WSRC-TR-94-0159
Rev. 1

Dynamic Compaction Facility Test Report (U)

March 1994

Scott R. McMullin
Scott A. Dendler

Environmental Restoration Department

UNCLASSIFIED
DOES NOT CONTAIN
UNCLASSIFIED CONTROLLED
NUCLEAR INFORMATION

ADC &
Reviewing
Official: Scott R. McMullin Senior Engineering
(Name and Title)

Date: 3/21/94

Westinghouse Savannah River Company
Savannah River Site
Aiken, SC 29808

SAFETY • RESPONSIBILITY • SECURITY
SRS
SAVANNAH RIVER SITE

Prepared for the U. S. Department of Energy under Contract No. DE-AC09-89R18035.

This document was prepared in conjunction with work accomplished under Contract No. DE-AC09-89SR18035 with the U.S. Department of Energy.

DISCLAIMER

Table of Contents

List of Tables

List of Figures

Executive Summary

The primary objective for the Dynamic Compaction Facility (DCF) test was to determine if dynamic compaction of buried low-level waste trenches would cause damage or failure to the adjacent Mixed Waste Management Facility (MWMF) closure system. A second objective was to quantify the success of dynamic compaction in consolidated buried B-25 boxes containing low-level waste. To accomplish these objectives, the DCF test program constructed a full-scale model of an engineered low level trench, containing B-25 boxes full of simulated waste. A 3-ft thick kaolin clay cap, modeling the as-built characteristic of the MWMF, was constructed adjacent to this trench. The buried waste was dynamically compacted with instrumentation to monitor the vibratory effects. At the conclusion of the drop testing, the kaolin clay cap hydraulic conductivity was measured, using Sealed Double-Ringed Infiltrometers (SDRI). Following the dynamic testing, the compacted B-25 boxes were excavated and the degree of compaction quantified.

The regulatory driver for the DCF test is the Solvent Rag Settlement Agreement between the U.S. Department of Energy (DOE) and the South Carolina Department of Health and Environmental Control (SCDHEC). This agreement mandates the closure of portions of the Savannah River Site (SRS) burial grounds as a mixed waste management facility under the Resource Conservation Recovery Act (RCRA). In response to this mandate, the first closure phase was completed in 1991 with the Mixed Waste Management Facility (MWMF) certification. The next closure phase is referred to as the Low-Level Radioactive Waste Disposal Facility (LLRWDF).

Noninvasive characterization was performed using the Spectral Analysis of Shear Waves method, evaluating the quality of the DCF model as compared to MWMF. The test results indicated that the MWMF clay cap was drier and stiffer than the newly constructed DCF clay cap. While the same clay and specifications were used for both, the difference in mechanical properties can be attributed to desiccation and aging. The reaching impact from desiccation cannot be quantified with the current data, but could potentially impact the regulatory quality of the closure.

Vibrations from dynamic compaction could potentially damage the existing MWMF kaolin clay cap. The industry standard threshold for damage to plaster structures is 2.0 inches per second (in/s), peak particle velocity (PPV). While this value is a conservative value for kaolin clay, it provides a target baseline. Using this 2.0 in/s threshold, evaluating the attenuation of PPV versus distance indicates a limiting distance of 33 ft for natural ground. There is uncertainty regarding the comparative response of the DCF to the MWMF kaolin clay caps (i.e., apparent brittleness of the MWMF cap). The conservative approach is to apply a 1.50 factor of safety to the limiting distance. The reasonable and recommended buffer is 50 ft between the drop locations and the MWMF kaolin cap.

The barrier material used in regulated closures must meet the 10^{-07} cm/sec hydraulic conductivity criterion. This value is the threshold for failure when evaluating barrier performance. To validate the buffer between dynamic compaction activities and the MWMF, the DCF kaolin cap was instrumented using six SDRI. The results of these *in situ* studies measured no appreciable change in hydraulic conductivity for the DCF cap.

Evaluatation of the dynamic compaction success by excavating the compacted wastes, provided valuable insight, improving the quality of future closures. The traditional SRS success criterion was a 6 ft displacement or 20 consecutive drops, which ever came first. Observations early in the test indicating this criterion was inadequate allowing modifications to be made to the test plan. Excavating and measuring the reduction in void ratio for the traditional criterion demonstrated the lack of compaction to the bottom tier of boxes. As a result, a new criterion for success is recommended. The recommendation is to implement a success criterion based upon the change in crater depth per drop. This criterion is two consecutive drops with a change in crater depth of no greater than 0.2 ft.

Introduction

This report presents the construction, testing, and data evaluation for the Dynamic Compaction Facility (DCF). DCF construction and testing will be discussed, followed by a synthesis of the data collected, and concluded with test result evaluation. The following discussion will present a brief overview of the test objectives, the background, and the organizational elements.

Test Objectives

The DCF test was performed to determine if dynamic compaction of buried low level waste trenches would induce damage or failure to the adjacent Mixed Waste Management Facility (MWMF) closure system. The second objective was to measure how successfully dynamic compaction consolidated buried B-25 boxes containing low-level waste.[1]

To accomplish these objectives, the DCF test program constructed a full-scale model of an engineered low level trench (ELLT), containing B-25 boxes full of simulated wastes. A 3-ft thick kaolin clay cap, modeling the as-built characteristics of the MWMF, was constructed adjacent to this trench. To dynamically compact the buried B-25 boxes, a 20-ton steel encased, concrete weight was dropped repeatedly from 50 ft in the air. Instrumentation monitored the effects of this dynamic compaction on the kaolin clay cap. At the conclusion of the drop testing, Sealed Double-Ring Infiltrometers (SDRI) were used to measure the kaolin clay hydraulic conductivity. Then, the compacted B-25 boxes were excavated to measure the degree of compaction.

Background

SRS burial ground receives low-level waste generated during production activities. This facility, located between the F and H separation areas, covers approximately 120 acres. The waste has been deposited in the burial ground has evolved over the years. Before 1985, low-level radioactive waste was randomly dumped into disposal trenches, with little or no containerization. After 1985, ELLTs were constructed to hold waste contained in low-carbon steel boxes, called B-25's. The design function of these boxes was to help handle and transport LLRW.

Over time, this facility received solvent wipe rags containing small amounts of organic solvents. Burying these wipe rags violated the waste disposal permit. This violation was resolved through the Solvent Rag Settlement Agreement between DOE and SCDHEC. This agreement mandates that portions of the SRS burial grounds be closed as a mixed waste management facility under RCRA.

In response to this mandate, the first closure phase was completed in 1991, with the MWMF certification. This interim closure covered 58 acres of dynamically consolidated trenches with a 3-ft thick kaolin clay cap, followed by 2 ft of topsoil and vegetative cover.

The next closure phase is referred to as the LLRWDF. Covering approximately 34 acres, the LLRWDF closure consists predominately of ELLTs, containing low-grade, carbon-steel B-25 boxes filled with low-level radioactive waste. Historically, these boxes contain approximately 10% - 50% void space, which must be reduced to minimize settlement potential and to ensure closure cap longevity.

To effect buried waste consolidation and stabilization, dynamic compaction was selected, provided it did not damage existing structures and permitted facilities. To this end, the DCF test was conceived and conducted.

Organizational Elements

The DCF test and test facility design were accomplished through two simultaneous efforts. Under the direction of Westinghouse Savannah River Company Environmental Restoration Department (WSRC-ERD), Bechtel Savannah River Incorporated (BSRI) Design Engineering provided the design and construction specifications for the facility.[2] The second effort, again under WSRC-ERD's direction of, EBASCO Services Incorporated (EBASCO) designed and implemented the instrumentation plan.[3] As part of this task order, EBASCO compiled the resulting test data into a workable form for WSRC-ERD to interpret and evaluate.[4]

DCF construction was performed by BSRI. Using onsite forces, BSRI excavated the model ELLT; filled, placed, and backfilled the B-25 boxes; and constructed the kaolin clay cap. Additionally, the 20-ton, steel-encased, concrete weight was fabricated onsite.

Construction

Model ELLT

ELLT is a terminal receptor of low-level waste containerized in low-grade, carbon-steel boxes, called B-25's. The B-25 boxes are usually stacked four high inside the trench. Trenches at SRS contain up to 100,000 boxes. After placement, the boxes are backfilled and buried under approximately 4 ft of soil.

The SRS standard specifications for ELLT construction were reflected in the project construction specifications.[2] The DCF ELLT was designed to contain 165 B-25 boxes, and an access ramp. The sides of the trench were cut back to minimize slope failure and to allow safe entry.

Prior to placement, the B-25 boxes were randomly filled with simulated waste. These clean, simulated wastes characterized the types of materials buried in the burial grounds. This included metal, wood, soil, and protective clothing. The boxes were randomly hand filled with variable densities and then placed in a random configuration in a 6 x 7 x 4 box matrix.

After the boxes were placed, the excavation was backfilled, hand compacting the soil against the boxes to ensure intimate contact. The backfilled soil was compacted as close as possible to the natural density of undisturbed soil. As with the burial grounds, the model ELLT was buried under 4 ft of overburden.

Kaolin Clay Cap

The CT Main Company was subcontracted to analyze the MWMF as-built moisture density relationships for each constructed lift These values were synthesized into representative target-moisture density values for the constructing the DCF kaolin clay cap.[2] This was done to provide a more representative target moisture-density relationship, increasing the probability for a representative model.

To ensure a representative model clay was procured from the same vendor that provided it for the MWMF, samples were taken and analyzed prior to purchase, ensuring clay quality and compatibility with the test design.

After the excavation and recompaction of a 4-ft subgrade base, the kaolin clay was spread in 8-in. thick lifts. The clay for each lift was pulverized the into 1/4-in. clods, mixing with water until moisture content target range was achieved. The lift was then compacted using a CAT 815B at a specified number of passes to achieve the target-range density. Quality assurance testing verified that the target moisture density specification was met.

After constructing the kaolin clay cap, 6 in. of topsoil was compacted on top of the kaolin clay to protect and preserve the clay moisture. This 6-in. thickness deviated from the standard 2 ft at the MWMF, but did not impact the test results.

Dynamic Compaction

The MWMF project dynamic compaction weight and drop-height was designed after extensive testing. This testing determined an optimal configuration of an 8 ft diameter 20-ton weight dropped from 42 ft. The success criteria were established at a 6-ft displacement or 20 drops, which ever came first. The DCF program modeled this existing standard.

The dynamic compaction weight was fabricated onsite by casting a reinforced concrete weight, encased in 1/4-in. steel shell. After fabrication and curing, the weight was found to be 42,000 lbs.

Providing the energy level anticipated during production is critical in modeling actual conditions. Production cranes are assumed to be 90% efficient. Using the 20-ton weight from 42 ft, this is interpreted to be 1.512 million ft-lbs. As described previously, the measured the efficiency for the DCF crane was 55%. Back calculating the energy, the DCF 20 ton weight needed to be dropped from 50 ft to approximate actual production energy.

Instrumentation

To DCF test goals, a complete suite of instrumentation was identified and implemented. This suite of instrumentation collected data supporting preliminary characterization of the kaolin clay caps, impact velocity determination, strong motion, inelastic deformation, and *in situ* permeability. The different instrumentation elements were installed and operated in accordance with the *Instrumentation Plan: Dynamic Test Facility, Final Report*, prepared by EBASCO[3]. The data acquisition was divided into six basic elements, which are briefly outlined below.

Characterization and Comparison of Kaolin Clay Caps

DCF and the MWMF kaolin clay caps similarities are a basic premise to the DCF test program. To quantify and calibrate the as-built similarities and dis-similarities, nondestructive field geophysical studies were implemented. These studies determined the relative physical properties of the DCF clay cap and the existing MWMF closure system prior initiating dynamic compaction work. Two different techniques were implemented and are described below.

These two methods were P- and S- wave seismic refraction and Spectral Analysis of Shear Waves (SASW). Both methods were used at DCF and MWMF. The P- and S- wave seismic refraction placed seismographs in a linear array across the sampling area. A 1- ton weight was dropped from 10 ft as an energy source. Testing was performed in natural, undisturbed soil areas, across the long axis of the DCF clay cap and across the MWMF clay cap. Refraction data acquisition was not optimal because the surface soils had a higher shear wave velocity than the underlying soils. This condition did not cause effective refraction of the energy wave and prevented sampling of the underlying soils. This testing did, however, measure the shear wave velocities in the surface soils, serving as a redundant check of the SASW.

The SASW is based upon measuring surface waves propagating in layered elastic media. The surface wave velocity varies with frequency in a layered system.[5] The variation is called dispersion. A dispersion curve is created by plotting the surface wave velocity versus the wavelength. Using established relations, the surface wave velocities determined from the dispersion curves can be used to estimate shear wave velocities for the same materials. Generally, a stiffer material will have a higher shear wave velocity, while a less stiff material will have a lower shear wave velocity. The material's stiffness is a function of the bulk density and the moisture content. In turn, these values are reflected in the Young's Modulus of Elasticity and the Poisson's Ratio for the material. By knowing these values for both the DCF and the MWMF closure material, a correlation can be developed to help extrapolate the DCF results to the MWMF.

Impact Velocity Survey and Energy Measurements

Dynamic compaction is performed by hoisting a weight to a specified height, then releasing the weight in free-fall until impact with the target material. Each crane has an inherent efficiency factor, which is a function of the internal friction for the cable spool, brake configuration, and associated pulleys. Production cranes are designed to minimize this internal friction, thus, maximizing the impact energy. Production cranes and may attain an efficiency factor between 80 - 90%.

To realistically model production cranes and actual closure LLRWDF conditions, the efficiency of the DCF crane must be measured and differences calibrated. The impact velocity survey and energy measurements were designed to measure the energy at impact compared to the free-fall energy described through Newton's Law. To achieve this evaluation, instrumentation was designed to measure the actual impact velocity of the dynamic compaction weight. The ratio between the actual impact velocity and the velocity computed from the ideal equation for kinetic energy provides the efficiency factor for the DCF crane (Appendix B.3).

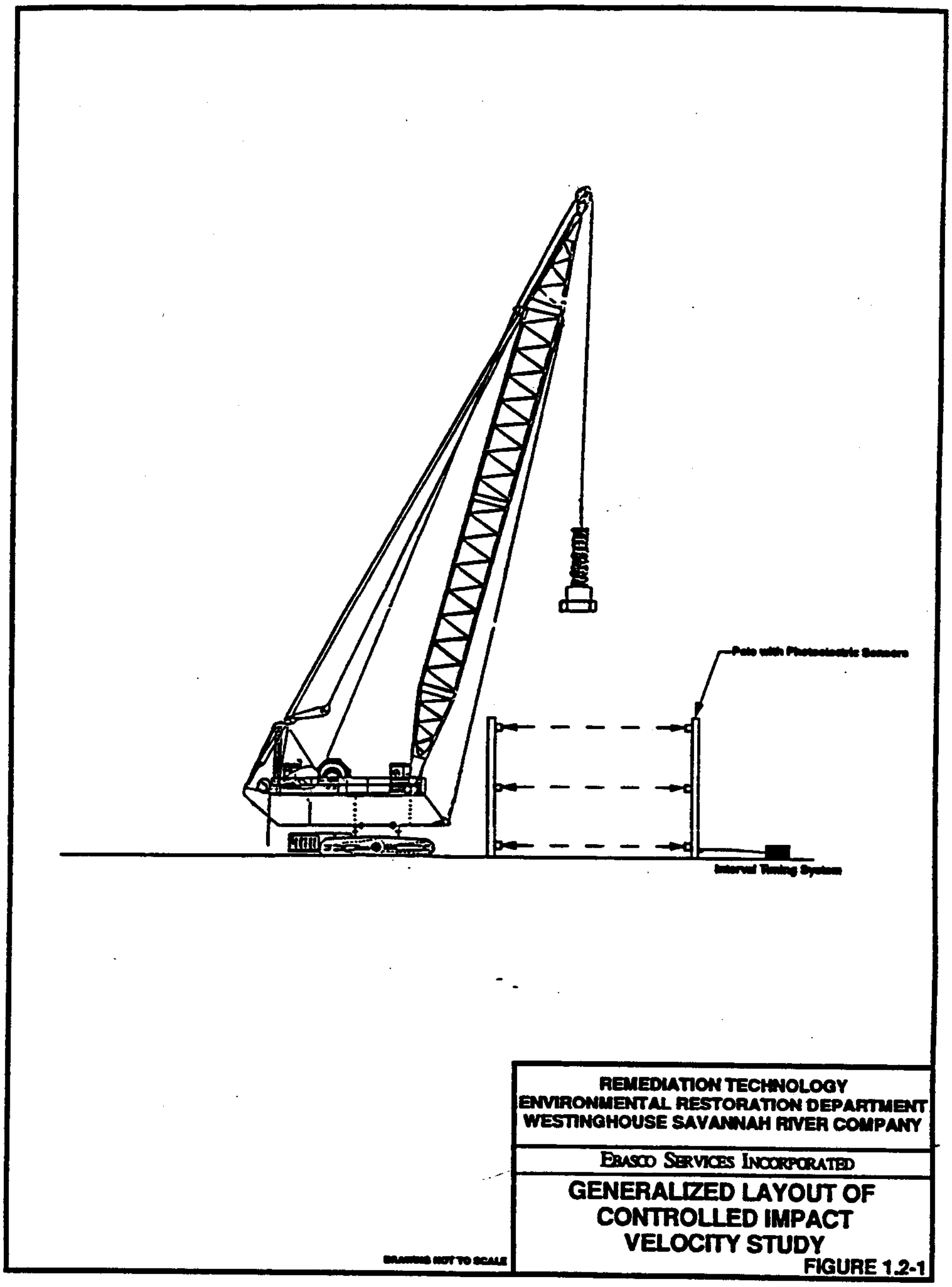


Figure 1 Generalized layout for the measurement of instantaneous velocity at impact during dynamic compaction activities.

To make these measurements, a series of laser diode photoelectric cells were mounted along two vertical poles at predetermined heights (Figure 1). As the weight fell downward, it sequentially broke a series of photocell beams at several predetermined heights above the ground surface. The interval between each successive break was recorded. Since the beams were located a known distance apart, the impact velocity and interval crane efficiency could be calculated. Determining instantaneous impact velocity is then a simple matter of extrapolation, using the quantities measured in the photocell gates.

The efficiency factor was measured during the preliminary drops prior to the actual compaction of the test waste matrix. Data evaluation measurements determined that the drop height for the DCF test should be increased from 42 ft to 50 ft to provide compactive energy similar to that anticipated during actual production.

Vibratory Ground Motion Monitoring Program

The key determination for the DCF test is to compare the range of vibratory ground motion with the changes in hydraulic conductivity. Literature indicates that 67% of the vibratory ground motion from dynamic compaction is manifest in the form of shear or surface waves.[6] Additionally, the frequency normally ranges between 5 and 200 Hz. A common method to measure and express these shear waves is to measure the peak particle velocity (PPV). The PPV is the instantaneous velocity at a point on the ground and provides the best evaluation of vibrations relative to potential structural damage.

To measure the PPV, strong motion sensors were set at predetermined locations on the kaolin clay cap and the surrounding undisturbed ground. The normal threshold values were set at 0.2 inches per second (in/s). Historical research and testing by the U.S. Bureau of Mines has set the threshold limit for damage to structures at 2.0 in/s.

A subcontractor provided 43 strong motion sensors for measurements during the DCF testing. Readouts from these instruments provided the following information:

- PPVs in the longitudinal, transverse, and vertical axis (inches per second)
- peak displacements in the longitudinal, transverse, and vertical axis (inches)
- peak particle accelerations in the longitudinal, transverse, and vertical axis (g)
- frequency, in the longitudinal transverse, and vertical axis (hz)
- the resultant peak particle velocity (inches per second)
- peak sound in decibels and pounds per square inch
- a graphical display of the vibrations in the longitudinal, transverse, and vertical axis
- a comparison with the US Bureau of Mines standard for damage to structures

Figure 2 presents a copy of a typical readout from a strong motion sensor. These data were measured for each dynamic compaction weight drop at each instrument location. The vibratory data for these locations determine the PPV dissipation across the DCF for each drop.

Inelastic Deformation Monitoring

As the DCF waste matrix is dynamically consolidated, there is a high potential for a resulting inelastic deformation. This deformation may be manifest through the lateral movement of the waste materials, causing the surrounding ground to either heave or subside. Either of these movements could potentially induce cracking and failure to the kaolin clay cap. To monitor the inelastic deformation, survey monuments were placed at predetermined locations surrounding the waste matrix. These brass caps, embedded in concrete, were surveyed based on the SRS coordinate system measuring the X, Y, and Z positions. Periodically during the DCF test, these positions were remeasured, with the final positions determined at the conclusion of the dynamic compaction phases of the DCF testing program.

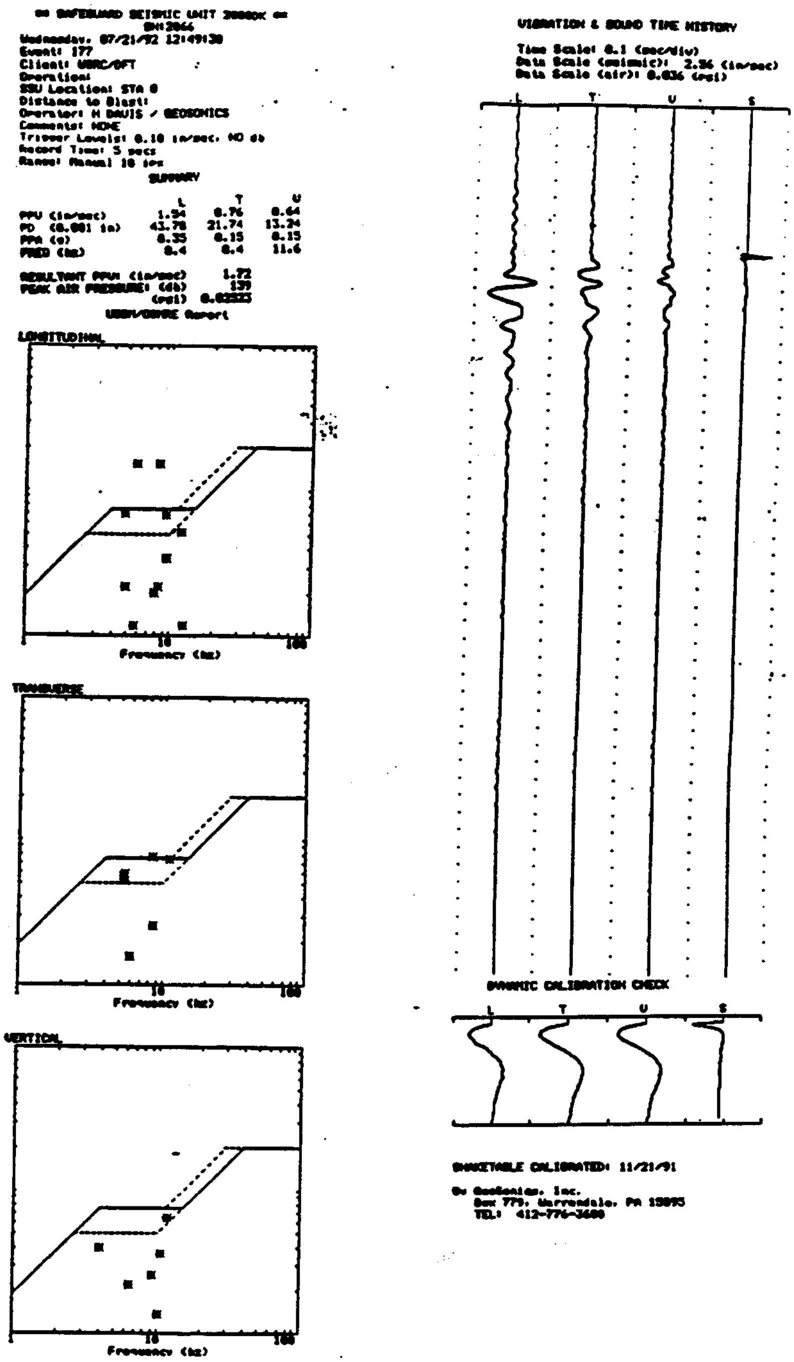


Figure 2 Sample readout from strong motion instrumentation. Note that the plots are representative of the U.S. Bureau of Mines threshold criterion. The distance from the drop location is 15 ft.

Postcompaction Infiltration Monitoring

The hydraulic conductivity of a waste site cover system is a key regulatory element. Any damage reflected on the MWMF closure cap by the dynamic compaction of the LLRWDF closure, will be manifest through changes in hydraulic conductivity (leaking). The second critical measurement for the DCF test is the hydraulic conductivity.

To accomplish this, a preliminary evaluation of the vibratory monitoring identified areas of high, medium, and low impact on the DCF kaolin cap. The Sealed Double-Ringed Infiltrometer (SDRI), designed by Drs. Stephen Trautwein of Houston, TX and David Daniels of the University of Texas chosen to measure the hydraulic conductivity. Six SDRIs were embedded in the DCF kaolin clay, with three placed in areas of high probability of impact, one placed in an area of medium probability of impact, and the remaining two placed in areas of low probability of impact.

Data Evaluation and Observations

Noninvasive Characterization of the DCF vs. MWMF Kaolin Clay Caps

A basic premise to the Dynamic Compaction Facility (DCF) test program is that the kaolin clay caps for both the DCF and the MWMF closure are structurally and mechanically similar. Because the MWMF closure system is a regulated closure, sampling and evaluation must be noninvasive and nondestructive. To meet these criteria and to determine the similarities between the two systems, the Spectral Analysis of Shear Waves (SASW) technique and the seismic refraction surveys were selected. During the DCF test design and construction, the intent was to emulate the specifications and as-built characteristics of the MWMF. As a reiteration, these efforts included purchasing the same clay and constructing the model cap to the same moisture/density relationship. Data included in Appendix A demonstrate the details of these efforts. An evaluation of these techniques and their results are presented herein.

The DCF kaolin cap was built from the same materials and to the same specifications as the MWMF closure cap. Theoretically, the DCF and the MWMF closure cap in situ properties should be virtually identical. The data quantitatively compare the *in situ* properties represented by the relative stiffness of each cap. This stiffness is represented by the accumulative shear wave velocities for each layer and material, using the seismic refraction and a SASW survey.

Refraction Surveys

P- and S-wave seismic refraction surveys were conducted on a limited basis at DCF and at two MWMF locations. These surveys consisted of a symmetrical array of strong motion sensors collecting data at a distance from the point of impact of a 1000-lb weight dropped from 10 ft high. These limited seismic refraction surveys measured only the fast, direct P- and S-wave velocities of the surface layer.

A linear, least-squares line was fitted through the seismic P- and S-wave refraction data for the three sites tested, as shown in figures 3, 4, and 5. These figures show a good data fit and a high correlation between r^2 values ranging from 0.977 to 0.997, with 1.0 representing a perfect correlation. The straight lines of these plots, without any faster, shorter time, refracted arrivals, indicate that the overlying topsoil and/or shallowest portions of the cap are faster than the rest of the underlying clay cap at the three sites tested. Consequently, while providing an estimate of near surface velocities of the soil cover and perhaps the shallowest kaolin clay, these data did not provide any definitive information on the velocity for the kaolin clay caps. Seismic wave velocities were generated by calculating the slope inverse of the lines, accounting for the vertical time scale in milliseconds. Compressional wave velocities for the surface layer using this refraction data were determined to be 1360 fps at the DCF location and 1580 and 1620 fps at the two MWMF locations. Calculation of the Poisson's ratios for each location suggests a value of 0.33 value for the surface layer for the DCF and 0.18 to 0.19 for the MWMF sites.

These studies confirm that the surface materials at both the DCF and the MWMF caps have higher seismic velocity values than the underlying kaolin clay caps. These limited seismic refraction surveys only measured the fast, direct P- and S-wave velocities of the surface layer. The measured direct shear wave velocities were generally comparable to those predicted by the SASW surveys.

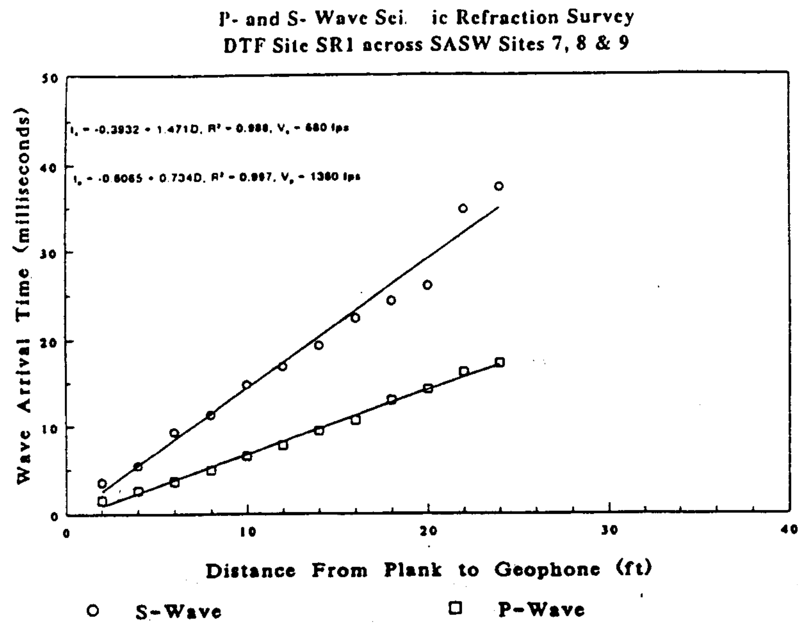


Figure 3 P- and S- Wave seismic refraction survey for DCF site SR1.

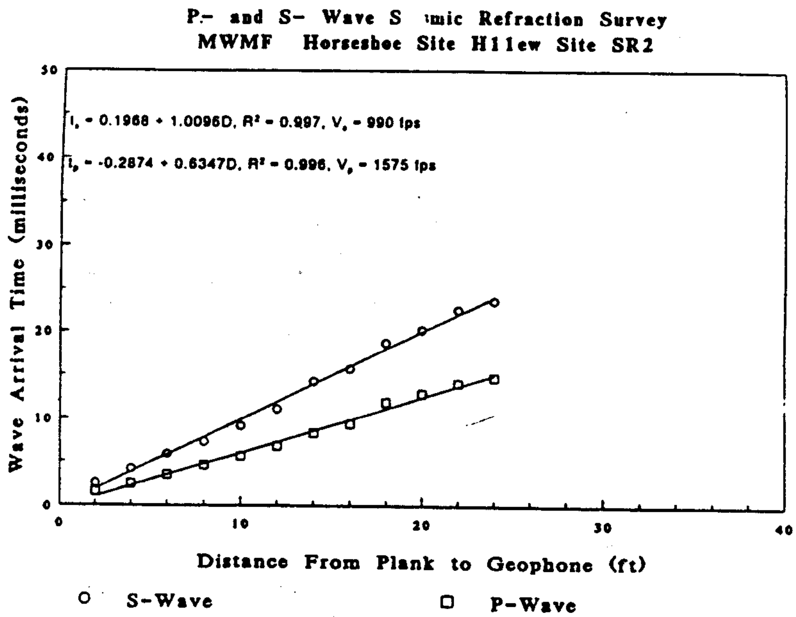


Figure 4 P- and S- Wave seismic refraction survey for the MWMF Horseshoe site.

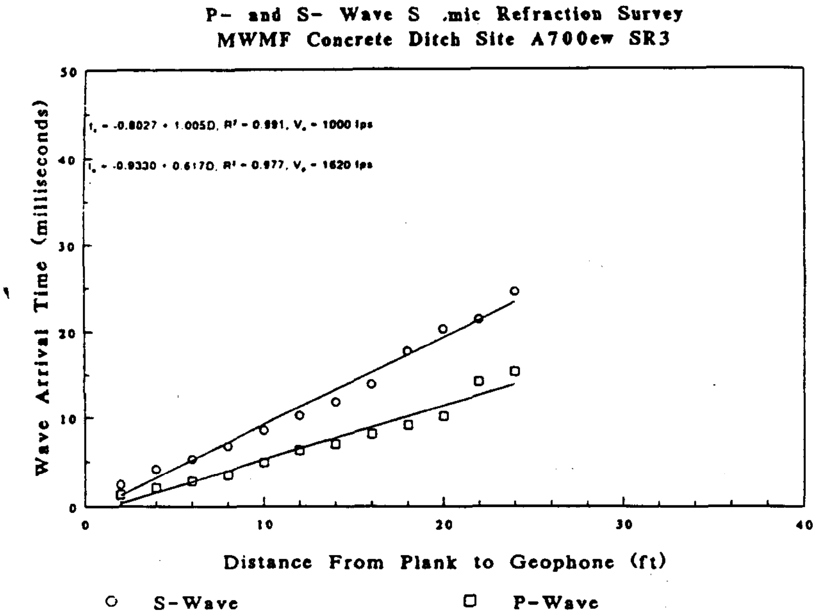


Figure 5 P- and S- Wave seismic refraction survey for the MWMF concrete ditch site.

Spectral Analysis of Shear Wave Analysis

The SASW uses a 3-Dimensional forward modeling technique to generate values for interpretation. The data provide the following information by model layer number from the surface down:

- layer thickness in units of feet
- an assumed compression wave velocity in units of feet per second
- shear wave velocity in units of feet per second
- an assumed Poisson's ratio
- an assumed mass density in units of $lb\text{-}sec^2/ft^4$

The shear wave velocities and layer thicknesses were adjusted and 2-D and 3-D forward modeling computer analyses performed until a reasonable match was obtained between the 3-D theoretical and experimental dispersion curves.

The DCF SASW data fall into three general categories: relatively high velocity soil or kaolin over lower velocity kaolin; uniform velocity within the soil and kaolin clay; and relatively low velocity soil or kaolin over a higher velocity kaolin. The SASW method identified the approximate thickness and shear wave velocity for each layer. Plots of the 3-D theoretical and experimental dispersion curves and the theoretically determined shear wave velocity versus depth profile are presented in Appendix B.1.

The SASW studies successfully measured the shear wave velocities of the underlying kaolin clays. Results indicate a mean shear wave velocity about 350 fps for the DCF kaolin clay cap zone. In comparison, mean shear wave velocities range from 500 to 550 fps for the MWMF kaolin clay cap zone. Shear wave velocities appear to be similar at the southeastern and northwestern portions of the MWMF cap.

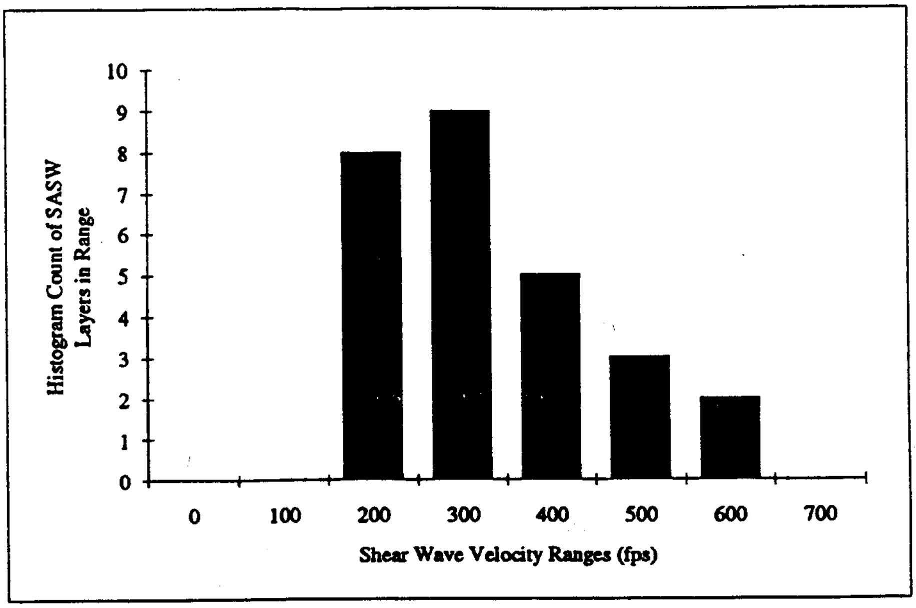


Figure 6 Histogram count of the SASW layers within a shear wave velocity range for the DCF test site (after Olson).

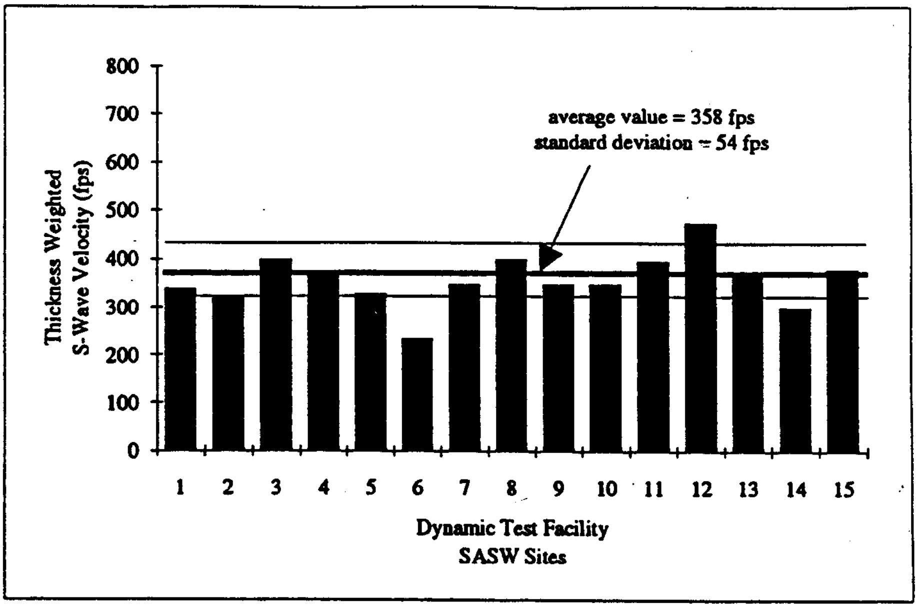


Figure 7 Thickness weighted S- Wave velocity values for each test location at the DCF test site (after Olson).

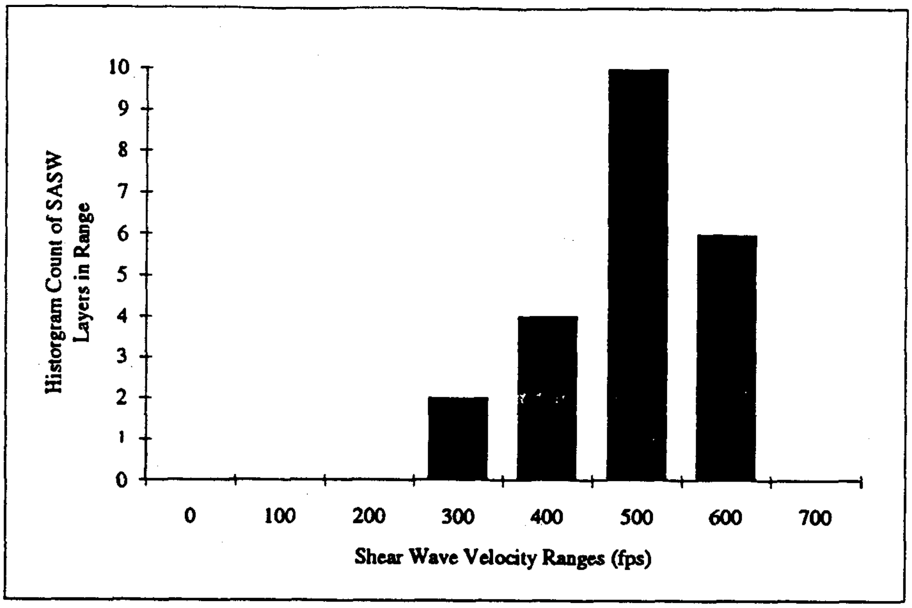


Figure 8 Histogram count of the SASW layers within a shear wave velocity range for the MWMF site #1 (after Olson).

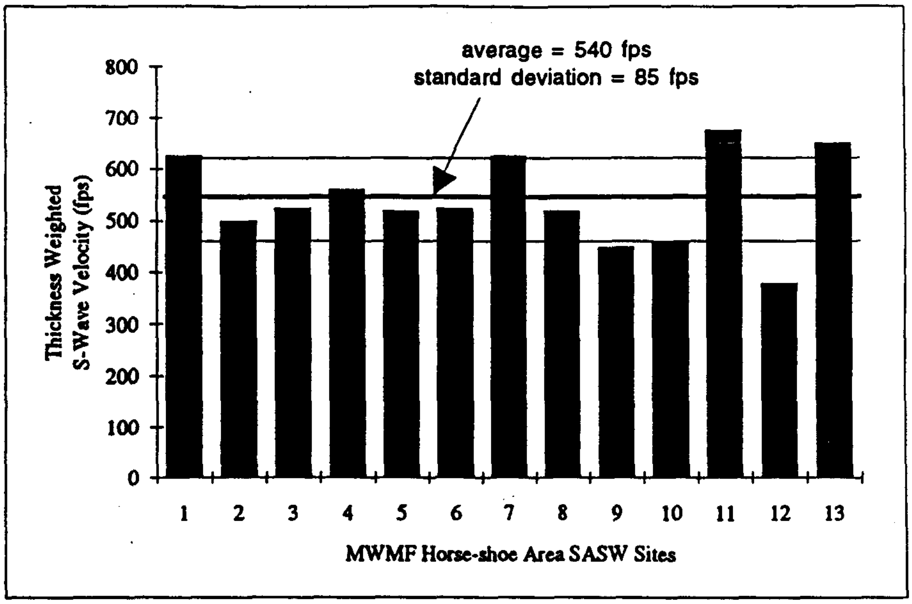


Figure 9 Thickness weighted S- Wave velocity values for each test location at the MWMF test site #1 (after Olson).

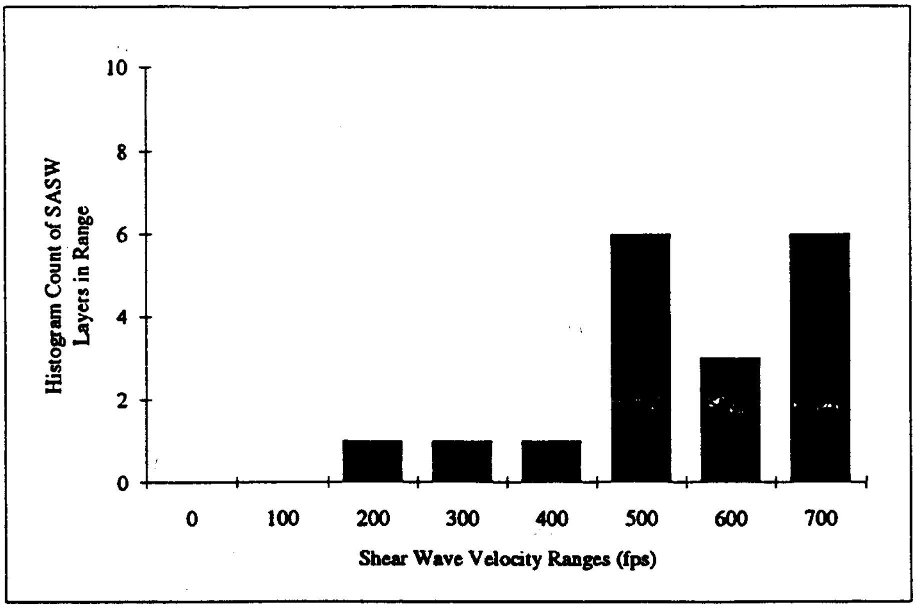


Figure 10 Histogram count of the SASW layers within a shear wave velocity range for the MWMF site #2 (after Olson).

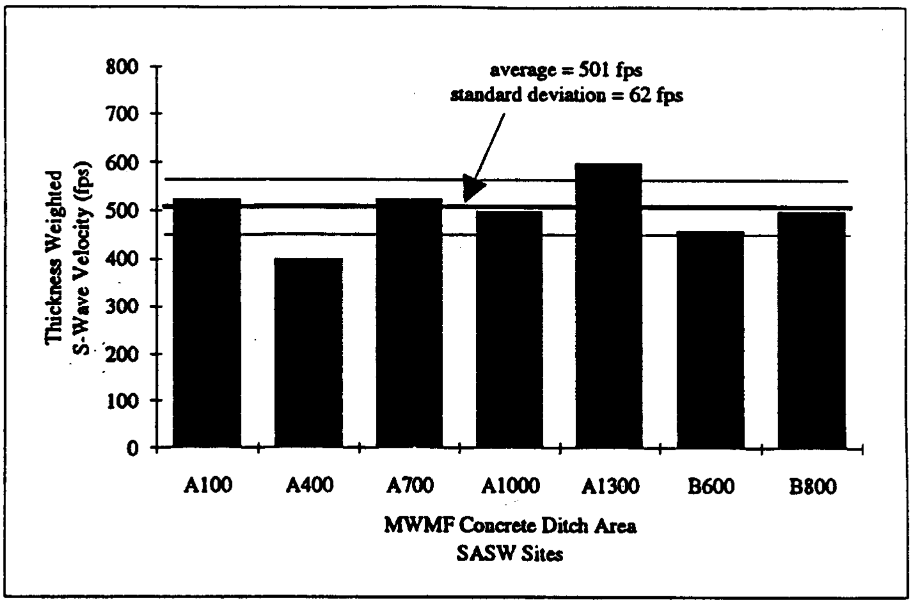


Figure 11 Thickness weighted S- Wave velocity values for each test location at the MWMF test site #2 (after Olson).

Figures 6 through 11 analyze the SASW data. Figures 6, 8, and 10 are histograms of the kaolin layers versus the shear wave velocity in feet per second. To obtain a better understanding, these data were normalized using layer thickness and are presented in figures 7, 9, and 11. Table 1 summarizes this evaluation for each of the characteristic sample locations.

Table 1 Shear Wave Velocities For Kaolin Clay, comparing the DCF and the MWMF

	Shear Wave Velocity (Vs)		
	Range (fps)	Mean (Fps)	Standard Deviation
DCF	200 to 680	350	57
MWMF-Site #1	380 to 670	359	83
MWMF-Site #2	380 to 650	502	60

The layer thickness weighted shear wave velocities range between 300 and 450 fps for the DCF sites and 400 to 700 fps for the MWMF sites. The difference between the two testing areas means that the MWMF closure cap is dryer or more brittle than the DCF closure cap. The higher the moisture content of a material, the more the material dampens the shear waves, resulting in a slower shear wave velocity. Conversely, with a low moisture content, the shear wave velocity will be higher.

The higher shear wave velocity observed at the MWMF may be caused by aging effects, which include drying of the kaolin clay over the past several years. In several instances, the shear wave velocities similar to those observed at the MWMF were documented in the shallowest portions of the DCF cap, consistent with the drying model. Further more, at one DCF site, the soil cover was removed, exposing the kaolin clay and allowing it to dry for several hours. The shear wave velocity for this clay was virtually identical to the mean values obtained at the older and presumably drier MWMF cap. The results of these studies suggest that the younger, wetter DCF cap may be less brittle than the older, drier MWMF cap.

Note that the data at the natural soil calibration site and the MWMF were collected during dry conditions. In contrast, the low-strain data at the DCF cap were collected the day after a heavy rain when the shallow soils at the drop point were very wet. This may explain the observed differences. The fact that the MWMF closure system appears dryer than the newly constructed DCF cap can be attributed to aging and desiccation. The regulatory impacts resulting from this desiccation are not distinct at this time. However, a conservative interpretation would be that the DCF cap materials tend to attenuate seismic waves faster than the MWMF cap.

Impact Velocity Calibration Results

The focus for this phase of testing was to establish the efficiency of the crane used to hoist and drop the 20-ton weight. Figure 12 shows the location of each drop point, drop location type (primary, secondary, or tertiary), and sequence in which each drop was completed. To examine reproducibility of the crane drops and photocell measurements, Appendix B.3 summarizes the instantaneous velocity and average crane efficiency at photocell 3 (v_3). The instantaneous velocity at photocell 3 averages 41.43 ft/s, with a standard deviation of 0.44 ft/s. The average crane efficiency for all production drops is 0.555 (55.5%), with a standard deviation of 0.015 (1.5%). These results indicate a high degree of reproducibility for both the crane and the interval photocell measurement equipment.

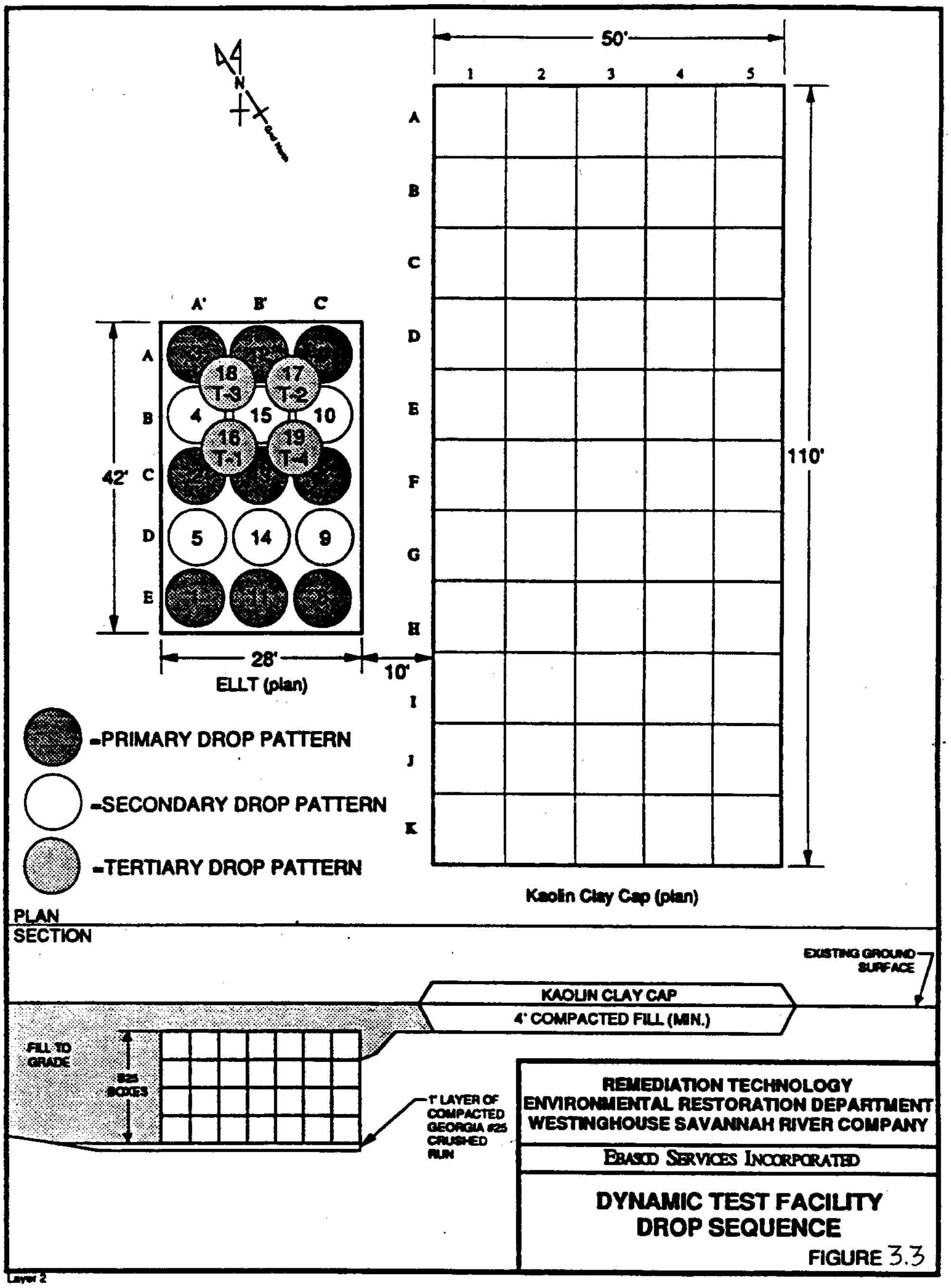


Figure 12 Dynamic Compaction Test drop locations and test site layout (after EBASCO).

Natural Soil Strong Motion Sensor Baseline

The dynamic compaction weight was dropped on undisturbed natural ground to obtain a PPV baseline and to ensure that surrounding structures would not sustain damage during the test. To provide this assurance, strong motion sensors were placed adjacent to nearby structures prior to testing. During actual dynamic compaction testing, these instruments were seldom triggered. These instruments demonstrated that at distance, the dynamic compaction test generated less vibration near sensitive structures than passing trucks, construction equipment, and trains.

Initial preliminary drops were conducted beginning at 10 ft, followed by drops at increasing heights of 15, 25, 35, 42, and 50 ft. This incremental approach was taken to ensure that the DCF program would have no negative impacts on nearby, sensitive structures (i.e., steamline, high-level transfer line and RCRA storage facility).

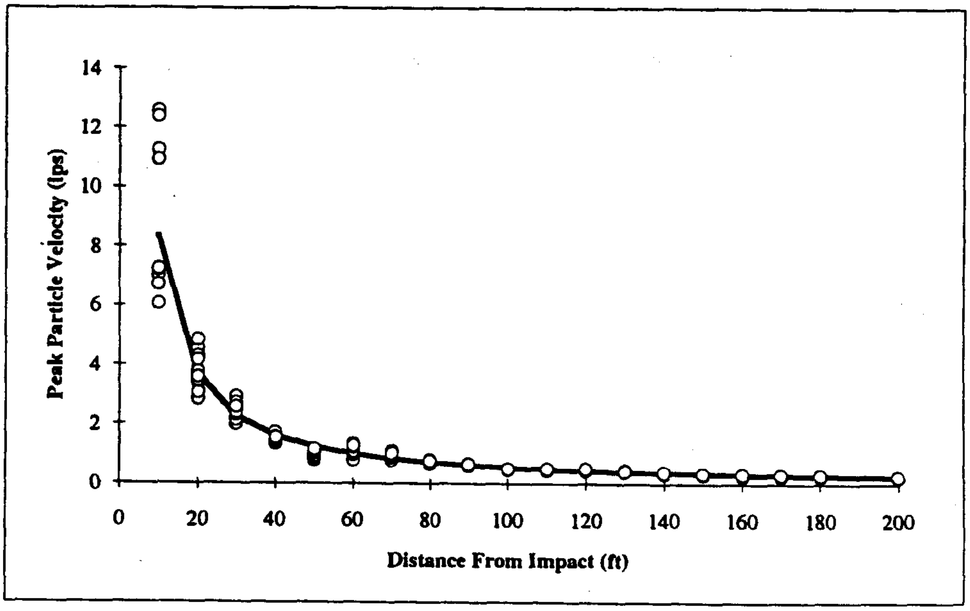


Figure 13 Plot of peak particle velocity versus distance from drop site for the natural ground, calibration drops. The regression curve provides an attenuation baseline for production drops.

Figure 13 plots the natural ground PPV against the distance from the drop point. This well-behaved data set demonstrates the natural attenuation of the shear wave energy with distance. The best fit curve for this data shows that on natural ground, the PPV at a distance of 33 ft from the impact site is below the 2 in/s threshold set by the U.S. Bureau of Mines. Calibration seismograph array locations/configurations are presented in Appendix B.4.

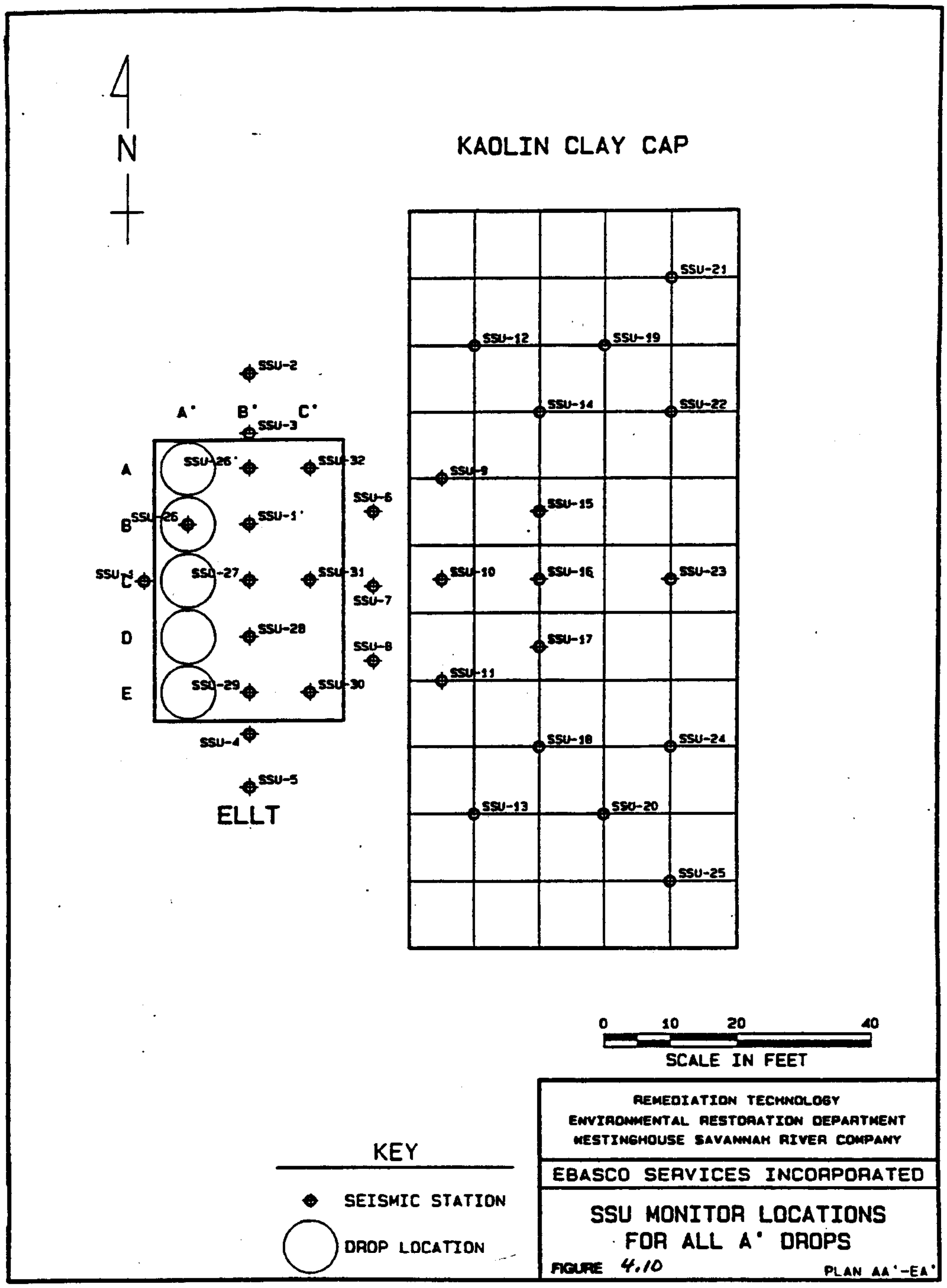


Figure 14 Locations for all strong motion sensors for A' drop locations. (After EBASCO).

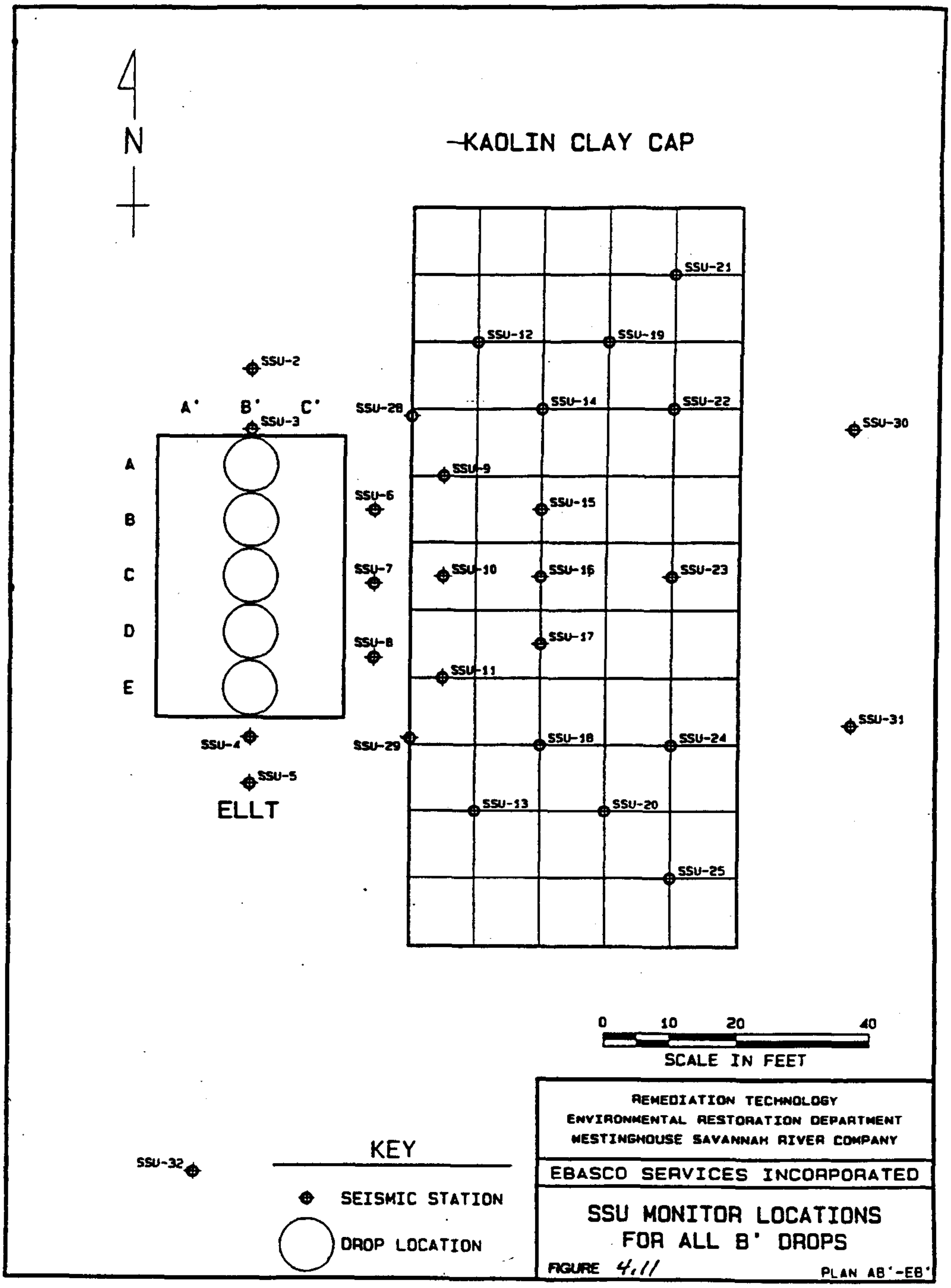


Figure 15 Locations for all strong motion sensors for B' drop locations. (After EBASCO).

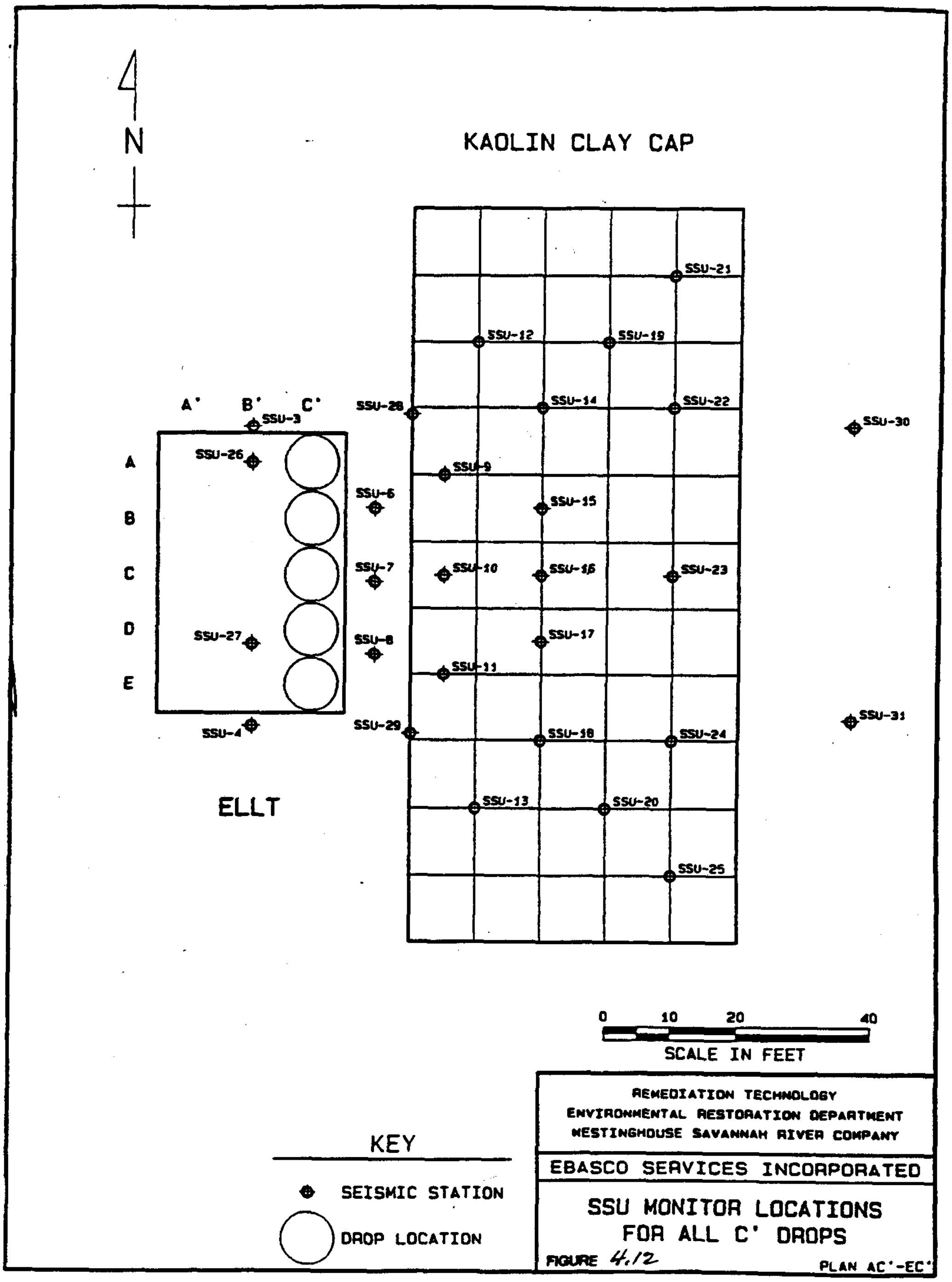


Figure 16 Locations for all strong motion sensors for C' drop locations. (After EBASCO).

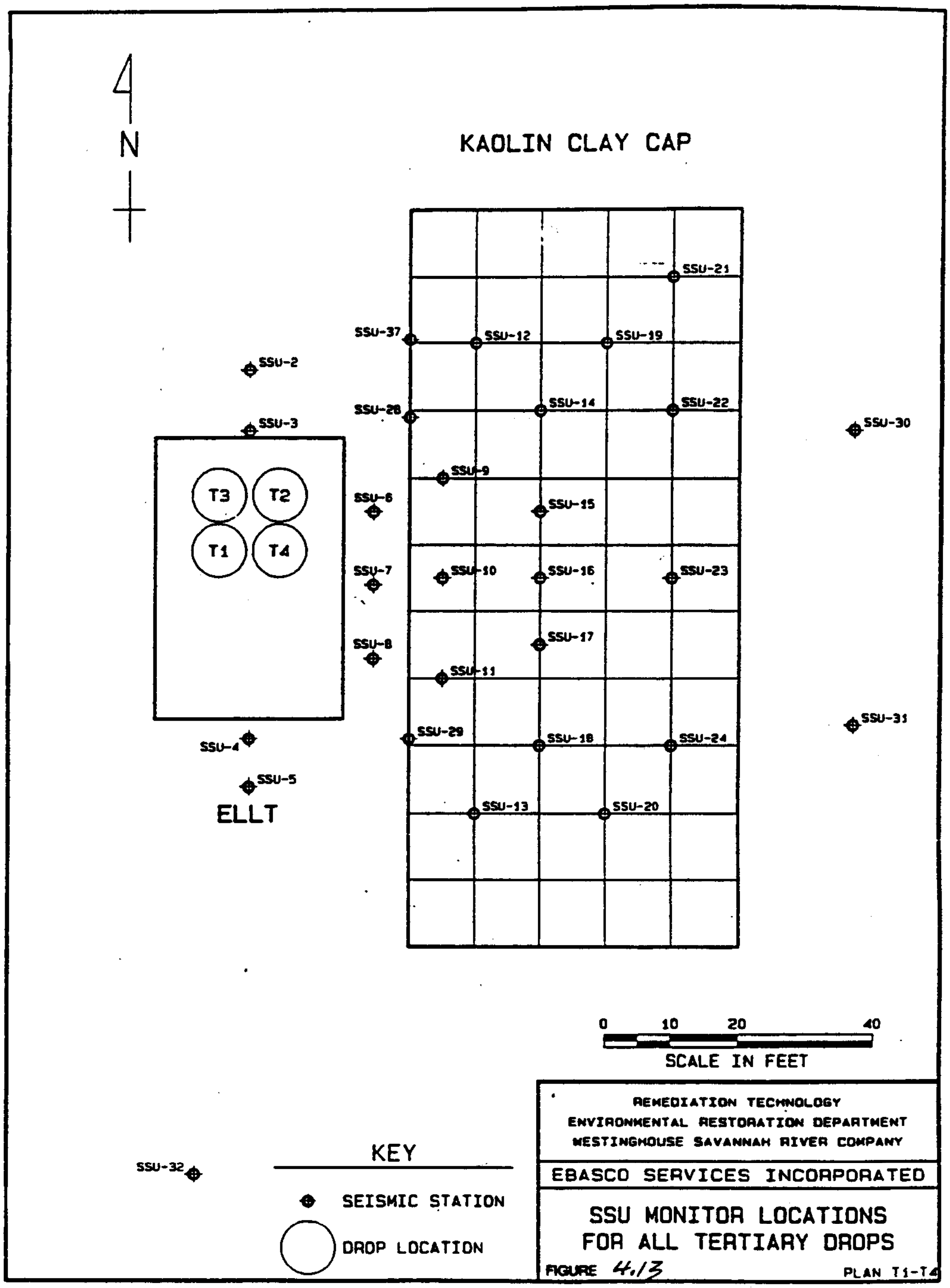


Figure 17 Locations for all strong motion sensors for TERTIARY drop locations. (After EBASCO).

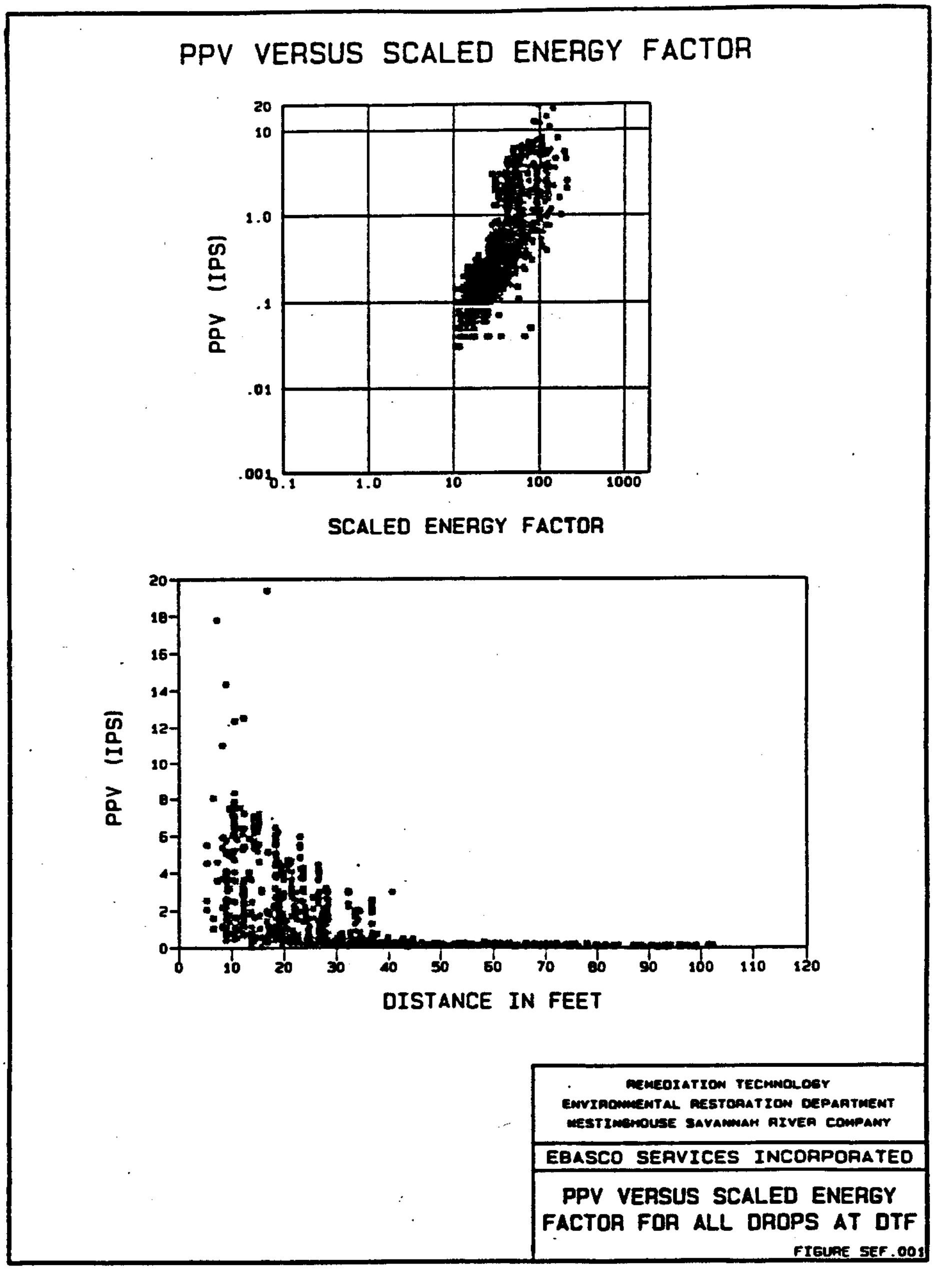


Figure 18 Peak particle velocity versus scaled energy factor for all drop locations at the DCF test facility. (After EBASCO)

Table 2 Summary data for primary, secondary, and tertiary production drops.

Drop Order	Drop Location	Drop Type	Total # Of Drops	Largest PPV On Cap	Sta. #	Drop #	Largest PPV Off Cap	Sta. #	Drop #
1	EA'	Primary	3	0.33	11	1	6.40	28	1
2	CA'	Primary	4	0.26	9	1	10.98	26	1
3	AA'	Primary	3	0.23	9	1	12.50	1	1
4	BA'	Secondary	5	0.36	9	5	5.75	1	1
5	DA'	Secondary	3	0.16	10	1	5.46	27	1
6	CC'	Primary	4	1.36	10	1	7.47	7	1
7	AC'	Primary	3	1.42	28	1	14.32	26	1
8	EC'	Primary	3	1.96	29	1	19.37	27	1
9	DC'	Secondary	4	0.71	11	1	7.16	8	1
10	BC'	Secondary	4	0.97	9	3	7.22	26	2
11	EB'	Primary	5	0.32	29	4	17.79	4	1
12	AB'	Primary	4	0.30	28	3	5.52	3	1
13	CB'	Primary	5	0.25	28	5	5.85	7	1
14	DB'	Secondary	8	0.30	29	4	3.98	7	1
15	BB'	Secondary	10	0.32	28	6	4.76	7	1
16	T1	Tertiary	8	0.67	28	5	4.40	3	5
17	T2	Tertiary	11	0.76	28	8	7.05	6	4
18	T3	Tertiary	9	0.65	28	7	8.34	3	5
19	T4	Tertiary	14	1.26	10	14	7.18	6	14

#Only 12 drops required to meet refusal criteria of 6 ft crater depth

Dynamic Compaction Strong Motion

The buried waste matrix was consolidated using three principle drop patterns: primary, secondary, and tertiary. The intent of these patterns was to emulate production methods by consolidating the waste matrix, while minimizing lateral spread. Sixty-eight drops were performed at 15 primary and secondary drop locations, and 42 drops were performed at 4 tertiary locations from 50 ft high. Consistency in drop height was maintained by placing a mark on the cable spool. The consistent impact velocity with small standard deviation verifies the consistency in drop height.

Summary data for the largest primary, secondary, and tertiary drops are given in Table 2. The location of stations that correspond to the largest or smallest PPV values given in Table 2 can be found in Figure 14 (all A' drops), Figure 15 (all B' drops), Figure 16 (all C' drops), and Figure 17 (all tertiary drops).

There are many variables controlling the impact of vibrations induced by dynamic compaction. One is drop location, (i.e., primary, secondary, and tertiary). Another variable is the drop number at each location, (i.e., 1st, 2nd, or 3rd drop). A brief discussion of several graphical permutations of data combinations is given below.

Figure 18 presents data for all production drops and stations at the DCF. This includes seismograph stations on the DCF cap, the ELLT surface, areas surrounding the ELLT, and areas surrounding the DCF cap. Maximum PPV values from 5 to 40 ft range from a maximum of 18 to 20 in/s near the point of tamper impact to less than 2 in/s near a 40-ft distance. Distances in excess of 40 ft had PPVs typically less than 0.5 - 0.7 in/s. Most of the scatter is from stations located off the DCF cap within the ELLT or surrounding soils. Figure 19 presents the attenuation curves for all the production drops, compared with the baseline from natural ground. The comparison suggests significantly higher attenuation values at the DCF.

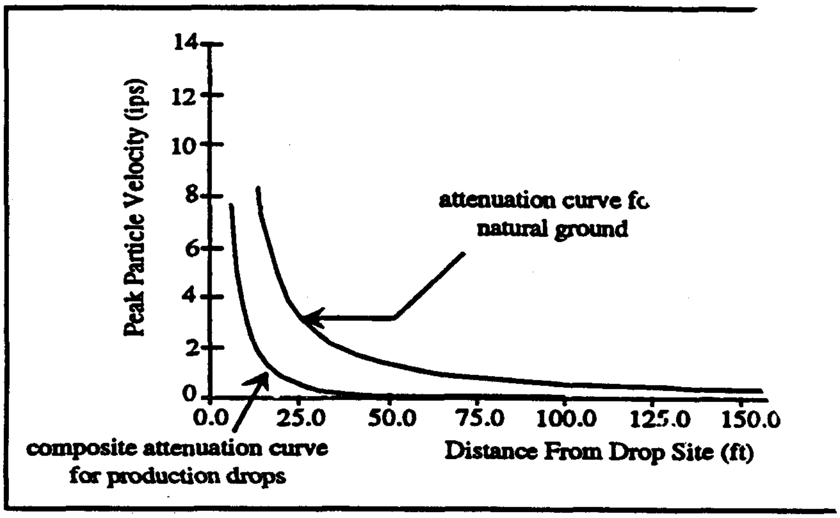


Figure 19 Comparison between the PPV attenuation curves for the natural ground versus the composite for all production drops.

The maximum observed PPV value for each seismograph station (for all production drops) is shown in Figure 20. The largest PPV values were recorded by stations located immediately adjacent to the impact area on the ELLT. Typical ELLT PPV values range from approximately 1 to 20 in/s. For the same data set, the DCF cap had significantly lower PPV's, ranging from 2.0 in/s on the western side of the cap to about 0.2 in/s on the eastern side.

Figures 21, 22, and 23 illustrate the variability observed for the production drops by drop number. As illustrated, the highest PPV values are clearly associated with the first drop. This is because the first drop had to rupture the compacted soil cover that was placed over the ELLT. This sandy clay was extremely hard and its rupture resulted in very high PPV values at stations located near the impact point. Virtually all PPV values above 8 in/s occurred during the first drop. The effect of the sandy clay soil cover is less apparent for stations more than 20 ft from the drop point.

Figures 24, 25, and 26 present data for the primary, secondary, and tertiary production drops, respectively. These figures show that for stations within about 20 ft of the drop point, the primary drops clearly resulted in higher ground motion levels. As discussed previously, the higher PPV

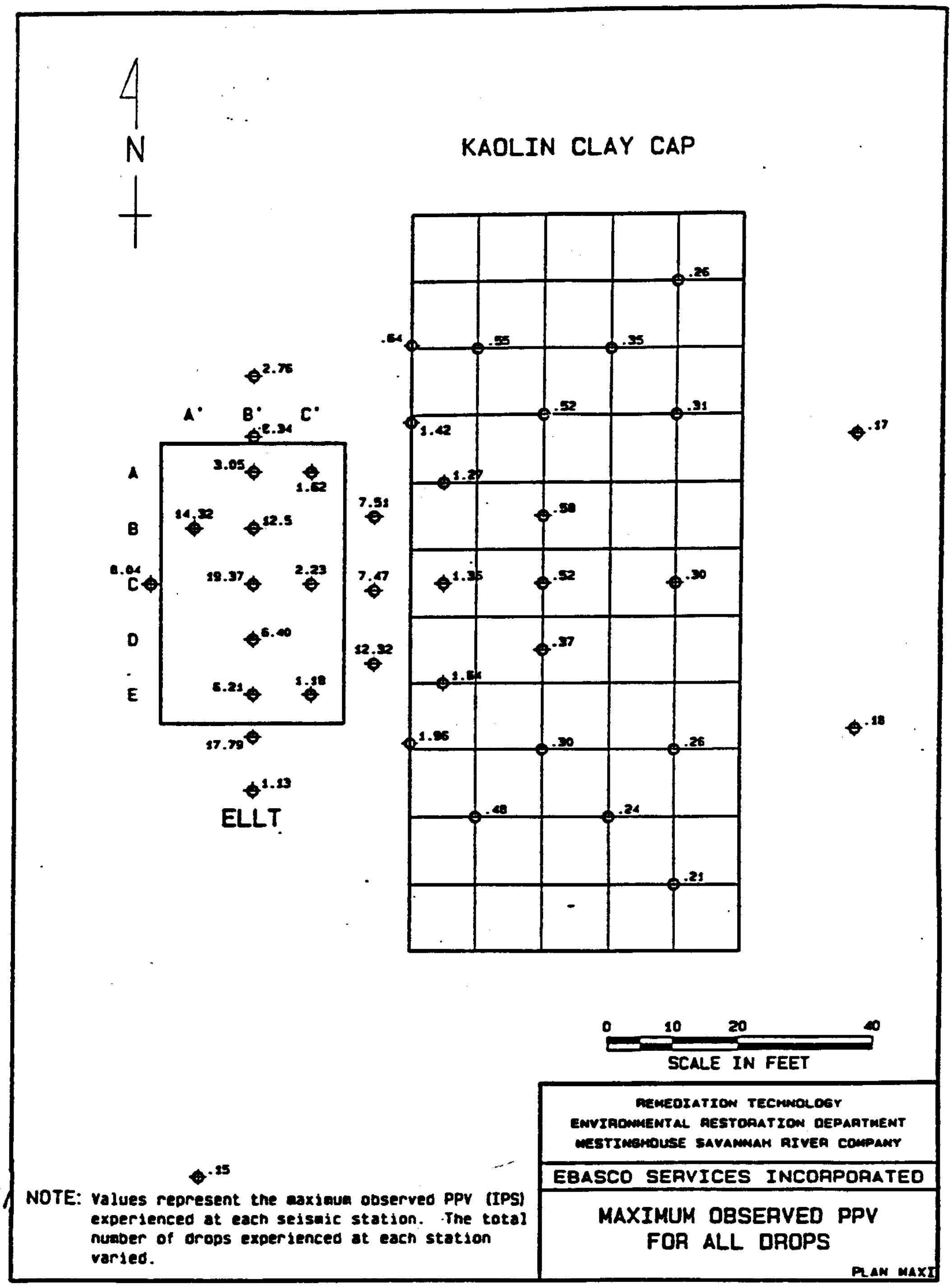


Figure 20 Tabulation of the maximum observed peak particle veolocities for all drop locations. (After EBASCO)

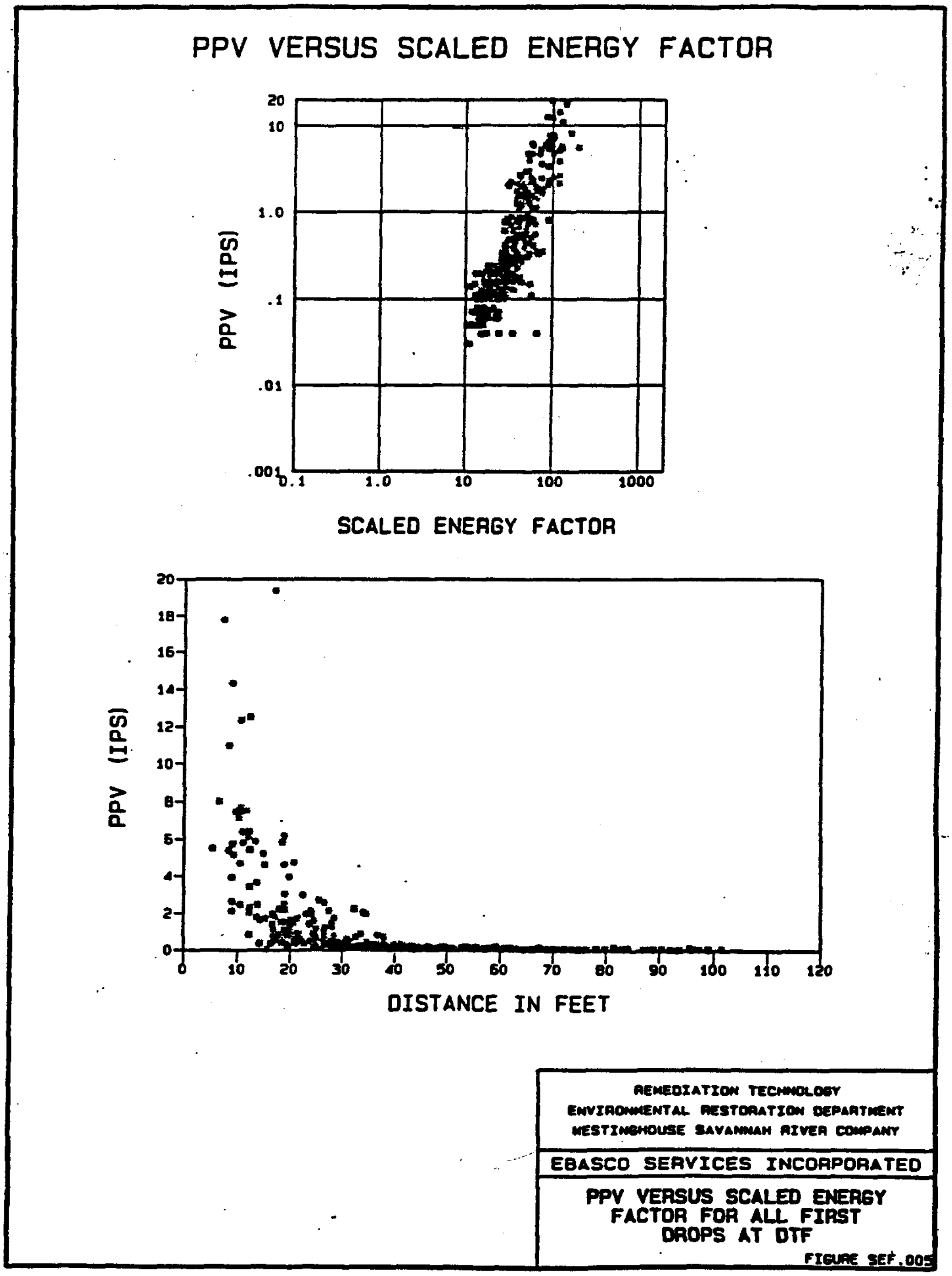


Figure 21 Peak particle velocities versus scaled energy factor for all first drops at the DCF. (After EBASCO)

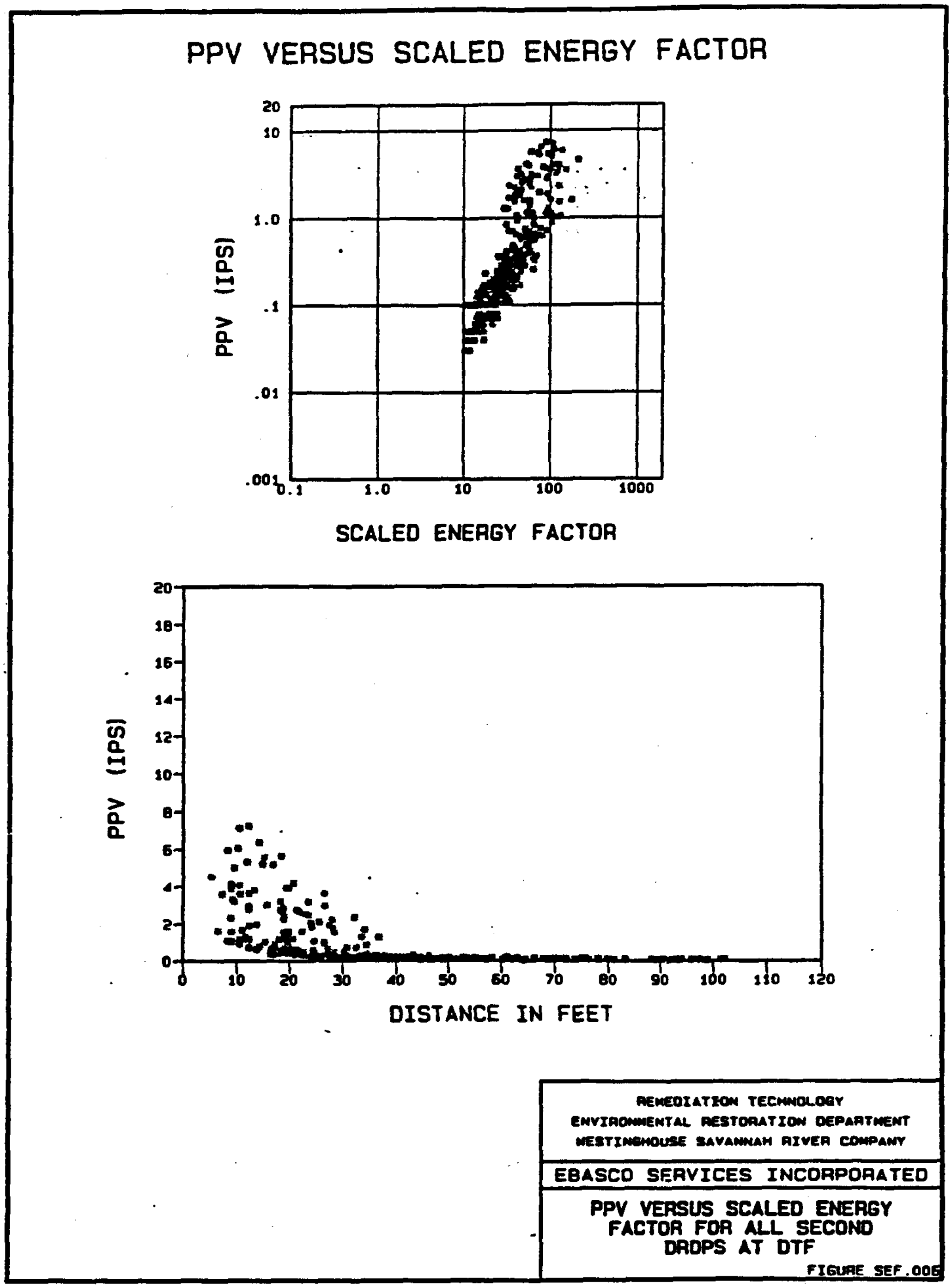


Figure 22 Peak particle velocities versus scaled energy factor for all second drops at the DCF. (After EBASCO)

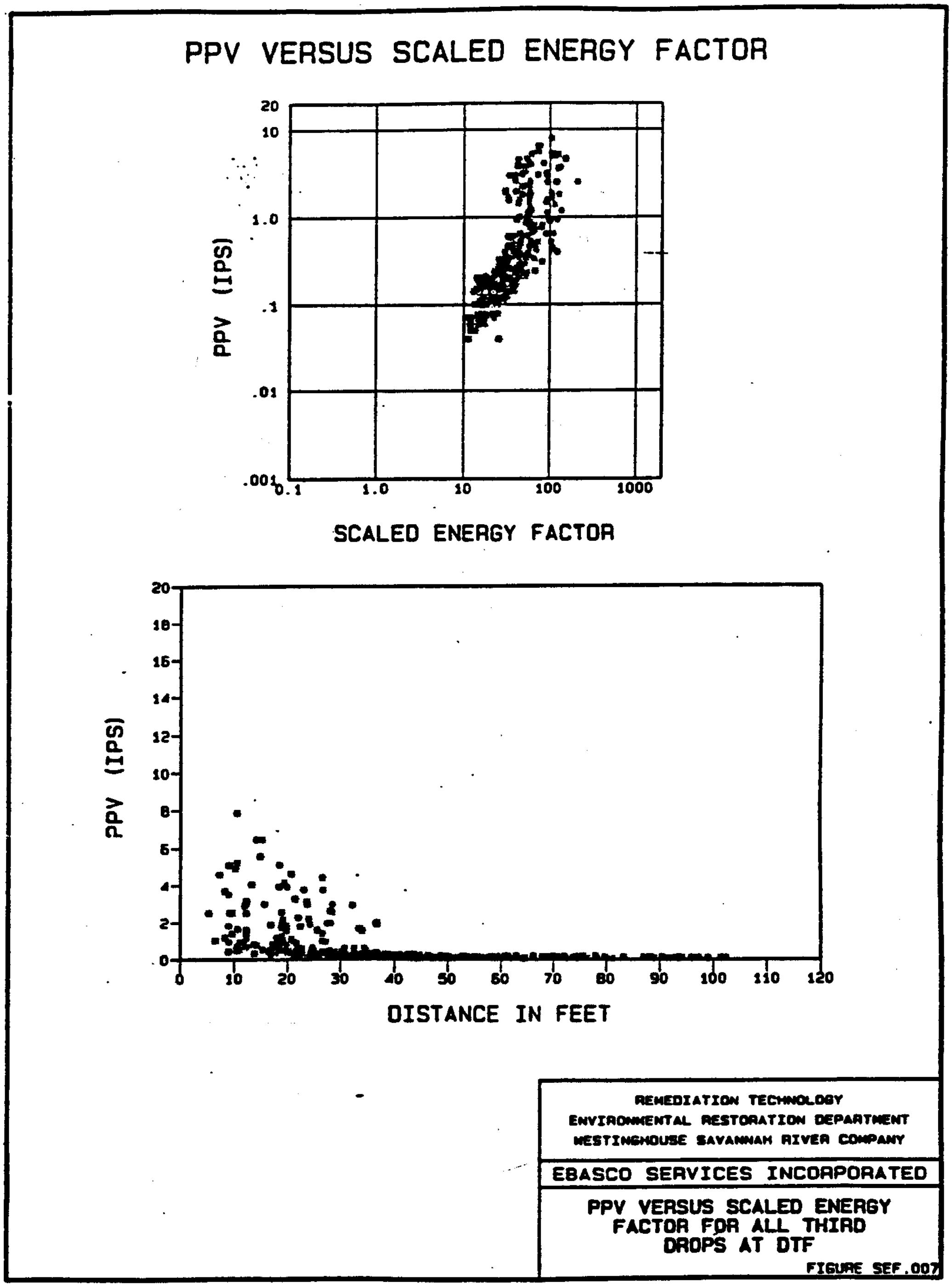


Figure 23 Peak particle velocities versus scaled energy factor for all third drops at the DCF. (After EBASCO)

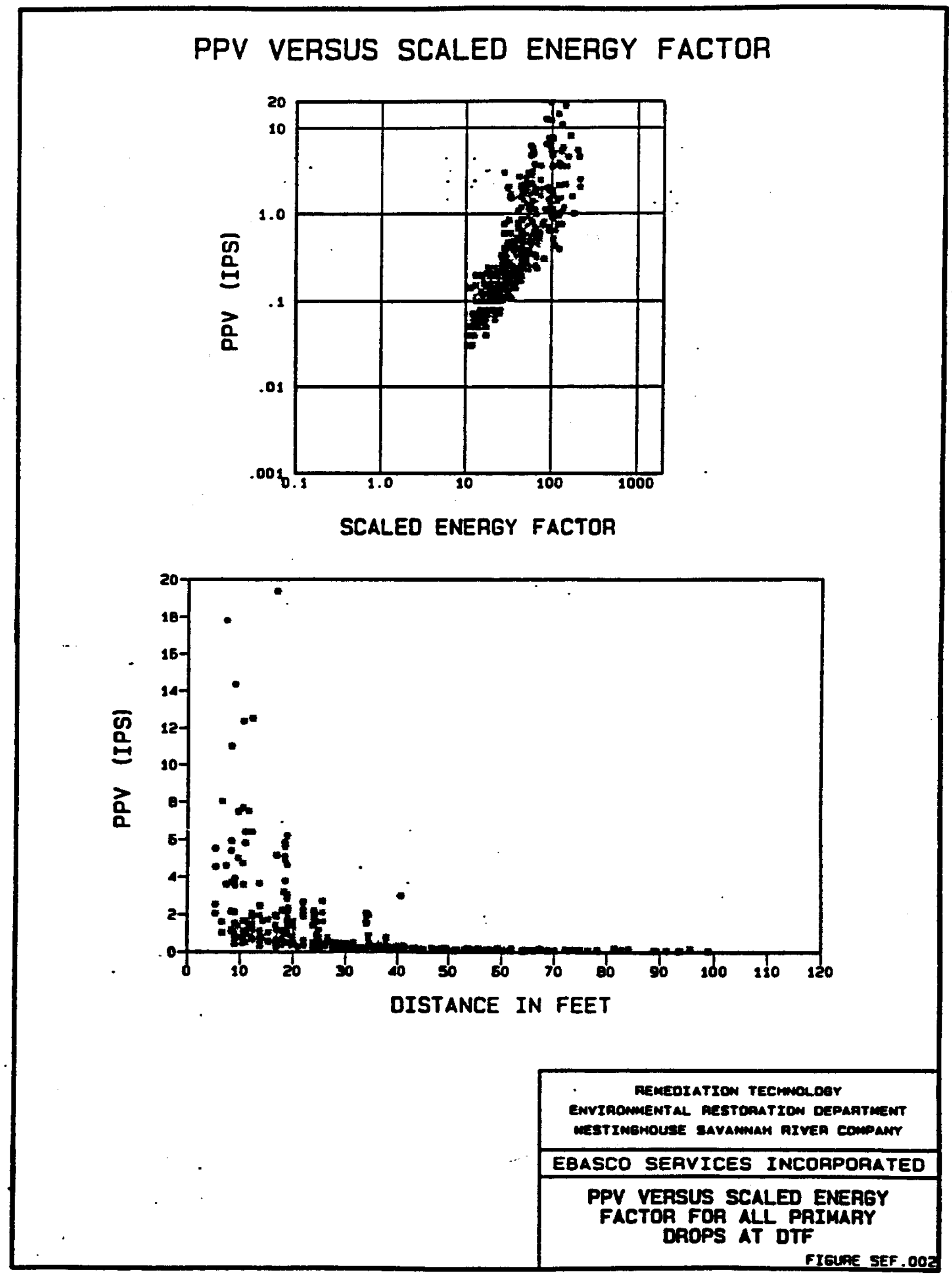


Figure 24 Peak particle velocities versus scaled energy factor for all primary drops at the DCF. (After EBASCO)

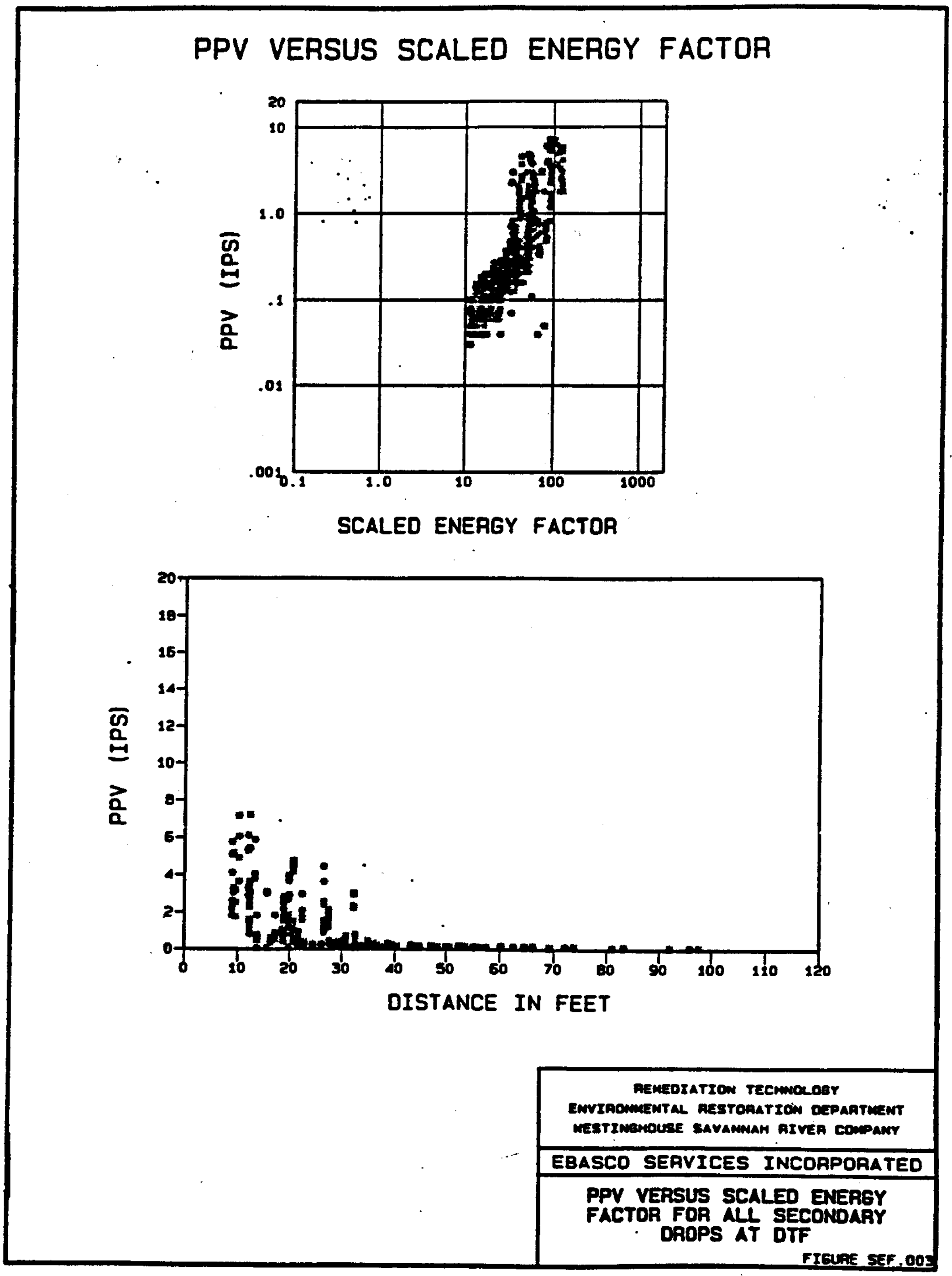


Figure 25 Peak particle velocities versus scaled energy factor for all secondary drops at the DCF. (After EBASCO)

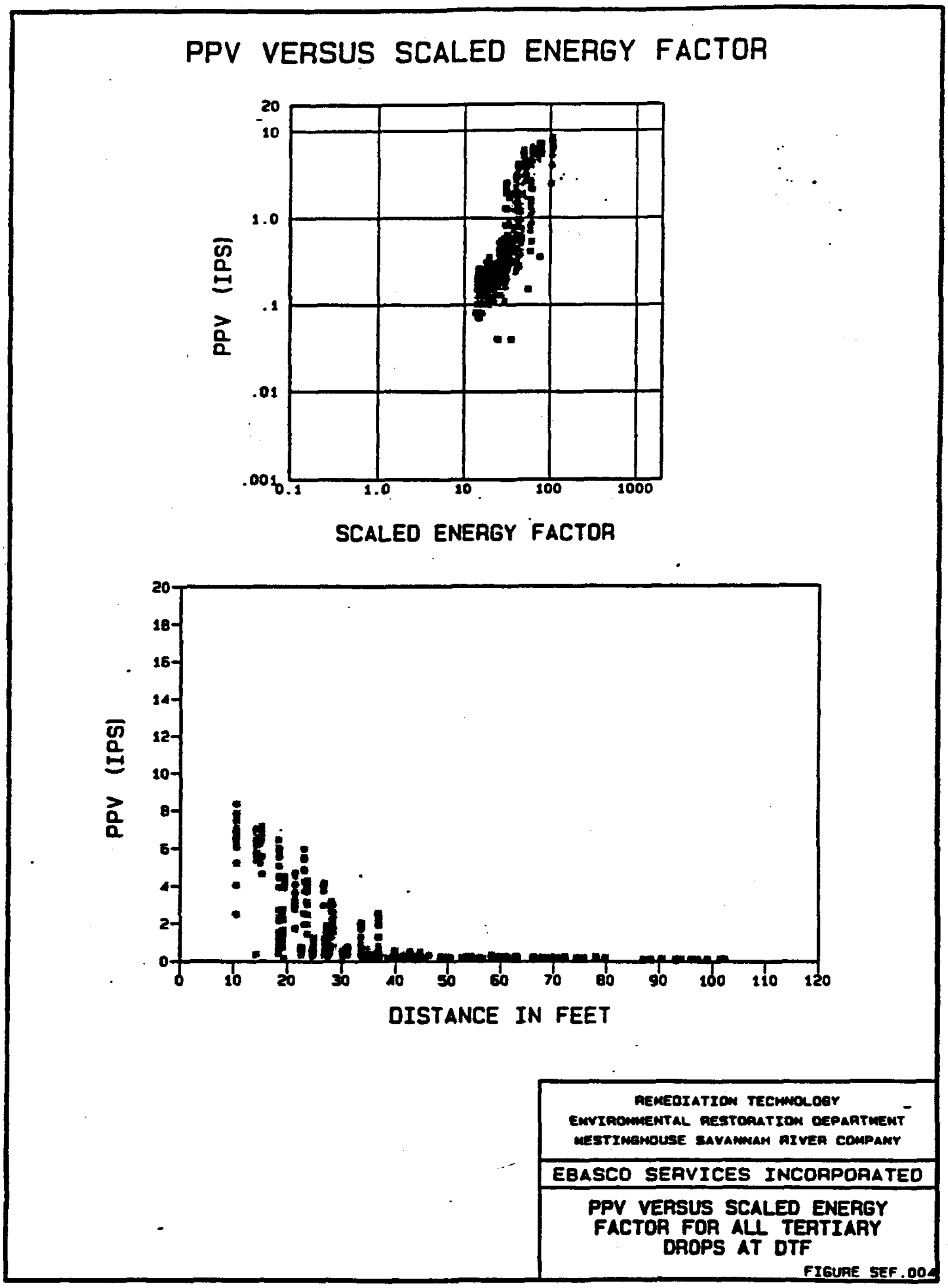


Figure 26 Peak particle velocities versus scaled energy factor for all tertiary drops at the DCF. (After EBASCO)

values are primarily associated with the first drops that had to break through the compacted sandy clay cover of the ELLT. However, a close comparison of these figures shows that for stations in the 20 - 40 ft distance range, the secondary drops generally resulted in higher PPV values than the primary drops and the tertiary drops resulted in even higher values. For example, PPVs in excess of 3 in/sec are rare in the primary drop data set, but are very common for tertiary drops. This increase probably reflects the improvement the compaction process has had on the waste matrix, suggesting PPV values could potentially be used to monitor this improvement.

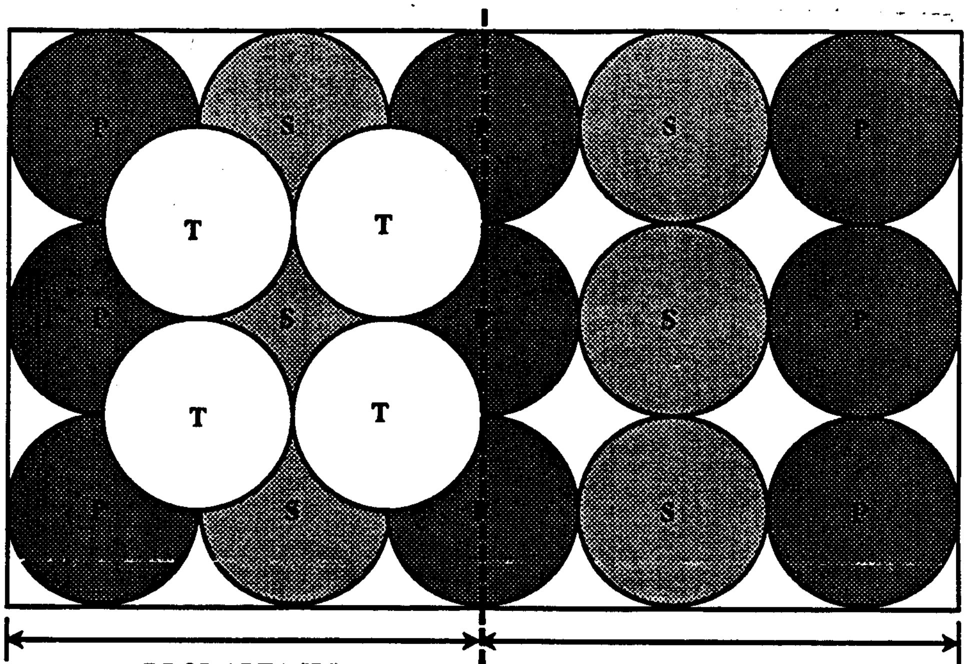


Figure 27 Drop area A was compacted to existing specifications while drop area B was over compacted to facilitate the generation of a new specifications.

During the early drop test phases, it became apparent that this was not the case, and the buried boxes were not being fully consolidated. To better evaluate and take advantage of instrumentation redundancy, the drop zone was divided into drop areas A and B (Figure 27). Drop area A was compacted using the traditional MWMF success criteria, while drop area B was compacted until very little improvement could be detected.

Table 3 presents a comparison between the displacements in the longitudinal, transverse, and vertical directions for the natural ground baseline and the DCF test. Note a marked decrease in vertical motion accompanied by an increase in displacements in the other directions. The data presented are the peak displacements, not the displacements at an instantaneous point in time. The instrumentation was oriented with the longitudinal direction corresponding with the long axis of the DCF test cap, and the transverse direction corresponding to the short axis. The wave forms generated by dynamic compaction propagate in a radial direction from the point of impact.

Table 3 A comparison between the natural ground baseline and the production drops. Table displays the percentage of total displacement in the longitudinal, transverse, and vertical directions.

Drop Location	Longitudinal		Transverse		Vertical	
	Average	St. Dev.	Average	St. Dev.	Average	St. Dev.
Baseline	40.6	1.4	1.0	2.7	58.3	1.5
A'	29.6	4.0	18.8	4.2	51.6	3.9
B'	31.0	3.3	12.5	4.4	56.5	4.2
C'	49.7	3.5	17.8	4.3	32.5	1.9
D'	37.4	4.6	32.5	2.6	30.1	4.5
T1	36.0	2.1	10.0	2.1	54.0	2.5
T2	40.8	2.6	16.4	3.3	42.8	3.9
T3	34.8	2.3	18.7	4.3	46.6	1.7
T4	38.3	1.1	10.3	4.7	51.4	1.7

Note: Values are expressed in percentage.

Understanding this principle and reexamining Table 5.3 shows that the percentages of true longitudinal and transverse displacement are severely distorted, compared with the natural ground baseline.

Wave Forms

To quantify the effects on the kaolin clay from vibrations induced by dynamic compaction, the physical effects of the wave form must also be considered. To understand the different wave forms and their effects, it is useful to consider a seismic event. With any seismic event, there are three basic types of elastic waves: the primary or P-wave, the secondary or S-wave, and the surface wave. The P-waves travel the fastest through the medium, typically 5000 ft/s. These wave forms alternatively compress and dilate the soil medium. The S-waves are slower, and as the waves propagate, they shear the medium sideways, normal to the direction of propagation. This motion may be both vertical and horizontal. The surface waves travel the slowest and are restricted to the near ground surface. Surface waves can be divided into two basic forms. The first is the Love wave motion, which is essentially the same as the S-wave, without the vertical component. The ground moves laterally back and forth. The second form is the Rayleigh wave. The Rayleigh wave produces a rolling motion, with both a horizontal and a vertical component. This motion can be described as an elliptical, retrograde motion.

Dynamic compaction energy manifests itself predominately as a Rayleigh type wave form[6]. Table 3 summarizes the percentage of total motion displayed as longitudinal, transfers, and vertical motion. Note that as the compaction process progresses, the ratios for longitudinal, transverse, and vertical displacements change. Woods[6] stated that 67% of the wave form motion is attributed to Rayleigh waves. Assuming the vertical motion is truly characteristic of Rayleigh waves, an analysis of the DCF test data establishes that 64% of the motion recorded for natural ground is Rayleigh waves. Note, however, that the standard deviation is high. Figure 28 presents the vertical displacement attenuation with distance for the natural ground baseline data.

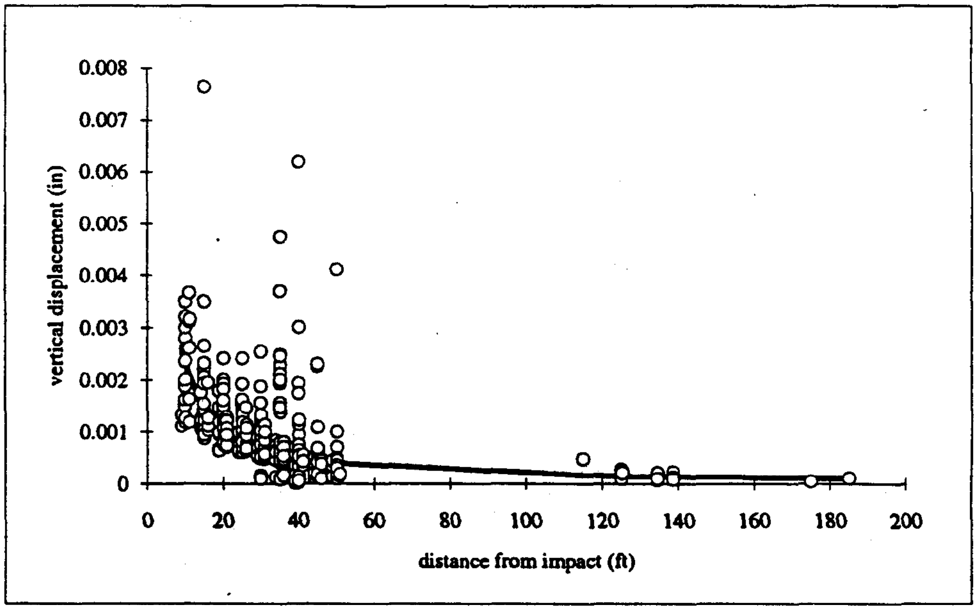


Figure 28 Plot of the vertical displacement versus distance from impact for natural, undisturbed soils.

If the medium has no material interface or surface, all the energy will be manifest as body waves or P- and S- waves. The surface waves occur with material interfaces and tend to travel along these surfaces. As these wave forms intersect a material boundary, they are reflected and refracted, converting some energy to other wave forms.

The basic premise that as the buried waste approached maximum density, the strong motion dispersion curve would approach the density established for natural, undisturbed soils was flawed. Figure 29 presents a comparison between the actual recorded wave forms.

The first that as wave forms move through a material interface, they are reflected and refracted. Through the interface, the wave form is transmuted into different wave forms. Additionally, when seismic waves are reflected and/or refracted, the phase of the wave is changed. These actions to greatly change the wave form behavior, explaining the deviations seen in Table 3.

In comparing the recorded wave forms for natural ground (Figure 29a) with those from production drops (Figure 29b and 29c), there are some distinct differences. Figure 29a is a relatively smooth sine curve with little interferences. Figures 29b and 29c represent a wave record of combined wave forms. The arrows show, smaller, out of phase vibrations showing up with the primary wave pattern. These additional vibrations are different in frequency, amplitude, and phase than the record for natural ground. This is assumed to be the result of the fused layer acting as a diaphragm, vibrating within the soil.

The combined effects of the wave form transmutation and the additional vibrational sources account for the different displacement ratios for the production drops. The benefit of all this "confusion" is a reduced PPV and vertical displacement, both of which are the primary sources of damage to a structure.

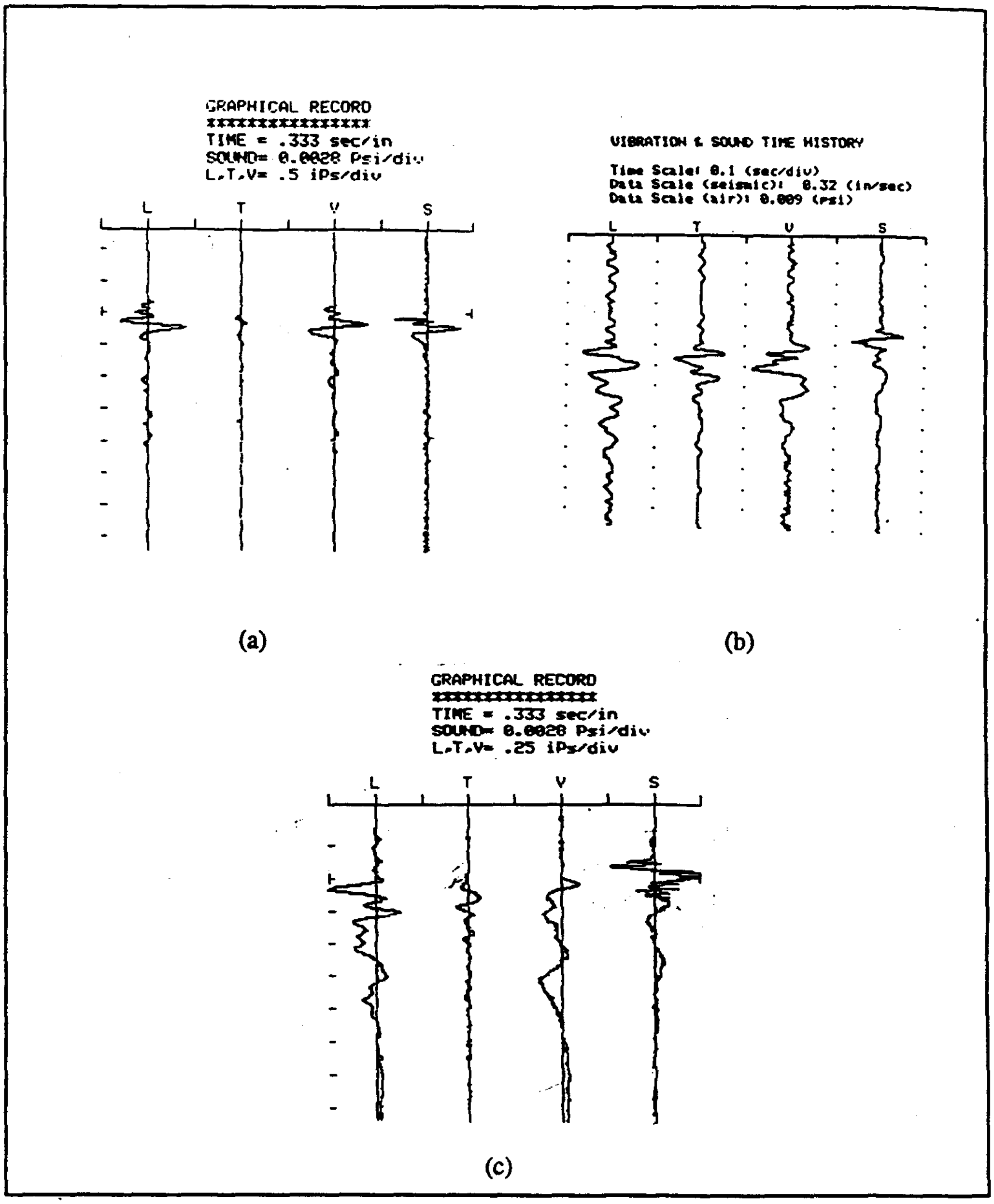


Figure 29 Comparison of actual wave form between (a) natural ground, (b) beginning tertiary drop, and (c) final DCF test drop. Note the difference in duration and wave shape. Tertiary drop records display a series of waves ranging from low to high frequencies.

Inelastic Deformation Test Results

Twenty-two survey monuments were in and around the DCF test site to monitor heave place around the DCF. Of the 22 monuments, 10 were located on the perimeter of the ELLT, four on the westerly DCF cap edge, four on virgin ground east of the DCF cap, and four on virgin ground surrounding the ELLT. Monument locations were resurveyed after completing of the A', C', B', and tertiary drop locations. The only movement observed was local movement toward the compacted boxes. After excavating the topsoil cover for infiltrometer placement, observations indicate that this subsidence caused some damage to the kaolin cap. The lose of foundation support apparently caused a "hinging" effect in the clay, rupturing the cap along the crest of the side slope (Figure 30). This effect is sensible and expected, considering the degree of compaction applied to the buried boxes.

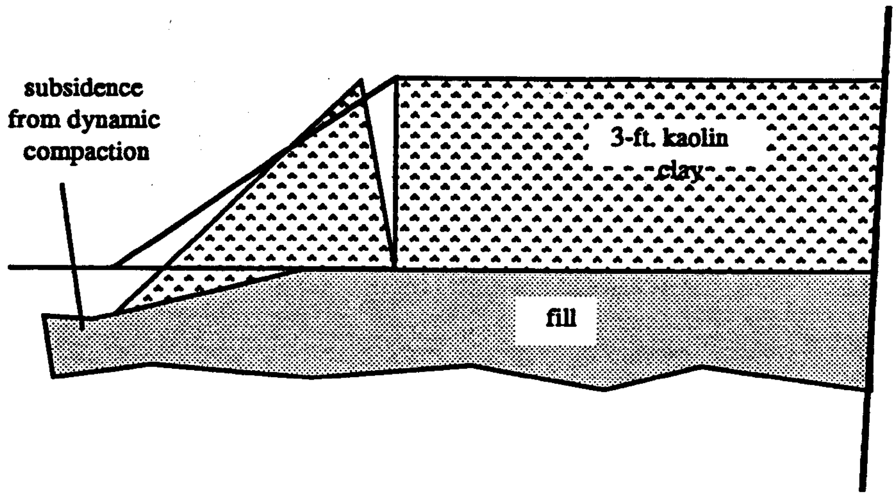


Figure 30 Schematic showing suspected mechanism for subsidence failure to the kaolin clay cap.

Structural Damage

There is little literature describing threshold limits for damage to compacted kaolin clay. The University of Kentucky performed a series of static load tests to determine the arching strength of kaolin clay[7]. In these tests, Dr. Richard Warner determined that a 3 ft-thick-clay layer could span a 3-ft hole, and when the clay deflected 6 in., it would crack and fail. The U.S. Bureau of Mines (USBM) has conducted a series of tests to evaluate structural damage thresholds for explosives. Explosives generate wave forms similar to seismic events, and even more so like those from dynamic compaction. Figure 31 presents a graph generated by this USBM research. Note that the threshold limit is defined by the heavy line marked, (a), and is a function of the vibration frequency. Frequencies recorded for the DCF dynamic compaction ranged between 50 and 80 Hz. At this frequency range, the threshold limit in PPV is 2 in/s. This value is conservative because it represents the threshold limit for damage to plaster structures. The compacted kaolin clay should have a much higher plastic range than a rigid structure and withstand higher vibrations without failure.

Another consideration is the definition of failure. For a rigid structure, failure might be cracking or even a catastrophic failure. For a regulated closure system, failure might be when the hydraulic conductivity exceeds 10^{-7} cm/sec. Clays are considered thixotropic because they tend to repair

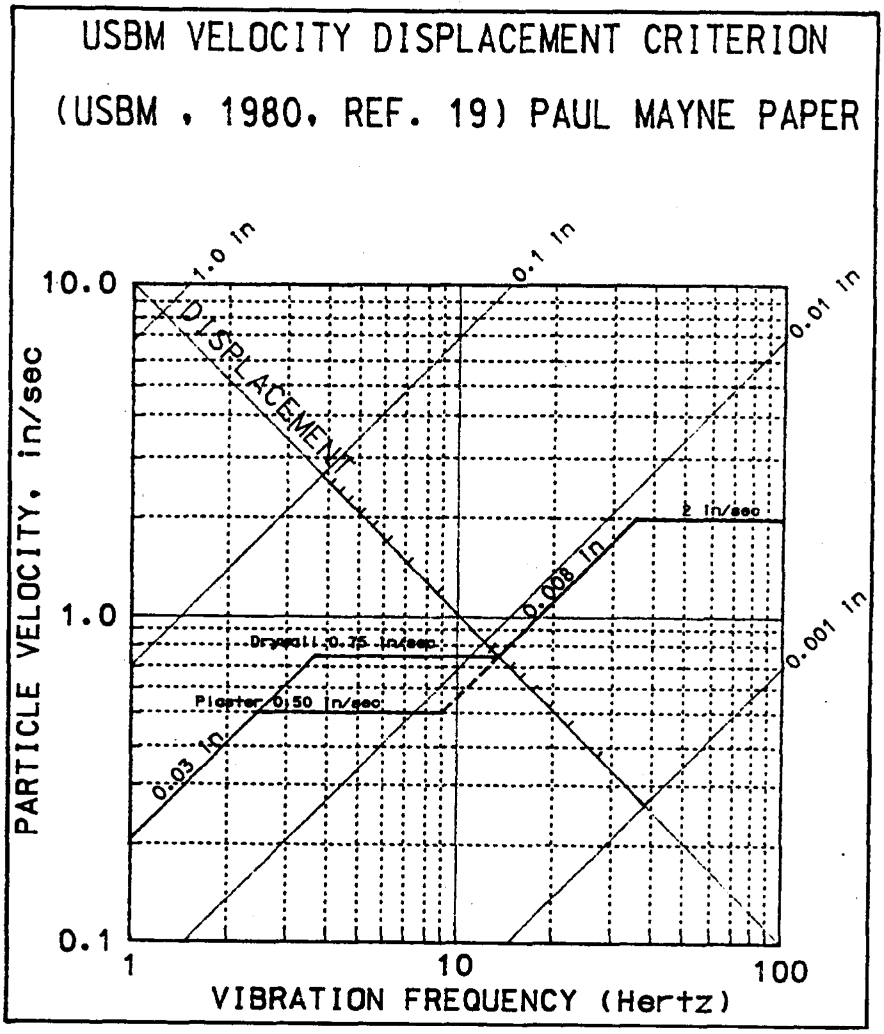


Figure 31 Graph presenting threshold limits for structural damage as a function of peak particle velocity versus frequency. (after U.S. Bureau of Mines)

themselves when minimally damaged. As part of this test, though not included herein, a helium injection system was employed to evaluate microfissuring. During compaction, helium was moving through the clay cap. However, by the next morning, there was no helium flux occurring. During the time between the two observations, the kaolin clay displayed thixotropic characteristics by recovering from microfissuring induced by the dynamic compaction.

Hydraulic Conductivity Measurements

At the conclusion of the active dynamic compaction phase, two data collection activities provided additional data. These two activities included evaluating the hydraulic conductivity and the success in consolidating the buried B-25 boxes.

Kaolin clay hydraulic conductivity was demonstrated prior to placing the MWMF closure system. Under subcontract to WSRC, Mueser-Rutledge, Inc., constructed nine test pads, using locally available kaolin clay. The test objectives were to identify a suitable source of clay, establish the in-place hydraulic conductivity, and to identify the characteristic soil parameters and construction methods. Methods modifying the proctor test were identified to ensure harmony with actual field conditions. Finally, the test established that kaolin clay met or exceeded the required 10-07 cm/sec hydraulic conductivity.

It was assumed that by constructing the kaolin clay cap to the Mueser-Rutledge specifications and by using the target moisture density values, the baseline hydraulic conductivity would met or exceed 10^{-07} cm/sec was considered. Conducting *in situ* permeability testing prior to dynamic compaction activities was eliminated because testing would cause saturation of the test cap, interfering with the propagation of shear waves across the cap. (Note that water will not transmit shear waves, and a high moisture content would dampen the shear wave energy.)

The ASTM D698-78 provided the optimal moisture density for the kaolin clay. Specifications, which included the CT Main target values for each lift, required the in-place moisture to range between 28 and 30% and the dry density to range between 90.0 and 95.0 pcf. Figure 32 presents the as built moisture and density gradations, relative to the window of acceptability. In all cases, the target values were met. During construction, areas not meeting the specifications were reworked until the specifications were achieved.

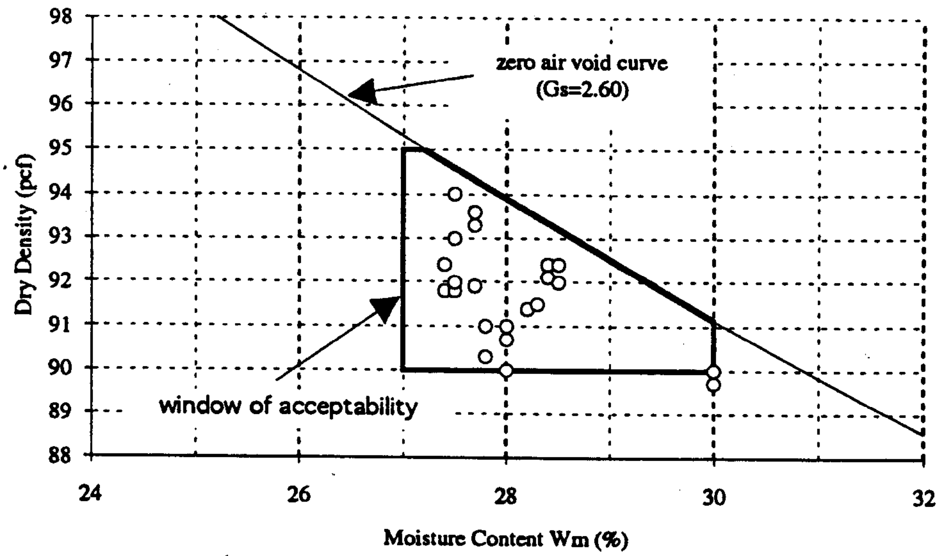


Figure 32 Plot of dry density versus moisture content for DCF as built quality assurance test data. Note that the window of acceptability was derived from the CT Main Corp. statistical analysis of the MWMF as built values.

As discussed previously, the hydraulic conductivity for a closure cap is a critical component for a RCRA closure. One of the purposes for the DCF is to determine any impacts on the MWMF kaolin closure system from dynamic compaction of the LLRWDF closure. The hydraulic conductivity was measured at the conclusion of dynamic testing to assist in making this determination. The instrument of choice is the SDRI, as discussed previously.

Postdynamic compaction analysis identified six sites on the DCF clay cap to be instrumented. Each of these sites was selected based upon a probability level for damage. Three sites were in high probability areas, one site was in a moderate probability area, and two were in low probability areas. Figure 33 shows the general locations tested.

Permeability testing was conducted between September 14, 1992, and January 8, 1993. During this time, each instrument was monitored with data collected regularly. Figures 34, 35, and 36 present a comparative composite for hydraulic conductivity for all instrumentation during the test.

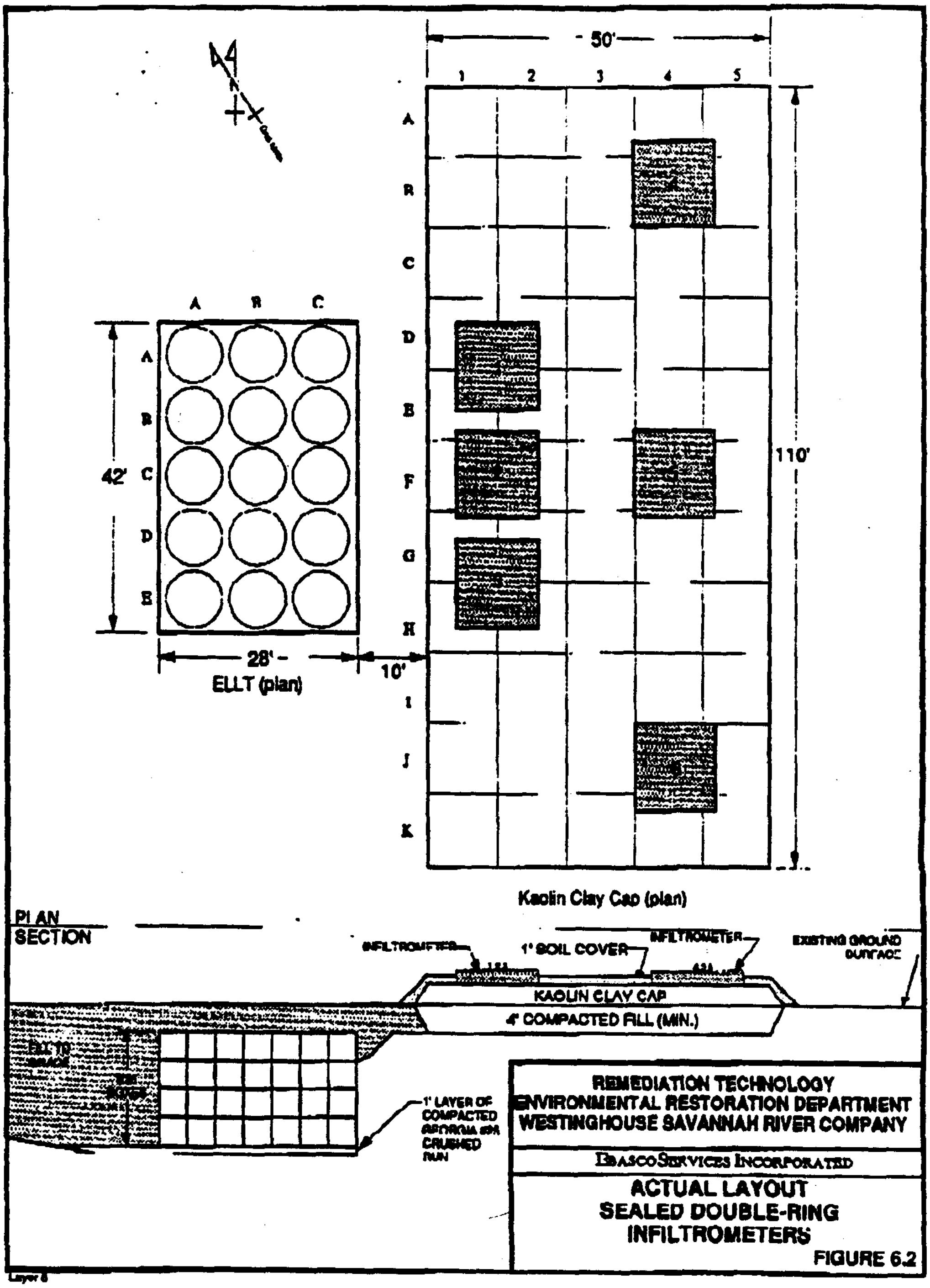


Figure 33 Plot displaying the locations for the six Sealed Double-Ring Infiltrometers. Placement was based upon preliminary evaluation of vibration montioring data. SDRI 1 - 3 are in areas of high probability for damage, SDRI 5 is in an area of moderate probability for damage, and SDRI 4 and 6 are in areas of low probability for damage. (after EBASCO)

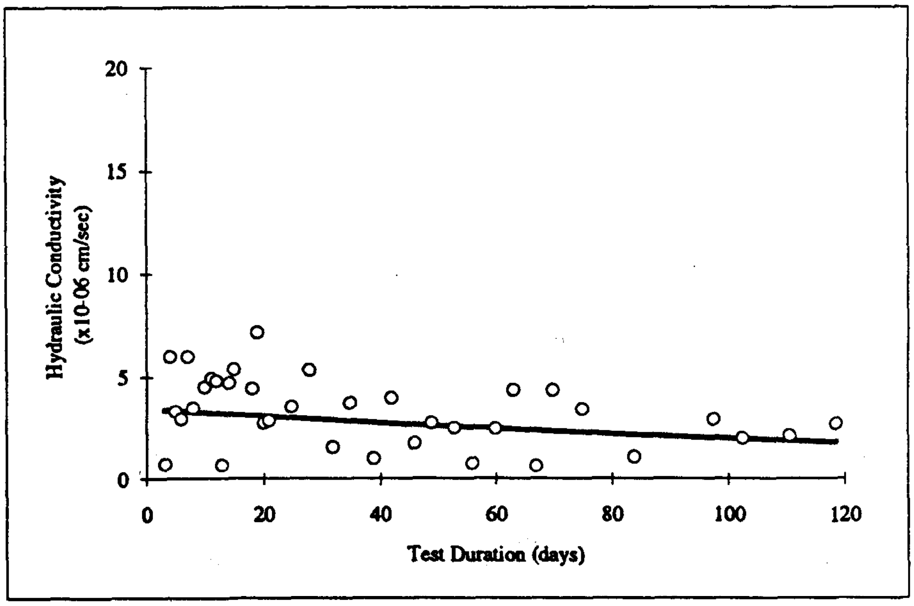


Figure 34-a Plot of variations in hydraulic conductivity, location W - N on the DCF kaolin clay cap.

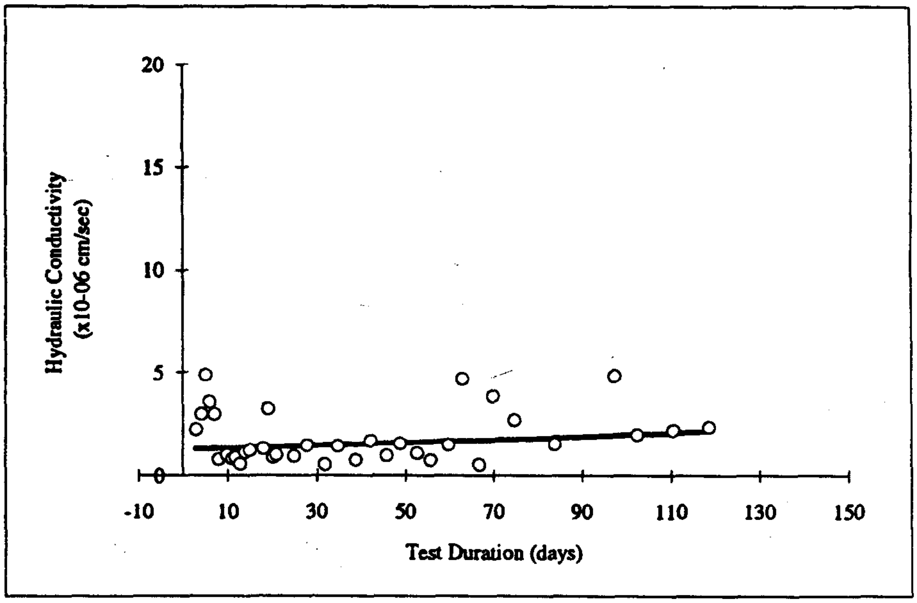


Figure 34-b Plot of variations in hydraulic conductivity, location W - C on the DCF kaolin clay cap.

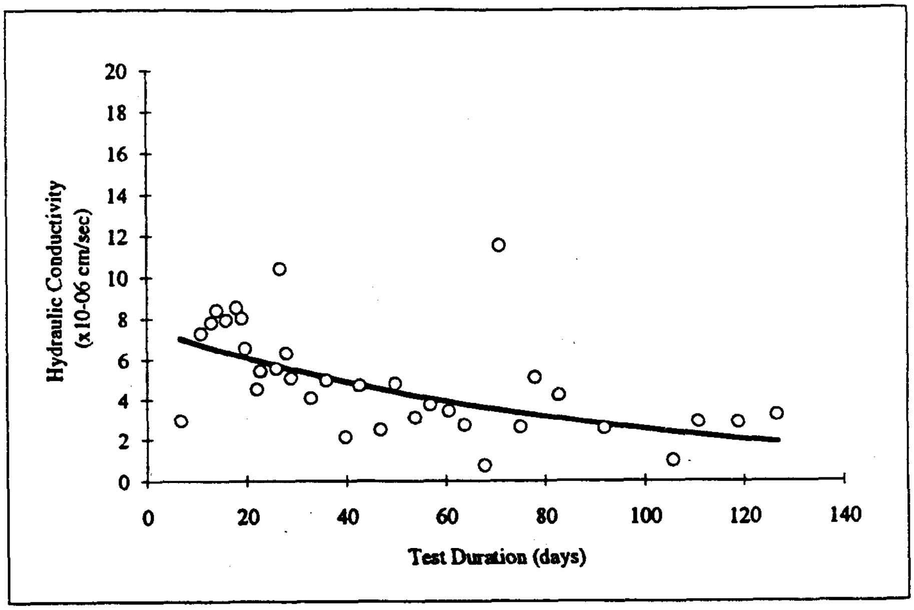


Figure 35-a Plot of variations in hydraulic conductivity, location W - S on the DCF kaolin clay cap.

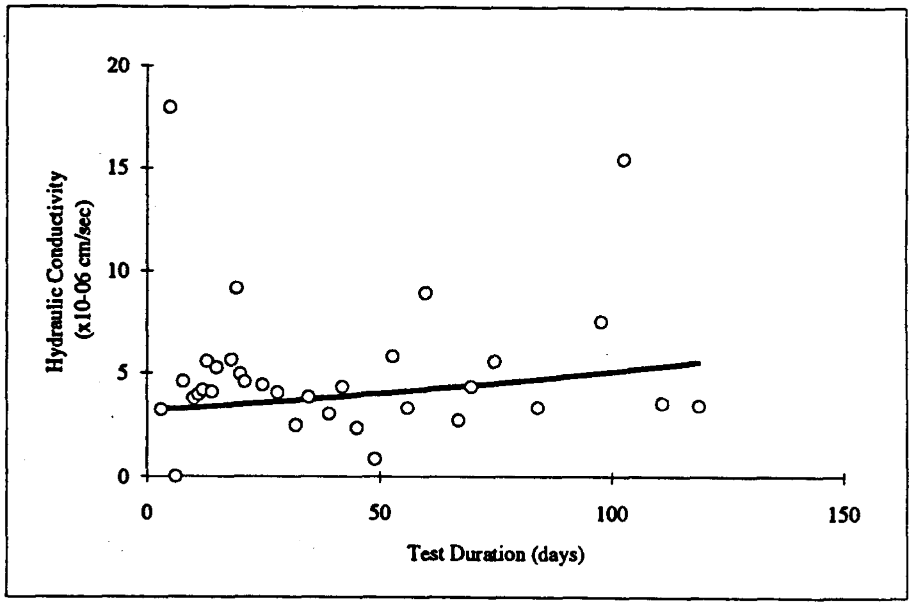


Figure 35-b Plot of variations in hydraulic conductivity, location E - N on the DCF kaolin clay cap.

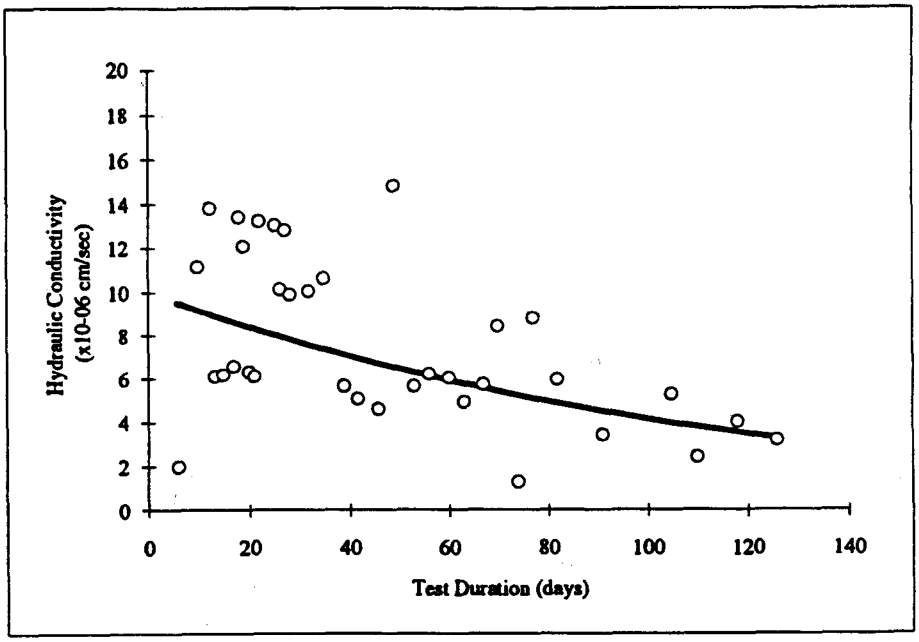


Figure 36-a Plot of variations in hydraulic conductivity, location E - C on the DCF kaolin clay cap.

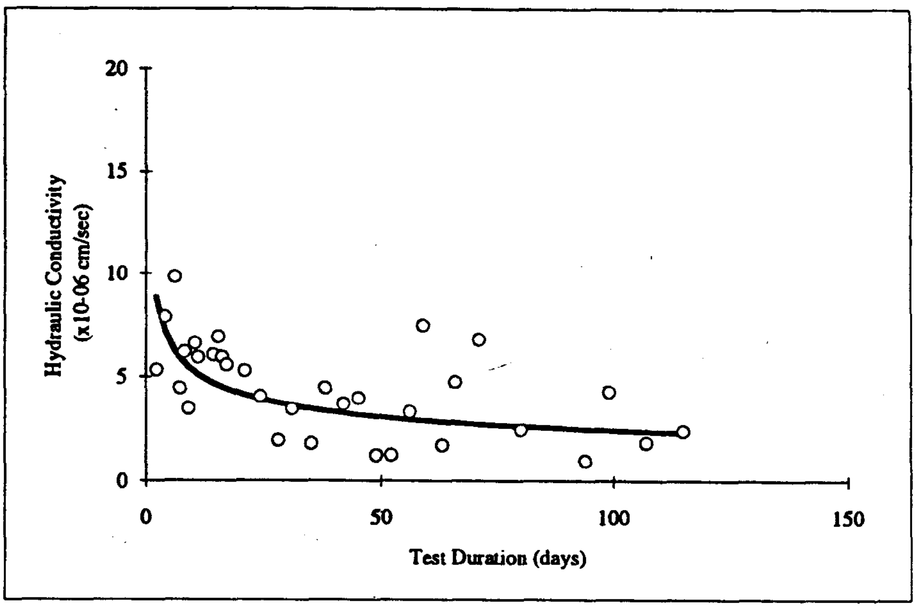


Figure 36-b Plot of variations in hydraulic conductivity, location E - S on the DCF kaolin clay cap.

Table 4 Statistical analysis for SDRI testing of hydraulic conductivity, DCF test cap.

Areas Subjected to Higher Vibrations				Areas Subjected to Lower Vibrations			
	Test Period	Average	Standard Deviation		Test Period	Average	Standard Deviation
W-N	Month 1	0.41	0.17	E-N	Month 1	0.53	0.38
	Month 2	0.23	0.11		Month 2	0.39	0.23
	Month 3	0.26	0.13		Month 3	0.57	0.44
W-C	Month 1	0.53	0.38	E-C	Month 1	0.95	0.37
	Month 2	0.39	0.23		Month 2	0.76	0.35
	Month 3	0.57	0.44		Month 3	0.48	0.23
W-S	Month 1	0.77	0.43	E-S	Month 1	0.57	0.19
	Month 2	0.37	0.11		Month 2	0.34	0.19
	Month 3	0.35	0.28		Month 3	0.32	0.20

This original work by Meuser-Rutledge established construction criteria that ensures compliance with RCRA requirements. The RCRA regulatory limit for hydraulic conductivity is 10-07 cm/sec. At the conclusion of the dynamic compaction phase, the DCF cap was instrumented with six SDRIs. These infiltrometers use a driving head to measure the in situ hydraulic conductivity. Note in figures 35a and b and 36a, there are data points exceeding the 10^{-07} cm/sec limit. However, as the clay reaches a steady state, the average hydraulic conductivity is consistently below the regulatory limit. These deviations are attributed to variations in the quality of construction, seams between the clay panels, and localized preferential pathways. Pathways within the clay are usually lateral, resulting from constructing the clay cap with 8 in. lifts. As these pathways are filled with water, the water must work it's way through the compacted clay. This is recorded as a higher flux at the SDRI. Table 4 presents the statistical variation for each SDRI for each 30-day testing period. Generally, with a little deviation, the hydraulic conductivity decreases with time. This is consistent with the clay becoming saturated and reaching a steady state. Note that on a general evaluation, there is little variation between all the infiltrometers. All locations meet regulatorily required hydraulic conductivity.

DCF kaolin cap for approximately 120 days. A breakthrough of the kaolin clay occurred after about 60 days. After the breakthrough, the instruments reached a steady state condition, or free and constant flow through the kaolin clay. There were some obvious deviations in hydraulic conductivity over time that are interesting and noteworthy.

The first observation is a noticeable increase in hydraulic conductivity at the time of the breakthrough. This increase may be attributed to an influence on the flux by the underlying, unsaturated soils. The negative pore pressure in the unsaturated soils could potentially exert a draw onto the steady state flux rate until enough of the underlying soils become saturated to negate this influence. The temporary increase in hydraulic conductivity was observed in all six instruments at or near the time of the breakthrough.

The second observation was a correlation between the changes in hydraulic conductivity and barometric pressure. As the barometric pressure changed, the steady state hydraulic conductivity was uniformly altered for all six SDRI's, simultaneously. This alteration ranged almost a full order of magnitude between the high and low points. This change can be attributed to an increase and/or decrease in the driving head under the influence of the barometric changes.

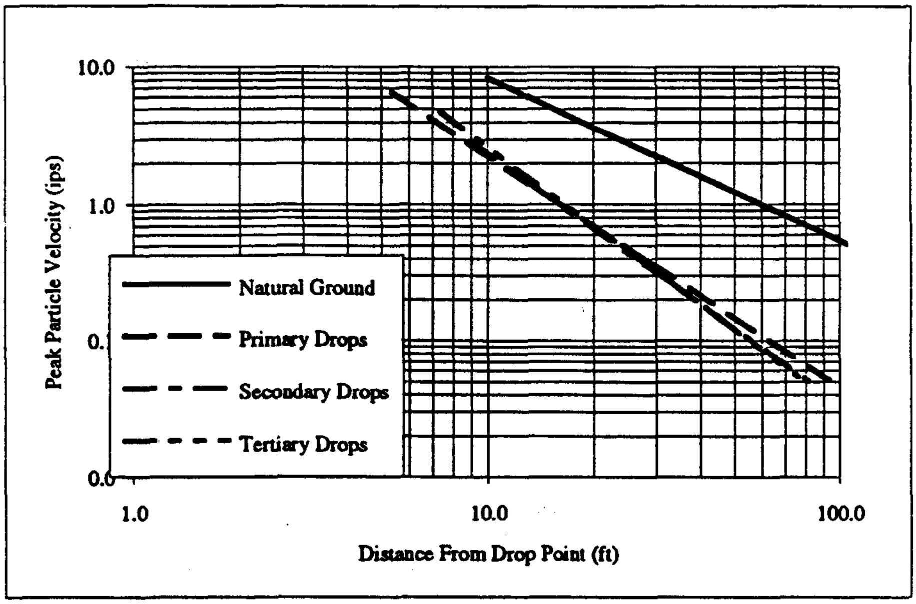


Figure 37 Log- log plot comparing attenuation of PPV versus distance between the natural ground baseline and the primary, secondary, and tertiary drops.

Buried Waste Compaction Evaluation

There were several key observations during dynamic compaction indicating that the buried wastes were not being consolidated. These were the differences in weight impact between the natural ground and the buried B-25 boxes; penetration of the weight into the buried wastes; and the small PPV's observed during impact. In response to these observations, the test plan was modified to establish drop zones A and B. Symmetry in the instrumentation allowed for this modification, without negatively impacting the test objectives. Drop area A was compacted, using the traditional SRS success criterion of a 6 ft displacement or 20 consecutive drops. Drop area B was overcompacted, using a primary, secondary, and tertiary drop pattern. Compaction was continued until the displacement appeared to be negligible.

Excavation of the consolidated B-25 boxes revealed that in both drop zones, there was a fused layer of boxes. This layer was formed by the lateral spread and interlocking of the compacted boxes. Failed boxes and materials were overlying each other so tightly that, in some cases, the cranes extracting the boxes tore the metal rather than separate the boxes.

This is supported by the divergence of the slope of attenuation from primary to secondary to tertiary drop sites on figure 37 (note that figure 37 has been plotted using a log-log scale to accentuate the relationship). The primary attenuation curve demonstrated a slope very similar to the baseline. As the fused layer formed, it absorbed energy, reducing the shear wave energy induced into the soil.

Additionally, the outside edges of the box matrix were not effectively consolidated. Apparently, the drop pattern did not overlap the exterior edge of the box matrix. The drop patterns were designed so that the distance between the center point of impact and the exterior edge was the radius of the weight. Failure to consolidate the box matrix edge may have contributed to the elastic nature of the fused box layer by providing supports to bridge the box matrix. Corrective action for future compactive efforts will ensure that the center point of the weight will impact on the exterior edge of the perimeter boxes.

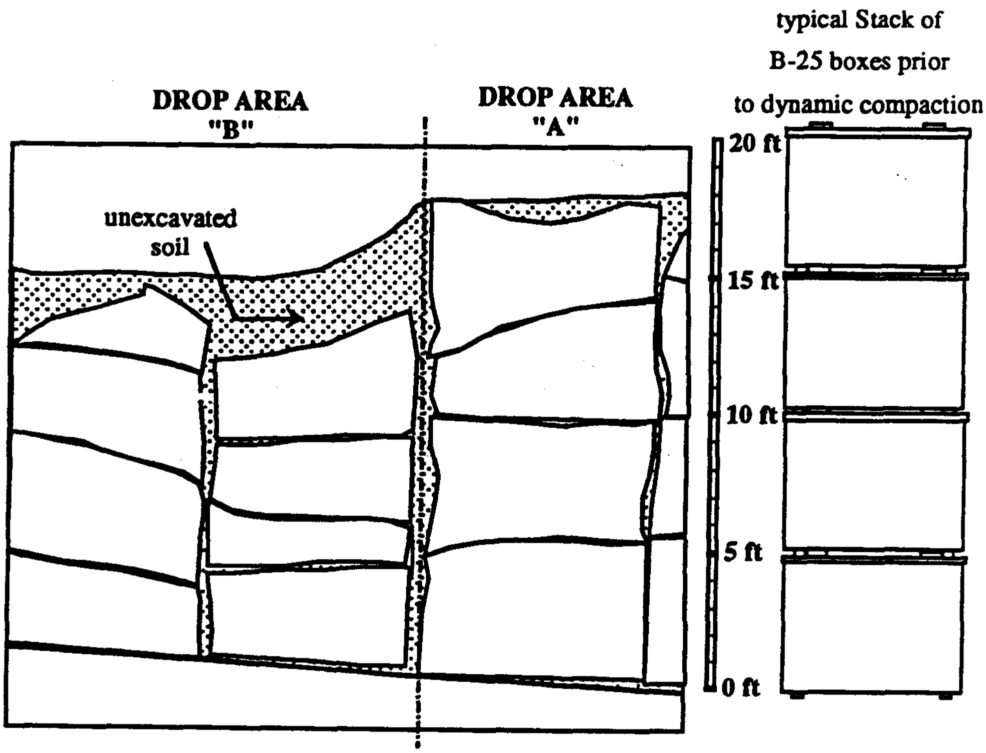


Figure 38 Westerly edge of excavated B-25 boxes, showing the difference in between compaction zones A and B.

The design purpose of B-25 boxes is to contain low-level waste at the generation point, to protect workers, and to facilitate transportation to the burial site. These boxes were never intended to provide contain waste within a burial; however, they do, by default, help minimize waste migration. An excavation of the consolidated boxes revealed that dynamic compaction accelerated the corrosion rate of these low grade, carbon steel boxes by bending and tearing the metal and by breaking the protective paint bonds. As part of another corrosion study, three B-25 boxes were buried uncompacted at a nearby location. To provide a comparison, when the boxes were excavated, the Savannah River Technology Center concluded that these undisturbed boxes experienced no observable corrosion. The DCF boxes had been in the ground six months when excavated, while the corrosion study boxes had been buried four years. Corrosion of the DCF boxes exceeded that of the long-term study, demonstrating that dynamic compaction had accelerated box corrosion and degradation.

Consideration should be taken to evaluate the burial site and consolidation goals relative to the effect of corrosion on containment. If corrosion minimization is important, then dynamic compaction should be reconsidered.

Supporting the observation that the traditional SRS success criteria were not successfully consolidating the lower boxes, excavation provided a measured quantification of the box densification. The boxes were excavated one by one, with measurements made of each dimension. The volume was compared with the initial volume to determine the percent compaction. The densification in drop area B was significantly more compacted than drop area A. Figure 38 shows the western side of the box matrix, with a sketch of the original configuration added for reference. Note that some of the bottom boxes in drop area A show little consolidation, while the boxes in drop area B are much more compressed. Generally, boxes in drop area B were 30% more compacted than those in drop area A, with local variations.

Most questions were answered during the actual excavation and final measurements of the compacted boxes. Drop zone A (which utilized the traditional drop pattern and compaction criteria) had not been adequately consolidated. Some of the bottom boxes had only cursory damage, depending upon the containerized materials and the location within the matrix. Drop zone B, however, compacted with additional drops and drop locations, showed a much more thorough consolidation.

To support a new compaction criterion proposal, the depth of influence for the SRS dynamic compaction efforts needed to be calculated. With simplifying assumptions, the Boussinesq Equation[8] was used to obtain an estimate of stress influence with depth. Note that this equation is independent of the material type.

The instantaneous velocity for each impact was measured as part of the DCF test program. Knowing this velocity, both the kinetic energy at impact and the negative acceleration were computed, using the standard equation for kinetic energy (1) and a change in velocity because of acceleration equation (2):

$$E=\frac{1}{2}mv^2 \quad (1)$$

$$v=v_o+2a\left(y_1-y_o\right) \quad (2)$$

where:

E = energy at impact,

$(y_1\text{-}y_0)$ = differential displacement induced by impact of the weight,

m = mass of the weight, and

v = velocity of the weight.

Once the negative acceleration was calculated, the stress induced at the surface by the impacting mass could be calculated using:

$$p=\frac{ma}{\pi r^2} \quad (3)$$

where:

p = stress,

m = mass of the weight,

a = negative acceleration, and

r = radius of the dynamic compaction weight.

Once these basic equations were combined to estimate the stress induced at the surface by the dynamic compaction weight, the value was entered into the Boussinesq Equation for a circular load to quantify the induced stress with depth.

$$\Delta p = q \left\{ 1 - \frac{1}{\left[\left(\frac{r}{z} \right)^2 + 1 \right]^{\frac{3}{2}}} \right\} \tag{4}$$

where:

Δp = change in stress,

q = induced stress,

r = radius of the dynamic compaction weight, and

z = depth of influence for which Δp is calculated.

Though the soil and the buried boxes are not elastic, homogeneous, and isotropic, equation (4) provides a reasonable estimate of stress influence with depth. Figure 39 was developed using the Boussinesq equation to plot the comparison between stress and depth of influence as a function of depth of differential displacements. The 3-ft displacement would relate to an average first drop in a primary pattern, while the 0.2-ft change would relate to a late secondary/tertiary type drop. Note that assuming the top of the bottom tier of boxes is 14-ft deep, the initial change of 3-ft induces no significant stress depth within the box matrix. As the box matrix becomes more stiff, the differential displacement becomes smaller, increasing stress with depth. Clearly, at the 0.2-ft displacement, the bottom tier of boxes is being influenced.

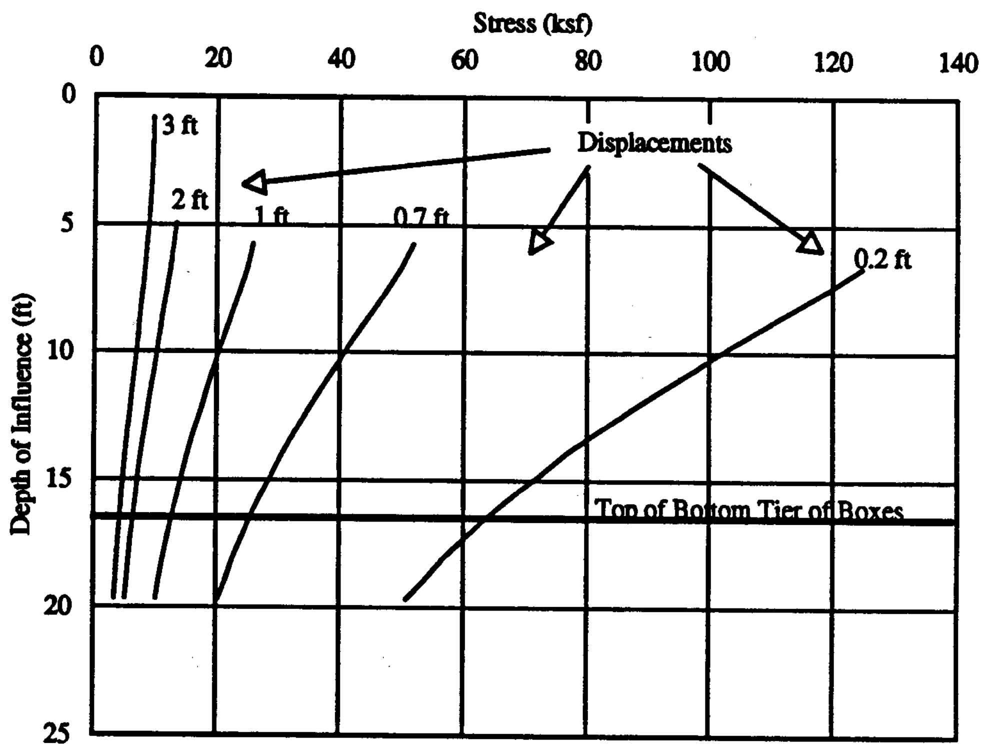


Figure 39 Plot of the influence of stress with depth, using the Boussinesq equation.

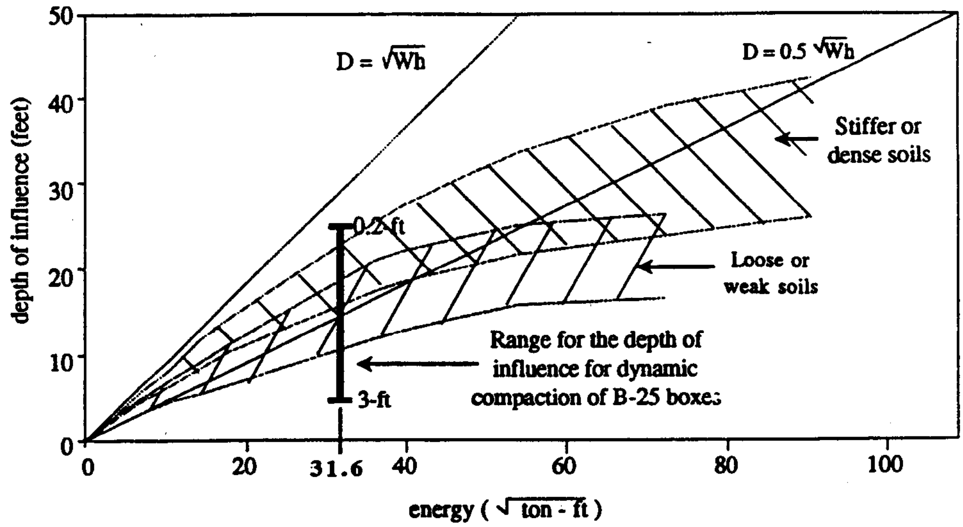


Figure 40 Plot of scaled energy versus depth, compared with Slocombe correlations for soil. (after Slocombe)

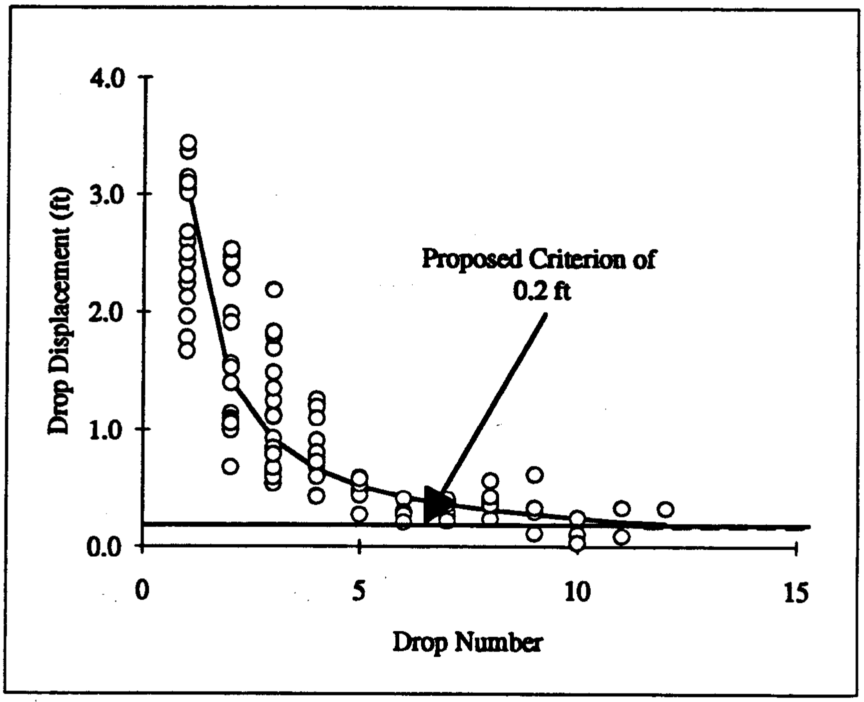


Figure 41 Plot comparing the drops with respect to the change in crater depth.

With the simplifying assumptions and the liberty taken to apply the Boussinesq equation to this scenario, a relationship developed by Slocombe[9] was used to calibrate the model. Slocombe's model presents the depth of influence as a function of scaled energy, using historical data and provided ranges for stiff or dense soils and loose or weak soils. The average kinetic energy at impact for the test was 31.6 ft-lb, at a computed differential displacement range between 3 and 0.2 ft This value was superimposed over the range of influence plotted on the Slocombe graph (Figure 40). The range of SRS data "fits" rather well over the data generated for soils. With this correlation, it is assumed that applying the Boussinesq equation provided a reasonable estimation of the depth of influence for the SRS dynamic compaction efforts.

There has been long discussions on the design purpose of B-25 boxes. The SRS design intent has been to contain low-level wastes at the generation point for worker protection and to facilitate transportation to the burial site. These boxes were never intended to provide containment within a burial. They do, however, by default, contribute to minimizing waste migration. Clearly, dynamic compaction accelerated the corrosion rate of these low-grade, carbon steel boxes. Consideration should be taken to evaluate the burial site consolidation goals and purposes relative to the effect of corrosion on containment. If corrosion minimization is important, then dynamic compaction of metal boxes should be reconsidered.

The final evaluation of dynamic compaction relative to consolidating buried B-25 boxes has generated a new success criteria based on a change in crater depth (displacement). Figure 41 is a plot comparing the drops with respect to the change in crater depth. The curve is best fit of all the drop data. This curve is approaching the asymptote at an approximate change in crater depth of 0.2 ft. The recommended criterion is two consecutive drops that change the crater depth no greater than 0.2 ft. Two consecutive drops at this criteria will ensure that no minor bridging of material occurs at the drop site. If the subsurface material bridge can withstand the energy given by two consecutive drops, then additional drops to destroy the bridge will most likely not be beneficial and therefore, not cost-effective.

Conclusions and Recommendations

Non-Invasive Characterization

The noninvasive characterization studies confirm that the surface materials at both the DCF and MWMF caps have higher seismic velocity values than the underlying kaolin clay caps. Consequently, the limited seismic refraction surveys only measured the fast, direct P- and S-wave velocities of the surface layer. However, measured direct shear wave velocities were, in general, comparable to those predicted by the SASW surveys.

The SASW studies successfully measured shear-wave velocities of the underlying kaolin clays at both the DCF and MWMF. Results indicate a mean shear wave velocity on the of 350 fps for the DCF kaolin clay cap, compared to 500 to 550 fps for the MWMF kaolin clay cap. Shear wave velocities appear to be similar at the southeastern and northwestern portions of the MWMF cap.

The higher shear wave velocity observed at the MWMF may be because of aging effects, which would be caused by drying of the kaolin clay over the past several years. In several instances, shear wave velocities similar to those observed at the MWMF were documented in the shallowest portions of the DCF cap, consistent with the drying model. Further more, at DCF site 11, the soil cover was removed and the exposed kaolin clay dried for several hours. At this location, the measured shear wave velocity was nearly identical to the mean values obtained at the older, presumably drier MWMF cap.

The results of the noninvasive characterization program suggest that the younger DCF cap may be less brittle than the older MWMF caps. Because of this difference, the reasonable buffer between the production drop locations and the MWMF clay cap should be adjusted with a factor of safety. This adjustment will be discussed below.

An important consideration resulting from the noninvasive characterization is the utility of the measurements. Currently, the only postclosure monitoring is through sparsely spaced, surface settlement monitors. As the MWMF and other closure systems mature, the need for noninvasive monitoring and interrogating of these systems increases. A prohibitor to traditional geophysical methods was demonstrated with the refraction survey work outlined in this report. With a higher velocity overlying a slower velocity material, the ability to see the shallow material is limited. The SASW method has demonstrated an ability to interrogate the near surface materials without this bias. The recommendation is to continue research in using the SASW technique on a more broad base over the SRS closure systems. By performing this work, the ability to detect closure system failure will improve.

Vibratory Impacts and Buffer

The primary focus for the DCF test was to determine a suitable buffer distance between dynamic compaction impact points and the existing MWMF kaolin cap. This determination is nontrivial, complicated by waste configuration, different soil responses, and the definition of failure for a kaolin clay cap. As discussed earlier, the response of the heterogenous mass of buried B-25 boxes to dynamic compaction causes transmutation of the wave forms and the wave form energy. Measurements of the PPVs and on evaluation of the generated wave forms indicate a relatively high attenuation factor for the buried wastes. This high attenuation factor reduces the degree and amount of vibratory energy entering the soil matrix and the kaolin clay cap. Figure 19 compared the attenuation curve for natural ground with that for the composite of all production drops. To achieve the 2.0 in/s threshold for the production drops, the distance from the drop location to the buried waste is approximately 12 ft For natural ground, this distance becomes 33 ft As discussed previously, there is some uncertainty regarding the comparative response of the DCF to the MWMF kaolin clay caps, because the MWMF cap appears to be more brittle. The conservative approach and the recommendation made in this report are to assume the natural undisturbed ground response and then apply a safety factor of 1.50 ft to the buffer distance. The reasonable and recommended buffer is 50 ft between the drop locations and the MWMF kaolin cap.

Hydraulic Conductivity of Kaolin Clay

The hydraulic conductivity of a barrier material used in a regulated closure must meet the 10^{-07} cm/sec criteria. This value is the threshold for failure when evaluating barrier performance. To determine the buffer between dynamic compaction activities and the MWMF, the DCF kaolin cap was instrumented after dynamic compaction, using six SDRI. These instruments use an induced hydraulic head to measure *in situ* the hydraulic conductivity of a material. The results of these studies measured no appreciable change in hydraulic conductivity for the DCF cap, assuming the construction specifications and methods met the intent of the Meuser-Rutledge study.

The changes in hydraulic conductivity resulting from environmental and boundary conditions had little impact on the generalized hydraulic conductivity for the kaolin clay. They do, however, raise the issue of absolute hydraulic conductivity and barrier performance over time. The SDRI instrumented were originally designed to test landfill liners. Simulating field conditions, the instruments employ a hydraulic driving head to cause the water to penetrate the test material. For testing barrier material, however, the model breaks down. Most closure barrier designs minimize the driving head within the system by implementing drainage systems and vegetation. While the SDRI is the industry standard and EPA instrument of choice, there is some question as to the applicability to the barrier system scenario and whether the hydraulic conductivity is higher than actuality as the result of the driving head. The barrier systems are nonsaturated systems, which apparently respond to variations in environmental conditions. The design and testing of alternative instrumentation accounting for the unsaturated conditions may derive a more realistic value for a more broad base of closure materials. These additional materials may include more sandy clay materials available at SRS, which would translate into cheaper closure systems for environmental restoration projects. The recommendation is to investigate the observed phenomenons and develop a more realistic testing scenario.

Dynamic Compaction of Buried Wastes

Excavation of the compacted wastes to evaluate the dynamic compaction success provided valuable insight that will improve the quality of future closures. The observation of the need to improve success criteria and the formation of the fused layer, are both new and unique. As stated previously, the traditional SRS success criteria was a 6-ft displacement or 20 consecutive drops, which ever came first. The observations early in the test that these criteria were inadequate allowed modifications to the test plan and the success of the program. While the inadequacy in the success criteria was apparent for the B-25 boxes, it should not be construed to be inadequate for open slit trenches.

As the boxes were excavated, the measured reduction in void ratio for the traditional criteria demonstrated the general lack of compaction to the bottom tier of boxes. At the same time, the excavation of the overcompacted boxes determine the new SRS criteria of two consecutive drops with a change in crater depth of no greater than 0.2 ft Two consecutive drops at this criteria will ensure that no minor bridging of material occurs at the drop site. If the subsurface material bridge can withstand the energy imparted by two consecutive drops, then additional drops to destroy the bridge will most likely not be beneficial and; therefore, not cost-effective.

An alternative to implementing the success criteria is to alter the weight shape, the weight mass, or the drop height. The recommended SRS criteria assume a flat bottom, and a 6-ft-diameter weight, weighing 20 tons. Altering the weight shape from flat bottomed to round or cylindrical would concentrate the force of impact, improving compaction at depth. Also, increasing the mass or drop height would also increase the compactive energy. These are design issues to addressed by the specific concerns for each site.

The test scenario assumed the buried boxes were stacked four high. Should this scenario change, then the direct assumptions and conclusions from this study may not be applicable.

The recommendation is to implement success criterion that are based upon the change in crater depth, per drop. This is a two consecutive drops with a change in crater depth of no greater than 0.2 ft. Additional consideration should be given to optimizing the weight shape to allow a more penetrating impact to break up any bridging and spanning by the compressed metal boxes.

REFERENCES

1. S.R. McMullin. *Test Program Plan for a Study: Analysis of Changes in Permeability in a Kaolin Clay Cap when Subjected to Shear Waves Generated By Dynamic Compaction.* Environmental Restoration Department, Westinghouse Savannah River Company, WER-ERG-920917, (1992).

2. *Dynamic Compaction Test Facility, Design Drawings and Specifications*, Engineering and Projects Division, C-CV-G-0006, 0007, & 0008 and C-SPC-G-00041, Savannah River Site, Aiken, SC 29808 (1992).

3. *Westinghouse Savannah River Company Project Engineering Services Contract Instrumentation Plan: Dynamic Test Facility.* USDOE Technical Report WSRC-TR-94-116, Savannah River Site, Aiken, SC 29808 (1992).

4. *Dynamic Test Facility: Data Report (Text and Figures).* USDOE Technical Report, WSRC-TR-94-117, Rev. 1, Savannah River Site, SC 29808 (September 1992).

5. K.H. Stokoe, S.Nazarian, G.J. Rix, I. Sanchez-Salinero, J.C. Sheu, and Y.J. Mok. "In Situ Seismic Testing of Hard-To-Sample Soils By Surface Wave Method". *Proceedings, American Society of Civil Engineers, Specialty Conference on Earthquake Engineering and Soil Dynamics II - Recent Advances in Ground Motion Evaluation,* Park City, Utah (June 1988).

6. R.D. Woods and L.P. Jedele. "Energy-Attenuation Relationships From Construction Vibrations". *Vibration Problems, ASCE,* (1987).

7. R.C. Warner. *Clay Cap Subsidence demosntration project report for the Mixed Wastes Management Facility, Savannah River Plant,* Submitted to E.I. DuPont de Nemours & Company, Inc. (1982).

8. B.M. Das. *Principles of Geotechnical Engineering*, PWS Engineering, Boston, MA (1985).

9. B.C. Slocombe. "Dynamic Compaction," *Ground Improvement,* CRC Press, (1993).

10. Dobry, Ricardo and George Gazetas. "Dynamic Stiffness and Damping of Foundations By Simple Methods". *Vibration Problems, ASCE,* (1987).

11. S.G. Wright, K.H. Stokoe, and J.M. Roesset. "SASW Measurements At Geotechnical Sites Overlaid By Water". *Dynamic Geotechnical Testing: Second Volume, STP 1213,* R.J. Ebelhar, V.P. Drnevich, and B.L. Kutter, Eds., American Society for Testing and Materials, Philadelphia, PA (1995).

12. J.M. Roesset, D.W. Chang, and K.H. Stokoe. "Comparison of 2-D and 3-D Models for Analysis of Surface Wave Tests". *Proceedings, 5th International Conference on Soil Dynamics and Earthquake Engineering,* Karlsruhe, Germany, (September 1991).

13. P.W. Mayne. "Ground Vibrations During Dynamic Compaction". *Vibration Problems, ASCE,* (1987).

14. R.F. Mera. *Analytical Study And Inversion For The Spectral Analysis Of Surface Waves Method* Master of Science in Engineering Thesis, The University of Texas at Austin (1991).

15. J.A. Barneich. "Vehicle Induced Ground Motion". *Vibration Problems, ASCE,* (1987).

16. S. Ahmad and T.M. Al-Hussaini. "Simplified Design for Vibration Screening By Open and In-Filled Trenches". *Journal of Geotechnical Engineering, Vol. 117, No. 1*, (January, 1991).

17. M. Vucetic and R. Dobry. "Effect of Soil Plasticity On Cyclic Response". *Journal of Geotechnical Engineering, Vol. 117, No. 1,* (January 1991).

18. R.F. Ballard Jr. "Determination of Soil Shear Moduli at Depth by In Situ Vibratory Techniques," *Miscellaneous Paper No. 4-691,* U.S. Army Engineering Waterways Experiment Station, Vicksburg, MS, (1964).

19. W.M. Ewing, W.S. Jardetzky, and F. Press. *Elastic Waves in Layered Media,* McGraw-Hill Book Company, Inc., New York, NY (1957).

20. N.A. Haskell. "The Dispersion of Surface Waves in Multilayered Media," *Bulletin of the Seismological Society of America, Vol. 43, pp. 17-34,* (1953).

21. S.W. Hull and E. Kausel. "Dynamic Loads in Layered Half-Spaces," *Proceedings of the 5th Engineering Mechnics Division Specialty Conference, ASCE,* Laramie, Wyoming, (1984).

22. R. Jones. "Insitu Measurement of the dynamic Properties of Soil by Vibration Methods," Geotechnique, Vol. 8, No. 1, pp. 1-21, (March, 1958).

23. R. Jones. "Surface Wave Technique for Measuring the Elastic Properties and Thickness of Roads: Theoretical Development," *British Journal of Applied Physics, Volume 13, pp. 21-29,* (1962).

24. E. Kausel and J.M. Roesset. "Stiffness Matrices for Layered Soils," *Bulletin of the Seismological society of America,* Vol. 71, pp 17-34, (1953).

25. W. Menke, W. *Geophysical Data Analysis, Discrete Inverse Theory,* Academic Press, Inc., (1984).

26. S. Nazarian. *In Situ Determination of Elastic Moduli of Soil Deposits and Pavement Systems by Spectral-Analysis-of-Surface-Waves Method,* Ph.D Dissertation, The University of Texas at Austin, 458 pp., (1984).

27. H.B. Seed, R.T. Wong, I.M. Idriss, and K. Tokimatsu. "Moduli and Damping Factors for Dynamic Analyses of Cohesionless Soils," *Journal of Geotechnical Engineering Division, Vol. 112, No. 11, ASCE, 17 pp.,* (1986).

28. K.H. Stokoe II, and S. Nazarian , "Use of Rayleigh Waves in Liquefaction Studies," *Proceedings, Measurement and Use of Shear Wave Velocity for Evaluating Dynamic Soil Properties,* Geotechnical Engineering Division, ASCE, pp. 1-14, (1985).

29. W.T. Thomson."Transmission of Elastic Waves Through a Stratified Solid". *Journal of Applied Physics, Vol. 21, pp 89-93,* (1950).

30. C.Vrettos and B. Prange. "Evaluation of Insitu Effective Shear Modulus from Dispersion Measurements". *Journal of Geotechnical Engineering Vol. 116, No. 10, pp. 1581-1585,* (October, 1990).

Appendix A Construction Quality Assurance

The success of the Dynamic Compaction Facility test is dependent upon the ability to model the actual field conditions. As described within this report, CT Main conducted a statistical analysis of the as-built moisture density values for the compacted kaolin clay used to construct MWMF closure system. These statistical values were input into the construction specifications.

Construction of a large, soil structure is not a precise endeavor. Specifications present a range of acceptable values for a construction target. Testing methods carry out a statistical approach to evaluating how well construction efforts meet the target range. Desiccation of the MWMF kaolin cap over the last three to four years is also variable, dependent upon the local conditions. These uncertainties introduce a degree of variability in how closely the DCF models the actual MWMF field conditions.

Construction efforts maximized the quality of the DCF model. Enclosed are copies of the quality assurance/quality control documentation. After review and evaluation, we determined that the kaolin clay cap was constructed as close to the MWMF as possible, meeting the test program goals.

Appendix A contains the quality assurance test data for the construction activities.

	A	B	C	D	E	F	G	H	I	J	
1	'TEST ANALYSIS RESULTS FOR THE DATF										
2											
3	CODE	REPORT#	TEST#	DATE	MATERIAL	% MOIST.	OPT. MOIST.	DRY DENS.	MAX. D. DENS.	WET DENS.	MAX. W. DENS
4	MDRT	4100	'1-DCM	4/21/92	KAOLIN	18.3%	30.2%	'-	88.5	'-	115.5
5		4100	'1-DCM	4/21/92	KAOLIN	25.8%	30.2%	83.9	88.5	105.6	115.5
6		4100	'1-DCM	4/21/92	KAOLIN	27.6%	30.2%	85.3	88.5	108.8	115.5
7		4100	'1-DCM	4/21/92	KAOLIN	29.0%	30.2%	87.9	88.5	113.4	115.5
8		4100	'1-DCM	4/21/92	KAOLIN	31.6%	30.2%	87.8	88.5	115.5	115.5
9		4100	'1-DCM	4/21/92	KAOLIN	33.5%	30.2%	85.2	88.5	113.8	115.5
10	MDRT	4100	2-DCM	4/21/92	KAOLIN	20.5%	30.8%	'-	88.0	'-	115.4
11		4100	2-DCM	4/21/92	KAOLIN	26.2%	30.8%	83.5	88.0	105.4	115.4
12		4100	2-DCM	4/21/92	KAOLIN	28.5%	30.8%	86.9	88.0	111.7	115.4
13		4100	2-DCM	4/21/92	KAOLIN	29.6%	30.8%	87.5	88.0	113.4	115.4
14		4100	2-DCM	4/21/92	KAOLIN	31.6%	30.8%	87.7	88.0	115.4	115.4
15		4100	2-DCM	4/21/92	KAOLIN	33.3%	30.8%	86.0	88.0	114.7	115.4
16	MDRT	4100	3-DCM	4/22/92	KAOLIN	34.0%	31.0%	'-	86.8	'-	113.6
17		4100	3-DCM	4/22/92	KAOLIN	28.8%	31.0%	84.5	86.8	108.8	113.6
18		4100	3-DCM	4/22/92	KAOLIN	30.1%	31.0%	86.4	86.8	112.4	113.6
19		4100	3-DCM	4/22/92	KAOLIN	32.1%	31.0%	86.0	86.8	113.6	113.6
20		4100	3-DCM	4/22/92	KAOLIN	33.7%	31.0%	84.9	86.8	113.5	113.6
21		4100	3-DCM	4/22/92	KAOLIN	35.4%	31.0%	82.9	86.8	112.3	113.6
22		4101	4-DCM	4/30/92	KAOLIN	25.8%	'-	'-	"-	'-	'-
23		4102	5-DCM	4/30/92	KAOLIN	21.9%	'-	'-	"-	'-	'-
24		4103	1-DATFS	5/11/92	SOIL	15.8%	'-	109.3	'-	126.6	'-
25		4103	1-DATFS	5/11/92	SOIL	16.3%	'-	106.1	'-	123.4	'-
26		4103	1-DATFS	5/11/92	SOIL	16.3%	'-	106.9	'-	124.3	'-
27		4104	6-DCM	5/15/92	KAOLIN	23.3%	26.8%	91.3	93.8	112.6	119.0
28		4104	6-DCM	5/15/92	KAOLIN	25.1%	26.8%	93.1	93.8	116.5	119.0
29		4104	6-DCM	5/15/92	KAOLIN	26.8%	26.8%	93.8	93.8	119.0	119.0
30		4104	6-DCM	5/15/92	KAOLIN	29.1%	26.8%	91.9	93.8	118.6	119.0
31		4104	6-DCM	5/15/92	KAOLIN	29.9%	26.8%	90.7	93.8	117.8	119.0
32		4107	3-DATFS	5/15/92	SOIL	16.8%	18.1%	105.1	105.1	122.8	107.2
33		4107	3-DATFS	5/15/92	SOIL	15.8%	18.1%	102.8	105.1	119.0	107.2
34		4107	3-DATFS	5/15/92	SOIL	14.9%	18.1%	99.4	105.1	114.2	107.2
35		4107	3-DATFS	5/15/92	SOIL	15.6%	18.1%	94.4	105.1	109.1	107.2
36		4107	3-DATFS	5/15/92	SOIL	15.2%	18.1%	103.4	105.1	119.1	107.2
37		4108	4-DATFS	5/16/92	SOIL	14.2%	18.1%	106.8	106.8	122.0	107.2
38		4108	4-DATFS	5/16/92	SOIL	14.6%	18.1%	101.8	106.8	116.7	107.2
39		4108	4-DATFS	5/16/92	SOIL	14.7%	18.1%	105.8	106.8	121.4	107.2
40		4108	4-DATFS	5/16/92	SOIL	16.4%	18.1%	104.7	106.8	121.9	107.2
41		4108	4-DATFS	5/16/92	SOIL	15.8%	18.1%	110.4	106.8	127.8	[illegible]
42		4108	4-DATFS	5/16/92	SOIL	16.1%	18.1%	106.8	106.8	124.0	107.2

	A	B	C	D	E	F	G	H	I	J	
43		4108	4-DATFS	5/16/92	SOIL	17.0%	18.1%	104.9	106.8	122.7	107.2
44		4108	4-DATFS	5/16/92	SOIL	16.4%	18.1%	99.8	106.8	116.9	107.2
45		'-	6-DATFS	5/18/92	SOIL	16.6%	18.1%	105.5	106.2	123.0	124.2
46		'-	6-DATFS	5/18/92	SOIL	16.9%	18.1%	106.2	106.2	124.2	124.2
47		'-	6-DATFS	5/18/92	SOIL	14.0%	18.1%	97.2	106.2	110.8	124.2
48		'-	6-DATFS	5/18/92	SOIL	13.8%	18.1%	91.6	106.2	104.2	124.2
49		'-	6-DATFS	5/18/92	SOIL	16.3%	18.1%	97.8	106.2	113.7	124.2
50		'-	6-DATFS	5/18/92	SOIL	14.7%	18.1%	103.7	106.2	118.9	124.2
51		4105	2-DATFS	5/19/92	SOIL	15.7%	19.2%	98.7	107.8	114.2	128.5
52		4105	2-DATFS	5/19/92	SOIL	17.3%	19.2%	102.3	107.8	120.0	128.5
53		4105	2-DATFS	5/19/92	SOIL	19.4%	19.2%	107.6	107.8	128.5	128.5
54	PRO/SC	4105	2-DATFS	5/19/92	SOIL	20.3%	19.2%	105.1	107.8	126.4	128.5
55		'-	5-DATFS	5/20/92	SOIL	16.9%	18.1%	107.1	110.0	125.2	107.2
56		'-	5-DATFS	5/20/92	SOIL	17.7%	18.1%	101.7	110.0	119.7	107.2
57		'-	5-DATFS	5/20/92	SOIL	15.1%	18.1%	110.1	110.0	126.7	107.2
58		'-	5-DATFS	5/20/92	SOIL	13.4%	18.1%	111.7	110.0	126.7	107.2
59		'-	5-DATFS	5/20/92	SOIL	16.5%	18.1%	110.0	110.0	128.2	107.2
60		'-	5-DATFS	5/20/92	SOIL	17.0%	18.1%	99.7	110.0	116.6	107.2

A.3

FOR INFORMATION ONLY

ASR 18-179 (3/92)
FILE ID # 80144

EBASCO SERVICES INCORPORATED
SAND METHOD DENSITY TEST & PERCENT COMPACTION

ASTM D-1556-(90)

REPT #: 4122 PROJ/AMO: 4794 WORK PACKAGE NO.: 92-WPW-EC-023

DA: C001 TWC: 96160 AXC: NA QCIR NO.: 92IR15-G-4794-1101-C-CV-G-0006-0002

CONTRACTOR: Bechtel

MATERIAL DESCRIPTION: Kaolin Clay A-LIFT DATE TESTED: 6-28-92

ACCEPTANCE CRITERIA: 95% Compaction, Dry Density 92-95 PCF LOCATION: Burial Ground Soils Dynamic Compaction

TEST NO.	65					
DISTANCE Approx. N/E CORNER	25'S, 20'W					
ELEVATION Approx.	293.2± *W.P. 6-28-92					
A. INITIAL WEIGHT OF SAND	6455.9					
B. FINAL WEIGHT OF SAND	2754.8					
C. DIFFERENCE (A-B)	3701.1					
D. WT. OF SAND IN FUNNEL & PLATE	1655.0					
E. WT. OF SAND IN HOLE (C-D)/LBS	2046.1 / 4.511					
F. WT. OF SAND CU./FT.	93.5					
G. VOL. OF HOLE CU./FT. (E/F)	.0482					
H. WT. OF WET SOIL REMOVED / LBS	2539.4 / 5.598					
I. WET DENSITY (H/G)	116.1			N/A		
J. WEIGHT OF WET SOIL	113.60					
K. WEIGHT OF DRY SOIL	88.66					
L. WEIGHT OF MOISTURE (J-K)	24.94					
M. MOISTURE %. (L/K)	28.0					
N. DRY DENSITY LBS/CU.FT. (IX100) (M+100)	90.7					
MAX. DENSITY (PROCTOR)	94.2					
OPTIMUM MOISTURE	26.5					
% COMPACTION REQUIRED	95.0					
% COMPACTION	96.2					

DENSITY PROCTOR REPORT #: WER-ERC-92-0544 DESIGN CATEGORY: GS

MOISTURE DETERMINATION: ☐ ASTM D-2216 ( ) ☑ ASTM D-4643 (87)

M&TE: F-11 (7-1-92 or 200 LBS. SAND); S-79 (5-6-93) PROCEDURE: C-QCP-021

NCR #: NA CR #: NA REV: 0

TEST RESULTS: ☐ CONFORMING ☑ ▲ NONCONFORMING ☐ N/A PCN'S: NA

SPECS: C-SPC-G-00041

REMARKS: OFFICIAL TEST 6-28-92 W.P. REV: 2

▲ accepted per DCF # Y-24984-R MK 9.14.92 DCF'S: N/A ▲ MK 9.14.92

M. Koval II 6.28.92 STANDARDS: N/A

INSPECTOR: Wyman Pope Jr. LEVEL: II DATE: 6-28-92

REVIEWER: [signature] LEVEL: II DATE: 9-15-92

MTP 9-15-92

FOR INFORMATION ONLY

FILE

ASR 18-178 (3/92)
FILE ID # 80143

EBASCO SERVICES INCORPORATED

DETERMINATION OF WATER CONTENT

☐ ASTM D-2216 ( ) ☑ ASTM D-4643 (87)

REPT #: 4122 PROJ/AMO: 4794
DA: C001 TWC: 9660 AXC: NA
WORK PACKAGE NO.: 92-WPW-EC-023
QCIR NO.: 92IR15-E-4794-1101-C-CV-G-0006-0002
LAB #: S92-708 DATE TESTED: 6-28-92 ACCPT. CRITERIA: AVG. 28-30%
MATERIAL DESCRIPTION: KAOLIN CLAY A-LIFT
LOCATION: BURIAL GROUND SOILS DYNAMIC COMPACTION

~~BORING NUMBER~~ * MWO NO.'S	1	2	4	5	6	4	5
SAMPLE NUMBER	1	2	3	4	5	6	7
WT. OF WET SAMPLE ~~+ TARE~~ *	113.15	113.34	113.83	113.21	113.64	113.41	113.03
WT. OF DRY SAMPLE ~~+ TARE~~ *	87.40	87.03	87.91	86.93	85.45	87.28	86.55
WEIGHT OF MOISTURE	25.75	26.31	25.92	26.28	28.19	26.13	26.48
TARE WEIGHT	NA	NA	NA	NA	NA	NA	NA
~~WEIGHT OF DRY SAMPLE~~ * % MOISTURE	29.5	30.2	29.5	30.2	32.9	29.9	30.6
% MOISTURE Rounded to 0.5%	29.5	30.0	29.5	30.0	33.0	30.0	30.5

~~BORING NUMBER~~ * MWO NO.'S	6	7	8	10			
SAMPLE NUMBER	8	9	10	SAND CONE F-11			
WT. OF WET SAMPLE ~~+ TARE~~ *	113.30	113.32	113.51	113.60			
WT. OF DRY SAMPLE ~~+ TARE~~ *	88.93	88.50	84.50	88.66			
WEIGHT OF MOISTURE	24.37	24.82	29.01	24.94		N/A	
TARE WEIGHT	NA	NA	NA	NA			
~~WEIGHT OF DRY SAMPLE~~ * % MOISTURE	27.4	28.0	34.3	28.1			
% MOISTURE Rounded to 0.5%	27.5	28.0	34.5	28.0			

MINIMUM SIZE SAMPLE ☑ CONFORMING ☐ NONCONFORMING REMARKS: N/A

MORE THAN ONE SOIL TYPE: NO

METHOD OF DRYING: ☐ 230 +/- 9 DEGREES F ☑ OTHER: MWO

MATERIAL (SIZE/AMOUNT) EXCLUDED FROM TEST: NO

M&TE: 5-73 (6-23-93)
NCR #: NA CR #: NA
TEST RESULTS: ☑ CONFORMING ☐ NONCONFORMING ☐ N/A

REMARKS: * OFFICIAL TEST, MICROWAVE AND SAND CONE AVG. 29.4/29.5%. * 6-28-92 W.P. this report clears Lab# S92-706 MK 6.25.92

PROCEDURE: C-QCP-021
REV: 0
PCN'S: NA
SPECS: C-SPC-G-00041
REV: 2
DCF'S: N/A
STANDARDS: N/A
DES. CAT: GS

M. Koval II 6.28.92
INSPECTOR: Wyman Pope Jr. LEVEL: II DATE: 6-28-92
REVIEWER: [signature] LEVEL: II DATE: 9-15-92

MJR 09-15-92

A S

FOR INFORMATION ONLY

ASR 18-178 (3/92)
FILE ID # 80143

EBASCO SERVICES INCORPORATED

DETERMINATION OF WATER CONTENT

☐ ASTM D-2216 ( ) ☑ ASTM D-4643 (87)

REPT #: 4122 PROJ/AMO: 4794 WORK PACKAGE NO.: 92-WPW-EC-023

DA: C001 TWC: 9660 AXC: NA QCIR NO.: 92IR15-E-4794-1101-C-CV-G-00060-0002

LAB #: S92-708 DATE TESTED: 6-28-92 ACCPT. CRITERIA: AVG. 28-30

MATERIAL DESCRIPTION: Kaolin Clay A-LIFT

LOCATION: Burial Ground soils Dynamic Compaction

~~BORING NUMBER~~ * MWO NO.'s	1	2	1	2			
SAMPLE NUMBER	5 R1	5 R1	10 R1	10 R1			
WT. OF WET SAMPLE ~~+ TARE~~ *	113.12	113.24	113.40	113.62			
WT. OF DRY SAMPLE ~~+ TARE~~ *	86.58	86.38	87.60	86.86			
WEIGHT OF MOISTURE	26.54	26.86	25.8	26.76	N	A	
TARE WEIGHT	NA	NA	NA	NA			
~~WEIGHT OF DRY SAMPLE~~ * % MOISTURE	30.7	31.1	29.5	30.8			
% MOISTURE Rounded to 0.5%	30.5	31.0	29.5	31.0			

Avg. 31.0 (samples 5 R1) — Avg. 30.5 (samples 10 R1)

BORING NUMBER							
SAMPLE NUMBER							
WT. OF WET SAMPLE + TARE							
WT. OF DRY SAMPLE + TARE				N	A		
WEIGHT OF MOISTURE							
TARE WEIGHT							
WEIGHT OF DRY SAMPLE							
% MOISTURE							

MINIMUM SIZE SAMPLE ☑ CONFORMING ☐ NONCONFORMING REMARKS: NA

MORE THAN ONE SOIL TYPE: NO

METHOD OF DRYING: ☐ 230 +/- 9 DEGREES F ☑ OTHER: MWO

MATERIAL (SIZE/AMOUNT) EXCLUDED FROM TEST: NO

M&TE: S-73 (6-23-93) PROCEDURE: C-QCP-021

NCR #: NA CR #: NA REV: 0

PCN'S: NA

TEST RESULTS: ☑ CONFORMING ☐ NONCONFORMING ☐ N/A

SPECS: C-SPC-G-00041

REMARKS: * OFFICIAL TEST, MICROWAVE AND SAND CONE AVG. 29.4/29.5%. * 6-28-92 W.P. this report clears Lab# S92-706 MK 6-28-92

REV: 2

DCF'S: N/A

STANDARDS: N/A

M. Koval II 6-28-92

INSPECTOR: Wyman [signature] LEVEL: II DATE: 6-28-92

REVIEWER: [signature] LEVEL: II DATE: 9-15-92

DES. CAT: GS

MJR 09-15-92

FOR INFORMATION ONLY

ASR 18-178 (3/92)
FILE ID # 80143

EBASCO SERVICES INCORPORATED

DETERMINATION OF WATER CONTENT

☐ ASTM D-2216 ( ) ☑ ASTM D-4643 (87)

REPT #: 4122 PROJ/AMO: 4794 WORK PACKAGE NO.: 92-WPW-EC-023

DA: C001 TWC: 9660 AXC: NA QCIR NO.: 92IRIS-E-4794-1101-C-CV-G-0006-0002

LAB #: S92-706 DATE TESTED: 6.27.92 ACCPT. CRITERIA: Avg. 28-30% moisture content

MATERIAL DESCRIPTION: Kaolin Clay A-Lift

LOCATION: Burial Ground Soils Dynamic Compaction

▲ MK 6.27.92

~~BORING~~ MICROWAVE NUMBER ▲	1	2	4	5	6	7	8
SAMPLE NUMBER	1	2	3	4	5	6	7
WT. OF WET SAMPLE ~~+ TARE~~ ▲	111.43	112.08	112.42	113.21	110.45	111.12	112.21
WT. OF DRY SAMPLE ~~+ TARE~~ ▲	88.74	88.23	89.32	87.05	85.97	88.80	86.85
WEIGHT OF MOISTURE	22.69	23.85	23.10	26.16	24.48	22.32	25.36
TARE WEIGHT	NA	NA	NA	NA	NA	NA	NA
~~WEIGHT OF DRY SAMPLE~~ ▲ % moisture	25.6	27.0	25.9	30.1	28.5	25.1	29.2
% MOISTURE rounded to 0.5%	25.5	27.0	26.0	30.0	28.5	25.0	29.0

~~BORING~~ MICROWAVE NUMBER ▲	9	10	11				
SAMPLE NUMBER	8	9	10				
WT. OF WET SAMPLE ~~+ TARE~~ ▲	112.92	113.52	111.75				
WT. OF DRY SAMPLE ~~+ TARE~~ ▲	88.28	87.54	88.12				
WEIGHT OF MOISTURE	24.64	25.98	23.63		N/A		
TARE WEIGHT	NA	NA	NA				
~~WEIGHT OF DRY SAMPLE~~ ▲ % moisture	27.9	29.7	26.8				
% MOISTURE rounded to 0.5%	28.0	29.5	27.0				

MINIMUM SIZE SAMPLE ☑ CONFORMING ☐ NONCONFORMING REMARKS: NA

MORE THAN ONE SOIL TYPE: No

METHOD OF DRYING: ☐ 230 +/- 9 DEGREES F ☑ OTHER: MWO

MATERIAL (SIZE/AMOUNT) EXCLUDED FROM TEST: No

M&TE: S-73 (6.23.93) PROCEDURE: C-QCP-021

NCR #: NA CR #: NA REV: 0

PCN'S: NA

TEST RESULTS: ☐ CONFORMING ☑ NONCONFORMING ☐ N/A

SPECS: C-SPC-G-00041

REMARKS: Official tests, Avg. moistures 27.6/27.5 MK 6.27.92 ref. Lab# S92-708 for conforming moistures. MK 6.28.92

REV: 2

DCF'S: N/A

STANDARDS: N/A

M. Kowal II 6.27.92

INSPECTOR: Wyman Pope Jr. LEVEL: III DATE: 6-27-92

REVIEWER: [signature] LEVEL: II DATE: 9-15-92

DES. CAT: GS

MJR 09-15-92

FOR INFORMATION ONLY

ASR 18-178 (3/92)
FILE ID # 80143

EBASCO SERVICES INCORPORATED

DETERMINATION OF WATER CONTENT

☐ ASTM D-2216 ( ) ☑ ASTM D-4643 (87)

FILE

DEPT #: 4122 PROJ/AMO: 4794 WORK PACKAGE NO.: 92-WPW-EC-023
DA: C001 TWC: 9660 AXC: NA QCIR NO.: 92IR15-E-4794-1101-C-CV-G-0006-0002
LAB #: S92-700 DATE TESTED: 6-25-92 ACCPT. CRITERIA: NA
MATERIAL DESCRIPTION: KAOLIN CLAY "A-LIFT"
LOCATION: BURIAL GROUND SOILS DYNAMIC COMPACTION

~~BORING NUMBER~~ * MWO NO.s	1	2	11	4	5	6	7
SAMPLE NUMBER	1	2	3	4	5	6	7
WT. OF WET SAMPLE ~~+ TARE~~ *	111.48	111.25	111.62	111.42	111.31	111.21	111.68
WT. OF DRY SAMPLE ~~+ TARE~~ *	91.27	89.45	91.37	88.65	89.91	87.84	89.12
WEIGHT OF MOISTURE	20.21	21.8	20.25	22.77	21.4	23.37	22.56
TARE WEIGHT	NA	NA	NA	NA	NA	NA	NA
~~WEIGHT OF DRY SAMPLE~~ * % moisture	22.1	24.4	22.2	25.7	23.8	26.6	25.3
% MOISTURE Rounded to 0.5%	22.0	24.5	22.0	25.5	24.0	26.5	25.5

~~BORING NUMBER~~ * MWO NO.s	8	9	10				
SAMPLE NUMBER	8	9	10				
WT. OF WET SAMPLE ~~+ TARE~~ *	111.89	111.68	111.79				
WT. OF DRY SAMPLE ~~+ TARE~~ *	88.21	87.69	88.76				
WEIGHT OF MOISTURE	23.68	23.99	23.03		N	A	
TARE WEIGHT	NA	NA	NA				
~~WEIGHT OF DRY SAMPLE~~ * % moisture	26.8	27.4	25.9				
% MOISTURE Rounded to 0.5%	27.0	27.5	26.0				

MINIMUM SIZE SAMPLE ☑ CONFORMING ☐ NONCONFORMING REMARKS: NA
MORE THAN ONE SOIL TYPE: NO
METHOD OF DRYING: ☐ 230 +/- 9 DEGREES F ☑ OTHER: MWO
MATERIAL (SIZE/AMOUNT) EXCLUDED FROM TEST: NO

M&TE: 5-73 (6-23-93) PROCEDURE: C-QCP-021
NCR #: NA CR #: NA REV: 0
TEST RESULTS: ☐ CONFORMING ☐ NONCONFORMING ☑ N/A PCN'S: NA
SPECS: C-SPC-G-00041
REMARKS: INFO ONLY TEST, * 6-25-92 W.P. REV: 2
AVG. 25.1/25.0% 6-25-92 W.P. DCF'S: N/A
N/A
STANDARDS: N/A

M. Kowal II 6.25.92
INSPECTOR: Wyman Pope LEVEL: II DATE: 6-25-92
REVIEWER: [signature] LEVEL: III DATE: 9-15-92 DES. CAT: 'GS'

MJR 09-15-92

FOR INFORMATION ONLY

ASR 18-178 (3/92)
FILE ID # 80143

EBASCO SERVICES INCORPORATED

DETERMINATION OF WATER CONTENT

☐ ASTM D-2216 ( ) ☑ ASTM D-4643 (87)

REPT #: 4122 PROJ/AMO: 4794
WORK PACKAGE NO.: 92-WPN-EC-023
DA: C001 TWC: 9606 AXC: NA
QCIR NO.: 92IRIS-E-4794-1101-C-CV-G-0006-0002
LAB #: S92-702 DATE TESTED: 6-27-92 ACCPT. CRITERIA: NA
MATERIAL DESCRIPTION: KAOLIN CLAY "A-LIFT"
LOCATION: BURIAL GROUND SOILS DYNAMIC * ~~Copaction~~ Compaction

~~BORING NUMBER~~ * MWO NO'S	1	2	4	5	6	7	8
SAMPLE NUMBER	1	2	3	4	5	6	7
WT. OF WET SAMPLE ~~+ TARE~~ *	109.99	110.67	109.70	112.89	108.48	106.77	108.55
WT. OF DRY SAMPLE ~~+ TARE~~ *	86.37	87.85	87.44	90.60	85.96	82.71	83.32
WEIGHT OF MOISTURE	23.62	22.82	22.26	22.29	22.52	24.06	25.23
TARE WEIGHT	NA	NA	NA	NA	NA	NA	NA
~~WEIGHT OF DRY SAMPLE~~ * % moisture	27.3	26.0	25.5	24.6	26.2	29.1	30.3
% MOISTURE Rounded to 0.5%	27.5	26.0	25.5	24.5	26.0	29.0	30.5

~~BORING NUMBER~~ * MWO NO.S	9	10	11	1	2	4	5
SAMPLE NUMBER	8	9	10	11	12	13	14
WT. OF WET SAMPLE ~~+ TARE~~ *	108.76	107.77	111.99	108.57	107.44	109.78	113.95
WT. OF DRY SAMPLE ~~+ TARE~~ *	83.66	82.25	86.84	81.97	84.14	84.46	87.85
WEIGHT OF MOISTURE	25.1	25.52	25.15	26.6	23.3	25.32	26.1
TARE WEIGHT	NA	NA	NA	NA	NA	NA	NA
~~WEIGHT OF DRY SAMPLE~~ * % moisture	30.0	31.0	29.0	32.4	27.7	30.0	29.7
% MOISTURE Rounded to 0.5%	30.0	31.0	29.0	32.5	27.5	30.0	29.5

MINIMUM SIZE SAMPLE ☑ CONFORMING ☐ NONCONFORMING REMARKS: NA
MORE THAN ONE SOIL TYPE: NO
METHOD OF DRYING: ☐ 230 +/- 9 DEGREES F ☑ OTHER: MWO
MATERIAL (SIZE/AMOUNT) EXCLUDED FROM TEST: NO

M&TE: S-73 (6-23-93)	PROCEDURE: C-QCP-021
NCR #: NA CR #: NA	REV: 0
TEST RESULTS: ☐ CONFORMING ☐ NONCONFORMING ☑ N/A	PCN'S: NA
REMARKS: INFO ONLY TEST, * 6-27-92 W.P. 6-27-92 W.P. N/A	SPECS: C-SPC-G-00041
	REV: 2
	DCF'S: N/A
INSPECTOR: M. Kowal [signature] LEVEL: II DATE: 6-27-92	STANDARDS: N/A
REVIEWER: [signature] LEVEL: II DATE: 9-15-92	DES. CAT: GS

MJR 09-15-92

FOR INFORMATION ONLY

ASR 18-178 (3/92)
FILE ID # 80143

EBASCO SERVICES INCORPORATED

DETERMINATION OF WATER CONTENT

☐ ASTM D-2216 ( ) ☑ ASTM D-4643 (87)

REPT #: 4122 PROJ/AMO: 4794 WORK PACKAGE NO.: 92-WPW-EC-023

DA: C001 TWC. 96160 AXC: NA QCIR NO.: 92ZRI5-E-4794-1101-C-CU-G-0006-0002

LAB #: 592-702 DATE TESTED: 6-27-92 ACCPT. CRITERIA: NA

MATERIAL DESCRIPTION: 6-27-92 W.P. ~~Kaoline~~ Kaolin Clay 'A-LIFT'

LOCATION: Burial Ground soils Dynamic Compaction

~~BORING NUMBER~~ * MWO No.	6	N/A					
SAMPLE NUMBER	15						
WT. OF WET SAMPLE ~~+ TARE~~ *	112.93						
WT. OF DRY SAMPLE ~~+ TARE~~ *	86.59						
WEIGHT OF MOISTURE	26.34						
TARE WEIGHT	NA						
~~WEIGHT OF DRY SAMPLE~~ * % moisture	30.4						
% MOISTURE Rounded to 0.5%	30.5						

BORING NUMBER	N/A						
SAMPLE NUMBER							
WT. OF WET SAMPLE + TARE							
WT. OF DRY SAMPLE + TARE							
WEIGHT OF MOISTURE							
TARE WEIGHT							
WEIGHT OF DRY SAMPLE							
% MOISTURE							

MINIMUM SIZE SAMPLE ☑ CONFORMING ☐ NONCONFORMING REMARKS: NA

MORE THAN ONE SOIL TYPE: NO

METHOD OF DRYING: ☐ 230 +/- 9 DEGREES F ☑ OTHER: MWO

MATERIAL (SIZE/AMOUNT) EXCLUDED FROM TEST: NO

M&TE: S-73 (6-23-93) PROCEDURE: C-QCP-021

NCR #: NA CR #: NA REV: 0

TEST RESULTS: ☐ CONFORMING ☐ NONCONFORMING ☑ N/A PCN'S: NA

SPECS: C-SPC-G-00041

REMARKS: INFO ONLY TEST, * 6-27-92 W.P.
6-27-92 W.P.
N/A

REV: 2

DCF'S: N/A

STANDARDS: N/A

M. Koval II 6-27-92

INSPECTOR: Wyman Lyn Jr. LEVEL: II DATE: 6-27-92

REVIEWER: [signature] LEVEL: II DATE: 9-15-92 DES. CAT: GS

MJR 09-15-92

FOR INFORMATION ONLY

ASR 18-178 (3/92)
FILE ID # 80143

EBASCO SERVICES INCORPORATED

FILE

DETERMINATION OF WATER CONTENT

☐ ASTM D-2216 ( ) ☑ ASTM D-4643 (87)

REPT #: 4122 PROJ/AMO: 4794
DA: C001 TWC: 9660 IXC: NA
LAB #: S92-705 DATE TESTED: 6-27-92

WORK PACKAGE NO.: 92-WPN-EC-023
QCIR NO.: 92IR15-E-4794-1101-C-CV-G-0006-0002
ACCPT. CRITERIA: NA

MATERIAL DESCRIPTION: KAOLIN CLAY A-LIFT

LOCATION: BURIAL GROUND SOILS DYNAMIC COMPACTION

~~BORING NUMBER~~ * MWO NO's	1	2	4	5	6	7	8
SAMPLE NUMBER	1	2	3	4	5	6	7
WT. OF WET SAMPLE ~~+ TARE~~ *	113.50	113.47	112.08	111.53	114.62	112.09	111.61
WT. OF DRY SAMPLE ~~+ TARE~~ *	89.44	87.95	87.14	87.08	89.44	88.07	88.58
WEIGHT OF MOISTURE	24.06	25.52	24.94	24.45	25.18	24.02	23.03
TARE WEIGHT	NA	NA	NA	NA	NA	NA	NA
~~WEIGHT OF DRY SAMPLE~~ * % moisture	26.9	29.0	28.6	28.1	28.2	27.3	26.0
% MOISTURE Rounded to 0.5%	27.0	29.0	28.5	28.0	28.0	27.5	26.0

~~BORING NUMBER~~ * MWO NO's	9	10	11				
SAMPLE NUMBER	8	9	10				
WT. OF WET SAMPLE ~~+ TARE~~ *	111.33	114.64	114.25				
WT. OF DRY SAMPLE ~~+ TARE~~ *	89.27	91.10	91.05				
WEIGHT OF MOISTURE	22.06	23.54	23.2		N	A	
TARE WEIGHT	NA	NA	NA				
~~WEIGHT OF DRY SAMPLE~~ * % moisture	24.7	25.8	25.5				
% MOISTURE Rounded to 0.5%	24.5	26.0	25.5				

MINIMUM SIZE SAMPLE ☑ CONFORMING ☐ NONCONFORMING REMARKS: NA

MORE THAN ONE SOIL TYPE: NO

METHOD OF DRYING: ☐ 230 +/- 9 DEGREES F ☑ OTHER: MWO

MATERIAL (SIZE/AMOUNT) EXCLUDED FROM TEST: NO

M&TE: S-73 (6-23-93)
NCR #: NA CR #: NA
TEST RESULTS: ☐ CONFORMING ☐ NONCONFORMING ☑ N/A

REMARKS: INFO ONLY TEST, * 6-27-92 W.P.
6-27-92 W.P.
N/A

PROCEDURE: C-QCP-021
REV: 0
PCN'S: NA
SPECS: C-SPC-G-00041
REV: 2
DCF'S: N/A
STANDARDS: N/A

M. Kowal II 6-27-92
INSPECTOR: Wyman Pope Jr. LEVEL: II DATE: 6-27-92
REVIEWER: [signature] LEVEL: II DATE: 9-15-92
DES. CAT: GS

MJR 09-15-92

FOR INFORMATION ONLY

ASR 18-178 (3/92)
FILE ID # 80143

EBASCO SERVICES INCORPORATED

DETERMINATION OF WATER CONTENT

☐ ASTM D-2216 ( ) ☑ ASTM D-4643 (87)

FILE

REPT #: 4122 PROJ/AMO: 4794 WORK PACKAGE NO.: 92-WPW-EC-023

DA: C001 TWC: 9660 AXC: NA QCIR NO.: 92IRIS-G-4794-1101-C-CV-G-0006-0002

LAB #: S92-704 DATE TESTED: 6-27-92 ACCPT. CRITERIA: NA

MATERIAL DESCRIPTION: Kaolin Clay A-Lift

LOCATION: Burial Ground soils Dynamic Compaction

~~BORING NUMBER~~ * MWO NO.'s	1	2	4	5	6	7	
SAMPLE NUMBER	1	1B	2	2B	3	3B	
WT. OF WET SAMPLE ~~+ TARE~~ *	112.33	112.17	111.63	111.81	112.76	112.67	
WT. OF DRY SAMPLE ~~+ TARE~~ *	85.90	86.14	85.72	85.58	89.56	87.98	N/A
WEIGHT OF MOISTURE	26.43	26.03	25.91	26.23	23.2	24.69	
TARE WEIGHT	NA	NA	NA	NA	NA	NA	
~~WEIGHT OF DRY SAMPLE~~ * % moisture	30.8	30.2	30.2	30.6	25.9	28.1	
% MOISTURE Rounded to 0.5%	31.0	30.0	30.0	30.5	26.0	28.0	

BORING NUMBER							
SAMPLE NUMBER							
WT. OF WET SAMPLE + TARE							
WT. OF DRY SAMPLE + TARE				N/A			
WEIGHT OF MOISTURE							
TARE WEIGHT							
WEIGHT OF DRY SAMPLE							
% MOISTURE							

MINIMUM SIZE SAMPLE ☑ CONFORMING ☐ NONCONFORMING REMARKS: NA

MORE THAN ONE SOIL TYPE: NO

METHOD OF DRYING: ☐ 230 +/- 9 DEGREES F ☑ OTHER: MWO

MATERIAL (SIZE/AMOUNT) EXCLUDED FROM TEST: NO

M&TE: S-73 (6-23-93)

PROCEDURE: C-QCP-021

NCR #: NA CR #: NA

REV: 0

TEST RESULTS: ☐ CONFORMING ☐ NONCONFORMING ☑ N/A

PCN'S: NA

SPECS: C-SPC-G-00041

REV: 2

REMARKS: INFO ONLY TEST, * 6-27-92 W.P.
6-27-92 W.P.
N/A

DCF'S: N/A

STANDARDS: N/A

M. Koval II 6.27.92

INSPECTOR: Wyman Pope Jr. LEVEL: II DATE: 6-27-92

REVIEWER: [signature] LEVEL: II DATE: 9-15-92

DES. CAT: GS

MJR 09-15-92

FOR INFORMATION ONLY

ASR 18-178 (3/92)
FILE ID # 80143

EBASCO SERVICES INCORPORATED

DETERMINATION OF WATER CONTENT

☐ ASTM D-2216 ( )   ☑ ASTM D-4643 (87)

REPT #: 4122   PROJ/AMO: 4794   WORK PACKAGE NO.: 92-WPN-EC-023
DA: C001   TWC: 9660   AXC: NA   QCIR NO.: 92IR15-E-4794-1101-C-CV-G-0006-0002
LAB #: S92-703   DATE TESTED: 6-27-92   ACCPT. CRITERIA: NA
MATERIAL DESCRIPTION: Kaolin Clay A-Lift
LOCATION: Burial Ground Soils Dynamic Compaction

~~BORING NUMBER~~ * MWO No's	1	2	4				
SAMPLE NUMBER	1	2	3				
WT. OF WET SAMPLE ~~+ TARE~~ *	113.62	113.20	113.50				
WT. OF DRY SAMPLE ~~+ TARE~~ *	86.76	88.56	86.0				
WEIGHT OF MOISTURE	26.86	24.64	27.50	N/A			
TARE WEIGHT	NA	NA	NA				
~~WEIGHT OF DRY SAMPLE~~ * % moisture	31.0	27.8	32.0				
% MOISTURE Rounded to 0.5%	31.0	28.0	32.0				

BORING NUMBER							
SAMPLE NUMBER							
WT. OF WET SAMPLE + TARE							
WT. OF DRY SAMPLE + TARE							
WEIGHT OF MOISTURE				N/A			
TARE WEIGHT							
WEIGHT OF DRY SAMPLE							
% MOISTURE							

MINIMUM SIZE SAMPLE ☑ CONFORMING ☐ NONCONFORMING REMARKS: N/A
MORE THAN ONE SOIL TYPE: NO
METHOD OF DRYING: ☐ 230 +/- 9 DEGREES F ☑ OTHER: MWO
MATERIAL (SIZE/AMOUNT) EXCLUDED FROM TEST: NO

M&TE: S-73 (6-23-93)   PROCEDURE: C-QCP-021
NCR #: NA   CR #: NA   REV: 0
TEST RESULTS: ☐ CONFORMING ☐ NONCONFORMING ☑ N/A   PCN'S: NA
SPECS: C-SPC-G-00041
REMARKS: INFO ONLY TEST, * 6-27-92 W.P.
6-27-92 W.P.
N/A
REV: 2
DCF'S: N/A
STANDARDS: N/A

M. Koval   II   6.27.92
INSPECTOR: [signature]   LEVEL: II   DATE: 6-27-92
REVIEWER: [signature]   LEVEL: II   DATE: 9-15-92   DES. CAT: GS

A.13

MJR 09-15-92

FOR INFORMATION ONLY

ASR 18-178 (3/92)
FILE ID # 80143

EBASCO SERVICES INCORPORATED

FILE

DETERMINATION OF WATER CONTENT

☐ ASTM D-2216 ( ) ☑ ASTM D-4643 (87)

REPT #: 4122 PROJ/AMO: 4794 WORK PACKAGE NO.: 92-WAW-FC-023
DA: C001 TWC: 9660 AXC: NA QCIR NO.: 92IR15-G-4794-1101-C-CV-G-0006-0002
LAB #: S92-707 DATE TESTED: 6-28-92 ACCPT. CRITERIA: NA
MATERIAL DESCRIPTION: Kaolin Clay A-Lift
LOCATION: Burial Ground Soils Dynamic Compaction

~~BORING NUMBER~~ * MWO No:s	1	2	4	N/A			
SAMPLE NUMBER	1	2	3				
WT. OF WET SAMPLE ~~+ TARE~~ *	113.65	113.43	113.85				
WT. OF DRY SAMPLE ~~+ TARE~~ *	89.30	88.96	87.99				
WEIGHT OF MOISTURE	24.35	24.47	25.86				
TARE WEIGHT	NA	NA	NA				
~~WEIGHT OF DRY SAMPLE~~ * % moisture	27.3	27.5	29.4				
% MOISTURE Rounded to 0.5%	27.5	27.5	29.5				

BORING NUMBER	N/A						
SAMPLE NUMBER							
WT. OF WET SAMPLE + TARE							
WT. OF DRY SAMPLE + TARE							
WEIGHT OF MOISTURE							
TARE WEIGHT							
WEIGHT OF DRY SAMPLE							
% MOISTURE							

MINIMUM SIZE SAMPLE ☑ CONFORMING ☐ NONCONFORMING REMARKS: NA

MORE THAN ONE SOIL TYPE: NO

METHOD OF DRYING: ☐ 230 +/- 9 DEGREES F ☑ OTHER: MWO

MATERIAL (SIZE/AMOUNT) EXCLUDED FROM TEST: NO

M&TE: S-73 (6-23-93)
PROCEDURE: C-QCP-021
NCR #: NA CR #: NA
REV: 0
TEST RESULTS: ☐ CONFORMING ☐ NONCONFORMING ☑ N/A
PCN'S: NA
SPECS: C-SPC-G-00041
REV: 2
REMARKS: INFO ONLY TEST, * 6-28-92 W.P.
6-28-92 W.P.
N/A
DCF'S: N/A
STANDARDS: N/A

M. Kowal II 6-28-92
INSPECTOR: Wyman Pope Jr. LEVEL: II DATE: 6-28-92
REVIEWER: [signature] LEVEL: II DATE: 9-15-92
DES. CAT: GS

MJR 09-15-92

FOR INFORMATION ONLY

ASR 18-179 (3/92)
FILE ID # 80144

EBASCO SERVICES INCORPORATED
SAND METHOD DENSITY TEST & PERCENT COMPACTION
ASTM D-1556-(90)

DEPT #: 4123 PROJ/AMO: 4794
DA: C001 TWC: 9660 AXC: NA
WORK PACKAGE NO.: 92-WPW-EC-023
QCIR NO.: 92IR15-E-4794-1101-C-CV-G-0006-0002
CONTRACTOR: Bechtel
MATERIAL DESCRIPTION: Kaolin Clay B Lift DATE TESTED: 6.29.92
ACCEPTANCE CRITERIA: 95% compaction, 90-94 PCF Dry Density LOCATION: Burial Ground Soil Dynamic Compaction

TEST NO. 66 adjacent to troxler 66 MK 6.29.92

DISTANCE S/W CORNER	30'N, 16'E					
ELEVATION 293.7	~~294.0~~	W.P. 6-29-92				
A. INITIAL WEIGHT OF SAND	6586.5					
B. FINAL WEIGHT OF SAND	2991.5					
C. DIFFERENCE (A-B)	3595.0					
D. WT. OF SAND IN FUNNEL & PLATE	1653.0					
E. WT. OF SAND IN HOLE (C-D)/LBS	1942.0 / 4.281					
F. WT. OF SAND CU./FT.	93.5					
G. VOL. OF HOLE CU./FT. (E/F)	.0458		N			
H. WT. OF WET SOIL REMOVED / LBS	2430.5 / 5.358					
I. WET DENSITY (H/G)	117.0					
J. WEIGHT OF WET SOIL	113.32					
K. WEIGHT OF DRY SOIL	88.93			A		
L. WEIGHT OF MOISTURE (J-K)	24.39					
M. MOISTURE %. (L/K)	27.4/27.5					
N. DRY DENSITY LBS/CU.FT. (IX100) (M+100)	91.8					
MAX. DENSITY (PROCTOR)	94.2					
OPTIMUM MOISTURE	26.4/26.5					
% COMPACTION REQUIRED	95.0					
% COMPACTION	97.5					

DENSITY PROCTOR REPORT #: WER-ERC-92-0544. DESIGN CATEGORY: GS
MOISTURE DETERMINATION: ☐ ASTM D-2216 ( ) ☑ ASTM D-4643 (87)

M&TE: F-10 (7.1.92 or 200 lbs. sand), S-79 (5.6.93)
NCR #: NA CR #: NA
TEST RESULTS: ☑ CONFORMING ☐ NONCONFORMING ☐ N/A
REMARKS: N/A

PROCEDURE: C-QCP-021
REV: 0
PCN'S: NA
SPECS: C-SPC-G-00041
REV: 2
DCF'S: N/A
STANDARDS: N/A

Wyman Pope p. # 6-29-92
INSPECTOR: M. Koval LEVEL: II DATE: 6.29.92
REVIEWER: [signature] LEVEL: II DATE: 9-15-92

MTR 09-15-92

FOR INFORMATION ONLY

ASR 18-180 (3/92)
FILE ID # 80145

EBASCO SERVICES INCORPORATED

MOISTURE & DENSITY TESTS USING SURFACE PROBES
ASTM D-2922 (81 R/90)

REPT #: 4123 PROJ/AMO: 4794 WORK PACKAGE NO.: 92-WPW-EC-023
DA: C001 TWC: 9660 AXC: NA QCIR NO.: 92IR15-E-4794-1101-C-CV-G-0006-0002
CONTRACTOR: Bechtel
MATERIAL DESCRIPTION: Kaolin Clay
ACCEPTANCE CRITERIA: 95% compaction, 90-94 PCF Dry Density
DRAWING(S) & REV(S): C-CV-G-0006 R/1
LOCATION: Burial Ground Soils Dynamic Compaction - B Lift

TEST NO.	66	67				
SW corner of clay cap DISTANCE Approx.	30' N 16' E	55' N 34' E				
ELEVATION Approx.	294.0	294.0				
WET DENSITY (LBS/CU. FT.) ▲	118.0 / 117.0	116.6 / 115.6				
WATER (LBS./CU. FT.)	NA	NA		N		
DRY DENSITY (LBS/CU. FT.)	91.8 / 92.0	90.3 / 90.0				
% MOISTURE rounded to 0.5%	27.4 / 27.5	27.8 / 28.0				
MAXIMUM DENSITY (PROCTOR)	94.2	94.2			A	
OPTIMUM MOISTURE rounded to 0.5%	26.4 / 26.5	26.4 / 26.5				
COMPACTION REQUIRED	95.0	95.0				
% COMPACTION rounded to 0.5%	97.7 / 97.5	95.5 / 95.5				

TROXLER #: 7 MODEL: 3440 SERIAL #: 17494
DENSITY PROCTOR REPT #: WER-ERC-92-0544 DESIGN CAT: GS
DENSITY: AVERAGE OF LAST 4 STANDARD COUNTS (No): 3832
DAILY STANDARD COUNTS (Ns): 3853
MOISTURE: AVERAGE OF LAST 4 STANDARD COUNTS (No): 604
DAILY STANDARD COUNTS (Ns): 602
MOISTURE DETERMINATION: ☐ ASTM D-2216 ( ) ☐ ASTM D-3017 ( ) ☑ ASTM D-4643 (87)

M&TE: refer to lab # 592-713 | PROCEDURE: C-QCP-021
NCR #: NA CR #: NA | REV: 0
TEST RESULTS: ☑ CONFORMING ☐ NONCONFORMING ☐ N/A | PCN'S: NA
SPECS: ▲▲ C-SPC-G-00041
REV: 2
REMARKS: ▲ nuclear density adjusted by a factor of 1, ▲▲ per page C2, par. 8 MK 6-29-92
DCF'S: N/A
STANDARDS: N/A

INSPECTOR: M. Koval LEVEL: II DATE: 6-29-92
REVIEWER: [signature] LEVEL: II DATE: 9-15-92

MJR 09-15-92

FOR INFORMATION ONLY

ASR 18-178 (3/92)
FILE ID # 80143

EBASCO SERVICES INCORPORATED

DETERMINATION OF WATER CONTENT

☐ ASTM D-2216 ( ) ☑ ASTM D-4643 (87)

FILE

REPT #: 4123 PROJ/AMO: 4794
DA: C001 TWC: 9660 AXC: NA
LAB #: S92-709 DATE TESTED: 6.29.92

WORK PACKAGE NO.: 92-WPW-EC-023
QCIR NO.: 92IRIS-E-4794-1101-C-CV-G-0006-0002
ACCPT. CRITERIA: NA

MATERIAL DESCRIPTION: Kaolin Clay B Lift
LOCATION: Burial Ground Soils Dynamic Compaction

▲MK 6.29.92

~~BORING~~ microwave NUMBER	1	2	4	5	6	7	8
SAMPLE NUMBER	1	2	3	4	5	6	7
WT. OF WET SAMPLE ~~+ TARE~~▲	112.80	112.21	114.41	112.49	112.86	113.38	113.25
WT. OF DRY SAMPLE ~~+ TARE~~▲	90.85	89.28	92.50	90.93	91.73	92.18	91.43
WEIGHT OF MOISTURE	21.95	22.93	21.91	21.56	21.13	21.20	21.82
TARE WEIGHT	NA	NA	NA	NA	NA	NA	NA
~~WEIGHT OF DRY SAMPLE~~▲ % moisture	24.2	25.7	23.7	23.7	23.0	23.0	23.9
% MOISTURE rounded to 0.5%	24.0	25.5	23.5	23.5	23.0	23.0	24.0

~~BORING~~ microwave NUMBER	9	10	11				
SAMPLE NUMBER	8	9	10				
WT. OF WET SAMPLE ~~+ TARE~~▲	111.38	112.50	113.92				
WT. OF DRY SAMPLE ~~+ TARE~~▲	91.12	91.44	92.07				
WEIGHT OF MOISTURE	20.26	21.06	21.85			N	A
TARE WEIGHT	NA	NA	NA				
~~WEIGHT OF DRY SAMPLE~~▲ % moisture	22.2	23.0	23.7				
% MOISTURE rounded to 0.5%	22.0	23.0	23.5				

MINIMUM SIZE SAMPLE ☑ CONFORMING ☐ NONCONFORMING REMARKS: NA

MORE THAN ONE SOIL TYPE: No

METHOD OF DRYING: ☐ 230 +/- 9 DEGREES F ☑ OTHER: MWO

MATERIAL (SIZE/AMOUNT) EXCLUDED FROM TEST: No

M&TE: S-73 (6.23.93)	PROCEDURE: C-QCP-021
NCR #: NA CR #: NA	REV: 0
TEST RESULTS: ☐ CONFORMING ☐ NONCONFORMING ☑ N/A	PCN'S: NA
REMARKS: tests taken for info only. Avg. 23.5% MK 6.29.92	SPECS: C-SPC-G-00041
	REV: 2
	DCF'S: N/A
M. Kowal II 6.29.92	STANDARDS: N/A
INSPECTOR: [signature] LEVEL: II DATE: 6-29-92	
REVIEWER: [signature] LEVEL: II DATE: 9-15-92	DES. CAT: GS

MJR 09-15-92

FOR INFORMATION ONLY

ASR 18-178 (3/92)
FILE ID # 80143

EBASCO SERVICES INCORPORATED

DETERMINATION OF WATER CONTENT

☐ ASTM D-2216 ( ) ☑ ASTM D-4643 (87)

REPT #: 4123 PROJ/AMO: 4794 WORK PACKAGE NO.: 92-WPW-EC-023

DA: C001 TWC: 9660 AXC: NA QCIR NO.: 92IR15-E-4794-1101-C-CV-G-0006-0002

LAB #: S92-710 DATE TESTED: 6-29-92 ACCPT. CRITERIA: NA

MATERIAL DESCRIPTION: Kaolin Clay B-Lift

LOCATION: Burial Ground soils Dynamic Compaction

~~BORING NUMBER~~ * MWO No.'s	1	2	4	1	2	4	5
SAMPLE NUMBER	1	2	3	4	5	6	7
WT. OF WET SAMPLE ~~+ TARE~~ *	113.48	113.10	113.85	113.46	113.15	113.02	113.55
WT. OF DRY SAMPLE ~~+ TARE~~ *	89.24	87.03	89.60	88.20	89.60	87.34	90.61
WEIGHT OF MOISTURE	24.24	26.07	24.25	25.26	23.55	25.68	22.94
TARE WEIGHT	NA	NA	NA	NA	NA	NA	NA
~~WEIGHT OF DRY SAMPLE~~ * % moisture	27.2	30.0	27.1	28.6	26.3	29.4	25.3
% MOISTURE Rounded to 0.5%	27.0	30.0	27.0	28.5	26.5	29.5	25.5

~~BORING NUMBER~~ * MWO No.'s	6	1	2	4			
SAMPLE NUMBER	8	9	10	11			
WT. OF WET SAMPLE ~~+ TARE~~ *	113.47	113.01	113.37	113.35			
WT. OF DRY SAMPLE ~~+ TARE~~ *	87.10	89.68	87.80	89.06		N	A
WEIGHT OF MOISTURE	26.37	23.33	25.57	24.29			
TARE WEIGHT	NA	NA	NA	NA			
~~WEIGHT OF DRY SAMPLE~~ * % moisture	30.3	26.0	29.1	27.3			
% MOISTURE Rounded to 0.5%	30.5	26.0	29.0	27.5			

MINIMUM SIZE SAMPLE ☑ CONFORMING ☐ NONCONFORMING REMARKS: NA

MORE THAN ONE SOIL TYPE: NO

METHOD OF DRYING: ☐ 230 +/- 9 DEGREES F ☑ OTHER: MWO

MATERIAL (SIZE/AMOUNT) EXCLUDED FROM TEST: NO

M&TE: 5-73 (6-23-93) ~~W~~ 6-29-92 W.P. | PROCEDURE: C-QCP-021

NCR #: NA CR #: NA | REV: 0

TEST RESULTS: ☐ CONFORMING ☐ NONCONFORMING ☑ N/A | PCN'S: NA

SPECS: C-SPC-G-00041

REMARKS: INFO ONLY TEST, * 6-29-92 W.P. | REV: 2

AVG. 28 % 6-29-92 W.P.

N/A | DCF'S: N/A

STANDARDS: N/A

M. Koval II 6.29.92

INSPECTOR: [signature] LEVEL: II DATE: 6-29-92

REVIEWER: [signature] LEVEL: II DATE: 9-15-92 | DES. CAT: GS

MJR 09-15-92

FOR INFORMATION ONLY

ASR 18-178 (3/92)
FILE ID # 80143

EBASCO SERVICES INCORPORATED

DETERMINATION OF WATER CONTENT

☐ ASTM D-2216 ( ) ☑ ASTM D-4643 (87)

REPT #: 4123 PROJ/AMO: 4794
DA: C001 TWC: 9660 AXC: NA
LAB #: S92-711 DATE TESTED: 6-29-92

WORK PACKAGE NO.: 92-WPW-EC-023
QCIR NO.: 92IR15-E-4794-1101-C-CV-G-0006-0002
ACCPT. CRITERIA: NA

MATERIAL DESCRIPTION: KAOLIN CLAY B-LIFT
LOCATION: BURIAL GROUND SOILS DYNAMIC COMPACTION

~~BORING NUMBER~~ * MWO NO.S	1	2	4	5	6	7	8
SAMPLE NUMBER	1	2	3	4	5	6	7
WT. OF WET SAMPLE ~~+ TARE~~ *	113.15	112.52	113.16	113.13	114.23	114.97	113.74
WT. OF DRY SAMPLE ~~+ TARE~~ *	87.26	84.62	87.64	88.44	88.14	88.55	88.12
WEIGHT OF MOISTURE	25.89	27.9	25.52	24.68	26.09	26.42	25.62
TARE WEIGHT	NA	NA	NA	NA	NA	NA	NA
~~WEIGHT OF DRY SAMPLE~~ * % moisture	29.7	32.9	29.1	27.9	29.6	29.8	29.1
% MOISTURE Rounded to 0.5%	29.5	33.0	29.0	28.0	29.5	30.0	29.0

~~BORING NUMBER~~ * MWO NO.S	9	10	11				
SAMPLE NUMBER	8	9	10				
WT. OF WET SAMPLE ~~+ TARE~~ *	112.06	113.16	112.94				
WT. OF DRY SAMPLE ~~+ TARE~~ *	88.24	89.76	88.06				
WEIGHT OF MOISTURE	23.82	23.4	24.88			N	A
TARE WEIGHT	NA	NA	NA				
~~WEIGHT OF DRY SAMPLE~~ * % moisture	26.9	26.1	28.3				
% MOISTURE Rounded to 0.5%	27.0	26.0	28.5				

MINIMUM SIZE SAMPLE ☑ CONFORMING ☐ NONCONFORMING REMARKS: NA

MORE THAN ONE SOIL TYPE: NO

METHOD OF DRYING: ☐ 230 +/- 9 DEGREES F ☑ OTHER: MWO

MATERIAL (SIZE/AMOUNT) EXCLUDED FROM TEST: NO

M&TE: S-73 (6-23-93)	PROCEDURE: C-QCP-021
NCR #: NA CR #: NA	REV: 0
TEST RESULTS: ☐ CONFORMING ☐ NONCONFORMING ☑ N/A	PCN'S: NA
REMARKS: INFO ONLY TEST, * 6-29-92 W.P. 6-29-92 W.P. N/A	SPECS: C-SPC-G-00041
	REV: 2
	DCF'S: N/A
	STANDARDS: N/A
INSPECTOR: M. Koval, Wyman Pope Jr. LEVEL: II DATE: 6-29-92	
REVIEWER: [signature] LEVEL: II DATE: 9-15-92	DES. CAT: GS

MJR 09-15-92

FOR INFORMATION ONLY

ASR 18-178 (3/92)
FILE ID # 80143

EBASCO SERVICES INCORPORATED

DETERMINATION OF WATER CONTENT

☐ ASTM D-2216 ( ) ☑ ASTM D-4643 (87)

REPT #: 4123 PROJ/AMO: 4794
DA: C001 TWC: 9660 AXC: NA
LAB #: S92-712 DATE TESTED: 6-30-92

WORK PACKAGE NO.: 92-WPW-EC-023
QCIR NO.: 92IR15-E-4794-1101-C-CV-G-0006-0002
ACCPT. CRITERIA: NA

MATERIAL DESCRIPTION: Kaolin Clay B-Lift
LOCATION: Burial Ground Soils Dynamic Compaction

~~BORING NUMBER~~ * MWO NO.s	10	11					
SAMPLE NUMBER	1R2	1R2					
WT. OF WET SAMPLE ~~+ TARE~~ *	113.32	113.67					
WT. OF DRY SAMPLE ~~+ TARE~~ *	87.31	87.73					
WEIGHT OF MOISTURE	26.01	25.94			N	A	
TARE WEIGHT	NA	NA					
~~WEIGHT OF DRY SAMPLE~~ * % moisture	29.8	29.6					
% MOISTURE Rounded to 0.5%	30.0	29.5					

AVG. 30

BORING NUMBER							
SAMPLE NUMBER							
WT. OF WET SAMPLE + TARE							
WT. OF DRY SAMPLE + TARE				N	A		
WEIGHT OF MOISTURE							
TARE WEIGHT							
WEIGHT OF DRY SAMPLE							
% MOISTURE							

MINIMUM SIZE SAMPLE ☑ CONFORMING ☐ NONCONFORMING REMARKS: NA

MORE THAN ONE SOIL TYPE: NO

METHOD OF DRYING: ☐ 230 +/- 9 DEGREES F ☑ OTHER: MWO

MATERIAL (SIZE/AMOUNT) EXCLUDED FROM TEST: NO

M&TE: S-73 (6-23-~~92~~ 93) 6-30-92 W.P.
NCR #: NA CR #: NA
TEST RESULTS: ☐ CONFORMING ☐ NONCONFORMING ☑ N/A

REMARKS: INFO ONLY TEST, * 6-30-92 W.P.
6-30-92 W.P.
N/A

PROCEDURE: C-QCP-021
REV: 0
PCN'S: NA
SPECS: C-SPC-G-00041
REV: 2
DCF'S: N/A
STANDARDS: N/A

M. Koval II 6.30.92
INSPECTOR: Wyman Pope Jr. LEVEL: II DATE: 6-30-92
REVIEWER: [signature] LEVEL: III DATE: 9-15-92
DES. CAT: GS

MJR 09-15-92

FOR INFORMATION ONLY

ASR 18-178 (3/92)
FILE ID # 80143

EBASCO SERVICES INCORPORATED

DETERMINATION OF WATER CONTENT

☐ ASTM D-2216 ( ) ☑ ASTM D-4643 (87)

REPT #: 4123 PROJ/AMO: 4794 WORK PACKAGE NO.: 92-WPW-EC-023

DA: C001 TWC: 9660 AXC: NA QCIR NO.: 92IR15-E-4794-1101-C-CV-G-0006-0002

LAB #: S92-712 DATE TESTED: **6-30-92 6-29-92 ACCPT. CRITERIA: AVG. 28-30 MOISTURE CONTENT

MATERIAL DESCRIPTION: KAOLIN CLAY B-LIFT

LOCATION: BURIAL GROUND SOILS DYNAMIC COMPACTION

~~BORING NUMBER~~ * MWO NO.'s	1	2	4	5	6	9	1
SAMPLE NUMBER	1	2	3	4	5	SAND ~~NUC~~ CONE F-10	6
WT. OF WET SAMPLE ~~+ TARE~~ *	113.53	113.62	113.49	113.10	113.52	113.32	113.21
WT. OF DRY SAMPLE ~~+ TARE~~ *	91.20	87.70	88.45	88.78	85.94	88.93	85.44
WEIGHT OF MOISTURE	22.33	25.92	25.04	24.32	27.58	24.39	27.77
TARE WEIGHT	NA	NA	NA	NA	NA	NA	NA
~~WEIGHT OF DRY SAMPLE~~ * % moisture	24.5	29.6	28.3	27.4	32.1	27.4	32.5
% MOISTURE Rounded to 0.5%	24.5	29.5	28.5	27.5	32.0	27.5	32.5

~~BORING NUMBER~~ * MWO NO.'s	2	4	5	1	2	7	8
SAMPLE NUMBER	7	8	NUC	9	10	1 R1	1 R1
WT. OF WET SAMPLE ~~+ TARE~~ *	113.41	113.37	113.84	113.92	113.22	113.18	113.42
WT. OF DRY SAMPLE ~~+ TARE~~ *	89.18	86.37	89.10	86.90	87.76	90.43	90.55
WEIGHT OF MOISTURE	24.23	27.0	24.74	27.02	25.46	22.75	22.87
TARE WEIGHT	NA	NA	NA	NA	NA	NA	NA
~~WEIGHT OF DRY SAMPLE~~ * % moisture	27.2	31.3	27.8	31.1	29.0	25.2	25.3
% MOISTURE Rounded to 0.5%	27.0	31.5	28.0	31.0	29.0	25.0	25.5

MINIMUM SIZE SAMPLE ☑ CONFORMING ☐ NONCONFORMING REMARKS: NA

MORE THAN ONE SOIL TYPE: NO

METHOD OF DRYING: ☐ 230 +/- 9 DEGREES F ☑ OTHER: MWO

MATERIAL (SIZE/AMOUNT) EXCLUDED FROM TEST: NO

M&TE: S-73 (6-23-93)

PROCEDURE: C-QCP-021

NCR #: NA CR #: NA

REV: 0

TEST RESULTS: ☐ CONFORMING ☑▲ NONCONFORMING ☐ N/A

PCN'S: NA

SPECS: C-SPC-G-00041

REV: 2

DCF'S: N/A ▲ MK 9.14.92

REMARKS: OFFICIAL TEST, * 6-30-92 WP
** TEST NO.'s 9 & 10 TAKEN ON 6-30-92
AVG. MOISTURE 29.4%/29.5% 6-29-92 W.P.
test method accepted per DCF# Y-24907-R MK 9.14.92 6.30.92
M. Kowal II 6.29.92

STANDARDS: N/A

INSPECTOR: Wyman Pope Jr. LEVEL: II DATE: 6-30-92 6-29-92

REVIEWER: [signature] LEVEL: II DATE: 9-15-92

DES. CAT: GS

tests 1 R/2 clears tests 1 and 1 R/1. MK 9.14.92 MJR 09-15-92

FOR INFORMATION ONLY

ASR 18-178 (3/92)
FILE ID # 80143

EBASCO SERVICES INCORPORATED

DETERMINATION OF WATER CONTENT

☐ ASTM D-2216 ( ) ☑ ASTM D-4643 (87)

REPT #: 4123 PROJ/AMO: 4794 WORK PACKAGE NO.: 92-WPW-EC-023
DA: C001 TWC: 91660 AXC: NA QCIR NO.: 92IRIS-E-4794-1101-C-CV-G-00016-0002
LAB #: S92-713 DATE TESTED: 6-30-92 ACCPT. CRITERIA: AVG. 28-30% MOISTURE CONTENT
MATERIAL DESCRIPTION: KAOLIN CLAY B-LIFT
LOCATION: BURIAL GROUND SOILS DYNAMIC COMPACTION

~~BORING NUMBER~~ * MWO NO.'s	1	2					
SAMPLE NUMBER	1 R23	1 R23	6-30-92 W.P.				
WT. OF WET SAMPLE ~~+ TARE~~ *	113.69	113.74					
WT. OF DRY SAMPLE ~~+ TARE~~ *	88.32	88.02					
WEIGHT OF MOISTURE	25.37	25.72		N	A		
TARE WEIGHT	NA	NA					
~~WEIGHT OF DRY SAMPLE~~ * % MOISTURE	28.7	29.2					
% MOISTURE Rounded TO 0.5%	28.5	29.0					

AVG. 29.0

BORING NUMBER							
SAMPLE NUMBER							
WT. OF WET SAMPLE + TARE							
WT. OF DRY SAMPLE + TARE				N	A		
WEIGHT OF MOISTURE							
TARE WEIGHT							
WEIGHT OF DRY SAMPLE							
% MOISTURE							

MINIMUM SIZE SAMPLE ☑ CONFORMING ☐ NONCONFORMING REMARKS: NA
MORE THAN ONE SOIL TYPE: NO
METHOD OF DRYING: ☐ 230 +/- 9 DEGREES F ☑ OTHER: MWO
MATERIAL (SIZE/AMOUNT) EXCLUDED FROM TEST: NO

M&TE: S-73 (6-23-93) PROCEDURE: C-QCP-021
NCR #: NA CR #: NA REV: 0
TEST RESULTS: ☑ CONFORMING ☐ NONCONFORMING ☐ N/A PCN'S: NA
SPECS: C-SPC-G-00041
REMARKS: OFFICIAL TEST, * 6-30-92 W.P. REV: 2
AVG. 29.4%/29.5% 6-30-92 W.P. DCF'S: N/A Y-24907-R MK 9.14.92
N/A test method accepted per DCF # Y-24907-R MK 9.14.92
STANDARDS: N/A
M. Koval II 6.30.92
INSPECTOR: Wyman Poe Jr. LEVEL: II DATE: 6-30-92
REVIEWER: [signature] LEVEL: II DATE: 9-15-92 DES. CAT: GS

the above tests clear tests 1 and 1R/1 MK 9.14.92 MJR 09-15-92

FOR INFORMATION ONLY

ASR 18-180 (3/92)
FILE ID # 80145

EBASCO SERVICES INCORPORATED

MOISTURE & DENSITY TESTS USING SURFACE PROBES

ASTM D-2922 (81 R/90)

REPT #: 4125 PROJ/AMO: 4794

DA: C001 TWC: 9660 AXC: NA

WORK PACKAGE NO.: 92-WPW-EC-023

QCIR NO.: 92IR15-E-4794-1101-C-CV-G-0006-0002

CONTRACTOR: Bechtel

MATERIAL DESCRIPTION: Kaolin Clay

ACCEPTANCE CRITERIA: 95% compaction; 90-94 PCF Dry Density

DRAWING(S) & REV(S): C-CV-G-0006 R/1

LOCATION: Burial Ground Soils Dynamic Compaction - C Lift

TEST NO.	68	69				
NW corner of clay cap DISTANCE Approx.	40' S 10' E	85' S 31' E				
ELEVATION Approx.	294.2	294.2				
WET DENSITY (LBS/CU. FT.) ▲	118.8 / 117.8	117.5 / 116.5				
WATER (LBS./CU. FT.)	NA	NA		N		
DRY DENSITY (LBS/CU. FT.)	92.4 / 92.0	91.0 / 91.0				
% MOISTURE rounded to 0.5%	27.4 / 27.5	27.8 / 28.0				
MAXIMUM DENSITY (PROCTOR)	94.2	94.2			A	
OPTIMUM MOISTURE rounded to 0.5%	26.4 / 26.5	26.4 / 26.5				
COMPACTION REQUIRED	95.0	95.0				
% COMPACTION rounded to 0.5%	97.7 / 97.5	96.6 / 96.5				

TROXLER #: 7 MODEL: 3440 SERIAL #: 17494

DENSITY PROCTOR REPT #: WER-ERC-92-0544 DESIGN CAT: GS

DENSITY: AVERAGE OF LAST 4 STANDARD COUNTS (No): 3838

DAILY STANDARD COUNTS (Ns): 3790

MOISTURE: AVERAGE OF LAST 4 STANDARD COUNTS (No): 603

DAILY STANDARD COUNTS (Ns): 605

MOISTURE DETERMINATION: ☐ ASTM D-2216 ( ) ☐ ASTM D-3017 ( ) ☑ ASTM D-4643 (87)

M&TE: refer to lab # 592-715

PROCEDURE: C-QCP-021

NCR #: NA CR #: NA

REV: 0

TEST RESULTS: ☑ CONFORMING ☐ NONCONFORMING ☐ N/A

PCN'S: NA

SPECS: ▲▲ C-SPC-G-00041

REV: 2

REMARKS: official test
▲ nuclear density adjusted by a factor of 1, ▲▲ per page C2, par. 8 MK 7.1.92

DCF'S: N/A

M. Kowal II 7.1.92

INSPECTOR: Wyman Pope Jr. LEVEL: II DATE: 7-1-92

REVIEWER: [signature] LEVEL: II DATE: 9-15-92

STANDARDS: N/A

MJR 09-15-92

FOR INFORMATION ONLY

ASR 18-178 (3/92)
FILE ID # 80143

EBASCO SERVICES INCORPORATED

DETERMINATION OF WATER CONTENT

☐ ASTM D-2216 ( ) ☑ ASTM D-4643 (87)

REPT #: 4125 PROJ/AMO: 4794 WORK PACKAGE NO.: 92-WPW-EC-023
DA: C001 TWC: 9660 AXC: NA QCIR NO.: 92IR15-E-4794-1101-C-CV-G-0006-0002
LAB #: 592-715 DATE TESTED: 7-1-92 ACCPT. CRITERIA: AVG. 28-30
MATERIAL DESCRIPTION: KAOLIN CLAY C-LIFT
LOCATION: BURIAL GROUND SOILS DYNAMIC COMPACTION

~~BORING NUMBER~~ * MWO NO.S	1	2	4	5	6	7	8
SAMPLE NUMBER	1	2	3	4	5	6	7
WT. OF WET SAMPLE ~~+ TARE~~ *	113.01	113.61	113.19	113.27	113.29	113.60	113.42
WT. OF DRY SAMPLE ~~+ TARE~~ *	87.33	85.28	88.13	87.18	87.74	88.68	89.85
WEIGHT OF MOISTURE	25.68	28.33	25.06	26.09	25.55	24.92	23.57
TARE WEIGHT	NA	NA	NA	NA	NA	NA	NA
~~WEIGHT OF DRY SAMPLE~~ * % moisture	29.4	33.2	28.4	29.9	29.1	28.1	26.2
% MOISTURE rounded to 0.5%	29.5	33.0	28.5	30.0	29.0	28.0	26.0

~~BORING NUMBER~~ * MWO NO.S	9	10	11	1	2	1	2
SAMPLE NUMBER	8	9	10	NUC #1	NUC #2	2 R1	2 R1
WT. OF WET SAMPLE ~~+ TARE~~ *	113.42	113.89	113.29	113.16	113.24	113.34	113.24
WT. OF DRY SAMPLE ~~+ TARE~~ *	88.00	86.69	87.75	88.82	88.60	87.52	87.60
WEIGHT OF MOISTURE	25.42	27.2	25.54	24.34	24.64	25.82	25.64
TARE WEIGHT	NA	NA	NA	NA	NA	NA	NA
~~WEIGHT OF DRY SAMPLE~~ * % moisture	28.9	31.4	29.1	27.4	27.8	29.5	29.3
% MOISTURE rounded to 0.5%	29.0	31.5	29.0	27.5	28.0	29.5	29.5

MINIMUM SIZE SAMPLE ☑ CONFORMING ☐ NONCONFORMING REMARKS: NA AVG. 29.5 7-1-92 W.P.
MORE THAN ONE SOIL TYPE: NO
METHOD OF DRYING: ☐ 230 +/- 9 DEGREES F ☑ OTHER: MWO
MATERIAL (SIZE/AMOUNT) EXCLUDED FROM TEST: NO

M&TE: 5-73 (6-23-93)
PROCEDURE: C-QCP-021
NCR #: NA CR #: NA
REV: 0
TEST RESULTS: ☑ CONFORMING ☐ NONCONFORMING ☐ N/A
PCN'S: NA
SPECS: C-SPC-G-00041
REMARKS: OFFICIAL TEST, * 7-1-92 W.P.
AVG. MOISTURE With NUC. 29% 7-1-92 W.P.
N/A
REV: 2
DCF'S: N/A
STANDARDS: N/A
M. Kowal II 7.1.92
INSPECTOR: Wyman Pope Jr. LEVEL: II DATE: 7-1-92
REVIEWER: [signature] LEVEL: II DATE: 9-15-92
DES. CAT: GS

MJR 09-15-92

FOR INFORMATION ONLY

ASR 18-178 (3/92)
FILE ID # 80143

EBASCO SERVICES INCORPORATED

DETERMINATION OF WATER CONTENT

☐ ASTM D-2216 ( ) ☑ ASTM D-4643 (87)

REPT #: 4125 PROJ/AMO: 4794 WORK PACKAGE NO.: 92-WPW-EC-023

DA: C001 TWC: 9660 AXC: NA QCIR NO.: 92IR15-E-4794-1101-C-CV-G-0006-0002

LAB #: S92-715 DATE TESTED: 7-1-92 ACCPT. CRITERIA: AVG. 28-30

MATERIAL DESCRIPTION: KAOLIN CLAY C-LIFT

LOCATION: BURIAL GROUND SOILS DYNAMIC COMPACTION

~~BORING NUMBER~~ * MWO NO.'S	4	5	N/A				
SAMPLE NUMBER	7R1	7R1					
WT. OF WET SAMPLE ~~+ TARE~~ *	113.45	113.32					
WT. OF DRY SAMPLE ~~+ TARE~~ *	88.75	88.18					
WEIGHT OF MOISTURE	24.7	25.14					
TARE WEIGHT	NA	NA					
~~WEIGHT OF DRY SAMPLE~~ * % MOISTURE	27.8	28.5					
% MOISTURE ROUNDED TO 0.5% 7-1-92 W.P.	28.0	28.5 AVG. 28.5					

BORING NUMBER	N/A						
SAMPLE NUMBER							
WT. OF WET SAMPLE + TARE							
WT. OF DRY SAMPLE + TARE							
WEIGHT OF MOISTURE							
TARE WEIGHT							
WEIGHT OF DRY SAMPLE							
% MOISTURE							

MINIMUM SIZE SAMPLE ☑ CONFORMING ☐ NONCONFORMING REMARKS: NA

MORE THAN ONE SOIL TYPE: NO

METHOD OF DRYING: ☐ 230 +/- 9 DEGREES F ☑ OTHER: MWO

MATERIAL (SIZE/AMOUNT) EXCLUDED FROM TEST: NO

M&TE: S-73 (6-23-93)

NCR #: NA CR #: NA

TEST RESULTS: ☑ CONFORMING ☐ NONCONFORMING ☐ N/A

REMARKS: OFFICIAL TEST, * 7-1-92 W.P.
AVG. MOISTURE WITH NUCLEAR TEST 29.0% W.P. 7-1-92
N/A

M. Kowal II 7-1-92

INSPECTOR: Wyman Pope Jr. LEVEL: II DATE: 7-1-92

REVIEWER: [signature] LEVEL: III DATE: 9-15-92

PROCEDURE: C-QCP-021

REV: 0

PCN'S: NA

SPECS: C-SPC-G-00041

REV: 2

DCF'S: N/A

STANDARDS: N/A

DES. CAT: GS

MJR 09-15-92

FOR INFORMATION ONLY

ASR 18-178 (3/92)
FILE ID # 80143

EBASCO SERVICES INCORPORATED

FILE

DETERMINATION OF WATER CONTENT

☐ ASTM D-2216 ( )   ☑ ASTM D-4643 (87)

REPT #: 4125   PROJ/AMO: 4794   WORK PACKAGE NO.: 92-WPW-EC-023

DA: C001   TWC: 91660   AXC: NA   QCIR NO.: 92IR15-E-4794-1101-C-CV-G-0006-0002

LAB #: 592-714   DATE TESTED: 7-1-92   ACCPT. CRITERIA: NA

MATERIAL DESCRIPTION: Kaolin Clay C-LIFT

LOCATION: BURIAL GROUND SOILS DYNAMIC COMPACTION

~~BORING NUMBER~~ * MWO NO.s	1	2	4	5	6	~~*4~~ 1	2
SAMPLE NUMBER	1	2	3	4	5	6	7
WT. OF WET SAMPLE ~~+ TARE~~ *	113.37	113.47	113.60	113.34	113.19	113.59	113.44
WT. OF DRY SAMPLE ~~+ TARE~~ *	88.72	91.00	90.34	90.05	91.38	88.17	88.34
WEIGHT OF MOISTURE	24.65	22.47	23.26	23.29	21.81	25.42	25.1
TARE WEIGHT	NA	NA	NA	NA	NA	NA	NA
~~WEIGHT OF DRY SAMPLE~~ * % moisture	27.8	24.7	25.7	25.9	23.9	28.8	28.4
% MOISTURE Rounded to 0.5%	28.0	24.5	25.5	26.0	24.0	29.0	28.5

~~BORING NUMBER~~ * MWO NO.s	4	5	6				
SAMPLE NUMBER	8	9	10				
WT. OF WET SAMPLE ~~+ TARE~~ *	113.41	113.15	113.57				
WT. OF DRY SAMPLE ~~+ TARE~~ *	88.42	87.36	90.45		N	A	
WEIGHT OF MOISTURE	24.99	25.79	23.12				
TARE WEIGHT	NA	NA	NA				
~~WEIGHT OF DRY SAMPLE~~ * % moisture	28.3	29.5	25.6				
% MOISTURE Rounded to 0.5%	28.5	29.5	25.5				

MINIMUM SIZE SAMPLE ☑ CONFORMING ☐ NONCONFORMING REMARKS: NA

MORE THAN ONE SOIL TYPE: NO

METHOD OF DRYING: ☐ 230 +/- 9 DEGREES F ☑ OTHER: MWO

MATERIAL (SIZE/AMOUNT) EXCLUDED FROM TEST: NO

M&TE: S-73 (6-23-93)	PROCEDURE: C-QCP-021
NCR #: NA CR #: NA	REV: 0
TEST RESULTS: ☐ CONFORMING ☐ NONCONFORMING ☑ N/A	PCN'S: NA
REMARKS: INFO ONLY TEST, * 7-1-92 W.P.	SPECS: C-SPC-G-00041
7-1-92 W.P.	REV: 2
N/A	DCF'S: N/A
M. Koval II 7.1.92	STANDARDS: N/A
INSPECTOR: Wyman Pope Jr. LEVEL: II DATE: 7-1-92	
REVIEWER: [signature] LEVEL: II DATE: 9-15-92	DES. CAT: GS

MJR 09-15-92

FOR INFORMATION ONLY

ASP 18-174 (4/91)
FILE ID NO. 80139

EBASCO SERVICES INCORPORATED

MOISTURE DENSITY RELATIONSHIP
ASTM D-1557 ( ); ASTM D-698 (78) R90

REPT #: 4125 AXC: N/A
PROJ/AMO: 4794 DA: C001 TWC: 9660
WORK PACKAGE NO. 92 WPW-EC023
QCIR NO. 92IR15-E-4794-1101-C-CV-G-0006-0002
MATERIAL DESCRIPTION: KAOLIN CLAY
LAB #: 592-716 DATE TESTED: 7-7-92 METHOD: A
LOCATION: BURIAL GROUND SOIL DYNAMIC CONSOLIDATION "C" LIFT *

	1	2	3	4	5
A. WEIGHT MOLD + WET SOIL	5972				
B. WEIGHT MOLD	4213				
C. WEIGHT WET SOIL (A-B) G./LBS.	1759 / 3.878				
D. VOLUME OF MOLD	30.30				
E. WET DENSITY, LBS./CU. FT.	117.5				
F. MOISTURE CAN NUMBER	015		N		
G. WEIGHT WET SAMPLE + TARE	1774.7			A	
H. WEIGHT DRY SAMPLE + TARE	1442.9				
I. WEIGHT MOISTURE (G-H)	331.8				
J. WEIGHT TARE	82.6				
K. WEIGHT DRY SAMPLE (H-J)	1360.3				
L. % MOISTURE (I/K X 100)	24.4				
M. DRY DENSITY, LBS./CU. FT.	94.4				

NOTE: DRY DENSITY (LINE M) = (LINE E X 100)/(100 + LINE L)

PREPARATION METHOD: ☑ DRY ☐ WET

RAMMER: ☐ MANUAL ☑ MECHANICAL

OPTIMUM MOISTURE: N/A

MAXIMUM DENSITY: N/A

ACCEPTANCE CRITERIA: N/A

DESIGN CATEGORY "GS" R.T 7-8-92

M&TE: S-54 (10-8-92); 10-1 (11-22-92); M-10 (1-13-93) APR-3 (10-13-92)
PROCEDURE: C-QCP-021
NCR #: N/A CR #: N/A
REV: 0
TEST RESULTS: ☐ CONFORMING ☐ NONCONFORMING ☑ N/A
PCN'S: N/A
SPECS: C-SPC-G-00041
REMARKS: * N/W CORNER CLAY CAP 40'S 10'E ELEV. 294.2' R.T 7-8-92
REF. DENSITY PROCTOR REPORT # WER-ERC-92-0544
REV: 2
DCF'S: N/A
INSPECTOR: [signature] LEVEL: II DATE: 7-8-92
ASTM'S: N/A
REVIEWER: [signature] LEVEL: II DATE: 9-15-92

MJR 09-15-92

FOR INFORMATION ONLY

ASR 18-179 (3/92)
FILE ID # 80144

EBASCO SERVICES INCORPORATED
SAND METHOD DENSITY TEST & PERCENT COMPACTION

ASTM D-1556-(90)

REPT #: 4126 PROJ/AMO: 4794 WORK PACKAGE NO.: 92-WPW-EC-023

DA: C001 TWC: 9660 AXC: NA QCIR NO.: 92IR15-E-4794-1101-C-CV-G-0006-0002

CONTRACTOR: Bechtel

MATERIAL DESCRIPTION: Kaolin Clay D Lift DATE TESTED: 7.4.92

ACCEPTANCE CRITERIA: 95% compaction / 90-94 PCF Dry Density LOCATION: Burial Ground Soil Dynamic compaction

TEST NO.	71 adjacent to troxler 71					
DISTANCE S/W corner clay cap Approx.	20'N 20'E					
ELEVATION Approx.	294.8					
A. INITIAL WEIGHT OF SAND	6732.9					
B. FINAL WEIGHT OF SAND	2229.7					
C. DIFFERENCE (A-B)	4503.2					
D. WT. OF SAND IN FUNNEL & PLATE	1664.0					
E. WT. OF SAND IN HOLE (C-D)/LBS	2839.2 / 6.259					
F. WT. OF SAND CU./FT.	93.8					
G. VOL. OF HOLE CU./FT. (E/F)	.0667		N			
H. WT. OF WET SOIL REMOVED / LBS	3592.1 / 7.919					
I. WET DENSITY (H/G)	118.7					
J. WEIGHT OF WET SOIL	113.06					
K. WEIGHT OF DRY SOIL	88.06				A	
L. WEIGHT OF MOISTURE (J-K)	25.00					
M. MOISTURE %, (L/K)	28.4 / 28.5					
N. DRY DENSITY LBS/CU.FT. (IX100) (M+100)	92.4					
MAX. DENSITY (PROCTOR)	94.2					
OPTIMUM MOISTURE	26.4 / 26.5					
% COMPACTION REQUIRED	95.0					
% COMPACTION rounded to 0.5%	98.1 / 98.0					

DENSITY PROCTOR REPORT #: WER-ERC-92-0544. DESIGN CATEGORY: GS

MOISTURE DETERMINATION: ☐ ASTM D-2216 ( ) ☑ ASTM D-4643 (87)

M&TE: F-11 (7.14.92 or 200 lbs. sand), S-79 (5.6.93)	PROCEDURE: C-QCP-021
NCR #: NA CR #: NA	REV: 0
TEST RESULTS: ☑ CONFORMING ☐ NONCONFORMING ☐ N/A	PCN'S: NA
	SPECS: C-SPC-G-00041
REMARKS: N/A	REV: 2
	DCF'S: N/A
INSPECTOR: J. A. Palmer LEVEL: II DATE: 7-4-92	STANDARDS: N/A
REVIEWER: [signature] LEVEL: II DATE: 9-15-92	

MTR 09-15-92

ASR 18-180 (3/92)
FILE ID # 80145

FOR INFORMATION ONLY

EBASCO SERVICES INCORPORATED

MOISTURE & DENSITY TESTS USING SURFACE PROBES

ASTM D-2922 (81 R/90)

REPT #: 4126 PROJ/AMO: 4794
DA: C001 TWC: 9660 AXC: NA
CONTRACTOR: Bechtel
WORK PACKAGE NO.: 92-WPW-EC-023
QCIR NO.: 92IR15-E-4794-1101-C-CV-G-0006-0002
MATERIAL DESCRIPTION: Kaolin Clay
ACCEPTANCE CRITERIA: 95% compaction, 90-94 PCF Dry Density
DRAWING(S) & REV(S): C-CV-G-0006 R/1
LOCATION: Burial Ground Soils Dynamic Compaction - D Lift

TEST NO.	70					
SW corner of clay cap	50'N					
DISTANCE Approx.	45'E					
ELEVATION Approx.	294.8					
WET DENSITY (LBS/CU. FT.) ▲	114.0 / 113.0					
WATER (LBS./CU. FT.)	NA		N			
DRY DENSITY (LBS/CU. FT.)	85.6 / 86.0					
% MOISTURE rounded to 0.5%	31.8 / 32.0					
MAXIMUM DENSITY (PROCTOR)	94.2				A	
OPTIMUM MOISTURE rounded to 0.5%	26.4 / 26.5					
COMPACTION REQUIRED	95.0					
% COMPACTION rounded to 0.5%	91.3 / 91.5					

TROXLER #: 7 MODEL: 3440 SERIAL #: 17494
DENSITY PROCTOR REPT #: WER-ERC-92-0544 DESIGN CAT: GS
DENSITY: AVERAGE OF LAST 4 STANDARD COUNTS (No): 3828
DAILY STANDARD COUNTS (Ns): 3827
MOISTURE: AVERAGE OF LAST 4 STANDARD COUNTS (No): 603
DAILY STANDARD COUNTS (Ns): 603
MOISTURE DETERMINATION: ☐ ASTM D-2216 ( ) ☐ ASTM D-3017 ( ) ☑ ASTM D-4643 (87)

M&TE: refer to lab # S92-718
PROCEDURE: C-QCP-021
NCR #: NA CR #: NA
REV: 0
TEST RESULTS: ☐ CONFORMING ☑ NONCONFORMING ☐ N/A
PCN'S: NA
SPECS: C-▲▲SPC-G-00041
REV: 2
REMARKS: complete panel was reworked, test 70 R/1 clears this report. ▲Density adjusted by a factor of 1, ▲▲page C2, par. 8 MK 7.3.92
DCF'S: N/A
STANDARDS: N/A
INSPECTOR: M. Koval LEVEL: II DATE: 7.3.92
REVIEWER: [signature] LEVEL: II DATE: 9-15-92

MJR 09-15-92

FOR INFORMATION ONLY

ASR 18-180 (3/92)
FILE ID # 80145

EBASCO SERVICES INCORPORATED

MOISTURE & DENSITY TESTS USING SURFACE PROBES
ASTM D-2922 (91 R/90)

REPT #: 4126 PROJ/AMO: 4794
DA: C001 TWC: 9660 AXC: NA
WORK PACKAGE NO.: 92-WPW-EC-023
QCIR NO.: 92IR15-E-4794-1101-C-CV-G-0006-0002
CONTRACTOR: Bechtel
MATERIAL DESCRIPTION: Kaolin Clay
ACCEPTANCE CRITERIA: 95% compaction; 90-94 PCF Dry Density
DRAWING(S) & REV(S): C-CV-G-0006 R/1
LOCATION: Burial Ground Soils Dynamic Compaction D Lift

TEST NO.	70 R/1	71				
SW corner of clay cap	55' N	20' N				
DISTANCE Approx.	40' E	20' E				
ELEVATION Approx.	294.8	294.8				
WET DENSITY (LBS/CU. FT.) ▲	118.0 / 117.0	117.4 / 118.4				
WATER (LBS./CU. FT.)	NA	NA		N		
DRY DENSITY (LBS/CU. FT.)	91.4 / 91.0	92.1 / 92.0				
% MOISTURE rounded to 0.5%	28.2 / 28.0	28.4 / 28.5			A	
MAXIMUM DENSITY (PROCTOR)	94.2	94.2				
OPTIMUM MOISTURE rounded to 0.5%	26.4 / 26.5	26.4 / 26.5				
COMPACTION REQUIRED	95.0	95.0				
% COMPACTION rounded to 0.5%	96.6 / 96.5	97.7 / 97.5				

TROXLER #: 7 MODEL: 3440 SERIAL #: 17494
DENSITY PROCTOR REPT #: WER-ERC-92-0544 DESIGN CAT: GS
DENSITY: AVERAGE OF LAST 4 STANDARD COUNTS (No): 3829
DAILY STANDARD COUNTS (Ns): 3819
MOISTURE: AVERAGE OF LAST 4 STANDARD COUNTS (No): 602
DAILY STANDARD COUNTS (Ns): 600
MOISTURE DETERMINATION: ☐ ASTM D-2216 ( ) ☐ ASTM D-3017 ( ) ☑ ASTM D-4643 (87)

M&TE: refer to lab # S92-719
PROCEDURE: C-QCP-021
NCR #: NA CR #: NA
REV: 0
TEST RESULTS: ☑ CONFORMING ☐ NONCONFORMING ☐ N/A
PCN'S: NA
SPECS: C-SPC-G-00041
REV: 2
REMARKS: test 70 R/1 clears test 70.
▲ Density adjusted by a factor of 1,
▲▲ page C2, par 8. MK 7.4.92
DCF'S: N/A
STANDARDS: N/A
INSPECTOR: M. Koval LEVEL: II DATE: 7.4.92
REVIEWER: [signature] LEVEL: II DATE: 9-15-92

MJR 09-15-92

FOR INFORMATION ONLY

ASR 18-178 (3/92)
FILE ID # 80143

EBASCO SERVICES INCORPORATED

DETERMINATION OF WATER CONTENT

☐ ASTM D-2216 ( ) ☑ ASTM D-4643 (87)

FILE

REPT #: 4126 PROJ/AMO: 4794 WORK PACKAGE NO.: 92-WPW-EC-023
DA: COOL TWC: 9660 AXC: NA QCIR NO.: 92IR15-E-4794-1101-C-CV-G-0006-0002
LAB #: 592-717 DATE TESTED: 7.3.92 ACCPT. CRITERIA: NA
MATERIAL DESCRIPTION: Kaolin Clay
LOCATION: Burial Ground Soils Dynamic Compaction, 0 Lift

▲MK 7.3.92

▲~~BORING~~ microwave NUMBER	1	2	4	5	6		
SAMPLE NUMBER	1	2	3	4	5		
WT. OF WET SAMPLE ~~+ TARE~~▲	113.77	113.61	113.60	113.17	113.56		
WT. OF DRY SAMPLE ~~+ TARE~~▲	89.98	89.98	87.39	88.58	90.24	N	
WEIGHT OF MOISTURE	23.79	23.63	26.21	24.59	23.32		
TARE WEIGHT	NA	NA	NA	NA	NA		A
~~WEIGHT OF DRY SAMPLE~~▲ % moisture	26.4	26.3	30.0	27.8	25.8		
% MOISTURE rounded to 0.5%	26.5	26.5	30.0	28.0	26.0		

BORING NUMBER							
SAMPLE NUMBER							
WT. OF WET SAMPLE + TARE							
WT. OF DRY SAMPLE + TARE			N				
WEIGHT OF MOISTURE							
TARE WEIGHT				A			
WEIGHT OF DRY SAMPLE							
% MOISTURE							

MINIMUM SIZE SAMPLE ☑ CONFORMING ☐ NONCONFORMING REMARKS: NA
MORE THAN ONE SOIL TYPE: NO
METHOD OF DRYING: ☐ 230 +/- 9 DEGREES F ☑ OTHER: microwave
MATERIAL (SIZE/AMOUNT) EXCLUDED FROM TEST: NA

M&TE: S-73 (6.23.93)
NCR #: NA CR #: NA
TEST RESULTS: ☐ CONFORMING ☐ NONCONFORMING ☑ N/A
REMARKS: tests taken for info MK 7.3.92
N/A
INSPECTOR: M. Koval LEVEL: II DATE: 7.3.92
REVIEWER: [signature] LEVEL: II DATE: 9-15-92

PROCEDURE: C-QCP-021
REV: 0
PCN'S: NA
SPECS: C-SPC-G-00041
REV: 2
DCF'S: N/A
STANDARDS: N/A
DES. CAT: GS

MJR 09-15-92

FOR INFORMATION ONLY

ASR 18-178 (3/92)
FILE ID # 80143

EBASCO SERVICES INCORPORATED

DETERMINATION OF WATER CONTENT

☐ ASTM D-2216 ( ) ☑ ASTM D-4643 (87)

REPT #: 4126 PROJ/AMO: 4794
WORK PACKAGE NO.: 92-WPW-EC-023
F/A: C001 TWC: 9660 AXC: NA
QCIR NO.: 92IR15-E-4794-1101-C-CV-G-0006-0002
LAB #: S92-718 DATE TESTED: 7.3.92 ACCPT. CRITERIA: Avg. 28-30% moisture content
MATERIAL DESCRIPTION: Kaolin Clay
LOCATION: Burial Ground Soils Dynamic Compaction - D Lift

~~BORING~~ microwave NUMBER	1	2	3	4	5	2	
SAMPLE NUMBER	1	2	3	4	5	nuc #1	
WT. OF WET SAMPLE ~~+ TARE~~	113.53	113.90	113.68	113.38	113.41	113.23	
WT. OF DRY SAMPLE ~~+ TARE~~	87.97	86.20	87.53	86.86	87.30	85.88	N
WEIGHT OF MOISTURE	25.56	27.70	26.15	26.52	26.11	27.35	
TARE WEIGHT	NA	NA	NA	NA	NA	NA	A
~~WEIGHT OF DRY SAMPLE~~ % moisture	29.1	32.1	29.9	30.5	29.9	31.8	
% MOISTURE rounded to 0.5%	29.0	32.0	30.0	30.5	30.0	32.0	

BORING NUMBER							
SAMPLE NUMBER							
WT. OF WET SAMPLE + TARE							
WT. OF DRY SAMPLE + TARE			N				
WEIGHT OF MOISTURE							
TARE WEIGHT				A			
WEIGHT OF DRY SAMPLE							
% MOISTURE							

MINIMUM SIZE SAMPLE ☑ CONFORMING ☐ NONCONFORMING REMARKS: NA
MORE THAN ONE SOIL TYPE: NO
METHOD OF DRYING: ☐ 230 +/- 9 DEGREES F ☑ OTHER: microwave
MATERIAL (SIZE/AMOUNT) EXCLUDED FROM TEST: NA

M&TE: S-73 (6.23.93)
NCR #: NA CR #: NA
TEST RESULTS: ☐ CONFORMING ☑ NONCONFORMING ☐ N/A
REMARKS: official tests, half of the panel was tested per request, due to non-compliance complete panel was reworked. Avg. 30.6/30.5 MK 7.3.92
INSPECTOR: M. Koval LEVEL: I DATE: 7.3.92
REVIEWER: [signature] LEVEL: II DATE: 9-15-92

PROCEDURE: C-QCP-021
REV: 0
PCN'S: NA
SPECS: C-SPC-G-00041
REV: 2
DCF'S: N/A
STANDARDS: N/A
DES. CAT: GS

MTR 09-15-92

FOR INFORMATION ONLY

ASR 18-178 (3/92)
FILE ID # 80143

EBASCO SERVICES INCORPORATED

FILE

DETERMINATION OF WATER CONTENT

☐ ASTM D-2216 ( )   ☑ ASTM D-4643 (87)

REPT #: 4126   PROJ/AMO: 4794

DA: C001   TWC: 9660   AXC: NA

LAB #: S92-719   DATE TESTED: 7.4.92

WORK PACKAGE NO.: 92-WPW-EC-023

QCIR NO.: 92IR15-E-4794-1101-C-CV-G-0006-0002

ACCPT. CRITERIA: Avg. 28-30% moisture content

MATERIAL DESCRIPTION: Kaolin Clay

LOCATION: Burial Ground Soils Dynamic Compaction - D Lift

MK 7.4.92

~~BORING~~ microwave NUMBER	1	2	4	5	6	7	8
SAMPLE NUMBER	1	2	3	4	5	6	7
WT. OF WET SAMPLE ~~+ TARE~~	113.99	113.37	113.71	113.85	113.15	113.68	113.46
WT. OF DRY SAMPLE ~~+ TARE~~	86.93	85.33	87.40	87.03	86.93	85.60	87.02
WEIGHT OF MOISTURE	27.06	28.04	26.31	26.82	26.22	28.08	26.44
TARE WEIGHT	NA	NA	NA	NA	NA	NA	NA
~~WEIGHT OF DRY SAMPLE~~ % moisture	31.1	32.9	30.1	30.8	30.2	32.8	30.4
% MOISTURE rounded to 0.5%	31.0	33.0	30.0	31.0	30.0	33.0	30.5

~~BORING~~ microwave NUMBER	9	10	11	1	2	1	2
SAMPLE NUMBER	8	9	10	nuc#1	sand cone / nuc#2	2 R/1	2 R/1
WT. OF WET SAMPLE ~~+ TARE~~	113.51	113.30	113.23	113.27	113.06	113.89	112.78
WT. OF DRY SAMPLE ~~+ TARE~~	86.10	86.55	88.00	88.32	88.06	85.93	83.62
WEIGHT OF MOISTURE	27.41	26.75	25.23	24.95	25.00	27.96	29.16
TARE WEIGHT	NA	NA	NA	NA	NA	NA	NA
~~WEIGHT OF DRY SAMPLE~~ % moisture	31.8	30.9	28.7	28.2	28.4	32.5	34.9
% MOISTURE rounded to 0.5%	32.0	31.0	28.5	28.0	28.5	32.5	35.0

MINIMUM SIZE SAMPLE ☑ CONFORMING ☐ NONCONFORMING   REMARKS: NA

MORE THAN ONE SOIL TYPE: NO

METHOD OF DRYING: ☐ 230 +/- 9 DEGREES F   ☑ OTHER: microwave

MATERIAL (SIZE/AMOUNT) EXCLUDED FROM TEST: NA

M&TE: S-73 (6.23.93)

NCR #: NA   CR #: NA

TEST RESULTS: ☐ CONFORMING ☑* NONCONFORMING ☐ N/A

REMARKS: official tests, Avg. 30.3/30.5 (MK 7.4.92)
*accepted per DCF# Y-25841-R MK 9.14.92

INSPECTOR: M. Koval   LEVEL: II   DATE: 7.4.92

REVIEWER: [signature]   LEVEL: II   DATE: 9-15-92

PROCEDURE: C-QCP-021

REV: 0

PCN'S: NA

SPECS: C-SPC-G-00041

REV: 2

DCF'S: ~~N/A~~ * MK 9.14.92

STANDARDS: N/A

DES. CAT: GS

MJR 09-15-92

FOR INFORMATION ONLY

ASR 18-178 (3/92)
FILE ID # 80143

EBASCO SERVICES INCORPORATED

FILE

DETERMINATION OF WATER CONTENT

☐ ASTM D-2216 ( )   ☑ ASTM D-4643 (87)

REPT #: 4126   PROJ/AMO: 4794   WORK PACKAGE NO.: 92-WPW-EC-023
DA: C001   TWC: 9660   AXC: NA   QCIR NO.: 92IR15-E-4794-1101-C-CV-G-0006-0002
LAB #: S92-719   DATE TESTED: 7.4.92   ACCPT. CRITERIA: Avg. 28-30% moisture content
MATERIAL DESCRIPTION: Kaolin Clay
LOCATION: Burial Ground Soils Dynamic Compaction D Lift

~~BORING~~ microwave NUMBER (MK 7.4.92)	4	5					
SAMPLE NUMBER	6 R/1	6 R/1					
WT. OF WET SAMPLE ~~+ TARE~~	113.62	112.38					
WT. OF DRY SAMPLE ~~+ TARE~~	86.14	86.14		N			
WEIGHT OF MOISTURE	27.48	26.24					
TARE WEIGHT	NA	NA			A		
~~WEIGHT OF DRY SAMPLE~~ % moisture	31.9	30.5					
% MOISTURE rounded to 0.5%	32.0	30.5					

Avg. 31.2/31.0

BORING NUMBER							
SAMPLE NUMBER							
WT. OF WET SAMPLE + TARE							
WT. OF DRY SAMPLE + TARE			N				
WEIGHT OF MOISTURE							
TARE WEIGHT				A			
WEIGHT OF DRY SAMPLE							
% MOISTURE							

MINIMUM SIZE SAMPLE ☑ CONFORMING ☐ NONCONFORMING   REMARKS: NA
MORE THAN ONE SOIL TYPE: No
METHOD OF DRYING: ☐ 230 +/- 9 DEGREES F ☑ OTHER: microwave
MATERIAL (SIZE/AMOUNT) EXCLUDED FROM TEST: NA

M&TE: S-73 (6.23.93)   PROCEDURE: C-QCP-021
NCR #: NA   CR #: NA   REV: 0
TEST RESULTS: ☐ CONFORMING ☑ * NONCONFORMING ☐ N/A   PCN'S: NA
SPECS: C-SPC-G-00041
REMARKS: official tests, Panel Avg. 30.3/30.5 (MK 7.4.92) * accepted per DCF # Y-25841-R MK 9.14.92   REV: 2
DCF'S: N/A * MK 9.14.92
STANDARDS: N/A
INSPECTOR: M. Koval   LEVEL: II   DATE: 7.4.92
REVIEWER: [signature]   LEVEL: 2   DATE: 9.15.92   DES. CAT: GS

MJR 09.15.92

FOR INFORMATION ONLY FILE

ASR 18-180 (3/92)
FILE ID # 80145

EBASCO SERVICES INCORPORATED

MOISTURE & DENSITY TESTS USING SURFACE PROBES

ASTM D-2922 (81 %c)

REPT #: 4127 PROJ/AMO: 4794
DA: C001 TWC: 9660 AXC: NA
WORK PACKAGE NO.: 92-WPW-EC-023
QCIR NO.: 92IR15-E-4794-1101-C-CV-G-0006-0002
CONTRACTOR: Bechtel
MATERIAL DESCRIPTION: Kaolin Clay
ACCEPTANCE CRITERIA: 95% compaction; 90-94 PCF Dry density
DRAWING(S) & REV(S): C-CV-G-0006 R/1
LOCATION: Burial Ground Soils Dynamic Compaction - E Lift

TEST NO.	72	73				
SW corner of clay cap DISTANCE Approx.	70'N 35'E	30'N 12'E	N/A			
ELEVATION Approx.	295.4	295.4				
WET DENSITY (LBS/CU. FT.) ▲	116.6 / 117.6	115.6 / 116.6				
WATER (LBS./CU. FT.)	NA	NA				
DRY DENSITY (LBS/CU. FT.)	91.5 / 92.0	89.7 / 90.0				
% MOISTURE	28.3 / 28.5	30.0 / 30.0				
MAXIMUM DENSITY (PROCTOR)	94.2	94.2				
OPTIMUM MOISTURE	26.4 / 26.5	26.4 / 26.5				
COMPACTION REQUIRED	95.0	95.0				
% COMPACTION	97.7 / 97.5	95.5 / 95.5				

TROXLER #: 7 MODEL: 3440 SERIAL #: 17494
DENSITY PROCTOR REPT #: WER-ERC-92-0544 DESIGN CAT: GS
DENSITY: AVERAGE OF LAST 4 STANDARD COUNTS (No): 3822
DAILY STANDARD COUNTS (Ns): 3846
MOISTURE: AVERAGE OF LAST 4 STANDARD COUNTS (No): 602
DAILY STANDARD COUNTS (Ns): 597
MOISTURE DETERMINATION: ☐ ASTM D-2216 ( ) ☐ ASTM D-3017 ( ) ☑ ASTM D-4643 (87)

M&TE: refer to lab# 592-721
PROCEDURE: C-QCP-021
REV: 0
NCR #: NA CR #: NA
PCN'S: NA
TEST RESULTS: ☐ CONFORMING ☑* NONCONFORMING ☐ N/A
SPECS: C-▲▲SPC-G-00041
REV: 2
REMARKS: ▲Density adjusted by a factor of 1, ▲▲page C2, par. 8, *accepted per DCF# Y-27060-R MK 9.14.92
DCF'S: W/A * MK 9.14.92
STANDARDS: N/A
INSPECTOR: M. Koval LEVEL: II DATE: 7.5.92
REVIEWER: [signature] LEVEL: II DATE: 9-15-92

MJR 09-15-92

FOR INFORMATION ONLY

ASR 18-178 (3/92)
FILE ID # 80143

EBASCO SERVICES INCORPORATED

DETERMINATION OF WATER CONTENT

☐ ASTM D-2216 ( ) ☑ ASTM D-4643 (87)

REPT #: 4127 PROJ/AMO: 4794 WORK PACKAGE NO.: 92-WPW-EC-023

DA: C001 TWC: 9660 AXC: NA QCIR NO.: 92IR15-E-4794-1101-C-CU-G-0006-0002

LAB #: S92-720 DATE TESTED: 7.5.92 ACCPT. CRITERIA: NA

MATERIAL DESCRIPTION: Kaolin Clay

LOCATION: Burial Ground Soils Dynamic Compaction - E Lift

~~BORING~~ microwave NUMBER	1	2	4	5	6	7	1
SAMPLE NUMBER	1	2	3	4	5	6	7
WT. OF WET SAMPLE ~~+ TARE~~	113.72	113.70	113.14	113.48	113.30	113.82	114.33
WT. OF DRY SAMPLE ~~+ TARE~~	87.35	86.83	86.08	87.65	86.60	86.65	87.27
WEIGHT OF MOISTURE	26.37	26.87	27.06	25.83	26.70	27.17	27.06
TARE WEIGHT	NA	NA	NA	NA	NA	NA	NA
~~WEIGHT OF DRY SAMPLE~~ % moisture	30.2	30.9	31.4	29.5	30.8	31.4	31.0
% MOISTURE rounded to 0.5%	30.0	31.0	31.5	29.5	31.0	31.5	31.0

~~BORING~~ microwave NUMBER	2	4	5	6	7		
SAMPLE NUMBER	8	9	10	11	12		
WT. OF WET SAMPLE ~~+ TARE~~	114.62	113.84	113.51	114.05	113.77		
WT. OF DRY SAMPLE ~~+ TARE~~	86.69	87.52	88.00	88.24	87.39	N	
WEIGHT OF MOISTURE	27.93	26.32	25.51	25.81	26.38		A
TARE WEIGHT	NA	NA	NA	NA	NA		
~~WEIGHT OF DRY SAMPLE~~ % moisture	32.2	30.1	29.0	29.2	30.2		
% MOISTURE rounded to 0.5%	32.0	30.0	29.0	29.0	30.0		

MINIMUM SIZE SAMPLE ☑ CONFORMING ☐ NONCONFORMING REMARKS: NA

MORE THAN ONE SOIL TYPE: NO

METHOD OF DRYING: ☐ 230 +/- 9 DEGREES F ☑ OTHER: microwave

MATERIAL (SIZE/AMOUNT) EXCLUDED FROM TEST: NA

M&TE: S-73 (6.23.93) PROCEDURE: C-QCP-021

NCR #: NA CR #: NA REV: 0

TEST RESULTS: ☐ CONFORMING ☐ NONCONFORMING ☑ N/A PCN'S: NA

SPECS: C-SPC-G-00041

REMARKS: tests taken for info MK 7.5.92 REV: 2

N/A DCF'S: N/A

STANDARDS: N/A

INSPECTOR: M. Koval LEVEL: II DATE: 7.5.92

REVIEWER: [signature] LEVEL: II DATE: 9-15-92 DES. CAT: GS

MJR 09-15-92

FOR INFORMATION ONLY

ASR 18-178 (3/92)
FILE ID # 80143

EBASCO SERVICES INCORPORATED

DETERMINATION OF WATER CONTENT

☐ ASTM D-2216 ( ) ☑ ASTM D-4643 (87)

REPT #: 4127 PROJ/AMO: 4794 WORK PACKAGE NO.: 92-WPW-EC-023
DA: C001 TWC: 9660 AXC: NA QCIR NO.: 92IR15-E-4794-1101-C-CV-G-0006-0002
LAB #: 592-720 DATE TESTED: 7.5.92 ACCPT. CRITERIA: N/A
MATERIAL DESCRIPTION: Kaolin Clay
LOCATION: Burial Ground Soils Dynamic Compaction - E Lift

△ MK 7.5.92

~~BORING~~ microwave NUMBER	1	2	4	5	6	7	8
SAMPLE NUMBER	1	2	3	4	5	6	7
WT. OF WET SAMPLE ~~+ TARE~~△	113.30	114.84	114.22	113.21	113.44	113.84	113.82
WT. OF DRY SAMPLE ~~+ TARE~~△	88.59	91.19	89.72	89.40	87.65	89.76	89.60
WEIGHT OF MOISTURE	24.71	23.65	24.50	23.81	25.79	24.08	24.22
TARE WEIGHT	NA	NA	NA	NA	NA	NA	NA
~~WEIGHT OF DRY SAMPLE~~△ % moisture	27.9	25.9	27.3	26.6	29.4	26.8	27.0
% MOISTURE rounded to 0.5%	28.0	26.0	27.5	26.5	29.5	27.0	27.0

~~BORING~~ microwave NUMBER	9	1	2	4	5	6	7
SAMPLE NUMBER	8	9	10	11	12	13	14
WT. OF WET SAMPLE ~~+ TARE~~△	113.53	113.91	114.17	113.38	113.68	114.45	114.70
WT. OF DRY SAMPLE ~~+ TARE~~△	88.50	89.28	88.32	88.52	88.93	88.60	89.52
WEIGHT OF MOISTURE	25.03	24.63	25.85	24.86	24.75	25.85	25.18
TARE WEIGHT	NA	NA	NA	NA	NA	NA	NA
~~WEIGHT OF DRY SAMPLE~~△ % moisture	28.3	27.6	29.3	28.1	27.8	29.2	28.1
% MOISTURE rounded to 0.5%	28.5	27.5	29.5	28.0	28.0	29.0	28.0

MINIMUM SIZE SAMPLE ☑ CONFORMING ☐ NONCONFORMING REMARKS: NA
MORE THAN ONE SOIL TYPE: NO
METHOD OF DRYING: ☐ 230 +/- 9 DEGREES F ☑ OTHER: microwave
MATERIAL (SIZE/AMOUNT) EXCLUDED FROM TEST: NA

M&TE: S-73 (6.23.93)
NCR #: NA CR #: NA
TEST RESULTS: ☐ CONFORMING ☐ NONCONFORMING ☑ N/A
REMARKS: tests taken for info MK 7.5.92
N/A

PROCEDURE: C-QCP-021
REV: 0
PCN'S: NA
SPECS: C-SPC-G-00041
REV: 2
DCF'S: N/A
STANDARDS: N/A

INSPECTOR: M. Koval LEVEL: II DATE: 7.5.92
REVIEWER: [signature] LEVEL: II DATE: 9.15.92
DES. CAT: GS

MTR 09-15-92

FOR INFORMATION ONLY

ASR 18-178 (3/92)
FILE ID # 80143

EBASCO SERVICES INCORPORATED

DETERMINATION OF WATER CONTENT

☐ ASTM D-2216 ( ) ☑ ASTM D-4643 (87)

FILE

REPT #: 4127 PROJ/AMO: 4794

DA: COOL TWC: 9660 AXC: NA

LAB #: S92-721 DATE TESTED: 7.5.92

WORK PACKAGE NO.: 92-WPW-EC-023

QCIR NO.: 92IR15-E-4794-1101-C-CV-G-0006-0002

ACCPT. CRITERIA: Avg. 28-30% moisture content

MATERIAL DESCRIPTION: Kaolin Clay

LOCATION: Burial Ground Soils Dynamic Compaction - E Lift

▲ MK 7.5.92

~~BORING~~ ▲ microwave NUMBER	1	2	4	5	6	7	8
SAMPLE NUMBER	1	2	3	4	5	6	7
WT. OF WET SAMPLE ~~+ TARE~~ ▲	113.16	113.62	113.75	113.46	114.87	113.01	113.37
WT. OF DRY SAMPLE ~~+ TARE~~ ▲	86.58	89.92	86.59	88.46	89.93	85.75	88.23
WEIGHT OF MOISTURE	26.58	23.70	27.16	25.00	24.94	27.26	25.14
TARE WEIGHT	NA	NA	NA	NA	NA	NA	NA
~~WEIGHT OF DRY SAMPLE~~ ▲ % moisture	30.7	26.4	31.4	28.3	27.7	31.8	28.5
% MOISTURE rounded to 0.5%	30.5	26.5	31.5	28.5	27.5	32.0	28.5

~~BORING~~ ▲ microwave NUMBER	9	10	11	1	2		
SAMPLE NUMBER	8	9	10	nuc#1	nuc#2		
WT. OF WET SAMPLE ~~+ TARE~~ ▲	113.50	113.91	113.70	113.39	113.54		
WT. OF DRY SAMPLE ~~+ TARE~~ ▲	88.67	88.09	87.44	88.36	87.33		A
WEIGHT OF MOISTURE	24.83	25.82	26.26	25.03	26.21	N	
TARE WEIGHT	NA	NA	NA	NA	NA		
~~WEIGHT OF DRY SAMPLE~~ ▲ % moisture	28.0	29.3	30.0	28.3	30.0		
% MOISTURE rounded to 0.5%	28.0	29.5	30.0	28.5	30.0		

MINIMUM SIZE SAMPLE ☑ CONFORMING ☐ NONCONFORMING REMARKS: NA

MORE THAN ONE SOIL TYPE: NO

METHOD OF DRYING: ☐ 230 +/- 9 DEGREES F ☑ OTHER: microwave

MATERIAL (SIZE/AMOUNT) EXCLUDED FROM TEST: NA

M&TE: S-73 (6.23.93)

NCR #: NA CR #: NA

TEST RESULTS: ☑ CONFORMING ☐ NONCONFORMING ☐ N/A

REMARKS: official tests, panel avg. 29.2/29.0 MK 7.5.92

PROCEDURE: C-QCP-021

REV: 0

PCN'S: NA

SPECS: C-SPC-G-00041

REV: 2

DCF'S: N/A

STANDARDS: N/A

INSPECTOR: M. Koval LEVEL: II DATE: 7.5.92

REVIEWER: [signature] LEVEL: II DATE: 9.15.92

DES. CAT: GS

MJR 09-15-92

FOR INFORMATION ONLY

ASF 15-174 (4/91)
FILE ID NO. 80139

FILE

EBASCO SERVICES INCORPORATED

MOISTURE DENSITY RELATIONSHIP
ASTM D-1557 ( ); ASTM D-698 (78)R 90

REPT #: 4127	AXC: N/A	WORK PACKAGE NO. 92 WPN-EC-023	
PROJ/AMO: 4794	DA: C001 TWC: 9660	QCIR NO. 92 IR15-E-4794-1101-C-CV-G 0006-0002	

MATERIAL DESCRIPTION: KAOLIN CLAY

LAB #: S92-722 DATE TESTED: 7-7-92 METHOD: A

LOCATION: BURIAL GROUND SOIL DYNAMIC CONSOLIDATION E LIFT *

	1	2	3	4	5
A. WEIGHT MOLD + WET SOIL	5989				
B. WEIGHT MOLD	4213				
C. WEIGHT WET SOIL (A-B) G./LBS.	1776 / 3.915				
D. VOLUME OF MOLD	30.30				
E. WET DENSITY, LBS./CU. FT.	118.6				
F. MOISTURE CAN NUMBER	01		N/		
G. WEIGHT WET SAMPLE + TARE	1821.3			A	
H. WEIGHT DRY SAMPLE + TARE	1466.2				
I. WEIGHT MOISTURE (G-H)	355.1				
J. WEIGHT TARE	83.7				
K. WEIGHT DRY SAMPLE (H-J)	1382.5				
L. % MOISTURE (I/K X 100)	25.7				
M. DRY DENSITY, LBS./CU. FT.	94.4				

NOTE: DRY DENSITY (LINE M) = (LINE E X 100)/(100 + LINE L)

PREPARATION METHOD: ☑ DRY ☐ WET

RAMMER: ☐ MANUAL ☑ MECHANICAL

OPTIMUM MOISTURE: N/A

MAXIMUM DENSITY: N/A

ACCEPTANCE CRITERIA: N/A

DESIGN CATEGORY: "GS" RIT 7-8-92

M&TE: S-54(10-8-92); LO-1(11-22-92); M-10(1-13-93); APR-3(10-13-92)	PROCEDURE: C-QCP-021
NCR #: N/A CR #: N/A	REV: 0
TEST RESULTS: ☐ CONFORMING ☐ NONCONFORMING ☑ N/A	PCN'S: N/A
REMARKS: * S/W CORNER CLAY CAP 70'N 35'E ELEV 295.4 RIT 7-8-92	SPECS: C-SPC-G-00041
REF. DENSITY PROCTOR REPORT # WER-ERC-92-0544	REV: 2
INSPECTOR: Richard Tugert LEVEL: II DATE: 7-8-92	DCF'S: N/A
REVIEWER: [signature] LEVEL: II DATE: 9-15-92	ASTM'S: N/A

A.39

MJR 09-15-92

FOR INFORMATION ONLY

FORMATION ONLY

PAGE 2 OF 3

PAGE 1 OF 3

EBASCO SERVICES INCORPORATED

ISTURE & DENSITY TESTS USING SURFACE PROBES

ASTM D-2922 (81 R/92)

JPW-EC-023
1794-1101-C-CV-
-0002

PROJ/AMO: 4794

9660 AXC: NA

chtel

WORK PACKAGE NO.: 92-WPW-EC-023

QCIR NO.: 92IR15-E-4794-1101-C-CV-G-0006-0002

:D: 7.6.92

ound Soils

: compaction

ON: Kaolin Clay

A: 95% compaction ; 90-94 PCF Dry Density

C-CV-G-0006 R/1

l Ground Soils Dynamic Compaction F Lift Partial

T NO.	74	75				
s cap	80' N	15' N				
pprox.	10' E	20' E				
pprox.	295.9	295.9				
. FT.) ▲	117.4 / 118.9	116.2 / 117.2				
	NA	NA		N		
. FT.)	93.3 / 93.0	91.4 / 92.0				
l to 0.5%	27.7 / 27.5	27.7 / 27.5				
ROCTOR)	94.2	94.2			A	
ounded to 0.5%	26.4 / 26.5	26.4 / 26.5				
ED	95.0	95.0				
ded to 0.5%	98.7 / 98.5	97.7 / 97.5				

A

MODEL: 3440 SERIAL #: 17494

#: WER-ERC-92-0544 DESIGN CAT: GS

OF LAST 4 STANDARD COUNTS (No): 3820

NDARD COUNTS (Ns): 3818

OF LAST 4 STANDARD COUNTS (No): 601

NDARD COUNTS (Ns): 608

GS

ASTM D-2216 ( ) ☐ ASTM D-3017 ( ) ☑ ASTM D-4643 (87)

to lab # S92-723	PROCEDURE: C-QCP-021
A CR #: NA	REV: 0
NFORMING ☐ NONCONFORMING ☐ N/A	PCN'S: NA
: density adjusted by a	SPECS: C-SPC-G-00041 ▲▲
▲▲ per page C2, par. 8 MK 7.6.92	REV: 2
	DCF'S: N/A
[signature] LEVEL: II DATE: 7.6.92	STANDARDS: N/A
[signature] LEVEL: II DATE: 9-15-92	

QCP-021

-G-00041

/

N/A

MJR 09-15-92

MJR 09-15-92

FOR INFORMATION ONLY

ASR 18-178 (3/92)
FILE ID # 80143

EBASCO SERVICES INCORPORATED

DETERMINATION OF WATER CONTENT

☐ ASTM D-2216 ( )   ☑ ASTM D-4643 (87)

REPT #: 4129 PROJ/AMO: 4794
DA: C001 TWC: 9660 AXC: NA
LAB #: S92-723 DATE TESTED: 7-6-92

WORK PACKAGE NO.: 92-WPW-EC-023
QCIR NO.: 92IR15-E-4794-1101-C-CV-G-0006-0002

ACCPT. CRITERIA: Avg. 28-30% moisture content

MATERIAL DESCRIPTION: Kaolin Clay

LOCATION: Burial Ground Soils Dynamic Compaction; Partial F Lift

▲MK 7-6-92

▲~~BORING~~ microwave NUMBER	1	2	4	5	6	7	8
SAMPLE NUMBER	1	2	3	4	5	6	7
WT. OF WET SAMPLE ~~+ TARE~~▲	113.91	113.85	113.19	114.31	113.81	113.95	113.69
WT. OF DRY SAMPLE ~~+ TARE~~▲	88.82	86.77	86.23	89.71	87.94	87.67	87.11
WEIGHT OF MOISTURE	25.09	27.08	26.96	24.60	25.87	26.28	26.58
TARE WEIGHT	NA	NA	NA	NA	NA	NA	NA
~~WEIGHT OF DRY SAMPLE~~▲ % moisture	28.2	31.2	31.3	27.4	29.4	30.0	30.5
% MOISTURE rounded to 0.5%	28.0	31.0	31.5	27.5	29.5	30.0	30.5

▲~~BORING~~ microwave NUMBER	9	10	11	1	2		
SAMPLE NUMBER	8	9	10	Auc #1	Auc #2 Sand cone		
WT. OF WET SAMPLE ~~+ TARE~~▲	113.65	113.72	114.11	113.84	113.61		A
WT. OF DRY SAMPLE ~~+ TARE~~▲	86.46	87.82	87.67	89.16	88.94		
WEIGHT OF MOISTURE	27.19	25.90	26.44	24.68	24.67	N	
TARE WEIGHT	NA	NA	NA	NA	NA	—	
~~WEIGHT OF DRY SAMPLE~~▲ % moisture	31.4	29.5	30.2	27.7	27.7		
% MOISTURE rounded to 0.5%	31.5	29.5	30.0	27.5	27.5		

MINIMUM SIZE SAMPLE ☑ CONFORMING ☐ NONCONFORMING REMARKS: NA

MORE THAN ONE SOIL TYPE: No

METHOD OF DRYING: ☐ 230 +/- 9 DEGREES F ☑ OTHER: microwave

MATERIAL (SIZE/AMOUNT) EXCLUDED FROM TEST: NA

M&TE: S-73 (6-23-93)
NCR #: NA CR #: NA
TEST RESULTS: ☑ CONFORMING ☐ NONCONFORMING ☐ N/A
REMARKS: official tests, Panel Avg. 29.5 MK 7-6-92
N/A

PROCEDURE: C-QCP-021
REV: 0
PCN'S: NA
SPECS: C-SPC-G-00041
REV: 2
DCF'S: N/A
STANDARDS: N/A

INSPECTOR: M. Koval LEVEL: II DATE: 7-6-92
REVIEWER: [signature] LEVEL: II DATE: 9-15-92
DES. CAT: GS

MJR 09-15-92

Appendix B Seismic and Vibratory Data

Appendix B consists of the preliminary, supporting data. This data was primarily used to calibrate the Dynamic Compaction Facility model with the actual Mixed Waste Management Facility. In addition, this work assessed the equipment and instrumentation performance criteria for actual testing. The following is a listing of the different sections within appendix B:

- Appendix B.1 presents the supportive data from the Spectral Analysis of Shear Waves (SASW) technique, which analyzed the similarities between the Dynamic Compaction Facility kaolin clay cap and the Mixed Waste Management Facility kaolin clay cap.
- Appendix B.2 presents the supportive data from the low-strain refraction surveys. Though this method was not particularly successful, it did provide a validation of the determination of the shear wave velocity.
- Appendix B.3 presents the supportive data from the impact velocity calibration. This work quantified the efficiency of the production crane in preparation to configure the actual dynamic compaction test.

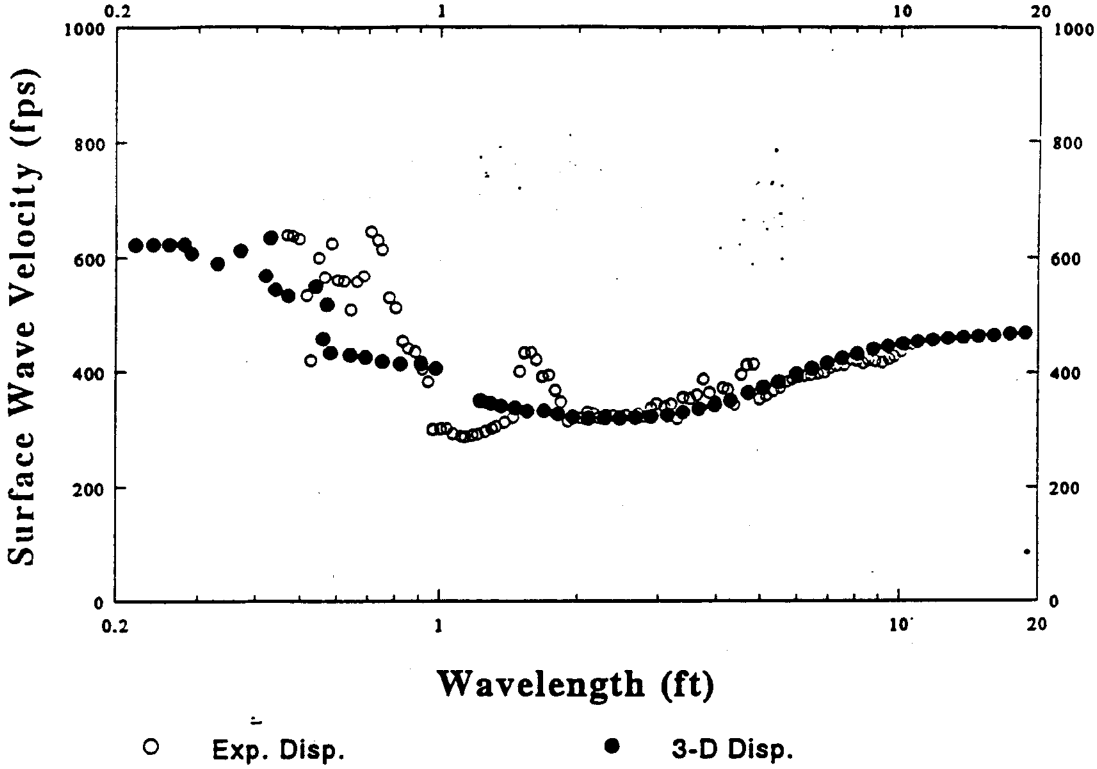
Appendix B.1 Spectral Analysis of Shear Waves

The impact of a dynamic compaction weight induces cyclic vibrations into the soil structure, similar to that from an earthquake. The dynamic displacement exerted on a structure is the mechanism for damage. To correctly assess the risk to the MWMF kaolin closure system, the seismic characteristics of the soils and structures, combined with strong motion monitoring during testing allow a quantification of damage thresholds.

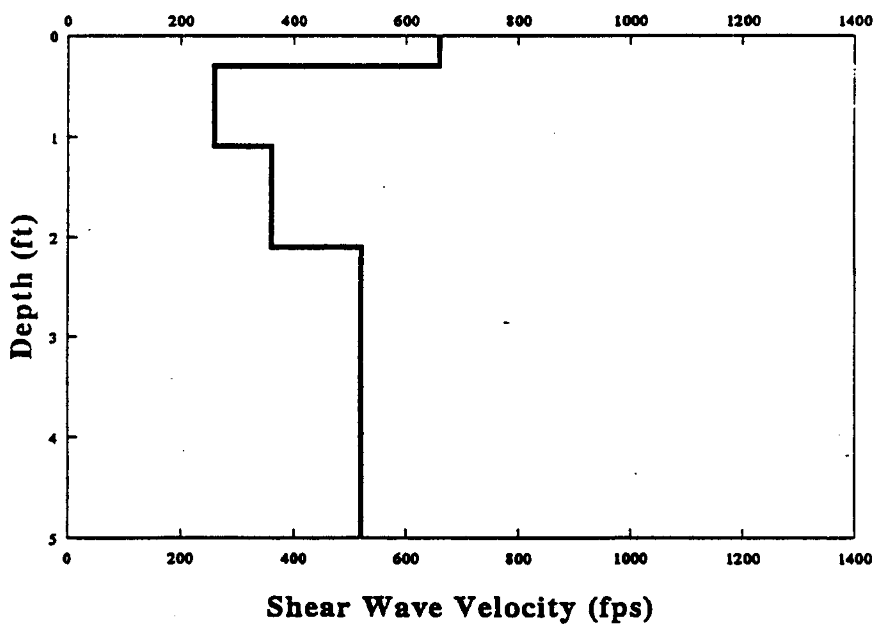
Shear wave analysis was done on both the MWMF and the DCF kaolin clay closure systems. The Spectral Analysis of Shear Waves method of analysis allowed examination of the near surface soil layers. From this analysis, the MWMF kaolin clay was found to be more "stiff" than the DCF kaolin clay. This stiffness is attributed to desiccation and aging of the MWMF clay.

The data included herein is a synopsis from the EBASCO report [4]. If a more complete data set is required, the information can be obtained from this reference.

Experimental and Theoretical Dispersions

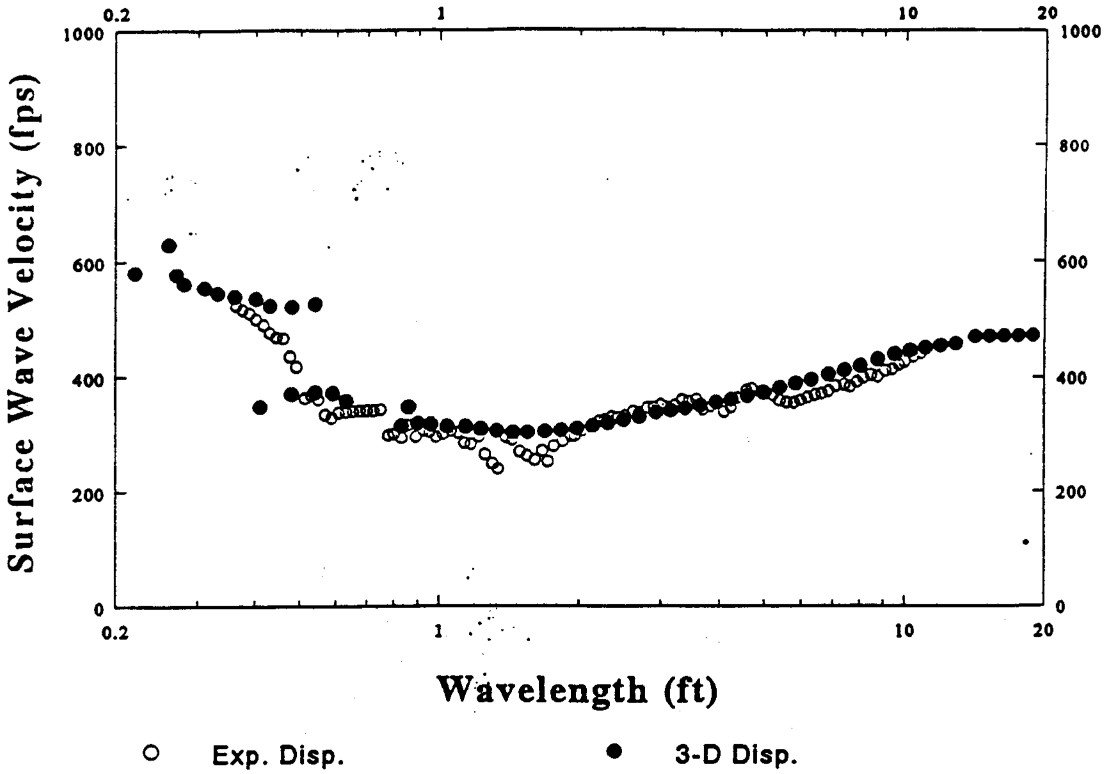


Shear Wave Velocity Profile

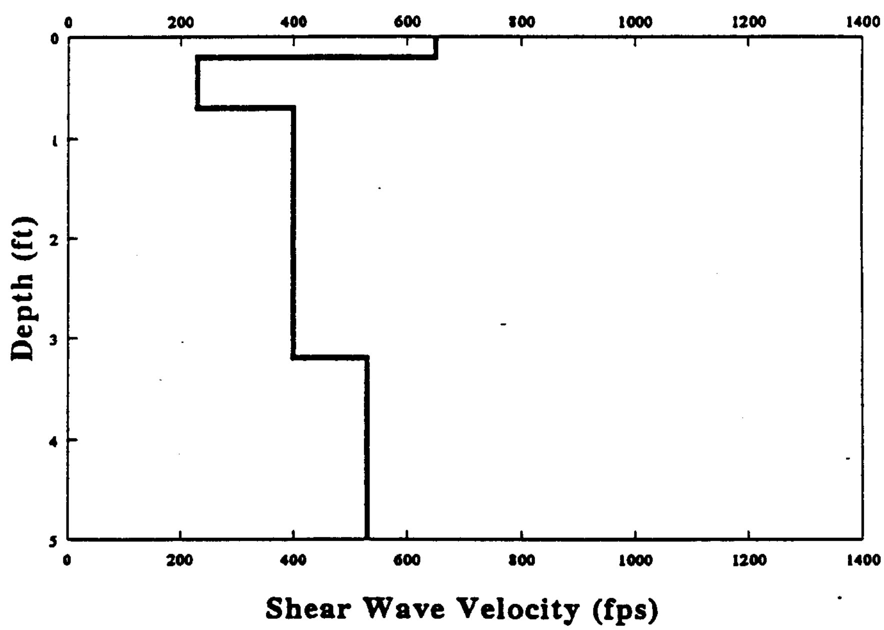


Job 205 Dynamic Test Facility - Site 2 (North - South) Fig. A-2

Experimental and Theoretical Dispersions



Shear Wave Velocity Profile

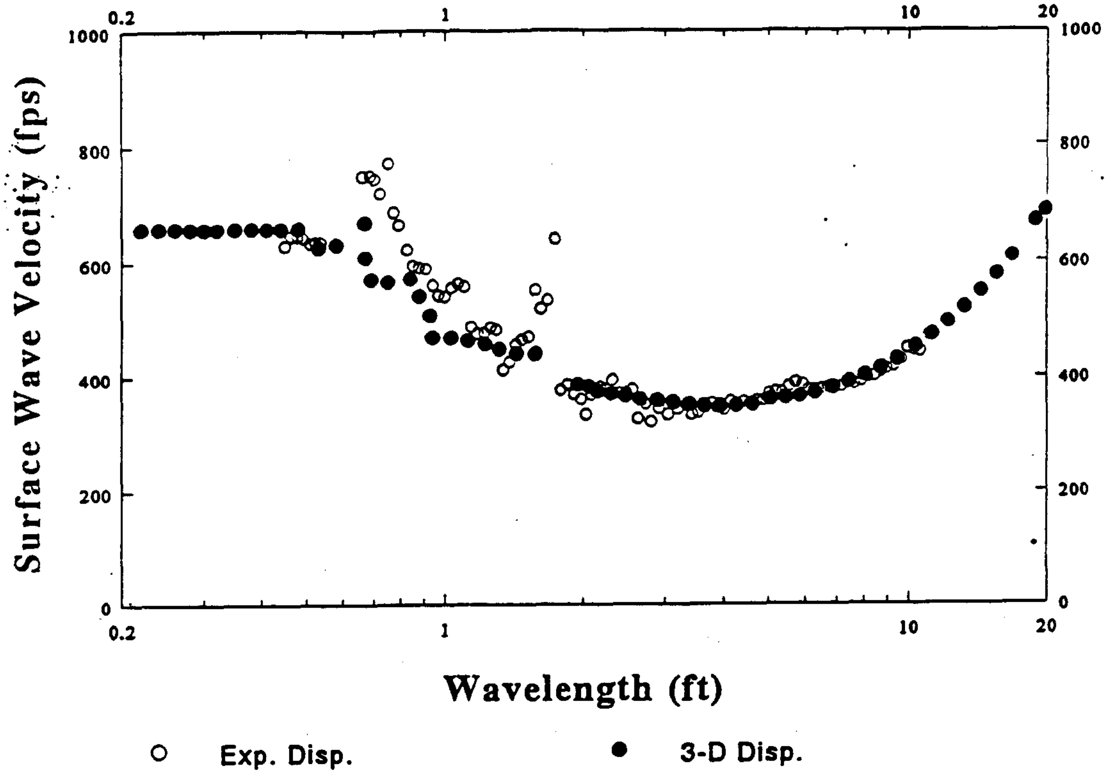


Job 205

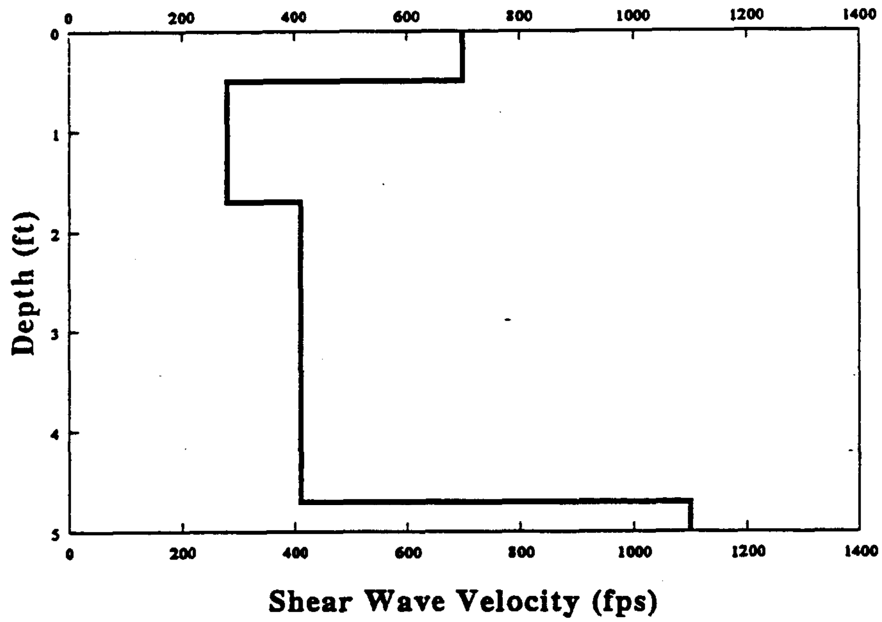
Dynamic Test Facility - Site 3 (East-West)

Fig. A-3

Experimental and Theoretical Dispersions



Shear Wave Velocity Profile

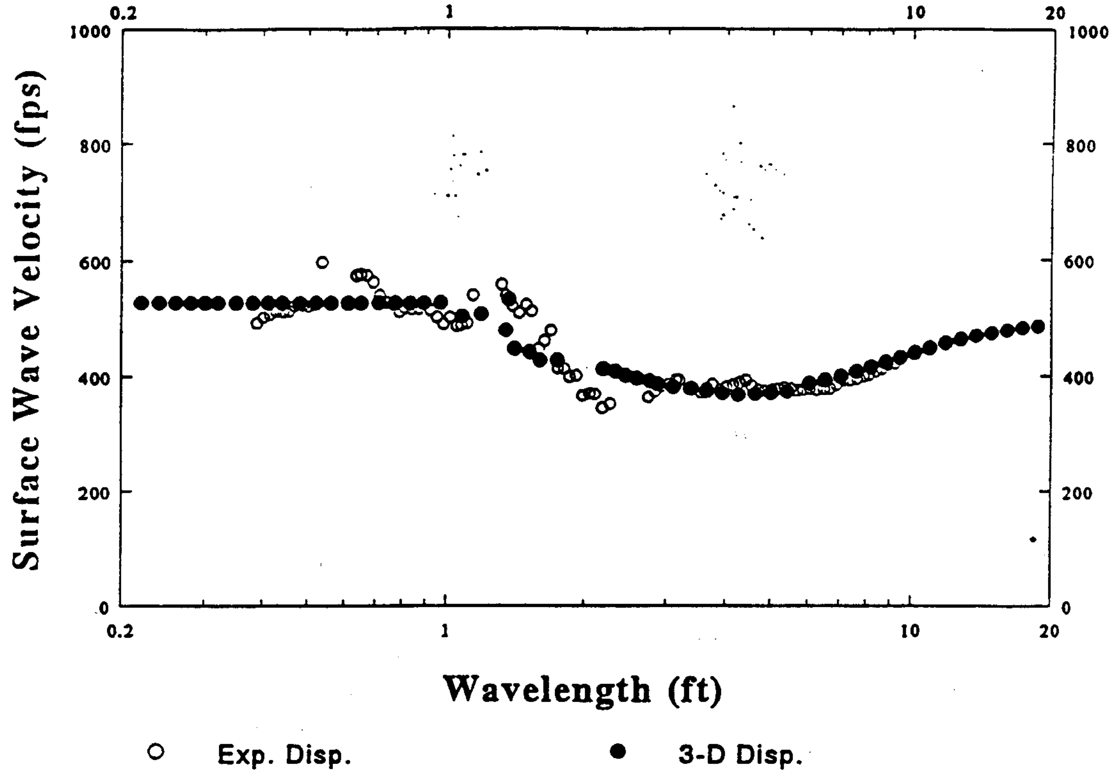


Job 205

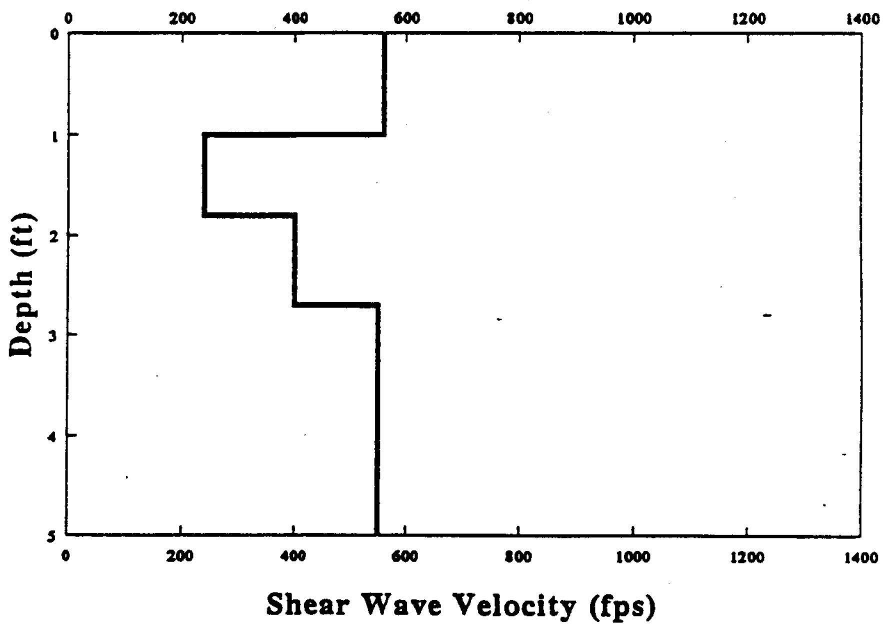
Dynamic Test Facility - Site 4 (East-West)

Fig. A-4

Experimental and Theoretical Dispersions

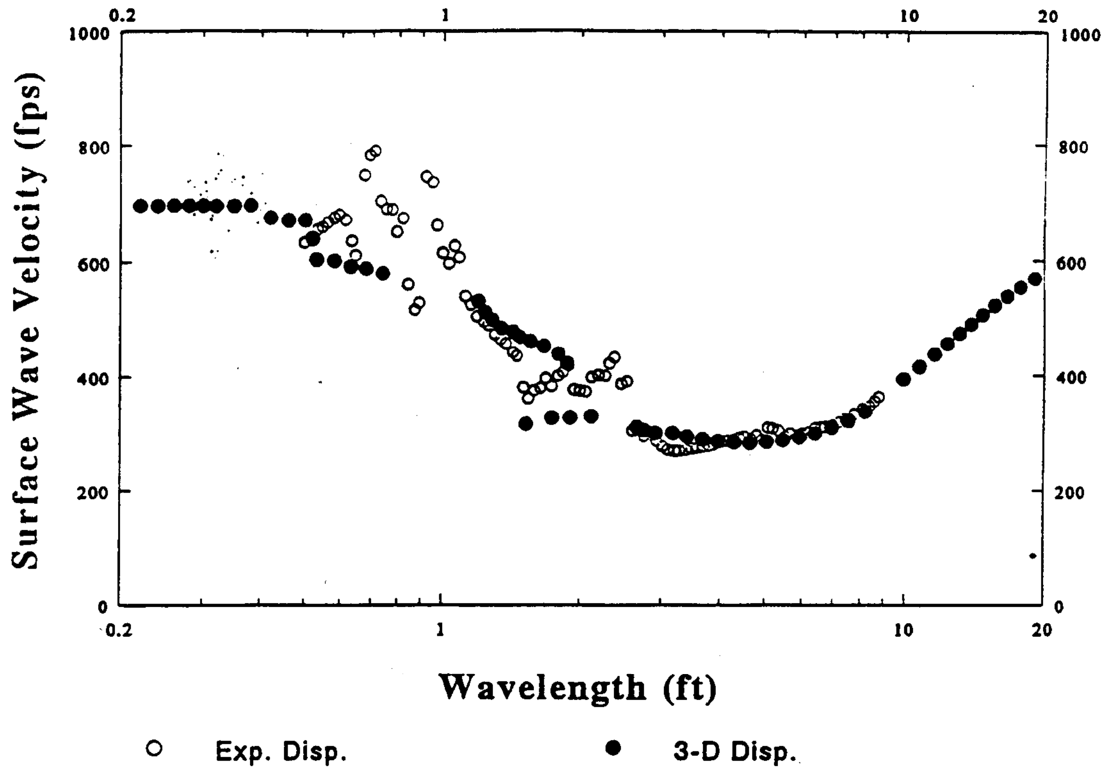


Shear Wave Velocity Profile

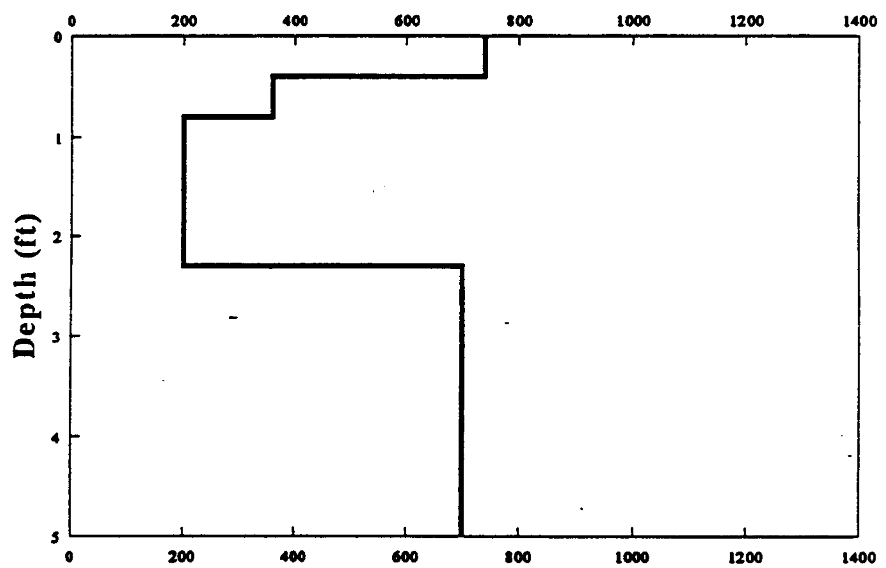


Job 205 **Dynamic Test Facility - Site 5 (East-West)** Fig. A-5

Experimental and Theoretical Dispersions

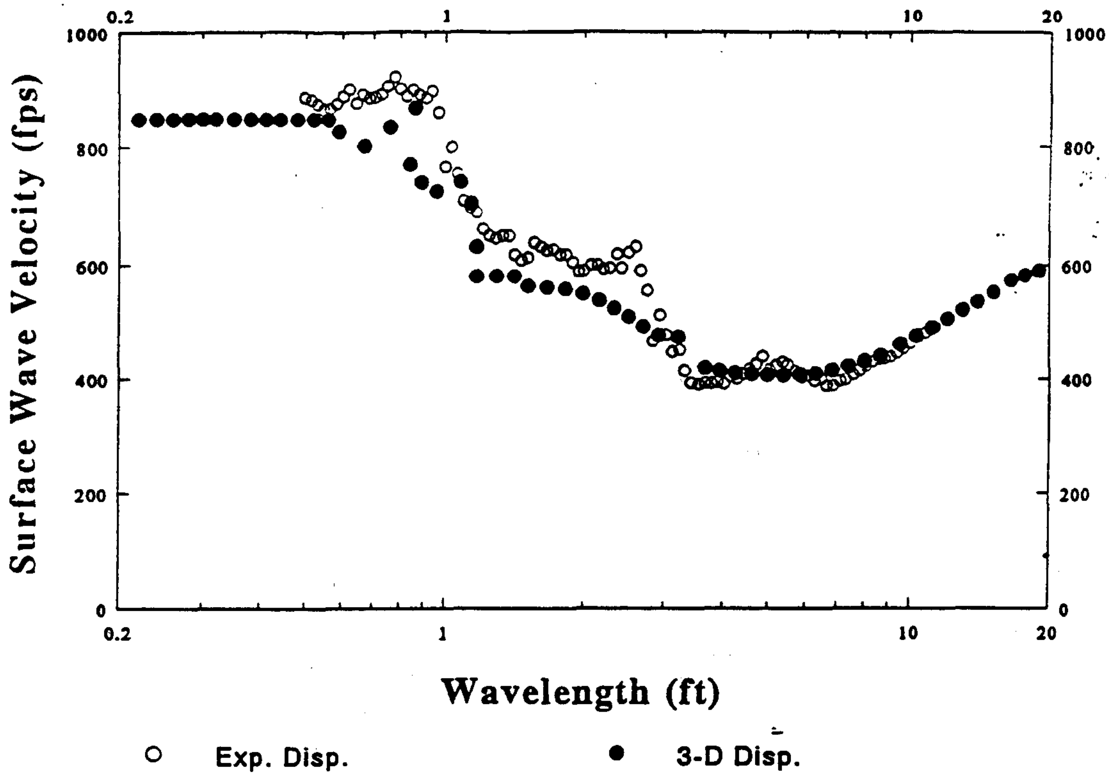


Shear Wave Velocity Profile

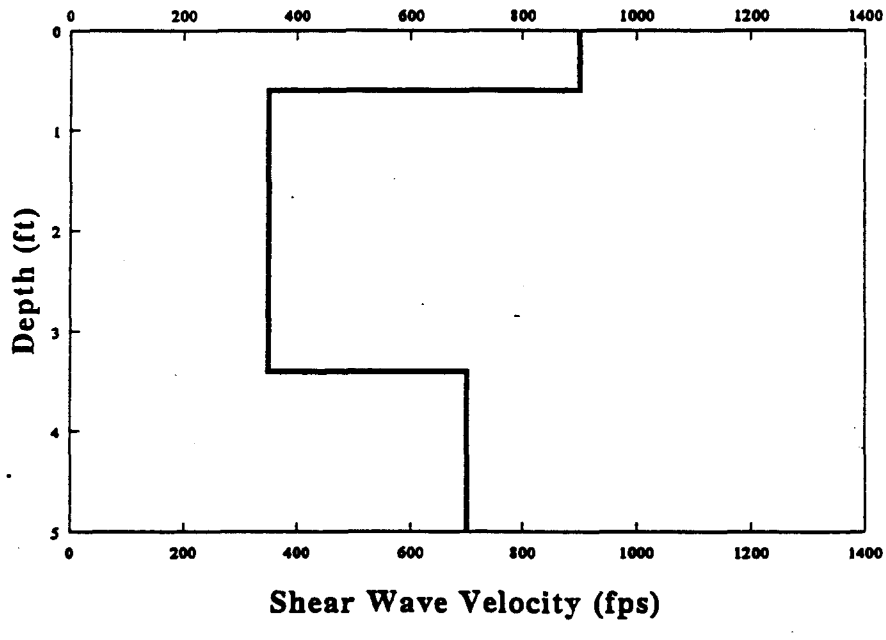


Job 205 **Dynamic Test Facility - Site 6 (North - South)** Fig. A-6

Experimental and Theoretical Dispersions



Shear Wave Velocity Profile

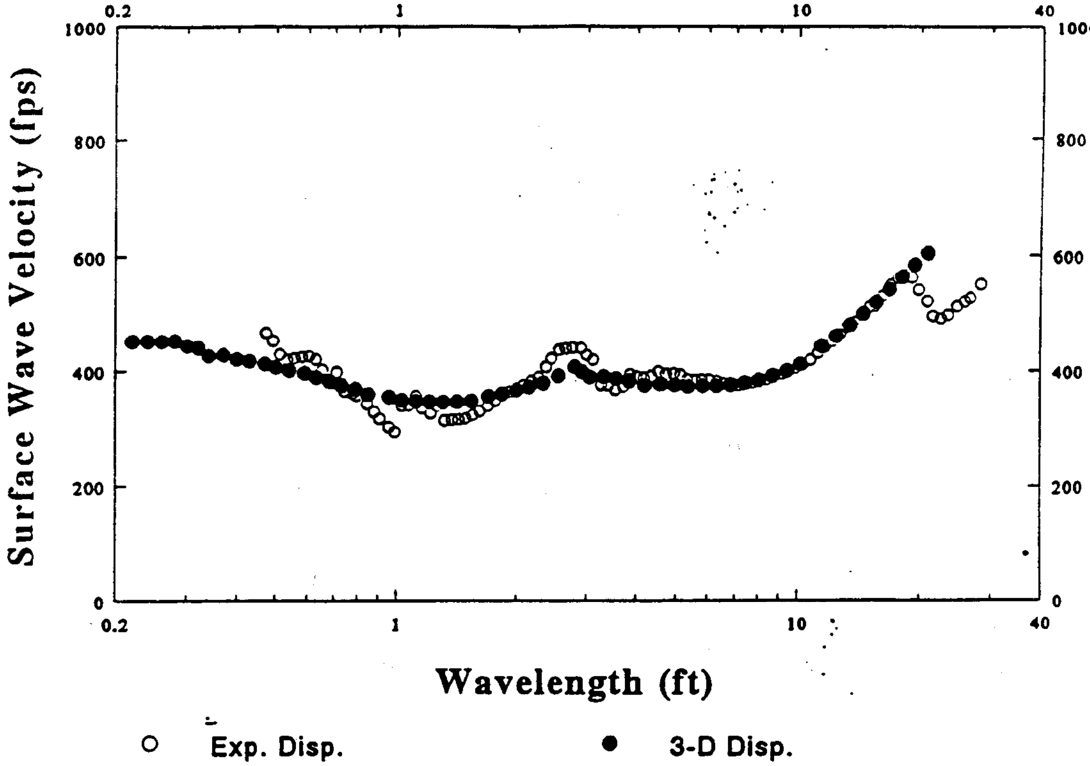


Job 205

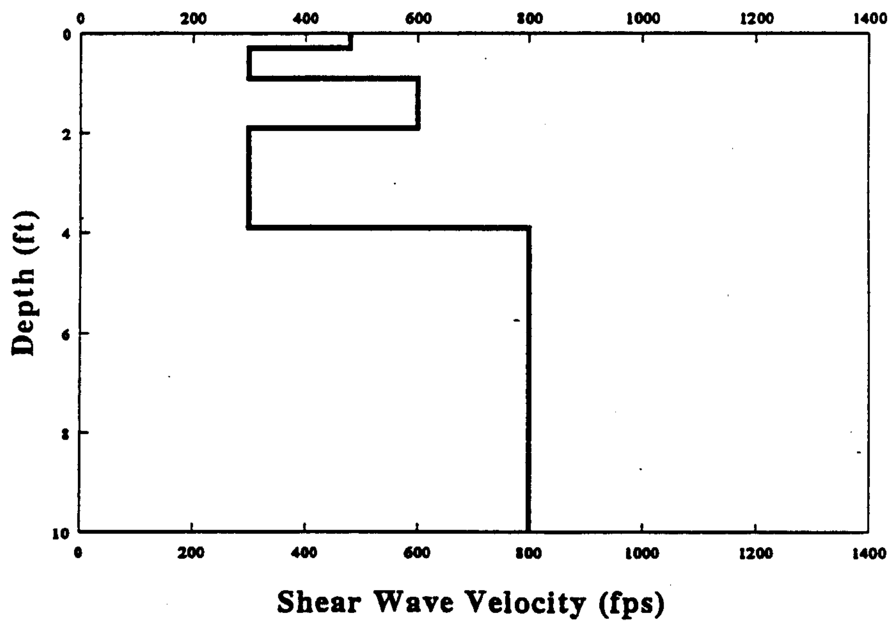
Dynamic Test Facility - Site 7 (East-West)

Fig. A-7

Experimental and Theoretical Dispersions



Shear Wave Velocity Profile

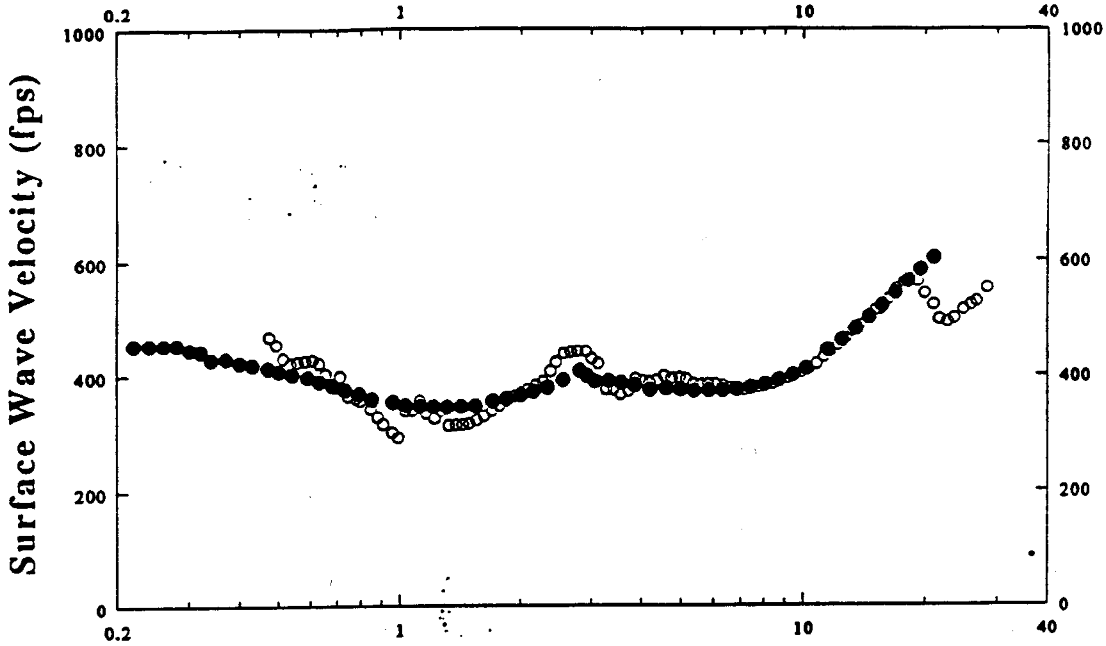


Dynamic Test Facility - Site 8 (North - South) Profile Depth < 10 ft

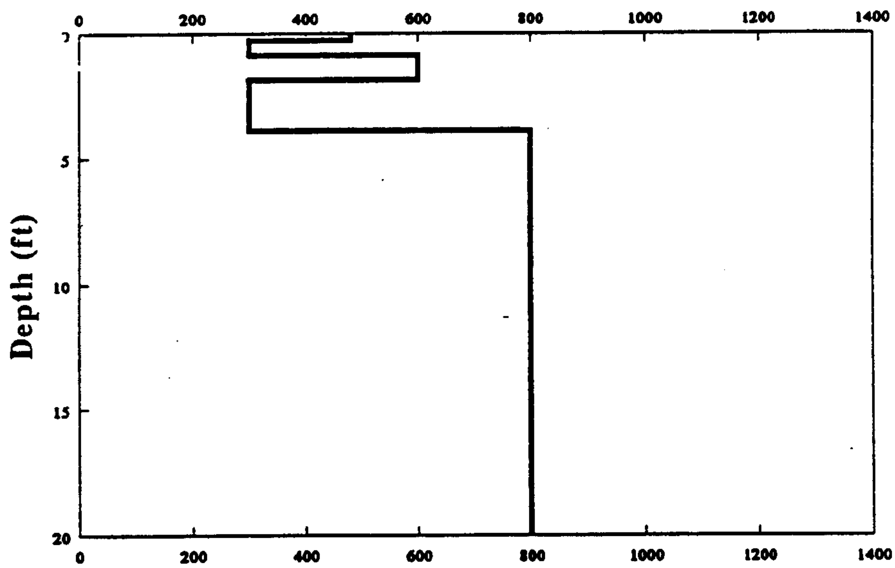
Job 205

Fig. A-8

Experimental and Theoretical Dispersions



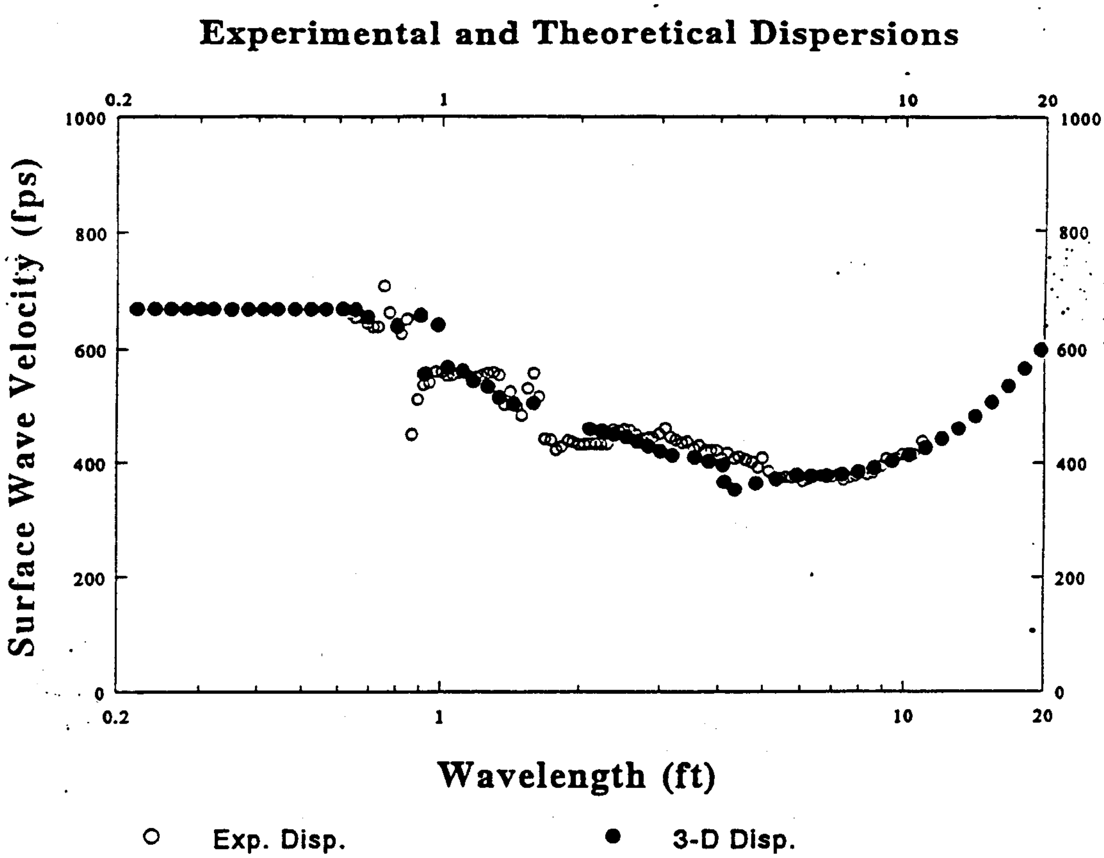
Shear Wave Velocity Profile

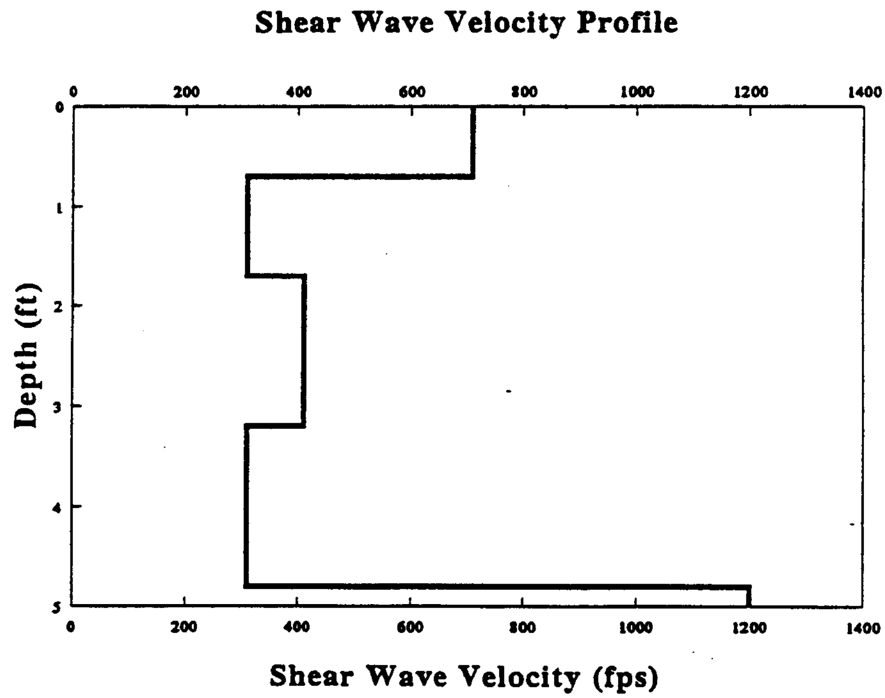


Dynamic Test Facility - Site 8 (North - South) Profile Depth < 20 ft

Job 205

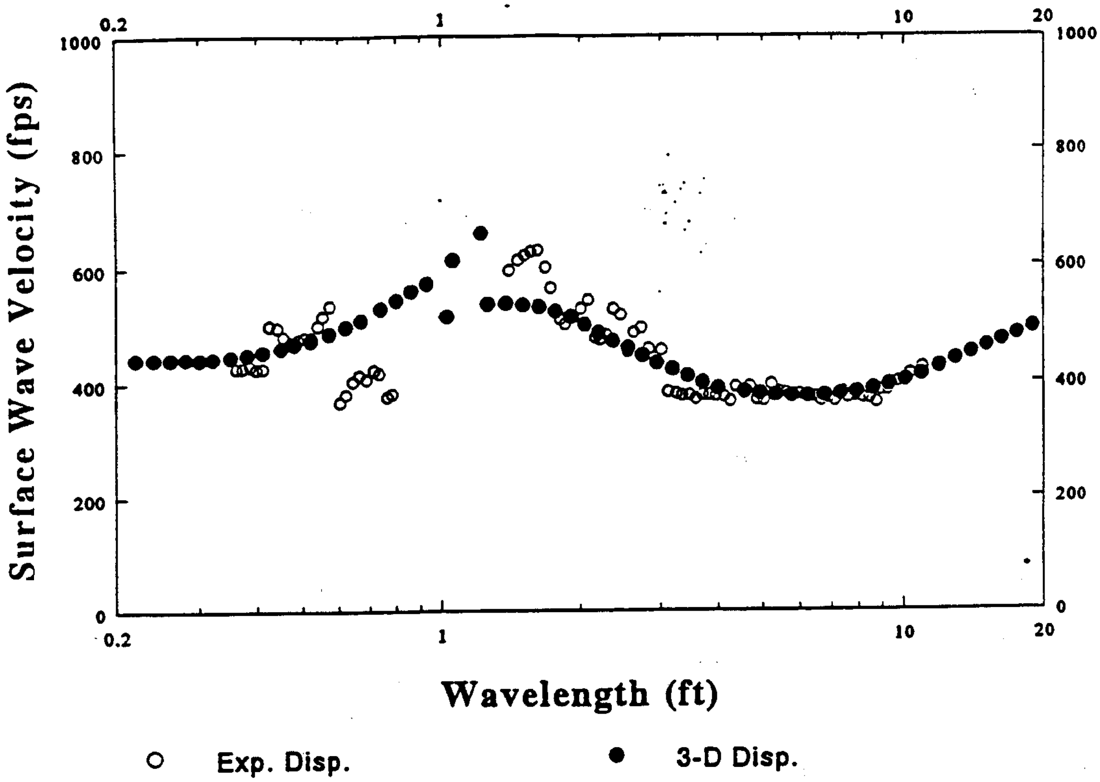
Fig. A-9



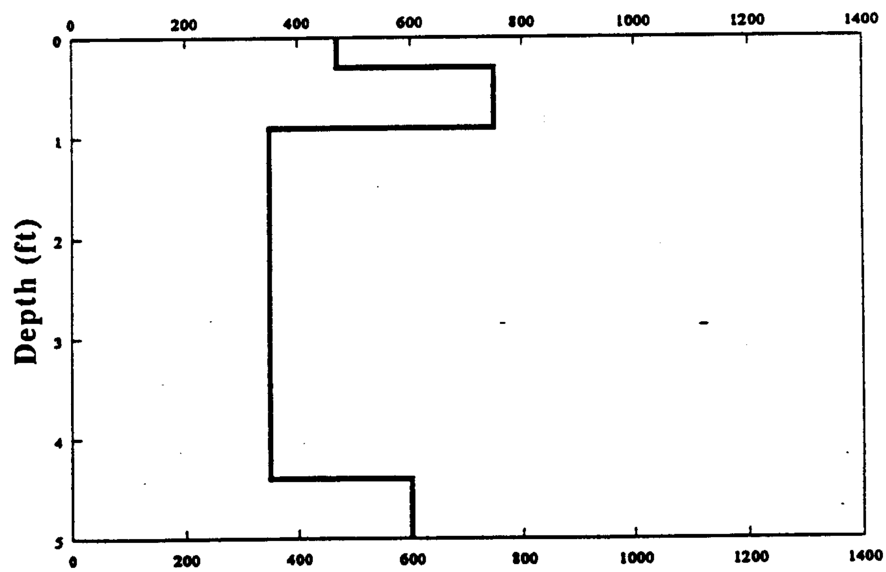


Job 205 Dynamic Test Facility - Site 9 (East - West) Fig. A-10

Experimental and Theoretical Dispersions



Shear Wave Velocity Profile

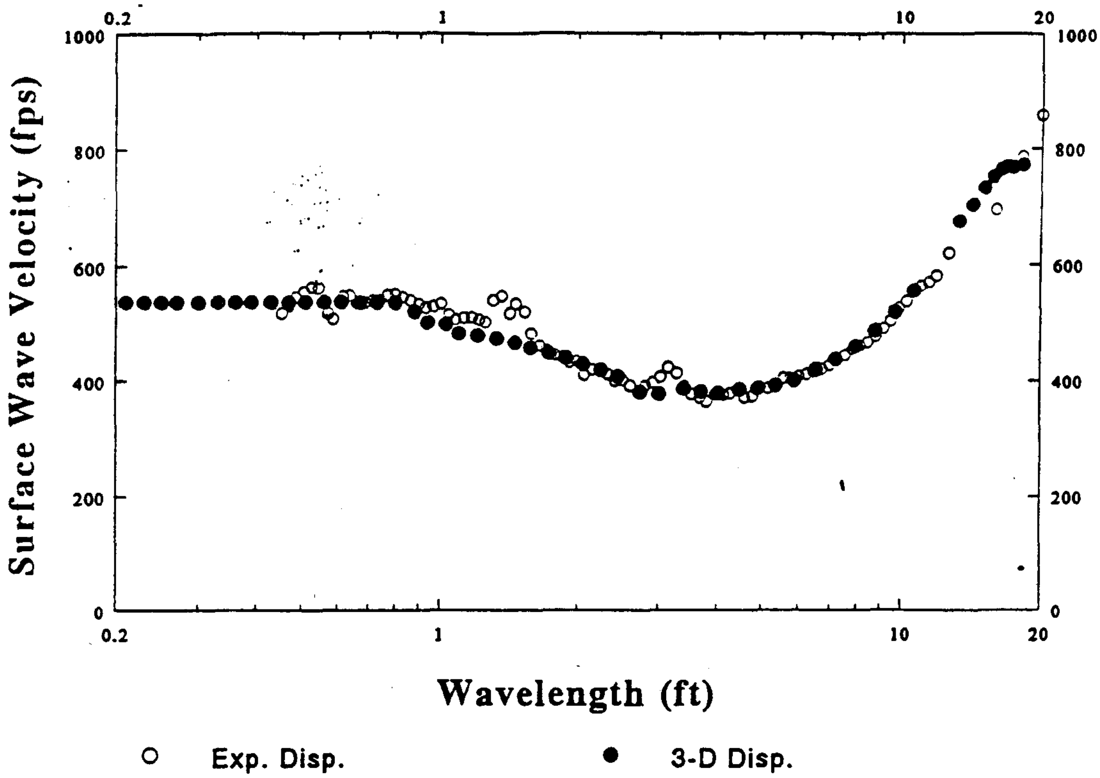


Dynamic Test Facility - Site 10 (North-South)

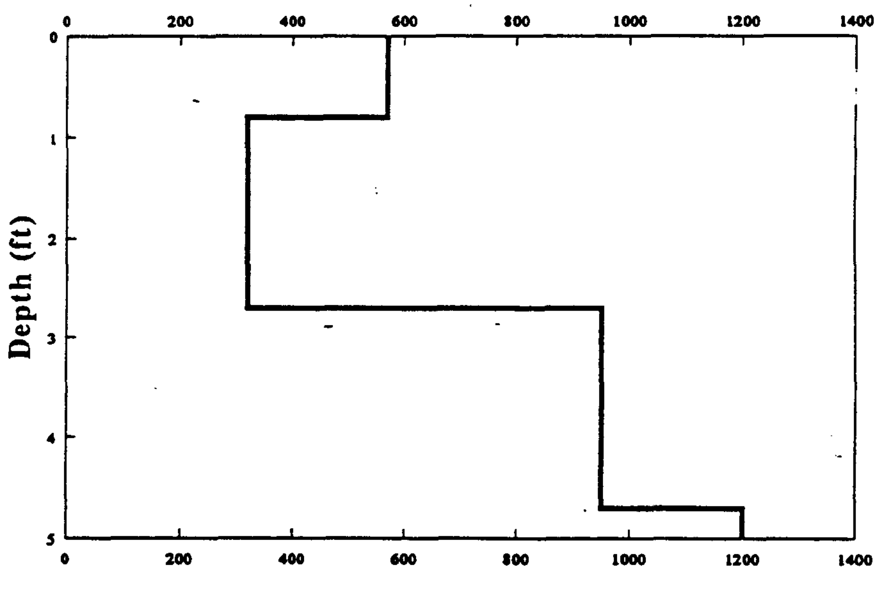
Job 205

Fig. A-11

Experimental and Theoretical Dispersions



Shear Wave Velocity Profile



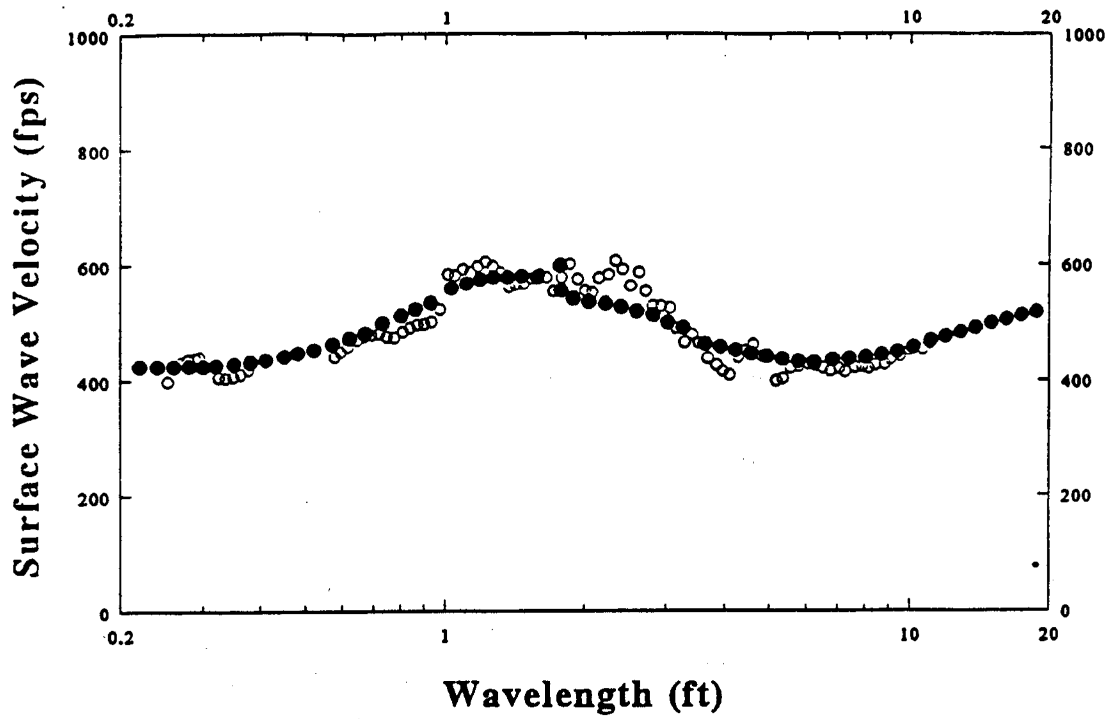
Dynamic Test Facility - Site 11 (North-South)

(Kaolin Clay Exposed is Excavation)

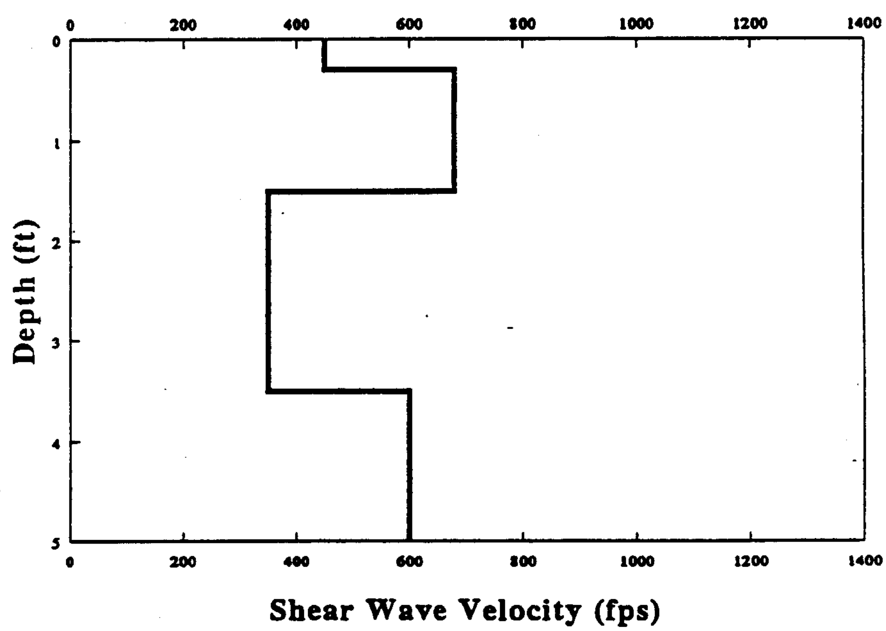
Job 205

Fig. A-12

Experimental and Theoretical Dispersions



Shear Wave Velocity Profile

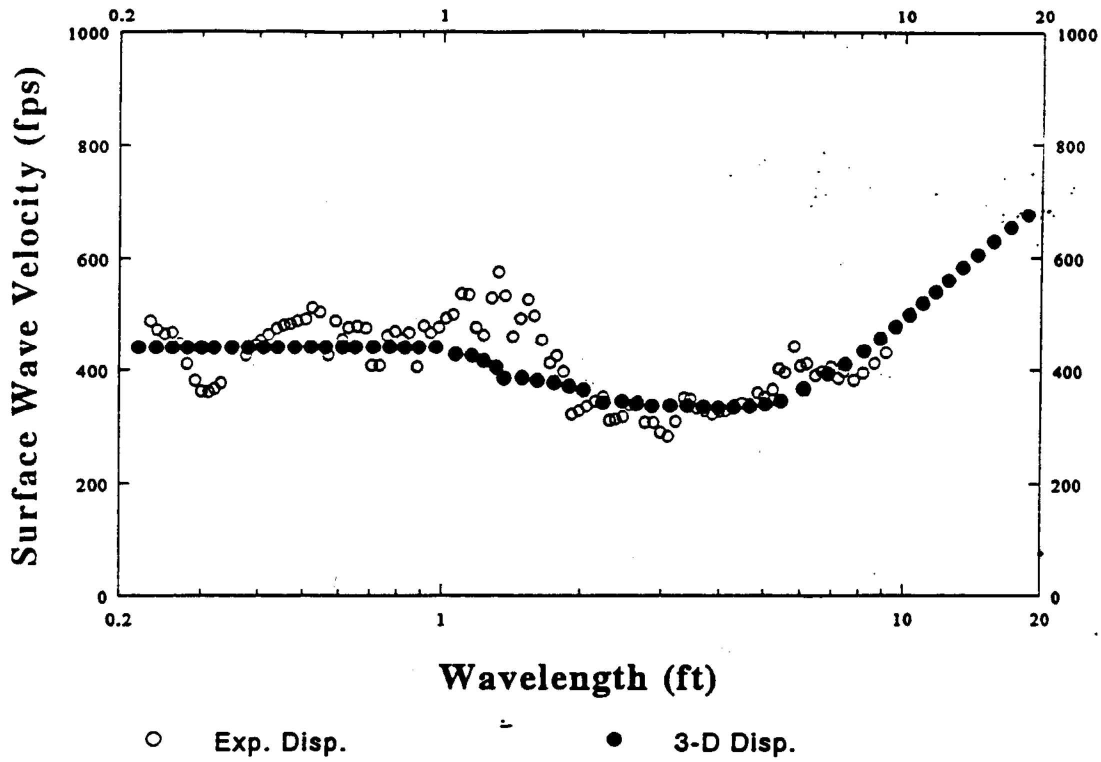


Dynamic Test Facility - Site 12 (East - West)

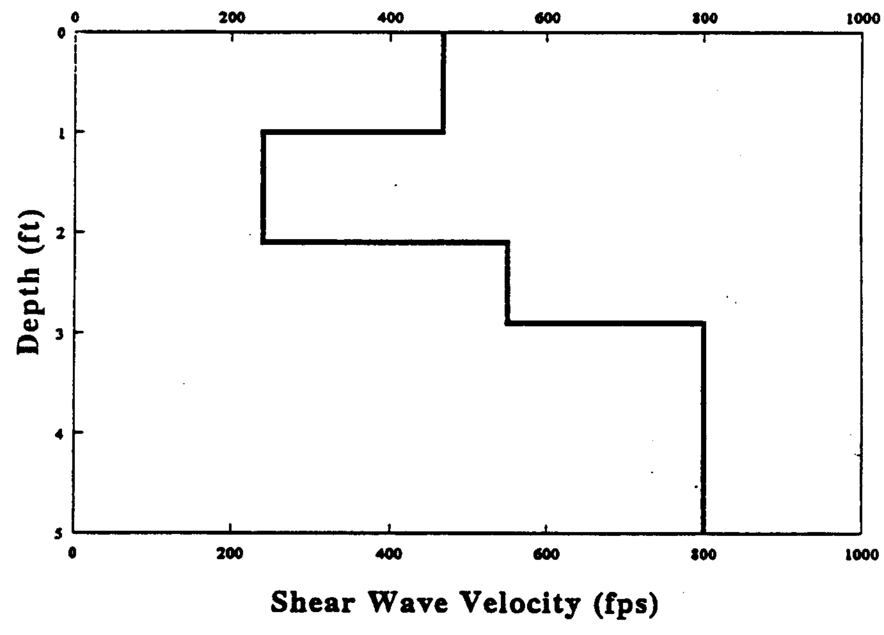
Job 205

Fig. A-13

Experimental and Theoretical Dispersions



Shear Wave Velocity Profile

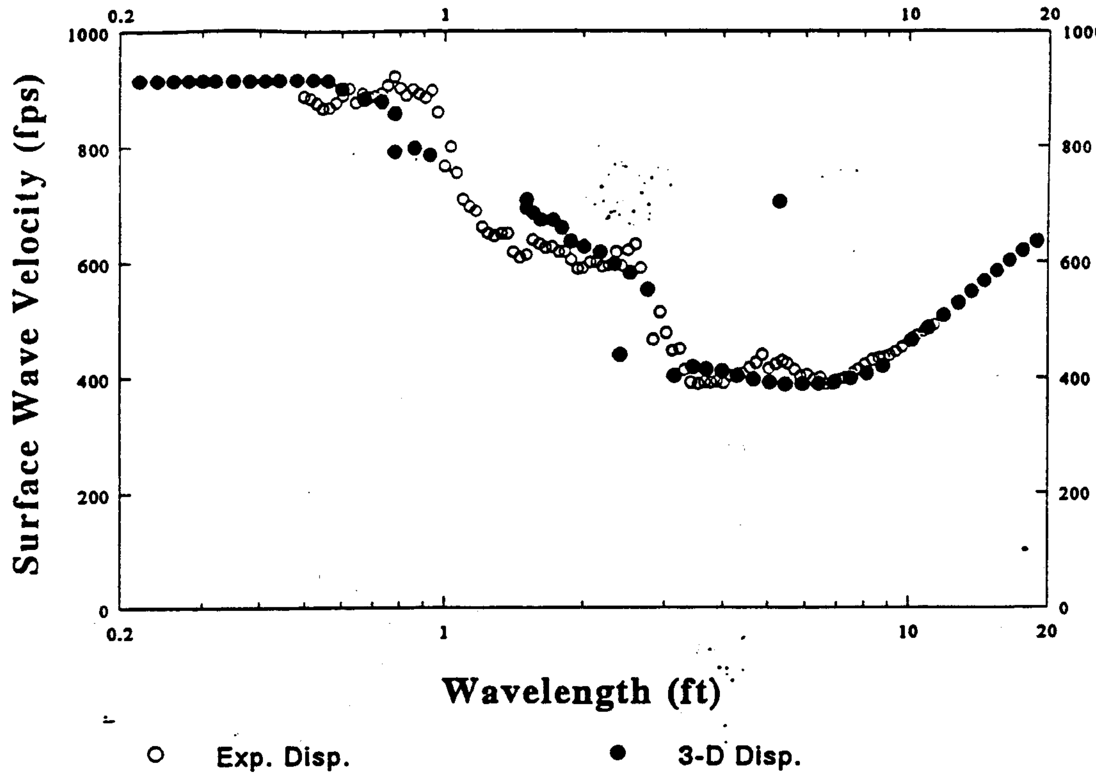


Job 205

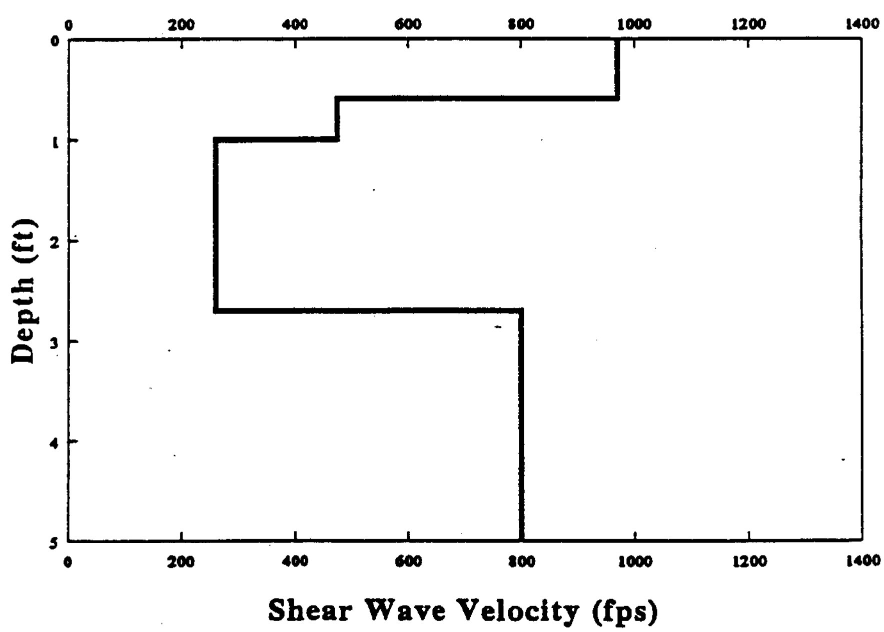
Dynamic Test Facility - Site 13 (North-South)

Fig. A-14

Experimental and Theoretical Dispersions



Shear Wave Velocity Profile

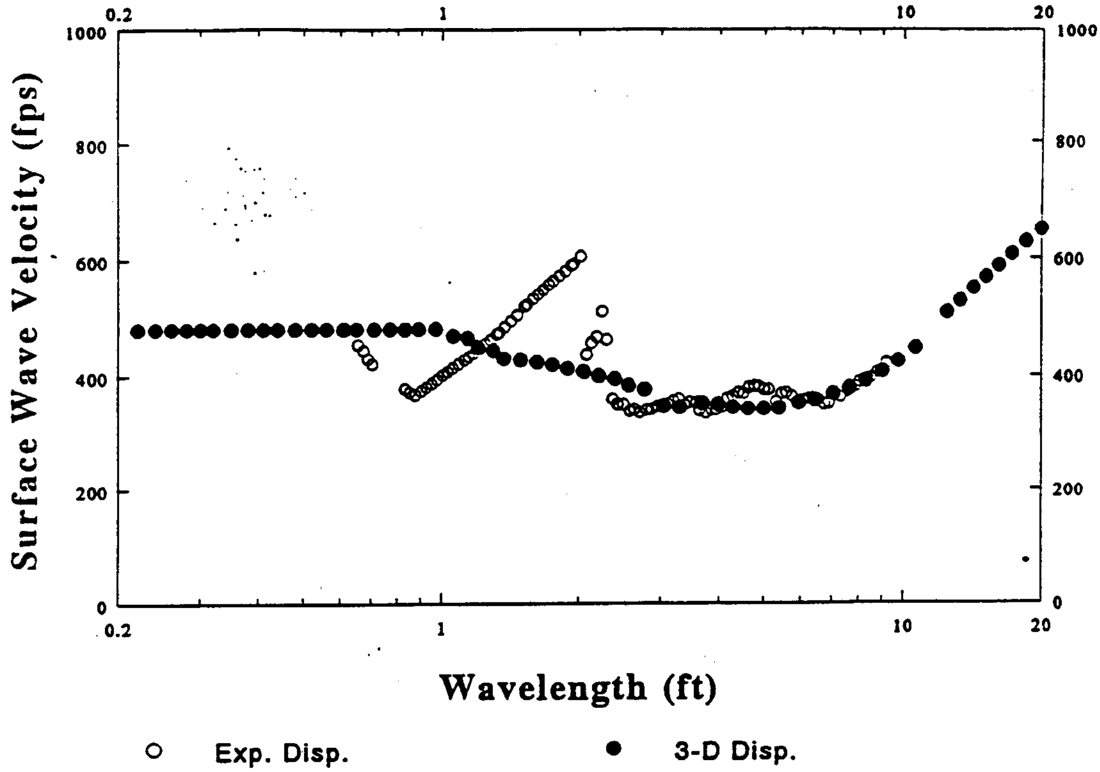


Job 205

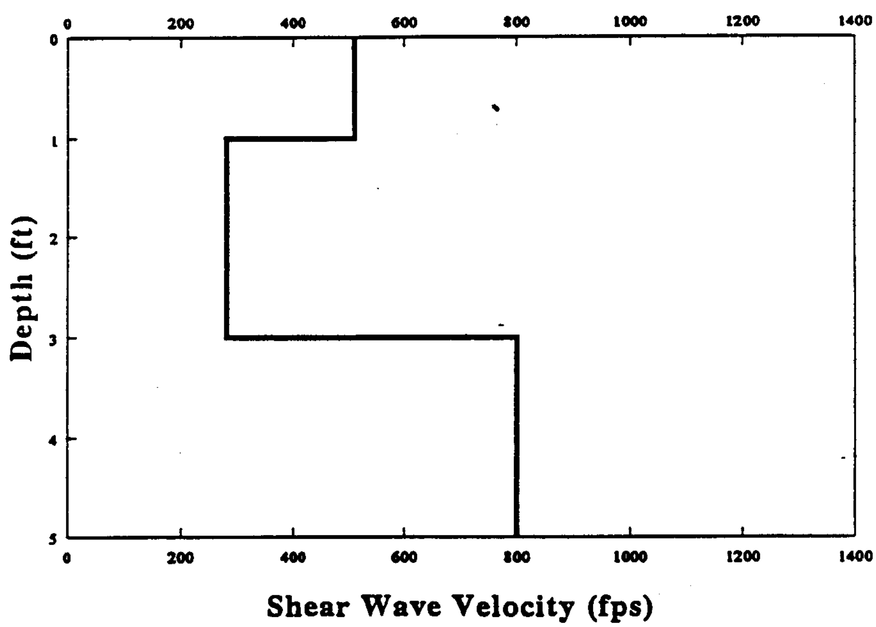
Dynamic Test Facility - Site 14 (East - West)

Fig. A-15

Experimental and Theoretical Dispersions



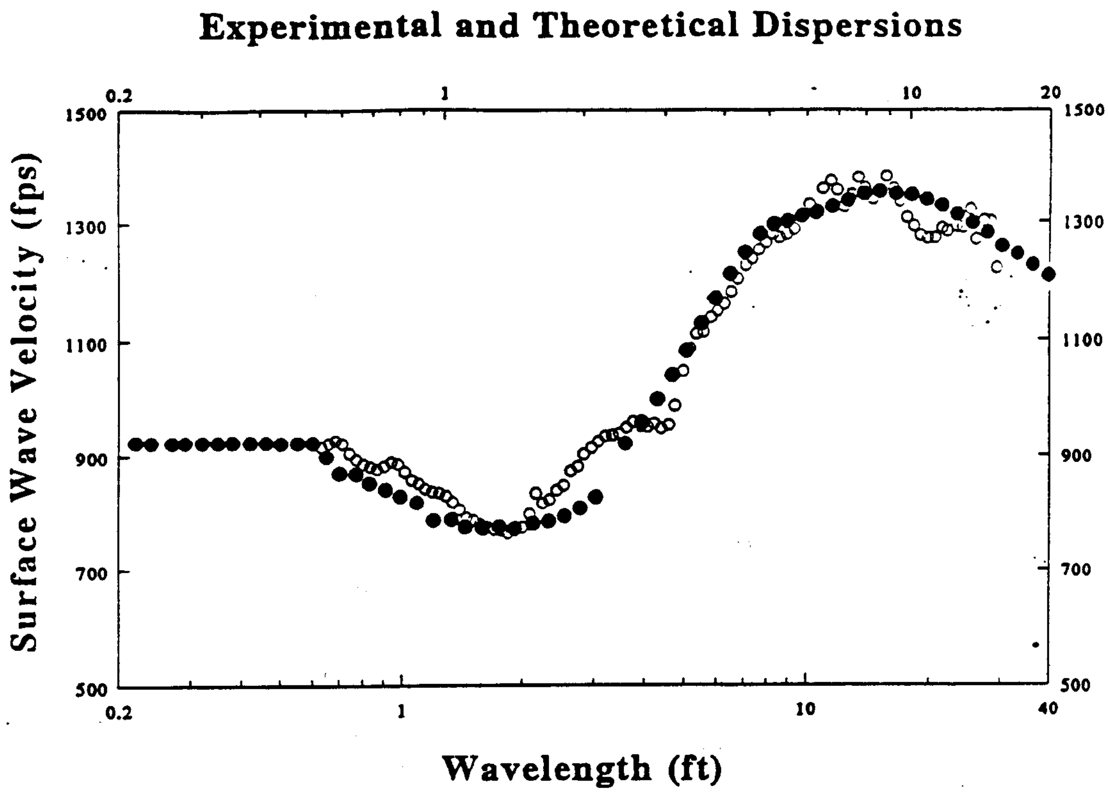
Shear Wave Velocity Profile

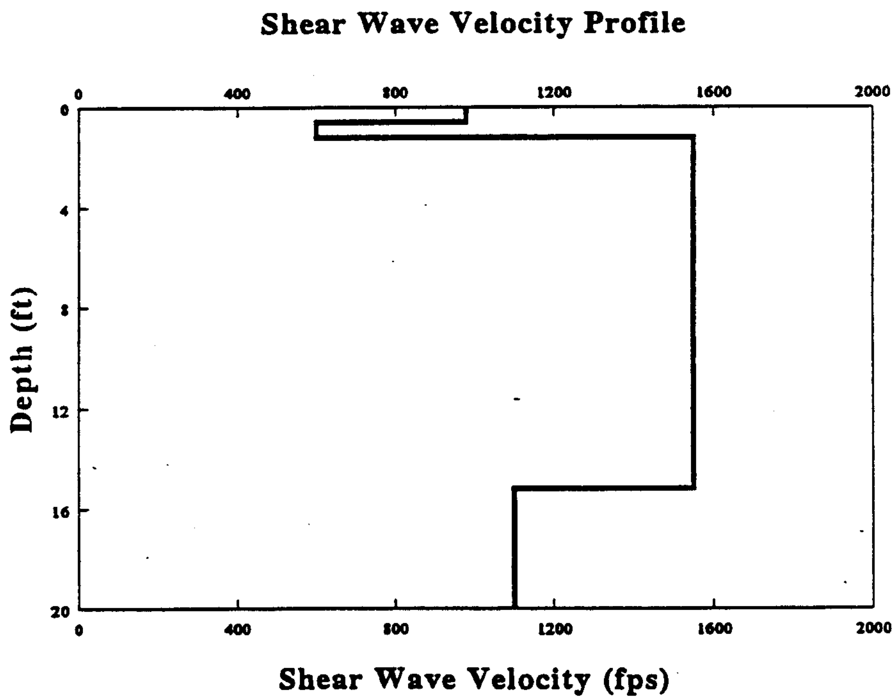


Job 205

Dynamic Test Facility - Site 15 (North - South)

Fig. A-16



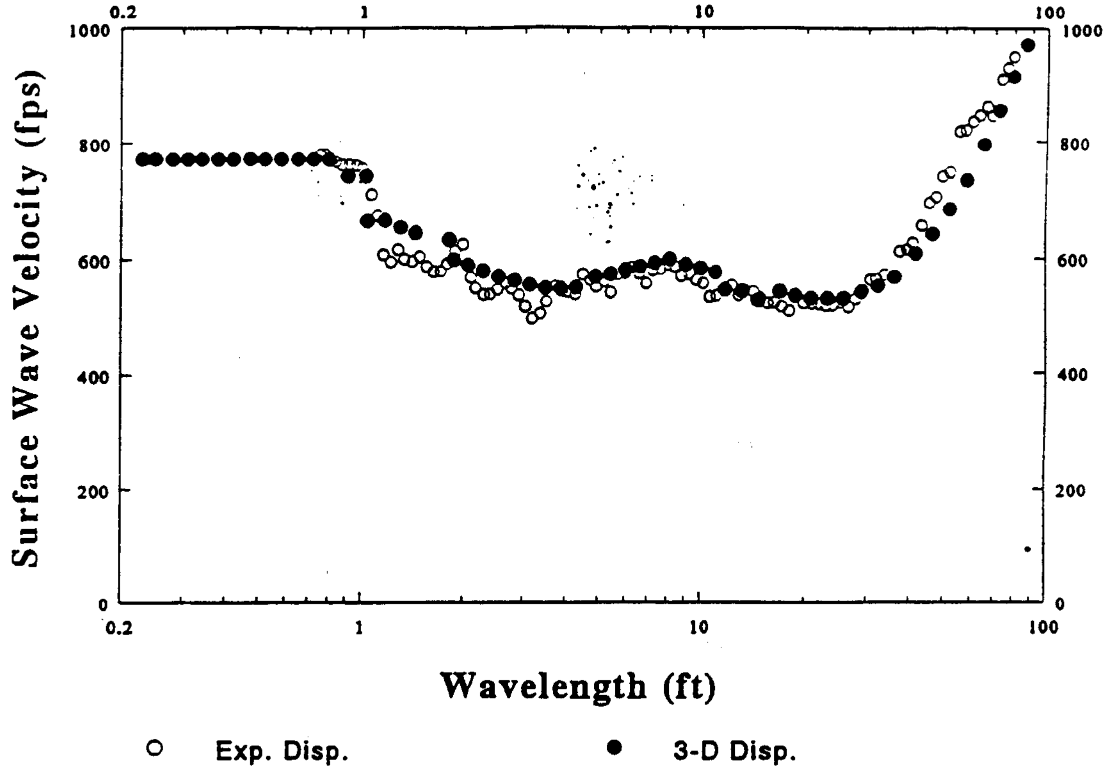


Dynamic Test Facility - Natural Ground Station 8 (East - West)

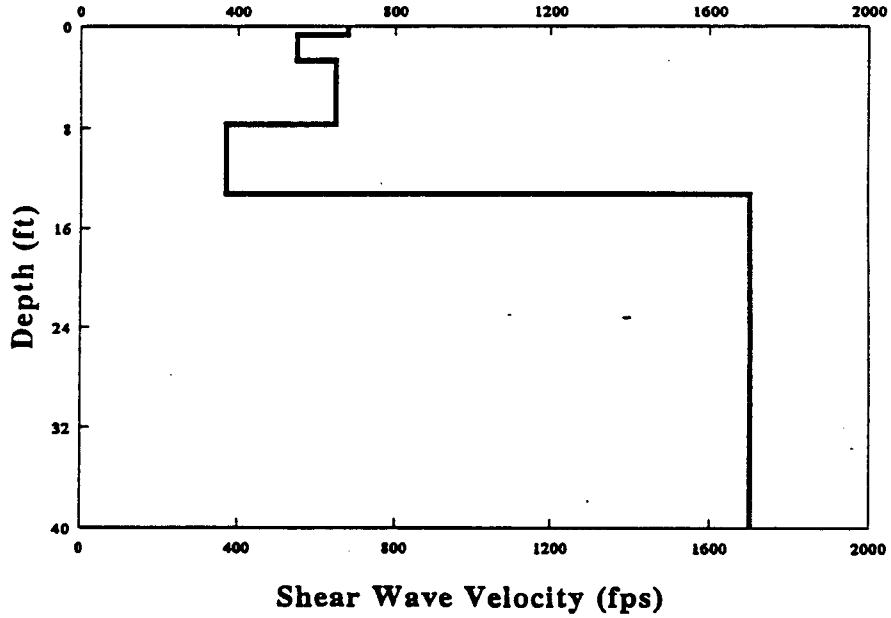
Job 205

Fig. A-17

Experimental and Theoretical Dispersions



Shear Wave Velocity Profile

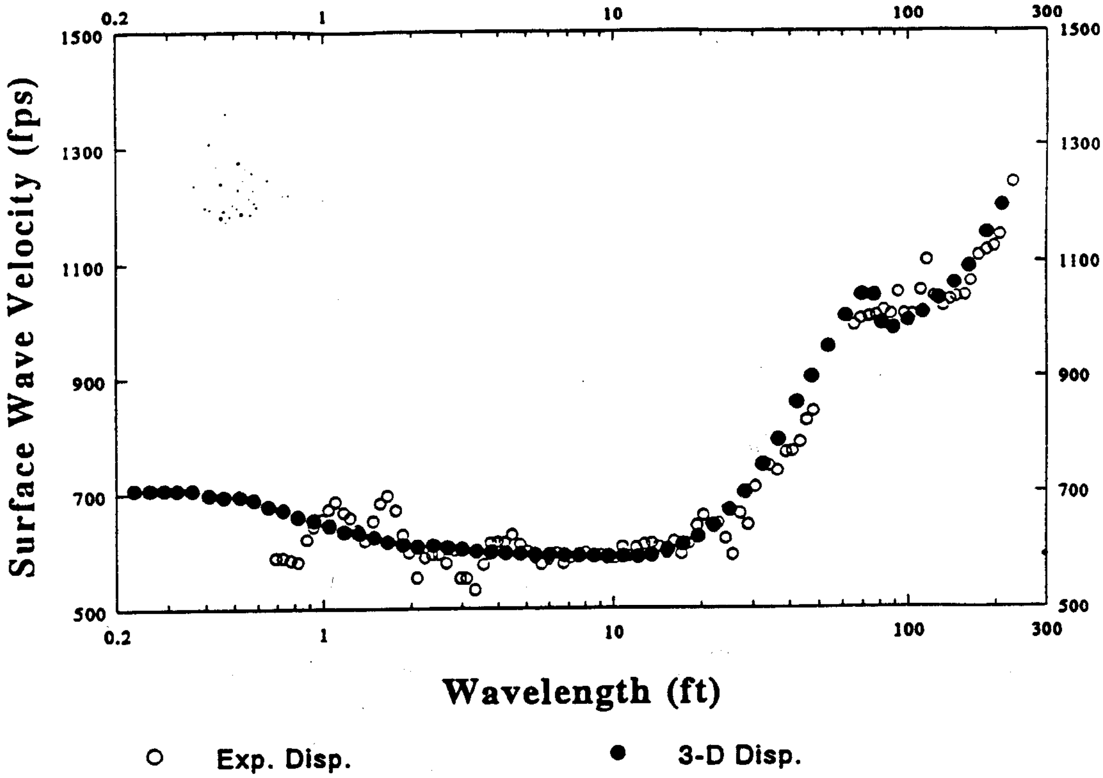


Job 205

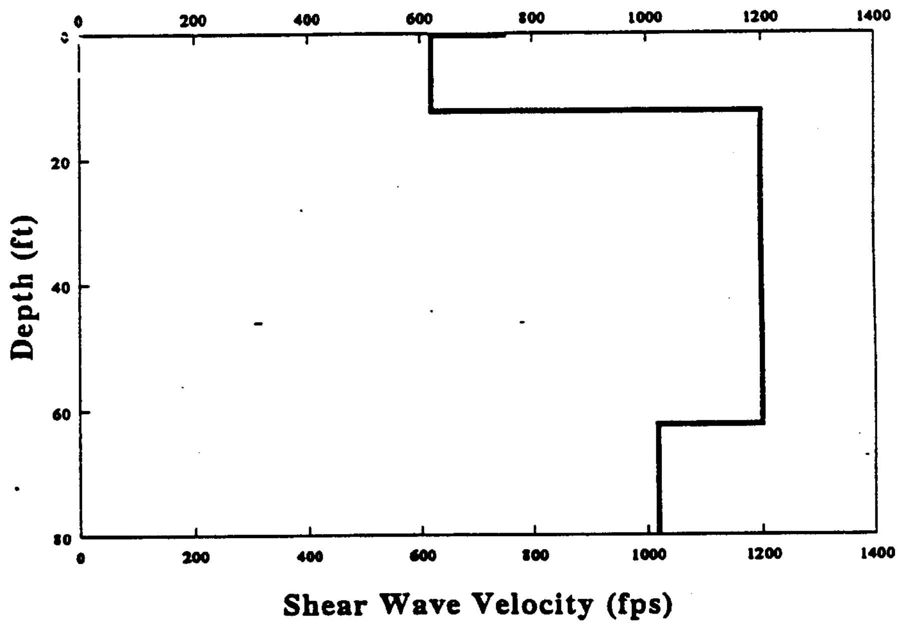
Boxes: Center (North-South)

Fig. A-18

Experimental and Theoretical Dispersions



Shear Wave Velocity Profile



Boxes: South Side (North-South)

Job 205

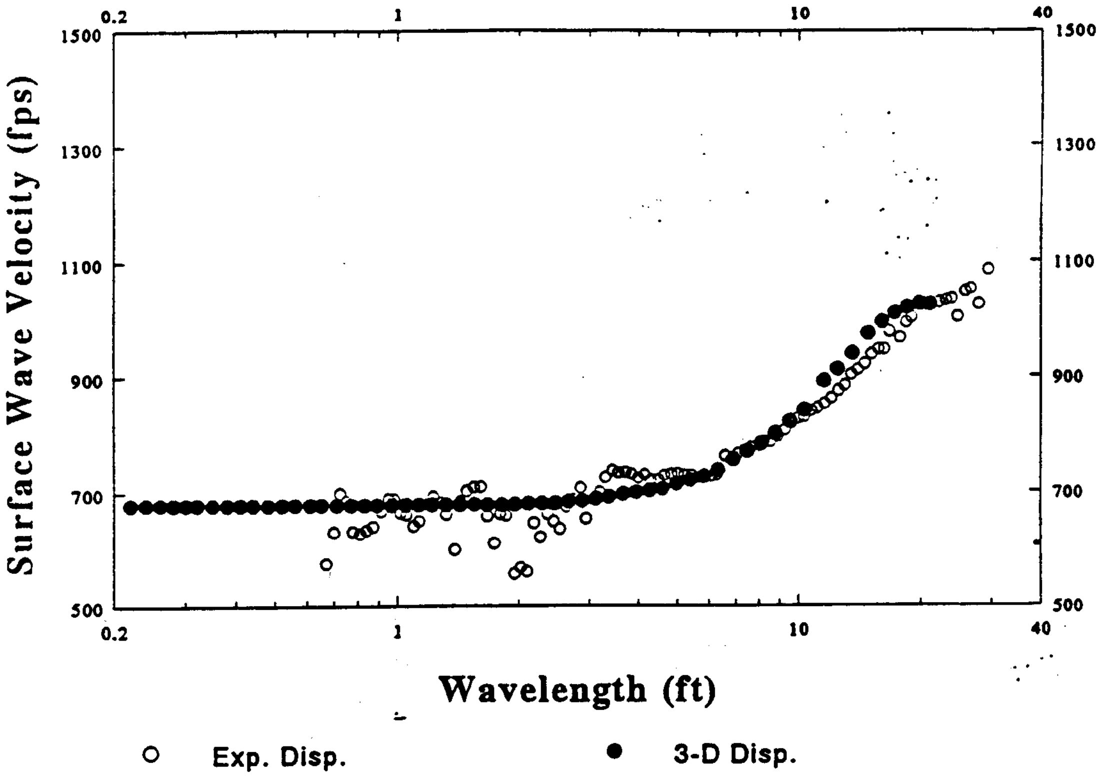
Fig. A-19

APPENDIX B

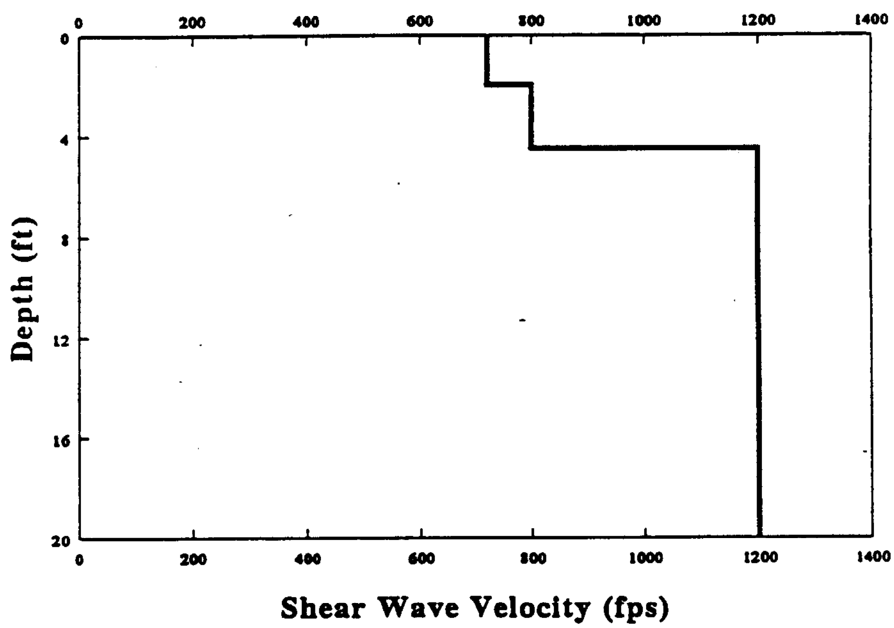
MIXED WASTE MANAGEMENT FACILITY
SASW DISPERSIONS
AND SHEAR WAVE
VELOCITY PROFILES

Job No. 205

Experimental and Theoretical Dispersions



Shear Wave Velocity Profile

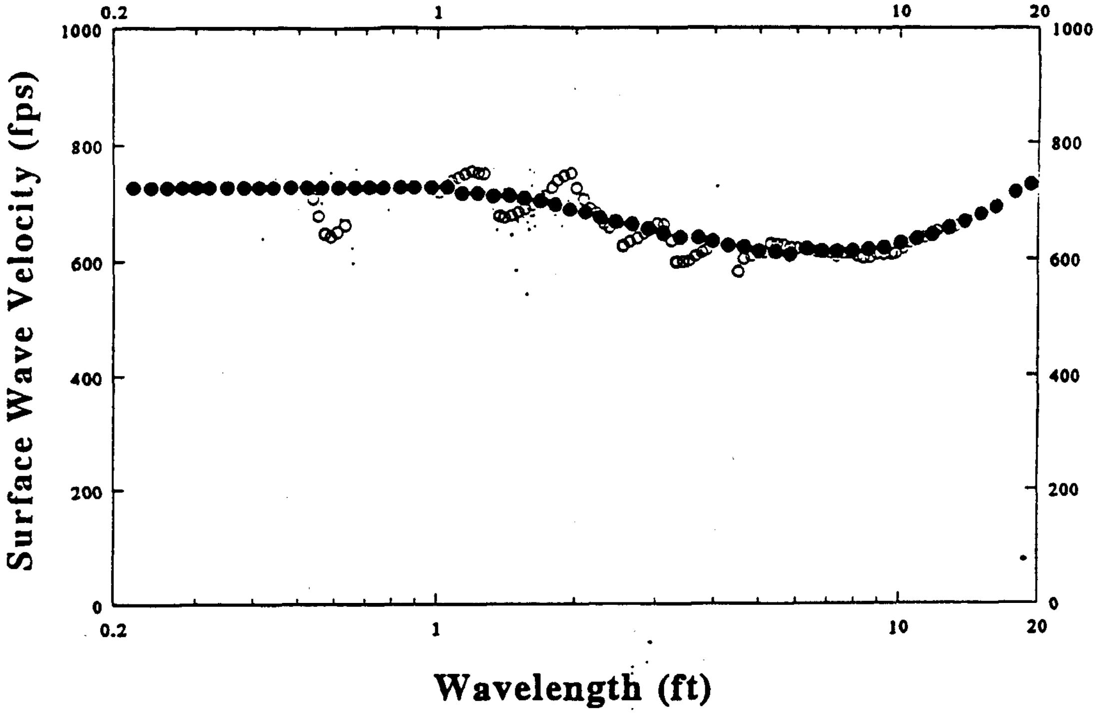


Horseshoe, Station 1 Natural Ground (North-South)

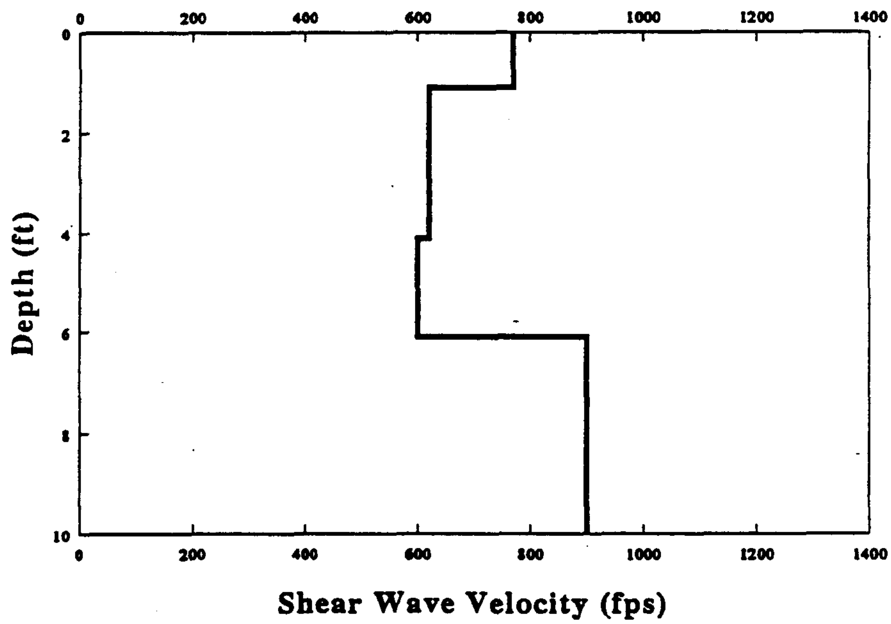
Job 205

Fig. B-1

Experimental and Theoretical Dispersions



Shear Wave Velocity Profile

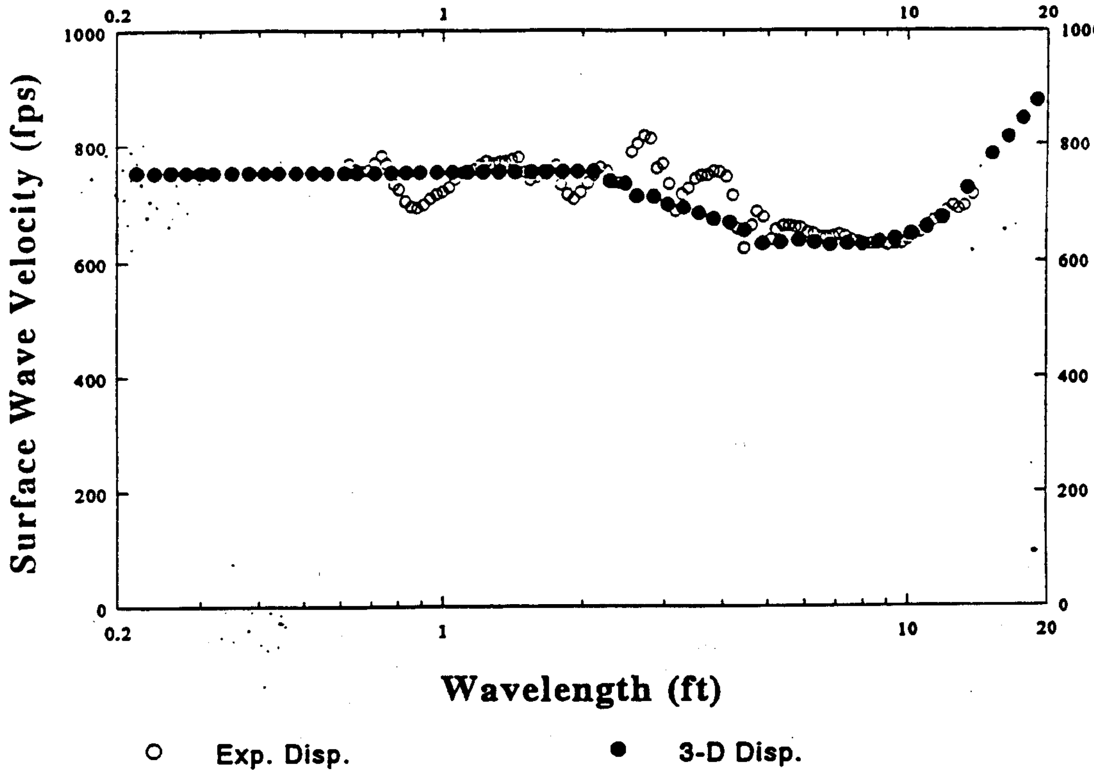


Job 205

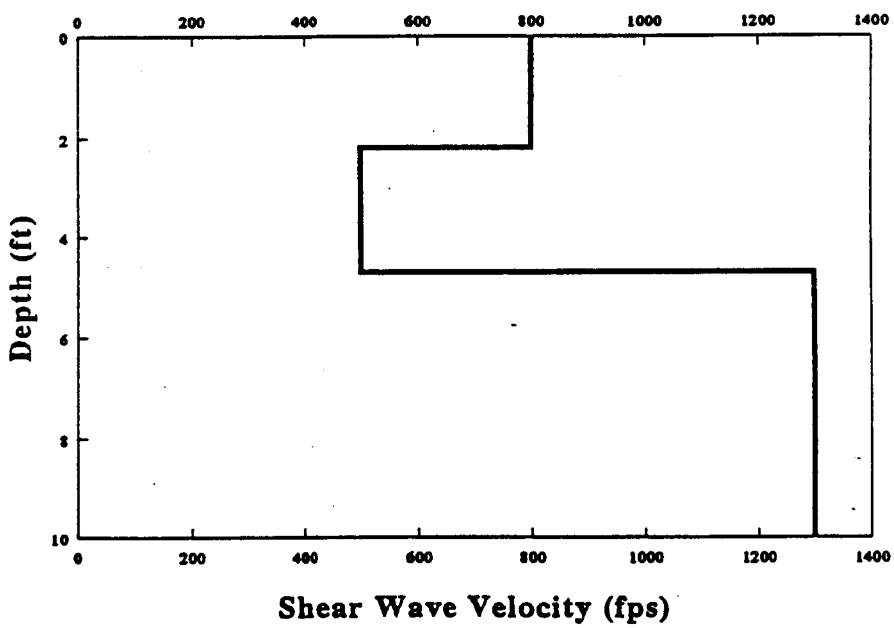
Horseshoe - Station 2 (North - South)

Fig. B-2

Experimental and Theoretical Dispersions



Shear Wave Velocity Profile

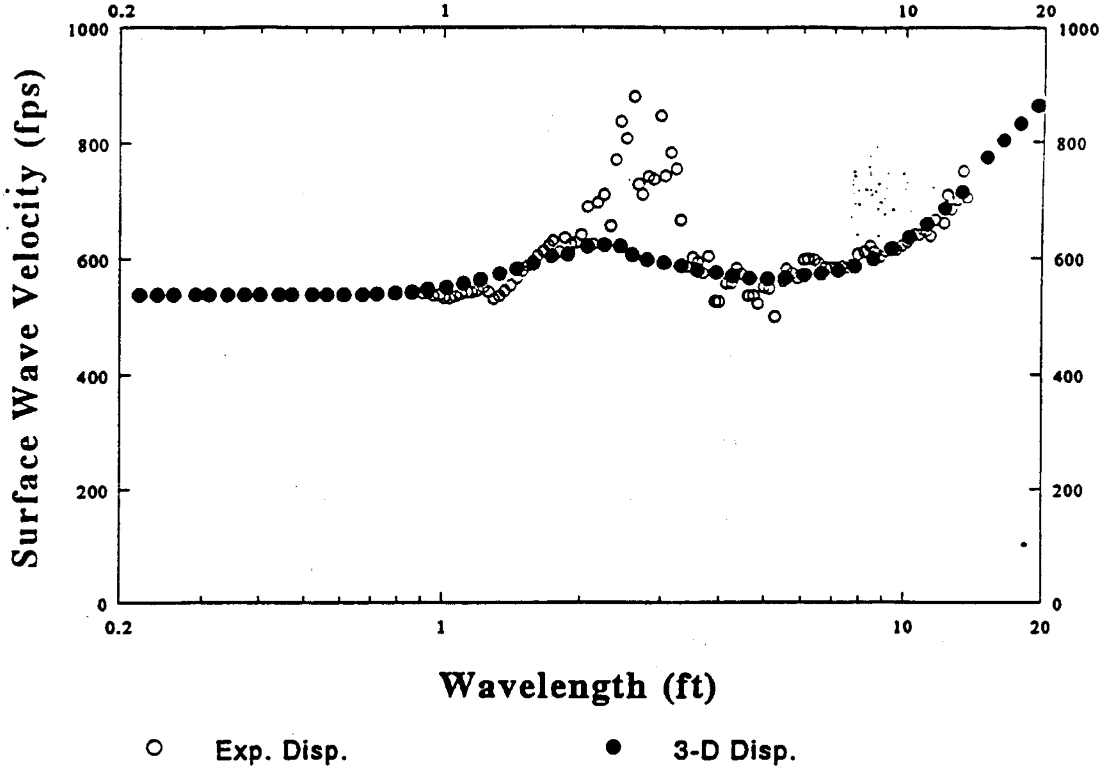


Horseshoe - Station 3 (North - South)

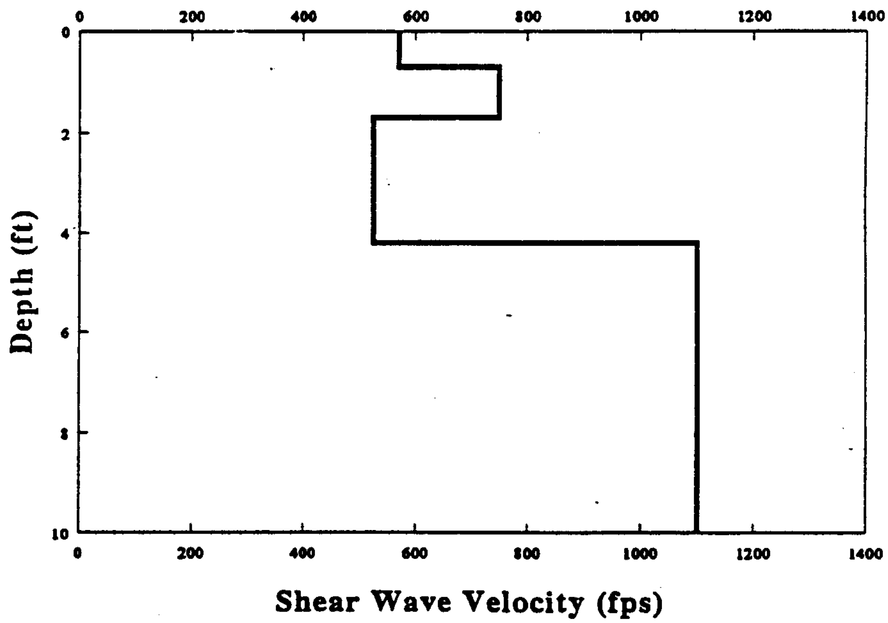
Job 205

Fig. B-3

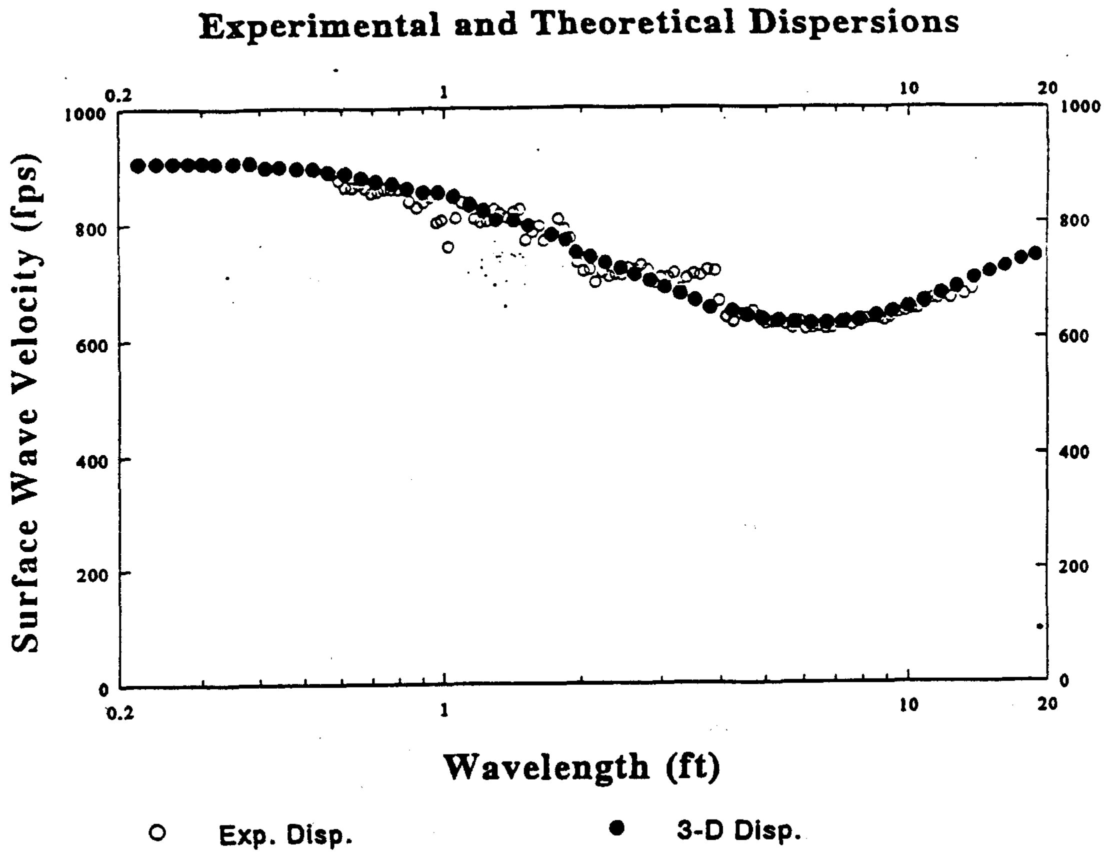
Experimental and Theoretical Dispersions

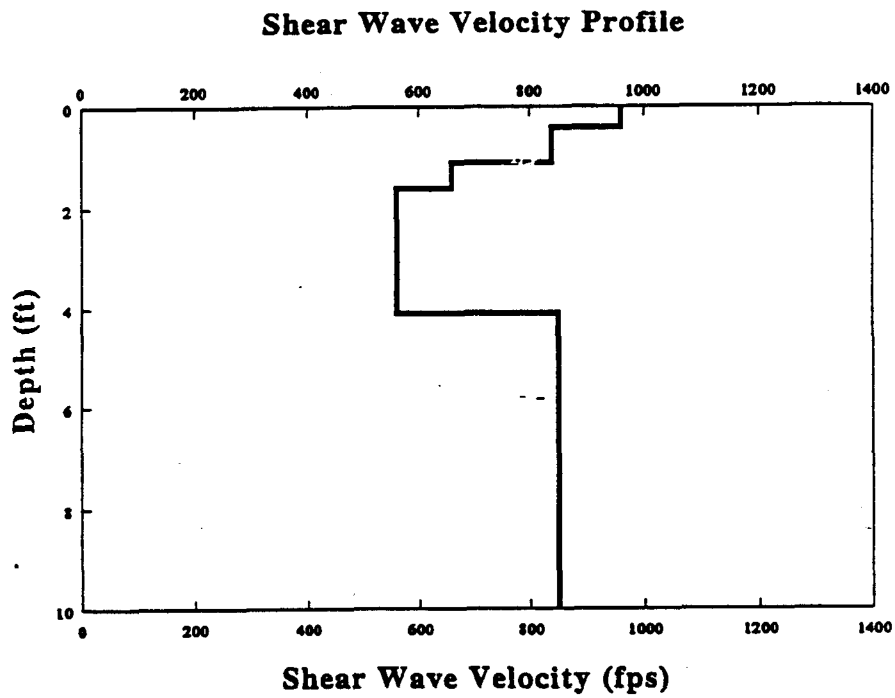


Shear Wave Velocity Profile



Job 205 **Horseshoe - Station 4 (East West)** Fig. B-4



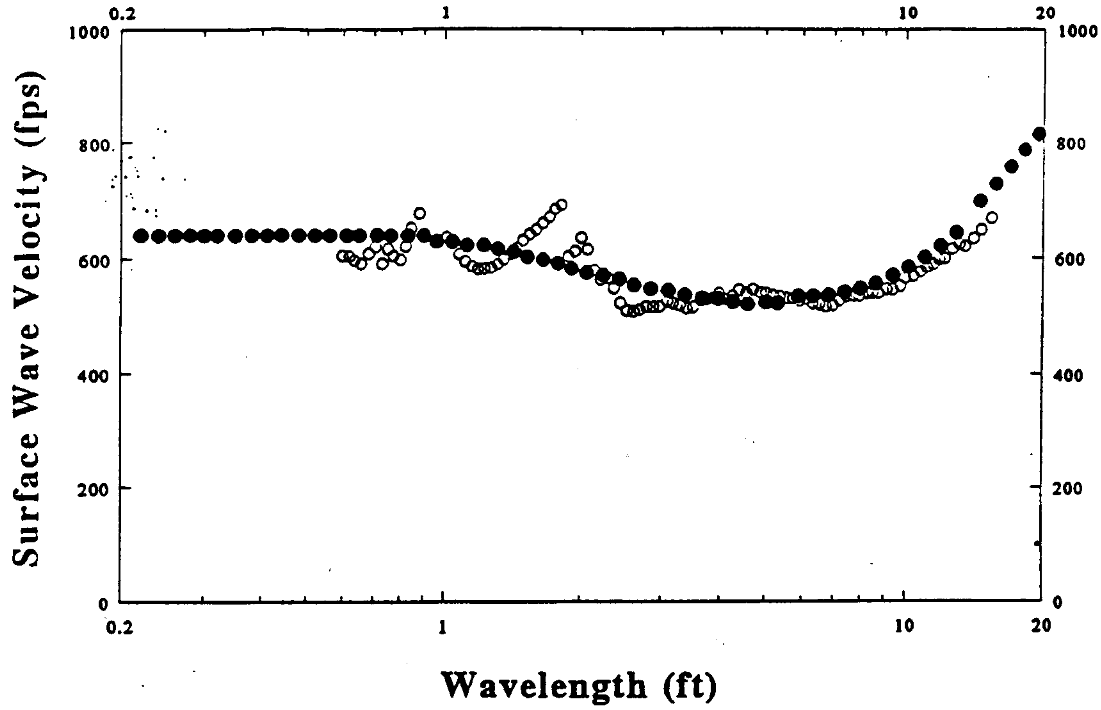


Horseshoe - Station 5 (North - South)

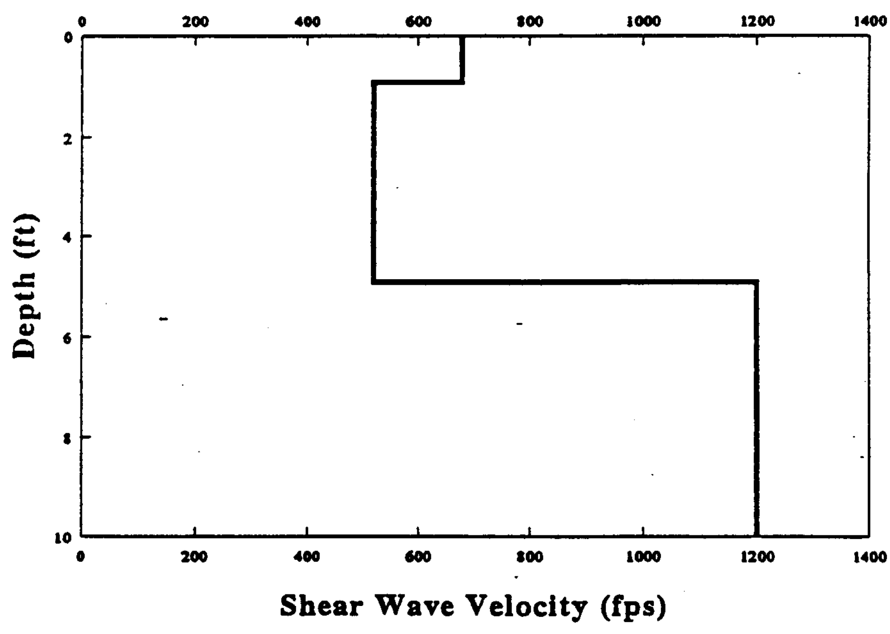
Job 205

Fig. B-5

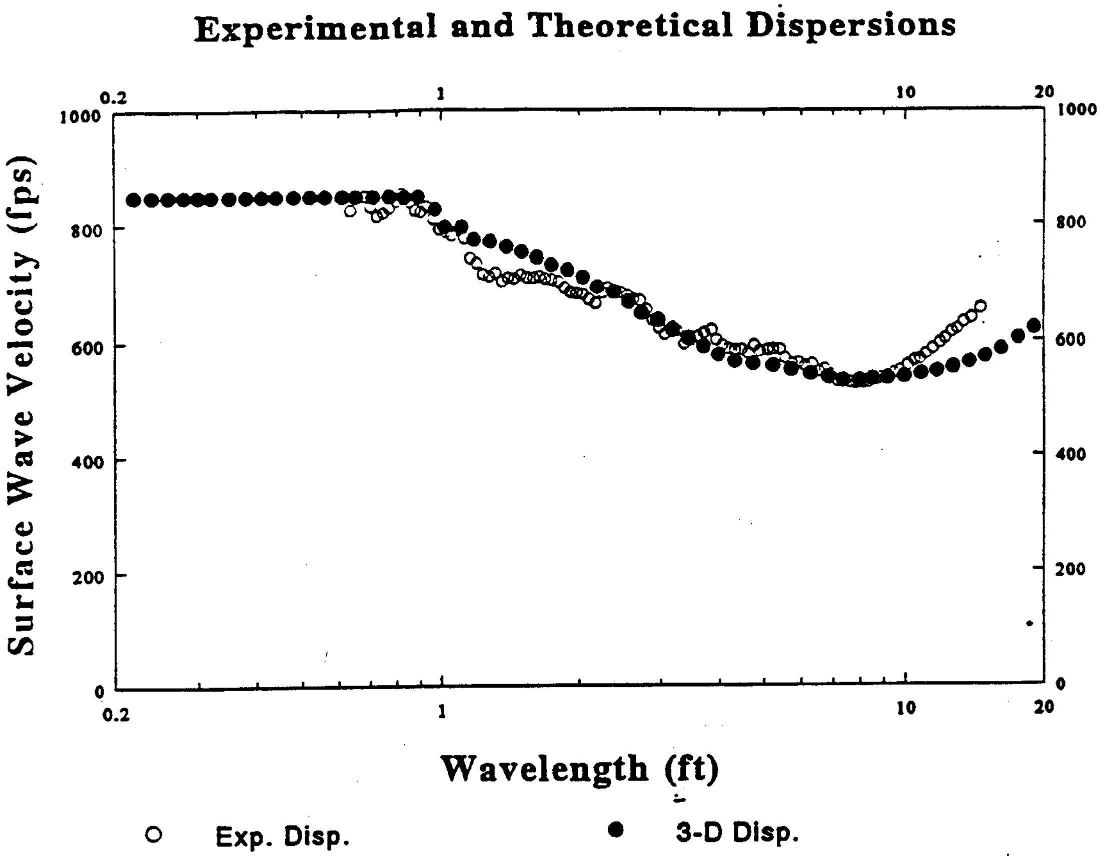
Experimental and Theoretical Dispersions

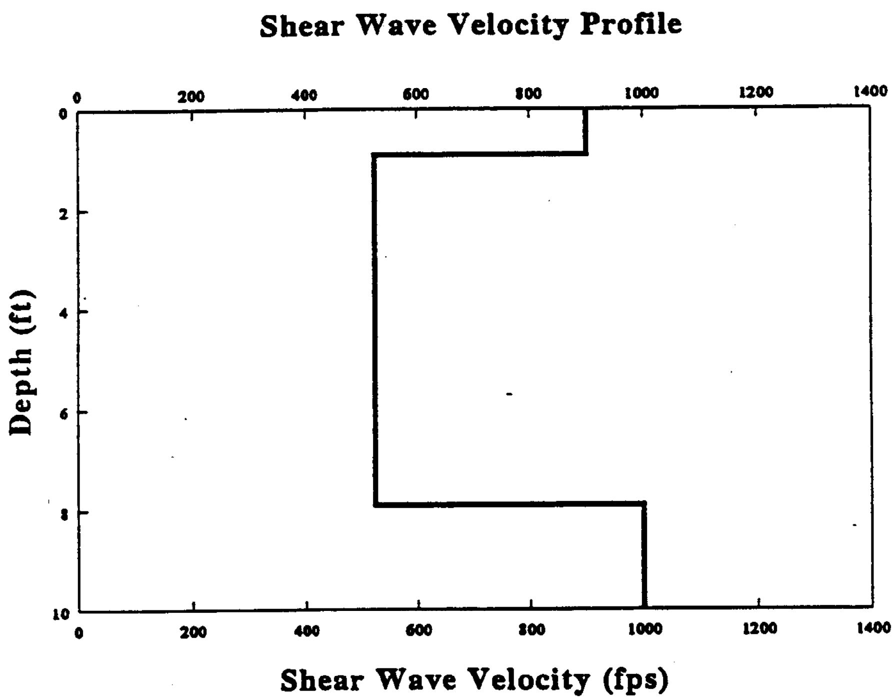


Shear Wave Velocity Profile



Job 205 **Horseshoe - Station 6 (North - South)** Fig. B-6

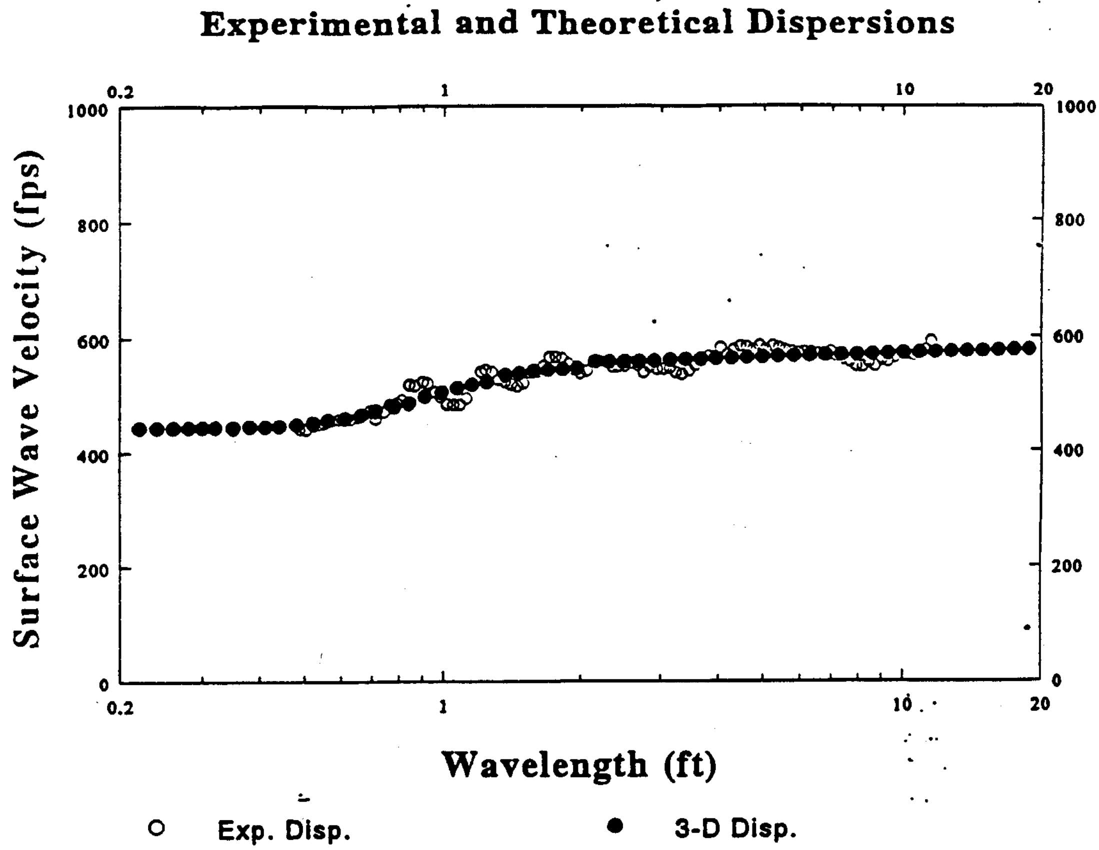


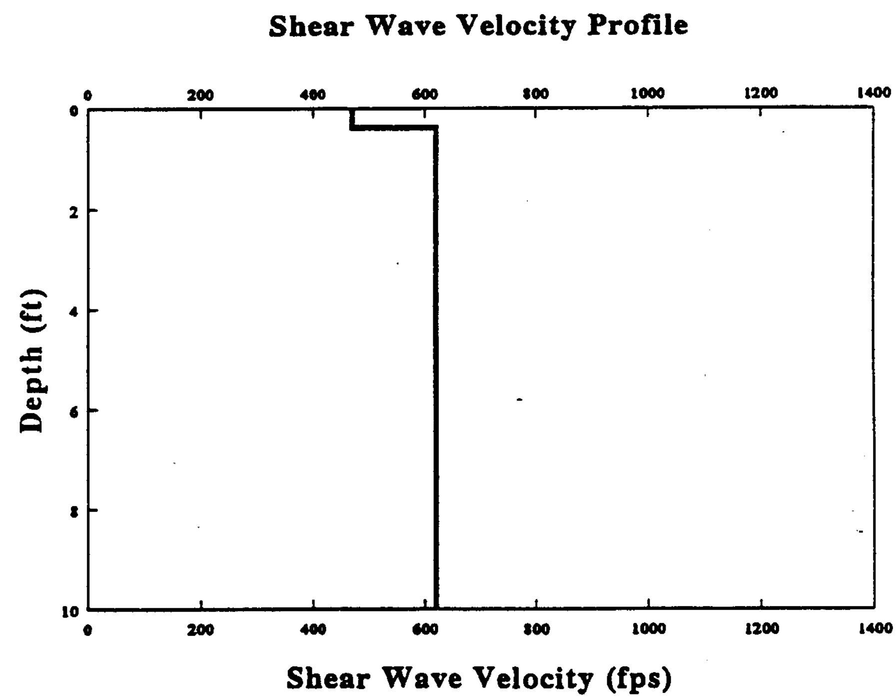


Horseshoe - Station 7 (North - South)

Job 205

Fig. B-7



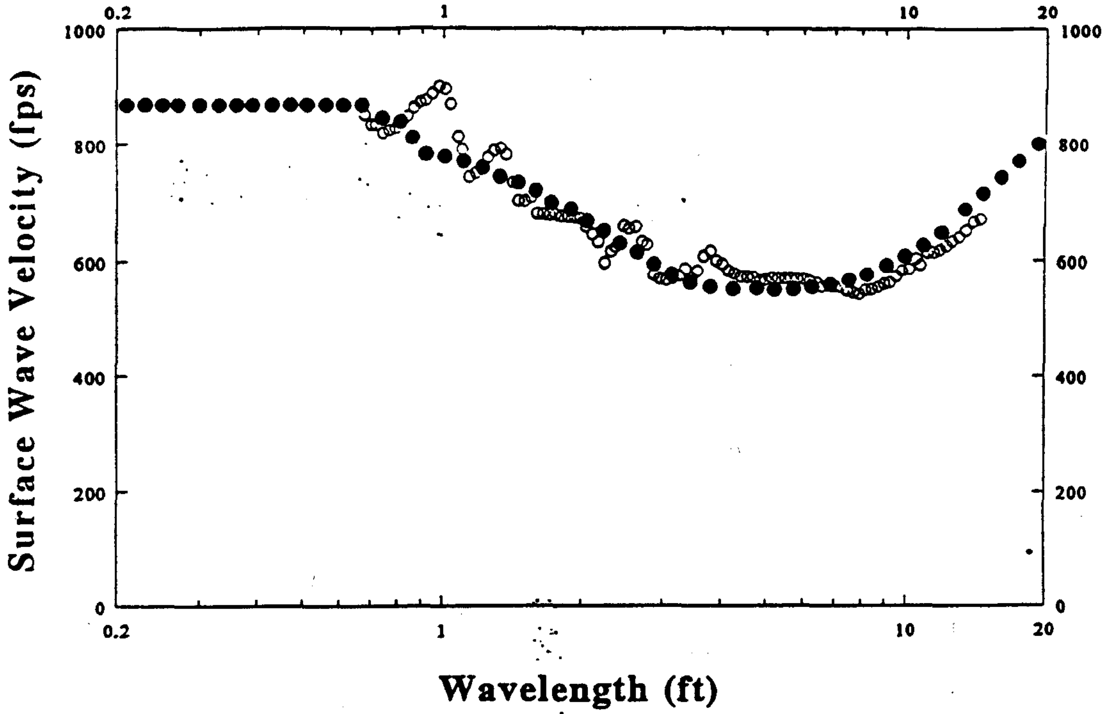


Job 205

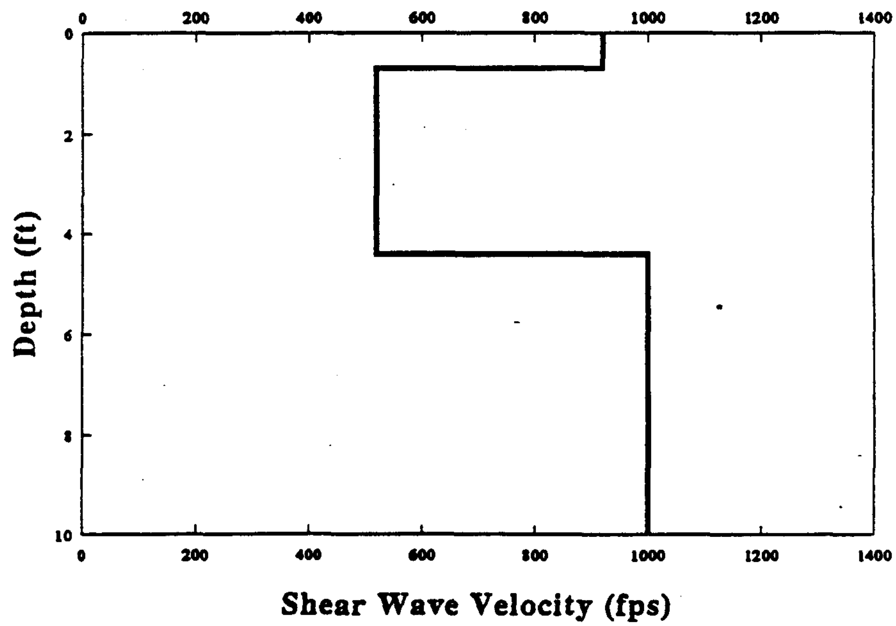
Horseshoe - Station 8 (East - West)

Fig. B-8

Experimental and Theoretical Dispersions

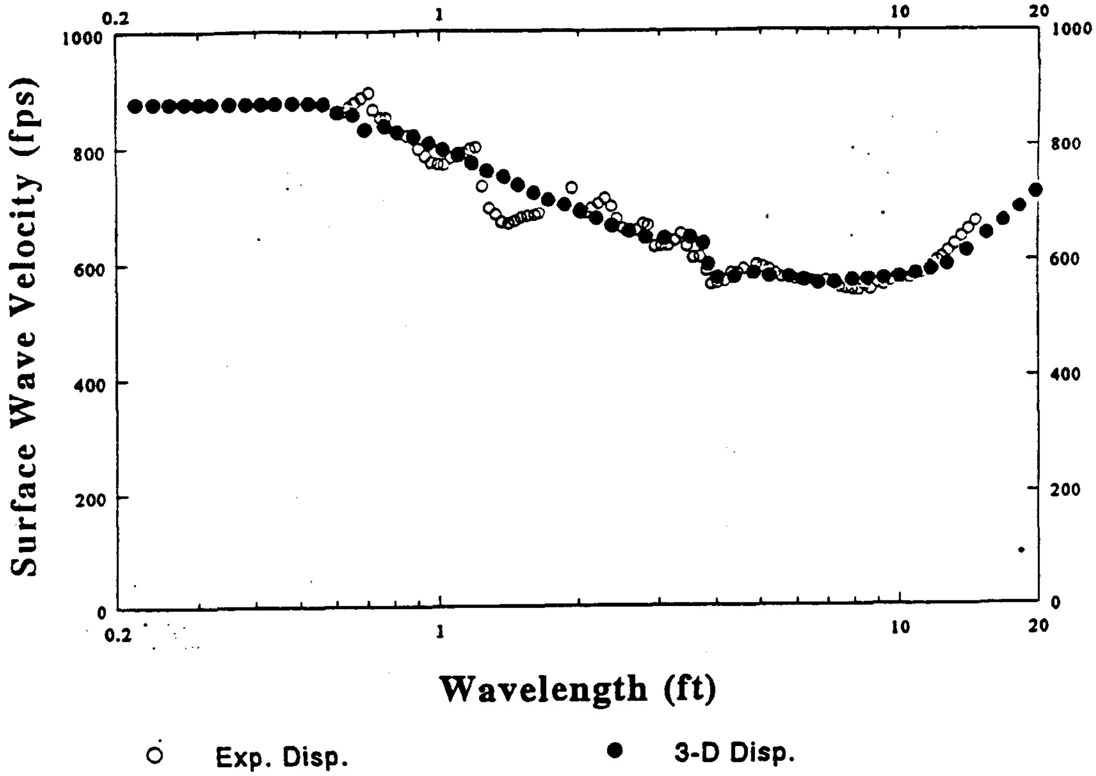


Shear Wave Velocity Profile

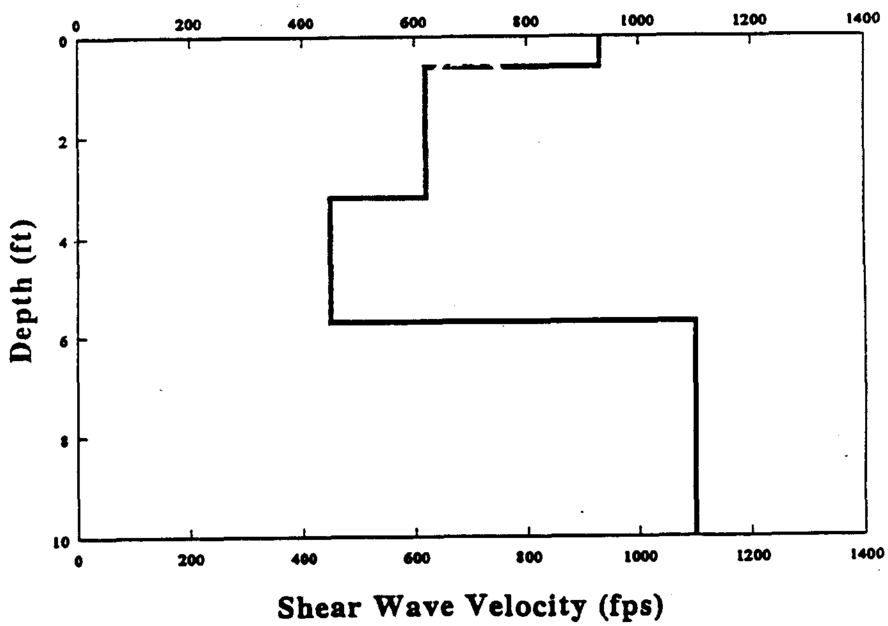


Job 205 **Horseshoe - Station 9 (East - West)** Fig. B-9

Experimental and Theoretical Dispersions



Shear Wave Velocity Profile

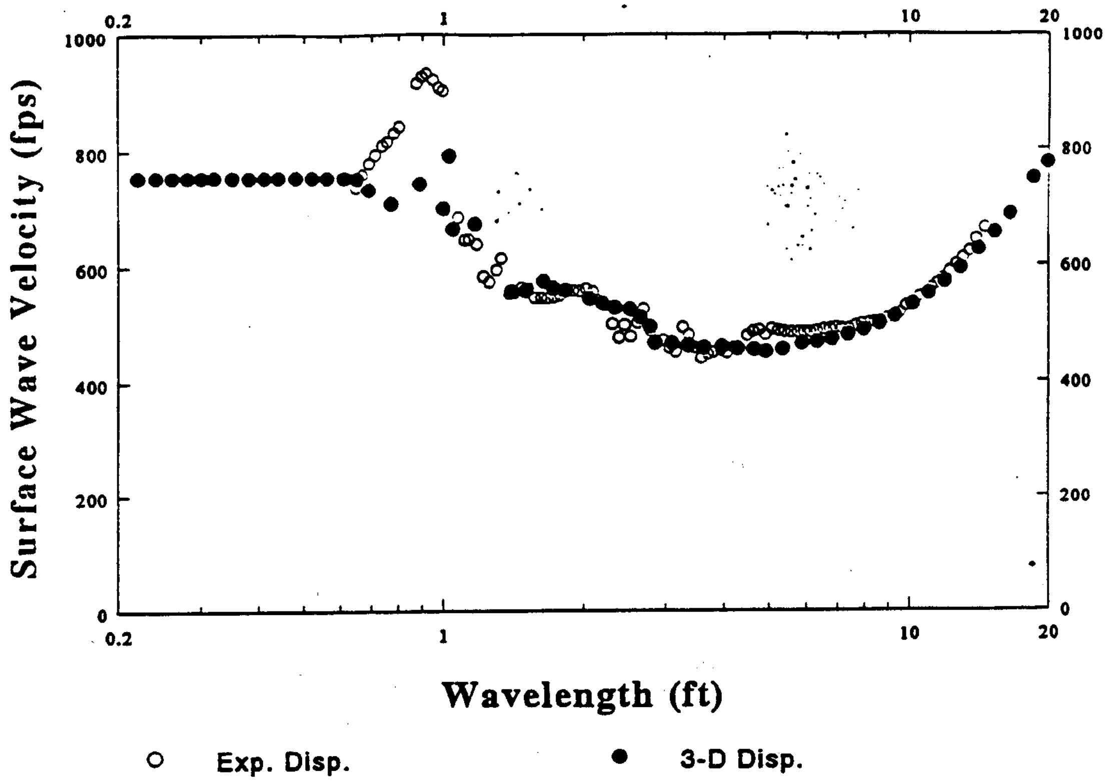


Job 205

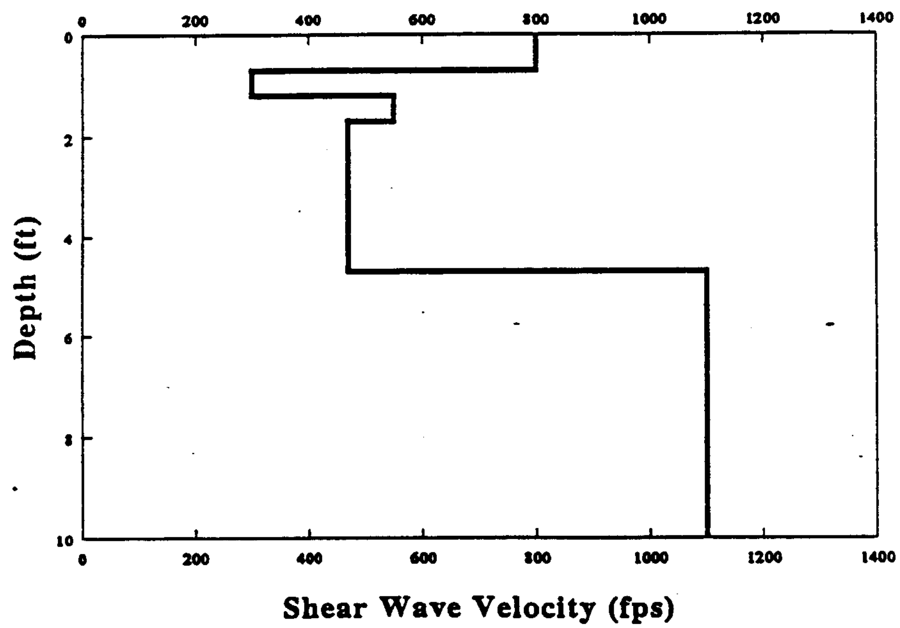
Horseshoe - Station 10 (East - West)

Fig. B-10

Experimental and Theoretical Dispersions



Shear Wave Velocity Profile

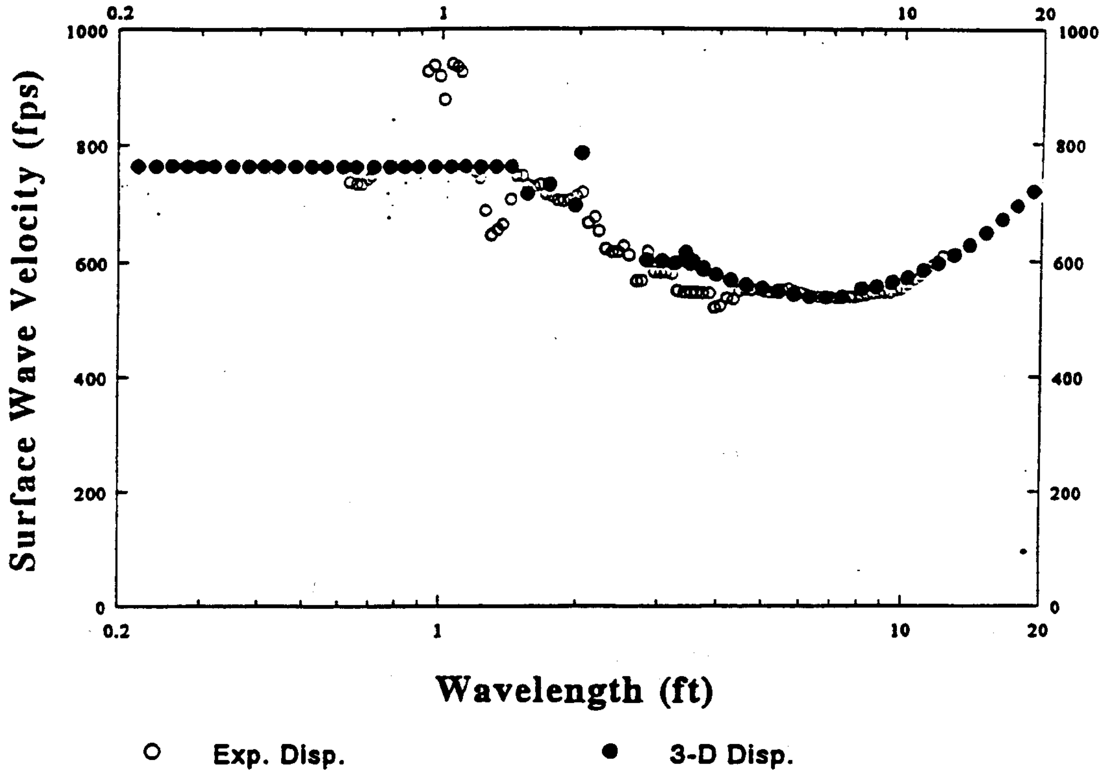


Job 205

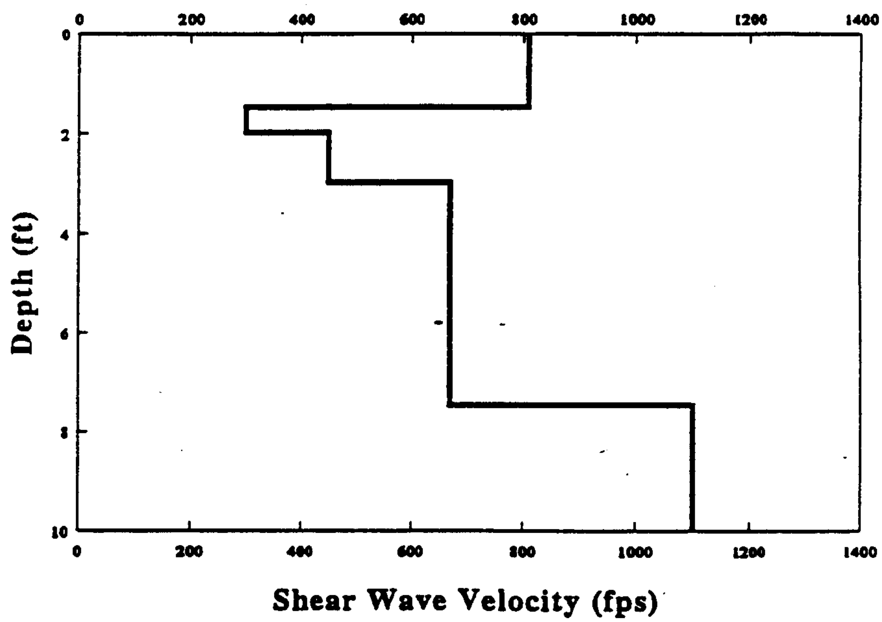
Horseshoe - Station 11 (East - West)

Fig. B-11

Experimental and Theoretical Dispersions



Shear Wave Velocity Profile

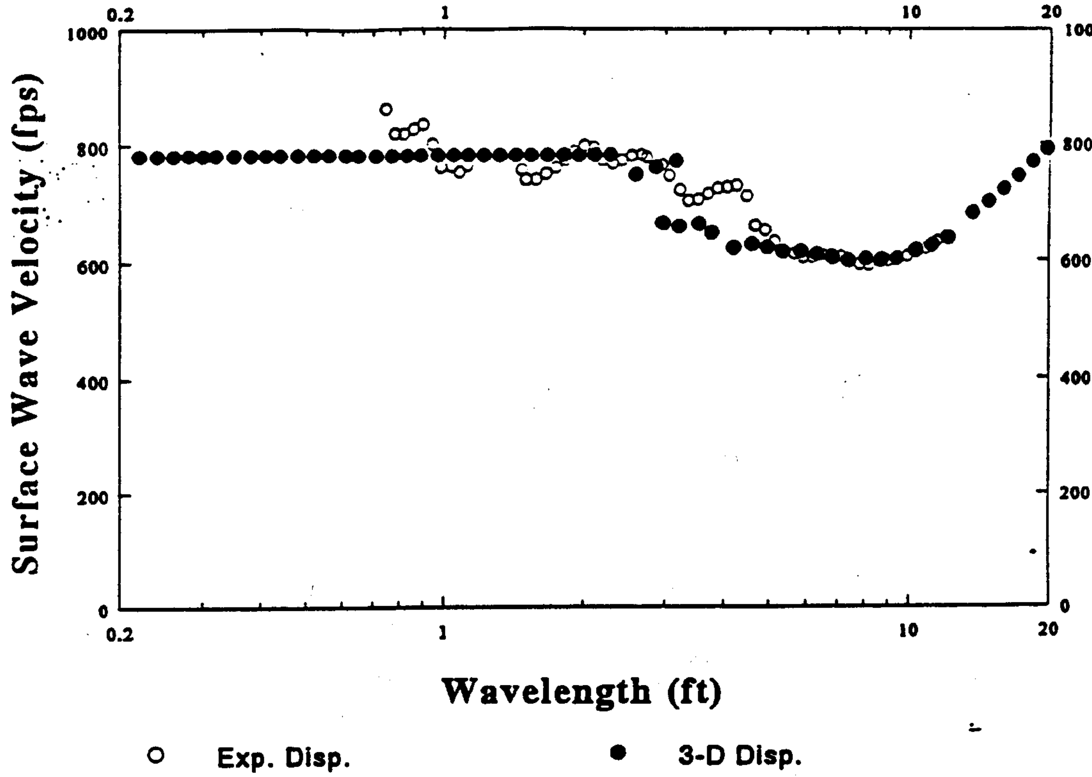


Job 205

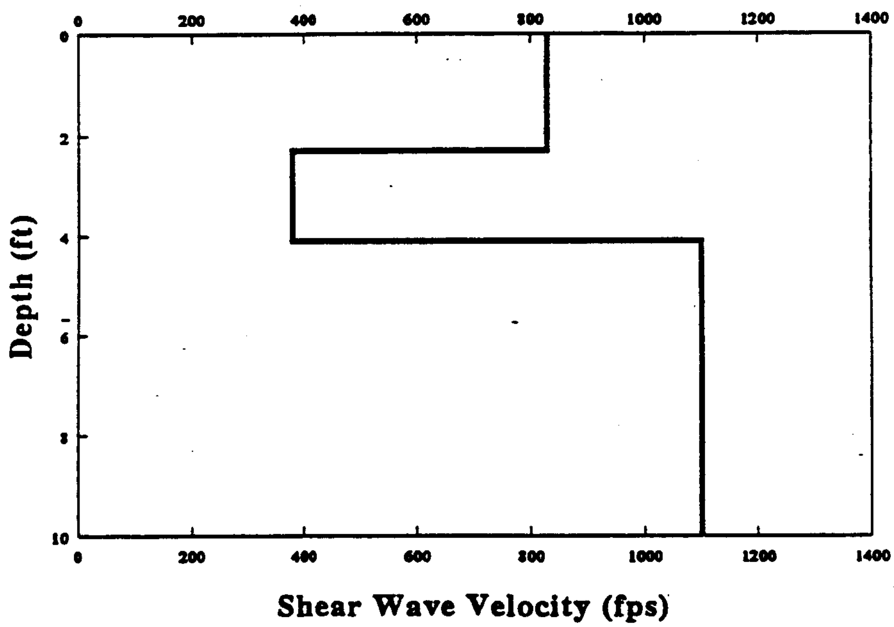
Horseshoe - Station 12 (East - West)

Fig. B-12

Experimental and Theoretical Dispersions



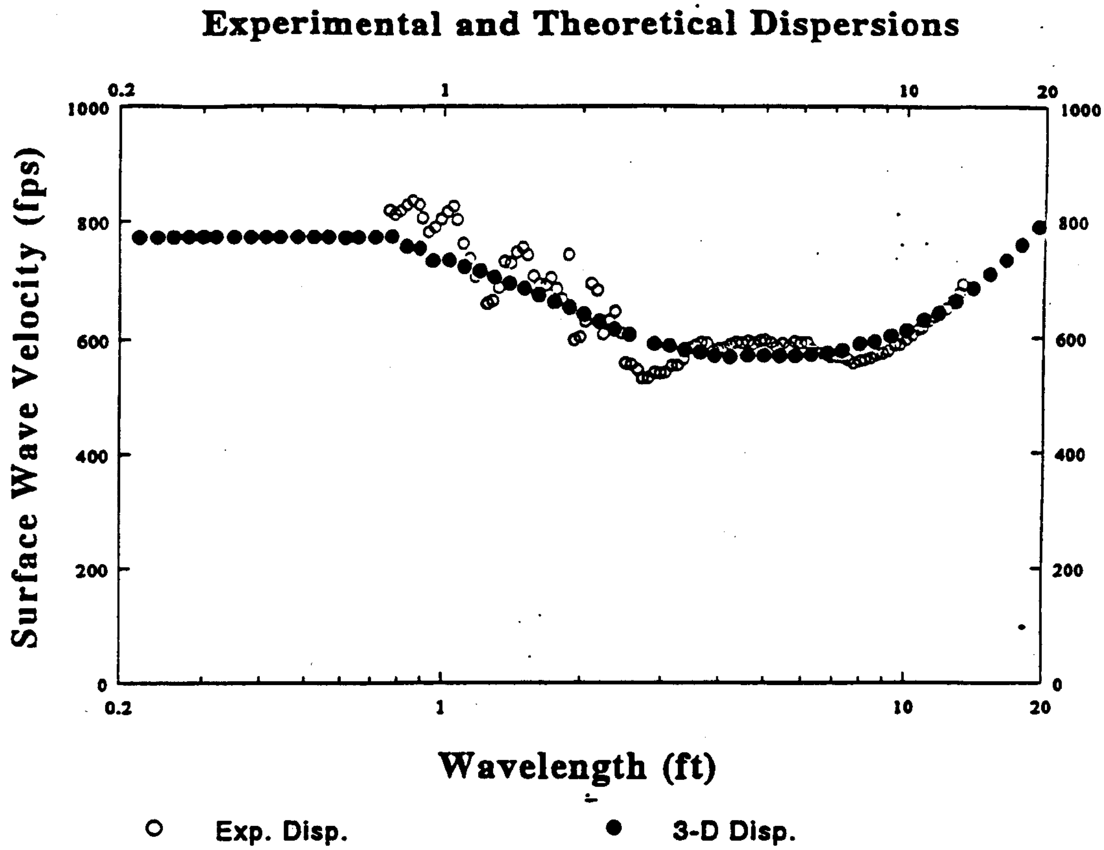
Shear Wave Velocity Profile

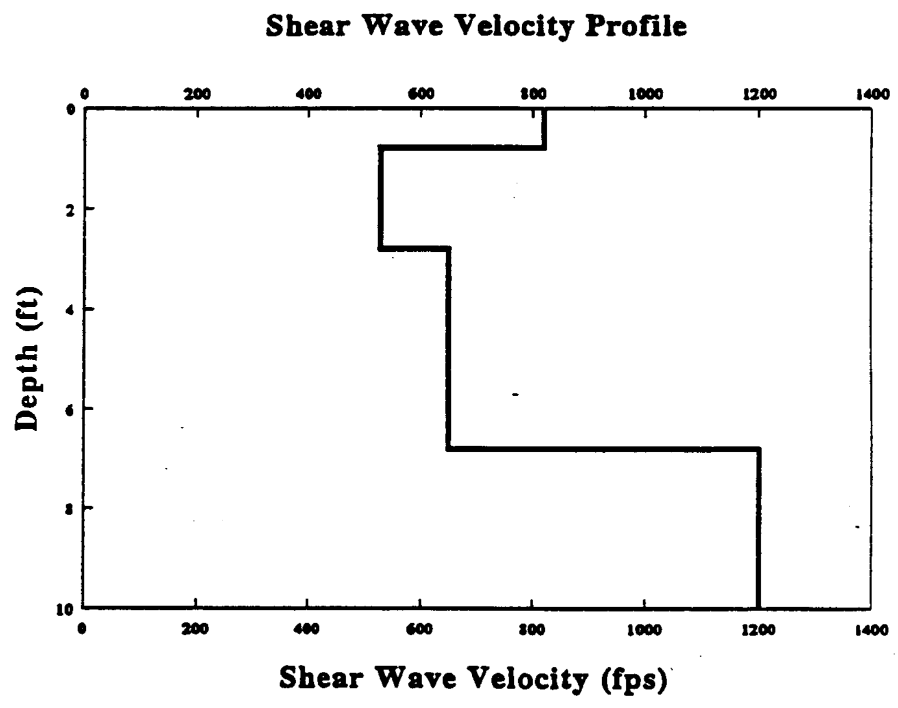


Job 205

Horseshoe - Station 13 (East - West)

Fig. B-13



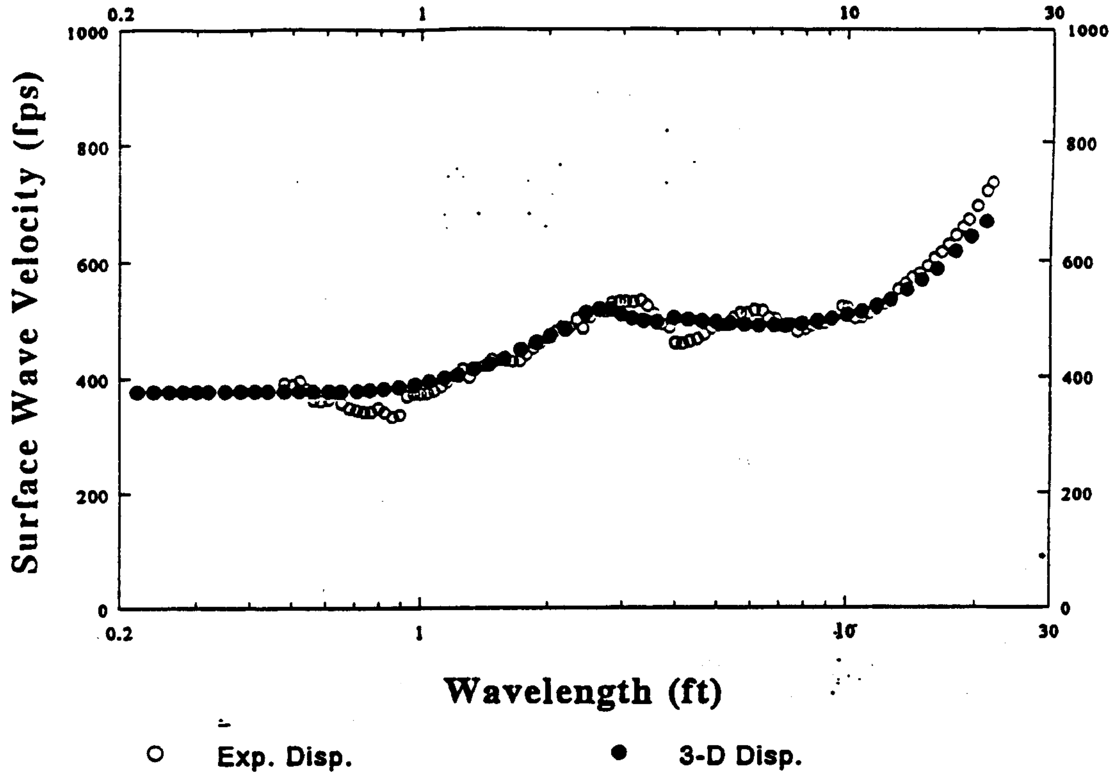


Job 205

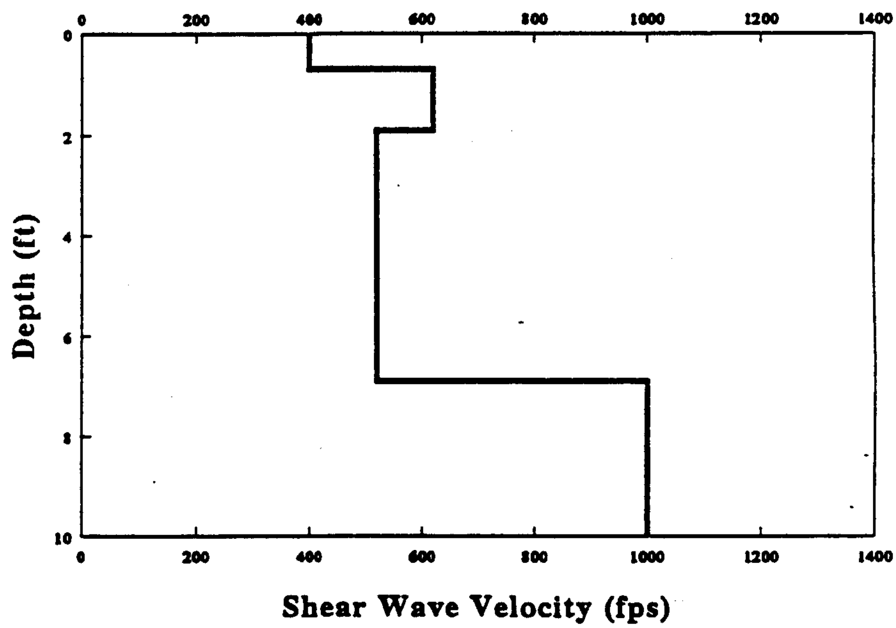
Horseshoe - Station 14 (East - West)

Fig. B-14

Experimental and Theoretical Dispersions

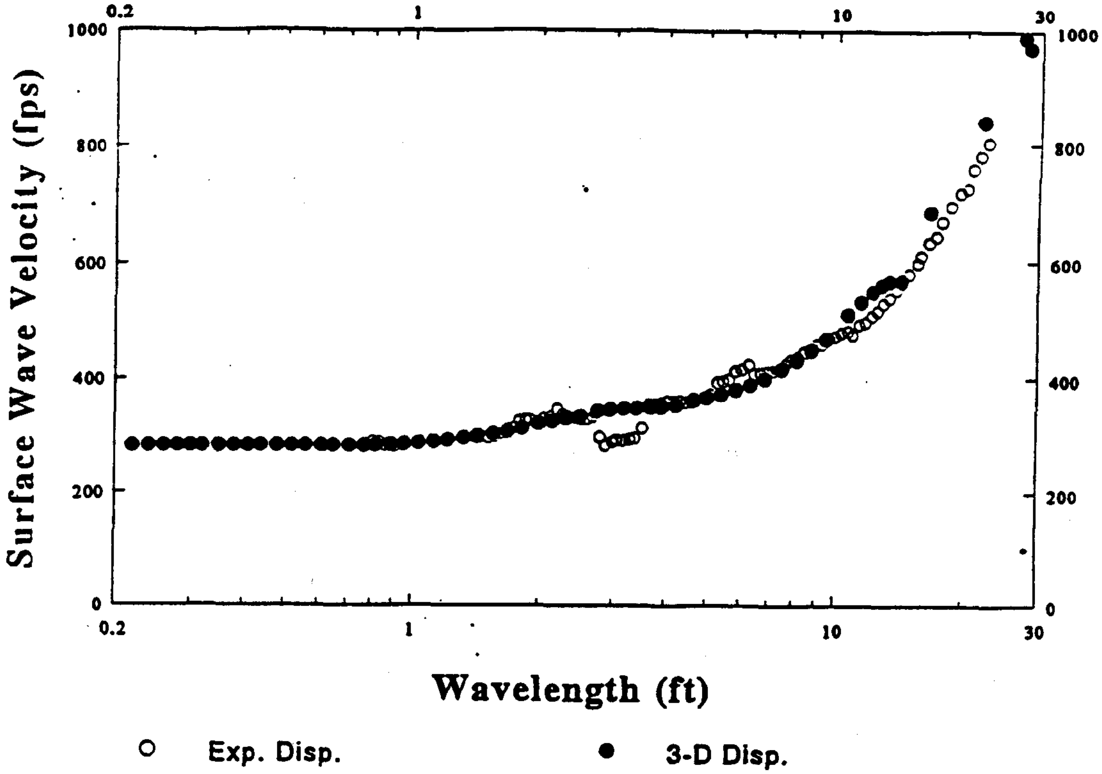


Shear Wave Velocity Profile

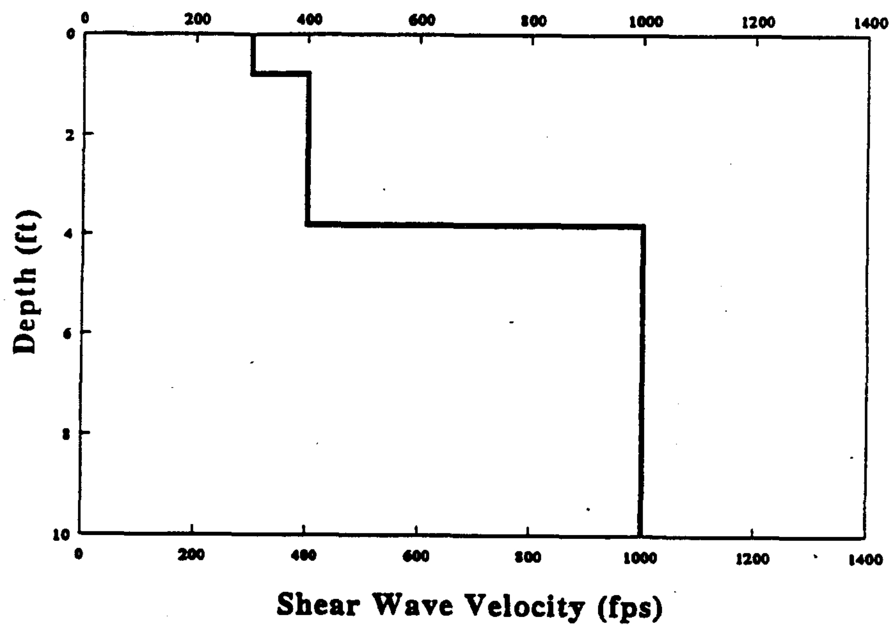


Job 205 **Mixed Waste Facility Line A (100 ft -- East - West)** Fig. B-15

Experimental and Theoretical Dispersions

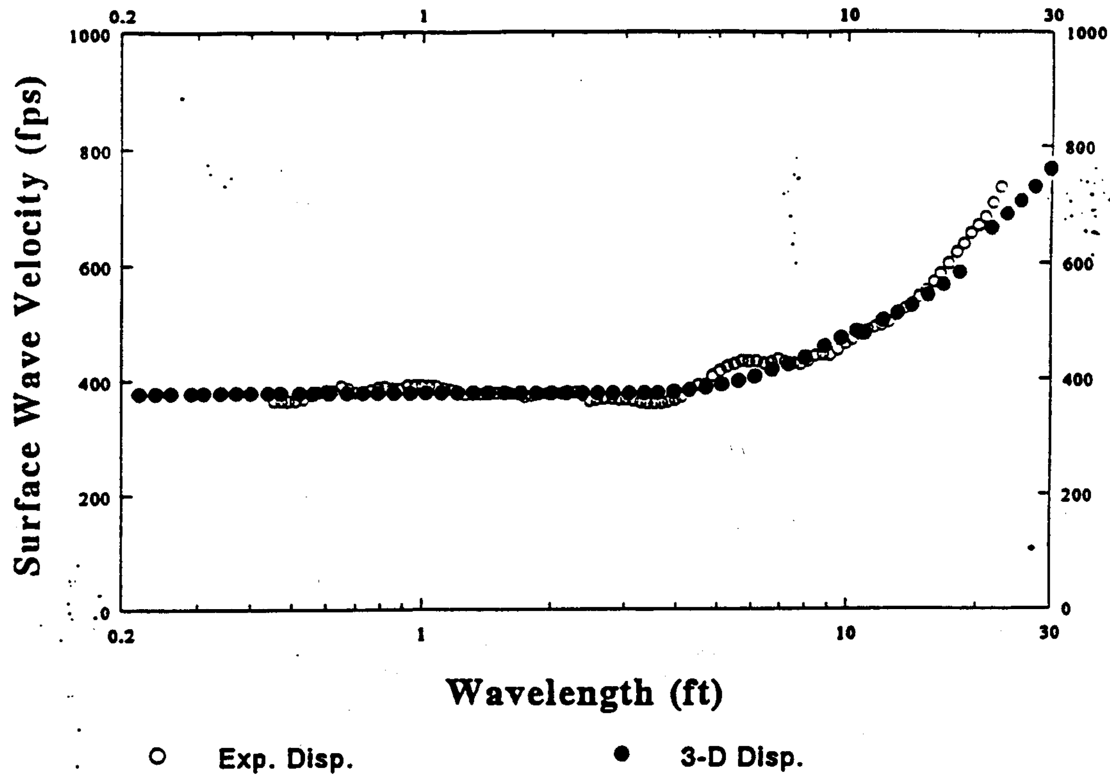


Shear Wave Velocity Profile

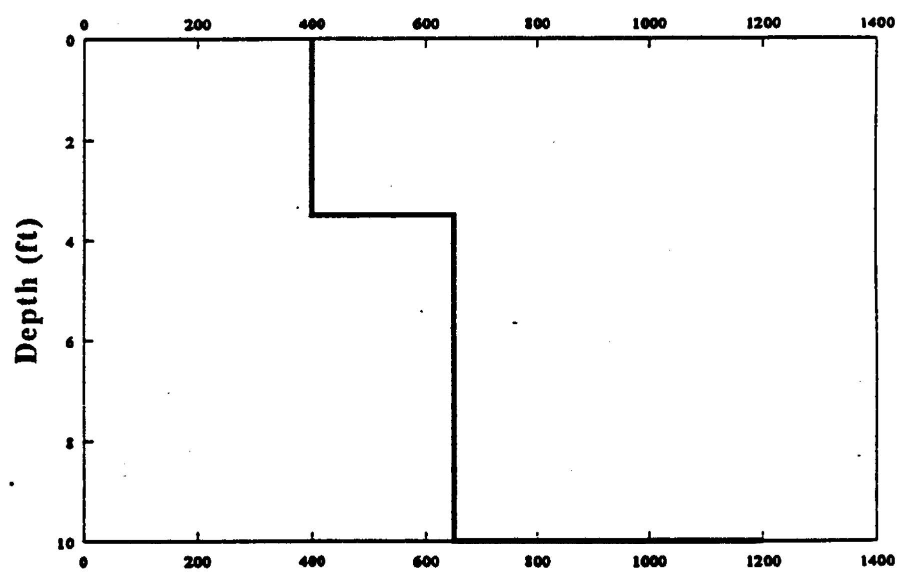


Job 205 Mixed Waste Facility Line A (400 ft -- East - West) Fig. B-16

Experimental and Theoretical Dispersions

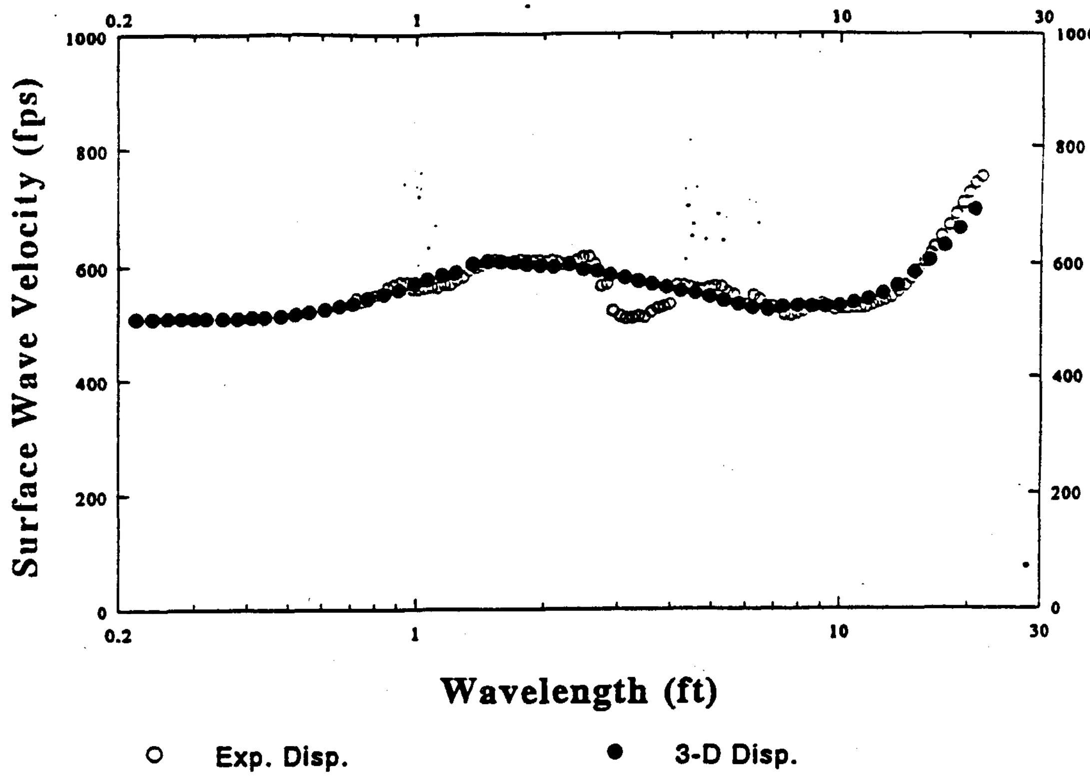


Shear Wave Velocity Profile

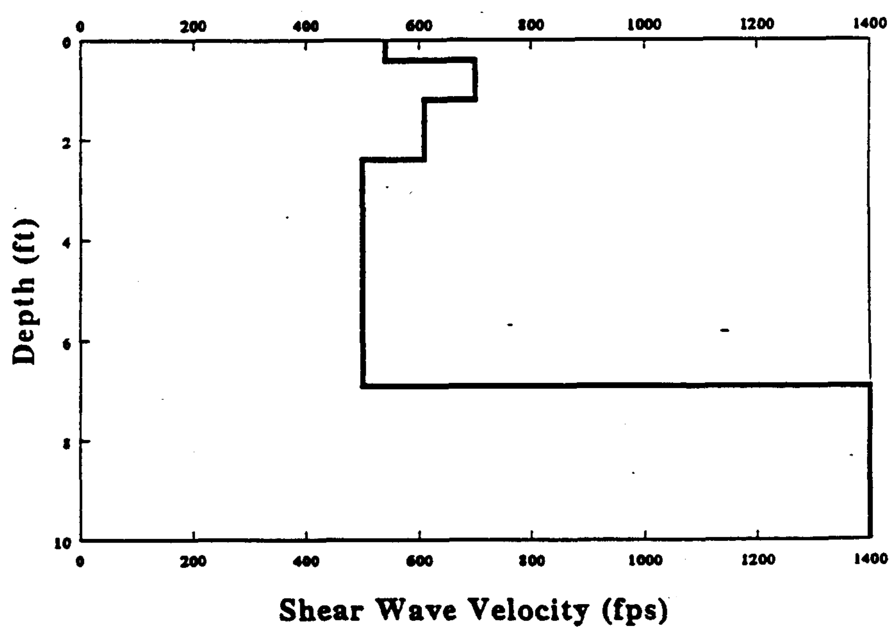


Job 205 Mixed Waste Facility Line A (700 ft -- East - West) Fig. B-17

Experimental and Theoretical Dispersions

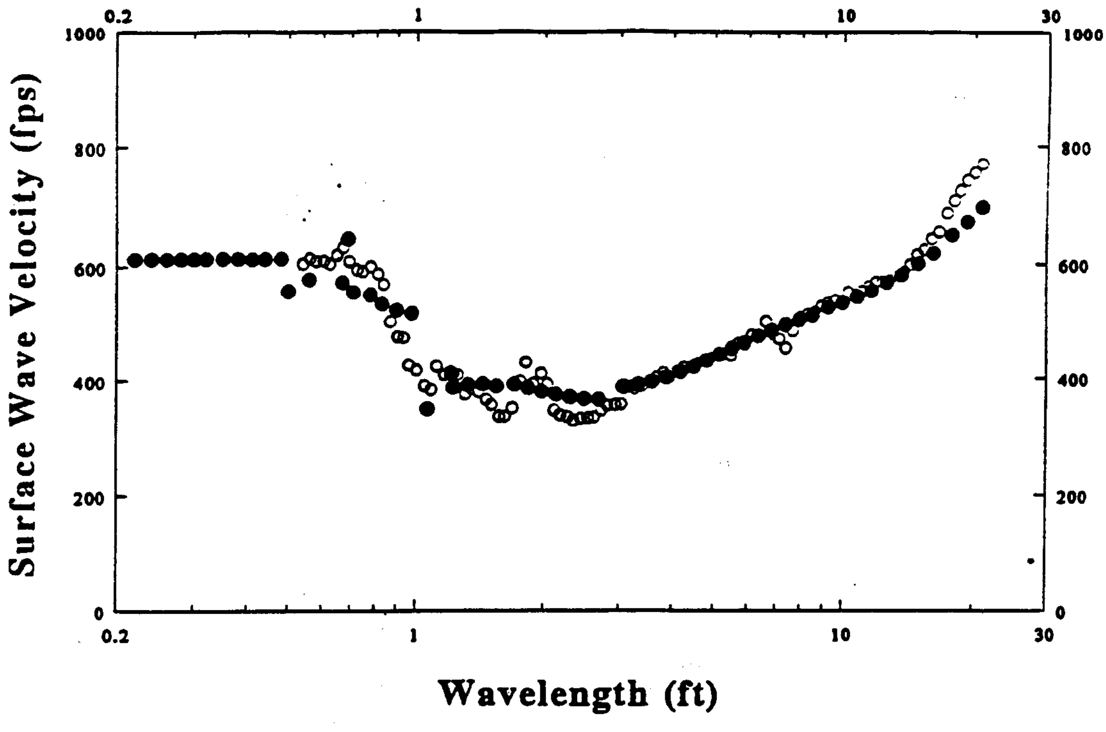


Shear Wave Velocity Profile

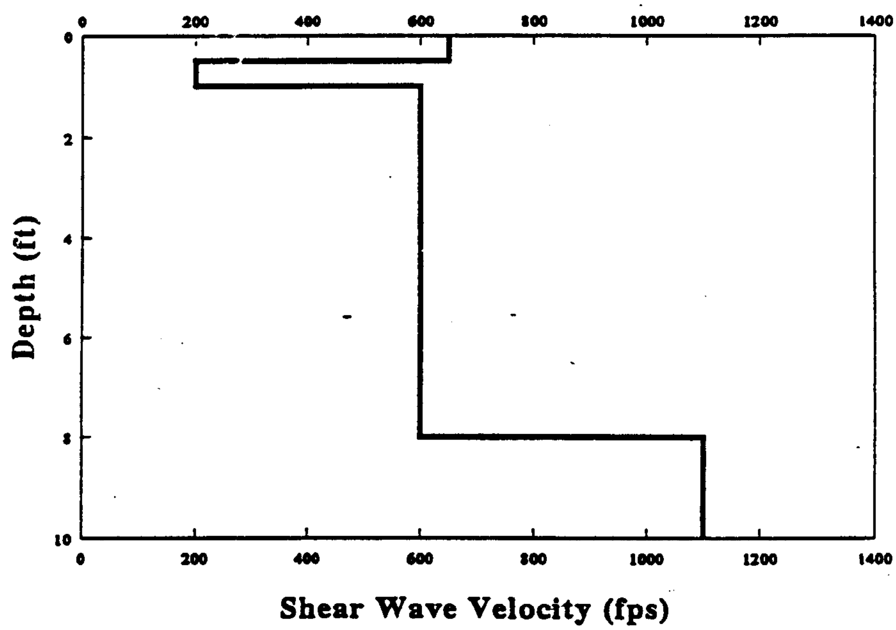


Job 205 Mixed Waste Facility Line A (1000 ft -- East - West) Fig. B-18

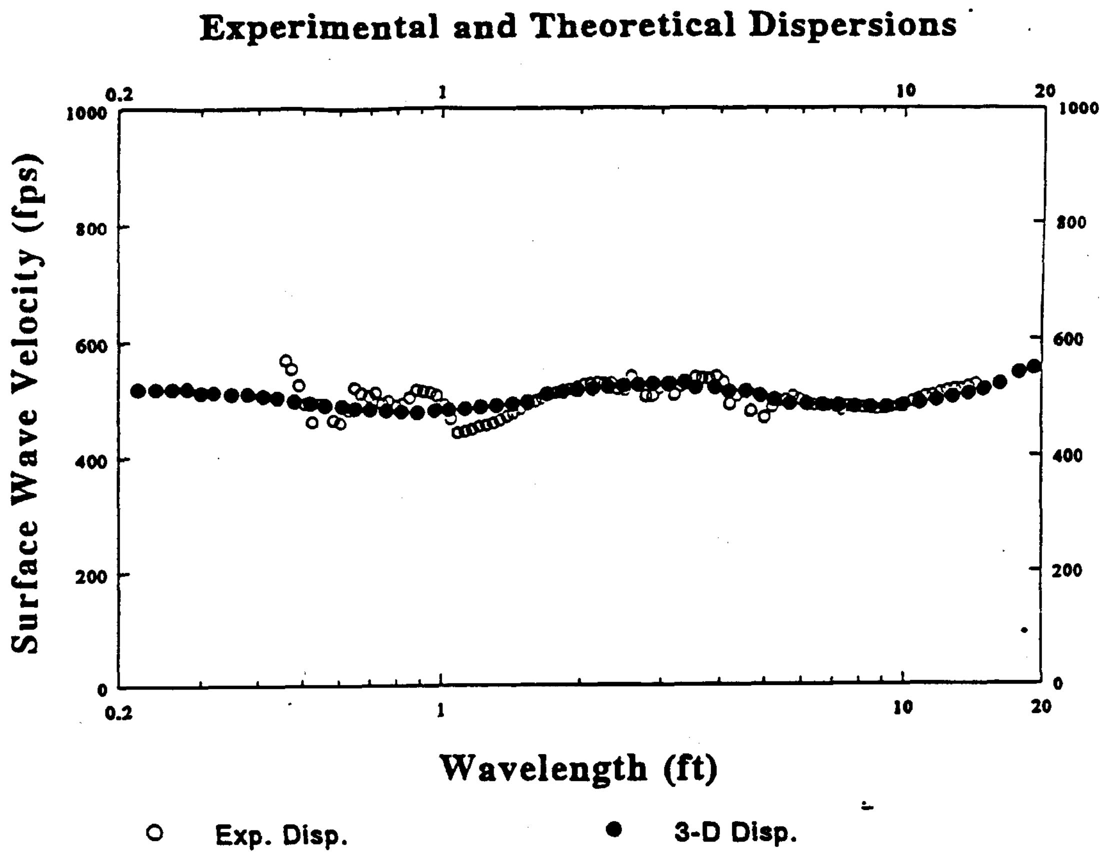
Experimental and Theoretical Dispersions

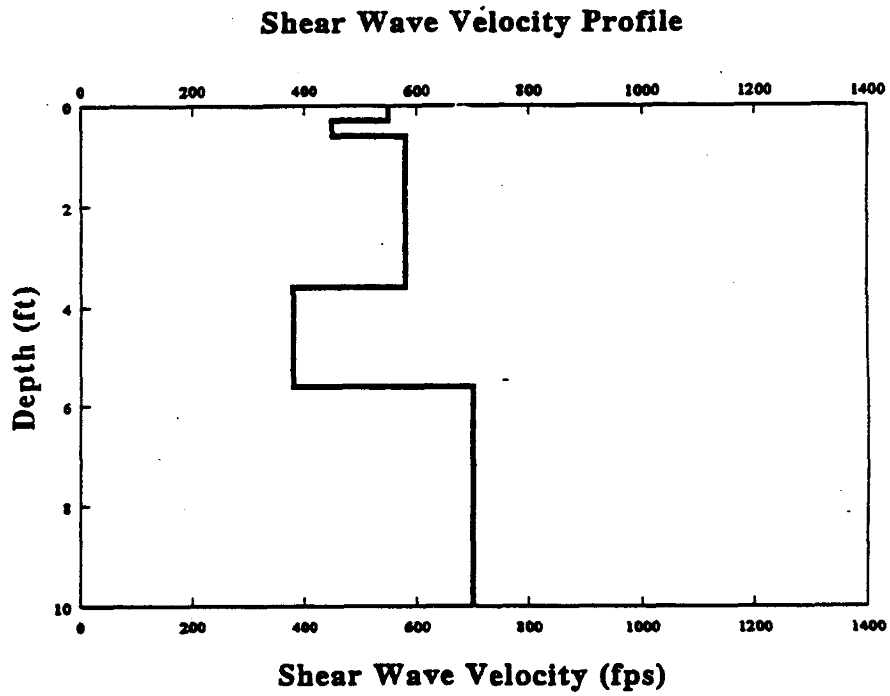


Shear Wave Velocity Profile



Job 205 **Mixed Waste Facility Line A (1300 ft, East-West)** Fig. B-19



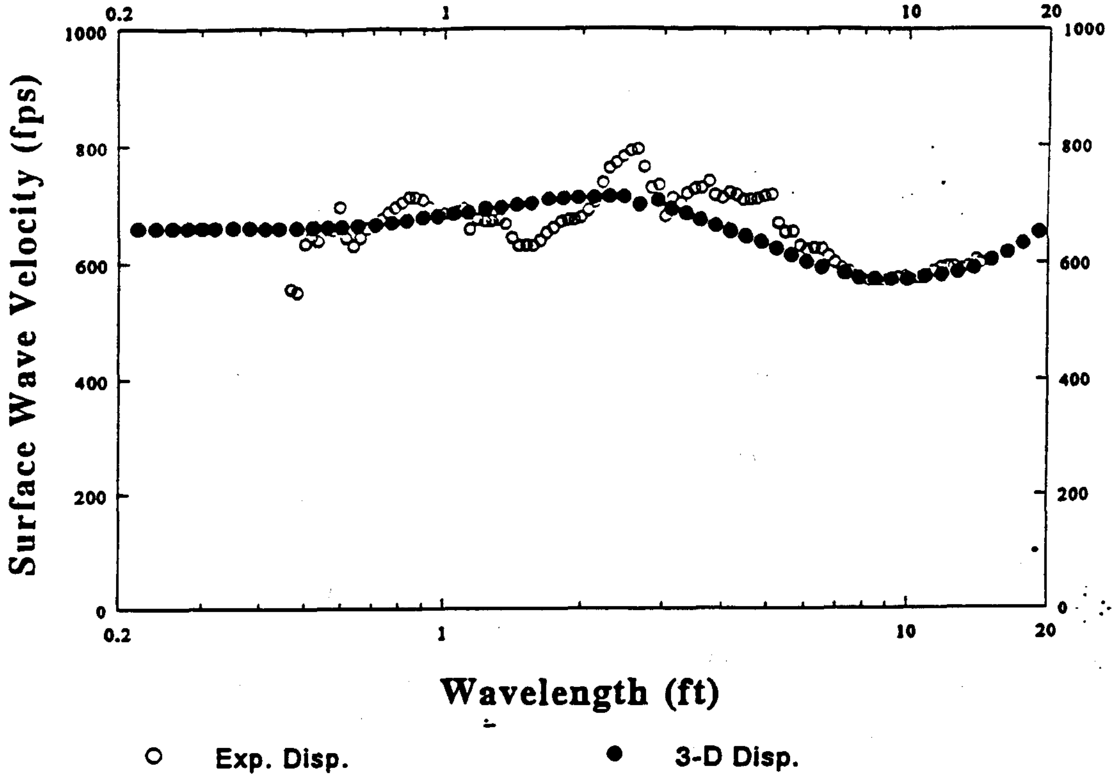


Mixed Waste Facility Line B (600 ft, East-West)

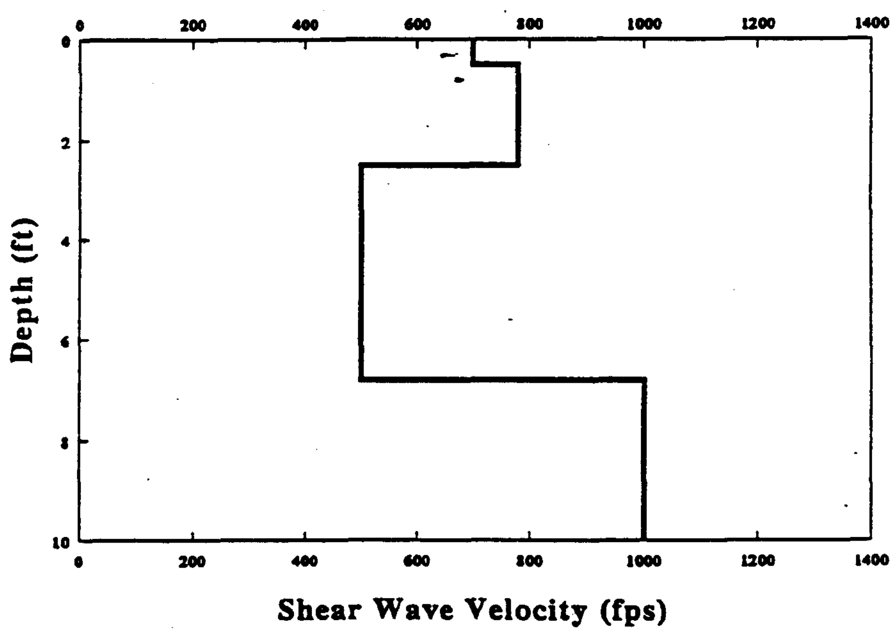
Job 205

Fig. B-20

Experimental and Theoretical Dispersions



Shear Wave Velocity Profile



Job 205

Mixed Waste Facility - Line B (800 ft -- East - West)

Fig. B-21

Appendix B.2 Low-Strain Test Data

As a companion to the Spectral Analysis of Shear Wave (SASW) program, a low-strain testing program was conducted. The energy for this program was generated by dropping a 2,000 lb weight from 10 ft. Though the low-strain, refraction program was inhibited by the soil structure configuration, it did successfully measure the shear wave velocity. This determination provided a redundant support to the SASW program.

The data included herein is a summary of the more complete discussion included in the EBASCO report [4]. If a more complete data set is required, the information can be obtained from this reference.

TABLE III
Seismic Refraction Data
for the Dynamic Test Facility (DTF) and the Mixed Waste Management Facility (MWMF)

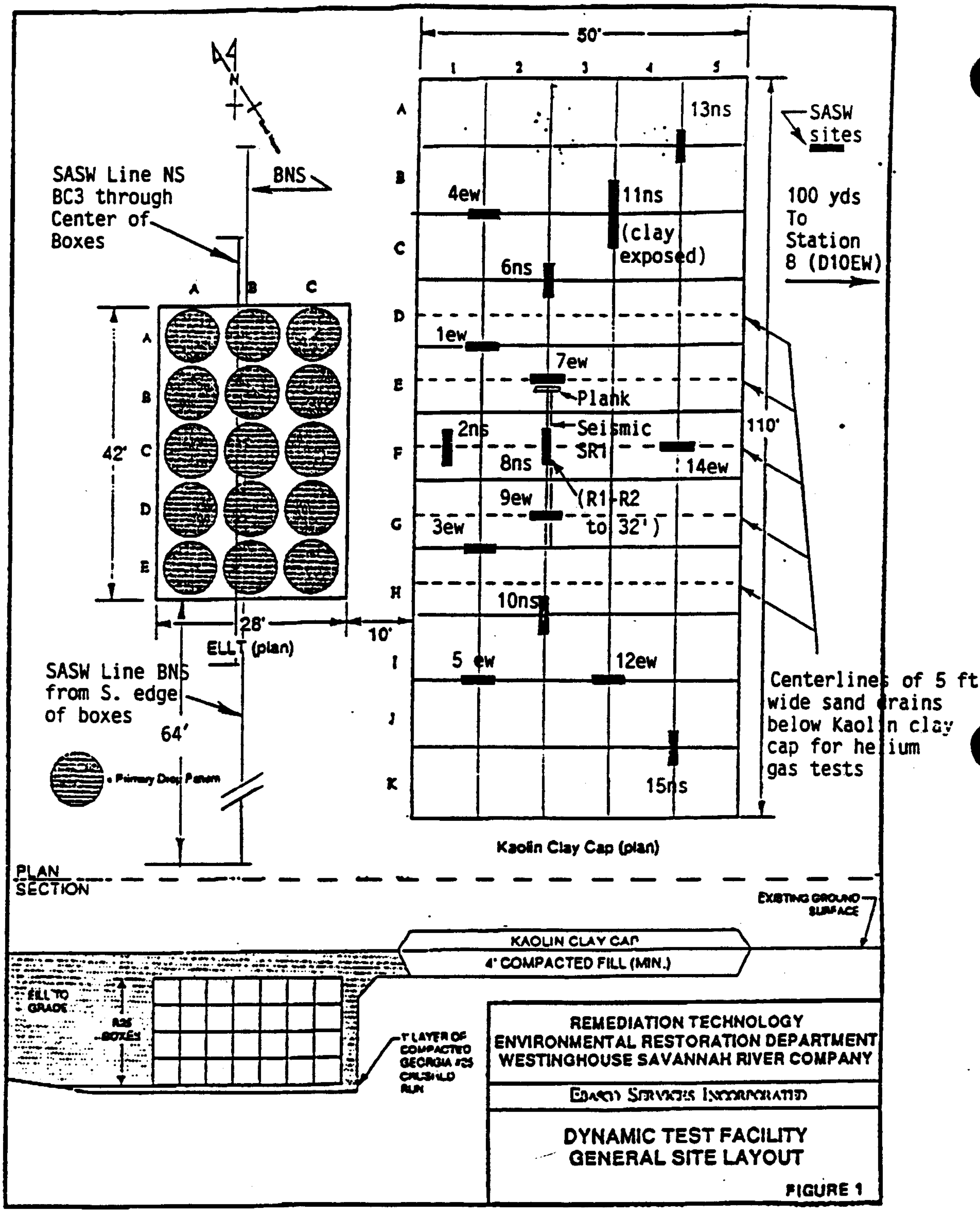
Geophone Distance	Arrival Times (milliseconds) S-Waves	P-Waves
DTF Site SR1 (See Fig. 1 for locations - data plotted in Fig. 9)		
2	2.52	1.55
4	4.16	2.45
6	5.92	3.47
8	7.36	4.58
10	9.12	5.64
12	11.1	6.84
14	14.2	8.32
16	15.65	9.36
18	18.68	11.84
20	20.18	12.8
22	22.56	14
24	23.68	14.72
MWMF (Horseshoe Area) Site SR2 (See Fig. 2 for Locations - data plotted in Fig. 10)		
2	3.58	1.57
4	5.41	2.6
6	9.3	3.63
8	11.3	4.91
10	14.7	6.56
12	16.8	7.76
14	19.2	9.4
16	22.3	10.6
18	24.2	12.84
20	25.9	14.12
22	34.7	16.12
24	37.4	17.16

Job No. 205

TABLE III (Cont.)
Seismic Refraction Data
for the Mixed Waste Management Facility

Geophone Distance	Arrival Times (milliseconds) S-Waves	P-Waves
MWMF (Concrete Ditch Area) Site SR3 (See Fig. 3 for locations - data plotted in Fig. 11)		
2	2.46	1.34
4	4.16	2.11
6	5.31	2.85
8	6.8	3.55
10	8.56	4.9
12	10.2	6.27
14	11.8	6.98
16	13.9	8.13
18	17.7	9.15
20	20.3	10.18
22	21.4	14.21
24	24.5	15.36

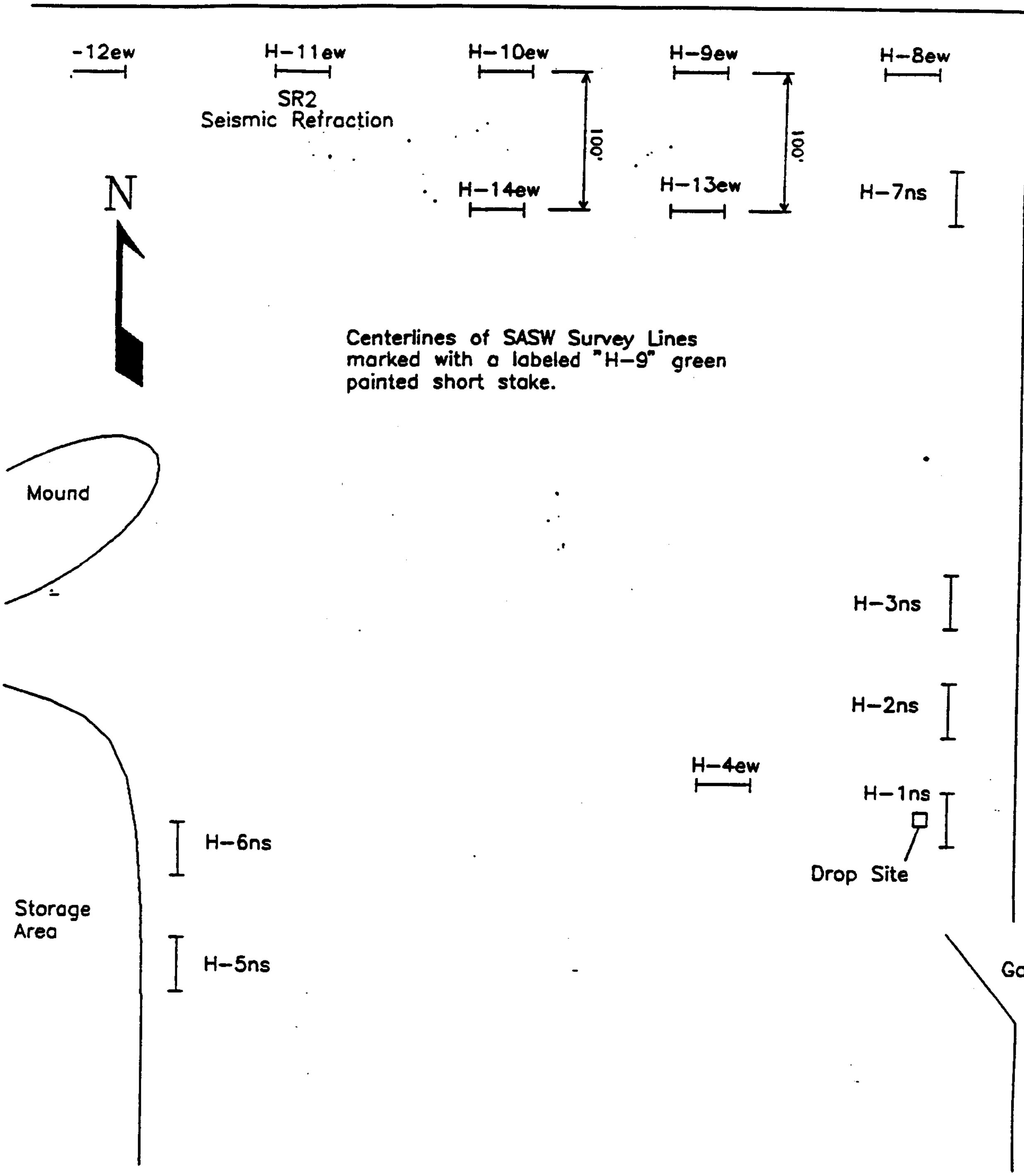
Job No. 205



DTF SASW SITES

Job No. 205

Fig. 1

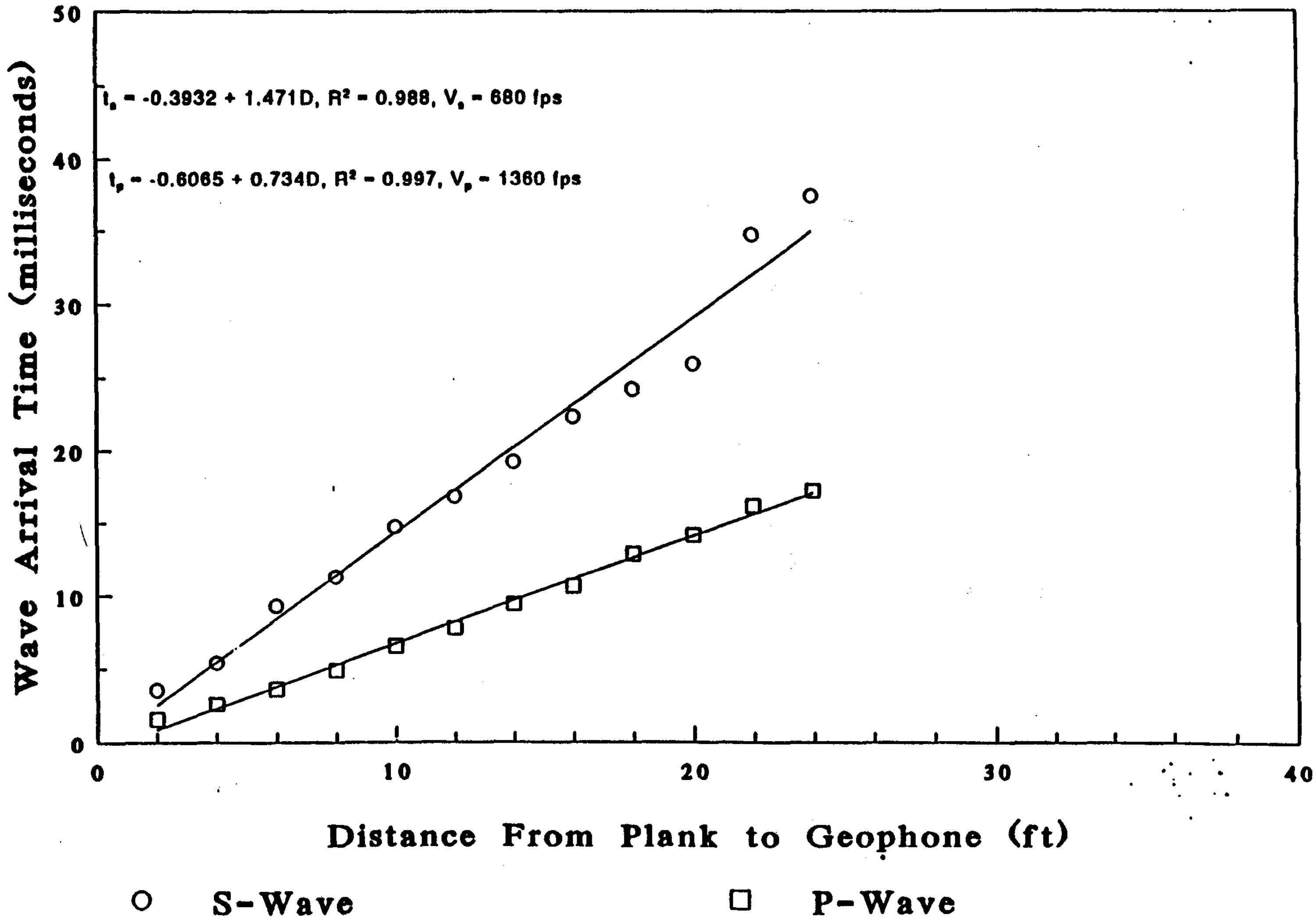


MWMF Horseshoe SASW Sites

Job No. 205

Fig. 2

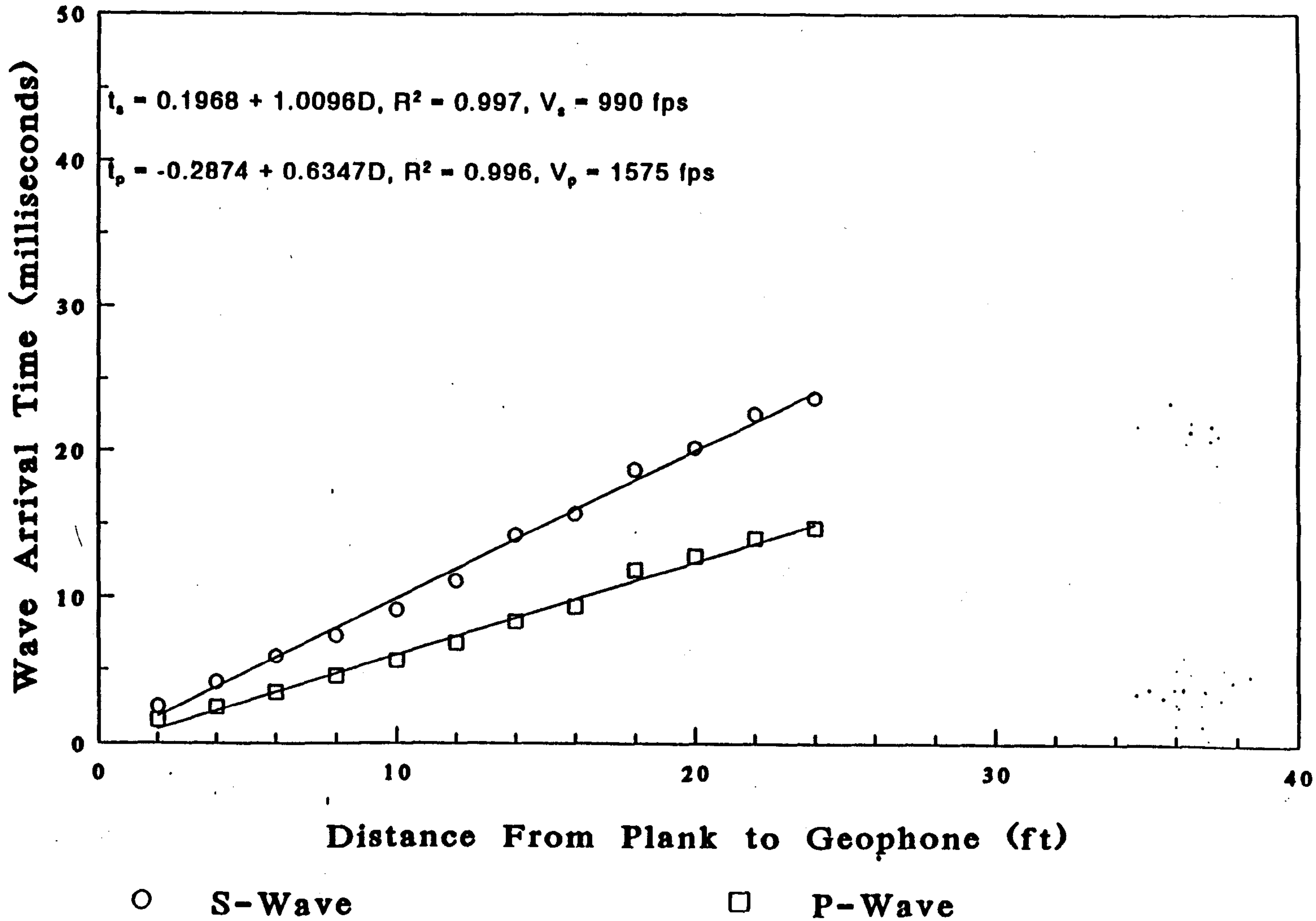
P- and S- Wave Seis c Refraction Survey
DTF Site SR1 across SASW Sites 7, 8 & 9



Job No. 205

Fig. 9

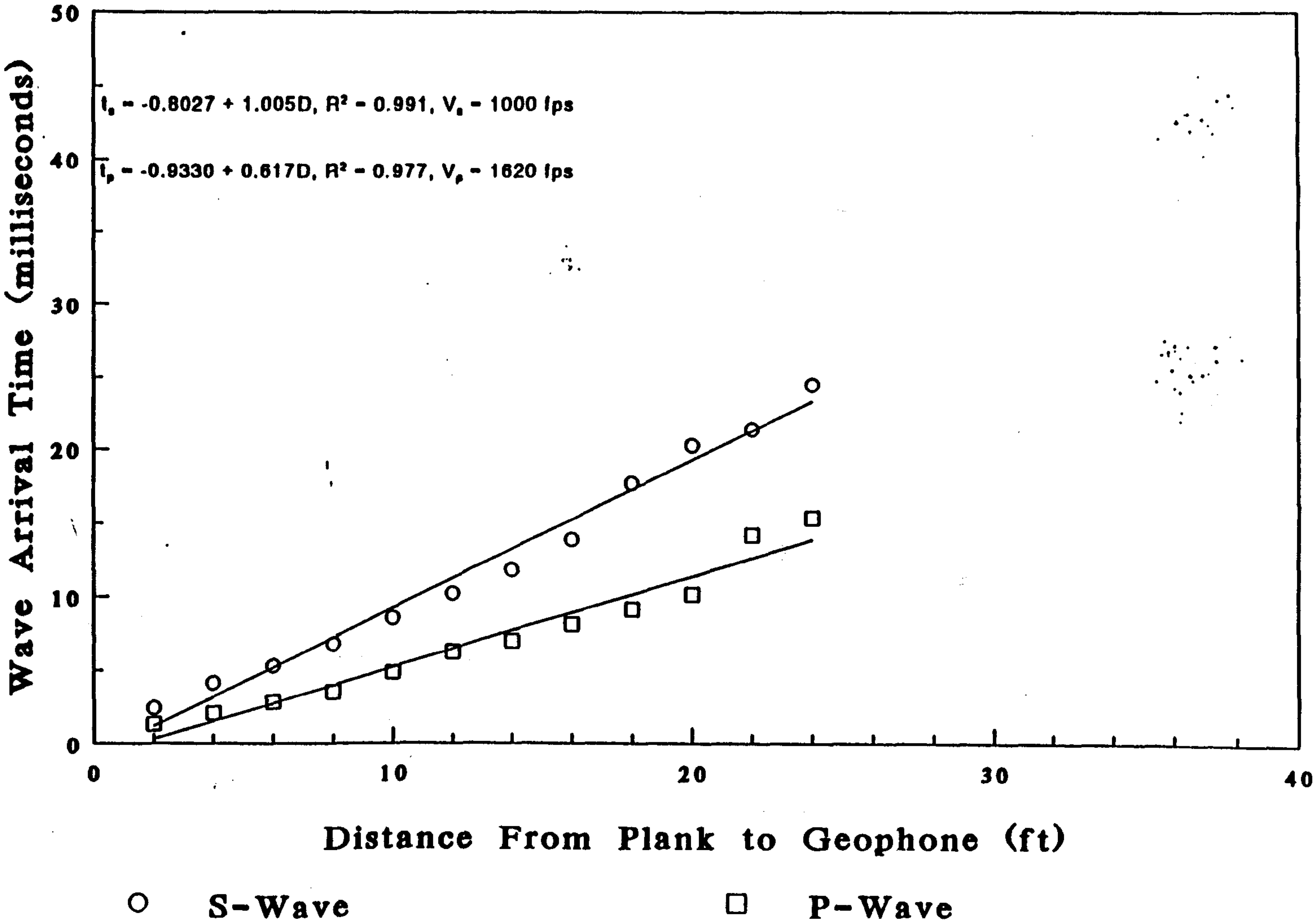
P- and S- Wave S mic Refraction Survey
MWMF Horseshoe Site H11ew Site SR2



Job No. 205

Fig. 10

P– and S– Wave Se[i]smic Refraction Survey
MWMF Concrete Ditch Site A700ew SR3



Job NO. 205

Fig. 11

Appendix B.3 Impact Velocity Calibration Data

Appendix Summary

Each crane used to hoist and drop a dynamic compaction weight has different configurations and resulting coefficients of friction. To optimize the energy imparted to buried wastes, it is important to monitor and control the crane efficiency. Also, the DCF test model required the correlation of the energy at impact between the test and actual production. To accomplish this end, the impact velocity calibration test phase was created and conducted.

The impact velocity calibration test phase was conducted by building two vertical towers between which the dynamic compaction weight would pass. A series of electronic sensors was placed along the towers. As the weight passes through the sensor beams, the velocity is computed. Knowing the instantaneous velocity, the impact energy can be calculated and compared to the frictionless model described by physics.

The data included herein is a summary of the more complete discussion included in the EBASCO report [4]. If a more complete data set is required, the information can be obtained from this reference. In addition, a discussion and outline of the mathematics is included.

Impact Velocity Testing Overview

The following discussion provides a more in depth explanation of the methods and calculations involved in the impact velocity calibration data. The kinetic energy delivered to the Dynamic Compaction Facility (DCF) test waste matrix by each drop can be determined using basic physics. In simplest terms the kinetic energy delivered is equal to one half the mass of the weight multiplied by the impact velocity squared. Because the efficiency of the crane that will be sued at the DCF is not known, the impact velocity of the weight cannot be easily calculated. Further, if a full-scale follow-up dynamic compaction program is implemented, a different type of crane might be used.

The technology chosen to determine weight impact velocity is a series of laser diode photoelectric cells mounted vertically on two poses at predetermined heights. As the tamper falls downward it sequentially breaks a series of photocell beams at several predetermined heights above the ground surface. The interval between each successive break was recorded. Since the beams are located a known distance apart, the interval velocity and interval crane efficiency can be calculated. Determination of instantaneous impact velocity is then a simple matter of extrapolation using the quantities measured in the photocell gates.

Calculations Involving Tamper Velocity/Crane Efficiency

For an object in free fall, the impact velocity (v) can be calculated as:

$$v = (2gh)^{1/2}$$

where g is the acceleration of gravity (32.15 ft/s^2) and h is the drop height. Note that for free fall calculations, impact velocity is independent of tamper weight. However, each crane unavoidable has inertia and fiction associated with the rotation of the cable drum and cable draw through the block/pulley system, etc. Therefore, the actual impact velocity is always less than the free fall value. As suggested by Lukas (1986), this can be accounted for by introducing an efficiency factor "e" such that the equation to calculate impact velocity becomes:

$$v = \left(2ghe_{avg}\right)^{1/2}$$

This efficiency factor "e" varies greatly depending on the type of equipment used. From this basic concept of crane efficiency the various quantities associated motion can be related through the following four general equations:

$$v = v_o + ge_{avg}t \tag{1}$$

$$h = v_o t + \frac{1}{2} ge_{avg}t^2 \tag{2}$$

$$v^2 = v_0^2 + 2ge_{avg}h \tag{3}$$

$$v_{avg} = \frac{(v + v_o)}{2} \tag{4}$$

where:

h	=	height (ft)
v	=	instantaneous velocity (ft/s)
v_o	=	initial velocity (ft/s)
v_{avg}	=	average velocity (ft/s)
t	=	time (seconds)
g	=	acceleration (32.15 ft/s)
e_{avg}	=	average crane efficiency (equals 1.0 for free-fall)

As demonstrated by these equations, the time it takes for an object to fall can provide a measure of impact velocity. For example, from a height of 42 feet, a free fall drop time of 1.62 seconds is predicted from equation 2. As previously mentioned, crane efficiencies always lower the effective velocity of a falling object (relative to free fall). For example, crane efficiencies of 80% and 60% increase drop times from 42 feet to 1.81 and 2.09 seconds, respectively. The technology that we have implemented for velocity measurements yields the time that it takes for the tamper to travel over two measured distances (interval 1 and interval 2). The measure quantities required by this technique are shown in Figure B.3.1.

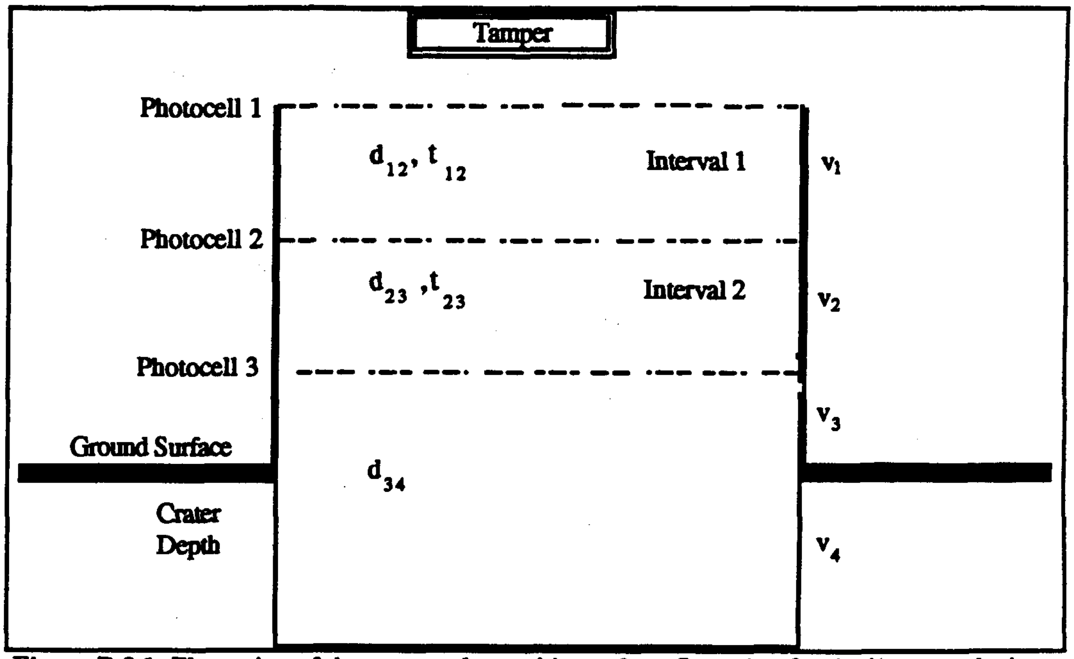


Figure B.3.1 Illustration of the measured quantities and configuration for the impact velocity measurements.

where:

d_{12} = distance between photocell 1 and photocell 2

d_{23} = distance between photocell 2 and photocell 3

d_{34} = distance between photocell 3 and crater bottom

t_{12} = time tamper takes to travel from photocell 1 to photocell 2

t_{23} = time tamper takes to travel from photocell 2 to photocell 3

v_0 = instantaneous velocity at time of tamper release (= 0)

the desired calculated quantities are:

v_1 = instantaneous velocity at photocell 1

v_2 = instantaneous velocity at photocell 2

v_3 = instantaneous velocity at photocell 3

v_4 = instantaneous velocity at impact (terminal velocity)

e_{12} = interval crane efficiency based on intervals 1,2

e_{avg} = average crane efficiency for entire drop

In order to effectively use the measured interval data in conjunction with equations (1), (2), (3), and (4) several algebraic manipulations must be undertaken to produce the desired results of terminal velocity and crane efficiency. The derivation of these equations is outlined as follows.

General Equations (1), (2), (3), and (4) become more specific to the interval velocity measurements, and are:

$$v = v_o + g e_{12} t \tag{5}$$

$$h = v_o t + \frac{1}{2} g e_{12} t^2 \tag{6}$$

$$v^2 = v_0^2 + 2 g e_{12} h \tag{7}$$

$$v_{avg} = \frac{(v + v_o)}{2} \tag{8}$$

where:

h	=	height (ft)
v	=	instantaneous velocity (ft/s)
v_o	=	initial velocity (ft/s)
v_{avg}	=	average velocity (ft/s)
t	=	time (seconds)
g	=	acceleration (32.15 ft/s^2)
e_{12}	=	interval 1,2 crane efficiency

<u>Calculation of Interval Crane Efficiency</u> (e_{12})

From equation (5), instantaneous velocity at photocell 2 is:

$$v_2 = v_1 + e_{12} g t_{12} \tag{9}$$

From equation (6), instantaneous velocity at photocell 3 is:

$$v_3 = v_2 + e_{12} g t_{23} \tag{10}$$

Adding equations (9) and (10):

$$v_2 + v_3 = v_1 + v_2 + e_{12} g \left(t_{12+t_{23}}\right) \tag{11}$$

Dividing (11) by 2 to get average interval velocity:

$$\frac{(v_2 + v_3)}{2} = \frac{(v_1 + v_2)}{2} + \frac{[e_{12} g (t_{12} + t_{23})]}{2} \tag{12}$$

Average velocity for interval 2 can be expressed two ways:

$$\frac{(v_1 + v_2)}{2} = \frac{d_{12}}{t_{12}} \tag{13}$$

Average velocity for interval 2 can be expressed two ways:

$$\frac{(v_2+v_3)}{2}=\frac{d_{23}}{t_{23}} \qquad (14)$$

Substituting average velocity based on distance and time (equations (13) and (14)) into equation (12):

$$\frac{d_{23}}{t_{23}}=\frac{d_{12}}{t_{12}}+\frac{[e_{12}g\,(t_{12}+t_{23})]}{2} \qquad (15)$$

Solving equation (15) for interval crane efficiency (e_{12}):

$$e_{12}=\frac{2\left(\frac{d_{23}}{t_{23}}-\frac{d_{12}}{t_{12}}\right)}{g\,(t_{12}+t_{23})} \qquad (16)$$

Calculation of Instantaneous Velocity at Point of Impact (v_4)

Solving equation (14) for v_2:

$$v_2=2\left(\frac{d_{23}}{t_{23}}\right)-v_3 \qquad (17)$$

Substituting v_2 from equation (17) into equation (10):

$$v_3=\left[2\left(\frac{d_{23}}{t_{23}}\right)-v_3\right]+e_{12}gt_{23} \qquad (18)$$

Simplifying equation (18):

$$v_3=\frac{d_{23}}{t_{23}}+\frac{(e_{12}gt_{23})}{2} \qquad (19)$$

Solving equation (13) for v_1:

$$v_1=2\left(\frac{d_{12}}{t_{12}}\right)-v_2 \qquad (20)$$

Substituting v_1 from equation (20) into equation (9):

$$v_2=\left[2\left(\frac{d_{12}}{t_{12}}\right)-v_2\right]+e_{12}gt_{12} \qquad (21)$$

Simplifying equation (21):

$$v_2=\frac{d_{12}}{t_{12}}+\frac{(e_{12}gt_{12})}{2} \qquad (22)$$

Solving equation (5) for v_1:

$$v_1 = v_2 = e_{12}gt_{12} \quad (23)$$

Substituting v_2 from equation (22) into equation (23):

$$v_1 = \left[\frac{d_{12}}{t_{12}} + \frac{(e_{12}gt_{12})}{2}\right] - e_{12}gt_{12} \quad (24)$$

Substituting v_3 from equation (19) into equation (7):

$$v_4 = \left[\left(\frac{d_{23}}{t_{23}} + \frac{(e_{12}gt_{23})}{2}\right)^2 + 2ge_{12}d_{34}\right]^{1/2} \quad (25)$$

<u>Calculation of Average Crane Efficiency for Entire Drop</u> (e_{avg})

From equation (3) $v_4^2 = v_o^2 + 2ge_{avg}h$. Substituting the initial tamper velocity of zero ($v_o = 0$) and v_4 from equation (25) into equation (26), and solving for e_{avg}:

$$e_{avg} = \frac{v_4^2}{2gh} \quad (26)$$

$$= \frac{\left\{\left[\left(\frac{d_{23}}{t_{23}} + \frac{(e_{12}gt_{23})}{2}\right)^2 + 2ge_{12}d_{34}\right]^{0.5}\right\}^2}{2gh} \quad (27)$$

$$= \frac{\left\{\left[\frac{d_{23}}{t_{23}} + \frac{(e_{12}gt_{23})}{2}\right]^2 + 2ge_{12}d_{34}\right\}}{2gh} \quad (28)$$

$$= \frac{d_{12}}{t_{12}} - \frac{e_{12}gt_{12}}{2} \quad (29)$$

<u>Calculation of Kinetic Energy For Weight Impact</u>

The approximate energy delivered to the DCF test waste matrix by each drop can be determined using basic physics. In simplest terms, the kinetic energy delivered to the DCF waste matrix can be expressed by:

$$k.e. = \tfrac{1}{2}mv^2$$

where:

k.e. = kinetic energy in ft/lbs

m = mass in slugs = (weight/gravity)

v = terminal velocity

Substituting the velocity value obtained from equation (25) and conversion of the 42,000 lb weight to mass (slugs), then kinetic energy delivered to the DCF matrix is:

$$k.e. = \frac{1}{2}\left[(42{,}000\ lbs)/(32.15\ ft/s^2)\right]v_4^2$$

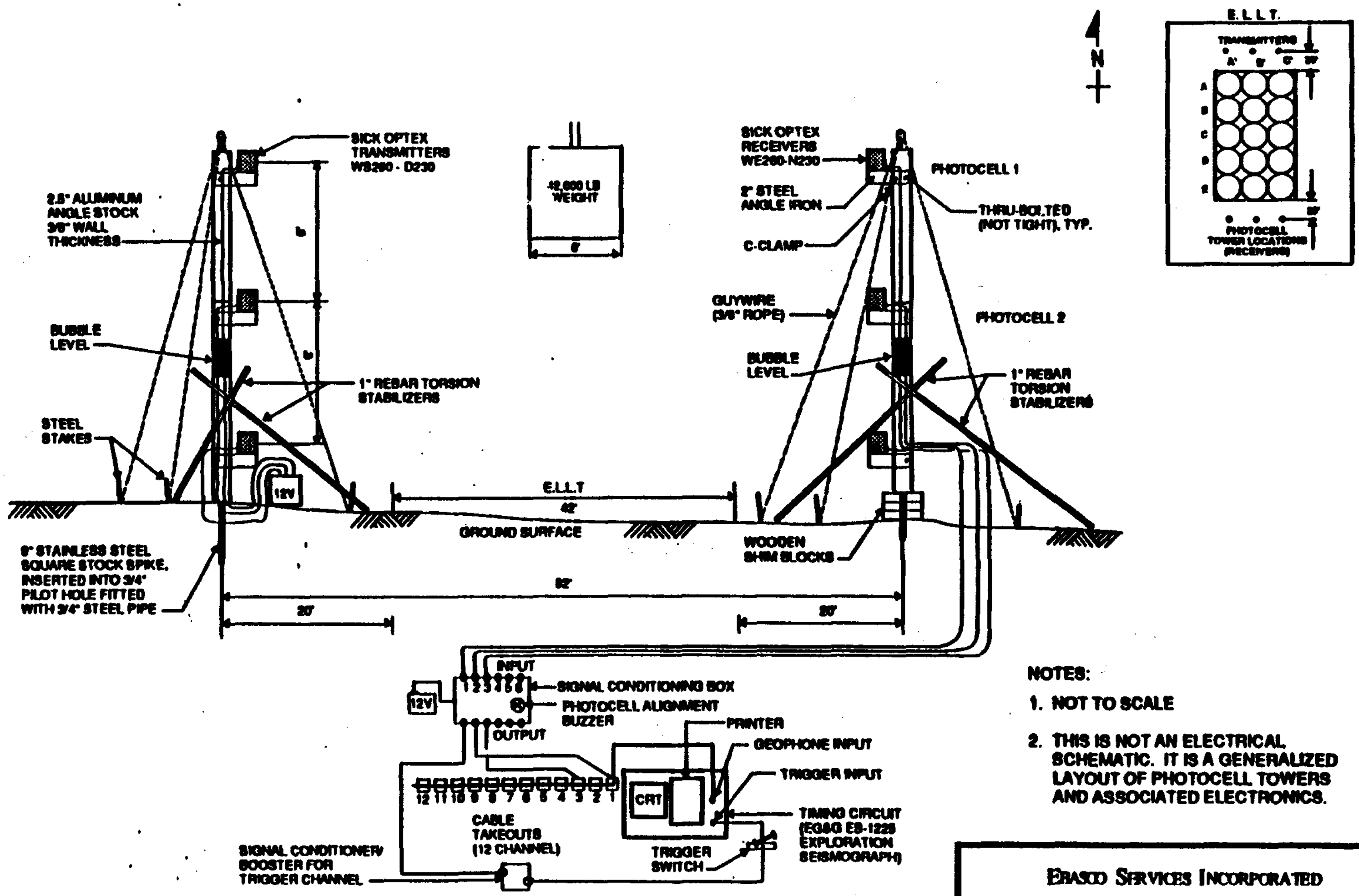
These formulae were incorporated into a spreadsheet so that real time calculations of weight terminal velocity and average crane efficiency could be determined.

A description of the field setup of the measuring equipment at the DCF and a summary of the observation results is included herein.

(Pages 57 through 58 Left Intentionally Blank)

1.6 FIELD SETUP OF MEASURING EQUIPMENT AT THE DTF

The field setup for photocell tower arrays and associated electronics is presented diagrammatically on Figure 1.6-1. The first step in setting up the photocell towers was to pre-drill pilot holes (3/4" diameter, 1' deep) at each of the tower locations (see Figure 1.6-1 inset). The pilot holes were then fitted with 3/4" diameter steel pipe (pounded flush with theground surface). The 9" stainless steel spike at the end of each tower was then inserted into the 3/4" pipe, allowing the tower to free-stand vertically. At this point the towers were shimmed with wood blocks to horizontality (or near horizontality), and 4"x4" fence post bubble levels were utilized to achieve a vertical tower orientation. The towers were then tied into position with guy-wires, with 6' to 7' long 1" diameter rebar stabilizers added at 90 degrees to one another and lashed to the tower. These stabilizers helped to provide additional resistance to swaying motions due to wind loading, and most importantly provided torsional (twisting) resistance. Electrical connections were then made, including 12V power to each photocell, line hookups to the signal conditioning box, and fitting the trigger and signal cables to the timing circuitry (EG&G ES-1225 exploration seismograph). At this point the photocell arrays were ready to be aligned. This process was accomplished by use of a 30" long stainless steel sighting tube and Sisteco hand leveling tool (accurate to 0.1 degree). The photocell signal conditioning box was outfitted with a loud piezoelectric buzzer that sounded as the photocell transmitter and receiver came into alignment. Alignment was accomplished by a combination of sighting and leveling of the sensor bracket/photocell assembly. The photocell bracket was thru-bolted (bolts not tightened) to the aluminum angle stock which allowed for up-and-down rotation of the photocells. Side-to-side sensor motion was accomplished by rotating the photocell assembly. Once the buzzer signaled alignment the photocell was tightened into position by use of a c-clamp (photocell assembly to aluminum angle stock) and wing-nut (photocell bracket to photocell assembly). Further alignment refinements were necessary at this point. Very small vertical and horizontal adjustments were made to assure that each photocell receiver was centered within the transmitter beam. The distance from photocell transmitter to receiver was set to 82 feet, which is more than the recommended maximum range of 65 feet. In practice this made the photocells extremely susceptible to small rotational movements (misalignment), thus requiring very precise initial photocell alignment. In order to complete the tower setup a measurement of the distance from the breakpoint in photocell beam number 3 to the ground surface (impact area) was made.



NOTES:

1. NOT TO SCALE
2. THIS IS NOT AN ELECTRICAL SCHEMATIC. IT IS A GENERALIZED LAYOUT OF PHOTOCELL TOWERS AND ASSOCIATED ELECTRONICS.

EBASCO SERVICES INCORPORATED

SCHEMATIC DIAGRAM PHOTOCELL TOWERS AND ASSOCIATED ELECTRONICS

FIGURE 1.6-1

DRAWN BY: PK CHECKED BY: RG

Once the photocell tower setup was completed the drop testing commenced. As the 42,000 pound weight descended it broke the 1st photocell beam, which triggered the seismograph to begin the timing circuit. The timing circuit window was typically set to record for 1.0 seconds (1000 milliseconds), which allowed data sampling (photocell 2 and 3 interrogation) to occur every 0.5 milliseconds. The seismograph was operated in "preview mode" which disallowed subsequent triggers (i.e. cable/block/choke assembly moving in front of the photocells) from stacking and corrupting the first trigger data. As soon as the compaction weight impacted the trigger channel was electrically disconnected from the seismograph by means of a toggle switch. This disconnection provided additional security against accidental triggers. At this point the seismograph operator used the built-in cursor capabilities of the seismograph to read off the event triggers for photocells 2 and 3, and made a hard copy printout of the record.

The 2 pieces of data gathered from the seismograph represents the time it took for the 42,000 pound weight to pass from photocell 1 to photocell 2, and from photocell 1 to photocell 3. To determine the instantaneous velocity at impact and other desired parameters (i.e. crane efficiency) these data were entered into a Lotus 1-2-3 spreadsheet running on a portable computer. This setup allowed for real time determination of tamper velocity and crane efficiency. The mathematics and layout of the calculation spreadsheet were discussed in Section 1.3.

Calibration drops with the 42,000 pound tamper were conducted 7/13/92 in a cleared field 380 feet east of the DTF, at calibration drop location D+10. Calibration tests were performed from several different drop heights (15, 20, 25, 35, 42, and 50 ft), with ordering of drop height from lowest to highest. Table 1.6-1 summarizes the average crane efficiencies realized from each of the different drop heights. The complete velocity/kinetic energy/efficiency spreadsheet used for the calibration drops is presented as Table 1.6-2. As shown on Table 1.6-1, the terminal (impact velocity, v_4) at the initially proposed production drop height of 42 ft was approximately 39.8 ft/s. This value was lower than the anticipated velocity of approximately 46 ft/s (for a 42 ft drop height and crane with 80-90% efficiency). This is due to the fact that the Manitowoc crane that was used could not lift the 42,000 pound weight with a single cable, and relied upon a block/pulley arrangement that reduced average crane efficiency to approximately 54% (see Table 1.6-1, which shows remarkably uniform average crane efficiencies given the large range of drop heights). Based on this lower crane efficiency and impact velocity it was determined that a higher drop height (50 ft) would be implemented for the production drops. Hard-copy paper records of the 13 DTF

Drop Number	Drop Height [Feet]	Average Crane Efficiency For Entire Drop [%]	COMMENTS:
C-1	15.0	0.554	
C-2	15.0	0.554	
C-3	15.0	0.567	
C-4	20.0	0.516	
C-5	20.0	0.512	
C-6	20.0	0.503	
C-7	25.0	0.509	
C-8	25.0	0.501	
C-9	35.0	0.554	
C-10	35.0	0.544	
C-11	42.0	0.574	
C-12	42.0	0.067	Bad Trigger From Measurement Rope
C-13	50.0	0.539	

42,000 Pound Tamper Calibration Drops Adjacent to (East Of) The DTF	
Average Crane Efficiency	
Average	0.536
Std. Dev.	0.025

Note: Test 12 Excluded (Bad Trigger)

Table 1.6-1. Calibration summary: velocity measuring technology at calibration drop area adjacent to (east of) the DTF. Statistics are given for average crane efficiency.

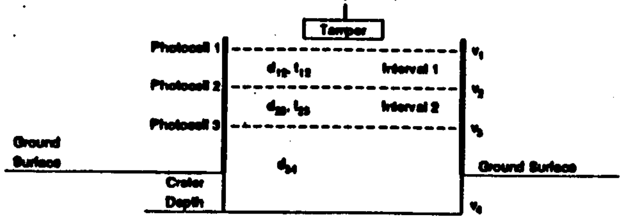
Table 1.6-2. Spreadsheet with calibration of velocity measuring technology at calibration drop area adjacent to (east of) the DTF.

Checked By: JENNIFER ROBERTS (Print Name) Jennifer Roberts (Signature) 7-23-92 (Date)

A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R
									Read From Seismograph			Calculations Based On Interval 1,2					
Drop Number	Date	Time [24 Hour]	Drop Height [Feet]	Crater Depth [Feet]	d_{12} [Feet]	d_{23} [Feet]	Distance, P. cell 3 to Ground Surface [Feet]	d_{34} [Feet]	t_{12} [Sec.]	t_{12-23} [Sec.]	t_{23} [Sec.]	Interval Crane Efficiency [%]	v_3 [ft/sec]	v_4 [ft/sec]	Calculated Energy [ft-lb]	Avg. Crane Efficiency For Entire Drop [%]	COMMENTS:
C-1	7/13/92	1151	15.0	0.00	6.00	6.00	1.42	1.42	0.470	0.780	0.31000	0.53702	22.0300	23.1170	348062	0.55407	
C-2	7/13/92	1256	15.0	0.08	6.00	6.00	1.42	1.50	0.470	0.780	0.31000	0.53640	22.0378	23.1000	351220	0.55442	
C-3	7/13/92	1310	15.0	0.17	6.00	6.00	1.42	1.59	0.452	0.756	0.30400	0.53177	22.3355	23.5100	361297	0.56719	
C-4	7/13/92	1318	20.0	0.25	6.00	6.00	1.42	1.67	0.322	0.583	0.26100	0.46400	24.9301	25.9180	438619	0.51565	
C-5	7/13/92	1328	20.0	0.33	6.00	6.00	1.42	1.75	0.319	0.580	0.26100	0.44630	24.0083	25.0055	437001	0.51171	
C-6	7/13/92	1342	20.0	0.42	6.00	6.00	1.42	1.84	0.325	0.589	0.26400	0.45053	24.8362	25.0062	431300	0.50297	
C-7	7/13/92	1356	25.0	0.50	6.00	6.00	1.42	1.92	0.266	0.485	0.22900	0.45601	27.8600	28.8820	544905	0.50870	
C-8	7/13/92	1431	25.0	0.58	6.00	6.00	1.42	2.00	0.266	0.500	0.23100	0.45650	27.0001	28.7121	538481	0.50115	
C-9	7/13/92	1440	35.0	0.67	6.00	6.00	1.42	2.09	0.206	0.389	0.18300	0.56541	34.8000	35.0200	829100	0.55352	
C-10	7/13/92	1451	35.0	0.75	6.00	6.00	1.42	2.17	0.205	0.390	0.18400	0.55546	34.2517	35.3850	818834	0.54406	
C-11	7/13/92	1502	42.0	0.83	6.00	6.00	1.42	2.25	0.181	0.344	0.16300	0.56190	38.5443	39.7691	1033071	0.57425	
C-12	7/13/92	1523	42.0	0.92	6.00	6.00	1.42	2.34	0.162	0.386	0.22400	-1.6521	38.8367	13.8361	1033071	0.06736	Bad Trigger From Measurement Rope
C-13	7/13/92	1532	50.0	1.00	6.00	6.00	1.42	2.42	0.162	0.313	0.15100	0.53623	41.8367	42.8411	1154480	0.53887	
															8319817		

Cumulative Energy

Note: Assume C-12 energy is = C-11 energy



Calculations Based On Interval 1,2 Measurements	Interval crane efficiency $(e_{12}) = 2*(d_{23}/t_{23} - d_{12}/t_{12}) / g(t_{12}+t_{23}) = 2*(G/L - F/J) / 32.16*(J + L)$ $v_1 = d_{12}/t_{12} - (egt_{12})/2 = F/J - (M*32.16*J)/2$ $v_2 = d_{12}/t_{12} + (egt_{12})/2 = F/J + (M*32.16*J)/2$ $v_3 = d_{23}/t_{23} + (egt_{23})/2 = G/L + (M*32.16*L)/2$ $v_4 = (v_3^2 + 2ged_{34})^{1/2} = (N^2 + 2*32.16*M*I)^{1/2}$
$k.e. = 1/2mv^2$	m = mass (slugs), v = velocity. k.e. = kinetic energy. mass = weight(pounds)/g (32.16 ft/s^2)
average crane efficiency for entire drop (e_{avg})	$e_{avg} = v_4^2/(2*32.16*h) = O^2/(2*32.16*(D+E))$

calibration drops are included as Appendix B.

1.7 PRODUCTION DROP DATA

Production dropping was conducted from 7/15/92 to 7/21/92, at a total of 19 drop points. Hard-copy paper records of all DTF production drops are included as Appendix C. Figure 1.7-1 shows the location of each drop point, drop location type (primary, secondary, or tertiary), and sequence in which each drop was completed. Table 1.7-1 includes all of the primary and secondary drop point spreadsheet calculations/data that were collected using the interval photocell measuring equipment. This includes determination of terminal velocity, kinetic energy, and average crane efficiency for each drop. For the purposes of examining reproducibility of the crane drops and photocell measurements, Table 1.7-2 summarizes the instantaneous velocity at photocell 3 (v_3) and average crane efficiency (the terminal velocity, v_4, was not chosen for comparative purposes because crater depth/terminal velocity changes with each drop). As shown on Table 1.7-2 the instantaneous velocity at photocell 3 averages 41.43 ft/s with a standard deviation of 0.44 ft/s. The average crane efficiency for all the production drops is 0.555 (55.5%) with a standard deviation of 0.015 (1.5%). These results indicate a high degree of reproducibility for both the crane and the interval photocell measurement equipment.

Due to this high degree of reproducibility (a fact that was available real time) it was determined that the interval photocell measurements were not necessary for the final four drop locations (tertiary drop points T-1, T-2, T-3, and T-4). By using the average crane efficiency obtained from measurements at the primary and secondary drop locations it is possible to calculate both tamper impact velocity and kinetic energy for each of the tertiary drops. Table 1.7-3 presents these data.

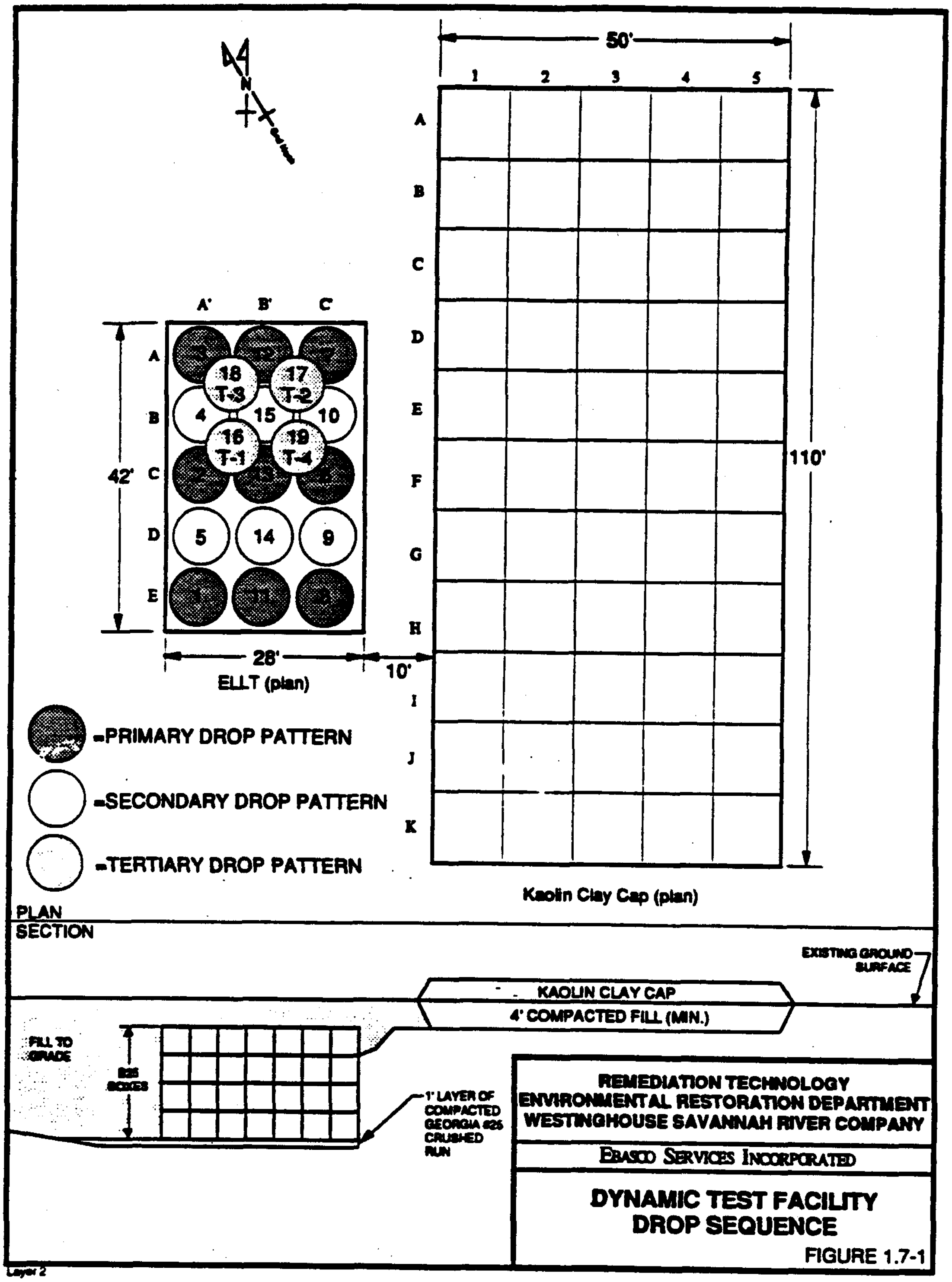

50'
1
2
3
4
5
A
B
C
D
E
F
G
H
I
J
K
110'
A'
B'
C'
42'
18
T-3
17
T-2
4
15
10
16
T-1
19
T-4
5
14
9
28'
ELLT (plan)
10'
=PRIMARY DROP PATTERN
=SECONDARY DROP PATTERN
=TERTIARY DROP PATTERN
Kaolin Clay Cap (plan)
PLAN
SECTION
EXISTING GROUND SURFACE
KAOLIN CLAY CAP
4' COMPACTED FILL (MIN.)
FILL TO GRADE
1' LAYER OF COMPACTED GEORGIA #25 CRUSHED RUN
REMEDIATION TECHNOLOGY
ENVIRONMENTAL RESTORATION DEPARTMENT
WESTINGHOUSE SAVANNAH RIVER COMPANY
EBASCO SERVICES INCORPORATED
DYNAMIC TEST FACILITY
DROP SEQUENCE
FIGURE 1.7-1

Table 1.7-1. Summary spreadsheet with production drop impact velocity, kinetic energy, and average crane efficiency calculations (based on average photocell measurements of primary and secondary drops).

A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R
							Distance, P-cell 3 to Ground Surface		Read From Seismograph			Calculations Based On Interval 1,2				Avg. Crane Efficiency Per Entire Drop	
Drop Number	Date	Time 24 Hour	Drop Height [Feet]	Crater Depth [Feet]	[illegible] [Feet]	[illegible] [Feet]	[Feet]	[illegible] [Feet]	[illegible] [Sec]	[illegible] [Sec]	[illegible] [Sec]	Interval Crane Efficiency [%]	v_p [ft/sec]	v_c [ft/sec]	Calculated Energy [ft-lb]	[%]	COMMENTS
AA'-1	7/16/92	1349	80.0	0.00	0.00	0.00	1.00	1.00	0.1605	0.3120	0.1455	0.640	41.57	42.16	1161169	0.653	
AA'-2	7/16/92	1359	80.0	2.00	0.00	0.00	1.00	3.00	0.1620	0.3120	0.1500	0.591	41.42	43.04	1210160	0.646	
AA'-3	7/16/92	1308	80.0	4.00	0.00	0.00	1.00	5.00	0.1605	0.3125	0.1450	0.711	41.57	45.00	1325510	0.675	
				0.56											[illegible]		
AB'-1	7/17/92	0936	80.0	0.00	0.00	0.00	1.40	1.40	0.1635	0.3145	0.1510	0.601	41.10	41.65	1143730	0.646	
AB'-2	7/17/92	0946	80.0	3.15	0.00	0.00	1.40	4.55	0.1620	0.3120	0.1500	0.634	41.55	43.71	1247004	0.639	
AB'-3	7/17/92	0956	80.0	4.65	0.00	0.00	1.40	6.05	0.1620	0.3125	0.1505	0.657	41.38	44.65	1307021	0.636	
AB'-4	7/17/92	1003	80.0	6.60	0.00	0.00	1.40	7.96	0.1625	0.3140	0.1505	0.626	41.38	44.70	1309016	0.636	
				0.57											[illegible]		
AC'-1	7/16/92	0956	80.0	0.00	0.00	0.00	0.85	0.85	0.1615	0.3105	0.1490	0.684	41.76	42.37	1164232	0.684	
AC'-2	7/16/92	1004	80.0	2.46	0.00	0.00	0.85	3.30	0.1605	0.3085	0.1490	0.680	41.60	43.14	1218635	0.682	
AC'-3	7/16/92	1012	80.0	4.87	0.00	0.00	0.85	5.82	0.1600	0.3080	0.1490	0.614	42.00	44.65	1303425	0.665	
				0.67											[illegible]		
BA'-1	7/16/92	1335	80.0	0.00	0.00	0.00	1.30	1.30	(−)	(−)	0.0000	(−)	(−)	(−)	1270009	(−)	Wind trigger: No data
BA'-2	7/16/92	1344	80.0	3.01	0.00	0.00	1.30	4.31	0.1605	0.3065	0.1460	0.657	42.00	44.10	1270009	0.671	
BA'-3	7/16/92	1353	80.0	4.00	0.00	0.00	1.30	5.30	0.1610	0.3085	0.1465	0.601	41.91	44.44	1299892	0.680	
BA'-4	7/16/92	1408	80.0	4.77	0.00	0.00	1.30	6.07	0.1610	0.3085	0.1465	0.601	41.91	44.75	1307080	0.680	
BA'-5	7/16/92	1411	80.0	5.50	0.00	0.00	1.30	6.80	0.1616	0.3120	0.1505	0.641	41.10	45.00	1302135	0.641	
				0.64											6401125	Note: Assume BA'−1 energy = BA'−2 energy	
BB'-1	7/17/92	1351	80.0	0.00	0.00	0.00	1.65	1.65	0.1630	0.3140	0.1510	0.650	41.14	41.60	1145702	0.640	
BB'-2	7/17/92	1400	80.0	2.13	0.00	0.00	1.65	3.78	0.1625	0.3125	0.1510	0.669	41.60	42.71	1191307	0.644	
BB'-3	7/17/92	1408	80.0	2.82	0.00	0.00	1.65	4.47	0.1625	0.3120	0.1505	0.665	41.38	43.27	1223064	0.651	
BB'-4	7/17/92	1417	80.0	3.67	0.00	0.00	1.65	5.32	0.1620	0.3125	0.1505	0.657	41.33	43.77	1251006	0.656	
BB'-5	7/17/92	1427	80.0	4.10	0.00	0.00	1.65	5.75	0.1615	0.3120	0.1515	0.467	40.78	42.94	1204642	0.660	
BB'-6	7/17/92	1436	80.0	4.38	0.00	0.00	1.65	6.05	0.1620	0.3125	0.1505	0.657	41.38	44.00	[illegible]	0.650	
BB'-7	7/17/92	1444	80.0	4.65	0.00	0.00	1.65	6.31	0.1625	0.3145	0.1510	0.601	41.10	44.65	1267664	0.662	
BB'-8	7/17/92	1455	80.0	5.00	0.00	0.00	1.65	6.65	0.1625	0.3130	0.1505	0.665	41.38	44.22	1277265	0.663	
BB'-9	7/17/92	1505	80.0	5.39	0.00	0.00	1.65	7.04	0.1630	0.3145	0.1515	0.650	40.85	45.00	1266746	0.641	
BB'-10	7/17/92	1512	80.0	5.73	0.00	0.00	1.65	7.38	0.1605	0.3115	0.1510	0.470	40.66	45.02	[illegible]	0.656	
				0.50											[illegible]		
BC'-1	7/16/92	1314	80.0	0.00	0.00	0.00	1.10	1.10	0.1620	0.3105	0.1485	0.673	42.01	42.58	1164177	0.684	
BC'-2	7/16/92	1324	80.0	2.50	0.00	0.00	1.10	3.60	0.1620	0.3115	0.1485	0.616	41.82	43.31	1234977	0.686	
BC'-3	7/16/92	1331	80.0	4.03	0.00	0.00	1.10	5.13	0.1620	0.3110	0.1480	0.646	41.82	44.30	1301482	0.665	
BC'-4	7/16/92	1338	80.0	5.15	0.00	0.00	1.10	6.25	0.1610	0.3100	0.1480	0.602	41.71	44.52	1294826	0.689	
				0.28											4985132		
[illegible]-1	7/16/92	1043	80.0	0.00	0.00	0.00	1.65	1.65	0.1650	0.3130	0.1480	0.680	41.82	42.47	1176880	0.691	
[illegible]	7/16/92	1054	80.0	3.00	0.00	0.00	1.65	4.11	0.1620	0.3130	0.1480	0.650	41.82	44.04	[illegible]	0.665	
[illegible]	7/16/92	1100	80.0	5.54	0.00	0.00	1.65	6.59	0.1580	0.3085	0.1465	0.404	41.20	43.71	1247746	0.635	
[illegible]-4	7/16/92	1116	80.0	7.00	0.00	0.00	1.65	8.00	0.1625	0.3105	0.1480	0.725	42.30	46.51	1412792	0.660	
				0.38											5105845		
CB'-1	7/17/92	1037	80.0	0.00	0.00	0.00	1.65	1.65	0.1635	0.3140	0.1505	0.650	41.38	42.38	1176237	0.657	
CB'-2	7/17/92	1040	80.0	2.95	0.00	0.00	1.65	4.60	0.1625	0.3140	0.1505	0.656	41.38	43.50	1240826	0.661	
CB'-3	7/17/92	1057	80.0	4.22	0.00	0.00	1.65	6.17	0.1630	0.3135	0.1505	0.657	41.33	44.15	1273226	0.669	
CB'-4	7/17/92	1105	80.0	5.15	0.00	0.00	1.65	7.10	0.1625	0.3145	0.1510	0.601	41.18	44.40	1287582	0.666	
CB'-5	7/17/92	1115	80.0	5.62	0.00	0.00	1.5[illegible]	7.87	0.1625	0.3135	0.1500	0.686	41.56	45.30	1349836	0.673	
				0.52											6017610		
CC'-1	7/16/92	0903	40.0	0.00	0.00	0.00	(−)	(−)	0.1550	(−)	(−)	(−)	(−)	(−)	1032504	(−)	2 FT SOIL MOUND
CC'-2	7/16/92	0914	80.0	1.12	0.00	0.00	1.10	2.22	0.1655	0.3105	0.1500	0.300	38.22	38.76	1032504	[illegible]	SURVEY MEAS.: 3.12', 5.11', 7.30', 8.87'
CC'-3	7/16/92	0923	80.0	3.11	0.00	0.00	1.10	4.21	0.1625	0.3125	0.1500	0.613	41.46	43.43	1232007	0.662	
CC'-4	7/16/92	0930	80.0	5.30	0.00	0.00	1.10	6.40	0.1650	0.3130	0.1500	0.691	41.42	44.36	1278884	0.651	
				0.88											4576570	Note: Assume CC'−1 energy = CC'−2 energy	
DA'-1	7/16/92	1404	80.0	0.00	0.00	0.00	1.30	1.30	0.1620	0.3105	0.1485	0.675	42.01	42.58	1156843	0.687	No Paper Record
DA'-2	7/16/92	1445	80.0	3.44	0.00	0.00	1.30	4.74	0.1620	0.3100	0.1480	0.708	42.21	44.58	1300315	0.661	
DA'-3	7/16/92	1453	80.0	5.35	0.00	0.00	1.30	6.65	0.1620	0.3110	0.1490	0.646	41.82	45.60	1322716	0.669	
				0.60											3819474		
DB'-1	7/17/92	1138	80.0	0.00	0.00	0.00	2.85	2.85	0.1650	0.3080	0.1480	0.389	41.15	41.86	1148063	0.646	Brake Adjustment; cable noise/drag
DB'-2	7/17/92	1146	80.0	2.31	0.00	0.00	2.85	4.88	0.1630	0.3135	0.1505	0.657	41.33	43.57	1239048	0.664	
DB'-3	7/17/92	1153	80.0	3.57	0.00	0.00	2.85	5.92	0.1630	0.3135	0.1505	0.657	41.33	44.04	[illegible]	0.665	
DB'-4	7/17/92	1250	80.0	4.17	0.00	0.00	2.85	6.72	0.1610	0.3115	0.1505	0.519	41.12	43.77	1251174	0.660	
DB'-5	7/17/92	1304	80.0	4.60	0.00	0.00	2.85	7.15	0.1605	0.3135	0.1500	0.686	41.56	45.08	1320117	0.676	
DB'-6	7/17/92	1308	80.0	5.19	0.00	0.00	2.85	7.74	0.1630	0.3135	0.1505	0.607	41.33	44.64	1313230	0.667	
DB'-7	7/17/92	1315	80.0	5.40	0.00	0.00	2.85	7.85	0.1605	0.3135	0.1500	0.685	41.56	45.43	1340130	0.679	
DB'-8	7/17/92	1322	80.0	5.81	0.00	0.00	2.85	8.28	0.1575	0.3085	0.1480	0.489	41.73	44.62	1312028	0.660	Cable noise/drag
				0.24											[illegible]		
DC'-1	7/16/92	1131	80.0	0.00	0.00	0.00	1.40	1.40	0.1635	0.3140	0.1505	0.656	41.38	42.08	1155731	0.660	
DC'-2	7/16/92	1138	80.0	3.10	0.00	0.00	1.40	4.50	0.1635	0.3140	0.1505	0.656	41.38	43.93	1237480	0.665	
DC'-3	7/16/92	1145	80.0	4.60	0.00	0.00	1.40	6.00	0.1630	0.3130	0.1500	0.684	41.93	44.38	1307080	0.661	
DC'-4	7/16/92	1152	80.0	5.80	0.00	0.00	1.40	7.20	0.1625	0.3125	0.1500	0.686	41.86	45.17	1352723	0.667	
				7.80											3012048		
EA'-1	7/15/92	0808	80.0	0.00	0.00	0.00	1.15	1.15	0.1640	0.3140	0.1500	0.676	41.68	42.23	1164782	0.665	
EA'-2	7/15/92	0820	80.0	3.14	0.00	0.00	1.15	4.29	0.1640	0.3140	0.1500	0.676	41.68	43.62	1252860	0.662	
EA'-3	7/15/92	0830	80.0	5.56	0.00	0.00	1.15	6.71	0.1610	0.3120	0.1510	0.482	40.65	43.46	1238880	0.656	
				0.60											3651640		
EB'-1	7/17/92	0830	80.0	0.00	0.00	0.00	1.55	1.55	0.1650	0.3170	0.1500	0.610	40.98	41.70	1135694	0.641	
EB'-2	7/17/92	0845	80.0	3.37	0.00	0.00	1.55	4.92	0.1655	0.3175	0.1520	0.601	41.62	43.38	1229166	0.646	
EB'-3	7/17/92	0853	80.0	4.94	0.00	0.00	1.55	6.49	0.1650	0.3165	0.1525	0.625	40.98	43.65	1301743	0.647	
EB'-4	7/17/92	0901	80.0	5.94	0.00	0.00	1.55	7.50	0.1655	0.3170	0.1515	0.657	41.21	44.69	1304794	0.650	
[illegible]-5	7/17/92	0910	80.0	6.35	0.00	0.00	1.55	8.00	0.1655	0.3175	0.1500	0.691	41.62	44.36	1278780	0.651	
				0.09											6211307		
[illegible]	7/16/92	1034	80.0	0.00	0.00	0.00	1.65	1.65	0.1655	0.3140	0.1505	0.635	41.38	41.80	1149450	0.646	
[illegible]-2	7/16/92	1043	80.0	2.45	0.00	0.00	1.65	3.80	0.1640	0.3150	0.1510	0.622	41.24	42.91	1202608	0.646	
EC'-3	7/16/92	1054	80.0	5.03	0.00	0.00	1.65	6.68	0.1625	0.3120	0.1455	0.640	41.57	44.57	1297764	0.662	
				0.88											3649821		

Drop Number	Drop Height	v_3 (ft/sec)	Average Crane Effiency For Entire Drop (%)	COMMENTS:
AA'-1	50.0	41.67	0.553	
AA'-2	50.0	41.42	0.548	
AA'-3	50.0	41.97	0.575	
AB'-1	50.0	41.19	0.545	
AB'-2	50.0	41.53	0.559	
AB'-3	50.0	41.33	0.553	
AB'-4	50.0	41.39	0.558	
AC'-1	50.0	41.76	0.554	
AC'-2	50.0	41.66	0.552	
AC'-3	50.0	42.00	0.565	
BA'-1	50.0	(-)	(-)	Wind trigger: No data
BA'-2	50.0	42.06	0.571	
BA'-3	50.0	41.91	0.563	
BA'-4	50.0	41.91	0.569	
BA'-5	50.0	41.18	0.541	
BB'-1	50.0	41.14	0.546	
BB'-2	50.0	41.09	0.544	
BB'-3	50.0	41.28	0.551	
BB'-4	50.0	41.33	0.555	
BB'-5	50.0	40.79	0.530	
BB'-6	50.0	41.33	0.556	
BB'-7	50.0	41.19	0.552	
BB'-8	50.0	41.28	0.553	
BB'-9	50.0	40.95	0.541	
BB'-10	50.0	40.88	0.528	
BC'-1	50.0	42.01	0.564	
BC'-2	50.0	41.62	0.556	
BC'-3	50.0	41.82	0.565	
BC'-4	50.0	41.71	0.559	
CA'-1	50.0	41.92	0.561	
CA'-2	50.0	41.92	0.568	
CA'-3	50.0	41.30	0.535	
CA'-4	50.0	42.26	0.580	
CB'-1	50.0	41.39	0.557	
CB'-2	50.0	41.39	0.561	
CB'-3	50.0	41.33	0.559	
CB'-4	50.0	41.19	0.556	
CB'-5	50.0	41.58	0.573	
CC'-1	48.0	(-)	(-)	2 ft soil mound (lower sensor blocked)
CC'-2	50.0	39.22	0.481	
CC'-3	50.0	41.48	0.552	
CC'-4	50.0	41.42	0.551	
DA'-1	50.0	42.01	0.567	
DA'-2	50.0	42.21	0.581	
DA'-3	50.0	41.82	0.569	
DB'-1	50.0	41.15	0.546	Brake Adjustment; cable noise/drag.
DB'-2	50.0	41.33	0.564	
DB'-3	50.0	41.33	0.565	
DB'-4	50.0	41.12	0.550	
DB'-5	50.0	41.58	0.578	
DB'-6	50.0	41.33	0.567	
DB'-7	50.0	41.58	0.579	
DB'-8	50.0	41.73	0.560	Cable noise/drag
DC'-1	50.0	41.39	0.550	
DC'-2	50.0	41.39	0.555	
DC'-3	50.0	41.53	0.561	
DC'-4	50.0	41.58	0.567	
EA'-1	50.0	41.63	0.555	
EA'-2	50.0	41.63	0.562	
EA'-3	50.0	40.93	0.528	
EB'-1	50.0	40.96	0.541	
EB'-2	50.0	41.02	0.548	
EB'-3	50.0	40.88	0.547	
EB'-4	50.0	41.21	0.559	
EB'-5	50.0	41.02	0.551	
EC'-1	50.0	41.39	0.546	
EC'-2	50.0	41.24	0.546	
EC'-3	50.0	41.67	0.562	

42,000 Pound Tamper -- Production Drops			
Velocity at Photocell 3		Average Crane Efficiency	
Average	41.43	Average	0.555
Std. Dev.	0.44	Std. Dev.	0.015

Note: Drop BA'-1 and CC'-1 Excluded

Table 1.7-2. Statistics of production drops including instantaneous velocity at photocell 3 (v_3) and average crane efficiency.

Table 1.7–3. Calculated impact velocity and kinetic energy values for tertiary drops (based on average crane efficiency derived from photocell measurements of primary and secondary drops).

A	B	C	D	E	F	G	H	I
Drop Number	Date	Time [24 Hour]	Drop Height [Feet]	Crater Depth [Feet]	v_4 [ft/sec]	Calculated Energy [ft–lb]	Avg. Crane Effiency For Primary & Sec. Drops [%]	COMMENTS:
T–1–1	7/20/92	0910	50.0	0.00	42.26	1166423	0.555	
T–1–2	7/20/92	0923	50.0	2.25	43.20	1218912	0.555	
T–1–3	7/20/92	0931	50.0	3.40	43.67	1245740	0.555	
T–1–4	7/20/92	0946	50.0	4.06	43.94	1261136	0.555	
T–1–5	7/20/92	0955	50.0	4.75	44.22	1277233	0.555	
T–1–6	7/20/92	1007	50.0	5.21	44.41	1287964	0.555	
T–1–7	7/20/92	1016	50.0	5.50	44.52	1294729	0.555	
T–1–8	7/20/92	1024	50.0	5.78	44.63	1301261	0.555	
				6.21		10053399		
T–2–1	7/20/92	1304	50.0	0.00	42.26	1166423	0.555	
T–2–2	7/21/92	0818	50.0	1.96	43.08	1212147	0.555	
T–2–3	7/21/92	0826	50.0	2.99	43.50	1236175	0.555	
T–2–4	7/21/92	0834	50.0	3.54	43.73	1249006	0.555	
T–2–5	7/21/92	0846	50.0	3.97	43.90	1259037	0.555	
T–2–6	7/21/92	0855	50.0	4.51	44.12	1271634	0.555	
T–2–7	7/21/92	0908	50.0	4.81	44.24	1278633	0.555	
T–2–8	7/21/92	0917	50.0	5.06	44.34	1284465	0.555	
T–2–9	7/21/92	0926	50.0	5.63	44.57	1297762	0.555	
T–2–10	7/21/92	0934	50.0	5.75	44.62	1300562	0.555	
T–2–11	7/21/92	0942	50.0	5.86	44.67	1303128	0.555	
				6.20		13858970		
T–3–1	7/21/92	1008	50.0	0.00	42.26	1166423	0.555	
T–3–2	7/21/92	1016	50.0	1.79	43.01	1208181	0.555	
T–3–3	7/21/92	1027	50.0	2.89	43.46	1233842	0.555	
T–3–4	7/21/92	1037	50.0	3.56	43.74	1249472	0.555	
T–3–5	7/21/92	1045	50.0	4.01	43.92	1259970	0.555	
T–3–6	7/21/92	1053	50.0	4.51	44.12	1271634	0.555	
T–3–7	7/21/92	1104	50.0	4.93	44.29	1281432	0.555	
T–3–8	7/21/92	1113	50.0	5.23	44.41	1288431	0.555	
T–3–9	7/21/92	1121	50.0	5.62	44.57	1297529	0.555	
				6.25		11256914		
T–4–1	7/21/92	1250	50.0	0.00	42.26	1166423	0.555	
T–4–2	7/21/92	1301	50.0	1.67	42.96	1205381	0.555	
T–4–3	7/21/92	1310	50.0	2.67	43.37	1228710	0.555	
T–4–4	7/21/92	1319	50.0	3.47	43.70	1247373	0.555	
T–4–5	7/21/92	1328	50.0	4.08	43.95	1261603	0.555	
T–4–6	7/21/92	1338	50.0	4.53	44.13	1272101	0.555	
T–4–7	7/21/92	1348	50.0	4.84	44.26	1279333	0.555	
T–4–8	7/21/92	1356	50.0	5.06	44.34	1284465	0.555	
T–4–9	7/21/92	1405	50.0	5.30	44.44	1290064	0.555	
T–4–10	7/21/92	1412	50.0	5.60	44.56	1297062	0.555	
T–4–11	7/21/92	1420	50.0	5.84	44.58	1297995	0.555	
T–4–12	7/21/92	1428	50.0	5.74	44.62	1300328	0.555	
				6.07		15130838		

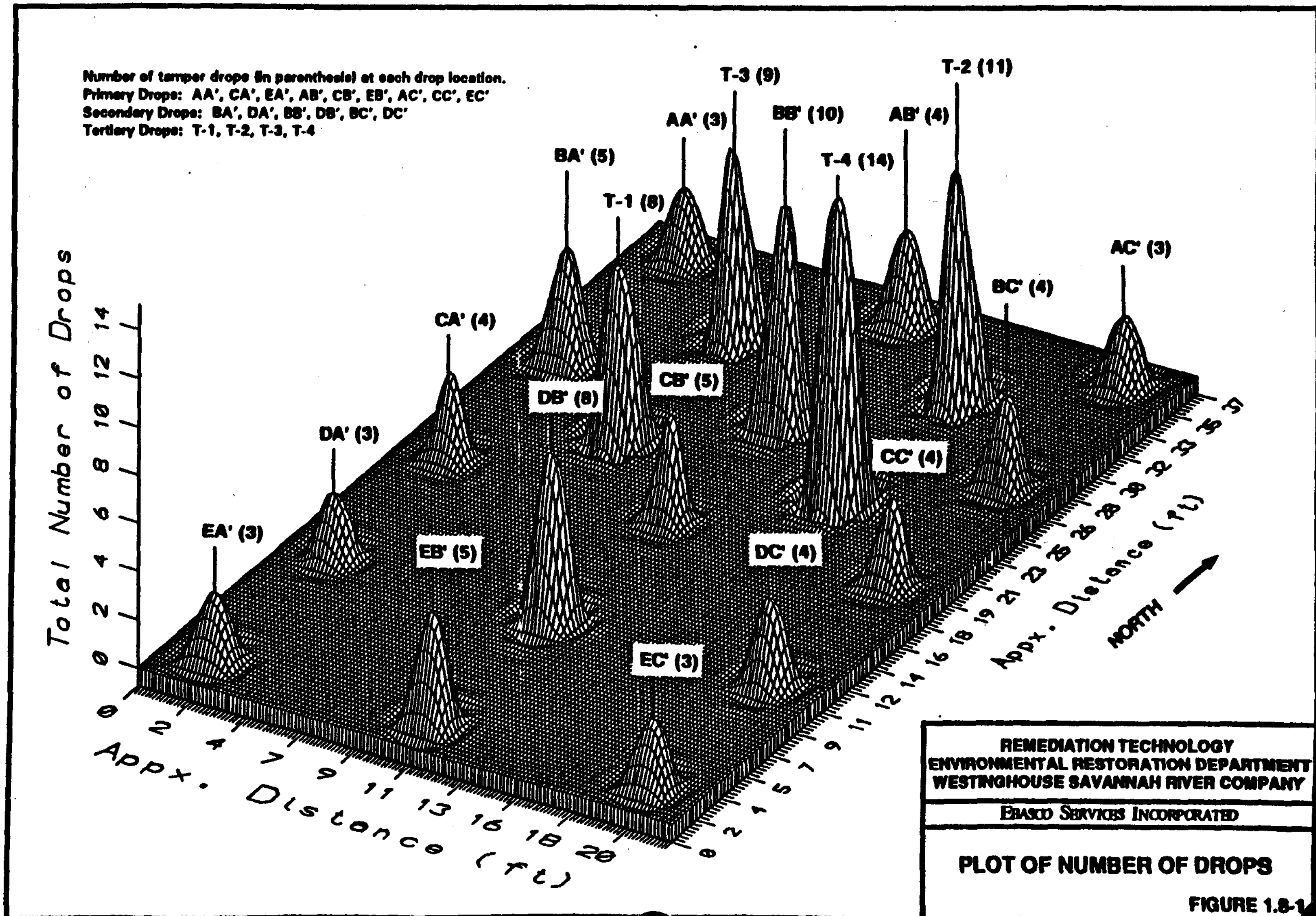
terminal velocity	$v_4 = (v_0^2 + 2ge_{avg}h)^{1/2} = (0^2 + (D+E)*2*32.15*0.555)^{1/2}$ (average crane efficiency = 0.555)
k.e. = $1/2mv^2$	m = mass (slugs), v = velocity, k.e. = kinetic energy, mass = weight(pounds)/g (32.15 ft/s^2)

1.8 OBSERVATIONS

All 19 production drop locations met the refusal criteria of a 6 ft deep crater prior to 20 drops. Primary drop locations (AA', CA', EA', AB', CB', EB', AC', CC', and EC') required the fewest number of blows to reach refusal (typically 3 to 5 drops). Secondary drop locations (BA', DA', BB', DB', BC', and DC') required more drops to reach 6 ft crater depth (3 to 10), and tertiary drop locations (T-1, T-2, T-3, and T-4) the most (8 to 12). The number of drops at each location is shown graphically on Figure 1.8-1. Not surprisingly the increase in number of drops from primary, to secondary, to tertiary locations reflects the fact that each successive location had an increase in neighboring sites that had been previously compacted.

The number of drops at each location is plotted against crater depth on Figure 1.8-2 [primary drops (Figure 1.8-2a), secondary drops (Figure 1.8-2b), and tertiary drops (Figure 1.8-2c)]. On these figures measured crater depth (y-axis) is plotted against corresponding drop number at each location. A nearly vertical line (i.e. the primary drops on Figure 1.8-2a) indicates a low number of drops required to reach the 6 ft crater depth refusal criteria, and a relatively large compaction (increase in crater depth) experienced per drop. A line that is arcuate describes a drop location that required a larger number of blows to reach the refusal criteria (i.e. the tertiary drops on Figure 1.8-2c), and experienced relatively little compaction per drop. If compaction was carried out to ≥20 drops the arcuate line would become horizontal to subhorizontal and indicate the ultimate refusal depth. Figure 1.8-2b (secondary drops, locations BA', DA', DC', and BC' transitioning to DB' and BB') shows an interesting change from a primary drop line signature (Figure 1.8-2a) to the more arcuate line signatures of the tertiary drops (Figure 1.8-2c). This change is a function of the sequencing of the drops, as later drops had neighboring waste materials/craters that had already been dynamically compacted and filled with soil (with infilled soil compacted to moderate density by gentle tamping with the 42,000 lb weight). The inflection point located near the top of the tertiary drops plots (Figure 1.8-2c) indicates a slight increase in compaction per drop for each of the last few drops. This might be the result of a temporary soil/waste "bridge" that gave way after repeated compaction drops, causing minor failure of lower B-25 box(es).

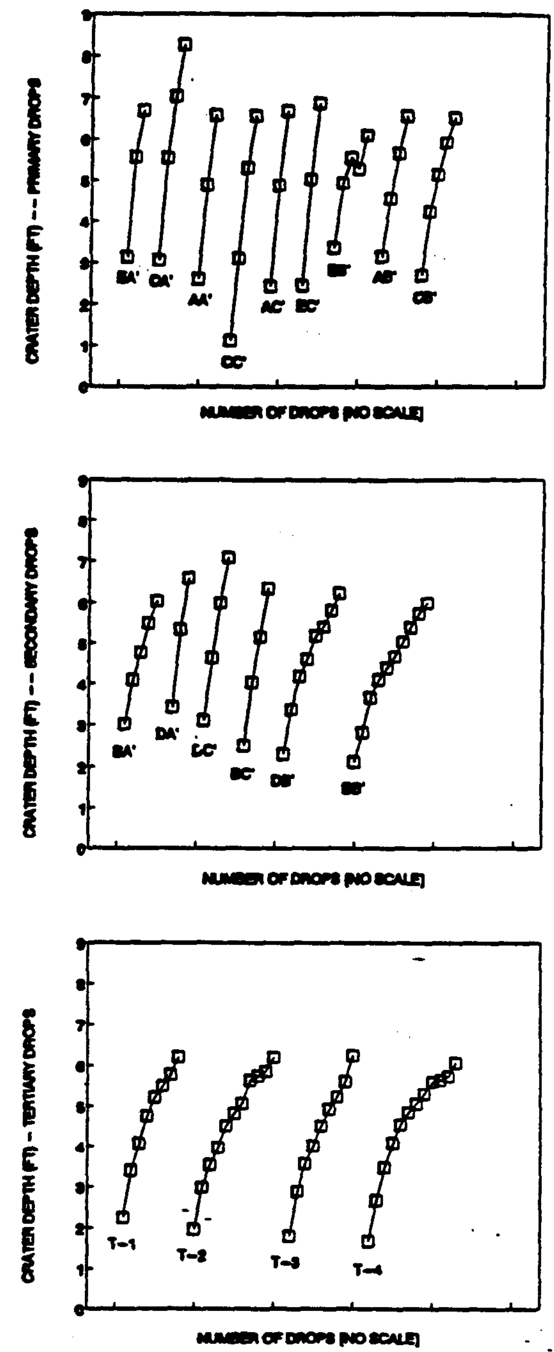
Figure 1.8-3 plots compaction per drop (feet) on the y-axis against drop number on the x-axis for: (a) all drops, (b) primary drops, (c) secondary drops, and (d) tertiary drops. The "T"- shaped plotting symbol shows the average (mean) compaction value for each drop number (the short horizontal bar) and the standard deviation about the mean (the vertical


Number of tamper drops (in parenthesis) at each drop location.
Primary Drops: AA', CA', EA', AB', CB', EB', AC', CC', EC'
Secondary Drops: BA', DA', BB', DB', BC', DC'
Tertiary Drops: T-1, T-2, T-3, T-4
T-3 (9)
T-2 (11)
AA' (3)
BB' (10)
AB' (4)
BA' (5)
T-4 (14)
T-1 (8)
AC' (3)
BC' (4)
CA' (4)
CB' (5)
DB' (8)
DA' (3)
CC' (4)
EA' (3)
EB' (5)
DC' (4)
EC' (3)
Total Number of Drops
Appx. Distance (ft)
Appx. Distance (ft)
NORTH
REMEDIATION TECHNOLOGY
ENVIRONMENTAL RESTORATION DEPARTMENT
WESTINGHOUSE SAVANNAH RIVER COMPANY
EBASCO SERVICES INCORPORATED
PLOT OF NUMBER OF DROPS
FIGURE 1.8-1

(a)

(b)

(c)



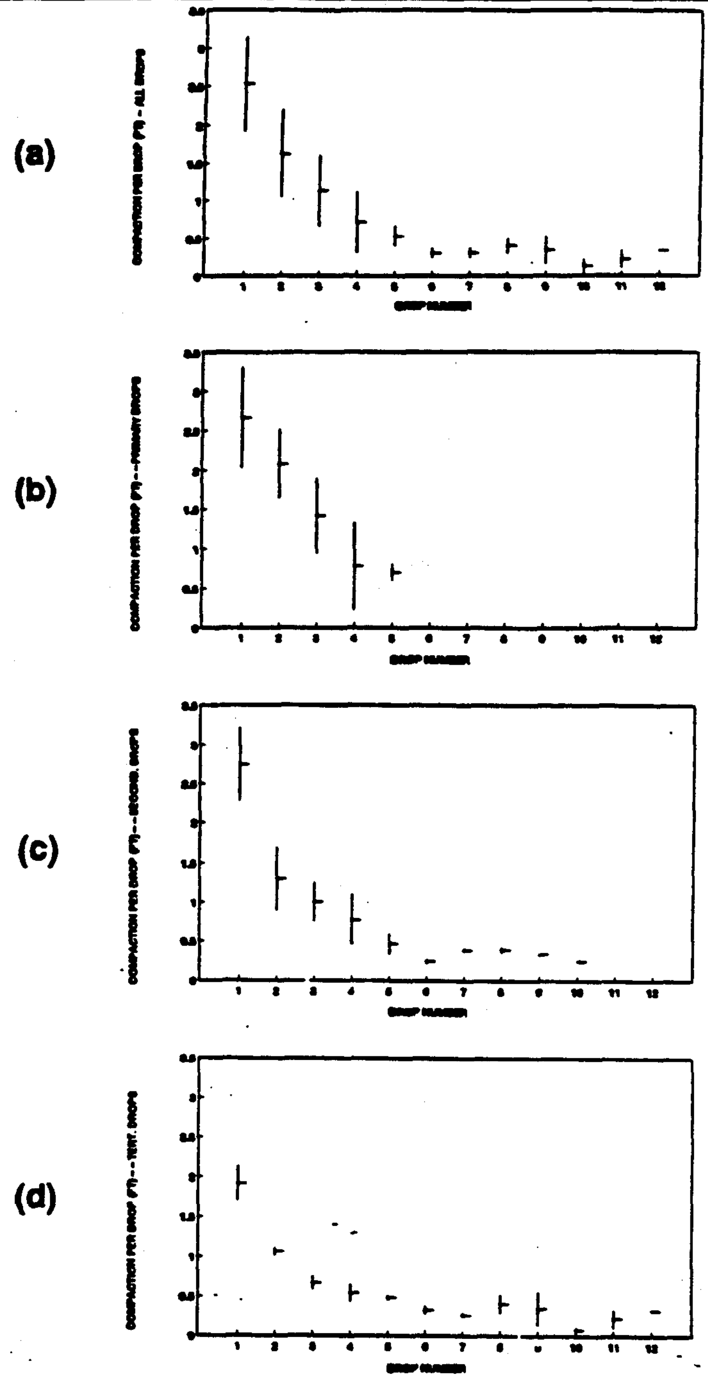
Figures have cumulative crater depth plotted on the y-axis, with x-axis representing number of drops (each measured crater depth is incremented the value of 1 on the x-axis).

REMEDIATION TECHNOLOGY
ENVIRONMENTAL RESTORATION DEPARTMENT
WESTINGHOUSE SAVANNAH RIVER COMPANY

EBASCO SERVICES INCORPORATED

PLOT OF CUMULATIVE CRATER DEPTH AGAINST DROP NUMBER

FIGURE 1.8-2



Short horizontal bar represents average (mean) compaction per drop. Vertical line is the standard deviation about the mean. Horizontal bars with no corresponding vertical line are drop numbers with only one value.

REMEDIATION TECHNOLOGY
ENVIRONMENTAL RESTORATION DEPARTMENT
WESTINGHOUSE SAVANNAH RIVER COMPANY

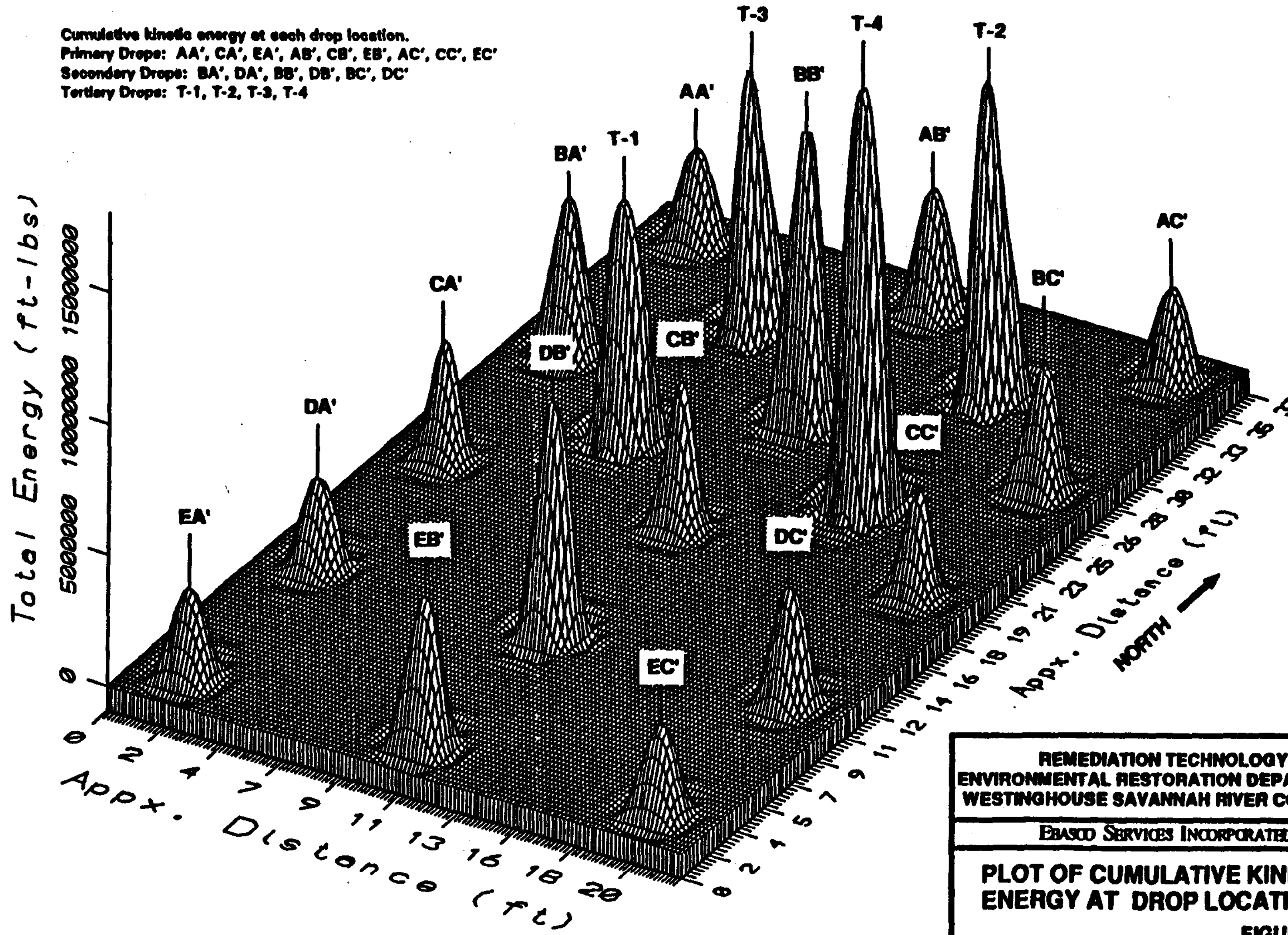
EBASCO SERVICES INCORPORATED

PLOT OF AVERAGE (MEAN) COMPACTION PER DROP (WITH STANDARD DEVIATION) AGAINST DROP NUMBER

FIGURE 1.8-3

line). As shown on Figure 1.8-3 the primary and secondary drops have the largest initial compaction for first-drops (appx. 2.7 to 2.8 feet). Tertiary first-drops realized significantly less compaction (appx. 1.9 feet). Other trends observed on Figure 1.8-3 include: (1) smaller standard deviations for secondary and tertiary drops relative to primary drops, and (2) a more rapid decrease in compaction-per-drop for subsequent secondary and tertiary drops relative to primary drops. The slight increase in compaction-per-drop observed in the secondary and tertiary drop plots for drop numbers 7, 8, and 9 may be related to a bridging effect giving way to failure of B-25 box(es) in the lower portion of the ELLT.

Figure 1.8-4 plots cumulative kinetic energy (k.e.) in foot/pounds delivered to the waste matrix at each drop point (the larger the peak the larger the energy input). Primary drop locations (AA', CA', EA', AB', CB' EB', AC', CC', and EC') typically received a uniform amount of kinetic energy (peak heights are fairly equivalent). Secondary drop locations BA', DA', BC', and DC' tend to have slightly larger to moderately larger k.e. values relative to primary drop points. Secondary drop locations BB' and DB' were surrounded by previously compacted drop locations, and therefore required more drops to meet the 6 ft crater refusal criteria (resulting in larger k.e. inputs). The tertiary locations (T-1, T-2, T-3, and T-4) underwent the largest number of tamper drops and received the largest energy inputs; approximately 3 to 4 times as great as the primary drop points. Energy calculations for each primary and secondary drop point are given on Table 1.7-1, and tertiary drop points on Table 1.7-3.



REMEDIATION TECHNOLOGY
ENVIRONMENTAL RESTORATION DEPARTMENT
WESTINGHOUSE SAVANNAH RIVER COMPANY

EBASCO SERVICES INCORPORATED

PLOT OF CUMULATIVE KINETIC ENERGY AT DROP LOCATIONS

FIGURE 1.8-4

2.0 REFERENCES

Lukas, R.G., "Dynamic Compaction for Highway Construction," Vol. 1, Design and Construction Guidelines, Federal Highway Administration, Office of Research and Development, U.S.D.O.T., Washington, D.C., Report No. FHWA/RD-86/133 (July 1986).

Westinghouse Savannah River Company Project Engineering Services Contract, Instrumentation Plan: Dynamic Test Facility, Task 048 (Draft Report), May 8, 1992. Prepared by: Ebasco Services Incorporated, 2528 Center West Parkway, Augusta, Georgia, 30909.

Ebasco Services Incorporated Project Engineering Services Contract, Task Order Proposal Cost Estimate for Task 048, Implementation of Dynamic Test Facility Instrumentation Plan, Prepared for Westinghouse Savannah River Company, June 9, 1992.

Appendix B.4 Strong-Motion Sensor Baseline Data

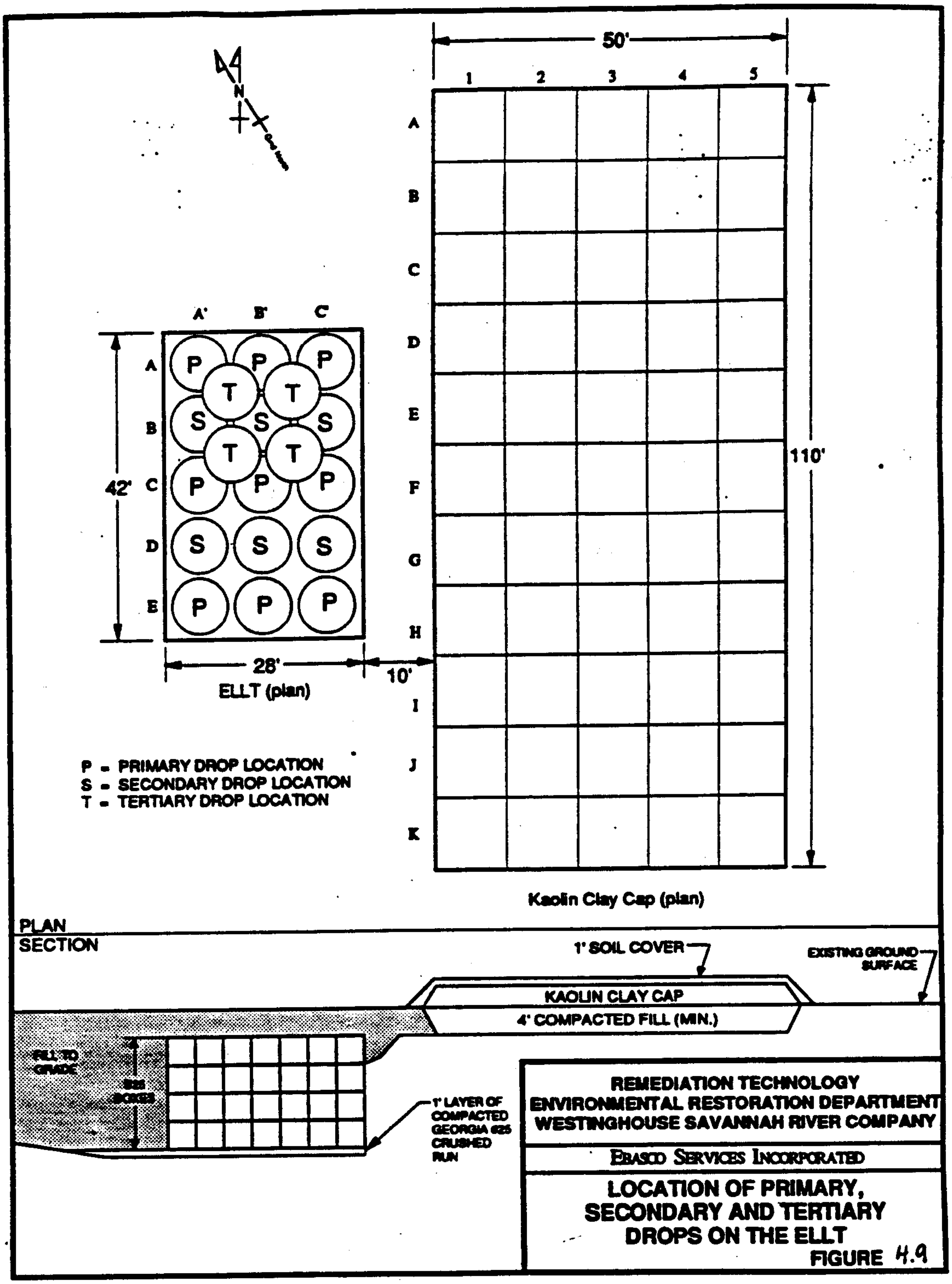
The dynamic compaction weight was dropped on natural undisturbed soils to establish an attenuation baseline to configure the actual test. Instrumentation was spread in a symmetrical array, radiating outward from the point of impact. This operation successfully defined an attenuation baseline for both the peak particle velocity and the vertical displacement decay.

The data included herein is a summary of the more complete discussion included in the EBASCO report[4]. If a more complete data set is required, the information can be obtained from this reference.

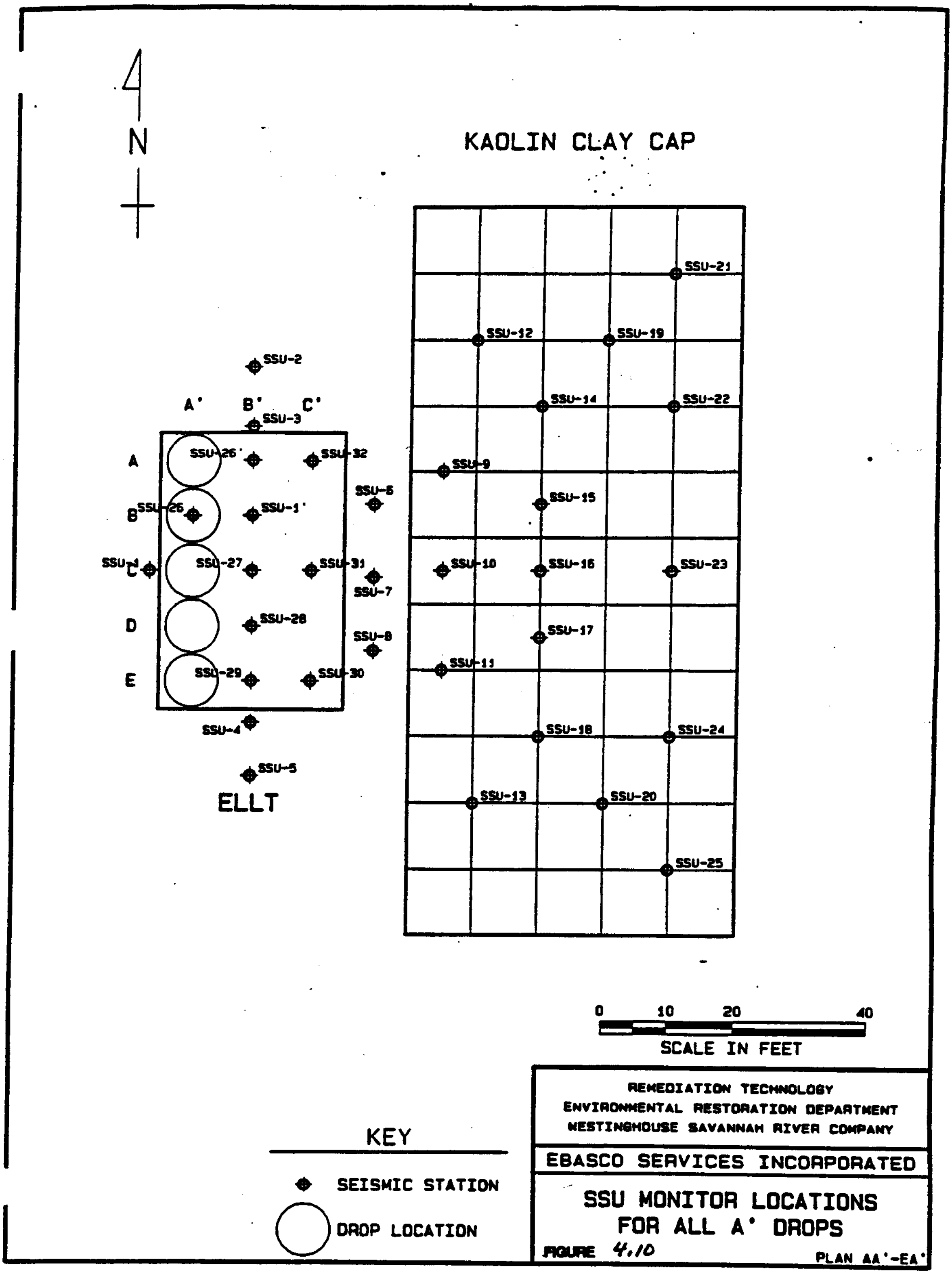
Appendix C Seismic and Vibratory Data

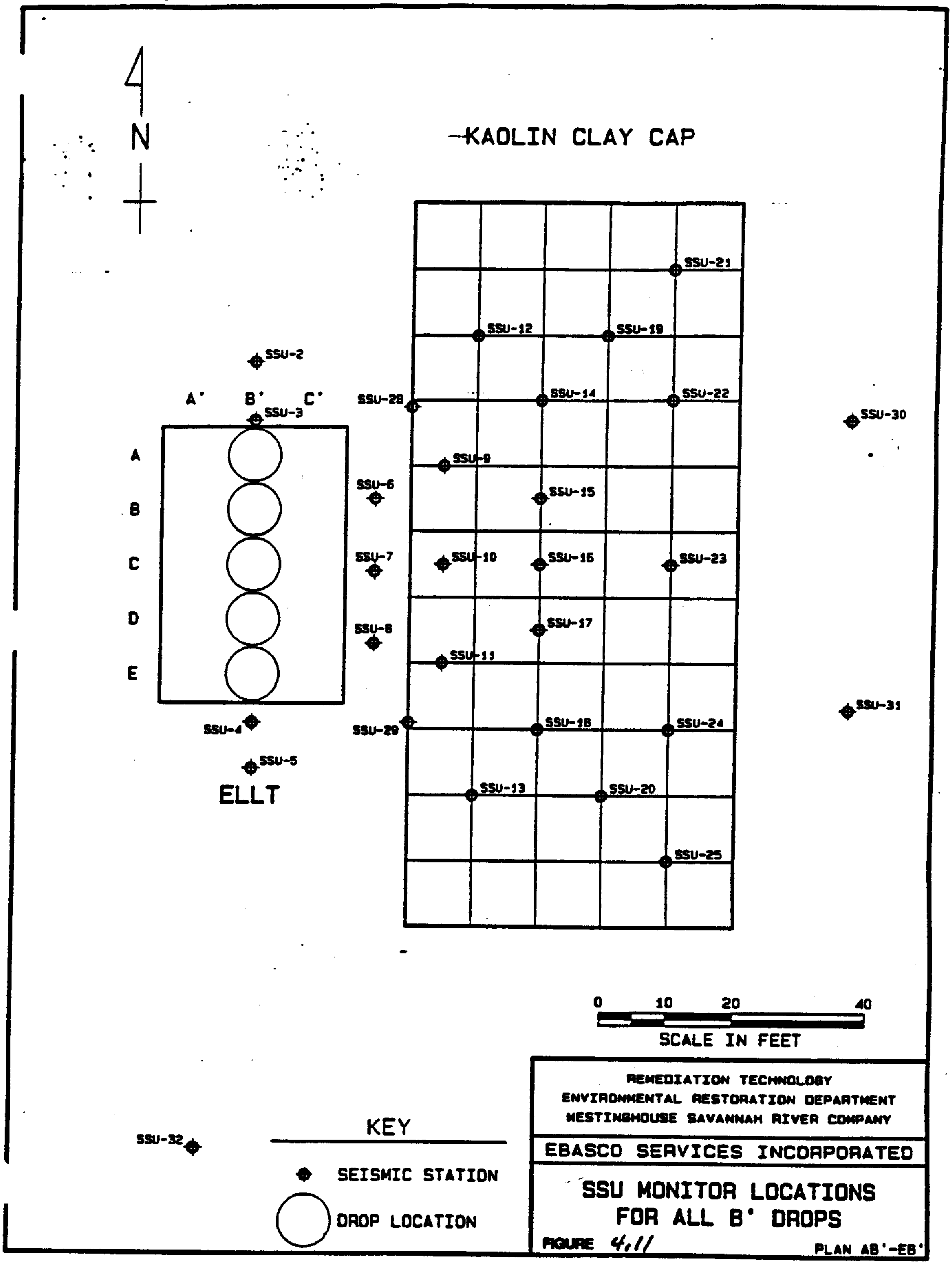
A key testing elements is the vibratory or strong motion monitoring during dynamic compaction. Dynamic compaction induces vibrations within the soil matrix similar to those produced during an earthquake. The key difference is the shape and location of the energy source. An earthquake is a rupture in the earth's structure and is normally deep and linear in shape and form. Dynamic compaction affects the surface and is considered a point source. These differences cause changes in the primary manifestation of the vibratory energy and wave forms. The predominate wave form is the Rayleigh wave, which is a retrograde elliptical motion in the vertical plane. Strong motion detectors can monitor many different, but related parameters. These parameters include frequencies, accelerations, velocities, and displacements. All these parameters are useful to some extent, dependent upon the analysis. For looking at damage to structures, the peak particle velocity (or instantaneous velocity at a point on the ground) is the best indicator of damage potential and annoyance levels. The displacement in the vertical direction also is a primary source of damage and can be used as an indicator to filter out the Rayleigh type wave forms.

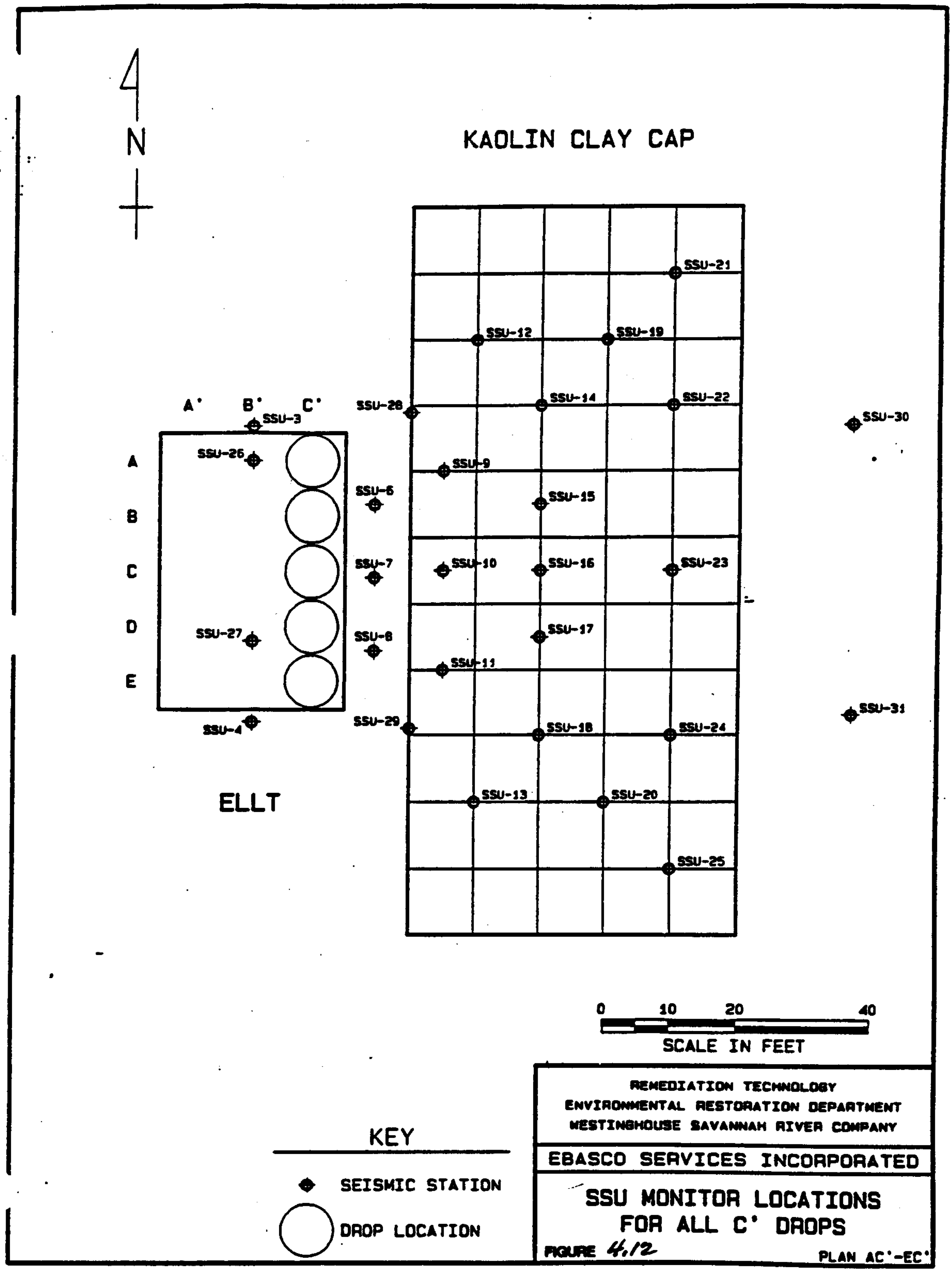
The data herein provides an overview of the peak particle velocity observations versus distance and scaled energy. This data is a synopsis from the EBASCO report [4]. If a comprehensive data set is required, the information can be obtained from this reference.

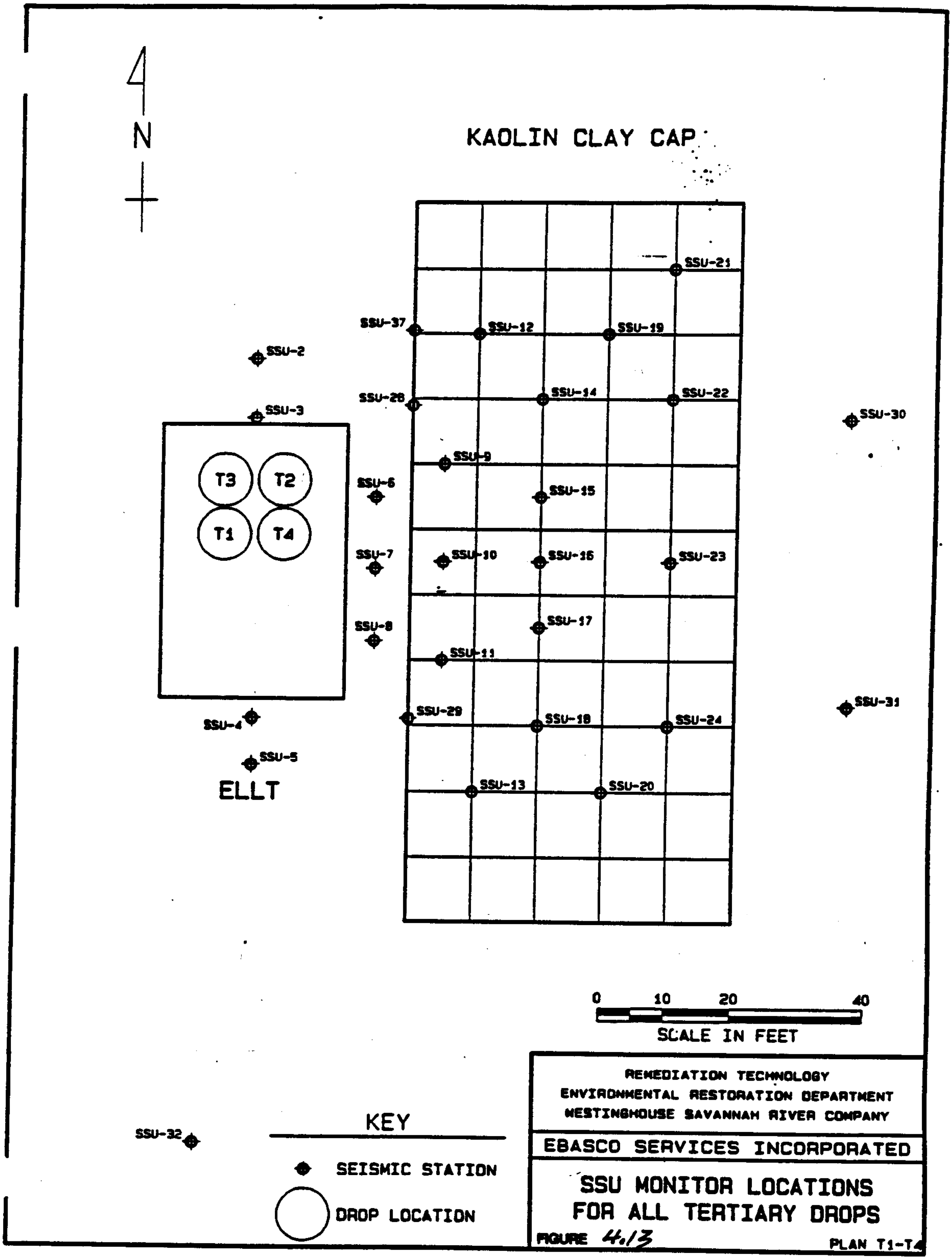


LOCATION OF PRIMARY, SECONDARY AND TERTIARY DROPS ON THE ELLT
FIGURE 4.9

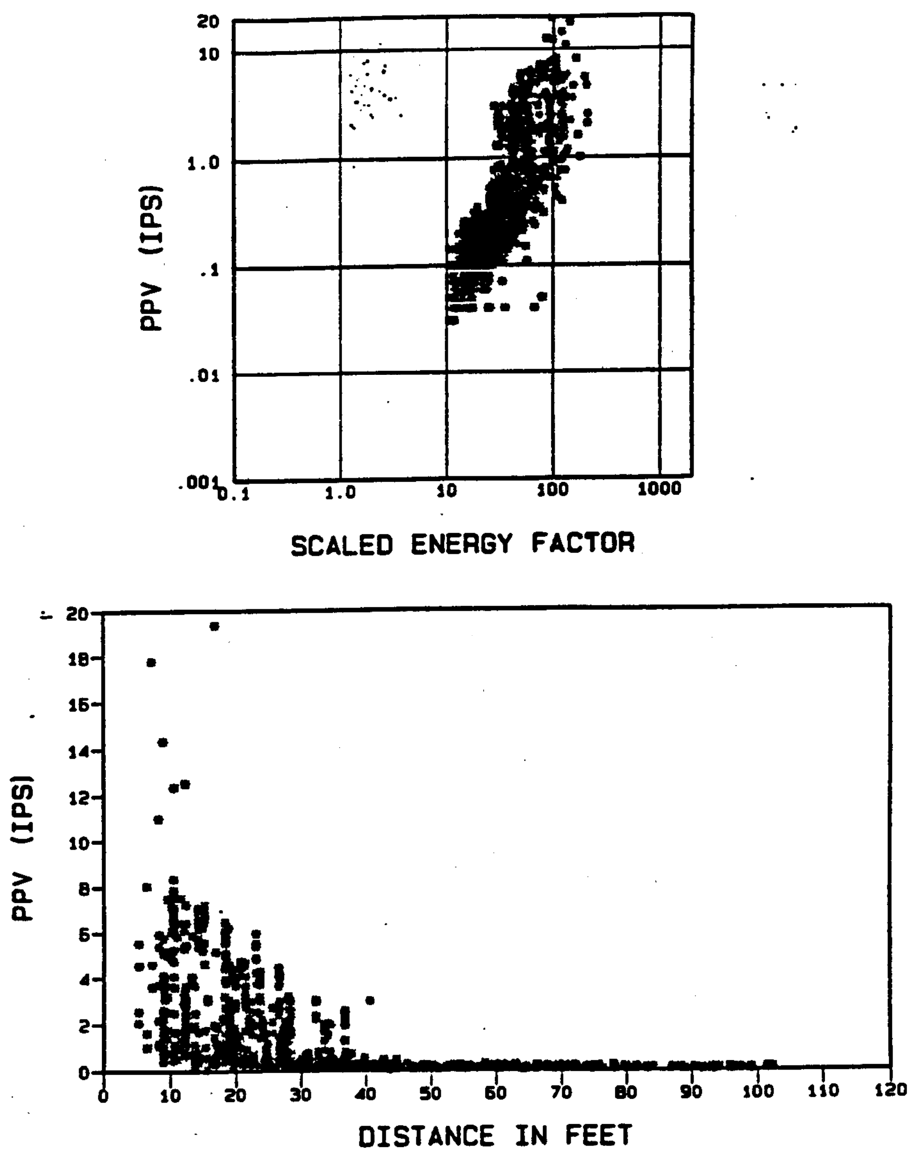

N
KAOLIN CLAY CAP
SSU-21
SSU-12
SSU-19
SSU-2
A'
B'
C'
SSU-3
SSU-14
SSU-22
A
SSU-26'
SSU-32
SSU-9
SSU-6
B
SSU-26
SSU-1'
SSU-15
SSU-1
C
SSU-27
SSU-31
SSU-10
SSU-16
SSU-23
SSU-7
D
SSU-28
SSU-8
SSU-17
SSU-11
E
SSU-29
SSU-30
SSU-4
SSU-18
SSU-24
SSU-5
ELLT
SSU-13
SSU-20
SSU-25
0
10
20
40
SCALE IN FEET
REMEDIATION TECHNOLOGY
ENVIRONMENTAL RESTORATION DEPARTMENT
WESTINGHOUSE SAVANNAH RIVER COMPANY
EBASCO SERVICES INCORPORATED
KEY
SEISMIC STATION
DROP LOCATION
SSU MONITOR LOCATIONS
FOR ALL A' DROPS
FIGURE 4.10
PLAN AA'-EA'


N
KAOLIN CLAY CAP
SSU-2
A'
B'
C'
SSU-3
A
B
C
D
E
SSU-4
SSU-5
ELLT
SSU-28
SSU-6
SSU-7
SSU-8
SSU-29
SSU-21
SSU-12
SSU-19
SSU-14
SSU-22
SSU-9
SSU-15
SSU-10
SSU-16
SSU-23
SSU-17
SSU-11
SSU-18
SSU-24
SSU-13
SSU-20
SSU-25
SSU-30
SSU-31
SSU-32
0
10
20
40
SCALE IN FEET
KEY
SEISMIC STATION
DROP LOCATION
REMEDIATION TECHNOLOGY
ENVIRONMENTAL RESTORATION DEPARTMENT
WESTINGHOUSE SAVANNAH RIVER COMPANY
EBASCO SERVICES INCORPORATED
SSU MONITOR LOCATIONS
FOR ALL B' DROPS
FIGURE 4.11
PLAN AB'-EB'


N
KAOLIN CLAY CAP
SSU-21
SSU-12
SSU-19
SSU-28
SSU-14
SSU-22
SSU-30
A'
B'
C'
SSU-3
A
B
C
D
E
SSU-26
SSU-27
SSU-4
SSU-6
SSU-7
SSU-8
SSU-9
SSU-15
SSU-10
SSU-16
SSU-23
SSU-17
SSU-11
SSU-29
SSU-18
SSU-24
SSU-31
SSU-13
SSU-20
SSU-25
ELLT
0 10 20 40
SCALE IN FEET
KEY
SEISMIC STATION
DROP LOCATION
REMEDIATION TECHNOLOGY
ENVIRONMENTAL RESTORATION DEPARTMENT
WESTINGHOUSE SAVANNAH RIVER COMPANY
EBASCO SERVICES INCORPORATED
SSU MONITOR LOCATIONS FOR ALL C' DROPS
FIGURE 4.12
PLAN AC'-EC'


N
KAOLIN CLAY CAP
SSU-21
SSU-37
SSU-12
SSU-19
SSU-2
SSU-28
SSU-14
SSU-22
SSU-30
SSU-3
SSU-9
T3
T2
T1
T4
SSU-6
SSU-15
SSU-7
SSU-10
SSU-16
SSU-23
SSU-8
SSU-17
SSU-11
SSU-29
SSU-18
SSU-24
SSU-31
SSU-4
SSU-5
ELLT
SSU-13
SSU-20
0 10 20 40
SCALE IN FEET
REMEDIATION TECHNOLOGY
ENVIRONMENTAL RESTORATION DEPARTMENT
WESTINGHOUSE SAVANNAH RIVER COMPANY
EBASCO SERVICES INCORPORATED
SSU MONITOR LOCATIONS
FOR ALL TERTIARY DROPS
FIGURE 4.13
PLAN T1-T4
KEY
SEISMIC STATION
DROP LOCATION
SSU-32

PPV VERSUS SCALED ENERGY FACTOR



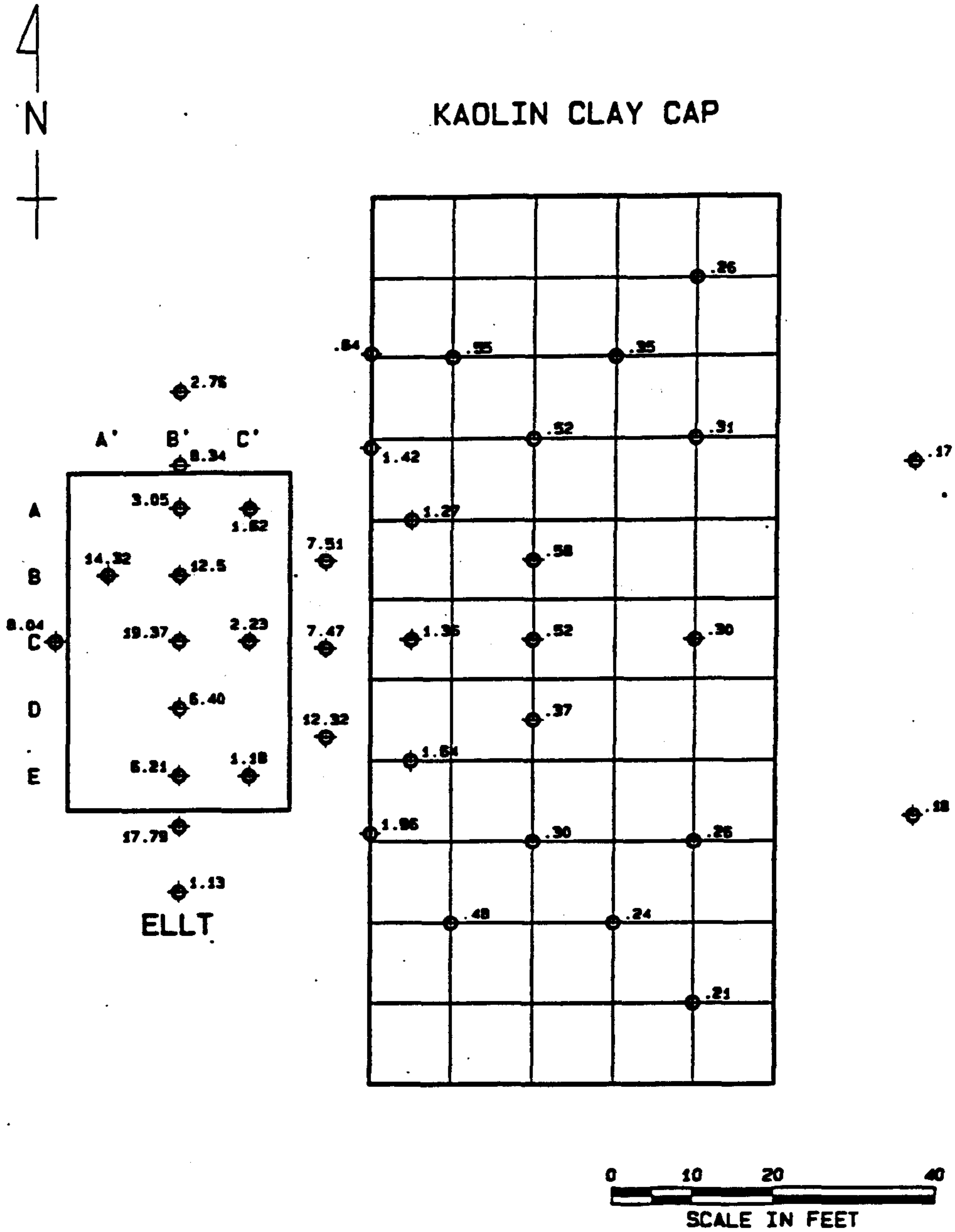
REMEDIATION TECHNOLOGY
ENVIRONMENTAL RESTORATION DEPARTMENT
WESTINGHOUSE SAVANNAH RIVER COMPANY

EBASCO SERVICES INCORPORATED

PPV VERSUS SCALED ENERGY FACTOR FOR ALL DROPS AT DTF

FIGURE SEF.001

Figure 4.14



NOTE: Values represent the maximum observed PPV (IPS) experienced at each seismic station. The total number of drops experienced at each station varied.

REMEDIATION TECHNOLOGY
ENVIRONMENTAL RESTORATION DEPARTMENT
WESTINGHOUSE SAVANNAH RIVER COMPANY

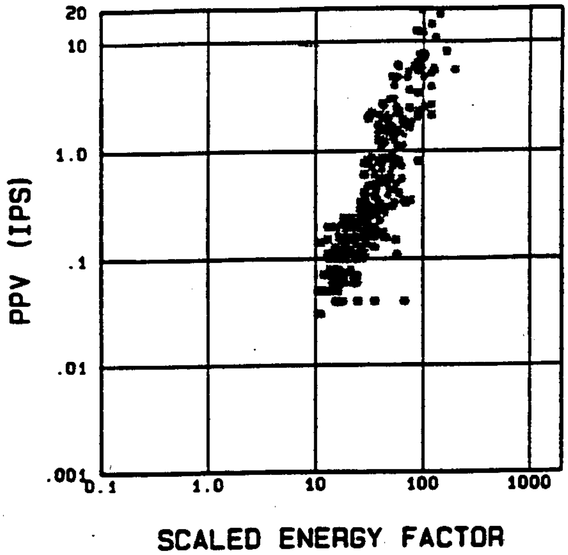
EBASCO SERVICES INCORPORATED

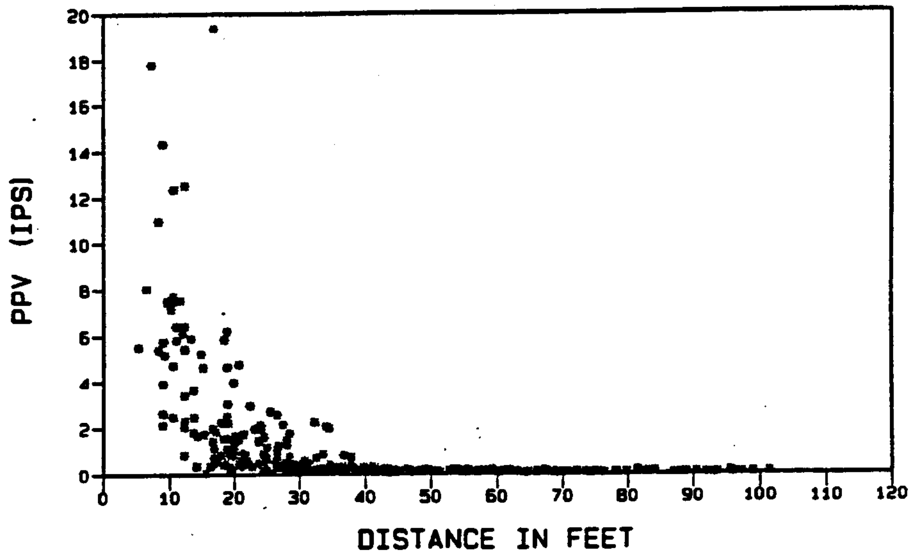
MAXIMUM OBSERVED PPV
FOR ALL DROPS

PLAN MAXI

Figure 4.15

PPV VERSUS SCALED ENERGY FACTOR





REMEDIATION TECHNOLOGY
ENVIRONMENTAL RESTORATION DEPARTMENT
WESTINGHOUSE SAVANNAH RIVER COMPANY

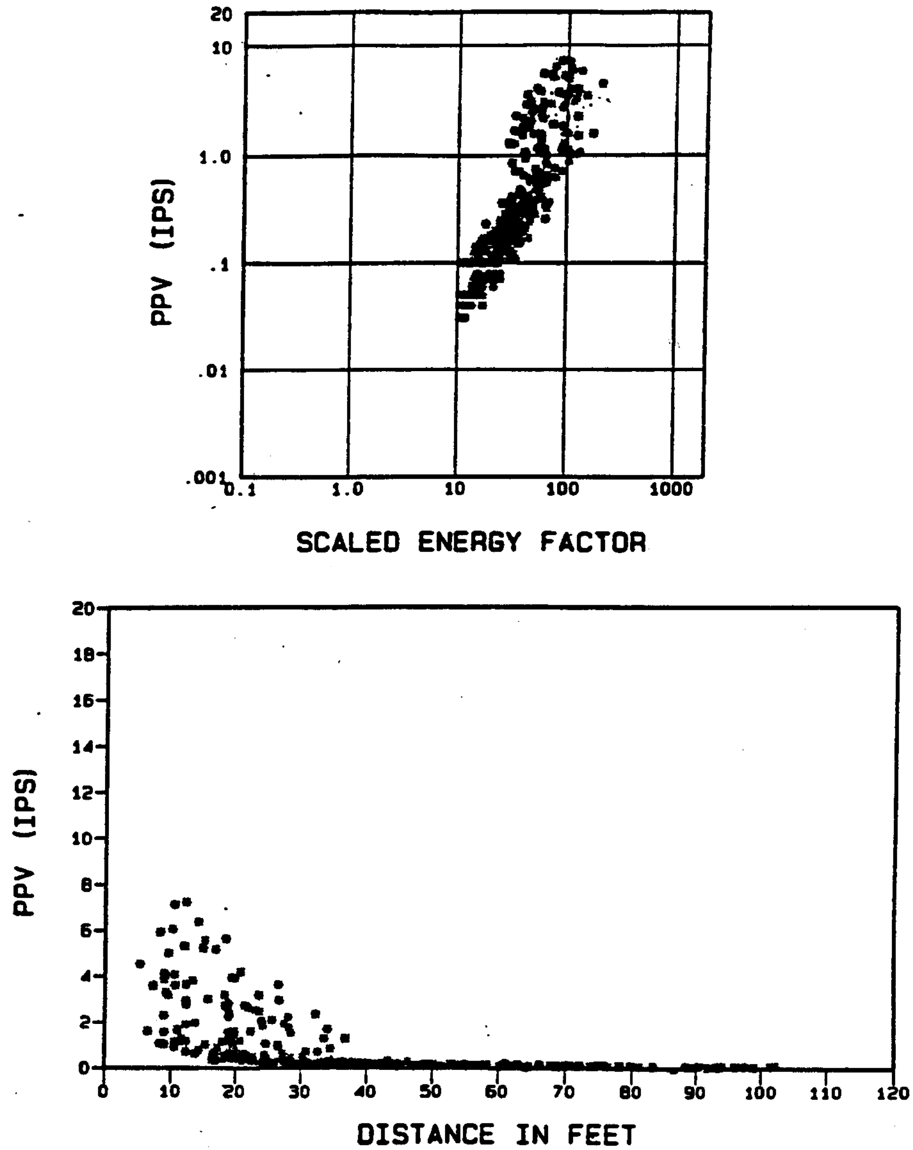
EBASCO SERVICES INCORPORATED

PPV VERSUS SCALED ENERGY FACTOR FOR ALL FIRST DROPS AT DTF

FIGURE SEF.005

Figure 4.16

PPV VERSUS SCALED ENERGY FACTOR



REMEDIATION TECHNOLOGY
ENVIRONMENTAL RESTORATION DEPARTMENT
WESTINGHOUSE SAVANNAH RIVER COMPANY

EBASCO SERVICES INCORPORATED

PPV VERSUS SCALED ENERGY FACTOR FOR ALL SECOND DROPS AT DTF

FIGURE SEF.006

Figure . 4.17

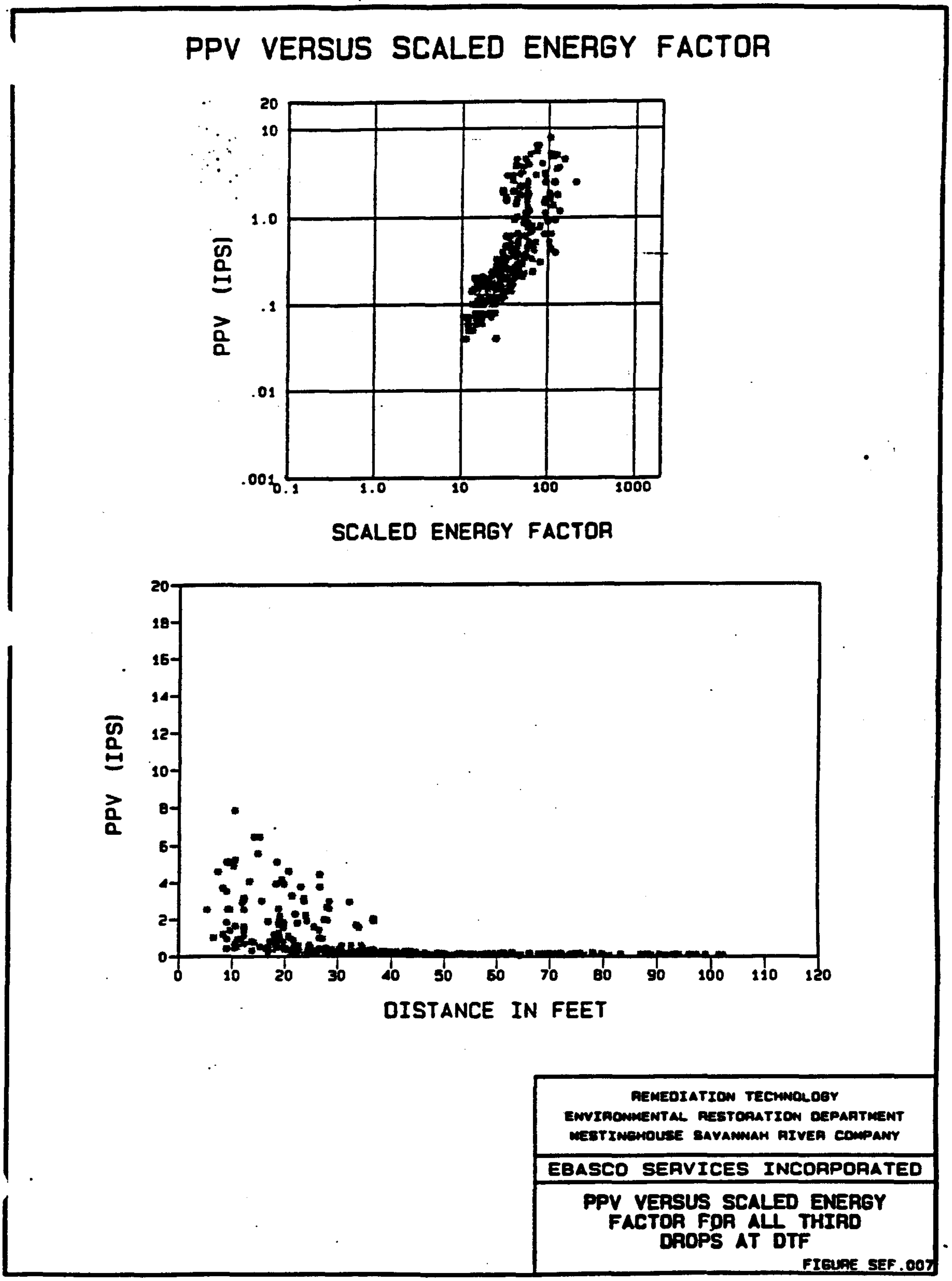
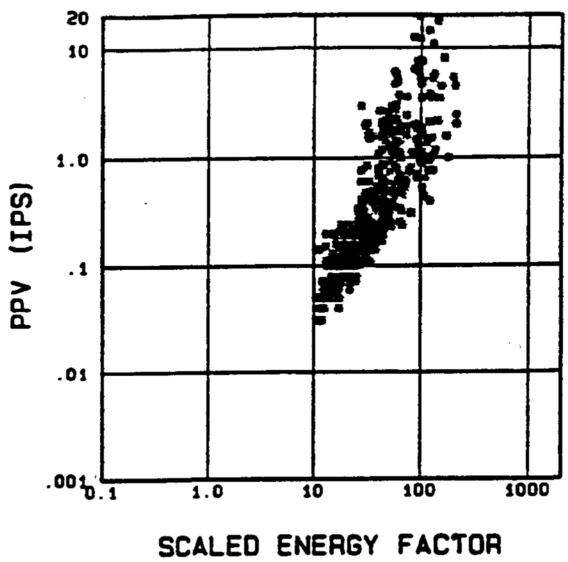
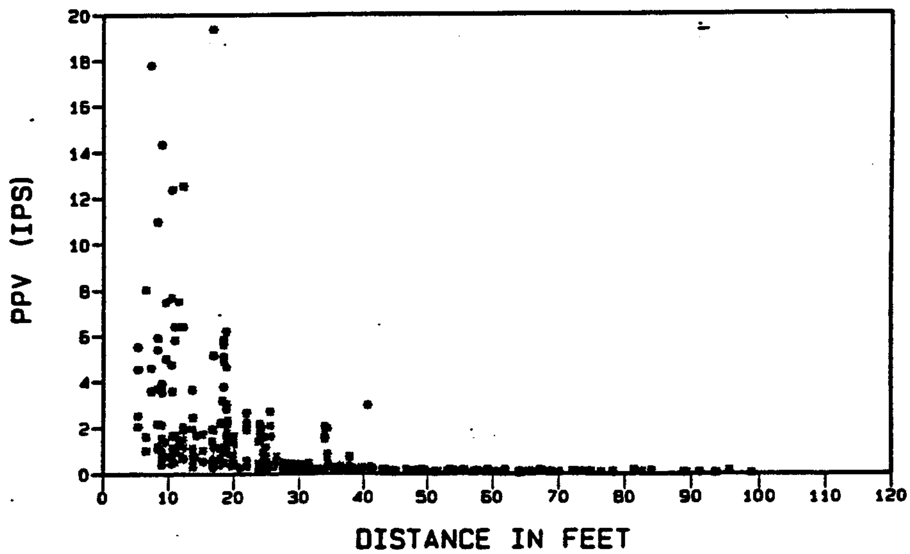

PPV VERSUS SCALED ENERGY FACTOR
PPV (IPS)
20
10
1.0
.1
.01
.001
0.1
1.0
10
100
1000
SCALED ENERGY FACTOR
PPV (IPS)
20
18
16
14
12
10
8
6
4
2
0
0
10
20
30
40
50
60
70
80
90
100
110
120
DISTANCE IN FEET
REMEDIATION TECHNOLOGY
ENVIRONMENTAL RESTORATION DEPARTMENT
WESTINGHOUSE SAVANNAH RIVER COMPANY
EBASCO SERVICES INCORPORATED
PPV VERSUS SCALED ENERGY FACTOR FOR ALL THIRD DROPS AT DTF
FIGURE SEF.007

Figure 4.18

PPV VERSUS SCALED ENERGY FACTOR





REMEDIATION TECHNOLOGY
ENVIRONMENTAL RESTORATION DEPARTMENT
WESTINGHOUSE SAVANNAH RIVER COMPANY

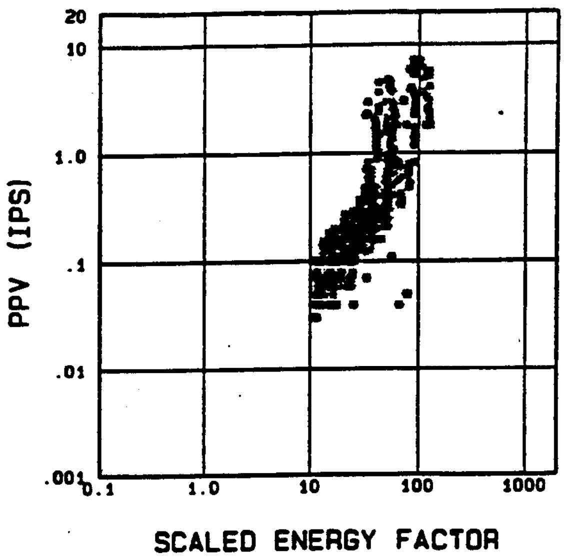
EBASCO SERVICES INCORPORATED

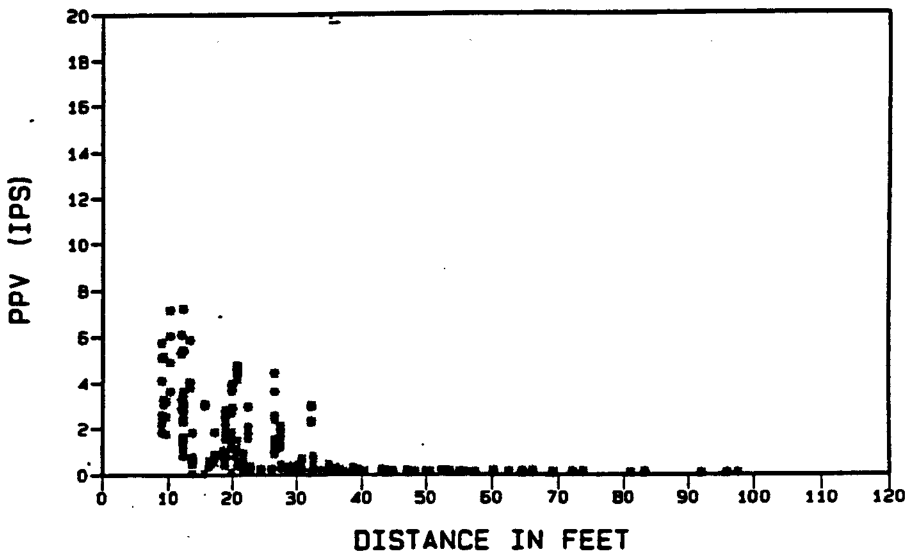
PPV VERSUS SCALED ENERGY FACTOR FOR ALL PRIMARY DROPS AT DTF

FIGURE SEF.002

Figure 4.19

PPV VERSUS SCALED ENERGY FACTOR





REMEDIATION TECHNOLOGY
ENVIRONMENTAL RESTORATION DEPARTMENT
WESTINGHOUSE SAVANNAH RIVER COMPANY

EBASCO SERVICES INCORPORATED

PPV VERSUS SCALED ENERGY FACTOR FOR ALL SECONDARY DROPS AT DTF

FIGURE SEF.003

Figure 4.20

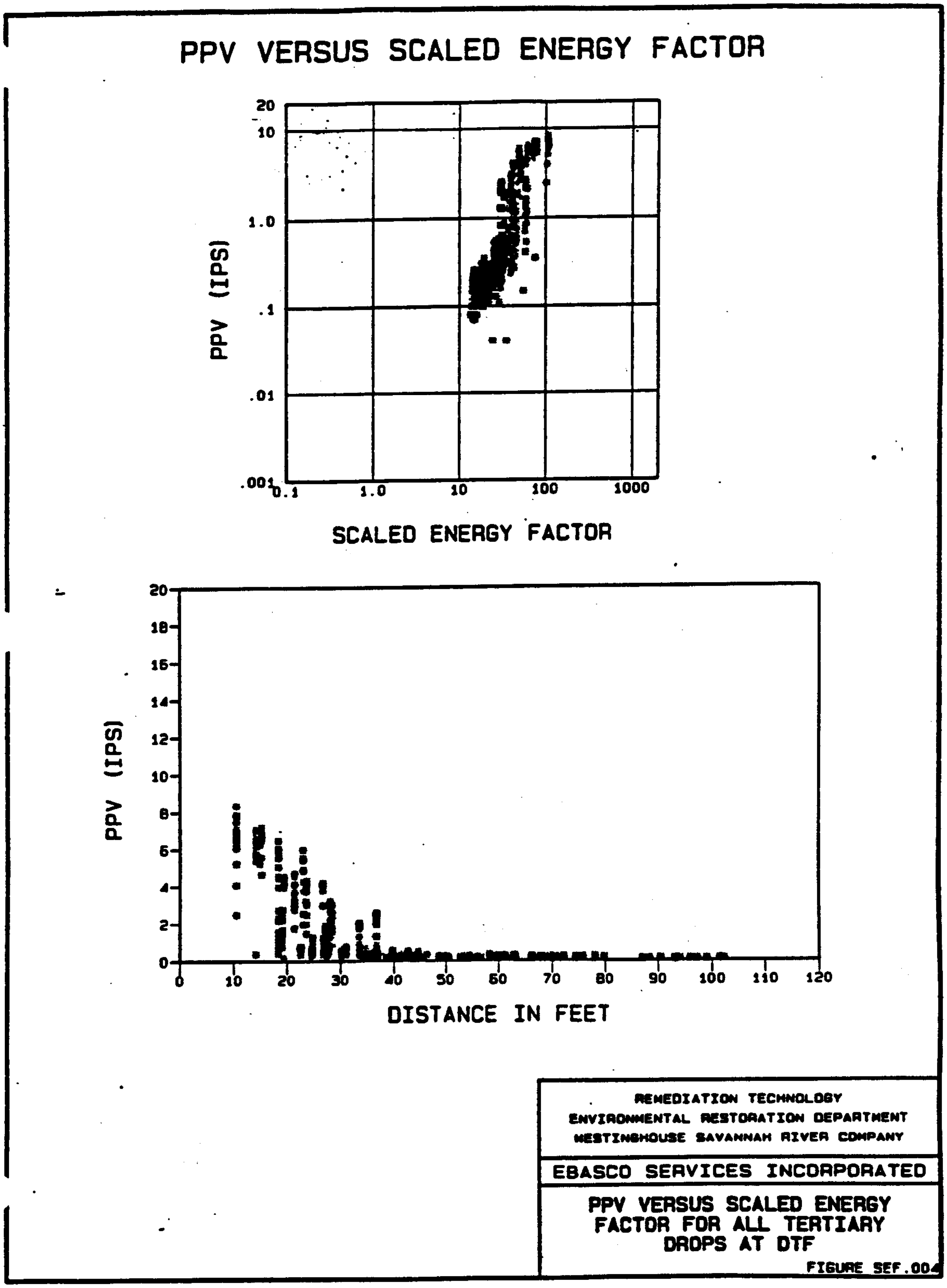
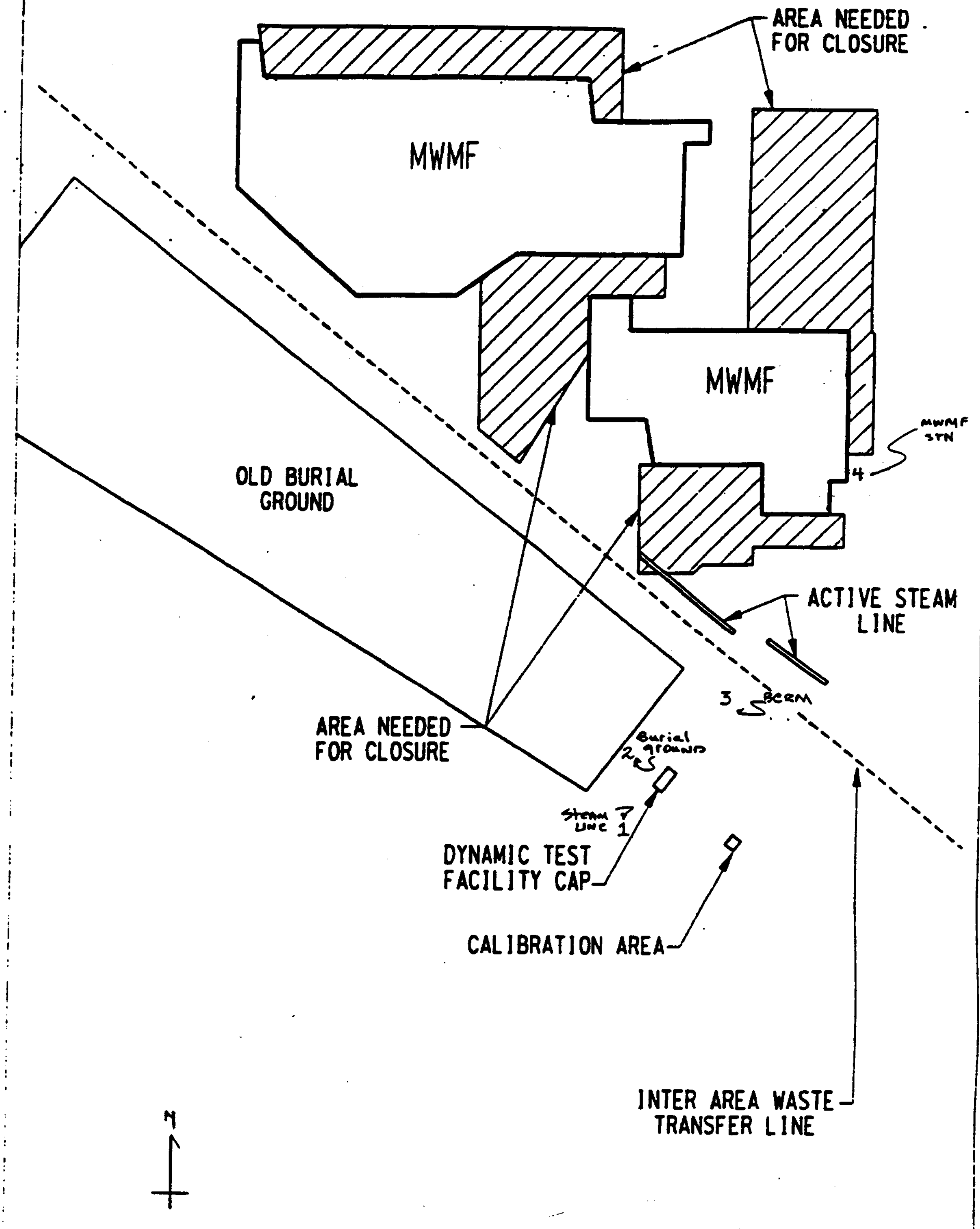
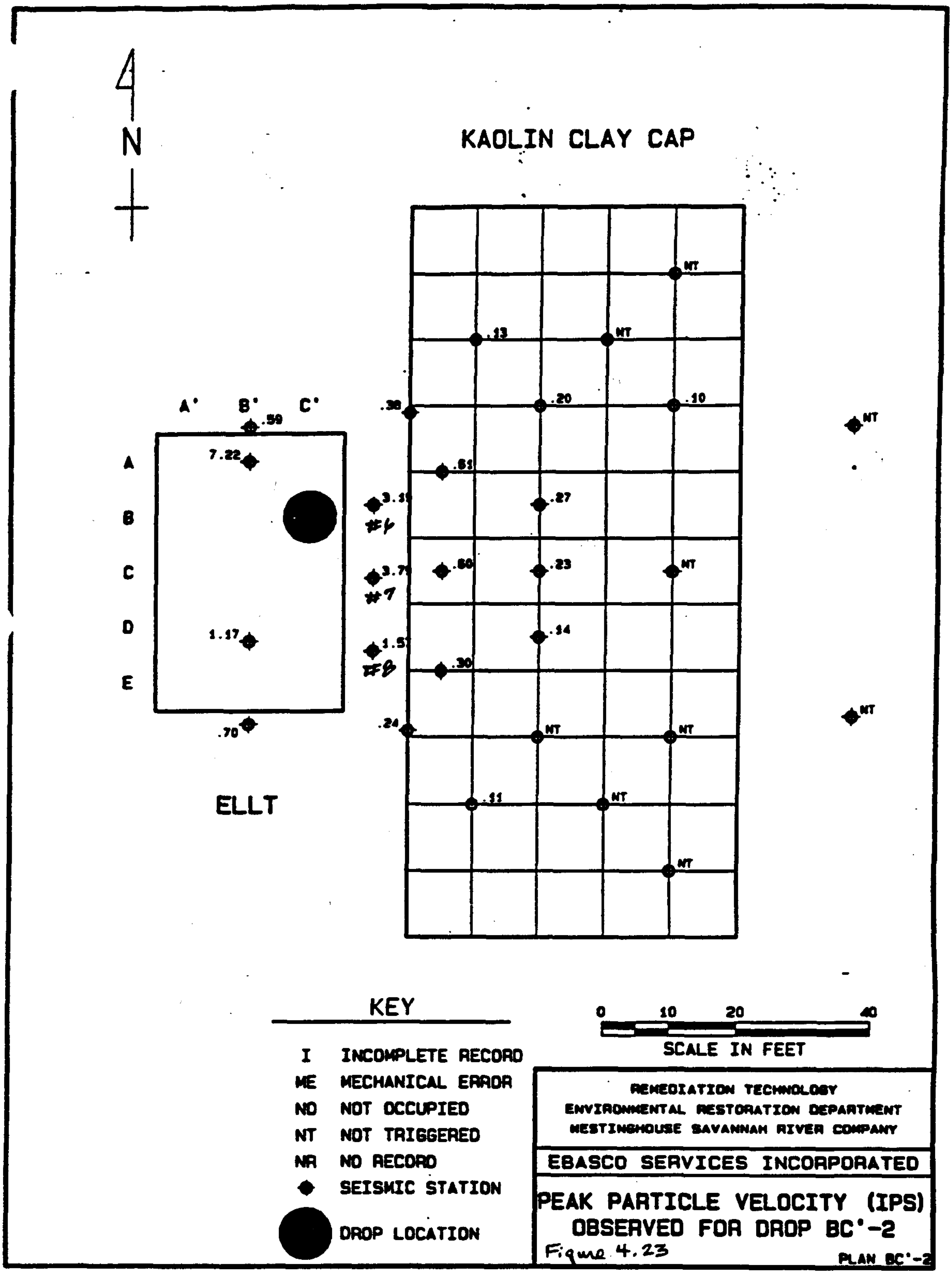

PPV VERSUS SCALED ENERGY FACTOR
20
10
1.0
.1
.01
.001
PPV (IPS)
0.1
1.0
10
100
1000
SCALED ENERGY FACTOR
20
18
16
14
12
10
8
6
4
2
0
PPV (IPS)
0
10
20
30
40
50
60
70
80
90
100
110
120
DISTANCE IN FEET
REMEDIATION TECHNOLOGY
ENVIRONMENTAL RESTORATION DEPARTMENT
WESTINGHOUSE SAVANNAH RIVER COMPANY
EBASCO SERVICES INCORPORATED
PPV VERSUS SCALED ENERGY FACTOR FOR ALL TERTIARY DROPS AT DTF
FIGURE SEF.004

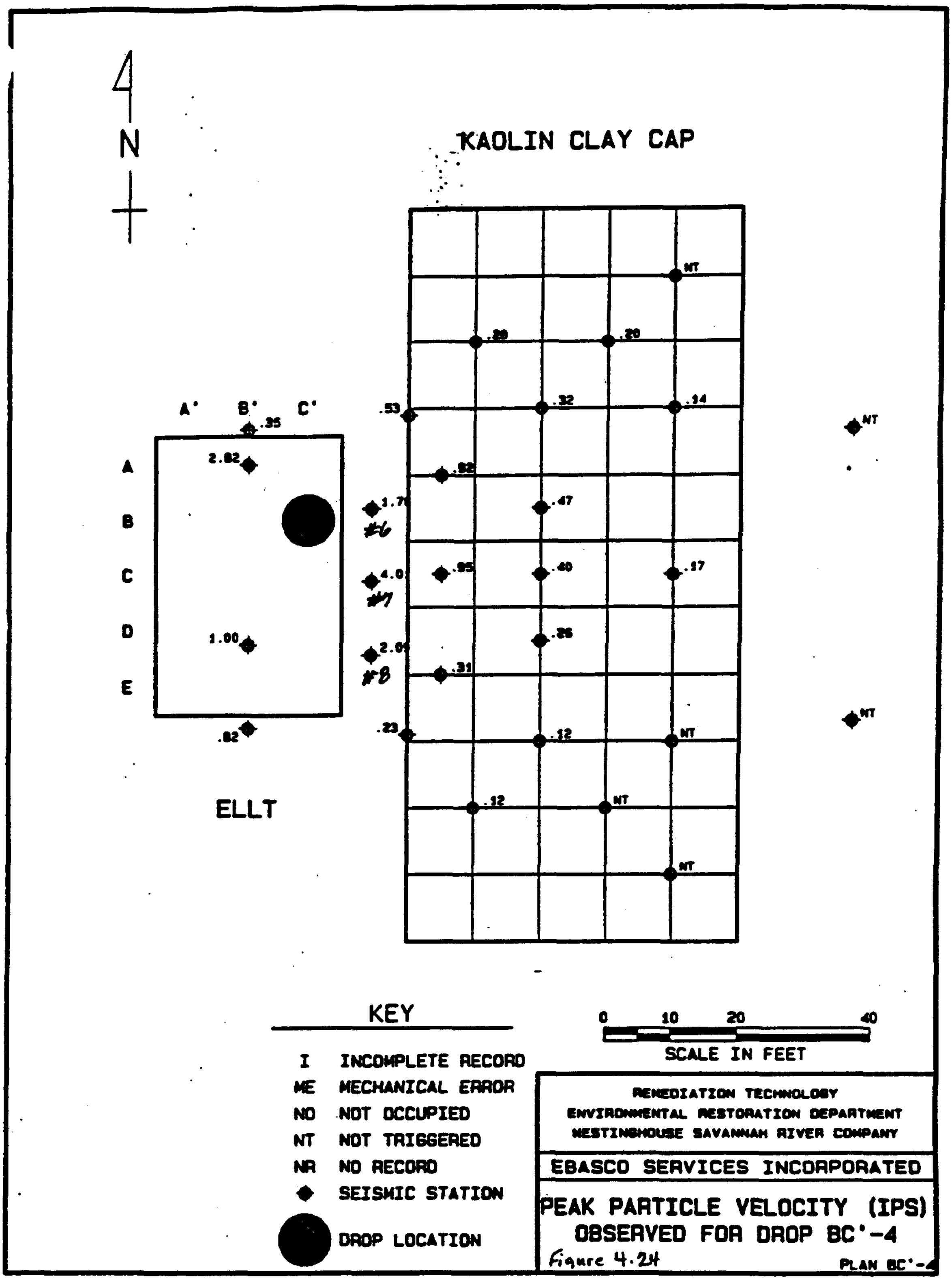
Figure 4.21

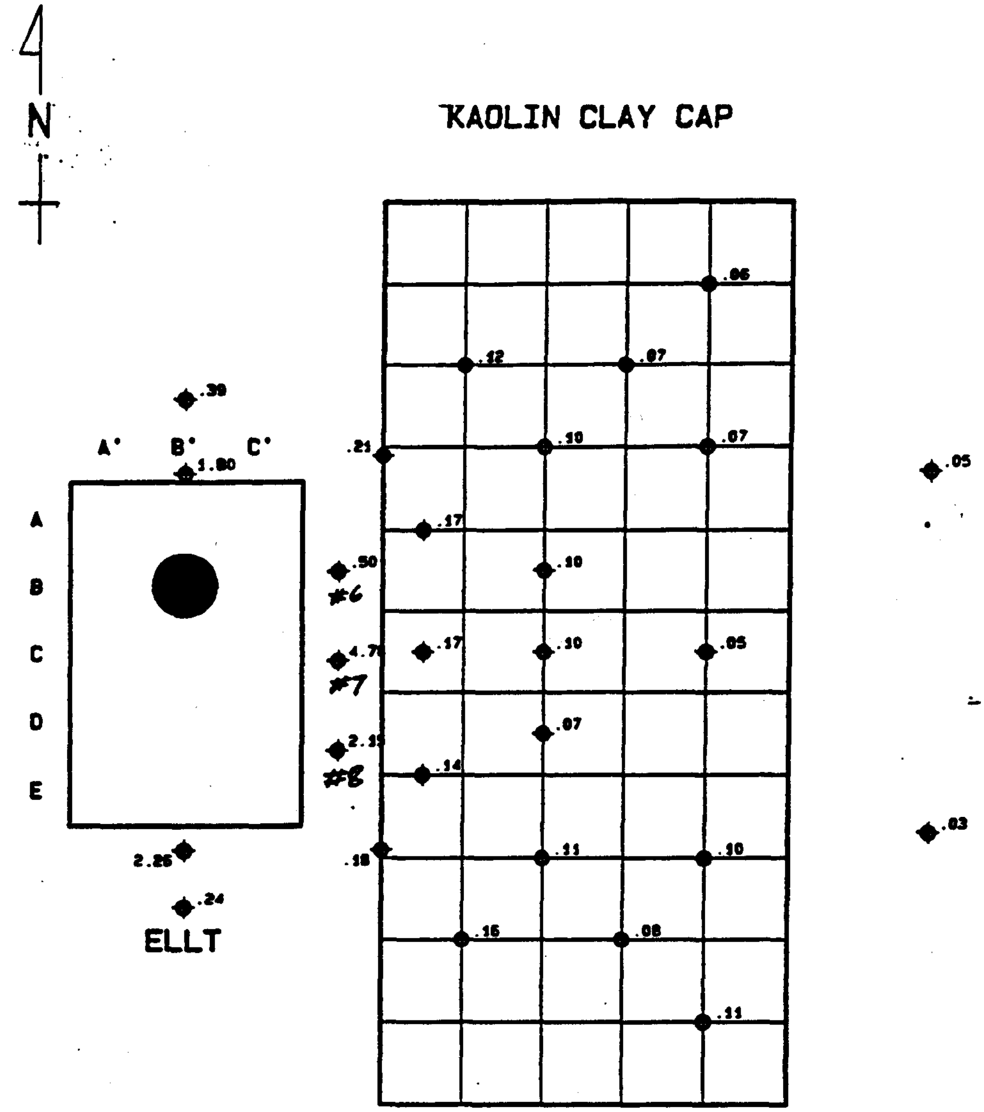


Confirmatory SURVEY LOCATIONS

Figure 4.22


N
KAOLIN CLAY CAP
A'
B'
C'
A
B
C
D
E
ELLT
7.22
.59
1.17
.70
#6
#7
#8
.38
.24
.13
NT
.20
.10
.61
.27
.60
.23
.14
.30
.11
KEY
I INCOMPLETE RECORD
ME MECHANICAL ERROR
NO NOT OCCUPIED
NT NOT TRIGGERED
NR NO RECORD
SEISMIC STATION
DROP LOCATION
0 10 20 40
SCALE IN FEET
REMEDIATION TECHNOLOGY
ENVIRONMENTAL RESTORATION DEPARTMENT
WESTINGHOUSE SAVANNAH RIVER COMPANY
EBASCO SERVICES INCORPORATED
PEAK PARTICLE VELOCITY (IPS)
OBSERVED FOR DROP BC'-2
Figure 4.23
PLAN BC'-2


N
KAOLIN CLAY CAP
ELLT
A' B' C'
A
B
C
D
E
#6
#7
#8
KEY
I INCOMPLETE RECORD
ME MECHANICAL ERROR
NO NOT OCCUPIED
NT NOT TRIGGERED
NR NO RECORD
SEISMIC STATION
DROP LOCATION
0 10 20 40
SCALE IN FEET
REMEDIATION TECHNOLOGY
ENVIRONMENTAL RESTORATION DEPARTMENT
WESTINGHOUSE SAVANNAH RIVER COMPANY
EBASCO SERVICES INCORPORATED
PEAK PARTICLE VELOCITY (IPS)
OBSERVED FOR DROP BC'-4
Figure 4.24
PLAN BC'-4



KEY

I	INCOMPLETE RECORD
ME	MECHANICAL ERROR
NO	NOT OCCUPIED
NT	NOT TRIGGERED
NR	NO RECORD
◆	SEISMIC STATION
●	DROP LOCATION

0 10 20 40
SCALE IN FEET

REMEDIATION TECHNOLOGY
ENVIRONMENTAL RESTORATION DEPARTMENT
WESTINGHOUSE SAVANNAH RIVER COMPANY

EBASCO SERVICES INCORPORATED

PEAK PARTICLE VELOCITY (IPS) OBSERVED FOR DROP BB'-1

Figure 4.25

PLAN BB'-1

Appendix D Post Test Data

The post dynamic compaction phase of testing included the measurement of the hydraulic conductivity of the kaolin clay and the evaluation of the compaction of the buried B-25 boxes. The hydraulic conductivity was measured insitu using six Sealed Double-Ringed Infiltrometers. The data obtained is presented herein.

The data included herein is a synopsis from the EBASCO report [4]. If a more complete data set is required, the information can be obtained from this reference.

SEALED DOUBLE-RINGED INFILTROMETER DATA, DCF TEST

PROJECT INFORMATION SHEET	
PROJECT:	Dynamic Compaction Test,
LOCATION:	E and 4 road
CLIENT:	WSRC
ENGINEER:	Scott R. McMullin
ITEM TESTED:	Kaolin Test cap
REQUIRED K (CM/SEC):	1x10-7
TEST AREA THICKNESS (FT.):	3
NUMBER OF LIFTS:	6
LOOSE LIFT THICKNESS (IN.):	8
BOTTOM BOUNDARY:	sandy clay
COMPACTION EQUIPMENT TYPE:	Cat 815B
LIQUID LIMIT (%)	64
PLASTIVC LIMIT (%):	32
PLASTICITY INDEX (%):	32
PERCENT FINES:	2
PERCENT BENTONITE ADDED:	0
MAXIMUM DRY DENSITY (PCF)	
OPTIMUM MOISTURE (%):	
AVERAGE DRY UNIT WEIGHT (PCF):	
AVERAGE COMPACTION Wm(%):	
AREA OF OUTER RING (CM2):	126451
AREA OF INNER RING (CM2):	23226
DATE OF RING INSTALLATION:	9/11/92
DATE AND TIME RINGS FILLED :	9/4/92

INFILTROMETER D-1 (W-N)			
NUMBER OF TENSIOMETERS USED:	9		
NOMINAL DEPTHS (IN.):	6	12	18
NUMBER AT EACH DEPTH:	3		
ACTUAL TIP DEPTH (IN.):	7	13	19
DATE AND TIME INSTALLED :	9/11/92	14:45	
AVERAGE DEPTH (IN.):	12		
INITIAL TENSIOMETER READINGS			
DATE:	9/11/92	14:45	
GROUP 1:			
6 inch	32		
12 inch	12		
18 inch	21		
GROUP 2:			
6 inch	28		
12 inch	12		
18 inch	0		
GROUP 3:			
6 inch	32		
12 inch	20		
18 inch	20		
INITIAL SWELL GAGE READINGS (CM):			
1	93.6		
2	55.5		
3	58.3		
4	85.2		
INITIAL AVERAGE WATER DEPTH (IN.):	11.0		
INITIAL WATER DEPTH READING (IN.):	3		
TOTAL FLOW, Q, (ml):	198		
TOTL FLOW DUE TO SWELL, Qs, (ml):	125415		

DATA SHEET FOR WATER BAGS
INFILTROMETER D-1 (W-N)

BAG CONNECTION AND DISCONNECTION				t	BAG 1		BAG 2		NET
DATE ON	DATE OFF	TIME ON	TIME OFF	INTERVAL TIME	INITIAL WEIGHT (g)	FINAL WEIGHT (g)	INITIAL WEIGHT (g)	FINAL WEIGHT (g)	CHANGE (g)
11-Sep	14-Sep	14:45	15:10	260700	3735.7	3551.4	3817.8	3559.8	442.3
14-Sep	-	15:53	-	-	3551.4	-	3559.8	-	NA
-	16-Sep	-	14:00	166020	-	3272.9	-	3023.6	814.7
16-Sep	17-Sep	15:43	13:55	79920	3272.9	3159.1	3023.6	2839.7	297.7
17-Sep	-	14:48	-	-	3159.1	-	2839.7	-	NA
-	19-Sep	-	10:29	157260	-	2387.3	-	3046.5	565.0
19-Sep	21-Sep	11:44	11:55	173460	2387.3	1567.9	3046.5	3198.8	667.1
21-Sep	22-Sep	13:50	13:28	85080	3508.4	3190.3	3146.9	3133.1	331.9
22-Sep	23-Sep	14:05	11:20	76500	3190.3	3144.8	3146.9	2914.9	277.5
23-Sep	24-Sep	12:04	11:00	82560	3144.8	2929.7	2914.9	3089.4	40.6
24-Sep	25-Sep	12:00	13:35	92100	2929.7	3150.1	3089.4	2571.3	297.7
25-Sep	26-Sep	14:22	11:05	74580	3150.1	2966.9	2571.3	2490.3	264.2
26-Sep	29-Sep	11:30	13:55	267900	2966.9	2916.6	2490.3	1591.5	949.1
29-Sep	30-Sep	14:45	14:47	86520	2916.6	2791.2	2736.4	2382.8	479.0
30-Sep	1-Oct	15:15	13:31	80160	2791.2	2842.6	2382.8	2172.2	159.2
1-Oct	2-Oct	14:00	13:35	84900	2842.6	2644.9	2172.2	2201.4	168.5
2-Oct	6-Oct	14:10	8:46	326160	2644.9	2029.3	2201.4	2074.0	743.0
6-Oct	9-Oct	9:20	12:45	271500	2714.2	2383.6	2138.4	1538.7	930.3
9-Oct	13-Oct	13:21	10:28	335220	2383.6	2176.3	2641.3	2550.9	297.7
13-Oct	16-Oct	11:00	10:05	255900	2176.3	2014.9	2550.9	2212.4	499.9
16-Oct	20-Oct	10:35	10:35	345600	2014.9	2070.8	2212.4	1983.5	173.0
20-Oct	23-Oct	10:35	12:45	267000	2070.8	2170.9	2731.6	2054.4	577.1
23-Oct	27-Oct	13:30	8:35	327900	2170.9	2171.8	2054.4	1756.3	297.2
27-Oct	30-Oct	9:53	12:55	270120	2171.8	2236.5	2901.0	2471.7	364.6
30-Oct	3-Nov	13:25	8:50	329100	2236.5	2206.6	2471.7	2109.3	392.3
3-Nov	6-Nov	9:25	11:12	265620	2206.6	2306.4	2109.3	1911.6	97.9
6-Nov	10-Nov	12:05	11:00	341700	2306.4	2353.5	2735.8	2307.3	381.4
10-Nov	13-Nov	11:55	10:15	253200	2353.5	2051.5	2307.3	2112.7	496.6
13-Nov	17-Nov	10:50	10:33	344580	2051.5	2113.8	2112.7	2149.3	-98.9
17-Nov	20-Nov	11:08	10:30	256920	2113.8	1819	2149.3	1968.7	475.4
20-Nov	25-Nov	11:10	10:20	429000	2556.7	2053.4	2796.3	2702.2	597.4
25-Nov	4-Dec	11:05	10:12	774420	2053.4	1992.9	2702.2	2438.6	324.1
4-Dec	18-Dec	10:50	13:46	1220160	1992.9	1700.2	2438.6	1421.2	1310.1
18-Dec	23-Dec	14:16	10:35	418740	3094.5	3092.6	3059.5	2762.2	299.2
23-Dec	31-Dec	11:05	10:46	690060	3092.6	2682.1	2762.2	2667.3	505.4
31-Dec	8-Jan	11:20	13:25	698700	2682.1	2103.7	2667.3	2601.4	644.3

SEALED DOUBLE-RINGED INFILTROMETER DATA, DCF TEST

DATA SHEET FOR WATER DEPTH AND TEMPERATURE
INFILTROMETER D-1 (W-N)

DATE	START WAT. DEPTH READING (In)	START WATER DEPTH (In.)	END WAT. DEPTH READING (In.)	END WATER DEPTH (In)	AVG. WATER DEPTH (In)	START WATER TEMP (oF)	END WATER TEMP (oF)	AVG. WATER TEMP oF	TEMP. CHANGE (oF)
14-Sep	3.00	11.00	3.00	11.00	11.00	82	73	78	-9
15-Sep	3.00	11.00	2.75	10.75	10.88	73	72	73	-1
16-Sep	2.75	10.75	2.75	10.75	10.75	72	74	73	2
17-Sep	2.75	10.75	2.75	10.75	10.75	74	74	74	0
18-Sep	2.75	10.75	2.75	10.75	10.75	74	74	74	0
19-Sep	2.75	10.75	2.75	10.75	10.75	74	74	74	0
21-Sep	2.75	10.75	2.50	10.50	10.63	74	75	75	1
22-Sep	2.50	10.50	2.50	10.50	10.50	75	77	76	2
23-Sep	2.50	10.50	2.50	10.50	10.50	77	76	77	-1
24-Sep	2.50	10.50	3.00	11.00	10.75	76	67	72	-9
25-Sep	3.00	11.00	2.75	10.75	10.88	67	65	66	-2
26-Sep	2.75	10.75	3.00	11.00	10.88	65	65	65	0
29-Sep	3.00	11.00	3.00	11.00	11.00	65	70	68	5
30-Sep	3.00	11.00	2.75	10.75	10.88	70	64	67	-6
1-Oct	2.75	10.75	2.50	10.50	10.63	64	62	63	-2
2-Oct	2.50	10.50	2.50	10.50	10.50	62	61	62	-1
6-Oct	2.50	10.50	3.75	11.75	11.13	61	58	60	-3
9-Oct	3.75	11.75	4.75	12.75	12.25	58	66	62	8
13-Oct	4.75	12.75	3.00	11.00	11.88	66	52	59	-14
16-Oct	3.00	11.00	3.00	11.00	11.00	52	63	58	11
20-Oct	3.00	11.00	3.00	11.00	11.00	63	53	58	-10
23-Oct	3.00	11.00	2.75	10.75	10.88	53	57	55	4
27-Oct	2.75	10.75	2.75	10.75	10.75	57	59	58	2
30-Oct	2.75	10.75	2.50	10.50	10.63	59	59	59	0
3-Nov	2.50	10.50	2.75	10.75	10.63	59	64	62	5
6-Nov	2.75	10.75	3.50	11.50	11.13	64	57	61	-7
10-Nov	3.50	11.50	3.25	11.25	11.38	57	50	54	-7
13-Nov	3.25	11.25	3.50	11.50	11.38	50	58	54	8
17-Nov	3.50	11.50	3.50	11.50	11.50	58	45	52	-13
20-Nov	3.50	11.50	3.50	11.50	11.50	45	50	48	5
25-Nov	3.50	11.50	3.25	11.25	11.38	50	59	55	9
4-Dec	3.25	11.25	3.50	11.50	11.38	59	46	53	-13
18-Dec	3.50	11.50	3.50	11.50	11.50	46	46	46	0
23-Dec	3.50	11.50	3.50	11.50	11.50	46	46	46	0
31-Dec	3.50	11.50	3.50	11.50	11.50	46	46	46	0
8-Jan	3.50	11.50	4.00	12.00	11.75	46	58	52	12

SEALED DOUBLE-RINGED INFILTROMETER DATA, DCF TEST

DATA SHEET FOR TENSIOMETER READINGS
INFILTROMETER D-1 (W-N)

DATE	DAY	GROUP NUMBER 1			GROUP NUMBER 2			GROUP NUMBER 3			AVERAGE TENSIOMETER READINGS		
		6 INCH (cb)	12 INCH (cb)	18 INCH (cb)	6 INCH (cb)	12 INCH (cb)	18 INCH (cb)	6 INCH (cb)	12 INCH (cb)	18 INCH (cb)	6 INCH (cb)	12 INCH (cb)	18 INCH (cb)
	1	0	0	0	0	0	0	0	0	0	0	0	0
14-Sep	3	32	12	21	28	12	0	32	20	20	31	15	14
15-Sep	4	12	24	26	6	15	16	8	22	29	9	20	24
16-Sep	5	11	22	25	0	15	16	0	22	28	4	20	23
17-Sep	6	8	14	23	0	12	16	2	18	27	3	15	22
18-Sep	7	3	12	22	2	16	14	0	17	22	2	15	19
19-Sep	8	4	10	19	0	12	13	2	15	23	2	12	18
21-Sep	10	4	9	18	0	10	12	2	12	20	2	10	17
22-Sep	11	4	8	18	0	10	12	2	11	18	2	10	16
23-Sep	12	2	8	16	0	10	10	2	10	18	1	9	15
24-Sep	13	2	2	14	0	8	9	0	10	15	1	7	13
25-Sep	14	2	4	16	0	10	10	0	12	20	1	9	15
26-Sep	15	6	5	16	0	8	10	0	12	22	2	8	16
29-Sep	18	0	2	15	0	5	9	0	9	18	0	5	14
30-Sep	19	0	2	14	0	6	8	0	10	16	0	6	13
1-Oct	20	0	2	15	0	7	9	0	10	20	0	6	15
2-Oct	21	0	2	16	0	8	10	0	12	21	0	7	16
6-Oct	25	0	0	12	0	2	8	0	8	17	0	3	12
9-Oct	28	0	0	12	0	2	7	0	8	18	0	3	12
13-Oct	32	0	0	10	0	0	2	0	4	14	0	1	9
16-Oct	35	0	0	8	0	0	0	0	4	14	0	1	7
20-Oct	39	0	0	8	0	0	2	0	7	16	0	2	9
23-Oct	42	0	0	0	0	0	5	0	7	17	0	2	7
27-Oct	46	0	0	8	0	0	0	0	7	15	0	2	8
30-Oct	49	0	0	8	0	0	2	0	7	12	0	2	7
3-Nov	53	0	0	4	0	0	1	0	4	12	0	1	6
6-Nov	56	0	0	2	0	0	0	0	4	10	0	1	4
10-Nov	60	0	0	4	0	0	0	0	4	16	0	1	7
13-Nov	63	0	0	6	0	0	0	0	4	13	0	1	6
17-Nov	67	0	0	2	0	0	0	0	6	14	0	2	5
20-Nov	70	0	0	2	0	0	0	0	4	14	0	1	5
25-Nov	75	0	0	0	0	0	0	0	2	10	0	1	3
4-Dec	84	0	0	0	0	0	0	0	4	13	0	1	4
18-Dec	97	0	0	0	0	0	0	0	4	12	0	1	4
23-Dec	102	0	0	0	0	0	0	0	0	0	0	0	0
31-Dec	110	0	0	0	0	0	0	0	0	10	0	0	3
8-Jan	118	0	0	0	0	0	0	0	0	0	0	0	0

SEALED DOUBLE-RINGED INFILTROMETER DATA, DCF TEST

DATA SHEET FOR SWELL DATA
INFILTROMETER D-1 (W-N)

CALCULATION SHEET FOR FLOW-RATE AND ADJUSTMENT VALUES
INFILTROMETER D-1 (W-N)

READING DATE	READING TIME	DAY NUMBER	SWELL INFORMATION S1	S2	S3	S4	DAY NO.	(mm) AVG. SWELL	Q (ml)	AVG DAY NO.	I (cm/sec)	EST. FLOW DUE TO TEMP. CHG. (ml)	% OF TOTAL FLOW (ml)	Q WHEN BAG WAS OFF (ml)
							1	0						
14-Sep	16:49	3	91.6	52.4	55.5	80.8	3	3.08	442.3	2	7.30E-08	-150.0	33.9	9
15-Sep	15:45	4	91.3	52.8	54.3	81.1	4	3.28	-	-	-	-16.7	-	-
16-Sep	14:10	5	91.8	52.6	47.8	81.8	5	4.65	814.7	4	2.11E-07	33.3	4.1	27
17-Sep	14:10	6	92.0	52.8	54.8	80.8	6	3.05	297.7	6	1.60E-07	0.0	0.0	12
18-Sep	15:34	7	91.2	51.2	54.6	81.3	7	3.58	-	-	-	0.0	-	-
19-Sep	10:51	8	90.4	52.7	54.4	80.7	8	3.60	565.0	7	1.55E-07	0.0	0.0	17
21-Sep	12:56	10	91.0	52.7	54.4	81.8	10	3.18	667.1	9	1.66E-07	16.7	2.5	26
22-Sep	14:25	11	91.2	52.5	54.3	81.7	11	3.23	331.9	10	1.68E-07	33.3	10.0	5
23-Sep	9:28	12	91.2	53.1	54.7	81.9	12	2.93	277.5	11	1.56E-07	-16.7	6.0	9
24-Sep	11:05	13	91.2	53.0	54.3	81.7	13	3.10	40.6	12	2.12E-08	-150.0	369.5	7
25-Sep	13:57	14	96.6	53.5	54.5	88.2	14	-0.05	297.7	13	1.39E-07	-33.3	11.2	10
26-Sep	10:27	15	98.6	54.1	54.6	88.3	15	-0.75	264.2	14	1.53E-07	0.0	0.0	7
29-Sep	13:03	18	118.7	55.7	55.6	105.2	18	-10.65	949.1	16	1.53E-07	83.3	8.8	8
30-Sep	10:48	19	108.4	55.1	55.6	94.4	19	-5.23	479.0	19	2.38E-07	-100.0	20.9	6
1-Oct	14:20	20	101.1	54.9	55.2	89.3	20	-1.98	159.2	19	8.55E-08	-33.3	20.9	4
2-Oct	12:52	21	98.6	54.6	55.0	88.3	21	-0.98	168.5	20	8.55E-08	-16.7	9.9	6
6-Oct	9:35	25	107.7	56.5	56.1	96.3	25	-6.00	743.0	23	9.81E-08	-50.0	6.7	3
9-Oct	12:04	28	120.5	107.1	62.6	63.3	28	-15.23	930.3	26	1.48E-07	133.3	14.3	6
13-Oct	9:40	32	121.5	63.6	63.7	109.2	32	-16.35	297.7	30	3.82E-08	-233.3	78.4	1
16-Oct	8:04	35	103.7	63.4	64.4	97.5	35	-9.10	499.9	33	8.41E-08	183.3	36.7	4
20-Oct	10:43	39	103.9	63.4	64.4	97.0	39	-9.03	173.0	37	2.16E-08	-166.7	96.3	0
23-Oct	13:41	42	103.1	63.5	63.8	97.6	42	-8.85	577.1	40	9.31E-08	66.7	11.6	5
27-Oct	9:47	46	99.5	62.5	63.8	94.0	46	-6.80	297.2	44	3.90E-08	33.3	11.2	5
30-Oct	11:16	49	99.5	61.9	62.5	92.4	49	-5.93	364.6	47	5.81E-08	0.0	0.0	2
3-Nov	8:22	53	107.0	61.5	63.4	98.8	53	-9.53	392.3	51	5.13E-08	83.3	21.2	2
6-Nov	10:33	56	117.1	62.9	53.3	110.1	56	-12.70	97.9	54	1.59E-08	-116.7	119.2	4
10-Nov	10:05	60	123.1	62.8	63.7	127.5	60	-21.13	381.4	58	4.81E-08	-116.7	30.6	1
13-Nov	9:38	63	132.0	64.0	65.4	138.5	63	-26.83	496.6	61	8.44E-08	133.3	26.8	4
17-Nov	9:38	67	99.4	63.4	64.1	102.0	67	-9.08	-98.9	65	-1.24E-08	-216.7	219.1	1
20-Nov	9:38	70	109.3	63.6	63	98.7	70	-10.50	475.4	68	7.97E-08	83.3	17.5	3
25-Nov	9:38	75	107.1	66.9	66	116.3	75	-15.93	597.4	72	6.00E-08	150.0	25.1	3
4-Dec	9:38	84	108.4	64.3	65.8	104.5	84	-12.60	324.1	79	1.80E-08	-216.7	66.9	1
18-Dec		97							1310.1	91	4.62E-08	0.0	0.0	2
23-Dec		102							299.2	100	3.08E-08	0.0	0.0	1
31-Dec		110							505.4	107	3.15E-08	0.0	0.0	1
8-Jan		118							644.3	115	3.97E-08	200.0	31.0	

SEALED DOUBLE-RINGED I[illegible]LTROMETER DATA, DCF TEST

CALCULATION SHEET FOR HYDRAULIC CONDUCTIVITY
INFILTROMETER D-1 (W-N)

DAY NO.	x10-7 I (cm/sec)	WATER DEPTH (in)	W. FRONT DEPTH (in)	GRADIENT	DAY NO.	X10-7 HYDRAULIC CON. (cm/sec)	x10-7 SWELL I (cm/sec)	X10-7 HYDRAULIC CON.-SWELL (cm/sec)
					1	0		
3	0.7	11.00	1.23	9.91	3	0.1	0.73	0.07
4	-	10.88	1.60	7.80	4	*0.6*	-	-
5	2.1	10.75	1.99	6.40	5	0.3	2.11	0.33
6	1.6	10.75	2.39	5.50	6	0.3	1.60	0.29
7	-	10.75	2.81	4.82	7	*0.6*	-	-
8	1.5	10.75	3.14	4.43	8	0.3	1.55	0.35
10	1.7	10.63	3.97	3.68	10	0.5	1.66	0.45
11	1.7	10.50	4.39	3.39	11	0.5	1.68	0.50
12	1.6	10.50	4.71	3.23	12	0.5	1.56	0.48
13	0.2	10.75	5.14	3.09	13	0.1	0.21	0.07
14	1.4	10.88	5.59	2.95	14	0.5	1.39	0.47
15	1.5	10.88	5.93	2.83	15	0.5	1.53	0.54
18	1.5	11.00	4.48	3.45	18	0.4	1.53	0.44
19	2.4	10.88	4.71	3.31	19	0.7	2.38	0.72
20	0.9	10.63	5.00	3.13	20	0.3	0.86	0.27
21	0.9	10.50	5.23	3.01	21	0.3	0.85	0.28
25	1.0	11.13	6.20	2.80	25	0.4	0.98	0.35
28	1.5	12.25	6.97	2.76	28	0.5	1.48	0.54
32	0.4	11.88	7.95	2.49	32	0.2	0.38	0.15
35	0.8	11.00	8.68	2.27	35	0.4	0.84	0.37
39	0.2	11.00	9.71	2.13	39	0.1	0.22	0.10
42	0.9	10.88	8.12	2.34	42	0.4		0.00
46	0.4	10.75	8.86	2.21	46	0.2	0.39	0.18
49	0.6	10.63	9.46	2.12	49	0.3	0.58	0.27
53	0.5	10.63	10.21	2.04	53	0.3	0.51	0.25
56	0.2	11.13	10.80	2.03	56	0.1	0.16	0.08
60	0.5	11.38	11.58	1.98	60	0.2	0.48	0.24
63	0.8	11.38	12.15	1.94	63	0.4	0.84	0.44
67	-0.1	11.50	12.93	1.89	67	-0.1	-0.12	-0.07
70	0.8	11.50	13.51	1.85	70	0.4	0.80	0.43
75	0.6	11.38	14.96	1.76	75	0.3	0.60	0.34
84	0.2	11.38	16.76	1.68	84	0.1	0.18	0.11
97	0.5	11.50	19.48	1.59	97	0.3	0.46	0.29
102	0.3	11.50	20.48	1.56	102	0.2	0.31	0.20
110	0.3	11.50	22.08	1.52	110	0.2	0.32	0.21
118	0.4	11.75	23.68	1.50	118	0.3	0.40	0.27

SEALED DOUBLE-RINGED INFILTROMETER DATA, DCF TEST

DATF PROJECT INFORMATION DATA SHEET		INFILTROMETER F-1 (W-C)			
PROJECT:	Dynamic Compaction Test,	NUMBER OF TENSIOMETERS USED:	9		
LOCATION:	E and 4 road	NOMINAL DEPTHS (IN.):	6	12	18
CLIENT:	WSRC	NUMBER AT EACH DEPTH:	3		
ENGINEER:	Scott R. McMullin	ACTUAL TIP DEPTH (IN.):	7	13	19
		DATE AND TIME INSTALLED :	9/11/92	14:45	
ITEM TESTED:	Kaolin Test cap	AVERAGE DEPTH (IN.):	12		
REQUIRED K (CM/SEC):	1x10-7				
TEST AREA THICKNESS (FT.):	3	INITIAL TENSIOMETER READINGS			
NUMBER OF LIFTS:	6	DATE:	9/11/92		
LOOSE LIFT THICKNESS (IN.):	8	GROUP 1:			
BOTTOM BOUNDARY:	sandy clay	6 inch	20		
COMPACTION EQUIPMENT TYPE:	Cat 815B	12 inch	34		
		18 inch	34		
LIQUID LIMIT (%)	64	GROUP 2:			
PLASTIVC LIMIT (%):	32	6 inch	24		
PLASTICITY INDEX (%):	32	12 inch	32		
PERCENT FINES:	2	18 inch	32		
PERCENT BENTONITE ADDED:	0	GROUP 3:			
MAXIMUM DRY DENSITY (PCF)		6 inch	23		
OPTIMUM MOISTURE (%):		12 inch	32		
AVERAGE DRY UNIT WEIGHT (PCF):		18 inch	32		
AVERAGE COMPACTION Wm(%):					
		INITIAL SWELL GAGE READINGS (MM):			
AREA OF OUTER RING (CM2):	126451	1	24.4		
AREA OF INNER RING (CM2):	23226	2	27		
DATE OF RING INSTALLATION:	9/11/92	3	44.2		
DATE AND TIME RINGS FILLED :	9/11/92	4	39		
		INITIAL AVERAGE WATER DEPTH (IN.):	12.8		
		INITIAL WATER DEPTH READING (IN.):	9		
		TOTAL FLOW, Q, (ml):	311		
		TOTL FLOW DUE TO SWELL, Qs, (ml):	125415		

SEALED DOUBLE-RINGED [illegible]LTROMETER DATA, DCF TEST

DATA SHEET FOR WATER BAGS
INFILTROMETER F-1 (W-C)

BAG CONNECTION AND DISCONNECTION				t	BAG 1		BAG 2		
DATE ON	DATE OFF	TIME ON	TIME OFF	INTERVAL TIME	INITIAL WEIGHT (g)	FINAL WEIGHT (g)	INITIAL WEIGHT (g)	FINAL WEIGHT (g)	NET CHANGE (g)
11-Sep	14-Sep	14:45	15:08	260580	3926.5	3197.6	3866.9	3310.9	1284.9
14-Sep	-	15:53	-	-	3197.6	-	3310.9	-	-
-	16-Sep	-	14:00	166020	-	2595.9	-	3272.7	639.9
16-Sep	17-Sep	15:43	13:57	80040	2595.7	2681.3	3272.7	2967.8	219.3
17-Sep	-	14:46	-	-	2681.3	-	2967.8	-	-
-	19-Sep	-	10:30	157440	-	2477.5	-	2659.8	511.8
19-Sep	21-Sep	11:43	11:56	173580	2477.5	2097.1	2659.8	2484.4	555.8
21-Sep	22-Sep	13:49	13:45	86160	2097.1	1645.3	2484.4	2693.4	242.8
22-Sep	23-Sep	14:07	11:22	76500	1645.3	1519.8	2693.4	2610.7	208.2
23-Sep	24-Sep	12:02	11:02	82800	1519.8	1652.9	2610.7	2340.1	137.5
24-Sep	25-Sep	12:02	13:37	92100	3331.4	3223.5	3396.8	3209.1	295.6
25-Sep	26-Sep	14:24	11:05	74460	3223.5	3156.5	3209.1	3038.3	237.8
26-Sep	29-Sep	11:30	13:55	267900	3156.5	2658.9	3038.3	2725.1	810.8
29-Sep	30-Sep	14:45	14:49	86640	2658.9	2719.2	2725.1	2074.7	590.1
30-Sep	1-Oct	15:16	13:32	80160	2719.2	2620.6	2074.7	2034.6	138.7
1-Oct	2-Oct	14:02	13:36	84840	2620.6	2369.0	2034.6	2122.8	163.4
2-Oct	6-Oct	14:12	8:47	326100	2369.0	1643.0	2122.8	2285.5	563.3
6-Oct	9-Oct	9:22	12:48	271560	1643.0	1605.4	2285.5	1647.1	676.0
9-Oct	13-Oct	13:15	10:29	335640	2620.8	2851.6	2603.4	2126.2	246.4
13-Oct	16-Oct	11:02	10:06	255840	2851.6	2766.8	2126.2	1743.4	467.6
16-Oct	20-Oct	10:37	10:36	345540	2766.8	2596.6	2613.4	2481.5	302.1
20-Oct	23-Oct	11:11	12:47	264960	2596.6	2777.9	2481.5	1815.0	485.2
23-Oct	27-Oct	13:32	8:40	328080	2777.9	2642.0	2786.3	2602.6	319.6
27-Oct	30-Oct	10:00	12:57	269820	2642.0	2355.0	2602.6	2489.8	399.8
30-Oct	3-Nov	13:37	8:53	328560	2355.0	2228.3	2489.8	2296.1	320.4
3-Nov	6-Nov	9:26	11:13	265620	2228.3	2341.4	2296.1	2002.4	180.6
6-Nov	10-Nov	12:07	11:02	341700	2341.4	2049.0	2002.4	1877.9	416.9
10-Nov	13-Nov	12:00	10:16	252960	2990.2	2982.5	3044.4	2466.3	585.8
13-Nov	17-Nov	10:51	10:34	344580	2982.5	2734.5	2466.3	2627	87.3
17-Nov	20-Nov	11:09	10:32	256980	2734.5	2656.1	2627	2251.5	453.9
20-Nov	25-Nov	11:12	10:22	429000	2656.1	2230.3	2251.5	2157.8	519.5
25-Nov	4-Dec	11:08	10:14	774360	2230.3	1958.1	2157.8	1925.6	504.4
4-Dec	18-Dec	10:55	13:47	1219920	3352.7	2027.4	3246.5	2178.8	2393.0
18-Dec	23-Dec	14:18	10:36	418680	3072.4	2908.4	3215.7	3058.3	321.4
23-Dec	31-Dec	11:07	10:48	690060	2908.4	2504.5	3058.3	2886.7	575.5
31-Dec	8-Jan	11:22	13:27	698700	2504.5	2650.3	2886.7	2130.3	610.6

SEALED DOUBLE-RINGED INFILTROMETER DATA, DCF TEST

DATA SHEET FOR WATER DEPTH AND TEMPERATURE
INFILTROMETER F-1 (W-C)

DATE	START WAT. DEPTH READING (in)	START WATER DEPTH (in.)	END WAT. DEPTH READING (in.)	END WATER DEPTH (in)	AVG. WATER DEPTH (in)	START WATER TEMP (oF)	END WATER TEMP (oF)	AVG. WATER TEMP oF	TEMP. CHANGE (oF)
14-Sep	9.00	12.75	9.00	12.75	12.75	84	74	79	-10
-	9.00	12.75	2.75	6.50	9.63	74	72	73	-2
16-Sep	2.75	6.50	9	12.75	9.63	72	73	73	1
17-Sep	9.00	12.75	9.00	12.75	12.75	73	72	73	-1
18-Sep	9.00	12.75	9.00	12.75	12.75	72	74	73	2
19-Sep	9.00	12.75	9.00	12.75	12.75	74	75	75	1
21-Sep	9.00	12.75	8.75	12.50	12.63	75	75	75	0
22-Sep	8.75	12.50	8.75	12.50	16.25	75	77	76	2
23-Sep	8.75	12.50	8.75	12.50	16.25	77	75	76	-2
24-Sep	8.75	12.50	9.00	12.75	16.50	75	67	71	-8
25-Sep	9.00	12.75	9.25	13.00	16.75	67	63	65	-4
26-Sep	9.25	13.00	9.25	13.00	16.75	63	63	63	0
29-Sep	9.25	13.00	9.00	12.75	16.50	63	69	66	6
30-Sep	9.00	12.75	9.00	12.75	16.50	69	64	67	-5
1-Oct	9.00	12.75	9.00	12.75	16.50	64	62	63	-2
2-Oct	9.00	12.75	9.00	12.75	16.50	62	60	61	-2
6-Oct	9.00	12.75	10.00	13.75	17.50	60	56	58	-4
9-Oct	10.00	13.75	11.25	15.00	18.75	56	65	61	9
13-Oct	11.25	15.00	9.25	13.00	16.75	65	59	62	-6
16-Oct	9.25	13.00	9.00	12.75	16.50	59	63	61	4
20-Oct	9.00	12.75	9.00	12.75	16.50	63	54	59	-9
23-Oct	9.00	12.75	9.00	12.75	16.50	54	57	56	3
27-Oct	9.00	12.75	8.75	12.50	16.25	57	58	58	1
30-Oct	8.75	12.50	8.75	12.50	16.25	58	63	61	5
3-Nov	8.75	12.50	9.00	12.75	16.50	63	64	64	1
6-Nov	9.00	12.75	9.50	13.25	17.00	64	58	61	-6
10-Nov	9.50	13.25	9.00	12.75	16.50	58	49	54	-9
13-Nov	9.00	12.75	9.75	13.50	17.25	49	58	54	9
17-Nov	9.75	13.50	9.25	13.00	16.75	58	46	52	-12
20-Nov	9.25	13.00	9.25	13.00	16.75	46	47	47	1
25-Nov	9.25	13.00	9.50	13.25	17.00	47	58	53	11
4-Dec	9.50	13.25	9.00	12.75	16.50	58	45	52	-13
18-Dec	9.00	12.75	9.25	13.00	16.75	45	45	45	0
23-Dec	9.25	13.00	9.25	13.00	16.75	45	45	45	0
31-Dec	9.25	13.00	9.25	13.00	16.75	45	45	45	0
8-Jan	9.25	13.00	10.00	13.75	17.50	45	57	51	12

DATA SHEET FOR TENSIOMETER READINGS
INFILTROMETER F-1 (W-C)

		GROUP NUMBER 1			GROUP NUMBER 2			GROUP NUMBER 3			AVERAGE TENSIOMETER READINGS		
DATE	DAY	6 INCH (cb)	12 INCH (cb)	18 INCH (cb)	6 INCH (cb)	12 INCH (cb)	18 INCH (cb)	6 INCH (cb)	12 INCH (cb)	18 INCH (cb)	6 INCH (cb)	12 INCH (cb)	18 INCH (cb)
	1												
14-Sep	3	0	22	28	0	0	28	3	20	24	1	14	27
-	4	0	20	29	0	0	29	2	18	24	1	13	27
16-Sep	5	0	20	29	0	0	28	2	16	24	1	12	27
17-Sep	6	0	20	29	0	0	29	2	18	24	1	13	27
18-Sep	7	0	16	25	0	0	24	0	14	20	0	10	23
19-Sep	8	0	16	24	0	0	24	0	12	18	0	9	22
21-Sep	10	0	14	22	0	0	22	0	12	18	0	9	21
22-Sep	11	0	14	20	0	0	20	0	11	15	0	8	18
23-Sep	12	0	12	18	0	0	20	0	10	15	0	7	18
24-Sep	13	0	11	0	0	0	18	0	9	18	0	7	12
25-Sep	14	0	12	0	0	0	20	0	12	18	0	8	13
26-Sep	15	0	11	2	0	0	20	0	12	20	0	8	14
29-Sep	18	0	8	1	0	0	16	0	8	16	0	5	11
30-Sep	19	0	0	2	0	0	17	0	8	16	0	3	12
1-Oct	20	0	8	2	0	0	16	0	9	16	0	6	11
2-Oct	21	0	9	2	0	0	18	0	8	16	0	6	12
6-Oct	25	0	4	0	0	0	12	0	6	14	0	3	9
9-Oct	28	0	6	2	0	0	10	0	6	12	0	4	8
13-Oct	32	0	4	0	0	0	8	0	4	10	0	3	6
16-Oct	35	0	2	0	0	0	0	0	2	8	0	1	3
20-Oct	39	0	0	0	0	0	0	0	2	4	0	1	1
23-Oct	42	0	0	2	0	0	1	0	1	5	0	0	3
27-Oct	46	0	0	2	0	0	3	0	0	6	0	0	4
30-Oct	49	0	0	1	0	0	7	0	2	8	0	1	5
3-Nov	53	0	2	0	0	0	10	0	2	4	0	1	5
6-Nov	56	0	2	0	0	0	4	0	0	4	0	1	3
10-Nov	60	0	0	2	0	0	0	0	2	2	0	1	1
13-Nov	63	0	0	0	0	0	0	0	0	4	0	0	1
17-Nov	67	0	0	0	0	0	0	0	0	2	0	0	1
20-Nov	70	0	0	0	0	0	0	0	0	2	0	0	1
25-Nov	75	0	0	2	0	0	0	0	0	2	0	0	1
4-Dec	84	0	0	0	0	0	0	0	0	2	0	0	1
18-Dec	97	0	0	0	0	0	0	0	0	0	0	0	0
23-Dec	102	0	0	0	0	0	0	0	0	0	0	0	0
31-Dec	110	0	0	0	0	0	0	0	0	0	0	0	0
8-Jan	118	0	0	0	0	0	0	0	0	0	0	0	0

SEALED DOUBLE-RINGED INFILTROMETER DATA, DCF TEST

DATA SHEET FOR SWELL DATA
INFILTROMETER F-1 (W-C)

CALCULATION SHEET FOR FLOW-RATE AND ADJUSTMENT VALUES
INFILTROMETER F-1 (W-C)

READING DATE	READING TIME	DAY NUMBER	SWELL INFORMATION S1	S2	S3	S4	(mm) AVG. SWELL	DAY NO.	Q (ml)	AVG DAY NO.	I (cm/sec)	EST. FLOW DUE TO TEMP. CHG. (ml)	% OF TOTAL FLOW (ml)	Q WHEN BAG WAS OFF (ml)
14-Sep	16:25	3	35.0	49.6	34.1	21.0	-0.28	3	1284.9	2	2.12E-07	-166.7	13.0	12
15-Sep	16:05	4	34.1	48.7	34.8	20.7	0.08	4	-	-	-	-33.3	-	-
16-Sep	14:53	5	33.9	47.4	34.3	19.9	0.78	5	639.9	4	1.66E-07	16.7	2.6	20
17-Sep	16:05	6	34.1	48.7	34.8	20.7	0.93	6	219.3	6	1.18E-07	-16.7	7.6	9
18-Sep	15:50	7	35.0	47.1	33.8	21.0	0.57	7	-	-	-	33.3	-	-
19-Sep	10:59	8	35.4	42.0	33.3	21.1	-0.70	8	511.8	7	1.40E-07	16.7	3.3	14
21-Sep	13:15	10	34.4	53.3	39.8	19.7	3.15	10	555.8	9	1.38E-07	0.0	0.0	20
22-Sep	14:41	11	31.5	50.6	36.8	16.8	0.27	11	242.8	10	1.21E-07	33.3	13.7	4
23-Sep	9:45	12	31.8	49.5	37.0	17.9	0.40	12	208.2	11	1.17E-07	-33.3	16.0	5
24-Sep	11:15	13	33.9	51.1	39.3	19.6	2.33	13	137.5	12	7.15E-08	-133.3	97.0	9
25-Sep	14:08	14					-33.65	14	295.6	13	1.38E-07	-66.7	22.6	9
26-Sep	10:33	15	35.6	57.2	44.3	20.4	5.73	15	237.8	14	1.38E-07	0.0	0.0	5
29-Sep	13:13	18	36.1	60.4	46.3	21.5	7.43	18	810.8	16	1.30E-07	100.0	12.3	15
30-Sep	11:16	19	35.2	51.1	38.9	20.7	2.83	19	590.1	19	2.93E-07	-83.3	14.1	7
1-Oct	14:35	20	35.7	53.0	40.7	21.0	3.95	20	138.7	19	7.45E-08	-33.3	24.0	3
2-Oct	12:58	21	35.6	53.6	39.9	20.4	3.73	21	163.4	20	8.29E-08	-33.3	20.4	4
6-Oct	9:45	25	38.5	60.4	47.4	21.2	8.23	25	563.3	23	7.44E-08	-66.7	11.8	4
9-Oct	12:10	28	44.5	65.6	54.5	28.3	14.58	28	676.0	26	1.07E-07	150.0	22.2	3
13-Oct	9:50	32	43.9	72.3	57.6	29.4	17.15	32	246.4	30	3.16E-08	-100.0	40.6	3
16-Oct	8:16	35	46.0	69.2	56.0	29.9	16.63	35	467.6	33	7.87E-08	66.7	14.3	3
20-Oct	10:58	39	46.1	68.4	54.7	30.3	16.23	39	302.1	37	3.76E-08	-150.0	49.7	3
23-Oct	14:06	42	46.1	68.5	55.1	29.3	16.10	42	485.2	40	7.88E-08	50.0	10.3	4
27-Oct	9:54	46	45.0	66.3	52.3	27.2	14.05	46	319.6	44	4.19E-08	16.7	5.2	6
30-Oct	11:20	49	44.3	63.5	48.0	28.7	12.48	49	399.8	47	6.38E-08	83.3	20.8	3
3-Nov	8:27	53	44.6	59.1	44.2	25.5	9.70	53	320.4	51	4.20E-08	16.7	5.2	2
6-Nov	10:40	56	44.3	59.6	44.3	28.0	10.40	56	180.6	54	2.93E-08	-100.0	55.4	3
10-Nov	10:40	60	43.2	59.8	45.2	27.1	10.18	60	416.9	58	5.25E-08	-150.0	36.0	6
13-Nov	10:40	63	45.7	61.1	45.3	29.4	11.73	63	585.8	61	9.97E-08	150.0	25.6	3
17-Nov	10:24	67	45.4	63.0	47.3	27.9	12.25	67	87.3	65	1.09E-08	-200.0	229.1	2
20-Nov	10:24	70	49.3	63.4	48.1	28.3	13.63	70	453.9	68	7.60E-08	16.7	3.7	4
25-Nov	10:24	75	50.6	7.1	53.6	33.4	2.52	75	519.5	72	5.21E-08	183.3	35.3	3
4-Dec	10:24	84	47.4	69.7	52.2	30.0	16.18	84	504.4	79	2.80E-08	-216.7	43.0	3
18-Dec		97							2393.0	91	8.45E-08	0.0	0.0	3
23-Dec		102							321.4	100	3.31E-08	0.0	0.0	1
31-Dec		110							575.5	107	3.59E-08	0.0	0.0	2
8-Jan		118							610.6	115	3.76E-08	200.0	32.8	

SEALED DOUBLE-RINGED INFILTROMETER DATA, DCF TEST

CALCULATION SHEET FOR HYDRAULIC CONDUCTIVITY
INFILTROMETER D-1 (W-C)

DAY NO.	x10-7 I (cm/sec)	WATER DEPTH (in)	W. FRONT DEPTH (in)	GRADIENT	DAY NO.	X10-7 HYDRAULIC CON. (cm/sec)	x10-7 SWELL I (cm/sec)	X10-7 HYDRAULIC CON.-SWELL (cm/sec)
					1			
2	2.1	12.75	1.51	9.45	3	0.2	2.12	0.22
-	-	9.63	-	-	4	0.3	-	-
4	1.7	9.63	4.01	3.40	5	0.5	1.66	0.49
6	1.2	12.75	5.50	3.32	6	0.4	1.18	0.36
-	-	12.75	-	-	7	0.3	-	-
7	1.4	12.75	0.77	17.60	8	0.1	1.40	0.08
9	1.4	12.63	0.99	13.80	10	0.1	1.38	0.10
10	1.2	16.25	1.16	14.98	11	0.1	1.21	0.08
11	1.2	16.25	1.27	13.81	12	0.1	1.17	0.08
12	0.7	16.50	1.37	13.01	13	0.1	0.71	0.05
13	1.4	16.75	1.49	12.23	14	0.1	1.38	0.11
14	1.4	16.75	1.60	11.46	15	0.1	1.38	0.12
16	1.3	16.50	1.82	10.05	18	0.1	1.30	0.13
19	2.9	16.50	2.06	9.03	19	0.3	2.93	0.32
19	0.7	16.50	2.17	8.62	20	0.1	0.74	0.09
20	0.8	16.50	2.27	8.26	21	0.1	0.83	0.10
23	0.7	17.50	2.54	7.89	25	0.1	0.74	0.09
26	1.1	18.75	2.93	7.40	28	0.1	1.07	0.14
30	0.3	16.75	3.32	6.05	32	0.1	0.32	0.05
33	0.8	16.50	3.70	5.46	35	0.1	0.79	0.14
37	0.4	16.50	4.09	5.03	39	0.1	0.38	0.07
40	0.8	16.50	4.49	4.68	42	0.2	0.79	0.17
44	0.4	16.25	4.87	4.34	46	0.1	0.42	0.10
47	0.6	16.25	5.26	4.09	49	0.2	0.64	0.16
51	0.4	16.50	5.65	3.92	53	0.1	0.42	0.11
54	0.3	17.00	6.04	3.82	56	0.1	0.29	0.08
58	0.5	16.50	6.43	3.57	60	0.1	0.53	0.15
61	1.0	17.25	15.34	2.12	63	0.5	1.00	0.47
65	0.1	16.75	16.21	2.03	67	0.1	0.11	0.05
68	0.8	16.75	17.08	1.98	70	0.4	0.76	0.38
72	0.5	17.00	18.08	1.94	75	0.3	0.52	0.27
79	0.3	16.50	19.83	1.83	84	0.2	0.28	0.15
91	0.8	16.75	22.73	1.74	97	0.5	0.84	0.49
100	0.3	16.75	25.10	1.67	102	0.2	0.33	0.20
107	0.4	16.75	26.71	1.63	110	0.2	0.36	0.22
115	0.4	17.50	28.73	1.61	118	0.2	0.38	0.23

SEALED DOUBLE-RINGED INFILTROMETER DATA, DCF TEST

DATF PROJECT INFORMATION DATA SHEET	
PROJECT:	Dynamic Compaction Test,
LOCATION:	E and 4 road
CLIENT:	WSRC
ENGINEER:	Scott R. McMullin
ITEM TESTED:	Kaolin Test cap
REQUIRED K (CM/SEC):	1x10-7
TEST AREA THICKNESS (FT.):	3
NUMBER OF LIFTS:	6
LOOSE LIFT THICKNESS (IN.):	8
BOTTOM BOUNDARY:	_ sandy clay
COMPACTION EQUIPMENT TYPE:	Cat 815B
LIQUID LIMIT (%)	64
PLASTIVC LIMIT (%):	32
PLASTICITY INDEX (%):	32
PERCENT FINES:	2
PERCENT BENTONITE ADDED:	0
MAXIMUM DRY DENSITY (PCF)	
OPTIMUM MOISTURE (%):	
AVERAGE DRY UNIT WEIGHT (PCF):	
AVERAGE COMPACTION Wm(%):	
AREA OF OUTER RING (CM2):	126451
AREA OF INNER RING (CM2):	23226
DATE OF RING INSTALLATION:	9/3/92
DATE AND TIME RINGS FILLED :	9/3/92

INFILTROMETER H-1 (W-S)			
NUMBER OF TENSIOMETERS USED:	9		
NOMINAL DEPTHS (IN.):	6	12	18
NUMBER AT EACH DEPTH:	3		
ACTUAL TIP DEPTH (IN.):	7	13	19
DATE AND TIME INSTALLED :	9/3/92	17:25	
AVERAGE DEPTH (IN.):	12		
INITIAL TENSIOMETER READINGS			
DATE:	9/3/92		
GROUP 1:			
6 inch	52		
12 inch	34		
18 inch	22		
GROUP 2:			
6 inch	36		
12 inch	22		
18 inch	19		
GROUP 3:			
6 inch	46		
12 inch	38		
18 inch	29		
INITIAL SWELL GAGE READINGS (MM):			
1	57.4		
2	72.2		
3	35.9		
4	21.8		
INITIAL AVERAGE WATER DEPTH (IN.):	6.8		
INITIAL WATER DEPTH READING (IN.):	3		
TOTAL FLOW, Q, (ml):	318		
TOTL FLOW DUE TO SWELL, Qs, (ml):	125415		

SEALED DOUBLE-RINGED INFILTROMETER DATA, DCF TEST

DATA SHEET FOR WATER BAGS
INFILTROMETER H-1 (W-S)

BAG CONNECTION AND DISCONNECTION					BAG 1		BAG 2		
DATE ON	DATE OFF	TIME ON	TIME OFF	t INTERVAL TIME	INITIAL WEIGHT (g)	FINAL WEIGHT (g)	INITIAL WEIGHT (g)	FINAL WEIGHT (g)	NET CHANGE (g)
3-Sep	4-Sep	17:25	-	-	3871.0	-	3658.0	-	-
4-Sep	5-Sep	-	-	-	-	-	-	-	-
5-Sep	10-Sep	-	12:15	586200	-	3118.6	-	3155.7	1254.7
10-Sep	14-Sep	12:45	15:05	354000	3387.3	1474.2	3155.7	2848.1	2220.7
14-Sep	15-Sep	15:47	-	-	3738.8	-	2848.1	-	-
15-Sep	16-Sep	-	14:02	166500	-	3208.1	-	2462.3	916.5
16-Sep	17-Sep	15:40	13:58	80280	3208.1	3042.1	2462.3	2192.6	435.7
17-Sep	-	14:41	-	-	3042.1	-	2192.6	-	-
-	19-Sep	-	10:31	157800	-	2478.1	-	1999.0	757.6
19-Sep	21-Sep	11:42	11:57	173700	2478.1	1899.9	1999.0	1746.5	830.7
21-Sep	22-Sep	13:45	13:50	86700	3444.4	3303.3	3290.0	3061.5	369.6
22-Sep	23-Sep	14:09	11:24	76500	3303.3	3222.7	3061.5	2762.2	379.9
23-Sep	24-Sep	12:00	11:04	83040	3222.7	3095.1	2762.2	1563.2	1326.6
24-Sep	25-Sep	12:02	13:38	92160	3095.1	3185.8	3194.7	2799.4	304.6
25-Sep	26-Sep	14:26	11:06	74400	3185.5	3190.6	2799.4	2508.9	285.4
26-Sep	29-Sep	11:31	13:56	267900	3190.6	2601.1	2508.9	2115.7	982.7
29-Sep	30-Sep	14:46	14:50	86640	2601.1	2297.5	2115.7	1850.6	568.7
30-Sep	1-Oct	15:17	13:33	80160	2297.5	2196.5	1850.6	1641.1	310.5
1-Oct	2-Oct	14:04	13:37	84780	2196.5	1931.3	1641.1	1647.5	258.8
2-Oct	6-Oct	14:14	8:48	326040	3190.8	2464.3	3049.1	2993.3	782.3
6-Oct	9-Oct	9:24	12:51	271620	2464.3	1753.4	2993.3	2924.6	779.6
9-Oct	13-Oct	13:20	10:30	335400	3056.8	2739.4	2924.6	2870.2	371.8
13-Oct	16-Oct	11:04	10:07	255780	2739.4	2552.0	2870.2	2503.0	554.6
16-Oct	20-Oct	10:39	10:37	345480	2552.0	2440.9	2503.0	2229.7	384.4
20-Oct	23-Oct	11:13	12:48	264900	2440.9	1582.5	2229.7	2552.0	536.1
23-Oct	27-Oct	13:35	8:43	328080	2658.8	2503.7	2552.0	2291.0	416.1
27-Oct	30-Oct	10:12	12:59	269220	2503.7	2414.0	2291.0	1981.7	399.0
30-Oct	3-Nov	13:39	8:56	328620	2414.0	2288.4	2982.8	2667.6	440.8
3-Nov	6-Nov	9:27	11:14	265620	2288.4	2241.3	2667.6	2435.2	279.5
6-Nov	10-Nov	12:09	11:04	341700	2241.3	2206.2	2435.2	2568.9	-98.6
10-Nov	13-Nov	12:02	10:17	252900	2206.2	1731.0	2568.9	1968.1	1076.0
13-Nov	17-Nov	10:52	10:35	344580	2957.4	2739.3	3004.8	2890.0	332.9
17-Nov	20-Nov	11:10	10:33	256980	2739.3	2285.2	2890.0	2879.2	464.9
20-Nov	25-Nov	11:14	10:25	429060	2285.2	2278.4	2879.2	2251.4	634.6
25-Nov	4-Dec	11:11	10:16	774300	2278.4	2053.9	2251.4	1802.3	673.6
4-Dec	18-Dec	11:16	13:49	1218780	2053.9	1753.4	1802.3	1724.4	378.4
18-Dec	23-Dec	14:20	10:37	418620	3169.6	3092.3	3106.1	2797.8	385.6
23-Dec	31-Dec	11:09	10:50	690060	3092.3	2664.8	2797.8	2605.8	619.5
31-Dec	8-Jan	11:24	13:29	698700	2664.8	2758	2605.8	1807.7	704.9

SEALED DOUBLE-RINGED INFILTROMETER DATA, DCF TEST

DATA SHEET FOR WATER DEPTH AND TEMPERATURE
INFILTROMETER H-1 (W-S)

DATE	START WAT. DEPTH READING (In)	START WATER DEPTH (In.)	END WAT. DEPTH READING (In.)	END WATER DEPTH (In)	AVG. WATER DEPTH (In)	START WATER TEMP (oF)	END WATER TEMP (oF)	AVG. WATER TEMP oF	TEMP. CHANGE (oF)
4-Sep	3.00	6.75	3.00	6.75	6.75	82	81	82	-1
5-Sep	3.00	6.75	3.00	6.75	6.75	81	79	80	-2
10-Sep	3.00	6.75	4	7.75	7.25	79	78	79	-1
14-Sep	3.75	7.50	4.00	7.75	7.63	78	75	77	-3
15-Sep	4.00	7.75	4.00	7.75	7.75	75	73	74	-2
16-Sep	4.00	7.75	3.75	7.50	7.63	73	74	74	1
17-Sep	3.75	7.50	3.75	7.50	7.50	74	75	75	1
18-Sep	3.75	7.50	3.75	7.50	7.50	75	76	76	1
19-Sep	3.75	7.50	3.75	7.50	7.50	76	76	76	0
21-Sep	3.75	7.50	3.75	7.50	7.50	76	77	77	1
22-Sep	3.75	7.50	3.75	7.50	7.50	77	78	78	1
23-Sep	3.75	7.50	3.75	7.50	7.50	78	77	78	-1
24-Sep	3.75	7.50	4.00	7.75	7.63	77	71	74	-6
25-Sep	4.00	7.75	4.25	8.00	7.88	71	68	70	-3
26-Sep	4.25	8.00	4.00	7.75	7.88	68	67	68	-1
29-Sep	4.00	7.75	4.00	7.75	7.75	67	71	69	4
30-Sep	4.00	7.75	4.00	7.75	7.75	71	67	69	-4
1-Oct	4.00	7.75	4.00	7.75	7.75	67	66	67	-1
2-Oct	4.00	7.75	4.00	7.75	7.75	66	64	65	-2
6-Oct	4.00	7.75	5.00	8.75	8.25	64	63	64	-1
9-Oct	5.00	8.75	5.00	8.75	8.75	63	67	65	4
13-Oct	5.00	8.75	3.50	7.25	8.00	67	63	65	-4
16-Oct	3.50	7.25	3.25	7.00	7.13	63	65	64	2
20-Oct	3.25	7.00	3.25	7.00	7.00	65	58	62	-7
23-Oct	3.25	7.00	3.00	6.75	6.88	58	61	60	3
27-Oct	3.00	6.75	3.00	6.75	6.75	61	60	61	-1
30-Oct	3.00	6.75	3.00	6.75	6.75	60	65	63	5
3-Nov	3.00	6.75	3.75	7.50	7.13	65	64	65	-1
6-Nov	3.75	7.50	3.50	7.25	7.38	64	63	64	-1
10-Nov	3.50	7.25	3.25	7.00	7.13	63	54	59	-9
13-Nov	3.25	7.00	3.5	7.25	7.13	54	60	57	6
17-Nov	3.50	7.25	3.5	7.25	7.25	60	50	55	-10
20-Nov	3.50	7.25	3.25	7.00	7.13	50	55	53	5
25-Nov	3.25	7.00	3.5	7.25	7.13	55	60	58	5
4-Dec	3.50	7.25	3.25	7.00	7.13	60	49	55	-11
18-Dec	3.25	7.00	3.5	7.25	7.13	49	49	49	0
23-Dec	3.50	7.25	3.25	7.00	7.13	49	49	49	0
31-Dec	3.25	7.00	3.5	7.25	7.13	49	49	49	0
8-Jan	3.50	7.25	4	7.75	7.50	49	58	54	9

SEALED DOUBLE-RINGED INFILTROMETER DATA, DCF TEST

DATA SHEET FOR TENSIOMETER READINGS
INFILTROMETER H-1 (W-S)

DATE	DAY	GROUP NUMBER 1			GROUP NUMBER 2			GROUP NUMBER 3			AVERAGE TENSIOMETER READINGS		
		6 INCH (cb)	12 INCH (cb)	18 INCH (cb)	6 INCH (cb)	12 INCH (cb)	18 INCH (cb)	6 INCH (cb)	12 INCH (cb)	18 INCH (cb)	6 INCH (cb)	12 INCH (cb)	18 INCH (cb)
4-Sep	1	42	40	32	32	31	26	40	46	38	38	39	32
5-Sep	2	30	34	32	22	28	28	26	42	38	26	35	33
10-Sep	7	6	16	22	0	10	18	6	20	28	4	15	23
14-Sep	11	0	12	18	0	2	14	2	16	20	1	10	17
15-Sep	12	0	12	18	0	0	13	0	14	22	0	9	18
16-Sep	13	0	12	18	0	0	13	0	13	22	0	8	18
17-Sep	14	0	10	17	0	0	13	2	13	20	1	8	17
18-Sep	15	0	10	16	0	0	12	0	12	18	0	7	15
19-Sep	16	0	10	16	0	0	12	0	12	18	0	7	15
21-Sep	18	0	18	15	0	0	10	0	10	16	0	9	14
22-Sep	19	0	9	15	0	0	10	0	10	16	0	6	14
23-Sep	20	0	8	14	0	0	10	0	10	16	0	6	13
24-Sep	21	0	8	12	0	0	4	0	8	16	0	5	11
25-Sep	22	0	8	14	0	0	8	0	10	18	0	6	13
26-Sep	23	0	8	15	0	0	10	0	10	18	0	6	14
29-Sep	26	0	7	14	0	0	10	0	8	15	0	5	13
30-Sep	27	0	8	12	0	0	10	0	10	14	0	6	12
1-Oct	28	0	7	14	0	0	8	0	9	16	0	5	13
2-Oct	29	0	8	14	0	0	10	0	9	16	0	6	13
6-Oct	33	0	4	12	0	0	8	0	7	14	0	4	11
9-Oct	36	0	6	13	0	0	9	0	9	16	0	5	13
13-Oct	40	0	4	10	0	0	4	0	4	14	0	3	9
16-Oct	43	0	2	11	0	0	5	0	4	13	0	2	10
20-Oct	47	0	2	12	0	0	4	0	4	14	0	2	10
23-Oct	50	0	3	12	0	0	10	0	4	15	0	2	12
27-Oct	54	0	2	11	0	0	8	0	3	12	0	2	10
30-Oct	57	0	4	12	0	0	9	0	4	12	0	3	11
3-Nov	61	0	2	10	0	0	8	0	2	10	0	1	9
6-Nov	64	0	0	8	0	0	6	0	2	10	0	1	8
10-Nov	68	0	2	11	0	0	8	0	6	14	0	3	11
13-Nov	71	0	0	10	0	0	9	0	2	12	0	1	10
17-Nov	75	0	2	10	0	0	8	0	2	14	0	1	11
20-Nov	78	0	0	10	0	0	10	0	3	12	0	1	11
25-Nov	83	0	0	8	0	0	6	0	0	9	0	0	8
4-Dec	92	0	2	10	0	0	8	0	4	12	0	2	10
18-Dec	106	0	0	8	0	0	8	0	2	12	0	1	9
23-Dec	111	0	0	8	0	0	8	0	0	10	0	0	9
31-Dec	119	0	0	8	0	0	8	0	0	10	0	0	9
8-Jan	127	0	0	8	0	0	6	0	0	8	0	0	7

SEALED DOUBLE-RINGED INFILTROMETER DATA, DCF TEST

DATA SHEET FOR SWELL DATA INFILTROMETER H-1 (W-S) | CALCULATION SHEET FOR FLOW-RATE AND ADJUSTMENT VALUES INFILTROMETER H-1 (W-S)

READING DATE	READING TIME	DAY NUMBER	SWELL INFORMATION S1	S2	S3	S4	(mm) AVG. SWELL	DAY NO.	Q (ml)	AVG DAY NO.	I (cm/sec)	EST. FLOW DUE TO TEMP. CHG. (ml)	% OF TOTAL FLOW (ml)	Q WHEN BAG WAS OFF (ml)
4-Sep	15:15	1	55.5	72.2	35.9	21.8	-0.48	1	-	1	-	-	-	-
5-Sep	8:55	2	56.3	66.9	32.2	15.3	-4.15	2	-	2	-	-	-	-
10-Sep	12:30	7	70.5	81.3	38.3	23.2	6.50	7	1254.7	3	9.22E-08	-16.7	1.3	8
14-Sep	16:15	11	98.0	30.4	45.5	106.5	23.28	11	2220.7	9	2.70E-07	-50.0	2.3	15
15-Sep	16:30	12	97.0	29.8	44.8	102.5	21.70	12	-	11	-	-	-	-
16-Sep	15:06	13	96.7	29.7	45.0	105.0	22.28	13	916.5	12	2.37E-07	16.7	1.8	32
17-Sep	14:32	14	96.2	34.6	49.8	104.3	24.40	14	435.7	13	2.34E-07	16.7	3.8	13
18-Sep	14:07	15	101.2	32.0	46.6	108.4	25.23	15	-	14	-	16.7	-	-
19-Sep	11:07	16	96.1	29.3	45.6	104.1	21.95	16	757.6	15	2.07E-07	0.0	0.0	20
21-Sep	12:10	18	85.5	27.0	42.9	96.4	16.13	18	830.7	17	2.06E-07	16.7	2.0	29
22-Sep	14:54	19	84.6	26.5	42.7	93.8	15.08	19	369.6	18	1.84E-07	16.7	4.5	5
23-Sep	10:03	20	76.7	24.6	39.7	86.8	10.13	20	379.9	19	2.14E-07	-16.7	4.4	23
24-Sep	11:24	21	90.7	26.2	42.6	100.0	18.05	21	1326.6	20	6.88E-07	-100.0	7.5	34
25-Sep	14:25	22	101.4	30.3	45.2	110.0	24.90	22	304.6	21	1.42E-07	-50.0	16.4	10
26-Sep	10:35	23	104.1	31.0	46.2	112.4	26.60	23	285.4	22	1.65E-07	-16.7	5.8	6
29-Sep	13:23	26	116.0	35.9	51.6	123.5	34.93	26	982.7	24	1.58E-07	66.7	6.8	15
30-Sep	11:29	27	111.2	31.8	48.0	117.4	30.28	27	568.7	26	2.83E-07	-66.7	11.7	8
1-Oct	14:30	28	110.3	31.2	47.4	117.0	29.65	28	310.5	27	1.67E-07	-16.7	5.4	6
2-Oct	13:03	29	108.6	31.1	46.6	115.6	28.65	29	258.8	28	1.31E-07	-33.3	12.9	6
6-Oct	9:55	33	122.0	36.8	53.8	25.4	12.68	33	782.3	31	1.03E-07	-16.7	2.1	6
9-Oct	12:14	36	133.6	57.8	72.7	137.5	53.58	36	779.6	34	1.24E-07	66.7	8.6	3
13-Oct	10:59	40	136.5	61.0	74.2	136.7	55.28	40	371.8	38	4.77E-08	-66.7	17.9	3
16-Oct	8:21	43	66.2	32.1	50.3	78.5	9.95	43	554.6	41	9.34E-08	33.3	6.0	3
20-Oct	11:06	47	67.6	32.0	50.8	79.8	10.73	47	384.4	45	4.79E-08	-116.7	30.4	3
23-Oct	13:37	50	67.7	30.8	48.9	80.0	10.03	50	536.1	48	8.71E-08	50.0	9.3	5
27-Oct	10:05	54	64.4	28.9	46.8	77.4	7.55	54	416.1	52	5.46E-08	-16.7	4.0	7
30-Oct	11:26	57	62.6	27.1	44.9	75.3	5.65	57	399.0	55	6.38E-08	83.3	20.9	3
3-Nov	8:32	61	61.6	25.7	43.8	74.5	4.58	61	440.8	59	5.78E-08	-16.7	3.8	2
6-Nov	10:46	64	66.1	29.0	45.9	78.8	8.13	64	279.5	62	4.53E-08	-16.7	6.0	1
10-Nov	10:25	68	65.6	29.3	46.4	79.8	8.45	68	-98.6	66	-1.24E-08	-150.0	152.1	7
13-Nov	9:51	71	78.5	34.6	53.1	88.9	16.95	71	1076.0	69	1.83E-07	100.0	9.3	5
17-Nov	10:39	75	-	-	-	-	-	75	332.9	73	4.16E-08	-166.7	50.1	3
20-Nov	10:15	78	76.1	34.5	51.6	86.4	15.33	78	464.9	76	7.79E-08	83.3	17.9	4
25-Nov	10:03	83	97.4	48.2	68.4	105.1	32.95	83	634.6	80	6.37E-08	83.3	13.1	3
4-Dec	10:03	92	87.4	42	61.2	94.7	24.50	92	673.6	87	3.75E-08	-183.3	27.2	2
18-Dec	10:03	106	87.4	42	61.2	94.7	24.50	106	378.4	99	1.34E-08	0.0	0.0	1
23-Dec	10:03	111	87.4	42	61.2	94.7	24.50	111	385.6	108	3.97E-08	0.0	0.0	2
31-Dec	10:03	119	87.4	42	61.2	94.7	24.50	119	619.5	115	3.87E-08	0.0	0.0	2
8-Jan	10:03	127	87.4	42	61.2	94.7	24.50	127	704.9	123	4.34E-08	150.0	21.3	

SEALED DOUBLE-RINGED INFILTROMETER DATA, DCF TEST

CALCULATION SHEET FOR HYDRAULIC CONDUCTIVITY
INFILTROMETER D-1 (W-S)

DAY NO.	x10-7 I (cm/sec)	WATER DEPTH (in)	W. FRONT DEPTH (in)	GRADIENT	DAY NO.	X10-7 HYDRAULIC CON. (cm/sec)	x10-7 SWELL I (cm/sec)	X10-7 HYDRAULIC CON.-SWELL (cm/sec)
1	-	6.75	-	-	1	-	-	-
2	-	6.75	-	-	2	-	-	-
3	0.9	7.25	3.39	3.14	7	0.3	0.92	0.29
9	2.7	7.63	2.80	3.73	11	0.7	2.70	0.72
11	-	7.75	-	-	12	-	-	-
12	2.4	7.63	3.76	3.03	13	0.8	2.37	0.78
13	2.3	7.50	4.23	2.77	14	0.8	2.34	0.84
14	-	7.50	-	-	15	-	-	-
15	2.1	7.50	4.67	2.60	16	0.8	2.07	0.79
17	2.1	7.50	5.29	2.42	18	0.9	2.06	0.85
18	1.8	7.50	5.79	2.29	19	0.8	1.84	0.80
19	2.1	7.50	3.31	3.27	20	0.7	2.14	0.65
20	6.9	7.63	3.47	3.20	21	2.2	6.88	2.15
21	1.4	7.88	3.65	3.16	22	0.5	1.42	0.45
22	1.7	7.88	3.82	3.06	23	0.5	1.65	0.54
24	1.6	7.75	4.17	2.86	26	0.6	1.58	0.55
26	2.8	7.75	4.52	2.71	27	1.0	2.83	1.04
27	1.7	7.75	4.69	2.65	28	0.6	1.67	0.63
28	1.3	7.75	4.86	2.59	29	0.5	1.31	0.51
31	1.0	8.25	5.27	2.56	33	0.4	1.03	0.40
34	1.2	8.75	5.87	2.49	36	0.5	1.24	0.50
38	0.5	8.00	6.48	2.24	40	0.2	0.48	0.21
41	0.9	7.13	7.07	2.01	43	0.5	0.93	0.46
45	0.5	7.00	7.67	1.91	47	0.3	0.48	0.25
48	0.9	6.88	8.28	1.83	50	0.5	0.87	0.48
52	0.5	6.75	8.87	1.76	54	0.3	0.55	0.31
55	0.6	6.75	9.47	1.71	57	0.4	0.64	0.37
59	0.6	7.13	10.07	1.71	61	0.3	0.58	0.34
62	0.5	7.38	10.66	1.69	64	0.3	0.45	0.27
66	-0.1	7.13	11.27	1.63	68	-0.1	-0.12	-0.08
69	1.8	7.13	11.87	1.60	71	1.1	1.83	1.14
73	0.4	7.25	12.47	1.58	75	0.3	0.42	0.26
76	0.8	7.13	13.07	1.55	78	0.5	0.78	0.50
80	0.6	7.13	13.75	1.52	83	0.4	0.64	0.42
87	0.4	7.13	14.95	1.48	92	0.3	0.37	0.25
99	0.1	7.13	16.94	1.42	106	0.1	0.13	0.09
108	0.4	7.13	18.56	1.38	111	0.3	0.40	0.29
115	0.4	7.13	19.67	1.36	119	0.3	0.39	0.28
123	0.4	7.50	21.05	1.36	127	0.3	0.43	0.32

SEALED DOUBLE-RINGED INFILTROMETER DATA, DCF TEST

DATF PROJECT INFORMATION DATA SHEET			INFILTROMETER B-4 (E-N)		
PROJECT:	Dynamic Compaction Test,		NUMBER OF TENSIOMETERS USED:	9	
LOCATION:	E and 4 road		NOMINAL DEPTHS (IN.):	6	12	18
CLIENT:	WSRC		NUMBER AT EACH DEPTH:	3	
ENGINEER:	Scott R. McMullin		ACTUAL TIP DEPTH (IN.):	7	13	19
			DATE AND TIME INSTALLED :	9/11/92	14:30
ITEM TESTED:	Kaolin Test cap		AVERAGE DEPTH (IN.):	12	
REQUIRED K (CM/SEC):	1x10-7				
TEST AREA THICKNESS (FT.):	3		INITIAL TENSIOMETER READINGS		
NUMBER OF LIFTS:	6		DATE:	9/11/92	
LOOSE LIFT THICKNESS (IN.):	8		GROUP 1:		
BOTTOM BOUNDARY:	sandy clay		6 inch	0	
COMPACTION EQUIPMENT TYPE:	Cat 815B		12 inch	24	
			18 inch	26	
LIQUID LIMIT (%)	64		GROUP 2:		
PLASTIVC LIMIT (%):	32		6 inch	10	
PLASTICITY INDEX (%):	32		12 inch	23	
PERCENT FINES:	2		18 inch	30	
PERCENT BENTONITE ADDED:	0		GROUP 3:		
MAXIMUM DRY DENSITY (PCF)			6 inch	0	
OPTIMUM MOISTURE (%):			12 inch	8	
AVERAGE DRY UNIT WEIGHT (PCF):			18 inch	21	
AVERAGE COMPACTION Wm(%):					
			INITIAL SWELL GAGE READINGS (MM):		
AREA OF OUTER RING (CM2):	126451		1	64.5	
AREA OF INNER RING (CM2):	23226		2	52.5	
DATE OF RING INSTALLATION:	9/10/92		3	54.4	
DATE AND TIME RINGS FILLED :	9/11/92	14:30	4	80.7	
			INITIAL AVERAGE WATER DEPTH (IN.):	12.3	
			INITIAL WATER DEPTH READING (IN.):	9	
			TOTAL FLOW, Q, (ml):	330	
			TOTL FLOW DUE TO SWELL, Qs, (ml):	125415	

SEALED DOUBLE-RINGED INFILTROMETER DATA, DCF TEST

DATA SHEET FOR WATER BAGS
INFILTROMETER B-4 (E-N)

BAG CONNECTION AND DISCONNECTION					BAG 1		BAG 2		
DATE ON	DATE OFF	TIME ON	TIME OFF	t INTERVAL TIME	INITIAL WEIGHT (g)	FINAL WEIGHT (g)	INITIAL WEIGHT (g)	FINAL WEIGHT (g)	NET CHANGE (g)
11-Sep	14-Sep	14:30	15:11	261660	3871.0	3339.4	3658.0	3329.4	860.2
14-Sep	15-Sep	15:37	-	-	3329.4	-	3329.4	-	-
-	16-Sep	-	15:15	171480	-	1269.9	-	3210.3	2178.6
16-Sep	17-Sep	15:44	14:01	80220	3303.7	3307.7	3210.3	3202.0	4.3
17-Sep	-	14:47	-	-	3307.7	-	3202.0	-	-
-	19-Sep	-	10:34	157620	-	2634.8	-	2976.3	898.6
19-Sep	21-Sep	11:36	12:00	174240	2634.8	2549.7	2976.3	2390.0	671.4
21-Sep	22-Sep	13:46	13:47	86460	2549.7	2441.1	2390.0	2175.3	323.3
22-Sep	23-Sep	14:15	11:32	76620	2441.1	2256.8	2175.3	2073.5	286.1
23-Sep	24-Sep	12:06	11:10	83040	2256.8	2150.7	2073.5	1788.4	391.2
24-Sep	25-Sep	12:10	13:42	91920	2150.7	2162.3	3221.0	2905.7	303.7
25-Sep	26-Sep	14:31	11:07	74160	2162.3	2131.0	2905.7	2635.2	301.8
26-Sep	29-Sep	11:32	13:58	267960	2131.0	1782.7	2635.2	1958.6	1024.9
29-Sep	30-Sep	14:47	14:51	86640	2497.0	1920.8	2719.7	2776.7	519.2
30-Sep	1-Oct	15:18	13:36	80280	1920.8	1809.1	2776.7	2639.3	249.1
1-Oct	2-Oct	14:10	13:40	84600	1809.1	1718.7	2639.3	2493.4	236.3
2-Oct	6-Oct	14:20	8:51	325860	3210.5	2482.0	2493.4	2418.5	803.4
6-Oct	9-Oct	9:27	12:57	271800	2418.5	1852.3	2418.5	2372.5	612.2
9-Oct	13-Oct	13:22	10:33	335460	2566.1	2404.5	2372.5	2109.0	425.1
13-Oct	16-Oct	11:10	10:10	255600	2404.5	1948.2	2109.0	2109.0	456.3
16-Oct	20-Oct	10:45	10:40	345300	1948.2	1775.7	2109	1819.9	461.6
20-Oct	23-Oct	11:19	12:54	264900	2821.5	2748.3	2768.5	2353.9	487.8
23-Oct	27-Oct	13:43	8:55	328320	2748.3	2975.6	2353.9	1812.3	314.3
27-Oct	30-Oct	10:31	13:05	268440	2975.6	2776.3	2856.3	2969.2	86.4
30-Oct	3-Nov	13:45	9:05	328800	2776.3	2504.7	2969.2	2549.1	691.7
3-Nov	6-Nov	9:30	11:17	265620	2504.7	2919.0	2549.1	1822.4	312.4
6-Nov	10-Nov	12:15	11:10	341700	2919.0	2630.9	2829.6	2052.2	1065.5
10-Nov	17-Nov	12:08	10:38	599400	2630.9	2339.7	3103.0	2844.1	550.1
17-Nov	20-Nov	11:13	10:38	257100	2339.7	2216.7	2844.1	2594.0	373.1
20-Nov	25-Nov	11:22	10:32	429000	2216.7	2175.6	2594.0	1860.1	775.0
25-Nov	4-Dec	11:18	10:22	774240	2175.6	1793.3	2830.0	2401.0	811.3
4-Dec	18-Dec	11:15	13:53	1219080	3319.9	957.8	2401.0	1964.5	2798.6
18-Dec	23-Dec	14:24	10:40	418560	2965.1	1877.5	2826.0	1971.3	1942.3
23-Dec	31-Dec	11:13	10:50	689820	3101.0	2583.2	2995.3	2788.3	724.8
31-Dec	8-Jan	11:24	13:25	698460	2583.2	1838.7	2788.3	2831.9	700.9

DATA SHEET FOR WATER DEPTH AND TEMPERATURE
INFILTROMETER B-4 (E-N)

DATE	START WAT. DEPTH READING (in)	START WATER DEPTH (in.)	END WAT. DEPTH READING (in.)	END WATER DEPTH (in)	AVG. WATER DEPTH (in)	START WATER TEMP (oF)	END WATER TEMP (oF)	AVG. WATER TEMP oF	TEMP. CHANGE (oF)
14-Sep	9.00	12.25	9.00	12.25	12.25	82	81	82	-1
15-Sep	9.00	12.25	9.00	12.25	12.25	81	74	78	-7
16-Sep	9.00	12.25	8.75	12.00	12.13	74	74	74	0
17-Sep	8.75	12.00	8.75	12.00	12.00	74	75	75	1
18-Sep	8.75	12.00	8.75	12.00	12.00	75	76	76	1
19-Sep	8.75	12.00	8.75	12.00	12.00	76	75	76	-1
21-Sep	8.75	12.00	8.75	12.00	12.00	75	77	76	2
22-Sep	8.75	12.00	8.75	12.00	12.00	77	77	77	0
23-Sep	8.75	12.00	8.75	12.00	12.00	77	77	77	0
24-Sep	8.75	12.00	9.00	12.25	12.13	77	66	72	-11
25-Sep	9.00	12.25	9.00	12.25	12.25	66	63	65	-3
26-Sep	9.00	12.25	9.00	12.25	12.25	63	64	64	1
29-Sep	9.00	12.25	9.00	12.25	12.25	64	71	68	7
30-Sep	9.00	12.25	9.00	12.25	12.25	71	65	68	-6
1-Oct	9.00	12.25	8.75	12.00	12.13	65	63	64	-2
2-Oct	8.75	12.00	8.75	12.00	12.00	63	62	63	-1
6-Oct	8.75	12.00	9.50	12.75	12.38	62	59	61	-3
9-Oct	9.50	12.75	11.75	15.00	13.88	59	67	63	8
13-Oct	11.75	15.00	9.25	12.50	13.75	67	60	64	-7
16-Oct	9.25	12.50	9.25	12.50	12.50	60	64	62	4
20-Oct	9.25	12.50	9.00	12.25	12.38	64	54	59	-10
23-Oct	9.00	12.25	9.00	12.25	12.25	54	58	56	4
27-Oct	9.00	12.25	8.75	12.00	12.13	58	59	59	1
30-Oct	8.75	8.75	8.75	12.00	10.38	59	64	62	5
3-Nov	8.75	8.75	8.75	12.00	10.38	64	65	65	1
6-Nov	8.75	9.25	8.75	12.00	10.63	65	59	62	-6
10-Nov	8.75	9.25	8.75	12.00	10.63	59	50	55	-9
17-Nov	8.75	9.50	8.75	12.00	10.75	50	58	54	8
20-Nov	8.75	9.25	8.75	12.00	10.63	58	48	53	-10
25-Nov	8.75	9.00	8.75	12.00	10.50	48	52	50	4
4-Dec	8.75	9.00	9.25	12.50	10.75	52	60	56	8
18-Dec	9.25	9.00	9.25	12.50	10.75	60	46	53	-14
23-Dec	9.25	9.00	9.25	12.50	10.75	46	46	46	0
31-Dec	9.25	9.00	9.25	12.50	10.75	46	46	46	0
8-Jan	9.25	9.00	10.00	13.25	11.13	46	58	52	12

SEALED DOUBLE-RINGED INFILTROMETER DATA, DCF TEST

DATA SHEET FOR TENSIOMETER READINGS
INFILTROMETER B-4 (E-N)

DATE	DAY	GROUP NUMBER 1			GROUP NUMBER 2			GROUP NUMBER 3			AVERAGE TENSIOMETER READINGS		
		6 INCH (cb)	12 INCH (cb)	18 INCH (cb)	6 INCH (cb)	12 INCH (cb)	18 INCH (cb)	6 INCH (cb)	12 INCH (cb)	18 INCH (cb)	6 INCH (cb)	12 INCH (cb)	18 INCH (cb)
14-Sep	3	0	24	26	10	23	30	0	8	21	3	18	26
15-Sep	4	0	26	28	8	23	31	0	28	30	3	26	30
16-Sep	5	6	22	27	2	22	31	6	26	28	5	23	29
17-Sep	6	0	20	25	0	18	26	0	22	25	0	20	25
18-Sep	15	0	18	24	0	17	27	0	20	24	0	18	25
19-Sep	8	0	12	18	0	0	13	0	13	22	0	8	18
21-Sep	10	0	12	20	0	14	23	0	16	21	0	14	21
22-Sep	11	0	12	22	0	14	22	0	0	20	0	9	21
23-Sep	12	0	8	18	0	12	22	0	0	20	0	7	20
24-Sep	13	0	0	18	0	12	22	0	0	18	0	4	19
25-Sep	14	0	1	22	0	12	22	0	0	18	0	4	21
26-Sep	15	0	2	22	0	12	26	0	8	17	0	7	22
29-Sep	18	0	2	16	0	8	20	0	8	18	0	6	18
30-Sep	19	0	0	16	0	4	18	0	7	14	0	4	16
1-Oct	20	0	0	17	0	4	18	0	3	13	0	2	16
2-Oct	21	0	0	18	0	0	20	0	4	13	0	1	17
6-Oct	25	0	0	16	0	0	14	0	0	8	0	0	13
9-Oct	28	0	2	16	0	0	10	0	0	8	0	1	11
13-Oct	32	0	0	14	0	0	10	0	0	4	0	0	9
16-Oct	35	0	0	12	0	0	0	0	0	0	0	0	4
20-Oct	39	0	0	12	0	0	0	0	0	0	0	0	4
23-Oct	42	0	0	8	0	0	0	0	0	0	0	0	3
27-Oct	46	0	0	9	0	0	0	0	0	0	0	0	3
30-Oct	49	0	0	6	0	0	1	0	0	0	0	0	2
3-Nov	53	0	0	6	0	0	0	0	0	0	0	0	2
6-Nov	56	0	0	0	0	0	0	0	0	0	0	0	0
10-Nov	60	0	2	0	0	0	0	0	0	0	0	1	0
17-Nov	67	0	0	0	0	0	0	0	0	0	0	0	0
20-Nov	70	0	0	0	0	0	0	0	0	0	0	0	0
25-Nov	75	0	0	0	0	0	0	0	0	0	0	0	0
4-Dec	84	0	0	0	0	0	0	0	0	0	0	0	0
18-Dec	98	0	0	0	0	0	0	0	0	0	0	0	0
23-Dec	103	0	0	0	0	0	0	0	0	0	0	0	0
31-Dec	111	0	0	0	0	0	0	0	0	0	0	0	0
8-Jan	119	0	0	0	0	0	0	0	0	0	0	0	0

SEALED DOUBLE-RINGED INFILTROMETER DATA, DCF TEST

DATA SHEET FOR SWELL DATA INFILTROMETER B-4 (E-N) | CALCULATION SHEET FOR FLOW-RATE AND ADJUSTMENT VALUES INFILTROMETER B-4 (E-N)

READING DATE	READING TIME	DAY NUMBER	SWELL INFORMATION S1	S2	S3	S4	(mm) AVG. SWELL	DAY NO.	Q (ml)	AVG DAY NO.	I (cm/sec)	EST. FLOW DUE TO TEMP. CHG. (ml)	% OF TOTAL FLOW (ml)	Q WHEN BAG WAS OFF (ml)
14-Sep	15:15	3	64.5	52.5	54.4	80.7	0.00	3	860.2	2	1.42E-07	-16.7	1.9	-2092
15-Sep	8:55	4	59.6	49.7	52.1	75.3	-3.85	4	-	-	-	-	-	-
16-Sep	12:30	5	59.8	49.6	52.8	75.5	-3.60	5	2178.6	4	5.47E-07	0.0	0.0	11
17-Sep	15:00	6	60.3	49.4	52.8	76.1	-3.38	6	4.3	6	2.31E-09	16.7	387.6	
-	17:00	-	60.0	49.8	52.5	75.6	-3.55		-	-	-	16.7	-	
19-Sep	11:32	8	60.5	49.9	52.4	76.4	-3.23	8	898.6	9	2.45E-07	-16.7	1.9	18
21-Sep	13:35	10	60.4	49.0	51.1	76.5	-3.78	10	671.4	9	1.66E-07	33.3	5.0	24
22-Sep	15:33	11	60.8	50.0	51.9	77.0	-3.10	11	323.3	10	1.61E-07	0.0	0.0	6
23-Sep	11:13	12	60.7	49.5	51.5	76.8	-3.40	12	286.1	11	1.61E-07	0.0	0.0	9
24-Sep	11:55	13	60.6	50.0	52.4	77.1	-3.00	13	391.2	12	2.03E-07	-183.3	46.9	14
25-Sep	15:01	14	62.2	51.5	54.8	77.7	-1.48	14	303.7	13	1.42E-07	-50.0	16.5	11
26-Sep	11:00	15	62.2	52.0	55.0	77.5	-1.35	15	301.8	14	1.75E-07	16.7	5.5	6
29-Sep	13:52	18	64.5	55.2	58.2	81.3	1.78	18	1024.9	16	1.65E-07	116.7	11.4	14
30-Sep	14:28	19	64.8	58.2	60.5	80.6	3.00	19	519.2	19	2.58E-07	-100.0	19.3	7
1-Oct	15:24	20	64.6	57.5	61.2	81.1	3.08	20	249.1	19	1.34E-07	-33.3	13.4	6
2-Oct	13:30	21	63.8	56.8	59.6	79.9	2.00	21	236.3	20	1.20E-07	-16.7	7.1	6
6-Oct	10:22	25	67.8	56.0	59.7	81.9	3.33	25	803.4	23	1.06E-07	-50.0	6.2	5
9-Oct	12:31	28	77.3	65.3	70.0	93.9	13.60	28	612.2	26	9.70E-08	133.3	21.8	3
13-Oct	10:24	32	80.7	66.5	71.0	97.0	15.78	32	425.1	30	5.46E-08	-116.7	27.4	3
16-Oct	8:42	35	71.2	62.8	64.5	87.9	8.58	35	456.3	33	7.69E-08	66.7	14.6	3
20-Oct	11:27	39	72.9	63.5	65.3	89.2	9.70	39	461.6	37	5.76E-08	-166.7	36.1	4
23-Oct	13:57	42	74.0	89.6	65.8	64.5	10.45	42	487.8	40	7.93E-08	66.7	13.7	4
27-Oct	10:32	46	73.3	63.8	64.9	91.0	10.23	46	314.3	44	4.12E-08	16.7	5.3	4
30-Oct	11:40	49	77.4	61.0	61.9	93.4	10.40	49	86.4	47	1.39E-08	83.3	96.5	3
3-Nov	8:47	53	71.5	57.8	60.7	87.4	6.33	53	691.7	51	9.06E-08	16.7	2.4	2
6-Nov	11:07	56	67.1	58.4	61.6	86.5	5.38	56	312.4	54	5.06E-08	-100.0	32.0	7
10-Nov	10:55	60	73.3	60.1	62.1	89.4	8.20	60	1065.5	58	1.34E-07	-150.0	14.1	7
17-Nov	10:11	67	65.9	61	55.4	83.9	3.53	67	550.1	63	3.95E-08	133.3	24.2	2
20-Nov	11:14	70	77.3	63.5	60	90.6	9.83	70	373.1	68	6.25E-08	-166.7	44.7	4
25-Nov	10:17	75	80.2	70.5	69.8	93.9	15.58	75	775.0	72	7.78E-08	66.7	8.6	4
4-Dec	10:10	84	73.3	71.8	73.1	88.5	13.65	84	811.3	79	4.51E-08	133.3	16.4	5
18-Dec	10:10	98	73.3	71.8	73.1	88.5	13.65	98	2798.6	91	9.88E-08	-233.3	8.3	6
23-Dec	10:10	103	73.3	71.8	73.1	88.5	13.65	103	1942.3	100	2.00E-07	0.0	0.0	6
31-Dec	10:10	111	73.3	71.8	73.1	88.5	13.65	111	724.8	107	4.52E-08	0.0	0.0	2
8-Jan	10:10	119	73.3	71.8	73.1	88.5	13.65	119	700.9	115	4.32E-08	200.0	28.5	#VALUE!

SEALED DOUBLE-RINGED [illegible]LTROMETER DATA, DCF TEST

CALCULATION SHEET FOR HYDRAULIC CONDUCTIVITY
INFILTROMETER D-1 (E-N)

DAY NO.	x10-7 I (cm/sec)	WATER DEPTH (in)	W. FRONT DEPTH (in)	GRADIENT	DAY NO.	X10-7 HYDRAULIC CON. (cm/sec)	x10-7 SWELL I (cm/sec)	X10-7 HYDRAULIC CON.-SWELL (cm/sec)
					1			
3	1.4	12.25	3.64	4.37	3	0.3	1.42	0.32
-	-	12.25			-	-	-	-
5	5.5	12.13	5.90	3.06	5	1.8	5.47	1.79
6	0.0	12.00	2.13	6.65	6	0.0	0.02	0.00
7	1	12.00	2.47		7	-	0.50	-
8	2.5	12.00	2.78	5.32	8	0.5	2.45	0.46
10	1.7	12.00	3.52	4.41	10	0.4	1.66	0.38
11	1.6	12.00	3.90	4.08	11	0.4	1.61	0.39
12	1.6	12.00	4.19	3.87	12	0.4	1.61	0.42
13	2.0	12.13	4.55	3.66	13	0.6	2.03	0.55
14	1.4	12.25	4.95	3.48	14	0.4	1.42	0.41
15	1.8	12.25	5.24	3.34	15	0.5	1.75	0.53
18	1.6	12.25	6.34	2.93	18	0.6	1.65	0.56
19	2.6	12.25	6.71	2.83	19	0.9	2.58	0.91
20	1.3	12.13	7.07	2.71	20	0.5	1.34	0.49
21	1.2	12.00	7.40	2.62	21	0.5	1.20	0.46
25	1.1	12.38	8.76	2.41	25	0.4	1.06	0.44
28	1.0	13.88	9.85	2.41	28	0.4	0.97	0.40
32	0.5	13.75	11.23	2.22	32	0.2	0.55	0.25
35	0.8	12.50	12.27	2.02	35	0.4	0.77	0.38
39	0.6	12.38	13.72	1.90	39	0.3	0.58	0.30
42	0.8	12.25	14.82	1.83	42	0.4	0.79	0.43
46	0.4	12.13	16.18	1.75	46	0.2	0.41	0.24
49	0.1	10.38	17.25	1.60	49	0.1	0.14	0.09
53	0.9	10.38	18.62	1.56	53	0.6	0.91	0.58
56	0.5	10.63	19.71	1.54	56	0.3	0.51	0.33
60	1.3	10.63	21.12	1.50	60	0.9	1.34	0.89
67	0.4	10.75	23.58	1.46	67	0.3	0.40	0.27
70	0.6	10.63	24.66	1.43	70	0.4	0.62	0.44
75	0.8	10.50	26.41	1.40	75	0.6	0.78	0.56
84	0.5	10.75	29.58	1.36	84	0.3	0.45	0.33
98	1.0	10.75	34.52	1.31	98	0.8	0.99	0.75
103	2.0	10.75	36.29	1.30	103	1.5	2.00	1.54
111	0.5	10.75	39.11	1.27	111	0.4	0.45	0.35
119	0.4	11.13	41.94	1.27	119	0.3	0.43	0.34

SEALED DOUBLE-RINGED INFILTROMETER DATA, DCF TEST

DATF PROJECT INFORMATION DATA SHEET			INFILTROMETER F-4 (E-C)			
PROJECT:	Dynamic Compaction Test,		NUMBER OF TENSIOMETERS USED:	9		
LOCATION:	E and 4 road		NOMINAL DEPTHS (IN.):	6	12	18
CLIENT:	WSRC		NUMBER AT EACH DEPTH:	3		
ENGINEER:	Scott R. McMullin		ACTUAL TIP DEPTH (IN.):	7	13	19
			DATE AND TIME INSTALLED :	9/4/92	15:30	
ITEM TESTED:	Kaolin Test cap		AVERAGE DEPTH (IN.):	12		
REQUIRED K (CM/SEC):	1x10-7					
TEST AREA THICKNESS (FT.):	3		INITIAL TENSIOMETER READINGS			
NUMBER OF LIFTS:	6		DATE:	9/4/92		
LOOSE LIFT THICKNESS (IN.):	8		GROUP 1:			
BOTTOM BOUNDARY:	sandy clay		6 inch	38		
COMPACTION EQUIPMENT TYPE:	Cat 815B		12 inch	38		
			18 inch	44		
LIQUID LIMIT (%)	64		GROUP 2:			
PLASTIVC LIMIT (%):	32		6 inch	29		
PLASTICITY INDEX (%):	32		12 inch	38		
PERCENT FINES:	2		18 inch	36		
PERCENT BENTONITE ADDED:	0		GROUP 3:			
MAXIMUM DRY DENSITY (PCF)			6 inch	24		
OPTIMUM MOISTURE (%):			12 inch	28		
AVERAGE DRY UNIT WEIGHT (PCF):			18 inch	26		
AVERAGE COMPACTION Wm(%):						
			INITIAL SWELL GAGE READINGS (MM):			
AREA OF OUTER RING (CM2):	126451		1	73.9		
AREA OF INNER RING (CM2):	23226		2	67.9		
DATE OF RING INSTALLATION:	9/4/92		3	40.8		
DATE AND TIME RINGS FILLED :	9/4/92	15:30	4	59.0		
			INITIAL AVERAGE WATER DEPTH (IN.):	11.5		
			INITIAL WATER DEPTH READING (IN.):	3		
			TOTAL FLOW, Q, (ml):	320		
			TOTL FLOW DUE TO SWELL, Qs, (ml):	125415		

SEALED DOUBLE-RINGED INFILTROMETER DATA, DCF TEST

DATA SHEET FOR WATER BAGS
INFILTROMETER F-4 (E-C)

BAG CONNECTION AND DISCONNECTION				t	BAG 1		BAG 2		
DATE ON	DATE OFF	TIME ON	TIME OFF	INTERVAL TIME	INITIAL WEIGHT (g)	FINAL WEIGHT (g)	INITIAL WEIGHT (g)	FINAL WEIGHT (g)	NET CHANGE (g)
4-Sep	-	14:15	-	-	3411.3	-	3595.4	-	-
-	10-Sep	-	12:15	511200	-	2909.2	-	3206.3	891.2
10-Sep	14-Sep	12:45	15:15	354600	2909.2	1537.1	3206.3	2057.8	2520.6
14-Sep	-	15:38	-	-	3417.1	-	3539.9	-	-
-	16-Sep	-	13:59	166860	-	2618.2	-	3150.2	1188.6
16-Sep	17-Sep	15:36	14:00	80640	2618.2	2182.2	3150.2	3004.5	581.7
17-Sep	-	14:45	-	-	2182.2	-	3004.5	-	-
-	19-Sep	-	10:33	157680	-	1998.9	-	2151.1	1036.7
19-Sep	21-Sep	11:38	11:59	174060	1998.9	1249.0	2151.1	1799.4	1101.6
21-Sep	22-Sep	13:46	13:51	86700	3329.7	2948.2	3404.4	3195.5	590.4
22-Sep	23-Sep	14:13	11:28	76500	2948.2	2852.5	3195.5	2835.8	455.4
23-Sep	24-Sep	11:56	11:08	83520	2852.5	2717.6	2835.8	2717.6	253.1
24-Sep	25-Sep	12:08	13:40	91920	2566.9	2404.1	2566.9	2465.0	264.7
25-Sep	26-Sep	14:30	11:07	74220	2404.1	1832.6	2465.0	2582.0	454.5
26-Sep	29-Sep	11:32	13:57	267900	1832.6	1215.9	2582.0	1678.8	1519.9
29-Sep	30-Sep	14:47	14:52	86700	2500.3	2410.1	2653.4	2372.9	370.7
30-Sep	1-Oct	15:19	13:35	80160	2410.1	2303.3	2372.9	2060.7	419.0
1-Oct	2-Oct	14:08	13:39	84660	2303.3	2129.6	2060.7	1901.4	333.0
2-Oct	6-Oct	14:18	8:50	325920	3231.5	2479.2	3185.4	2684.4	1253.3
6-Oct	9-Oct	9:26	12:55	271740	2479.2	2064.3	2684.4	2007.4	1091.9
9-Oct	13-Oct	13:20	10:32	335520	2064.3	1096.3	2007.4	2287.1	688.3
13-Oct	16-Oct	11:08	10:09	255660	2692.8	2845.9	2287.1	1688.3	445.7
16-Oct	20-Oct	10:43	10:39	345360	2845.9	2383.3	2606.5	2539.5	529.6
20-Oct	23-Oct	11:17	12:53	264960	2383.3	1375.6	2539.5	2264.8	1282.4
23-Oct	27-Oct	13:41	8:50	328140	2682.5	1981.2	2264.8	2379.5	586.6
27-Oct	30-Oct	10:30	13:03	268380	2923.1	2609.6	2379.5	2172.6	520.4
30-Oct	3-Nov	13:43	9:01	328680	2609.6	2419.2	2172.6	1750.6	612.4
3-Nov	6-Nov	9:29	11:16	265620	2419.2	2214.0	1750.6	1556.8	399.0
6-Nov	10-Nov	12:13	11:08	341700	2214.0	1841.2	2890.1	2675.7	587.2
10-Nov	13-Nov	12:06	10:19	252780	2751.8	2207.3	2675.7	2581.4	638.8
13-Nov	17-Nov	10:54	10:37	344580	2207.3	2065.9	2581.4	2591.6	131.2
17-Nov	20-Nov	11:12	10:36	257040	2065.9	1313.3	2591.6	2682.1	662.1
20-Nov	25-Nov	11:19	10:30	429060	2809.4	2233.0	2682.1	2521.3	737.2
25-Nov	4-Dec	11:16	10:20	774240	2233.0	1583.6	2841.3	2736.9	753.8
4-Dec	18-Dec	11:10	13:52	1219320	3229.8	2086.7	2736.7	2107.9	1771.9
18-Dec	23-Dec	14:23	10:39	418560	2086.7	1736.6	2107.9	2179.4	278.6
23-Dec	31-Dec	11:11	10:48	689820	3093.4	2866.2	2927.2	2400.6	753.8
31-Dec	8-Jan	11:22	13:27	698700	2866.2	2345.7	2400.6	2316.4	604.7

SEALED DOUBLE-RINGED INFILTROMETER DATA, DCF TEST

DATA SHEET FOR WATER DEPTH AND TEMPERATURE
INFILTROMETER F-4 (E-C)

DATE	START WAT. DEPTH READING (In)	START WATER DEPTH (In.)	END WAT. DEPTH READING (In.)	END WATER DEPTH (In)	AVG. WATER DEPTH (In)	START WATER TEMP (oF)	END WATER TEMP (oF)	AVG. WATER TEMP oF	TEMP. CHANGE (oF)
5-Sep	3.0	11.5	3.0	11.5	11.5	83	81	82	-2
10-Sep	3.0	11.5	4.4	12.9	12.2	81	77	79	-5
14-Sep	4.4	12.9	4.5	13.0	12.9	77	74	75	-3
15-Sep	4.5	13.0	4.0	12.5	12.8	74	74	74	0
16-Sep	4.0	12.5	4.3	12.8	12.6	74	73	74	-1
17-Sep	4.3	12.8	4.3	12.8	12.8	73	74	74	1
18-Sep	4.3	12.8	4.3	12.8	12.8	74	76	75	2
19-Sep	4.3	12.8	4.3	12.8	12.8	76	75	76	-1
21-Sep	4.3	12.8	4.3	12.8	12.8	75	75	75	0
22-Sep	4.3	12.8	4.3	12.8	12.8	75	76	76	1
23-Sep	4.3	12.8	4.0	12.5	12.6	76	76	76	0
24-Sep	4.0	12.5	4.5	13.0	12.8	76	68	72	-8
25-Sep	4.5	13.0	4.5	13.0	13.0	68	65	67	-3
26-Sep	4.5	13.0	4.5	13.0	13.0	65	65	65	0
29-Sep	4.5	13.0	4.5	13.0	13.0	65	70	68	5
30-Sep	4.5	13.0	4.0	12.5	12.8	70	65	68	-5
1-Oct	4.0	12.5	3.5	12.0	12.3	65	63	64	-2
2-Oct	3.5	12.0	3.5	12.0	12.0	63	61	62	-2
6-Oct	3.5	12.0	4.3	12.8	12.4	61	60	61	-1
9-Oct	3.5	12.0	5.8	14.3	13.1	60	67	64	7
13-Oct	5.8	14.3	3.8	12.3	13.3	67	60	64	-7
16-Oct	3.8	12.3	3.5	12.0	12.1	60	63	62	3
20-Oct	3.5	12.0	3.5	12.0	12.0	63	55	59	-8
23-Oct	3.5	12.0	3.3	11.8	11.9	55	58	57	3
27-Oct	3.3	11.8	3.3	11.8	11.8	58	58	58	0
30-Oct	3.3	11.8	3.2	11.7	11.7	58	66	62	8
3-Nov	3.2	11.7	3.5	12.0	11.9	66	65	66	-1
6-Nov	3.5	12.0	3.8	12.3	12.1	65	60	63	-5
10-Nov	3.8	12.3	3.5	12.0	12.1	60	49	55	-11
13-Nov	3.5	12.0	3.8	12.3	12.1	49	58	54	9
17-Nov	3.8	12.3	3.5	12.0	12.1	58	47	53	-11
20-Nov	3.5	12.0	3.5	12.0	12.0	47	51	49	4
25-Nov	3.5	12.0	4.0	12.5	12.3	51	59	55	8
4-Dec	4.0	12.5	3.3	11.8	12.1	59	46	53	-13
18-Dec	3.3	11.8	3.8	12.3	12.0	46	46	46	0
23-Dec	3.8	12.3	3.5	12.0	12.1	46	46	46	0
31-Dec	3.5	12.0	3.5	12.0	12.0	46	46	46	0
8-Jan	3.5	12.0	4.0	12.5	12.3	46	58	52	12

DATA SHEET FOR TENSIOMETER READINGS
INFILTROMETER F-4 (E-C)

DATE	DAY	GROUP NUMBER 1			GROUP NUMBER 2			GROUP NUMBER 3			AVERAGE TENSIOMETER READINGS		
		6 INCH (cb)	12 INCH (cb)	18 INCH (cb)	6 INCH (cb)	12 INCH (cb)	18 INCH (cb)	6 INCH (cb)	12 INCH (cb)	18 INCH (cb)	6 INCH (cb)	12 INCH (cb)	18 INCH (cb)
5-Sep	1	28	26	24	28	39	32	34	39	32	30	35	29
10-Sep	6	6	16	18	2	17	23	6	18	21	5	17	21
14-Sep	10	0	10	14	0	10	14	0	11	14	0	10	14
15-Sep	11	0	10	14	0	8	16	0	10	14	0	9	15
16-Sep	12	0	9	14	0	8	16	0	8	13	0	8	14
17-Sep	13	0	8	12	0	6	15	0	8	10	0	7	12
18-Sep	14	0	8	12	0	4	14	0	7	8	0	6	11
19-Sep	15	0	5	10	0	2	13	0	4	8	0	4	10
21-Sep	17	0	4	10	0	0	12	0	2	4	0	2	9
22-Sep	18	0	4	11	0	0	13	0	2	4	0	2	9
23-Sep	19	0	4	9	0	0	10	0	1	0	0	2	6
24-Sep	20	0	2	8	0	0	8	0	0	0	0	1	5
25-Sep	21	0	0	10	0	0	10	0	0	0	0	0	7
26-Sep	22	0	0	10	0	0	10	0	0	0	0	0	7
29-Sep	25	0	0	8	0	0	8	0	0	0	0	0	5
30-Sep	26	0	0	8	0	0	8	0	0	0	0	0	5
1-Oct	27	0	0	8	0	0	8	0	0	0	0	0	5
2-Oct	28	0	2	10	0	0	10	0	0	0	0	1	7
6-Oct	32	0	0	7	0	0	4	0	0	0	0	0	4
9-Oct	35	0	2	8	0	0	8	0	0	0	0	1	5
13-Oct	39	0	0	4	0	0	4	0	0	0	0	0	3
16-Oct	42	0	0	3	0	0	2	0	0	0	0	0	2
20-Oct	46	0	0	4	0	0	4	0	1	0	0	0	3
23-Oct	49	0	0	8	0	0	8	0	0	0	0	0	5
27-Oct	53	0	0	4	0	0	4	0	0	0	0	0	3
30-Oct	56	0	2	4	0	0	5	0	0	0	0	1	3
3-Nov	60	0	0	2	0	0	2	0	0	2	0	0	2
6-Nov	63	0	0	2	0	0	2	0	0	0	0	0	1
10-Nov	67	0	0	7	0	0	7	0	0	0	0	0	5
13-Nov	70	0	0	4	0	0	2	0	0	0	0	0	2
17-Nov	74	0	0	4	0	0	3	0	0	0	0	0	2
20-Nov	77	0	0	6	0	0	4	0	0	0	0	0	3
25-Nov	82	0	0	2	0	0	0	0	0	0	0	0	1
4-Dec	91	0	0	6	0	0	6	0	0	0	0	0	4
18-Dec	105	0	0	2	0	0	4	0	0	0	0	0	2
23-Dec	110	0	0	2	0	0	2	0	0	0	0	0	1
31-Dec	118	0	0	0	0	0	0	0	0	0	0	0	0
8-Jan	126	0	0	0	0	0	0	0	0	0	0	0	0

SEALED DOUBLE-RINGED INFILTROMETER DATA, DCF TEST

DATA SHEET FOR SWELL DATA INFILTROMETER F-4 (E-C)								CALCULATION SHEET FOR FLOW-RATE AND ADJUSTMENT VALUES INFILTROMETER F-4 (E-C)						
READING DATE	READING TIME	DAY NUMBER	SWELL INFORMATION S1	S2	S3	S4	(mm) AVG. SWELL	DAY NO.	Q (ml)	AVG DAY NO.	I (cm/sec)	EST. FLOW DUE TO TEMP. CHG. (ml)	% OF TOTAL FLOW (ml)	Q WHEN BAG WAS OFF (ml)
5-Sep	9:10	1	74.0	67.8	40.8	59.0	0.00	1	-	-	-	-33.3	-	-
10-Sep	11:15	6	75.0	78.4	73.9	90.1	18.95	6	891.2	3	7.51E-08	-75.0	8.4	8
14-Sep	12:30	10	59.8	49.6	52.8	75.5	-0.98	10	2520.6	8	3.06E-07	-41.7	1.7	10
15-Sep	16:15	11	89.4	55.6	32.5	73.7	2.40	11	-	-	-	0.0	-	-
16-Sep	16:50	12	88.7	56.2	33.0	74.4	2.68	12	1188.6	11	3.07E-07	-16.7	1.4	42
17-Sep	14:54	13	88.7	56.7	32.8	75.4	3.00	13	581.7	12	3.11E-07	16.7	2.9	10
18-Sep	16:54	14	89.5	61.1	37.3	75.0	5.33	14	-			33.3	-	-
19-Sep	11:21	15	90.1	60.2	36.6	75.6	5.23	15	1036.7	14	2.83E-07	-16.7	1.6	25
21-Sep	12:34	17	90.0	59.9	36.4	74.7	4.85	17	1101.6	16	2.72E-07	0.0	0.0	42
22-Sep	15:20	18	90.8	60.3	36.9	75.2	5.40	18	590.4	17	2.93E-07	16.7	2.8	8
23-Sep	10:56	19	90.2	59.9	36.9	75.0	5.10	19	455.4	18	2.56E-07	0.0	0.0	8
24-Sep	11:45	20	90.5	59.8	37.4	75.5	5.40	20	253.1	19	1.30E-07	-133.3	52.7	11
25-Sep	14:58	21	91.0	61.1	38.4	76.2	6.28	21	264.7	20	1.24E-07	-50.0	18.9	14
26-Sep	10:47	22	92.0	61.4	38.4	76.7	6.73	22	454.5	21	2.64E-07	0.0	0.0	9
29-Sep	13:42	25	92.9	63.4	40.0	77.1	7.95	25	1519.9	23	2.44E-07	83.3	5.5	15
30-Sep	14:00	26	92.7	62.3	39.1	77.4	7.48	26	370.7	25	1.84E-07	-83.3	22.5	8
1-Oct	15:14	27	92.8	62.3	39.2	77.3	7.50	27	419.0	26	2.25E-07	-33.3	8.0	9
2-Oct	13:19	28	92.6	62.1	38.9	77.4	7.35	28	333.0	27	1.69E-07	-33.3	10.0	9
6-Oct	10:13	32	96.1	68.7	44.6	80.6	12.10	32	1253.3	30	1.66E-07	-16.7	1.3	8
9-Oct	12:25	35	96.6	66.6	43.6	82.4	11.90	35	1091.9	33	1.73E-07	116.7	10.7	5
13-Oct	10:15	39	97.8	67.6	43.4	84.2	12.85	39	688.3	37	8.83E-08	-116.7	16.9	4
16-Oct	8:35	42	92.8	63.0	44.7	81.8	10.18	42	445.7	40	7.51E-08	50.0	11.2	3
20-Oct	11:21	46	93.0	62.7	44.5	82.4	10.25	46	529.6	44	6.60E-08	-133.3	25.2	7
23-Oct	13:30	49	93.4	62.8	43.3	81.6	9.88	49	1282.4	47	2.08E-07	50.0	3.9	10
27-Oct	10:25	53	92.6	61.4	42.8	80.5	8.93	53	586.6	51	7.70E-08	0.0	0.0	11
30-Oct	11:36	56	92.7	60.9	41.9	80.3	8.55	56	520.4	54	8.35E-08	133.3	25.6	5
3-Nov	8:42	60	93.5	61.2	42.3	79.9	8.83	60	612.4	58	8.02E-08	-16.7	2.7	3
6-Nov	11:00	63	93.6	63.4	43.2	81.5	10.03	63	399.0	61	6.47E-08	-83.3	20.9	6
10-Nov	10:45	67	93.4	62.3	42.9	81.0	9.50	67	587.2	65	7.40E-08	-183.3	31.2	7
13-Nov	10:04	70	96.5	68.3	50.2	85.3	14.68	70	638.8	68	1.09E-07	150.0	23.5	3
17-Nov	10:59	74	90.5	65.5	45.7	84.2	11.08	74	131.2	72	1.64E-08	-183.3	139.7	3
20-Nov	10:20	77	93.0	64.5	47.5	79.4	10.70	77	662.1	75	1.11E-07	66.7	10.1	6
25-Nov	10:12	82	104.2	75.5	60.0	95.6	23.43	82	737.2	79	7.40E-08	133.3	18.1	4
4-Dec	10:05	91	97.8	68.2	50.4	86.0	15.20	91	753.8	86	4.19E-08	-216.7	28.7	4
18-Dec	10:05	105	97.8	68.2	50.4	86.0	15.20	105	1771.9	98	6.26E-08	0.0	0.0	2
23-Dec	10:05	110	97.8	68.2	50.4	86.0	15.20	110	278.6	107	2.87E-08	0.0	0.0	2
31-Dec	10:05	118	97.8	68.2	50.4	86.0	15.20	118	753.8	114	4.70E-08	0.0	0.0	2
8-Jan	10:05	126	97.8	68.2	50.4	86.0	15.20	126	604.7	122	3.73E-08	200.0	33.1	

CALCULATION SHEET FOR HYDRAULIC CONDUCTIVITY
INFILTROMETER D-1 (E-C)

DAY NO.	x10-7 I (cm/sec)	WATER DEPTH (in)	W. FRONT DEPTH (in)	GRADIENT	DAY NO.	X10-7 HYDRAULIC CON. (cm/sec)	x10-7 SWELL I (cm/sec)	X10-7 HYDRAULIC CON.-SWELL (cm/sec)
-	-	11.50	-	-	-	-	-	-
6	0.8	12.18	4.37	3.79	6	0.2	0.75	0.20
10	3.1	12.93	7.41	2.75	10	1.1	3.06	1.11
-	-	12.75	-	-	-	-	-	-
12	3.1	12.63	10.33	2.22	12	1.4	3.07	1.38
13	3.1	12.75	3.11	5.09	13	0.6	3.11	0.61
-	-	12.75	-	-	-	-	-	-
15	2.8	12.78	3.56	4.59	15	0.6	2.83	0.62
17	2.7	12.78	4.05	4.15	17	0.7	2.72	0.66
18	2.9	12.75	10.80	2.18	18	1.3	2.93	1.34
19	2.6	12.63	11.29	2.12	19	1.2	2.56	1.21
20	1.3	12.75	11.91	2.07	20	0.6	1.30	0.63
21	1.2	13.00	12.59	2.03	21	0.6	1.24	0.61
22	2.6	13.00	13.08	1.99	22	1.3	2.64	1.32
25	2.4	13.00	14.96	1.87	25	1.3	2.44	1.31
26	1.8	12.75	15.56	1.82	26	1.0	1.84	1.01
27	2.3	12.25	16.19	1.76	27	1.3	2.25	1.28
28	1.7	12.00	16.75	1.72	28	1.0	1.69	0.99
32	1.7	12.38	19.07	1.65	32	1.0	1.66	1.00
35	1.7	13.13	20.92	1.63	35	1.1	1.73	1.06
39	0.9	13.25	23.27	1.57	39	0.6	0.88	0.56
42	0.8	12.13	25.03	1.48	42	0.5	0.75	0.51
46	0.7	12.00	27.50	1.44	46	0.5	0.66	0.46
49	2.1	11.88	29.35	1.40	49	1.5	2.08	1.48
53	0.8	11.75	31.67	1.37	53	0.6	0.77	0.56
56	0.8	11.74	33.50	1.35	56	0.6	0.83	0.62
60	0.8	11.87	35.83	1.33	60	0.6	0.80	0.60
63	0.6	12.13	37.69	1.32	63	0.5	0.65	0.49
67	0.7	12.13	40.08	1.30	67	0.6	0.74	0.57
70	1.1	12.13	41.86	1.29	70	0.8	1.09	0.84
74	0.2	12.13	44.29	1.27	74	0.1	0.16	0.13
77	1.1	12.00	46.07	1.26	77	0.9	1.11	0.88
82	0.7	12.25	49.07	1.25	82	0.6	0.74	0.59
91	0.4	12.13	54.46	1.22	91	0.3	0.42	0.34
105	0.6	12.00	62.86	1.19	105	0.5	0.63	0.53
110	0.3	12.13	65.86	1.18	110	0.2	0.29	0.24
118	0.5	12.00	70.66	1.17	118	0.4	0.47	0.40
126	0.4	12.25	75.46	1.16	126	0.3	0.37	0.32

SEALED DOUBLE-RINGED INFILTROMETER DATA, DCF TEST

DATF PROJECT INFORMATION DATA SHEET		INFILTROMETER J-4 (E-S)			
PROJECT:	Dynamic Compaction Test,	NUMBER OF TENSIOMETERS USED:	9		
LOCATION:	E and 4 road	NOMINAL DEPTHS (IN.):	6	12	18
CLIENT:	WSRC	NUMBER AT EACH DEPTH:	3		
ENGINEER:	Scott R. McMullin	ACTUAL TIP DEPTH (IN.):	7	13	19
		DATE AND TIME INSTALLED :	9/15/92	15:30	
ITEM TESTED:	Kaolin Test cap	AVERAGE DEPTH (IN.):	12		
REQUIRED K (CM/SEC):	1x10-7				
TEST AREA THICKNESS (FT.):	3	INITIAL TENSIOMETER READINGS			
NUMBER OF LIFTS:	6	DATE:	9/15/92	9:30	
LOOSE LIFT THICKNESS (IN.):	8	GROUP 1:			
BOTTOM BOUNDARY:	sandy clay	6 inch	30		
COMPACTION EQUIPMENT TYPE:	Cat 815B	12 inch	37		
		18 inch	36		
LIQUID LIMIT (%)	64	GROUP 2:			
PLASTIVC LIMIT (%):	32	6 inch	15		
PLASTICITY INDEX (%):	32	12 inch	22		
PERCENT FINES:	2	18 inch	20		
PERCENT BENTONITE ADDED:	0	GROUP 3:			
MAXIMUM DRY DENSITY (PCF)		6 inch	15		
OPTIMUM MOISTURE (%):		12 inch	20		
AVERAGE DRY UNIT WEIGHT (PCF):		18 inch	26		
AVERAGE COMPACTION Wm(%):					
		INITIAL SWELL GAGE READINGS (MM):			
AREA OF OUTER RING (CM2):	126451	1	46.4		
AREA OF INNER RING (CM2):	23226	2	32.1		
DATE OF RING INSTALLATION:	9/13/92	3	24.1		
DATE AND TIME RINGS FILLED :	9/15/92 15:30	4	58.8		
		INITIAL AVERAGE WATER DEPTH (IN.):	11.8		
		INITIAL WATER DEPTH READING (IN.):	9		
		TOTAL FLOW, Q, (ml):	-526		
		TOTL FLOW DUE TO SWELL, Qs, (ml):	125415		

SEALED DOUBLE-RINGED INFILTROMETER DATA, DCF TEST

DATA SHEET FOR WATER BAGS
INFILTROMETER J-4 (E-S)

BAG CONNECTION AND DISCONNECTION				t INTERVAL TIME	BAG 1		BAG 2		NET CHANGE (g)
DATE ON	DATE OFF	TIME ON	TIME OFF		INITIAL WEIGHT (g)	FINAL WEIGHT (g)	INITIAL WEIGHT (g)	FINAL WEIGHT (g)	
-	-	-	-	-	-	-	-	-	-
16-Sep	17-Sep	15:34	13:59	80700	3104.5	2641.2	2987.2	2997.0	453.5
17-Sep	-	14:43	-	-	2641.2	-	2997.0	-	-
-	19-Sep	-	10:32	157740	-	2266.4	-	2533.7	838.1
19-Sep	21-Sep	11:40	11:58	173880	2266.4	1757.3	2533.7	2152.1	890.7
21-Sep	22-Sep	13:44	13:54	87000	2900.0	2556.7	2152.1	2026.3	469.1
22-Sep	23-Sep	14:11	11:26	76500	2556.7	1941.9	2026.3	2111.1	530.0
23-Sep	24-Sep	11:58	11:06	83280	1941.9	1665.6	2111.1	2089.4	298.0
24-Sep	25-Sep	12:06	13:39	91980	3094.4	2436.7	2089.4	2172.3	574.8
25-Sep	26-Sep	13:28	11:06	77880	2436.7	2435.5	2172.3	1760.0	413.5
26-Sep	29-Sep	11:31	13:57	267960	2435.5	2217.4	1760.0	751.1	1227.0
29-Sep	30-Sep	14:46	14:53	86820	2217.4	2126.3	2475.6	2136.6	430.1
30-Sep	1-Oct	15:20	13:34	80040	2126.3	2120.4	2136.6	1817.3	325.2
1-Oct	2-Oct	14:06	13:38	84720	2120.4	1800.4	1817.3	1826.7	310.6
2-Oct	6-Oct	14:16	8:49	325980	2752.7	2308.3	2788.6	2208.2	1024.8
6-Oct	9-Oct	9:25	12:53	271680	2308.3	1675.2	2208.2	1891.8	949.5
9-Oct	13-Oct	13:18	10:31	335580	2360.0	2203.8	2404.0	2049.6	510.6
13-Oct	16-Oct	11:06	10:08	255720	2203.8	1854.2	2049.6	1789.0	610.2
16-Oct	20-Oct	10:41	10:38	345420	2382.4	2370.5	2499.4	2123.4	387.9
20-Oct	23-Oct	11:15	12:51	264960	2370.5	2225.9	2123.4	1568.7	699.3
23-Oct	27-Oct	13:38	8:45	328020	2225.9	1837.3	2502.0	2221.0	669.6
27-Oct	30-Oct	10:20	13:01	268860	2456.8	1945.5	2221.0	2166.0	566.3
30-Oct	3-Nov	13:41	8:58	328620	2366.0	2147.9	2166.0	2181.4	202.7
3-Nov	6-Nov	9:28	11:15	265620	2147.9	2088.9	2181.4	2074.6	165.8
6-Nov	10-Nov	12:11	11:06	341700	2088.9	1908.0	2074.6	1708.2	547.3
10-Nov	13-Nov	12:04	10:18	252840	2659.4	2005.6	2497.2	2267.1	883.9
13-Nov	17-Nov	10:53	10:36	344580	2005.6	1985.5	2267.1	2021.2	266.0
17-Nov	20-Nov	11:11	10:35	257040	1985.5	1756.2	2021.2	1710.6	539.9
20-Nov	25-Nov	11:17	10:27	429000	2787.8	2001.1	2446.4	1985.0	1248.1
25-Nov	4-Dec	11:13	10:18	774300	2625.4	2244.0	2822.2	2435.3	768.3
4-Dec	18-Dec	11:05	13:51	1219560	2244.0	2190.5	2435.3	2043.2	445.6
18-Dec	23-Dec	14:21	10:38	418620	2190.5	2081.6	2043.2	2820.1	-668.0
23-Dec	31-Dec	11:10	10:46	689760	2081.6	1988.9	2820.1	2451.3	461.5
31-Dec	8-Jan	11:20	13:29	698940	1988.9	1387.9	2451.3	2451.5	600.8

SEALED DOUBLE-RINGED INFILTROMETER DATA, DCF TEST

DATA SHEET FOR WATER DEPTH AND TEMPERATURE
INFILTROMETER J-4 (E-S)

DATE	START WAT. DEPTH READING (in)	START WATER DEPTH (in.)	END WAT. DEPTH READING (in.)	END WATER DEPTH (in)	AVG. WATER DEPTH (in)	START WATER TEMP (oF)	END WATER TEMP (oF)	AVG. WATER TEMP oF	TEMP. CHANGE (oF)
16-Sep	9.0	11.8	9.00	11.8	11.8	74	74	74	0
17-Sep	9.0	11.8	9.00	11.8	11.8	74	76	75	2
18-Sep	9.0	11.8	9.00	11.8	11.8	76	76	76	0
19-Sep	9.0	11.8	8.75	11.5	11.6	76	75	76	-1
21-Sep	8.8	11.5	8.75	11.5	11.5	75	77	76	2
22-Sep	8.8	11.5	8.75	11.5	11.5	77	78	78	1
23-Sep	8.8	11.5	8.75	11.5	11.5	78	76	77	-2
24-Sep	8.8	11.5	9.00	11.8	11.6	76	67	72	-9
25-Sep	9.0	11.8	9.00	11.8	11.8	67	65	66	-2
26-Sep	9.0	11.8	9.25	12.0	11.9	65	65	65	0
29-Sep	9.3	12.0	9.25	12.0	12.0	65	71	68	6
30-Sep	9.3	12.0	9.00	11.8	11.9	71	64	68	-7
1-Oct	9.0	11.8	9.00	11.8	11.8	64	63	64	-1
2-Oct	9.0	11.8	9.00	11.8	11.8	63	61	62	-2
6-Oct	9.0	11.8	10.25	13.0	12.4	61	60	61	-1
9-Oct	9.5	12.3	11.25	14.0	13.1	60	66	63	6
13-Oct	11.3	14.0	9.75	12.5	13.3	66	60	63	-6
16-Oct	9.8	12.5	9.25	12.0	12.3	60	64	62	4
20-Oct	9.3	12.0	9.00	11.8	11.9	64	55	60	-9
23-Oct	9.0	11.8	9.00	11.8	11.8	55	58	57	3
27-Oct	9.0	11.8	8.70	11.5	11.6	58	59	59	1
30-Oct	8.7	11.5	8.75	11.5	11.5	59	62	61	3
3-Nov	8.8	11.5	9.00	11.8	11.6	62	65	64	3
6-Nov	9.0	11.8	9.25	12.0	11.9	65	59	62	-6
10-Nov	9.3	12.0	9.00	11.8	11.9	59	49	54	-10
13-Nov	9.0	11.8	9.50	12.3	12.0	49	59	54	10
17-Nov	9.5	12.3	9.00	11.8	12.0	59	46	53	-13
20-Nov	9.0	11.8	9.25	12.0	11.9	46	49	48	3
25-Nov	9.3	12.0	9.25	12.0	12.0	49	60	55	11
4-Dec	9.3	12.0	9.00	11.8	11.9	60	45	53	-15
18-Dec	9.0	11.8	9.25	12.0	11.9	45	45	45	0
23-Dec	9.3	12.0	9.25	12.0	12.0	45	45	45	0
31-Dec	9.3	12.0	9.25	12.0	12.0	45	45	45	0
8-Jan	9.3	12.0	10.00	12.8	12.4	45	59	52	14

SEALED DOUBLE-RINGED INFILTROMETER DATA, DCF TEST

DATA SHEET FOR TENSIOMETER READINGS
INFILTROMETER J-4 (E-S)

DATE	DAY	GROUP NUMBER 1			GROUP NUMBER 2			GROUP NUMBER 3			AVERAGE TENSIOMETER READINGS		
		6 INCH (cb)	12 INCH (cb)	18 INCH (cb)	6 INCH (cb)	12 INCH (cb)	18 INCH (cb)	6 INCH (cb)	12 INCH (cb)	18 INCH (cb)	6 INCH (cb)	12 INCH (cb)	18 INCH (cb)
16-Sep	1	18	30	34	10	20	22	10	20	29	13	23	28
17-Sep	2	12	25	30	8	16	22	4	14	24	8	18	25
18-Sep	3	9	22	26	2	16	20	3	12	26	5	17	24
19-Sep	4	4	21	26	2	12	20	2	12	22	3	15	23
21-Sep	6	2	16	24	0	10	17	0	12	21	1	13	21
22-Sep	7	2	16	22	0	10	18	0	11	20	1	12	20
23-Sep	8	0	14	21	0	10	18	0	11	19	0	12	19
24-Sep	9	0	12	20	0	10	18	0	12	18	0	11	19
25-Sep	10	0	14	22	2	10	16	0	12	20	1	12	19
26-Sep	11	0	12	22	0	8	16	0	16	20	0	12	19
29-Sep	14	0	9	16	6	8	17	0	8	16	2	8	16
30-Sep	15	0	10	16	0	6	12	0	8	16	0	8	15
1-Oct	16	0	10	18	2	10	18	0	10	18	1	10	18
2-Oct	17	0	10	18	0	10	17	0	9	18	0	10	18
6-Oct	21	0	8	16	0	0	12	0	4	15	0	4	14
9-Oct	24	2	6	14	0	2	12	0	6	16	1	5	14
13-Oct	28	0	4	12	0	0	10	0	4	12	0	3	11
16-Oct	31	0	4	12	0	0	10	0	4	12	0	3	11
20-Oct	35	0	8	12	0	2	10	0	8	13	0	6	12
23-Oct	38	0	4	13	0	2	10	0	6	12	0	4	12
27-Oct	42	0	2	12	0	0	8	0	6	10	0	3	10
30-Oct	45	0	3	11	0	0	8	0	3	11	0	2	10
3-Nov	49	0	2	10	0	0	8	0	4	10	0	2	9
6-Nov	52	0	2	8	0	0	7	0	3	8	0	2	8
10-Nov	56	0	6	10	0	6	10	0	2	10	0	5	10
13-Nov	59	0	2	8	0	0	8	0	2	9	0	1	8
17-Nov	63	0	3	9	0	2	8	0	4	10	0	3	9
20-Nov	66	0	2	8	0	0	10	0	3	8	0	2	9
25-Nov	71	0	2	7	0	0	4	0	2	8	0	1	6
4-Dec	80	0	5	9	0	0	7	0	4	10	0	3	9
18-Dec	94										0	0	0
23-Dec	99										0	0	0
31-Dec	107										0	0	0
8-Jan	115										0	0	0

SEALED DOUBLE-RINGED INFILTROMETER DATA, DCF TEST

DATA SHEET FOR SWELL DATA INFILTROMETER J-4 (E-S)								CALCULATION SHEET FOR FLOW-RATE AND ADJUSTMENT VALUES INFILTROMETER J-4 (E-S)						
			SWELL INFORMATION											
READING DATE	READING TIME	DAY NUMBER	S1	S2	S3	S4	AVG. SWELL (mm)	DAY NO.	Q (ml)	AVG DAY NO.	I (cm/sec)	EST. FLOW DUE TO TEMP. CHG. (ml)	% OF TOTAL FLOW (ml)	Q WHEN BAG WAS OFF (ml)
15-Sep	17:05	0	42.3	27.8	20.2	56.2	3.73	0						
16-Sep	9:10	1	41.0	28.6	20.8	55.6	3.85	1	-	-	-	0.0	-	-
17-Sep	14:46	2	41.4	28.0	21.4	56.0	3.65	2	453.5	1	2.42E-07	33.3	7.4	-454
18-Sep	16:22	3	40.4	27.9	21.1	55.4	4.15	3	-	-	-	0.0	-	-
19-Sep	11:15	4	41.2	28.3	21.7	54.9	3.83	4	838.1	3	2.29E-07	-16.7	2.0	-862
21-Sep	13:35	6	41.6	29.1	22.2	56.8	2.93	6	890.7	5	2.21E-07	33.3	3.7	33
22-Sep	15:03	7	42.3	30.0	22.4	57.1	2.40	7	469.1	6	2.32E-07	16.7	3.6	6
23-Sep	10:37	8	41.9	29.4	22.3	56.8	2.75	8	530.0	7	2.98E-07	-33.3	6.3	10
24-Sep	11:38	9	42.0	29.5	22.9	57.2	2.45	9	298.0	8	1.54E-07	-150.0	50.3	18
25-Sep	14:40	10	56.7	31.3	34.2	71.1	-7.98	10	574.8	9	2.69E-07	-33.3	5.8	-4
26-Sep	10:43	11	62.0	32.8	24.5	74.1	-8.00	11	413.5	10	2.29E-07	0.0	0.0	7
29-Sep	13:31	14	78.9	34.5	27.5	92.6	-18.03	14	1227.0	12	1.97E-07	100.0	8.1	14
30-Sep	13:25	15	75.5	34.3	27.9	86.6	-15.73	15	430.1	14	2.13E-07	-116.7	27.1	7
1-Oct	15:03	16	76.1	35.0	28.0	86.4	-16.03	16	325.2	15	1.75E-07	-16.7	5.1	7
2-Oct	13:09	17	75.5	33.9	27.8	86.6	-15.60	17	310.6	16	1.58E-07	-33.3	10.7	8
6-Oct	10:02	21	95.5	36.6	29.9	106.0	-26.65	21	1024.8	19	1.35E-07	-16.7	1.6	7
9-Oct	12:20	24	126.7	50.6	45.5	138.5	-49.98	24	949.5	22	1.50E-07	100.0	10.5	4
13-Oct	10:07	28	129.9	78.4	68.7	141.0	-64.15	28	510.6	26	6.55E-08	-100.0	19.6	4
16-Oct	8:27	31	60.5	44.7	38.7	72.6	-13.78	31	610.2	29	1.03E-07	66.7	10.9	3
20-Oct	11:13	35	64.4	45.8	39.4	76.4	-16.15	35	387.9	33	4.84E-08	-150.0	38.7	4
23-Oct	13:50	38	65.8	41.2	47.4	77.3	-17.58	38	699.3	36	1.14E-07	50.0	7.2	7
27-Oct	10:15	42	63.3	47.5	40.8	75.8	-16.50	42	669.6	40	8.79E-08	16.7	2.5	12
30-Oct	11:32	45	61.5	42.4	37.5	74.4	-13.60	45	566.3	43	9.07E-08	50.0	8.8	3
3-Nov	8:37	49	55.6	39.5	34.3	66.3	-8.58	49	202.7	47	2.66E-08	50.0	24.7	1
6-Nov	10:53	52	60.3	41.4	35.6	71.8	-11.93	52	165.8	50	2.69E-08	-100.0	60.3	4
10-Nov	10:35	56	82.4	49.4	43.2	95.4	-27.25	56	547.3	54	6.90E-08	-166.7	30.5	9
13-Nov	9:57	59	95.6	53.2	47.2	108.1	-35.68	59	883.9	57	1.51E-07	166.7	18.9	4
17-Nov	10:44	63	97.8	57.3	48.4	111.5	-38.40	63	266.0	61	3.32E-08	-216.7	81.5	3
20-Nov	10:18	66	82.1	57.5	48.4	82.9	-27.38	66	539.9	64	9.04E-08	50.0	9.3	6
25-Nov	10:08	71	80.4	80.7	70.1	106.2	-44.00	71	1248.1	68	1.25E-07	183.3	14.7	5
4-Dec	10:00	80	60.1	36.5	32.8	71.5	-9.88	80	768.3	75	4.27E-08	-250.0	32.5	2
18-Dec	10:00	94	60.1	36.5	32.8	71.5	-9.88	94	445.6	87	1.57E-08	0.0	0.0	-1
23-Dec	10:00	99	60.1	36.5	32.8	71.5	-9.88	99	-668.0	96	-6.87E-08	0.0	0.0	-1
31-Dec	10:00	107	60.1	36.5	32.8	71.5	-9.88	107	461.5	103	2.88E-08	0.0	0.0	2
8-Jan	10:00	115	60.1	36.5	32.8	71.5	-9.88	115	600.8	111	3.70E-08	233.3	38.8	

SEALED DOUBLE-RINGED [illegible]LTROMETER DATA, DCF TEST

CALCULATION SHEET FOR HYDRAULIC CONDUCTIVITY
INFILTROMETER D-1 (E-S)

DAY NO.	x10-7 I (cm/sec)	WATER DEPTH (in)	W. FRONT DEPTH (in)	GRADIENT	DAY NO.	X10-7 HYDRAULIC CON. (cm/sec)	x10-7 SWELL I (cm/sec)	X10-7 HYDRAULIC CON.-SWELL (cm/sec)
1	-	11.75	-	-	1	-	-	-
2	2.4	11.75	3.33	4.53	2	0.5	2.42	0.53
3	-	11.75	-	#REF!	3	-	-	-
4	2.3	11.63	6.11	2.90	4	0.8	2.29	0.79
6	2.2	11.50	9.26	2.24	6	1.0	2.21	0.98
7	2.3	11.50	2.71	5.24	7	0.4	2.32	0.44
8	3.0	11.50	3.02	4.81	8	0.6	2.98	0.62
9	1.5	11.63	3.41	4.41	9	0.3	1.54	0.35
10	2.7	11.75	3.83	4.07	10	0.7	2.69	0.66
11	2.3	11.88	4.14	3.87	11	0.6	2.29	0.59
14	2.0	12.00	5.31	3.26	14	0.6	1.97	0.60
15	2.1	11.88	5.69	3.09	15	0.7	2.13	0.69
16	1.7	11.75	6.09	2.93	16	0.6	1.75	0.60
17	1.6	11.75	6.43	2.83	17	0.6	1.58	0.56
21	1.4	12.38	7.88	2.57	21	0.5	1.35	0.53
24	1.5	13.13	4.82	3.72	24	0.4	1.50	0.40
28	0.7	13.25	5.61	3.36	28	0.2	0.66	0.19
31	1.0	12.25	6.19	2.98	31	0.3	1.03	0.34
35	0.5	11.88	7.01	2.69	35	0.2	0.48	0.18
38	1.1	11.75	7.64	2.54	38	0.4	1.14	0.45
42	0.9	11.60	8.41	2.38	42	0.4	0.88	0.37
45	0.9	11.48	9.02	2.27	45	0.4	0.91	0.40
49	0.3	11.63	9.79	2.19	49	0.1	0.27	0.12
52	0.3	11.88	10.41	2.14	52	0.1	0.27	0.13
56	0.7	11.88	11.21	2.06	56	0.3	0.69	0.33
59	1.5	12.00	11.80	2.02	59	0.7	1.51	0.75
63	0.3	12.00	12.61	1.95	63	0.2	0.33	0.17
66	0.9	11.88	13.21	1.90	66	0.5	0.90	0.48
71	1.3	12.00	14.21	1.84	71	0.7	1.25	0.68
80	0.4	11.88	16.00	1.74	80	0.2	0.43	0.25
94	0.2	11.88	18.80	1.63	94	0.1	0.16	0.10
99	-0.7	12.00	19.80	1.61	99	-0.4	-0.69	-0.43
107	0.3	12.00	21.40	1.56	107	0.2	0.29	0.18
115	0.4	12.38	23.00	1.54	115	0.2	0.37	0.24