	V_s	V_p			V_s	V_p	
(ft)	(ft/s)	(ft/s)		(m)	(m/s)	(m/s)	
131.2	5700	13330	0.39	40.0	1740	4060	0.39
132.9	4870	13330	0.42	40.5	1480	4060	0.42
133.9	6140	13330	0.37	40.8	1870	4060	0.37
136.2	5130	12580	0.40	41.5	1560	3830	0.40
137.8	6600	15150	0.38	42.0	2010	4620	0.38
139.4	5380	14180	0.42	42.5	1640	4320	0.42
141.1	4900	10930	0.37	43.0	1490	3330	0.37
142.7	6380	13070	0.34	43.5	1940	3980	0.34
144.4	8950	15150	0.23	44.0	2730	4620	0.23
146.0	5380	13610	0.41	44.5	1640	4150	0.41
147.6	6840	14490	0.36	45.0	2080	4420	0.36
149.3	8600	13890	0.19	45.5	2620	4230	0.19
150.9	7530	14810	0.33	46.0	2300	4520	0.33
152.6	6870	11900	0.25	46.5	2090	3630	0.25
154.2	6730	15500	0.38	47.0	2050	4730	0.38
155.8	7750	15150	0.32	47.5	2360	4620	0.32
157.5	10580	18520	0.26	48.0	3230	5640	0.26
159.1	10580	19050	0.28	48.5	3230	5810	0.28
160.8	10580	19610	0.29	49.0	3230	5980	0.29
162.4	10750	17540	0.20	49.5	3280	5350	0.20
164.0	8440	15870	0.30	50.0	2570	4840	0.30
165.7	11110	18020	0.19	50.5	3390	5490	0.19
167.3	8180	17540	0.36	51.0	2490	5350	0.36
169.0	10580	19050	0.28	51.5	3230	5810	0.28
170.6	10670	19610	0.29	52.0	3250	5980	0.29
172.2	10180	16670	0.20	52.5	3100	5080	0.20
173.9	7890	15870	0.34	53.0	2400	4840	0.34
175.5	8600	14810	0.25	53.5	2620	4520	0.25
177.2	9520	17540	0.29	54.0	2900	5350	0.29
178.8	8440	17540	0.35	54.5	2570	5350	0.35
180.5	9800	18020	0.29	55.0	2990	5490	0.29
182.1	10670	17540	0.21	55.5	3250	5350	0.21
183.7	8600	15500	0.28	56.0	2620	4730	0.28
185.4	7800	18020	0.38	56.5	2380	5490	0.38
187.0	8440	17540	0.35	57.0	2570	5350	0.35

Notes: "-" means no data available at that particular interval of depth.

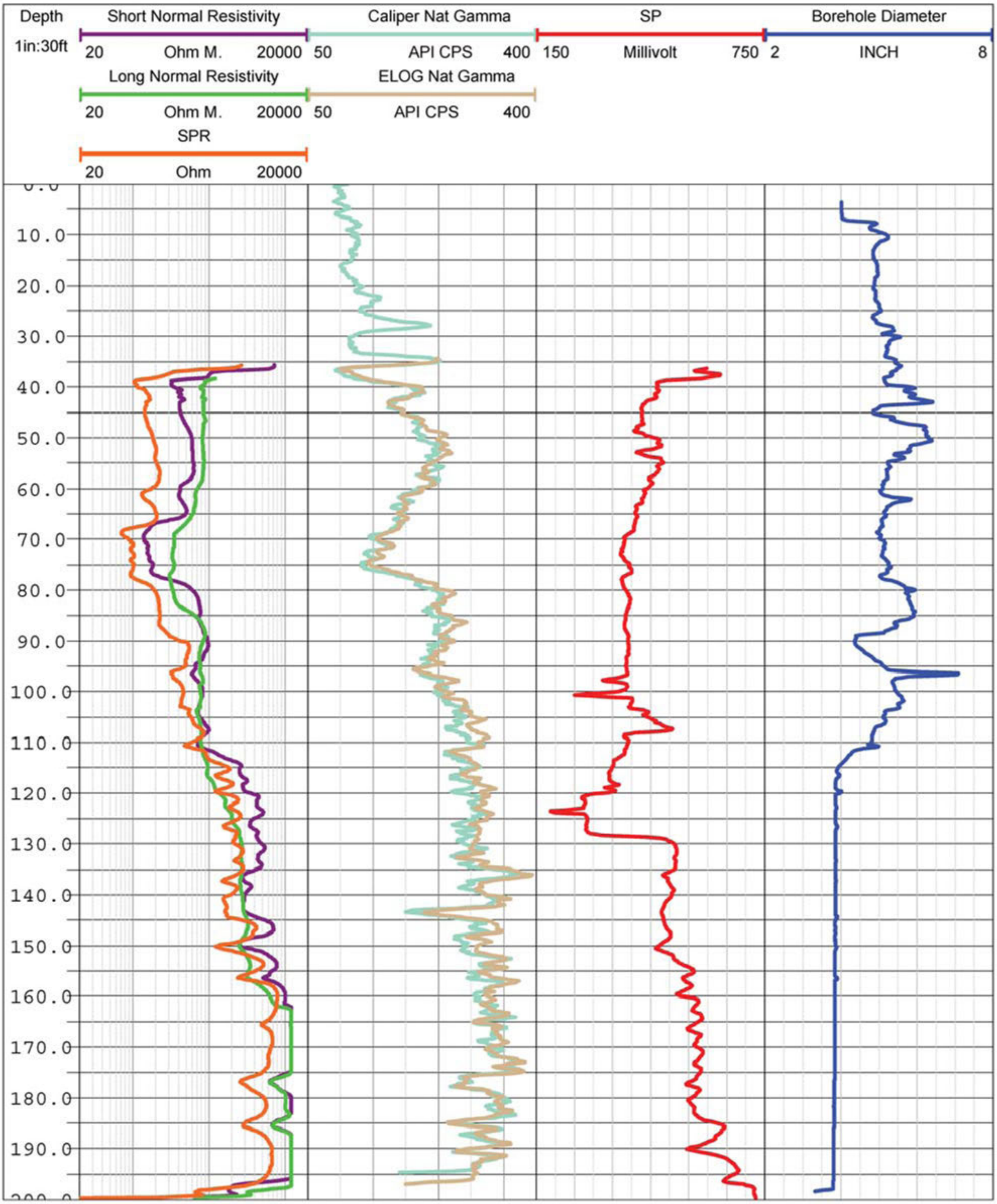


Figure 6: Boring M-10DH, Caliper, Natural gamma, Resistivity and SP logs

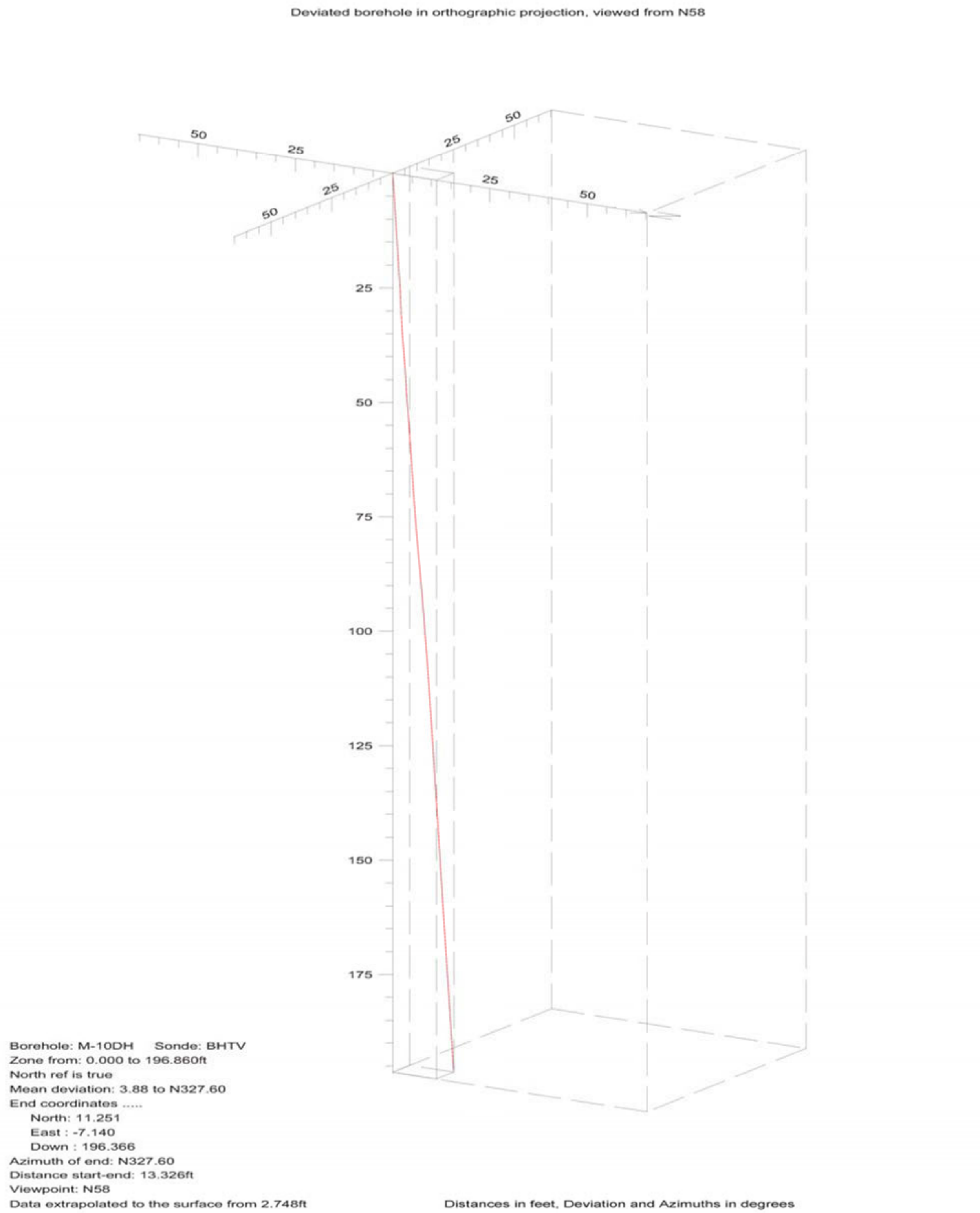


Figure 7. Boring M-10DH, Deviation Projection

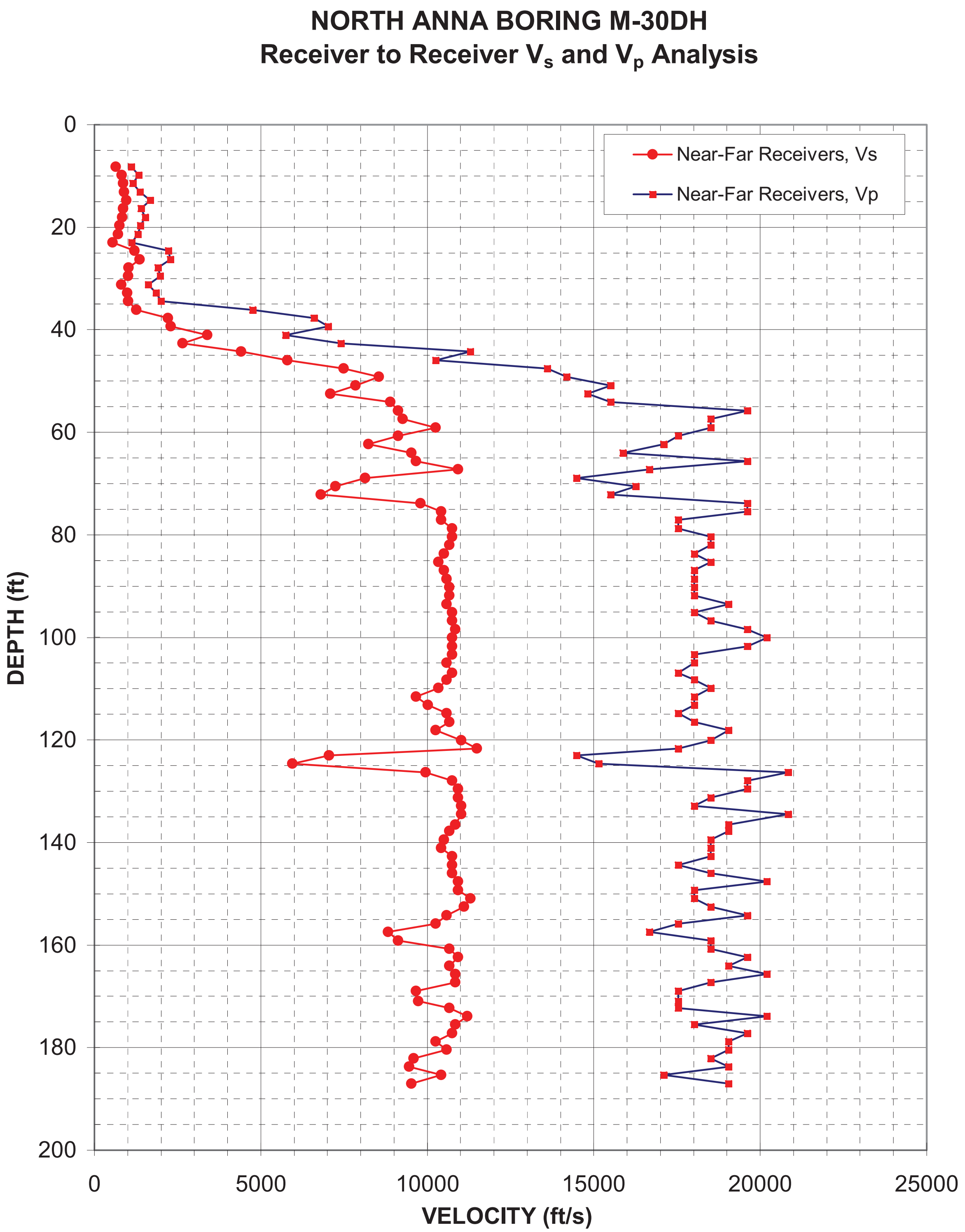


Figure 8: Boring M-30DH, Suspension R1-R2 P- and S_H-wave velocities

Table 6. Boring M-30DH, Suspension R1-R2 depths and P- and S_H-wave velocities

Summary of Compressional Wave Velocity, Shear Wave Velocity, and Poisson's Ratio
Based on Receiver-to-Receiver Travel Time Data - Borehole M-30DH

American Units				Metric Units			
Depth at Midpoint Between Receivers	Velocity		Poisson's Ratio	Depth at Midpoint Between Receivers	Velocity		Poisson's Ratio
	V_s	V_p			V_s	V_p	
(ft)	(ft/s)	(ft/s)		(m)	(m/s)	(m/s)	
8.2	650	1110	0.24	2.5	200	340	0.24
9.8	830	1330	0.18	3.0	250	400	0.18
11.5	870	1160	-	3.5	260	350	-
13.1	890	1380	0.13	4.0	270	420	0.13
14.8	960	1680	0.26	4.5	290	510	0.26
16.4	870	1410	0.19	5.0	260	430	0.19
18.0	840	1530	0.29	5.5	260	470	0.29
19.7	760	1390	0.29	6.0	230	420	0.29
21.3	710	1310	0.29	6.5	220	400	0.29
23.0	560	1130	0.34	7.0	170	340	0.34
24.6	1200	2220	0.29	7.5	370	680	0.29
26.3	1370	2280	0.22	8.0	420	700	0.22
27.9	1030	1900	0.29	8.5	310	580	0.29
29.5	1020	1980	0.32	9.0	310	600	0.32
31.2	810	1630	0.34	9.5	250	500	0.34
32.8	990	1850	0.30	10.0	300	560	0.30
34.5	1020	2010	0.33	10.5	310	610	0.33
36.1	1270	4760	0.46	11.0	390	1450	0.46
37.7	2210	6600	0.44	11.5	670	2010	0.44
39.4	2300	7020	0.44	12.0	700	2140	0.44
41.0	3400	5750	0.23	12.5	1040	1750	0.23
42.7	2660	7410	0.43	13.0	810	2260	0.43
44.3	4420	11300	0.41	13.5	1350	3440	0.41
45.9	5800	10260	0.27	14.0	1770	3130	0.27
47.6	7490	13610	0.28	14.5	2280	4150	0.28
49.2	8550	14180	0.21	15.0	2610	4320	0.21
50.9	7840	15500	0.33	15.5	2390	4730	0.33
52.5	7090	14810	0.35	16.0	2160	4520	0.35
54.1	8890	15500	0.26	16.5	2710	4730	0.26
55.8	9130	19610	0.36	17.0	2780	5980	0.36
57.4	9260	18520	0.33	17.5	2820	5640	0.33
59.1	10260	18520	0.28	18.0	3130	5640	0.28
60.7	9130	17540	0.31	18.5	2780	5350	0.31
62.3	8230	17090	0.35	19.0	2510	5210	0.35
64.0	9520	15870	0.22	19.5	2900	4840	0.22
65.6	9660	19610	0.34	20.0	2940	5980	0.34
67.3	10930	16670	0.12	20.5	3330	5080	0.12

Summary of Compressional Wave Velocity, Shear Wave Velocity, and Poisson's Ratio Based on Receiver-to-Receiver Travel Time Data - Borehole M-30DH

American Units				Metric Units			
Depth at Midpoint Between Receivers	Velocity		Poisson's Ratio	Depth at Midpoint Between Receivers	Velocity		Poisson's Ratio
	V_s	V_p			V_s	V_p	
(ft)	(ft/s)	(ft/s)		(m)	(m/s)	(m/s)	
68.9	8130	14490	0.27	21.0	2480	4420	0.27
70.5	7250	16260	0.38	21.5	2210	4960	0.38
72.2	6800	15500	0.38	22.0	2070	4730	0.38
73.8	9800	19610	0.33	22.5	2990	5980	0.33
75.5	10420	19610	0.30	23.0	3180	5980	0.30
77.1	10420	17540	0.23	23.5	3180	5350	0.23
78.7	10750	17540	0.20	24.0	3280	5350	0.20
80.4	10750	18520	0.25	24.5	3280	5640	0.25
82.0	10670	18520	0.25	25.0	3250	5640	0.25
83.7	10500	18020	0.24	25.5	3200	5490	0.24
85.3	10340	18520	0.27	26.0	3150	5640	0.27
86.9	10500	18020	0.24	26.5	3200	5490	0.24
88.6	10580	18020	0.24	27.0	3230	5490	0.24
90.2	10670	18020	0.23	27.5	3250	5490	0.23
91.9	10670	18020	0.23	28.0	3250	5490	0.23
93.5	10580	19050	0.28	28.5	3230	5810	0.28
95.1	10750	18020	0.22	29.0	3280	5490	0.22
96.8	10750	18520	0.25	29.5	3280	5640	0.25
98.4	10840	19610	0.28	30.0	3300	5980	0.28
100.1	10750	20200	0.30	30.5	3280	6160	0.30
101.7	10750	19610	0.28	31.0	3280	5980	0.28
103.4	10750	18020	0.22	31.5	3280	5490	0.22
105.0	10580	18020	0.24	32.0	3230	5490	0.24
107.0	10750	17540	0.20	32.6	3280	5350	0.20
108.3	10580	18020	0.24	33.0	3230	5490	0.24
109.9	10340	18520	0.27	33.5	3150	5640	0.27
111.6	9660	18020	0.30	34.0	2940	5490	0.30
113.2	10030	18020	0.28	34.5	3060	5490	0.28
114.8	10580	17540	0.21	35.0	3230	5350	0.21
116.5	10670	18020	0.23	35.5	3250	5490	0.23
118.1	10260	19050	0.30	36.0	3130	5810	0.30
120.1	11020	18520	0.23	36.6	3360	5640	0.23
121.7	11490	17540	0.12	37.1	3500	5350	0.12
123.0	7050	14490	0.34	37.5	2150	4420	0.34
124.7	5950	15150	0.41	38.0	1810	4620	0.41
126.3	9950	20830	0.35	38.5	3030	6350	0.35
128.0	10750	19610	0.28	39.0	3280	5980	0.28
129.6	10930	19610	0.27	39.5	3330	5980	0.27
131.2	10930	18520	0.23	40.0	3330	5640	0.23

Summary of Compressional Wave Velocity, Shear Wave Velocity, and Poisson's Ratio Based on Receiver-to-Receiver Travel Time Data - Borehole M-30DH

American Units				Metric Units			
Depth at Midpoint Between Receivers	Velocity		Poisson's Ratio	Depth at Midpoint Between Receivers	Velocity		Poisson's Ratio
	V_s	V_p			V_s	V_p	
(ft)	(ft/s)	(ft/s)		(m)	(m/s)	(m/s)	
132.9	11020	18020	0.20	40.5	3360	5490	0.20
134.5	11020	20830	0.31	41.0	3360	6350	0.31
136.5	10840	19050	0.26	41.6	3300	5810	0.26
137.8	10670	19050	0.27	42.0	3250	5810	0.27
139.4	10500	18520	0.26	42.5	3200	5640	0.26
141.1	10420	18520	0.27	43.0	3180	5640	0.27
142.7	10750	18520	0.25	43.5	3280	5640	0.25
144.4	10750	17540	0.20	44.0	3280	5350	0.20
146.0	10750	18520	0.25	44.5	3280	5640	0.25
147.6	10930	20200	0.29	45.0	3330	6160	0.29
149.3	10930	18020	0.21	45.5	3330	5490	0.21
150.9	11300	18020	0.18	46.0	3440	5490	0.18
152.6	11110	18520	0.22	46.5	3390	5640	0.22
154.2	10580	19610	0.29	47.0	3230	5980	0.29
155.8	10260	17540	0.24	47.5	3130	5350	0.24
157.5	8830	16670	0.30	48.0	2690	5080	0.30
159.1	9130	18520	0.34	48.5	2780	5640	0.34
160.8	10670	18520	0.25	49.0	3250	5640	0.25
162.4	10930	19610	0.27	49.5	3330	5980	0.27
164.0	10670	19050	0.27	50.0	3250	5810	0.27
165.7	10840	20200	0.30	50.5	3300	6160	0.30
167.3	10840	18520	0.24	51.0	3300	5640	0.24
169.0	9660	17540	0.28	51.5	2940	5350	0.28
170.9	9730	17540	0.28	52.1	2970	5350	0.28
172.2	10670	17540	0.21	52.5	3250	5350	0.21
173.9	11200	20200	0.28	53.0	3420	6160	0.28
175.5	10840	18020	0.22	53.5	3300	5490	0.22
177.2	10750	19610	0.28	54.0	3280	5980	0.28
178.8	10260	19050	0.30	54.5	3130	5810	0.30
180.5	10580	19050	0.28	55.0	3230	5810	0.28
182.1	9590	18520	0.32	55.5	2920	5640	0.32
183.7	9460	19050	0.34	56.0	2880	5810	0.34
185.4	10420	17090	0.20	56.5	3180	5210	0.20
187.0	9520	19050	0.33	57.0	2900	5810	0.33

Notes: "-" means no data available at that particular interval of depth.

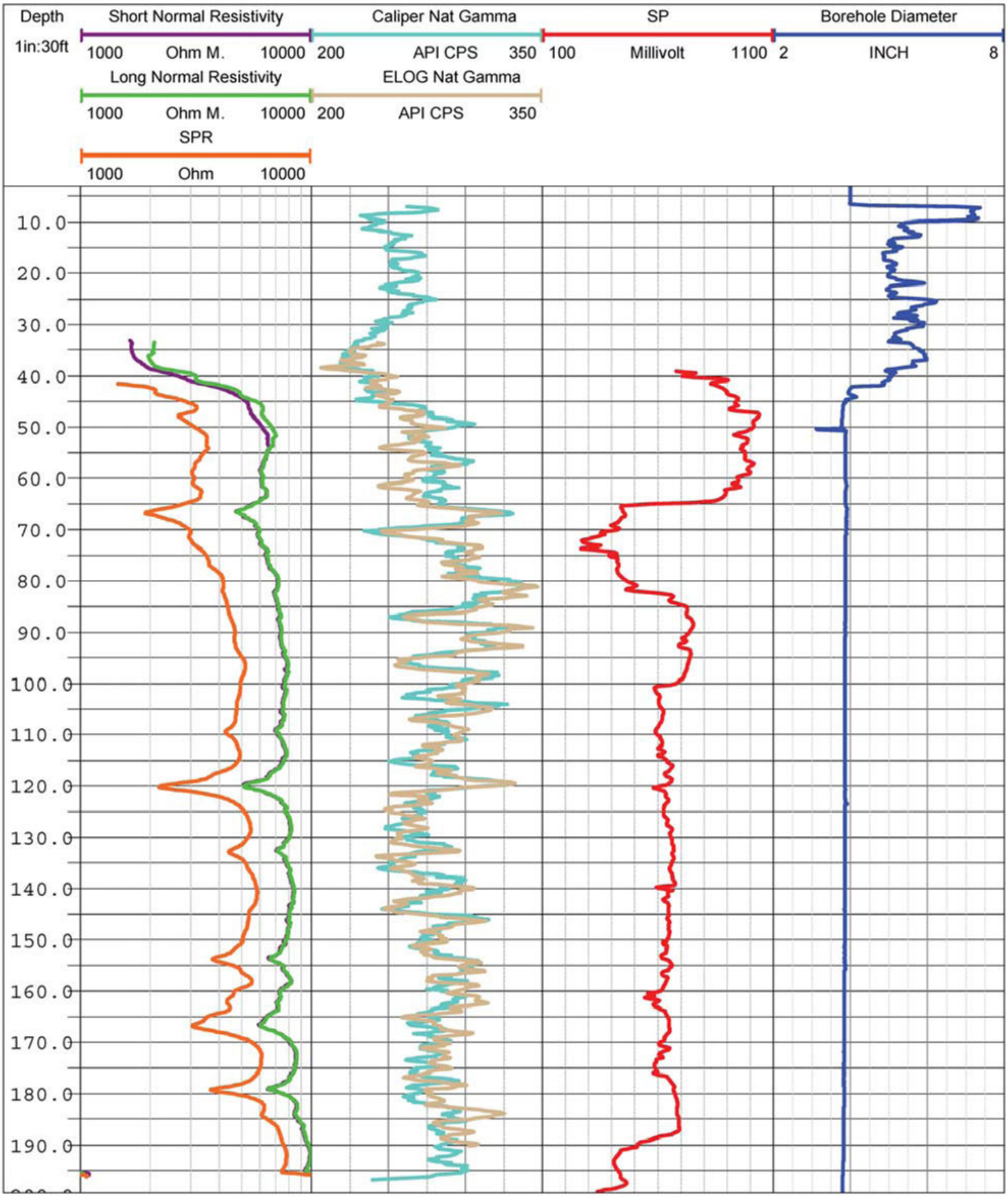


Figure 9. Boring M-30DH, Caliper, Natural gamma, Resistivity and SP logs

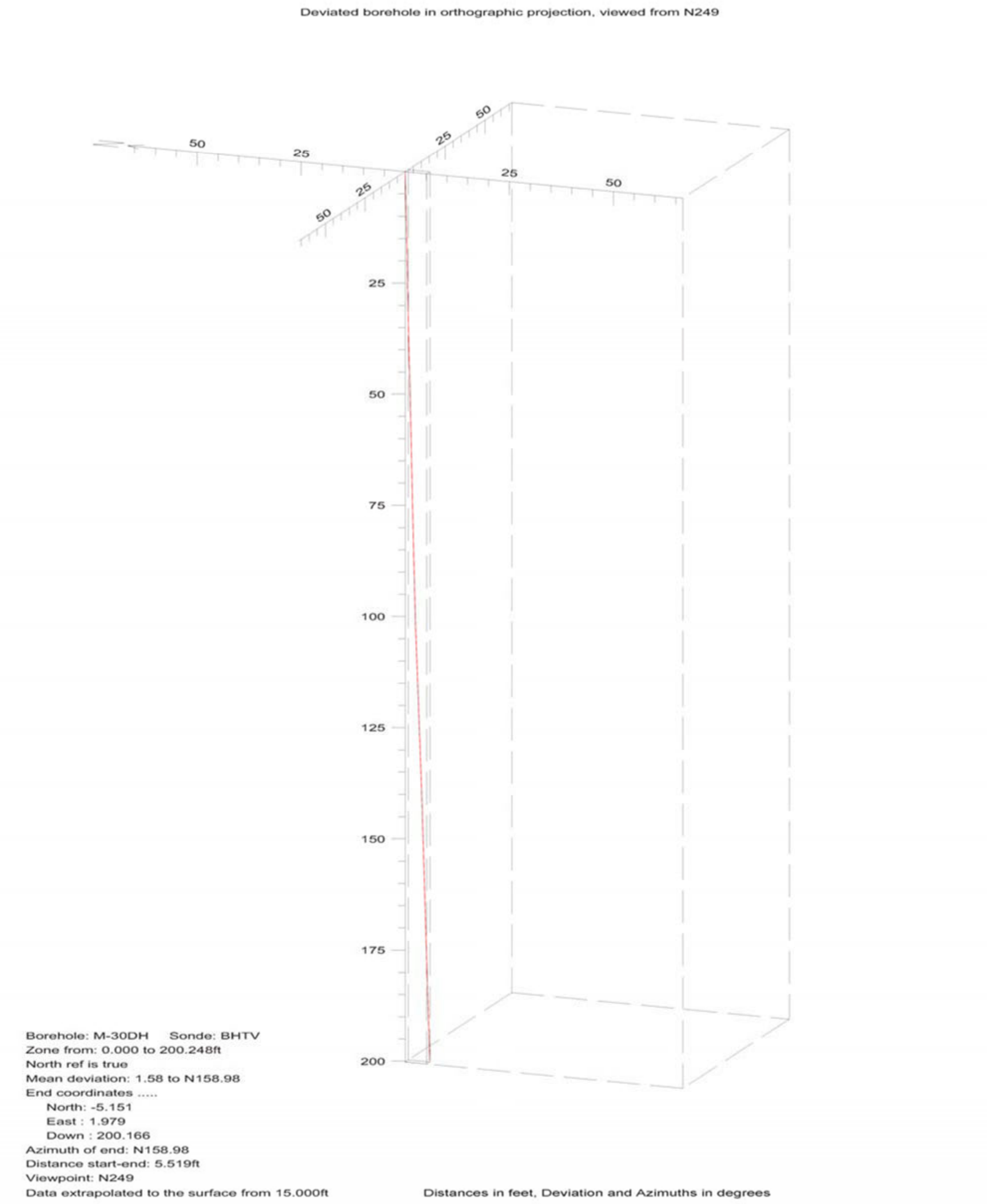


Figure 10. Boring M-30DH, Deviation Projection

APPENDIX A

SUSPENSION VELOCITY MEASUREMENT COMPARISON OF SOURCE TO RECEIVER 1 AND RECEIVER 1 TO RECEIVER 2 ANALYSIS RESULTS

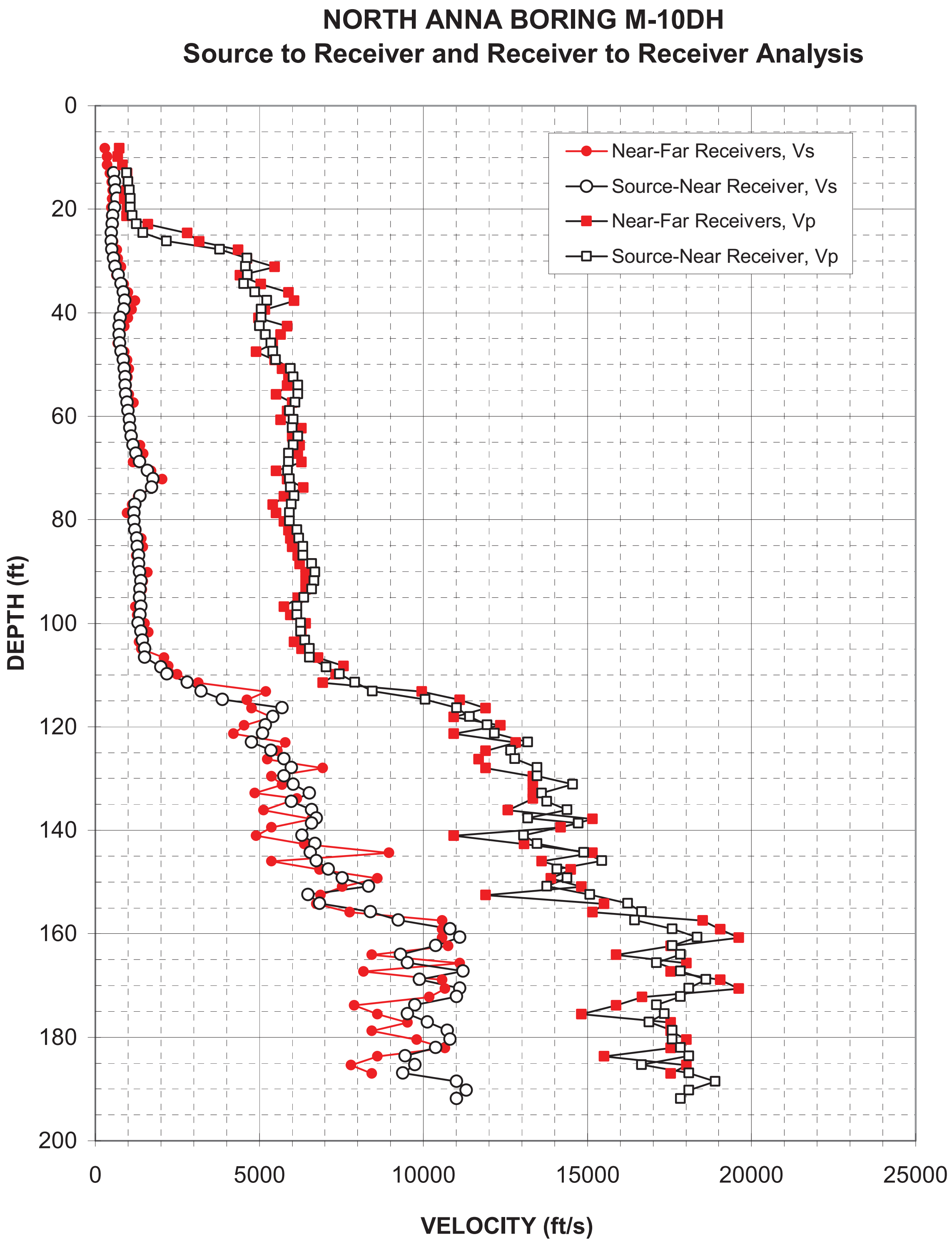


Figure A-1: Boring M-10DH, Suspension S-R1 P- and S_H-wave velocities

Table A-1. Boring M-10DH, Suspension S-R1 depths and P- and S_H-wave velocities

Summary of Compressional Wave Velocity, Shear Wave Velocity, and Poisson's Ratio
Based on Source-to-Receiver Travel Time Data - Borehole M-10DH

American Units				Metric Units			
Depth at Midpoint Between Source and Near Receiver	Velocity		Poisson's Ratio	Depth at Midpoint Between Source and Near Receiver	Velocity		Poisson's Ratio
	V_s	V_p			V_s	V_p	
(ft)	(ft/s)	(ft/s)		(m)	(m/s)	(m/s)	
13.0	570	960	0.23	4.0	170	290	0.23
14.7	590	1000	0.23	4.5	180	310	0.23
16.3	620	1040	0.22	5.0	190	320	0.22
18.0	660	1070	0.18	5.5	200	330	0.18
19.6	590	1070	0.28	6.0	180	330	0.28
21.2	540	1130	0.35	6.5	160	350	0.35
22.9	520	1260	0.40	7.0	160	380	0.40
24.5	490	1450	0.44	7.5	150	440	0.44
26.2	490	2170	0.47	8.0	150	660	0.47
27.8	510	3790	0.49	8.5	160	1160	0.49
29.4	570	4620	0.49	9.0	170	1410	0.49
31.1	600	4590	0.49	9.5	180	1400	0.49
32.7	710	4640	0.49	10.0	220	1410	0.49
34.4	790	4520	0.48	10.5	240	1380	0.48
36.0	860	4870	0.48	11.0	260	1480	0.48
37.6	910	5230	0.48	11.5	280	1590	0.48
39.3	880	5060	0.48	12.0	270	1540	0.48
40.9	760	5060	0.49	12.5	230	1540	0.49
42.6	730	5000	0.49	13.0	220	1530	0.49
44.2	730	5190	0.49	13.5	220	1580	0.49
45.8	750	5360	0.49	14.0	230	1640	0.49
47.5	780	5410	0.49	14.5	240	1650	0.49
49.1	860	5500	0.49	15.0	260	1680	0.49
50.8	890	5940	0.49	15.5	270	1810	0.49
52.4	910	6030	0.49	16.0	280	1840	0.49
54.0	910	6180	0.49	16.5	280	1880	0.49
55.7	920	6180	0.49	17.0	280	1880	0.49
57.3	980	6090	0.49	17.5	300	1860	0.49
59.0	1000	5920	0.49	18.0	310	1800	0.49
60.6	1040	6030	0.48	18.5	320	1840	0.48
62.2	1060	6000	0.48	19.0	320	1830	0.48
63.9	1100	6180	0.48	19.5	340	1880	0.48
65.5	1160	6030	0.48	20.0	350	1840	0.48
67.2	1230	5890	0.48	20.5	380	1790	0.48
68.8	1360	5890	0.47	21.0	410	1790	0.47
70.5	1590	5860	0.46	21.5	480	1790	0.46
72.1	1760	5920	0.45	22.0	540	1800	0.45
73.7	1720	5940	0.45	22.5	530	1810	0.45
75.4	1360	6060	0.47	23.0	410	1850	0.47
77.0	1210	5970	0.48	23.5	370	1820	0.48

Summary of Compressional Wave Velocity, Shear Wave Velocity, and Poisson's Ratio Based on Source-to-Receiver Travel Time Data - Borehole M-10DH

American Units				Metric Units			
Depth at Midpoint Between Source and Near Receiver	Velocity		Poisson's Ratio	Depth at Midpoint Between Source and Near Receiver	Velocity		Poisson's Ratio
	V_s	V_p			V_s	V_p	
(ft)	(ft/s)	(ft/s)		(m)	(m/s)	(m/s)	
78.7	1180	5920	0.48	24.0	360	1800	0.48
80.3	1180	5920	0.48	24.5	360	1800	0.48
81.9	1220	6150	0.48	25.0	370	1870	0.48
83.6	1270	6210	0.48	25.5	390	1890	0.48
85.2	1290	6330	0.48	26.0	390	1930	0.48
86.9	1320	6330	0.48	26.5	400	1930	0.48
88.5	1330	6590	0.48	27.0	400	2010	0.48
90.1	1360	6700	0.48	27.5	410	2040	0.48
91.8	1400	6660	0.48	28.0	430	2030	0.48
93.4	1370	6590	0.48	28.5	420	2010	0.48
95.1	1360	6360	0.48	29.0	410	1940	0.48
96.7	1400	6150	0.47	29.5	430	1870	0.47
98.3	1370	6150	0.47	30.0	420	1870	0.47
100.0	1320	6270	0.48	30.5	400	1910	0.48
101.6	1400	6270	0.47	31.0	430	1910	0.47
103.3	1440	6390	0.47	31.5	440	1950	0.47
104.9	1500	6530	0.47	32.0	460	1990	0.47
106.5	1510	6530	0.47	32.5	460	1990	0.47
108.5	2000	7030	0.46	33.1	610	2140	0.46
109.8	2180	7450	0.45	33.5	670	2270	0.45
111.5	2800	7910	0.43	34.0	850	2410	0.43
113.1	3230	8440	0.41	34.5	980	2570	0.41
114.7	3880	10050	0.41	35.0	1180	3060	0.41
116.4	5700	11010	0.32	35.5	1740	3360	0.32
118.0	5410	11410	0.35	36.0	1650	3480	0.35
119.7	5190	11940	0.38	36.5	1580	3640	0.38
121.3	5100	12170	0.39	37.0	1560	3710	0.39
122.9	4760	13190	0.43	37.5	1450	4020	0.43
124.6	5360	12660	0.39	38.0	1640	3860	0.39
126.2	5750	12790	0.37	38.5	1750	3900	0.37
127.9	5970	13470	0.38	39.0	1820	4110	0.38
129.5	5750	13470	0.39	39.5	1750	4110	0.39
131.1	6030	14550	0.40	40.0	1840	4440	0.40
132.8	6530	13610	0.35	40.5	1990	4150	0.35
134.4	5970	13760	0.38	41.0	1820	4190	0.38
136.1	6590	14390	0.37	41.5	2010	4380	0.37
137.7	6730	13190	0.32	42.0	2050	4020	0.32
138.7	6590	14720	0.37	42.3	2010	4490	0.37
141.0	6300	13050	0.35	43.0	1920	3980	0.35
142.6	6700	13470	0.34	43.5	2040	4110	0.34
144.3	6560	14890	0.38	44.0	2000	4540	0.38
145.9	6730	15440	0.38	44.5	2050	4710	0.38

Summary of Compressional Wave Velocity, Shear Wave Velocity, and Poisson's Ratio Based on Source-to-Receiver Travel Time Data - Borehole M-10DH

American Units			
Depth at Midpoint Between Source and Near Receiver	Velocity		Poisson's Ratio
	V_s	V_p	
(ft)	(ft/s)	(ft/s)	
147.6	7110	14070	0.33
149.2	7540	14390	0.31
150.8	8330	13760	0.21
152.5	6490	15070	0.39
154.1	6840	16230	0.39
155.8	8380	16660	0.33
157.4	9240	16440	0.27
159.0	10820	17580	0.20
160.7	11110	18350	0.21
162.3	10380	17580	0.23
164.0	9310	17830	0.31
165.6	9520	17110	0.28
167.2	11200	17830	0.17
168.9	9890	18620	0.30
170.5	11110	18090	0.20
172.2	11010	17830	0.19
173.8	9740	17110	0.26
175.4	9520	17340	0.28
177.1	10130	16880	0.22
178.7	10730	17580	0.20
180.4	10820	17580	0.20
182.0	10380	17830	0.24
183.6	9450	18090	0.31
185.3	9740	16660	0.24
186.9	9380	18090	0.32
188.6	11010	18900	0.24
190.2	11300	18090	0.18
191.8	11010	17830	0.19

Metric Units			
Depth at Midpoint Between Source and Near Receiver	Velocity		Poisson's Ratio
	V_s	V_p	
(m)	(m/s)	(m/s)	
45.0	2170	4290	0.33
45.5	2300	4380	0.31
46.0	2540	4190	0.21
46.5	1980	4590	0.39
47.0	2090	4950	0.39
47.5	2560	5080	0.33
48.0	2820	5010	0.27
48.5	3300	5360	0.20
49.0	3380	5590	0.21
49.5	3160	5360	0.23
50.0	2840	5430	0.31
50.5	2900	5210	0.28
51.0	3410	5430	0.17
51.5	3010	5670	0.30
52.0	3380	5510	0.20
52.5	3360	5430	0.19
53.0	2970	5210	0.26
53.5	2900	5290	0.28
54.0	3090	5150	0.22
54.5	3270	5360	0.20
55.0	3300	5360	0.20
55.5	3160	5430	0.24
56.0	2880	5510	0.31
56.5	2970	5080	0.24
57.0	2860	5510	0.32
57.5	3360	5760	0.24
58.0	3450	5510	0.18
58.5	3360	5430	0.19

Notes: "-" means no data available at that particular interval of depth.

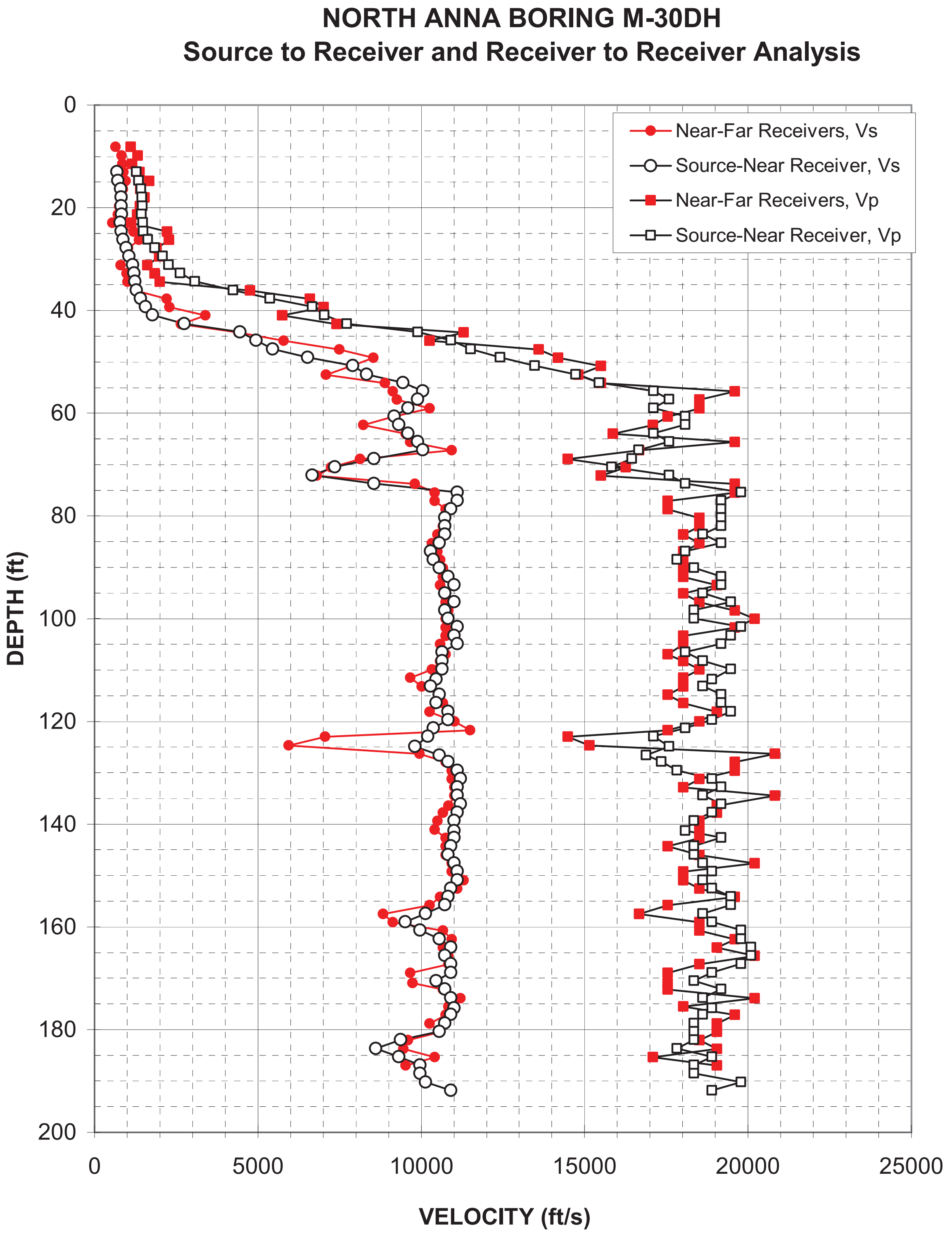


Figure A-2: Boring M-30DH, Suspension S-R1 P- and S_H-wave velocities

Table A-2. Boring M-30DH, Suspension S-R1 depths and P- and S_H-wave velocities

Summary of Compressional Wave Velocity, Shear Wave Velocity, and Poisson's Ratio Based on Source-to-Receiver Travel Time Data - Borehole M-30DH

American Units				Metric Units			
Depth at Midpoint Between Source and Near Receiver	Velocity		Poisson's Ratio	Depth at Midpoint Between Source and Near Receiver	Velocity		Poisson's Ratio
	V_s	V_p			V_s	V_p	
(ft)	(ft/s)	(ft/s)		(m)	(m/s)	(m/s)	
13.0	690	1280	0.30	4.0	210	390	0.30
14.7	720	1350	0.30	4.5	220	410	0.30
16.3	800	1430	0.27	5.0	240	430	0.27
18.0	820	1460	0.27	5.5	250	440	0.27
19.6	820	1470	0.27	6.0	250	450	0.27
21.2	840	1440	0.24	6.5	260	440	0.24
22.9	790	1480	0.30	7.0	240	450	0.30
24.5	820	1500	0.29	7.5	250	460	0.29
26.2	880	1630	0.30	8.0	270	500	0.30
27.8	970	1850	0.31	8.5	300	560	0.31
29.4	1060	2080	0.32	9.0	320	630	0.32
31.1	1170	2270	0.32	9.5	360	690	0.32
32.7	1220	2620	0.36	10.0	370	800	0.36
34.4	1250	3070	0.40	10.5	380	940	0.40
36.0	1280	4250	0.45	11.0	390	1290	0.45
37.6	1410	5360	0.46	11.5	430	1640	0.46
39.3	1570	6660	0.47	12.0	480	2030	0.47
40.9	1780	7030	0.47	12.5	540	2140	0.47
42.6	2750	7720	0.43	13.0	840	2350	0.43
44.2	4460	9890	0.37	13.5	1360	3010	0.37
45.8	4950	10910	0.37	14.0	1510	3330	0.37
47.5	5460	11510	0.35	14.5	1660	3510	0.35
49.1	6530	12410	0.31	15.0	1990	3780	0.31
50.8	7910	13470	0.24	15.5	2410	4110	0.24
52.4	8330	14720	0.26	16.0	2540	4490	0.26
54.0	9450	15440	0.20	16.5	2880	4710	0.20
55.7	10050	17110	0.24	17.0	3060	5210	0.24
57.3	9890	17580	0.27	17.5	3010	5360	0.27
59.0	9590	17110	0.27	18.0	2920	5210	0.27
60.6	9170	18090	0.33	18.5	2800	5510	0.33
62.2	9310	18090	0.32	19.0	2840	5510	0.32
63.9	9590	17110	0.27	19.5	2920	5210	0.27
65.5	9890	17580	0.27	20.0	3010	5360	0.27
67.2	10050	16660	0.21	20.5	3060	5080	0.21
68.8	8550	16440	0.31	21.0	2610	5010	0.31
70.5	7360	15830	0.36	21.5	2240	4820	0.36
72.1	6660	17580	0.42	22.0	2030	5360	0.42
73.7	8550	18090	0.36	22.5	2610	5510	0.36
75.4	11110	19780	0.27	23.0	3380	6030	0.27
77.0	11110	19180	0.25	23.5	3380	5850	0.25

Summary of Compressional Wave Velocity, Shear Wave Velocity, and Poisson's Ratio Based on Source-to-Receiver Travel Time Data - Borehole M-30DH

American Units				Metric Units			
Depth at Midpoint Between Source and Near Receiver	Velocity V_s	Velocity V_p	Poisson's Ratio	Depth at Midpoint Between Source and Near Receiver	Velocity V_s	Velocity V_p	Poisson's Ratio
(ft)	(ft/s)	(ft/s)		(m)	(m/s)	(m/s)	
78.7	10910	19180	0.26	24.0	3330	5850	0.26
80.3	10730	19180	0.27	24.5	3270	5850	0.27
81.9	10730	19180	0.27	25.0	3270	5850	0.27
83.6	10730	18620	0.25	25.5	3270	5670	0.25
85.2	10550	19180	0.28	26.0	3220	5850	0.28
86.9	10290	18090	0.26	26.5	3140	5510	0.26
88.5	10380	17830	0.24	27.0	3160	5430	0.24
90.1	10550	18350	0.25	27.5	3220	5590	0.25
91.8	10820	19180	0.27	28.0	3300	5850	0.27
93.4	11010	19180	0.25	28.5	3360	5850	0.25
95.1	10730	18620	0.25	29.0	3270	5670	0.25
96.7	11010	19480	0.27	29.5	3360	5940	0.27
98.3	10730	18350	0.24	30.0	3270	5590	0.24
100.0	10820	18350	0.23	30.5	3300	5590	0.23
101.6	11110	19780	0.27	31.0	3380	6030	0.27
103.3	11010	19480	0.27	31.5	3360	5940	0.27
104.9	11110	19180	0.25	32.0	3380	5850	0.25
106.5	10640	18090	0.24	32.5	3240	5510	0.24
108.2	10640	18620	0.26	33.0	3240	5670	0.26
109.8	10640	19480	0.29	33.5	3240	5940	0.29
111.8	10460	18900	0.28	34.1	3190	5760	0.28
113.1	10290	18620	0.28	34.5	3140	5670	0.28
114.7	10550	19180	0.28	35.0	3220	5850	0.28
116.4	10460	19180	0.29	35.5	3190	5850	0.29
118.0	10820	19480	0.28	36.0	3300	5940	0.28
119.7	10820	18900	0.26	36.5	3300	5760	0.26
121.3	10380	18090	0.25	37.0	3160	5510	0.25
122.9	10210	17110	0.22	37.5	3110	5210	0.22
124.9	9810	17580	0.27	38.1	2990	5360	0.27
126.6	10550	16880	0.18	38.6	3220	5150	0.18
127.9	10820	17340	0.18	39.0	3300	5290	0.18
129.5	11110	17830	0.18	39.5	3380	5430	0.18
131.1	11200	18900	0.23	40.0	3410	5760	0.23
132.8	11110	19180	0.25	40.5	3380	5850	0.25
134.4	11110	18620	0.22	41.0	3380	5670	0.22
136.1	11200	19180	0.24	41.5	3410	5850	0.24
137.7	11110	18900	0.24	42.0	3380	5760	0.24
139.3	11010	18350	0.22	42.5	3360	5590	0.22
141.3	11010	18090	0.21	43.1	3360	5510	0.21
142.6	11010	19180	0.25	43.5	3360	5850	0.25
144.3	10910	18350	0.23	44.0	3330	5590	0.23
145.9	10820	18350	0.23	44.5	3300	5590	0.23

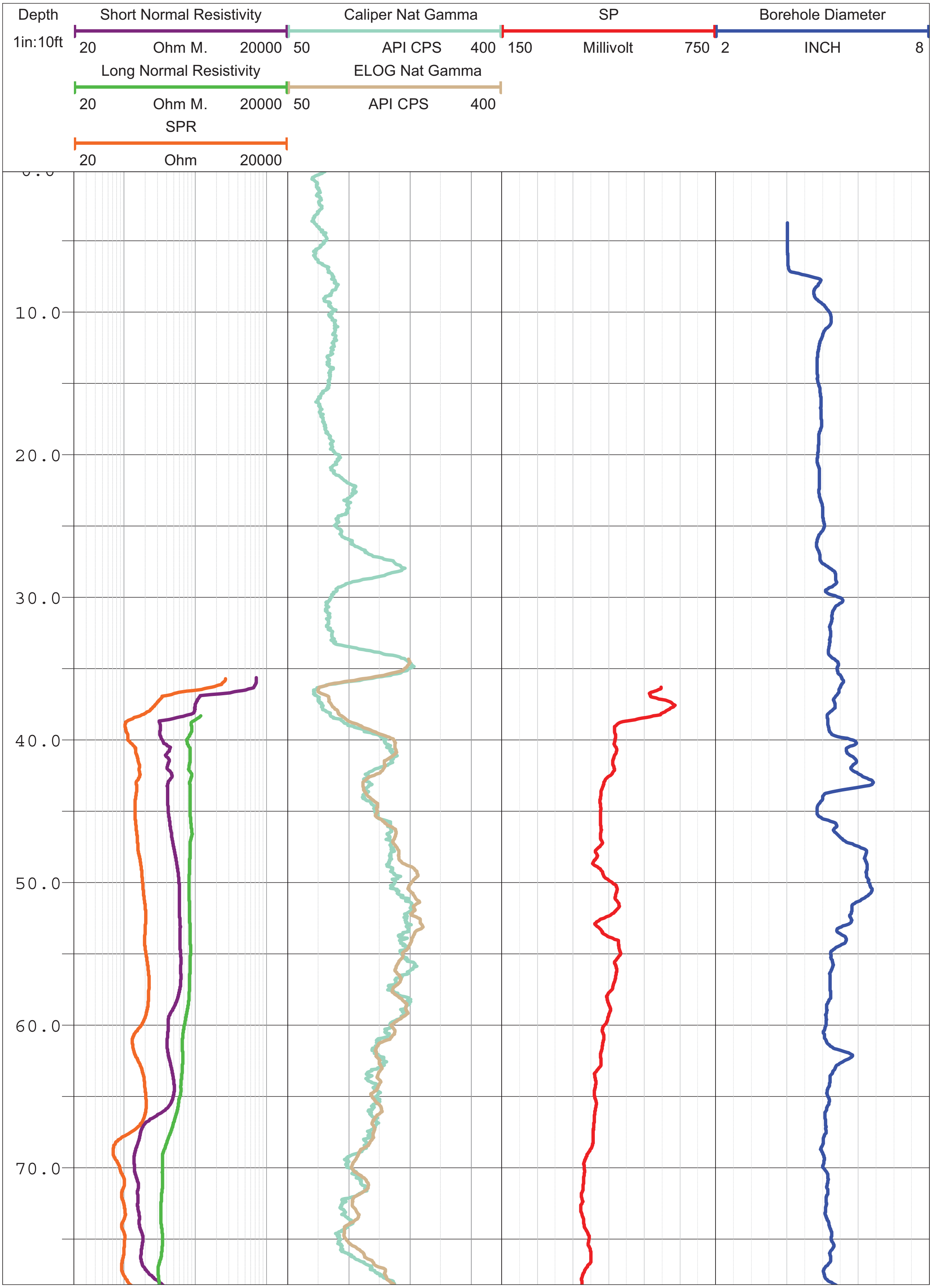
Summary of Compressional Wave Velocity, Shear Wave Velocity, and Poisson's Ratio Based on Source-to-Receiver Travel Time Data - Borehole M-30DH

American Units				Metric Units			
Depth at Midpoint Between Source and Near Receiver	Velocity		Poisson's Ratio	Depth at Midpoint Between Source and Near Receiver	Velocity		Poisson's Ratio
	V_s	V_p			V_s	V_p	
(ft)	(ft/s)	(ft/s)		(m)	(m/s)	(m/s)	
147.6	11010	18620	0.23	45.0	3360	5670	0.23
149.2	11110	18900	0.24	45.5	3380	5760	0.24
150.8	11110	18620	0.22	46.0	3380	5670	0.22
152.5	10910	18900	0.25	46.5	3330	5760	0.25
154.1	10820	19480	0.28	47.0	3300	5940	0.28
155.8	10730	19480	0.28	47.5	3270	5940	0.28
157.4	10130	18620	0.29	48.0	3090	5670	0.29
159.0	9520	18900	0.33	48.5	2900	5760	0.33
160.7	9970	19780	0.33	49.0	3040	6030	0.33
162.3	10550	19780	0.30	49.5	3220	6030	0.30
164.0	10910	20100	0.29	50.0	3330	6130	0.29
165.6	10730	20100	0.30	50.5	3270	6130	0.30
167.2	10910	19780	0.28	51.0	3330	6030	0.28
168.9	10910	18900	0.25	51.5	3330	5760	0.25
170.5	10460	18350	0.26	52.0	3190	5590	0.26
172.2	10730	19180	0.27	52.5	3270	5850	0.27
173.8	10910	18620	0.24	53.0	3330	5670	0.24
175.8	11010	18900	0.24	53.6	3360	5760	0.24
177.1	10910	18620	0.24	54.0	3330	5670	0.24
178.7	10730	18350	0.24	54.5	3270	5590	0.24
180.4	10550	18350	0.25	55.0	3220	5590	0.25
182.0	9380	18350	0.32	55.5	2860	5590	0.32
183.6	8610	17830	0.35	56.0	2630	5430	0.35
185.3	9310	18900	0.34	56.5	2840	5760	0.34
186.9	9970	18350	0.29	57.0	3040	5590	0.29
188.6	9970	18350	0.29	57.5	3040	5590	0.29
190.2	10130	19780	0.32	58.0	3090	6030	0.32
191.8	10910	18900	0.25	58.5	3330	5760	0.25

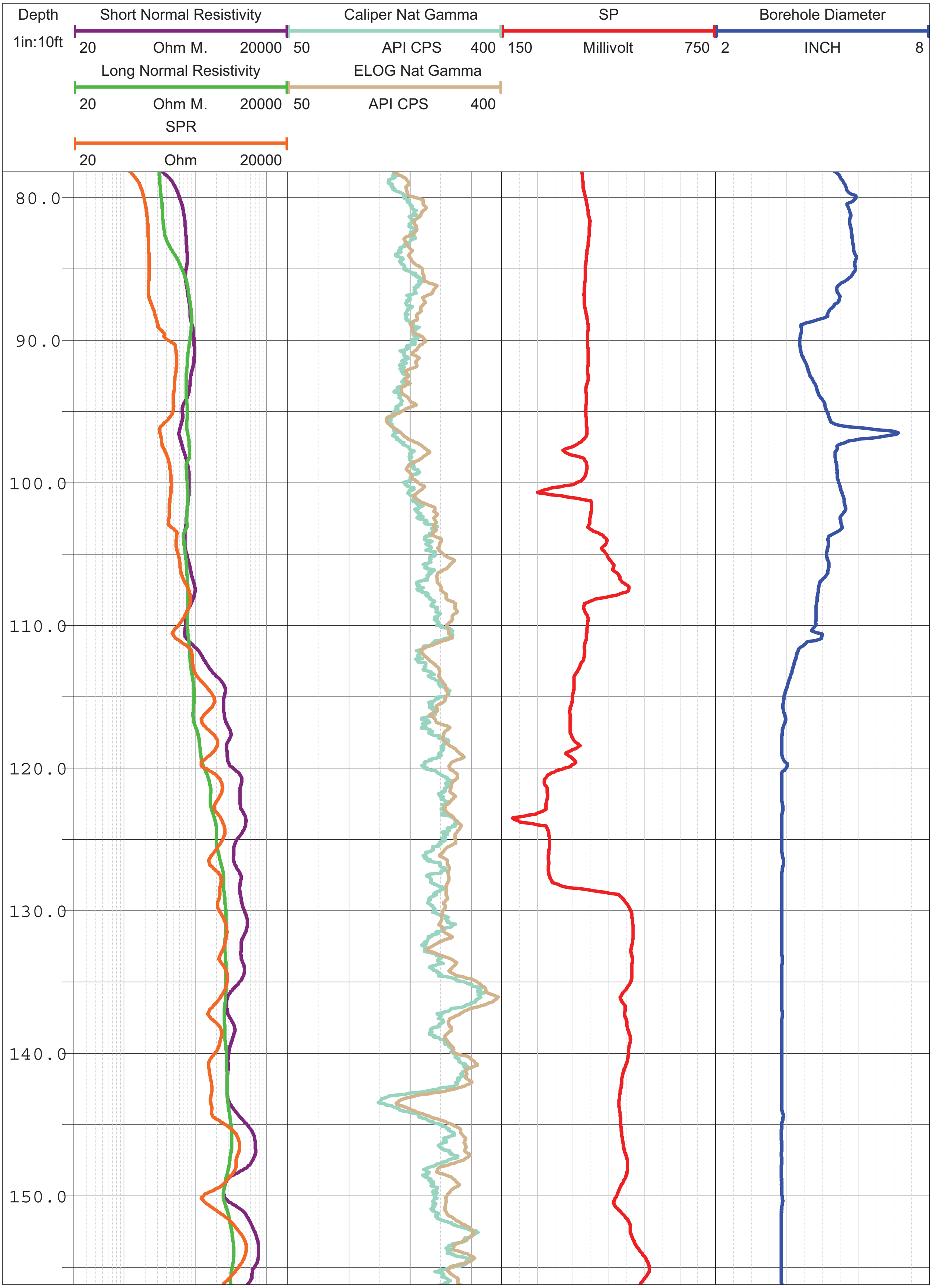
Notes: "-" means no data available at that particular interval of depth.

APPENDIX B

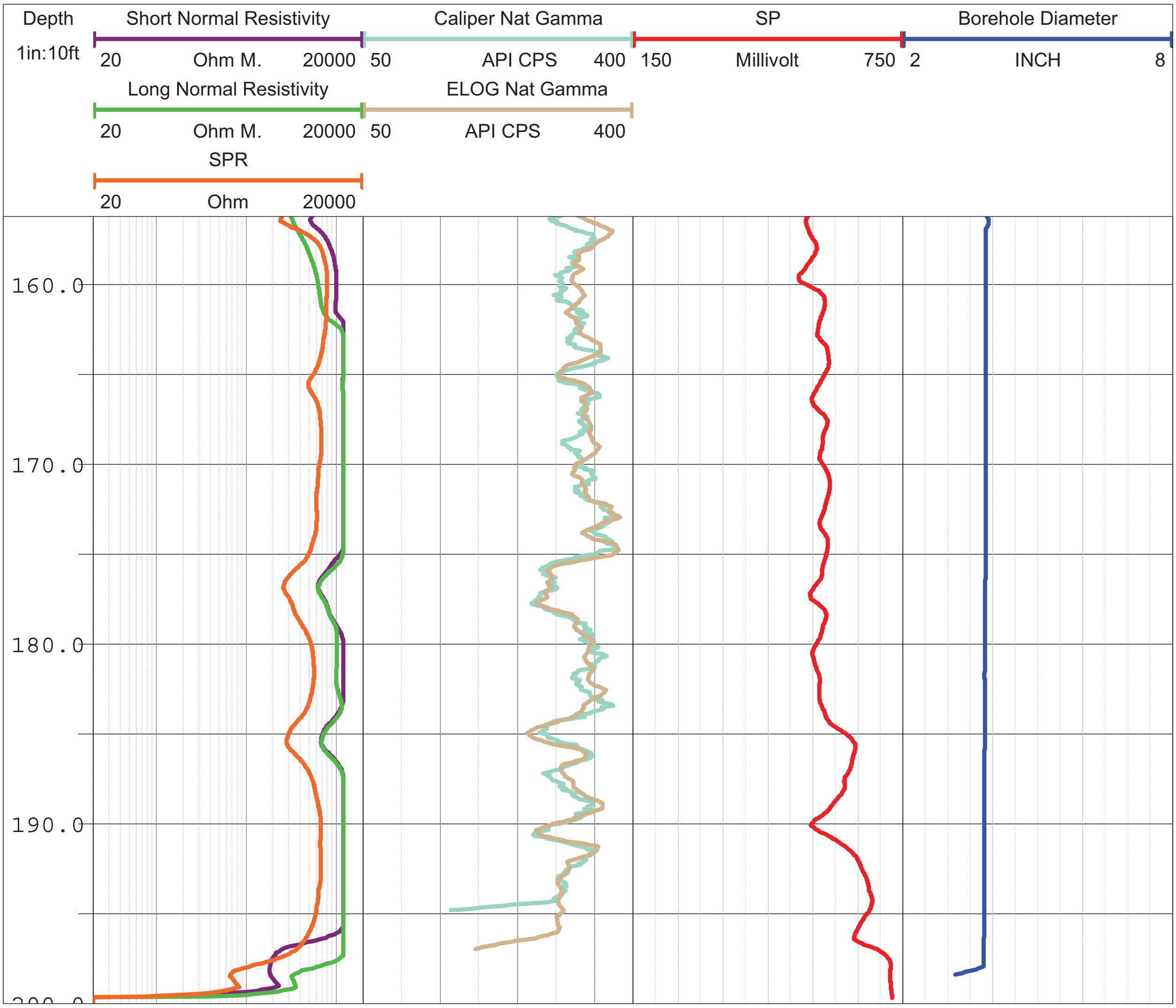
CALIPER, NATURAL GAMMA, RESISTIVITY, AND SPONTANEOUS POTENTIAL LOGS



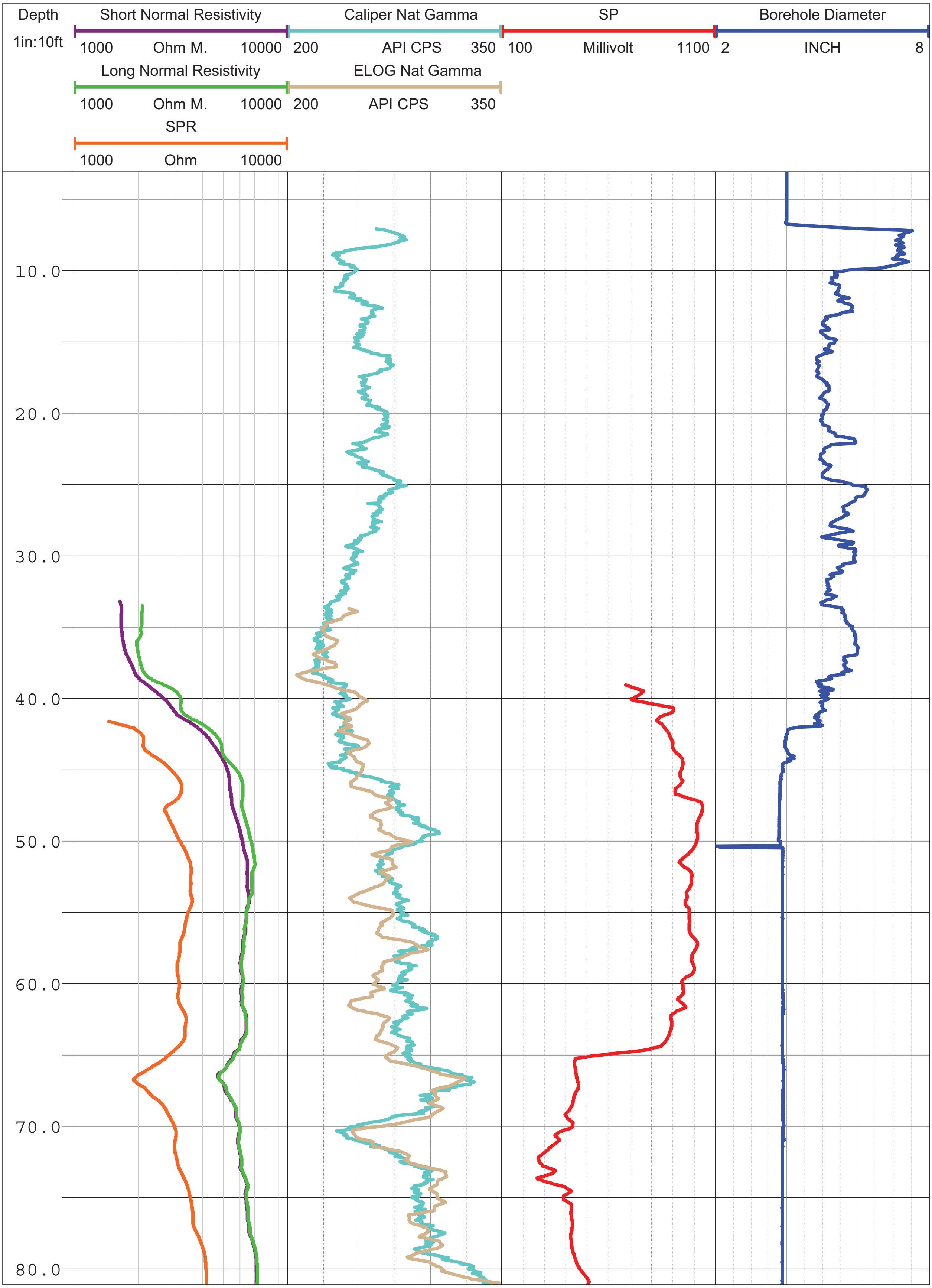
North Anna Boring M-10DH ELOG, Caliper and Natural Gamma rev 1 Sheet 1 of 3



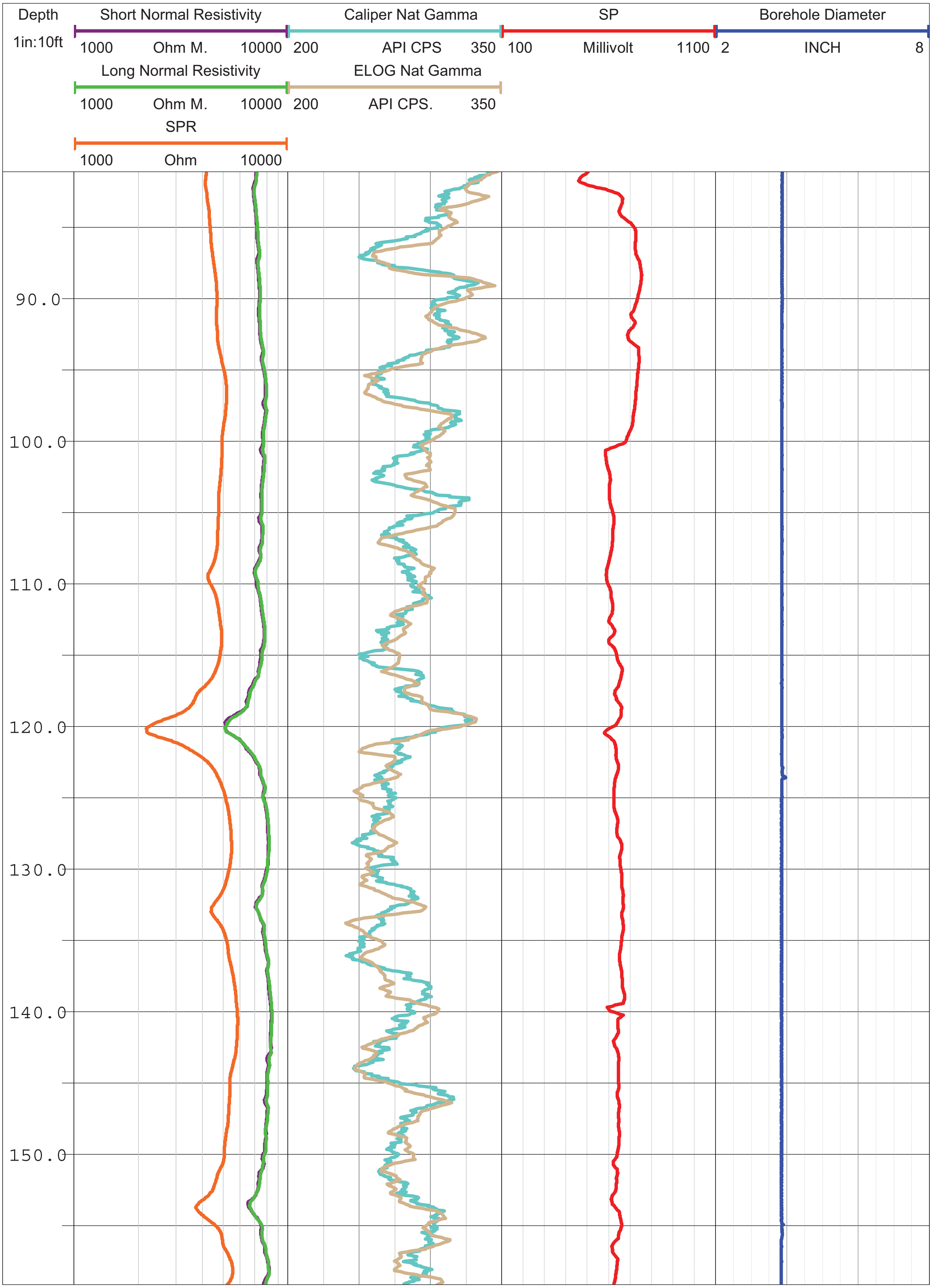
North Anna Boring M-10DH ELOG, Caliper and Natural Gamma rev 1 Sheet 2 of 3



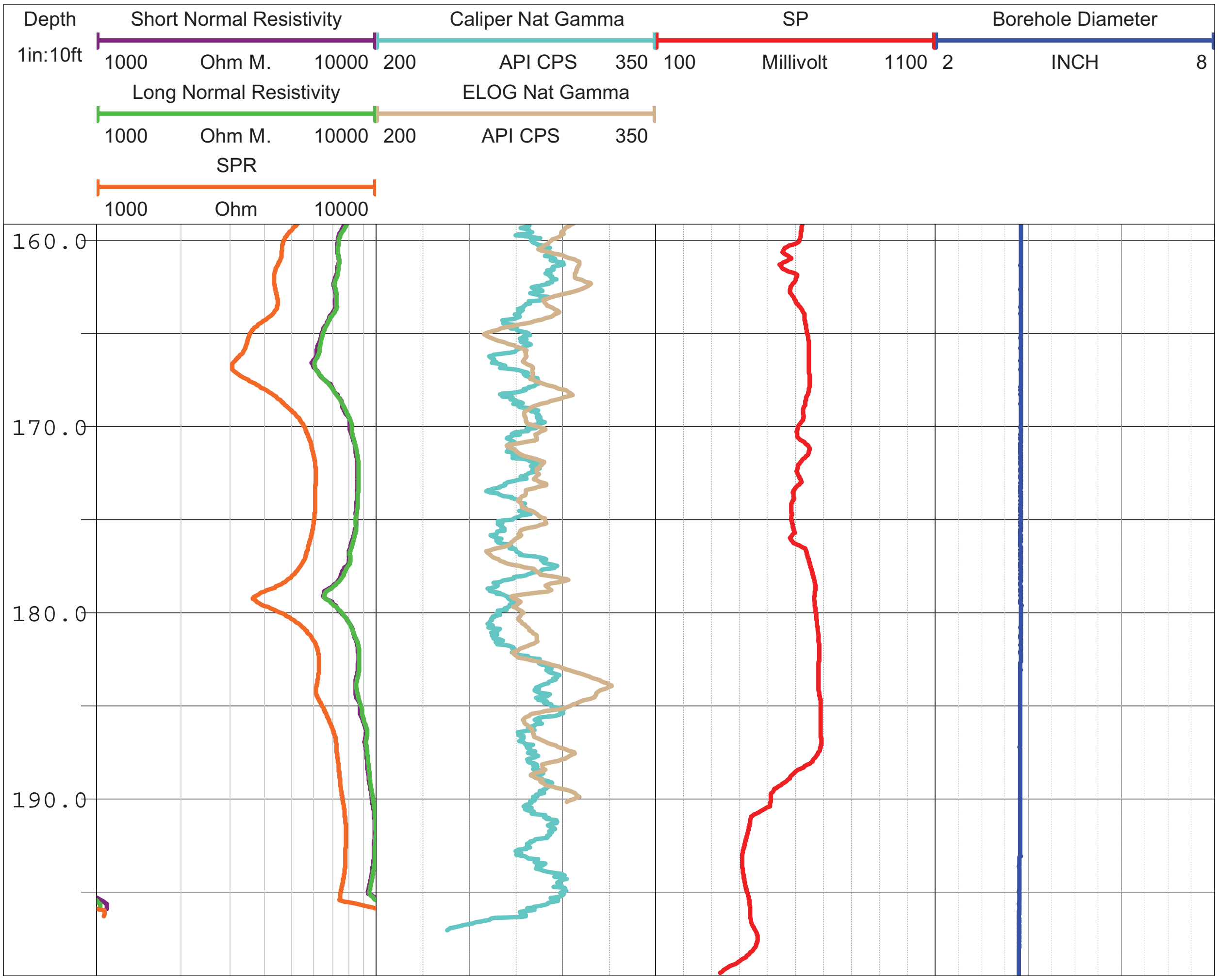
North Anna Boring M-10DH ELOG, Caliper and Natural Gamma rev 1 Sheet 3 of 3



North Anna Boring M-30DH ELOG, Caliper and Natural Gamma rev 1 Sheet 1 of 3



North Anna Boring M-30DH ELOG, Caliper and Natural Gamma rev 1 Sheet 2 of 3



North Anna Boring M-30DH ELOG, Caliper and Natural Gamma rev 1 Sheet 3 of 3

APPENDIX C

ACOUSTIC TELEVIEWER DIP LOGS

BHTV DATA PROCESSING
RGLDIP vsn 6.2
INTERPRETED BHTV DIPS LOG

MACTEC

Borehole: M-10DH

NORTH ANNA

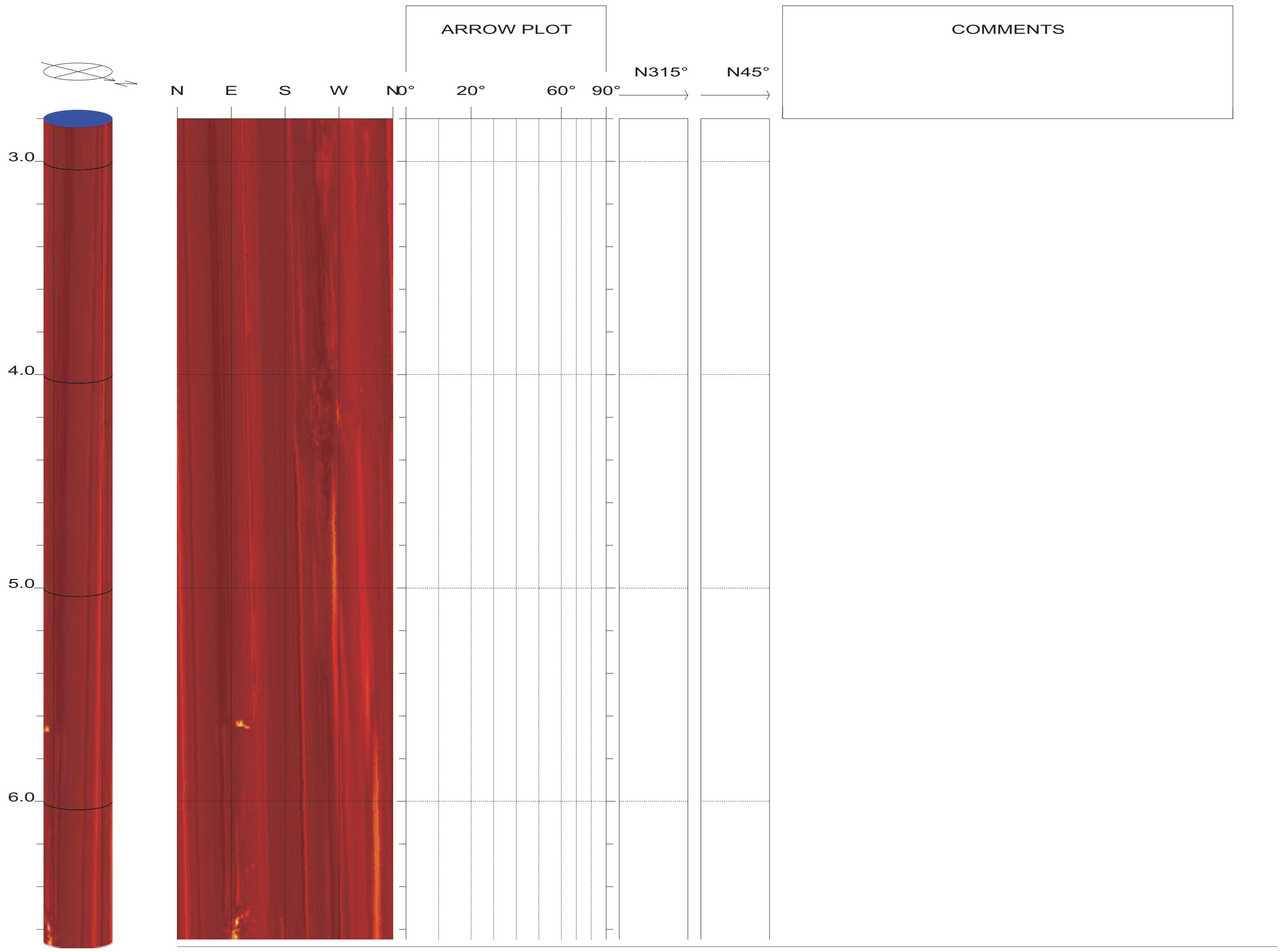
top of borehole.....	North ref. is true
East: _	Depth units are feet
North:_	Vertical scale: 1/10
Elev: _	Horiz scale = 1.00x Vert scale

Zone from 196.896 to 2.800ft	Borehole diam: 3.860inch
Format: BHTV-NESWN	Vertical = borehole-axis
	Image: Amplitude

Stratigraphic dips

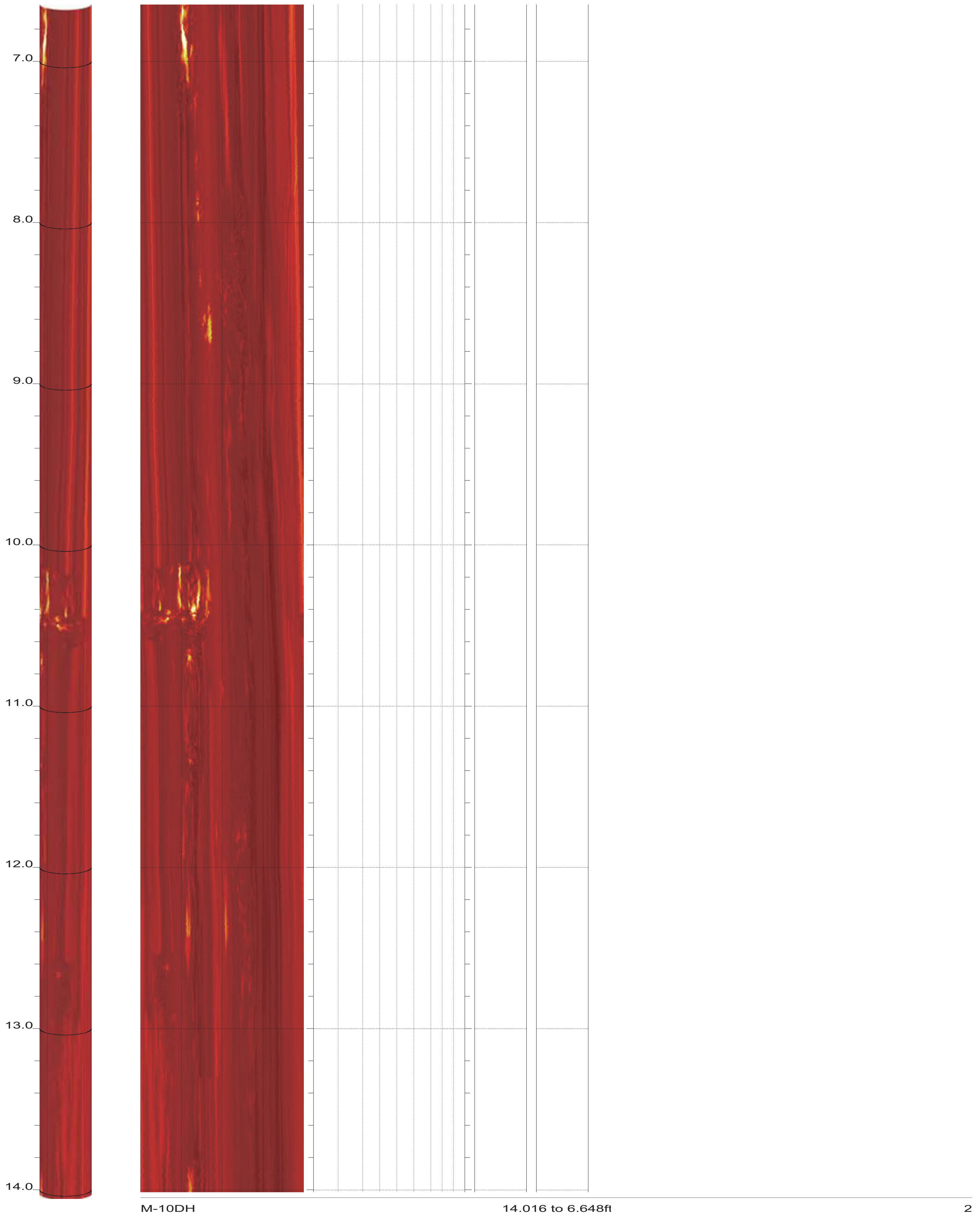
Non-stratigraphic dips

Identified units

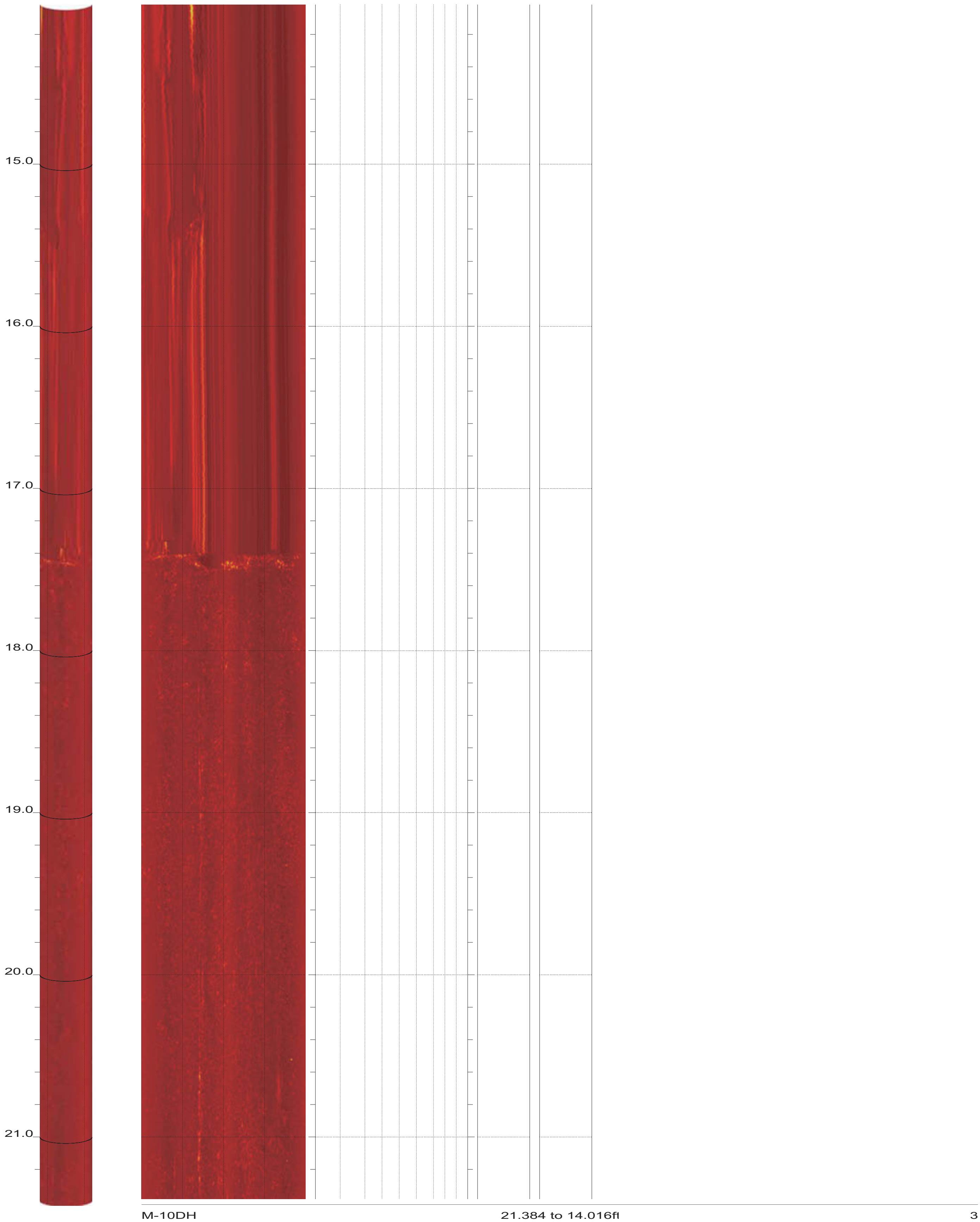


M-10DH 6.648 to 2.800ft 1

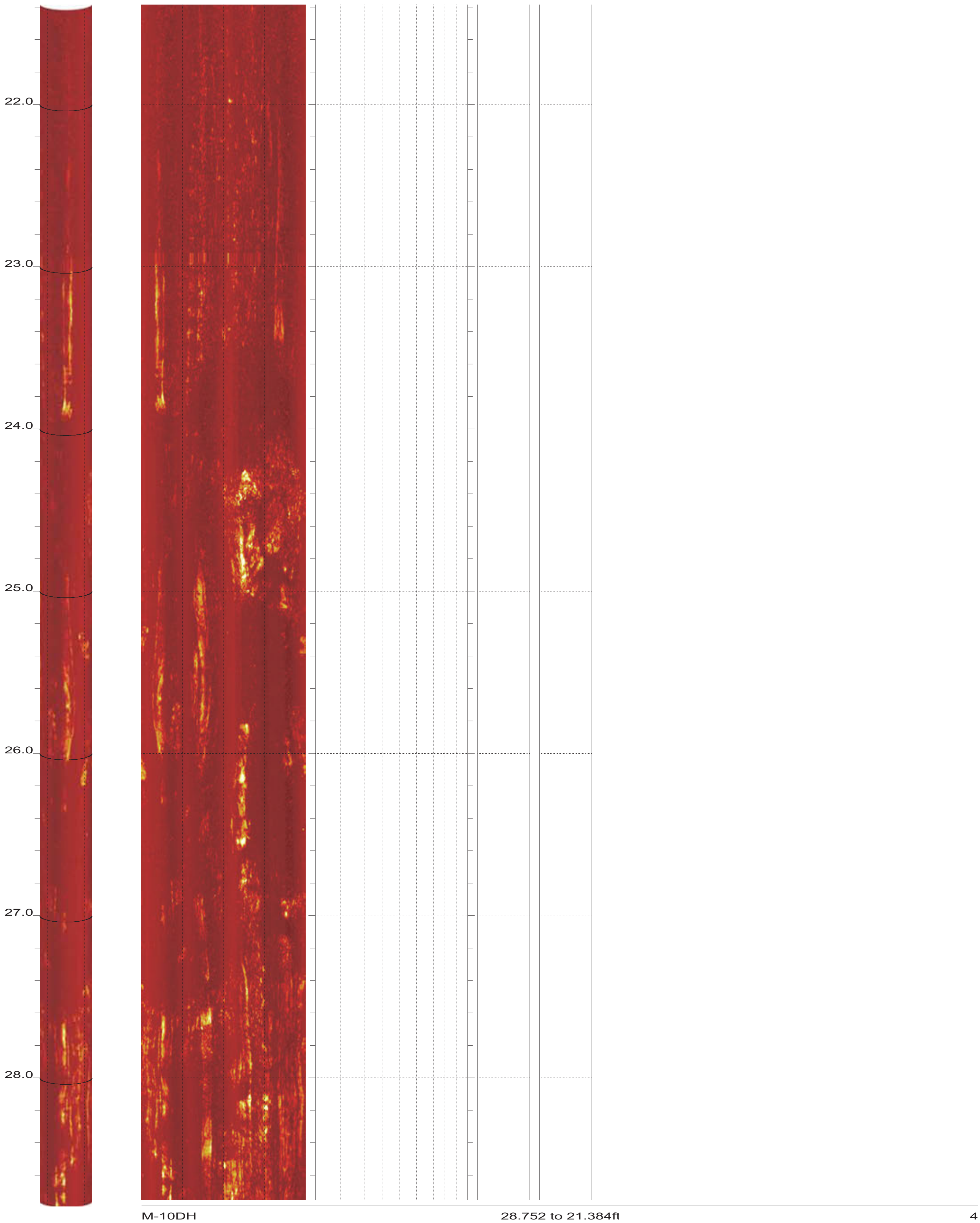
North Anna Boring M-10DH Acoustic Televiewer Dips rev 1 Sheet 1 of 27



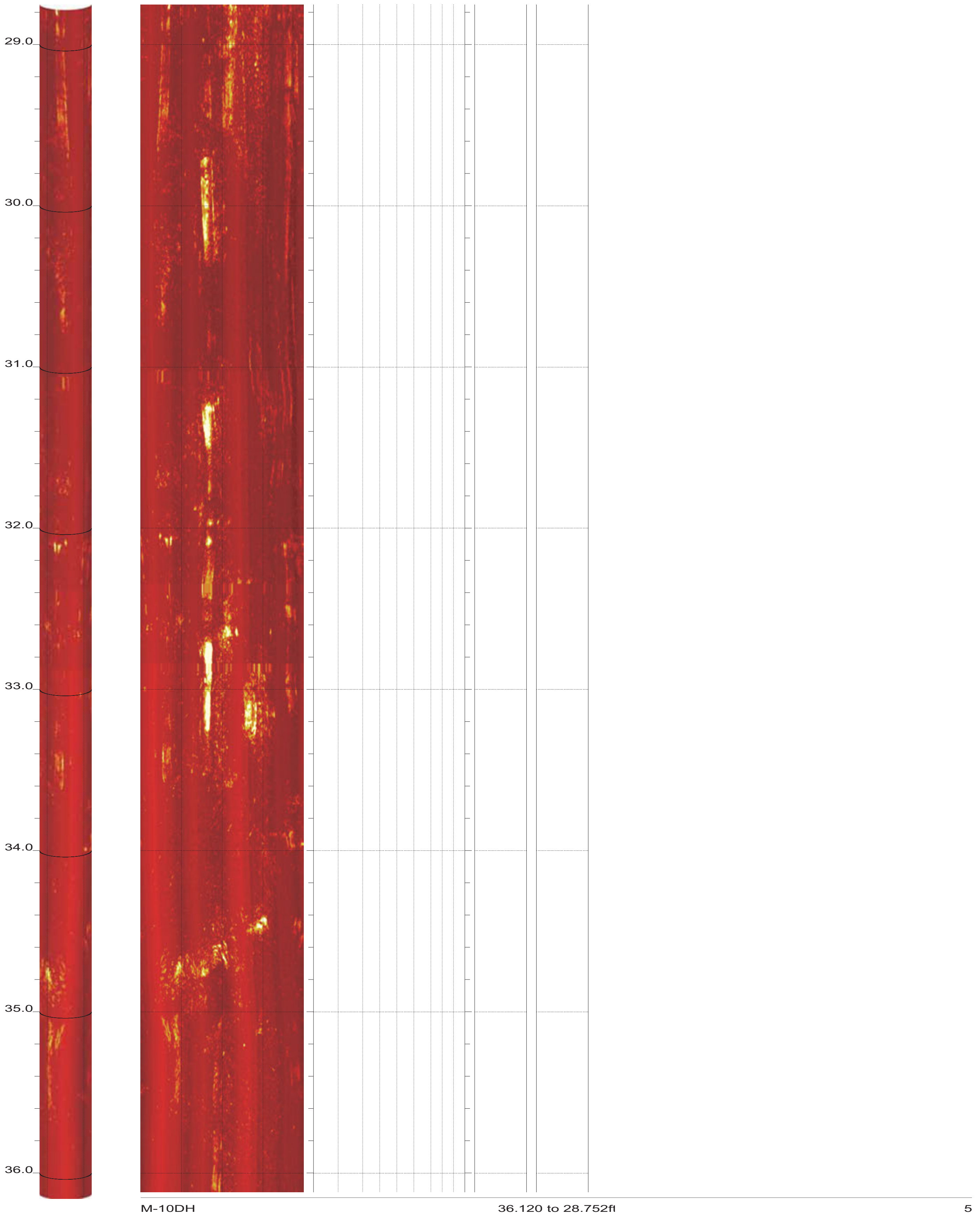
North Anna Boring M-10DH Acoustic Televiewer Dips rev 1 Sheet 2 of 27



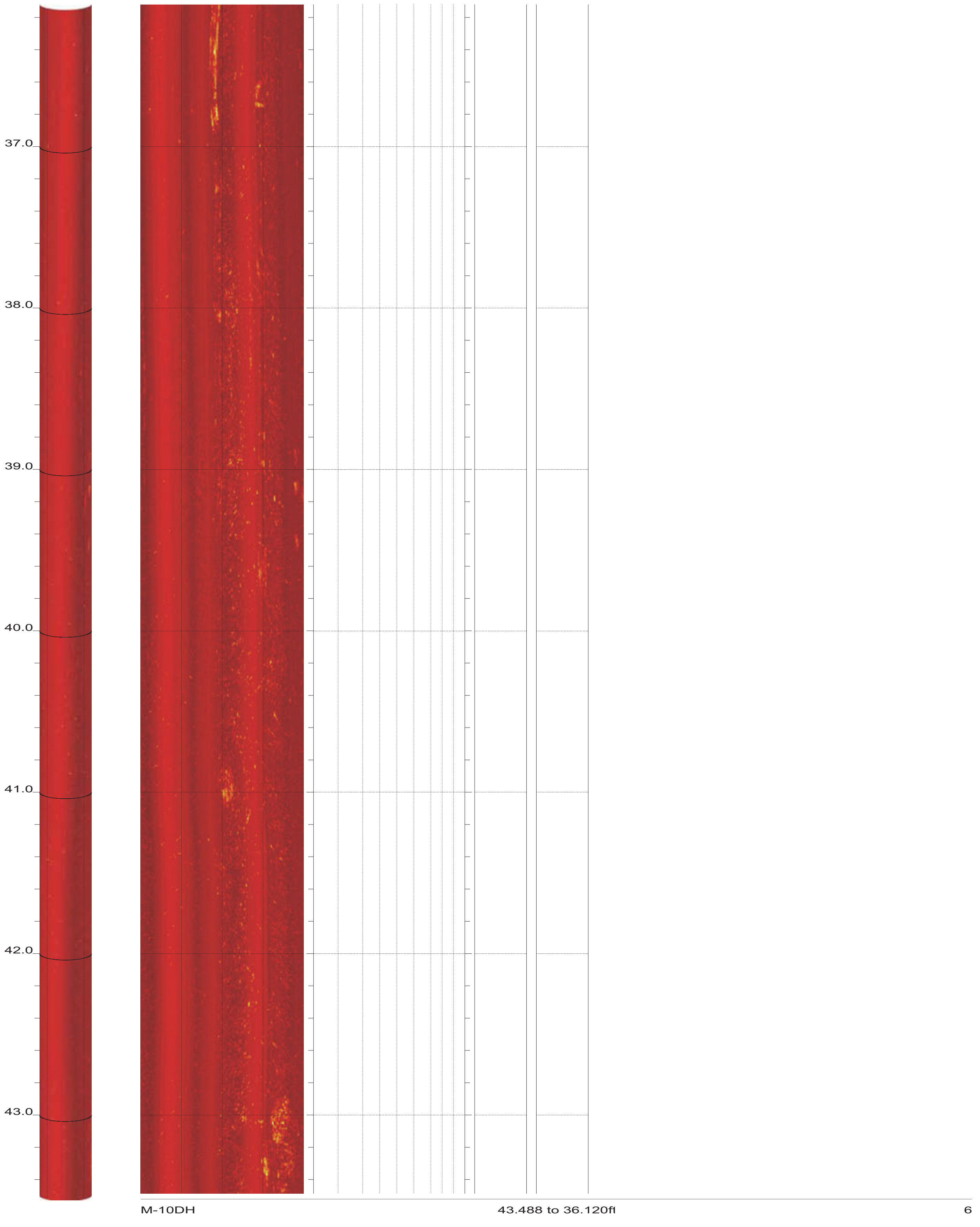
North Anna Boring M-10DH Acoustic Televiewer Dips rev 1 Sheet 3 of 27



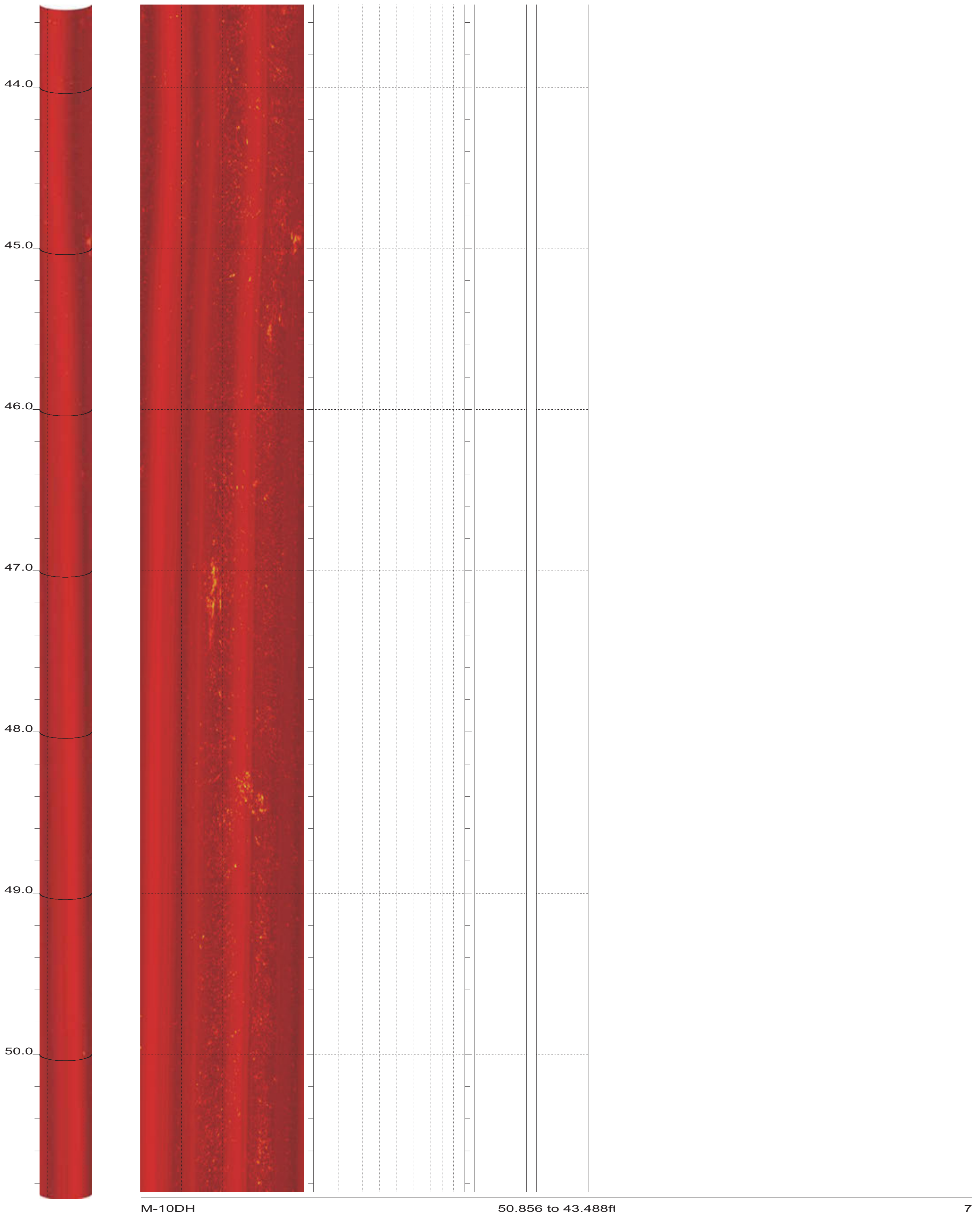
North Anna Boring M-10DH Acoustic Televiewer Dips rev 1 Sheet 4 of 27



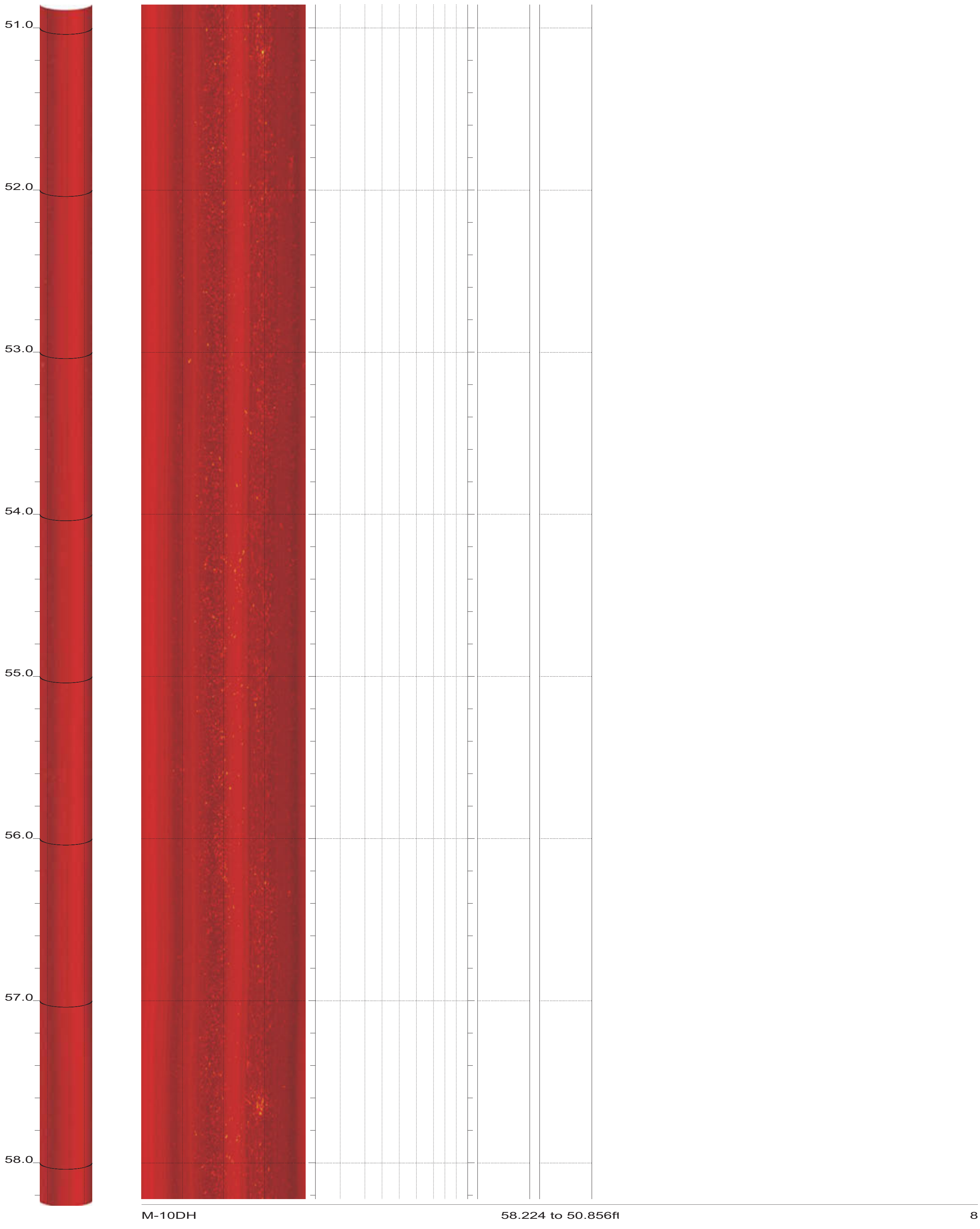
North Anna Boring M-10DH Acoustic Televiewer Dips rev 1 Sheet 5 of 27



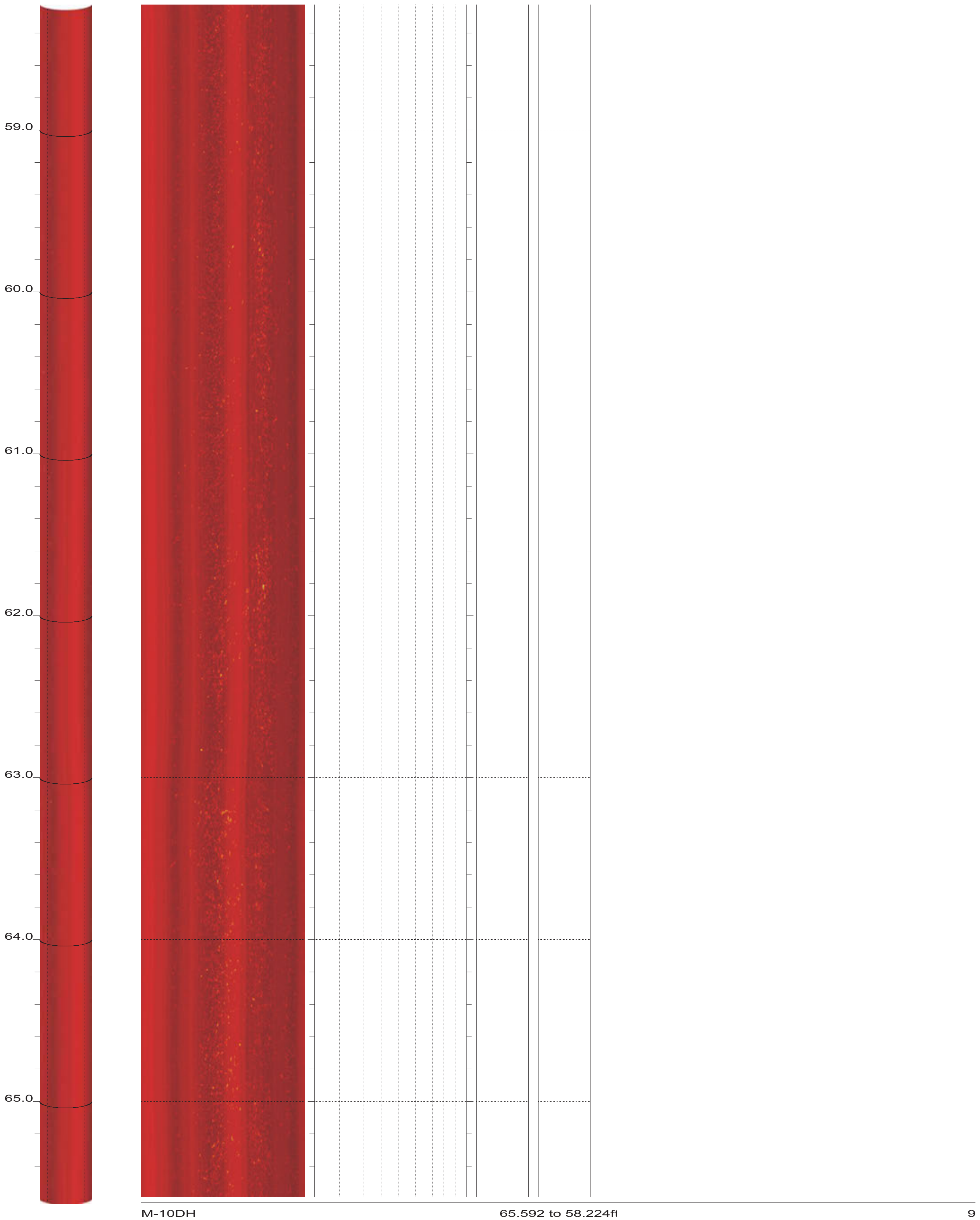
North Anna Boring M-10DH Acoustic Televiewer Dips rev 1 Sheet 6 of 27



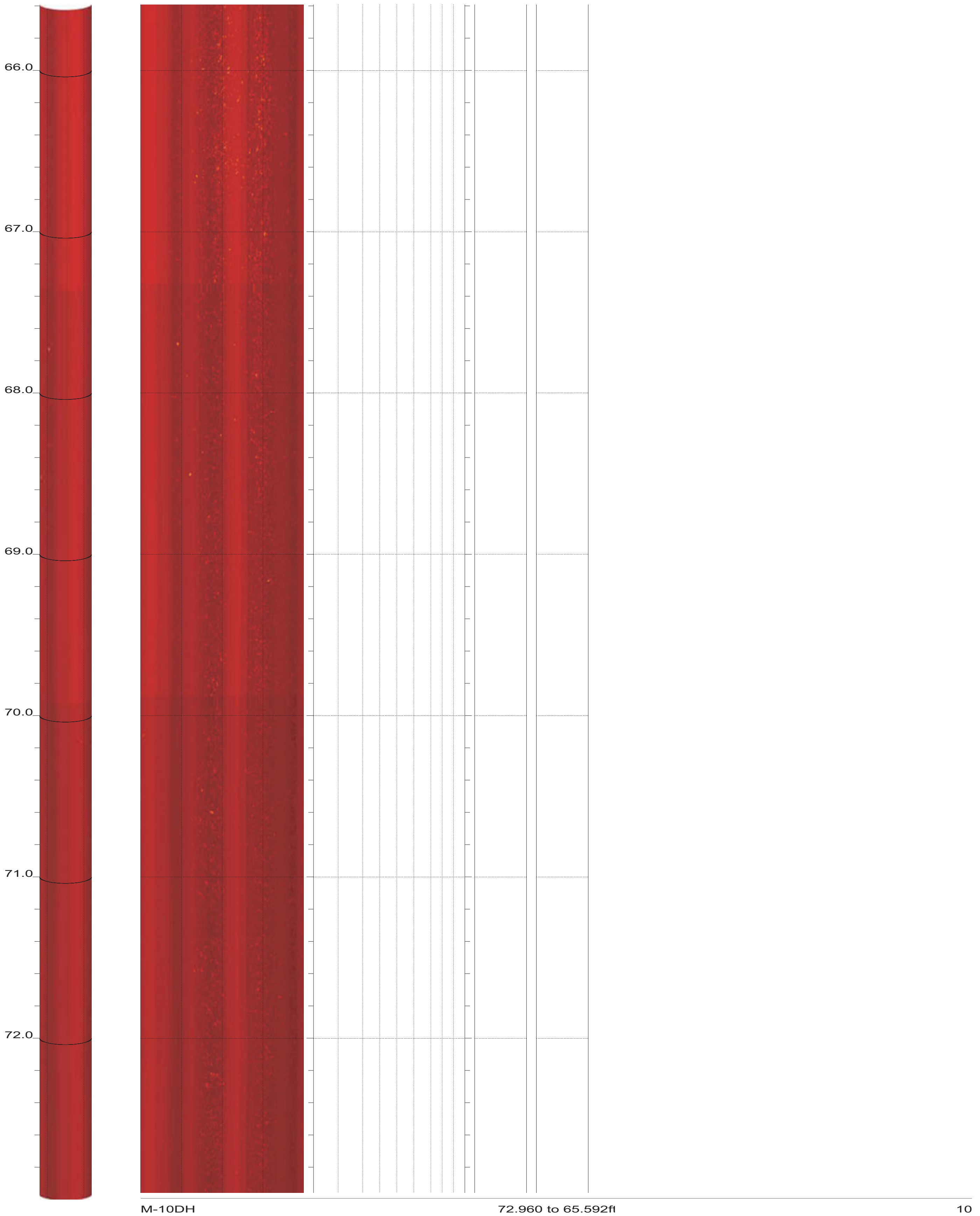
North Anna Boring M-10DH Acoustic Televiewer Dips rev 1 Sheet 7 of 27



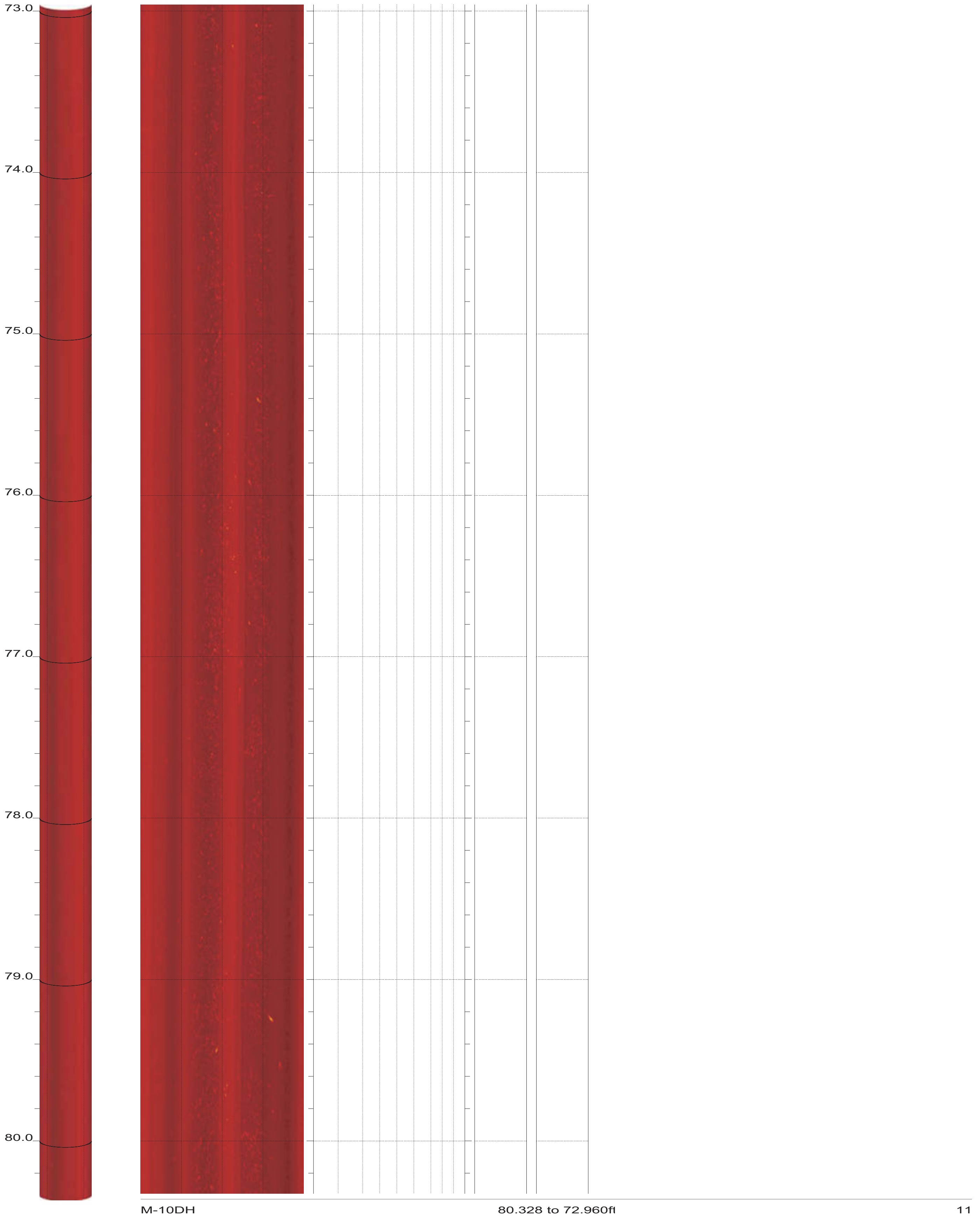
North Anna Boring M-10DH Acoustic Televiewer Dips rev 1 Sheet 8 of 27



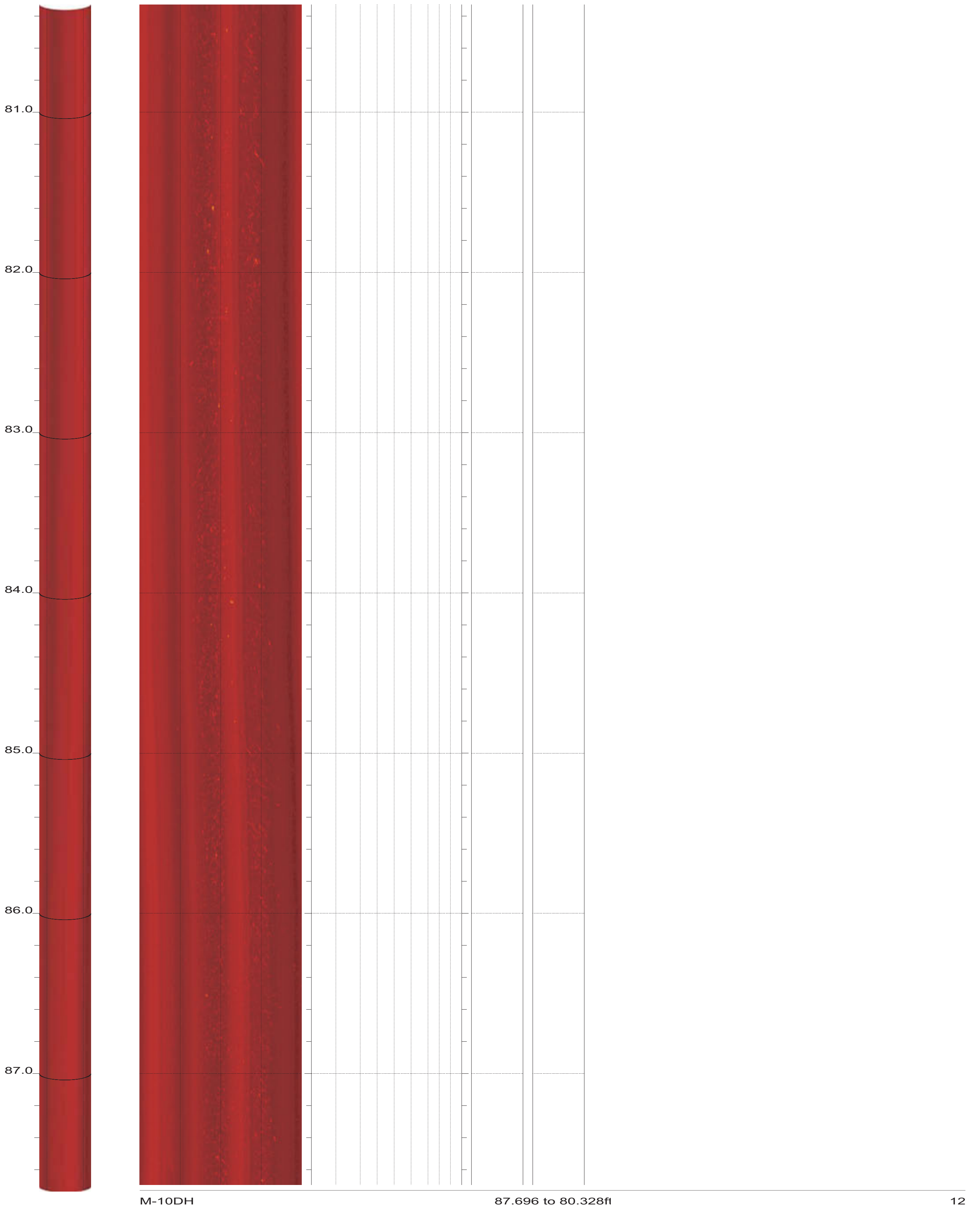
North Anna Boring M-10DH Acoustic Televiewer Dips rev 1 Sheet 9 of 27



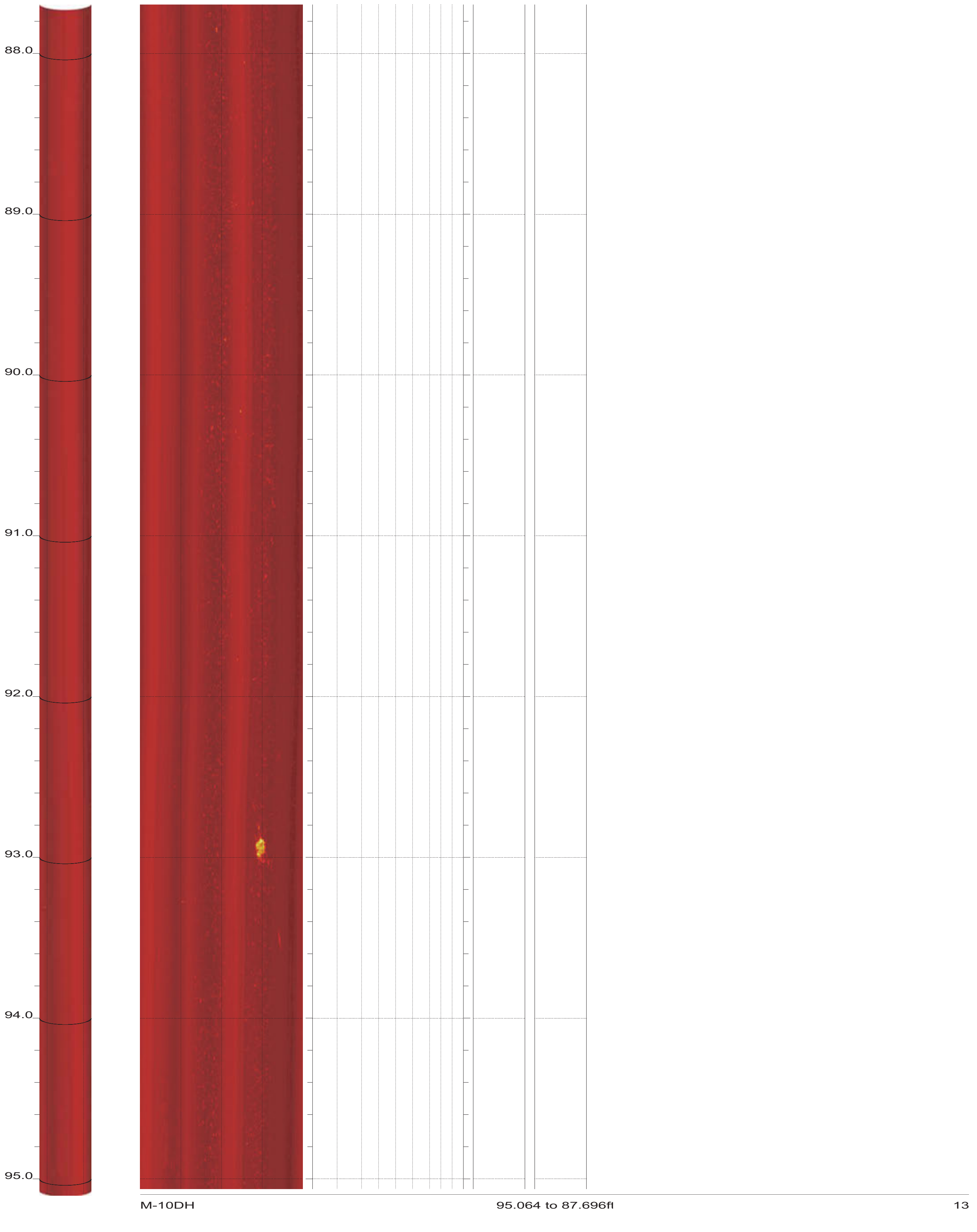
North Anna Boring M-10DH Acoustic Televiewer Dips rev 1 Sheet 10 of 27



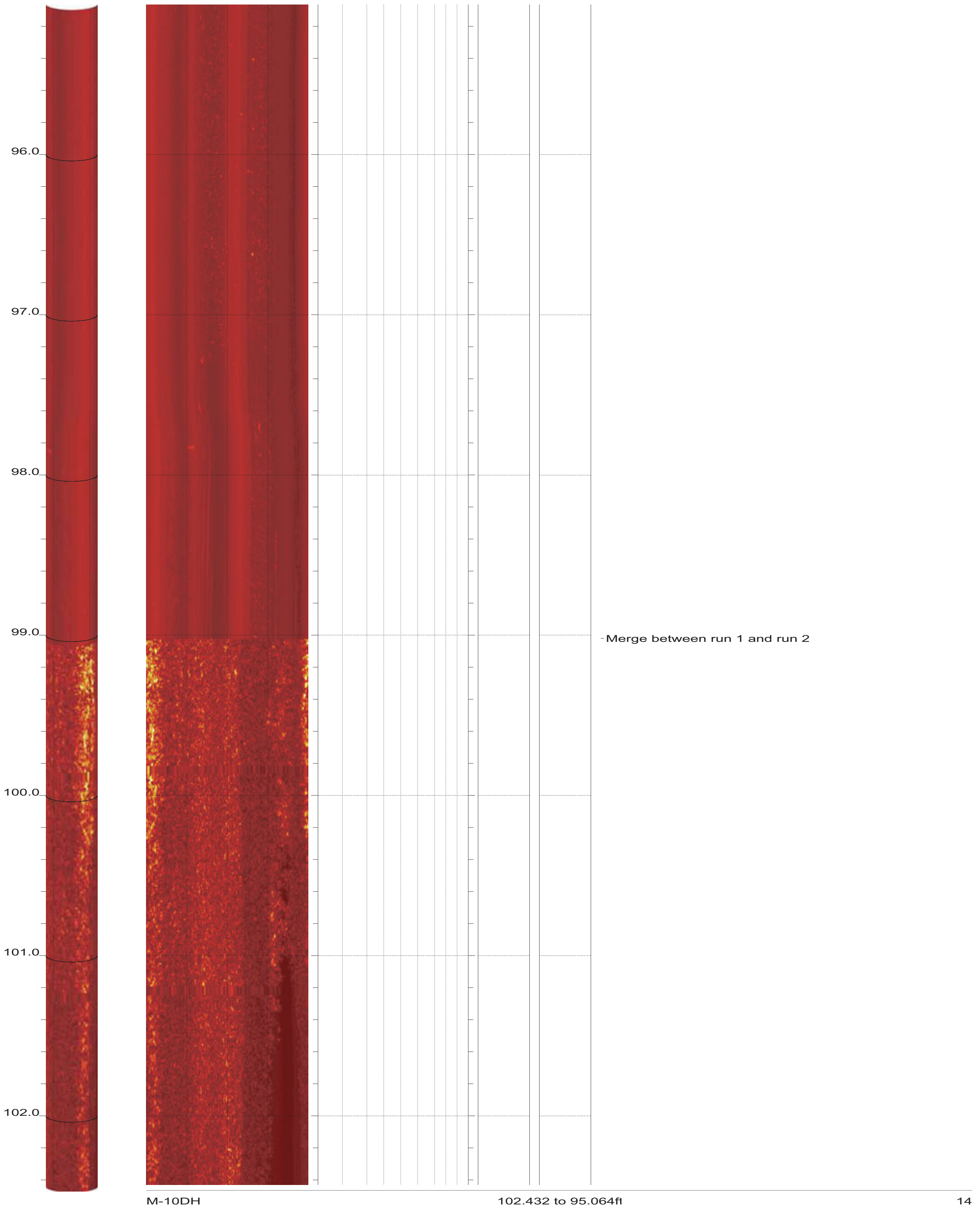
North Anna Boring M-10DH Acoustic Televiewer Dips rev 1 Sheet 11 of 27



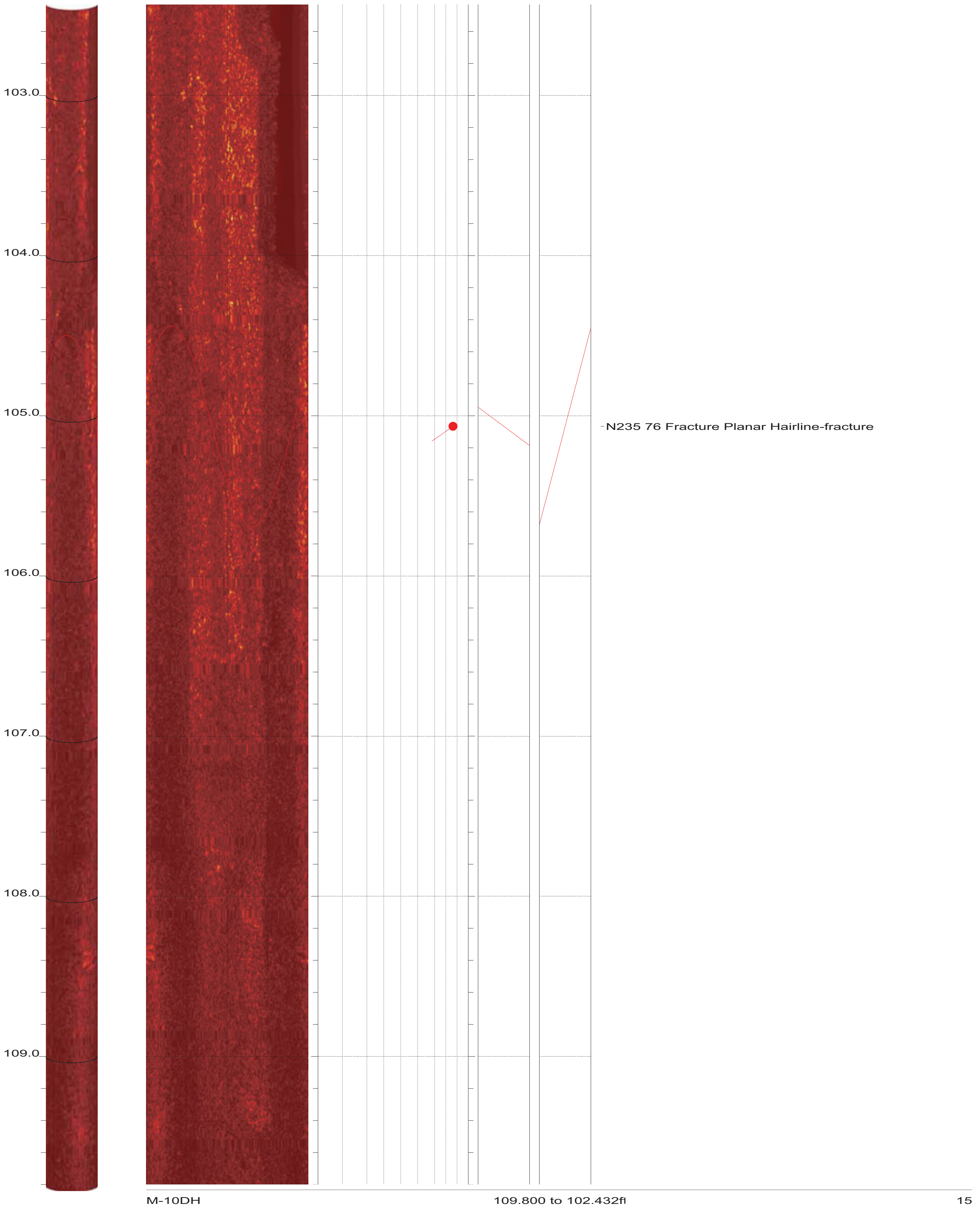
North Anna Boring M-10DH Acoustic Televiewer Dips rev 1 Sheet 12 of 27



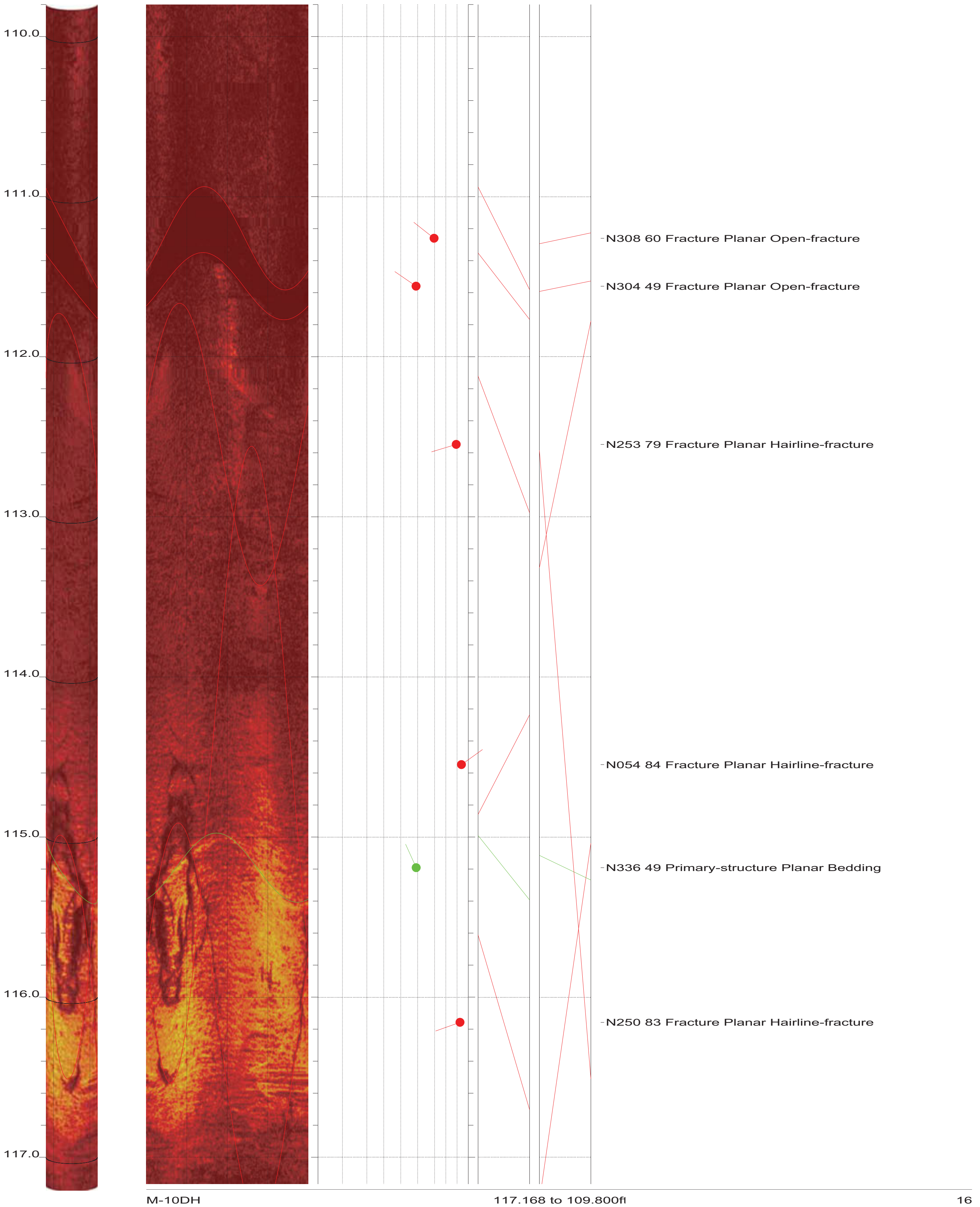
North Anna Boring M-10DH Acoustic Televiewer Dips rev 1 Sheet 13 of 27



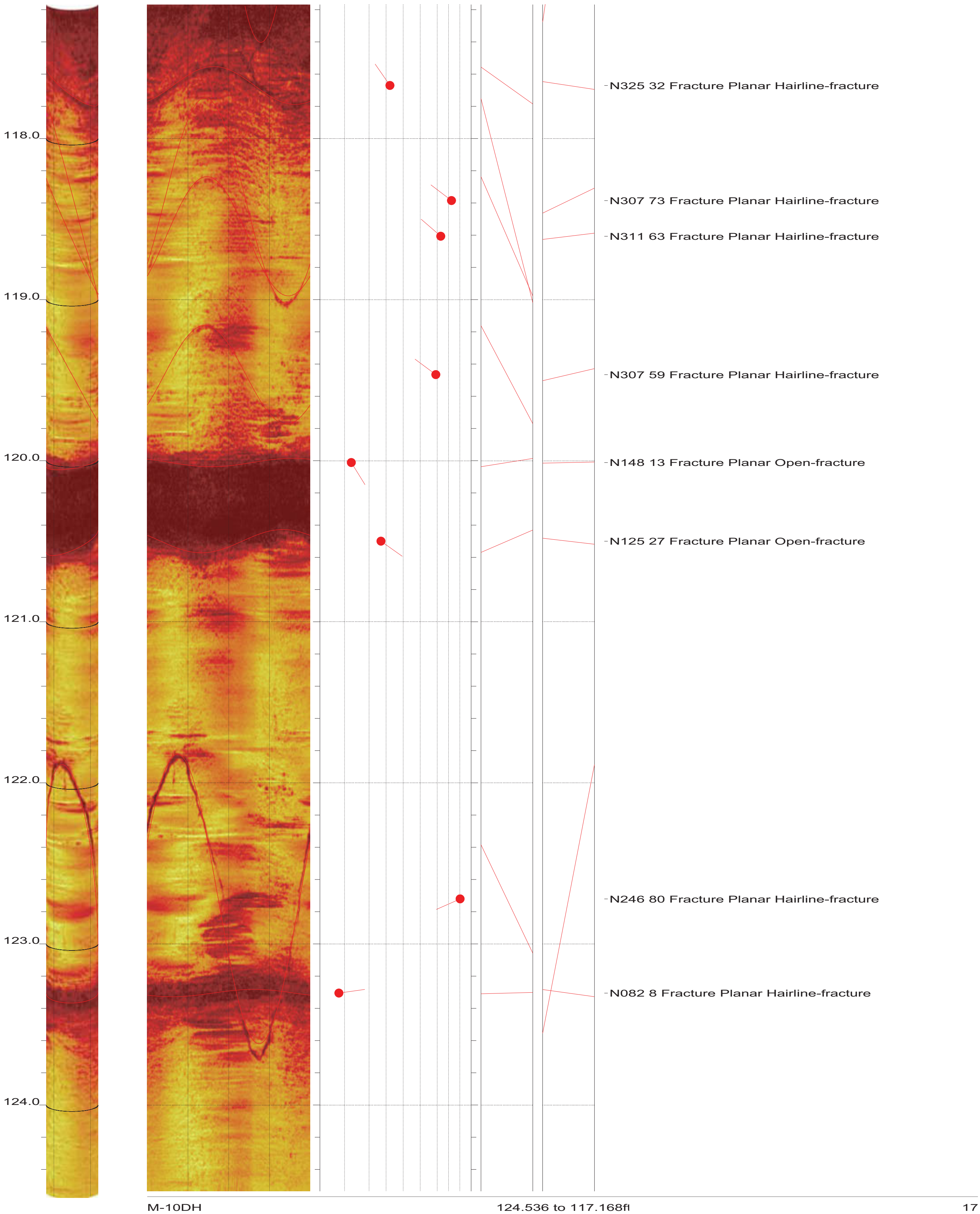
North Anna Boring M-10DH Acoustic Televiewer Dips rev 1 Sheet 14 of 27



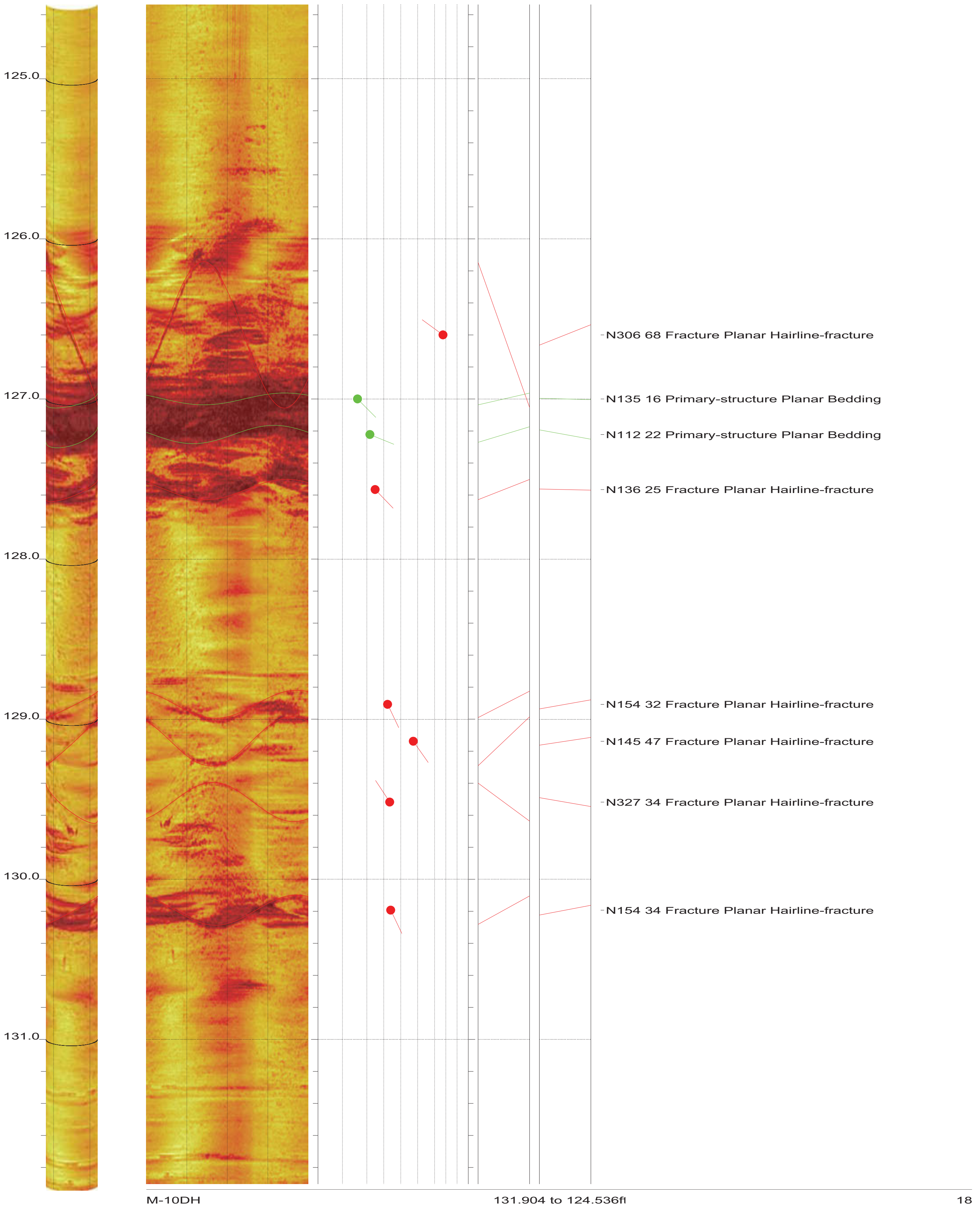
North Anna Boring M-10DH Acoustic Televiewer Dips rev 1 Sheet 15 of 27



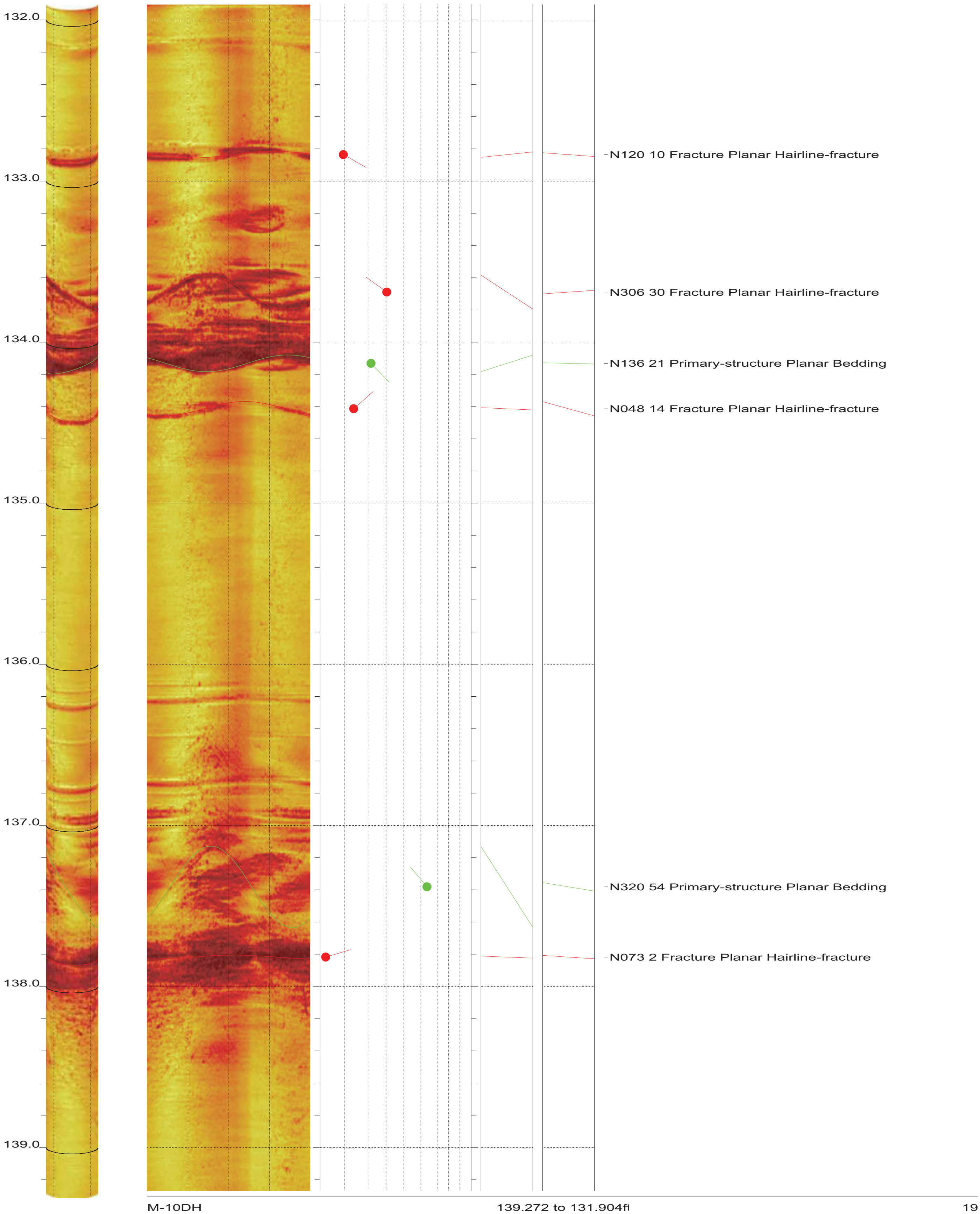
North Anna Boring M-10DH Acoustic Televiewer Dips rev 1 Sheet 16 of 27



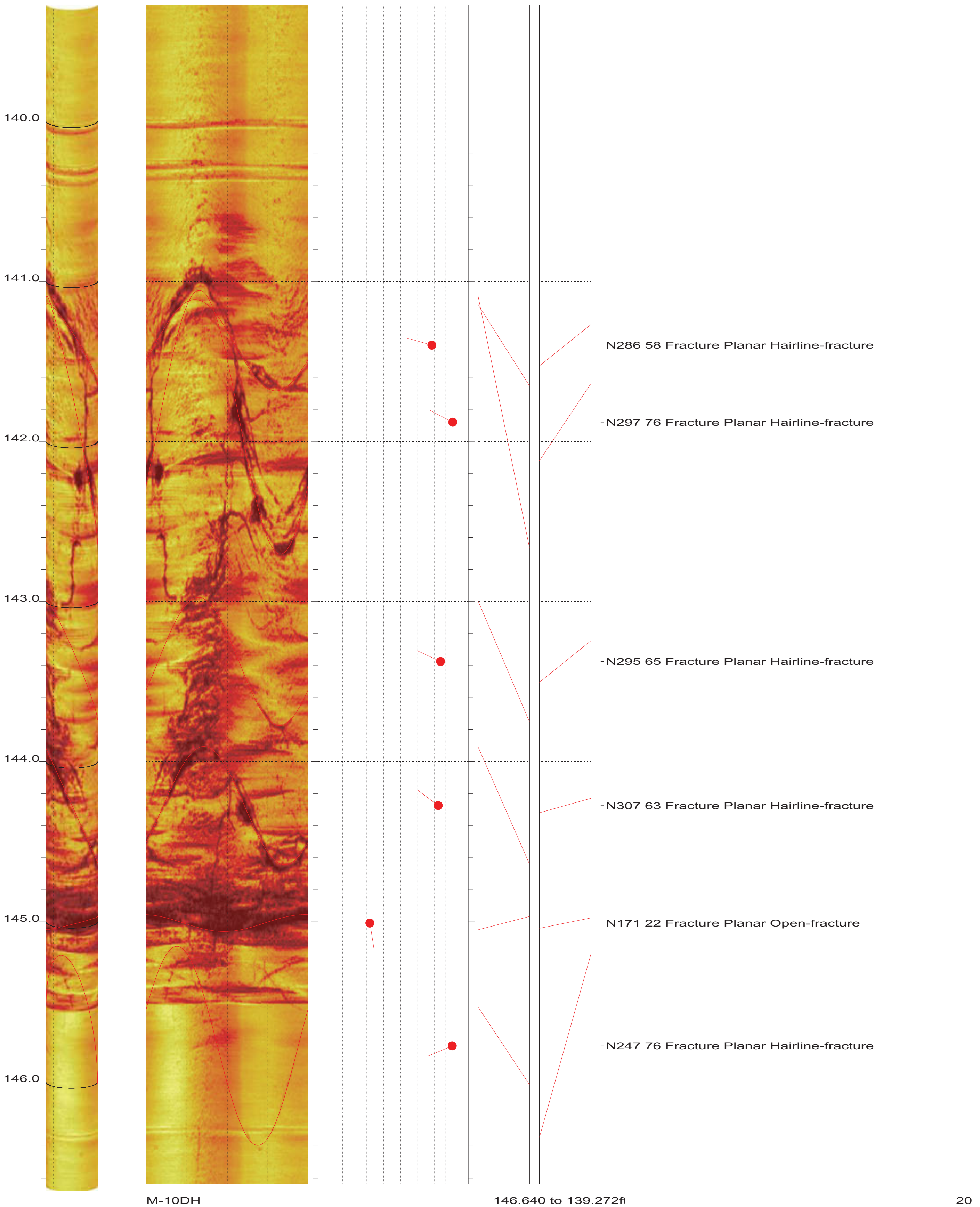
North Anna Boring M-10DH Acoustic Televiewer Dips rev 1 Sheet 17 of 27



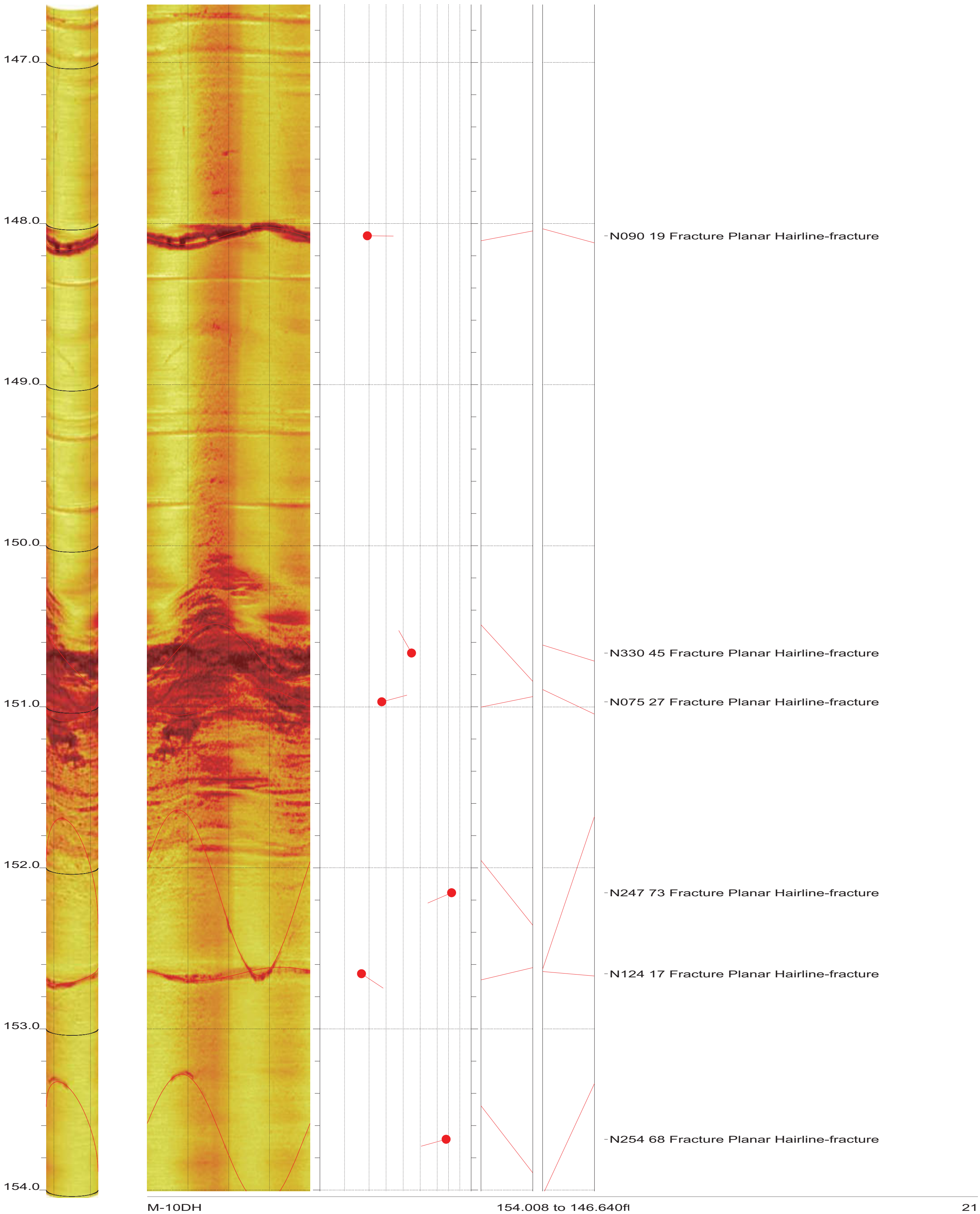
North Anna Boring M-10DH Acoustic Televiewer Dips rev 1 Sheet 18 of 27



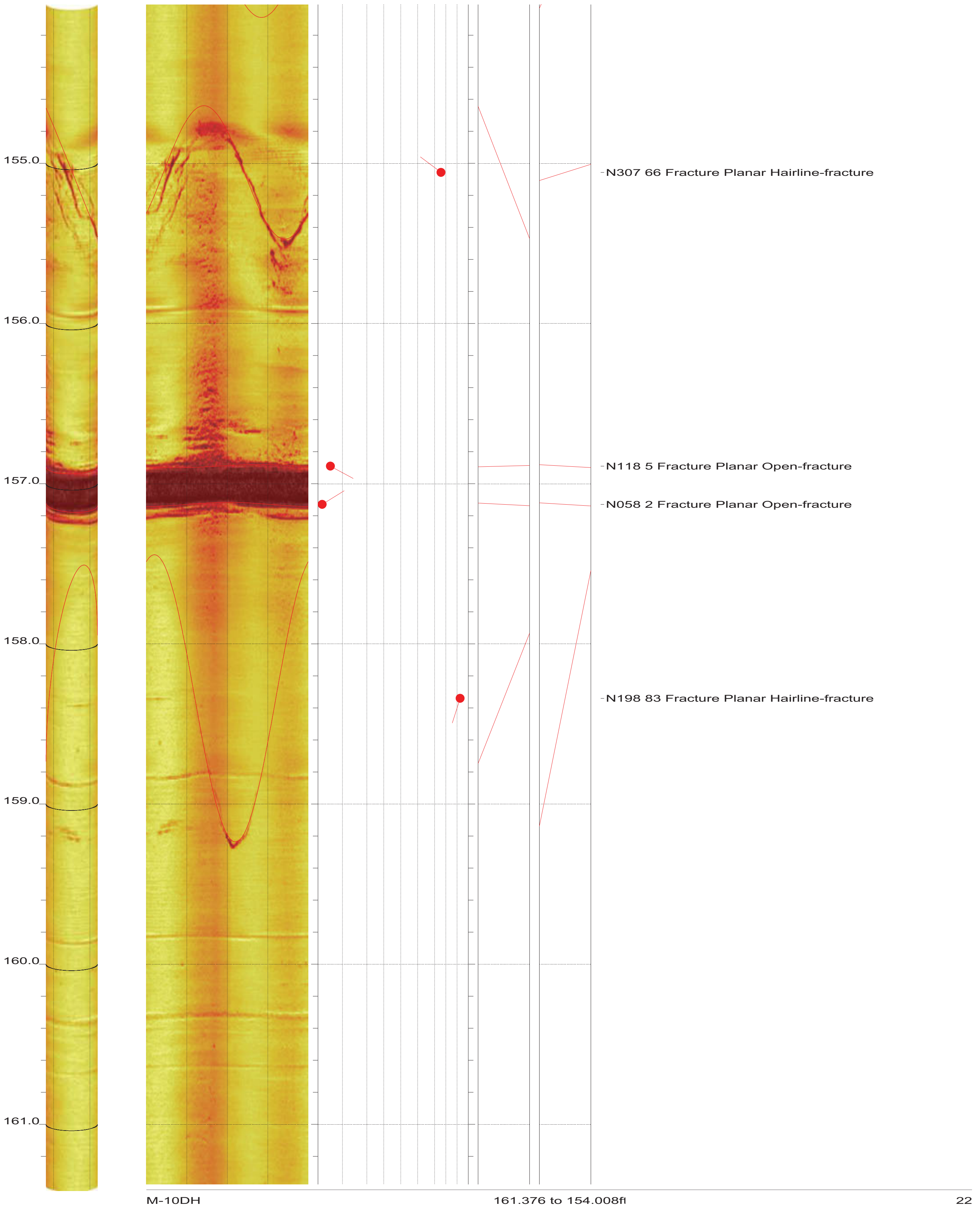
North Anna Boring M-10DH Acoustic Televiewer Dips rev 1 Sheet 19 of 27



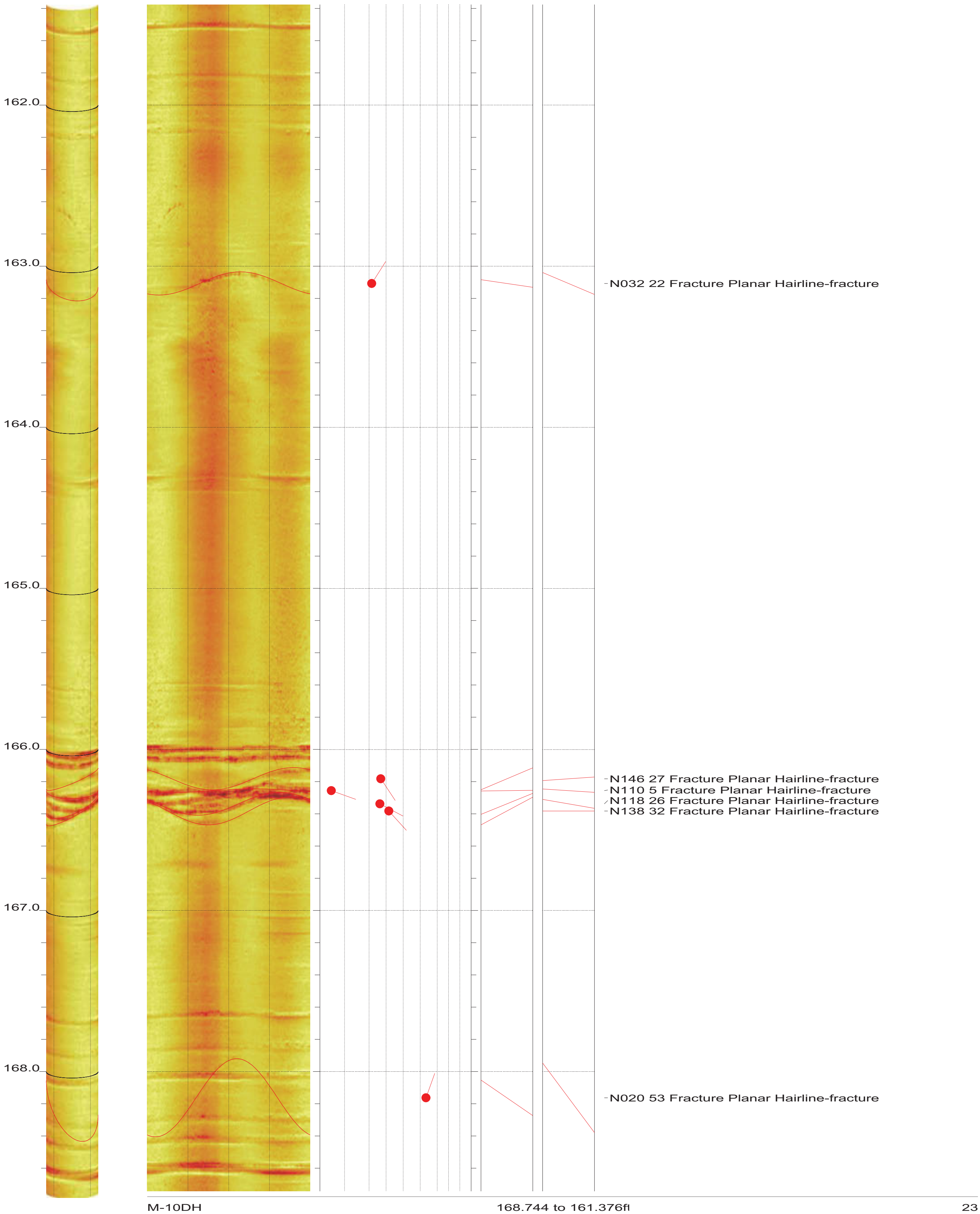
North Anna Boring M-10DH Acoustic Televiewer Dips rev 1 Sheet 20 of 27



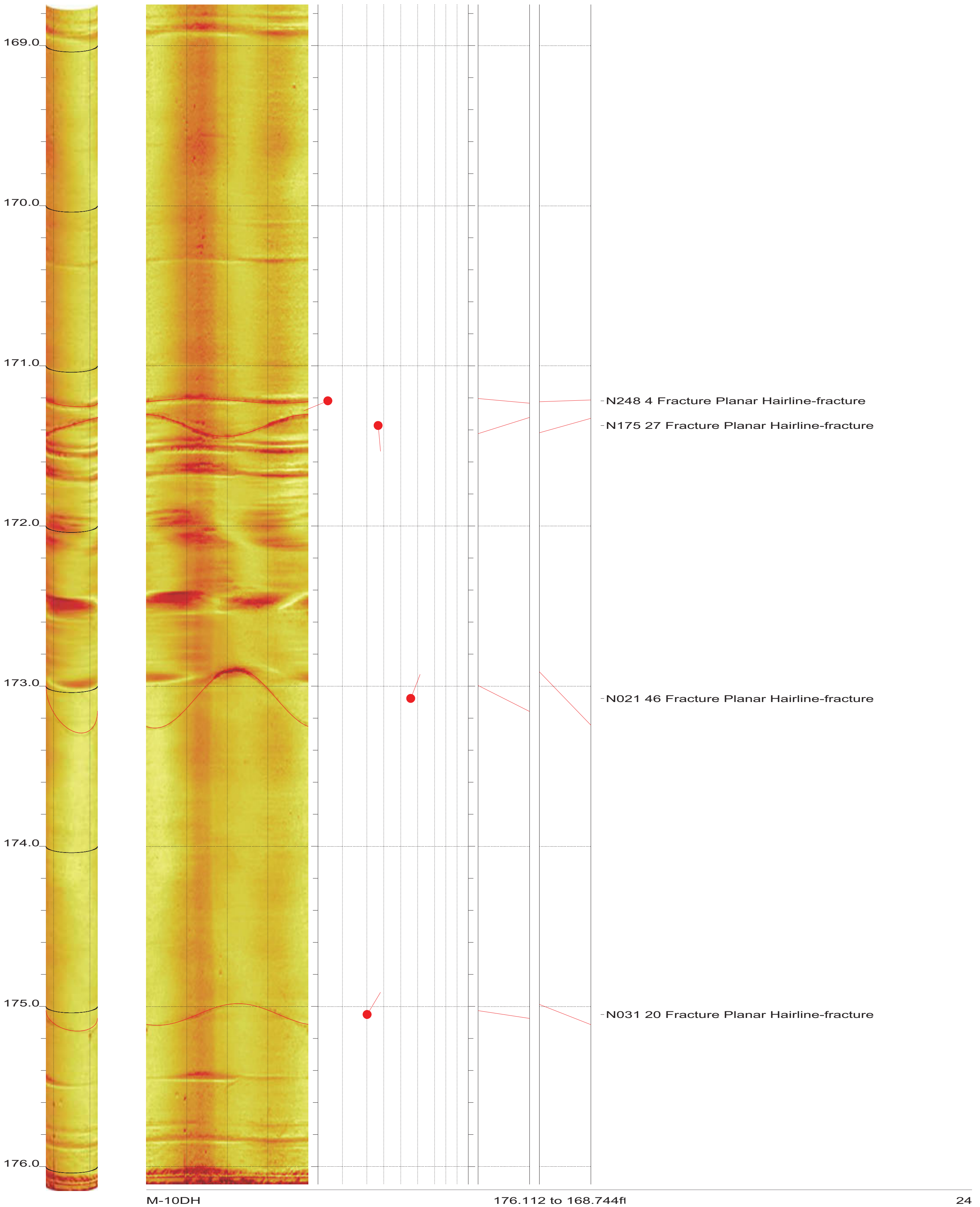
North Anna Boring M-10DH Acoustic Televiewer Dips rev 1 Sheet 21 of 27



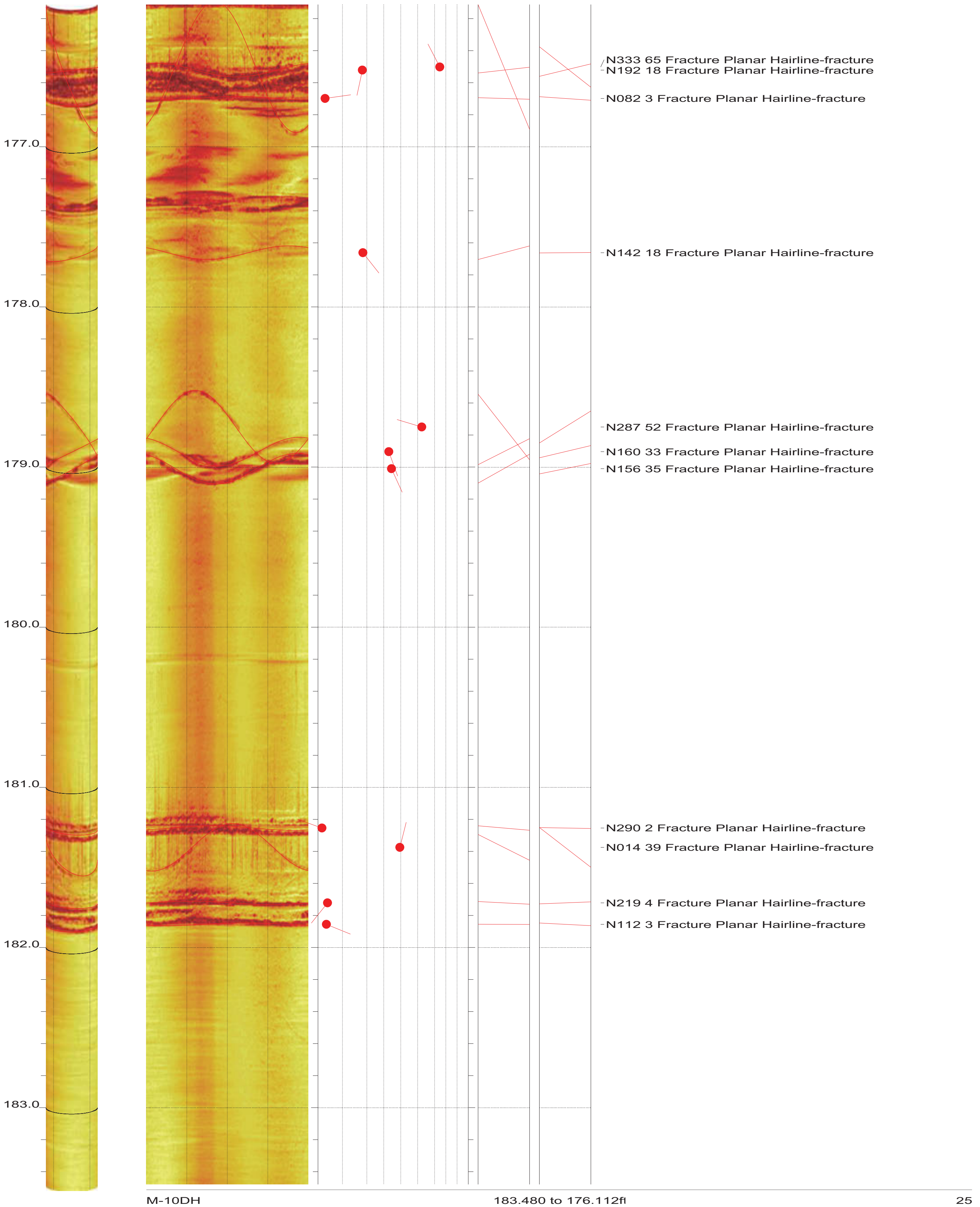
North Anna Boring M-10DH Acoustic Televiewer Dips rev 1 Sheet 22 of 27



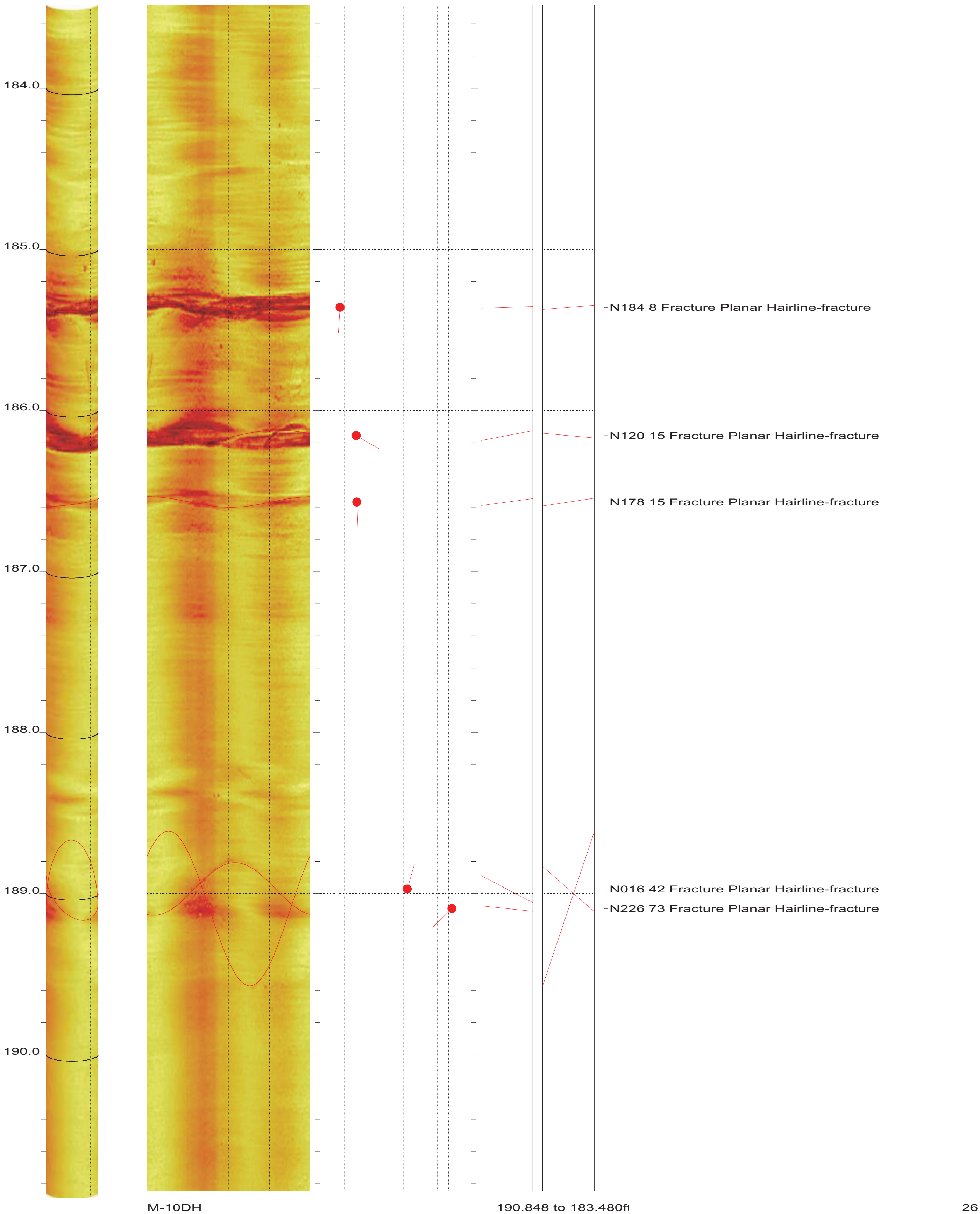
North Anna Boring M-10DH Acoustic Televiewer Dips rev 1 Sheet 23 of 27



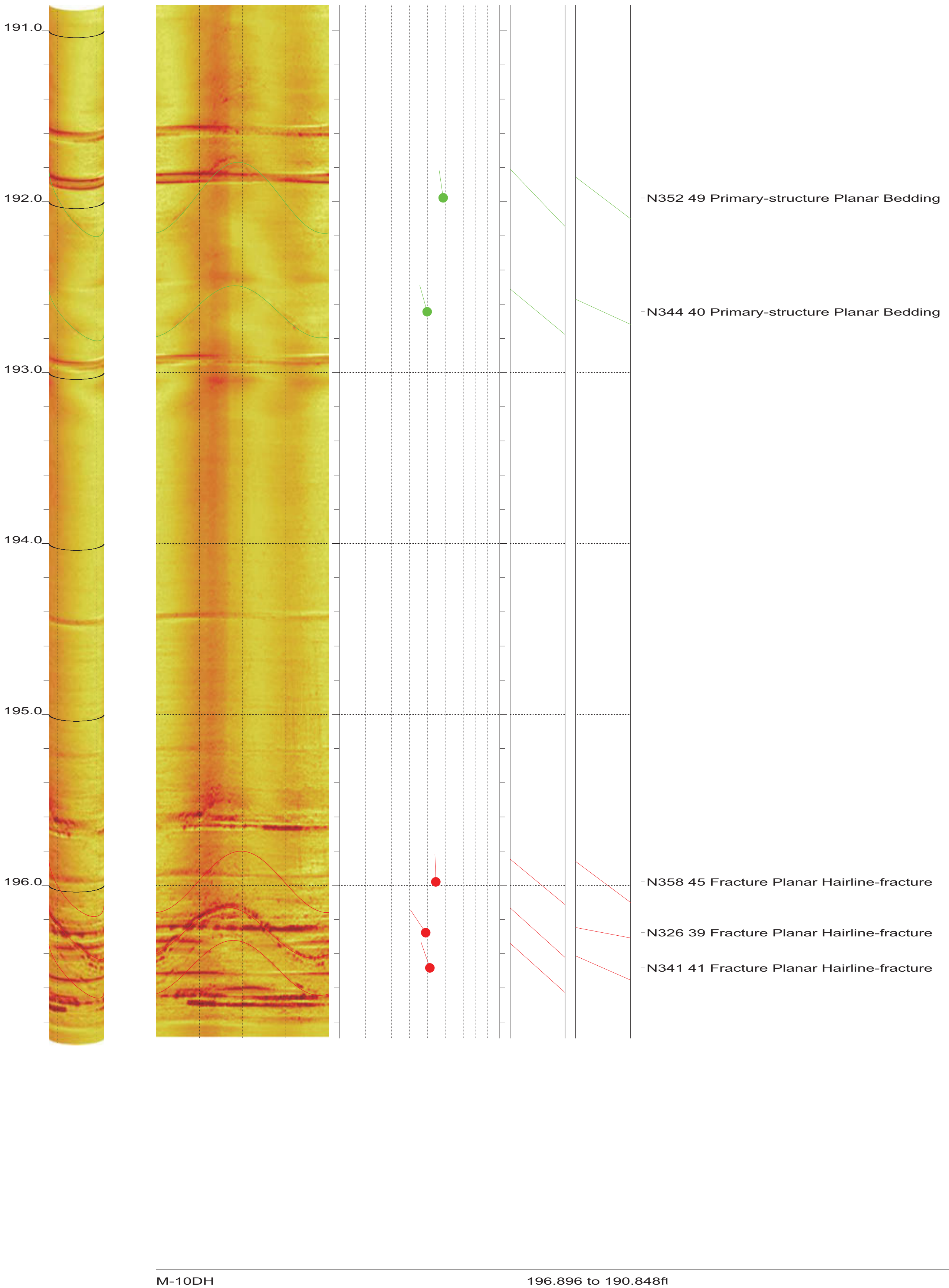
North Anna Boring M-10DH Acoustic Televiewer Dips rev 1 Sheet 24 of 27



North Anna Boring M-10DH Acoustic Televiewer Dips rev 1 Sheet 25 of 27



North Anna Boring M-10DH Acoustic Televiewer Dips rev 1 Sheet 26 of 27



North Anna Boring M-10DH Acoustic Televiewer Dips rev 1 Sheet 27 of 27

BHTV DATA PROCESSING
RGLDIP vsn 6.2
INTERPRETED BHTV DIPS LOG

MACTEC

Borehole: M-30DH

NORTH ANNA

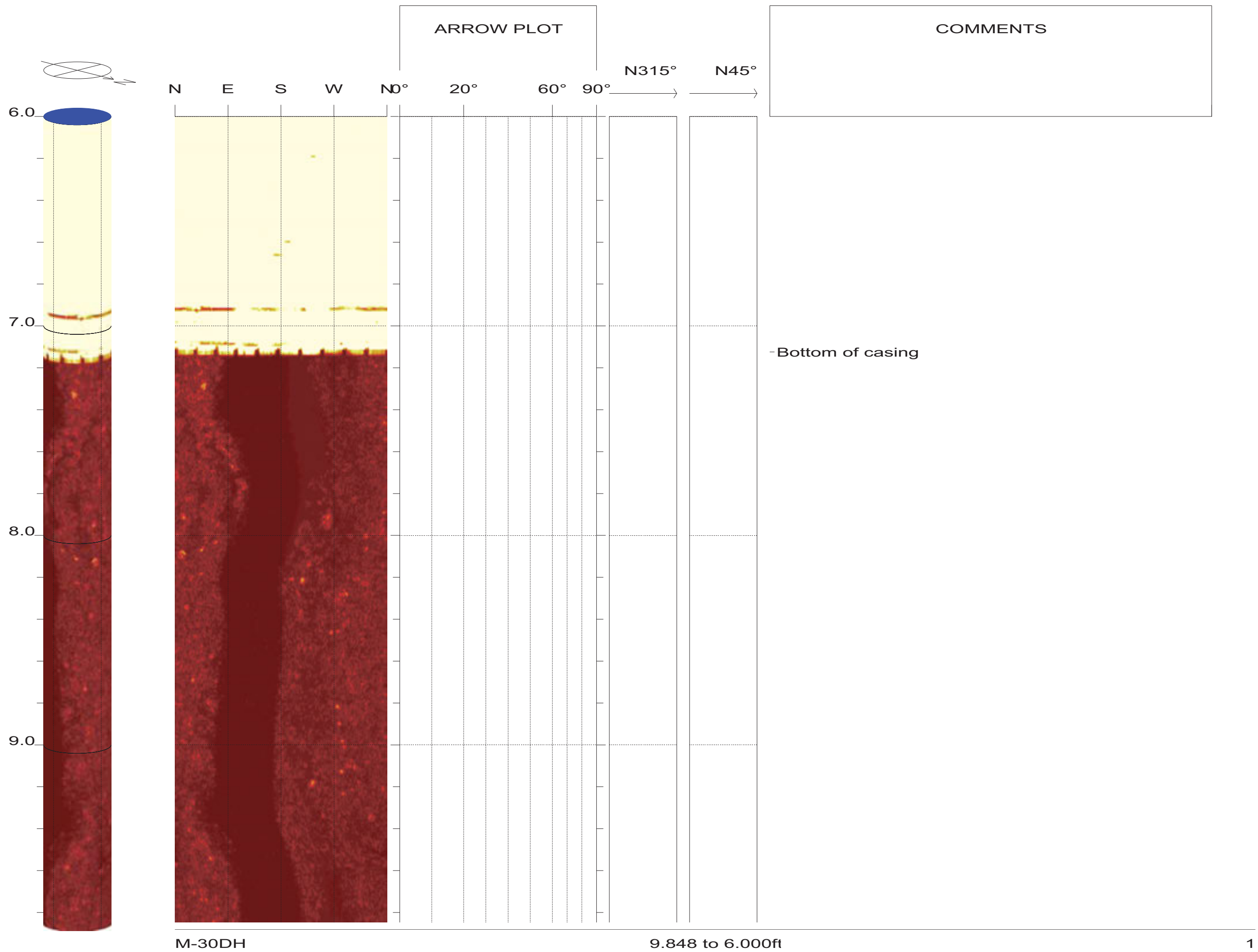
top of borehole.....
East: _
North:_
Elev: _

North ref. is true
Depth units are feet
Vertical scale: 1/10
Horiz scale = 1.00x Vert scale

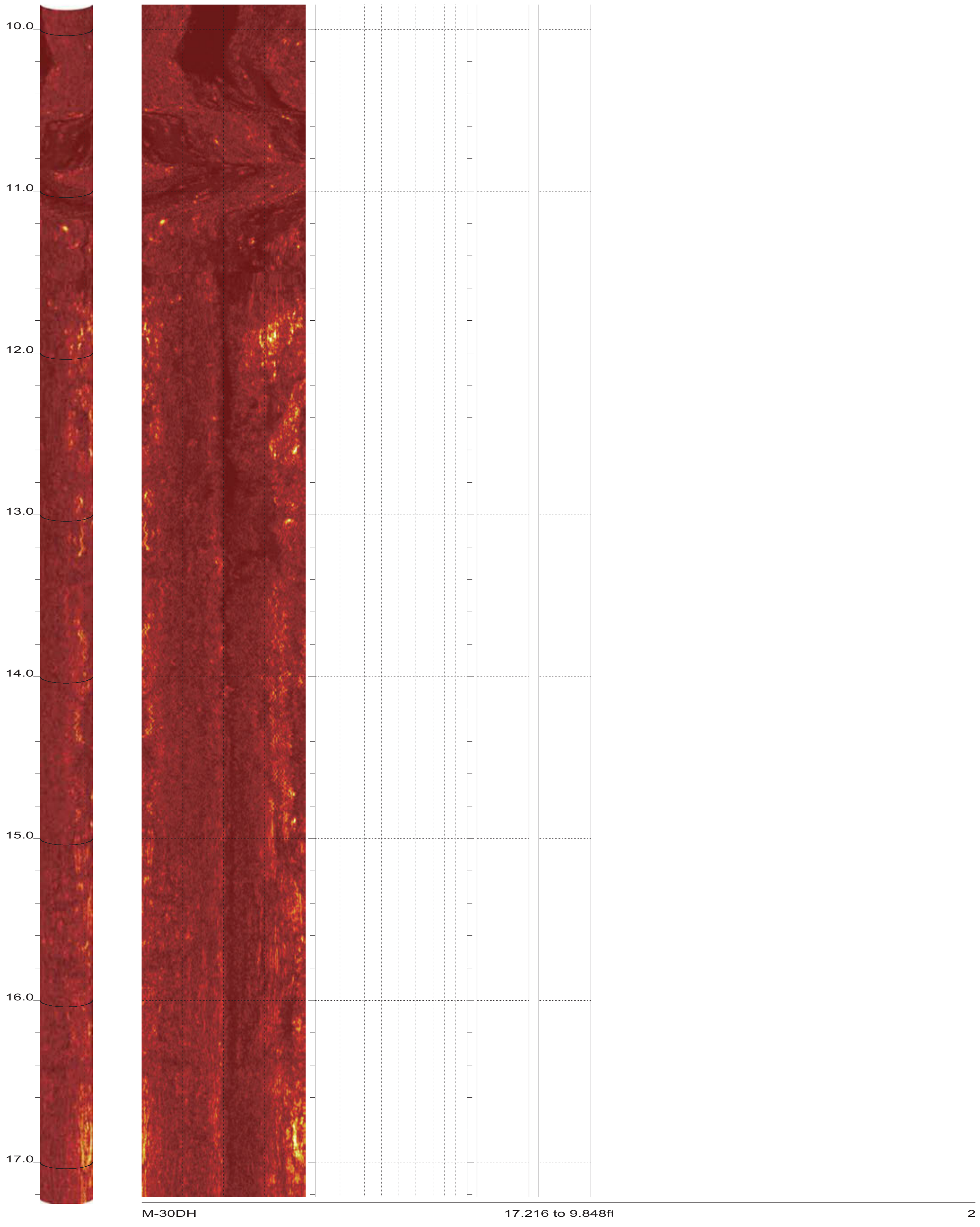
Zone from 200.200 to 6.000ft
Format: BHTV-NESWN

Borehole diam: 3.860inch
Vertical = borehole-axis
Image: Amplitude

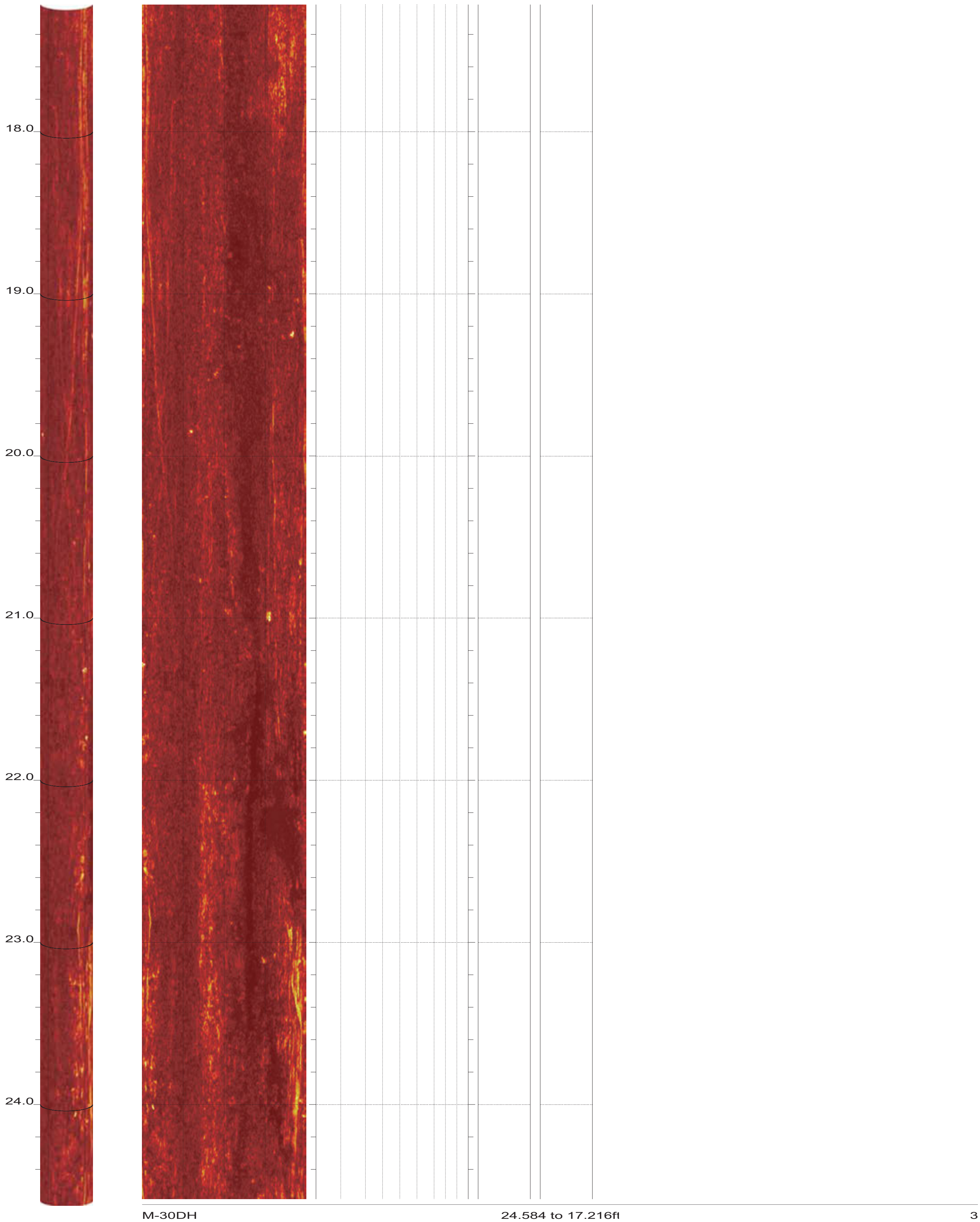
Stratigraphic dips
Non-stratigraphic dips
Identified units



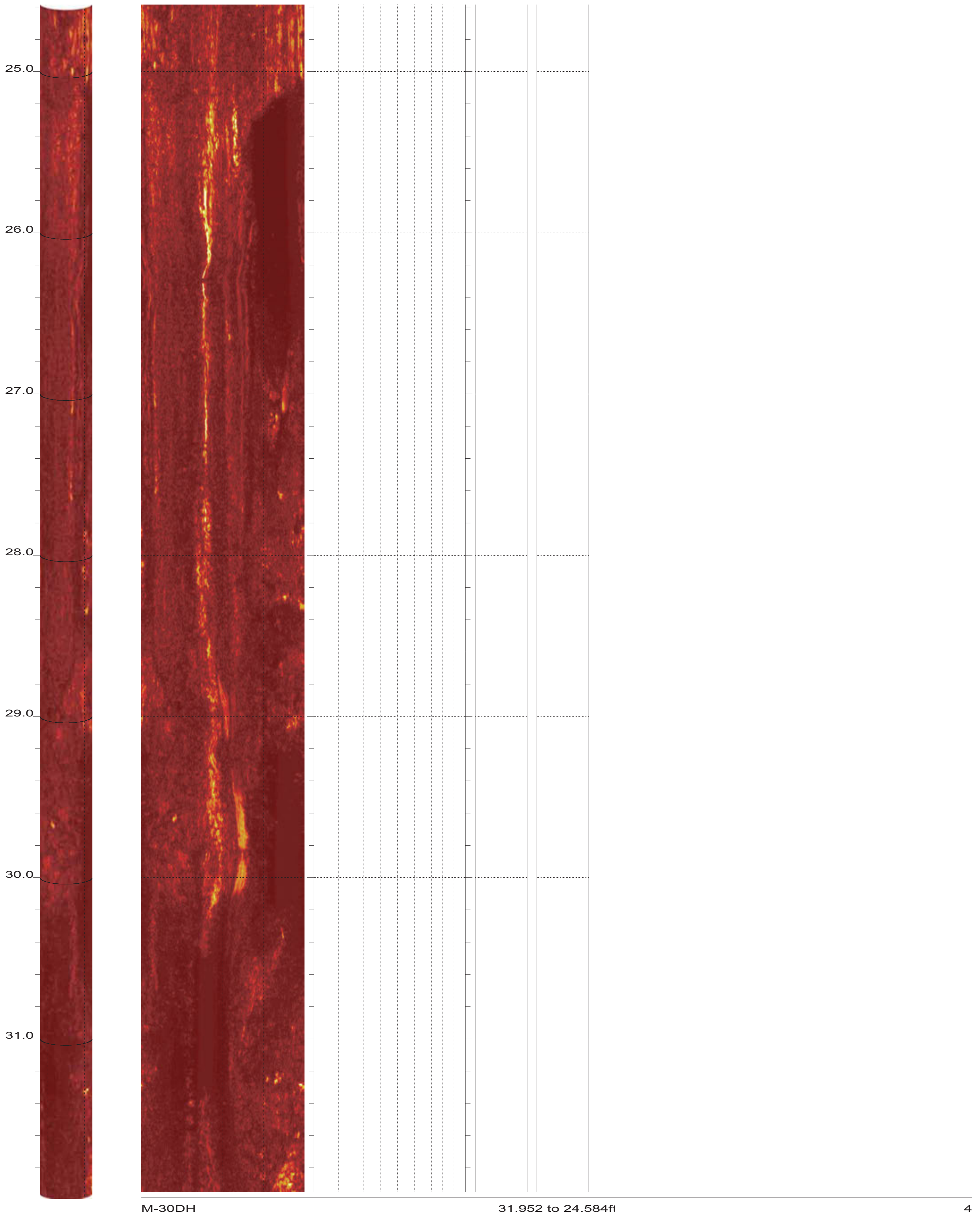
North Anna Boring M-30DH Acoustic Televiewer Dips rev 1 Sheet 1 of 27



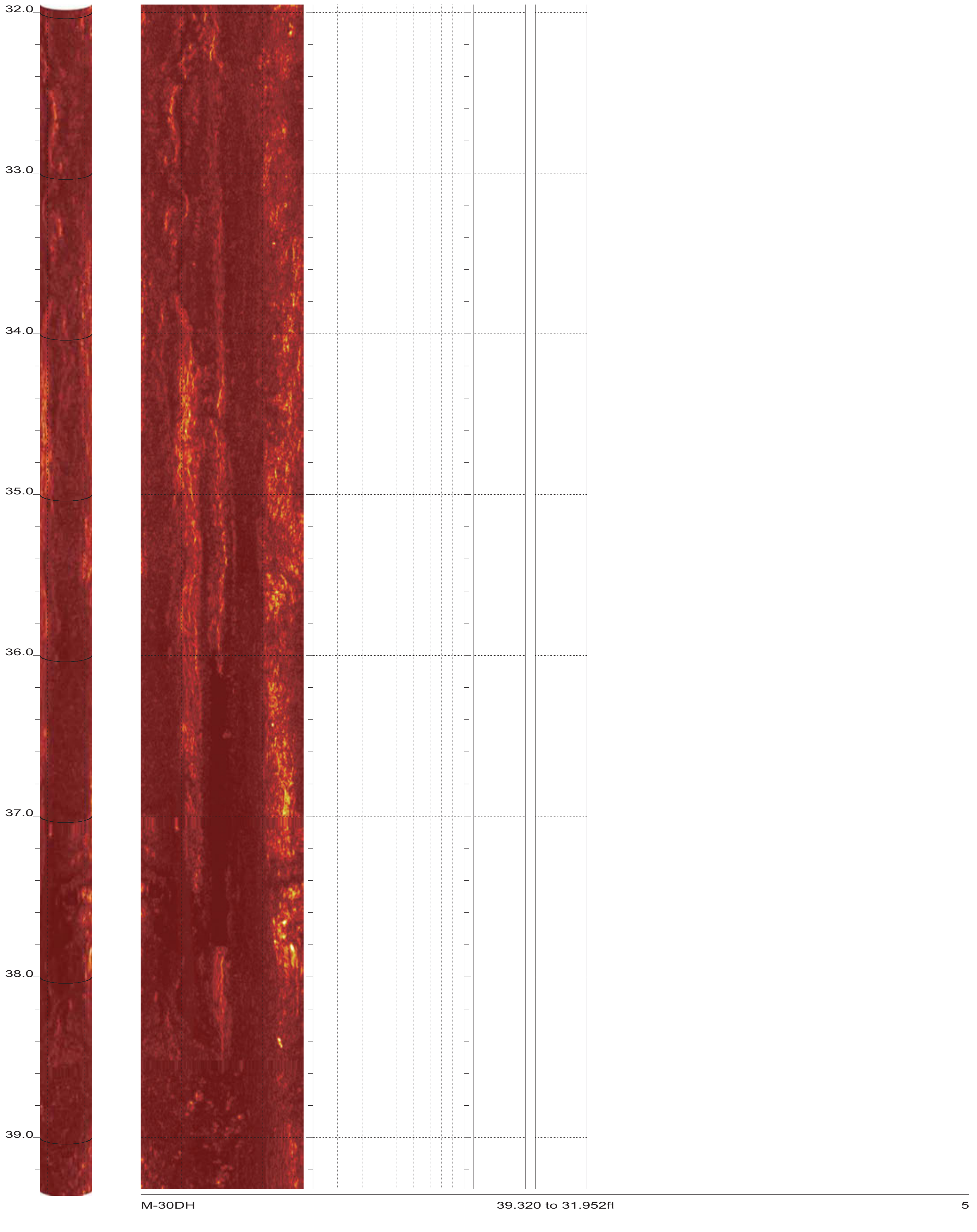
North Anna Boring M-30DH Acoustic Televiewer Dips rev 1 Sheet 2 of 27



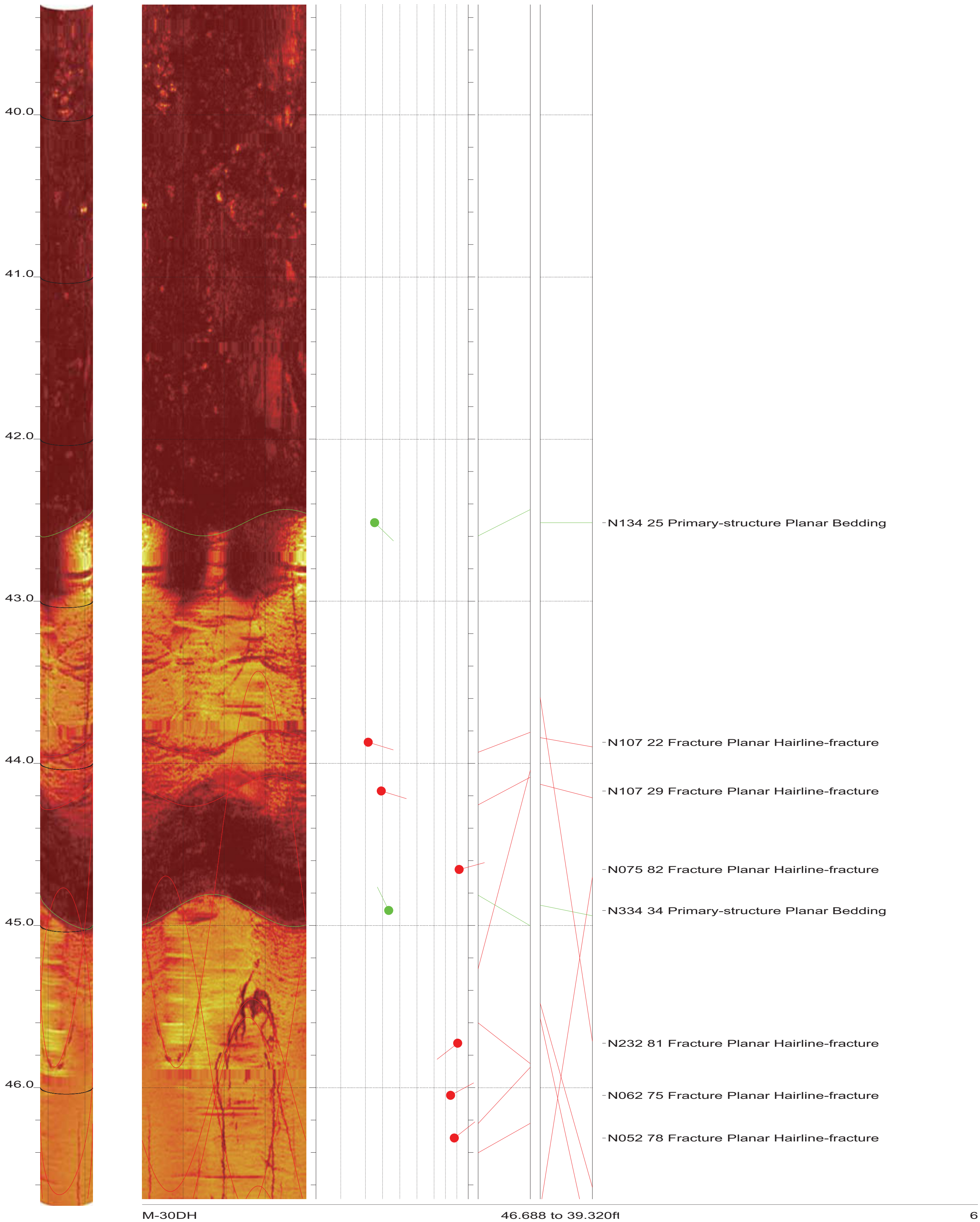
North Anna Boring M-30DH Acoustic Televiewer Dips rev 1 Sheet 3 of 27



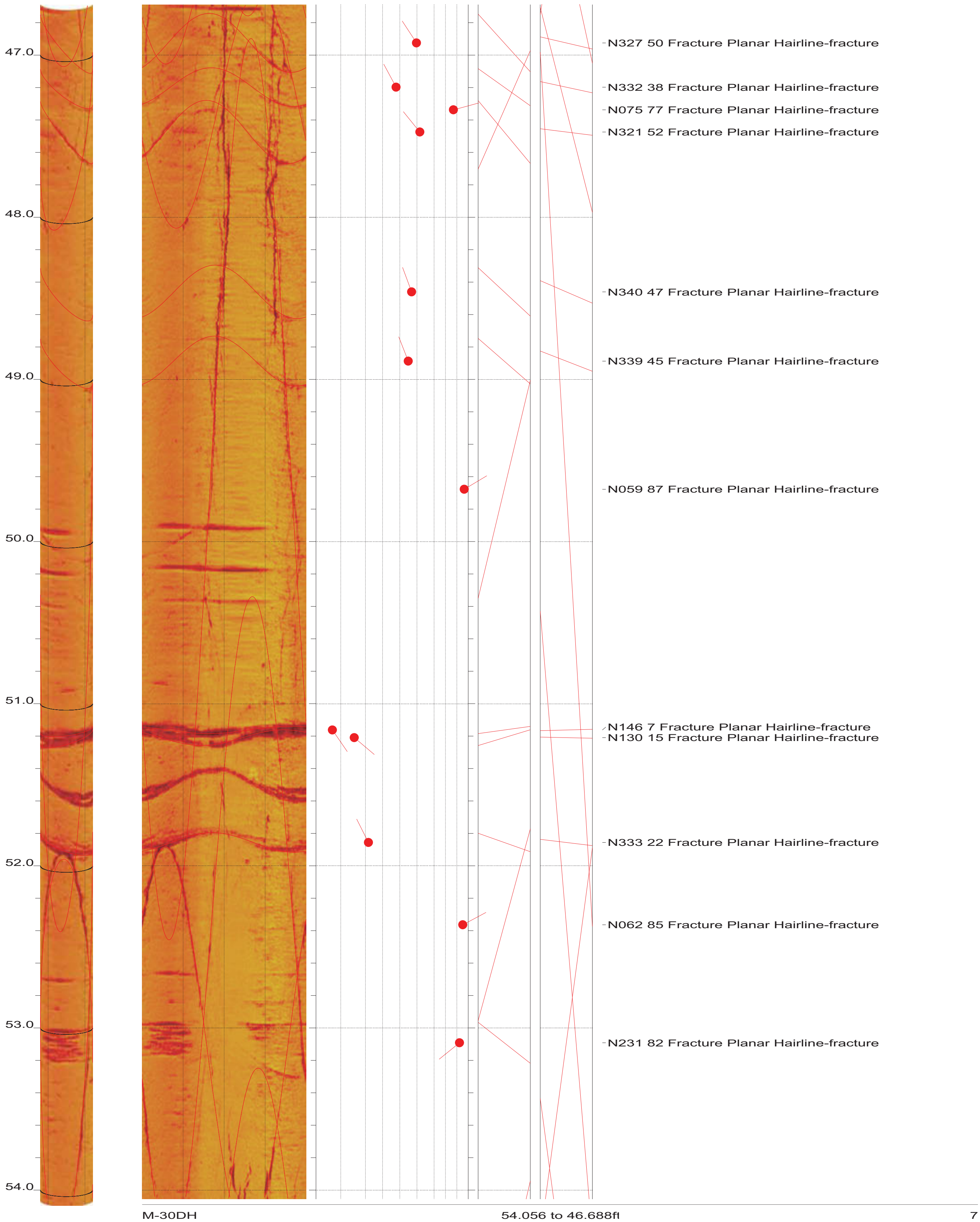
North Anna Boring M-30DH Acoustic Televiewer Dips rev 1 Sheet 4 of 27



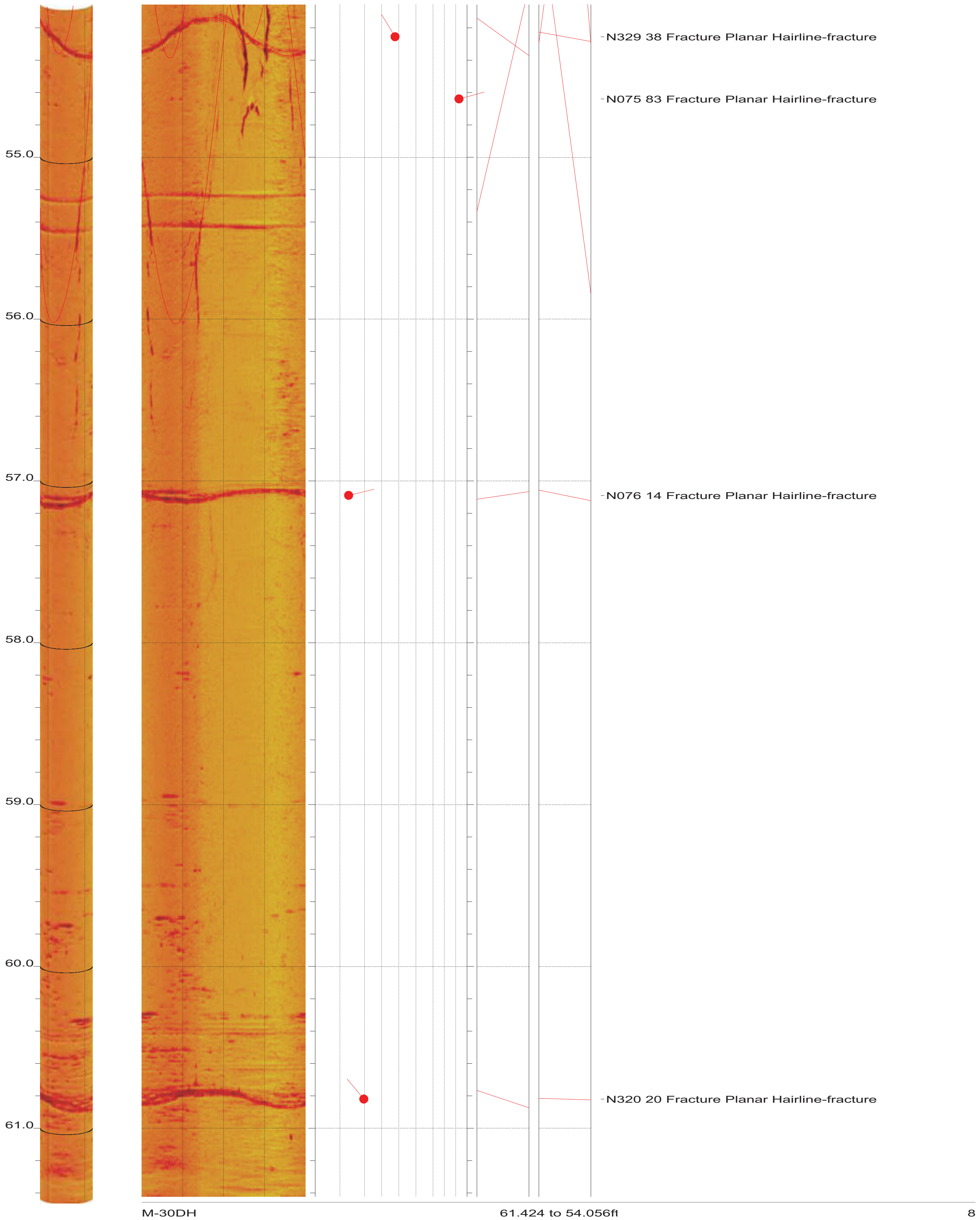
North Anna Boring M-30DH Acoustic Televiewer Dips rev 1 Sheet 5 of 27



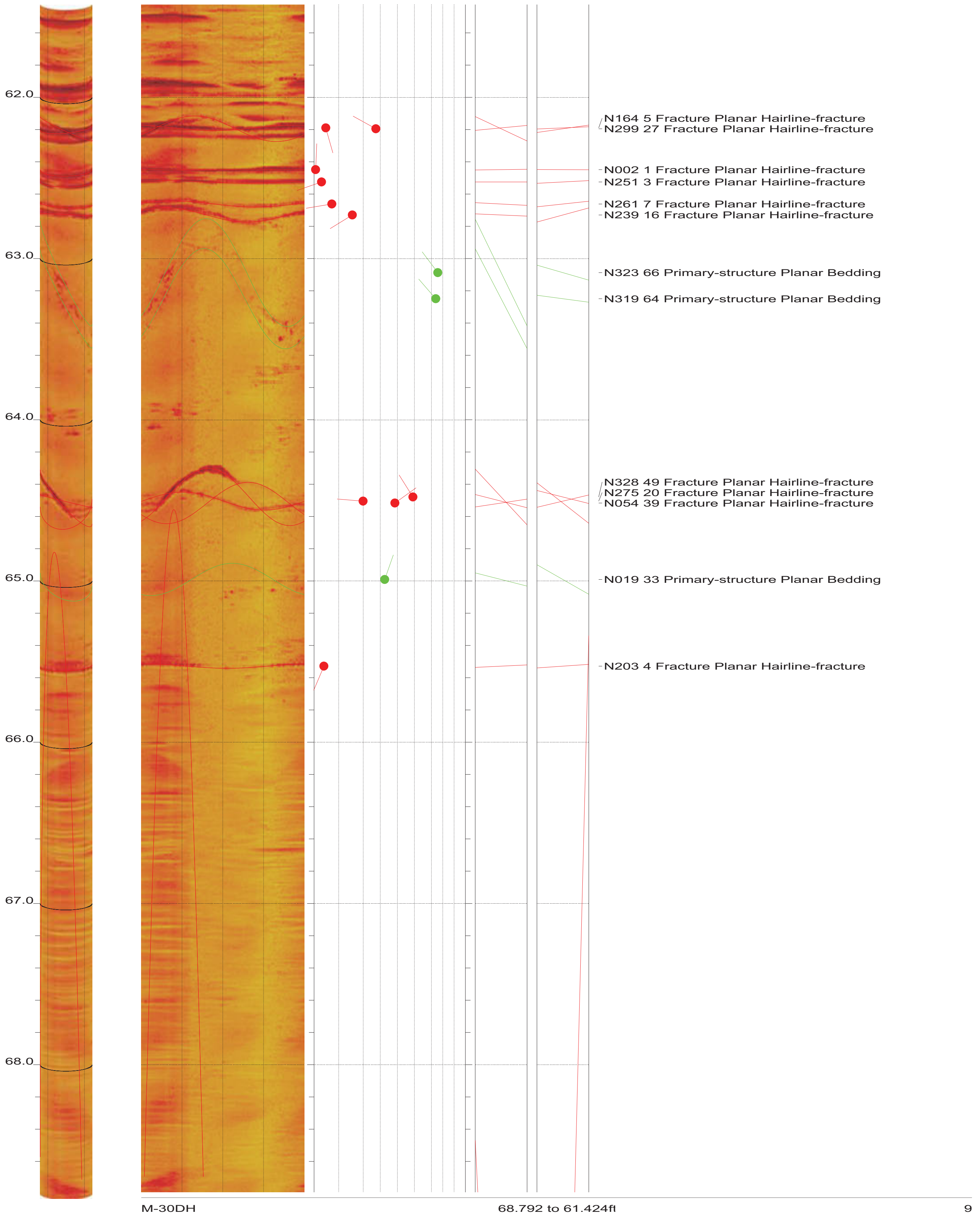
North Anna Boring M-30DH Acoustic Televiewer Dips rev 1 Sheet 6 of 27



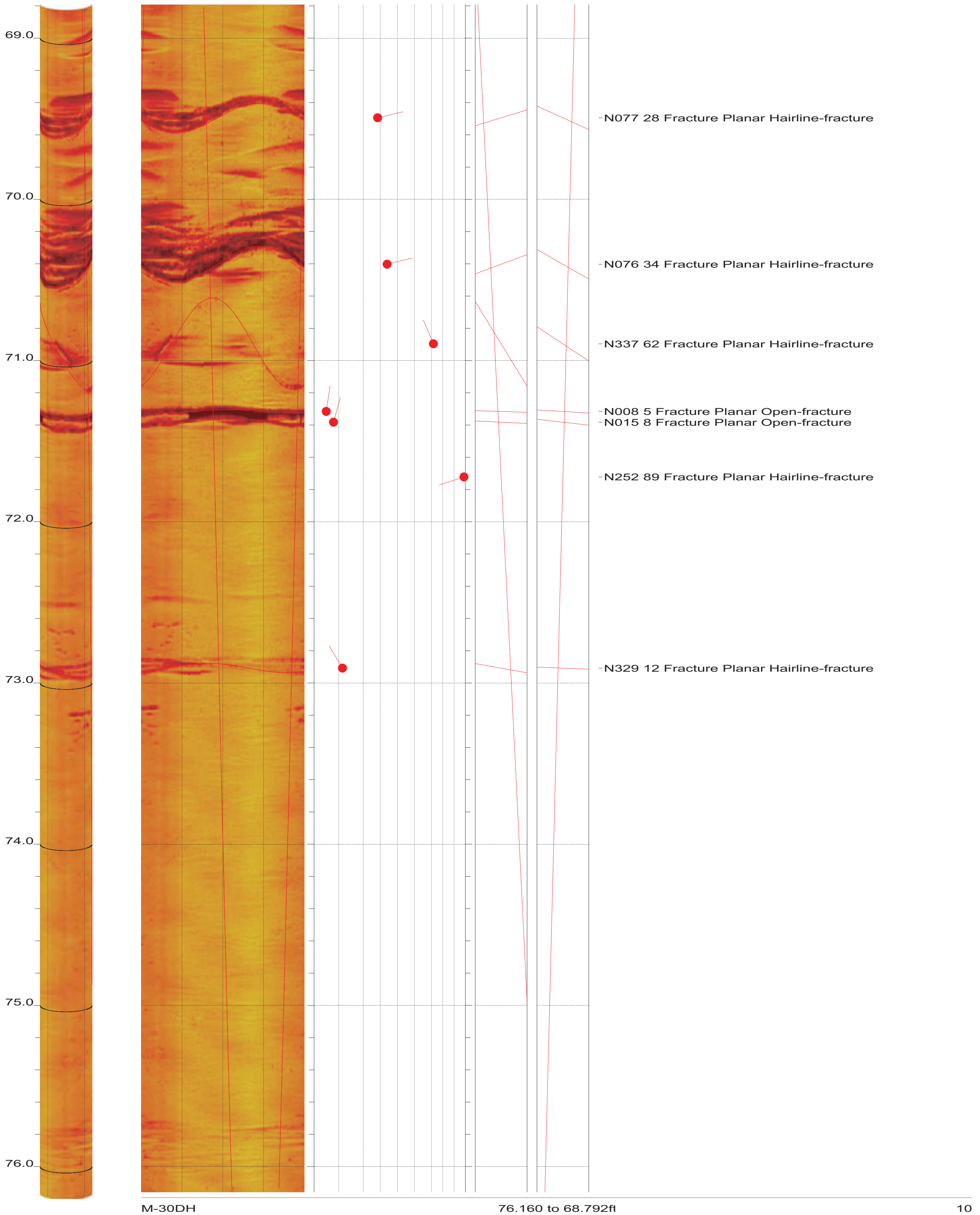
North Anna Boring M-30DH Acoustic Televiewer Dips rev 1 Sheet 7 of 27



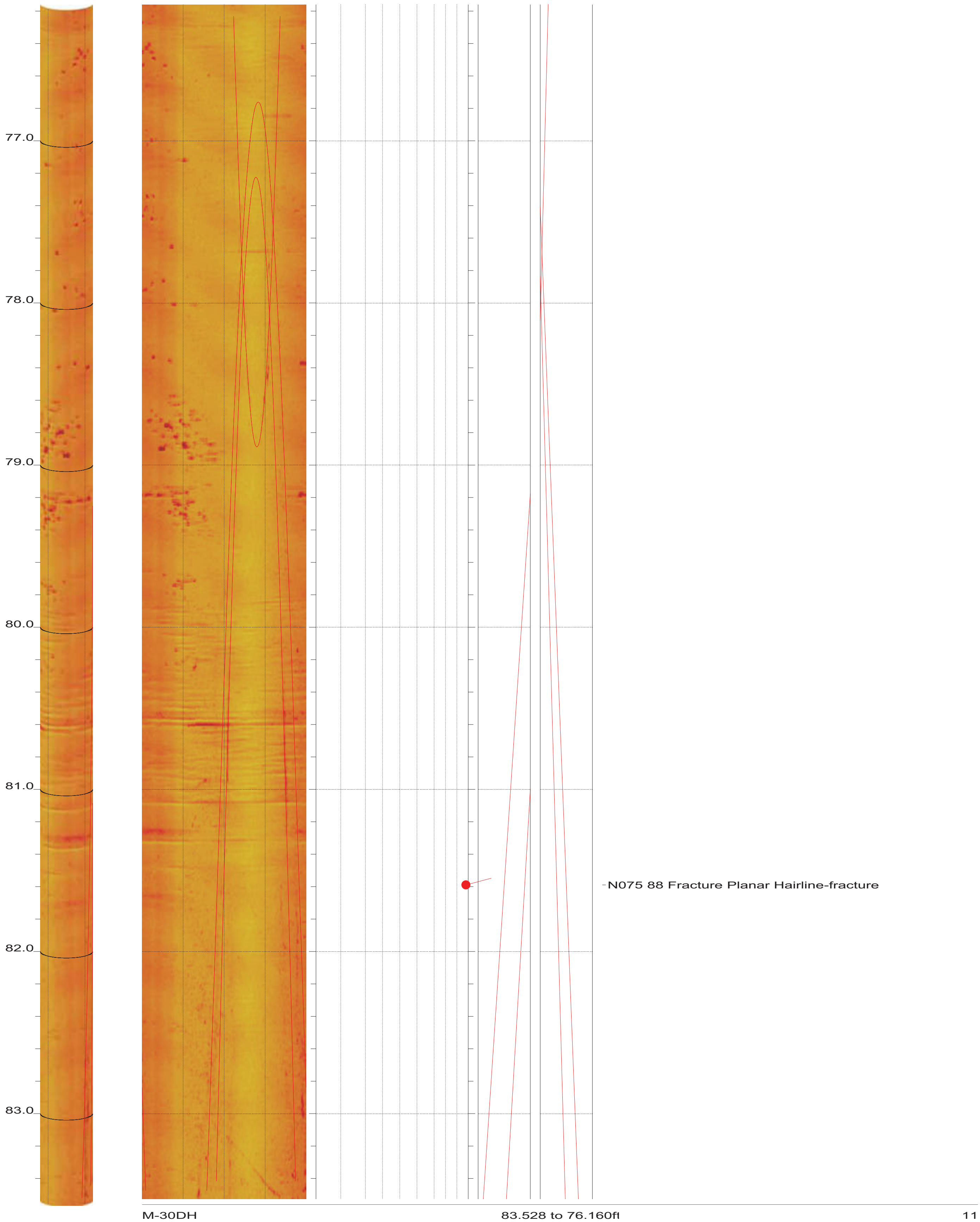
North Anna Boring M-30DH Acoustic Televiewer Dips rev 1 Sheet 8 of 27



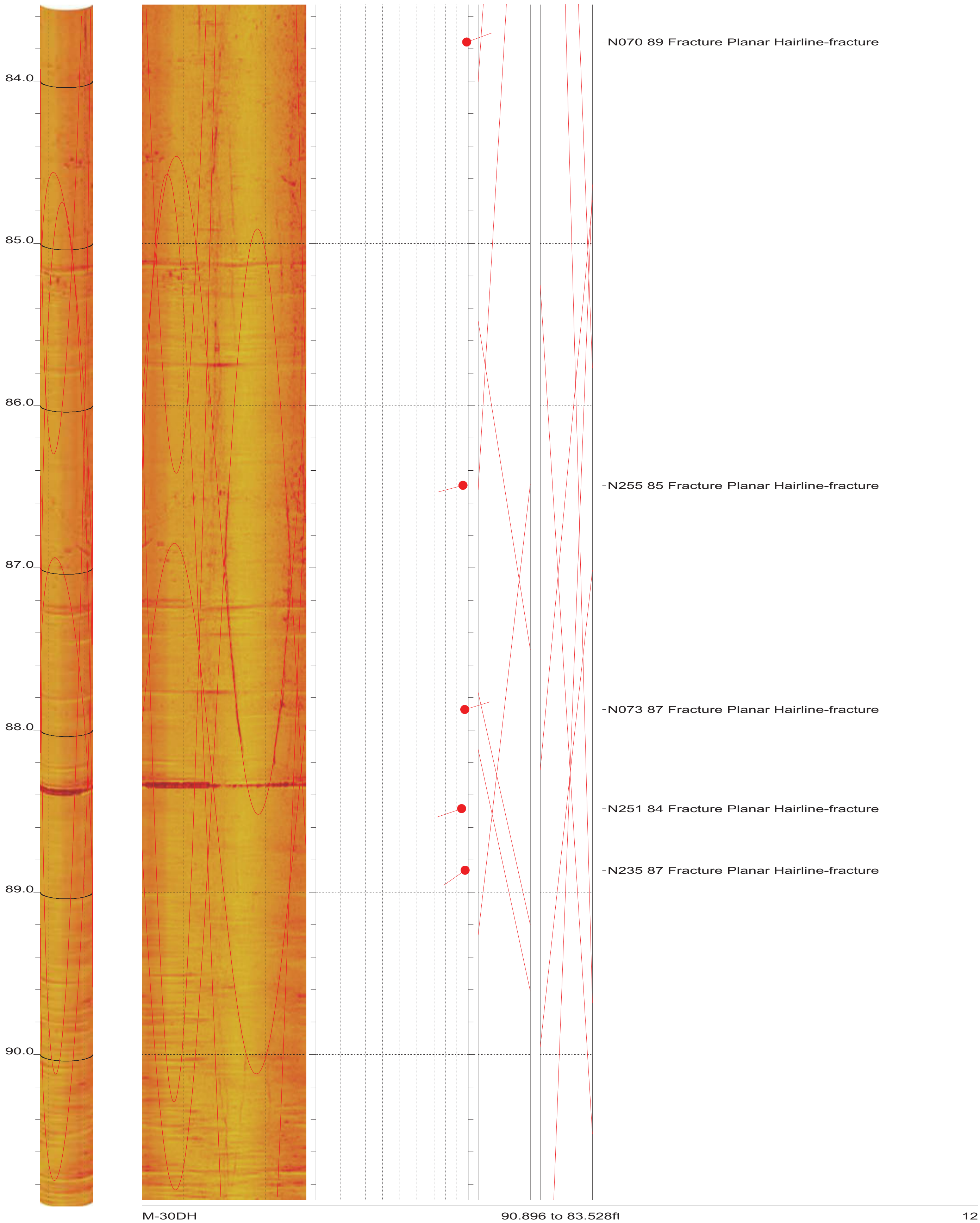
North Anna Boring M-30DH Acoustic Televiewer Dips rev 1 Sheet 9 of 27



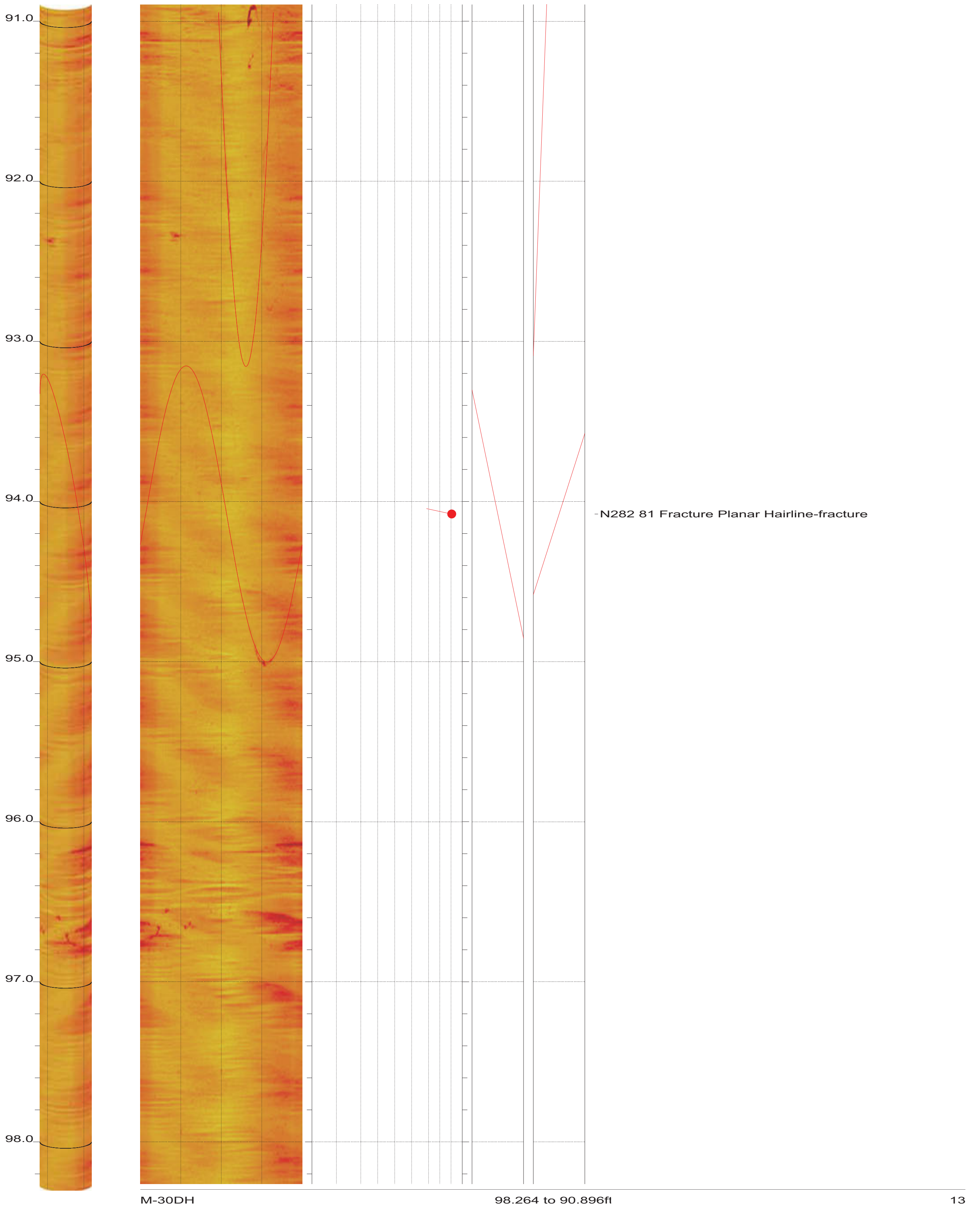
North Anna Boring M-30DH Acoustic Televiewer Dips rev 1 Sheet 10 of 27



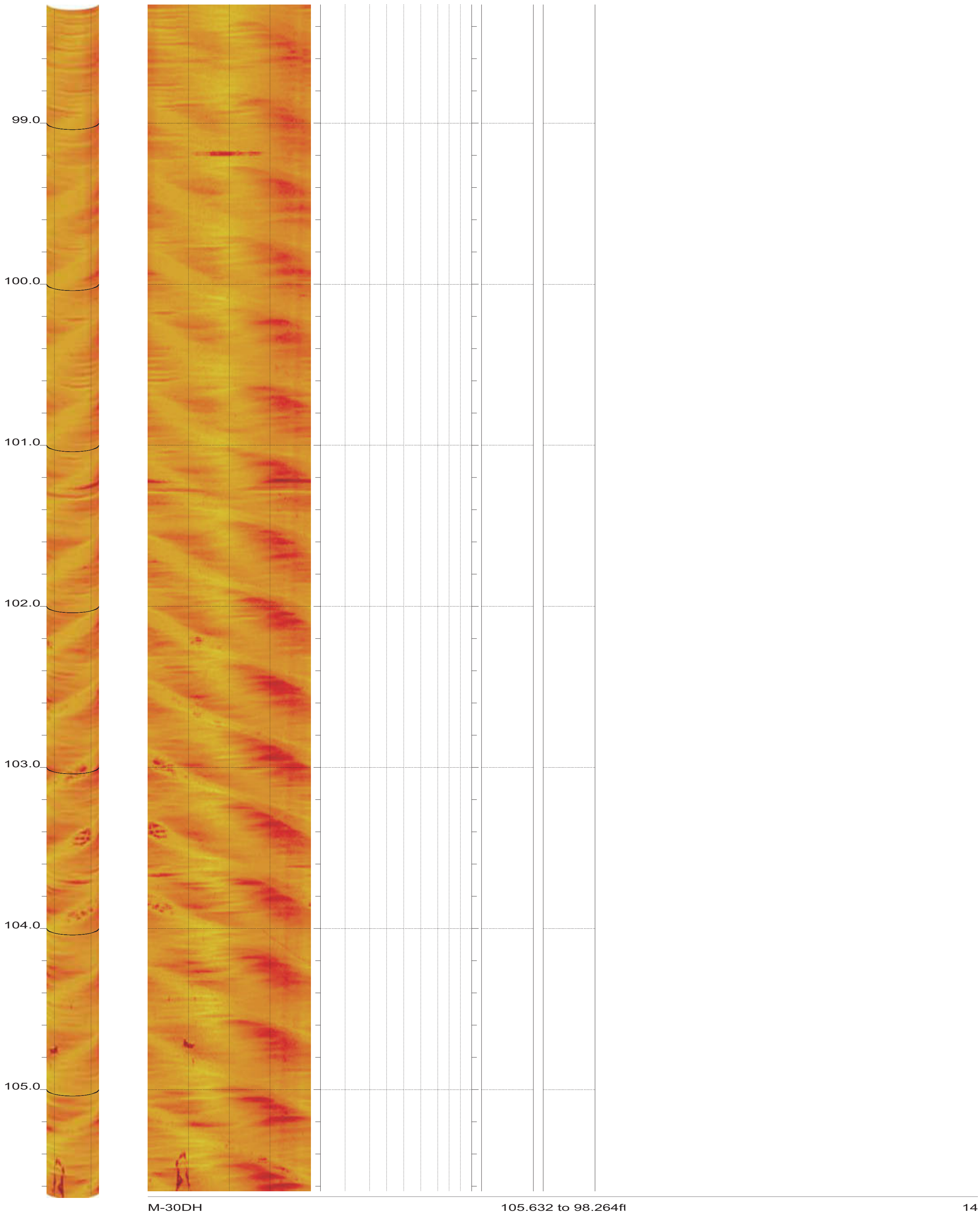
North Anna Boring M-30DH Acoustic Televiewer Dips rev 1 Sheet 11 of 27



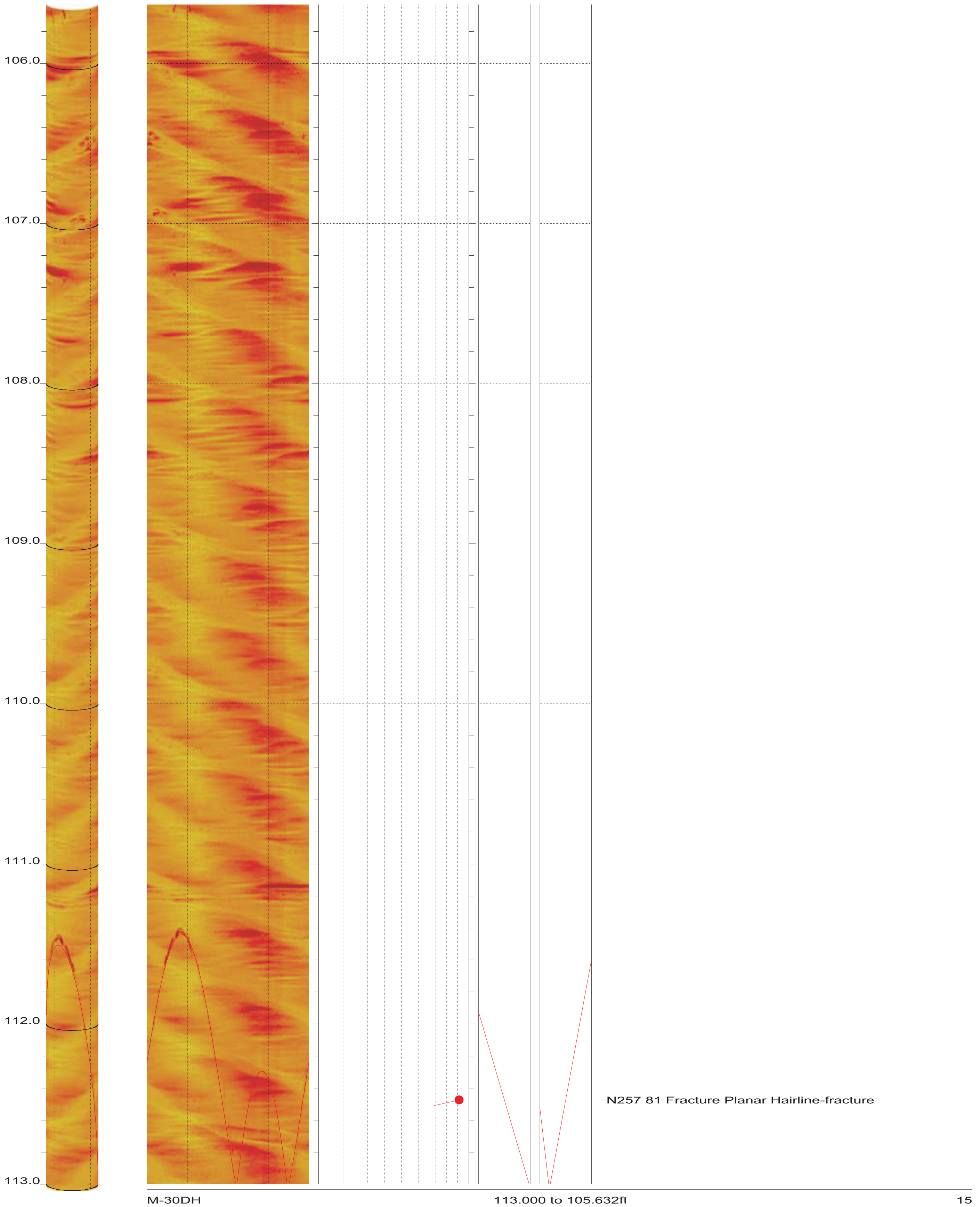
North Anna Boring M-30DH Acoustic Televiewer Dips rev 1 Sheet 12 of 27



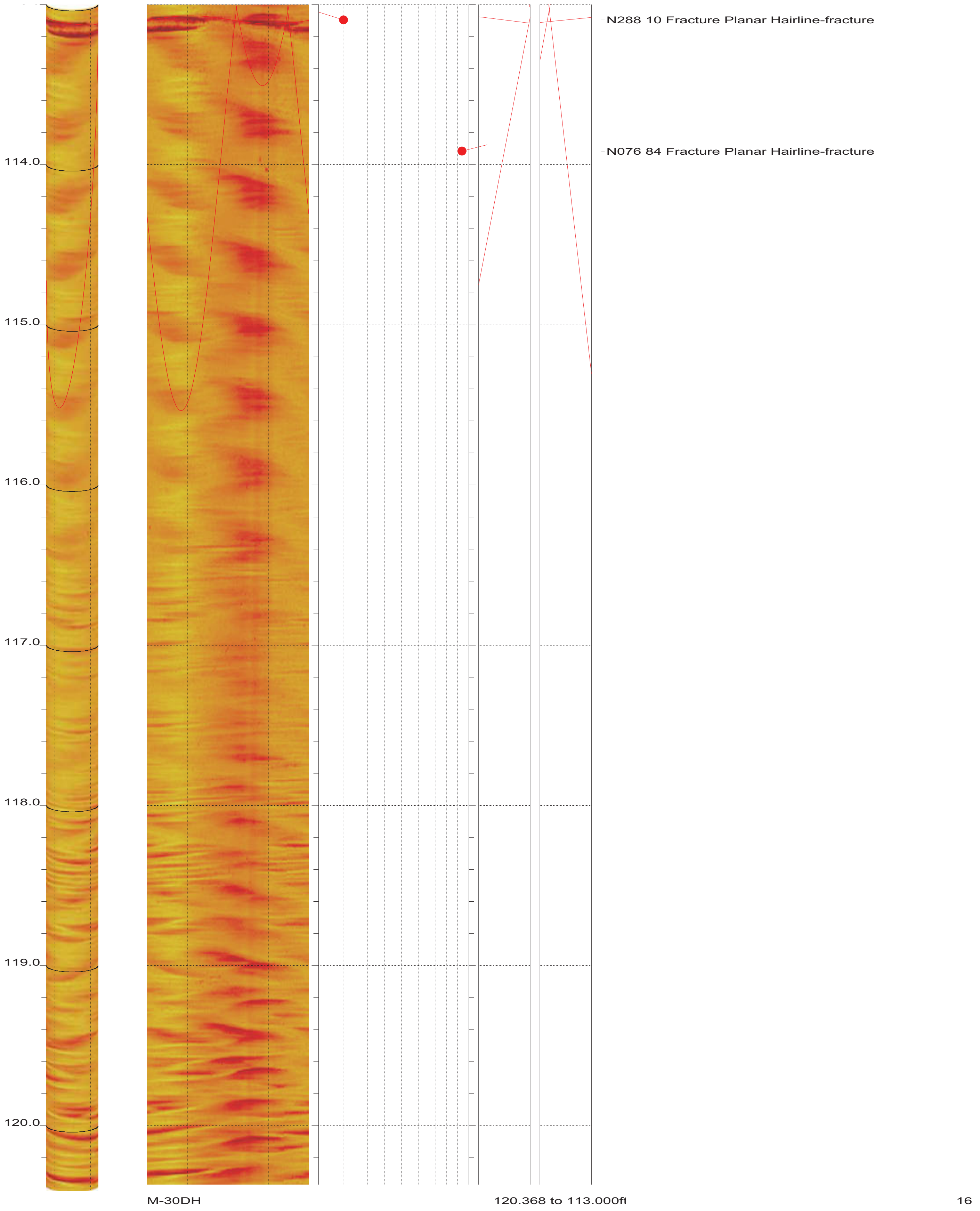
North Anna Boring M-30DH Acoustic Televiewer Dips rev 1 Sheet 13 of 27



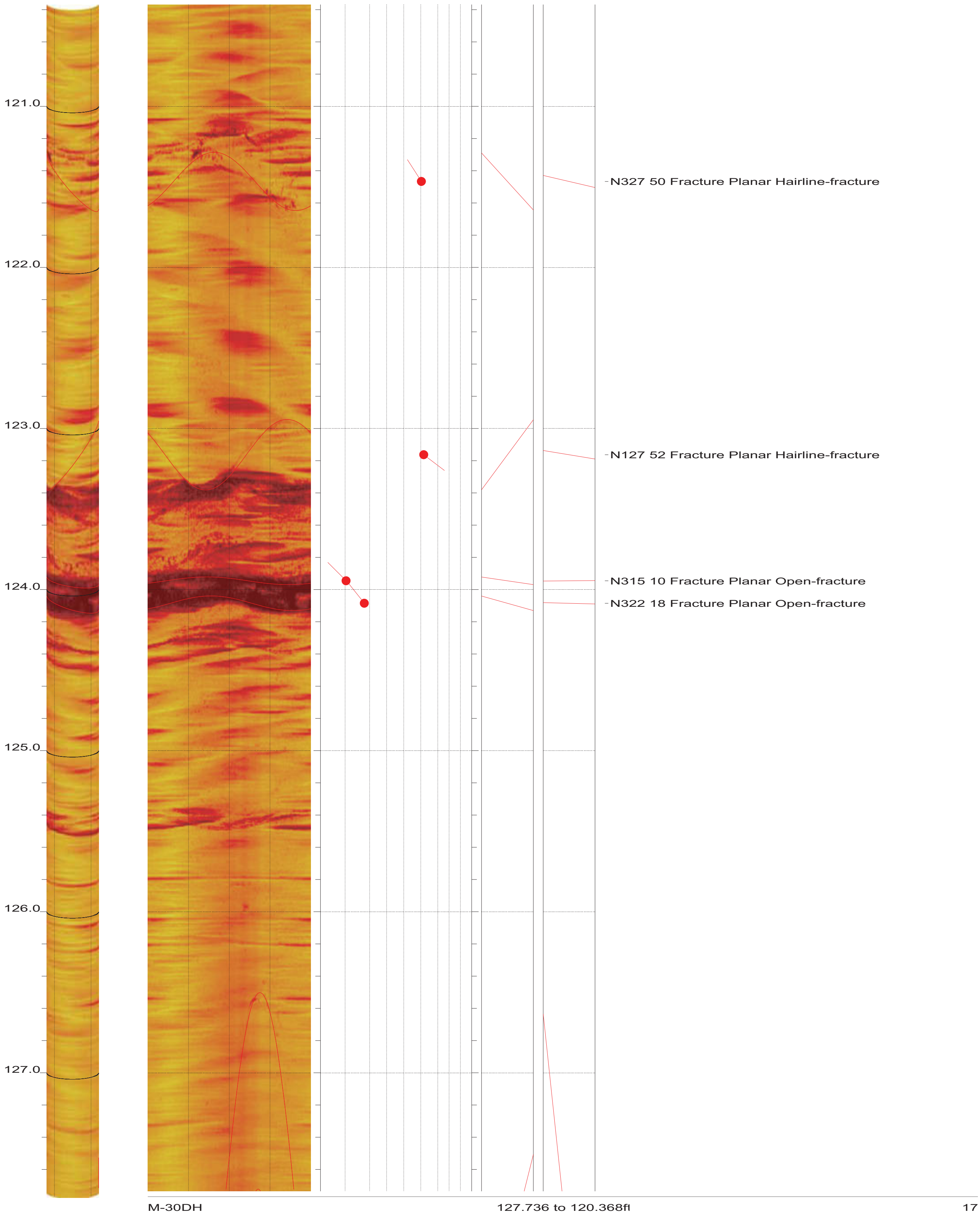
North Anna Boring M-30DH Acoustic Televiewer Dips rev 1 Sheet 14 of 27



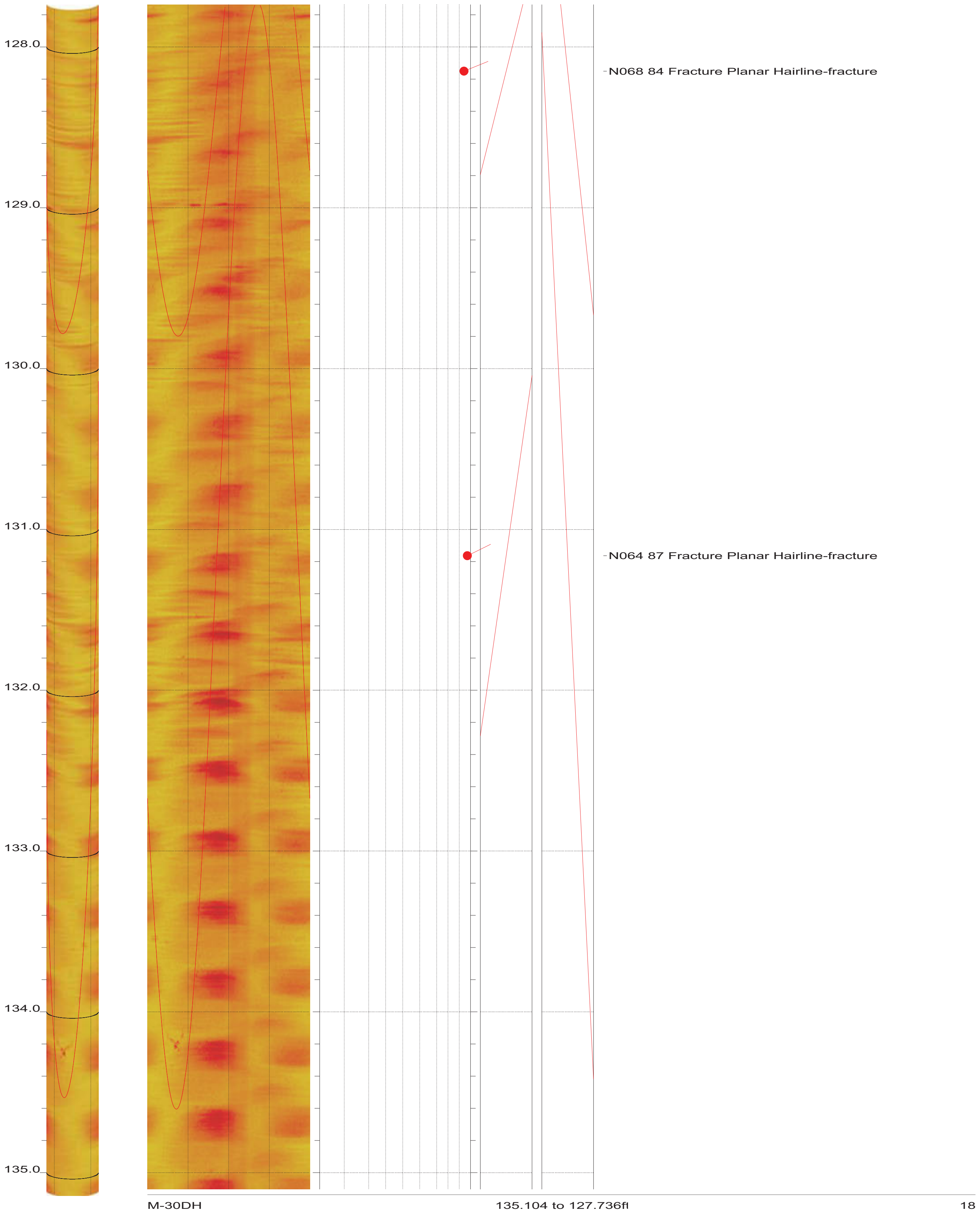
North Anna Boring M-30DH Acoustic Televiewer Dips rev 1 Sheet 15 of 27



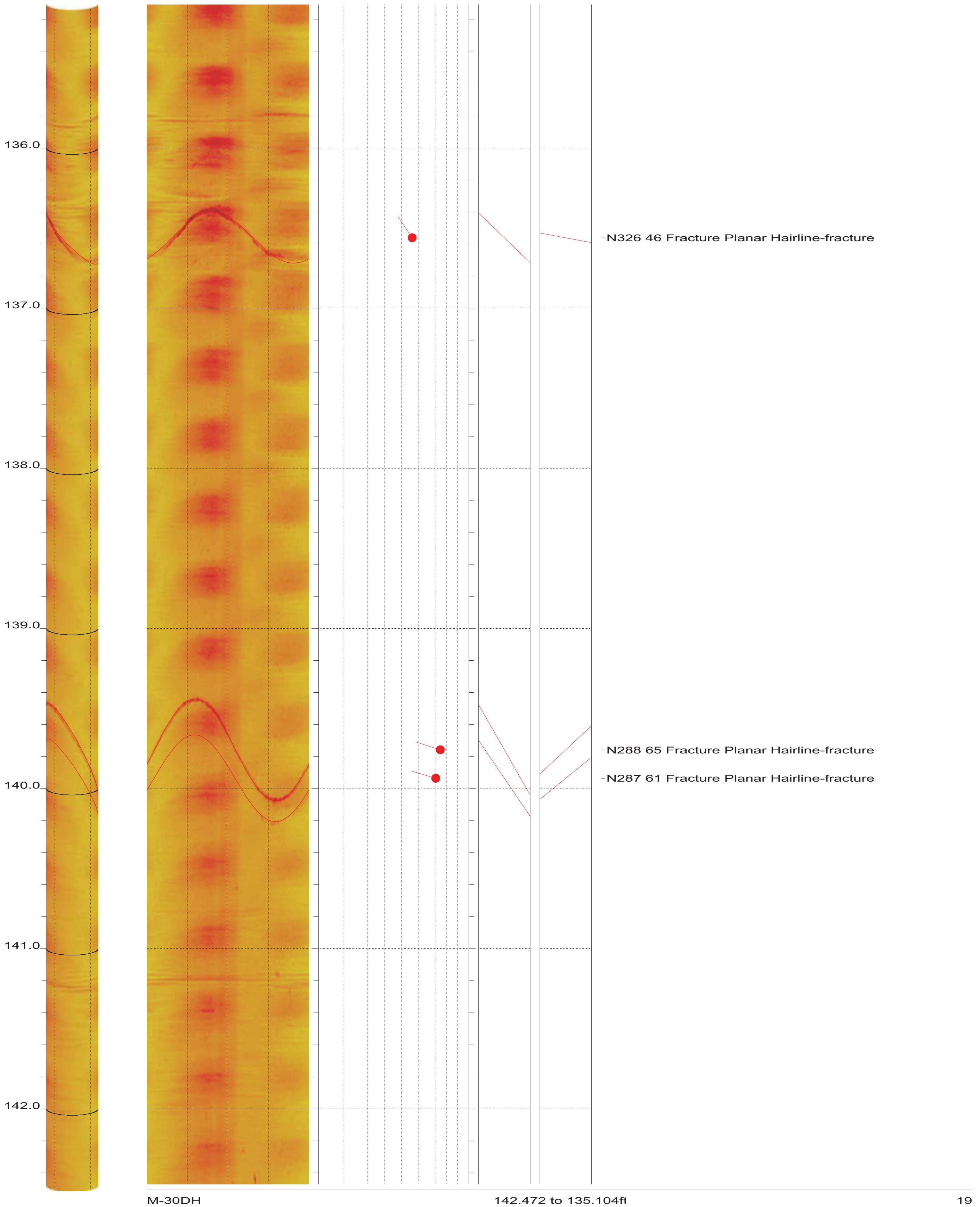
North Anna Boring M-30DH Acoustic Televiewer Dips rev 1 Sheet 16 of 27



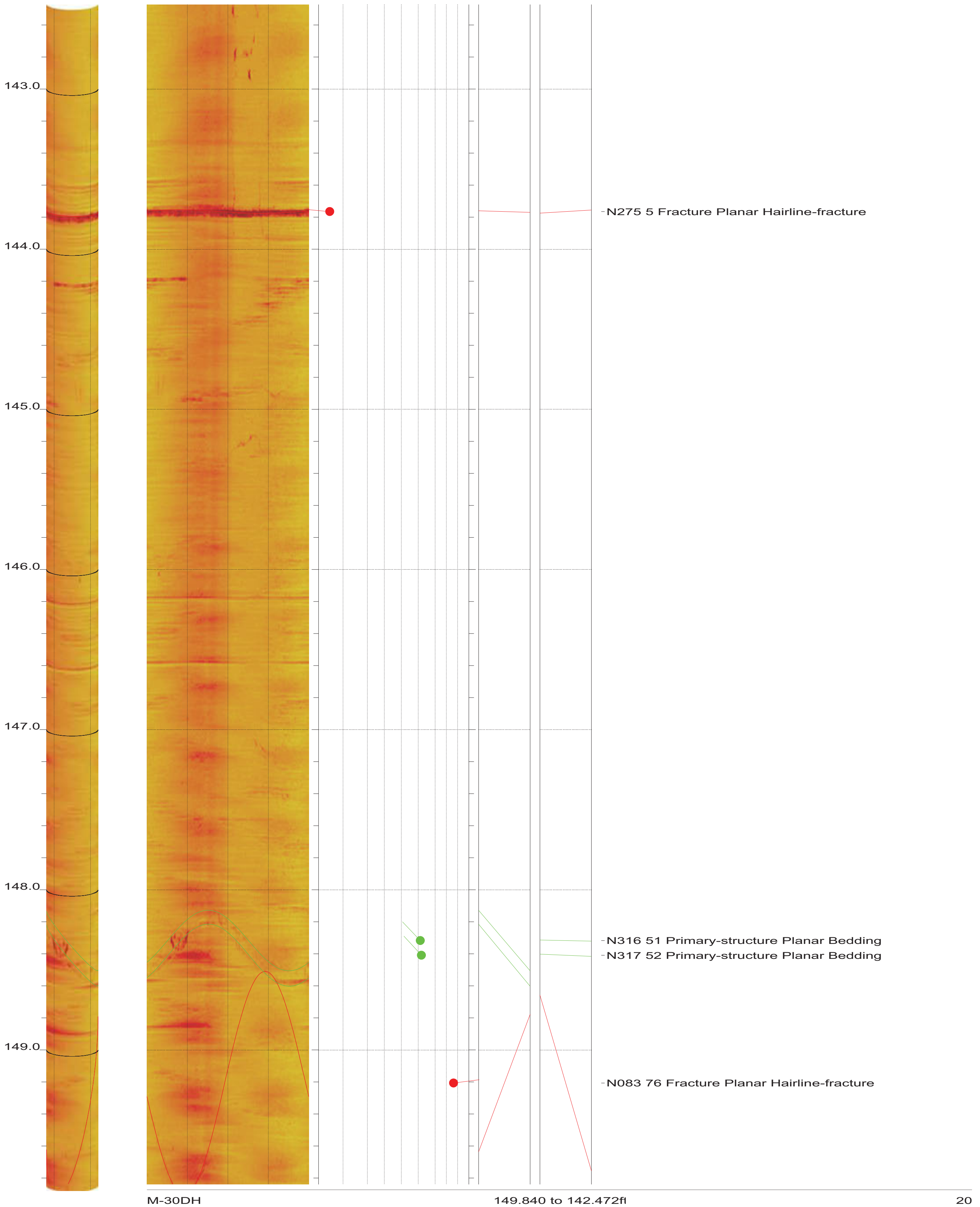
North Anna Boring M-30DH Acoustic Televiewer Dips rev 1 Sheet 17 of 27



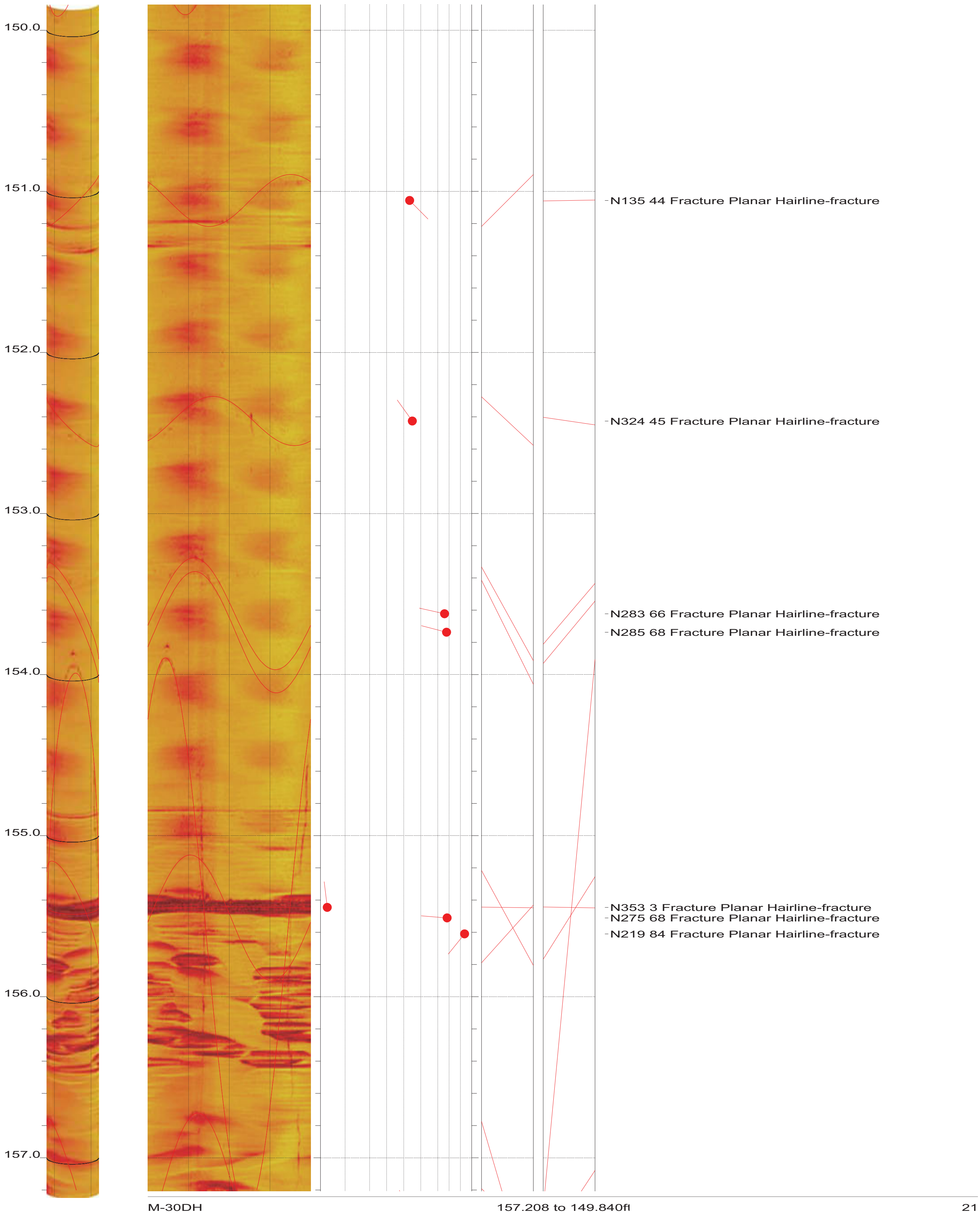
North Anna Boring M-30DH Acoustic Televiewer Dips rev 1 Sheet 18 of 27



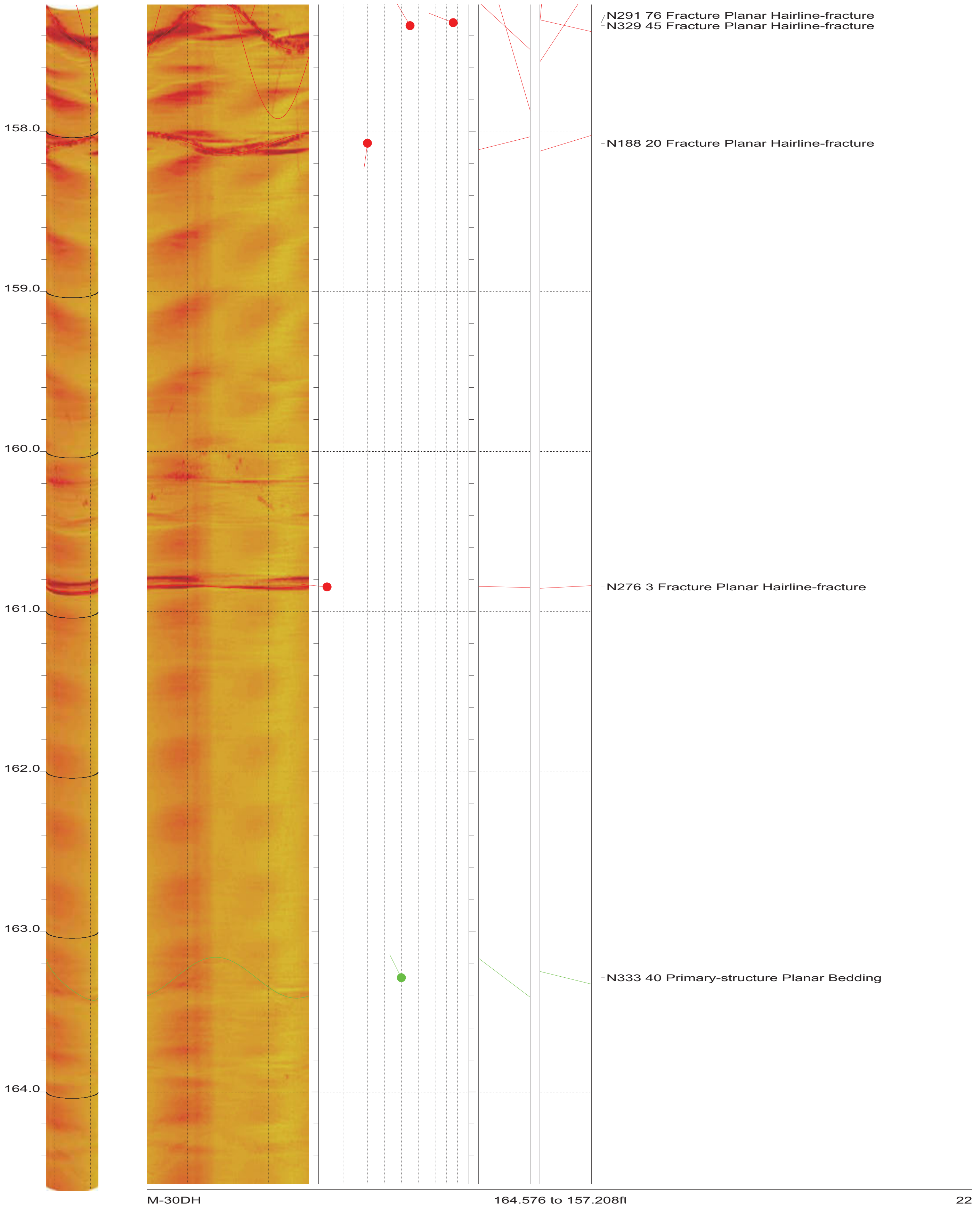
North Anna Boring M-30DH Acoustic Televiewer Dips rev 1 Sheet 19 of 27



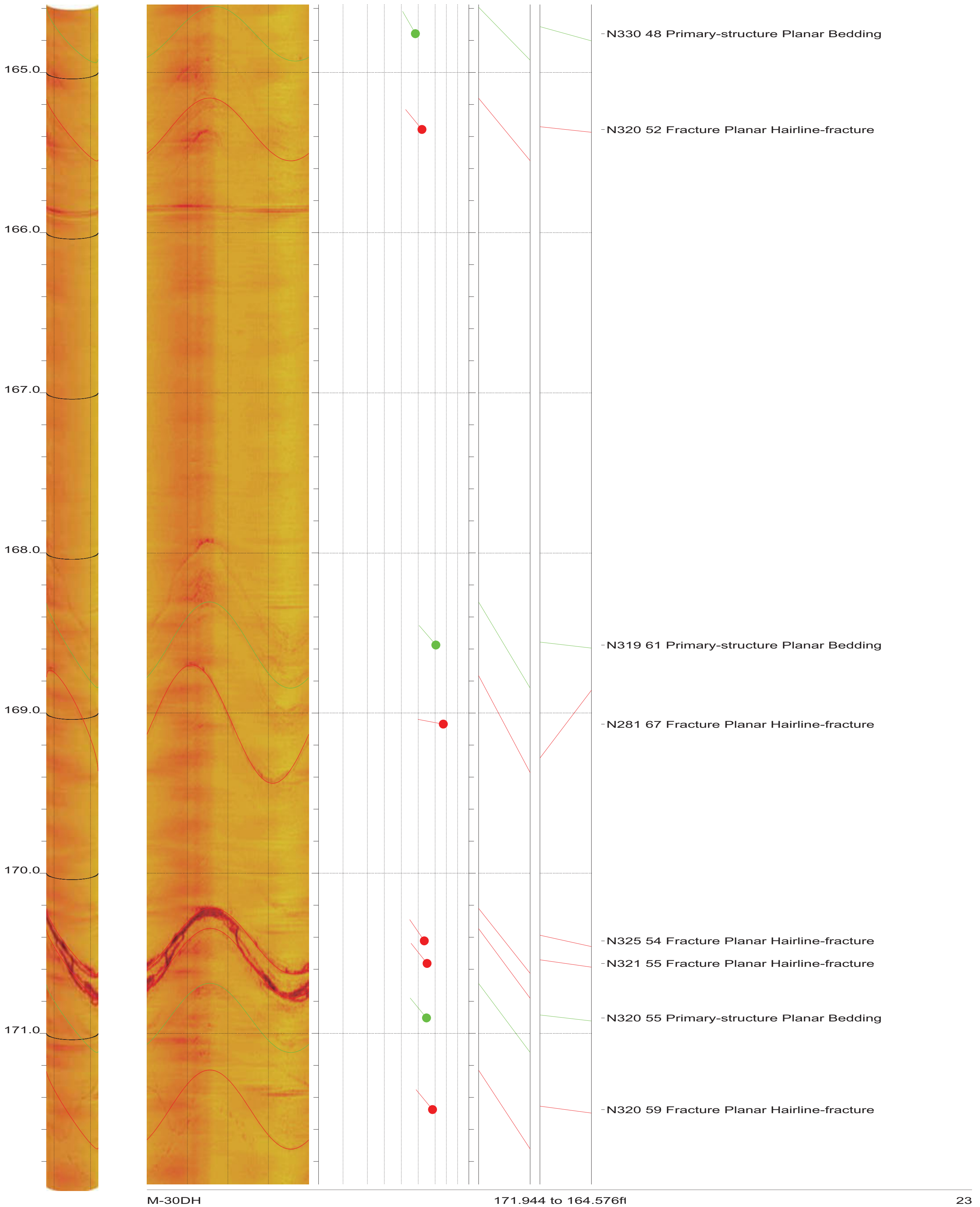
North Anna Boring M-30DH Acoustic Televiewer Dips rev 1 Sheet 20 of 27



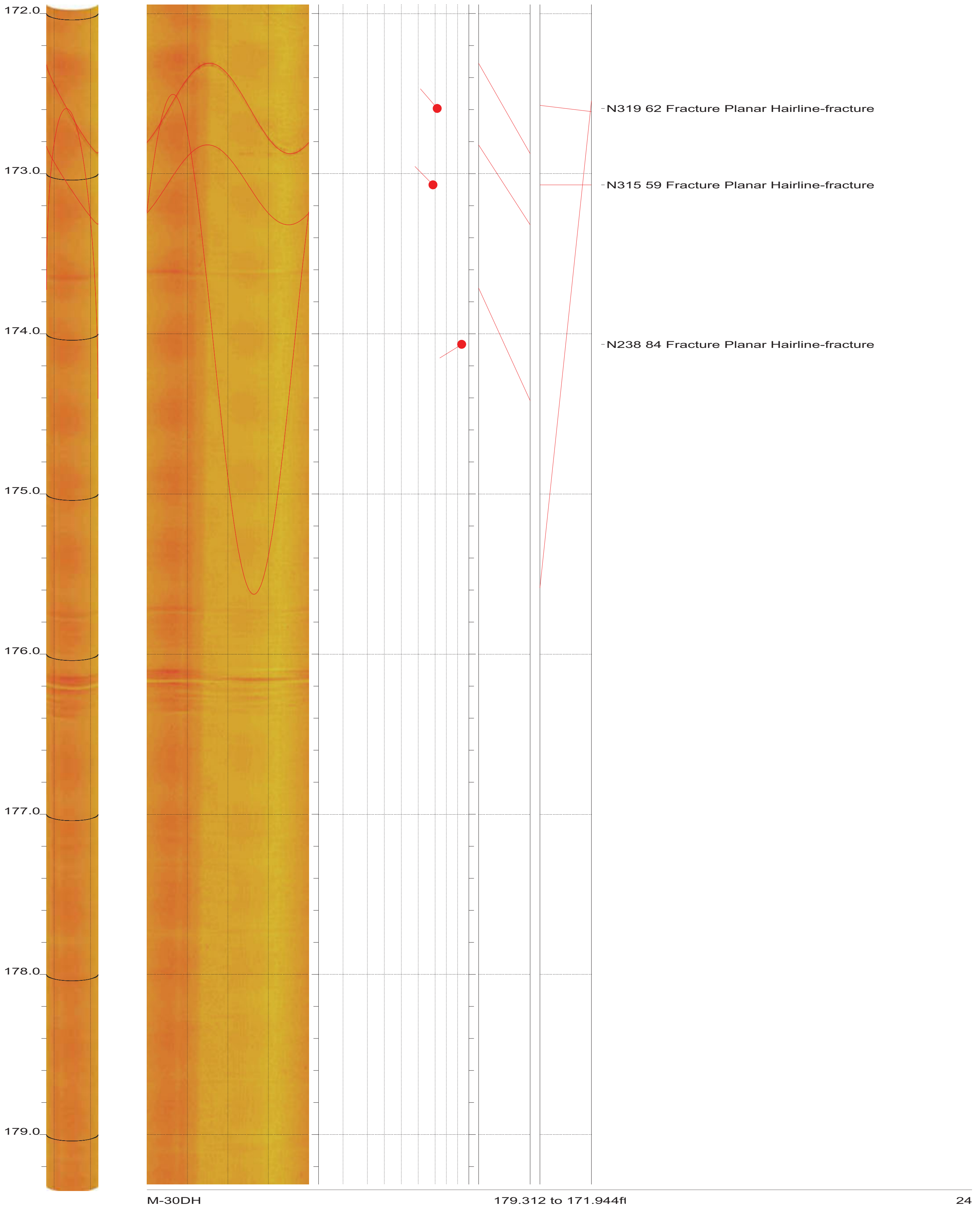
North Anna Boring M-30DH Acoustic Televiewer Dips rev 1 Sheet 21 of 27



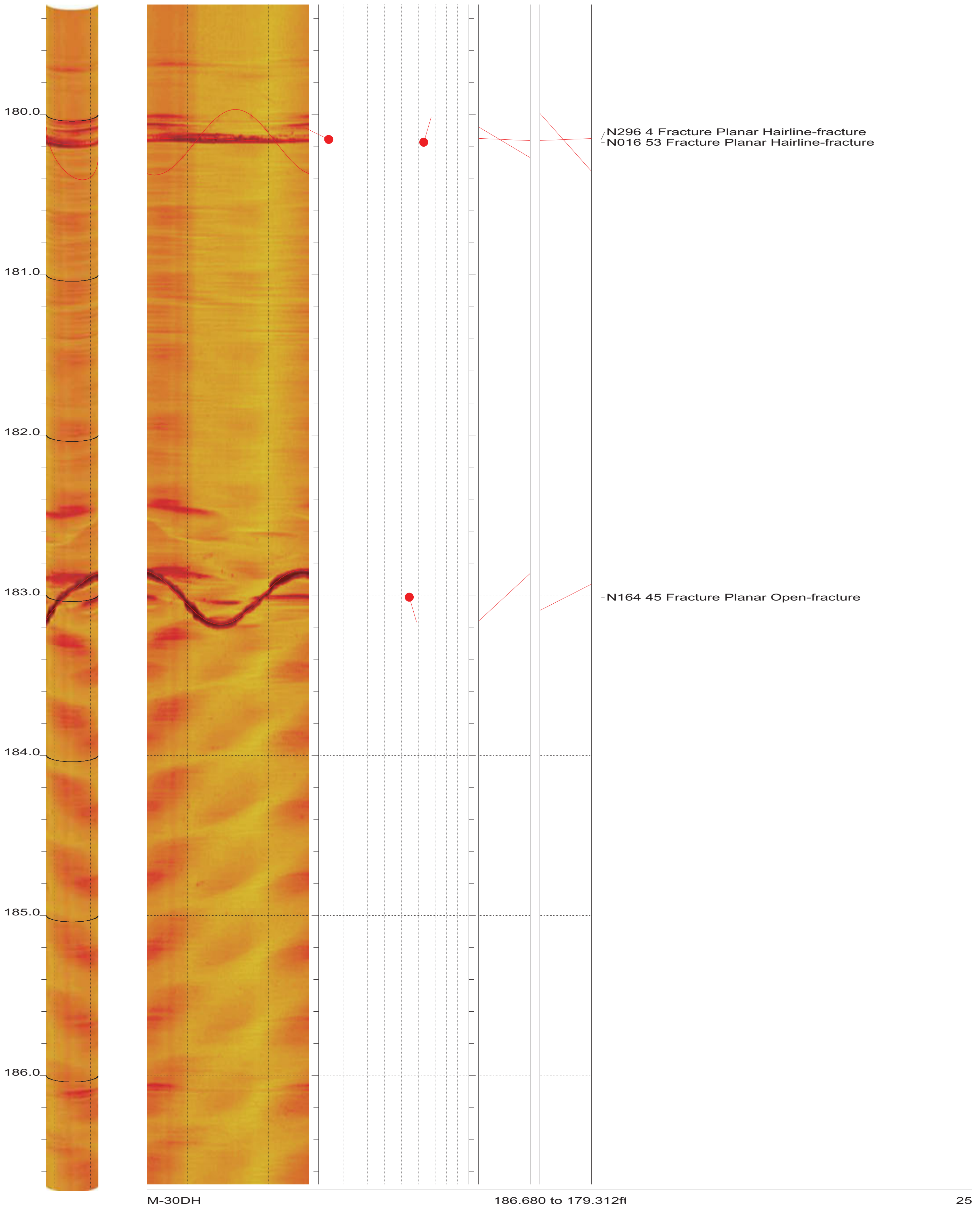
North Anna Boring M-30DH Acoustic Televiewer Dips rev 1 Sheet 22 of 27



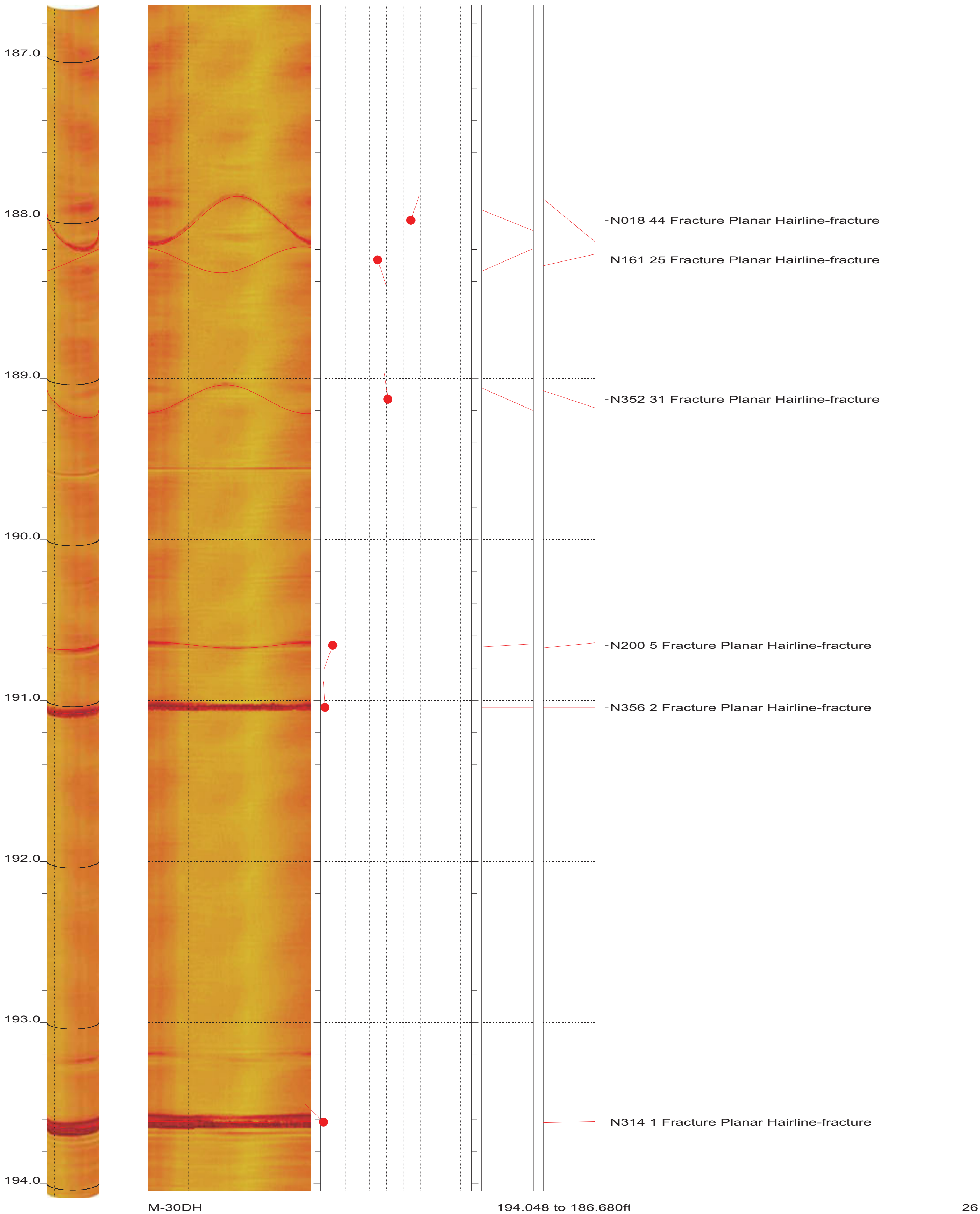
North Anna Boring M-30DH Acoustic Televiewer Dips rev 1 Sheet 23 of 27



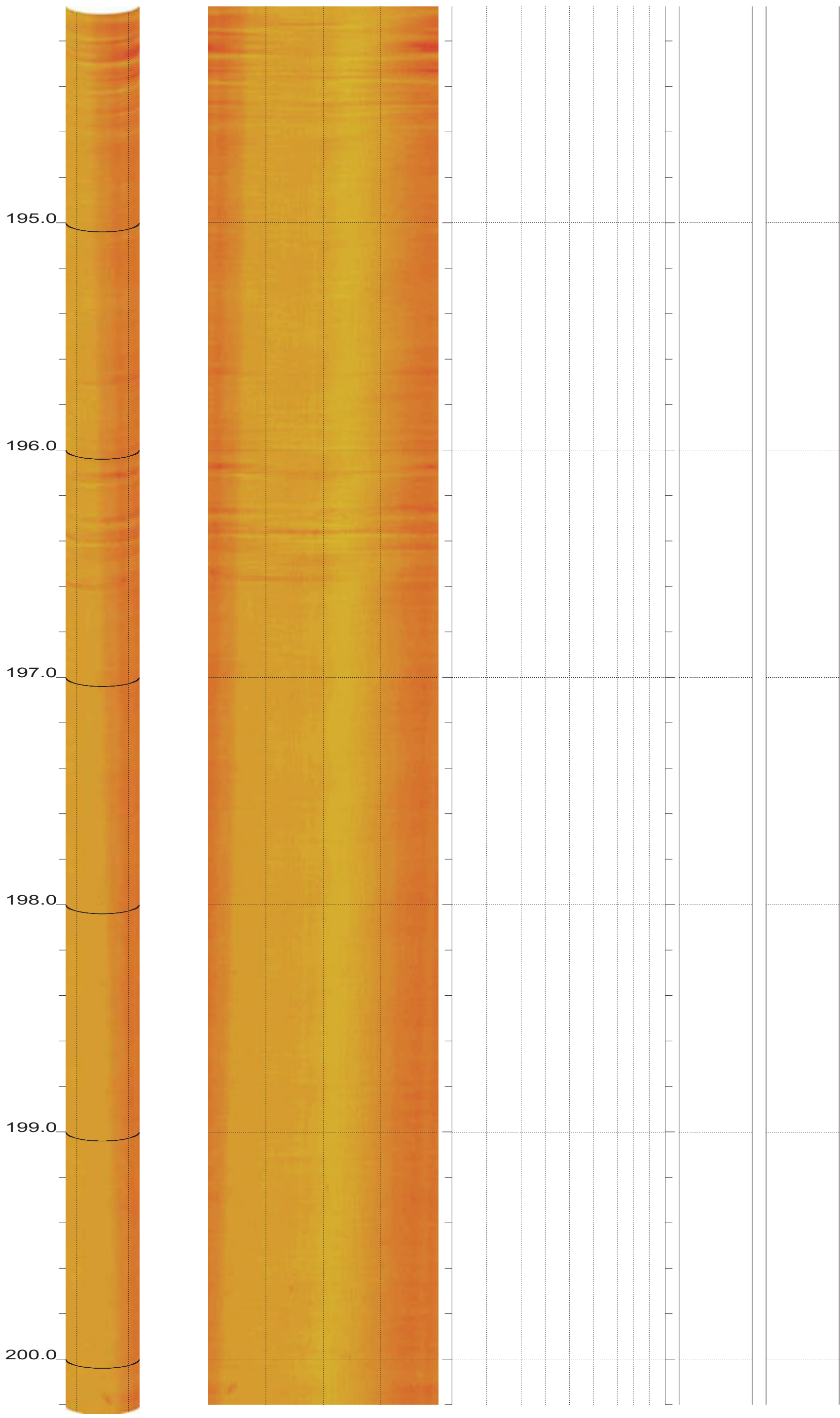
North Anna Boring M-30DH Acoustic Televiewer Dips rev 1 Sheet 24 of 27



North Anna Boring M-30DH Acoustic Televiewer Dips rev 1 Sheet 25 of 27



North Anna Boring M-30DH Acoustic Televiewer Dips rev 1 Sheet 26 of 27



M-30DH 200.200 to 194.048ft 27

North Anna Boring M-30DH Acoustic Televiewer Dips rev 1 Sheet 27 of 27

APPENDIX D

BORING GEOPHYSICAL LOGGING SYSTEMS - NIST TRACEABLE CALIBRATION PROCEDURES AND CALIBRATION RECORDS

GEOVision SUSPENSION PS SEISMIC LOGGER/RECORDER

CALIBRATION PROCEDURE

Reviewed 7/21/08

Objective

The timing/sampling accuracy of seismic recorders or data loggers is required for several GEOVision field procedures including Seismic Refraction, Downhole P-S Seismic Velocity Logging, and Suspension P-S Seismic Velocity Logging. This procedure describes the method for measuring the timing accuracy of a seismic data logger, such as the OYO Model 170 or OYO/Robertson Model 3403. The objective of this procedure is to verify that the timing accuracy of the recorder is accurate to within 1%.

Frequency of Calibration

The calibration of each GEOVision seismic data logger is twelve (12) months. In the case of rented seismic logger/recorders, calibration must be performed prior to use.

Test Equipment Required

The following equipment is required. Item #2 must have current NIST traceable calibration.

1. Function generator, Krohn Hite 5400B or equivalent
2. Frequency counter, HP 5315A or equivalent
3. Test cables, from item 1 to item 2, and from item 1 to subject data logger.

Procedure

This procedure is designed to be performed using the accompanying Suspension P-S Seismic Logger/Recorder Calibration Data Form with the same revision number. All data must be entered and the procedure signed by the technician performing the test.

1. Record all identification data on the form provided.
2. Connect function generator to data logger (such as OYO Model 170) using test cable
3. Connect the function generator to the frequency counter using test cable.
4. Set signal generator to target frequency specified on data form, 0.25 volt (amplitude is approximate, modify as necessary to yield less than full scale waveforms on

logger display) peak sine wave. Verify frequency using the counter and note actual frequency on the data form.

5. Set data logger to file length specified on data form and record a data file to disk. Note file name on data form.

6. Measure the duration of 9 complete sine wave cycles on the data file. This measurement must be made using the analysis program PSLOG.EXE version 1.00, and saved as a .sps pick file. Note the duration in milliseconds in the spaces provided on the data form. Calculate average recorded sine wave frequency for each channel pair (Hn, Hr, V) by dividing the duration by 9. Note the average frequency of each channel pair on the data form.

7. Repeat steps 4 through 6 until all target frequencies have been recorded, producing 6 separate data and pick files.

Criteria

The average frequency for the nine cycles (obtained by dividing 9 cycles by the duration in seconds) must be within plus or minus 1% of the actual frequency for each of the 6 records.

If the results are outside this range, the data logger must be marked with a GEOVision REJECT tag until it can be repaired and retested.

If results are acceptable affix label indicating the initials of the person performing the calibration, the date of calibration, and the due date for the next calibration (12 months).

Procedure Approval

Approved by:

John G. Diehl	President
Name	Title
	July 21, 2008
Signature	Date

Calibration Laboratory Approval (if required):

Name	Title
Signature	Date

Page 1 of 4

TEST NUMBER
573794

EDISON ESI℠ Calibration Report

A SOUTHERN CALIFORNIA EDISON® Company

Metrology
7300 Fenwick Lane
Westminster, CA 92683
Toll Free: 866-723-2257

GEOVision Geophysical Services
1124 Olympic Drive
Corona, CA 92881-3390

NVLAP®

Lab Code: 105014-0

Manufacturer: Oyo
Model Number: 3403
Description: Unit, Suspension Telemetry
Asset Number: 160023
Serial Number: 160023
Cal. Procedure: Customer
PO Number: 9200-090716-01

Ambient Temperature: 23° C
Ambient Humidity: 56% RH
Condition As Found: In Tolerance
Condition As Left: In Tolerance - No Adjustment
Calibration Date: 07/17/2009
Calibration Due Date: 07/17/2010
Calibration Interval: 12 Months

Remarks:
The unit was calibrated with the customer's procedure and specification's which have been reviewed by Metrology Engineering and documented in SCE Document M013987. The data can be found on pages 2 and 3 of this report with the original observation data on page 4.

Standards Utilized

I.D. No.	Manufacturer	Model No.	Description	Cal. Date	Due Date
S1-01252	Hewlett Packard	5335A OPT 010,203040	Counter, Universal	01/29/2009	07/29/2009
S1-01347	Hewlett Packard	3325A	Generator, Function, Synthesizer	05/04/2009	11/04/2009
S1-03686	Fluke	910	Standard, Frequency, Controlled, Gps	01/24/2009	01/24/2010

Calibration Performed By:			Quality Reviewer:	
Branson, Craig A CA	Metrologist	714-895-0714	[signature]	7/17/09
Name	Title	Phone	Name	Date

Custom Specification Report

Test No. 573794
Asset No. 160023

Oyo 3403 Unit, Suspension Telemetry,

STEP NUM	FUNCTION TESTED	NOMINAL VALUE	AS FOUND	AS LEFT	Out of Tol	CALIBRATION TOLERANCE
	CH HN Frequency Sine Wave	50.00 Hz	50.00	Same		49.50 to 50.50 Hz [EMU 0.000250]
	|	100.0 Hz	100.0	Same		99.0 to 101.0 Hz [EMU 0.000500]
	|	200.0 Hz	200.0	Same		198.0 to 202.0 Hz [EMU 0.001000]
	|	500.0 Hz	500.0	Same		495.0 to 505.0 Hz [EMU 0.002500]
	|	1000 Hz	1000	Same		990 to 1010 Hz [EMU 0.005000]
	|	2000 Hz	2000	Same		1980 to 2020 Hz [EMU 0.010000]
	CH HR Frequency Sine Wave	50.00 Hz	50.00	Same		49.50 to 50.50 Hz [EMU 0.000250]
	|	100.0 Hz	100.0	Same		99.0 to 101.0 Hz [EMU 0.000500]
	|	200.0 Hz	200.0	Same		198.0 to 202.0 Hz [EMU 0.001000]
	|	500.0 Hz	500.0	Same		495.0 to 505.0 Hz [EMU 0.002500]
	|	1000 Hz	1000	Same		990 to 1010 Hz [EMU 0.005000]
	|	2000 Hz	2000	Same		1980 to 2020 Hz [EMU 0.010000]
	CH V Frequency Sine Wave	50.00 Hz	50.00	Same		49.50 to 50.50 Hz [EMU 0.000250]
	|	100.0 Hz	100.0	Same		99.0 to 101.0 Hz [EMU 0.000500]
	|	200.0 Hz	200.0	Same		198.0 to 202.0 Hz [EMU 0.001000]
	|	500.0 Hz	500.0	Same		495.0 to 505.0 Hz [EMU 0.002500]

Remarks:

MudCats CPM: Version 2.2.2 (Professional)
Src DUI: {9548AF3D-C74D-4C9F-AEEF-21EF560BC451} (c)
Doc DUI: {AB10F47E-4C5F-4650-91CB-A05A72E361C1} (o)

ATTACHMENT 2
Page 1 of 2

Customer

Custom Specification Report

Test No. 573794
Asset No. 160023

Oyo 3403 Unit, Suspension Telemetry,

Page 3 of 4

STEP NUM	FUNCTION TESTED	NOMINAL VALUE	AS FOUND	AS LEFT	Out of Tol	CALIBRATION TOLERANCE
	CH V Frequency Sine Wave	1000 Hz	998.9	Same		990 to 1010 Hz [EMU 0.005000]
	|	2000 Hz	2000	Same		1980 to 2020 Hz [EMU 0.010000]

Remarks:

MudCats CPM: Version 2.2.2 (Professional)
Src DUI: {9548AF3D-C74D-4C9F-AEEF-21EF560BC451} (c)
Doc DUI: {AB10F47E-4C5F-4650-91CB-A05A72E361C1} (o)

ATTACHMENT 2
Page 2 of 2

Customer

Pg 4 of 4
160023
573794

GEOVision
geophysical services

SUSPENSION PS SEISMIC LOGGER/RECORDER CALIBRATION DATA FORM

INSTRUMENT DATA

System mfg.:	Oyo	Model no.:	3403
Serial no.:	160023	Calibration date:	7/17/2009
By:	Craig Branson	Due date:	7/17/2010
Counter mfg.:	Hewlett-Packard	Model no.:	5335A
Serial no.:	2626A09881	Calibration date:	1/29/2009
By:	SCE #S1-01252	Due date:	7/29/2009
Signal generator mfg.:	Hewlett-Packard	Model no.:	3325A
Serial no.:	2652A25647	Calibration date:	5/4/2009
By:	SCE #S1-01347	Due date:	11/4/2009

SYSTEM SETTINGS:

Gain:	8
Filter	10KHz
Range:	See sample period in table below
Delay:	0
Stack (1 std)	1
System date = correct date and time	7/17/2009 1019

PROCEDURE:

Set sine wave frequency to target frequency with amplitude of approximately 0.25 volt peak
Note actual frequency on data form.
Set sample period and record data file to disk. Note file name on data form.
Pick duration of 9 cycles using PSLOG.EXE program, note duration on data form, and save as .sps file. Calculate average frequency for each channel pair and note on data form.

Average frequency must be within +/- 1% of actual frequency at all data points.

Maximum error ((AVG-ACT)/ACT*100)% As found -0.11% As left -0.11%

Target Frequency (Hz)	Actual Frequency (Hz)	Sample Period (microS)	File Name	Time for 9 cycles Hn (msec)	Average Frequency Hn (Hz)	Time for 9 cycles Hr (msec)	Average Frequency Hr (Hz)	Time for 9 cycles V (msec)	Average Frequency V (Hz)
50.00	50.00	200	401	180.00	50.00	180.00	50.00	180.00	50.00
100.0	100.0	100	402	90.00	100.0	90.00	100.0	90.00	100.0
200.0	200.0	50	403	45.00	200.0	45.00	200.0	45.00	200.0
500.0	500.0	20	404	18.00	500.0	18.00	500.0	18.00	500.0
1000	1000	10	405	9.000	1000	9.000	1000	9.010	998.9
2000	2000	5	406	4.500	2000	4.500	2000	4.500	2000

Calibrated by:	Craig Branson	7/17/2009	Craig Branson
	Name	Date	Signature
Witnessed by:	Robert Steller	7/17/2009	[signature]
	Name	Date	Signature

Suspension PS Seismic Recorder/Logger Calibration Data Form Rev 2.0 July 21, 2008

MICRO PRECISION CALIBRATION, INC.
12686 HOOVER STREET
GARDEN GROVE CA. 92841-1823
714.901.5659

Certificate of Calibration

Date: 10/16/2009 **Lab #** AC-1274 **Certificate #: 749437**

Customer:
GEOVISION
1124 OLYMPIC DRIVE
CORONA, CA, 92881

Purchase Order: 9333-100601-001
Work Order: 61143

MPC Control #: AM6767
Asset ID: 160023
Gage Type: LOGGER
Manufacturer: OYO
Model Number: 3403
Size: N/A
Temp./RH: 73 °F / 45 %

Serial Number: 160023
Department: N/A
Performed By: KYU HAN
Received Condition: IN TOLERANCE
Returned Condition: IN TOLERANCE
Cal Date: October 12, 2009
Cal. Interval: 12 MONTHS
Cal. Due Date: October 12, 2010

Found conditions meet or exceed manufacturer specifications.

***Calibration Notes:**

The UUT (unit under test) was calibrated using the customers procedures in our Garden Grove lab. The UUT was operated by the customers personnel and data collection was observed by MPC personnel. The UUT was found to be in tolerance to customer supplied specifications. The reference standards used are in complience with ISO/IEC 17025:2005, ISO9001:2000, ANSI/NCSL Z540-1-1994 and laboratory accreditiation for lab code 935.11. Frequency is accredited. Measurement uncertainity is 0.2 x E12 Hz. Please see attached data sheet.

Standards Used To Calibrate Equipment

I.D.	Description	Model	Serial	Manufacturer	Cal. Due Date	Traceability #
AM4000	WAVEFORM GENERATOR	33250A	MY40000703	AGILENT	7/15/2010	662404
T1100	COUNTER	53131A	3546A09912	HEWLETT PACKARD	1/12/2010	646688

Calibrating Technician: KYU HAN

QC Approval: Tammy Webster

Unless Otherwise Noted, Uncertainty Estimated at >= 4 to 1. Uncertainties have been estimated at a 95 percent confidence level (k=2). Services rendered comply with ISO 17025:2005, ISO 9001:2000, ANSI/NCSL Z540-1, MPC Quality Manual, MPC CSD and with customer purchase order instructions.

Calibration cycles and resulting due dates were submitted/approved by the customer. Any number of factors may cause an instrument to drift out of tolerance before the next scheduled calibration. Recalibration cycles should be based on frequency of use, environmental conditions and customer's established systematic accuracy. The information on this report, pertains only to the instrument identified.

All standards are traceable to the National Institute of Standards and Technology (NIST). Services rendered include proper manufacture's service instructions and are warranted for no less than (30) days. This report may not be reproduced in part or in whole without the prior written approval of the issuing MPC lab.

Page 1 of 1 *(CERT, Rev 0)*

AM 6767

GEOVision geophysical services

SUSPENSION PS SEISMIC LOGGER/RECORDER CALIBRATION DATA FORM

INSTRUMENT DATA

System mfg.:	Oyo	Model no.:	3403
Serial no.:	160023	Calibration date:	10/12/2009
By:	Charles Carter	Due date:	10/12/2010
Counter mfg.:	Hewlett-Packard	Model no.:	53131A
Serial no.:	3546a09912	Calibration date:	1/12/2009
By:	Microprecision	Due date:	1/12/2010
Signal generator mfg.:	Agilent	Model no.:	33250A
Serial no.:	MY40000703	Calibration date:	7/15/2009
By:	Microprecision	Due date:	7/15/2010

SYSTEM SETTINGS:

Gain:	2
Filter	10KHz
Range:	See sample period in table below
Delay:	0
Stack (1 std)	1
System date = correct date and time	10/12/2009

PROCEDURE:

Set sine wave frequency to target frequency with amplitude of approximately 0.25 volt peak
Note actual frequency on data form.
Set sample period and record data file to disk. Note file name on data form.
Pick duration of 9 cycles using PSLOG.EXE program, note duration on data form, and save as .sps file. Calculate average frequency for each channel pair and note on data form.

Average frequency must be within +/- 1% of actual frequency at all data points.

Maximum error ((AVG-ACT)/ACT*100)% As found + 0.20% As left + 0.20%

Target Frequency (Hz)	Actual Frequency (Hz)	Sample Period (microS)	File Name	Time for 9 cycles Hn (msec)	Average Frequency Hn (Hz)	Time for 9 cycles Hr (msec)	Average Frequency Hr (Hz)	Time for 9 cycles V (msec)	Average Frequency V (Hz)
50.00	50.00	200	2	180.2	49.94	179.8	50.06	180.2	49.94
100.0	100.0	100	3	90.00	100.0	90.10	99.9	90.00	100.0
200.0	200.0	50	4	44.95	200.2	44.95	200.2	44.95	200.2
500.0	500.0	20	5	18.00	500.0	18.00	500.0	18.00	500.0
1000	1000	10	6	9.000	1000	8.990	1001.1	9.000	1000.0
2000	2000	5	7	4.495	2002	4.505	1998	4.500	2000

Calibrated by: Charles Carter (Name) 10/12/2009 (Date) Charles Carter (Signature)

Witnessed by: Kyu Han (Name) 10/12/2009 (Date) (Signature)

Suspension PS Seismic Recorder/Logger Calibration Data Form Rev 2.0 July 21, 2008

APPENDIX E

BORING GEOPHYSICAL LOGGING
FIELD DATA LOGS

BORING SUMMARY LOG REV 1 1a.pdf

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M-10DH BORING GEOPHYSICS FIELD LOG SUMMARY
Borehole*

SITE*: North Anna
DATE*: 9/16/2009
CLIENT*: Mactec
JOB*: 9333
AUTHOR*: V Gonzalez
PAGE*: 1 OF

CONTACT:
PHONE:

BOREHOLE CONSTRUCTION: CASED ___ UNCASED X
DIAMETERS AND DEPTH RANGES: 3.8" 0 TO 201.9 FT ; ___, ___ TO ___
BOREHOLE TOTAL DEPTH AS DRILLED*:
SURFACE CASING?: YES X DEPTH TO BOTTOM OF CASING 89.8 Ft ; NO ___
DEPTH TO BEDROCK: ~90 FT
BOREHOLE FLUID: WATER X ; FRESH WATER MUD ___; SALT WATER MUD ___;

LOGGING CREW: V. Gonzalez, C. Carter

LOG TYPE*	FILE NAME*	DEPTH RANGE*	DATE*	TIMES*
ELOG	M10DHELOGUP01	200.1 - 86 FT	9/16/2009	13:35 – 13:45
SUSP	M10DHSUSPDOWN01	28.0 m - 57.0 m	9/16/2009	14:24 - 15:11
ATV	M10DHAUUP01	86.9 - 196.9 FT	9/16/2009	16:15 - 16:52
CALIPER	M10DHCALUP01	~~86.9 - 196.9 FT~~ 84 - 198.8 FT	9/16/2009	17:27 - 17:38
ELOG	M10DHELOGTEST01	N/A	9/16/2009	13:03 – 13:05
CALIPER	M10DHCALTEST01	N/A	9/16/2009	17:09 - 17:11
CALIPER	M10DHCALTEST02	N/A	9/16/2009	17:50 - 17:51

VG 9/16/09

*ITEMS WITH * MUST BE COMPLETED. OTHER INFORMATION IS OPTIONAL*

GEOVision Geophysical Services 1151 Pomona Road, Unit P, Corona, CA 92882 Ph (951) 549-1234 Fx (951) 549-1236

ELOG FIELD LOG REV 1.1a

GEOVision
geophysical services

M-10DH ELOG FIELD LOG
Borehole*

SITE*: North Anna DATE*: 9/16/2009
CLIENT*: Mactec JOB*: 9333
AUTHOR*: V Gonzalez PAGE: 1 OF 2

CONTACT: PHONE: Off Cell

CONTACT: PHONE: Off Cell

CONTACT: PHONE: Off Cell

CONTACT: PHONE: Off Cell
COMPANY:

GENERAL SITE CONDITIONS/LOCATION:

COUNTY: RANGE: TOWNSHIP: SECTION:
BOREHOLE CONSTRUCTION: CASED UNCASED X
DIAMETERS AND DEPTH RANGES: 3.8" 0 TO 201.9 FT ; , TO

BOREHOLE TOTAL DEPTH AS DRILLED*: 201.9FT

SURFACE CASING?: YES X DEPTH TO BOTTOM OF CASING 89.8FT NO
DEPTH TO BEDROCK: ~ 90 DEPTH TO WATER TABLE: N/A
BOREHOLE FLUID: WATER x ; FRESH WATER MUD ; SALT WATER MUD ;
OTHER:
DEPTH TO BOREHOLE FLUID: N/A TIME SINCE LAST CIRCULATION: N/A

LOGGING CREW: V.Gonzalez, C.Carter
VEHICLE(S) USED AND MILEAGE:
MOBILIZED FROM: Fredericksburg, VA DEPARTURE TIME: 6:15
ARRIVED ON SITE: 7:15
STANDBY TIME: N/A CAUSE:

*ITEMS WITH * MUST BE COMPLETED. OTHER INFORMATION IS OPTIONAL*

GEOVision Geophysical Services 1124 Olympic Drive, Corona, CA 92881 Ph (951) 549-1234 Fx (951) 549-1236

ELOG FIELD LOG REV 1.1a

GEOVision
geophysical services

M-10DH ELOG FIELD LOG
Borehole*

SITE*: North Anna
CLIENT*: Mactec
AUTHOR*: V Gonzalez
DATE*: 9/16/2009
JOB*: 9333
PAGE: PAGE 2 OF 2

WINCH: COMPROBE____ SILVER X OYO____ RG________ OTHER__________
MICROLOGGER* 5310 [ ] 5772 [X] OTHER
ELOG PROBE* 5490 [X] OTHER
SHEAVE* COMPROBE [ ] OYO 101 [ ] 102 [X] 103 [ ] RG [ ]

PROBE LENGTH	2.50M(8.20 FT)	
PLUS YOKE 10.0M (32.8 FT)*	32.8 Ft	
MINUS CASING STICK-UP*	1.5 Ft	REF TO GROUND SURFACE
DEPTH REF. OFFSET AT START*	39.5 Ft	REF TO GROUND SURFACE
DEPTH REF. OFFSET AT END*	39.45 Ft	REF TO GROUND SURFACE
AFTER SURVEY DEPTH ERROR*	0.05 Ft	

LOG NAME*	START DEPTH*	START TIME	END DEPTH*	END TIME
M10DH ELOG UP01	200.1	13:35	~ 86 Ft	13:45
M10DH ELOG TEST 01	N/A	13:03	N/A	13:05

MAINTENANCE PERFORMED ON SITE*: N/A (N/A if none)

EQUIPMENT PROBLEMS OR FAILURES*: N/A (N/A if none)

SUGGESTIONS, ADDITIONS, CHANGES:

*ITEMS WITH * MUST BE COMPLETED. OTHER INFORMATION IS OPTIONAL*

GEOVision Geophysical Services 1124 Olympic Drive, Corona, CA 92881 Ph (951) 549-1234 Fx (951) 549-1236

P-S FIELD LOG REV V1.4

GEOVision
geophysical services

M-10DH **P-S SUSPENSION VELOCITY FIELD LOG REV 1.4**
Borehole
CORRESPONDING P-S SUSPENSION PROCEDURE REV 1.4.

SITE*: North Anna DATE*: 9/16/2009
CLIENT*: Mactec JOB*: 9333
AUTHOR*: V Gonzalez PAGE 1 OF * 4

CONTACT: PHONE: Off Cell

CONTACT: PHONE: Off Cell

CONTACT: PHONE: Off Cell

CONTACT: PHONE: Off Cell

DIRECTIONS TO SITE:

GENERAL SITE CONDITIONS/LOCATION:

COUNTY: RANGE: TOWNSHIP: SECTION:
BOREHOLE CONSTRUCTION*: CASED UNCASED x
DIAMETERS AND DEPTH RANGES*: 3.8" 0 TO 201.9 Ft ; , TO
BOREHOLE TOTAL DEPTH AS DRILLED*: 201.9 Ft
SURFACE CASING?: x DEPTH TO BOTTOM OF CASING 89.8 Ft ; NO
DEPTH TO BEDROCK: ~90 DEPTH TO WATER TABLE: N/A
BOREHOLE FLUID: WATER x ; FRESH WATER MUD ; SALT WATER MUD;
OTHER:
DEPTH TO BOREHOLE FLUID*: N/A TIME SINCE LAST CIRCULATION: N/A

*ITEMS WITH * MUST BE COMPLETED. OTHER INFORMATION IS OPTIONAL*

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P-S FIELD LOG REV V1.4

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M-10DH
Borehole

P-S SUSPENSION VELOCITY FIELD LOG REV 1.4

CORRESPONDING P-S SUSPENSION PROCEDURE REV 1.4.

SITE*: North Anna DATE*: 9/16/2009
CLIENT*: mactec JOB*: 9333
AUTHOR*: V Gonzalez PAGE 2 OF * 4

LOGGING CREW*: V Gonzalez, C. Carter
MOBILIZED FROM: Fredericksburg, VA DEPARTURE TIME: 6:15
ARRIVED ON SITE: 7:15
STANDBY TIME: N/A CAUSE:
LOGGING STARTED: 14:24 LOGGING COMPLETED: 15:11

BATTERIES CHANGED BEFORE LOGGING: YES____; NO X ; STORED WITH NEW____
WINCH COMPROBE ☐ GREY ☒ OYO ☐ RG ☐ OTH ____
INSTRUMENT* OYO 12004 ☐ 15014 ☐ 19029 ☐ RG 160023 ☒ 160024 ☐
RECEIVER S/N* 12008 ☐ 20042 ☐ 26066 ☐ 11001 ☐ 23053 ☐ 30086 ☒
ISOLATION TUBE S/N* 300083 ☒ 24053 ☐ 28068 ☐ 28072 ☐ 2M ____
SHEAVE* COMPROBE ☐ OYO 101 ☐ 102 ☒ 103 ☐ RG ☐
MICROLOGGER* 5310 ☐ 5772 ☒ NOT APPLICABLE (OYO) ☐
PROBE OFFSET* OYO 2.0M ☐ RG 2.5M ☒
MINUS CASING STICK-UP* 0.46m
DEPTH REF. OFFSET AT START* 2.04m
DEPTH REF. OFFSET AT END* 2.03m
AFTER SURVEY DEPTH ERROR* 0.01 m
} REF TO GROUND SURFACE

LOG NAME*	START DEPTH*	START TIME	END DEPTH *	END TIME
M10DHSUSPDOWN01	28.0m	14:24	57.0m	15:11

MAINTENANCE PERFORMED ON SITE*: N/A (N/A if none)

EQUIPMENT PROBLEMS OR FAILURES*: N/A (N/A if none)

DEVIATIONS FROM TEST PLAN*: N/A (N/A if none)

*ITEMS WITH * MUST BE COMPLETED. OTHER INFORMATION IS OPTIONAL*

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P-S FIELD LOG REV 1.4

M-10 DH GEOVISION SUSPENSION LOGGING FIELD NOTES

SITE*: North Anna DATE*: 9/16/2009
CLIENT*: Mactec JOB*: 9333
AUTHOR*: V Gonzalez PAGE* 3 OF 4

*ITEMS WITH * MUST BE COMPLETED. OTHER INFORMATION IS OPTIONAL*

DEPTH METERS	DEPTH FEET	UNFILTERED FILE NO*.	FILTERED FILE NO*. (if any)	COMMENTS CASING, WATER, ROCK, ETC
20.5	67.26			
21.0	68.90			
21.5	70.54			
22.0	72.18			
22.5	73.82			
23.0	75.46			
23.5	77.10			
24.0	78.74			
24.5	80.38			
25.0	82.02			
25.5	83.66			
26.0	85.30			
26.5	86.94			
27.0	88.58			
27.5	90.22			
28.0	91.86	001		14:24
28.5	93.50	002		
29.0	95.14	003		
29.5	96.78	004		
30.0	98.43	005		
30.5	100.07	006		
31.0	101.71	007		
31.5	103.35	008		
32.0	104.99	009		
32.5	106.63	010		
33.0	108.27	011		
33.5	109.91	012		
34.0	111.55	013		
34.5	113.19	014		
35.0	114.83	015		
35.5	116.47	016		
36.0	118.11	017		
36.5	119.75	018		
37.0	121.39	019		
37.5	123.03	020		
38.0	124.67	021		
38.5	126.31	022		
39.0	127.95	023		
39.5	129.59	024		
40.0	131.23	025		

P-S FIELD LOG REV 1.4

M-10DH **GEOVISION SUSPENSION LOGGING FIELD NOTES**

SITE*: North Anna DATE*: 9/16/2009
CLIENT*: Mactec JOB*: 9333
AUTHOR*: V Gonzalez PAGE* 4 OF 4

*ITEMS WITH * MUST BE COMPLETED. OTHER INFORMATION IS OPTIONAL*

DEPTH METERS	DEPTH FEET	UNFILTERED FILE NO*.	FILTERED FILE NO*. (if any)	COMMENTS CASING, WATER, ROCK, ETC
40.5	132.87	026		
41.0	134.51	027		
41.5	136.15	028		
42.0	137.80	029		
42.5	139.44	030		
43.0	141.08	031		
43.5	142.72	032		
44.0	144.36	033		
44.5	146.00	034		
45.0	147.64	035		
45.5	149.28	036		
46.0	150.92	037		
46.5	152.56	038		
47.0	154.20	039		
47.5	155.84	040		
48.0	157.48	041		
48.5	159.12	042		
49.0	160.76	043		
49.5	162.40	044		
50.0	164.04	045		
50.5	165.68	046		
51.0	167.32	047		
51.5	168.96	048		
52.0	170.60	049		
52.5	172.24	050		
53.0	173.88	051		
53.5	175.52	052		
54.0	177.17	053		
54.5	178.81	054		
55.0	180.45	055		
55.5	182.09	056		
56.0	183.73	057		
56.5	185.37	058		
57.0	187.01	059		15:11
57.5	188.65			
58.0	190.29			
58.5	191.93			
59.0	193.57			
59.5	195.21			
60.0	196.85			

ACOUSTIC TELEVIEWER LOG FORM 1.1.pdf

GEOVision
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M-10DH ACOUSTIC TELEVIEWER FIELD LOG Rev 1.1

Borehole*

GEOVISION HI-RES ACOUSTIC TELEVIEWER PROCEDURE V1.0

SITE*: North Anna
DATE*: 9/16/2009
CLIENT*: Mactec
JOB*: 9333
AUTHOR*: V Gonzalez
PAGE 1 OF 2
REVIEWER: ________ (post field work)

CONTACT: ________ PHONE: Off Cell ________

CONTACT: ________ PHONE: Off Cell ________

DRILLER COMPANY: ________ PHONE: Off Cell ________

GENERAL SITE CONDITIONS/LOCATION: ________

COUNTY: ________ RANGE: ________ TOWNSHIP: ________ SECTION: ________
BOREHOLE CONSTRUCTION: CASED ____ UNCASED X
DIAMETERS AND DEPTH RANGES: 3.8" 0 TO 201.9 FT ; ____, ____ TO ____

BOREHOLE TOTAL DEPTH AS DRILLED*: 201.9 FT

SURFACE CASING?: YES x DEPTH TO BOTTOM OF CASING 89.8FT NO ____
DEPTH TO BEDROCK: ~90 FT
DEPTH TO WATER TABLE: N/A
BOREHOLE FLUID: WATER x ; FRESH WATER MUD ____; SALT WATER MUD ____;
OTHER: ________
DEPTH TO BOREHOLE FLUID: N/A
TIME SINCE LAST CIRCULATION: N/A

LOGGING CREW: V Gonzalez, C. Carter
VEHICLE(S) USED AND MILEAGE: ________
MOBILIZED FROM: Fredericksburg, VA
DEPARTURE TIME: 6:15
ARRIVED ON SITE: 7:15
STANDBY TIME: ________
CAUSE: ________

*ITEMS WITH * MUST BE COMPLETED. OTHER INFORMATION IS OPTIONAL*

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ACOUSTIC TELEVIEWER LOG FORM 1.1.pdf

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M-10DH ACOUSTIC TELEVIEWER FIELD LOG Rev 1.1
Borehole*
GEOVISION HI-RES ACOUSTIC TELEVIEWER PROCEDURE V1.0

SITE*: North Anna DATE*: 9/16/2009
CLIENT*: Mactec JOB*: 9333
AUTHOR*: V Gonzalez PAGE 2 OF 2
REVIEWER: ________ (post field work)

WINCH: COMPROBE____ SILVER X OYO____ OTHER________
MICROLOGGER* 5310___ 5772 X
TELEVIEWER* ACOUSTIC #5174____ OTHER 6641
SHEAVE* COMPROBE_____ OYO 101____ 102X 103____ RG________

PROBE TILT TEST* 88.22 BRUNTON TILT* 88
PROBE TILT TEST* 17.76 BRUNTON TILT* 18
PROBE TILT TEST* 42.90 BRUNTON TILT* 43 AFTER LOG* Yes
PROBE AZIMUTH TEST* 147.5 BRUNTON AZIMUTH* 153
PROBE AZIMUTH TEST* 258.7 BRUNTON AZIMUTH* 248
PROBE AZIMUTH TEST* 180.3 BRUNTON AZIMUTH* 179 AFTER LOG* Yes

PROBE OFFSET*	1.44M(4.72FT)	
MINUS CASING STICK-UP*	1.50 FT	REF TO GROUND SURFACE
DEPTH REF. OFFSET AT START*	3.22	
DEPTH REF. OFFSET AT END*	3.16	
AFTER SURVEY DEPTH ERROR*	0.06 FT	

LOG NAME*	START DEPTH*	START TIME	END DEPTH *	END TIME
M10DHAVUP01	196.9 FT	16:15	86.9 FT	16:52

MAINTENANCE PERFORMED ON SITE*: ________ (N/A if none)

DEVIATION FROM PROCEDURE (IF ANY) OR EQUIPMENT PROBLEMS OR FAILURES* (N/A if none)

1. unmarked utilities and grounding grid around borehole and surroundings which may have affected probe compass during pre-log testing.
2. sluff/sludge at ~197 FT. SUBMERGED PROBE INITIALLY AND THEN RAISED TO ~100 FT and relowered to ~197 to clean off probe window in borehole water. Reset at ~197 to begin logging run upward

*ITEMS WITH * MUST BE COMPLETED. OTHER INFORMATION IS OPTIONAL*

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GEOVision geophysical services

CALIPER FIELD LOG REV 1.2.PDF

M-10DH
Borehole*

CALIPER FIELD LOG

Procedure ASTM D6167-97(2004)

SITE*: North Anna
DATE*: 9/16/2009
CLIENT*: Mactec
JOB*: 9333
AUTHOR*: V. Gonzalez
PAGE: 1 OF 2

CONTACT: ______ PHONE: Off Cell ______

CONTACT: ______ PHONE: Off Cell ______

CONTACT: ______ PHONE: Off Cell ______

DRILLER ______ PHONE: Off Cell ______
COMPANY: ______

GENERAL SITE CONDITIONS/LOCATION: ______

COUNTY: ______ RANGE: ______ TOWNSHIP: ______ SECTION: ______
BOREHOLE CONSTRUCTION: CASED ______ UNCASED ______
DIAMETERS AND DEPTH RANGES: 3.8" 0 TO 201.9 ft ; ______, ______ TO ______

BOREHOLE TOTAL DEPTH AS DRILLED*: 201.9 FT

SURFACE CASING?: YES x DEPTH TO BOTTOM OF CASING 89.8 FT; NO ______
DEPTH TO BEDROCK: ~90 Ft
DEPTH TO WATER TABLE: N/A
BOREHOLE FLUID: WATER x ; FRESH WATER MUD ______; SALT WATER MUD ______;
OTHER: ______
DEPTH TO BOREHOLE FLUID: N/A
TIME SINCE LAST CIRCULATION: N/A

LOGGING CREW: V Gonzalez, C Carter
VEHICLE(S) USED AND MILEAGE: ______
MOBILIZED FROM: Fredericksburg, VA
DEPARTURE TIME: 6:15
ARRIVED ON SITE: 7:15
STANDBY TIME: ______
CAUSE: ______

*ITEMS WITH * MUST BE COMPLETED. OTHER INFORMATION IS OPTIONAL*

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CALIPER FIELD LOG REV 1.2.PDF

M-10DH
Borehole*

CALIPER FIELD LOG

Procedure ASTM D6167-97(2004)

SITE*: North Anna
DATE*: 9/16/2009
CLIENT*: Mactec
JOB*: 9333
AUTHOR*: V. Gonzalez
PAGE: PAGE 2 OF 2

WINCH: COMPROBE___ SILVER X OYO___ RG___ OTHER___
MICROLOGGER* 5310 ☐ 5772 ☒ OTHER
CALIPER PROBE* 5368 ☐ OTHER 6621
SHEAVE* COMPROBE ☐ OYO 101 ☐ 102 ☒ 103 ☐ RG ☐

PROBE OFFSET	2.08M(6.82 FT)	12 IN MAX
MINUS CASING STICK-UP*	1.50ft	REF TO GROUND SURFACE
DEPTH REF. OFFSET AT START*	5.32ft	
DEPTH REF. OFFSET AT END*	5.25ft	
AFTER SURVEY DEPTH ERROR*	0.07ft	

LOG NAME*	START DEPTH*	START TIME*	END DEPTH*	END TIME*
M10DHCALTEST01	N/A	17:09	N/A	17:11
M10DHCALUP01	198.8	17:27	84	17:38
M10DHCALTEST02	N/A	17:50	N/A	17:51

CALIBRATION PLATE S/N 201

	FILE NAME	AS BUILT 1.968 IN (50 MM)	3.937 IN (100 MM)	8.000 IN (203.2 MM)	PVC FITTING 4.504 IN (114.4 MM)
AS MEAS.*	M10DHCALTEST01	2.02	3.96	8.03	4.54
AS MEAS.*	M10DHCALTEST02	2.02	4.00	8.06	4.59
AS MEAS.					
AS MEAS.					
AS MEAS.					
AS MEAS.					

MAINTENANCE PERFORMED ON SITE*: ______ (N/A if none)

EQUIPMENT PROBLEMS OR FAILURES*: ______ (N/A if none)

SUGGESTIONS, ADDITIONS, CHANGES: ______

*ITEMS WITH * MUST BE COMPLETED. OTHER INFORMATION IS OPTIONAL*

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BORING SUMMARY LOG REV 1.1a.pdf

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M-10DH BORING GEOPHYSICS FIELD LOG SUMMARY

Borehole*

SITE*: North Anna DATE*: 9/17/09
CLIENT*: MACTEC JOB*: 9333
AUTHOR*: C. Carter PAGE*: 1 OF 1 cc 9/21/09

CONTACT: PHONE:

BOREHOLE CONSTRUCTION: CASED UNCASED x
DIAMETERS AND DEPTH RANGES: 3.78" 0 TO 201.9 ft ; ______, ______ TO ______
BOREHOLE TOTAL DEPTH AS DRILLED*: 201.9 ft
SURFACE CASING?: YES x DEPTH TO BOTTOM OF CASING 7 ft ; NO______
DEPTH TO BEDROCK: ~90 ft
BOREHOLE FLUID: WATER_____; FRESH WATER MUD X ; SALT WATER MUD _____;

LOGGING CREW: C. Carter, V. Gonzalez

cc 9/21/09

LOG TYPE*	FILE NAME*	DEPTH RANGE*	DATE*	TIMES*	Date
ELOG	M10DHELOGTEST02	NA	~~9/16/09~~	3:48 - 3:49 pm	9/17/09
ELOG	M10DHELOGUP02	105.55-36.6 ft	~~9/16/09~~	4:02 - 4:08 pm	9/17/09
P-S velocity	M10DHSUSPDOWN02	2.5-30.0m	~~9/16/09~~	4:27 - 4:57 pm	9/17/09
Caliper	M10DHCALTEST03	NA	~~9/16/09~~	5:17 - 5:20 pm	9/17/09
Caliper	M10DHCALUP02	100.9 - 3.85 ft	~~9/16/09~~	5:33 - 5:44 pm	9/17/09
Caliper	M10DHCALTEST04	NA	~~9/16/09~~	5:50 - 5:51 pm	9/17/09

ITEMS WITH * MUST BE COMPLETED. OTHER INFORMATION IS OPTIONAL

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ELOG FIELD LOG REV 1.1a

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M-100H ELOG FIELD LOG
Borehole*

SITE*: North Anna
DATE*: 9/17/09
CLIENT*: MACTEC
JOB*: 9333
AUTHOR*: C.Carter
PAGE: 1 OF 2

CONTACT: PHONE: Off Cell

CONTACT: PHONE: Off Cell

CONTACT: PHONE: Off Cell

CONTACT: PHONE: Off Cell
COMPANY:

GENERAL SITE CONDITIONS/LOCATION:

COUNTY: RANGE: TOWNSHIP: SECTION:
BOREHOLE CONSTRUCTION: CASED UNCASED X
DIAMETERS AND DEPTH RANGES: 3.78 0 TO 102.9 ft ; , TO

BOREHOLE TOTAL DEPTH AS DRILLED*: 102.9 ft

SURFACE CASING?: YES X DEPTH TO BOTTOM OF CASING 7 ft; NO
DEPTH TO BEDROCK: ~100 ft DEPTH TO WATER TABLE: ~25 ft
BOREHOLE FLUID: WATER ; FRESH WATER MUD X ; SALT WATER MUD ;
OTHER:
DEPTH TO BOREHOLE FLUID: TIME SINCE LAST CIRCULATION: NA

LOGGING CREW: C.Carter, V. Gonzalez
VEHICLE(S) USED AND MILEAGE:
MOBILIZED FROM: Fredricksburg DEPARTURE TIME: 6:15am
ARRIVED ON SITE: 7am
STANDBY TIME: NA CAUSE:

*ITEMS WITH * MUST BE COMPLETED. OTHER INFORMATION IS OPTIONAL*

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ELOG FIELD LOG REV 1.1a

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M-10DH ELOG FIELD LOG
Borehole*

SITE*: North Anna
CLIENT*: MACTEC
AUTHOR*: C. Carter
DATE*: 9/17/09
JOB*: 9333
PAGE: PAGE 2 OF 2

WINCH: COMPROBE ___ SILVER X OYO ___ RG ___ OTHER ___
MICROLOGGER* 5310 [ ] 5772 [X] OTHER ___
ELOG PROBE* 5490 [X] OTHER ___
SHEAVE* COMPROBE [ ] OYO 101 [ ] 102 [X] 103 [ ] RG [ ]

PROBE LENGTH	2.50M(8.20 FT)	
PLUS YOKE 10.0M (32.8 FT)*	32.8	
MINUS CASING STICK-UP*	2.83	REF TO GROUND SURFACE
DEPTH REF. OFFSET AT START*	38.17	
DEPTH REF. OFFSET AT END*	38.20	
AFTER SURVEY DEPTH ERROR*	.03	

LOG NAME*	START DEPTH*	START TIME	END DEPTH*	END TIME
M10DHELOGTEST02	NA	3:48	NA	3:49
M10DHELOGUP02	105.55ft	4:02	36.6ft	4:08

MAINTENANCE PERFORMED ON SITE*: NA (N/A if none)

EQUIPMENT PROBLEMS OR FAILURES*: NA (N/A if none)

SUGGESTIONS, ADDITIONS, CHANGES:

*ITEMS WITH * MUST BE COMPLETED. OTHER INFORMATION IS OPTIONAL*

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P-S FIELD LOG REV V1.4

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M-10DH P-S SUSPENSION VELOCITY FIELD LOG REV 1.4

Borehole

CORRESPONDING P-S SUSPENSION PROCEDURE REV 1.4.

SITE*: North Anna DATE*: 9/17/09
CLIENT*: MACTEC JOB*: 9333
AUTHOR*: C. Carter PAGE 1 OF * 4

CONTACT: ______ PHONE: Off Cell ______

CONTACT: ______ PHONE: Off Cell ______

CONTACT: ______ PHONE: Off Cell ______

CONTACT: ______ PHONE: Off Cell ______

DIRECTIONS TO SITE: ______

GENERAL SITE CONDITIONS/LOCATION: ______

COUNTY: ______ RANGE: ______ TOWNSHIP: ______ SECTION: ______
BOREHOLE CONSTRUCTION*: CASED ______ UNCASED X
DIAMETERS AND DEPTH RANGES*: 3.78" 0 TO 201.9 ft; ______, ______ TO ______
BOREHOLE TOTAL DEPTH AS DRILLED*: 201.9 ft
SURFACE CASING?: yes DEPTH TO BOTTOM OF CASING 7 ft; NO ______
DEPTH TO BEDROCK: ~90 ft DEPTH TO WATER TABLE: ~25 ft
BOREHOLE FLUID: WATER ______; FRESH WATER MUD X; SALT WATER MUD; ______
OTHER: ______
DEPTH TO BOREHOLE FLUID*: Ø TIME SINCE LAST CIRCULATION: NA

*ITEMS WITH * MUST BE COMPLETED. OTHER INFORMATION IS OPTIONAL*

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P-S FIELD LOG REV V1.4

GEOVision geophysical services

M-100A

Borehole

P-S SUSPENSION VELOCITY FIELD LOG REV 1.4

CORRESPONDING P-S SUSPENSION PROCEDURE REV 1.4.

SITE*: North Anna DATE*: 8/17/09
CLIENT*: MACTEC JOB*: 9333
AUTHOR*: C. Carter PAGE 2 OF * 4

LOGGING CREW*: C. Carter, V. Gonzalez
MOBILIZED FROM: Fredricksburg DEPARTURE TIME: 6:15 am
ARRIVED ON SITE: 7am
STANDBY TIME: NA CAUSE:
LOGGING STARTED: 4:27 LOGGING COMPLETED: 4:57pm

BATTERIES CHANGED BEFORE LOGGING: YES____; NO X; STORED WITH NEW____
WINCH COMPROBE ☐ GREY ☒ OYO ☐ RG ☐ OTH ____
INSTRUMENT* OYO 12004 ☐ 15014 ☐ 19029 ☐ RG 160023 ☒ 160024 ☐
RECEIVER S/N* 12008 ☐ 20042 ☐ 26066 ☐ 11001 ☐ 23053 ☐ 30086 ☒
ISOLATION TUBE S/N* 300083 ☒ 24053 ☐ 28068 ☐ 28072 ☐ 2M ____
SHEAVE* COMPROBE ☐ OYO 101 ☐ 102 ☒ 103 ☐ RG ☐
MICROLOGGER* 5310 ☐ 5772 ☒ NOT APPLICABLE (OYO) ☐
PROBE OFFSET* OYO 2.0M ☐ RG 2.5M ☒
MINUS CASING STICK-UP* .86 m
DEPTH REF. OFFSET AT START* 1.64 m
DEPTH REF. OFFSET AT END* 1.65 m
AFTER SURVEY DEPTH ERROR* 0.01 m

11/3/09 REF TO GROUND SURFACE

LOG NAME*	START DEPTH*	START TIME	END DEPTH *	END TIME
	2.5m	4:27	30.0m	4:57pm

MAINTENANCE PERFORMED ON SITE*: N/A (N/A if none)

EQUIPMENT PROBLEMS OR FAILURES*: N/A (N/A if none)

DEVIATIONS FROM TEST PLAN*: NA (N/A if none)

*ITEMS WITH * MUST BE COMPLETED. OTHER INFORMATION IS OPTIONAL*

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P-S FIELD LOG REV 1.4

M-10DH GEOVISION SUSPENSION LOGGING FIELD NOTES

SITE*: North Anna DATE*: 9/17/09
CLIENT*: MACTEC JOB*: 9333
AUTHOR*: C. Corbet PAGE* 3 OF 4

*ITEMS WITH * MUST BE COMPLETED. OTHER INFORMATION IS OPTIONAL*

DEPTH METERS	DEPTH FEET	UNFILTERED FILE NO*.	FILTERED FILE NO*. (if any)	COMMENTS CASING, WATER, ROCK, ETC
0.5	1.64			
1.0	3.28			
1.5	4.92			
2.0	6.56	~~CC 9/17/09~~		
2.5	8.20	~~001~~ 200		4:27
3.0	9.84	201		
3.5	11.48	202		
4.0	13.12	203		
4.5	14.76	204		
5.0	16.40	205		
5.5	18.04	206		
6.0	19.69	207		
6.5	21.33	208		
7.0	22.97	209		
7.5	24.61	210		
8.0	26.25	211		
8.5	27.89	212		
9.0	29.53	213		
9.5	31.17	214		
10.0	32.81	215		
10.5	34.45	216		
11.0	36.09	217		
11.5	37.73	218		
12.0	39.37	219		
12.5	41.01	220		
13.0	42.65	221		
13.5	44.29	222		
14.0	45.93	223		
14.5	47.57	224		
15.0	49.21	225		
15.5	50.85	226		
16.0	52.49	227		
16.5	54.13	228		
17.0	55.77	229		
17.5	57.41	230		
18.0	59.06	231		
18.5	60.70	232		
19.0	62.34	233		
19.5	63.98	234		
20.0	65.62	235		

P-S FIELD LOG REV 1.4

M-10DH GEOVISION SUSPENSION LOGGING FIELD NOTES

SITE*: North Anna DATE*: 9/17/09
CLIENT*: MACTEC JOB*: 9333
AUTHOR*: C. Carter PAGE* 4 OF 4

*ITEMS WITH * MUST BE COMPLETED. OTHER INFORMATION IS OPTIONAL*

DEPTH METERS	DEPTH FEET	UNFILTERED FILE NO*.	FILTERED FILE NO*. (if any)	COMMENTS CASING, WATER, ROCK, ETC
20.5	67.26	236		
21.0	68.90	237		
21.5	70.54	238		
22.0	72.18	239		
22.5	73.82	240		
23.0	75.46	241		
23.5	77.10	242		
24.0	78.74	243		
24.5	80.38	244		
25.0	82.02	245		
25.5	83.66	246		
26.0	85.30	247		
26.5	86.94	248		
27.0	88.58	249		
27.5	90.22	250		
28.0	91.86	251		
28.5	93.50	252		
29.0	95.14	253		
29.5	96.78	254		
30.0	98.43	255		4:57
30.5	100.07			
31.0	101.71			
31.5	103.35			
32.0	104.99			
32.5	106.63			
33.0	108.27			
33.5	109.91			
34.0	111.55			
34.5	113.19			
35.0	114.83			
35.5	116.47			
36.0	118.11			
36.5	119.75			
37.0	121.39			
37.5	123.03			
38.0	124.67			
38.5	126.31			
39.0	127.95			
39.5	129.59			
40.0	131.23			

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CALIPER FIELD LOG REV 1.2.PDF

M-10DH
Borehole*

CALIPER FIELD LOG

Procedure ASTM D6167-97(2004)

SITE*: North Anna
DATE*: 9/17/09
CLIENT*: MACTEC
JOB*: 9333
AUTHOR*: C. Carter
PAGE: 1 OF 2

CONTACT: ______ PHONE: Off Cell

CONTACT: ______ PHONE: Off Cell

CONTACT: ______ PHONE: Off Cell

DRILLER COMPANY: ______ PHONE: Off Cell

GENERAL SITE CONDITIONS/LOCATION: ______

COUNTY: ______ RANGE: ______ TOWNSHIP: ______ SECTION: ______
BOREHOLE CONSTRUCTION: CASED ______ UNCASED x
DIAMETERS AND DEPTH RANGES: 3.78" 0 TO 201.9 ft ; ______, ______ TO ______

BOREHOLE TOTAL DEPTH AS DRILLED*: 201.9 ft

SURFACE CASING?: YES x DEPTH TO BOTTOM OF CASING 7 ft ; NO ______
DEPTH TO BEDROCK: ~90 ft DEPTH TO WATER TABLE: ~25
BOREHOLE FLUID: WATER ______; FRESH WATER MUD x ; SALT WATER MUD ______;
OTHER: ______
DEPTH TO BOREHOLE FLUID: ~15 ft TIME SINCE LAST CIRCULATION: NA

LOGGING CREW: C. Carter, V. Gonzalez
VEHICLE(S) USED AND MILEAGE: ______
MOBILIZED FROM: Fredericksburg DEPARTURE TIME: 6:15
ARRIVED ON SITE: 7am
STANDBY TIME: NA CAUSE: ______

*ITEMS WITH * MUST BE COMPLETED. OTHER INFORMATION IS OPTIONAL*

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CALIPER FIELD LOG REV 1.2.PDF

CALIPER FIELD LOG

Procedure ASTM D6167-97(2004)

Borehole*: M-10DH

SITE*: North Anna
CLIENT*: MACTEC
AUTHOR*: C.Carter

DATE*: 9/17/09
JOB*: 9333
PAGE: PAGE 2 OF 2

WINCH: COMPROBE ___ SILVER ✓ OYO ___ RG ___ OTHER ___
MICROLOGGER* 5310 ☐ 5772 ☑ OTHER
CALIPER PROBE* 5368 ☐ OTHER 6621
SHEAVE* COMPROBE ☐ OYO 101 ☐ 102 ☑ 103 ☐ RG ☐

PROBE OFFSET	2.08M(6.82 FT)	12 IN MAX
MINUS CASING STICK-UP*	2.83	REF TO GROUND SURFACE
DEPTH REF. OFFSET AT START*	3.99	
DEPTH REF. OFFSET AT END*	4.00	
AFTER SURVEY DEPTH ERROR*	.01	

LOG NAME*	START DEPTH*	START TIME*	END DEPTH*	END TIME*
M10DHCALTEST03	NA	5:17	NA	5:20pm
M10DHCALUP02	100.9 ft	5:33	3.85 ft	5:44pm
M10DHCALTEST04	NA	5:50	NA	5:51

CALIBRATION PLATE S/N 201

	FILE NAME	AS BUILT 1.968 IN (50 MM)	3.937 IN (100 MM)	8.000 IN (203.2 MM)	PVC FITTING 4.504 IN (114.4 MM)
AS MEAS.*	M10DHCALTEST03	1.94	3.92	8.00	4.50
AS MEAS.*	M10DHCALTEST04	1.96	3.89	7.99	4.51
AS MEAS.					
AS MEAS.					
AS MEAS.					
AS MEAS.					

MAINTENANCE PERFORMED ON SITE*: NA (N/A if none)

EQUIPMENT PROBLEMS OR FAILURES*: NA (N/A if none)

SUGGESTIONS, ADDITIONS, CHANGES:

*ITEMS WITH * MUST BE COMPLETED. OTHER INFORMATION IS OPTIONAL*

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BORING SUMMARY LOG REV 1.1a.pdf

GEOVision
geophysical services

M-10DH BORING GEOPHYSICS FIELD LOG SUMMARY

Borehole*

SITE*: North Anna DATE*: 9/17/09, 9/18/09

CLIENT*: MACTEC JOB*: 9333

AUTHOR*: C. Carter PAGE*: 1 OF 1

CONTACT: PHONE:

BOREHOLE CONSTRUCTION: CASED UNCASED x

DIAMETERS AND DEPTH RANGES: 3.78" 0 TO 201.9 ft ; ______, ______ TO ______,

BOREHOLE TOTAL DEPTH AS DRILLED*: 201.9 ft

SURFACE CASING?: YES ✓ DEPTH TO BOTTOM OF CASING 7ft/9ft; NO______

DEPTH TO BEDROCK: ~90 ft

BOREHOLE FLUID: WATER_____; FRESH WATER MUD X ; SALT WATER MUD _____;

LOGGING CREW: C. Carter, V. Gonzalez

cc 9/18/09

LOG TYPE*	FILE NAME*	DEPTH RANGE*	DATE*	TIMES*	Date
ELOG	M10DHELOGTEST02	NA	~~9/16/09~~	3:48 – 3:49 pm	9/17/09
ELOG	M10DHELOGUP02	105.55-36.6 ft	~~9/16/09~~	4:02 - 4:08 pm	9/17/09
P-S velocity	M10DHSUSPDOWN02	2.5-30.0 m	~~9/16/09~~	4:27 - 4:57 pm	9/17/09
Caliper	M10DHCALTEST03	NA	~~9/16/09~~	5:17 - 5:20 pm	9/17/09
Caliper	M10DHCALUP02	100.9 - 3.85 ft	~~9/16/09~~	5:33 - 5:44 pm	9/17/09
Caliper	M10DHCALTEST04	NA	~~9/16/09~~	5:50 - 5:51 pm	9/17/09
ATV	M10DHAUUP02	99.4 - 2.8 ft	9/18/09	9:33 - 10:04 am	9/18/09
		cc 9/21/09			

ITEMS WITH * MUST BE COMPLETED. OTHER INFORMATION IS OPTIONAL

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ACOUSTIC TELEVIEWER LOG FORM 1.1.pdf

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M-10DH ACOUSTIC TELEVIEWER FIELD LOG Rev 1.1

Borehole*

GEOVISION HI-RES ACOUSTIC TELEVIEWER PROCEDURE V1.0

SITE*: North Anna
DATE*: 9/18/09
CLIENT*: MACTEC
JOB*: 9333
AUTHOR*: C. Carter
PAGE 1 OF 2
REVIEWER: ________ (post field work)

CONTACT: ________ PHONE: Off Cell ________

CONTACT: ________ PHONE: Off Cell ________

DRILLER COMPANY: ________ PHONE: Off Cell ________

GENERAL SITE CONDITIONS/LOCATION: ________

COUNTY: ________ RANGE: ________ TOWNSHIP: ________ SECTION: ________
BOREHOLE CONSTRUCTION: CASED ____ UNCASED X
DIAMETERS AND DEPTH RANGES: 3.78" 0 TO 201.9ft ; ____, ____ TO ____

BOREHOLE TOTAL DEPTH AS DRILLED*: 201.9 ft

SURFACE CASING?: YES X DEPTH TO BOTTOM OF CASING 9 ft ; NO ____
DEPTH TO BEDROCK: ~90 ft DEPTH TO WATER TABLE: ~25 ft
BOREHOLE FLUID: WATER ____; FRESH WATER MUD X ; SALT WATER MUD ____;
OTHER: ________
DEPTH TO BOREHOLE FLUID: 21 ft TIME SINCE LAST CIRCULATION: 9am

LOGGING CREW: C. Carter, V. Gonzalez
VEHICLE(S) USED AND MILEAGE: ________
MOBILIZED FROM: Fredricksburg DEPARTURE TIME: 6:15
ARRIVED ON SITE: 7:15
STANDBY TIME: 7:30-9am CAUSE: Drillers cleaning out borehole

*ITEMS WITH * MUST BE COMPLETED. OTHER INFORMATION IS OPTIONAL*

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ACOUSTIC TELEVIEWER LOG FORM 1.1.pdf

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M-10DH ACOUSTIC TELEVIEWER FIELD LOG Rev 1.1

Borehole*

GEOVISION HI-RES ACOUSTIC TELEVIEWER PROCEDURE V1.0

SITE*: North Anna DATE*: 9/18/09
CLIENT*: MACTEC JOB*: 9333
AUTHOR*: C. Carter PAGE 2 OF 2
REVIEWER: ________ (post field work)

WINCH: COMPROBE____ SILVER X OYO____ OTHER________
MICROLOGGER* 5310___ 5772 X
TELEVIEWER* ACOUSTIC #5174___ OTHER 6641
SHEAVE* COMPROBE____ OYO 101___ 102 X 103___ RG________

PROBE TILT TEST* 90.66 BRUNTON TILT* 90
PROBE TILT TEST* 24.10 BRUNTON TILT* 24
PROBE TILT TEST* 26.74 BRUNTON TILT* 27 AFTER LOG* yes
PROBE AZIMUTH TEST* 125.30 BRUNTON AZIMUTH* 133
PROBE AZIMUTH TEST* 217.40 BRUNTON AZIMUTH* 211
PROBE AZIMUTH TEST* 152.20 BRUNTON AZIMUTH* 158 AFTER LOG* yes

PROBE OFFSET*	1.44M(4.72FT)	
MINUS CASING STICK-UP*	1.92	REF TO GROUND SURFACE
DEPTH REF. OFFSET AT START*	2.8	
DEPTH REF. OFFSET AT END*	2.74	
AFTER SURVEY DEPTH ERROR*	.06	

LOG NAME*	START DEPTH*	START TIME	END DEPTH *	END TIME
M10DHAVUP02	99.4 ft	9:33	2.8 ft	10:04

MAINTENANCE PERFORMED ON SITE*: N/A (N/A if none)

DEVIATION FROM PROCEDURE (IF ANY) OR EQUIPMENT PROBLEMS OR FAILURES* (N/A if none)
Water level dropped to ~21 ft, while running the log. The window got thick clay when it came out of water. We could not fill hole w/probe in the hole due to unstable borehole condition.

*ITEMS WITH * MUST BE COMPLETED. OTHER INFORMATION IS OPTIONAL*

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BORING SUMMARY LOG REV 1 19 jul

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M-30DH BORING GEOPHYSICS FIELD LOG SUMMARY

Borehole*

SITE*: North Anna DATE*: 9/15/09
CLIENT*: MACTEC JOB*: 9333
AUTHOR*: C.Carter PAGE*: 1 OF 1

CONTACT: PHONE:

BOREHOLE CONSTRUCTION: CASED UNCASED X
DIAMETERS AND DEPTH RANGES: 3.78" 0 TO ~~102.7 ft~~; ____, ____ TO ____
BOREHOLE TOTAL DEPTH AS DRILLED*: ~~102.7 ft~~ cc 11/3/09 201.7 ft
SURFACE CASING?: YES X DEPTH TO BOTTOM OF CASING 44 ft; NO____
DEPTH TO BEDROCK: 45 ft
BOREHOLE FLUID: WATER____; FRESH WATER MUD X; SALT WATER MUD ____;

LOGGING CREW: C.Carter, V. Gonzalez

LOG TYPE*	FILE NAME*	DEPTH RANGE*	DATE*	TIMES*
ELOG	M30DHELOGTEST01	NA	9/15/09	3:05 - 3:07 pm
ELOG	M30DHELOGUP01	200.45-39.55 ft	9/15/09	3:49 - 4:05 pm
cc 9/21/09 ~~P-S velocity~~	~~M30DHSUSPDOWN01~~	~~14.0-57.0~~	9/15/09	
ELOG	M30DHELOGUP02	75-39.85 ft	9/15/09	4:11 - 4:15
P-S velocity	M30DHSUSPDOWN01	14.0-57.0 m	9/15/09	4:52 - 5:40 pm

ITEMS WITH * MUST BE COMPLETED. OTHER INFORMATION IS OPTIONAL

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ELOG FIELD LOG REV 1.1a

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M-30 DH ELOG FIELD LOG
Borehole*

SITE*: North Anna DATE*: 9/15/09
CLIENT*: MACTEC JOB*: 9333
AUTHOR*: C. Carter PAGE: 1 OF 2

CONTACT: ______ PHONE: Off Cell ______

CONTACT: ______ PHONE: Off Cell ______

CONTACT: ______ PHONE: Off Cell ______

CONTACT: ______ PHONE: Off Cell ______
COMPANY: ______

GENERAL SITE CONDITIONS/LOCATION: ______

COUNTY: ______ RANGE: ______ TOWNSHIP: ______ SECTION: ______
BOREHOLE CONSTRUCTION: CASED ______ UNCASED X
DIAMETERS AND DEPTH RANGES: 3.78" 0 TO ~~102.7 ft~~ ; ______, ______ TO ______

BOREHOLE TOTAL DEPTH AS DRILLED*: ~~102.7 ft~~ cc 11/3/09 201.7 ft

SURFACE CASING?: YES X DEPTH TO BOTTOM OF CASING 44 ft; NO ______
DEPTH TO BEDROCK: 45 ft DEPTH TO WATER TABLE: NA
BOREHOLE FLUID: WATER X ; FRESH WATER MUD ______; SALT WATER MUD ______;
OTHER: ______
DEPTH TO BOREHOLE FLUID: ~4 ft TIME SINCE LAST CIRCULATION: NA

LOGGING CREW: C. Carter, V. Gonzalez
VEHICLE(S) USED AND MILEAGE: ~~Fredricksburg VA~~ cc 9/15/09 cc 9/15/09
cc 9/15/09 MOBILIZED FROM: ~~6:15am~~ Fredricksburg DEPARTURE TIME: ~~7:15am~~ 6:15 am
ARRIVED ON SITE: 7:15am
STANDBY TIME: NA CAUSE: ______

*ITEMS WITH * MUST BE COMPLETED. OTHER INFORMATION IS OPTIONAL*

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ELOG FIELD LOG REV 1.1a

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M-30DH ELOG FIELD LOG
Borehole*

SITE*: North Anna
CLIENT*: MACTEC
AUTHOR*: C. Carter
DATE*: 8/25/09
JOB*: 9333
PAGE: PAGE 2 OF 2

WINCH: COMPROBE____ SILVER X OYO____ RG________ OTHER__________
MICROLOGGER* 5310 [ ] 5772 [X] OTHER
ELOG PROBE* 5490 [X] OTHER
SHEAVE* COMPROBE [ ] OYO 101 [ ] 102 [X] 103 [ ] RG [ ]

PROBE LENGTH	2.50M(8.20 FT)	
PLUS YOKE 10.0M (32.8 FT)*	32.8	
MINUS CASING STICK-UP*	1.08	REF TO GROUND SURFACE
DEPTH REF. OFFSET AT START*	39.92	
DEPTH REF. OFFSET AT END*	39.55 39.95	
AFTER SURVEY DEPTH ERROR*	.37	

LOG NAME*	START DEPTH*	START TIME	END DEPTH*	END TIME
M30DHELOGTEST01	NA	3:05	NA	3:07
M30DHELOGUP01	200.45 ft	3:49	39.55 ft	4:05
M30DHELOGUP02	75 ft	4:11	39.85 ft	4:15

MAINTENANCE PERFORMED ON SITE*: NA (N/A if none)

EQUIPMENT PROBLEMS OR FAILURES*: NA (N/A if none)

SUGGESTIONS, ADDITIONS, CHANGES:

*ITEMS WITH * MUST BE COMPLETED. OTHER INFORMATION IS OPTIONAL*

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P-S FIELD LOG REV V1.4

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M-30DH P-S SUSPENSION VELOCITY FIELD LOG REV 1.4

Borehole

CORRESPONDING P-S SUSPENSION PROCEDURE REV 1.4.

SITE*: North Anna DATE*: 9/15/09
CLIENT*: MACTEC JOB*: 9333
AUTHOR*: C.Carter PAGE 1 OF * 5

CONTACT: PHONE: Off Cell

CONTACT: PHONE: Off Cell

CONTACT: PHONE: Off Cell

CONTACT: PHONE: Off Cell

DIRECTIONS TO SITE:

GENERAL SITE CONDITIONS/LOCATION:

COUNTY: RANGE: TOWNSHIP: SECTION:
BOREHOLE CONSTRUCTION*: CASED UNCASED X
DIAMETERS AND DEPTH RANGES*: 3.78" 0 TO 201.7 ft ; , TO
BOREHOLE TOTAL DEPTH AS DRILLED*: 201.7 ft
SURFACE CASING?: yes DEPTH TO BOTTOM OF CASING 44 ft ; NO
DEPTH TO BEDROCK: 45 ft DEPTH TO WATER TABLE:
BOREHOLE FLUID: WATER X ; FRESH WATER MUD ; SALT WATER MUD;
OTHER:
DEPTH TO BOREHOLE FLUID*: ~17 ft TIME SINCE LAST CIRCULATION: NA

*ITEMS WITH * MUST BE COMPLETED. OTHER INFORMATION IS OPTIONAL*

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P-S FIELD LOG REV V1.4

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M-30DH **P-S SUSPENSION VELOCITY FIELD LOG REV 1.4**
Borehole
CORRESPONDING P-S SUSPENSION PROCEDURE REV 1.4.

SITE*: North Anna DATE*: 9/15/09
CLIENT*: MACTEC JOB*: 9333
AUTHOR*: C.Carter PAGE 2 OF * 5

LOGGING CREW*: C.Carter, V. Gonzalez
MOBILIZED FROM: Fredricksburg DEPARTURE TIME: 6:15
ARRIVED ON SITE: 7:15
STANDBY TIME: ____ CAUSE: ____
LOGGING STARTED: ____ LOGGING COMPLETED: ____

BATTERIES CHANGED BEFORE LOGGING: YES ____; NO X; STORED WITH NEW ____
WINCH COMPROBE ☐ GREY ☒ OYO ☐ RG ☐ OTH ____
INSTRUMENT* OYO 12004 ☐ 15014 ☐ 19029 ☐ RG 160023 ☒ 160024 ☐
RECEIVER S/N* 12008 ☐ 20042 ☐ 26066 ☐ 11001 ☐ 23053 ☐ 30086 ☒
ISOLATION TUBE S/N* 300083 ☒ 24053 ☐ 28068 ☐ 28072 ☐ 2M ____
SHEAVE* COMPROBE ☐ OYO 101 ☐ 102 ☒ 103 ☐ RG ☐
MICROLOGGER* 5310 ☐ 5772 ☒ NOT APPLICABLE (OYO) ☐
PROBE OFFSET* OYO 2.0M ☐ RG 2.5M ☒
MINUS CASING STICK-UP* .33 m
DEPTH REF. OFFSET AT START* 2.17 m
DEPTH REF. OFFSET AT END* 2.17 m
AFTER SURVEY DEPTH ERROR* 0.0 m
cc 11/3/09
REF TO GROUND SURFACE

LOG NAME*	START DEPTH*	START TIME	END DEPTH *	END TIME
M30DHSUSPDOWN01	14.0m	4:52	57.0m	5:40pm

MAINTENANCE PERFORMED ON SITE*: NA (N/A if none)

EQUIPMENT PROBLEMS OR FAILURES*: NA (N/A if none)

DEVIATIONS FROM TEST PLAN*: NA (N/A if none)

*ITEMS WITH * MUST BE COMPLETED. OTHER INFORMATION IS OPTIONAL*

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P-S FIELD LOG REV 1.4

M-30DH GEOVISION SUSPENSION LOGGING FIELD NOTES

SITE*: North Anna
DATE*: 9/15/09
CLIENT*: MACTEC
JOB*: 9333
AUTHOR*: C. Carter
PAGE* 3 OF 5

*ITEMS WITH * MUST BE COMPLETED. OTHER INFORMATION IS OPTIONAL*

DEPTH METERS	DEPTH FEET	UNFILTERED FILE NO*.	FILTERED FILE NO*. (if any)	COMMENTS CASING, WATER, ROCK, ETC
0.5	1.64			
1.0	3.28			
1.5	4.92			
2.0	6.56			
2.5	8.20			
3.0	9.84			
3.5	11.48			
4.0	13.12			
4.5	14.76			
5.0	16.40			
5.5	18.04			
6.0	19.69			
6.5	21.33			
7.0	22.97			
7.5	24.61			
8.0	26.25			
8.5	27.89			
9.0	29.53			
9.5	31.17			
10.0	32.81			
10.5	34.45			
11.0	36.09			
11.5	37.73			
12.0	39.37			
12.5	41.01			
13.0	42.65			
13.5	44.29			
14.0	45.93	001		4:52
14.5	47.57	2		
15.0	49.21	3		
15.5	50.85	4		
16.0	52.49	5		
16.5	54.13	6		
17.0	55.77	7		
17.5	57.41	8		
18.0	59.06	9		
18.5	60.70	10		
19.0	62.34	11		
19.5	63.98	12		
20.0	65.62	13		

P-S FIELD LOG REV 1.4

M-30DH **GEOVISION SUSPENSION LOGGING FIELD NOTES**

SITE*: North Anna DATE*: 9/15/09

CLIENT*: MACTEC JOB*: 9333

AUTHOR*: C. Carter PAGE* 4 OF 5

*ITEMS WITH * MUST BE COMPLETED. OTHER INFORMATION IS OPTIONAL*

DEPTH METERS	DEPTH FEET	UNFILTERED FILE NO*.	FILTERED FILE NO*. (if any)	COMMENTS CASING, WATER, ROCK, ETC
20.5	67.26	14		
21.0	68.90	15		
21.5	70.54	16		
22.0	72.18	17		
22.5	73.82	18		
23.0	75.46	19		
23.5	77.10	20		
24.0	78.74	21		
24.5	80.38	22		
25.0	82.02	23		
25.5	83.66	24		
26.0	85.30	25		
26.5	86.94	26		
27.0	88.58	27		
27.5	90.22	28		
28.0	91.86	29		
28.5	93.50	30		
29.0	95.14	31		
29.5	96.78	32		
30.0	98.43	33		
30.5	100.07	34		
31.0	101.71	35		
31.5	103.35	36		
32.0	104.99	37		
32.5	106.63	38		
33.0	108.27	39		
33.5	109.91	40		
34.0	111.55	41		
34.5	113.19	42		
35.0	114.83	43		
35.5	116.47	44		
36.0	118.11	45		
36.5	119.75	46		
37.0	121.39	47		
37.5	123.03	48		
38.0	124.67	49		
38.5	126.31	~~#~~ 50 cc 9/15/09		
39.0	127.95	51		
39.5	129.59	52		
40.0	131.23	53		

M-30DH **GEOVISION SUSPENSION LOGGING FIELD NOTES**

P-S FIELD LOG REV 1.4

SITE*: North Anna DATE*: 9/15/09
CLIENT*: MACTEC JOB*: 9333
AUTHOR*: C. Carter PAGE* 5 OF 5

ITEMS WITH * MUST BE COMPLETED. OTHER INFORMATION IS OPTIONAL

DEPTH METERS	DEPTH FEET	UNFILTERED FILE NO*.	FILTERED FILE NO*. (if any)	COMMENTS CASING, WATER, ROCK, ETC
40.5	132.87	54		
41.0	134.51	55		
41.5	136.15	56		
42.0	137.80	57		
42.5	139.44	58		
43.0	141.08	59		
43.5	142.72	60		
44.0	144.36	61		
44.5	146.00	62		
45.0	147.64	63		
45.5	149.28	64		
46.0	150.92	65		
46.5	152.56	66		
47.0	154.20	67		
47.5	155.84	68		
48.0	157.48	69		
48.5	159.12	70		
49.0	160.76	71		
49.5	162.40	72		
50.0	164.04	73		
50.5	165.68	74		
51.0	167.32	75		
51.5	168.96	76		
52.0	170.60	77		
52.5	172.24	78		
53.0	173.88	79		
53.5	175.52	80		
54.0	177.17	81		
54.5	178.81	82		
55.0	180.45	83		
55.5	182.09	84		
56.0	183.73	85		
56.5	185.37	86		
57.0	187.01	87		5:40
57.5	188.65			
58.0	190.29			
58.5	191.93			
59.0	193.57			
59.5	195.21			
60.0	196.85			

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M-30DH
Borehole*

BORING GEOPHYSICS FIELD LOG SUMMARY

SITE*: North Anna DATE*: 9/15/09, 9/16/09
CLIENT*: MACTEC JOB*: 9333
AUTHOR*: C.Carter PAGE*: 1 OF 1

CONTACT: ____ PHONE: ____

BOREHOLE CONSTRUCTION: CASED ____ UNCASED X
DIAMETERS AND DEPTH RANGES: 3.78" 0 TO 102.7 ft; ____, ____ TO ____
BOREHOLE TOTAL DEPTH AS DRILLED*: 102.7 ft
SURFACE CASING?: YES X DEPTH TO BOTTOM OF CASING 44 ft; NO ____
DEPTH TO BEDROCK: 45 ft
BOREHOLE FLUID: WATER ____; FRESH WATER MUD X; SALT WATER MUD ____;

LOGGING CREW: C.Carter, V. Gonzalez

LOG TYPE*	FILE NAME*	DEPTH RANGE*	DATE*	TIMES*
ELOG	M30DHELOGTEST01	NA	9/15/09	3:05 - 3:07 pm
ELOG	M30DHELOGUP01	200.45 - 39.55 ft	9/15/09	3:49 - 4:05 pm
cc 9/21/09 ~~P-S velocity~~	~~M30DHSUSPDOWN01~~	~~14.0 - 57.0~~	9/15/09	
ELOG	M30DHELOGUP02	75 - 39.85 ft	9/15/09	4:11 - 4:15
P-S velocity	M30DHSUSPDOWN01	14.0 - 57.0 m	9/15/09	4:52 - 5:40 pm
ATV	M30DHAUUP01	200.2 - 40.2 ft	9/16/09	9:09 - 10:01 am
ATV	M30DHAUUP02	55.4 - 41.8 ft	9/16/09	10:05 - 10:08 am
Caliper	M30DHCALTEST01	NA	9/16/09	10:40 - 10:42
Caliper	M30DHCALUP01	200.1 - 33.2 ft	9/16/09	11:30 - 11:46
Caliper	M30DHCALTEST02	NA	9/16/09	12:00 - 12:01

ITEMS WITH * MUST BE COMPLETED. OTHER INFORMATION IS OPTIONAL

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ACOUSTIC TELEVIEWER LOG FORM 1.1.pdf

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M-306H ACOUSTIC TELEVIEWER FIELD LOG Rev 1.1

Borehole*
GEOVISION HI-RES ACOUSTIC TELEVIEWER PROCEDURE V1.0

SITE*: North Anna
DATE*: 9/16/09
CLIENT*: MACTEC
JOB*: 9333
AUTHOR*: C. Carter
PAGE 1 OF 2
REVIEWER: ________ (post field work)

CONTACT: ________ PHONE: Off Cell ________

CONTACT: ________ PHONE: Off Cell ________

DRILLER COMPANY: ________ PHONE: Off Cell ________

GENERAL SITE CONDITIONS/LOCATION: ________

COUNTY: ________ RANGE: ________ TOWNSHIP: ________ SECTION: ________
BOREHOLE CONSTRUCTION: CASED ____ UNCASED x
DIAMETERS AND DEPTH RANGES: 3.78" 0 TO 201.7 ft ; ______, ______ TO ______

BOREHOLE TOTAL DEPTH AS DRILLED*: 201.7 ft

SURFACE CASING?: YES ✓ DEPTH TO BOTTOM OF CASING 42 ft ; NO ____
DEPTH TO BEDROCK: ~42 ft
DEPTH TO WATER TABLE: NA
BOREHOLE FLUID: WATER ✓ ; FRESH WATER MUD ____; SALT WATER MUD ____;
OTHER: ________
DEPTH TO BOREHOLE FLUID: 25 ft
TIME SINCE LAST CIRCULATION: NA

LOGGING CREW: C. Carter, V. Gonzalez
VEHICLE(S) USED AND MILEAGE: ________
MOBILIZED FROM: Fredricksburg
DEPARTURE TIME: 6:15
ARRIVED ON SITE: 7:15
STANDBY TIME: NA
CAUSE: ________

*ITEMS WITH * MUST BE COMPLETED. OTHER INFORMATION IS OPTIONAL*

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ACOUSTIC TELEVIEWER LOG FORM 1.1.pdf

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M-30DH ACOUSTIC TELEVIEWER FIELD LOG Rev 1.1

Borehole*

GEOVISION HI-RES ACOUSTIC TELEVIEWER PROCEDURE V1.0

SITE*: North Anna　　DATE*: 9/16/09
CLIENT*: MACTEC　　JOB*: 9333
AUTHOR*: C. Carter　　PAGE 2 OF 2
REVIEWER: ________ (post field work)

WINCH: COMPROBE____ SILVER X OYO____ OTHER________
MICROLOGGER* 5310___ 5772 X
TELEVIEWER* ACOUSTIC #5174 ~~X~~ cc 9/16/09 OTHER 6641
SHEAVE* COMPROBE_____ OYO 101____ 102 X 103____ RG________

PROBE TILT TEST* 93　BRUNTON TILT* 93
cc 9/16/09 PROBE TILT TEST* 14.39 ~~288.9~~　BRUNTON TILT* ~~281~~ cc 9/16/09 14
PROBE TILT TEST* 12.42　BRUNTON TILT* 13　AFTER LOG* yes
PROBE AZIMUTH TEST* 288.70　BRUNTON AZIMUTH* 281
cc 9/16/09 PROBE AZIMUTH TEST* ~~14.39~~ 10.10　BRUNTON AZIMUTH* ~~14~~ 10 cc 9/16/09
PROBE AZIMUTH TEST* 351.40　BRUNTON AZIMUTH* 350　AFTER LOG* yes

PROBE OFFSET*	1.44M(4.72FT)	
MINUS CASING STICK-UP*	1.08	REF TO GROUND SURFACE
DEPTH REF. OFFSET AT START*	3.64	REF TO GROUND SURFACE
DEPTH REF. OFFSET AT END*	3.62	REF TO GROUND SURFACE
AFTER SURVEY DEPTH ERROR*	.02	

LOG NAME*	START DEPTH*	START TIME	END DEPTH *	END TIME
M30DHAUUP01	200.2	9:09	40.2	10:01
M30DHAUUP02	55.4	10:05	41.8	10:08

MAINTENANCE PERFORMED ON SITE*: NA (N/A if none)

DEVIATION FROM PROCEDURE (IF ANY) OR EQUIPMENT PROBLEMS OR FAILURES* (N/A if none)
NA

*ITEMS WITH * MUST BE COMPLETED. OTHER INFORMATION IS OPTIONAL*

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CALIPER FIELD LOG REV 1.2.PDF

M-30DH
Borehole*

CALIPER FIELD LOG

Procedure ASTM D6167-97(2004)

SITE*: North Anna
CLIENT*: Mactec
AUTHOR*: V. Gonzalez

DATE*: 9/16/2009
JOB*: 1333
PAGE: 1 OF 2

CONTACT: ____ PHONE: Off Cell

CONTACT: ____ PHONE: Off Cell

CONTACT: ____ PHONE: Off Cell

DRILLER COMPANY: ____ PHONE: Off Cell

GENERAL SITE CONDITIONS/LOCATION: ____

COUNTY: ____ RANGE: ____ TOWNSHIP: ____ SECTION: ____
BOREHOLE CONSTRUCTION: CASED____ UNCASED____
DIAMETERS AND DEPTH RANGES: 3.78" 0 TO 201.7 ft ; ____, ____ TO ____

BOREHOLE TOTAL DEPTH AS DRILLED*: 201.7ft

SURFACE CASING?: YES x DEPTH TO BOTTOM OF CASING 42 FT ; NO____
DEPTH TO BEDROCK: ~42 FT DEPTH TO WATER TABLE: NA
BOREHOLE FLUID: WATER x ; FRESH WATER MUD____; SALT WATER MUD ____;
OTHER: ____
DEPTH TO BOREHOLE FLUID: 25 FT TIME SINCE LAST CIRCULATION: N/A

LOGGING CREW: V Gonzalez, C. Carter
VEHICLE(S) USED AND MILEAGE: ____
MOBILIZED FROM: Fredericksburg DEPARTURE TIME: 6:15
ARRIVED ON SITE: 7:15
STANDBY TIME: N/A CAUSE: ____

*ITEMS WITH * MUST BE COMPLETED. OTHER INFORMATION IS OPTIONAL*

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CALIPER FIELD LOG REV 1.2.PDF

CALIPER FIELD LOG

Procedure ASTM D6167-97(2004)

Borehole*: M -30DH

SITE*: North Anna
CLIENT*: Mactec
AUTHOR*: V. Gonzalez
DATE*: 9/16/2009
JOB*: 9333
PAGE: PAGE 2 OF 2

WINCH: COMPROBE ___ SILVER X OYO ___ RG ___ OTHER ___
MICROLOGGER* 5310 [ ] 5772 [X] OTHER ~~6621~~ VG 9/16/09
CALIPER PROBE* 5368 [ ] OTHER 6621
SHEAVE* COMPROBE [ ] OYO 101 [ ] 102 [X] 103 [ ] RG [ ]

PROBE OFFSET	2.08M(6.82 FT)	12 IN MAX
MINUS CASING STICK-UP*	1.08 FT	REF TO GROUND SURFACE
DEPTH REF. OFFSET AT START*	5.74 FT	
DEPTH REF. OFFSET AT END*	5.70 FT	
AFTER SURVEY DEPTH ERROR*	0.04 FT	

LOG NAME*	START DEPTH*	START TIME*	END DEPTH*	END TIME*
M30DHCALUP01	200.1	11:30	33.20 FT	11:46
M30DHCALTEST01	N/A	10:40	N/A	10:42
M30DH CALTEST02	N/A	12:00	N/A	12:01

CALIBRATION PLATE S/N 201

	FILE NAME	AS BUILT 1.968 IN (50 MM)	3.937 IN (100 MM)	8.000 IN (203.2 MM)	PVC FITTING 4.504 IN (114.4 MM)
AS MEAS.*	M30DH CALTEST01	2.00	3.96	8.02	4.55
AS MEAS.*	M30DH CALTEST02	2.00	3.95	8.03	4.56
AS MEAS.					
AS MEAS.					
AS MEAS.					
AS MEAS.					

MAINTENANCE PERFORMED ON SITE*: N/A (N/A if none)

EQUIPMENT PROBLEMS OR FAILURES*: N/A (N/A if none)

SUGGESTIONS, ADDITIONS, CHANGES:

ITEMS WITH * MUST BE COMPLETED. OTHER INFORMATION IS OPTIONAL

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BORING SUMMARY LOG REV 1.1a.pdf

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M-30DH BORING GEOPHYSICS FIELD LOG SUMMARY

Borehole*

SITE*: North Anna DATE*: 9/17/09

CLIENT*: MACTEC JOB*: 9333

AUTHOR*: C. Carter PAGE*: 1 OF 1

CONTACT: PHONE:

BOREHOLE CONSTRUCTION: CASED UNCASED

DIAMETERS AND DEPTH RANGES: 3.78" 0 TO 201.7 ft; ______, ______ TO ______

BOREHOLE TOTAL DEPTH AS DRILLED*: 201.7 ft

SURFACE CASING?: YES X DEPTH TO BOTTOM OF CASING 7 ft ; NO______

DEPTH TO BEDROCK: ~42 ft

BOREHOLE FLUID: WATER_____; FRESH WATER MUD X ; SALT WATER MUD _____;

LOGGING CREW: C. Carter, V. Gonzalez

cc 9/17/09

LOG TYPE*	FILE NAME*	DEPTH RANGE*	DATE*	TIMES*
ELOG	~~E~~ M30DHELOGTEST02	NA	9/17/09	8:34 - 8:35am
ELOG	M30DHELOGUP03	65.4 - 34.7 ft	9/17/09	9:17 - 9:20am
P-S velocity	M30DHSUSPDOWN02	2.5 - 16.0 m	9/17/09	9:35 - 9:52am
ATV	M30DHAUUP03	45.9 - 5.9 ft	9/17/09	10:26 - 10:38am
Caliper	M30DHCALTEST03	NA	9/17/09	11:00 - 11:03am
Caliper	M30DHCALTEST04	NA	9/17/09	11:34 - 11:36am
Caliper	M30DHCALUP02	50.7 - 3.3 ft	9/17/09	11:20 - 11:26am

ITEMS WITH * MUST BE COMPLETED. OTHER INFORMATION IS OPTIONAL

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ELOG FIELD LOG REV 1.1a

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M-30DH ELOG FIELD LOG
Borehole*

SITE*: North Anna DATE*: 9/17/09
CLIENT*: MACTEC JOB*: 9333
AUTHOR*: C. Carter PAGE: 1 OF 2

CONTACT: PHONE: Off Cell

CONTACT: PHONE: Off Cell

CONTACT: PHONE: Off Cell

CONTACT: PHONE: Off Cell
COMPANY:

GENERAL SITE CONDITIONS/LOCATION:

COUNTY: RANGE: TOWNSHIP: SECTION:
BOREHOLE CONSTRUCTION: CASED UNCASED X
DIAMETERS AND DEPTH RANGES: 3.78" 0 TO 201.7 ft; , TO

BOREHOLE TOTAL DEPTH AS DRILLED*: 201.7 ft

SURFACE CASING?: YES X DEPTH TO BOTTOM OF CASING 7 ft; NO
DEPTH TO BEDROCK: 42 ft DEPTH TO WATER TABLE: ~25 ft
BOREHOLE FLUID: WATER ; FRESH WATER MUD X ; SALT WATER MUD ;
OTHER:
DEPTH TO BOREHOLE FLUID: ~2 ft TIME SINCE LAST CIRCULATION: 9am

LOGGING CREW: C. Carter V. Gonzalez
VEHICLE(S) USED AND MILEAGE:
MOBILIZED FROM: Fredricksburg DEPARTURE TIME: 6:15 am
ARRIVED ON SITE: 7am
STANDBY TIME: NA CAUSE:

*ITEMS WITH * MUST BE COMPLETED. OTHER INFORMATION IS OPTIONAL*

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ELOG FIELD LOG REV 1.1a

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M-30DH ELOG FIELD LOG
Borehole*

SITE*: North Anna
CLIENT*: MACTEC
AUTHOR*: C. Carter

DATE*: 9/17/09
JOB*: 9333
PAGE: PAGE 2 OF 2

WINCH: COMPROBE___ SILVER ✓ OYO___ RG___ OTHER___
MICROLOGGER* 5310 ☐ 5772 ☒ OTHER
ELOG PROBE* 5490 ✓ OTHER
SHEAVE* COMPROBE ☐ OYO 101 ☐ 102 ☒ 103 ☐ RG ☐

PROBE LENGTH	2.50M(8.20 FT)	
PLUS YOKE 10.0M (32.8 FT)*	32.8	
MINUS CASING STICK-UP*	-3.35	REF TO GROUND SURFACE
DEPTH REF. OFFSET AT START*	37.65	REF TO GROUND SURFACE
DEPTH REF. OFFSET AT END*	37.75	REF TO GROUND SURFACE
AFTER SURVEY DEPTH ERROR*	.10	

LOG NAME*	START DEPTH*	START TIME	END DEPTH*	END TIME
M30DHELOGTEST02	NA	8:34	NA	8:35am
M30DHELOGUP03	65.4 ft	9:17	34.7 ft	9:20am

MAINTENANCE PERFORMED ON SITE*: NA (N/A if none)

EQUIPMENT PROBLEMS OR FAILURES*: NA (N/A if none)

SUGGESTIONS, ADDITIONS, CHANGES:

*ITEMS WITH * MUST BE COMPLETED. OTHER INFORMATION IS OPTIONAL*

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P-S FIELD LOG REV V1.4

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M-30DH P-S SUSPENSION VELOCITY FIELD LOG REV 1.4

Borehole

CORRESPONDING P-S SUSPENSION PROCEDURE REV 1.4.

SITE*: North Anna
DATE*: 9/17/09
CLIENT*: MACTEC
JOB*: 9333
AUTHOR*: C. Carter
PAGE 1 OF * 3

CONTACT: ______ PHONE: Off Cell ______

CONTACT: ______ PHONE: Off Cell ______

CONTACT: ______ PHONE: Off Cell ______

CONTACT: ______ PHONE: Off Cell ______

DIRECTIONS TO SITE: ______

GENERAL SITE CONDITIONS/LOCATION: ______

COUNTY: ______ RANGE: ______ TOWNSHIP: ______ SECTION: ______
BOREHOLE CONSTRUCTION*: CASED ______ UNCASED X
DIAMETERS AND DEPTH RANGES*: 3.78" 0 TO 201.7 ft ; ______, ______ TO ______
BOREHOLE TOTAL DEPTH AS DRILLED*: 201.7 ft
SURFACE CASING?: yes DEPTH TO BOTTOM OF CASING 7 ft ; NO ______
DEPTH TO BEDROCK: 42 ft DEPTH TO WATER TABLE: ~25 ft
BOREHOLE FLUID: WATER ______; FRESH WATER MUD X ; SALT WATER MUD; ______
OTHER: ______
DEPTH TO BOREHOLE FLUID*: ~5 ft TIME SINCE LAST CIRCULATION: 9am

*ITEMS WITH * MUST BE COMPLETED. OTHER INFORMATION IS OPTIONAL*

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P-S FIELD LOG REV V1.4

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M-30DH
Borehole

P-S SUSPENSION VELOCITY FIELD LOG REV 1.4

CORRESPONDING P-S SUSPENSION PROCEDURE REV 1.4.

SITE*: North Anna DATE*: 9/17/09
CLIENT*: MACTEC JOB*: 9333
AUTHOR*: C. Carter PAGE 2 OF * 3

LOGGING CREW*: C. Carter, V. Gonzalez
MOBILIZED FROM: Fredricksburg DEPARTURE TIME: 6:15
ARRIVED ON SITE: 7am
STANDBY TIME: ______ CAUSE: ______
LOGGING STARTED: 9:35am LOGGING COMPLETED: 9:52am

BATTERIES CHANGED BEFORE LOGGING: YES____; NO X ; STORED WITH NEW____
WINCH COMPROBE ☐ GREY ☒ OYO ☐ RG ☐ OTH ____
INSTRUMENT* OYO 12004 ☐ 15014 ☐ 19029 ☐ RG 160023 ☒ 160024 ☐
RECEIVER S/N* 12008 ☐ 20042 ☐ 26066 ☐ 11001 ☐ 23053 ☐ 30086 ☒
ISOLATION TUBE S/N* 300083 ☒ 24053 ☐ 28068 ☐ 28072 ☐ 2M ______
SHEAVE* COMPROBE ☐ OYO 101 ☐ 102 ☒ 103 ☐ RG ☐
MICROLOGGER* 5310 ☐ 5772 ☒ NOT APPLICABLE (OYO) ☐
PROBE OFFSET* OYO 2.0M ☐ RG 2.5M ☒
MINUS CASING STICK-UP* 1.02 m
DEPTH REF. OFFSET AT START* 1.48 m
DEPTH REF. OFFSET AT END* 1.49 m
AFTER SURVEY DEPTH ERROR* .01 m
cc 11/3/09
REF TO GROUND SURFACE

LOG NAME*	START DEPTH*	START TIME	END DEPTH *	END TIME
M30DHSUSPDOWN02	2.5m	9:35am	16m	9:52am

MAINTENANCE PERFORMED ON SITE*: NA (N/A if none)

EQUIPMENT PROBLEMS OR FAILURES*: NA (N/A if none)

DEVIATIONS FROM TEST PLAN*: NA (N/A if none)

*ITEMS WITH * MUST BE COMPLETED. OTHER INFORMATION IS OPTIONAL*

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P-S FIELD LOG REV 1.4

M-30DH GEOVISION SUSPENSION LOGGING FIELD NOTES

SITE*: North Anna DATE*: 9/17/09
CLIENT*: MACTEC JOB*: 9333
AUTHOR*: C. Carter PAGE* 3 OF 3

*ITEMS WITH * MUST BE COMPLETED. OTHER INFORMATION IS OPTIONAL*

DEPTH METERS	DEPTH FEET	UNFILTERED FILE NO*.	FILTERED FILE NO*. (if any)	COMMENTS CASING, WATER, ROCK, ETC
0.5	1.64			
1.0	3.28			
1.5	4.92			
2.0	6.56			
2.5	8.20	200		9:35
3.0	9.84	201		
3.5	11.48	202		
4.0	13.12	203		
4.5	14.76	204		
5.0	16.40	205		
5.5	18.04	206		
6.0	19.69	207		
6.5	21.33	208		
7.0	22.97	209		
7.5	24.61	210		
8.0	26.25	211		
8.5	27.89	212		
9.0	29.53	213		
9.5	31.17	214		
10.0	32.81	215		
10.5	34.45	216		
11.0	36.09	217		
11.5	37.73	218		
12.0	39.37	219		
12.5	41.01	220		
13.0	42.65	221		
13.5	44.29	222		
14.0	45.93	223		
14.5	47.57	224		
15.0	49.21	225		
15.5	50.85	226		
16.0	52.49	227		9:52
16.5	54.13			
17.0	55.77			
17.5	57.41			
18.0	59.06			
18.5	60.70			
19.0	62.34			
19.5	63.98			
20.0	65.62			

ACOUSTIC TELEVIEWER LOG FORM 1.1.pdf

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M-30DH ACOUSTIC TELEVIEWER FIELD LOG Rev 1.1

Borehole*

GEOVISION HI-RES ACOUSTIC TELEVIEWER PROCEDURE V1.0

SITE*: North Anna DATE*: 9/17/09
CLIENT*: MACTEC JOB*: 9333
AUTHOR*: C. Carter PAGE 1 OF 2
REVIEWER: ________ (post field work)

CONTACT: ________ PHONE: Off Cell

CONTACT: ________ PHONE: Off Cell

DRILLER ________ PHONE: Off Cell
COMPANY: ________

GENERAL SITE CONDITIONS/LOCATION: ________

COUNTY: ________ RANGE: ________ TOWNSHIP: ________ SECTION: ________
BOREHOLE CONSTRUCTION: CASED ____ UNCASED X
DIAMETERS AND DEPTH RANGES: 3.78" 0 TO 201.7 ft ; ____, ____ TO ____

BOREHOLE TOTAL DEPTH AS DRILLED*: 201.7 ft

SURFACE CASING?: YES X DEPTH TO BOTTOM OF CASING 7 ft ; NO ____
DEPTH TO BEDROCK: ~42 ft DEPTH TO WATER TABLE: ~25 ft
BOREHOLE FLUID: WATER ____; FRESH WATER MUD X ; SALT WATER MUD ____;
OTHER: ________
DEPTH TO BOREHOLE FLUID: 5 ft TIME SINCE LAST CIRCULATION: 9am

LOGGING CREW: C. Carter, V. Gonzalez
VEHICLE(S) USED AND MILEAGE: ________
MOBILIZED FROM: Fredricksburg DEPARTURE TIME: 6:15 am
ARRIVED ON SITE: 7am
STANDBY TIME: NA CAUSE: ________

*ITEMS WITH * MUST BE COMPLETED. OTHER INFORMATION IS OPTIONAL*

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ACOUSTIC TELEVIEWER LOG FORM 1.1.pdf

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M-30DA ACOUSTIC TELEVIEWER FIELD LOG Rev 1.1

Borehole*
GEOVISION HI-RES ACOUSTIC TELEVIEWER PROCEDURE V1.0

SITE*: North Anna
DATE*: 9/17/09
CLIENT*: MACTEC
JOB*: 9333
AUTHOR*: C. Carter
PAGE 2 OF 2
REVIEWER: ________ (post field work)

WINCH: COMPROBE____ SILVER X OYO____ OTHER________
MICROLOGGER* 5310___ 5772 X
TELEVIEWER* ACOUSTIC #5174____ OTHER 6641
SHEAVE* COMPROBE____ OYO 101____ 102 X 103____ RG________

PROBE TILT TEST* 91.47 BRUNTON TILT* 91
PROBE TILT TEST* 17.38 BRUNTON TILT* 17
PROBE TILT TEST* 52.40 BRUNTON TILT* 52 AFTER LOG* yes
PROBE AZIMUTH TEST* 315.30 BRUNTON AZIMUTH* 310
PROBE AZIMUTH TEST* 249.50 BRUNTON AZIMUTH* 247
PROBE AZIMUTH TEST* 312.40 BRUNTON AZIMUTH* 305 AFTER LOG* yes

PROBE OFFSET*	1.44M(4.72FT)	
MINUS CASING STICK-UP*	3.35	REF TO GROUND SURFACE
DEPTH REF. OFFSET AT START*	1.37	
DEPTH REF. OFFSET AT END*	1.37	
AFTER SURVEY DEPTH ERROR*	Ø	

LOG NAME*	START DEPTH*	START TIME	END DEPTH *	END TIME
M30DHAUUP03	45.9 ft	10:26am	5.9 ft	10:38 am

MAINTENANCE PERFORMED ON SITE*: NA (N/A if none)

DEVIATION FROM PROCEDURE (IF ANY) OR EQUIPMENT PROBLEMS OR FAILURES*(N/A if none)
NA

*ITEMS WITH * MUST BE COMPLETED. OTHER INFORMATION IS OPTIONAL*

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CALIPER FIELD LOG REV 1.2.PDF

M-30DH
Borehole*

CALIPER FIELD LOG

Procedure ASTM D6167-97(2004)

SITE*: North Anna DATE*: 9/17/2009
CLIENT*: Mactec JOB*: 9333
AUTHOR*: V Gonzalez PAGE: 1 OF 2

CONTACT: PHONE: Off Cell

CONTACT: PHONE: Off Cell

CONTACT: PHONE: Off Cell

DRILLER PHONE: Off Cell
COMPANY:

GENERAL SITE CONDITIONS/LOCATION:

COUNTY: RANGE: TOWNSHIP: SECTION:
BOREHOLE CONSTRUCTION: CASED UNCASED
DIAMETERS AND DEPTH RANGES: 3.78" 0 TO 201.7FT ; , TO

BOREHOLE TOTAL DEPTH AS DRILLED*: 201.7

SURFACE CASING?: YES x DEPTH TO BOTTOM OF CASING 7ft ; NO
DEPTH TO BEDROCK: 42ft DEPTH TO WATER TABLE: N/A
BOREHOLE FLUID: WATER ; FRESH WATER MUD x ; SALT WATER MUD ;
OTHER:
DEPTH TO BOREHOLE FLUID: N/A TIME SINCE LAST CIRCULATION: N/A

LOGGING CREW: V.Gonzalez, C. Carter
VEHICLE(S) USED AND MILEAGE:
MOBILIZED FROM: Fredericksburg, VA DEPARTURE TIME: 615
ARRIVED ON SITE: 715
STANDBY TIME: N/A CAUSE:

*ITEMS WITH * MUST BE COMPLETED. OTHER INFORMATION IS OPTIONAL*

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CALIPER FIELD LOG REV 1.2.PDF

CALIPER FIELD LOG

Procedure ASTM D6167-97(2004)

Borehole*: M-30DH

SITE*: North Anna DATE*: 9/17/09
CLIENT*: Mactec JOB*: 9333
AUTHOR*: VGon PAGE: PAGE 2 OF 2

WINCH: COMPROBE___ SILVER X OYO___ RG___ OTHER___
MICROLOGGER* 5310 [ ] 5772 [X] OTHER
CALIPER PROBE* 5368 [ ] OTHER 6621
SHEAVE* COMPROBE [ ] OYO 101 [ ] 102 [X] 103 [ ] RG [ ]

PROBE OFFSET	2.08M(6.82 FT)	12 IN MAX
MINUS CASING STICK-UP*	3.35	REF TO GROUND SURFACE
DEPTH REF. OFFSET AT START*	3.47	
DEPTH REF. OFFSET AT END*	3.45	
AFTER SURVEY DEPTH ERROR*	0.02	

LOG NAME*	START DEPTH*	START TIME*	END DEPTH*	END TIME*
VG 9/17/09 ~~M030D~~ M30DHCALTEST03	N/A	1100	N/A	11:03
M30DHCALUP02	50.7 FT	11:20	3.3	11:26
M30DHCALTEST04	N/A	11:34	N/A	11:36

CALIBRATION PLATE S/N 201

	FILE NAME	AS BUILT 1.968 IN (50 MM)	3.937 IN (100 MM)	8.000 IN (203.2 MM)	PVC FITTING 4.504 IN (114.4 MM)
AS MEAS.*	M30DHCALTEST03	1.96	3.92	7.99	4.51
AS MEAS.*	M30DHCALTEST04	1.95	3.92	8.00	4.52
AS MEAS.					
AS MEAS.					
AS MEAS.					
AS MEAS.					

MAINTENANCE PERFORMED ON SITE*: N/A (N/A if none)

EQUIPMENT PROBLEMS OR FAILURES*: N/A (N/A if none)

SUGGESTIONS, ADDITIONS, CHANGES:

*ITEMS WITH * MUST BE COMPLETED. OTHER INFORMATION IS OPTIONAL*

GEOVision Geophysical Services 1124 Olympic Drive Corona, CA 92881 Ph (951) 549-1234 Fx (951) 549-1236

APPENDIX F

BORING GEOPHYSICAL LOGGING
FIELD MEASUREMENT PROCEDURES

Work Instruction No. 9
North Anna 3 Project
MACTEC Engineering and Consulting, Inc.
Project Number: 6468-09-2473

Issued To: Charles Carter, John Diehl, Victor Gonzalez, Robert Stellar (GEOVision) Rev. No. 0

Issued By: D. Steven Copley, P.E. DSC 9-11-09 Date: September 11, 2009

Valid From: September 14, 2009 To: September 14, 2010

Task Description: Downhole Geophysical Testing to include P-S Logging, Natural gamma, spontaneous potential, single-point resistance, long-and short-normal resistivity, three arm caliper and directional survey testing; review and interpretation of results; report preparation

Applicable Technical Procedures or Plans, or other reference:

MACTEC Geotechnical Work Plan (latest revision), on file at the field office.
Long- and short-normal resistivity, spontaneous potential, single-point resistance, ASTM D 5753 – 05 (attached)
Three-arm caliper, ASTM D 6167 - 97 (Reapproved 2004) (attached)
Natural gamma, ASTM D 6274 – 98 (Reapproved 2004) (attached)
Directional Survey, GeoVision Procedure HiRAT Field Procedure Rev. 1.0 (attached)
GeoVision Procedure for OYO P-S Suspension Seismic Velocity Logging (Rev. 1.4) (attached)

Specific Instructions (note attachments where necessary):

MACTEC will perform drilling of the referenced boreholes prior to performing the geophysical logging. A MACTEC drill rig will remain at the boring location to install casing, refresh drilling mud, and assist GeoVision as needed to complete the logging. The geophysical logging should be conducted in each designated borehole using a sequence of tests that will optimize data collection and data quality.

Report Format: Use GeoVision field data forms as approved by MACTEC (attached). Present results of logging in data report. Include electronic copies of digital logs on CD with report.

Specific Quality Assurance Procedures Applicable: QAP 20-1, QAP-Reporting Nuclear-related Defects or Noncompliances, per Federal Regulation 10CFR21 and Section 206 of the Energy Reorganization Act of 1974.

Hold Points or Witness Points: None

Records: All records generated shall be considered QA Records.

Reviewed and Approved By (Note: Only one signature required for issuance):

Project Manager: ______ Date: ______

Principal: D. Steven Copley Date: 9-11-09

Site Manager: ______ Date: ______

No. of Pages: 66

DCN: NAP ~~137~~ 135 SAW 9-22-09

QA Form 24-1 Revised 8/12/2009

Page 1 of 66
DCN# NAP135

PROCEDURE FOR USING THE ROBERTSON GEOLOGGING HI-RESOLUTION ACOUSTIC TELEVIEWER (HiRAT)

Reviewed 2/13/06

Reviewed and Approved by MACTEC for use on North Anna 3
MACTEC Principal Professional 8/19/09

Background

The acoustic televiewer is a device for producing a qualitative image of the wall of a borehole. Because it uses ultrasound rather than visible light it is able to work in dirty or opaque borehole fluids, although heavy drilling mud will cause excessive dispersion of the acoustic beam. The picture below shows the sonde's lower nylon section, and one of the bowspring attachments which are used to centralize the sonde in the borehole.

Pulses of ultrasound (0.5 - 1.5MHz) are generated by a piezo-electric resonator. The pulses are transmitted through the oil in which the resonator is immersed, through the wall of the acoustic housing, then propagate through the borehole fluid and are reflected from the wall of the borehole. The reflected energy is picked up by the same transducer, from which is recorded both the ***amplitude*** of the returned pulse and the ***travel-time*** which have elapsed. Blanking must be applied to prevent the transducer from registering reflections from the inside surface of the acoustic housing. The material of the housing is chosen so that its acoustic properties are similar to the oil which fills it. The housing is not designed to withstand borehole fluid pressures, but has a piston device to allow equalization between inside and outside pressure.

The ***amplitude*** of the returned pulse is a function of the acoustic reflectivity of the borehole wall. If the beam strikes a hard borehole wall normally to the surface the energy will be returned to the transducer and a strong return will be recorded. If the formation is softer, then less energy will be reflected. Also, if the surface of the borehole is rough, or effectively missing because of the presence of a fracture or other structure, then energy will be dispersed and a poor return will be recorded.

The ***travel-time*** is a simple function of the diameter of the borehole and the velocity of sound in the borehole fluid (typically 1.5Km/sec). An A/D converter monitors the output from the transducer once the blanking period has expired and a comparator is used to detect the peak amplitude during the sampling window.

The coaxially-mounted transducer has a planar radiating surface, but the vibration characteristics are such that the acoustic pulse is emitted as a 'pencil' beam. The emitted beam is deflected by a planar mirror so that it leaves the acoustic housing at right angles to the sonde axis. The mirror is rotated to scan the borehole wall. The ultrasound pulses are synchronized with rotation of the mirror so that up to 360 pulses are emitted in every revolution. Because of the time which must elapse for the two-way transit of the borehole fluid, there is an upper limit upon the number of radial samples that may be acquired from a borehole of a particular radius. In larger boreholes, therefore, it may be necessary to reduce the number of radial samples. The sonde is able to operate at 90, 180 or 360 samples per revolution.

An image of the borehole wall is produced by moving the sonde along the borehole axis while it is scanning radially. By the same logic as shown above, it can be seen that any horizontal point will be imaged by more than one sweep of the acoustic beam so long as the axial movement of the sonde during one complete sweep is no greater than the beam diameter. An upper limit is therefore imposed upon the logging speed which will be a function of the rotational speed of the transducer, the radial sampling interval and borehole diameter.

Objective

The objective of this procedure is to provide a pseudo "core" of the borehole, and map the orientation and angles of cracks and voids in rock boreholes.

Instrumentation

This procedure is written specifically for the Robertson Geologging High-Resolution Acoustic Televiewer (HiRAT). The required equipment includes:

1. The Robertson High-Resolution Acoustic Televiewer (HiRAT) sonde with centralizers
2. A 4-conductor wire-line winch with cable at least 30m (100ft) longer than the depth of the borehole (RG Smart Winch or equivalent. GEOVision has adapted all our 4-conductor winches)
3. A sheave with depth encoder with minimum 500 pulse/revolution
4. A Robertson Geologging Micrologger II
5. A laptop with Winlogger installed and the following minimum system requirements:
   - Windows 98SE or above
   - 64M System memory
   - 800x600x24 SVGA Display with DirectX 8.0
   - 500Mhz CPU
   - USB 2.0 connection
6. Battery power supply with cables

Environmental Conditions

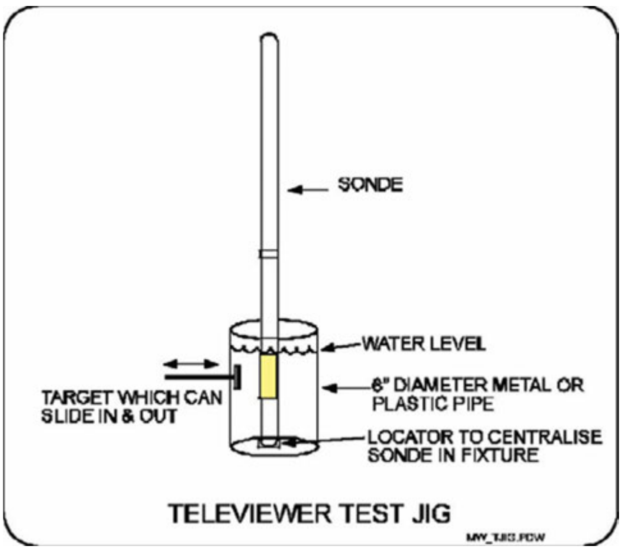
This tool is designed for fluid-filled boreholes between 67 and 150mm (3-6in) in rock. Since fine cracks are usually not visible in the walls of soil borings, the televiewers add very little information from a soil boring than a simple video. Now if the boring has soil AND rock, televiewer visuals in the soil may still be useful.

Calibration

The acoustic televiewer uses the variability in reflectance and the travel time to make an image of the borehole wall, mostly resulting from relative differences of materials and the physical characteristics of the wall. Since these are relative measurements, no field calibration of the sonde is required. However, it is important that the same location in the borehole be checked at the start and finish of the logging to make sure that the response or functionality haven't changed during the measurement.

A test fixture may be used to check function of the acoustic televiewer prior to use. This test fixture should comprise a plastic pipe, with a known internal diameter between 3 and 6 inches. This should be filled with water and the sonde stood upright in the fixture. A target made of metal or metal foil is glued on the inside of the container, or optionally on a seal and shaft so that it can be moved in and out on a line radial to the center-line of the pipe. A representation of this is shown in the figure below.

The purpose of this test fixture is to check the ability of the sonde to differentiate between materials of different acoustic reflectances, and different travel times, and to check the calibration of the caliper function of the sensor using the measured diameter of the pipe. However, if calibrated caliper measurements are required, it is recommended that a mechanical 3-arm caliper tool be used for this purpose because it can be calibrated in the field prior to use. The HiRAT will give very accurate results but this procedure does not cover calibration.

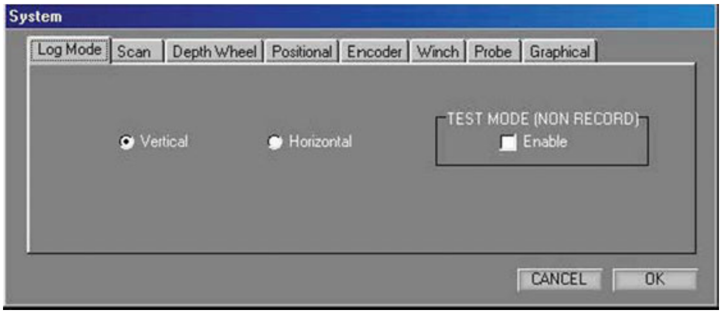


Hi-RAT Field Procedure

Because the logging software is a standalone module, there are a number of settings which must be initialized independently of the WinLogger software. These include the depth measurement subsystem and sonde operating modes. Click on ‘System’ on the menu bar to show the following dialog boxes:

1.0 Log Mode

The sonde can operate in three distinct modes:



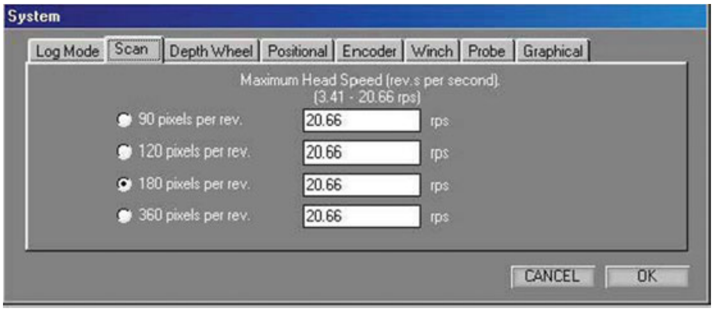
- Vertical mode is used for boreholes which are drilled from the surface and are deviated at less than 70 degrees from the vertical. Most exploration boreholes will fall into this class. In this mode the image is orientated according to compass directions (magnetic co-ordinates).

- Horizontal mode is used for boreholes which are sub-horizontal so their inclination will probably exceed 70 degrees from the vertical. Boreholes in this class would normally be drilled as part of ground investigations for tunneling and mining, drilling ahead of a drive to determine the nature and extent of fracturing. In this mode the image is orientated according to gravitational coordinates (up/down) since there is no unique point of the image circle which can be orientated to North with any precision.

- Test mode is used to exercise all sonde functions without creating a log. The image will scroll on the screen in the normal fashion, and orientation readouts will be refreshed continuously.

2.0 Scan Parameters

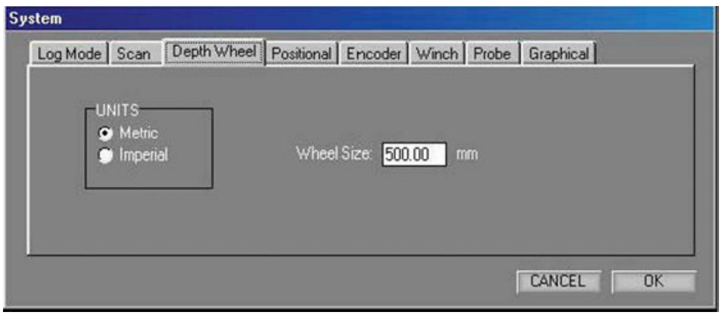
The scan parameters control the radial sampling of the borehole. The values will be retained between logging sessions, so the sonde will be initialized correctly at power-on. There are three parameters in the dialog:



- The radial sampling rate can be set to one of 90, 120, 180, 360 samples per revolution. There is a relationship between the logging speed and the radial sampling rate, since the time taken to send the dataset to the surface depends upon its length. The size of the log file is also determined by the radial sampling rate. The probe will always try to use the maximum head speed entered. If limited by a low Baud rate or a large 'window' setting then the probe will reduce its head speed automatically to compensate - see sonde operation section.

3.0 Depth Wheel Configuration

The depth measurement system is dependent upon the combination of depth measurement wheel with its calibrated groove, and the shaft encoder which translates rotation into pulses which are counted by the logging system controller. Two parameters are therefore required: depth wheel circumference and encoder pulse rate. The encoder parameters are covered in a subsequent topic.

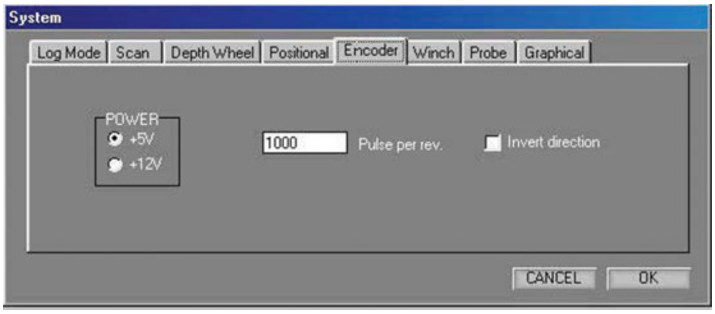


- Select Metric or Imperial depth measurement units from the left-hand pane.

- Type the circumference of the depth measurement wheel into the 'wheel size' box. The standard sizes of GEOVision wheels are 1000mm. If you are measuring in Imperial units (or changing back to metric units), the standard wheel size can be converted automatically by clicking the left mouse button and choosing the appropriate conversion. The size is always specified in units of 1/1000 of the depth unit i.e. millimetres (mm) or millifeet (mft).

4.0 Encoder Configuration

The depth measurement system is dependent upon the combination of depth measurement wheel with its calibrated groove, and the shaft encoder which translates rotation into pulses which are counted by the logging system controller. The depth wheel circumference is covered in a previous topic. In order to accommodate a variety of encoders, their operational characteristics can be configured in the software.



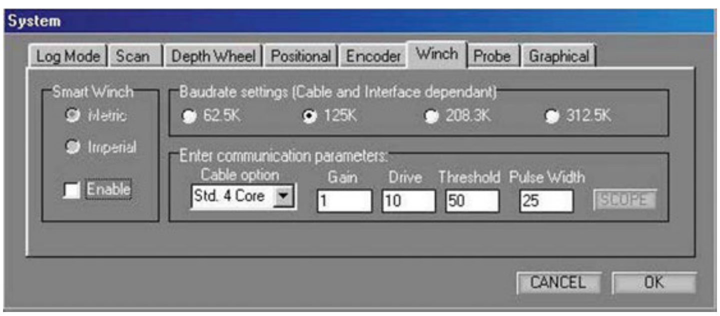
- Select supply voltage from the radio buttons in the left-hand pane. The options are 5 Volt and 12 Volt. GEOVision encoders are always specified for 5 Volt operation.

- Type the number of pulses emitted per revolution into the central box. The standard values for all GEOVision winches are 500 pulses/rev.

- The logical direction of movement can be reversed if required to accommodate the directional characteristics (phase lead or lag) of the different encoder types.

5.0 Winch and Cable Configuration

Support for remote control of the RG Smart Winch is provided, and can be enabled by checking the ***Enable*** control in the left-hand Smart Winch pane. If the Smart Winch control is enabled, it is also necessary to select the measure units in force - select ***Metric*** or ***Imperial*** from the radio buttons on offer.



The Baud settings can be chosen to match the *quality* of the communication channel. The channel will be effected by cable type and length. Typically a Baudrate of 312.5K is used. The remaining controls in the dialog relate to the communications parameters. The operation is entirely compatible with the WinLogger software operation and the values would be expected to be the same as those in force for logging six-channel type sondes with that software. (Certain probe types may be fitted with a digital interface that does not require set-up and in this case the parameter edit boxes will not appear.)

- ***Cable Option*** is used to select the logging cable type which is available on the winch. The options are *Not Connected*, *Std. 4 Core*, *Differential* and *Monocable*. The only cable types used in GEOVision systems is Std. 4 Core. Select the appropriate type from the drop-down menu box. Note this value can only be changed when the probe power is turned off.

- ***Gain*** is related to cable length and uphole signal attenuation. Gain values range from 0-3 and control the amplification applied to the incoming signal. Use the *Scope* dialog to visualize the incoming signals. Gain should be set so that the signal reaches between 70% and 100% of the height of the display, generally obtained with a setting of 0 for GEOVision winches. If the peak height exceeds this level, clipping will result in artifacts which will be detected erroneously. Click *Apply* to set the parameters before proceeding to the *Scope* dialog.

- ***Threshold*** is the level at which the incoming signals are detected. Gain and Threshold are related, and can be visualized using the *Scope* dialog. Set the gain so that the signal reaches between 70% and 100% of the height of the display. Then adjust the threshold so that it is between 50% and 70% of the height of the pulses displayed and clear of any region of 'overshoot' of the positive and negative pulses. This will ensure that peaks are detected and noise is ignored. Generally a setting of 25 is used for GEOVision winches. When the scope dialog is displayed, the position of the mouse is reported as a threshold value to make it simpler to infer the correct setting. The scope option is greyed out when the probe power is turned off.

- ***Drive*** sets the strength of the downhole signal. It is not possible to visualize the downhole signal, but the effect of insufficient drive is to disable downhole communication, which will result in the commands being ignored by the sonde. Values range from 0 -127, and for GEOVision winches will be around 10. Increase the drive for longer cables.

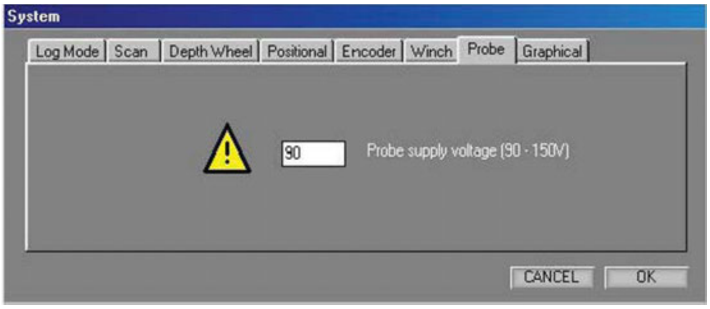
- ***Pulse Width*** This is the width of the transmitted communication pulses in 100nS steps. The default is 25 equivalent to 2.5uS. The range is from 8 to 64. The pulse width can be reduced to prevent signal overshoot on short cables. The default value is used in most cases. Note any changes only come into effect during a log. (Note setting too large a pulse width when using the highest Baud rates will automatically be prevented within the probe and the pulse width reduced.)

IMPORTANT Please note the effects of changing 'Baud' will not appear until the first new log is made. The setting for 'threshold' may be effected by an increase in the 'Baud' rate please recheck 'threshold' if 'Baud' is altered using the 'Scope' function after making a short test log.

The parameters which are entered will be applied automatically if you close the dialog with ***OK***. The above parameters once set correctly will be remembered by the system and should never need to be altered.

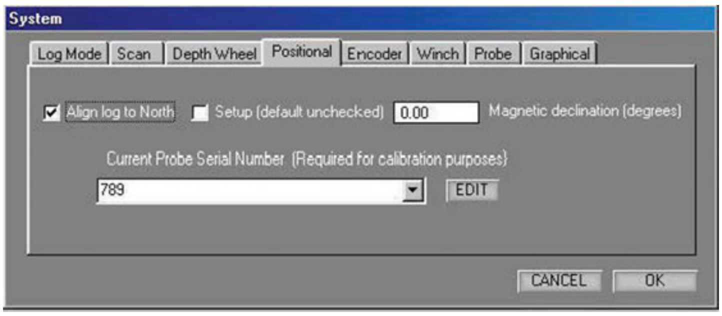
6.0 Probe Configuration

The probe is normally energized at 90 Volts from the surface. However, it may be necessary to compensate for voltage drop on longer cables due to the higher power draw of this sonde. The voltage at the surface may be increased in order to deliver 90 Volts at the sonde. Simply type the value into the text box provided. The voltage should be set at 90V for all GEOVision winches. Values outside the indicated range will be rejected.



7.0 Positional Configuration

The probe includes a 3-axis orientation package, and is capable of producing a borehole image aligned to geographic North. This is achieved by determining and applying two image rotation parameters:



- ***Magnetic Declination*** is used to correct for the difference between Magnetic North and True North. The value varies from place to place, so the local value must be inserted here if you wish to perform this correction during data collection. This correction may also be made during processing. If the value is zero, the log will be referred to Magnetic North.
- ***Align to North*** is a check-box used to select image rotation to start at Magnetic North. If in addition a value is set for Magnetic Declination (see above) the image will be rotated to start at True North. If the box is not checked, the image will not be oriented to geographic co-ordinates, but will use the local co-ordinate frame of the sonde (X, Y, Z axis of the orientation module). This mode may be used to inspect the inside of magnetic casing, where an orientated image would be subjected to random effects caused by the metalwork.
- Set-up mode is selected by checking the ***Setup*** box, and is used to determine the required image rotation offset to correct for the angle between the axis of the orientation package and the index mark of the rotating transducer section. In set-up mode the normal sonde azimuth display is modified, and will instead show the 'relative bearing' which is measured between the high side of the borehole and the orientation sensor index. Check ***Setup***, then OK to close the dialog. The icon adjacent to the sonde azimuth readout at the top of the screen is modified with the legend CAL when the system is in set-up mode. The sonde must now be placed in a stand or jig so that it

is inclined at about 20 degrees to the vertical, and adjacent to a target fixed to the jig so that it is directly above the transducer in the vertical plane. Lower the sonde with its attachment into a large bucket of water so that the transducer and target are fully immersed. Start the radial amplitude display, when it will be possible to see the strong signal returning from the target. Rotate the sonde so that the image of the target moves to the top of the display. When the two are coincident, the 'relative bearing' reads out the image rotation offset. This value is fixed for the sonde unless it is disassembled and rebuilt, at which point the procedure MUST be repeated. Please see the additional topic on the Radial Amplitude Display for further details.

- The ***Serial Number*** list box is used to select the sonde which is in use. When the appropriate sonde is selected, the image rotation offset determined by the above procedure is selected. To edit the image offset click the '***Edit***' and enter the new offset. Several serial numbers and associated offsets can be stored and selected as required.

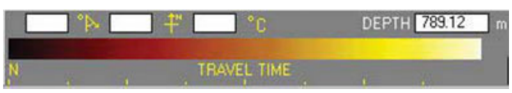
8.0 Graphical

The palette can be changed between a colored and grey scale setting. The changes affect the log screen palette display and are also applied when replaying a log. Selecting Full range in the 'AGC Palette' will cause the software to spread the palette over the full 16bit signal. 'Mid range' will spread the palette over the first quarter of the 16bit range and 'Low range' will spread the palette over the first eighth of the 16 bit range. In most cases the 'Low range' selection is used. Note these settings do not affect the stored log data in any way. The 'Filter Width' is applied to the Natural Gamma trace data and is a simply running average filter. The range of the filter width is from 1 to 50 (x 10 millidepth units ie. mm or mft).

9.0 Sonde Operation

When the operations specified above have been reviewed and the correct settings have been selected, the system is ready for use. The main screen area is divided into 3 horizontal elements. At the top is the depth and orientation readout, together with the scale headings for the scrolling display of unwrapped borehole image.

On the left side of the depth track is the travel time display, with text boxes for sonde inclination, azimuth and head temperature.



On the right side is the display of amplitude and indication of current operating mode. Located in the center above the depth track are the text boxes for depth and cable speed (computed at the surface). The ranges for the 'Natural Gamma' channel overlay (optional) are shown above the Amplitude.

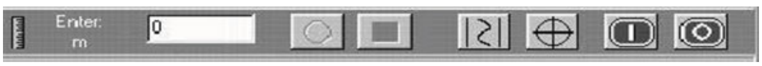
The central area is utilized for the scrolling display of unwrapped borehole data. The display is orientated with the left edge corresponding to North point of the aligned image data (if orientation is selected) according to the outputs of the sonde's orientation package.

The lower area has controls for the winch (applicable to RG Smart Winch only), depth initialization and sonde control.

The winch control area is only displayed when RG SmartWinch operation is enabled - see section 5 - and has four controls. Set Target Speed by typing the required speed into the window and pressing Enter.

Cable movement is initiated by clicking on either the UP or DOWN arrow control.

Cable movement is halted by clicking on the square STOP control.



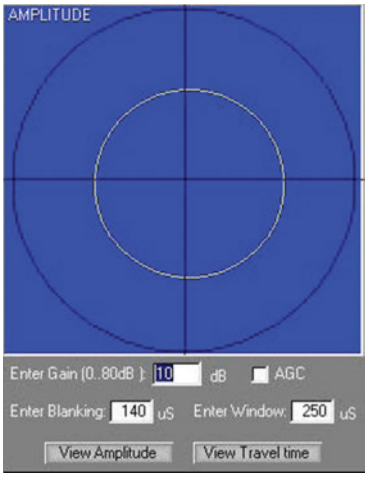
Depth is initialized by typing the required value into the entry box and pressing Enter. The entry box is not available at times when the system is in logging mode and the depth should not be changed by user entry.

Sonde power is applied by clicking on the green-colored 1 button. Power is turned off by clicking on the red-colored 0 button. There is no indicator for the state of the power supply on the desktop, so the external indicators should be observed for this purpose.

To make a log ensure that the Test Mode is disabled - see section 1, Log Mode setting. Click File|New Log and select a filename. Old logs may be overwritten if necessary -TAKE CARE. The header editor will be started automatically. A previous set of header data may be loaded by clicking LOAD and choosing a template.

To start logging, click on the red Record (circle) control. The log data will start to scroll down the screen after a brief pause for synchronization. The messages "DSP2: Detecting data stream" and "Updating probe settings" will be observed at the bottom of the screen during this process. Note that the screen scrolling direction is not affected by the actual direction of movement of the sonde. To cease logging, click on the black STOP control (square). The data should be immediately backed up to a USB drive, CD, or other data storage prior to beginning another log.

If the data display from a probe which is properly connected appears to occupy only half of the track area, with the remainder filled with random colors such as green which are not part of the regular palette, then it is most likely that the downhole data communication is not functioning properly. This symptom is due to the fact that the probe settings cannot be communicated properly, and it is operating in its default power-up mode. If this is the case, the Drive setting of the System|Winch dialog should be increased or decreased accordingly. See section 5 for full details.



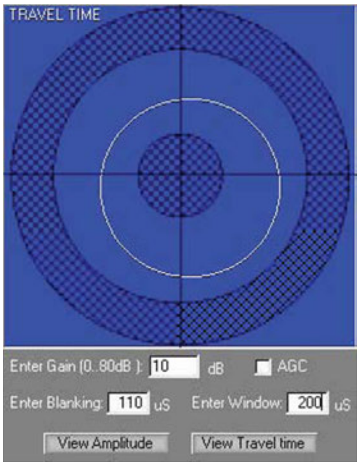
To adjust the sonde gain it is necessary to use the Radial Amplitude plot, which is enabled by clicking on the circle with cross-hairs symbol. When the dialog is active a new window will open on top of the unwrapped data display. In this display, the data is presented as a ‘polar’ plot. Press the ‘View Amplitude’ button to display the amplitude plot. This plot shows amplitude increasing towards the outside of the circle and the compass direction following the sweep of the transducer. The line indicating the data is drawn in the regular palette, so that high amplitudes are drawn in white and low amplitudes in black/brown. The picture here shows the image of the inside of a cylinder.

If the data is concentrated in a small circle at the center, the gain is too low and should be increased. If the data is obviously clipped at the outside of the circle, then the gain should be reduced. Type the new gain value into the entry box and press Enter. The ideal would be to set a gain value which allows the peak values to be displayed without clipping, with the majority of the data around the half-way level. It may also be necessary to adjust the blanking to ensure that internal reflections from the acoustic housing are not detected at the new gain value. This will be apparent in the unwrapped data display as pronounced patterning unrelated to the true target. The AGC option causes the probe to set gain automatically thus preventing signal saturation in most cases. (The gain is varied in 6dB steps

Blanking Period and window length can be set independently. Blanking is set to avoid reflections from the housing of the acoustic transducer or random reflections from a rugose borehole, and window length is set to accommodate the range of borehole radius that might be expected. An error will be indicated if the sum of the blanking period and window length would be greater than 409 microseconds, which is the maximum range of the timer. The default value for the blanking period is 145 microseconds, which is the minimum required for the two-way transit from the transceiver to the outer surface of the acoustic housing. It is not advisable to reduce this value beyond the default setting, although it may be increased for larger boreholes at the rate of 1.5mm of one-way travel per microsecond.

Window Length (sample time) defines the period during which the arrival gate remains open to detect the returned acoustic pulse. The acoustic pulse will travel in water at a speed of approximately 1.5mm per microsecond. The default window length is 150 microseconds, which is equivalent to 225 mm of (two-way) travel in the borehole fluid, or approximately 110mm of borehole diameter. If this is added to the default blanking period, which is equivalent to the outside diameter of the acoustic housing, it can be seen that the default set-up will be correct for boreholes up to 150mm. An error will be indicated if the sum of the blanking period and window length would be greater than 409 microseconds, which is the maximum range of the timer. Choose your window setting to best match the borehole diameter.

Pressing the ‘View Travel time’ button changes the display to that shown below:



The unhatched ring between the two cross hatched zones represents the sample window. The width of this ring will vary with window length value. The profile of a cylinder is represented here appearing as a circle in the sample window.

Pressing this button displays the following dialog box:

This box allows you to enable the Natural Gamma option by checking the ‘Enable Overlay’ check box. The Overlay appears as a trace upon the Amplitude plot. The trace range and color can also be set by this dialog. The level of filtering can also be altered (see section 8) (note that any displayed trace data is automatically aligned with the acoustic scan data but only when logging up. The Natural Gamma sensor occupies a higher position in the probe so sufficient data has to be prebuffered so that the acoustic data can depth aligned with gamma. The prebuffering results in a delay at the start of a log before correct gamma data appears this is normal.)

Data Analysis and Interpretation

RG-DIP, the manufacturer’s image interpretation package, offers manual and automatic feature recognition options. Feature orientations (dip/strike and azimuth) are automatically calculated. Display options include stereographic projections of zone axes, orientation frequency plots and 'synthetic cores' for comparison with real core data. The last option is invaluable for orientating core samples, particularly in the case of incomplete recovery.

Reporting

The final report will include the objective and scope of the survey, location of the boreholes, discussion of instrumentation and procedures in the field and lab. For each borehole there will be a plot showing the dip/strike and azimuth of features. The next page shows an example.

Assumptions and limitations of the results will be discussed. Supporting references will be listed as necessary

Required Field Records

Field log for each borehole showing

a) Location and description of the borehole

b) Date of test

c) Field personnel

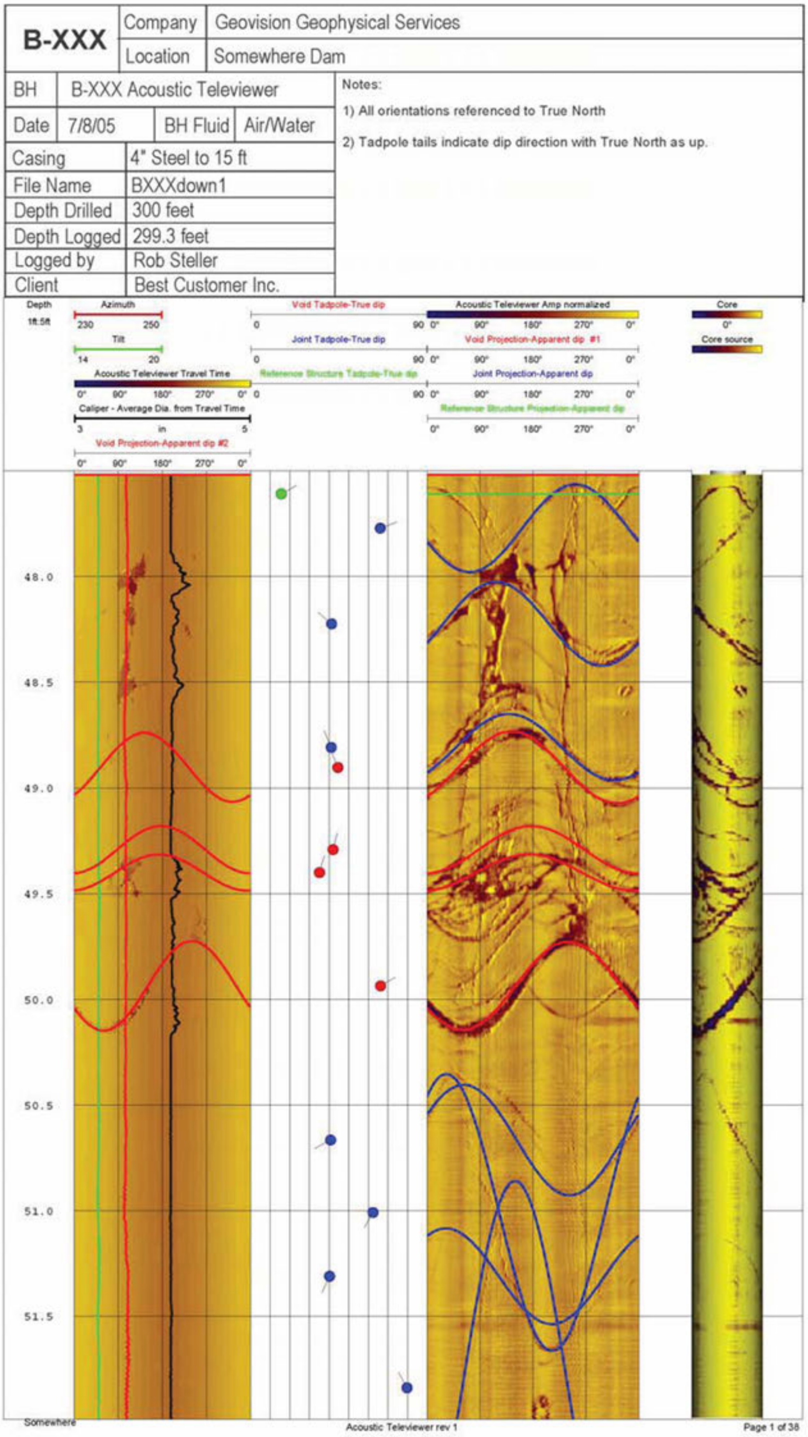
d) Instrumentation

e) Any deviations from test plan and action taken as a result

This procedure has been reviewed and approved by the undersigned:

Professional Geophysicist Antony J Martin Date Feb 13. 2006

QA Review ________ Date Feb 13. 2006


B-XXX
Company
Geovision Geophysical Services
Location
Somewhere Dam
BH
B-XXX Acoustic Televiewer
Date
7/8/05
BH Fluid
Air/Water
Casing
4" Steel to 15 ft
File Name
BXXXdown1
Depth Drilled
300 feet
Depth Logged
299.3 feet
Logged by
Rob Steller
Client
Best Customer Inc.
Notes:
1) All orientations referenced to True North
2) Tadpole tails indicate dip direction with True North as up.
Depth
Azimuth
Tilt
Acoustic Televiewer Travel Time
Caliper - Average Dia. from Travel Time
Void Projection-Apparent dip #2
Void Tadpole-True dip
Joint Tadpole-True dip
Reference Structure Tadpole-True dip
Acoustic Televiewer Amp normalized
Void Projection-Apparent dip #1
Joint Projection-Apparent dip
Reference Structure Projection-Apparent dip
Core
Core source
48.0
48.5
49.0
49.5
50.0
50.5
51.0
51.5
Somewhere
Acoustic Televiewer rev 1
Page 1 of 38

PROCEDURE FOR

OYO P-S SUSPENSION SEISMIC VELOCITY LOGGING

Procedure Reviewed by MACTEC and approved for use on North Anna 3 Project
[signature] Principal Professional 8-17-09

Background

This procedure describes a method for measuring shear and compressional wave velocities in soil and rock. The OYO P-S Suspension Method is applied by generating shear and compressional waves in a borehole using the OYO P-S Suspension Logger borehole tool and measuring the travel time between two receiver geophones or hydrophones located in the same tool.

Objective

The outcome of this procedure is a plot and table of P and S_H wave velocity versus depth for each borehole. Standard analysis is performed on receiver to receiver data. Processed data is presented in report format, and transmitted in Excel, Word or ASCII format.

Instrumentation

1. OYO Model 170 Digital Logging Recorder, Robertson Model 3403 Digital Telemetry, or equivalent
2. OYO P-S Suspension Logger probe or equivalent, including two sets horizontal and vertical geophones or hydrophones (hereafter referred to simply as "geophones"), seismic source, and power supply for the source and receivers
3. Winch and winch controller, with logging cable
4. Batteries to operate P-S Logger and winch

The Suspension P-S Logger system, manufactured by OYO Corporation, or the Robertson Digital P-S Suspension Probe with the Robertson Micrologger2 are currently the only commercially available suspension logging systems. As shown in Figure 1, these systems consists of a borehole probe suspended by a cable and a recording/control electronics package on the surface.

The suspension system probe consists of a combined reversible polarity solenoid horizontal shear-wave generator (S_H) and compressional-wave generator (P), joined to two biaxial geophones by a flexible isolation cylinder. The separation of the two geophones is one meter, allowing average wave velocity in the region between the geophones to be determined by inversion of the wave travel time between the two geophones. The total length of the probe is approximately 7 meters; the center point of the geophones is approximately 4 meters above the bottom end of the probe.

The probe receives control signals from, and sends the amplified geophone signals to, the instrumentation package on the surface via an armored 4 or 7 conductor cable. The cable is wound onto the drum of a winch and is used to support the probe. Cable travel is measured by a rotary encoder to provide probe depth data.

The entire probe is suspended by the cable and may be centered in the borehole by nylon "whiskers." Therefore, source motion is not coupled directly to the borehole walls; rather, the source motion creates a horizontally propagating pressure wave in the fluid filling the borehole and surrounding the source. This pressure wave produces a horizontal displacement of the soil forming the wall of the borehole. This displacement propagates up and down the borehole wall, in turn causing a pressure wave to be generated in the fluid surrounding the geophones as the soil displacement wave passes their location.

Environmental Conditions

The OYO P-S Suspension Logging Method can be used in either cased or uncased boreholes. For best results, the uncased borehole must be between 10 and 20 cm in diameter, or 4 to 8 inches. A cased borehole may be as small as 3 inches, if properly grouted (see below). The grout annulus may be up to 2 inches for a 4 inch casing. A smaller annulus is preferred for 3 inch casing.

Uncased boreholes are preferred because the effects of the casing and grouting are removed. It is recommended that the borehole be drilled using the rotary mud method. This method does little damage to the borehole wall, and the drilling fluid coats and seals the borehole wall reducing fluid loss and wall collapse. The borehole fluid is required for the logging, and must be well circulated prior to logging.

If the borehole must be cased, the casing must be PVC and properly installed and grouted. Any voids in the grout will cause problems with the data. Likewise, large grout bulbs used to fill cavities will also cause problems. The grout must be set before testing. This means the grouting must take place at least 48 hours before testing.

For borehole casing, applicable preparation procedures are presented in ASTM Standard D4428/D4428M-91 Section 4.1 (see ASTM website for copy).

Calibration

Calibration of the digital recorder is required. Calibration is limited to the timing accuracy of the recorder. GEOVision's "Suspension PS Logger Calibration Procedure" or equivalent should be used. Calibration must be performed on an annual basis.

Measurement Procedure

The entire probe is lowered into the borehole to a specific measurement depth by the winch. A measurement sequence is then initiated by the operator from the instrumentation package control panel. No further operator intervention is then needed to complete the measurement sequence described below.

The system electronics activates the SH-wave source in one direction and records the output of the two horizontally oriented geophone axes which are situated parallel to the axis of motion of the source. The source is then activated in the opposite direction, and the horizontal output signals are again recorded, producing a SH-wave record of polarity opposite to the previous record. The source is finally actuated in the first direction again, and the responses of the vertical geophone axes to the resultant P-wave are recorded during this sampling.

The data from each geophone during each source activation is recorded as a different channel on the recording system. The seismograph has at least six channels (two simultaneous recording channels), each with at least a 12 bit 1024 sample record. Newer seismographs may have longer record lengths. The recorded data is displayed on a CRT or LCD display as six channels with a common time scale. Data is stored on digital media for further processing. Up to 8 sampling sequences can be stacked (averaged) to improve the signal to noise ratio of the signals.

Review of the data on the display allows the operator to set the gains, filters, delay time, pulse length (energy), sample rate, and stacking number in order to optimize the quality of the data before recording. Digital media should be verified from time-to-time by opening saved files (at least one) and viewing stored data. This should also be done on transferred or back-up files (see item 2 under required Field Records).

Typical depth spacing for measurements is 1.0 meters, or 3.3 feet. Alternative spacing is 0.5 meter, or 1.6 feet.

Required Field Records

1) Field log for each borehole showing
   a) Borehole identification
   b) Date of test
   c) Tester or data recorder
   d) Description of measurement
   e) Any deviations from test plan and action taken as a result
2) Data must be stored in at least 2 places, such as the laptop hard disk and CDRom, or hard disk and USB flash drive, or uploaded to FTP, prior to leaving the site.

3) List of record ID numbers (for data on digital media) and corresponding depth

4) All removable digital media, such as CDRoms or USB flash drives with backup copies of data on hard disk, must be "labeled" with job number, borehole designation, record ID number range, date, and tester name. For USB flash drives or hard disks on separate computers, the "label" can be a .txt file with this information, or even a PSLOG .sps file with preliminary information stored. File directories should have job number, project name and borehole name.

An example Field Log is attached to this procedure.

Analysis

Following completion of field work, the recorded digital records are processed by computer using the OYO Corporation software program PSLOG and interactively analyzed by an experienced geophysicist to produce plots and tables of P and S_H wave velocity versus depth.

The digital time series records from each depth are transferred to a personal computer for analysis. Figure 2 shows a sample of the data from a single depth. These digital records are analyzed to locate the first minima on the vertical axis records, indicating the arrival of P-wave energy. The difference in travel time between these arrivals is used to calculate the P-wave velocity for that 1-meter interval. When observable, P-wave arrivals on the horizontal axis records are used to verify the velocities determined from the vertical axis data. In addition, the soil velocity calculated from the travel time from source to first receiver is compared to the velocity derived from the travel time between receivers.

The digital records are studied to establish the presence of clear SH-wave pulses, as indicated by the presence of opposite polarity pulses on each pair of horizontal records. Ideally, the SH-wave signals from the 'normal' and 'reverse' source pulses are very nearly inverted images of each other. Digital FFT – IFFT lowpass filtering may be used to remove the higher frequency P-wave signal from the SH-wave signal.

The first maxima are picked for the 'normal' signals and the first minima are picked for the 'reverse' signals. The absolute arrival time of the 'normal' and 'reverse' signals may vary by +/- 0.2 milliseconds, due to differences in actuation time of the solenoid source caused by constant mechanical bias in the source or by borehole inclination. This variation does not affect the velocity determinations, as the differential time is measured between arrivals of waves created by the same source actuation. The final velocity value is the average of the values obtained from the 'normal' and 'reverse' source actuations.

In Figure 2, the time difference over the 1-meter interval of 1.70 millisecond is equivalent to a SH-wave velocity of 588 m/sec. Whenever possible, time differences are determined from several phase points on the S_H -wave pulse trains to verify the data obtained from the first arrival of the S_H -wave pulse. In addition, the soil velocity calculated from the travel time from source to first receiver is compared to the velocity derived from the travel time between receivers.

Figure 3 is a sample composite plot of the far normal horizontal geophone records for a range of depths. This plot shows the waveforms at each depth, clearly showing the S-wave arrivals. This display format is used during analysis to observe trends in velocity with changing depth.

Once the proper picks are entered in PSLOG, the picks are transferred to an Excel spreadsheet where Vs and Vp are calculated. The spreadsheet allows output for presentation in charts and tables.

Standard analysis is performed on receiver 1 to receiver 2 data, with separate analysis performed on source to receiver data as a quality assurance procedure.

Registered Geophysicist________ Date 5/20/09

QA Review________ Date 5/20/09

References:

1. "In Situ P and S Wave Velocity Measurement", Ohya, S. 1986. Proceedings of In-Situ '86, *Use of In-Situ Tests In Geotechnical Engineering*, an ASCE Specialty Conference sponsored by the Geotechnical Engineering Division of ASCE and co-sponsored by the Civil Engineering Dept of Virginia Tech.

2. Guidelines for Determining Design Basis Ground Motions, Report TR-102293, Electric Power Research Institute, Palo Alto, California, November 1993, Sections 7 and 8.

3. "Standard test Methods for Crosshole Seismic Testing", ASTM Standard D4428/D4428M-07, approved July 1, 2007.

OYO SUSPENSION P-S VELOCITY LOGGING SETUP

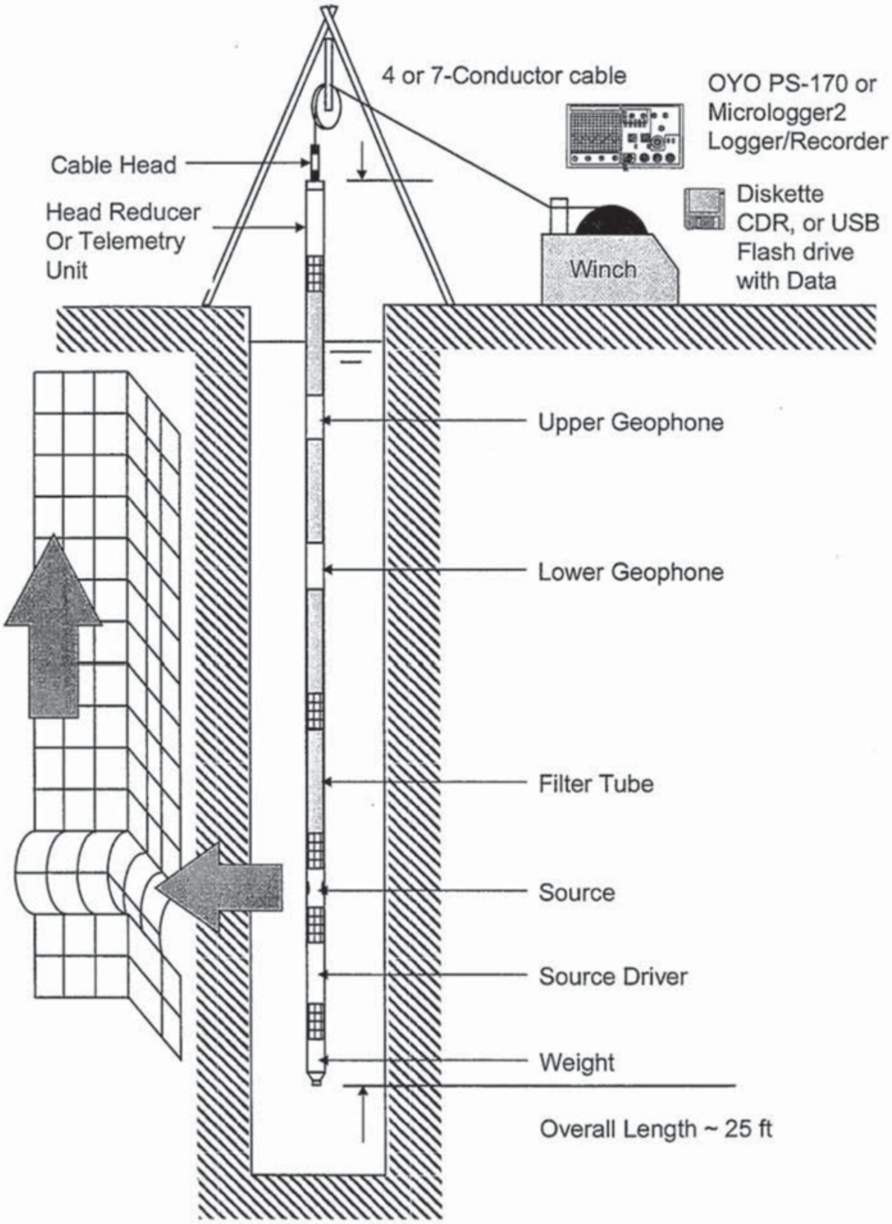


Figure 1. Suspension PS logging method setup

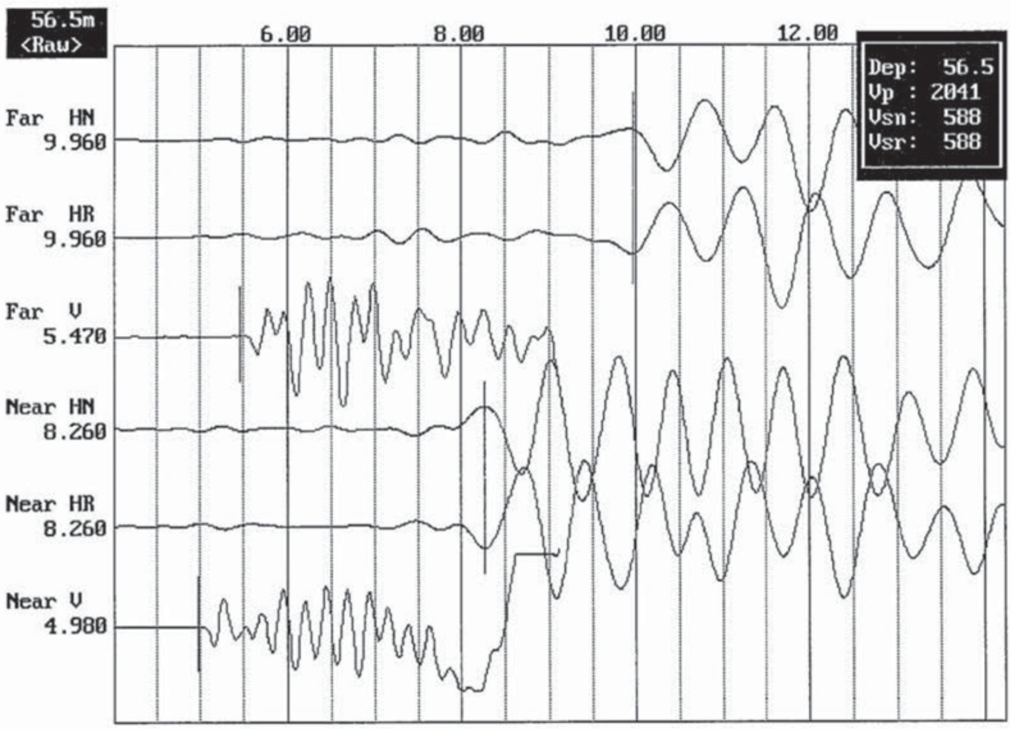


Figure 2. Sample suspension method waveform data showing horizontal normal and reversed (HR and HN), and vertical (V) waveforms received at the near (bottom 3 channels) and far (top 3 channels) geophones. The arrivals in milliseconds for each pick are shown on the left. The box in the upper right corner shows the depth in the borehole and the velocities calculated based on the picks.

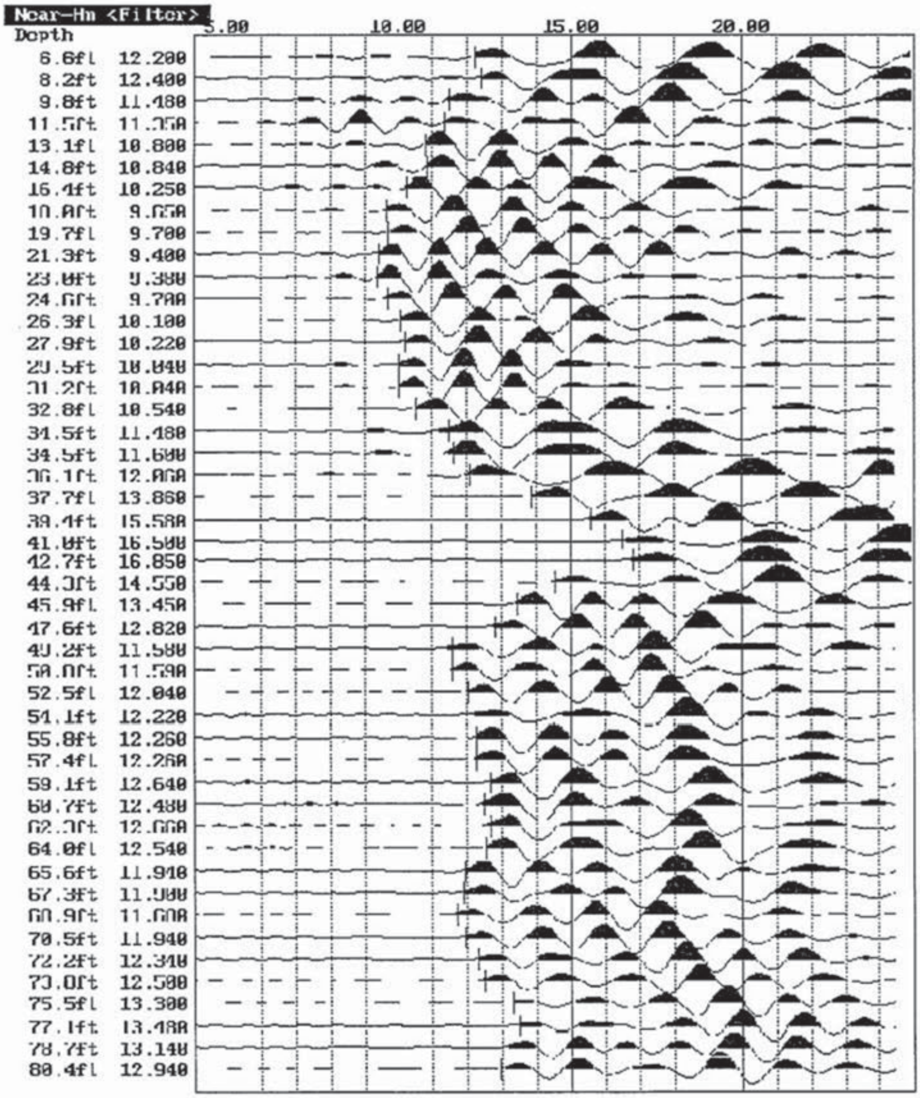


Figure 3. Sample composite waveform plot for normal shear waves received at the near geophone in a single borehole

P-S FIELD LOG REV V1.4

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______ P-S SUSPENSION VELOCITY FIELD LOG REV 1.4

Borehole

CORRESPONDING P-S SUSPENSION PROCEDURE REV 1.4.

SITE*: ______ DATE*: ______
CLIENT*: ______ JOB*: ______
AUTHOR*: ______ PAGE 1 OF * ______

CONTACT: ______ PHONE: Off Cell ______

CONTACT: ______ PHONE: Off Cell ______

CONTACT: ______ PHONE: Off Cell ______

CONTACT: ______ PHONE: Off Cell ______

DIRECTIONS TO SITE: ______

GENERAL SITE CONDITIONS/LOCATION: ______

COUNTY: ______ RANGE: ______ TOWNSHIP: ______ SECTION: ______
BOREHOLE CONSTRUCTION*: CASED ______ UNCASED ______
DIAMETERS AND DEPTH RANGES*: ______ 0 TO ______ ; ______, ______ TO ______
BOREHOLE TOTAL DEPTH AS DRILLED*: ______
SURFACE CASING?: ______ DEPTH TO BOTTOM OF CASING______; NO______
DEPTH TO BEDROCK: ______ DEPTH TO WATER TABLE: ______
BOREHOLE FLUID: WATER_____; FRESH WATER MUD_____; SALT WATER MUD; ______
OTHER: ______
DEPTH TO BOREHOLE FLUID*: ______ TIME SINCE LAST CIRCULATION: ______

*ITEMS WITH * MUST BE COMPLETED. OTHER INFORMATION IS OPTIONAL*

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P-S FIELD LOG REV V1.4

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_________P-S SUSPENSION VELOCITY FIELD LOG REV 1.4

Borehole

CORRESPONDING P-S SUSPENSION PROCEDURE REV 1.4.

SITE*: ______________________ DATE*: ______________
CLIENT*: ______________________ JOB*: ______________
AUTHOR*: ______________________ PAGE 2 OF * _________

LOGGING CREW*: ______________________
MOBILIZED FROM: ______________ DEPARTURE TIME: ______________
ARRIVED ON SITE: ______________
STANDBY TIME: ______________ CAUSE: ______________
LOGGING STARTED: ______________ LOGGING COMPLETED: ______________

BATTERIES CHANGED BEFORE LOGGING: YES_____; NO_____; STORED WITH NEW_____
WINCH COMPROBE ☐ GREY ☐ OYO ☐ RG ☐ OTH ______
INSTRUMENT* OYO 12004 ☐ 15014 ☐ 19029 ☐ RG 160023 ☐ 160024 ☐
RECEIVER S/N* 12008 ☐ 20042 ☐ 26066 ☐ 11001 ☐ 23053 ☐ 30086 ☐
ISOLATION TUBE S/N* 300083 ☐ 24053 ☐ 28068 ☐ 28072 ☐ 2M __________
SHEAVE* COMPROBE ☐ OYO 101 ☐ 102 ☐ 103 ☐ RG ☐
MICROLOGGER* 5310 ☐ 5772 ☐ NOT APPLICABLE (OYO) ☐
PROBE OFFSET* OYO 2.0M ☐ RG 2.5M ☐
MINUS CASING STICK-UP* ________
DEPTH REF. OFFSET AT START* ________
DEPTH REF. OFFSET AT END* ________
AFTER SURVEY DEPTH ERROR* ________
REF TO GROUND SURFACE

LOG NAME*	START DEPTH*	START TIME	END DEPTH *	END TIME

MAINTENANCE PERFORMED ON SITE*: ______________ (N/A if none)

EQUIPMENT PROBLEMS OR FAILURES*: ______________ (N/A if none)

DEVIATIONS FROM TEST PLAN*: ______________ (N/A if none)

*ITEMS WITH * MUST BE COMPLETED. OTHER INFORMATION IS OPTIONAL*

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P-S FIELD LOG REV 1.4

__________GEOVISION SUSPENSION LOGGING FIELD NOTES

SITE*:______________________________ DATE*:______________
CLIENT*:____________________________ JOB*:______________
AUTHOR*:____________________________ PAGE*________OF________

*ITEMS WITH * MUST BE COMPLETED. OTHER INFORMATION IS OPTIONAL*

DEPTH METERS	DEPTH FEET	UNFILTERED FILE NO*.	FILTERED FILE NO*. (if any)	COMMENTS CASING, WATER, ROCK, ETC
0.5	1.64			
1.0	3.28			
1.5	4.92			
2.0	6.56			
2.5	8.20			
3.0	9.84			
3.5	11.48			
4.0	13.12			
4.5	14.76			
5.0	16.40			
5.5	18.04			
6.0	19.69			
6.5	21.33			
7.0	22.97			
7.5	24.61			
8.0	26.25			
8.5	27.89			
9.0	29.53			
9.5	31.17			
10.0	32.81			
10.5	34.45			
11.0	36.09			
11.5	37.73			
12.0	39.37			
12.5	41.01			
13.0	42.65			
13.5	44.29			
14.0	45.93			
14.5	47.57			
15.0	49.21			
15.5	50.85			
16.0	52.49			
16.5	54.13			
17.0	55.77			
17.5	57.41			
18.0	59.06			
18.5	60.70			
19.0	62.34			
19.5	63.98			
20.0	65.62			

ACOUSTIC TELEVIEWER LOG FORM 1.1.pdf

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________ACOUSTIC TELEVIEWER FIELD LOG Rev 1.1

Borehole* GEOVISION HI-RES ACOUSTIC TELEVIEWER PROCEDURE V1.0

SITE*:______________________ DATE*:__________
CLIENT*:____________________ JOB*:___________
AUTHOR*:____________________ PAGE 1 OF 2
REVIEWER:________ (post field work)

CONTACT:______________ PHONE: Off Cell__________

CONTACT:______________ PHONE: Off Cell__________

DRILLER ______________ PHONE: Off Cell__________
COMPANY:______________

GENERAL SITE CONDITIONS/LOCATION:______________________
____
____
____

COUNTY:__________RANGE:________TOWNSHIP:________SECTION:______
BOREHOLE CONSTRUCTION: CASED_____ UNCASED______
DIAMETERS AND DEPTH RANGES: _______ 0 TO _________ ; ______, _______ TO ________

BOREHOLE TOTAL DEPTH AS DRILLED*:______________

SURFACE CASING?: YES____ DEPTH TO BOTTOM OF CASING______; NO____
DEPTH TO BEDROCK:________ DEPTH TO WATER TABLE:_________
BOREHOLE FLUID: WATER____; FRESH WATER MUD____; SALT WATER MUD _____;
OTHER:______________________________
DEPTH TO BOREHOLE FLUID:_________ TIME SINCE LAST CIRCULATION:_________

LOGGING CREW:______________________________
VEHICLE(S) USED AND MILEAGE: ____________________
MOBILIZED FROM:______________ DEPARTURE TIME:______________
ARRIVED ON SITE:______________
STANDBY TIME:______________ CAUSE:______________

*ITEMS WITH * MUST BE COMPLETED. OTHER INFORMATION IS OPTIONAL*

Approved by MACTEC for use on North Anna 3 project

D. Stoner Copley
PRINCIPAL PROFESSIONAL
8-20-09

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ACOUSTIC TELEVIEWER LOG FORM 1.1.pdf

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______ ACOUSTIC TELEVIEWER FIELD LOG Rev 1.1

Borehole*

GEOVISION HI-RES ACOUSTIC TELEVIEWER PROCEDURE V1.0

SITE*: ______ DATE*: ______
CLIENT*: ______ JOB*: ______
AUTHOR*: ______ PAGE 2 OF 2
REVIEWER: ______ (post field work)

WINCH: COMPROBE____ SILVER____ OYO____ OTHER______
MICROLOGGER* 5310___ 5772______
TELEVIEWER* ACOUSTIC #5174____ OTHER______
SHEAVE* COMPROBE____ OYO 101____ 102____ 103____ RG______

PROBE TILT TEST* ______ BRUNTON TILT* ______
PROBE TILT TEST* ______ BRUNTON TILT* ______
PROBE TILT TEST* ______ BRUNTON TILT* ______ AFTER LOG* ______
PROBE AZIMUTH TEST* ______ BRUNTON AZIMUTH* ______
PROBE AZIMUTH TEST* ______ BRUNTON AZIMUTH* ______
PROBE AZIMUTH TEST* ______ BRUNTON AZIMUTH* ______ AFTER LOG* ______

PROBE OFFSET* 1.44M(4.72FT)
MINUS CASING STICK-UP* ______
DEPTH REF. OFFSET AT START* ______ } REF TO GROUND SURFACE
DEPTH REF. OFFSET AT END* ______
AFTER SURVEY DEPTH ERROR* ______

LOG NAME*	START DEPTH*	START TIME	END DEPTH *	END TIME

MAINTENANCE PERFORMED ON SITE*: ______ (N/A if none)

______

______

DEVIATION FROM PROCEDURE (IF ANY) OR EQUIPMENT PROBLEMS OR FAILURES* (N/A if none)

______

______

______

______

*ITEMS WITH * MUST BE COMPLETED. OTHER INFORMATION IS OPTIONAL*

Approved by MACTEC for use on North Anna 3 project

D. Agner Copley
Principal Professional
8-20-09

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GEOVision geophysical services

CALIPER FIELD LOG REV 1.2.PDF

CALIPER FIELD LOG

Procedure ASTM D6167-97(2004)

____________ Borehole*

SITE*: ____________ DATE*: ____________
CLIENT*: ____________ JOB*: ____________
AUTHOR*: ____________ PAGE: 1 OF 2

CONTACT: ____________ PHONE: Off Cell ____________

CONTACT: ____________ PHONE: Off Cell ____________

CONTACT: ____________ PHONE: Off Cell ____________

DRILLER ____________ PHONE: Off Cell ____________
COMPANY: ____________

GENERAL SITE CONDITIONS/LOCATION: ____________

COUNTY:________ RANGE:________ TOWNSHIP:________ SECTION:______
BOREHOLE CONSTRUCTION: CASED_____ UNCASED______
DIAMETERS AND DEPTH RANGES: ______ 0 TO ________ ; ______, _______ TO ________

BOREHOLE TOTAL DEPTH AS DRILLED*:________

SURFACE CASING?: YES____ DEPTH TO BOTTOM OF CASING_______; NO____
DEPTH TO BEDROCK:________ DEPTH TO WATER TABLE:_________
BOREHOLE FLUID: WATER____; FRESH WATER MUD_____; SALT WATER MUD _____;
OTHER:____________
DEPTH TO BOREHOLE FLUID:__________ TIME SINCE LAST CIRCULATION:__________

LOGGING CREW:____________
VEHICLE(S) USED AND MILEAGE: ____________
MOBILIZED FROM:____________ DEPARTURE TIME:____________
ARRIVED ON SITE:____________
STANDBY TIME:____________ CAUSE:____________

*ITEMS WITH * MUST BE COMPLETED. OTHER INFORMATION IS OPTIONAL*

Approved by MACTEC for use on North Anna 3 project

D. Steven Copley
Principal Professional
8-20-09

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Page 55 of 66
DCN# NAP135

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CALIPER FIELD LOG REV 1.2.PDF

CALIPER FIELD LOG

Borehole*

Procedure ASTM D6167-97(2004)

SITE*: ______ DATE*: ______
CLIENT*: ______ JOB*: ______
AUTHOR*: ______ PAGE: PAGE 2 OF 2

WINCH: COMPROBE____ SILVER____ OYO____ RG________ OTHER________
MICROLOGGER* 5310 ☐ 5772 ☐ OTHER ______
CALIPER PROBE* 5368 ☐ OTHER ______
SHEAVE* COMPROBE ☐ OYO 101 ☐ 102 ☐ 103 ☐ RG ☐

PROBE OFFSET	2.08M(6.82 FT)	12 IN MAX
MINUS CASING STICK-UP*	______	REF TO GROUND SURFACE
DEPTH REF. OFFSET AT START*	______	
DEPTH REF. OFFSET AT END*	______	
AFTER SURVEY DEPTH ERROR*	______	

LOG NAME*	START DEPTH*	START TIME*	END DEPTH*	END TIME*

CALIBRATION PLATE S/N 201

		AS BUILT			PVC FITTING
		1.968 IN	3.937 IN	8.000 IN	4.504 IN
	FILE NAME	(50 MM)	(100 MM)	(203.2 MM)	(114.4 MM)
AS MEAS.*					
AS MEAS.*					
AS MEAS.					
AS MEAS.					
AS MEAS.					
AS MEAS.					

MAINTENANCE PERFORMED ON SITE*: ______ (N/A if none)

EQUIPMENT PROBLEMS OR FAILURES*: ______ (N/A if none)

SUGGESTIONS, ADDITIONS, CHANGES: ______

*ITEMS WITH * MUST BE COMPLETED. OTHER INFORMATION IS OPTIONAL*

Approved by MACTEC for use on North Anna 3 project

D. Steven Copley
Principal Professional
8-20-09

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ELOG FIELD LOG REV 1.1a

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______________ ELOG FIELD LOG
Borehole*

SITE*: ____________________ DATE*: ____________________
CLIENT*: ____________________ JOB*: ____________________
AUTHOR*: ____________________ PAGE: 1 OF 2

CONTACT: ____________________ PHONE: Off Cell ____________________

CONTACT: ____________________ PHONE: Off Cell ____________________

CONTACT: ____________________ PHONE: Off Cell ____________________

CONTACT: ____________________ PHONE: Off Cell ____________________
COMPANY: ____________________

GENERAL SITE CONDITIONS/LOCATION: ____________________

COUNTY: ________ RANGE: ________ TOWNSHIP: ________ SECTION: ______
BOREHOLE CONSTRUCTION: CASED_____ UNCASED______
DIAMETERS AND DEPTH RANGES: _______ 0 TO _________ ; ______, _______ TO ________

BOREHOLE TOTAL DEPTH AS DRILLED*: ____________

SURFACE CASING?: YES____ DEPTH TO BOTTOM OF CASING_______; NO____
DEPTH TO BEDROCK: ________ DEPTH TO WATER TABLE: _________
BOREHOLE FLUID: WATER_____; FRESH WATER MUD_____; SALT WATER MUD _____;
OTHER: ____________________
DEPTH TO BOREHOLE FLUID: __________ TIME SINCE LAST CIRCULATION: __________

LOGGING CREW: ____________________
VEHICLE(S) USED AND MILEAGE: ____________________
MOBILIZED FROM: ____________________ DEPARTURE TIME: ____________________
ARRIVED ON SITE: ____________________
STANDBY TIME: ____________________ CAUSE: ____________________

*ITEMS WITH * MUST BE COMPLETED. OTHER INFORMATION IS OPTIONAL*

Approved by MACTEC for use on North Anna 3 project

D. Steven Copley
Principal Professional
8-20-09

GEOVision Geophysical Services *1124 Olympic Drive, Corona, CA 92881* *Ph (951) 549-1234 Fx (951) 549-1236*

ELOG FIELD LOG REV 1.1a

GEOVision
geophysical services

______________ ELOG FIELD LOG
Borehole*

SITE*: ______________ DATE*: ______________
CLIENT*: ______________ JOB*: ______________
AUTHOR*: ______________ PAGE: PAGE 2 OF 2

WINCH: COMPROBE____ SILVER____ OYO____ RG________ OTHER________
MICROLOGGER* 5310 ☐ 5772 ☐ OTHER ______________
ELOG PROBE* 5490 ☐ OTHER ______________
SHEAVE* COMPROBE ☐ OYO 101☐ 102☐ 103☐ RG☐

PROBE LENGTH	2.50M(8.20 FT)	
PLUS YOKE 10.0M (32.8 FT)*	______	
MINUS CASING STICK-UP*	______	REF TO GROUND SURFACE
DEPTH REF. OFFSET AT START*	______	
DEPTH REF. OFFSET AT END*	______	
AFTER SURVEY DEPTH ERROR*	______	

LOG NAME*	START DEPTH*	START TIME	END DEPTH*	END TIME

MAINTENANCE PERFORMED ON SITE*: ______________ (N/A if none)

EQUIPMENT PROBLEMS OR FAILURES*: ______________ (N/A if none)

SUGGESTIONS, ADDITIONS, CHANGES: ______________

*ITEMS WITH * MUST BE COMPLETED. OTHER INFORMATION IS OPTIONAL*

Approved by MACTEC for use on North Anna 3 project

D. Steven Copley
Principal Professional
8-20-09

GEOVision Geophysical Services 1124 Olympic Drive, Corona, CA 92881 Ph (951) 549-1234 Fx (951) 549-1236

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DCN# NAP135

INDUCTION FIELD LOG REV 1.1b.PDF

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________________INDUCTION FIELD LOG

Borehole*

SITE*: ______________________ DATE*: ______________________
CLIENT*: ______________________ JOB*: ______________________
AUTHOR*: ______________________ PAGE: 1 OF 2

CONTACT: ______________________ PHONE: Off Cell ______________________

CONTACT: ______________________ PHONE: Off Cell ______________________

CONTACT: ______________________ PHONE: Off Cell ______________________

DRILLER ______________________ PHONE: Off Cell ______________________
COMPANY: ______________________

GENERAL SITE CONDITIONS/LOCATION: ______________________

COUNTY: ____________ RANGE: ________ TOWNSHIP: __________ SECTION: ______
BOREHOLE CONSTRUCTION: CASED_____ UNCASED______
DIAMETERS AND DEPTH RANGES: _______ 0 TO _________ ; ______, _______ TO ________

BOREHOLE TOTAL DEPTH AS DRILLED*: ______________

SURFACE CASING?: YES____ DEPTH TO BOTTOM OF CASING_______; NO____
DEPTH TO BEDROCK: ________ DEPTH TO WATER TABLE: _________
BOREHOLE FLUID: WATER_____; FRESH WATER MUD_____; SALT WATER MUD _____;
OTHER: ______________________
DEPTH TO BOREHOLE FLUID: _________ TIME SINCE LAST CIRCULATION: _________

LOGGING CREW: ______________________
VEHICLE(S) USED AND MILEAGE: ______________________
MOBILIZED FROM: ______________________ DEPARTURE TIME: ______________________
ARRIVED ON SITE: ______________________
STANDBY TIME: ______________________ CAUSE: ______________________

*ITEMS WITH * MUST BE COMPLETED. OTHER INFORMATION IS OPTIONAL*

Approved by MACTEC for use on North Anna 3 project

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8-20-09

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DCN# NAP135

INDUCTION FIELD LOG REV 1.1b.PDF

GEOVision geophysical services

______ INDUCTION FIELD LOG
Borehole*

SITE*: ______ DATE*: ______
CLIENT*: ______ JOB*: ______
AUTHOR*: ______ PAGE: PAGE 2 OF 2

WINCH: COMPROBE___ SILVER___ OYO___ RG___ OTHER___
MICROLOGGER* 5310 ☐ 5772 ☐ OTHER ______
INDUCTION PROBE* 3007 ☐ OTHER ______
SHEAVE* COMPROBE ☐ 101 ☐ 102 ☐ 103 ☐ RG ☐

PROBE OFFSET	2.56M(8.4 FT)	
MINUS CASING STICK-UP*		
DEPTH REF. OFFSET AT START*		REF TO GROUND SURFACE
DEPTH REF. OFFSET AT END*		
AFTER SURVEY DEPTH ERROR*		

LOG NAME*	START DEPTH*	START TIME*	END DEPTH*	END TIME*

TEST RING S/N* ______

	FILE NAME	AS BUILT 0 ms/m	104 ms/m	415 ms/m	
AS MEAS.*					
AS MEAS.					
AS MEAS.					
AS MEAS.					
AS MEAS.					
AS MEAS.					

MAINTENANCE PERFORMED ON SITE*: ______ (N/A if none)

EQUIPMENT PROBLEMS OR FAILURES*: ______ (N/A if none)

SUGGESTIONS, ADDITIONS, CHANGES: ______

*ITEMS WITH * MUST BE COMPLETED. OTHER INFORMATION IS OPTIONAL*

Approved by MACTEC for use on North Anna 3 project

D. Steven Copley
Principal Professional
8-20-09

GEOVision Geophysical Services 1124 Olympic Drive Corona, CA 92881 Ph (951) 549-1234 Fx (951) 549-1236

P-S FIELD LOG REV V1.4

GEOVision
geophysical services

___________ P-S SUSPENSION VELOCITY FIELD LOG REV 1.4

Borehole

CORRESPONDING P-S SUSPENSION PROCEDURE REV 1.4.

SITE*: ________________________ DATE*: ____________

CLIENT*: ________________________ JOB*: ____________

AUTHOR*: ________________________ PAGE 1 OF * ________

CONTACT: ____________________ PHONE: Off Cell ____________

CONTACT: ____________________ PHONE: Off Cell ____________

CONTACT: ____________________ PHONE: Off Cell ____________

CONTACT: ____________________ PHONE: Off Cell ____________

DIRECTIONS TO SITE: ____

____

____

GENERAL SITE CONDITIONS/LOCATION: ____________________________

____

____

____

____

COUNTY: _________ RANGE: _________ TOWNSHIP: _________ SECTION: _________

BOREHOLE CONSTRUCTION*: CASED _________ UNCASED _________

DIAMETERS AND DEPTH RANGES*: _______ 0 TO ________ ; ______, _______ TO ________

BOREHOLE TOTAL DEPTH AS DRILLED*: ____________

SURFACE CASING?: _________ DEPTH TO BOTTOM OF CASING_______; NO _________

DEPTH TO BEDROCK: _____________ DEPTH TO WATER TABLE: _________

BOREHOLE FLUID: WATER_____; FRESH WATER MUD____; SALT WATER MUD; _________

OTHER: ____

DEPTH TO BOREHOLE FLUID*: _________ TIME SINCE LAST CIRCULATION: _________

*ITEMS WITH * MUST BE COMPLETED. OTHER INFORMATION IS OPTIONAL*

GEOVision Geophysical Services 1124 Olympic Drive, Corona, CA 92881 Ph (951) 549-1234 Fx (951) 549-1236

Approved by MACTEC for use on North Anna 3 project

D. Steven Copley
Principal Professional
8-20-09

P-S FIELD LOG REV V1.4

GEOVision geophysical services

________ P-S SUSPENSION VELOCITY FIELD LOG REV 1.4

Borehole

CORRESPONDING P-S SUSPENSION PROCEDURE REV 1.4.

SITE*: ____________________ DATE*: ____________

CLIENT*: ____________________ JOB*: ____________

AUTHOR*: ____________________ PAGE 2 OF * ________

LOGGING CREW*: ____________________

MOBILIZED FROM: ____________ DEPARTURE TIME: ____________

ARRIVED ON SITE: ____________

STANDBY TIME: ____________ CAUSE: ____________

LOGGING STARTED: ____________ LOGGING COMPLETED: ____________

BATTERIES CHANGED BEFORE LOGGING: YES_____; NO_____; STORED WITH NEW_____

WINCH COMPROBE ☐ GREY ☐ OYO ☐ RG ☐ OTH ______

INSTRUMENT* OYO 12004 ☐ 15014 ☐ 19029 ☐ RG 160023 ☐ 160024 ☐

RECEIVER S/N* 12008 ☐ 20042 ☐ 26066 ☐ 11001 ☐ 23053 ☐ 30086 ☐

ISOLATION TUBE S/N* 300083 ☐ 24053 ☐ 28068 ☐ 28072 ☐ 2M ________

SHEAVE* COMPROBE ☐ OYO 101 ☐ 102 ☐ 103 ☐ RG ☐

MICROLOGGER* 5310 ☐ 5772 ☐ NOT APPLICABLE (OYO) ☐

PROBE OFFSET* OYO 2.0M ☐ RG 2.5M ☐

MINUS CASING STICK-UP* ________

DEPTH REF. OFFSET AT START* ________

DEPTH REF. OFFSET AT END* ________

AFTER SURVEY DEPTH ERROR* ________

REF TO GROUND SURFACE

LOG NAME*	START DEPTH*	START TIME	END DEPTH *	END TIME

MAINTENANCE PERFORMED ON SITE*: ____________________ (N/A if none)

EQUIPMENT PROBLEMS OR FAILURES*: ____________________ (N/A if none)

DEVIATIONS FROM TEST PLAN*: ____________________ (N/A if none)

*ITEMS WITH * MUST BE COMPLETED. OTHER INFORMATION IS OPTIONAL*

GEOVision Geophysical Services 1124 Olympic Drive, Corona, CA 92881 Ph (951) 549-1234 Fx (951) 549-1236

Approved by MACTEC for use on North Anna 3 project

D. Steven Copley
Principal Professional
8-20-09

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DCN# NAP135

P-S FIELD LOG REV 1.4

GEOVISION SUSPENSION LOGGING FIELD NOTES

SITE*:______________________ DATE*:______________
CLIENT*:______________________ JOB*:______________
AUTHOR*:______________________ PAGE*__________OF________

*ITEMS WITH * MUST BE COMPLETED. OTHER INFORMATION IS OPTIONAL*

DEPTH METERS	DEPTH FEET	UNFILTERED FILE NO*.	FILTERED FILE NO*. (if any)	COMMENTS CASING, WATER, ROCK, ETC
0.5	1.64			
1.0	3.28			
1.5	4.92			
2.0	6.56			
2.5	8.20			
3.0	9.84			
3.5	11.48			
4.0	13.12			
4.5	14.76			
5.0	16.40			
5.5	18.04			
6.0	19.69			
6.5	21.33			
7.0	22.97			
7.5	24.61			
8.0	26.25			
8.5	27.89			
9.0	29.53			
9.5	31.17			
10.0	32.81			
10.5	34.45			
11.0	36.09			
11.5	37.73			
12.0	39.37			
12.5	41.01			
13.0	42.65			
13.5	44.29			
14.0	45.93			
14.5	47.57			
15.0	49.21			
15.5	50.85			
16.0	52.49			
16.5	54.13			
17.0	55.77			
17.5	57.41			
18.0	59.06			
18.5	60.70			
19.0	62.34			
19.5	63.98			
20.0	65.62			

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D. Stoner Copley
Principal Professional
8-20-09

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DCN# NAP135

P-S FIELD LOG REV 1.4

GEOVISION SUSPENSION LOGGING FIELD NOTES

SITE*: DATE*:
CLIENT*: JOB*:
AUTHOR*: PAGE* OF

*ITEMS WITH * MUST BE COMPLETED. OTHER INFORMATION IS OPTIONAL*

DEPTH METERS	DEPTH FEET	UNFILTERED FILE NO*.	FILTERED FILE NO*. (if any)	COMMENTS CASING, WATER, ROCK, ETC
20.5	67.26			
21.0	68.90			
21.5	70.54			
22.0	72.18			
22.5	73.82			
23.0	75.46			
23.5	77.10			
24.0	78.74			
24.5	80.38			
25.0	82.02			
25.5	83.66			
26.0	85.30			
26.5	86.94			
27.0	88.58			
27.5	90.22			
28.0	91.86			
28.5	93.50			
29.0	95.14			
29.5	96.78			
30.0	98.43			
30.5	100.07			
31.0	101.71			
31.5	103.35			
32.0	104.99			
32.5	106.63			
33.0	108.27			
33.5	109.91			
34.0	111.55			
34.5	113.19			
35.0	114.83			
35.5	116.47			
36.0	118.11			
36.5	119.75			
37.0	121.39			
37.5	123.03			
38.0	124.67			
38.5	126.31			
39.0	127.95			
39.5	129.59			
40.0	131.23			

Approved by MACTEC for use on North Anna 3 project

D. Steven Copley
Principal Professional
8-20-09

Page 64 of 66
DCN# NAP135

P-S FIELD LOG REV 1.4

GEOVISION SUSPENSION LOGGING FIELD NOTES

SITE*: ______ DATE*: ______
CLIENT*: ______ JOB*: ______
AUTHOR*: ______ PAGE* ______ OF ______

*ITEMS WITH * MUST BE COMPLETED. OTHER INFORMATION IS OPTIONAL*

DEPTH METERS	DEPTH FEET	UNFILTERED FILE NO*.	FILTERED FILE NO*. (if any)	COMMENTS CASING, WATER, ROCK, ETC
40.5	132.87			
41.0	134.51			
41.5	136.15			
42.0	137.80			
42.5	139.44			
43.0	141.08			
43.5	142.72			
44.0	144.36			
44.5	146.00			
45.0	147.64			
45.5	149.28			
46.0	150.92			
46.5	152.56			
47.0	154.20			
47.5	155.84			
48.0	157.48			
48.5	159.12			
49.0	160.76			
49.5	162.40			
50.0	164.04			
50.5	165.68			
51.0	167.32			
51.5	168.96			
52.0	170.60			
52.5	172.24			
53.0	173.88			
53.5	175.52			
54.0	177.17			
54.5	178.81			
55.0	180.45			
55.5	182.09			
56.0	183.73			
56.5	185.37			
57.0	187.01			
57.5	188.65			
58.0	190.29			
58.5	191.93			
59.0	193.57			
59.5	195.21			
60.0	196.85			

Approved by MACTEC for use on North Anna 3 project

D. Stoner Copley
Principal Professional
8-20-09

P-S FIELD LOG REV 1.4

GEOVISION SUSPENSION LOGGING FIELD NOTES

SITE*: DATE*:
CLIENT*: JOB*:
AUTHOR*: PAGE* OF

*ITEMS WITH * MUST BE COMPLETED. OTHER INFORMATION IS OPTIONAL*

DEPTH METERS	DEPTH FEET	UNFILTERED FILE NO*.	FILTERED FILE NO*. (if any)	COMMENTS CASING, WATER, ROCK, ETC
60.5	198.49			
61.0	200.13			
61.5	201.77			
62.0	203.41			
62.5	205.05			
63.0	206.69			
63.5	208.33			
64.0	209.97			
64.5	211.61			
65.0	213.25			
65.5	214.90			
66.0	216.54			
66.5	218.18			
67.0	219.82			
67.5	221.46			
68.0	223.10			
68.5	224.74			
69.0	226.38			
69.5	228.02			
70.0	229.66			
70.5	231.30			
71.0	232.94			
71.5	234.58			
72.0	236.22			
72.5	237.86			
73.0	239.50			
73.5	241.14			
74.0	242.78			
74.5	244.42			
75.0	246.06			
75.5	247.70			
76.0	249.34			
76.5	250.98			
77.0	252.62			
77.5	254.27			
78.0	255.91			
78.5	257.55			
79.0	259.19			
79.5	260.83			
80.0	262.47			

Approved by MACTEC for use on North Anna 3 project

D. Steven Copley
Principal Professional
8-20-09

FINAL DATA REPORT
Revision 0
GEOTECHNICAL EXPLORATION AND TESTING
SUPPLEMENT 2
DOMINION POWER
NORTH ANNA NUCLEAR POWER STATION
NORTH ANNA 3 PROJECT
MINERAL, LOUISA COUNTY, VIRGINIA

December 16, 2009

VOLUME 1

APPENDIX D
Laboratory Test Data

Prepared By:

MACTEC ENGINEERING AND CONSULTING, INC.
RALEIGH, NORTH CAROLINA

MACTEC PROJECT No. 6468-09-2473

Prepared For:

Bechtel Power Corporation
Subcontractor No. 25161-500-HC4-CY00-00001

GEOTECHNICAL LABORATORY TEST ASSIGNMENT

Date 9/28/2009 Assignment 01, Rev. 1 Job Name North Anna S-COLA Job No. 25161 Requested By John Davie

SAMPLE LOCATION				PHYSICAL PROPERTIES										STRENGTH TESTS								COM-PACTION			CONSOLIDATION
								Grain Size Analysis																	NOTE: Stress increments and rebound cycles, ksf.
Boring No.	Sample Type (Tube Sample Length)	Top of Sample/Core Run Depth, Ft	Sample/Run Number	Moisture Content	Unit Weight	Specific Gravity	Atterberg Limits	Sieve Only	Sieve + Hydrometer	Chemical Analysis (pH, chloride, sulphate)	Organic Content			Unconsolidated-Undrained Triaxial	Consolidated-Undrained Triaxial (3-stage w/pore-pressure meas.)	Unconfined Compression (Soil)	Confining Pressures (psi)	Direct Shear	TSRC	Unconfined Compression (rock)	Unconfined Compression (rock) w/stress-strain measurements	Standard (A, B, C, D)	Modified (A, B, C, D)	CBR	
M-10(DH)	Jar	11.7	2	x			x		x																
M-10(DH)	Jar	19.2	4	x			x		x																
M-10(DH)	Jar	24.2	5	x			x		x																
M-10(DH)	Jar	29.2	6	x			x		x																
M-10(DH)	Jar	39.1	8	x			x		x																
M-10(DH)	Jar	49.1	10	x				x																	
M-10(DH)	Jar	59.1	12	x				x																	
M-10(DH)	Jar	74.1	15	x				x																	
M-10(DH)	Jar	84.1	17	x				x																	
M-10(DH)	Core	116.9	R-7		x															x					
M-10(DH)	Core	133.4	R-10		x															x					
M-10(DH)	Core	153.4	R-15		x															x					
M-10(DH)	Core	177.4	R-20		x															x					
M-10(DH)	Core	196.6	R-24		x															x					

Contact John Davie of Bechtel if there are any questions: Phone (301) 228-7647; e-mail JDAVIE@BECHTEL.COM.

(1) For rock core testing, MACTEC will select suitable (and typical) section of the core run for testing, and note actual depth tested.

GEOTECHNICAL LABORATORY TEST ASSIGNMENT

Date 9/28/2009 Job Name North Anna S-COLA Job No. 25161 Requested By John Davie

Assignment 01, Rev. 1

SAMPLE LOCATION				PHYSICAL PROPERTIES										STRENGTH TESTS								COM-PACTION			CONSOLIDATION						
Boring No.	Sample Type (Tube Sample Length)	Top of Sample/Core Run Depth, Ft	Sample/Run Number	Moisture Content	Unit Weight	Specific Gravity	Atterberg Limits	Grain Size Analysis: Sieve Only	Grain Size Analysis: Sieve + Hydrometer	Chemical Analysis (pH, chloride, sulphate)	Organic Content			Unconsolidated-Undrained Triaxial	Consolidated-Undrained Triaxial (3-stage w/pore-pressure meas.)	Unconfined Compression (Soil)	Confining Pressures (psi)	Direct Shear	TSRC	Unconfined Compression (rock)	Unconfined Compression (rock) w/stress-strain measurements	Standard (A, B, C, D)	Modified (A, B, C, D)	CBR	NOTE: Stress increments and rebound cycles, ksf.						
M-30(DH)	Jar	8.7	1	x				x																							
M-30(DH)	Jar	13.7	3	x				x																							
M-30(DH)	Jar	25.2	5	x				x																							
M-30(DH)	Jar	35.2	7	x				x																							
M-30(DH)	Core	56.7	R-4		x															x											
M-30(DH)	Core	95.3	R-18		x															x											
M-30(DH)	Core	134.7	R-26		x															x											
M-30(DH)	Core	166.7	R-34		x															x											
M-30(DH)	Core	196.7	R-40		x															x											

Contact John Davie of Bechtel if there are any questions: Phone (301) 228-7647; e-mail JDAVIE@BECHTEL.COM.

(1) For rock core testing, MACTEC will select suitable (and typical) section of the core run for testing, and note actual depth tested.

FINAL DATA REPORT
Revision 0
GEOTECHNICAL EXPLORATION AND TESTING
SUPPLEMENT 2
DOMINION POWER
NORTH ANNA NUCLEAR POWER STATION
NORTH ANNA 3 PROJECT
MINERAL, LOUISA COUNTY, VIRGINIA

December 16, 2009

VOLUME 1

APPENDIX D.1
Soil Index and Particle Size Distribution Tests

Prepared By:

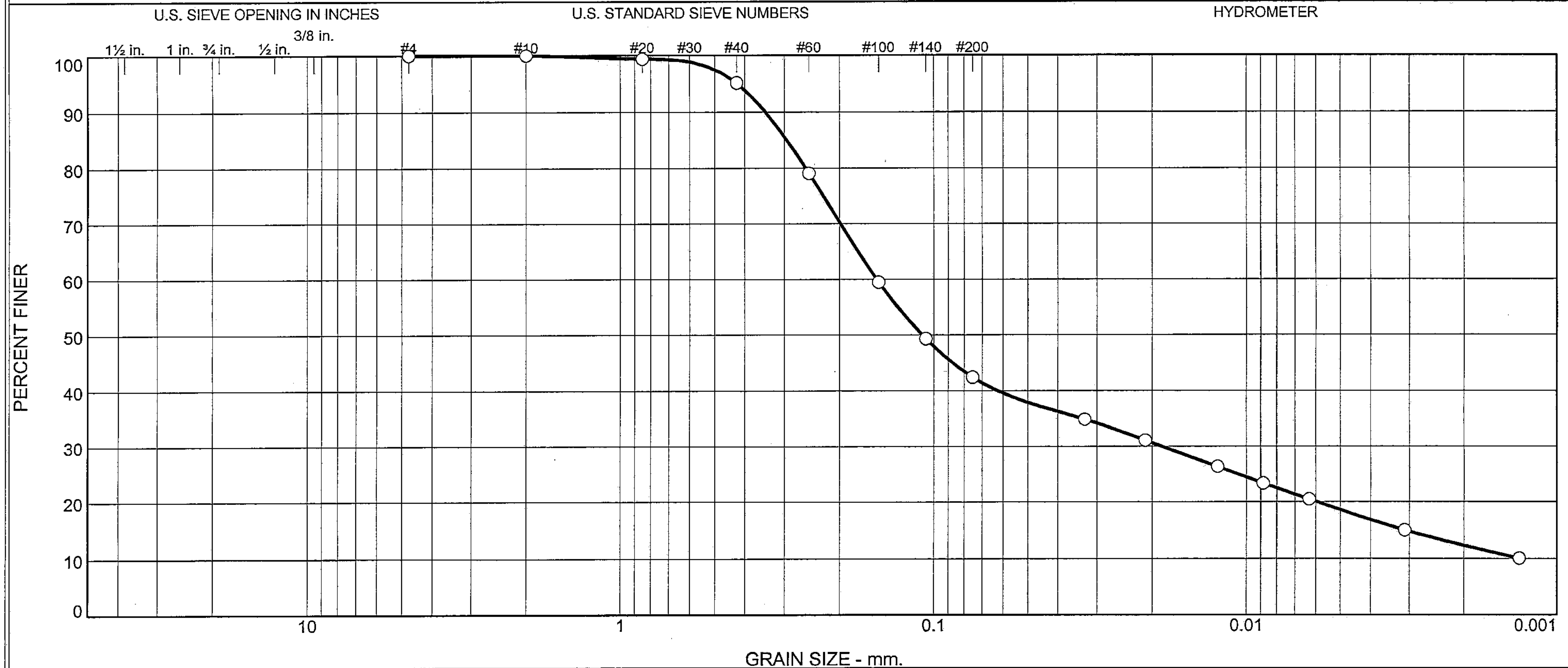
MACTEC ENGINEERING AND CONSULTING, INC.
RALEIGH, NORTH CAROLINA

MACTEC PROJECT No. 6468-09-2473

Prepared For:

Bechtel Power Corporation
Subcontractor No. 25161-500-HC4-CY00-00001

Particle Size Distribution Report ASTM D 422-63 (2007)



	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
○	0.0	0.0	0.0	4.9	52.6	30.2	12.3

	Source	Sample #	Depth/Elev.	Date Sampled	USCS	Material Description	NM %	LL	PL
○	Boring M-10(DH)	SS-2	11.7-13.2'	9/1/09	SM	Red Silty SAND	48.5	59	50

Client BECHTEL POWER CORPORATION Project North Anna 3 Project Project No. 6468092473 Figure NA	**MACTEC Engineering and Consulting, Inc.** **Raleigh, North Carolina**	○ Specific Gravity is assumed NA = Not Applicable

Tested By: CS **Checked By:** MDC DSC 11-12-09

GRAIN SIZE DISTRIBUTION TEST DATA

11/4/2009

Client: BECHTEL POWER CORPORATION
Project: North Anna 3 Project
Project Number: 6468092473
Location: Boring M-10(DH)
Depth: 11.7-13.2' **Sample Number:** SS-2
Material Description: Red Silty SAND
Date: 9/1/09 **Natural Moisture:** 48.5
Liquid Limit: 59 **Plastic Limit:** 50 **USCS Class.:** SM
Testing Remarks: Specific Gravity is assumed
NA = Not Applicable
Tested by: CS **Checked by:** MDC

Sieve Test Data

Dry Sample and Tare (grams)	Tare (grams)	Cumulative Pan Tare Weight (grams)	Sieve Opening Size	Cumulative Weight Retained (grams)	Percent Finer
242.46	0.00	0.00	#4	0.00	100.0
			#10	0.00	100.0
52.63	0.00	0.00	#20	0.35	99.3
			#40	2.59	95.1
			#60	11.03	79.0
			#100	21.36	59.4
			#140	26.69	49.3
			#200	30.28	42.5

Hydrometer Test Data

Hydrometer test uses material passing #10
Percent passing #10 based upon complete sample = 100.0
Weight of hydrometer sample =52.62
Hygroscopic moisture correction:
Moist weight and tare = 29.31
Dry weight and tare = 29.06
Tare weight = 15.53
Hygroscopic moisture = 1.8%
Table of composite correction values:

Temp., deg. C:	10.2	29.5
Comp. corr.:	-8.0	-4.0

Meniscus correction only = 1.0
Specific gravity of solids = 2.700
Hydrometer type = 152H
Hydrometer effective depth equation: L = 16.294964 - 0.164* **x Rm**

Elapsed Time (min.)	Temp. (deg. C.)	Actual Reading	Corrected Reading	K	Rm	Eff. Depth	Diameter (mm.)	Percent Finer
2.00	21.0	24.0	18.2	0.0133	25.0	12.2	0.0328	34.9
5.00	21.0	22.0	16.2	0.0133	23.0	12.5	0.0210	31.1
15.00	21.0	19.5	13.7	0.0133	20.5	12.9	0.0123	26.3
30.00	20.8	18.0	12.2	0.0133	19.0	13.2	0.0088	23.3
60.00	20.8	16.5	10.7	0.0133	17.5	13.4	0.0063	20.5
250.00	21.6	13.5	7.9	0.0132	14.5	13.9	0.0031	15.0
1440.00	21.1	11.0	5.3	0.0133	12.0	14.3	0.0013	10.1

MACTEC Engineering and Consulting, Inc.

Fractional Components

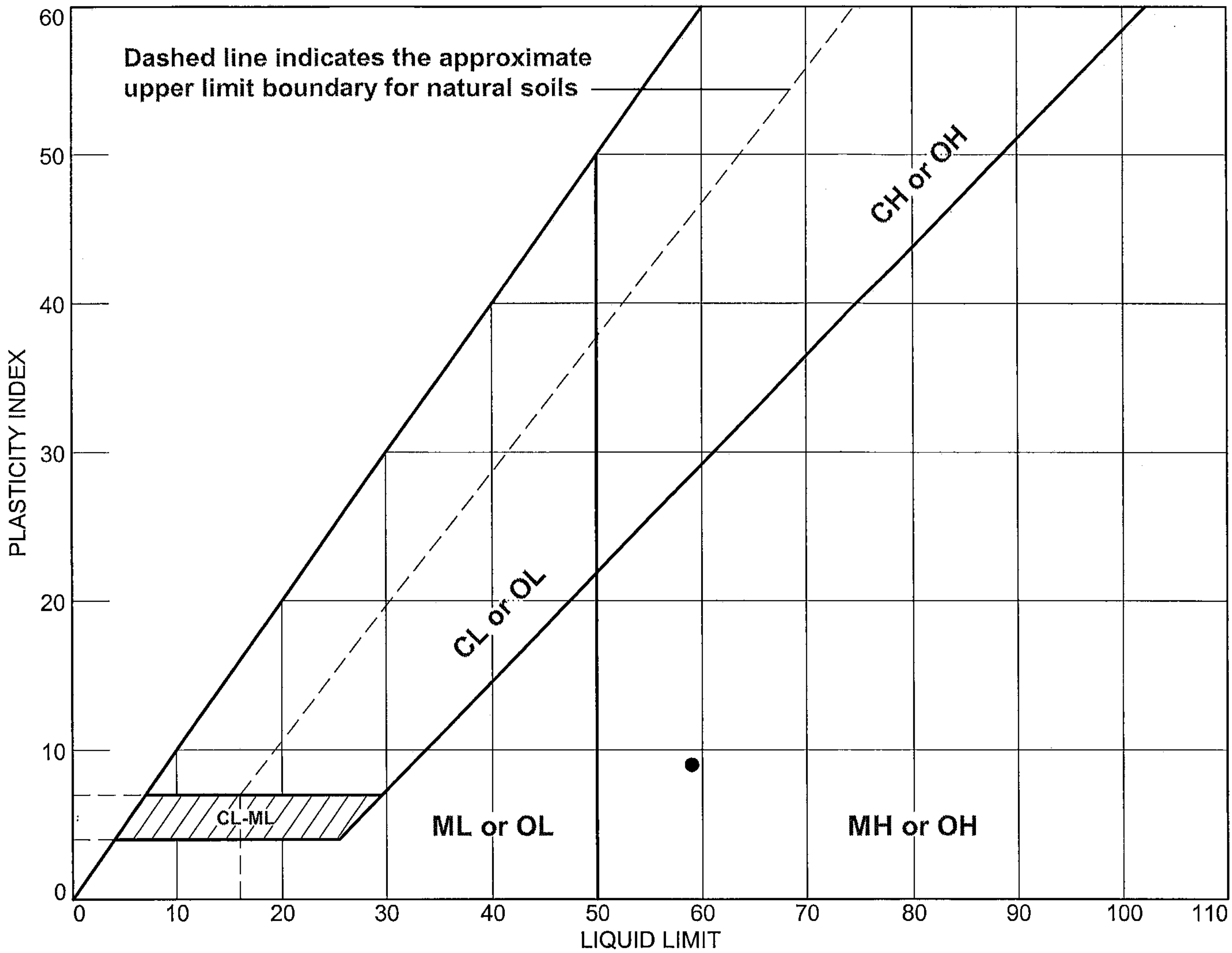
Cobbles	Gravel			Sand				Fines		
	Coarse	Fine	Total	Coarse	Medium	Fine	Total	Silt	Clay	Total
0.0	0.0	0.0	0.0	0.0	4.9	52.6	57.5	30.2	12.3	42.5

D_{10}	D_{15}	D_{20}	D_{30}	D_{50}	D_{60}	D_{80}	D_{85}	D_{90}	D_{95}
	0.0031	0.0059	0.0186	0.1091	0.1526	0.2564	0.2943	0.3444	0.4232

Fineness Modulus
0.57

MACTEC Engineering and Consulting, Inc.

LIQUID AND PLASTIC LIMITS TEST REPORT ASTM D4318 (05)



SOIL DATA								
SYMBOL	SOURCE	SAMPLE NO.	DEPTH	NATURAL WATER CONTENT (%)	PLASTIC LIMIT (%)	LIQUID LIMIT (%)	PLASTICITY INDEX (%)	USCS
●	Boring M-10(DH)	SS-2	11.7-13.2'	48.5	50	59	9	SM

MACTEC Engineering and Consulting, Inc.

Raleigh, North Carolina

Client: BECHTEL POWER CORPORATION
Project: North Anna 3 Project
Project No.: 6468092473 **Figure** NA

Tested By: CS **Checked By:** MDC DJC 11-12-09

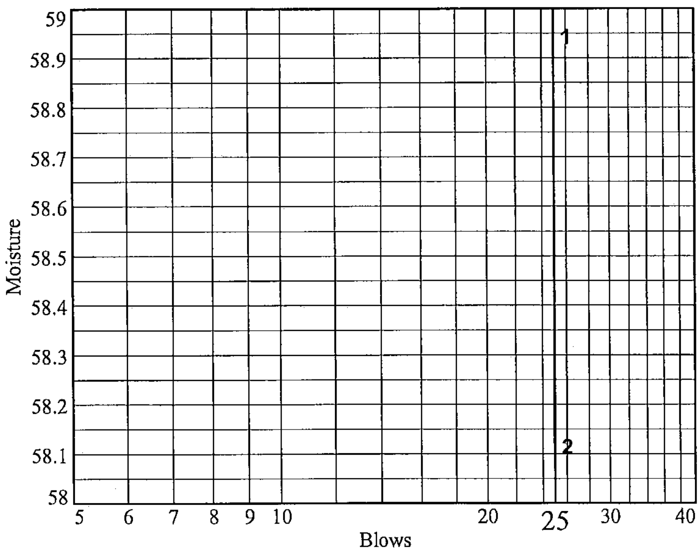
LIQUID AND PLASTIC LIMIT TEST DATA

11/4/2009

Client: BECHTEL POWER CORPORATION
Project: North Anna 3 Project
Project Number: 6468092473
Location: Boring M-10(DH)
Depth: 11.7-13.2'
Sample Number: SS-2
Material Description: Red Silty SAND
USCS: SM
AASHTO: A-5(2)
Tested by: CS
Checked by: MDC

Liquid Limit Data

Run No.	1	2	3	4	5	6
Wet+Tare	26.74	25.12				
Dry+Tare	22.72	20.00				
Tare	15.90	11.19				
# Blows	26	26				
Moisture	58.9	58.1				



Liquid Limit= 59
Plastic Limit= 50
Plasticity Index= 9
Natural Moisture= 48.5
Liquidity Index= -0.2

Plastic Limit Data

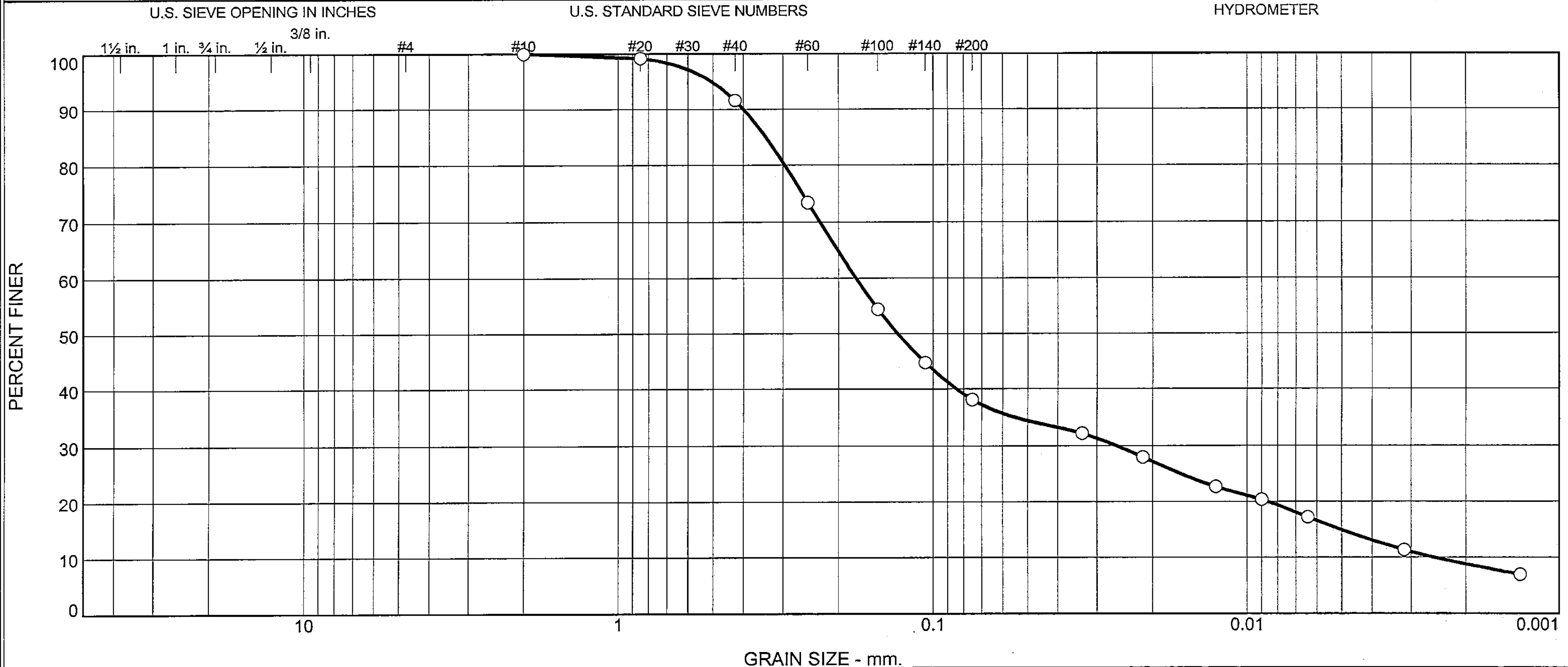
Run No.	1	2	3	4	
Wet+Tare	23.21	24.95			
Dry+Tare	20.66	21.86			
Tare	15.62	15.68			
Moisture	50.6	50.0			

Natural Moisture Data

Wet+Tare	Dry+Tare	Tare	Moisture
92.45	78.55	49.88	48.5

MACTEC Engineering and Consulting, Inc.

Particle Size Distribution Report ASTM D 422-63 (2007)



	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
○	0.0	0.0	0.0	8.4	53.5	29.4	8.7

	Source	Sample #	Depth/Elev.	Date Sampled	USCS	Material Description	NM %	LL	PL
○	Boring M-10(DH)	SS-4	19.2-20.7'	9/1/09	SM	Strong Brown Silty SAND	35.9	54	48

Client BECHTEL POWER CORPORATION
Project North Anna 3 Project
Project No. 6468092473 Figure NA

MACTEC Engineering and Consulting, Inc.
Raleigh, North Carolina

○ Specific Gravity is assumed
NA = Not Applicable

Tested By: CS **Checked By:** MDC DSC 11-12-09

GRAIN SIZE DISTRIBUTION TEST DATA

11/4/2009

Client: BECHTEL POWER CORPORATION
Project: North Anna 3 Project
Project Number: 6468092473
Location: Boring M-10(DH)
Depth: 19.2-20.7' **Sample Number:** SS-4
Material Description: Strong Brown Silty SAND
Date: 9/1/09 **Natural Moisture:** 35.9
Liquid Limit: 54 **Plastic Limit:** 48 **USCS Class.:** SM
Testing Remarks: Specific Gravity is assumed
NA = Not Applicable
Tested by: CS **Checked by:** MDC

Sieve Test Data

Dry Sample and Tare (grams)	Tare (grams)	Cumulative Pan Tare Weight (grams)	Sieve Opening Size	Cumulative Weight Retained (grams)	Percent Finer
243.11	0.00	0.00	#10	0.00	100.0
48.46	0.00	0.00	#20	0.39	99.2
			#40	4.08	91.6
			#60	12.88	73.4
			#100	22.10	54.4
			#140	26.78	44.7
			#200	29.99	38.1

Hydrometer Test Data

Hydrometer test uses material passing #10
Percent passing #10 based upon complete sample = 100.0
Weight of hydrometer sample =48.46
Hygroscopic moisture correction:
Moist weight and tare = 27.58
Dry weight and tare = 27.17
Tare weight = 15.27
Hygroscopic moisture = 3.4%
Table of composite correction values:

Temp., deg. C:	10.2	29.5
Comp. corr.:	-8.0	-4.0

Meniscus correction only = 1.0
Specific gravity of solids = 2.700
Hydrometer type = 152H
Hydrometer effective depth equation: L = 16.294964 - 0.164* **x Rm**

Elapsed Time (min.)	Temp. (deg. C.)	Actual Reading	Corrected Reading	K	Rm	Eff. Depth	Diameter (mm.)	Percent Finer
2.00	21.0	21.0	15.2	0.0133	22.0	12.7	0.0334	32.2
5.00	21.0	19.0	13.2	0.0133	20.0	13.0	0.0214	27.9
15.00	21.0	16.5	10.7	0.0133	17.5	13.4	0.0126	22.7
30.00	20.6	15.5	9.7	0.0133	16.5	13.6	0.0090	20.4
60.00	20.6	14.0	8.2	0.0133	15.0	13.8	0.0064	17.2
250.00	21.6	11.0	5.4	0.0132	12.0	14.3	0.0032	11.3
1440.00	21.2	9.0	3.3	0.0132	10.0	14.7	0.0013	6.9

MACTEC Engineering and Consulting, Inc.

Fractional Components

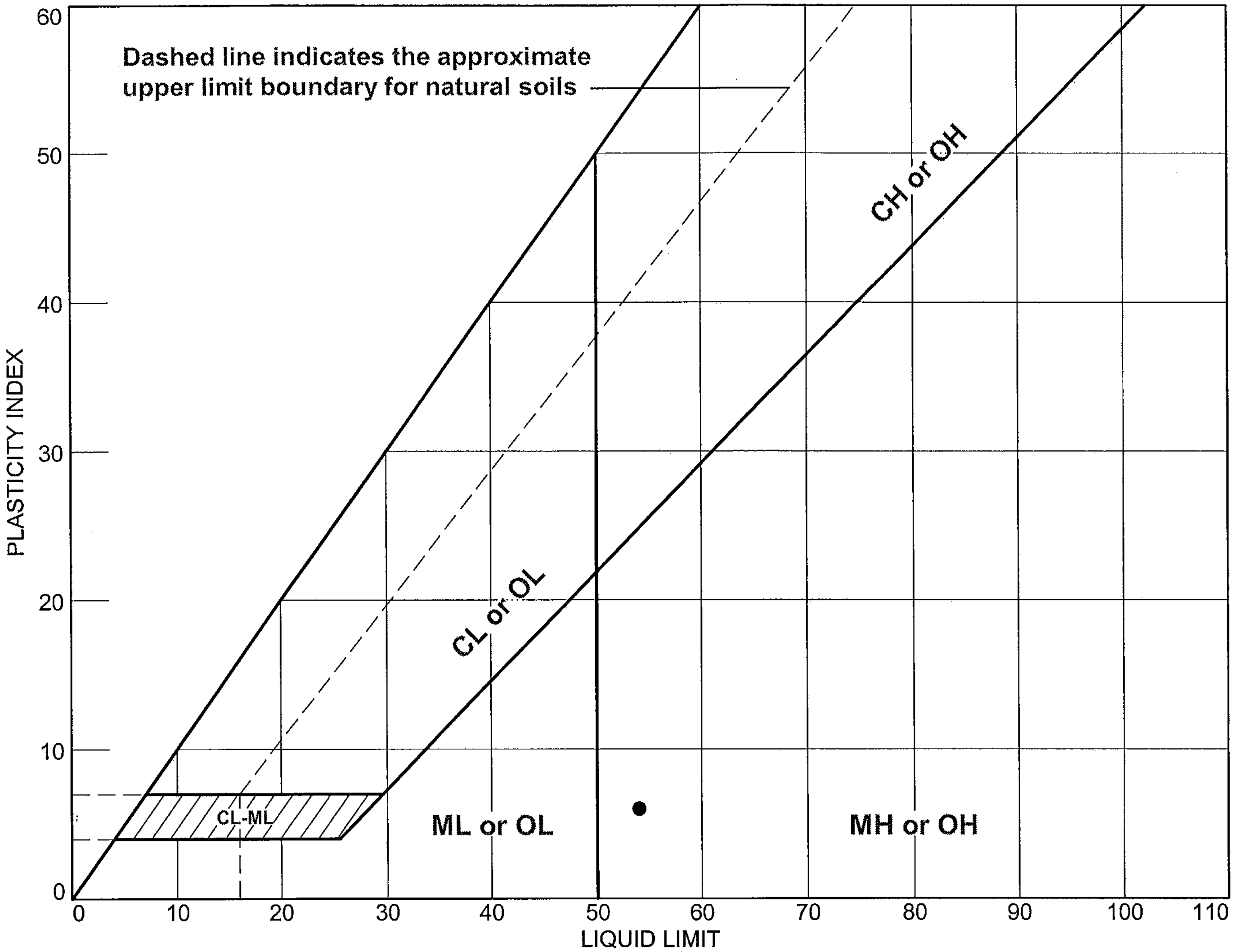
Cobbles	Gravel			Sand				Fines		
	Coarse	Fine	Total	Coarse	Medium	Fine	Total	Silt	Clay	Total
0.0	0.0	0.0	0.0	0.0	8.4	53.5	61.9	29.4	8.7	38.1

D_{10}	D_{15}	D_{20}	D_{30}	D_{50}	D_{60}	D_{80}	D_{85}	D_{90}	D_{95}
0.0025	0.0051	0.0086	0.0261	0.1298	0.1764	0.2963	0.3404	0.3999	0.5038

Fineness Modulus	C_u	C_c
0.68	69.41	1.51

MACTEC Engineering and Consulting, Inc.

LIQUID AND PLASTIC LIMITS TEST REPORT ASTM D4318 (05)



SOIL DATA								
SYMBOL	SOURCE	SAMPLE NO.	DEPTH	NATURAL WATER CONTENT (%)	PLASTIC LIMIT (%)	LIQUID LIMIT (%)	PLASTICITY INDEX (%)	USCS
●	Boring M-10(DH)	SS-4	19.2-20.7'	35.9	48	54	6	SM

MACTEC Engineering and Consulting, Inc. **Raleigh, North Carolina**	**Client:** BECHTEL POWER CORPORATION **Project:** North Anna 3 Project **Project No.:** 6468092473 **Figure** NA

Tested By: CS **Checked By:** MDC DSC 11-12-09

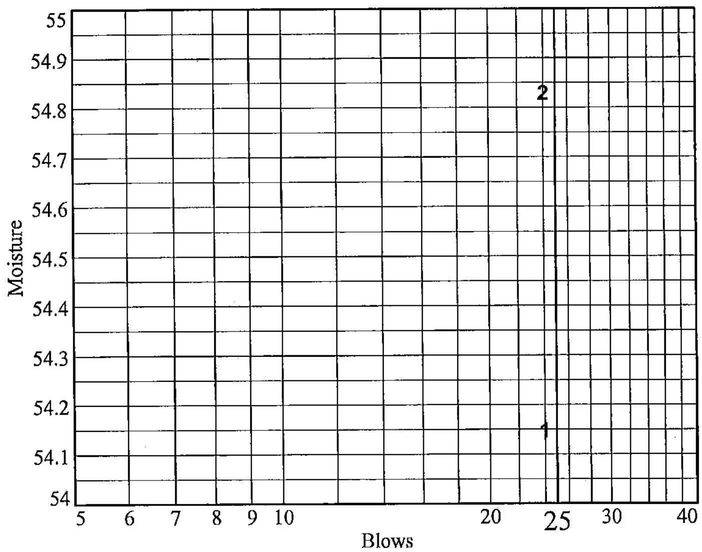
LIQUID AND PLASTIC LIMIT TEST DATA

11/4/2009

Client: BECHTEL POWER CORPORATION
Project: North Anna 3 Project
Project Number: 6468092473
Location: Boring M-10(DH)
Depth: 19.2-20.7'
Sample Number: SS-4
Material Description: Strong Brown Silty SAND
USCS: SM
AASHTO: A-5(0)
Tested by: CS
Checked by: MDC

Liquid Limit Data

Run No.	1	2	3	4	5	6
Wet+Tare	22.47	23.99				
Dry+Tare	18.49	19.45				
Tare	11.14	11.17				
# Blows	24	24				
Moisture	54.1	54.8				



Liquid Limit= 54
Plastic Limit= 48
Plasticity Index= 6
Natural Moisture= 35.9
Liquidity Index= -2.0

Plastic Limit Data

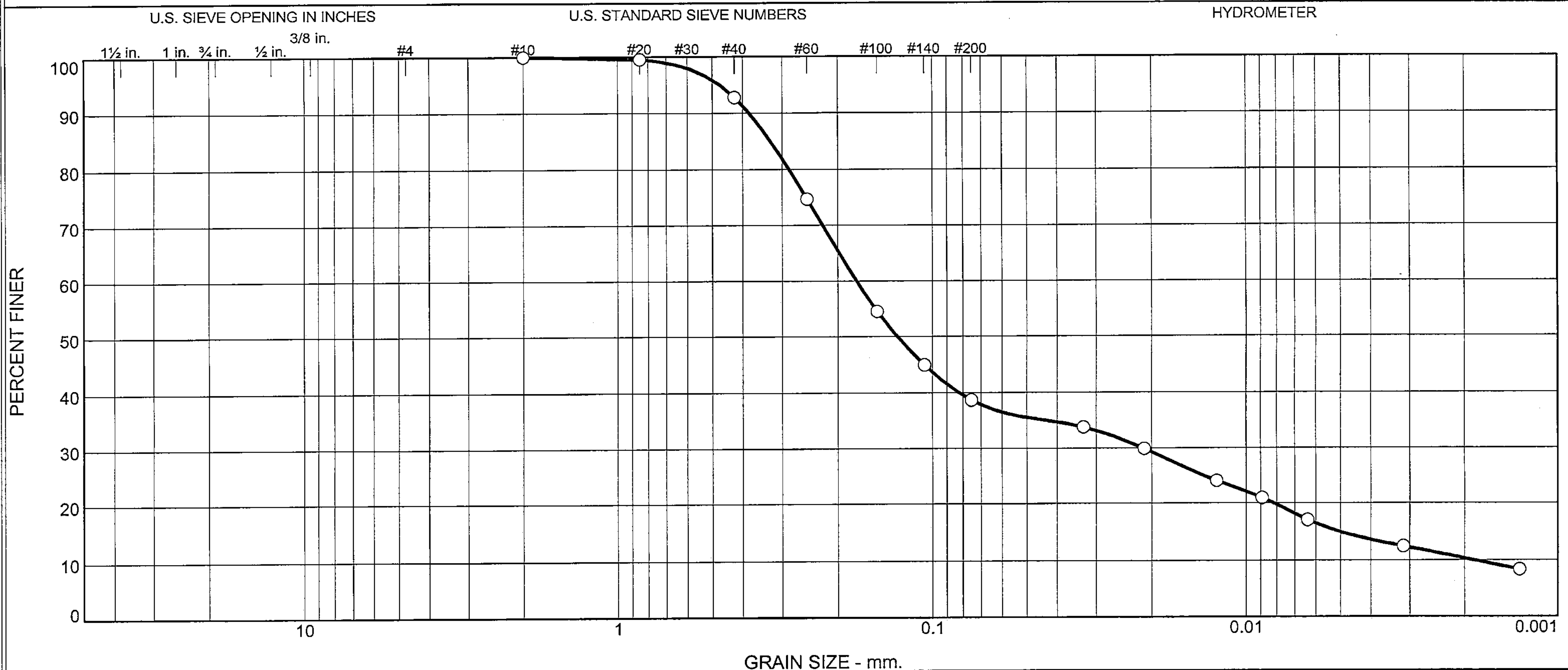
Run No.	1	2	3	4
Wet+Tare	25.61	26.84		
Dry+Tare	22.38	23.20		
Tare	15.69	15.54		
Moisture	48.3	47.5		

Natural Moisture Data

Wet+Tare	Dry+Tare	Tare	Moisture
105.76	90.93	49.59	35.9

MACTEC Engineering and Consulting, Inc.

Particle Size Distribution Report ASTM D 422-63 (2007)



	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
○	0.0	0.0	0.0	7.3	54.0	28.4	10.3

	Source	Sample #	Depth/Elev.	Date Sampled	USCS	Material Description	NM %	LL	PL
○	Boring M-10(DH)	SS-5	24.2-25.7'	9/1/09	SM	Strong Brown Silty SAND	53.7	59	47

Client BECHTEL POWER CORPORATION
Project North Anna 3 Project
Project No. 6468092473 Figure NA

MACTEC Engineering and Consulting, Inc.
Raleigh, North Carolina

○ Specific Gravity is assumed
NA = Not Applicable

Tested By: CS **Checked By:** MDC DSC 11-12-09

GRAIN SIZE DISTRIBUTION TEST DATA

11/4/2009

Client: BECHTEL POWER CORPORATION
Project: North Anna 3 Project
Project Number: 6468092473
Location: Boring M-10(DH)
Depth: 24.2-25.7' **Sample Number:** SS-5
Material Description: Strong Brown Silty SAND
Date: 9/1/09 **Natural Moisture:** 53.7
Liquid Limit: 59 **Plastic Limit:** 47 **USCS Class.:** SM
Testing Remarks: Specific Gravity is assumed
NA = Not Applicable
Tested by: CS **Checked by:** MDC

Sieve Test Data

Dry Sample and Tare (grams)	Tare (grams)	Cumulative Pan Tare Weight (grams)	Sieve Opening Size	Cumulative Weight Retained (grams)	Percent Finer
272.86	0.00	0.00	#10	0.00	100.0
50.98	0.00	0.00	#20	0.25	99.5
			#40	3.70	92.7
			#60	12.92	74.7
			#100	23.21	54.5
			#140	28.06	45.0
			#200	31.24	38.7

Hydrometer Test Data

Hydrometer test uses material passing #10
Percent passing #10 based upon complete sample = 100.0
Weight of hydrometer sample =50.98
Hygroscopic moisture correction:
Moist weight and tare = 24.35
Dry weight and tare = 24.24
Tare weight = 11.24
Hygroscopic moisture = 0.8%
Table of composite correction values:

Temp., deg. C:	10.2	29.5
Comp. corr.:	-8.0	-4.0

Meniscus correction only = 1.0
Specific gravity of solids = 2.700
Hydrometer type = 152H
Hydrometer effective depth equation: L = 16.294964 - 0.164* **x Rm**

Elapsed Time (min.)	Temp. (deg. C.)	Actual Reading	Corrected Reading	K	Rm	Eff. Depth	Diameter (mm.)	Percent Finer
2.00	21.2	23.0	17.3	0.0132	24.0	12.4	0.0329	33.8
5.00	21.2	21.0	15.3	0.0132	22.0	12.7	0.0211	29.9
15.00	21.2	18.0	12.3	0.0132	19.0	13.2	0.0124	24.0
30.00	20.9	16.5	10.7	0.0133	17.5	13.4	0.0089	21.0
60.00	20.9	14.5	8.7	0.0133	15.5	13.8	0.0064	17.1
250.00	21.5	12.0	6.3	0.0132	13.0	14.2	0.0031	12.4
1440.00	21.2	10.0	4.3	0.0132	11.0	14.5	0.0013	8.4

MACTEC Engineering and Consulting, Inc.

Fractional Components

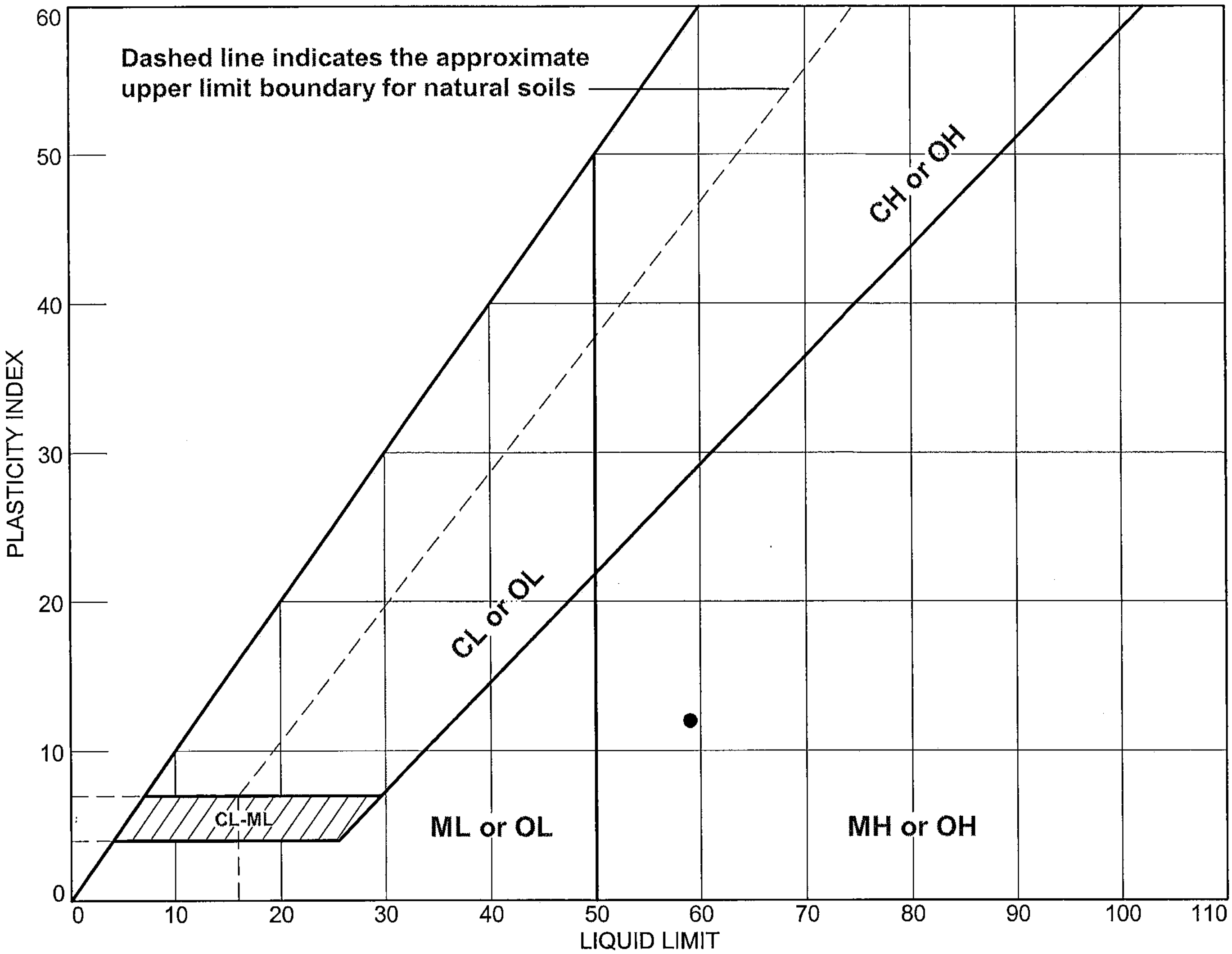
Cobbles	Gravel			Sand				Fines		
	Coarse	Fine	Total	Coarse	Medium	Fine	Total	Silt	Clay	Total
0.0	0.0	0.0	0.0	0.0	7.3	54.0	61.3	28.4	10.3	38.7

D_{10}	D_{15}	D_{20}	D_{30}	D_{50}	D_{60}	D_{80}	D_{85}	D_{90}	D_{95}
0.0019	0.0051	0.0082	0.0213	0.1296	0.1747	0.2857	0.3271	0.3825	0.4750

Fineness Modulus	C_u	C_c
0.66	93.28	1.39

MACTEC Engineering and Consulting, Inc.

LIQUID AND PLASTIC LIMITS TEST REPORT ASTM D4318 (05)



SOIL DATA								
SYMBOL	SOURCE	SAMPLE NO.	DEPTH	NATURAL WATER CONTENT (%)	PLASTIC LIMIT (%)	LIQUID LIMIT (%)	PLASTICITY INDEX (%)	USCS
●	Boring M-10(DH)	SS-5	24.2-25.7'	53.7	47	59	12	SM

MACTEC Engineering and Consulting, Inc. **Raleigh, North Carolina**	**Client:** BECHTEL POWER CORPORATION **Project:** North Anna 3 Project **Project No.:** 6468092473 **Figure** NA

Tested By: CS **Checked By:** MDC DSC 11-12-09

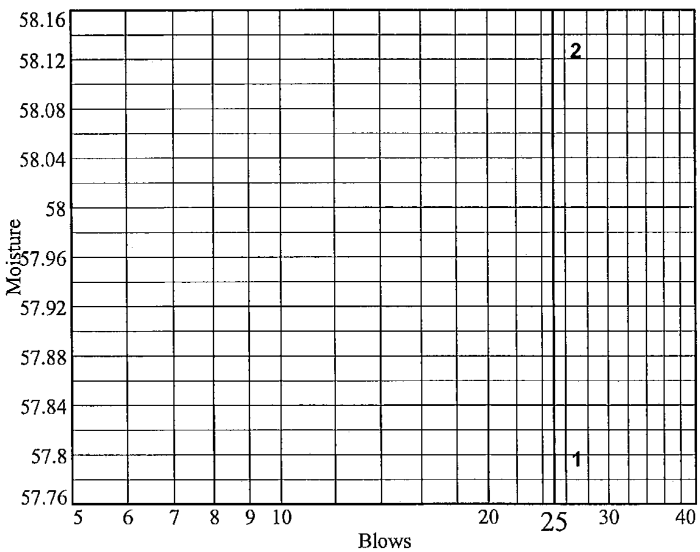
LIQUID AND PLASTIC LIMIT TEST DATA

11/4/2009

Client: BECHTEL POWER CORPORATION
Project: North Anna 3 Project
Project Number: 6468092473
Location: Boring M-10(DH)
Depth: 24.2-25.7'
Sample Number: SS-5
Material Description: Strong Brown Silty SAND
USCS: SM
AASHTO: A-7-5(2)
Tested by: CS
Checked by: MDC

Liquid Limit Data

Run No.	1	2	3	4	5	6
Wet+Tare	28.36	27.63				
Dry+Tare	23.69	23.16				
Tare	15.61	15.47				
# Blows	27	27				
Moisture	57.8	58.1				



Liquid Limit= 59
Plastic Limit= 47
Plasticity Index= 12
Natural Moisture= 53.7
Liquidity Index= 0.6

Plastic Limit Data

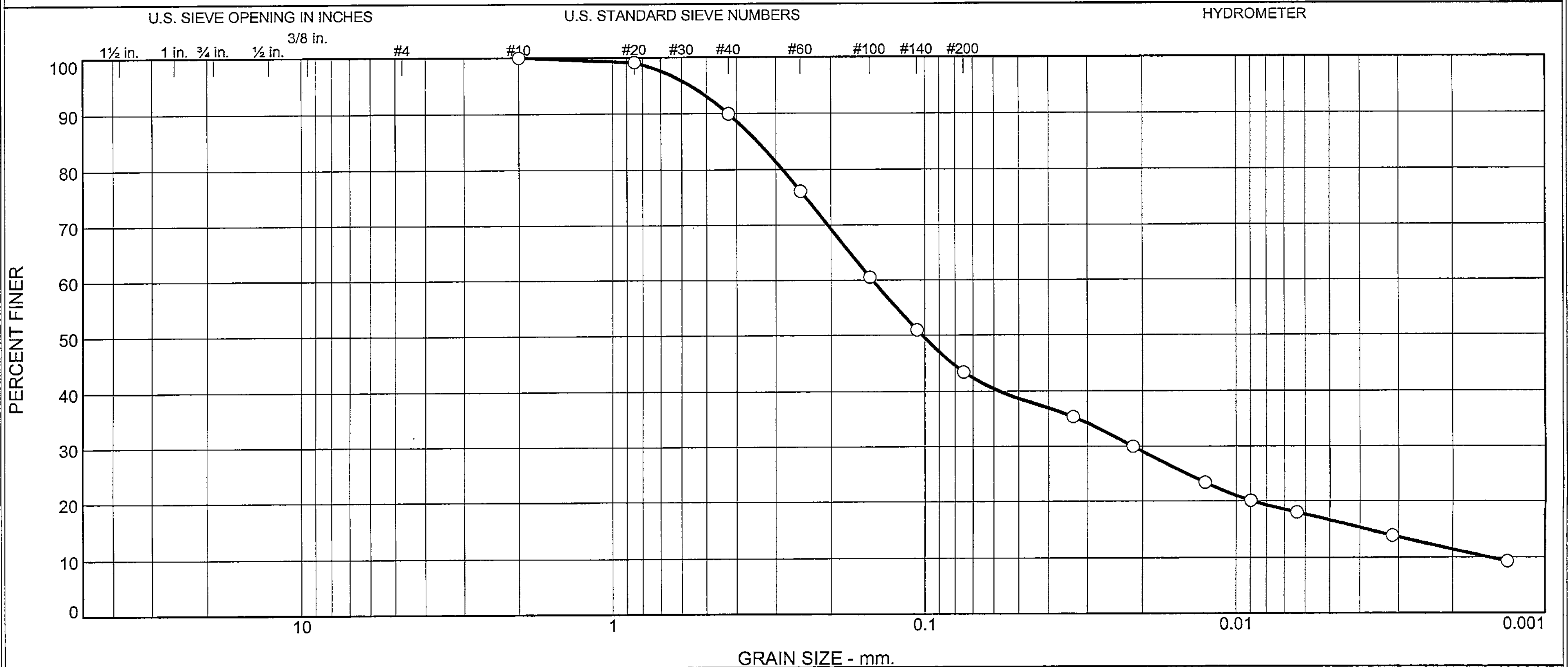
Run No.	1	2	3	4	
Wet+Tare	26.36	36.56			
Dry+Tare	22.86	29.86			
Tare	15.49	15.50			
Moisture	47.5	46.7			

Natural Moisture Data

Wet+Tare	Dry+Tare	Tare	Moisture
126.23	99.69	50.29	53.7

MACTEC Engineering and Consulting, Inc.

Particle Size Distribution Report ASTM D 422-63 (2007)



	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
○	0.0	0.0	0.0	10.0	46.6	31.9	11.5

	Source	Sample #	Depth/Elev.	Date Sampled	USCS	Material Description	NM %	LL	PL
○	Boring M-10(DH)	SS-6	29.2-30.7'	9/1/09	SM	Yellowish Brown Silty SAND	66.7	51	44

Client BECHTEL POWER CORPORATION
Project North Anna 3 Project
Project No. 6468092473 Figure NA

MACTEC Engineering and Consulting, Inc.
Raleigh, North Carolina

○ Specific Gravity is assumed
NA = Not Applicable

Tested By: CS **Checked By:** MDC DSC 11-12-09

GRAIN SIZE DISTRIBUTION TEST DATA

11/4/2009

Client: BECHTEL POWER CORPORATION
Project: North Anna 3 Project
Project Number: 6468092473
Location: Boring M-10(DH)
Depth: 29.2-30.7' **Sample Number:** SS-6
Material Description: Yellowish Brown Silty SAND
Date: 9/1/09 **Natural Moisture:** 66.7
Liquid Limit: 51 **Plastic Limit:** 44 **USCS Class.:** SM
Testing Remarks: Specific Gravity is assumed
NA = Not Applicable
Tested by: CS **Checked by:** MDC

Sieve Test Data

Dry Sample and Tare (grams)	Tare (grams)	Cumulative Pan Tare Weight (grams)	Sieve Opening Size	Cumulative Weight Retained (grams)	Percent Finer
206.01	0.00	0.00	#10	0.00	100.0
46.68	0.00	0.00	#20	0.43	99.1
			#40	4.68	90.0
			#60	11.17	76.1
			#100	18.44	60.5
			#140	22.90	50.9
			#200	26.40	43.4

Hydrometer Test Data

Hydrometer test uses material passing #10
Percent passing #10 based upon complete sample = 100.0
Weight of hydrometer sample =46.68
Hygroscopic moisture correction:
Moist weight and tare = 28.03
Dry weight and tare = 27.65
Tare weight = 15.56
Hygroscopic moisture = 3.1%
Table of composite correction values:

Temp., deg. C:	10.2	29.5
Comp. corr.:	-8.0	-4.0

Meniscus correction only = 1.0
Specific gravity of solids = 2.700
Hydrometer type = 152H
Hydrometer effective depth equation: L = 16.294964 - 0.164* **x Rm**

Elapsed Time (min.)	Temp. (deg. C.)	Actual Reading	Corrected Reading	K	Rm	Eff. Depth	Diameter (mm.)	Percent Finer
2.00	20.8	22.0	16.2	0.0133	23.0	12.5	0.0333	35.4
5.00	20.8	19.5	13.7	0.0133	20.5	12.9	0.0214	29.9
15.00	20.8	16.5	10.7	0.0133	17.5	13.4	0.0126	23.4
30.00	20.8	15.0	9.2	0.0133	16.0	13.7	0.0090	20.1
60.00	21.0	14.0	8.2	0.0133	15.0	13.8	0.0064	18.0
250.00	21.6	12.0	6.4	0.0132	13.0	14.2	0.0031	13.9
1440.00	21.2	10.0	4.3	0.0132	11.0	14.5	0.0013	9.4

MACTEC Engineering and Consulting, Inc.

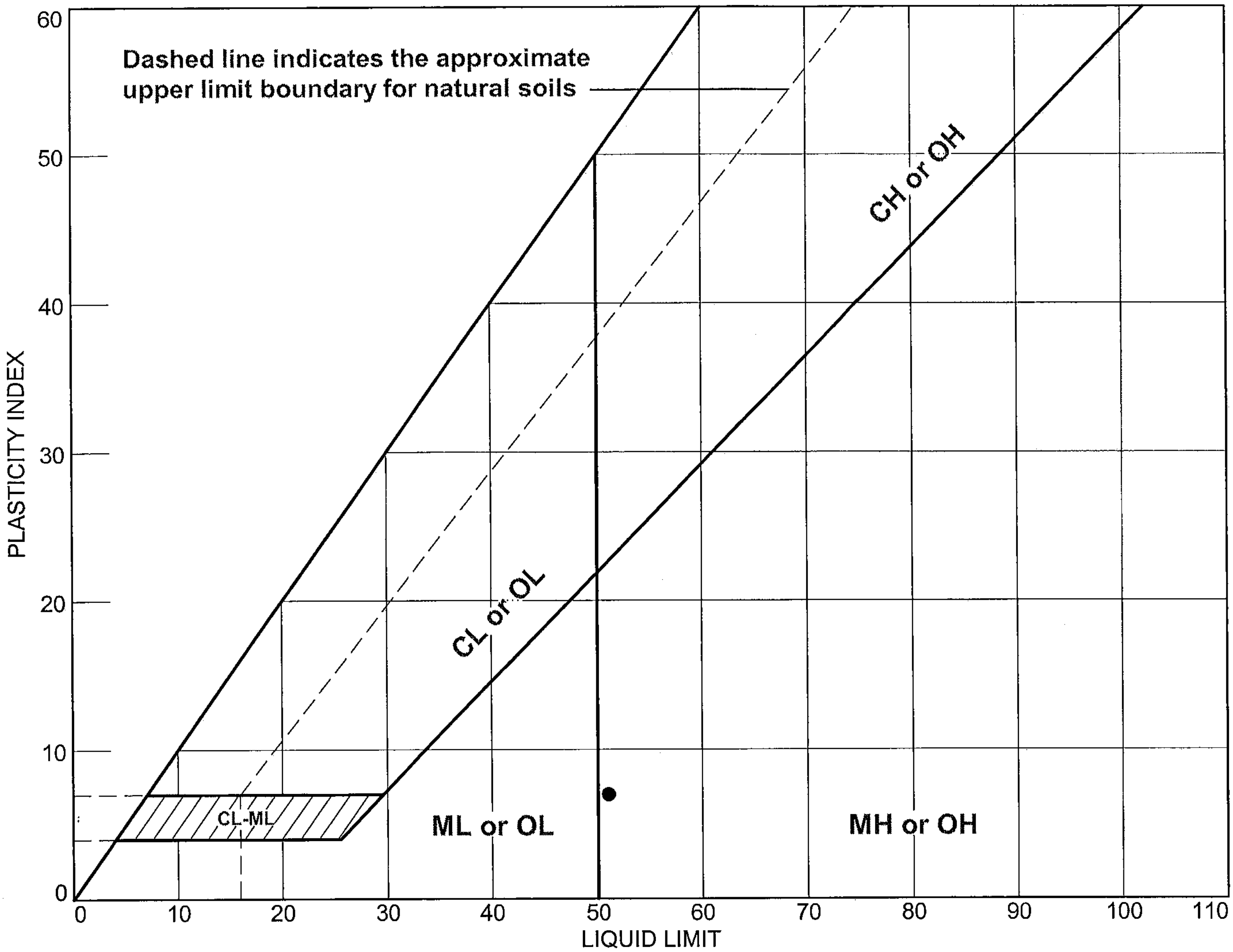
Fractional Components

Cobbles	Gravel			Sand				Fines		
	Coarse	Fine	Total	Coarse	Medium	Fine	Total	Silt	Clay	Total
0.0	0.0	0.0	0.0	0.0	10.0	46.6	56.6	31.9	11.5	43.4

D_{10}	D_{15}	D_{20}	D_{30}	D_{50}	D_{60}	D_{80}	D_{85}	D_{90}	D_{95}
0.0015	0.0038	0.0089	0.0215	0.1021	0.1475	0.2859	0.3437	0.4255	0.5660

Fineness Modulus	C_u	C_c
0.63	97.76	2.08

LIQUID AND PLASTIC LIMITS TEST REPORT ASTM D4318 (05)



SOIL DATA								
SYMBOL	SOURCE	SAMPLE NO.	DEPTH	NATURAL WATER CONTENT (%)	PLASTIC LIMIT (%)	LIQUID LIMIT (%)	PLASTICITY INDEX (%)	USCS
●	Boring M-10(DH)	SS-6	29.2-30.7'	66.7	44	51	7	SM

MACTEC Engineering and Consulting, Inc.

Raleigh, North Carolina

Client: BECHTEL POWER CORPORATION
Project: North Anna 3 Project
Project No.: 6468092473 **Figure** NA

Tested By: CS **Checked By:** MDC DSC 11-12-09

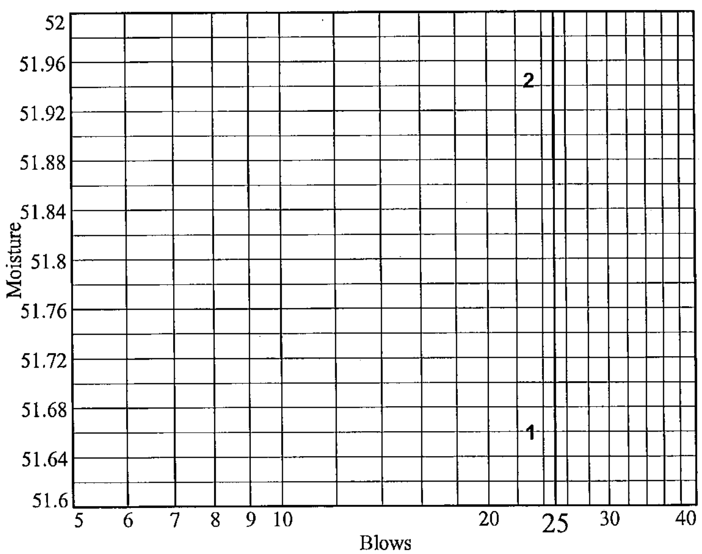
LIQUID AND PLASTIC LIMIT TEST DATA

11/4/2009

Client: BECHTEL POWER CORPORATION
Project: North Anna 3 Project
Project Number: 6468092473
Location: Boring M-10(DH)
Depth: 29.2-30.7' **Sample Number:** SS-6
Material Description: Yellowish Brown Silty SAND
USCS: SM **AASHTO:** A-5(1)
Tested by: CS **Checked by:** MDC

Liquid Limit Data

Run No.	1	2	3	4	5	6
Wet+Tare	30.08	27.59				
Dry+Tare	25.10	23.45				
Tare	15.46	15.48				
# Blows	23	23				
Moisture	51.7	51.9				



Liquid Limit= 51
Plastic Limit= 44
Plasticity Index= 7
Natural Moisture= 66.7
Liquidity Index= 3.2

Plastic Limit Data

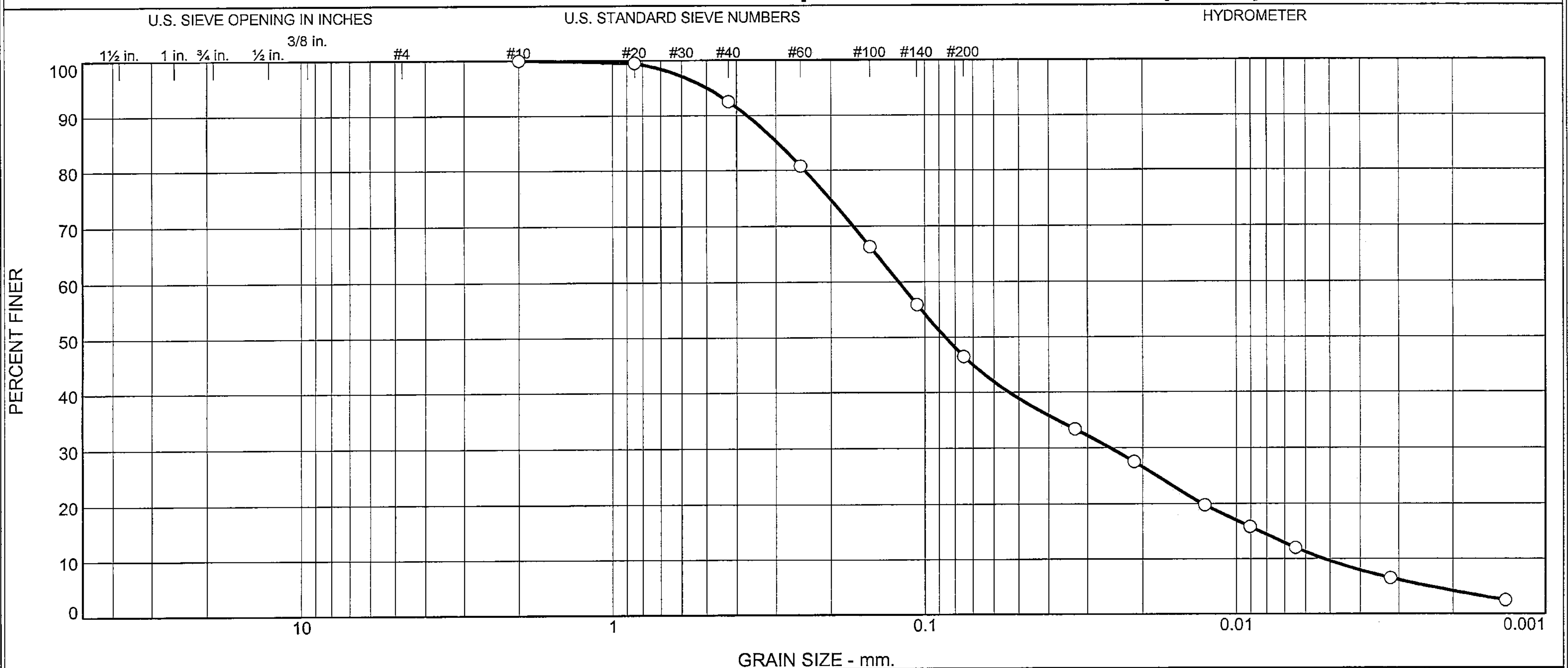
Run No.	1	2	3	4
Wet+Tare	27.30	26.68		
Dry+Tare	23.70	23.25		
Tare	15.47	15.55		
Moisture	43.7	44.5		

Natural Moisture Data

Wet+Tare	Dry+Tare	Tare	Moisture
185.01	131.20	50.54	66.7

MACTEC Engineering and Consulting, Inc.

Particle Size Distribution Report ASTM D 422-63 (2007)



	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
○	0.0	0.0	0.0	7.4	46.1	42.4	4.1

	Source	Sample #	Depth/Elev.	Date Sampled	USCS	Material Description	NM %	LL	PL
○	Boring M-10(DH)	SS-8	39.1-40.6'	9/1/09	SM	Yellowish Brown Silty SAND	30.6	42	36

Client BECHTEL POWER CORPORATION Project North Anna 3 Project Project No. 6468092473 Figure NA	**MACTEC Engineering and Consulting, Inc.** **Raleigh, North Carolina**	○ Specific Gravity is assumed NA = Not Applicable

Tested By: CS **Checked By:** MDC DSC 11-12-09

GRAIN SIZE DISTRIBUTION TEST DATA

11/4/2009

Client: BECHTEL POWER CORPORATION
Project: North Anna 3 Project
Project Number: 6468092473
Location: Boring M-10(DH)
Depth: 39.1-40.6' **Sample Number:** SS-8
Material Description: Yellowish Brown Silty SAND
Date: 9/1/09 **Natural Moisture:** 30.6
Liquid Limit: 42 **Plastic Limit:** 36 **USCS Class.:** SM
Testing Remarks: Specific Gravity is assumed
NA = Not Applicable
Tested by: CS **Checked by:** MDC

Sieve Test Data

Dry Sample and Tare (grams)	Tare (grams)	Cumulative Pan Tare Weight (grams)	Sieve Opening Size	Cumulative Weight Retained (grams)	Percent Finer
252.78	0.00	0.00	#10	0.00	100.0
53.06	0.00	0.00	#20	0.26	99.5
			#40	3.93	92.6
			#60	10.23	80.7
			#100	17.86	66.3
			#140	23.39	55.9
			#200	28.38	46.5

Hydrometer Test Data

Hydrometer test uses material passing #10
Percent passing #10 based upon complete sample = 100.0
Weight of hydrometer sample =53.06
Hygroscopic moisture correction:
Moist weight and tare = 25.26
Dry weight and tare = 24.76
Tare weight = 11.27
Hygroscopic moisture = 3.7%
Table of composite correction values:

Temp., deg. C:	10.2	29.5
Comp. corr.:	-8.0	-4.0

Meniscus correction only = 1.0
Specific gravity of solids = 2.700
Hydrometer type = 152H
Hydrometer effective depth equation: L = 16.294964 - 0.164* **x Rm**

Elapsed Time (min.)	Temp. (deg. C.)	Actual Reading	Corrected Reading	K	Rm	Eff. Depth	Diameter (mm.)	Percent Finer
2.00	21.1	23.0	17.3	0.0133	24.0	12.4	0.0330	33.4
5.00	21.1	20.0	14.3	0.0133	21.0	12.9	0.0213	27.6
15.00	21.0	16.0	10.2	0.0133	17.0	13.5	0.0126	19.8
30.00	20.9	14.0	8.2	0.0133	15.0	13.8	0.0090	15.9
60.00	20.9	12.0	6.2	0.0133	13.0	14.2	0.0065	12.0
250.00	21.6	9.0	3.4	0.0132	10.0	14.7	0.0032	6.5
1440.00	21.2	7.0	1.3	0.0132	8.0	15.0	0.0014	2.5

MACTEC Engineering and Consulting, Inc.

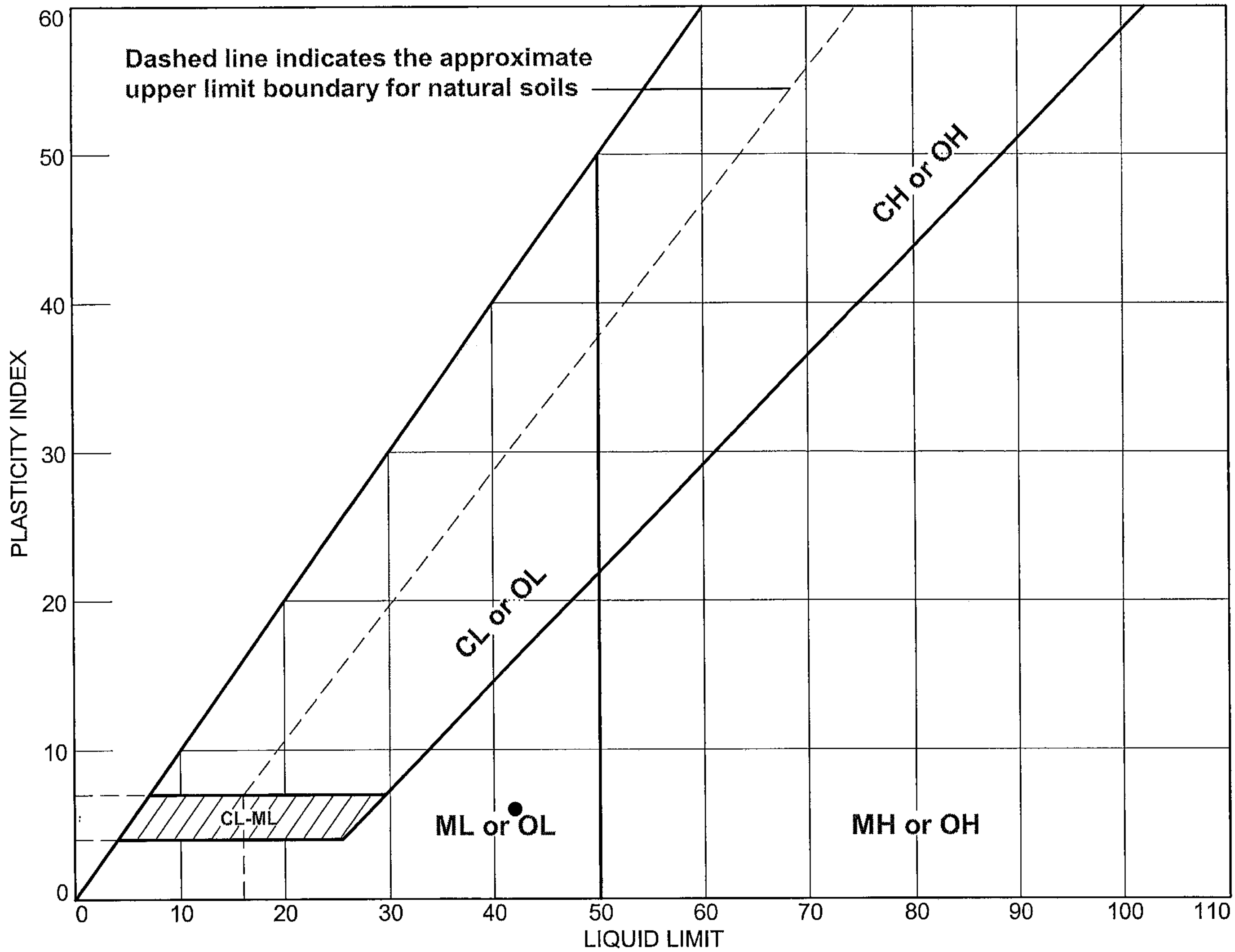
Fractional Components

Cobbles	Gravel			Sand				Fines		
	Coarse	Fine	Total	Coarse	Medium	Fine	Total	Silt	Clay	Total
0.0	0.0	0.0	0.0	0.0	7.4	46.1	53.5	42.4	4.1	46.5

D_{10}	D_{15}	D_{20}	D_{30}	D_{50}	D_{60}	D_{80}	D_{85}	D_{90}	D_{95}
0.0052	0.0084	0.0128	0.0253	0.0861	0.1215	0.2432	0.2962	0.3702	0.4974

Fineness Modulus	C_u	C_c
0.51	23.17	1.01

LIQUID AND PLASTIC LIMITS TEST REPORT ASTM D4318 (05)



SOIL DATA								
SYMBOL	SOURCE	SAMPLE NO.	DEPTH	NATURAL WATER CONTENT (%)	PLASTIC LIMIT (%)	LIQUID LIMIT (%)	PLASTICITY INDEX (%)	USCS
●	Boring M-10(DH)	SS-8	39.1-40.6'	30.6	36	42	6	SM

MACTEC Engineering and Consulting, Inc. **Raleigh, North Carolina**	**Client:** BECHTEL POWER CORPORATION **Project:** North Anna 3 Project **Project No.:** 6468092473 **Figure** NA

Tested By: CS **Checked By:** MDC DSC 11-12-09

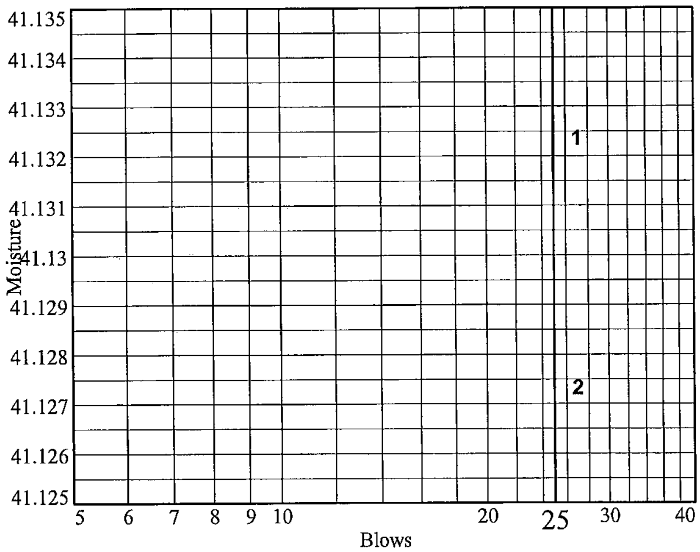
LIQUID AND PLASTIC LIMIT TEST DATA

11/4/2009

Client: BECHTEL POWER CORPORATION
Project: North Anna 3 Project
Project Number: 6468092473
Location: Boring M-10(DH)
Depth: 39.1-40.6'
Sample Number: SS-8
Material Description: Yellowish Brown Silty SAND
USCS: SM
AASHTO: A-5(1)
Tested by: CS
Checked by: MDC

Liquid Limit Data

Run No.	1	2	3	4	5	6
Wet+Tare	28.18	24.64				
Dry+Tare	23.24	20.70				
Tare	11.23	11.12				
# Blows	27	27				
Moisture	41.1	41.1				



Liquid Limit= 42
Plastic Limit= 36
Plasticity Index= 6
Natural Moisture= 30.6
Liquidity Index= -0.9

Plastic Limit Data

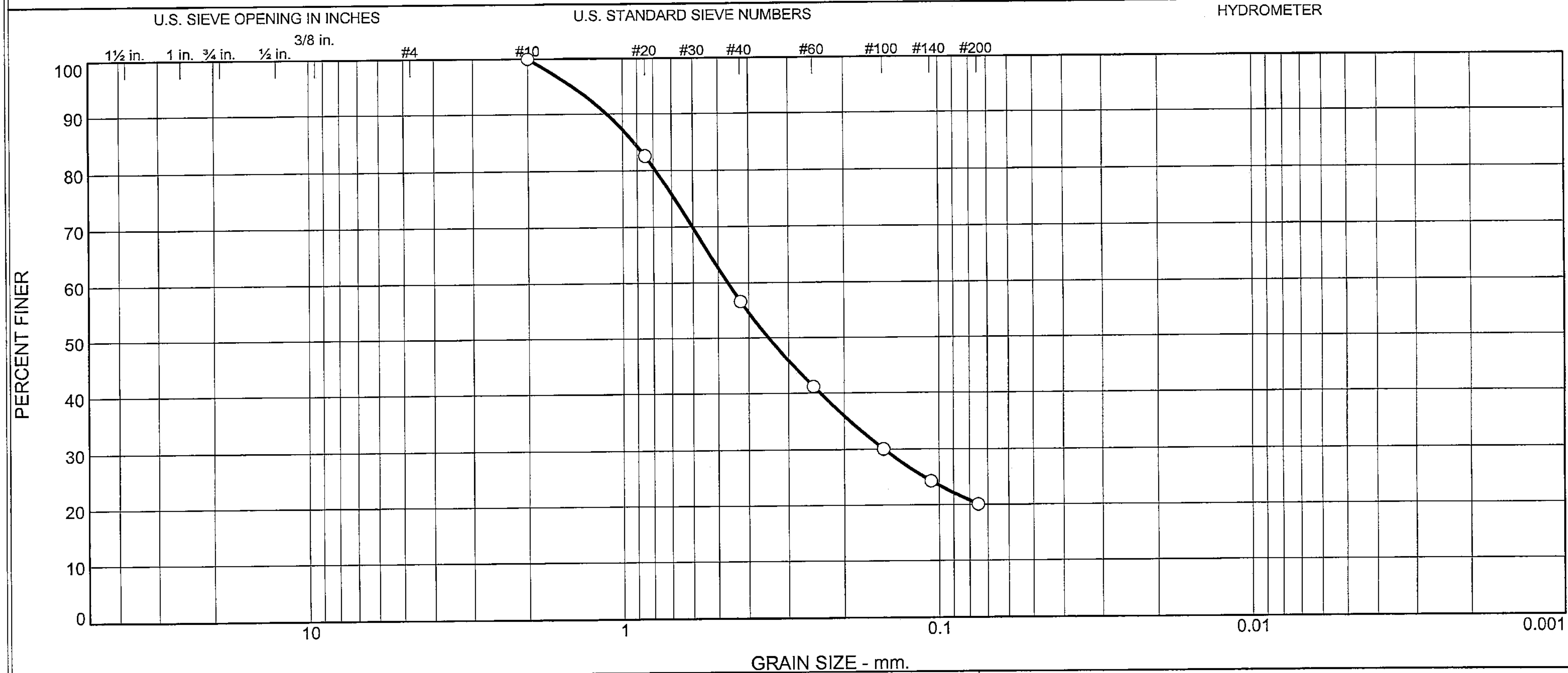
Run No.	1	2	3	4
Wet+Tare	19.71	26.14		
Dry+Tare	17.42	23.37		
Tare	11.08	15.60		
Moisture	36.1	35.6		

Natural Moisture Data

Wet+Tare	Dry+Tare	Tare	Moisture
166.38	139.20	50.39	30.6

MACTEC Engineering and Consulting, Inc.

Particle Size Distribution Report ASTM D 6913-04e2



	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
○	0.0	0.0	0.0	43.4	36.5	20.1	

	Source	Sample #	Depth/Elev.	Date Sampled	USCS	Material Description	NM %	LL	PL
○	Boring M-10(DH)	SS-10	49.1-50.6'	9/1/09	SM (visual)	Pale Brown Silty SAND (visual)	16.4	ND	ND

Client BECHTEL POWER CORPORATION
Project North Anna 3 Project

Project No. 6468092473   Figure NA

MACTEC Engineering and Consulting, Inc.

Raleigh, North Carolina

○ ND = Not Determined
NA = Not Applicable
ASTM D 6913-04e2 Method B

Tested By: CS   **Checked By:** MDC DSC 11-12-09

GRAIN SIZE DISTRIBUTION TEST DATA

11/4/2009

Client: BECHTEL POWER CORPORATION
Project: North Anna 3 Project
Project Number: 6468092473
Location: Boring M-10(DH)
Depth: 49.1-50.6' **Sample Number:** SS-10
Material Description: Pale Brown Silty SAND (visual)
Date: 9/1/09 **Natural Moisture:** 16.4
Liquid Limit: ND **Plastic Limit:** ND **USCS Class.:** SM (visual)
Testing Remarks: ND = Not Determined
NA = Not Applicable
ASTM D 6913-04e2 Method B
Tested by: CS **Checked by:** MDC

Sieve Test Data

Dry Sample and Tare (grams)	Tare (grams)	Cumulative Pan Tare Weight (grams)	Sieve Opening Size	Cumulative Weight Retained (grams)	Percent Finer
294.04	0.00	0.00	#10	0.00	100.0
54.09	0.00	0.00	#20	9.44	82.5
			#40	23.50	56.6
			#60	31.81	41.2
			#100	37.84	30.0
			#140	40.93	24.3
			#200	43.23	20.1

Fractional Components

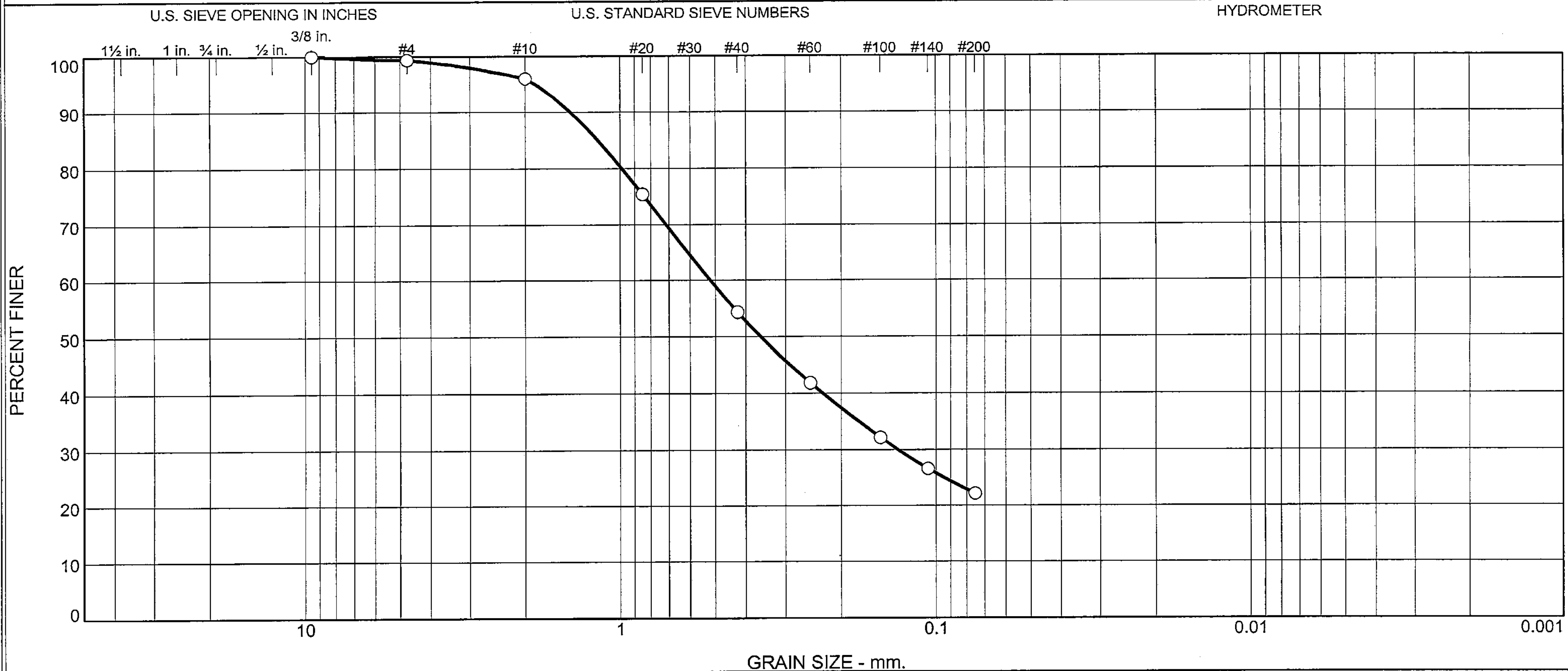
Cobbles	Gravel			Sand				Fines		
	Coarse	Fine	Total	Coarse	Medium	Fine	Total	Silt	Clay	Total
0.0	0.0	0.0	0.0	0.0	43.4	36.5	79.9			20.1

D_{10}	D_{15}	D_{20}	D_{30}	D_{50}	D_{60}	D_{80}	D_{85}	D_{90}	D_{95}
			0.1497	0.3471	0.4672	0.7872	0.9219	1.1221	1.4490

Fineness Modulus
1.63

MACTEC Engineering and Consulting, Inc.

Particle Size Distribution Report ASTM D 6913-04e2



	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
○	0.0	0.7	3.3	41.8	32.1	22.1	

	Source	Sample #	Depth/Elev.	Date Sampled	USCS	Material Description	NM %	LL	PL
○	Boring M-10(DH)	SS-12	59.1-60.6	9/2/09	SM (visual)	Very Pale Brown Silty SAND (visual)	15.1	ND	ND

Client BECHTEL POWER CORPORATION

Project North Anna 3 Project

Project No. 6468092473 Figure NA

MACTEC Engineering and Consulting, Inc.

Raleigh, North Carolina

○ ND = Not Determined
NA = Not Applicable
ASTM D 6913-04e2 Method B

Tested By: CS **Checked By:** MDC DSC 11-12-09

GRAIN SIZE DISTRIBUTION TEST DATA

11/4/2009

Client: BECHTEL POWER CORPORATION
Project: North Anna 3 Project
Project Number: 6468092473
Location: Boring M-10(DH)
Depth: 59.1-60.6 **Sample Number:** SS-12
Material Description: Very Pale Brown Silty SAND (visual)
Date: 9/2/09 **Natural Moisture:** 15.1
Liquid Limit: ND **Plastic Limit:** ND **USCS Class.:** SM (visual)
Testing Remarks: ND = Not Determined
NA = Not Applicable
ASTM D 6913-04e2 Method B
Tested by: CS **Checked by:** MDC

Sieve Test Data

Dry Sample and Tare (grams)	Tare (grams)	Cumulative Pan Tare Weight (grams)	Sieve Opening Size	Cumulative Weight Retained (grams)	Percent Finer
365.85	0.00	0.00	3/8"	0.00	100.0
			#4	2.42	99.3
			#10	14.64	96.0
103.77	0.00	0.00	#20	22.26	75.4
			#40	45.15	54.2
			#60	58.54	41.8
			#100	69.02	32.1
			#140	75.01	26.6
			#200	79.83	22.1

Fractional Components

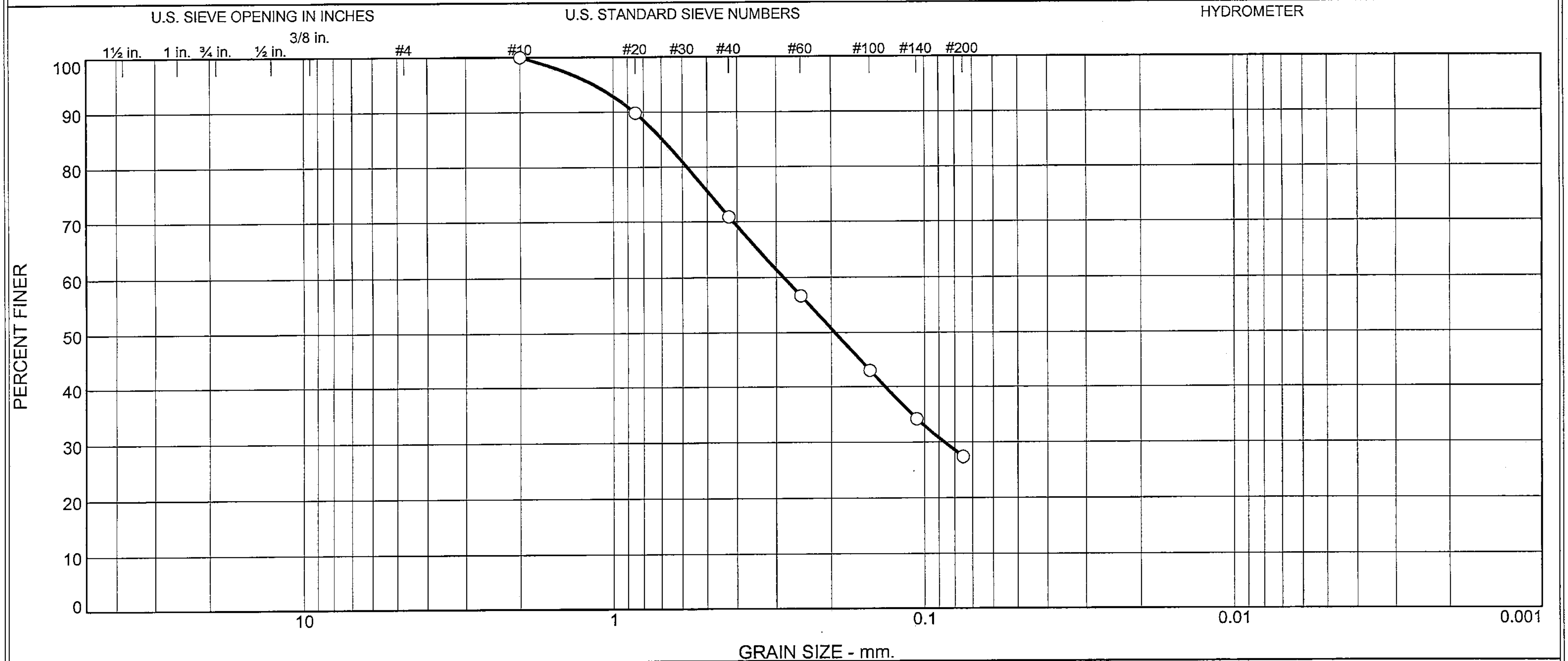
Cobbles	Gravel			Sand				Fines		
	Coarse	Fine	Total	Coarse	Medium	Fine	Total	Silt	Clay	Total
0.0	0.0	0.7	0.7	3.3	41.8	32.1	77.2			22.1

D_{10}	D_{15}	D_{20}	D_{30}	D_{50}	D_{60}	D_{80}	D_{85}	D_{90}	D_{95}
			0.1321	0.3606	0.5195	0.9889	1.1797	1.4410	1.8660

Fineness Modulus
1.76

MACTEC Engineering and Consulting, Inc.

Particle Size Distribution Report ASTM D 6913-04e2



	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
○	0.0	0.0	0.0	29.2	43.4	27.4	

	Source	Sample #	Depth/Elev.	Date Sampled	USCS	Material Description	NM %	LL	PL
○	Boring M-10(DH)	SS-15	74.1-75.6	9/2/09	SM (visual)	Very Dark Bluish Gray Silty SAND (visual)	29.9	ND	ND

Client BECHTEL POWER CORPORATION Project North Anna 3 Project Project No. 6468092473 Figure NA	MACTEC Engineering and Consulting, Inc. Raleigh, North Carolina	○ ND = Not Determined NA = Not Applicable ASTM D 6913-04e2 Method B

Tested By: CS **Checked By:** MDC DSC 11-12-09

GRAIN SIZE DISTRIBUTION TEST DATA

11/4/2009

Client: BECHTEL POWER CORPORATION
Project: North Anna 3 Project
Project Number: 6468092473
Location: Boring M-10(DH)
Depth: 74.1-75.6 **Sample Number:** SS-15
Material Description: Very Dark Bluish Gray Silty SAND (visual)
Date: 9/2/09 **Natural Moisture:** 29.9
Liquid Limit: ND **Plastic Limit:** ND **USCS Class.:** SM (visual)
Testing Remarks: ND = Not Determined
NA = Not Applicable
ASTM D 6913-04e2 Method B
Tested by: CS **Checked by:** MDC

Sieve Test Data

Dry Sample and Tare (grams)	Tare (grams)	Cumulative Pan Tare Weight (grams)	Sieve Opening Size	Cumulative Weight Retained (grams)	Percent Finer
346.65	0.00	0.00	#10	0.00	100.0
102.83	0.00	0.00	#20	10.45	89.8
			#40	30.00	70.8
			#60	44.61	56.6
			#100	58.62	43.0
			#140	67.70	34.2
			#200	74.67	27.4

Fractional Components

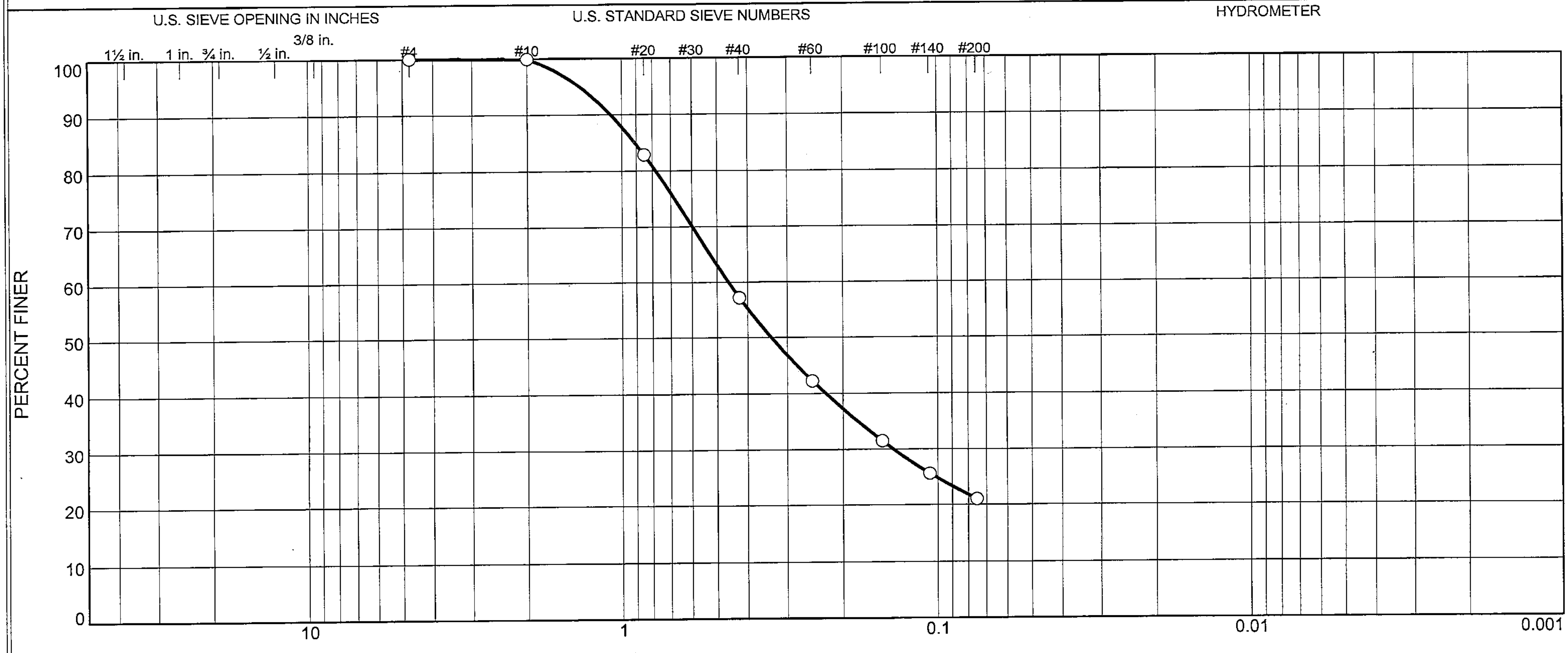
Cobbles	Gravel			Sand				Fines		
	Coarse	Fine	Total	Coarse	Medium	Fine	Total	Silt	Clay	Total
0.0	0.0	0.0	0.0	0.0	29.2	43.4	72.6			27.4

D_{10}	D_{15}	D_{20}	D_{30}	D_{50}	D_{60}	D_{80}	D_{85}	D_{90}	D_{95}
			0.0865	0.1948	0.2845	0.5812	0.6951	0.8566	1.1564

Fineness Modulus
1.19

MACTEC Engineering and Consulting, Inc.

Particle Size Distribution Report ASTM D 6913-04e2



	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
○	0.0	0.0	0.1	42.8	36.1	21.0	

	Source	Sample #	Depth/Elev.	Date Sampled	USCS	Material Description	NM %	LL	PL
○	Boring M-10(DH)	SS-17	84.1-85.6'	9/2/09	SM (visual)	Very Pale Brown Silty SAND (visual)	15.1	ND	ND

Client BECHTEL POWER CORPORATION
Project North Anna 3 Project
Project No. 6468092473 Figure NA

MACTEC Engineering and Consulting, Inc.
Raleigh, North Carolina

○ ND = Not Determined
NA = Not Applicable
ASTM D 6913-04e2 Method B

Tested By: CS **Checked By:** MDC DSC 11-12-09

11/4/2009

GRAIN SIZE DISTRIBUTION TEST DATA

Client: BECHTEL POWER CORPORATION
Project: North Anna 3 Project
Project Number: 6468092473
Location: Boring M-10(DH)
Depth: 84.1-85.6'
Sample Number: SS-17
Material Description: Very Pale Brown Silty SAND (visual)
Date: 9/2/09
Natural Moisture: 15.1
Liquid Limit: ND
Plastic Limit: ND
USCS Class.: SM (visual)
Testing Remarks: ND = Not Determined
NA = Not Applicable
ASTM D 6913-04e2 Method B
Tested by: CS
Checked by: MDC

Sieve Test Data

Dry Sample and Tare (grams)	Tare (grams)	Cumulative Pan Tare Weight (grams)	Sieve Opening Size	Cumulative Weight Retained (grams)	Percent Finer
369.27	0.00	0.00	#4	0.00	100.0
			#10	0.37	99.9
49.68	0.00	0.00	#20	8.46	82.9
			#40	21.26	57.1
			#60	28.66	42.3
			#100	34.03	31.5
			#140	36.95	25.6
			#200	39.24	21.0

Fractional Components

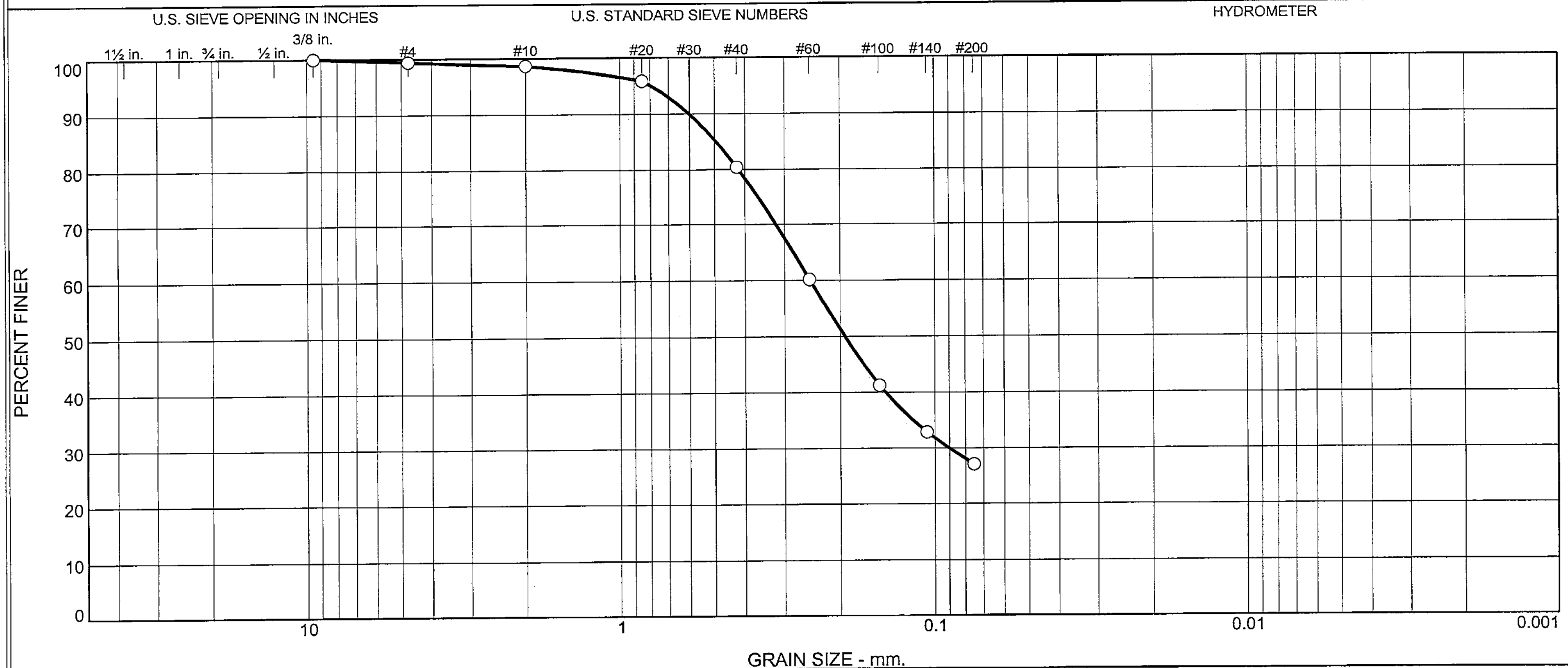
Cobbles	Gravel			Sand				Fines		
	Coarse	Fine	Total	Coarse	Medium	Fine	Total	Silt	Clay	Total
0.0	0.0	0.0	0.0	0.1	42.8	36.1	79.0			21.0

D_{10}	D_{15}	D_{20}	D_{30}	D_{50}	D_{60}	D_{80}	D_{85}	D_{90}	D_{95}
			0.1385	0.3377	0.4608	0.7812	0.9082	1.0859	1.3676

Fineness Modulus
1.60

MACTEC Engineering and Consulting, Inc.

Particle Size Distribution Report ASTM D 6913-04e2



	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
○	0.0	0.6	0.8	18.2	53.3	27.1	

	Source	Sample #	Depth/Elev.	Date Sampled	USCS	Material Description	NM %	LL	PL
○	Boring M-30(DH)	SS-1	8.7-10.2'	9/1/09	SM (visual)	Yellow Silty SAND (visual)	17.0	ND	ND

Client BECHTEL POWER CORPORATION
Project North Anna 3 Project
Project No. 6468092473 Figure N/A

MACTEC Engineering and Consulting, Inc.
Raleigh, North Carolina

○ ND = Not Determined
NA = Not Applicable
ASTM D 6913-04e2 Method B

Tested By: CS **Checked By:** BS DSC 11-12-09

GRAIN SIZE DISTRIBUTION TEST DATA

11/4/2009

Client: BECHTEL POWER CORPORATION
Project: North Anna 3 Project
Project Number: 6468092473
Location: Boring M-30(DH)
Depth: 8.7-10.2' **Sample Number:** SS-1
Material Description: Yellow Silty SAND (visual)
Date: 9/1/09 **Natural Moisture:** 17.0
Liquid Limit: ND **Plastic Limit:** ND **USCS Class.:** SM (visual)
Testing Remarks: ND = Not Determined
NA = Not Applicable
ASTM D 6913-04e2 Method B
Tested by: CS **Checked by:** BS

Sieve Test Data

Dry Sample and Tare (grams)	Tare (grams)	Cumulative Pan Tare Weight (grams)	Sieve Opening Size	Cumulative Weight Retained (grams)	Percent Finer
233.76	0.00	0.00	3/8"	0.00	100.0
			#4	1.50	99.4
			#10	3.25	98.6
100.91	0.00	0.00	#20	2.84	95.8
			#40	18.65	80.4
			#60	39.39	60.1
			#100	58.65	41.3
			#140	67.26	32.9
			#200	73.21	27.1

Fractional Components

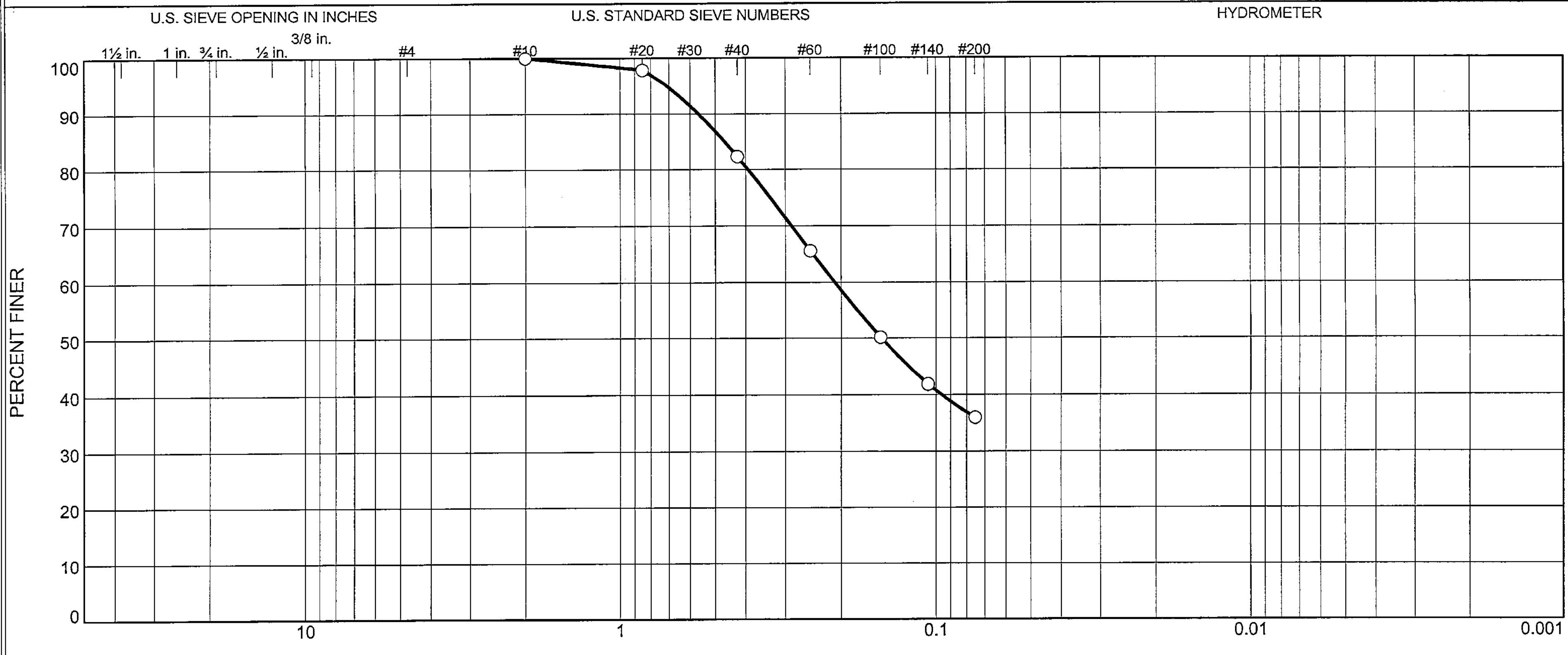
Cobbles	Gravel			Sand				Fines		
	Coarse	Fine	Total	Coarse	Medium	Fine	Total	Silt	Clay	Total
0.0	0.0	0.6	0.6	0.8	18.2	53.3	72.3			27.1

D_{10}	D_{15}	D_{20}	D_{30}	D_{50}	D_{60}	D_{80}	D_{85}	D_{90}	D_{95}
			0.0902	0.1935	0.2493	0.4201	0.4941	0.6020	0.7955

Fineness Modulus
1.06

MACTEC Engineering and Consulting, Inc.

Particle Size Distribution Report ASTM D 6913-04e2



	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
○	0.0	0.0	0.0	17.7	46.3	36.0	

	Source	Sample #	Depth/Elev.	Date Sampled	USCS	Material Description	NM %	LL	PL
○	Boring M-30(DH)	SS-3	13.7-15.2	9/1/09	SM (visual)	Yellow Silty SAND (visual)	19.8	ND	ND

Client BECHTEL POWER CORPORATION
Project North Anna 3 Project
Project No. 6468092473 Figure N/A

MACTEC Engineering and Consulting, Inc.

Raleigh, North Carolina

○ ND = Not Determined
NA = Not Applicable
ASTM D 6913-04e2 Method B

Tested By: CS **Checked By:** BS DSC 11-12-09

GRAIN SIZE DISTRIBUTION TEST DATA

11/4/2009

Client: BECHTEL POWER CORPORATION
Project: North Anna 3 Project
Project Number: 6468092473
Location: Boring M-30(DH)
Depth: 13.7-15.2 **Sample Number:** SS-3
Material Description: Yellow Silty SAND (visual)
Date: 9/1/09 **Natural Moisture:** 19.8
Liquid Limit: ND **Plastic Limit:** ND **USCS Class.:** SM (visual)
Testing Remarks: ND = Not Determined
NA = Not Applicable
ASTM D 6913-04e2 Method B
Tested by: CS **Checked by:** BS

Sieve Test Data

Dry Sample and Tare (grams)	Tare (grams)	Cumulative Pan Tare Weight (grams)	Sieve Opening Size	Cumulative Weight Retained (grams)	Percent Finer
218.25	0.00	0.00	#10	0.00	100.0
51.75	0.00	0.00	#20	1.12	97.8
			#40	9.18	82.3
			#60	17.81	65.6
			#100	25.82	50.1
			#140	30.09	41.9
			#200	33.12	36.0

Fractional Components

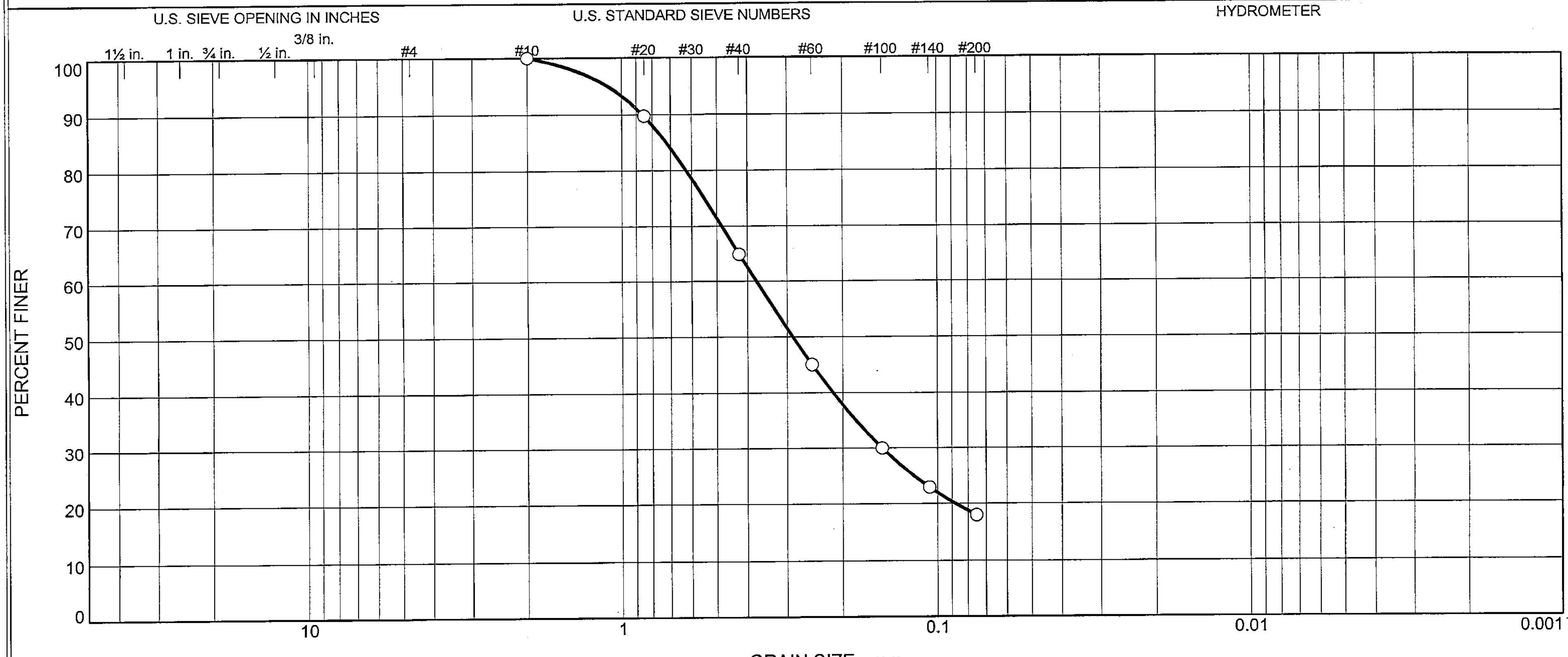
Cobbles	Gravel			Sand				Fines		
	Coarse	Fine	Total	Coarse	Medium	Fine	Total	Silt	Clay	Total
0.0	0.0	0.0	0.0	0.0	17.7	46.3	64.0			36.0

D_{10}	D_{15}	D_{20}	D_{30}	D_{50}	D_{60}	D_{80}	D_{85}	D_{90}	D_{95}
				0.1494	0.2097	0.3940	0.4674	0.5646	0.7103

Fineness Modulus
0.88

MACTEC Engineering and Consulting, Inc.

Particle Size Distribution Report ASTM D 6913-04e2



	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
○	0.0	0.0	0.0	35.1	46.9	18.0	

	Source	Sample #	Depth/Elev.	Date Sampled	USCS	Material Description	NM %	LL	PL
○	Boring M-30(DH)	SS-5	23.7-25.2'	9/1/09	SM (visual)	Pale Yellow Silty SAND (visual)	18.5	ND	ND

Client BECHTEL POWER CORPORATION
Project North Anna 3 Project
Project No. 6468092473 Figure N/A

MACTEC Engineering and Consulting, Inc.
Raleigh, North Carolina

○ ND = Not Determined
NA = Not Applicable
ASTM D 6913-04e2 Method B

Tested By: CS **Checked By:** BS DSC 11-12-09

GRAIN SIZE DISTRIBUTION TEST DATA

11/4/2009

Client: BECHTEL POWER CORPORATION
Project: North Anna 3 Project
Project Number: 6468092473
Location: Boring M-30(DH)
Depth: 23.7-25.2'
Sample Number: SS-5
Material Description: Pale Yellow Silty SAND (visual)
Date: 9/1/09
Natural Moisture: 18.5
Liquid Limit: ND
Plastic Limit: ND
USCS Class.: SM (visual)
Testing Remarks: ND = Not Determined
NA = Not Applicable
ASTM D 6913-04e2 Method B
Tested by: CS
Checked by: BS

Sieve Test Data

Dry Sample and Tare (grams)	Tare (grams)	Cumulative Pan Tare Weight (grams)	Sieve Opening Size	Cumulative Weight Retained (grams)	Percent Finer
346.85	0.00	0.00	#10	0.00	100.0
102.89	0.00	0.00	#20	10.59	89.7
			#40	36.14	64.9
			#60	56.55	45.0
			#100	72.09	29.9
			#140	79.39	22.8
			#200	84.41	18.0

Fractional Components

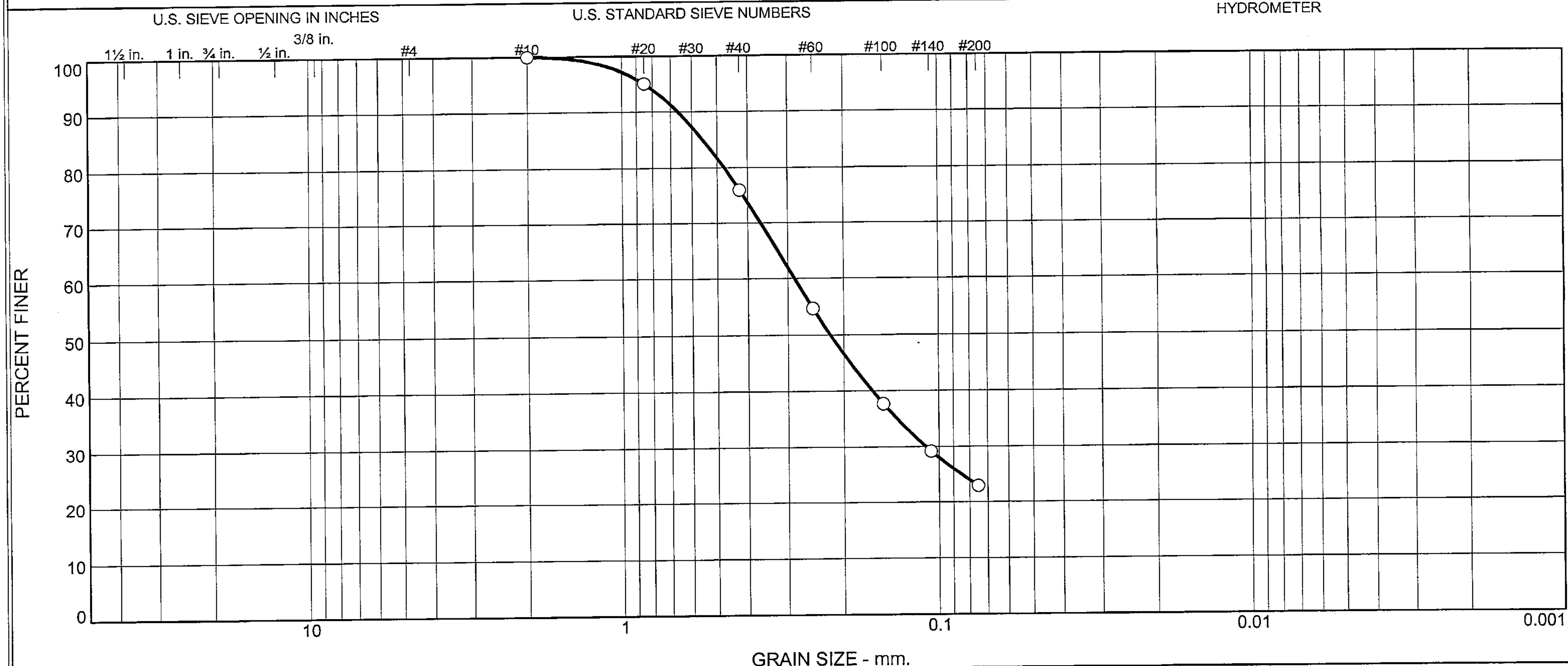
Cobbles	Gravel			Sand				Fines		
	Coarse	Fine	Total	Coarse	Medium	Fine	Total	Silt	Clay	Total
0.0	0.0	0.0	0.0	0.0	35.1	46.9	82.0			18.0

D_{10}	D_{15}	D_{20}	D_{30}	D_{50}	D_{60}	D_{80}	D_{85}	D_{90}	D_{95}
		0.0876	0.1504	0.2879	0.3756	0.6255	0.7230	0.8599	1.1087

Fineness Modulus
1.44

MACTEC Engineering and Consulting, Inc.

Particle Size Distribution Report ASTM D 6913-04e2



	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
○	0.0	0.0	0.0	24.0	53.1	22.9	

	Source	Sample #	Depth/Elev.	Date Sampled	USCS	Material Description	NM %	LL	PL
○	Boring M-30(DH)	SS-7	33.7-35.2	9/1/09	SM (visual)	Yellow Silty SAND (visual)	14.8	ND	ND

Client BECHTEL POWER CORPORATION
Project North Anna 3 Project
Project No. 6468092473 Figure NA

MACTEC Engineering and Consulting, Inc.
Raleigh, North Carolina

○ ND = Not Determined
NA = Not Applicable
ASTM D 6913-04e2 Method B

Tested By: CS **Checked By:** BS DSC 11-12-09

GRAIN SIZE DISTRIBUTION TEST DATA

11/4/2009

Client: BECHTEL POWER CORPORATION
Project: North Anna 3 Project
Project Number: 6468092473
Location: Boring M-30(DH)
Depth: 33.7-35.2 **Sample Number:** SS-7
Material Description: Yellow Silty SAND (visual)
Date: 9/1/09 **Natural Moisture:** 14.8
Liquid Limit: ND **Plastic Limit:** ND **USCS Class.:** SM (visual)
Testing Remarks: ND = Not Determined
NA = Not Applicable
ASTM D 6913-04e2 Method B
Tested by: CS **Checked by:** BS

Sieve Test Data

Dry Sample and Tare (grams)	Tare (grams)	Cumulative Pan Tare Weight (grams)	Sieve Opening Size	Cumulative Weight Retained (grams)	Percent Finer
384.34	0.00	0.00	#10	0.00	100.0
51.82	0.00	0.00	#20	2.58	95.0
			#40	12.45	76.0
			#60	23.52	54.6
			#100	32.29	37.7
			#140	36.72	29.1
			#200	39.95	22.9

Fractional Components

Cobbles	Gravel			Sand				Fines		
	Coarse	Fine	Total	Coarse	Medium	Fine	Total	Silt	Clay	Total
0.0	0.0	0.0	0.0	0.0	24.0	53.1	77.1			22.9

D_{10}	D_{15}	D_{20}	D_{30}	D_{50}	D_{60}	D_{80}	D_{85}	D_{90}	D_{95}
			0.1104	0.2208	0.2862	0.4750	0.5540	0.6647	0.8489

Fineness Modulus
1.14

MACTEC Engineering and Consulting, Inc.

FINAL DATA REPORT
Revision 0
GEOTECHNICAL EXPLORATION AND TESTING
SUPPLEMENT 2
DOMINION POWER
NORTH ANNA NUCLEAR POWER STATION
NORTH ANNA 3 PROJECT
MINERAL, LOUISA COUNTY, VIRGINIA

December 16, 2009

VOLUME 1

APPENDIX D.2
Rock Core Unconfined Strength Tests

Prepared By:

MACTEC ENGINEERING AND CONSULTING, INC.
RALEIGH, NORTH CAROLINA

MACTEC PROJECT No. 6468-09-2473

Prepared For:

Bechtel Power Corporation
Subcontractor No. 25161-500-HC4-CY00-00001

North Anna 3 Project

MACTEC Project: 6468-09-2473

Summary Report for Rock Core Testing

NAP301 1/2

MACTEC

Summary of Laboratory Testing
Standard Test Method for Compressive Strength and Elastic Moduli of Intact Rock Core Specimens under Varying States of Stress and Temperatures
ASTM D7012-07e1

Project Name: North Anna 3
MACTEC Project No.: 6468-09-2473

Boring Number	Run Number	Sample Depth (ft)	Diameter (in)	Length (in)	Time to Failure	Unconfined Compressive Strength (psi)	As Received Unit Weight (pcf)
M-10 (DH)	RS-1	117.45-117.9	2.41	5.15	5 min 6 sec	7960	160.1
M-10 (DH)	RS-2	133.75-134.2	2.41	5.09	15 min 13 sec	19640	161.9
M-10 (DH)	RS-3	153.7-154.15	2.41	5.08	16 min 0 sec	33830	163.5
M-10 (DH)	RS-4	177.6-178.05	2.39	5.14	26 min 44 sec	20880	163.3
M-10 (DH)	RS-5	196.7-197.15	2.39	5.18	12 min 59 sec	30780	163.7
M-30 (DH)	RS-6	57.0-57.45	2.40	5.18	14 min 8 sec	28650	162.8
M-30 (DH)	RS-7	95.4-95.85	2.39	5.06	9 min 39 sec	23700	162.7
M-30 (DH)	RS-8	134.9-135.35	2.39	5.26	9 min 47 sec	26200	163.7
M-30 (DH)	RS-9	166.9-167.35	2.40	5.06	7 min 5 sec	24820	164.6
M-30 (DH)	RS-10	197.05-197.5	2.40	5.16	10 min 29 sec	33040	162.6

Created By: DAK 12-1-09
Checked By: JHA 12-1-09
Reviewed By: MA 12-1-09