Vermont Agency of Transportation (VTrans)
Materials and Research Section

Evaluation of SPT Hammer Energy Variability

Windsor, VT

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16. Abstract

This report presents an evaluation of the Standard Penetration Test (SPT) hammer energy delivered to the SPT samplers from VTrans equipment as well as measured energy values of SPT hammers from drilling companies that do work for the State of Vermont during the performance of ASTM D1586, “Standard Test Method for Standard Penetration Test (SPT) and Split-Barrel Sampling of Soils.” The variability of the measurements was assessed and a summary of the energy transfer ratios are provided. This report also supplies some guidance on recommended frequency of SPT hammer energy measurement on VTrans equipment.

Nine different SPT hammer configurations were tested in this study. Variables included hammer type, drill rods, rig type, soil type and condition, operator, and drilling method. This study attempted to isolate these variables in order to quantify the contribution of each variable on the measured SPT hammer energy. A number of variables (e.g., rod type, soil type, groundwater condition) became evident as potential causes, but isolation of any one variable was not possible.

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TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

LIST OF SYMBOLS

Symbol	Definition
A	cross sectional area of the steel
BPM	the operating rate of the SPT hammer in blows per minute
C_n	adjustment factor by which the N-value should be multiplied in order to obtain N_{60} (ETR/60)
E	elastic modulus of the steel
E_i	Energy in Drill Rod
E_v	Kinetic Energy
EA/c	rod impedance
EF2	the energy transmitted to the drill rod from the hammer during the impact event determined by the F2 method
EFV (EMX)	the energy transmitted to the drill rod from the hammer during the impact event determined by the F-V method
ETR (EFV/PE)	ratio of the measured energy transferred to the drill rods to the theoretical potential energy
F	force at time
FMX	the force delivered by the SPT hammer
H, h	Hammer fall height
K_1	Correction factor for the distance between the anvil and the measurement device (F^2 method)
K_2	Correction factor for short rods of less than 30 ft (F^2 method)
K_c	Correction factor for the ratio of the actual to the theoretical time at which the force at the rod top becomes equal to zero (F^2 method)
L	length between the location of transducers on the instrumented rod and the bottom of the penetrometer
N-value	the number of hammer blows required to advance the sampler from 6 in. to 18 in. driven during the SPT test
N_{60}	the N-value adjusted to a hammer efficiency of 60 percent (N-value x C_n)
PE (ER)	the theoretical potential energy of the hammer positioned at the specified height above the impact surface (350 ft-lbs per the ASTM standard)
V	velocity at time
c	speed of wave propagation in steel (16,810 feet/sec)
g	acceleration due to gravity
m	hammer mass
t	time
v	theoretical free fall velocity
w	weight of SPT hammer
2L/c	the time required for the stress wave (traveling at a known wave speed, c, in steel) to travel from the measurement location to the bottom of the penetrometer and return to the measurement location

1 INTRODUCTION

This report presents an evaluation of the Standard Penetration Test (SPT) hammer energy delivered to the SPT sampler during the performance of ASTM D1586. The technical literature has shown that variations in test equipment used to perform ASTM D1586 leads to different values of kinetic energy delivered to the SPT sampler (although the potential energy of 350 ft-lbs is standardized by ASTM). In turn, this difference in energy delivered to the sampler can affect the measured penetration resistance in the soil (i.e., the N-value). This variation in N-value (defined as the cumulative hammer blow counts needed to penetrate the sampler through the second and third 6-inch increment while performing ASTM D1586) may lead to conservative engineering designs (when the hammer system used is highly efficient) or non-conservative engineering designs (when the hammer system has high frictional losses) when appropriate energy correction factors are not applied to the field measured N-values.

Many engineering relationships from SPT N-values to soil design parameters such as relative density, angle of internal friction, shear strength, soil liquefaction potential, and bearing pressure of shallow foundations are found in the literature (USACE 1988, ASTM D4633-05). Therefore, accurately measuring the N-value and correcting this value with the appropriate energy correction factor is extremely important in engineering design. Factors affecting the applied energy include the mechanism of the drill rig, the fall height of the hammer, the efficiency of the energy transfer at the impact from hammer to anvil, the drill rod, the length and type of drill rod, and for safety and donut hammers, the number of turns of the rope around the cathead, the age of the rope, and the operator (USACE 1988). As stated in ASTM D1586-08 under the Precision and Bias section, the use of faulty equipment, such as extremely massive or damaged anvil, a rusty cathead, a low speed cathead, an old, oily rope, or a massive of poorly lubricated rope sheaves can significantly contribute to differences in N-values obtained between operator-drill rig systems. Knowing the applied energy to the sampler and correcting for this delivered energy would help to account for some of these factors.

ASTM D1586-08 also states in the Precision and Bias section that variations in N-values of 100% or more have been observed when using different Standard Penetration Test apparatus and drillers for adjacent boreholes in the same soil formation. When the same apparatus and driller are used, N-values in the same soil can be reproduced with a coefficient of variation of about 10%. Having knowledge of the applied energy by the SPT hammer to the sampler would allow for better comparisons between drill rigs and provide better precision to measured N-values.

Included in this report are comparisons of nine different SPT test configurations using standard SPT hammers, drill rods, and drill rigs configurations. Data were measured from five different drill rigs using seven different SPT Hammers (Safety Hammers and Automatic Hammers). The drill rigs used included three VTrans drill rigs and two private company drill rigs. Each drill rig was equipped with different SPT hammers and drill rods and this equipment was used to create a total of nine different SPT hammer configurations. These configurations were used to compare the different applied SPT Hammer energies to the SPT sampler.

1.1 Objective

The objective of this report is to provide measured energy values of SPT hammers from VTrans equipment as well as measured energy values of SPT hammers from drilling companies that do work for the State of Vermont. The variability of the measurements will be assessed and a summary of the energy transfer ratios will be given. This report also provides some guidance on recommended frequency of SPT hammer energy measurement on VTrans equipment.

1.2 Literature Review

A review of the SPT hammer energy research literature was completed for this study and a summary is presented in this report. As stated in the literature, SPT hammer energies vary depending on the SPT hammer type used to conduct ASTM 1586. As stated in the test standard, the SPT hammer must be 140 pounds and the hammer must free fall for a distance of 30 inches on to the drill string providing an energy of 350 ft-lbs. The method of raising and free falling the SPT hammer varies per hammer type and manufacturer. This difference results in different SPT hammer energy efficiencies because of frictional losses within each hammer system.

As hammer technology has progressed over the years (i.e., initially pin-weight and donut hammers were used in the 1950s then safety hammers became popular in the 1960s to 1980s, and now automatic hammers are common), so has the efficiency in SPT hammer systems. As stated in Akbas and Kulhawy (2008), hammer energy ratios have increased from 40% efficiency in the 1950s to 90% efficiency in the 1990s. Finno (1989) demonstrated in a uniform sand deposit that the N-values from one SPT hammer type (rope and cathead with safety hammer) were 2 to 3 times higher than those of a second SPT hammer of a different type (automatic hammer). This observation provides factual information that even though the SPT is a standardized test, the diversity of equipment allowed to perform SPT can have a significant influence on the resulting SPT N-value.

1.3 Organization of Report

This report is divided into eleven chapters including an appendix chapter. Chapter 1 is an introductory chapter; Chapter 2 presents the test equipment used to perform the field test evaluation of this project. Chapter 3 presents the SPT hammer energy measurement procedure and Chapter 4 is a literature review. Chapter 5 presents information about the test site used to perform this study. Chapter 6 and 7 provides the presentation and discussion of results, respectively. Chapter 8 presents the conclusions of the project and Chapter 9 acknowledges the entities involved in this project. Chapter 10 lists the references used in this report and Chapter 11 includes the appendices for the report.

2 SPT TEST EQUIPMENT

The equipment used to conduct the SPT and to measure the applied energy is described herein. There were seven different hammers employed in this study using five different drill rigs resulting in nine different SPT hammer configurations. All configurations were employed using standard drilling techniques. Table 1 presents a list of all of the variations tested for this study.

The hammer energy measurement equipment used in this study was developed by Pile Dynamics, Inc. (PDI). It is designed to measure energy delivered to the SPT sampler by a SPT hammer using standard drill rod connections.

Table 1 List of SPT Hammer Energy Variations used in this Study.

Boring ID	Date	Hammer Type	Hammer drop system	Drill Rig (year of manufacture)	Vehicle #	Company	Hammer Operator	Drill Rods	Drilling Technique
GD-1	9/23/08	CME Auto-matic	Auto-matic	CME 55 – Track (2007)	356675	VTrans	Glenn Porter	AWJ	4 inch HW Casing, spin and wash with roller bit ahead of casing to advance
GD-2	9/23/08	CME Auto-matic	Auto-matic	CME 45C Skid-rig on trailer (1996)	277564	VTrans	Howard Garrow	AWJ	3 1/4" HSA with auger plug – no water
GD-3	9/24/08	CME Auto-matic	Auto-matic	CME 55 – Track (2007)	356675	VTrans	Glenn Porter	NWJ	4 inch HW Casing, spin and wash with roller bit ahead of casing to advance
GD-4	9/24/08	Safety	Rope and Cathead	CME 45C Skid-rig on trailer (1996)	277564	VTrans	Howard Garrow	AWJ	3 1/4" HSA with auger plug – no water
GD-5	9/25/08	CME Auto-matic	Auto-matic	CME 75 – Track (1988)	200587	Trans-Tech	John Leonhardt	AWJ	4 1/4" HSA with auger plug – no water
GD-6	9/25/08	Safety	Rope and Cathead	CME 75 – Track (1988)	200587	Trans-Tech	John Leonhardt	AWJ	3 1/4" HSA with auger plug – no water
GD-7	9/26/08	CME Automatic	Automatic	CME 45C Track (2001)	306614	VTrans	Glenn Porter	AWJ	3 1/4" HSA with auger plug – no water
GD-8	9/26/08	CME Automatic	Automatic	CME 45C Track (2001)	306614	VTrans	Glenn Porter	NWJ	3 1/4" HSA with auger plug – no water

Table 1 (continued) List of SPT Hammer Energy Variations used in this Study.

Boring ID	Date	Ham-mer Type	Ham-mer drop system	Drill Rig (year of manufacture)	Vehicle #	Comp-any	Hammer Operator	Drill Rods	Drilling Technique
GD-9	9/29/08	Down-hole Safety Hammer	Mobile Safe-T Driver	Simco 2800 (1997)	n/a	SDI	Chris Aldrich	AWJ	4 1/4" HSA with auger plug – no water

2.1 Drill Rigs

This study used 5 different drill rigs from 3 different agencies/companies as summarized in Table 1. VTrans rigs used in this study were a CME 55 on a track rig, CME 45C on a skid rig, and a CME 45C on a track rig. TransTech Drilling Services (TransTech) from Schenectady, NY used a CME 75 on a track rig. Specialty Drilling and Investigation (SDI) from Burlington, VT used a Simco 2800 HS HT on a truck. The following figures present the photos of each drill rig used in this study.

Figure 1 VTrans CME 55 used on Boreholes GD-1 and GD-3.

Figure 2 VTrans CME 45C Skid Rig on Trailer used on Boreholes GD-2 and GD-4.

Figure 3 VTrans CME45C on Track Rig used for Boreholes GD-7 and GD-8.

Figure 4 TransTech CME 75 on Track Rig used for Boreholes GD-5 and GD-6.

Figure 5 SDI Simco Drill Rig used for Borehole GD-9.

2.2 Drill Rods

This study used two different types of drill rods, AWJ and NWJ rods. The AWJ rods are 1 3/4 inch diameter with a 1/4 inch rod wall thickness. The NWJ rods are 2 5/8 inch diameter with a 3/16 inch rod wall thickness. The "J" designation indicates that the drill rods have a tapered thread. Table 2 presents dimensions of these two types of drill rods.

Table 2 Dimensions of Common Taper-Thread Drill Rods

SIZE OF DRILL ROD	AWJ	NWJ
Outside Diameter	1 3/4"	2 5/8"
Inside Diameter	1 1/4"	2 1/4"
Bore of Coupling	5/8"	1 3/8"
No. Threads Per Inch	5	4
Weight	4.2 lbs/ft	5.8 lbs/ft

2.3 Spilt-Spoon Sampler

The split-spoon samplers used in this study were standard 2-inch split spoons. Each split-spoon had drive shoes that were not worn (i.e., shoe tips were not sharpened, blunt, or rounded off). Plastic split-spoon catchers were used for this study and any that were observed to be worn (i.e., plastic teeth bent over or broken off) were replaced with new catchers. All SPTs in this study were performed without split spoon liners.

2.4 Drilling Method

Two drilling methods were used in this study and are described herein. There methods meet the intent of the ASTM D1586 SPT procedure.

Figure 6 Drill Rigs using HSA and Washed Bore Drilling Techniques.

2.4.1 Hollow Stem Auger

This study used two different types of hollow stem augers (HSA). 3 ¼ inch and 4 ¼ inch (inside diameter) HSA were used to drill 7 boreholes. Water was not used when drilling with the HSA for this study (i.e., boreholes were drilled in the dry). The CME 45C on a skid rig (see Figure 6) and the CME 45C on a track rig by VTrans used 3 ¼ inch HSA. The CME 75 on a track rig by TransTech drilled two boreholes with one borehole using 3 ¼ inch and the other using 4 ¼ inch HSA. The Simco 2800 HS HT by SDI used 4 ¼ inch HSA. All boreholes used a HSA pilot plug attached to the drill rods during augering to prevent soil from going up into augers.

2.4.2 Flush Mounted Casing

Two boreholes were drilled using HW drill casing (4 inch ID). The CME 55 on a track rig by VTrans used the 4-inch casing and water was used to flush out the cuttings from the inside of the casing (see Figure 6). The water was pumped down the center of the casing and came to the surface along the outside annular space around the casing. An attempt to keep the water at the top of the casing was made during SPT sampling. A tricone roller bit with water was used to clean out casing prior to sampling.

2.5 SPT Hammer

This study employed three standard hammer energy systems in order to measure the variations of hammer energy delivered to the sampler.

2.5.1 Safety Hammer

The safety hammers used in this study were manufactured by Mobile Drilling Company, Inc. (Mobile) and Central Mine Equipment Company (CME). The VTrans rigs used the Mobile safety hammers and TransTech used the CME safety hammer.

The CME 45C on a skid rig by VTrans used a rope and cathead to raise and lower the safety hammer onto the drill string. The rope used by VTrans was fairly new and the cathead was reportedly not used often.

The CME 75 on a track rig by TranTech used a rope and cathead to raise and lower the safety hammer onto the drill string. The rope used by TransTech was worn and the cathead was freshly painted upon arrival. The driller scraped off fresh paint on the cathead surface prior to starting boring.

As can be seen in Figure 7, the drill rig operator followed the recommended number of rope turns (2 ½) around the cathead as described in Figure 1 of ASTM D1586-08. The 30 inch drop height was observed during the operation of this hammer.

Figure 7 Photograph of Safety Hammer with Driller "Throwing the Rope" at GD-4.

2.5.2 Down-Hole Safety Hammer

A down-hole safety hammer was used by SDI. The hammer was raised and lowered by a Mobile Safe-T-Driver (see Figure 8). This system uses a wire-line attached to a “frictionless” hydraulic winch which raises and lowers the down-hole safety hammer on to the drill string. The 30 inch drop height mark was observed during the operation of this hammer.

Figure 8 Photograph of Down-Hole Safety Hammer (leaning on right hand side of rig).

2.5.3 Automatic Hammer

The automatic hammers used in this study were manufactured by CME. The CME 55 on a track rig, CME 45C on a skid rig, and the CME 45C on a track rig by VTrans used automatic hammers manufactured by CME. Each rig had its own designated automatic hammer. The CME 75 on a track rig by TransTech used an automatic hammer. All automatic hammers used in this study had sight tubes on the side of the hammer casing to assure hammer drop height. The bottom of the hammer was observed in the sight tube during performance of these hammers.

Figure 9 Placing Automatic Hammer on top of Drill String.

2.6 Energy Measurement System

The SPT procedure as defined by ASTM D1586 employs a SPT hammer, drill rods, and a split-spoon sampler. The installation of the sampler into the ground is governed by stress wave propagation. One-dimensional wave mechanics can be used to analyze the delivered stress wave through the steel drill rods from the SPT hammer to the sampler. This analysis in turn can be used to evaluate the energy transfer from the hammer system to the sampler. ASTM D1586 requires that the SPT hammer weigh 140 pounds and the hammer must be dropped from a height of 30 inches above the drill string but the standard does not specify the delivery system (i.e., how the hammer is raised and lowered on the drill string). Since there is no specification, many delivery systems have been developed over the years and in turn the amount of energy applied to the sampler has historically varied.

To calculate the applied hammer energy, the force delivered to the drill rods and acceleration of the drill rods during each hammer blow are measured using an instrumented drill rod and data acquisition system. The data are collected and analyzed to provide an applied energy value to the sampler. This study used an energy measurement system design and manufactured by PDI and it is called the SPT Analyzer.

2.6.1 Instrumented Rods

Sensor systems to measure both force and velocity are attached to a 2 foot long instrumented drill rod. Figure 10 and Figure 11 present the two styles of instrumented drill rods used in this study, an AWJ rod and a NWJ rod, respectively.

Figure 10 AWJ instrumented Drill Rod.

Figure 11 NWJ Instrumented Drill Rod with Driller Holding Wires During Driving.

In order to measure force, the SPT Analyzer requires the measurement of strain, which is converted to force using the cross sectional area of the rod and the elastic modulus of the steel. Foil strain gages (350 ohm) are glued directly on to the instrumented rod in a full Wheatstone bridge configuration and a short cable with a quick connect is attached. There are two opposing force transducers on each instrumented rod so that an average force measurement is recorded. This is to account for the potential of the instrumented rod bending during driving (Pile Dynamics, Inc. 1999). The calibration sheets for the force transducer are presented in Appendix 12.

The measurement of acceleration is directly measured by an attached accelerometer. The accelerometer (piezoresistive) is attached to a rigid aluminum block which is bolted on to the instrumented rod. The accelerometer has a quick connect plug to attach the instrumentation cable to the SPT Analyzer. The calibration sheet for the accelerometer is presented in Appendix 12.

The measured acceleration is integrated to velocity. Both the force and velocity measurements are required for the calculation of energy transferred to the drill rod from the SPT hammer during each hammer impact.

2.6.2 SPT Analyzer

The SPT Analyzer signal conditioning and processing unit records strain and acceleration during each hammer blow, converts the strain and acceleration to force and velocity, records and displays the velocity and force waveforms, records the number of hammer blows, records the frequency of hammer blows, and calculates the energy values using both the F^2 and FV methods.

A short cable connects the instrumented rod to the data acquisition system. The signal conditioner includes an analog to digital (A/D) converter and microprocessors with an on-board 12-volt DC battery for remote operation. A power supply connected to 120 AC may also be used for power.

The unit has an LCD touch-screen used to enter the rod area and length, description of each test hole, name of operator, and operator comments. The user can also initiate data recording with the touch-screen by pressing the record button on the screen. The data is recorded after each hammer blow when the hand-held unit is in record mode. For each hammer blow, the unit records force, velocity, number of hammer blows, and time between hammer blows. The user interface allows for data control and review during and after testing (Pile Dynamics, Inc. 1999).

Figure 12 Photograph of the SPT Analyzer Data Acquisition Box.

3 SPT HAMMER ENERGY MEASUREMENT PROCEDURE

The procedure used to measure SPT hammer energy is described herein. The SPT analyzer is used to collect and process the data measured by the instrumented rod. This section also discusses some of the theory behind the current ASTM D4633-05 energy measurements (i.e., the F-V (EFV) method) and discusses some of the historical aspects of the F^2 (EF2) method used to calculate energy.

The original ASTM D4633-86 Energy Measurement for Dynamic Penetrometers was first adopted by ASTM in 1986 but was then withdrawn in 1995. 10 years passed before the standard was re-instated on November 2005 as ASTM D4633-05 (Krusinski 2007). The old standard considered the normal proportionality between force and velocity and therefore only required measurement of force. The hammer energy was then obtained from the integral of the force squared (divided by rod impedance). This EF2 method also required the use of correction factors, K_1, K_2, and K_c. Common errors that were not properly corrected using this method were non-uniform rod sections and loose rod connections. It was also determined in the old standard that the correction factor for short rod connections was incorrect as stated ASTM D4633-05.

For the EF2 method to be valid, the first tension wave reflection time needed to be equal to the theoretical 2L/c time. A modification to the standard to accommodate this requirement was that the time ratio (defined as the actual first tension return time divided by the theoretical time, 2L/c) had to be within 90% to 120%. If this was not observed, then EF2 method could not be used. To avoid the complexity and possible errors using the EF2 method (since it is highly unlikely that true one-directional wave propagation exists in any dynamic penetrometer system, Pile Dynamics, Inc. 2004), the Force-Velocity (EFV) method was created and is now the recommended method in ASTM D4633-05 standard.

The EFV method is the only fundamentally correct method of measuring energy content. It integrates force and velocity over the complete wave event to measure the total energy content of the event. Correction factors are not necessary for the EFV method.

3.1 General Operation

The procedure to measure the SPT hammer energy involves threading an instrumented rod on to the drill string and measuring the strain and acceleration in the drill string while performing ASTM D1586. Measuring the SPT hammer energy does not detract from the SPT procedure or the measured N-values.

The instrumented rod is attached at the top of the drill string and tightened. The hammer anvil is then attached to the drill string, maintaining the required distance between the top of the transducers and the hammer striking surface per the ASTM standard D4633-05. The sensors are connected to the SPT Analyzer and just prior to hammer operation, the SPT analyzer is activated. The hammer is operated in a normal manner while the analyzer is recording, processing, and displaying data on the readout unit. The number of hammer blows is recorded by the data acquisition system as well. The sampler penetration into the ground is recorded by the user by pressing a hand-held remote connected to the analyzer. After sampler penetration is complete, the instrumented rod is then disconnected, the soil sample is brought to the surface, and the borehole is then advanced to the next sampling depth. The process is repeated for each sampling interval that SPT energy measurements are desired.

In this study, all equipment was operated by the drill rig operators in the manner typically used on a daily basis by the operators. The SPT automatic hammers were not pre-lubricated, the sheaves and cathead for the rope and cathead operation were not pre-greased for this study. It is assumed that all rigs were lubricated and greased on their typical schedule of standard maintenance per the manufacturer's recommendations.

3.2 Sensor Connections

After the sensors are connected to the SPT Analyzer via quick connect plugs, the connection is verified by the data acquisition system. The SPT Analyzer is capable of sensing the status of each sensor and the operator must assure that all sensors are functional prior to starting the test.

During the drive, the sensor cables are supported and carefully observed to assure no damage to the cables occurs during driving (see Figure 11 showing the driller holding the communication cables). After each drive, the sensor main cable is disconnected from the instrumented rod and the instrumented rod is threaded off of the drill string. The rods are removed from the ground, the sampler brought to the surface, the borehole advanced to the next sampling depth to repeat the process.

3.3 Data Collection

Prior to beginning the test, the user must enter the appropriate data into the unit. These data include, sample depth interval, rod area and length, project information, and calibration factors for the force transducers and accelerometer. After entering all project information and sampling interval information, the SPT Analyzer is initialized to collect new data. A record button on the touch-screen of the data acquisition system is pressed to initialize the unit. This initiates the hand-held unit to record each hammer blow when the hammer strikes the anvil. The data acquisition system records the data from each blow by monitoring a user designated sensor, typically one of the force transducers is selected. Once force is sensed by the data acquisition system, data are recorded at 20 kHz for a period of 100 milliseconds.

A remote control button attached to the data acquisition system is pressed during the test as the sampler penetrates into the ground in order to advance the recorded depth interval on the touch-screen. The analog data from the gauges are digitized at 20 kHz. These data are continuously displayed on the touch-screen as the force wave (from the strain gauges) and the velocity wave (from the integral of the acceleration measurement). The trace of the velocity wave is scaled such that it is proportional to the force wave. This allows the user to see if the force and velocity traces are reasonable during testing as will be discussed in Section 3.4.

3.4 Data Review

During the test, the operator checks the quality of the data. Data checks include good wave matching for both force transducers (only one accelerometer was used in this study, therefore the accelerometer data could not be matched). The force and velocity measurements should be proportional to the rod impedance (EA/c, where E = Modulus of Elasticity for steel, A = cross sectional area of the steel, and c = speed of wave propagation in steel) during the first 2L/c time, where L is defined as the length of rod below the measurement point and c as defined above, after the initial hammer impact and through out driving. After 2L/c time goes by, the force and velocity wave traces should diverge from each other and then both the force and velocity records should go to near zero at the end of each record. Successive force and velocity records should be generally similar as well.

After field testing was complete, the data were downloaded to a computer from the PCMCIA data storage card that is on-board in the data acquisition system. These data are reviewed and evaluated using PDA-W® software developed by PDI for proper response from the transducers. If any wave traces did not behave appropriately (per the previously described behavior), the computed energy was not included in the summary tables. Example responses plots from PDA-W® are presented in Appendix 6. PDI plot® software is used after the data have been interpreted in PDA-W® in order to present the data in graphical form. A summary table of measured hammer energies is presented in Appendix 7. The output files from PDI plot® are presented in Appendix 8.

3.5 Energy Measurement Methods

The SPT analyzer measures the maximum transferred energy applied to the sampler from the hammer system. If no friction losses occur in the hammer systems, the theoretical amount of delivered energy available to the sampler is equal to the potential energy of the hammer system (350 ft-lbs), as first discussed in Section 1. It has been shown in the literature that every hammer system has some frictional losses and the SPT analyzer is able to measure this delivered energy.

There are two methods used to calculate the maximum transferred energy to the sampler from the SPT hammer through the drill rods. The first method is described in ASTM D4633-05 as the Force-Velocity method. This method integrates the product of the force and velocity record over time for each hammer blow. This method is also referred to as the EFV method (and referred to as the EMX method per the PDA-W® manual by PDI). The second method was described in ASTM D4633-86 as the Force Squared method (F^2). This method uses the theoretical proportionality of force and velocity to substitute force divided by rod impedance for the velocity. The energy is calculated by integrating the force squared over time and multiplying the result by the inverse of the rod impedance.

3.5.1 Potential and Kinetic Energies

The potential energy (PE) delivered to the sampler by the SPT hammer is calculated by multiplying the fall height of the hammer by the weight of the hammer. Using the quantities listed in ASTM D1586-08, the potential energy by the SPT hammer is equal to 350 ft-lbs.

The derivation of the potential energy comes from the definition of the theoretical free fall energy, i.e., kinetic energy of the system and inserting the value for the theoretical free fall velocity of the hammer as described by the following equation;

$$E_v = \frac{1}{2} \cdot mv^2 \qquad (1)$$

where E_v = kinetic energy

m = mass of hammer = $\frac{w}{g}$

where; w = weight of hammer

g = acceleration due to gravity

v = theoretical free fall velocity = $\sqrt{2gh}$

Inserting the definition of v and m into Equation (1) yields a result of potential energy being equal to hammer weight multiplied by fall height (350 ft-lbs).

Figure 13 presents an illustration from Kovacs et al. (1983) in which the location of the energies applied to the drill string is depicted. Point A is the location of the potential energy before the 140 lb SPT hammer is dropped 30 inches on to the drill string anvil. If a frictionless system was possible, the kinetic energy delivered to the drill string would be equal to the potential energy but because friction exists, Point B represents the reduction of the potential energy. A further reduction of energy passing through the anvil occurs at Point B′.

The resulting kinetic energy, E_v, produces a compression stress wave in the drill rods and is measured by the instrumented rod as stress wave energy, E_i also referred to the maximum transferred energy (Point C in Figure 13). The E_i value is calculated using one of two methods by the SPT Analyzer. EFV method uses the measured force and velocity applied to the instrumented rod and the EF2 method using the square of the measured force to calculate E_i.

The Energy Transfer Ratio (ETR) is defined at the measured maximum transferred energy divided by the potential energy of the SPT hammer system as presented in Equation 2.

$$ETR = {EFV}/{PE} \qquad (2)$$

This equation is then used to calculate the "standard energy ratio" adjustment factor as defined by Equation 3.

$$C_n = {ETR}/{60} \qquad (3)$$

This C_n value is multiplied by all field measured N-values to calculate N_{60}. N_{60} values are used in engineering property correlations for site evaluations as discussed in Section 1.

It should be noted that there are other correction factors that can be applied to field measured N-values (e.g., overburden, rod correction, anvil correction, borehole diameter, etc.) but presentation of those values is beyond the scope of work for this project. The reader is referred to Skempton (1986) and Aggour and Radding (2001) for a summary of correction factors found in the literature as well as ASTM D 6066-96 (2004) for a discussion on the overburden correction.

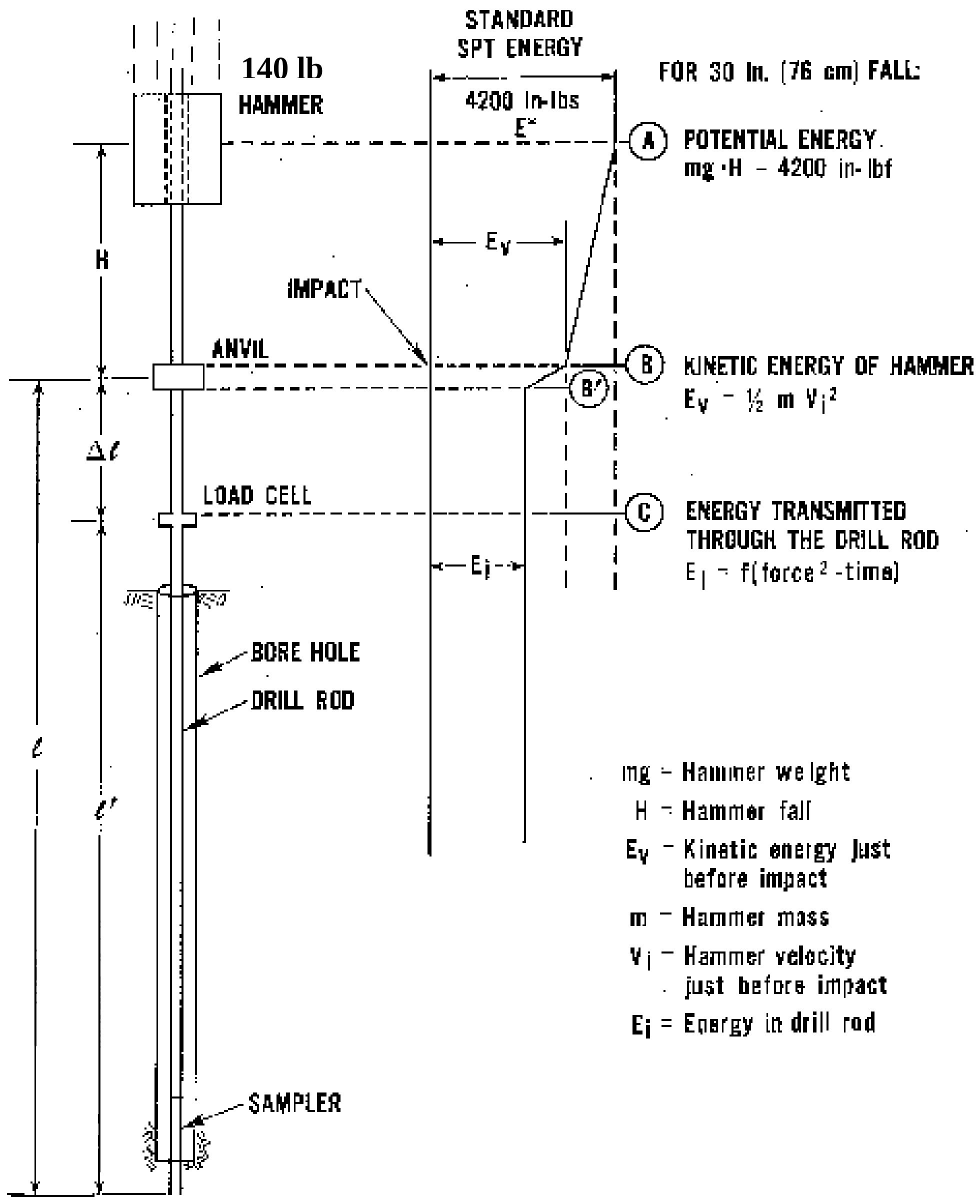

Figure 13 Depictions of the Potential and Kinetic Energies during the SPT Procedure (from Kovacs et al. 1983).

3.5.2 Force-Velocity Method

The force-velocity method is determined by:

$$EFV = \int F(t) \cdot V(t) dt \qquad (4)$$

where: EFV = the energy transmitted to the drill rod from the hammer during the impact event determined by the F-V method,
F = force at time, t
V = velocity at time, t.

The integration begins at impact by the SPT hammer and ends at the time at which energy transferred to the rod reaches a maximum value (i.e., the integration over the entire force and velocity record). This method requires the measurement of force and velocity which are obtained by the strain measurements from the force transducers and the acceleration measurements from the accelerometer. No correction factors are necessary using this method as it is theoretically correct. It also applies to any drill rod (loose connections or differing cross-sectional area).

3.5.3 Force-Squared Method

The force-squared method was used early on because at the time of development there was not a good method to measure acceleration for steel to steel impacts. Researchers took advantage of wave propagation theory for waves traveling in one (downward) direction. The theory states:

$$V(t) = \frac{F(t)}{EA/c} \qquad (5)$$

where: EA/c = rod impedance,
E = elastic modulus of the steel,
A = cross sectional area of the steel,
c = speed of wave propagation in steel (16,810 feet/sec).

Substituting Equation (5) in to Equation (4) leads to

$$E(t) = \frac{c}{EA} \int [F(t)]^2 dt = EF2 \qquad (6)$$

where: EF2 = the energy transmitted to the drill rod from the hammer during the impact event determined by the F^2 method

This method integrates the energy content of the first compression pulse traveling down the drill rods, and as such, only measures part of the energy delivered to the sampler. Several correction factors (K_1, K_2, and K_c) are recommended in the old standard. It was determined over time that these correction factors were inherently wrong (ASTM D4633-05) and it is recommended that this method not be used. Another issue was that there were many causes of the first wave not making it down to the sampler due to differences in cross-sectional area; loose rods, etc. therefore further justifying not using this method.

4 LITERATURE REVIEW

4.1 Overview

As part of this project, a number of papers, reports, and articles found in the research literature were reviewed to find previously published values of SPT hammer energies and to evaluate SPT hammer energy testing frequency employed by other agencies.

4.2 SPT Hammer Energy Literature Values

The following table presents a summary of the research literature that was reviewed as part of this study. The superscripts (as defined in the legend at the bottom of the table) in Table 3 depict the energy method used by the referred authors. Appendix 11 presents all data from each reference reviewed for this study. Table 4 presents a summary of the data presented in Table 3. As can be seen, the average energy transfer ratio between EFV and EF2 is within 10% of each other and that is a typical comparison between the two energy calculation methods (ASTM 2005). The majority of the data reviewed in the literature for this study were from other State DOTs.

Table 3 List of Average ETR and C_n published in the Reviewed Literature.

Test Agency	Hammer Type	AVG ETR (%)	AVG C_n Using EFV energy	Source
Caltrans	Automatic	80.4[1]	1.34	Caltrans "Drill Rig Hammer Evaluation", File 59-910683, 12/7/2005 & August 2008
	Safety	55.6[1]	0.93	
Oregon DOT Recommended SPT energy Correction Factors, Theoretical	Automatic	76.4[4]	1.27	"SPT Energy Measurements with the Pile Driving Analyzer" PowerPoint Presentation, Laura Krusinski, P.E., Maine DOT
	Safety	67[4]	1.12	
	Safe-T-Driver	48[4]	0.80	

Table 1 (continued) List of Average ETR and C_n presented in the Literature.

Test Agency	Hammer Type	AVG ETR (%)		AVG C_n Using EFV energy	Source
Maryland DOT	Automatic	81.4 [1]		1.36	"Research Report, SPT Correction", M. Sherif Aggour and Rose Radding, Department of Civil and Environmental Engineering, University of Maryland, September 2001
	Safety Pin	70.2 [1]		1.17	
	Sprauge and Henwood Donut	63.5 [1]		1.06	
Compiled "In Situ Testing Techniques in Geotechnical Engineering" Alan J. Lutenegger, UMASS - Amherst	Automatic	89.8 [3]		1.50	Multiple sources
	Safety	64.1 [3]		1.07	
	Donut	55.2 [3]		0.92	
Compiled "Summary of SPT energy measurement experience" Jeffrey A. Farrar, U.S. Department of Interior, Bureau of Reclamation (1998)	Automatic	87.5 [2]	77.7 [1]	1.30	Multiple sources
	Safety	61.0 [2]	64.6 [1]	1.08	
	Safe-T-Driver	37.5 [2]	38.0 [1]	0.63	
Department of Civil & Environmental Engineering, Korea Advanced Institute of Science and Technology, Daejon, Korea	Automatic	61.2 [2]	63.2 [1]	1.05	Energy Ratio Measurements of SPT equipment", Dong-Soo Kim et al. (2004)
	Safety	56.4 [2]	58.6 [1]	0.98	
	Donut	37.8 [2]	39.7 [1]	0.66	
	Donut - hydraulic	51.9 [2]	59.1 [1]	0.98	

Table 1 (continued) List of Average ETR and C_n presented in the Literature.

Test Agency	Hammer Type	AVG ETR (%)	AVG C_n Using EFV energy	Source
Multiple Testing Agencies	Pinweight	72 [3]	1.20	Typical SPT Energy by country, "Case History of SPT Energy ratio for automatic hammer in northeastern U.S. practice", S.O. Akbas & F.H. Kulhawy
	Safety - pulley	85[3]	1.42	
	Safety - rope and cathead	85[3]	1.42	
	Donut-rope and cathead	64.5[3]	1.08	
	Donut - pulley	51.6[3]	0.86	
Utah DOT	Automatic	76.1[1]	1.27	SPT Energy Measurements with the PDA, Darin Sjoblom et al.
	Safety	66.6[1]	1.11	
	Safe-T-Driver	49.8[1]	0.83	
	Rope and Cathead (Safety?)	74.8[1]	1.25	
U.S. Department of Interior Bureau of Reclamation, 1999	Automatic	87.8[2] / 79.2[1]	1.32	Multiple sources
Maine DOT	CME Automatic	77[1]	1.28	"SPT Energy Measurements with the Pile Driving Analyzer" PowerPoint Presentation, Laura Krusinski, P.E., Maine DOT

Legend	
FV	1
F^2	2
Unspecified Energy Method	3
Theoretical	4

Table 4 Summary Table of Average SPT Hammer Energy Transfer Ratios from Literature.

Hammer Type	OVERALL AVERAGE F^2	OVERALL AVERAGE F-V	UNSPECIFIED ENERGY METHOD
Automatic	78.8	76.4	83.1
Safety	58.7	65.0	72.0
Donut-rope and cathead	37.8	51.6	59.8
Donut - hydraulic	51.9	59.1	51.6
Safe-T-Driver	37.5	43.9	48.0
Pinweight	n/a	n/a	72
Safety-pulley	n/a	n/a	85

4.3 SPT Hammer Energy and Influence from Soil Types

Bosscher and Showers (1987) present data that suggests soil type influences the measured SPT hammer energy. Bosscher and Showers (1987) focuses on numerical modeling and the paper concludes that hard soils produce more energy than soft soils given the same hammer blow. But Hall (1982) states that in order to use wave compression theory (and therefore the energy measurement method described herein), it is inherently implied that the first compression wave is independent of soil type. Further study is needed to evaluate if soil type directly influences the measured SPT hammer energy.

5 TEST SITE DESCRIPTION

The test site used for this research project is presented herein. The site was chosen for its expected relatively uniform soil profile nature, anticipated range of in situ SPT N-values matching the recommended ASTM range of N-values for the SPT hammer evaluation, and the readily available location.

VTrans sent out a drill rig crew to "pre-investigate" the proposed research site. Two locations were chosen during this "pre-investigation" phase and the second location was selected by VTrans for its measured N-values and soil stratigraphy.

5.1 Location

The research site is located in Windsor, VT on the property of Miller Construction as seen in the figures presented in Appendix 1. A grassy field on the construction company's land was utilized to perform nine soil borings set in a grid pattern. The site is on a flat terrace adjacent to the Connecticut River at approximate ground elevation of 335 feet. The Connecticut River is at approximate 292 feet elevation along the test site. The coordinates of the test site are 43º25'39" North and 72º23'49" West.

Figure 6, Figure 14, and Figure 15 present general photos of the test site while collecting the research data.

Figure 14 Photo of the Test Site at Borehole GD-8.

Figure 15 Photo of Test Site while Drilling Boreholes GD-8 and GD-9.

As presented in Appendix 1, Figure 16 presents the site location on the Mt. Ascutney quadrangle, which orients the site along the south eastern portion of the Miller Construction property; Figure 17 and Figure 18 present a plan view of the Miller Construction Inc. site and a zoomed-in plan view of the soil boring locations, respectively. Appendix 2 presents Figure 19, Figure 20, and Figure 21 that depicts the subsurface profiles A-A′, B-B′, and C-C′, respectively, at the site.

5.2 Geology

Glacial surficial geology of the test site is a Fluvial Sand deposit as described by Doll (1970). By definition, fluvial deposits are created by river deposition. This deposit is associated with the draining of Glacial Lake Hitchcock approximately 12,000 to 14,000 years ago (Little 2004). The draining of the lake allowed the Connecticut River to flow and create multiple flood plains and river terraces along its banks. The test site is on one of these described river terraces.

5.3 Subsurface Description

5.3.1 General

Four subsurface stratigraphy layers were encountered at the test site down to 50 feet below grade. Silty fine Sand approximately 10 feet thick is underlain by fine to medium Sand and Gravel that is approximately 15 feet thick. A 20-foot thick Sand and Silt layer underlies the Sand and Gravel layer and a lower silty fine Sand layer underlies the Sand and Silt layer. This layer was penetrated about 5 to 8 feet and the assumed underlying bedrock was not encountered. Appendix 2 presents three cross sections showing the stratigraphy across the site.

Encountered soil resistance values (N-values) for this deposit were within the recommended resistance values (5 to 50 blows per foot (bpf)) per ASTM D4633-05 as stated in Note 1 under Significance and Use in the standard. The boring logs are presented in Appendix 3. The depth ranges tested in this study were also within the ASTM acceptable limits (greater than 30 feet) as stated in Note 6 under Procedure in this standard.

5.3.2 Upper Silty Fine Sand

This stratum begins at the ground surface and extends to about 10 feet below grade. The average N_{60} value in this layer was 9 bpf with a range between 4 and 20 bpf. The layer is considered loose using this average N_{60}-value. The average percent recovery for 24 inches of penetration was 74%. Appendix 3 presents a graph depicting recovery versus depth for all GD-borings. Grain-size analyses were performed on five soil samples in this layer. The average percentage of sand was between 60% and 80% and the average percentage of material less than No. 200 sieve was approximately 20% to 40%. Appendix 4 presents two graphs depicting percent gravel and percent fines versus depth for all GD-borings. The color of this layer was brown to tannish brown and the soil was moist. Appendices 4 and 5 present the grain-size analysis for select samples within this layer.

5.3.3 Fine to Medium Sand and Gravel

This stratum begins about 10 feet below grade and extends down to about 25 to 30 feet below grade. The average N_{60} value in this layer was 21 bpf with a range between 6 and 47 bpf. The layer is considered medium dense using this average N_{60}-value. The average percent recovery for 24 inches of penetration was 70%. Appendix 3 presents a graph depicting recovery versus depth for all GD-borings. Grain-size analyses were performed on ten soil samples in this layer. The average percentage of gravel was between 10% and 20%, the average percentage of sand was between 70% and 85%, and the average percentage of material less than No. 200 sieve was approximately 5% to 10%. Appendix 4 presents two graphs depicting percent gravel and percent fines versus depth for all GD-borings. The color of this layer was tan to brown and the soil was moist. Appendices 4 and 5 present the grain-size analysis for select samples within this layer.

5.3.4 Silt and Sand

This stratum begins about 25 to 30 feet below grade and extends down to about 45 feet below grade. The average N_{60} value in this layer was 17 bpf with a range between 4 and 38 bpf. The layer is considered medium dense using this average N_{60}-value. The average percent recovery for 24 inches of penetration was 81%. Appendix 3 presents a graph depicting recovery versus depth for all GD-borings. Grain-size analyses were performed on fifteen soil samples in this layer. The average percentage of gravel was between 2% and 5%, the average percentage of sand was between 20% and 70%, and the average percentage of material less than No. 200 sieve was approximately 30% to 70%. Appendix 4 presents two graphs depicting percent gravel and percent fines versus depth for all GD-borings. The color of this layer was grayish brown and the soil became wet around 40 feet below grade. Appendices 4 and 5 present the grain-size analysis for select samples within this layer.

5.3.5 Lower Silty Fine Sand

This stratum begins about 45 feet below grade and the bottom of the layer was not encountered in this evaluation. The average N_{60} value in this layer was 23 bpf with a range between 8 and 33 bpf. The layer is considered medium dense using this average N_{60}-value. The average percent recovery for 24 inches of penetration was 85%. Appendix 3 presents a graph depicting recovery versus depth for all GD-borings. Grain-size analyses were performed on nine soil samples in this layer. The average percentage of gravel was between 0% and 2%, the average percentage of sand was between 70% and 85%, and the average percentage of material less than No. 200 sieve was approximately 10% to 20%. Appendix 4 presents two graphs depicting percent gravel and percent fines versus depth for all GD-borings. The color of this layer was grayish brown and the soil became wet around 40 feet below grade. Appendices 4 and 5 present the grain-size analysis for select samples within this layer.

5.3.6 Groundwater

Groundwater was encountered in an open borehole (GD-1) that was left open for 5 days at 44 feet below grade (El 291 feet). The borehole, GD-1, was initially drilled to 50 feet and subsequently collapsed to 45 feet below grade after the 4-inch casing was removed. All other groundwater observations were inferred by wet soil samples from the SPT split spoons. These soil sample depths were between 45 feet and 50 feet below grade.

The observed groundwater elevation in GD-1 corresponds to the average river elevation as observed on location topography maps.

6 PRESENTATION OF RESULTS

There were a total of 9 SPT hammer configurations tested using a total of 5 different drill rigs (3 State of Vermont rigs and 2 private contractor rigs), 7 different hammers, 2 different types of drill rods, 2 different drilling techniques, and 2 sizes of hollow stem augers. Each borehole consisted of similar equipment for the entire sounding (e.g., drill rod type from the anvil section to sampler was the same rod type) and each drill string was adjusted for verticality during the testing, when necessary.

A total of 9 boreholes were drilled in order to perform the 9 different SPT hammer configurations. One additional boring (B1-B) was drilled by VTrans during the "pre-investigation" phase to evaluate the research site. The boring logs presented in Appendix 3 provide sampling interval, sample recovery, field measured N-values, and visual soil descriptions. All borings were drilled to 50 feet below grade and sampled using a 5-foot sampling interval except for borings GD-3, and GD-6. These two borings were only sampled to 34 feet and 27 feet, respectively, due to time constraints during drilling.

At the beginning of each day, the drill rig operator performed a preparatory sequence of blows prior to energy measurement per the procedure outlined in ASTM D4633-05. These consisted of at least one SPT sample obtained in the upper 5 feet of the profile prior to SPT hammer energy measurement. Most boreholes had multiple preparatory sequences prior to the first energy measurement (i.e., continuous sampling to 10 feet below grade).

The weather for each testing day was partly cloudy with no precipitation except for September 26, 2008. Rain was observed on September 26, 2008. The automatic hammer on the CME45C track rig was the only hammer used that day.

Table 1 presents the configurations used in this study.

6.1 Data Quality Assessment

Appendix 6 presents sample data from the field. Presented are force and velocity traces during individual hammer blows from borings GD-2 and GD-5. As shown, the force and velocity plots have similar shapes up to a time equal to 2L/c and then the force and velocity plots diverge from each other. This divergence continues until both force and velocity go to zero. The shape and characteristic of these wave traces are indications that the field data for these hammer blows are a good data set. Also, the bottom figure shows the velocity measurements from the two transducers on the instrumented rod and as can be seen, the two strain gages matched (another indication of good data). As previously stated, only one accelerometer was used for this study therefore no comparison of accelerometer data is possible.

6.2 SPT Hammer Energy Transfer Ratios

The energy transfer ratio is the measured hammer energy delivered to the drill string divided by the potential energy of the system (as defined in Section 3.5.1). Once the entire hammer blow record for each depth interval was reviewed, the bad recorded data sets were removed from the group. This process was repeated for all nine boreholes. Only data having reasonable wave traces (as described above) were included in the summary tables. Appendix 7 presents a summary table with the test results from the SPT hammer energy measurements. The table headings in order from the left to right on the table include hammer type, drill rig, drill rig serial number, drill rod, type of drilling, owner, driller, SPT energy measurement operator, location of test with date and time, boring ID, sample depth, energy delivered using EFV and EF2 methods, potential energy, energy transfer ratio, force, hammer blow rate, recorded hammer blows, analyzed hammer blows, N-value, adjustment factor, N_{60} value, average ETR and C_n, depth to water, and soil type for each test.

The average, standard deviation, minimum, and maximum values for SPT energy measurements (EFV and EF2), ETR, FMX, and BPM were calculated. These parameters were determined for each sampling interval, as well as analyzed over the entire borehole. The entire data set, including some graphs with measured SPT energy parameters plotted versus depth, are presented in Appendix 8. Energy Transfer Ratio frequency plots (showing the normal distribution of the ETR data) is presented in Appendix 9.

ETR and C_n were calculated for the each borehole using the energy from the EFV method. The data were averaged and reported using every hammer blow for both; the entire sounding and data obtained below 30 feet deep (as suggested by the ASTM D4633-05). Table 5 presents the ETR minimum, maximum, average, standard deviation, and average from data greater than 30 feet deep and standard deviation from data greater than 30 feet deep. As presented in the table, the automatic hammers had the largest ETR values (between 80 and 90%) and the wire-line safe-t-driver resulted in the lowest ETR value (51%). The average ETR greater than 30 feet using the EF2 method is also presented. As seen in Table 5 the ETR using the EF2 method are significantly higher.

Table 5 List of Measured SPT Hammer Efficiencies from this Study.
(VTrans rigs are highlighted)

		entire borehole					>30 feet deep			
Boring ID	Hammer Type	MIN (%)	MAX (%)	AVG (%)	Std Dev (%)	# of hammer blows analyzed	AVG (%)	Std Dev (%)	# of hammer blows analyzed	AVG EF2 (%)
GD-1	CME Automatic	63.6	94.5	85	4.9	215	87.5	1.3	136	112.9
GD-2	CME Automatic	60.6	86.4	77.4	5	211	79.6	1.4	129	105.4

Table 5 (cont) List of Measured SPT Hammer Efficiencies from this Study.
(VTrans rigs are highlighted)

		entire borehole					>30 feet deep			
Boring ID	Hammer Type	MIN (%)	MAX (%)	AVG (%)	Std Dev (%)	# of hammer blows analyzed	AVG (%)	Std Dev (%)	# of hammer blows analyzed	AVG EF2 (%)
GD-3	CME Automatic	64.4	94.9	87.4	5.4	205	90.5	1.7	85	110.7
GD-4	Safety	40	82.4	66.3	7.7	289	69.2	5.6	179	84.1
GD-5	CME Automatic	60.9	95.4	84	5.3	173	85.6	1.5	120	115.1
GD-6	Safety	34.3	94.6	60.3	10.9	143	n/a	n/a	n/a	69.3
GD-7	CME Automatic	65.6	92.4	80.6	3.9	240	80.2	1.8	129	103.1
GD-8	CME Automatic	58.4	93.3	81.1	5.8	176	84.2	2.3	66	100.9
GD-9	Mobile Safety Driver	32	62.9	48.1	5.7	354	51.0	4.8	124	63.6

6.3 SPT Hammer Energy Adjustment Factor

The SPT Hammer Energy Adjustment Factor, C_n, is defined as the ETR divided by 60% energy where 60% energy is also referred to as the standard energy. ETR was presented in Section 3.5.1.

As discussed in Section 6.2, a table in Appendix 7 presents a summary of field measurements made during the SPT hammer energy testing. The minimum, maximum, average, and average greater than 30 feet deep adjustment factor, C_n, are summarized in Table 6. The data in Table 6 were calculated using the EFV energy. Appendix 8 presents the entire field data set measured for this study and plots a number of parameters versus depth for each borehole.

The adjustment factor, C_n, is the factor used to multiply with the field measured N-values to calculate the N_{60}-value (the standard energy applied to the sampler which equals 60% of the potential energy). This “standard” energy is accepted by several authors and publications. This “standard” energy is also recommended by Aggour (2001) to allow reproducible and consistent blow counts among different drill companies at the same site.

The automatic hammers had the highest measured C_n values (1.3 to 1.5) in this study and the wire-line safe-t-driver resulted in the lowest measured C_n value (0.9) in this study.

Table 6 List of Measured SPT Hammer Correction Factors from this Study.
(VTrans rigs are highlighted)

			Adjustment Factor, C_n			
Boring ID	**Hammer Type**	**Date**	**MIN**	**MAX**	**AVG entire borehole**	**AVG >30'**
GD-1	CME Automatic	9/23/2008	1.10	1.60	1.40	1.46
GD-2	CME Automatic	9/23/2008	1.00	1.40	1.30	1.33
GD-3	CME Automatic	9/24/2008	1.10	1.60	1.50	1.51
GD-4	Safety	9/24/2008	0.70	1.40	1.10	1.15
GD-5	CME Automatic	9/25/2008	1.00	1.60	1.40	1.43
GD-6	Safety	9/25/2008	0.60	1.60	1.00	-
GD-7	CME Automatic	9/26/2008	1.10	1.50	1.30	1.34
GD-8	CME Automatic	9/26/2008	1.00	1.60	1.40	1.40
GD-9	Mobile Safety Driver	9/29/2008	0.50	1.00	0.80	0.85

6.4 SPT N_{60} Values

SPT N_{60} values are defined as the field N-values multiplied by the C_n. Appendix 10 presents the SPT N-values and SPT N_{60} values for all 9 boreholes. The first graph presents all of the N-values together (field measured and corrected). The second graph presents the field measured SPT N-values for each borehole. The third graph presents only the corrected N_{60} values which were calculated using the average adjustment factor from each borehole (i.e., SPT hammer configuration).

The next nine graphs present the SPT N-value, SPT N_{60}-value, and the SPT $N_{60\ indiv}$-value for each borehole. SPT $N_{60\ indiv}$-value data were calculated by using the average adjustment factor for each sample interval and not the average for the entire borehole. These graphs were created to evaluate the magnitude of the energy correction for each SPT hammer configuration.

7 DISCUSSION OF RESULTS

The following sections provide a discussion of the data presented in the report. Comparisons of the different configurations are made as well as comparisons to literature values.

The boreholes were placed in a roughly 25-foot grid spacing on a flat site in a relatively uniformly layered sand deposit. As discussed in Section 5.3 and presented in Appendix 2, the site consists of a silty fine sand underlain by a fine to medium sand and gravel layer, underlain by a sand/silt, underlain by a silty fine sand.

The four different sand layers have varying values of silt and gravel content as seen in Appendix 4 and 5. Appendix 4 presents the grain-size data for each borehole and Appendix 5 presents the grain-size for each soil layer. As shown in the appendices, the sieve data analyses indicate that the upper and lower silty fine sand strata and the sand/silt layer are poorly graded. The sand and gravel layer is uniformly graded. The recoveries from each split spoon sample varied from 33% to 100% with the average recovery per soil layer equaling 74%, 70%, 81%, and 85% as presented in the graph shown in Appendix 3. There does not appear to be a trend with recovery versus depth.

As shown in Appendix 2, the four different sand layers have relatively uniform layer thicknesses between borings.

These soil characteristics made this site a good candidate for this SPT hammer energy study, while there are some natural variations in the composition within each layer.

7.1 Data Quality Assessment

Prior to starting any SPT hammer energy measurement, the transducers and the SPT analyzer box were checked for data quality using the manufacturers recommended procedure. As presented in Section 6.1, the force and velocity traces were reviewed prior to summarizing the hammer energy data that is presented in Appendix 7.

As can be seen in the Appendix 6a example plots, both velocity and force traces have similar shapes and when these values returned to zero after the initial hammer impact, at a time equal to 2L/c, the traces diverged from one another indicating that the data is of good quality. The force and velocity records returned to zero at the end of the record and successive force and velocity records were similar, all indicating good data.

Individual pairs of force signals versus time were very similar, providing an additional comparison for good quality data. There was only one accelerometer used in this study and no comparison was made for acceleration.

Any small time shifts between the force and velocity were corrected by shifting one signal versus the other up to 0.1 milliseconds. Any data set requiring larger time shifts was eliminated from the overall average because large time shifts indicate deficiencies in the measurement system.

7.2 SPT Hammer Energy Transfer Ratios

Energy measurements of good quality data (as described in Section 7.1) for at least five sample depths per borehole were recorded while using the SPT system in as nearly a routine manner as practical for all borings, as suggested by ASTM D4366-05. Most of the boreholes were drilled to 50 feet below grade using a 5-foot sample interval and the measured energy results were averaged for each borehole (per ASTM D4633-05 standard).

7.2.1 Data Distribution

As shown in Table 5, the standard deviation of the ETR data for the entire data set averages around 6%. When the data were analyzed by only using the data obtained below 30 feet from the ground surface (per the ASTM standard), the standard deviation average if around 2.5%. Appendix 9 presents the ETR (%) data as a function of occurrence and as can be seen. The plotted data follows typical normal distribution plots with each graph having the bell curve shape.

7.2.2 Rod comparison

Boreholes GD-1 and GD-3 used the same drilling equipment (CME 55 Track Rig with Auto hammer) and drilling technique (wash bore using HW casing) except that AWJ rods were used for GD-1 and the heavier NWJ rods were used for GD-3. As seen in Table 5, the NWJ rods provided a slightly higher ETR value (~3% higher).

Similarly, boreholes GD-7 and GD-8 used the same drilling equipment (CME 45C track rig with Auto hammer) and drilling technique (3 ¼ inch HSA) except that AWJ rods were used for GD-7 and NWJ rods were used for GD-8. As seen in Table 5, the NWJ rods provided a slightly higher ETR value (~4% higher).

NWJ rods are larger than AWJ rods and appear to give a higher efficiency due to the larger mass and cross-sectional area of the rod. Intuitively, this observation makes sense since the larger rod would have a larger moment of inertia thus preventing the larger drill rods from bending more than the smaller drill rods therefore allowing more of the energy to be transferred down to the sampler.

7.2.3 Hammer Comparison

Boreholes GD-2 and GD-4 used the same drill rig (CME 45C on skid rig) and drilling technique (3 ¼-inch HSA), but GD-2 used an auto hammer and GD-4 used a safety hammer. The automatic hammer had an ETR value of 79.6% and the safety hammer had an ETR value of 69.2% as presented in Table 5. These observations are consistent with expected values.

Boreholes GD-5 and GD-6 used the same drill rig (CME 75 track) and similar drilling technique (3 ¼-inch and 4 ¼-inch HSA) but GD-5 used an auto hammer (with 4 ¼-inch HSA) and GD-6 used a safety hammer (with 3 ¼-inch HSA). The automatic hammer had an ETR value of 85.6% and the safety hammer had an ETR value of 60.3% as presented in Table 5. These observations are consistent with expected values.

The Mobile Safe-T-Driver using a down-hole hammer (that was kept above grade for each sample interval) had an ETR value of 51%. This was the lowest value measured in this study. An issue with measuring the hammer energy of the down-hole hammer was that the hammer had to be hoisted high up above the top of the drill string because of the hammer length (in order to have the instrumented rod stay above the ground surface). This created a large amount of rod wobble during the driving, perhaps causing lower efficiencies since there was a large amount of unsupported rod length during the test. As stated in ASTM 4633-05, down-hole hammers should not be tested and perhaps rod wobble is the reason for this recommendation.

7.3 SPT Hammer Energy Adjustment Factor

The C_n values are the ETR values divided by a constant (60% energy) and as such the comparisons made in Section 7.2 apply to these data as well except that the ratios are inversely proportional to the ETR values.

A value of 1 for C_n, by definition, means that the measured energy was 60% and therefore no correction has to be made to these data.

7.4 SPT N_{60} Values

As can be seen in the first graph presented in Appendix 10a, the uncorrected and corrected N-values have a high amount of variability, ranging from 3 to 52 bpf and 4 to 47 bpf for the uncorrected and corrected N-values, respectively. The second and third graphs present the N_{60}-values and the N-values, respectively on single graphs. As can be seen on these graphs, the plots do not compress on to a single N_{60} plot, which would be expected when correcting field measured N-values within the same soil deposit when different drill rigs with different hammers were employed. This large amount of variation may be caused by the grain-size distribution of each soil layer within this native sand deposit. Appendix 4 presents the percent fines and the percent gravel versus depth for the samples that were analyzed. No trend in these data is evident when comparing the percent fines and percent gravel to N_{60} values although only 21 grain size analyses were performed out of 102 samples, leaving 81 soil samples not analyzed. The literature reviewed for this project is not concise regarding SPT hammer energy measurements and soil type, therefore no conclusion can be made without further obtaining more grain size data.

The graphs in Appendix 10b present the N-values measured for each borehole on individual graphs, comparing the uncorrected N-value (field measured), the corrected N_{60} –value using the average C_n for that borehole, and the corrected N_{60} –value using the individually measured C_n for the corresponding depth interval. As shown on these graphs, correcting to N_{60} –values using the average C_n or using the C_n measured at that soil depth does not drastically change the plotted N-values (i.e., the individually measured C_n values are not that different than the overall average for each borehole).

7.5 Comparison to ETR Literature Values

As seen in Table 7 the five boreholes that used the Automatic hammer had an average energy transfer of 84.6% using the EFV method and 108.0% using the EF2 method. The automatic hammer average ETR in the literature using the EFV method was found to be 76.4% (a difference of 8%) and using the EF2 method was found to be 78.8% (a difference of 29%).

As seen in Table 7 the two boreholes that used the Safety hammer had an average energy of 64.8% using the EFV method and 76.7% using the EF2 method. The safety hammer average ETR in the literature using the EFV method was found to be 65% (a difference of – ¼%) and using the EF2 method was found to be 58.7% (a difference of 18%).

As seen in Table 7 the one borehole that used the down-hole hammer had an average energy of 51% using the EFV method and 63.6% using the EF2 method. The down-hole hammer average ETR in the literature using the EFV method was found to be 43.9% (a difference of 7%) and using the EF2 method was found to be 37.5% (a difference of 26%).

As previously stated in Section 3.5.3, the EF2 method is inherently incorrect and typically is +/- 10% to 15% of the EFV method (ASTM D4633-05) which more accurately estimates the actual measured energy to the sampler since a force transducer and an accelerometer are used. This study found the EF2 method to be 15% to 20% higher than the EFV method.

There is a good comparison between this study ETR values using the EFV method to the ETR literature values using the EFV method. The ETR values using the EF2 method do not compare as well, most likely due to reasons previously stated in Section 3.5.3.

7.6 Calibration Interval

Per the ASTM D4633-05, the recommended calibration interval is at a regular time interval (at least yearly), or based on frequency of use as specified in the owner's quality assurance plan, or based on the client's quality assurance requirements. For frequently used hammers, the required calibration interval may be shorter and for infrequently used hammers, it is advisable to calibrate on first use. For rope and cathead systems, calibration is also related to operator changes.

As stated in ASTM D1586-08 under the Precision and Bias section, the use of faulty equipment, such as extremely massive or damaged anvil, a rusty cathead, a low speed cathead, an old, oily rope, or massive or poorly lubricated rope sheaves can significantly contribute to differences in N-values obtained between operator-drill rig systems. The conditions occur over time and will influence the hammer efficiency and in turn affect the measured N-values with these systems.

UDOT, per Sjoblom et al., (2005) states that the Department has had a SPT hammer calibration interval of about 4 years. They observed that the efficiency of the SPT hammers typically went down about 5% with time. They recommend periodic calibration of their hammers and also suggest that keeping hammers well maintained is always good practice.

MaineDOT, per Krusinski (2007) states that the Department has established a policy to calibrate their rigs on an annual basis. They also require all contracted automatic and spooling winches on State Projects to be calibrated annually.

MinnesotaDOT and OregonDOT both have found that calibrating SPT hammers provides value in their engineering designs as it provides standardization to all reported N-values (all converted to N_{60}) and it was estimated that the cost of calibrating was more than offset by the reduction in conservatism when using more efficient hammers (Krusinski 2007).

8 CONCLUSIONS AND RECOMMENDATIONS

Nine different SPT hammer configurations were tested in this study. Variables included hammer type, drill rods, rig type, soil type and condition, operator, and drilling method. This study attempted to isolate these variables in order to quantify the contribution of each variable on the measured SPT hammer energy.

8.1 SPT Hammer Energy Transfer Ratio

The recommended energy transfer ratio for the tested SPT hammer configurations are presented in Table 7. The automatic hammer on the CME 55 – Track rig (VTrans) had the highest efficiency, 90.5% and the Mobile Safety Driver on the Simco 2800 (SDI) had the lowest efficiency, 51%. The safety hammer on the CME 45C skid-rig trailer (VTrans) had an efficiency of 69.2% and the safety hammer on the CME 75 track rig (TransTech) had an efficiency of 60.3%. The other automatic hammers averaged about 83%. All measured hammer energies compared well with literature values. VTrans should use the ETR values presented in Table 7 for their respective drill rigs and equipment configurations. It is recommended that this value be listed on all boring logs with the date of last calibration and recommended date of recalibration. The field N-values (as recorded in the field) should be on the boring logs and the corrected N_{60} values using the respective ETR value should be listed adjacent to the field value.

The table uses a ^ symbol to indicate the standard equipment used by these drill rigs. These are the typical efficiencies of the hammers operating in the field by these drill rigs.

Table 7 Recommended ETR Values for the Tested SPT Hammer Configurations.

SPT Test Date	Hammer Type	Drill Rig	Drill Rod	ETR (%)
9/23/2008	CME Automatic	CME 55 - Track	AWJ	87.5^
9/23/2008	CME Automatic	CME 45C Skid-rig on trailer	AWJ	79.6^
9/24/2008	CME Automatic	CME 55 - Track	NWJ	90.5
9/24/2008	Safety	CME 45C Skid-rig on trailer	AWJ	69.2
9/25/2008	CME Automatic	CME 75 - Track	AWJ	85.6^
9/25/2008	Safety	CME 75 - Track	AWJ	60.3*
9/26/2008	CME Automatic	CME 45C Track	AWJ	80.2^
SPT Test Date	CME Automatic	CME 45C Track	NWJ	84.2

9/26/2008	Mobile Safety Driver	Simco 2800	AWJ	51.0^

* value calculated from measurements above the recommended 30-foot depth
^ standard equipment used on drill rig on typical projects

8.2 SPT Hammer Energy Adjustment Factor

The recommended adjustment factors for the tested SPT hammer configurations are presented in Table 8. The automatic hammer on the CME 55 – Track rig had the highest adjustment factor, 1.51 and the Mobile Safety Driver on the Simco 2800 had the lowest adjustment factor, 0.85 The safety hammer on the CME 45C skid-rig trailer had an adjustment factor of 1.15. The other automatic hammers averaged about 1.4. All measured adjustment factors compared well with literature values. VTrans should use the C_n values presented in Table 8 for their respective drill rigs and equipment configurations. It is recommended that this value be listed on all boring logs with the date of last calibration and recommended date of recalibration. The field N-values (as recorded in the field) should be on the boring logs and the corrected N_{60} values using the respective C_n value should be listed adjacent to the field value.

The table uses a ^ symbol to indicate the standard equipment used by these drill rigs. These values should be used to correct field N-values to N_{60}-values when N_{60}-values are needed for correlation to engineering properties using N_{60}-value correlations or liquefaction design (per ASTM D6066-96).

Table 8 Recommended Adjustment Factors for the SPT Hammer Configurations Tested.

SPT Test Date	Hammer Type	Drill Rig	Drill Rod	C_n
9/23/2008	CME Automatic	CME 55 - Track	AWJ	1.46^
9/23/2008	CME Automatic	CME 45C Skid-rig on trailer	AWJ	1.33^
9/24/2008	CME Automatic	CME 55 - Track	NWJ	1.51
9/24/2008	Safety	CME 45C Skid-rig on trailer	AWJ	1.15
9/25/2008	CME Automatic	CME 75 - Track	AWJ	1.43^
9/25/2008	Safety	CME 75 - Track	AWJ	1.00*
9/26/2008	CME Automatic	CME 45C Track	AWJ	1.34^
SPT Test Date	CME Automatic	CME 45C Track	NWJ	1.40
9/26/2008	Mobile Safety Driver	Simco 2800	AWJ	0.85^

* value calculated from measurements above the recommended 30-foot depth
^ standard equipment used on drill rig on typical projects

8.3 Calibration Interval

We recommended that the SPT hammers be recalibrated in one year (as recommended in ASTM 4633-05) and then the new SPT hammer energies compared to September 2008 data. If less than 5% change is noted on average, we recommend extending the next calibration date out two years (following the general procedure established by UDOT). Prior to recalibrating, the hammers should be put on a regularly scheduled service/maintenance plan per the manufacturers recommendations.

8.4 Future Work

An attempt was made to determine some of the major causes of measured differences in hammer efficiency (other than hammer type). A number of variables (e.g., rod type, soil type, groundwater condition) became evident as potential causes, but isolation of any one variable was not possible. To further this study, we recommend that additional boreholes be drilled in the same study area and variables be isolated in the additional test locations. These additional borings would provide further data to assist in determining the variable contribution to hammer energy efficiency. This study data could help explain why the corrected SPT N_{60} did not converge on a band of data versus depth in the study site (see Appendix 10). This additional work will significantly contribute to the current research literature as isolation of soil type on SPT hammer energy measurement has not been well documented. The question of the need to adjust the ETR value because of grain size can be evaluated with this additional research.

The completion of the grain-size analyses on the remaining 81 soil samples is also recommended to determine if percent fines, percent gravel, or percent sand have an affect on the measured energies. This will assist in the evaluation of soil type affect on SPT hammer energy measurement.

9 ACKNOWLEDGEMENTS

The author would like to acknowledge all involved in this research project. First the author acknowledges VTrans for the funding for this project and having the insight to recognize the importance of these measurements for geotechnical engineering design work. VTrans also provided three drill rigs to be tested and the personnel to run those rigs over multiple days. This work provided the bulk of the data presented in this report.

The author acknowledges two drilling companies that donated their time, personnel, and equipment for this study. TransTech Drilling Services from Schenectady, NY and Specialty Drilling and Investigation from South Burlington, VT both donated one day of drilling services for this project. The time and effort from these companies is greatly appreciated.

The author acknowledges Professor Alan J. Lutenegger from the University of Massachusetts at Amherst for his expertise in in situ testing, for reviewing drafts of this report, and for providing the testing equipment used in this study.

The author acknowledges Miller Construction Company for allowing us to perform the study on their property in Windsor, VT. The subsurface conditions were ideal for this study and the author is extremely grateful to Miller Construction for the access to their site.

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10 REFERENCES

Abou-matar, H., and Goble, G.G. (1997). "SPT Dynamic Analysis and Measurements." J. Geotech. Geoenviron. Eng., ASCE, 123(10), 921-928.

Aggour, M.S., and Radding, W.R. (2001). "Standard Penetration Test (SPT) Correction." Maryland Department of Transportation, Maryland.

Akbas, S.O., and Kulhawy, F.H. (2008). "Case History of SPT Energy Ration for an Automatic Hammer in Northeastern U.S. Practice." *Geotechnical and Geophysical Site Characterization,* Taylor and Francis Group, London.

American Society for Testing and Materials (ASTM) (2008). *2008 Annual Book of ASTM Standards*, Volume 04.08 Soil and Rock (I): D420-D5876, West Conshohocken, Pennsylvania.

Bosscher, P., and Showers, D. (1987). "Effect of Soil Type on Standard Penetration Test Input Energy." *J. Geotech. Eng.,* ASCE, 113(4), 385-389.

Butler, J.J., Caliendo, J.A., and Goble, G.G. (1998). "Comparison of SPT Energy Measurement Methods." *Proc., Int. Conf. on Site Characterization, ISC '98,* A.A. Balkema, Rotterdam, The Netherlands, 901-906.

Caltrans. (2005-2008). "Drill Rig Hammer Evaluation." *Foundation Testing Branch,* State of California Department of Transportation, California.

Daniel, C., and Howie, J. (2005). "Effect of hammer shape on energy transfer measurement in the Standard Penetration Test." *Soils and Foundations,* Japanese Geotechnical Society, Tainan, Taiwan, 45(5), 121-128.

Diedrich Drill Incorporated. (2004). "Diedrich Automatic Hammer Operation Instructions." LaPorte, IN.

Diedrich Drill Incorporated. (1996). "Diedrich Automatic SPT Hammer System." LaPorte, IN.

Doll, C.G., Stewart, D.P., and MacClintock, P. (1970). “Surficial Geologic Map of Vermont.” *Vermont Department of Water Resources*, Map, scale 1:250000.

Drumright, E.E., Pfingsten, C.W., and Lukas, R.G. (1996). "Influence of Hammer Type on SPT Results." *J. Geotech. Eng.,* ASCE, 122(7), 598-599.

Farrar, J.A. (1998). "Summary of Standard Penetration Test (SPT) Energy Measurement Experiment." *Proc., Int. Conf. on Site Characterization, ISC '98,* A.A. Balkema, Rotterdam, The Netherlands, 919-926.

Farrar, J.A., and Chitwood, D. (1999). "CME Automatic Hammer Operations Bulletin." *Earth Sciences and Research Laboratory,* U.S. Department of the Interior Bureau of Reclamation, Denver, CO.

Finno, R.J. (1989). “Subsurface Conditions and Pile Installation Data, Predicted and Observed Behavior of Piles.” *Results of a Pile Prediction Symposium*, ASCE Geotechnical Special Publication, No. 23, 1-74.

Frost, D.J. (1992). "Evaluation of the Repeatability and Efficiency of Energy Delivered with a Diedrich Automatic SPT Hammer System." Diedrich Drill Incorporated, LaPorte, IN.

Goble, G.G., and Abou-matar, H. (1992). "Determination of Wave Equation Soil Constants from the Standard Penetration Test." *Proc. 4th Int. Conf. on the Application of Stress-Wave Theory to Piles,* A.A. Balkema, Rotterdam, The Netherlands, 99-103.

Hall, J.R. (1982). "Drill Rod Energy as a Basis For Correlation for SPT Data." *Proc. of the 2nd Symp. On Penetration Testing.,* A.A. Balkema, Rotterdam, 57-60.

Howie, J., and Campanella R.G. (2008). "Energy Measurement in the Standard Penetration Test (SPT)." Department of Civil Engineering, University of British Columbia, Vancouver, BC, Canada, <www.civil.ubc.ca/research/geotech/sptenergy/sptenergy.htm> (April 16, 2009).

ISSMFE Technical Committee on Penetration Testing, SPT Working Party. (1988). "Standard Penetration Test (SPT): International Reference Test Procedure." *Proc. of the 1st Int. Symp. On Penetration Testing,* A.A. Balkema, Rotterdam, The Netherlands, 3-26.

Johnsen, L.F., Bemben, S.M., and Jagello, J.J. (2001). "SPT Energy Transfer Measurements for Liquefaction Evaluations in the Northeast." *Proc. of the 4th Int. Conf. on Recent Advances in Geotechnical Earthquake Engineering and Soil Dynamics,* San Diego, CA, 4.20, 1-6.

Kim, D.S., Seo, W.S., and Bang, E.S. (2004). "Energy Ratio Measurement of SPT Equipment." *Proc. ISC-2 on Geotechnical and Geophysical Site Characterization,* Millpress, Rotterdam, The Netherlands, 339-344.

Kovacs, W.D., Evans, J.C., and Griffith, A.H. (1975). "A Comparative Investigation of the Mobile Drilling Company's Safe-T-Driver with the Standard Cathead with Manila Rope for the Performance of the Standard Penetration Test." *School of Civil Engineering,* Purdue University, West Lafayette, IN.

Kovacs, W.D., Evans, J.C., and Griffith, A.H. (1977). "Towards a More Standardized SPT." *Proc. of the 9th Int. Conf. on Soil Mechanics and Foundation Engineering,* Tokyo, Japan, 269-276.

Kovacs, W.D., Griffith, A.H., and Evans, J.C. (1978). "Alternative to the Cathead and Rope for the Standard Penetration Test." *Geotech. Testing J.,* 1(2), 72-81.

Kovacs, W.D., Salomone, L.A., and Yokel, F.Y. (1981). "Energy Measurements in the Standard Penetration Test." *Natl. Bureau of Standards Bldg. Sci. Series 135,* U.S. Department of Commerce, Washington, D.C.

Kovacs, W.D., Salomone, L.A., and Yokel, F.Y. (1983). "Comparison of Energy Measurements in the Standard Penetration Test Using the Cathead and Rope Method." *National Bureau of Standards Report to the US Nuclear Regulatory Commission,* Washington, D.C.

Krusinski, L. (2007). "SPT Energy Measurements with the Pile Driving Analyzer." Maine Department of Transportation, 48th Annual Conference of the Northeast States Geotechnical Engineers, October 23-25, 2007, John Hancock Hotel & Conference Center, Boston, MA

Little, R.D. (2004). “Geological History of the Connecticut River Valley.” *Earth View LLC*, <http://www.earthview.pair.com/ctriver.html> (June 9, 2009).

Lutenegger, A.J. (1999). "In Situ Testing Techniques in Geotechnical Engineering." *Department of Civil and Environmental Engineering,* University of Massachusetts, Amherst, MA.

Morgano, C.M., and Liang, R. (1992). "Energy Transfer in SPT - Rod Length Effect." *Proc. 4th Int. Conf. on the Application of Stress-Wave Theory to Piles,* A.A. Balkema, Rotterdam, The Netherlands, 121-127.

Odebrecht, E., Schnaid, F., Rocha, M.M., and Bernardes, G.P. (2004). "Energy Measurements for Standard Penetration Tests and the Effects of the Length of the Rods." *Proc. ISC-2 on Geotechnical and Geophysical Site Characterization,* Millpress, Rotterdam, The Netherlands, 351-358.

Odebrecht, E., Schnaid, F., Rocha, M.M., and Bernardes, G.P. (2005). "Energy Efficiency for Standard Penetration Tests" *J. Geotech. Geoenviron. Eng.,* ASCE, 131(10), 1252-1263.

Pile Dynamics, Inc. (2004). “Pile Driving Analyzer Manual: PDA-W Manual of Operation.” *Pile Dynamics, Inc.*, Cleveland, OH.

Pile Dynamics, Inc. (1999). “SPT Analyzer User’s Manual.” *Pile Dynamics, Inc*., Cleveland, OH, 1-30.

Riggs, C.O., Schmidt, N.O., and Rassieur, C.L. (1983). "Reproducible SPT Hammer Impact Force with an Automatic Free Fall SPT Hammer System." *Geotech. Testing J.,* 6(3), 201-209.

Robertson, P.K., Woeller, D.J., and Addo, O. (1992). "Standard Penetration Test Energy Measurements Using a System Based on the Personal Computer." *Can. Geotech. J.,* 29, 551-557.

Schmertmann, J., and Palacios, A. (1979). "Energy Dynamics of SPT." *J. Geotech. Engrg. Div.,* ASCE, 105(8), 909-926.

Seed, H.B., Tokimatsu, K., Harder, L.F., and Chung, R.M. (1985). "The Influence of SPT Procedures in Soil Liquefaction Resistance Evaluations." *J. Geotech. Eng.,* ASCE, 111(12), 1425-1445.

Sjoblom, D., Bischoff, J., and Cox, K. (2002). "SPT Energy Measurements with the PDA." *Proc., of the 2nd Int. Conf. on the Application of Geophysicals and NDT Methodologies to Transportation Facilities and Infrastructure,* Federal Highway Administration, Washington, D.C., 15-19.

Skempton, A.W. (1986). "Standard Penetration Test Procedures and the Effects in Sands of Overburden Pressure, Density, Particle Size, Aging and Overconsolidation." *Geotechnique,* London, 36(3), 425-447.

Steiger, F. (1980). "Experimental Investigation of the Force/Penetration Relationships of Rod Impact." *Geotech. Testing J.,* 3(4), 163-166.

Sy, A., and Campanella, R.G. (1993). "Standard Penetration Test Energy Measurements Using a System Based on the Personal Computer." *Can. Geotech. J.,* 30, 876-882.

Tsai, J.S., Liou, Y.J., Liu, F.C., and Chen, C.H. (2004). "Effect of Hammer Shape on Energy Transfer Measurement in the Standard Penetration Test." *Soils and Foundations,* Japanese Geotechnical Society, Tainan, Taiwan, 44(3), 103-114.

U.S. Army Corps of Engineers. (1988). "Engineering and Design Standard Penetration Test." Department of the Army, Washington, D.C., No. 1110-1-138.

U.S. Patent Office. (2001). "US Patent 6286613-Impact method and the device used in standard penetration test." <www.patents/6286613/description.html> (April 16, 2009).

van der Graaf, H.J., and van den Heuvel, M.H.J.P. (1992). "Determination of the Penetration Energy in the Standard Penetration Test." *Proc. 4th Int. Conf. on the Application of Stress-Wave Theory to Piles,* A.A. Balkema, Rotterdam, The Netherlands, 253-257.

Yokel, F. (1982). "Energy Transfer in Standard Penetration Test." *J. Geotech. Engrg. Div.,* ASCE, 108(9), 1197-1202.

Youd, T.L., Bartholomew, H.W., and Steidl, J.H. (2008). "SPT Hammer Energy Ratio Versus Drop Height." *J. Geotech. Geoenviron. Eng.,* ASCE, 134(3), 397-400.

Youd, T.L., et al. (2001). "Liquefaction Resistance of Soils." *J. Geotech. Geoenviron. Eng.,* ASCE, 127(10), 817-833.

11 APPENDICES

APPENDIX 1 – SITE LOCATION

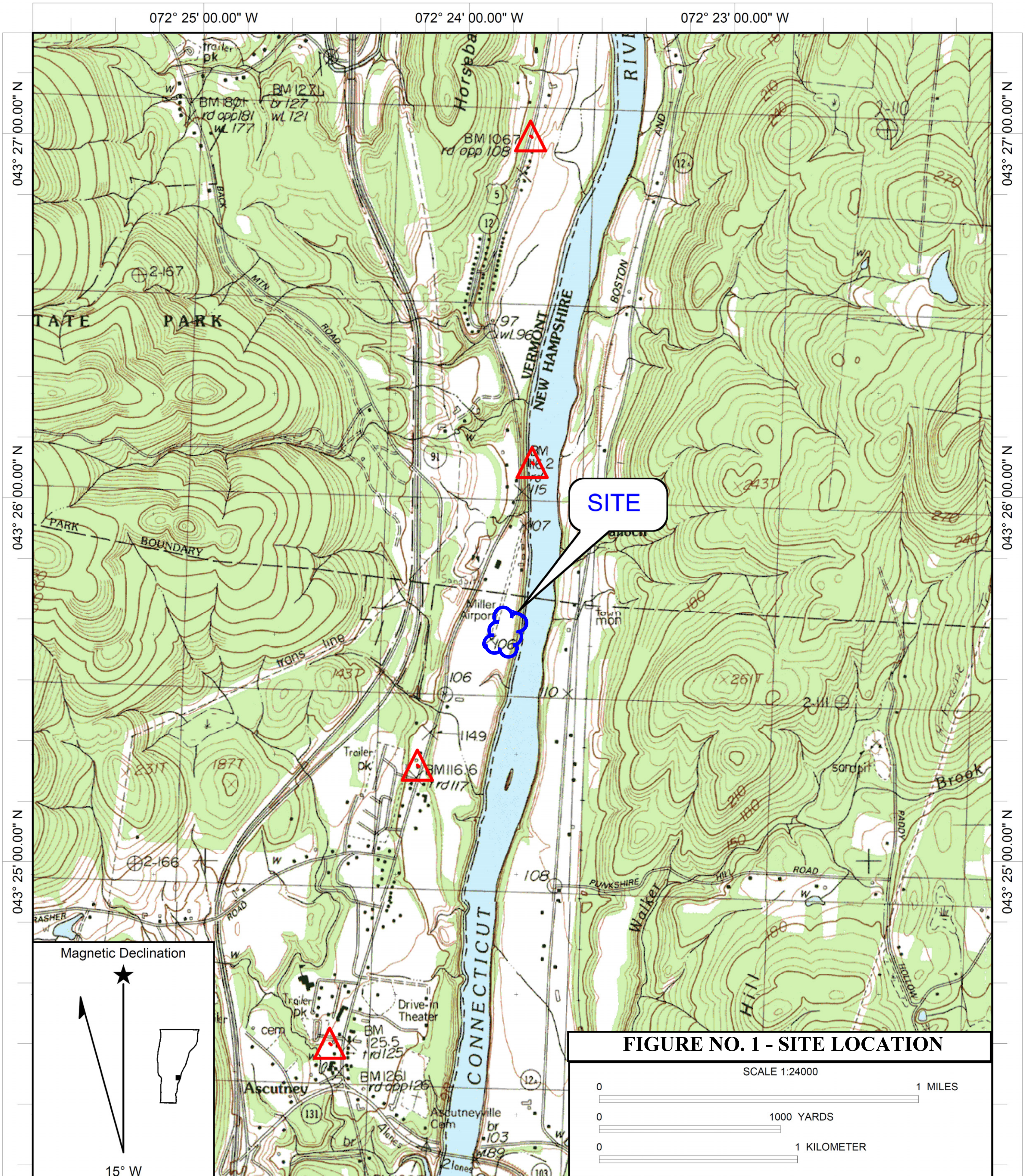

FIGURE NO. 1 - SITE LOCATION

Name: MT ASCUTNEY
Date: 4/1/2009
Scale: 1 inch equals 2000 feet

Location: 043° 25' 41.88" N 072° 23' 50.45"

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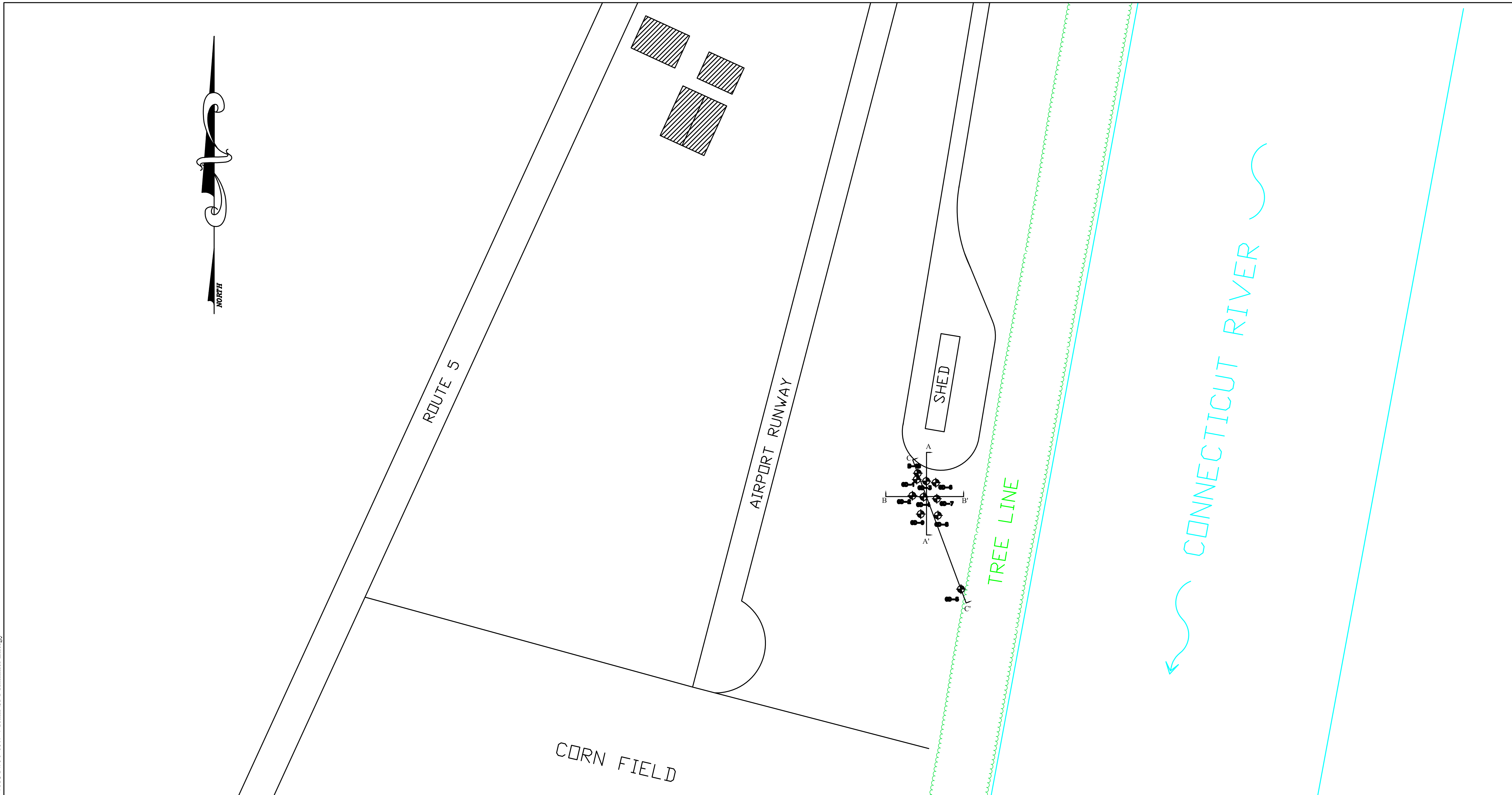
Datum: NAD27



NOTES:

1. Exploration Location Plan derived from measuring distances from site features observed in the program 'Google Earth' and by adding soil boring locations from a field sketch created by using taped measurements from existing site features.
2. Refer to 'Evaluation of SPT Hammer Energy' report for information regarding the drilling contractors, equipment used, and the date the explorations were performed.
3. All site feature locations and boring locations shown on this drawing are approximate, and should only be considered accurate to the degree implied by the method used to locate them.

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DRAWN BY: JPM | REVIEWED BY: SPK

MILLER CONSTRUCTION SITE PLAN
EVALUATION OF SPT HAMMER ENERGY
WINDSOR, VERMONT
FILE NO. 750-05.7

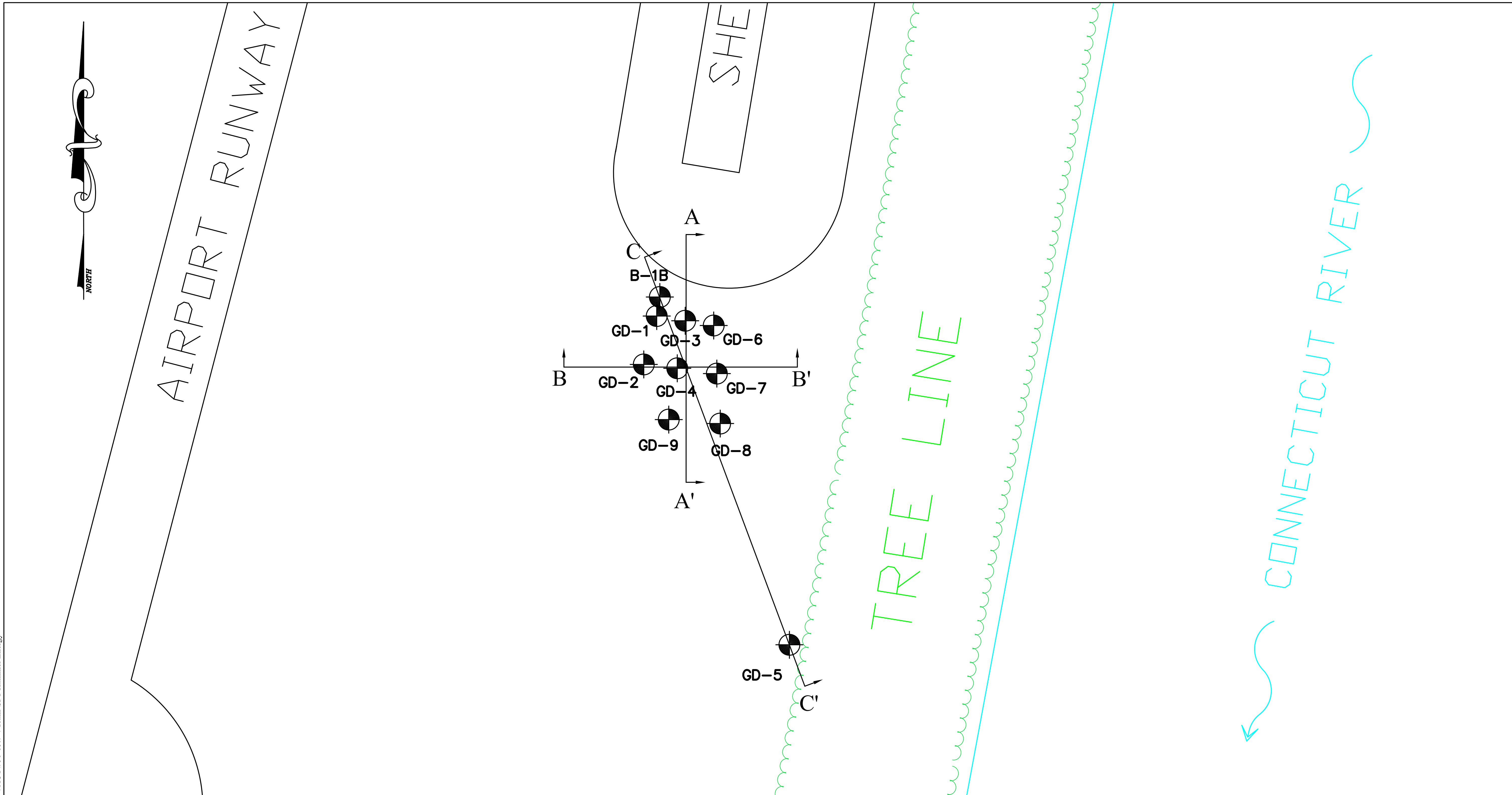
SCALE IN FEET
1" = 150'
0 125 150 300

DATE: 04/01/09

FIGURE NO. 2A

CAD FILE No. O:\Client related\CL-700 to 799\750-VAOT\750-05.7 VTrans SPT Hammer Energy

CAD FILE No. O:\Client related\CL-700 to 799\750-VAOT\750-05.7 VTrans SPT Hammer Energy



NOTES:

1. Exploration Location Plan derived from measuring distances from site features observed in the program 'Google Earth' and by adding soil boring locations from a field sketch created by using taped measurements from existing site features.
2. Refer to 'Evaluation of SPT Hammer Energy' report for information regarding the drilling contractors, equipment used, and the date the explorations were performed.
3. All site feature locations and boring locations shown on this drawing are approximate, and should only be considered accurate to the degree implied by the method used to locate them.

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DRAWN BY: JPM

REVIEWED BY: SPK

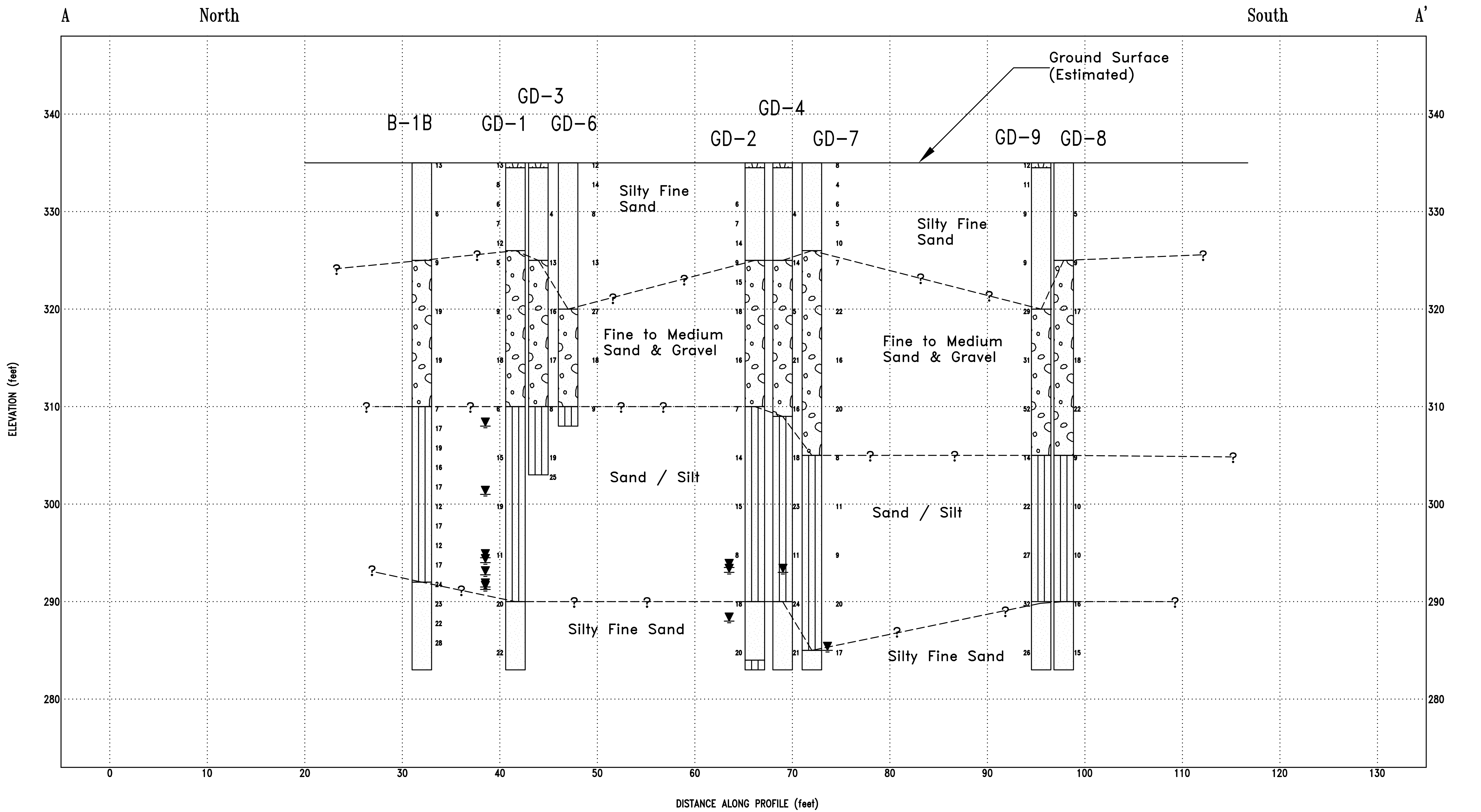
EXPLORATION LOCATION PLAN
EVALUATION OF SPT HAMMER ENERGY
WINDSOR, VERMONT
FILE NO. 750-05.7

SCALE IN FEET
1" = 50'
0 25 50 100

DATE: 04/01/09

FIGURE NO. 2B

APPENDIX 2 – CROSS SECTIONS



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Scale (feet): 0 – 10

Notes:

1. Data concerning the various strata have been interpreted at boring locations only. The stratigraphy between borings may vary from that shown.
2. Refer to plan view for subsurface profile location. For strata details and symbol legend, see Subsurface Profile Legend and boring logs appended to this report.
3. Numbers displayed beside boring(s) represent SPT "N" values corresponding to their respective sampling interval. Where coring was performed, numbers represent Recovery and RQD values.

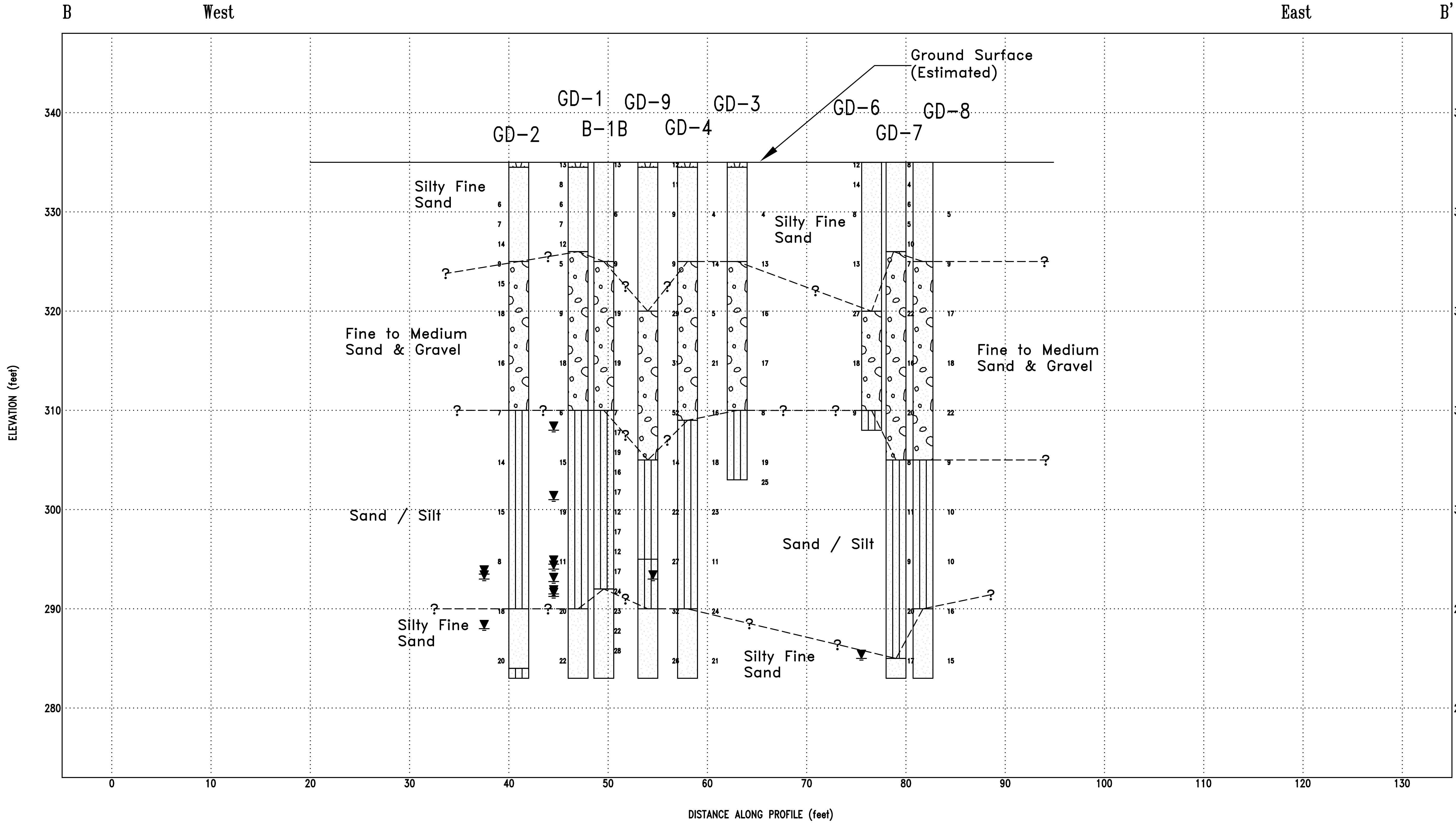
SUBSURFACE PROFILE A-A'

VTRANS SPT Hammer Efficiency

Windsor, VT

Date: 4/10/09	Drawn By: JFW	Reviewed By: SPK	File No.: 750-05.7	Figure No.: 3

VT GEO STANDARD 11 X 17 5-21-04 750-05.7 FENCES.GPJ FBNWNL01.GDT 4/10/09



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So. Burlington, VT 05403
Phone: 802-652-5140

Scale (feet): 0 – 10

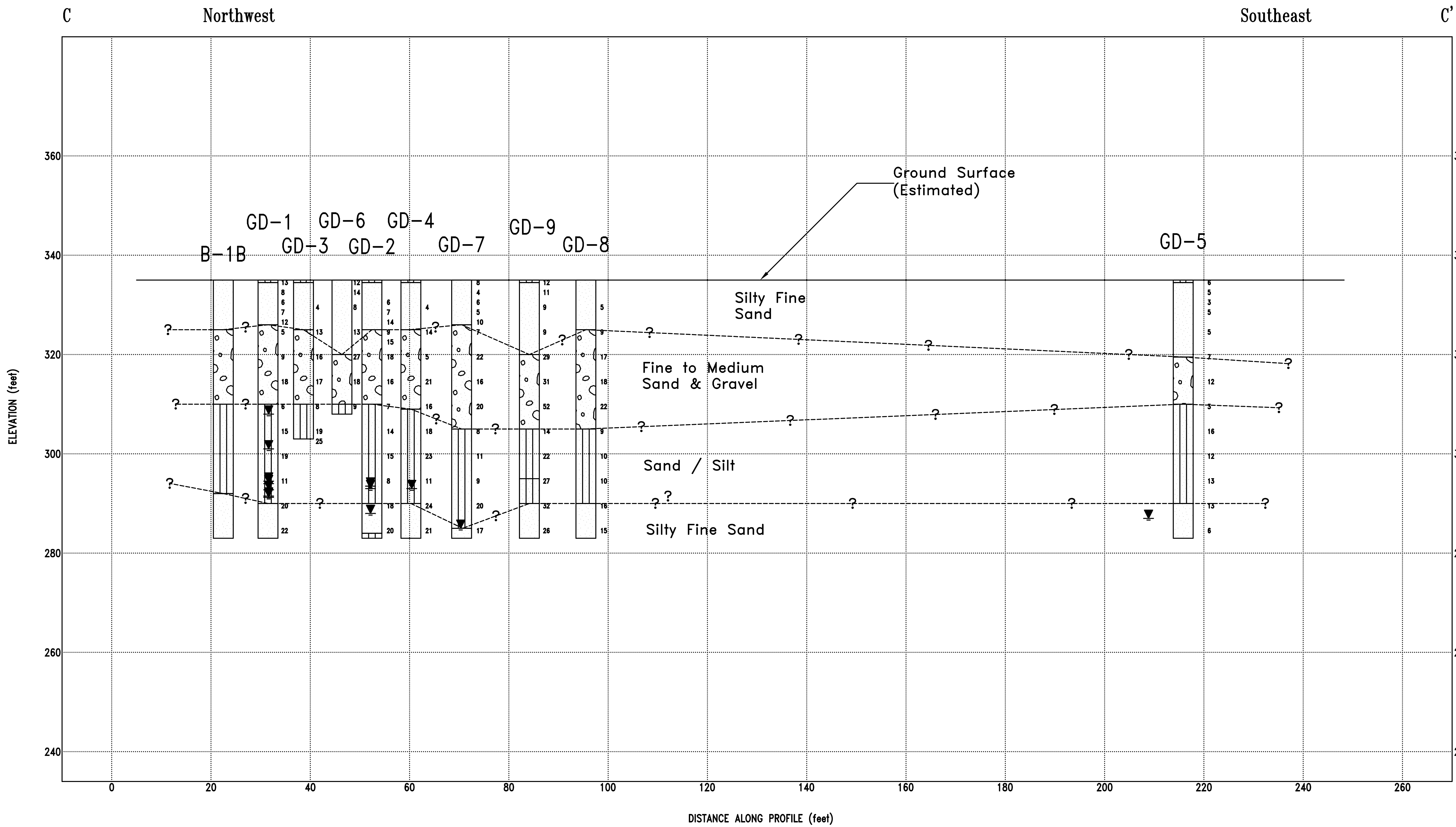
Notes:
1. Data concerning the various strata have been interpreted at boring locations only. The stratigraphy between borings may vary from that shown.
2. Refer to plan view for subsurface profile location. For strata details and symbol legend, see Subsurface Profile Legend and boring logs appended to this report.
3. Numbers displayed beside boring(s) represent SPT "N" values corresponding to their respective sampling interval. Where coring was performed, numbers represent Recovery and RQD values.

SUBSURFACE PROFILE B-B'

VTRANS SPT Hammer Efficiency

Windsor, VT

Date: 4/10/09	Drawn By: JFW	Reviewed By: SPK	File No.: 750-05.7	Figure No.: 4



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Notes:
1. Data concerning the various strata have been interpreted at boring locations only. The stratigraphy between borings may vary from that shown.
2. Refer to plan view for subsurface profile location. For strata details and symbol legend, see Subsurface Profile Legend and boring logs appended to this report.
3. Numbers displayed beside boring(s) represent SPT "N" values corresponding to their respective sampling interval. Where coring was performed, numbers represent Recovery and RQD values.

SUBSURFACE PROFILE C-C'

VTRANS SPT Hammer Efficiency

Windsor, VT

Date: 4/10/09	Drawn By: JFW	Reviewed By: SPK	File No.: 750-05.7	Figure No.: 5

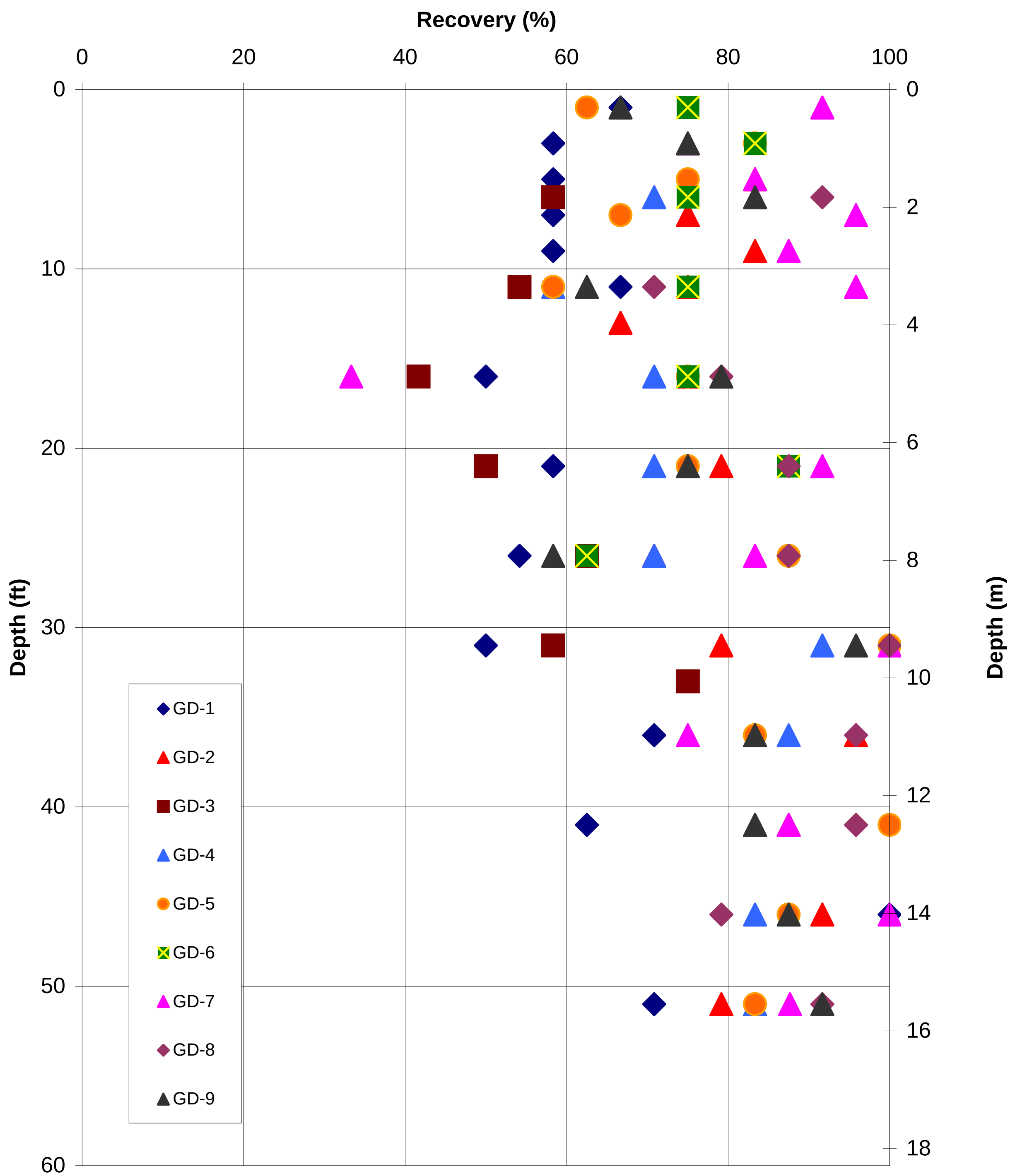
VT GEO STANDARD 11 X 17 5-21-04 750-05.7 FENCES.GPJ FBNWNL01.GDT 4/10/09

APPENDIX 3 – BORING LOGS

GeoDesign, Inc.
Windsor, VT
Job No. 750-5.7

Vtrans # RSCH012-703

SPT Hammer Energy Variability Evaluation
Windsor, VT



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BORING LOG

Project Name: VTRANS SPT Hammer Efficiency, Windsor, VT

Boring No.: B-1B
Page No.: 1 of 2
File No.: 750-05.7
Checked By: SPK

Boring Company: VTRANS
Foreman: Glen Porter
GeoDesign Rep.: NOT OBSERVED BY GEODESIGN
Date Started: September 16, 2008 Date Finished: September 16, 2008
N. Coordinate: E. Coordinate:
Ground Surface Elevation (feet): 335
Station: Offset: ft

	Casing:	Sampler:
Type:	HW	SS
I.D.:	4.0 in.	1.38 in.
Hammer Wt.:	NA	140 lbs
Hammer Fall:	NA	30 in.
Rig Type:	CME 55 Track	
Hammer/Rod Type:	Auto - AWJ	

Groundwater Observations

Date	Depth (ft)	Elev. (ft)	Notes
9/16/08, 0:00	10.0	325.0	Wet sample.
9/16/08, 0:00	39.0	296.0	Wet sample.

Classification System: Burmister

Depth (ft)	Casing Blows/ft	Number	Type	Penetration (inches)	Recovery (inches)	Depth (ft)	Blows 0 - 6	Blows 6 - 12	Blows 12 - 18	Blows 18 - 24	Coring Time (min./ft)	Moisture Content (%)	Strata Description (Depth & Elevation (feet))	Sample Description
		S1	SS	24	19	0	5	6	7	7		14	Silty Fine Sand	S1) Medium dense, brown SAND and SILT, trace Gravel, moist.
5		S2	SS	24	12	5	3	3	3	5		18.3		S2) Loose, brown SAND, some Silt, trace Gravel, moist.
10		S3	SS	24	13	10	6	4	5	5		18	10 / 325.0 Fine to medium Sand & Gravel	S3) Loose, brown SAND. little Gravel, trace Silt, wet.
15		S4	SS	24	13	15	10	10	9	10		10.8		S4) Medium dense, brown SAND, little Gravel, trace Silt, wet.
20		S5	SS	24	13	20	11	9	10	11		11.6		S5) Medium dense, brown SAND, some Gravel, trace Silt, wet.
25		S6	SS	24	12	25	6	4	3	6		26.1	25 / 310.0 Sand/ Silt	S6) Loose, brown SILT, some Sand, trace Gravel, wet.
		S7	SS	24	13	27	6	8	9	12		17.3		S7) Medium dense, brown SAND, some Silt, trace Gravel, moist.
30		S8	SS	24	13	29	9	8	11	11		15.3		S8) Medium dense, brown SAND, some Silt,

Remarks
1) Cannot advance casing at 10', 2 gallons of bentonite used.
2) 2 gallons of bentonite used advancing from 10' to 15' deep.
3) 2 gallons of bentonite used advancing from 15' to 20' deep.
4) From 25' to 49' deep, sampling consisted of a 2' sample, followed by cleaning the hole with the rollercone for 2', followed by another sample.
5) Advanced casing to 31' after sampling at 29' deep.

Notes:
1) Stratification Lines Represent Approximate Boundary Between Material Types, Transitions May Be Gradual.
2) Water Level Readings Have Been Made At Times And Under Conditions Stated, Fluctuations Of Groundwater May Occur Due To Other Factors Than Those Present At The Time Measurements Were Made. A.C. = After coring; N.R. = Not Recorded.
3) Sample Type Coding: A=Auger; C=Core; D=Driven; G=Grab; PS=Piston Sampler; SS=Split Barrel (Split Spoon); ST=Shelby Tube; Geo=GeoProbe V=Vane; WOR/H=Weight of Rod/Hammer
4) Proportions Used: Trace = 1-10%; Little = 10-20%; Some = 20-35%; And = 35-50%
5) Stratification lines represent approximate boundary between material types, transitions may be gradual.

Boring No.: B-1B

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Phone: 802-652-5140

BORING LOG

Project Name: VTRANS SPT Hammer Efficiency, Windsor, VT

Boring No.: **B-1B**

File No.: 750-05.7
Checked By: SPK

Boring Company: VTRANS
Foreman: Glen Porter
GeoDesign Rep.: NOT OBSERVED BY GEODESIGN
Date Started: September 16, 2008 Date Finished: September 16, 2008
N. Coordinate: E. Coordinate:
Ground Surface Elevation (feet): 335
Station: Offset: ft

	Casing:	Sampler:
Type:	HW	SS
I.D.:	4.0 in.	1.38 in.
Hammer Wt.:	NA	140 lbs
Hammer Fall:	NA	30 in.
Rig Type:	CME 55 Track	
Hammer/Rod Type:	Auto - AWJ	

Groundwater Observations

Date	Depth (ft)	Elev. (ft)	Notes
9/16/08, 0:00	10.0	325.0	Wet sample.
9/16/08, 0:00	39.0	296.0	Wet sample.

Depth (ft)	Casing Blows/ft	Number	Type	Penetration (inches)	Recovery (inches)	Depth (ft)	0 - 6	6 - 12	12 - 18	18 - 24	Coring Time (min./ft)	Moisture Content (%)	Strata Description (Depth & Elevation(feet))	Sample Description (Classification System: Burmister)
													Sand/ Silt *(Continued)*	moist.
		S9	SS	24	14	31	5	7	9	11		19.3		S9) Medium dense, brown SAND, some Silt, trace Gravel, moist.
		S10	SS	24	14	33	7	8	9	12		16		S10) Medium dense, brown SAND, some Silt, trace Gravel, moist.
35		S11	SS	24	23	35	7	6	6	7		14.5		S11) Medium dense, brown SAND, some Silt, trace Gravel, moist.
		S12	SS	24	15	37	7	9	8	8		19.9		S12) Medium dense, brown SILT and SAND, little Gravel, moist.
40		S13	SS	24	18	39	4	6	6	7		27.6		S13) Medium dense, brown SILT, little Sand, trace Gravel, wet.
		S14	SS	24	12	41	6	7	10	10		21.7	43	S14) Medium dense, brown-gray SAND, some Silt, trace Gravel, wet.
		S15	SS	24	14	43	9	11	13	15		18.5	Silty Fine Sand 292.0	S15) Medium dense, brown-gray SAND, little Silt, wet.
45		S16	SS	24	13	45	8	10	13	16		18.4		S16) Medium dense, brown-gray SAND, little Silt, wet.
		S17	SS	24	13	47	9	8	14	16		20.4		S17) Medium dense, brown-gray SAND, little Silt, wet.
50		S18	SS	24	15	49	9	12	16	18		19.1		S18) Medium dense, brown-gray SAND, little Silt, wet.
													52	
													Bottom of Exploration at 51.0 ft 283.0	
55														
60														

Remarks:
6) Advanced casing to 35' after sampling at 33' deep.
7) Advanced casing to 41' after sampling at 39' deep.
8) Advanced casing to 45' after sampling at 43'.

Notes:
1) Stratification Lines Represent Approximate Boundary Between Material Types, Transitions May Be Gradual.
2) Water Level Readings Have Been Made At Times And Under Conditions Stated, Fluctuations Of Groundwater May Occur Due To Other Factors Than Those Present At The Time Measurements Were Made.
A.C. = After coring; N.R. = Not Recorded.
3) Sample Type Coding: A=Auger; C=Core; D=Driven; G=Grab; PS=Piston Sampler; SS=Split Barrel (Split Spoon); ST=Shelby Tube; Geo=GeoProbe V=Vane; WOR/H=Weight of Rod/Hammer
4) Proportions Used: Trace = 1-10%; Little = 10-20%; Some = 20-35%; And = 35-50%
5) Stratification lines represent approximate boundary between material types, transitions may be gradual.

Boring No.: **B-1B**

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So. Burlington, VT 05403
Phone: 802-652-5140

BORING LOG

Project Name

VTRANS SPT Hammer Efficiency

Windsor, VT

Boring No.: GD-1

File No.: 750-05.7
Checked By: SPK

Boring Company: VTRANS
Foreman: Glen Porter
GeoDesign Rep.: Shawn Kelley & Joe Kidd
Date Started: September 23, 2008 Date Finished: September 24, 2008
N. Coordinate: E. Coordinate:
Ground Surface Elevation (feet): 335
Station: Offset: ft

	Casing:	Sampler:
Type:	HW	SS
I.D.:	4.0 in.	1.38 in.
Hammer Wt.:	NA	140 lbs
Hammer Fall:	NA	30 in.
Rig Type:	CME 55 Track	
Hammer/Rod Type:	Auto - AWJ	

Groundwater Observations

Date	Depth (ft)	Elev. (ft)	Notes
9/24/08, 0:00	43.5	291.5	In open hole
9/24/08, 14:00	27.0	308.0	Hole collapsed at 45'
9/24/08, 17:30	34.0	301.0	
9/25/08, 9:00	40.5	294.5	In open hole (collapse at 45')
9/25/08, 16:00	41.0	294.0	In open hole (collapse at 45')
9/26/08, 11:40	42.3	292.8	In open hole (collapse at 45')
9/29/08, 13:00	43.8	291.3	In open hole (collapse at 45')

Sample Information

Depth (ft)	Casing Blows/ft	Number	Type	Penetration (inches)	Recovery (inches)	Depth (ft)	Blows 0 - 6	Blows 6 - 12	Blows 12 - 18	Blows 18 - 24	Coring Time (min./ft)	Moisture Content (%)	Strata Description (Depth & Elevation (feet))	Sample Description (Classification System: Burmister)
		S1	SS	24	16	0	2	6	7	6			Topsoil; 334.5 Silty Fine Sand	S1) Top 3" - Brown fine SAND and SILT, trace roots. Bottom 13" - Tannish brown fine SAND, little(+) Silt.
		S2	SS	24	14	2	2	3	5	4				S2) Tannish brown fine SAND, little Silt, trace mica, moist.
5		S3	SS	24	14	4	2	3	3	4				S3) Tannish brown fine SAND, little Silt, trace mica, moist.
		S4	SS	24	14	6	2	3	4	4				S4) Tannish brown fine SAND, little Silt, trace mica, moist.
		S5	SS	24	14	8	2	4	8	10			9; 326.0 Fine to Medium Sand and Gravel	S5) Top 6" - Brown fine SAND, little(-) Silt. Bottom 8" - Brown fine to medium SAND, trace Silt, trace fine Gravel, moist.
10		S6	SS	24	16	10	5	3	2	3				S6) Brown fine SAND, trace fine Gravel, trace Silt, moist.
15		S7	SS	24	12	15	3	4	5	6				S7) Brown fine to medium SAND, trace fine Gravel, trace Silt, wet.
20		S8	SS	24	14	20	4	9	9	8				S8) Brown fine to medium SAND, trace fine Gravel, trace Silt, wet.
25		S9	SS	24	13	25	7	3	3	5			25; 310.0 Sand/Silt	S9) Brown fine SAND, some(+) Silt, trace clay seam layered, trace mica, wet.
30														

Remarks
1) Sampled 0' to 10' continuously.
2) Used wash bore technique with bentonite in wash water.
3) Using water in casing while spinning in ground (i.e.. not pound and wash) 0' to 30'.
4) At 30', roller bit ahead of casing.

Notes:
1) Stratification Lines Represent Approximate Boundary Between Material Types, Transitions May Be Gradual.
2) Water Level Readings Have Been Made At Times And Under Conditions Stated, Fluctuations Of Groundwater May Occur Due To Other Factors Than Those Present At The Time Measurements Were Made.
A.C. = After coring; N.R. = Not Recorded.
3) Sample Type Coding: A=Auger; C=Core; D=Driven; G=Grab; PS=Piston Sampler; SS=Split Barrel (Split Spoon); ST=Shelby Tube; Geo=GeoProbe V=Vane; WOR/H=Weight of Rod/Hammer
4) Proportions Used: Trace = 1-10%; Little = 10-20%; Some = 20-35%; And = 35-50%
5) Stratification lines represent approximate boundary between material types, transitions may be gradual.

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Phone: 802-652-5140

BORING LOG

Project Name

VTRANS SPT Hammer Efficiency

Windsor, VT

Boring No.: GD-1

File No.: 750-05.7
Checked By: SPK

Boring Company: VTRANS
Foreman: Glen Porter
GeoDesign Rep.: Shawn Kelley & Joe Kidd
Date Started: September 23, 2008 Date Finished: September 24, 2008
N. Coordinate: E. Coordinate:
Ground Surface Elevation (feet): 335
Station: Offset: ft

	Casing:	Sampler:
Type:	HW	SS
I.D.:	4.0 in.	1.38 in.
Hammer Wt.:	NA	140 lbs
Hammer Fall:	NA	30 in.
Rig Type:	CME 55 Track	
Hammer/Rod Type:	Auto - AWJ	

Groundwater Observations

Date	Depth (ft)	Elev. (ft)	Notes
9/24/08, 0:00	43.5	291.5	In open hole
9/24/08, 14:00	27.0	308.0	Hole collapsed at 45'
9/24/08, 17:30	34.0	301.0	
9/25/08, 9:00	40.5	294.5	In open hole (collapse at 45')
9/25/08, 16:00	41.0	294.0	In open hole (collapse at 45')
9/26/08, 11:40	42.3	292.8	In open hole (collapse at 45')
9/29/08, 13:00	43.8	291.3	In open hole (collapse at 45')

Sample Information

Depth (ft)	Casing Blows/ft	Number	Type	Penetration (inches)	Recovery (inches)	Depth (ft)	Blows 0 - 6	Blows 6 - 12	Blows 12 - 18	Blows 18 - 24	Coring Time (min./ft)	Moisture Content (%)	Strata Description (Depth & Elevation (feet))	Sample Description (Classification System: Burmister)
		S10	SS	24	12	30	6	7	8	9			Sand/Silt *(Continued)*	S10) Tannish brown fine SAND, trace(+) Silt, trace mica, moist.
35		S11	SS	24	17	35	6	9	10	12				S11) Tannish brown fine SAND, little Silt layered (top 9"), trace mica, moist.
40		S12	SS	24	15	40	5	4	7	10				S12) Grayish tan, layered fine SAND and SILT, trace mica, wet.
45		S13	SS	24	24	45	4	9	11	16			45 Silty Fine Sand 290.0	S13) Tannish gray fine SAND, trace Silt, trace mica, 2" lens of medium SAND, wet.
50		S14	SS	24	17	50	12	11	11	11				S14) Grayish tan fine SAND, trace Silt, trace mica, 2-3" lens of SILT and fine SAND (layered), moist to wet.
													52 Bottom of Exploration at 52.0 ft 283.0	
55														
60														

Remarks

5) Sample open hole 35' to 37'.
6) Casing down to 35'.
7) From 40' deep to end of the borehole, sampling procedure consisted of a 2' split-spoon sample, followed by advancing casing an additional 5' prior to rollerconing ahead for the next sample.
12) Hole collapsed to 48.5'.
13) 9/24/08 Hole collapsed to 46'. Warm up hammer with 46' to 48'.

Notes:
1) Stratification Lines Represent Approximate Boundary Between Material Types, Transitions May Be Gradual.
2) Water Level Readings Have Been Made At Times And Under Conditions Stated, Fluctuations Of Groundwater May Occur Due To Other Factors Than Those Present At The Time Measurements Were Made.
A.C. = After coring; N.R. = Not Recorded.
3) Sample Type Coding: A=Auger; C=Core; D=Driven; G=Grab; PS=Piston Sampler; SS=Split Barrel (Split Spoon); ST=Shelby Tube; Geo=GeoProbe V=Vane; WOR/H=Weight of Rod/Hammer
4) Proportions Used: Trace = 1-10%; Little = 10-20%; Some = 20-35%; And = 35-50%
5) Stratification lines represent approximate boundary between material types, transitions may be gradual.

Boring No.: GD-1

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Phone: 802-652-5140

BORING LOG

Project Name: VTRANS SPT Hammer Efficiency, Windsor, VT

Boring No.: GD-2

File No.: 750-05.7
Checked By: SPK

Boring Company: VTRANS
Foreman: Howard Garrow
GeoDesign Rep.: Shawn Kelley
Date Started: September 23, 2008 Date Finished: September 24, 2008
N. Coordinate: E. Coordinate:
Ground Surface Elevation (feet): 335
Station: Offset: ft

	Casing:	Sampler:
Type:	H.S.A.	SS
I.D.:	3.25 in.	1.38 in.
Hammer Wt.:	NA	140 lbs
Hammer Fall:	NA	30 in.
Rig Type:	CME 45C Skid	
Hammer/Rod Type:	Auto - AWJ	

Groundwater Observations

Date	Depth (ft)	Elev. (ft)	Notes
9/23/08, 0:00	47.0	288.0	Wet Sample
9/23/08, 0:00	42.0	293.0	See note 3.
9/24/08, 0:00	41.5	293.5	Hole collapsed
9/24/08, 17:30	41.5	293.5	See note 4.

Depth (ft)	Casing Blows/ft	Number	Type	Penetration (inches)	Recovery (inches)	Depth (ft)	0 - 6	6 - 12	12 - 18	18 - 24	Coring Time (min./ft)	Moisture Content (%)	Strata Description (Depth & Elevation (feet))	Sample Description (Classification System: Burmister)
													Topsoil 334.5; Silty Fine Sand	
5		S1	SS	24	20	4	3	3	3	2				S1) Tan fine SAND, little(-) Silt, trace mica, dry.
		S2	SS	24	18	6	3	4	3	4				S2) Tan-brown fine SAND, trace(+) Silt, trace mica, dry.
		S3	SS	24	20	8	4	5	9	7				S3) Tan-brown fine SAND, trace Silt, trace fine Gravel, dry.
10													10	
		S4	SS	24	18	10	4	5	4	7			Fine to Medium Sand and Gravel 325.0	S4) Tan-brown fine to course SAND, trace Silt, trace mica, dry.
		S5	SS	24	16	12	7	8	7	13				S5) Tan-brown fine to medium SAND, trace Silt, trace mica, trace fine Gravel, dry.
15														
		S6	SS	24	18	15	5	9	9	9				S6) Tan-brown fine to medium SAND, little fine Gravel, trace Silt, trace mica, dry.
20														
		S7	SS	24	19	20	3	6	10	12				S7) Tan-brown fine to medium SAND, trace Silt, trace mica, trace fine Gravel, dry.
25													25	
		S8	SS	24	17	25	2	3	4	5			Sand/Silt 310.0	S8) Top 10" - Brown fine SAND and SILT, trace mica, moist. Bottom 7" - Tan fine SAND, little Silt, trace mica, dry.
30														

Remarks

1) GD-2 26.5' North of GD-2.
2) From 4' to end of borehole, HSA were advanced to top of sampling interval immediately prior to sampling.

Notes:
1) Stratification Lines Represent Approximate Boundary Between Material Types, Transitions May Be Gradual.
2) Water Level Readings Have Been Made At Times And Under Conditions Stated, Fluctuations Of Groundwater May Occur Due To Other Factors Than Those Present At The Time Measurements Were Made. A.C. = After coring; N.R. = Not Recorded.
3) Sample Type Coding: A=Auger; C=Core; D=Driven; G=Grab; PS=Piston Sampler; SS=Split Barrel (Split Spoon); ST=Shelby Tube; Geo=GeoProbe V=Vane; WOR/H=Weight of Rod/Hammer
4) Proportions Used: Trace = 1-10%; Little = 10-20%; Some = 20-35%; And = 35-50%
5) Stratification lines represent approximate boundary between material types, transitions may be gradual.

Boring No.: GD-2

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BORING LOG

Project Name

VTRANS SPT Hammer Efficiency

Windsor, VT

Boring No.: GD-2

File No.: 750-05.7
Checked By: SPK

Boring Company: VTRANS
Foreman: Howard Garrow
GeoDesign Rep.: Shawn Kelley
Date Started: September 23, 2008 Date Finished: September 24, 2008
N. Coordinate: E. Coordinate:
Ground Surface Elevation (feet): 335
Station: Offset: ft

	Casing:	Sampler:
Type:	H.S.A.	SS
I.D.:	3.25 in.	1.38 in.
Hammer Wt.:	NA	140 lbs
Hammer Fall:	NA	30 in.
Rig Type:	CME 45C Skid	
Hammer/Rod Type:	Auto - AWJ	

Groundwater Observations

Date	Depth (ft)	Elev. (ft)	Notes
9/23/08, 0:00	47.0	288.0	Wet Sample
9/23/08, 0:00	42.0	293.0	See note 3.
9/24/08, 0:00	41.5	293.5	Hole collapsed
9/24/08, 17:30	41.5	293.5	See note 4.

Depth (ft)	Casing Blows/ft	Number	Type	Penetration (inches)	Recovery (inches)	Depth (ft)	0 - 6	6 - 12	12 - 18	18 - 24	Coring Time (min./ft)	Moisture Content (%)	Depth & Elevation(feet) / Strata Description	Sample Description (Classification System: Burmister)
		S9	SS	24	19	30	5	7	7	9			Sand/Silt *(Continued)*	S9) Tan fine SAND, trace Silt, trace fine Gravel, trace mica, dry.
35		S10	SS	24	23	35	5	8	7	7				S10) Top 12" - Fine to medium SAND, trace Silt, trace mica, dry. Bottom 12" - Fine SAND, little Silt, trace mica, moist.
40		S11	SS	24	21	40	3	3	5	13				S11) Brown fine SAND, some(+) Silt, trace mica, trace fine Gravel - layered.
45		S12	SS	24	22	45	4	9	9	12			45 — 290.0 Silty Fine Sand	S12) Tan-brown fine SAND, little (+) Silt, trace mica, trace fine Gravel, moist.
50		S13	SS	24	19	50	25	10	10	10			51 — 284.0 Sand/Silt	S13) Brown fine SAND, trace Silt, trace mica, wet. Bottom 2" fine SAND and SILT layered.
													52 — 283.0 Bottom of Exploration at 52.0 ft	
55														
60														

Remarks

3) Dry - hole collapsed after HSA removal.
4) Dry, (no water observed in borehole).

Notes:
1) Stratification Lines Represent Approximate Boundary Between Material Types, Transitions May Be Gradual.
2) Water Level Readings Have Been Made At Times And Under Conditions Stated, Fluctuations Of Groundwater May Occur Due To Other Factors Than Those Present At The Time Measurements Were Made. A.C. = After coring; N.R. = Not Recorded.
3) Sample Type Coding: A=Auger; C=Core; D=Driven; G=Grab; PS=Piston Sampler; SS=Split Barrel (Split Spoon); ST=Shelby Tube; Geo=GeoProbe V=Vane; WOR/H=Weight of Rod/Hammer
4) Proportions Used: Trace = 1-10%; Little = 10-20%; Some = 20-35%; And = 35-50%
5) Stratification lines represent approximate boundary between material types, transitions may be gradual.

Boring No.: GD-2

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BORING LOG

Project Name

VTRANS SPT Hammer Efficiency

Windsor, VT

Boring No.: GD-3

File No.: 750-05.7

Checked By: SPK

Boring Company: VTRANS
Foreman: Howard Garrow
GeoDesign Rep.: Shawn Kelley
Date Started: September 24, 2008 Date Finished: September 24, 2008
N. Coordinate: E. Coordinate:
Ground Surface Elevation (feet): 335
Station: Offset: ft

	Casing:	Sampler:
Type:	HW	SS
I.D.:	4.0 in.	1.38 in.
Hammer Wt.:	NA	140 lbs
Hammer Fall:	NA	30 in.
Rig Type:	CME 55 Track	
Hammer/Rod Type:	Auto - NWJ	

Groundwater Observations

Date	Depth (ft)	Elev. (ft)	Notes
9/24/08, 0:00			Collapse to 30'

Sample Information

Depth (ft)	Casing Blows/ft	Number	Type	Penetration (inches)	Recovery (inches)	Depth (ft)	Blows / 6 inch Interval 0 - 6	6 - 12	12 - 18	18 - 24	Coring Time (min./ft)	Moisture Content (%)	Strata Description (Depth & Elevation (feet))	Sample Description (Classification System: Burmister)
													Topsoil 334.5 Silty Fine Sand	
5		S1	SS	24	14	5	2	2	2	2				S1) Brown fine SAND, trace(+) Silt, trace mica, dry.
10		S2	SS	24	13	10	4	6	7	6			10 / 325.0 Fine to Medium Sand and Gravel	S2) Brown fine to medium SAND, little fine Gravel, trace Silt, trace mica, wet.
15		S3	SS	24	10	15	7	8	8	10				S3) Brown fine to coarse SAND, trace (+) fine Gravel, trace Silt, trace mica, wet.
20		S4	SS	24	12	20	5	8	9	12				S4) Fine to medium SAND, trace Silt, trace fine Gravel, trace mica, wet.
25		S5	SS	24	15	25	7	4	4	7			25 / 310.0 Sand/Silt	S5) Top 1" - Gray CLAY, wet. Bottom 14" - Fine SAND and SILT layered, trace mica, moist.
30														

Remarks

1) Advance casing to the top of each sampling interval immediately prior to sampling.

Notes:
1) Stratification Lines Represent Approximate Boundary Between Material Types, Transitions May Be Gradual.
2) Water Level Readings Have Been Made At Times And Under Conditions Stated, Fluctuations Of Groundwater May Occur Due To Other Factors Than Those Present At The Time Measurements Were Made.
A.C. = After coring; N.R. = Not Recorded.
3) Sample Type Coding: A=Auger; C=Core; D=Driven; G=Grab; PS=Piston Sampler; SS=Split Barrel (Split Spoon); ST=Shelby Tube; Geo=GeoProbe V=Vane; WOR/H=Weight of Rod/Hammer
4) Proportions Used: Trace = 1-10%; Little = 10-20%; Some = 20-35%; And = 35-50%
5) Stratification lines represent approximate boundary between material types, transitions may be gradual.

Boring No.: GD-3

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So. Burlington, VT 05403
Phone: 802-652-5140

BORING LOG

Project Name

VTRANS SPT Hammer Efficiency

Windsor, VT

Boring No.: **GD-3**

File No.: 750-05.7

Checked By: SPK

Boring Company: VTRANS
Foreman: Howard Garrow
GeoDesign Rep.: Shawn Kelley
Date Started: September 24, 2008 Date Finished: September 24, 2008
N. Coordinate: E. Coordinate:
Ground Surface Elevation (feet): 335
Station: Offset: ft

	Casing:	Sampler:
Type:	HW	SS
I.D.:	4.0 in.	1.38 in.
Hammer Wt.:	NA	140 lbs
Hammer Fall:	NA	30 in.
Rig Type:	CME 55 Track	
Hammer/Rod Type:	Auto - NWJ	

Groundwater Observations

Date	Depth (ft)	Elev. (ft)	Notes
9/24/08, 0:00			Collapse to 30'

Depth (ft)	Casing Blows/ft	Number	Type	Penetration (inches)	Recovery (inches)	Depth (ft)	Blows / 6 inch Interval 0 - 6	6 - 12	12 - 18	18 - 24	Coring Time (min./ft)	Moisture Content (%)	Strata Description Depth & Elevation(feet)	Symbol	Sample Description Classification System: Burmister
		S6	SS	24	14	30	8	9	10	14			Sand/Silt *(Continued)* 32		S6) Tannish gray fine SAND, little Silt, trace fine Gravel, trace mica, dry.
		S7	SS	24	18	32	12	12	13	14			303.0		S7) Tan fine SAND, trace(+) Silt, trace fine Gravel, trace mica, dry.
35													Bottom of Exploration at 34.0 ft		
40															
45															
50															
55															
60															

Remarks

Notes:
1) Stratification Lines Represent Approximate Boundary Between Material Types, Transitions May Be Gradual.
2) Water Level Readings Have Been Made At Times And Under Conditions Stated, Fluctuations Of Groundwater May Occur Due To Other Factors Than Those Present At The Time Measurements Were Made.
A.C. = After coring; N.R. = Not Recorded.
3) Sample Type Coding: A=Auger; C=Core; D=Driven; G=Grab; PS=Piston Sampler; SS=Split Barrel (Split Spoon); ST=Shelby Tube; Geo=GeoProbe V=Vane; WOR/H=Weight of Rod/Hammer
4) Proportions Used: Trace = 1-10%; Little = 10-20%; Some = 20-35%; And = 35-50%
5) Stratification lines represent approximate boundary between material types, transitions may be gradual.

Boring No.: **GD-3**

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BORING LOG

Project Name

VTRANS SPT Hammer Efficiency

Windsor, VT

Boring No.: **GD-4**

File No.: 750-05.7

Checked By: SPK

Boring Company: VTRANS
Foreman: Howard Garrow
GeoDesign Rep.: Shawn Kelley
Date Started: September 24, 2008 Date Finished: September 24, 2008
N. Coordinate: E. Coordinate:
Ground Surface Elevation (feet): 335
Station: Offset: ft

	Casing:	Sampler:
Type:	H.S.A.	SS
I.D.:	3.25 in.	1.38 in.
Hammer Wt.:	NA	140 lbs
Hammer Fall:	NA	30 in.
Rig Type:	CME 45C Track	
Hammer/Rod Type:	Safety - AWJ	

Groundwater Observations

Date	Depth (ft)	Elev. (ft)	Notes
9/24/08, 0:00	42.0	293.0	Wet Sample

Depth (ft)	Casing Blows/ft	Number	Type	Penetration (inches)	Recovery (inches)	Depth (ft)	Blows 0 - 6	Blows 6 - 12	Blows 12 - 18	Blows 18 - 24	Coring Time (min./ft)	Moisture Content (%)	Strata Description (Depth & Elevation(feet))	Sample Description (Classification System: Burmister)
													Topsoil; 334.5 Silty Fine Sand	
5		S1	SS	24	17	5	4	2	2	2				S1) Tan fine SAND, trace Silt, trace mica, dry.
10		S2	SS	24	14	10	4	7	7	7			10; 325.0 Fine to Medium Sand and Gravel	S2) Tan fine to medium SAND, trace Silt, trace mica, dry.
15		S3	SS	24	17	15	2	3	2	2				S3) Tan-brown fine to medium SAND, trace Silt, trace fine Gravel, trace mica, dry.
20		S4	SS	24	17	20	3	6	15	16				S4) Same as S-3.
25		S5	SS	24	17	25	7	9	7	7			26; 309.0 Sand/Silt	S5) Top 5" - Same as S3. Bottom 12" - Brown fine SAND little(-) Silt, trace mica.
30														

Remarks: 1) Advance HSA to the top of each sampling interval immediately prior to sampling.

Notes:
1) Stratification Lines Represent Approximate Boundary Between Material Types, Transitions May Be Gradual.
2) Water Level Readings Have Been Made At Times And Under Conditions Stated, Fluctuations Of Groundwater May Occur Due To Other Factors Than Those Present At The Time Measurements Were Made. A.C. = After coring; N.R. = Not Recorded.
3) Sample Type Coding: A=Auger; C=Core; D=Driven; G=Grab; PS=Piston Sampler; SS=Split Barrel (Split Spoon); ST=Shelby Tube; Geo=GeoProbe V=Vane; WOR/H=Weight of Rod/Hammer
4) Proportions Used: Trace = 1-10%; Little = 10-20%; Some = 20-35%; And = 35-50%
5) Stratification lines represent approximate boundary between material types, transitions may be gradual.

BORING LOG

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Project Name: VTRANS SPT Hammer Efficiency, Windsor, VT

Boring No.: **GD-4**

File No.: 750-05.7
Checked By: SPK

Boring Company: VTRANS
Foreman: Howard Garrow
GeoDesign Rep.: Shawn Kelley
Date Started: September 24, 2008 Date Finished: September 24, 2008
N. Coordinate: E. Coordinate:
Ground Surface Elevation (feet): 335
Station: Offset: ft

	Casing:	Sampler:
Type:	H.S.A.	SS
I.D.:	3.25 in.	1.38 in.
Hammer Wt.:	NA	140 lbs
Hammer Fall:	NA	30 in.
Rig Type:	CME 45C Track	
Hammer/Rod Type:	Safety - AWJ	

Groundwater Observations

Date	Depth (ft)	Elev. (ft)	Notes
9/24/08, 0:00	42.0	293.0	Wet Sample

Depth (ft)	Casing Blows/ft	Number	Type	Penetration (inches)	Recovery (inches)	Depth (ft)	Blows 0 - 6	Blows 6 - 12	Blows 12 - 18	Blows 18 - 24	Coring Time (min./ft)	Moisture Content (%)	Strata Description, Depth & Elevation (feet)	Sample Description (Classification System: Burmister)
		S6	SS	24	22	30	5	8	10	11			Sand/Silt *(Continued)*	S6) Tan fine SAND, trace Silt, trace fine Gravel, trace mica, dry.
35		S7	SS	24	21	35	5	13	10	9				S7) Tannish brown fine SAND, little Silt, trace fine Gravel, trace mica, moist. 5" layer fine to medium SAND, trace Silt, dry (same as S-3).
40		S8	SS	24	20	40	3	5	6	11				S8) Brown fine SAND and SILT, trace mica, wet. (Layered)
45		S9	SS	24	20	45	6	11	13	14			45 Silty Fine Sand 290.0	S9) Tan fine SAND, trace Silt, trace mica, dry. 2" layer (middle of spoon) fine SAND, some Silt, moist.
50		S10	SS	24	20	50	8	11	10	9				S10) Brown fine SAND, trace(+) Silt, trace mica, wet. Bottom 5" - Fine SAND and SILT, layered, wet.
													52 Bottom of Exploration at 52.0 ft 283.0	
55														
60														

Remarks:

Notes:
1) Stratification Lines Represent Approximate Boundary Between Material Types, Transitions May Be Gradual.
2) Water Level Readings Have Been Made At Times And Under Conditions Stated, Fluctuations Of Groundwater May Occur Due To Other Factors Than Those Present At The Time Measurements Were Made.
A.C. = After coring; N.R. = Not Recorded.
3) Sample Type Coding: A=Auger; C=Core; D=Driven; G=Grab; PS=Piston Sampler; SS=Split Barrel (Split Spoon); ST=Shelby Tube; Geo=GeoProbe V=Vane; WOR/H=Weight of Rod/Hammer
4) Proportions Used: Trace = 1-10%; Little = 10-20%; Some = 20-35%; And = 35-50%
5) Stratification lines represent approximate boundary between material types, transitions may be gradual.

Boring No.: **GD-4**

GEODESIGN INCORPORATED

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BORING LOG

Project Name

VTRANS SPT Hammer Efficiency

Windsor, VT

Boring No.: GD-5

File No.: 750-05.7

Checked By: SPK

Boring Company: TransTech
Foreman: John Leonhardt
GeoDesign Rep.: Shawn Kelley
Date Started: September 25, 2008 Date Finished: September 25, 2008
N. Coordinate: E. Coordinate:
Ground Surface Elevation (feet): 335
Station: Offset: ft

	Casing:	Sampler:
Type:	H.S.A.	SS
I.D.:	4.25 in.	1.38 in.
Hammer Wt.:	NA	140 lbs
Hammer Fall:	NA	30 in.
Rig Type:	CME 75 Track	
Hammer/Rod Type:	Auto - AWJ	

Groundwater Observations

Date	Depth (ft)	Elev. (ft)	Notes
9/25/08, 0:00	48.0	287.0	Wet Sample

Sample Information

Depth (ft)	Casing Blows/ft	Number	Type	Penetration (inches)	Recovery (inches)	Depth (ft)	Blows 0 - 6	Blows 6 - 12	Blows 12 - 18	Blows 18 - 24	Coring Time (min./ft)	Moisture Content (%)	Strata Description (Depth & Elevation(feet))	Sample Description (Classification System: Burmister)
		S1	SS	24	15	0	2	3	3	2			Topsoil / Silty Fine Sand 334.5	S1) Tan fine SAND, little(+) Silt, top 2" topsoil, dry.
		S2	SS	24	20	2	2	2	3	3				S2) Same as S1, except with trace mica.
5		S3	SS	24	18	4	2	1	2	1				S3) Tan fine SAND and SILT, trace mica, dry.
		S4	SS	24	16	6	2	2	3	3				S4)Tan fine SAND, trace (+) Silt, trace mica, dry.
10		S5	SS	24	14	10	1	2	3	4				S5) Grayish tan fine SAND, little(-) Silt, trace mica, moist.
15		S6	SS	24	18	15	1	3	4	7			15.5 Fine to Medium Sand and Gravel 319.5	S6) Top 9" - Same as S5 except moist to wet. Bottom 9" - Brown fine to coarse SAND, trace Silt, trace mica, moist.
20		S7	SS	24	18	20	4	7	5	4				S7) Brown fine to coarse SAND, trace Silt, trace fine Gravel, trace mica.
25		S8	SS	24	21	25	1	1	2	2			25 Sand/Silt 310.0	S8) Grayish brown fine SAND and SILT, trace mica layered, 1" seam of gray Clay, moist.
30														

Remarks

1) S1 and S2 sampled from ground surface.
2) Auger to 4' and sampled twice.
3) Between 10' and bottom of the borehole augers were advanced to the top of the sampling interval immediately prior to sampling.

Notes:
1) Stratification Lines Represent Approximate Boundary Between Material Types, Transitions May Be Gradual.
2) Water Level Readings Have Been Made At Times And Under Conditions Stated, Fluctuations Of Groundwater May Occur Due To Other Factors Than Those Present At The Time Measurements Were Made.
A.C. = After coring; N.R. = Not Recorded.
3) Sample Type Coding: A=Auger; C=Core; D=Driven; G=Grab; PS=Piston Sampler; SS=Split Barrel (Split Spoon); ST=Shelby Tube; Geo=GeoProbe V=Vane; WOR/H=Weight of Rod/Hammer
4) Proportions Used: Trace = 1-10%; Little = 10-20%; Some = 20-35%; And = 35-50%
5) Stratification lines represent approximate boundary between material types, transitions may be gradual.

Boring No.: GD-5

GEODESIGN INCORPORATED

Geotechnical Engineers-Environmental Consultants-Construction Engineers

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BORING LOG

Project Name: VTRANS SPT Hammer Efficiency, Windsor, VT

Boring No.: GD-5

File No.: 750-05.7
Checked By: SPK

Boring Company:	TransTech
Foreman:	John Leonhardt
GeoDesign Rep.:	Shawn Kelley
Date Started:	September 25, 2008
Date Finished:	September 25, 2008
N. Coordinate:	
E. Coordinate:	
Ground Surface Elevation (feet):	335
Station:	
Offset:	ft

	Casing:	Sampler:
Type:	H.S.A.	SS
I.D.:	4.25 in.	1.38 in.
Hammer Wt.:	NA	140 lbs
Hammer Fall:	NA	30 in.
Rig Type:	CME 75 Track	
Hammer/Rod Type:	Auto - AWJ	

Groundwater Observations

Date	Depth (ft)	Elev. (ft)	Notes
9/25/08, 0:00	48.0	287.0	Wet Sample

Depth (ft)	Casing Blows/ft	Number	Type	Penetration (inches)	Recovery (inches)	Depth (ft)	Blows 0 - 6	Blows 6 - 12	Blows 12 - 18	Blows 18 - 24	Coring Time (min./ft)	Moisture Content (%)	Strata Description (Depth & Elevation (feet))	Sample Description (Classification System: Burmister)
		S9	SS	24	24	30	6	8	8	10			Sand/Silt *(Continued)*	S9) Gray tan fine SAND, some Silt layered, trace fine Gravel, trace mica, dry.
35		S10	SS	24	20	35	4	6	6	8				S10) Grayish brown fine SAND, some(-) Silt, trace mica, 2" layer of fine SAND with trace Silt, moist.
40		S11	SS	24	24	40	2	5	8	11				S11) Top 12" - Same as S10. Bottom 12" - Grayish tan fine SAND, trace Silt, trace mica, dry.
45		S12	SS	24	21	45	4	6	7	8			45 Silty Fine Sand 290.0	S12) Top 10" - Grayish brown fine SAND, some (+) Silt, trace mica, moist. Bottom 11" - Grayish tan fine SAND, trace Silt, trace mica, dry.
50		S13	SS	24	20	50	1	3	3	4				S13) Top 14" - Brown fine SAND and SILT, trace mica, wet. Bottom 6" - Gray SILT, little (+) fine Sand, trace mica.
													52 Bottom 283.0 of Exploration at 52.0 ft	
55														
60														

Remarks:
4) Inclinometer: 1-94lb bag of cement, 1/2 - 50lb bag of bentonite powder, 40 gallons of water} grout mix x4 batches
Install 50' inclinometer with 2.5' stick up.
A0/A180 N-S
Measure 34.5' open hole at 4:30pm 9/25/08 on outside of inclinometer pipe.
Fill with grout on 9/29/08.
Measure 9' to top of grout at 3:00pm then backfilled with native cuttings.

Notes:
1) Stratification Lines Represent Approximate Boundary Between Material Types, Transitions May Be Gradual.
2) Water Level Readings Have Been Made At Times And Under Conditions Stated, Fluctuations Of Groundwater May Occur Due To Other Factors Than Those Present At The Time Measurements Were Made.
A.C. = After coring; N.R. = Not Recorded.
3) Sample Type Coding: A=Auger; C=Core; D=Driven; G=Grab; PS=Piston Sampler; SS=Split Barrel (Split Spoon); ST=Shelby Tube; Geo=GeoProbe V=Vane; WOR/H=Weight of Rod/Hammer
4) Proportions Used: Trace = 1-10%; Little = 10-20%; Some = 20-35%; And = 35-50%
5) Stratification lines represent approximate boundary between material types, transitions may be gradual.

Boring No.: GD-5

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BORING LOG

Project Name

VTRANS SPT Hammer Efficiency

Windsor, VT

Boring No.: **GD-6**

File No.: 750-05.7
Checked By: SPK

Boring Company: TransTech
Foreman: John Leonhardt and Mike Blakely
GeoDesign Rep.: Shawn Kelley
Date Started: September 25, 2008 Date Finished: September 25, 2008
N. Coordinate: E. Coordinate:
Ground Surface Elevation (feet): 335
Station: Offset: ft

	Casing:	Sampler:
Type:	H.S.A.	SS
I.D.:	3.25 in.	1.38 in.
Hammer Wt.:	NA	140 lbs
Hammer Fall:	NA	30 in.
Rig Type:	CME 75 Track	
Hammer/Rod Type:	Safety - AWJ	

Groundwater Observations

Date	Depth (ft)	Elev. (ft)	Notes
9/25/08, 0:00			None

Depth (ft)	Casing Blows/ft	Number	Type	Penetration (inches)	Recovery (inches)	Depth (ft)	Blows 0 - 6	Blows 6 - 12	Blows 12 - 18	Blows 18 - 24	Coring Time (min./ft)	Moisture Content (%)	Strata Description (Depth & Elevation (feet))	Sample Description (Classification System: Burmister)
		S1	SS	24	18	0	6	6	6	6			Silty Fine Sand.	S1) Tannish brown fine SAND, little Silt, trace mica, dry.
		S2	SS	24	20	2	5	7	7	8				S2) Tannish brown fine SAND, trace (+) Silt, trace mica, dry.
5		S3	SS	24	18	5	3	3	5	5				S3) Tan fine SAND, trace(+) Silt, trace mica, dry.
10		S4	SS	24	18	10	5	6	7	7				S4) Tan fine to medium SAND, trace Silt, trace mica, dry.
15		S5	SS	24	18	15	11	13	14	12			15 / 320.0 Fine to Medium Sand and Gravel	S5) Tan brown fine to medium SAND, trace(+) fine Gravel, trace mica, dry.
20		S6	SS	24	21	20	5	8	10	9				S6) Tan brown fine to medium SAND, trace (+) fine Gravel, trace mica, dry.
25		S7	SS	24	15	25	6	4	5	8			25 / 310.0 Sand/Silt	S7) Tannish brown fine SAND, little(+) Silt, trace mica, moist. (Layered)
													27 / 308.0 Bottom of Exploration at 27.0 ft	
30														

Remarks
1) Sampled twice from ground surface.
2) From 5' to bottom of borehole, HSA were advanced to top of sampling interval immediately prior to sampling.

Notes:
1) Stratification Lines Represent Approximate Boundary Between Material Types, Transitions May Be Gradual.
2) Water Level Readings Have Been Made At Times And Under Conditions Stated, Fluctuations Of Groundwater May Occur Due To Other Factors Than Those Present At The Time Measurements Were Made.
A.C. = After coring; N.R. = Not Recorded.
3) Sample Type Coding: A=Auger; C=Core; D=Driven; G=Grab; PS=Piston Sampler; SS=Split Barrel (Split Spoon); ST=Shelby Tube; Geo=GeoProbe V=Vane; WOR/H=Weight of Rod/Hammer
4) Proportions Used: Trace = 1-10%; Little = 10-20%; Some = 20-35%; And = 35-50%
5) Stratification lines represent approximate boundary between material types, transitions may be gradual.

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BORING LOG

Project Name

VTRANS SPT Hammer Efficiency

Windsor, VT

Boring No.: GD-7

File No.: 750-05.7
Checked By: SPK

Boring Company: VTRANS
Foreman: Glen Porter
GeoDesign Rep.: Shawn Kelley & Joe Kidd
Date Started: September 26, 2008 Date Finished: September 26, 2008
N. Coordinate: E. Coordinate:
Ground Surface Elevation (feet): 335
Station: Offset: ft

	Casing:	Sampler:
Type:	H.S.A.	SS
I.D.:	3.25 in.	1.38 in.
Hammer Wt.:	NA	140 lbs
Hammer Fall:	NA	30 in.
Rig Type:	CME 45C Track	
Hammer/Rod Type:	Auto - AWJ	

Groundwater Observations

Date	Depth (ft)	Elev. (ft)	Notes
9/26/08, 0:00	50.0	285.0	Wet Sample
9/26/08, 0:00			Hole collapsed 15.5'

Sample Information

Depth (ft)	Casing Blows/ft	Number	Type	Penetration (inches)	Recovery (inches)	Depth (ft)	Blows 0 - 6	Blows 6 - 12	Blows 12 - 18	Blows 18 - 24	Coring Time (min./ft)	Moisture Content (%)	Strata Description (Depth & Elevation (feet))	Sample Description (Classification System: Burmister)
		S1	SS	24	22	0	2	4	4	3			Silty Fine Sand	S1) Loose, brown fine SAND, little(+) Silt, trace mica, slightly moist.
		S2	SS	24	18	2	3	2	2	3				S2) Very loose, brown fine SAND, little(+) Silt, trace mica, slightly moist.
5		S3	SS	24	20	4	2	3	3	3				S3) Loose, tan fine SAND, little Silt, trace mica, dry.
		S4	SS	24	23	6	2	2	3	3				S4) Top 8" - Tan fine SAND, little(+) Silt, trace mica, dry. Bottom 15" - Loose, tan fine SAND, trace Silt, trace mica, dry.
		S5	SS	24	21	8	3	3	7	10			9 / Fine Sand and Gravel 326.0	S5) Medium dense: S5A - Top 12": Tannish brown fine SAND, little Silt, trace mica, moist. S5B - Bottom 9": Tannish brown fine to coarse SAND, little fine Gravel, trace Silt.
10		S6	SS	24	23	10	3	4	3	4				S6) Loose, tannish brown fine to medium SAND, trace Silt, trace fine Gravel, dry.
15		S7	SS	24	8	15	5	9	13	14				S7) Medium dense, tannish brown fine to coarse SAND, trace fine Gravel, trace Silt, slightly moist.
20		S8	SS	24	22	20	6	7	9	11				S8) Medium dense, tannish brown fine to coarse SAND, trace fine Gravel, trace Silt, slightly moist.
25		S9	SS	24	20	25	4	9	11	9				S9) Tannish brown fine to coarse SAND, trace fine Gravel, trace Silt, moist.
30													30	

Remarks: 1) Advanced HSA to top of sampling interval immediately prior to sampling.

Notes:
1) Stratification Lines Represent Approximate Boundary Between Material Types, Transitions May Be Gradual.
2) Water Level Readings Have Been Made At Times And Under Conditions Stated, Fluctuations Of Groundwater May Occur Due To Other Factors Than Those Present At The Time Measurements Were Made.
A.C. = After coring; N.R. = Not Recorded.
3) Sample Type Coding: A=Auger; C=Core; D=Driven; G=Grab; PS=Piston Sampler; SS=Split Barrel (Split Spoon); ST=Shelby Tube; Geo=GeoProbe V=Vane; WOR/H=Weight of Rod/Hammer
4) Proportions Used: Trace = 1-10%; Little = 10-20%; Some = 20-35%; And = 35-50%
5) Stratification lines represent approximate boundary between material types, transitions may be gradual.

Boring No.: GD-7

GEODESIGN INCORPORATED

Geotechnical Engineers-Environmental Consultants-Construction Engineers

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Windsor, VT 05089
Phone: 802-674-2033/Fax: 802-674-5943

1233 Shelburne Rd., Suite 360
So. Burlington, VT 05403
Phone: 802-652-5140

BORING LOG

Project Name: VTRANS SPT Hammer Efficiency, Windsor, VT

Boring No.: GD-7
Page No.: 2 of 2
File No.: 750-05.7
Checked By: SPK

Boring Company: VTRANS
Foreman: Glen Porter
GeoDesign Rep.: Shawn Kelley & Joe Kidd
Date Started: September 26, 2008 Date Finished: September 26, 2008
N. Coordinate: E. Coordinate:
Ground Surface Elevation (feet): 335
Station: Offset: ft

	Casing:	Sampler:
Type:	H.S.A.	SS
I.D.:	3.25 in.	1.38 in.
Hammer Wt.:	NA	140 lbs
Hammer Fall:	NA	30 in.
Rig Type:	CME 45C Track	
Hammer/Rod Type:	Auto - AWJ	

Groundwater Observations

Date	Depth (ft)	Elev. (ft)	Notes
9/26/08, 0:00	50.0	285.0	Wet Sample
9/26/08, 0:00			Hole collapsed 15.5'

Depth (ft)	Casing Blows/ft	Number	Type	Penetration (inches)	Recovery (inches)	Depth (ft)	Blows 0 - 6	Blows 6 - 12	Blows 12 - 18	Blows 18 - 24	Coring Time (min./ft)	Moisture Content (%)	Strata Description (Depth & Elevation (feet))	Sample Description (Classification System: Burmister)
		S10	SS	24	24	30	3	4	4	5			Sand/Silt 305.0	S10) Tan fine SAND, little Silt, trace mica, dry.
35		S11	SS	24	18	35	4	5	6	6				S11) Tan fine SAND, trace(+) Silt, trace mica, dry. 2" seam of brown fine SAND, little(+) Silt, trace mica.
40		S12	SS	24	21	40	3	5	4	6				S12) Brownish gray fine SAND and SILT, trace mica, trace fine Gravel layered, moist.
45		S13	SS	24	24	45	6	9	11	10				S13) Tan fine SAND, trace Silt, trace mica, dry.
50		S14	SS	24	24	50	9	10	7	10			50 Silty Fine Sand 285.0	S14A) Top 16" - Grayish brown fine SAND, trace(+) Silt, trace mica, wet. S14B) Bottom 8" - Gray/brown fine SAND and SILT, trace mica, wet.
													52 Bottom of Exploration at 52.0 ft 283.0	
55														
60														

Remarks

Notes:
1) Stratification Lines Represent Approximate Boundary Between Material Types, Transitions May Be Gradual.
2) Water Level Readings Have Been Made At Times And Under Conditions Stated, Fluctuations Of Groundwater May Occur Due To Other Factors Than Those Present At The Time Measurements Were Made. A.C. = After coring; N.R. = Not Recorded.
3) Sample Type Coding: A=Auger; C=Core; D=Driven; G=Grab; PS=Piston Sampler; SS=Split Barrel (Split Spoon); ST=Shelby Tube; Geo=GeoProbe V=Vane; WOR/H=Weight of Rod/Hammer
4) Proportions Used: Trace = 1-10%; Little = 10-20%; Some = 20-35%; And = 35-50%
5) Stratification lines represent approximate boundary between material types, transitions may be gradual.

Boring No.: GD-7

GEODESIGN INCORPORATED
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1233 Shelburne Rd., Suite 360
So. Burlington, VT 05403
Phone: 802-652-5140

BORING LOG

Project Name

VTRANS SPT Hammer Efficiency

Windsor, VT

Boring No.: **GD-8**

File No.: 750-05.7
Checked By: SPK

Boring Company: VTRANS
Foreman: Glen Porter and Eric
GeoDesign Rep.: Shawn Kelley
Date Started: September 26, 2008 Date Finished: September 26, 2008
N. Coordinate: E. Coordinate:
Ground Surface Elevation (feet): 335
Station: Offset: ft

	Casing:	Sampler:
Type:	H.S.A.	SS
I.D.:	3.25 in.	1.38 in.
Hammer Wt.:	NA	140 lbs
Hammer Fall:	NA	30 in.
Rig Type:	CME 45C Track	
Hammer/Rod Type:	Auto - NWJ	

Groundwater Observations

Date	Depth (ft)	Elev. (ft)	Notes
9/26/08, 0:00	50.0	285.0	Wet sample.

Depth (ft)	Casing Blows/ft	Number	Type	Penetration (inches)	Recovery (inches)	Depth (ft)	Blows 0 - 6	Blows 6 - 12	Blows 12 - 18	Blows 18 - 24	Coring Time (min./ft)	Moisture Content (%)	Strata Description (Depth & Elevation(feet))	Sample Description (Classification System: Burmister)
0													Silty Fine Sand	
5		S1	SS	24	22	5	2	2	3	2		10.1		S1) Tan fine SAND, little Silt, trace mica, dry. Layers of fine SAND, little Silt.
10		S2	SS	24	17	10	3	4	5	5		4.0	10 / 325.0 Fine to Medium Sand and Gravel	S2) Tan fine to coarse SAND, some fine Gravel, trace Silt. dry.
15		S3	SS	24	19	15	9	10	7	7		3.7		S3) Tan fine to coarse SAND, little fine Gravel, trace Silt, dry.
20		S4	SS	24	21	20	6	9	9	13		4.3		S4) Tan fine to coarse SAND, trace(+) fine Gravel, trace Silt, dry.
25		S5	SS	24	21	25	9	11	11	14		4.5		S5) Tan/brown fine to coarse SAND, trace mica, trace Silt, trace Gravel.
30													30	

Remarks
1) Advanced HSA to top of sampling interval immediately prior to sampling.
2) Auger grinding at 10'.

Notes:
1) Stratification Lines Represent Approximate Boundary Between Material Types, Transitions May Be Gradual.
2) Water Level Readings Have Been Made At Times And Under Conditions Stated, Fluctuations Of Groundwater May Occur Due To Other Factors Than Those Present At The Time Measurements Were Made.
A.C. = After coring; N.R. = Not Recorded.
3) Sample Type Coding: A=Auger; C=Core; D=Driven; G=Grab; PS=Piston Sampler; SS=Split Barrel (Split Spoon); ST=Shelby Tube; Geo=GeoProbe V=Vane; WOR/H=Weight of Rod/Hammer
4) Proportions Used: Trace = 1-10%; Little = 10-20%; Some = 20-35%; And = 35-50%
5) Stratification lines represent approximate boundary between material types, transitions may be gradual.

Boring No.: **GD-8**

BORING LOG

GEODESIGN INCORPORATED

Geotechnical Engineers-Environmental Consultants-Construction Engineers
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Project Name: VTRANS SPT Hammer Efficiency, Windsor, VT

Boring No.: GD-8
Page No.: 2 of 2
File No.: 750-05.7
Checked By: SPK

Boring Company: VTRANS
Foreman: Glen Porter and Eric
GeoDesign Rep.: Shawn Kelley
Date Started: September 26, 2008 | Date Finished: September 26, 2008
N. Coordinate: | E. Coordinate:
Ground Surface Elevation (feet): 335
Station: | Offset: ft

	Casing:	Sampler:
Type:	H.S.A.	SS
I.D.:	3.25 in.	1.38 in.
Hammer Wt.:	NA	140 lbs
Hammer Fall:	NA	30 in.
Rig Type:	CME 45C Track	
Hammer/Rod Type:	Auto - NWJ	

Groundwater Observations

Date	Depth (ft)	Elev. (ft)	Notes
9/26/08, 0:00	50.0	285.0	Wet sample.

Depth (ft)	Casing Blows/ft	Number	Type	Penetration (inches)	Recovery (inches)	Depth (ft)	Blows 0 - 6	Blows 6 - 12	Blows 12 - 18	Blows 18 - 24	Coring Time (min./ft)	Moisture Content (%)	Strata Description, Depth & Elevation (feet)	Sample Description (Classification System: Burmister)
		S6	SS	24	24	30	4	4	5	7		7.4	Sand/Silt 305.0	S6) Tan fine SAND, little Silt, trace mica, wet.
35		S7	SS	24	23	35	4	4	6	6		12.6		S7) Tannish brown fine SAND, some Silt, trace mica, moist.
40		S8	SS	24	23	40	5	3	7	9		26.1		S8) Brown SILT, little fine Sand, trace fine Gravel, trace mica, wet, layered.
45		S9	SS	24	19	45	5	7	9	10		8.2	45 Silty Fine Sand 290.0	S9) Tan fine SAND, some Silt, trace mica, moist.
50		S10	SS	24	22	50	6	7	8	8		23.8		S10) Top 15" - Brown fine SAND, trace Silt, trace mica, wet. Bottom 7" - Fine SAND and SILT, trace mica, layered, wet.
													52 Bottom of Exploration at 52.0 ft 283.0	
55														
60														

Remarks:

Notes:
1) Stratification Lines Represent Approximate Boundary Between Material Types, Transitions May Be Gradual.
2) Water Level Readings Have Been Made At Times And Under Conditions Stated, Fluctuations Of Groundwater May Occur Due To Other Factors Than Those Present At The Time Measurements Were Made.
A.C. = After coring; N.R. = Not Recorded.
3) Sample Type Coding: A=Auger; C=Core; D=Driven; G=Grab; PS=Piston Sampler; SS=Split Barrel (Split Spoon); ST=Shelby Tube; Geo=GeoProbe V=Vane; WOR/H=Weight of Rod/Hammer
4) Proportions Used: Trace = 1-10%; Little = 10-20%; Some = 20-35%; And = 35-50%
5) Stratification lines represent approximate boundary between material types, transitions may be gradual.

Boring No.: GD-8

BORING LOG

GEODESIGN INCORPORATED

Geotechnical Engineers-Environmental Consultants-Construction Engineers

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1233 Shelburne Rd., Suite 360, So. Burlington, VT 05403, Phone: 802-652-5140

Project Name: VTRANS SPT Hammer Efficiency, Windsor, VT

Boring No.: **GD-9**
Page No.: 1 of 2
File No.: 750-05.7
Checked By: SPK

Boring Company: Specialty Drilling & Investigation
Foreman: Chris Aldrich and Matthew Miller
GeoDesign Rep.: Shawn Kelley
Date Started: September 29, 2008 Date Finished: September 29, 2008
N. Coordinate: E. Coordinate:
Ground Surface Elevation (feet): 335
Station: Offset: ft

	Casing:	Sampler:
Type:	H.S.A.	SS
I.D.:	4.25 in.	1.38 in.
Hammer Wt.:	NA	140 lbs
Hammer Fall:	NA	30 in.
Rig Type:	Simco 2800 Truck	
Hammer/Rod Type:	Wireline - AWJ	

Groundwater Observations

Date	Depth (ft)	Elev. (ft)	Notes
9/29/08, 0:00	50.0	285.0	Wet sample.

Sample Information

Depth (ft)	Casing Blows/ft	Number	Type	Penetration (inches)	Recovery (inches)	Depth (ft)	0 - 6	6 - 12	12 - 18	18 - 24	Coring Time (min./ft)	Moisture Content (%)	Strata Description (Depth & Elevation(feet))	Sample Description (Classification System: Burmister)
		S1	SS	24	16	0	3	6	6	7			Topsoil; Silty Fine Sand 334.5	S1) Top 6" - Topsoil. Bottom 10" - Tan/orange fine SAND, little Silt, moist.
		S2	SS	24	18	2	3	4	7	7				S2) Tan/brown fine SAND, trace(+) Silt, trace mica, moist.
5														
		S3	SS	24	20	5	3	5	4	4				S3) Tan fine SAND, trace Silt, trace fine Gravel, trace mica, moist.
10														
		S4	SS	24	15	10	5	4	5	6				S4) Tan fine Sand, trace Silt, trace fine Gravel, trace mica, moist.
15													15	
		S5	SS	24	19	15	9	13	16	18			Fine to Medium Sand and Gravel 320.0	S5) Tannish brown fine to medium SAND, trace fine Gravel, trace Silt, trace mica, moist.
20														
		S6	SS	24	18	20	7	14	17	18				S6) Tan fine to medium SAND, trace fine Gravel, trace mica, trace Silt, moist.
25														
		S7	SS	24	14	25	18	27	25	15				S7) Tan fine to coarse SAND, trace fine Gravel, trace Silt, trace mica.
30													30	

Remarks:
1) Sampled twice from ground surface 0' to 4'.
2) From 5' to bottom of borehole, advanced HSA to top of sampling interval immediately prior to sampling.

Notes:
1) Stratification Lines Represent Approximate Boundary Between Material Types, Transitions May Be Gradual.
2) Water Level Readings Have Been Made At Times And Under Conditions Stated, Fluctuations Of Groundwater May Occur Due To Other Factors Than Those Present At The Time Measurements Were Made. A.C. = After coring; N.R. = Not Recorded.
3) Sample Type Coding: A=Auger; C=Core; D=Driven; G=Grab; PS=Piston Sampler; SS=Split Barrel (Split Spoon); ST=Shelby Tube; Geo=GeoProbe V=Vane; WOR/H=Weight of Rod/Hammer
4) Proportions Used: Trace = 1-10%; Little = 10-20%; Some = 20-35%; And = 35-50%
5) Stratification lines represent approximate boundary between material types, transitions may be gradual.

BORING LOG

GEODESIGN INCORPORATED
Geotechnical Engineers-Environmental Consultants-Construction Engineers
P.O. Box 699, Windsor, VT 05089
1233 Shelburne Rd., Suite 360, So. Burlington, VT 05403
Phone: 802-674-2033/Fax: 802-674-5943
Phone: 802-652-5140

Project Name: VTRANS SPT Hammer Efficiency, Windsor, VT

Boring No.: GD-9

File No.: 750-05.7
Checked By: SPK

Boring Company: Specialty Drilling & Investigation
Foreman: Chris Aldrich and Matthew Miller
GeoDesign Rep.: Shawn Kelley
Date Started: September 29, 2008 — Date Finished: September 29, 2008
N. Coordinate: — E. Coordinate:
Ground Surface Elevation (feet): 335
Station: — Offset: ft

	Casing:	Sampler:
Type:	H.S.A.	SS
I.D.:	4.25 in.	1.38 in.
Hammer Wt.:	NA	140 lbs
Hammer Fall:	NA	30 in.
Rig Type:	Simco 2800 Truck	
Hammer/Rod Type:	Wireline - AWJ	

Groundwater Observations

Date	Depth (ft)	Elev. (ft)	Notes
9/29/08, 0:00	50.0	285.0	Wet sample.

Sample Information

Depth (ft)	Casing Blows/ft	Number	Type	Penetration (inches)	Recovery (inches)	Depth (ft)	Blows 0 - 6	Blows 6 - 12	Blows 12 - 18	Blows 18 - 24	Coring Time (min./ft)	Moisture Content (%)	Strata Description / Depth & Elevation (feet)	Sample Description (Classification System: Burmister)
		S8	SS	24	23	30	4	6	8	10			Sand/Silt 305.0	S8) Tan fine SAND, trace Silt, trace mica, moist.
35		S9	SS	24	20	35	5	9	13	12				S9) Grayish brown fine SAND, little(-) Silt, trace mica.
40		S10	SS	24	20	40	9	12	15	15				S10) Grayish tan fine SAND, trace Silt, trace mica, layered, moist.
45		S11	SS	24	21	45	11	16	16	12				S11) Tannish gray fine SAND, trace Silt, trace mica, moist. 2" seam of brown fine SAND, little(+) Silt.
50		S12	SS	24	22	50	10	10	16	17			52 — Bottom of Exploration at 52.0 ft, 283.0	S12) Brown/dark gray fine SAND and SILT, trace mica, layered. Bottom 6" - Fine SAND, trace Silt, trace mica, wet.
55														
60														

Remarks:

Notes:
1) Stratification Lines Represent Approximate Boundary Between Material Types, Transitions May Be Gradual.
2) Water Level Readings Have Been Made At Times And Under Conditions Stated, Fluctuations Of Groundwater May Occur Due To Other Factors Than Those Present At The Time Measurements Were Made.
A.C. = After coring; N.R. = Not Recorded.
3) Sample Type Coding: A=Auger; C=Core; D=Driven; G=Grab; PS=Piston Sampler; SS=Split Barrel (Split Spoon); ST=Shelby Tube; Geo=GeoProbe V=Vane; WOR/H=Weight of Rod/Hammer
4) Proportions Used: Trace = 1-10%; Little = 10-20%; Some = 20-35%; And = 35-50%
5) Stratification lines represent approximate boundary between material types, transitions may be gradual.

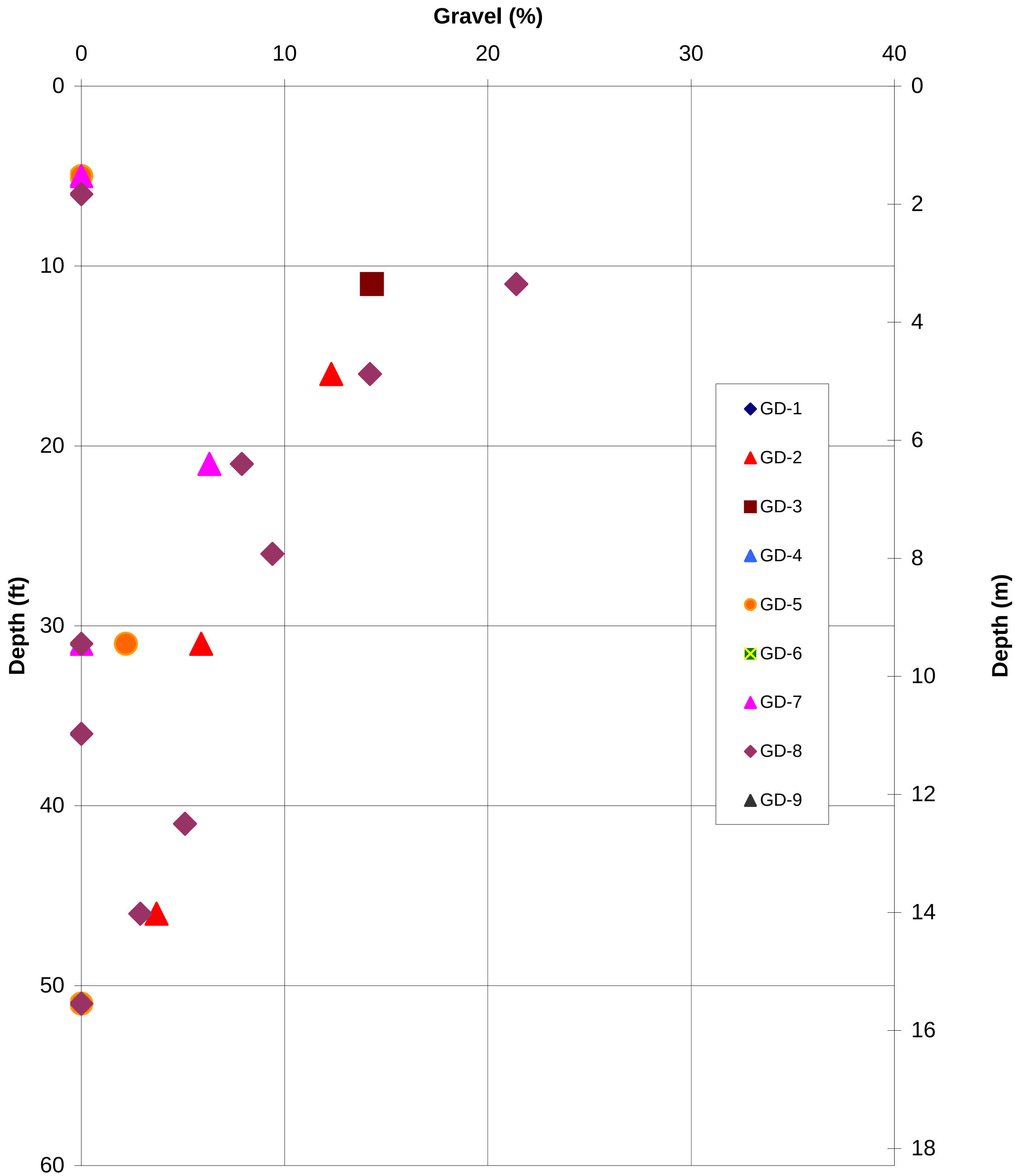
Boring No.: GD-9

APPENDIX 4 – GRAIN-SIZE ANALYSES (BY BORING)

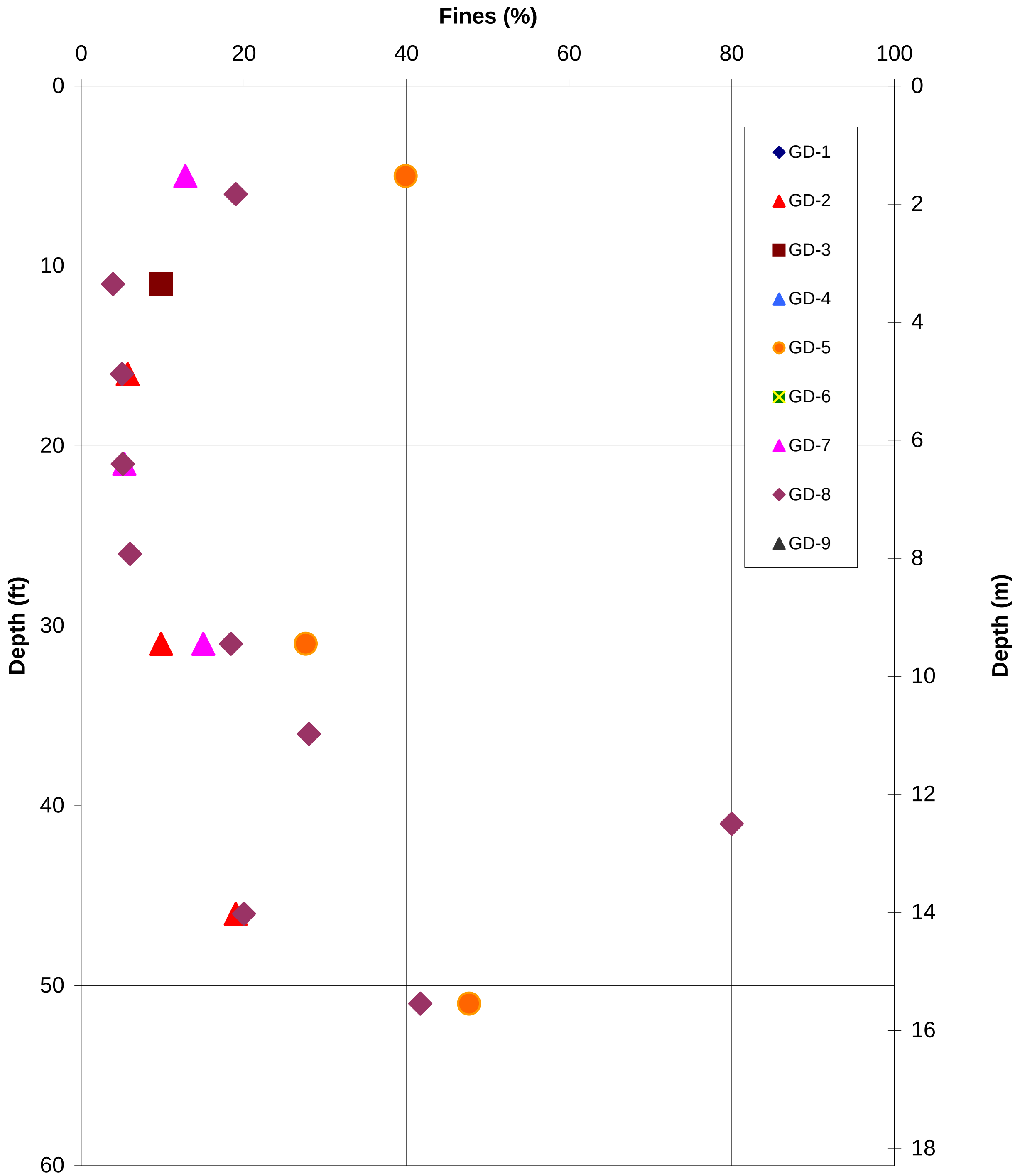
GeoDesign, Inc.
Windsor, VT
Job No. 750-5.7

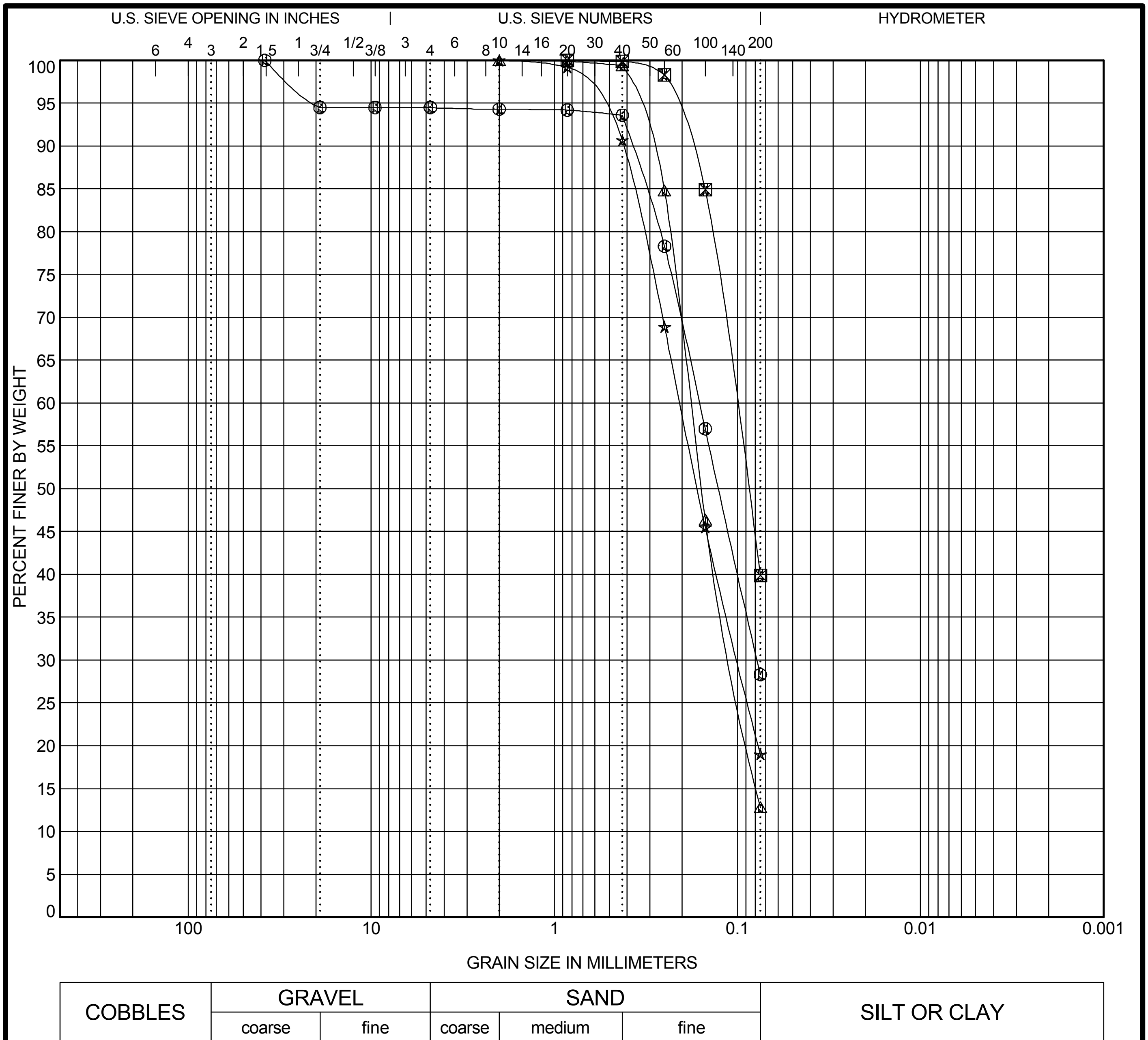
Vtrans # RSCH012-703

SPT Hammer Energy Variability Evaluation
Windsor, VT



SPT Hammer Energy Variability Evaluation
Windsor, VT





	Borehole No.	Sample No.	Depth (ft)	Water Content	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay	Fines based on % passing No. 4 sieve.
⊕	B-1B	S2	5.0	18.3	38.1	0.161	0.078		5.5	66.2	28.3		29.9
⊠	GD-5	S3	4.0		0.85	0.102			0.0	60.1	39.9		
△	GD-7	S3	4.0		2	0.18	0.107		0.0	87.2	12.8		
☆	GD-8	S1	5.0	10.1	2	0.206	0.1		0.0	81.0	19.0		

Note: Upper Silty Fine Sand Strata

SIEVE FORM 750-05.7.GPJ US LAB.GDT 5/29/09

GEODESIGN INCORPORATED

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Windsor, VT 05089
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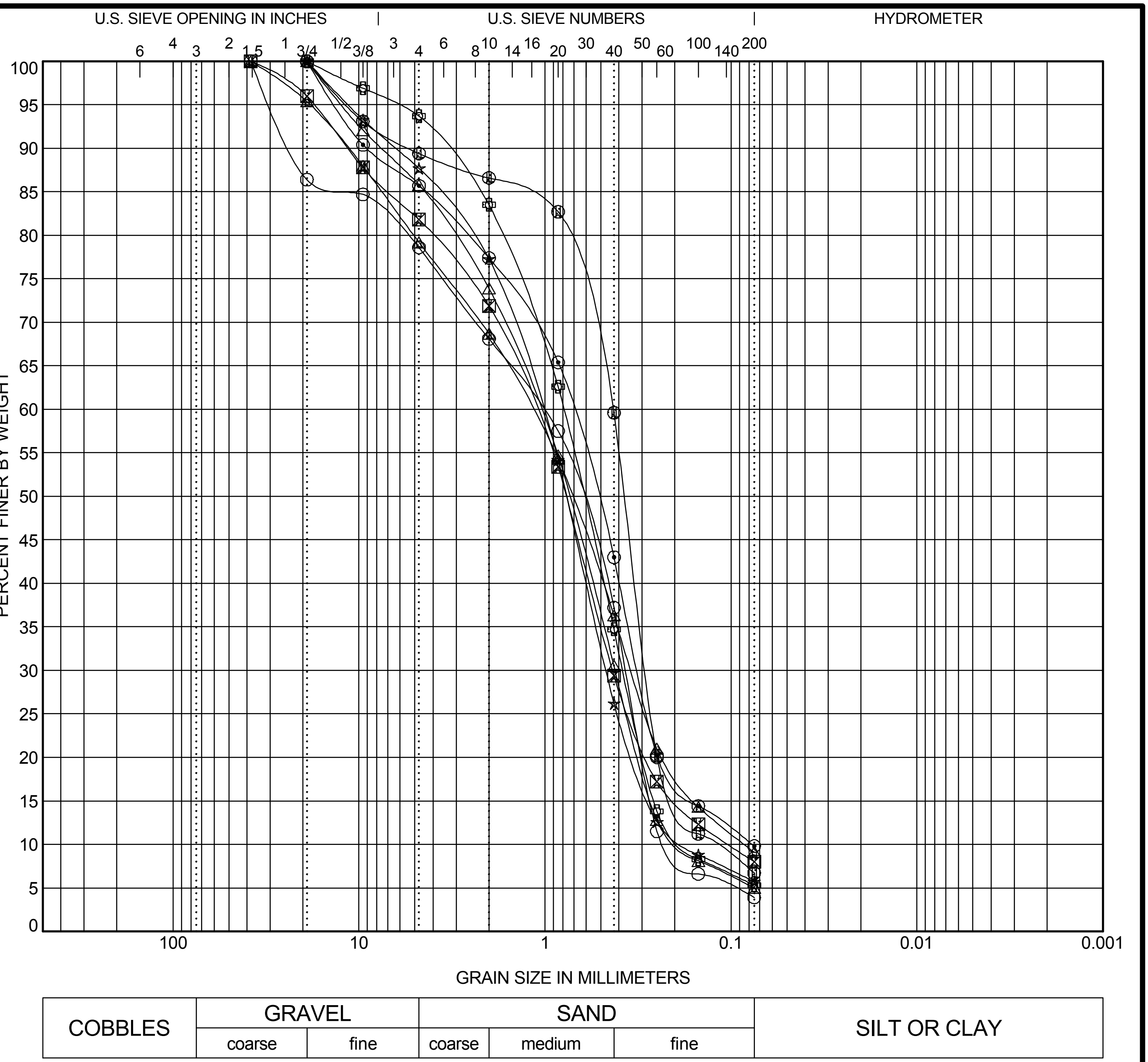
Fax: (802) 674-5943

GRAIN SIZE DISTRIBUTION

Project: VTRANS SPT Hammer Efficiency
Location: Windsor, VT
Number: 750-05.7
Tested By: VTRANS Reviewed By:VTRANS
Date:2009 Method: ASTM D6913 (Method A)



Borehole No.	Sample No.	Depth (ft)	Water Content	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay	Fines based on % passing No. 4 sieve.
B-1B	S3	10.0	18	19.05	0.43	0.286	0.125	10.6	82.7	6.7		7.5
B-1B	S4	15.0	10.8	38.1	1.153	0.432	0.104	18.2	73.8	8.0		9.8
B-1B	S5	20.0	11.6	38.1	1.193	0.342	0.085	20.8	70.1	9.1		11.5
GD-2	S6	15.0		19	1.054	0.467	0.176	12.3	82.0	5.7		6.5
GD-3	S2	10.0		19	0.719	0.314	0.077	14.3	75.9	9.8		11.4
GD-7	S8	20.0		19	0.797	0.377	0.176	6.3	88.4	5.3		5.7
GD-8	S2	10.0	4.0	38.1	1.04	0.366	0.214	21.4	74.7	3.9		5.0
GD-8	S3	15.0	3.7	19.05	1.076	0.419	0.184	14.2	80.8	5.0		5.8

Note: Sand & Gravel Strata

GEODESIGN INCORPORATED

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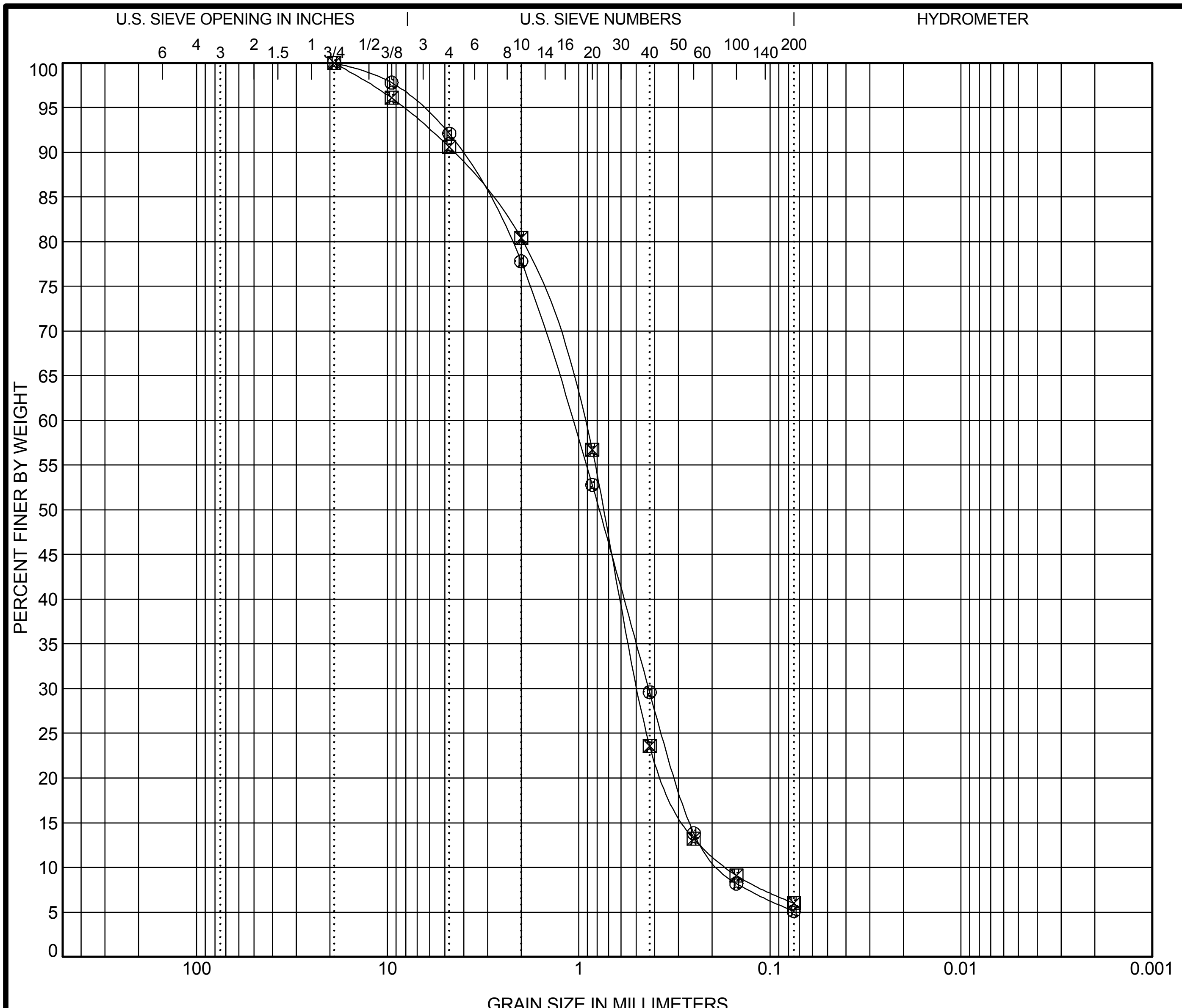
Fax: (802) 674-5943

GRAIN SIZE DISTRIBUTION

Project: VTRANS SPT Hammer Efficiency
Location: Windsor, VT
Number: 750-05.7
Tested By: VTRANS Reviewed By:VTRANS
Date:2009 Method: ASTM D6913 (Method A)



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	Borehole No.	Sample No.	Depth (ft)	Water Content	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay	Fines based on % passing No. 4 sieve.
⊕	**GD-8**	**S4**	**20.0**	**4.3**	**19.05**	**1.088**	**0.43**	**0.177**	**7.9**	**87.0**	**5.1**		**5.5**
⊠	**GD-8**	**S5**	**25.0**	**4.5**	**19.05**	**0.958**	**0.486**	**0.168**	**9.4**	**84.6**	**6.0**		**6.6**

Note: Sand & Gravel Strata

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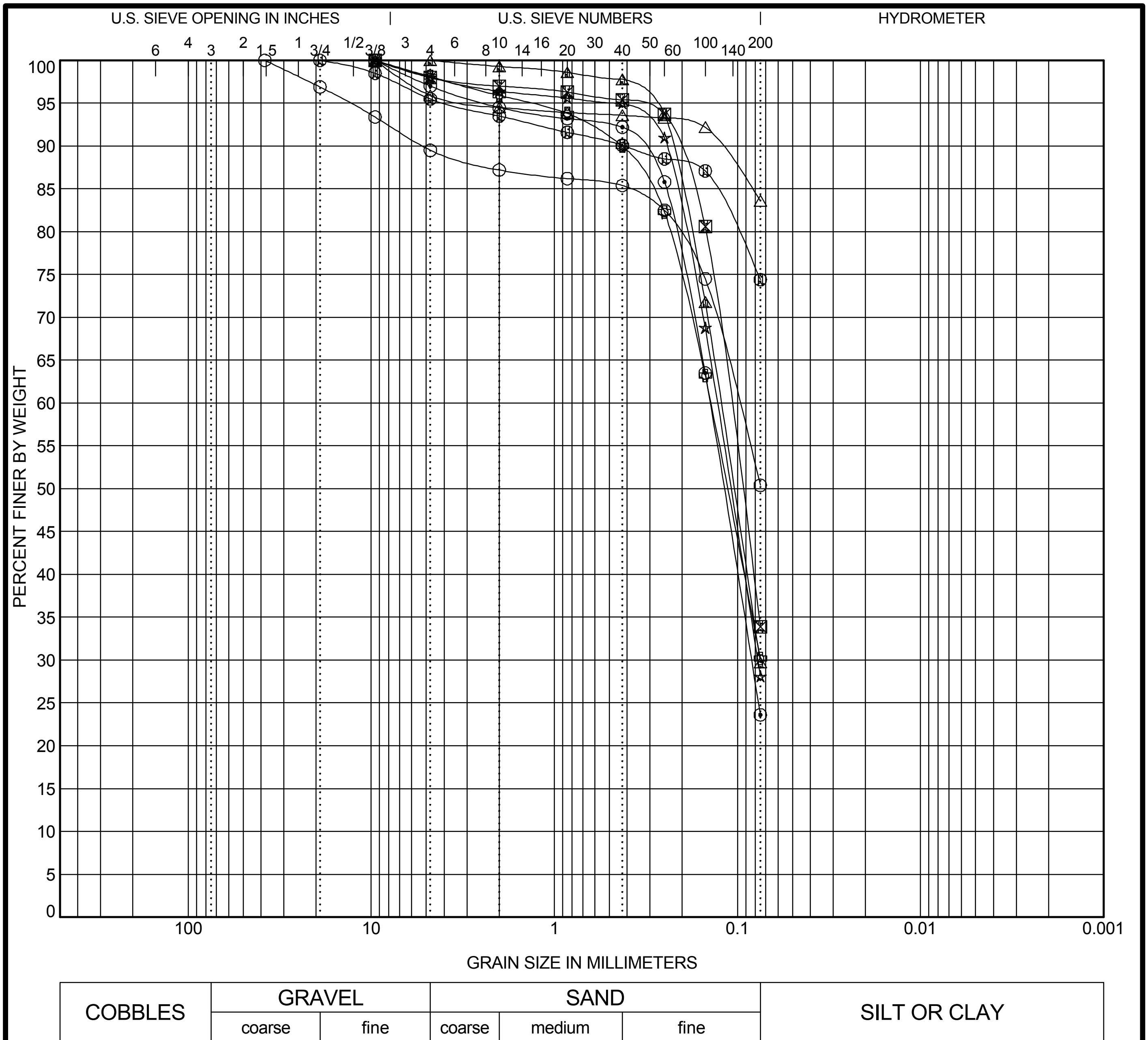
Fax: (802) 674-5943

GRAIN SIZE DISTRIBUTION

Project: VTRANS SPT Hammer Efficiency
Location: Windsor, VT
Number: 750-05.7
Tested By: VTRANS Reviewed By:VTRANS
Date:2009 Method: ASTM D6913 (Method A)



	Borehole No.	Sample No.	Depth (ft)	Water Content	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay	Fines based on % passing No. 4 sieve.
⊕	**B-1B**	**S6**	**25.0**	**26.1**	**19.05**				**4.5**	**21.1**	**74.4**		**77.9**
⊠	**B-1B**	**S7**	**27.0**	**17.3**	**9.525**	**0.11**			**2.0**	**64.1**	**33.9**		**34.6**
⚠	**B-1B**	**S8**	**29.0**	**15.3**	**4.75**	**0.124**	**0.075**		**0.0**	**70.3**	**29.7**		**29.7**
☆	**B-1B**	**S9**	**31.0**	**19.3**	**9.525**	**0.129**	**0.077**		**2.0**	**69.9**	**28.1**		**28.7**
⊙	**B-1B**	**S10**	**33.0**	**16**	**9.525**	**0.141**	**0.084**		**3.0**	**73.4**	**23.6**		**24.3**
⊕	**B-1B**	**S11**	**35.0**	**14.5**	**9.525**	**0.14**			**1.9**	**67.9**	**30.2**		**30.8**
○	**B-1B**	**S12**	**37.0**	**19.9**	**38.1**	**0.099**			**10.5**	**39.1**	**50.4**		**56.3**
△	**B-1B**	**S13**	**39.0**	**27.6**	**9.525**				**4.1**	**12.3**	**83.6**		**87.2**

Note: Sand/Silt Strata

SIEVE FORM 750-05.7.GPJ US LAB.GDT 5/29/09

GEODESIGN INCORPORATED

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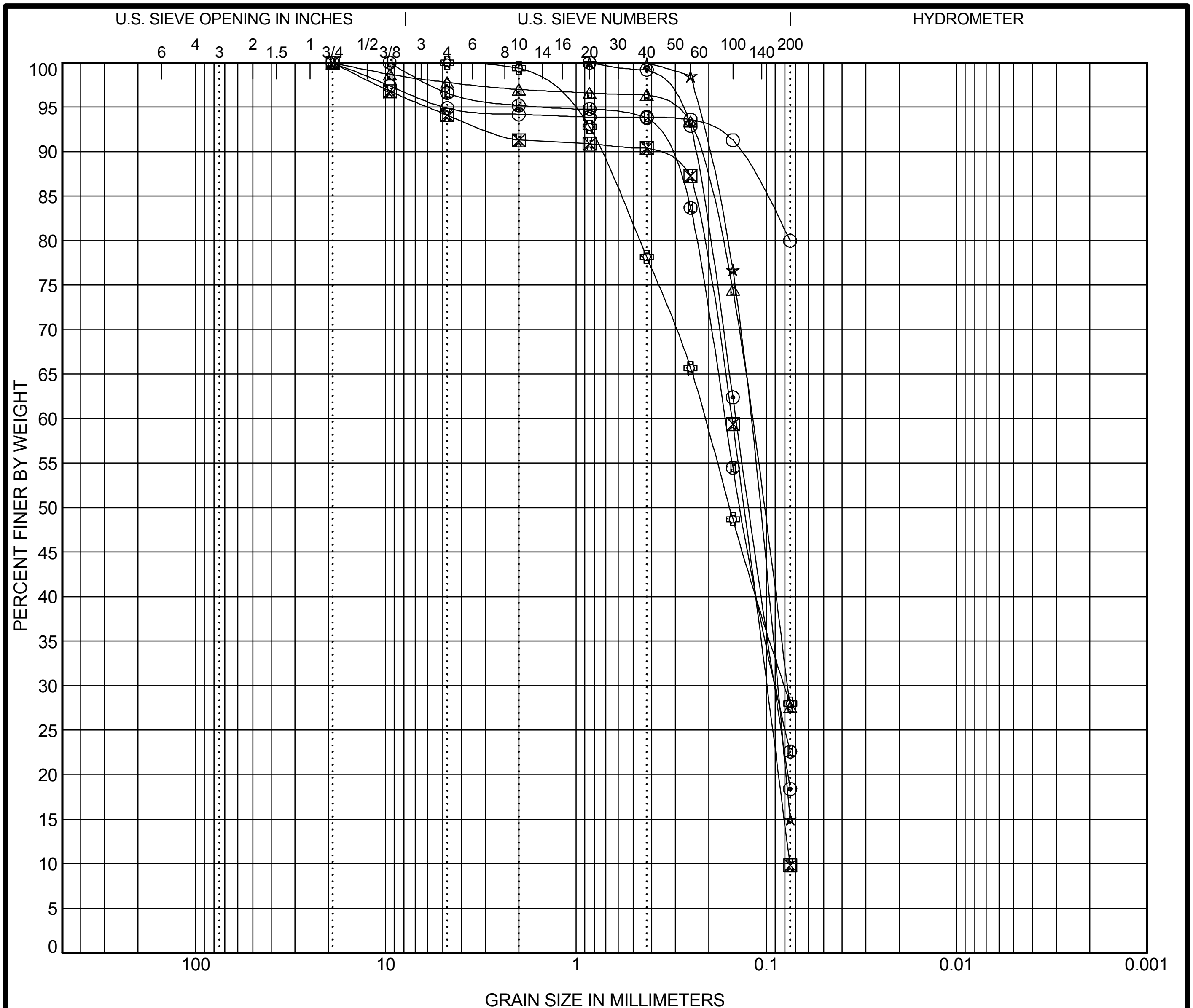
GRAIN SIZE DISTRIBUTION

Project: VTRANS SPT Hammer Efficiency
Location: Windsor, VT
Number: 750-05.7
Tested By: VTRANS Reviewed By:VTRANS
Date:2009 Method: ASTM D6913 (Method A)



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	Borehole No.	Sample No.	Depth (ft)	Water Content	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay	Fines based on % passing No. 4 sieve.
⊕	**B-1B**	**S14**	**41.0**	**21.7**	**9.525**	**0.165**	**0.088**		**3.4**	**74.0**	**22.6**		**23.4**
⊠	**GD-2**	**S9**	**30.0**		**19**	**0.152**	**0.099**	**0.075**	**5.9**	**84.3**	**9.8**		**10.4**
⚠	**GD-5**	**S9**	**30.0**		**19**	**0.121**	**0.078**		**2.2**	**70.2**	**27.6**		**28.2**
☆	**GD-7**	**S10**	**30.0**		**0.85**	**0.124**	**0.089**		**0.0**	**85.0**	**15.0**		
⊙	**GD-8**	**S6**	**30.0**	**7.4**	**0.85**	**0.144**	**0.09**		**0.0**	**81.6**	**18.4**		
⊕	**GD-8**	**S7**	**35.0**	**12.6**	**4.75**	**0.211**	**0.08**		**0.0**	**72.0**	**28.0**		**28.0**
○	**GD-8**	**S8**	**40.0**	**26.1**	**19.05**				**5.1**	**14.9**	**80.0**		**84.3**

Note: Sand/Silt Strata

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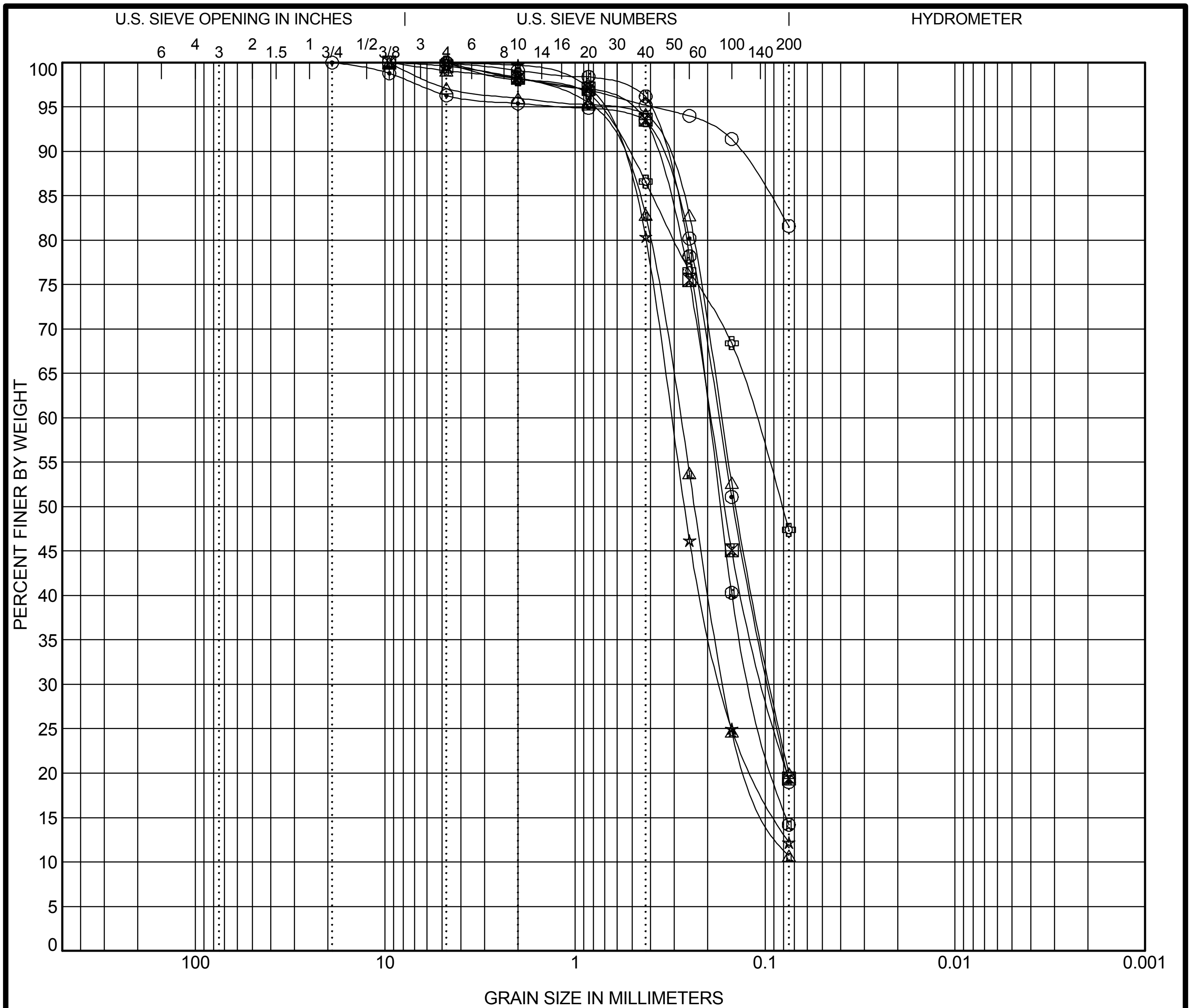
SIEVE FORM 750-05.7.GPJ US LAB.GDT 5/29/09



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	Borehole No.	Sample No.	Depth (ft)	Water Content	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay	Fines based on % passing No. 4 sieve.
⊕	**B-1B**	**S15**	**43.0**	**18.5**	**9.525**	**0.196**	**0.114**		**0.1**	**85.7**	**14.2**		**14.2**
⊠	**B-1B**	**S16**	**45.0**	**18.4**	**9.525**	**0.193**	**0.1**		**0.4**	**80.2**	**19.4**		**19.5**
⚠	**B-1B**	**S17**	**47.0**	**20.4**	**9.525**	**0.28**	**0.165**		**0.9**	**88.4**	**10.7**		**10.8**
☆	**B-1B**	**S18**	**49.0**	**19.1**	**4.75**	**0.31**	**0.169**		**0.0**	**87.8**	**12.2**		**12.2**
⊙	**GD-2**	**S12**	**45.0**		**19**	**0.175**	**0.095**		**3.7**	**77.3**	**19.0**		**19.7**
⊕	**GD-5**	**S13**	**50.0**		**4.75**	**0.114**			**0.0**	**52.6**	**47.4**		**47.4**
○	**GD-5**		**51.2**		**4.75**				**0.0**	**18.4**	**81.6**		**81.6**
△	**GD-8**	**S9**	**45.0**	**8.2**	**9.525**	**0.17**	**0.093**		**2.9**	**77.1**	**20.0**		**20.6**

Note: Lower Silty Fine Sand Strata

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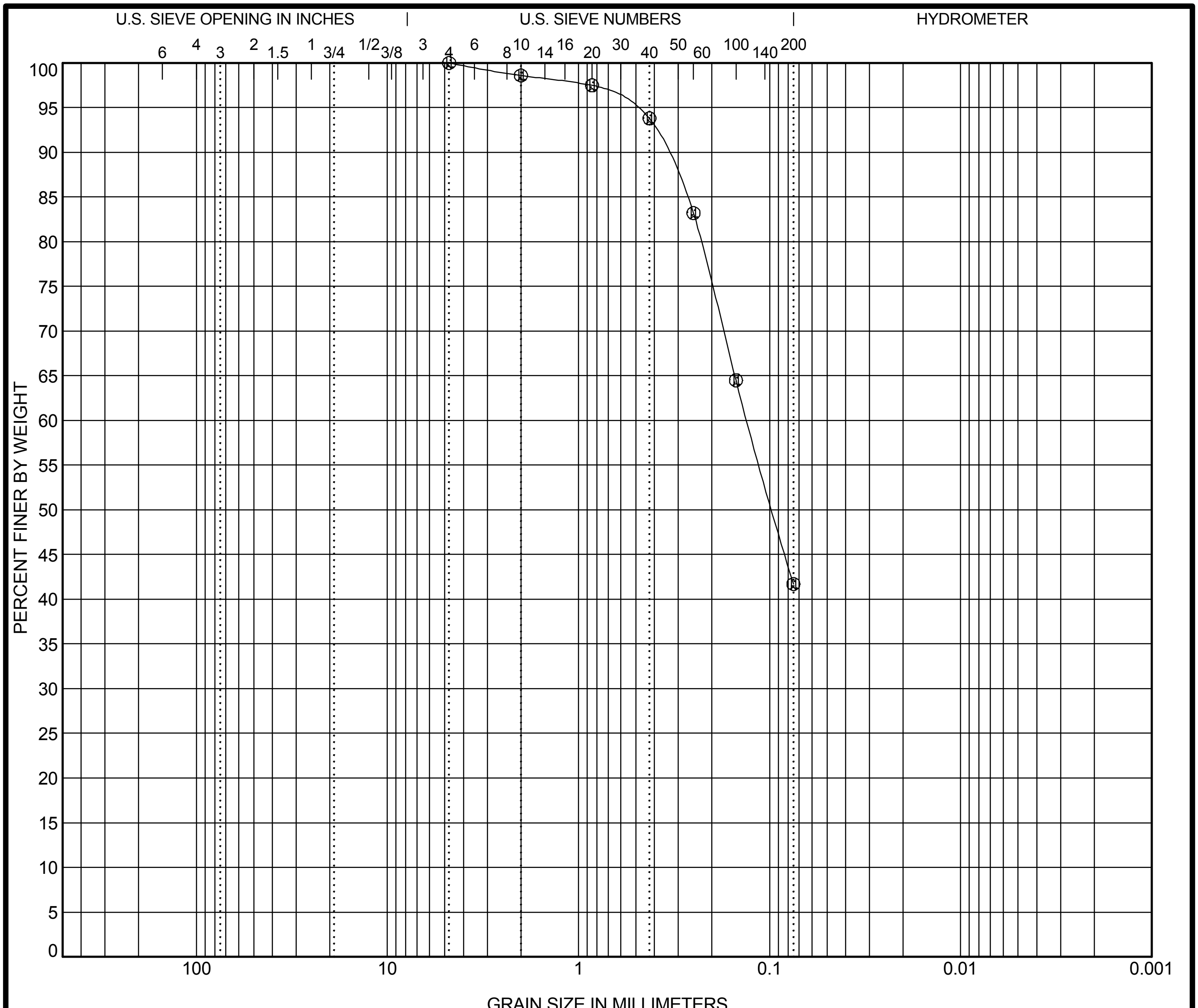

COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	Borehole No.	Sample No.	Depth (ft)	Water Content	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay	Fines based on % passing No. 4 sieve.
⊕	**GD-8**	**S10**	**50.0**	**23.8**	**4.75**	**0.131**			**0.0**	**58.3**	**41.7**		**41.7**

Note: Lower Silty Fine Sand Strata

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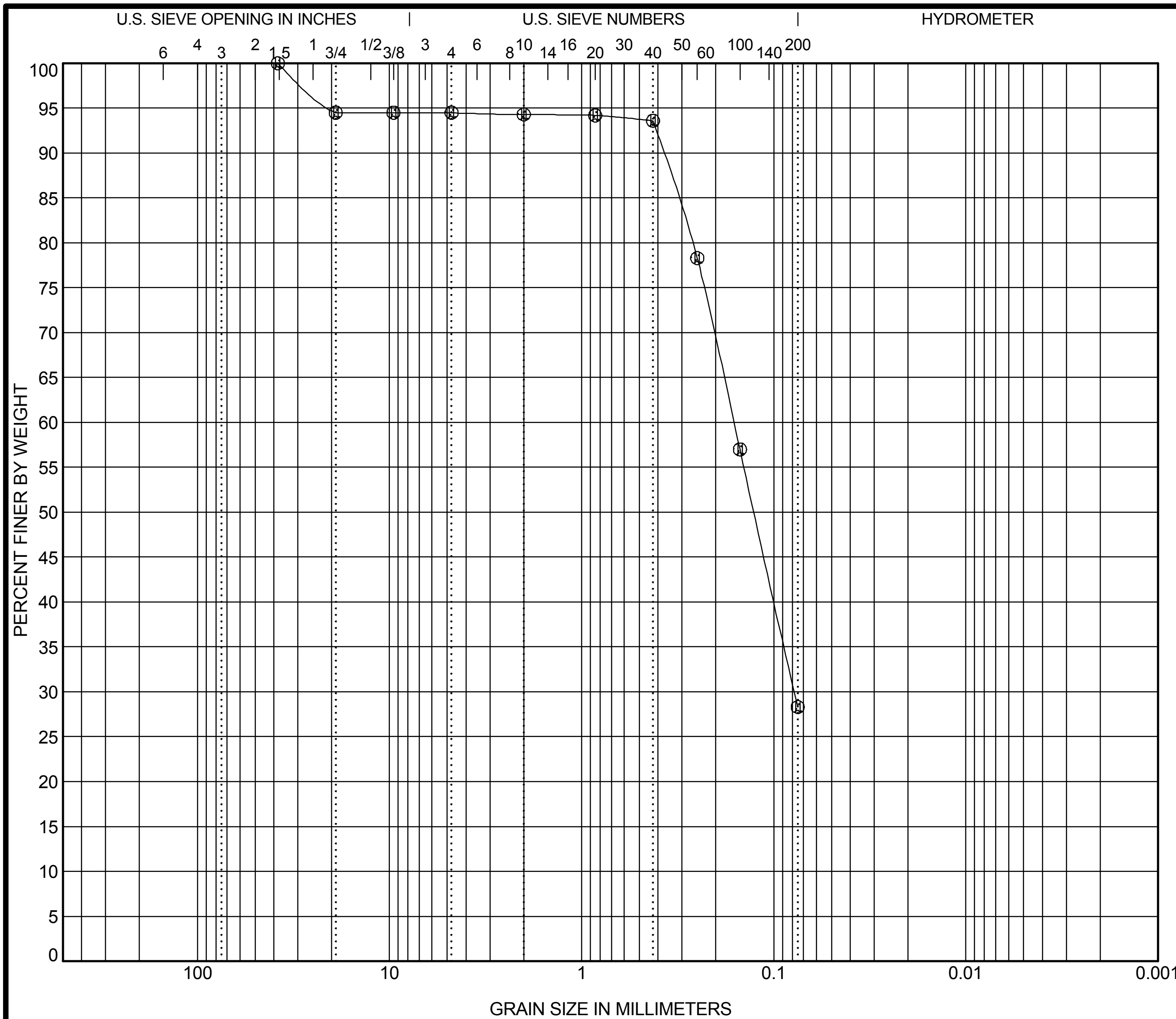

COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	Borehole No.	Sample No.	Depth (ft)	Water Content	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay	Fines based on % passing No. 4 sieve.
⊕	**B-1B**	**S2**	**5.0**	**18.3**	**38.1**	**0.161**	**0.078**		**5.5**	**66.2**	**28.3**		**29.9**

Note: Upper Silty Fine Sand Strata

SIEVE FORM 750-05.7.GPJ US LAB.GDT 5/29/09

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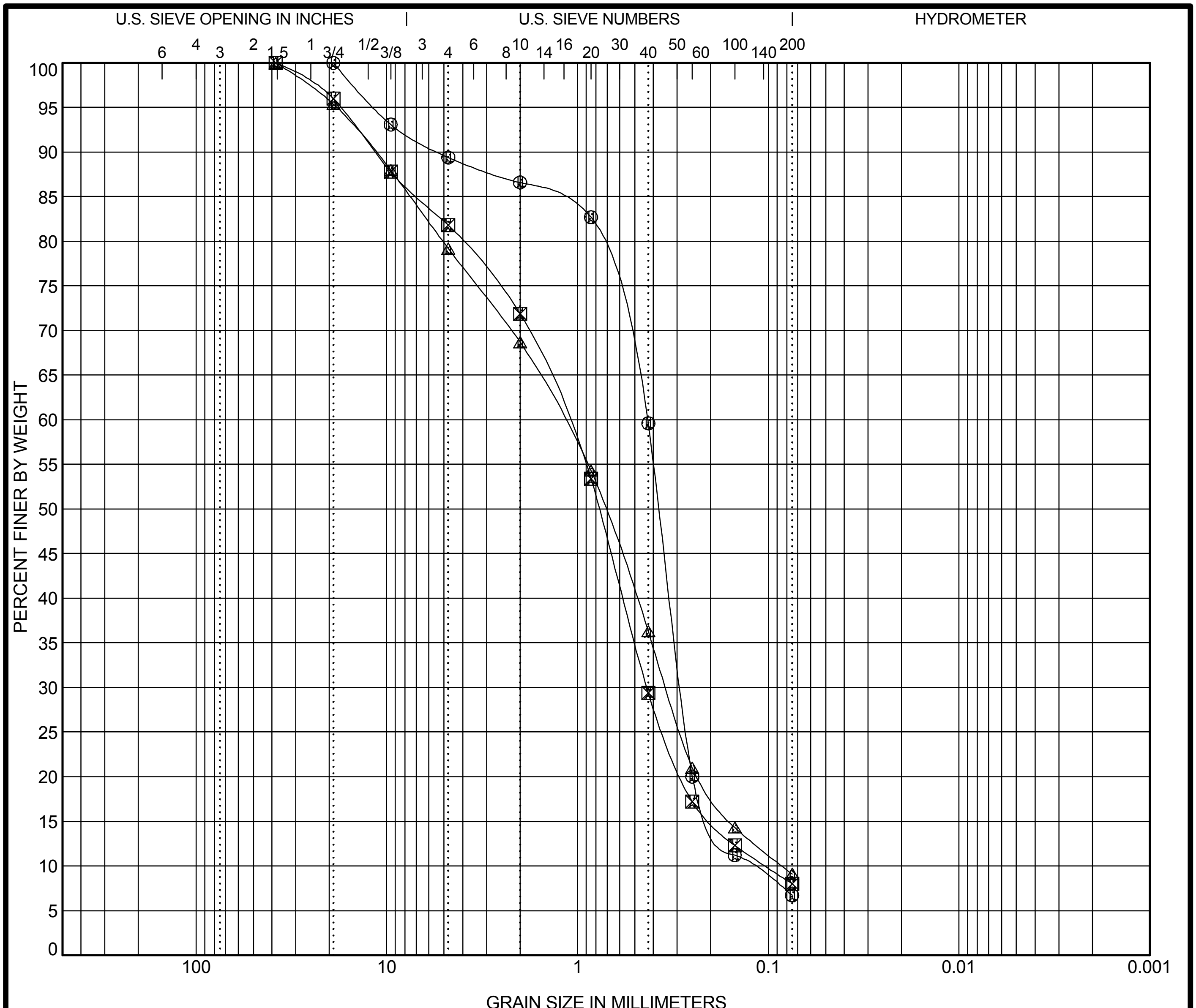

COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	Borehole No.	Sample No.	Depth (ft)	Water Content	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay	Fines based on % passing No. 4 sieve.
⦶	**B-1B**	**S3**	**10.0**	**18**	**19.05**	**0.43**	**0.286**	**0.125**	**10.6**	**82.7**	**6.7**		**7.5**
⊠	**B-1B**	**S4**	**15.0**	**10.8**	**38.1**	**1.153**	**0.432**	**0.104**	**18.2**	**73.8**	**8.0**		**9.8**
⚠	**B-1B**	**S5**	**20.0**	**11.6**	**38.1**	**1.193**	**0.342**	**0.085**	**20.8**	**70.1**	**9.1**		**11.5**

Note: Sand & Gravel Strata

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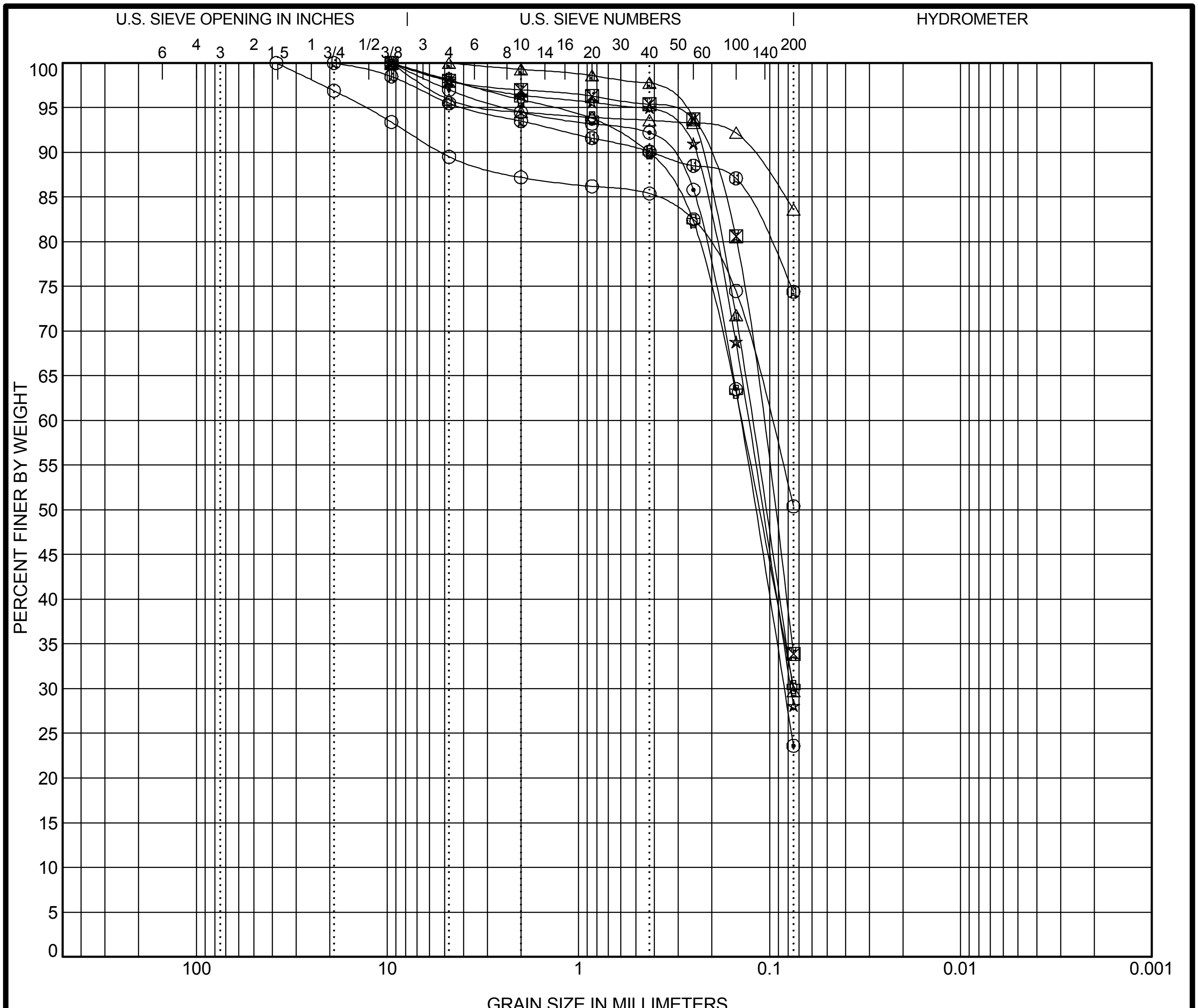
Date:2009 Method: ASTM D6913 (Method A)



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

Borehole No.	Sample No.	Depth (ft)	Water Content	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay	Fines based on % passing No. 4 sieve.
B-1B	S6	25.0	26.1	19.05				4.5	21.1	74.4		77.9
B-1B	S7	27.0	17.3	9.525	0.11			2.0	64.1	33.9		34.6
B-1B	S8	29.0	15.3	4.75	0.124	0.075		0.0	70.3	29.7		29.7
B-1B	S9	31.0	19.3	9.525	0.129	0.077		2.0	69.9	28.1		28.7
B-1B	S10	33.0	16	9.525	0.141	0.084		3.0	73.4	23.6		24.3
B-1B	S11	35.0	14.5	9.525	0.14			1.9	67.9	30.2		30.8
B-1B	S12	37.0	19.9	38.1	0.099			10.5	39.1	50.4		56.3
B-1B	S13	39.0	27.6	9.525				4.1	12.3	83.6		87.2

Note: Sand/Silt Strata

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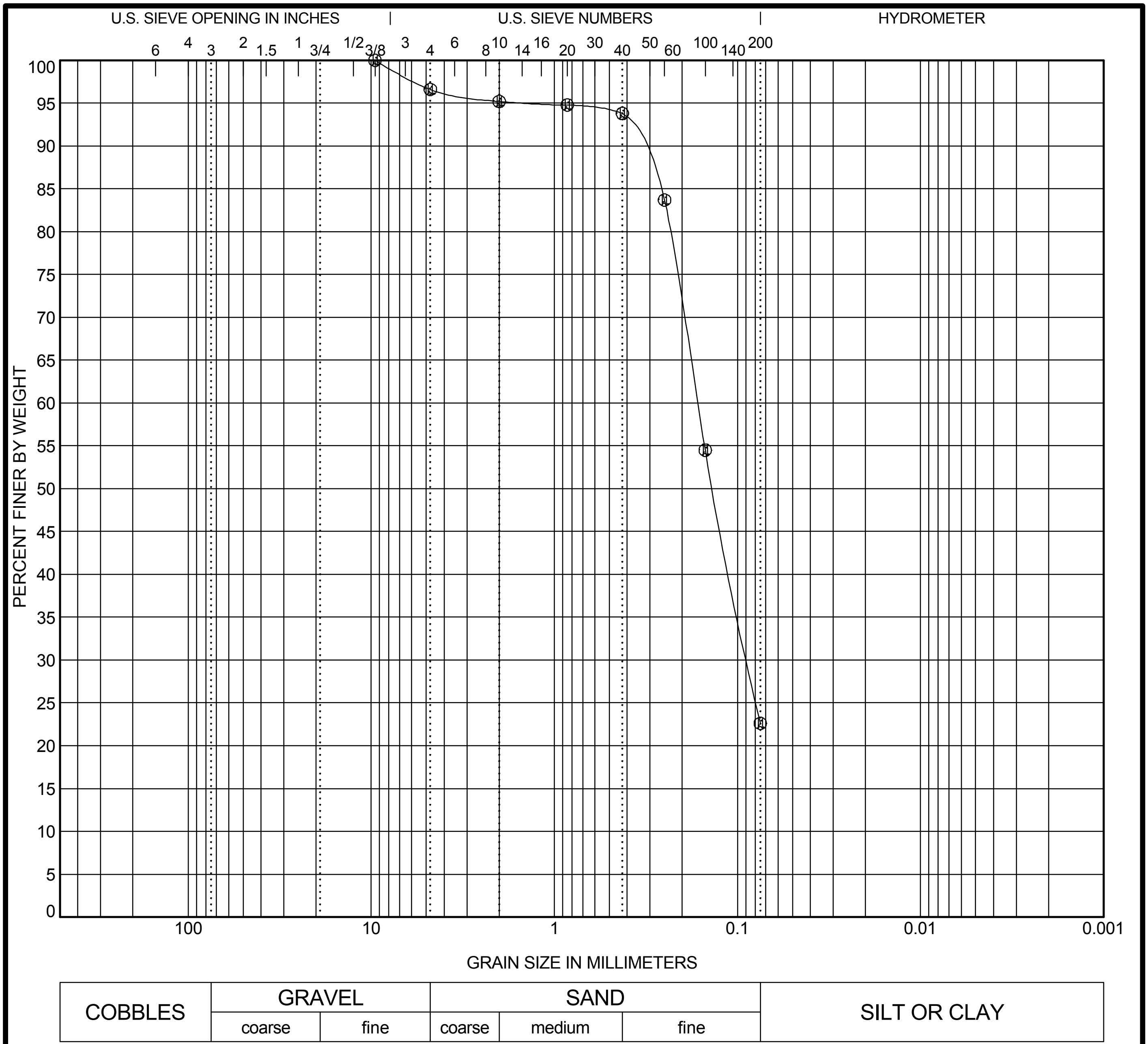

Borehole No.	Sample No.	Depth (ft)	Water Content	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay	Fines based on % passing No. 4 sieve.
B-1B	S14	41.0	21.7	9.525	0.165	0.088		3.4	74.0	22.6		23.4

Note: Sand/Silt Strata

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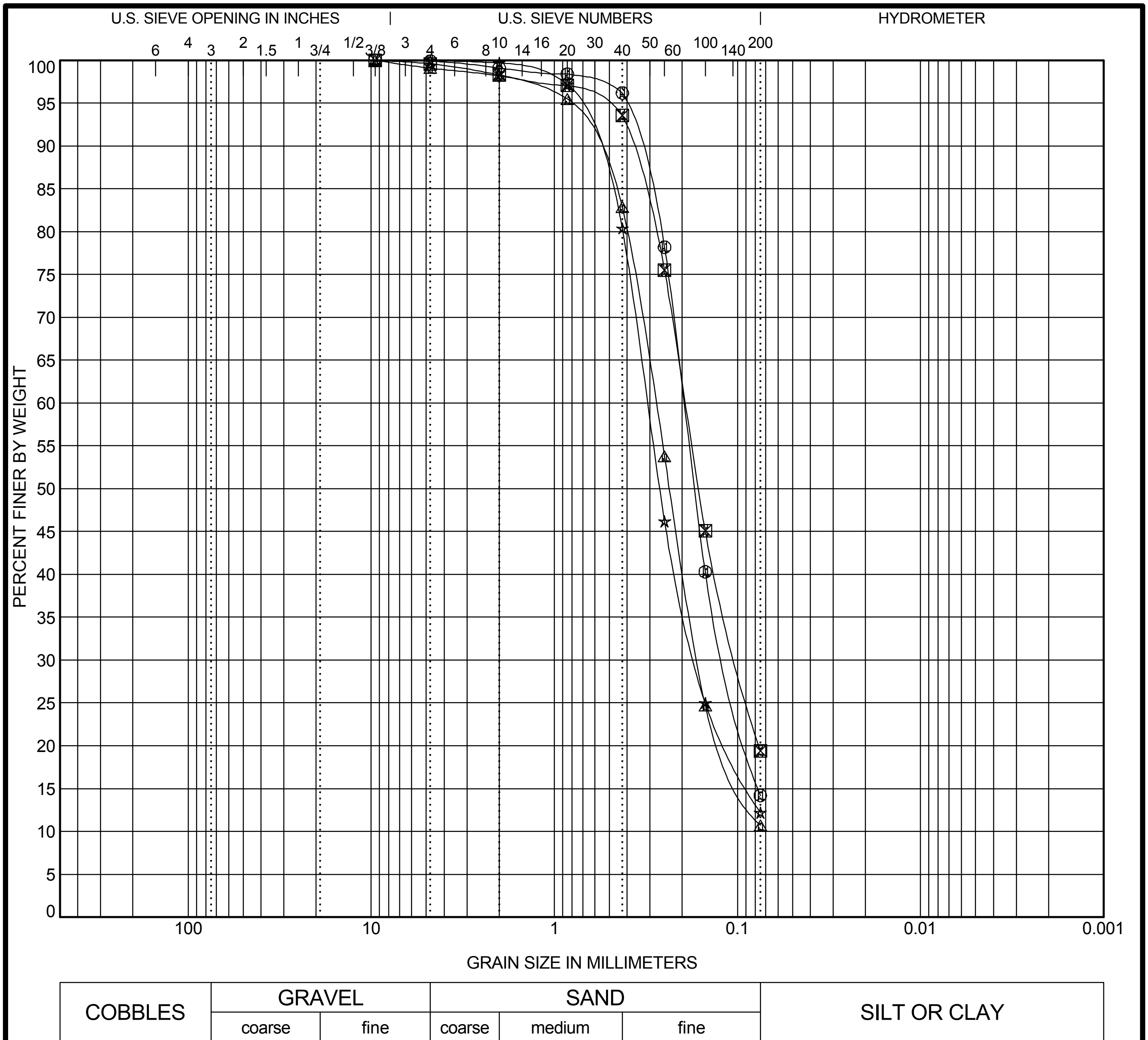

	Borehole No.	Sample No.	Depth (ft)	Water Content	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay	Fines based on % passing No. 4 sieve.
⊕	B-1B	S15	43.0	18.5	9.525	0.196	0.114		0.1	85.7	14.2		14.2
⊠	B-1B	S16	45.0	18.4	9.525	0.193	0.1		0.4	80.2	19.4		19.5
△	B-1B	S17	47.0	20.4	9.525	0.28	0.165		0.9	88.4	10.7		10.8
☆	B-1B	S18	49.0	19.1	4.75	0.31	0.169		0.0	87.8	12.2		12.2

Note: Lower Silty Fine Sand Strata

GRAIN SIZE DISTRIBUTION

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Number: 750-05.7
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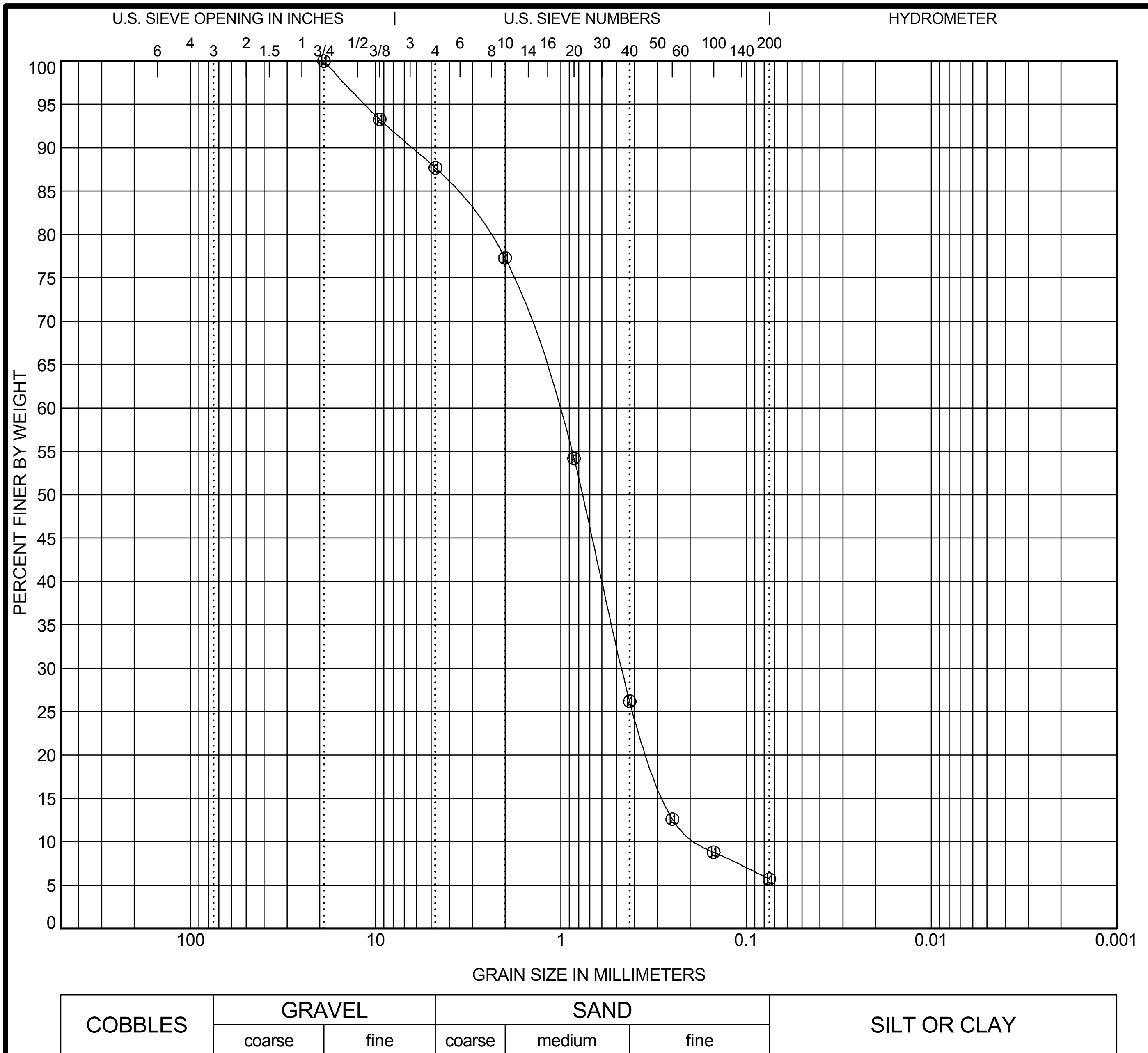

Borehole No.	Sample No.	Depth (ft)	Water Content	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay	Fines based on % passing No. 4 sieve.
GD-2	S6	15.0		19	1.054	0.467	0.176	12.3	82.0	5.7		6.5

Note: Sand & Gravel Strata

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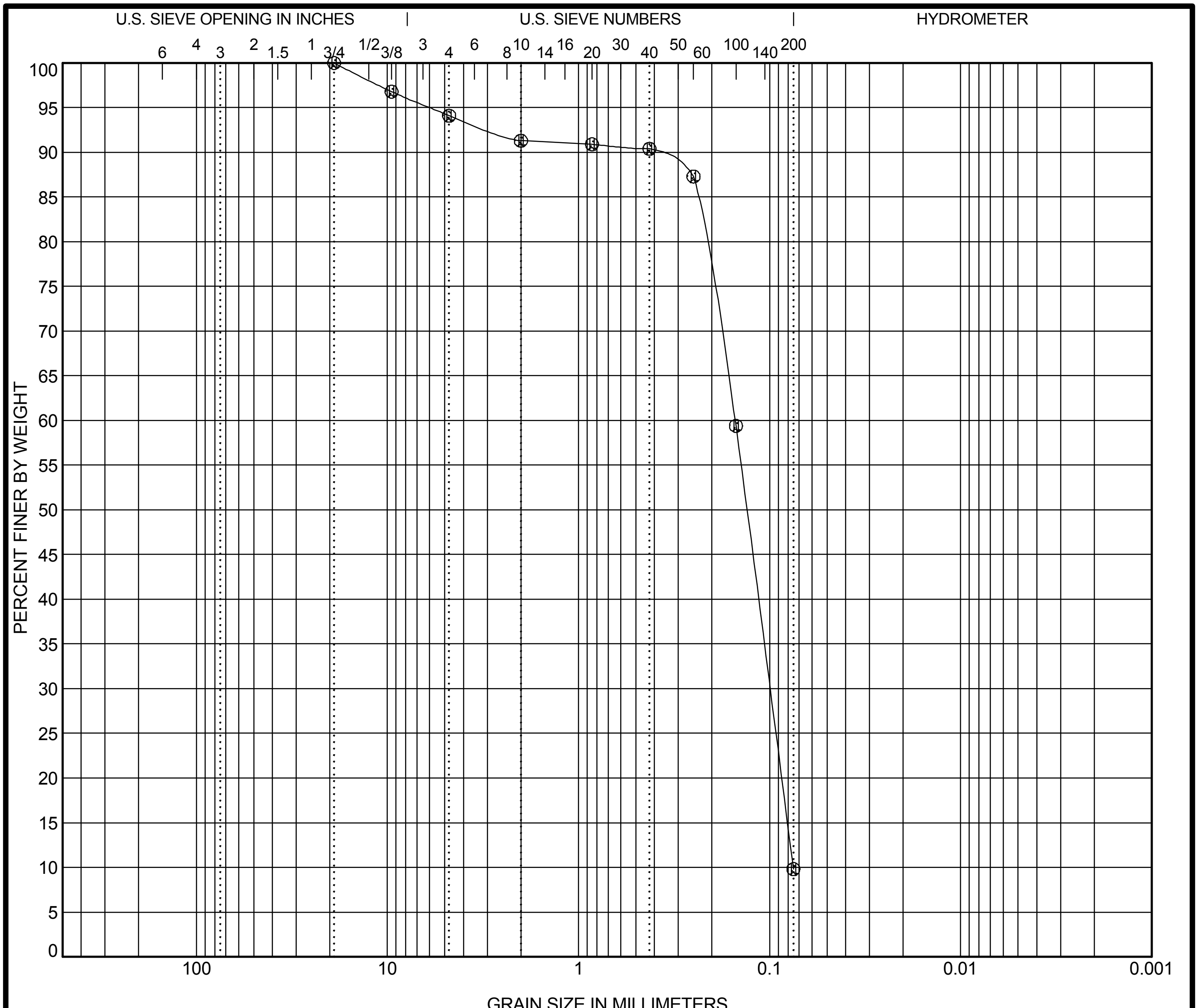

COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	Borehole No.	Sample No.	Depth (ft)	Water Content	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay	Fines based on % passing No. 4 sieve.
①	**GD-2**	**S9**	**30.0**		**19**	**0.152**	**0.099**	**0.075**	**5.9**	**84.3**	**9.8**		**10.4**

Note: Sand/Silt Strata

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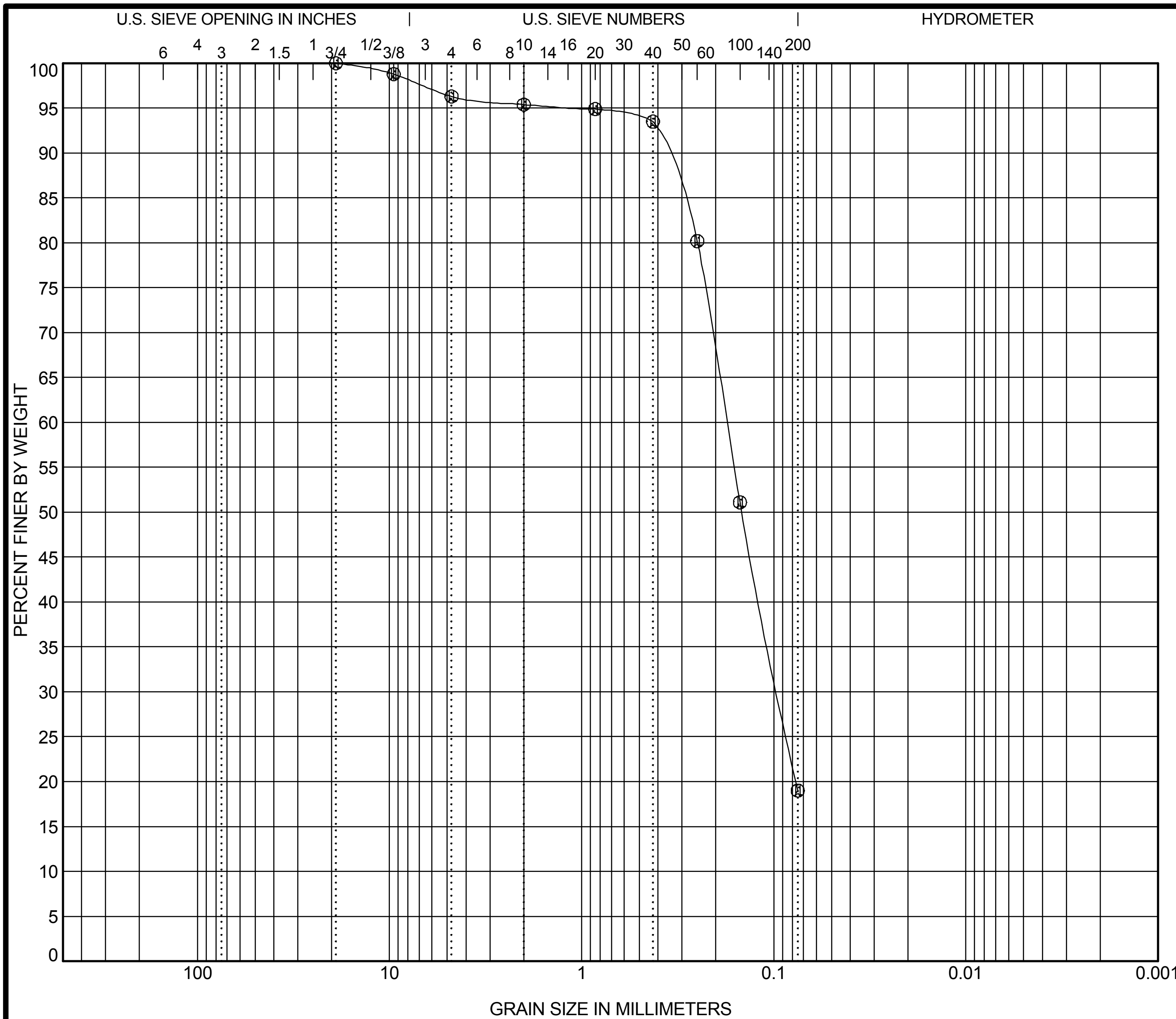

COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	Borehole No.	Sample No.	Depth (ft)	Water Content	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay	Fines based on % passing No. 4 sieve.
⊕	**GD-2**	**S12**	**45.0**		**19**	**0.175**	**0.095**		**3.7**	**77.3**	**19.0**		**19.7**

Note: Lower Silty Fine Sand Strata

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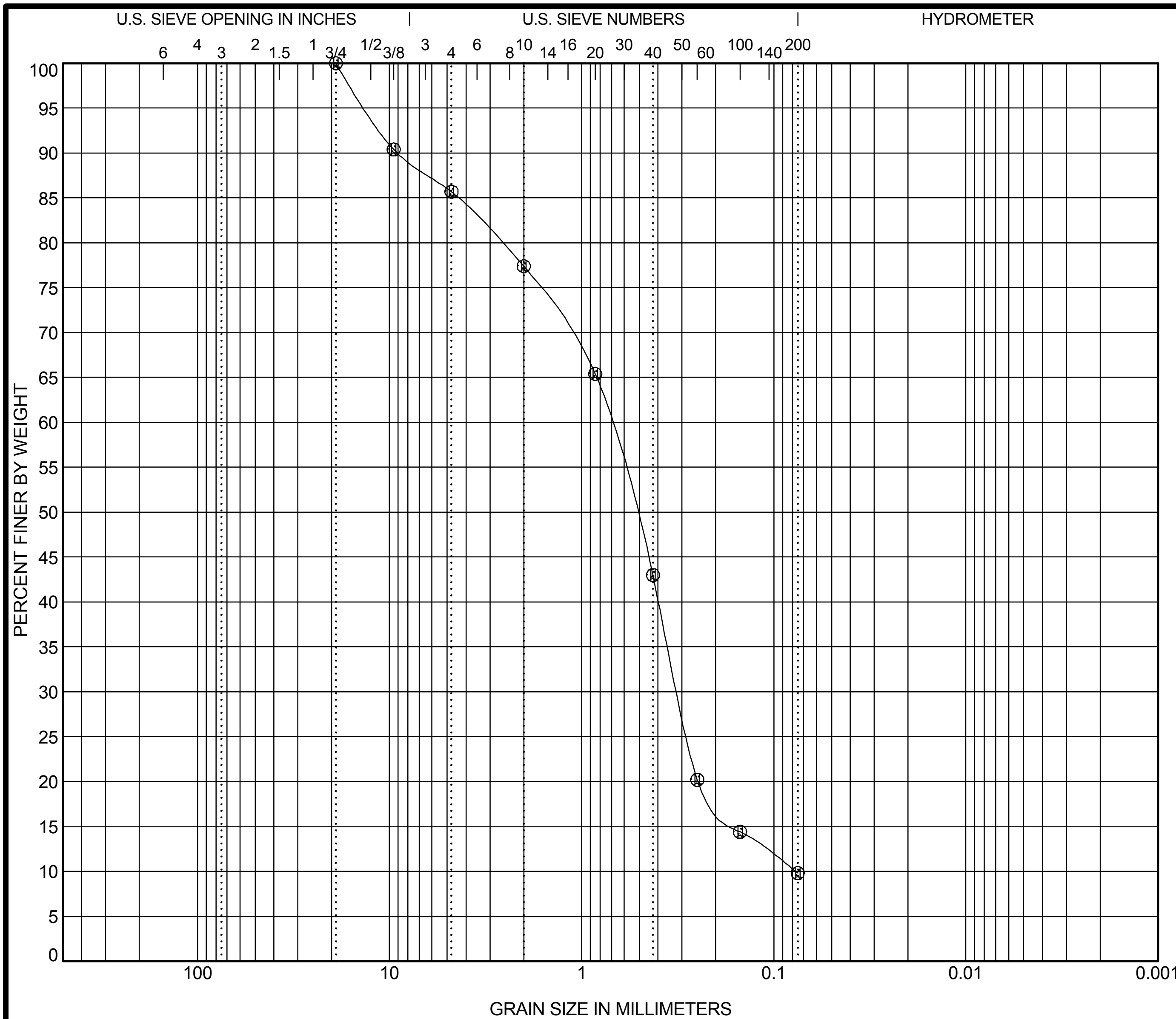

COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

Borehole No.	Sample No.	Depth (ft)	Water Content	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay	Fines based on % passing No. 4 sieve.
GD-3	S2	10.0		19	0.719	0.314	0.077	14.3	75.9	9.8		11.4

Note: Sand & Gravel Strata

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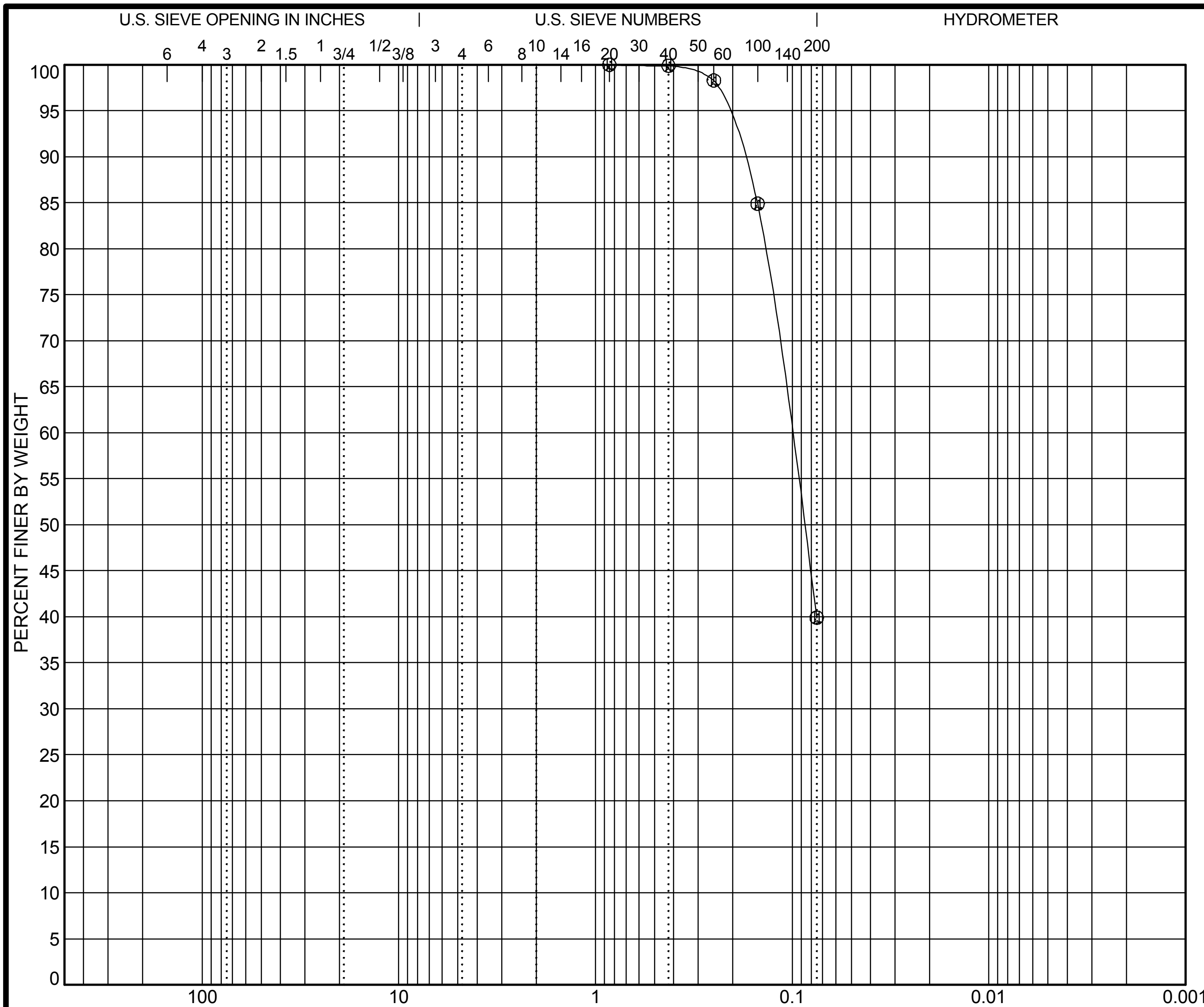

COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

Borehole No.	Sample No.	Depth (ft)	Water Content	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay	Fines based on % passing No. 4 sieve.
GD-5	S3	4.0		0.85	0.102			0.0	60.1	39.9		

Note: Upper Silty Fine Sand Strata

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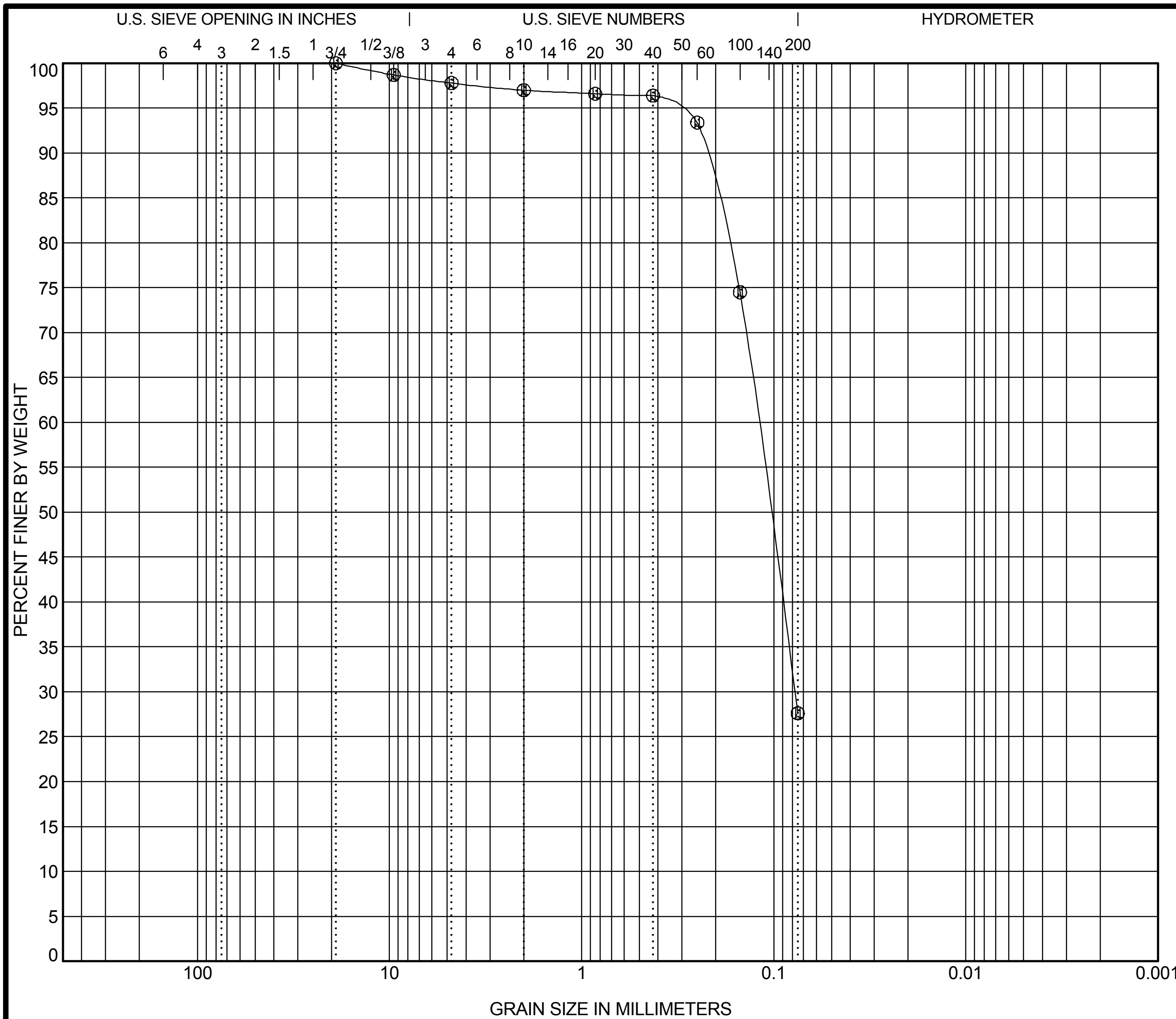

COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

Borehole No.	Sample No.	Depth (ft)	Water Content	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay	Fines based on % passing No. 4 sieve.
GD-5	S9	30.0		19	0.121	0.078		2.2	70.2	27.6		28.2

Note: Sand/Silt Strata

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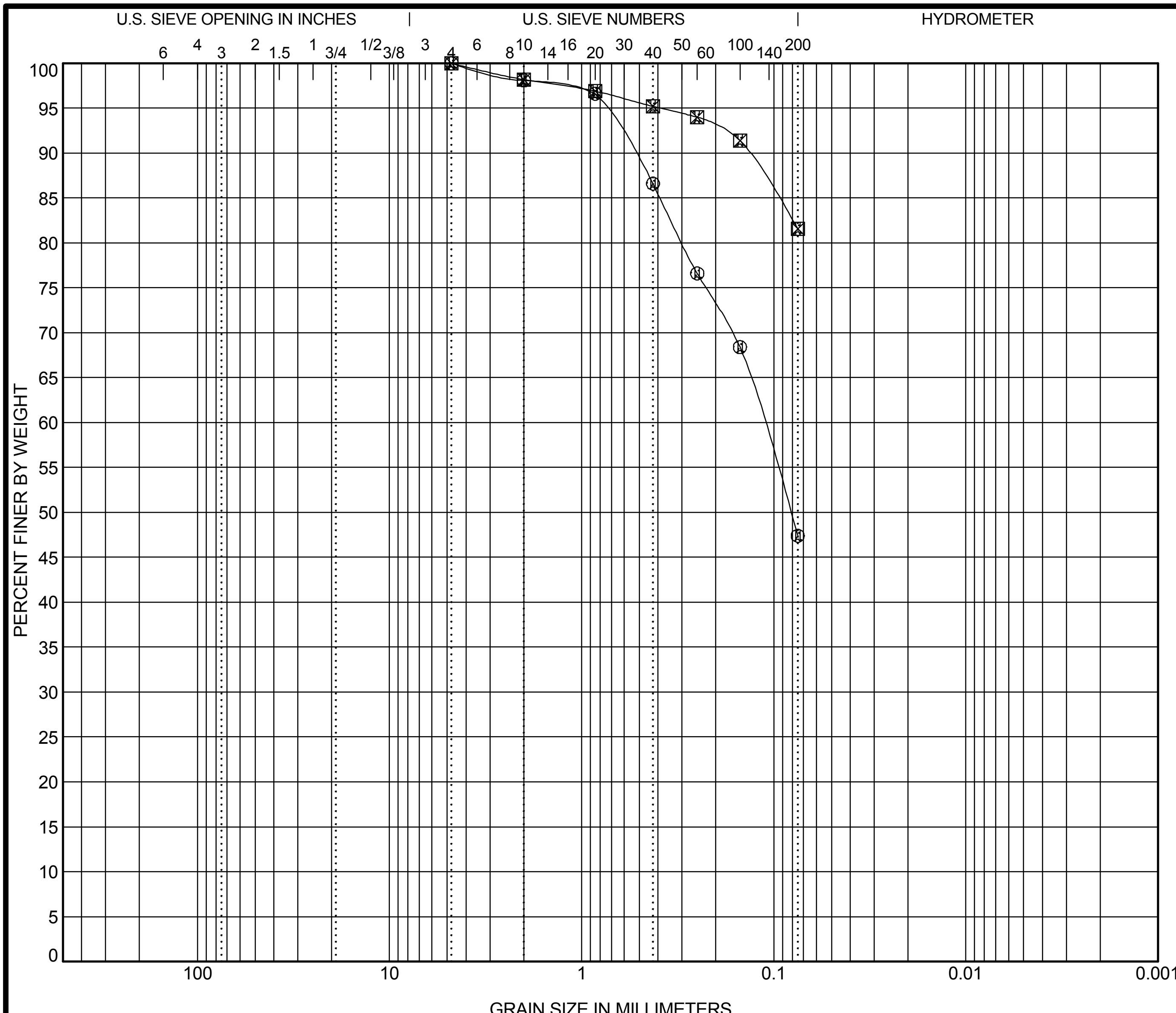


COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	Borehole No.	Sample No.	Depth (ft)	Water Content	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay	Fines based on % passing No. 4 sieve.
⦶	**GD-5**	**S13**	**50.0**		**4.75**	**0.114**			**0.0**	**52.6**	**47.4**		**47.4**
⊠	**GD-5**		**51.2**		**4.75**				**0.0**	**18.4**	**81.6**		**81.6**

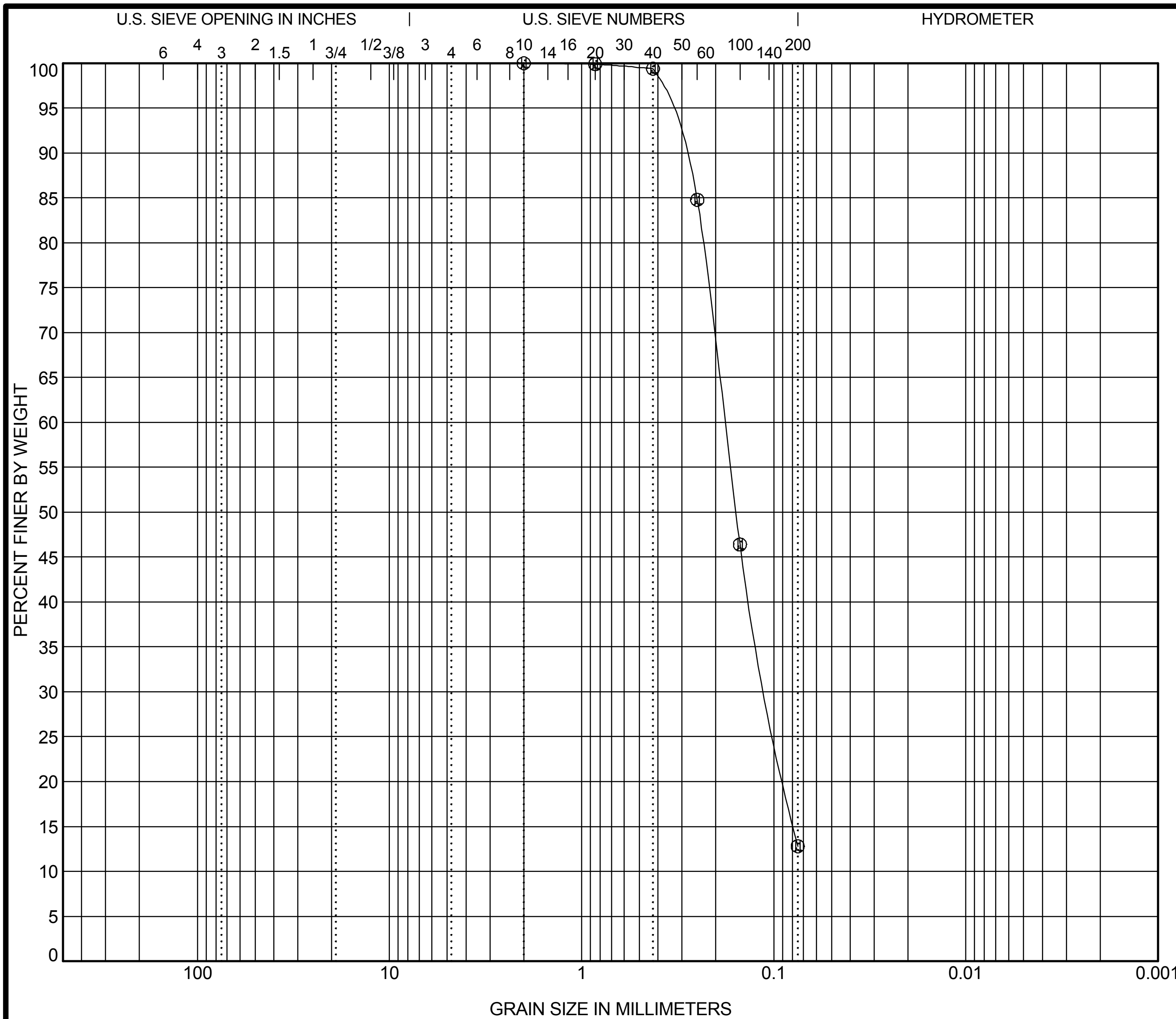
Note: Lower Silty Fine Sand Strata

SIEVE FORM 750-05.7.GPJ US LAB.GDT 5/29/09

GEODESIGN INCORPORATED
54 Main Street
Windsor, VT 05089
Telephone: (802) 674-2033
Fax: (802) 674-5943

GRAIN SIZE DISTRIBUTION

Project: VTRANS SPT Hammer Efficiency
Location: Windsor, VT
Number: 750-05.7
Tested By: VTRANS Reviewed By:VTRANS
Date:2009 Method: ASTM D6913 (Method A)



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	Borehole No.	Sample No.	Depth (ft)	Water Content	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay	Fines based on % passing No. 4 sieve.
⊕	**GD-7**	**S3**	**4.0**		**2**	**0.18**	**0.107**		**0.0**	**87.2**	**12.8**		

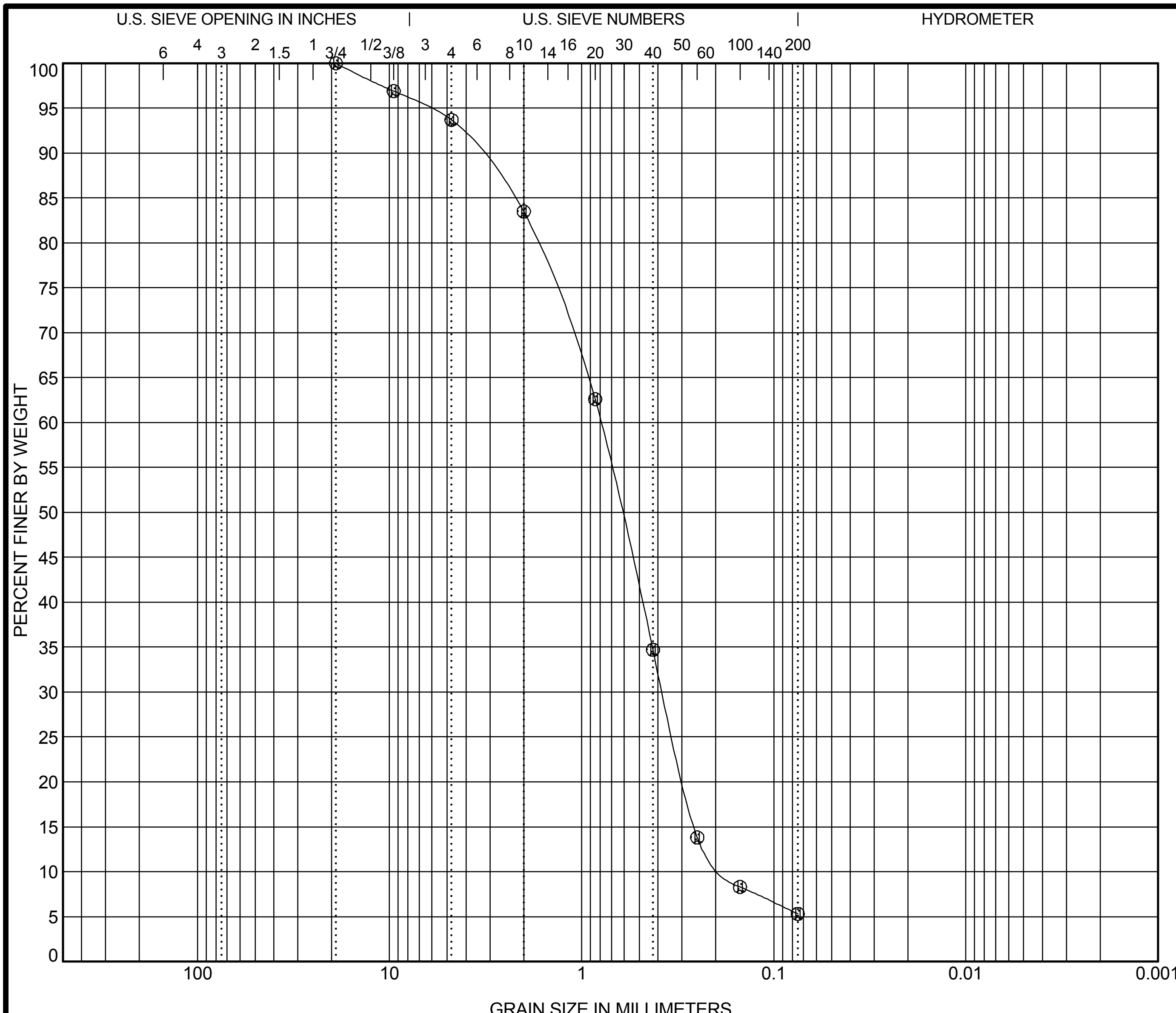
Note: Upper Silty Fine Sand Strata

SIEVE FORM 750-05.7.GPJ US LAB.GDT 5/29/09

GEODESIGN INCORPORATED
54 Main Street
Windsor, VT 05089
Telephone: (802) 674-2033
Fax: (802) 674-5943

GRAIN SIZE DISTRIBUTION

Project: VTRANS SPT Hammer Efficiency
Location: Windsor, VT
Number: 750-05.7
Tested By: VTRANS Reviewed By:VTRANS
Date:2009 Method: ASTM D6913 (Method A)



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

Borehole No.	Sample No.	Depth (ft)	Water Content	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay	Fines based on % passing No. 4 sieve.
GD-7	S8	20.0		19	0.797	0.377	0.176	6.3	88.4	5.3		5.7

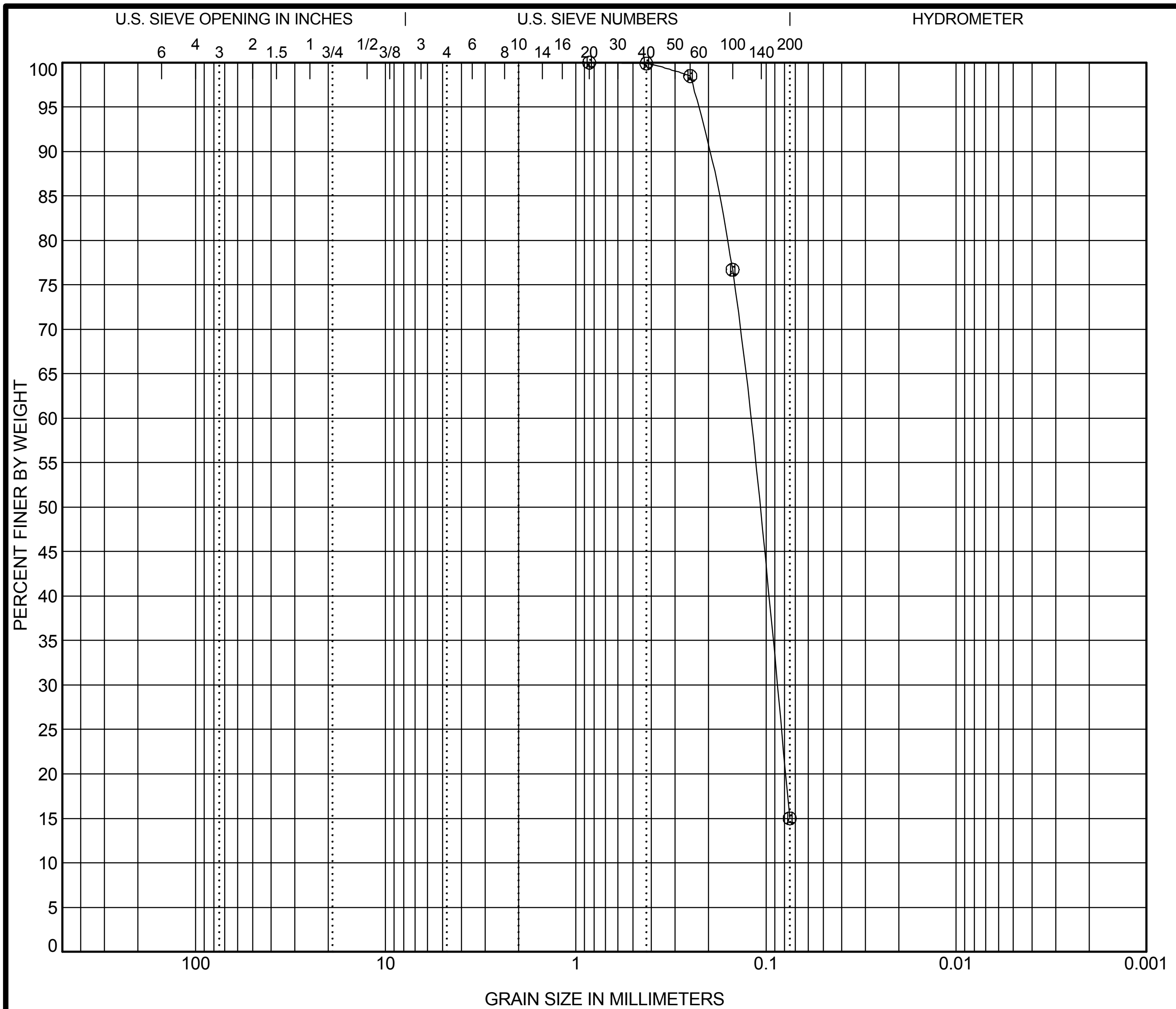
Note: Sand & Gravel Strata

GEODESIGN INCORPORATED
54 Main Street
Windsor, VT 05089
Telephone: (802) 674-2033
Fax: (802) 674-5943

GRAIN SIZE DISTRIBUTION

Project: VTRANS SPT Hammer Efficiency
Location: Windsor, VT
Number: 750-05.7
Tested By: VTRANS Reviewed By:VTRANS
Date:2009 Method: ASTM D6913 (Method A)

SIEVE FORM 750-05.7.GPJ US LAB.GDT 5/29/09



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	Borehole No.	Sample No.	Depth (ft)	Water Content	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay	Fines based on % passing No. 4 sieve.
⊕	GD-7	S10	30.0		0.85	0.124	0.089		0.0	85.0	15.0		

Note: Sand/Silt Strata

SIEVE FORM 750-05.7.GPJ US LAB.GDT 5/29/09

GEODESIGN INCORPORATED

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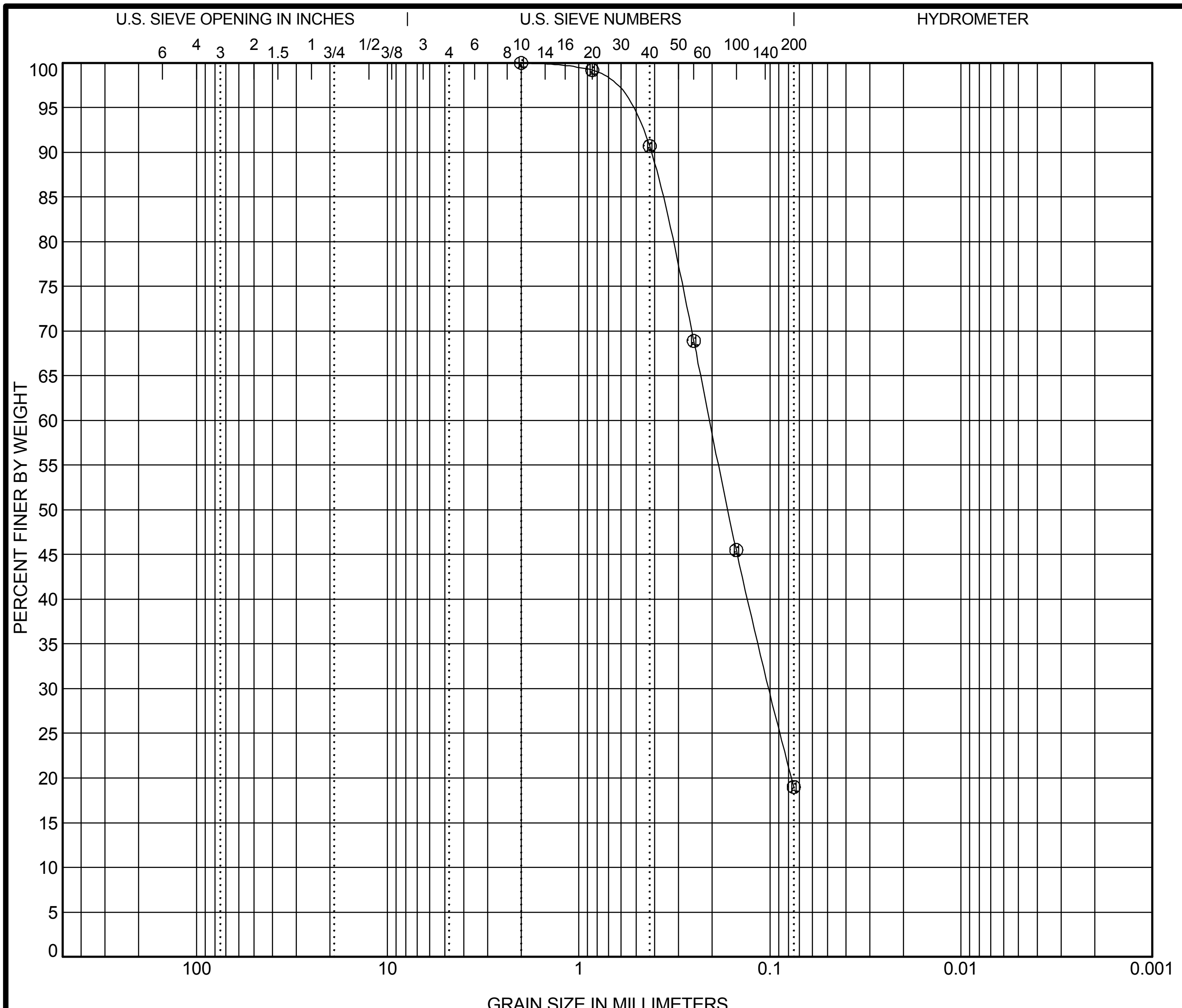
Windsor, VT 05089
Telephone: (802) 674-2033
Fax: (802) 674-5943

GRAIN SIZE DISTRIBUTION

Project: VTRANS SPT Hammer Efficiency
Location: Windsor, VT
Number: 750-05.7
Tested By: VTRANS Reviewed By:VTRANS
Date:2009 Method: ASTM D6913 (Method A)



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	Borehole No.	Sample No.	Depth (ft)	Water Content	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay	Fines based on % passing No. 4 sieve.
⊕	GD-8	S1	5.0	10.1	2	0.206	0.1		0.0	81.0	19.0		

Note: Upper Silty Fine Sand Strata

SIEVE FORM 750-05.7.GPJ US LAB.GDT 5/29/09

GEODESIGN INCORPORATED

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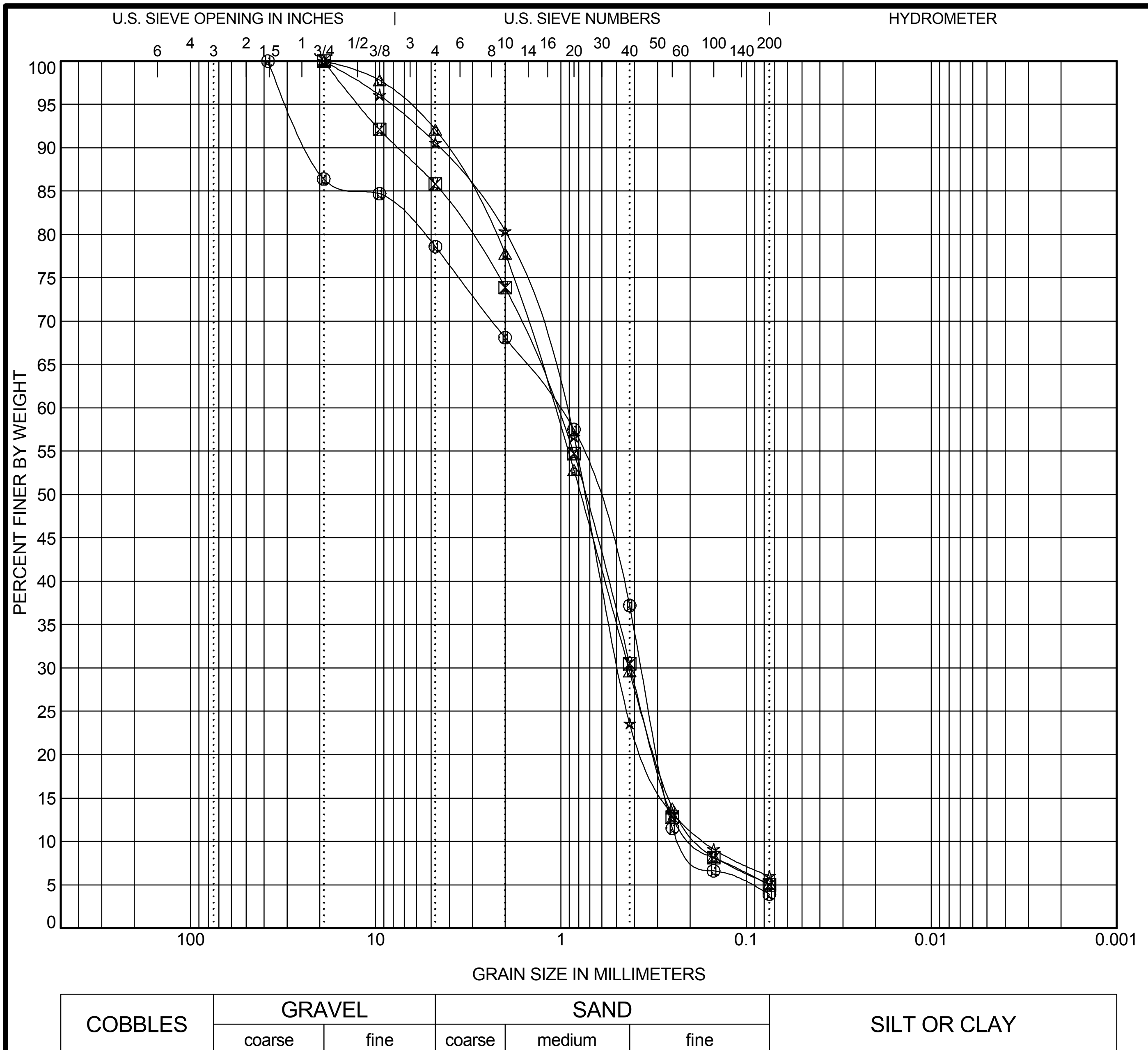
Fax: (802) 674-5943

GRAIN SIZE DISTRIBUTION

Project: VTRANS SPT Hammer Efficiency
Location: Windsor, VT
Number: 750-05.7
Tested By: VTRANS Reviewed By:VTRANS
Date:2009 Method: ASTM D6913 (Method A)



Borehole No.		Sample No.	Depth (ft)	Water Content	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay	Fines based on % passing No. 4 sieve.
⊕	**GD-8**	**S2**	**10.0**	**4.0**	**38.1**	**1.04**	**0.366**	**0.214**	**21.4**	**74.7**	**3.9**		**5.0**
⊠	**GD-8**	**S3**	**15.0**	**3.7**	**19.05**	**1.076**	**0.419**	**0.184**	**14.2**	**80.8**	**5.0**		**5.8**
⚠	**GD-8**	**S4**	**20.0**	**4.3**	**19.05**	**1.088**	**0.43**	**0.177**	**7.9**	**87.0**	**5.1**		**5.5**
☆	**GD-8**	**S5**	**25.0**	**4.5**	**19.05**	**0.958**	**0.486**	**0.168**	**9.4**	**84.6**	**6.0**		**6.6**

Note: Sand & Gravel Strata

GRAIN SIZE DISTRIBUTION

Project: VTRANS SPT Hammer Efficiency
Location: Windsor, VT
Number: 750-05.7
Tested By: VTRANS Reviewed By:VTRANS
Date:2009 Method: ASTM D6913 (Method A)

GEODESIGN INCORPORATED
54 Main Street
Windsor, VT 05089
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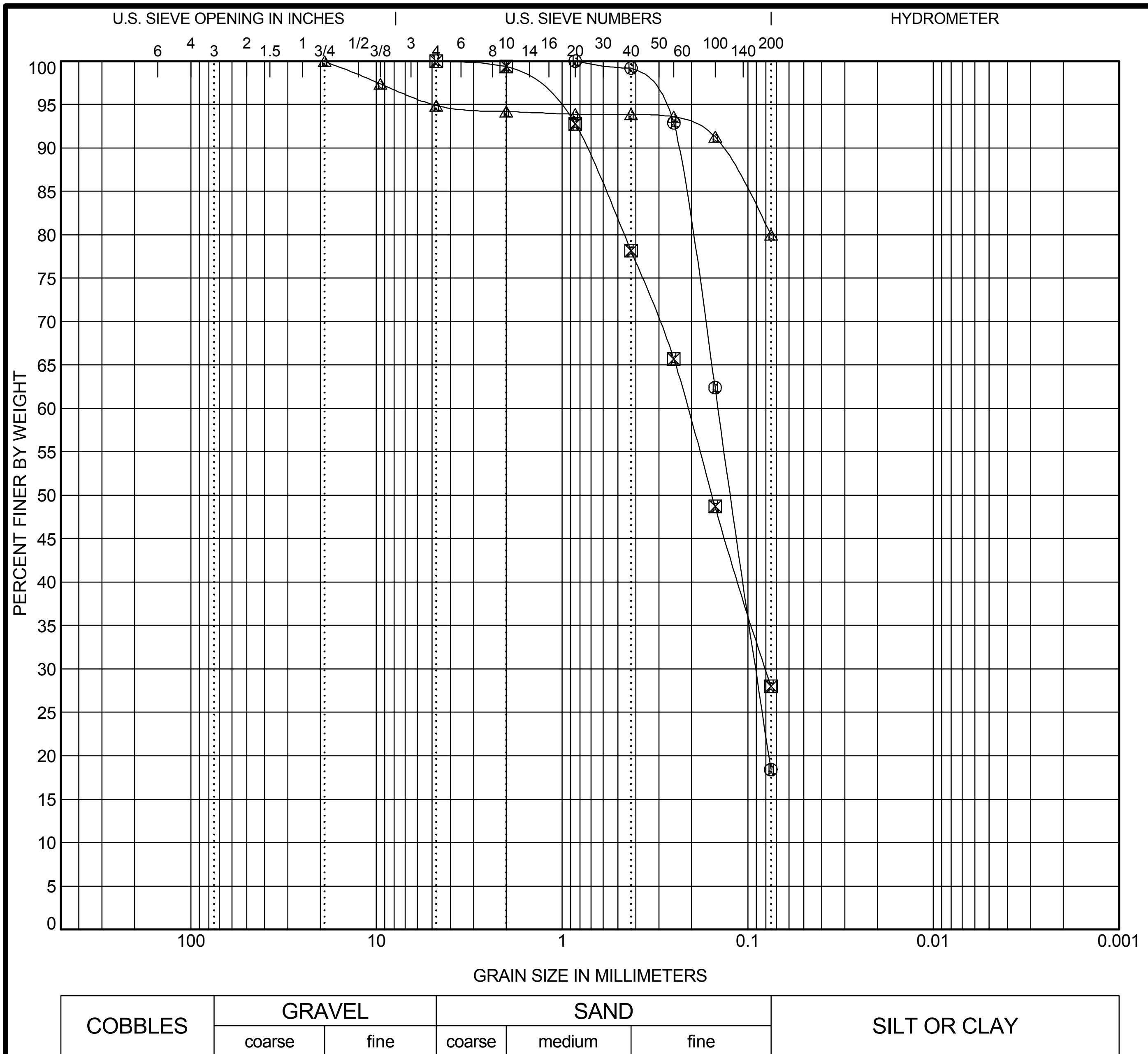
SIEVE FORM 750-05.7.GPJ US LAB.GDT 5/29/09



Borehole No.	Sample No.	Depth (ft)	Water Content	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay	Fines based on % passing No. 4 sieve.
⦶ GD-8	S6	30.0	7.4	0.85	0.144	0.09		0.0	81.6	18.4		
⊠ GD-8	S7	35.0	12.6	4.75	0.211	0.08		0.0	72.0	28.0		28.0
▲ GD-8	S8	40.0	26.1	19.05				5.1	14.9	80.0		84.3

Note: Sand/Silt Strata

SIEVE FORM 750-05.7.GPJ US LAB.GDT 5/29/09

GEODESIGN INCORPORATED

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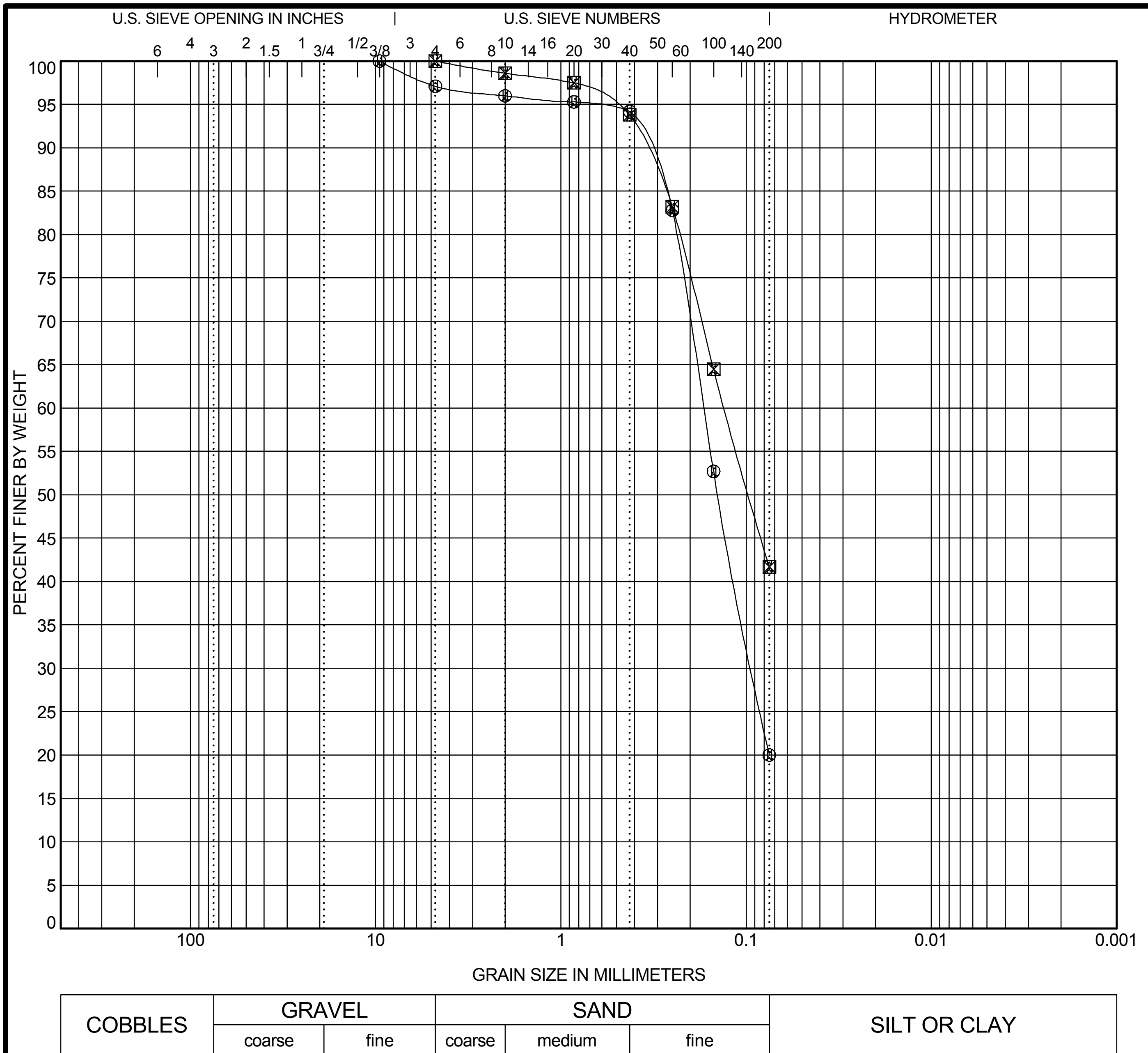
GRAIN SIZE DISTRIBUTION

Project: VTRANS SPT Hammer Efficiency
Location: Windsor, VT
Number: 750-05.7
Tested By: VTRANS Reviewed By:VTRANS
Date:2009 Method: ASTM D6913 (Method A)



Borehole No.	Sample No.	Depth (ft)	Water Content	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay	Fines based on % passing No. 4 sieve.
GD-8	S9	45.0	8.2	9.525	0.17	0.093		2.9	77.1	20.0		20.6
GD-8	S10	50.0	23.8	4.75	0.131			0.0	58.3	41.7		41.7

Note: Lower Silty Fine Sand Strata

SIEVE FORM 750-05.7.GPJ US LAB.GDT 5/29/09

GRAIN SIZE DISTRIBUTION

GEODESIGN INCORPORATED

54 Main Street
Windsor, VT 05089
Telephone: (802) 674-2033
Fax: (802) 674-5943

Project: VTRANS SPT Hammer Efficiency
Location: Windsor, VT
Number: 750-05.7
Tested By: VTRANS Reviewed By:VTRANS
Date:2009 Method: ASTM D6913 (Method A)

HAMMER STUDY, WINDSOR

HOLE: B-1B 09/16/08 – 09/17/08

DEPTH FT.	% MOIST.	CLASS.	DES.	N VALUE	% PASS 1.5“	% PASS 3/4“	% PASS 3/8”	% PASS #4	% PASS #10	% PASS #20	% PASS #40	% PASS #60	% PASS #100	% PASS #200
0-2	14.0	A-4	Sa Si	13		100	98.4	94.9	88.5	80.2	73.0	68.6	63.8	45.2
5-7	18.3	A-2-4	Si Sa	6	100	94.5	94.5	94.5	94.3	94.2	93.6	78.3	57.0	28.3
10-12	18.0	A-3	Sa	9		100	93.1	89.4	86.6	82.7	59.6	20.0	11.2	6.7
15-17	10.8	A-1-b	Gr Sa	19	100	96.0	87.8	81.8	71.9	53.4	29.4	17.2	12.3	8.0
20-22	11.6	A-1-b	Gr Sa	19	100	95.4	88.0	79.2	68.7	54.3	36.3	21.0	14.3	9.1
25-27	26.1	A-4	Si	7		100	98.5	95.5	93.5	91.6	90.1	88.5	87.1	74.4
27-29	17.3	A-2-4	Si Sa	17			100	98.0	97.0	96.3	95.4	93.7	80.6	33.9
29-31	15.3	A-2-4	Si Sa	19				100	99.3	98.6	97.8	93.8	71.8	29.7
31-33	19.3	A-2-4	Si Sa	16			100	98.0	96.4	95.6	95.0	91.0	68.8	28.1
33-35	16.0	A-2-4	Si Sa	17			100	97.0	94.5	93.2	92.2	85.8	63.5	23.6
35-37	14.5	A-2-4	Si Sa	12			100	98.1	95.9	93.8	90.0	82.3	63.2	30.2
37-39	19.9	A-4	Sa Si	17	100	96.9	93.4	89.5	87.2	86.2	85.4	82.5	74.5	50.4
39-41	27.6	A-4	Si	12			100	95.9	94.5	93.9	93.6	93.3	92.2	83.6
41-43	21.7	A-2-4	Si Sa	17			100	96.6	95.2	94.8	93.8	83.7	54.5	22.6
43-45	18.5	A-2-4	Sa	24			100	99.9	99.1	98.4	96.2	78.2	40.3	14.2
45-47	18.4	A-2-4	Sa	23			100	99.6	98.3	97.1	93.6	75.5	45.1	19.4
47-49	20.4	A-2-4	Sa	22			100	99.1	98.2	95.5	82.9	53.8	24.7	10.7
49-51	19.1	A-2-4	Sa	28				100	99.7	97.2	80.4	46.2	25.0	12.2

G:/Soils&Foundation/Projects/Hammer Study/Boring Logs/B-1b samples

Vermont Agency of Transportation
Materials and Research Section
1 National Life Drive
Montpelier, VT 05633-5001

Distribution list

Report on Soil Sample

Lab number: E090289 **Corrected copy:** N/A **Report Date:** 4/20/2009 12:55:24
Project: HAMMER STUDY **Number:** WINDSOR **Site:** RSCH011-703

Date sampled: **Received:** **Tested:** 4/13/2009 **Tested by:** J. TOUCHETTE
Station: **Offset:** **Hole:** GD-2 **Depth:** 15 FT **to:** 17 FT
Field description:
Submitted by: WERNER/GeoDesign **Address:**
Sample type: SPLIT BARREL **Quantity:**
Sample source/Outside agency name:
Location used: **Examined for:** CLASSIFICATION
Comment:

Test Results

T-88	Sieve Analysis % Passing Total Sample
75 mm (3.0"):	
37.5 mm (1.5"):	
19 mm (3/4"):	
9.5 mm (3/8"):	93.3%
4.75 mm (#4):	87.7%
2.00 mm (#10):	77.3%
850 µm (#20):	54.2%
425 µm (#40):	26.2%
250 µm (#60):	12.6%
150 µm (#100):	8.8%
75 µm (#200):	5.7%

Hydrometer Analysis

Particles smaller	% total sample
0.05 mm:	
0.02 mm:	
0.005 mm:	
0.002 mm:	
0.001 mm:	

Limits

T-265 Moisture content: 3.3%
T-89 Liquid Limit:
T-90 Plastic Limit:
T-90 Plasticity Index: NP

Moisture Density

Test method: T-180 **Method:**
Maximum density: **pcf**
Optimum moisture:
T-100 Specific Gravity:

Gr: 22.7% **D2487:** SP-SM
Sa: 71.6% **M145:** A-1-b Gravelly Sand
Si: 5.7%

Comments: GD-2 S-6

Reviewed by: Christopher C. Benda, PE, Soils & Foundations Engineer

Vertmont Agency of Transportation
Materials and Research Section
1 National Life Drive
Montpelier, VT 05633-5001

Distribution list

Report on Soil Sample

Lab number: E090290 **Corrected copy:** N/A **Report Date:** 4/20/2009 12:55:24
Project: HAMMER STUDY **Number:** WINDSOR **Site:** RSCH011-703

Date sampled: **Received:** **Tested:** 4/13/2009 **Tested by:** J. TOUCHETTE
Station: **Offset:** **Hole:** GD-2 **Depth:** 30 FT **to:** 32 FT
Field description:
Submitted by: WERNER/GeoDesign **Address:**
Sample type: SPLIT BARREL **Quantity:**
Sample source/Outside agency name:
Location used: **Examined for:** CLASSIFICATION
Comment:

Test Results

T-88	Sieve Analysis % Passing Total Sample
75 mm (3.0"):	
37.5 mm (1.5"):	
19 mm (3/4"):	
9.5 mm (3/8"):	96.8%
4.75 mm (#4):	94.1%
2.00 mm (#10):	91.3%
850 µm (#20):	90.9%
425 µm (#40):	90.4%
250 µm (#60):	87.3%
150 µm (#100):	59.4%
75 µm (#200):	9.8%

Hydrometer Analysis

Particles smaller	% total sample
0.05 mm:	
0.02 mm:	
0.005 mm:	
0.002 mm:	
0.001 mm:	

Limits

T-265 Moisture content: 5.9%
T-89 Liquid Limit:
T-90 Plastic Limit:
T-90 Plasticity Index: NP

Moisture Density

Test method: T-180 **Method:**
Maximum density: **pcf**
Optimum moisture:
T-100 Specific Gravity:

Gr:	8.7%	**D2487:**	SP-SM	
Sa:	81.5%	**M145:**	A-3	Sand
Si:	9.8%			

Comments: GD-2 S-9

Reviewed by: Christopher C. Benda, PE, Soils & Foundations Engineer

Vertmont Agency of Transportation

Distribution list

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Materials and Research Section
1 National Life Drive
Montpelier, VT 05633-5001

Report on Soil Sample

Lab number: E090291 **Corrected copy:** N/A **Report Date:** 4/20/2009 12:55:25
Project: HAMMER STUDY **Number:** WINDSOR **Site:** RSCH011-703

Date sampled: **Received:** **Tested:** 4/13/2009 **Tested by:** J. TOUCHETTE
Station: **Offset:** **Hole:** GD-2 **Depth:** 45 FT **to:** 47 FT
Field description:
Submitted by: WERNER/GeoDesign **Address:**
Sample type: SPLIT BARREL **Quantity:**
Sample source/Outside agency name:
Location used: **Examined for:** CLASSIFICATION
Comment:

Test Results

T-88	Sieve Analysis % Passing Total Sample
75 mm (3.0"):	
37.5 mm (1.5"):	
19 mm (3/4"):	
9.5 mm (3/8"):	98.8%
4.75 mm (#4):	96.3%
2.00 mm (#10):	95.4%
850 µm (#20):	94.9%
425 µm (#40):	93.5%
250 µm (#60):	80.2%
150 µm (#100):	51.1%
75 µm (#200):	19.0%

Hydrometer Analysis

Particles smaller	% total sample
0.05 mm:	
0.02 mm:	
0.005 mm:	
0.002 mm:	
0.001 mm:	

Limits

T-265 Moisture content: 11.0%
T-89 Liquid Limit:
T-90 Plastic Limit:
T-90 Plasticity Index: NP

Moisture Density

Test method: T-180 **Method:**
Maximum density: **pcf**
Optimum moisture:
T-100 Specific Gravity:

Gr:	4.6%	**D2487:**	SM	
Sa:	76.4%	**M145:**	A-2-4	Sand
Si:	19.0%			

Comments: GD-2 S-12

Reviewed by: Christopher C. Benda, PE, Soils & Foundations Engineer

Vermont Agency of Transportation
Materials and Research Section
1 National Life Drive
Montpelier, VT 05633-5001

Distribution list

Report on Soil Sample

Lab number: E090292 **Corrected copy:** N/A **Report Date:** 4/20/2009 12:55:26
Project: HAMMER STUDY **Number:** WINDSOR **Site:** RSCH011-703

Date sampled: **Received:** **Tested:** 4/13/2009 **Tested by:** J. TOUCHETTE
Station: **Offset:** **Hole:** GD-3 **Depth:** 10 FT **to:** 12 FT
Field description:
Submitted by: WERNER/GeoDesign **Address:**
Sample type: SPLIT BARREL **Quantity:**
Sample source/Outside agency name:
Location used: **Examined for:** CLASSIFICATION
Comment:

Test Results

Sieve Analysis

T-88	% Passing Total Sample
75 mm (3.0"):	
37.5 mm (1.5"):	
19 mm (3/4"):	
9.5 mm (3/8"):	90.4%
4.75 mm (#4):	85.7%
2.00 mm (#10):	77.4%
850 µm (#20):	65.4%
425 µm (#40):	43.0%
250 µm (#60):	20.2%
150 µm (#100):	14.4%
75 µm (#200):	9.8%

Hydrometer Analysis

Particles smaller	% total sample
0.05 mm:	
0.02 mm:	
0.005 mm:	
0.002 mm:	
0.001 mm:	

Limits

T-265 Moisture content: 12.8%
T-89 Liquid Limit:
T-90 Plastic Limit:
T-90 Plasticity Index: NP

Moisture Density

Test method: T-180 **Method:**
Maximum density: **pcf**
Optimum moisture:
T-100 Specific Gravity:

Gr:	22.6%	**D2487:**	SP-SM	
Sa:	67.5%	**M145:**	A-1-b	Gravelly Sand
Si:	9.8%			

Comments: GD-3 S-2

Reviewed by: Christopher C. Benda, PE, Soils & Foundations Engineer

Vertmont Agency of Transportation

Distribution list

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Materials and Research Section
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Montpelier, VT 05633-5001

Report on Soil Sample

Lab number: E090293 **Corrected copy:** N/A **Report Date:** 4/20/2009 12:55:26
Project: HAMMER STUDY **Number:** WINDSOR **Site:** RSCH011-703

Date sampled: **Received:** **Tested:** 4/13/2009 **Tested by:** J. TOUCHETTE
Station: **Offset:** **Hole:** GD-5 **Depth:** 4 FT **to:** 6 FT
Field description:
Submitted by: WERNER/GeoDesign **Address:**
Sample type: SPLIT BARREL **Quantity:**
Sample source/Outside agency name:
Location used: **Examined for:** CLASSIFICATION
Comment:

Test Results

T-88	Sieve Analysis % Passing Total Sample
75 mm (3.0"):	
37.5 mm (1.5"):	
19 mm (3/4"):	
9.5 mm (3/8"):	
4.75 mm (#4):	100.0%
2.00 mm (#10):	100.0%
850 µm (#20):	
425 µm (#40):	99.9%
250 µm (#60):	98.3%
150 µm (#100):	84.9%
75 µm (#200):	39.9%

Hydrometer Analysis

Particles smaller	% total sample
0.05 mm:	
0.02 mm:	
0.005 mm:	
0.002 mm:	
0.001 mm:	

Limits

T-265 Moisture content: 7.2%
T-89 Liquid Limit:
T-90 Plastic Limit:
T-90 Plasticity Index: NP

Moisture Density

Test method: T-180 **Method:**
Maximum density: **pcf**
Optimum moisture:
T-100 Specific Gravity:

Gr:	0.0%	**D2487:**	SM	
Sa:	60.1%	**M145:**	A-4	Silty Sand
Si:	39.9%			

Comments: GD-5 S-3

Reviewed by: Christopher C. Benda, PE, Soils & Foundations Engineer

Vermont Agency of Transportation
Materials and Research Section
1 National Life Drive
Montpelier, VT 05633-5001

Distribution list

Report on Soil Sample

Lab number: E090294 **Corrected copy:** N/A **Report Date:** 4/20/2009 12:55:27
Project: HAMMER STUDY **Number:** WINDSOR **Site:** RSCH011-703

Date sampled: **Received:** **Tested:** 4/13/2009 **Tested by:** J. TOUCHETTE
Station: **Offset:** **Hole:** GD-5 **Depth:** 30 FT **to:** 32 FT
Field description:
Submitted by: WERNER/GeoDesign **Address:**
Sample type: SPLIT BARREL **Quantity:**
Sample source/Outside agency name:
Location used: **Examined for:** CLASSIFICATION
Comment:

Test Results

T-88	Sieve Analysis % Passing Total Sample
75 mm (3.0"):	
37.5 mm (1.5"):	
19 mm (3/4"):	
9.5 mm (3/8"):	98.7%
4.75 mm (#4):	97.8%
2.00 mm (#10):	97.0%
850 µm (#20):	96.6%
425 µm (#40):	96.4%
250 µm (#60):	93.4%
150 µm (#100):	74.5%
75 µm (#200):	27.6%

Hydrometer Analysis

Particles smaller	% total sample
0.05 mm:	
0.02 mm:	
0.005 mm:	
0.002 mm:	
0.001 mm:	

Limits

T-265 Moisture content: 9.1%
T-89 Liquid Limit:
T-90 Plastic Limit:
T-90 Plasticity Index: NP

Moisture Density

Test method: T-180 **Method:**
Maximum density: **pcf**
Optimum moisture:
T-100 Specific Gravity:

Gr:	3.0%	**D2487:**	SM	
Sa:	69.4%	**M145:**	A-2-4	Silty Sand
Si:	27.6%			

Comments: GD-5 S-9

Reviewed by: Christopher C. Benda, PE, Soils & Foundations Engineer

Vertmont Agency of Transportation

Distribution list

Materials and Research Section
1 National Life Drive
Montpelier, VT 05633-5001

Report on Soil Sample

Lab number: E090295 **Corrected copy:** N/A **Report Date:** 4/20/2009 12:55:27
Project: HAMMER STUDY **Number:** WINDSOR **Site:** RSCH011-703

Date sampled: **Received:** **Tested:** 4/13/2009 **Tested by:** J. TOUCHETTE
Station: **Offset:** **Hole:** GD-5 **Depth:** 50 FT **to:** 52 FT
Field description:
Submitted by: WERNER/GeoDesign **Address:**
Sample type: SPLIT BARREL **Quantity:**
Sample source/Outside agency name:
Location used: **Examined for:** CLASSIFICATION
Comment:

Test Results

T-88	Sieve Analysis % Passing Total Sample
75 mm (3.0"):	
37.5 mm (1.5"):	
19 mm (3/4"):	
9.5 mm (3/8"):	
4.75 mm (#4):	100.0%
2.00 mm (#10):	98.1%
850 µm (#20):	96.6%
425 µm (#40):	86.6%
250 µm (#60):	76.6%
150 µm (#100):	68.4%
75 µm (#200):	47.4%

Hydrometer Analysis

Particles smaller	% total sample
0.05 mm:	
0.02 mm:	
0.005 mm:	
0.002 mm:	
0.001 mm:	

Limits

T-265 Moisture content: 20.6%
T-89 Liquid Limit:
T-90 Plastic Limit:
T-90 Plasticity Index: NP

Moisture Density

Test method: T-180 **Method:**
Maximum density: **pcf**
Optimum moisture:
T-100 Specific Gravity:

Gr:	1.9%	**D2487:**	SM	
Sa:	50.7%	**M145:**	A-4	Silty Sand
Si:	47.4%			

Comments: GD-5 S-13a

Reviewed by: Christopher C. Benda, PE, Soils & Foundations Engineer

Vermont Agency of Transportation
Materials and Research Section
1 National Life Drive
Montpelier, VT 05633-5001

Distribution list

Report on Soil Sample

Lab number: E090299 **Corrected copy:** N/A **Report Date:** 4/20/2009 12:55:29

Project: HAMMER STUDY **Number:** WINDSOR **Site:** RSCH011-703

Date sampled: **Received:** **Tested:** 4/13/2009 **Tested by:** J. TOUCHETTE

Station: **Offset:** **Hole:** GD-5 **Depth:** 50 FT **to:** 52 FT

Field description:

Submitted by: WERNER/GeoDesign **Address:**

Sample type: SPLIT BARREL **Quantity:**

Sample source/Outside agency name:

Location used: **Examined for:** CLASSIFICATION

Comment:

Test Results

T-88	Sieve Analysis % Passing Total Sample
75 mm (3.0"):	
37.5 mm (1.5"):	
19 mm (3/4"):	
9.5 mm (3/8"):	
4.75 mm (#4):	100.0%
2.00 mm (#10):	98.2%
850 µm (#20):	96.9%
425 µm (#40):	95.2%
250 µm (#60):	94.0%
150 µm (#100):	91.4%
75 µm (#200):	81.6%

Hydrometer Analysis

Particles smaller	% total sample
0.05 mm:	
0.02 mm:	
0.005 mm:	
0.002 mm:	
0.001 mm:	

Limits

T-265 Moisture content: 31.5%

T-89 Liquid Limit:

T-90 Plastic Limit:

T-90 Plasticity Index: NP

Moisture Density

Test method: T-180 **Method:**

Maximum density: **pcf**

Optimum moisture:

T-100 Specific Gravity:

Gr:	1.8%	**D2487:**	ML	
Sa:	16.6%	**M145:**	A-4	Silt
Si:	81.6%			

Comments: GD-5 S-13b

Reviewed by: Christopher C. Benda, PE, Soils & Foundations Engineer

Vermont Agency of Transportation
Materials and Research Section
1 National Life Drive
Montpelier, VT 05633-5001

Distribution list

Report on Soil Sample

Lab number: E090296 **Corrected copy:** N/A **Report Date:** 4/20/2009 12:55:28
Project: HAMMER STUDY **Number:** WINDSOR **Site:** RSCH011-703

Date sampled: **Received:** **Tested:** 4/13/2009 **Tested by:** J. TOUCHETTE
Station: **Offset:** **Hole:** GD-7 **Depth:** 4 FT **to:** 6 FT
Field description:
Submitted by: WERNER/GeoDesign **Address:**
Sample type: SPLIT BARREL **Quantity:**
Sample source/Outside agency name:
Location used: **Examined for:** CLASSIFICATION
Comment:

Test Results

T-88	Sieve Analysis % Passing Total Sample
75 mm (3.0"):	
37.5 mm (1.5"):	
19 mm (3/4"):	
9.5 mm (3/8"):	
4.75 mm (#4):	100.0%
2.00 mm (#10):	100.0%
850 µm (#20):	99.9%
425 µm (#40):	99.4%
250 µm (#60):	84.8%
150 µm (#100):	46.4%
75 µm (#200):	12.8%

Hydrometer Analysis

Particles smaller	% total sample
0.05 mm:	
0.02 mm:	
0.005 mm:	
0.002 mm:	
0.001 mm:	

Limits

T-265 Moisture content: 7.7%
T-89 Liquid Limit:
T-90 Plastic Limit:
T-90 Plasticity Index: NP

Moisture Density

Test method: T-180 **Method:**
Maximum density: **pcf**
Optimum moisture:
T-100 Specific Gravity:

Gr:	0.0%	**D2487:**	SM	
Sa:	87.2%	**M145:**	A-2-4	Sand
Si:	12.8%			

Comments: GD-7 S-3

Reviewed by: Christopher C. Benda, PE, Soils & Foundations Engineer

Vermont Agency of Transportation
Materials and Research Section
1 National Life Drive
Montpelier, VT 05633-5001

Distribution list

Report on Soil Sample

Lab number: E090297 **Corrected copy:** N/A **Report Date:** 4/20/2009 12:55:28
Project: HAMMER STUDY **Number:** WINDSOR **Site:** RSCH011-703

Date sampled: **Received:** **Tested:** 4/13/2009 **Tested by:** J. TOUCHETTE
Station: **Offset:** **Hole:** GD-7 **Depth:** 20 FT **to:** 22 FT
Field description:
Submitted by: WERNER/GeoDesign **Address:**
Sample type: SPLIT BARREL **Quantity:**
Sample source/Outside agency name:
Location used: **Examined for:** CLASSIFICATION
Comment:

Test Results

T-88	Sieve Analysis % Passing Total Sample
75 mm (3.0"):	
37.5 mm (1.5"):	
19 mm (3/4"):	
9.5 mm (3/8"):	96.9%
4.75 mm (#4):	93.7%
2.00 mm (#10):	83.5%
850 µm (#20):	62.6%
425 µm (#40):	34.7%
250 µm (#60):	13.8%
150 µm (#100):	8.3%
75 µm (#200):	5.3%

Hydrometer Analysis

Particles smaller	% total sample
0.05 mm:	
0.02 mm:	
0.005 mm:	
0.002 mm:	
0.001 mm:	

Limits

T-265 Moisture content: 4.6%
T-89 Liquid Limit:
T-90 Plastic Limit:
T-90 Plasticity Index: NP

Moisture Density

Test method: T-180 **Method:**
Maximum density: **pcf**
Optimum moisture:
T-100 Specific Gravity:

Gr:	16.5%	**D2487:**	SP-SM	
Sa:	78.1%	**M145:**	A-1-b	Sand
Si:	5.3%			

Comments: GD-7 S-8

Reviewed by: Christopher C. Benda, PE, Soils & Foundations Engineer

Vertmont Agency of Transportation

Materials and Research Section

1 National Life Drive

Montpelier, VT 05633-5001

Distribution list

Report on Soil Sample

Lab number: E090298 **Corrected copy:** N/A **Report Date:** 4/20/2009 12:55:29

Project: HAMMER STUDY **Number:** WINDSOR **Site:** RSCH011-703

Date sampled: **Received:** **Tested:** 4/13/2009 **Tested by:** J. TOUCHETTE

Station: **Offset:** **Hole:** GD-7 **Depth:** 30 FT **to:** 32 FT

Field description:

Submitted by: WERNER/GeoDesign **Address:**

Sample type: SPLIT BARREL **Quantity:**

Sample source/Outside agency name:

Location used: **Examined for:** CLASSIFICATION

Comment:

Test Results

T-88	Sieve Analysis % Passing Total Sample
75 mm (3.0"):	
37.5 mm (1.5"):	
19 mm (3/4"):	
9.5 mm (3/8"):	
4.75 mm (#4):	100.0%
2.00 mm (#10):	100.0%
850 µm (#20):	
425 µm (#40):	99.9%
250 µm (#60):	98.5%
150 µm (#100):	76.7%
75 µm (#200):	15.0%

Hydrometer Analysis

Particles smaller	% total sample
0.05 mm:	
0.02 mm:	
0.005 mm:	
0.002 mm:	
0.001 mm:	

Limits

T-265 Moisture content: 3.9%

T-89 Liquid Limit:

T-90 Plastic Limit:

T-90 Plasticity Index: NP

Moisture Density

Test method: T-180 **Method:**

Maximum density: **pcf**

Optimum moisture:

T-100 Specific Gravity:

Gr:	0.0%	**D2487:**	SM	
Sa:	85.0%	**M145:**	A-2-4	Sand
Si:	15.0%			

Comments: GD-7 S-10

Reviewed by: Christopher C. Benda, PE, Soils & Foundations Engineer

HAMMER STUDY, WINDSOR

HOLE: GD-8 09/26/2008

DEPTH FT.	SAMPLE #	% MOIST.	CLASS.	DES.	% PASS 1.5“	% PASS 3/4“	% PASS 3/8”	% PASS #4	% PASS #10	% PASS #20	% PASS #40	% PASS #60	% PASS #100	% PASS #200
5-7	1	10.1	A-2-4	Sa					100	99.2	90.7	68.9	45.5	19.0
10-12	2	4.0	A-1-b	Gr Sa	100	86.4	84.7	78.6	68.1	57.5	37.2	11.5	6.6	3.9
15-17	3	3.7	A-1-b	Gr Sa		100	92.1	85.8	73.9	54.7	30.5	12.8	8.1	5.0
20-22	4	4.3	A-1-b	Gr Sa		100	97.8	92.1	77.8	52.8	29.6	13.8	8.2	5.1
25-27	5	4.5	A-1-b	Sa		100	96.1	90.6	80.4	56.7	23.6	13.2	9.1	6.0
30-32	6	7.4	A-2-4	Sa						100	99.2	92.9	62.4	18.4
35-37	7	12.6	A-2-4	Si Sa				100	99.4	92.8	78.2	65.7	48.7	28.0
40-42	8	26.1	A-4	Si		100	97.4	94.9	94.2	93.9	93.9	93.6	91.3	80.0
45-47	9	8.2	A-2-4	Si Sa			100	97.1	96.0	95.3	94.2	82.8	52.7	20.0
50-52	10	23.8	A-4	Si Sa				100	98.6	97.5	93.8	83.2	64.5	41.7

G:/Soils&Foundation/Projects/Hammer Study/Boring Logs/GD-8 samples

APPENDIX 5 – GRAIN-SIZE ANALYSES (BY SOIL LAYER)

						Hammer Efficiency, ETR (%)				Adjustment Factor, C_n			
Hammer Type	**Drill Rig**	**Vehicle #**	**Hammer Operator**	**SPT Test Date**	**Boring ID**	**MIN**	**MAX**	**AVG**	**>30'**	**MIN**	**MAX**	**AVG**	**>30'**
CME Automatic	CME 55 - Track	356675	Glen Porter	9/23/2008	GD-1	63.6	94.5	85	87.5	1.1	1.6	1.4	1.5
CME Automatic	CME 45C Skid-rig on trailer	277564	Howard Garrow	9/23/2008	GD-2	60.6	86.4	77.4	79.6	1	1.4	1.3	1.3
CME Automatic	CME 55 - Track	356675	Glen Porter	9/24/2008	GD-3	64.4	94.9	87.4	90.5	1.1	1.6	1.5	1.5
Safety	CME 45C Skid-rig on trailer	277564	Howard Garrow	9/24/2008	GD-4	40	82.4	66.3	69.2	0.7	1.4	1.1	1.2
CME Automatic	CME 75 - Track	200587	John Leonhardt	9/25/2008	GD-5	60.9	95.4	84	85.6	1	1.6	1.4	1.4
Safety	CME 75 - Track	200587	John Leonhardt	9/25/2008	GD-6	34.3	94.6	60.3	-	0.6	1.6	1	-
CME Automatic	CME 45C Track	306614	Glen Porter	9/26/2008	GD-7	65.6	92.4	80.6	80.2	1.1	1.5	1.3	1.3
CME Automatic	CME 45C Track	306614	Glen Porter	9/26/2008	GD-8	58.4	93.3	81.1	84.2	1	1.6	1.4	1.4
Mobile Safety Driver	Simco 2800		Chris Aldrich	9/29/2008	GD-9	32	62.9	48.1	51.0	0.5	1	0.8	0.9

Hammer Type	Drill Rig	Serial #	Rod type	Borehole Type Penetration Method	Owner	Hammer Operator	Testing Engineer	Location of Boring	Date and Start Time	Boring	Sample Depth (feet)		EMX (kip-ft)	EF2 (kip-ft)	ER (kip-ft)	ETR (%)	FMX (kips)	BPM (blows/ minute)	N	Cn	N60	ETR Average (%)	Cn Average	Depth to H_2O (ft)	Soil Description
Automatic Hammer - CME	CME 55 - Track	356675	AWJ	4 inch HW Casing	Vtrans	Glen Porter	Shawn Kelley	Miller Construction Yard, Windsor, VT	9/23/2008 10:00	GD-1	All depths	Average	0.297	0.377	0.350	85.0	27.4	52.6	14	1.4	20	85	1.4	43.8	cohesionless soil
												Std.Dev.	0.017	0.032	0.000	4.9	0.3	3.2							
												Maximum	0.331	0.423	0.350	94.5	28.2	53.8	22	1.6	35				
												Minimum	0.222	0.281	0.350	63.6	26.5	26.7	5	1.1	5				
											10'-12'	Average	0.249	0.284	0.350	71.2	27.1	52.8	5	1.2	6				Fine to Medium Sand and Gravel
												Std.Dev.	0.014	0.002	0.000	4.1	0.2	0.2							
												Maximum	0.272	0.288	0.350	77.7	27.5	53.0	5	1.3	6				
												Minimum	0.222	0.281	0.350	63.6	26.8	52.5	5	1.1	5				
											15'-17'	Average	0.278	0.332	0.350	79.3	27.4	52.9	9	1.3	12				Fine to Medium Sand and Gravel
												Std.Dev.	0.013	0.002	0.000	3.8	0.2	0.1							
												Maximum	0.292	0.337	0.350	83.5	27.8	53.1	9	1.4	13				
												Minimum	0.254	0.328	0.350	72.6	26.7	52.7	9	1.2	11				
				spin and wash ahead with roller bit							20'-22'	Average	0.299	0.360	0.350	85.3	27.1	53.4	18	1.4	26				Fine to Medium Sand and Gravel
												Std.Dev.	0.010	0.004	0.000	2.7	0.2	0.2							
												Maximum	0.319	0.370	0.350	91.1	27.4	53.7	18	1.5	27				
												Minimum	0.277	0.352	0.350	79.2	26.7	53.1	18	1.3	24				
											25'-27'	Average	0.296	0.384	0.350	84.6	27.2	53.1	6	1.4	8				Silty Fine Sand
												Std.Dev.	0.011	0.007	0.000	3.0	0.1	0.2							
												Maximum	0.330	0.407	0.350	94.2	27.6	53.3	6	1.6	9		ETR Average (>30') (%)		
												Minimum	0.286	0.376	0.350	81.8	26.9	52.8	6	1.4	8				
											30'-32'	Average	0.300	0.398	0.350	85.8	27.6	53.1	15	1.4	21				Silty Fine Sand
												Std.Dev.	0.004	0.005	0.000	1.1	0.2	0.1							
												Maximum	0.309	0.408	0.350	88.3	27.9	53.3	15	1.5	22				
												Minimum	0.294	0.389	0.350	84.1	27.1	52.7	15	1.4	21		87.5		
											35'-37'	Average	0.312	0.408	0.350	89.2	27.6	49.6	19	1.5	28				Silty Fine Sand
												Std.Dev.	0.004	0.007	0.000	1.2	0.2	9.3							
												Maximum	0.320	0.423	0.350	91.3	28.2	53.8	19	1.5	29				
												Minimum	0.305	0.398	0.350	87.1	27.2	26.7	19	1.5	28				
											40'-42'	Average	0.316	0.390	0.350	90.1	27.5	53.2	11	1.5	17				Silty Fine Sand
												Std.Dev.	0.005	0.014	0.000	1.4	0.1	0.2							
												Maximum	0.331	0.416	0.350	94.5	27.8	53.6	11	1.6	17				
												Minimum	0.305	0.361	0.350	87.1	27.1	52.8	11	1.5	16				
											45'-47'	Average	0.305	0.389	0.350	87.3	27.3	50.7	20	1.5	29				Fine Sand
												Std.Dev.	0.005	0.010	0.000	1.4	0.3	6.5							
												Maximum	0.313	0.411	0.350	89.5	27.7	53.7	20	1.5	30				
												Minimum	0.295	0.373	0.350	84.3	26.7	30.4	20	1.4	28				
											50'-52'	Average	0.298	0.391	0.350	85.2	27.4	52.8	22	1.4	31				Fine Sand
												Std.Dev.	0.005	0.006	0.000	1.5	0.3	0.2							
												Maximum	0.310	0.404	0.350	88.4	27.9	53.2	22	1.5	32				
												Minimum	0.286	0.372	0.350	81.7	26.5	52.3	22	1.4	30				
Automatic Hammer - CME	CME 45C skid rig on trailer	277564	AWJ	3 1/4" HSA with auger plug	Vtrans	Howard Garrow	Shawn Kelley	Miller Construction Yard, Windsor, VT	9/23/2008 12:25	GD-2	All depths	Average	0.271	0.353	0.350	77.4	25.5	59.8	14	1.3	18	77.4	1.3	47.0	cohesionless soil
												Std.Dev.	0.018	0.026	0.000	5.0	0.5	1.8							
												Maximum	0.302	0.399	0.350	86.4	26.8	63.6	20	1.4	29				
												Minimum	0.212	0.272	0.350	60.6	22.9	55.8	7	1.0	7				
											10'-12'	Average	0.237	0.287	0.350	67.7	25.4	59.3	9	1.1	10				Fine to Medium Sand and Gravel
												Std.Dev.	0.023	0.006	0.000	6.5	0.3	1.1							
												Maximum	0.290	0.299	0.350	82.9	25.8	60.5	9	1.4	12				
												Minimum	0.212	0.280	0.350	60.6	24.7	55.9	9	1.0	9				
											15'-17'	Average	0.250	0.323	0.350	71.3	25.9	62.1	18	1.2	21				Fine to Medium Sand and Gravel
												Std.Dev.	0.006	0.005	0.000	1.8	0.2	0.2							
												Maximum	0.264	0.335	0.350	75.3	26.2	62.6	18	1.3	23				
												Minimum	0.239	0.312	0.350	68.1	25.3	61.8	18	1.1	20				
											20'-22'	Average	0.278	0.351	0.350	79.5	25.8	61.9	16	1.3	21				Fine to Medium Sand and Gravel
												Std.Dev.	0.011	0.006	0.000	3.2	0.4	0.3							
												Maximum	0.299	0.369	0.350	85.4	26.8	62.8	16	1.4	23				
												Minimum	0.259	0.339	0.350	74.0	25.2	61.3	16	1.2	20				
											25'-27'	Average	0.269	0.360	0.350	76.9	26.0	61.1	7	1.3	9				Silty Fine Sand
												Std.Dev.	0.007	0.008	0.000	2.0	0.3	0.5							
				n/a								Maximum	0.288	0.376	0.350	82.3	26.5	62.3	7	1.4	10				
												Minimum	0.262	0.353	0.350	74.7	25.5	60.3	7	1.2	9				
											30'-32'	Average	0.270	0.370	0.350	77.1	25.8	60.3	14	1.3	18		ETR Average (>30') (%)		Silty Fine Sand
												Std.Dev.	0.004	0.005	0.000	1.0	0.3	1.4							
												Maximum	0.277	0.383	0.350	79.2	26.1	62.2	14	1.3	18				
												Minimum	0.265	0.363	0.350	75.8	25.2	55.8	14	1.3	18		79.6		
											35'-37'	Average	0.288	0.371	0.350	82.2	24.9	59.2	15	1.4	21				Silty Fine Sand
												Std.Dev.	0.006	0.004	0.000	1.6	0.5	0.3							
												Maximum	0.298	0.381	0.350	85.3	25.7	60.1	15	1.4	21				
												Minimum	0.278	0.361	0.350	79.4	23.9	58.8	15	1.3	20				
											40'-42'	Average	0.283	0.378	0.350	80.9	25.5	60.2	8	1.3	11				Silty Fine Sand
												Std.Dev.	0.006	0.007	0.000	1.7	0.3	0.5							
												Maximum	0.302	0.399	0.350	86.4	26.2	61.5	8	1.4	12				
												Minimum	0.274	0.367	0.350	78.4	24.9	59.4	8	1.3	10				
											45'-47'	Average	0.277	0.363	0.350	79.2	25.8	57.8	18	1.3	24				Fine Sand
												Std.Dev.	0.005	0.006	0.000	1.6	0.3	0.6							
												Maximum	0.291	0.380	0.350	83.3	26.6	60.4	18	1.4	25				
												Minimum	0.269	0.355	0.350	76.8	25.3	57.1	18	1.3	23				
											50'-52'	Average	0.275	0.362	0.350	78.6	25.3	57.4	20	1.3	26				Fine Sand
												Std.Dev.	0.005	0.006	0.000	1.3	0.3	0.6							
												Maximum	0.286	0.376	0.350	81.7	25.8	59.0	20	1.4	27				
												Minimum	0.265	0.346	0.350	75.8	24.7	56.1	20	1.3	25				

Hammer Type	Drill Rig	Serial #	Rod type	Borehole Type Penetration Method	Owner	Hammer Operator	Testing Engineer	Location of Boring	Date and Start Time	Boring	Sample Depth (feet)		EMX (kip-ft)	EF2 (kip-ft)	ER (kip-ft)	ETR (%)	FMX (kips)	BPM (blows/ minute)	N	Cn	N60	ETR Average (%)	Cn Average	Depth to H_2O (ft)	Soil Description
Automatic Hammer - CME	CME 55 - Track	356675	NWJ	4 inch HW Casing	Vtrans	Glen Porter	Shawn Kelley	Miller Construction Yard, Windsor, VT	9/24/2008 9:45	GD-3	All depths	Average	0.306	0.364	0.350	87.4	42.2	53.6	15	1.5	21	87.4	1.5	none	cohesionless soil
												Std.Dev.	0.019	0.031	0.000	5.4	2.3	0.2							
												Maximum	0.332	0.420	0.350	94.9	47.1	53.9	25	1.6	40				
												Minimum	0.225	0.270	0.350	64.4	39.0	53.0	4	1.1	4				
											5'-7'	Average	0.248	0.280	0.350	70.8	40.7	53.2	4	1.2	5				Fine Sand
												Std.Dev.	0.018	0.004	0.000	5.2	0.4	0.1							
												Maximum	0.274	0.284	0.350	78.3	41.4	53.3	4	1.3	5				
												Minimum	0.225	0.270	0.350	64.4	40.2	53.0	4	1.1	4				
											10'-12'	Average	0.284	0.319	0.350	81.2	41.3	53.5	13	1.4	18				Fine to Medium Sand and Gravel
												Std.Dev.	0.015	0.006	0.000	4.3	0.6	0.1							
												Maximum	0.327	0.332	0.350	93.5	42.3	53.7	13	1.6	20				
												Minimum	0.266	0.310	0.350	76.1	39.9	53.3	13	1.3	16				
				spin and wash ahead with roller bit							15'-17'	Average	0.304	0.349	0.350	86.8	41.8	53.5	16	1.4	23				Fine to Medium Sand and Gravel
												Std.Dev.	0.008	0.006	0.000	2.2	0.6	0.2							
												Maximum	0.327	0.370	0.350	93.4	43.1	53.8	16	1.6	25				
												Minimum	0.282	0.338	0.350	80.5	40.5	53.2	16	1.3	21				
											20'-22'	Average	0.308	0.363	0.350	88.0	39.8	53.6	17	1.5	25				Fine to Medium Sand and Gravel
												Std.Dev.	0.009	0.006	0.000	2.5	0.6	0.1							
												Maximum	0.331	0.372	0.350	94.6	41.3	53.9	17	1.6	27				
												Minimum	0.293	0.351	0.350	83.7	39.0	53.3	17	1.4	24				
											25'-27'	Average	0.307	0.374	0.350	87.8	41.6	53.7	8	1.5	12				Silty Fine Sand
												Std.Dev.	0.005	0.009	0.000	1.5	1.0	0.1							
												Maximum	0.317	0.396	0.350	90.6	43.3	53.9	8	1.5	12				
												Minimum	0.297	0.358	0.350	85.0	39.6	53.4	8	1.4	11				
											30'-32'	Average	0.307	0.371	0.350	87.7	41.0	53.6	19	1.5	28		ETR Average (>30') (%)		Silty Fine Sand
												Std.Dev.	0.009	0.009	0.000	2.5	0.5	0.2							
												Maximum	0.329	0.384	0.350	94.1	42.2	53.9	19	1.6	30				
												Minimum	0.290	0.333	0.350	82.9	39.8	53.2	19	1.4	26		90.5		
											32'-34'	Average	0.327	0.404	0.350	93.3	46.3	53.5	25	1.6	39				Silty Fine Sand
												Std.Dev.	0.003	0.011	0.000	0.9	0.5	0.1							
												Maximum	0.332	0.420	0.350	94.9	47.1	53.8	25	1.6	40				
												Minimum	0.318	0.383	0.350	90.8	44.6	53.4	25	1.5	38				
Safety Hammer	CME 45C skid rig on trailer	277564	AWJ	3 1/4" HSA with auger plug	Vtrans	Howard Garrow	Shawn Kelley	Miller Construction Yard, Windsor, VT	9/24/2008 13:30	GD-4	All depths	Average	0.232	0.267	0.350	66.3	19.2	31.1	16	1.1	17	66.3	1.1	42.0	cohesionless soil
												Std.Dev.	0.027	0.049	0.000	7.7	1.3	3.4							
												Maximum	0.288	0.357	0.350	82.4	21.8	39.1	24	1.4	33				
												Minimum	0.140	0.128	0.350	40.0	15.0	19.4	4	0.7	3				
											5'-7'	Average	0.204	0.165	0.350	58.3	18.5	30.1	4	1.0	4				Fine Sand
												Std.Dev.	0.033	0.012	0.000	9.4	0.8	1.8							
												Maximum	0.273	0.184	0.350	78.0	19.8	32.9	4	1.3	5				
												Minimum	0.158	0.144	0.350	45.0	17.1	27.5	4	0.8	3				
											10'-12'	Average	0.194	0.173	0.350	55.5	16.9	20.2	14	0.9	13				Fine to Medium Sand and Gravel
												Std.Dev.	0.019	0.019	0.000	5.6	0.9	0.6							
												Maximum	0.224	0.205	0.350	64.1	18.2	20.8	14	1.1	15				
												Minimum	0.140	0.128	0.350	40.0	15.0	19.4	14	0.7	9				
				n/a							15'-17'	Average	0.199	0.237	0.350	56.8	19.1	24.8	5	0.9	5				Fine to Medium Sand and Gravel
												Std.Dev.	0.019	0.021	0.000	5.4	0.9	2.6							
												Maximum	0.220	0.263	0.350	63.0	20.1	27.0	5	1.0	5				
												Minimum	0.174	0.209	0.350	49.6	17.7	21.2	5	0.8	4				
											20'-22'	Average	0.216	0.237	0.350	61.7	18.2	29.6	21	1.0	22				Fine to Medium Sand and Gravel
												Std.Dev.	0.018	0.018	0.000	5.2	0.7	2.9							
												Maximum	0.252	0.280	0.350	72.1	19.8	34.0	21	1.2	25				
												Minimum	0.172	0.200	0.350	49.2	16.9	19.5	21	0.8	17				
											25'-27'	Average	0.231	0.255	0.350	66.0	18.9	34.9	16	1.1	18				Silty Fine Sand
												Std.Dev.	0.022	0.024	0.000	6.3	1.0	1.7							
												Maximum	0.281	0.300	0.350	80.3	20.9	39.1	16	1.3	21				
												Minimum	0.190	0.208	0.350	54.3	16.9	31.7	16	0.9	14				
											30'-32'	Average	0.237	0.278	0.350	67.7	18.9	31.0	18	1.1	20		Average (>30') (%)		Silty Fine Sand
												Std.Dev.	0.025	0.027	0.000	7.1	0.9	2.7							
												Maximum	0.279	0.329	0.350	79.7	20.6	36.5	18	1.3	24				
												Minimum	0.190	0.220	0.350	54.4	16.4	22.3	18	0.9	16		69.2		
											35'-37'	Average	0.246	0.293	0.350	70.3	19.8	30.5	23	1.2	27				Silty Fine Sand
												Std.Dev.	0.016	0.018	0.000	4.6	0.6	4.0							
												Maximum	0.280	0.335	0.350	80.1	20.9	36.0	23	1.3	31				
												Minimum	0.206	0.243	0.350	58.9	17.9	19.7	23	1.0	23				
											40'-42'	Average	0.230	0.281	0.350	65.7	19.4	32.2	11	1.1	12				Silty Fine Sand
												Std.Dev.	0.021	0.024	0.000	5.9	0.8	3.2							
												Maximum	0.288	0.342	0.350	82.4	21.1	35.7	11	1.4	15				
												Minimum	0.193	0.236	0.350	55.2	17.8	24.7	11	0.9	10				
											45'-47'	Average	0.248	0.305	0.350	70.9	204.0	31.0	24	1.2	28				Fine Sand
												Std.Dev.	0.020	0.028	0.000	5.8	0.9	2.3							
												Maximum	0.286	0.357	0.350	81.8	21.8	35.7	24	1.4	33				
												Minimum	0.165	0.201	0.350	47.1	16.3	22.4	24	0.8	19				
											50'-52'	Average	0.251	0.315	0.350	71.6	20.4	31.1	21	1.2	25				Fine Sand
												Std.Dev.	0.016	0.021	0.000	4.7	0.7	2.6							
												Maximum	0.279	0.351	0.350	79.7	21.7	34.2	21	1.3	28				
												Minimum	0.216	0.272	0.350	61.8	19.0	23.2	21	1.0	22				

Hammer Type	Drill Rig	Serial #	Rod type	Borehole Type Penetration Method	Owner	Hammer Operator	Testing Engineer	Location of Boring	Date and Start Time	Boring	Sample Depth (feet)		EMX (kip-ft)	EF2 (kip-ft)	ER (kip-ft)	ETR (%)	FMX (kips)	BPM (blows/ minute)	N	Cn	N60	ETR Average (%)	Cn Average	Depth to H_2O (ft)	Soil Description
Automatic Hammer - CME	CME 75 - track	200587	AWJ	4 1/4" HSA with auger plug	Transtech	John Leonhardt	Shawn Kelley	Miller Construction Yard, Windsor, VT	9/25/2008 9:50	GD-5	All depths	Average	0.294	0.388	0.350	84.0	26.6	51.3	10	1.4	14	84.0	1.4	48.0	cohesionless soil
												Std.Dev.	0.018	0.027	0.000	5.3	0.7	5.9							
												Maximum	0.334	0.437	0.350	95.4	27.8	58.6	16	1.6	25				
												Minimum	0.213	0.296	0.350	60.9	24.8	33.4	3	1.0	3				
											10'-12'	Average	0.249	0.307	0.350	71.1	26.1	45.9	5	1.2	6				Fine Sand
												Std.Dev.	0.023	0.005	0.000	6.6	0.3	1.0							
												Maximum	0.276	0.312	0.350	78.8	26.4	47.2	5	1.3	7				
												Minimum	0.213	0.296	0.350	60.9	25.4	44.3	5	1.0	5				
											15'-17'	Average	0.302	0.361	0.350	86.3	26.6	55.7	7	1.4	10				Fine Sand
												Std.Dev.	0.019	0.012	0.000	5.4	0.4	1.3							
												Maximum	0.334	0.382	0.350	95.4	27.4	56.7	7	1.6	11				
												Minimum	0.256	0.337	0.350	73.2	25.7	51.8	7	1.2	9				
				n/a							20'-22'	Average	0.291	0.380	0.350	83.1	27.4	53.4	12	1.4	17				Fine to Medium Sand and Gravel
												Std.Dev.	0.012	0.011	0.000	3.4	0.5	2.4							
												Maximum	0.317	0.392	0.350	90.4	27.8	54.5	12	1.5	18				
												Minimum	0.260	0.341	0.350	74.2	25.7	43.9	12	1.2	15				
											25'-27'	Average	0.276	0.375	0.350	79.0	25.7	47.1	3	1.3	4				Silty Fine Sand
												Std.Dev.	0.011	0.016	0.000	3.0	0.6	6.6							
												Maximum	0.286	0.392	0.350	81.7	26.6	52.7	3	1.4	4				
												Minimum	0.259	0.347	0.350	74.0	24.8	33.4	3	1.2	4				
											30'-32'	Average	0.275	0.371	0.350	78.6	25.9	42.0	16	1.3	21		ETR Average (>30') (%)		Silty Fine Sand
												Std.Dev.	0.005	0.007	0.000	1.5	0.3	3.4							
												Maximum	0.289	0.383	0.350	82.5	26.5	45.7	16	1.4	22				
												Minimum	0.262	0.352	0.350	74.8	25.0	37.4	16	1.2	20		85.6		
											35'-37'	Average	0.302	0.406	0.350	86.3	26.0	51.8	12	1.4	17				Silty Fine Sand
												Std.Dev.	0.004	0.005	0.000	1.2	0.5	0.3							
												Maximum	0.310	0.413	0.350	88.5	27.0	52.5	12	1.5	18				
												Minimum	0.291	0.395	0.350	83.2	25.3	51.1	12	1.4	17				
											40'-42'	Average	0.311	0.420	0.350	88.7	27.2	57.7	13	1.5	19				Silty Fine Sand
												Std.Dev.	0.007	0.007	0.000	1.9	0.2	0.4							
												Maximum	0.322	0.431	0.350	92.1	27.6	58.6	13	1.5	20				
												Minimum	0.295	0.402	0.350	84.3	26.8	57.0	13	1.4	18				
											45'-47'	Average	0.301	0.400	0.350	85.9	27.0	53.2	13	1.4	19				Fine Sand
												Std.Dev.	0.004	0.005	0.000	1.2	0.2	1.0							
												Maximum	0.315	0.411	0.350	89.9	27.5	54.1	13	1.5	20				
												Minimum	0.294	0.390	0.350	83.9	26.4	50.5	13	1.4	18				
											50'-52'	Average	0.310	0.418	0.350	88.6	26.9	53.7	6	1.5	9				Fine Sand
												Std.Dev.	0.006	0.009	0.000	1.7	0.4	1.3							
												Maximum	0.324	0.437	0.350	92.6	27.3	54.7	6	1.5	9				
												Minimum	0.301	0.403	0.350	85.9	26.0	50.6	6	1.4	9				
Safety Hammer	CME 75 - track	200587	AWJ	3 1/4" HSA with auger plug	Transtech	John Leonhardt	Shawn Kelley	Miller Construction Yard, Windsor, VT	9/25/2008 13:40	GD-6	All depths	Average	0.211	0.244	0.350	60.3	21.9	55.7	15	1.0	15	60.3	1.0	none	cohesionless soil
												Std.Dev.	0.038	0.049	0.000	10.9	1.7	2.3							
												Maximum	0.331	0.329	0.350	94.6	24.8	61.7	27	1.6	43				
												Minimum	0.120	0.139	0.350	34.3	16.5	48.7	8	0.6	5				
											5'-7'	Average	0.200	0.187	0.350	57.3	22.3	54.4	8	1.0	8				Fine Sand
												Std.Dev.	0.023	0.020	0.000	6.5	1.0	1.8							
												Maximum	0.235	0.218	0.350	67.2	23.8	57.1	8	1.1	9				
												Minimum	0.158	0.156	0.350	45.2	20.2	50.7	8	0.8	6				
											10'-12'	Average	0.233	0.235	0.350	66.4	22.6	55.7	13	1.1	14				Fine Sand
												Std.Dev.	0.040	0.023	0.000	11.3	1.1	1.7							
												Maximum	0.331	0.281	0.350	94.6	24.7	58.8	13	1.6	20				
												Minimum	0.161	0.163	0.350	46.1	19.4	51.6	13	0.8	10				
											15'-17'	Average	0.185	0.218	0.350	52.8	20.6	57.4	27	0.9	24				Fine to Medium Sand and Gravel
												Std.Dev.	0.039	0.044	0.000	11.2	1.9	2.4							
												Maximum	0.281	0.321	0.350	80.2	24.8	61.7	27	1.3	36				
												Minimum	0.120	0.139	0.350	34.3	16.5	48.7	27	0.6	15				
											20'-22'	Average	0.226	0.283	0.350	64.6	22.6	55.0	18	1.1	19				Fine to Medium Sand and Gravel
												Std.Dev.	0.024	0.029	0.000	6.9	1.2	1.0							
												Maximum	0.262	0.322	0.350	74.7	24.3	56.5	18	1.2	22				
												Minimum	0.159	0.203	0.350	45.3	19.5	51.4	18	0.8	14				
											25'-27'	Average	0.227	0.290	0.350	64.8	22.8	54.1	9	1.1	10				Silty Fine Sand
												Std.Dev.	0.025	0.033	0.000	7.0	1.3	2.1							
												Maximum	0.255	0.329	0.350	73.0	24.1	61.2	9	1.2	11				
												Minimum	0.138	0.173	0.350	39.4	18.0	50.4	9	0.7	6				

Hammer Type	Drill Rig	Serial #	Rod type	Borehole Type Penetration Method	Owner	Hammer Operator	Testing Engineer	Location of Boring	Date and Start Time	Boring	Sample Depth (feet)		EMX (kip-ft)	EF2 (kip-ft)	ER (kip-ft)	ETR (%)	FMX (kips)	BPM (blows/ minute)	N	Cn	N60	ETR Average (%)	Cn Average	Depth to H_2O (ft)	Soil Description
Automatic Hammer - CME	CME 45C Track	306614	AWJ	3 1/4" HSA with auger plug	Vtrans	Glen Porter	Shawn Kelley	Miller Construction Yard, Windsor, VT	9/26/2008 9:00	GD-7	All depths	Average	0.282	0.351	0.350	80.6	25.0	53.5	14	1.3	19	80.6	1.3	50.0	cohesionless soil
												Std.Dev.	0.014	0.019	0.000	3.9	0.9	1.9							
												Maximum	0.323	0.391	0.350	92.4	26.5	55.0	22	1.5	34				
												Minimum	0.230	0.282	0.350	65.6	22.8	26.7	7	1.1	8				
											10'-12'	Average	0.257	0.302	0.350	73.5	25.8	53.6	7	1.2	9				Fine to Medium Sand and Gravel
												Std.Dev.	0.018	0.011	0.000	5.2	0.4	0.8							
												Maximum	0.283	0.318	0.350	81.0	26.4	54.5	7	1.3	9				
												Minimum	0.230	0.282	0.350	65.6	25.0	52.3	7	1.1	8				
											15'-17'	Average	0.292	0.324	0.350	83.4	25.1	52.8	22	1.4	31				Fine to Medium Sand and Gravel
												Std.Dev.	0.010	0.007	0.000	2.8	0.6	4.3							
												Maximum	0.313	0.340	0.350	89.4	26.2	55.0	22	1.5	33				
												Minimum	0.267	0.309	0.350	76.3	23.8	26.7	22	1.3	28				
											20'-22'	Average	0.295	0.354	0.350	84.3	24.1	53.5	16	1.4	22				Fine to Medium Sand and Gravel
												Std.Dev.	0.015	0.006	0.000	4.2	1.0	0.8							
												Maximum	0.323	0.368	0.350	92.4	26.2	54.2	16	1.5	25				
												Minimum	0.270	0.342	0.350	77.0	22.9	49.7	16	1.3	21				
											25'-27'	Average	0.271	0.361	0.350	77.5	25.7	53.7	20	1.3	26				Fine to Medium Sand and Gravel
												Std.Dev.	0.006	0.006	0.000	1.6	0.4	0.3							
												Maximum	0.280	0.375	0.350	80.0	26.4	54.5	20	1.3	27				
												Minimum	0.260	0.347	0.350	74.4	25.0	53.2	20	1.2	25				
											30'-32'	Average	0.275	0.361	0.350	78.6	24.9	53.6	8	1.3	10		ETR Average (>30') (%)		Silty Fine Sand
												Std.Dev.	0.006	0.007	0.000	1.8	0.3	0.4							
												Maximum	0.287	0.374	0.350	81.9	25.6	54.1	8	1.4	11				
												Minimum	0.263	0.348	0.350	75.0	24.4	52.6	8	1.3	10		80.2		
											35'-37'	Average	0.283	0.369	0.350	80.8	25.7	53.8	11	1.3	15				Silty Fine Sand
												Std.Dev.	0.005	0.007	0.000	1.5	0.4	0.4							
												Maximum	0.294	0.391	0.350	84.0	26.3	54.6	11	1.4	15				
												Minimum	0.273	0.358	0.350	78.0	25.0	53.2	11	1.3	14				
											40'-42'	Average	0.291	0.376	0.350	83.1	26.0	53.8	9	1.4	12				Silty Fine Sand
												Std.Dev.	0.005	0.006	0.000	1.5	0.3	0.4							
												Maximum	0.302	0.385	0.350	86.4	26.5	54.5	9	1.4	13				
												Minimum	0.281	0.363	0.350	80.4	25.2	52.7	9	1.3	12				
											45'-47'	Average	0.270	0.345	0.350	77.2	25.0	53.6	20	1.3	26				Silty Fine Sand
												Std.Dev.	0.007	0.009	0.000	2.1	0.5	0.3							
												Maximum	0.285	0.366	0.350	81.4	26.2	54.3	20	1.4	27				
												Minimum	0.256	0.329	0.350	73.1	24.3	52.9	20	1.2	24				
											50'-52'	Average	0.284	0.354	0.350	81.1	24.1	53.6	17	1.4	23				Fine Sand
												Std.Dev.	0.008	0.008	0.000	2.3	0.7	0.5							
												Maximum	0.296	0.374	0.350	84.7	25.8	54.6	17	1.4	24				
												Minimum	0.268	0.336	0.350	76.5	22.8	52.7	17	1.3	22				

Hammer Type	Drill Rig	Serial #	Rod type	Borehole Type Penetration Method	Owner	Hammer Operator	Testing Engineer	Location of Boring	Date and Start Time	Boring
Automatic Hammer - CME	CME 45C - Track	306614	NWJ	3 1/4" HSA with auger plug	Vtrans	Glen Porter	Shawn Kelley	Miller Construction Yard, Windsor, VT	9/26/2008 12:05	GD-8

Sample Depth (feet)		EMX (kip-ft)	EF2 (kip-ft)	ER (kip-ft)	ETR (%)	FMX (kips)	BPM (blows/ minute)	N	Cn	N60	ETR Average (%)	Cn Average	Depth to H_2O (ft)	Soil Description
All depths	Average	0.284	0.338	0.350	81.1	40.3	51.7	13	1.4	17	81.1	1.4	40.0	cohesionless soil
	Std.Dev.	0.020	0.025	0.000	5.8	0.9	5.1							
	Maximum	0.327	0.372	0.350	93.3	42.7	54.8	22	1.6	34				
	Minimum	0.204	0.246	0.350	58.4	37.6	26.8	5	1.0	5				
5'-7'	Average	0.238	0.254	0.350	67.9	39.6	52.3	5	1.1	6				Fine Sand
	Std.Dev.	0.031	0.006	0.000	8.8	0.8	0.3							
	Maximum	0.299	0.267	0.350	85.3	40.6	52.7	5	1.4	7				
	Minimum	0.204	0.246	0.350	58.4	38.0	51.6	5	1.0	5				
10'-12'	Average	0.254	0.312	0.350	72.7	40.7	53.8	9	1.2	11				Fine to Medium Sand and Gravel
	Std.Dev.	0.012	0.005	0.000	3.3	0.5	0.4							
	Maximum	0.281	0.323	0.350	80.2	41.6	54.4	9	1.3	12				
	Minimum	0.243	0.303	0.350	69.3	39.9	53.2	9	1.2	10				
15'-17'	Average	0.292	0.329	0.350	83.6	39.9	51.8	17	1.4	24				Fine to Medium Sand and Gravel
	Std.Dev.	0.016	0.008	0.000	4.7	0.9	2.4							
	Maximum	0.327	0.348	0.350	93.3	41.8	52.8	17	1.6	26				
	Minimum	0.269	0.312	0.350	76.9	37.6	40.1	17	1.3	22				
20'-22'	Average	0.279	0.345	0.350	79.7	39.9	53.5	18	1.3	24				Fine to Medium Sand and Gravel
	Std.Dev.	0.006	0.008	0.000	1.8	0.7	0.4							
	Maximum	0.300	0.367	0.350	85.6	40.9	54.2	18	1.4	26				
	Minimum	0.268	0.323	0.350	76.7	38.2	52.6	18	1.3	23				
25'-27'	Average	0.292	0.338	0.350	83.3	40.2	40.9	22	1.4	31				Fine to Medium Sand and Gravel
	Std.Dev.	0.006	0.010	0.000	1.8	0.8	10.0							
	Maximum	0.307	0.357	0.350	87.8	41.9	54.8	22	1.5	32				
	Minimum	0.279	0.321	0.350	79.7	38.4	26.8	22	1.3	29				
30'-32'	Average	0.299	0.354	0.350	85.4	41.3	53.9	9	1.4	13		ETR Average (>30') (%)		Silty Fine Sand
	Std.Dev.	0.004	0.008	0.000	1.2	0.7	0.3							
	Maximum	0.308	0.369	0.350	88.1	42.7	54.3	9	1.5	13				
	Minimum	0.288	0.335	0.350	82.2	39.4	53.4	9	1.4	12		84.2		
35'-37'	Average	0.295	0.355	0.350	84.2	40.5	51.5	10	1.4	14				Silty Fine Sand
	Std.Dev.	0.004	0.003	0.000	1.1	0.6	3.3							
	Maximum	0.301	0.361	0.350	86.0	41.5	52.7	10	1.4	14				
	Minimum	0.286	0.350	0.350	81.8	39.3	37.4	10	1.4	14				
40'-42'	Average	0.290	0.357	0.350	82.9	40.6	53.5	10	1.4	14				Silty Fine Sand
	Std.Dev.	0.013	0.007	0.000	3.7	1.0	0.2							
	Maximum	0.319	0.372	0.350	91.2	42.0	54.0	10	1.5	15				
	Minimum	0.260	0.349	0.350	74.2	39.1	53.1	10	1.2	12				
45'-47' ** only 2 blows	Average	0.238	0.346	0.350	68.2	40.6	52.5	16	1.1	18				Fine Sand
	Std.Dev.	0.011	0.004	0.000	3.3	0.1	0.0							
	Maximum	0.250	0.350	0.350	71.5	40.8	52.5	16	1.2	19				
	Minimum	0.227	0.342	0.350	64.9	40.5	52.5	16	1.1	17				
50'-52' **	Average			0.350				15						Fine Sand
	Std.Dev.			0.000										
	Maximum			0.350				15						
	Minimum			0.350				15						

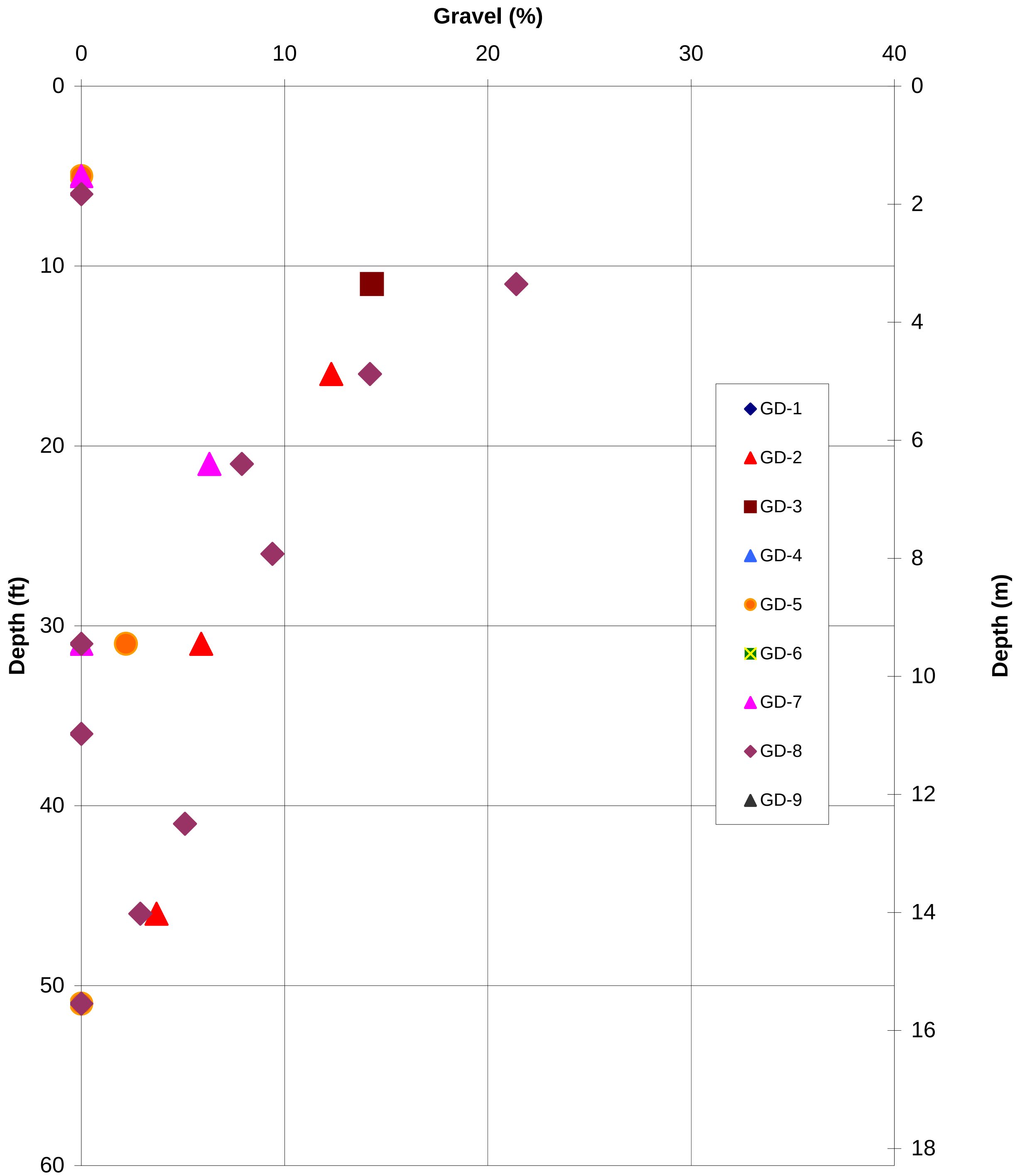
Hammer Type	Drill Rig	Serial #	Rod type	Borehole Type Penetration Method	Owner	Hammer Operator	Testing Engineer	Location of Boring	Date and Start Time	Boring	Sample Depth (feet)		EMX (kip-ft)	EF2 (kip-ft)	ER (kip-ft)	ETR (%)	FMX (kips)	BPM (blows/ minute)	N	Cn	N60	ETR Average (%)	Cn Average	Depth to H_2O (ft)	Soil Description
Safety Driver Hammer - Mobile	Simco 2800		AWJ	4 1/4" HSA with auger plug	Specialty Drilling & Investigation	Chris Aldrich	Shawn Kelley	Miller Construction Yard, Windsor, VT	9/29/2008 9:45	GD-9	All depths	Average	0.168	0.197	0.350	48.1	18.3	46.1	25	0.8	20	48.1	0.8	50.0	cohesionless soil
												Std.Dev.	0.020	0.028	0.000	5.7	0.9	2.7							
												Maximum	0.220	0.255	0.350	62.9	20.6	53.3	52	1.0	54				
												Minimum	0.112	0.109	0.350	32.0	15.2	38.3	9	0.5	5				
											5'-7'	Average	0.135	0.120	0.350	38.5	17.0	41.7	9	0.6	6				Fine Sand
												Std.Dev.	0.014	0.009	0.000	4.0	1.0	2.3							
												Maximum	0.167	0.145	0.350	47.6	19.5	45.4	9	0.8	7				
												Minimum	0.112	0.109	0.350	32.0	15.7	38.3	9	0.5	5				
											10'-12'	Average	0.162	0.156	0.350	46.4	18.1	45.1	9	0.8	7				Fine Sand
												Std.Dev.	0.026	0.013	0.000	7.5	0.7	1.5							
												Maximum	0.218	0.176	0.350	62.4	19.3	48.5	9	1.0	9				
												Minimum	0.115	0.131	0.350	33.0	17.1	42.5	9	0.5	5				
											15'-17'	Average	0.182	0.177	0.350	51.9	18.2	44.0	29	0.9	25				Fine to Medium Sand and Gravel
												Std.Dev.	0.018	0.016	0.000	5.0	1.2	2.0							
												Maximum	0.211	0.208	0.350	60.2	20.3	48.2	29	1.0	29				
												Minimum	0.145	0.140	0.350	41.5	15.2	39.9	29	0.7	20				
											20'-22'	Average	0.170	0.203	0.350	48.4	18.6	47.7	31	0.8	25				Fine to Medium Sand and Gravel
												Std.Dev.	0.017	0.017	0.000	4.8	1.0	1.8							
												Maximum	0.204	0.239	0.350	58.4	20.6	53.3	31	1.0	30				
												Minimum	0.127	0.159	0.350	36.2	16.5	44.4	31	0.6	19				
											25'-27'	Average	0.156	0.196	0.350	44.5	18.1	48.6	52	0.7	39				Fine to Medium Sand and Gravel
												Std.Dev.	0.012	0.012	0.000	3.4	0.6	1.8							
												Maximum	0.197	0.227	0.350	56.3	19.4	52.0	52	0.9	49				
												Minimum	0.128	0.163	0.350	36.6	16.8	44.8	52	0.6	32				
											30'-32'	Average	0.181	0.224	0.350	51.6	18.8	43.7	14	0.9	12		ETR Average (>30') (%)		Silty Fine Sand
												Std.Dev.	0.017	0.012	0.000	4.8	0.6	1.9							
												Maximum	0.220	0.249	0.350	62.9	20.0	46.8	14	1.0	15				
												Minimum	0.156	0.202	0.350	44.6	17.3	39.6	14	0.7	10		51.0		
											35'-37'	Average	0.174	0.221	0.350	49.9	18.3	47.3	22	0.8	18				Silty Fine Sand
												Std.Dev.	0.010	0.012	0.000	3.0	0.7	1.7							
												Maximum	0.203	0.246	0.350	58.0	19.7	51.9	22	1.0	21				
												Minimum	0.156	0.194	0.350	44.6	16.4	43.9	22	0.7	16				
											40'-42'	Average	0.169	0.215	0.350	48.2	18.2	44.9	27	0.8	22				Silty Fine Sand
												Std.Dev.	0.017	0.020	0.000	4.7	0.9	1.8							
												Maximum	0.219	0.255	0.350	62.6	19.8	49.8	27	1.0	28				
												Minimum	0.131	0.168	0.350	37.5	16.2	39.9	27	0.6	17				
											45'-47' ** only 6 blows	Average	0.191	0.231	0.350	54.4	18.9	47.0	32	0.9	29				Silty Fine Sand
												Std.Dev.	0.024	0.009	0.000	6.8	0.5	1.5							
												Maximum	0.219	0.244	0.350	62.6	19.5	49.6	32	1.0	33				
												Minimum	0.142	0.218	0.350	40.5	18.0	45.3	32	0.7	22				
											50'-52' **	Average			0.350				26						Silty Fine Sand
												Std.Dev.			0.000										
												Maximum			0.350				26						
												Minimum			0.350				26						

Legend:
EMX (kip-ft) = the energy delivered by the hammer to the top of the drill string as determined by the EMX method
EF2 (kip-ft) = the energy delivered by the hammer to the top of the drill string as determined by the F-squared method
ER (kip-ft) = 0.35 kip-ft, the theoretical free hall hammer energy for the SPT hammers
ETR (%) = EMX/ER, energy transfer ratio, the efficiency of the hammer as calculated by the SPT Analyzer
FMX (kips) = the force delivered by the hammer
BPM (blows / minute) = the operating rate of the hammer in blows per minute
N = the number of blow counts required to drive the SPT sampler over the depth interval of 6 inches to 18 inches for an 24-inch sampling episode
N_{60} = {(N x EMX) / (0.60 x ER)} = {(N/0.60) x ETR}, the N-value adjusted to a hammer efficiency of 60 percent
C_η = {(ETR / 0.60)} = {EMX / (0.60 x ER)} = {(N_{60} / N) x 60}, the adjustment factor by which the N-value should be multiplied in order to obtain N_{60}

** Acceleration data erratic

APPENDIX 6 – EXAMPLE OF SPT ANALYZER FIELD DATA (FORCE – VELOCITY PLOTS)

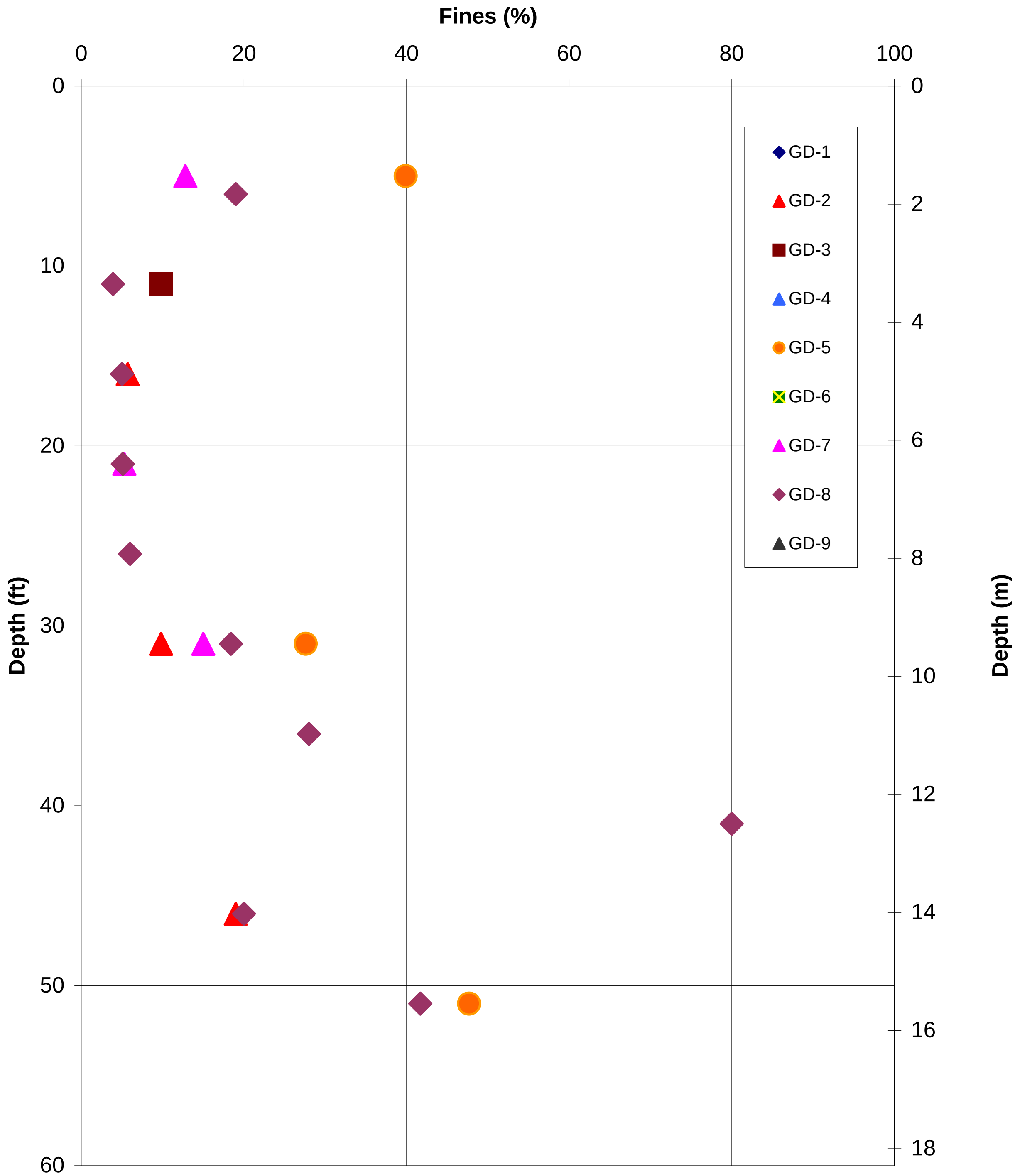
SPT Hammer Energy Variability Evaluation
Windsor, VT



GeoDesign, Inc.
Windsor, VT
Job No. 750-5.7

Vtrans # RSCH012-703

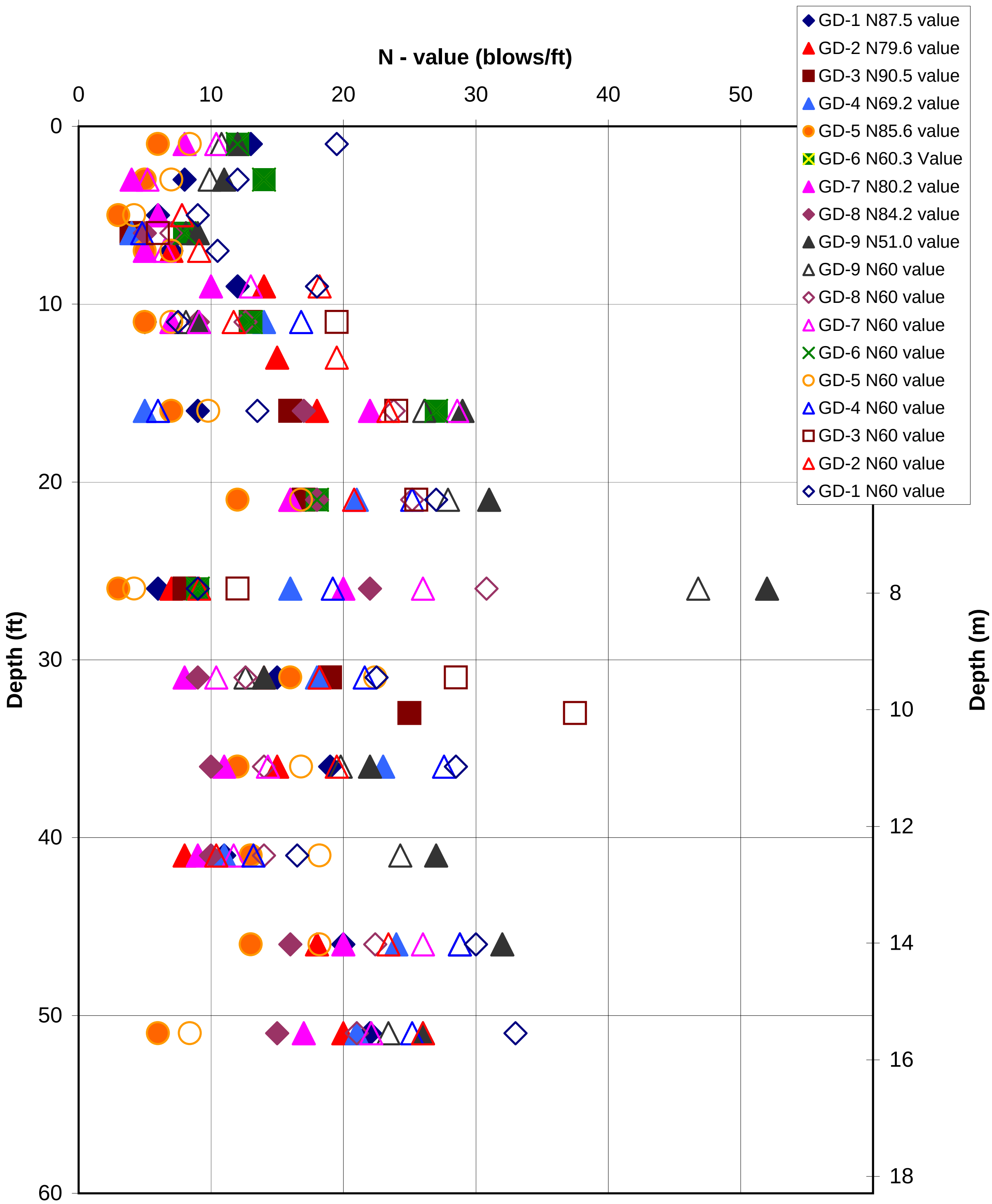
SPT Hammer Energy Variability Evaluation
Windsor, VT



GeoDesign, Inc.
Windsor, VT
Job No. 750-5.7

Vtrans # RSCH012-703

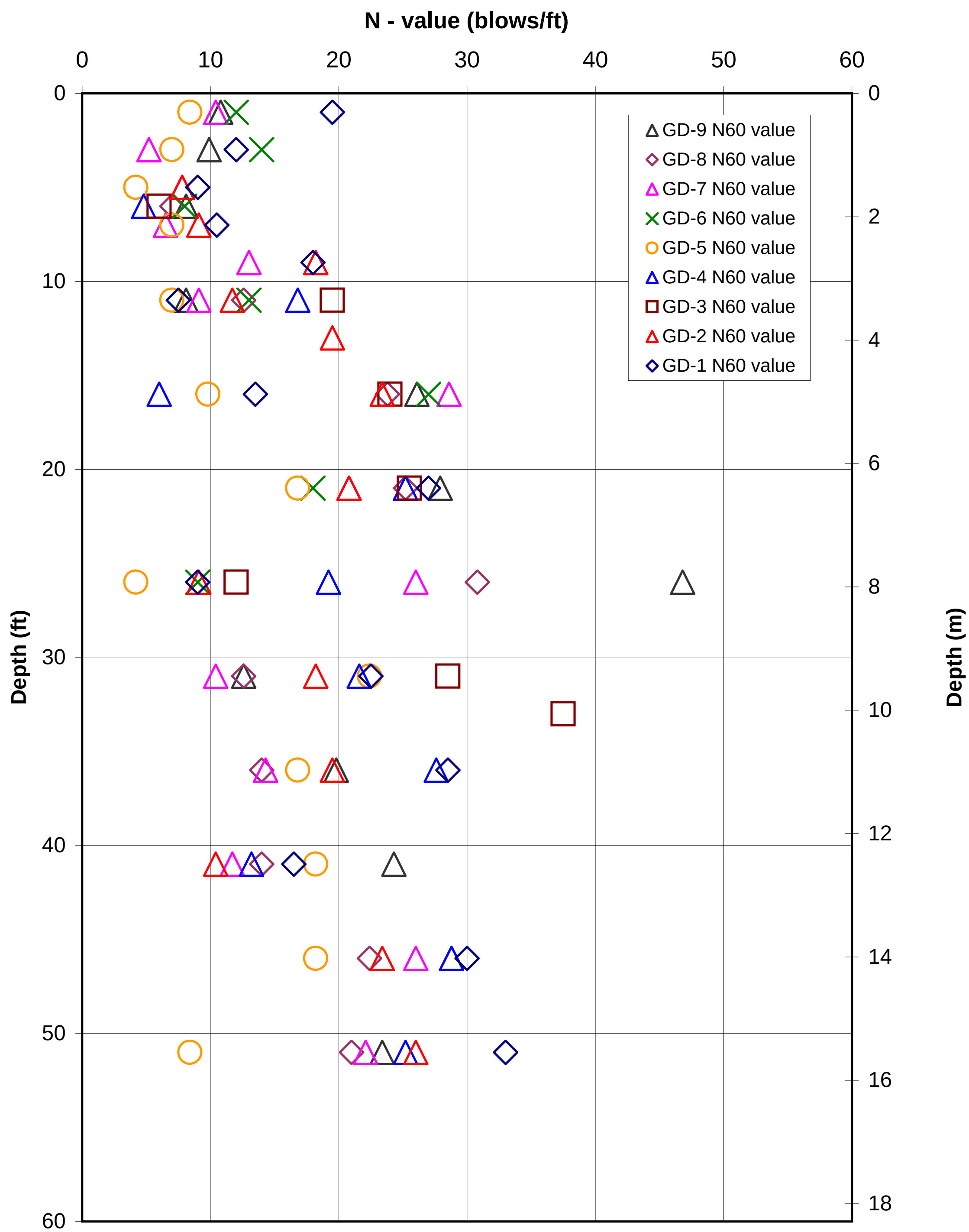
SPT Hammer Energy Variability Evaluation
Windsor, VT



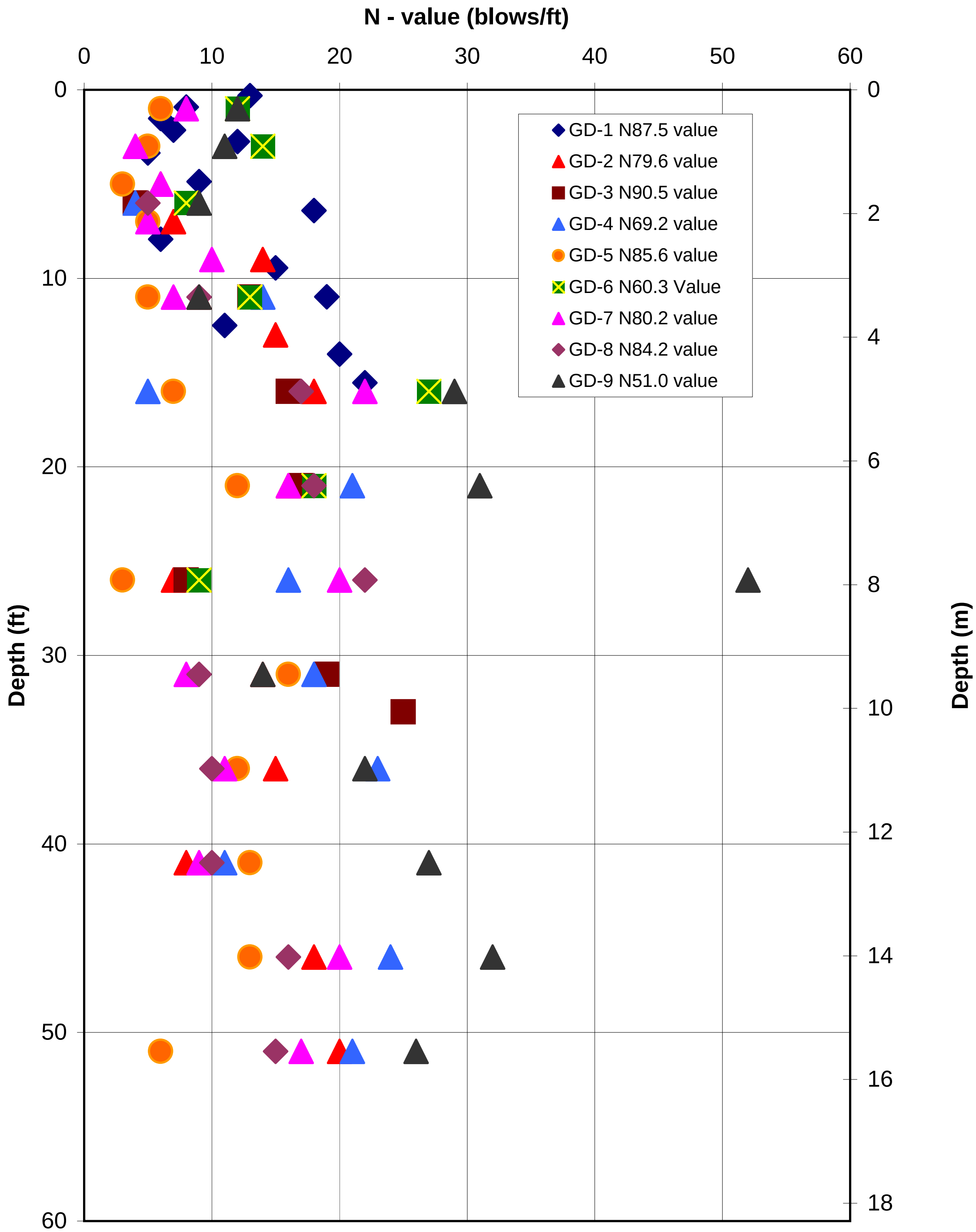
GeoDesign, Inc.
Windsor, VT
Job No. 750-5.7

Vtrans # RSCH012-703

SPT Hammer Energy Variability
Evaluation Windsor, VT



SPT Hammer Energy Variability Evaluation
Windsor, VT

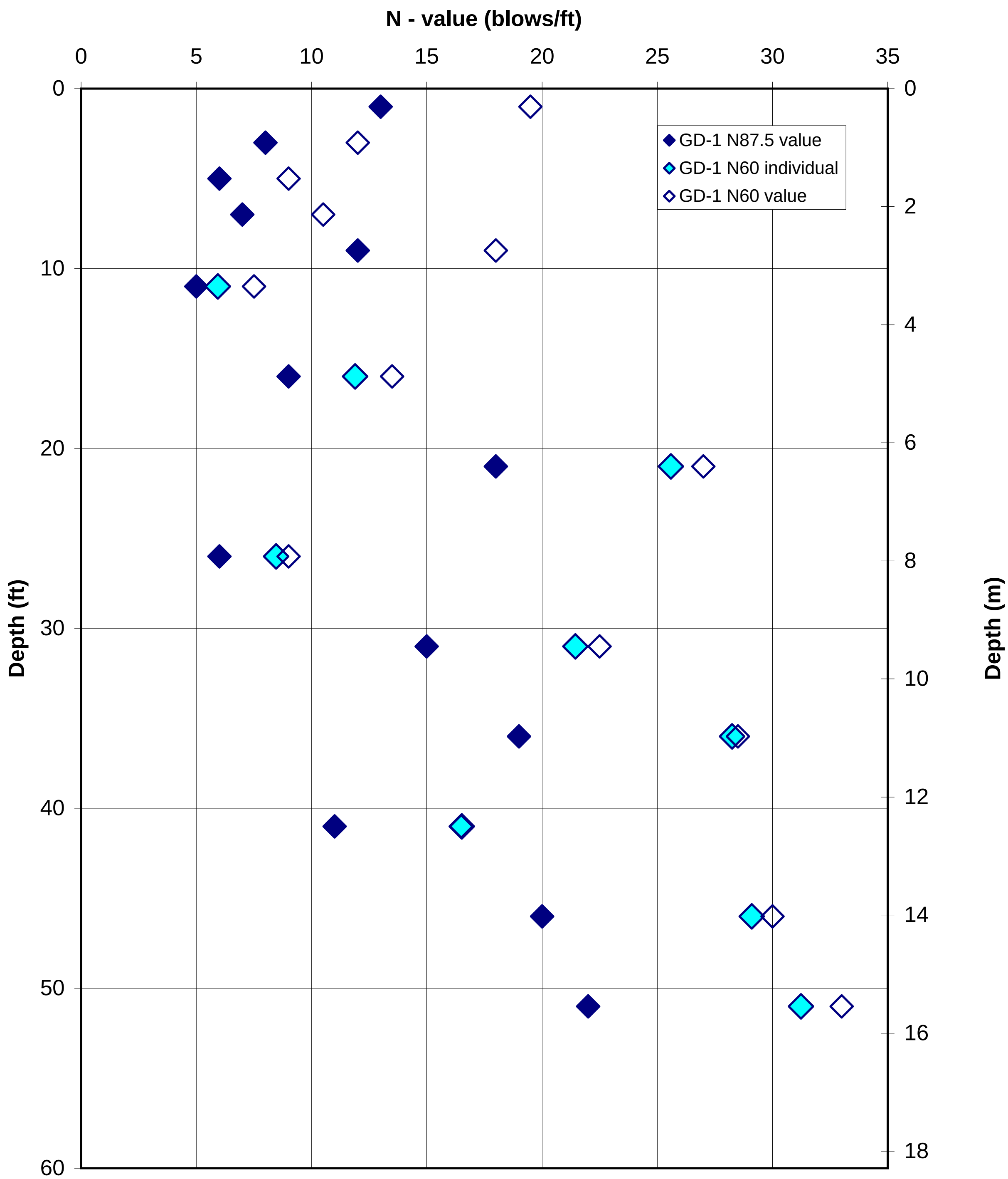


GeoDesign, Inc.
Windsor, VT
Job No. 750-5.7

Vtrans # RSCH012-703

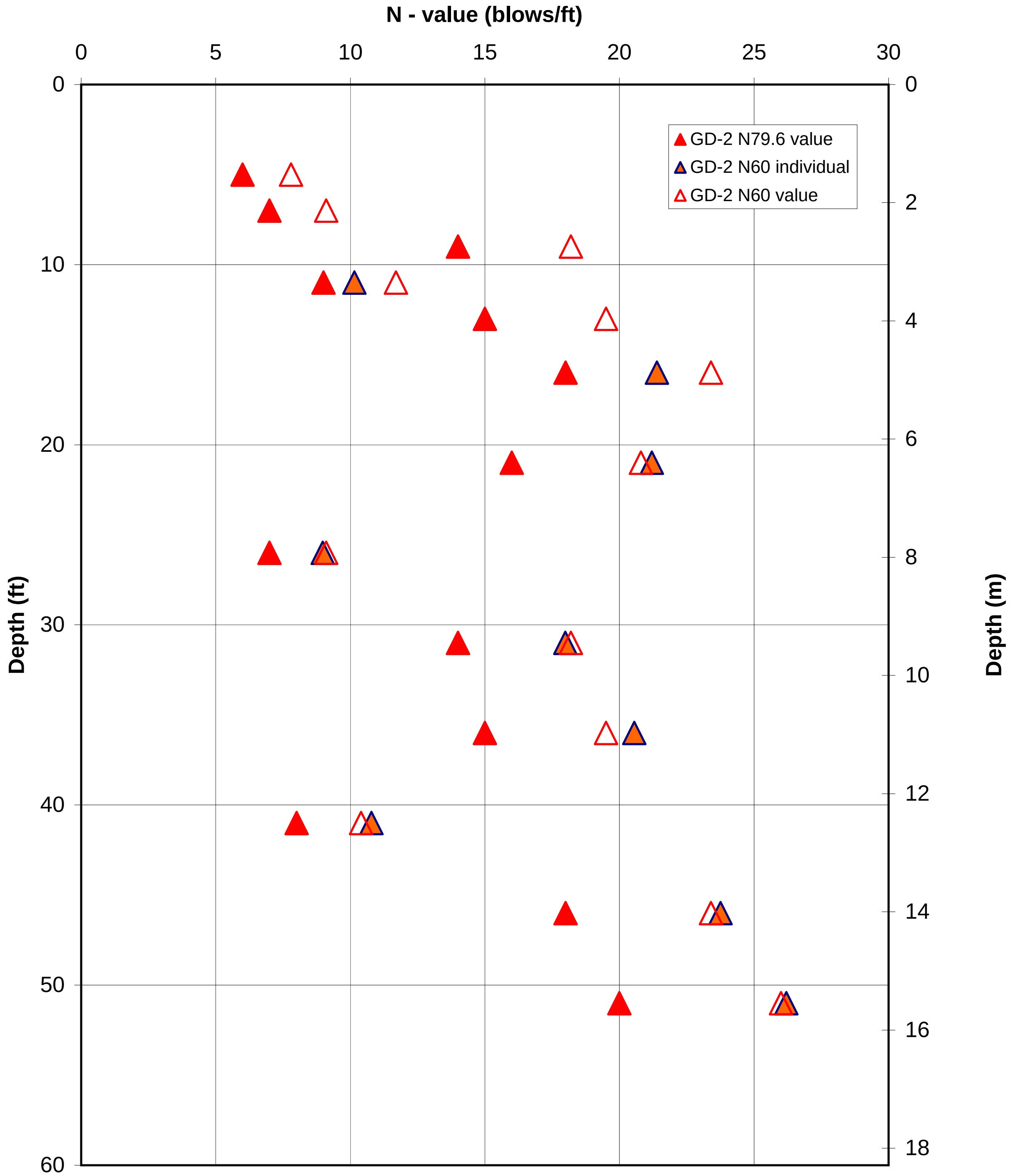
SPT Hammer Energy Variability Evaluation Windsor, VT

GD-1 - CME Automatic Hammer - AWJ rods - HW Casing with H2O



SPT Hammer Energy Variability Evaluation Windsor, VT

GD-2 - CME Automatic Hammer - AWJ rods - 3 1/4" HSA

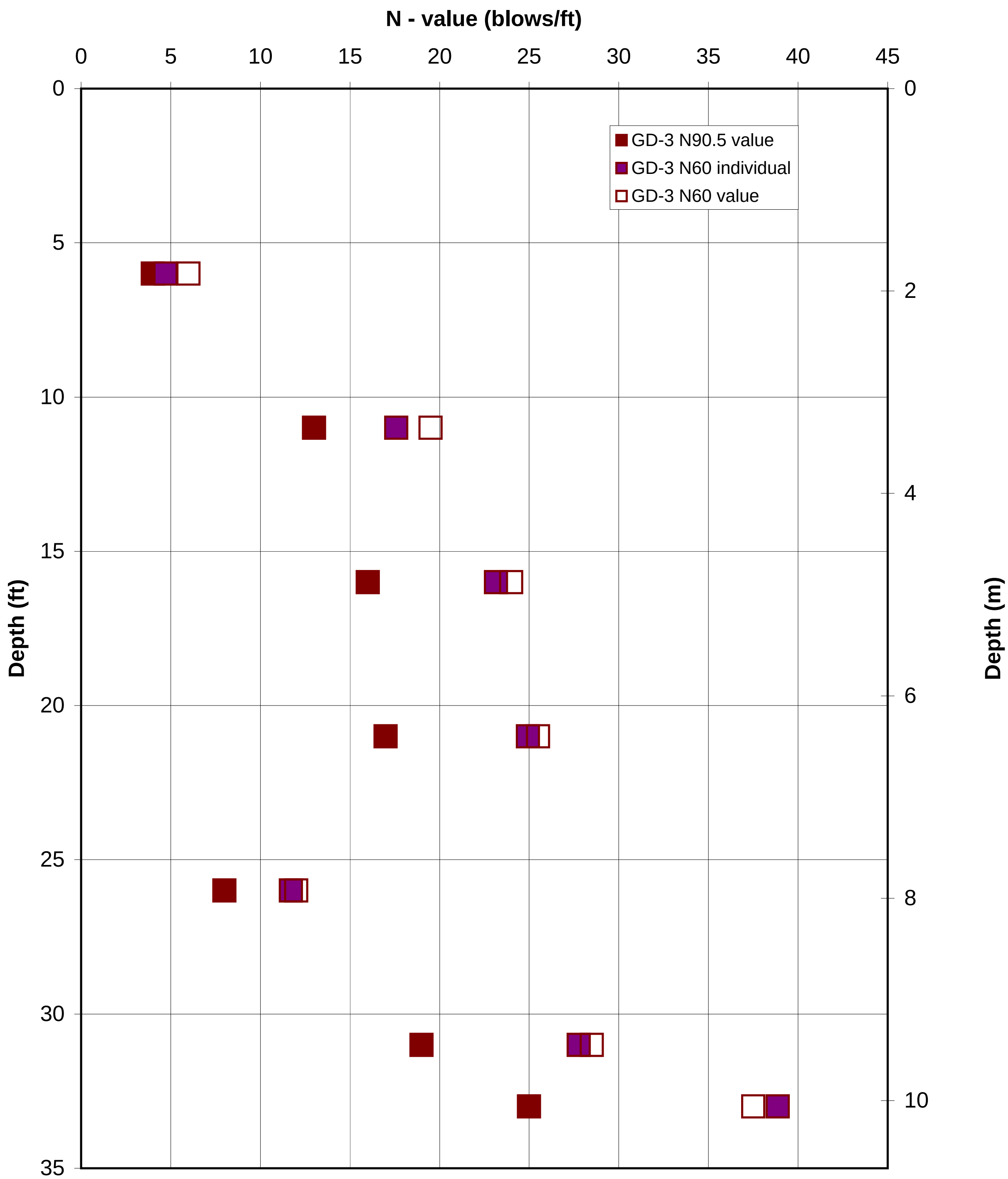


GeoDesign, Inc.
Windsor, VT
Job No. 750-5.7

Vtrans # RSCH012-703

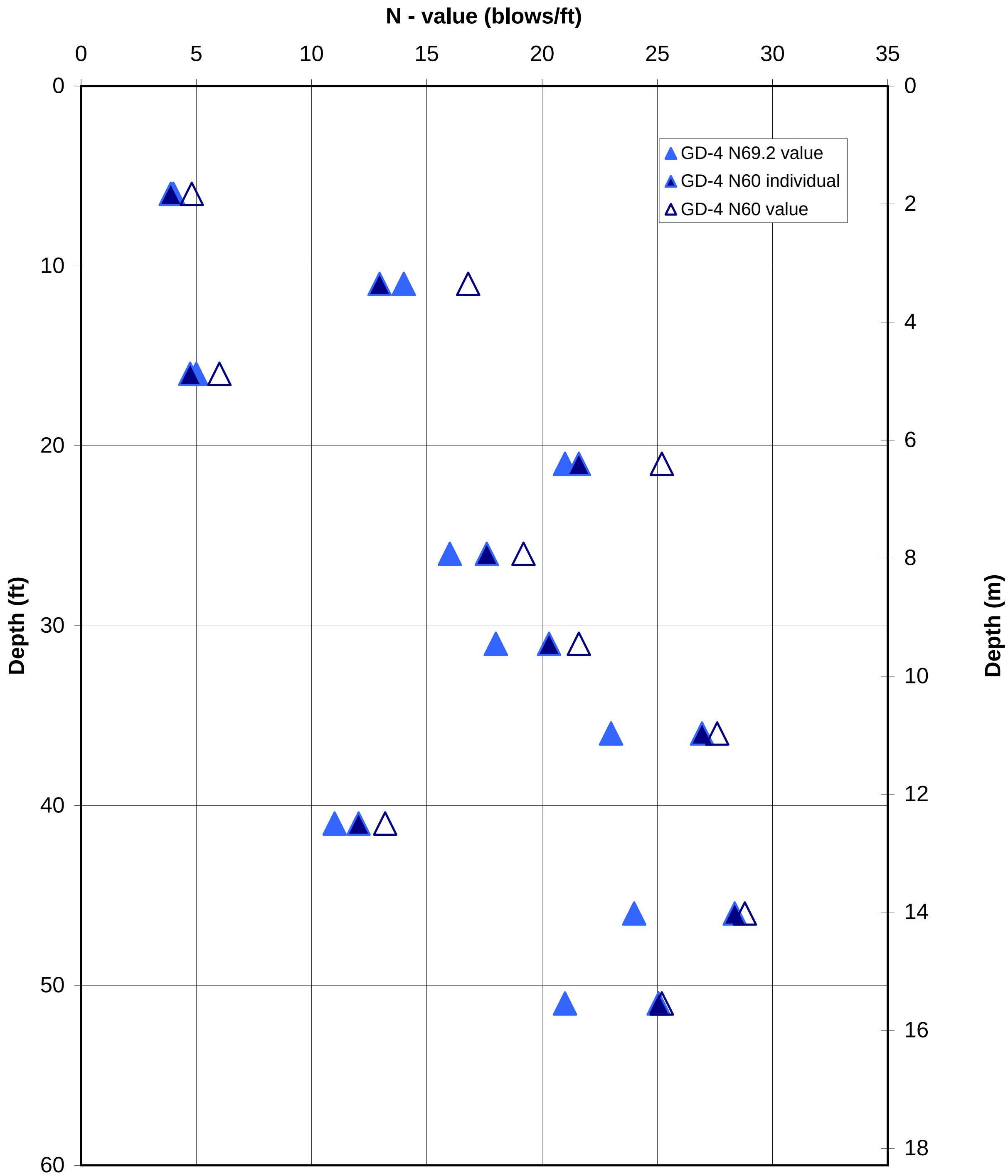
SPT Hammer Energy Variability
Evaluation Windsor, VT

GD-3 - CME Automatic Hammer - NWJ rods - HW Casing with H2O



SPT Hammer Energy Variability Evaluation Windsor, VT

GD-4 - Mobile Safety Hammer - AWJ rods - 3 1/4" HSA

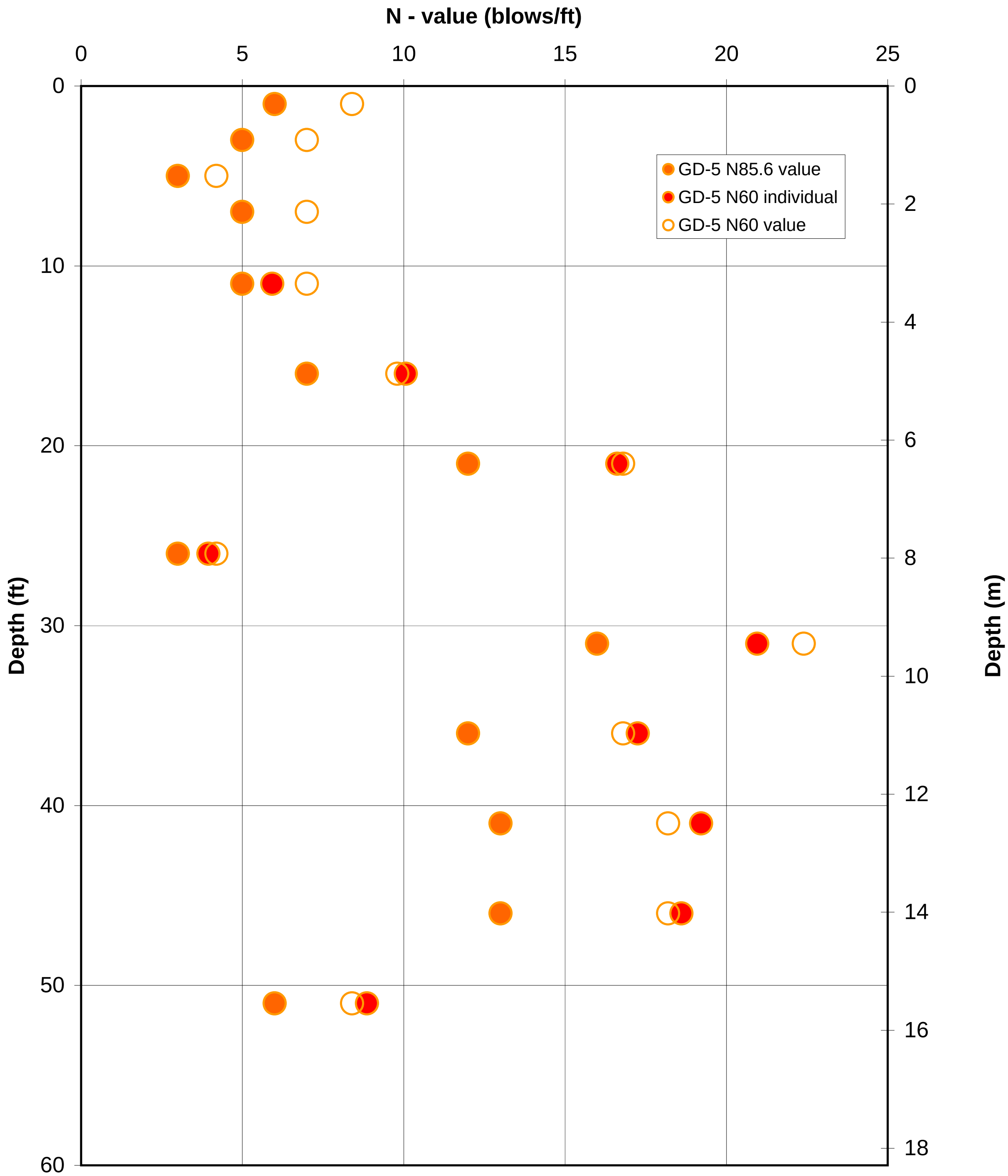


GeoDesign, Inc.
Windsor, VT
Job No. 750-5.7

Vtrans # RSCH012-703

SPT Hammer Energy Variability Evaluation Windsor, VT

GD-5 - CME Automatic Hammer - AWJ rods - 4 1/4 HSA

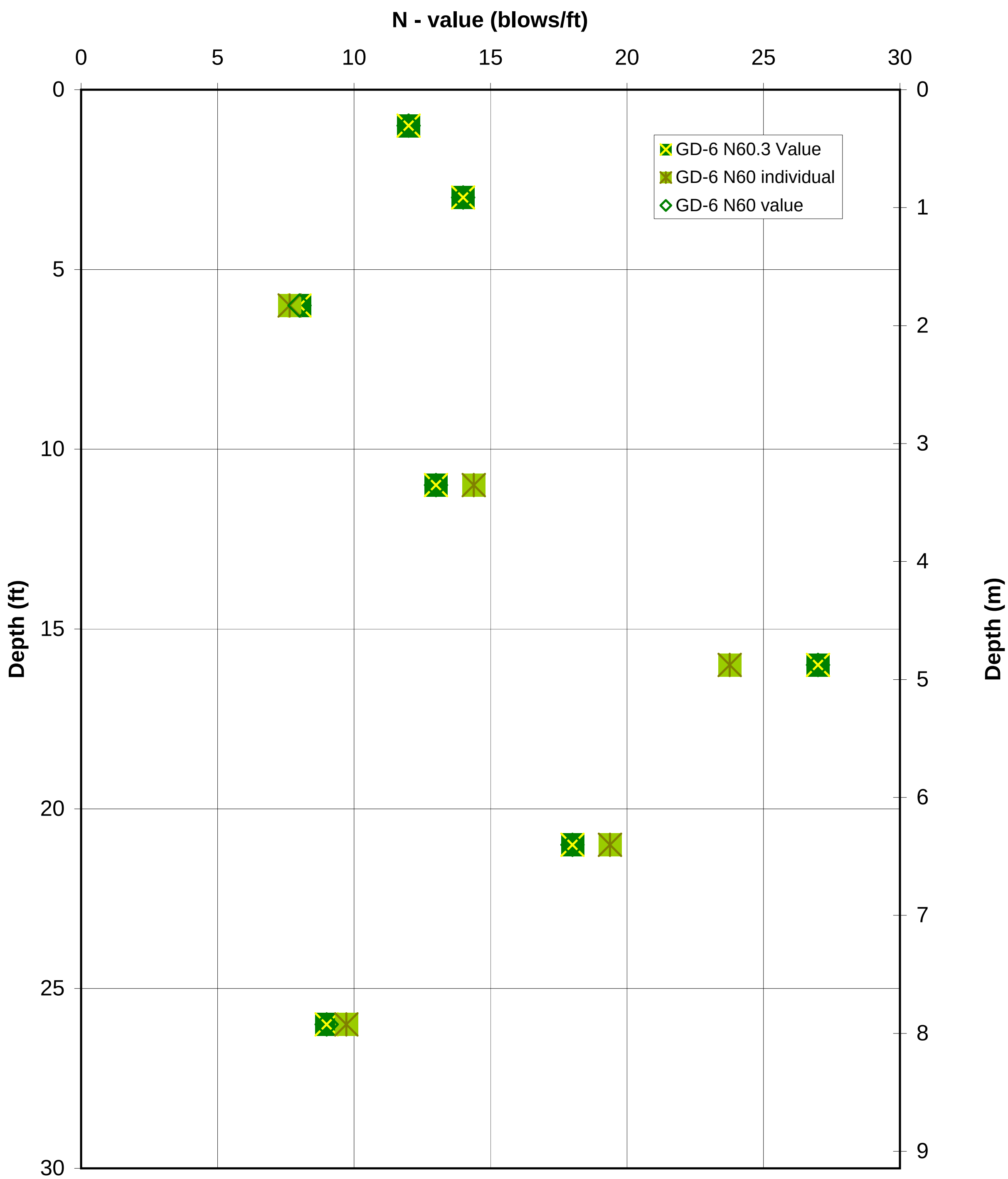


GeoDesign, Inc.
Windsor, VT
Job No. 750-5.7

Vtrans # RSCH012-703

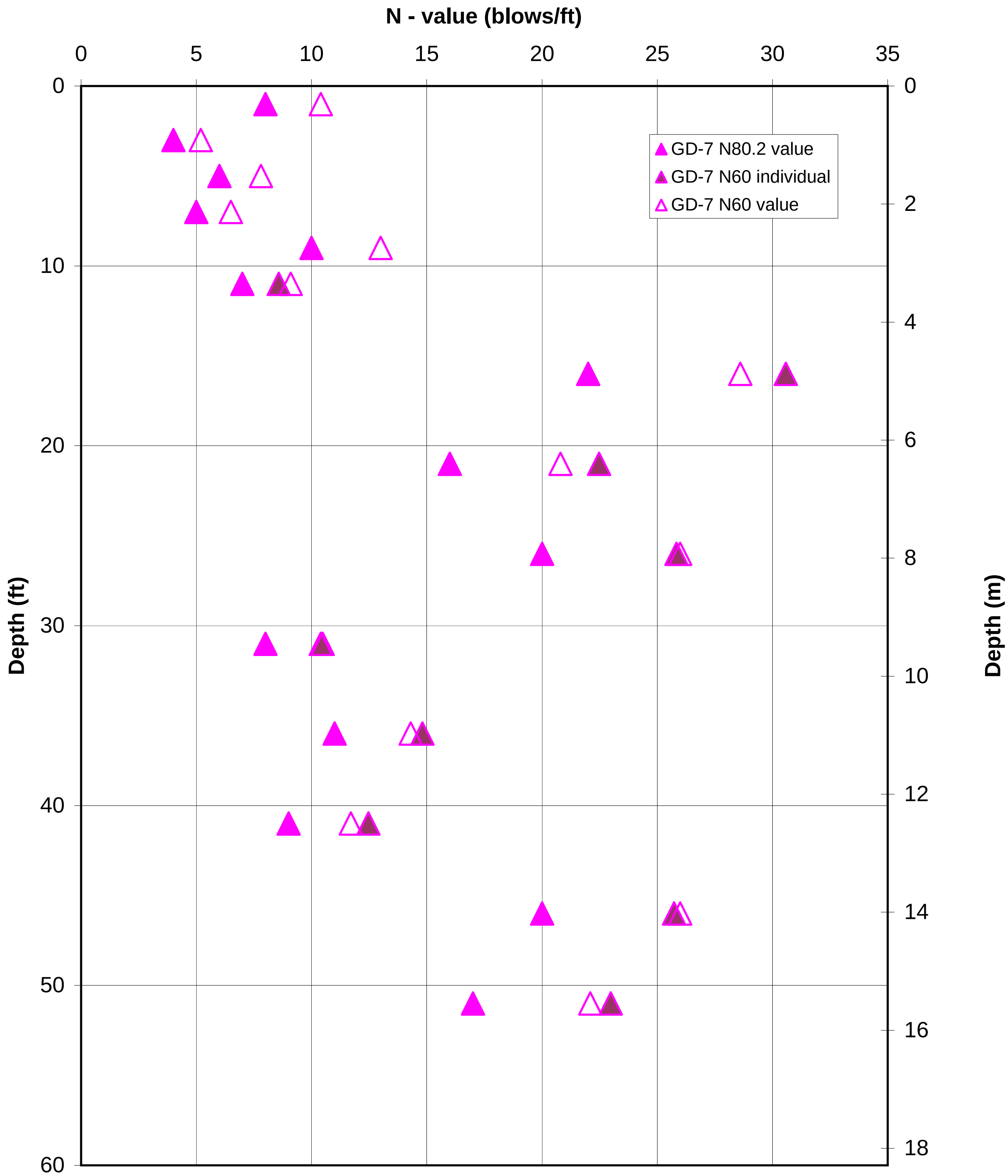
SPT Hammer Energy Variability Evaluation Windsor, VT

GD-6 - Mobile Safety Hammer - AWJ rods - 3 1/4 HSA



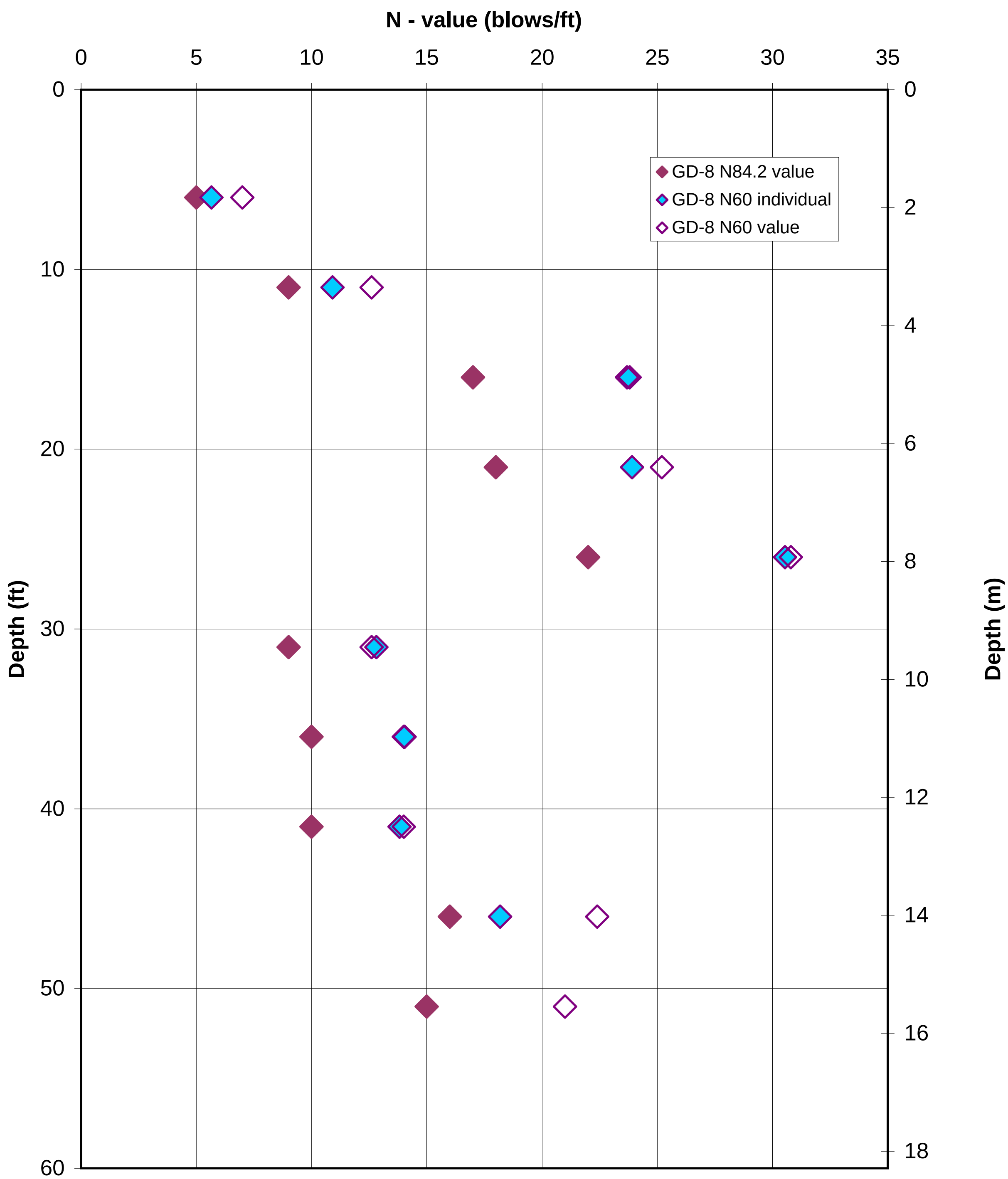
SPT Hammer Energy Variability
Evaluation Windsor, VT

GD-7 - CME Automatic Hammer - AWJ rods - 3 1/4 HSA



SPT Hammer Energy Variability Evaluation Windsor, VT

GD-8 - CME Automatic Hammer - NWJ rods - 3 1/4 HSA

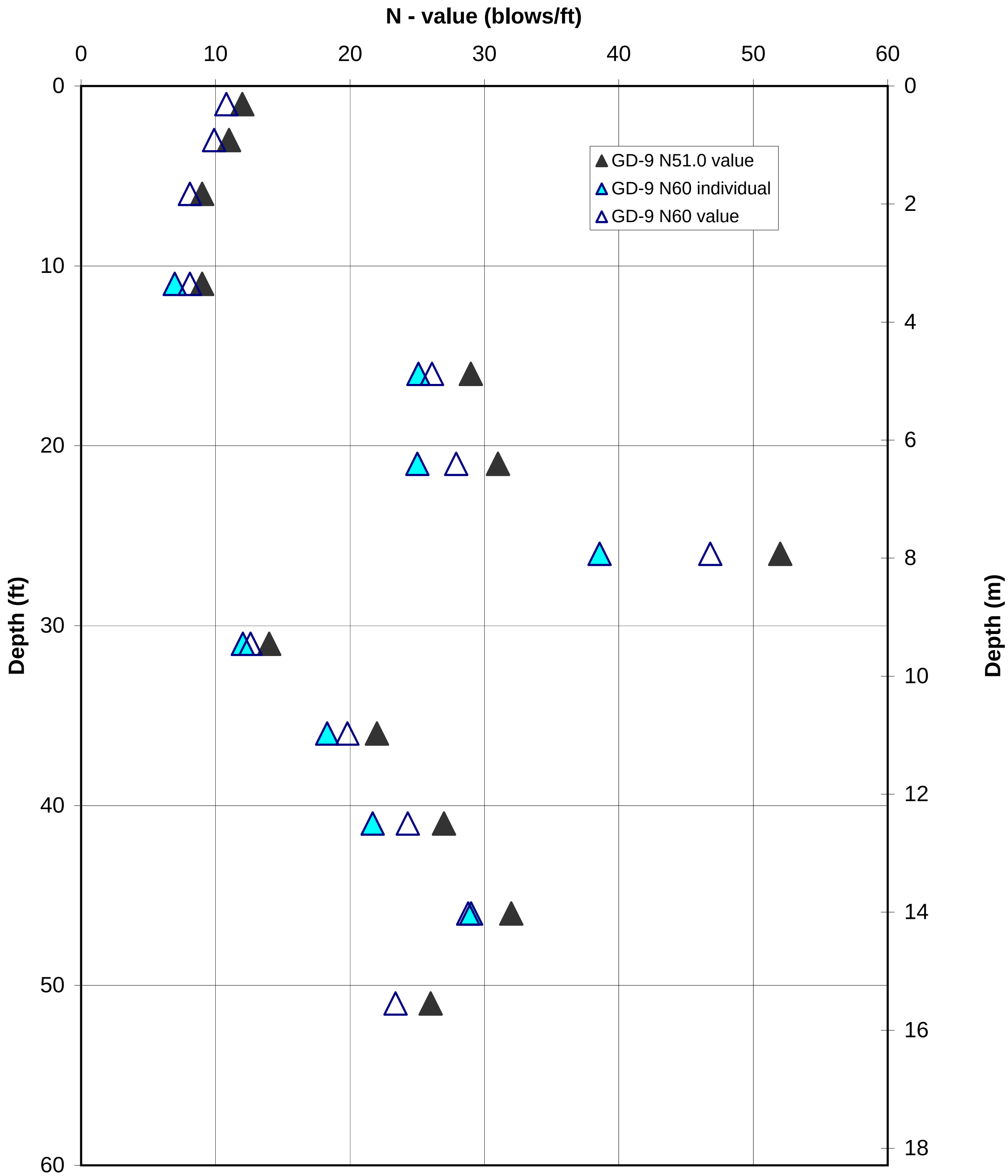


GeoDesign, Inc.
Windsor, VT
Job No. 750-5.7

Vtrans # RSCH012-703

SPT Hammer Energy Variability Evaluation Windsor, VT

GD-9 - Wireline Safety Driver - Downhole Hammer - AWJ rods - 4 1/4 HSA



APPENDIX 7 – SPT HAMMER ENERGY SUMMARY SHEETS

Hammer Type	Drill Rig	Serial #	Rod type	Borehole Type / Penetration Method	Owner	Hammer Operator	Testing Engineer	Location of Boring	Date and Start Time	Boring	Sample Depth (feet)		EMX (kip-ft)	EF2 (kip-ft)	ER (kip-ft)	ETR (%)	FMX (kips)	BPM (blows/minute)	Recorded hammer blows	Analyzed hammer blows	N	Cn	N60	ETR Average (%)	Cn Average	Depth to H_2O (ft)	Soil Description
Automatic Hammer - CME	CME 55 - Track	356675	AWJ	4 inch HW Casing	Vtrans	Glenn Porter	Shawn Kelley	Miller Construction Yard, Windsor, VT	9/23/2008 10:00	GD-1	All depths	Average	0.297	0.377	0.350	85.0	27.4	52.6	257	215	14	1.4	20	85.0	1.4	43.8	cohesionless soil
												Std.Dev.	0.017	0.032	0.000	4.9	0.3	3.2									
												Maximum	0.331	0.423	0.350	94.5	28.2	53.8	45	45	22	1.6	35				
												Minimum	0.222	0.281	0.350	63.6	26.5	26.7	13	13	5	1.1	5				
											10'-12'	Average	0.249	0.284	0.350	71.2	27.1	52.8	13	13	5	1.2	6				Fine to Medium Sand and Gravel
												Std.Dev.	0.014	0.002	0.000	4.1	0.2	0.2									
												Maximum	0.272	0.288	0.350	77.7	27.5	53.0	13	13	5	1.3	6				
												Minimum	0.222	0.281	0.350	63.6	26.8	52.5	13	13	5	1.1	5				
											15'-17'	Average	0.278	0.332	0.350	79.3	27.4	52.9	18	18	9	1.3	12				Fine to Medium Sand and Gravel
												Std.Dev.	0.013	0.002	0.000	3.8	0.2	0.1									
												Maximum	0.292	0.337	0.350	83.5	27.8	53.1	18	18	9	1.4	13				
												Minimum	0.254	0.328	0.350	72.6	26.7	52.7	18	18	9	1.2	11				
											20'-22'	Average	0.299	0.360	0.350	85.3	27.1	53.4	30	30	18	1.4	26				Fine to Medium Sand and Gravel
												Std.Dev.	0.010	0.004	0.000	2.7	0.2	0.2									
												Maximum	0.319	0.370	0.350	91.1	27.4	53.7	30	30	18	1.5	27				
												Minimum	0.277	0.352	0.350	79.2	26.7	53.1	30	30	18	1.3	24				
				spin and wash ahead with roller bit							25'-27'	Average	0.296	0.384	0.350	84.6	27.2	53.1	18	18	6	1.4	8				Silty Fine Sand
												Std.Dev.	0.011	0.007	0.000	3.0	0.1	0.2									
												Maximum	0.330	0.407	0.350	94.2	27.6	53.3	18	18	6	1.6	9				
												Minimum	0.286	0.376	0.350	81.8	26.9	52.8	18	18	6	1.4	8		ETR Average (>30') (%)		
											30'-32'	Average	0.300	0.398	0.350	85.8	27.6	53.1	30	31	15	1.4	21				Silty Fine Sand
												Std.Dev.	0.004	0.005	0.000	1.1	0.2	0.1									
												Maximum	0.309	0.408	0.350	88.3	27.9	53.3	30	31	15	1.5	22				
												Minimum	0.294	0.389	0.350	84.1	27.1	52.7	30	31	15	1.4	21		87.5		
											35'-37'	Average	0.312	0.408	0.350	89.2	27.6	49.6	37	18	19	1.5	28				Silty Fine Sand
												Std.Dev.	0.004	0.007	0.000	1.2	0.2	9.3									
												Maximum	0.320	0.423	0.350	91.3	28.2	53.8	37	18	19	1.5	29				
												Minimum	0.305	0.398	0.350	87.1	27.2	26.7	37	18	19	1.5	28				
											40'-42'	Average	0.316	0.390	0.350	90.1	27.5	53.2	26	25	11	1.5	17				Silty Fine Sand
												Std.Dev.	0.005	0.014	0.000	1.4	0.1	0.2									
												Maximum	0.331	0.416	0.350	94.5	27.8	53.6	26	25	11	1.6	17				
												Minimum	0.305	0.361	0.350	87.1	27.1	52.8	26	25	11	1.5	16				
											45'-47'	Average	0.305	0.389	0.350	87.3	27.3	50.7	40	17	20	1.5	29				Fine Sand
												Std.Dev.	0.005	0.010	0.000	1.4	0.3	6.5									
												Maximum	0.313	0.411	0.350	89.5	27.7	53.7	40	17	20	1.5	30				
												Minimum	0.295	0.373	0.350	84.3	26.7	30.4	40	17	20	1.4	28				
											50'-52'	Average	0.298	0.391	0.350	85.2	27.4	52.8	45	45	22	1.4	31				Fine Sand
												Std.Dev.	0.005	0.006	0.000	1.5	0.3	0.2									
												Maximum	0.310	0.404	0.350	88.4	27.9	53.2	45	45	22	1.5	32				
												Minimum	0.286	0.372	0.350	81.7	26.5	52.3	45	45	22	1.4	30				
Automatic Hammer - CME	CME 45C - skid rig on trailer	277564	AWJ	3 1/4" HSA with auger plug	Vtrans	Howard Garrow	Shawn Kelley	Miller Construction Yard, Windsor, VT	9/23/2008 12:25	GD-2	All depths	Average	0.271	0.353	0.350	77.4	25.5	59.8	245	211	14	1.3	18	77.4	1.3	47.0	cohesionless soil
												Std.Dev.	0.018	0.026	0.000	5.0	0.5	1.8									
												Maximum	0.302	0.399	0.350	86.4	26.8	63.6	35	34	20	1.4	29				
												Minimum	0.212	0.272	0.350	60.6	22.9	55.8	14	12	7	1.0	7				
											10'-12'	Average	0.237	0.287	0.350	67.7	25.4	59.3	20	13	9	1.1	10				Fine to Medium Sand and Gravel
												Std.Dev.	0.023	0.006	0.000	6.5	0.3	1.1									
												Maximum	0.290	0.299	0.350	82.9	25.8	60.5	20	13	9	1.4	12				
												Minimum	0.212	0.280	0.350	60.6	24.7	55.9	20	13	9	1.0	9				
											15'-17'	Average	0.250	0.323	0.350	71.3	25.9	62.1	32	29	18	1.2	21				Fine to Medium Sand and Gravel
												Std.Dev.	0.006	0.005	0.000	1.8	0.2	0.2									
												Maximum	0.264	0.335	0.350	75.3	26.2	62.6	32	29	18	1.3	23				
												Minimum	0.239	0.312	0.350	68.1	25.3	61.8	32	29	18	1.1	20				
											20'-22'	Average	0.278	0.351	0.350	79.5	25.8	61.9	31	28	16	1.3	21				Fine to Medium Sand and Gravel
												Std.Dev.	0.011	0.006	0.000	3.2	0.4	0.3									
												Maximum	0.299	0.369	0.350	85.4	26.8	62.8	31	28	16	1.4	23				
												Minimum	0.259	0.339	0.350	74.0	25.2	61.3	31	28	16	1.2	20				
				n/a							25'-27'	Average	0.269	0.360	0.350	76.9	26.0	61.1	14	12	7	1.3	9				Silty Fine Sand
												Std.Dev.	0.007	0.008	0.000	2.0	0.3	0.5									
												Maximum	0.288	0.376	0.350	82.3	26.5	62.3	14	12	7	1.4	10				
												Minimum	0.262	0.353	0.350	74.7	25.5	60.3	14	12	7	1.2	9				
											30'-32'	Average	0.270	0.370	0.350	77.1	25.8	60.3	28	15	14	1.3	18		ETR Average (>30') (%)		Silty Fine Sand
												Std.Dev.	0.004	0.005	0.000	1.0	0.3	1.4									
												Maximum	0.277	0.383	0.350	79.2	26.1	62.2	28	15	14	1.3	18				
												Minimum	0.265	0.363	0.350	75.8	25.2	55.8	28	15	14	1.3	18		79.6		
											35'-37'	Average	0.288	0.371	0.350	82.2	24.9	59.2	27	26	15	1.4	21				Silty Fine Sand
												Std.Dev.	0.006	0.004	0.000	1.6	0.5	0.3									
												Maximum	0.298	0.381	0.350	85.3	25.7	60.1	27	26	15	1.4	21				
												Minimum	0.278	0.361	0.350	79.4	23.9	58.8	27	26	15	1.3	20				
											40'-42'	Average	0.283	0.378	0.350	80.9	25.5	60.2	24	23	8	1.3	11				Silty Fine Sand
												Std.Dev.	0.006	0.007	0.000	1.7	0.3	0.5									
												Maximum	0.302	0.399	0.350	86.4	26.2	61.5	24	23	8	1.4	12				
												Minimum	0.274	0.367	0.350	78.4	24.9	59.4	24	23	8	1.3	10				
											45'-47'	Average	0.277	0.363	0.350	79.2	25.8	57.8	34	31	18	1.3	24				Fine Sand
												Std.Dev.	0.005	0.006	0.000	1.6	0.3	0.6									
												Maximum	0.291	0.380	0.350	83.3	26.6	60.4	34	31	18	1.4	25				
												Minimum	0.269	0.355	0.350	76.8	25.3	57.1	34	31	18	1.3	23				
											50'-52'	Average	0.275	0.362	0.350	78.6	25.3	57.4	35	34	20	1.3	26				Fine Sand
												Std.Dev.	0.005	0.006	0.000	1.3	0.3	0.6									
												Maximum	0.286	0.376	0.350	81.7	25.8	59.0	35	34	20	1.4	27				
												Minimum	0.265	0.346	0.350	75.8	24.7	56.1	35	34	20	1.3	25				

Hammer Type	Drill Rig	Serial #	Rod type	Borehole Type / Penetration Method	Owner	Hammer Operator	Testing Engineer	Location of Boring	Date and Start Time	Boring	Sample Depth (feet)		EMX (kip-ft)	EF2 (kip-ft)	ER (kip-ft)	ETR (%)	FMX (kips)	BPM (blows/ minute)	Recorded hammer blows	Analyzed hammer blows	N	Cn	N60	ETR Average (%)	Cn Average	Depth to H_2O (ft)	Soil Description
Automatic Hammer - CME	CME 55 - Track	356675	NWJ	4 inch HW Casing	Vtrans	Glennn Porter	Shawn Kelley	Miller Construction Yard, Windsor, VT	9/24/2008 9:45	GD-3	All depths	Average	0.306	0.364	0.350	87.4	42.2	53.6	212	205	15	1.5	21	87.4	1.5	none	cohesionless soil
												Std.Dev.	0.019	0.031	0.000	5.4	2.3	0.2									
												Maximum	0.332	0.420	0.350	94.9	47.1	53.9	51	44	25	1.6	40				
												Minimum	0.225	0.270	0.350	64.4	39.0	53.0	8	8	4	1.1	4				
											5'-7'	Average	0.248	0.280	0.350	70.8	40.7	53.2	8	8	4	1.2	5				Fine Sand
												Std.Dev.	0.018	0.004	0.000	5.2	0.4	0.1									
												Maximum	0.274	0.284	0.350	78.3	41.4	53.3	8	8	4	1.3	5				
												Minimum	0.225	0.270	0.350	64.4	40.2	53.0	8	8	4	1.1	4				
											10'-12'	Average	0.284	0.319	0.350	81.2	41.3	53.5	23	23	13	1.4	18				Fine to Medium Sand and Gravel
												Std.Dev.	0.015	0.006	0.000	4.3	0.6	0.1									
												Maximum	0.327	0.332	0.350	93.5	42.3	53.7	23	23	13	1.6	20				
												Minimum	0.266	0.310	0.350	76.1	39.9	53.3	23	23	13	1.3	16				
				spin and wash ahead with roller bit							15'-17'	Average	0.304	0.349	0.350	86.8	41.8	53.5	33	34	16	1.4	23				Fine to Medium Sand and Gravel
												Std.Dev.	0.008	0.006	0.000	2.2	0.6	0.2									
												Maximum	0.327	0.370	0.350	93.4	43.1	53.8	33	34	16	1.6	25				
												Minimum	0.282	0.338	0.350	80.5	40.5	53.2	33	34	16	1.3	21				
											20'-22'	Average	0.308	0.363	0.350	88.0	39.8	53.6	34	33	17	1.5	25				Fine to Medium Sand and Gravel
												Std.Dev.	0.009	0.006	0.000	2.5	0.6	0.1									
												Maximum	0.331	0.372	0.350	94.6	41.3	53.9	34	33	17	1.6	27				
												Minimum	0.293	0.351	0.350	83.7	39.0	53.3	34	33	17	1.4	24				
											25'-27'	Average	0.307	0.374	0.350	87.8	41.6	53.7	22	22	8	1.5	12				Silty Fine Sand
												Std.Dev.	0.005	0.009	0.000	1.5	1.0	0.1									
												Maximum	0.317	0.396	0.350	90.6	43.3	53.9	22	22	8	1.5	12				
												Minimum	0.297	0.358	0.350	85.0	39.6	53.4	22	22	8	1.4	11				
											30'-32'	Average	0.307	0.371	0.350	87.7	41.0	53.6	41	41	19	1.5	28		ETR Average (>30') (%)		Silty Fine Sand
												Std.Dev.	0.009	0.009	0.000	2.5	0.5	0.2									
												Maximum	0.329	0.384	0.350	94.1	42.2	53.9	41	41	19	1.6	30				
												Minimum	0.290	0.333	0.350	82.9	39.8	53.2	41	41	19	1.4	26		90.5		
											32'-34'	Average	0.327	0.404	0.350	93.3	46.3	53.5	51	44	25	1.6	39				Silty Fine Sand
												Std.Dev.	0.003	0.011	0.000	0.9	0.5	0.1									
												Maximum	0.332	0.420	0.350	94.9	47.1	53.8	51	44	25	1.6	40				
												Minimum	0.318	0.383	0.350	90.8	44.6	53.4	51	44	25	1.5	38				
Safety Hammer	CME 45C - skid rig on trailer	277564	AWJ	3 1/4" HSA with auger plug	Vtrans	Howard Garrow	Shawn Kelley	Miller Construction Yard, Windsor, VT	9/24/2008 13:30	GD-4	All depths	Average	0.232	0.267	0.350	66.3	19.2	31.1	292	289	16	1.1	17	66.3	1.1	42.0	cohesionless soil
												Std.Dev.	0.027	0.049	0.000	7.7	1.3	3.4									
												Maximum	0.288	0.357	0.350	82.4	21.8	39.1	44	44	24	1.4	33				
												Minimum	0.140	0.128	0.350	40.0	15.0	19.4	9	5	4	0.7	3				
											5'-7'	Average	0.204	0.165	0.350	58.3	18.5	30.1	10	10	4	1.0	4				Fine Sand
												Std.Dev.	0.033	0.012	0.000	9.4	0.8	1.8									
												Maximum	0.273	0.184	0.350	78.0	19.8	32.9	10	10	4	1.3	5				
												Minimum	0.158	0.144	0.350	45.0	17.1	27.5	10	10	4	0.8	3				
											10'-12'	Average	0.194	0.173	0.350	55.5	16.9	20.2	25	25	14	0.9	13				Fine to Medium Sand and Gravel
												Std.Dev.	0.019	0.019	0.000	5.6	0.9	0.6									
												Maximum	0.224	0.205	0.350	64.1	18.2	20.8	25	25	14	1.1	15				
												Minimum	0.140	0.128	0.350	40.0	15.0	19.4	25	25	14	0.7	9				
				n/a							15'-17'	Average	0.199	0.237	0.350	56.8	19.1	24.8	9	5	5	0.9	5				Fine to Medium Sand and Gravel
												Std.Dev.	0.019	0.021	0.000	5.4	0.9	2.6									
												Maximum	0.220	0.263	0.350	63.0	20.1	27.0	9	5	5	1.0	5				
												Minimum	0.174	0.209	0.350	49.6	17.7	21.2	9	5	5	0.8	4				
											20'-22'	Average	0.216	0.237	0.350	61.7	18.2	29.6	40	40	21	1.0	22				Fine to Medium Sand and Gravel
												Std.Dev.	0.018	0.018	0.000	5.2	0.7	2.9									
												Maximum	0.252	0.280	0.350	72.1	19.8	34.0	40	40	21	1.2	25				
												Minimum	0.172	0.200	0.350	49.2	16.9	19.5	40	40	21	0.8	17				
											25'-27'	Average	0.231	0.255	0.350	66.0	18.9	34.9	30	30	16	1.1	18				Silty Fine Sand
												Std.Dev.	0.022	0.024	0.000	6.3	1.0	1.7									
												Maximum	0.281	0.300	0.350	80.3	20.9	39.1	30	30	16	1.3	21				
												Minimum	0.190	0.208	0.350	54.3	16.9	31.7	30	30	16	0.9	14				
											30'-32'	Average	0.237	0.278	0.350	67.7	18.9	31.0	34	35	18	1.1	20		Average (>30') (%)		Silty Fine Sand
												Std.Dev.	0.025	0.027	0.000	7.1	0.9	2.7									
												Maximum	0.279	0.329	0.350	79.7	20.6	36.5	34	35	18	1.3	24				
												Minimum	0.190	0.220	0.350	54.4	16.4	22.3	34	35	18	0.9	16		69.2		
											35'-37'	Average	0.246	0.293	0.350	70.3	19.8	30.5	37	37	23	1.2	27				Silty Fine Sand
												Std.Dev.	0.016	0.018	0.000	4.6	0.6	4.0									
												Maximum	0.280	0.335	0.350	80.1	20.9	36.0	37	37	23	1.3	31				
												Minimum	0.206	0.243	0.350	58.9	17.9	19.7	37	37	23	1.0	23				
											40'-42'	Average	0.230	0.281	0.350	65.7	19.4	32.2	25	25	11	1.1	12				Silty Fine Sand
												Std.Dev.	0.021	0.024	0.000	5.9	0.8	3.2									
												Maximum	0.288	0.342	0.350	82.4	21.1	35.7	25	25	11	1.4	15				
												Minimum	0.193	0.236	0.350	55.2	17.8	24.7	25	25	11	0.9	10				
											45'-47'	Average	0.248	0.305	0.350	70.9	204.0	31.0	44	44	24	1.2	28				Fine Sand
												Std.Dev.	0.020	0.028	0.000	5.8	0.9	2.3									
												Maximum	0.286	0.357	0.350	81.8	21.8	35.7	44	44	24	1.4	33				
												Minimum	0.165	0.201	0.350	47.1	16.3	22.4	44	44	24	0.8	19				
											50'-52'	Average	0.251	0.315	0.350	71.6	20.4	31.1	38	38	21	1.2	25				Fine Sand
												Std.Dev.	0.016	0.021	0.000	4.7	0.7	2.6									
												Maximum	0.279	0.351	0.350	79.7	21.7	34.2	38	38	21	1.3	28				
												Minimum	0.216	0.272	0.350	61.8	19.0	23.2	38	38	21	1.0	22				

Hammer Type	Drill Rig	Serial #	Rod type	Borehole Type / Penetration Method	Owner	Hammer Operator	Testing Engineer	Location of Boring	Date and Start Time	Boring	Sample Depth (feet)		EMX (kip-ft)	EF2 (kip-ft)	ER (kip-ft)	ETR (%)	FMX (kips)	BPM (blows/ minute)	Recorded hammer blows	Analyzed hammer blows	N	Cn	N60	ETR Average (%)	Cn Average	Depth to H_2O (ft)	Soil Description
Automatic Hammer - CME	CME 75 - track	200587	AWJ	4 1/4" HSA with auger plug	Transtech	John Leonhardt	Shawn Kelley	Miller Construction Yard, Windsor, VT	9/25/2008 9:50	GD-5	All depths	Average	0.294	0.388	0.350	84.0	26.6	51.3	169	173	10	1.4	14	84.0	1.4	48.0	cohesionless soil
												Std.Dev.	0.018	0.027	0.000	5.3	0.7	5.9									
												Maximum	0.334	0.437	0.350	95.4	27.8	58.6	32	34	16	1.6	25				
												Minimum	0.213	0.296	0.350	60.9	24.8	33.4	6	6	3	1.0	3				
											10'-12'	Average	0.249	0.307	0.350	71.1	26.1	45.9	10	6	5	1.2	6				Fine Sand
												Std.Dev.	0.023	0.005	0.000	6.6	0.3	1.0									
												Maximum	0.276	0.312	0.350	78.8	26.4	47.2	10	6	5	1.3	7				
												Minimum	0.213	0.296	0.350	60.9	25.4	44.3	10	6	5	1.0	5				
											15'-17'	Average	0.302	0.361	0.350	86.3	26.6	55.7	15	21	7	1.4	10				Fine Sand
												Std.Dev.	0.019	0.012	0.000	5.4	0.4	1.3									
												Maximum	0.334	0.382	0.350	95.4	27.4	56.7	15	21	7	1.6	11				
												Minimum	0.256	0.337	0.350	73.2	25.7	51.8	15	21	7	1.2	9				
				n/a							20'-22'	Average	0.291	0.380	0.350	83.1	27.4	53.4	20	18	12	1.4	17				Fine to Medium Sand and Gravel
												Std.Dev.	0.012	0.011	0.000	3.4	0.5	2.4									
												Maximum	0.317	0.392	0.350	90.4	27.8	54.5	20	18	12	1.5	18				
												Minimum	0.260	0.341	0.350	74.2	25.7	43.9	20	18	12	1.2	15				
											25'-27'	Average	0.276	0.375	0.350	79.0	25.7	47.1	6	8	3	1.3	4				Silty Fine Sand
												Std.Dev.	0.011	0.016	0.000	3.0	0.6	6.6									
												Maximum	0.286	0.392	0.350	81.7	26.6	52.7	6	8	3	1.4	4				
												Minimum	0.259	0.347	0.350	74.0	24.8	33.4	6	8	3	1.2	4				
											30'-32'	Average	0.275	0.371	0.350	78.6	25.9	42.0	32	34	16	1.3	21		ETR Average (>30') (%)		Silty Fine Sand
												Std.Dev.	0.005	0.007	0.000	1.5	0.3	3.4									
												Maximum	0.289	0.383	0.350	82.5	26.5	45.7	32	34	16	1.4	22		85.6		
												Minimum	0.262	0.352	0.350	74.8	25.0	37.4	32	34	16	1.2	20				
											35'-37'	Average	0.302	0.406	0.350	86.3	26.0	51.8	24	24	12	1.4	17				Silty Fine Sand
												Std.Dev.	0.004	0.005	0.000	1.2	0.5	0.3									
												Maximum	0.310	0.413	0.350	88.5	27.0	52.5	24	24	12	1.5	18				
												Minimum	0.291	0.395	0.350	83.2	25.3	51.1	24	24	12	1.4	17				
											40'-42'	Average	0.311	0.420	0.350	88.7	27.2	57.7	26	26	13	1.5	19				Silty Fine Sand
												Std.Dev.	0.007	0.007	0.000	1.9	0.2	0.4									
												Maximum	0.322	0.431	0.350	92.1	27.6	58.6	26	26	13	1.5	20				
												Minimum	0.295	0.402	0.350	84.3	26.8	57.0	26	26	13	1.4	18				
											45'-47'	Average	0.301	0.400	0.350	85.9	27.0	53.2	25	25	13	1.4	19				Fine Sand
												Std.Dev.	0.004	0.005	0.000	1.2	0.2	1.0									
												Maximum	0.315	0.411	0.350	89.9	27.5	54.1	25	25	13	1.5	20				
												Minimum	0.294	0.390	0.350	83.9	26.4	50.5	25	25	13	1.4	18				
											50'-52'	Average	0.310	0.418	0.350	88.6	26.9	53.7	11	11	6	1.5	9				Fine Sand
												Std.Dev.	0.006	0.009	0.000	1.7	0.4	1.3									
												Maximum	0.324	0.437	0.350	92.6	27.3	54.7	11	11	6	1.5	9				
												Minimum	0.301	0.403	0.350	85.9	26.0	50.6	11	11	6	1.4	9				
Safety Hammer	CME 75 - track	200587	AWJ	3 1/4" HSA with auger plug	Transtech	John Leonhardt	Shawn Kelley	Miller Construction Yard, Windsor, VT	9/25/2008 13:40	GD-6	All depths	Average	0.211	0.244	0.350	60.3	21.9	55.7	146	143	15	1.0	15	60.3	1.0	none	cohesionless soil
												Std.Dev.	0.038	0.049	0.000	10.9	1.7	2.3									
												Maximum	0.331	0.329	0.350	94.6	24.8	61.7	50	46	27	1.6	43				
												Minimum	0.120	0.139	0.350	34.3	16.5	48.7	16	16	8	0.6	5				
											5'-7'	Average	0.200	0.187	0.350	57.3	22.3	54.4	16	16	8	1.0	8				Fine Sand
												Std.Dev.	0.023	0.020	0.000	6.5	1.0	1.8									
												Maximum	0.235	0.218	0.350	67.2	23.8	57.1	16	16	8	1.1	9				
												Minimum	0.158	0.156	0.350	45.2	20.2	50.7	16	16	8	0.8	6				
											10'-12'	Average	0.233	0.235	0.350	66.4	22.6	55.7	25	25	13	1.1	14				Fine Sand
												Std.Dev.	0.040	0.023	0.000	11.3	1.1	1.7									
												Maximum	0.331	0.281	0.350	94.6	24.7	58.8	25	25	13	1.6	20				
												Minimum	0.161	0.163	0.350	46.1	19.4	51.6	25	25	13	0.8	10				
											15'-17'	Average	0.185	0.218	0.350	52.8	20.6	57.4	50	46	27	0.9	24				Fine to Medium Sand and Gravel
												Std.Dev.	0.039	0.044	0.000	11.2	1.9	2.4									
												Maximum	0.281	0.321	0.350	80.2	24.8	61.7	50	46	27	1.3	36				
												Minimum	0.120	0.139	0.350	34.3	16.5	48.7	50	46	27	0.6	15				
											20'-22'	Average	0.226	0.283	0.350	64.6	22.6	55.0	32	34	18	1.1	19				Fine to Medium Sand and Gravel
												Std.Dev.	0.024	0.029	0.000	6.9	1.2	1.0									
												Maximum	0.262	0.322	0.350	74.7	24.3	56.5	32	34	18	1.2	22				
												Minimum	0.159	0.203	0.350	45.3	19.5	51.4	32	34	18	0.8	14				
											25'-27'	Average	0.227	0.290	0.350	64.8	22.8	54.1	23	22	9	1.1	10				Silty Fine Sand
												Std.Dev.	0.025	0.033	0.000	7.0	1.3	2.1									
												Maximum	0.255	0.329	0.350	73.0	24.1	61.2	23	22	9	1.2	11				
												Minimum	0.138	0.173	0.350	39.4	18.0	50.4	23	22	9	0.7	6				

Hammer Type	Drill Rig	Serial #	Rod type	Borehole Type / Penetration Method	Owner	Hammer Operator	Testing Engineer	Location of Boring	Date and Start Time	Boring
Automatic Hammer - CME	CME 45C - Track	306614	AWJ	3 1/4" HSA with auger plug	Vtrans	Glenn Porter	Shawn Kelley	Miller Construction Yard, Windsor, VT	9/26/2008 9:00	GD-7

Sample Depth (feet)		EMX (kip-ft)	EF2 (kip-ft)	ER (kip-ft)	ETR (%)	FMX (kips)	BPM (blows/ minute)	Recorded hammer blows	Analyzed hammer blows	N	Cn	N60	ETR Average (%)	Cn Average	Depth to H_2O (ft)	Soil Description
All depths	Average	0.282	0.351	0.350	80.6	25.0	53.5	248	240	14	1.3	19	80.6	1.3	50.0	cohesionless soil
	Std.Dev.	0.014	0.019	0.000	3.9	0.9	1.9									
	Maximum	0.323	0.391	0.350	92.4	26.5	55.0	41	41	22	1.5	34				
	Minimum	0.230	0.282	0.350	65.6	22.8	26.7	14	6	7	1.1	8				
10'-12'	Average	0.257	0.302	0.350	73.5	25.8	53.6	14	6	7	1.2	9				Fine to Medium Sand and Gravel
	Std.Dev.	0.018	0.011	0.000	5.2	0.4	0.8									
	Maximum	0.283	0.318	0.350	81.0	26.4	54.5	14	6	7	1.3	9				
	Minimum	0.230	0.282	0.350	65.6	25.0	52.3	14	6	7	1.1	8				
15'-17'	Average	0.292	0.324	0.350	83.4	25.1	52.8	41	41	22	1.4	31				Fine to Medium Sand and Gravel
	Std.Dev.	0.010	0.007	0.000	2.8	0.6	4.3									
	Maximum	0.313	0.340	0.350	89.4	26.2	55.0	41	41	22	1.5	33				
	Minimum	0.267	0.309	0.350	76.3	23.8	26.7	41	41	22	1.3	28				
20'-22'	Average	0.295	0.354	0.350	84.3	24.1	53.5	33	32	16	1.4	22				Fine to Medium Sand and Gravel
	Std.Dev.	0.015	0.006	0.000	4.2	1.0	0.8									
	Maximum	0.323	0.368	0.350	92.4	26.2	54.2	33	32	16	1.5	25				
	Minimum	0.270	0.342	0.350	77.0	22.9	49.7	33	32	16	1.3	21				
25'-27'	Average	0.271	0.361	0.350	77.5	25.7	53.7	33	32	20	1.3	26				Fine to Medium Sand and Gravel
	Std.Dev.	0.006	0.006	0.000	1.6	0.4	0.3									
	Maximum	0.280	0.375	0.350	80.0	26.4	54.5	33	32	20	1.3	27				
	Minimum	0.260	0.347	0.350	74.4	25.0	53.2	33	32	20	1.2	25				
30'-32'	Average	0.275	0.361	0.350	78.6	24.9	53.6	16	16	8	1.3	10		ETR Average (>30') (%)		Silty Fine Sand
	Std.Dev.	0.006	0.007	0.000	1.8	0.3	0.4									
	Maximum	0.287	0.374	0.350	81.9	25.6	54.1	16	16	8	1.4	11				
	Minimum	0.263	0.348	0.350	75.0	24.4	52.6	16	16	8	1.3	10		80.2		
35'-37'	Average	0.283	0.369	0.350	80.8	25.7	53.8	21	21	11	1.3	15				Silty Fine Sand
	Std.Dev.	0.005	0.007	0.000	1.5	0.4	0.4									
	Maximum	0.294	0.391	0.350	84.0	26.3	54.6	21	21	11	1.4	15				
	Minimum	0.273	0.358	0.350	78.0	25.0	53.2	21	21	11	1.3	14				
40'-42'	Average	0.291	0.376	0.350	83.1	26.0	53.8	18	19	9	1.4	12				Silty Fine Sand
	Std.Dev.	0.005	0.006	0.000	1.5	0.3	0.4									
	Maximum	0.302	0.385	0.350	86.4	26.5	54.5	18	19	9	1.4	13				
	Minimum	0.281	0.363	0.350	80.4	25.2	52.7	18	19	9	1.3	12				
45'-47'	Average	0.270	0.345	0.350	77.2	25.0	53.6	36	37	20	1.3	26				Silty Fine Sand
	Std.Dev.	0.007	0.009	0.000	2.1	0.5	0.3									
	Maximum	0.285	0.366	0.350	81.4	26.2	54.3	36	37	20	1.4	27				
	Minimum	0.256	0.329	0.350	73.1	24.3	52.9	36	37	20	1.2	24				
50'-52'	Average	0.284	0.354	0.350	81.1	24.1	53.6	36	36	17	1.4	23				Fine Sand
	Std.Dev.	0.008	0.008	0.000	2.3	0.7	0.5									
	Maximum	0.296	0.374	0.350	84.7	25.8	54.6	36	36	17	1.4	24				
	Minimum	0.268	0.336	0.350	76.5	22.8	52.7	36	36	17	1.3	22				

Hammer Type	Drill Rig	Serial #	Rod type	Borehole Type / Penetration Method	Owner	Hammer Operator	Testing Engineer	Location of Boring	Date and Start Time	Boring
Automatic Hammer - CME	CME 45C - Track	306614	NWJ	3 1/4" HSA with auger plug	Vtrans	Glenn Porter	Shawn Kelley	Miller Construction Yard, Windsor, VT	9/26/2008 12:05	GD-8

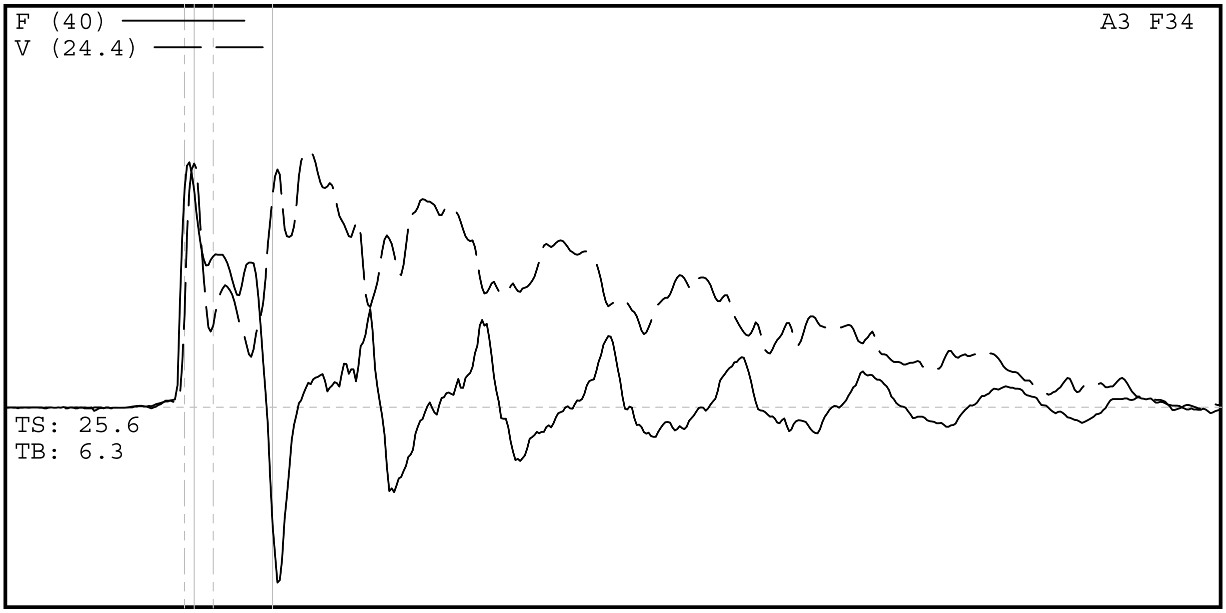
Sample Depth (feet)		EMX (kip-ft)	EF2 (kip-ft)	ER (kip-ft)	ETR (%)	FMX (kips)	BPM (blows/ minute)	Recorded hammer blows	Analyzed hammer blows	N	Cn	N60	ETR Average (%)	Cn Average	Depth to H_2O (ft)	Soil Description
All depths	Average	0.284	0.338	0.350	81.1	40.3	51.7	265	176	13	1.4	17	81.1	1.4	40.0	cohesionless soil
	Std.Dev.	0.020	0.025	0.000	5.8	0.9	5.1									
	Maximum	0.327	0.372	0.350	93.3	42.7	54.8	45	37	22	1.6	34				
	Minimum	0.204	0.246	0.350	58.4	37.6	26.8	9	2	5	1.0	5				
5'-7'	Average	0.238	0.254	0.350	67.9	39.6	52.3	9	9	5	1.1	6				Fine Sand
	Std.Dev.	0.031	0.006	0.000	8.8	0.8	0.3									
	Maximum	0.299	0.267	0.350	85.3	40.6	52.7	9	9	5	1.4	7				
	Minimum	0.204	0.246	0.350	58.4	38.0	51.6	9	9	5	1.0	5				
10'-12'	Average	0.254	0.312	0.350	72.7	40.7	53.8	17	14	9	1.2	11				Fine to Medium Sand and Gravel
	Std.Dev.	0.012	0.005	0.000	3.3	0.5	0.4									
	Maximum	0.281	0.323	0.350	80.2	41.6	54.4	17	14	9	1.3	12				
	Minimum	0.243	0.303	0.350	69.3	39.9	53.2	17	14	9	1.2	10				
15'-17'	Average	0.292	0.329	0.350	83.6	39.9	51.8	33	32	17	1.4	24				Fine to Medium Sand and Gravel
	Std.Dev.	0.016	0.008	0.000	4.7	0.9	2.4									
	Maximum	0.327	0.348	0.350	93.3	41.8	52.8	33	32	17	1.6	26				
	Minimum	0.269	0.312	0.350	76.9	37.6	40.1	33	32	17	1.3	22				
20'-22'	Average	0.279	0.345	0.350	79.7	39.9	53.5	37	37	18	1.3	24				Fine to Medium Sand and Gravel
	Std.Dev.	0.006	0.008	0.000	1.8	0.7	0.4									
	Maximum	0.300	0.367	0.350	85.6	40.9	54.2	37	37	18	1.4	26				
	Minimum	0.268	0.323	0.350	76.7	38.2	52.6	37	37	18	1.3	23				
25'-27'	Average	0.292	0.338	0.350	83.3	40.2	40.9	45	18	22	1.4	31				Fine to Medium Sand and Gravel
	Std.Dev.	0.006	0.010	0.000	1.8	0.8	10.0									
	Maximum	0.307	0.357	0.350	87.8	41.9	54.8	45	18	22	1.5	32				
	Minimum	0.279	0.321	0.350	79.7	38.4	26.8	45	18	22	1.3	29				
30'-32'	Average	0.299	0.354	0.350	85.4	41.3	53.9	20	20	9	1.4	13		ETR Average (>30') (%)		Silty Fine Sand
	Std.Dev.	0.004	0.008	0.000	1.2	0.7	0.3									
	Maximum	0.308	0.369	0.350	88.1	42.7	54.3	20	20	9	1.5	13				
	Minimum	0.288	0.335	0.350	82.2	39.4	53.4	20	20	9	1.4	12		84.2		
35'-37'	Average	0.295	0.355	0.350	84.2	40.5	51.5	20	20	10	1.4	14				Silty Fine Sand
	Std.Dev.	0.004	0.003	0.000	1.1	0.6	3.3									
	Maximum	0.301	0.361	0.350	86.0	41.5	52.7	20	20	10	1.4	14				
	Minimum	0.286	0.350	0.350	81.8	39.3	37.4	20	20	10	1.4	14				
40'-42'	Average	0.290	0.357	0.350	82.9	40.6	53.5	24	24	10	1.4	14				Silty Fine Sand
	Std.Dev.	0.013	0.007	0.000	3.7	1.0	0.2									
	Maximum	0.319	0.372	0.350	91.2	42.0	54.0	24	24	10	1.5	15				
	Minimum	0.260	0.349	0.350	74.2	39.1	53.1	24	24	10	1.2	12				
45'-47' ** only 2 blows	Average	0.238	0.346	0.350	68.2	40.6	52.5	31	2	16	1.1	18				Fine Sand
	Std.Dev.	0.011	0.004	0.000	3.3	0.1	0.0		2							
	Maximum	0.250	0.350	0.350	71.5	40.8	52.5	31		16	1.2	19				
	Minimum	0.227	0.342	0.350	64.9	40.5	52.5	31		16	1.1	17				
50'-52' **	Average			0.350				29		15						Fine Sand
	Std.Dev.			0.000												
	Maximum			0.350				29		15						
	Minimum			0.350				29		15						

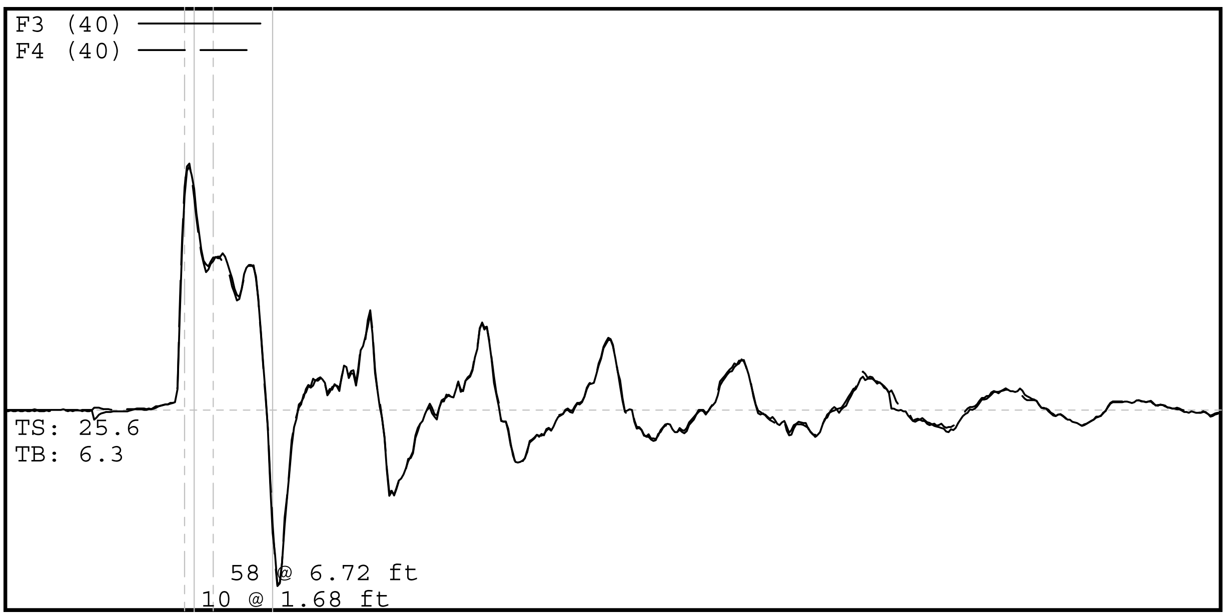
Hammer Type	Drill Rig	Serial #	Rod type	Borehole Type Penetration Method	Owner	Hammer Operator	Testing Engineer	Location of Boring	Date and Start Time	Boring	Sample Depth (feet)		EMX (kip-ft)	EF2 (kip-ft)	ER (kip-ft)	ETR (%)	FMX (kips)	BPM (blows/ minute)	Recorded hammer blows	Analyzed hammer blows	N	Cn	N60	ETR Average (%)	Cn Average	Depth to H_2O (ft)	Soil Description
Safety Driver Hammer - Mobile	Simco 2800		AWJ	4 1/4" HSA with auger plug	Specialty Drilling & Investigation	Chris Aldrich	Shawn Kelley	Miller Construction Yard, Windsor, VT	9/29/2008 9:45	GD-9	All depths	Average	0.168	0.197	0.350	48.1	18.3	46.1	459	354	25	0.8	20	48.1	0.8	50.0	cohesionless soil
												Std.Dev.	0.020	0.028	0.000	5.7	0.9	2.7									
												Maximum	0.220	0.255	0.350	62.9	20.6	53.3	85	81	52	1.0	54				
												Minimum	0.112	0.109	0.350	32.0	15.2	38.3	16	6	9	0.5	5				
											5'-7'	Average	0.135	0.120	0.350	38.5	17.0	41.7	16	14	9	0.6	6				Fine Sand
												Std.Dev.	0.014	0.009	0.000	4.0	1.0	2.3									
												Maximum	0.167	0.145	0.350	47.6	19.5	45.4	16	14	9	0.8	7				
												Minimum	0.112	0.109	0.350	32.0	15.7	38.3	16	14	9	0.5	5				
											10'-12'	Average	0.162	0.156	0.350	46.4	18.1	45.1	20	20	9	0.8	7				Fine Sand
												Std.Dev.	0.026	0.013	0.000	7.5	0.7	1.5									
												Maximum	0.218	0.176	0.350	62.4	19.3	48.5	20	20	9	1.0	9				
												Minimum	0.115	0.131	0.350	33.0	17.1	42.5	20	20	9	0.5	5				
											15'-17'	Average	0.182	0.177	0.350	51.9	18.2	44.0	56	58	29	0.9	25				Fine to Medium Sand and Gravel
												Std.Dev.	0.018	0.016	0.000	5.0	1.2	2.0									
												Maximum	0.211	0.208	0.350	60.2	20.3	48.2	56	58	29	1.0	29				
												Minimum	0.145	0.140	0.350	41.5	15.2	39.9	56	58	29	0.7	20				
											20'-22'	Average	0.170	0.203	0.350	48.4	18.6	47.7	56	57	31	0.8	25				Fine to Medium Sand and Gravel
												Std.Dev.	0.017	0.017	0.000	4.8	1.0	1.8									
												Maximum	0.204	0.239	0.350	58.4	20.6	53.3	56	57	31	1.0	30				
												Minimum	0.127	0.159	0.350	36.2	16.5	44.4	56	57	31	0.6	19				
											25'-27'	Average	0.156	0.196	0.350	44.5	18.1	48.6	85	81	52	0.7	39				Fine to Medium Sand and Gravel
												Std.Dev.	0.012	0.012	0.000	3.4	0.6	1.8									
												Maximum	0.197	0.227	0.350	56.3	19.4	52.0	85	81	52	0.9	49				
												Minimum	0.128	0.163	0.350	36.6	16.8	44.8	85	81	52	0.6	32				
											30'-32'	Average	0.181	0.224	0.350	51.6	18.8	43.7	28	27	14	0.9	12		ETR Average (>30') (%)		Silty Fine Sand
												Std.Dev.	0.017	0.012	0.000	4.8	0.6	1.9									
												Maximum	0.220	0.249	0.350	62.9	20.0	46.8	28	27	14	1.0	15				
												Minimum	0.156	0.202	0.350	44.6	17.3	39.6	28	27	14	0.7	10		51.0		
											35'-37'	Average	0.174	0.221	0.350	49.9	18.3	47.3	39	39	22	0.8	18				Silty Fine Sand
												Std.Dev.	0.010	0.012	0.000	3.0	0.7	1.7									
												Maximum	0.203	0.246	0.350	58.0	19.7	51.9	39	39	22	1.0	21				
												Minimum	0.156	0.194	0.350	44.6	16.4	43.9	39	39	22	0.7	16				
											40'-42'	Average	0.169	0.215	0.350	48.2	18.2	44.9	51	52	27	0.8	22				Silty Fine Sand
												Std.Dev.	0.017	0.020	0.000	4.7	0.9	1.8									
												Maximum	0.219	0.255	0.350	62.6	19.8	49.8	51	52	27	1.0	28				
												Minimum	0.131	0.168	0.350	37.5	16.2	39.9	51	52	27	0.6	17				
											45'-47' ** only 6 blows	Average	0.191	0.231	0.350	54.4	18.9	47.0	55	6	32	0.9	29				Silty Fine Sand
												Std.Dev.	0.024	0.009	0.000	6.8	0.5	1.5									
												Maximum	0.219	0.244	0.350	62.6	19.5	49.6	55	6	32	1.0	33				
												Minimum	0.142	0.218	0.350	40.5	18.0	45.3	55	6	32	0.7	22				
											50'-52' **	Average			0.350				53		26						Silty Fine Sand
												Std.Dev.			0.000												
												Maximum			0.350				53		26						
												Minimum			0.350				53		26						

** Acceleration data erratic
total blows

Legend: EMX (kip-ft) = the energy delivered by the hammer to the top of the drill string as determined by the EMX method
EF2 (kip-ft) = the energy delivered by the hammer to the top of the drill string as determined by the F-squared method
ER (kip-ft) = 0.35 kip-ft, the theoretical free hall hammer energy for the SPT hammers
ETR (%) = EMX/ER, energy transfer ratio, the efficiency of the hammer as calculated by the SPT Analyzer
FMX (kips) = the force delivered by the hammer
BPM (blows / minute) = the operating rate of the hammer in blows per minute
N = the number of blow counts required to drive the SPT sampler over the depth interval of 6 inches to 18 inches for an 24-inch sampling episode
N_{60} = {(N x EMX) / (0.60 x ER)} = {(N/0.60) x ETR}, the N-value adjusted to a hammer efficiency of 60 percent
C_{η} = {(ETR / 0.60)} = {EMX / (0.60 x ER)} = {(N_{60} / N) x 60}, the adjustment factor by which the N-value should be multiplied in order to obtain N_{60}

VTRANS RSCH011-703 GD-2





Project Information
PROJECT: VTRANS RSCH011-703
PILE NAME: GD-2
DESCR: 2 INCH SS;CME-45C;VTRANS
OPERATOR: SPK
FILE: GD-2ALL
9/23/2008 1:22:40 PM
Blow Number 1

Pile Properties

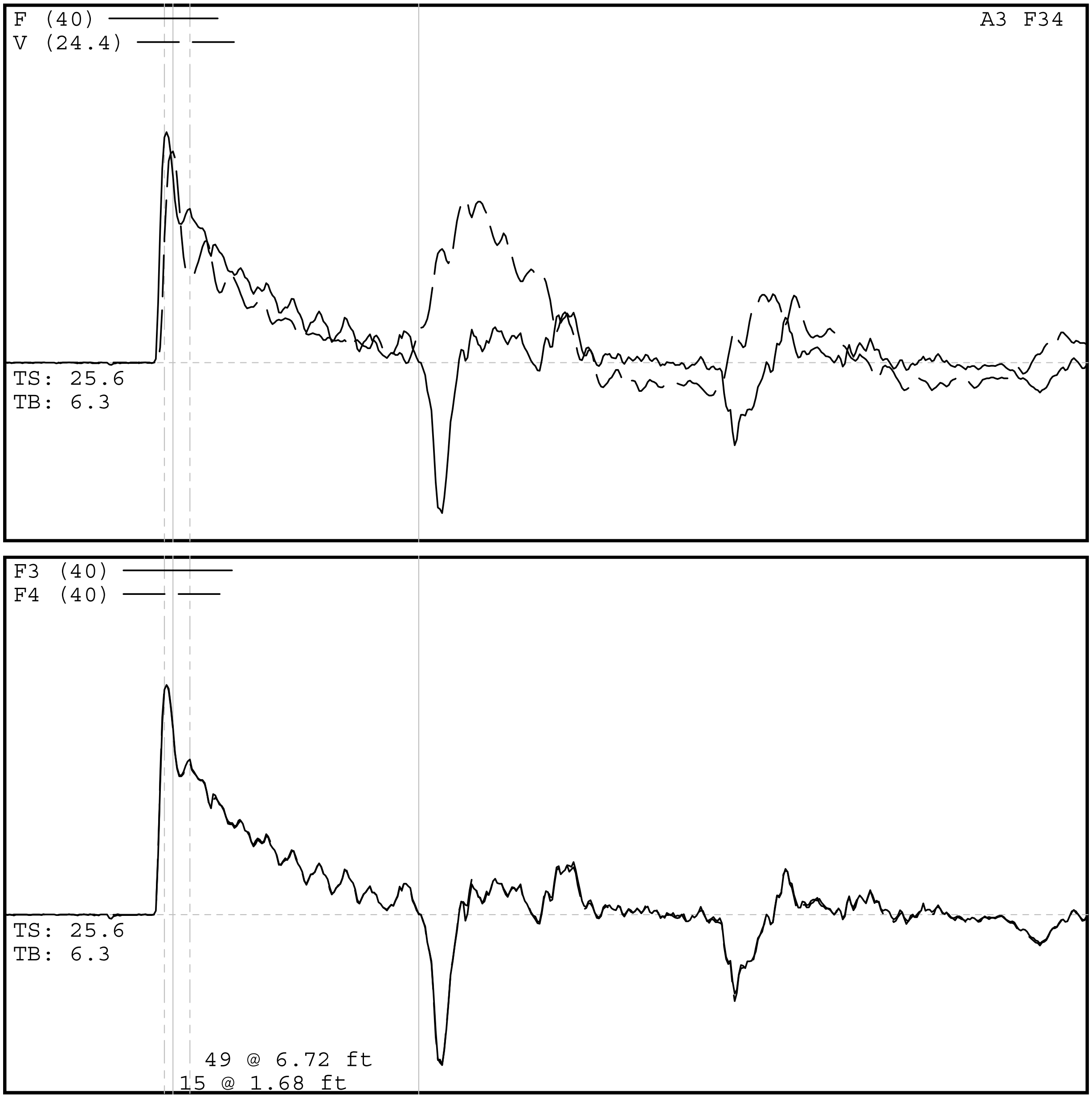
LE	13.83 ft
AR	0.92 in^2
EM	30000 ksi
SP	0.492 k/ft3
WS	16807.7 f/s
EA/C	1.6 ksec/ft
2L/C	1.65 ms
JC	0.00 []
LP	10.00 ft

Quantity Results

EMX	0.2 k-ft
EF2	0.3 k-ft
ER	0.4 k-ft
ETR	57.0 (%)
FMX	24 kips
VMX	15.5 f/s
DMX	1.89 in
DFN	1.89 in
BPM	0.0 bpm

Sensors
F3: [F1] 220.2 (1)
F4: [F2] 219.66 (1)
A3: [A1] 330 mv/5000g's (1)
CLIP: OK
F3/F4: OK 1.04
V1/V2: USE 2 ACCELS

VTRANS RSCH011-703 GD-2



Project Information
PROJECT: VTRANS RSCH011-703
PILE NAME: GD-2
DESCR: 2 INCH SS;CME-45C;VTRANS
OPERATOR: SPK
FILE: GD-2ALL
9/24/2008 11:38:39 AM
Blow Number 23/186

Pile Properties

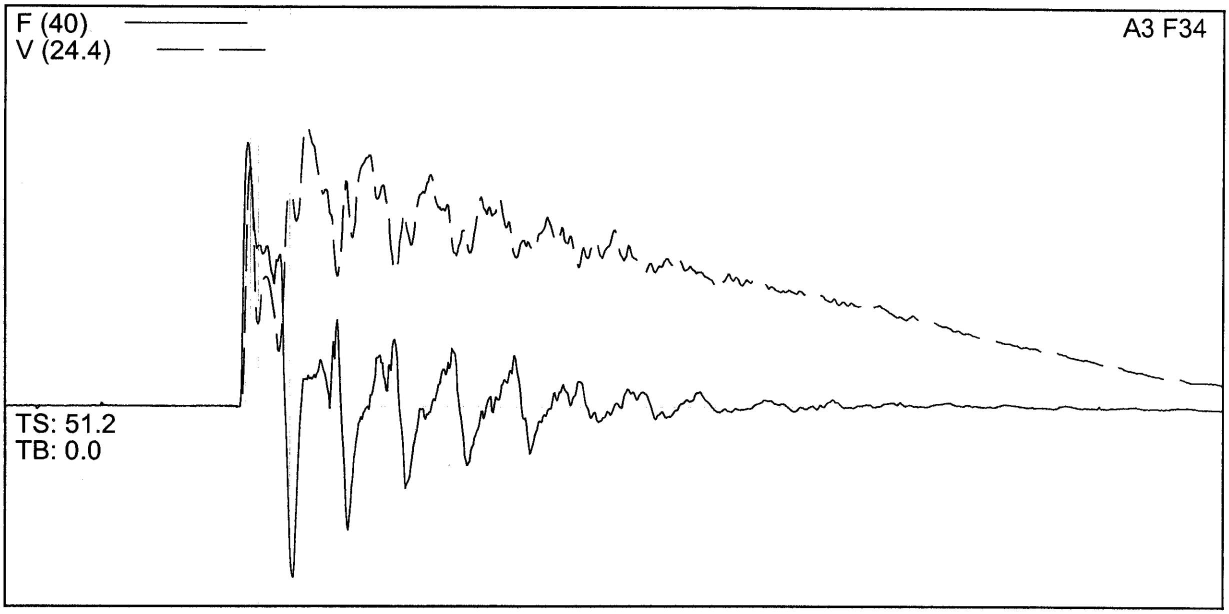
LE	48.83 ft
AR	0.92 in^2
EM	30000 ksi
SP	0.492 k/ft3
WS	16807.7 f/s
EA/C	1.6 ksec/ft
2L/C	5.81 ms
JC	0.00 []
LP	46.50 ft

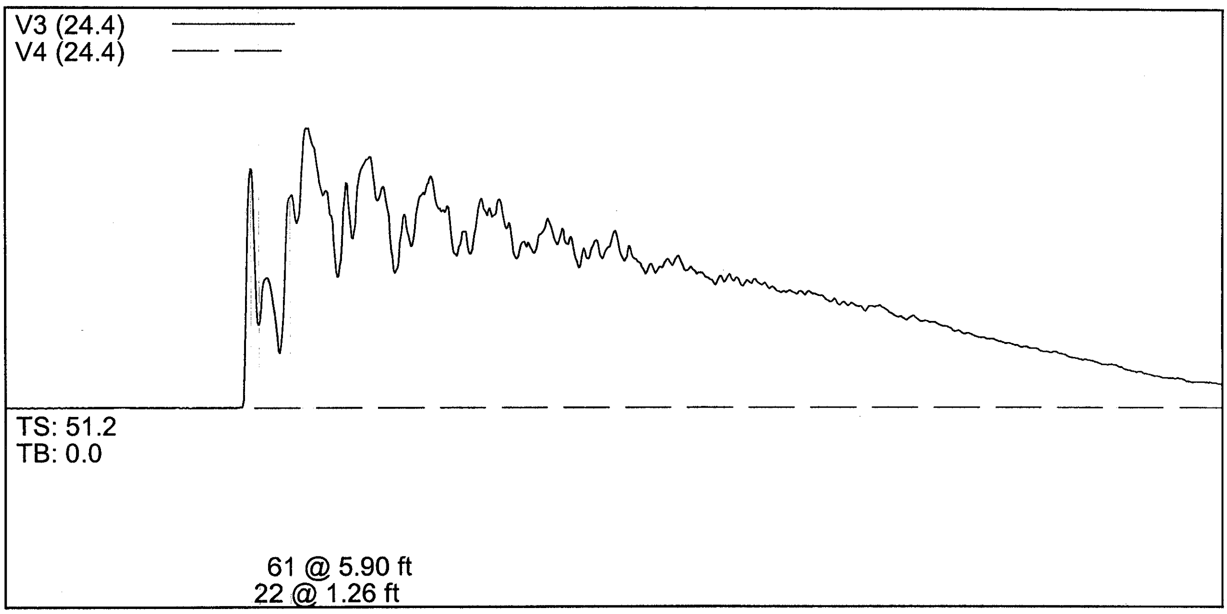
Quantity Results

EMX	0.3 k-ft
EF2	0.4 k-ft
ER	0.4 k-ft
ETR	79.2 (%)
FMX	26 kips
VMX	14.3 f/s
DMX	0.73 in
DFN	0.73 in
BPM	57.7 bpm

Sensors
F3: [F1] 220.2 (1)
F4: [F2] 219.66 (1)
A3: [A1] 330 mv/5000g's (1)
CLIP: OK
F3/F4: OK 1.01
V1/V2: USE 2 ACCELS

VRANS RSCH001-703 G





Project Information

PROJECT: VRANS RSCH001-703
PILE NAME: GD-5
DESCR: 2 INCH SS;CME75 TRACK;TRANSTECH
OPERATOR: SPK
FILE: GD-5ALLMod
9/25/2008 10:02:58 AM
Blow Number 1

Pile Properties

LE	13.71 ft
AR	0.92 in^2
EM	30000 ksi
SP	0.492 k/ft3
WS	16807.7 f/s
EA/C	1.6 ksec/ft
2L/C	1.63 ms
JC	0.00 []
LP	13.12 ft

Quantity Results

EMX	0.2 k-ft
EF2	0.3 k-ft
ER	0.4 k-ft
ETR	63.6 (%) ✓
FMX	26 kips
VMX	17.0 f/s ✓
DMX	3.66 in ✓
DFN	3.66 in ✓
BPM	0.0 bpm ✓

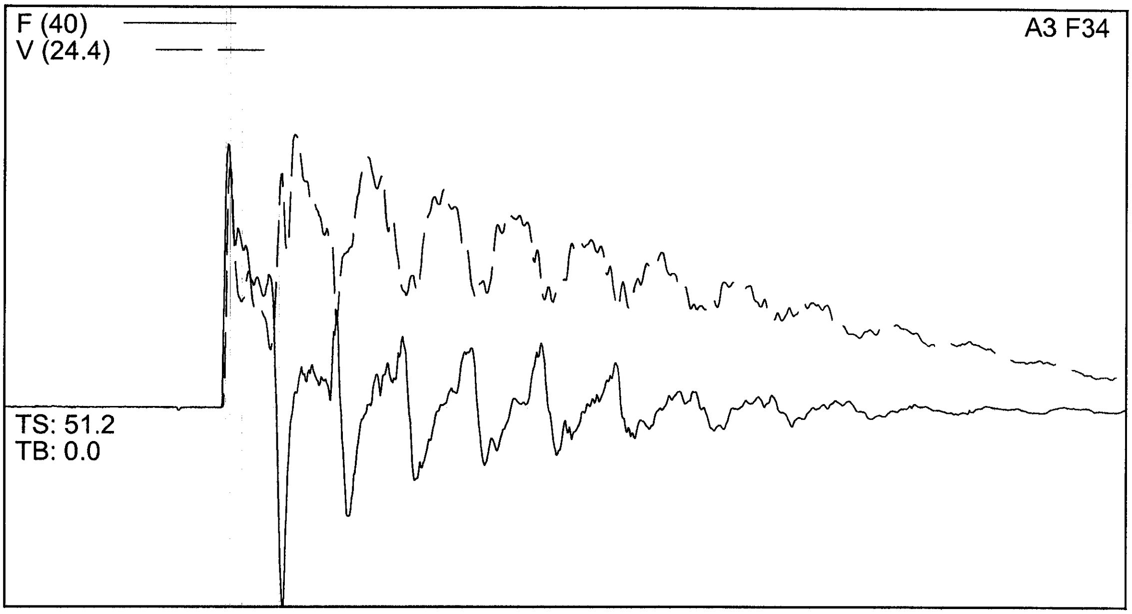
OK

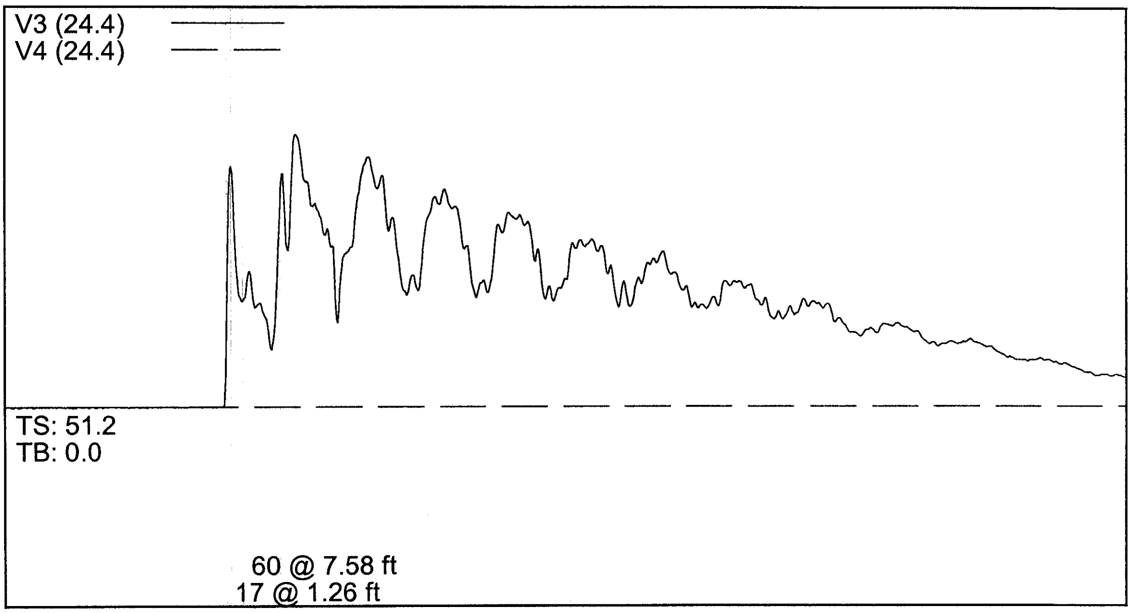
Sensors

F3: [F1] 220.2 (1)
F4: [F2] 219.66 (1)
A3: [A1] 330 mv/5000g's (1)
CLIP: OK
F3/F4: OK 0.99
V1/V2: USE 2 ACCELS

GTR Pile Driving Analyzer ®

VRANS RSCH001-703 GD-5





Project Information
PROJECT: VRANS RSCH001-703
PILE NAME: GD-5
DESCR: 2 INCH SS;CME75 TRACK;TRANSTECH
OPERATOR: SPK
FILE: GD-5ALLMod
9/25/2008 10:16:52 AM
Blow Number 1/7 7

Pile Properties

LE	18.71 ft
AR	0.92 in^2
EM	30000 ksi
SP	0.492 k/ft3
WS	16807.7 f/s
EA/C	1.6 ksec/ft
2L/C	2.22 ms
JC	0.00 []
LP	15.00 ft

Quantity Results

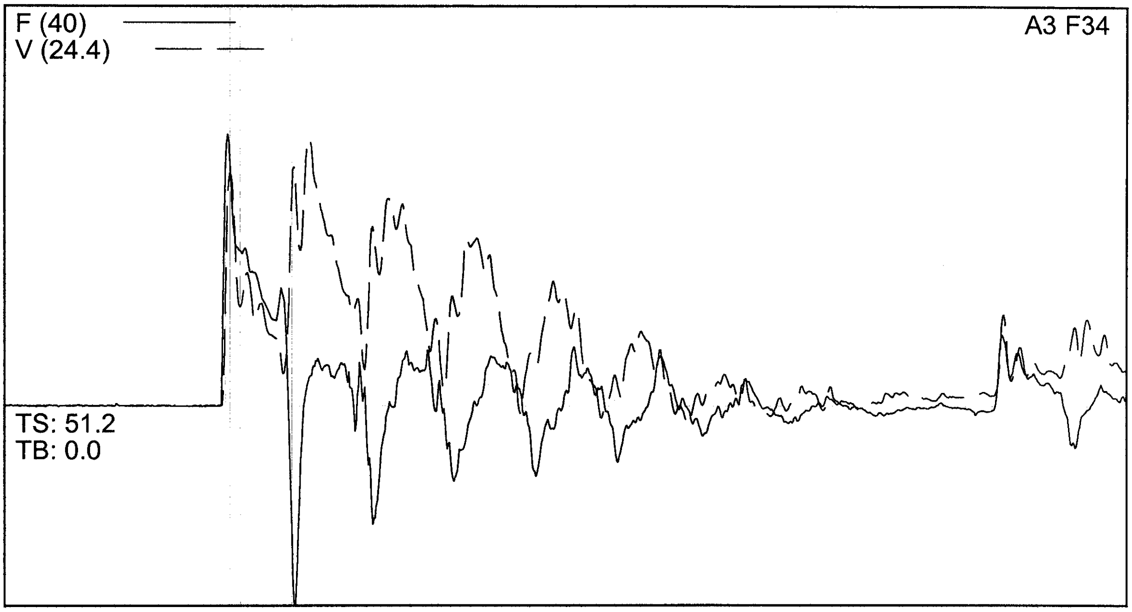
EMX	0.3 k-ft
EF2	0.4 k-ft
ER	0.4 k-ft
ETR	78.3 (%) ✓
FMX	26 kips
VMX	16.6 f/s ✓
DMX	3.51 in ✓
DFN	3.51 in ✓
BPM	0.0 bpm ✓

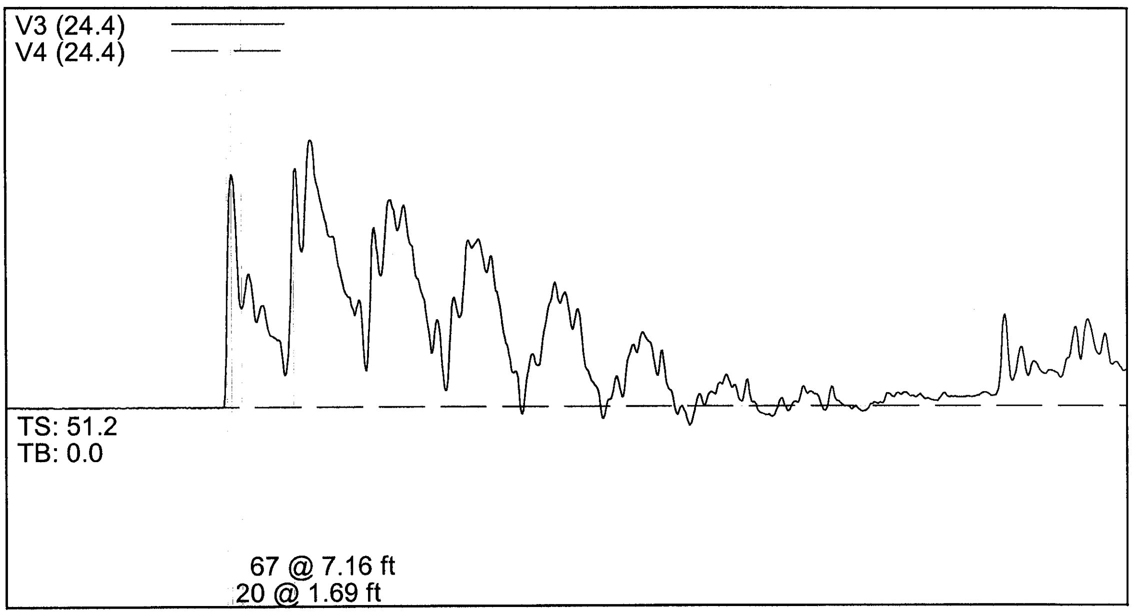
Ok

Sensors
F3: [F1] 220.2 (1)
F4: [F2] 219.66 (1)
A3: [A1] 330 mv/5000g's (1)
CLIP: OK
F3/F4: OK 1.03
V1/V2: USE 2 ACCELS

Version 2008.098.043

VRANS RSCH001-703 GD-5





Project Information

PROJECT: VRANS RSCH001-703
PILE NAME: GD-5
DESCR: 2 INCH SS;CME75 TRACK;TRANSTECH
OPERATOR: SPK
FILE: GD-5ALLMod
9/25/2008 10:28:53 AM
Blow Number ~~2/29~~ 29 29

Pile Properties

LE	23.71 ft
AR	0.92 in^2
EM	30000 ksi
SP	0.492 k/ft3
WS	16807.7 f/s
EA/C	1.6 ksec/ft
2L/C	2.81 ms
JC	0.00 []
LP	20.50 ft

Quantity Results

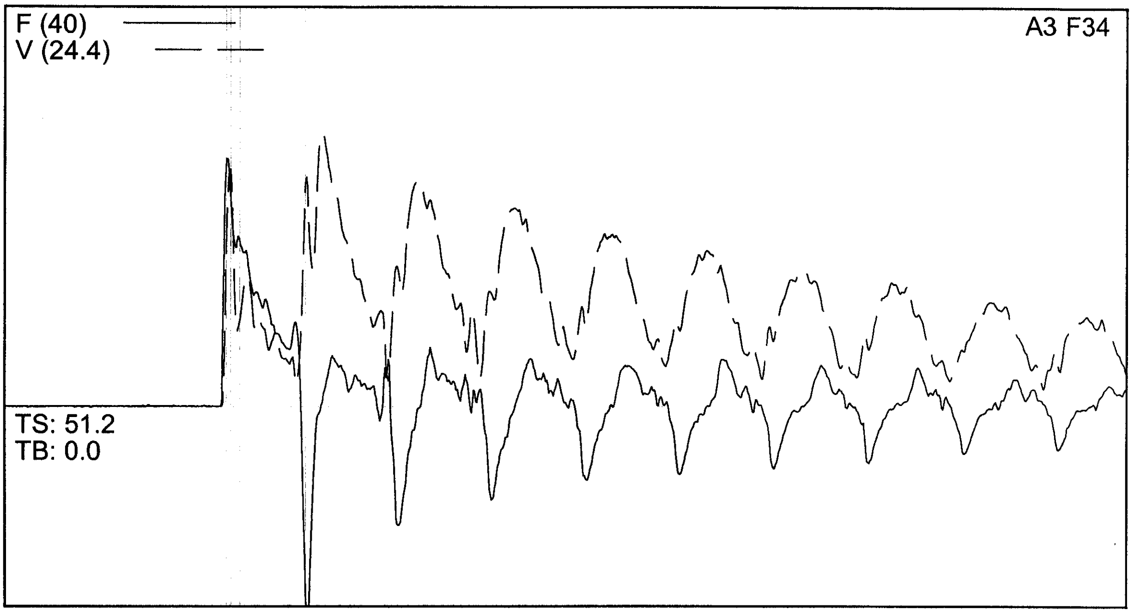
EMX	0.3 k-ft
EF2	0.4 k-ft
ER	0.4 k-ft
ETR	83.8 (%) ✓
FMX	27 kips
VMX	16.2 f/s ✓
DMX	1.78 in 0 1.79
DFN	1.78 in 13K
BPM	43.9 bpm ✓

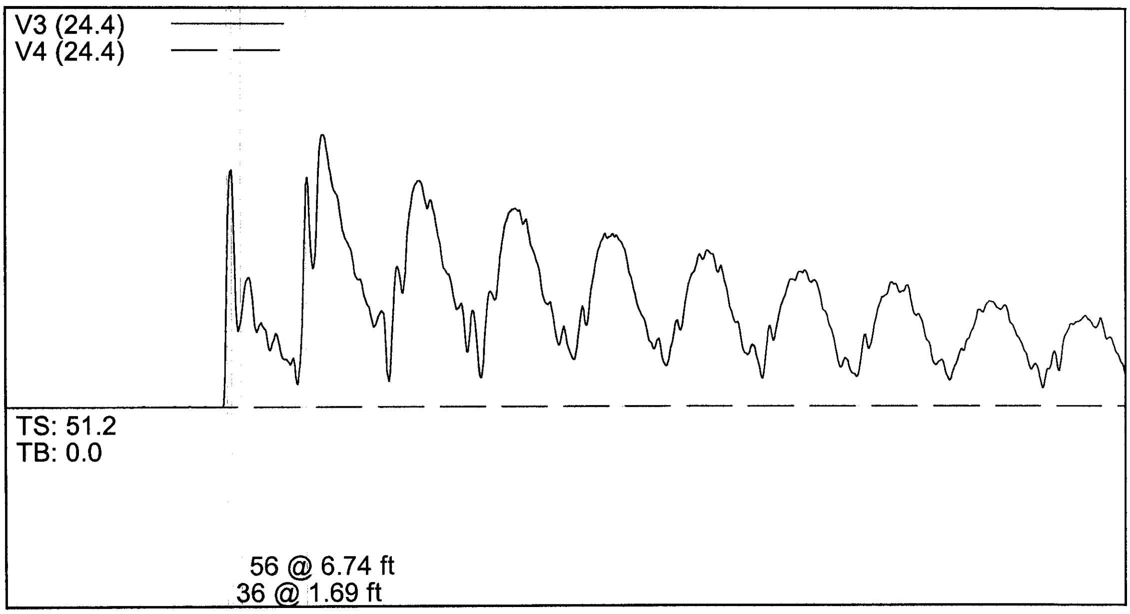
Sensors

F3: [F1] 220.2 (1)
F4: [F2] 219.66 (1)
A3: [A1] 330 mv/5000g's (1)
CLIP: OK
F3/F4: OK 1.00
V1/V2: USE 2 ACCELS

VRANS RSCH001-703

GD-5





Project Information
PROJECT: VRANS RSCH001-703
PILE NAME: GD-5
DESCR: 2 INCH SS;CME75 TRACK;TRANSTECH
OPERATOR: SPK
FILE: GD-5ALLMod
9/25/2008 10:40:30 AM
Blow Number 1/47 47

Pile Properties

LE	28.71 ft
AR	0.92 in^2
EM	30000 ksi
SP	0.492 k/ft3
WS	16807.7 f/s
EA/C	1.6 ksec/ft
2L/C	3.41 ms
JC	0.00 []
LP	25.00 ft

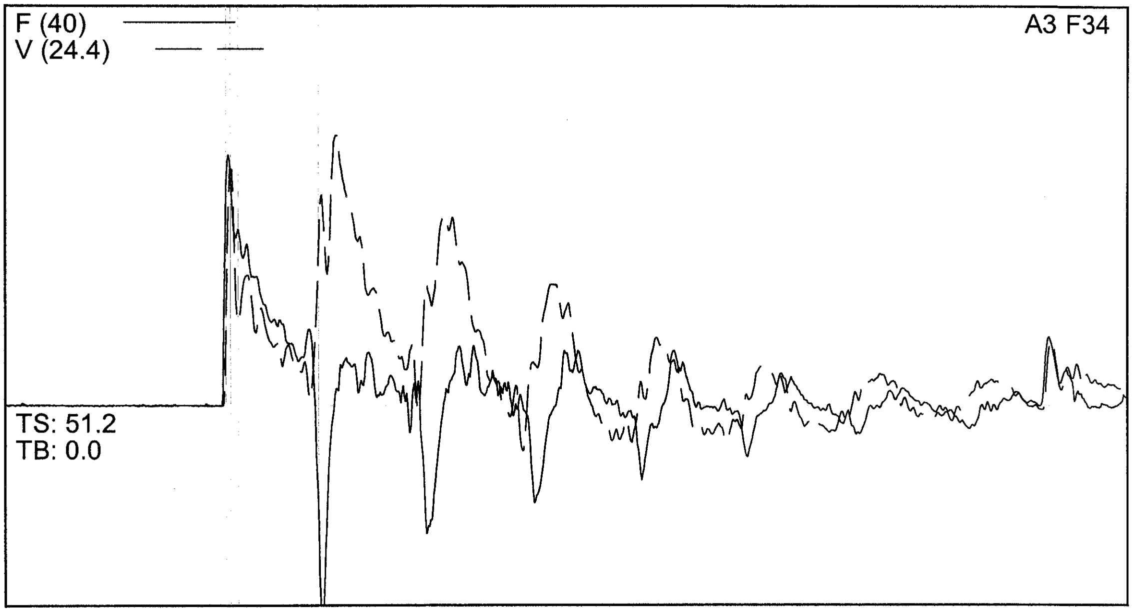
Quantity Results

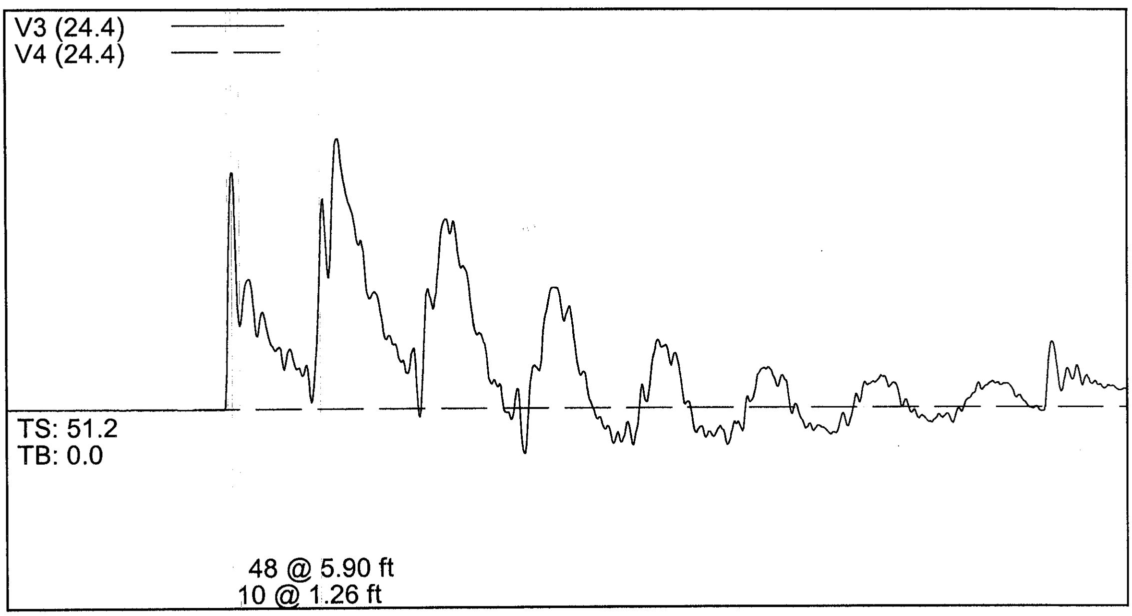
EMX	0.3 k-ft
EF2	0.3 k-ft
ER	0.4 k-ft
ETR	74.0 (%) ✓
FMX	25 kips
VMX	16.6 f/s ✓ Ok
DMX	3.11 in ✓
DFN	3.11 in ✓
BPM	0.0 bpm ✓

Sensors
F3: [F1] 220.2 (1)
F4: [F2] 219.66 (1)
A3: [A1] 330 mv/5000g's (1)
CLIP: OK
F3/F4: OK 0.98
V1/V2: USE 2 ACCELS

GTR Pile Driving Analyzer ®

VRANS RSCH001-703 GD-5





Project Information

PROJECT: VRANS RSCH001-703
PILE NAME: GD-5
DESCR: 2 INCH SS;CME75 TRACK;TRANSTECH
OPERATOR: SPK
FILE: GD-5ALLMod
9/25/2008 10:52:39 AM
Blow Number 1/55

Pile Properties

LE	33.71 ft
AR	0.92 in^2
EM	30000 ksi
SP	0.492 k/ft3
WS	16807.7 f/s
EA/C	1.6 ksec/ft
2L/C	4.00 ms
JC	0.00 []
LP	30.00 ft

Quantity Results

EMX	0.3 k-ft
EF2	0.4 k-ft
ER	0.4 k-ft
ETR	77.8 (%) ✓
FMX	25 kips
VMX	16.4 f/s ✓
DMX	1.22 in ✓
DFN	1.22 in ✓
BPM	0.0 bpm

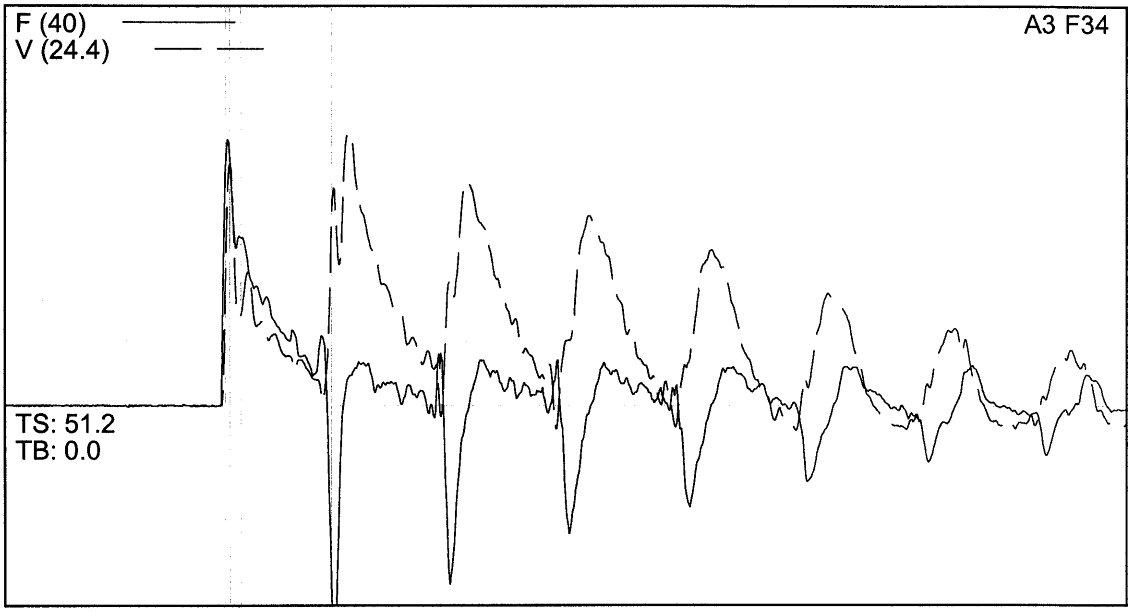
Sensors

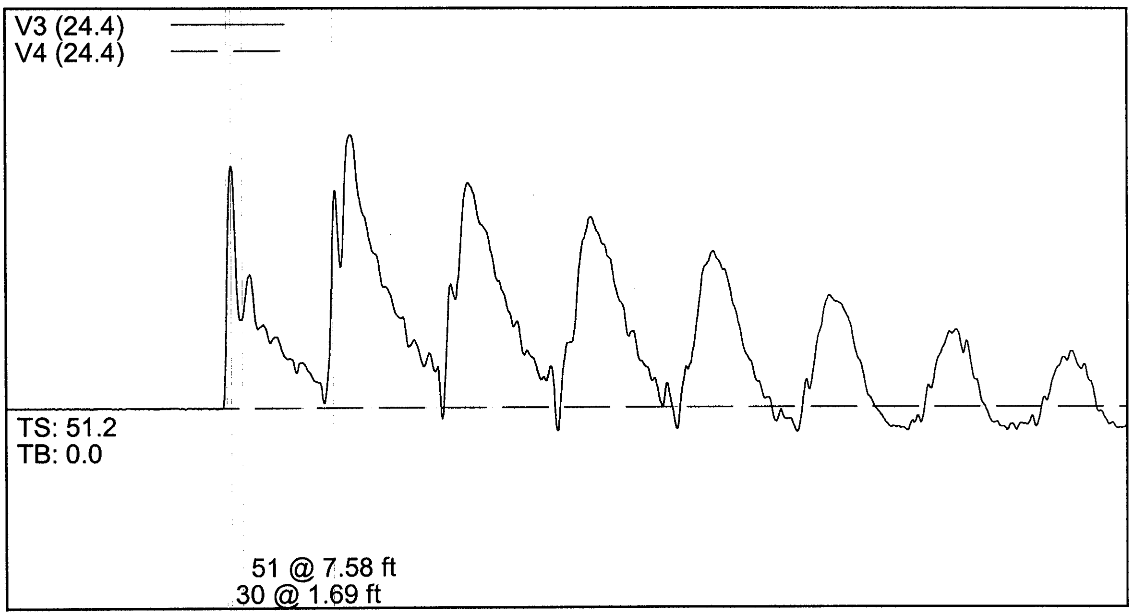
F3: [F1] 220.2 (1)
F4: [F2] 219.66 (1)
A3: [A1] 330 mv/5000g's (1)
CLIP: OK
F3/F4: OK 1.01
V1/V2: USE 2 ACCELS

Version 2008.098.043

GTR Pile Driving Analyzer ®

VRANS RSCH001-703 GD-5





Project Information
PROJECT: VRANS RSCH001-703
PILE NAME: GD-5
DESCR: 2 INCH SS;CME75 TRACK;TRANSTECH
OPERATOR: SPK
FILE: GD-5ALLMod
9/25/2008 11:06:22 AM
Blow Number 1/89

Pile Properties

LE	38.70 ft
~~AR~~	~~0.92 in^2~~
EM	30000 ksi
SP	0.492 k/ft3
WS	16807.7 f/s
EA/C	1.6 ksec/ft
2L/C	4.59 ms
JC	0.00 []
LP	35.00 ft

Quantity Results

EMX	0.3 k-ft
EF2	0.4 k-ft
ER	0.4 k-ft
ETR	84.8 (%) ✓
FMX	27 kips ✓
VMX	16.6 f/s ✓
DMX	1.96 in ✓
DFN	1.94 in ✓
BPM	0.0 bpm ✓

ok

Sensors
F3: [F1] 220.2 (1)
F4: [F2] 219.66 (1)
A3: [A1] 330 mv/5000g's (1)
CLIP: OK
F3/F4: OK 0.99
V1/V2: USE 2 ACCELS

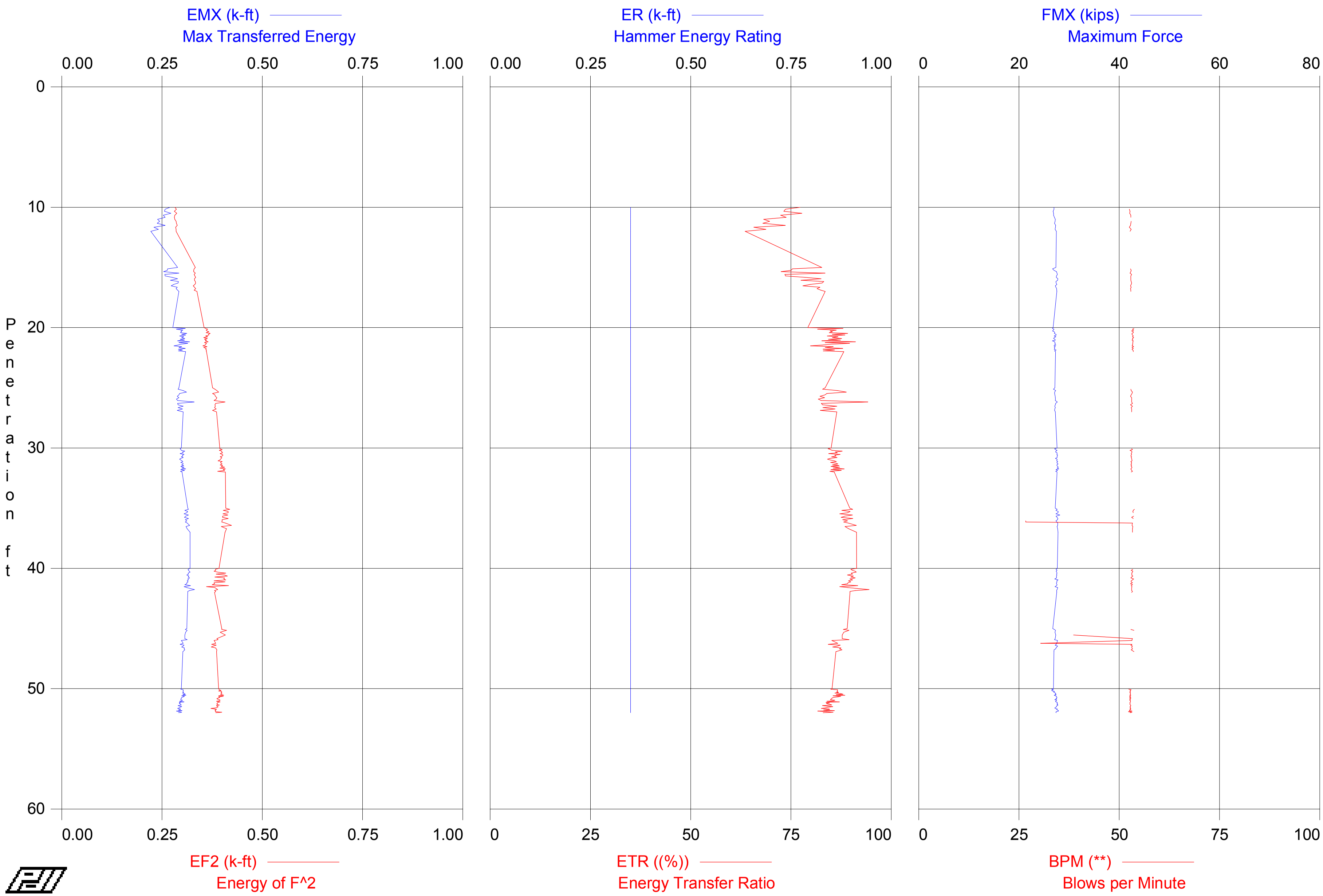
APPENDIX 8 – PDI PLOT OUTPUT DATA AND PLOTS

Geosciences Testing & Research Inc - Case Method Results

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

Test date: 23-Sep-2008

VTRANS RSCH011-703 - GD-1



VTRANS RSCH011-703 - GD-1
OP: SPK

2 INCH SS;CME-55 AUTO;VTRANS
Test date: 23-Sep-2008

AR: 0.92 in^2
LE: 53.75 ft
WS: 16,807.7 f/s

SP: 0.492 k/ft3
EM: 30,000 ksi
JC: 0.00

EMX: Max Transferred Energy
EF2: Energy of F^2
ER: Hammer Energy Rating
ETR: Energy Transfer Ratio
FMX: Maximum Force

VMX: Maximum Velocity
DMX: Maximum Displacement
DFN: Final Displacement
BPM: Blows per Minute

Statistics for entire file (215 blows)

	EMX	EF2	ER	ETR	FMX	VMX	DMX	DFN	BPM
	k-ft	k-ft	k-ft	(%)	kips	f/s	in	in	**
Average	0.297	0.377	0.350	85.0	27.4	16.1	0.99	0.93	52.6
Std. Dev.	0.017	0.032	0.001	4.9	0.3	0.8	0.43	0.51	3.2
Maximum	0.331	0.423	0.350	94.5	28.2	18.3	2.31	2.31	53.8
@ Blow#	155	126	1	155	117	15	69	69	112
Minimum	0.222	0.281	0.350	63.6	26.5	14.5	0.48	-0.81	26.7
@ Blow#	13	3	1	13	187	186	179	171	122

Time Summary

Drive	2 minutes 12 seconds	10:10:39 AM - 10:12:51 AM (9/23/2008) BN 1 - 13
Stop	15 minutes 45 seconds	10:12:51 AM - 10:28:36 AM
Drive	19 seconds	10:28:36 AM - 10:28:55 AM BN 14 - 31
Stop	24 minutes 21 seconds	10:28:55 AM - 10:53:16 AM
Drive	32 seconds	10:53:16 AM - 10:53:48 AM BN 32 - 61
Stop	17 minutes 39 seconds	10:53:48 AM - 11:11:27 AM
Drive	19 seconds	11:11:27 AM - 11:11:46 AM BN 62 - 79
Stop	23 minutes 58 seconds	11:11:46 AM - 11:35:44 AM
Drive	33 seconds	11:35:44 AM - 11:36:17 AM BN 80 - 110
Stop	59 minutes 44 seconds	11:36:17 AM - 12:36:01 PM
Drive	40 seconds	12:36:01 PM - 12:36:41 PM BN 111 - 132
Stop	21 minutes 42 seconds	12:36:41 PM - 12:58:23 PM
Drive	27 seconds	12:58:23 PM - 12:58:50 PM BN 133 - 158
Stop	31 minutes 23 seconds	12:58:50 PM - 1:30:13 PM
Drive	43 seconds	1:30:13 PM - 1:30:56 PM BN 159 - 185
Stop	19 hours 15 minutes 27 seconds	1:30:56 PM - 8:46:23 AM
Drive	49 seconds	8:46:23 AM - 8:47:12 AM BN 186 - 230

Total time [22:36:33] = (Driving [0:06:34] + Stop [22:29:59])

VTRANS RSCH011-703 - GD-1
OP: SPK

2 INCH SS;CME-55 AUTO;VTRANS
Test date: 23-Sep-2008

AR: 0.92 in^2
LE: 53.75 ft
WS: 16,807.7 f/s

SP: 0.492 k/ft3
EM: 30,000 ksi
JC: 0.00

EMX: Max Transferred Energy
EF2: Energy of F^2
ER: Hammer Energy Rating
ETR: Energy Transfer Ratio
FMX: Maximum Force

VMX: Maximum Velocity
DMX: Maximum Displacement
DFN: Final Displacement
BPM: Blows per Minute

BL#	depth	BLC	EMX	EF2	ER	ETR	FMX	VMX	DMX	DFN	BPM
	ft	bl/ft	k-ft	k-ft	k-ft	(%)	kips	f/s	in	in	**
1	10.00	6	0.270	0.282	0.350	77.2	27.0	16.3	1.36	1.36	0.0
2	10.17	6	0.258	0.286	0.350	73.6	27.0	15.0	0.88	0.54	52.5
3	10.33	6	0.256	0.281	0.350	73.2	26.8	15.4	1.03	0.90	52.7
4	10.50	6	0.272	0.287	0.350	77.7	26.9	16.3	1.25	1.23	52.6
5	10.67	6	0.253	0.282	0.350	72.4	26.9	16.2	1.25	1.06	52.9
6	10.83	6	0.258	0.281	0.350	73.8	27.1	15.8	1.67	1.67	52.9
7	11.00	6	0.239	0.282	0.350	68.2	27.2	16.3	1.63	1.56	0.0
8	11.17	6	0.244	0.285	0.350	69.7	27.2	16.6	1.93	1.92	53.0
9	11.33	6	0.238	0.286	0.350	68.0	27.1	17.0	2.26	2.26	52.9
10	11.50	6	0.258	0.288	0.350	73.6	27.3	16.9	2.09	2.09	52.8
11	11.67	6	0.230	0.284	0.350	65.8	27.3	17.1	1.99	1.99	52.5
12	11.83	6	0.241	0.285	0.350	68.7	27.2	16.6	1.95	1.95	53.0
13	12.00	6	0.222	0.285	0.350	63.6	27.5	16.6	2.03	2.03	52.7
		Average	0.249	0.284	0.350	71.2	27.1	16.3	1.64	1.58	52.8
		Std. Dev.	0.014	0.002	0.000	4.1	0.2	0.6	0.43	0.51	0.2
		Maximum	0.272	0.288	0.350	77.7	27.5	17.1	2.26	2.26	53.0
		@ Blow#	4	10	1	4	13	11	9	9	8
		Minimum	0.222	0.281	0.350	63.6	26.8	15.0	0.88	0.54	52.5
		@ Blow#	13	3	1	13	3	2	2	2	2

Total number of blows analyzed: 13

Time Summary

Drive	2 minutes 12 seconds	10:10:39 AM - 10:12:51 AM (9/23/2008) BN 1 - 13
Stop	15 minutes 45 seconds	10:12:51 AM - 10:28:36 AM
Drive	19 seconds	10:28:36 AM - 10:28:55 AM BN 14 - 31
Stop	24 minutes 21 seconds	10:28:55 AM - 10:53:16 AM
Drive	32 seconds	10:53:16 AM - 10:53:48 AM BN 32 - 61
Stop	17 minutes 39 seconds	10:53:48 AM - 11:11:27 AM
Drive	19 seconds	11:11:27 AM - 11:11:46 AM BN 62 - 79
Stop	23 minutes 58 seconds	11:11:46 AM - 11:35:44 AM
Drive	33 seconds	11:35:44 AM - 11:36:17 AM BN 80 - 110
Stop	59 minutes 44 seconds	11:36:17 AM - 12:36:01 PM
Drive	40 seconds	12:36:01 PM - 12:36:41 PM BN 111 - 132
Stop	21 minutes 42 seconds	12:36:41 PM - 12:58:23 PM
Drive	27 seconds	12:58:23 PM - 12:58:50 PM BN 133 - 158
Stop	31 minutes 23 seconds	12:58:50 PM - 1:30:13 PM
Drive	43 seconds	1:30:13 PM - 1:30:56 PM BN 159 - 185
Stop	19 hours 15 minutes 27 seconds	1:30:56 PM - 8:46:23 AM
Drive	49 seconds	8:46:23 AM - 8:47:12 AM BN 186 - 230

Total time [22:36:33] = (Driving [0:06:34] + Stop [22:29:59])

VTRANS RSCH011-703 - GD-1
OP: SPK

2 INCH SS;CME-55 AUTO;VTRANS
Test date: 23-Sep-2008

AR: 0.92 in^2
LE: 53.75 ft
WS: 16,807.7 f/s

SP: 0.492 k/ft3
EM: 30,000 ksi
JC: 0.00

EMX: Max Transferred Energy
EF2: Energy of F^2
ER: Hammer Energy Rating
ETR: Energy Transfer Ratio
FMX: Maximum Force

VMX: Maximum Velocity
DMX: Maximum Displacement
DFN: Final Displacement
BPM: Blows per Minute

BL#	depth	BLC	EMX	EF2	ER	ETR	FMX	VMX	DMX	DFN	BPM
	ft	bl/ft	k-ft	k-ft	k-ft	(%)	kips	f/s	in	in	**
14	15.00	0	0.289	0.333	0.350	82.7	27.4	16.9	1.54	1.54	0.0
15	15.12	9	0.264	0.330	0.350	75.3	26.7	18.3	1.86	1.86	52.8
16	15.24	9	0.263	0.329	0.350	75.0	27.0	18.0	1.71	1.71	53.0
17	15.35	9	0.254	0.329	0.350	72.6	27.5	17.9	1.74	1.73	52.9
18	15.47	9	0.292	0.333	0.350	83.5	27.6	17.8	2.11	2.11	52.7
19	15.59	9	0.257	0.330	0.350	73.5	27.7	17.7	1.57	1.57	53.1
20	15.71	9	0.258	0.332	0.350	73.7	27.5	18.0	1.56	1.53	52.9
21	15.82	9	0.275	0.334	0.350	78.5	27.4	18.0	1.64	1.64	52.9
22	15.94	9	0.289	0.331	0.350	82.5	27.8	17.7	1.49	1.49	52.9
23	16.06	9	0.271	0.331	0.350	77.5	27.7	17.6	1.30	1.30	52.9
24	16.18	9	0.291	0.333	0.350	83.2	27.4	18.2	1.41	1.41	53.0
25	16.29	9	0.290	0.334	0.350	82.7	27.4	17.8	1.49	1.49	53.1
26	16.41	9	0.279	0.332	0.350	79.8	27.6	17.0	1.00	0.99	53.0
27	16.53	9	0.273	0.328	0.350	78.0	27.3	17.1	1.03	1.03	52.8
28	16.65	9	0.288	0.331	0.350	82.2	27.4	17.1	1.08	1.08	53.0
29	16.76	9	0.285	0.334	0.350	81.5	27.5	17.7	1.21	1.21	52.8
30	16.88	9	0.289	0.330	0.350	82.5	27.5	17.2	1.22	1.22	52.9
31	17.00	9	0.292	0.337	0.350	83.5	27.6	17.7	1.17	1.15	52.9
		Average	0.278	0.332	0.350	79.3	27.4	17.6	1.45	1.45	52.9
		Std. Dev.	0.013	0.002	0.000	3.8	0.2	0.4	0.29	0.30	0.1
		Maximum	0.292	0.337	0.350	83.5	27.8	18.3	2.11	2.11	53.1
		@ Blow#	18	31	14	31	22	15	18	18	19
		Minimum	0.254	0.328	0.350	72.6	26.7	16.9	1.00	0.99	52.7
		@ Blow#	17	27	14	17	15	14	26	26	18

Total number of blows analyzed: 18

Time Summary

Drive	2 minutes 12 seconds	10:10:39 AM - 10:12:51 AM (9/23/2008) BN 1 - 13
Stop	15 minutes 45 seconds	10:12:51 AM - 10:28:36 AM
Drive	19 seconds	10:28:36 AM - 10:28:55 AM BN 14 - 31
Stop	24 minutes 21 seconds	10:28:55 AM - 10:53:16 AM
Drive	32 seconds	10:53:16 AM - 10:53:48 AM BN 32 - 61
Stop	17 minutes 39 seconds	10:53:48 AM - 11:11:27 AM
Drive	19 seconds	11:11:27 AM - 11:11:46 AM BN 62 - 79
Stop	23 minutes 58 seconds	11:11:46 AM - 11:35:44 AM
Drive	33 seconds	11:35:44 AM - 11:36:17 AM BN 80 - 110
Stop	59 minutes 44 seconds	11:36:17 AM - 12:36:01 PM
Drive	40 seconds	12:36:01 PM - 12:36:41 PM BN 111 - 132
Stop	21 minutes 42 seconds	12:36:41 PM - 12:58:23 PM
Drive	27 seconds	12:58:23 PM - 12:58:50 PM BN 133 - 158
Stop	31 minutes 23 seconds	12:58:50 PM - 1:30:13 PM
Drive	43 seconds	1:30:13 PM - 1:30:56 PM BN 159 - 185
Stop	19 hours 15 minutes 27 seconds	1:30:56 PM - 8:46:23 AM
Drive	49 seconds	8:46:23 AM - 8:47:12 AM BN 186 - 230

Total time [22:36:33] = (Driving [0:06:34] + Stop [22:29:59])

Geosciences Testing & Research Inc
Case Method Results

PDIPLOT Ver. 2008.2 - Printed: 2-Apr-2009

VTRANS RSCH011-703 - GD-1
OP: SPK

2 INCH SS;CME-55 AUTO;VTRANS
Test date: 23-Sep-2008

AR: 0.92 in^2
LE: 53.75 ft
WS: 16,807.7 f/s

SP: 0.492 k/ft3
EM: 30,000 ksi
JC: 0.00

EMX: Max Transferred Energy
EF2: Energy of F^2
ER: Hammer Energy Rating
ETR: Energy Transfer Ratio
FMX: Maximum Force

VMX: Maximum Velocity
DMX: Maximum Displacement
DFN: Final Displacement
BPM: Blows per Minute

BL#	depth ft	BLC bl/ft	EMX k-ft	EF2 k-ft	ER k-ft	ETR (%)	FMX kips	VMX f/s	DMX in	DFN in	BPM **
32	20.00	0	0.277	0.355	0.350	79.2	26.8	18.1	2.25	2.25	0.0
33	20.07	15	0.308	0.359	0.350	88.0	26.7	18.0	1.45	1.45	53.7
34	20.14	15	0.286	0.364	0.350	81.6	27.0	17.2	0.99	0.94	53.3
35	20.21	15	0.302	0.360	0.350	86.3	26.9	16.8	1.07	1.07	53.6
36	20.28	15	0.297	0.362	0.350	84.8	26.7	16.9	1.09	1.09	53.1
37	20.34	15	0.299	0.367	0.350	85.3	27.0	16.9	0.90	0.90	53.5
38	20.41	15	0.296	0.360	0.350	84.5	27.2	16.8	1.14	1.14	53.5
39	20.48	15	0.312	0.370	0.350	89.1	27.0	17.0	1.00	1.00	53.2
40	20.55	15	0.299	0.366	0.350	85.3	27.4	16.9	0.80	0.80	53.2
41	20.62	15	0.309	0.367	0.350	88.4	27.4	16.7	0.99	0.99	53.3
42	20.69	15	0.294	0.359	0.350	84.1	27.0	16.6	0.73	0.63	53.5
43	20.76	15	0.304	0.364	0.350	86.7	27.4	16.6	0.80	0.80	53.3
44	20.83	15	0.299	0.354	0.350	85.3	27.1	16.6	0.91	0.91	53.6
45	20.90	15	0.307	0.363	0.350	87.6	26.9	16.8	0.90	0.90	53.3
46	20.97	15	0.295	0.356	0.350	84.3	27.2	16.5	0.76	0.76	53.4
47	21.03	15	0.306	0.361	0.350	87.3	27.3	16.6	0.96	0.96	53.2
48	21.10	15	0.289	0.358	0.350	82.7	26.7	16.9	0.72	0.55	53.5
49	21.17	15	0.319	0.365	0.350	91.1	27.1	16.9	1.24	1.24	53.4
50	21.24	15	0.292	0.356	0.350	83.5	27.2	16.7	0.72	0.59	53.4
51	21.31	15	0.314	0.361	0.350	89.6	27.2	16.8	1.13	1.13	53.4
52	21.38	15	0.297	0.359	0.350	85.0	27.1	16.9	1.14	1.14	53.3
53	21.45	15	0.290	0.358	0.350	82.8	27.4	16.4	0.76	0.61	53.4
54	21.52	15	0.280	0.352	0.350	79.9	27.0	16.8	0.95	0.95	53.2
55	21.59	15	0.299	0.362	0.350	85.5	27.3	16.7	0.85	0.77	53.6
56	21.66	15	0.292	0.354	0.350	83.5	27.1	16.6	1.05	1.05	53.2
57	21.72	15	0.308	0.360	0.350	87.9	27.2	16.7	1.12	1.12	53.5
58	21.79	15	0.291	0.359	0.350	83.0	27.0	16.9	0.90	0.90	53.2
59	21.86	15	0.301	0.361	0.350	85.9	27.4	16.6	0.91	0.91	53.4
60	21.93	15	0.291	0.360	0.350	83.0	27.1	16.8	0.83	0.77	53.5
61	22.00	15	0.309	0.361	0.350	88.2	27.3	16.6	1.16	1.16	53.5
		Average	0.299	0.360	0.350	85.3	27.1	16.8	1.01	0.98	53.4
		Std. Dev.	0.010	0.004	0.000	2.7	0.2	0.4	0.29	0.31	0.2
		Maximum	0.319	0.370	0.350	91.1	27.4	18.1	2.25	2.25	53.7
		@ Blow#	49	39	32	49	41	32	32	32	33
		Minimum	0.277	0.352	0.350	79.2	26.7	16.4	0.72	0.55	53.1
		@ Blow#	32	54	32	32	33	53	48	48	36

Total number of blows analyzed: 30

Time Summary

Drive	2 minutes 12 seconds	10:10:39 AM - 10:12:51 AM (9/23/2008) BN 1 - 13
Stop	15 minutes 45 seconds	10:12:51 AM - 10:28:36 AM
Drive	19 seconds	10:28:36 AM - 10:28:55 AM BN 14 - 31
Stop	24 minutes 21 seconds	10:28:55 AM - 10:53:16 AM
Drive	32 seconds	10:53:16 AM - 10:53:48 AM BN 32 - 61
Stop	17 minutes 39 seconds	10:53:48 AM - 11:11:27 AM
Drive	19 seconds	11:11:27 AM - 11:11:46 AM BN 62 - 79
Stop	23 minutes 58 seconds	11:11:46 AM - 11:35:44 AM
Drive	33 seconds	11:35:44 AM - 11:36:17 AM BN 80 - 110
Stop	59 minutes 44 seconds	11:36:17 AM - 12:36:01 PM
Drive	40 seconds	12:36:01 PM - 12:36:41 PM BN 111 - 132
Stop	21 minutes 42 seconds	12:36:41 PM - 12:58:23 PM
Drive	27 seconds	12:58:23 PM - 12:58:50 PM BN 133 - 158
Stop	31 minutes 23 seconds	12:58:50 PM - 1:30:13 PM
Drive	43 seconds	1:30:13 PM - 1:30:56 PM BN 159 - 185
Stop	19 hours 15 minutes 27 seconds	1:30:56 PM - 8:46:23 AM
Drive	49 seconds	8:46:23 AM - 8:47:12 AM BN 186 - 230

Total time [22:36:33] = (Driving [0:06:34] + Stop [22:29:59])

VTRANS RSCH011-703 - GD-1
OP: SPK

2 INCH SS;CME-55 AUTO;VTRANS
Test date: 23-Sep-2008

AR: 0.92 in^2
LE: 53.75 ft
WS: 16,807.7 f/s

SP: 0.492 k/ft3
EM: 30,000 ksi
JC: 0.00

EMX: Max Transferred Energy
EF2: Energy of F^2
ER: Hammer Energy Rating
ETR: Energy Transfer Ratio
FMX: Maximum Force

VMX: Maximum Velocity
DMX: Maximum Displacement
DFN: Final Displacement
BPM: Blows per Minute

BL#	depth	BLC	EMX	EF2	ER	ETR	FMX	VMX	DMX	DFN	BPM
	ft	bl/ft	k-ft	k-ft	k-ft	(%)	kips	f/s	in	in	**
62	25.00	0	0.292	0.376	0.350	83.5	27.2	16.0	0.95	0.92	0.0
63	25.12	9	0.290	0.382	0.350	82.9	26.9	16.7	0.82	0.74	52.9
64	25.24	9	0.303	0.387	0.350	86.6	27.3	16.4	0.94	0.94	53.0
65	25.35	9	0.311	0.391	0.350	88.8	27.1	16.8	1.03	1.03	53.3
66	25.47	9	0.294	0.376	0.350	83.9	27.1	16.4	1.13	1.13	53.2
67	25.59	9	0.292	0.382	0.350	83.5	27.2	16.4	1.28	1.28	53.0
68	25.71	9	0.288	0.383	0.350	82.2	27.2	16.2	2.16	2.16	52.8
69	25.82	9	0.292	0.387	0.350	83.4	27.2	16.9	2.31	2.31	53.1
70	25.94	9	0.286	0.385	0.350	81.8	27.3	16.2	1.70	1.68	53.1
71	26.06	9	0.289	0.380	0.350	82.5	27.3	16.3	2.07	2.07	53.1
72	26.18	9	0.330	0.407	0.350	94.2	27.6	16.3	1.96	1.95	53.1
73	26.29	9	0.289	0.384	0.350	82.6	27.3	16.4	2.01	2.01	53.3
74	26.41	9	0.290	0.382	0.350	82.9	27.3	16.4	1.54	1.54	52.8
75	26.53	9	0.303	0.383	0.350	86.4	27.1	16.3	1.48	1.48	53.3
76	26.65	9	0.290	0.381	0.350	82.9	27.2	16.4	1.47	1.47	53.0
77	26.76	9	0.301	0.385	0.350	86.0	27.1	16.5	1.52	1.52	53.1
78	26.88	9	0.288	0.376	0.350	82.3	27.1	16.4	1.41	1.41	53.1
79	27.00	9	0.303	0.386	0.350	86.4	27.3	16.3	1.40	1.40	53.1
		Average	0.296	0.384	0.350	84.6	27.2	16.4	1.51	1.50	53.1
		Std. Dev.	0.011	0.007	0.000	3.0	0.1	0.2	0.44	0.45	0.2
		Maximum	0.330	0.407	0.350	94.2	27.6	16.9	2.31	2.31	53.3
		@ Blow#	72	72	62	72	72	69	69	69	65
		Minimum	0.286	0.376	0.350	81.8	26.9	16.0	0.82	0.74	52.8
		@ Blow#	70	62	62	70	63	62	63	63	68

Total number of blows analyzed: 18

Time Summary

Drive	2 minutes 12 seconds	10:10:39 AM - 10:12:51 AM (9/23/2008) BN 1 - 13
Stop	15 minutes 45 seconds	10:12:51 AM - 10:28:36 AM
Drive	19 seconds	10:28:36 AM - 10:28:55 AM BN 14 - 31
Stop	24 minutes 21 seconds	10:28:55 AM - 10:53:16 AM
Drive	32 seconds	10:53:16 AM - 10:53:48 AM BN 32 - 61
Stop	17 minutes 39 seconds	10:53:48 AM - 11:11:27 AM
Drive	19 seconds	11:11:27 AM - 11:11:46 AM BN 62 - 79
Stop	23 minutes 58 seconds	11:11:46 AM - 11:35:44 AM
Drive	33 seconds	11:35:44 AM - 11:36:17 AM BN 80 - 110
Stop	59 minutes 44 seconds	11:36:17 AM - 12:36:01 PM
Drive	40 seconds	12:36:01 PM - 12:36:41 PM BN 111 - 132
Stop	21 minutes 42 seconds	12:36:41 PM - 12:58:23 PM
Drive	27 seconds	12:58:23 PM - 12:58:50 PM BN 133 - 158
Stop	31 minutes 23 seconds	12:58:50 PM - 1:30:13 PM
Drive	43 seconds	1:30:13 PM - 1:30:56 PM BN 159 - 185
Stop	19 hours 15 minutes 27 seconds	1:30:56 PM - 8:46:23 AM
Drive	49 seconds	8:46:23 AM - 8:47:12 AM BN 186 - 230

Total time [22:36:33] = (Driving [0:06:34] + Stop [22:29:59])

VTRANS RSCH011-703 - GD-1
OP: SPK

2 INCH SS;CME-55 AUTO;VTRANS
Test date: 23-Sep-2008

AR: 0.92 in^2
LE: 53.75 ft
WS: 16,807.7 f/s

SP: 0.492 k/ft3
EM: 30,000 ksi
JC: 0.00

EMX: Max Transferred Energy
EF2: Energy of F^2
ER: Hammer Energy Rating
ETR: Energy Transfer Ratio
FMX: Maximum Force

VMX: Maximum Velocity
DMX: Maximum Displacement
DFN: Final Displacement
BPM: Blows per Minute

BL#	depth ft	BLC bl/ft	EMX k-ft	EF2 k-ft	ER k-ft	ETR (%)	FMX kips	VMX f/s	DMX in	DFN in	BPM **
80	30.00	0	0.298	0.394	0.350	85.0	27.6	16.0	0.86	0.84	0.0
81	30.07	15	0.295	0.394	0.350	84.3	27.1	16.1	0.99	0.98	53.1
82	30.13	15	0.297	0.400	0.350	84.8	27.3	16.3	0.76	0.69	53.3
83	30.20	15	0.298	0.393	0.350	85.2	27.6	16.0	0.88	0.86	52.7
84	30.27	15	0.307	0.399	0.350	87.8	27.4	16.2	0.98	0.97	53.1
85	30.33	15	0.301	0.399	0.350	86.1	27.3	16.3	0.99	0.98	53.2
86	30.40	15	0.303	0.401	0.350	86.5	27.6	15.9	0.80	0.75	53.1
87	30.47	15	0.295	0.395	0.350	84.4	27.6	16.0	1.07	1.07	53.0
88	30.53	15	0.305	0.400	0.350	87.2	27.6	16.2	1.02	1.02	53.1
89	30.60	15	0.301	0.402	0.350	85.9	27.7	16.1	1.15	1.15	53.0
90	30.67	15	0.302	0.400	0.350	86.2	27.6	16.2	0.90	0.90	52.9
91	30.73	15	0.298	0.395	0.350	85.1	27.7	16.0	0.88	0.87	53.1
92	30.80	15	0.303	0.399	0.350	86.5	27.6	16.0	0.81	0.79	53.0
93	30.87	15	0.297	0.398	0.350	84.7	27.3	16.3	0.85	0.84	53.1
94	30.93	15	0.294	0.396	0.350	84.1	27.6	15.8	0.71	0.43	53.1
95	31.00	15	0.297	0.394	0.350	84.9	27.6	16.1	0.96	0.96	53.2
96	31.07	15	0.300	0.390	0.350	85.8	27.5	15.8	0.81	0.79	53.2
97	31.13	15	0.302	0.400	0.350	86.3	27.8	16.2	0.99	0.99	52.9
98	31.20	15	0.297	0.396	0.350	84.9	27.6	16.2	0.80	0.78	53.1
99	31.27	15	0.302	0.397	0.350	86.2	27.6	16.2	0.99	0.99	53.0
100	31.33	15	0.303	0.400	0.350	86.7	27.8	16.1	0.84	0.83	53.1
101	31.40	15	0.299	0.395	0.350	85.3	27.6	16.3	0.80	0.78	52.9
102	31.47	15	0.304	0.401	0.350	87.0	27.6	16.1	0.82	0.81	53.1
103	31.53	15	0.297	0.398	0.350	85.0	27.7	16.0	0.72	0.69	53.0
104	31.60	15	0.305	0.406	0.350	87.1	27.9	16.1	0.82	0.82	53.2
105	31.67	15	0.299	0.394	0.350	85.5	27.6	16.2	0.81	0.81	53.1
106	31.73	15	0.309	0.408	0.350	88.3	27.9	16.2	0.84	0.84	52.9
107	31.80	15	0.297	0.403	0.350	85.0	27.4	16.4	0.77	0.77	53.0
108	31.87	15	0.306	0.406	0.350	87.5	27.7	16.4	0.77	0.77	53.1
109	31.93	15	0.296	0.389	0.350	84.7	27.3	16.1	0.76	0.76	53.3
110	32.00	15	0.300	0.408	0.350	85.8	27.6	16.2	0.75	0.75	53.0
		Average	0.300	0.398	0.350	85.8	27.6	16.1	0.87	0.85	53.1
		Std. Dev.	0.004	0.005	0.000	1.1	0.2	0.2	0.11	0.13	0.1
		Maximum	0.309	0.408	0.350	88.3	27.9	16.4	1.15	1.15	53.3
		@ Blow#	106	106	80	106	106	107	89	89	82
		Minimum	0.294	0.389	0.350	84.1	27.1	15.8	0.71	0.43	52.7
		@ Blow#	94	109	80	94	81	94	94	94	83

Total number of blows analyzed: 31

Time Summary

Drive	2 minutes 12 seconds	10:10:39 AM - 10:12:51 AM (9/23/2008) BN 1 - 13
Stop	15 minutes 45 seconds	10:12:51 AM - 10:28:36 AM
Drive	19 seconds	10:28:36 AM - 10:28:55 AM BN 14 - 31
Stop	24 minutes 21 seconds	10:28:55 AM - 10:53:16 AM
Drive	32 seconds	10:53:16 AM - 10:53:48 AM BN 32 - 61
Stop	17 minutes 39 seconds	10:53:48 AM - 11:11:27 AM
Drive	19 seconds	11:11:27 AM - 11:11:46 AM BN 62 - 79
Stop	23 minutes 58 seconds	11:11:46 AM - 11:35:44 AM
Drive	33 seconds	11:35:44 AM - 11:36:17 AM BN 80 - 110
Stop	59 minutes 44 seconds	11:36:17 AM - 12:36:01 PM
Drive	40 seconds	12:36:01 PM - 12:36:41 PM BN 111 - 132
Stop	21 minutes 42 seconds	12:36:41 PM - 12:58:23 PM
Drive	27 seconds	12:58:23 PM - 12:58:50 PM BN 133 - 158
Stop	31 minutes 23 seconds	12:58:50 PM - 1:30:13 PM
Drive	43 seconds	1:30:13 PM - 1:30:56 PM BN 159 - 185
Stop	19 hours 15 minutes 27 seconds	1:30:56 PM - 8:46:23 AM
Drive	49 seconds	8:46:23 AM - 8:47:12 AM BN 186 - 230

Geosciences Testing & Research Inc
Case Method Results

PDIPLOT Ver. 2008.2 - Printed: 2-Apr-2009

VTRANS RSCH011-703 - GD-1
OP: SPK

2 INCH SS;CME-55 AUTO;VTRANS
Test date: 23-Sep-2008

AR: 0.92 in^2
LE: 53.75 ft
WS: 16,807.7 f/s

SP: 0.492 k/ft3
EM: 30,000 ksi
JC: 0.00

EMX: Max Transferred Energy
EF2: Energy of F^2
ER: Hammer Energy Rating
ETR: Energy Transfer Ratio
FMX: Maximum Force

VMX: Maximum Velocity
DMX: Maximum Displacement
DFN: Final Displacement
BPM: Blows per Minute

BL#	depth	BLC	EMX	EF2	ER	ETR	FMX	VMX	DMX	DFN	BPM
	ft	bl/ft	k-ft	k-ft	k-ft	(%)	kips	f/s	in	in	**
111	35.00	0	0.314	0.409	0.350	89.7	27.2	17.0	1.05	0.85	0.0
112	35.10	11	0.316	0.419	0.350	90.4	27.6	17.1	1.21	1.21	53.8
113	35.19	11	0.307	0.403	0.350	87.7	27.4	16.8	1.08	0.97	53.5
114	35.29	11	0.314	0.415	0.350	89.7	27.9	17.1	1.15	1.15	53.4
115	35.38	11	0.312	0.415	0.350	89.2	27.8	17.1	0.91	0.88	53.5
116	35.48	11	0.305	0.402	0.350	87.1	27.4	16.7	0.69	0.29	0.0
117	35.57	11	0.316	0.414	0.350	90.3	28.2	17.0	1.02	1.02	0.0
118	35.67	11	0.309	0.401	0.350	88.4	27.4	16.5	0.66	0.65	53.6
119	35.76	11	0.306	0.401	0.350	87.5	27.6	16.6	0.61	-0.02	53.1
120	35.86	11	0.316	0.415	0.350	90.4	27.8	16.9	0.67	0.64	53.5
121	35.95	11	0.308	0.400	0.350	87.9	27.7	16.4	0.62	0.21	0.0
122	36.05	11	0.312	0.400	0.350	89.1	27.4	16.3	0.93	0.93	26.7
123	36.14	11	0.308	0.399	0.350	88.1	27.5	16.4	0.66	0.56	26.7
124	36.24	11	0.313	0.408	0.350	89.3	27.8	16.3	0.76	0.76	53.3
126	36.43	11	0.319	0.423	0.350	91.3	27.7	16.9	0.73	0.73	53.2
127	36.52	11	0.310	0.398	0.350	88.5	27.6	16.1	0.71	0.71	53.4
129	36.71	11	0.313	0.411	0.350	89.4	27.7	16.7	0.68	0.68	53.3
132	37.00	11	0.320	0.407	0.350	91.3	27.8	16.5	1.00	1.00	53.3
		Average	0.312	0.408	0.350	89.2	27.6	16.7	0.84	0.73	49.6
		Std. Dev.	0.004	0.007	0.000	1.2	0.2	0.3	0.20	0.31	9.3
		Maximum	0.320	0.423	0.350	91.3	28.2	17.1	1.21	1.21	53.8
		@ Blow#	132	126	111	132	117	112	112	112	112
		Minimum	0.305	0.398	0.350	87.1	27.2	16.1	0.61	-0.02	26.7
		@ Blow#	116	127	111	116	111	127	119	119	122

Total number of blows analyzed: 18

Time Summary

Drive	2 minutes 12 seconds	10:10:39 AM - 10:12:51 AM (9/23/2008) BN 1 - 13
Stop	15 minutes 45 seconds	10:12:51 AM - 10:28:36 AM
Drive	19 seconds	10:28:36 AM - 10:28:55 AM BN 14 - 31
Stop	24 minutes 21 seconds	10:28:55 AM - 10:53:16 AM
Drive	32 seconds	10:53:16 AM - 10:53:48 AM BN 32 - 61
Stop	17 minutes 39 seconds	10:53:48 AM - 11:11:27 AM
Drive	19 seconds	11:11:27 AM - 11:11:46 AM BN 62 - 79
Stop	23 minutes 58 seconds	11:11:46 AM - 11:35:44 AM
Drive	33 seconds	11:35:44 AM - 11:36:17 AM BN 80 - 110
Stop	59 minutes 44 seconds	11:36:17 AM - 12:36:01 PM
Drive	40 seconds	12:36:01 PM - 12:36:41 PM BN 111 - 132
Stop	21 minutes 42 seconds	12:36:41 PM - 12:58:23 PM
Drive	27 seconds	12:58:23 PM - 12:58:50 PM BN 133 - 158
Stop	31 minutes 23 seconds	12:58:50 PM - 1:30:13 PM
Drive	43 seconds	1:30:13 PM - 1:30:56 PM BN 159 - 185
Stop	19 hours 15 minutes 27 seconds	1:30:56 PM - 8:46:23 AM
Drive	49 seconds	8:46:23 AM - 8:47:12 AM BN 186 - 230

Total time [22:36:33] = (Driving [0:06:34] + Stop [22:29:59])

remove
26.7 BPM
BPM ave = 53.4

VTRANS RSCH011-703 - GD-1
OP: SPK

2 INCH SS;CME-55 AUTO;VTRANS
Test date: 23-Sep-2008

AR: 0.92 in^2
LE: 53.75 ft
WS: 16,807.7 f/s

SP: 0.492 k/ft3
EM: 30,000 ksi
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EMX: Max Transferred Energy
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DFN: Final Displacement
BPM: Blows per Minute

BL#	depth	BLC	EMX	EF2	ER	ETR	FMX	VMX	DMX	DFN	BPM
	ft	bl/ft	k-ft	k-ft	k-ft	(%)	kips	f/s	in	in	**
133	40.00	0	0.320	0.392	0.350	91.4	27.7	15.7	1.28	1.27	0.0
134	40.08	13	0.315	0.383	0.350	89.9	27.4	15.7	1.19	1.16	53.4
135	40.16	13	0.316	0.384	0.350	90.3	27.6	15.7	1.48	1.48	53.0
136	40.24	13	0.318	0.380	0.350	91.0	27.4	15.6	1.27	1.26	53.4
137	40.32	13	0.320	0.388	0.350	91.3	27.5	15.8	1.54	1.54	53.3
138	40.40	13	0.315	0.409	0.350	90.0	27.6	16.0	1.38	1.37	53.1
139	40.48	13	0.316	0.385	0.350	90.3	27.5	15.6	1.35	1.33	53.2
140	40.56	13	0.312	0.406	0.350	89.1	27.6	15.8	1.42	1.40	53.1
141	40.64	13	0.317	0.413	0.350	90.6	27.5	15.9	1.53	1.53	53.4
142	40.72	13	0.315	0.382	0.350	89.9	27.5	15.6	1.37	1.37	53.1
143	40.80	13	0.319	0.406	0.350	91.0	27.5	15.9	1.71	1.71	52.9
144	40.88	13	0.314	0.404	0.350	89.7	27.1	16.0	1.32	1.32	53.6
145	40.96	13	0.316	0.409	0.350	90.4	27.8	15.9	0.65	0.59	53.3
146	41.04	13	0.313	0.380	0.350	89.3	27.5	15.8	0.74	0.73	53.0
147	41.12	13	0.315	0.407	0.350	89.9	27.6	16.1	1.03	1.03	53.0
148	41.20	13	0.312	0.380	0.350	89.2	27.5	15.8	0.69	0.57	53.3
149	41.28	13	0.312	0.381	0.350	89.1	27.5	15.7	0.67	0.51	52.8
150	41.36	13	0.307	0.375	0.350	87.7	27.6	15.8	0.69	0.63	53.3
151	41.44	13	0.321	0.416	0.350	91.6	27.5	15.9	1.11	1.11	53.0
152	41.52	13	0.305	0.361	0.350	87.1	27.2	15.8	1.15	1.15	53.2
153	41.60	13	0.312	0.382	0.350	89.2	27.8	15.7	0.62	0.16	53.1
155	41.76	13	0.331	0.389	0.350	94.5	27.6	15.9	0.98	0.98	53.1
156	41.84	13	0.319	0.381	0.350	91.1	27.5	15.7	0.65	0.61	53.1
157	41.92	13	0.314	0.384	0.350	89.7	27.5	15.7	0.61	0.53	53.3
158	42.00	13	0.314	0.381	0.350	89.7	27.5	15.8	0.66	0.66	53.1
		Average	0.316	0.390	0.350	90.1	27.5	15.8	1.08	1.04	53.2
		Std. Dev.	0.005	0.014	0.000	1.4	0.1	0.1	0.35	0.41	0.2
		Maximum	0.331	0.416	0.350	94.5	27.8	16.1	1.71	1.71	53.6
		@ Blow#	155	151	133	155	145	147	143	143	144
		Minimum	0.305	0.361	0.350	87.1	27.1	15.6	0.61	0.16	52.8
		@ Blow#	152	152	133	152	144	136	157	153	149

Total number of blows analyzed: 25

Time Summary

Drive	2 minutes 12 seconds	10:10:39 AM - 10:12:51 AM (9/23/2008) BN 1 - 13
Stop	15 minutes 45 seconds	10:12:51 AM - 10:28:36 AM
Drive	19 seconds	10:28:36 AM - 10:28:55 AM BN 14 - 31
Stop	24 minutes 21 seconds	10:28:55 AM - 10:53:16 AM
Drive	32 seconds	10:53:16 AM - 10:53:48 AM BN 32 - 61
Stop	17 minutes 39 seconds	10:53:48 AM - 11:11:27 AM
Drive	19 seconds	11:11:27 AM - 11:11:46 AM BN 62 - 79
Stop	23 minutes 58 seconds	11:11:46 AM - 11:35:44 AM
Drive	33 seconds	11:35:44 AM - 11:36:17 AM BN 80 - 110
Stop	59 minutes 44 seconds	11:36:17 AM - 12:36:01 PM
Drive	40 seconds	12:36:01 PM - 12:36:41 PM BN 111 - 132
Stop	21 minutes 42 seconds	12:36:41 PM - 12:58:23 PM
Drive	27 seconds	12:58:23 PM - 12:58:50 PM BN 133 - 158
Stop	31 minutes 23 seconds	12:58:50 PM - 1:30:13 PM
Drive	43 seconds	1:30:13 PM - 1:30:56 PM BN 159 - 185
Stop	19 hours 15 minutes 27 seconds	1:30:56 PM - 8:46:23 AM
Drive	49 seconds	8:46:23 AM - 8:47:12 AM BN 186 - 230

Total time [22:36:33] = (Driving [0:06:34] + Stop [22:29:59])

Geosciences Testing & Research Inc
Case Method Results

PDIPLOT Ver. 2008.2 - Printed: 2-Apr-2009

VTRANS RSCH011-703 - GD-1
OP: SPK

2 INCH SS;CME-55 AUTO;VTRANS
Test date: 23-Sep-2008

AR: 0.92 in^2
LE: 53.75 ft
WS: 16,807.7 f/s

SP: 0.492 k/ft3
EM: 30,000 ksi
JC: 0.00

EMX: Max Transferred Energy
EF2: Energy of F^2
ER: Hammer Energy Rating
ETR: Energy Transfer Ratio
FMX: Maximum Force

VMX: Maximum Velocity
DMX: Maximum Displacement
DFN: Final Displacement
BPM: Blows per Minute

BL#	depth	BLC	EMX	EF2	ER	ETR	FMX	VMX	DMX	DFN	BPM
	ft	bl/ft	k-ft	k-ft	k-ft	(%)	kips	f/s	in	in	**
159	45.00	0	0.312	0.399	0.350	89.0	26.7	15.4	2.17	2.17	0.0
160	45.08	13	0.308	0.399	0.350	88.1	27.1	15.3	1.28	1.28	52.9
161	45.15	13	0.313	0.411	0.350	89.4	27.3	14.9	0.96	0.96	53.7
163	45.31	13	0.309	0.395	0.350	88.2	27.2	15.2	0.64	0.55	0.0
166	45.54	13	0.307	0.408	0.350	87.8	27.3	15.4	0.55	0.50	38.6
170	45.85	13	0.307	0.387	0.350	87.8	27.2	15.0	0.53	-0.13	53.3
171	45.92	13	0.313	0.390	0.350	89.5	27.1	15.3	0.49	-0.81	53.2
172	46.00	13	0.298	0.380	0.350	85.2	27.7	14.8	0.50	-0.07	53.2
175	46.23	13	0.303	0.384	0.350	86.7	27.5	14.9	0.50	0.40	30.4
176	46.31	13	0.295	0.374	0.350	84.3	27.4	15.1	0.48	0.07	53.2
177	46.38	13	0.305	0.385	0.350	87.3	27.2	15.2	0.49	0.32	52.9
178	46.46	13	0.303	0.378	0.350	86.6	27.7	14.7	0.49	0.31	53.3
179	46.54	13	0.299	0.373	0.350	85.4	27.5	14.7	0.48	0.03	53.1
180	46.62	13	0.306	0.384	0.350	87.5	27.4	15.0	0.50	0.39	53.2
181	46.69	13	0.305	0.385	0.350	87.1	27.3	14.9	0.49	0.35	53.3
182	46.77	13	0.307	0.387	0.350	87.7	27.0	15.3	0.51	0.48	53.0
184	46.92	13	0.302	0.386	0.350	86.2	27.0	15.1	0.49	0.40	53.7
		Average	0.305	0.389	0.350	87.3	27.3	15.1	0.68	0.42	50.7
		Std. Dev.	0.005	0.010	0.000	1.4	0.3	0.2	0.43	0.62	6.5
		Maximum	0.313	0.411	0.350	89.5	27.7	15.4	2.17	2.17	53.7
		@ Blow#	161	161	159	171	178	159	159	159	161
		Minimum	0.295	0.373	0.350	84.3	26.7	14.7	0.48	-0.81	30.4
		@ Blow#	176	179	159	176	159	178	179	171	175

Total number of blows analyzed: 17

Remove 30.4 and 38.6
BPM avg = 53.2

Time Summary

Drive	2 minutes 12 seconds	10:10:39 AM - 10:12:51 AM (9/23/2008) BN 1 - 13
Stop	15 minutes 45 seconds	10:12:51 AM - 10:28:36 AM
Drive	19 seconds	10:28:36 AM - 10:28:55 AM BN 14 - 31
Stop	24 minutes 21 seconds	10:28:55 AM - 10:53:16 AM
Drive	32 seconds	10:53:16 AM - 10:53:48 AM BN 32 - 61
Stop	17 minutes 39 seconds	10:53:48 AM - 11:11:27 AM
Drive	19 seconds	11:11:27 AM - 11:11:46 AM BN 62 - 79
Stop	23 minutes 58 seconds	11:11:46 AM - 11:35:44 AM
Drive	33 seconds	11:35:44 AM - 11:36:17 AM BN 80 - 110
Stop	59 minutes 44 seconds	11:36:17 AM - 12:36:01 PM
Drive	40 seconds	12:36:01 PM - 12:36:41 PM BN 111 - 132
Stop	21 minutes 42 seconds	12:36:41 PM - 12:58:23 PM
Drive	27 seconds	12:58:23 PM - 12:58:50 PM BN 133 - 158
Stop	31 minutes 23 seconds	12:58:50 PM - 1:30:13 PM
Drive	43 seconds	1:30:13 PM - 1:30:56 PM BN 159 - 185
Stop	19 hours 15 minutes 27 seconds	1:30:56 PM - 8:46:23 AM
Drive	49 seconds	8:46:23 AM - 8:47:12 AM BN 186 - 230

Total time [22:36:33] = (Driving [0:06:34] + Stop [22:29:59])

VTRANS RSCH011-703 - GD-1
OP: SPK

2 INCH SS;CME-55 AUTO;VTRANS
Test date: 23-Sep-2008

AR: 0.92 in^2
LE: 53.75 ft
WS: 16,807.7 f/s

SP: 0.492 k/ft3
EM: 30,000 ksi
JC: 0.00

EMX: Max Transferred Energy
EF2: Energy of F^2
ER: Hammer Energy Rating
ETR: Energy Transfer Ratio
FMX: Maximum Force

VMX: Maximum Velocity
DMX: Maximum Displacement
DFN: Final Displacement
BPM: Blows per Minute

BL#	depth	BLC	EMX	EF2	ER	ETR	FMX	VMX	DMX	DFN	BPM
	ft	bl/ft	k-ft	k-ft	k-ft	(%)	kips	f/s	in	in	**
186	50.00	0	0.298	0.391	0.350	85.2	26.9	14.5	0.80	0.59	0.0
187	50.05	22	0.297	0.392	0.350	84.9	26.5	14.8	0.58	0.38	52.4
188	50.09	22	0.303	0.393	0.350	86.6	26.9	15.2	0.68	0.68	53.0
189	50.14	22	0.303	0.397	0.350	86.6	26.5	15.3	0.53	0.26	52.7
190	50.18	22	0.303	0.391	0.350	86.6	26.6	15.3	0.58	0.58	52.8
191	50.23	22	0.303	0.398	0.350	86.7	27.1	15.2	0.54	0.50	52.8
192	50.27	22	0.302	0.399	0.350	86.4	26.9	15.2	0.53	0.44	52.6
193	50.32	22	0.304	0.397	0.350	86.9	27.1	15.4	0.55	0.53	52.8
194	50.36	22	0.301	0.399	0.350	85.9	27.3	15.0	0.54	0.49	52.7
195	50.41	22	0.306	0.399	0.350	87.5	27.4	15.2	0.56	0.44	52.8
196	50.45	22	0.308	0.396	0.350	88.0	27.2	15.5	0.88	0.88	52.8
197	50.50	22	0.302	0.399	0.350	86.3	27.4	15.1	0.60	0.60	52.7
198	50.55	22	0.310	0.404	0.350	88.4	27.0	14.9	0.72	0.72	52.9
199	50.59	22	0.299	0.391	0.350	85.5	27.3	15.3	0.57	0.42	52.6
200	50.64	22	0.306	0.403	0.350	87.4	27.5	15.0	0.69	0.69	52.8
201	50.68	22	0.303	0.391	0.350	86.7	27.5	15.2	0.82	0.82	52.6
202	50.73	22	0.300	0.394	0.350	85.7	27.6	15.1	0.55	0.38	52.9
203	50.77	22	0.298	0.391	0.350	85.3	27.6	15.1	0.57	0.55	52.6
204	50.82	22	0.298	0.387	0.350	85.2	27.4	15.2	0.69	0.69	52.9
205	50.86	22	0.297	0.388	0.350	85.0	27.5	15.2	0.71	0.71	52.6
206	50.91	22	0.297	0.393	0.350	84.8	27.2	15.2	0.54	0.41	52.8
207	50.95	22	0.301	0.395	0.350	85.9	27.5	15.1	0.68	0.68	52.6
208	51.00	22	0.299	0.393	0.350	85.6	27.5	15.1	0.58	0.55	52.8
209	51.05	22	0.294	0.386	0.350	84.0	27.3	15.1	0.56	0.39	52.8
210	51.09	22	0.305	0.395	0.350	87.1	27.4	15.0	0.89	0.89	52.8
211	51.14	22	0.293	0.390	0.350	83.7	27.6	15.1	0.59	0.46	52.7
212	51.18	22	0.296	0.388	0.350	84.6	27.6	15.1	0.65	0.65	52.7
213	51.23	22	0.293	0.387	0.350	83.8	27.6	15.2	0.60	0.41	52.7
214	51.27	22	0.295	0.388	0.350	84.2	27.7	15.1	0.75	0.75	52.7
215	51.32	22	0.297	0.387	0.350	84.9	27.6	15.1	0.74	0.74	52.7
216	51.36	22	0.298	0.393	0.350	85.2	27.8	15.1	0.62	0.57	52.8
217	51.41	22	0.290	0.386	0.350	82.9	27.6	15.1	0.57	0.35	52.9
218	51.45	22	0.294	0.387	0.350	84.0	27.5	15.2	0.76	0.76	52.8
219	51.50	22	0.299	0.390	0.350	85.4	27.5	15.0	0.62	0.62	52.7
220	51.55	22	0.295	0.389	0.350	84.3	27.4	15.2	0.56	0.55	52.8
221	51.59	22	0.293	0.385	0.350	83.7	27.2	15.1	0.57	0.56	52.7
222	51.64	22	0.289	0.372	0.350	82.6	27.2	15.2	0.61	0.49	52.9
223	51.68	22	0.296	0.382	0.350	84.5	27.7	15.3	0.64	0.61	52.7
224	51.73	22	0.296	0.386	0.350	84.6	27.5	15.1	0.65	0.63	52.9
225	51.77	22	0.291	0.382	0.350	83.1	27.7	15.2	0.63	0.48	52.6
226	51.82	22	0.300	0.384	0.350	85.8	27.9	15.5	0.61	-0.06	52.5
227	51.86	22	0.286	0.383	0.350	81.7	27.9	15.1	0.54	0.20	53.2
228	51.91	22	0.294	0.383	0.350	83.9	27.4	15.2	0.52	-0.45	52.3
229	51.95	22	0.299	0.399	0.350	85.5	27.3	15.1	0.52	0.41	53.2
230	52.00	22	0.291	0.384	0.350	83.0	27.4	15.0	0.51	0.29	52.7
		Average	0.298	0.391	0.350	85.2	27.4	15.1	0.63	0.52	52.8
		Std. Dev.	0.005	0.006	0.000	1.5	0.3	0.2	0.10	0.23	0.2
		Maximum	0.310	0.404	0.350	88.4	27.9	15.5	0.89	0.89	53.2
		@ Blow#	198	198	186	198	226	196	210	210	227
		Minimum	0.286	0.372	0.350	81.7	26.5	14.5	0.51	-0.45	52.3
		@ Blow#	227	222	186	227	187	186	230	228	228

Total number of blows analyzed: 45

Time Summary

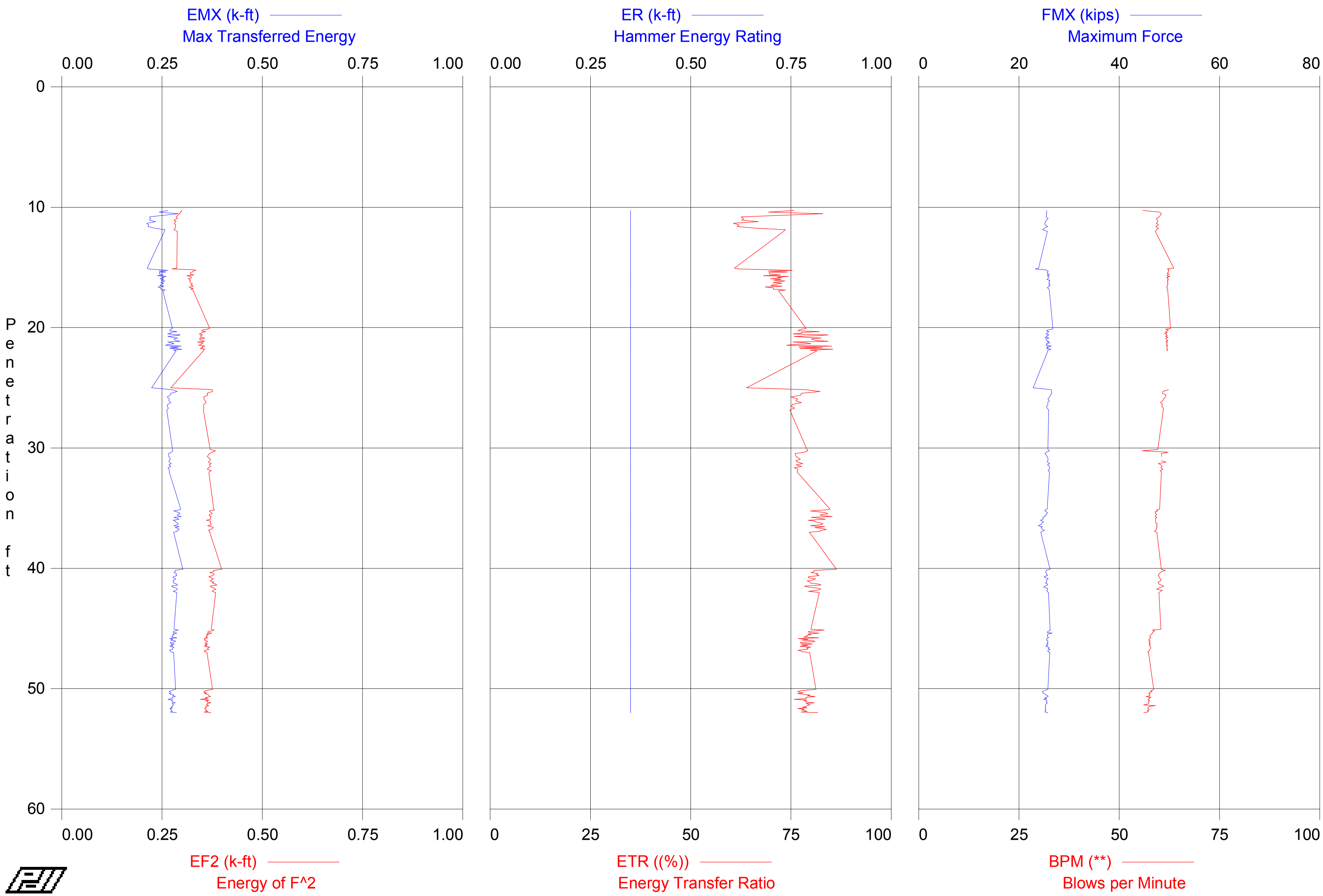
Drive	2 minutes 12 seconds	10:10:39 AM - 10:12:51 AM (9/23/2008) BN 1 - 13
Stop	15 minutes 45 seconds	10:12:51 AM - 10:28:36 AM
Drive	19 seconds	10:28:36 AM - 10:28:55 AM BN 14 - 31

Geosciences Testing & Research Inc - Case Method Results

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

Test date: 23-Sep-2008

VTRANS RSCH011-703 - GD-2



VTRANS RSCH011-703 - GD-2
OP: SPK

2 INCH SS;CME-45C;VTRANS
Test date: 23-Sep-2008

AR: 0.92 in^2
LE: 53.83 ft
WS: 16,807.7 f/s

SP: 0.492 k/ft3
EM: 30,000 ksi
JC: 0.00

EMX: Max Transferred Energy
EF2: Energy of F^2
ER: Hammer Energy Rating
ETR: Energy Transfer Ratio
FMX: Maximum Force

VMX: Maximum Velocity
DMX: Maximum Displacement
DFN: Final Displacement
BPM: Blows per Minute

Statistics for entire file (214 blows)

	EMX	EF2	ER	ETR	FMX	VMX	DMX	DFN	BPM
	k-ft	k-ft	k-ft	(%)	kips	f/s	in	in	**
Average	0.271	0.353	0.350	77.4	25.5	14.7	0.95	0.81	59.8
Std. Dev.	0.018	0.026	0.001	5.0	0.5	0.5	0.40	0.71	1.8
Maximum	0.302	0.399	0.350	86.4	26.8	17.0	3.08	3.08	63.6
@ Blow#	141	141	3	141	51	82	83	83	18
Minimum	0.212	0.272	0.350	60.6	22.9	12.8	0.45	-4.75	55.8
@ Blow#	11	81	3	11	81	19	155	11	97

Time Summary

Drive	19 seconds	1:22:40 PM - 1:22:59 PM (9/23/2008) BN 1 - 16
Stop	19 hours 15 minutes 11 seconds	1:22:59 PM - 8:38:10 AM
Drive	31 seconds	8:38:10 AM - 8:38:41 AM BN 17 - 49
Stop	19 minutes 16 seconds	8:38:41 AM - 8:57:57 AM
Drive	28 seconds	8:57:57 AM - 8:58:25 AM BN 50 - 80
Stop	19 minutes 22 seconds	8:58:25 AM - 9:17:47 AM
Drive	12 seconds	9:17:47 AM - 9:17:59 AM BN 81 - 94
Stop	18 minutes 22 seconds	9:17:59 AM - 9:36:21 AM
Drive	26 seconds	9:36:21 AM - 9:36:47 AM BN 95 - 112
Stop	22 minutes 47 seconds	9:36:47 AM - 9:59:34 AM
Drive	26 seconds	9:59:34 AM - 10:00:00 AM BN 113 - 139
Stop	1 hour 6 minutes 37 seconds	10:00:00 AM - 11:06:37 AM
Drive	22 seconds	11:06:37 AM - 11:06:59 AM BN 140 - 163
Stop	31 minutes 18 seconds	11:06:59 AM - 11:38:17 AM
Drive	31 seconds	11:38:17 AM - 11:38:48 AM BN 164 - 195
Stop	25 minutes 49 seconds	11:38:48 AM - 12:04:37 PM
Drive	35 seconds	12:04:37 PM - 12:05:12 PM BN 196 - 230

Total time [22:42:32] = (Driving [0:03:50] + Stop [22:38:42])

VTRANS RSCH011-703 - GD-2
OP: SPK

2 INCH SS;CME-45C;VTRANS
Test date: 23-Sep-2008

AR: 0.92 in^2
LE: 53.83 ft
WS: 16,807.7 f/s

SP: 0.492 k/ft3
EM: 30,000 ksi
JC: 0.00

EMX: Max Transferred Energy
EF2: Energy of F^2
ER: Hammer Energy Rating
ETR: Energy Transfer Ratio
FMX: Maximum Force

VMX: Maximum Velocity
DMX: Maximum Displacement
DFN: Final Displacement
BPM: Blows per Minute

BL#	depth	BLC	EMX	EF2	ER	ETR	FMX	VMX	DMX	DFN	BPM
	ft	bl/ft	k-ft	k-ft	k-ft	(%)	kips	f/s	in	in	**
3	10.27	8	0.265	0.299	0.350	75.7	25.4	16.0	2.17	2.17	55.9
4	10.40	8	0.243	0.297	0.350	69.4	25.6	15.7	1.47	1.47	60.1
5	10.53	8	0.290	0.294	0.350	82.9	25.5	15.3	2.43	2.43	60.5
7	10.80	8	0.219	0.285	0.350	62.6	25.4	15.9	1.15	0.72	60.0
8	10.93	8	0.221	0.289	0.350	63.2	25.8	15.2	1.06	0.33	59.3
9	11.07	8	0.219	0.280	0.350	62.7	25.5	15.6	1.08	0.50	59.5
10	11.20	8	0.234	0.285	0.350	66.9	25.3	15.7	1.14	0.64	59.6
11	11.33	8	0.212	0.281	0.350	60.6	25.2	14.9	0.74	-4.75	59.3
12	11.47	8	0.217	0.284	0.350	62.1	25.2	15.1	0.75	-2.37	59.8
13	11.60	8	0.215	0.283	0.350	61.6	25.8	14.9	0.71	-3.68	59.1
14	11.73	8	0.232	0.283	0.350	66.3	25.0	15.1	0.75	-0.74	59.8
15	11.87	8	0.257	0.280	0.350	73.6	24.7	15.0	0.84	0.30	59.3
16	12.00	8	0.256	0.288	0.350	73.2	25.7	15.0	0.82	-0.31	59.0
		Average	0.237	0.287	0.350	67.7	25.4	15.3	1.16	-0.25	59.3
		Std. Dev.	0.023	0.006	0.000	6.5	0.3	0.4	0.53	2.07	1.1
		Maximum	0.290	0.299	0.350	82.9	25.8	16.0	2.43	2.43	60.5
		@ Blow#	5	3	3	5	8	3	5	5	5
		Minimum	0.212	0.280	0.350	60.6	24.7	14.9	0.71	-4.75	55.9
		@ Blow#	11	9	3	11	15	11	13	11	3

Total number of blows analyzed: 13

Geosciences Testing & Research Inc
Case Method Results

PDIPLOT Ver. 2008.2 - Printed: 3-Apr-2009

VTRANS RSCH011-703 - GD-2
OP: SPK

2 INCH SS;CME-45C;VTRANS
Test date: 23-Sep-2008

AR: 0.92 in^2
LE: 53.83 ft
WS: 16,807.7 f/s

SP: 0.492 k/ft3
EM: 30,000 ksi
JC: 0.00

EMX: Max Transferred Energy
EF2: Energy of F^2
ER: Hammer Energy Rating
ETR: Energy Transfer Ratio
FMX: Maximum Force

VMX: Maximum Velocity
DMX: Maximum Displacement
DFN: Final Displacement
BPM: Blows per Minute

BL#	depth	BLC	EMX	EF2	ER	ETR	FMX	VMX	DMX	DFN	BPM
	ft	bl/ft	k-ft	k-ft	k-ft	(%)	kips	f/s	in	in	**
20	15.19	16	0.244	0.329	0.350	69.7	25.3	14.5	0.92	0.92	62.4
21	15.25	16	0.264	0.335	0.350	75.3	25.5	15.4	1.42	1.42	62.3
22	15.31	16	0.243	0.327	0.350	69.4	25.8	14.4	0.73	0.27	62.3
23	15.38	16	0.259	0.326	0.350	74.0	25.7	14.5	1.18	1.18	62.2
24	15.44	16	0.243	0.321	0.350	69.5	25.6	14.7	0.73	0.65	62.2
25	15.50	16	0.244	0.320	0.350	69.7	25.9	14.9	0.96	0.96	61.9
26	15.56	16	0.244	0.321	0.350	69.8	25.7	14.8	0.72	0.63	62.4
27	15.63	16	0.253	0.329	0.350	72.4	26.1	15.1	1.16	1.16	62.0
28	15.69	16	0.239	0.312	0.350	68.1	25.6	14.9	1.16	1.16	61.9
29	15.75	16	0.260	0.321	0.350	74.3	25.9	14.7	1.16	1.16	62.6
30	15.81	16	0.250	0.323	0.350	71.5	25.9	14.5	0.68	0.35	61.8
31	15.88	16	0.254	0.323	0.350	72.6	25.9	14.7	0.73	0.73	62.2
32	15.94	16	0.245	0.316	0.350	69.9	25.7	14.7	0.66	0.57	62.0
33	16.00	16	0.254	0.319	0.350	72.5	25.6	14.9	1.08	1.08	62.3
34	16.06	16	0.248	0.321	0.350	70.8	26.2	14.7	0.67	0.38	62.0
35	16.13	16	0.257	0.319	0.350	73.5	26.0	14.8	1.03	1.03	62.2
36	16.19	16	0.252	0.320	0.350	72.0	26.1	15.0	0.97	0.97	62.0
37	16.25	16	0.247	0.321	0.350	70.6	26.1	14.9	0.74	0.74	62.0
38	16.31	16	0.254	0.323	0.350	72.7	25.9	14.7	0.87	0.87	62.2
39	16.38	16	0.250	0.326	0.350	71.5	26.1	15.2	0.73	0.49	62.1
40	16.44	16	0.247	0.322	0.350	70.5	26.0	15.1	0.96	0.96	62.0
41	16.50	16	0.245	0.325	0.350	70.0	26.2	15.0	0.72	0.43	62.1
42	16.56	16	0.255	0.328	0.350	72.7	26.0	15.1	0.99	0.99	62.0
43	16.63	16	0.240	0.318	0.350	68.6	25.8	15.0	0.94	0.94	61.8
44	16.69	16	0.247	0.321	0.350	70.6	25.7	15.1	0.74	0.74	62.0
45	16.75	16	0.247	0.328	0.350	70.6	25.9	15.1	0.72	0.72	62.0
46	16.81	16	0.247	0.322	0.350	70.6	26.0	14.9	1.07	1.07	61.9
47	16.88	16	0.258	0.327	0.350	73.7	26.0	15.3	0.92	0.92	62.1
48	16.94	16	0.252	0.328	0.350	71.9	26.1	15.4	0.66	0.53	62.1
		Average	0.250	0.323	0.350	71.3	25.9	14.9	0.90	0.83	62.1
		Std. Dev.	0.006	0.005	0.000	1.8	0.2	0.3	0.20	0.29	0.2
		Maximum	0.264	0.335	0.350	75.3	26.2	15.4	1.42	1.42	62.6
		@ Blow#	21	21	20	21	41	48	21	21	29
		Minimum	0.239	0.312	0.350	68.1	25.3	14.4	0.66	0.27	61.8
		@ Blow#	28	28	20	28	20	22	32	22	30

Total number of blows analyzed: 29

VTRANS RSCH011-703 - GD-2
OP: SPK

2 INCH SS;CME-45C;VTRANS
Test date: 23-Sep-2008

AR: 0.92 in^2
LE: 53.83 ft
WS: 16,807.7 f/s

SP: 0.492 k/ft3
EM: 30,000 ksi
JC: 0.00

EMX: Max Transferred Energy
EF2: Energy of F^2
ER: Hammer Energy Rating
ETR: Energy Transfer Ratio
FMX: Maximum Force

VMX: Maximum Velocity
DMX: Maximum Displacement
DFN: Final Displacement
BPM: Blows per Minute

BL#	depth	BLC	EMX	EF2	ER	ETR	FMX	VMX	DMX	DFN	BPM
	ft	bl/ft	k-ft	k-ft	k-ft	(%)	kips	f/s	in	in	**
51	20.07	15	0.276	0.369	0.350	78.8	26.8	15.1	1.76	1.76	62.8
52	20.13	15	0.272	0.362	0.350	77.7	26.6	14.8	1.29	1.16	61.6
53	20.20	15	0.270	0.352	0.350	77.0	25.8	14.3	1.37	1.37	62.3
54	20.27	15	0.269	0.349	0.350	76.7	25.5	13.9	1.07	1.05	61.9
55	20.33	15	0.287	0.359	0.350	82.0	26.0	14.1	1.55	1.55	61.6
56	20.40	15	0.272	0.350	0.350	77.6	25.7	14.3	0.92	0.92	62.0
57	20.47	15	0.272	0.348	0.350	77.7	25.6	14.0	0.91	0.91	61.3
58	20.53	15	0.264	0.343	0.350	75.5	25.4	14.4	0.78	0.72	61.8
59	20.60	15	0.295	0.351	0.350	84.2	26.0	13.9	1.54	1.54	61.7
60	20.67	15	0.287	0.346	0.350	82.1	25.6	13.8	0.90	0.90	62.0
61	20.73	15	0.265	0.348	0.350	75.8	25.7	14.4	0.66	0.07	61.6
62	20.80	15	0.276	0.346	0.350	78.8	25.2	14.1	0.93	0.93	62.2
63	20.87	15	0.289	0.357	0.350	82.5	26.0	14.1	0.89	0.89	61.6
64	20.93	15	0.280	0.343	0.350	80.1	25.3	14.0	0.95	0.95	61.7
66	21.07	15	0.284	0.349	0.350	81.3	25.5	14.0	0.63	0.38	62.1
67	21.13	15	0.295	0.356	0.350	84.2	25.9	14.1	0.93	0.93	61.7
68	21.20	15	0.264	0.339	0.350	75.5	25.6	14.5	0.57	-0.02	62.1
69	21.27	15	0.275	0.353	0.350	78.7	26.2	14.4	0.59	0.47	61.7
70	21.33	15	0.280	0.348	0.350	79.9	25.5	14.2	1.06	1.06	61.9
71	21.40	15	0.265	0.348	0.350	75.7	25.6	14.2	0.57	0.30	62.0
72	21.47	15	0.259	0.342	0.350	74.0	25.4	14.4	0.56	0.47	61.7
73	21.53	15	0.298	0.357	0.350	85.1	26.5	14.2	1.08	1.08	62.1
74	21.60	15	0.270	0.350	0.350	77.0	25.6	14.4	0.57	0.38	61.9
75	21.67	15	0.290	0.352	0.350	82.8	25.9	14.3	0.99	0.99	61.8
76	21.73	15	0.270	0.345	0.350	77.2	25.5	14.2	0.56	0.26	62.0
77	21.80	15	0.299	0.357	0.350	85.4	26.4	14.2	1.19	1.19	61.9
78	21.87	15	0.279	0.353	0.350	79.8	25.7	14.3	0.56	0.21	62.1
79	21.93	15	0.285	0.353	0.350	81.5	25.8	14.2	0.96	0.96	61.8
		Average	0.278	0.351	0.350	79.5	25.8	14.2	0.94	0.83	61.9
		Std. Dev.	0.011	0.006	0.000	3.2	0.4	0.3	0.33	0.45	0.3
		Maximum	0.299	0.369	0.350	85.4	26.8	15.1	1.76	1.76	62.8
		@ Blow#	77	51	51	77	51	51	51	51	51
		Minimum	0.259	0.339	0.350	74.0	25.2	13.8	0.56	-0.02	61.3
		@ Blow#	72	68	51	72	62	60	72	68	57

Total number of blows analyzed: 28

Geosciences Testing & Research Inc
Case Method Results

PDIPLOT Ver. 2008.2 - Printed: 3-Apr-2009

VTRANS RSCH011-703 - GD-2
OP: SPK

2 INCH SS;CME-45C;VTRANS
Test date: 23-Sep-2008

AR: 0.92 in^2
LE: 53.83 ft
WS: 16,807.7 f/s

SP: 0.492 k/ft3
EM: 30,000 ksi
JC: 0.00

EMX: Max Transferred Energy
EF2: Energy of F^2
ER: Hammer Energy Rating
ETR: Energy Transfer Ratio
FMX: Maximum Force

VMX: Maximum Velocity
DMX: Maximum Displacement
DFN: Final Displacement
BPM: Blows per Minute

BL#	depth	BLC	EMX	EF2	ER	ETR	FMX	VMX	DMX	DFN	BPM
	ft	bl/ft	k-ft	k-ft	k-ft	(%)	kips	f/s	in	in	**
82	25.15	7	0.275	0.375	0.350	78.6	26.4	17.0	2.82	2.82	62.3
83	25.31	7	0.288	0.376	0.350	82.3	26.5	16.6	3.08	3.08	60.9
84	25.46	7	0.272	0.362	0.350	77.6	26.5	16.0	1.99	1.94	60.8
85	25.62	7	0.271	0.364	0.350	77.5	26.4	15.0	1.92	1.92	61.7
86	25.77	7	0.263	0.354	0.350	75.0	26.1	14.9	1.52	1.52	61.5
87	25.92	7	0.268	0.355	0.350	76.7	25.8	14.7	1.56	1.56	61.1
88	26.08	7	0.267	0.358	0.350	76.2	26.1	14.6	1.34	1.18	60.8
89	26.23	7	0.272	0.360	0.350	77.6	25.7	14.7	1.45	1.45	60.3
90	26.38	7	0.264	0.354	0.350	75.4	25.8	14.4	1.22	1.16	60.8
91	26.54	7	0.263	0.354	0.350	75.1	25.5	14.5	1.13	0.95	60.6
92	26.69	7	0.266	0.354	0.350	75.9	25.6	14.6	1.49	1.49	61.0
93	26.85	7	0.262	0.353	0.350	74.7	25.9	14.1	0.98	0.81	61.0
		Average	0.269	0.360	0.350	76.9	26.0	15.1	1.71	1.66	61.1
		Std. Dev.	0.007	0.008	0.000	2.0	0.3	0.9	0.62	0.67	0.5
		Maximum	0.288	0.376	0.350	82.3	26.5	17.0	3.08	3.08	62.3
		@ Blow#	83	83	82	83	84	82	83	83	82
		Minimum	0.262	0.353	0.350	74.7	25.5	14.1	0.98	0.81	60.3
		@ Blow#	93	93	82	93	91	93	93	93	89

Total number of blows analyzed: 12

VTRANS RSCH011-703 - GD-2
OP: SPK

2 INCH SS;CME-45C;VTRANS
Test date: 23-Sep-2008

AR: 0.92 in^2
LE: 53.83 ft
WS: 16,807.7 f/s

SP: 0.492 k/ft3
EM: 30,000 ksi
JC: 0.00

EMX: Max Transferred Energy
EF2: Energy of F^2
ER: Hammer Energy Rating
ETR: Energy Transfer Ratio
FMX: Maximum Force

VMX: Maximum Velocity
DMX: Maximum Displacement
DFN: Final Displacement
BPM: Blows per Minute

BL#	depth	BLC	EMX	EF2	ER	ETR	FMX	VMX	DMX	DFN	BPM
	ft	bl/ft	k-ft	k-ft	k-ft	(%)	kips	f/s	in	in	**
96	30.12	9	0.276	0.370	0.350	79.0	25.8	16.3	1.47	1.47	59.6
97	30.24	9	0.277	0.383	0.350	79.2	26.1	15.1	0.99	0.89	55.8
98	30.35	9	0.274	0.375	0.350	78.3	25.4	15.8	1.14	1.14	62.2
99	30.47	9	0.266	0.368	0.350	76.0	25.2	15.5	0.95	0.93	60.5
101	30.71	9	0.267	0.363	0.350	76.3	25.6	14.7	1.07	1.07	60.6
103	30.94	9	0.271	0.371	0.350	77.3	25.8	14.3	0.91	0.91	0.0
104	31.06	9	0.267	0.369	0.350	76.2	25.7	14.2	0.72	0.60	60.5
105	31.18	9	0.268	0.366	0.350	76.7	25.7	14.2	0.71	0.68	61.7
106	31.29	9	0.273	0.373	0.350	78.0	26.1	14.1	0.71	0.61	59.8
107	31.41	9	0.267	0.368	0.350	76.3	25.7	14.3	0.72	0.68	60.4
108	31.53	9	0.272	0.371	0.350	77.6	26.1	14.1	0.70	0.61	60.7
109	31.65	9	0.265	0.366	0.350	75.8	26.1	14.3	0.69	0.63	60.4
110	31.76	9	0.268	0.363	0.350	76.7	26.0	14.5	0.80	0.78	60.9
111	31.88	9	0.268	0.373	0.350	76.6	25.8	14.4	0.75	0.73	60.2
112	32.00	9	0.268	0.367	0.350	76.5	26.1	13.8	0.67	0.51	60.5
		Average	0.270	0.370	0.350	77.1	25.8	14.7	0.87	0.81	60.3
		Std. Dev.	0.004	0.005	0.000	1.0	0.3	0.7	0.22	0.25	1.4
		Maximum	0.277	0.383	0.350	79.2	26.1	16.3	1.47	1.47	62.2
		@ Blow#	97	97	96	97	106	96	96	96	98
		Minimum	0.265	0.363	0.350	75.8	25.2	13.8	0.67	0.51	55.8
		@ Blow#	109	101	96	109	99	112	112	112	97

Total number of blows analyzed: 15

VTRANS RSCH011-703 - GD-2
OP: SPK

2 INCH SS;CME-45C;VTRANS
Test date: 23-Sep-2008

AR: 0.92 in^2
LE: 53.83 ft
WS: 16,807.7 f/s

SP: 0.492 k/ft3
EM: 30,000 ksi
JC: 0.00

EMX: Max Transferred Energy
EF2: Energy of F^2
ER: Hammer Energy Rating
ETR: Energy Transfer Ratio
FMX: Maximum Force

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DMX: Maximum Displacement
DFN: Final Displacement
BPM: Blows per Minute

BL#	depth	BLC	EMX	EF2	ER	ETR	FMX	VMX	DMX	DFN	BPM
	ft	bl/ft	k-ft	k-ft	k-ft	(%)	kips	f/s	in	in	**
114	35.08	13	0.297	0.379	0.350	84.7	25.6	16.7	1.44	1.44	60.1
115	35.15	13	0.292	0.381	0.350	83.4	25.3	14.9	0.93	0.72	59.3
116	35.23	13	0.279	0.368	0.350	79.8	25.1	14.2	0.90	0.79	59.6
117	35.31	13	0.287	0.370	0.350	82.1	25.5	14.3	1.14	1.14	58.9
118	35.38	13	0.293	0.374	0.350	83.7	25.7	14.5	1.35	1.35	59.1
119	35.46	13	0.295	0.375	0.350	84.2	25.5	14.5	0.89	0.82	59.0
120	35.54	13	0.288	0.368	0.350	82.3	25.5	14.5	1.10	1.10	59.4
121	35.62	13	0.289	0.368	0.350	82.5	25.2	14.4	1.04	1.04	59.1
122	35.69	13	0.298	0.373	0.350	85.3	25.2	14.6	1.15	1.15	58.9
123	35.77	13	0.280	0.371	0.350	80.1	24.8	14.5	0.72	0.57	59.4
124	35.85	13	0.288	0.371	0.350	82.2	24.8	14.6	1.05	1.05	59.1
125	35.92	13	0.292	0.371	0.350	83.5	24.8	14.6	1.22	1.22	59.1
126	36.00	13	0.278	0.361	0.350	79.4	24.3	14.6	1.26	1.26	59.1
127	36.08	13	0.283	0.371	0.350	80.8	24.6	14.8	0.78	0.61	59.1
128	36.15	13	0.284	0.371	0.350	81.2	24.9	14.9	0.96	0.96	59.1
129	36.23	13	0.288	0.370	0.350	82.4	24.6	14.6	1.24	1.24	59.1
130	36.31	13	0.291	0.373	0.350	83.0	24.6	14.7	1.04	1.04	59.5
131	36.38	13	0.287	0.372	0.350	82.0	24.2	15.1	0.89	0.87	59.4
132	36.46	13	0.280	0.364	0.350	79.9	23.9	14.9	1.09	1.09	59.3
133	36.54	13	0.292	0.374	0.350	83.4	24.7	14.9	1.21	1.21	59.5
134	36.62	13	0.283	0.378	0.350	81.0	24.4	15.2	0.80	0.80	59.3
135	36.69	13	0.290	0.375	0.350	82.8	24.5	14.8	0.96	0.96	59.4
136	36.77	13	0.293	0.371	0.350	83.8	24.7	14.6	1.16	1.16	59.2
137	36.85	13	0.288	0.366	0.350	82.4	25.1	14.7	0.77	0.71	59.0
138	36.92	13	0.288	0.369	0.350	82.3	24.6	14.9	1.16	1.16	58.8
139	37.00	13	0.279	0.369	0.350	79.6	24.3	15.2	0.68	0.49	59.4
		Average	0.288	0.371	0.350	82.2	24.9	14.8	1.04	1.00	59.2
		Std. Dev.	0.006	0.004	0.000	1.6	0.5	0.4	0.20	0.24	0.3
		Maximum	0.298	0.381	0.350	85.3	25.7	16.7	1.44	1.44	60.1
		@ Blow#	122	115	114	122	118	114	114	114	114
		Minimum	0.278	0.361	0.350	79.4	23.9	14.2	0.68	0.49	58.8
		@ Blow#	126	126	114	126	132	116	139	139	138

Total number of blows analyzed: 26

Geosciences Testing & Research Inc
Case Method Results

PDIPLOT Ver. 2008.2 - Printed: 3-Apr-2009

VTRANS RSCH011-703 - GD-2
OP: SPK

2 INCH SS;CME-45C;VTRANS
Test date: 23-Sep-2008

AR: 0.92 in^2
LE: 53.83 ft
WS: 16,807.7 f/s

SP: 0.492 k/ft3
EM: 30,000 ksi
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EMX: Max Transferred Energy
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DFN: Final Displacement
BPM: Blows per Minute

BL#	depth	BLC	EMX	EF2	ER	ETR	FMX	VMX	DMX	DFN	BPM
	ft	bl/ft	k-ft	k-ft	k-ft	(%)	kips	f/s	in	in	**
141	40.09	12	0.302	0.399	0.350	86.4	26.2	15.9	1.66	1.65	60.5
142	40.17	12	0.283	0.379	0.350	80.8	25.4	15.3	1.63	1.63	61.5
143	40.26	12	0.283	0.379	0.350	80.8	25.4	14.9	1.60	1.60	60.7
144	40.35	12	0.280	0.369	0.350	80.0	25.3	14.9	1.83	1.83	60.2
145	40.43	12	0.286	0.379	0.350	81.7	25.6	15.3	2.17	2.17	60.0
146	40.52	12	0.285	0.380	0.350	81.4	25.5	14.5	1.32	1.23	59.9
147	40.61	12	0.287	0.377	0.350	82.0	25.7	14.5	1.49	1.49	59.7
148	40.70	12	0.278	0.367	0.350	79.3	25.0	14.4	1.54	1.54	60.0
149	40.78	12	0.278	0.372	0.350	79.4	25.4	14.3	0.99	0.99	60.1
150	40.87	12	0.284	0.378	0.350	81.1	25.8	14.6	0.99	0.94	60.2
151	40.96	12	0.282	0.374	0.350	80.6	25.6	14.3	1.03	1.03	60.4
152	41.04	12	0.277	0.370	0.350	79.0	25.4	14.4	0.69	0.69	60.3
153	41.13	12	0.279	0.379	0.350	79.8	25.5	14.6	0.46	0.24	59.7
154	41.22	12	0.279	0.375	0.350	79.8	25.3	14.2	0.45	0.24	59.8
155	41.30	12	0.286	0.383	0.350	81.9	25.7	14.6	0.45	0.37	59.9
156	41.39	12	0.289	0.387	0.350	82.5	25.7	14.7	0.49	0.49	60.4
157	41.48	12	0.274	0.370	0.350	78.4	25.2	14.6	0.58	0.58	61.1
158	41.57	12	0.278	0.374	0.350	79.4	24.9	14.4	0.48	0.21	60.5
159	41.65	12	0.287	0.380	0.350	82.0	25.7	14.3	0.50	0.48	59.8
160	41.74	12	0.288	0.384	0.350	82.4	25.7	14.3	0.50	0.36	59.4
161	41.83	12	0.285	0.378	0.350	81.5	25.6	14.5	0.92	0.92	60.7
162	41.91	12	0.278	0.375	0.350	79.4	25.6	14.5	0.59	0.59	60.3
163	42.00	12	0.287	0.384	0.350	82.1	25.9	14.3	0.66	0.66	59.9
		Average	0.283	0.378	0.350	80.9	25.5	14.6	1.00	0.95	60.2
		Std. Dev.	0.006	0.007	0.000	1.7	0.3	0.4	0.53	0.57	0.5
		Maximum	0.302	0.399	0.350	86.4	26.2	15.9	2.17	2.17	61.5
		@ Blow#	141	141	141	141	141	141	145	145	142
		Minimum	0.274	0.367	0.350	78.4	24.9	14.2	0.45	0.21	59.4
		@ Blow#	157	148	141	157	158	154	155	158	160

Total number of blows analyzed: 23

VTRANS RSCH011-703 - GD-2
OP: SPK

2 INCH SS;CME-45C;VTRANS
Test date: 23-Sep-2008

AR: 0.92 in^2
LE: 53.83 ft
WS: 16,807.7 f/s

SP: 0.492 k/ft3
EM: 30,000 ksi
JC: 0.00

EMX: Max Transferred Energy
EF2: Energy of F^2
ER: Hammer Energy Rating
ETR: Energy Transfer Ratio
FMX: Maximum Force

VMX: Maximum Velocity
DMX: Maximum Displacement
DFN: Final Displacement
BPM: Blows per Minute

BL#	depth	BLC	EMX	EF2	ER	ETR	FMX	VMX	DMX	DFN	BPM
	ft	bl/ft	k-ft	k-ft	k-ft	(%)	kips	f/s	in	in	**
165	45.06	16	0.280	0.373	0.350	80.0	26.2	14.4	1.21	1.21	60.4
166	45.13	16	0.291	0.380	0.350	83.3	26.3	14.5	1.26	1.26	58.3
167	45.19	16	0.283	0.374	0.350	80.8	26.0	14.4	0.98	0.94	58.8
168	45.26	16	0.278	0.365	0.350	79.3	25.7	14.5	1.00	0.99	58.5
169	45.32	16	0.278	0.364	0.350	79.5	25.6	14.5	0.98	0.98	58.3
170	45.39	16	0.287	0.374	0.350	82.0	26.6	14.7	0.79	0.67	58.3
171	45.45	16	0.277	0.361	0.350	79.2	25.7	14.4	0.87	0.87	58.1
172	45.52	16	0.280	0.366	0.350	80.0	25.8	14.7	0.74	0.63	57.9
173	45.58	16	0.276	0.361	0.350	78.9	25.6	14.7	0.80	0.80	57.7
174	45.65	16	0.277	0.363	0.350	79.0	25.8	14.6	0.74	0.64	57.6
175	45.71	16	0.274	0.359	0.350	78.2	25.7	14.8	0.75	0.75	57.8
176	45.77	16	0.287	0.364	0.350	81.9	25.9	14.6	0.85	0.85	57.9
177	45.84	16	0.269	0.355	0.350	76.9	25.6	14.6	0.71	0.67	57.5
178	45.90	16	0.277	0.358	0.350	79.2	25.6	14.5	0.78	0.78	57.5
179	45.97	16	0.272	0.356	0.350	77.8	25.5	14.7	0.72	0.72	57.4
180	46.03	16	0.283	0.361	0.350	80.8	25.8	14.6	0.79	0.79	57.7
181	46.10	16	0.283	0.364	0.350	80.9	25.8	14.5	0.80	0.80	57.4
182	46.16	16	0.271	0.359	0.350	77.3	25.7	14.6	0.64	0.49	57.7
183	46.23	16	0.271	0.357	0.350	77.4	25.6	14.5	0.74	0.74	57.4
184	46.29	16	0.281	0.364	0.350	80.3	25.8	14.4	0.88	0.88	57.8
185	46.35	16	0.272	0.357	0.350	77.6	25.5	14.6	0.60	0.56	57.5
186	46.42	16	0.277	0.362	0.350	79.2	25.7	14.3	0.73	0.73	57.7
187	46.48	16	0.270	0.356	0.350	77.3	25.3	14.6	0.63	0.63	57.6
188	46.55	16	0.280	0.369	0.350	80.0	25.8	14.5	0.63	0.63	57.8
189	46.61	16	0.276	0.364	0.350	78.8	26.0	14.6	0.57	0.53	57.9
190	46.68	16	0.277	0.364	0.350	79.3	25.8	14.5	0.73	0.73	57.8
191	46.74	16	0.276	0.367	0.350	78.9	26.2	14.9	0.49	0.35	57.6
192	46.81	16	0.269	0.360	0.350	76.8	25.9	14.9	0.47	0.34	57.5
193	46.87	16	0.271	0.355	0.350	77.5	25.7	14.8	0.55	0.55	57.4
194	46.94	16	0.272	0.358	0.350	77.8	25.9	14.9	0.49	0.46	57.1
195	47.00	16	0.279	0.362	0.350	79.7	26.2	14.7	0.74	0.74	57.3
		Average	0.277	0.363	0.350	79.2	25.8	14.6	0.76	0.73	57.8
		Std. Dev.	0.005	0.006	0.000	1.6	0.3	0.1	0.18	0.21	0.6
		Maximum	0.291	0.380	0.350	83.3	26.6	14.9	1.26	1.26	60.4
		@ Blow#	166	166	165	166	170	194	166	166	165
		Minimum	0.269	0.355	0.350	76.8	25.3	14.3	0.47	0.34	57.1
		@ Blow#	177	177	165	192	187	186	192	192	194

Total number of blows analyzed: 31

Geosciences Testing & Research Inc
Case Method Results

PDIPLOT Ver. 2008.2 - Printed: 3-Apr-2009

VTRANS RSCH011-703 - GD-2
OP: SPK

2 INCH SS;CME-45C;VTRANS
Test date: 23-Sep-2008

AR: 0.92 in^2
LE: 53.83 ft
WS: 16,807.7 f/s

SP: 0.492 k/ft3
EM: 30,000 ksi
JC: 0.00

EMX: Max Transferred Energy
EF2: Energy of F^2
ER: Hammer Energy Rating
ETR: Energy Transfer Ratio
FMX: Maximum Force

VMX: Maximum Velocity
DMX: Maximum Displacement
DFN: Final Displacement
BPM: Blows per Minute

BL#	depth ft	BLC bl/ft	EMX k-ft	EF2 k-ft	ER k-ft	ETR (%)	FMX kips	VMX f/s	DMX in	DFN in	BPM **
197	50.06	17	0.284	0.376	0.350	81.3	25.8	14.8	0.86	0.82	58.6
198	50.12	17	0.276	0.365	0.350	78.8	25.3	14.7	0.77	0.71	58.3
199	50.18	17	0.271	0.358	0.350	77.4	25.1	14.6	0.76	0.72	57.9
200	50.24	17	0.268	0.357	0.350	76.6	24.7	14.2	0.71	0.62	58.2
201	50.29	17	0.270	0.354	0.350	77.2	24.7	13.8	0.75	0.75	57.6
202	50.35	17	0.273	0.361	0.350	78.0	24.9	14.8	0.72	0.72	57.8
203	50.41	17	0.268	0.356	0.350	76.7	25.0	14.4	0.66	0.52	57.3
204	50.47	17	0.273	0.364	0.350	78.1	25.3	14.0	0.69	0.66	57.6
205	50.53	17	0.279	0.366	0.350	79.7	25.4	14.4	0.68	0.61	57.6
206	50.59	17	0.277	0.367	0.350	79.1	25.7	14.7	0.66	0.45	57.6
207	50.65	17	0.283	0.371	0.350	81.0	25.8	14.9	0.70	0.69	56.7
208	50.71	17	0.276	0.363	0.350	79.0	25.5	14.6	0.80	0.80	57.9
209	50.76	17	0.275	0.358	0.350	78.7	25.2	14.8	0.68	0.68	57.4
210	50.82	17	0.276	0.364	0.350	78.8	25.5	14.3	0.65	0.63	57.6
211	50.88	17	0.265	0.346	0.350	75.8	24.9	14.6	0.61	0.54	57.3
212	50.94	17	0.276	0.367	0.350	78.9	25.5	14.9	0.64	0.64	57.2
213	51.00	17	0.274	0.359	0.350	78.2	25.6	14.7	0.63	0.50	57.6
214	51.06	17	0.276	0.364	0.350	78.9	25.5	14.9	0.74	0.74	57.3
215	51.12	17	0.276	0.363	0.350	78.8	25.4	14.4	0.67	0.62	57.4
216	51.18	17	0.283	0.372	0.350	80.8	25.7	14.3	0.59	-0.06	57.4
217	51.24	17	0.275	0.362	0.350	78.7	25.5	14.4	0.72	0.70	57.3
218	51.29	17	0.278	0.363	0.350	79.4	25.4	14.3	0.77	0.77	56.8
219	51.35	17	0.279	0.361	0.350	79.8	25.4	14.7	0.89	0.89	56.1
220	51.41	17	0.276	0.367	0.350	79.0	25.3	14.7	0.69	0.53	59.0
221	51.47	17	0.276	0.359	0.350	78.8	25.4	14.6	0.68	0.57	57.5
222	51.53	17	0.273	0.361	0.350	77.9	25.3	14.6	0.61	0.56	57.3
223	51.59	17	0.276	0.358	0.350	79.0	25.2	14.8	0.69	0.69	57.2
224	51.65	17	0.269	0.356	0.350	76.7	25.3	14.7	0.69	0.69	57.1
225	51.71	17	0.274	0.359	0.350	78.3	25.4	15.0	0.71	0.66	57.4
226	51.76	17	0.272	0.360	0.350	77.7	25.2	14.2	0.75	0.68	57.5
227	51.82	17	0.274	0.359	0.350	78.4	25.4	14.4	0.80	0.79	57.0
228	51.88	17	0.276	0.365	0.350	79.0	25.2	14.9	0.82	0.82	57.3
229	51.94	17	0.271	0.355	0.350	77.5	25.2	15.1	0.67	0.58	57.1
230	52.00	17	0.286	0.372	0.350	81.7	25.8	14.6	0.82	0.82	56.1
		Average	0.275	0.362	0.350	78.6	25.3	14.6	0.71	0.65	57.4
		Std. Dev.	0.005	0.006	0.000	1.3	0.3	0.3	0.07	0.16	0.6
		Maximum	0.286	0.376	0.350	81.7	25.8	15.1	0.89	0.89	59.0
		@ Blow#	230	197	197	230	207	229	219	219	220
		Minimum	0.265	0.346	0.350	75.8	24.7	13.8	0.59	-0.06	56.1
		@ Blow#	211	211	197	211	200	201	216	216	219

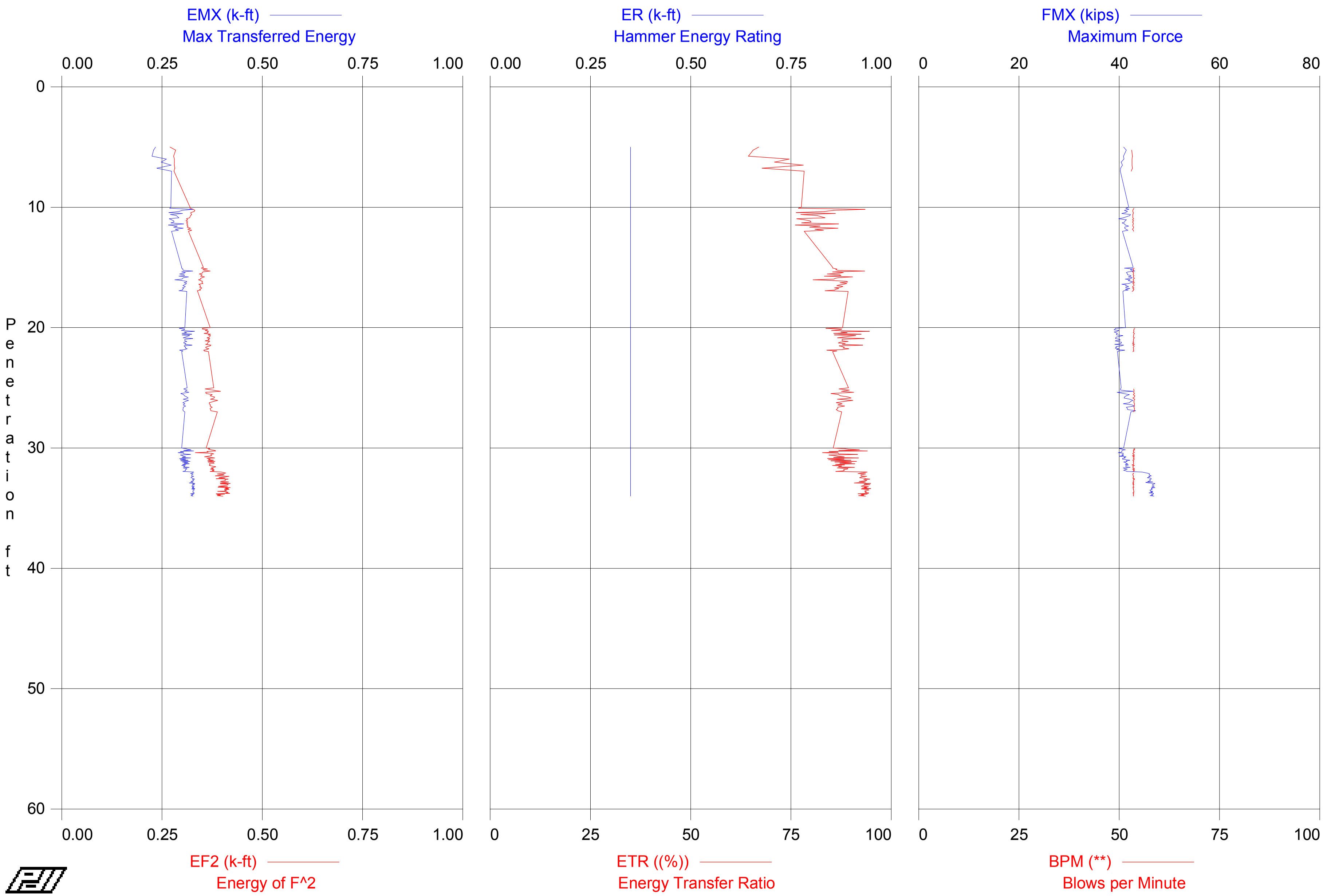
Total number of blows analyzed: 34

Geosciences Testing & Research Inc - Case Method Results

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

Test date: 24-Sep-2008

VRANS RSCH001-703 - GD-3



VRANS RSCH001-703 - GD-3
OP: SPK

2 INCH SS;CME55 AUTO;VTRANS
Test date: 24-Sep-2008

AR: 1.45 in^2
LE: 37.08 ft
WS: 16,807.7 f/s

SP: 0.492 k/ft3
EM: 30,000 ksi
JC: 0.00

EMX: Max Transferred Energy
EF2: Energy of F^2
ER: Hammer Energy Rating
ETR: Energy Transfer Ratio
FMX: Maximum Force

VMX: Maximum Velocity
DMX: Maximum Displacement
DFN: Final Displacement
BPM: Blows per Minute

Statistics for entire file (205 blows)

	EMX	EF2	ER	ETR	FMX	VMX	DMX	DFN	BPM
	k-ft	k-ft	k-ft	(%)	kips	f/s	in	in	**
Average	0.306	0.364	0.350	87.4	42.2	15.4	0.91	0.86	53.6
Std. Dev.	0.019	0.031	0.001	5.4	2.3	1.2	0.39	0.42	0.2
Maximum	0.332	0.420	0.350	94.9	47.1	17.8	2.72	2.68	53.9
@ Blow#	189	189	1	200	198	16	1	1	69
Minimum	0.225	0.270	0.350	64.4	39.0	13.1	0.48	-0.11	53.0
@ Blow#	4	1	1	4	71	174	161	72	9

Time Summary

Drive	9 seconds	10:57:43 AM - 10:57:52 AM (9/24/2008) BN 1 - 9
Stop	27 minutes 39 seconds	10:57:52 AM - 11:25:31 AM
Drive	26 seconds	11:25:31 AM - 11:25:57 AM BN 10 - 33
Stop	28 minutes 57 seconds	11:25:57 AM - 11:54:54 AM
Drive	36 seconds	11:54:54 AM - 11:55:30 AM BN 34 - 67
Stop	55 minutes 16 seconds	11:55:30 AM - 12:50:46 PM
Drive	36 seconds	12:50:46 PM - 12:51:22 PM BN 68 - 101
Stop	27 minutes 43 seconds	12:51:22 PM - 1:19:05 PM
Drive	23 seconds	1:19:05 PM - 1:19:28 PM BN 102 - 123
Stop	25 minutes 22 seconds	1:19:28 PM - 1:44:50 PM
Drive	44 seconds	1:44:50 PM - 1:45:34 PM BN 124 - 164
Stop	26 minutes 23 seconds	1:45:34 PM - 2:11:57 PM
Drive	56 seconds	2:11:57 PM - 2:12:53 PM BN 165 - 216

Total time [3:15:10] = (Driving [0:03:50] + Stop [3:11:20])

VRANS RSCH001-703 - GD-3
OP: SPK

2 INCH SS;CME55 AUTO;VTRANS
Test date: 24-Sep-2008

AR: 1.45 in^2
LE: 37.08 ft
WS: 16,807.7 f/s

SP: 0.492 k/ft3
EM: 30,000 ksi
JC: 0.00

EMX: Max Transferred Energy
EF2: Energy of F^2
ER: Hammer Energy Rating
ETR: Energy Transfer Ratio
FMX: Maximum Force

VMX: Maximum Velocity
DMX: Maximum Displacement
DFN: Final Displacement
BPM: Blows per Minute

BL#	depth	BLC	EMX	EF2	ER	ETR	FMX	VMX	DMX	DFN	BPM
	ft	bl/ft	k-ft	k-ft	k-ft	(%)	kips	f/s	in	in	**
1	5.00	4	0.234	0.270	0.350	66.9	40.9	16.8	2.72	2.68	0.0
2	5.25	4	0.229	0.284	0.350	65.6	41.4	16.8	2.32	2.22	53.1
4	5.75	4	0.225	0.279	0.350	64.4	40.9	16.1	2.10	2.10	53.3
5	6.00	4	0.261	0.281	0.350	74.6	40.9	16.3	2.63	2.63	53.2
6	6.25	4	0.248	0.281	0.350	70.9	40.4	15.8	2.42	2.42	53.2
7	6.50	4	0.273	0.281	0.350	78.1	40.7	15.8	2.27	2.27	53.2
8	6.75	4	0.237	0.282	0.350	67.8	40.3	16.0	2.07	2.07	53.3
9	7.00	4	0.274	0.280	0.350	78.3	40.2	15.8	1.93	1.93	53.0
		Average	0.248	0.280	0.350	70.8	40.7	16.2	2.31	2.29	53.2
		Std. Dev.	0.018	0.004	0.000	5.2	0.4	0.4	0.26	0.25	0.1
		Maximum	0.274	0.284	0.350	78.3	41.4	16.8	2.72	2.68	53.3
		@ Blow#	9	2	1	9	2	2	1	1	4
		Minimum	0.225	0.270	0.350	64.4	40.2	15.8	1.93	1.93	53.0
		@ Blow#	4	1	1	4	9	9	9	9	9

Total number of blows analyzed: 8

Geosciences Testing & Research Inc
Case Method Results

PDIPLOT Ver. 2008.2 - Printed: 3-Apr-2009

VRANS RSCH001-703 - GD-3
OP: SPK

2 INCH SS;CME55 AUTO;VTRANS
Test date: 24-Sep-2008

AR: 1.45 in^2
LE: 37.08 ft
WS: 16,807.7 f/s

SP: 0.492 k/ft3
EM: 30,000 ksi
JC: 0.00

EMX: Max Transferred Energy
EF2: Energy of F^2
ER: Hammer Energy Rating
ETR: Energy Transfer Ratio
FMX: Maximum Force

VMX: Maximum Velocity
DMX: Maximum Displacement
DFN: Final Displacement
BPM: Blows per Minute

BL#	depth	BLC	EMX	EF2	ER	ETR	FMX	VMX	DMX	DFN	BPM
	ft	bl/ft	k-ft	k-ft	k-ft	(%)	kips	f/s	in	in	**
10	10.00	0	0.272	0.320	0.350	77.6	41.9	16.8	1.85	1.85	0.0
11	10.09	12	0.269	0.320	0.350	76.9	41.3	17.6	1.01	0.79	53.7
12	10.17	12	0.327	0.328	0.350	93.5	41.9	16.8	1.50	1.50	53.5
13	10.26	12	0.300	0.332	0.350	85.7	41.0	16.7	1.19	1.19	53.4
14	10.35	12	0.292	0.330	0.350	83.3	41.6	16.6	1.23	1.22	53.4
15	10.43	12	0.267	0.322	0.350	76.3	41.2	16.2	1.13	1.09	53.5
16	10.52	12	0.301	0.322	0.350	86.1	40.5	17.8	1.30	1.30	53.5
17	10.61	12	0.271	0.324	0.350	77.5	42.3	16.7	1.10	1.08	53.4
18	10.70	12	0.286	0.321	0.350	81.6	42.1	17.1	1.13	1.12	53.4
20	10.87	12	0.292	0.319	0.350	83.5	40.8	15.8	1.00	1.00	53.4
21	10.96	12	0.268	0.311	0.350	76.4	39.9	15.3	1.11	1.11	53.6
22	11.04	12	0.274	0.314	0.350	78.4	41.5	15.6	0.91	0.82	53.3
23	11.13	12	0.279	0.310	0.350	79.8	41.2	15.6	1.03	1.03	53.6
24	11.22	12	0.280	0.314	0.350	80.0	41.1	15.6	1.02	1.02	53.3
25	11.30	12	0.272	0.311	0.350	77.6	40.6	15.7	1.15	1.15	53.5
26	11.39	12	0.304	0.314	0.350	86.8	41.1	15.6	1.21	1.21	53.5
27	11.48	12	0.266	0.312	0.350	76.1	41.2	15.6	1.08	1.05	53.4
28	11.57	12	0.288	0.315	0.350	82.3	41.8	16.0	1.07	1.05	53.4
29	11.65	12	0.279	0.313	0.350	79.7	41.1	15.9	1.26	1.26	53.6
30	11.74	12	0.303	0.321	0.350	86.7	41.1	15.8	1.06	1.06	53.5
31	11.83	12	0.283	0.314	0.350	81.0	41.3	15.8	1.18	1.18	53.3
32	11.91	12	0.291	0.324	0.350	83.1	41.7	15.8	0.93	0.86	53.5
33	12.00	12	0.274	0.316	0.350	78.3	40.6	15.4	1.13	1.13	53.6
		Average	0.284	0.319	0.350	81.2	41.3	16.2	1.15	1.13	53.5
		Std. Dev.	0.015	0.006	0.000	4.3	0.6	0.7	0.19	0.22	0.1
		Maximum	0.327	0.332	0.350	93.5	42.3	17.8	1.85	1.85	53.7
		@ Blow#	12	13	10	12	17	16	10	10	11
		Minimum	0.266	0.310	0.350	76.1	39.9	15.3	0.91	0.79	53.3
		@ Blow#	27	23	10	27	21	21	22	11	22

Total number of blows analyzed: 23

Geosciences Testing & Research Inc
Case Method Results

PDIPLOT Ver. 2008.2 - Printed: 3-Apr-2009

VRANS RSCH001-703 - GD-3
2 INCH SS;CME55 AUTO;VTRANS
OP: SPK
Test date: 24-Sep-2008

AR: 1.45 in^2
LE: 37.08 ft
WS: 16,807.7 f/s
SP: 0.492 k/ft3
EM: 30,000 ksi
JC: 0.00

EMX: Max Transferred Energy
EF2: Energy of F^2
ER: Hammer Energy Rating
ETR: Energy Transfer Ratio
FMX: Maximum Force
VMX: Maximum Velocity
DMX: Maximum Displacement
DFN: Final Displacement
BPM: Blows per Minute

BL#	depth	BLC	EMX	EF2	ER	ETR	FMX	VMX	DMX	DFN	BPM
	ft	bl/ft	k-ft	k-ft	k-ft	(%)	kips	f/s	in	in	**
34	15.00	0	0.299	0.353	0.350	85.4	42.8	15.7	1.01	1.01	0.0
35	15.06	17	0.299	0.348	0.350	85.4	41.0	15.5	0.72	0.72	53.8
36	15.12	17	0.302	0.363	0.350	86.4	42.7	16.3	0.65	0.54	53.4
37	15.18	17	0.302	0.352	0.350	86.2	42.2	16.6	0.71	0.70	53.6
38	15.24	17	0.303	0.356	0.350	86.7	42.4	16.2	0.89	0.89	53.6
39	15.30	17	0.327	0.370	0.350	93.4	43.1	16.5	0.76	0.70	53.6
40	15.36	17	0.299	0.352	0.350	85.4	41.8	15.9	0.79	0.77	53.3
41	15.42	17	0.308	0.351	0.350	88.1	41.5	16.1	1.03	1.03	53.6
42	15.48	17	0.305	0.350	0.350	87.1	41.5	16.2	0.83	0.83	53.6
43	15.55	17	0.294	0.343	0.350	84.1	41.6	16.5	0.75	0.74	53.5
44	15.61	17	0.305	0.350	0.350	87.1	41.7	16.8	0.81	0.81	53.5
45	15.67	17	0.306	0.349	0.350	87.5	42.3	16.9	0.92	0.92	53.7
46	15.73	17	0.292	0.346	0.350	83.3	42.4	16.6	0.77	0.67	53.5
47	15.79	17	0.316	0.356	0.350	90.4	41.8	16.9	1.08	1.08	53.6
48	15.85	17	0.304	0.350	0.350	86.8	42.6	16.7	0.97	0.97	53.6
49	15.91	17	0.301	0.346	0.350	86.0	42.3	16.7	0.90	0.90	53.8
50	15.97	17	0.300	0.347	0.350	85.7	41.2	16.2	0.82	0.78	53.5
51	16.03	17	0.282	0.341	0.350	80.5	42.2	16.7	0.89	0.89	53.5
52	16.09	17	0.300	0.346	0.350	85.7	41.8	16.1	0.84	0.84	53.5
53	16.15	17	0.311	0.351	0.350	88.9	42.3	16.4	0.93	0.93	53.7
54	16.21	17	0.312	0.350	0.350	89.1	42.7	16.4	1.00	1.00	53.3
55	16.27	17	0.305	0.350	0.350	87.2	42.3	16.1	0.77	0.77	53.8
56	16.33	17	0.311	0.352	0.350	88.9	41.9	16.4	0.76	0.76	53.4
57	16.39	17	0.309	0.342	0.350	88.2	40.5	16.2	0.95	0.95	53.6
58	16.45	17	0.305	0.345	0.350	87.1	41.4	16.2	0.82	0.82	53.7
59	16.52	17	0.302	0.345	0.350	86.4	41.3	16.2	0.73	0.73	53.7
60	16.58	17	0.308	0.346	0.350	88.0	41.9	16.3	0.87	0.87	53.4
61	16.64	17	0.306	0.344	0.350	87.4	41.3	16.1	0.83	0.83	53.3
62	16.70	17	0.301	0.349	0.350	85.9	41.3	15.8	0.61	0.52	53.7
63	16.76	17	0.304	0.348	0.350	87.0	42.1	16.5	0.67	0.67	53.4
64	16.82	17	0.301	0.344	0.350	86.1	41.2	15.7	0.76	0.76	53.7
65	16.88	17	0.301	0.346	0.350	85.9	41.8	16.6	0.56	0.34	53.5
66	16.94	17	0.292	0.338	0.350	83.5	40.9	15.7	0.78	0.78	53.5
67	17.00	17	0.312	0.339	0.350	89.2	40.7	16.0	0.58	0.56	53.2
		Average	0.304	0.349	0.350	86.8	41.8	16.3	0.82	0.80	53.5
		Std. Dev.	0.008	0.006	0.000	2.2	0.6	0.4	0.13	0.15	0.2
		Maximum	0.327	0.370	0.350	93.4	43.1	16.9	1.08	1.08	53.8
		@ Blow#	39	39	34	39	39	45	47	47	35
		Minimum	0.282	0.338	0.350	80.5	40.5	15.5	0.56	0.34	53.2
		@ Blow#	51	66	34	51	57	35	65	65	67

Total number of blows analyzed: 34

VRANS RSCH001-703 - GD-3
OP: SPK

2 INCH SS;CME55 AUTO;VTRANS
Test date: 24-Sep-2008

AR: 1.45 in^2
LE: 37.08 ft
WS: 16,807.7 f/s

SP: 0.492 k/ft3
EM: 30,000 ksi
JC: 0.00

EMX: Max Transferred Energy
EF2: Energy of F^2
ER: Hammer Energy Rating
ETR: Energy Transfer Ratio
FMX: Maximum Force

VMX: Maximum Velocity
DMX: Maximum Displacement
DFN: Final Displacement
BPM: Blows per Minute

BL#	depth	BLC	EMX	EF2	ER	ETR	FMX	VMX	DMX	DFN	BPM
	ft	bl/ft	k-ft	k-ft	k-ft	(%)	kips	f/s	in	in	**
68	20.00	0	0.307	0.370	0.350	87.8	41.3	15.7	1.35	1.07	0.0
69	20.06	17	0.293	0.351	0.350	83.7	39.2	15.2	0.90	0.84	53.9
70	20.12	17	0.307	0.351	0.350	87.7	39.2	15.1	0.79	0.72	53.7
71	20.18	17	0.305	0.364	0.350	87.1	39.0	15.0	0.79	0.36	53.7
72	20.24	17	0.298	0.358	0.350	85.1	39.9	14.9	0.77	-0.11	53.6
73	20.30	17	0.331	0.366	0.350	94.6	39.7	15.0	1.47	1.47	53.7
74	20.36	17	0.306	0.363	0.350	87.5	39.0	14.9	0.89	0.78	53.6
75	20.42	17	0.311	0.365	0.350	89.0	39.4	14.7	1.02	1.02	53.5
76	20.48	17	0.300	0.355	0.350	85.7	39.7	15.2	1.09	1.09	53.8
77	20.55	17	0.324	0.371	0.350	92.5	39.4	15.0	0.94	0.94	53.7
78	20.61	17	0.300	0.365	0.350	85.8	39.5	15.1	0.85	0.83	53.6
79	20.67	17	0.319	0.371	0.350	91.1	40.7	15.2	1.03	1.03	53.6
81	20.79	17	0.308	0.368	0.350	87.9	39.5	15.1	0.78	0.61	53.5
82	20.85	17	0.303	0.362	0.350	86.6	39.3	15.1	0.87	0.87	53.8
83	20.91	17	0.327	0.369	0.350	93.3	39.3	15.0	0.96	0.96	53.6
84	20.97	17	0.307	0.365	0.350	87.8	40.0	15.0	0.81	0.81	53.6
85	21.03	17	0.307	0.368	0.350	87.7	40.2	15.4	0.80	0.80	53.5
86	21.09	17	0.307	0.358	0.350	87.8	39.2	15.1	1.05	1.05	53.6
87	21.15	17	0.312	0.369	0.350	89.3	39.7	15.3	0.83	0.83	53.6
88	21.21	17	0.305	0.365	0.350	87.2	40.4	15.5	0.66	0.63	53.4
89	21.27	17	0.304	0.364	0.350	86.8	40.4	15.5	0.67	0.67	53.7
90	21.33	17	0.310	0.364	0.350	88.5	40.2	15.3	0.73	0.73	53.3
91	21.39	17	0.307	0.359	0.350	87.8	39.1	15.0	0.61	0.56	53.8
92	21.45	17	0.325	0.372	0.350	92.9	40.9	15.3	0.99	0.99	53.4
93	21.52	17	0.305	0.370	0.350	87.0	40.4	15.2	0.59	0.37	53.7
94	21.58	17	0.307	0.362	0.350	87.8	39.4	15.1	0.66	0.66	53.7
95	21.64	17	0.309	0.359	0.350	88.3	39.4	15.2	0.74	0.74	53.5
96	21.70	17	0.308	0.360	0.350	88.1	39.2	15.1	0.92	0.92	53.5
97	21.76	17	0.313	0.367	0.350	89.4	39.9	15.2	0.58	0.43	53.6
98	21.82	17	0.307	0.362	0.350	87.8	39.5	15.1	0.85	0.85	53.6
99	21.88	17	0.294	0.354	0.350	83.9	41.1	15.7	0.72	0.72	53.5
100	21.94	17	0.302	0.356	0.350	86.4	40.0	15.2	0.66	0.66	53.7
101	22.00	17	0.299	0.366	0.350	85.4	39.7	15.6	0.57	0.50	53.4
		Average	0.308	0.363	0.350	88.0	39.8	15.2	0.85	0.77	53.6
		Std. Dev.	0.009	0.006	0.000	2.5	0.6	0.2	0.20	0.27	0.1
		Maximum	0.331	0.372	0.350	94.6	41.3	15.7	1.47	1.47	53.9
		@ Blow#	73	92	68	73	68	68	73	73	69
		Minimum	0.293	0.351	0.350	83.7	39.0	14.7	0.57	-0.11	53.3
		@ Blow#	69	69	68	69	71	75	101	72	90

Total number of blows analyzed: 33

Geosciences Testing & Research Inc
Case Method Results

PDIPLOT Ver. 2008.2 - Printed: 3-Apr-2009

VRANS RSCH001-703 - GD-3
OP: SPK

2 INCH SS;CME55 AUTO;VTRANS
Test date: 24-Sep-2008

AR: 1.45 in^2
LE: 37.08 ft
WS: 16,807.7 f/s

SP: 0.492 k/ft3
EM: 30,000 ksi
JC: 0.00

EMX: Max Transferred Energy
EF2: Energy of F^2
ER: Hammer Energy Rating
ETR: Energy Transfer Ratio
FMX: Maximum Force

VMX: Maximum Velocity
DMX: Maximum Displacement
DFN: Final Displacement
BPM: Blows per Minute

BL#	depth	BLC	EMX	EF2	ER	ETR	FMX	VMX	DMX	DFN	BPM
	ft	bl/ft	k-ft	k-ft	k-ft	(%)	kips	f/s	in	in	**
102	25.00	0	0.313	0.379	0.350	89.4	40.4	15.5	0.88	0.87	0.0
103	25.10	11	0.304	0.358	0.350	87.0	40.2	15.6	0.65	0.61	53.6
104	25.19	11	0.313	0.377	0.350	89.6	40.3	15.0	0.72	0.57	53.7
105	25.29	11	0.307	0.396	0.350	87.6	42.8	15.1	0.72	0.44	53.7
106	25.38	11	0.317	0.359	0.350	90.6	39.6	15.1	1.29	1.29	53.6
107	25.48	11	0.297	0.360	0.350	85.0	40.9	15.2	1.27	1.21	53.8
108	25.57	11	0.304	0.375	0.350	86.9	42.0	15.6	1.75	1.74	53.5
109	25.67	11	0.306	0.370	0.350	87.3	41.4	15.3	1.36	1.30	53.9
110	25.76	11	0.312	0.381	0.350	89.3	41.0	15.3	1.42	1.42	53.8
111	25.86	11	0.315	0.380	0.350	90.0	41.0	15.5	1.49	1.46	53.4
112	25.95	11	0.303	0.371	0.350	86.6	42.1	15.2	1.72	1.72	53.9
113	26.05	11	0.316	0.389	0.350	90.4	42.7	15.2	1.84	1.84	53.7
114	26.14	11	0.308	0.378	0.350	88.1	42.2	15.2	1.31	1.27	53.7
115	26.24	11	0.302	0.368	0.350	86.3	42.0	14.9	1.16	1.12	53.7
116	26.33	11	0.307	0.368	0.350	87.7	40.8	15.2	1.18	1.18	53.8
117	26.43	11	0.303	0.371	0.350	86.7	42.5	15.1	1.19	1.19	53.8
118	26.52	11	0.309	0.370	0.350	88.4	43.0	15.4	1.44	1.44	53.7
119	26.62	11	0.303	0.375	0.350	86.6	41.4	15.3	0.97	0.90	53.7
120	26.71	11	0.303	0.370	0.350	86.7	41.6	15.4	0.95	0.93	53.8
121	26.81	11	0.302	0.371	0.350	86.3	41.7	15.5	1.06	1.06	53.8
122	26.91	11	0.303	0.372	0.350	86.7	43.3	16.0	1.00	1.00	53.8
123	27.00	11	0.307	0.388	0.350	87.6	42.3	16.3	0.86	0.83	53.6
		Average	0.307	0.374	0.350	87.8	41.6	15.4	1.19	1.15	53.7
		Std. Dev.	0.005	0.009	0.000	1.5	1.0	0.3	0.33	0.36	0.1
		Maximum	0.317	0.396	0.350	90.6	43.3	16.3	1.84	1.84	53.9
		@ Blow#	106	105	102	106	122	123	113	113	109
		Minimum	0.297	0.358	0.350	85.0	39.6	14.9	0.65	0.44	53.4
		@ Blow#	107	103	102	107	106	115	103	105	111

Total number of blows analyzed: 22

Geosciences Testing & Research Inc
Case Method Results

PDIPLOT Ver. 2008.2 - Printed: 3-Apr-2009

VRANS RSCH001-703 - GD-3
OP: SPK

2 INCH SS;CME55 AUTO;VTRANS
Test date: 24-Sep-2008

AR: 1.45 in^2
LE: 37.08 ft
WS: 16,807.7 f/s

SP: 0.492 k/ft3
EM: 30,000 ksi
JC: 0.00

EMX: Max Transferred Energy
EF2: Energy of F^2
ER: Hammer Energy Rating
ETR: Energy Transfer Ratio
FMX: Maximum Force

VMX: Maximum Velocity
DMX: Maximum Displacement
DFN: Final Displacement
BPM: Blows per Minute

BL#	depth ft	BLC bl/ft	EMX k-ft	EF2 k-ft	ER k-ft	ETR (%)	FMX kips	VMX f/s	DMX in	DFN in	BPM **
124	30.00	0	0.299	0.360	0.350	85.5	40.9	16.3	0.78	0.50	0.0
125	30.05	21	0.310	0.369	0.350	88.5	40.0	16.0	1.43	1.43	53.9
126	30.10	21	0.313	0.366	0.350	89.3	40.5	16.5	0.86	0.34	53.6
127	30.15	21	0.322	0.372	0.350	92.1	41.2	16.5	1.14	1.14	53.9
128	30.20	21	0.304	0.381	0.350	86.9	40.6	16.4	0.81	0.78	53.5
129	30.24	21	0.329	0.384	0.350	94.1	40.5	16.3	1.05	1.05	53.7
130	30.29	21	0.296	0.362	0.350	84.5	40.5	16.4	0.86	0.86	53.5
131	30.34	21	0.304	0.365	0.350	86.8	40.5	16.7	0.75	0.75	53.6
132	30.39	21	0.290	0.333	0.350	82.9	39.8	16.5	0.94	0.94	53.8
133	30.44	21	0.304	0.373	0.350	86.8	40.8	16.7	0.65	0.47	53.4
134	30.49	21	0.304	0.379	0.350	86.9	40.8	16.6	0.96	0.96	53.4
135	30.54	21	0.321	0.372	0.350	91.6	40.8	16.5	0.98	0.98	53.6
136	30.59	21	0.296	0.372	0.350	84.5	40.5	16.2	0.70	0.56	53.8
137	30.63	21	0.301	0.374	0.350	85.9	40.9	16.4	0.73	0.61	53.3
138	30.68	21	0.303	0.366	0.350	86.7	40.0	16.2	0.96	0.96	53.8
139	30.73	21	0.309	0.356	0.350	88.3	41.4	16.8	0.84	0.84	53.4
140	30.78	21	0.300	0.371	0.350	85.6	41.0	16.5	0.73	0.71	53.7
141	30.83	21	0.321	0.381	0.350	91.9	41.2	16.2	0.90	0.90	53.7
142	30.88	21	0.294	0.362	0.350	84.1	40.7	16.6	0.69	0.59	53.5
143	30.93	21	0.309	0.370	0.350	88.2	40.6	16.4	0.98	0.98	53.8
144	30.98	21	0.295	0.366	0.350	84.4	41.3	16.5	0.75	0.75	53.5
145	31.02	21	0.315	0.378	0.350	89.9	42.1	16.6	0.74	0.74	53.4
146	31.07	21	0.297	0.364	0.350	85.0	41.4	16.5	0.68	0.67	53.7
147	31.12	21	0.320	0.382	0.350	91.3	41.6	16.3	0.80	0.80	53.5
148	31.17	21	0.301	0.365	0.350	85.9	40.9	16.4	0.84	0.84	53.6
149	31.22	21	0.315	0.379	0.350	90.1	41.3	16.7	0.72	0.72	53.5
150	31.27	21	0.305	0.380	0.350	87.2	41.4	16.6	0.65	0.65	53.6
151	31.32	21	0.318	0.368	0.350	90.9	41.7	16.4	0.77	0.77	53.6
152	31.37	21	0.301	0.369	0.350	86.1	41.2	16.6	0.59	0.59	53.6
153	31.41	21	0.309	0.370	0.350	88.4	41.8	16.7	0.70	0.70	53.2
154	31.46	21	0.299	0.368	0.350	85.4	41.3	16.7	0.55	0.39	53.8
155	31.51	21	0.307	0.375	0.350	87.6	41.3	16.8	0.56	0.56	53.4
156	31.56	21	0.304	0.384	0.350	86.9	41.4	16.5	0.61	0.61	53.5
157	31.61	21	0.318	0.379	0.350	90.8	42.2	17.2	0.79	0.79	53.4
158	31.66	21	0.303	0.373	0.350	86.6	40.8	16.6	0.53	0.50	53.5
159	31.71	21	0.312	0.378	0.350	89.2	41.1	16.5	0.56	0.56	53.8
160	31.76	21	0.312	0.371	0.350	89.0	41.6	17.1	0.89	0.89	53.3
161	31.80	21	0.308	0.380	0.350	88.1	41.2	16.7	0.48	0.20	53.8
162	31.85	21	0.309	0.375	0.350	88.3	40.9	16.4	0.51	0.51	53.5
163	31.90	21	0.308	0.380	0.350	88.0	41.3	16.5	0.52	0.52	53.8
164	31.95	21	0.302	0.370	0.350	86.2	41.5	16.5	0.50	0.50	53.4
		Average	0.307	0.371	0.350	87.7	41.0	16.5	0.77	0.72	53.6
		Std. Dev.	0.009	0.009	0.000	2.5	0.5	0.2	0.19	0.23	0.2
		Maximum	0.329	0.384	0.350	94.1	42.2	17.2	1.43	1.43	53.9
		@ Blow#	129	129	124	129	157	157	125	125	125
		Minimum	0.290	0.333	0.350	82.9	39.8	16.0	0.48	0.20	53.2
		@ Blow#	132	132	124	132	132	125	161	161	153

Total number of blows analyzed: 41

Geosciences Testing & Research Inc
Case Method Results

PDIPLOT Ver. 2008.2 - Printed: 3-Apr-2009

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DFN: Final Displacement
BPM: Blows per Minute

BL#	depth	BLC	EMX	EF2	ER	ETR	FMX	VMX	DMX	DFN	BPM
	ft	bl/ft	k-ft	k-ft	k-ft	(%)	kips	f/s	in	in	**
165	32.00	21	0.329	0.398	0.350	94.0	44.6	13.7	0.56	0.24	0.0
167	32.08	26	0.324	0.409	0.350	92.6	45.6	13.3	0.55	0.49	53.5
168	32.12	26	0.321	0.403	0.350	91.7	45.9	13.3	0.58	0.58	53.6
169	32.16	26	0.328	0.388	0.350	93.6	46.1	13.4	0.73	0.73	53.4
171	32.24	26	0.324	0.405	0.350	92.5	45.9	13.4	0.57	0.57	53.4
173	32.31	26	0.324	0.383	0.350	92.5	46.4	13.5	0.73	0.73	53.5
174	32.35	26	0.329	0.417	0.350	93.9	45.9	13.1	0.56	0.07	53.6
175	32.39	26	0.324	0.411	0.350	92.6	46.1	13.2	0.60	0.51	53.5
177	32.47	26	0.322	0.392	0.350	92.1	45.6	13.2	0.65	0.65	53.5
178	32.51	26	0.327	0.407	0.350	93.5	46.3	13.3	0.62	0.60	53.4
179	32.55	26	0.327	0.385	0.350	93.5	46.4	13.3	0.79	0.79	53.8
180	32.59	26	0.331	0.415	0.350	94.6	46.4	13.4	0.75	0.75	53.5
181	32.63	26	0.326	0.407	0.350	93.2	46.1	13.3	0.79	0.79	53.8
183	32.71	26	0.329	0.408	0.350	93.9	46.2	13.4	0.85	0.85	53.5
185	32.78	26	0.322	0.396	0.350	92.0	45.7	13.5	0.55	0.47	53.5
186	32.82	26	0.328	0.416	0.350	93.6	46.7	13.5	0.59	0.56	53.7
187	32.86	26	0.325	0.406	0.350	92.9	45.3	13.3	0.69	0.69	53.4
188	32.90	26	0.318	0.395	0.350	90.8	45.9	13.6	0.58	0.36	53.6
189	32.94	26	0.332	0.420	0.350	94.9	47.1	13.6	0.66	0.66	53.4
190	32.98	26	0.328	0.396	0.350	93.6	47.0	13.7	0.68	0.68	53.6
191	33.02	26	0.326	0.414	0.350	93.2	46.9	13.7	0.57	0.55	53.4
192	33.06	26	0.331	0.415	0.350	94.7	46.6	13.7	0.62	0.62	53.7
193	33.10	26	0.327	0.411	0.350	93.3	46.7	13.7	0.54	0.17	53.5
195	33.18	26	0.324	0.391	0.350	92.5	47.0	13.8	0.52	0.44	53.5
196	33.22	26	0.330	0.413	0.350	94.3	46.6	13.6	0.54	0.42	53.5
197	33.25	26	0.326	0.390	0.350	93.2	46.5	13.5	0.70	0.70	53.7
198	33.29	26	0.329	0.420	0.350	93.9	47.1	13.9	0.53	0.48	53.4
199	33.33	26	0.325	0.408	0.350	92.7	46.4	13.6	0.54	0.51	53.5
200	33.37	26	0.332	0.416	0.350	94.9	46.6	13.6	0.55	0.38	53.5
201	33.41	26	0.324	0.406	0.350	92.6	46.4	13.4	0.57	0.57	53.6
202	33.45	26	0.330	0.417	0.350	94.1	46.6	13.7	0.60	0.60	53.5
203	33.49	26	0.330	0.406	0.350	94.4	46.1	13.4	0.77	0.77	53.6
205	33.57	26	0.327	0.411	0.350	93.4	46.2	13.4	0.68	0.68	53.6
206	33.61	26	0.327	0.389	0.350	93.4	46.7	13.6	0.54	0.42	53.7
207	33.65	26	0.328	0.410	0.350	93.8	46.3	13.5	0.65	0.65	53.6
208	33.69	26	0.327	0.415	0.350	93.5	46.6	13.7	0.53	0.48	53.7
209	33.73	26	0.330	0.409	0.350	94.4	45.9	13.4	0.65	0.65	53.4
210	33.76	26	0.330	0.419	0.350	94.2	46.9	13.5	0.62	0.62	53.6
211	33.80	26	0.321	0.385	0.350	91.7	46.8	13.6	0.55	0.55	53.6
212	33.84	26	0.329	0.406	0.350	94.0	46.8	13.5	0.64	0.64	53.6
213	33.88	26	0.324	0.387	0.350	92.5	46.4	13.7	0.53	0.53	53.5
214	33.92	26	0.326	0.396	0.350	93.2	46.7	13.5	0.54	0.54	53.6
215	33.96	26	0.322	0.388	0.350	91.9	46.1	13.6	0.50	0.10	53.5
216	34.00	26	0.328	0.402	0.350	93.6	47.0	13.6	0.68	0.68	53.6
		Average	0.327	0.404	0.350	93.3	46.3	13.5	0.62	0.56	53.5
		Std. Dev.	0.003	0.011	0.000	0.9	0.5	0.2	0.09	0.17	0.1
		Maximum	0.332	0.420	0.350	94.9	47.1	13.9	0.85	0.85	53.8
		@ Blow#	189	189	165	200	198	198	183	183	179
		Minimum	0.318	0.383	0.350	90.8	44.6	13.1	0.50	0.07	53.4
		@ Blow#	188	173	165	188	165	174	215	174	169

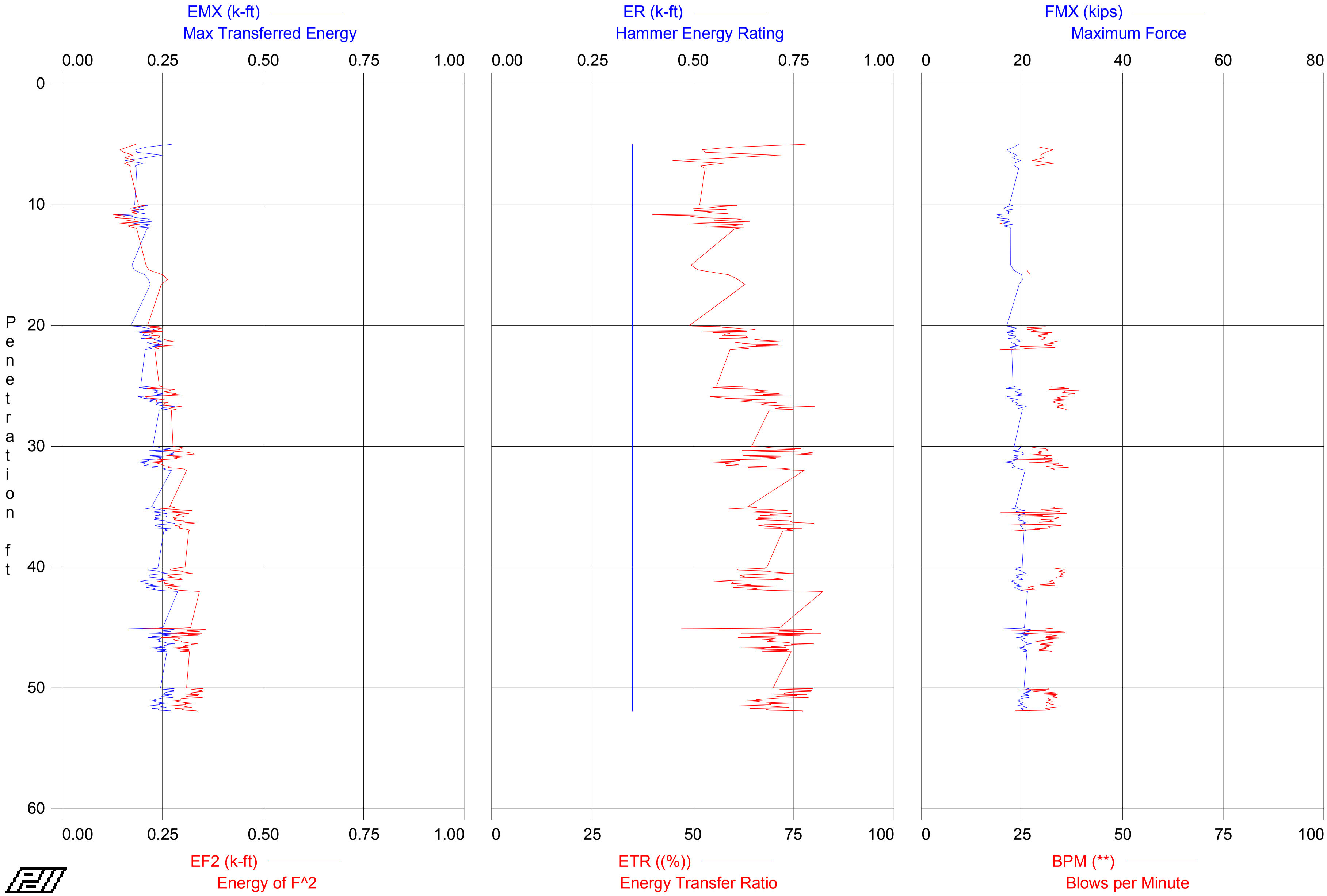
Total number of blows analyzed: 44

Geosciences Testing & Research Inc - Case Method Results

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

Test date: 24-Sep-2008

VRANS RSCH001-703 - GD-4



VRANS RSCH001-703 - GD-4
OP: SPK

2 INCH SS;CME45C SAFETY;VTRANS
Test date: 24-Sep-2008

AR: 0.92 in^2
LE: 53.83 ft
WS: 16,807.7 f/s

SP: 0.492 k/ft3
EM: 30,000 ksi
JC: 0.00

EMX: Max Transferred Energy
EF2: Energy of F^2
ER: Hammer Energy Rating
ETR: Energy Transfer Ratio
FMX: Maximum Force

VMX: Maximum Velocity
DMX: Maximum Displacement
DFN: Final Displacement
BPM: Blows per Minute

Statistics for entire file (289 blows)

	EMX	EF2	ER	ETR	FMX	VMX	DMX	DFN	BPM
	k-ft	k-ft	k-ft	(%)	kips	f/s	in	in	**
Average	0.232	0.267	0.350	66.3	19.2	12.0	0.92	0.88	31.1
Std. Dev.	0.027	0.049	0.001	7.7	1.3	1.0	0.46	0.48	3.4
Maximum	0.288	0.357	0.350	82.4	21.8	16.4	3.20	3.20	39.1
@ Blow#	208	212	1	208	238	5	5	5	87
Minimum	0.140	0.128	0.350	40.0	15.0	9.2	0.42	0.14	19.4
@ Blow#	21	21	1	21	21	211	69	204	30

Time Summary

Drive	19 seconds	1:33:10 PM - 1:33:29 PM (9/24/2008) BN 1 - 10
Stop	19 minutes 26 seconds	1:33:29 PM - 1:52:55 PM
Drive	1 minute 42 seconds	1:52:55 PM - 1:54:37 PM BN 11 - 35
Stop	27 minutes 16 seconds	1:54:37 PM - 2:21:53 PM
Drive	36 seconds	2:21:53 PM - 2:22:29 PM BN 36 - 41
Stop	20 minutes 7 seconds	2:22:29 PM - 2:42:36 PM
Drive	1 minute 23 seconds	2:42:36 PM - 2:43:59 PM BN 42 - 81
Stop	14 minutes 31 seconds	2:43:59 PM - 2:58:30 PM
Drive	51 seconds	2:58:30 PM - 2:59:21 PM BN 82 - 111
Stop	15 minutes 11 seconds	2:59:21 PM - 3:14:32 PM
Drive	1 minute 8 seconds	3:14:32 PM - 3:15:40 PM BN 112 - 146
Stop	16 minutes 51 seconds	3:15:40 PM - 3:32:31 PM
Drive	1 minute 16 seconds	3:32:31 PM - 3:33:47 PM BN 147 - 183
Stop	18 minutes 20 seconds	3:33:47 PM - 3:52:07 PM
Drive	57 seconds	3:52:07 PM - 3:53:04 PM BN 184 - 208
Stop	19 minutes 41 seconds	3:53:04 PM - 4:12:45 PM
Drive	3 minutes 4 seconds	4:12:45 PM - 4:15:49 PM BN 209 - 252
Stop	18 minutes 7 seconds	4:15:49 PM - 4:33:56 PM
Drive	1 minute 38 seconds	4:33:56 PM - 4:35:34 PM BN 253 - 291

Total time [3:02:24] = (Driving [0:12:54] + Stop [2:49:30])

Geosciences Testing & Research Inc
Case Method Results

PDIPLOT Ver. 2008.2 - Printed: 3-Apr-2009

VRANS RSCH001-703 - GD-4
OP: SPK

2 INCH SS;CME45C SAFETY;VTRANS
Test date: 24-Sep-2008

AR: 0.92 in^2
LE: 53.83 ft
WS: 16,807.7 f/s

SP: 0.492 k/ft3
EM: 30,000 ksi
JC: 0.00

EMX: Max Transferred Energy
EF2: Energy of F^2
ER: Hammer Energy Rating
ETR: Energy Transfer Ratio
FMX: Maximum Force

VMX: Maximum Velocity
DMX: Maximum Displacement
DFN: Final Displacement
BPM: Blows per Minute

BL#	depth	BLC	EMX	EF2	ER	ETR	FMX	VMX	DMX	DFN	BPM
	ft	bl/ft	k-ft	k-ft	k-ft	(%)	kips	f/s	in	in	**
1	5.00	5	0.273	0.184	0.350	78.0	19.3	16.3	2.14	2.14	0.0
2	5.22	5	0.211	0.164	0.350	60.4	18.4	14.6	1.79	1.79	29.2
3	5.44	5	0.183	0.144	0.350	52.4	17.1	13.9	1.77	1.77	32.6
4	5.67	5	0.186	0.154	0.350	53.2	17.6	14.9	1.88	1.88	30.8
5	5.89	5	0.252	0.177	0.350	72.0	19.1	16.4	3.20	3.20	29.6
6	6.11	5	0.207	0.158	0.350	59.2	18.1	15.8	2.97	2.97	30.3
7	6.33	5	0.158	0.180	0.350	45.0	19.8	15.9	2.53	2.35	27.5
8	6.56	5	0.202	0.155	0.350	57.7	18.4	15.5	3.10	3.10	32.9
9	6.78	5	0.181	0.170	0.350	51.8	18.5	14.6	2.50	2.50	28.2
10	7.00	5	0.186	0.169	0.350	53.0	19.3	15.7	2.64	2.64	0.0
		Average	0.204	0.165	0.350	58.3	18.5	15.4	2.45	2.43	30.1
		Std. Dev.	0.033	0.012	0.000	9.4	0.8	0.8	0.51	0.51	1.8
		Maximum	0.273	0.184	0.350	78.0	19.8	16.4	3.20	3.20	32.9
		@ Blow#	1	1	1	1	7	5	5	5	8
		Minimum	0.158	0.144	0.350	45.0	17.1	13.9	1.77	1.77	27.5
		@ Blow#	7	3	1	7	3	3	3	3	7

Total number of blows analyzed: 10

VRANS RSCH001-703 - GD-4
OP: SPK

2 INCH SS;CME45C SAFETY;VTRANS
Test date: 24-Sep-2008

AR: 0.92 in^2
LE: 53.83 ft
WS: 16,807.7 f/s

SP: 0.492 k/ft3
EM: 30,000 ksi
JC: 0.00

EMX: Max Transferred Energy
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ER: Hammer Energy Rating
ETR: Energy Transfer Ratio
FMX: Maximum Force

VMX: Maximum Velocity
DMX: Maximum Displacement
DFN: Final Displacement
BPM: Blows per Minute

BL#	depth	BLC	EMX	EF2	ER	ETR	FMX	VMX	DMX	DFN	BPM
	ft	bl/ft	k-ft	k-ft	k-ft	(%)	kips	f/s	in	in	**
11	10.00	0	0.181	0.190	0.350	51.7	17.5	13.9	1.45	1.42	0.0
12	10.08	12	0.213	0.205	0.350	60.9	18.1	13.9	1.93	1.93	0.0
13	10.17	12	0.199	0.192	0.350	56.9	17.2	13.6	1.57	1.56	0.0
14	10.25	12	0.188	0.174	0.350	53.7	16.4	12.7	1.21	1.20	0.0
15	10.33	12	0.176	0.171	0.350	50.2	16.5	12.8	1.02	1.00	0.0
16	10.42	12	0.204	0.191	0.350	58.3	18.0	13.8	1.33	1.33	0.0
17	10.50	12	0.176	0.174	0.350	50.4	16.9	14.1	0.96	0.85	0.0
18	10.58	12	0.194	0.186	0.350	55.5	17.6	13.0	0.96	0.87	0.0
19	10.67	12	0.188	0.174	0.350	53.7	17.3	13.0	1.14	1.14	0.0
20	10.75	12	0.206	0.186	0.350	58.8	17.3	12.6	1.20	1.20	0.0
21	10.83	12	0.140	0.128	0.350	40.0	15.0	11.7	0.68	0.30	20.8
22	10.92	12	0.179	0.151	0.350	51.1	15.7	12.6	1.03	1.03	0.0
23	11.00	12	0.173	0.156	0.350	49.3	16.1	13.2	0.87	0.28	0.0
24	11.08	12	0.185	0.133	0.350	52.8	15.0	12.2	1.43	1.43	0.0
25	11.17	12	0.220	0.182	0.350	62.7	17.6	12.6	1.33	1.33	0.0
26	11.25	12	0.213	0.179	0.350	60.7	17.1	11.7	1.01	1.01	0.0
27	11.33	12	0.194	0.161	0.350	55.4	15.8	12.4	1.07	1.07	0.0
28	11.42	12	0.224	0.190	0.350	64.1	17.6	11.7	0.98	0.98	0.0
29	11.50	12	0.172	0.139	0.350	49.0	16.0	10.2	0.99	0.99	20.3
30	11.58	12	0.190	0.164	0.350	54.2	16.8	11.8	0.92	0.92	19.4
31	11.67	12	0.218	0.192	0.350	62.4	18.2	13.0	1.15	1.14	0.0
32	11.75	12	0.209	0.165	0.350	59.8	16.4	11.8	1.41	1.41	0.0
33	11.83	12	0.187	0.171	0.350	53.4	17.4	12.0	0.96	0.92	0.0
34	11.92	12	0.219	0.181	0.350	62.7	17.7	12.5	1.33	1.33	0.0
35	12.00	12	0.211	0.186	0.350	60.4	17.8	12.5	1.33	1.33	0.0
		Average	0.194	0.173	0.350	55.5	16.9	12.6	1.17	1.12	20.2
		Std. Dev.	0.019	0.019	0.000	5.6	0.9	0.9	0.26	0.34	0.6
		Maximum	0.224	0.205	0.350	64.1	18.2	14.1	1.93	1.93	20.8
		@ Blow#	28	12	11	28	31	17	12	12	21
		Minimum	0.140	0.128	0.350	40.0	15.0	10.2	0.68	0.28	19.4
		@ Blow#	21	21	11	21	21	29	21	23	30

Total number of blows analyzed: 25

Geosciences Testing & Research Inc
Case Method Results

PDIPLOT Ver. 2008.2 - Printed: 3-Apr-2009

VRANS RSCH001-703 - GD-4
OP: SPK

2 INCH SS;CME45C SAFETY;VTRANS
Test date: 24-Sep-2008

AR: 0.92 in^2
LE: 53.83 ft
WS: 16,807.7 f/s

SP: 0.492 k/ft3
EM: 30,000 ksi
JC: 0.00

EMX: Max Transferred Energy
EF2: Energy of F^2
ER: Hammer Energy Rating
ETR: Energy Transfer Ratio
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VMX: Maximum Velocity
DMX: Maximum Displacement
DFN: Final Displacement
BPM: Blows per Minute

BL#	depth	BLC	EMX	EF2	ER	ETR	FMX	VMX	DMX	DFN	BPM
	ft	bl/ft	k-ft	k-ft	k-ft	(%)	kips	f/s	in	in	**
36	15.00	0	0.174	0.209	0.350	49.6	17.7	13.4	2.03	1.99	0.0
37	15.40	3	0.180	0.216	0.350	51.3	18.3	13.0	1.82	1.82	26.2
38	15.80	3	0.206	0.251	0.350	59.0	19.9	14.0	2.75	2.75	27.0
39	16.20	3	0.215	0.263	0.350	61.3	20.1	13.4	2.48	2.48	0.0
40	16.60	3	0.220	0.247	0.350	63.0	19.4	13.2	1.63	1.48	21.2
		Average	0.199	0.237	0.350	56.8	19.1	13.4	2.14	2.10	24.8
		Std. Dev.	0.019	0.021	0.000	5.4	0.9	0.3	0.41	0.46	2.6
		Maximum	0.220	0.263	0.350	63.0	20.1	14.0	2.75	2.75	27.0
		@ Blow#	40	39	36	40	39	38	38	38	38
		Minimum	0.174	0.209	0.350	49.6	17.7	13.0	1.63	1.48	21.2
		@ Blow#	36	36	36	36	36	37	40	40	40

Total number of blows analyzed: 5

VRANS RSCH001-703 - GD-4
OP: SPK

2 INCH SS;CME45C SAFETY;VTRANS
Test date: 24-Sep-2008

AR: 0.92 in^2
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WS: 16,807.7 f/s

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BL#	depth ft	BLC bl/ft	EMX k-ft	EF2 k-ft	ER k-ft	ETR (%)	FMX kips	VMX f/s	DMX in	DFN in	BPM **
42	20.00	0	0.172	0.213	0.350	49.2	17.0	11.6	1.89	1.87	0.0
43	20.05	20	0.174	0.213	0.350	49.8	16.9	11.2	1.62	1.62	0.0
44	20.10	20	0.199	0.242	0.350	56.8	17.9	12.2	1.78	1.78	30.8
45	20.15	20	0.200	0.219	0.350	57.3	17.8	11.3	1.47	1.47	26.2
46	20.21	20	0.212	0.248	0.350	60.7	18.9	11.6	1.33	1.33	29.9
47	20.26	20	0.218	0.238	0.350	62.2	18.5	11.8	1.04	1.04	27.3
48	20.31	20	0.229	0.240	0.350	65.5	18.2	11.3	1.14	1.14	26.3
49	20.36	20	0.225	0.243	0.350	64.4	18.3	11.8	0.95	0.95	28.3
50	20.41	20	0.215	0.232	0.350	61.5	18.1	11.7	0.76	0.74	27.7
51	20.46	20	0.183	0.201	0.350	52.3	17.0	11.0	0.61	0.58	29.5
52	20.51	20	0.222	0.250	0.350	63.4	18.5	12.1	0.68	0.68	27.3
53	20.56	20	0.193	0.200	0.350	55.1	17.1	11.4	0.68	0.68	32.4
54	20.62	20	0.206	0.222	0.350	58.7	17.8	11.7	0.62	0.62	29.6
55	20.67	20	0.207	0.225	0.350	59.2	18.1	11.8	0.55	0.55	31.4
56	20.72	20	0.202	0.217	0.350	57.7	17.3	11.2	0.67	0.67	29.4
57	20.77	20	0.203	0.220	0.350	58.1	17.4	11.0	0.49	0.37	31.3
58	20.82	20	0.201	0.223	0.350	57.4	17.4	11.6	0.51	0.51	29.4
59	20.87	20	0.221	0.244	0.350	63.1	18.7	12.1	0.66	0.66	29.0
60	20.92	20	0.222	0.241	0.350	63.4	18.7	12.0	0.73	0.73	30.0
61	20.97	20	0.223	0.242	0.350	63.6	18.5	11.9	0.69	0.69	30.8
62	21.03	20	0.213	0.237	0.350	61.0	18.2	11.7	0.46	0.43	30.0
63	21.08	20	0.198	0.209	0.350	56.6	17.3	11.1	0.62	0.62	30.6
64	21.13	20	0.234	0.252	0.350	67.0	18.8	12.3	1.07	1.07	30.5
65	21.18	20	0.229	0.256	0.350	65.4	19.0	12.1	0.54	0.54	29.9
66	21.23	20	0.241	0.264	0.350	68.9	19.4	11.6	0.48	0.20	0.0
67	21.28	20	0.252	0.280	0.350	72.1	19.8	11.8	0.66	0.66	34.0
68	21.33	20	0.240	0.270	0.350	68.5	19.3	11.5	0.49	0.48	33.1
69	21.38	20	0.212	0.228	0.350	60.5	17.8	11.9	0.42	0.35	32.8
70	21.44	20	0.216	0.235	0.350	61.8	18.0	12.1	0.51	0.51	32.1
71	21.49	20	0.218	0.239	0.350	62.4	18.3	12.3	0.43	0.14	32.8
72	21.54	20	0.226	0.241	0.350	64.5	18.6	12.2	0.65	0.65	31.3
73	21.59	20	0.249	0.251	0.350	71.1	18.8	12.4	1.23	1.23	30.5
74	21.64	20	0.230	0.253	0.350	65.7	18.7	12.4	0.44	0.16	32.4
75	21.69	20	0.252	0.279	0.350	72.1	19.5	12.6	0.50	0.39	30.2
76	21.74	20	0.227	0.240	0.350	64.8	18.2	12.1	0.60	0.60	24.5
77	21.79	20	0.219	0.231	0.350	62.6	17.6	12.2	0.53	0.53	33.2
78	21.85	20	0.213	0.239	0.350	60.9	18.6	11.6	0.44	0.32	30.5
79	21.90	20	0.223	0.240	0.350	63.8	18.7	11.5	0.66	0.66	25.9
80	21.95	20	0.214	0.230	0.350	61.1	18.3	11.8	0.63	0.63	25.0
81	22.00	20	0.207	0.231	0.350	59.2	18.0	12.0	0.43	0.15	19.5
		Average	0.216	0.237	0.350	61.7	18.2	11.8	0.76	0.72	29.6
		Std. Dev.	0.018	0.018	0.000	5.2	0.7	0.4	0.38	0.42	2.9
		Maximum	0.252	0.280	0.350	72.1	19.8	12.6	1.89	1.87	34.0
		@ Blow#	67	67	42	67	67	75	42	42	67
		Minimum	0.172	0.200	0.350	49.2	16.9	11.0	0.42	0.14	19.5
		@ Blow#	42	53	42	42	43	51	69	71	81

Total number of blows analyzed: 40

Geosciences Testing & Research Inc
Case Method Results

PDIPLOT Ver. 2008.2 - Printed: 3-Apr-2009

VRANS RSCH001-703 - GD-4
OP: SPK

2 INCH SS;CME45C SAFETY;VTRANS
Test date: 24-Sep-2008

AR: 0.92 in^2
LE: 53.83 ft
WS: 16,807.7 f/s

SP: 0.492 k/ft3
EM: 30,000 ksi
JC: 0.00

EMX: Max Transferred Energy
EF2: Energy of F^2
ER: Hammer Energy Rating
ETR: Energy Transfer Ratio
FMX: Maximum Force

VMX: Maximum Velocity
DMX: Maximum Displacement
DFN: Final Displacement
BPM: Blows per Minute

BL#	depth ft	BLC bl/ft	EMX k-ft	EF2 k-ft	ER k-ft	ETR (%)	FMX kips	VMX f/s	DMX in	DFN in	BPM **
82	25.00	0	0.196	0.242	0.350	55.9	18.2	13.6	1.78	1.71	0.0
83	25.07	15	0.219	0.251	0.350	62.5	18.7	11.4	1.14	1.14	32.2
84	25.14	15	0.192	0.223	0.350	55.0	17.5	10.6	0.86	0.86	35.3
85	25.21	15	0.203	0.212	0.350	58.0	16.9	10.2	1.00	1.00	36.6
86	25.28	15	0.232	0.280	0.350	66.2	19.6	12.2	0.81	0.63	31.7
87	25.34	15	0.228	0.267	0.350	65.2	18.9	11.6	0.95	0.95	39.1
88	25.41	15	0.241	0.271	0.350	68.7	19.1	11.8	1.27	1.27	35.2
89	25.48	15	0.234	0.254	0.350	66.8	18.7	11.7	1.03	1.03	35.6
90	25.55	15	0.230	0.261	0.350	65.6	19.0	12.1	0.84	0.84	35.1
91	25.62	15	0.250	0.284	0.350	71.5	19.9	12.5	0.86	0.86	38.1
92	25.69	15	0.236	0.274	0.350	67.5	19.2	12.1	0.69	0.47	36.6
93	25.76	15	0.259	0.300	0.350	74.1	20.4	12.2	1.07	1.01	0.0
94	25.83	15	0.219	0.243	0.350	62.5	18.5	10.9	1.03	1.03	37.7
95	25.90	15	0.190	0.208	0.350	54.3	17.1	10.2	0.78	0.75	35.0
96	25.97	15	0.199	0.210	0.350	57.0	17.0	10.3	0.83	0.83	33.8
97	26.03	15	0.204	0.222	0.350	58.3	17.8	10.9	0.84	0.82	34.5
98	26.10	15	0.238	0.255	0.350	68.0	19.3	11.8	0.99	0.99	32.9
99	26.17	15	0.214	0.237	0.350	61.2	18.6	11.1	0.81	0.75	36.2
100	26.24	15	0.226	0.235	0.350	64.6	18.1	11.0	0.97	0.97	33.4
101	26.31	15	0.216	0.236	0.350	61.7	18.0	10.8	0.87	0.84	32.7
102	26.38	15	0.248	0.264	0.350	70.7	19.0	11.4	1.02	1.02	33.0
103	26.45	15	0.239	0.256	0.350	68.2	19.2	11.4	1.06	1.06	34.0
104	26.52	15	0.235	0.254	0.350	67.1	18.9	11.4	0.97	0.97	35.0
105	26.59	15	0.241	0.250	0.350	68.8	19.0	11.4	1.08	1.08	35.4
106	26.66	15	0.258	0.278	0.350	73.6	20.4	12.3	1.01	1.00	33.6
107	26.72	15	0.281	0.297	0.350	80.3	20.9	12.4	1.22	1.22	34.1
108	26.79	15	0.251	0.274	0.350	71.8	19.9	11.7	1.12	1.12	33.8
109	26.86	15	0.247	0.266	0.350	70.6	19.3	11.3	1.17	1.17	35.1
110	26.93	15	0.262	0.284	0.350	74.9	20.2	11.7	1.25	1.25	35.9
111	27.00	15	0.242	0.272	0.350	69.0	20.0	11.5	1.18	1.18	36.1
		Average	0.231	0.255	0.350	66.0	18.9	11.5	1.02	0.99	34.9
		Std. Dev.	0.022	0.024	0.000	6.3	1.0	0.7	0.20	0.22	1.7
		Maximum	0.281	0.300	0.350	80.3	20.9	13.6	1.78	1.71	39.1
		@ Blow#	107	93	82	107	107	82	82	82	87
		Minimum	0.190	0.208	0.350	54.3	16.9	10.2	0.69	0.47	31.7
		@ Blow#	95	95	82	95	85	95	92	92	86

Total number of blows analyzed: 30

Geosciences Testing & Research Inc
Case Method Results

PDIPLOT Ver. 2008.2 - Printed: 3-Apr-2009

VRANS RSCH001-703 - GD-4
OP: SPK

2 INCH SS;CME45C SAFETY;VTRANS
Test date: 24-Sep-2008

AR: 0.92 in^2
LE: 53.83 ft
WS: 16,807.7 f/s

SP: 0.492 k/ft3
EM: 30,000 ksi
JC: 0.00

EMX: Max Transferred Energy
EF2: Energy of F^2
ER: Hammer Energy Rating
ETR: Energy Transfer Ratio
FMX: Maximum Force

VMX: Maximum Velocity
DMX: Maximum Displacement
DFN: Final Displacement
BPM: Blows per Minute

BL#	depth	BLC	EMX	EF2	ER	ETR	FMX	VMX	DMX	DFN	BPM
	ft	bl/ft	k-ft	k-ft	k-ft	(%)	kips	f/s	in	in	**
112	30.00	0	0.226	0.276	0.350	64.6	18.4	12.4	1.72	1.72	0.0
113	30.06	17	0.237	0.290	0.350	67.7	19.7	12.7	1.42	1.30	28.8
114	30.12	17	0.244	0.300	0.350	69.6	19.6	12.6	0.94	0.59	27.5
115	30.18	17	0.269	0.298	0.350	76.9	19.6	12.5	1.27	1.27	30.9
116	30.24	17	0.246	0.295	0.350	70.4	19.2	12.2	0.84	0.74	30.9
117	30.29	17	0.264	0.290	0.350	75.4	19.3	12.4	1.18	1.18	31.3
118	30.35	17	0.218	0.255	0.350	62.3	18.2	11.4	0.83	0.83	31.3
119	30.41	17	0.235	0.282	0.350	67.1	18.6	12.0	0.77	0.75	29.3
120	30.47	17	0.273	0.307	0.350	78.1	19.9	12.6	1.12	1.12	30.2
121	30.53	17	0.279	0.318	0.350	79.7	20.2	12.4	1.17	1.17	29.0
122	30.59	17	0.270	0.327	0.350	77.0	20.2	12.4	0.83	0.65	29.2
123	30.65	17	0.279	0.329	0.350	79.7	20.3	12.8	0.92	0.91	29.8
124	30.71	17	0.261	0.305	0.350	74.6	19.8	12.3	0.95	0.94	27.0
125	30.76	17	0.219	0.260	0.350	62.6	18.4	11.2	0.76	0.76	32.3
126	30.82	17	0.225	0.278	0.350	64.2	18.9	11.8	0.72	0.55	31.4
127	30.88	17	0.252	0.297	0.350	71.9	19.1	12.2	0.84	0.84	30.9
128	30.94	17	0.235	0.277	0.350	67.1	18.3	11.8	0.71	0.69	30.4
129	31.00	17	0.247	0.286	0.350	70.6	19.2	12.0	0.79	0.79	32.4
130	31.06	17	0.234	0.271	0.350	66.9	19.3	11.7	0.70	0.47	22.3
131	31.12	17	0.200	0.236	0.350	57.0	18.1	10.7	0.59	0.48	32.7
132	31.18	17	0.216	0.248	0.350	61.7	18.5	10.9	0.66	0.66	32.4
133	31.24	17	0.211	0.250	0.350	60.2	17.9	10.9	0.68	0.68	30.8
134	31.29	17	0.190	0.220	0.350	54.4	16.4	10.5	0.74	0.74	33.4
135	31.35	17	0.208	0.247	0.350	59.4	18.0	10.8	0.61	0.56	26.7
136	31.41	17	0.203	0.238	0.350	58.0	18.0	10.7	0.61	0.61	34.0
137	31.47	17	0.208	0.245	0.350	59.6	18.4	10.9	0.52	0.37	33.9
138	31.53	17	0.215	0.251	0.350	61.3	18.4	11.3	0.60	0.60	32.7
139	31.59	17	0.204	0.252	0.350	58.2	18.2	11.3	0.55	0.43	35.2
140	31.65	17	0.239	0.267	0.350	68.4	18.6	11.8	0.83	0.83	31.0
141	31.71	17	0.223	0.265	0.350	63.6	18.5	11.3	0.61	0.52	31.9
142	31.76	17	0.224	0.265	0.350	63.9	18.0	11.6	0.61	0.61	36.5
143	31.82	17	0.252	0.288	0.350	72.0	19.1	12.0	0.84	0.84	32.2
144	31.88	17	0.259	0.304	0.350	74.1	19.6	12.3	0.73	0.73	33.1
145	31.94	17	0.252	0.306	0.350	72.1	20.3	12.5	0.63	0.48	32.7
146	32.00	17	0.272	0.310	0.350	77.7	20.6	12.3	0.83	0.83	0.0
		Average	0.237	0.278	0.350	67.7	18.9	11.8	0.83	0.78	31.0
		Std. Dev.	0.025	0.027	0.000	7.1	0.9	0.7	0.26	0.28	2.7
		Maximum	0.279	0.329	0.350	79.7	20.6	12.8	1.72	1.72	36.5
		@ Blow#	121	123	112	121	146	123	112	112	142
		Minimum	0.190	0.220	0.350	54.4	16.4	10.5	0.52	0.37	22.3
		@ Blow#	134	134	112	134	134	134	137	137	130

Total number of blows analyzed: 35

VRANS RSCH001-703 - GD-4
OP: SPK

2 INCH SS;CME45C SAFETY;VTRANS
Test date: 24-Sep-2008

AR: 0.92 in^2
LE: 53.83 ft
WS: 16,807.7 f/s

SP: 0.492 k/ft3
EM: 30,000 ksi
JC: 0.00

EMX: Max Transferred Energy
EF2: Energy of F^2
ER: Hammer Energy Rating
ETR: Energy Transfer Ratio
FMX: Maximum Force

VMX: Maximum Velocity
DMX: Maximum Displacement
DFN: Final Displacement
BPM: Blows per Minute

BL#	depth	BLC	EMX	EF2	ER	ETR	FMX	VMX	DMX	DFN	BPM
	ft	bl/ft	k-ft	k-ft	k-ft	(%)	kips	f/s	in	in	**
147	35.00	0	0.223	0.268	0.350	63.7	18.7	11.6	0.62	0.61	0.0
148	35.06	18	0.230	0.280	0.350	65.8	19.2	12.1	0.78	0.78	33.1
149	35.11	18	0.219	0.271	0.350	62.7	18.9	11.6	0.60	0.52	32.0
150	35.17	18	0.206	0.243	0.350	58.9	17.9	10.7	0.68	0.68	35.1
151	35.22	18	0.241	0.278	0.350	68.9	19.8	11.5	0.76	0.76	29.9
152	35.28	18	0.248	0.300	0.350	71.0	19.6	12.2	0.78	0.78	30.1
153	35.33	18	0.257	0.323	0.350	73.4	20.5	12.7	0.67	0.59	31.4
154	35.39	18	0.231	0.278	0.350	66.1	18.8	11.4	0.70	0.70	34.4
155	35.44	18	0.227	0.269	0.350	64.9	19.3	11.3	0.71	0.71	33.1
156	35.50	18	0.247	0.304	0.350	70.5	20.1	12.7	0.59	0.53	19.7
157	35.56	18	0.261	0.315	0.350	74.5	20.5	13.1	0.59	0.40	36.0
158	35.61	18	0.242	0.288	0.350	69.2	19.5	12.3	0.64	0.64	31.4
159	35.67	18	0.245	0.299	0.350	70.1	19.7	12.3	0.58	0.54	21.5
160	35.72	18	0.233	0.284	0.350	66.7	19.3	12.0	0.58	0.57	30.1
161	35.78	18	0.259	0.298	0.350	73.9	20.3	11.9	0.86	0.86	27.6
162	35.83	18	0.260	0.304	0.350	74.3	20.1	13.0	0.77	0.77	32.7
163	35.89	18	0.233	0.278	0.350	66.5	19.3	11.5	0.61	0.60	34.1
164	35.94	18	0.231	0.280	0.350	66.1	19.6	11.1	0.57	0.56	33.1
165	36.00	18	0.248	0.287	0.350	70.8	19.6	11.9	0.78	0.78	34.1
166	36.06	18	0.230	0.279	0.350	65.7	19.2	11.5	0.56	0.52	29.7
167	36.11	18	0.239	0.280	0.350	68.3	19.3	11.8	0.63	0.62	32.4
168	36.17	18	0.258	0.304	0.350	73.9	20.3	12.4	0.68	0.67	31.9
169	36.22	18	0.260	0.303	0.350	74.3	20.4	12.0	0.72	0.72	32.8
170	36.28	18	0.262	0.306	0.350	74.8	20.4	12.1	0.85	0.85	29.3
171	36.33	18	0.276	0.335	0.350	78.8	20.9	12.8	0.77	0.77	0.0
172	36.39	18	0.280	0.324	0.350	80.1	20.4	12.8	0.90	0.90	0.0
173	36.44	18	0.264	0.298	0.350	75.5	19.5	12.0	1.02	1.02	21.9
174	36.50	18	0.238	0.293	0.350	67.9	19.9	12.1	0.65	0.54	33.4
175	36.56	18	0.232	0.282	0.350	66.4	19.6	11.9	0.65	0.64	34.7
176	36.61	18	0.240	0.292	0.350	68.6	19.8	12.4	0.76	0.76	31.6
177	36.67	18	0.249	0.289	0.350	71.2	20.0	11.5	0.92	0.92	31.8
178	36.72	18	0.251	0.293	0.350	71.7	20.0	11.6	0.92	0.92	31.8
179	36.78	18	0.238	0.291	0.350	67.9	19.9	11.5	0.64	0.34	31.5
180	36.83	18	0.270	0.300	0.350	77.0	20.3	11.8	1.20	1.20	28.2
181	36.89	18	0.257	0.311	0.350	73.4	20.6	12.3	0.68	0.51	29.3
182	36.94	18	0.262	0.317	0.350	74.8	20.7	12.3	0.71	0.71	25.4
183	37.00	18	0.253	0.315	0.350	72.3	20.4	12.2	0.73	0.59	22.4
		Average	0.246	0.293	0.350	70.3	19.8	12.0	0.73	0.69	30.5
		Std. Dev.	0.016	0.018	0.000	4.6	0.6	0.5	0.14	0.17	4.0
		Maximum	0.280	0.335	0.350	80.1	20.9	13.1	1.20	1.20	36.0
		@ Blow#	172	171	147	172	171	157	180	180	157
		Minimum	0.206	0.243	0.350	58.9	17.9	10.7	0.56	0.34	19.7
		@ Blow#	150	150	147	150	150	150	166	179	156

Total number of blows analyzed: 37

Geosciences Testing & Research Inc
Case Method Results

PDIPLOT Ver. 2008.2 - Printed: 3-Apr-2009

VRANS RSCH001-703 - GD-4
OP: SPK

2 INCH SS;CME45C SAFETY;VTRANS
Test date: 24-Sep-2008

AR: 0.92 in^2
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EM: 30,000 ksi
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DFN: Final Displacement
BPM: Blows per Minute

BL#	depth	BLC	EMX	EF2	ER	ETR	FMX	VMX	DMX	DFN	BPM
	ft	bl/ft	k-ft	k-ft	k-ft	(%)	kips	f/s	in	in	**
184	40.00	0	0.239	0.306	0.350	68.4	20.0	12.5	1.57	1.56	0.0
185	40.08	12	0.238	0.286	0.350	68.0	19.1	12.5	1.85	1.85	33.1
186	40.17	12	0.214	0.269	0.350	61.1	18.7	11.2	1.01	0.92	35.5
187	40.25	12	0.215	0.270	0.350	61.3	19.3	11.1	1.12	1.05	35.2
188	40.33	12	0.240	0.299	0.350	68.6	20.0	11.5	1.28	1.24	34.2
189	40.42	12	0.246	0.305	0.350	70.3	20.2	12.3	1.68	1.68	35.7
190	40.50	12	0.263	0.325	0.350	75.0	20.9	12.8	1.71	1.70	34.8
191	40.58	12	0.241	0.301	0.350	68.9	20.5	12.2	1.49	1.48	35.2
192	40.67	12	0.216	0.263	0.350	61.7	18.9	10.7	1.03	1.00	34.6
193	40.75	12	0.220	0.273	0.350	62.8	19.3	10.9	1.23	1.23	35.0
194	40.83	12	0.217	0.263	0.350	61.9	18.8	10.6	1.18	1.18	33.5
195	40.92	12	0.245	0.291	0.350	69.9	19.6	11.1	1.03	1.03	33.6
196	41.00	12	0.254	0.299	0.350	72.5	20.2	12.1	0.91	0.91	0.0
197	41.08	12	0.210	0.258	0.350	60.1	18.2	11.3	0.75	0.65	32.7
198	41.17	12	0.193	0.236	0.350	55.2	17.8	10.2	0.72	0.69	31.7
199	41.25	12	0.210	0.256	0.350	60.1	18.6	10.3	0.68	0.68	32.7
200	41.33	12	0.208	0.254	0.350	59.5	18.5	10.4	0.61	0.57	33.1
201	41.42	12	0.226	0.278	0.350	64.5	19.4	10.7	0.69	0.69	29.5
202	41.50	12	0.213	0.258	0.350	60.9	18.8	10.6	0.55	0.52	33.2
203	41.58	12	0.247	0.295	0.350	70.5	20.1	11.1	0.84	0.84	28.2
204	41.67	12	0.210	0.264	0.350	60.0	18.5	10.9	0.48	0.14	26.6
205	41.75	12	0.231	0.270	0.350	65.9	19.0	10.7	0.87	0.87	27.5
206	41.83	12	0.222	0.278	0.350	63.6	19.2	10.8	0.52	0.31	28.2
207	41.92	12	0.240	0.292	0.350	68.6	19.8	11.5	0.57	0.47	24.7
208	42.00	12	0.288	0.342	0.350	82.4	21.1	13.1	0.80	0.80	0.0
		Average	0.230	0.281	0.350	65.7	19.4	11.3	1.01	0.96	32.2
		Std. Dev.	0.021	0.024	0.000	5.9	0.8	0.8	0.39	0.44	3.2
		Maximum	0.288	0.342	0.350	82.4	21.1	13.1	1.85	1.85	35.7
		@ Blow#	208	208	184	208	208	208	185	185	189
		Minimum	0.193	0.236	0.350	55.2	17.8	10.2	0.48	0.14	24.7
		@ Blow#	198	198	184	198	198	198	204	204	207

Total number of blows analyzed: 25

VRANS RSCH001-703 - GD-4
OP: SPK
2 INCH SS;CME45C SAFETY;VTRANS
Test date: 24-Sep-2008

AR: 0.92 in^2
LE: 53.83 ft
WS: 16,807.7 f/s
SP: 0.492 k/ft3
EM: 30,000 ksi
JC: 0.00

EMX: Max Transferred Energy
EF2: Energy of F^2
ER: Hammer Energy Rating
ETR: Energy Transfer Ratio
FMX: Maximum Force
VMX: Maximum Velocity
DMX: Maximum Displacement
DFN: Final Displacement
BPM: Blows per Minute

BL#	depth	BLC	EMX	EF2	ER	ETR	FMX	VMX	DMX	DFN	BPM
	ft	bl/ft	k-ft	k-ft	k-ft	(%)	kips	f/s	in	in	**
209	45.00	0	0.251	0.320	0.350	71.6	20.5	13.5	1.03	0.90	0.0
210	45.05	22	0.234	0.298	0.350	67.0	19.9	13.1	0.89	0.85	32.7
211	45.09	22	0.165	0.201	0.350	47.1	16.3	9.2	0.59	0.55	30.8
212	45.14	22	0.279	0.357	0.350	79.6	21.7	13.9	0.96	0.96	0.0
213	45.19	22	0.265	0.341	0.350	75.7	21.0	13.0	0.82	0.82	30.4
214	45.23	22	0.250	0.311	0.350	71.5	20.4	12.2	0.73	0.73	31.0
215	45.28	22	0.266	0.339	0.350	75.9	21.1	12.5	0.71	0.47	22.4
216	45.33	22	0.271	0.342	0.350	77.5	21.4	12.6	0.78	0.78	33.6
217	45.37	22	0.247	0.306	0.350	70.5	20.5	11.7	0.70	0.70	35.7
218	45.42	22	0.242	0.294	0.350	69.1	20.4	11.5	0.90	0.90	31.1
219	45.47	22	0.217	0.260	0.350	62.0	18.7	10.7	0.59	0.52	28.9
220	45.51	22	0.286	0.347	0.350	81.8	21.4	13.0	0.89	0.89	25.4
221	45.56	22	0.269	0.342	0.350	76.8	21.4	12.6	0.68	0.62	32.3
222	45.60	22	0.249	0.314	0.350	71.3	20.3	11.8	0.63	0.63	0.0
223	45.65	22	0.268	0.337	0.350	76.6	21.2	12.4	0.66	0.58	32.4
224	45.70	22	0.250	0.298	0.350	71.5	20.4	11.7	0.83	0.83	33.8
225	45.74	22	0.225	0.273	0.350	64.4	19.9	10.9	0.71	0.71	31.1
226	45.79	22	0.247	0.299	0.350	70.7	20.1	12.0	0.72	0.72	34.2
227	45.84	22	0.214	0.247	0.350	61.2	18.9	10.5	0.87	0.87	30.9
228	45.88	22	0.248	0.289	0.350	70.7	20.2	11.3	0.79	0.79	34.0
229	45.93	22	0.243	0.292	0.350	69.5	20.5	11.4	0.61	0.61	31.6
230	45.98	22	0.235	0.281	0.350	67.2	20.0	11.1	0.55	0.52	32.6
231	46.02	22	0.244	0.278	0.350	69.8	19.9	11.2	0.81	0.81	31.1
232	46.07	22	0.241	0.285	0.350	69.0	20.1	11.3	0.59	0.58	30.0
233	46.12	22	0.249	0.298	0.350	71.1	20.5	11.5	0.56	0.54	28.3
234	46.16	22	0.240	0.297	0.350	68.5	20.4	11.4	0.53	0.20	29.1
235	46.21	22	0.252	0.300	0.350	71.9	20.5	11.7	0.61	0.61	31.0
236	46.26	22	0.259	0.313	0.350	74.0	20.9	12.0	0.61	0.61	32.6
237	46.30	22	0.260	0.321	0.350	74.2	21.1	12.2	0.55	0.46	31.5
238	46.35	22	0.280	0.337	0.350	80.0	21.8	12.4	0.72	0.72	29.9
239	46.40	22	0.261	0.322	0.350	74.5	21.0	12.4	0.54	0.41	29.6
240	46.44	22	0.267	0.322	0.350	76.2	20.7	12.3	0.56	0.56	32.9
241	46.49	22	0.255	0.306	0.350	72.8	20.5	12.0	0.67	0.67	31.4
242	46.53	22	0.255	0.319	0.350	72.9	20.7	11.8	0.54	0.48	30.1
243	46.58	22	0.243	0.302	0.350	69.6	20.3	12.2	0.53	0.49	31.6
244	46.63	22	0.256	0.314	0.350	73.0	20.4	12.3	0.65	0.65	31.0
245	46.67	22	0.218	0.277	0.350	62.2	19.2	11.5	0.48	0.27	30.3
246	46.72	22	0.235	0.290	0.350	67.2	19.7	11.3	0.55	0.55	30.9
247	46.77	22	0.239	0.298	0.350	68.4	20.1	11.9	0.52	0.46	29.6
248	46.81	22	0.259	0.316	0.350	74.0	20.8	11.8	0.68	0.68	29.3
249	46.86	22	0.231	0.294	0.350	65.9	20.0	11.7	0.49	0.30	30.7
250	46.91	22	0.257	0.315	0.350	73.4	21.0	12.4	0.54	0.51	29.3
251	46.95	22	0.236	0.295	0.350	67.3	20.2	11.8	0.50	0.38	32.4
252	47.00	22	0.261	0.317	0.350	74.5	21.0	12.2	0.57	0.57	32.1
		Average	0.248	0.305	0.350	70.9	20.4	11.9	0.67	0.62	31.0
		Std. Dev.	0.020	0.028	0.000	5.8	0.9	0.8	0.14	0.18	2.3
		Maximum	0.286	0.357	0.350	81.8	21.8	13.9	1.03	0.96	35.7
		@ Blow#	220	212	209	220	238	212	209	212	217
		Minimum	0.165	0.201	0.350	47.1	16.3	9.2	0.48	0.20	22.4
		@ Blow#	211	211	209	211	211	211	245	234	215

Total number of blows analyzed: 44

Geosciences Testing & Research Inc
Case Method Results

PDIPLOT Ver. 2008.2 - Printed: 3-Apr-2009

VRANS RSCH001-703 - GD-4
OP: SPK

2 INCH SS;CME45C SAFETY;VTRANS
Test date: 24-Sep-2008

AR: 0.92 in^2
LE: 53.83 ft
WS: 16,807.7 f/s

SP: 0.492 k/ft3
EM: 30,000 ksi
JC: 0.00

EMX: Max Transferred Energy
EF2: Energy of F^2
ER: Hammer Energy Rating
ETR: Energy Transfer Ratio
FMX: Maximum Force

VMX: Maximum Velocity
DMX: Maximum Displacement
DFN: Final Displacement
BPM: Blows per Minute

BL#	depth	BLC	EMX	EF2	ER	ETR	FMX	VMX	DMX	DFN	BPM
	ft	bl/ft	k-ft	k-ft	k-ft	(%)	kips	f/s	in	in	**
253	50.00	0	0.245	0.310	0.350	70.0	20.4	13.9	1.60	1.60	0.0
254	50.05	19	0.279	0.351	0.350	79.7	21.4	12.6	0.97	0.97	31.4
255	50.11	19	0.251	0.322	0.350	71.6	20.7	12.2	0.71	0.56	31.7
256	50.16	19	0.273	0.336	0.350	78.1	21.2	12.3	1.01	1.01	24.1
257	50.21	19	0.278	0.347	0.350	79.5	21.7	12.5	1.06	1.06	30.8
258	50.26	19	0.259	0.331	0.350	74.0	20.7	11.9	0.66	0.41	29.6
259	50.32	19	0.278	0.351	0.350	79.3	21.7	13.1	0.97	0.97	27.8
260	50.37	19	0.262	0.336	0.350	74.8	21.3	12.4	0.67	0.40	31.6
261	50.42	19	0.255	0.320	0.350	72.8	20.3	12.2	0.69	0.64	33.4
262	50.47	19	0.255	0.325	0.350	72.7	20.6	12.1	0.79	0.79	30.5
263	50.53	19	0.274	0.340	0.350	78.3	21.1	12.8	0.81	0.81	33.8
264	50.58	19	0.246	0.309	0.350	70.2	20.3	12.3	0.62	0.57	30.9
265	50.63	19	0.265	0.338	0.350	75.8	21.3	12.7	0.67	0.54	33.3
266	50.68	19	0.246	0.306	0.350	70.3	19.6	11.8	0.63	0.62	32.5
267	50.74	19	0.250	0.313	0.350	71.5	20.0	11.9	0.70	0.70	33.0
268	50.79	19	0.275	0.349	0.350	78.7	21.4	12.8	0.67	0.65	33.7
269	50.84	19	0.250	0.314	0.350	71.3	20.3	12.0	0.64	0.64	31.6
270	50.89	19	0.242	0.297	0.350	69.1	19.8	11.5	0.82	0.82	31.5
271	50.95	19	0.230	0.294	0.350	65.8	19.4	11.4	0.54	0.39	32.1
272	51.00	19	0.236	0.295	0.350	67.3	19.6	11.4	0.58	0.57	31.5
273	51.05	19	0.222	0.278	0.350	63.5	19.2	11.2	0.64	0.64	32.2
274	51.11	19	0.231	0.286	0.350	66.1	19.4	11.3	0.67	0.67	32.5
275	51.16	19	0.234	0.295	0.350	66.9	19.8	11.6	0.66	0.66	32.3
276	51.21	19	0.244	0.305	0.350	69.6	20.2	12.2	0.67	0.58	31.0
277	51.26	19	0.261	0.326	0.350	74.5	20.1	12.2	0.78	0.78	32.1
278	51.32	19	0.242	0.306	0.350	69.0	19.6	11.8	0.74	0.74	31.8
279	51.37	19	0.243	0.308	0.350	69.5	20.1	12.2	0.73	0.71	32.8
280	51.42	19	0.216	0.272	0.350	61.8	19.0	11.1	0.70	0.70	31.2
281	51.47	19	0.237	0.299	0.350	67.7	19.7	11.5	0.75	0.75	31.1
282	51.53	19	0.247	0.306	0.350	70.7	20.4	11.4	0.72	0.72	0.0
283	51.58	19	0.255	0.315	0.350	72.7	20.6	11.7	0.86	0.86	34.2
284	51.63	19	0.259	0.322	0.350	73.9	21.0	12.2	0.70	0.67	32.5
285	51.68	19	0.225	0.282	0.350	64.2	19.7	11.2	0.70	0.70	31.0
286	51.74	19	0.243	0.305	0.350	69.3	20.3	12.4	0.72	0.72	30.6
287	51.79	19	0.239	0.299	0.350	68.3	20.1	12.1	0.72	0.65	31.9
288	51.84	19	0.241	0.307	0.350	68.9	20.2	12.3	0.72	0.60	30.9
289	51.89	19	0.270	0.333	0.350	77.3	21.4	12.2	0.98	0.98	23.3
290	51.95	19	0.271	0.338	0.350	77.3	21.5	12.2	0.81	0.81	23.2
		Average	0.251	0.315	0.350	71.6	20.4	12.1	0.76	0.73	31.1
		Std. Dev.	0.016	0.021	0.000	4.7	0.7	0.6	0.18	0.21	2.6
		Maximum	0.279	0.351	0.350	79.7	21.7	13.9	1.60	1.60	34.2
		@ Blow#	254	254	253	254	257	253	253	253	283
		Minimum	0.216	0.272	0.350	61.8	19.0	11.1	0.54	0.39	23.2
		@ Blow#	280	280	253	280	280	280	271	271	290

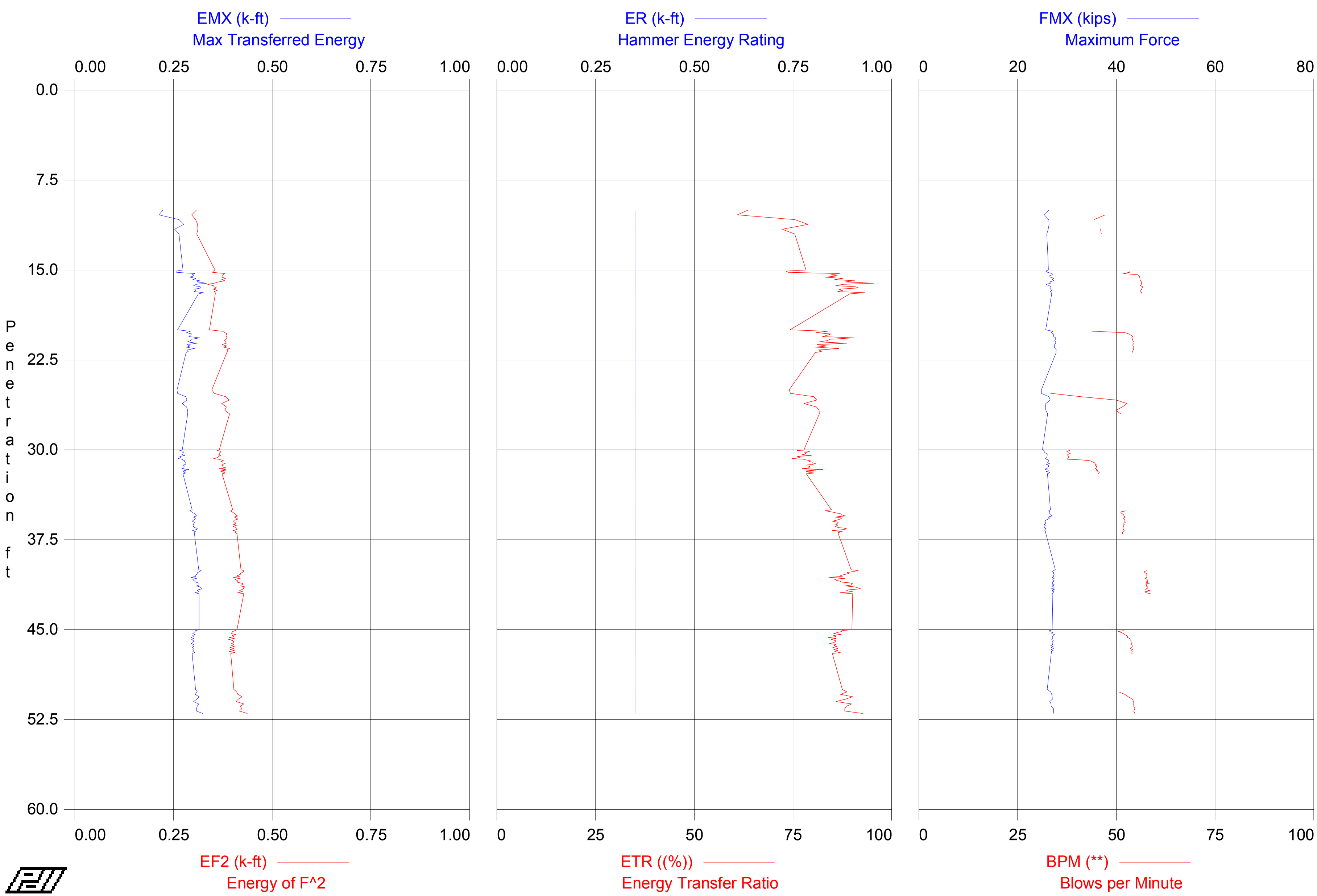
Total number of blows analyzed: 38

Geosciences Testing & Research Inc - Case Method Results

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

Test date: 25-Sep-2008

VRANS RSCH001-703 - GD-5



VRANS RSCH001-703 - GD-5
OP: SPK

2 INCH SS;CME75 TRACK;TRANSTECH
Test date: 25-Sep-2008

AR: 0.92 in^2
LE: 53.71 ft
WS: 16,807.7 f/s

SP: 0.492 k/ft3
EM: 30,000 ksi
JC: 0.00

EMX: Max Transferred Energy
EF2: Energy of F^2
ER: Hammer Energy Rating
ETR: Energy Transfer Ratio
FMX: Maximum Force

VMX: Maximum Velocity
DMX: Maximum Displacement
DFN: Final Displacement
BPM: Blows per Minute

Statistics for entire file (173 blows)

	EMX	EF2	ER	ETR	FMX	VMX	DMX	DFN	BPM
	k-ft	k-ft	k-ft	(%)	kips	f/s	in	in	**
Average	0.294	0.388	0.350	84.0	26.6	15.5	1.19	1.14	51.3
Std. Dev.	0.018	0.027	0.001	5.3	0.7	0.6	0.63	0.66	5.9
Maximum	0.334	0.437	0.350	95.4	27.8	17.2	3.66	3.66	58.6
@ Blow#	18	174	1	18	43	53	1	1	135
Minimum	0.213	0.296	0.350	60.9	24.8	14.4	0.56	0.18	33.4
@ Blow#	2	2	1	2	47	63	136	136	48

VRANS RSCH001-703 - GD-5
OP: SPK

2 INCH SS;CME75 TRACK;TRANSTECH
Test date: 25-Sep-2008

AR: 0.92 in^2
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WS: 16,807.7 f/s

SP: 0.492 k/ft3
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EMX: Max Transferred Energy
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BPM: Blows per Minute

BL#	depth	BLC	EMX	EF2	ER	ETR	FMX	VMX	DMX	DFN	BPM
	ft	bl/ft	k-ft	k-ft	k-ft	(%)	kips	f/s	in	in	**
1	10.00	3	0.223	0.308	0.350	63.6	26.3	17.0	3.66	3.66	0.0
2	10.40	3	0.213	0.296	0.350	60.9	25.4	15.6	2.68	2.63	47.2
3	10.80	3	0.264	0.306	0.350	75.5	26.3	16.5	2.90	2.90	44.3
4	11.20	3	0.276	0.311	0.350	78.8	26.4	17.2	3.08	3.08	0.0
5	11.60	3	0.253	0.312	0.350	72.3	26.2	16.0	1.82	1.81	46.0
6	12.00	3	0.264	0.309	0.350	75.4	25.9	16.7	2.11	2.11	46.2
		Average	0.249	0.307	0.350	71.1	26.1	16.5	2.71	2.70	45.9
		Std. Dev.	0.023	0.005	0.000	6.6	0.3	0.6	0.61	0.61	1.0
		Maximum	0.276	0.312	0.350	78.8	26.4	17.2	3.66	3.66	47.2
		@ Blow#	4	5	1	4	4	4	1	1	2
		Minimum	0.213	0.296	0.350	60.9	25.4	15.6	1.82	1.81	44.3
		@ Blow#	2	2	1	2	2	2	5	5	3

Total number of blows analyzed: 6

Time Summary

Drive	10 seconds	10:02:58 AM - 10:03:08 AM (9/25/2008) BN 1 - 6
Stop	13 minutes 44 seconds	10:03:08 AM - 10:16:52 AM
Drive	21 seconds	10:16:52 AM - 10:17:13 AM BN 7 - 27
Stop	11 minutes 38 seconds	10:17:13 AM - 10:28:51 AM
Drive	20 seconds	10:28:51 AM - 10:29:11 AM BN 28 - 46
Stop	11 minutes 19 seconds	10:29:11 AM - 10:40:30 AM
Drive	9 seconds	10:40:30 AM - 10:40:39 AM BN 47 - 54
Stop	12 minutes	10:40:39 AM - 10:52:39 AM
Drive	46 seconds	10:52:39 AM - 10:53:25 AM BN 55 - 88
Stop	12 minutes 57 seconds	10:53:25 AM - 11:06:22 AM
Drive	26 seconds	11:06:22 AM - 11:06:48 AM BN 89 - 112
Stop	13 minutes 24 seconds	11:06:48 AM - 11:20:12 AM
Drive	26 seconds	11:20:12 AM - 11:20:38 AM BN 113 - 138
Stop	11 minutes 49 seconds	11:20:38 AM - 11:32:27 AM
Drive	27 seconds	11:32:27 AM - 11:32:54 AM BN 139 - 163
Stop	10 minutes 26 seconds	11:32:54 AM - 11:43:20 AM
Drive	11 seconds	11:43:20 AM - 11:43:31 AM BN 164 - 174

Total time [1:40:33] = (Driving [0:03:16] + Stop [1:37:17])

VRANS RSCH001-703 - GD-5
OP: SPK

2 INCH SS;CME75 TRACK;TRANSTECH
Test date: 25-Sep-2008

AR: 0.92 in^2
LE: 53.71 ft
WS: 16,807.7 f/s

SP: 0.492 k/ft3
EM: 30,000 ksi
JC: 0.00

EMX: Max Transferred Energy
EF2: Energy of F^2
ER: Hammer Energy Rating
ETR: Energy Transfer Ratio
FMX: Maximum Force

VMX: Maximum Velocity
DMX: Maximum Displacement
DFN: Final Displacement
BPM: Blows per Minute

BL#	depth	BLC	EMX	EF2	ER	ETR	FMX	VMX	DMX	DFN	BPM
	ft	bl/ft	k-ft	k-ft	k-ft	(%)	kips	f/s	in	in	**
7	15.00	0	0.274	0.355	0.350	78.3	26.2	16.6	3.51	3.51	0.0
8	15.10	10	0.256	0.351	0.350	73.2	25.7	16.3	2.88	2.88	53.2
9	15.20	10	0.258	0.349	0.350	73.8	26.1	15.8	2.17	2.10	53.3
10	15.30	10	0.304	0.380	0.350	86.8	26.9	16.2	1.58	1.54	51.8
11	15.40	10	0.297	0.376	0.350	84.7	27.1	14.7	1.08	1.01	55.4
12	15.50	10	0.302	0.374	0.350	86.4	26.4	14.8	1.15	1.15	55.8
13	15.60	10	0.291	0.372	0.350	83.2	26.7	14.8	1.07	1.07	55.9
14	15.70	10	0.307	0.382	0.350	87.6	27.4	14.5	0.96	0.85	56.0
15	15.80	10	0.299	0.372	0.350	85.6	27.0	14.8	0.95	0.89	56.0
16	15.90	10	0.317	0.380	0.350	90.7	27.3	14.6	0.98	0.98	56.1
17	16.00	10	0.309	0.364	0.350	88.2	26.5	15.2	1.05	1.05	56.4
18	16.10	10	0.334	0.353	0.350	95.4	26.7	15.6	1.47	1.47	56.4
19	16.20	10	0.307	0.337	0.350	87.6	25.8	14.7	0.82	0.82	56.3
20	16.30	10	0.301	0.351	0.350	85.9	26.4	15.5	0.67	0.31	56.1
21	16.40	10	0.318	0.353	0.350	90.9	26.8	15.3	1.65	1.65	56.7
22	16.50	10	0.320	0.359	0.350	91.6	26.7	15.3	0.90	0.90	56.5
23	16.60	10	0.303	0.350	0.350	86.6	26.7	15.2	0.64	0.52	56.4
24	16.70	10	0.307	0.361	0.350	87.6	26.9	15.5	0.69	0.69	56.2
25	16.80	10	0.302	0.353	0.350	86.4	26.6	15.6	0.61	0.47	56.2
26	16.90	10	0.326	0.356	0.350	93.1	26.8	15.4	1.19	1.19	56.4
27	17.00	10	0.313	0.356	0.350	89.4	26.9	15.4	1.12	1.12	56.5
		Average	0.302	0.361	0.350	86.3	26.6	15.3	1.29	1.25	55.7
		Std. Dev.	0.019	0.012	0.000	5.4	0.4	0.6	0.72	0.75	1.3
		Maximum	0.334	0.382	0.350	95.4	27.4	16.6	3.51	3.51	56.7
		@ Blow#	18	14	7	18	14	7	7	7	21
		Minimum	0.256	0.337	0.350	73.2	25.7	14.5	0.61	0.31	51.8
		@ Blow#	8	19	7	8	8	14	25	20	10

Total number of blows analyzed: 21

VRANS RSCH001-703 - GD-5
OP: SPK

2 INCH SS;CME75 TRACK;TRANSTECH
Test date: 25-Sep-2008

AR: 0.92 in^2
LE: 53.71 ft
WS: 16,807.7 f/s

SP: 0.492 k/ft3
EM: 30,000 ksi
JC: 0.00

EMX: Max Transferred Energy
EF2: Energy of F^2
ER: Hammer Energy Rating
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DFN: Final Displacement
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BL#	depth	BLC	EMX	EF2	ER	ETR	FMX	VMX	DMX	DFN	BPM
	ft	bl/ft	k-ft	k-ft	k-ft	(%)	kips	f/s	in	in	**
28	20.00	0	0.260	0.341	0.350	74.2	25.7	16.4	1.82	1.70	0.0
29	20.11	9	0.293	0.374	0.350	83.8	27.1	16.2	1.79	1.79	43.9
30	20.22	9	0.283	0.380	0.350	80.8	26.8	15.6	1.25	1.22	52.2
31	20.33	9	0.296	0.386	0.350	84.7	27.2	15.8	1.21	1.21	53.2
32	20.44	9	0.293	0.383	0.350	83.7	27.2	16.3	1.22	1.22	53.7
33	20.56	9	0.289	0.384	0.350	82.5	27.3	15.7	1.03	0.96	54.1
34	20.67	9	0.317	0.386	0.350	90.4	27.7	14.9	1.09	1.09	53.9
35	20.78	9	0.295	0.383	0.350	84.4	27.6	14.8	0.88	0.72	54.1
36	20.89	9	0.293	0.379	0.350	83.7	27.5	15.1	0.98	0.93	54.2
37	21.00	9	0.285	0.382	0.350	81.6	27.7	14.6	0.90	0.55	54.5
38	21.11	9	0.310	0.384	0.350	88.7	27.7	14.8	1.15	1.15	54.5
39	21.22	9	0.284	0.373	0.350	81.1	27.4	15.2	1.26	1.26	54.2
40	21.33	9	0.293	0.385	0.350	83.7	27.5	15.3	1.22	1.21	54.2
41	21.44	9	0.282	0.377	0.350	80.7	27.4	15.6	1.50	1.50	54.4
42	21.56	9	0.303	0.392	0.350	86.7	27.6	16.5	1.77	1.77	54.4
43	21.67	9	0.285	0.385	0.350	81.5	27.8	16.4	1.72	1.72	54.3
44	21.78	9	0.288	0.388	0.350	82.4	27.8	16.6	1.63	1.62	54.1
45	21.89	9	0.282	0.385	0.350	80.7	27.8	16.3	1.44	1.44	54.2
		Average	0.291	0.380	0.350	83.1	27.4	15.7	1.32	1.28	53.4
		Std. Dev.	0.012	0.011	0.000	3.4	0.5	0.6	0.30	0.35	2.4
		Maximum	0.317	0.392	0.350	90.4	27.8	16.6	1.82	1.79	54.5
		@ Blow#	34	42	28	34	43	44	28	29	37
		Minimum	0.260	0.341	0.350	74.2	25.7	14.6	0.88	0.55	43.9
		@ Blow#	28	28	28	28	28	37	35	37	29

Total number of blows analyzed: 18

VRANS RSCH001-703 - GD-5
OP: SPK

2 INCH SS;CME75 TRACK;TRANSTECH
Test date: 25-Sep-2008

AR: 0.92 in^2
LE: 53.71 ft
WS: 16,807.7 f/s

SP: 0.492 k/ft3
EM: 30,000 ksi
JC: 0.00

EMX: Max Transferred Energy
EF2: Energy of F^2
ER: Hammer Energy Rating
ETR: Energy Transfer Ratio
FMX: Maximum Force

VMX: Maximum Velocity
DMX: Maximum Displacement
DFN: Final Displacement
BPM: Blows per Minute

BL#	depth	BLC	EMX	EF2	ER	ETR	FMX	VMX	DMX	DFN	BPM
	ft	bl/ft	k-ft	k-ft	k-ft	(%)	kips	f/s	in	in	**
47	25.00	0	0.259	0.347	0.350	74.0	24.8	16.6	3.11	3.11	0.0
48	25.29	4	0.260	0.353	0.350	74.4	24.8	16.9	3.49	3.49	33.4
49	25.57	4	0.281	0.382	0.350	80.3	26.3	16.7	2.55	2.55	41.0
50	25.86	4	0.284	0.391	0.350	81.0	26.6	16.4	2.25	2.25	50.0
51	26.14	4	0.272	0.372	0.350	77.7	25.7	16.5	2.62	2.62	52.7
52	26.43	4	0.283	0.384	0.350	80.9	25.6	17.0	2.87	2.87	51.5
53	26.71	4	0.286	0.380	0.350	81.6	25.7	17.2	2.18	2.18	49.9
54	27.00	4	0.286	0.392	0.350	81.7	26.1	15.5	1.13	1.03	51.1
		Average	0.276	0.375	0.350	79.0	25.7	16.6	2.52	2.51	47.1
		Std. Dev.	0.011	0.016	0.000	3.0	0.6	0.5	0.66	0.69	6.6
		Maximum	0.286	0.392	0.350	81.7	26.6	17.2	3.49	3.49	52.7
		@ Blow#	53	54	47	54	50	53	48	48	51
		Minimum	0.259	0.347	0.350	74.0	24.8	15.5	1.13	1.03	33.4
		@ Blow#	47	47	47	47	47	54	54	54	48

Total number of blows analyzed: 8

VRANS RSCH001-703 - GD-5
OP: SPK

2 INCH SS;CME75 TRACK;TRANSTECH
Test date: 25-Sep-2008

AR: 0.92 in^2
LE: 53.71 ft
WS: 16,807.7 f/s

SP: 0.492 k/ft3
EM: 30,000 ksi
JC: 0.00

EMX: Max Transferred Energy
EF2: Energy of F^2
ER: Hammer Energy Rating
ETR: Energy Transfer Ratio
FMX: Maximum Force

VMX: Maximum Velocity
DMX: Maximum Displacement
DFN: Final Displacement
BPM: Blows per Minute

BL#	depth	BLC	EMX	EF2	ER	ETR	FMX	VMX	DMX	DFN	BPM
	ft	bl/ft	k-ft	k-ft	k-ft	(%)	kips	f/s	in	in	**
55	30.00	0	0.272	0.366	0.350	77.8	25.0	16.4	1.22	1.22	0.0
56	30.06	17	0.266	0.361	0.350	76.1	25.3	15.6	0.92	0.92	38.2
57	30.12	17	0.277	0.370	0.350	79.3	25.4	14.8	0.98	0.98	37.4
58	30.18	17	0.276	0.369	0.350	78.8	25.4	14.6	0.96	0.95	37.7
59	30.24	17	0.273	0.367	0.350	78.0	25.5	14.7	0.96	0.95	37.8
60	30.30	17	0.274	0.367	0.350	78.2	25.8	14.7	0.88	0.85	38.3
61	30.36	17	0.274	0.367	0.350	78.2	26.0	14.7	0.87	0.87	37.9
62	30.42	17	0.270	0.364	0.350	77.1	26.0	14.8	0.79	0.77	37.6
63	30.48	17	0.279	0.369	0.350	79.6	26.0	14.4	0.98	0.98	37.8
64	30.55	17	0.266	0.365	0.350	76.0	26.0	14.8	0.73	0.59	37.8
65	30.61	17	0.269	0.363	0.350	76.9	25.9	15.0	0.85	0.85	38.0
66	30.67	17	0.267	0.360	0.350	76.2	25.9	14.9	0.73	0.68	37.7
67	30.73	17	0.262	0.352	0.350	74.8	25.6	14.6	0.81	0.81	37.7
68	30.79	17	0.272	0.364	0.350	77.8	25.8	15.0	0.84	0.83	37.6
69	30.85	17	0.274	0.371	0.350	78.3	26.2	15.2	0.87	0.87	41.3
70	30.91	17	0.278	0.377	0.350	79.4	26.3	14.8	0.80	0.79	43.3
71	30.97	17	0.277	0.370	0.350	79.1	26.2	15.0	0.91	0.91	43.8
72	31.03	17	0.280	0.375	0.350	79.9	26.2	15.0	0.83	0.82	44.1
73	31.09	17	0.280	0.375	0.350	79.9	26.0	15.0	0.81	0.81	44.5
74	31.15	17	0.282	0.381	0.350	80.7	26.5	15.2	0.77	0.73	44.6
75	31.21	17	0.280	0.374	0.350	80.0	25.8	15.2	1.04	1.04	44.7
76	31.27	17	0.275	0.372	0.350	78.5	26.2	15.3	0.71	0.60	45.0
77	31.33	17	0.275	0.376	0.350	78.5	26.3	15.3	0.78	0.78	44.7
78	31.39	17	0.277	0.375	0.350	79.3	26.2	15.3	0.69	0.67	45.0
79	31.45	17	0.276	0.375	0.350	78.9	26.1	15.6	0.86	0.86	45.1
80	31.52	17	0.277	0.383	0.350	79.2	26.1	15.3	0.69	0.64	45.0
81	31.58	17	0.271	0.366	0.350	77.3	25.7	15.2	0.65	0.62	44.7
82	31.64	17	0.289	0.383	0.350	82.5	25.6	14.9	1.07	1.07	45.0
83	31.70	17	0.275	0.371	0.350	78.4	26.3	15.4	0.61	0.36	44.9
84	31.76	17	0.283	0.382	0.350	80.7	26.4	15.4	0.68	0.68	45.4
85	31.82	17	0.274	0.370	0.350	78.4	25.8	15.0	0.68	0.68	45.3
86	31.88	17	0.277	0.378	0.350	79.2	26.5	15.4	0.62	0.52	45.7
87	31.94	17	0.281	0.381	0.350	80.3	26.3	15.3	0.69	0.69	45.5
88	32.00	17	0.274	0.373	0.350	78.4	26.0	15.1	0.62	0.60	45.4
		Average	0.275	0.371	0.350	78.6	25.9	15.1	0.82	0.79	42.0
		Std. Dev.	0.005	0.007	0.000	1.5	0.3	0.4	0.14	0.17	3.4
		Maximum	0.289	0.383	0.350	82.5	26.5	16.4	1.22	1.22	45.7
		@ Blow#	82	80	55	82	74	55	55	55	86
		Minimum	0.262	0.352	0.350	74.8	25.0	14.4	0.61	0.36	37.4
		@ Blow#	67	67	55	67	55	63	83	83	57

Total number of blows analyzed: 34

VRANS RSCH001-703 - GD-5
OP: SPK

2 INCH SS;CME75 TRACK;TRANSTECH
Test date: 25-Sep-2008

AR: 0.92 in^2
LE: 53.71 ft
WS: 16,807.7 f/s

SP: 0.492 k/ft3
EM: 30,000 ksi
JC: 0.00

EMX: Max Transferred Energy
EF2: Energy of F^2
ER: Hammer Energy Rating
ETR: Energy Transfer Ratio
FMX: Maximum Force

VMX: Maximum Velocity
DMX: Maximum Displacement
DFN: Final Displacement
BPM: Blows per Minute

BL#	depth	BLC	EMX	EF2	ER	ETR	FMX	VMX	DMX	DFN	BPM
	ft	bl/ft	k-ft	k-ft	k-ft	(%)	kips	f/s	in	in	**
89	35.00	0	0.297	0.400	0.350	84.8	26.6	16.6	1.96	1.94	0.0
90	35.09	12	0.291	0.395	0.350	83.2	26.3	15.3	0.99	0.86	52.5
91	35.17	12	0.296	0.398	0.350	84.7	26.5	15.2	0.98	0.98	51.3
92	35.26	12	0.300	0.402	0.350	85.9	26.5	14.8	0.79	0.66	51.1
93	35.35	12	0.305	0.406	0.350	87.0	26.5	15.1	0.81	0.79	51.5
94	35.43	12	0.306	0.407	0.350	87.4	26.7	15.0	0.92	0.92	51.9
95	35.52	12	0.309	0.413	0.350	88.3	27.0	15.2	1.06	1.06	51.9
96	35.61	12	0.300	0.404	0.350	85.7	26.2	15.2	0.91	0.87	52.3
97	35.70	12	0.306	0.409	0.350	87.3	26.5	15.2	1.16	1.16	51.8
98	35.78	12	0.304	0.413	0.350	86.9	26.2	15.3	1.05	0.99	51.9
99	35.87	12	0.301	0.404	0.350	86.1	25.7	14.8	1.11	1.11	52.2
100	35.96	12	0.297	0.402	0.350	84.9	25.5	15.0	1.02	1.02	52.1
101	36.04	12	0.303	0.405	0.350	86.5	25.6	15.0	1.14	1.14	52.3
102	36.13	12	0.302	0.408	0.350	86.3	25.7	14.8	0.91	0.69	51.9
103	36.22	12	0.300	0.402	0.350	85.8	25.4	15.0	1.15	1.15	52.0
104	36.30	12	0.302	0.410	0.350	86.4	25.6	14.9	0.93	0.82	51.7
105	36.39	12	0.300	0.401	0.350	85.7	25.3	15.0	1.07	1.07	51.9
106	36.48	12	0.303	0.408	0.350	86.4	25.4	15.0	0.85	0.70	51.7
107	36.57	12	0.310	0.409	0.350	88.5	25.6	15.0	1.05	1.05	51.7
108	36.65	12	0.309	0.411	0.350	88.2	25.8	15.2	0.96	0.96	51.8
109	36.74	12	0.298	0.401	0.350	85.0	25.5	15.1	0.74	0.50	52.0
110	36.83	12	0.306	0.409	0.350	87.5	25.6	15.4	1.02	1.02	51.7
111	36.91	12	0.302	0.407	0.350	86.4	25.7	15.3	0.73	0.51	51.5
112	37.00	12	0.303	0.411	0.350	86.5	25.7	15.5	0.75	0.70	51.6
		Average	0.302	0.406	0.350	86.3	26.0	15.2	1.00	0.95	51.8
		Std. Dev.	0.004	0.005	0.000	1.2	0.5	0.4	0.24	0.28	0.3
		Maximum	0.310	0.413	0.350	88.5	27.0	16.6	1.96	1.94	52.5
		@ Blow#	107	95	89	107	95	89	89	89	90
		Minimum	0.291	0.395	0.350	83.2	25.3	14.8	0.73	0.50	51.1
		@ Blow#	90	90	89	90	105	92	111	109	92

Total number of blows analyzed: 24

Time Summary

Drive	10 seconds	10:02:58 AM - 10:03:08 AM (9/25/2008) BN 1 - 6
Stop	13 minutes 44 seconds	10:03:08 AM - 10:16:52 AM
Drive	21 seconds	10:16:52 AM - 10:17:13 AM BN 7 - 27
Stop	11 minutes 38 seconds	10:17:13 AM - 10:28:51 AM
Drive	20 seconds	10:28:51 AM - 10:29:11 AM BN 28 - 46
Stop	11 minutes 19 seconds	10:29:11 AM - 10:40:30 AM
Drive	9 seconds	10:40:30 AM - 10:40:39 AM BN 47 - 54
Stop	12 minutes	10:40:39 AM - 10:52:39 AM
Drive	46 seconds	10:52:39 AM - 10:53:25 AM BN 55 - 88
Stop	12 minutes 57 seconds	10:53:25 AM - 11:06:22 AM
Drive	26 seconds	11:06:22 AM - 11:06:48 AM BN 89 - 112
Stop	13 minutes 24 seconds	11:06:48 AM - 11:20:12 AM
Drive	26 seconds	11:20:12 AM - 11:20:38 AM BN 113 - 138
Stop	11 minutes 49 seconds	11:20:38 AM - 11:32:27 AM
Drive	27 seconds	11:32:27 AM - 11:32:54 AM BN 139 - 163
Stop	10 minutes 26 seconds	11:32:54 AM - 11:43:20 AM
Drive	11 seconds	11:43:20 AM - 11:43:31 AM BN 164 - 174

Total time [1:40:33] = (Driving [0:03:16] + Stop [1:37:17])

Geosciences Testing & Research Inc
Case Method Results

PDIPLOT Ver. 2008.2 - Printed: 3-Apr-2009

VRANS RSCH001-703 - GD-5
OP: SPK

2 INCH SS;CME75 TRACK;TRANSTECH
Test date: 25-Sep-2008

AR: 0.92 in^2
LE: 53.71 ft
WS: 16,807.7 f/s

SP: 0.492 k/ft3
EM: 30,000 ksi
JC: 0.00

EMX: Max Transferred Energy
EF2: Energy of F^2
ER: Hammer Energy Rating
ETR: Energy Transfer Ratio
FMX: Maximum Force

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DMX: Maximum Displacement
DFN: Final Displacement
BPM: Blows per Minute

BL#	depth	BLC	EMX	EF2	ER	ETR	FMX	VMX	DMX	DFN	BPM
	ft	bl/ft	k-ft	k-ft	k-ft	(%)	kips	f/s	in	in	**
113	40.00	0	0.314	0.421	0.350	89.8	27.6	17.0	2.13	2.13	0.0
114	40.08	13	0.320	0.427	0.350	91.5	27.3	17.2	1.91	1.91	57.6
115	40.16	13	0.316	0.427	0.350	90.2	26.9	16.7	1.41	1.40	57.1
116	40.24	13	0.311	0.424	0.350	88.8	27.3	15.8	0.97	0.82	57.0
117	40.32	13	0.312	0.420	0.350	89.1	27.3	15.7	0.95	0.88	57.6
118	40.40	13	0.309	0.419	0.350	88.2	27.4	15.7	0.96	0.96	57.5
119	40.48	13	0.305	0.412	0.350	87.1	27.2	16.0	0.84	0.67	57.7
120	40.56	13	0.306	0.417	0.350	87.5	27.3	15.7	0.86	0.85	57.7
121	40.64	13	0.295	0.402	0.350	84.3	27.0	15.8	0.79	0.63	57.7
122	40.72	13	0.309	0.419	0.350	88.2	27.4	16.1	0.85	0.84	57.3
123	40.80	13	0.299	0.406	0.350	85.5	27.1	16.0	0.80	0.77	57.7
124	40.88	13	0.301	0.410	0.350	86.0	27.2	15.9	0.76	0.70	57.9
125	40.96	13	0.304	0.414	0.350	87.0	27.4	16.1	0.75	0.69	58.0
126	41.04	13	0.306	0.411	0.350	87.3	27.1	16.2	0.74	0.68	57.4
127	41.12	13	0.315	0.422	0.350	90.1	27.1	15.7	0.76	0.76	58.4
128	41.20	13	0.314	0.427	0.350	89.7	27.0	15.8	0.68	0.46	57.4
129	41.28	13	0.315	0.422	0.350	89.9	27.4	15.8	0.68	0.54	57.7
130	41.36	13	0.308	0.420	0.350	88.1	26.9	16.1	0.68	0.68	57.5
131	41.44	13	0.317	0.431	0.350	90.6	27.3	15.3	0.62	0.38	57.9
132	41.52	13	0.320	0.427	0.350	91.5	27.4	15.6	0.62	0.25	58.0
133	41.60	13	0.322	0.427	0.350	92.1	26.8	15.7	1.17	1.17	57.6
134	41.68	13	0.312	0.422	0.350	89.1	27.5	16.0	0.59	0.31	57.4
135	41.76	13	0.310	0.417	0.350	88.5	26.9	15.8	0.80	0.80	58.6
136	41.84	13	0.315	0.425	0.350	90.1	27.3	15.7	0.56	0.18	57.3
137	41.92	13	0.304	0.413	0.350	87.0	27.3	16.2	0.57	0.48	57.5
138	42.00	13	0.315	0.428	0.350	90.1	27.0	15.5	0.57	0.48	58.6
		Average	0.311	0.420	0.350	88.7	27.2	16.0	0.88	0.79	57.7
		Std. Dev.	0.007	0.007	0.000	1.9	0.2	0.4	0.38	0.44	0.4
		Maximum	0.322	0.431	0.350	92.1	27.6	17.2	2.13	2.13	58.6
		@ Blow#	133	131	113	133	113	114	113	113	135
		Minimum	0.295	0.402	0.350	84.3	26.8	15.3	0.56	0.18	57.0
		@ Blow#	121	121	113	121	133	131	136	136	116

Total number of blows analyzed: 26

Time Summary

Drive	10 seconds	10:02:58 AM - 10:03:08 AM (9/25/2008) BN 1 - 6
Stop	13 minutes 44 seconds	10:03:08 AM - 10:16:52 AM
Drive	21 seconds	10:16:52 AM - 10:17:13 AM BN 7 - 27
Stop	11 minutes 38 seconds	10:17:13 AM - 10:28:51 AM
Drive	20 seconds	10:28:51 AM - 10:29:11 AM BN 28 - 46
Stop	11 minutes 19 seconds	10:29:11 AM - 10:40:30 AM
Drive	9 seconds	10:40:30 AM - 10:40:39 AM BN 47 - 54
Stop	12 minutes	10:40:39 AM - 10:52:39 AM
Drive	46 seconds	10:52:39 AM - 10:53:25 AM BN 55 - 88
Stop	12 minutes 57 seconds	10:53:25 AM - 11:06:22 AM
Drive	26 seconds	11:06:22 AM - 11:06:48 AM BN 89 - 112
Stop	13 minutes 24 seconds	11:06:48 AM - 11:20:12 AM
Drive	26 seconds	11:20:12 AM - 11:20:38 AM BN 113 - 138
Stop	11 minutes 49 seconds	11:20:38 AM - 11:32:27 AM
Drive	27 seconds	11:32:27 AM - 11:32:54 AM BN 139 - 163
Stop	10 minutes 26 seconds	11:32:54 AM - 11:43:20 AM
Drive	11 seconds	11:43:20 AM - 11:43:31 AM BN 164 - 174

Total time [1:40:33] = (Driving [0:03:16] + Stop [1:37:17])

VRANS RSCH001-703 - GD-5
OP: SPK

2 INCH SS;CME75 TRACK;TRANSTECH
Test date: 25-Sep-2008

AR: 0.92 in^2
LE: 53.71 ft
WS: 16,807.7 f/s

SP: 0.492 k/ft3
EM: 30,000 ksi
JC: 0.00

EMX: Max Transferred Energy
EF2: Energy of F^2
ER: Hammer Energy Rating
ETR: Energy Transfer Ratio
FMX: Maximum Force

VMX: Maximum Velocity
DMX: Maximum Displacement
DFN: Final Displacement
BPM: Blows per Minute

BL#	depth	BLC	EMX	EF2	ER	ETR	FMX	VMX	DMX	DFN	BPM
	ft	bl/ft	k-ft	k-ft	k-ft	(%)	kips	f/s	in	in	**
139	45.00	0	0.315	0.411	0.350	89.9	27.1	16.7	1.55	1.55	0.0
140	45.08	12	0.306	0.406	0.350	87.4	26.4	16.4	1.72	1.72	51.8
141	45.17	12	0.305	0.400	0.350	87.3	26.6	15.8	1.29	1.29	50.5
142	45.25	12	0.302	0.398	0.350	86.2	27.1	15.1	1.27	1.26	51.3
143	45.33	12	0.299	0.397	0.350	85.3	26.9	15.6	1.29	1.29	51.9
144	45.42	12	0.305	0.408	0.350	87.2	27.5	15.6	1.23	1.22	52.0
145	45.50	12	0.299	0.399	0.350	85.3	27.2	15.4	1.12	1.10	52.6
146	45.58	12	0.300	0.403	0.350	85.8	27.1	15.5	1.04	1.02	52.8
147	45.67	12	0.294	0.391	0.350	83.9	27.0	15.2	0.93	0.84	52.8
148	45.75	12	0.301	0.404	0.350	85.9	27.1	15.3	0.97	0.95	53.4
149	45.83	12	0.296	0.390	0.350	84.7	26.9	15.1	0.95	0.91	53.5
150	45.92	12	0.300	0.400	0.350	85.8	27.2	15.5	0.94	0.94	53.7
151	46.00	12	0.301	0.402	0.350	85.9	27.0	15.2	0.86	0.76	53.7
152	46.08	12	0.299	0.403	0.350	85.4	27.0	15.3	0.88	0.81	53.8
153	46.17	12	0.295	0.397	0.350	84.3	27.1	15.0	0.77	0.37	53.8
154	46.25	12	0.301	0.402	0.350	85.9	27.1	15.3	0.96	0.96	53.9
155	46.33	12	0.299	0.397	0.350	85.5	26.7	15.3	0.82	0.68	54.0
156	46.42	12	0.301	0.404	0.350	86.1	27.2	15.6	0.82	0.82	54.0
157	46.50	12	0.298	0.393	0.350	85.1	26.8	15.6	0.78	0.75	53.9
158	46.58	12	0.302	0.402	0.350	86.4	27.3	15.7	0.76	0.70	53.5
159	46.67	12	0.299	0.394	0.350	85.4	26.8	15.6	0.74	0.73	54.1
160	46.75	12	0.302	0.404	0.350	86.3	27.2	15.7	0.72	0.64	53.9
161	46.83	12	0.299	0.391	0.350	85.6	26.8	15.9	0.77	0.77	54.0
162	46.92	12	0.304	0.405	0.350	87.0	26.9	15.6	0.70	0.52	53.7
163	47.00	12	0.297	0.395	0.350	85.0	26.8	15.7	0.70	0.69	54.0
		Average	0.301	0.400	0.350	85.9	27.0	15.6	0.98	0.93	53.2
		Std. Dev.	0.004	0.005	0.000	1.2	0.2	0.4	0.27	0.31	1.0
		Maximum	0.315	0.411	0.350	89.9	27.5	16.7	1.72	1.72	54.1
		@ Blow#	139	139	139	139	144	139	140	140	159
		Minimum	0.294	0.390	0.350	83.9	26.4	15.0	0.70	0.37	50.5
		@ Blow#	147	149	139	147	140	153	162	153	141

Total number of blows analyzed: 25

Time Summary

Drive	10 seconds	10:02:58 AM - 10:03:08 AM (9/25/2008) BN 1 - 6
Stop	13 minutes 44 seconds	10:03:08 AM - 10:16:52 AM
Drive	21 seconds	10:16:52 AM - 10:17:13 AM BN 7 - 27
Stop	11 minutes 38 seconds	10:17:13 AM - 10:28:51 AM
Drive	20 seconds	10:28:51 AM - 10:29:11 AM BN 28 - 46
Stop	11 minutes 19 seconds	10:29:11 AM - 10:40:30 AM
Drive	9 seconds	10:40:30 AM - 10:40:39 AM BN 47 - 54
Stop	12 minutes	10:40:39 AM - 10:52:39 AM
Drive	46 seconds	10:52:39 AM - 10:53:25 AM BN 55 - 88
Stop	12 minutes 57 seconds	10:53:25 AM - 11:06:22 AM
Drive	26 seconds	11:06:22 AM - 11:06:48 AM BN 89 - 112
Stop	13 minutes 24 seconds	11:06:48 AM - 11:20:12 AM
Drive	26 seconds	11:20:12 AM - 11:20:38 AM BN 113 - 138
Stop	11 minutes 49 seconds	11:20:38 AM - 11:32:27 AM
Drive	27 seconds	11:32:27 AM - 11:32:54 AM BN 139 - 163
Stop	10 minutes 26 seconds	11:32:54 AM - 11:43:20 AM
Drive	11 seconds	11:43:20 AM - 11:43:31 AM BN 164 - 174

Total time [1:40:33] = (Driving [0:03:16] + Stop [1:37:17])

VRANS RSCH001-703 - GD-5
OP: SPK

2 INCH SS;CME75 TRACK;TRANSTECH
Test date: 25-Sep-2008

AR: 0.92 in^2
LE: 53.71 ft
WS: 16,807.7 f/s

SP: 0.492 k/ft3
EM: 30,000 ksi
JC: 0.00

EMX: Max Transferred Energy
EF2: Energy of F^2
ER: Hammer Energy Rating
ETR: Energy Transfer Ratio
FMX: Maximum Force

VMX: Maximum Velocity
DMX: Maximum Displacement
DFN: Final Displacement
BPM: Blows per Minute

BL#	depth	BLC	EMX	EF2	ER	ETR	FMX	VMX	DMX	DFN	BPM
	ft	bl/ft	k-ft	k-ft	k-ft	(%)	kips	f/s	in	in	**
164	50.00	0	0.306	0.403	0.350	87.5	26.0	16.4	2.28	2.28	0.0
165	50.20	5	0.310	0.410	0.350	88.7	26.7	15.8	1.93	1.93	50.6
166	50.40	5	0.305	0.413	0.350	87.1	26.9	15.5	1.74	1.73	52.1
167	50.60	5	0.315	0.424	0.350	90.1	27.0	15.6	1.84	1.84	53.0
168	50.80	5	0.309	0.414	0.350	88.3	27.1	15.7	1.90	1.90	54.0
169	51.00	5	0.301	0.409	0.350	85.9	26.5	15.5	1.23	1.22	54.4
170	51.20	5	0.314	0.428	0.350	89.8	26.8	14.9	0.92	0.67	54.4
171	51.40	5	0.310	0.419	0.350	88.5	26.8	15.0	1.29	1.28	54.4
172	51.60	5	0.308	0.423	0.350	88.1	27.3	16.1	1.52	1.52	54.7
173	51.80	5	0.308	0.417	0.350	88.1	27.3	15.8	1.99	1.99	54.4
174	52.00	5	0.324	0.437	0.350	92.6	27.2	16.7	2.04	2.04	54.7
		Average	0.310	0.418	0.350	88.6	26.9	15.7	1.70	1.67	53.7
		Std. Dev.	0.006	0.009	0.000	1.7	0.4	0.5	0.39	0.44	1.3
		Maximum	0.324	0.437	0.350	92.6	27.3	16.7	2.28	2.28	54.7
		@ Blow#	174	174	164	174	173	174	164	164	172
		Minimum	0.301	0.403	0.350	85.9	26.0	14.9	0.92	0.67	50.6
		@ Blow#	169	164	164	169	164	170	170	170	165

Total number of blows analyzed: 11

Time Summary

Drive	10 seconds	10:02:58 AM - 10:03:08 AM (9/25/2008) BN 1 - 6
Stop	13 minutes 44 seconds	10:03:08 AM - 10:16:52 AM
Drive	21 seconds	10:16:52 AM - 10:17:13 AM BN 7 - 27
Stop	11 minutes 38 seconds	10:17:13 AM - 10:28:51 AM
Drive	20 seconds	10:28:51 AM - 10:29:11 AM BN 28 - 46
Stop	11 minutes 19 seconds	10:29:11 AM - 10:40:30 AM
Drive	9 seconds	10:40:30 AM - 10:40:39 AM BN 47 - 54
Stop	12 minutes	10:40:39 AM - 10:52:39 AM
Drive	46 seconds	10:52:39 AM - 10:53:25 AM BN 55 - 88
Stop	12 minutes 57 seconds	10:53:25 AM - 11:06:22 AM
Drive	26 seconds	11:06:22 AM - 11:06:48 AM BN 89 - 112
Stop	13 minutes 24 seconds	11:06:48 AM - 11:20:12 AM
Drive	26 seconds	11:20:12 AM - 11:20:38 AM BN 113 - 138
Stop	11 minutes 49 seconds	11:20:38 AM - 11:32:27 AM
Drive	27 seconds	11:32:27 AM - 11:32:54 AM BN 139 - 163
Stop	10 minutes 26 seconds	11:32:54 AM - 11:43:20 AM
Drive	11 seconds	11:43:20 AM - 11:43:31 AM BN 164 - 174

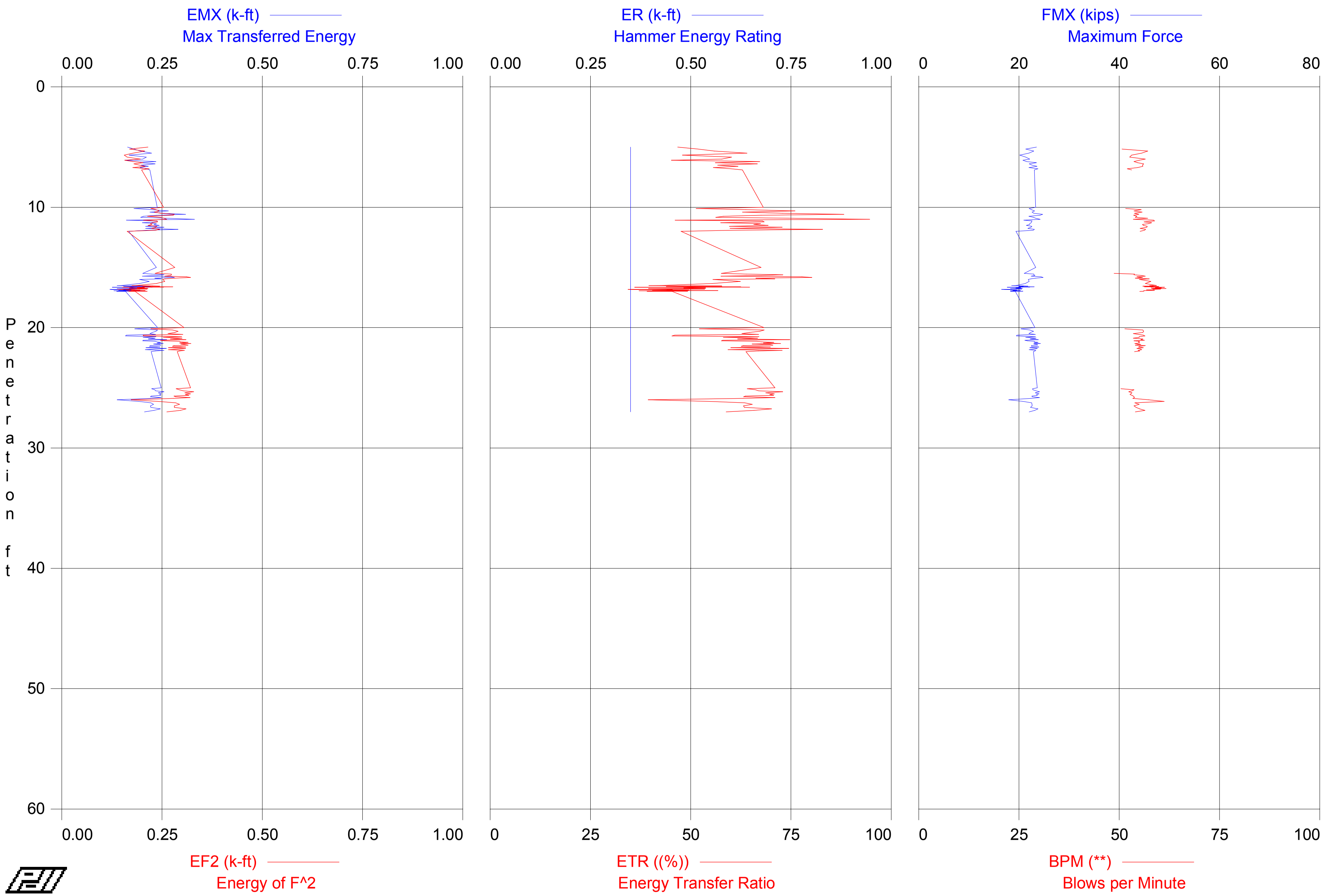
Total time [1:40:33] = (Driving [0:03:16] + Stop [1:37:17])

Geosciences Testing & Research Inc - Case Method Results

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

Test date: 25-Sep-2008

VRANS RSCH001-703 - GD-6



Geosciences Testing & Research Inc
Case Method Results

PDIPLOT Ver. 2008.2 - Printed: 3-Apr-2009

VRANS RSCH001-703 - GD-6
OP: SPK

2 INCH SS;CME75 TRACK SAFETY;TRANSTECH
Test date: 25-Sep-2008

AR: 0.92 in^2
LE: 28.71 ft
WS: 16,807.7 f/s

SP: 0.492 k/ft3
EM: 30,000 ksi
JC: 0.00

EMX: Max Transferred Energy
EF2: Energy of F^2
ER: Hammer Energy Rating
ETR: Energy Transfer Ratio
FMX: Maximum Force

VMX: Maximum Velocity
DMX: Maximum Displacement
DFN: Final Displacement
BPM: Blows per Minute

Statistics for entire file (143 blows)

	EMX	EF2	ER	ETR	FMX	VMX	DMX	DFN	BPM
	k-ft	k-ft	k-ft	(%)	kips	f/s	in	in	**
Average	0.211	0.244	0.350	60.3	21.9	14.7	1.10	0.97	55.7
Std. Dev.	0.038	0.049	0.001	10.9	1.7	2.0	0.48	0.65	2.3
Maximum	0.331	0.329	0.350	94.6	24.8	19.8	2.87	2.87	61.7
@ Blow#	29	128	1	29	50	13	4	4	73
Minimum	0.120	0.139	0.350	34.3	16.5	10.0	0.47	-2.41	48.7
@ Blow#	77	77	1	77	77	138	53	96	44

Time Summary

Drive	17 seconds	1:45:39 PM - 1:45:56 PM (9/25/2008) BN 1 - 17
Stop	10 minutes 26 seconds	1:45:56 PM - 1:56:22 PM
Drive	27 minutes 21 seconds	1:56:22 PM - 2:23:43 PM BN 18 - 146

Total time [0:38:04] = (Driving [0:27:38] + Stop [0:10:26])

Geosciences Testing & Research Inc
Case Method Results

PDIPLOT Ver. 2008.2 - Printed: 3-Apr-2009

VRANS RSCH001-703 - GD-6
OP: SPK

2 INCH SS;CME75 TRACK SAFETY;TRANSTECH
Test date: 25-Sep-2008

AR: 0.92 in^2
LE: 28.71 ft
WS: 16,807.7 f/s

SP: 0.492 k/ft3
EM: 30,000 ksi
JC: 0.00

EMX: Max Transferred Energy
EF2: Energy of F^2
ER: Hammer Energy Rating
ETR: Energy Transfer Ratio
FMX: Maximum Force

VMX: Maximum Velocity
DMX: Maximum Displacement
DFN: Final Displacement
BPM: Blows per Minute

BL#	depth ft	BLC bl/ft	EMX k-ft	EF2 k-ft	ER k-ft	ETR (%)	FMX kips	VMX f/s	DMX in	DFN in	BPM **
1	5.00	6	0.164	0.215	0.350	46.7	23.5	19.5	1.74	1.51	0.0
2	5.17	6	0.181	0.169	0.350	51.8	21.4	17.1	2.43	2.43	50.7
3	5.33	6	0.196	0.207	0.350	55.9	23.0	19.1	2.40	2.40	57.1
4	5.50	6	0.224	0.178	0.350	64.0	22.0	18.0	2.87	2.87	55.6
5	5.67	6	0.168	0.156	0.350	47.9	20.2	16.6	1.55	1.55	53.1
6	5.83	6	0.211	0.163	0.350	60.2	21.4	16.0	1.88	1.88	52.6
7	6.00	6	0.202	0.196	0.350	57.8	22.2	18.3	1.60	1.60	56.5
8	6.10	10	0.158	0.157	0.350	45.2	20.8	16.7	1.06	0.80	55.0
9	6.20	10	0.235	0.177	0.350	67.2	21.5	17.6	2.11	2.11	53.7
10	6.30	10	0.196	0.203	0.350	56.1	23.5	19.3	1.29	0.86	54.6
11	6.40	10	0.233	0.180	0.350	66.6	22.1	18.2	2.09	2.09	56.1
12	6.50	10	0.198	0.194	0.350	56.7	22.6	18.7	1.53	1.52	55.8
13	6.60	10	0.216	0.208	0.350	61.8	23.6	19.8	1.42	1.34	55.9
14	6.70	10	0.195	0.177	0.350	55.6	22.0	17.4	1.22	1.08	54.6
15	6.80	10	0.210	0.218	0.350	60.0	23.8	19.5	1.25	0.95	52.0
16	6.90	10	0.220	0.199	0.350	62.9	23.1	18.7	1.41	1.41	53.1
		Average	0.200	0.187	0.350	57.3	22.3	18.2	1.74	1.65	54.4
		Std. Dev.	0.023	0.020	0.000	6.5	1.0	1.1	0.50	0.58	1.8
		Maximum	0.235	0.218	0.350	67.2	23.8	19.8	2.87	2.87	57.1
		@ Blow#	9	15	1	9	15	13	4	4	3
		Minimum	0.158	0.156	0.350	45.2	20.2	16.0	1.06	0.80	50.7
		@ Blow#	8	5	1	8	5	6	8	8	2

Total number of blows analyzed: 16

Time Summary

Drive	17 seconds	1:45:39 PM - 1:45:56 PM (9/25/2008) BN 1 - 17
Stop	10 minutes 26 seconds	1:45:56 PM - 1:56:22 PM
Drive	27 minutes 21 seconds	1:56:22 PM - 2:23:43 PM BN 18 - 146

Total time [0:38:04] = (Driving [0:27:38] + Stop [0:10:26])

VRANS RSCH001-703 - GD-6
OP: SPK
2 INCH SS;CME75 TRACK SAFETY;TRANSTECH
Test date: 25-Sep-2008

AR: 0.92 in^2
LE: 28.71 ft
WS: 16,807.7 f/s
SP: 0.492 k/ft3
EM: 30,000 ksi
JC: 0.00

EMX: Max Transferred Energy
EF2: Energy of F^2
ER: Hammer Energy Rating
ETR: Energy Transfer Ratio
FMX: Maximum Force
VMX: Maximum Velocity
DMX: Maximum Displacement
DFN: Final Displacement
BPM: Blows per Minute

BL#	depth	BLC	EMX	EF2	ER	ETR	FMX	VMX	DMX	DFN	BPM
	ft	bl/ft	k-ft	k-ft	k-ft	(%)	kips	f/s	in	in	**
18	10.00	0	0.238	0.254	0.350	68.1	23.3	18.0	2.11	2.11	0.0
19	10.10	10	0.180	0.222	0.350	51.3	22.0	16.4	1.16	0.99	51.6
20	10.20	10	0.223	0.235	0.350	63.7	22.5	16.2	1.49	1.49	55.5
21	10.30	10	0.266	0.243	0.350	76.0	23.1	15.7	1.73	1.73	53.7
22	10.40	10	0.220	0.231	0.350	62.9	22.6	15.0	1.13	1.07	55.7
23	10.50	10	0.255	0.247	0.350	72.9	22.9	16.0	1.53	1.53	53.8
24	10.58	12	0.309	0.281	0.350	88.2	24.7	16.8	1.93	1.93	54.9
25	10.67	12	0.236	0.278	0.350	67.6	24.2	16.9	1.03	0.81	53.6
26	10.75	12	0.204	0.214	0.350	58.1	22.0	15.2	1.16	1.16	54.4
27	10.83	12	0.197	0.246	0.350	56.3	22.9	15.2	0.85	-0.39	54.0
28	10.92	12	0.265	0.255	0.350	75.6	23.3	17.1	1.51	1.51	57.1
29	11.00	12	0.331	0.262	0.350	94.6	24.2	16.0	2.24	2.24	53.5
30	11.07	14	0.161	0.204	0.350	46.1	21.0	14.2	1.07	-0.16	58.6
31	11.14	14	0.238	0.237	0.350	67.9	22.6	15.4	0.95	0.95	58.8
32	11.21	14	0.239	0.239	0.350	68.3	22.5	15.0	1.03	1.03	56.2
33	11.29	14	0.201	0.226	0.350	57.5	22.4	14.6	0.91	0.42	58.1
34	11.36	14	0.236	0.221	0.350	67.4	22.2	14.4	1.34	1.34	57.3
35	11.43	14	0.230	0.225	0.350	65.7	22.1	14.6	1.35	1.35	55.8
36	11.50	14	0.243	0.215	0.350	69.3	21.5	14.2	1.75	1.75	56.0
37	11.58	12	0.209	0.237	0.350	59.6	22.6	15.1	1.08	0.85	57.0
38	11.67	12	0.255	0.234	0.350	72.8	22.4	15.0	1.83	1.83	56.9
39	11.75	12	0.209	0.224	0.350	59.8	21.8	15.5	1.32	1.32	55.2
40	11.83	12	0.290	0.244	0.350	82.9	23.1	15.2	2.15	2.15	56.6
41	11.92	12	0.211	0.234	0.350	60.2	22.9	14.7	0.99	0.83	56.3
42	12.00	12	0.167	0.163	0.350	47.6	19.4	12.4	1.07	1.07	55.2
		Average	0.233	0.235	0.350	66.4	22.6	15.4	1.39	1.24	55.7
		Std. Dev.	0.040	0.023	0.000	11.3	1.1	1.1	0.41	0.64	1.7
		Maximum	0.331	0.281	0.350	94.6	24.7	18.0	2.24	2.24	58.8
		@ Blow#	29	24	18	29	24	18	29	29	31
		Minimum	0.161	0.163	0.350	46.1	19.4	12.4	0.85	-0.39	51.6
		@ Blow#	30	42	18	30	42	42	27	27	19

Total number of blows analyzed: 25

Time Summary

Drive	17 seconds	1:45:39 PM - 1:45:56 PM (9/25/2008) BN 1 - 17
Stop	10 minutes 26 seconds	1:45:56 PM - 1:56:22 PM
Drive	27 minutes 21 seconds	1:56:22 PM - 2:23:43 PM BN 18 - 146

Total time [0:38:04] = (Driving [0:27:38] + Stop [0:10:26])

Geosciences Testing & Research Inc
Case Method Results

PDIPLOT Ver. 2008.2 - Printed: 3-Apr-2009

VRANS RSCH001-703 - GD-6
OP: SPK

2 INCH SS;CME75 TRACK SAFETY;TRANSTECH
Test date: 25-Sep-2008

AR: 0.92 in^2
LE: 28.71 ft
WS: 16,807.7 f/s

SP: 0.492 k/ft3
EM: 30,000 ksi
JC: 0.00

EMX: Max Transferred Energy
EF2: Energy of F^2
ER: Hammer Energy Rating
ETR: Energy Transfer Ratio
FMX: Maximum Force

VMX: Maximum Velocity
DMX: Maximum Displacement
DFN: Final Displacement
BPM: Blows per Minute

BL#	depth ft	BLC bl/ft	EMX k-ft	EF2 k-ft	ER k-ft	ETR (%)	FMX kips	VMX f/s	DMX in	DFN in	BPM **
43	15.00	0	0.236	0.282	0.350	67.5	23.4	17.4	1.28	1.23	0.0
44	15.50	2	0.202	0.233	0.350	57.6	21.0	16.1	1.23	1.23	48.7
45	15.56	18	0.224	0.273	0.350	63.9	23.0	17.4	0.88	0.88	53.8
46	15.61	18	0.255	0.274	0.350	73.0	23.0	16.7	1.09	1.09	53.7
47	15.67	18	0.237	0.271	0.350	67.6	23.2	15.9	0.66	0.66	55.6
48	15.72	18	0.201	0.257	0.350	57.5	22.4	16.0	0.53	0.05	56.5
49	15.78	18	0.272	0.311	0.350	77.7	24.4	18.1	1.00	1.00	54.4
50	15.83	18	0.281	0.321	0.350	80.2	24.8	17.9	0.95	0.95	55.8
51	15.89	18	0.232	0.282	0.350	66.2	23.4	16.6	0.57	0.43	54.0
52	15.94	18	0.248	0.258	0.350	71.0	22.4	16.7	1.80	1.80	57.5
53	16.00	18	0.194	0.252	0.350	55.5	21.9	15.0	0.47	-0.59	55.0
54	16.17	6	0.218	0.257	0.350	62.4	22.0	16.3	0.68	0.68	57.9
55	16.33	6	0.194	0.236	0.350	55.3	21.3	15.1	0.71	0.71	56.5
56	16.50	6	0.149	0.186	0.350	42.5	19.4	14.5	0.66	0.59	59.3
57	16.52	66	0.138	0.175	0.350	39.6	18.5	14.4	1.00	1.00	57.6
58	16.53	66	0.202	0.226	0.350	57.7	20.8	15.2	0.82	0.82	57.6
59	16.55	66	0.202	0.244	0.350	57.7	21.8	14.7	0.55	0.50	58.5
60	16.56	66	0.179	0.203	0.350	51.1	20.1	14.0	1.07	1.07	55.9
61	16.58	66	0.171	0.221	0.350	48.9	20.9	13.1	0.48	0.00	59.9
62	16.59	66	0.154	0.200	0.350	43.9	20.0	12.8	0.47	0.23	57.4
63	16.61	66	0.219	0.277	0.350	62.4	23.1	15.5	0.59	-0.11	56.3
64	16.62	66	0.193	0.246	0.350	55.2	21.9	16.6	0.63	0.40	59.6
65	16.64	66	0.226	0.254	0.350	64.7	22.1	15.5	1.12	1.12	57.9
66	16.65	66	0.126	0.151	0.350	36.0	17.7	11.1	0.62	0.62	61.3
67	16.67	66	0.188	0.206	0.350	53.7	20.4	13.5	0.84	0.84	60.3
68	16.68	66	0.177	0.206	0.350	50.7	20.3	14.2	0.55	0.28	59.0
70	16.71	66	0.169	0.188	0.350	48.2	19.4	12.9	0.62	0.62	60.5
71	16.73	66	0.188	0.215	0.350	53.7	20.7	13.9	0.77	0.77	59.0
72	16.74	66	0.177	0.210	0.350	50.5	20.4	14.5	1.15	1.15	58.0
73	16.76	66	0.138	0.168	0.350	39.5	18.3	13.1	0.67	0.67	61.7
74	16.77	66	0.166	0.191	0.350	47.4	19.6	12.1	1.04	1.04	58.3
75	16.79	66	0.170	0.199	0.350	48.6	19.8	12.8	0.67	0.58	59.7
76	16.80	66	0.187	0.213	0.350	53.5	20.5	13.5	1.01	1.01	60.3
77	16.82	66	0.120	0.139	0.350	34.3	16.5	10.2	0.96	0.96	58.9
78	16.83	66	0.124	0.147	0.350	35.5	17.2	10.7	0.56	0.56	58.5
79	16.85	66	0.159	0.174	0.350	45.4	18.6	11.7	0.96	0.96	58.7
80	16.86	66	0.154	0.181	0.350	44.1	18.6	12.1	0.82	0.82	56.8
81	16.88	66	0.173	0.185	0.350	49.5	19.5	11.5	1.13	1.13	57.5
82	16.89	66	0.156	0.195	0.350	44.7	19.6	11.8	0.67	0.67	57.9
83	16.91	66	0.142	0.173	0.350	40.4	18.8	11.6	0.72	0.72	58.8
84	16.92	66	0.199	0.208	0.350	56.8	20.3	12.8	2.19	2.19	56.2
85	16.94	66	0.130	0.162	0.350	37.1	18.3	11.7	0.65	0.65	56.1
86	16.95	66	0.158	0.192	0.350	45.2	19.4	13.4	0.85	0.85	0.0
87	16.97	66	0.172	0.213	0.350	49.2	20.8	13.2	0.68	0.20	56.2
88	16.98	66	0.137	0.167	0.350	39.1	18.3	11.2	0.53	0.34	55.9
89	17.00	66	0.159	0.183	0.350	45.4	19.3	12.7	0.75	0.75	55.1
		Average	0.185	0.218	0.350	52.8	20.6	14.1	0.84	0.74	57.4
		Std. Dev.	0.039	0.044	0.000	11.2	1.9	2.1	0.33	0.46	2.4
		Maximum	0.281	0.321	0.350	80.2	24.8	18.1	2.19	2.19	61.7
		@ Blow#	50	50	43	50	50	49	84	84	73
		Minimum	0.120	0.139	0.350	34.3	16.5	10.2	0.47	-0.59	48.7
		@ Blow#	77	77	43	77	77	77	53	53	44

Total number of blows analyzed: 46

Time Summary

Drive 17 seconds 1:45:39 PM - 1:45:56 PM (9/25/2008) BN 1 - 17
Stop 10 minutes 26 seconds 1:45:56 PM - 1:56:22 PM

VRANS RSCH001-703 - GD-6
OP: SPK

2 INCH SS;CME75 TRACK SAFETY;TRANSTECH
Test date: 25-Sep-2008

AR: 0.92 in^2
LE: 28.71 ft
WS: 16,807.7 f/s

SP: 0.492 k/ft3
EM: 30,000 ksi
JC: 0.00

EMX: Max Transferred Energy
EF2: Energy of F^2
ER: Hammer Energy Rating
ETR: Energy Transfer Ratio
FMX: Maximum Force

VMX: Maximum Velocity
DMX: Maximum Displacement
DFN: Final Displacement
BPM: Blows per Minute

BL#	depth	BLC	EMX	EF2	ER	ETR	FMX	VMX	DMX	DFN	BPM
	ft	bl/ft	k-ft	k-ft	k-ft	(%)	kips	f/s	in	in	**
90	20.00	0	0.239	0.305	0.350	68.3	23.2	17.0	1.45	1.32	0.0
91	20.10	10	0.182	0.222	0.350	52.1	20.4	15.5	1.15	1.04	51.4
92	20.20	10	0.239	0.276	0.350	68.3	22.2	16.7	2.15	2.15	55.9
93	20.30	10	0.235	0.290	0.350	67.2	22.9	16.1	1.66	1.66	56.1
94	20.40	10	0.226	0.282	0.350	64.6	22.3	15.0	1.27	1.25	55.9
95	20.50	10	0.220	0.265	0.350	62.7	22.0	15.2	1.55	1.55	53.5
96	20.56	16	0.234	0.302	0.350	66.9	23.3	14.4	0.65	-2.41	54.8
97	20.63	16	0.161	0.203	0.350	46.0	19.6	12.1	0.89	0.89	56.0
98	20.69	16	0.159	0.204	0.350	45.3	19.5	11.5	0.53	-0.17	56.4
99	20.75	16	0.235	0.299	0.350	67.0	23.3	13.6	0.82	0.51	55.0
100	20.81	16	0.203	0.253	0.350	58.1	21.3	13.0	0.92	0.92	55.0
101	20.88	16	0.233	0.300	0.350	66.7	23.4	14.0	0.73	-0.04	53.5
102	20.94	16	0.216	0.271	0.350	61.7	22.2	13.5	0.70	0.68	55.9
103	21.00	16	0.262	0.310	0.350	74.7	23.9	14.8	1.10	1.10	55.4
104	21.05	22	0.203	0.246	0.350	58.0	21.2	13.0	0.87	0.87	56.3
105	21.09	22	0.202	0.256	0.350	57.7	21.7	13.1	0.57	0.40	53.7
106	21.14	22	0.233	0.294	0.350	66.5	23.1	14.1	0.66	0.62	55.1
107	21.18	22	0.237	0.296	0.350	67.7	23.1	14.1	0.66	0.62	54.8
108	21.23	22	0.247	0.315	0.350	70.7	23.8	14.6	0.65	0.45	54.9
109	21.27	22	0.238	0.294	0.350	68.1	23.0	13.8	0.64	0.63	55.1
110	21.32	22	0.253	0.322	0.350	72.4	24.3	14.6	0.66	0.28	53.9
111	21.36	22	0.229	0.297	0.350	65.3	23.0	13.6	0.63	0.44	54.5
112	21.41	22	0.244	0.306	0.350	69.8	23.6	14.2	0.74	0.70	55.4
113	21.45	22	0.247	0.315	0.350	70.5	23.7	14.4	0.74	0.49	54.0
114	21.50	22	0.221	0.280	0.350	63.1	22.5	13.7	0.76	0.76	56.5
115	21.56	18	0.219	0.276	0.350	62.6	22.5	13.8	0.68	0.64	55.1
116	21.61	18	0.245	0.309	0.350	69.9	24.0	14.5	0.71	0.64	54.8
117	21.67	18	0.210	0.266	0.350	60.0	22.2	13.1	0.61	0.17	56.0
118	21.72	18	0.261	0.309	0.350	74.5	23.7	14.4	1.15	1.15	54.4
119	21.78	18	0.233	0.294	0.350	66.5	23.3	14.3	0.64	0.46	55.3
120	21.83	18	0.208	0.266	0.350	59.3	22.0	12.8	0.57	0.37	55.6
121	21.89	18	0.255	0.306	0.350	72.8	23.4	14.5	1.06	1.06	54.7
122	21.94	18	0.234	0.294	0.350	66.9	23.2	14.1	0.66	0.50	55.1
123	22.00	18	0.223	0.288	0.350	63.7	22.9	13.9	0.64	0.54	53.8
		Average	0.226	0.283	0.350	64.6	22.6	14.2	0.88	0.65	55.0
		Std. Dev.	0.024	0.029	0.000	6.9	1.2	1.1	0.36	0.71	1.0
		Maximum	0.262	0.322	0.350	74.7	24.3	17.0	2.15	2.15	56.5
		@ Blow#	103	110	90	103	110	90	92	92	114
		Minimum	0.159	0.203	0.350	45.3	19.5	11.5	0.53	-2.41	51.4
		@ Blow#	98	97	90	98	98	98	98	96	91

Total number of blows analyzed: 34

Time Summary

Drive	17 seconds	1:45:39 PM - 1:45:56 PM (9/25/2008) BN 1 - 17
Stop	10 minutes 26 seconds	1:45:56 PM - 1:56:22 PM
Drive	27 minutes 21 seconds	1:56:22 PM - 2:23:43 PM BN 18 - 146

Total time [0:38:04] = (Driving [0:27:38] + Stop [0:10:26])

Geosciences Testing & Research Inc
Case Method Results

PDIPLOT Ver. 2008.2 - Printed: 3-Apr-2009

VRANS RSCH001-703 - GD-6
OP: SPK

2 INCH SS;CME75 TRACK SAFETY;TRANSTECH
Test date: 25-Sep-2008

AR: 0.92 in^2
LE: 28.71 ft
WS: 16,807.7 f/s

SP: 0.492 k/ft3
EM: 30,000 ksi
JC: 0.00

EMX: Max Transferred Energy
EF2: Energy of F^2
ER: Hammer Energy Rating
ETR: Energy Transfer Ratio
FMX: Maximum Force

VMX: Maximum Velocity
DMX: Maximum Displacement
DFN: Final Displacement
BPM: Blows per Minute

BL#	depth	BLC	EMX	EF2	ER	ETR	FMX	VMX	DMX	DFN	BPM
	ft	bl/ft	k-ft	k-ft	k-ft	(%)	kips	f/s	in	in	**
124	25.00	0	0.248	0.321	0.350	71.0	23.6	16.4	1.36	1.14	0.0
125	25.08	12	0.224	0.285	0.350	64.1	22.7	14.8	0.96	0.95	50.4
126	25.17	12	0.232	0.293	0.350	66.2	22.8	15.1	1.00	0.94	53.7
127	25.25	12	0.234	0.303	0.350	66.9	23.4	14.3	1.14	1.14	53.2
128	25.33	12	0.255	0.329	0.350	73.0	24.1	15.3	1.31	1.23	52.4
129	25.42	12	0.241	0.307	0.350	68.7	23.3	15.0	1.83	1.82	53.2
130	25.50	12	0.248	0.321	0.350	70.9	24.0	14.7	1.29	1.04	52.9
131	25.56	16	0.244	0.308	0.350	69.7	23.5	13.6	1.28	1.20	52.7
132	25.63	16	0.247	0.317	0.350	70.7	23.7	13.7	1.11	0.58	53.2
133	25.69	16	0.223	0.280	0.350	63.6	22.6	12.9	1.79	1.79	53.5
134	25.75	16	0.221	0.284	0.350	63.2	22.6	13.2	1.50	1.49	53.7
135	25.81	16	0.248	0.320	0.350	71.0	24.1	13.9	1.55	1.46	53.8
136	25.88	16	0.221	0.279	0.350	63.1	22.4	12.7	1.68	1.68	53.4
138	26.00	16	0.138	0.173	0.350	39.4	18.0	10.0	0.76	0.71	57.3
139	26.13	8	0.192	0.241	0.350	54.8	20.8	12.1	1.03	1.03	61.2
140	26.25	8	0.222	0.284	0.350	63.5	22.5	13.2	1.07	1.07	53.9
141	26.38	8	0.229	0.294	0.350	65.4	22.6	13.9	0.88	0.71	55.0
142	26.50	8	0.221	0.281	0.350	63.2	22.6	13.3	1.04	1.04	53.7
143	26.63	8	0.222	0.281	0.350	63.4	22.3	13.4	0.82	0.68	54.2
144	26.75	8	0.246	0.310	0.350	70.2	23.8	14.3	1.43	1.43	55.1
145	26.88	8	0.230	0.296	0.350	65.8	23.1	14.1	0.81	0.72	56.4
146	27.00	8	0.206	0.262	0.350	58.8	22.0	12.7	0.74	0.66	54.0
		Average	0.227	0.290	0.350	64.8	22.8	13.8	1.20	1.11	54.1
		Std. Dev.	0.025	0.033	0.000	7.0	1.3	1.3	0.32	0.36	2.1
		Maximum	0.255	0.329	0.350	73.0	24.1	16.4	1.83	1.82	61.2
		@ Blow#	128	128	124	128	135	124	129	129	139
		Minimum	0.138	0.173	0.350	39.4	18.0	10.0	0.74	0.58	50.4
		@ Blow#	138	138	124	138	138	138	146	132	125

Total number of blows analyzed: 22

Time Summary

Drive	17 seconds	1:45:39 PM - 1:45:56 PM (9/25/2008) BN 1 - 17
Stop	10 minutes 26 seconds	1:45:56 PM - 1:56:22 PM
Drive	27 minutes 21 seconds	1:56:22 PM - 2:23:43 PM BN 18 - 146

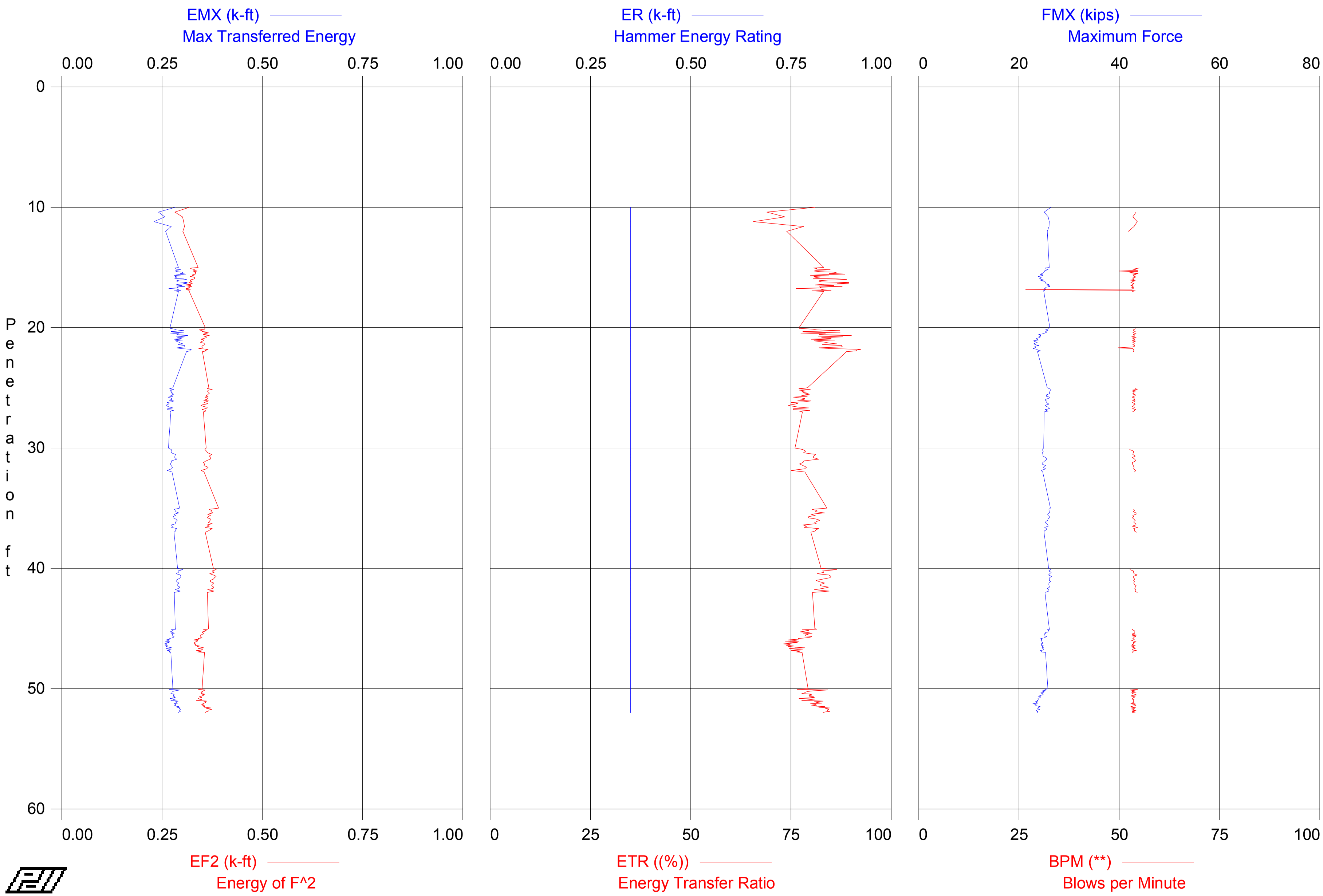
Total time [0:38:04] = (Driving [0:27:38] + Stop [0:10:26])

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

Geosciences Testing & Research Inc - Case Method Results

Test date: 26-Sep-2008

VTRANS RSCH011-703 - GD-7



VTRANS RSCH011-703 - GD-7
OP: SPK

2 INCH SS;CME45C AUTO;VTRANS
Test date: 26-Sep-2008

AR: 0.92 in^2
LE: 53.80 ft
WS: 16,807.7 f/s

SP: 0.492 k/ft3
EM: 30,000 ksi
JC: 0.00

EMX: Max Transferred Energy
EF2: Energy of F^2
ER: Hammer Energy Rating
ETR: Energy Transfer Ratio
FMX: Maximum Force

VMX: Maximum Velocity
DMX: Maximum Displacement
DFN: Final Displacement
BPM: Blows per Minute

Statistics for entire file (240 blows)

	EMX	EF2	ER	ETR	FMX	VMX	DMX	DFN	BPM
	k-ft	k-ft	k-ft	(%)	kips	f/s	in	in	**
Average	0.282	0.351	0.350	80.6	25.0	14.9	1.17	1.15	53.5
Std. Dev.	0.014	0.019	0.001	3.9	0.9	1.0	0.40	0.42	1.9
Maximum	0.323	0.391	0.350	92.4	26.5	17.9	2.99	2.99	55.0
@ Blow#	76	128	1	76	155	80	128	128	8
Minimum	0.230	0.282	0.350	65.6	22.8	12.7	0.53	0.26	26.7
@ Blow#	4	2	1	4	227	178	42	193	44

Time Summary

Drive	6 seconds	9:09:43 AM - 9:09:49 AM (9/26/2008) BN 1 - 6
Stop	14 minutes 35 seconds	9:09:49 AM - 9:24:24 AM
Drive	45 seconds	9:24:24 AM - 9:25:09 AM BN 7 - 47
Stop	11 minutes 38 seconds	9:25:09 AM - 9:36:47 AM
Drive	34 seconds	9:36:47 AM - 9:37:21 AM BN 48 - 79
Stop	10 minutes 19 seconds	9:37:21 AM - 9:47:40 AM
Drive	34 seconds	9:47:40 AM - 9:48:14 AM BN 80 - 111
Stop	10 minutes 26 seconds	9:48:14 AM - 9:58:40 AM
Drive	16 seconds	9:58:40 AM - 9:58:56 AM BN 112 - 127
Stop	11 minutes 59 seconds	9:58:56 AM - 10:10:55 AM
Drive	22 seconds	10:10:55 AM - 10:11:17 AM BN 128 - 148
Stop	18 minutes 19 seconds	10:11:17 AM - 10:29:36 AM
Drive	19 seconds	10:29:36 AM - 10:29:55 AM BN 149 - 167
Stop	17 minutes 37 seconds	10:29:55 AM - 10:47:32 AM
Drive	40 seconds	10:47:32 AM - 10:48:12 AM BN 168 - 204
Stop	19 minutes 4 seconds	10:48:12 AM - 11:07:16 AM
Drive	38 seconds	11:07:16 AM - 11:07:54 AM BN 205 - 240

Total time [1:58:11] = (Driving [0:04:14] + Stop [1:53:57])

VTRANS RSCH011-703 - GD-7
OP: SPK

2 INCH SS;CME45C AUTO;VTRANS
Test date: 26-Sep-2008

AR: 0.92 in^2
LE: 53.80 ft
WS: 16,807.7 f/s

SP: 0.492 k/ft3
EM: 30,000 ksi
JC: 0.00

EMX: Max Transferred Energy
EF2: Energy of F^2
ER: Hammer Energy Rating
ETR: Energy Transfer Ratio
FMX: Maximum Force

VMX: Maximum Velocity
DMX: Maximum Displacement
DFN: Final Displacement
BPM: Blows per Minute

BL#	depth	BLC	EMX	EF2	ER	ETR	FMX	VMX	DMX	DFN	BPM
	ft	bl/ft	k-ft	k-ft	k-ft	(%)	kips	f/s	in	in	**
1	10.00	3	0.283	0.318	0.350	81.0	26.4	17.2	2.07	2.07	0.0
2	10.40	3	0.241	0.282	0.350	69.0	25.0	16.5	2.20	2.20	54.2
3	10.80	3	0.257	0.301	0.350	73.5	25.8	17.2	2.01	2.01	53.4
4	11.20	3	0.230	0.304	0.350	65.6	26.0	16.8	1.44	1.36	54.5
5	11.60	3	0.273	0.306	0.350	78.1	26.0	16.1	1.84	1.84	53.7
6	12.00	3	0.259	0.302	0.350	73.9	25.7	16.6	1.99	1.99	52.3
		Average	0.257	0.302	0.350	73.5	25.8	16.7	1.92	1.91	53.6
		Std. Dev.	0.018	0.011	0.000	5.2	0.4	0.4	0.24	0.27	0.8
		Maximum	0.283	0.318	0.350	81.0	26.4	17.2	2.20	2.20	54.5
		@ Blow#	1	1	1	1	1	1	2	2	4
		Minimum	0.230	0.282	0.350	65.6	25.0	16.1	1.44	1.36	52.3
		@ Blow#	4	2	1	4	2	5	4	4	6

Total number of blows analyzed: 6

Time Summary

Drive	6 seconds	9:09:43 AM - 9:09:49 AM (9/26/2008) BN 1 - 6
Stop	14 minutes 35 seconds	9:09:49 AM - 9:24:24 AM
Drive	45 seconds	9:24:24 AM - 9:25:09 AM BN 7 - 47
Stop	11 minutes 38 seconds	9:25:09 AM - 9:36:47 AM
Drive	34 seconds	9:36:47 AM - 9:37:21 AM BN 48 - 79
Stop	10 minutes 19 seconds	9:37:21 AM - 9:47:40 AM
Drive	34 seconds	9:47:40 AM - 9:48:14 AM BN 80 - 111
Stop	10 minutes 26 seconds	9:48:14 AM - 9:58:40 AM
Drive	16 seconds	9:58:40 AM - 9:58:56 AM BN 112 - 127
Stop	11 minutes 59 seconds	9:58:56 AM - 10:10:55 AM
Drive	22 seconds	10:10:55 AM - 10:11:17 AM BN 128 - 148
Stop	18 minutes 19 seconds	10:11:17 AM - 10:29:36 AM
Drive	19 seconds	10:29:36 AM - 10:29:55 AM BN 149 - 167
Stop	17 minutes 37 seconds	10:29:55 AM - 10:47:32 AM
Drive	40 seconds	10:47:32 AM - 10:48:12 AM BN 168 - 204
Stop	19 minutes 4 seconds	10:48:12 AM - 11:07:16 AM
Drive	38 seconds	11:07:16 AM - 11:07:54 AM BN 205 - 240

Total time [1:58:11] = (Driving [0:04:14] + Stop [1:53:57])

VTRANS RSCH011-703 - GD-7
OP: SPK

2 INCH SS;CME45C AUTO;VTRANS
Test date: 26-Sep-2008

AR: 0.92 in^2
LE: 53.80 ft
WS: 16,807.7 f/s

SP: 0.492 k/ft3
EM: 30,000 ksi
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EMX: Max Transferred Energy
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VMX: Maximum Velocity
DMX: Maximum Displacement
DFN: Final Displacement
BPM: Blows per Minute

BL#	depth	BLC	EMX	EF2	ER	ETR	FMX	VMX	DMX	DFN	BPM
	ft	bl/ft	k-ft	k-ft	k-ft	(%)	kips	f/s	in	in	**
7	15.00	0	0.291	0.340	0.350	83.2	26.0	15.8	1.48	1.47	0.0
8	15.05	20	0.282	0.324	0.350	80.7	25.2	14.7	1.05	1.05	55.0
9	15.10	20	0.285	0.321	0.350	81.5	25.2	14.1	0.76	0.68	54.2
10	15.15	20	0.285	0.328	0.350	81.4	25.5	14.3	0.86	0.86	53.4
11	15.20	20	0.297	0.331	0.350	84.8	25.8	14.4	1.12	1.12	54.1
12	15.25	20	0.285	0.329	0.350	81.4	25.3	14.5	1.03	1.03	54.6
13	15.30	20	0.283	0.338	0.350	80.7	25.0	15.1	1.07	1.07	49.9
14	15.35	20	0.288	0.329	0.350	82.3	25.1	15.0	1.25	1.25	54.6
15	15.40	20	0.300	0.332	0.350	85.7	24.9	15.2	1.23	1.23	53.5
16	15.45	20	0.302	0.335	0.350	86.3	25.0	15.2	1.35	1.35	52.6
17	15.50	20	0.296	0.333	0.350	84.5	24.5	14.9	1.12	1.12	54.7
18	15.55	20	0.310	0.333	0.350	88.5	24.8	15.2	1.47	1.47	53.4
19	15.60	20	0.291	0.327	0.350	83.0	24.2	15.3	1.09	1.09	54.2
20	15.65	20	0.280	0.325	0.350	79.9	24.8	14.8	0.66	0.65	53.6
21	15.70	20	0.296	0.330	0.350	84.4	24.4	14.9	1.15	1.15	53.6
22	15.75	20	0.283	0.320	0.350	80.7	23.8	14.9	1.15	1.15	54.0
23	15.80	20	0.287	0.329	0.350	82.1	24.5	14.9	0.96	0.96	53.4
24	15.85	20	0.284	0.332	0.350	81.2	24.2	14.7	0.72	0.72	54.0
25	15.90	20	0.282	0.330	0.350	80.5	24.3	14.6	0.76	0.76	53.4
26	15.95	20	0.303	0.332	0.350	86.5	24.1	14.7	0.96	0.96	53.5
27	16.00	20	0.311	0.325	0.350	88.8	24.6	14.4	1.21	1.21	53.7
28	16.05	20	0.294	0.320	0.350	84.1	25.0	14.9	0.99	0.99	52.8
29	16.10	20	0.287	0.321	0.350	82.0	24.3	15.2	0.66	0.66	54.0
30	16.15	20	0.287	0.325	0.350	82.0	25.1	15.0	0.54	0.40	53.5
31	16.20	20	0.289	0.320	0.350	82.6	25.2	14.9	0.55	0.38	53.2
32	16.25	20	0.313	0.317	0.350	89.4	25.3	14.7	1.38	1.38	52.9
33	16.30	20	0.303	0.326	0.350	86.6	25.3	15.4	0.61	0.56	53.4
34	16.35	20	0.313	0.321	0.350	89.4	25.4	15.2	1.41	1.41	53.7
35	16.40	20	0.291	0.322	0.350	83.1	26.0	14.8	0.76	0.76	53.3
36	16.45	20	0.284	0.309	0.350	81.1	25.5	14.9	0.91	0.91	53.5
37	16.50	20	0.300	0.322	0.350	85.7	26.0	14.9	1.06	1.06	52.9
38	16.55	20	0.287	0.314	0.350	82.1	25.8	14.9	0.89	0.89	53.5
39	16.60	20	0.307	0.324	0.350	87.8	26.2	15.1	1.30	1.30	53.3
40	16.65	20	0.288	0.319	0.350	82.3	25.4	15.2	0.81	0.81	53.6
41	16.70	20	0.289	0.316	0.350	82.5	25.3	15.0	1.06	1.06	53.0
42	16.75	20	0.267	0.310	0.350	76.3	25.1	14.8	0.53	0.42	53.5
43	16.80	20	0.291	0.322	0.350	83.1	25.4	14.9	0.90	0.90	53.2
44	16.85	20	0.289	0.310	0.350	82.6	24.9	15.1	0.90	0.90	26.7
45	16.90	20	0.297	0.317	0.350	85.0	25.2	15.5	1.24	1.24	53.0
46	16.95	20	0.281	0.318	0.350	80.2	24.9	15.6	0.71	0.71	54.0
47	17.00	20	0.291	0.318	0.350	83.2	25.0	15.6	0.84	0.84	53.3
		Average	0.292	0.324	0.350	83.4	25.1	15.0	0.99	0.97	52.8
		Std. Dev.	0.010	0.007	0.000	2.8	0.6	0.3	0.26	0.28	4.3
		Maximum	0.313	0.340	0.350	89.4	26.2	15.8	1.48	1.47	55.0
		@ Blow#	32	7	7	32	39	7	7	7	8
		Minimum	0.267	0.309	0.350	76.3	23.8	14.1	0.53	0.38	26.7
		@ Blow#	42	36	7	42	22	9	42	31	44

Total number of blows analyzed: 41

Time Summary

Drive	6 seconds	9:09:43 AM - 9:09:49 AM (9/26/2008) BN 1 - 6
Stop	14 minutes 35 seconds	9:09:49 AM - 9:24:24 AM
Drive	45 seconds	9:24:24 AM - 9:25:09 AM BN 7 - 47
Stop	11 minutes 38 seconds	9:25:09 AM - 9:36:47 AM
Drive	34 seconds	9:36:47 AM - 9:37:21 AM BN 48 - 79
Stop	10 minutes 19 seconds	9:37:21 AM - 9:47:40 AM
Drive	34 seconds	9:47:40 AM - 9:48:14 AM BN 80 - 111

VTRANS RSCH011-703 - GD-7
OP: SPK

2 INCH SS;CME45C AUTO;VTRANS
Test date: 26-Sep-2008

AR: 0.92 in^2
LE: 53.80 ft
WS: 16,807.7 f/s

SP: 0.492 k/ft3
EM: 30,000 ksi
JC: 0.00

EMX: Max Transferred Energy
EF2: Energy of F^2
ER: Hammer Energy Rating
ETR: Energy Transfer Ratio
FMX: Maximum Force

VMX: Maximum Velocity
DMX: Maximum Displacement
DFN: Final Displacement
BPM: Blows per Minute

BL#	depth	BLC	EMX	EF2	ER	ETR	FMX	VMX	DMX	DFN	BPM
	ft	bl/ft	k-ft	k-ft	k-ft	(%)	kips	f/s	in	in	**
48	20.00	0	0.270	0.358	0.350	77.0	26.2	16.0	2.45	2.45	0.0
49	20.06	16	0.270	0.357	0.350	77.1	25.8	16.1	1.32	1.32	54.0
50	20.13	16	0.282	0.356	0.350	80.5	25.7	15.1	1.17	1.14	53.9
51	20.19	16	0.285	0.343	0.350	81.3	25.3	14.7	1.37	1.37	53.5
52	20.26	16	0.305	0.350	0.350	87.2	25.8	14.9	1.39	1.39	53.5
53	20.32	16	0.273	0.351	0.350	77.9	25.3	15.1	1.23	1.23	54.0
54	20.39	16	0.305	0.366	0.350	87.2	25.5	15.6	1.43	1.43	53.4
55	20.45	16	0.271	0.354	0.350	77.5	25.2	15.5	1.25	1.25	53.7
56	20.52	16	0.292	0.363	0.350	83.6	24.7	15.3	1.16	1.14	54.2
57	20.58	16	0.287	0.353	0.350	82.0	23.9	15.5	1.38	1.38	53.5
58	20.65	16	0.315	0.368	0.350	90.0	24.4	15.2	1.30	1.30	53.7
59	20.71	16	0.286	0.355	0.350	81.8	24.0	15.5	1.31	1.31	53.9
60	20.77	16	0.308	0.361	0.350	87.9	24.3	15.6	1.21	1.21	53.1
61	20.84	16	0.289	0.360	0.350	82.7	24.0	15.9	0.88	0.88	54.2
62	20.90	16	0.298	0.354	0.350	85.0	23.5	15.8	1.09	1.09	53.4
63	20.97	16	0.280	0.347	0.350	80.0	23.5	15.7	1.12	1.12	53.6
64	21.03	16	0.301	0.355	0.350	85.9	23.8	16.1	1.29	1.29	54.0
65	21.10	16	0.283	0.353	0.350	80.7	22.9	16.0	0.87	0.87	53.2
66	21.16	16	0.288	0.348	0.350	82.2	23.1	16.1	1.01	1.01	54.0
67	21.23	16	0.293	0.346	0.350	83.7	23.6	15.6	1.24	1.24	53.4
68	21.29	16	0.296	0.354	0.350	84.6	23.2	16.3	0.82	0.82	53.7
69	21.35	16	0.303	0.356	0.350	86.5	22.9	16.4	1.31	1.31	53.8
70	21.42	16	0.290	0.357	0.350	82.8	23.3	16.2	0.73	0.72	53.4
71	21.48	16	0.306	0.352	0.350	87.6	24.0	15.4	1.29	1.29	53.9
72	21.55	16	0.307	0.350	0.350	87.8	23.1	15.7	1.13	1.13	53.8
73	21.61	16	0.306	0.349	0.350	87.5	23.4	15.5	1.35	1.35	53.4
74	21.68	16	0.287	0.351	0.350	82.0	23.2	15.7	0.90	0.90	49.7
75	21.74	16	0.295	0.342	0.350	84.4	22.9	15.3	1.41	1.41	53.3
76	21.81	16	0.323	0.365	0.350	92.4	23.6	15.9	1.21	1.21	53.5
77	21.87	16	0.320	0.357	0.350	91.4	23.8	16.0	1.42	1.42	53.6
78	21.94	16	0.320	0.361	0.350	91.3	24.3	15.7	1.15	1.15	53.7
79	22.00	16	0.311	0.351	0.350	88.8	23.7	16.0	1.19	1.19	53.5
		Average	0.295	0.354	0.350	84.3	24.1	15.7	1.23	1.23	53.5
		Std. Dev.	0.015	0.006	0.000	4.2	1.0	0.4	0.28	0.28	0.8
		Maximum	0.323	0.368	0.350	92.4	26.2	16.4	2.45	2.45	54.2
		@ Blow#	76	58	48	76	48	69	48	48	56
		Minimum	0.270	0.342	0.350	77.0	22.9	14.7	0.73	0.72	49.7
		@ Blow#	48	75	48	48	75	51	70	70	74

Total number of blows analyzed: 32

Time Summary

Drive	6 seconds	9:09:43 AM - 9:09:49 AM (9/26/2008) BN 1 - 6
Stop	14 minutes 35 seconds	9:09:49 AM - 9:24:24 AM
Drive	45 seconds	9:24:24 AM - 9:25:09 AM BN 7 - 47
Stop	11 minutes 38 seconds	9:25:09 AM - 9:36:47 AM
Drive	34 seconds	9:36:47 AM - 9:37:21 AM BN 48 - 79
Stop	10 minutes 19 seconds	9:37:21 AM - 9:47:40 AM
Drive	34 seconds	9:47:40 AM - 9:48:14 AM BN 80 - 111
Stop	10 minutes 26 seconds	9:48:14 AM - 9:58:40 AM
Drive	16 seconds	9:58:40 AM - 9:58:56 AM BN 112 - 127
Stop	11 minutes 59 seconds	9:58:56 AM - 10:10:55 AM
Drive	22 seconds	10:10:55 AM - 10:11:17 AM BN 128 - 148
Stop	18 minutes 19 seconds	10:11:17 AM - 10:29:36 AM
Drive	19 seconds	10:29:36 AM - 10:29:55 AM BN 149 - 167
Stop	17 minutes 37 seconds	10:29:55 AM - 10:47:32 AM
Drive	40 seconds	10:47:32 AM - 10:48:12 AM BN 168 - 204
Stop	19 minutes 4 seconds	10:48:12 AM - 11:07:16 AM

Geosciences Testing & Research Inc
Case Method Results

PDIPLOT Ver. 2008.2 - Printed: 3-Apr-2009

VTRANS RSCH011-703 - GD-7
OP: SPK

2 INCH SS;CME45C AUTO;VTRANS
Test date: 26-Sep-2008

AR: 0.92 in^2
LE: 53.80 ft
WS: 16,807.7 f/s

SP: 0.492 k/ft3
EM: 30,000 ksi
JC: 0.00

EMX: Max Transferred Energy
EF2: Energy of F^2
ER: Hammer Energy Rating
ETR: Energy Transfer Ratio
FMX: Maximum Force

VMX: Maximum Velocity
DMX: Maximum Displacement
DFN: Final Displacement
BPM: Blows per Minute

BL#	depth ft	BLC bl/ft	EMX k-ft	EF2 k-ft	ER k-ft	ETR (%)	FMX kips	VMX f/s	DMX in	DFN in	BPM **
80	25.00	0	0.277	0.367	0.350	79.1	25.7	17.9	1.61	1.61	0.0
81	25.06	16	0.269	0.363	0.350	77.0	26.0	16.4	1.04	1.04	54.0
82	25.13	16	0.279	0.375	0.350	79.8	26.4	16.0	1.10	1.10	54.5
83	25.19	16	0.270	0.366	0.350	77.1	26.3	15.6	0.95	0.94	53.3
84	25.26	16	0.275	0.364	0.350	78.6	26.2	14.9	1.28	1.28	54.2
85	25.32	16	0.272	0.364	0.350	77.7	26.2	15.6	0.93	0.93	53.4
86	25.39	16	0.273	0.367	0.350	78.1	26.1	15.8	0.99	0.99	53.7
87	25.45	16	0.278	0.368	0.350	79.3	26.1	15.5	0.97	0.97	53.7
88	25.52	16	0.274	0.366	0.350	78.2	26.0	15.1	0.98	0.98	53.3
89	25.58	16	0.279	0.364	0.350	79.6	25.5	15.2	1.11	1.11	54.0
90	25.65	16	0.272	0.360	0.350	77.7	25.5	15.7	0.94	0.94	54.0
91	25.71	16	0.277	0.365	0.350	79.1	25.5	15.8	0.91	0.91	53.7
92	25.77	16	0.265	0.357	0.350	75.6	26.1	16.6	0.72	0.66	53.2
93	25.84	16	0.271	0.363	0.350	77.4	26.1	16.5	1.11	1.11	53.8
94	25.90	16	0.275	0.364	0.350	78.5	25.7	16.0	1.06	1.06	53.7
95	25.97	16	0.274	0.361	0.350	78.3	25.2	15.5	1.04	1.04	53.9
96	26.03	16	0.268	0.354	0.350	76.7	25.3	16.0	0.96	0.96	53.3
97	26.10	16	0.280	0.366	0.350	80.0	25.5	15.1	0.93	0.93	54.0
98	26.16	16	0.274	0.360	0.350	78.2	25.4	15.4	1.07	1.07	53.7
99	26.23	16	0.263	0.355	0.350	75.1	25.6	16.3	0.78	0.78	53.3
100	26.29	16	0.268	0.364	0.350	76.7	25.7	15.8	0.85	0.85	53.7
101	26.35	16	0.266	0.360	0.350	76.0	26.0	15.7	0.90	0.90	54.0
102	26.42	16	0.262	0.350	0.350	74.9	25.5	15.5	0.81	0.81	53.6
103	26.48	16	0.260	0.347	0.350	74.4	25.3	16.2	1.08	1.08	53.7
104	26.55	16	0.265	0.354	0.350	75.8	25.5	16.5	1.12	1.12	53.2
105	26.61	16	0.270	0.362	0.350	77.1	25.9	16.0	0.93	0.91	53.8
106	26.68	16	0.278	0.363	0.350	79.4	25.7	15.5	1.24	1.24	53.7
107	26.74	16	0.264	0.357	0.350	75.6	26.1	16.2	1.12	1.12	53.3
108	26.81	16	0.264	0.350	0.350	75.5	25.2	15.3	1.31	1.31	54.1
109	26.87	16	0.279	0.358	0.350	79.7	25.4	15.5	1.23	1.23	53.9
110	26.94	16	0.270	0.359	0.350	77.1	25.8	16.8	1.35	1.35	53.7
111	27.00	16	0.272	0.353	0.350	77.9	25.0	16.4	1.47	1.47	53.3
		Average	0.271	0.361	0.350	77.5	25.7	15.9	1.06	1.06	53.7
		Std. Dev.	0.006	0.006	0.000	1.6	0.4	0.6	0.19	0.20	0.3
		Maximum	0.280	0.375	0.350	80.0	26.4	17.9	1.61	1.61	54.5
		@ Blow#	97	82	80	97	82	80	80	80	82
		Minimum	0.260	0.347	0.350	74.4	25.0	14.9	0.72	0.66	53.2
		@ Blow#	103	103	80	103	111	84	92	92	92

Total number of blows analyzed: 32

Time Summary

Drive	6 seconds	9:09:43 AM - 9:09:49 AM (9/26/2008) BN 1 - 6
Stop	14 minutes 35 seconds	9:09:49 AM - 9:24:24 AM
Drive	45 seconds	9:24:24 AM - 9:25:09 AM BN 7 - 47
Stop	11 minutes 38 seconds	9:25:09 AM - 9:36:47 AM
Drive	34 seconds	9:36:47 AM - 9:37:21 AM BN 48 - 79
Stop	10 minutes 19 seconds	9:37:21 AM - 9:47:40 AM
Drive	34 seconds	9:47:40 AM - 9:48:14 AM BN 80 - 111
Stop	10 minutes 26 seconds	9:48:14 AM - 9:58:40 AM
Drive	16 seconds	9:58:40 AM - 9:58:56 AM BN 112 - 127
Stop	11 minutes 59 seconds	9:58:56 AM - 10:10:55 AM
Drive	22 seconds	10:10:55 AM - 10:11:17 AM BN 128 - 148
Stop	18 minutes 19 seconds	10:11:17 AM - 10:29:36 AM
Drive	19 seconds	10:29:36 AM - 10:29:55 AM BN 149 - 167
Stop	17 minutes 37 seconds	10:29:55 AM - 10:47:32 AM
Drive	40 seconds	10:47:32 AM - 10:48:12 AM BN 168 - 204
Stop	19 minutes 4 seconds	10:48:12 AM - 11:07:16 AM

VTRANS RSCH011-703 - GD-7
OP: SPK

2 INCH SS;CME45C AUTO;VTRANS
Test date: 26-Sep-2008

AR: 0.92 in^2
LE: 53.80 ft
WS: 16,807.7 f/s

SP: 0.492 k/ft3
EM: 30,000 ksi
JC: 0.00

EMX: Max Transferred Energy
EF2: Energy of F^2
ER: Hammer Energy Rating
ETR: Energy Transfer Ratio
FMX: Maximum Force

VMX: Maximum Velocity
DMX: Maximum Displacement
DFN: Final Displacement
BPM: Blows per Minute

BL#	depth	BLC	EMX	EF2	ER	ETR	FMX	VMX	DMX	DFN	BPM
	ft	bl/ft	k-ft	k-ft	k-ft	(%)	kips	f/s	in	in	**
112	30.00	0	0.266	0.360	0.350	76.0	24.9	16.2	2.37	2.37	0.0
113	30.13	8	0.273	0.357	0.350	77.9	24.6	15.8	2.04	2.04	52.6
114	30.27	8	0.275	0.361	0.350	78.7	24.9	15.4	1.72	1.70	53.6
115	30.40	8	0.273	0.364	0.350	78.1	24.7	15.8	1.72	1.69	53.5
116	30.53	8	0.284	0.374	0.350	81.2	24.8	16.2	1.90	1.90	53.4
117	30.67	8	0.282	0.368	0.350	80.6	24.8	16.2	1.98	1.98	54.0
118	30.80	8	0.282	0.372	0.350	80.5	25.3	16.0	1.64	1.63	53.3
119	30.93	8	0.287	0.370	0.350	81.9	25.6	16.9	1.76	1.76	53.9
120	31.07	8	0.274	0.360	0.350	78.3	25.2	17.1	1.94	1.94	54.1
121	31.20	8	0.273	0.353	0.350	78.0	24.8	17.1	1.77	1.77	53.3
122	31.33	8	0.270	0.356	0.350	77.1	24.6	15.5	1.58	1.58	53.3
123	31.47	8	0.273	0.355	0.350	78.0	25.3	16.0	1.86	1.86	53.5
124	31.60	8	0.276	0.365	0.350	78.9	24.8	15.7	1.24	1.24	53.7
125	31.73	8	0.274	0.361	0.350	78.4	25.3	16.5	1.40	1.40	53.6
126	31.87	8	0.263	0.348	0.350	75.0	24.4	15.3	1.15	1.15	54.1
127	32.00	8	0.275	0.355	0.350	78.5	24.7	15.2	1.29	1.29	53.8
		Average	0.275	0.361	0.350	78.6	24.9	16.1	1.71	1.71	53.6
		Std. Dev.	0.006	0.007	0.000	1.8	0.3	0.6	0.31	0.31	0.4
		Maximum	0.287	0.374	0.350	81.9	25.6	17.1	2.37	2.37	54.1
		@ Blow#	119	116	112	119	119	120	112	112	120
		Minimum	0.263	0.348	0.350	75.0	24.4	15.2	1.15	1.15	52.6
		@ Blow#	126	126	112	126	126	127	126	126	113

Total number of blows analyzed: 16

Time Summary

Drive	6 seconds	9:09:43 AM - 9:09:49 AM (9/26/2008) BN 1 - 6
Stop	14 minutes 35 seconds	9:09:49 AM - 9:24:24 AM
Drive	45 seconds	9:24:24 AM - 9:25:09 AM BN 7 - 47
Stop	11 minutes 38 seconds	9:25:09 AM - 9:36:47 AM
Drive	34 seconds	9:36:47 AM - 9:37:21 AM BN 48 - 79
Stop	10 minutes 19 seconds	9:37:21 AM - 9:47:40 AM
Drive	34 seconds	9:47:40 AM - 9:48:14 AM BN 80 - 111
Stop	10 minutes 26 seconds	9:48:14 AM - 9:58:40 AM
Drive	16 seconds	9:58:40 AM - 9:58:56 AM BN 112 - 127
Stop	11 minutes 59 seconds	9:58:56 AM - 10:10:55 AM
Drive	22 seconds	10:10:55 AM - 10:11:17 AM BN 128 - 148
Stop	18 minutes 19 seconds	10:11:17 AM - 10:29:36 AM
Drive	19 seconds	10:29:36 AM - 10:29:55 AM BN 149 - 167
Stop	17 minutes 37 seconds	10:29:55 AM - 10:47:32 AM
Drive	40 seconds	10:47:32 AM - 10:48:12 AM BN 168 - 204
Stop	19 minutes 4 seconds	10:48:12 AM - 11:07:16 AM
Drive	38 seconds	11:07:16 AM - 11:07:54 AM BN 205 - 240

Total time [1:58:11] = (Driving [0:04:14] + Stop [1:53:57])

VTRANS RSCH011-703 - GD-7
OP: SPK

2 INCH SS;CME45C AUTO;VTRANS
Test date: 26-Sep-2008

AR: 0.92 in^2
LE: 53.80 ft
WS: 16,807.7 f/s

SP: 0.492 k/ft3
EM: 30,000 ksi
JC: 0.00

EMX: Max Transferred Energy
EF2: Energy of F^2
ER: Hammer Energy Rating
ETR: Energy Transfer Ratio
FMX: Maximum Force

VMX: Maximum Velocity
DMX: Maximum Displacement
DFN: Final Displacement
BPM: Blows per Minute

BL#	depth	BLC	EMX	EF2	ER	ETR	FMX	VMX	DMX	DFN	BPM
	ft	bl/ft	k-ft	k-ft	k-ft	(%)	kips	f/s	in	in	**
128	35.00	0	0.294	0.391	0.350	84.0	26.3	16.8	2.99	2.99	0.0
129	35.10	10	0.281	0.368	0.350	80.3	26.0	15.5	2.01	2.01	53.6
130	35.20	10	0.285	0.374	0.350	81.5	26.0	15.1	1.62	1.62	53.8
131	35.30	10	0.284	0.372	0.350	81.1	26.2	15.2	1.38	1.38	53.5
132	35.40	10	0.292	0.377	0.350	83.4	26.0	15.7	1.49	1.49	54.2
133	35.50	10	0.280	0.364	0.350	80.0	25.7	14.2	1.36	1.36	54.2
134	35.60	10	0.284	0.371	0.350	81.0	25.8	14.0	1.36	1.36	53.4
135	35.70	10	0.278	0.365	0.350	79.4	26.1	14.8	1.51	1.51	53.6
136	35.80	10	0.278	0.363	0.350	79.3	26.1	14.5	1.69	1.69	53.3
137	35.90	10	0.284	0.371	0.350	81.2	25.8	13.8	1.49	1.49	53.6
138	36.00	10	0.288	0.370	0.350	82.2	25.7	14.1	1.35	1.35	54.0
139	36.10	10	0.285	0.368	0.350	81.5	25.4	14.5	1.47	1.47	53.7
140	36.20	10	0.283	0.366	0.350	80.9	25.2	14.1	1.37	1.37	53.7
141	36.30	10	0.285	0.375	0.350	81.3	25.5	13.9	1.12	1.12	54.1
142	36.40	10	0.273	0.362	0.350	78.0	25.7	13.8	1.27	1.27	54.2
143	36.50	10	0.276	0.368	0.350	78.9	25.8	14.4	1.31	1.31	53.2
144	36.60	10	0.274	0.358	0.350	78.3	25.1	14.1	1.05	1.01	54.6
145	36.70	10	0.287	0.375	0.350	81.9	25.5	14.0	1.21	1.21	53.6
146	36.80	10	0.284	0.370	0.350	81.2	25.5	14.0	1.30	1.30	53.9
147	36.90	10	0.284	0.365	0.350	81.1	25.0	14.0	1.34	1.34	53.8
148	37.00	10	0.280	0.358	0.350	80.0	25.0	13.4	1.25	1.25	54.3
		Average	0.283	0.369	0.350	80.8	25.7	14.5	1.47	1.47	53.8
		Std. Dev.	0.005	0.007	0.000	1.5	0.4	0.8	0.39	0.40	0.4
		Maximum	0.294	0.391	0.350	84.0	26.3	16.8	2.99	2.99	54.6
		@ Blow#	128	128	128	128	128	128	128	128	144
		Minimum	0.273	0.358	0.350	78.0	25.0	13.4	1.05	1.01	53.2
		@ Blow#	142	144	128	142	148	148	144	144	143

Total number of blows analyzed: 21

Time Summary

Drive	6 seconds	9:09:43 AM - 9:09:49 AM (9/26/2008) BN 1 - 6
Stop	14 minutes 35 seconds	9:09:49 AM - 9:24:24 AM
Drive	45 seconds	9:24:24 AM - 9:25:09 AM BN 7 - 47
Stop	11 minutes 38 seconds	9:25:09 AM - 9:36:47 AM
Drive	34 seconds	9:36:47 AM - 9:37:21 AM BN 48 - 79
Stop	10 minutes 19 seconds	9:37:21 AM - 9:47:40 AM
Drive	34 seconds	9:47:40 AM - 9:48:14 AM BN 80 - 111
Stop	10 minutes 26 seconds	9:48:14 AM - 9:58:40 AM
Drive	16 seconds	9:58:40 AM - 9:58:56 AM BN 112 - 127
Stop	11 minutes 59 seconds	9:58:56 AM - 10:10:55 AM
Drive	22 seconds	10:10:55 AM - 10:11:17 AM BN 128 - 148
Stop	18 minutes 19 seconds	10:11:17 AM - 10:29:36 AM
Drive	19 seconds	10:29:36 AM - 10:29:55 AM BN 149 - 167
Stop	17 minutes 37 seconds	10:29:55 AM - 10:47:32 AM
Drive	40 seconds	10:47:32 AM - 10:48:12 AM BN 168 - 204
Stop	19 minutes 4 seconds	10:48:12 AM - 11:07:16 AM
Drive	38 seconds	11:07:16 AM - 11:07:54 AM BN 205 - 240

Total time [1:58:11] = (Driving [0:04:14] + Stop [1:53:57])

Geosciences Testing & Research Inc
Case Method Results

PDIPLOT Ver. 2008.2 - Printed: 3-Apr-2009

VTRANS RSCH011-703 - GD-7
OP: SPK

2 INCH SS;CME45C AUTO;VTRANS
Test date: 26-Sep-2008

AR: 0.92 in^2
LE: 53.80 ft
WS: 16,807.7 f/s

SP: 0.492 k/ft3
EM: 30,000 ksi
JC: 0.00

EMX: Max Transferred Energy
EF2: Energy of F^2
ER: Hammer Energy Rating
ETR: Energy Transfer Ratio
FMX: Maximum Force

VMX: Maximum Velocity
DMX: Maximum Displacement
DFN: Final Displacement
BPM: Blows per Minute

BL#	depth	BLC	EMX	EF2	ER	ETR	FMX	VMX	DMX	DFN	BPM
	ft	bl/ft	k-ft	k-ft	k-ft	(%)	kips	f/s	in	in	**
149	40.00	0	0.289	0.378	0.350	82.5	25.9	16.0	2.18	2.18	0.0
150	40.11	9	0.302	0.385	0.350	86.4	26.4	15.8	1.74	1.74	52.7
151	40.22	9	0.290	0.375	0.350	82.9	25.9	16.0	1.48	1.48	53.5
152	40.33	9	0.291	0.380	0.350	83.2	26.5	15.3	1.67	1.67	53.6
153	40.44	9	0.285	0.369	0.350	81.5	26.1	16.0	1.75	1.75	53.7
154	40.56	9	0.296	0.378	0.350	84.4	25.9	14.2	1.86	1.86	54.5
155	40.67	9	0.297	0.385	0.350	84.9	26.5	14.0	1.36	1.32	53.5
156	40.78	9	0.297	0.381	0.350	84.8	26.2	13.8	1.80	1.80	53.5
157	40.89	9	0.290	0.378	0.350	83.0	26.1	14.6	2.09	2.09	53.9
158	41.00	9	0.285	0.371	0.350	81.3	26.1	14.5	1.96	1.96	53.6
159	41.11	9	0.287	0.371	0.350	82.0	26.3	14.5	1.85	1.85	53.8
160	41.22	9	0.292	0.379	0.350	83.4	26.0	13.8	1.48	1.48	53.6
161	41.33	9	0.288	0.375	0.350	82.4	26.0	13.7	1.46	1.46	53.8
162	41.44	9	0.288	0.374	0.350	82.4	26.0	13.8	1.59	1.59	54.2
163	41.56	9	0.295	0.379	0.350	84.4	26.1	13.8	1.49	1.49	54.0
164	41.67	9	0.291	0.377	0.350	83.0	25.7	13.5	0.86	0.86	53.9
165	41.78	9	0.283	0.364	0.350	80.9	26.0	13.6	1.11	1.11	54.1
166	41.89	9	0.296	0.380	0.350	84.5	26.0	13.6	1.03	1.03	53.9
167	42.00	9	0.281	0.363	0.350	80.4	25.2	13.4	1.11	1.11	54.5
		Average	0.291	0.376	0.350	83.1	26.0	14.4	1.57	1.57	53.8
		Std. Dev.	0.005	0.006	0.000	1.5	0.3	0.9	0.35	0.36	0.4
		Maximum	0.302	0.385	0.350	86.4	26.5	16.0	2.18	2.18	54.5
		@ Blow#	150	150	149	150	155	151	149	149	154
		Minimum	0.281	0.363	0.350	80.4	25.2	13.4	0.86	0.86	52.7
		@ Blow#	167	167	149	167	167	167	164	164	150

Total number of blows analyzed: 19

Time Summary

Drive	6 seconds	9:09:43 AM - 9:09:49 AM (9/26/2008) BN 1 - 6
Stop	14 minutes 35 seconds	9:09:49 AM - 9:24:24 AM
Drive	45 seconds	9:24:24 AM - 9:25:09 AM BN 7 - 47
Stop	11 minutes 38 seconds	9:25:09 AM - 9:36:47 AM
Drive	34 seconds	9:36:47 AM - 9:37:21 AM BN 48 - 79
Stop	10 minutes 19 seconds	9:37:21 AM - 9:47:40 AM
Drive	34 seconds	9:47:40 AM - 9:48:14 AM BN 80 - 111
Stop	10 minutes 26 seconds	9:48:14 AM - 9:58:40 AM
Drive	16 seconds	9:58:40 AM - 9:58:56 AM BN 112 - 127
Stop	11 minutes 59 seconds	9:58:56 AM - 10:10:55 AM
Drive	22 seconds	10:10:55 AM - 10:11:17 AM BN 128 - 148
Stop	18 minutes 19 seconds	10:11:17 AM - 10:29:36 AM
Drive	19 seconds	10:29:36 AM - 10:29:55 AM BN 149 - 167
Stop	17 minutes 37 seconds	10:29:55 AM - 10:47:32 AM
Drive	40 seconds	10:47:32 AM - 10:48:12 AM BN 168 - 204
Stop	19 minutes 4 seconds	10:48:12 AM - 11:07:16 AM
Drive	38 seconds	11:07:16 AM - 11:07:54 AM BN 205 - 240

Total time [1:58:11] = (Driving [0:04:14] + Stop [1:53:57])

VTRANS RSCH011-703 - GD-7
OP: SPK

2 INCH SS;CME45C AUTO;VTRANS
Test date: 26-Sep-2008

AR: 0.92 in^2
LE: 53.80 ft
WS: 16,807.7 f/s

SP: 0.492 k/ft3
EM: 30,000 ksi
JC: 0.00

EMX: Max Transferred Energy
EF2: Energy of F^2
ER: Hammer Energy Rating
ETR: Energy Transfer Ratio
FMX: Maximum Force

VMX: Maximum Velocity
DMX: Maximum Displacement
DFN: Final Displacement
BPM: Blows per Minute

BL#	depth	BLC	EMX	EF2	ER	ETR	FMX	VMX	DMX	DFN	BPM
	ft	bl/ft	k-ft	k-ft	k-ft	(%)	kips	f/s	in	in	**
168	45.00	0	0.283	0.366	0.350	80.9	26.0	13.9	1.45	1.45	0.0
169	45.06	18	0.285	0.364	0.350	81.4	26.2	13.8	1.41	1.41	53.4
170	45.11	18	0.273	0.353	0.350	77.9	25.7	13.8	1.58	1.58	53.2
171	45.17	18	0.278	0.360	0.350	79.5	26.0	13.7	1.18	1.18	53.7
172	45.22	18	0.275	0.358	0.350	78.5	25.8	13.7	0.91	0.91	53.9
173	45.28	18	0.270	0.351	0.350	77.2	25.9	13.6	0.76	0.76	53.9
174	45.33	18	0.277	0.351	0.350	79.2	25.3	13.3	1.06	1.06	53.9
175	45.39	18	0.281	0.355	0.350	80.3	25.4	13.4	1.03	1.03	53.9
176	45.44	18	0.273	0.353	0.350	78.1	25.1	13.3	0.93	0.93	53.3
177	45.50	18	0.277	0.350	0.350	79.3	25.1	13.0	0.91	0.91	53.3
178	45.56	18	0.276	0.346	0.350	78.8	25.0	12.7	0.95	0.95	54.3
179	45.61	18	0.275	0.345	0.350	78.6	25.0	12.8	0.78	0.78	53.2
180	45.67	18	0.280	0.347	0.350	80.1	25.5	12.9	0.99	0.99	54.1
181	45.72	18	0.279	0.346	0.350	79.8	25.3	13.4	1.25	1.25	53.7
182	45.78	18	0.275	0.350	0.350	78.6	25.0	12.8	0.67	0.63	53.6
183	45.83	18	0.269	0.340	0.350	76.8	24.3	13.1	0.98	0.98	53.4
184	45.89	18	0.269	0.342	0.350	76.8	24.6	13.1	0.82	0.82	53.8
185	45.94	18	0.260	0.329	0.350	74.3	24.4	12.9	1.13	1.13	53.5
186	46.00	18	0.265	0.339	0.350	75.8	24.5	13.1	0.64	0.54	53.1
187	46.06	18	0.269	0.338	0.350	76.9	24.6	13.2	1.51	1.51	53.7
188	46.11	18	0.258	0.334	0.350	73.6	24.6	12.8	0.63	0.28	54.2
189	46.17	18	0.268	0.331	0.350	76.6	24.7	12.9	1.54	1.54	53.5
190	46.22	18	0.263	0.333	0.350	75.3	24.8	12.9	1.19	1.19	53.7
191	46.28	18	0.256	0.330	0.350	73.1	24.4	12.9	0.62	0.61	53.5
192	46.33	18	0.261	0.334	0.350	74.7	24.6	12.9	1.12	1.12	53.2
193	46.39	18	0.259	0.333	0.350	73.9	24.4	13.0	0.60	0.26	54.0
194	46.44	18	0.265	0.343	0.350	75.6	24.9	13.2	0.82	0.82	52.9
195	46.50	18	0.260	0.338	0.350	74.3	24.7	13.3	0.61	0.48	53.6
196	46.56	18	0.267	0.347	0.350	76.2	24.6	13.1	1.12	1.12	53.8
197	46.61	18	0.275	0.354	0.350	78.5	25.0	13.4	0.89	0.89	53.3
198	46.67	18	0.261	0.341	0.350	74.6	24.7	13.6	0.59	0.46	54.0
199	46.72	18	0.267	0.349	0.350	76.3	24.8	13.8	0.80	0.80	53.4
200	46.78	18	0.273	0.352	0.350	77.9	24.9	13.5	0.92	0.92	53.2
201	46.83	18	0.263	0.336	0.350	75.0	24.3	13.8	1.01	1.01	54.3
202	46.89	18	0.270	0.348	0.350	77.1	24.5	13.7	0.59	0.45	53.4
203	46.94	18	0.267	0.339	0.350	76.3	24.4	13.6	0.65	0.65	53.5
204	47.00	18	0.272	0.356	0.350	77.8	25.3	13.8	0.61	0.54	53.3
		Average	0.270	0.345	0.350	77.2	25.0	13.3	0.95	0.92	53.6
		Std. Dev.	0.007	0.009	0.000	2.1	0.5	0.4	0.29	0.34	0.3
		Maximum	0.285	0.366	0.350	81.4	26.2	13.9	1.58	1.58	54.3
		@ Blow#	169	168	168	169	169	168	170	170	178
		Minimum	0.256	0.329	0.350	73.1	24.3	12.7	0.59	0.26	52.9
		@ Blow#	191	185	168	191	201	178	202	193	194

Total number of blows analyzed: 37

Time Summary

Drive	6 seconds	9:09:43 AM - 9:09:49 AM (9/26/2008) BN 1 - 6
Stop	14 minutes 35 seconds	9:09:49 AM - 9:24:24 AM
Drive	45 seconds	9:24:24 AM - 9:25:09 AM BN 7 - 47
Stop	11 minutes 38 seconds	9:25:09 AM - 9:36:47 AM
Drive	34 seconds	9:36:47 AM - 9:37:21 AM BN 48 - 79
Stop	10 minutes 19 seconds	9:37:21 AM - 9:47:40 AM
Drive	34 seconds	9:47:40 AM - 9:48:14 AM BN 80 - 111
Stop	10 minutes 26 seconds	9:48:14 AM - 9:58:40 AM
Drive	16 seconds	9:58:40 AM - 9:58:56 AM BN 112 - 127
Stop	11 minutes 59 seconds	9:58:56 AM - 10:10:55 AM
Drive	22 seconds	10:10:55 AM - 10:11:17 AM BN 128 - 148

VTRANS RSCH011-703 - GD-7
OP: SPK

2 INCH SS;CME45C AUTO;VTRANS
Test date: 26-Sep-2008

AR: 0.92 in^2
LE: 53.80 ft
WS: 16,807.7 f/s

SP: 0.492 k/ft3
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EMX: Max Transferred Energy
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DFN: Final Displacement
BPM: Blows per Minute

BL#	depth	BLC	EMX	EF2	ER	ETR	FMX	VMX	DMX	DFN	BPM
	ft	bl/ft	k-ft	k-ft	k-ft	(%)	kips	f/s	in	in	**
205	50.00	0	0.277	0.350	0.350	79.3	25.8	14.1	1.02	1.02	0.0
206	50.06	18	0.268	0.341	0.350	76.5	25.2	14.0	0.71	0.32	54.6
207	50.11	18	0.295	0.358	0.350	84.2	25.6	14.4	1.63	1.63	52.7
208	50.17	18	0.282	0.353	0.350	80.4	24.7	14.9	0.97	0.97	54.0
209	50.23	18	0.277	0.351	0.350	79.2	25.0	15.0	0.88	0.88	53.2
210	50.29	18	0.275	0.347	0.350	78.6	24.3	14.7	0.82	0.82	54.2
211	50.34	18	0.275	0.350	0.350	78.5	24.9	14.4	0.93	0.93	53.1
212	50.40	18	0.272	0.348	0.350	77.7	24.5	14.2	0.67	0.54	53.3
213	50.46	18	0.281	0.357	0.350	80.2	24.9	14.4	0.70	0.59	53.8
214	50.51	18	0.278	0.349	0.350	79.4	24.7	14.0	0.96	0.96	54.3
215	50.57	18	0.279	0.353	0.350	79.7	24.2	14.5	1.06	1.06	53.1
216	50.63	18	0.282	0.348	0.350	80.7	23.9	14.6	0.76	0.72	53.1
217	50.69	18	0.278	0.343	0.350	79.5	24.3	14.5	1.15	1.15	54.0
218	50.74	18	0.283	0.349	0.350	80.8	24.2	14.6	1.02	1.02	53.6
219	50.80	18	0.270	0.340	0.350	77.0	23.8	14.3	0.61	0.50	53.3
220	50.86	18	0.283	0.343	0.350	80.9	23.9	14.5	0.87	0.87	53.2
221	50.91	18	0.279	0.349	0.350	79.7	24.0	14.3	0.88	0.88	53.7
222	50.97	18	0.272	0.336	0.350	77.7	23.7	14.3	0.83	0.83	53.5
223	51.03	18	0.291	0.362	0.350	83.0	23.8	15.0	0.83	0.83	53.5
224	51.09	18	0.283	0.354	0.350	80.8	23.2	15.1	0.73	0.61	53.7
225	51.14	18	0.285	0.359	0.350	81.5	23.5	14.8	0.98	0.98	53.4
226	51.20	18	0.289	0.355	0.350	82.7	23.8	15.0	1.09	1.09	54.0
227	51.26	18	0.280	0.352	0.350	79.9	22.8	15.6	0.84	0.75	52.9
228	51.31	18	0.284	0.349	0.350	81.1	23.4	15.3	1.00	1.00	53.8
229	51.37	18	0.285	0.356	0.350	81.4	23.3	15.6	0.80	0.62	54.2
230	51.43	18	0.280	0.350	0.350	80.0	23.5	15.7	0.77	0.75	53.8
231	51.49	18	0.292	0.357	0.350	83.5	24.2	15.5	1.34	1.34	52.9
232	51.54	18	0.287	0.356	0.350	81.9	24.0	15.2	0.69	0.56	54.1
233	51.60	18	0.296	0.372	0.350	84.6	23.8	15.3	0.72	0.55	53.0
234	51.66	18	0.293	0.361	0.350	83.6	23.7	14.9	1.22	1.22	53.8
235	51.71	18	0.296	0.374	0.350	84.4	24.1	15.2	0.74	0.45	53.7
236	51.77	18	0.294	0.367	0.350	84.1	23.6	15.3	1.16	1.16	53.1
237	51.83	18	0.294	0.367	0.350	84.1	23.4	15.2	0.84	0.84	54.2
238	51.89	18	0.296	0.364	0.350	84.7	23.8	15.2	0.96	0.96	53.2
239	51.94	18	0.292	0.359	0.350	83.4	23.6	15.1	0.67	0.67	54.0
240	52.00	18	0.290	0.358	0.350	83.0	23.7	15.5	0.60	0.60	53.2
		Average	0.284	0.354	0.350	81.1	24.1	14.8	0.90	0.85	53.6
		Std. Dev.	0.008	0.008	0.000	2.3	0.7	0.5	0.21	0.27	0.5
		Maximum	0.296	0.374	0.350	84.7	25.8	15.7	1.63	1.63	54.6
		@ Blow#	233	235	205	238	205	230	207	207	206
		Minimum	0.268	0.336	0.350	76.5	22.8	14.0	0.60	0.32	52.7
		@ Blow#	206	222	205	206	227	206	240	206	207

Total number of blows analyzed: 36

Time Summary

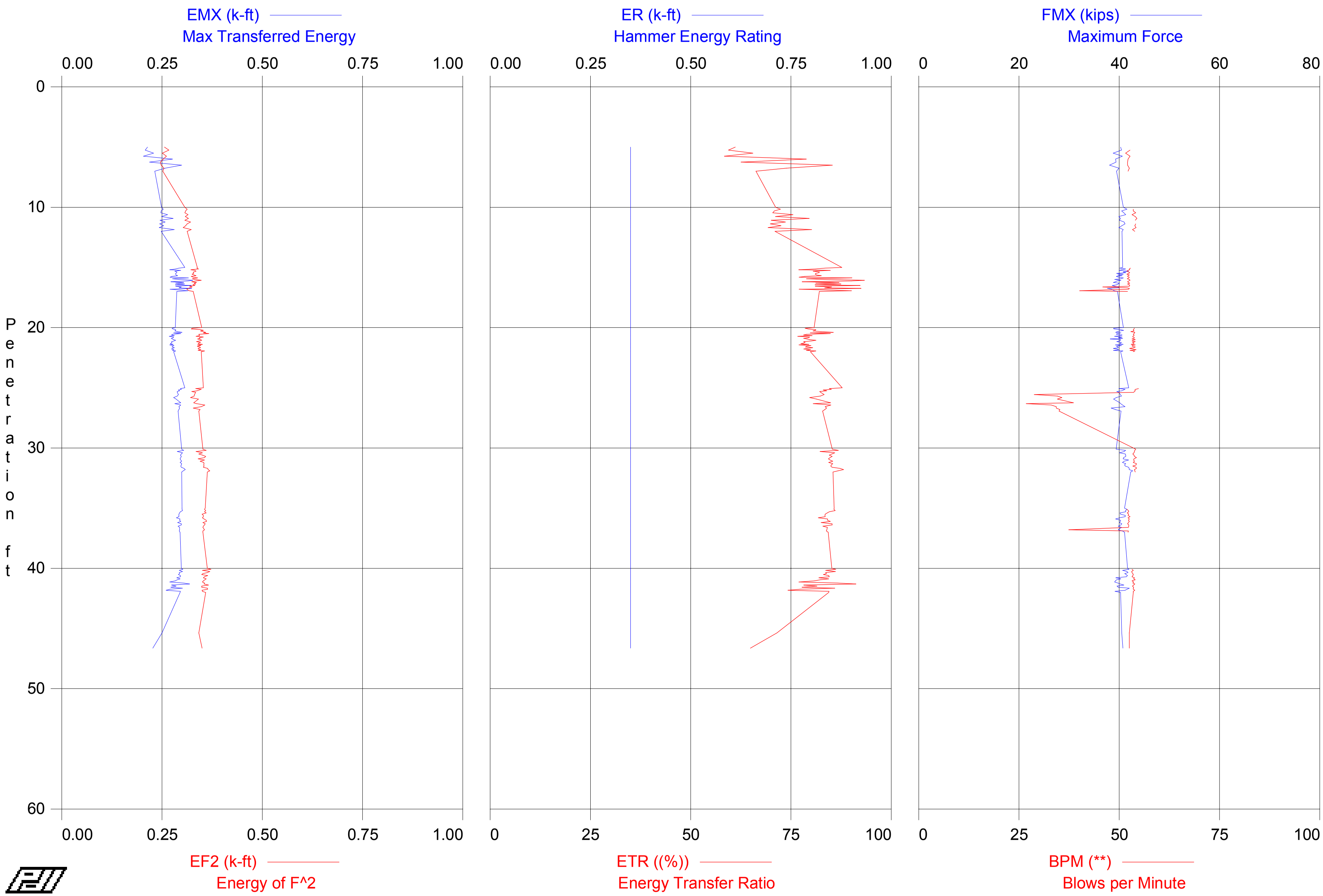
Drive	6 seconds	9:09:43 AM - 9:09:49 AM (9/26/2008) BN 1 - 6
Stop	14 minutes 35 seconds	9:09:49 AM - 9:24:24 AM
Drive	45 seconds	9:24:24 AM - 9:25:09 AM BN 7 - 47
Stop	11 minutes 38 seconds	9:25:09 AM - 9:36:47 AM
Drive	34 seconds	9:36:47 AM - 9:37:21 AM BN 48 - 79
Stop	10 minutes 19 seconds	9:37:21 AM - 9:47:40 AM
Drive	34 seconds	9:47:40 AM - 9:48:14 AM BN 80 - 111
Stop	10 minutes 26 seconds	9:48:14 AM - 9:58:40 AM
Drive	16 seconds	9:58:40 AM - 9:58:56 AM BN 112 - 127
Stop	11 minutes 59 seconds	9:58:56 AM - 10:10:55 AM
Drive	22 seconds	10:10:55 AM - 10:11:17 AM BN 128 - 148
Stop	18 minutes 19 seconds	10:11:17 AM - 10:29:36 AM

Geosciences Testing & Research Inc - Case Method Results

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

Test date: 26-Sep-2008

VTRANS RSCH011-703 - GD-8



VTRANS RSCH011-703 - GD-8
OP: SPK

2 INCH SS;CME45C AUTO;VTRANS
Test date: 26-Sep-2008

AR: 1.45 in^2
LE: 54.50 ft
WS: 16,807.7 f/s

SP: 0.492 k/ft3
EM: 30,000 ksi
JC: 0.00

EMX: Max Transferred Energy
EF2: Energy of F^2
ER: Hammer Energy Rating
ETR: Energy Transfer Ratio
FMX: Maximum Force

VMX: Maximum Velocity
DMX: Maximum Displacement
DFN: Final Displacement
BPM: Blows per Minute

Statistics for entire file (176 blows)

	EMX	EF2	ER	ETR	FMX	VMX	DMX	DFN	BPM
	k-ft	k-ft	k-ft	(%)	kips	f/s	in	in	**
Average	0.284	0.338	0.350	81.1	40.3	14.5	1.09	1.03	51.7
Std. Dev.	0.020	0.025	0.001	5.8	0.9	1.0	0.49	0.64	5.1
Maximum	0.327	0.372	0.350	93.3	42.7	16.8	2.90	2.90	54.8
@ Blow#	41	170	1	41	146	2	2	2	95
Minimum	0.204	0.246	0.350	58.4	37.6	12.0	0.08	-2.64	26.8
@ Blow#	4	6	1	4	52	215	215	215	115

Time Summary

Drive	9 seconds	12:04:42 PM - 12:04:51 PM (9/26/2008)	BN 1 - 9
Stop	11 minutes 54 seconds	12:04:51 PM - 12:16:45 PM	
Drive	17 seconds	12:16:45 PM - 12:17:02 PM	BN 10 - 23
Stop	16 minutes 26 seconds	12:17:02 PM - 12:33:28 PM	
Drive	36 seconds	12:33:28 PM - 12:34:04 PM	BN 24 - 56
Stop	13 minutes 29 seconds	12:34:04 PM - 12:47:33 PM	
Drive	40 seconds	12:47:33 PM - 12:48:13 PM	BN 57 - 93
Stop	2 days 21 hours 30 minutes 21 seconds	12:48:13 PM - 10:18:34 AM	
Drive	48 seconds	10:18:34 AM - 10:19:22 AM	BN 94 - 126
Stop	23 minutes 14 seconds	10:19:22 AM - 10:42:36 AM	
Drive	22 seconds	10:42:36 AM - 10:42:58 AM	BN 127 - 147
Stop	16 minutes 24 seconds	10:42:58 AM - 10:59:22 AM	
Drive	23 seconds	10:59:22 AM - 10:59:45 AM	BN 148 - 168
Stop	21 minutes 51 seconds	10:59:45 AM - 11:21:36 AM	
Drive	26 seconds	11:21:36 AM - 11:22:02 AM	BN 169 - 192
Stop	29 minutes 11 seconds	11:22:02 AM - 11:51:13 AM	
Drive	34 seconds	11:51:13 AM - 11:51:47 AM	BN 193 - 220
Stop	1 hour 44 seconds	11:51:47 AM - 12:52:31 PM	
Drive	41 seconds	12:52:31 PM - 12:53:12 PM	BN 221 - 246

Total time [72:48:30] = (Driving [0:04:56] + Stop [72:43:34])

VTRANS RSCH011-703 - GD-8
OP: SPK

2 INCH SS;CME45C AUTO;VTRANS
Test date: 26-Sep-2008

AR: 1.45 in^2
LE: 54.50 ft
WS: 16,807.7 f/s

SP: 0.492 k/ft3
EM: 30,000 ksi
JC: 0.00

EMX: Max Transferred Energy
EF2: Energy of F^2
ER: Hammer Energy Rating
ETR: Energy Transfer Ratio
FMX: Maximum Force

VMX: Maximum Velocity
DMX: Maximum Displacement
DFN: Final Displacement
BPM: Blows per Minute

BL#	depth	BLC	EMX	EF2	ER	ETR	FMX	VMX	DMX	DFN	BPM
	ft	bl/ft	k-ft	k-ft	k-ft	(%)	kips	f/s	in	in	**
1	5.00	4	0.214	0.256	0.350	61.1	40.3	16.4	1.98	1.98	0.0
2	5.25	4	0.208	0.267	0.350	59.4	40.5	16.8	2.90	2.90	52.7
3	5.50	4	0.229	0.251	0.350	65.5	38.8	16.8	2.66	2.62	51.6
4	5.75	4	0.204	0.261	0.350	58.4	40.6	16.5	2.53	2.49	52.7
5	6.00	4	0.276	0.253	0.350	78.8	39.3	16.0	2.49	2.49	52.2
6	6.25	4	0.219	0.246	0.350	62.5	39.4	15.6	2.16	2.16	52.1
7	6.50	4	0.299	0.248	0.350	85.3	38.0	16.5	2.62	2.62	52.1
8	6.75	4	0.258	0.255	0.350	73.8	39.9	15.5	2.20	2.20	52.5
9	7.00	4	0.232	0.252	0.350	66.3	39.5	15.4	2.19	2.19	52.2
		Average	0.238	0.254	0.350	67.9	39.6	16.2	2.42	2.41	52.3
		Std. Dev.	0.031	0.006	0.000	8.8	0.8	0.5	0.28	0.28	0.3
		Maximum	0.299	0.267	0.350	85.3	40.6	16.8	2.90	2.90	52.7
		@ Blow#	7	2	1	7	4	2	2	2	2
		Minimum	0.204	0.246	0.350	58.4	38.0	15.4	1.98	1.98	51.6
		@ Blow#	4	6	1	4	7	9	1	1	3

Total number of blows analyzed: 9

VTRANS RSCH011-703 - GD-8
OP: SPK

2 INCH SS;CME45C AUTO;VTRANS
Test date: 26-Sep-2008

AR: 1.45 in^2
LE: 54.50 ft
WS: 16,807.7 f/s

SP: 0.492 k/ft3
EM: 30,000 ksi
JC: 0.00

EMX: Max Transferred Energy
EF2: Energy of F^2
ER: Hammer Energy Rating
ETR: Energy Transfer Ratio
FMX: Maximum Force

VMX: Maximum Velocity
DMX: Maximum Displacement
DFN: Final Displacement
BPM: Blows per Minute

BL#	depth	BLC	EMX	EF2	ER	ETR	FMX	VMX	DMX	DFN	BPM
	ft	bl/ft	k-ft	k-ft	k-ft	(%)	kips	f/s	in	in	**
10	10.00	0	0.249	0.307	0.350	71.2	40.8	15.5	2.42	2.42	0.0
11	10.15	7	0.253	0.313	0.350	72.4	41.6	15.3	1.84	1.84	53.5
12	10.31	7	0.248	0.309	0.350	70.9	40.5	15.1	1.52	1.52	53.5
13	10.46	7	0.247	0.307	0.350	70.5	40.9	15.0	1.50	1.50	54.1
14	10.62	7	0.264	0.315	0.350	75.5	41.3	15.1	1.49	1.49	53.2
15	10.77	7	0.249	0.308	0.350	71.1	39.9	15.1	1.50	1.50	54.0
16	10.92	7	0.278	0.316	0.350	79.6	40.2	15.0	1.49	1.49	54.4
17	11.08	7	0.245	0.307	0.350	70.1	40.1	15.4	1.47	1.47	54.0
18	11.23	7	0.258	0.321	0.350	73.6	41.0	15.3	1.35	1.35	0.0
19	11.38	7	0.244	0.313	0.350	69.8	41.2	15.2	1.36	1.36	54.1
20	11.54	7	0.254	0.309	0.350	72.5	40.5	15.3	1.49	1.49	53.9
21	11.69	7	0.243	0.303	0.350	69.3	39.9	14.9	1.30	1.29	54.2
22	11.85	7	0.281	0.323	0.350	80.2	40.8	15.3	1.45	1.45	53.3
23	12.00	7	0.248	0.313	0.350	71.0	40.6	15.0	1.28	1.27	53.9
		Average	0.254	0.312	0.350	72.7	40.7	15.2	1.53	1.53	53.8
		Std. Dev.	0.012	0.005	0.000	3.3	0.5	0.2	0.28	0.28	0.4
		Maximum	0.281	0.323	0.350	80.2	41.6	15.5	2.42	2.42	54.4
		@ Blow#	22	22	10	22	11	10	10	10	16
		Minimum	0.243	0.303	0.350	69.3	39.9	14.9	1.28	1.27	53.2
		@ Blow#	21	21	10	21	15	21	23	23	14

Total number of blows analyzed: 14

Geosciences Testing & Research Inc
Case Method Results

PDIPLOT Ver. 2008.2 - Printed: 3-Apr-2009

VTRANS RSCH011-703 - GD-8
OP: SPK

2 INCH SS;CME45C AUTO;VTRANS
Test date: 26-Sep-2008

AR: 1.45 in^2
LE: 54.50 ft
WS: 16,807.7 f/s

SP: 0.492 k/ft3
EM: 30,000 ksi
JC: 0.00

EMX: Max Transferred Energy
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FMX: Maximum Force

VMX: Maximum Velocity
DMX: Maximum Displacement
DFN: Final Displacement
BPM: Blows per Minute

BL#	depth	BLC	EMX	EF2	ER	ETR	FMX	VMX	DMX	DFN	BPM
	ft	bl/ft	k-ft	k-ft	k-ft	(%)	kips	f/s	in	in	**
24	15.00	0	0.307	0.338	0.350	87.7	40.7	15.5	1.50	1.50	0.0
25	15.06	16	0.292	0.337	0.350	83.5	40.1	14.8	0.99	0.99	52.8
26	15.13	16	0.284	0.341	0.350	81.2	41.3	13.5	0.74	0.70	52.5
27	15.19	16	0.269	0.322	0.350	76.9	40.5	12.9	0.68	0.68	52.6
28	15.25	16	0.297	0.332	0.350	84.8	40.0	13.7	0.73	0.73	52.2
29	15.31	16	0.282	0.335	0.350	80.5	41.8	13.1	0.55	0.41	51.9
30	15.38	16	0.287	0.329	0.350	82.1	40.8	12.8	0.56	0.56	52.4
31	15.44	16	0.287	0.328	0.350	82.0	41.3	13.0	0.67	0.67	52.6
32	15.50	16	0.284	0.329	0.350	81.2	39.5	12.9	0.53	0.45	52.4
33	15.56	16	0.284	0.325	0.350	81.0	40.8	13.4	0.70	0.70	51.9
34	15.63	16	0.285	0.330	0.350	81.4	39.7	13.2	0.64	0.64	52.5
35	15.69	16	0.289	0.335	0.350	82.6	40.6	13.0	0.64	0.64	52.2
36	15.75	16	0.275	0.323	0.350	78.5	39.4	12.9	0.69	0.69	52.1
37	15.81	16	0.270	0.328	0.350	77.0	39.9	13.2	0.63	0.59	52.5
38	15.88	16	0.316	0.339	0.350	90.2	40.8	13.7	0.89	0.89	52.4
39	15.94	16	0.276	0.326	0.350	78.8	40.3	13.5	0.70	0.59	52.0
40	16.00	16	0.292	0.331	0.350	83.4	39.1	13.3	0.77	0.77	52.5
41	16.06	16	0.327	0.348	0.350	93.3	40.3	13.9	0.88	0.88	52.7
42	16.13	16	0.315	0.335	0.350	90.0	39.6	14.1	0.90	0.90	52.4
43	16.19	16	0.272	0.324	0.350	77.8	39.2	13.8	0.78	0.69	52.1
44	16.25	16	0.304	0.336	0.350	87.0	38.8	13.8	0.89	0.87	52.3
45	16.31	16	0.284	0.330	0.350	81.2	40.0	13.8	0.85	0.78	52.6
46	16.38	16	0.306	0.334	0.350	87.5	39.8	14.3	0.95	0.95	52.1
47	16.44	16	0.283	0.327	0.350	81.0	39.5	14.6	0.94	0.94	52.5
48	16.50	16	0.323	0.332	0.350	92.3	38.6	13.7	1.14	1.14	52.6
49	16.56	16	0.284	0.319	0.350	81.0	39.1	13.9	0.95	0.95	52.5
50	16.63	16	0.298	0.325	0.350	85.1	39.9	13.5	0.86	0.81	45.9
51	16.69	16	0.292	0.319	0.350	83.4	39.9	13.4	1.05	1.05	52.0
52	16.75	16	0.324	0.315	0.350	92.5	37.6	13.6	1.07	1.07	52.5
53	16.81	16	0.270	0.312	0.350	77.0	38.5	13.6	1.10	1.10	52.4
55	16.94	16	0.315	0.318	0.350	90.1	39.0	13.8	1.51	1.51	40.1
56	17.00	16	0.287	0.328	0.350	82.1	39.6	14.2	1.14	1.14	52.1
		Average	0.292	0.329	0.350	83.6	39.9	13.6	0.86	0.84	51.8
		Std. Dev.	0.016	0.008	0.000	4.7	0.9	0.6	0.24	0.26	2.4
		Maximum	0.327	0.348	0.350	93.3	41.8	15.5	1.51	1.51	52.8
		@ Blow#	41	41	24	41	29	24	55	55	25
		Minimum	0.269	0.312	0.350	76.9	37.6	12.8	0.53	0.41	40.1
		@ Blow#	27	53	24	27	52	30	32	29	55

Total number of blows analyzed: 32

Geosciences Testing & Research Inc
Case Method Results

PDIPLOT Ver. 2008.2 - Printed: 3-Apr-2009

VTRANS RSCH011-703 - GD-8
OP: SPK

2 INCH SS;CME45C AUTO;VTRANS
Test date: 26-Sep-2008

AR: 1.45 in^2
LE: 54.50 ft
WS: 16,807.7 f/s

SP: 0.492 k/ft3
EM: 30,000 ksi
JC: 0.00

EMX: Max Transferred Energy
EF2: Energy of F^2
ER: Hammer Energy Rating
ETR: Energy Transfer Ratio
FMX: Maximum Force

VMX: Maximum Velocity
DMX: Maximum Displacement
DFN: Final Displacement
BPM: Blows per Minute

BL#	depth	BLC	EMX	EF2	ER	ETR	FMX	VMX	DMX	DFN	BPM
	ft	bl/ft	k-ft	k-ft	k-ft	(%)	kips	f/s	in	in	**
57	20.00	0	0.283	0.349	0.350	80.8	40.8	14.0	1.62	1.62	0.0
58	20.06	18	0.275	0.326	0.350	78.5	38.9	13.4	1.00	0.88	53.8
59	20.11	18	0.277	0.323	0.350	79.2	39.0	13.2	1.30	1.30	53.7
60	20.17	18	0.284	0.346	0.350	81.2	40.3	13.7	1.39	1.39	53.5
61	20.22	18	0.284	0.353	0.350	81.1	40.9	13.3	1.02	1.02	53.6
62	20.28	18	0.282	0.346	0.350	80.5	40.2	13.7	1.05	1.05	53.7
63	20.33	18	0.289	0.352	0.350	82.5	39.7	13.9	0.93	0.92	52.9
64	20.39	18	0.300	0.359	0.350	85.6	39.3	14.2	1.05	1.05	53.9
65	20.44	18	0.279	0.353	0.350	79.8	40.4	13.8	1.06	1.06	53.8
66	20.50	18	0.297	0.367	0.350	84.9	39.5	13.7	0.86	0.86	53.7
67	20.56	18	0.276	0.342	0.350	78.9	39.5	13.4	0.91	0.91	53.5
68	20.61	18	0.274	0.343	0.350	78.1	40.6	13.9	1.12	1.12	53.7
69	20.67	18	0.281	0.344	0.350	80.3	40.3	14.1	0.83	0.80	53.7
70	20.72	18	0.268	0.335	0.350	76.7	39.1	13.9	0.81	0.81	53.4
71	20.78	18	0.279	0.353	0.350	79.6	40.6	13.9	0.83	0.83	53.4
72	20.83	18	0.278	0.343	0.350	79.4	39.8	13.0	0.85	0.84	53.8
73	20.89	18	0.273	0.345	0.350	78.1	40.7	14.2	0.77	0.76	53.7
74	20.94	18	0.276	0.339	0.350	79.0	38.2	13.2	0.79	0.73	53.2
75	21.00	18	0.279	0.346	0.350	79.7	40.3	14.0	1.01	1.01	54.0
76	21.06	18	0.284	0.349	0.350	81.2	40.3	13.4	0.94	0.94	53.5
77	21.11	18	0.280	0.343	0.350	80.1	40.0	13.7	0.79	0.79	53.2
78	21.17	18	0.274	0.336	0.350	78.2	39.5	13.5	0.79	0.79	54.0
79	21.22	18	0.275	0.346	0.350	78.5	40.4	13.7	0.88	0.88	53.3
80	21.28	18	0.273	0.342	0.350	78.1	40.2	13.7	0.58	0.48	53.7
81	21.33	18	0.271	0.340	0.350	77.5	40.2	14.0	0.64	0.64	53.6
82	21.39	18	0.278	0.351	0.350	79.4	40.8	13.9	0.60	0.60	53.0
83	21.44	18	0.269	0.339	0.350	77.0	39.2	13.7	0.59	0.59	54.0
84	21.50	18	0.280	0.347	0.350	80.0	40.5	13.1	0.58	0.52	53.2
85	21.56	18	0.276	0.338	0.350	78.9	39.4	12.3	0.85	0.85	53.3
86	21.61	18	0.275	0.343	0.350	78.6	39.7	13.3	0.65	0.65	54.0
87	21.67	18	0.281	0.346	0.350	80.4	39.9	13.0	0.75	0.75	53.6
88	21.72	18	0.276	0.340	0.350	79.0	38.8	12.8	0.62	0.62	52.6
89	21.78	18	0.274	0.341	0.350	78.2	39.6	12.6	0.87	0.87	53.4
90	21.83	18	0.280	0.347	0.350	79.9	39.9	13.2	0.80	0.80	54.2
91	21.89	18	0.276	0.340	0.350	78.8	38.8	12.7	0.54	0.52	52.7
92	21.94	18	0.284	0.356	0.350	81.2	40.7	13.9	0.68	0.68	53.9
93	22.00	18	0.279	0.348	0.350	79.8	40.3	13.9	0.59	0.59	53.5
		Average	0.279	0.345	0.350	79.7	39.9	13.5	0.86	0.85	53.5
		Std. Dev.	0.006	0.008	0.000	1.8	0.7	0.5	0.23	0.24	0.4
		Maximum	0.300	0.367	0.350	85.6	40.9	14.2	1.62	1.62	54.2
		@ Blow#	64	66	57	64	61	73	57	57	90
		Minimum	0.268	0.323	0.350	76.7	38.2	12.3	0.54	0.48	52.6
		@ Blow#	70	59	57	70	74	85	91	80	88

Total number of blows analyzed: 37

VTRANS RSCH011-703 - GD-8
2 INCH SS;CME45C AUTO;VTRANS
OP: SPK
Test date: 26-Sep-2008

AR: 1.45 in^2
LE: 54.50 ft
WS: 16,807.7 f/s
SP: 0.492 k/ft3
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DFN: Final Displacement
BPM: Blows per Minute

BL#	depth	BLC	EMX	EF2	ER	ETR	FMX	VMX	DMX	DFN	BPM
	ft	bl/ft	k-ft	k-ft	k-ft	(%)	kips	f/s	in	in	**
94	25.00	0	0.307	0.353	0.350	87.8	41.9	15.0	1.46	1.46	0.0
95	25.06	16	0.296	0.334	0.350	84.6	39.9	14.4	1.09	1.09	54.8
96	25.13	16	0.298	0.348	0.350	85.1	41.2	14.9	1.09	1.09	54.1
97	25.19	16	0.291	0.343	0.350	83.0	40.9	14.6	0.64	0.61	53.9
98	25.25	16	0.294	0.337	0.350	83.9	40.5	14.7	0.68	0.68	54.0
99	25.31	16	0.288	0.324	0.350	82.2	39.5	14.5	0.75	0.75	53.8
100	25.38	16	0.288	0.334	0.350	82.4	39.9	14.1	0.67	0.67	53.6
103	25.56	16	0.291	0.331	0.350	83.3	40.2	14.2	0.77	0.77	28.8
105	25.69	16	0.288	0.330	0.350	82.3	40.5	14.4	0.88	0.88	34.6
107	25.81	16	0.279	0.321	0.350	79.7	39.4	14.3	0.90	0.90	35.7
109	25.94	16	0.285	0.341	0.350	81.4	38.9	13.9	0.83	0.83	34.6
114	26.25	16	0.297	0.329	0.350	84.9	40.1	14.7	0.80	0.80	38.6
115	26.31	16	0.282	0.336	0.350	80.5	40.3	14.1	0.77	0.77	26.8
117	26.44	16	0.297	0.357	0.350	85.0	40.7	14.3	0.59	0.59	33.1
119	26.56	16	0.292	0.348	0.350	83.5	41.2	14.6	0.74	0.74	34.3
121	26.69	16	0.294	0.328	0.350	83.9	38.4	14.0	0.78	0.78	34.3
123	26.81	16	0.292	0.345	0.350	83.5	39.3	14.1	0.51	0.51	35.2
125	26.94	16	0.290	0.342	0.350	82.9	40.4	14.5	0.48	0.47	35.0
		Average	0.292	0.338	0.350	83.3	40.2	14.4	0.80	0.80	40.9
		Std. Dev.	0.006	0.010	0.000	1.8	0.8	0.3	0.23	0.23	10.0
		Maximum	0.307	0.357	0.350	87.8	41.9	15.0	1.46	1.46	54.8
		@ Blow#	94	117	94	94	94	94	94	94	95
		Minimum	0.279	0.321	0.350	79.7	38.4	13.9	0.48	0.47	26.8
		@ Blow#	107	107	94	107	121	109	125	125	115

Total number of blows analyzed: 18

Geosciences Testing & Research Inc
Case Method Results

PDIPLOT Ver. 2008.2 - Printed: 3-Apr-2009

VTRANS RSCH011-703 - GD-8
OP: SPK

2 INCH SS;CME45C AUTO;VTRANS
Test date: 26-Sep-2008

AR: 1.45 in^2
LE: 54.50 ft
WS: 16,807.7 f/s

SP: 0.492 k/ft3
EM: 30,000 ksi
JC: 0.00

EMX: Max Transferred Energy
EF2: Energy of F^2
ER: Hammer Energy Rating
ETR: Energy Transfer Ratio
FMX: Maximum Force

VMX: Maximum Velocity
DMX: Maximum Displacement
DFN: Final Displacement
BPM: Blows per Minute

BL#	depth	BLC	EMX	EF2	ER	ETR	FMX	VMX	DMX	DFN	BPM
	ft	bl/ft	k-ft	k-ft	k-ft	(%)	kips	f/s	in	in	**
128	30.10	10	0.299	0.352	0.350	85.3	39.4	15.1	1.71	1.71	54.1
129	30.20	10	0.304	0.360	0.350	86.8	41.3	15.2	1.65	1.65	53.9
130	30.30	10	0.288	0.335	0.350	82.2	41.0	15.2	1.43	1.41	53.8
131	30.40	10	0.301	0.351	0.350	85.9	40.1	15.2	1.58	1.58	53.7
132	30.50	10	0.298	0.342	0.350	85.2	41.2	15.2	1.40	1.38	53.4
133	30.60	10	0.296	0.351	0.350	84.5	41.3	15.2	1.58	1.58	53.7
134	30.70	10	0.298	0.359	0.350	85.3	41.3	15.2	1.32	1.31	53.8
135	30.80	10	0.297	0.356	0.350	84.7	40.9	15.1	1.28	1.27	54.3
136	30.90	10	0.295	0.340	0.350	84.4	40.8	15.1	1.55	1.55	53.7
137	31.00	10	0.297	0.356	0.350	84.8	41.9	15.3	1.25	1.20	53.6
138	31.10	10	0.299	0.345	0.350	85.4	41.0	15.2	1.34	1.34	53.8
139	31.20	10	0.295	0.354	0.350	84.4	40.6	15.1	1.16	1.10	53.5
140	31.30	10	0.299	0.355	0.350	85.4	41.3	15.1	1.20	1.20	54.3
141	31.40	10	0.298	0.354	0.350	85.1	41.1	15.4	1.11	1.11	54.2
142	31.50	10	0.297	0.355	0.350	84.9	41.2	15.2	1.10	1.10	53.4
143	31.60	10	0.298	0.353	0.350	85.2	41.8	15.3	1.11	1.11	54.2
144	31.70	10	0.305	0.364	0.350	87.2	42.0	15.9	1.04	0.98	54.3
145	31.80	10	0.308	0.365	0.350	88.1	42.0	15.8	1.45	1.45	53.8
146	31.90	10	0.303	0.369	0.350	86.7	42.7	15.8	1.05	0.95	53.9
147	32.00	10	0.299	0.363	0.350	85.5	42.3	15.6	1.28	1.28	54.0
		Average	0.299	0.354	0.350	85.4	41.3	15.3	1.33	1.31	53.9
		Std. Dev.	0.004	0.008	0.000	1.2	0.7	0.3	0.20	0.22	0.3
		Maximum	0.308	0.369	0.350	88.1	42.7	15.9	1.71	1.71	54.3
		@ Blow#	145	146	128	145	146	144	128	128	135
		Minimum	0.288	0.335	0.350	82.2	39.4	15.1	1.04	0.95	53.4
		@ Blow#	130	130	128	130	128	136	144	146	132

Total number of blows analyzed: 20

VTRANS RSCH011-703 - GD-8
OP: SPK

2 INCH SS;CME45C AUTO;VTRANS
Test date: 26-Sep-2008

AR: 1.45 in^2
LE: 54.50 ft
WS: 16,807.7 f/s

SP: 0.492 k/ft3
EM: 30,000 ksi
JC: 0.00

EMX: Max Transferred Energy
EF2: Energy of F^2
ER: Hammer Energy Rating
ETR: Energy Transfer Ratio
FMX: Maximum Force

VMX: Maximum Velocity
DMX: Maximum Displacement
DFN: Final Displacement
BPM: Blows per Minute

BL#	depth ft	BLC bl/ft	EMX k-ft	EF2 k-ft	ER k-ft	ETR (%)	FMX kips	VMX f/s	DMX in	DFN in	BPM **
148	35.00	0	0.300	0.358	0.350	85.8	41.1	15.3	2.04	2.04	0.0
149	35.10	10	0.300	0.356	0.350	85.7	41.5	15.1	1.77	1.77	51.9
150	35.20	10	0.301	0.359	0.350	86.0	41.3	15.3	1.45	1.45	52.3
151	35.30	10	0.296	0.356	0.350	84.6	41.3	14.9	1.55	1.55	52.4
152	35.40	10	0.294	0.360	0.350	84.1	40.2	14.7	1.29	1.29	52.0
153	35.50	10	0.292	0.350	0.350	83.5	40.3	14.8	1.39	1.39	52.4
154	35.60	10	0.292	0.353	0.350	83.5	41.2	14.8	1.33	1.33	52.2
155	35.70	10	0.292	0.353	0.350	83.5	41.2	14.8	1.40	1.40	52.7
156	35.80	10	0.286	0.351	0.350	81.8	40.1	14.5	1.47	1.47	52.2
157	35.90	10	0.295	0.355	0.350	84.1	39.3	15.1	1.56	1.56	52.5
158	36.00	10	0.294	0.360	0.350	84.1	40.3	14.9	1.05	1.05	52.3
159	36.10	10	0.297	0.361	0.350	84.8	40.2	15.1	0.92	0.86	52.5
160	36.20	10	0.289	0.352	0.350	82.5	40.0	14.8	0.92	0.90	52.3
161	36.30	10	0.298	0.358	0.350	85.2	40.5	15.3	0.93	0.87	52.1
162	36.40	10	0.298	0.356	0.350	85.3	40.4	14.7	1.15	1.15	52.4
163	36.50	10	0.290	0.353	0.350	83.0	39.8	15.0	0.93	0.86	52.4
164	36.60	10	0.294	0.352	0.350	84.1	40.4	15.3	0.98	0.93	52.3
166	36.80	10	0.294	0.356	0.350	83.9	39.8	15.0	1.15	1.15	37.4
167	36.90	10	0.293	0.352	0.350	83.8	40.6	14.7	1.13	1.12	52.3
168	37.00	10	0.295	0.352	0.350	84.3	41.1	14.5	1.18	1.18	52.2
		Average	0.295	0.355	0.350	84.2	40.5	14.9	1.28	1.26	51.5
		Std. Dev.	0.004	0.003	0.000	1.1	0.6	0.3	0.30	0.31	3.3
		Maximum	0.301	0.361	0.350	86.0	41.5	15.3	2.04	2.04	52.7
		@ Blow#	150	159	148	150	149	150	148	148	155
		Minimum	0.286	0.350	0.350	81.8	39.3	14.5	0.92	0.86	37.4
		@ Blow#	156	153	148	156	157	168	159	159	166

Total number of blows analyzed: 20

VTRANS RSCH011-703 - GD-8
OP: SPK

2 INCH SS;CME45C AUTO;VTRANS
Test date: 26-Sep-2008

AR: 1.45 in^2
LE: 54.50 ft
WS: 16,807.7 f/s

SP: 0.492 k/ft3
EM: 30,000 ksi
JC: 0.00

EMX: Max Transferred Energy
EF2: Energy of F^2
ER: Hammer Energy Rating
ETR: Energy Transfer Ratio
FMX: Maximum Force

VMX: Maximum Velocity
DMX: Maximum Displacement
DFN: Final Displacement
BPM: Blows per Minute

BL#	depth	BLC	EMX	EF2	ER	ETR	FMX	VMX	DMX	DFN	BPM
	ft	bl/ft	k-ft	k-ft	k-ft	(%)	kips	f/s	in	in	**
169	40.00	0	0.298	0.363	0.350	85.2	41.7	15.8	1.72	1.72	0.0
170	40.09	12	0.302	0.372	0.350	86.2	41.9	16.5	1.56	1.56	53.2
171	40.17	12	0.293	0.351	0.350	83.6	40.7	16.2	1.29	1.29	53.5
172	40.26	12	0.301	0.369	0.350	86.1	41.6	16.0	1.38	1.38	53.1
173	40.35	12	0.293	0.363	0.350	83.6	41.8	16.0	1.55	1.55	53.2
174	40.43	12	0.294	0.352	0.350	83.9	41.1	16.0	1.54	1.54	53.4
175	40.52	12	0.291	0.349	0.350	83.1	41.4	16.1	1.72	1.72	53.5
176	40.61	12	0.296	0.364	0.350	84.4	41.6	16.0	1.35	1.34	53.4
177	40.70	12	0.296	0.356	0.350	84.5	41.4	16.1	1.18	1.17	53.2
178	40.78	12	0.287	0.353	0.350	82.0	39.3	15.5	1.15	1.15	53.8
179	40.87	12	0.295	0.360	0.350	84.4	40.3	16.2	0.70	0.65	53.6
180	40.96	12	0.288	0.357	0.350	82.3	39.5	15.5	0.79	0.76	54.0
181	41.04	12	0.283	0.353	0.350	80.9	39.3	15.5	0.50	0.19	53.2
182	41.13	12	0.269	0.351	0.350	76.9	39.1	15.2	0.50	0.23	53.6
183	41.22	12	0.304	0.356	0.350	86.7	39.7	15.0	1.16	1.16	53.4
184	41.30	12	0.319	0.355	0.350	91.2	40.2	15.2	1.04	1.02	53.9
185	41.39	12	0.274	0.366	0.350	78.2	40.9	15.5	0.41	-0.34	53.6
186	41.48	12	0.285	0.349	0.350	81.5	39.5	14.9	0.34	-0.79	53.3
187	41.57	12	0.272	0.349	0.350	77.7	39.8	14.9	0.32	-0.76	53.6
188	41.65	12	0.301	0.363	0.350	85.9	42.0	14.5	0.66	0.42	53.5
189	41.74	12	0.270	0.364	0.350	77.3	41.6	15.0	0.38	-0.39	53.5
190	41.83	12	0.260	0.350	0.350	74.2	41.2	14.4	0.24	-0.95	53.9
191	41.91	12	0.296	0.351	0.350	84.5	39.2	14.4	0.74	0.67	53.5
192	42.00	12	0.295	0.359	0.350	84.4	40.3	14.5	0.38	-0.56	53.5
		Average	0.290	0.357	0.350	82.9	40.6	15.4	0.94	0.66	53.5
		Std. Dev.	0.013	0.007	0.000	3.7	1.0	0.6	0.49	0.86	0.2
		Maximum	0.319	0.372	0.350	91.2	42.0	16.5	1.72	1.72	54.0
		@ Blow#	184	170	169	184	188	170	175	175	180
		Minimum	0.260	0.349	0.350	74.2	39.1	14.4	0.24	-0.95	53.1
		@ Blow#	190	175	169	190	182	191	190	190	172

Total number of blows analyzed: 24

VTRANS RSCH011-703 - GD-8
OP: SPK

2 INCH SS;CME45C AUTO;VTRANS
Test date: 26-Sep-2008

AR: 1.45 in^2
LE: 54.50 ft
WS: 16,807.7 f/s

SP: 0.492 k/ft3
EM: 30,000 ksi
JC: 0.00

EMX: Max Transferred Energy
EF2: Energy of F^2
ER: Hammer Energy Rating
ETR: Energy Transfer Ratio
FMX: Maximum Force

VMX: Maximum Velocity
DMX: Maximum Displacement
DFN: Final Displacement
BPM: Blows per Minute

BL#	depth	BLC	EMX	EF2	ER	ETR	FMX	VMX	DMX	DFN	BPM
	ft	bl/ft	k-ft	k-ft	k-ft	(%)	kips	f/s	in	in	**
198	45.37	14	0.250	0.342	0.350	71.5	40.5	15.2	0.48	0.12	52.5
215	46.63	14	0.227	0.350	0.350	64.9	40.8	12.0	0.08	-2.64	52.5
		Average	0.238	0.346	0.350	68.2	40.6	13.6	0.28	-1.26	52.5
		Std. Dev.	0.011	0.004	0.000	3.3	0.1	1.6	0.20	1.38	0.0
		Maximum	0.250	0.350	0.350	71.5	40.8	15.2	0.48	0.12	52.5
		@ Blow#	198	215	198	198	215	198	198	198	198
		Minimum	0.227	0.342	0.350	64.9	40.5	12.0	0.08	-2.64	52.5
		@ Blow#	215	198	198	215	198	215	215	215	198

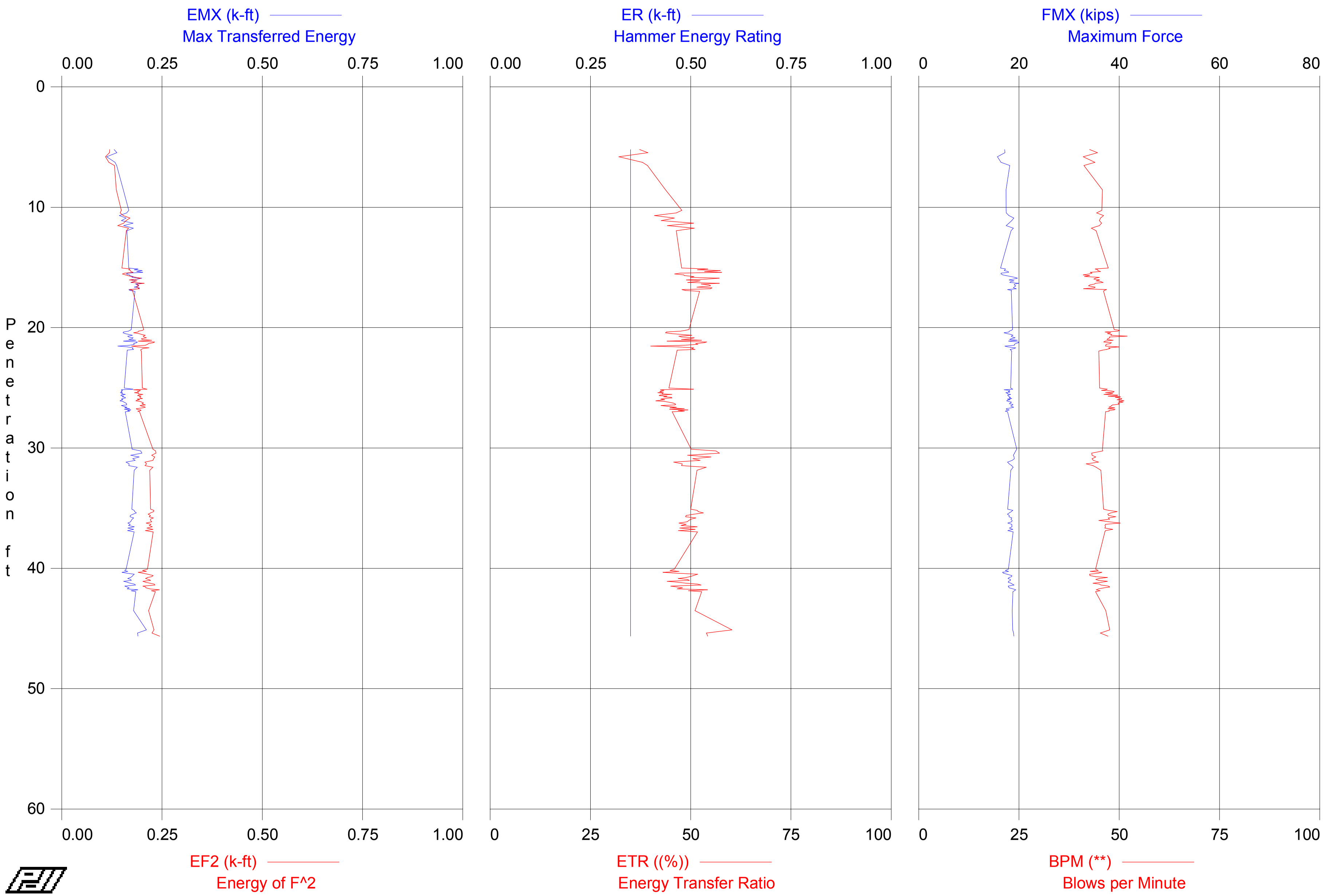
Total number of blows analyzed: 2

Geosciences Testing & Research Inc - Case Method Results

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

Test date: 29-Sep-2008

VTRANS RSCH011-703 - GD-9



VTRANS RSCH011-703 - GD-9
OP: SPK

2 INCH SS;MOBILE SAFETY DRIVE;SDI
Test date: 29-Sep-2008

AR: 0.92 in^2
LE: 53.71 ft
WS: 16,807.7 f/s

SP: 0.492 k/ft3
EM: 30,000 ksi
JC: 0.00

EMX: Max Transferred Energy
EF2: Energy of F^2
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ETR: Energy Transfer Ratio
FMX: Maximum Force

VMX: Maximum Velocity
DMX: Maximum Displacement
DFN: Final Displacement
BPM: Blows per Minute

Statistics for entire file (354 blows)

	EMX	EF2	ER	ETR	FMX	VMX	DMX	DFN	BPM
	k-ft	k-ft	k-ft	(%)	kips	f/s	in	in	**
Average	0.168	0.197	0.350	48.1	18.3	13.0	0.78	0.74	46.1
Std. Dev.	0.020	0.028	0.001	5.7	0.9	1.1	0.39	0.44	2.7
Maximum	0.220	0.255	0.350	62.9	20.6	16.2	2.24	2.24	53.3
@ Blow#	242	340	2	242	129	243	37	37	115
Minimum	0.112	0.109	0.350	32.0	15.2	10.6	0.30	-2.37	38.3
@ Blow#	7	7	2	7	38	140	191	357	9

Time Summary

Drive	20 minutes 25 seconds	9:50:46 AM - 10:11:11 AM (9/29/2008) BN 1 - 94
Stop	14 minutes 27 seconds	10:11:11 AM - 10:25:38 AM
Drive	11 minutes 39 seconds	10:25:38 AM - 10:37:17 AM BN 95 - 236
Stop	12 minutes 57 seconds	10:37:17 AM - 10:50:14 AM
Drive	39 seconds	10:50:14 AM - 10:50:53 AM BN 237 - 265
Stop	14 minutes 55 seconds	10:50:53 AM - 11:05:48 AM
Drive	11 minutes 54 seconds	11:05:48 AM - 11:17:42 AM BN 266 - 356
Stop	11 minutes 21 seconds	11:17:42 AM - 11:29:03 AM
Drive	2 minutes 51 seconds	11:29:03 AM - 11:31:54 AM BN 357 - 410
Stop	32 minutes 9 seconds	11:31:54 AM - 12:04:03 PM
Drive	3 minutes 21 seconds	12:04:03 PM - 12:07:24 PM BN 411 - 452

Total time [2:16:38] = (Driving [0:50:49] + Stop [1:25:49])

Geosciences Testing & Research Inc
Case Method Results

PDIPLOT Ver. 2008.2 - Printed: 3-Apr-2009

VTRANS RSCH011-703 - GD-9
OP: SPK

2 INCH SS;MOBILE SAFETY DRIVE;SDI
Test date: 29-Sep-2008

AR: 0.92 in^2
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SP: 0.492 k/ft3
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DMX: Maximum Displacement
DFN: Final Displacement
BPM: Blows per Minute

BL#	depth	BLC	EMX	EF2	ER	ETR	FMX	VMX	DMX	DFN	BPM
	ft	bl/ft	k-ft	k-ft	k-ft	(%)	kips	f/s	in	in	**
2	5.13	8	0.136	0.121	0.350	38.8	17.4	13.6	1.67	1.67	40.4
3	5.27	8	0.125	0.118	0.350	35.6	16.9	13.5	1.62	1.62	44.8
4	5.40	8	0.124	0.117	0.350	35.5	17.4	13.5	1.38	1.38	45.4
5	5.53	8	0.151	0.121	0.350	43.1	17.0	12.7	1.96	1.96	43.8
6	5.67	8	0.133	0.121	0.350	38.0	17.1	13.2	1.44	1.44	38.7
7	5.80	8	0.112	0.109	0.350	32.0	15.7	12.5	1.32	1.32	41.0
8	5.93	8	0.147	0.133	0.350	41.9	17.7	13.5	1.64	1.64	39.4
9	6.07	8	0.122	0.109	0.350	34.8	16.1	12.4	1.36	1.36	38.3
10	6.20	8	0.138	0.110	0.350	39.3	15.7	12.5	1.45	1.45	44.3
11	6.33	8	0.128	0.125	0.350	36.6	17.1	12.5	1.52	1.52	43.6
12	6.47	8	0.150	0.118	0.350	42.8	16.8	12.7	1.53	1.53	41.0
13	6.60	8	0.124	0.145	0.350	35.6	19.5	14.6	1.81	1.81	41.4
14	6.73	8	0.167	0.113	0.350	47.6	15.7	13.1	1.60	1.60	39.3
16	7.00	8	0.132	0.125	0.350	37.6	17.3	14.1	1.56	1.56	43.1
		Average	0.135	0.120	0.350	38.5	17.0	13.2	1.56	1.56	41.7
		Std. Dev.	0.014	0.009	0.000	4.0	1.0	0.6	0.17	0.17	2.3
		Maximum	0.167	0.145	0.350	47.6	19.5	14.6	1.96	1.96	45.4
		@ Blow#	14	13	2	14	13	13	5	5	4
		Minimum	0.112	0.109	0.350	32.0	15.7	12.4	1.32	1.32	38.3
		@ Blow#	7	7	2	7	7	9	7	7	9

Total number of blows analyzed: 14

Geosciences Testing & Research Inc
Case Method Results

PDIPLOT Ver. 2008.2 - Printed: 3-Apr-2009

VTRANS RSCH011-703 - GD-9
OP: SPK

2 INCH SS;MOBILE SAFETY DRIVE;SDI
Test date: 29-Sep-2008

AR: 0.92 in^2
LE: 53.71 ft
WS: 16,807.7 f/s

SP: 0.492 k/ft3
EM: 30,000 ksi
JC: 0.00

EMX: Max Transferred Energy
EF2: Energy of F^2
ER: Hammer Energy Rating
ETR: Energy Transfer Ratio
FMX: Maximum Force

VMX: Maximum Velocity
DMX: Maximum Displacement
DFN: Final Displacement
BPM: Blows per Minute

BL#	depth	BLC	EMX	EF2	ER	ETR	FMX	VMX	DMX	DFN	BPM
	ft	bl/ft	k-ft	k-ft	k-ft	(%)	kips	f/s	in	in	**
17	10.00	0	0.161	0.176	0.350	46.0	18.8	15.9	1.96	1.96	0.0
18	10.11	10	0.175	0.147	0.350	49.9	17.5	14.0	1.44	1.44	48.5
19	10.21	10	0.146	0.151	0.350	41.7	17.8	13.6	0.87	0.75	45.8
20	10.32	10	0.188	0.146	0.350	53.8	17.1	13.2	1.45	1.45	45.5
21	10.42	10	0.131	0.139	0.350	37.5	17.2	13.0	0.89	0.80	45.0
22	10.53	10	0.193	0.152	0.350	55.2	17.7	14.3	1.70	1.70	43.7
23	10.63	10	0.118	0.148	0.350	33.8	17.9	15.1	0.92	0.59	45.1
24	10.74	10	0.169	0.159	0.350	48.1	18.1	14.8	1.64	1.64	47.1
25	10.84	10	0.141	0.176	0.350	40.3	19.3	16.2	1.46	1.44	44.0
26	10.95	10	0.180	0.164	0.350	51.6	18.6	15.5	1.60	1.60	46.7
27	11.05	10	0.115	0.147	0.350	33.0	17.9	15.4	0.98	0.09	43.9
28	11.16	10	0.183	0.174	0.350	52.3	19.2	15.3	1.32	1.32	46.2
29	11.26	10	0.137	0.140	0.350	39.1	17.6	14.8	1.35	1.35	45.7
30	11.37	10	0.218	0.169	0.350	62.4	18.5	14.0	1.54	1.54	45.5
31	11.47	10	0.171	0.131	0.350	48.9	17.2	14.1	2.15	2.15	44.5
32	11.58	10	0.138	0.148	0.350	39.4	17.7	14.2	1.09	1.07	45.6
33	11.68	10	0.191	0.169	0.350	54.5	19.0	15.4	1.59	1.59	43.6
34	11.79	10	0.166	0.164	0.350	47.3	18.7	14.6	1.38	1.38	42.5
35	11.90	10	0.162	0.160	0.350	46.3	18.1	14.3	1.27	1.27	45.7
36	12.00	10	0.163	0.162	0.350	46.4	18.8	14.7	1.64	1.64	42.8
		Average	0.162	0.156	0.350	46.4	18.1	14.6	1.41	1.34	45.1
		Std. Dev.	0.026	0.013	0.000	7.5	0.7	0.8	0.34	0.47	1.5
		Maximum	0.218	0.176	0.350	62.4	19.3	16.2	2.15	2.15	48.5
		@ Blow#	30	17	17	30	25	25	31	31	18
		Minimum	0.115	0.131	0.350	33.0	17.1	13.0	0.87	0.09	42.5
		@ Blow#	27	31	17	27	20	21	19	27	34

Total number of blows analyzed: 20

VTRANS RSCH011-703 - GD-9
OP: SPK

2 INCH SS;MOBILE SAFETY DRIVE;SDI
Test date: 29-Sep-2008

AR: 0.92 in^2
LE: 53.71 ft
WS: 16,807.7 f/s

SP: 0.492 k/ft3
EM: 30,000 ksi
JC: 0.00

EMX: Max Transferred Energy
EF2: Energy of F^2
ER: Hammer Energy Rating
ETR: Energy Transfer Ratio
FMX: Maximum Force

VMX: Maximum Velocity
DMX: Maximum Displacement
DFN: Final Displacement
BPM: Blows per Minute

BL#	depth	BLC	EMX	EF2	ER	ETR	FMX	VMX	DMX	DFN	BPM
	ft	bl/ft	k-ft	k-ft	k-ft	(%)	kips	f/s	in	in	**
37	15.00	0	0.145	0.157	0.350	41.5	16.7	15.1	2.24	2.24	0.0
38	15.04	29	0.165	0.140	0.350	47.2	15.2	12.6	1.29	1.29	46.4
39	15.07	29	0.169	0.160	0.350	48.2	17.4	13.8	0.78	0.78	48.1
40	15.11	29	0.185	0.173	0.350	52.8	17.2	13.5	0.81	0.81	43.3
41	15.14	29	0.195	0.167	0.350	55.7	17.5	13.4	1.31	1.31	44.7
42	15.18	29	0.208	0.179	0.350	59.5	17.3	13.2	1.39	1.39	44.1
43	15.21	29	0.154	0.155	0.350	43.9	17.1	11.9	0.62	0.45	45.2
44	15.25	29	0.197	0.173	0.350	56.3	17.1	13.1	1.28	1.28	45.8
45	15.28	29	0.204	0.170	0.350	58.4	17.0	12.8	1.20	1.20	43.6
46	15.32	29	0.174	0.170	0.350	49.7	18.2	14.0	0.78	0.78	47.8
47	15.35	29	0.200	0.175	0.350	57.2	17.5	13.7	1.02	1.02	42.9
48	15.39	29	0.193	0.185	0.350	55.2	18.4	14.1	0.94	0.94	43.8
49	15.42	29	0.211	0.171	0.350	60.2	17.5	13.2	1.25	1.25	41.8
50	15.46	29	0.163	0.158	0.350	46.6	16.7	12.7	0.84	0.84	41.6
51	15.49	29	0.168	0.157	0.350	47.9	16.3	11.7	0.77	0.77	44.8
52	15.53	29	0.158	0.153	0.350	45.2	16.5	12.2	0.91	0.91	42.4
53	15.56	29	0.164	0.149	0.350	46.8	16.3	12.2	0.79	0.79	42.6
54	15.60	29	0.160	0.157	0.350	45.7	16.6	12.6	0.73	0.73	41.9
55	15.63	29	0.178	0.161	0.350	50.8	17.0	13.1	0.95	0.95	40.1
56	15.67	29	0.158	0.152	0.350	45.0	16.5	12.4	0.85	0.85	44.4
57	15.70	29	0.181	0.177	0.350	51.8	18.3	13.6	0.73	0.73	40.8
58	15.74	29	0.160	0.155	0.350	45.8	17.3	12.6	0.75	0.75	40.8
59	15.77	29	0.195	0.193	0.350	55.8	19.4	13.7	0.72	0.72	41.9
60	15.81	29	0.189	0.195	0.350	53.9	19.4	14.5	0.80	0.80	44.6
61	15.84	29	0.161	0.176	0.350	45.9	18.9	13.4	0.46	0.42	45.5
62	15.88	29	0.200	0.202	0.350	57.3	20.0	13.8	0.65	0.65	44.9
63	15.91	29	0.199	0.192	0.350	57.0	19.4	13.7	0.83	0.83	43.3
64	15.95	29	0.199	0.185	0.350	56.7	18.4	13.3	1.01	1.01	43.8
65	15.98	29	0.180	0.188	0.350	51.5	19.4	13.3	0.62	0.62	43.5
66	16.02	29	0.177	0.167	0.350	50.5	17.4	12.3	0.74	0.74	45.0
67	16.05	29	0.166	0.170	0.350	47.4	18.7	13.3	0.68	0.68	45.2
68	16.09	29	0.189	0.186	0.350	54.1	18.5	13.2	0.84	0.84	42.7
69	16.12	29	0.177	0.189	0.350	50.5	19.6	13.5	0.46	0.35	45.8
70	16.16	29	0.179	0.170	0.350	51.2	17.5	11.9	1.06	1.06	46.4
71	16.19	29	0.180	0.190	0.350	51.5	19.3	12.6	0.43	0.39	44.4
72	16.23	29	0.159	0.163	0.350	45.4	17.3	10.8	0.77	0.77	46.3
73	16.26	29	0.186	0.184	0.350	53.1	19.1	13.0	0.54	0.54	45.7
74	16.30	29	0.205	0.206	0.350	58.5	20.1	14.2	0.80	0.80	43.2
75	16.33	29	0.195	0.205	0.350	55.8	19.8	13.5	0.58	0.58	44.9
76	16.37	29	0.170	0.174	0.350	48.6	18.6	11.9	0.72	0.72	42.1
77	16.40	29	0.198	0.200	0.350	56.6	19.6	13.6	0.59	0.59	45.5
78	16.44	29	0.173	0.179	0.350	49.5	18.8	12.4	0.81	0.81	42.7
79	16.47	29	0.209	0.197	0.350	59.6	19.3	12.9	0.78	0.78	42.7
80	16.51	29	0.184	0.183	0.350	52.6	18.9	12.8	0.87	0.87	41.1
81	16.54	29	0.200	0.200	0.350	57.3	19.8	13.4	0.46	0.41	43.6
82	16.58	29	0.206	0.208	0.350	59.0	20.3	14.3	0.76	0.76	39.9
83	16.61	29	0.198	0.196	0.350	56.5	19.2	13.3	0.58	0.58	42.2
84	16.65	29	0.163	0.176	0.350	46.5	18.8	13.3	0.46	0.46	45.8
85	16.68	29	0.209	0.188	0.350	59.6	18.4	12.6	1.17	1.17	44.1
86	16.72	29	0.178	0.192	0.350	51.0	19.3	13.8	0.45	0.44	43.5
87	16.75	29	0.206	0.204	0.350	58.9	19.8	13.8	0.84	0.84	41.7
88	16.79	29	0.178	0.183	0.350	50.9	19.1	13.1	0.46	0.43	40.5
89	16.83	29	0.183	0.178	0.350	52.3	18.0	12.2	0.76	0.76	45.5
90	16.86	29	0.152	0.159	0.350	43.3	17.4	11.7	0.42	0.42	48.2
91	16.90	29	0.159	0.168	0.350	45.5	18.1	12.1	0.45	0.45	46.7
92	16.93	29	0.181	0.188	0.350	51.8	19.0	12.1	0.60	0.60	45.8
93	16.97	29	0.202	0.192	0.350	57.8	19.3	13.4	0.86	0.86	45.3

VTRANS RSCH011-703 - GD-9
OP: SPK

2 INCH SS;MOBILE SAFETY DRIVE;SDI
Test date: 29-Sep-2008

BL#	depth	BLC	EMX	EF2	ER	ETR	FMX	VMX	DMX	DFN	BPM
	ft	bl/ft	k-ft	k-ft	k-ft	(%)	kips	f/s	in	in	**
94	17.00	29	0.163	0.162	0.350	46.6	17.7	12.2	0.58	0.58	46.9
		Average	0.182	0.177	0.350	51.9	18.2	13.0	0.81	0.80	44.0
		Std. Dev.	0.018	0.016	0.000	5.0	1.2	0.8	0.31	0.31	2.0
		Maximum	0.211	0.208	0.350	60.2	20.3	15.1	2.24	2.24	48.2
		@ Blow#	49	82	37	49	82	37	37	37	90
		Minimum	0.145	0.140	0.350	41.5	15.2	10.8	0.42	0.35	39.9
		@ Blow#	37	38	37	37	38	72	90	69	82

Total number of blows analyzed: 58

VTRANS RSCH011-703 - GD-9
OP: SPK

2 INCH SS;MOBILE SAFETY DRIVE;SDI
Test date: 29-Sep-2008

AR: 0.92 in^2
LE: 53.71 ft
WS: 16,807.7 f/s

SP: 0.492 k/ft3
EM: 30,000 ksi
JC: 0.00

EMX: Max Transferred Energy
EF2: Energy of F^2
ER: Hammer Energy Rating
ETR: Energy Transfer Ratio
FMX: Maximum Force

VMX: Maximum Velocity
DMX: Maximum Displacement
DFN: Final Displacement
BPM: Blows per Minute

BL#	depth	BLC	EMX	EF2	ER	ETR	FMX	VMX	DMX	DFN	BPM
	ft	bl/ft	k-ft	k-ft	k-ft	(%)	kips	f/s	in	in	**
95	20.00	0	0.177	0.224	0.350	50.5	19.7	14.9	1.42	1.39	0.0
97	20.07	29	0.179	0.229	0.350	51.1	20.1	15.9	0.80	0.74	0.0
98	20.10	29	0.158	0.195	0.350	45.1	18.3	13.1	0.68	0.68	0.0
99	20.14	29	0.178	0.202	0.350	50.8	18.2	12.5	0.95	0.95	49.4
100	20.17	29	0.169	0.207	0.350	48.3	19.3	13.9	0.75	0.75	48.1
101	20.21	29	0.180	0.201	0.350	51.5	18.0	12.6	0.97	0.97	48.2
102	20.24	29	0.160	0.202	0.350	45.8	19.0	14.0	0.64	0.64	52.0
103	20.28	29	0.181	0.196	0.350	51.8	17.6	13.0	0.96	0.96	49.0
104	20.31	29	0.151	0.187	0.350	43.2	18.6	13.6	1.04	1.04	50.3
105	20.35	29	0.164	0.199	0.350	46.8	17.8	11.9	0.57	0.52	46.1
106	20.38	29	0.144	0.181	0.350	41.1	18.3	12.7	0.55	0.55	46.9
107	20.41	29	0.173	0.193	0.350	49.3	17.3	12.0	0.82	0.82	47.6
108	20.45	29	0.133	0.166	0.350	38.0	16.8	11.9	0.45	0.38	48.1
109	20.48	29	0.154	0.185	0.350	44.1	17.3	11.6	0.62	0.62	48.3
110	20.52	29	0.162	0.200	0.350	46.2	18.0	11.7	0.67	0.67	45.8
111	20.55	29	0.176	0.205	0.350	50.1	19.0	12.4	0.64	0.64	50.1
112	20.59	29	0.158	0.193	0.350	45.3	17.8	11.7	0.62	0.62	46.1
113	20.62	29	0.197	0.230	0.350	56.2	20.1	13.5	0.76	0.76	47.5
114	20.66	29	0.155	0.186	0.350	44.3	17.6	11.9	0.64	0.64	48.3
115	20.69	29	0.171	0.215	0.350	49.0	19.4	13.2	0.51	0.50	53.3
116	20.72	29	0.158	0.191	0.350	45.1	17.5	11.6	0.68	0.68	50.7
117	20.76	29	0.172	0.210	0.350	49.1	19.4	13.4	0.61	0.61	47.7
118	20.79	29	0.162	0.201	0.350	46.3	18.1	12.1	0.63	0.63	47.4
119	20.83	29	0.160	0.202	0.350	45.7	19.3	13.7	0.52	0.36	47.7
120	20.86	29	0.196	0.220	0.350	56.0	19.2	12.9	1.12	1.12	47.6
121	20.90	29	0.166	0.207	0.350	47.3	19.4	13.2	0.47	0.16	47.1
122	20.93	29	0.185	0.191	0.350	52.9	17.7	11.7	1.28	1.28	47.3
123	20.97	29	0.151	0.193	0.350	43.2	18.2	12.2	0.59	0.59	48.0
124	21.00	29	0.183	0.207	0.350	52.2	18.1	13.1	0.54	0.46	45.9
125	21.03	29	0.165	0.211	0.350	47.0	19.1	12.3	0.47	0.45	47.8
126	21.07	29	0.204	0.237	0.350	58.4	20.3	13.3	0.83	0.83	49.2
127	21.10	29	0.143	0.180	0.350	40.9	17.6	11.5	0.40	0.32	48.6
128	21.14	29	0.165	0.202	0.350	47.3	18.2	11.9	0.45	0.42	44.4
129	21.17	29	0.188	0.239	0.350	53.8	20.6	13.7	0.58	0.58	46.7
130	21.21	29	0.189	0.224	0.350	54.1	19.3	13.3	0.86	0.86	45.6
131	21.24	29	0.176	0.221	0.350	50.2	20.2	13.6	0.56	0.56	47.8
132	21.28	29	0.198	0.236	0.350	56.5	19.6	12.9	0.63	0.63	48.3
133	21.31	29	0.169	0.212	0.350	48.3	19.2	12.7	0.44	0.28	48.6
134	21.35	29	0.190	0.220	0.350	54.2	19.4	12.7	0.60	0.60	46.9
135	21.38	29	0.169	0.198	0.350	48.3	18.1	11.8	1.18	1.18	47.0
136	21.41	29	0.193	0.230	0.350	55.3	20.1	12.8	0.45	0.32	46.5
137	21.45	29	0.162	0.205	0.350	46.2	18.7	12.0	0.72	0.72	48.2
138	21.48	29	0.176	0.212	0.350	50.3	19.4	12.1	0.46	0.46	45.1
139	21.52	29	0.153	0.189	0.350	43.9	17.9	11.8	0.43	0.42	47.3
140	21.55	29	0.127	0.159	0.350	36.2	16.5	10.6	0.45	0.45	45.8
141	21.59	29	0.154	0.190	0.350	44.1	17.9	11.8	0.52	0.52	51.2
142	21.62	29	0.174	0.188	0.350	49.7	17.7	11.6	0.67	0.67	48.7
143	21.66	29	0.163	0.200	0.350	46.7	18.3	11.7	0.64	0.64	47.4
144	21.69	29	0.192	0.235	0.350	54.8	20.4	13.4	0.49	0.43	47.3
145	21.72	29	0.161	0.192	0.350	46.0	18.4	12.5	0.43	0.43	48.3
146	21.76	29	0.191	0.214	0.350	54.4	19.7	12.8	0.55	0.55	47.1
147	21.79	29	0.155	0.176	0.350	44.3	17.1	11.2	0.83	0.83	45.5
148	21.83	29	0.203	0.220	0.350	57.9	19.3	12.3	0.98	0.98	48.2
149	21.86	29	0.155	0.192	0.350	44.2	18.2	11.6	0.41	0.32	45.5
150	21.90	29	0.172	0.202	0.350	49.0	18.6	12.4	0.74	0.74	46.1
151	21.93	29	0.149	0.188	0.350	42.6	17.6	11.1	0.40	0.33	44.9
152	21.97	29	0.177	0.209	0.350	50.5	19.5	12.4	0.48	0.47	44.9

VTRANS RSCH011-703 - GD-9
OP: SPK

2 INCH SS;MOBILE SAFETY DRIVE;SDI
Test date: 29-Sep-2008

	EMX	EF2	ER	ETR	FMX	VMX	DMX	DFN	BPM
	k-ft	k-ft	k-ft	(%)	kips	f/s	in	in	**
Average	0.170	0.203	0.350	48.4	18.6	12.6	0.67	0.64	47.7
Std. Dev.	0.017	0.017	0.000	4.8	1.0	0.9	0.23	0.25	1.8
Maximum	0.204	0.239	0.350	58.4	20.6	15.9	1.42	1.39	53.3
@ Blow#	126	129	95	126	129	97	95	95	115
Minimum	0.127	0.159	0.350	36.2	16.5	10.6	0.40	0.16	44.4
@ Blow#	140	140	95	140	140	140	127	121	128

Total number of blows analyzed: 57

Geosciences Testing & Research Inc
Case Method Results

PDIPLOT Ver. 2008.2 - Printed: 3-Apr-2009

VTRANS RSCH011-703 - GD-9
OP: SPK

2 INCH SS;MOBILE SAFETY DRIVE;SDI
Test date: 29-Sep-2008

AR: 0.92 in^2
LE: 53.71 ft
WS: 16,807.7 f/s

SP: 0.492 k/ft3
EM: 30,000 ksi
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EMX: Max Transferred Energy
EF2: Energy of F^2
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DMX: Maximum Displacement
DFN: Final Displacement
BPM: Blows per Minute

BL#	depth	BLC	EMX	EF2	ER	ETR	FMX	VMX	DMX	DFN	BPM
	ft	bl/ft	k-ft	k-ft	k-ft	(%)	kips	f/s	in	in	**
154	25.00	0	0.165	0.219	0.350	47.2	19.0	14.6	0.98	0.95	0.0
155	25.02	41	0.156	0.201	0.350	44.5	18.4	13.3	0.61	0.60	45.1
156	25.05	41	0.154	0.200	0.350	43.9	18.5	13.1	0.52	0.47	0.0
157	25.07	41	0.161	0.206	0.350	46.1	19.0	13.1	0.87	0.87	0.0
158	25.10	41	0.197	0.227	0.350	56.3	18.7	12.7	0.77	0.77	46.3
159	25.12	41	0.158	0.198	0.350	45.1	18.8	13.4	0.65	0.65	47.7
160	25.15	41	0.169	0.196	0.350	48.2	17.3	11.8	0.70	0.70	46.2
161	25.17	41	0.128	0.163	0.350	36.6	16.8	11.0	0.65	0.65	47.1
162	25.20	41	0.155	0.200	0.350	44.3	17.8	12.3	0.40	0.17	44.8
163	25.22	41	0.148	0.192	0.350	42.4	18.3	12.1	0.61	0.61	46.4
164	25.24	41	0.153	0.202	0.350	43.8	18.3	12.2	0.37	0.25	48.5
165	25.27	41	0.145	0.187	0.350	41.4	18.1	11.8	0.35	0.22	47.4
166	25.29	41	0.147	0.187	0.350	41.9	17.6	12.0	0.36	0.31	50.5
167	25.32	41	0.149	0.191	0.350	42.7	18.1	12.5	0.37	0.37	47.0
168	25.34	41	0.159	0.197	0.350	45.4	18.2	12.2	0.43	0.43	48.6
169	25.37	41	0.143	0.186	0.350	41.0	18.1	12.1	0.33	0.25	48.5
170	25.39	41	0.159	0.194	0.350	45.5	17.4	11.1	0.53	0.53	47.0
171	25.42	41	0.133	0.169	0.350	38.1	17.4	11.8	0.47	0.47	46.2
172	25.44	41	0.157	0.194	0.350	44.7	17.4	11.2	0.42	0.42	48.2
173	25.46	41	0.145	0.188	0.350	41.4	18.0	11.8	0.37	0.37	48.6
174	25.49	41	0.150	0.190	0.350	42.7	17.2	11.3	0.43	0.43	45.6
175	25.51	41	0.150	0.192	0.350	42.9	18.2	12.1	0.38	0.38	50.0
176	25.54	41	0.163	0.204	0.350	46.7	18.1	11.9	0.43	0.43	46.8
177	25.56	41	0.154	0.200	0.350	43.9	18.6	12.2	0.33	0.24	45.6
178	25.59	41	0.149	0.197	0.350	42.5	17.5	10.8	0.39	0.39	48.9
179	25.61	41	0.148	0.188	0.350	42.4	18.1	12.2	0.43	0.43	50.2
180	25.63	41	0.149	0.194	0.350	42.5	17.6	11.1	0.36	0.36	49.7
181	25.66	41	0.146	0.184	0.350	41.8	17.9	11.5	0.35	0.29	49.4
182	25.68	41	0.158	0.203	0.350	45.2	17.9	11.2	0.34	0.24	48.0
183	25.71	41	0.150	0.192	0.350	42.9	18.1	11.4	0.33	0.33	46.5
184	25.73	41	0.152	0.194	0.350	43.5	17.4	11.3	0.61	0.61	50.4
185	25.76	41	0.150	0.194	0.350	43.0	18.6	12.4	0.34	0.24	50.2
186	25.78	41	0.165	0.202	0.350	47.1	18.1	11.8	0.42	0.42	47.4
187	25.81	41	0.151	0.190	0.350	43.3	18.5	12.3	0.43	0.43	50.6
188	25.83	41	0.173	0.209	0.350	49.3	18.0	12.0	0.57	0.57	49.0
189	25.85	41	0.145	0.183	0.350	41.3	18.1	12.0	0.32	0.30	50.7
190	25.88	41	0.157	0.205	0.350	44.8	18.6	11.6	0.32	0.30	52.0
191	25.90	41	0.147	0.198	0.350	41.9	18.5	11.6	0.30	0.27	49.2
192	25.93	41	0.139	0.180	0.350	39.8	17.7	11.5	0.31	0.31	49.3
193	25.95	41	0.159	0.197	0.350	45.3	17.7	12.3	0.51	0.51	51.8
194	25.98	41	0.153	0.193	0.350	43.7	18.3	12.5	0.67	0.67	49.0
195	26.00	41	0.152	0.195	0.350	43.3	18.1	12.4	0.31	0.15	49.9
196	26.02	41	0.135	0.172	0.350	38.6	17.5	11.5	0.36	0.36	49.5
197	26.05	41	0.162	0.203	0.350	46.2	17.9	11.5	0.57	0.57	51.8
198	26.07	41	0.143	0.184	0.350	40.8	17.9	11.7	0.52	0.52	51.5
199	26.10	41	0.147	0.186	0.350	41.9	17.3	11.0	0.39	0.39	50.8
200	26.12	41	0.149	0.192	0.350	42.7	18.1	11.3	0.31	0.30	51.7
201	26.15	41	0.155	0.198	0.350	44.3	17.7	10.9	0.45	0.45	48.1
202	26.17	41	0.151	0.194	0.350	43.1	18.2	11.4	0.51	0.51	51.1
204	26.22	41	0.160	0.205	0.350	45.8	18.9	10.9	0.33	0.29	50.8
205	26.24	41	0.164	0.215	0.350	46.9	18.8	11.7	0.33	0.33	48.8
207	26.29	41	0.155	0.193	0.350	44.3	17.8	11.5	0.33	0.18	50.6
208	26.32	41	0.165	0.204	0.350	47.1	18.2	11.9	0.44	0.44	50.8
209	26.34	41	0.158	0.196	0.350	45.0	18.0	11.4	0.38	0.38	49.1
210	26.37	41	0.155	0.190	0.350	44.4	18.4	11.4	0.42	0.42	49.8
211	26.39	41	0.169	0.215	0.350	48.2	19.1	12.5	0.36	0.22	50.1
212	26.42	41	0.169	0.219	0.350	48.3	19.4	11.6	0.36	0.32	48.3

Geosciences Testing & Research Inc
Case Method Results

PDIPLOT Ver. 2008.2 - Printed: 3-Apr-2009

VTRANS RSCH011-703 - GD-9
OP: SPK

2 INCH SS;MOBILE SAFETY DRIVE;SDI
Test date: 29-Sep-2008

BL#	depth	BLC	EMX	EF2	ER	ETR	FMX	VMX	DMX	DFN	BPM
	ft	bl/ft	k-ft	k-ft	k-ft	(%)	kips	f/s	in	in	**
213	26.44	41	0.153	0.198	0.350	43.7	18.2	11.8	0.34	0.18	48.5
214	26.46	41	0.142	0.185	0.350	40.6	18.1	11.8	0.33	0.26	46.6
215	26.49	41	0.156	0.206	0.350	44.5	18.8	12.7	0.35	0.21	49.5
216	26.51	41	0.138	0.179	0.350	39.4	17.5	12.1	0.34	0.25	48.4
217	26.54	41	0.168	0.218	0.350	47.9	19.3	13.5	0.38	0.31	47.6
218	26.56	41	0.159	0.202	0.350	45.4	18.5	13.0	0.46	0.46	46.8
219	26.59	41	0.156	0.208	0.350	44.6	18.8	13.1	0.38	0.37	48.7
220	26.61	41	0.160	0.207	0.350	45.7	18.7	12.9	0.38	0.29	46.6
221	26.63	41	0.165	0.210	0.350	47.2	19.2	13.0	0.61	0.61	48.3
222	26.66	41	0.166	0.213	0.350	47.5	18.8	13.1	0.39	0.27	49.1
223	26.68	41	0.148	0.191	0.350	42.2	18.1	12.1	0.42	0.42	48.6
224	26.71	41	0.184	0.199	0.350	52.6	17.8	12.8	0.96	0.96	47.2
225	26.73	41	0.158	0.198	0.350	45.1	18.1	12.3	0.42	0.31	0.0
226	26.76	41	0.155	0.173	0.350	44.3	17.2	12.6	0.90	0.90	47.2
227	26.78	41	0.166	0.190	0.350	47.4	17.0	12.5	0.82	0.82	49.0
228	26.81	41	0.147	0.185	0.350	42.1	17.9	12.2	0.45	0.43	48.9
229	26.83	41	0.186	0.199	0.350	53.1	17.6	12.0	0.89	0.89	47.2
230	26.85	41	0.159	0.194	0.350	45.5	18.5	12.4	0.69	0.69	50.2
231	26.88	41	0.168	0.200	0.350	48.0	17.1	13.0	0.48	0.18	46.7
232	26.90	41	0.160	0.195	0.350	45.7	18.1	12.7	0.65	0.65	48.2
233	26.93	41	0.192	0.196	0.350	54.9	16.8	13.2	1.34	1.34	44.9
234	26.95	41	0.147	0.183	0.350	41.9	17.7	12.2	0.54	0.54	50.1
235	26.98	41	0.178	0.216	0.350	51.0	18.3	12.7	0.55	0.55	48.1
236	27.00	41	0.139	0.172	0.350	39.8	17.2	11.7	0.56	0.56	45.1
		Average	0.156	0.196	0.350	44.5	18.1	12.1	0.49	0.45	48.6
		Std. Dev.	0.012	0.012	0.000	3.4	0.6	0.7	0.19	0.22	1.8
		Maximum	0.197	0.227	0.350	56.3	19.4	14.6	1.34	1.34	52.0
		@ Blow#	158	158	154	158	212	154	233	233	190
		Minimum	0.128	0.163	0.350	36.6	16.8	10.8	0.30	0.15	44.8
		@ Blow#	161	161	154	161	161	178	191	195	162

Total number of blows analyzed: 81

VTRANS RSCH011-703 - GD-9
OP: SPK

2 INCH SS;MOBILE SAFETY DRIVE;SDI
Test date: 29-Sep-2008

AR: 0.92 in^2
LE: 53.71 ft
WS: 16,807.7 f/s

SP: 0.492 k/ft3
EM: 30,000 ksi
JC: 0.00

EMX: Max Transferred Energy
EF2: Energy of F^2
ER: Hammer Energy Rating
ETR: Energy Transfer Ratio
FMX: Maximum Force

VMX: Maximum Velocity
DMX: Maximum Displacement
DFN: Final Displacement
BPM: Blows per Minute

BL#	depth	BLC	EMX	EF2	ER	ETR	FMX	VMX	DMX	DFN	BPM
	ft	bl/ft	k-ft	k-ft	k-ft	(%)	kips	f/s	in	in	**
237	30.00	0	0.180	0.237	0.350	51.4	19.7	15.7	1.93	1.93	0.0
238	30.07	14	0.169	0.219	0.350	48.3	19.1	14.4	1.13	0.97	46.5
239	30.14	14	0.182	0.236	0.350	51.9	20.0	15.6	1.21	1.19	45.1
240	30.21	14	0.216	0.237	0.350	61.7	19.1	14.9	1.88	1.88	46.6
241	30.29	14	0.178	0.231	0.350	50.9	19.6	15.2	1.24	1.24	45.2
242	30.36	14	0.220	0.249	0.350	62.9	19.8	15.7	1.93	1.93	42.8
243	30.43	14	0.163	0.211	0.350	46.5	18.6	16.2	0.99	0.83	39.6
244	30.50	14	0.180	0.221	0.350	51.5	18.5	15.0	1.10	1.10	43.5
245	30.57	14	0.174	0.227	0.350	49.8	19.3	15.6	0.93	0.93	42.6
246	30.64	14	0.170	0.221	0.350	48.6	18.5	14.7	1.00	1.00	43.8
247	30.71	14	0.187	0.237	0.350	53.3	19.6	15.7	0.86	0.85	43.8
248	30.79	14	0.199	0.227	0.350	56.8	18.5	14.8	1.62	1.62	44.5
249	30.86	14	0.179	0.228	0.350	51.1	19.2	16.1	0.82	0.77	42.2
250	30.93	14	0.175	0.230	0.350	49.9	18.9	14.3	0.94	0.94	44.2
251	31.00	14	0.197	0.238	0.350	56.3	19.2	14.6	1.01	1.01	44.2
252	31.07	14	0.169	0.217	0.350	48.4	18.1	14.3	0.95	0.95	42.9
253	31.14	14	0.164	0.209	0.350	46.9	18.2	13.5	0.76	0.75	45.5
254	31.21	14	0.156	0.206	0.350	44.6	17.3	13.5	0.84	0.84	44.2
255	31.29	14	0.163	0.206	0.350	46.4	18.4	13.5	0.74	0.73	42.7
256	31.36	14	0.173	0.217	0.350	49.4	17.7	13.4	0.83	0.82	40.8
257	31.43	14	0.165	0.202	0.350	47.1	18.3	13.6	0.74	0.64	45.5
258	31.50	14	0.169	0.213	0.350	48.3	18.8	13.8	0.80	0.80	41.4
259	31.57	14	0.193	0.222	0.350	55.2	18.6	13.9	1.05	1.05	44.5
260	31.64	14	0.184	0.233	0.350	52.5	19.1	14.0	0.69	0.48	44.0
262	31.79	14	0.198	0.230	0.350	56.6	18.4	13.7	1.04	1.04	44.1
263	31.86	14	0.212	0.222	0.350	60.5	18.0	13.1	1.21	1.21	39.9
264	31.93	14	0.163	0.209	0.350	46.6	18.4	13.7	0.65	0.46	46.8
		Average	0.181	0.224	0.350	51.6	18.8	14.5	1.07	1.04	43.7
		Std. Dev.	0.017	0.012	0.000	4.8	0.6	0.9	0.36	0.39	1.9
		Maximum	0.220	0.249	0.350	62.9	20.0	16.2	1.93	1.93	46.8
		@ Blow#	242	242	237	242	239	243	242	242	264
		Minimum	0.156	0.202	0.350	44.6	17.3	13.1	0.65	0.46	39.6
		@ Blow#	254	257	237	254	254	263	264	264	243

Total number of blows analyzed: 27

VTRANS RSCH011-703 - GD-9
OP: SPK

2 INCH SS;MOBILE SAFETY DRIVE;SDI
Test date: 29-Sep-2008

AR: 0.92 in^2
LE: 53.71 ft
WS: 16,807.7 f/s

SP: 0.492 k/ft3
EM: 30,000 ksi
JC: 0.00

EMX: Max Transferred Energy
EF2: Energy of F^2
ER: Hammer Energy Rating
ETR: Energy Transfer Ratio
FMX: Maximum Force

VMX: Maximum Velocity
DMX: Maximum Displacement
DFN: Final Displacement
BPM: Blows per Minute

BL#	depth	BLC	EMX	EF2	ER	ETR	FMX	VMX	DMX	DFN	BPM
	ft	bl/ft	k-ft	k-ft	k-ft	(%)	kips	f/s	in	in	**
266	35.00	0	0.176	0.225	0.350	50.2	18.0	12.4	1.65	1.65	0.0
267	35.05	19	0.172	0.220	0.350	49.3	17.8	13.6	1.49	1.49	45.7
268	35.11	19	0.177	0.223	0.350	50.7	17.7	12.2	1.49	1.49	46.5
269	35.16	19	0.181	0.228	0.350	51.8	19.0	14.3	1.31	1.31	47.9
270	35.21	19	0.180	0.231	0.350	51.3	18.6	13.3	1.20	1.20	46.8
271	35.26	19	0.191	0.231	0.350	54.4	17.9	14.0	1.31	1.31	48.4
272	35.32	19	0.173	0.227	0.350	49.4	19.1	13.7	0.93	0.93	50.6
273	35.37	19	0.169	0.210	0.350	48.3	17.5	13.4	0.96	0.96	48.7
274	35.42	19	0.203	0.233	0.350	58.0	18.7	14.2	1.30	1.30	47.0
275	35.47	19	0.162	0.201	0.350	46.3	17.5	13.4	0.66	0.55	47.8
276	35.53	19	0.193	0.230	0.350	55.2	17.9	13.6	1.12	1.12	46.5
277	35.58	19	0.186	0.246	0.350	53.1	19.7	14.1	0.62	0.56	48.5
278	35.63	19	0.156	0.196	0.350	44.6	16.4	12.6	0.64	0.63	46.2
279	35.68	19	0.165	0.220	0.350	47.3	18.1	12.1	0.58	0.56	51.9
280	35.74	19	0.176	0.216	0.350	50.2	17.9	12.1	0.81	0.81	46.4
281	35.79	19	0.188	0.234	0.350	53.8	18.5	13.3	0.67	0.66	46.7
282	35.84	19	0.171	0.223	0.350	48.8	18.7	12.6	0.63	0.63	47.8
283	35.90	19	0.166	0.202	0.350	47.3	17.7	13.8	0.64	0.64	47.2
284	35.95	19	0.185	0.240	0.350	52.8	19.1	12.9	0.76	0.76	48.0
285	36.00	19	0.185	0.233	0.350	52.8	18.8	14.2	0.62	0.56	45.9
286	36.05	19	0.162	0.210	0.350	46.2	18.5	12.8	0.63	0.63	43.9
287	36.11	19	0.174	0.219	0.350	49.6	18.0	13.3	0.60	0.50	48.7
288	36.16	19	0.170	0.230	0.350	48.7	19.0	12.5	0.52	0.33	46.1
289	36.21	19	0.158	0.194	0.350	45.1	16.5	12.9	0.71	0.71	51.6
290	36.26	19	0.172	0.227	0.350	49.0	19.1	11.9	0.55	0.49	48.9
291	36.32	19	0.174	0.228	0.350	49.8	18.2	13.1	0.57	0.51	48.3
292	36.37	19	0.168	0.217	0.350	48.0	18.9	13.4	0.63	0.62	44.9
293	36.42	19	0.162	0.207	0.350	46.2	17.8	12.8	0.68	0.68	47.4
294	36.47	19	0.171	0.230	0.350	48.9	19.4	13.4	0.68	0.68	45.5
295	36.53	19	0.183	0.223	0.350	52.2	18.2	13.7	0.84	0.84	47.5
296	36.58	19	0.179	0.228	0.350	51.0	19.0	14.1	0.65	0.65	45.6
297	36.63	19	0.165	0.206	0.350	47.3	17.4	13.4	0.76	0.76	45.3
298	36.68	19	0.165	0.219	0.350	47.3	18.8	11.7	0.48	0.13	47.5
299	36.74	19	0.188	0.231	0.350	53.7	18.9	13.6	0.84	0.84	47.0
300	36.79	19	0.170	0.224	0.350	48.5	18.7	12.2	0.58	0.55	49.8
301	36.84	19	0.170	0.209	0.350	48.6	17.7	12.3	0.81	0.81	45.6
302	36.90	19	0.158	0.208	0.350	45.2	17.8	11.5	0.63	0.63	47.5
303	36.95	19	0.177	0.219	0.350	50.7	18.3	12.6	0.84	0.84	47.4
304	37.00	19	0.184	0.237	0.350	52.7	19.4	13.4	0.90	0.90	45.4
		Average	0.174	0.221	0.350	49.9	18.3	13.1	0.83	0.80	47.3
		Std. Dev.	0.010	0.012	0.000	3.0	0.7	0.7	0.30	0.33	1.7
		Maximum	0.203	0.246	0.350	58.0	19.7	14.3	1.65	1.65	51.9
		@ Blow#	274	277	266	274	277	269	266	266	279
		Minimum	0.156	0.194	0.350	44.6	16.4	11.5	0.48	0.13	43.9
		@ Blow#	278	289	266	278	278	302	298	298	286

Total number of blows analyzed: 39

VTRANS RSCH011-703 - GD-9
OP: SPK

2 INCH SS;MOBILE SAFETY DRIVE;SDI
Test date: 29-Sep-2008

AR: 0.92 in^2
LE: 53.71 ft
WS: 16,807.7 f/s

SP: 0.492 k/ft3
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EMX: Max Transferred Energy
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BPM: Blows per Minute

BL#	depth	BLC	EMX	EF2	ER	ETR	FMX	VMX	DMX	DFN	BPM
	ft	bl/ft	k-ft	k-ft	k-ft	(%)	kips	f/s	in	in	**
305	40.00	0	0.170	0.230	0.350	48.7	18.8	14.4	1.17	1.16	0.0
306	40.04	26	0.164	0.217	0.350	46.8	18.4	14.0	1.20	1.20	43.1
307	40.08	26	0.160.	0.207	0.350	45.6	17.9	13.0	0.96	0.82	0.0
308	40.12	26	0.157	0.210	0.350	44.9	17.4	12.7	0.63	0.63	45.1
309	40.16	26	0.157	0.198	0.350	44.8	17.9	13.2	1.09	1.09	45.7
310	40.20	26	0.157	0.205	0.350	44.9	16.7	12.6	0.66	0.65	43.8
311	40.24	26	0.149	0.186	0.350	42.7	17.2	12.7	0.73	0.73	42.3
312	40.28	26	0.180	0.236	0.350	51.5	18.6	12.9	0.70	0.70	43.2
313	40.31	26	0.143	0.182	0.350	41.0	17.2	12.6	0.48	0.26	46.1
314	40.35	26	0.158	0.199	0.350	45.2	16.3	12.3	0.59	0.58	45.2
315	40.39	26	0.143	0.176	0.350	40.9	16.7	12.2	0.73	0.73	44.5
316	40.43	26	0.183	0.228	0.350	52.3	17.2	12.9	0.65	0.65	45.1
317	40.47	26	0.143	0.177	0.350	40.9	16.7	12.4	0.72	0.72	43.2
318	40.51	26	0.219	0.252	0.350	62.6	18.6	13.6	1.26	1.26	42.0
319	40.55	26	0.157	0.201	0.350	44.9	18.0	13.2	0.66	0.66	39.9
320	40.59	26	0.188	0.243	0.350	53.8	18.7	13.6	0.62	0.60	40.8
321	40.63	26	0.166	0.213	0.350	47.5	18.5	14.0	0.54	0.36	44.6
322	40.67	26	0.192	0.247	0.350	54.8	18.9	13.3	0.70	0.69	43.2
323	40.71	26	0.157	0.202	0.350	44.9	18.1	14.3	0.54	0.53	44.9
324	40.75	26	0.178	0.217	0.350	50.7	17.5	13.0	0.94	0.94	47.5
325	40.78	26	0.165	0.211	0.350	47.0	18.6	13.9	0.53	0.45	46.6
326	40.82	26	0.173	0.218	0.350	49.3	17.6	12.9	0.82	0.82	45.5
327	40.86	26	0.156	0.200	0.350	44.5	18.0	13.5	0.55	0.48	44.5
328	40.90	26	0.180	0.219	0.350	51.5	17.8	13.2	0.94	0.94	44.0
329	40.94	26	0.164	0.214	0.350	46.9	18.9	13.5	0.52	0.48	44.3
330	40.98	26	0.178	0.221	0.350	50.9	17.8	13.0	0.89	0.89	43.8
331	41.02	26	0.169	0.222	0.350	48.4	18.9	14.4	0.52	0.47	46.0
332	41.06	26	0.178	0.237	0.350	50.7	19.6	14.1	0.56	0.56	45.9
333	41.10	26	0.131	0.168	0.350	37.5	16.2	11.7	0.47	0.47	48.2
334	41.14	26	0.162	0.205	0.350	46.3	17.0	12.4	0.67	0.67	46.8
335	41.18	26	0.165	0.213	0.350	47.2	18.7	14.3	0.52	0.52	44.4
336	41.22	26	0.176	0.227	0.350	50.3	18.0	13.2	0.77	0.77	42.2
337	41.26	26	0.165	0.212	0.350	47.2	18.8	14.0	0.49	0.42	44.7
338	41.29	26	0.182	0.228	0.350	51.9	18.1	12.8	0.77	0.77	43.9
339	41.33	26	0.180	0.233	0.350	51.6	19.3	13.7	0.53	0.45	46.2
340	41.37	26	0.205	0.255	0.350	58.5	19.2	13.7	0.94	0.94	46.3
341	41.41	26	0.163	0.210	0.350	46.6	18.9	13.6	0.51	0.51	44.6
342	41.45	26	0.175	0.230	0.350	50.1	18.9	12.8	0.66	0.66	45.6
343	41.49	26	0.140	0.175	0.350	39.9	16.8	12.4	0.49	0.43	49.0
344	41.53	26	0.176	0.231	0.350	50.4	18.1	12.7	0.61	0.61	49.8
345	41.57	26	0.150	0.187	0.350	42.8	17.8	13.0	0.53	0.49	45.5
346	41.61	26	0.178	0.218	0.350	50.9	17.6	12.5	0.89	0.89	44.5
347	41.65	26	0.158	0.202	0.350	45.0	18.5	13.2	0.47	0.20	48.0
348	41.69	26	0.165	0.224	0.350	47.3	19.1	12.6	0.47	0.47	45.4
349	41.73	26	0.161	0.216	0.350	46.0	18.5	13.2	0.48	0.48	44.3
350	41.77	26	0.186	0.241	0.350	53.1	19.8	14.5	0.50	0.33	44.8
351	41.80	26	0.193	0.246	0.350	55.2	18.9	13.0	0.85	0.85	43.8
352	41.84	26	0.179	0.228	0.350	51.2	19.5	14.2	0.51	0.45	45.1
353	41.88	26	0.167	0.219	0.350	47.6	18.7	13.2	0.48	0.39	45.4
354	41.92	26	0.174	0.227	0.350	49.8	19.0	13.6	0.49	0.44	44.2
355	41.96	26	0.195	0.240	0.350	55.7	18.6	12.8	1.00	1.00	44.0
356	42.00	26	0.158	0.200	0.350	45.1	18.1	13.4	0.47	0.43	46.1

VTRANS RSCH011-703 - GD-9
OP: SPK

2 INCH SS;MOBILE SAFETY DRIVE;SDI
Test date: 29-Sep-2008

	EMX	EF2	ER	ETR	FMX	VMX	DMX	DFN	BPM
	k-ft	k-ft	k-ft	(%)	kips	f/s	in	in	**
Average	0.169	0.215	0.350	48.2	18.2	13.2	0.68	0.65	44.9
Std. Dev.	0.017	0.020	0.000	4.7	0.9	0.6	0.21	0.24	1.8
Maximum	0.219	0.255	0.350	62.6	19.8	14.5	1.26	1.26	49.8
@ Blow#	318	340	305	318	350	350	318	318	344
Minimum	0.131	0.168	0.350	37.5	16.2	11.7	0.47	0.20	39.9
@ Blow#	333	333	305	333	333	333	356	347	319

Total number of blows analyzed: 52

Geosciences Testing & Research Inc
Case Method Results

PDIPLOT Ver. 2008.2 - Printed: 3-Apr-2009

VTRANS RSCH011-703 - GD-9
OP: SPK

2 INCH SS;MOBILE SAFETY DRIVE;SDI
Test date: 29-Sep-2008

AR: 0.92 in^2
LE: 53.71 ft
WS: 16,807.7 f/s

SP: 0.492 k/ft3
EM: 30,000 ksi
JC: 0.00

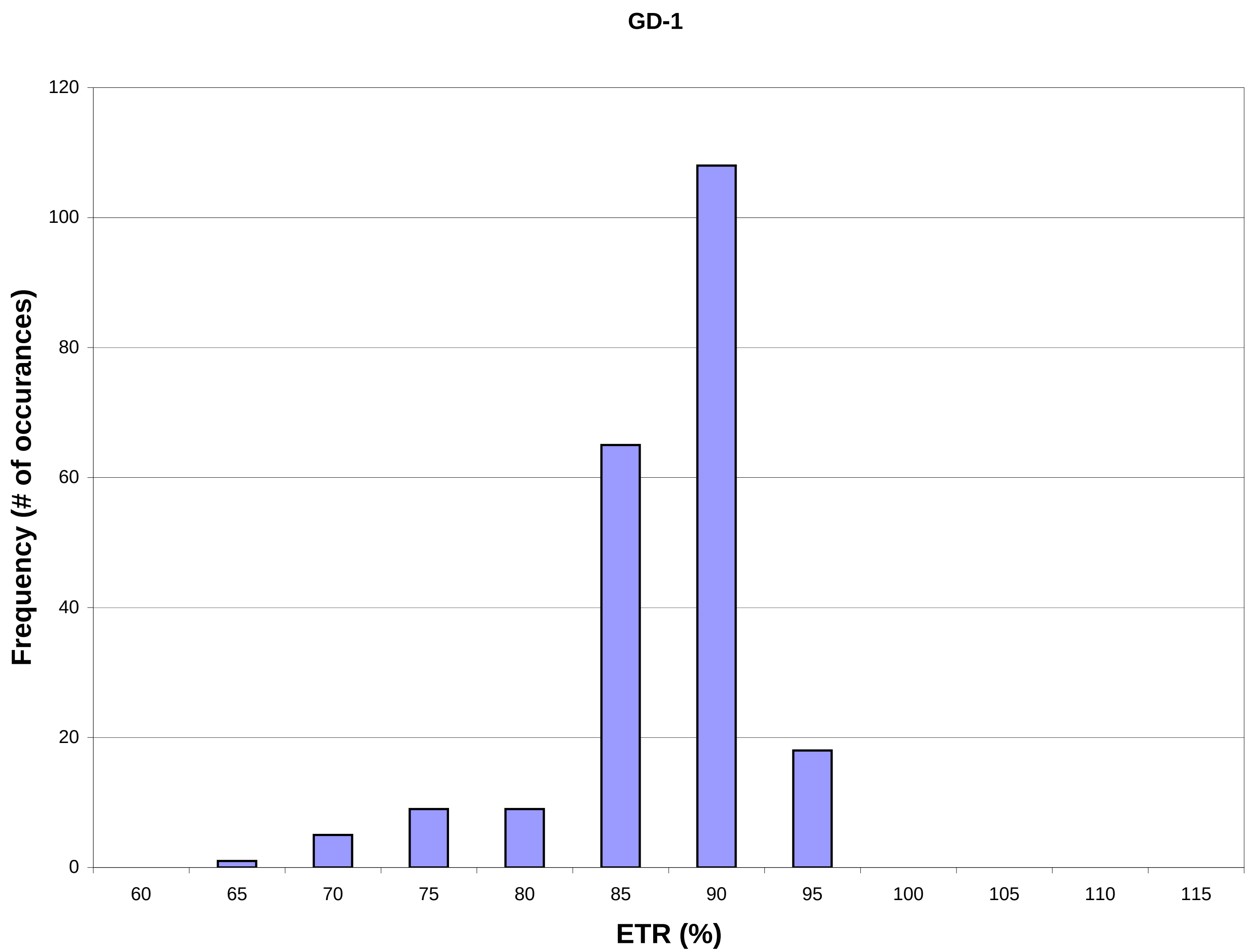
EMX: Max Transferred Energy
EF2: Energy of F^2
ER: Hammer Energy Rating
ETR: Energy Transfer Ratio
FMX: Maximum Force

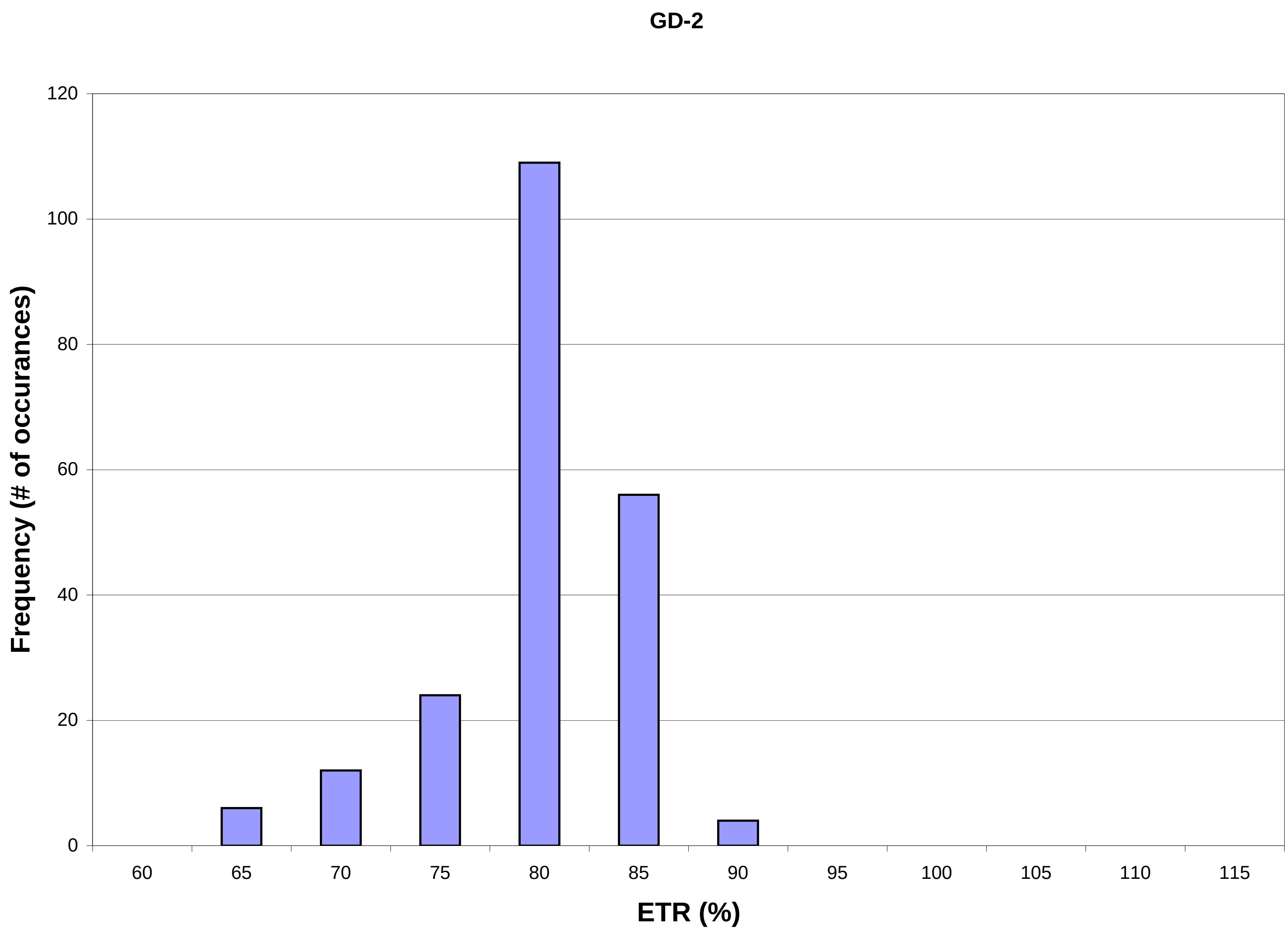
VMX: Maximum Velocity
DMX: Maximum Displacement
DFN: Final Displacement
BPM: Blows per Minute

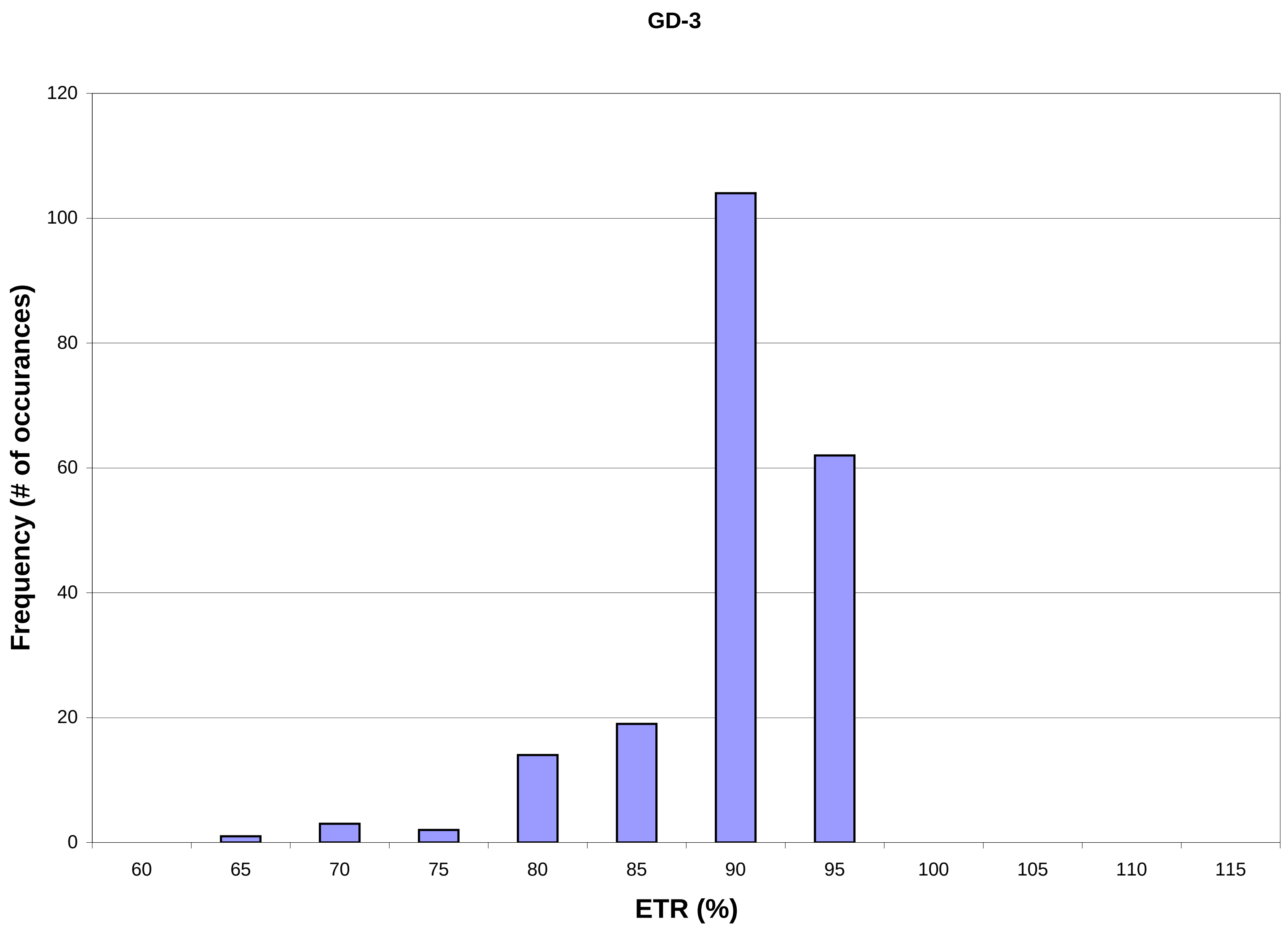
BL#	depth	BLC	EMX	EF2	ER	ETR	FMX	VMX	DMX	DFN	BPM
	ft	bl/ft	k-ft	k-ft	k-ft	(%)	kips	f/s	in	in	**
357	45.00	0	0.142	0.227	0.350	40.5	18.9	12.1	0.32	-2.37	0.0
358	45.04	27	0.200	0.233	0.350	57.0	19.3	14.7	0.92	-0.30	47.2
359	45.08	27	0.203	0.242	0.350	57.9	19.5	13.5	1.16	1.09	49.6
361	45.15	27	0.219	0.218	0.350	62.6	18.0	12.7	2.07	2.07	45.7
367	45.38	27	0.189	0.225	0.350	53.9	18.9	15.4	1.49	1.49	45.3
374	45.64	27	0.190	0.244	0.350	54.2	19.0	12.0	0.75	0.75	47.2
		Average	0.191	0.231	0.350	54.4	18.9	13.4	1.12	0.46	47.0
		Std. Dev.	0.024	0.009	0.000	6.8	0.5	1.3	0.56	1.45	1.5
		Maximum	0.219	0.244	0.350	62.6	19.5	15.4	2.07	2.07	49.6
		@ Blow#	361	374	357	361	359	367	361	361	359
		Minimum	0.142	0.218	0.350	40.5	18.0	12.0	0.32	-2.37	45.3
		@ Blow#	357	361	357	357	361	374	357	357	367

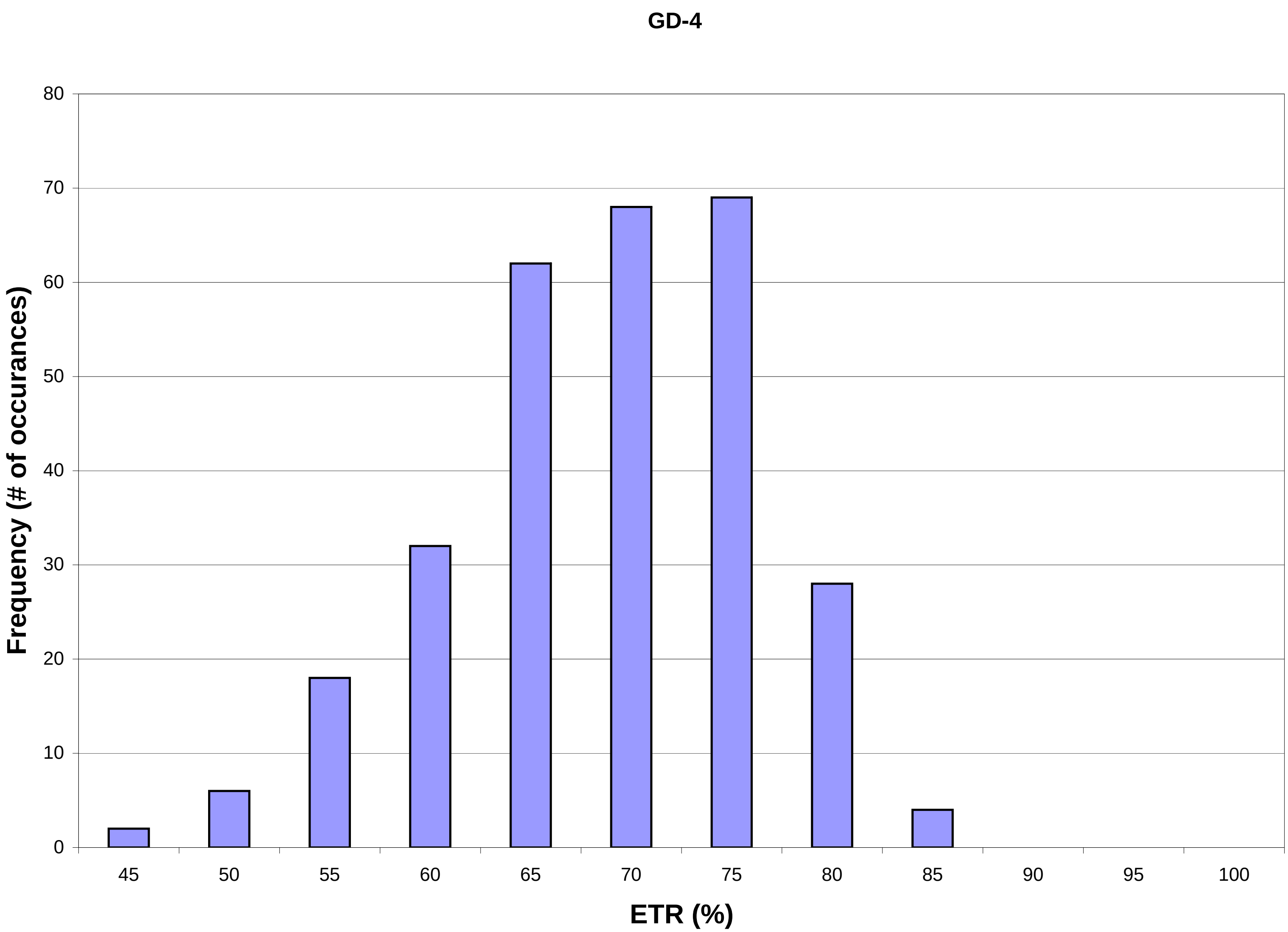
Total number of blows analyzed: 6

APPENDIX 9 – NORMAL DISTRIBUTION PLOTS OF ETR(%) VALUES

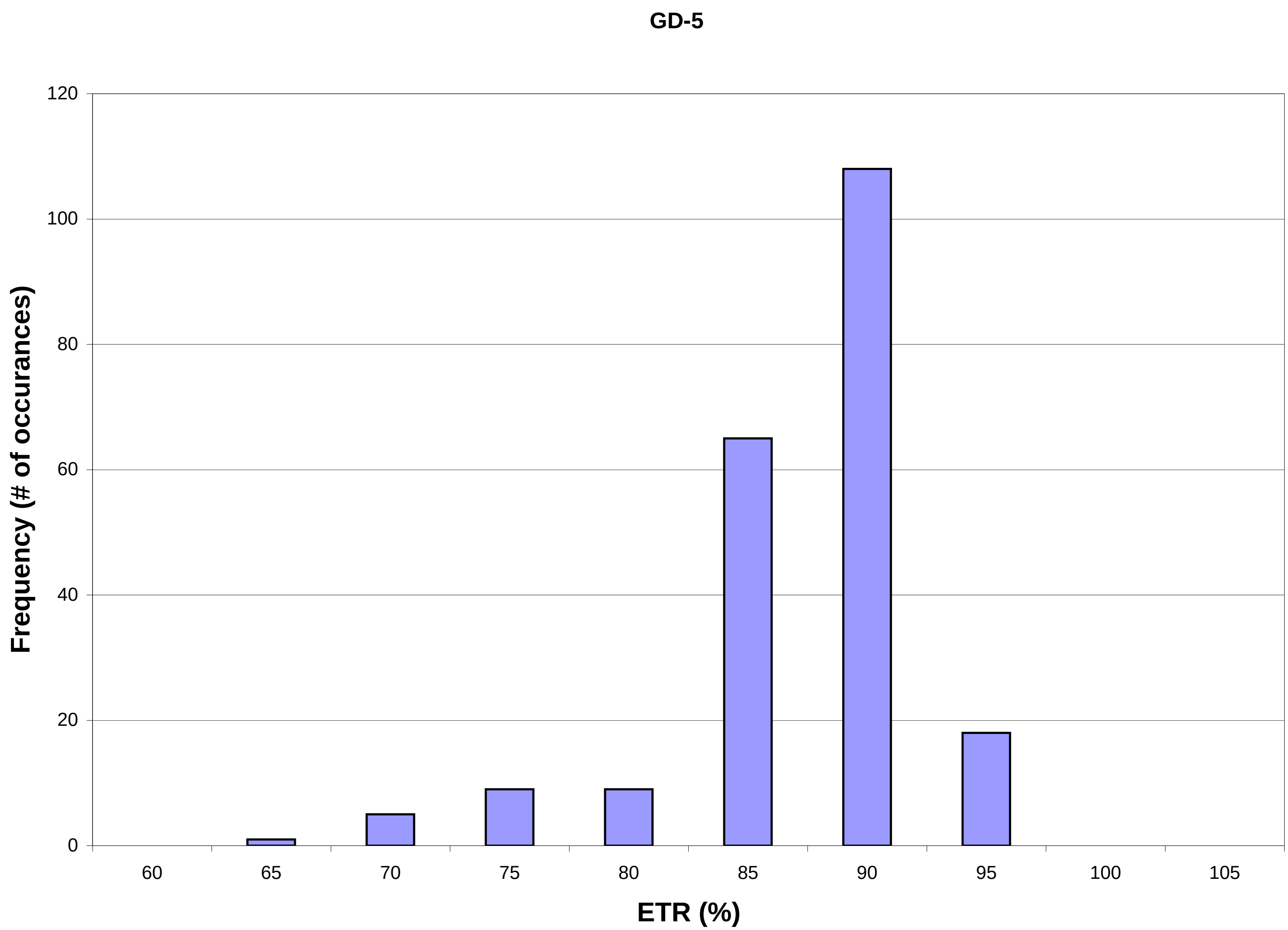

GD-1
Frequency (# of occurances)
120
100
80
60
40
20
0
60
65
70
75
80
85
90
95
100
105
110
115
ETR (%)


GD-2
Frequency (# of occurances)
120
100
80
60
40
20
0
60
65
70
75
80
85
90
95
100
105
110
115
ETR (%)

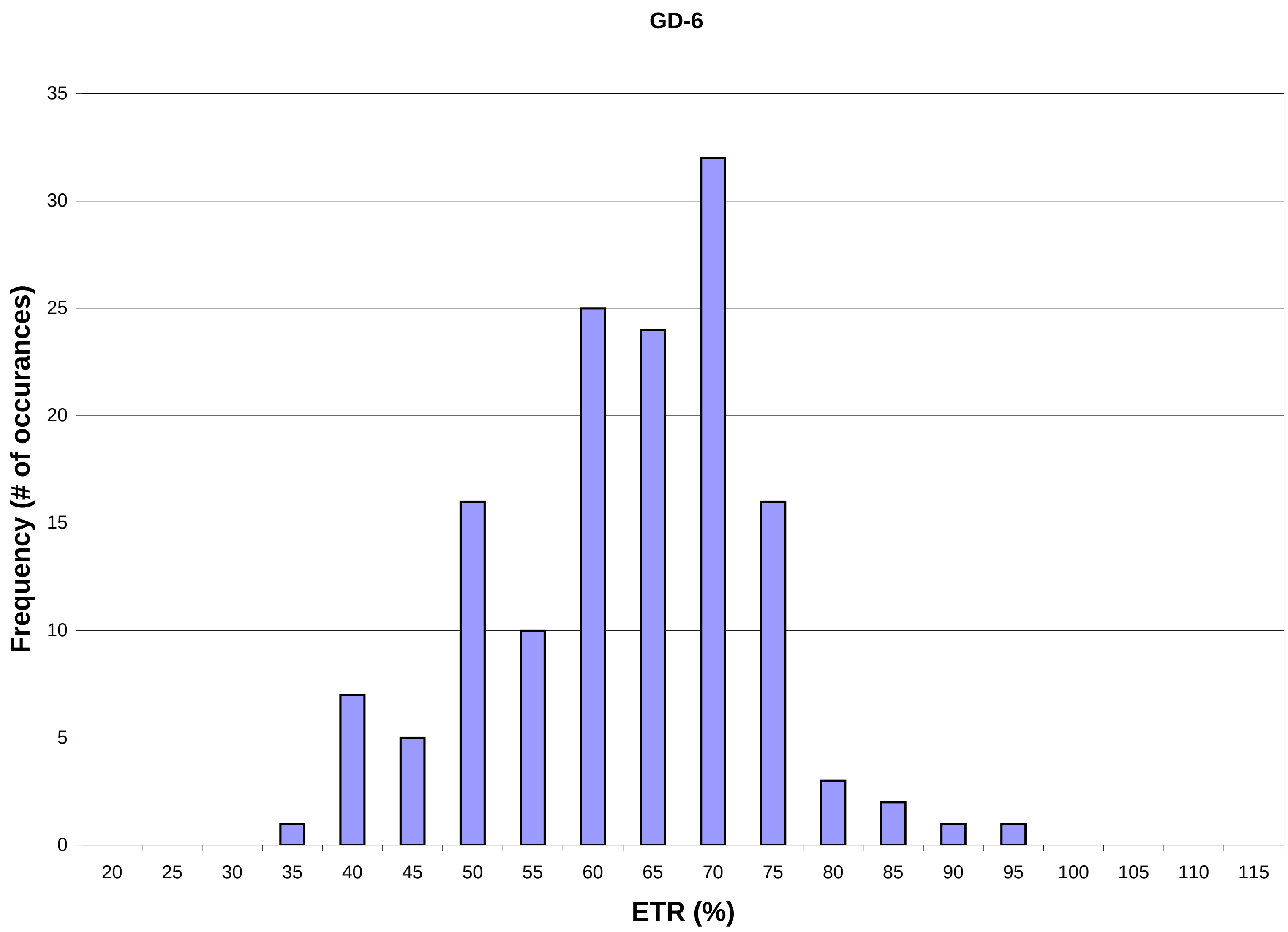

GD-3
Frequency (# of occurances)
0
20
40
60
80
100
120
60
65
70
75
80
85
90
95
100
105
110
115
ETR (%)

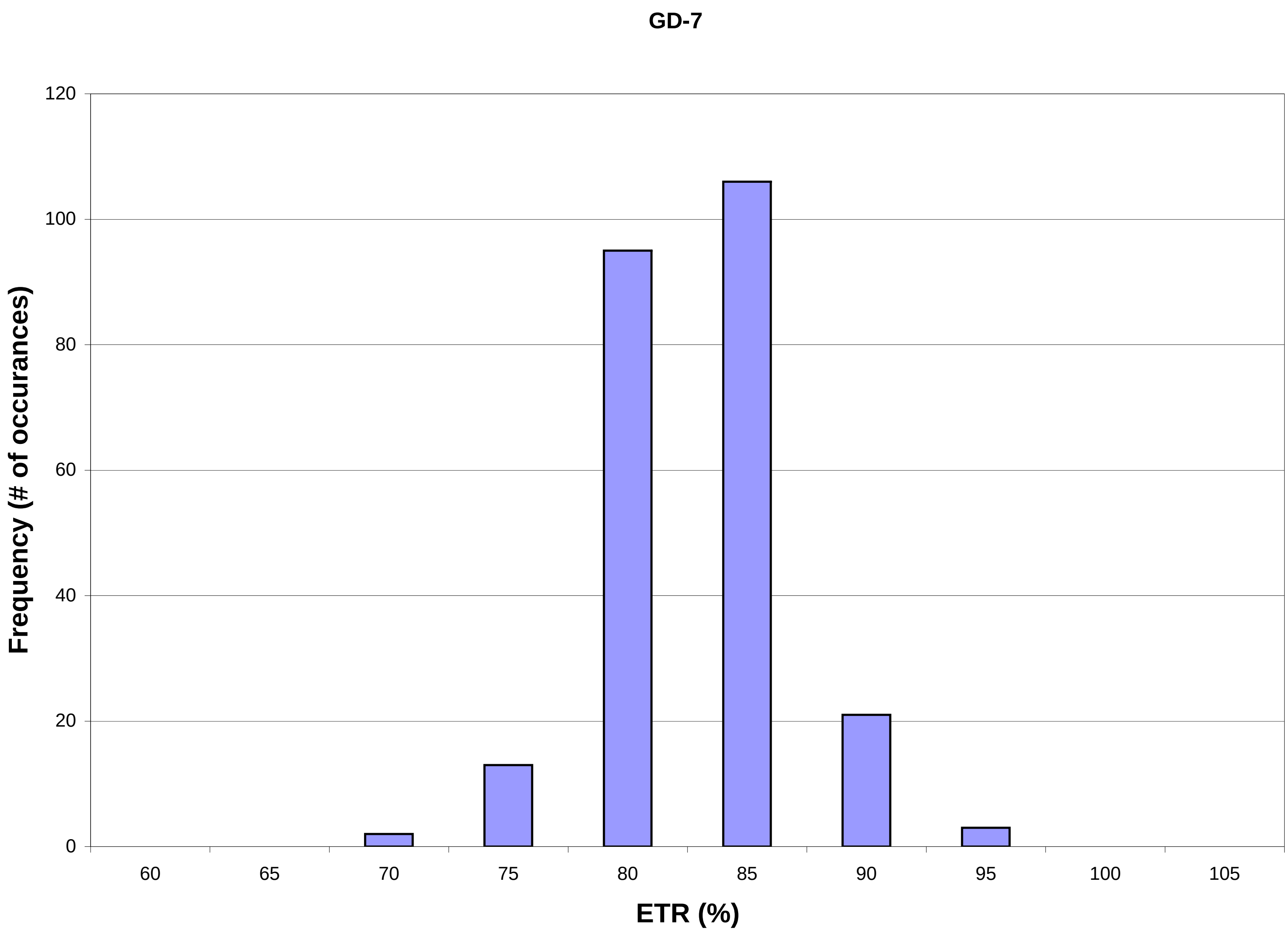


GD-4
Frequency (# of occurances)
0
10
20
30
40
50
60
70
80
45
50
55
60
65
70
75
80
85
90
95
100
ETR (%)

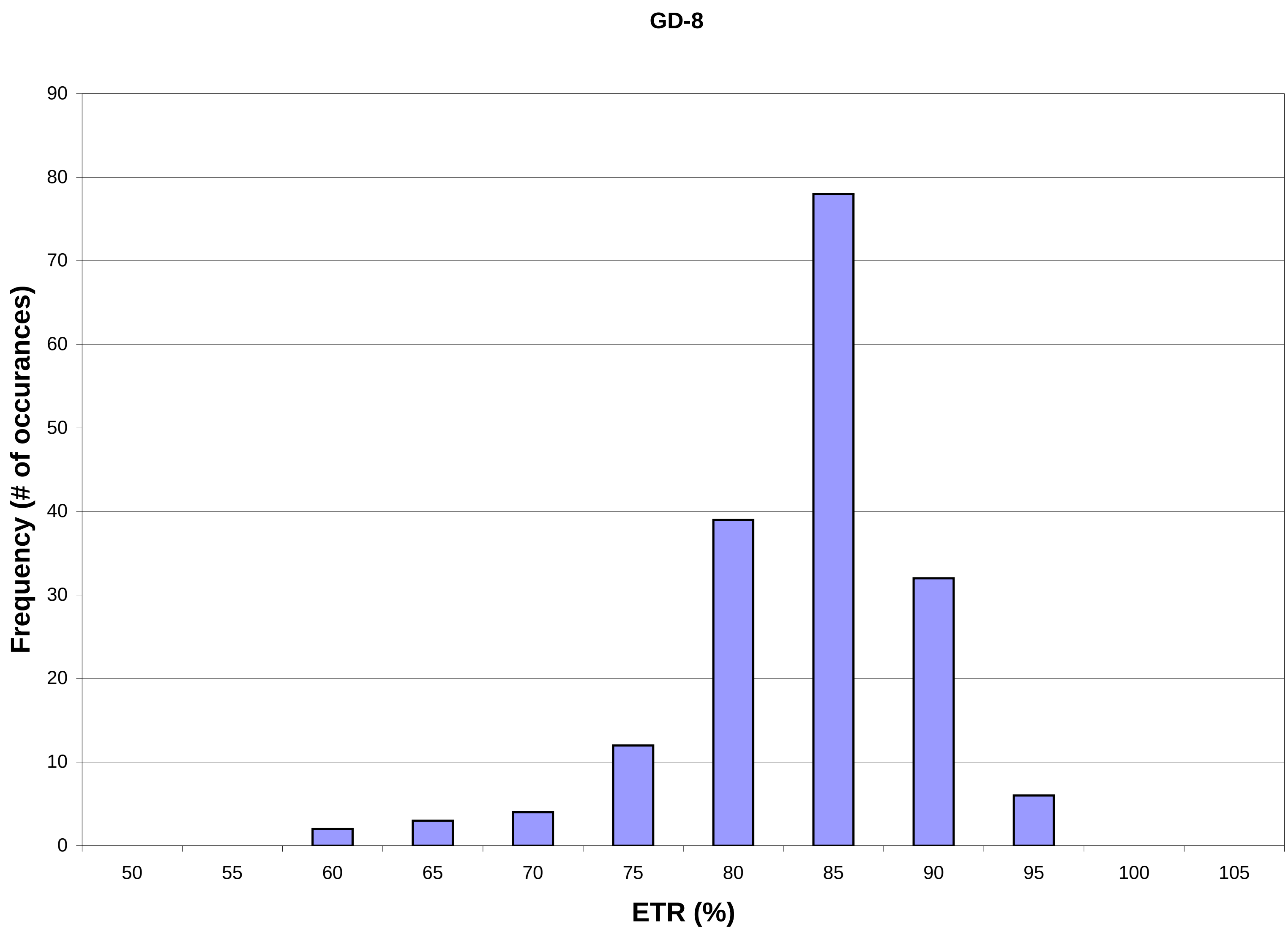


GD-5
Frequency (# of occurances)
120
100
80
60
40
20
0
60
65
70
75
80
85
90
95
100
105
ETR (%)

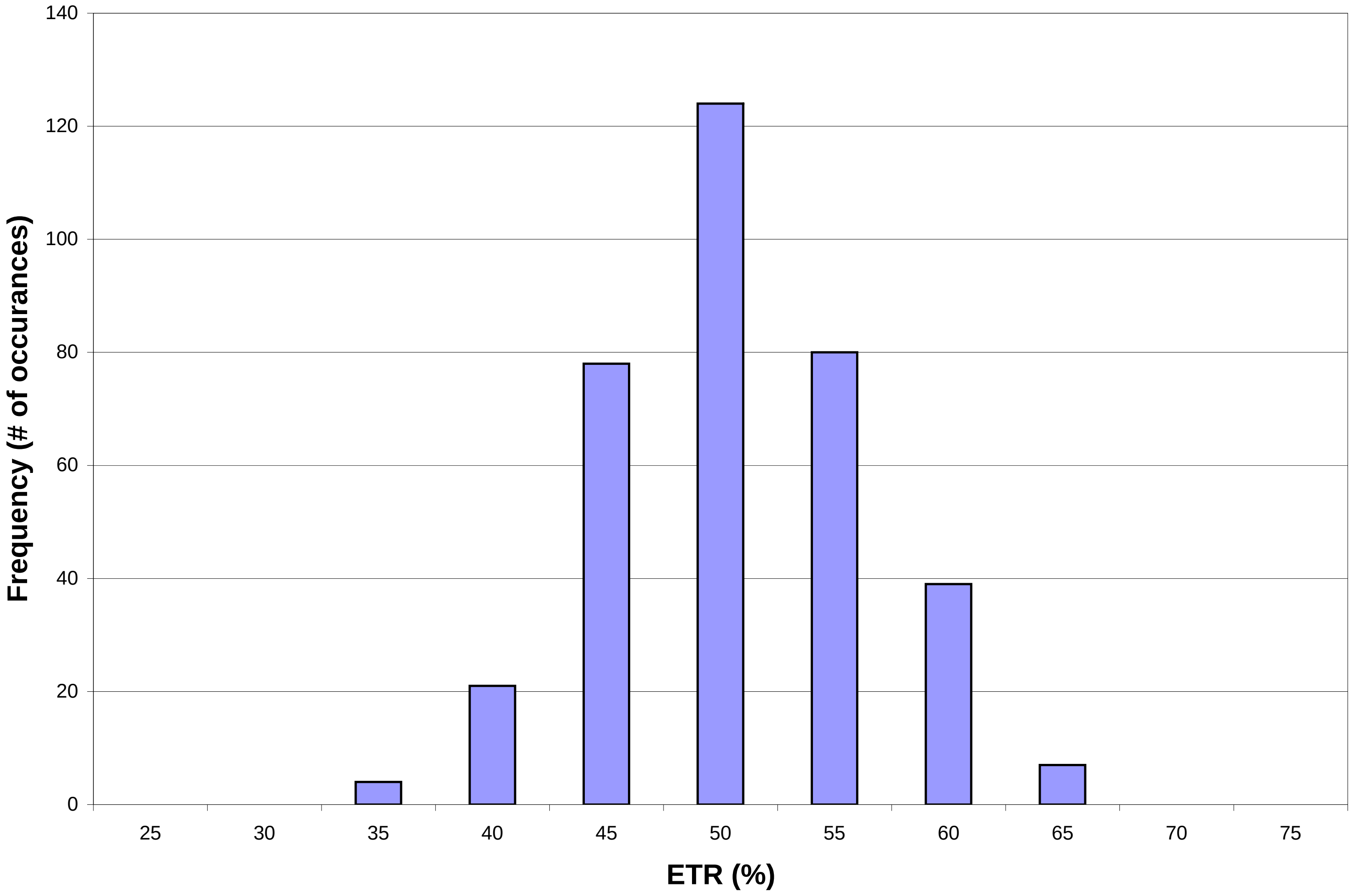

GD-6
Frequency (# of occurances)
35
30
25
20
15
10
5
0
20
25
30
35
40
45
50
55
60
65
70
75
80
85
90
95
100
105
110
115
ETR (%)



GD-7
120
100
80
60
40
20
0
Frequency (# of occurances)
60
65
70
75
80
85
90
95
100
105
ETR (%)


GD-8
Frequency (# of occurances)
90
80
70
60
50
40
30
20
10
0
50
55
60
65
70
75
80
85
90
95
100
105
ETR (%)

GD-9



Frequency (# of occurances)
140
120
100
80
60
40
20
0
25
30
35
40
45
50
55
60
65
70
75
ETR (%)

Note: Unless otherwise noted, ETR% data below is obtained using the F^2 method.

Test Agency	Hammer Type	Drill Rig	AVG ETR (%)		AVG C_n	Source
Caltrans	Diedrich Automatic	Christensen CS 1000	80		1.33	Caltrans "Drill Rig Hammer Evaluation", File 59-910683, 12/7/2005
	Diedrich Automatic	Christensen CS 1000	84		1.4	
	CME Automatic	CME-75	82		1.36	
	CME Automatic	Cme-85	87		1.46	
	Safety Driver	Acker 75 Soil Max	43		0.72	
	Safety Driver	Christensen CS 500	31		0.52	
	Safety Driver	Foremost Mobile B-47	56		0.94	
	Safety Driver	Foremost Mobile B-48	53		0.88	
	Safety Driver	Foremost Mobile B-49	50		0.84	
	Safety Driver	Foremost Mobile B-50	51		0.85	
	Safety Driver	Foremost Mobile B-51	63		1.05	
	Safety Driver	Foremost Mobile B-52	68		1.13	
	Safety Driver	Foremost Mobile B-53	51		0.85	
	Safety Driver	Foremost Mobile B-54	65		1.08	
	Safety Driver	Foremost Mobile B-55	70		1.17	

Oregon DOT Recommended SPT energy Correction Factors, Theoretical	CME Automatic	CME 850	82		1.4	"SPT Energy Measurements with the Pile Driving Analyzer" PowerPoint Presentation, Laura Krusinski, P.E., Maine DOT
	Auto-trip Safety, spooling winch, down hole	Mobile B-53	48		0.8	
	Safety; Cathead	Mobile B-50	78		1.3	
	Safety; Cathead	Longyear 24	62		1	
	CME Automatic	CME 750	78		1.3	
	Safety; Cathead	Mobile B-50	61		1	
	Automatic; Hydraulic Drive	Mobile	62		1	
	CME Automatic	CME 750	82		1.4	
	CME Automatic	CME 750	78		1.3	
Maryland DOT	Automatic	CME ATV 550	81.4		1.36	"Research Report, SPT Correction", M. Sherif Aggour and Rose Radding, Department of Civil and Environmental Engineering, University of Maryland, September 2001
	Safety Pin	Mobile B61	70.2		1.17	
	Sprauge and Henwood Donut	Mobile B61	63.5		1.06	

Compiled "In Situ Testing Techniques in Geotechnical Engineering" Alan J. Lutenegger, UMASS - Amherst	Donut; Rope and Cathead		31		0.52	Schmertmann & Palacios (1979)
	Donut; Rope and Cathead		45		0.75	Kovacs et al. (1981)
	Donut; Rope and Cathead		43		0.72	Robertson et al. (1983)
	Donut; Rope and Cathead		47		0.78	Robertson et al. (1985)
	Donut; Tombi		80		1.33	Kovacs & Salmone (1982)
	Donut; Tombi		80-90			Tokimatsu & Yoshimi (1983)
	Safety; Rope and Cathead		52		0.87	Schmertmann & Palacios (1979)
	Safety; Rope and Cathead		55		0.92	Schmertmann & Palacios (1979)
	Safety; Rope and Cathead		61		1.02	Kovacs et al. (1981)
	Safety; Rope and Cathead		52		0.87	Kovacs & Salmone (1982)
	Safety; Rope and Cathead		62		1.03	Robertson et al. (1983)
	Safety; Rope and Cathead		55-115			Riggs et al. (1983)
	Safety; Rope and Cathead		71-91			Riggs et al. (1984)
	Automatic		56-115			Riggs et al. (1983)
	Automatic		90		1.50	Riggs et al. (1983)
	Automatic		86-91			Schmertmann (1984)
	Automatic		84-106			Frost (1992)

Compiled "Summary of SPT energy measurement experience" Jeffrey A. Farrar, U.S. Department of Interior, Bureau of Reclamation	CME Automatic		86		1.43	1990 Globe CDOT-USBR
	Safety; NW guide		54		0.90	1991, Sy, UBC study
	Diedrich Automatic		100 (area probably wrong)			1992 Frost, Diedrich Drill
	Diedrich Automatic		85		1.42	1993 Frost, Diedrich Drill
	Safety		51		0.85	1993 GRL Texas A&M
	BK-81 Auto		67		1.12	1994 ASCE Seattle
	Safety		56		0.93	1995 ASCE Seattle
	CME Automatic		81		1.35	1996 ASCE Seattle
	Safety; Spooling Winch		21		0.35	1997 ASCE Seattle
	CME Automatic		74		1.23	1998 ASCE Seattle
	Safety		61		1.02	1995 GRL Oregon DOT
	Safety		61		1.02	1996 GRL Oregon DOT
	Safety		82		1.37	1997 GRL Oregon DOT
	Safety		65		1.08	1998 GRL Oregon DOT
	Safety; Spooling Winch		54		0.90	1999 GRL Oregon DOT
	Safety		58		0.97	1995 Jackson, B.C. Hydro
	Unknown Automatic		89		1.48	1996 Jackson, B.C. Hydro
	Mobile Automatic		60		1.00	1995 GRL Oregon DOT
	CME Automatic		95		1.58	1996 GRL Oregon DOT
	CME Automatic		93		1.55	1997 GRL Oregon DOT
	CME Automatic		118		1.97	1998 GRL Oregon DOT
	CME Automatic		102		1.70	1999 GRL Oregon DOT

Department of Civil & Environmental Engineering, Korea Advanced Institute of Science and Technology, Daejon, Korea	Donut; Hydraulic Lift Steel wire; <10 m depth		44.9		0.75	Energy Ratio Measurements of SPT equipment", Dong-Soo Kim et al.
	Donut; Hydraulic Lift Steel wire; >10 m		58.9		0.98	
	CME Automatic; <10m		57.4		0.96	
	CME Automatic; >10m		64.9		1.08	
	Safety; < 10 m		54.7		0.91	
	Safety; > 10 m		58		0.97	
	Donut; Rope and Pulley; < 10 m		36.9		0.62	
	Donut; Rope and Pulley; > 10 m		38.6		0.64	
Argentina	Donut; Rope and Pulley		45		0.75	Typical SPT Energy by country, "Case History of SPT Energy ration for automatic hammer in northeastern U.S. practice", S.O. Akbas & F.H. Kulhawy
Brazil	Pinweight		72		1.20	
China	Pilcon type		60		1.00	
China	Donut; manual		55		0.92	
Columbia	Donut; Rope and Pulley		50		0.83	
Italy	Donut; free fall		65		1.08	
Japan	Donut; free fall		78		1.30	
Japan	Donut; Rope and Pulley		68		1.13	
Paraguay	Pinweight		72		1.20	
U.K.	Donut; free fall		60		1.00	
U.K.	Donut; Rope and Pulley		50		0.83	
U.S.A.	Donut; Rope and Pulley		45		0.75	
U.S.A.	Safety; Rope and Pulley		60		1.00	
U.S.A.	Safety; Free fall		85		1.42	
Venezuela	Donut; Rope and Pulley		43		0.72	

Utah DOT	Rope and Cathead (Safety?)	Mobile B-57	62.2		1.04	SPT Energy Measurements wit the PDA, Darin Sjoblom et al.
	Rope and Cathead (Safety?)	Mobile B-53	58.2		0.97	
	Rope and Cathead (Safety?)	Mobile B-53	55.4		0.92	
	Rope and Cathead (Safety?)	Mobile B-80	74.8		1.25	
	Rope and Cathead (Safety?)	Mobile B-80	61.2		1.02	
	Automatic	CME 750	86.6		1.44	
	Automatic	CME 170	87.1		1.45	
	Automatic	CME 75	81.7		1.36	
	Automatic	CME 75	78.7		1.31	
	Wire Line	CME 75	49.8		0.83	
	Automatic	BK-66	70.8		1.18	
	Automatic	BK-66	68.6		1.14	
	Automatic	CME 55	85.3		1.42	
	Automatic	CME 75	94.6		1.58	
	Automatic	CME 55	85.4		1.42	
	Automatic	CME 55	81		1.35	
	Rope and Cathead (Safety?)	Saitech GH3	75.4		1.26	
	Rope and Cathead (Safety?)	Saitech GH3	69.7		1.16	
	Rope and Cathead (Safety?)	Saitech GH3	76.3		1.27	
	Automatic	CME 75	58.3		0.97	
	Automatic	CME 75	64.5		1.08	
	Rope and Cathead (Safety?)	Mobile B-61	66.3		1.11	
	Automatic	Mobile B-57	75.5		1.26	
	Automatic	Mobile B-80	70.4		1.17	
	Rope and Cathead (Safety?)	CME 55	69.1		1.15	
	Automatic	BK-81	83.7		1.40	
	Automatic	CME 850	62.7		1.05	
	Rope and Cathead (Safety?)	Terramec 100	63.7		1.06	
	Automatic	CME 750	66.6		1.11	
	Automatic	CME 850	82		1.37	
	Automatic	Diedrich D-120	88.8		1.48	
	Automatic	Diedrich D-120	46		0.77	
	Automatic	Diedrich D-120	80		1.33	

U.S. Department of Interior Bureau of Reclamation	CME Automatic		90		1.50	Schmertmann and Smith (1977)
	CME Automatic	CME 750	83		1.38	Riggs (1982)
	CME Automatic		100+			Riggs et al. (1983)
	CME Automatic		88-91			Riggs et al. (1984)
	CME Automatic	CME 750	92		1.53	Kovacs (1984)
	CME Automatic	CME 750, 55	95		1.58	Farrar (1990)
	CME Automatic		86	86	1.43	Goble (1990)
	CME Automatic	CME 75	92-97		1.53	Farrar (1991)
	CME Automatic	CME 75	81	81	1.35	GRL ASCE Seattle (1994)
	CME Automatic		74	73	1.23	GRL ASCE Seattle (1994)
	CME Automatic		74	73	1.23	GRL ASCE Seattle (1994)
	CME Automatic	CME 750	95	82	1.58	GRL Oregon DOT (1995)
	CME Automatic	CME 750	93	78	1.55	GRL Oregon DOT (1995)
	CME Automatic	CME 750	118	78	1.97	GRL Oregon DOT (1995)
	CME Automatic	CME 850	102	82	1.70	GRL Oregon DOT (1995)
	CME Automatic			86-66		Lamb (1997)
	CME Automatic		75	81	1.25	GRL Wyoming DOT (1998)
	CME Automatic		76	81	1.27	GRL Wyoming DOT (1998)
	CME Automatic		76	78	1.27	GRL Wyoming DOT (1998)
	CME Automatic		75	81	1.25	GRL Los Angeles USACE (1998)

Legend

F^2
FV
No PDA
Theoretical
Method
Unclear

APPENDIX 10 – SPT N VALUE AND N_{60} VALUE PLOTS

Author(s)	Year	Title	Publication	Publisher	Published Location	Need to Obtain Copy
Abou-matar, H., and Goble, G.G.	(1997).	"SPT Dynamic Analysis and Measurements."	*Journal of Geotechnical and Geoenvironmental Engineering,*	ASCE,	Reston, VA.	
Aggour, M.S., and Radding, W.R.	(2001).	"Standard Penetration Test (SPT) Correction."		Maryland DOT,	Maryland.	
Akbas, S.O., and Kulhawy, F.H.	(2008).	"Case History of SPT Energy Ration for an Automatic Hammer in Northeastern U.S. Practice."	*Geotechnical and Geophysical Site Characterization,*	Taylor and Francis Group,	Taipei, Taiwan.	
Bosscher, Peter and Showers, Dale	"1987"	"Effect of Soil Type on Standard Penetration Test Input Energy"	*Journal of Geotechnical Engineering,*	ASCE,		
Butler, J.J., Caliendo, J.A., and Goble, G.G.	(1998).	"Comparison of SPT Energy Measurement Methods."	*Proceedings of the First International Conference on Site Characterization,*	Geotechnical Site Characterization,	Atlanta, GA.	
Caltrans.	(2005-2008).	"Drill Rig Hammer Evaluation."			California.	
Daniel, C., Howie, J.	"2005"	"Effect of hammer shape on energy transfer measurement in the Standard Penetration Test- Vol. 45."	Soils and Foundations	Japanese Geotechnical Society		
Diedrich Drill Incorporated.	(2004)	"Diedrich Automatic Hammer Operation Instructions"				
Diedrich Drill Incorporated.	(1996).	"Diedrich Automatic SPT Hammer System."			LaPorte, IN.	
Drumright, E.E., Pfingsten, C.W., and Lukas, R.G.	(1996).	"Influence of Hammer Type on SPT Results."	*Journal of Geotechnical Engineering,*	ASCE,	Reston, VA.	
Farrar, J., Nickell, J., Allen, M., Goble, G., Berger, J.	"1998"	"Energy loss in long rod penetration testing-Terminus Dam Liquefaction Investigation"	Geotechnical Special Publication	ASCE,		X
Farrar, J.A.	(1998).	"Summary of Standard Penetration Test (SPT) Energy Measurement Experiment."	*Proceedings of the First International Conference on Site Characterization,*	Geotechnical Site Characterization,	Atlanta, GA.	
Farrar, J.A., and Chitwood, D.	(1999).	"CME Automatic Hammer Operations Bulletin."		US Bureau of Reclamation,	Denver, CO.	
Frost, D.J.	(1992).	"Evaluation of the Repeatability and Efficiency of Energy Delivered with a Diedrich Automatic SPT Hammer System."		Diedrich Drill Incorporated,	LaPorte, IN.	
Goble, G.G., and Abou-matar, H.	(1992).	"Determination of Wave Equation Soil Constants from the Standard Penetration Test."	*Proceedings of the Fourth International Conference on the Application of Stress-Wave Theory to Piles,*		The Netherlands.	
Hall, J.R.	"1982"	"Drill Rod Energy As A Basis For Correlation for SPT Data"	Proceedings of the 2nd. European Symposium	Amsterdam	Balkema	

Howie, J., and Campanella R.G.		"Energy Measurement in the Standard Penetration Test (SPT)"	www.civil.ubc.ca/research/geotech/sptenergy/sptenergy.htm	Department of Civil Engineering	University of British Columbia, Vancouver, BC, Canada	
Johnsen, L.F., Bemben, S.M., and Jagello, J.J.	(2001).	"SPT Energy Transfer Measurements for Liquefaction Evaluations in the Northeast."	*Proceedings of the Fourth International Conference on Recent Advances in Geotechnical Earthquake Engineering and Soil Dynamics,*		San Diego, CA.	
Kim, D.S., Seo, W.S., and Bang, E.S.	(2004).	"Energy Ratio Measurement of SPT Equipment."	*Proceedings ISC-2 on Geotechnical and Geophysical Site Characterization,*		Porto, Portugal.	
Kovacs, W.	"1979"	"Velocity Measurement of Free-Fall SPT Hammer"	Journal of the Geotechnical Engineering Division			X
Kovacs, W.D. Evans, J.C., Griffith, A.H.		"Towards a More Standardized SPT"	Proceedings of the Ninth International Conference on Soil Mechanics and Foundation Eng	Purdue University,	West Lafayette, IN.	
Kovacs, W.D., Evans, J.C., and Griffith, A.H.	(1975).	"A Comparative Investigation of the Mobile Drilling Company's Safe-T-Driver with the Standard Cathead with Manila Rope for the Performance of the Standard Penetration Test."		Purdue University,	West Lafayette, IN.	
Kovacs, W.D., Griffith, A.H., Evans, J.C.	"1978"	"Alternative To The Cathead and Rope For The Standard Penetration Test"	Geotechnical Testing Journal	American Society for Testing & Materials		
Kovacs, W.D., Salomone, L.A.	"1984"	"Field Evaluation of SPT Energy, Equipment and Methods in Japan Compared with SPT in the United States"	National Bureau of Standards	Department of Commerce		X
Kovacs, W.D., Salomone, L.A., and Yokel, F.Y.	(1980).	"Comparison of Energy Measurements in the Standard Penetration Test Using the Cathead and Rope Method."		U.S. N.R.C.,	Washington, D.C.	
Kovacs, W.D., Salomone, L.A., and Yokel, F.Y.	(1981).	"Energy Measurements in the Standard Penetration Test."		National Bureau of Standards,	Washington, D.C.	
Krusinski, L.		"SPT Energy Measurements with the Pile Driving Analyzer."		Maine DOT,	Maine.	
Lutenegger, A.J.	(1999).	"In Situ Testing Techniques in Geotechnical Engineering."		University of Massachusetts,	Amherst, MA.	
Morgano, C.M., and Liang, R.	(1992).	"Energy Transfer in SPT - Rod Length Effect."	*Proceedings of the Fourth International Conference on the Application of Stress-Wave Theory to Piles,*		The Netherlands.	

Odebrecht, E., Schnaid, F., Rocha, M.M., and Bernardes, G.P.	(2004).	"Energy Measurements for Standard Penetration Tests and the Effects of the Length of the Rods."	*Proceedings ISC-2 on Geotechnical and Geophysical Site Characterization,*		Porto, Portugal.	
Odebrecht, E., Schnaid, F., Rocha, M.M., and Bernardes, G.P.	(2005)	"Energy Efficiency for Standard Penetration Tests"	Journal of Geotechnical and Geoenvironmental Engineering,	ASCE,		
Palacios, A.	"1997"	"The theory and Measurement of Energy Transfer During Standard Penetration Test Sampling"	Ph.D Thesis	University of Florida	Gainesville, FL	X
Peixoto, A.S.P., de Carvalho, D., and Giacheti, H.L.	(2004).	"SPT-T: Test Procedure and Applications."	*Proceedings ISC-2 on Geotechnical and Geophysical Site Characterization,*		Porto, Portugal.	
Riggs, C.O., Schmidt, N.O., and Rassieur, C.L.	(1983).	"Reproducible SPT Hammer Impact Force with an Automatic Free Fall SPT Hammer System."	*Geotechnical Testing Journal,*	ASTM,	Philadelphia, PA.	
Robertson, P.K., Woeller, D.J.	"1991"	"SPT Energy Measurements Using a PC Based System"	Canadian Geotechnical Conference	Canadian Geotechnical Society		X
Robertson, P.K., Woeller, D.J., and Addo, O.	(1992).	"Standard Penetration Test Energy Measurements Using a System Based on the Personal Computer."	*Canadian Geotechnical Journal,*	National Research Council Canada,	Fredericton, New Brunswick, Canada.	
Schmertmann, J., Palacios, A.	"1979"	"Energy Dynamics of SPT"	Journal of the Geotechnical Engineering Division	ASCE,	University of Florida	
Seed, H.B., Tokimatsu, K., Harder, L.F., Chung, R.M.	"1985"	"Influence of SPT Procedures in Soil Liquefaction Resistance Evaluations"	Journal of Geotechnical Engineering,			

Sjoblom, D., Bischoff, J., and Cox, K.	(2002).	"SPT Energy Measurements with the PDA."	*The 2nd Annual Conference on the Application of Geophysical and NDT Methodologies to Transportation Facilities and Infrastructure,*	Federal Highway Administration,	Washington, D.C.	
Skepton, A.W.	"1986"	"Standard Penetration Test Procedures and the Effects in Sands of Overburden Pressure, Density, Particle Size, Aging and Overconsolidation"	Geotechnique			
Steiger, F.		"Experimental Investigation Of The Force/Penetration Relationships of Rod Impact"	Geotechnical Testing Journal			
Sy, Alex, Campanella, R.G.	"1993"	"Standard Penetration Test Energy Measurements Using a System Based on the Personal Computer -Discussion"	Discussion	University of British Columbia		
Tsai, J., Liou, Y., Liu, F., Chen, H.	"2004"	"Effect of hammer shape on energy transfer measurement in the Standard Penetration Test- Vol. 44"	Soils and Foundations	Japanese Geotechnical Society	Tainan, Taiwan	
van der Graaf, H.J., and van den Heuvel, M.H.J.P.	(1992).	"Determination of the Penetration Energy in the Standard Penetration Test."	*Proceedings of the Fourth International Conference on the Application of Stress-Wave Theory to Piles,*		The Netherlands.	
Yokel,F.	"1982"	"Energy Transfer in Standard Penetration Test"	Journal of the Geotechnical Engineering Division	ASCE,	Washington, D.C.	
Youd, T.L., Bartholomew, H.W., and Steidl, J.H.	(2008).	"SPT Hammer Energy Ratio Versus Drop Height."	*Journal of Geotechnical and Geoenvironmental Engineering,*	ASCE,	Reston, VA.	
Youd, T.L., et al.,	"2001"	"Liquefaction Resistance of Soils"	Journal of Geotechnical and Geoenvironmental Engineering,			
	"2001"	"US Patent 6286613-Impact method and the device used in standard penetration test	www.patents/6286613/description.html			
	"1991"	"DCDMA Technical Manual"	Drilling Equipment Manufacturers Association		Columbia, SC	X
	"1988"	"Standard Penetration Test (SPT): International Reference Test Procedure"	Penetration Testing	Balkema		

Entered from ASTM D4633 - 05 References

Entered from Compendex Database

APPENDIX 11 – SPT HAMMER ENERGY LITERAURE VALUES

APPENDIX 12 – SPT INSTRUMENTED ROD CALIBRATION SHEETS