Appendix 4

To: Cripple Creek & Victor Gold Mining Company
100 North Third Street
P.O. BOX 191
Victor, Colorado 80860

Date: March 8, 2000

Subject:

GROUND MOTION ATTENUATION STUDY
NORTH CRESSON AREA
February 25, 2000

1 OF 4

Matheson Mining Consultants, Inc.

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CRIPPLE CREEK AND VICTOR GOLD MINING COMPANY
GROUND MOTION ATTENUATION STUDY
NORTH CRESSON AREA

February 25, 2000

Executive Summary

Matheson Mining Consultants, Inc. (MMC) monitored four test blasts located in the North Cresson area on Cripple Creek & Victor Gold Mining Company (CC&V) property east of the town of Cripple Creek, Colorado, with eleven seismographs. A photograph index and photos of the test site and procedure follow the body of this report. Attached as Appendices I through V are: a map of the test site, seismograph calibration certificates, seismograph information, seismograph records, and linear regression analysis, respectively.

Scaled distance is a relationship used in explosives engineering to interrelate blasts with different maximum charge weights per delay period:

$$SD = D/\sqrt{W}$$

Where: SD = Scaled Distance
D = Distance, in feet
W = Maximum charge weight per delay period, in pounds

The recommended scaled distance to not exceed a 0.50 inches per second peak particle velocity for the North Cresson Area is 43.8. The analysis is comprised of forty data points and has a correlation coefficient of 0.913, this is an excellent correlation coefficient.

Below is Table 1 showing distances and charge weights per delay based on the 0.50 inch per second peak particle velocity and the site-specific scaled distance determination of 43.8. The charge weight per delay is the maximum explosive charge that may be fired at a given distance.

Table 1: Distance vs. Charge Weight for SD=43.8

Distance, feet	Charge Weight, pounds per 8ms delay
500	130
1000	521
1500	1,173
2000	2,085
2500	3,258
3000	4,691
3500	6,385
4000	8,340
4500	10,555
5000	13,031

INTRODUCTION

Matheson Mining Consultants, Inc. (MMC) was retained by Cripple Creek & Victor Gold Mining Company (CC&V) to perform a ground motion attenuation study of ground vibrations created by test blasting in the North Cresson area. This area is located east of the town of Cripple Creek, Colorado. Appendix I contains a map showing the test shot and seismograph recording locations. Photographs showing test shots and seismograph locations are located after the text of this report. Eleven seismographs were used to record the ground motion from each of four test blasts. The seismographs were positioned at varying distances from each test blast towards the nearest structures in Cripple Creek.

Particle velocity data acquired in the field are input into a least squares linear regression analysis program. The United States Office of Surface Mining and Reclamation Enforcement (OSMRE) have approved this program. The regression analysis yields a site-specific vibration attenuation formula in the form:

$$PPV = H(SD)^{-B}$$

Where: PPV = the peak particle velocity in inches per second,
H = the velocity (y axis intercept) at a scaled distance of one,
SD = scaled distance = distance from shot to recorder divided by the square root of the charge weight, and
B = the slope of the curve.

The program also yields the correlation coefficient (goodness of fit), r^2. The procedure for the analysis performed is outlined in the "Blasting Guidance Manual," March 1987, published by the OSMRE.

The resulting analysis is used to determine distance and charge weight relationships required for ground motion regulatory compliance. This study was designed to be conservative in nature. The intent was to maximize the ground motion produced by the test shots. Typically in mine production blasting, explosive energy is consumed by fragmentation and displacement of the rock mass. The confined test blasts minimized fragmentation and displacement while maximizing ground motion.

INSTRUMENTATION

Vibration records were collected using eleven blasting seismographs: three Blastmate III models, and eight MiniMate Plus models. The seismographs record particle velocity digitally in the frequency range of 1.5 to 250 Hertz. Each shot is measured in three orthogonal channels of ground motion: vertical, longitudinal, and transverse. Zero-crossings of each of the three-waveform components are calculated to determine frequency response. The instruments are seismically triggered and record each channel digitally at the rate of 1024 samples per second. Each vibration recording is printed on a single page with date, time, trigger source, trigger level, range, record time length, instrument serial number, battery level, calibration date, and file name in the title block.

An independent party using a shake table and electronics traceable to the National Bureau of Standards calibrates all instruments annually. Copies of calibration certificates are found in Appendix II. In addition, each instrument performs a self-test after each recorded event. This is a check of the geophone's overswing and dampening. Attached as Appendix III, is an excerpt from the Blastmate III User's Manual describing the specifications and function of the instrumentation and record processing.

PROCEDURE

Four, six inch diameter holes were drilled to a depth of 40 feet at the test site. Each hole was loaded with 100 pounds of ANFO initiated by a cast booster, with approximately 34 feet of stemming (drill hole cuttings). Each shot was detonated individually. The charge weight was selected to maximize the ground motion created by each detonation, while eliminating energy loss due to creation of fly-rock and permanent ground displacement. This method is inherently conservative, as comparison of production blasting to previous studies has demonstrated.

Seismographs were placed at distances from 102 feet to 789 feet away from the test shots (see map in Appendix I) and were set up in an approximate line between the test shots and the nearest structures in Cripple Creek. Care was taken to ensure good geophone coupling with the ground. Snow and the top frozen soil layer were removed and spikes were used on the geophones. The vibration recordings for each of the test shots are found in Appendix IV. Distances were surveyed by CC&V. Seismic data was obtained for scaled distances in the range from 10.2 to 78.9.

A least squares linear regression analysis was then performed on the data set to determine the +95% confidence equation as recommended by OSMRE and USBM regulatory guidelines. The statistical validity of the data set is evaluated using the correlation coefficient calculated during the analysis. The equation for the +95% confidence interval is then used to calculate the maximum charge weight per delay period for any given particle velocity and distance. Recommendations are made based on regulatory criteria, accepted citizen tolerance levels, and historic vibration monitoring from existing mine production.

RESULTS

The regression analysis and scaled distance tables are found in Appendix V.

The +95% confidence equation with correlation coefficient calculated from the regression analysis is:

$$PPV = 168(SD)^{-1.54}; \quad r^2 = .913$$

Given a not-to-exceed peak particle velocity and a distance, the maximum charge weight per delay may be calculated using the equation above. For a 0.50 inch per second peak particle velocity, the preceding +95% confidence equation yields a scaled distance is 43.8. Tables are attached to the regression analysis in Appendix V using this equation to calculate maximum peak particle velocities based on scaled distance.

The equation is in accordance with previous studies that have been performed in the area. MMC conducted "Ground Motion Attenuation Studies, Ajax and Ridge Road Test Sites," on May 28 & 29, 1997. Vibra-Tech Engineers, Inc. conducted similar studies in the Globe Hill, Ironclad and Cresson mining areas in May 1993. This most recent data set has an excellent correlation coefficient. A high degree of reliability may be placed on these results.

CONCLUSIONS

The North Cresson analysis recommends a scaled distance of 43.8 in order to not exceed the 0.50 inch per second peak particle velocity limit on ground motion created by CC&V blasting operations at the nearest privately owned structures. A high degree of confidence may be placed in the recommended Scaled Distance. The site-specific ground motion attenuation equation can be used to calculate a Scaled Distance for any peak particle velocity.

Appendix IV contains a summary sheet and the individual seismograph records measured and used in this study. Attached to Appendix V, are tables listing maximum particle velocities at varying scaled distances.

Sincerely,

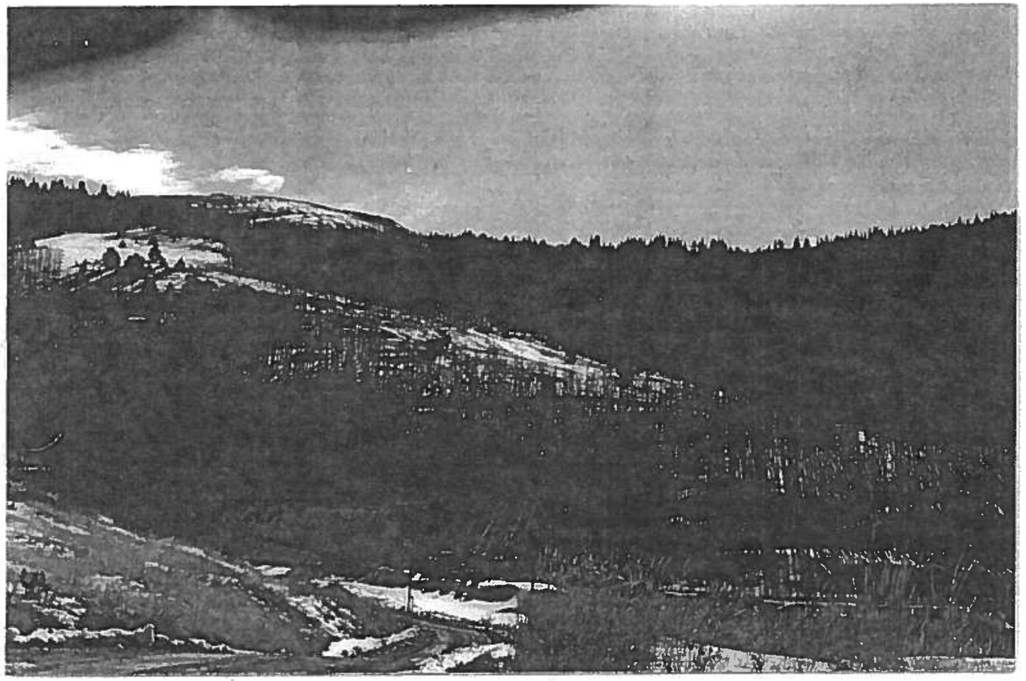
Mark L. Burgus,
Geophysicist

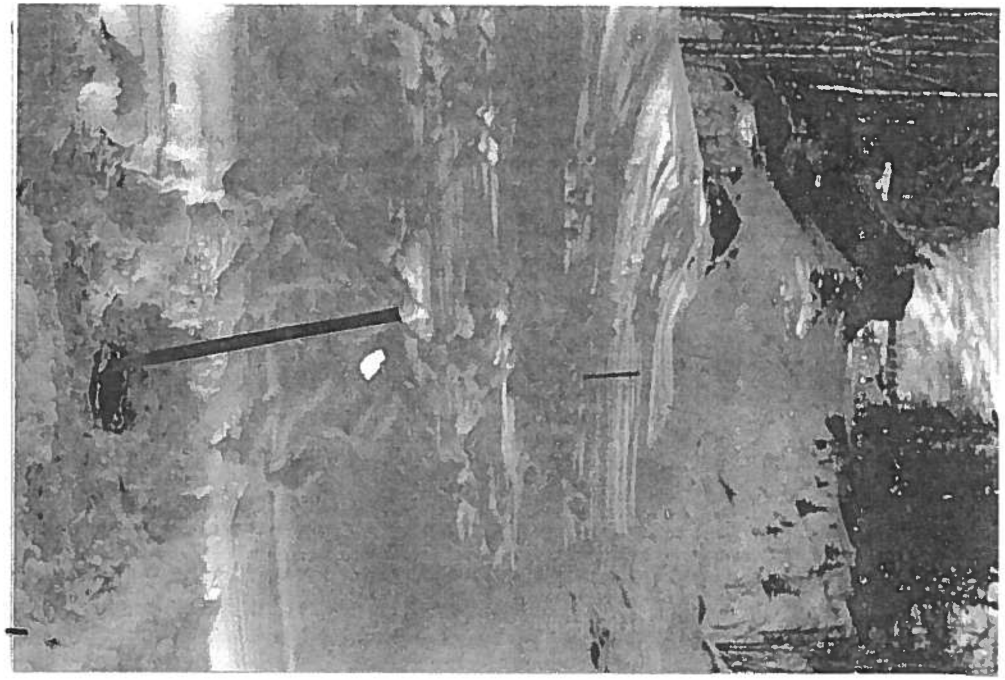
Colin M. Matheson
Mining Engineer

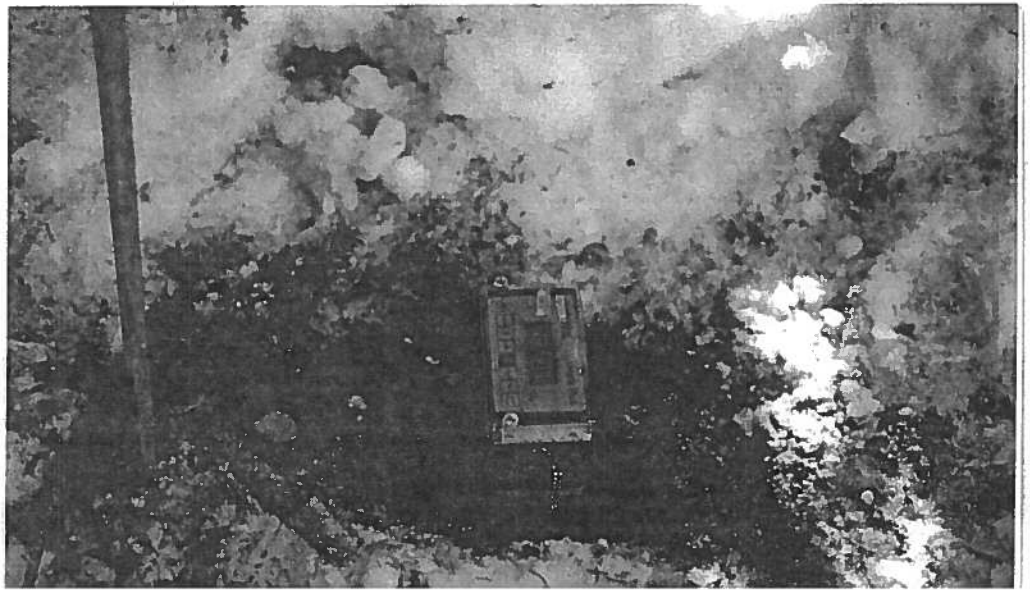
PHOTOGRAPH INDEX

1. Test Shot Locations. Test shot 1 is the furthest away, with test shot 4 in the foreground.
2. Looking in the direction of the nearest Cripple Creek structures from the test shot location.
3. Looking back towards the test shot location (near the center of the photo and slightly below the ridgeline) from the nearest Cripple Creek structures.
4. Typical Minimate Plus seismograph recording location.
5. Typical Blastmate III seismograph recording location.
6. Shows three recording locations, Station B (nearest), Station C-20, and Station C.
7. Another view of the recording locations shown in photo 6.

CC9.V







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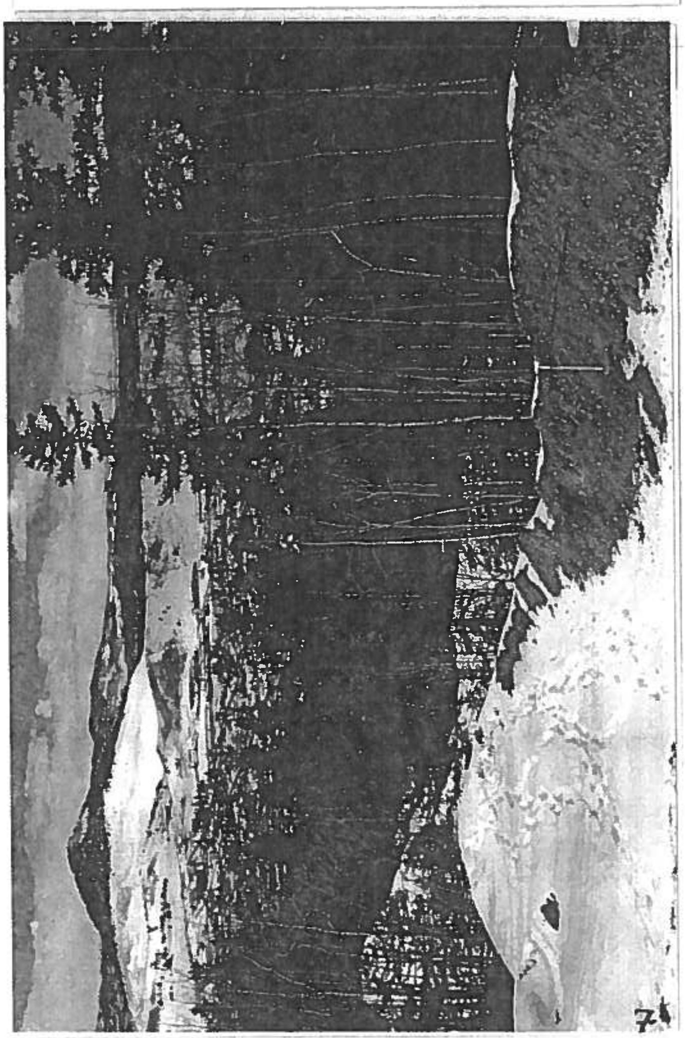

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Appendix I

Map

Appendix II

Calibration Certificates

Calibration Certificate

Model BlastMate III

Date: August 9, 1999

Unit S/N: BA5546

TEST REFERENCES*	Model	Serial No.
Bruel & Kjaer Accelerometer	4370	925067
Bruel & Kjaer Charge Amplifier	2635	974792
Stanford Spectrum Analyzer	SR760	41067
Good Will Inst. Frequency Counter	GUC-2010G	5110825
Bruel & Kjaer HPMC	4221	1733488
Bruel & Kjaer Mic Carrier System	2804	1904947
Bruel & Kjaer Microphone	4193	1886724

INSTANTEL INC. hereby certifies that this unit has been calibrated and that the results are consistent with the specifications published regarding this instrument. The SENSORCHECK™ feature of the unit is sufficiently reliable to indicate proper operation, although it is recommended that this unit be sent to INSTANTEL or an authorized service centre for regular calibration.

AUTHORIZED BY: ______________________

*References are traceable to NRC, NIST or equivalent

Calibration Certificate

Part Number: 714A0801

Description: BlastMate III

Date: October 26, 1999

Unit S/N: BA5738

TEST REFERENCES*	Model	Serial No.
Stanford Spectrum Analyzer	SR760	41036
Good Will Inst. Frequency Counter	GUC-2010G	5110825
Fluke Multimeter	87III	71990510
VOD Cable Simulation Test Jug	717J0201	n/a
Bruel & Kjaer Accelerometer	4381	1160721
Bruel & Kjaer Charge Amplifier	2635	1423229
Bruel & Kjaer Mic Power Supply	2804	1904864
Bruel & Kjaer Microphone Preamplifier	2669	1936412
Bruel & Kjaer Microphone Element	4193	1886724

INSTANTEL INC. hereby certifies that this unit has been calibrated and that the results are consistent with the specifications published regarding this instrument. The SENSORCHECK™ feature of the unit is sufficiently reliable to indicate proper operation, although it is recommended that this unit be sent to INSTANTEL or an authorized service centre for regular calibration.

AUTHORIZED BY: ____________________

*References are traceable to NRC, NIST or equivalent

Calibration Certificate

Part Number: 716A0401

Description: MiniMate Plus

Date: November 24, 1999

Unit S/N: BC5534

TEST REFERENCES*	Model	Serial No.
Stanford Spectrum Analyzer	SR760	41036
Good Will Inst. Frequency Counter	GUC-2010G	5110825
Fluke Multimeter	87III	71990510
VOD Cable Simulation Test Jug	717J0201	n/a
Bruel & Kjaer Accelerometer	4381	1160721
Bruel & Kjaer Charge Amplifier	2635	1423229
Bruel & Kjaer Mic Power Supply	2804	1904864
Bruel & Kjaer Microphone Preamplifier	2669	1936412
Bruel & Kjaer Microphone Element	4193	1886724

INSTANTEL INC. hereby certifies that this unit has been calibrated and that the results are consistent with the specifications published regarding this instrument. The SENSORCHECK™ feature of the unit is sufficiently reliable to indicate proper operation, although it is recommended that this unit be sent to INSTANTEL or an authorized service centre for regular calibration.

AUTHORIZED BY: ____________________

*References are traceable to NRC, NIST or equivalent

Calibration Certificate

Model: MiniMate Plus

Date: March 5, 1999

Unit S/N: BC5576

TEST REFERENCES*	Model	Serial No.
Bruel & Kjaer Accelerometer	4381	1160721
Bruel & Kjaer Charge Amplifier	2635	1423229
Stanford Spectrum Analyzer	SR760	41036
Good Will Inst. Frequency Counter	GUC-2010G	5110825
Bruel & Kjaer HPMC	4221	745522
Bruel & Kjaer Mic Carrier System	2804	1904864
Bruel & Kjaer Microphone	4193	1863904

INSTANTEL INC. hereby certifies that this unit has been calibrated and that the results are consistent with the specifications published regarding this instrument. The SENSORCHECK™ feature of the unit is sufficiently reliable to indicate proper operation, although it is recommended that this unit be sent to INSTANTEL or an authorized service centre for regular calibration.

AUTHORIZED BY: ____________________

*References are traceable to NRC, NIST or equivalent

Calibration Certificate

Model: MiniMate Plus

Date: July 21, 1999

Unit S/N: BC5571

TEST REFERENCES*	Model	Serial No.
Bruel & Kjaer Accelerometer	4381	1160721
Bruel & Kjaer Charge Amplifier	2635	1423229
Stanford Spectrum Analyzer	SR760	41036
Good Will Inst. Frequency Counter	GUC-2010G	5110825
Bruel & Kjaer HPMC	4221	745522
Bruel & Kjaer Mic Carrier System	2804	1904864
Bruel & Kjaer Microphone	4193	1863904

INSTANTEL INC. hereby certifies that this unit has been calibrated and that the results are consistent with the specifications published regarding this instrument. The SENSORCHECK™ feature of the unit is sufficiently reliable to indicate proper operation, although it is recommended that this unit be sent to INSTANTEL or an authorized service centre for regular calibration.

AUTHORIZED BY: ______________________

*References are traceable to NRC, NIST or equivalent

Calibration Certificate

Model MiniMate Plus

Date: August 10, 1999

Unit S/N: BC6076

TEST REFERENCES*	Model	Serial No.
Bruel & Kjaer Accelerometer	4370	925067
Bruel & Kjaer Charge Amplifier	2635	974792
Stanford Spectrum Analyzer	SR760	41067
Good Will Inst. Frequency Counter	GUC-2010G	5110825
Bruel & Kjaer HPMC	4221	1733488
Bruel & Kjaer Mic Carrier System	2804	1904947
Bruel & Kjaer Microphone	4193	1886724

INSTANTEL INC. hereby certifies that this unit has been calibrated and that the results are consistent with the specifications published regarding this instrument. The SENSORCHECK™ feature of the unit is sufficiently reliable to indicate proper operation, although it is recommended that this unit be sent to INSTANTEL or an authorized service centre for regular calibration.

AUTHORIZED BY: ______________________

*References are traceable to NRC, NIST or equivalent

Calibration Certificate

Part Number: 716A0401

Description: MiniMate Plus

Date: November 4, 1999

Unit S/N: BC6255

TEST REFERENCES*	Model	Serial No.
Stanford Spectrum Analyzer	SR760	41036
Good Will Inst. Frequency Counter	GUC-2010G	5110825
Fluke Multimeter	87III	71990510
VOD Cable Simulation Test Jug	717J0201	n/a
Bruel & Kjaer Accelerometer	4381	1160721
Bruel & Kjaer Charge Amplifier	2635	1423229
Bruel & Kjaer Mic Power Supply	2804	1904864
Bruel & Kjaer Microphone Preamplifier	2669	1936412
Bruel & Kjaer Microphone Element	4193	1886724

INSTANTEL INC. hereby certifies that this unit has been calibrated and that the results are consistent with the specifications published regarding this instrument. The SENSORCHECK™ feature of the unit is sufficiently reliable to indicate proper operation, although it is recommended that this unit be sent to INSTANTEL or an authorized service centre for regular calibration.

AUTHORIZED BY: ______________________

*References are traceable to NRC, NIST or equivalent

Calibration Certificate

Model: MiniMate Plus

Date: October 8, 1999

Unit S/N: BC6796

TEST REFERENCES*	Model	Serial No.
Bruel & Kjaer Accelerometer	4370	925067
Bruel & Kjaer Charge Amplifier	2635	974792
Stanford Spectrum Analyzer	SR760	41067
Good Will Inst. Frequency Counter	GUC-2010G	5110825
Bruel & Kjaer HPMC	4221	1733488
Bruel & Kjaer Mic Carrier System	2804	1904947
Bruel & Kjaer Microphone	4193	1886724

INSTANTEL INC. hereby certifies that this unit has been calibrated and that the results are consistent with the specifications published regarding this instrument. The SENSORCHECK™ feature of the unit is sufficiently reliable to indicate proper operation, although it is recommended that this unit be sent to INSTANTEL or an authorized service centre for regular calibration.

AUTHORIZED BY: ____________

*References are traceable to NRC, NIST or equivalent

Calibration Certificate

Model: MiniMate Plus

Date: September 22, 1999

Unit S/N: BC6248

TEST REFERENCES*	Model	Serial No.
Bruel & Kjaer Accelerometer	4370	925067
Bruel & Kjaer Charge Amplifier	2635	974792
Stanford Spectrum Analyzer.	SR760	41067
Good Will Inst. Frequency Counter	GUC-2010G	5110825
Bruel & Kjaer HPMC	4221	1733488
Bruel & Kjaer Mic Carrier System	2804	1904947
Bruel & Kjaer Microphone	4193	1886724

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AUTHORIZED BY: ____________________

*References are traceable to NRC, NIST or equivalent

Calibration Certificate

Part Number: 716A0401

Description: MiniMate Plus

Date: January 24, 2000

Unit S/N: BC5536

TEST REFERENCES*	Model	Serial No.
Stanford Spectrum Analyzer	SR760	41036
Good Will Inst. Frequency Counter	GUC-2010G	5110825
Fluke Multimeter	87III	71990510
VOD Cable Simulation Test Jug	717J0201	n/a
Bruel & Kjaer Accelerometer	4381	1160721
Bruel & Kjaer Charge Amplifier	2635	1423229
Bruel & Kjaer Mic Power Supply	2804	1904864
Bruel & Kjaer Microphone Preamplifier	2669	1936412
Bruel & Kjaer Microphone Element	4193	1886724

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AUTHORIZED BY: ______________________

*References are traceable to NRC, NIST or equivalent

Appendix III

Instrument Specifications

b) Series III Specifications

Seismic	Range	10 in/s (254 mm/s).
	Resolution	0.005 in/s (0.127 mm/s), to 0.000625 in/s (0.0159 mm/s) with built–in preamp.
	Trigger Levels	0.005 to 10 in/s (0.127 to 254 mm/s) in steps of 0.001 in/s (0.01 mm).
	Frequency Analysis	National and Local Standards for all countries (see text).
	Accuracy	3% at 15 Hz.
	Acceleration, Displacement	Calculated using entire waveform, not estimated at peak.
Air Linear	Range	88–148 dB, 2.9 x 10-4 psi to 0.0725 psi, 2 Pa to 500 Pa.
	Resolution	0.1 dB above 120 dB (0.25 Pa).
	Trigger Levels	100–148 dB in 1 dB steps.
	Accuracy	0.2 dB at 30 Hertz and 127 dB.
"A" Weight (optional)	Range	50 to 110 dB in steps of 0.1 dB. (Impulse Response – 35 milliseconds)
Sampling Rate		Standard 1024 samples per second per channel to 16,384 (8,192 for 8 channel).
Event Storage	Full Waveform Events	300 standard, 900 and 1500 optional at standard sample rate of 1024.
	Summary Events	1750 standard, 5250 and 8750 optional at standard sample rates of 1024.
Frequency Response	2 to 300 Hz	Ground and Air, Independent of record time.
Full Waveform Recording	Fixed Record Modes	Manual, single shot, continuous and programmed start/stop.
	Fixed Record Time	1 to 100, 300 or 500 sec plus 0.25 sec pretrigger.
	Auto Record Mode	1 to 100, 300 or 500 sec plus 0.25 sec pretrigger.
Strip Chart Recording	Record Method	Record to memory and/or internal printer. Program interval 5, 15, 60 or 300 sec.
	Days Storage	3, 9 or 15 days at 5 second interval. 34, 107, or 180 days at 5 minute interval.
Special Functions	Timer Operation	Programmed start/stop.
	Self Check	Programmable daily check.
	Scaled Distance	Weight and distance stored with event.
	Monitor Log	History printout programmable up to all events stored.
	Measurement Units	Imperial or metric, dB or linear air pressure, or in units of custom sensors.
	Location	Log GPS (Global Positioning System) data into record.
Printer	Resolution	576 dots/line and 0.0049 inches (0.125 mm) per dot.
	Print Time	Less than 10 seconds for typical 1 second event with full analysis.
	Paper Control	Paper tear slot or automatic paper takeup, separate keys for feed and takeup.
	Rated Life – print head	18 miles (30 km) of printing.
	Number of Copies	1 to 10 copies automatic, any number manual.
User interface	Keyboard	64 domed tactile with separate keys for common functions.
	Display	4 line by 20 character high contrast backlit display with on line help.
Battery Life		30 days continuous recording, 70 days with timer, printing will decrease life.
Dimensions		10.6 " x 14.0 " x 6.5 " (269 mm x 355 mm x 165 mm).
Weight		14 lbs. (6.4 kg).
Warranty	2 Years Parts and Labour	Calibration and equipment check required at 1 year to maintain warranty.
Environmental	Printer/ LCD	14 to 122 degrees F (–10 to 50 degrees C) operating.
	Electronics	–4 to 140 degrees F (–20 to 60 degrees C) operating.
	Storage	–4 to 160 degrees F (–20 to 70 degrees C).

iantel reserves the right to change any specifications without notice.

a) Series III Specifications

Seismic	Range	10 in/s (254 mm/s).
	Resolution	0.005 in/s (0.127 mm/s), to 0.000625 in/s (0.0159 mm/s) with built-in preamp.
	Trigger Levels	0.005 to 10 in/s (0.127 to 254 mm/s) in steps of 0.001 in/s (0.01 mm).
	Frequency Analysis	National and Local Standards for all countries (see text).
	Accuracy	3% at 15 Hz.
	Acceleration, Displacement	Calculated using entire waveform, not estimated at peak.
Air Linear	Range	88–148 dB , 2.9 x 10^{-4} psi to 0.0725 psi, 2 Pa to 500 Pa.
	Resolution	0.1 dB above 120 dB (0.25 Pa).
	Trigger Levels	100–148 dB in 1 dB steps.
	Accuracy	0.2 dB at 30 Hertz and 127 dB.
A weight (optional)	Range	50 to 110 dB in steps of 0.1 dB. (Impulse Response – 35 milliseconds)
Sampling Rate		Standard 1024 samples per second per channel to 16,384 (8,192 for 8 channel).
Event Storage	Full Waveform Events	300 standard and 1500 optional at standard sample rate of 1024.
	Summary Events	1750 standard, 5250 and 8750 optional at standard sample rates of 1024.
Frequency Response	2 to 300 Hz	Ground and Air, Independent of record time.
Full Waveform Recording	Fixed Record Modes	Manual, single shot, continuous and programmed start/stop.
	Fixed Record Time	1 to 100, 300 or 500 sec plus 0.25 sec pretrigger.
	Auto Record Mode	1 to 100, 300 or 500 sec plus 0.25 sec pretrigger.
Strip Chart Recording	Record Method	Record to memory and/or internal printer. Program interval 5, 15, 60 or 300 sec.
	Days Storage	3, 9 or 15 days at 5 second interval. 34, 107, or 180 days at 5 minute interval.
Special Functions	Timer Operation	Programmed start/stop.
	Self Check	Programmable daily check.
	Scaled Distance	Weight and distance stored with event.
	Monitor Log	History printout programmable up to all events stored.
	Measurement Units	Imperial or metric, dB or linear air pressure, or in units of custom sensors.
	Location	Log GPS (Global Positioning System) data into record.
User interface	Keyboard	8 domed tactile with separate keys for common functions.
	Display	4 line by 20 character high contrast backlit display with on line help.
Battery Life		10 days continuous recording, 25 days with timer.
Dimensions		3.2" x 3.6" x 6.3" (81 mm x 91 mm x 160 mm).
Weight		3 lbs. (1.4 kg).
Warranty	2 Years Parts and Labour	Calibration and equipment check required at 1 year to maintain warranty.
Environmental	LCD	14 to 122 degrees F (–10 to 50 degrees C) operating.
	Electronics	–4 to 140 degrees F (–20 to 60 degrees C) operating.
	Storage	–4 to 160 degrees F (–20 to 70 degrees C).

Instantel reserves the right to change any specifications without notice.

3. Compliance Module

This chapter provides instructions to install and setup the BlastMate III.

3.1. What is Event Monitoring?

Event monitoring measures both ground vibrations and air pressure. The monitor measures transverse, vertical, and longitudinal ground vibrations. Transverse ground vibrations agitate particles in a side to side motion. Vertical ground vibrations agitate particles in an up and down motion. Longitudinal ground vibrations agitate particles in a forward and back motion progressing outward from the event site. Events also affect air pressure by creating what is commonly referred to as "air blast". By measuring air pressures, we can determine the effect of air blast energy on structures, measured on the Linear "L" scale, or as perceived by the human ear, measured on the "A" Weight scale.

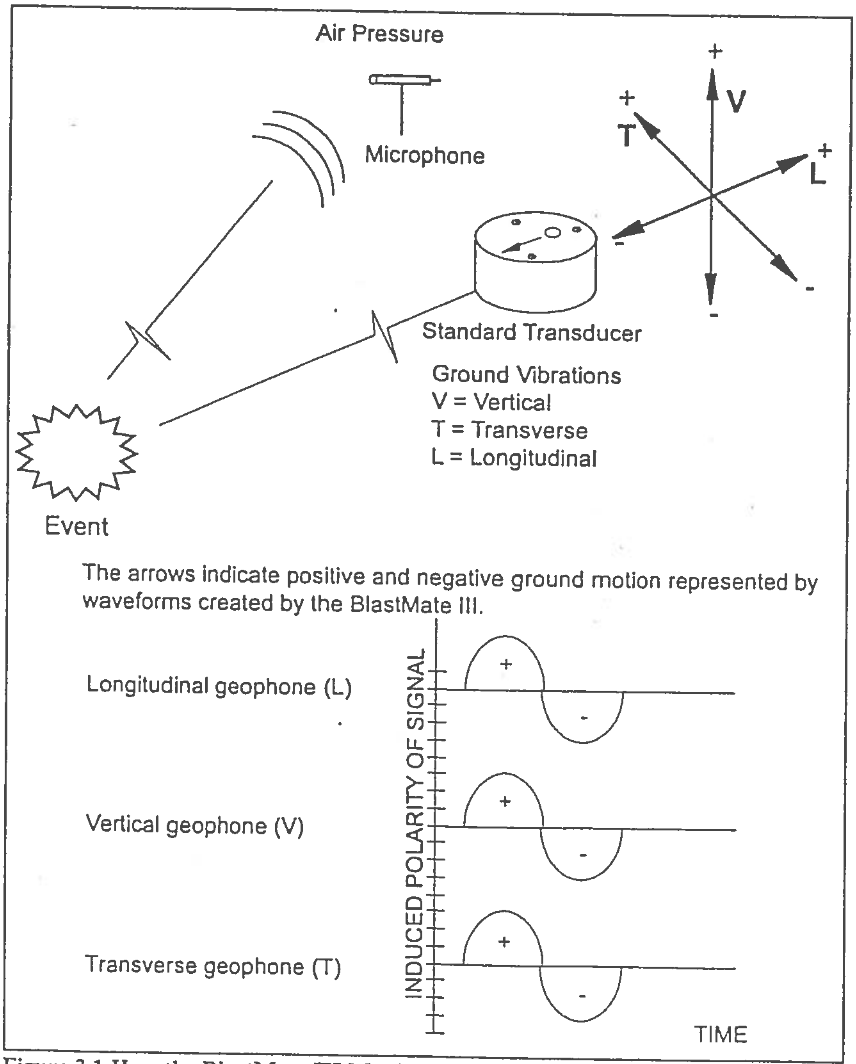


Figure 3.1 How the BlastMate III Monitors Events.

a. Geophone Operation

Functionally a geophone sensor is a coil of wire suspended around a magnet. The magnet is free to move in a field of magnetic flux lines. By Lenzs' Law, induced voltage is proportional to the speed at which flux lines are traversed. Induced coil voltage is therefore proportional to the relative velocity of the coil to the magnet. In practice, it does not matter whether the coil or the magnet moves. Only the motion and speed relative to each other are important.

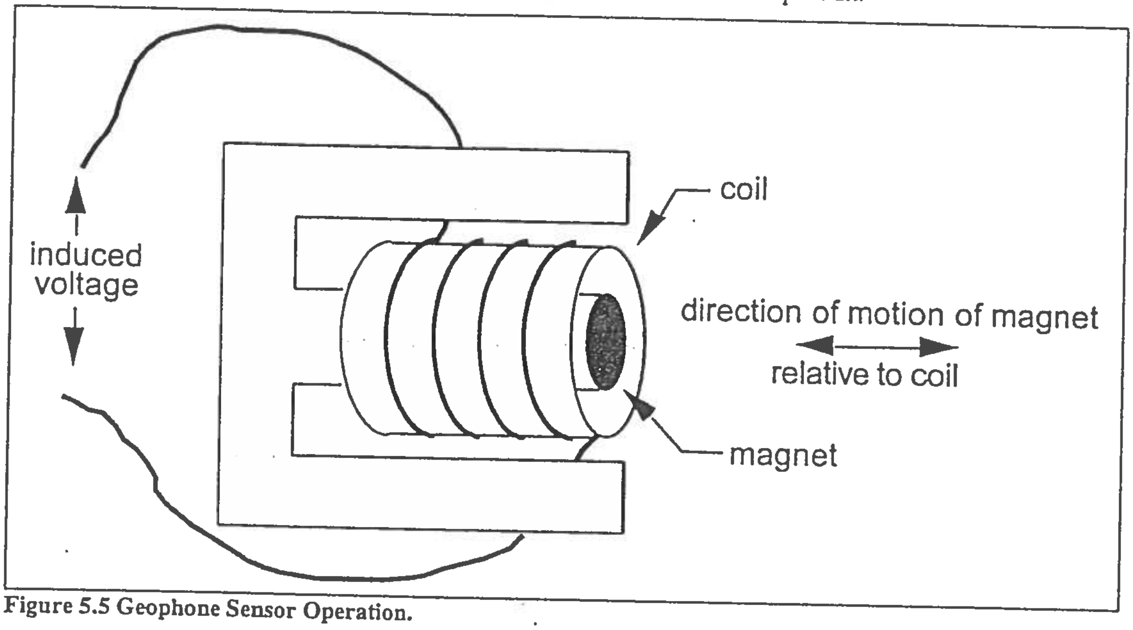


Figure 5.5 Geophone Sensor Operation.

Geophone sensor specifications give a number known as the Intrinsic Voltage Sensitivity. It is the coil voltage induced for a given coil versus magnet speed with units of V/in/s. In seismic applications, the magnet is moved by the blast energy because it is coupled to the particles of the surrounding terrain. The coil, because of its inertia, does not move and the resulting magnet versus coil motion induces a voltage which is proportional to particle velocity.

b. Instantel Standard Transducer

Instantel offers a 2 to 300 Hz standard transducer in a round package. The transducer may be installed on a floor, wall, or ceiling using a variety of installation procedures including ground spikes, burying, mounting rod, or optional levelling plate with levelling feet and integrated bubble level. The figure below includes an Instantel Standard Transducer (a) and a Standard Transducer with levelling plate (b).

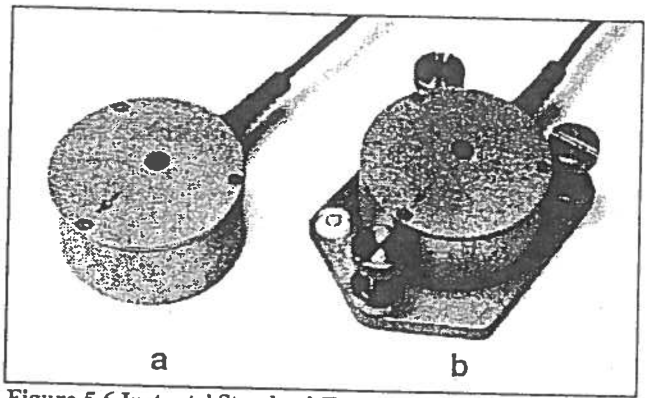


Figure 5.6 Instantel Standard Transducer (a) and Standard Transducer with Optional Levelling Plate (b).

c. Transducer Calibration Requirements

The geophone sensors inside Instantel's transducers must be calibrated annually by Instantel or an authorized Instantel service facility. Contact your dealer for further information.

5.2.2. Microphone

The microphone measures air pressure. Instantel offers two types, Linear "L" (standard) and "A" Weight (optional). Both come with a three foot (one meter) microphone mounting stand.

a. Measurement Scales

The BlastMate III supports two sound pressure measurement scales: Linear "L" and "A" Weight.

(1) Linear "L"

Linear measurement is generally used to measure the effect of low frequency air pressure on buildings. The linear scale records sound pressure without modification in the 2 to 300 Hz range. Measurement units may be in absolute, Pascal, or relative dB scales.

(2) Weight

"A" Weight measures noise levels people may consider an annoyance. The signal is then converted to root mean square (RMS). Units are measured using the decibel scale, dB(A).

b. Microphone Calibration Requirements

Instantel's microphone must be calibrated annually by Instantel or an authorized Instantel service facility. Contact your dealer for further information.

5.3. Sensorcheck®

Sensorcheck performs a two stage test on the BlastMate III and its sensors. In the first stage, the program displays the BlastMate III serial number, software version, the total amount of memory installed in the BlastMate III, the total amount of memory available to store events, and the number of events presently stored in memory. The second stage tests each geophone within Instantel's transducer and the microphone operation. The program also tests the operation of the BlastMate III itself and the sensor connecting cables. Pass or fail results appear on the display. See the Basic Reference chapter of this manual to choose when Sensorcheck operates automatically.

5.3.1. Checking the Transducer's Geophones

Sensorcheck measures a geophone's natural frequency and damping indicated by an Overswing Ratio (OR). Sensorcheck sends an electric pulse to the geophones and measures the response. If the geophone's response falls within a specified calibration range, the geophone is in calibration and monitoring operations can continue. If the geophone's response does not fall within a specified calibration range, the geophone is not calibrated. You cannot record events until you fix or replace the geophones. See the troubleshooting section of this manual for the appropriate procedures to follow.

a. Natural Frequency

Waveform measurements check the natural period (t) of a geophone's sensor coil assembly. Referring to the figure below, the distance from P_1 to P_2 represents 0.125 seconds. Since Frequency is the reciprocal of the period, F=1/t, the frequency is approximately 8 Hz. A calibrated sensor has a natural frequency between 6.5 and 9.5 Hertz. Calculations for all geophones appear with each recorded event.

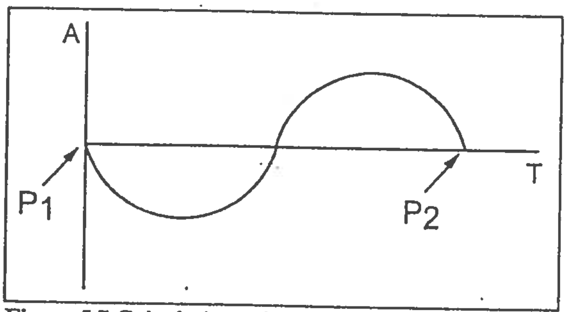


Figure 5.7 Calculating a Geophone's Natural Frequency.

b. Damping – Overswing Ratio (OR)

The overswing ratio (OR) measures damping and is calculated by computing the ratio of the magnitude of adjacent waveform peaks according to the following formula:

$$OR = \frac{A_1}{A_2}$$

Acceptable overswing ratios range from 2.8 to 4.8. The figure below displays a graph of a geophone coil's "free fall" response. A_1 and A_2 are used for overswing calculations.

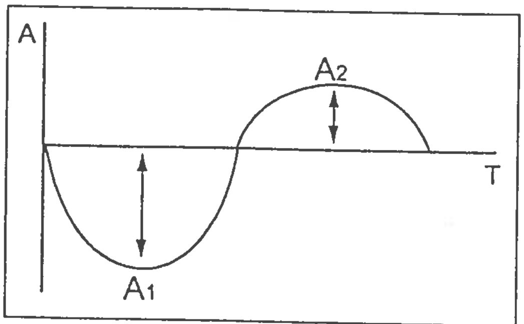


Figure 5.8 Calculating a Geophone's Overswing Ratio.

5.3.2. Checking the Microphone

Sensorcheck tests the microphone's operation by sending a signal to the microphone and measuring its frequency and amplitude response. If the results of the test fall within specified ranges, the microphone is within calibration.

5.3.3. Sensorcheck Report

The Sensorcheck report appears on the BlastMate III display. The message "All Channels Working, Press Print to Print" indicates the BlastMate III sensors have passed the Sensorcheck.

5.4. Antialias Filters

Aliasing occurs when a high–frequency signal appears as an erroneous low frequency because the waveform was sampled at too low a sampling rate. An antialiasing filter solves this problem by removing the high–frequencies.

5.5. Data Analysis Techniques

The following sections define the BlastMate III data analysis techniques. The first section, ground vibrations, discusses calculations applied to event data recorded by a transducer. The second section, sound pressure, describes the microphone event data calculations.

5.5.1. Ground Vibrations

The BlastMate III calculates the Peak Particle Velocity, Zero Crossing Frequency, Peak Acceleration, and Peak Displacement for each of the transverse, vertical, and longitudinal axes. The BlastMate III calculates Peak Vector Sum using data from all three axes.

a. Peak Particle Velocity (PPV)

Peak Particle Velocity indicates the maximum speed particles travel resulting from an event's ground vibrations. The BlastMate III calculates the PPV for each geophone.

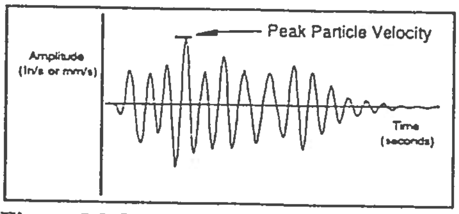


Figure 5.9 Calculating Peak Particle Velocity.

b. Zero Crossing Frequency (ZC Freq)

The Zero Crossing Frequency calculates the event waveform's frequency at the largest peak.

(1) Calculating Zero Crossing Frequency

To calculate the Zero Crossing Frequency, we need to determine the period of oscillation of the waveform. Convenient waveform positions for measuring period, the time for one complete cycle, occur between two successive peaks, troughs, or zero crossings. The BlastMate III measures between zero crossings. Frequency is the number of periods that occur in one second calculated by the formula: Frequency = 1/period.

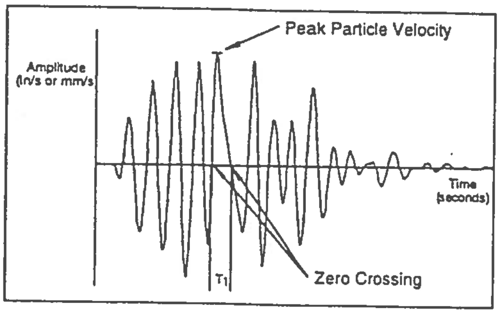


Figure 5.10 Calculating the Zero Crossing Frequency.

(2) Zero Crossing Frequency Limitation

The Zero Crossing Frequency calculation is limited because it assumes a single predominant frequency at the peak, typically represented by sinusoidal waveforms. In practice, the peak may be the result of two or more major frequency components representing compound waveforms as illustrated in the figure below. It is therefore only an approximation of the frequency of the Peak Particle Velocity.

Waveforms may have the same Peak Particle Velocities but different Zero Crossing Frequencies depending on the shape of the waveforms involved. With reference to the figures above and below; both waveforms have the same Peak Particle Velocities however their Zero Crossing Frequencies differ. In the figure above, the zero crossing frequency uses the 1/2 period indicated by T_1. In the figure below, the zero crossing frequency uses the 1/2 period indicated by T_2. Notice that T_1 is less than T_2 because of the different waveform shapes, therefore the Zero Crossing Frequency in figure above is greater than the Zero Crossing Frequency in the figure below. It is for this reason, the Zero Crossing Frequency may differ for peaks having the same Peak Particle Velocity.

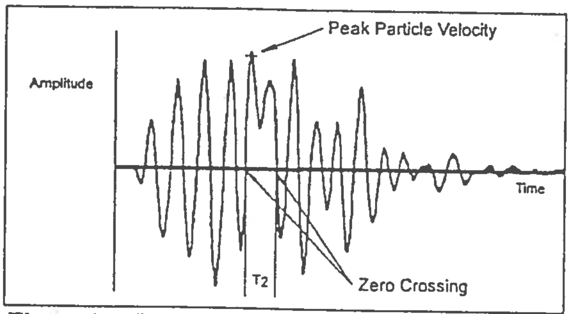


Figure 5.11 Zero Crossing Frequency Calculation Limitation.

(3) Sample Rate Error

The Zero Crossing Frequency requires the period of a wavelength before it can calculate the wavelength's frequency using the formula 1/period. A sampling error occurs for higher frequencies when wavelength periods become relatively small and the sampling rate begins to miss zero crossing points. In other words, the wavelength periods occur much faster than a BlastMate III can sample and use in the calculation.

At higher frequencies there are fewer sample points per cycle and therefore greater error. The following table illustrates how error increases with frequency.

Zero Crossing Frequency Sample Rate Error		
Frequency Range	Recording Rate	
	Standard (1024 Hz)	Fast (2048 Hz)
0 – 30 Hz	negligible error	negligible error
31 – 50 Hz	up to 5 Hz error	up to 2.5 Hz error
51 – 70 Hz	up to 8 Hz error	up to 4 Hz error
71 – 90 Hz	up to 18 Hz error	up to 9 Hz error
91 – 150 Hz	up to 50 Hz error	up to 25 Hz error

The BlastMate III does not calculate frequencies above 100 Hz because of the high error level at 1024 samples per second. The message ">100 Hz" displays. Furthermore if a waveform is very complex, or if it contains a large offset value, the zero crossings may lie outside an acceptable window. Whenever a frequency cannot be calculated the message "<1 Hz" displays. The message N/A indicates an entire waveform was not captured and therefore no frequency could be calculated. More accurate analysis is available using the BlastWare III software.

c. Peak Acceleration

The BlastMate III calculates peak acceleration, the rate of change of velocity, by dividing the difference in velocity by the difference in time. To obtain the peak acceleration, the BlastMate III subtracts two velocity readings and divides the result by the elapsed time between them.

$$a = \frac{dV}{dT} \approx \frac{\Delta V}{\Delta T}$$

where:

Δt = a small interval

The BlastMate III calculates the peak acceleration at each point along the entire waveform and reports the peak value. Note that this is not necessarily at the peak velocity for an individual waveform.

d. Peak Displacement

The BlastMate III calculates peak displacement, or particle distance travelled, by multiplying speed by time. In the BlastMate III the interval velocity is multiplied by the time interval and the resulting displacement segments are summed.

$$s = \int V dt \approx \sum (V \Delta t)$$

where:

V = the velocity in each interval

To obtain the peak displacement, the BlastMate III integrates each wave segment of the entire waveform between zero crossings, selects the largest, then divides the value by half. Note that this is not necessarily at the peak velocity of the waveform.

e. Peak Vector Sum (PVS)

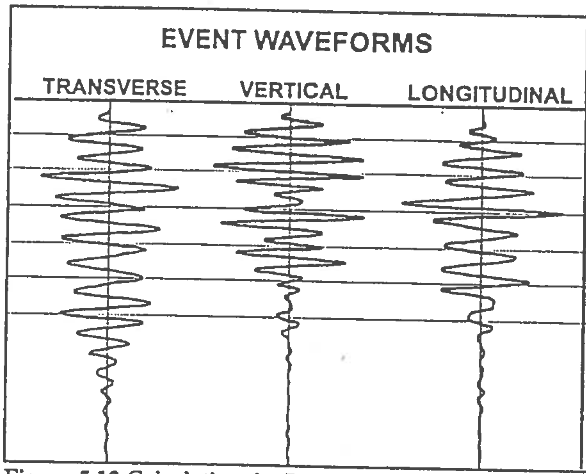
The figure below displays three event waveforms. The figure illustrates the procedure of graphically calculating peak vector sums. Measured magnitudes are tabulated for six different times and represent velocities in each of the three axes. The vector sum represents the resultant particle velocity magnitude and is calculated by squaring and adding the magnitudes and taking the square root.

$$PVS = \sqrt{T^2 + V^2 + L^2}$$

where:

T = particle velocity along the transverse plane
V = particle velocity along the vertical plane
L = particle velocity along the longitudinal plane

The BlastMate III calculates the peak vector sum for each point of the sampled waveforms and displays the largest value. Note that this is not necessarily at the peak velocity for an individual waveform.



MAGNITUDE T	MAGNITUDE V	MAGNITUDE L	PEAK VECTOR
-0.34	-0.33	0.14	0.494
0.38	-0.47	0.38	0.714
0.29	-0.31	0.51	0.663
-0.53	0.23	-0.31	0.655
0.24	0.07	0.36	0.440
-0.23	-0.16	-0.15	0.318

Figure 5.12 Calculating the Peak Vector Sum.

5.5.2. Sound Pressure

The BlastMate III calculates two sound pressure indicators, peak sound pressure and zero crossing frequency.

a. Peak Sound Pressure (PSP)

The BlastMate III checks the entire event waveform and displays the largest sound pressure called the Peak Sound Pressure (PSP), also referred to as the Peak Air Over–Pressure. Results appear on the BlastMate III display and in the Event Summary Report.

b. Zero Crossing Frequency (ZC Freq)

The Zero Crossing Frequency calculation for sound pressure is the same calculation used for ground vibrations. Please see above for a complete discussion.

Note: The Zero Crossing Frequency calculation is performed for Linear microphones only. This calculation does not appear on the BlastMate III display or on Event Summary Reports when using an "A" Weight microphone.

5.6. Alternate Manual Waveform Calculations

The following sections discuss manual waveform analysis techniques. These have been included for reference purposes only. They do not represent the calculation techniques employed by the BlastMate III.

Graphical methods for calculating area and slope depend on the shape of the waveform being analyzed. A complete discussion of the procedures is beyond the scope of this manual. Two useful reference texts are G. A. BOLLIGER, *BLAST VIBRATION ANALYSIS*, Southern Illinois University Press and CHARLES H. DOWDING, *BLAST VIBRATION MONITORING AND CONTROL*, Prentice-Hall Inc.

In each of the subsequent examples some formulae appear with no attempt at derivation. The following definitions apply:

A = amplitude in inches/second measured from the zero line

A_m = amplitude measured in millimetres/second

T = period in seconds

Y = absolute change in amplitude over time measured in inches/second

Y_m = absolute change in amplitude over time measured in millimetres/second

5.6.1. Sinusoidal Waveforms

The motion is essentially sinusoidal with gradual amplitude and frequency changes.

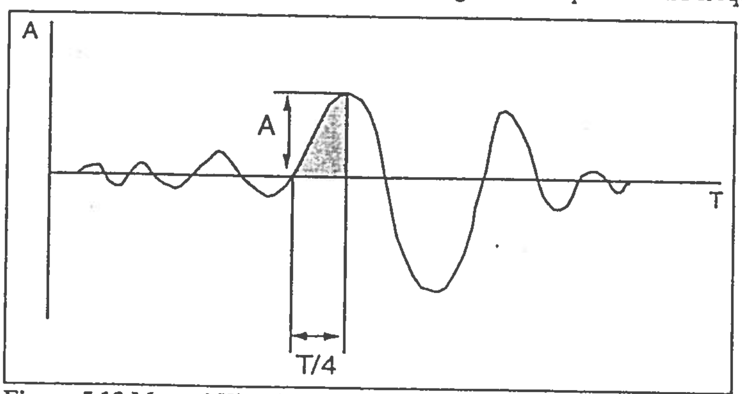


Figure 5.13 Manual Waveform Calculations on Sinusoidal Waveforms.

a. Calculating Displacement:

Maximum Displacement (in.) $= \frac{T}{2\pi} \times A$

Maximum Displacement (mm) $= \frac{T}{2\pi} \times A_m$

b. Calculating Acceleration:

Maximum Acceleration (in./s²) $= \frac{2\pi}{T} \times A$

Maximum Acceleration (mm/s²) $= \frac{2\pi}{T} \times A_m$

5.6.2. Nearly Triangular Waveforms

Motion is irregular and has large amplitude.

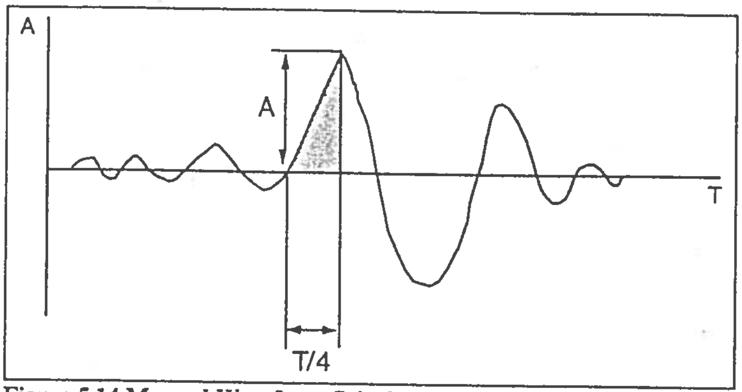


Figure 5.14 Manual Waveform Calculations on Nearly Triangular Waveforms.

a. Calculating Displacement:

Maximum Displacement (in.) $= \frac{T}{8} \times A$

Maximum Displacement (mm) $= \frac{T}{8} \times A_m$

b. Calculating Acceleration:

Maximum Acceleration (in./s^2) $= \frac{1}{T} \times Y$

Maximum Acceleration (mm/s^2) $= \frac{1}{T} \times Y_m$

5.6.3. Compound Waveforms

If the record exhibits interference by two or more predominant frequencies then the maximum displacement will be the sum of the maximum of each individual frequency component.

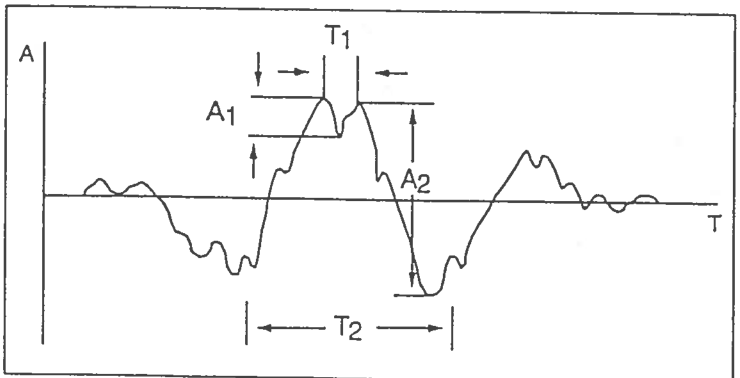


Figure 5.15 Manual Waveform Calculations on Compound Waveforms.

a. Calculating Displacement:

Maximum Displacement (in.) $= \frac{T_1}{2\pi} \times A_1 + \frac{T_2}{2\pi} \times A_2$

Maximum Displacement (mm) $= \frac{T_1}{2\pi} \times A_{1m} + \frac{T_2}{2\pi} \times A_{2m}$

b. Calculating Acceleration:

Maximum Acceleration (in./s²) $= \frac{2\pi}{T_1} \times A_1 + \frac{2\pi}{T_2} \times A_2$

Maximum Acceleration (mm/s²) $= \frac{2\pi}{T_1} \times A_{1m} + \frac{2\pi}{T_2} \times A_{2m}$

5.6.4. Irregular Waveforms

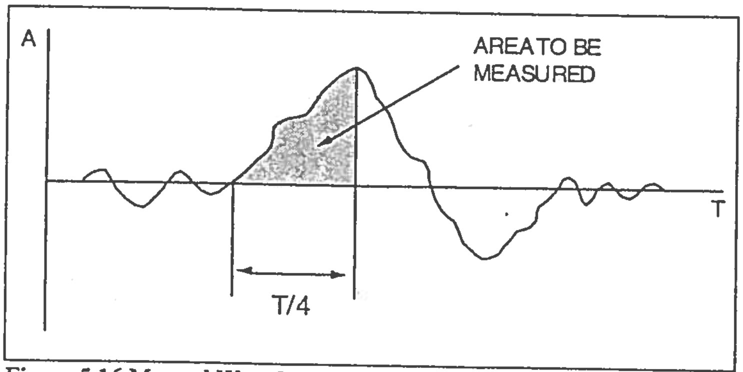


Figure 5.16 Manual Waveform Calculations on Irregular Waveforms.

a. Calculating Displacement:

Maximum Displacement = area under curve measured by a planimeter.

Appendix IV

Seismograph Records

Test Shot 1

GROUND MOTION STUDY EVENT

Date/Time	Tran at 10:49:44 February 25, 2000
Trigger Source	Geo: 0.0500 in/s
Range	Geo :10.00 in/s
Record Time	5.75 sec (Auto=5Sec) at 1024 sps

Serial Number	BC5576 V 3.74-3.74 MiniMate Plus
Battery Level	6.0 Volts
Calibration	March 5, 1999 by Instantel Inc.
File Name	G5767WN4.QW0

Notes
Location:
Client: CC&V
User Name: MMC, Inc.
General: Ground Vibration Attenuation Study

Post Event Notes
Shot 1
Station A

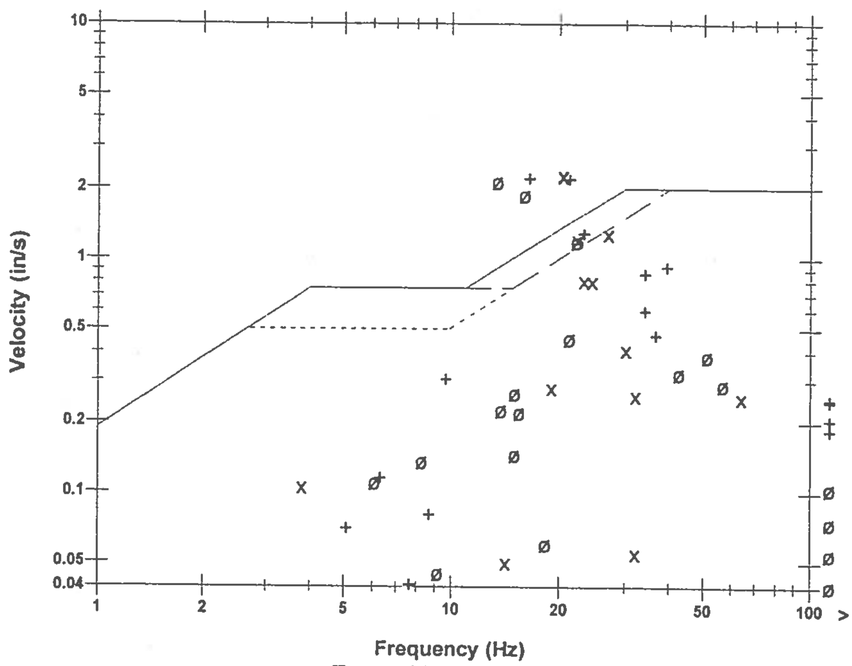
Microphone	Disabled
PSPL	N/A
ZC Freq	N/A
Channel Test	N/A

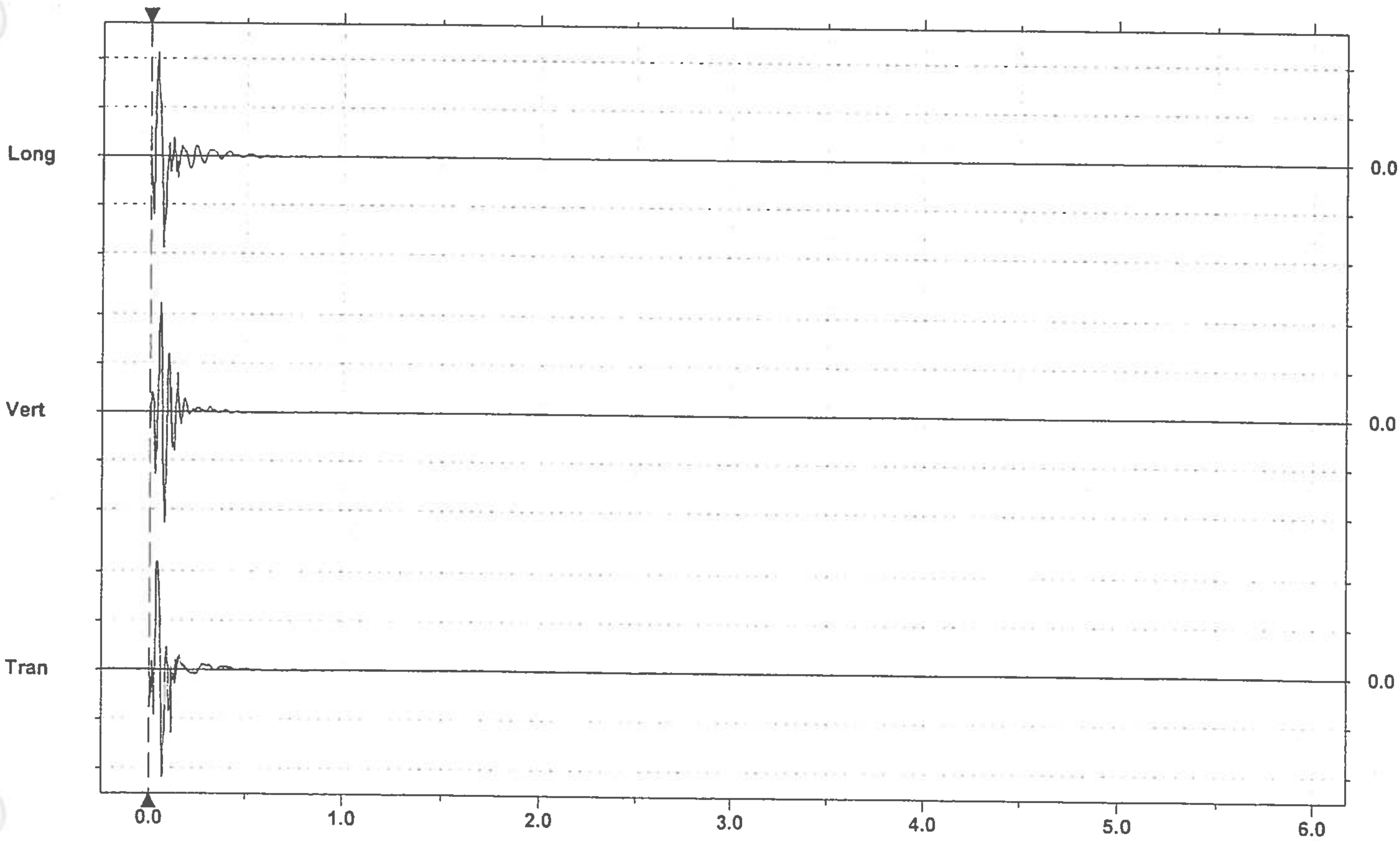
	Tran	Vert	Long	
PPV	2.20	2.28	2.12	in/s
ZC Freq	17	20	13	Hz
Time (Rel. to Trig)	0.044	0.078	0.038	sec
Peak Acceleration	1.68	1.84	0.835	g
Peak Displacement	0.0229	0.0174	0.0222	in
Sensorcheck ™	Passed	Passed	Passed	

Peak Vector Sum 3.06 in/s at 0.036 sec

N/A: Not Applicable

USBM RI8507 And OSMRE





Time Scale: 0.50 sec/div **Amplitude Scale:** Geo: 1.000 in/s/div
Trigger = ▶— — — ◀

Printed: February 29, 2000 (V 3.74g - 3.74g)

GROUND MOTION STUDY EVENT

Date/Time	Vert at 10:50:06 February 25, 2000	**Serial Number**	BC6796 V 4.02-4.02 MiniMate Plus
Trigger Source	Geo: 0.0500 in/s	**Battery Level**	6.3 Volts
Range	Geo :10.00 in/s	**Calibration**	October 8, 1999 by Instantel Inc.
Record Time	3.75 sec (Auto=3Sec) at 1024 sps	**File Name**	H7967WN4.RI0

Notes
Location:
Client:
User Name:
General:

Post Event Notes
M.M.C., Inc., for CC&V
Ground Motion Attenuation Study
Shot 1
Station B

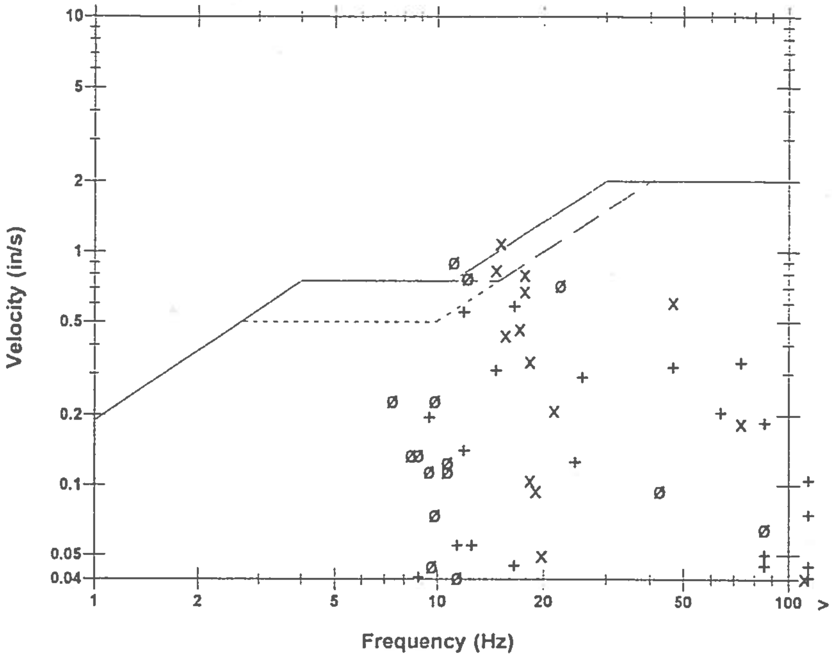
Microphone	Disabled
PSPL	N/A
ZC Freq	N/A
Channel Test	N/A

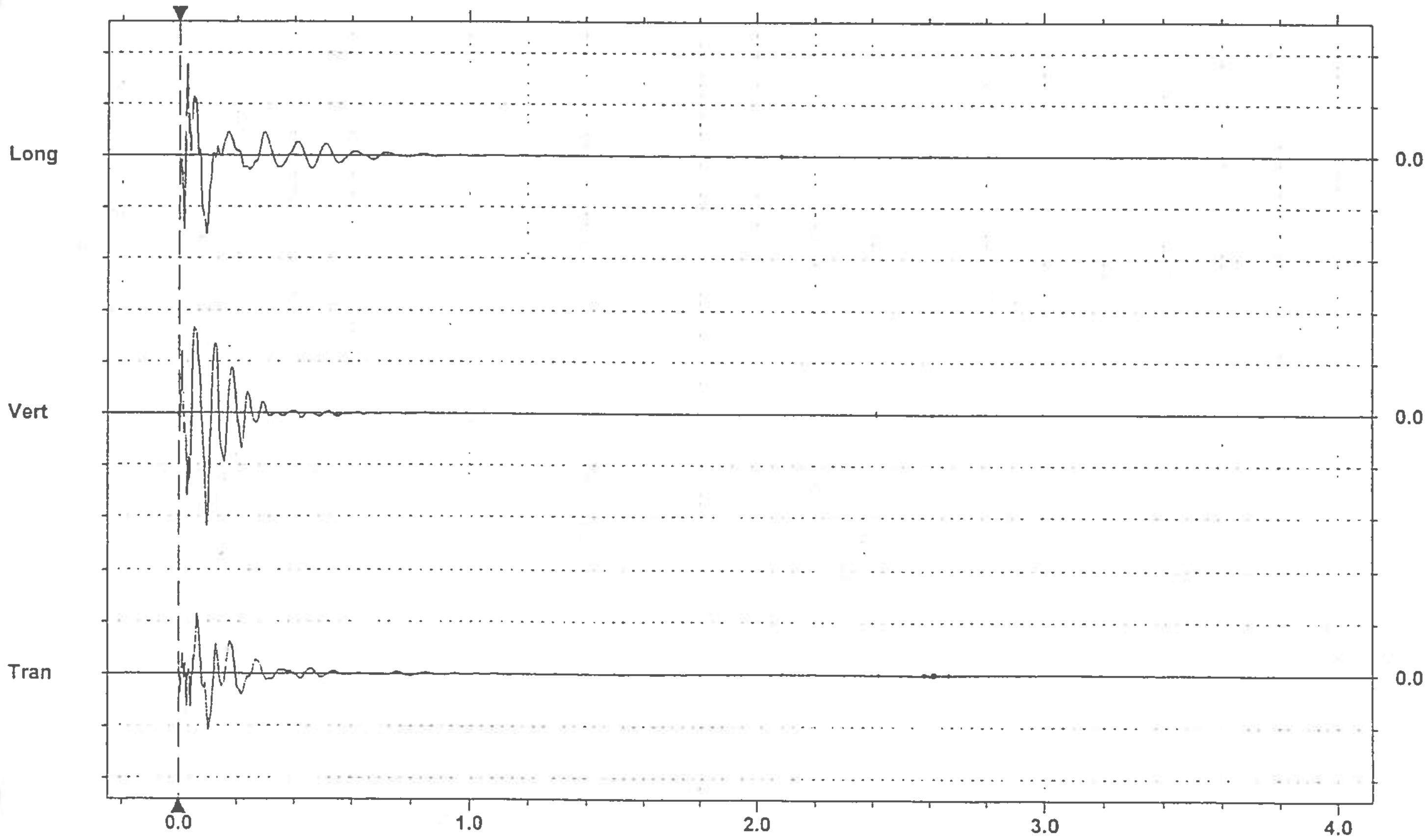
	Tran	Vert	Long	
PPV	0.580	1.09	0.905	in/s
ZC Freq	17	15	11	Hz
Time (Rel. to Trig)	0.065	0.098	0.027	sec
Peak Acceleration	0.371	0.437	0.756	g
Peak Displacement	0.00564	0.00964	0.00959	in
Sensorcheck ™	Passed	Passed	Passed	

Peak Vector Sum 1.36 in/s at 0.098 sec

N/A: Not Applicable

USBM RI8507 And OSMRE





Time Scale: 0.20 sec/div **Amplitude Scale:** Geo: 0.500 in/s/div
Trigger = ▶— — — ◀

Printed: February 29, 2000 (V 3.74g - 3.74g)

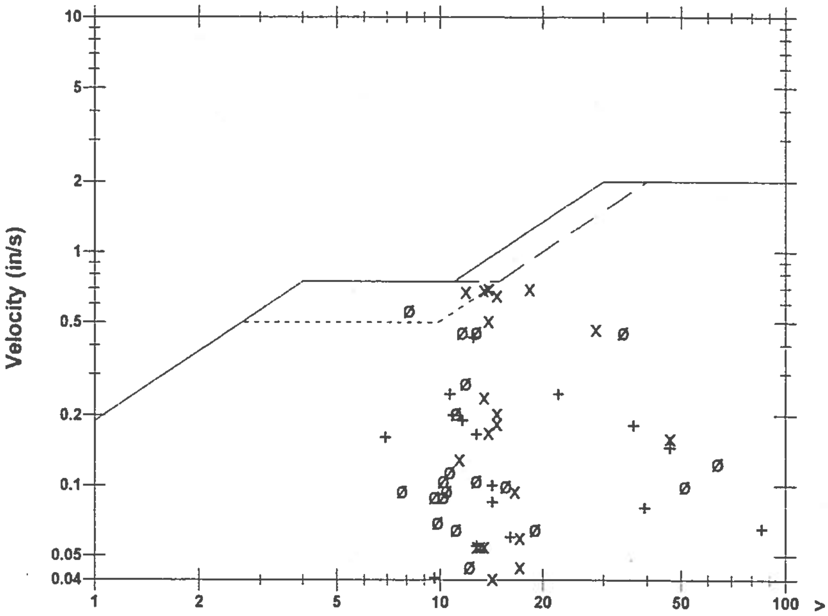
GROUND MOTION STUDY EVENT

Date/Time	Vert at 10:44:31 February 25, 2000	**Serial Number**	BA5738 V 4.02-4.02 BlastMate III
Trigger Source	Geo: 0.0500 in/s	**Battery Level**	6.0 Volts
Range	Geo :10.00 in/s	**Calibration**	October 26, 1999 by Instantel Inc.
Record Time	5.75 sec (Auto=5Sec) at 1024 sps	**File Name**	G7387WN4.I70

Notes
Location:
Client: CC&V
User Name: MMC, Inc.
General: Ground Vibration Attenuation Study

Post Event Notes
Shot 1
Station C

USBM RI8507 And OSMRE



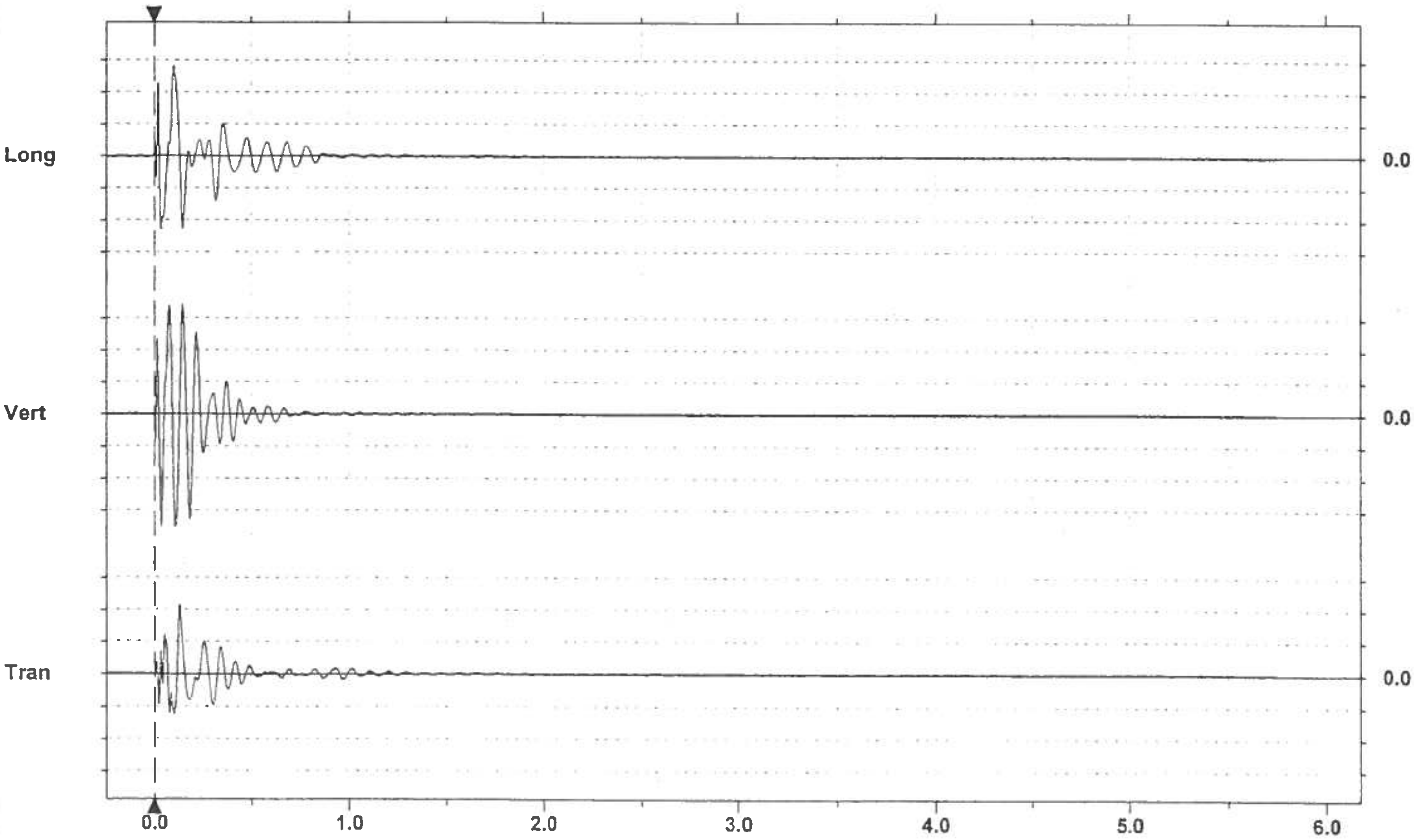
Frequency (Hz)
Tran: + Vert: x Long: ø

Microphone Disabled
PSPL N/A
ZC Freq N/A
Channel Test N/A

	Tran	Vert	Long	
PPV	0.430	0.700	0.565	in/s
ZC Freq	12	18	8.1	Hz
Time (Rel. to Trig)	0.131	0.038	0.101	sec
Peak Acceleration	0.133	0.239	0.252	g
Peak Displacement	0.00467	0.00860	0.00910	in
Sensorcheck ™	Passed	Passed	Passed	

Peak Vector Sum 0.889 in/s at 0.106 sec

N/A: Not Applicable



Time Scale: 0.50 sec/div **Amplitude Scale:** Geo: 0.200 in/s/div
Trigger = ▶— — — ◀

GROUND MOTION STUDY EVENT

Date/Time	Vert at 10:48:55 February 25, 2000	**Serial Number**	BA6008 V 4.02-4.02 BlastMate III
Trigger Source	Geo: 0.0500 in/s	**Battery Level**	6.2 Volts
Range	Geo :10.00 in/s	**Calibration**	May 26, 1999 by Instantel Inc.
Record Time	5.75 sec (Auto=5Sec) at 1024 sps	**File Name**	H0087WN4.PJ0

Notes
Location:
Client: CC&V
User Name: MMC, Inc.
General: Ground Motion Attenuation Study

Post Event Notes
Shot 1
Station D

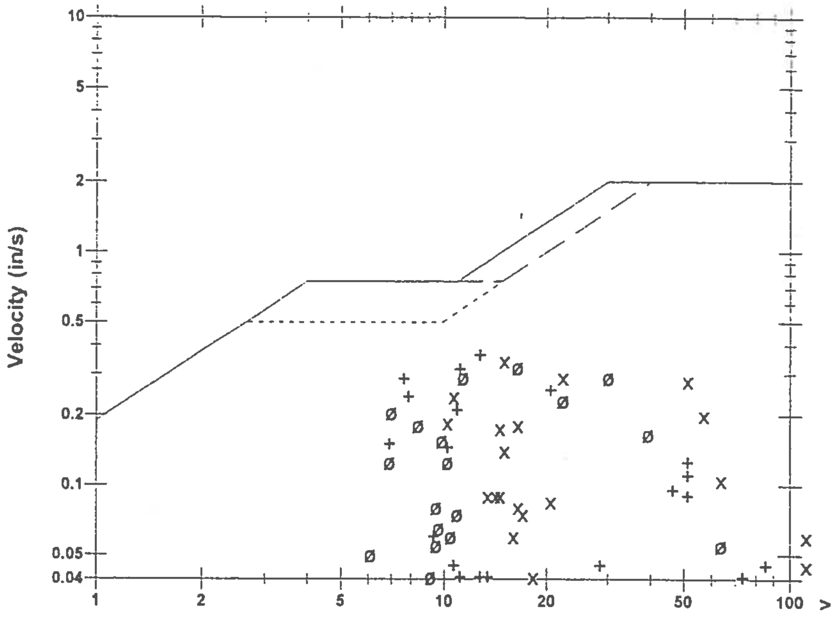
Microphone	Disabled
PSPL	N/A
ZC Freq	N/A
Channel Test	N/A

	Tran	Vert	Long	
PPV	0.360	0.340	0.320	in/s
ZC Freq	13	15	17	Hz
Time (Rel. to Trig)	0.137	0.118	0.081	sec
Peak Acceleration	0.119	0.278	0.172	g
Peak Displacement	0.00520	0.00330	0.00401	in
Sensorcheck ™	Passed	Passed	Passed	

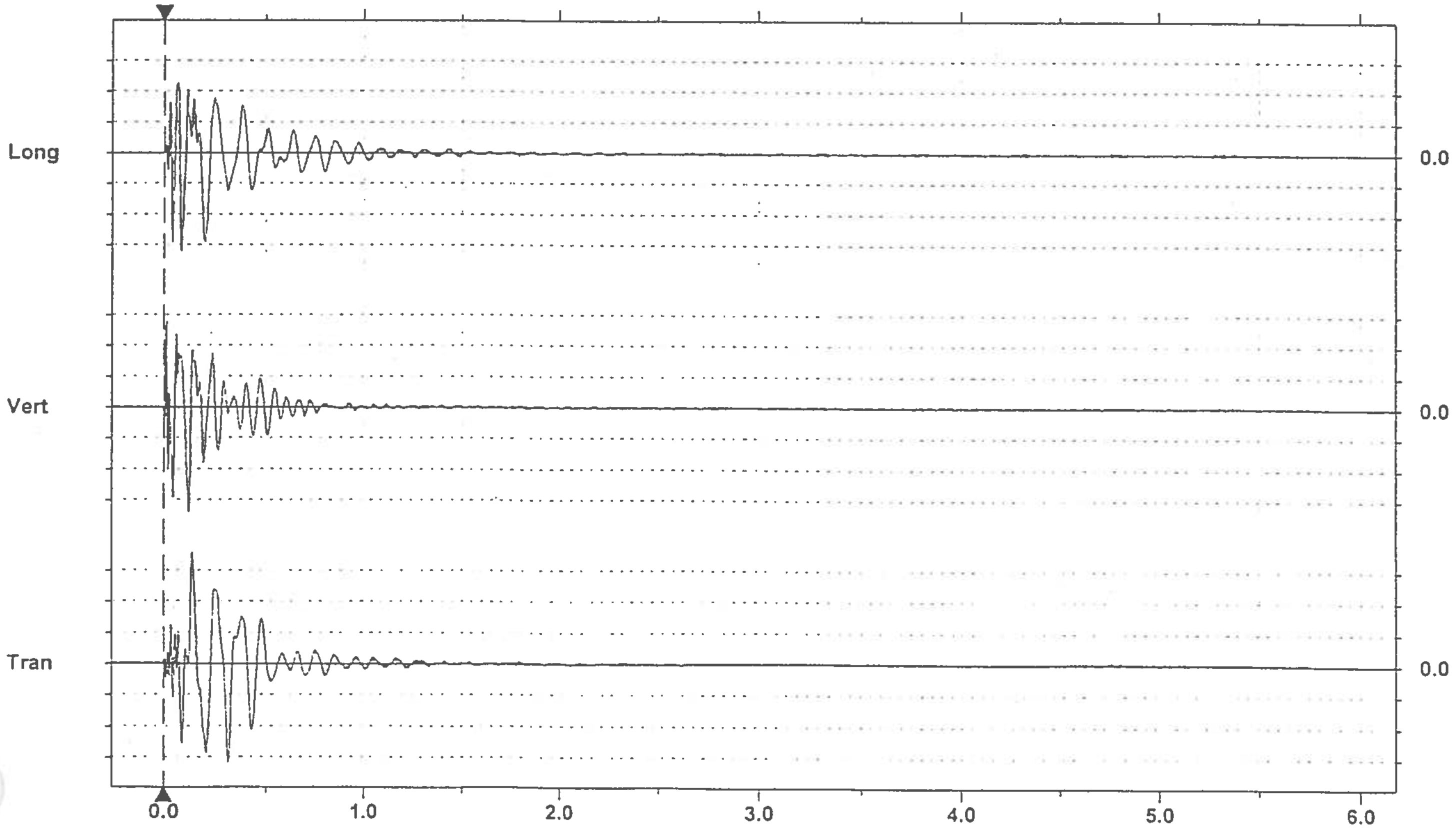
Peak Vector Sum 0.422 in/s at 0.083 sec

N/A: Not Applicable

USBM RI8507 And OSMRE



Frequency (Hz)
Tran: + Vert: x Long: ø



Time Scale: 0.50 sec/div **Amplitude Scale:** Geo: 0.100 in/s/div
Trigger = ▶— — —◀

GROUND MOTION STUDY EVENT

Date/Time	Vert at 10:46:45 February 25, 2000	**Serial Number**	BA5546 V 4.02-4.02 BlastMate III
Trigger Source	Geo: 0.0200 in/s	**Battery Level**	6.1 Volts
Range	Geo :10.00 in/s	**Calibration**	August 9, 1999 by Instantel Inc.
Record Time	6.25 sec (Auto=5Sec) at 1024 sps	**File Name**	G5467WN4.LX0

Notes
Location:
Client: CC&V
User: MMC, Inc.
Ground Vibration Attenuation Study

Post Event Notes
Shot 1
Station E

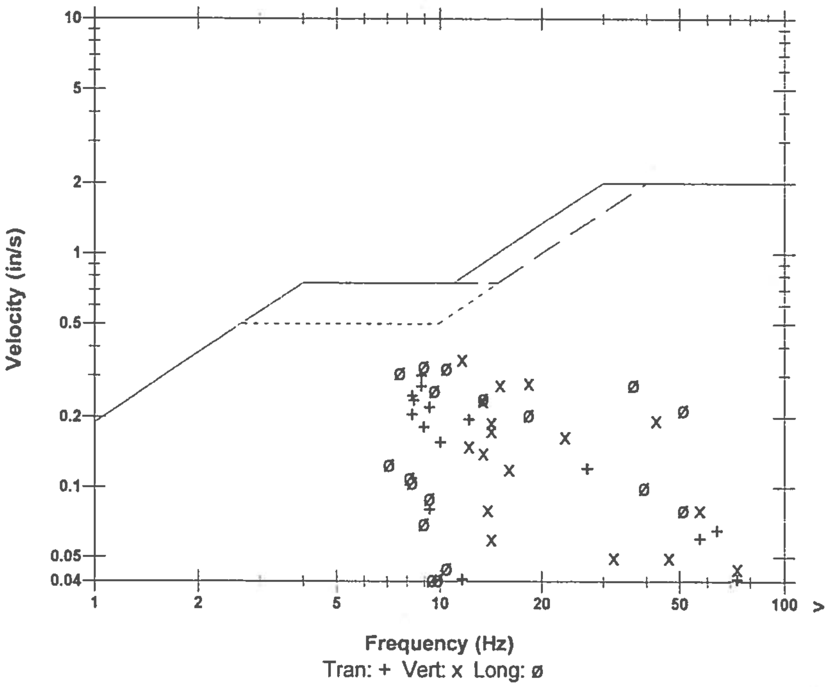
Microphone	Disabled
PSPL	N/A
ZC Freq	N/A
Channel Test	N/A

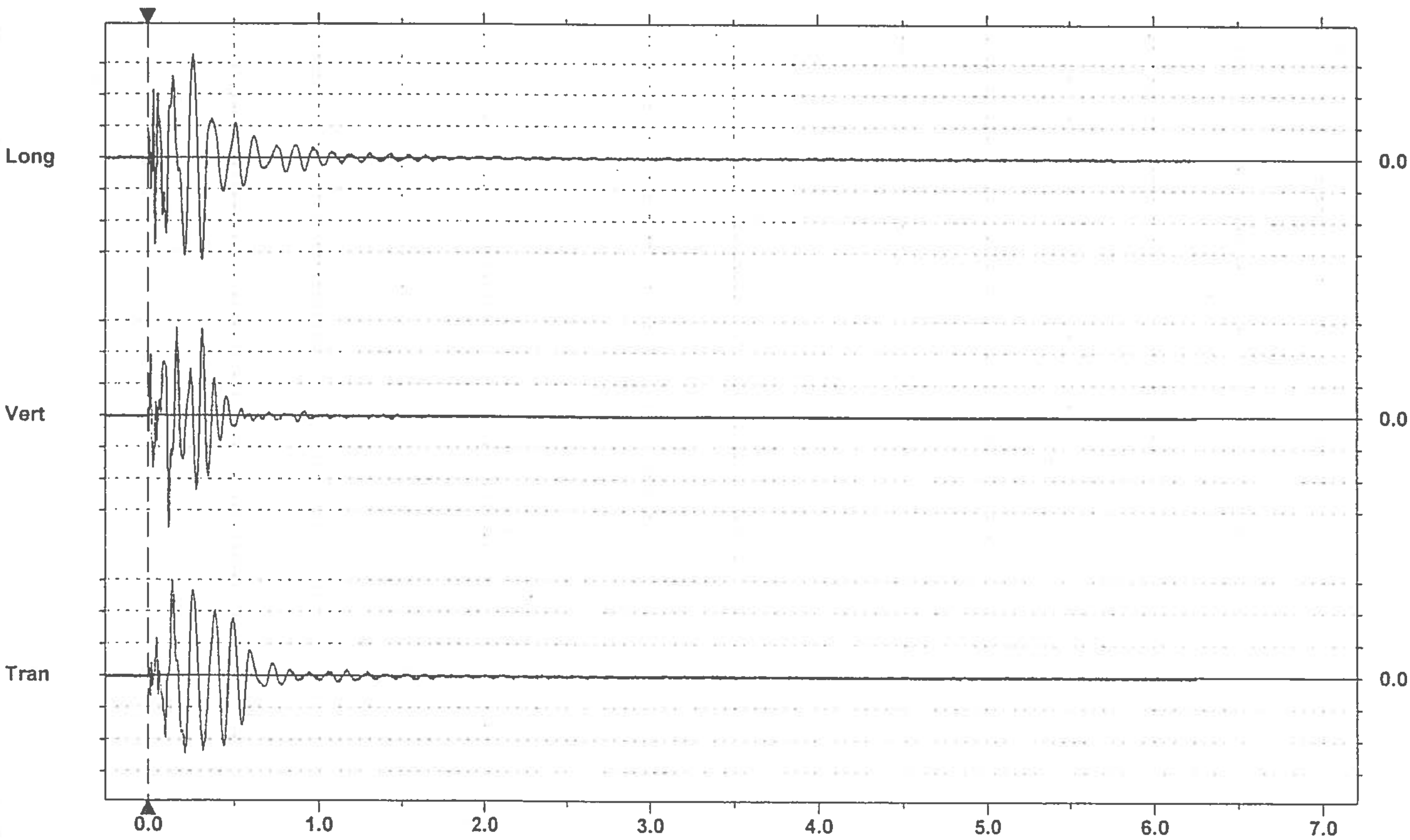
	Tran	Vert	Long	
PPV	0.300	0.355	0.330	in/s
ZC Freq	8.8	12	9.0	Hz
Time (Rel. to Trig)	0.138	0.118	0.258	sec
Peak Acceleration	0.0795	0.146	0.199	g
Peak Displacement	0.00479	0.00345	0.00572	in
Sensorcheck ™	Passed	Passed	Passed	

Peak Vector Sum 0.480 in/s at 0.314 sec

N/A: Not Applicable

USBM RI8507 And OSMRE





Time Scale: 0.50 sec/div **Amplitude Scale:** Geo: 0.100 in/s/div
Trigger = ▶— — — ◀

Printed: February 29, 2000 (V 3.74g - 3.74g)

GROUND MOTION STUDY EVENT

Date/Time	Vert at 10:50:21 February 25, 2000
Trigger Source	Geo: 0.0500 in/s
Range	Geo :10.00 in/s
Record Time	5.75 sec (Auto=5Sec) at 1024 sps

Serial Number	BC6255 V 4.02-4.02 MiniMate Plus
Battery Level	6.2 Volts
Calibration	November 4, 1999 by Instantel Inc.
File Name	H2557WN4.RX0

Notes
Location:
Client: CC&V
User Name: MMC, Inc.
General: Ground Motion Attenuation Study

Extended Notes

Post Event Notes
Shot 1
Station F

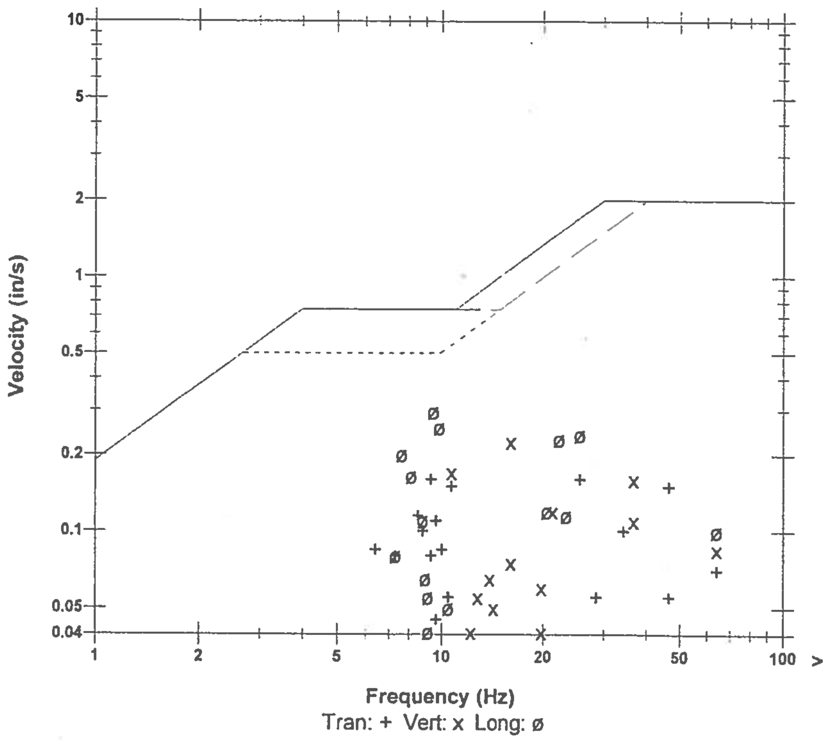
Microphone	Disabled
PSPL	N/A
ZC Freq	N/A
Channel Test	N/A

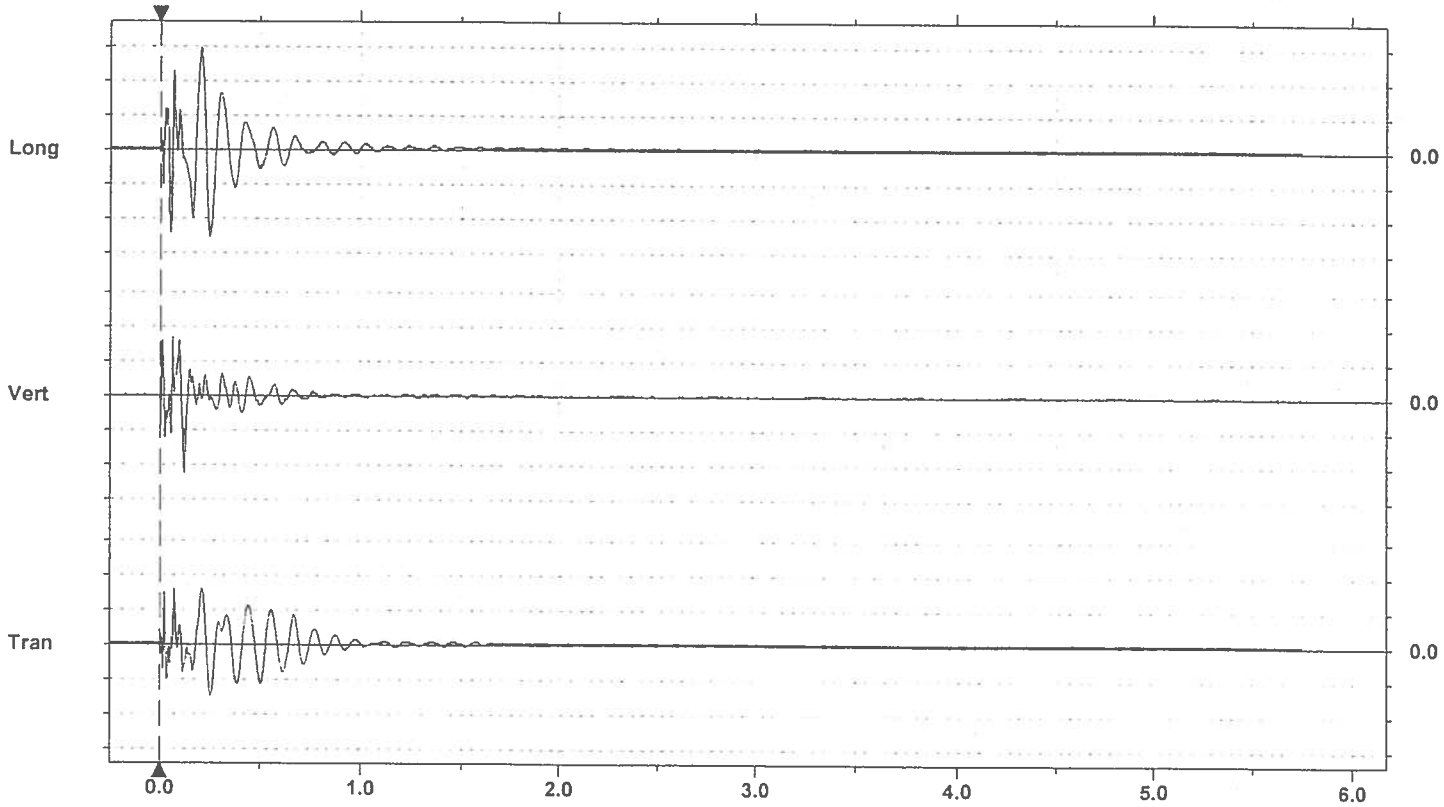
	Tran	Vert	Long	
PPV	0.160	0.225	0.295	in/s
ZC Freq	26	16	9.5	Hz
Time (Rel. to Trig)	0.072	0.121	0.201	sec
Peak Acceleration	0.119	0.146	0.146	g
Peak Displacement	0.00249	0.00209	0.00482	in
Sensorcheck ™	Passed	Passed	Passed	

Peak Vector Sum 0.329 in/s at 0.206 sec

N/A: Not Applicable

USBM RI8507 And OSMRE





Time Scale: 0.50 sec/div **Amplitude Scale:** Geo: 0.100 in/s/div
Trigger = ▶— — — ◀

Printed: February 29, 2000 (V 3.74g - 3.74g)

GROUND MOTION STUDY EVENT

Date/Time	Vert at 10:49:51 February 25, 2000	**Serial Number**	BC5536 V 4.02-4.02 MiniMate Plus
Trigger Source	Geo: 0.0500 in/s	**Battery Level**	6.3 Volts
Range	Geo :10.00 in/s	**Calibration**	January 24, 2000 by Instantel Inc.
Record Time	3.75 sec (Auto=3Sec) at 1024 sps	**File Name**	G5367WN4.R30

Notes
Location:
Client:
User Name:
General:

Post Event Notes
M.M.C., Inc., for CC&V
Ground Vibration Attenuation Study
Shot 1
Station G

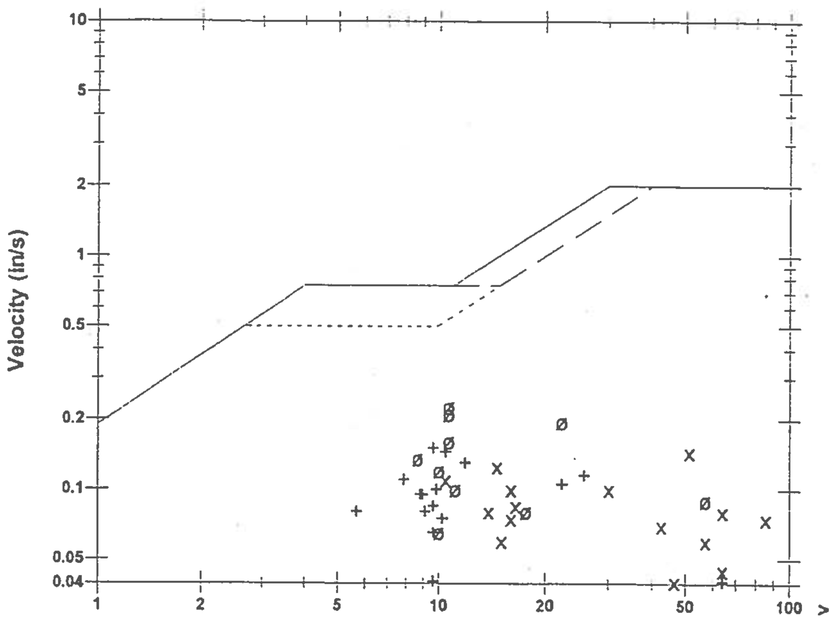
Microphone	Disabled
PSPL	N/A
ZC Freq	N/A
Channel Test	N/A

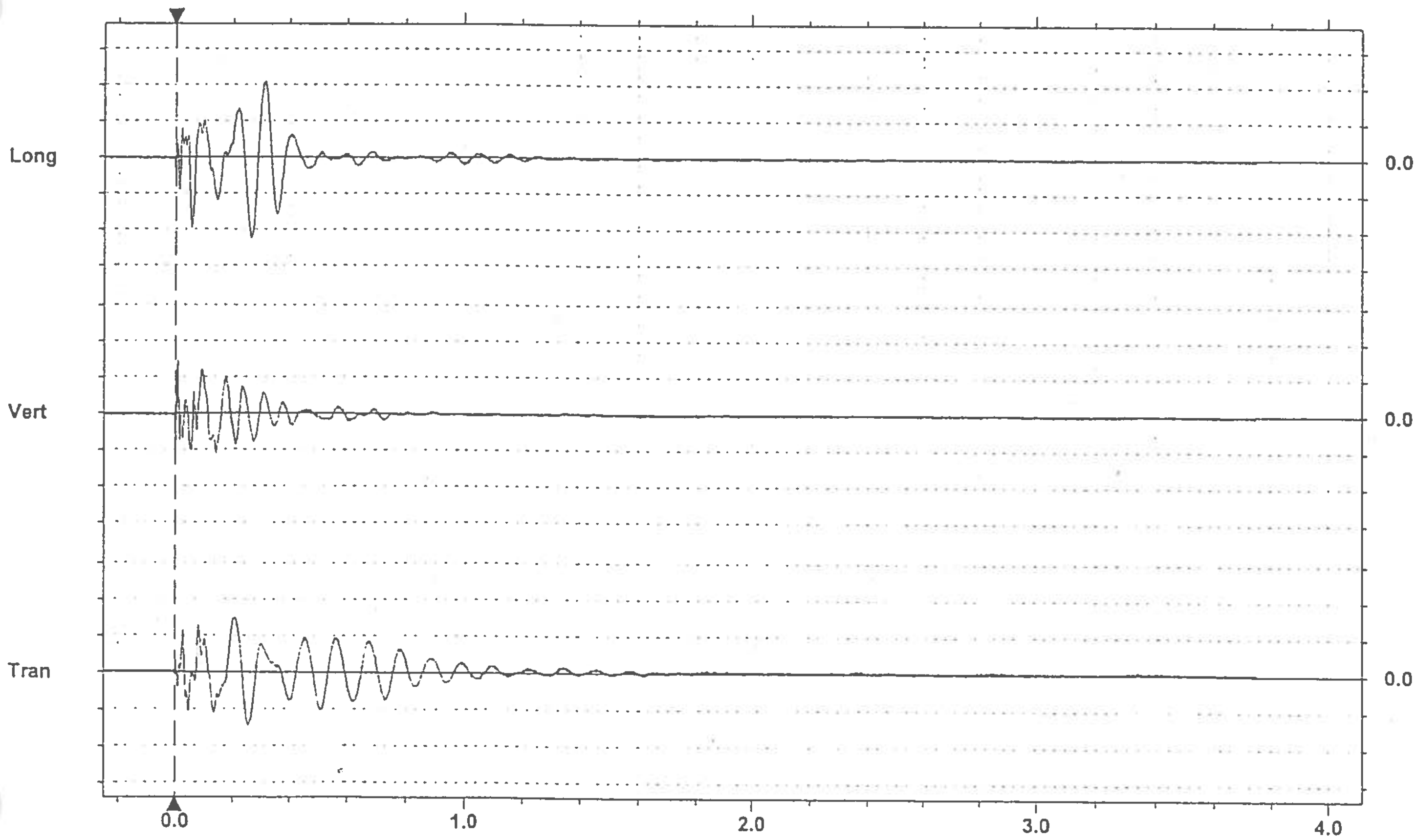
	Tran	Vert	Long	
PPV	0.150	0.145	0.225	in/s
ZC Freq	9.7	51	11	Hz
Time (Rel. to Trig)	0.206	0.009	0.264	sec
Peak Acceleration	0.0928	0.146	0.106	g
Peak Displacement	0.00254	0.00160	0.00331	in
Sensorcheck ™	Passed	Passed	Passed	

Peak Vector Sum 0.264 in/s at 0.264 sec

N/A: Not Applicable

USBM RI8507 And OSMRE





Time Scale: 0.20 sec/div Amplitude Scale: Geo: 0.100 in/s/div
Trigger = ▶— — —◀

GROUND MOTION STUDY EVENT

Date/Time	Vert at 10:46:53 February 25, 2000	**Serial Number**	BC6248 V 4.02-4.02 MiniMate Plus
Trigger Source	Geo: 0.0500 in/s	**Battery Level**	6.2 Volts
Range	Geo :10.00 in/s	**Calibration**	September 22, 1999 by Instantel Inc.
Record Time	3.75 sec (Auto=3Sec) at 1024 sps	**File Name**	H2487WN4.M50

Notes
Location:
Client:
User Name:
General:

Post Event Notes
M.M.C. Inc., for CC&V
Ground Motion Attenuation Study
Shot 1
Station I

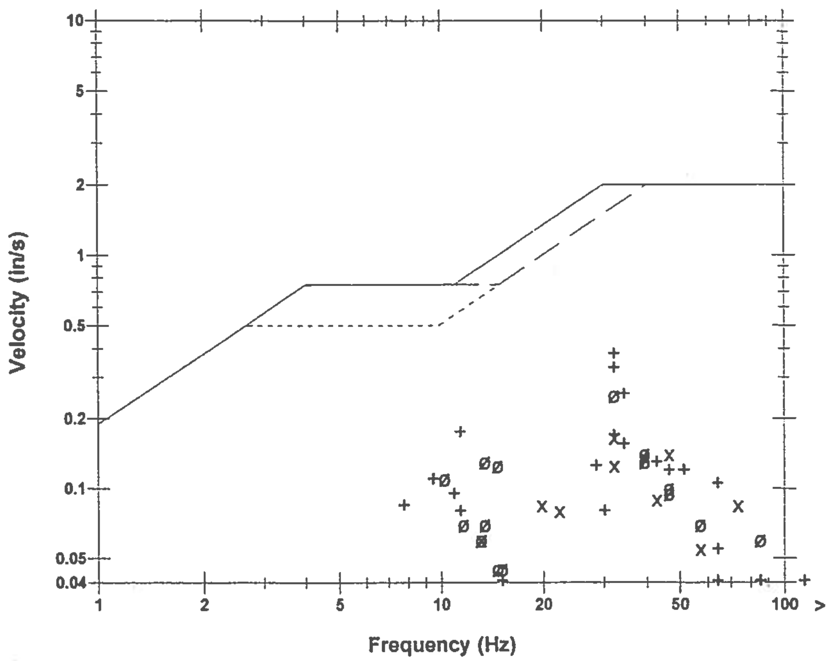
Microphone	Disabled
PSPL	N/A
ZC Freq	N/A
Channel Test	N/A

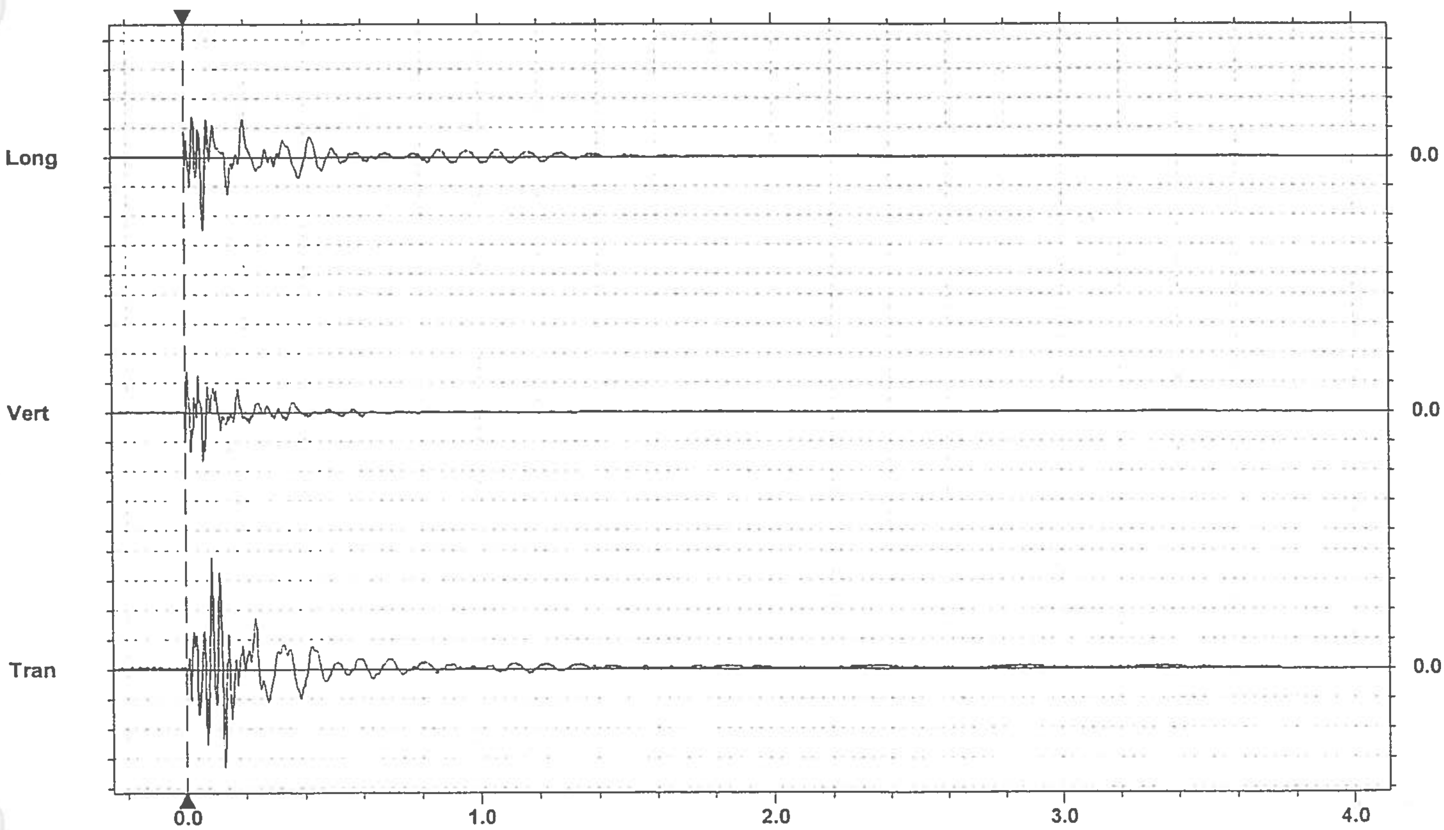
	Tran	Vert	Long	
PPV	0.380	0.165	0.250	in/s
ZC Freq	32	32	32	Hz
Time (Rel. to Trig)	0.087	0.060	0.063	sec
Peak Acceleration	0.199	0.186	0.146	g
Peak Displacement	0.00184	0.00081	0.00125	in
Sensorcheck ™	Passed	Passed	Passed	

Peak Vector Sum 0.381 in/s at 0.087 sec

N/A: Not Applicable

USBM RI8507 And OSMRE





Time Scale: 0.20 sec/div **Amplitude Scale:** Geo: 0.100 in/s/div
Trigger = ▶— — — ◀

Printed: February 29, 2000 (V 3.74g - 3.74g)

GROUND MOTION STUDY EVENT

Date/Time	Vert at 10:49:49 February 25, 2000	**Serial Number**	BC5534 V 4.02-4.02 MiniMate Plus
Trigger Source	Geo: 0.0500 in/s	**Battery Level**	6.3 Volts
Range	Geo :10.00 in/s	**Calibration**	November 24, 1999 by Instantel Inc.
Record Time	5.75 sec (Auto=5Sec) at 1024 sps	**File Name**	G5347WN4.R10

Notes
Location:
Client: CC&V
User Name: MMC, Inc.
General: Ground Motion Attenuation Study

Post Event Notes
Shot 1
Station J

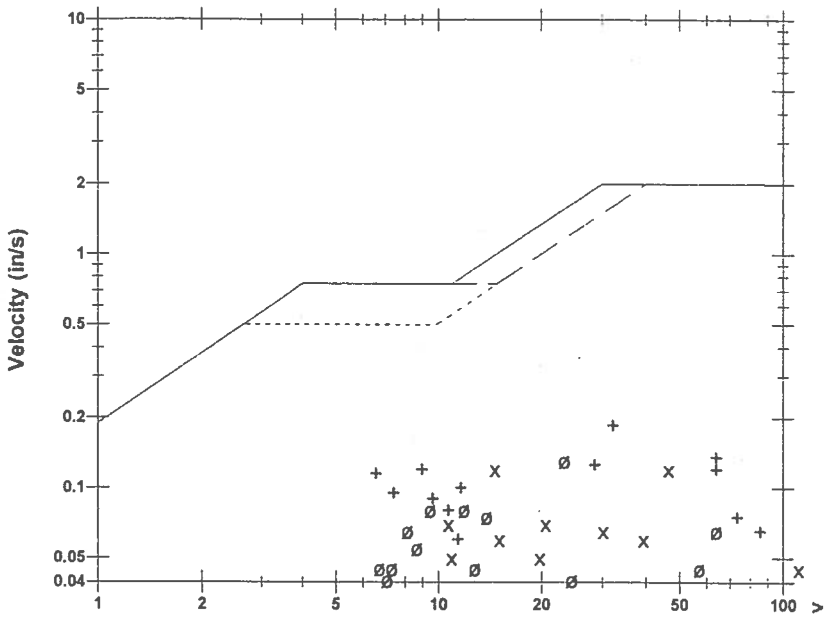
Microphone Disabled
PSPL N/A
ZC Freq N/A
Channel Test N/A

	Tran	Vert	Long	
PPV	0.185	0.120	0.130	in/s
ZC Freq	32	47	23	Hz
Time (Rel. to Trig)	0.018	0.004	0.058	sec
Peak Acceleration	0.172	0.106	0.106	g
Peak Displacement	0.00245	0.00162	0.00184	in
Sensorcheck ™	Passed	Passed	Passed	

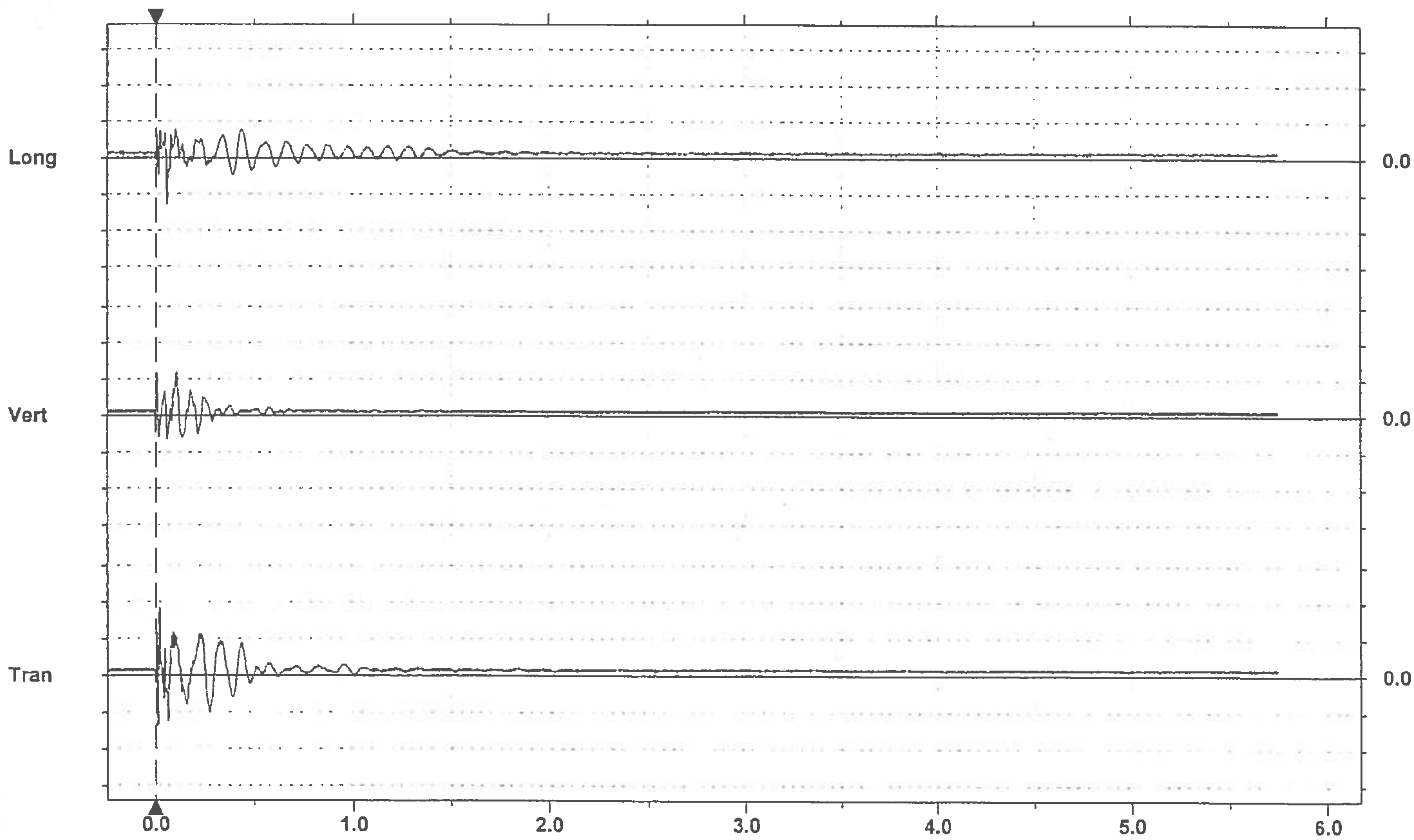
Peak Vector Sum 0.201 in/s at 0.019 sec

N/A: Not Applicable

USBM RI8507 And OSMRE



Frequency (Hz)
Tran: + Vert: x Long: ø



Time Scale: 0.50 sec/div **Amplitude Scale:** Geo: 0.100 in/s/div
Trigger = ▶— — —◀

Printed: February 29, 2000 (V 3.74g - 3.74g) **Format Copyrighted 1996-1999**

GROUND MOTION STUDY EVENT

Date/Time	Vert at 10:49:38 February 25, 2000	**Serial Number**	BC5571 V 4.02-4.02 MiniMate Plus
Trigger Source	Geo: 0.0500 in/s	**Battery Level**	6.2 Volts
Range	Geo :10.00 in/s	**Calibration**	July 21, 1999 by Instantel Inc.
Record Time	5.75 sec (Auto=5Sec) at 1024 sps	**File Name**	G5717WN4.QQ0

Notes
Location:
Client: CC&V
User Name: MMC, Inc.
General: Ground Motion Attenuation Study

Post Event Notes
Shot 1
Station K

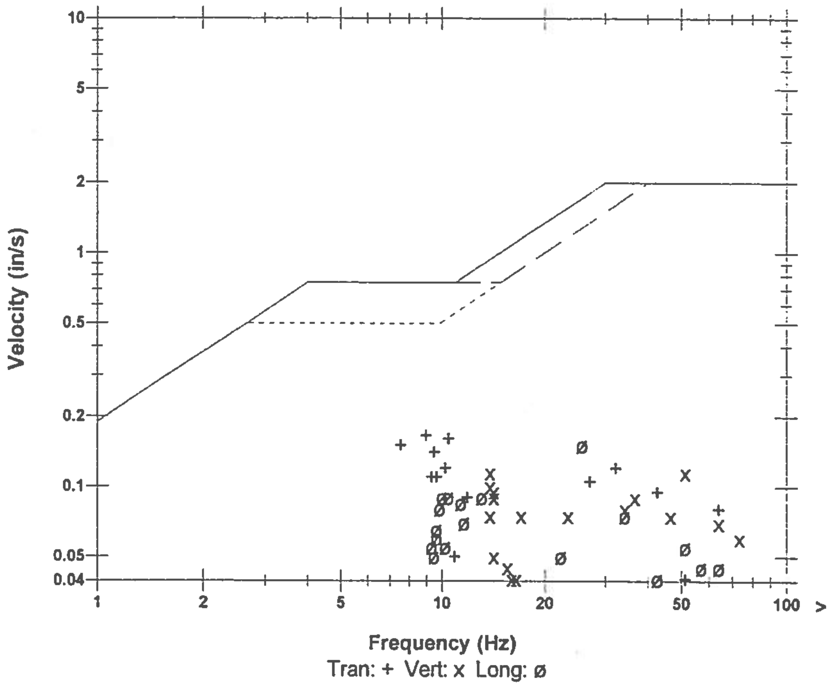
Microphone Disabled
PSPL N/A
ZC Freq N/A
Channel Test N/A

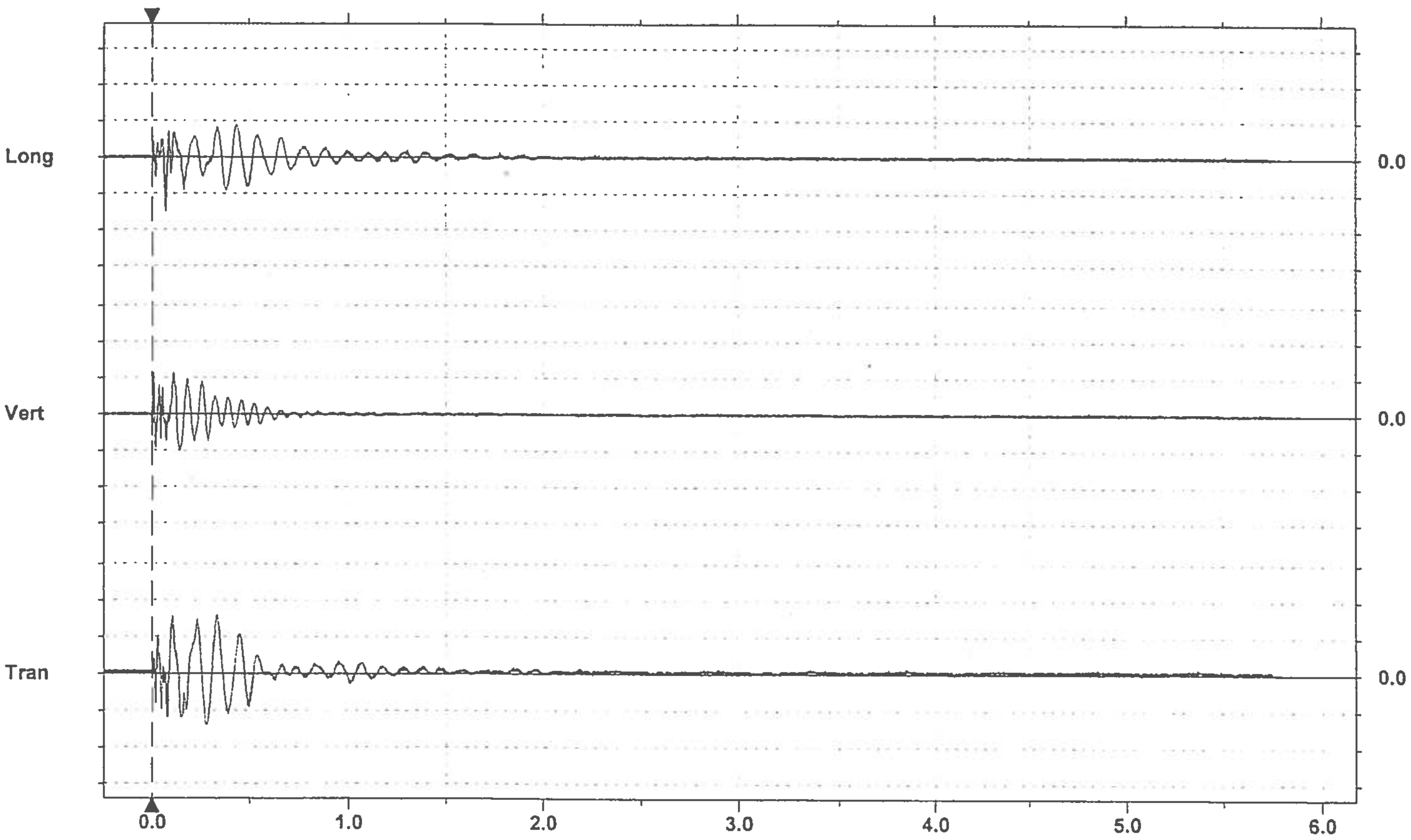
	Tran	Vert	Long	
PPV	0.165	0.115	0.150	in/s
ZC Freq	9.0	51	26	Hz
Time (Rel. to Trig)	0.336	0.008	0.069	sec
Peak Acceleration	0.0795	0.106	0.0663	g
Peak Displacement	0.00274	0.00125	0.00145	in
Sensorcheck ™	Passed	Passed	Passed	

Peak Vector Sum 0.199 in/s at 0.110 sec

N/A: Not Applicable

USBM RI8507 And OSMRE





Time Scale: 0.50 sec/div **Amplitude Scale:** Geo: 0.100 in/s/div
Trigger = ▶— — — —◀

Test Shot 2

GROUND MOTION STUDY EVENT

Date/Time	Tran at 11:02:20 February 25, 2000
Trigger Source	Geo: 0.0500 in/s
Range	Geo :10.00 in/s
Record Time	5.75 sec (Auto=3Sec) at 1024 sps

Serial Number	BC6796 V 4.02-4.02 MiniMate Plus
Battery Level	6.3 Volts
Calibration	October 8, 1999 by Instantel Inc.
File Name	H7967WN5.BW0

Notes
Location:
Client:
User Name:
General:

Post Event Notes
M.M.C. Inc., for CC&V
Ground Motion Attenuation Study
Shot 2
Station B

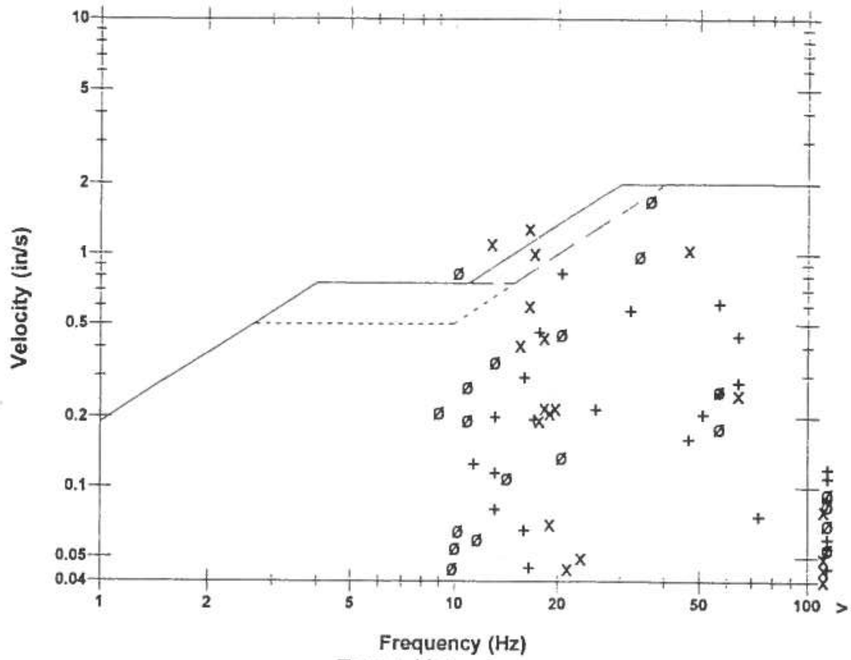
Microphone	Disabled
PSPL	N/A
ZC Freq	N/A
Channel Test	N/A

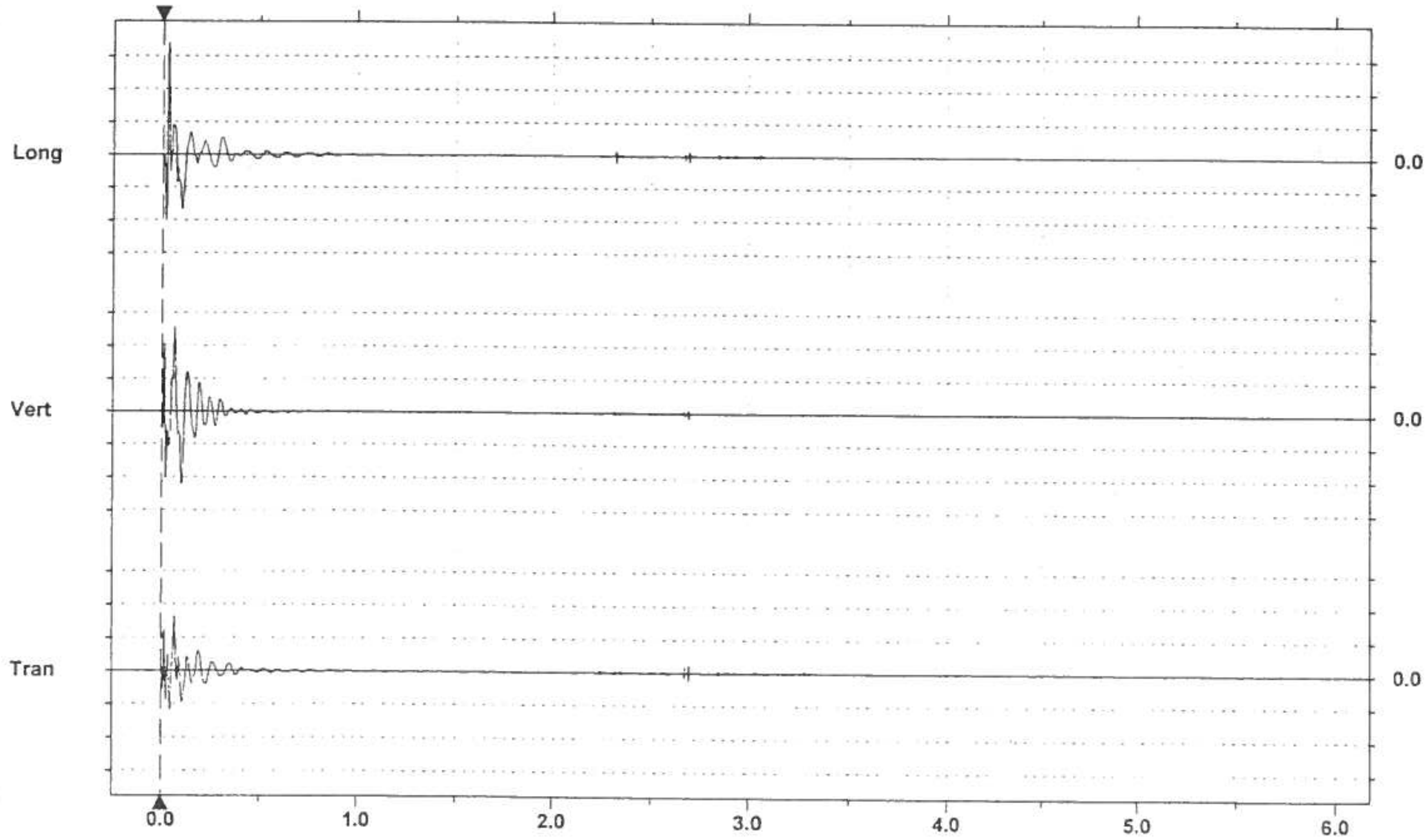
	Tran	Vert	Long	
PPV	0.825	1.29	1.70	in/s
ZC Freq	20	17	37	Hz
Time (Rel. to Trig)	0.067	0.065	0.028	sec
Peak Acceleration	0.477	1.30	1.19	g
Peak Displacement	0.00497	0.0105	0.0108	in
Sensorcheck ™	Passed	Passed	Passed	

Peak Vector Sum 1.74 in/s at 0.028 sec

N/A: Not Applicable

USBM RI8507 And OSMRE





Time Scale: 0.50 sec/div **Amplitude Scale:** Geo: 0.500 in/s/div
Trigger = ▶— — — ◀

Printed: February 29, 2000 (V 3.74g - 3.74g)

GROUND MOTION STUDY EVENT

Date/Time	Vert at 11:01:08 February 25, 2000	**Serial Number**	BA6008 V 4.02-4.02 BlastMate III
Trigger Source	Geo: 0.0500 in/s	**Battery Level**	6.2 Volts
Range	Geo :10.00 in/s	**Calibration**	May 26, 1999 by Instantel Inc.
Record Time	5.75 sec (Auto=5Sec) at 1024 sps	**File Name**	H0087WN5.9W0

Notes
Location:
Client: CC&V
User Name: MMC, Inc.
General: Ground Motion Attenuation Study

Post Event Notes
Shot 2
Station D

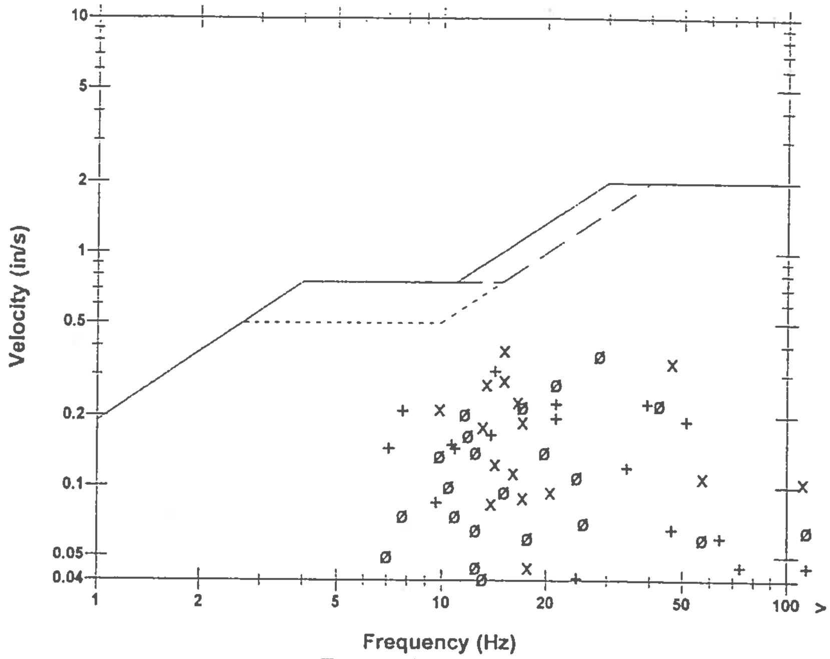
Microphone Disabled
PSPL N/A
ZC Freq N/A
Channel Test N/A

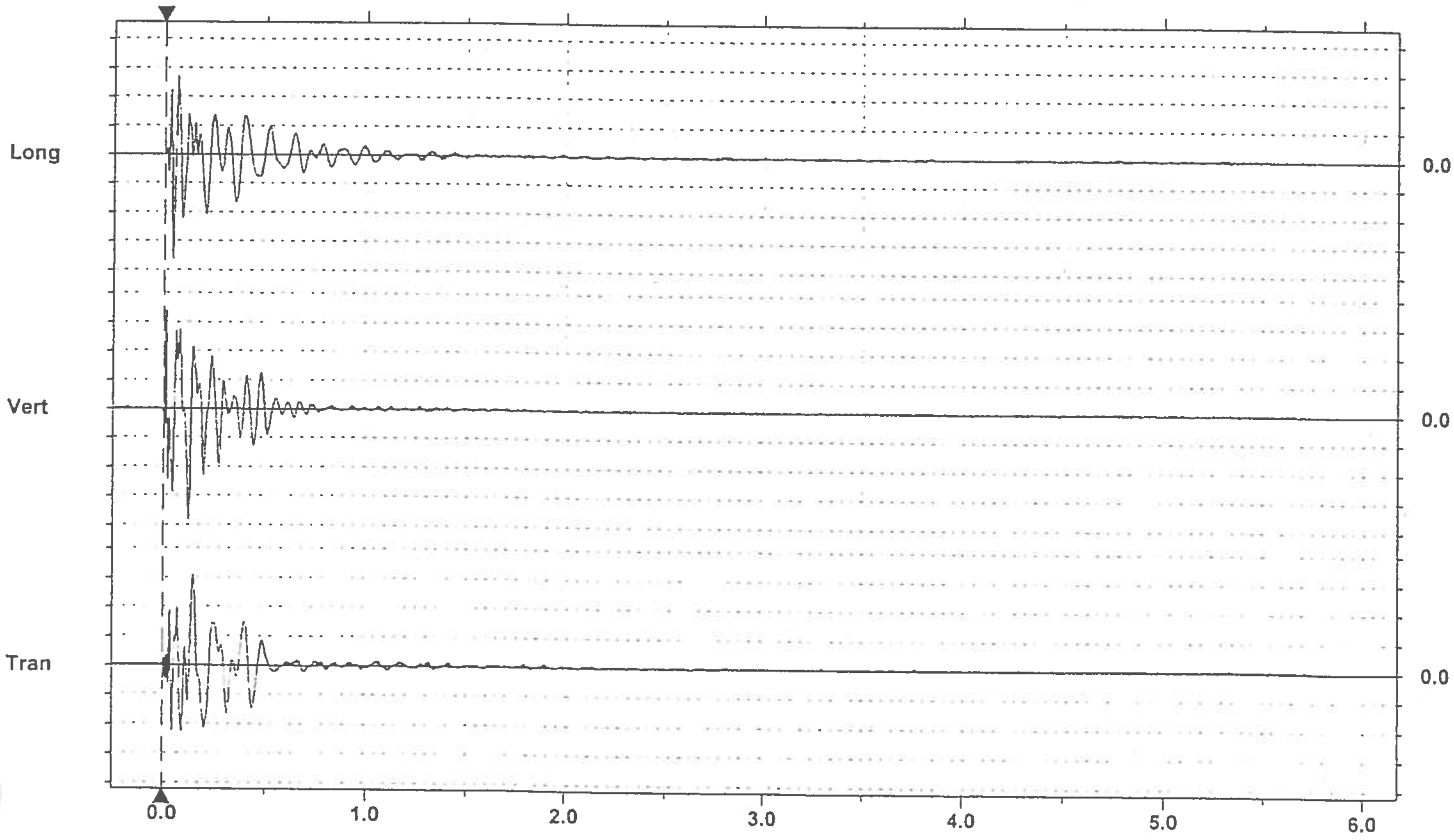
	Tran	Vert	Long	
PPV	0.310	0.385	0.365	in/s
ZC Freq	14	15	28	Hz
Time (Rel. to Trig)	0.143	0.121	0.041	sec
Peak Acceleration	0.159	0.318	0.199	g
Peak Displacement	0.00376	0.00342	0.00269	in
Sensorcheck ™	Passed	Passed	Passed	

Peak Vector Sum 0.473 in/s at 0.042 sec

N/A: Not Applicable

USBM RI8507 And OSMRE





Time Scale: 0.50 sec/div **Amplitude Scale:** Geo: 0.100 in/s/div
Trigger = ▶— — — ◀

Printed: February 29, 2000 (V 3.74g - 3.74g)

GROUND MOTION STUDY EVENT

Date/Time	Vert at 10:58:58 February 25, 2000	**Serial Number**	BA5546 V 4.02-4.02 BlastMate III
Trigger Source	Geo: 0.0200 in/s	**Battery Level**	6.1 Volts
Range	Geo :10.00 in/s	**Calibration**	August 9, 1999 by Instantel Inc.
Record Time	6.25 sec (Auto=5Sec) at 1024 sps	**File Name**	G5467WN5.6A0

Notes
Location:
Client: CC&V
User: MMC, Inc.
Ground Vibration Attenuation Study

Post Event Notes
Shot 2
Station E

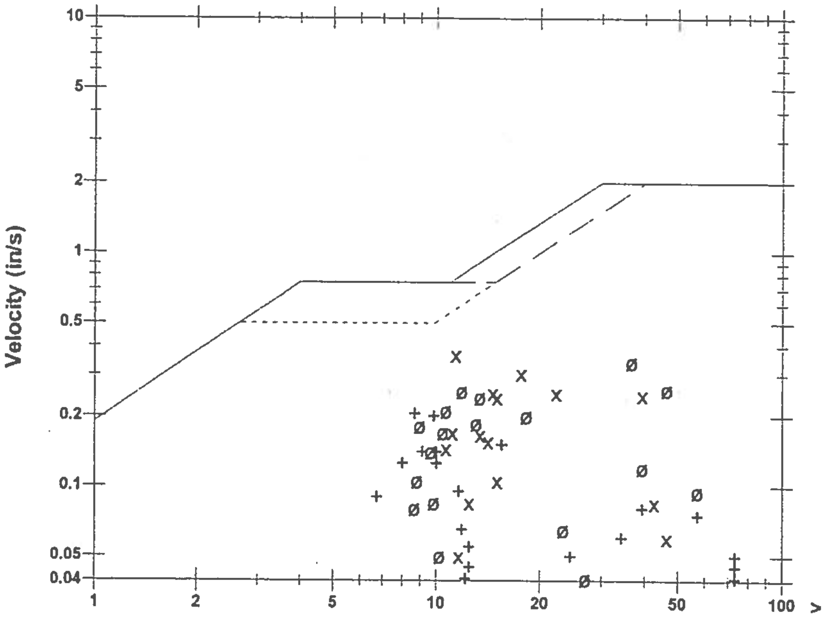
Microphone	Disabled
PSPL	N/A
ZC Freq	N/A
Channel Test	N/A

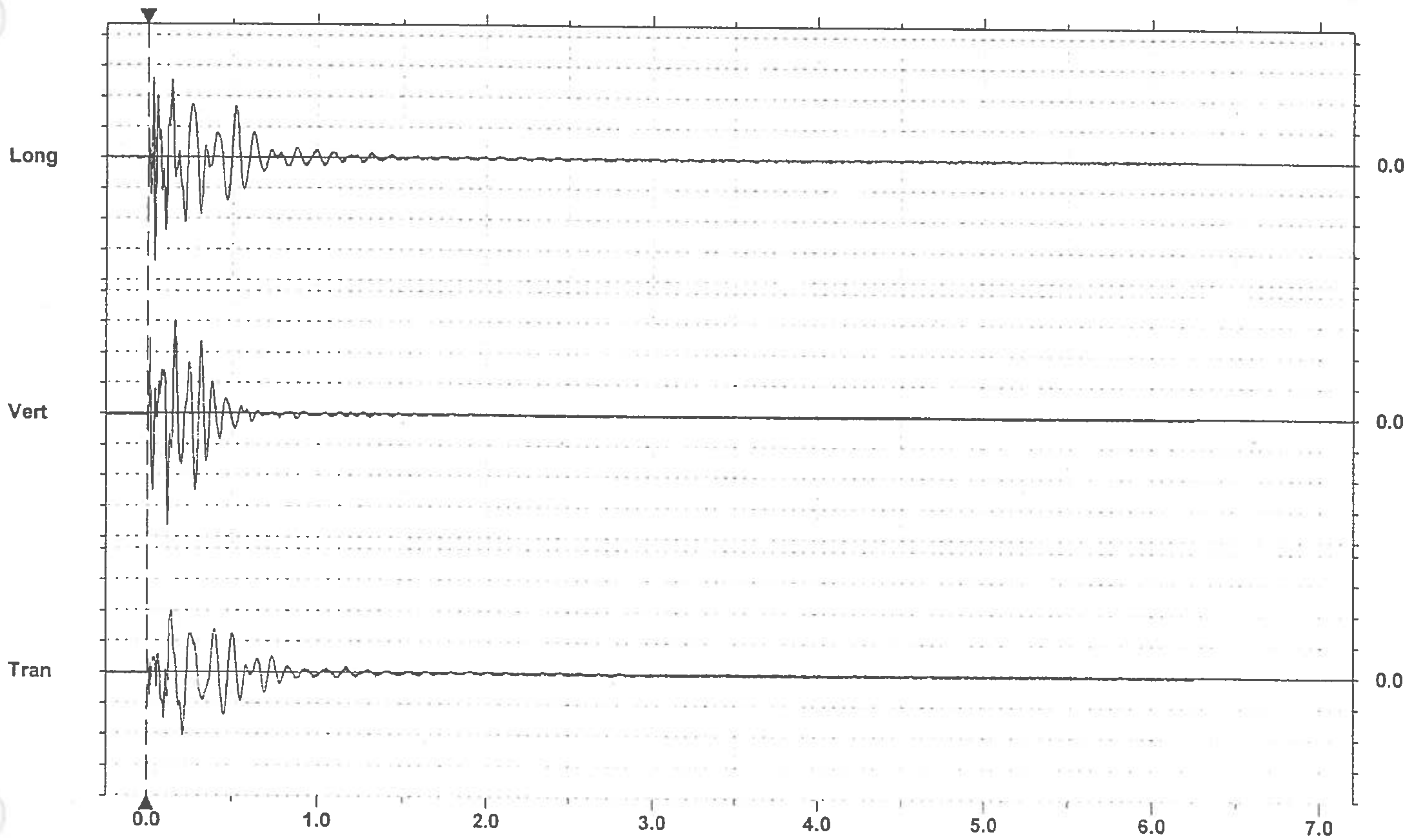
	Tran	Vert	Long	
PPV	0.205	0.365	0.340	in/s
ZC Freq	8.7	11	37	Hz
Time (Rel. to Trig)	0.211	0.119	0.042	sec
Peak Acceleration	0.0663	0.159	0.239	g
Peak Displacement	0.00326	0.00341	0.00331	in
Sensorcheck ™	Passed	Passed	Passed	

Peak Vector Sum 0.387 in/s at 0.119 sec

N/A: Not Applicable

USBM RI8507 And OSMRE





Time Scale: 0.50 sec/div **Amplitude Scale:** Geo: 0.100 in/s/div
Trigger = ▶— — —◀

Printed: February 29, 2000 (V 3.74g - 3.74g)

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GROUND MOTION STUDY EVENT

Date/Time	Vert at 11:02:35 February 25, 2000
Trigger Source	Geo: 0.0500 in/s
Range	Geo :10.00 in/s
Record Time	5.75 sec (Auto=5Sec) at 1024 sps
Serial Number	BC6255 V 4.02-4.02 MiniMate Plus
Battery Level	6.1 Volts
Calibration	November 4, 1999 by Instantel Inc.
File Name	H2557WN5.CB0

Notes
Location:
Client: CC&V
User Name: MMC, Inc.
General: Ground Motion Attenuation Study

Extended Notes

Post Event Notes
Shot 2
Station F

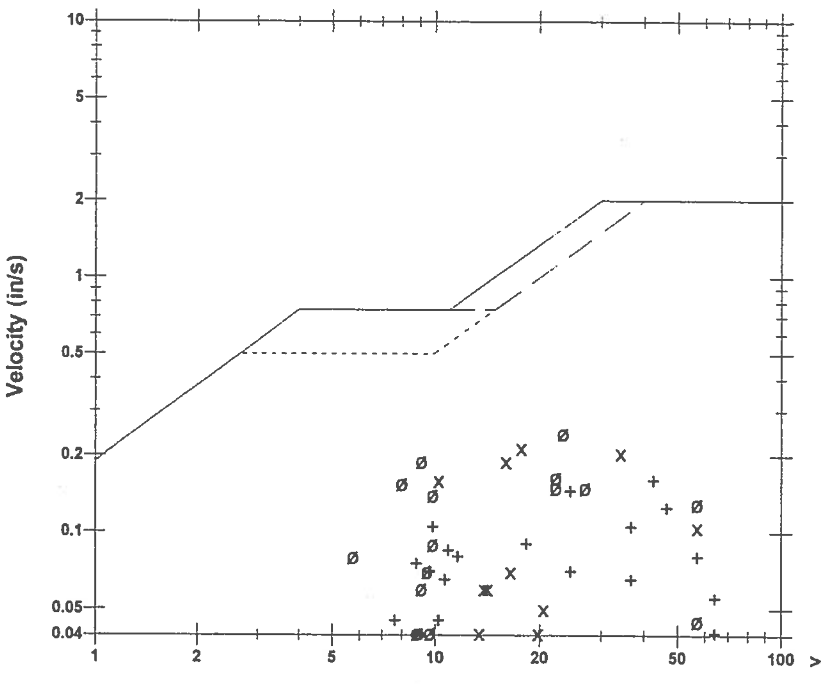
Microphone Disabled
PSPL N/A
ZC Freq N/A
Channel Test N/A

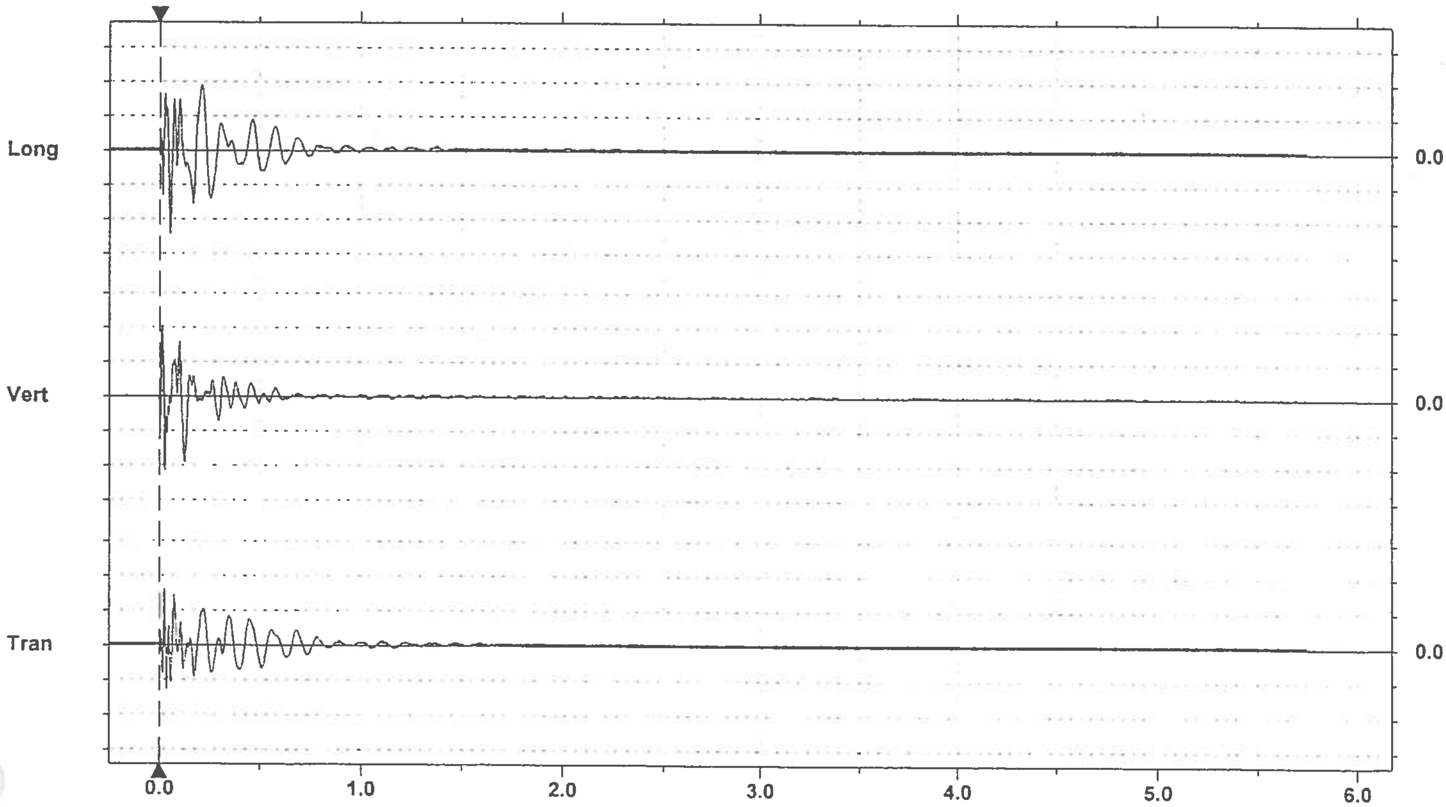
	Tran	Vert	Long	
PPV	0.160	0.215	0.245	in/s
ZC Freq	43	18	23	Hz
Time (Rel. to Trig)	0.023	0.024	0.052	sec
Peak Acceleration	0.119	0.172	0.119	g
Peak Displacement	0.00169	0.00193	0.00332	in
Sensorcheck ™	Passed	Passed	Passed	

Peak Vector Sum 0.307 in/s at 0.024 sec

N/A: Not Applicable

USBM RI8507 And OSMRE





Time Scale: 0.50 sec/div Amplitude Scale: Geo: 0.100 in/s/div
Trigger = ▶— — — ◀

GROUND MOTION STUDY EVENT

Date/Time	Vert at 11:02:04 February 25, 2000
Trigger Source	Geo: 0.0500 in/s
Range	Geo :10.00 in/s
Record Time	3.75 sec (Auto=3Sec) at 1024 sps
Serial Number	BC5536 V 4.02-4.02 MiniMate Plus
Battery Level	6.3 Volts
Calibration	January 24, 2000 by Instantel Inc.
File Name	G5367WN5.BG0

Notes
Location:
Client:
User Name:
General:

Post Event Notes
M.M.C., Inc., for CC&V
Ground Motion Attenuation Study
Shot 2
Station G

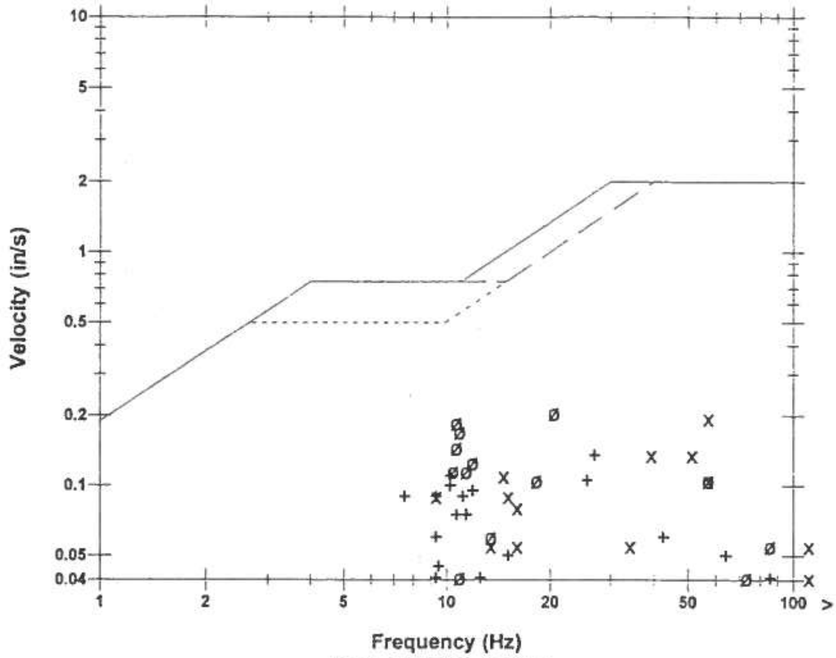
Microphone	Disabled
PSPL	N/A
ZC Freq	N/A
Channel Test	N/A

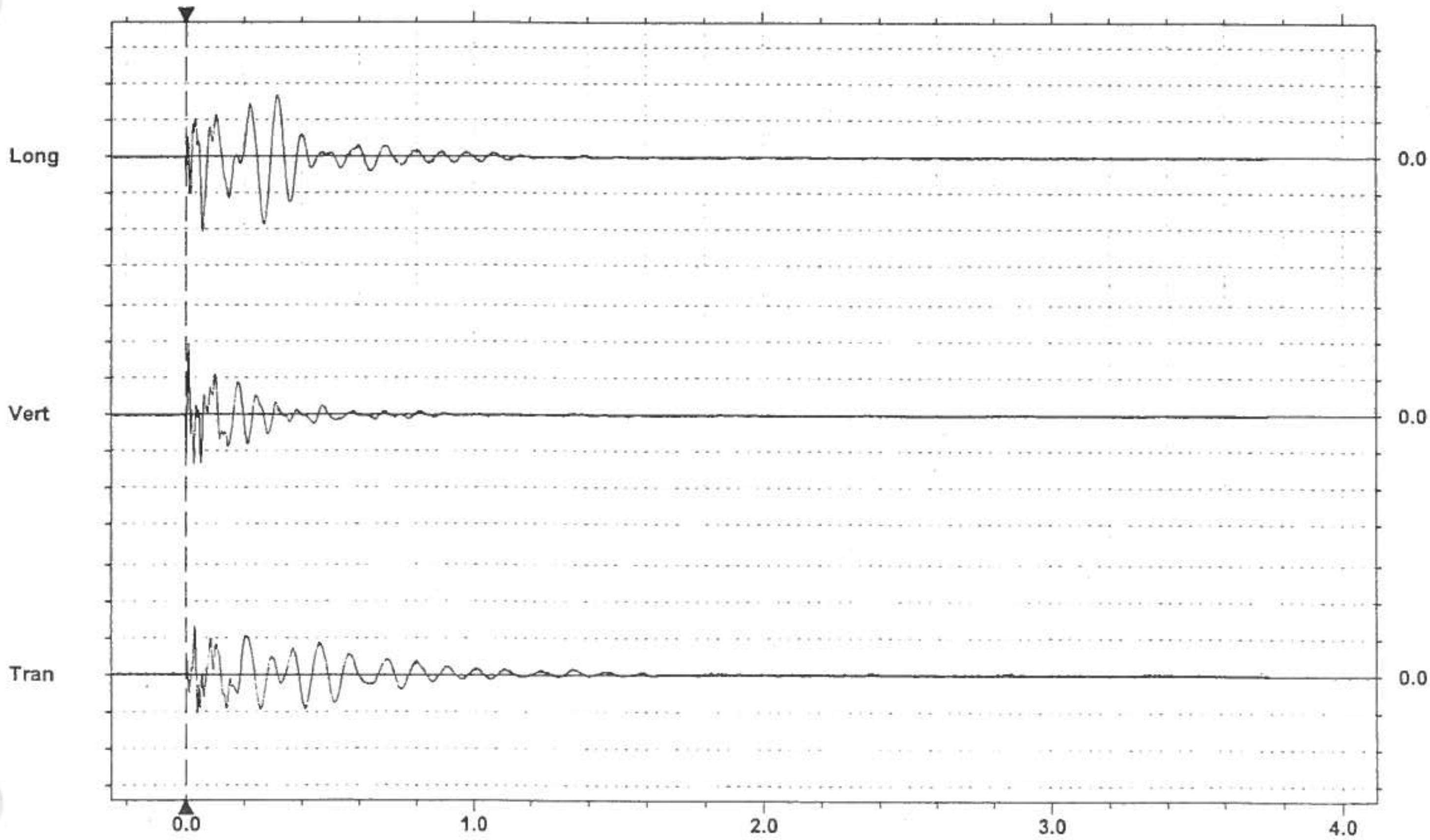
	Tran	Vert	Long	
PPV	0.135	0.195	0.205	in/s
ZC Freq	27	57	20	Hz
Time (Rel. to Trig)	0.028	0.009	0.056	sec
Peak Acceleration	0.106	0.172	0.106	g
Peak Displacement	0.00180	0.00149	0.00273	in
Sensorcheck ™	Passed	Passed	Passed	

Peak Vector Sum 0.214 in/s at 0.056 sec

N/A: Not Applicable

USBM RI8507 And OSMRE





Time Scale: 0.20 sec/div **Amplitude Scale:** Geo: 0.100 in/s/div
Trigger = ▶— — —◀

Printed: February 29, 2000 (V 3.74g - 3.74g)

GROUND MOTION STUDY EVENT

Date/Time	Vert at 11:01:10 February 25, 2000	**Serial Number**	BC6076 V 3.74-3.74 MiniMate Plus
Trigger Source	Geo: 0.0500 in/s	**Battery Level**	6.0 Volts
Range	Geo :10.00 in/s	**Calibration**	August 10, 1999 by Instantel Inc.
Record Time	5.75 sec (Auto=5Sec) at 1024 sps	**File Name**	H0767WN5.9Y0

Notes
Location:
Client: CC&V
User Name: MMC, Inc.
General: Ground Vibration Attenuation Study

Post Event Notes
Shot 2
Station H

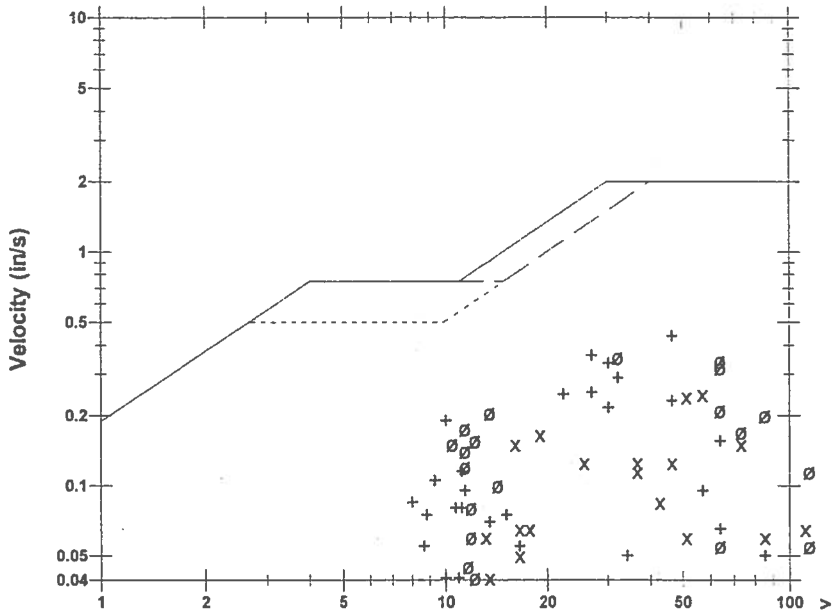
Microphone Disabled
PSPL N/A
ZC Freq N/A
Channel Test N/A

	Tran	Vert	Long	
PPV	0.435	0.245	0.355	in/s
ZC Freq	47	57	32	Hz
Time (Rel. to Trig)	0.074	0.008	0.064	sec
Peak Acceleration	0.371	0.331	0.331	g
Peak Displacement	0.00244	0.00148	0.00260	in
Sensorcheck ™	Passed	Passed	Passed	

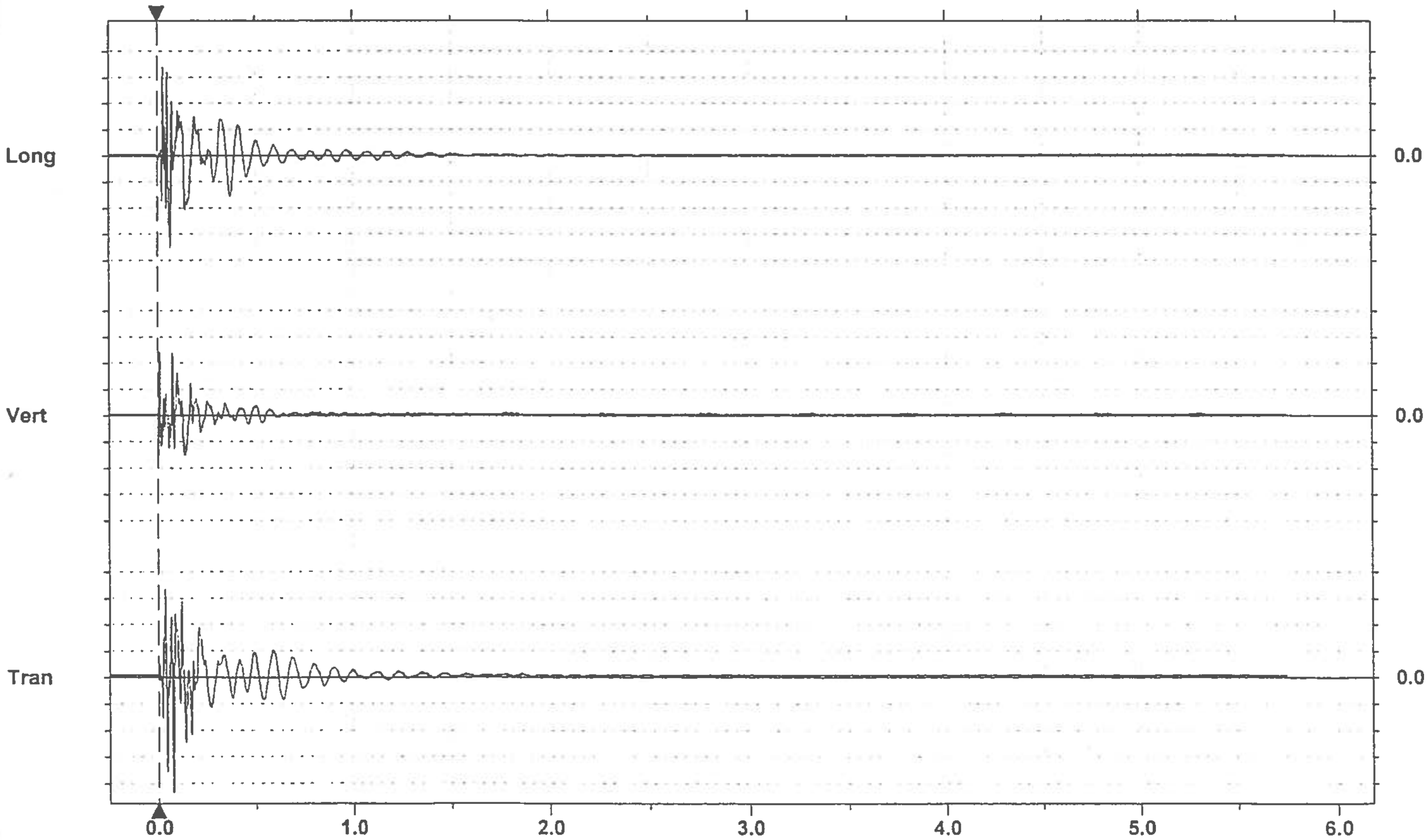
Peak Vector Sum 0.534 in/s at 0.074 sec

N/A: Not Applicable

USBM RI8507 And OSMRE



Frequency (Hz)
Tran: + Vert: x Long: ø



Time Scale: 0.50 sec/div **Amplitude Scale:** Geo: 0.100 in/s/div
Trigger = ▶— — —◀

Printed: February 29, 2000 (V 3.74g - 3.74g)

GROUND MOTION STUDY EVENT

Date/Time	Vert at 10:59:07 February 25, 2000	**Serial Number**	BC6248 V 4.02-4.02 MiniMate Plus
Trigger Source	Geo: 0.0500 in/s	**Battery Level**	6.2 Volts
Range	Geo :10.00 in/s	**Calibration**	September 22, 1999 by Instantel Inc.
Record Time	3.75 sec (Auto=3Sec) at 1024 sps	**File Name**	H2487WN5.6J0

Notes
Location:
Client:
User Name:
General:

Post Event Notes
M.M.C. Inc., for CC&V
Ground Motion Attenuation Study
Shot 2
Station I

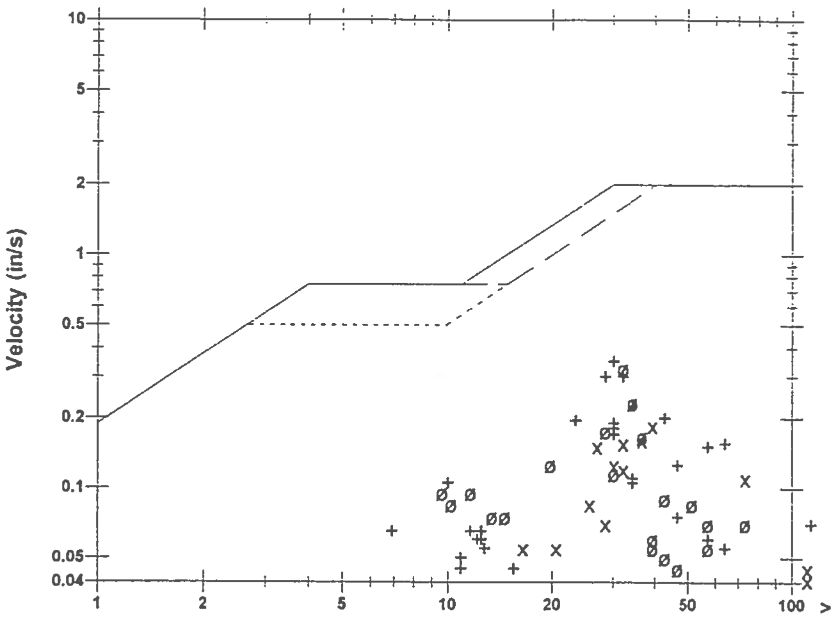
Microphone	Disabled
PSPL	N/A
ZC Freq	N/A
Channel Test	N/A

	Tran	Vert	Long	
PPV	0.350	0.185	0.325	in/s
ZC Freq	30	39	32	Hz
Time (Rel. to Trig)	0.132	0.007	0.065	sec
Peak Acceleration	0.199	0.225	0.186	g
Peak Displacement	0.00176	0.00084	0.00163	in
Sensorcheck ™	Passed	Passed	Passed	

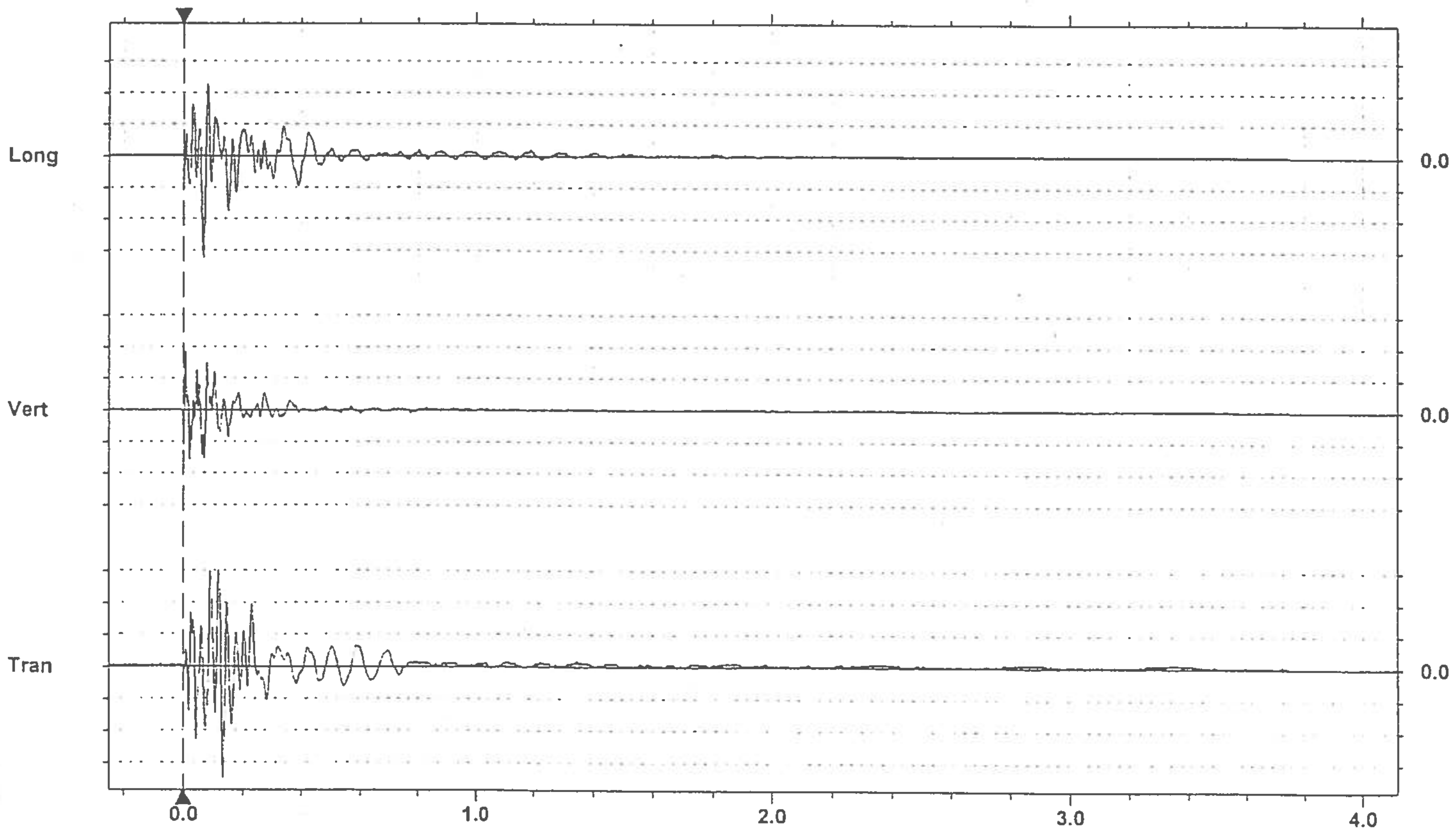
Peak Vector Sum 0.352 in/s at 0.132 sec

N/A: Not Applicable

USBM RI8507 And OSMRE



Tran: + Vert: x Long: ø



Time Scale: 0.20 sec/div **Amplitude Scale:** Geo: 0.100 in/s/div
Trigger = ▶— — — ◀

Printed: February 29, 2000 (V 3.74g - 3.74g)

GROUND MOTION STUDY EVENT

Date/Time	Vert at 11:02:02 February 25, 2000
Trigger Source	Geo: 0.0500 in/s
Range	Geo :10.00 in/s
Record Time	5.75 sec (Auto=5Sec) at 1024 sps

Serial Number	BC5534 V 4.02-4.02 MiniMate Plus
Battery Level	6.3 Volts
Calibration	November 24, 1999 by Instantel Inc.
File Name	G5347WN5.BE0

Notes
Location:
Client: CC&V
User Name: MMC, Inc.
General: Ground Motion Attenuation Study

Post Event Notes
Shot 2
Station J

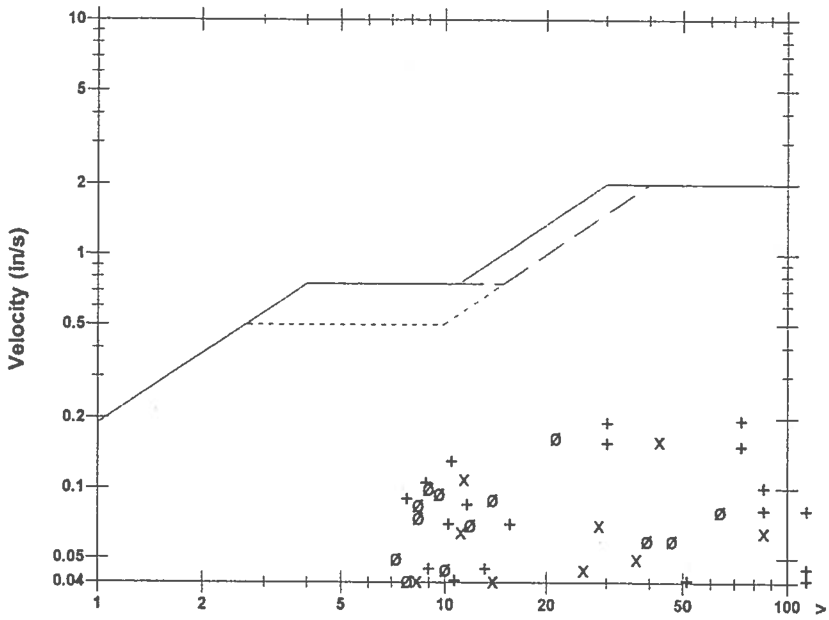
Microphone	Disabled
PSPL	N/A
ZC Freq	N/A
Channel Test	N/A

	Tran	Vert	Long	
PPV	0.195	0.160	0.165	in/s
ZC Freq	73	43	21	Hz
Time (Rel. to Trig)	0.015	0.008	0.063	sec
Peak Acceleration	0.212	0.133	0.119	g
Peak Displacement	0.00213	0.00165	0.00190	in
Sensorcheck ™	Passed	Passed	Passed	

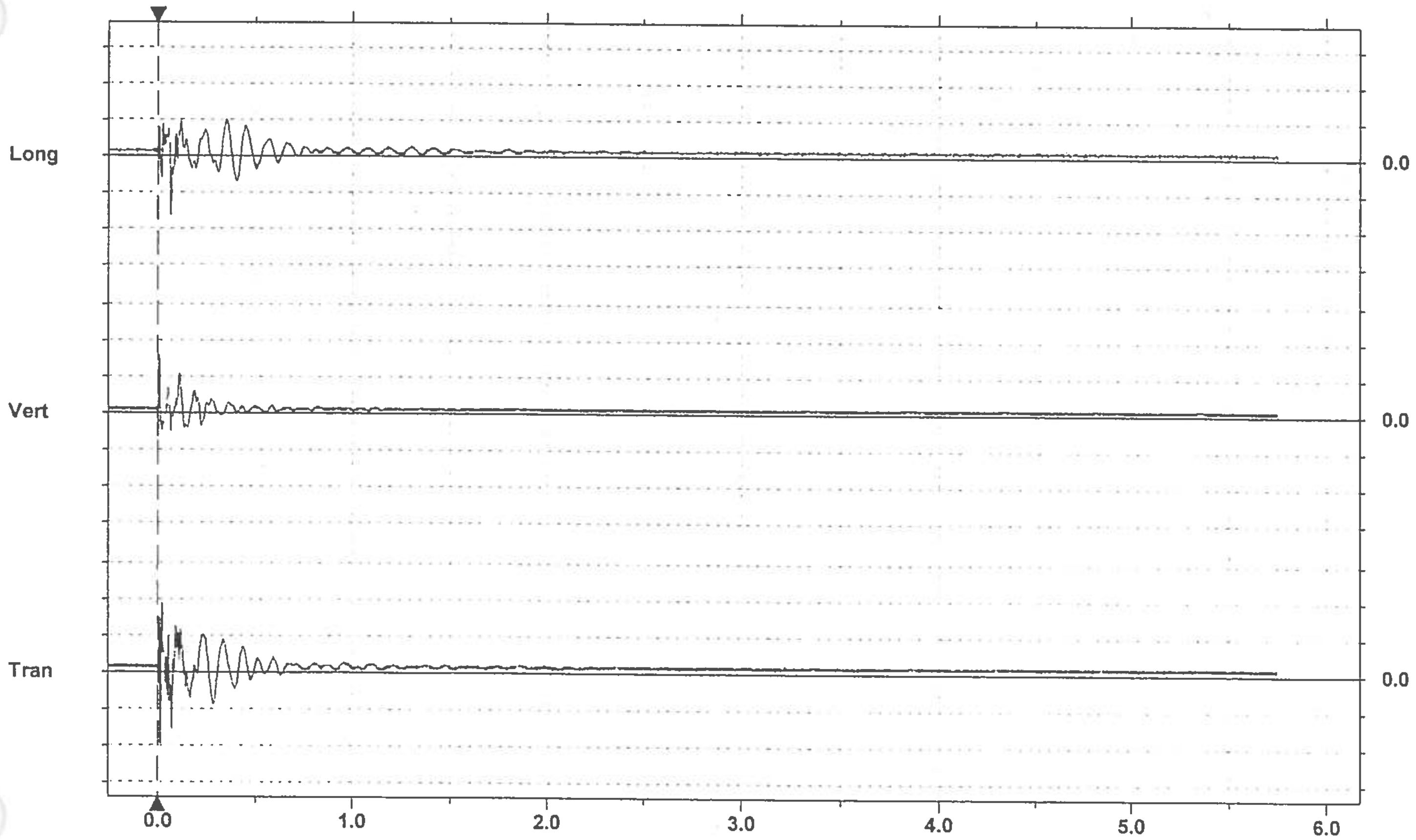
Peak Vector Sum 0.230 in/s at 0.008 sec

N/A: Not Applicable

USBM RI8507 And OSMRE



Frequency (Hz)
Tran: + Vert: x Long: ø



Time Scale: 0.50 sec/div **Amplitude Scale:** Geo: 0.100 in/s/div
Trigger = ▶— — — ◀

Printed: February 29, 2000 (V 3.74g - 3.74g)

GROUND MOTION STUDY EVENT

Date/Time	Vert at 11:01:52 February 25, 2000	**Serial Number**	BC5571 V 4.02-4.02 MiniMate Plus
Trigger Source	Geo: 0.0500 in/s	**Battery Level**	6.2 Volts
Range	Geo :10.00 in/s	**Calibration**	July 21, 1999 by Instantel Inc.
Record Time	5.75 sec (Auto=5Sec) at 1024 sps	**File Name**	G5717WN5.B40

Notes
Location:
Client: CC&V
User Name: MMC, Inc.
General: Ground Motion Attenuation Study

Post Event Notes
Shot 2
Station K

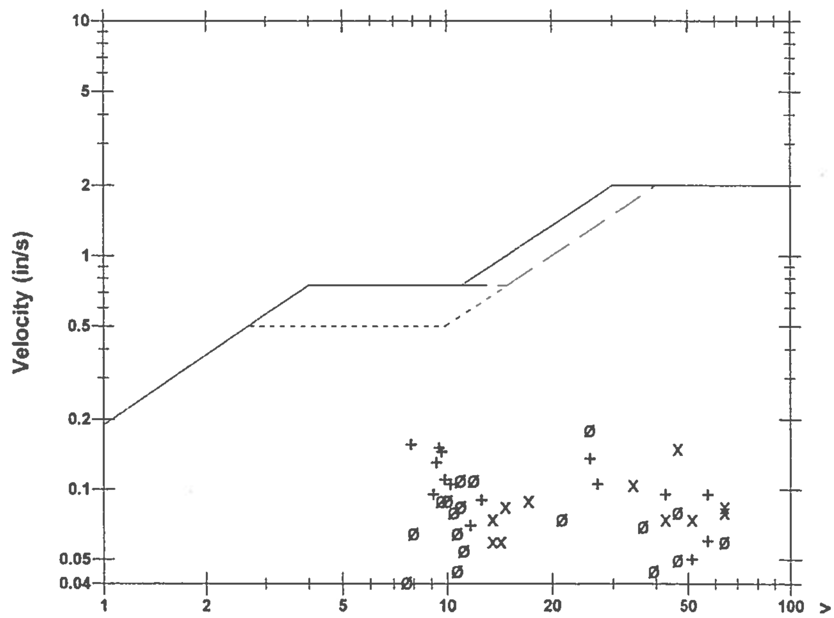
Microphone Disabled
PSPL N/A
ZC Freq N/A
Channel Test N/A

	Tran	Vert	Long	
PPV	0.155	0.150	0.180	in/s
ZC Freq	7.9	47	26	Hz
Time (Rel. to Trig)	0.229	0.008	0.069	sec
Peak Acceleration	0.0795	0.146	0.0928	g
Peak Displacement	0.00248	0.00103	0.00158	in
Sensorcheck ™	Passed	Passed	Passed	

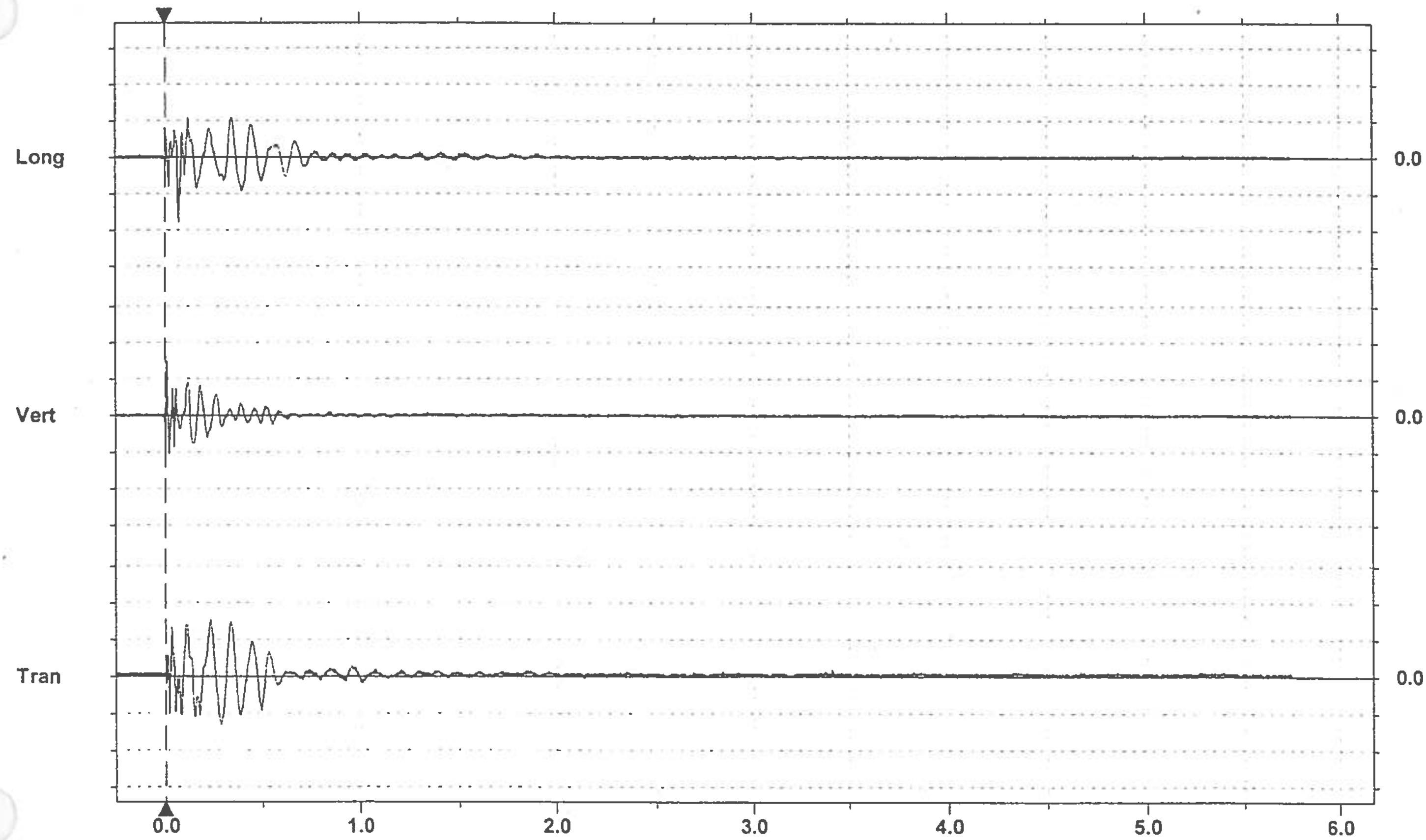
Peak Vector Sum 0.182 in/s at 0.069 sec

N/A: Not Applicable

USBM RI8507 And OSMRE



Frequency (Hz)
Tran: + Vert: x Long: ø



Time Scale: 0.50 sec/div **Amplitude Scale:** Geo: 0.100 in/s/div
Trigger = ▶— — — —◀

Printed: February 29, 2000 (V 3.74g - 3.74g)

Test Shot 3

GROUND MOTION STUDY EVENT

Date/Time	Tran at 12:24:13 February 25, 2000	**Serial Number**	BC5576 V 3.74-3.74 MiniMate Plus
Trigger Source	Geo: 0.0500 in/s	**Battery Level**	6.0 Volts
Range	Geo :10.00 in/s	**Calibration**	March 5, 1999 by Instantel Inc.
Record Time	5.75 sec (Auto=5Sec) at 1024 sps	**File Name**	G5767WN9.4D0

Notes
Location:
Client: CC&V
User Name: MMC, Inc.
General: Ground Vibration Attenuation Study

Post Event Notes
Shot 3
Station A

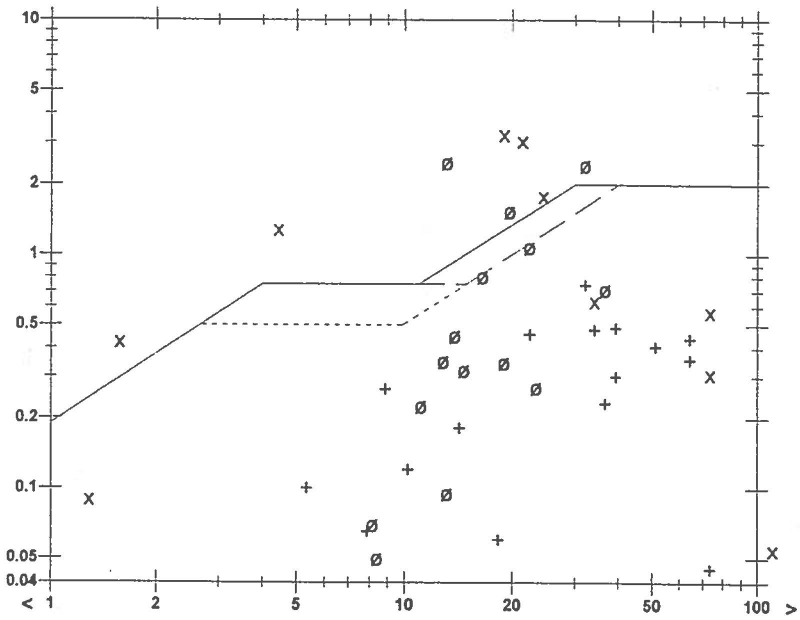
Microphone Disabled
PSPL N/A
ZC Freq N/A
Channel Test N/A

	Tran	Vert	Long	
PPV	0.740	3.25	2.47	in/s
ZC Freq	32	19	13	Hz
Time (Rel. to Trig)	0.065	0.083	0.085	sec
Peak Acceleration	0.530	2.28	1.55	g
Peak Displacement	0.00481	0.0330	0.0234	in
Sensorcheck ™	Passed	Passed	Passed	

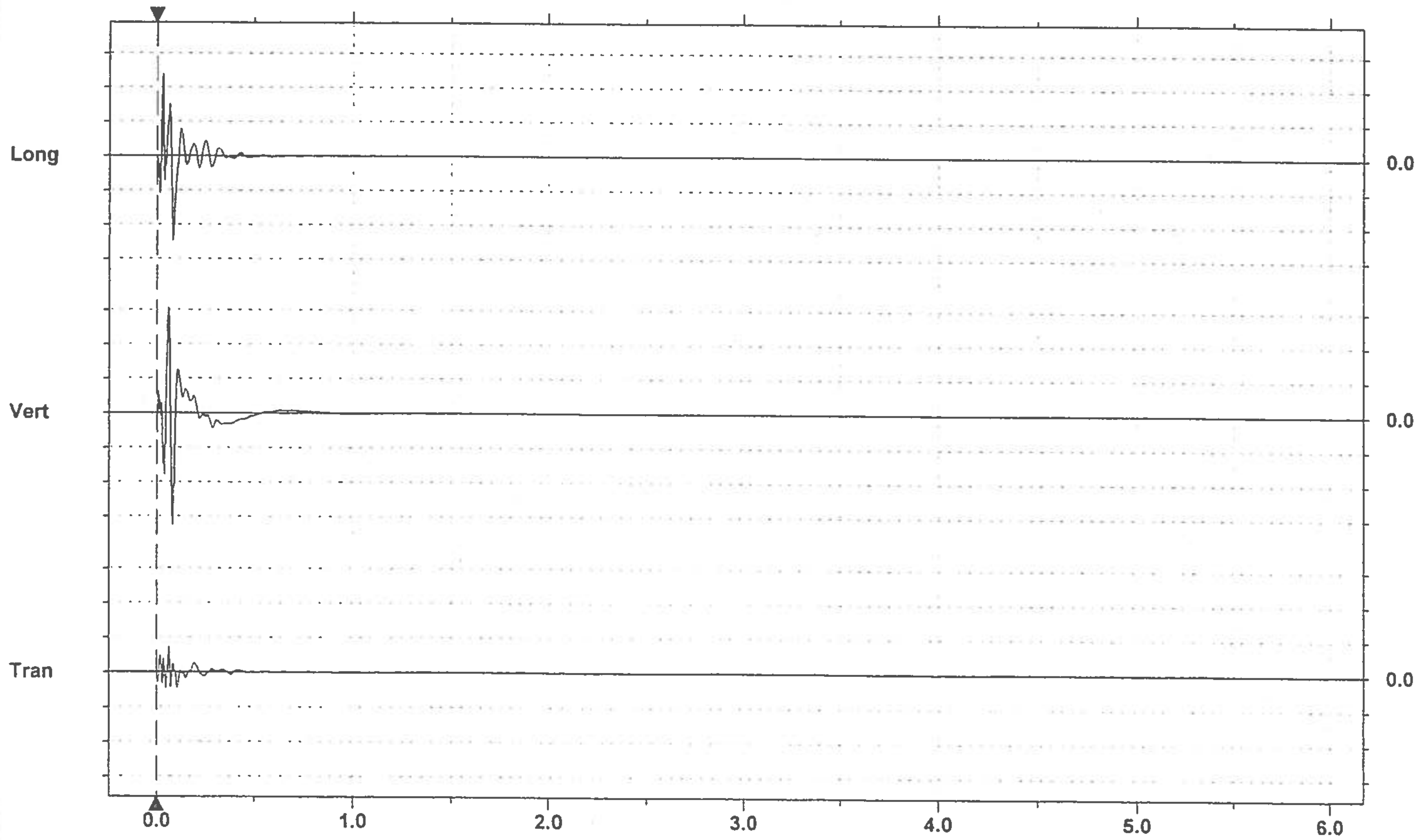
Peak Vector Sum 4.06 in/s at 0.084 sec

N/A: Not Applicable

USBM RI8507 And OSMRE



Frequency (Hz)
Tran: + Vert: x Long: ø



Time Scale: 0.50 sec/div **Amplitude Scale:** Geo: 1.000 in/s/div
Trigger = ▶— — — ◀

Printed: February 29, 2000 (V 3.74g - 3.74g) **Format Copyrighted 1996-1999**

GROUND MOTION STUDY EVENT

Date/Time	Tran at 12:24:36 February 25, 2000	**Serial Number**	BC6796 V 4.02-4.02 MiniMate Plus
Trigger Source	Geo: 0.0500 in/s	**Battery Level**	6.3 Volts
Range	Geo :10.00 in/s	**Calibration**	October 8, 1999 by Instantel Inc.
Record Time	5.25 sec (Auto=3Sec) at 1024 sps	**File Name**	H7967WN9.500

Notes
Location:
Client:
User Name:
General:

Post Event Notes
M.M.C., Inc., for CC&V
Ground Motion Attenuation Study
Shot 3
Station B

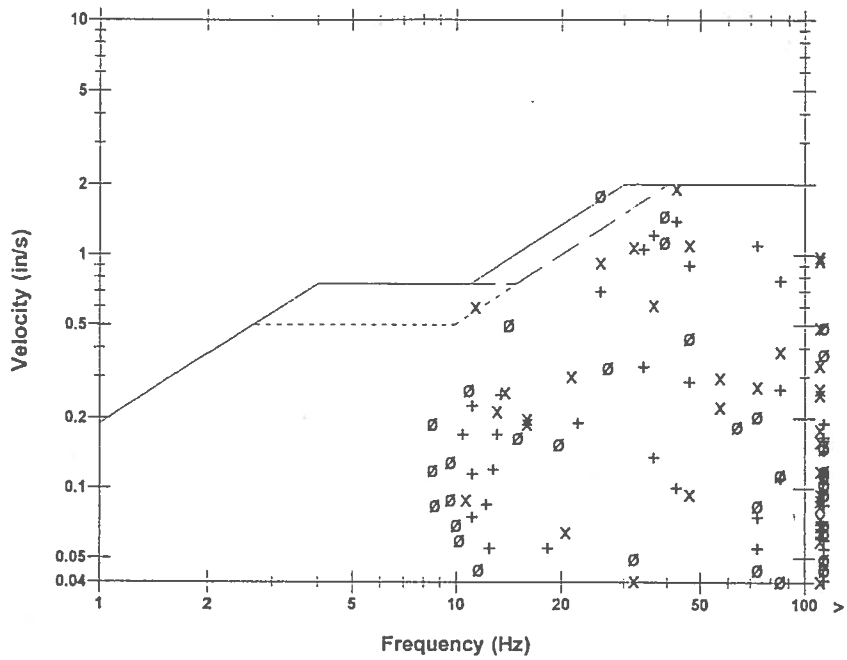
Microphone	Disabled
PSPL	N/A
ZC Freq	N/A
Channel Test	N/A

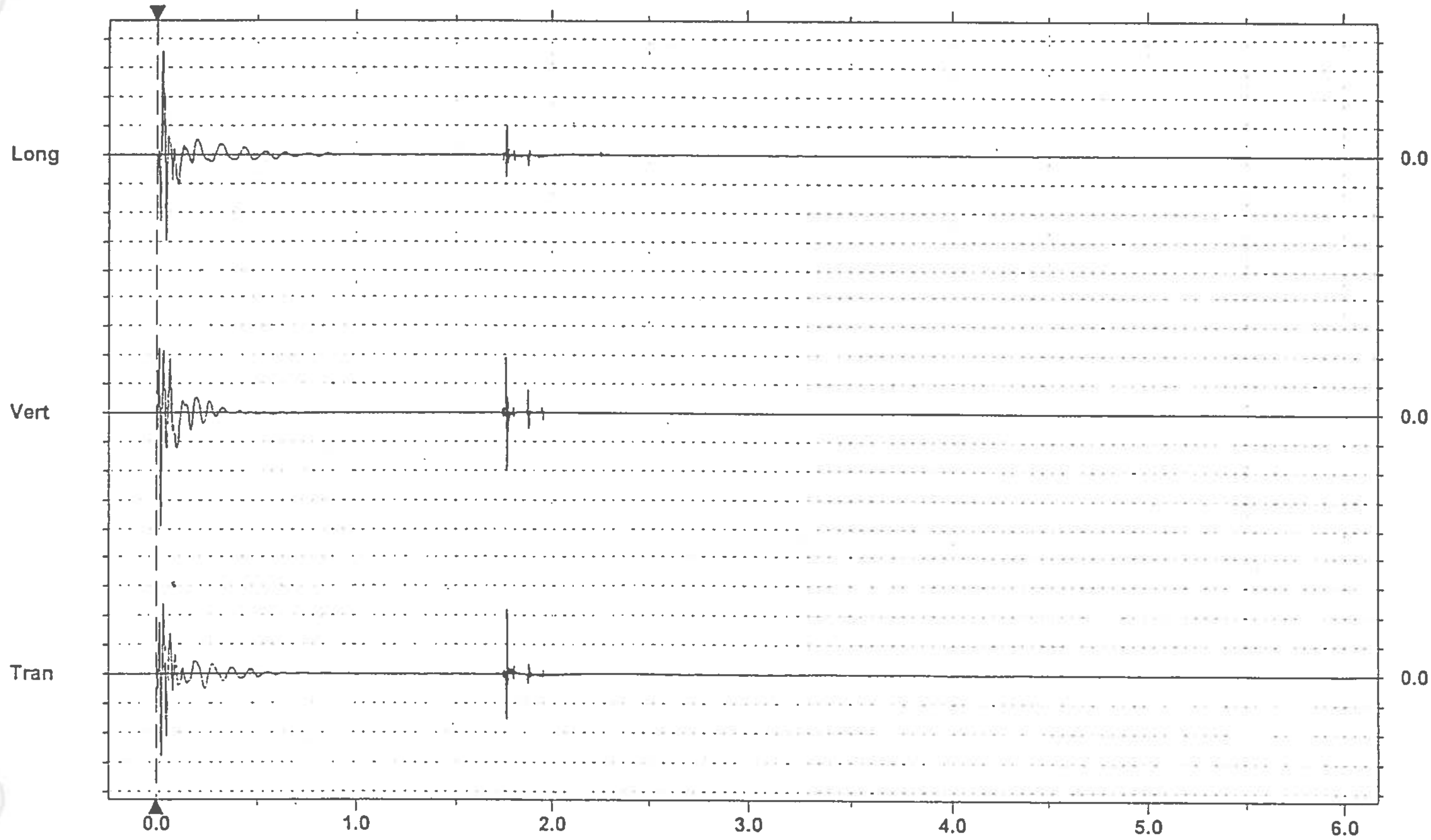
	Tran	Vert	Long	
PPV	1.38	1.93	1.79	in/s
ZC Freq	43	43	26	Hz
Time (Rel. to Trig)	0.026	0.021	0.029	sec
Peak Acceleration	2.31	2.40	1.34	g
Peak Displacement	0.00533	0.00796	0.0105	in
Sensorcheck ™	Passed	Passed	Passed	

Peak Vector Sum 2.27 in/s at 0.027 sec

N/A: Not Applicable

USBM RI8507 And OSMRE





Time Scale: 0.50 sec/div **Amplitude Scale:** Geo: 0.500 in/s/div
Trigger = ▶— — —◀

Printed: February 29, 2000 (V 3.74g - 3.74g)

GROUND MOTION STUDY EVENT

Date/Time	Long at 12:21:14 February 25, 2000
Trigger Source	Geo: 0.0200 in/s
Range	Geo :10.00 in/s
Record Time	6.25 sec (Auto=5Sec) at 1024 sps

Serial Number	BA5546 V 4.02-4.02 BlastMate III
Battery Level	6.1 Volts
Calibration	August 9, 1999 by Instantel Inc.
File Name	G5467WN8.ZE0

Notes
Location:
Client: CC&V
User: MMC, Inc.
Ground Vibration Attenuation Study

Post Event Notes
Shot 3
Station C-20

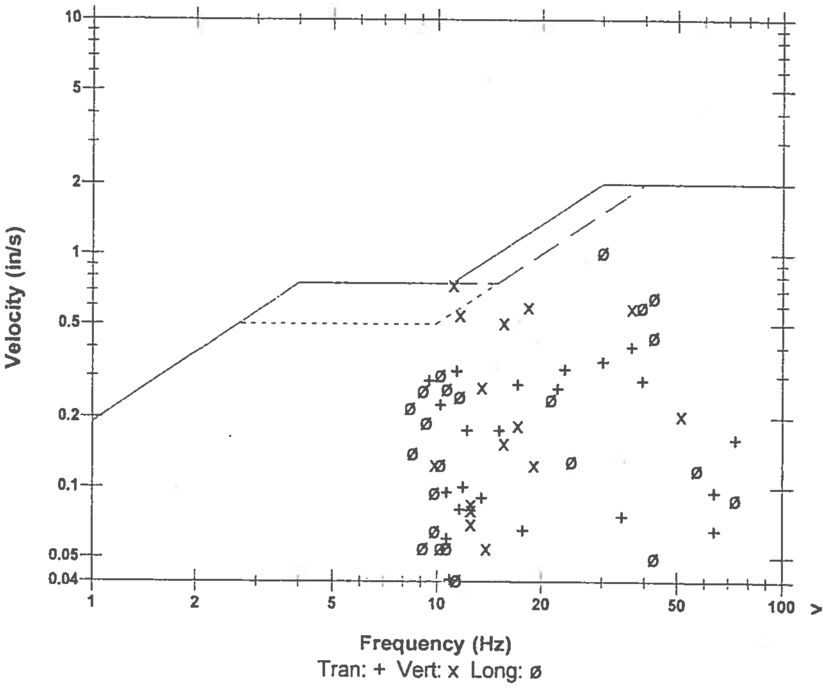
Microphone	Disabled
PSPL	N/A
ZC Freq	N/A
Channel Test	N/A

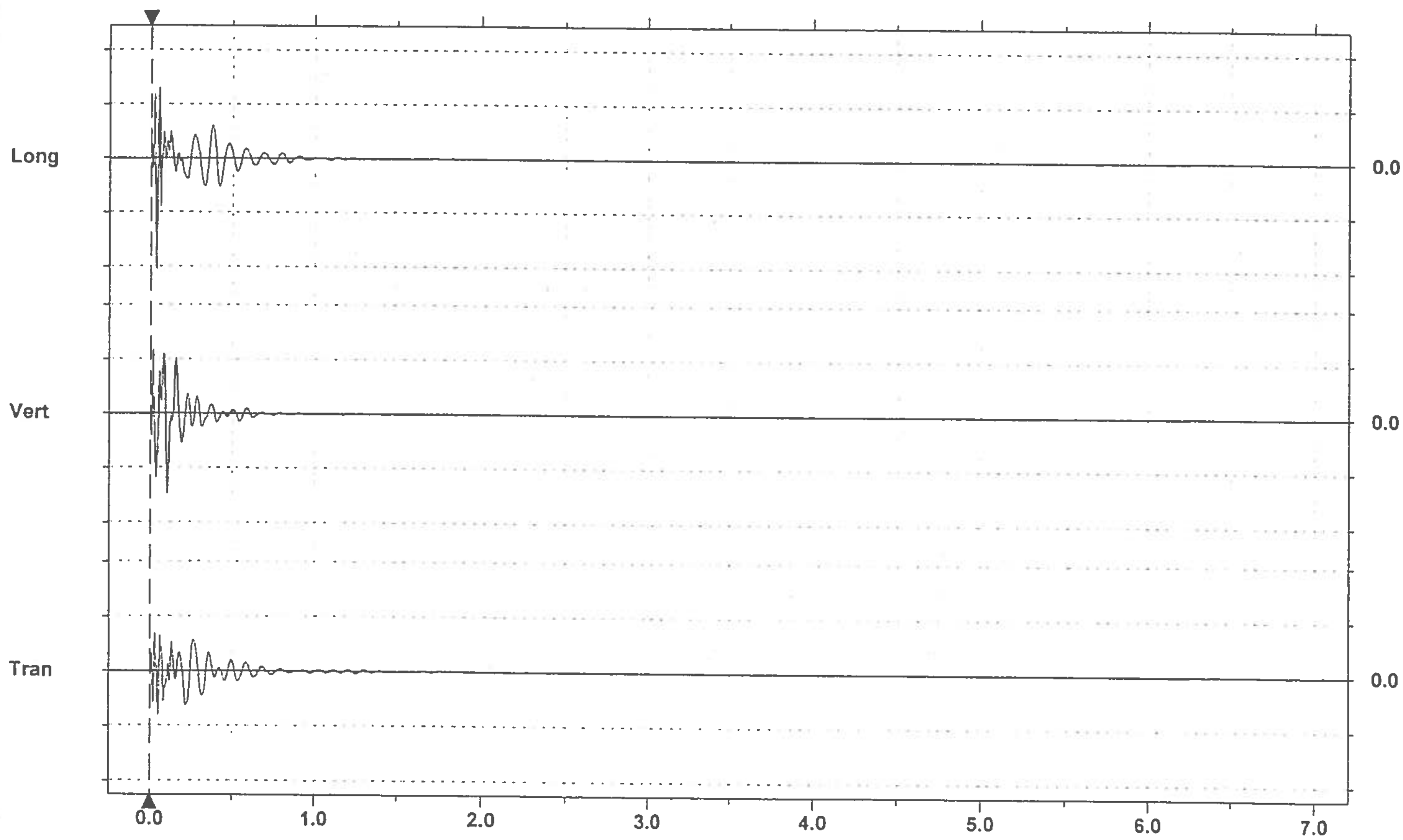
	Tran	Vert	Long	
PPV	0.400	0.740	1.02	in/s
ZC Freq	37	11	30	Hz
Time (Rel. to Trig)	0.049	0.104	0.034	sec
Peak Acceleration	0.292	0.331	0.464	g
Peak Displacement	0.00480	0.00676	0.00521	in
Sensorcheck ™	Passed	Passed	Passed	

Peak Vector Sum 1.19 in/s at 0.034 sec

N/A: Not Applicable

USBM RI8507 And OSMRE





Time Scale: 0.50 sec/div **Amplitude Scale:** Geo: 0.500 in/s/div
Trigger = ▶— — — —◀

Printed: February 29, 2000 (V 3.74g - 3.74g)

GROUND MOTION STUDY EVENT

Date/Time	Vert at 12:22:56 February 25, 2000	**Serial Number**	BA5738 V 4.02-4.02 BlastMate III
Trigger Source	Geo: 0.0500 in/s	**Battery Level**	6.0 Volts
Range	Geo :10.00 in/s	**Calibration**	October 26, 1999 by Instantel Inc.
Record Time	6.25 sec (Auto=5Sec) at 1024 sps	**File Name**	G7387WN9.280

Notes
Location:
Client: CC&V
User Name: MMC, Inc.
General: Ground Vibration Attenuation Study

Post Event Notes
Shot 3
Station C

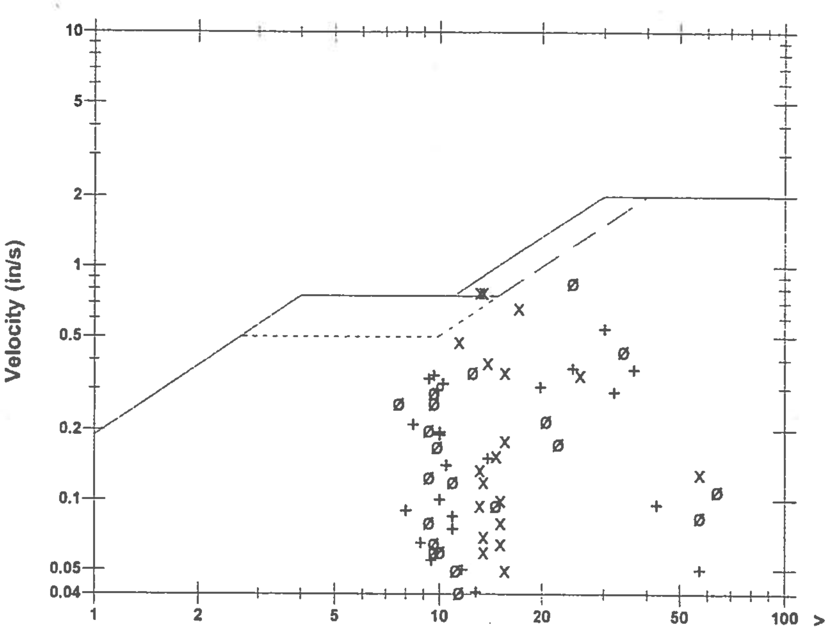
Microphone	Disabled
PSPL	N/A
ZC Freq	N/A
Channel Test	N/A

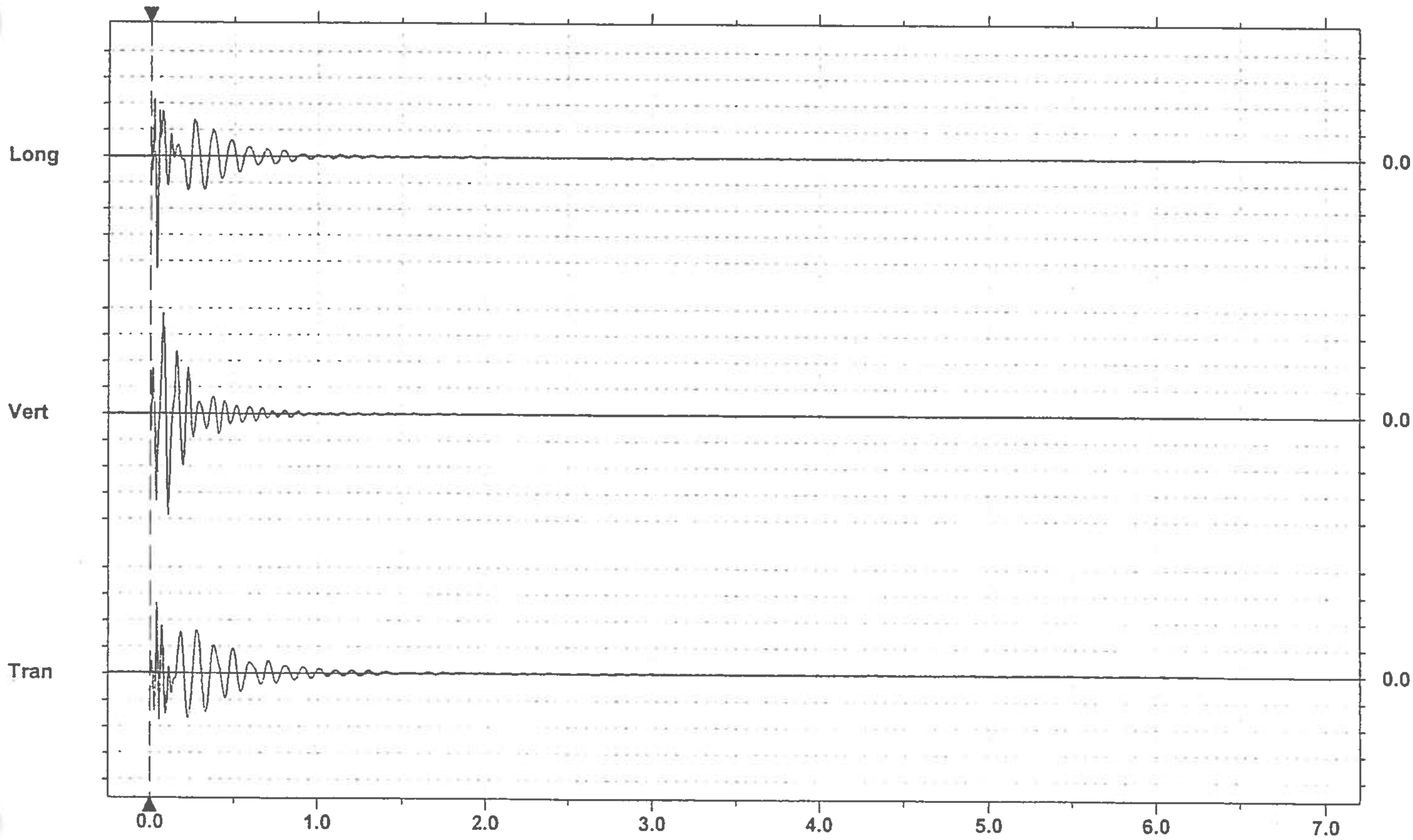
	Tran	Vert	Long	
PPV	0.540	0.775	0.855	in/s
ZC Freq	30	13	24	Hz
Time (Rel. to Trig)	0.040	0.077	0.037	sec
Peak Acceleration	0.252	0.225	0.305	g
Peak Displacement	0.00568	0.00816	0.00535	in
Sensorcheck ™	Passed	Passed	Passed	

Peak Vector Sum 1.18 in/s at 0.038 sec

N/A: Not Applicable

USBM RI8507 And OSMRE





Time Scale: 0.50 sec/div **Amplitude Scale:** Geo: 0.200 in/s/div
Trigger = ▶— — — —◀

Printed: February 29, 2000 (V 3.74g - 3.74g)

GROUND MOTION STUDY EVENT

Date/Time	Vert at 12:23:25 February 25, 2000	**Serial Number**	BA6008 V 4.02-4.02 BlastMate III
Trigger Source	Geo: 0.0500 in/s	**Battery Level**	6.2 Volts
Range	Geo :10.00 in/s	**Calibration**	May 26, 1999 by Instantel Inc.
Record Time	5.75 sec (Auto=5Sec) at 1024 sps	**File Name**	H0087WN9.310

Notes
Location:
Client: CC&V
User Name: MMC, Inc.
General: Ground Motion Attenuation Study

Post Event Notes
Shot 3
Station D

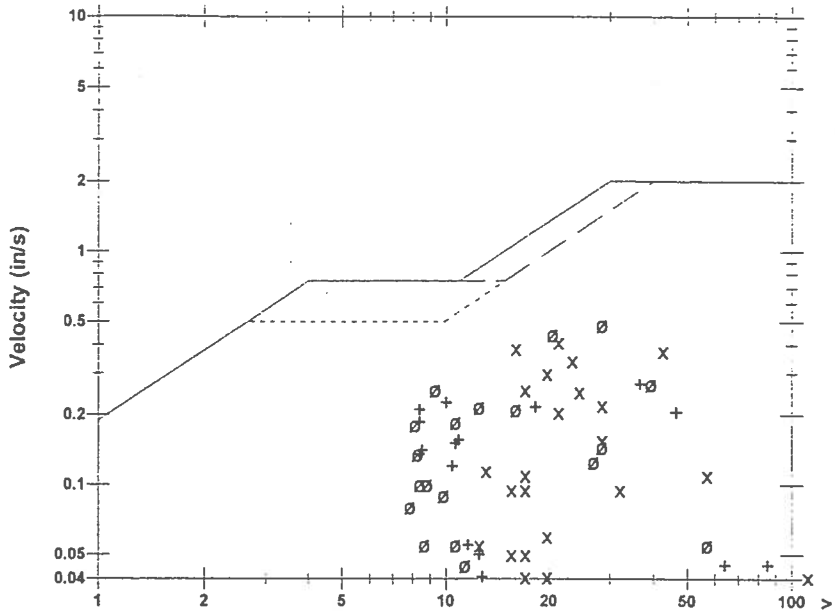
Microphone Disabled
PSPL N/A
ZC Freq N/A
Channel Test N/A

	Tran	Vert	Long	
PPV	0.270	0.410	0.485	in/s
ZC Freq	37	21	28	Hz
Time (Rel. to Trig)	0.046	0.123	0.042	sec
Peak Acceleration	0.159	0.358	0.225	g
Peak Displacement	0.00366	0.00283	0.00377	in
Sensorcheck ™	Passed	Passed	Passed	

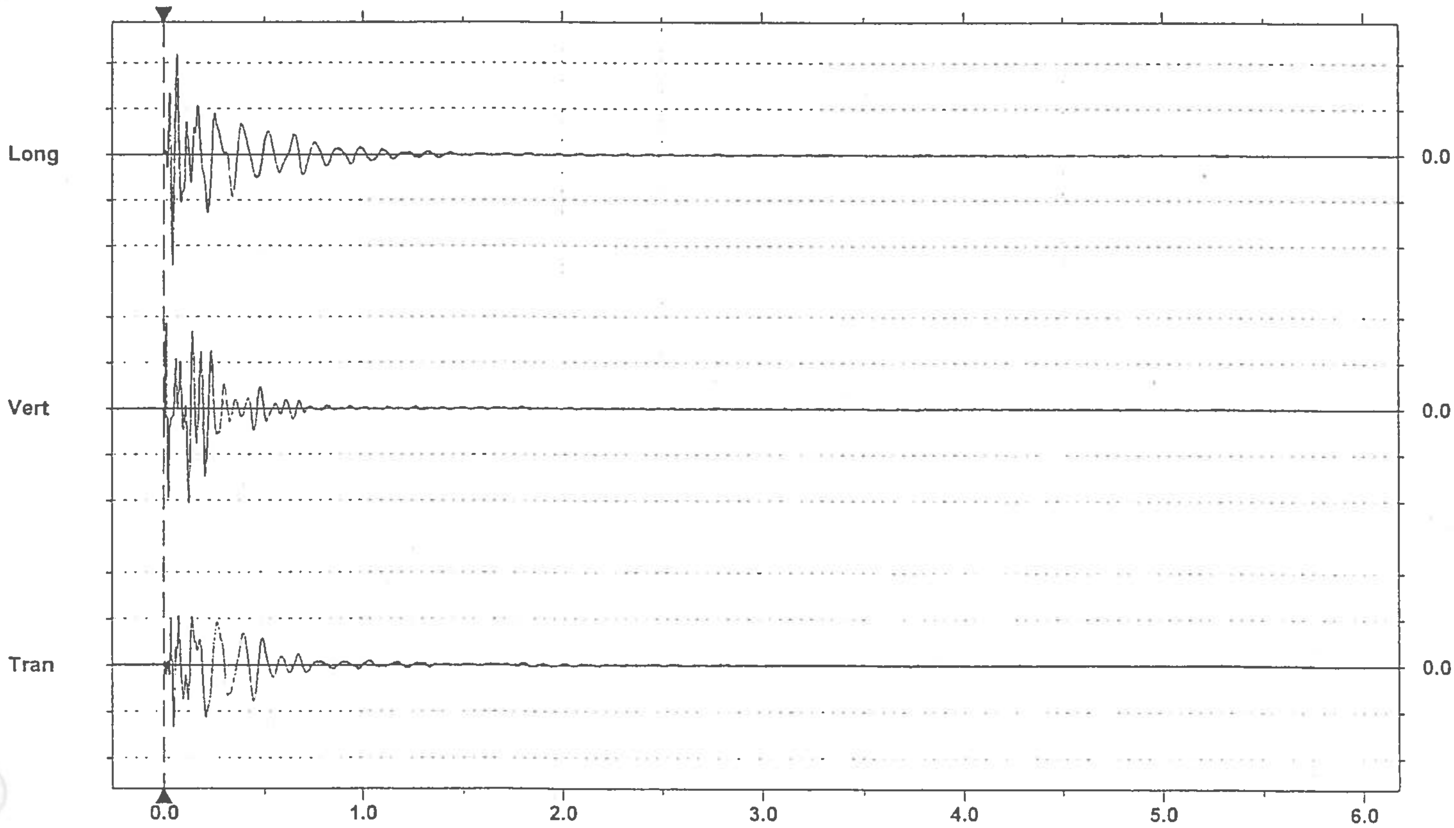
Peak Vector Sum 0.520 in/s at 0.043 sec

N/A: Not Applicable

USBM RI8507 And OSMRE



Frequency (Hz)
Tran: + Vert: x Long: ø



Time Scale: 0.50 sec/div Amplitude Scale: Geo: 0.200 in/s/div
Trigger = ▶— — —◀

Printed: February 29, 2000 (V 3.74g - 3.74g)

GROUND MOTION STUDY EVENT

Date/Time	Vert at 12:24:51 February 25, 2000	**Serial Number**	BC6255 V 4.02-4.02 MiniMate Plus
Trigger Source	Geo: 0.0500 in/s	**Battery Level**	6.1 Volts
Range	Geo :10.00 in/s	**Calibration**	November 4, 1999 by Instantel Inc.
Record Time	5.75 sec (Auto=5Sec) at 1024 sps	**File Name**	H2557WN9.5F0

Notes
Location:
Client: CC&V
User Name: MMC, Inc.
General: Ground Motion Attenuation Study

Extended Notes

Post Event Notes
Shot 3
Station F

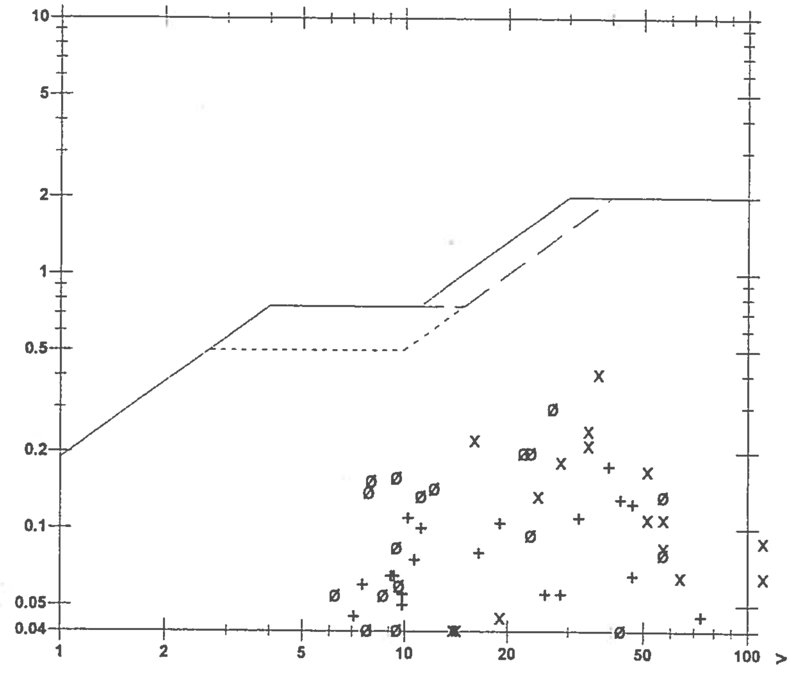
Microphone Disabled
PSPL N/A
ZC Freq N/A
Channel Test N/A

	Tran	Vert	Long	
PPV	0.175	0.410	0.300	in/s
ZC Freq	39	37	27	Hz
Time (Rel. to Trig)	0.037	0.027	0.051	sec
Peak Acceleration	0.146	0.252	0.133	g
Peak Displacement	0.00165	0.00189	0.00328	in
Sensorcheck ™	Passed	Passed	Passed	

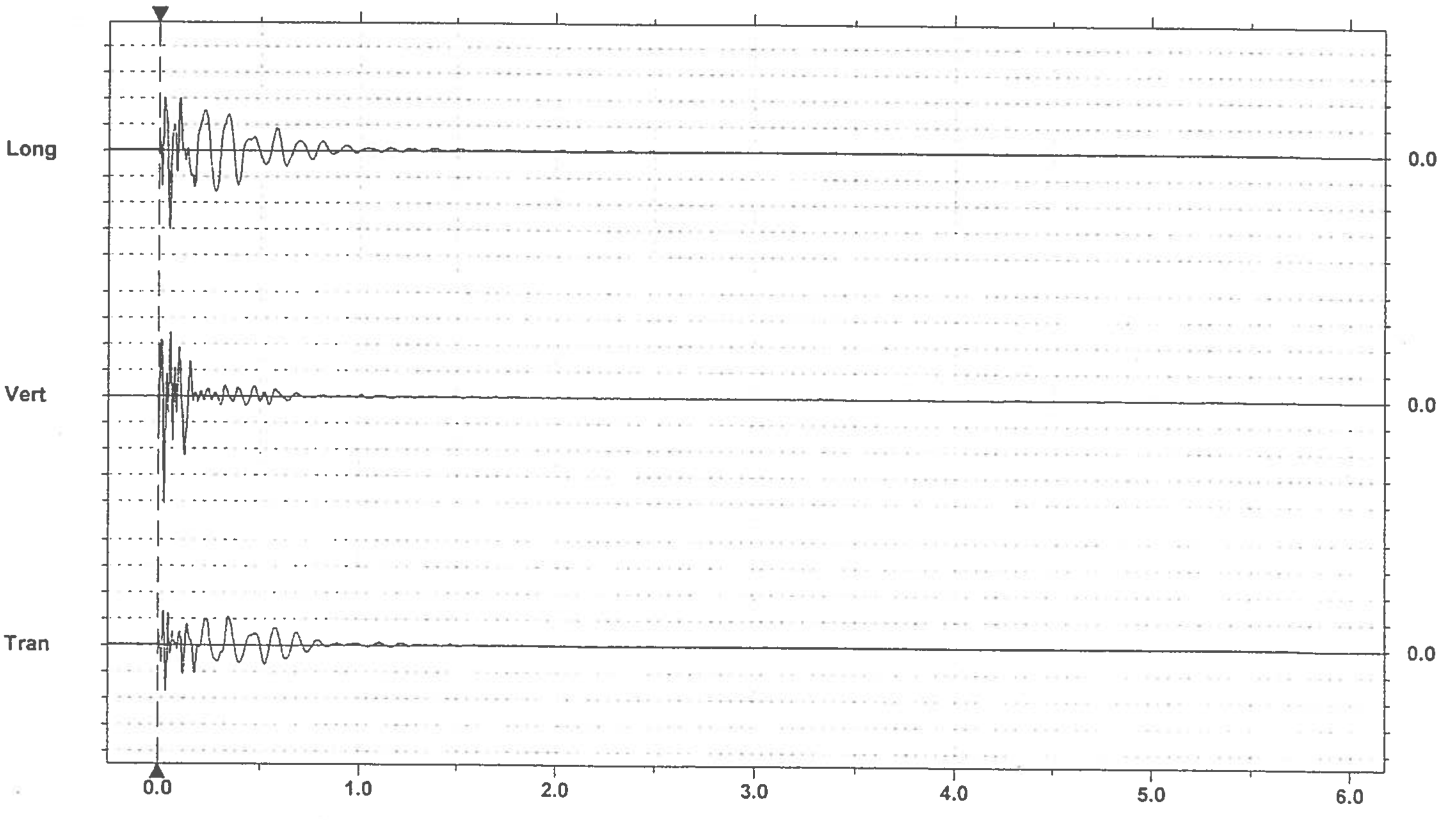
Peak Vector Sum 0.472 in/s at 0.027 sec

N/A: Not Applicable

USBM RI8507 And OSMRE



Frequency (Hz)
Tran: + Vert: x Long: ø



Time Scale: 0.50 sec/div **Amplitude Scale:** Geo: 0.100 in/s/div
Trigger = ▶— — —◀

Printed: February 29, 2000 (V 3.74g - 3.74g) **Format Copyrighted 1996-1999**

GROUND MOTION STUDY EVENT

Date/Time	Vert at 12:24:20 February 25, 2000	**Serial Number**	BC5536 V 4.02-4.02 MiniMate Plus
Trigger Source	Geo: 0.0500 in/s	**Battery Level**	6.3 Volts
Range	Geo :10.00 in/s	**Calibration**	January 24, 2000 by Instantel Inc.
Record Time	5.75 sec (Auto=5Sec) at 1024 sps	**File Name**	G5367WN9.4K0

Notes
Location:
Client:
User Name:
General:

Post Event Notes
M.M.C., Inc., for CC&V
Ground Motion Attenuation Study
Shot 3
Station G

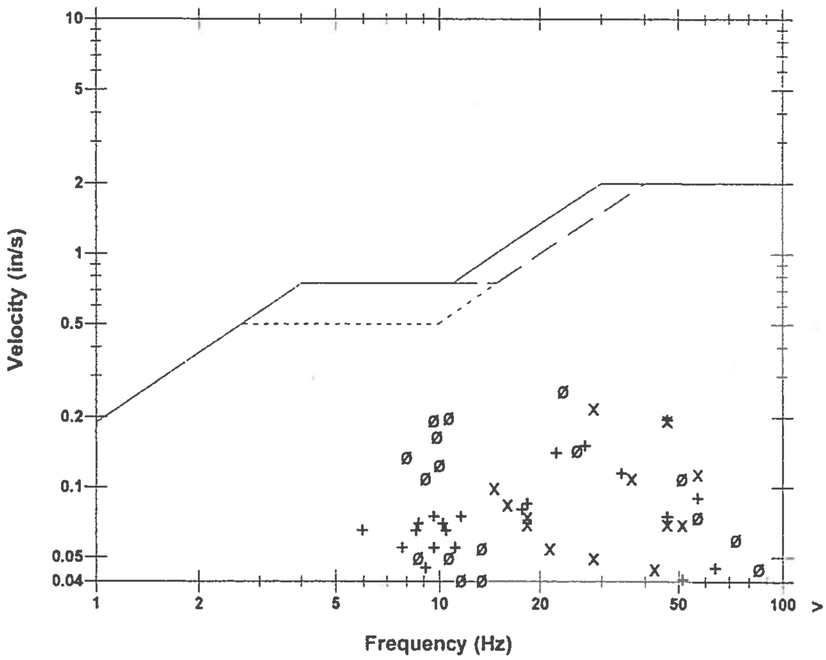
Microphone	Disabled
PSPL	N/A
ZC Freq	N/A
Channel Test	N/A

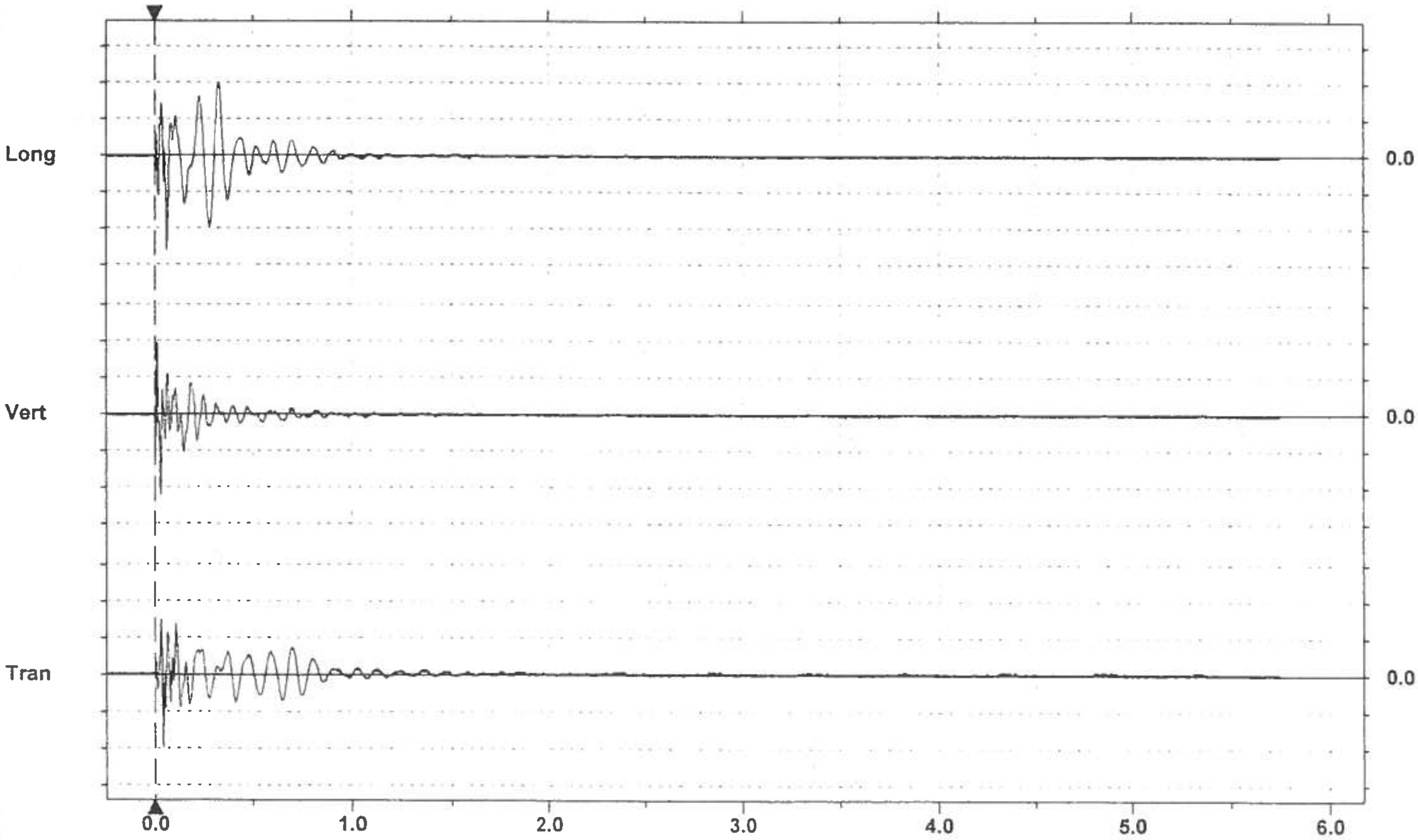
	Tran	Vert	Long	
PPV	0.195	0.220	0.260	in/s
ZC Freq	47	28	23	Hz
Time (Rel. to Trig)	0.040	0.028	0.060	sec
Peak Acceleration	0.146	0.186	0.119	g
Peak Displacement	0.00155	0.00100	0.00320	in.
Sensorcheck ™	Passed	Passed	Passed	

Peak Vector Sum 0.294 in/s at 0.061 sec

N/A: Not Applicable

USBM RI8507 And OSMRE





Time Scale: 0.50 sec/div **Amplitude Scale:** Geo: 0.100 in/s/div
Trigger = ▶— — — —◀

Printed: February 29, 2000 (V 3.74g - 3.74g)

GROUND MOTION STUDY EVENT

Date/Time	Vert at 12:21:23 February 25, 2000	**Serial Number**	BC6248 V 4.02-4.02 MiniMate Plus
Trigger Source	Geo: 0.0500 in/s	**Battery Level**	6.1 Volts
Range	Geo :10.00 in/s	**Calibration**	September 22, 1999 by Instantel Inc.
Record Time	4.75 sec (Auto=4Sec) at 1024 sps	**File Name**	H2487WN8.ZN0

Notes
Location:
Client:
User Name:
General:

Post Event Notes
M.M.C., Inc., for CC&V
Ground Motion Attenuation Study
Shot 3
Station I

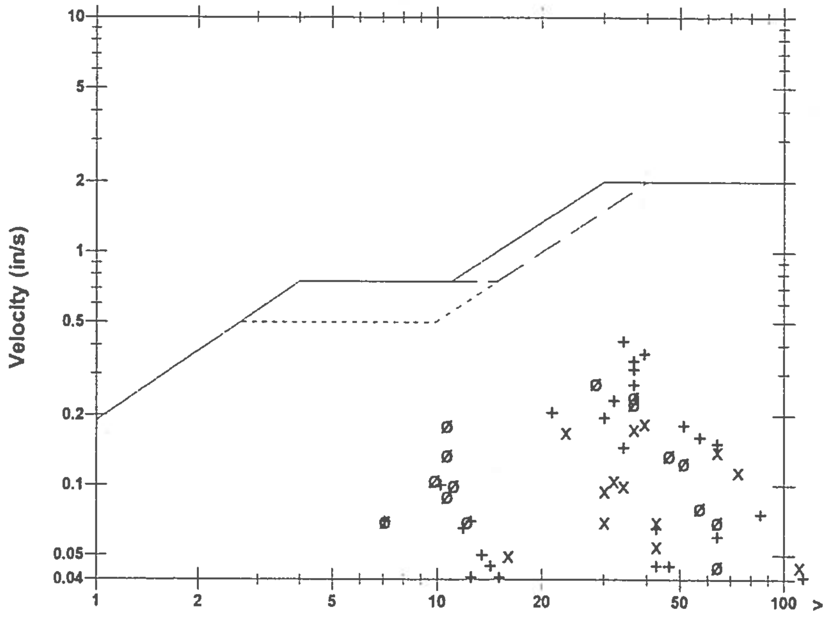
Microphone	Disabled
PSPL	N/A
ZC Freq	N/A
Channel Test	N/A

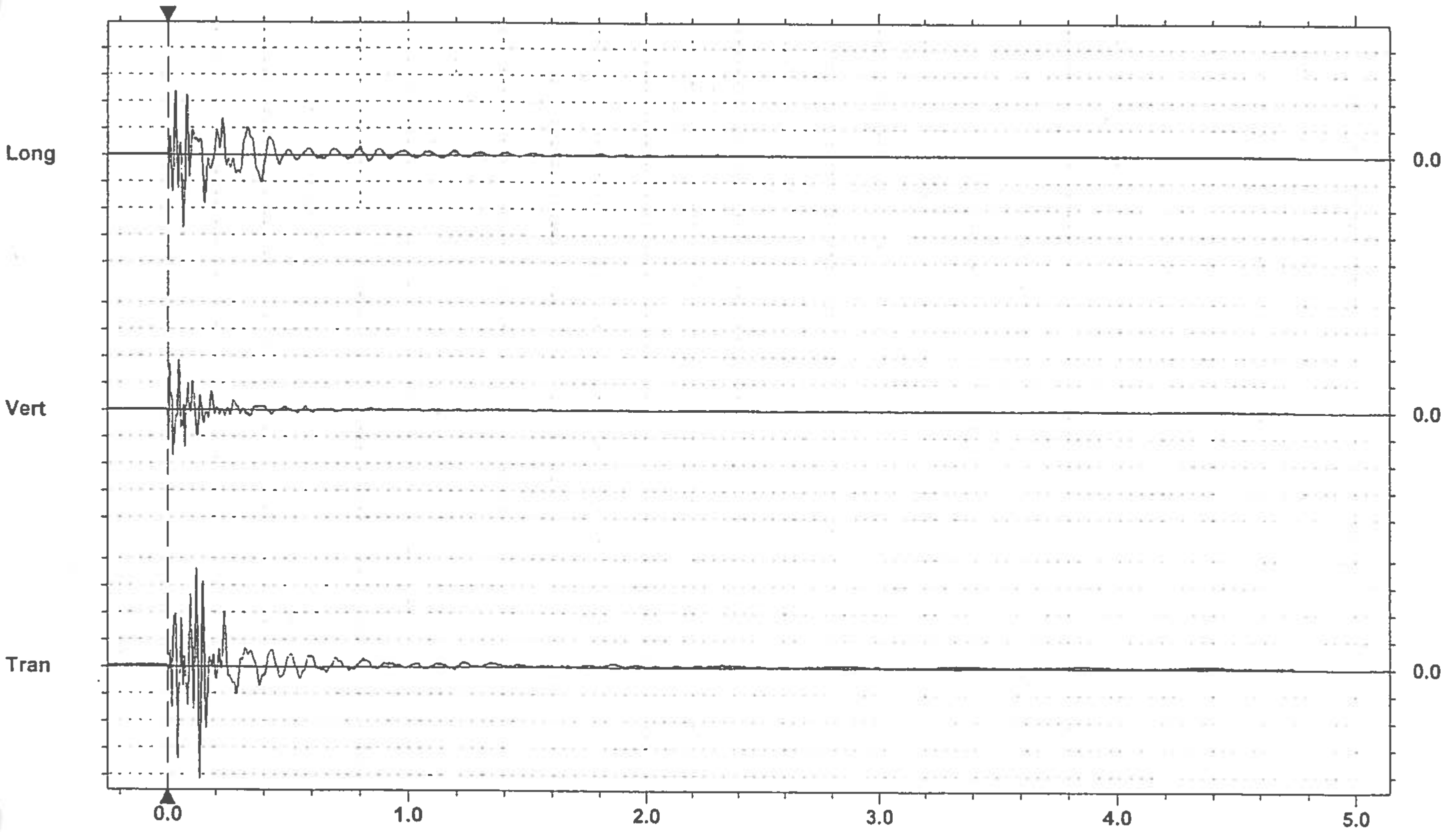
	Tran	Vert	Long	
PPV	0.415	0.185	0.275	in/s
ZC Freq	34	39	28	Hz
Time (Rel. to Trig)	0.132	0.047	0.064	sec
Peak Acceleration	0.265	0.225	0.159	g
Peak Displacement	0.00184	0.00081	0.00166	in
Sensorcheck ™	Passed	Passed	Passed	

Peak Vector Sum 0.421 in/s at 0.132 sec

N/A: Not Applicable

USBM RI8507 And OSMRE





Time Scale: 0.20 sec/div Amplitude Scale: Geo: 0.100 in/s/div
Trigger = ▶— — — ◀

Printed: February 29, 2000 (V 3.74g - 3.74g)

GROUND MOTION STUDY EVENT

Date/Time	Vert at 12:24:18 February 25, 2000	**Serial Number**	BC5534 V 4.02-4.02 MiniMate Plus
Trigger Source	Geo: 0.0500 in/s	**Battery Level**	6.3 Volts
Range	Geo :10.00 in/s	**Calibration**	November 24, 1999 by Instantel Inc.
Record Time	5.75 sec (Auto=5Sec) at 1024 sps	**File Name**	G5347WN9.4I0

Notes
Location:
Client: CC&V
User Name: MMC, Inc.
General: Ground Motion Attenuation Study

Post Event Notes
Shot 3
Station J

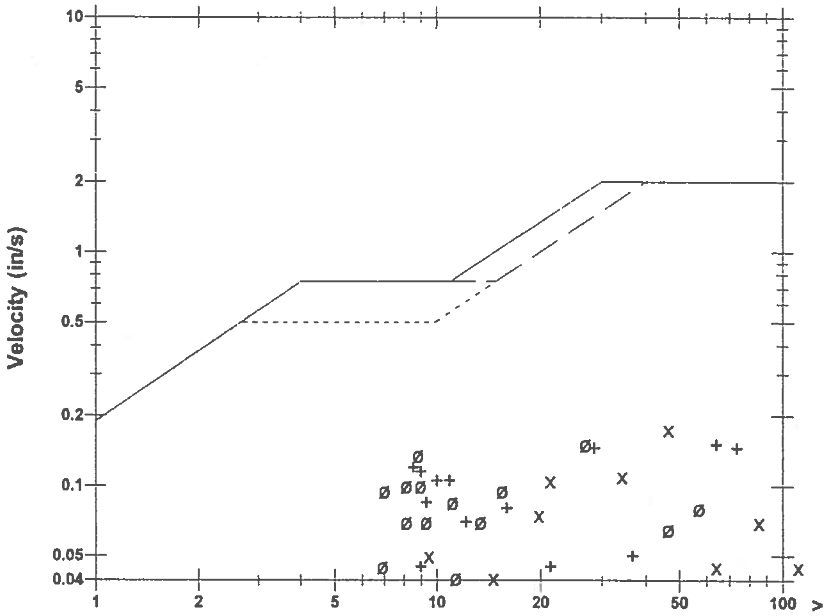
Microphone Disabled
PSPL N/A
ZC Freq N/A
Channel Test N/A

	Tran	Vert	Long	
PPV	0.150	0.175	0.150	in/s
ZC Freq	64	47	27	Hz
Time (Rel. to Trig)	0.014	0.009	0.064	sec
Peak Acceleration	0.186	0.133	0.0928	g
Peak Displacement	0.00259	0.00171	0.00231	in
Sensorcheck ™	Passed	Passed	Passed	

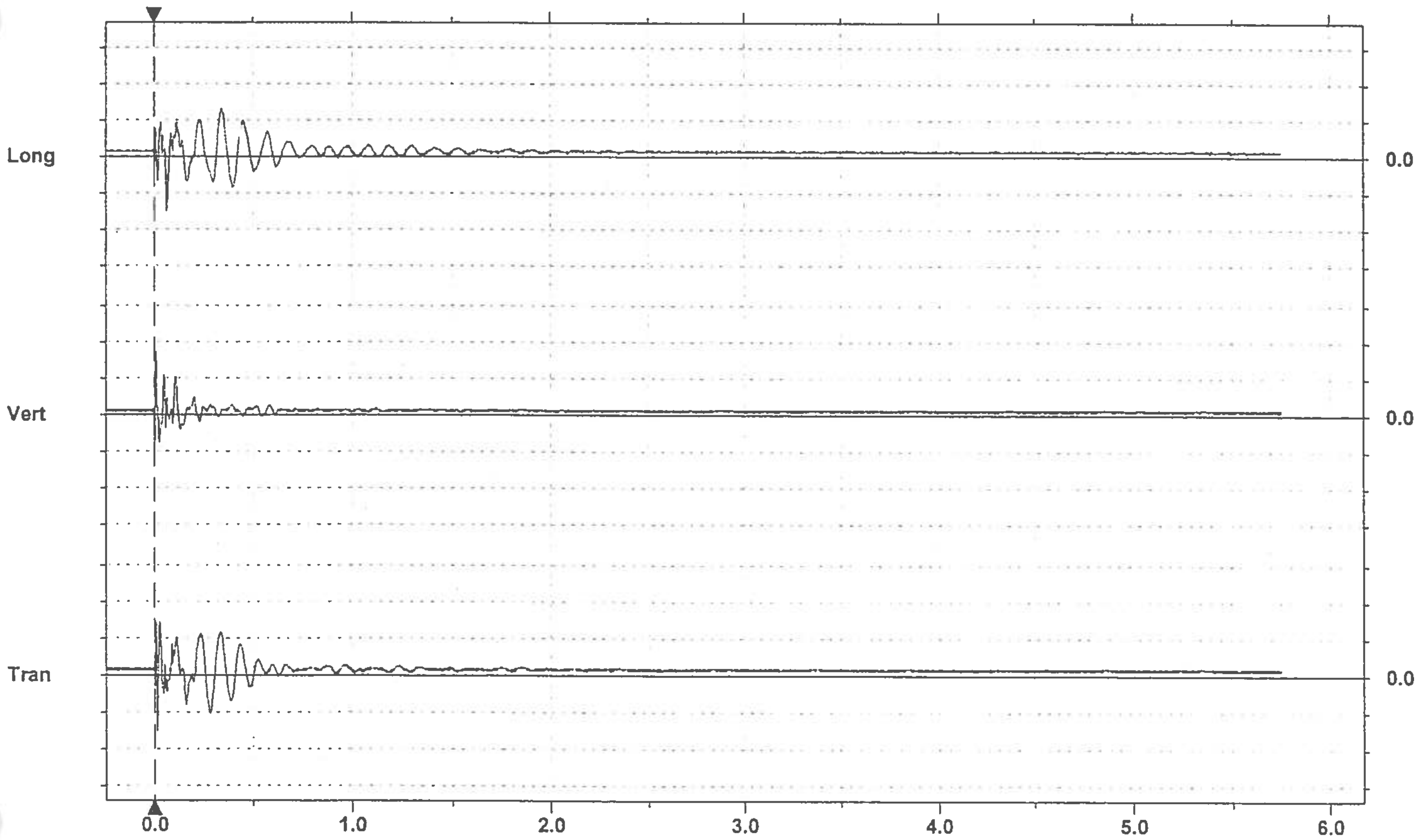
Peak Vector Sum 0.224 in/s at 0.008 sec

N/A: Not Applicable

USBM RI8507 And OSMRE



Frequency (Hz)
Tran: + Vert: x Long: ø



Time Scale: 0.50 sec/div **Amplitude Scale:** Geo: 0.100 in/s/div
Trigger = ▶— — — ◀

Printed: February 29, 2000 (V 3.74g - 3.74g)

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GROUND MOTION STUDY EVENT

Date/Time	Vert at 12:23:26 February 25, 2000	**Serial Number**	BC6076 V 3.74-3.74 MiniMate Plus
Trigger Source	Geo: 0.0500 in/s	**Battery Level**	6.0 Volts
Range	Geo :10.00 in/s	**Calibration**	August 10, 1999 by Instantel Inc.
Record Time	5.75 sec (Auto=5Sec) at 1024 sps	**File Name**	H0767WN9.320

Notes
Location:
Client: CC&V
User Name: MMC, Inc.
General: Ground Vibration Attenuation Study

Post Event Notes
Shot 3
Station L

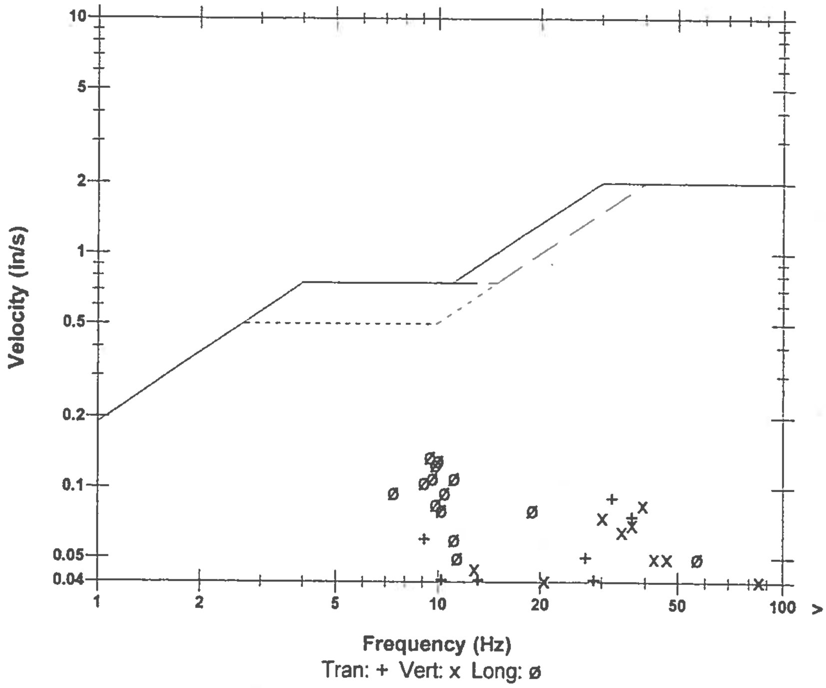
Microphone Disabled
PSPL N/A
ZC Freq N/A
Channel Test N/A

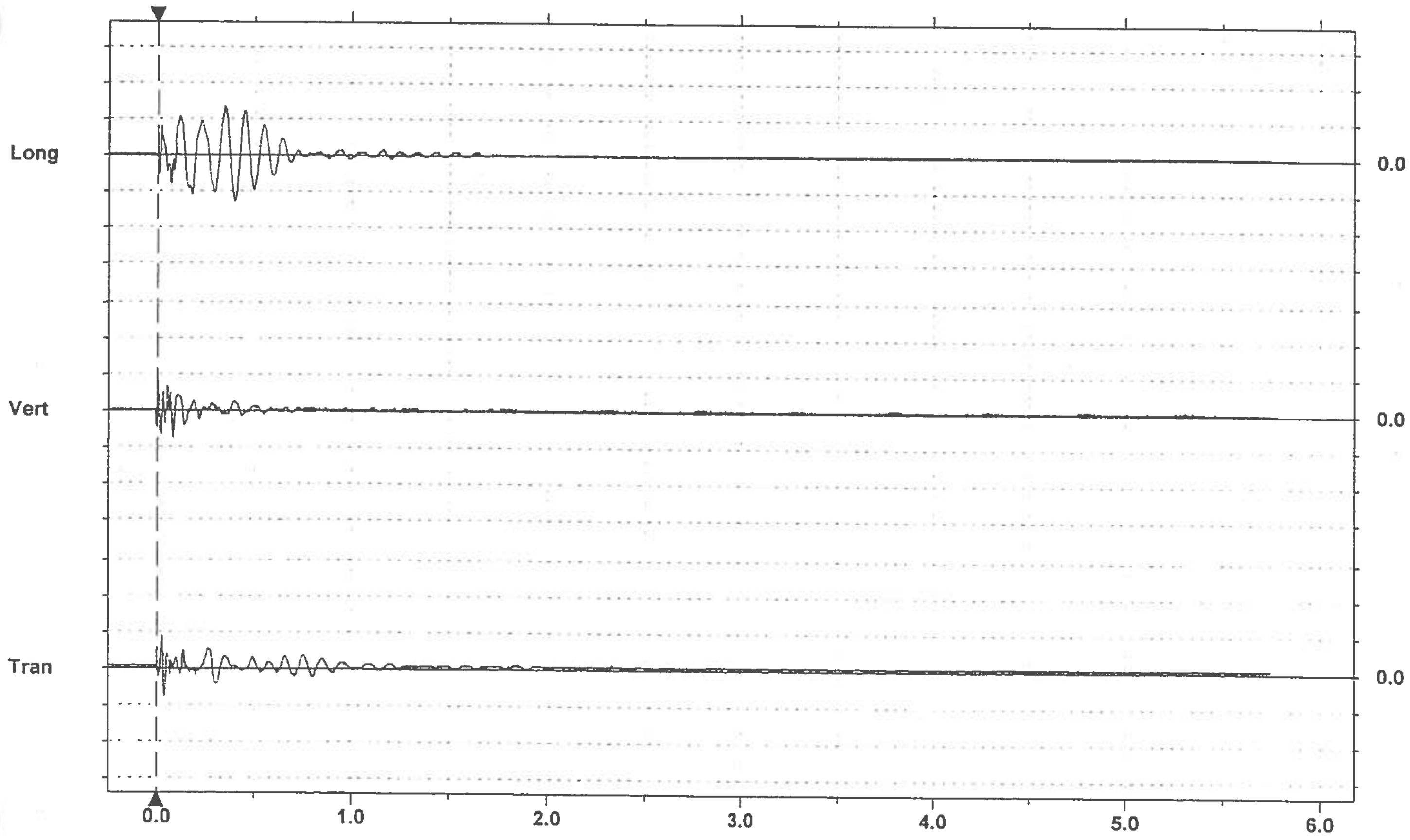
	Tran	Vert	Long	
PPV	0.0900	0.0850	0.135	in/s
ZC Freq	32	39	9.5	Hz
Time (Rel. to Trig)	0.025	0.003	0.340	sec
Peak Acceleration	0.0928	0.0663	0.0530	g
Peak Displacement	0.00093	0.00066	0.00224	in
Sensorcheck ™	Passed	Passed	Passed	

Peak Vector Sum 0.140 in/s at 0.341 sec

N/A: Not Applicable

USBM RI8507 And OSMRE





Time Scale: 0.50 sec/div **Amplitude Scale:** Geo: 0.100 in/s/div
Trigger = ▶— — — ◀

Printed: February 29, 2000 (V 3.74g - 3.74g)

GROUND MOTION STUDY EVENT

Date/Time	Tran at 12:24:08 February 25, 2000
Trigger Source	Geo: 0.0500 in/s
Range	Geo :10.00 in/s
Record Time	5.75 sec (Auto=5Sec) at 1024 sps

Serial Number	BC5571 V 4.02-4.02 MiniMate Plus
Battery Level	6.1 Volts
Calibration	July 21, 1999 by Instantel Inc.
File Name	G5717WN9.480

Notes
Location:
Client: CC&V
User Name: MMC, Inc.
General: Ground Motion Attenuation Study

Post Event Notes
Shot 3
Station M

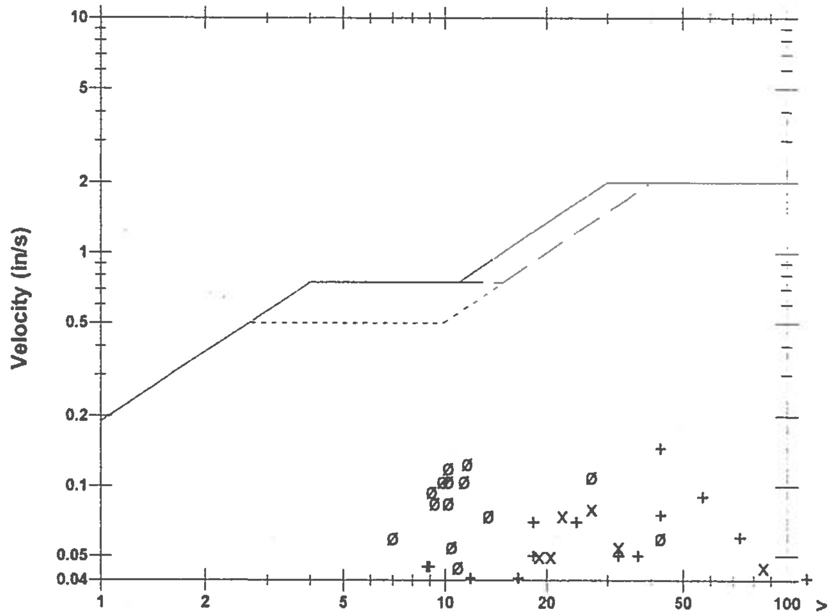
Microphone	Disabled
PSPL	N/A
ZC Freq	N/A
Channel Test	N/A

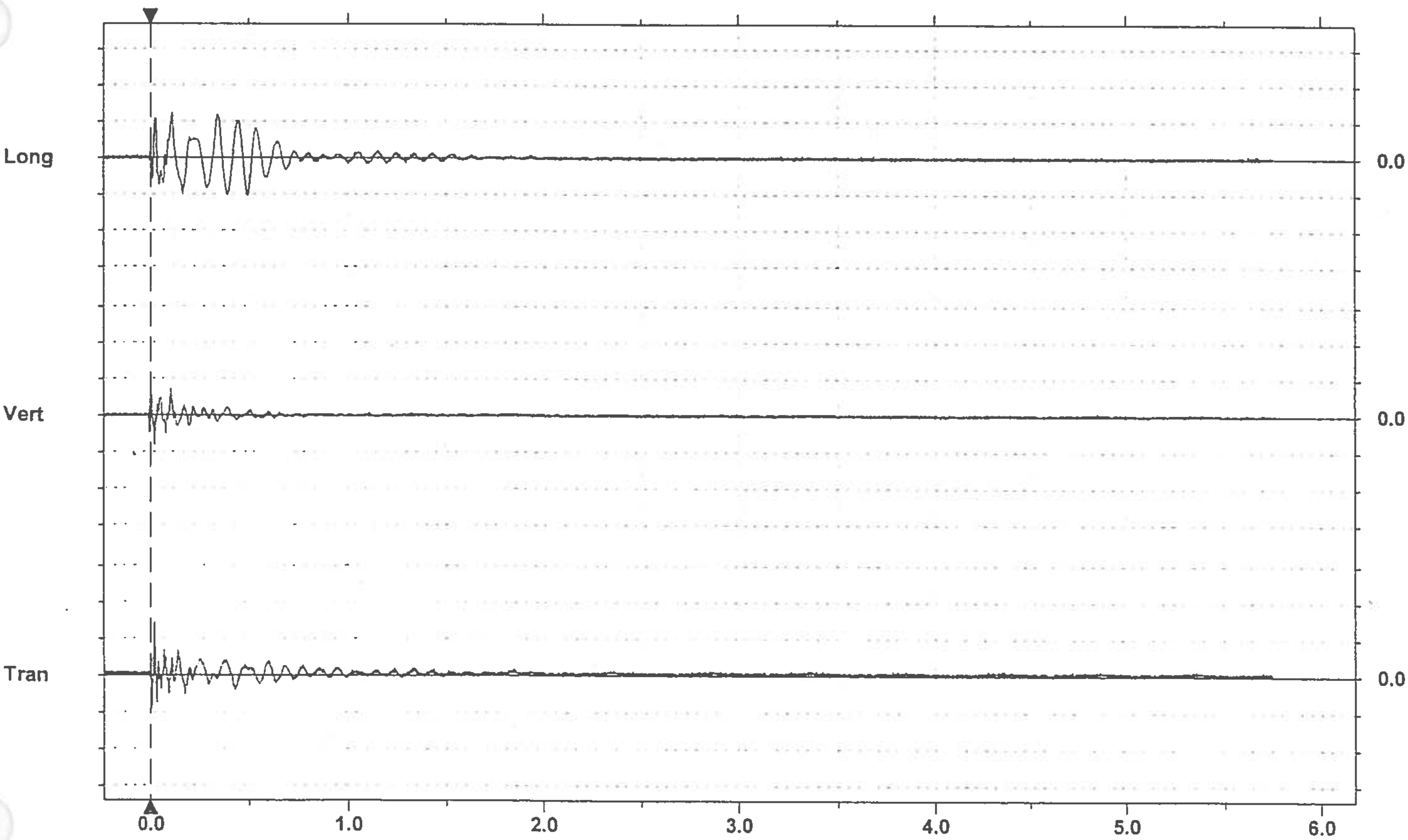
	Tran	Vert	Long	
PPV	0.145	0.0800	0.125	in/s
ZC Freq	43	27	12	Hz
Time (Rel. to Trig)	0.021	0.021	0.112	sec
Peak Acceleration	0.106	0.0663	0.0663	g
Peak Displacement	0.00080	0.00044	0.00174	in
Sensorcheck ™	Passed	Passed	Passed	

Peak Vector Sum 0.191 in/s at 0.021 sec

N/A: Not Applicable

USBM RI8507 And OSMRE





Time Scale: 0.50 sec/div **Amplitude Scale:** Geo: 0.100 in/s/div
Trigger = ▶— — —◀

Printed: February 29, 2000 (V 3.74g - 3.74g)

Test Shot 4

GROUND MOTION STUDY EVENT

Date/Time Vert at 12:40:22 February 25, 2000
Trigger Source Geo: 0.0500 in/s
Range Geo :10.00 in/s
Record Time 7.25 sec (Auto=5Sec) at 1024 sps

Serial Number BC5576 V 3.74-3.74 MiniMate Plus
Battery Level 6.0 Volts
Calibration March 5, 1999 by Instantel Inc.
File Name G5767WN9.VA0

Notes
Location:
Client: CC&V
User Name: MMC, Inc.
General: Ground Vibration Attenuation Study

Post Event Notes
Shot 4
Station A

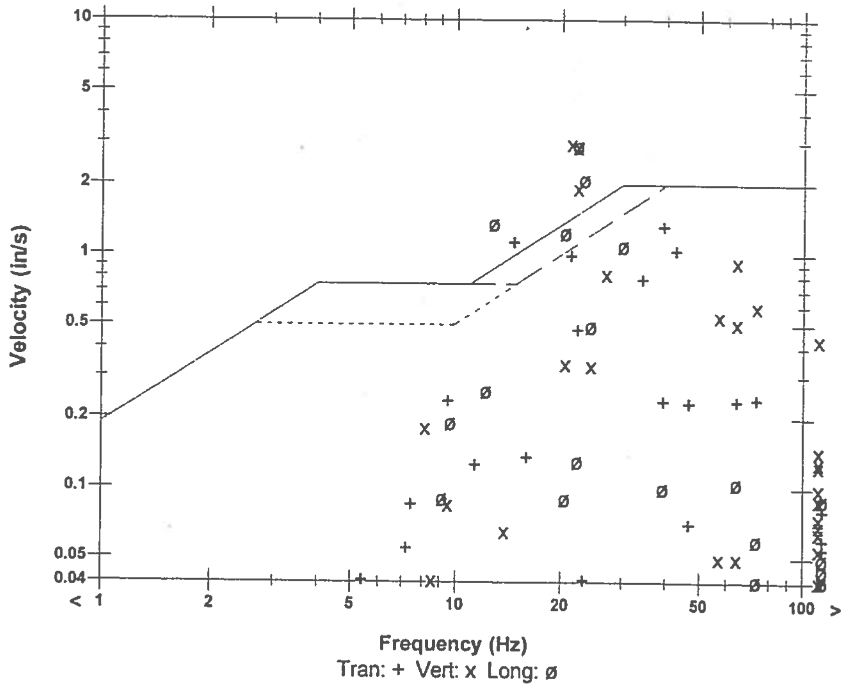
Microphone Disabled
PSPL N/A
ZC Freq N/A
Channel Test N/A

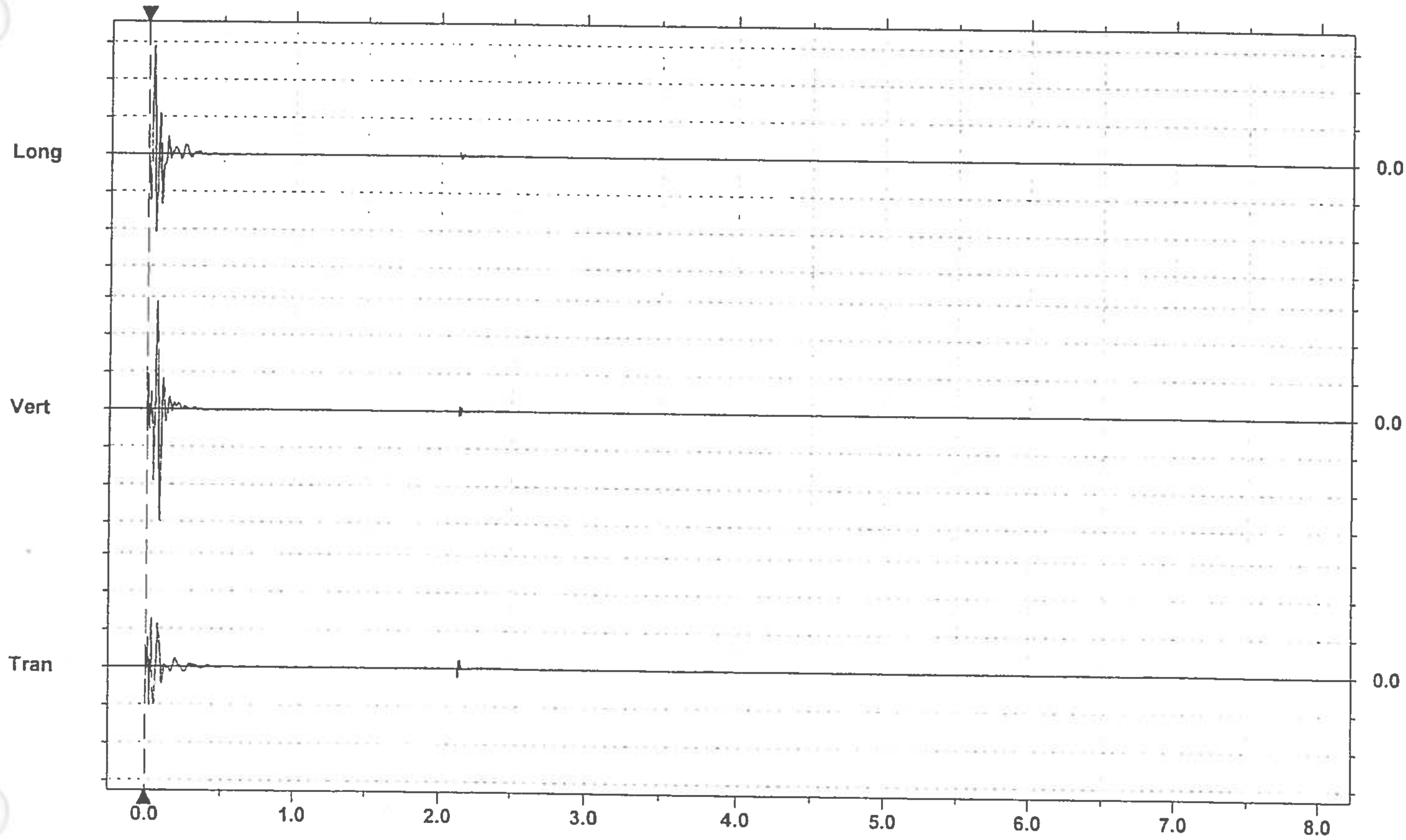
	Tran	Vert	Long	
PPV	1.32	2.96	2.89	in/s
ZC Freq	39	21	22	Hz
Time (Rel. to Trig)	0.041	0.089	0.035	sec
Peak Acceleration	1.05	1.55	1.68	g
Peak Displacement	0.00935	0.0208	0.0218	in
Sensorcheck ™	Passed	Passed	Passed	

Peak Vector Sum 3.34 in/s at 0.089 sec

N/A: Not Applicable

USBM RI8507 And OSMRE





Time Scale: 0.50 sec/div **Amplitude Scale:** Geo: 1.000 in/s/div
Trigger = ▶— — — ◀

Printed: February 29, 2000 (V 3.74g - 3.74g)

GROUND MOTION STUDY EVENT

Date/Time	Tran at 12:40:45 February 25, 2000	**Serial Number**	BC6796 V 4.02-4.02 MiniMate Plus
Trigger Source	Geo: 0.0500 in/s	**Battery Level**	6.3 Volts
Range	Geo :10.00 in/s	**Calibration**	October 8, 1999 by Instantel Inc.
Record Time	3.75 sec (Auto=3Sec) at 1024 sps	**File Name**	H7967WN9.VX0

Notes
Location:
Client:
User Name:
General:

Post Event Notes
M.M.C., Inc., for CC&V
Ground Motion Attenuation Study
Shot 4
Station B

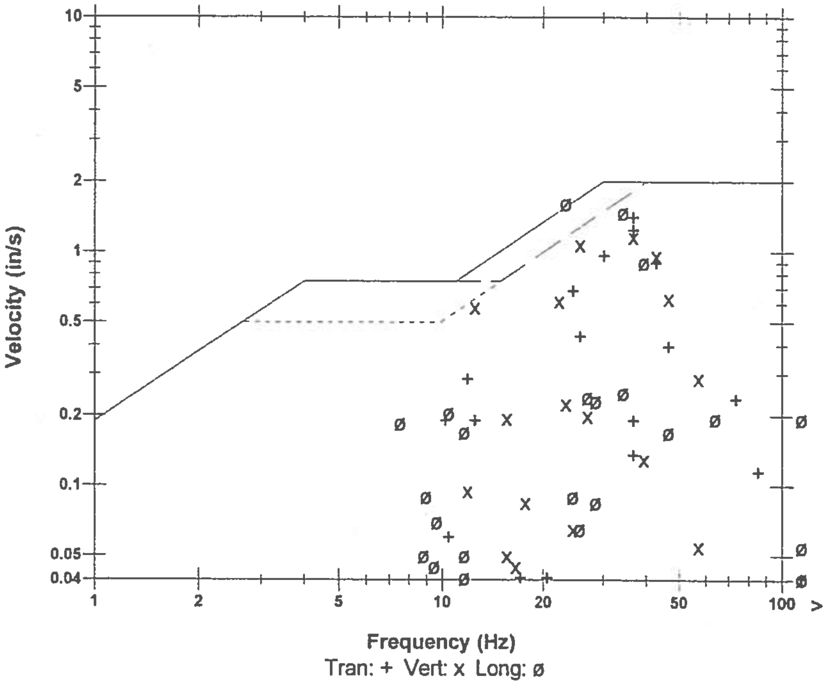
Microphone	Disabled
PSPL	N/A
ZC Freq	N/A
Channel Test	N/A

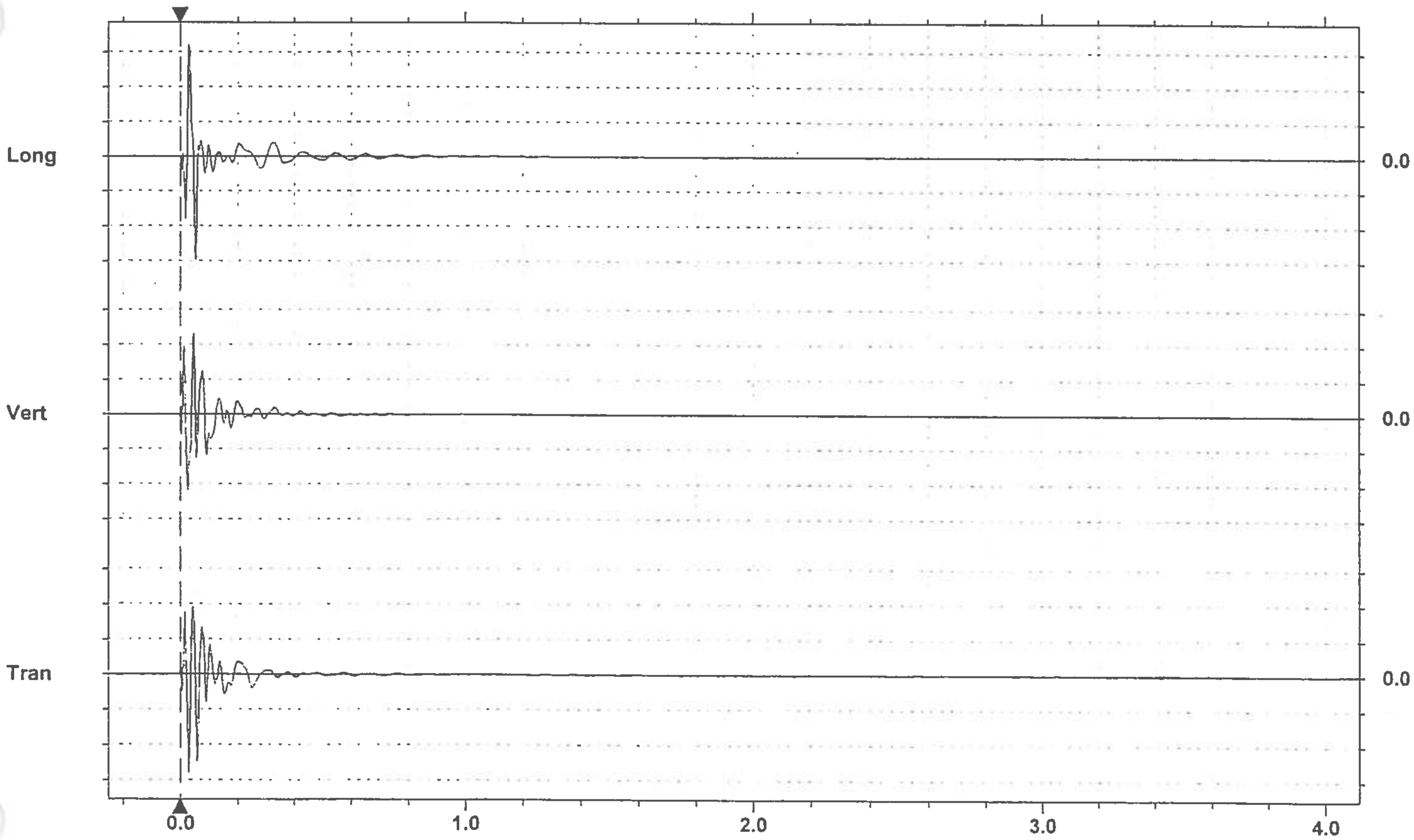
	Tran	Vert	Long	
PPV	1.40	1.16	1.61	in/s
ZC Freq	37	37	23	Hz
Time (Rel. to Trig)	0.029	0.046	0.029	sec
Peak Acceleration	1.07	0.809	1.13	g
Peak Displacement	0.00586	0.00640	0.00939	in
Sensorcheck ™	Passed	Passed	Passed	

Peak Vector Sum 2.26 in/s at 0.029 sec

N/A: Not Applicable

USBM RI8507 And OSMRE





Time Scale: 0.20 sec/div **Amplitude Scale:** Geo: 0.500 in/s/div
Trigger = ▶— — —◀

Printed: February 29, 2000 (V 3.74g - 3.74g)

GROUND MOTION STUDY EVENT

Date/Time	Long at 12:37:23 February 25, 2000	**Serial Number**	BA5546 V 4.02-4.02 BlastMate III
Trigger Source	Geo: 0.0200 in/s	**Battery Level**	6.1 Volts
Range	Geo :10.00 in/s	**Calibration**	August 9, 1999 by Instantel Inc.
Record Time	6.25 sec (Auto=5Sec) at 1024 sps	**File Name**	G5467WN9.QB0

Notes
Location:
Client: CC&V
User: MMC, Inc.
Ground Vibration Attenuation Study

Post Event Notes
Shot 4
Station C-20

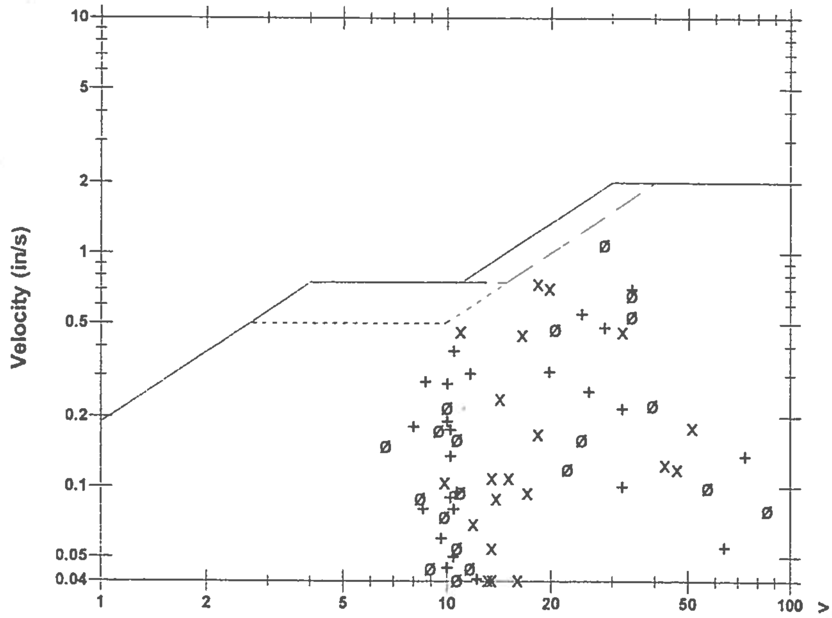
Microphone	Disabled
PSPL	N/A
ZC Freq	N/A
Channel Test	N/A

	Tran	Vert	Long	
PPV	0.700	0.745	1.09	in/s
ZC Freq	34	18	28	Hz
Time (Rel. to Trig)	0.054	0.107	0.035	sec
Peak Acceleration	0.371	0.252	0.490	g
Peak Displacement	0.00554	0.00746	0.00617	in
Sensorcheck ™	Passed	Passed	Passed	

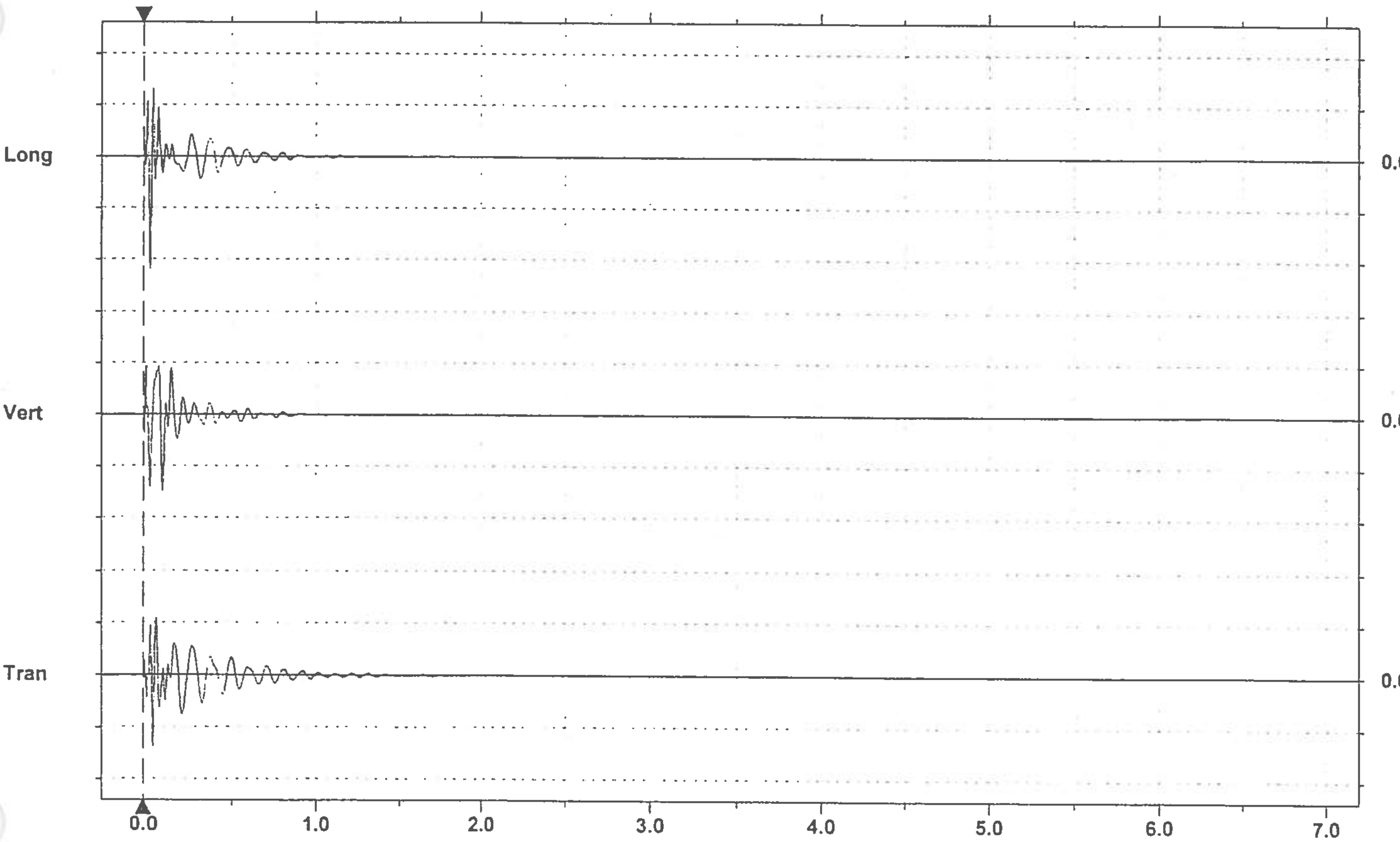
Peak Vector Sum 1.36 in/s at 0.036 sec

N/A: Not Applicable

USBM RI8507 And OSMRE



Frequency (Hz)
Tran: + Vert: x Long: ø



Time Scale: 0.50 sec/div **Amplitude Scale:** Geo: 0.500 in/s/div
Trigger = ▶— — —◀

GROUND MOTION STUDY EVENT

Date/Time	Vert at 12:22:56 February 25, 2000	**Serial Number**	BA5738 V 4.02-4.02 BlastMate III
Trigger Source	Geo: 0.0500 in/s	**Battery Level**	6.0 Volts
Range	Geo :10.00 in/s	**Calibration**	October 26, 1999 by Instantel Inc.
Record Time	6.25 sec (Auto=5Sec) at 1024 sps	**File Name**	G7387WN9.280

Notes
Location:
Client: CC&V
User Name: MMC, Inc.
General: Ground Vibration Attenuation Study

Post Event Notes
Shot 4
Station C

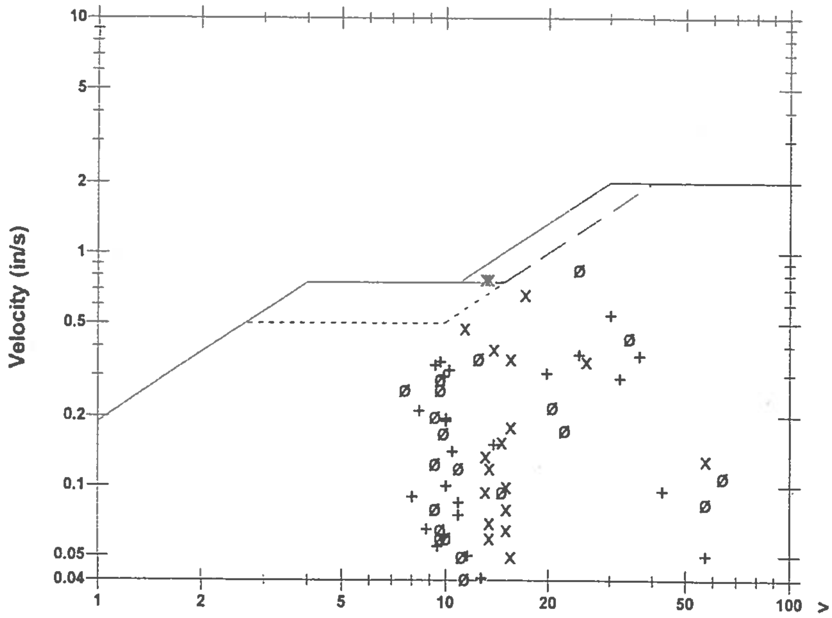
Microphone Disabled
PSPL N/A
ZC Freq N/A
Channel Test N/A

	Tran	Vert	Long	
PPV	0.540	0.775	0.855	in/s
ZC Freq	30	13	24	Hz
Time (Rel. to Trig)	0.040	0.077	0.037	sec
Peak Acceleration	0.252	0.225	0.305	g
Peak Displacement	0.00568	0.00816	0.00535	in
Sensorcheck ™	Passed	Passed	Passed	

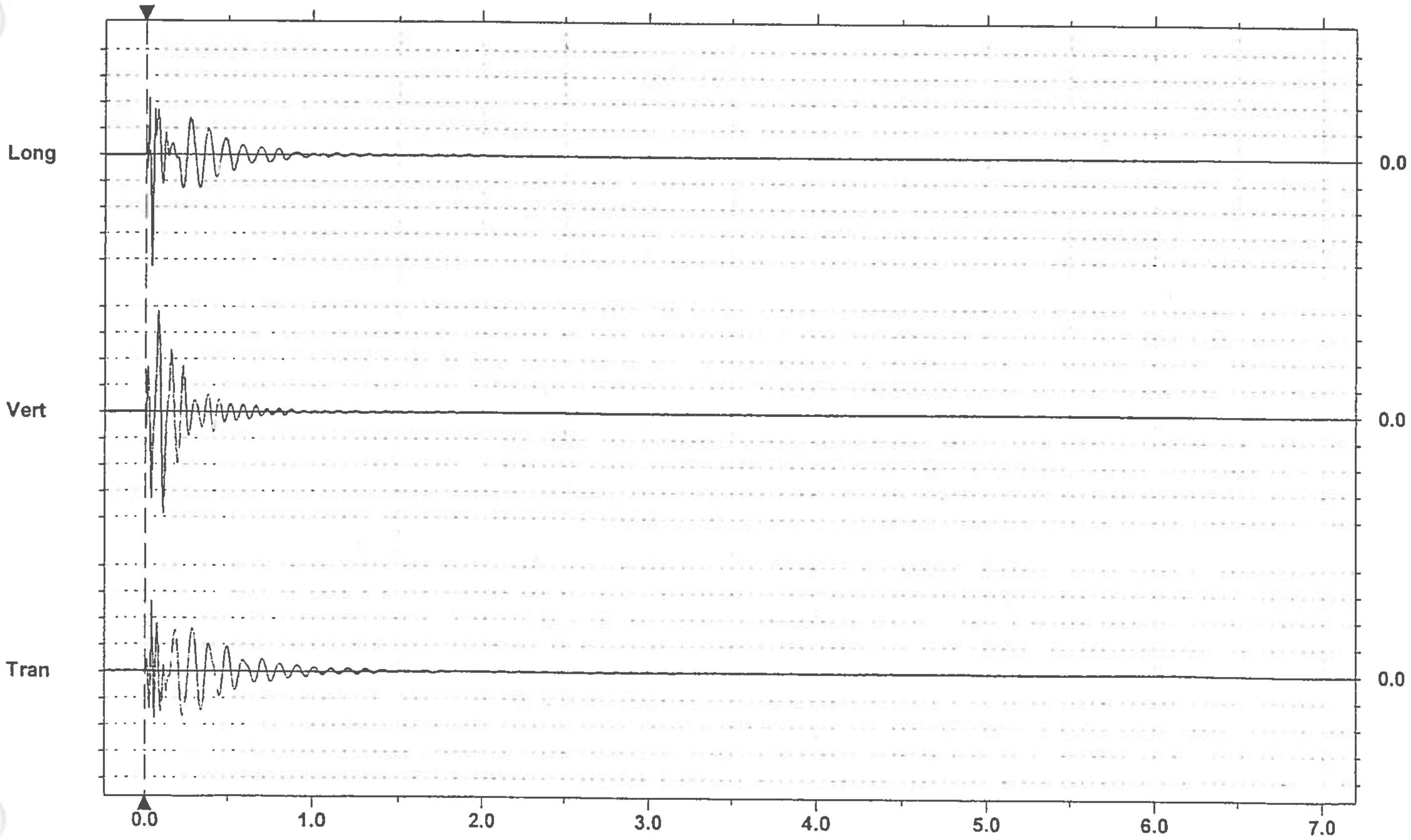
Peak Vector Sum 1.18 in/s at 0.038 sec

N/A: Not Applicable

USBM RI8507 And OSMRE



Frequency (Hz)
Tran: + Vert: x Long: ø



Time Scale: 0.50 sec/div Amplitude Scale: Geo: 0.200 in/s/div
Trigger = ▶— — —◀

Printed: February 29, 2000 (V 3.74g - 3.74g)

GROUND MOTION STUDY EVENT

Date/Time	Vert at 12:39:34 February 25, 2000	**Serial Number**	BA6008 V 4.02-4.02 BlastMate III
Trigger Source	Geo: 0.0500 in/s	**Battery Level**	6.2 Volts
Range	Geo :10.00 in/s	**Calibration**	May 26, 1999 by Instantel Inc.
Record Time	5.75 sec (Auto=5Sec) at 1024 sps	**File Name**	H0087WN9.TY0

Notes
Location:
Client: CC&V
User Name: MMC, Inc.
General: Ground Motion Attenuation Study

Post Event Notes
Shot 4
Station D

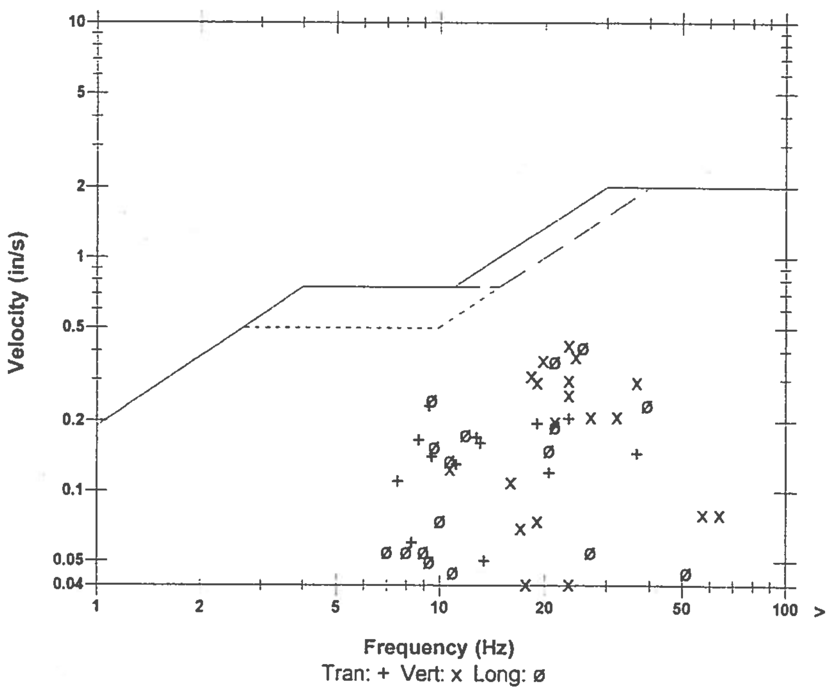
Microphone	Disabled
PSPL	N/A
ZC Freq	N/A
Channel Test	N/A

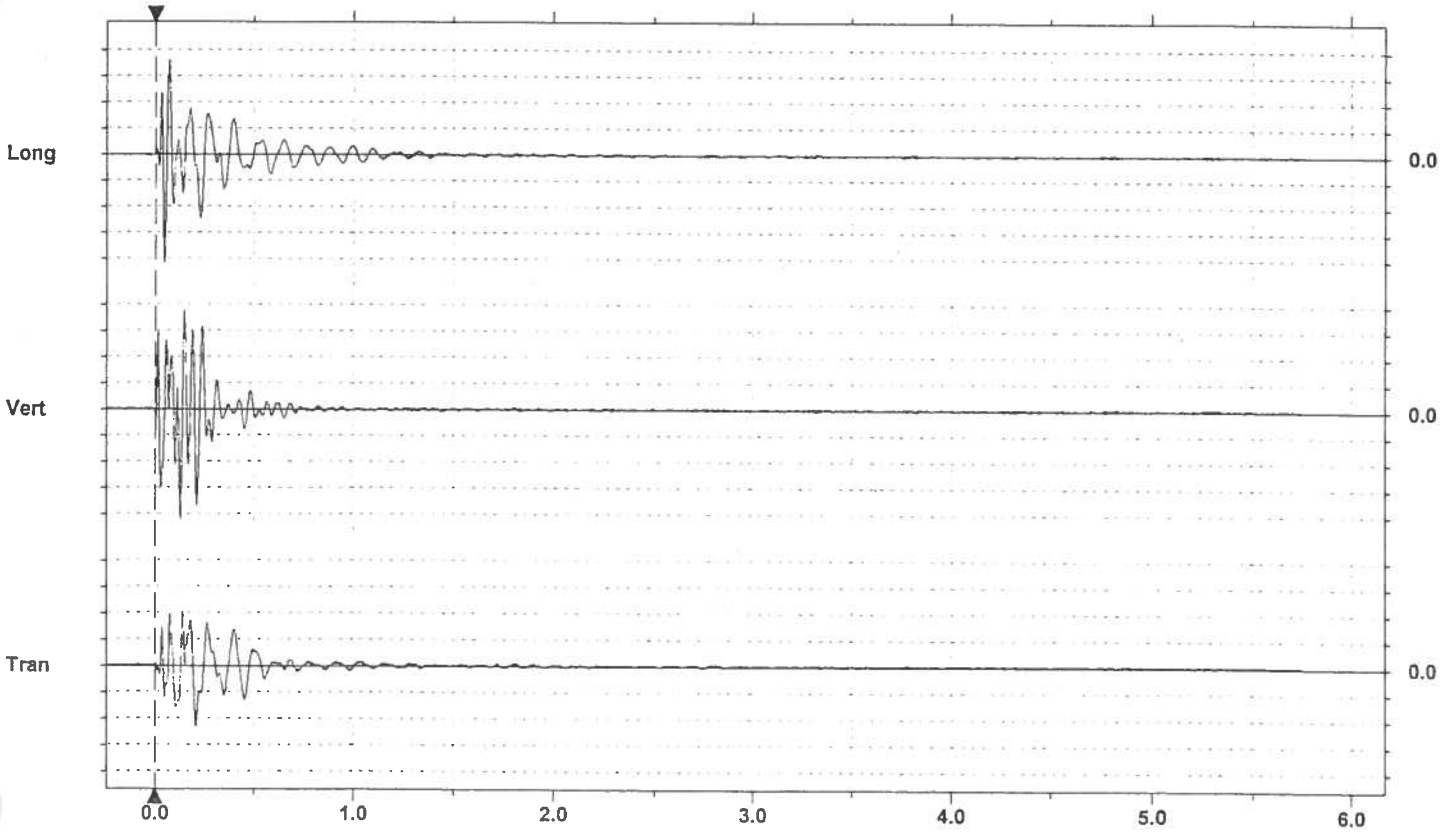
	Tran	Vert	Long	
PPV	0.230	0.425	0.415	in/s
ZC Freq	9.3	23	26	Hz
Time (Rel. to Trig)	0.205	0.127	0.043	sec
Peak Acceleration	0.0928	0.199	0.199	g
Peak Displacement	0.00327	0.00292	0.00330	in
Sensorcheck ™	Passed	Passed	Passed	

Peak Vector Sum 0.438 in/s at 0.127 sec

N/A: Not Applicable

USBM RI8507 And OSMRE





Time Scale: 0.50 sec/div **Amplitude Scale:** Geo: 0.100 in/s/div
Trigger = ▶— — —◀

Printed: February 29, 2000 (V 3.74g - 3.74g)

GROUND MOTION STUDY EVENT

Date/Time	Vert at 12:41:00 February 25, 2000	**Serial Number**	BC6255 V 4.02-4.02 MiniMate Plus
Trigger Source	Geo: 0.0500 in/s	**Battery Level**	6.1 Volts
Range	Geo :10.00 in/s	**Calibration**	November 4, 1999 by Instantel Inc.
Record Time	5.75 sec (Auto=5Sec) at 1024 sps	**File Name**	H2557WN9.WC0

Notes
Location:
Client: CC&V
User Name: MMC, Inc.
General: Ground Motion Attenuation Study

Extended Notes

Post Event Notes
Shot 4
Station F

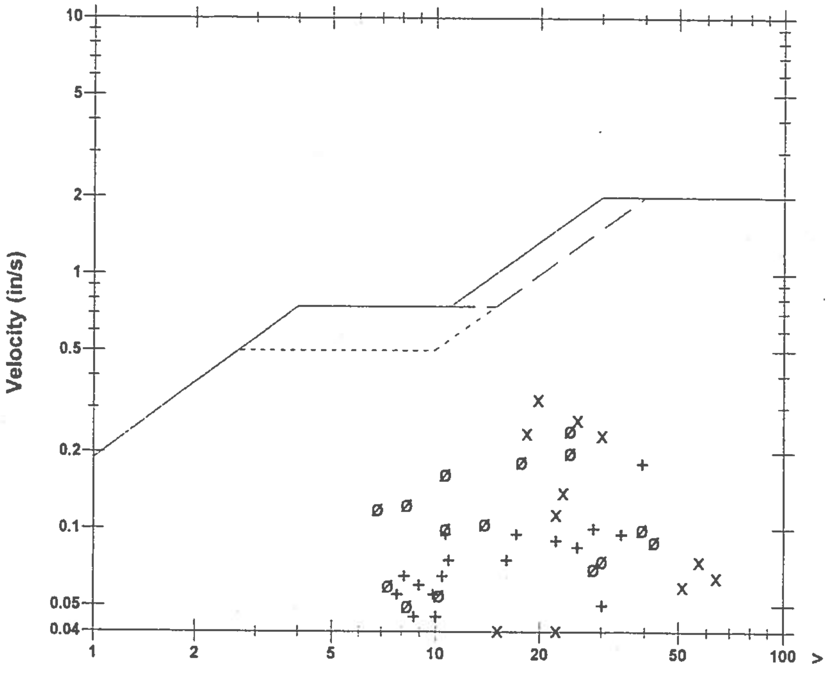
Microphone Disabled
PSPL N/A
ZC Freq N/A
Channel Test N/A

	Tran	Vert	Long	
PPV	0.180	0.325	0.245	in/s
ZC Freq	39	20	24	Hz
Time (Rel. to Trig)	0.039	0.028	0.050	sec
Peak Acceleration	0.106	0.172	0.106	g
Peak Displacement	0.00137	0.00209	0.00256	in
Sensorcheck ™	Passed	Passed	Passed	

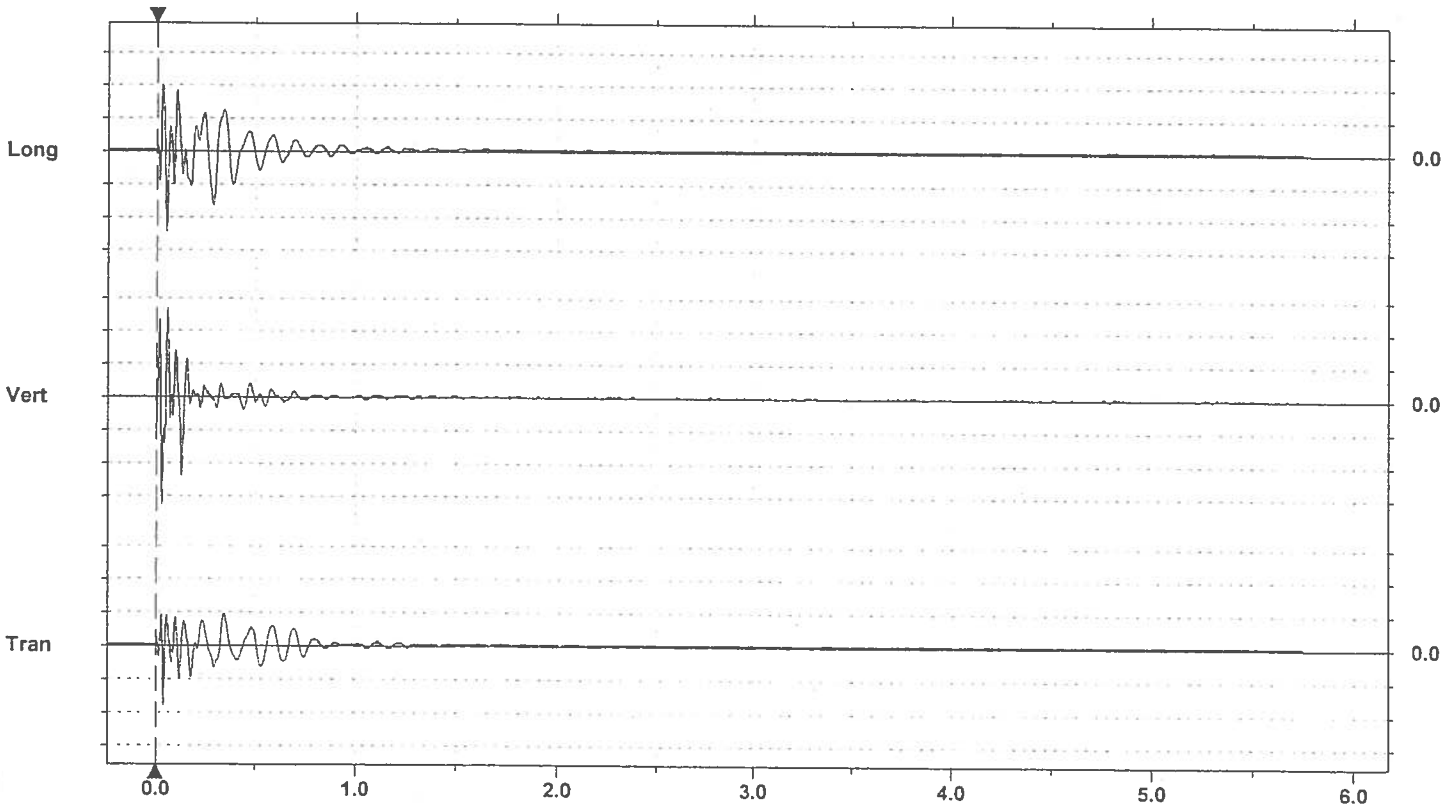
Peak Vector Sum 0.393 in/s at 0.028 sec

N/A: Not Applicable

USBM RI8507 And OSMRE



Frequency (Hz)
Tran: + Vert: x Long: ø



Time Scale: 0.50 sec/div Amplitude Scale: Geo: 0.100 in/s/div
Trigger = ▶— — — ◀

Printed: February 29, 2000 (V 3.74g - 3.74g)

GROUND MOTION STUDY EVENT

Date/Time	Vert at 12:40:30 February 25, 2000	**Serial Number**	BC5536 V 4.02-4.02 MiniMate Plus
Trigger Source	Geo: 0.0500 in/s	**Battery Level**	6.3 Volts
Range	Geo :10.00 in/s	**Calibration**	January 24, 2000 by Instantel Inc.
Record Time	5.75 sec (Auto=5Sec) at 1024 sps	**File Name**	G5367WN9.VI0

Notes
Location:
Client:
User Name:
General:

Post Event Notes
M.M.C., Inc., for CC&V
Ground Motion Attenuation Study
Shot 4
Station G

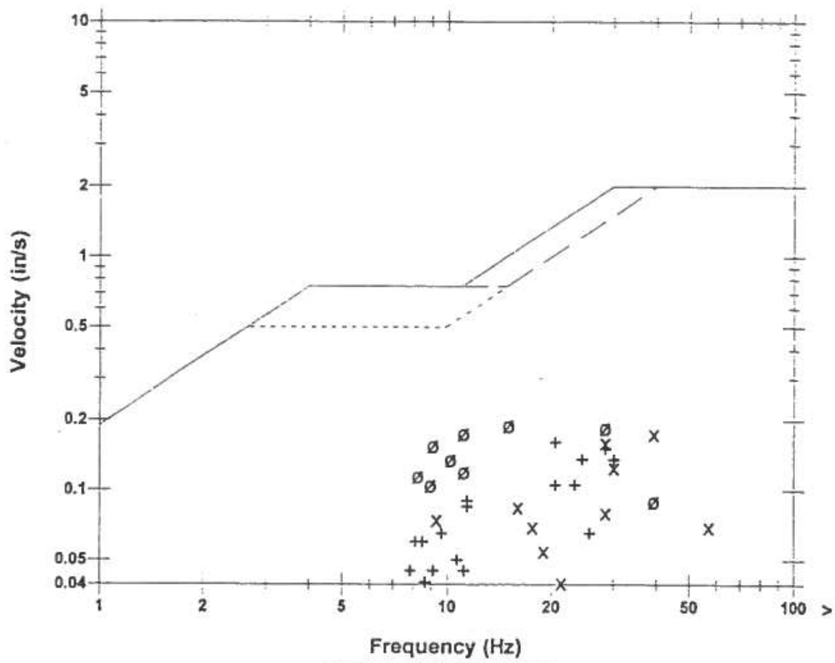
Microphone	Disabled
PSPL	N/A
ZC Freq	N/A
Channel Test	N/A

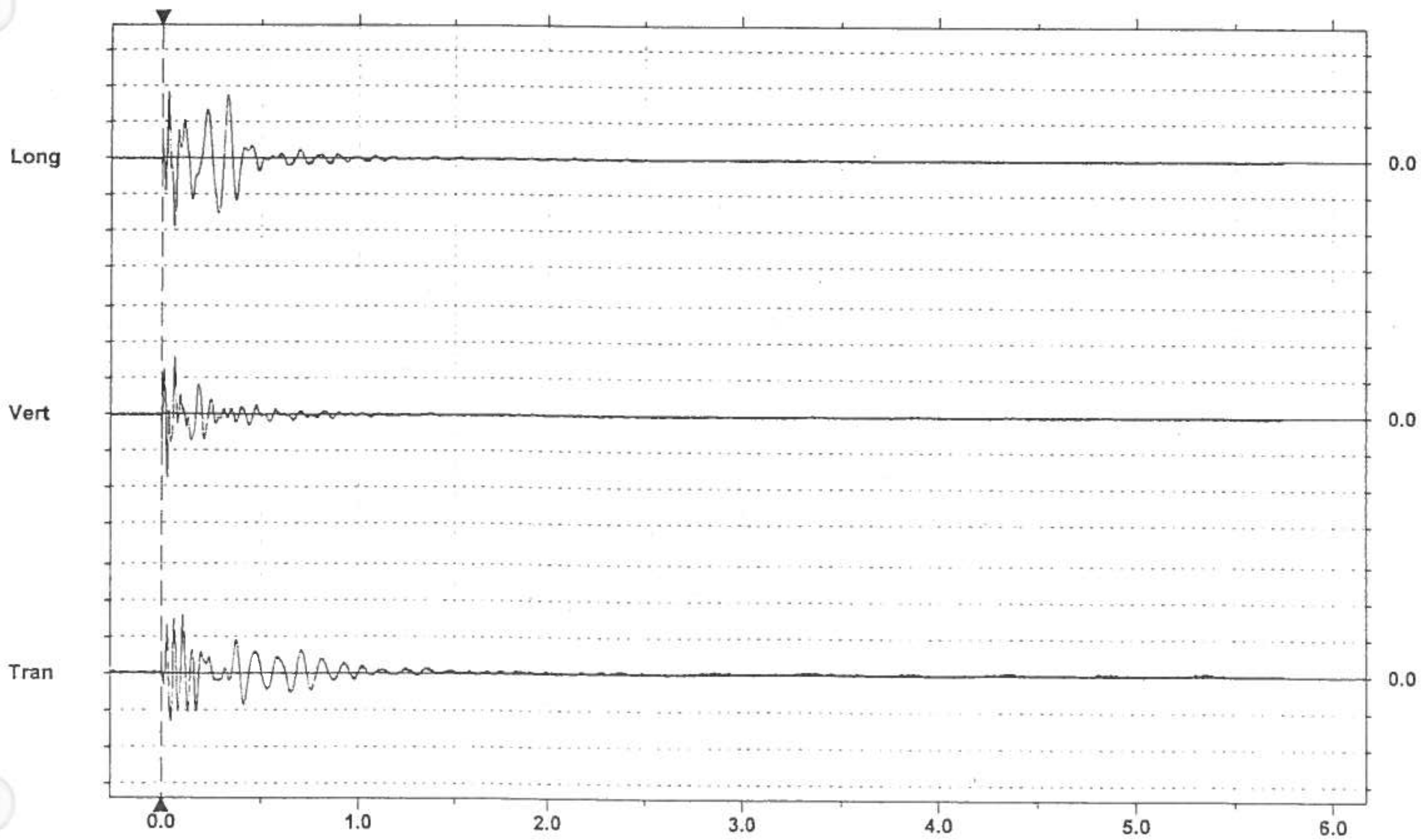
	Tran	Vert	Long	
PPV	0.160	0.175	0.190	in/s
ZC Freq	20	39	15	Hz
Time (Rel. to Trig)	0.106	0.028	0.062	sec
Peak Acceleration	0.106	0.0928	0.0928	g
Peak Displacement	0.00121	0.00113	0.00266	in
Sensorcheck ™	Passed	Passed	Passed	

Peak Vector Sum 0.278 in/s at 0.063 sec

N/A: Not Applicable

USBM RI8507 And OSMRE





Time Scale: 0.50 sec/div **Amplitude Scale:** Geo: 0.100 in/s/div
Trigger = ▶— — —◀

Printed: February 29, 2000 (V 3.74g - 3.74g)

GROUND MOTION STUDY EVENT

Date/Time	Vert at 12:37:32 February 25, 2000	**Serial Number**	BC6248 V 4.02-4.02 MiniMate Plus
Trigger Source	Geo: 0.0500 in/s	**Battery Level**	6.1 Volts
Range	Geo :10.00 in/s	**Calibration**	September 22, 1999 by Instantel Inc.
Record Time	4.75 sec (Auto=4Sec) at 1024 sps	**File Name**	H2487WN9.QK0

Notes
Location:
Client:
User Name:
General:

Post Event Notes
M.M.C. Inc., for CC&V
Ground Motion Attenuation Study
Shot 4
Station I

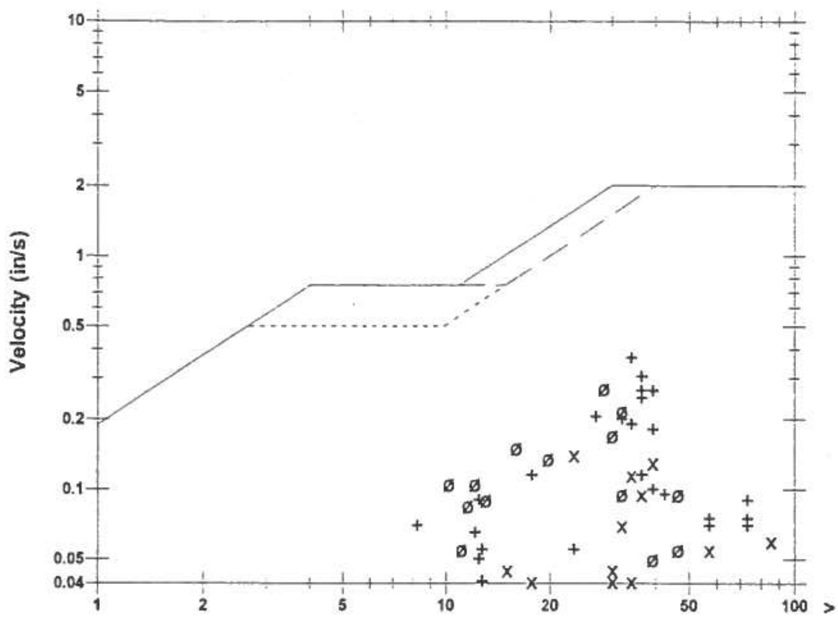
Microphone	Disabled
PSPL	N/A
ZC Freq	N/A
Channel Test	N/A

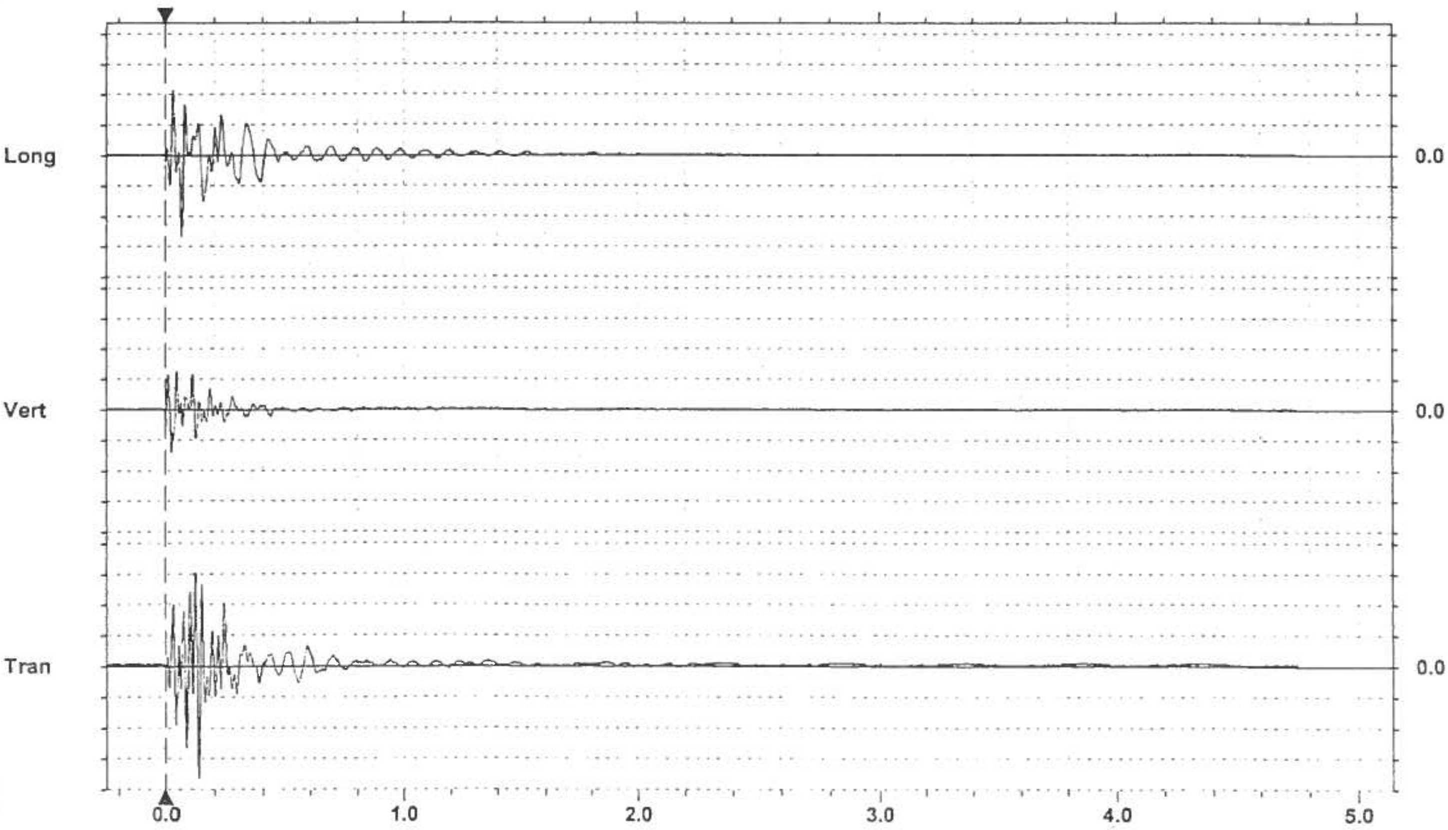
	Tran	Vert	Long	
PPV	0.365	0.140	0.270	in/s
ZC Freq	34	23	28	Hz
Time (Rel. to Trig)	0.132	0.025	0.066	sec
Peak Acceleration	0.212	0.0928	0.146	g
Peak Displacement	0.00165	0.00081	0.00167	in
Sensorcheck ™	Passed	Passed	Passed	

Peak Vector Sum 0.381 in/s at 0.133 sec

N/A: Not Applicable

USBM RI8507 And OSMRE





Time Scale: 0.20 sec/div Amplitude Scale: Geo: 0.100 in/s/div
Trigger = ▶— — —◀

Printed: February 29, 2000 (V 3.74g - 3.74g)

GROUND MOTION STUDY EVENT

Date/Time	Tran at 12:40:27 February 25, 2000	**Serial Number**	BC5534 V 4.02-4.02 MiniMate Plus
Trigger Source	Geo: 0.0500 in/s	**Battery Level**	6.3 Volts
Range	Geo :10.00 in/s	**Calibration**	November 24, 1999 by Instantel Inc.
Record Time	5.75 sec (Auto=5Sec) at 1024 sps	**File Name**	G5347WN9.VF0

Notes
Location:
Client: CC&V
User Name: MMC, Inc.
General: Ground Motion Attenuation Study

Post Event Notes
Shot 4
Station J

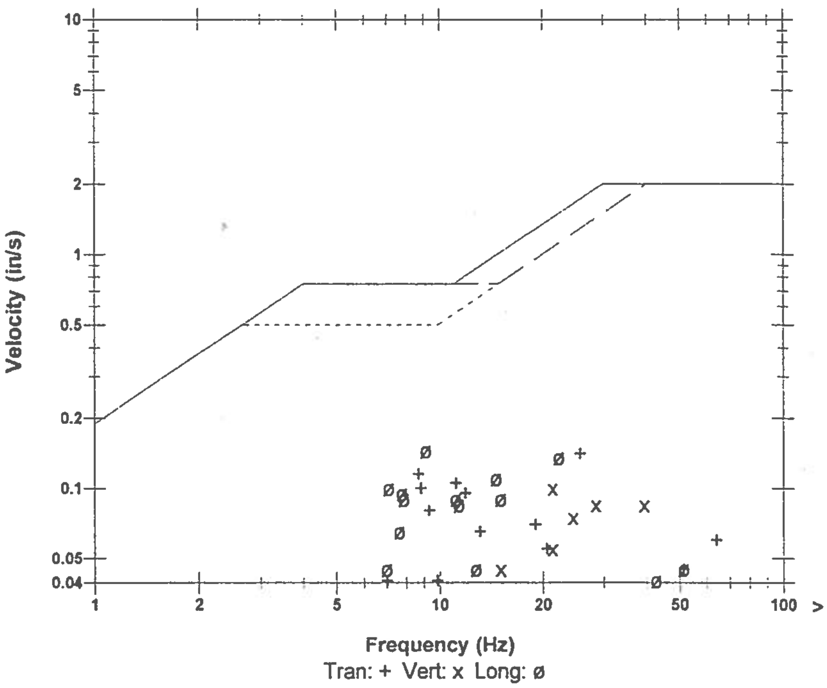
Microphone Disabled
PSPL N/A
ZC Freq N/A
Channel Test N/A

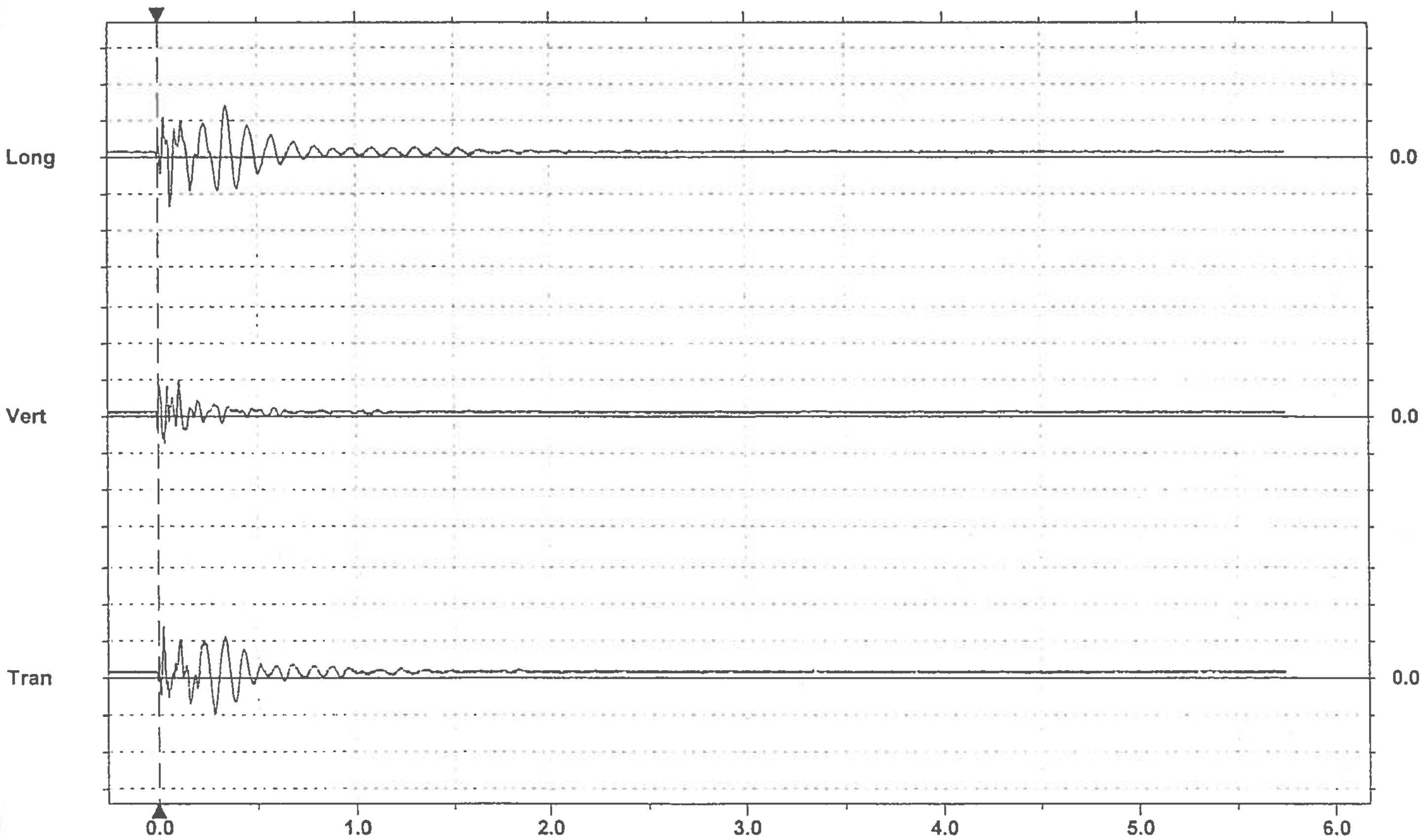
	Tran	Vert	Long	
PPV	0.140	0.1000	0.145	in/s
ZC Freq	26	21	9.1	Hz
Time (Rel. to Trig)	0.024	0.104	0.344	sec
Peak Acceleration	0.0663	0.0663	0.0663	g
Peak Displacement	0.00219	0.00171	0.00243	in
Sensorcheck ™	Passed	Passed	Passed	

Peak Vector Sum 0.176 in/s at 0.341 sec

N/A: Not Applicable

USBM RI8507 And OSMRE





Time Scale: 0.50 sec/div Amplitude Scale: Geo: 0.100 in/s/div
Trigger = ▶— — —◀

Printed: February 29, 2000 (V 3.74g - 3.74g)

GROUND MOTION STUDY EVENT

Date/Time	Vert at 12:39:35 February 25, 2000	**Serial Number**	BC6076 V 3.74-3.74 MiniMate Plus
Trigger Source	Geo: 0.0500 in/s	**Battery Level**	6.0 Volts
Range	Geo :10.00 in/s	**Calibration**	August 10, 1999 by Instantel Inc.
Record Time	5.75 sec (Auto=5Sec) at 1024 sps	**File Name**	H0767WN9.TZ0

Notes
Location:
Client: CC&V
User Name: MMC, Inc.
General: Ground Vibration Attenuation Study

Post Event Notes
Shot 4
Station L

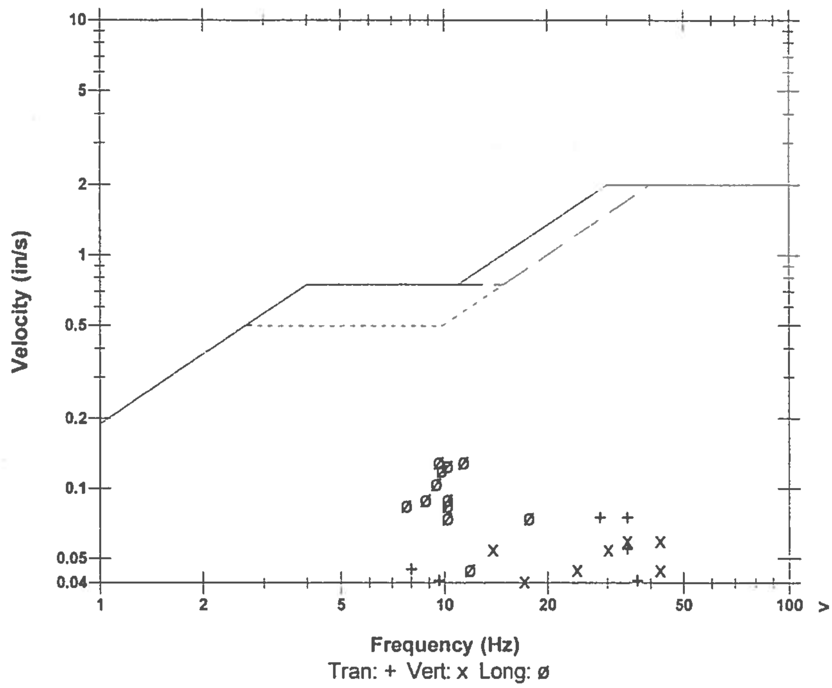
Microphone Disabled
PSPL N/A
ZC Freq N/A
Channel Test N/A

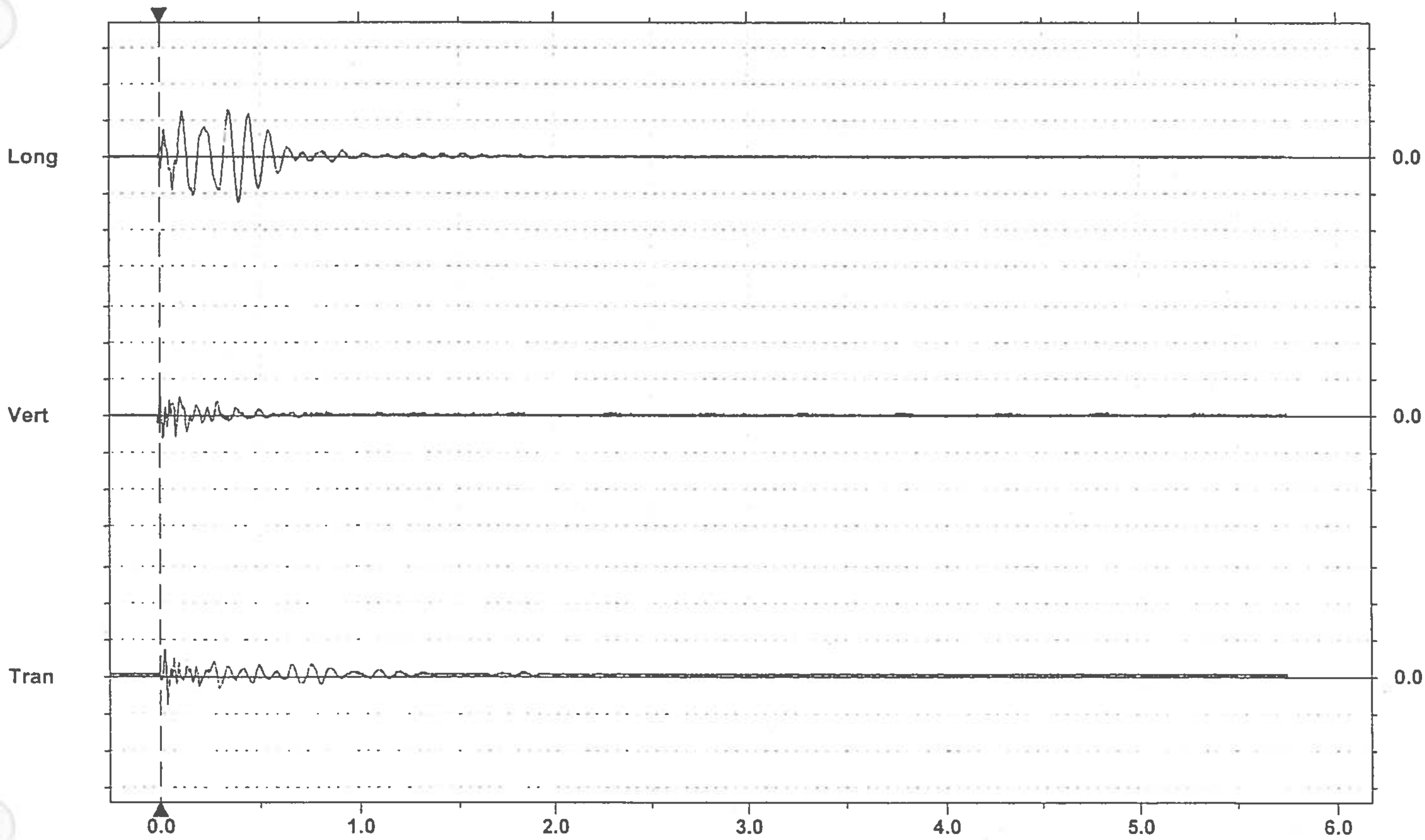
	Tran	Vert	Long	
PPV	0.0750	0.0600	0.130	in/s
ZC Freq	28	43	11	Hz
Time (Rel. to Trig)	0.022	0.014	0.111	sec
Peak Acceleration	0.0530	0.0530	0.0398	g
Peak Displacement	0.00075	0.00057	0.00212	in
Sensorcheck ™	Passed	Passed	Passed	

Peak Vector Sum 0.134 in/s at 0.337 sec

N/A: Not Applicable

USBM RI8507 And OSMRE





Time Scale: 0.50 sec/div **Amplitude Scale:** Geo: 0.100 in/s/div
Trigger = ▶— — —◀

GROUND MOTION STUDY EVENT

Date/Time	Vert at 12:40:17 February 25, 2000	**Serial Number**	BC5571 V 4.02-4.02 MiniMate Plus
Trigger Source	Geo: 0.0500 in/s	**Battery Level**	6.1 Volts
Range	Geo :10.00 in/s	**Calibration**	July 21, 1999 by Instantel Inc.
Record Time	5.75 sec (Auto=5Sec) at 1024 sps	**File Name**	G5717WN9.V50

Notes
Location:
Client: CC&V
User Name: MMC, Inc.
General: Ground Motion Attenuation Study

Post Event Notes
Shot 4
Station M

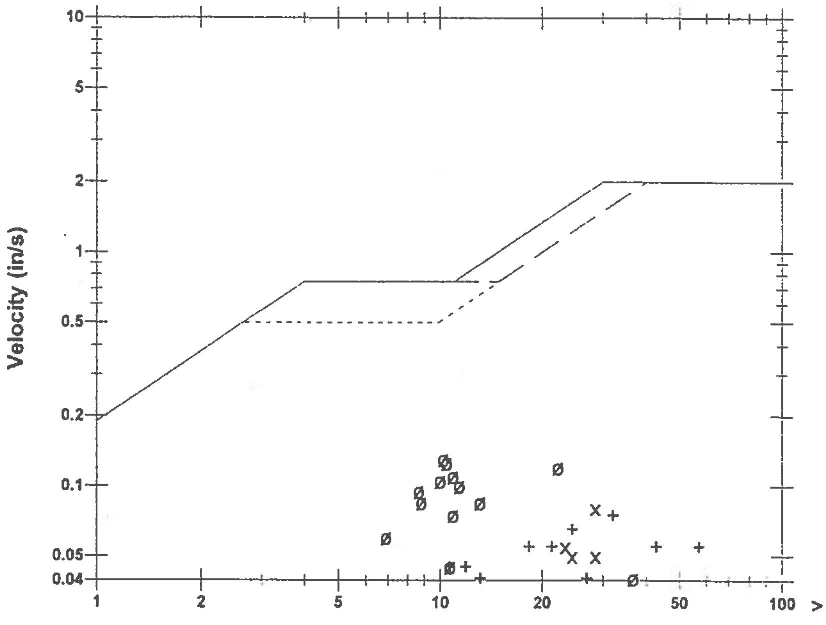
Microphone Disabled
PSPL N/A
ZC Freq N/A
Channel Test N/A

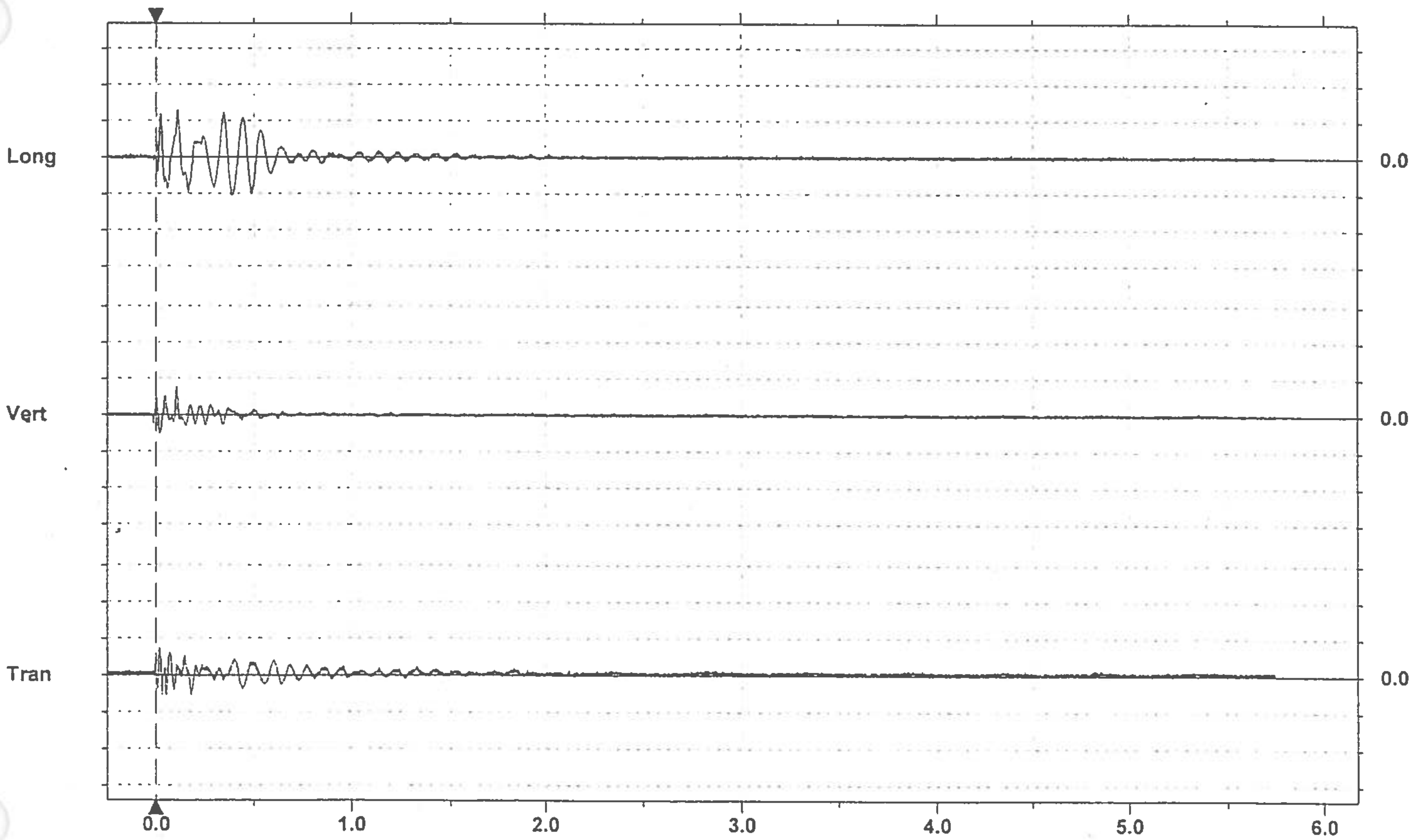
	Tran	Vert	Long	
PPV	0.0750	0.0800	0.130	in/s
ZC Freq	32	28	10	Hz
Time (Rel. to Trig)	0.018	0.106	0.108	sec
Peak Acceleration	0.0663	0.0398	0.0530	g
Peak Displacement	0.00071	0.00043	0.00175	in
Sensorcheck ™	Passed	Passed	Passed	

Peak Vector Sum 0.147 in/s at 0.107 sec

N/A: Not Applicable

USBM RI8507 And OSMRE





Time Scale: 0.50 sec/div **Amplitude Scale:** Geo: 0.100 in/s/div
Trigger = ▶— — — —◀

Appendix V

Regression Analysis and Tables

NORTH CRESSON ATTENUATION STUDY

Client: CC&V

Date: February 25, 2000

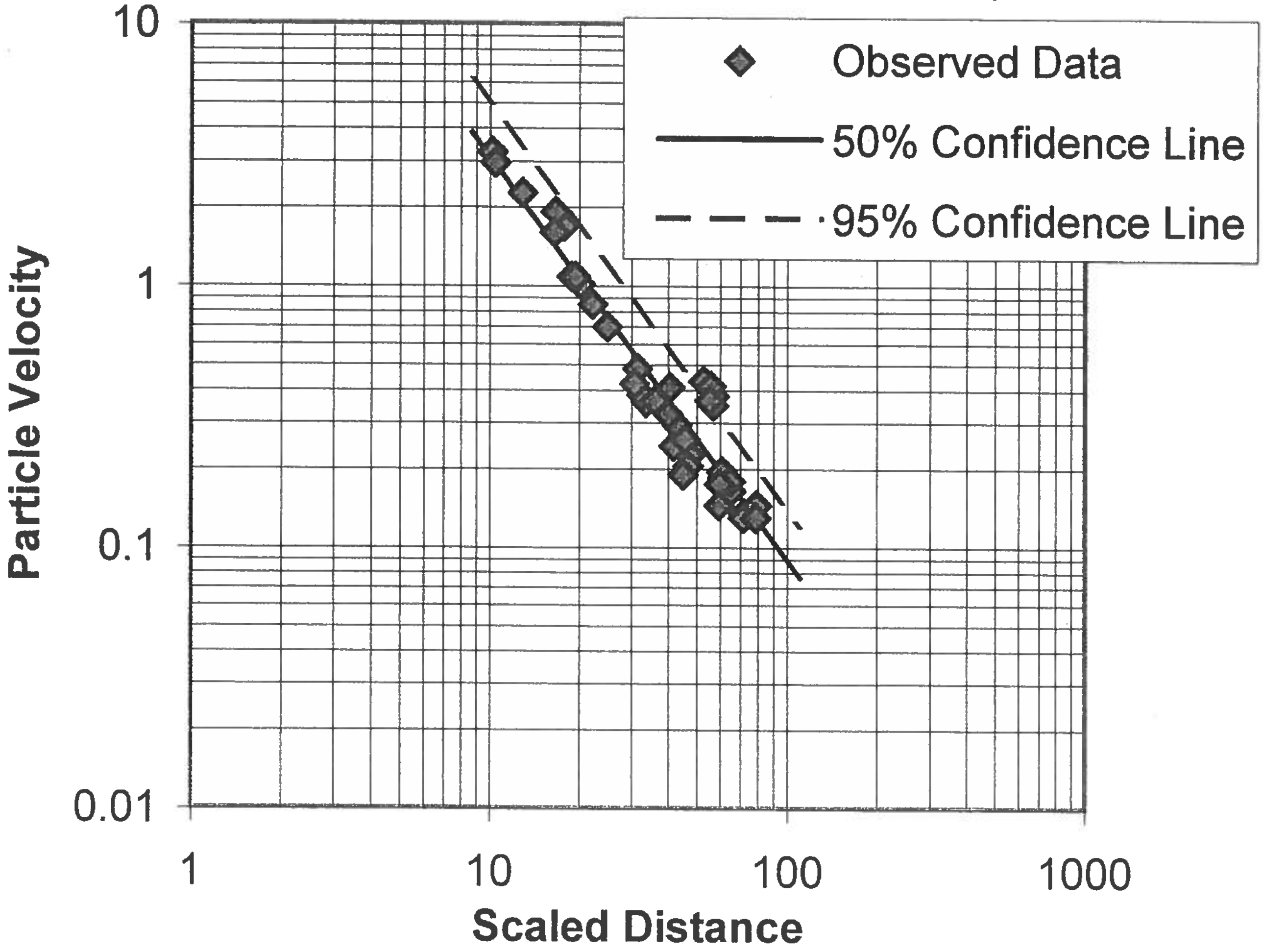
Location: Teller County, Colorado

Test Shot	Recording Station	Charge Weight (pounds)	Instrument Number	Surface Distance (ft)	Scaled Distance	Peak Particle Velocity (inches per second)	Recording Time
1	A	100.0	BC5576	129	12.9	2.280	10:49:44
1	B	100.0	BC6796	189	18.9	1.090	10:50:06
1	C	100.0	BA5738	250	25.0	0.700	10:44:31
1	D	100.0	BA6008	337	33.7	0.360	10:48:55
1	E	100.0	BA5546	371	37.1	0.355	10:46:45
1	F	100.0	BC6255	428	42.8	0.295	10:50:21
1	G	100.0	BC5536	474	47.4	0.225	10:49:51
1	I	100.0	BC6248	572	57.2	0.380	10:46:53
1	J	100.0	BC5534	611	61.1	0.185	10:49:49
1	K	100.0	BC5571	650	65.0	0.165	10:49:38
2	B	100.0	BC6796	178	17.8	1.700	11:02:20
2	D	100.0	BA6008	327	32.7	0.385	11:01:08
2	E	100.0	BA5546	361	36.1	0.365	10:58:58
2	F	100.0	BC6255	419	41.9	0.245	11:02:35
2	G	100.0	BC5536	467	46.7	0.205	11:02:04
2	H	100.0	BC6076	526	52.6	0.435	11:01:10
2	I	100.0	BC6248	568	56.8	0.350	10:59:07
2	J	100.0	BC5534	607	60.7	0.195	11:02:02
2	K	100.0	BC5571	647	64.7	0.180	11:01:52
3	A	100.0	BC5576	102	10.2	3.250	12:24:13
3	B	100.0	BC6796	167	16.7	1.930	12:24:36
3	C-20	100.0	BA5546	202	20.2	1.020	12:21:14
3	C	100.0	BA5738	222	22.2	0.855	12:22:56
3	D	100.0	BA6008	315	31.5	0.485	12:23:25
3	F	100.0	BC6255	407	40.7	0.410	12:24:51
3	G	100.0	BC5536	456	45.6	0.260	12:24:20
3	I	100.0	BC6248	559	55.9	0.415	12:21:23
3	J	100.0	BC5534	598	59.8	0.175	12:24:18
3	L	100.0	BC6076	720	72.0	0.135	12:23:26
3	M	100.0	BC5571	792	79.2	0.145	12:24:08
4	A	100.0	BC5576	104	10.4	2.960	12:40:22
4	B	100.0	BC6796	165	16.5	1.610	12:40:45
4	C-20	100.0	BA5546	194	19.4	1.090	12:37:23
4	D	100.0	BA6008	308	30.8	0.425	12:39:34
4	F	100.0	BC6255	400	40.0	0.325	12:41:00
4	G	100.0	BC5536	450	45.0	0.190	12:40:30
4	I	100.0	BC6248	554	55.4	0.365	12:37:32
4	J	100.0	BC5534	594	59.4	0.145	12:40:27
4	L	100.0	BC6076	717	71.7	0.130	12:39:35
4	M	100.0	BC5571	789	78.9	0.130	12:40:17

Regression Analysis

CRIPPLE CREEK AND VICTOR GOLD MINING COMPANY

NORTH CRESSON AREA, FEBRUARY 25, 2000



The 95% Confidence Equation

PPV= 168.6 X (SD)^ $^{-1.54}$

The Correlation Coeficient r^2 is: 0.913

Prepared by Matheson Mining Consultants 3/2/00

REGRESSION ANALYSIS

CRIPPLE CREEK AND VICTOR GOLD MINING COMPANY
NORTH CRESSON AREA, FEBRUARY 25, 2000

Data Statisics

N	Max_PPV	Min_PPV	Max_SD	Min_SD
40.0	3.25	0.13	79	10

Calculated Sums

Sum_X	Sum_Y	Sum_X2	Sum_Y2	Sum_XY
144.4	-35.159	533.630	63.546	-146.3

Sums Of Squares

SS_X	SS_Y	SS_XY	SumXSumY	$(SumX)^2$
12.63	32.64	-19.41	-5075.517	20840.039

Calculated Means & Calulated Coefficients

X_Bar	Y_Bar	a	K_{50}	K_{95}	K_{99}	$K_{.99}$	B_{50}
3.609	-0.879	4.67	106.3	168.6	204.1	55.4	-1.54

Sample Standard Deviation & Coefficient of Correlation

S	S_{e2}	r	r^2
0.273	2.824	-0.956	0.913

The 95% Confidence Level Equation

PPV= 168.6 X (SD)^ $^{-1.54}$

Prepared by Matheson Mining Consultants 3/2/00

REGRESSION ANALYSIS

50% Confidence Level

SCALED DISTANCE TABLE

CRIPPLE CREEK & VICTOR GOLD MINING COMPANY

NORTH CRESSON AREA, FEBRUARY 25, 2000

Scaled Distance	Particle Velocity	Scaled Distance	Particle Velocity
1	106.34 ips	125	0.06 ips
5	8.97 ips	130	0.06 ips
10	3.09 ips	135	0.06 ips
15	1.66 ips	140	0.05 ips
20	1.07 ips	145	0.05 ips
25	0.76 ips	150	0.05 ips
30	0.57 ips	155	0.05 ips
35	0.45 ips	160	0.04 ips
40	0.37 ips	165	0.04 ips
45	0.31 ips	170	0.04 ips
50	0.26 ips	175	0.04 ips
55	0.23 ips	180	0.04 ips
60	0.20 ips	185	0.03 ips
65	0.17 ips	190	0.03 ips
70	0.16 ips	195	0.03 ips
75	0.14 ips	200	0.03 ips
80	0.13 ips	205	0.03 ips
85	0.12 ips	210	0.03 ips
90	0.11 ips	215	0.03 ips
95	0.10 ips	220	0.03 ips
100	0.09 ips	225	0.03 ips
105	0.08 ips	230	0.02 ips
110	0.08 ips	235	0.02 ips
115	0.07 ips	240	0.02 ips
120	0.07 ips	245	0.02 ips

REGRESSION ANALYSIS

95% Confidence Level

SCALED DISTANCE TABLE

CRIPPLE CREEK & VICTOR GOLD MINING COMPANY

NORTH CRESSON AREA, FEBRUARY 25, 2000

Scaled Distance	Particle Velocity	Scaled Distance	Particle Velocity
1	168.6 ips	125	0.10 ips
5	14.22 ips	130	0.10 ips
10	4.90 ips	135	0.09 ips
15	2.63 ips	140	0.08 ips
20	1.69 ips	145	0.08 ips
25	1.20 ips	150	0.08 ips
30	0.91 ips	155	0.07 ips
35	0.71 ips	160	0.07 ips
40	0.58 ips	165	0.07 ips
45	0.49 ips	170	0.06 ips
50	0.41 ips	175	0.06 ips
55	0.36 ips	180	0.06 ips
60	0.31 ips	185	0.06 ips
65	0.28 ips	190	0.05 ips
70	0.25 ips	195	0.05 ips
75	0.22 ips	200	0.05 ips
80	0.20 ips	205	0.05 ips
85	0.18 ips	210	0.05 ips
90	0.17 ips	215	0.04 ips
95	0.15 ips	220	0.04 ips
100	0.14 ips	225	0.04 ips
105	0.13 ips	230	0.04 ips
110	0.12 ips	235	0.04 ips
115	0.11 ips	240	0.04 ips
120	0.11 ips	245	0.04 ips