PNNL-16476
6303-01 Vol. 2
Rev. 1

Pacific Northwest
National Laboratory
Operated by Battelle for the
U.S. Department of Energy

Final Data Report: P- and S-Wave Velocity Logging Borings C4993, C4996, And C4997 Part B: Overall Logs

J. Diehl
R. Steller

March 2007

Prepared by GEOVision Geophysical Services
for the Pacific Northwest National Laboratory
under Contract DE-AC05-76RL01830
with the U.S. Department of Energy

GEOVision
geophysical services

FINAL DATA REPORT

P- AND S-WAVE VELOCITY LOGGING
BORINGS C4993, C4996 AND C4997
PART B: OVERALL LOGS

WTP SEISMIC BOREHOLE PROJECT
Hanford, Washington

6303-01 Vol 2 of 3 WTP P-S Logging rev 1

February 26, 2007

Revised March 8, 2007

FINAL DATA REPORT

P- AND S-WAVE VELOCITY LOGGING BORINGS C4993, C4996 AND C4997 PART B: OVERALL LOGS

WTP SEISMIC BOREHOLE PROJECT Hanford, Washington

Prepared for:

Pacific Northwest National Laboratory
902 Battelle Boulevard
Richland, Washington 99352

Prepared by

GEOVision Geophysical Services
1151 Pomona Road, Unit P
Corona, California 92882
(951) 549-1234

DISCLAIMER

PACIFIC NORTHWEST NATIONAL LABORATORY
operated by
BATTELLE
for the
UNITED STATES DEPARTMENT OF ENERGY
under Contract DE-AC05-76RL01830

Printed in the United States of America

Available to DOE and DOE contractors from the
Office of Scientific and Technical Information,
P.O. Box 62, Oak Ridge, TN 37831-0062;
ph: (865) 576-8401
fax: (865) 576-5728
email: reports@adonis.osti.gov

Available to the public from the National Technical Information Service,
U.S. Department of Commerce, 5285 Port Royal Rd., Springfield, VA 22161
ph: (800) 553-6847
fax: (703) 605-6900
email: orders@ntis.fedworld.gov
online ordering: http://www.ntis.gov/ordering.htm

TABLE OF CONTENTS

Table of Figures

Table of Tables

1.0 INTRODUCTION

Insitu borehole P- and S-wave velocity measurements were collected in three borings located within the Waste Treatment Plant (WTP) boundaries at the Hanford Site, southeastern Washington. Geophysical data acquisition was performed between August and October of 2006 by Rob Steller, Charles Carter, Antony Martin and John Diehl of **GEO***Vision*. Data analysis was performed by Rob Steller and John Diehl, and reviewed by Antony Martin of GEOVision, and report preparation was performed by John Diehl and reviewed by Rob Steller. The work was performed under subcontract with Battelle, Pacific Northwest Division with Marty Gardner as Battelle's Technical Representative and Alan Rohay serving as the Technical Administrator for Pacific Northwest National Laboratory (PNNL).

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

2.0 SCOPE OF WORK

This report presents the results of insitu geophysical PS suspension seismic measurements collected between August and October, 2006, in three borings, as detailed below and summarized in Table 1. The purpose of these studies was to acquire shear wave velocities and compressional wave velocities as a function of depth, to support the WTP Seismic Borehole Project. This work was performed within the boundaries of the Hanford Site.

Table 1. Boring locations

BORING DESIGNATION	X	Y	Z
BH-C4993	307755.440	5158260.488	200.499
BH-C4996	307826.310	5158555.282	204.079
BH-C4997	307977.327	5158249.420	206.406

Reference:
Waste Treatment Plant Borehole Survey, January 15-16, 2007
UTM Zone 11, Horizontal Datum NAD83, Horizontal and Vertical Units Meters, Vertical Datum NAVD88

The primary focus of borehole geophysics was to measure the seismic velocities in the "interbeds" between basalt flows. GEOVision acquired this data (this report, Part A) in freshly drilled segments, beginning nominally 50ft below the previous interbed, and continuing to about 30ft below the next interbed. Part A of this report describes the results of these interval measurements. This Part B of this report describes overall measurements in completed, but cemented boreholes.

The OYO Model 170 Suspension Logging Recorder and Suspension Logging Probe was used to obtain in-situ horizontal shear and compressional wave velocity measurements at generally 3.3 foot (1m) intervals. The acquired data was analyzed and a profile of velocity versus depth was produced for both compressional and horizontally polarized shear waves.

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.

3.0 INSTRUMENTATION

Suspension soil velocity measurements were performed in all borings using the Model 170 suspension logging system, manufactured by OYO Corporation. This system is described in detail in Volume 1 of this report, Section 3.0.

4.0 MEASUREMENT PROCEDURES

Measurements followed the **GEO***Vision* Procedure for P-S Suspension Seismic Velocity Logging, revision 1.3, as presented in Appendix D. In each boring, the probe was positioned with the mid-point between receivers at ground surface, as verified with a tape measure, and recorded on the field logs. The probe was lowered to the bottom of the boring, and then returned to the surface, stopping at 3.3 foot intervals to collect data, as summarized in Table 2.

Table 2. Logging dates and depth ranges (BGS)

BORING NUMBER	RUN NUMBER	DEPTH RANGE (FEET)	OPEN HOLE (FEET)	DEPTH TO BOTTOM OF CASING (FEET)	SAMPLE INTERVAL (FEET)	RECEIVER	DATE LOGGED
BH-C4993	Log 6+	357.6 – 1400.9	1411	363	3.3	330094	10/14/06
BH-C4996*	Log 5B+	347.8 - 1263.1	1276	349	3.3	26066	8/28/06
BH-C4996	Log 5A	1266 - 1322	1276	349	1.6	23053	8/28/06
BH-C4996	Log 6	1325.5 - 1362	1463	349	1.6	26066	9/6/06
BH-C4996	Log 7+	1364.8 - 1453.4	1465	349	3.30	26066	9/19/06
BH-C4997	Log 7+	383.9 - 1417.3	1429	384	3.3	330094	10/13/06

* BH-C4996 is labeled in the Figures and Tables as Log 5B + 7 to indicate it is a compilation

+ These logs were done at 1m intervals over the entire borehole after final cementing.

OYO PS170 Data Logger/Recorder Model 3331 S/N 15014 was used for all of these logs

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 printed on paper tape, checked, and recorded on diskette 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.

5.0 DATA ANALYSIS

Data analysis was completed as described in Volume 1 (Part A) of this report, Section 5.0.

6.0 RESULTS

Suspension R1-R2 P- and S_H-wave velocities are plotted in Figures 4, 5, and 6. The suspension velocity data presented in these figures are presented in Tables 3, 4, and 5. The PSLOG and EXCEL analysis files for each boring are included in the boring specific directories on volume 3 of 3 (CDR) of this report, along with the raw and filtered waveforms.

P- and S_H-wave velocity data from R1-R2 analysis and quality assurance analysis of S-R1 data are plotted together in Appendix A (Figures A-1 through A-3) 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 6.75 feet, creating a significant smoothing relative to the R1-R2 plots. S-R1 data are presented in Appendix A (Tables A-1 through A-3), and included in the EXCEL analysis files for each boring on volume 3 of 3 (CDR) of this report.

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

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

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

7.0 SUMMARY

Discussion of Suspension Results

Suspension PS velocity data is ideally collected in an uncased fluid filled boring, drilled with rotary mud (rotary wash) methods. The drilling method used in all of these boreholes was ideal for collection of suspension PS velocity data. The borehole diameters, at 9 inches, is larger than optimal, but the logs in all boreholes were successful. All boreholes showed good to excellent correlation between R1 – R2 and S – R1 data, as well as excellent correlation between P-wave and S_H-wave velocities except in transition zones. P- and S-wave arrivals in the basalt portions of these boreholes were weak, as is generally the case in hard rock borings.

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.

Based on these criteria, most of the data collected at the Hanford WTP site are of good to excellent quality. Even though arrivals in basalt were weak, once identified, they were quite consistent. Following are specific discussions:

BH-C4993 LOG 6

The data quality was good, and the results agree well with the interval logs, particularly in the interbeds.

BH C4996 COMBINATION LOG 5B, 5A, 6 and 7

Unlike C4993 or C4997, which were logged in one long session with a single probe, this is a compilation of several logs. Unfortunately, not all sections are from the cemented borehole. There is a data gap in the cemented borehole log from 1322 to 1364ft. This has been filled with data from Log 6. Part of 5A may also be from the uncemented borehole, but this data (dates of cementation) are not known to this author. Despite the combination of different logs, different days, and different receivers, the data quality is good and this data agrees well with the interval logs, particularly in the interbeds.

There was one adjustment in the source delay to accommodate a shift in travel time, apparently due to the use of an older (more used) source for Log #7. This can be seen in column D of sheet: "Analysis, S-R1" in the Excel file "C4996 All", in Volume 3, Data, C4996 starting at depth 1383 and proceeding to the bottom at 1461 ft (adjusted S-R1 depths). This small shift of 0.09ms increase in delay helps the S-R1 results match up with the R1-R2 results. This is actually understandable, considering this log is compiled from four different logs using different equipment over almost a month.

BH-C4997 LOG 7

Part of borehole BH-C4997 data did not meet the above quality criteria. There was a failure of a source spring midway through the log. This is indicated by high variability in the source to receiver arrivals above about 810 feet, and lack of arrival time symmetry between normal and reverse. While receiver to receiver picks could still be made, and were made, they cannot be confirmed or verified by the source to receiver measurements in this part of the borehole. Because of the difficulty in picking, and lack of S-R1 confirmation, the measurements above 850ft, this upper part of the borehole is not considered as reliable as the associated interval logs. There were several measurements where picks were not made due to this difficulty, and are shown as gaps.

Despite these difficulties, the overall results are good and this data agrees well with the interval logs, particularly in the interbeds.

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* quality assurance 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 S_H-wave measurements are very reliable with estimated precision of +/- 5%. Due to the difficulty in picking weak signals and high velocities, which can be seen in the greater scatter of P-wave picks, P-wave measurements have an estimated precision of +/- 10%. Standardized field procedures and quality assurance checks contribute to the reliability of these data.

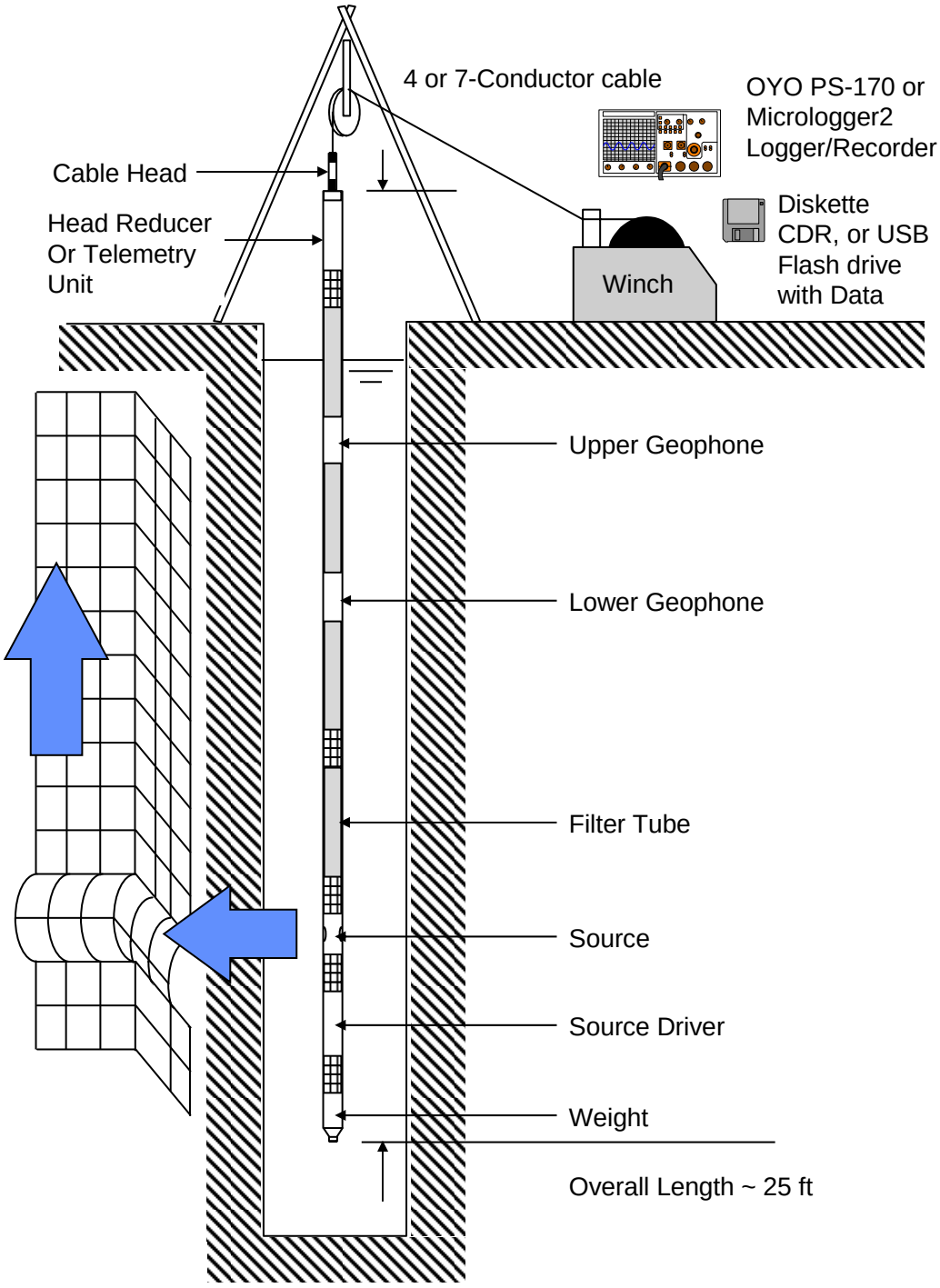


Figure 1: Concept illustration of P-S logging system

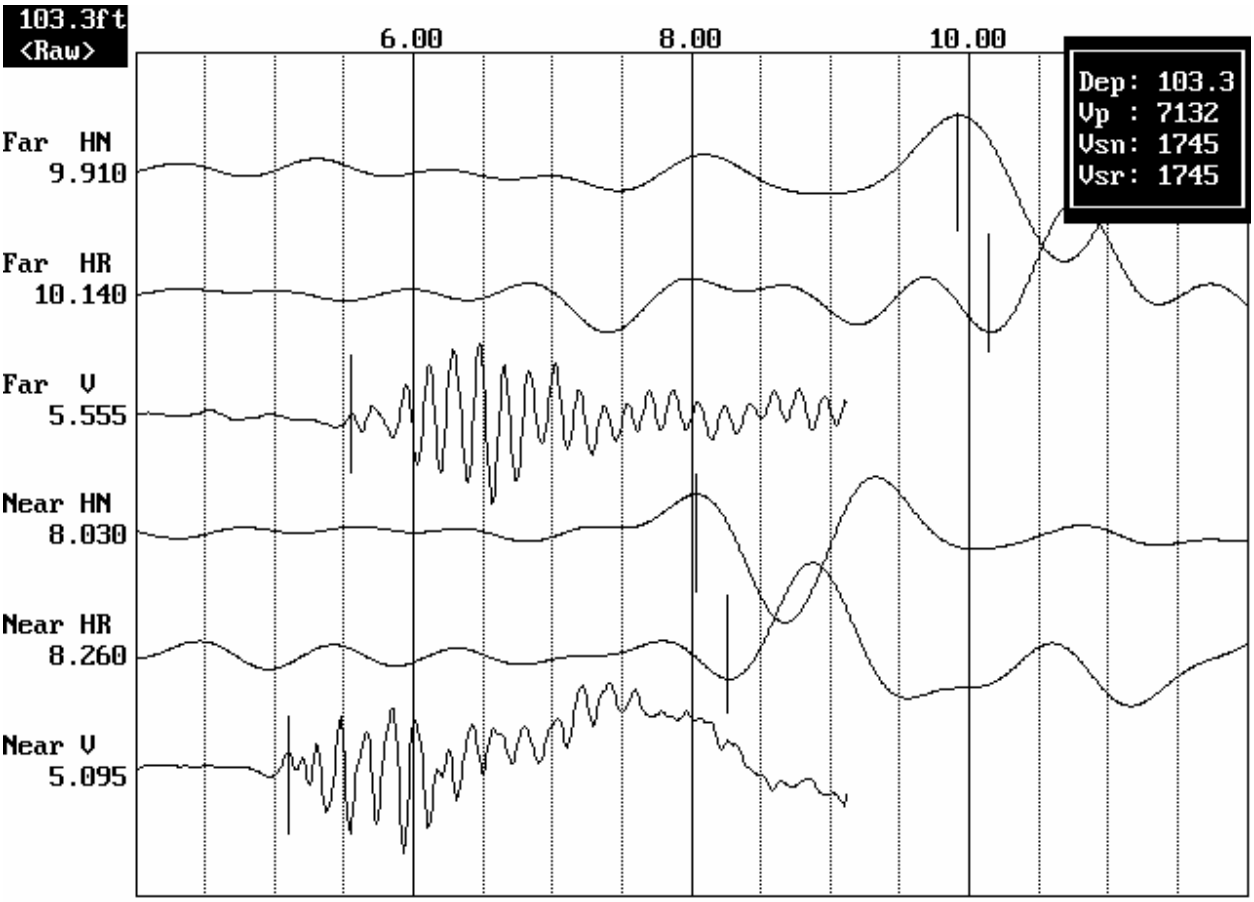


Figure 2: Example of filtered (1400 Hz lowpass) record

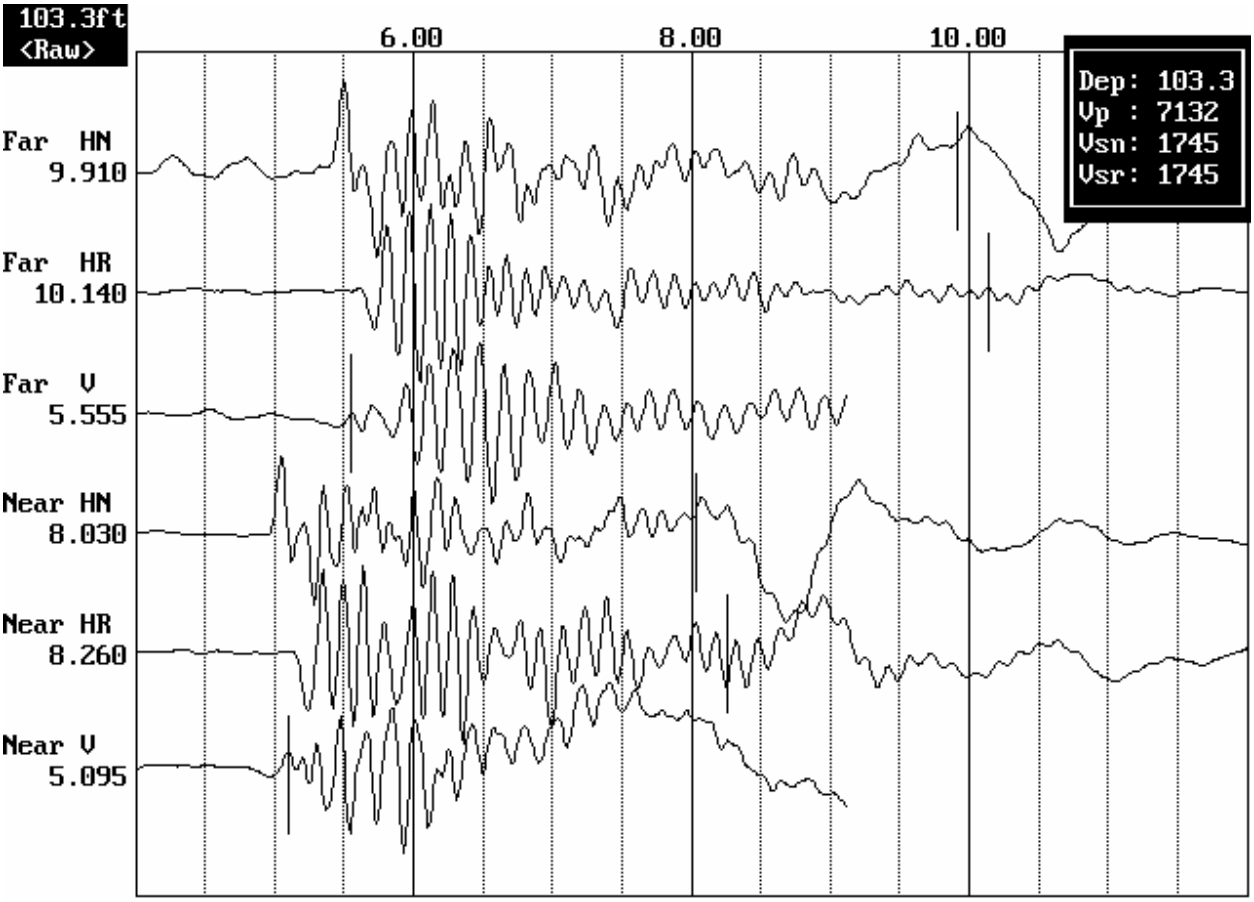


Figure 3. Example of unfiltered record

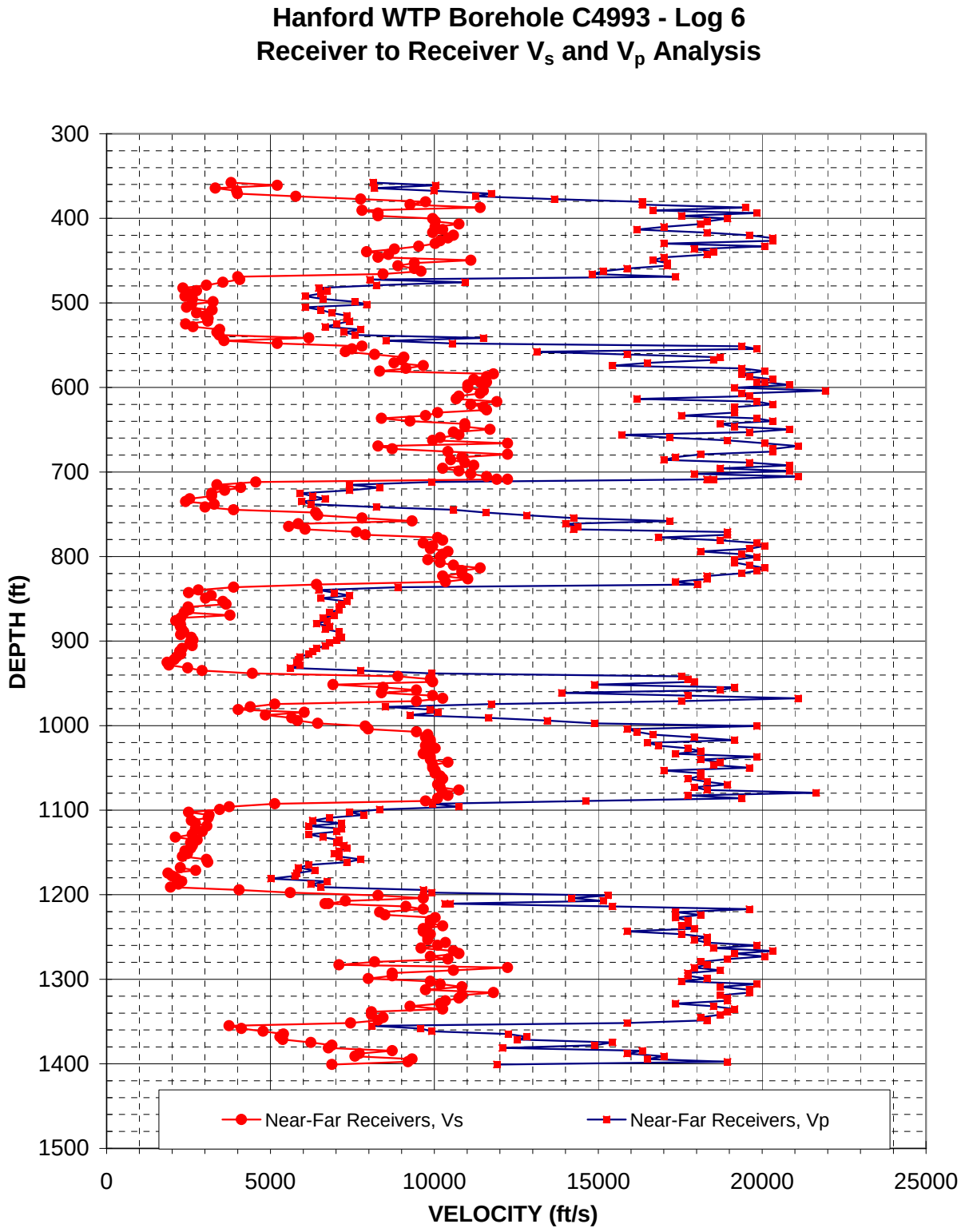


Figure 4: Boring BH-C4993 Log 6, Suspension R1-R2 P- and S_H-wave velocities

Table 3. Boring BH-C4993 Log 6, 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 C4993 RUN#6

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)	
357.6	3800	8130	0.36	109.0	1160	2480	0.36
360.9	5210	10040	0.32	110.0	1590	3060	0.32
364.2	3320	8170	0.40	111.0	1010	2490	0.40
367.5	3970	9980	0.41	112.0	1210	3040	0.41
370.7	3990	11740	0.43	113.0	1220	3580	0.43
374.0	5770	11260	0.32	114.0	1760	3430	0.32
377.3	7750	13660	0.26	115.0	2360	4160	0.26
380.6	9730	16340	0.23	116.0	2970	4980	0.23
383.9	9260	16340	0.26	117.0	2820	4980	0.26
387.1	11400	19490	0.24	118.0	3470	5940	0.24
390.4	7800	16670	0.36	119.0	2380	5080	0.36
393.7	8280	19840	0.39	120.0	2520	6050	0.39
397.0	8280	17540	0.36	121.0	2520	5350	0.36
400.3	9950	18940	0.31	122.0	3030	5770	0.31
403.5	10030	18320	0.29	123.0	3060	5580	0.29
406.8	10750	18120	0.23	124.0	3280	5520	0.23
410.1	10030	17010	0.23	125.0	3060	5180	0.23
413.4	10260	16180	0.16	126.0	3130	4930	0.16
416.7	9950	18320	0.29	127.0	3030	5580	0.29
420.0	10580	19610	0.29	128.0	3230	5980	0.29
423.2	10420	20330	0.32	129.0	3180	6200	0.32
426.5	10180	20330	0.33	130.0	3100	6200	0.33
429.8	10030	17010	0.23	131.0	3060	5180	0.23
433.1	9520	20080	0.35	132.0	2900	6120	0.35
436.4	8780	17920	0.34	133.0	2680	5460	0.34
439.6	7940	18520	0.39	134.0	2420	5640	0.39
442.9	8600	18320	0.36	135.0	2620	5580	0.36
446.2	8280	17010	0.34	136.0	2520	5180	0.34
449.5	11110	16670	0.10	137.0	3390	5080	0.10
452.8	9390	17090	0.28	138.0	2860	5210	0.28
456.0	8890	17090	0.31	139.0	2710	5210	0.31
459.3	9390	15870	0.23	140.0	2860	4840	0.23
462.6	9590	15150	0.17	141.0	2920	4620	0.17
465.9	8440	14810	0.26	142.0	2570	4520	0.26

Summary of Compressional Wave Velocity, Shear Wave Velocity, and Poisson's Ratio
Based on Receiver-to-Receiver Travel Time Data - Borehole C4993 RUN#6

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)	
469.2	4000	17360	0.47	143.0	1220	5290	0.47
472.4	4070	8030	0.33	144.0	1240	2450	0.33
475.7	3550	10930	0.44	145.0	1080	3330	0.44
479.0	3040	8230	0.42	146.0	930	2510	0.42
482.3	2330	6470	0.43	147.0	710	1970	0.43
485.6	2740	6730	0.40	148.0	840	2050	0.40
488.9	2560	6540	0.41	149.0	780	1990	0.41
492.1	2390	6060	0.41	150.0	730	1850	0.41
495.4	2620	6600	0.41	151.0	800	2010	0.41
498.7	3250	7580	0.39	152.0	990	2310	0.39
502.0	2590	7940	0.44	153.0	790	2420	0.44
505.3	2440	6060	0.40	154.0	740	1850	0.40
508.5	3220	6540	0.34	155.0	980	1990	0.34
511.8	2740	6870	0.41	156.0	840	2090	0.41
515.1	3020	7330	0.40	157.0	920	2230	0.40
518.4	3100	7330	0.39	158.0	950	2230	0.39
521.7	3090	7410	0.39	159.0	940	2260	0.39
524.9	2420	7020	0.43	160.0	740	2140	0.43
528.2	2640	6670	0.41	161.0	800	2030	0.41
531.5	3450	7750	0.38	162.0	1050	2360	0.38
534.8	3370	7250	0.36	163.0	1030	2210	0.36
538.1	3440	7580	0.37	164.0	1050	2310	0.37
541.3	6170	11490	0.30	165.0	1880	3500	0.30
544.6	3580	8530	0.39	166.0	1090	2600	0.39
547.9	5210	10550	0.34	167.0	1590	3220	0.34
551.2	7800	19380	0.40	168.0	2380	5910	0.40
554.5	7490	19840	0.42	169.0	2280	6050	0.42
557.7	7290	13120	0.28	170.0	2220	4000	0.28
561.0	8180	15870	0.32	171.0	2490	4840	0.32
564.3	9070	18730	0.35	172.0	2760	5710	0.35
567.6	9010	18520	0.34	173.0	2750	5640	0.34
570.9	8770	16500	0.30	174.0	2670	5030	0.30
574.2	9660	15430	0.18	175.0	2940	4700	0.18
577.4	9130	19380	0.36	176.0	2780	5910	0.36
580.7	8330	20080	0.40	177.0	2540	6120	0.40
584.0	11800	19380	0.21	178.0	3600	5910	0.21
587.3	11590	19610	0.23	179.0	3530	5980	0.23
590.6	11200	20330	0.28	180.0	3420	6200	0.28

Summary of Compressional Wave Velocity, Shear Wave Velocity, and Poisson's Ratio
Based on Receiver-to-Receiver Travel Time Data - Borehole C4993 RUN#6

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)	
593.8	11400	19840	0.25	181.0	3470	6050	0.25
593.8	11590	20080	0.25	181.0	3530	6120	0.25
597.1	11020	20830	0.31	182.0	3360	6350	0.31
600.4	11020	19160	0.25	183.0	3360	5840	0.25
603.7	11490	21930	0.31	184.0	3500	6680	0.31
607.0	11400	19380	0.24	185.0	3470	5910	0.24
610.2	10750	19610	0.28	186.0	3280	5980	0.28
613.5	10670	16180	0.12	187.0	3250	4930	0.12
616.8	11900	19840	0.22	188.0	3630	6050	0.22
620.1	11110	20330	0.29	189.0	3390	6200	0.29
623.4	11490	19160	0.22	190.0	3500	5840	0.22
626.6	11590	19160	0.21	191.0	3530	5840	0.21
629.9	10100	19160	0.31	192.0	3080	5840	0.31
633.2	9730	17540	0.28	193.0	2970	5350	0.28
636.5	8390	19840	0.39	194.0	2560	6050	0.39
639.8	9260	20330	0.37	195.0	2820	6200	0.37
643.0	10930	18730	0.24	196.0	3330	5710	0.24
646.3	10930	19160	0.26	197.0	3330	5840	0.26
649.6	11700	20830	0.27	198.0	3560	6350	0.27
652.9	10580	19610	0.29	199.0	3230	5980	0.29
656.2	10750	15720	0.06	200.0	3280	4790	0.06
659.5	10180	17180	0.23	201.0	3100	5240	0.23
662.7	9950	18940	0.31	202.0	3030	5770	0.31
666.0	12230	20080	0.20	203.0	3730	6120	0.20
669.3	8280	21100	0.41	204.0	2520	6430	0.41
672.6	8710	20330	0.39	205.0	2660	6200	0.39
675.9	10420	20330	0.32	206.0	3180	6200	0.32
679.1	12230	18120	0.08	207.0	3730	5520	0.08
682.4	10840	17360	0.18	208.0	3300	5290	0.18
685.7	10500	17010	0.19	209.0	3200	5180	0.19
689.0	10930	19610	0.27	210.0	3330	5980	0.27
692.3	11200	20830	0.30	211.0	3420	6350	0.30
695.5	10260	18730	0.29	212.0	3130	5710	0.29
698.8	10750	20830	0.32	213.0	3280	6350	0.32
702.1	11110	17920	0.19	214.0	3390	5460	0.19
705.4	11590	21100	0.28	215.0	3530	6430	0.28
708.7	11900	18320	0.13	216.0	3630	5580	0.13
708.7	12230	18520	0.11	216.0	3730	5640	0.11

Summary of Compressional Wave Velocity, Shear Wave Velocity, and Poisson's Ratio
Based on Receiver-to-Receiver Travel Time Data - Borehole C4993 RUN#6

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)	
711.9	4550	9920	0.37	217.0	1390	3020	0.37
715.2	3370	7410	0.37	218.0	1030	2260	0.37
718.5	4090	8330	0.34	219.0	1250	2540	0.34
721.8	3600	7410	0.34	220.0	1100	2260	0.34
725.1	3210	5900	0.29	221.0	980	1800	0.29
728.4	3210	6290	0.32	222.0	980	1920	0.32
731.6	2530	6670	0.42	223.0	770	2030	0.42
734.9	2420	5950	0.40	224.0	740	1810	0.40
738.2	3280	6230	0.31	225.0	1000	1900	0.31
741.5	3000	8230	0.42	226.0	920	2510	0.42
744.8	3880	10580	0.42	227.0	1180	3230	0.42
748.0	6380	11570	0.28	228.0	1940	3530	0.28
751.3	6440	12820	0.33	229.0	1960	3910	0.33
754.6	7800	14250	0.29	230.0	2380	4340	0.29
757.9	9320	17180	0.29	231.0	2840	5240	0.29
761.2	5850	14010	0.39	232.0	1780	4270	0.39
764.4	5560	14370	0.41	233.0	1690	4380	0.41
767.7	6060	14250	0.39	234.0	1850	4340	0.39
771.0	7620	18940	0.40	235.0	2320	5770	0.40
774.3	7890	18940	0.40	236.0	2400	5770	0.40
777.6	10100	16840	0.22	237.0	3080	5130	0.22
780.8	10260	18730	0.29	238.0	3130	5710	0.29
784.1	9660	19840	0.34	239.0	2940	6050	0.34
787.4	9950	20080	0.34	240.0	3030	6120	0.34
790.7	9880	19610	0.33	241.0	3010	5980	0.33
794.0	10420	18120	0.25	242.0	3180	5520	0.25
797.2	10260	19380	0.31	243.0	3130	5910	0.31
800.5	10180	19840	0.32	244.0	3100	6050	0.32
803.8	9800	19160	0.32	245.0	2990	5840	0.32
807.1	10180	19160	0.30	246.0	3100	5840	0.30
810.4	10580	19610	0.29	247.0	3230	5980	0.29
813.7	11400	20080	0.26	248.0	3470	6120	0.26
816.9	10840	19840	0.29	249.0	3300	6050	0.29
819.9	10840	19380	0.27	249.9	3300	5910	0.27
823.2	10260	18320	0.27	250.9	3130	5580	0.27
826.4	11020	18320	0.22	251.9	3360	5580	0.22
829.7	10340	17360	0.23	252.9	3150	5290	0.23
833.0	6410	18020	0.43	253.9	1950	5490	0.43

Summary of Compressional Wave Velocity, Shear Wave Velocity, and Poisson's Ratio
Based on Receiver-to-Receiver Travel Time Data - Borehole C4993 RUN#6

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)	
836.3	3880	8890	0.38	254.9	1180	2710	0.38
839.6	2800	6470	0.38	255.9	850	1970	0.38
842.9	2510	6940	0.43	256.9	760	2120	0.43
846.1	3190	7410	0.39	257.9	970	2260	0.39
849.4	3020	6540	0.36	258.9	920	1990	0.36
853.0	3550	7330	0.35	260.0	1080	2230	0.35
856.3	3640	7170	0.33	261.0	1110	2180	0.33
859.6	2490	7090	0.43	262.0	760	2160	0.43
862.9	2520	7090	0.43	263.0	770	2160	0.43
866.1	2370	6800	0.43	264.0	720	2070	0.43
869.4	3770	6940	0.29	265.0	1150	2120	0.29
872.7	2270	6600	0.43	266.0	690	2010	0.43
876.0	2110	6730	0.45	267.0	640	2050	0.45
879.3	2250	6410	0.43	268.0	690	1950	0.43
882.6	2250	6800	0.44	269.0	690	2070	0.44
885.8	2290	6670	0.43	270.0	700	2030	0.43
889.1	2360	7090	0.44	271.0	720	2160	0.44
892.4	2260	7090	0.44	272.0	690	2160	0.44
895.7	2580	7170	0.43	273.0	790	2180	0.43
899.0	2640	7020	0.42	274.0	800	2140	0.42
902.2	2540	6800	0.42	275.0	780	2070	0.42
905.5	2610	6670	0.41	276.0	800	2030	0.41
908.8	2310	6410	0.43	277.0	700	1950	0.43
912.1	2230	6290	0.43	278.0	680	1920	0.43
915.4	2270	6170	0.42	279.0	690	1880	0.42
918.6	2140	5900	0.42	280.0	650	1800	0.42
921.9	2060	5850	0.43	281.0	630	1780	0.43
925.2	1850	5800	0.44	282.0	560	1770	0.44
928.5	1900	5900	0.44	283.0	580	1800	0.44
931.8	2480	5600	0.38	284.0	760	1710	0.38
935.0	2910	7750	0.42	285.0	890	2360	0.42
938.3	4440	9920	0.37	286.0	1350	3020	0.37
941.6	8890	17540	0.33	287.0	2710	5350	0.33
944.9	9880	17730	0.28	288.0	3010	5400	0.28
948.2	9950	17920	0.28	289.0	3030	5460	0.28
951.4	6910	14880	0.36	290.0	2110	4540	0.36
954.7	8440	19160	0.38	291.0	2570	5840	0.38
958.0	9460	18730	0.33	292.0	2880	5710	0.33

Summary of Compressional Wave Velocity, Shear Wave Velocity, and Poisson's Ratio
Based on Receiver-to-Receiver Travel Time Data - Borehole C4993 RUN#6

American Units			
Depth at Midpoint Between Receivers	Velocity		Poisson's Ratio
	V_s	V_p	
(ft)	(ft/s)	(ft/s)	
961.3	8390	13890	0.21
964.6	9950	17730	0.27
967.9	10260	21100	0.35
971.1	9460	17540	0.30
974.4	5130	11740	0.38
977.7	4390	8500	0.32
981.0	4020	9860	0.40
984.3	6030	10100	0.22
987.5	4850	9260	0.31
990.8	5650	11660	0.35
994.1	5820	13440	0.38
997.4	6440	14880	0.38
1000.7	7890	19840	0.41
1003.9	7980	15870	0.33
1007.2	9460	16180	0.24
1010.5	9800	16670	0.24
1013.8	9730	17920	0.29
1017.1	9880	19160	0.32
1020.3	9880	16500	0.22
1023.6	9730	16840	0.25
1026.9	10030	17730	0.27
1030.2	9730	18120	0.30
1033.5	9660	17360	0.28
1036.8	9880	19840	0.34
1040.0	9880	18120	0.29
1043.3	10420	18730	0.28
1046.6	9950	18520	0.30
1049.9	9950	19610	0.33
1053.2	10030	17010	0.23
1056.4	10030	18120	0.28
1059.7	10180	18120	0.27
1063.0	10260	17730	0.25
1066.3	10180	18320	0.28
1069.6	10100	18940	0.30
1072.8	10180	17920	0.26
1076.1	10750	18320	0.24
1079.4	10260	21650	0.36
1082.7	10420	17730	0.24

Metric Units			
Depth at Midpoint Between Receivers	Velocity		Poisson's Ratio
	V_s	V_p	
(m)	(m/s)	(m/s)	
293.0	2560	4230	0.21
294.0	3030	5400	0.27
295.0	3130	6430	0.35
296.0	2880	5350	0.30
297.0	1560	3580	0.38
298.0	1340	2590	0.32
299.0	1220	3010	0.40
300.0	1840	3080	0.22
301.0	1480	2820	0.31
302.0	1720	3550	0.35
303.0	1770	4100	0.38
304.0	1960	4540	0.38
305.0	2400	6050	0.41
306.0	2430	4840	0.33
307.0	2880	4930	0.24
308.0	2990	5080	0.24
309.0	2970	5460	0.29
310.0	3010	5840	0.32
311.0	3010	5030	0.22
312.0	2970	5130	0.25
313.0	3060	5400	0.27
314.0	2970	5520	0.30
315.0	2940	5290	0.28
316.0	3010	6050	0.34
317.0	3010	5520	0.29
318.0	3180	5710	0.28
319.0	3030	5640	0.30
320.0	3030	5980	0.33
321.0	3060	5180	0.23
322.0	3060	5520	0.28
323.0	3100	5520	0.27
324.0	3130	5400	0.25
325.0	3100	5580	0.28
326.0	3080	5770	0.30
327.0	3100	5460	0.26
328.0	3280	5580	0.24
329.0	3130	6600	0.36
330.0	3180	5400	0.24

Summary of Compressional Wave Velocity, Shear Wave Velocity, and Poisson's Ratio
Based on Receiver-to-Receiver Travel Time Data - Borehole C4993 RUN#6

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)	
1086.0	10100	19380	0.31	331.0	3080	5910	0.31
1089.2	9730	14620	0.10	332.0	2970	4460	0.10
1092.5	5130	9950	0.32	333.0	1560	3030	0.32
1095.8	3750	10750	0.43	334.0	1140	3280	0.43
1099.1	3450	8330	0.40	335.0	1050	2540	0.40
1102.4	2510	7410	0.44	336.0	760	2260	0.44
1105.6	3130	7840	0.41	337.0	950	2390	0.41
1108.9	3100	6800	0.37	338.0	950	2070	0.37
1112.2	2580	6290	0.40	339.0	790	1920	0.40
1115.5	2710	7170	0.42	340.0	830	2180	0.42
1118.8	3060	6170	0.34	341.0	930	1880	0.34
1122.1	2710	7170	0.42	342.0	830	2180	0.42
1125.3	2920	7020	0.39	343.0	890	2140	0.39
1128.6	2610	6170	0.39	344.0	800	1880	0.39
1131.9	2100	6600	0.44	345.0	640	2010	0.44
1135.2	2770	7090	0.41	346.0	840	2160	0.41
1138.5	2560	7020	0.42	347.0	780	2140	0.42
1141.7	2620	7250	0.42	348.0	800	2210	0.42
1145.0	2570	7330	0.43	349.0	780	2230	0.43
1148.3	2390	7090	0.44	350.0	730	2160	0.44
1151.6	2470	6940	0.43	351.0	750	2120	0.43
1154.9	2310	7090	0.44	352.0	710	2160	0.44
1158.1	3040	7750	0.41	353.0	930	2360	0.41
1161.4	3090	7330	0.39	354.0	940	2230	0.39
1164.7	-	6170	-	355.0	-	1880	-
1168.0	2250	5850	0.41	356.0	690	1780	0.41
1171.3	2720	6350	0.39	357.0	830	1940	0.39
1174.5	1870	5800	0.44	358.0	570	1770	0.44
1177.8	2000	5750	0.43	359.0	610	1750	0.43
1181.1	2140	5010	0.39	360.0	650	1530	0.39
1184.4	2290	6730	0.43	361.0	700	2050	0.43
1187.7	2190	6230	0.43	362.0	670	1900	0.43
1190.9	1950	6540	0.45	363.0	590	1990	0.45
1194.2	4040	9660	0.39	364.0	1230	2940	0.39
1197.5	5600	9920	0.27	365.0	1710	3020	0.27
1200.8	8280	15290	0.29	366.0	2520	4660	0.29
1204.1	9660	14180	0.07	367.0	2940	4320	0.07
1207.4	7290	15150	0.35	368.0	2220	4620	0.35

Summary of Compressional Wave Velocity, Shear Wave Velocity, and Poisson's Ratio
Based on Receiver-to-Receiver Travel Time Data - Borehole C4993 RUN#6

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)	
1210.6	6770	10480	0.14	369.0	2060	3190	0.14
1210.6	6670	10320	0.14	369.0	2030	3150	0.14
1213.9	9130	15430	0.23	370.0	2780	4700	0.23
1217.2	9660	19610	0.34	371.0	2940	5980	0.34
1220.5	8330	17360	0.35	372.0	2540	5290	0.35
1223.8	8490	18120	0.36	373.0	2590	5520	0.36
1227.0	10030	17360	0.25	374.0	3060	5290	0.25
1230.3	9880	17730	0.28	375.0	3010	5400	0.28
1233.6	9880	17730	0.28	376.0	3010	5400	0.28
1236.9	10260	17540	0.24	377.0	3130	5350	0.24
1240.2	9660	17920	0.30	378.0	2940	5460	0.30
1243.4	9660	15870	0.21	379.0	2940	4840	0.21
1246.7	9880	17540	0.27	380.0	3010	5350	0.27
1250.0	9800	18320	0.30	381.0	2990	5580	0.30
1253.3	9800	17920	0.29	382.0	2990	5460	0.29
1256.6	10340	18320	0.27	383.0	3150	5580	0.27
1259.8	10100	19840	0.33	384.0	3080	6050	0.33
1263.1	9590	18520	0.32	385.0	2920	5640	0.32
1266.4	10580	20330	0.31	386.0	3230	6200	0.31
1269.7	10750	19160	0.27	387.0	3280	5840	0.27
1273.0	9880	20080	0.34	388.0	3010	6120	0.34
1276.3	10420	18940	0.28	389.0	3180	5770	0.28
1279.5	8180	18120	0.37	390.0	2490	5520	0.37
1282.8	7090	18320	0.41	391.0	2160	5580	0.41
1286.1	12230	17920	0.06	392.0	3730	5460	0.06
1289.4	10580	18730	0.27	393.0	3230	5710	0.27
1292.7	8710	17730	0.34	394.0	2660	5400	0.34
1295.9	8710	17730	0.34	395.0	2660	5400	0.34
1299.2	7980	18320	0.38	396.0	2430	5580	0.38
1302.5	9880	17540	0.27	397.0	3010	5350	0.27
1305.8	10180	19840	0.32	398.0	3100	6050	0.32
1309.1	10840	18730	0.25	399.0	3300	5710	0.25
1312.3	9730	19610	0.34	400.0	2970	5980	0.34
1315.6	11800	19610	0.22	401.0	3600	5980	0.22
1318.9	10840	18730	0.25	402.0	3300	5710	0.25
1322.2	10750	18940	0.26	403.0	3280	5770	0.26
1325.5	10340	18940	0.29	404.0	3150	5770	0.29
1328.7	10180	17360	0.24	405.0	3100	5290	0.24

Summary of Compressional Wave Velocity, Shear Wave Velocity, and Poisson's Ratio Based on Receiver-to-Receiver Travel Time Data - Borehole C4993 RUN#6

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)	
1332.0	9260	18520	0.33	406.0	2820	5640	0.33
1335.3	10260	19160	0.30	407.0	3130	5840	0.30
1338.6	8080	18940	0.39	408.0	2460	5770	0.39
1341.9	8080	18730	0.39	409.0	2460	5710	0.39
1345.1	8440	18120	0.36	410.0	2570	5520	0.36
1348.4	8280	18320	0.37	411.0	2520	5580	0.37
1351.7	7450	15870	0.36	412.0	2270	4840	0.36
1355.0	3730	8090	0.36	413.0	1140	2470	0.36
1358.3	4120	9580	0.39	414.0	1250	2920	0.39
1361.6	4780	9920	0.35	415.0	1460	3020	0.35
1364.8	5400	12250	0.38	416.0	1650	3740	0.38
1368.1	5290	12820	0.40	417.0	1610	3910	0.40
1371.4	5380	12530	0.39	418.0	1640	3820	0.39
1374.7	6230	15430	0.40	419.0	1900	4700	0.40
1378.0	6870	14880	0.36	420.0	2090	4540	0.36
1381.2	6770	12080	0.27	421.0	2060	3680	0.27
1384.5	8710	16340	0.30	422.0	2660	4980	0.30
1387.8	7710	15870	0.35	423.0	2350	4840	0.35
1391.1	7580	17010	0.38	424.0	2310	5180	0.38
1394.4	9320	16500	0.27	425.0	2840	5030	0.27
1397.6	9200	18940	0.35	426.0	2800	5770	0.35
1400.9	6870	11900	0.25	427.0	2090	3630	0.25

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

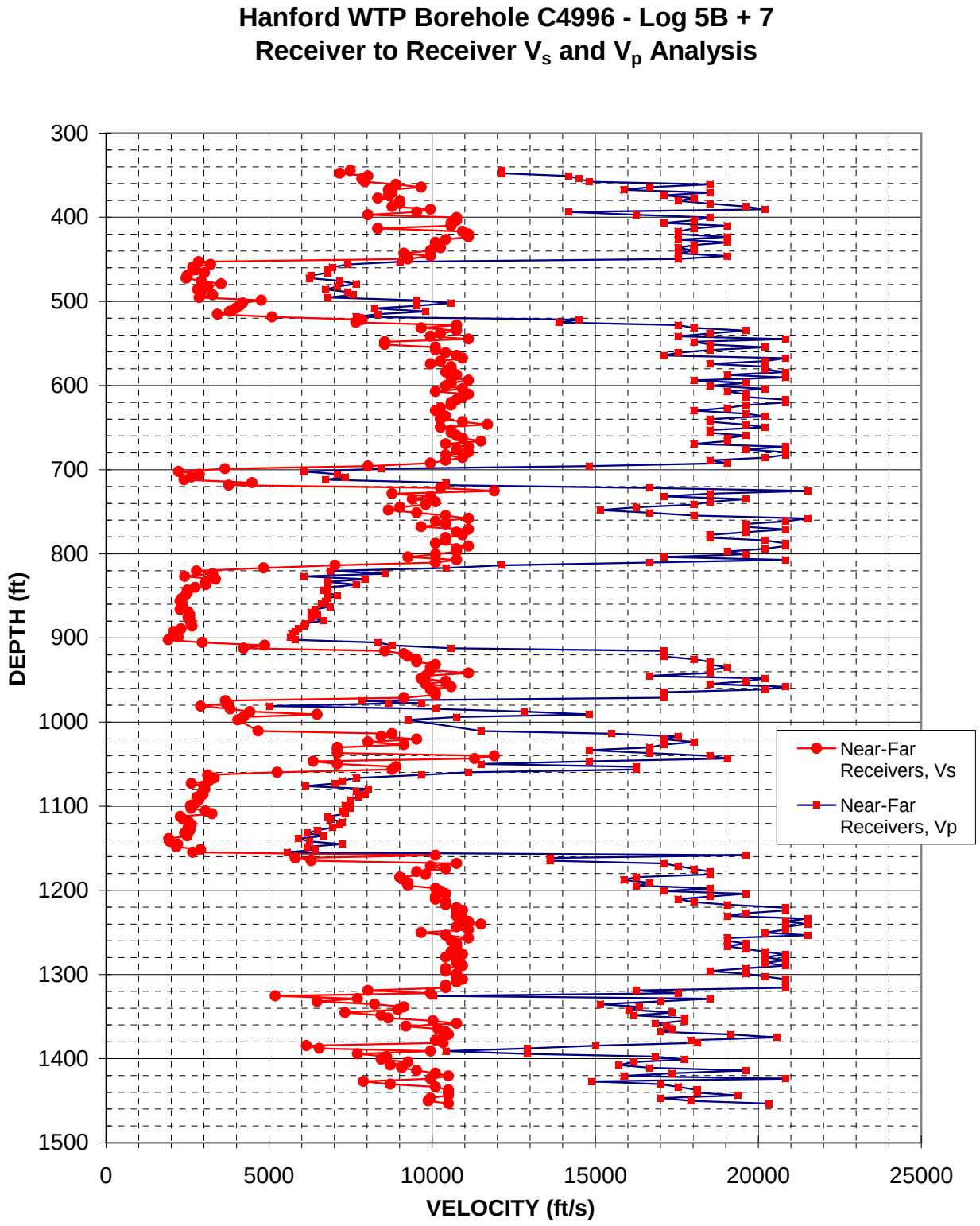


Figure 5: Boring BH-C4996 - Log 5B + 7, Suspension R1-R2 P- and S_H-wave velocities

Table 4. Boring BH-C4996 - 5B + 7, 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 C4996

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)	
344.5	7490	12120	0.19	105.0	2280	3690	0.19
347.8	7170	12120	0.23	106.0	2180	3690	0.23
351.1	8030	14180	0.26	107.0	2450	4320	0.26
354.3	7840	14490	0.29	108.0	2390	4420	0.29
357.6	7940	14810	0.30	109.0	2420	4520	0.30
360.9	8890	18520	0.35	110.0	2710	5640	0.35
364.2	9660	16670	0.25	111.0	2940	5080	0.25
367.5	8660	15870	0.29	112.0	2640	4840	0.29
370.7	8770	18520	0.36	113.0	2670	5640	0.36
374.0	8660	17090	0.33	114.0	2640	5210	0.33
377.3	8330	18020	0.36	115.0	2540	5490	0.36
380.6	9010	17540	0.32	116.0	2750	5350	0.32
383.9	9010	18520	0.34	117.0	2750	5640	0.34
387.1	8770	19610	0.37	118.0	2670	5980	0.37
390.4	9950	20200	0.34	119.0	3030	6160	0.34
393.7	9520	14180	0.09	120.0	2900	4320	0.09
397.0	8030	16260	0.34	121.0	2450	4960	0.34
400.3	10750	18520	0.25	122.0	3280	5640	0.25
403.5	10750	18020	0.22	123.0	3280	5490	0.22
406.8	10580	17090	0.19	124.0	3230	5210	0.19
410.1	10580	19050	0.28	125.0	3230	5810	0.28
413.4	8330	18020	0.36	126.0	2540	5490	0.36
416.7	10930	17540	0.18	127.0	3330	5350	0.18
420.0	11110	17540	0.17	128.0	3390	5350	0.17
423.2	11110	19050	0.24	129.0	3390	5810	0.24
426.5	10420	17540	0.23	130.0	3180	5350	0.23
429.8	10100	19050	0.30	131.0	3080	5810	0.30
433.1	10100	18020	0.27	132.0	3080	5490	0.27
436.4	10260	17540	0.24	133.0	3130	5350	0.24
439.6	9950	18020	0.28	134.0	3030	5490	0.28
442.9	9130	17540	0.31	135.0	2780	5350	0.31
446.2	9950	19050	0.31	136.0	3030	5810	0.31
449.5	9260	17540	0.31	137.0	2820	5350	0.31
452.8	2840	9010	0.44	138.0	860	2750	0.44
456.0	3210	7410	0.38	139.0	980	2260	0.38

Summary of Compressional Wave Velocity, Shear Wave Velocity, and Poisson's Ratio
Based on Receiver-to-Receiver Travel Time Data - Borehole C4996

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)	
459.3	2660	6940	0.41	140.0	810	2120	0.41
462.6	2750	6800	0.40	141.0	840	2070	0.40
465.9	3020	6800	0.38	142.0	920	2070	0.38
469.2	2490	6290	0.41	143.0	760	1920	0.41
472.4	2450	6230	0.41	144.0	750	1900	0.41
475.7	2920	7170	0.40	145.0	890	2180	0.40
479.0	3530	7660	0.37	146.0	1080	2340	0.37
482.3	3130	7090	0.38	147.0	950	2160	0.38
485.6	2810	6730	0.39	148.0	860	2050	0.39
488.9	2920	7410	0.41	149.0	890	2260	0.41
492.1	3270	7580	0.39	150.0	1000	2310	0.39
495.4	2860	6800	0.39	151.0	870	2070	0.39
498.7	4760	9520	0.33	152.0	1450	2900	0.33
502.0	4190	10580	0.41	153.0	1280	3230	0.41
505.3	4090	9520	0.39	154.0	1250	2900	0.39
508.5	3970	8230	0.35	155.0	1210	2510	0.35
511.8	3790	9800	0.41	156.0	1150	2990	0.41
515.1	3420	8330	0.40	157.0	1040	2540	0.40
518.4	5090	7660	0.11	158.0	1550	2340	0.11
521.7	7840	14490	0.29	159.0	2390	4420	0.29
524.9	7660	13890	0.28	160.0	2340	4230	0.28
528.2	10750	17540	0.20	161.0	3280	5350	0.20
531.5	9660	18020	0.30	162.0	2940	5490	0.30
534.8	10750	19610	0.28	163.0	3280	5980	0.28
538.1	10260	18520	0.28	164.0	3130	5640	0.28
541.3	9950	17540	0.26	165.0	3030	5350	0.26
544.6	11110	20830	0.30	166.0	3390	6350	0.30
547.9	8550	18020	0.35	167.0	2610	5490	0.35
551.2	8550	18520	0.36	168.0	2610	5640	0.36
554.5	10100	20200	0.33	169.0	3080	6160	0.33
557.7	10100	18520	0.29	170.0	3080	5640	0.29
561.0	10420	17540	0.23	171.0	3180	5350	0.23
564.3	10750	17090	0.17	172.0	3280	5210	0.17
567.6	10930	20830	0.31	173.0	3330	6350	0.31
570.9	10260	20200	0.33	174.0	3130	6160	0.33
574.2	9950	18520	0.30	175.0	3030	5640	0.30
577.4	10580	20200	0.31	176.0	3230	6160	0.31
580.7	10580	20200	0.31	177.0	3230	6160	0.31

Summary of Compressional Wave Velocity, Shear Wave Velocity, and Poisson's Ratio
Based on Receiver-to-Receiver Travel Time Data - Borehole C4996

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)	
584.0	10420	20830	0.33	178.0	3180	6350	0.33
587.3	10750	19050	0.27	179.0	3280	5810	0.27
590.6	10580	20830	0.33	180.0	3230	6350	0.33
593.8	11110	18020	0.19	181.0	3390	5490	0.19
597.1	10580	19610	0.29	182.0	3230	5980	0.29
600.4	10420	18520	0.27	183.0	3180	5640	0.27
603.7	10930	20200	0.29	184.0	3330	6160	0.29
607.0	10100	19050	0.30	185.0	3080	5810	0.30
610.2	11110	19610	0.26	186.0	3390	5980	0.26
613.5	10930	19610	0.27	187.0	3330	5980	0.27
616.8	10750	20830	0.32	188.0	3280	6350	0.32
620.1	10580	20830	0.33	189.0	3230	6350	0.33
623.4	10580	19610	0.29	190.0	3230	5980	0.29
626.6	10260	19050	0.30	191.0	3130	5810	0.30
629.9	10100	18020	0.27	192.0	3080	5490	0.27
633.2	10260	19610	0.31	193.0	3130	5980	0.31
636.5	10420	20200	0.32	194.0	3180	6160	0.32
639.8	10260	18520	0.28	195.0	3130	5640	0.28
643.0	10930	18520	0.23	196.0	3330	5640	0.23
646.3	11700	19610	0.22	197.0	3560	5980	0.22
649.6	10260	20200	0.33	198.0	3130	6160	0.33
652.9	10580	18520	0.26	199.0	3230	5640	0.26
656.2	10580	18520	0.26	200.0	3230	5640	0.26
659.5	10750	19610	0.28	201.0	3280	5980	0.28
662.7	10930	19050	0.25	202.0	3330	5810	0.25
666.0	11490	19050	0.21	203.0	3500	5810	0.21
669.3	10420	18020	0.25	204.0	3180	5490	0.25
672.6	11110	20830	0.30	205.0	3390	6350	0.30
675.9	10750	19610	0.28	206.0	3280	5980	0.28
679.1	11110	20830	0.30	207.0	3390	6350	0.30
682.4	10420	20830	0.33	208.0	3180	6350	0.33
685.7	10930	20200	0.29	209.0	3330	6160	0.29
689.0	10420	18520	0.27	210.0	3180	5640	0.27
692.3	9950	19050	0.31	211.0	3030	5810	0.31
695.5	8030	14810	0.29	212.0	2450	4520	0.29
698.8	3640	8440	0.39	213.0	1110	2570	0.39
702.1	2220	6060	0.42	214.0	680	1850	0.42
705.4	2860	7090	0.40	215.0	870	2160	0.40

Summary of Compressional Wave Velocity, Shear Wave Velocity, and Poisson's Ratio
Based on Receiver-to-Receiver Travel Time Data - Borehole C4996

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)	
708.7	2610	7330	0.43	216.0	800	2230	0.43
711.9	2390	6730	0.43	217.0	730	2050	0.43
715.6	4470	10420	0.39	218.1	1360	3180	0.39
718.5	3770	10420	0.42	219.0	1150	3180	0.42
721.8	10260	16670	0.20	220.0	3130	5080	0.20
725.1	11900	21510	0.28	221.0	3630	6550	0.28
728.4	8770	18520	0.36	222.0	2670	5640	0.36
731.6	9950	17090	0.24	223.0	3030	5210	0.24
734.9	9390	19610	0.35	224.0	2860	5980	0.35
738.2	10100	18520	0.29	225.0	3080	5640	0.29
741.5	9800	18020	0.29	226.0	2990	5490	0.29
744.8	9010	16260	0.28	227.0	2750	4960	0.28
748.0	8660	15150	0.26	228.0	2640	4620	0.26
751.3	9520	16670	0.26	229.0	2900	5080	0.26
754.6	10420	18020	0.25	230.0	3180	5490	0.25
757.9	11110	21510	0.32	231.0	3390	6550	0.32
761.2	10100	20830	0.35	232.0	3080	6350	0.35
764.4	10420	19610	0.30	233.0	3180	5980	0.30
767.7	9660	19610	0.34	234.0	2940	5980	0.34
771.0	11110	20830	0.30	235.0	3390	6350	0.30
774.3	10750	19610	0.28	236.0	3280	5980	0.28
777.6	10930	18520	0.23	237.0	3330	5640	0.23
780.8	10420	18520	0.27	238.0	3180	5640	0.27
784.1	10420	20200	0.32	239.0	3180	6160	0.32
787.4	10100	20830	0.35	240.0	3080	6350	0.35
790.7	11110	20830	0.30	241.0	3390	6350	0.30
794.0	10750	20200	0.30	242.0	3280	6160	0.30
797.2	10750	19050	0.27	243.0	3280	5810	0.27
800.5	10100	19610	0.32	244.0	3080	5980	0.32
803.8	9260	17090	0.29	245.0	2820	5210	0.29
807.1	10750	20830	0.32	246.0	3280	6350	0.32
810.4	10100	16670	0.21	247.0	3080	5080	0.21
813.7	7020	12120	0.25	248.0	2140	3690	0.25
816.9	4830	10420	0.36	249.0	1470	3180	0.36
820.2	2780	6870	0.40	250.0	850	2090	0.40
823.5	3270	8550	0.41	251.0	1000	2610	0.41
826.8	2420	6060	0.41	252.0	740	1850	0.41
830.1	3350	7940	0.39	253.0	1020	2420	0.39

Summary of Compressional Wave Velocity, Shear Wave Velocity, and Poisson's Ratio
Based on Receiver-to-Receiver Travel Time Data - Borehole C4996

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)	
833.3	3060	6800	0.37	254.0	930	2070	0.37
836.6	3060	7660	0.41	255.0	930	2340	0.41
839.9	2730	6800	0.40	256.0	830	2070	0.40
843.2	2490	6670	0.42	257.0	760	2030	0.42
846.5	2490	6800	0.42	258.0	760	2070	0.42
849.7	2420	7090	0.43	259.0	740	2160	0.43
853.0	2320	6800	0.43	260.0	710	2070	0.43
856.3	2280	6730	0.44	261.0	690	2050	0.44
859.6	2340	6600	0.43	262.0	710	2010	0.43
862.9	2350	6870	0.43	263.0	720	2090	0.43
866.1	2280	6410	0.43	264.0	690	1950	0.43
869.4	2530	6290	0.40	265.0	770	1920	0.40
872.7	2570	6470	0.41	266.0	780	1970	0.41
876.0	2520	6290	0.40	267.0	770	1920	0.40
879.3	2580	6670	0.41	268.0	790	2030	0.41
882.6	2600	6120	0.39	269.0	790	1860	0.39
885.8	2640	6060	0.38	270.0	800	1850	0.38
889.1	2300	5900	0.41	271.0	700	1800	0.41
892.4	2080	5800	0.43	272.0	630	1770	0.43
895.7	2080	5700	0.42	273.0	630	1740	0.42
899.0	2210	5650	0.41	274.0	680	1720	0.41
902.2	1910	5800	0.44	275.0	580	1770	0.44
905.5	2950	8330	0.43	276.0	900	2540	0.43
908.8	4870	8770	0.28	277.0	1480	2670	0.28
912.1	4220	10580	0.41	278.0	1290	3230	0.41
915.4	8550	17090	0.33	279.0	2610	5210	0.33
918.6	9130	17090	0.30	280.0	2780	5210	0.30
921.9	9260	17090	0.29	281.0	2820	5210	0.29
925.2	9520	18020	0.31	282.0	2900	5490	0.31
928.5	9520	18520	0.32	283.0	2900	5640	0.32
931.8	10100	18520	0.29	284.0	3080	5640	0.29
935.0	9950	19050	0.31	285.0	3030	5810	0.31
938.3	9950	18520	0.30	286.0	3030	5640	0.30
941.6	11110	18520	0.22	287.0	3390	5640	0.22
944.9	9800	16670	0.24	288.0	2990	5080	0.24
948.2	9660	20200	0.35	289.0	2940	6160	0.35
951.4	10420	19610	0.30	290.0	3180	5980	0.30
954.7	9800	18520	0.31	291.0	2990	5640	0.31

Summary of Compressional Wave Velocity, Shear Wave Velocity, and Poisson's Ratio
Based on Receiver-to-Receiver Travel Time Data - Borehole C4996

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)	
958.0	10580	20830	0.33	292.0	3230	6350	0.33
961.3	9950	20200	0.34	293.0	3030	6160	0.34
964.6	10100	17090	0.23	294.0	3080	5210	0.23
967.9	10100	17090	0.23	295.0	3080	5210	0.23
971.1	9130	17090	0.30	296.0	2780	5210	0.30
974.4	3660	7840	0.36	297.0	1120	2390	0.36
977.7	3680	9660	0.41	298.0	1120	2940	0.41
977.7	3750	8660	0.38	298.0	1140	2640	0.38
981.0	2900	5010	0.25	299.0	880	1530	0.25
984.3	3810	10100	0.42	300.0	1160	3080	0.42
987.5	4420	12820	0.43	301.0	1350	3910	0.43
990.8	6470	14810	0.38	302.0	1970	4520	0.38
994.1	4220	10750	0.41	303.0	1290	3280	0.41
997.4	4040	9260	0.38	304.0	1230	2820	0.38
1010.5	4660	11490	0.40	308.0	1420	3500	0.40
1013.8	8770	15500	0.26	309.0	2670	4730	0.26
1017.1	8440	17540	0.35	310.0	2570	5350	0.35
1020.3	9520	17090	0.27	311.0	2900	5210	0.27
1023.6	8030	18020	0.38	312.0	2450	5490	0.38
1026.9	9130	17090	0.30	313.0	2780	5210	0.30
1030.2	7090	16670	0.39	314.0	2160	5080	0.39
1033.5	7090	14810	0.35	315.0	2160	4520	0.35
1036.8	7090	16670	0.39	316.0	2160	5080	0.39
1040.0	11900	18520	0.15	317.0	3630	5640	0.15
1043.3	11300	19050	0.23	318.0	3440	5810	0.23
1046.6	6350	14810	0.39	319.0	1940	4520	0.39
1049.9	7090	11490	0.19	320.0	2160	3500	0.19
1053.2	8890	16260	0.29	321.0	2710	4960	0.29
1056.4	8770	16260	0.29	322.0	2670	4960	0.29
1059.7	5250	11110	0.36	323.0	1600	3390	0.36
1063.0	3120	9660	0.44	324.0	950	2940	0.44
1066.3	3320	7660	0.38	325.0	1010	2340	0.38
1069.6	3160	7250	0.38	326.0	960	2210	0.38
1072.8	2610	7020	0.42	327.0	800	2140	0.42
1076.1	3000	6120	0.34	328.0	920	1860	0.34
1079.4	3030	8030	0.42	329.0	920	2450	0.42
1082.7	2960	7660	0.41	330.0	900	2340	0.41
1086.0	2980	7940	0.42	331.0	910	2420	0.42

Summary of Compressional Wave Velocity, Shear Wave Velocity, and Poisson's Ratio
Based on Receiver-to-Receiver Travel Time Data - Borehole C4996

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)	
1089.2	2790	7750	0.43	332.0	850	2360	0.43
1092.5	2850	7490	0.42	333.0	870	2280	0.42
1095.8	2750	7490	0.42	334.0	840	2280	0.42
1099.1	2590	7330	0.43	335.0	790	2230	0.43
1102.4	2600	7490	0.43	336.0	790	2280	0.43
1105.6	3040	7250	0.39	337.0	930	2210	0.39
1108.9	3250	7330	0.38	338.0	990	2230	0.38
1112.2	2280	6800	0.44	339.0	700	2070	0.44
1115.5	2360	6870	0.43	340.0	720	2090	0.43
1118.8	2530	7250	0.43	341.0	770	2210	0.43
1122.1	2610	7170	0.42	342.0	800	2180	0.42
1125.3	2530	6940	0.42	343.0	770	2120	0.42
1128.6	2570	6470	0.41	344.0	780	1970	0.41
1131.9	2420	6170	0.41	345.0	740	1880	0.41
1135.2	2490	6670	0.42	346.0	760	2030	0.42
1138.5	1930	5900	0.44	347.0	590	1800	0.44
1141.7	1940	6230	0.45	348.0	590	1900	0.45
1145.0	2190	7250	0.45	349.0	670	2210	0.45
1148.3	2160	6170	0.43	350.0	660	1880	0.43
1151.6	2900	6410	0.37	351.0	880	1950	0.37
1154.9	2660	5560	0.35	352.0	810	1690	0.35
1158.1	10100	19610	0.32	353.0	3080	5980	0.32
1161.4	5800	13610	0.39	354.0	1770	4150	0.39
1164.7	6290	13610	0.36	355.0	1920	4150	0.36
1168.0	10750	17090	0.17	356.0	3280	5210	0.17
1171.3	9950	17540	0.26	357.0	3030	5350	0.26
1174.5	10420	18020	0.25	358.0	3180	5490	0.25
1177.8	9520	18520	0.32	359.0	2900	5640	0.32
1181.1	9800	18520	0.31	360.0	2990	5640	0.31
1184.4	9010	16260	0.28	361.0	2750	4960	0.28
1187.7	9130	15870	0.25	362.0	2780	4840	0.25
1190.9	9260	16670	0.28	363.0	2820	5080	0.28
1194.2	9260	16260	0.26	364.0	2820	4960	0.26
1197.5	10100	18520	0.29	365.0	3080	5640	0.29
1200.8	10260	17090	0.22	366.0	3130	5210	0.22
1204.1	10420	19610	0.30	367.0	3180	5980	0.30
1207.4	10100	18520	0.29	368.0	3080	5640	0.29
1210.6	10100	17540	0.25	369.0	3080	5350	0.25

Summary of Compressional Wave Velocity, Shear Wave Velocity, and Poisson's Ratio
Based on Receiver-to-Receiver Travel Time Data - Borehole C4996

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)	
1213.9	10420	18020	0.25	370.0	3180	5490	0.25
1217.2	10420	19050	0.29	371.0	3180	5810	0.29
1220.5	10750	20830	0.32	372.0	3280	6350	0.32
1223.8	10930	20830	0.31	373.0	3330	6350	0.31
1227.0	10750	19610	0.28	374.0	3280	5980	0.28
1230.3	10750	19050	0.27	375.0	3280	5810	0.27
1233.6	10930	21510	0.33	376.0	3330	6550	0.33
1236.9	11110	20830	0.30	377.0	3390	6350	0.30
1240.2	11490	21510	0.30	378.0	3500	6550	0.30
1243.4	10750	20830	0.32	379.0	3280	6350	0.32
1246.7	11110	20830	0.30	380.0	3390	6350	0.30
1250.0	9660	20200	0.35	381.0	2940	6160	0.35
1253.3	10420	21510	0.35	382.0	3180	6550	0.35
1256.6	11110	19050	0.24	383.0	3390	5810	0.24
1259.8	10580	19050	0.28	384.0	3230	5810	0.28
1263.1	10750	19610	0.28	385.0	3280	5980	0.28
1266.4	10750	19050	0.27	386.0	3280	5810	0.27
1269.7	10750	19610	0.28	387.0	3280	5980	0.28
1273.0	10580	20200	0.31	388.0	3230	6160	0.31
1276.3	10930	20830	0.31	389.0	3330	6350	0.31
1279.5	10420	20200	0.32	390.0	3180	6160	0.32
1282.8	10750	20830	0.32	391.0	3280	6350	0.32
1286.1	10750	20200	0.30	392.0	3280	6160	0.30
1289.4	10930	20830	0.31	393.0	3330	6350	0.31
1292.7	10420	19610	0.30	394.0	3180	5980	0.30
1295.9	10420	18520	0.27	395.0	3180	5640	0.27
1299.2	10750	19610	0.28	396.0	3280	5980	0.28
1302.5	10750	20200	0.30	397.0	3280	6160	0.30
1305.8	10930	20830	0.31	398.0	3330	6350	0.31
1309.1	10750	20830	0.32	399.0	3280	6350	0.32
1312.3	10420	20830	0.33	400.0	3180	6350	0.33
1315.6	10420	20830	0.33	401.0	3180	6350	0.33
1318.9	8030	16260	0.34	402.0	2450	4960	0.34
1322.2	9950	17540	0.26	403.0	3030	5350	0.26
1325.5	5190	10040	0.32	404.0	1580	3060	0.32
1328.7	7710	18520	0.40	405.0	2350	5640	0.40
1332.0	6470	17010	0.42	406.0	1970	5180	0.42
1335.3	8230	15150	0.29	407.0	2510	4620	0.29

Summary of Compressional Wave Velocity, Shear Wave Velocity, and Poisson's Ratio Based on Receiver-to-Receiver Travel Time Data - Borehole C4996

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)	
1338.6	9130	16340	0.27	408.0	2780	4980	0.27
1341.9	8950	16030	0.27	409.0	2730	4880	0.27
1345.1	7330	17360	0.39	410.0	2230	5290	0.39
1348.4	8440	16180	0.31	411.0	2570	4930	0.31
1351.7	8660	17730	0.34	412.0	2640	5400	0.34
1355.0	10030	17730	0.27	413.0	3060	5400	0.27
1358.3	10750	16840	0.16	414.0	3280	5130	0.16
1361.6	9200	17180	0.30	415.0	2800	5240	0.30
1364.8	10180	17360	0.24	416.0	3100	5290	0.24
1368.1	10420	17010	0.20	417.0	3180	5180	0.20
1371.4	10500	19160	0.29	418.0	3200	5840	0.29
1374.7	10340	20580	0.33	419.0	3150	6270	0.33
1378.0	10100	17920	0.27	420.0	3080	5460	0.27
1381.2	10340	18120	0.26	421.0	3150	5520	0.26
1384.5	6140	15020	0.40	422.0	1870	4580	0.40
1387.8	6540	12920	0.33	423.0	1990	3940	0.33
1391.1	9950	10420	-4.71	424.0	3030	3180	-4.71
1394.4	7710	12920	0.22	425.0	2350	3940	0.22
1397.6	8600	16840	0.32	426.0	2620	5130	0.32
1400.9	8440	17730	0.35	427.0	2570	5400	0.35
1404.2	9260	16180	0.26	428.0	2820	4930	0.26
1407.5	8710	15720	0.28	429.0	2660	4790	0.28
1410.8	9070	16670	0.29	430.0	2760	5080	0.29
1414.0	9520	19610	0.35	431.0	2900	5980	0.35
1417.3	10100	17360	0.24	432.0	3080	5290	0.24
1420.6	10500	15870	0.11	433.0	3200	4840	0.11
1423.9	9950	20830	0.35	434.0	3030	6350	0.35
1427.2	7890	14880	0.30	435.0	2400	4540	0.30
1430.5	8710	17010	0.32	436.0	2660	5180	0.32
1433.7	10100	17540	0.25	437.0	3080	5350	0.25
1437.0	10500	18120	0.25	438.0	3200	5520	0.25
1440.3	10500	18120	0.25	439.0	3200	5520	0.25
1443.6	10500	19380	0.29	440.0	3200	5910	0.29
1446.9	9950	17010	0.24	441.0	3030	5180	0.24
1450.1	9880	17920	0.28	442.0	3010	5460	0.28
1453.4	10500	20330	0.32	443.0	3200	6200	0.32

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

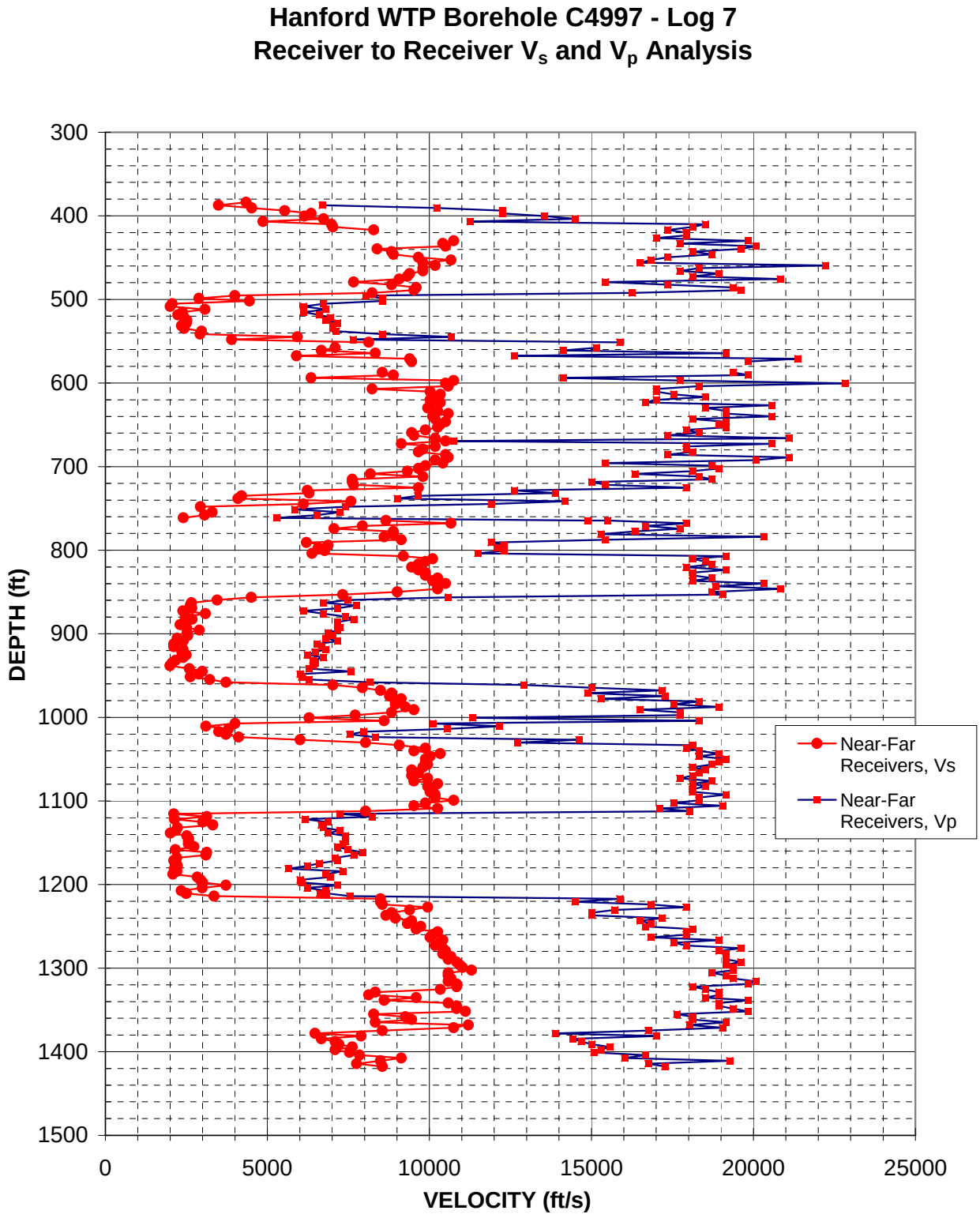


Figure 6: Boring BH-C4997 Log 7, Suspension R1-R2 P- and S_H-wave velocities

Table 5: Boring BH-C4997 Log 7, 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 C4997 LOG #7							
American Units				**Metric Units**			
Depth at	**Velocity**			**Depth at**	**Velocity**		
Midpoint Between Receivers	**V_s**	**V_p**	**Poisson's Ratio**	**Midpoint Between Receivers**	**V_s**	**V_p**	**Poisson's Ratio**
(ft)	(ft/s)	(ft/s)		(m)	(m/s)	(m/s)	
383.9	4340	-	-	117.0	1320	-	-
387.1	3490	6690	0.31	118.0	1060	2040	0.31
390.4	4520	10220	0.38	119.0	1380	3120	0.38
393.7	5530	12250	0.37	120.0	1690	3740	0.37
397.0	6350	12250	0.32	121.0	1940	3740	0.32
400.3	6140	13550	0.37	122.0	1870	4130	0.37
403.5	6730	14490	0.36	123.0	2050	4420	0.36
406.8	4870	11260	0.39	124.0	1480	3430	0.39
410.1	6980	18520	0.42	125.0	2130	5640	0.42
413.4	7020	18120	0.41	126.0	2140	5520	0.41
416.7	8280	17360	0.35	127.0	2520	5290	0.35
420.0	-	17920	-	128.0	-	5460	-
423.2	-	17920	-	129.0	-	5460	-
426.5	-	17010	-	130.0	-	5180	-
429.8	10750	19840	0.29	131.0	3280	6050	0.29
433.1	10420	17730	0.24	132.0	3180	5400	0.24
436.4	10500	20080	0.31	133.0	3200	6120	0.31
439.6	8390	19610	0.39	134.0	2560	5980	0.39
442.9	8830	18120	0.34	135.0	2690	5520	0.34
446.2	8890	18730	0.35	136.0	2710	5710	0.35
449.5	9660	17360	0.28	137.0	2940	5290	0.28
452.8	10670	16840	0.16	138.0	3250	5130	0.16
456.0	9800	16500	0.23	139.0	2990	5030	0.23
459.3	10180	22220	0.37	140.0	3100	6770	0.37
462.6	9800	18320	0.30	141.0	2990	5580	0.30
465.9	9800	17730	0.28	142.0	2990	5400	0.28
469.2	9390	18940	0.34	143.0	2860	5770	0.34
472.4	9320	18120	0.32	144.0	2840	5520	0.32
475.7	9070	20830	0.38	145.0	2760	6350	0.38
479.0	7660	15430	0.34	146.0	2340	4700	0.34
482.3	8830	17360	0.33	147.0	2690	5290	0.33
485.6	9590	19380	0.34	148.0	2920	5910	0.34
488.9	9520	19610	0.35	149.0	2900	5980	0.35
492.1	8230	16260	0.33	150.0	2510	4960	0.33
495.4	3990	8030	0.34	151.0	1220	2450	0.34
498.7	2890	8550	0.44	152.0	880	2610	0.44
502.0	4440	8550	0.31	153.0	1350	2610	0.31

Summary of Compressional Wave Velocity, Shear Wave Velocity, and Poisson's Ratio
Based on Receiver-to-Receiver Travel Time Data - Borehole C4997 LOG #7

American Units				Metric Units			
Depth at	Velocity			Depth at	Velocity		
Midpoint Between Receivers	V_s	V_p	Poisson's Ratio	Midpoint Between Receivers	V_s	V_p	Poisson's Ratio
(ft)	(ft/s)	(ft/s)		(m)	(m/s)	(m/s)	
505.3	2060	6730	0.45	154.0	630	2050	0.45
508.5	2000	6120	0.44	155.0	610	1860	0.44
511.8	3070	6800	0.37	156.0	940	2070	0.37
515.1	2380	6120	0.41	157.0	730	1860	0.41
518.4	2240	6600	0.44	158.0	680	2010	0.44
521.7	2430	6940	0.43	159.0	740	2120	0.43
524.9	2520	6800	0.42	160.0	770	2070	0.42
528.2	2510	7170	0.43	161.0	760	2180	0.43
531.5	2350	7020	0.44	162.0	720	2140	0.44
534.8	2430	7020	0.43	163.0	740	2140	0.43
538.1	2970	7120	0.39	164.0	910	2170	0.39
541.3	2920	8550	0.43	165.0	890	2610	0.43
544.6	5930	10680	0.28	166.0	1810	3260	0.28
547.9	3900	7650	0.32	167.0	1190	2330	0.32
551.2	8130	15870	0.32	168.0	2480	4840	0.32
554.5	-	-	-	169.0	-	-	-
557.7	7090	15150	0.36	170.0	2160	4620	0.36
561.0	6670	14120	0.36	171.0	2030	4310	0.36
564.3	8330	19160	0.38	172.0	2540	5840	0.38
567.6	5900	12630	0.36	173.0	1800	3850	0.36
570.9	9390	21370	0.38	174.0	2860	6510	0.38
574.2	9460	19840	0.35	175.0	2880	6050	0.35
577.4	-	-	-	176.0	-	-	-
580.7	-	-	-	177.0	-	-	-
584.0	-	-	-	178.0	-	-	-
587.3	8550	19380	0.38	179.0	2610	5910	0.38
590.6	8890	19840	0.37	180.0	2710	6050	0.37
593.8	6350	14120	0.37	181.0	1940	4310	0.37
597.1	10750	17730	0.21	182.0	3280	5400	0.21
600.4	10500	22830	0.37	183.0	3200	6960	0.37
603.7	10580	18320	0.25	184.0	3230	5580	0.25
607.0	8230	17010	0.35	185.0	2510	5180	0.35
610.2	10030	17010	0.23	186.0	3060	5180	0.23
613.5	10340	17540	0.23	187.0	3150	5350	0.23
616.8	10260	18520	0.28	188.0	3130	5640	0.28
620.1	10030	17010	0.23	189.0	3060	5180	0.23
623.4	10340	16670	0.19	190.0	3150	5080	0.19
626.6	10030	20580	0.34	191.0	3060	6270	0.34
629.9	9950	18520	0.30	192.0	3030	5640	0.30
633.2	10260	19160	0.30	193.0	3130	5840	0.30

Summary of Compressional Wave Velocity, Shear Wave Velocity, and Poisson's Ratio
Based on Receiver-to-Receiver Travel Time Data - Borehole C4997 LOG #7

American Units				Metric Units			
Depth at	Velocity			Depth at	Velocity		
Midpoint Between Receivers	V_s	V_p	Poisson's Ratio	Midpoint Between Receivers	V_s	V_p	Poisson's Ratio
(ft)	(ft/s)	(ft/s)		(m)	(m/s)	(m/s)	
636.5	10580	19160	0.28	194.0	3230	5840	0.28
639.8	10100	20580	0.34	195.0	3080	6270	0.34
643.0	10180	18120	0.27	196.0	3100	5520	0.27
646.3	10500	19160	0.29	197.0	3200	5840	0.29
649.6	10340	18940	0.29	198.0	3150	5770	0.29
652.9	10260	19160	0.30	199.0	3130	5840	0.30
656.2	9880	17920	0.28	200.0	3010	5460	0.28
659.5	9460	18320	0.32	201.0	2880	5580	0.32
662.7	9520	17360	0.28	202.0	2900	5290	0.28
666.0	10180	21100	0.35	203.0	3100	6430	0.35
669.3	10500	10750	-	204.0	3200	3280	-
672.6	9130	20580	0.38	205.0	2780	6270	0.38
675.9	10180	17920	0.26	206.0	3100	5460	0.26
679.1	9800	17920	0.29	207.0	2990	5460	0.29
682.4	9660	18120	0.30	208.0	2940	5520	0.30
685.7	10500	17360	0.21	209.0	3200	5290	0.21
689.0	10580	21100	0.33	210.0	3230	6430	0.33
692.3	10180	20080	0.33	211.0	3100	6120	0.33
695.5	10420	15430	0.08	212.0	3180	4700	0.08
698.8	9880	18730	0.31	213.0	3010	5710	0.31
702.1	9660	18940	0.32	214.0	2940	5770	0.32
705.4	9320	18120	0.32	215.0	2840	5520	0.32
708.7	8180	16340	0.33	216.0	2490	4980	0.33
711.9	9800	18320	0.30	217.0	2990	5580	0.30
715.2	7620	18730	0.40	218.0	2320	5710	0.40
718.5	7620	15020	0.33	219.0	2320	4580	0.33
721.8	7660	15430	0.34	220.0	2340	4700	0.34
725.1	9660	17920	0.30	221.0	2940	5460	0.30
728.4	6230	12630	0.34	222.0	1900	3850	0.34
731.6	6290	13890	0.37	223.0	1920	4230	0.37
734.9	4210	9630	0.38	224.0	1280	2940	0.38
738.2	4090	9010	0.37	225.0	1250	2750	0.37
741.5	7580	14180	0.30	226.0	2310	4320	0.30
744.8	6120	11900	0.32	227.0	1860	3630	0.32
748.0	2940	7410	0.41	228.0	900	2260	0.41
751.3	-	5850	-	229.0	-	1780	-
754.6	3300	7250	0.37	230.0	1010	2210	0.37
757.9	3060	6540	0.36	231.0	930	1990	0.36
761.2	2410	5290	0.37	232.0	730	1610	0.37
764.4	-	14880	-	233.0	-	4540	-

Summary of Compressional Wave Velocity, Shear Wave Velocity, and Poisson's Ratio
Based on Receiver-to-Receiver Travel Time Data - Borehole C4997 LOG #7

American Units				Metric Units			
Depth at	Velocity			Depth at	Velocity		
Midpoint Between Receivers	V_s	V_p	Poisson's Ratio	Midpoint Between Receivers	V_s	V_p	Poisson's Ratio
(ft)	(ft/s)	(ft/s)		(m)	(m/s)	(m/s)	
764.4	8660	15500	0.27	233.0	2640	4730	0.27
767.7	10670	17920	0.23	234.0	3250	5460	0.23
771.0	7940	16670	0.35	235.0	2420	5080	0.35
774.3	7050	17730	0.41	236.0	2150	5400	0.41
777.6	8890	16340	0.29	237.0	2710	4980	0.29
780.8	8890	15290	0.24	238.0	2710	4660	0.24
784.1	8600	20330	0.39	239.0	2620	6200	0.39
787.4	9130	15430	0.23	240.0	2780	4700	0.23
790.7	6200	11900	0.31	241.0	1890	3630	0.31
794.0	6870	12300	0.27	242.0	2090	3750	0.27
797.2	6570	12080	0.29	243.0	2000	3680	0.29
800.5	6770	12300	0.28	244.0	2060	3750	0.28
803.8	6380	11490	0.28	245.0	1940	3500	0.28
807.1	9200	19160	0.35	246.0	2800	5840	0.35
810.4	10100	18120	0.27	247.0	3080	5520	0.27
813.7	9880	18520	0.30	248.0	3010	5640	0.30
816.9	9660	18730	0.32	249.0	2940	5710	0.32
820.2	9460	17920	0.31	250.0	2880	5460	0.31
823.5	9660	19160	0.33	251.0	2940	5840	0.33
826.8	9880	18120	0.29	252.0	3010	5520	0.29
830.1	9880	18120	0.29	253.0	3010	5520	0.29
833.3	10260	18730	0.29	254.0	3130	5710	0.29
836.6	10100	18120	0.27	255.0	3080	5520	0.27
839.9	10500	20330	0.32	256.0	3200	6200	0.32
843.2	10260	18830	0.29	257.0	3130	5740	0.29
846.5	10260	20830	0.34	258.0	3130	6350	0.34
849.7	9010	18730	0.35	259.0	2750	5710	0.35
853.0	7330	19050	0.41	260.0	2230	5810	0.41
856.3	4500	10580	0.39	261.0	1370	3230	0.39
859.6	3450	7490	0.36	262.0	1050	2280	0.36
862.9	2660	6730	0.41	263.0	810	2050	0.41
866.1	2620	7750	0.44	264.0	800	2360	0.44
869.4	2670	7170	0.42	265.0	810	2180	0.42
872.7	2390	6120	0.41	266.0	730	1860	0.41
876.0	3090	6730	0.37	267.0	940	2050	0.37
879.3	2480	7410	0.44	268.0	760	2260	0.44
882.6	2680	7660	0.43	269.0	820	2340	0.43
885.8	2430	7170	0.43	270.0	740	2180	0.43
889.1	2310	7170	0.44	271.0	700	2180	0.44
892.4	2510	7250	0.43	272.0	760	2210	0.43

Summary of Compressional Wave Velocity, Shear Wave Velocity, and Poisson's Ratio
Based on Receiver-to-Receiver Travel Time Data - Borehole C4997 LOG #7

American Units				Metric Units			
Depth at	Velocity			Depth at	Velocity		
Midpoint Between Receivers	V_s	V_p	Poisson's Ratio	Midpoint Between Receivers	V_s	V_p	Poisson's Ratio
(ft)	(ft/s)	(ft/s)		(m)	(m/s)	(m/s)	
895.7	2900	7170	0.40	273.0	880	2180	0.40
899.0	2530	6870	0.42	274.0	770	2090	0.42
902.2	2540	7020	0.42	275.0	780	2140	0.42
905.5	2210	6800	0.44	276.0	680	2070	0.44
908.8	2410	7170	0.44	277.0	730	2180	0.44
912.1	2110	6540	0.44	278.0	640	1990	0.44
915.4	2110	6670	0.44	279.0	640	2030	0.44
918.6	2400	6800	0.43	280.0	730	2070	0.43
921.9	2360	6470	0.42	281.0	720	1970	0.42
925.2	2500	6230	0.40	282.0	760	1900	0.40
928.5	2400	6730	0.43	283.0	730	2050	0.43
931.8	2170	6410	0.44	284.0	660	1950	0.44
935.0	2060	6470	0.44	285.0	630	1970	0.44
938.3	2000	6410	0.45	286.0	610	1950	0.45
941.6	2590	6290	0.40	287.0	790	1920	0.40
944.9	2990	7580	0.41	288.0	910	2310	0.41
948.2	2890	6010	0.35	289.0	880	1830	0.35
951.4	2620	6060	0.38	290.0	800	1850	0.38
954.7	3220	6290	0.32	291.0	980	1920	0.32
958.0	3720	8170	0.37	292.0	1140	2490	0.37
961.3	7020	12920	0.29	293.0	2140	3940	0.29
964.6	7940	15020	0.31	294.0	2420	4580	0.31
967.9	8490	17180	0.34	295.0	2590	5240	0.34
971.1	8830	14880	0.23	296.0	2690	4540	0.23
974.4	8770	17270	0.33	297.0	2670	5260	0.33
977.7	9130	15290	0.22	298.0	2780	4660	0.22
981.0	8950	18320	0.34	299.0	2730	5580	0.34
984.3	8950	17540	0.32	300.0	2730	5350	0.32
987.5	9260	18940	0.34	301.0	2820	5770	0.34
990.8	9520	16500	0.25	302.0	2900	5030	0.25
994.1	8830	17730	0.34	303.0	2690	5400	0.34
997.4	7710	17730	0.38	304.0	2350	5400	0.38
1000.7	6290	11340	0.28	305.0	1920	3460	0.28
1003.9	8600	18320	0.36	306.0	2620	5580	0.36
1007.2	4000	10100	0.41	307.0	1220	3080	0.41
1010.5	3100	12170	0.47	308.0	950	3710	0.47
1013.8	3810	10550	0.43	309.0	1160	3220	0.43
1017.1	3500	7970	0.38	310.0	1070	2430	0.38
1020.3	3720	7540	0.34	311.0	1140	2300	0.34
1023.6	4120	8330	0.34	312.0	1250	2540	0.34

Summary of Compressional Wave Velocity, Shear Wave Velocity, and Poisson's Ratio
Based on Receiver-to-Receiver Travel Time Data - Borehole C4997 LOG #7

American Units				Metric Units			
Depth at	Velocity			Depth at	Velocity		
Midpoint Between Receivers	V_s	V_p	Poisson's Ratio	Midpoint Between Receivers	V_s	V_p	Poisson's Ratio
(ft)	(ft/s)	(ft/s)		(m)	(m/s)	(m/s)	
1026.9	6010	14620	0.40	313.0	1830	4460	0.40
1030.2	8030	12720	0.17	314.0	2450	3880	0.17
1033.5	9070	18120	0.33	315.0	2760	5520	0.33
1036.8	9880	17920	0.28	316.0	3010	5460	0.28
1040.0	9520	18320	0.31	317.0	2900	5580	0.31
1043.3	10340	18940	0.29	318.0	3150	5770	0.29
1046.6	10030	18320	0.29	319.0	3060	5580	0.29
1049.9	9880	19160	0.32	320.0	3010	5840	0.32
1053.2	9880	18940	0.31	321.0	3010	5770	0.31
1056.4	9950	18730	0.30	322.0	3030	5710	0.30
1059.7	9800	18120	0.29	323.0	2990	5520	0.29
1063.0	9460	18520	0.32	324.0	2880	5640	0.32
1066.3	9660	18320	0.31	325.0	2940	5580	0.31
1069.6	9460	18120	0.31	326.0	2880	5520	0.31
1072.8	9950	17730	0.27	327.0	3030	5400	0.27
1076.1	9520	18730	0.33	328.0	2900	5710	0.33
1079.4	10260	18120	0.26	329.0	3130	5520	0.26
1082.7	9950	18520	0.30	330.0	3030	5640	0.30
1086.0	10100	18120	0.27	331.0	3080	5520	0.27
1089.2	10030	18120	0.28	332.0	3060	5520	0.28
1092.5	10180	19160	0.30	333.0	3100	5840	0.30
1095.8	10180	18320	0.28	334.0	3100	5580	0.28
1099.1	10750	18320	0.24	335.0	3280	5580	0.24
1102.4	9880	17540	0.27	336.0	3010	5350	0.27
1105.6	9520	19050	0.33	337.0	2900	5810	0.33
1108.9	10260	17090	0.22	338.0	3130	5210	0.22
1112.2	8030	18020	0.38	339.0	2450	5490	0.38
1115.5	2110	7250	0.45	340.0	640	2210	0.45
1118.8	3130	8230	0.42	341.0	950	2510	0.42
1122.1	2140	6170	0.43	342.0	650	1880	0.43
1125.3	3000	6870	0.38	343.0	920	2090	0.38
1128.6	3320	6670	0.34	344.0	1010	2030	0.34
1131.9	2220	6730	0.44	345.0	680	2050	0.44
1135.2	2180	7250	0.45	346.0	660	2210	0.45
1138.5	2010	6870	0.45	347.0	610	2090	0.45
1141.7	2520	7410	0.43	348.0	770	2260	0.43
1145.0	2570	7410	0.43	349.0	780	2260	0.43
1148.3	2560	7410	0.43	350.0	780	2260	0.43
1151.6	2560	7330	0.43	351.0	780	2230	0.43
1154.9	2730	7170	0.42	352.0	830	2180	0.42

Summary of Compressional Wave Velocity, Shear Wave Velocity, and Poisson's Ratio
Based on Receiver-to-Receiver Travel Time Data - Borehole C4997 LOG #7

American Units				Metric Units			
Depth at	Velocity			Depth at	Velocity		
Midpoint Between Receivers	V_s	V_p	Poisson's Ratio	Midpoint Between Receivers	V_s	V_p	Poisson's Ratio
(ft)	(ft/s)	(ft/s)		(m)	(m/s)	(m/s)	
1158.1	2160	7490	0.45	353.0	660	2280	0.45
1161.4	3130	7940	0.41	354.0	950	2420	0.41
1164.7	3100	7660	0.40	355.0	950	2340	0.40
1168.0	2200	7090	0.45	356.0	670	2160	0.45
1171.3	2110	7170	0.45	357.0	640	2180	0.45
1174.5	2190	6600	0.44	358.0	670	2010	0.44
1177.8	2220	6230	0.43	359.0	680	1900	0.43
1181.1	2140	5650	0.42	360.0	650	1720	0.42
1184.4	2210	7330	0.45	361.0	670	2230	0.45
1187.7	2080	6800	0.45	362.0	640	2070	0.45
1190.9	2840	6940	0.40	363.0	860	2120	0.40
1194.2	2940	6010	0.34	364.0	900	1830	0.34
1197.5	3000	6060	0.34	365.0	920	1850	0.34
1200.8	3720	7170	0.32	366.0	1140	2180	0.32
1204.1	2990	6230	0.35	367.0	910	1900	0.35
1207.4	2340	6800	0.43	368.0	710	2070	0.43
1210.6	2510	6610	0.42	369.0	760	2020	0.42
1210.6	2490	6830	0.42	369.0	760	2080	0.42
1213.9	3350	7540	0.38	370.0	1020	2300	0.38
1217.2	8490	15870	0.30	371.0	2590	4840	0.30
1220.5	8490	14490	0.24	372.0	2590	4420	0.24
1223.8	8550	16840	0.33	373.0	2610	5130	0.33
1227.0	9950	17920	0.28	374.0	3030	5460	0.28
1230.3	9390	15720	0.22	375.0	2860	4790	0.22
1233.6	8830	15020	0.24	376.0	2690	4580	0.24
1236.9	8660	15020	0.25	377.0	2640	4580	0.25
1240.2	8950	17180	0.31	378.0	2730	5240	0.31
1243.4	9460	16500	0.26	379.0	2880	5030	0.26
1246.7	9320	16840	0.28	380.0	2840	5130	0.28
1250.0	9730	16670	0.24	381.0	2970	5080	0.24
1253.3	9590	18120	0.31	382.0	2920	5520	0.31
1256.6	10260	17920	0.26	383.0	3130	5460	0.26
1259.8	10100	17920	0.27	384.0	3080	5460	0.27
1263.1	10030	16840	0.23	385.0	3060	5130	0.23
1266.4	10420	18940	0.28	386.0	3180	5770	0.28
1269.7	10340	17540	0.23	387.0	3150	5350	0.23
1273.0	10180	17920	0.26	388.0	3100	5460	0.26
1276.3	10420	19610	0.30	389.0	3180	5980	0.30
1279.5	10500	18940	0.28	390.0	3200	5770	0.28
1282.8	10420	19160	0.29	391.0	3180	5840	0.29

Summary of Compressional Wave Velocity, Shear Wave Velocity, and Poisson's Ratio
Based on Receiver-to-Receiver Travel Time Data - Borehole C4997 LOG #7

American Units				Metric Units			
Depth at	Velocity			Depth at	Velocity		
Midpoint Between Receivers	V_s	V_p	Poisson's Ratio	Midpoint Between Receivers	V_s	V_p	Poisson's Ratio
(ft)	(ft/s)	(ft/s)		(m)	(m/s)	(m/s)	
1286.1	10670	19160	0.28	392.0	3250	5840	0.28
1289.4	10580	19160	0.28	393.0	3230	5840	0.28
1292.7	10840	19610	0.28	394.0	3300	5980	0.28
1295.9	10930	19160	0.26	395.0	3330	5840	0.26
1299.2	11020	19380	0.26	396.0	3360	5910	0.26
1302.5	11300	19380	0.24	397.0	3440	5910	0.24
1305.8	10580	18730	0.27	398.0	3230	5710	0.27
1309.1	10580	19160	0.28	399.0	3230	5840	0.28
1312.3	10670	19380	0.28	400.0	3250	5910	0.28
1315.6	10580	20080	0.31	401.0	3230	6120	0.31
1318.9	10840	19840	0.29	402.0	3300	6050	0.29
1322.2	10840	18120	0.22	403.0	3300	5520	0.22
1325.5	10340	18520	0.27	404.0	3150	5640	0.27
1328.7	8330	18940	0.38	405.0	2540	5770	0.38
1332.0	8130	18940	0.39	406.0	2480	5770	0.39
1335.3	9590	18520	0.32	407.0	2920	5640	0.32
1338.6	8600	19840	0.38	408.0	2620	6050	0.38
1341.9	10580	18940	0.27	409.0	3230	5770	0.27
1345.1	10840	18940	0.26	410.0	3300	5770	0.26
1348.4	10840	19380	0.27	411.0	3300	5910	0.27
1351.7	11110	19840	0.27	412.0	3390	6050	0.27
1355.0	8280	17640	0.36	413.0	2520	5380	0.36
1358.3	9260	18120	0.32	414.0	2820	5520	0.32
1361.6	9460	18120	0.31	415.0	2880	5520	0.31
1364.8	8330	19160	0.38	416.0	2540	5840	0.38
1368.1	11200	18020	0.18	417.0	3420	5490	0.18
1371.4	10750	19050	0.27	418.0	3280	5810	0.27
1374.7	8550	16750	0.32	419.0	2610	5110	0.32
1378.0	6470	13890	0.36	420.0	1970	4230	0.36
1381.2	7890	17010	0.36	421.0	2400	5180	0.36
1384.5	6670	14430	0.36	422.0	2030	4400	0.36
1387.8	7090	14680	0.35	423.0	2160	4480	0.35
1391.1	7210	15020	0.35	424.0	2200	4580	0.35
1394.4	7620	15580	0.34	425.0	2320	4750	0.34
1397.6	7090	15290	0.36	426.0	2160	4660	0.36
1400.9	7530	15080	0.33	427.0	2300	4600	0.33
1404.2	7840	16670	0.36	428.0	2390	5080	0.36
1407.5	9130	16030	0.26	429.0	2780	4880	0.26
1410.8	8490	19270	0.38	430.0	2590	5870	0.38
1414.4	7750	16750	0.36	431.1	2360	5110	0.36

Summary of Compressional Wave Velocity, Shear Wave Velocity, and Poisson's Ratio
Based on Receiver-to-Receiver Travel Time Data - Borehole C4997 LOG #7

American Units				Metric Units			
Depth at	Velocity			Depth at	Velocity		
Midpoint Between Receivers	V_s	V_p	Poisson's Ratio	Midpoint Between Receivers	V_s	V_p	Poisson's Ratio
(ft)	(ft/s)	(ft/s)		(m)	(m/s)	(m/s)	
1417.7	8550	17270	0.34	432.1	2610	5260	0.34

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

APPENDIX A

SUSPENSION VELOCITY MEASUREMENT QUALITY ASSURANCE SUSPENSION SOURCE TO RECEIVER ANALYSIS RESULTS

Table of Figures

Table of Tables

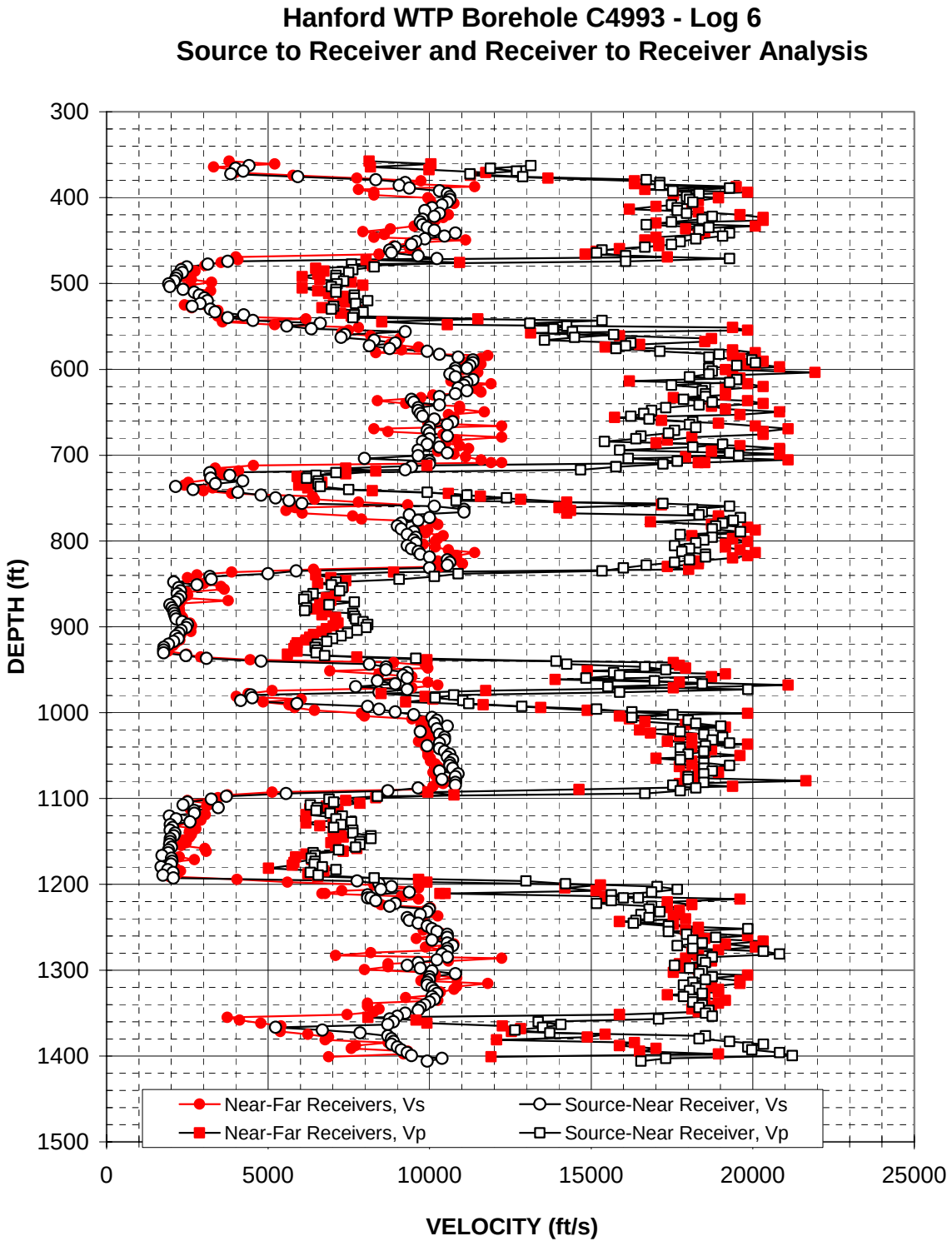


Figure A-1 Boring BH-C4993 Log 6, Suspension S-R1 P- and S_H-wave velocities

Table A-1 Boring BH-C4993 Log 6, 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 C4993 RUN#6

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)	
362.7	4410	13130	0.44	110.5	1340	4000	0.44
365.9	3990	11880	0.44	111.5	1220	3620	0.44
369.2	4230	12690	0.44	112.5	1290	3870	0.44
372.5	3850	11250	0.43	113.5	1170	3430	0.43
375.8	5920	12880	0.37	114.5	1800	3930	0.37
379.1	8330	16710	0.33	115.5	2540	5090	0.33
382.3	9250	17130	0.29	116.5	2820	5220	0.29
385.6	9060	17130	0.31	117.5	2760	5220	0.31
388.9	9380	19290	0.35	118.5	2860	5880	0.35
392.2	10310	17530	0.24	119.5	3140	5340	0.24
395.5	10550	18340	0.25	120.5	3210	5590	0.25
398.7	10630	17950	0.23	121.5	3240	5470	0.23
402.0	10630	18050	0.23	122.5	3240	5500	0.23
405.3	10550	18150	0.24	123.5	3210	5530	0.24
408.6	10380	17490	0.23	124.5	3170	5330	0.23
411.9	10070	17670	0.26	125.5	3070	5390	0.26
415.1	9850	17670	0.27	126.5	3000	5390	0.27
418.4	10310	17950	0.25	127.5	3140	5470	0.25
421.7	10150	18750	0.29	128.5	3090	5710	0.29
425.0	9780	18440	0.30	129.5	2980	5620	0.30
428.3	9710	17490	0.28	130.5	2960	5330	0.28
431.6	9780	16710	0.24	131.5	2980	5090	0.24
434.8	9930	18650	0.30	132.5	3030	5680	0.30
438.1	10150	18340	0.28	133.5	3090	5590	0.28
441.4	10800	19290	0.27	134.5	3290	5880	0.27
444.7	10470	19070	0.28	135.5	3190	5810	0.28
448.0	9850	18240	0.29	136.5	3000	5560	0.29
451.2	9570	17760	0.30	137.5	2920	5410	0.30
454.5	9440	17490	0.29	138.5	2880	5330	0.29
457.8	8940	16670	0.30	139.5	2730	5080	0.30
461.1	8770	15340	0.26	140.5	2670	4680	0.26
464.4	8820	15170	0.24	141.5	2690	4620	0.24
467.6	9640	16070	0.22	142.5	2940	4900	0.22
470.9	10230	19290	0.30	143.5	3120	5880	0.30
474.2	3750	16070	0.47	144.5	1140	4900	0.47

Summary of Compressional Wave Velocity, Shear Wave Velocity, and Poisson's Ratio
Based on Source-to-Receiver Travel Time Data - Borehole C4993 RUN#6

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)	
477.5	3140	7580	0.40	145.5	960	2310	0.40
480.8	2480	8280	0.45	146.5	760	2520	0.45
484.0	2310	7630	0.45	147.5	700	2320	0.45
487.3	2350	7500	0.45	148.5	720	2290	0.45
490.6	2180	7110	0.45	149.5	660	2170	0.45
493.9	2150	7110	0.45	150.5	660	2170	0.45
497.2	2100	7340	0.46	151.5	640	2240	0.46
500.5	1920	7140	0.46	152.5	590	2180	0.46
503.7	1960	6960	0.46	153.5	600	2120	0.46
507.0	2370	7110	0.44	154.5	720	2170	0.44
510.3	2710	7110	0.41	155.5	830	2170	0.41
513.6	2870	7670	0.42	156.5	880	2340	0.42
516.9	3030	7670	0.41	157.5	920	2340	0.41
520.1	3130	8080	0.41	158.5	950	2460	0.41
523.4	2900	7710	0.42	159.5	880	2350	0.42
526.7	2650	7030	0.42	160.5	810	2140	0.42
530.0	3210	6960	0.36	161.5	980	2120	0.36
533.3	3360	7940	0.39	162.5	1020	2420	0.39
536.5	4250	7670	0.28	163.5	1290	2340	0.28
539.8	3750	7630	0.34	164.5	1140	2320	0.34
543.1	4530	15340	0.45	165.5	1380	4680	0.45
546.4	6620	13110	0.33	166.5	2020	3990	0.33
549.7	5580	14240	0.41	167.5	1700	4340	0.41
552.9	6340	13830	0.37	168.5	1930	4220	0.37
556.2	9250	14420	0.15	169.5	2820	4400	0.15
559.5	7380	15700	0.36	170.5	2250	4780	0.36
562.8	7260	14480	0.33	171.5	2210	4420	0.33
566.1	8280	13550	0.20	172.5	2520	4130	0.20
569.3	8940	16230	0.28	173.5	2730	4950	0.28
572.6	8130	16070	0.33	174.5	2480	4900	0.33
575.9	8770	15770	0.28	175.5	2670	4810	0.28
579.2	9930	17130	0.25	176.5	3030	5220	0.25
582.5	10310	18960	0.29	177.5	3140	5780	0.29
585.8	10890	18650	0.24	178.5	3320	5680	0.24
589.0	11340	19970	0.26	179.5	3460	6090	0.26
592.3	11340	20090	0.27	180.5	3460	6120	0.27
595.6	11250	19510	0.25	181.5	3430	5950	0.25
598.9	10800	18650	0.25	182.5	3290	5680	0.25
598.9	11160	18650	0.22	182.5	3400	5680	0.22

Summary of Compressional Wave Velocity, Shear Wave Velocity, and Poisson's Ratio
Based on Source-to-Receiver Travel Time Data - Borehole C4993 RUN#6

American Units			
Depth at Midpoint Between Source and Near Receiver	Velocity V_s	Velocity V_p	Poisson's Ratio
(ft)	(ft/s)	(ft/s)	
602.2	10800	18750	0.25
605.4	10630	18650	0.26
608.7	10800	18050	0.22
612.0	11340	19510	0.24
615.3	11160	19290	0.25
618.6	11070	17490	0.17
621.8	10890	18540	0.24
625.1	11160	18440	0.21
628.4	10800	18540	0.24
631.7	10310	18540	0.28
635.0	9440	17860	0.31
638.2	9510	18750	0.33
641.5	10310	18340	0.27
644.8	9640	17310	0.27
648.1	9640	16880	0.26
651.4	9710	16630	0.24
654.7	9780	16230	0.21
657.9	10150	16790	0.21
661.2	10710	18150	0.23
664.5	10550	18050	0.24
667.8	10000	18240	0.29
671.1	9930	17580	0.27
674.3	10000	17400	0.25
677.6	10550	16540	0.16
680.9	10000	16380	0.20
684.2	9780	15410	0.16
687.5	9930	19070	0.31
690.7	10310	18150	0.26
694.0	9640	15880	0.21
697.3	10550	19290	0.29
700.6	9640	19570	0.34
703.9	7990	16150	0.34
707.1	10000	17670	0.26
710.4	10000	17220	0.25
713.7	9440	15770	0.22
713.7	9440	15770	0.22
717.0	9250	14670	0.17
720.3	3200	7110	0.37
723.5	3810	6490	0.24

Metric Units			
Depth at Midpoint Between Source and Near Receiver	Velocity V_s	Velocity V_p	Poisson's Ratio
(m)	(m/s)	(m/s)	
183.5	3290	5710	0.25
184.5	3240	5680	0.26
185.5	3290	5500	0.22
186.5	3460	5950	0.24
187.5	3400	5880	0.25
188.5	3370	5330	0.17
189.5	3320	5650	0.24
190.5	3400	5620	0.21
191.5	3290	5650	0.24
192.5	3140	5650	0.28
193.5	2880	5440	0.31
194.5	2900	5710	0.33
195.5	3140	5590	0.27
196.5	2940	5280	0.27
197.5	2940	5140	0.26
198.5	2960	5070	0.24
199.5	2980	4950	0.21
200.5	3090	5120	0.21
201.5	3270	5530	0.23
202.5	3210	5500	0.24
203.5	3050	5560	0.29
204.5	3030	5360	0.27
205.5	3050	5300	0.25
206.5	3210	5040	0.16
207.5	3050	4990	0.20
208.5	2980	4700	0.16
209.5	3030	5810	0.31
210.5	3140	5530	0.26
211.5	2940	4840	0.21
212.5	3210	5880	0.29
213.5	2940	5960	0.34
214.5	2430	4920	0.34
215.5	3050	5390	0.26
216.5	3050	5250	0.25
217.5	2880	4810	0.22
217.5	2880	4810	0.22
218.5	2820	4470	0.17
219.5	980	2170	0.37
220.5	1160	1980	0.24

Summary of Compressional Wave Velocity, Shear Wave Velocity, and Poisson's Ratio
Based on Source-to-Receiver Travel Time Data - Borehole C4993 RUN#6

American Units			
Depth at Midpoint Between Source and Near Receiver	Velocity		Poisson's Ratio
	V_s	V_p	
(ft)	(ft/s)	(ft/s)	
726.8	3230	6190	0.31
730.1	4220	6550	0.15
733.4	3380	6550	0.32
736.7	2140	6620	0.44
740.0	2680	7500	0.43
743.2	4070	9930	0.40
746.5	4790	11160	0.39
749.8	5230	12390	0.39
753.1	5650	10820	0.31
756.4	6050	17220	0.43
759.6	10150	19290	0.31
762.9	11070	18150	0.20
766.2	11070	18440	0.22
769.5	9380	18340	0.32
772.8	10000	19620	0.32
776.0	9640	19400	0.34
779.3	9120	19070	0.35
782.6	9000	18850	0.35
785.9	9120	18750	0.34
789.2	9510	19620	0.35
792.4	9310	17760	0.31
795.7	9570	18750	0.32
799.0	9510	18490	0.32
802.3	9570	18240	0.31
805.6	9310	17580	0.31
808.9	9440	18050	0.31
812.1	9640	17810	0.29
815.4	9710	18540	0.31
818.7	10000	18540	0.29
822.0	10550	18050	0.24
824.9	10630	17580	0.21
828.2	10550	16710	0.17
831.5	10000	16000	0.18
834.8	5870	15340	0.41
838.1	5000	10890	0.37
841.3	3200	10150	0.44
844.6	3250	9060	0.43
847.9	2080	7110	0.45
851.2	2800	6960	0.40

Metric Units			
Depth at Midpoint Between Source and Near Receiver	Velocity		Poisson's Ratio
	V_s	V_p	
(m)	(m/s)	(m/s)	
221.5	980	1890	0.31
222.5	1290	2000	0.15
223.5	1030	2000	0.32
224.5	650	2020	0.44
225.5	820	2290	0.43
226.5	1240	3030	0.40
227.5	1460	3400	0.39
228.5	1590	3780	0.39
229.5	1720	3300	0.31
230.5	1850	5250	0.43
231.5	3090	5880	0.31
232.5	3370	5530	0.20
233.5	3370	5620	0.22
234.5	2860	5590	0.32
235.5	3050	5980	0.32
236.5	2940	5910	0.34
237.5	2780	5810	0.35
238.5	2740	5750	0.35
239.5	2780	5710	0.34
240.5	2900	5980	0.35
241.5	2840	5410	0.31
242.5	2920	5710	0.32
243.5	2900	5640	0.32
244.5	2920	5560	0.31
245.5	2840	5360	0.31
246.5	2880	5500	0.31
247.5	2940	5430	0.29
248.5	2960	5650	0.31
249.5	3050	5650	0.29
250.5	3210	5500	0.24
251.4	3240	5360	0.21
252.4	3210	5090	0.17
253.4	3050	4880	0.18
254.4	1790	4680	0.41
255.4	1520	3320	0.37
256.4	980	3090	0.44
257.4	990	2760	0.43
258.4	640	2170	0.45
259.4	850	2120	0.40

Summary of Compressional Wave Velocity, Shear Wave Velocity, and Poisson's Ratio
Based on Source-to-Receiver Travel Time Data - Borehole C4993 RUN#6

American Units			
Depth at Midpoint Between Source and Near Receiver	Velocity V_s	Velocity V_p	Poisson's Ratio
(ft)	(ft/s)	(ft/s)	
854.5	2240	7300	0.45
858.1	2290	7220	0.44
861.3	2190	6400	0.43
864.6	2300	6190	0.42
867.9	2220	6110	0.42
871.2	2140	7670	0.46
874.5	1960	6890	0.46
877.7	2030	6190	0.44
881.0	2080	6140	0.44
884.3	2100	7630	0.46
887.6	2130	7670	0.46
890.9	2160	7710	0.46
894.2	2340	7940	0.45
897.4	2510	8080	0.45
900.7	2460	8040	0.45
904.0	2310	7760	0.45
907.3	2250	7460	0.45
910.6	2150	7260	0.45
913.8	2220	6990	0.44
917.1	2080	6820	0.45
920.4	1920	6520	0.45
923.7	1780	6460	0.46
927.0	1770	6520	0.46
930.2	1770	6490	0.46
933.5	2450	6750	0.42
936.8	3100	9570	0.44
940.1	4790	13920	0.43
943.4	8130	14240	0.26
946.6	8650	16670	0.32
949.9	8650	17310	0.33
953.2	9310	15700	0.23
956.5	9180	15880	0.25
959.8	9310	14840	0.18
963.1	8390	16960	0.34
966.3	8940	18440	0.35
969.6	7710	15520	0.34
972.9	9310	19850	0.36
976.2	8440	15880	0.30
979.5	4470	10750	0.40

Metric Units			
Depth at Midpoint Between Source and Near Receiver	Velocity V_s	Velocity V_p	Poisson's Ratio
(m)	(m/s)	(m/s)	
260.4	680	2220	0.45
261.5	700	2200	0.44
262.5	670	1950	0.43
263.5	700	1890	0.42
264.5	680	1860	0.42
265.5	650	2340	0.46
266.5	600	2100	0.46
267.5	620	1890	0.44
268.5	630	1870	0.44
269.5	640	2320	0.46
270.5	650	2340	0.46
271.5	660	2350	0.46
272.5	710	2420	0.45
273.5	760	2460	0.45
274.5	750	2450	0.45
275.5	700	2360	0.45
276.5	690	2270	0.45
277.5	660	2210	0.45
278.5	680	2130	0.44
279.5	630	2080	0.45
280.5	580	1990	0.45
281.5	540	1970	0.46
282.5	540	1990	0.46
283.5	540	1980	0.46
284.5	750	2060	0.42
285.5	940	2920	0.44
286.5	1460	4240	0.43
287.5	2480	4340	0.26
288.5	2640	5080	0.32
289.5	2640	5280	0.33
290.5	2840	4780	0.23
291.5	2800	4840	0.25
292.5	2840	4520	0.18
293.5	2560	5170	0.34
294.5	2730	5620	0.35
295.5	2350	4730	0.34
296.5	2840	6050	0.36
297.5	2570	4840	0.30
298.5	1360	3280	0.40

Summary of Compressional Wave Velocity, Shear Wave Velocity, and Poisson's Ratio
Based on Source-to-Receiver Travel Time Data - Borehole C4993 RUN#6

American Units			
Depth at Midpoint Between Source and Near Receiver	Velocity V_s	Velocity V_p	Poisson's Ratio
(ft)	(ft/s)	(ft/s)	
982.7	4520	10170	0.38
986.0	4150	11030	0.42
989.3	5900	11210	0.31
992.6	8080	12860	0.17
995.9	8440	15170	0.28
999.1	8940	16270	0.28
1002.4	9510	17530	0.29
1005.7	10070	16270	0.19
1009.0	10230	18000	0.26
1012.3	10150	18240	0.28
1015.5	10550	19010	0.28
1018.8	10230	17530	0.24
1022.1	9710	17760	0.29
1025.4	10310	18490	0.27
1028.7	10470	19070	0.28
1031.9	10470	18750	0.27
1035.2	10310	19290	0.30
1038.5	9930	18540	0.30
1041.8	10310	17760	0.25
1045.1	10470	18490	0.26
1048.4	10630	18000	0.23
1051.6	10550	17760	0.23
1054.9	10710	17760	0.21
1058.2	10630	18490	0.25
1061.5	10630	19290	0.28
1064.8	10710	18490	0.25
1068.0	10310	18750	0.28
1071.3	10890	18490	0.23
1074.6	10800	18000	0.22
1077.9	10380	18000	0.25
1081.2	10800	18490	0.24
1084.4	10800	17530	0.19
1087.7	9640	18240	0.31
1091.0	8710	17760	0.34
1094.3	5560	16670	0.44
1097.6	3710	8390	0.38
1100.8	3250	6890	0.36
1104.1	2510	7030	0.43
1107.4	2370	6310	0.42

Metric Units			
Depth at Midpoint Between Source and Near Receiver	Velocity V_s	Velocity V_p	Poisson's Ratio
(m)	(m/s)	(m/s)	
299.5	1380	3100	0.38
300.5	1270	3360	0.42
301.5	1800	3420	0.31
302.5	2460	3920	0.17
303.5	2570	4620	0.28
304.5	2730	4960	0.28
305.5	2900	5340	0.29
306.5	3070	4960	0.19
307.5	3120	5490	0.26
308.5	3090	5560	0.28
309.5	3210	5800	0.28
310.5	3120	5340	0.24
311.5	2960	5410	0.29
312.5	3140	5640	0.27
313.5	3190	5810	0.28
314.5	3190	5710	0.27
315.5	3140	5880	0.30
316.5	3030	5650	0.30
317.5	3140	5410	0.25
318.5	3190	5640	0.26
319.5	3240	5490	0.23
320.5	3210	5410	0.23
321.5	3270	5410	0.21
322.5	3240	5640	0.25
323.5	3240	5880	0.28
324.5	3270	5640	0.25
325.5	3140	5710	0.28
326.5	3320	5640	0.23
327.5	3290	5490	0.22
328.5	3170	5490	0.25
329.5	3290	5640	0.24
330.5	3290	5340	0.19
331.5	2940	5560	0.31
332.5	2650	5410	0.34
333.5	1690	5080	0.44
334.5	1130	2560	0.38
335.5	990	2100	0.36
336.5	760	2140	0.43
337.5	720	1920	0.42

Summary of Compressional Wave Velocity, Shear Wave Velocity, and Poisson's Ratio
Based on Source-to-Receiver Travel Time Data - Borehole C4993 RUN#6

American Units			
Depth at Midpoint Between Source and Near Receiver	Velocity		Poisson's Ratio
	V_s	V_p	
(ft)	(ft/s)	(ft/s)	
1110.7	3460	6520	0.30
1114.0	2710	6490	0.39
1117.2	2720	6920	0.41
1120.5	1950	7300	0.46
1123.8	2160	7110	0.45
1127.1	2590	7580	0.43
1130.4	1970	7260	0.46
1133.7	2050	7030	0.45
1136.9	1970	7630	0.46
1140.2	2120	7630	0.46
1143.5	2080	8180	0.47
1146.8	1970	8180	0.47
1150.1	1970	7850	0.47
1153.3	1960	7850	0.47
1156.6	2010	7710	0.46
1159.9	1920	7180	0.46
1163.2	1910	6400	0.45
1166.5	1720	6460	0.46
1169.7	2010	6340	0.44
1173.0	2030	6460	0.45
1176.3	2000	6430	0.45
1179.6	1690	6680	0.47
1182.9	1900	7110	0.46
1186.1	2060	6310	0.44
1189.4	1750	6550	0.46
1192.7	2070	8280	0.47
1196.0	7760	12980	0.22
1199.3	8440	14210	0.23
1202.6	8820	17050	0.32
1205.8	8490	17670	0.35
1209.1	9380	16880	0.28
1212.4	8080	15630	0.32
1215.7	8080	16460	0.34
1215.7	8180	16000	0.32
1219.0	8330	15630	0.30
1222.2	8940	15170	0.23
1225.5	8770	16880	0.32
1228.8	10000	16790	0.23
1232.1	9930	17130	0.25

Metric Units			
Depth at Midpoint Between Source and Near Receiver	Velocity		Poisson's Ratio
	V_s	V_p	
(m)	(m/s)	(m/s)	
338.5	1060	1990	0.30
339.5	830	1980	0.39
340.5	830	2110	0.41
341.5	590	2220	0.46
342.5	660	2170	0.45
343.5	790	2310	0.43
344.5	600	2210	0.46
345.5	630	2140	0.45
346.5	600	2320	0.46
347.5	650	2320	0.46
348.5	640	2490	0.47
349.5	600	2490	0.47
350.5	600	2390	0.47
351.5	600	2390	0.47
352.5	610	2350	0.46
353.5	580	2190	0.46
354.5	580	1950	0.45
355.5	520	1970	0.46
356.5	610	1930	0.44
357.5	620	1970	0.45
358.5	610	1960	0.45
359.5	520	2040	0.47
360.5	580	2170	0.46
361.5	630	1920	0.44
362.5	530	2000	0.46
363.5	630	2520	0.47
364.5	2360	3960	0.22
365.5	2570	4330	0.23
366.5	2690	5200	0.32
367.5	2590	5390	0.35
368.5	2860	5140	0.28
369.5	2460	4760	0.32
370.5	2460	5020	0.34
370.5	2490	4880	0.32
371.5	2540	4760	0.30
372.5	2730	4620	0.23
373.5	2670	5140	0.32
374.5	3050	5120	0.23
375.5	3030	5220	0.25

Summary of Compressional Wave Velocity, Shear Wave Velocity, and Poisson's Ratio
Based on Source-to-Receiver Travel Time Data - Borehole C4993 RUN#6

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)	
1235.4	9710	16540	0.24	376.5	2960	5040	0.24
1238.6	9310	16790	0.28	377.5	2840	5120	0.28
1241.9	9380	16380	0.26	378.5	2860	4990	0.26
1245.2	9640	16300	0.23	379.5	2940	4970	0.23
1248.5	9930	17400	0.26	380.5	3030	5300	0.26
1251.8	10070	19850	0.33	381.5	3070	6050	0.33
1255.0	10230	17400	0.24	382.5	3120	5300	0.24
1258.3	10550	17950	0.24	383.5	3210	5470	0.24
1261.6	10550	18850	0.27	384.5	3210	5750	0.27
1264.9	10070	18150	0.28	385.5	3070	5530	0.28
1268.2	10550	18440	0.26	386.5	3210	5620	0.26
1271.4	10710	17670	0.21	387.5	3270	5390	0.21
1274.7	10550	18150	0.24	388.5	3210	5530	0.24
1278.0	10550	20330	0.32	389.5	3210	6200	0.32
1281.3	10380	20830	0.33	390.5	3170	6350	0.33
1284.6	10550	18750	0.27	391.5	3210	5710	0.27
1287.9	10230	18440	0.28	392.5	3120	5620	0.28
1291.1	9640	18540	0.31	393.5	2940	5650	0.31
1294.4	9310	17580	0.31	394.5	2840	5360	0.31
1297.7	9710	18050	0.30	395.5	2960	5500	0.30
1301.0	10070	18440	0.29	396.5	3070	5620	0.29
1304.3	10800	18340	0.23	397.5	3290	5590	0.23
1307.5	10000	18750	0.30	398.5	3050	5710	0.30
1310.8	10000	18540	0.29	399.5	3050	5650	0.29
1314.1	9930	18150	0.29	400.5	3030	5530	0.29
1317.4	9930	17860	0.28	401.5	3030	5440	0.28
1320.7	10070	18240	0.28	402.5	3070	5560	0.28
1323.9	10150	18050	0.27	403.5	3090	5500	0.27
1327.2	10230	18440	0.28	404.5	3120	5620	0.28
1330.5	10070	17860	0.27	405.5	3070	5440	0.27
1333.8	10150	18150	0.27	406.5	3090	5530	0.27
1337.1	10000	18150	0.28	407.5	3050	5530	0.28
1340.3	9850	18440	0.30	408.5	3000	5620	0.30
1343.6	9710	18340	0.31	409.5	2960	5590	0.31
1346.9	9640	18650	0.32	410.5	2940	5680	0.32
1350.2	9250	18540	0.33	411.5	2820	5650	0.33
1353.5	9000	18750	0.35	412.5	2740	5710	0.35
1356.8	8770	17090	0.32	413.5	2670	5210	0.32
1360.0	8880	13370	0.10	414.5	2710	4070	0.10

Summary of Compressional Wave Velocity, Shear Wave Velocity, and Poisson's Ratio
Based on Source-to-Receiver Travel Time Data - Borehole C4993 RUN#6

American Units			
Depth at Midpoint Between Source and Near Receiver	Velocity V_s	Velocity V_p	Poisson's Ratio
(ft)	(ft/s)	(ft/s)	
1363.3	8710	14060	0.19
1366.6	5230	13500	0.41
1369.9	6680	12640	0.31
1373.2	7850	13720	0.26
1376.4	8710	18540	0.36
1379.7	8820	18340	0.35
1383.0	8880	19290	0.37
1386.3	8820	20330	0.38
1389.6	9000	19850	0.37
1392.8	9120	19970	0.37
1396.1	9310	20830	0.38
1399.4	9440	21230	0.38
1402.7	10380	17310	0.22
1406.0	9930	16540	0.22

Metric Units			
Depth at Midpoint Between Source and Near Receiver	Velocity V_s	Velocity V_p	Poisson's Ratio
(m)	(m/s)	(m/s)	
415.5	2650	4290	0.19
416.5	1590	4110	0.41
417.5	2040	3850	0.31
418.5	2390	4180	0.26
419.5	2650	5650	0.36
420.5	2690	5590	0.35
421.5	2710	5880	0.37
422.5	2690	6200	0.38
423.5	2740	6050	0.37
424.5	2780	6090	0.37
425.5	2840	6350	0.38
426.5	2880	6470	0.38
427.5	3170	5280	0.22
428.5	3030	5040	0.22

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

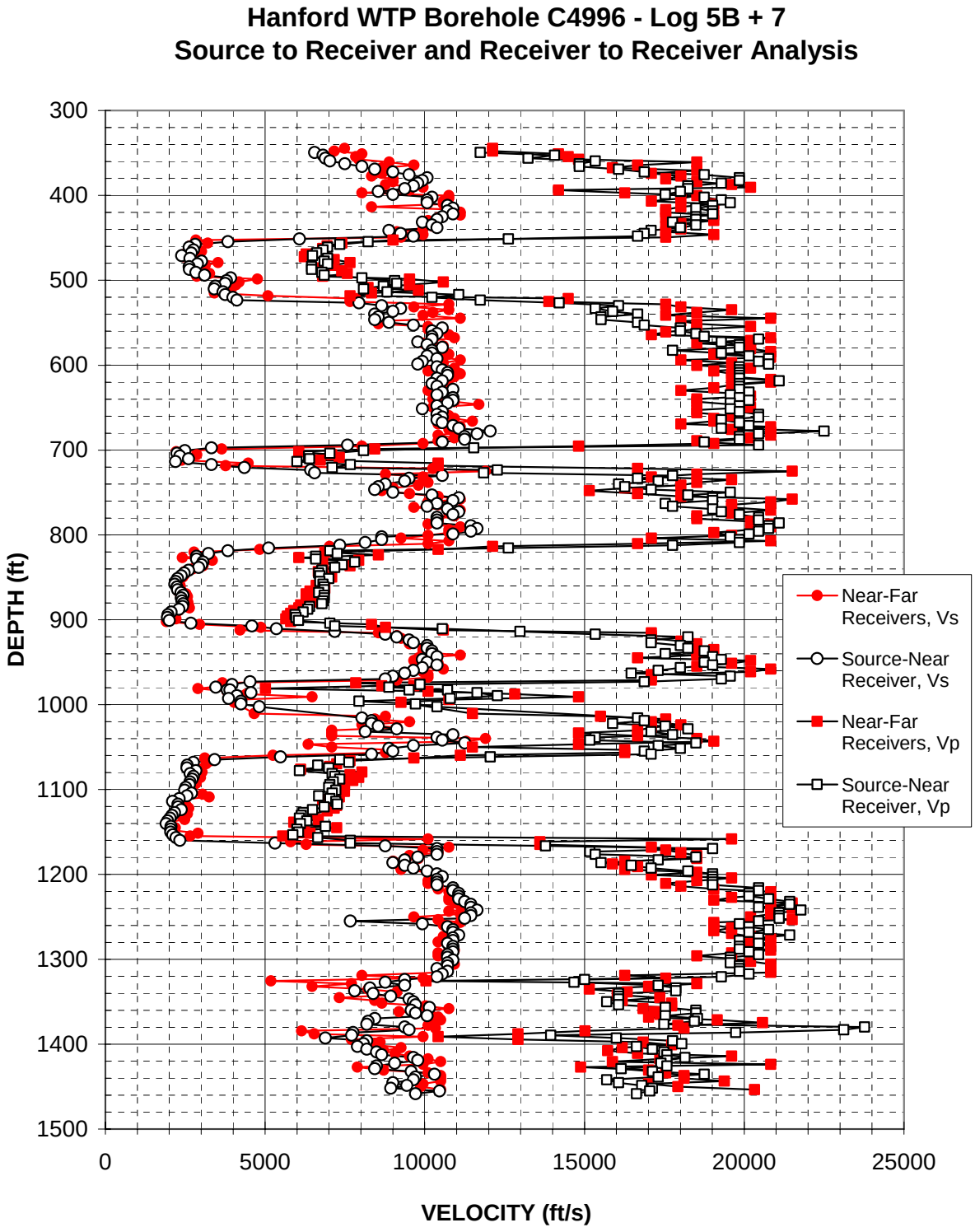


Figure A-2 Boring BH-C4996 Log 5B + 7, Suspension S-R1 P- and S_H-wave velocities

Table A-2 Boring BH-C4996 Log 5B + 7, 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 C4996							
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)	
349.5	6550	11740	0.27	106.5	2000	3580	0.27
352.8	6820	14060	0.35	107.5	2080	4290	0.35
356.1	6890	13240	0.31	108.5	2100	4030	0.31
359.4	7030	15340	0.37	109.5	2140	4680	0.37
362.7	7500	14840	0.33	110.5	2290	4520	0.33
365.9	8040	14840	0.29	111.5	2450	4520	0.29
369.2	8440	16070	0.31	112.5	2570	4900	0.31
372.5	9000	16880	0.30	113.5	2740	5140	0.30
375.8	9510	18750	0.33	114.5	2900	5710	0.33
379.1	10070	19850	0.33	115.5	3070	6050	0.33
382.3	9930	19850	0.33	116.5	3030	6050	0.33
385.6	9780	19290	0.33	117.5	2980	5880	0.33
388.9	9640	18240	0.31	118.5	2940	5560	0.31
392.2	9380	18240	0.32	119.5	2860	5560	0.32
395.5	8540	18000	0.35	120.5	2600	5490	0.35
398.7	9000	17530	0.32	121.5	2740	5340	0.32
402.0	10230	18750	0.29	122.5	3120	5710	0.29
405.3	10070	19290	0.31	123.5	3070	5880	0.31
408.6	10070	19570	0.32	124.5	3070	5960	0.32
411.9	10710	19010	0.27	125.5	3270	5800	0.27
415.1	10890	18490	0.23	126.5	3320	5640	0.23
418.4	10710	19010	0.27	127.5	3270	5800	0.27
421.7	10890	19010	0.26	128.5	3320	5800	0.26
425.0	10550	18490	0.26	129.5	3210	5640	0.26
428.3	10380	18490	0.27	130.5	3170	5640	0.27
431.6	9930	17760	0.27	131.5	3030	5410	0.27
434.8	10230	18490	0.28	132.5	3120	5640	0.28
438.1	10380	18000	0.25	133.5	3170	5490	0.25
441.4	8880	17090	0.31	134.5	2710	5210	0.31
444.7	9250	16880	0.29	135.5	2820	5140	0.29
448.0	9640	16670	0.25	136.5	2940	5080	0.25
451.2	6080	12620	0.35	137.5	1850	3850	0.35
454.5	3840	8230	0.36	138.5	1170	2510	0.36
457.8	2810	7340	0.41	139.5	860	2240	0.41
461.1	2630	6960	0.42	140.5	800	2120	0.42
464.4	2770	6820	0.40	141.5	840	2080	0.40
467.6	2690	6620	0.40	142.5	820	2020	0.40
470.9	2390	6490	0.42	143.5	730	1980	0.42

Summary of Compressional Wave Velocity, Shear Wave Velocity, and Poisson's Ratio
Based on Source-to-Receiver Travel Time Data - Borehole C4996

American Units				Metric Units			
Depth at Midpoint	Velocity			Depth at Midpoint	Velocity		
Between Source and Near Receiver	V_s	V_p	Poisson's Ratio	Between Source and Near Receiver	V_s	V_p	Poisson's Ratio
(ft)	(ft/s)	(ft/s)		(m)	(m/s)	(m/s)	
474.2	2650	6960	0.42	144.5	810	2120	0.42
477.5	3010	6850	0.38	145.5	920	2090	0.38
480.8	2880	6960	0.40	146.5	880	2120	0.40
484.0	2630	6460	0.40	147.5	800	1970	0.40
487.3	2640	6460	0.40	148.5	800	1970	0.40
490.6	2840	6780	0.39	149.5	860	2070	0.39
493.9	3110	6850	0.37	150.5	950	2090	0.37
497.2	3920	8040	0.34	151.5	1200	2450	0.34
500.5	3790	9060	0.39	152.5	1160	2760	0.39
503.7	3750	9120	0.40	153.5	1140	2780	0.40
507.0	3440	8710	0.41	154.5	1050	2650	0.41
510.3	3410	8080	0.39	155.5	1040	2460	0.39
513.6	3690	8820	0.39	156.5	1120	2690	0.39
516.9	3750	11070	0.44	157.5	1140	3370	0.44
520.1	3990	10230	0.41	158.5	1220	3120	0.41
523.4	4120	11740	0.43	159.5	1250	3580	0.43
526.7	7940	14210	0.27	160.5	2420	4330	0.27
530.0	8650	16070	0.30	161.5	2640	4900	0.30
533.3	9250	15340	0.21	162.5	2820	4680	0.21
536.5	9000	15880	0.26	163.5	2740	4840	0.26
539.8	8440	16670	0.33	164.5	2570	5080	0.33
543.1	8540	15520	0.28	165.5	2600	4730	0.28
546.4	8440	15520	0.29	166.5	2570	4730	0.29
549.7	8880	16670	0.30	167.5	2710	5080	0.30
552.9	9640	16880	0.26	168.5	2940	5140	0.26
556.2	10550	18000	0.24	169.5	3210	5490	0.24
559.5	10230	18000	0.26	170.5	3120	5490	0.26
562.8	10380	18490	0.27	171.5	3170	5640	0.27
566.1	10230	18750	0.29	172.5	3120	5710	0.29
569.3	10230	20450	0.33	173.5	3120	6230	0.33
572.6	9780	19290	0.33	174.5	2980	5880	0.33
575.9	10070	19850	0.33	175.5	3070	6050	0.33
579.2	10550	19850	0.30	176.5	3210	6050	0.30
582.5	10230	17760	0.25	177.5	3120	5410	0.25
585.8	10230	19290	0.30	178.5	3120	5880	0.30
589.0	10070	20150	0.33	179.5	3070	6140	0.33
592.3	10380	20770	0.33	180.5	3170	6330	0.33
595.6	9930	20450	0.35	181.5	3030	6230	0.35
598.9	9780	20770	0.36	182.5	2980	6330	0.36
602.2	10380	19850	0.31	183.5	3170	6050	0.31
605.4	10550	19850	0.30	184.5	3210	6050	0.30

Summary of Compressional Wave Velocity, Shear Wave Velocity, and Poisson's Ratio
Based on Source-to-Receiver Travel Time Data - Borehole C4996

American Units				Metric Units			
Depth at Midpoint	Velocity			Depth at Midpoint	Velocity		
Between Source and Near Receiver	V_s	V_p	Poisson's Ratio	Between Source and Near Receiver	V_s	V_p	Poisson's Ratio
(ft)	(ft/s)	(ft/s)		(m)	(m/s)	(m/s)	
608.7	10710	19850	0.29	185.5	3270	6050	0.29
612.0	10710	19850	0.29	186.5	3270	6050	0.29
615.3	10380	19850	0.31	187.5	3170	6050	0.31
618.6	10550	21090	0.33	188.5	3210	6430	0.33
621.8	10230	19850	0.32	189.5	3120	6050	0.32
625.1	10380	19850	0.31	190.5	3170	6050	0.31
628.4	10890	19850	0.28	191.5	3320	6050	0.28
631.7	10550	20150	0.31	192.5	3210	6140	0.31
635.0	10380	19570	0.30	193.5	3170	5960	0.30
638.2	10890	19850	0.28	194.5	3320	6050	0.28
641.5	10890	20150	0.29	195.5	3320	6140	0.29
644.8	10710	19570	0.29	196.5	3270	5960	0.29
648.1	10380	19850	0.31	197.5	3170	6050	0.31
651.4	9930	19570	0.33	198.5	3030	5960	0.33
654.7	10550	19850	0.30	199.5	3210	6050	0.30
657.9	10380	20450	0.33	200.5	3170	6230	0.33
661.2	10550	20450	0.32	201.5	3210	6230	0.32
664.5	10380	19290	0.30	202.5	3170	5880	0.30
667.8	10550	19850	0.30	203.5	3210	6050	0.30
671.1	10890	20150	0.29	204.5	3320	6140	0.29
674.3	11070	19290	0.25	205.5	3370	5880	0.25
677.6	12050	22500	0.30	206.5	3670	6860	0.30
680.9	11640	20450	0.26	207.5	3550	6230	0.26
684.2	11250	19850	0.26	208.5	3430	6050	0.26
687.5	11250	19850	0.26	209.5	3430	6050	0.26
690.7	10550	18750	0.27	210.5	3210	5710	0.27
694.0	7580	20450	0.42	211.5	2310	6230	0.42
697.3	3330	11540	0.45	212.5	1010	3520	0.45
700.6	2490	8080	0.45	213.5	760	2460	0.45
703.9	2240	7030	0.44	214.5	680	2140	0.44
707.1	2340	6370	0.42	215.5	710	1940	0.42
710.4	2610	6400	0.40	216.5	790	1950	0.40
713.7	2200	6000	0.42	217.5	670	1830	0.42
717.0	3330	7670	0.38	218.5	1010	2340	0.38
720.6	4350	7110	0.20	219.6	1330	2170	0.20
723.5	6430	12270	0.31	220.5	1960	3740	0.31
726.8	6550	11840	0.28	221.5	2000	3610	0.28
730.1	10550	17760	0.23	222.5	3210	5410	0.23
733.4	9510	16670	0.26	223.5	2900	5080	0.26
736.7	9380	17310	0.29	224.5	2860	5280	0.29
740.0	8770	16070	0.29	225.5	2670	4900	0.29

Summary of Compressional Wave Velocity, Shear Wave Velocity, and Poisson's Ratio
Based on Source-to-Receiver Travel Time Data - Borehole C4996

American Units				Metric Units			
Depth at Midpoint	Velocity			Depth at Midpoint	Velocity		
Between Source and Near Receiver	V_s	V_p	Poisson's Ratio	Between Source and Near Receiver	V_s	V_p	Poisson's Ratio
(ft)	(ft/s)	(ft/s)		(m)	(m/s)	(m/s)	
743.2	8540	16270	0.31	226.5	2600	4960	0.31
746.5	8440	17090	0.34	227.5	2570	5210	0.34
749.8	9000	19570	0.37	228.5	2740	5960	0.37
753.1	10230	18240	0.27	229.5	3120	5560	0.27
756.4	11070	19010	0.24	230.5	3370	5800	0.24
759.6	10890	19010	0.26	231.5	3320	5800	0.26
762.9	10380	17530	0.23	232.5	3170	5340	0.23
766.2	10070	17760	0.26	233.5	3070	5410	0.26
769.5	10710	19010	0.27	234.5	3270	5800	0.27
772.8	11070	19290	0.25	235.5	3370	5880	0.25
776.0	10890	19850	0.28	236.5	3320	6050	0.28
779.3	10380	20450	0.33	237.5	3170	6230	0.33
782.6	10380	20450	0.33	238.5	3170	6230	0.33
785.9	10380	21090	0.34	239.5	3170	6430	0.34
789.2	11440	20770	0.28	240.5	3490	6330	0.28
792.4	11640	20770	0.27	241.5	3550	6330	0.27
795.7	11440	20450	0.27	242.5	3490	6230	0.27
799.0	10890	20150	0.29	243.5	3320	6140	0.29
802.3	8650	19570	0.38	244.5	2640	5960	0.38
805.6	8650	19850	0.38	245.5	2640	6050	0.38
808.9	8130	19850	0.40	246.5	2480	6050	0.40
812.1	7340	17760	0.40	247.5	2240	5410	0.40
815.4	5110	12620	0.40	248.5	1560	3850	0.40
818.7	3840	7030	0.29	249.5	1170	2140	0.29
822.0	3230	7260	0.38	250.5	980	2210	0.38
825.3	2860	6590	0.38	251.5	870	2010	0.38
828.5	2860	6590	0.38	252.5	870	2010	0.38
831.8	3050	7800	0.41	253.5	930	2380	0.41
835.1	3010	7420	0.40	254.5	920	2260	0.40
838.4	2920	7180	0.40	255.5	890	2190	0.40
841.7	2610	6780	0.41	256.5	790	2070	0.41
844.9	2470	6680	0.42	257.5	750	2040	0.42
848.2	2380	6720	0.43	258.5	720	2050	0.43
851.5	2270	6990	0.44	259.5	690	2130	0.44
854.8	2210	6720	0.44	260.5	670	2050	0.44
858.1	2180	6820	0.44	261.5	660	2080	0.44
861.3	2240	6850	0.44	262.5	680	2090	0.44
864.6	2270	6850	0.44	263.5	690	2090	0.44
867.9	2370	6680	0.43	264.5	720	2040	0.43
871.2	2440	6850	0.43	265.5	740	2090	0.43
874.5	2380	6850	0.43	266.5	720	2090	0.43

Summary of Compressional Wave Velocity, Shear Wave Velocity, and Poisson's Ratio
Based on Source-to-Receiver Travel Time Data - Borehole C4996

American Units				Metric Units			
Depth at Midpoint	Velocity			Depth at Midpoint	Velocity		
Between Source and Near Receiver	V_s	V_p	Poisson's Ratio	Between Source and Near Receiver	V_s	V_p	Poisson's Ratio
(ft)	(ft/s)	(ft/s)		(m)	(m/s)	(m/s)	
877.7	2400	6820	0.43	267.5	730	2080	0.43
881.0	2440	6780	0.43	268.5	740	2070	0.43
884.3	2420	6400	0.42	269.5	740	1950	0.42
887.6	2300	6340	0.42	270.5	700	1930	0.42
890.9	2060	6190	0.44	271.5	630	1890	0.44
894.2	1960	5950	0.44	272.5	600	1810	0.44
897.4	1950	5970	0.44	273.5	590	1820	0.44
900.7	2000	6050	0.44	274.5	610	1850	0.44
904.0	2680	7030	0.42	275.5	820	2140	0.42
907.3	4590	7180	0.15	276.5	1400	2190	0.15
910.6	5360	10550	0.33	277.5	1630	3210	0.33
913.8	7180	12980	0.28	278.5	2190	3960	0.28
917.1	8770	15340	0.26	279.5	2670	4680	0.26
920.4	9120	18240	0.33	280.5	2780	5560	0.33
923.7	9510	17090	0.28	281.5	2900	5210	0.28
927.0	9640	17090	0.27	282.5	2940	5210	0.27
930.2	10070	18000	0.27	283.5	3070	5490	0.27
933.5	10070	18240	0.28	284.5	3070	5560	0.28
936.8	10230	18750	0.29	285.5	3120	5710	0.29
940.1	10230	17530	0.24	286.5	3120	5340	0.24
943.4	10380	19010	0.29	287.5	3170	5800	0.29
946.6	9930	19290	0.32	288.5	3030	5880	0.32
949.9	10070	18750	0.30	289.5	3070	5710	0.30
953.2	10380	19010	0.29	290.5	3170	5800	0.29
956.5	9930	18000	0.28	291.5	3030	5490	0.28
959.8	9640	17310	0.27	292.5	2940	5280	0.27
963.1	9380	16460	0.26	293.5	2860	5020	0.26
966.3	9000	19570	0.37	294.5	2740	5960	0.37
969.6	8770	19290	0.37	295.5	2670	5880	0.37
972.9	4530	16880	0.46	296.5	1380	5140	0.46
976.2	3970	9850	0.40	297.5	1210	3000	0.40
979.5	3460	8880	0.41	298.5	1060	2710	0.41
982.7	3810	10710	0.43	299.5	1160	3270	0.43
982.7	3900	9510	0.40	299.5	1190	2900	0.40
986.0	4560	11640	0.41	300.5	1390	3550	0.41
989.3	4120	12270	0.44	301.5	1250	3740	0.44
992.6	3860	10800	0.43	302.5	1180	3290	0.43
995.9	4250	7940	0.30	303.5	1290	2420	0.30
999.1	4250	9710	0.38	304.5	1290	2960	0.38
1002.4	4820	10380	0.36	305.5	1470	3170	0.36
1015.5	8040	16670	0.35	309.5	2450	5080	0.35

Summary of Compressional Wave Velocity, Shear Wave Velocity, and Poisson's Ratio
Based on Source-to-Receiver Travel Time Data - Borehole C4996

American Units				Metric Units			
Depth at Midpoint	Velocity			Depth at Midpoint	Velocity		
Between Source and Near Receiver	V_s	V_p	Poisson's Ratio	Between Source and Near Receiver	V_s	V_p	Poisson's Ratio
(ft)	(ft/s)	(ft/s)		(m)	(m/s)	(m/s)	
1018.8	8330	16880	0.34	310.5	2540	5140	0.34
1022.1	8330	15880	0.31	311.5	2540	4840	0.31
1025.4	8540	17530	0.34	312.5	2600	5340	0.34
1028.7	9120	18240	0.33	313.5	2780	5560	0.33
1031.9	8130	17090	0.35	314.5	2480	5210	0.35
1035.2	10890	17760	0.20	315.5	3320	5410	0.20
1038.5	10380	15340	0.08	316.5	3170	4680	0.08
1041.8	10550	15170	0.03	317.5	3210	4620	0.03
1045.1	11250	18490	0.21	318.5	3430	5640	0.21
1048.4	9640	17310	0.27	319.5	2940	5280	0.27
1051.6	8880	18000	0.34	320.5	2710	5490	0.34
1054.9	9000	16880	0.30	321.5	2740	5140	0.30
1058.2	8330	17090	0.34	322.5	2540	5210	0.34
1061.5	5490	12050	0.37	323.5	1670	3670	0.37
1064.8	3430	7340	0.36	324.5	1040	2240	0.36
1068.0	2760	7630	0.42	325.5	840	2320	0.42
1071.3	2570	6650	0.41	326.5	780	2030	0.41
1074.6	2560	6990	0.42	327.5	780	2130	0.42
1077.9	2840	6080	0.36	328.5	860	1850	0.36
1081.2	2660	7110	0.42	329.5	810	2170	0.42
1084.4	2760	7180	0.41	330.5	840	2190	0.41
1087.7	2720	7340	0.42	331.5	830	2240	0.42
1091.0	2650	7140	0.42	332.5	810	2180	0.42
1094.3	2640	7030	0.42	333.5	800	2140	0.42
1097.6	2520	6990	0.43	334.5	770	2130	0.43
1100.8	2480	7220	0.43	335.5	760	2200	0.43
1104.1	2700	7110	0.42	336.5	820	2170	0.42
1107.4	2560	6680	0.41	337.5	780	2040	0.41
1110.7	2310	7030	0.44	338.5	700	2140	0.44
1114.0	2100	7220	0.45	339.5	640	2200	0.45
1117.2	2280	7260	0.45	340.5	700	2210	0.45
1120.5	2280	6850	0.44	341.5	700	2090	0.44
1123.8	2380	6490	0.42	342.5	720	1980	0.42
1127.1	2170	6190	0.43	343.5	660	1890	0.43
1130.4	2090	6140	0.43	344.5	640	1870	0.43
1133.7	2030	6080	0.44	345.5	620	1850	0.44
1136.9	1960	6310	0.45	346.5	600	1920	0.45
1140.2	1900	6110	0.45	347.5	580	1860	0.45
1143.5	2060	6890	0.45	348.5	630	2100	0.45
1146.8	2050	6000	0.43	349.5	630	1830	0.43
1150.1	2050	6050	0.44	350.5	620	1850	0.44

Summary of Compressional Wave Velocity, Shear Wave Velocity, and Poisson's Ratio
Based on Source-to-Receiver Travel Time Data - Borehole C4996

American Units				Metric Units			
Depth at Midpoint	Velocity			Depth at Midpoint	Velocity		
Between Source and Near Receiver	V_s	V_p	Poisson's Ratio	Between Source and Near Receiver	V_s	V_p	Poisson's Ratio
(ft)	(ft/s)	(ft/s)		(m)	(m/s)	(m/s)	
1153.3	2110	5870	0.43	351.5	640	1790	0.43
1156.6	2210	6650	0.44	352.5	670	2030	0.44
1159.9	2340	7670	0.45	353.5	710	2340	0.45
1163.2	5310	7670	0.04	354.5	1620	2340	0.04
1166.5	8770	13780	0.16	355.5	2670	4200	0.16
1169.7	10380	19010	0.29	356.5	3170	5800	0.29
1173.0	10380	15170	0.06	357.5	3170	4620	0.06
1176.3	10380	15340	0.08	358.5	3170	4680	0.08
1179.6	9780	18490	0.31	359.5	2980	5640	0.31
1182.9	9380	17310	0.29	360.5	2860	5280	0.29
1186.1	9000	15520	0.25	361.5	2740	4730	0.25
1189.4	9380	16460	0.26	362.5	2860	5020	0.26
1192.7	9640	17090	0.27	363.5	2940	5210	0.27
1196.0	10070	18240	0.28	364.5	3070	5560	0.28
1199.3	10380	19010	0.29	365.5	3170	5800	0.29
1202.6	10550	19010	0.28	366.5	3210	5800	0.28
1205.8	10380	19010	0.29	367.5	3170	5800	0.29
1209.1	10380	19010	0.29	368.5	3170	5800	0.29
1212.4	10380	19010	0.29	369.5	3170	5800	0.29
1215.7	10890	20450	0.30	370.5	3320	6230	0.30
1219.0	10890	20450	0.30	371.5	3320	6230	0.30
1222.2	11070	20150	0.28	372.5	3370	6140	0.28
1225.5	11070	20150	0.28	373.5	3370	6140	0.28
1228.8	11070	20770	0.30	374.5	3370	6330	0.30
1232.1	11250	21430	0.31	375.5	3430	6530	0.31
1235.4	11440	21430	0.30	376.5	3490	6530	0.30
1238.6	11440	20450	0.27	377.5	3490	6230	0.27
1241.9	11640	21770	0.30	378.5	3550	6640	0.30
1245.2	11440	21090	0.29	379.5	3490	6430	0.29
1248.5	11440	21090	0.29	380.5	3490	6430	0.29
1251.8	11250	21090	0.30	381.5	3430	6430	0.30
1255.0	7670	20450	0.42	382.5	2340	6230	0.42
1258.3	9930	19850	0.33	383.5	3030	6050	0.33
1261.6	10710	20150	0.30	384.5	3270	6140	0.30
1264.9	10890	20770	0.31	385.5	3320	6330	0.31
1268.2	10890	20150	0.29	386.5	3320	6140	0.29
1271.4	11070	21430	0.32	387.5	3370	6530	0.32
1274.7	10890	20450	0.30	388.5	3320	6230	0.30
1278.0	10890	19850	0.28	389.5	3320	6050	0.28
1281.3	10710	20450	0.31	390.5	3270	6230	0.31
1284.6	10890	19850	0.28	391.5	3320	6050	0.28

Summary of Compressional Wave Velocity, Shear Wave Velocity, and Poisson's Ratio
Based on Source-to-Receiver Travel Time Data - Borehole C4996

American Units				Metric Units			
Depth at Midpoint	Velocity			Depth at Midpoint	Velocity		
Between Source and Near Receiver	V_s	V_p	Poisson's Ratio	Between Source and Near Receiver	V_s	V_p	Poisson's Ratio
(ft)	(ft/s)	(ft/s)		(m)	(m/s)	(m/s)	
1287.9	10890	19850	0.28	392.5	3320	6050	0.28
1291.1	10890	20150	0.29	393.5	3320	6140	0.29
1294.4	10710	20450	0.31	394.5	3270	6230	0.31
1297.7	10710	19570	0.29	395.5	3270	5960	0.29
1301.0	10890	19570	0.28	396.5	3320	5960	0.28
1304.3	10710	19570	0.29	397.5	3270	5960	0.29
1307.5	10710	19850	0.29	398.5	3270	6050	0.29
1310.8	10380	19850	0.31	399.5	3170	6050	0.31
1314.1	10710	19850	0.29	400.5	3270	6050	0.29
1317.4	10550	20150	0.31	401.5	3210	6140	0.31
1320.7	10380	19290	0.30	402.5	3170	5880	0.30
1323.9	9380	15000	0.18	403.5	2860	4570	0.18
1327.2	8770	14670	0.22	404.5	2670	4470	0.22
1330.5	9380	17310	0.29	405.5	2860	5280	0.29
1333.8	8280	17860	0.36	406.5	2520	5440	0.36
1337.1	7800	17860	0.38	407.5	2380	5440	0.38
1340.3	8390	16070	0.31	408.5	2560	4900	0.31
1343.6	8940	16070	0.28	409.5	2730	4900	0.28
1346.9	9510	16070	0.23	410.5	2900	4900	0.23
1350.2	9640	15700	0.20	411.5	2940	4780	0.20
1353.5	9710	16070	0.21	412.5	2960	4900	0.21
1356.8	10150	17530	0.25	413.5	3090	5340	0.25
1360.0	9570	18490	0.32	414.5	2920	5640	0.32
1363.3	9710	18490	0.31	415.5	2960	5640	0.31
1366.6	10070	17530	0.25	416.5	3070	5340	0.25
1369.9	8440	18540	0.37	417.5	2570	5650	0.37
1373.2	8230	18440	0.38	418.5	2510	5620	0.38
1376.4	8180	17490	0.36	419.5	2490	5330	0.36
1379.7	9380	23770	0.41	420.5	2860	7240	0.41
1383.0	9510	23120	0.40	421.5	2900	7050	0.40
1386.3	7760	19740	0.41	422.5	2360	6020	0.41
1389.6	7710	13950	0.28	423.5	2350	4250	0.28
1392.8	6890	16000	0.39	424.5	2100	4880	0.39
1396.1	8180	17760	0.37	425.5	2490	5410	0.37
1399.4	8080	18050	0.37	426.5	2460	5500	0.37
1402.7	7890	16630	0.35	427.5	2410	5070	0.35
1406.0	8180	17130	0.35	428.5	2490	5220	0.35
1409.2	8490	17490	0.35	429.5	2590	5330	0.35
1412.5	8650	17580	0.34	430.5	2640	5360	0.34
1415.8	9640	18150	0.30	431.5	2940	5530	0.30
1419.1	9780	17580	0.28	432.5	2980	5360	0.28

Summary of Compressional Wave Velocity, Shear Wave Velocity, and Poisson's Ratio
Based on Source-to-Receiver Travel Time Data - Borehole C4996

American Units				Metric Units			
Depth at Midpoint	**Velocity**			**Depth at Midpoint**	**Velocity**		
Between Source and Near Receiver	**V_s**	**V_p**	**Poisson's Ratio**	**Between Source and Near Receiver**	**V_s**	**V_p**	**Poisson's Ratio**
(ft)	(ft/s)	(ft/s)		(m)	(m/s)	(m/s)	
1422.4	9060	17400	0.31	433.5	2760	5300	0.31
1425.6	8490	17580	0.35	434.5	2590	5360	0.35
1428.9	8440	16150	0.31	435.5	2570	4920	0.31
1432.2	9570	17130	0.27	436.5	2920	5220	0.27
1435.5	10310	18750	0.28	437.5	3140	5710	0.28
1438.8	9710	17310	0.27	438.5	2960	5280	0.27
1442.1	9640	15700	0.20	439.5	2940	4780	0.20
1445.3	9000	16070	0.27	440.5	2740	4900	0.27
1448.6	9440	16790	0.27	441.5	2880	5120	0.27
1451.9	8940	17130	0.31	442.5	2730	5220	0.31
1455.2	10470	17050	0.20	443.5	3190	5200	0.20
1458.5	9710	16630	0.24	444.5	2960	5070	0.24

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

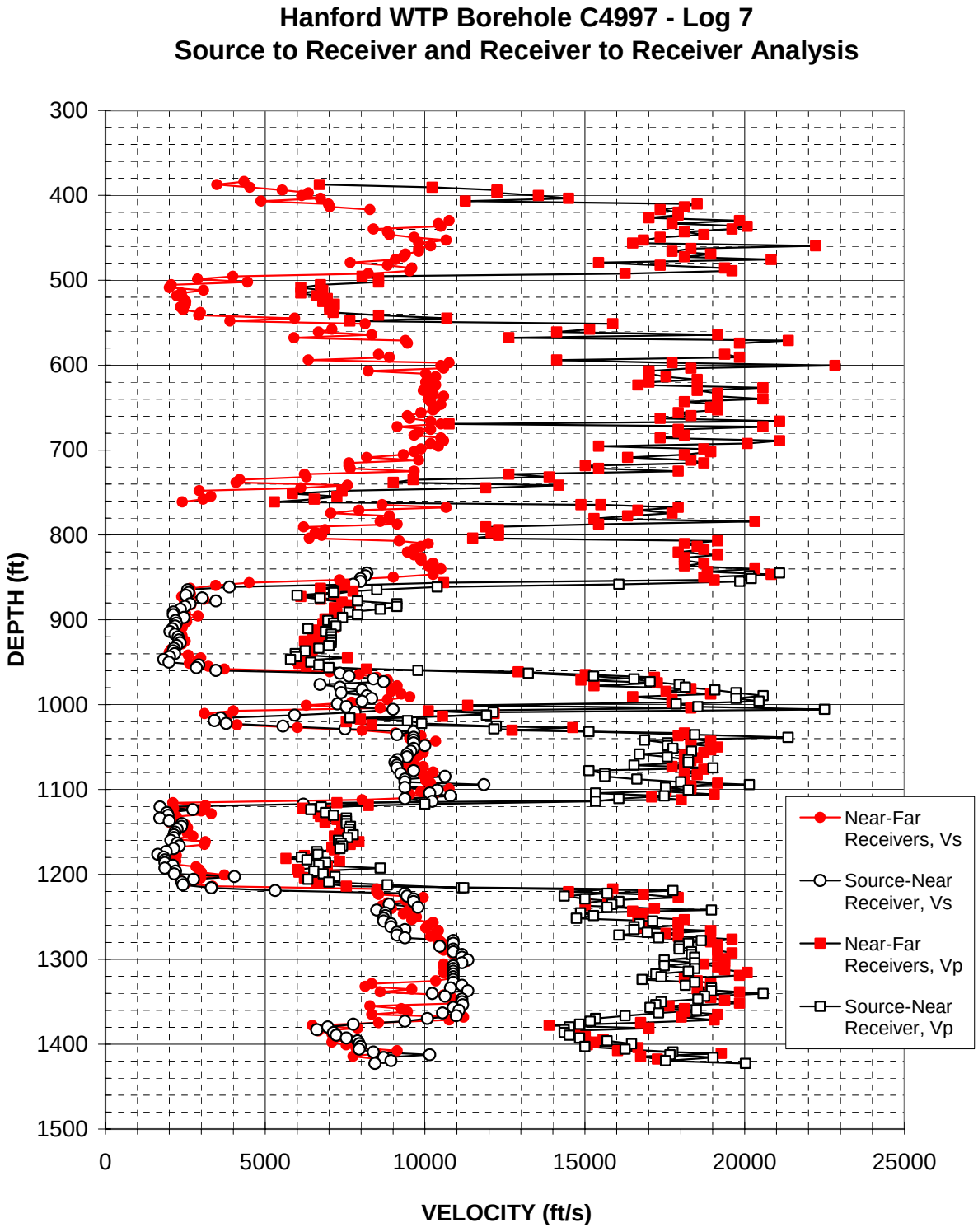


Figure A-3 Boring BH-C4997 Log 7, Suspension S-R1 P- and S_H-wave velocities

Table A-3 Boring BH-C4997 Log 7, 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 C4997 LOG #7

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)	
388.9	-	-	-	118.5	-	-	-
392.2	-	-	-	119.5	-	-	-
395.5	-	-	-	120.5	-	-	-
398.7	-	-	-	121.5	-	-	-
402.0	-	-	-	122.5	-	-	-
405.3	-	-	-	123.5	-	-	-
408.6	-	-	-	124.5	-	-	-
411.9	-	-	-	125.5	-	-	-
415.1	-	-	-	126.5	-	-	-
418.4	-	-	-	127.5	-	-	-
421.7	-	-	-	128.5	-	-	-
425.0	-	-	-	129.5	-	-	-
428.3	-	-	-	130.5	-	-	-
431.6	-	-	-	131.5	-	-	-
434.8	-	-	-	132.5	-	-	-
438.1	-	-	-	133.5	-	-	-
441.4	-	-	-	134.5	-	-	-
444.7	-	-	-	135.5	-	-	-
448.0	-	-	-	136.5	-	-	-
451.2	-	-	-	137.5	-	-	-
454.5	-	-	-	138.5	-	-	-
457.8	-	-	-	139.5	-	-	-
461.1	-	-	-	140.5	-	-	-
464.4	-	-	-	141.5	-	-	-
467.6	-	-	-	142.5	-	-	-
470.9	-	-	-	143.5	-	-	-
474.2	-	-	-	144.5	-	-	-
477.5	-	-	-	145.5	-	-	-
480.8	-	-	-	146.5	-	-	-
484.0	-	-	-	147.5	-	-	-
487.3	-	-	-	148.5	-	-	-
490.6	-	-	-	149.5	-	-	-
493.9	-	-	-	150.5	-	-	-
497.2	-	-	-	151.5	-	-	-
500.5	-	-	-	152.5	-	-	-

Summary of Compressional Wave Velocity, Shear Wave Velocity, and Poisson's Ratio Based on Source-to-Receiver Travel Time Data - Borehole C4997 LOG #7

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)	
503.7	-	-	-	153.5	-	-	-
507.0	-	-	-	154.5	-	-	-
510.3	-	-	-	155.5	-	-	-
513.6	-	-	-	156.5	-	-	-
516.9	-	-	-	157.5	-	-	-
520.1	-	-	-	158.5	-	-	-
523.4	-	-	-	159.5	-	-	-
526.7	-	-	-	160.5	-	-	-
530.0	-	-	-	161.5	-	-	-
533.3	-	-	-	162.5	-	-	-
536.5	-	-	-	163.5	-	-	-
539.8	-	-	-	164.5	-	-	-
543.1	-	-	-	165.5	-	-	-
546.4	-	-	-	166.5	-	-	-
549.7	-	-	-	167.5	-	-	-
552.9	-	-	-	168.5	-	-	-
556.2	-	-	-	169.5	-	-	-
559.5	-	-	-	170.5	-	-	-
562.8	-	-	-	171.5	-	-	-
566.1	-	-	-	172.5	-	-	-
569.3	-	-	-	173.5	-	-	-
572.6	-	-	-	174.5	-	-	-
575.9	-	-	-	175.5	-	-	-
579.2	-	-	-	176.5	-	-	-
582.5	-	-	-	177.5	-	-	-
585.8	-	-	-	178.5	-	-	-
589.0	-	-	-	179.5	-	-	-
592.3	-	-	-	180.5	-	-	-
595.6	-	-	-	181.5	-	-	-
598.9	-	-	-	182.5	-	-	-
602.2	-	-	-	183.5	-	-	-
605.4	-	-	-	184.5	-	-	-
608.7	-	-	-	185.5	-	-	-
612.0	-	-	-	186.5	-	-	-
615.3	-	-	-	187.5	-	-	-
618.6	-	-	-	188.5	-	-	-
621.8	-	-	-	189.5	-	-	-
625.1	-	-	-	190.5	-	-	-
628.4	-	-	-	191.5	-	-	-

Summary of Compressional Wave Velocity, Shear Wave Velocity, and Poisson's Ratio Based on Source-to-Receiver Travel Time Data - Borehole C4997 LOG #7

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)	
631.7	-	-	-	192.5	-	-	-
635.0	-	-	-	193.5	-	-	-
638.2	-	-	-	194.5	-	-	-
641.5	-	-	-	195.5	-	-	-
644.8	-	-	-	196.5	-	-	-
648.1	-	-	-	197.5	-	-	-
651.4	-	-	-	198.5	-	-	-
654.7	-	-	-	199.5	-	-	-
657.9	-	-	-	200.5	-	-	-
661.2	-	-	-	201.5	-	-	-
664.5	-	-	-	202.5	-	-	-
667.8	-	-	-	203.5	-	-	-
671.1	-	-	-	204.5	-	-	-
674.3	-	-	-	205.5	-	-	-
677.6	-	-	-	206.5	-	-	-
680.9	-	-	-	207.5	-	-	-
684.2	-	-	-	208.5	-	-	-
687.5	-	-	-	209.5	-	-	-
690.7	-	-	-	210.5	-	-	-
694.0	-	-	-	211.5	-	-	-
697.3	-	-	-	212.5	-	-	-
700.6	-	-	-	213.5	-	-	-
703.9	-	-	-	214.5	-	-	-
707.1	-	-	-	215.5	-	-	-
710.4	-	-	-	216.5	-	-	-
713.7	-	-	-	217.5	-	-	-
717.0	-	-	-	218.5	-	-	-
720.3	-	-	-	219.5	-	-	-
723.5	-	-	-	220.5	-	-	-
726.8	-	-	-	221.5	-	-	-
730.1	-	-	-	222.5	-	-	-
733.4	-	-	-	223.5	-	-	-
736.7	-	-	-	224.5	-	-	-
740.0	-	-	-	225.5	-	-	-
743.2	-	-	-	226.5	-	-	-
746.5	-	-	-	227.5	-	-	-
749.8	-	-	-	228.5	-	-	-
753.1	-	-	-	229.5	-	-	-
756.4	-	-	-	230.5	-	-	-

Summary of Compressional Wave Velocity, Shear Wave Velocity, and Poisson's Ratio Based on Source-to-Receiver Travel Time Data - Borehole C4997 LOG #7

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)	
759.6	-	-	-	231.5	-	-	-
762.9	-	-	-	232.5	-	-	-
766.2	-	-	-	233.5	-	-	-
769.5	-	-	-	234.5	-	-	-
769.5	-	-	-	234.5	-	-	-
772.8	-	-	-	235.5	-	-	-
776.0	-	-	-	236.5	-	-	-
779.3	-	-	-	237.5	-	-	-
782.6	-	-	-	238.5	-	-	-
785.9	-	-	-	239.5	-	-	-
789.2	-	-	-	240.5	-	-	-
792.4	-	-	-	241.5	-	-	-
795.7	-	-	-	242.5	-	-	-
799.0	-	-	-	243.5	-	-	-
802.3	-	-	-	244.5	-	-	-
805.6	-	-	-	245.5	-	-	-
808.9	-	-	-	246.5	-	-	-
812.1	-	-	-	247.5	-	-	-
815.4	-	-	-	248.5	-	-	-
818.7	-	-	-	249.5	-	-	-
822.0	-	-	-	250.5	-	-	-
825.3	-	-	-	251.5	-	-	-
828.5	-	-	-	252.5	-	-	-
831.8	-	-	-	253.5	-	-	-
835.1	-	-	-	254.5	-	-	-
838.4	-	-	-	255.5	-	-	-
841.7	-	-	-	256.5	-	-	-
844.9	8180	21090	0.41	257.5	2490	6430	0.41
848.2	8130	20150	0.40	258.5	2480	6140	0.40
851.5	7990	20210	0.41	259.5	2430	6160	0.41
854.8	7990	19850	0.40	260.5	2430	6050	0.40
858.1	7760	16070	0.35	261.5	2360	4900	0.35
861.3	3880	10380	0.42	262.5	1180	3170	0.42
864.6	2580	8490	0.45	263.5	790	2590	0.45
867.9	2610	7140	0.42	264.5	790	2180	0.42
871.2	2520	6000	0.39	265.5	770	1830	0.39
874.5	3030	6720	0.37	266.5	920	2050	0.37
877.7	3460	7890	0.38	267.5	1060	2410	0.38
881.0	2650	9120	0.45	268.5	810	2780	0.45

Summary of Compressional Wave Velocity, Shear Wave Velocity, and Poisson's Ratio
Based on Source-to-Receiver Travel Time Data - Borehole C4997 LOG #7

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)	
884.3	2490	9120	0.46	269.5	760	2780	0.46
887.6	2350	8600	0.46	270.5	720	2620	0.46
890.9	2130	7630	0.46	271.5	650	2320	0.46
894.2	2130	7890	0.46	272.5	650	2410	0.46
897.4	2450	7420	0.44	273.5	750	2260	0.44
900.7	2200	6960	0.44	274.5	670	2120	0.44
904.0	2220	7140	0.45	275.5	680	2180	0.45
907.3	2180	7220	0.45	276.5	670	2200	0.45
910.6	2100	6340	0.44	277.5	640	1930	0.44
913.8	2020	6890	0.45	278.5	620	2100	0.45
917.1	2180	7070	0.45	279.5	660	2150	0.45
920.4	2280	7070	0.44	280.5	700	2150	0.44
923.7	2300	7070	0.44	281.5	700	2150	0.44
927.0	2340	7070	0.44	282.5	710	2150	0.44
930.2	2240	6990	0.44	283.5	680	2130	0.44
933.5	2150	6680	0.44	284.5	660	2040	0.44
936.8	2130	6250	0.43	285.5	650	1910	0.43
940.1	2170	5950	0.42	286.5	660	1810	0.42
943.4	2010	5970	0.44	287.5	610	1820	0.44
946.6	1820	5790	0.44	288.5	560	1770	0.44
949.9	1990	6430	0.45	289.5	610	1960	0.45
953.2	2920	6680	0.38	290.5	890	2040	0.38
956.5	2850	6990	0.40	291.5	870	2130	0.40
959.8	3460	9780	0.43	292.5	1060	2980	0.43
963.1	7340	13240	0.28	293.5	2240	4030	0.28
966.3	7630	15270	0.33	294.5	2320	4650	0.33
969.6	8390	16540	0.33	295.5	2560	5040	0.33
972.9	8710	17050	0.32	296.5	2650	5200	0.32
976.2	6720	17950	0.42	297.5	2050	5470	0.42
979.5	7340	18150	0.40	298.5	2240	5530	0.40
982.7	8040	19070	0.39	299.5	2450	5810	0.39
986.0	7380	19740	0.42	300.5	2250	6020	0.42
989.3	8180	20580	0.41	301.5	2490	6270	0.41
992.6	8330	19740	0.39	302.5	2540	6020	0.39
995.9	8040	20450	0.41	303.5	2450	6230	0.41
999.1	7260	17860	0.40	304.5	2210	5440	0.40
1002.4	7540	18540	0.40	305.5	2300	5650	0.40
1005.7	9000	22500	0.40	306.5	2740	6860	0.40
1009.0	7800	12140	0.15	307.5	2380	3700	0.15

Summary of Compressional Wave Velocity, Shear Wave Velocity, and Poisson's Ratio
Based on Source-to-Receiver Travel Time Data - Borehole C4997 LOG #7

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)	
1012.3	5920	11930	0.34	308.5	1800	3630	0.34
1015.5	3610	7650	0.36	309.5	1100	2330	0.36
1018.8	3410	9450	0.43	310.5	1040	2880	0.43
1022.1	3780	9900	0.41	311.5	1150	3020	0.41
1025.4	5560	12230	0.37	312.5	1690	3730	0.37
1028.7	7500	12160	0.19	313.5	2290	3710	0.19
1031.9	9640	15130	0.16	314.5	2940	4610	0.16
1035.2	9120	18440	0.34	315.5	2780	5620	0.34
1038.5	9640	21360	0.37	316.5	2940	6510	0.37
1041.8	9640	16880	0.26	317.5	2940	5140	0.26
1045.1	9640	17580	0.28	318.5	2940	5360	0.28
1048.4	10000	17580	0.26	319.5	3050	5360	0.26
1051.6	9640	17760	0.29	320.5	2940	5410	0.29
1054.9	9560	18340	0.31	321.5	2910	5590	0.31
1058.2	9440	16710	0.27	322.5	2880	5090	0.27
1061.5	9440	17580	0.30	323.5	2880	5360	0.30
1064.8	9150	18240	0.33	324.5	2790	5560	0.33
1068.0	9060	18240	0.34	325.5	2760	5560	0.34
1071.3	9120	16540	0.28	326.5	2780	5040	0.28
1074.6	9120	19010	0.35	327.5	2780	5800	0.35
1077.9	9640	15130	0.16	328.5	2940	4610	0.16
1081.2	9250	15630	0.23	329.5	2820	4760	0.23
1084.4	10630	15630	0.07	330.5	3240	4760	0.07
1087.7	9370	16630	0.27	331.5	2860	5070	0.27
1091.0	9370	18000	0.31	332.5	2860	5490	0.31
1094.3	11840	20150	0.24	333.5	3610	6140	0.24
1097.6	9370	17530	0.30	334.5	2860	5340	0.30
1100.8	10380	18240	0.26	335.5	3170	5560	0.26
1104.1	10150	15340	0.11	336.5	3090	4680	0.11
1107.4	10800	17490	0.19	337.5	3290	5330	0.19
1110.7	9370	16070	0.24	338.5	2860	4900	0.24
1114.0	10230	15340	0.10	339.5	3120	4680	0.10
1117.2	6190	10000	0.19	340.5	1890	3050	0.19
1120.5	1710	6750	0.47	341.5	520	2060	0.47
1123.8	2730	6430	0.39	342.5	830	1960	0.39
1127.1	1920	6890	0.46	343.5	590	2100	0.46
1130.4	1960	7140	0.46	344.5	600	2180	0.46
1133.7	1700	7540	0.47	345.5	520	2300	0.47
1136.9	2000	7540	0.46	346.5	610	2300	0.46

Summary of Compressional Wave Velocity, Shear Wave Velocity, and Poisson's Ratio
Based on Source-to-Receiver Travel Time Data - Borehole C4997 LOG #7

American Units			
Depth at Midpoint Between Source and Near Receiver	Velocity		Poisson's Ratio
	V_s	V_p	
(ft)	(ft/s)	(ft/s)	
1140.2	2400	7540	0.44
1143.5	2390	7670	0.45
1146.8	2250	7630	0.45
1150.1	2180	7630	0.46
1153.3	2150	7760	0.46
1156.6	2150	7580	0.46
1159.9	2050	7300	0.46
1163.2	2250	7380	0.45
1166.5	2310	7420	0.45
1169.7	2140	7340	0.45
1173.0	1900	6620	0.46
1176.3	1640	6650	0.47
1179.6	1830	6140	0.45
1182.9	1860	6310	0.45
1186.1	1860	6890	0.46
1189.4	2120	6680	0.44
1192.7	1860	8600	0.48
1196.0	2200	6520	0.44
1199.3	2160	6820	0.44
1202.6	4040	7180	0.27
1205.8	2760	6340	0.38
1209.1	2390	6990	0.43
1212.4	2430	8820	0.46
1215.7	3320	11140	0.45
1215.7	3320	11210	0.45
1219.0	5310	17760	0.45
1222.2	9370	15700	0.22
1225.5	9440	14360	0.12
1228.8	9640	15000	0.15
1232.1	9640	16070	0.22
1235.4	8880	15850	0.27
1238.6	9780	15700	0.18
1241.9	8490	18960	0.37
1245.2	8770	14870	0.23
1248.5	8770	15270	0.25
1251.8	8710	14740	0.23
1255.0	8710	17130	0.33
1258.3	8940	16710	0.30
1261.6	8940	16540	0.29

Metric Units			
Depth at Midpoint Between Source and Near Receiver	Velocity		Poisson's Ratio
	V_s	V_p	
(m)	(m/s)	(m/s)	
347.5	730	2300	0.44
348.5	730	2340	0.45
349.5	690	2320	0.45
350.5	660	2320	0.46
351.5	660	2360	0.46
352.5	660	2310	0.46
353.5	630	2220	0.46
354.5	690	2250	0.45
355.5	700	2260	0.45
356.5	650	2240	0.45
357.5	580	2020	0.46
358.5	500	2030	0.47
359.5	560	1870	0.45
360.5	570	1920	0.45
361.5	570	2100	0.46
362.5	640	2040	0.44
363.5	570	2620	0.48
364.5	670	1990	0.44
365.5	660	2080	0.44
366.5	1230	2190	0.27
367.5	840	1930	0.38
368.5	730	2130	0.43
369.5	740	2690	0.46
370.5	1010	3400	0.45
370.5	1010	3420	0.45
371.5	1620	5410	0.45
372.5	2860	4780	0.22
373.5	2880	4380	0.12
374.5	2940	4570	0.15
375.5	2940	4900	0.22
376.5	2710	4830	0.27
377.5	2980	4780	0.18
378.5	2590	5780	0.37
379.5	2670	4530	0.23
380.5	2670	4650	0.25
381.5	2650	4490	0.23
382.5	2650	5220	0.33
383.5	2730	5090	0.30
384.5	2730	5040	0.29

Summary of Compressional Wave Velocity, Shear Wave Velocity, and Poisson's Ratio
Based on Source-to-Receiver Travel Time Data - Borehole C4997 LOG #7

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)	
1264.9	9370	16540	0.26	385.5	2860	5040	0.26
1268.2	9120	16960	0.30	386.5	2780	5170	0.30
1271.4	9120	16070	0.26	387.5	2780	4900	0.26
1274.7	9370	17310	0.29	388.5	2860	5280	0.29
1278.0	10890	18650	0.24	389.5	3320	5680	0.24
1281.3	10890	18240	0.22	390.5	3320	5560	0.22
1284.6	10470	17950	0.24	391.5	3190	5470	0.24
1287.9	10890	17950	0.21	392.5	3320	5470	0.21
1291.1	10890	18340	0.23	393.5	3320	5590	0.23
1294.4	11160	18340	0.21	394.5	3400	5590	0.21
1297.7	11160	18440	0.21	395.5	3400	5620	0.21
1301.0	11340	17490	0.14	396.5	3460	5330	0.14
1304.3	11160	18440	0.21	397.5	3400	5620	0.21
1307.5	10890	17490	0.18	398.5	3320	5330	0.18
1310.8	10890	18440	0.23	399.5	3320	5620	0.23
1314.1	10890	18240	0.22	400.5	3320	5560	0.22
1317.4	10890	17220	0.17	401.5	3320	5250	0.17
1320.7	10890	17400	0.18	402.5	3320	5300	0.18
1323.9	10890	16790	0.14	403.5	3320	5120	0.14
1327.2	10890	18440	0.23	404.5	3320	5620	0.23
1330.5	11160	18150	0.20	405.5	3400	5530	0.20
1333.8	10800	18960	0.26	406.5	3290	5780	0.26
1337.1	11340	18960	0.22	407.5	3460	5780	0.22
1340.3	10230	20580	0.34	408.5	3120	6270	0.34
1343.6	10630	18750	0.26	409.5	3240	5710	0.26
1346.9	11160	18540	0.22	410.5	3400	5650	0.22
1350.2	11160	17400	0.15	411.5	3400	5300	0.15
1353.5	11180	17220	0.14	412.5	3410	5250	0.14
1356.8	10890	17050	0.16	413.5	3320	5200	0.16
1360.0	11070	18490	0.22	414.5	3370	5640	0.22
1363.3	10550	17310	0.20	415.5	3210	5280	0.20
1366.6	10980	16270	0.08	416.5	3350	4960	0.08
1369.9	10070	15340	0.12	417.5	3070	4680	0.12
1373.2	9370	15170	0.19	418.5	2860	4620	0.19
1376.4	7760	14840	0.31	419.5	2360	4520	0.31
1379.7	6960	14520	0.35	420.5	2120	4420	0.35
1383.0	6620	14360	0.37	421.5	2020	4380	0.37
1386.3	7140	14360	0.34	422.5	2180	4380	0.34
1389.6	7230	14520	0.34	423.5	2200	4420	0.34

Summary of Compressional Wave Velocity, Shear Wave Velocity, and Poisson's Ratio Based on Source-to-Receiver Travel Time Data - Borehole C4997 LOG #7

American Units			
Depth at Midpoint Between Source and Near Receiver	Velocity		Poisson's Ratio
	V_s	V_p	
(ft)	(ft/s)	(ft/s)	
1392.8	7540	14840	0.33
1396.1	7890	15700	0.33
1399.4	7940	16460	0.35
1402.7	7990	15000	0.30
1406.0	7940	16270	0.34
1409.2	8390	17760	0.36
1412.5	10150	17670	0.25
1415.8	8710	19010	0.37
1419.4	8940	17530	0.32
1422.7	8440	20030	0.39

Metric Units			
Depth at Midpoint Between Source and Near Receiver	Velocity		Poisson's Ratio
	V_s	V_p	
(m)	(m/s)	(m/s)	
424.5	2300	4520	0.33
425.5	2410	4780	0.33
426.5	2420	5020	0.35
427.5	2430	4570	0.30
428.5	2420	4960	0.34
429.5	2560	5410	0.36
430.5	3090	5390	0.25
431.5	2650	5800	0.37
432.6	2730	5340	0.32
433.6	2570	6110	0.39

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

APPENDIX B

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

CALIBRATION PROCEDURE FOR

GEOVision SEISMIC RECORDER/LOGGER

Reviewed 4/6/06

Objective

The timing/sampling accuracy of seismic recorders or data loggers is required for several GEOVision field procedures including Seismic Refraction, Downhole Seismic Velocity Logging, and P-S Suspension Logging. This procedure describes the method for measuring the timing accuracy of a seismic data logger, such as the OYO Model 170, OYO/Robertson Model 3403, Geometrics Strataview or Geometrics Geode. 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 data loggers, 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 Seismograph Calibration Data Sheet 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 up generator to produce a 100.0 Hz, 0.25 volt (amplitude is approximate, modify as necessary to yield less than full scale waveforms on logger display) peak square wave or sine wave. Verify frequency using the counter and initial space on the data sheet.

5. Initialize data logger and record a data record of at least 0.1 second using a 100 microsecond or less sample period.

6. Measure the recorded square wave frequency by measuring the duration of 9 cycles of data. This measurement can be made using the data logger display device, or by printing out a paper tape. If a paper tape can be printed, the resulting printout must be attached to this procedure. Record the data in the space provided.

7. Repeat steps 5 and 6 three more times using separate files.

Criteria

The duration for 9 cycles in any file must be 90.0 milliseconds plus or minus 0.9 milliseconds, corresponding to an average frequency for the nine cycles of 100.0 Hz plus or minus 1 Hz (obtained by dividing 9 cycles by the duration in milliseconds).

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
Signature	April 6, 2006
	Date

Client Approval (if required):

Name	Title
Signature	Date

TEST NUMBER(S)
506737

EDISON ESI®
A SOUTHERN CALIFORNIA EDISON® Company

Calibration Report

METROLOGY
7300 Fenwick Lane
Westminster, CA 92683
866-723-2257
edisonmetrology.com

GEOVision Geophysical Services
1151 Pomona Road, Unit P
Corona, CA 92882
P.O. No.: 6303-060815-01

Manufacturer:	Oyo
Model Number:	03331-0000
Description:	Seismograph,
Asset Number:	15014
Serial Number:	15014

Calibration Date:	08/16/2006
Calibration Due Date:	08/16/2007
Calibration Interval:	12 Months
Condition As Found:	In Tolerance
Condition As Left:	In Tolerance

Remarks:
The UUT (unit under test) was calibrated using the customer's procedure. The UUT was operated by the customer's personnel and data collection was observed by SCE personnel. The UUT was found to be in tolerance to customer supplied specifications. The reference standards used are in compliance with ISO/IEC 17025:1999 and laboratory accreditation criteria established by NIST/NVLAP under the specific scope of accreditation for lab code 105014-0. Frequency is accredited.
Please see attached data.

Standards Utilized

I.D. No.	Mfg.	Model No.	Description	Cal. Date	Due Date
S1-01252	Hewlett Packard	5335A OPT 010,203040	Counter, Universal,	06/16/2006	12/16/2006
S1-03079	Hewlett Packard	3325B	Generator, Function,	04/04/2006	04/04/2007
S1-03686	Fluke	910	Standard, Frequency, Controlled, Gps	01/16/2006	01/16/2007

Procedure: Customer
Temperature: 23° C
Humidity: 47% RH
Test No.: 506737

Calibration Performed By:			Quality Reviewer:	
Cordero, Denise M	Metrologist	714-895-0714		8/16/2006
Name	Title	Phone	Name	Date

GEOVision geophysical services

SEISMOGRAPH CALIBRATION DATA SHEET REV 4/6/06

INSTRUMENT DATA

SYSTEM MFR:	OYO	MODEL NO.:	3331
SERIAL NO.:	15014	CALIBRATION DATE:	8/16/2006
BY:	ROBERT STELLER	DUE DATE: 8/16/2007	8/16/2007
COUNTER MFR	HEWLETT PACKARD	MODEL NO.:	5335A
SERIAL NO.:	2626A09881	CALIBRATION DATE:	6/16/2006
BY:	SCE #S1-01252	DUE DATE:	12/16/2006
FCTN GEN MFR	HEWLETT PACKARD	MODEL NO.:	3325B
SERIAL NO.:	2847A11880	CALIBRATION DATE:	4/4/2006
BY:	SCE #S1-03073	DUE DATE:	4/4/2007

SYSTEM SETTINGS:

GAIN:	10
FILTER:	20 KHZ
RANGE:	100 MILLISEC
DELAY:	0
STACK: 1 (STD)	1
PULSE:	1.6
DISPLAY:	NA
SYSTEM: DATE = CORRECT DATE & TIME	8/16/2006, 10:38 AM

PROCEDURE:

SET FREQUENCY TO 100.0HZ SQUAREWAVE WITH AMPLITUDE APPROXIMATELY 0.25 VOLT PEAK. RECORD BOTH ON DISK AND PAPER TAPE, IF AVAILABLE. ANALYZE AND PRINT WAVEFORMS FROM ANALYSIS UTILITY. ATTACH PAPER COPIES OF PRINTOUT AND PAPER TAPES, IF AVAILABLE, TO THIS FORM. AVERAGE FREQUENCY MUST BE BETWEEN 99.0 AND 101.0 HZ.

AS FOUND 100.0 AS LEFT 100.0

WAVEFORM	FILE NO	FREQUENCY	TIME FOR 9 CYCLES Hn	TIME FOR 9 CYCLES Hr	TIME FOR 9 CYCLES V	AVERAGE FREQ.
SQUARE	501	100.0	90.0	90.0	90.0	100.0
SQUARE	502	100.0	90.0	90.0	90.0	100.0
SINE	503	100.0	90.0	90.0	90.0	100.0
SINE	504	100.0	90.0	90.0	90.0	100.0

CALIBRATED BY: ROBERT STELLER 8/16/2006 Robt Steller

NAME DATE SIGNATURE

Seismic recorder/Logger Calibration Data Sheet Rev 1.30 4-6-06

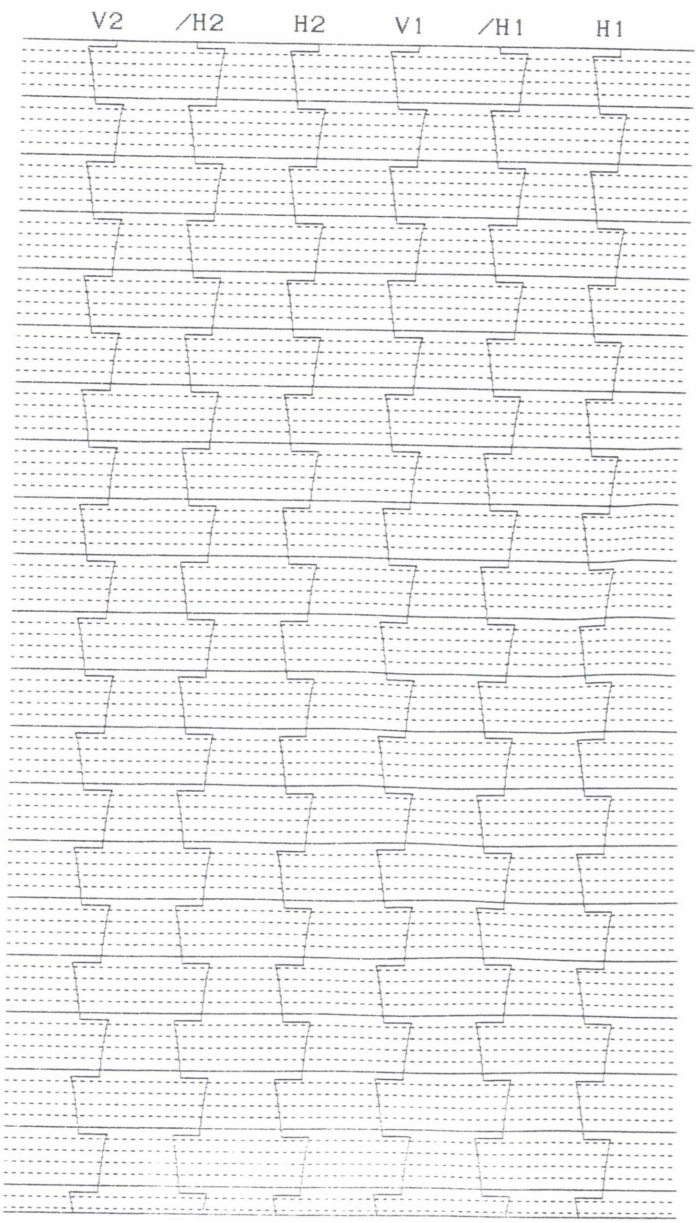
OYO S/N 15014

Suspension 170 1.42

ID_NO. : 501
HOLE NO. : 0
DEPTH : 0.0 [m]
DATE : 16/08/06 10:44:56 AM
H-SAMPLE RATE: 100 [μSEC]
V-SAMPLE RATE: 100 [μSEC]
PULSE WIDTH : 1.6 [mSEC]
DELAY TIME : 0 [mSEC]

	H1	/H1	V1	H2	/H2	V2
GAIN	X 10	X 10	X 10	X 10	X 10	X 10
LCF[Hz]	5	5	5	5	5	5
HCF[Hz]	20K	20K	20K	20K	20K	20K
STACK	1	1	1	1	1	1

TRACE SIZE : 1
H-TIME SCALE: 1.00 [mSEC/LINE]
V-TIME SCALE: 1.00 [mSEC/LINE]



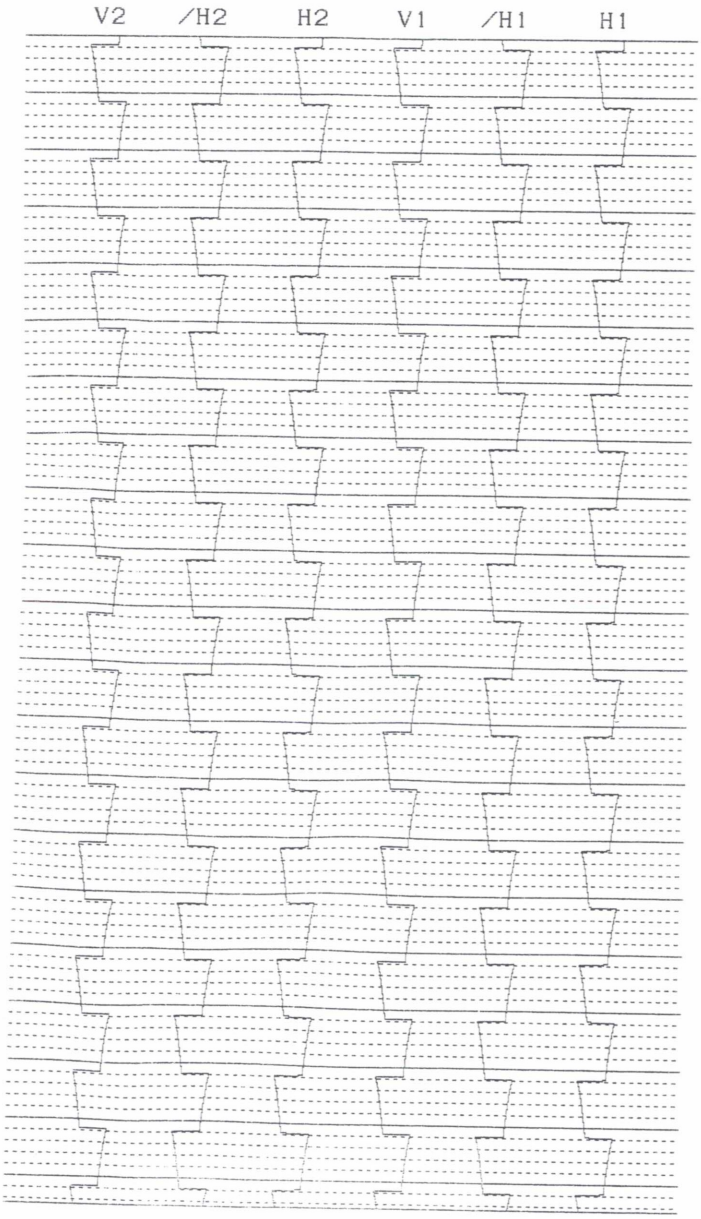
OYO S/N 15014

Suspension 170 1.42

ID_NO. : 502
HOLE NO. : 0
DEPTH : 0.0 [m]
DATE : 16/08/06 10:45:55 AM
H-SAMPLE RATE: 100 [μSEC]
V-SAMPLE RATE: 100 [μSEC]
PULSE WIDTH : 1.6 [mSEC]
DELAY TIME : 0 [mSEC]

	H1	/H1	V1	H2	/H2	V2
GAIN	X 10	X 10	X 10	X 10	X 10	X 10
LCF[Hz]	5	5	5	5	5	5
HCF[Hz]	20K	20K	20K	20K	20K	20K
STACK	1	1	1	1	1	1

TRACE SIZE : 1
H-TIME SCALE: 1.00 [mSEC/LINE]
V-TIME SCALE: 1.00 [mSEC/LINE]



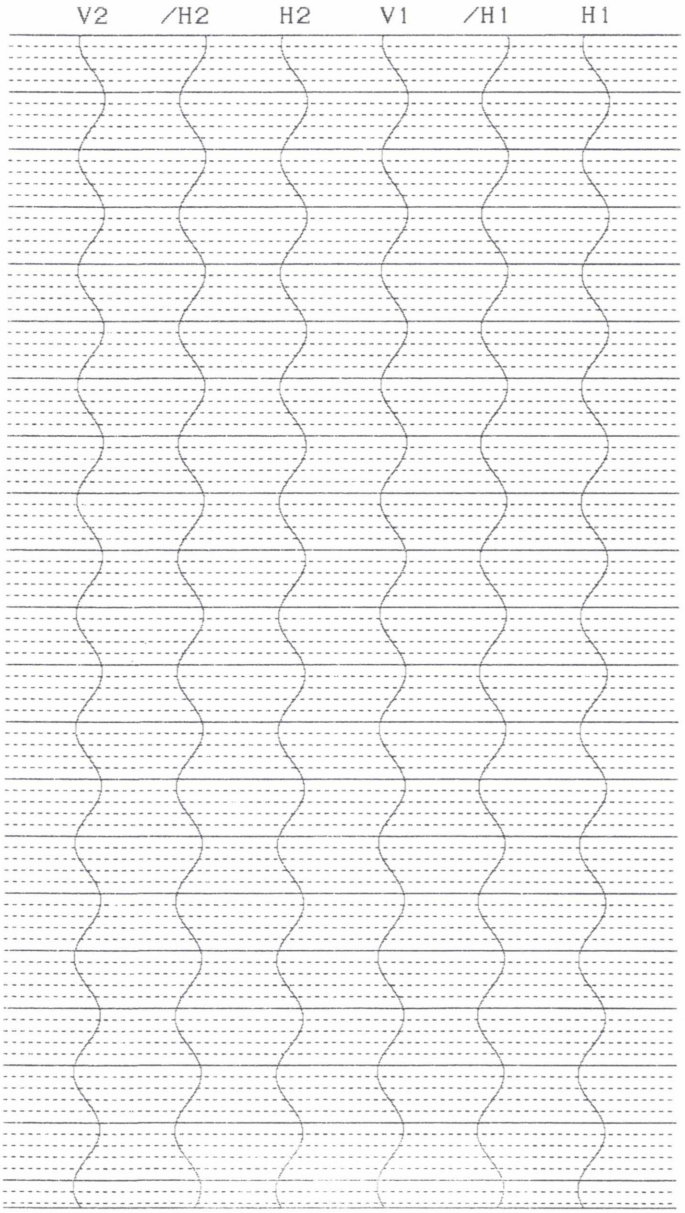
OYO

Suspension 170 1.42 S/N 15014

ID_NO. : 503
HOLE NO. : 0
DEPTH : 0.0 [m]
DATE : 16/08/06 10:46:52 AM
H-SAMPLE RATE: 100 [μSEC]
V-SAMPLE RATE: 100 [μSEC]
PULSE WIDTH : 1.6 [mSEC]
DELAY TIME : 0 [mSEC]

	H1	/H1	V1	H2	/H2	V2
GAIN	X 10	X 10	X 10	X 10	X 10	X 10
LCF[Hz]	5	5	5	5	5	5
HCF[Hz]	20K	20K	20K	20K	20K	20K
STACK	1	1	1	1	1	1

TRACE SIZE : 1
H-TIME SCALE: 1.00 [mSEC/LINE]
V-TIME SCALE: 1.00 [mSEC/LINE]



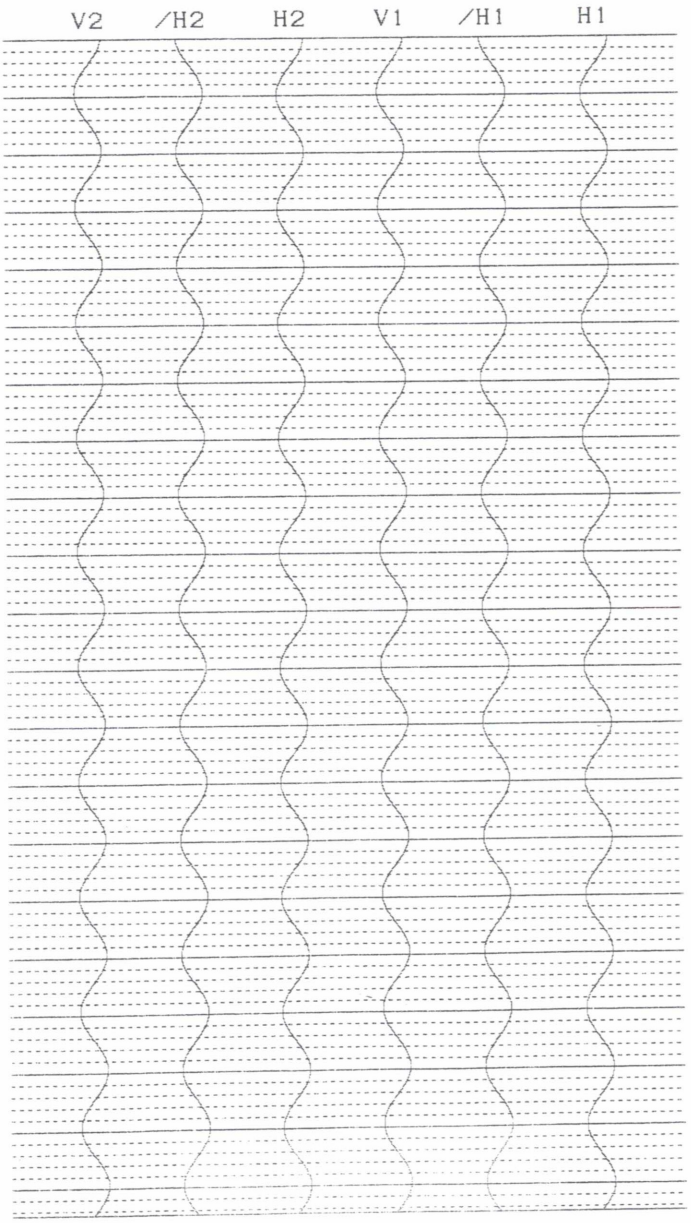
OYO S/N 15014

Suspension 170 1.42

ID_NO. : 504
HOLE NO. : 0
DEPTH : 0.0 [m]
DATE : 16/08/06 10:47:45 AM
H-SAMPLE RATE: 100 [μSEC]
V-SAMPLE RATE: 100 [μSEC]
PULSE WIDTH : 1.6 [mSEC]
DELAY TIME : 0 [mSEC]

	H1	/H1	V1	H2	/H2	V2
GAIN	X 10	X 10	X 10	X 10	X 10	X 10
LCF[Hz]	5	5	5	5	5	5
HCF[Hz]	20K	20K	20K	20K	20K	20K
STACK	1	1	1	1	1	1

TRACE SIZE : 1
H-TIME SCALE: 1.00 [mSEC/LINE]
V-TIME SCALE: 1.00 [mSEC/LINE]



APPENDIX C

BORING GEOPHYSICAL LOGGING FIELD DATA LOGS

Table of Contents

GEOVision
geophysical services

P-S SUSPENSION VELOCITY FIELD LOG

SITE: Hanford WTP DATE: 10-14-06
CLIENT: PNNL JOB: 6303
AUTHOR: DIETZ JOB PAGE 1 OF 19

CONTACT: Marty Gardner OFFICE PHONE: cell 509-372-8029

CONTACT: Alan Rohay OFFICE PHONE: cell 509-531-2295

CONTACT: Tim Brouns OFFICE PHONE: cell 509-531-7478

CONTACT: OFFICE PHONE:

CONTACT: OFFICE PHONE:
CONTACT: OFFICE PHONE:

DIRECTIONS TO SITE:
Richland, WA - drive north on George Washington Blvd all the way, turn right at the T

GENERAL SITE CONDITIONS/LOCATION:
JOB 1-23-07

EA#:
BOREHOLE DESIGNATION: C4993 RUN #7 6 LOCATION: " PIT "

COUNTY: RANGE: TOWNSHIP: SECTION:
BOREHOLE CONSTRUCTION: CASED UNCASED X
DIAMETERS AND DEPTH RANGES: 9" 0 TO all. ; , TO
BOREHOLE TOTAL DEPTH AS DRILLED: 1411
CONDUCTOR CASING?: YES DEPTH TO BOTTOM OF CASING ; NO
DEPTH TO BEDROCK: DEPTH TO WATER TABLE:
BOREHOLE FLUID: WATER ; FRESH WATER MUD X ; SALT WATER MUD;
OTHER:
DEPTH TO BOREHOLE FLUID: TIME SINCE LAST CIRCULATION: 3 days.

GEOVision
geophysical services

SITE: Hanford WTP DATE: 10-14-06
CLIENT: PNNL JOB: 6303
AUTHOR: JGD. PAGE 1 OF 19
2

JGD 10-14-06

LOGGING CREW: Dichl + Rojas.
VEHICLE(S) USED AND MILEAGE:
MOBILIZED FROM: DEPARTURE TIME:
ARRIVED ON SITE: 810
STANDBY TIME: CAUSE:
LOGGING STARTED: 918 LOGGING COMPLETED: 1251
STANDBY TIME: CAUSE:
LOGGING STARTED: LOGGING COMPLETED:
DEMOBILIZED TO: ARRIVAL TIME:
ADDITIONAL DEMOB TIME: REASON:

BATTERIES CHANGED BEFORE LOGGING: YES____; NO X ; STORED WITH NEW____
Yesterday.

WINCH	COMPROBE ☑		GREY ☐		OYO ☐		RG ☐		OTH ☐	
INSTRUMENT	OYO	12004 ☐	15014 ☑	19029 ☐		RG	160023 ☐	160024 ☐		
RECEIVER S/N		12008 ☐	20042 ☐	26066 ☐	11001 ☐		23053 ☐	330094 ☑		

MAINTENANCE PERFORMED ON SITE:

EQUIPMENT PROBLEMS OR FAILURES:

SUGGESTIONS, ADDITIONS, CHANGES:

COMMENTS: rcd. 21037
isd. 300083
source. 39118
driv. 33093
wt. 470151

GEOVISION SUSPENSION LOGGING FIELD NOTES

SITE: Hanford WTP
DATE: 10-14-06
CLIENT: PNNL
JOB: 6303
AUTHOR: JDD
PAGE 3 OF 19

DEPTH METERS	DEPTH FEET	UNFILTERED FILE NO.	FILTERED FILE NO.	COMMENTS CASING, WATER, ROCK, ETC
93.0	305.12			
93.5	306.76			
94.0	308.40			
94.5	310.04			
95.0	311.68			
95.5	313.32			
96.0	314.96			
96.5	316.60			
97.0	318.24			
97.5	319.88			
98.0	321.52			
98.5	323.16			
99.0	324.80			
99.5	326.44			427
100.0	328.08			−109
100.5	329.72			318
101.0	331.36			
101.5	333.01			3.5 hrs.
102.0	334.65			~ 100/hr
102.5	336.29			
103.0	337.93			
103.5	339.57			
104.0	341.21			
104.5	342.85			
105.0	344.49			
105.5	346.13			
106.0	347.77			
106.5	349.41	JDD 10-14-06		
107.0	351.05			
107.5	352.69			
108.0	354.33	~~324~~	last.	
108.5	355.97			
109.0	357.61	323.		Stop.
109.5	359.25			
110.0	360.89	322	top in casing.	
110.5	362.53			
111.0	364.17	321		

GEOVISION SUSPENSION LOGGING FIELD NOTES

SITE: Hanford WTP
DATE: 10-14-06
CLIENT: PNNL
JOB: 6303
AUTHOR: JD
PAGE 4 OF 19

DEPTH METERS	DEPTH FEET	UNFILTERED FILE NO.	FILTERED FILE NO.	COMMENTS CASING, WATER, ROCK, ETC
111.5	365.81			
112.0	367.45	320		
112.5	369.09			
113.0	370.73	319		
113.5	372.38			
114.0	374.02	318		
114.5	375.66			
115.0	377.30	317		
115.5	378.94			
116.0	380.58	316		
116.5	382.22			
117.0	383.86	315		
117.5	385.50			
118.0	387.14	314		
118.5	388.78			
119.0	390.42	313		
119.5	392.06			
120.0	393.70	312		
120.5	395.34			
121.0	396.98	311		
121.5	398.62			
122.0	400.26	310		
122.5	401.90			
123.0	403.54	309		
123.5	405.18			
124.0	406.82	308		
124.5	408.46			
125.0	410.10	307		
125.5	411.75			
126.0	413.39	306		
126.5	415.03			
127.0	416.67	305		
127.5	418.31			
128.0	419.95	304		
128.5	421.59			
129.0	423.23	303		
129.5	424.87			

GEOVISION SUSPENSION LOGGING FIELD NOTES

SITE: Hanford WTP DATE: 10-14-06
CLIENT: PNNL JOB: 6303
AUTHOR: JRD PAGE 5 OF 19

DEPTH METERS	DEPTH FEET	UNFILTERED FILE NO.	FILTERED FILE NO.	COMMENTS CASING, WATER, ROCK, ETC
130.0	426.51	302		
130.5	428.15			
131.0	429.79	301		
131.5	431.43			
132.0	433.07	300		
132.5	434.71			
133.0	436.35	299		
133.5	437.99			
134.0	439.63	298		
134.5	441.27			
135.0	442.91	297		
135.5	444.55			
136.0	446.19	296		
136.5	447.83			
137.0	449.48	295		
137.5	451.12			
138.0	452.76	294		
138.5	454.40			
139.0	456.04	293		
139.5	457.68			
140.0	459.32	292		
140.5	460.96			
141.0	462.60	291		
141.5	464.24			
142.0	465.88	290		
142.5	467.52			
143.0	469.16	289		range ↓
143.5	470.80			
144.0	472.44	288		
144.5	474.08			Rattlesnake
145.0	475.72	287		gain ↓↓ ↓
145.5	477.36			
146.0	479.00	286		
146.5	480.64			
147.0	482.28	285		
147.5	483.92			

GEOVISION SUSPENSION LOGGING FIELD NOTES

SITE: Hanford WTP DATE: 10-14-06
CLIENT: PNNL JOB: 6303
AUTHOR: JDD PAGE 6 OF 19

DEPTH METERS	DEPTH FEET	UNFILTERED FILE NO.	FILTERED FILE NO.	COMMENTS CASING, WATER, ROCK, ETC
148.0	485.56	284		
148.5	487.20			
149.0	488.85	283		
149.5	490.49			
150.0	492.13	282		
150.5	493.77			
151.0	495.41	281		
151.5	497.05			
152.0	498.69	280		
152.5	500.33			
153.0	501.97	279		
153.5	503.61			
154.0	505.25	278		
154.5	506.89			
155.0	508.53	277		
155.5	510.17			
156.0	511.81	276		
156.5	513.45			
157.0	515.09	275		
157.5	516.73			
158.0	518.37	274		
158.5	520.01			
159.0	521.65	273		
159.5	523.29			
160.0	524.93	272		gain ↓↓
160.5	526.57			
161.0	528.22	271		
161.5	529.86			
162.0	531.50	270		↑ Rattlesnake
162.5	533.14			
163.0	534.78	269		gain ↑
163.5	536.42			
164.0	538.06	268		
164.5	539.70			
165.0	541.34	267		gain ↑↑ range ↑
165.5	542.98			
166.0	544.62	266		

GEOVISION SUSPENSION LOGGING FIELD NOTES

SITE: Hanford WTP DATE: 10-14-06
CLIENT: PNNL JOB: 6303
AUTHOR: JAO PAGE 7 OF 19

DEPTH METERS	DEPTH FEET	UNFILTERED FILE NO.	FILTERED FILE NO.	COMMENTS CASING, WATER, ROCK, ETC
166.5	546.26			
167.0	547.90	265		
167.5	549.54			
168.0	551.18	264		
168.5	552.82			
169.0	554.46	263		
169.5	556.10			
170.0	557.74	262		
170.5	559.38			
171.0	561.02	261		
171.5	562.66			
172.0	564.30	260		
172.5	565.94			
173.0	567.59	259		
173.5	569.23			
174.0	570.87	258		
174.5	572.51			
175.0	574.15	257		
175.5	575.79			
176.0	577.43	256		
176.5	579.07			
177.0	580.71	255		
177.5	582.35			
178.0	583.99	254		
178.5	585.63			
179.0	587.27	253		
179.5	588.91			
180.0	590.55	~~251~~ 252	JAO 10-14-06	
180.5	592.19			
181.0	593.83	250, 251		
181.5	595.47			
182.0	597.11	249		
182.5	598.75			
183.0	600.39	248		
183.5	602.03			
184.0	603.67			
184.5	605.31	↑ 247		

GEOVISION SUSPENSION LOGGING FIELD NOTES

SITE: Hanford WTP DATE: 10-14-06

CLIENT: PNNL JOB: 6303 C4993

AUTHOR: JD PAGE 8 OF 19

DEPTH METERS	DEPTH FEET	UNFILTERED FILE NO.	FILTERED FILE NO.	COMMENTS CASING, WATER, ROCK, ETC
185.0	606.96	246		
185.5	608.60			
186.0	610.24	245		
186.5	611.88			
187.0	613.52	244		
187.5	615.16			
188.0	616.80	243		
188.5	618.44			
189.0	620.08	242		
189.5	621.72			
190.0	623.36	241		
190.5	625.00			
191.0	626.64	240		
191.5	628.28			
192.0	629.92	239		
192.5	631.56			
193.0	633.20	238		
193.5	634.84			
194.0	636.48	237		
194.5	638.12			
195.0	639.76	236		
195.5	641.40			
196.0	643.04	235		
196.5	644.69			
197.0	646.33	234		
197.5	647.97			
198.0	649.61	233		
198.5	651.25			
199.0	652.89	232		
199.5	654.53			
200.0	656.17	231		
200.5	657.81			
201.0	659.45	230		
201.5	661.09			
202.0	662.73	229		
202.5	664.37			
203.0	666.01	228		

GEOVISION SUSPENSION LOGGING FIELD NOTES

SITE: Hanford WTP DATE: 10-14-06
CLIENT: PNNL JOB: 6303
AUTHOR: JBD PAGE 9 OF 19

DEPTH METERS	DEPTH FEET	UNFILTERED FILE NO.	FILTERED FILE NO.	COMMENTS CASING, WATER, ROCK, ETC
203.5	667.65			
204.0	669.29	227		
204.5	670.93			
205.0	672.57	226		
205.5	674.21			
206.0	675.85	225		
206.5	677.49			
207.0	679.13	224		
207.5	680.77			
208.0	682.41	223		
208.5	684.06			
209.0	685.70	222		
209.5	687.34			
210.0	688.98	221		
210.5	690.62			
211.0	692.26	220		
211.5	693.90			
212.0	695.54	219		
212.5	697.18			
213.0	698.82	218		
213.5	700.46			
214.0	702.10	217		
214.5	703.74			
215.0	705.38	216		
215.5	707.02			
216.0	708.66	214, 215		gain ↓
216.5	710.30			
217.0	711.94	213		gain ↓ range ↓
217.5	713.58			
218.0	715.22	212		
218.5	716.86			
219.0	718.50	211		
219.5	720.14			
220.0	721.78	210		
220.5	723.43			
221.0	725.07	209		
221.5	726.71			selan
222.0	728.35	208		↓
222.5	729.99			
223.0	731.63	207		nice
223.5	733.27			
224.0	734.91	206		gain ↑

GEOVISION SUSPENSION LOGGING FIELD NOTES

SITE: Hanford WTP DATE: 10-14-06
CLIENT: PNNL JOB: 6303
AUTHOR: JBD PAGE 10 OF 19

DEPTH METERS	DEPTH FEET	UNFILTERED FILE NO.	FILTERED FILE NO.	COMMENTS CASING, WATER, ROCK, ETC
224.5	736.55			
225.0	738.19	205		gain ↑ far.
225.5	739.83			
226.0	741.47	204		↑ Sdah.
226.5	743.11			
227.0	744.75	203		range ↑
227.5	746.39			
228.0	748.03	202		
228.5	749.67			
229.0	751.31	201		
229.5	752.95			
230.0	754.59	200		
230.5	756.23			
231.0	757.87	199		
231.5	759.51			
232.0	761.15	198		
232.5	762.80			
233.0	764.44	197		
233.5	766.08			
234.0	767.72	196		
234.5	769.36			
235.0	771.00	195		
235.5	772.64			
236.0	774.28	194		
236.5	775.92			
237.0	777.56	193		
237.5	779.20			
238.0	780.84	192		
238.5	782.48			
239.0	784.12	191		
239.5	785.76			
240.0	787.40	190		
240.5	789.04			
241.0	790.68	189		
241.5	792.32			
242.0	793.96	188		
242.5	795.60			
243.0	797.24	187		
243.5	798.88			
244.0	800.52	186		
244.5	802.17			
245.0	803.81	185		

GEOVISION SUSPENSION LOGGING FIELD NOTES

SITE: Hanford WTP DATE: 10-14-06
CLIENT: PNNL JOB: 6303
AUTHOR: JGO PAGE 11 OF 19

DEPTH METERS	DEPTH FEET	UNFILTERED FILE NO.	FILTERED FILE NO.	COMMENTS CASING, WATER, ROCK, ETC
245.5	805.45			
246.0	807.09	184		
246.5	808.73			
247.0	810.37	183		
247.5	812.01			
248.0	813.65	182		
248.5	815.29			
249.0	816.93	181		
249.5	818.57			
250.0	820.21	180		
250.5	821.85			
251.0	823.49	179		
251.5	825.13			
252.0	826.77	178		
252.5	828.41			
253.0	830.05	177		gain ↓ near, range ↓
253.5	831.69			
254.0	833.33	176		
254.5	834.97			
255.0	836.61	175		far is out of cc. gain ↓ far
255.5	838.25			
256.0	839.90	174		
256.5	841.54			
257.0	843.18	173		
257.5	844.82			↓ Cold Creek
258.0	846.46	172		
258.5	848.10			
259.0	849.74	171		
259.5	851.38			
260.0	853.02	170		
260.5	854.66			
261.0	856.30	169		
261.5	857.94			
262.0	859.58	168		
262.5	861.22			
263.0	862.86	167		
263.5	864.50			
264.0	866.14	165, 166		disk write problem?
264.5	867.78			
265.0	869.42	164		
265.5	871.06			
266.0	872.70	163		

GEOVISION SUSPENSION LOGGING FIELD NOTES

SITE: Hanford WTP
CLIENT: PNNL
AUTHOR: JDD

DATE: 10-14-06
JOB: 6303
PAGE 12 OF 19

DEPTH METERS	DEPTH FEET	UNFILTERED FILE NO.	FILTERED FILE NO.	COMMENTS CASING, WATER, ROCK, ETC
266.5	874.34			
267.0	875.98	162		
267.5	877.62			
268.0	879.27	161		
268.5	880.91			
269.0	882.55	160		
269.5	884.19			
270.0	885.83	159		
270.5	887.47			
271.0	889.11	158		
271.5	890.75			
272.0	892.39	157		
272.5	894.03			
273.0	895.67	156		
273.5	897.31			
274.0	898.95	155		
274.5	900.59			
275.0	902.23	154		
275.5	903.87			
276.0	905.51	153		gain↓ nice
276.5	907.15			
277.0	908.79	152		
277.5	910.43			-
278.0	912.07	151		nice.
278.5	913.71			
279.0	915.35	150		gain↓
279.5	916.99			
280.0	918.64	149		
280.5	920.28			
281.0	921.92	148		
281.5	923.56			
282.0	925.20	147		
282.5	926.84			
283.0	928.48	146		
283.5	930.12			
284.0	931.76	145	gain↑↑	
284.5	933.40			↑ Cold Creek
285.0	935.04	144	gain↑ range↑	
285.5	936.68			
286.0	938.32	143		
286.5	939.96			
287.0	941.60	142		

GEOVISION SUSPENSION LOGGING FIELD NOTES

SITE: Hanford WTP DATE: 10-14-06
CLIENT: PNNL JOB: 6303
AUTHOR: JD PAGE 13 OF 19

DEPTH METERS	DEPTH FEET	UNFILTERED FILE NO.	FILTERED FILE NO.	COMMENTS CASING, WATER, ROCK, ETC
287.5	943.24			
288.0	944.88	~~151~~ 141		
288.5	946.52			
289.0	948.16	~~138~~ 140		
289.5	949.80			
290.0	951.44	~~137~~ 139		
290.5	953.08			
291.0	954.72	~~136~~ 138		
291.5	956.36			
292.0	958.01	~~135~~ 137		
292.5	959.65		JM 10-14-06	
293.0	961.29	~~134~~ 136		
293.5	962.93			
294.0	964.57	~~133~~ 135		
294.5	966.21			
295.0	967.85	~~132~~ 134		
295.5	969.49			
296.0	971.13	~~131~~ 133		
296.5	972.77			
297.0	974.41	~~130~~ 132		
297.5	976.05			
298.0	977.69	~~129~~ 131		
298.5	979.33			
299.0	980.97	~~128~~ 130		
299.5	982.61			
300.0	984.25	129		alternated.
300.5	985.89			
301.0	987.53	128		
301.5	989.17			
302.0	990.81	127		
302.5	992.45			
303.0	994.09	126		
303.5	995.73			
304.0	997.38	125		
304.5	999.02			
305.0	1000.66	124		
305.5	1002.30			
306.0	1003.94	123		
306.5	1005.58			
307.0	1007.22	122		
307.5	1008.86			
308.0	1010.50	121		

GEOVISION SUSPENSION LOGGING FIELD NOTES

SITE: Hanford WTP DATE: 10-14-06
CLIENT: PNNL JOB: 6303
AUTHOR: JGD. PAGE 14 OF 19

DEPTH METERS	DEPTH FEET	UNFILTERED FILE NO.	FILTERED FILE NO.	COMMENTS CASING, WATER, ROCK, ETC
308.5	1012.14			
309.0	1013.78	120		
309.5	1015.42			
310.0	1017.06	119		
310.5	1018.70			
311.0	1020.34	118		
311.5	1021.98			
312.0	1023.62	117		
312.5	1025.26			
313.0	1026.90	116		
313.5	1028.54			
314.0	1030.18	115		
314.5	1031.82			
315.0	1033.46	114		
315.5	1035.10			
316.0	1036.75	113		
316.5	1038.39			
317.0	1040.03	112		
317.5	1041.67			
318.0	1043.31	111		
318.5	1044.95			
319.0	1046.59	110		
319.5	1048.23			
320.0	1049.87	109		
320.5	1051.51			
321.0	1053.15	108		
321.5	1054.79			
322.0	1056.43	107		
322.5	1058.07			
323.0	1059.71	106		
323.5	1061.35			
324.0	1062.99	105		
324.5	1064.63			
325.0	1066.27	104		
325.5	1067.91			
326.0	1069.55	103		
326.5	1071.19			
327.0	1072.83	102		
327.5	1074.48			
328.0	1076.12	101		
328.5	1077.76			
329.0	1079.40	100		

1 hr = 100 ms = 100m = 300 ft.

GEOVISION SUSPENSION LOGGING FIELD NOTES

SITE: Hanford WTP DATE: 10-14-06
CLIENT: PNNL JOB: 6303
AUTHOR: JM PAGE 15 OF 19

DEPTH METERS	DEPTH FEET	UNFILTERED FILE NO.	FILTERED FILE NO.	COMMENTS CASING, WATER, ROCK, ETC
329.5	1081.04			
330.0	1082.68	99		
330.5	1084.32			
331.0	1085.96	98		
331.5	1087.60			
332.0	1089.24	97	range ↓	
332.5	1090.88			
333.0	1092.52	96	gain ↓	
333.5	1094.16			
334.0	1095.80	95	gain ↓	
334.5	1097.44			↓ Mabton
335.0	1099.08	94		
335.5	1100.72			
336.0	1102.36	93		
336.5	1104.00			
337.0	1105.64	92		
337.5	1107.28			
338.0	1108.92	91		
338.5	1110.56			
339.0	1112.20	90		gain ↓ fur.
339.5	1113.85			
340.0	1115.49	89		
340.5	1117.13			
341.0	1118.77	88		
341.5	1120.41			
342.0	1122.05	87		
342.5	1123.69			
343.0	1125.33	86		
343.5	1126.97			
344.0	1128.61	85		
344.5	1130.25			
345.0	1131.89	84		nice
345.5	1133.53			
346.0	1135.17	83		
346.5	1136.81			
347.0	1138.45	82		
347.5	1140.09			
348.0	1141.73	81		nice
348.5	1143.37			
349.0	1145.01	80		gain ↓
349.5	1146.65			
350.0	1148.29	79		

GEOVISION SUSPENSION LOGGING FIELD NOTES

SITE: Hanford WTP DATE: 10-14-06

CLIENT: PNNL JOB: 6303 C4993

AUTHOR: JDO PAGE 16 OF 19

DEPTH METERS	DEPTH FEET	UNFILTERED FILE NO.	FILTERED FILE NO.	COMMENTS CASING, WATER, ROCK, ETC
350.5	1149.93			
351.0	1151.57	78		
351.5	1153.22			
352.0	1154.86	77		gain up ↑↑
352.5	1156.50			
353.0	1158.14	76		nice
353.5	1159.78			
354.0	1161.42	75		
354.5	1163.06			
355.0	1164.70	74		
355.5	1166.34			
356.0	1167.98	73		
356.5	1169.62			
357.0	1171.26	72		
357.5	1172.90			
358.0	1174.54	71		
358.5	1176.18			
359.0	1177.82	70		
359.5	1179.46			
360.0	1181.10	69		
360.5	1182.74			
361.0	1184.38	68		
361.5	1186.02			
362.0	1187.66	67		gain ↑ near ↑ Mabton
362.5	1189.30			
363.0	1190.94	66		
363.5	1192.59			
364.0	1194.23	65		gain up on far range ↑
364.5	1195.87			
365.0	1197.51	64		
365.5	1199.15			
366.0	1200.79	63		
366.5	1202.43			
367.0	1204.07	~~62~~ 62	JW 10-14-06 OK	
367.5	1205.71			
368.0	1207.35	~~60~~ 61		
368.5	1208.99			
369.0	1210.63	59, 60		
369.5	1212.27			
370.0	1213.91	58		
370.5	1215.55			
371.0	1217.19	57		

GEOVISION SUSPENSION LOGGING FIELD NOTES

SITE: Hanford WTP DATE: 10-14-06
CLIENT: PNNL JOB: 6303
AUTHOR: JGD PAGE 17 OF 19

DEPTH METERS	DEPTH FEET	UNFILTERED FILE NO.	FILTERED FILE NO.	COMMENTS CASING, WATER, ROCK, ETC
371.5	1218.83			
372.0	1220.47	58		
372.5	1222.11			
373.0	1223.75	55		
373.5	1225.39			
374.0	1227.03	54		
374.5	1228.67			
375.0	1230.31	53		
375.5	1231.96			
376.0	1233.60	52		
376.5	1235.24			
377.0	1236.88	51		
377.5	1238.52			
378.0	1240.16	50		
378.5	1241.80			
379.0	1243.44	49		
379.5	1245.08			
380.0	1246.72	48		
380.5	1248.36			
381.0	1250.00	47		
381.5	1251.64			
382.0	1253.28	46		
382.5	1254.92			
383.0	1256.56	45		
383.5	1258.20			
384.0	1259.84	44		
384.5	1261.48			
385.0	1263.12	43		
385.5	1264.76			
386.0	1266.40	42		
386.5	1268.04			
387.0	1269.69	41		
387.5	1271.33			
388.0	1272.97	40		
388.5	1274.61			
389.0	1276.25	39		
389.5	1277.89			
390.0	1279.53	38		
390.5	1281.17			
391.0	1282.81	37		
391.5	1284.45			
392.0	1286.09	36		

GEOVISION SUSPENSION LOGGING FIELD NOTES

SITE: Hanford WTP DATE: 10-14-06

CLIENT: PNNL JOB: 6303 C4993

AUTHOR: JGO. PAGE 18 OF 19

DEPTH METERS	DEPTH FEET	UNFILTERED FILE NO.	FILTERED FILE NO.	COMMENTS CASING, WATER, ROCK, ETC
392.5	1287.73			
393.0	1289.37	35		
393.5	1291.01			
394.0	1292.65	34		
394.5	1294.29			
395.0	1295.93	33		
395.5	1297.57			
396.0	1299.21	32		
396.5	1300.85			
397.0	1302.49	31		
397.5	1304.13			
398.0	1305.77	30		
398.5	1307.41			
399.0	1309.06	29		
399.5	1310.70			
400.0	1312.34	28		
400.5	1313.98			
401.0	1315.62	27		
401.5	1317.26			
402.0	1318.90	26		
402.5	1320.54			
403.0	1322.18	25		
403.5	1323.82			
404.0	1325.46	24		
404.5	1327.10			
405.0	1328.74	23		
405.5	1330.38			
406.0	1332.02	22		
406.5	1333.66			
407.0	1335.30	21		
407.5	1336.94			
408.0	1338.58	20		
408.5	1340.22			
409.0	1341.86	19		
409.5	1343.50			
410.0	1345.14	18		1411
410.5	1346.78			- 12.5
411.0	1348.43	17		gain ↓↓ 1398.5
411.5	1350.07			
412.0	1351.71	16		
412.5	1353.35			
413.0	1354.99	15		gain ↑↑

GEOVISION SUSPENSION LOGGING FIELD NOTES

SITE: Hanford WTP
CLIENT: PNNL
AUTHOR: JGD.

DATE: 10-19-06
JOB: 6303 C4993
PAGE 19 OF 19

DEPTH METERS	DEPTH FEET	UNFILTERED FILE NO.	FILTERED FILE NO.	COMMENTS CASING, WATER, ROCK, ETC
413.5	1356.63			
414.0	1358.27	14		
414.5	1359.91			
415.0	1361.55	13		
415.5	1363.19			
416.0	1364.83	12		
416.5	1366.47			
417.0	1368.11	11		
417.5	1369.75			
418.0	1371.39	10		
418.5	1373.03			
419.0	1374.67	9		
419.5	1376.31			
420.0	1377.95	8		
420.5	1379.59			
421.0	1381.23	7		
421.5	1382.87			
422.0	1384.51	6		
422.5	1386.15			
423.0	1387.80	5		
423.5	1389.44			
424.0	1391.08	4		
424.5	1392.72			
425.0	1394.36	3		
425.5	1396.00			
426.0	1397.64	002		
426.5	1399.28			← TD ? start
427.0	1400.92	001		
427.5	1402.56			@ 918
428.0	1404.20			
428.5	1405.84			
429.0	1407.48			
429.5	1409.12			
430.0	1410.76			TD.
430.5	1412.40			
431.0	1414.04			
431.5	1415.68			
432.0	1417.32			
432.5	1418.96			
433.0	1420.60			
433.5	1422.24			
434.0	1423.88			

GEOVision
geophysical services

P-S SUSPENSION VELOCITY FIELD LOG

SITE: Hanford WTP DATE: 8/28/06
CLIENT: PNNL JOB: 6303
AUTHOR: CC PAGE 1 OF 18

CONTACT: Marty Gardner OFFICE PHONE: cell 509-372-8029

CONTACT: Alan Rohay OFFICE PHONE: cell 509-531-2295

CONTACT: Tim Brouns OFFICE PHONE: cell 509-531-7478

CONTACT: OFFICE PHONE:

CONTACT: OFFICE PHONE:
CONTACT: OFFICE PHONE:

DIRECTIONS TO SITE:
Richland, WA - drive north on George Washington Blvd all the way, turn right at the T

GENERAL SITE CONDITIONS/LOCATION:

EA#:
BOREHOLE DESIGNATION: C4996 LOCATION:
Runs 5A + 5B
COUNTY: RANGE: TOWNSHIP: SECTION:
BOREHOLE CONSTRUCTION: CASED UNCASED
DIAMETERS AND DEPTH RANGES: 0 TO ; , TO
BOREHOLE TOTAL DEPTH AS DRILLED:
CONDUCTOR CASING?: YES DEPTH TO BOTTOM OF CASING; NO
DEPTH TO BEDROCK: DEPTH TO WATER TABLE:
BOREHOLE FLUID: WATER; FRESH WATER MUD X; SALT WATER MUD;
OTHER:
DEPTH TO BOREHOLE FLUID: TIME SINCE LAST CIRCULATION:

notes and * initials added by JGO per telecon with Charles Carter This date 2-26-07 JW

GEOVision geophysical services

SITE: Hanford WTP DATE: 8/28/06
CLIENT: PNNL JOB: 6303
AUTHOR: CC * PAGE 2 OF 18

LOGGING CREW:
VEHICLE(S) USED AND MILEAGE:
MOBILIZED FROM: DEPARTURE TIME:
ARRIVED ON SITE: 8:00 am
STANDBY TIME: CAUSE:
LOGGING STARTED: LOGGING COMPLETED: trip in @ 9:00 am
STANDBY TIME: CAUSE:
LOGGING STARTED: LOGGING COMPLETED:
DEMOBILIZED TO: ARRIVAL TIME:
ADDITIONAL DEMOB TIME: REASON:

BATTERIES CHANGED BEFORE LOGGING: YES X ; NO ; STORED WITH NEW

WINCH	COMPROBE	☒	GREY	☐	OYO	☐	RG	☐	OTH ☐
INSTRUMENT	OYO 12004	☐	15014	☒	19029	☐	RG 160023	☐	160024 ☐
RECEIVER S/N	12008	☐	20042	☐	26066	☒ 5B *	11001	☐	23053 ☒ 5A *

NOTES added by JGO per telecon WJ CC 2-26-07

MAINTENANCE PERFORMED ON SITE:

EQUIPMENT PROBLEMS OR FAILURES: See also notes after p. 18. JW 2-26-07

SUGGESTIONS, ADDITIONS, CHANGES:

COMMENTS: Set RP (0.44m) @ 9:00am
Read 408m @ 10:20am
Recheck RP @ 2:30pm after receiver failure
Run 2: set RP @ 0.4m at 3:10pm
Read 385.0m @ 3:45pm. Read 105m @ 7:30pm. Check RP @ 9:05pm

GEOVISION SUSPENSION LOGGING FIELD NOTES

SITE: Hanford WTP
DATE: 8/28/2006
CLIENT: PNNL
JOB: 6303
AUTHOR: CC CC *
PAGE 3 OF 18

DEPTH METERS	DEPTH FEET	UNFILTERED FILE NO.	FILTERED FILE NO.	COMMENTS CASING, WATER, ROCK, ETC
98.0	321.52			
98.5	323.16		** NOTES ADDED BY JGD 2-26-07	
99.0	324.80		PER TELECON WITH CC.	
99.5	326.44		1. These two pages were	
100.0	328.08		collected in the field on	
100.5	329.72		CC's laptop during logging	
101.0	331.36		because there were	
101.5	333.01		insufficient pages on the	
102.0	334.65		field form.	
102.5	336.29		2. These pages were printed and	
103.0	337.93		added to the hand log	
103.5	339.57		upon return to GEOVision.	
104.0	341.21		JGD	
104.5	342.85		** 2-26-07	
105.0	344.49	503		
105.5	346.13			
106.0	347.77	502		
106.5	349.41			
107.0	351.05	501		
107.5	352.69			
108.0	354.33	500		
~~108.5~~	~~355.97~~			
109.0	357.61	499		
109.5	359.25			
110.0	360.89	498		
110.5	362.53			
111.0	364.17	497		
111.5	365.81			
112.0	367.45	496		
112.5	369.09			
113.0	370.73	495		
113.5	372.38			
114.0	374.02	494		
114.5	375.66			
115.0	377.30	493		
115.5	378.94			
116.0	380.58	492		
116.5	382.22			
117.0	383.86	491		

GEOVISION SUSPENSION LOGGING FIELD NOTES

SITE: Hanford WTP
DATE: 8/28/2006
CLIENT: PNNL
JOB: 6303
AUTHOR: CC CC*
PAGE 4 OF 18

DEPTH METERS	DEPTH FEET	UNFILTERED FILE NO.	FILTERED FILE NO.	COMMENTS CASING, WATER, ROCK, ETC
117.5	385.50			
118.0	387.14	490	** -	see previous page VOD 2-26-07
118.5	388.78			
119.0	390.42	489		
119.5	392.06			
120.0	393.70	488		
120.5	395.34			
121.0	396.98	487		
121.5	398.62			
122.0	400.26	486		
122.5	401.90			
123.0	403.54	485		
123.5	405.18			
124.0	406.82	484		
124.5	408.46			
125.0	410.10	483		
125.5	411.75			
126.0	413.39	482		
126.5	415.03			
127.0	416.67	481		
127.5	418.31			
128.0	419.95	480		
128.5	421.59			
129.0	423.23	479		
129.5	424.87			
130.0	426.51			
130.5	428.15			
131.0	429.79			
131.5	431.43			
132.0	433.07			
132.5	434.71			
133.0	436.35			
133.5	437.99			
134.0	439.63			
134.5	441.27			
135.0	442.91			
135.5	444.55			
136.0	446.19			

GEOVISION SUSPENSION LOGGING FIELD NOTES

SITE: Hanford WTP DATE: 8/28/06
CLIENT: PNNL JOB: 6303
AUTHOR: CC + PAGE 5 OF 18

DEPTH METERS	DEPTH FEET	UNFILTERED FILE NO.	FILTERED FILE NO.	COMMENTS CASING, WATER, ROCK, ETC
130.0	426.51	478		
130.5	428.15			
131.0	429.79	477		
131.5	431.43			
132.0	433.07	476		
132.5	434.71			
133.0	436.35	475		
133.5	437.99			
134.0	439.63	474		
134.5	441.27			
135.0	442.91	473		
135.5	444.55			
136.0	446.19	472		
136.5	447.83			
137.0	449.48	471		
137.5	451.12			
138.0	452.76	470		
138.5	454.40			
139.0	456.04	469		
139.5	457.68			
140.0	459.32	468		
140.5	460.96			
141.0	462.60	467		
141.5	464.24			
142.0	465.88	466		
142.5	467.52			
143.0	469.16	465		
143.5	470.80			
144.0	472.44	464		
144.5	474.08			
145.0	475.72	463		
145.5	477.36			
146.0	479.00	462		
146.5	480.64			
147.0	482.28	461		
147.5	483.92			

GEOVISION SUSPENSION LOGGING FIELD NOTES

SITE: Hanford WTP DATE: 8/28/06
CLIENT: PNNL JOB: 6303
AUTHOR: CC & PAGE 6 OF 18

DEPTH METERS	DEPTH FEET	UNFILTERED FILE NO.	FILTERED FILE NO.	COMMENTS CASING, WATER, ROCK, ETC
148.0	485.56	460		
148.5	487.20			
149.0	488.85	459		
149.5	490.49			
150.0	492.13	458		
150.5	493.77			
151.0	495.41	457		New paper
151.5	497.05			
152.0	498.69	456		
152.5	500.33			
153.0	501.97	455		
153.5	503.61			
154.0	505.25	454		
154.5	506.89			
155.0	508.53	453		
155.5	510.17			
156.0	511.81	452		
156.5	513.45			
157.0	515.09	451		
157.5	516.73			
158.0	518.37	450		
158.5	520.01			
159.0	521.65	449		
159.5	523.29			
160.0	524.93	448		
160.5	526.57			
161.0	528.22	447		
161.5	529.86			
162.0	531.50	446		
162.5	533.14			
163.0	534.78	445		
163.5	536.42			
164.0	538.06	444		
164.5	539.70			
165.0	541.34	443		
165.5	542.98			
166.0	544.62	442		

GEOVISION SUSPENSION LOGGING FIELD NOTES

SITE: Hanford WTP DATE: 8/28/06

CLIENT: PNNL JOB: 6303

AUTHOR: CC * PAGE 7 OF 18

DEPTH METERS	DEPTH FEET	UNFILTERED FILE NO.	FILTERED FILE NO.	COMMENTS CASING, WATER, ROCK, ETC
166.5	546.26			
167.0	547.90	441		
167.5	549.54			
168.0	551.18	440		
168.5	552.82			
169.0	554.46	439		
169.5	556.10			
170.0	557.74	438		
170.5	559.38			
171.0	561.02	437		
171.5	562.66			
172.0	564.30	436		
172.5	565.94			
173.0	567.59	435		
173.5	569.23			
174.0	570.87	434		
174.5	572.51			
175.0	574.15	433		
175.5	575.79			
176.0	577.43	432		
176.5	579.07			
177.0	580.71	431		
177.5	582.35			
178.0	583.99	430		
178.5	585.63			
179.0	587.27	429		
179.5	588.91			
180.0	590.55	428		
180.5	592.19			
181.0	593.83	427		
181.5	595.47			
182.0	597.11	426		
182.5	598.75			
183.0	600.39	425		
183.5	602.03			
184.0	603.67	424		
184.5	605.31			

GEOVISION SUSPENSION LOGGING FIELD NOTES

SITE: Hanford WTP DATE: 8/28/06
CLIENT: PNNL JOB: 6303
AUTHOR: CC * PAGE 8 OF 18

DEPTH METERS	DEPTH FEET	UNFILTERED FILE NO.	FILTERED FILE NO.	COMMENTS CASING, WATER, ROCK, ETC
185.0	606.96	423		
185.5	608.60			
186.0	610.24	422		
186.5	611.88			
187.0	613.52	421		
187.5	615.16			
188.0	616.80	420		
188.5	618.44			
189.0	620.08	419		
189.5	621.72			
190.0	623.36	418		
190.5	625.00			
191.0	626.64	417		
191.5	628.28			
192.0	629.92	416		
192.5	631.56			
193.0	633.20	415		
193.5	634.84			
194.0	636.48	414		
194.5	638.12			
195.0	639.76	413		
195.5	641.40			
196.0	643.04	412		
196.5	644.69			
197.0	646.33	411		
197.5	647.97			
198.0	649.61	410		
198.5	651.25			
199.0	652.89	409		
199.5	654.53			
200.0	656.17	408		
200.5	657.81			
201.0	659.45	407		
201.5	661.09			
202.0	662.73	406		
202.5	664.37			
203.0	666.01	405		

GEOVISION SUSPENSION LOGGING FIELD NOTES

SITE: Hanford WTP DATE: 8/28/06
CLIENT: PNNL JOB: 6303
AUTHOR: CC & PAGE 9 OF 18

DEPTH METERS	DEPTH FEET	UNFILTERED FILE NO.	FILTERED FILE NO.	COMMENTS CASING, WATER, ROCK, ETC
203.5	667.65			
204.0	669.29	404		
204.5	670.93			
205.0	672.57	403		
205.5	674.21			
206.0	675.85	402		
206.5	677.49			
207.0	679.13	401		
207.5	680.77			
208.0	682.41	400		
208.5	684.06			
209.0	685.70	399		DISK CHANGE
209.5	687.34			
210.0	688.98	398		
210.5	690.62			
211.0	692.26	397		
211.5	693.90			
212.0	695.54	396		
212.5	697.18			
213.0	698.82	395		
213.5	700.46			
214.0	702.10	394		
214.5	703.74			
215.0	705.38	393		
215.5	707.02			
216.0	708.66	392		
216.5	710.30			
217.0	711.94	391		
217.5	713.58			
218.0	715.22	390		
218.5	716.86			
219.0	718.50	389		
219.5	720.14			
220.0	721.78	388		
220.5	723.43			
221.0	725.07	387		
221.5	726.71			
222.0	728.35	386		
222.5	729.99			
223.0	731.63	385		
223.5	733.27			
224.0	734.84	384		

GEOVISION SUSPENSION LOGGING FIELD NOTES

SITE: Hanford WTP DATE: 8/28/06
CLIENT: PNNL JOB: 6303
AUTHOR: CC* PAGE 10 OF 18

DEPTH METERS	DEPTH FEET	UNFILTERED FILE NO.	FILTERED FILE NO.	COMMENTS CASING, WATER, ROCK, ETC
224.5	736.55			
225.0	738.19	383		
225.5	739.83			
226.0	741.47	382		
226.5	743.11			
227.0	744.75	381		
227.5	746.39			
228.0	748.03	380		
228.5	749.67			
229.0	751.31	379		
229.5	752.95			
230.0	754.59	378		
230.5	756.23			
231.0	757.87	377		
231.5	759.51			
232.0	761.15	376		
232.5	762.80			
233.0	764.44	375		
233.5	766.08			
234.0	767.72	374		
234.5	769.36			
235.0	771.00	373		
235.5	772.64			
236.0	774.28	372		
236.5	775.92			
237.0	777.56	371		
237.5	779.20			
238.0	780.84	370		
238.5	782.48			
239.0	784.12	369		
239.5	785.76			
240.0	787.40	368		
240.5	789.04			
241.0	790.68	367		
241.5	792.32			
242.0	793.96	366		
242.5	795.60			
243.0	797.24	365		
243.5	798.88			
244.0	800.52	364		
244.5	802.17			
245.0	803.81	363		

GEOVISION SUSPENSION LOGGING FIELD NOTES

SITE: Hanford WTP DATE: 8/28/06
CLIENT: PNNL JOB: 6303
AUTHOR: CC * PAGE 11 OF 18

DEPTH METERS	DEPTH FEET	UNFILTERED FILE NO.	FILTERED FILE NO.	COMMENTS CASING, WATER, ROCK, ETC
245.5	805.45			
246.0	807.09	362		
246.5	808.73			
247.0	810.37	361		
247.5	812.01			
248.0	813.65	360		
248.5	815.29			
249.0	816.93	359		
249.5	818.57			
250.0	820.21	358		
250.5	821.85			
251.0	823.49	357		
251.5	825.13			
252.0	826.77	356		
252.5	828.41			
253.0	830.05	355		
253.5	831.69			
254.0	833.33	354		
254.5	834.97			
255.0	836.61	353		
255.5	838.25			
256.0	839.90	352		
256.5	841.54			
257.0	843.18	351		
257.5	844.82			
258.0	846.46	350		
258.5	848.10			
259.0	849.74	349		
259.5	851.38			
260.0	853.02	348		
260.5	854.66			
261.0	856.30	347		
261.5	857.94			
262.0	859.58	346		
262.5	861.22			
263.0	862.86	345		
263.5	864.50			
264.0	866.14	344		
264.5	867.78			
265.0	869.42	343		
265.5	871.06			
266.0	872.70	342		

GEOVISION SUSPENSION LOGGING FIELD NOTES

SITE: Hanford WTP DATE: 8/28/06
CLIENT: PNNL JOB: 6303
AUTHOR: CC & PAGE 12 OF 18

DEPTH METERS	DEPTH FEET	UNFILTERED FILE NO.	FILTERED FILE NO.	COMMENTS CASING, WATER, ROCK, ETC
266.5	874.34			
267.0	875.98	341		
267.5	877.62			
268.0	879.27	340		
268.5	880.91			
269.0	882.55	339		
269.5	884.19			
270.0	885.83	338		
270.5	887.47			
271.0	889.11	337		
271.5	890.75			
272.0	892.39	336		
272.5	894.03			
273.0	895.67	335		
273.5	897.31			
274.0	898.95	334		
274.5	900.59			
275.0	902.23	333		
275.5	903.87			
276.0	905.51	332		
276.5	907.15			
277.0	908.79	331		
277.5	910.43			
278.0	912.07	330		
278.5	913.71			
279.0	915.35	329		New paper
279.5	916.99			
280.0	918.64	328		
280.5	920.28			
281.0	921.92	327		
281.5	923.56			
282.0	925.20	326		
282.5	926.84			
283.0	928.48	325		
283.5	930.12			
284.0	931.76	324		
284.5	933.40			
285.0	935.04	323		
285.5	936.68			
286.0	938.32	322		
286.5	939.96			
287.0	941.60	321		

GEOVISION SUSPENSION LOGGING FIELD NOTES

SITE: Hanford WTP DATE: 8/28/06
CLIENT: PNNL JOB: 6303
AUTHOR: CC * PAGE 13 OF 18

DEPTH METERS	DEPTH FEET	UNFILTERED FILE NO.	FILTERED FILE NO.	COMMENTS CASING, WATER, ROCK, ETC
287.5	943.24			
288.0	944.88	320		
288.5	946.52			
289.0	948.16	319		
289.5	949.80			
290.0	951.44	318		
290.5	953.08			
291.0	954.72	317		
291.5	956.36			
292.0	958.01	316		
292.5	959.65			
293.0	961.29	313		
293.5	962.93			
294.0	964.57	312		
294.5	966.21			
295.0	967.85	311		
295.5	969.49			
296.0	971.13	310		
296.5	972.77			
297.0	974.41	309		
297.5	976.05			
298.0	977.69	* 315 *		
298.5	979.33			
299.0	980.97	307		
299.5	982.61			
300.0	984.25	306		
300.5	985.89			
301.0	987.53	* 314 *		
301.5	989.17			
302.0	990.81	305		
302.5	992.45			
303.0	994.09	304 *		
303.5	995.73			
304.0	997.38	303		Disk change
304.5	999.02			
305.0	1000.66	302		
305.5	1002.30			
306.0	1003.94	301		
306.5	1005.58			
307.0	1007.22	300		
307.5	1008.86			
308.0	1010.50	296		

GEOVISION SUSPENSION LOGGING FIELD NOTES

SITE: Hanford WTP DATE: 8/28/06
CLIENT: PNNL JOB: 6303
AUTHOR: CC + PAGE 14 OF 18

DEPTH METERS	DEPTH FEET	UNFILTERED FILE NO.	FILTERED FILE NO.	COMMENTS CASING, WATER, ROCK, ETC
308.5	1012.14			
309.0	1013.78	298		
309.5	1015.42			
310.0	1017.06	297		
310.5	1018.70			
311.0	1020.34	296		
311.5	1021.98			
312.0	1023.62	295		
312.5	1025.26			
313.0	1026.90	294		
313.5	1028.54			
314.0	1030.18	293		
314.5	1031.82			
315.0	1033.46	292		
315.5	1035.10			
316.0	1036.75	291		
316.5	1038.39			
317.0	1040.03	290		
317.5	1041.67			
318.0	1043.31	289		
318.5	1044.95			
319.0	1046.59	288		
319.5	1048.23			
320.0	1049.87	287		
320.5	1051.51			
321.0	1053.15	286		
321.5	1054.79			
322.0	1056.43	285		
322.5	1058.07			
323.0	1059.71	284		
323.5	1061.35			
324.0	1062.99	283		
324.5	1064.63			
325.0	1066.27	163 282	++ see next page JBP 2-26-07	
325.5	1067.91			
326.0	1069.55	162 281		
326.5	1071.19			
327.0	1072.83	161 280		
327.5	1074.48			
328.0	1076.12	160 279		
328.5	1077.76			
329.0	1079.40	159 278		

GEOVISION SUSPENSION LOGGING FIELD NOTES

SITE: Hanford WTP DATE: 8/28/06

CLIENT: PNNL JOB: 6303

AUTHOR: CC # PAGE 15 OF 18

DEPTH METERS	DEPTH FEET	UNFILTERED FILE NO.	FILTERED FILE NO.	COMMENTS CASING, WATER, ROCK, ETC
329.5	1081.04	158		
330.0	1082.68	157 277		++ NOTE ADDED BY JGD 2-26-07. Receiver failure started at #123 (see below). Receiver was changed at #163 and logging on Run #2 (5B) commenced with #200 at 385m. Duplicate logs are due to overlap of data deemed necessary by Charles Carter, geophysicist in the field. This note added per telecon with C. Carter by J. Diehl JGD 2-26-07
330.5	1084.32	156		
331.0	1085.96	155 276		
331.5	1087.60	154		
332.0	1089.24	153 275		
332.5	1090.88	152		
333.0	1092.52	151 274		
333.5	1094.16	150		
334.0	1095.80	149 273		
334.5	1097.44	148		
335.0	1099.08	147 272		
335.5	1100.72	146		
336.0	1102.36	145 271		
336.5	1104.00	144		
337.0	1105.64	143 270		
337.5	1107.28	142		
338.0	1108.92	141 269		
338.5	1110.56	140		
339.0	1112.20	139 268		
339.5	1113.85	138		
340.0	1115.49	137 267		
~~340.5~~	~~1117.13~~	~~136~~		
341.0	1118.77	135 266		
341.5	1120.41	134		
342.0	1122.05	133 265		
342.5	1123.69	132		
343.0	1125.33	131 264		
343.5	1126.97	130		
344.0	1128.61	129 263		
344.5	1130.25	128		
345.0	1131.89	127 262		
345.5	1133.53	126		
346.0	1135.17	125 261		
346.5	1136.81	124		
347.0	1138.45	123 260		
347.5	1140.09	122		? can't get H1 (R1)
348.0	1141.73	121 259		
348.5	1143.37	120		
349.0	1145.01	119 258		
349.5	1146.65	118		
350.0	1148.29	117 257		

GEOVISION SUSPENSION LOGGING FIELD NOTES

SITE: Hanford WTP DATE: 8/28/06
CLIENT: PNNL JOB: 6303
AUTHOR: CC # PAGE 16 OF 18

DEPTH METERS	DEPTH FEET	UNFILTERED FILE NO.	FILTERED FILE NO.	COMMENTS CASING, WATER, ROCK, ETC
350.5	1149.93	116		
351.0	1151.57	115 256		
351.5	1153.22	114		
352.0	1154.86	113 255		
352.5	1156.50	112		
353.0	1158.14	111 254		
353.5	1159.78	110		
354.0	1161.42	109 253		
354.5	1163.06	108		disk change (R1)
355.0	1164.70	107 252		
355.5	1166.34	106		
356.0	1167.98	105 251		
356.5	1169.62	104		
357.0	1171.26	103 250		
357.5	1172.90	102		
358.0	1174.54	101 249		
358.5	1176.18	100		
359.0	1177.82	99 248		
359.5	1179.46	98		
360.0	1181.10	97 247		
360.5	1182.74	96		
361.0	1184.38	95 246		
361.5	1186.02	94		
362.0	1187.66	93 245		
362.5	1189.30	92		
363.0	1190.94	91 244		GO TO 1M
363.5	1192.59	90 243		
364.0	1194.23	89 242		
364.5	1195.87	88 241		
365.0	1197.51	87 240		
365.5	1199.15	86 239		
366.0	1200.79	85 238		
366.5	1202.43	84 237		
367.0	1204.07	83 236		
367.5	1205.71	82 235		
368.0	1207.35	81 234		
368.5	1208.99	80 233		
369.0	1210.63	79 232		
369.5	1212.27	78 231		
370.0	1213.91	77 230		
370.5	1215.55	76 229		
371.0	1217.19	75 228		

GEOVISION SUSPENSION LOGGING FIELD NOTES

SITE: Hanford WTP DATE: 8/25/06
CLIENT: PNNL JOB: 6303
AUTHOR: CC * PAGE 17 OF 18

DEPTH METERS	DEPTH FEET	UNFILTERED FILE NO.	FILTERED FILE NO.	COMMENTS CASING, WATER, ROCK, ETC
371.5	1218.83	74 227		
372.0	1220.47	73 226		
372.5	1222.11	72 225		
373.0	1223.75	71 224		
373.5	1225.39	70 223		
374.0	1227.03	69 222		
374.5	1228.67	68 221		
375.0	1230.31	67 220		
375.5	1231.96	66 219		
376.0	1233.60	65 218		
376.5	1235.24	64 217		
377.0	1236.88	63 216		
377.5	1238.52	62 215		
378.0	1240.16	61 214		
378.5	1241.80	60 213		
379.0	1243.44	59 212		
379.5	1245.08	58 211		
380.0	1246.72	57 210		
380.5	1248.36	56 209		
381.0	1250.00	55 208		
381.5	1251.64	54 207		
382.0	1253.28	53 206		
382.5	1254.92	52 205		
383.0	1256.56	51 204		
383.5	1258.20	50 203		Paper change Run 2
384.0	1259.84	49 202		Paper change 1 p
384.5	1261.48	48 201		
385.0	1263.12	47 200		
385.5	1264.76	46		
386.0	1266.40	45		
386.5	1268.04	44		
387.0	1269.69	43		
387.5	1271.33	42		
388.0	1272.97	41		
388.5	1274.61	40		
389.0	1276.25	39		
389.5	1277.89	38		
390.0	1279.53	37		
390.5	1281.17	36		
391.0	1282.81	35		
391.5	1284.45	34		
392.0	1286.09	33		

GEOVISION SUSPENSION LOGGING FIELD NOTES

SITE: Hanford WTP DATE: 8/28/06
CLIENT: PNNL JOB: 6303
AUTHOR: CC + PAGE 18 OF 18 *

DEPTH METERS	DEPTH FEET	UNFILTERED FILE NO.	FILTERED FILE NO.	COMMENTS CASING, WATER, ROCK, ETC
392.5	1287.73	32		
393.0	1289.37	31		
393.5	1291.01	30		
394.0	1292.65	29		
394.5	1294.29	28		
395.0	1295.93	27		
395.5	1297.57	26		
396.0	1299.21	25		
396.5	1300.85	24		
397.0	1302.49	23		
397.5	1304.13	22		
398.0	1305.77	21		
398.5	1307.41	20		
399.0	1309.06	19		
399.5	1310.70	18		
400.0	1312.34	17		
400.5	1313.98	16		
401.0	1315.62	15		
401.5	1317.26	14		
402.0	1318.90	13		
402.5	1320.54	12		
403.0	1322.18	11		
403.5	1323.82	10		
404.0	1325.46	9		
404.5	1327.10	8		
405.0	1328.74	007		
405.5	1330.38	6		
406.0	1332.02	5		
406.5	1333.66	4		
407.0	1335.30	3		
407.5	1336.94	2		
408.0	1338.58	001		
408.5	1340.22			
409.0	1341.86			
409.5	1343.50			
410.0	1345.14			
410.5	1346.78			
411.0	1348.43			
411.5	1350.07			
412.0	1351.71			
412.5	1353.35			
413.0	1354.99			

John Diehl

From: Charles G. Carter
Sent: Monday, February 26, 2007 2:43 PM
To: John Diehl
Subject: C4996

received by JMD 2/26/07 notes by Charles Carter in field notebook on 8/28/06

John,
here is what I have in my field notebook.

C4996 8/28

Reference point = 0.44m

Set zero (0.44m) @ 9:00am
Acquired file 001 @ 408.0m @ 10:20am
Checked zero (0.1m) @ 2:30pm

Run 2

Set zero (0.44m) @ 3:10pm
Acquired file 200 @ 385.0m @ 3:45pm
Acquired reading @ 105m @ 7:30pm
Checked zero (0.4m) @ 9:05pm

The reason for the time gap between last reading and checking zero was getting the winch cable stuck between the drum and the winch frame.

Before I started I noted:

Head Reducer : S/N 20034
Reciever: S/N 23053
1m Iso Tube: S/N 24053
Source: S/N 21050
Source Driver: S/N 33093
Weight: S/N 38118

confirmed with A. Martin, The replacement receiver is S/N 26066 JMD 2/26/07

I did not record the receiver S/N for Run 2, but I left it connected to the iso tube, and Tony called and asked where the iso tube was. He probably used the same one.

-----Original Message-----
From: John Diehl
Sent: Fri 2/23/2007 5:15 PM
To: Charles G. Carter
Cc: Robert Steller (Interserv)
Subject: RE: Pittsburg site map

OK. No problem. If someone ships me a receiver I can do these.

John

GEOVision geophysical services

P-S SUSPENSION VELOCITY FIELD LOG

SITE: Hanford WTP DATE: 9-19-06
CLIENT: PNNL JOB: 6303
AUTHOR: JDD PAGE 1 OF 4

CONTACT: Marty Gardner OFFICE PHONE: cell 509-372-8029

CONTACT: Alan Rohay OFFICE PHONE: cell 509-531-2295

CONTACT: Tim Brouns OFFICE PHONE: cell 509-531-7478

CONTACT: OFFICE PHONE:

CONTACT: OFFICE PHONE:
CONTACT: OFFICE PHONE:

DIRECTIONS TO SITE:
Richland, WA - drive north on George Washington Blvd all the way, turn right at the T

GENERAL SITE CONDITIONS/LOCATION:

EA#:
BOREHOLE DESIGNATION: C4996 LOCATION:
RUN #7
COUNTY: RANGE: TOWNSHIP: SECTION:
BOREHOLE CONSTRUCTION: CASED UNCASED X
DIAMETERS AND DEPTH RANGES: 0 TO ; , TO
BOREHOLE TOTAL DEPTH AS DRILLED: 1467.8
CONDUCTOR CASING?: YES DEPTH TO BOTTOM OF CASING 349; NO
DEPTH TO BEDROCK: DEPTH TO WATER TABLE:
BOREHOLE FLUID: WATER ; FRESH WATER MUD X; SALT WATER MUD;
OTHER:
DEPTH TO BOREHOLE FLUID: TIME SINCE LAST CIRCULATION: 4 days

GEOVision
geophysical services

SITE: Hanford WTP DATE: 9-19-06
CLIENT: PNNL JOB: 6303
AUTHOR: JDP PAGE 1 OF 4
2

JDP 9-19-06

LOGGING CREW:
VEHICLE(S) USED AND MILEAGE:
MOBILIZED FROM: DEPARTURE TIME:
ARRIVED ON SITE: 0700
STANDBY TIME: 0 CAUSE:
LOGGING STARTED: 0815 down hole LOGGING COMPLETED: 0930
STANDBY TIME: 0 CAUSE:
LOGGING STARTED: LOGGING COMPLETED:
DEMOBILIZED TO: ARRIVAL TIME:
ADDITIONAL DEMOB TIME: REASON:

BATTERIES CHANGED BEFORE LOGGING: YES X; 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 ☐			

MAINTENANCE PERFORMED ON SITE:

EQUIPMENT PROBLEMS OR FAILURES:

SUGGESTIONS, ADDITIONS, CHANGES:

COMMENTS: Source 21050.
driver 33093
wt 470151
ISO 300083
reducer 21037

GEOVISION SUSPENSION LOGGING FIELD NOTES

SITE: Hanford WTP DATE: 9-19-06
CLIENT: PNNL JOB: 6303
AUTHOR: JBD PAGE 3 OF 4

DEPTH METERS	DEPTH FEET	UNFILTERED FILE NO.	FILTERED FILE NO.	COMMENTS CASING, WATER, ROCK, ETC
413.5	1356.63			
414.0	1358.27			CASING ZERO.
414.5	1359.91			
415.0	1361.55			− 0.2m ~ − 6in
415.5	1363.19			
416.0	1364.83	028		
416.5	1366.47			start here
417.0	1368.11	027		
417.5	1369.75			
418.0	1371.39	026		
418.5	1373.03			
419.0	1374.67	025		
419.5	1376.31			
420.0	1377.95	024		
420.5	1379.59			
421.0	1381.23	023		
421.5	1382.87			
422.0	1384.51	022		
422.5	1386.15			
423.0	1387.80	021		signal diminished
423.5	1389.44			
424.0	1391.08	020		
424.5	1392.72			
425.0	1394.36	019		
425.5	1396.00			
426.0	1397.64	018		
426.5	1399.28			
427.0	1400.92	017		
427.5	1402.56			
428.0	1404.20	016		
428.5	1405.84			
429.0	1407.48	015		
429.5	1409.12			
430.0	1410.76	014		
430.5	1412.40			
431.0	1414.04	013		
431.5	1415.68			
432.0	1417.32	012		
432.5	1418.96			
433.0	1420.60	011		
433.5	1422.24			
434.0	1423.88	010		

3.2808) 1455.7

1467.8
− 12.1
1455.7
= 443.7m

site: Hanford WTP
Client: PNNL
Author: JOB

Date: 9-19-06
Job: 6303
Page: 4 of 4

434 See next page

435 009

436 008

437 007

438 006

439 005

440 004

441 003

442 002

443m. 001

TD @ 443.1

GEOVision
geophysical services

P-S SUSPENSION VELOCITY FIELD LOG

SITE: Hanford WTP DATE: 10-13-06
CLIENT: PNNL JOB: 6303
AUTHOR: Dicht (JH) PAGE 1 OF 18

CONTACT: Marty Gardner OFFICE PHONE: cell 509-372-8029

CONTACT: Alan Rohay OFFICE PHONE: cell 509-531-2295

CONTACT: Tim Brouns OFFICE PHONE: cell 509-531-7478

CONTACT: OFFICE PHONE:

CONTACT: OFFICE PHONE:
CONTACT: OFFICE PHONE:

DIRECTIONS TO SITE:
Richland, WA - drive north on George Washington Blvd all the way, turn right at the T

GENERAL SITE CONDITIONS/LOCATION:

EA#:
BOREHOLE DESIGNATION: C4997 LOCATION: Center site.
RUN # 7
COUNTY: RANGE: TOWNSHIP: SECTION:
BOREHOLE CONSTRUCTION: CASED UNCASED X
DIAMETERS AND DEPTH RANGES: 0 TO ; , TO
BOREHOLE TOTAL DEPTH AS DRILLED: 1428'
CONDUCTOR 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:

GEOVision
geophysical services

SITE: Hanford WTP DATE: 10-13-06
CLIENT: PNNL JOB: 6303
AUTHOR: JHD PAGE 1 2 OF 18

LOGGING CREW:
VEHICLE(S) USED AND MILEAGE:
MOBILIZED FROM: DEPARTURE TIME:
ARRIVED ON SITE: 1320.
STANDBY TIME: CAUSE:
LOGGING STARTED: 1420. LOGGING COMPLETED: 1900
STANDBY TIME: CAUSE:
LOGGING STARTED: LOGGING COMPLETED:
DEMOBILIZED TO: ARRIVAL TIME:
ADDITIONAL DEMOB TIME: REASON:

BATTERIES CHANGED BEFORE LOGGING: YES X ; NO ; STORED WITH NEW

WINCH COMPROBE [V] GREY [ ] OYO [ ] RG [ ] OTH [ ]

INSTRUMENT OYO 12004 [ ] 15014 [V] 19029 [ ] RG 160023 [ ] 160024 [ ]

RECEIVER S/N 12008 [ ] 20042 [ ] 26066 [ ] 11001 [ ] 23053 [ ] 330094 [V]

MAINTENANCE PERFORMED ON SITE:

EQUIPMENT PROBLEMS OR FAILURES: none.

SUGGESTIONS, ADDITIONS, CHANGES:

COMMENTS: Rcd. 21037
Source 21050
iso 300083
driver 33093
nut. 470151

GEOVISION SUSPENSION LOGGING FIELD NOTES

SITE: Hanford WTP
CLIENT: PNNL
AUTHOR: JDI

DATE: 10-13-06
JOB: 6303
PAGE 3 OF 18

DEPTH METERS	DEPTH FEET	UNFILTERED FILE NO.	FILTERED FILE NO.	COMMENTS CASING, WATER, ROCK, ETC
111.5	365.81			
112.0	367.45		Zero clock.	
112.5	369.09		@ gs	reading = 1.0m bgs.
113.0	370.73			
113.5	372.38			
114.0	374.02			
114.5	375.66			
115.0	377.30			
115.5	378.94			
116.0	380.58			
116.5	382.22			← stop.
117.0	383.86	318		
117.5	385.50			
118.0	387.14	317		
118.5	388.78			
119.0	390.42	316		
119.5	392.06			
120.0	393.70	315		
120.5	395.34			
121.0	396.98	314		
121.5	398.62			
122.0	400.26	313		
122.5	401.90			
123.0	403.54	312		
123.5	405.18			
124.0	406.82	311		
124.5	408.46			
125.0	410.10	310		
125.5	411.75			
126.0	413.39	309		
126.5	415.03			
127.0	416.67	308		
127.5	418.31			
128.0	419.95	307		
128.5	421.59			
129.0	423.23	306		
129.5	424.87			

GEOVISION SUSPENSION LOGGING FIELD NOTES

SITE: Hanford WTP DATE: 10-13-06
CLIENT: PNNL JOB: 6303
AUTHOR: JDP PAGE 4 OF 18

DEPTH METERS	DEPTH FEET	UNFILTERED FILE NO.	FILTERED FILE NO.	COMMENTS CASING, WATER, ROCK, ETC
130.0	426.51	305		
130.5	428.15			
131.0	429.79	304		
131.5	431.43			
132.0	433.07	303		
132.5	434.71			
133.0	436.35	302		
133.5	437.99			
134.0	439.63	301		
134.5	441.27			
135.0	442.91	300		
135.5	444.55			
136.0	446.19	299		
136.5	447.83			
137.0	449.48	298		
137.5	451.12			
138.0	452.76	297		
138.5	454.40			
139.0	456.04	296		
139.5	457.68			
140.0	459.32	295		
140.5	460.96			
141.0	462.60	294		
141.5	464.24			
142.0	465.88	293		
142.5	467.52			
143.0	469.16	292		
143.5	470.80			
144.0	472.44	291		
144.5	474.08			
145.0	475.72	290		
145.5	477.36			
146.0	479.00	289		
146.5	480.64			
147.0	482.28	288		
147.5	483.92			

GEOVISION SUSPENSION LOGGING FIELD NOTES

SITE: Hanford WTP DATE: 10-13-06
CLIENT: PNNL JOB: 6303
AUTHOR: JBO PAGE 5 OF 19

DEPTH METERS	DEPTH FEET	UNFILTERED FILE NO.	FILTERED FILE NO.	COMMENTS CASING, WATER, ROCK, ETC
148.0	485.56	287		gain far ↓
148.5	487.20			range ↓
149.0	488.85	286		
149.5	490.49			
150.0	492.13	285		↓ Rattle.
150.5	493.77			
151.0	495.41	284		
151.5	497.05			
152.0	498.69	283		gain ↓↓
152.5	500.33			
153.0	501.97	282		
153.5	503.61			
154.0	505.25	281		
154.5	506.89			
155.0	508.53	280		
155.5	510.17			
156.0	511.81	279		
156.5	513.45			
157.0	515.09	278		
157.5	516.73			
158.0	518.37	277		
158.5	520.01			
159.0	521.65	276		
159.5	523.29			
160.0	524.93	275		
160.5	526.57			↑ Rattle snake
161.0	528.22	274		
161.5	529.86			
162.0	531.50	273		
162.5	533.14			
163.0	534.78	272		range ↑
163.5	536.42			
164.0	538.06	271		
164.5	539.70			
165.0	541.34	270		
165.5	542.98			
166.0	544.62	269		

GEOVISION SUSPENSION LOGGING FIELD NOTES

SITE: Hanford WTP DATE: 10-13-06
CLIENT: PNNL JOB: 6303
AUTHOR: JRD PAGE 6 OF 18

DEPTH METERS	DEPTH FEET	UNFILTERED FILE NO.	FILTERED FILE NO.	COMMENTS CASING, WATER, ROCK, ETC
166.5	546.26			
167.0	547.90	268		
167.5	549.54			
168.0	551.18	267		
168.5	552.82			
169.0	554.46	266		
169.5	556.10			
170.0	557.74	265		
170.5	559.38			
171.0	561.02	264		
171.5	562.66			
172.0	564.30	263		
172.5	565.94			
173.0	567.59	262		
173.5	569.23			
174.0	570.87	261		
174.5	572.51			
175.0	574.15	260		gain ↑
175.5	575.79			
176.0	577.43	259		gain ↓
176.5	579.07			
177.0	580.71	258		
177.5	582.35			
178.0	583.99	257		gain ↑↑
178.5	585.63			
179.0	587.27	256		
179.5	588.91			
180.0	590.55	255		
180.5	592.19			
181.0	593.83	254		
181.5	595.47			
182.0	597.11	253		
182.5	598.75			
183.0	600.39	252		
183.5	602.03			
184.0	603.67	251		
184.5	605.31			

GEOVISION SUSPENSION LOGGING FIELD NOTES

SITE: Hanford WTP DATE: 10-13-06
CLIENT: PNNL JOB: 6303
AUTHOR: JHO PAGE 7 OF 18

DEPTH METERS	DEPTH FEET	UNFILTERED FILE NO.	FILTERED FILE NO.	COMMENTS CASING, WATER, ROCK, ETC
185.0	606.96	250.		
185.5	608.60			
186.0	610.24	249		
186.5	611.88			
187.0	613.52	248		
187.5	615.16			
188.0	616.80	247		
188.5	618.44			
189.0	620.08	246		
189.5	621.72			
190.0	623.36	245		
190.5	625.00			
191.0	626.64	244		
191.5	628.28			
192.0	629.92	243		
192.5	631.56			
193.0	633.20	242		
193.5	634.84			
194.0	636.48	241		
194.5	638.12			
195.0	639.76	240		
195.5	641.40			
196.0	643.04	239		
196.5	644.69			
197.0	646.33	238		
197.5	647.97			
198.0	649.61	237		
198.5	651.25			
199.0	652.89	236		
199.5	654.53			
200.0	656.17	235		
200.5	657.81			
201.0	659.45	234		
201.5	661.09			
202.0	662.73	233		
202.5	664.37			
203.0	666.01	232		

GEOVISION SUSPENSION LOGGING FIELD NOTES

SITE: Hanford WTP DATE: 10-13-06
CLIENT: PNNL JOB: 6303
AUTHOR: JBO PAGE 8 OF 18

DEPTH METERS	DEPTH FEET	UNFILTERED FILE NO.	FILTERED FILE NO.	COMMENTS CASING, WATER, ROCK, ETC
203.5	667.65			
204.0	669.29	231		
204.5	670.93			
205.0	672.57	230		
205.5	674.21			
206.0	675.85	229		
206.5	677.49			
207.0	679.13	228		
207.5	680.77			
208.0	682.41	227		
208.5	684.06			
209.0	685.70	226		
209.5	687.34			
210.0	688.98	225		
210.5	690.62			
211.0	692.26	224		
211.5	693.90			
212.0	695.54	223		
212.5	697.18			
213.0	698.82	222		
213.5	700.46			
214.0	702.10	221		
214.5	703.74			
215.0	705.38	220		
215.5	707.02			
216.0	708.66	219		
216.5	710.30			
217.0	711.94	218		
217.5	713.58			
218.0	715.22	217	JBO 10-13-06	
218.5	716.86			
219.0	718.50	~~216~~ 215		
219.5	720.14			
220.0	721.78	~~215~~ 214		
220.5	723.43		NOTE:	or rename 206 → 1206
221.0	725.07	~~214~~ 213		
221.5	726.71		206 → 215 need to be renumbered. +1	
222.0	728.35	~~213~~ 212		
222.5	729.99			
223.0	731.63	~~212~~ 211		
223.5	733.27			
224.0	734.91	~~211~~ 210		

GEOVISION SUSPENSION LOGGING FIELD NOTES

SITE: Hanford WTP DATE: 10-12-06
CLIENT: PNNL JOB: 6303
AUTHOR: PAGE 9 OF 18

DEPTH METERS	DEPTH FEET	UNFILTERED FILE NO.	FILTERED FILE NO.	COMMENTS CASING, WATER, ROCK, ETC
224.5	736.55		Job 13.06	↓ Selah.
225.0	738.19	~~210~~ 209	10'	gain ↓
225.5	739.83			
226.0	741.47	~~209~~ 208	See	
226.5	743.11		Note	
227.0	744.75	~~208~~ 207	next	
227.5	746.39		page	
228.0	748.03	~~207~~ 206		changed. diam.
228.5	749.67		(8)	
229.0	751.31	206		
229.5	752.95			
230.0	754.59	205		
230.5	756.23			
231.0	757.87	204		↑ Selah
231.5	759.51			
232.0	761.15	203		
232.5	762.80			
233.0	764.44	201, 202		gain ↑ 202 RT ↑
233.5	766.08			
234.0	767.72	200		
234.5	769.36			
235.0	771.00	199		
235.5	772.64			
236.0	774.28	198		
236.5	775.92			
237.0	777.56	197		
237.5	779.20			
238.0	780.84	196		
238.5	782.48			
239.0	784.12	195		
239.5	785.76			
240.0	787.40	194		
240.5	789.04			
241.0	790.68	193		
241.5	792.32			
242.0	793.96	192		
242.5	795.60			
243.0	797.24	191		
243.5	798.88			
244.0	800.52	190		
244.5	802.17			
245.0	803.81	189		

GEOVISION SUSPENSION LOGGING FIELD NOTES

SITE: Hanford WTP DATE: 10-13-06
CLIENT: PNNL JOB: 6303
AUTHOR: JGO PAGE 10 OF 18

DEPTH METERS	DEPTH FEET	UNFILTERED FILE NO.	FILTERED FILE NO.	COMMENTS CASING, WATER, ROCK, ETC
245.5	805.45			
246.0	807.09	188		
246.5	808.73			
247.0	810.37	187		
247.5	812.01			
248.0	813.65	186		
248.5	815.29			
249.0	816.93	185		
249.5	818.57			
250.0	820.21	184		
250.5	821.85			
251.0	823.49	183		
251.5	825.13			
252.0	826.77	182		
252.5	828.41			
253.0	830.05	181		
253.5	831.69			
254.0	833.33	180		
254.5	834.97			
255.0	836.61	179		
255.5	838.25			
256.0	839.90	178		
256.5	841.54			
257.0	843.18	177		
257.5	844.82			
258.0	846.46	176		
258.5	848.10			
259.0	849.74	175		range ↓
259.5	851.38			↓ cold creek
260.0	853.02	174		
260.5	854.66			
261.0	856.30	173		gain ↓↓
261.5	857.94			
262.0	859.58	172		gain ↓
262.5	861.22			
263.0	862.86	171		gain ↑
263.5	864.50			
264.0	866.14	170		
264.5	867.78			
265.0	869.42	169		
265.5	871.06			
266.0	872.70	168		

GEOVISION SUSPENSION LOGGING FIELD NOTES

SITE: Hanford WTP DATE: 10-13-06
CLIENT: PNNL JOB: 6303
AUTHOR: JBD PAGE 11 OF 18

DEPTH METERS	DEPTH FEET	UNFILTERED FILE NO.	FILTERED FILE NO.	COMMENTS CASING, WATER, ROCK, ETC
266.5	874.34			
267.0	875.98	167		
267.5	877.62			
268.0	879.27	166		
268.5	880.91			
269.0	882.55	165		
269.5	884.19			
270.0	885.83	164		
270.5	887.47			
271.0	889.11	163		
271.5	890.75			
272.0	892.39	162		
272.5	894.03			
273.0	895.67	161		
273.5	897.31			
274.0	898.95	160		
274.5	900.59			
275.0	902.23	159		
275.5	903.87			
276.0	905.51	158		
276.5	907.15			
277.0	908.79	157		
277.5	910.43			
278.0	912.07	156		
278.5	913.71			
279.0	915.35	155		
279.5	916.99			
280.0	918.64	154		
280.5	920.28			
281.0	921.92	153		
281.5	923.56			
282.0	925.20	152		
282.5	926.84			
283.0	928.48	151		
283.5	930.12			
284.0	931.76	150		
284.5	933.40			
285.0	935.04	149		
285.5	936.68			
286.0	938.32	148		
286.5	939.96			
287.0	941.60	147		

GEOVISION SUSPENSION LOGGING FIELD NOTES

SITE: Hanford WTP DATE: 10-13-06
CLIENT: PNNL JOB: 6303
AUTHOR: JND PAGE 12 OF 18

DEPTH METERS	DEPTH FEET	UNFILTERED FILE NO.	FILTERED FILE NO.	COMMENTS CASING, WATER, ROCK, ETC
287.5	943.24			
288.0	944.88	146		
288.5	946.52			
289.0	948.16	145		↑ Cold Creek
289.5	949.80			
290.0	951.44	144		gain ↑
290.5	953.08			
291.0	954.72	143		gain ↑ range ↑
291.5	956.36			
292.0	958.01	142		
292.5	959.65			
293.0	961.29	141		
293.5	962.93			
294.0	964.57	140		
294.5	966.21			
295.0	967.85	139		
295.5	969.49			
296.0	971.13	138		
296.5	972.77			
297.0	974.41	137		
297.5	976.05			
298.0	977.69	136		
298.5	979.33			
299.0	980.97	135		
299.5	982.61			
300.0	984.25	134		
300.5	985.89			
301.0	987.53	133		
301.5	989.17			
302.0	990.81	132		
302.5	992.45			
303.0	994.09	131		
303.5	995.73			
304.0	997.38	130		
304.5	999.02			
305.0	1000.66	129		gain ↓↓
305.5	1002.30			
306.0	1003.94	128		signal returning.
306.5	1005.58			
307.0	1007.22	127		
307.5	1008.86			
308.0	1010.50	126		

GEOVISION SUSPENSION LOGGING FIELD NOTES

SITE: Hanford WTP DATE: 10-13-06
CLIENT: PNNL JOB: 6303
AUTHOR: JM PAGE 13 OF 18

DEPTH METERS	DEPTH FEET	UNFILTERED FILE NO.	FILTERED FILE NO.	COMMENTS CASING, WATER, ROCK, ETC
308.5	1012.14			
309.0	1013.78	125		
309.5	1015.42			
310.0	1017.06	124		still atten.
310.5	1018.70			
311.0	1020.34	123		gain ↑↑
311.5	1021.98			
312.0	1023.62	122		gain ↑ ?
312.5	1025.26			
313.0	1026.90	121		
313.5	1028.54			
314.0	1030.18	120		
314.5	1031.82			
315.0	1033.46	119		
315.5	1035.10			
316.0	1036.75	118		
316.5	1038.39			
317.0	1040.03	117		
317.5	1041.67			
318.0	1043.31	116		
318.5	1044.95			
319.0	1046.59	115		
319.5	1048.23			
320.0	1049.87	114		
320.5	1051.51			
321.0	1053.15	113		
321.5	1054.79			
322.0	1056.43	112		
322.5	1058.07			
323.0	1059.71	111		
323.5	1061.35			
324.0	1062.99	110		
324.5	1064.63			
325.0	1066.27	109		
325.5	1067.91			
326.0	1069.55	108		
326.5	1071.19			
327.0	1072.83	107		
327.5	1074.48			
328.0	1076.12	106		
328.5	1077.76			
329.0	1079.40	105		

GEOVISION SUSPENSION LOGGING FIELD NOTES

SITE: Hanford WTP
CLIENT: PNNL
AUTHOR: JM

DATE: 10-13-06
JOB: 6303
PAGE 14 OF 18

DEPTH METERS	DEPTH FEET	UNFILTERED FILE NO.	FILTERED FILE NO.	COMMENTS CASING, WATER, ROCK, ETC
329.5	1081.04			
330.0	1082.68	104		
330.5	1084.32			
331.0	1085.96	103		
331.5	1087.60			
332.5	1090.88			
333.0	1092.52	101		
333.5	1094.16			
334.0	1095.80	100		
334.5	1097.44			
335.0	1099.08	99		
335.5	1100.72			
336.0	1102.36	98		gain ↓
336.5	1104.00			
337.0	1105.64	97		Motion ↓
337.5	1107.28			
338.0	1108.92	96		
338.5	1110.56			
339.0	1112.20	95		
339.5	1113.85			
340.0	1115.49	94		
340.5	1117.13			
341.0	1118.77	93		
341.5	1120.41			
342.0	1122.05	92		
342.5	1123.69			
343.0	1125.33	91		
343.5	1126.97			
344.0	1128.61	90		
344.5	1130.25			
345.0	1131.89	89		
345.5	1133.53			
346.0	1135.17	88		
346.5	1136.81			
347.0	1138.45	87		
347.5	1140.09			
348.0	1141.73	86		
348.5	1143.37			
349.0	1145.01	85		
349.5	1146.65			
350.0	1148.29	84		

GEOVISION SUSPENSION LOGGING FIELD NOTES

SITE: Hanford WTP DATE: 10-13-06
CLIENT: PNNL JOB: 6303
AUTHOR: JDD PAGE 15 OF 18

DEPTH METERS	DEPTH FEET	UNFILTERED FILE NO.	FILTERED FILE NO.	COMMENTS CASING, WATER, ROCK, ETC
350.5	1149.93			
351.0	1151.57	83		
351.5	1153.22			
352.0	1154.86	82		
352.5	1156.50			
353.0	1158.14	81		
353.5	1159.78			
354.0	1161.42	80		
354.5	1163.06			
355.0	1164.70	79		
355.5	1166.34			
356.0	1167.98	78		
356.5	1169.62			
357.0	1171.26	77		
357.5	1172.90			
358.0	1174.54	76		
358.5	1176.18			
359.0	1177.82	75		
359.5	1179.46			
360.0	1181.10	74		
360.5	1182.74			
361.0	1184.38	73		
361.5	1186.02			
362.0	1187.66	72		
362.5	1189.30			
363.0	1190.94	71		
363.5	1192.59			
364.0	1194.23	70		
364.5	1195.87			
365.0	1197.51	69		
365.5	1199.15			
366.0	1200.79	68		
366.5	1202.43			
367.0	1204.07	67		Maloton ↑
367.5	1205.71		JDD 10-13-06	
368.0	1207.35	~~65~~ 66		gain ↑ on near + far range ↑
368.5	1208.99			
369.0	1210.63	64, 65		65 gain up on far.
369.5	1212.27			
370.0	1213.91	63		
370.5	1215.55			
371.0	1217.19	62		

GEOVISION SUSPENSION LOGGING FIELD NOTES

SITE: Hanford WTP DATE: 10-13-06

CLIENT: PNNL JOB: 6303

AUTHOR: JGO PAGE 16 OF 18

DEPTH METERS	DEPTH FEET	UNFILTERED FILE NO.	FILTERED FILE NO.	COMMENTS CASING, WATER, ROCK, ETC
371.5	1218.83			
372.0	1220.47	61		
372.5	1222.11			
373.0	1223.75	60		
373.5	1225.39			
374.0	1227.03	59		
374.5	1228.67			
375.0	1230.31	58		
375.5	1231.96			
376.0	1233.60	57		
376.5	1235.24			
377.0	1236.88	56		
377.5	1238.52			
378.0	1240.16	55		
378.5	1241.80			
379.0	1243.44	54		
379.5	1245.08			
380.0	1246.72	53		
380.5	1248.36			
381.0	1250.00	52		
381.5	1251.64			
382.0	1253.28	51		
382.5	1254.92			
383.0	1256.56	50		
383.5	1258.20			
384.0	1259.84	49		
384.5	1261.48			
385.0	1263.12	48		
385.5	1264.76			
386.0	1266.40	47		
386.5	1268.04			
387.0	1269.69	46		
387.5	1271.33			
388.0	1272.97	45		
388.5	1274.61			
389.0	1276.25	44		
389.5	1277.89			
390.0	1279.53	43		
390.5	1281.17			
391.0	1282.81	42		
391.5	1284.45			
392.0	1286.09	41		

GEOVISION SUSPENSION LOGGING FIELD NOTES

SITE: Hanford WTP DATE: 10-13-06 10-13-06
CLIENT: PNNL JOB: 6303
AUTHOR: VM PAGE 17 OF 18

DEPTH METERS	DEPTH FEET	UNFILTERED FILE NO.	FILTERED FILE NO.	COMMENTS CASING, WATER, ROCK, ETC
392.5	1287.73			
393.0	1289.37	40		
393.5	1291.01			
394.0	1292.65	39		
394.5	1294.29			
395.0	1295.93	38		
395.5	1297.57			
396.0	1299.21	37		
396.5	1300.85			
397.0	1302.49	36		
397.5	1304.13	~~35~~		
398.0	1305.77	35		
398.5	1307.41			
399.0	1309.06	34		
399.5	1310.70			
400.0	1312.34	33		
400.5	1313.98			
401.0	1315.62	32		
401.5	1317.26			
402.0	1318.90	31		
402.5	1320.54			
403.0	1322.18	30		
403.5	1323.82			
404.0	1325.46	29		
404.5	1327.10			
405.0	1328.74	28		
405.5	1330.38			
406.0	1332.02	27		
406.5	1333.66			
407.0	1335.30	26		
407.5	1336.94			
408.0	1338.58	25		
408.5	1340.22			
409.0	1341.86	24		
409.5	1343.50			
410.0	1345.14	23		
410.5	1346.78			
411.0	1348.43	22		
411.5	1350.07			
412.0	1351.71	21		
412.5	1353.35			
413.0	1354.99	20		

GEOVISION SUSPENSION LOGGING FIELD NOTES

SITE: Hanford WTP DATE: 10-13-06
CLIENT: PNNL JOB: 6303
AUTHOR: JGD PAGE 18 OF 18

DEPTH METERS	DEPTH FEET	UNFILTERED FILE NO.	FILTERED FILE NO.	COMMENTS CASING, WATER, ROCK, ETC
413.5	1356.63			
414.0	1358.27	19		
414.5	1359.91			
415.0	1361.55	18		
415.5	1363.19			
416.0	1364.83	17		
416.5	1366.47			
417.0	1368.11	16		
417.5	1369.75			
418.0	1371.39	15		
418.5	1373.03			
419.0	1374.67	14		
419.5	1376.31			
420.0	1377.95	13		
420.5	1379.59			
421.0	1381.23	12		
421.5	1382.87			
422.0	1384.51	11		
422.5	1386.15			
423.0	1387.80	10		
423.5	1389.44	~~9~~	JGD 10-13-06	
424.0	1391.08	9		
424.5	1392.72			
425.0	1394.36	8		
425.5	1396.00			
426.0	1397.64	7	JGD 10-13-06	
426.5	1399.28	~~7~~		
427.0	1400.92	6		
427.5	1402.56			
428.0	1404.20	5		
428.5	1405.84			
429.0	1407.48	4		
429.5	1409.12			
430.0	1410.76	3		
430.5	1412.40			
431.0	1414.04	002		
431.5	1415.68			← start
432.0	1417.32	001.		
432.5	1418.96			
433.0	1420.60			
433.5	1422.24			
434.0	1423.88			

APPENDIX D

BORING GEOPHYSICAL LOGGING FIELD MEASUREMENT PROCEDURES

PROCEDURE FOR

OYO P-S SUSPENSION SEISMIC VELOCITY LOGGING

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. Data is presented in report format, with ASCII data files and digital records transmitted on diskette.

Instrumentation

1. OYO Model 170 Digital Logging Recorder or equivalent
2. OYO P-S Suspension Logger probe, including two sets horizontal and vertical geophones, seismic source, and power supply for the source and receivers
3. Winch and winch controller, with logging cable
4. Batteries to operate OYO 170 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 5 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 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 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 borehole must be between 10 and 20 cm in diameter, or 4 to 8 inches.

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 Seismograph 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 Model 170 has six channels (two simultaneous recording channels), each with a 12 bit 1024 sample record. The recorded data is displayed on a CRT display and on paper tape output as six channels with a common time scale. Data is stored on 3.5-inch floppy diskettes for further processing. Up to 8 sampling sequences can be stacked (averaged) to improve the signal to noise ratio of the signals.

The Robertson Micrologger2 also stores data digitally, but instead of storing it on floppy disk, data is delivered to an adjacent field computer (laptop PC) via USB cable and stored on hard disk. No paper record is generated.

Review of the displayed data on the CRT or paper tape 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. In the case of the Model 170, printed data is verified by the operator prior to moving the probe. In the case of the Robertson Micrologger2, storage on the hard disk should be verified from time-to-time, certainly before exiting the borehole.

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

f) QA Review

2) Paper output records are no longer required, since the Micrologger2 cannot generate them. However, data must be stored in at least 2 places prior to leaving the site

3) List of record ID numbers (for data on diskette) and corresponding depth

4) Diskettes, CDRom, or USB flash drives with backup copies of data on hard disk, labeled with borehole designation, record ID numbers, date, and tester 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 are 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, PSLOG automatically calculates both V_s and V_p for each depth. The program allows spreadsheet output for presentation in either charts or tables or both.

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__6/20/00_____

QA Review_____Date__6/20/00___

References:

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

2. The P-S Velocity Logging Method, R.L. Nigbor and T. Imai, XIII ICSMFE, 1994, New Delhi, India / XIII CIMSTF, 1994, New Delhi, India

3. "Standard test Methods for Crosshole Seismic Testing", ASTM Standard D4428/D4428M-91, July 1991, Philadelphia, PA

OYO SUSPENSION P-S VELOCITY LOGGING SETUP

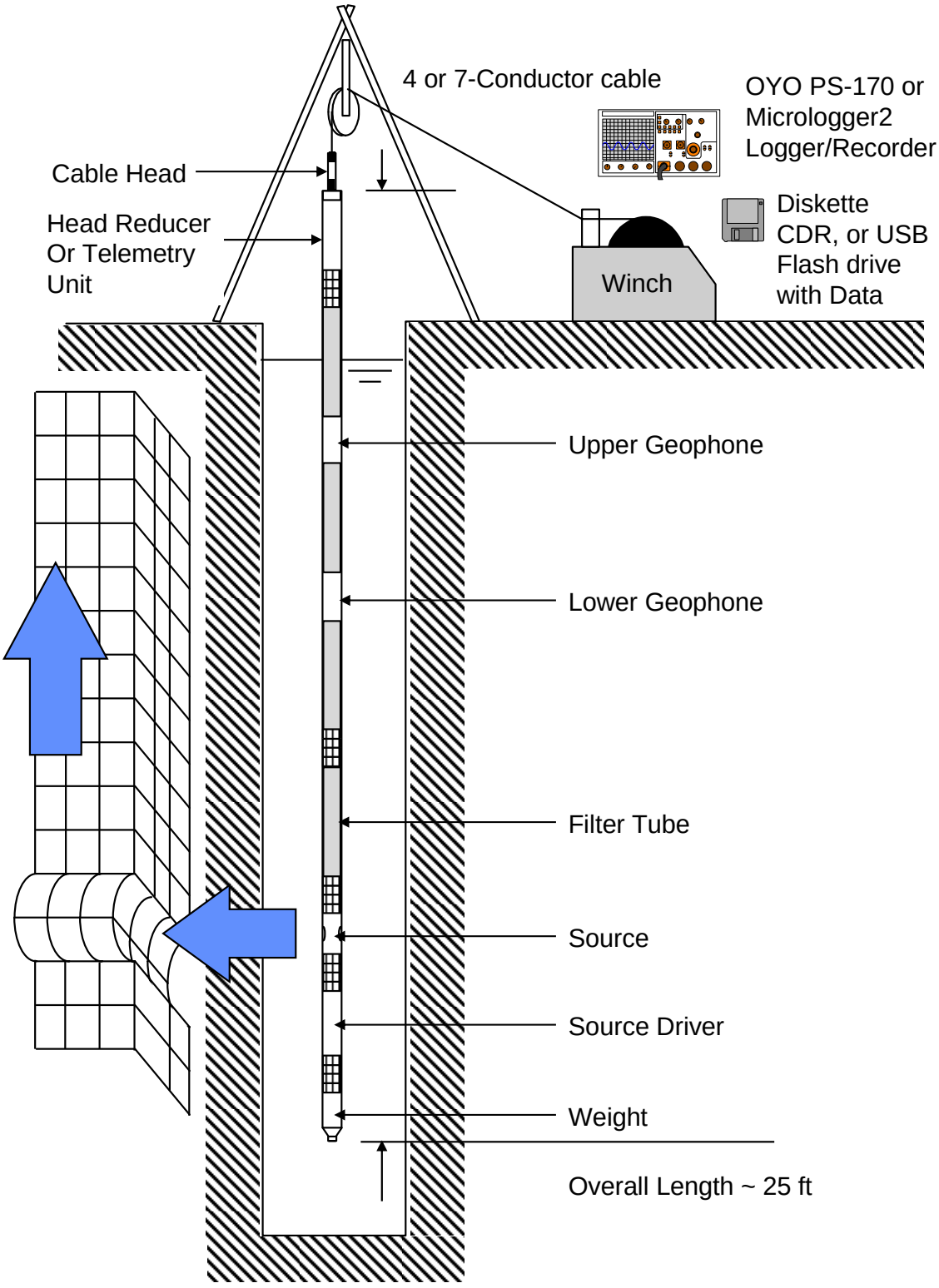


Figure 1. Suspension PS logging method setup

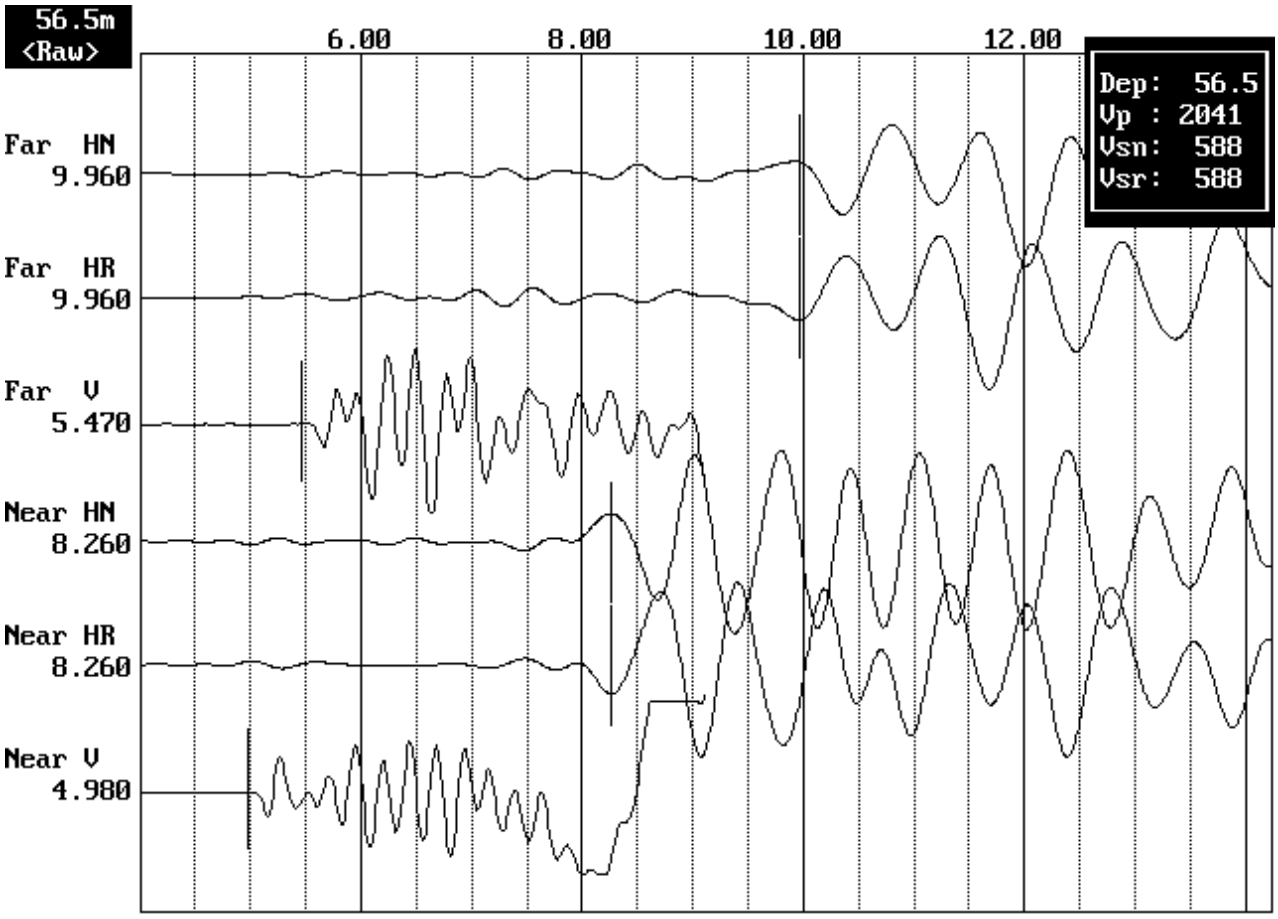


Figure 2. Sample suspension method waveform data showing horizontal normal and reversed (HR and HN), and vertical (V) waveforms received at the near (bottom 3 channels) and far (top 3 channels) geophones. The arrivals in milliseconds for each pick are shown on the left. The box in the upper right corner shows the depth in the borehole and the velocities calculated based on the picks.

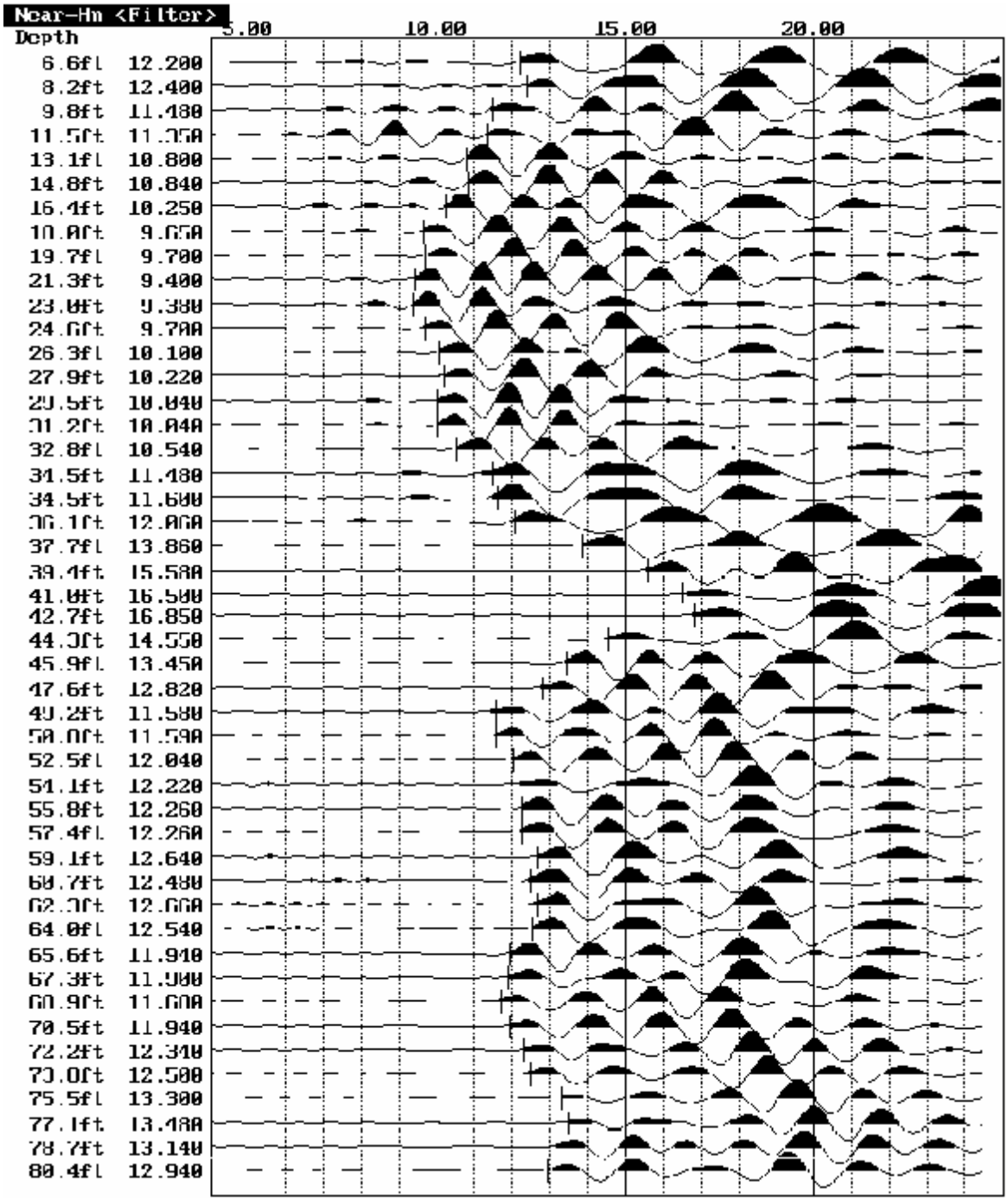


Figure 3. Sample composite waveform plot for normal shear waves received at the near geophone in a single borehole

GEOVision geophysical services

P-S SUSPENSION VELOCITY FIELD LOG

SITE:_____ DATE:_____
CLIENT:_____ JOB:_____
AUTHOR:_____ PAGE 1 OF _____

CONTACT:_____ _OFFICE__ PHONE:_____
_____ PHONE:_____
CONTACT:_____ _OFFICE__ PHONE:_____
_____ PHONE:_____
CONTACT:_____ _____ PHONE:_____
_____ PHONE:_____
CONTACT:_____ _____ PHONE:_____
_____ PHONE:_____
DRILLER:_____ _____ PHONE:_____
COMPANY:_____ _____ PHONE:_____

DIRECTIONS TO SITE:_____
_____
_____
_____
_____

GENERAL SITE CONDITIONS/LOCATION:_____
_____

EA#:_____
BOREHOLE DESIGNATION:_____LOCATION:_____
_____
COUNTY:_____RANGE:_____TOWNSHIP:_____SECTION:_____
BOREHOLE CONSTRUCTION: CASED_____ UNCASED_____
DIAMETERS AND DEPTH RANGES: _____ 0 TO _____ ; _____, _____ TO _____
BOREHOLE TOTAL DEPTH AS DRILLED:_____
CONDUCTOR 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:_____

GEOVision
geophysical services

SITE:_____ DATE:_____
CLIENT:_____ JOB:_____
AUTHOR:_____ PAGE 2 OF _____

LOGGING CREW:_____
VEHICLE(S) USED AND MILEAGE: _____
MOBILIZED FROM:_____ DEPARTURE TIME:_____
ARRIVED ON SITE:_____
STANDBY TIME:_____ CAUSE:_____
LOGGING STARTED:_____ LOGGING COMPLETED:_____
STANDBY TIME:_____ CAUSE:_____
LOGGING STARTED:_____ LOGGING COMPLETED:_____
DEMOBILIZED TO:_____ ARRIVAL TIME:_____
ADDITIONAL DEMOB TIME:_____ REASON:_____

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 ☐			

MAINTENANCE PERFORMED ON SITE:_____
_____
_____
_____
EQUIPMENT PROBLEMS OR FAILURES:_____
_____
_____

SUGGESTIONS, ADDITIONS, CHANGES:_____
_____
_____

COMMENTS:_____
_____
_____
_____
_____
_____

GEOVISION SUSPENSION LOGGING FIELD NOTES

SITE: _____ DATE: _____

CLIENT: _____ JOB: _____

AUTHOR: _____ PAGE _____ OF _____

DEPTH METERS	DEPTH FEET	UNFILTERED FILE NO.	FILTERED FILE NO.	COMMENTS CASING, WATER, ROCK, ETC
90.5	296.92			
91.0	298.56			
91.5	300.20			
92.0	301.84			
92.5	303.48			
93.0	305.12			
93.5	306.76			
94.0	308.40			
94.5	310.04			
95.0	311.68			
95.5	313.32			
96.0	314.96			
96.5	316.60			
97.0	318.24			
97.5	319.88			
98.0	321.52			
98.5	323.16			
99.0	324.80			
99.5	326.44			
100.0	328.08			
100.5	329.72			
101.0	331.36			
101.5	333.01			
102.0	334.65			
102.5	336.29			
103.0	337.93			
103.5	339.57			
104.0	341.21			
104.5	342.85			
105.0	344.49			
105.5	346.13			
106.0	347.77			
106.5	349.41			
107.0	351.05			
107.5	352.69			
108.0	354.33			

GEOVISION SUSPENSION LOGGING FIELD NOTES

SITE: _____ DATE: _____

CLIENT: _____ JOB: _____

AUTHOR: _____ PAGE _____ OF _____

DEPTH METERS	DEPTH FEET	UNFILTERED FILE NO.	FILTERED FILE NO.	COMMENTS CASING, WATER, ROCK, ETC
108.5	355.97			
109.0	357.61			
109.5	359.25			
110.0	360.89			
110.5	362.53			
111.0	364.17			
111.5	365.81			
112.0	367.45			
112.5	369.09			
113.0	370.73			
113.5	372.38			
114.0	374.02			
114.5	375.66			
115.0	377.30			
115.5	378.94			
116.0	380.58			
116.5	382.22			
117.0	383.86			
117.5	385.50			
118.0	387.14			
118.5	388.78			
119.0	390.42			
119.5	392.06			
120.0	393.70			
120.5	395.34			
121.0	396.98			
121.5	398.62			
122.0	400.26			
122.5	401.90			
123.0	403.54			
123.5	405.18			
124.0	406.82			
124.5	408.46			
125.0	410.10			
125.5	411.75			
126.0	413.39			