GEOTECHNICAL INVESTIGATION

TAILING DAMS TP-1 AND TP-2 ELIZABETH MINE, SOUTH STRAFFORD, VERMONT

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TABLE OF CONTENTS

Section 1 Introduction and Project Background 1-1

1.1 Site History 1-1
1.2 Relevant Site Features 1-2
1.3 Site-Specific Definition of Problem 1-2
1.4 Report Organization 1-3
1.5 Summary of Upstream Tailing Dam Construction 1-3

Section 2 Site Characteristics 2-1

2.1 Climate 2-1
2.2 Watershed Description 2-1
2.3 Geology 2-2
2.4 Tailing Dam TP-1 2-2
2.5 TP-1 and TP-2 Decant Systems 2-3

Section 3 Seismic Hazards Analysis 3-1

3.1 Introduction 3-1
3.2 Seismic Hazard Analysis Methodology 3-1
3.3 Seismotectonic Setting and Historical Seismicity 3-2
3.4 Input to Analysis 3-3
3.5 Probabilistic Seismic Hazard Analysis 3-5
3.6 Site Response Analysis 3-5

Section 4 Site Investigation 4-1

4.1 Work Completed by Others 4-1
4.2 Initial Dam Observations 4-1
4.3 Test Boreholes 4-2
4.4 Test Trenches 4-3
4.5 Cone Penetration Test Soundings 4-4
4.6 Decant Inspection 4-5

Section 5 Laboratory Investigation 5-1

5.1 Engineering Properties 5-2

Section 6 Subsurface Conditions 6-1

6.1 General Subsurface Profile 6-1
6.2 Tailing Dam TP-1 6-1
6.2.1 Tailing Dam TP-1 Downstream Toe 6-2
6.2.2 TP-1 Sand Shell 6-3
6.2.3 TP-1 Decant Pond 6-4
6.2.4 TP-1 Pond Perimeter 6-5
6.3 Dam TP-2 6-7

TABLE OF CONTENTS

6.3.1 TP-2 Sand Shell 6-7
6.3.2 TP-2 Decant Pond 6-8
6.3.3 TP-2 Perimeter 6-8
6.4 Decant Structure 6-9
6.4.1 Inspection Results 6-10

Section 7 Geotechnical Analyses 7-1

7.1 Approach to Analysis 7-1
7.2 Material Characterization 7-1
7.2.1 Cone Penetration Test Sounding Results 7-2
7.3 Data Correlation 7-4
7.4 Liquefaction Evaluation 7-4
7.5 Slope Stability Analyses 7-5
7.6 Results 7-6

Section 8 Dam Breach and Runout Analysis 8-1

8.1 Tailing Properties 8-1
8.2 Estimated Tailing Release Volume 8-2
8.3 Model Components 8-3
8.4 Descriptions of Modeling Methods 8-5
8.5 Hydraulic Model Development 8-6
8.6 Tailing Debris Flow Model Development 8-8
8.7 Results 8-9
8.8 Sensitivity Analysis 8-10
8.9 Results Summary 8-11

Section 9 Conclusion and Recommendations 9-1

9.1 Conclusions 9-1
9.2 Recommendations 9-4

Section 10 References 10-1

Tables

Table 3-1 Mean Probabilistic Peak Horizontal Ground Acceleration on Rock and Soil

Table 4-1 Test Borehole Drilling Summary

Table 4-2 Test Trench Excavation Summary

Table 5-1 Summary of Laboratory Test Results

Table 7-1 Summary of Data Comparison

Table 7-2 Summary of Stability Analyses Material Properties.

Table 7-3 Summary of Stability Results
Table 8-1 Data on Elizabeth Mine TP-1
Table 8-2 Elizabeth Mine TP-1 Hydraulic Breach Parameters and Initial Conditions
Table 8-3 DAMBRK Model Cross Sections, Elizabeth Mine TP-1
Table 8-4 Breach and Runout Analysis Results, Elizabeth Mine TP-1
Table 8-5 Hydraulic Flow Results for Case 1.0

Figures

Figure 3-1 Historical Seismicity of the Site Region (1700-2003)
Figure 4-1 Site Plan TP-1 and TP-2
Figure 4-2 Profile 1 TP-1 and General Legend and Notes Vermont
Figure 4-3 Sections A, B, C, and D TP-1
Figure 4-4 Profile 2 and Sections E and F TP-2
Figure 4-5 Test Trench Summary Logs
Figure 4-6 Legend and Notes for CPT Results Tailings Pile 1 and 2
Figure 4-7 Tailing Pile 1 CS-1
Figure 4-8 Tailing Pile 1 CS-2
Figure 4-9 Tailing Pile 1 CS-3
Figure 4-10 Tailing Pile 1 CS-4
Figure 4-11 Tailing Pile 1 CS-5
Figure 4-12 Tailing Pile 1 CS-6
Figure 4-13 Tailing Pile 1 CS-7
Figure 4-14 Tailing Pile 2 CS-8
Figure 4-15 Tailing Pile 2 CS-9
Figure 4-16 Tailing Pile 2 CS-10
Figure 4-17 Tailing Pile 1 CS-11
Figure 4-18 Tailing Pile 1 CS-12
Figure 4-19 Tailing Pile 1 CS-13
Figure 5-1 Percent Fines vs. Depth, Tailing Piles 1 and 2
Figure 5-2 Water Content vs. Depth, Tailing Piles 1 and 2
Figure 5-3 Dry Unit Weight vs. Depth, Tailing Piles 1 and 2
Figure 5-4 Specific Gravity vs. Depth, Tailing Piles 1 and 2
Figure 5-5 Permeability vs. Depth, Tailing Piles 1 and 2

Figure 5-6 Void Ratio vs. Depth, Tailing Piles 1 and 2
Figure 5-7 Particle Size Distribution, Test Borehole TB-9
Figure 5-8 Particle Size Distribution, Test Borehole TB-10
Figure 5-9 Particle Size Distribution, Test Borehole TB-11
Figure 5-10 Particle Size Distribution, Test Borehole TB-12
Figure 5-11 Particle Size Distribution, Test Borehole TB-13
Figure 5-12 Particle Size Distribution, Test Borehole TB-14
Figure 5-13 Particle Size Distribution, Test Borehole TB-15
Figure 5-14 Particle Size Distribution, Test Borehole TB-16
Figure 5-15 Particle Size Distribution, Test Borehole TB-17
Figure 5-16 Particle Size Distribution, Test Borehole TB-18
Figure 7-1 TP-1, Section A Slope Stability Results, Existing Phreatic Surface
Figure 7-2 TP-1, Section B Slope Stability Results, Existing Phreatic Surface
Figure 7-3 TP-1, Section C Slope Stability Results, Existing Phreatic Surface
Figure 7-4 TP-1, Section D Slope Stability Results, Existing Phreatic Surface
Figure 7-5 TP-1, Section A Slope Stability Results, Raised Phreatic Surface
Figure 7-6 TP-1, Section B Slope Stability Results, Raised Phreatic Surface
Figure 7-7 TP-1, Section C Slope Stability Results, Raised Phreatic Surface
Figure 7-8 TP-1, Section D Slope Stability Results, Raised Phreatic Surface
Figure 8-1 Elevation Storage Curve TP-1
Figure 8-2 Watershed Area
Figure 8-3 Case 1 Tailing and Decant Pond Depletion Curve
Figure 8-4 Case 1 Outflow Hydrograph at TP-1
Figure 8-5 Hypothetical Stage Water Storage Curve TP-1
Figure 8-6 Potential Range of Inundation
Figure 8-7 Potential Range of Inundation
Figure 8-8 Weighted Average Channel Slope
Figure 8-9 Predicted Equilibrium Surface Profile Tailing Flow Failure
Figure 8-10 Case 1 Simulated Peak Flow Discharge Profile
Figure 8-11 Case 1 Simulated Time to Flood Peak
Figure 8-12 Discharge Profile for Hydraulic Flow Failure
Figure 8-13 Case 1 Peak Flow Discharge Profile for Various Failure Times

TABLE OF CONTENTS

Appendices

Appendix A Probabilistic Seismic Hazard Analysis

Appendix B Laboratory Results

- Appendix B.1 Gradation Analyses Results
- Appendix B.2 Permeability Results
- Appendix B.3 Consolidation Results
- Appendix B.4 Undisturbed CIU' Test Results
- Appendix B.5 Remolded CIU' Test Results

Appendix C Liquefaction Results

- Appendix C.1 Earthquake Magnitude 5.7
- Appendix C.2 Earthquake Magnitude 6.5

Appendix D Stability Analyses Output Files

- Appendix D.1 Steady-State, Existing Phreatic Surface
- Appendix D.2 Post-Earthquake
- Appendix D.3 Steady-State, Raised Phreatic Surface

Appendix E Dam Breach and Runout Analysis Output Files

- Appendix E.1 Case 1.0
- Appendix E.2 Case 2.0
- Appendix E.3 Case 3.0
- Appendix E.4 Case 4.1
- Appendix E.5 Case 4.2
- Appendix E.6 Case 5.1
- Appendix E.7 Case 5.2
- Appendix E.8 Case 6.1
- Appendix E.9 Case 6.2
- Appendix E.10 Case 7.1

TABLE OF CONTENTS

Abbreviations

°F	degrees Fahrenheit
ϕ′	effective friction angle
<	less than
ADL	Arthur D. Little, Inc.
AF	acre-feet
AGS	at ground surface
API	Advanced Pipe Inspections, Inc.
ARD	acid rock drainage
ASTM	American Society for Testing and Materials
bgs	below ground surface
BOSS	Boss International Corporation
C'	effective cohesion
CEUS	Central and Eastern United States
cfs	cubic feet per second
CIU′	Consolidated Isotropical Undrained Triaxial Test
cm/sec	centimeter per second
cm^2	square centimeter
CPT	cone penetration test
CS	cone sounding
cy	cubic yard
DAMBRK	National Weather Service Dam Break Flood Forecasting Model
deg	degrees
EBOR	East Branch of the Ompompanoosuc River
EE/CA	Engineering Evaluation/Cost Analysis
EL	elevation
El.	elevation
EMSG	Elizabeth Mine Study Group
EPRI	Electric Power Research Institute
FOS	factor-of-safety
fps	feet per second
ft	feet

ft/sec	feet per second
g	ground acceleration
GPS	Global Positioning System
hrs	hours
ID	identification
IDF	inflow design flood
km	kilometers
ksf	kips per square foot
M	magnitude
m_b	body-wave magnitude
mcy	million cubic yards
MM	Modified Mercalli
NA	not applicable
NEHRP	National Earthquake Hazards Reduction Program
NGVD	National Geodetic Vertical Datum
NP	non-plastic
NTCRA	Non-Time-Critical Removal Action
OCR	over-consolidation ratio
OR	Ompompanoosuc River
PAL	Public Archeological Laboratory
pcf	pounds per cubic foot
PE&A	Pacific Engineering and Analysis
PGA	peak horizontal ground acceleration
psf	pounds per square foot
PSHA	Probabilistic Seismic Hazard Analysis
psi	pounds per square foot
PVC	polyvinyl chloride
QA/QC	quality assurance/quality control
RI	remedial investigation
RI/FS	Remedial Investigation/Feasibility Study
SOW	Statement of Work
SPT	standard penetration test
SS	split spoon

ST	shelby tube
TB	test borehole
TP-1	Tailing Dam TP-1
TP-2	Tailing Dam TP-2
TP-3	Tailing Pile TP-3
tsf	tons per square foot
TT	test trench
URS	URS Corporation
USACE	United States Army Corp of Engineers
USCS	Unified Soil Classification System
USEPA	United State Environmental Protection Agency
USGS	United States Geological Survey
V_s	shear-wave velocity
VTANR	Vermont Agency of Natural Resources
W.L.	water level
WBOR	West Branch of the Ompompanoosuc River
yrs	years

Section 1

This report summarizes geotechnical investigations and analyses of tailing dams TP-1 and TP-2 at the Elizabeth Mine site located in South Strafford, Vermont. Work activities completed for this report were performed by URS Corporation (URS) under contract (DACA31-00-D-0011) with the U.S. Army Corps of Engineers (USACE) and in accordance with the Scope of Work (SOW) for Remedial Investigation/Feasibility Study (RI/FS) and Pre-Design Activities Supporting a Non-Time-Critical Removal Action (NTCRA) at the Elizabeth Mine site.

The geotechnical investigation and analyses performed as part of this assessment include:

- Slope Stability Analysis – Evaluated the stability of the existing TP-1 slope for steady-state seepage and seismic conditions. This included an evaluation of the liquefaction potential and post-earthquake stability and a parametric analysis to determine the sensitivity of the stability of the slopes to changes in the phreatic surface for steady-state seepage conditions.
- Probabilistic Seismic Hazard Analysis – Performed a probabilistic seismic hazard analysis (PSHA) for this site. The results were used to estimate earthquake magnitudes and ground accelerations for a given return period and to evaluate the liquefaction potential and post-earthquake stability.
- Dam breach and Runout Analysis – Conducted a dam breach and runout analysis of TP-1 assuming various decant pond elevations in order to evaluate the consequences of a dam failure and the range of potential downstream impacts.

This report follows an Engineering Evaluation and Cost Analysis (EE/CA) that was completed for the abandoned Elizabeth Mine site in 2002 (ADL 2002). The EE/CA was subject to a public comment period from March 10, 2002 to April 10, 2002. In September 2002, the U.S. Environmental Protection Agency (EPA) signed an Action Memorandum authorizing the implementation of a NTCRA to address the acid rock drainage and stability concerns relating the three large waste areas at the Elizabeth Mine site (TP-1, TP-2, and TP-3). The USACE has been hired by the EPA through an inter-agency agreement to perform the RI/FS site wide investigation program and NTCRA support. As part of the ongoing site wide investigation program, the USACE requested URS evaluate the stability of TP-1 and the decant structure, provide an opinion regarding the current condition, and provide recommendations for further action to stabilize the dam, as necessary.

1.1 SITE HISTORY

Elizabeth Mine is located in the towns of South Strafford and Thetford, Vermont and is the largest mining complex of the Vermont Copper Belt. A summary account of the site history is provided in *Historical Context and Preliminary Resource Evaluation of the Elizabeth Mine* (PAL 2001), as well as in the United States Geological Survey (USGS) Guidebook Series, Volume 35 (2001), *Part II. Environmental Geochemistry and Mining History of Massive Sulfide Deposits in the Vermont Copper Belt.* A brief summary of the site history is provided below.

Elizabeth Mine has a long history of copperas surface leaching operations and, in later years, milling of massive sulfide ore deposits. The ore deposit is characterized as a "besshi-type" massive sulfide with mineralization occurring as massive bands and disseminated sulfides. Pyrrhotite is a principal mineral in the deposit.

The Elizabeth Mine ore body was reportedly first discovered in 1793 and mine production for copperas (i.e., iron sulfate) occurred on a near-continuous basis from 1809 into the 1880s. From 1830 until 1919, and again from 1943 to 1958, the ore body was mined for copper, although operations were not continuous during these periods.

The majority of the observable mining infrastructure described below is associated with the final phase of site operations when the mine resumed operations in 1943. Mining for copper occurred during this period, and the mill and flotation operations process was used for the mineral benefication. During this period, it is estimated that 90 percent of the mine's total copper production was produced. The two existing tailing dams (TP-1 and TP-2) were created as waste by-product from these copper milling operations.

1.2 RELEVANT SITE FEATURES

The primary physical topographical features at the site include two open cuts (north and south open cuts), two tailing dams referred to as TP-1 and TP-2, and a leach pile referred to as Tailing Pile 3 (TP-3). The largest impoundment is TP-1, which covers approximately 27 acres. The smaller TP-2 impoundment covers approximately 8 acres. TP-1 also has an active decant structure approximately 820 feet long.

TP-1 and TP-2 contain the waste product (tailing) generated from the on-site milling and flotation processes. It is estimated that the dams contain more than 2 million cubic yards of hydraulically-deposited fine sand, silt, and clay size material. The impoundments vary in thickness from a few feet along the perimeter to a maximum depth of approximately 110 feet. The tailing impoundments are underlain by alluvium and/or glacial till.

TP-3 is a historic side-slope leach pile that covers approximately 12 acres and is comprised of old leach ore, roasted ore, and spent ore consisting of a heterogeneous mixture of boulders, cobbles, gravels, sands, and silts. TP-3 is irregularly shaped, varying in thickness from several feet to tens of feet thick. TP-3 is underlain by bedrock and in some areas by glacial till overlying the bedrock.

Other notable features at the site include the historic support buildings that formerly housed flotation and milling operations, and underground workings, including adits, shafts, tunnel, and stopes.

1.3 SITE-SPECIFIC DEFINITION OF PROBLEM

Multiple source areas with the potential to impact groundwater, surface water, sediment, and soils in the vicinity and downstream of the Elizabeth Mine site have been identified. These potential source areas include TP-3, TP-1/TP-2, a former air vent, which currently discharges mine water under artesian conditions to the West Branch of the Ompompanoosuc River (WBOR), and the south open cut. The site also includes as-yet uninvestigated features, including the copper ore roast beds located in the Sargent Brook Watershed and along the WBOR at Furnace Flats, waste rock pile designated as TP-4, the South Mine, and former mine infrastructure (e.g., World War II mine buildings).

The primary type of impacts identified at the site during pre-remedial investigation (RI) activities are acid rock drainage (ARD) emanating from TP-1, TP-2, TP-3, the underground workings (i.e.,

the air vent) and the South Open Cut. The geochemical processes which results in ARD have been found to add significant metal loads and acidity to surface water runoff, which results in impacts to surface water quality, sediment quality, and aquatic habitat located downstream of mine wastes (e.g., Copperas Brook, WBOR).

1.4 REPORT ORGANIZATION

This report has been organized in the following sections:

- Section 1 – Introduction and Project Background
- Section 2 – Site Characteristics
- Section 3 – Seismic Hazards Analysis
- Section 4 – Site Investigation
- Section 5 – Laboratory Investigation
- Section 6 – Subsurface Conditions
- Section 7 – Geotechnical Analysis
- Section 8 – Dam Breach and Runout Analysis
- Section 9 – Conclusions and Recommendations

A list of references has been provided at the end of this document. The report also includes tables, figures, and appendices presenting the results of the probabilistic seismic hazard evaluation, laboratory investigations, geotechnical analyses, and dam breach and runout analyses.

1.5 SUMMARY OF UPSTREAM TAILING DAM CONSTRUCTION

Tailing dams can be constructed as either water retention dams or of tailing. The former uses an engineered dam to impound tailing. The latter use careful tailing sand placement to create an impoundment and was the method employed at the Elizabeth Mine site.

This section has been included to provide a description of the procedures and methods historically used for constructing dams of tailing and specifically using the upstream tailing dam construction method. The discussion is limited to describing header and spigot deposition methods; the type of deposition used for TP-1 and TP-2. This section is also provided for a better understanding of the importance of tailing management during the tailing dam construction process and the complexity of tailing storage facilities, which is not readily visible from surface observation of an inactive tailing dam, such as at the Elizabeth Mine site.

The tailing dam analyses presented in this report involve modeling the tailing dam on a macroscale and as an "idealized" and "uniform" structure. However, on a microscale, tailing consists of materials that are nonhomogeneous and isotropic. Engineering properties differ with lateral location and depth. The tailing materials also can physically change with time from geochemical weathering.

Overview

The upstream tailing deposition construction method, as employed at the Elizabeth Mine site, uses fine tailing sand to impound the even finer sand, silt, and clay size material. Successful construction of a tailing dam requires a relatively well-drained, well-constructed, and well-maintained downstream shell for dam stability and is dependent upon continuous management of the tailing placement process.

This process uses hydraulic separation and the natural process of particle sorting and classification to create a stable, free-draining shell of tailing sand. Improper tailing deposition practices or lapses in deposition management can adversely affect drainage properties and reduce the overall dam stability.

Tailing dam construction is a continuous process that occurs with active mining and milling. Once mining is complete, the dam construction is also complete.

Tailing deposition and, more importantly, tailing dam construction requires stewardship and attentive operators in order to achieve the intended results and satisfactory embankment performance. Changes in the ore body, milling practices, depositional practices, weather, personnel, and other factors can significantly affect the overall performance and behavior of a tailing impoundment.

Tailing Deposition

The successful movement of the tailing slurry depends on maintaining sufficient energy in the whole tailing stream (slurry) to keep particles in suspension. Once the slurry reaches the discharge point, such as a launder outfall from the header, the system energy is dissipated. Most of the energy is dissipated at the point where the slurry meets the tailing beach. At this point, a plunge pool forms and the kinetic energy decreases significantly. The larger suspended tailing particles begin to settle and the tailing beach begins to aggrade. The coarsest sand tailing will settle most quickly because of relatively small surface area compared to mass. The tailing beach aggrades more quickly at the header discharge point creating a cone of fine sand. The header discharge points are spaced so that the sand cones overlap and create a generally uniform beach slope. When properly constructed, this slope will extend from the dam crest to the decant pond.

Tailing management is the process of controlling the deposition location and rate such that the tailing beach area does not aggrade too quickly. Should this occur, the tailing stream will meander away from the core to the lower portions of the dam crest. In this example, the finer tailing will pool in the low spot and allow the finer silt and clay fraction to settle and deposit in that area. When this occurs, areas or zones of low permeability are created which influence the tailing shell drainage characteristics. These impacts can be significant. Fine layers can cause a locally perched water table, impeded drainage, and localized slope instability. Areas with high pore pressures can also have a high potential for losing strength during liquefaction.

The aggraded beach is generally concave upward, steepest near the crest of the dam (i.e., the sand cone) and flattening further from the dam crest. In the steeper portions of the beach area, the tailing flow is generally perpendicular to the dam crest axis for a short distance and at some distance from the crest, the tailing stream begins to meander. As the flow proceeds, small pools are created and covered. Finer tailing is deposited in these pools, creating a layer or zone of tailing known as transition tailing. At the decant pond, the tailing flow is held for long periods in

a still pool and, as a result, the decant pond contains mostly tailing fines (slimes) consisting of silt and clay size material.

A critical portion of tailing management is the art of maintaining a tailing stream flow that runs perpendicular from the dam crest and produces a uniform, clean sand beach.

At the Elizabeth Mine site, the tailing slurry was selectively deposited along the dam crest in a process that is similar to the present-day header and spigot deposition method. Elevated wooden launders (i.e., headers) constructed along the dam axis carried the tailing slurry along the dam crest. Sluice gates, installed along the launder length, allowed selective tailing deposition at each gate and drop chute (i.e., spigot). This system was replaced in later years with a header line and spigots.

Dam Stability

Slope stability of a tailing dam is achieved by controlled tailing management so that a wide free-draining shell of sand tailing is produced. The coarse sand will have a relatively high shear strength, but more importantly will have good drainage characteristics. The deposition of fine material in the coarse, free-draining dam shell is counterproductive to stability because it will impede drainage and can significantly reduce dam stability.

The upstream tailing deposition process places the material in a relatively loose state. Void ratios can be in excess of 1.0, generally resulting in a contractive behavior when the tailing is subjected to shear stresses. Upstream method tailing dams are prone to elevated pore pressures resulting from normal pore water drainage, the rate at which the dam is raised, and tailing management practices. These excess pore pressures can cause instability from static and/or dynamic liquefaction. Tailing management and deposition processes are designed to minimize raise rates such that pore pressures are allowed to dissipate and the resulting dam has a free-draining shell with a low phreatic surface (internal water level) in order to maintain dam stability.

Current Practices

Present-day mining and milling operations for the copper and base metal industries produce tailing impoundments with relatively flat downstream slopes. Tailing dams constructed today, using header and spigot deposition, typically have slopes ranging from approximately 3.5:1 (horizontal:vertical) up to 5:1, depending on the tailing properties. The actual slope of a specific tailing dam depends on the engineering properties of the tailing, including the tailing shear strength and grind, as well as the tailing management practices. The slopes noted above provide the dam designer some flexibility and allow for modest variations in tailing deposition practices. Tailing dams require continuous monitoring and maintenance during the deposition process. Engineering evaluations are made and instruments are installed to monitor dam performance at regular intervals. The instruments are monitored regularly during and after deposition.

Section 2

This section provides the general site characteristics, including climate, watershed, and site geology. Although more detailed site-specific hydrologic analysis will be completed in the future, the following sections provides a general overview of site conditions. Also included in this section are descriptions of tailing dam TP-1 and the existing and historic decant systems for the tailing dams at the site.

2.1 CLIMATE

The state of Vermont is subdivided into three climatological divisions (Western, Northeastern, and Southeastern divisions). Elizabeth Mine is located in the Northeastern Division, where precipitation occurs throughout the year with most of the annual precipitation generated by local frontal systems directed by jet stream flows. However, during the summer months, thunderstorms are responsible for heavy localized rainfall. Based on weather data obtained from the Vermont State Climatological Office (2002), precipitation is generally uniform throughout the year, with January receiving the lowest precipitation levels and April and August being the wettest months, on average. Snow can occur between mid-October through late April, with the majority of the snowfall being received during December, January, February, and early March. In general, the site area receives an average of 36 to 40 inches of precipitation each year.

The lowest average low temperature occurs during January and is approximately 25°F (degrees Fahrenheit). The highest average high temperature occurs during July and is approximately 81°F.

2.2 WATERSHED DESCRIPTION

Elizabeth Mine is located within the Copperas Brook Watershed, a tributary to WBOR. The drainage area contributing to TP-1 encompasses an area of approximately 275 acres (ADL 2001). The trapezoidal-shaped basin is orientated with the longest axis trending in the east-west direction.

The site elevation ranges from approximately 1,480 feet above sea level at the top of the watershed to approximately 780 feet at the confluence of Copperas Brook and WBOR. The site is bounded by Copperas Hill and Copperas Hill Brook to the west and by Lords Brook and Grove Hill to the south and east, respectively. Copperas Brook is an intermittent stream in the upper reaches and a continuously flowing stream in the lower reaches below TP-1, with base flow being provided by seepage from TP-1 and discharge from the TP-1 decant system. The upper areas of the watershed include exposed bedrock outcrops, surface leach piles (TP-3), and tailing impoundments (TP-1 and TP-2).

The local topography is characterized by gently rolling hills with the site generally sloped north towards WBOR. The main drainage from the site is provided by Copperas Brook, which flows toward the north at an approximate slope of 10 percent. The steepest channel slopes are located in the vicinity of TP-3. These slopes range between 2:1 to 1.5:1.

Copperas Brook originates within TP-3, and after crossing under Mine Road in a culvert, flows through a historic breach in tailing dam TP-2 and onto the surface of TP-1. Surface water on TP-1 (i.e., decant pond) is drained by a historic decant structure consisting of a pipeline buried in the tailing near the right abutment. The outlet of the decant structure discharges water into a channel bed, which flows unimpeded to WBOR. A spring and several seeps flow from the base

of TP-1 across deposited tailing materials before joining the main branch of Copperas Brook. The tailing located downstream of the TP-1 tailing embankment may have been eroded by surface water flows on the embankment slopes and deposited in the bottom of the stream valley.

Copperas Brook joins with WBOR approximately 2,000 feet downstream of TP-1. WBOR flows to the east and south joining with the Ompompanoosuc River (OR) approximately 4 miles downstream.

The USACE Union Village Dam is located just downstream of the WBOR and OR confluence, providing flood control. Approximately 4 miles downstream of Union Village Dam, OR flows into the Connecticut River.

2.3 GEOLOGY

Elizabeth Mine is located on the eastern limb of the Green Mountain Anticlinorium in east-central Vermont. Topography in the region consists of rounded low mountains, hills, and valleys that have been shaped and modified by regional glaciation. Bedrock in this region consists of structurally complex, folded and faulted, medium- to high-grade metamorphic rocks of Paleozoic age. The massive sulfide mineral deposit at Elizabeth Mine is located in the Vermont Copper Belt.

Elizabeth Mine is located approximately 10 miles west of the Connecticut River, along the east side of Copperas Hill. The surface and underground workings were developed by mining a number of ore bodies located along an approximately 2-mile-long band in the area south of and beneath Copperas Hill. The tailing disposal facility (TP-1 and TP-1) is located east of Copperas Hill across the Copperas Brook Valley. The tailing impoundment was constructed in a relatively wide, gently sloping portion of the Copperas Brook Valley that curves south and west of Copperas Hill.

Bedrock consists of medium- to high-grade meta-sedimentary rocks (schist) of the Devonian Age Giles Mountain Formation (Howard 1969). The bedrock is intensely folded (with overturned folds), faulted, and contains a number of types of rock mass discontinuities, including relic bedding, joints, faults, foliation, and rock cleavage. The rock mass is probably closely to moderately fractured.

The bedrock underlying the waste rockpile (TP-3) is overlain in areas by glacial till. The till is laterally extensive at lower elevations and has been identified in all test borings located in the vicinity of TP-1 and TP-2, where depths have been estimated to be up to 50 to 75 feet thick (ADL 2002). The till consists of compact (dense) sand and gravel with a clay/silt matrix. The upper portion of the till is believed to be an ablation till containing glacial outwash materials, consisting of till reworked into sand and gravel deposits. The glacial till is locally overlain by alluvium consisting of sand and gravel deposits with cobbles and occasional boulders. The alluvium extends under portions of TP-1.

2.4 TAILING DAM TP-1

Tailing dam TP-1 is an L-shaped side valley impoundment that covers approximately 27 acres. The impoundment has a total crest length of approximately 2,100 feet and a maximum

embankment height of approximately 120 feet. The dam has a downstream slope ranging from approximately 1.37:1 to 1.5:1.

TP-1 tailing deposition was initiated behind a small starter dam located in a small erosion valley within Copperas Brook. The starter dam is estimated to be approximately 25 feet high at the maximum section with a crest elevation at approximately 970 feet. The starter dam is believed to be constructed of glacial till borrow from the surrounding area. Field condition did not allow for drilling of a planned test borehole in the starter dam area.

Historic photos show that hydraulic tailing deposition and the upstream construction method were used to construct dams TP-1 and TP-2. The upstream construction method uses the hydraulic segregation and natural classification of sand, silt, and clay size tailing fraction to create a relatively sandy, free-draining slope (i.e., shell). This sand shell provides embankment stability and serves to impound the larger volume of finer silt- and clay-sized tailing (i.e., slimes), as described in Section 1.5.

2.5 TP-1 AND TP-2 DECANT SYSTEMS

Tailing was delivered to the dam as a slurry, a mixture of solids and water, with a pulp (solids) content of between 30 and 40 percent by weight. The excess water was collected in a surface pool, referred to as a decant pool or pond, located at the upstream end of the impoundment. Water was removed from the pond by a decant system.

Decant systems are used to manage water during active tailing deposition. The decant pond elevation and the volume of process water held within the system is controlled by the height of the decant towers above the pond surface. At Elizabeth Mine, gravity decant systems were constructed at both tailing dams TP-1 and TP-2. The gravity systems consisted of a series of vertical inlet towers. The towers functioned as ungated spillway structures connected by a horizontal discharge pipe sloping toward the outfall at the dam toe. Water collected from the decant pools was either reused in the milling process or released downstream into Copperas Brook.

The TP-1 decant structure is located at the right (south) abutment of TP-1. The majority of the decant structure is aligned parallel to the existing drainage and extends approximately 250 feet west of the right abutment. The current decant system outfall is located at an elevation of approximately 1,017 feet, well above the valley floor and a significant volume of tailing. This high current outfall elevation suggests that one or several remnant lower decant systems providing water removal for early phases of dam operation may be buried in the tailing.

When mining operations ceased, the decant systems were no longer required to manage process waters and currently serve only as a surface water conveyance system and emergency spillway, protecting the dams to an unknown extent from overtopping during flood events. Decant flow consists of water from spring snowmelt runoff, normal precipitation events, and groundwater that enters through leaking pipe joints.

The TP-2 decant structure failed at some point in the 1970s, potentially leading to the TP-2 tailing dam failure. The cause of the TP-2 decant structure failure is unknown. Only remnant pipes remain in the TP-2 decant branch. The TP-1 decant structure continues to serve as an emergency spillway for both dams and transmits Copperas Brook through TP-1.

Section 3

A probabilistic seismic hazard assessment and a site response analysis were performed for the Elizabeth Mine site. Presented below is a brief overview of the analysis. A full description of the assessment and analysis is presented in Appendix A.

The study was completed to estimate the levels of earthquake ground motions associated with a range of return periods for this site. The results were used to evaluate the post-earthquake stability of the dam and the liquefaction potential of the tailing.

3.1 INTRODUCTION

Elizabeth Mine is located in east-central Vermont as shown on Figure 3-1. The site is on the currently passive eastern margin of the U.S. The region has a complex tectonic history including several major orogenies. There has been significant historical seismicity in the region, though there is a marked absence of mapped Quaternary faults, and almost all known earthquakes cannot be associated with specific geologic structure.

For this evaluation, geologic and seismologic data were used to evaluate and characterize potential seismic source zones, the likelihood of earthquakes of various magnitudes occurring within those source zones, and the likelihood of the earthquakes producing ground motions greater than a specified level. The PSHA methodology used in this study allows for the explicit inclusion of the range of possible interpretations in components of the seismic hazard model, including seismic source characterization and ground motion estimation.

Presented below is a summary of the seismotectonic setting and the historical seismicity of the site region, a seismic source characterization, a discussion of the attenuation relationships used in the probabilistic analysis, and the results of the hazard calculations. Section 3.6 contains a discussion of the estimated earthquake ground motions at the site based on a site response analysis, incorporating the effects of the site geology.

3.2 SEISMIC HAZARD ANALYSIS METHODOLOGY

The seismic hazard approach used in this study is based on the model developed principally by Cornell (1968). The occurrence of ground motions at the site in excess of a specified level is a Poisson process if (1) the occurrence of earthquakes is a Poisson process, and (2) the probability that any one event will result in ground motions at the site in excess of a specified level is independent of the occurrence of other events.

Two types of earthquake sources are characterized in this seismic hazard analysis: fault sources and aerial source zones. Fault sources are modeled as three-dimensional fault surfaces and details of their behavior are incorporated into the source characterization. Arial source zones are regions where earthquakes are assumed to occur randomly with no clear association with any of the faults that might be included in the seismic source model. In this analysis, all seismic sources were modeled as aerial source zones, with the exception of the fault source for the 1886 Charleston, South Carolina earthquake. All seismic sources are modeled in the hazard analysis in terms of geometry and earthquake recurrence.

Gaussian smoothing was also used in addition to the traditional approach of using aerial source zones (assuming uniformly distributed seismicity). The version of Gaussian smoothing adopted

in this study (Frankel 1995) is the same approach used in national hazard maps (Frankel et al. 1996).

Uncertainties in the source parameters are included in the hazard model using logic trees. In the logic tree approach, discrete values of the source input parameters have been included along with the estimated likelihood that the discrete value represents the actual value. In this probabilistic analysis, all input parameters have been generally represented by three values that together represent a distribution about the best estimate.

3.3 SEISMOTECTONIC SETTING AND HISTORICAL SEISMICITY

The Elizabeth Mine site is located within the Northern Appalachian Mountain Belt. The Appalachian Mountains consist of an eroded core of a Paleozoic mountain chain that extends at least 3,000 kilometers (km) from the southeastern U.S. to Newfoundland, Canada. The structural history of this portion of the U.S. is reflected in the major tectonic stages of the Appalachian Orogenic Belt.

The current tectonic setting of eastern North America is on a passive margin, several thousand kilometers from any active plate boundary. The location makes it difficult to explain the seismic activity in the region in terms of a simple plate-tectonic model (Ebel and Kafka 1991). The last major tectonic activity in the eastern U.S. took place during the Mesozoic period. The occurrence of seismicity in the absence of significant tectonic activity in this region is further complicated by a dearth of individual structures that can be mapped at the surface. The regional seismicity generally does not delineate any clearly active structural boundaries to serve as a guide in mapping active faults that may be correlated with seismic activity, with a few local exceptions (Ebel and Kafka 1991).

The most widely accepted interpretation of the cause of seismicity in the northeastern U.S. is that earthquakes result from the reactivation of ancient structures in the present-day stress field (Ebel and Kafka 1991). The central and eastern United States (CEUS) are part of a broad mid-plate compressive stress province that also includes most of Canada (Zoback and Zoback 1991). Based on a compilation of focal mechanism data, Ebel and Kafka (1991) report that the current stress field over this large region is in a relatively uniform east-northeast direction of maximum horizontal compression. This direction of maximum horizontal compression corresponds well to the direction of absolute plate motion of the North American Plate. This suggests that a far-field tectonic source, such as ridge-push or basal drag at the Mid-Atlantic Ridge, may be the primary source of stress in the mid-plate region (Zoback and Zoback 1991). Most of the ancient structures and zones of weakness in the eastern U.S. trend approximately north-northeast, largely resulting from east-west directed continental collision and rifting events.

The Elizabeth Mine site is located in the northeastern U.S., a region that includes New York, Vermont, New Hampshire, Maine, Massachusetts, Connecticut, and Rhode Island. Significant historical earthquakes have occurred in New England, and the northeastern U.S. has been strongly affected by large earthquakes originating in adjacent southeastern Canada, particularly from the St. Lawrence River Region (Figure 3-1). Ebel and Kafka (1991) observed that seismicity tends to reoccur in certain places, which may indicate preferential reactivation of older structures within the present stress field in these locations.

Recent Earthquake Events

Significant earthquakes within the study region include:

- The 1755 body-wave magnitude (m_b) 5.8 earthquake east of Cape Ann, Massachusetts, with a reported Modified Mercalli (MM) intensity of VIII.
- The 1929 m_b 5.2 earthquake near Attica, New York, with a reported MM VIII, and the 1929 magnitude (M) 7.2 Grand Banks earthquake.
- The 1940 m_b 5.5 earthquakes near Ossipee Lake, New Hampshire.
- The 1944 m_b 5.8 earthquake near Massena, New York.
- The 1983 m_b 5.2 earthquake near Blue Mountain Lake, New York.
- The 2002 M5 earthquake near AuSable Forks, New York.

It was estimated that the Elizabeth Mine site may have been subject to high-intensity ground shaking (MM V) during the 1940 earthquakes near Ossipee Lake, New Hampshire and possibly during the 1983 earthquake near Blue Mountain Lake, New York. There have been six earthquakes within 50 km of the site in the historical record (Figure 3-1). The nearest event was a m_b 3.3 event that occurred on December 20, 1800, 12 km southeast of the site. The largest event within 50 km was a m_b 3.6 that occurred on April 11, 1934, 35 km west-northwest of the site.

3.4 INPUT TO ANALYSIS

Seismic sources were characterized and considered in the probabilistic seismic hazard analyses and site-specific attenuation relationships were selected and used.

Seismic Sources

Seismic source characterization is concerned with three fundamental elements:

- The identification and characterization of significant sources of future earthquakes.
- The maximum size of these earthquakes.
- The rate at which different size earthquakes occur.

Fifteen aerial source zones that represent earthquakes probably associated with buried and generally unknown faults (background) were characterized and used in the probabilistic analysis.

Available published and unpublished data for the region were relied on to characterize the seismic parameters for each seismic source. Relevant parts of several unpublished seismic hazard reports were also reviewed for sites in the region (e.g., Geomatrix Consultants 1996; 1997) and recent seismic hazard reports by the Canadian Geological Survey (Adams and Halchuk 2003), in addition to published regional-scale geologic and fault maps and other publications.

The major challenge in understanding the earthquake potential in the central and eastern U.S. has been the attempt to associate the observed seismicity with specific geologic structures. Few active faults are known east of the Rocky Mountains. Thus, the traditional approach in addressing the seismic hazard in the CEUS has relied on the historical earthquake record and the

use of seismic source zones that separate regions of different seismotectonic characteristics and, hence, possibly different earthquake potential. For this analysis of the site, 15 seismic source zones were characterized and one fault was also included in the probabilistic analysis.

The zones represent regions having a common geologic history that distinguishes them from neighboring areas. They may have a similar structure (e.g., faults or fractures of similar age, type, orientation), a similar pattern of seismicity, and/or a homogeneous stress regime. Each seismic source zone was defined and characterized according to geologic, tectonic, and seismicity data. The seismogenic crust was assumed to be 20-km thick in the site region based on an analysis of historical seismicity (Ebel and Kafka 1991). In almost all cases, the recurrence parameters and maximum magnitudes were adopted from Adams and Halchuk (2003).

Gaussian Smoothing

Regional-scale seismic source zones were incorporated into the analysis to account for the hazard from earthquakes that are not definitively associated with known or mapped faults. In the case of most of the CEUS, this is the majority of the historical record. In the western U.S., this seismicity is described as "background earthquakes." This seems somewhat misleading for the CEUS because it suggests that mapped fault-related seismicity is discernible, when in fact it rarely is.

A potential disadvantage in the traditional use of seismic source zones is the assumption that seismicity is distributed homogeneously and randomly within each zone, thus displaying nonstationary behavior. It has been argued, however, that seismicity in the CEUS is nonrandom and that samples of the short-term historical record resemble the long-term record. Thus, in addition to the use of seismic source zones, Gaussian smoothing of the historical seismicity was also used in the hazard analysis.

The two approaches of Gaussian smoothing (Frankel 1995) and the seismotectonic province approach using aerial source zones were weighted equally at 0.5 each. This approach addresses both the spatial stationarity of seismicity and its randomness. The historical background seismicity was smoothed to incorporate a degree of stationarity, using a spatial window of 25 km.

Ground Motion Attenuation

For this study, two ground motion attenuation relationships were selected that are applicable to the eastern North America: the Toro et al. (1997) Model and the "fitted" Atkinson and Boore Model. Both relationships are stochastic-based models, employ the m_b scale, and assume hard rock site conditions.

These two relationships are considered the most reliable and applicable relations developed for hard rock conditions in eastern North America. In the probabilistic analysis, the relationship of Toro et al. (1997) was assigned a weight of 0.67, while the fitted Atkinson and Boore (1998) was given a weight of 0.33. These weightings are based on the applicability of the two relationships (URS 2001). For reference, the ground motion attenuation relationships used by the USGS in preparing the 2002 versions of the National Seismic Hazard Maps included the Toro et al. (1997) and Atkinson and Boore (1995) relationships along with three other models.

3.5 PROBABILISTIC SEISMIC HAZARD ANALYSIS

The results of the PSHA for the Elizabeth Mine site are presented in terms of ground motion as a function of annual exceedance probability. This probability is the reciprocal of the average return period. The values for mean peak horizontal ground acceleration (PGA) are listed in Table 3-1 for return periods of 500; 1,000; 2,500; and 5,000 years.

3.6 SITE RESPONSE ANALYSIS

To evaluate the potential amplification of ground motions due to the presence of glacial till beneath the tailing dams, a site response analysis was conducted. The analysis was performed using one-dimensional wave propagation methods included in the computer program SHAKE (Schnabel et al., 1972) to calculate the PGA values at the ground surface. The soil behavior is modeled using the equivalent-linear method proposed by Seed and Idriss (1970). The analysis is performed in iterations until the shear modulus and damping values used in the analysis are compatible with the computed shear strain. The modified time histories were input at the top of rock surface of the idealized profile to calculate the PGAs at the ground surface.

The glacial till varies in thickness beneath the dams from about 45 to 75 feet thick. The idealized soil profile used in the analysis consists of about 60 feet of glacial till underlain by the siliceous/mica-quartz of the Giles Mountain Formation.

No site-specific shear-wave velocities were available for the site. However, standard penetration test (SPT) blow counts have been measured at the site and range from the mid-50s to 100-plus per foot. In the National Earthquake Hazards Reduction Program (NEHRP) site categorization for very dense soil and soft rock (Site Class C), which is appropriate for till, the range of shear-wave velocity (V_S) is 1,200 to 2,500 feet per second (ft/sec) for standard penetration of resistance blow counts greater than 50 per foot. Therefore, the V_S range of 1,200 to 2,500 ft/sec was adopted for the 60 feet of till. The shear wave velocities were varied in a sensitivity analysis. For bedrock, a lower V_S of 8,000 ft/sec was adopted based on values of 9,184 ft/sec from Atkinson and Boore (1997) and 9,300 ft/sec from Pacific Engineering and Analysis (PE&A). The lower value represents the probability that the top layer of the schist is weathered/fractured to some degree.

Softening of the soil stiffness is specified using the shear modulus degradation ratio (G/G_{max}) and damping versus shear strain curves. The shear modulus degradation ratio (G/G_{max}) and damping curves for generic cohesionless soils from the Electric Power Research Institute (EPRI 1993) were applied for the glacial till.

The horizontal-component time histories of the December 25, 1985 1543 UTC M 5.7 (m_b 5.3) Nahanni, Canada earthquake, recorded at the Northwest Territories Station, were selected for analyses. These time histories were selected because their overall characteristics are consistent with those controlling the probabilistic hazard at the site. Characteristics considered included magnitude and recording distance. The results of the probabilistic hazard analysis indicate that ground motions at the project site are dominated by earthquake events in the range of m_b 5.3 to 5.9 at a distance approximately 25 km.

To develop acceleration time histories with response spectra that match those of the rock target spectra, the selected time histories were modified using the method proposed by Lilhanand and Tseng (1988) and modified by Abrahamson (1993). In this method, the time history is adjusted

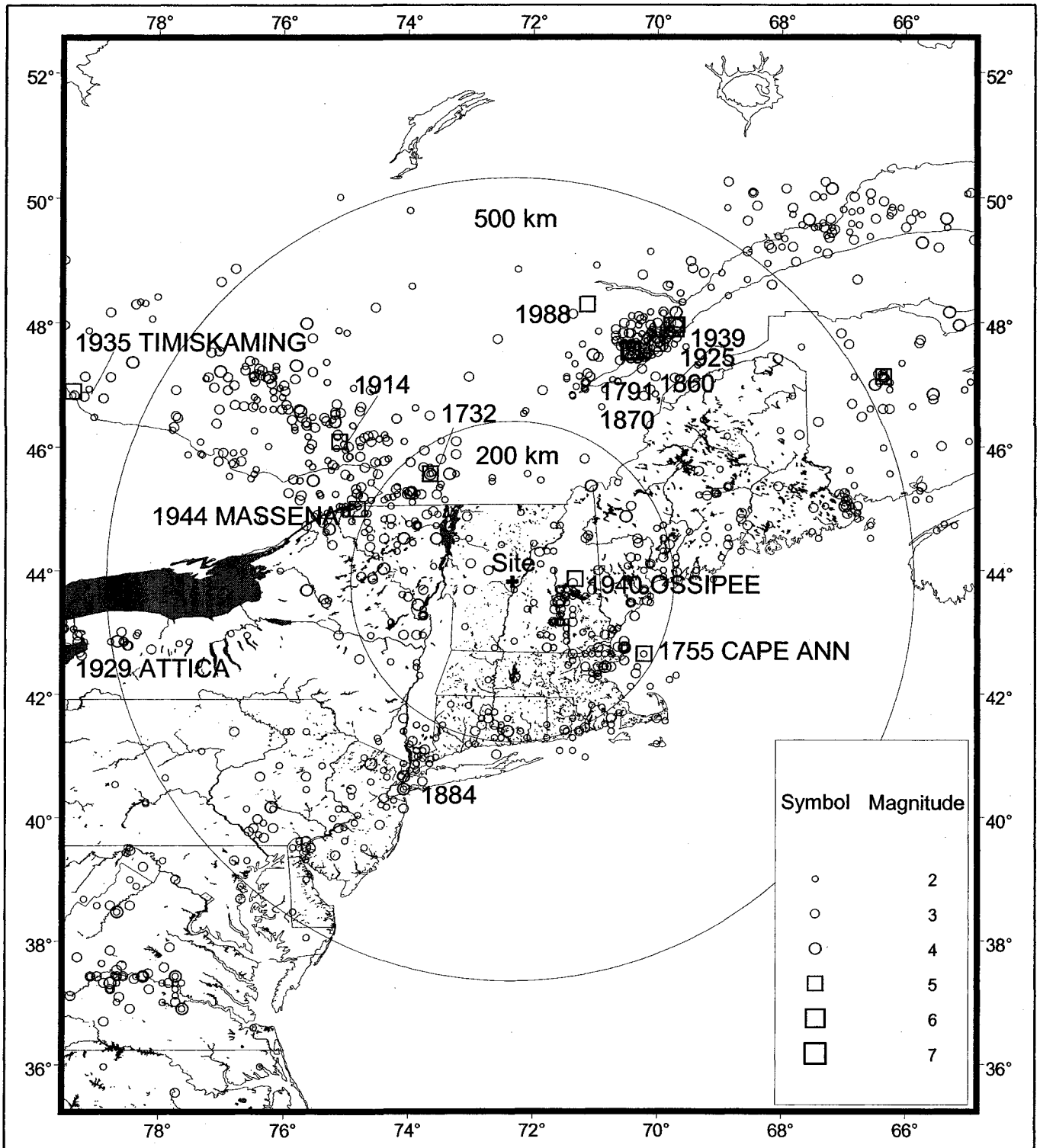
in time domain by adding wavelets in iterations until a satisfactory match to the target spectrum is obtained. The method has been shown to preserve the nonstationary characteristics of the recorded time histories.

The calculated PGAs at the ground surface are tabulated on Table 3-1. The presence of the glacial till amplifies the rock PGAs by a factor of approximately 2. The soil values were used in the liquefaction analysis and the seismic stability evaluation.

Table 3-1

MEAN PROBABILISTIC PEAK HORIZONTAL GROUND ACCELERATION ON ROCK AND SOIL

Return Period (yrs)	Rock PGA (g's)	Soil PGA (g's)
500	0.04	0.10
1,000	0.07	0.14
2,500	0.12	0.24
5,000	0.18	0.31



Project No. 22235583 Elizabeth Mine, Strafford, VT URS	**Historical Seismicity of the Site Region (1700-2003)**	Figure 3-1

Section 4

As part of the field investigations completed during the RI, data were collected to evaluate the subsurface materials contained in or near tailing dams TP-1 and TP-2 and to collect samples of these materials for geotechnical laboratory testing. An inspection of the TP-1 decant structure interior was also completed as part of the field investigations.

In general, the field investigations included:

- Performance of a remote video inspection of the TP-1 decant structure
- Visual inspection of tailing dams TP-1 and TP-2
- Drilling and sampling test boreholes
- Excavating and sampling test trenches
- Performance of cone penetration testing (CPT)

The remote video inspection was completed on August 16, 2002, and the visual inspection of the tailing dams were completed on October 30, 2002. Ten test boreholes, 17 test trenches, and 13 CPT soundings were completed between October 29, 2002 and November 23, 2002. The locations of the test boreholes, test trenches, and soundings are shown on Figure 4-1, and the summary logs for the test boreholes and test trenches are provided on Figures 4-2 through 4-5. The CPT soundings results are presented on Figures 4-6 through 4-19. Presented below is a brief summary of historical work completed by others, followed by discussions of current field investigations completed during the RI and incorporated into this report.

4.1 WORK COMPLETED BY OTHERS

Historical data collection activities relating to Elizabeth Mine began in 1977 with a limited study performed by the Vermont Agency of Environmental Conservation, including sample collection for analysis of certain metals. Other organizations that have conducted investigations at Elizabeth Mine include the Vermont Agency of Natural Resources (VTANR), the USACE, Colorado School of Mines, USGS, the Elizabeth Mine Study Group (EMSG), and Arthur D. Little, Inc. (ADL). Most of the data collected were for environmental evaluations, and the media collected and analyzed (primarily for metals) during these studies included mine tailing, waste rock, surface water, sediment, fish tissues, groundwater, and drinking water. Limited geotechnical data was collected prior to the field investigation completed as part of the RI and presented in this report.

4.2 INITIAL DAM OBSERVATIONS

A visual inspection of tailing dams TP-1 and TP-2 was performed by URS on October 30, 2002 prior to initiating intrusive investigation activities. The purpose of the inspection was to observe the condition of the tailing dams and finalize the test boreholes, test trenches, and CPT soundings locations. At the time of our field investigations, the TP-1 decant pond area and decant structure were dry.

TP-1 Observations

The northern downstream toe of TP-1 showed signs of ongoing seepage. Figure 4-1 shows the appropriate seepage locations observed. Seepage at the dam toe, downstream of the eventual

location of test borehole TB-11, showed evidence of internal erosion (piping). A small quantity of tailing, estimated to be several cubic feet, had discharged and been deposited in the area just downstream of the seep. Seepage was also observed on the left abutment along the north toe of TP-1 just above the left abutment.

The downstream toe of the starter dam was generally saturated, soft, and showed signs of continuous seepage. Sand boils were observed at the toe and a small amount of fresh unoxidized tailing material had been deposited downstream of the toe.

Seepage was also observed at the starter dam crest. It appeared that the starter dam may be a barrier to seepage. The tailing impounded behind the starter dam is saturated and seepage flows over the starter dam crest and beneath the starter dam in the foundation soils.

The TP-1 starter dam crest was graded during field activities to provide access for the drill rig using a small track backhoe. Soft, saturated tailing material was graded from the starter dam crest area in an effort to establish a relatively firm working platform for the drill rig. Following this disturbance, fresh unoxidized gray tailing began piping from the TP-1 face onto the newly regraded surface. Because of soft saturated conditions on the starter dam, test borehole TB-8 was inaccessible and could not be drilled.

The west side of TP-1, along the downstream toe, was dry and had no visible signs of surface seepage or disturbance.

TP-2 Observations

The downstream toe of TP-2 also showed signs of ongoing seepage. There appeared to be an upward gradient and seepage emanating from the downstream toe of TP-2. The area was generally soft and able to support only limited foot traffic. Disturbance from foot traffic caused small isolated areas of the tailing to momentarily liquefy and lose shear strength.

4.3 TEST BOREHOLES

Test boreholes were drilled in tailing dams TP-1 and TP-2 from October 29, 2002 through November 12, 2002. Five test boreholes were drilled near the crest of TP-1, and two test boreholes were drilled in the TP-1 decant pond area. Two test boreholes were drilled at the TP-2 crest and one borehole was located in the decant pond. Each test borehole was advanced at least several feet into the natural foundation soils underlying the tailing. Piezometers, consisting of solid-wall pipe with 10-foot screened sections, were installed in all of the test boreholes. The depths of the test boreholes are summarized in Table 4-1. The test borehole locations are shown on Figure 4-1, and summary logs are presented on Figures 4-2 through 4-4.

Drilling Summary

The test boreholes were drilled by Parratt and Wolff, Inc. of East Syracuse, New York, under subcontract to URS. Test boreholes were drilled using a rotary wash drilling method, using a biodegradable polymer slurry to maintain a positive fluid pressure within the borehole and to circulate cuttings while drilling. The boreholes were advanced with a Deitrick Model D-90 drill rig.

Each borehole was sampled using a split-spoon sampler and/or Shelby tube sampler as described below. Subsurface samples were visually classified in the field and splits were obtained for geochemical and geotechnical testing. Geotechnical laboratory tests were performed on selected soil samples and the results are presented in Section 5. Geochemical results will be presented as part of the RI report.

SPT samples were collected in all of the boreholes at approximately 5-foot vertical intervals using a standard 2-inch-diameter split-spoon sampler. The split-spoon sampler was advanced 24 inches using a 140-pound safety hammer falling 30 inches. The hammer was operated using a rope wrapped around a cathead and activated by the driller. Penetration resistance was recorded by field personnel as blows per each 6 inches of sampler penetration.

The SPT resistance (or blow count) is the total number of blows required to drive the sampler from 6 inches to 18 inches of penetration and is reported as "blows per foot." The first 6 inches of penetration (0 to 6 inches) is considered to be a "seating" zone, and the last 6 inches of penetration (18 to 24 inches) is included to collect additional volume of physical sample.

"Undisturbed" samples were collected at selected depths using a 3-inch-diameter Shelby tube sampler. The undisturbed sample locations generally correspond with the upper, middle, and lower thirds of each completed test borehole. At each sample location, the undisturbed sampler was advanced approximately 30 inches. The Shelby tube samples were sealed with wax and a perforated packer, then shipped to the URS Laboratory in Totowa, New Jersey for geotechnical testing.

Piezometers

A temporary piezometer was installed in each borehole. A 2-inch-diameter flush-threaded Schedule 40 polyvinyl chloride (PVC) pipe was inserted into the finished borehole. A 10-foot-long, 0.01-inch slot screened section was installed at the bottom of the piezometer. The remainder of the pipe above the slotted section was solid-wall PVC pipe. Piezometers were generally installed for the full tailing depth.

The annular space between the slotted PVC pipe and the test borehole wall was backfilled with a sand pack consisting of No. 0 silica sand. The sand pack was placed to approximately 2 feet above the screened section and a 3-foot bentonite pellet seal was placed above the sand pack. The remaining borehole was backfilled with drill cuttings (i.e., tailing) to the ground surface, and the piezometers were fitted with a PVC cap.

4.4 TEST TRENCHES

The excavation of test trenches was performed on October 30, 2002 and October 31, 2002. The work was supervised by URS, and Northwoods Excavating of Thetford Center, Vermont was subcontracted to URS to provide and operate a backhoe for the test trench excavations. Test trenches were excavated with a Kobelco Model 70SR track-mounted backhoe capable of a maximum excavation depth of approximately 15 feet.

The test trenches were logged and photographed, and bag samples were collected at selected depths and locations to better characterize the subsurface materials around the perimeter of the tailing impoundments. Once the excavation was complete, the excavated material was replaced in the test trench.

Test trenches were generally located where the tailing contacts the natural ground surface and at the downstream toes of tailing dam TP-1 and tailing dam TP-2. The excavations were used to determine the tailing thickness and depth to glacial till and were excavated through the surface tailing material until the glacial till foundation was encountered, generally within a few feet below ground surface.

Test trenches TT-5 through TT-8, TT-20, and TT-21 were excavated at the toe of TP-1. Test trenches TT-9 through TT-11 and TT-14 through TT-16 were excavated around the perimeter of TP-1. Test trenches TT-12 and TT-13 were excavated around the perimeter of TP-2 and test trench TT-19 was excavated at the toe of TP-2.

The depths of the test trenches are summarized in Table 4-2. The test trenches were generally excavated 1 to 4 feet into the glacial till foundation soils, except for test trenches TT-7, TT-11, and TT-19, which all collapsed prior to reaching the glacial till material. The locations of the test trenches are shown in Figure 4-1, and summary logs are presented on Figure 4-5.

4.5 CONE PENETRATION TEST SOUNDINGS

A CPT program was performed from November 21, 2002 through November 23, 2002 on portions of TP-1 and TP-2. Applied Research Associates of South Royalton, Vermont, a subcontractor to URS, performed the CPT program under URS observation.

CPT soundings provide a continuous record of the subsurface materials. They provide insight into the microstratigraphy of the subsurface tailing and are well suited for fine-grained hydraulically deposited materials. The information collected from CPT soundings can be used to help understand the internal dam characteristics such as the apparent construction methods used, as well as historic tailing deposition patterns.

CPT was performed along the crest and within the impoundments of both tailing dam TP-1 and tailing dam TP-2. Some CPT soundings were collocated with a test borehole to allow correlation with measured in-situ parameters using SPT and laboratory results performed on tailing samples.

A CPT rig with a dead-weight of 23 tons and equipped with piezocone testing equipment was used. Five CPT soundings were located near the crest of TP-1, two soundings were performed near the crest of TP-2, three soundings were performed in TP-1 decant pond area TP-1, and one sounding was performed in the TP-2 decant pond area. The locations of the piezocone soundings are shown on Figure 4-1.

CPT soundings were generally advanced to the glacial till foundation soils which corresponded to depths between approximately 50 and 90 feet. The soundings were made by pushing a 15-square-centimeter electric piezocone penetrometer into the tailing at a standard rate of approximately 2 centimeters per second. Measurement of the tip resistance (q_c), sleeve friction (f_s), and dynamic pore water pressure measured behind the cone tip (u_2) were recorded every 2 centimeters. A polypropylene pore pressure filter element was saturated with silicone oil prior to penetration to maintain system saturation during penetration above the phreatic level. The q_c, f_s, friction ratio (f_s-q_c), and u_2 were recorded and plotted as a function of depth. The results of the CPT soundings are presented on Figures 4-6 through 4-19.

Correlations have been developed that use the q_c, f_s, and u_2, to estimate material properties soil classification, corrected SPT blow counts and shear strength parameters, including the effective friction angle (ϕ'), and the undrained strength.

For the field program completed for this project, the results of CPT soundings were used to estimate the ϕ', corrected SPT blow counts and undrained strengths. These correlations are provided in the Figures 4-6 through 4-19.

The pore pressures measured during penetration are referred to as the dynamic pore pressures and are the result of soil response to the advancing cone. These pore pressures do not reflect actual static in-situ pore pressure.

Static pore pressures are measured by stopping the sounding process and allowing the dynamic pore pressures to dissipate, providing measurement of the static pore pressures at a given depth. Static pore pressures were measured by stopping penetration at selected depths, removing the hydraulic pressure from the rod, and allowing the dynamic pore pressures to dissipate and reach equilibrium in a process referred to as dissipation testing. The locations for dissipation tests were individually selected in identified zones of coarse sand. These locations were selected because the equilibrium pore pressures can be achieved in a relatively short period of time (10 to 15 minutes).

4.6 DECANT INSPECTION

A video inspection of the decant system including decant towers and decant discharge pipes was performed on August 16, 2002. Figure 4-1 shows the location of the TP-1 decant system. The inspection was completed by Advanced Pipe Inspections, Inc. (API) of Boston, Massachusetts and observed by URS. Prior to beginning the inspection, the covers to Decant Towers 1 and 2 were removed by lifting the cover using a chain and small backhoe.

A remote-controlled video camera was lowered into Decant Tower 1 to view the discharge pipe downstream between Decant Tower 1 and the outfall. A significant amount of sediment debris was encountered and the travel length of the camera was limited to approximately 210 feet. The camera was then directed upstream and the section of discharge pipe between Decant Towers 1 and 2 was inspected for the full length. The video equipment was relocated to the decant system outfall, and the discharge pipe was inspected in an upstream direction from the outfall toward Decant Tower 1. Thick iron precipitates restricted camera travel and only about 72 feet of the pipe could be viewed. Approximately 140 feet of the pipe was not able to be observed between Decant Tower 1 and the outfall. Finally, the camera was deployed in Decant Tower 2, and the full length of the decant pipe between Decant Towers 2 and 3 was inspected. Results of the decant inspection are presented in Section 6.4.

TABLE 4-1

TEST BOREHOLE DRILLING SUMMARY

Test Borehole ID	Drilled Depth (ft)	Water Depth Observed During Drilling (ft)
TP-1		
TB-9	85	49
TB-10	120	95
TB-11	70	59
TB-12	47	38
TB-13	65	43
TB-14	67	45
TB-15	27	7
TP-2		
TB-16	47	34
TB-17	52	32
TB-18	32	11

Table 4-2

TEST TRENCH EXCAVATION SUMMARY

Test Trench Number	Approximated Depth Excavated (ft)	Approximate Water Depth During Excavation (ft)
TT-5	6.5	4.3
TT-6	5.8	N/A
TT-7	3	AGS
TT-8	4	4
TT-9	3.7	N/A
TT-10	1.5	N/A
TT-11	2.5	AGS
TT-12	3.5	0.5
TT-13	6.5	N/A
TT-14	11.5	11
TT-15	3.2	N/A
TT-16	3	N/A
TT-17	9	N/A
TT-18	5	N/A
TT-19	3.5	2
TT-20	6.8	2.5
TT-21	6	4

NOTES:

N/A = Not applicable. Water not encountered during excavation.

AGS = At ground surface water was approximately encountered at the ground surface during excavation.

URS

N

PLAN

0 100 200 300

SCALE IN FEET

NOTES:

1. TOPOGRAPHIC MAP PROVIDED BY U.S. ARMY CORPS OF ENGINEERS.
2. TEST BOREHOLES, TEST TRENCHES, AND CONE SOUNDINGS LOCATIONS SHOWN ARE BASED ON HAND HELD GPS MEASUREMENTS TAKEN IN THE FIELD.

LEGEND

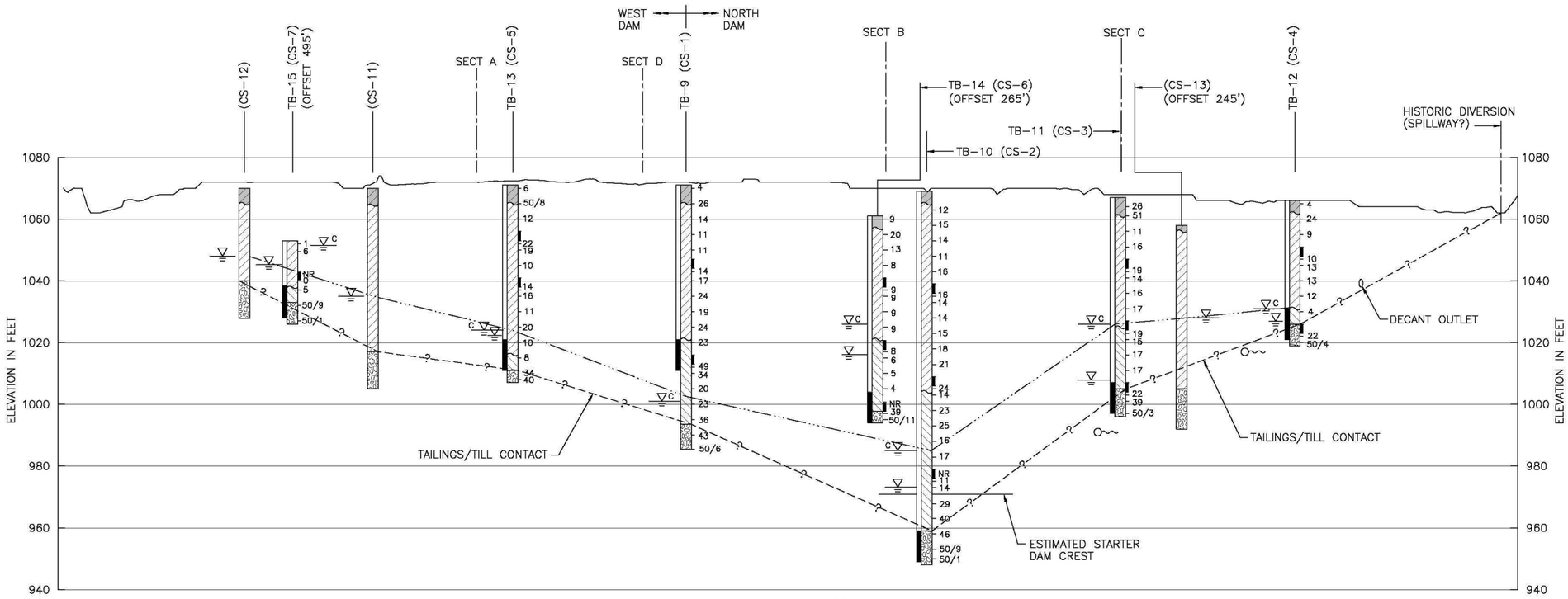
TT–5	TEST TRENCH NUMBER 5
TB–9	TEST BOREHOLE NUMBER 9
CS–1	CONE SOUNDING NUMBER 1
	SEEPAGE
TW1	DECANT TOWER 1
0	DECANT OUTLET
A 4–3	INDICATES CROSS SECTION LOCATION. "A" REFERS TO THE CROSS SECTION DESIGNATION. "4–3" REFERS TO THE FIGURE WHERE THE SECTION IS SHOWN.

Job No. :	22235583
Prepared By :	CNH
Date :	3/28/03

SITE PLAN
TP–1 AND TP–2
ELIZABETH MINE, VERMONT

ELIZ–01

FIG. 4–1



PROFILE P1 (4-1)

0 100 200 300
HORIZONTAL SCALE IN FEET

0 20 40 60
VERTICAL SCALE IN FEET

GENERAL LEGEND

- VERY LOOSE TO DENSE, MOIST TO WET, RED TO BLACK, SLIGHTLY SILTY TO VERY SILTY, NO CLAY TO SLIGHTLY CLAYEY, SAND, ORGANIC MATTER, ODOROUS, PEAT AND TOPSOIL (PT, SM)
- VERY LOOSE TO LOOSE, WET, RED TO BROWN, VERY GRAVELLY SAND, VERY SANDY GRAVEL, SILTY TO VERY SILTY SAND AND GRAVEL, TRACE COBBLES, ALLUVIUM (GM–SM)
- LOOSE TO MEDIUM DENSE, MOIST TO WET, GRAY TO BLACK, TRACE FINE TO MEDIUM SAND, SILT, TAILING (ML, SM)
- VERY LOOSE TO MEDIUM DENSE, SLIGHTLY MOIST TO WET, LIGHT GRAY TO YELLOW TO ORANGE, OCCASIONAL FERRICRETE LAYERS UP TO 1 FOOT THICK, SILTY SAND, TAILING (SM, SP–SM, SP)
- VERY LOOSE TO MEDIUM DENSE, SLIGHTLY MOIST TO WET, GREENISH GRAY TO GRAY TO BLACK, SILTY SAND, TAILING (SM, SP–SM, SP)
- VERY LOOSE TO VERY DENSE, SLIGHTLY MOIST TO WET, LIGHT BROWN TO BROWN, BLACK, CLAYEY, SILTY, GRAVELLY, SAND, OCCASIONAL COBBLES AND BOULDERS, GLACIAL TILL
- INDICATES GRADUAL CHANGE IN MATERIALS. EXACT STRATA CHANGE NOT LOCATED.
- SHELBY TUBE SAMPLE COLLECTED
- INDICATES WELL PIEZOMETER INSTALLED IN TEST HOLE. SOLID BOX INDICATES SCREENED SECTION

- 50/9 — INDICATES 50 BLOWS OF A 140–POUND HAMMER FALLING 30–INCHES WERE REQUIRED TO DRIVE A 2–INCH DIAMETER SAMPLE 9–INCHES.
- 1 — INDICATES 1 BLOW OF A 140–POUND HAMMER FALLING 30–INCHES WAS REQUIRED TO DRIVE A 2–INCH DIAMETER SAMPLER 12–INCHES.
- ESTIMATED PHREATIC WATER SURFACE
- TILL/TAILING INTERFACE
- SEEPAGE
- 0 — DECANT OUTLET
- ESTIMATED AVERAGE SAND/SLIME INTERFACE
- WATER ELEVATION AS INTERPRETED FROM CPT DATA
- WATER LEVEL ENCOUNTERED DURING EXCAVATION OR DRILLING
- NR — NO RECOVERY
- P1 (4-1) — INDICATES CROSS SECTION DETAIL. "P1" REFERS TO THE CROSS SECTION DESIGNATION. "4–1" REFERS TO THE FIGURE WHERE THE SECTION LOCATION IS SHOWN

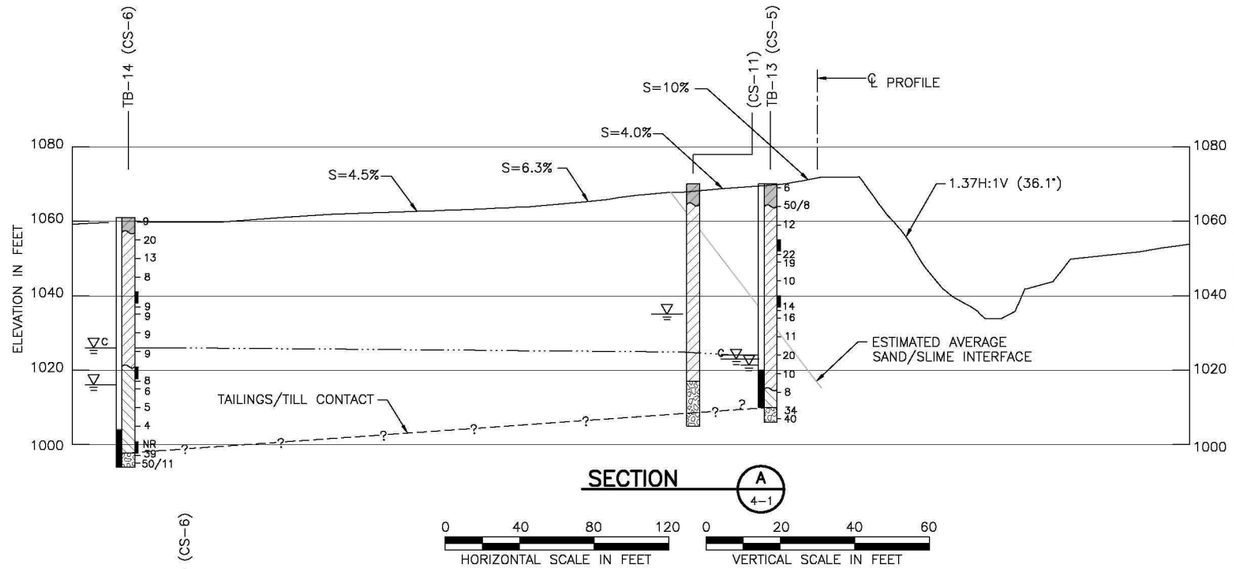
GENERAL NOTES

1. TEST BOREHOLES WERE DRILLED ON OCTOBER 29 THROUGH NOVEMBER 12, 2002 BY PARRAT & WOLFF, INC.
2. CONE SOUNDINGS WERE PERFORMED NOVEMBER 21 THROUGH NOVEMBER 23, 2002 BY APPLIED RESEARCH ASSOCIATES.
3. CONE SOUNDINGS SUMMARY LOGS ARE BASED ON INTERPOLATION OF CONE SOUNDINGS DATA SHOWN ON FIGURES 4–6 THROUGHOUT 4–19.
4. FOR TEST TRENCHES SUMMARY LOGS REFER TO FIGURE 4–5.
5. LOCATIONS OF TEST BOREHOLES AND CONE SOUNDINGS IN PLAN VIEW ARE SHOWN ON FIGURE 4–1.

Job No. : 22235583	PROFILE 1 TP–1 AND GENERAL LEGEND AND NOTES ELIZABETH MINE, VERMONT
Prepared By : CNH	
Date : 3/28/03	

ELIZ–01

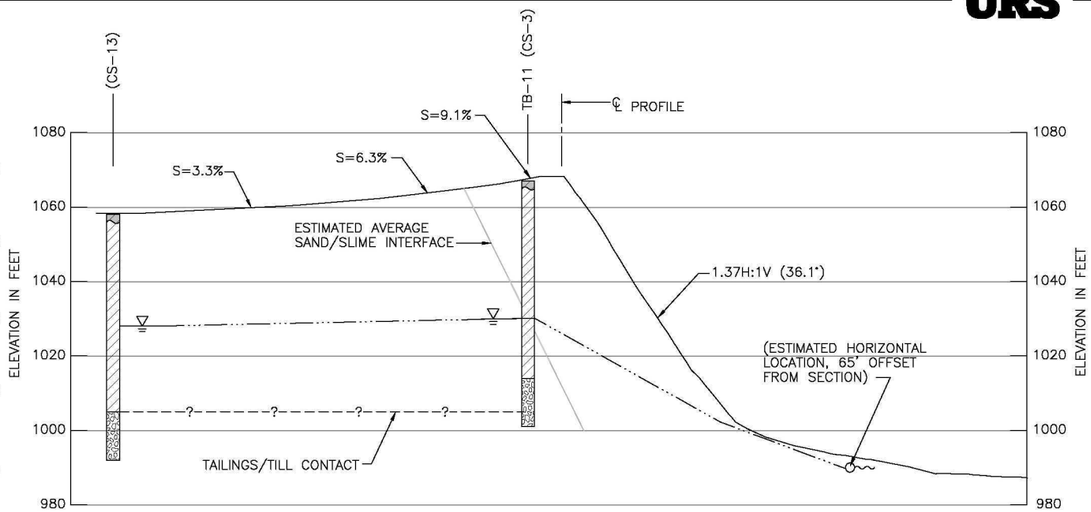
FIG. 4–2



SECTION A 4-1

0 40 80 120 HORIZONTAL SCALE IN FEET

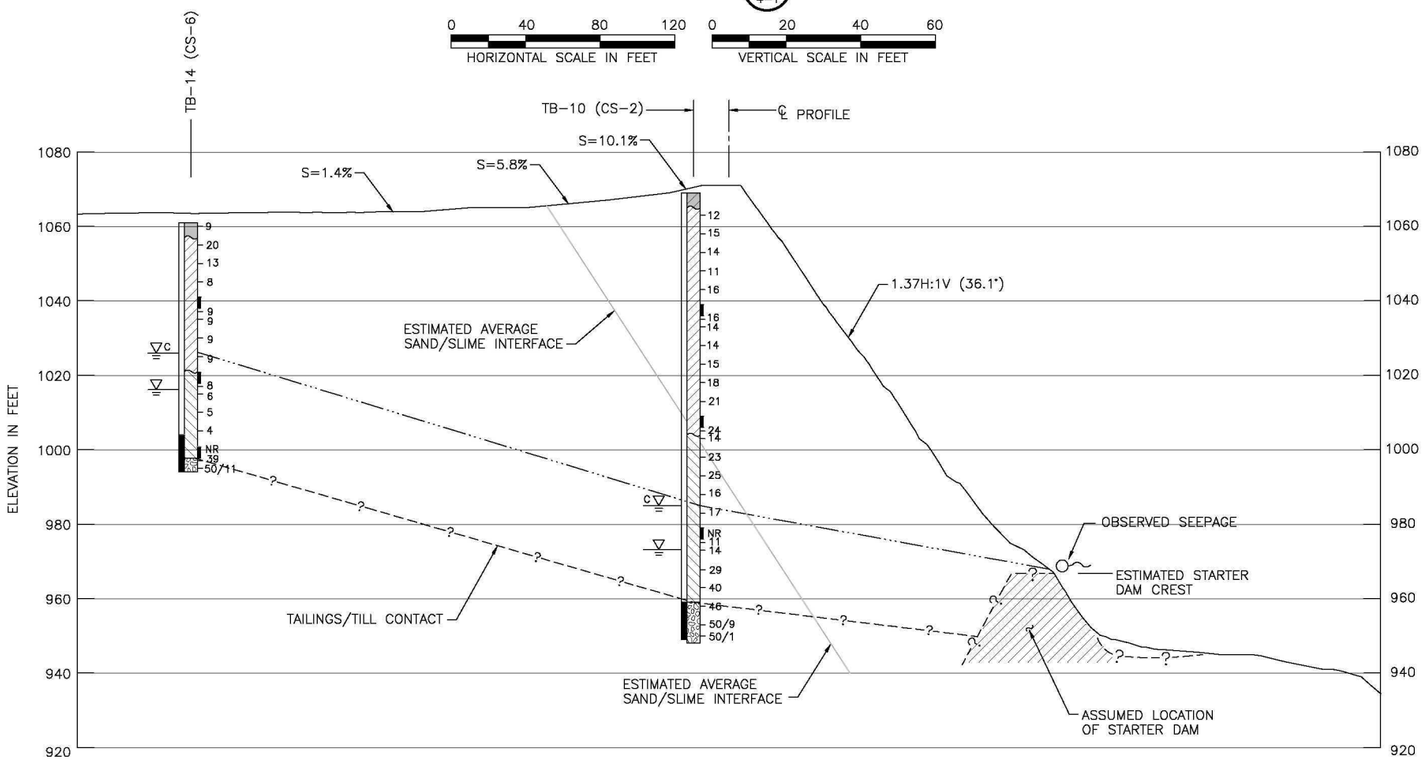
0 20 40 60 VERTICAL SCALE IN FEET



SECTION C 4-1

0 40 80 120 HORIZONTAL SCALE IN FEET

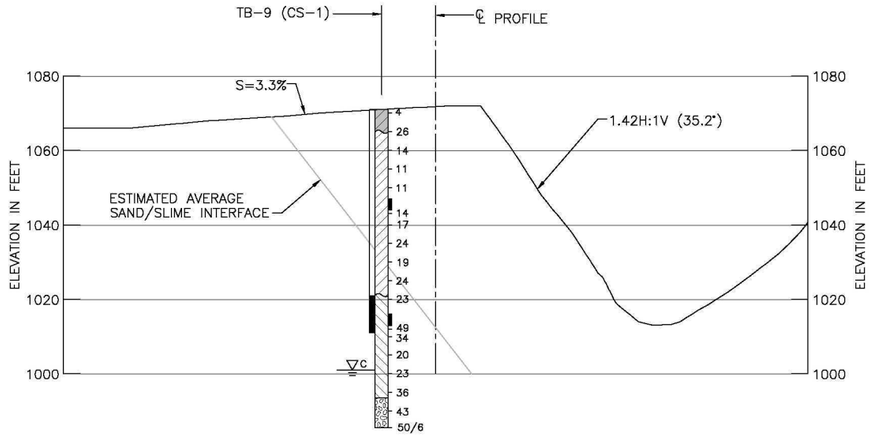
0 20 40 60 VERTICAL SCALE IN FEET



SECTION B 4-1

0 40 80 120 HORIZONTAL SCALE IN FEET

0 20 40 60 VERTICAL SCALE IN FEET



SECTION D 4-1

0 40 80 120 HORIZONTAL SCALE IN FEET

0 20 40 60 VERTICAL SCALE IN FEET

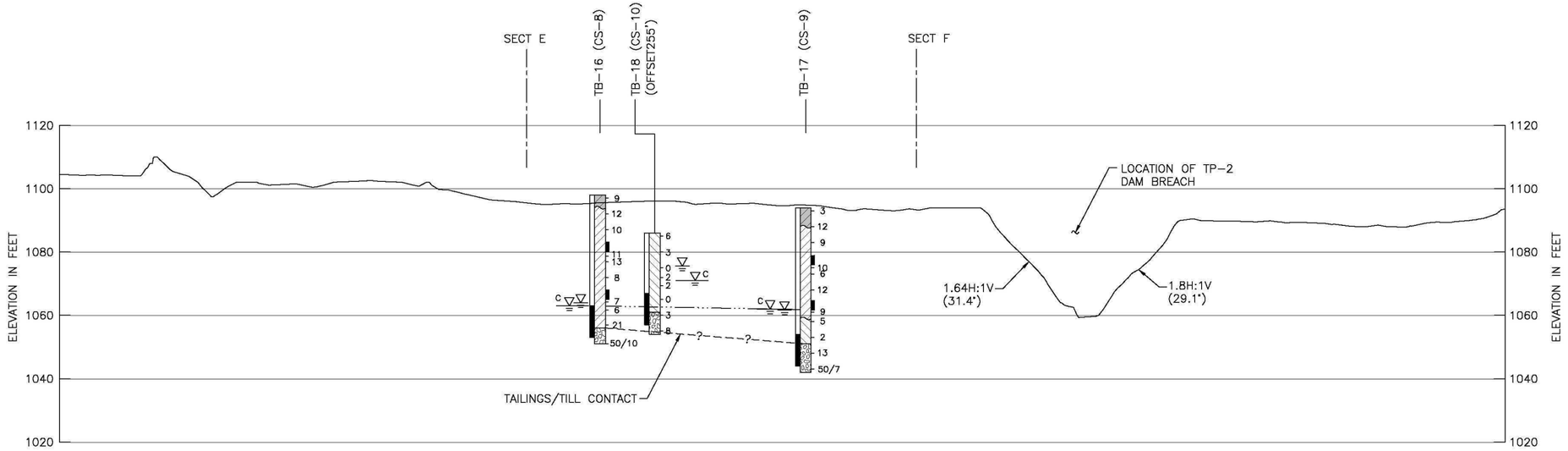
NOTES:

1. SEE FIGURE 4-2 FOR GENERAL LEGEND AND NOTES.
2. ESTIMATED AVERAGE SAND/SLIME INTERFACE SHOWN IS BASED ON INTERPRETATION OF CPT SOUNDINGS AND TESTBORE HOLES DATA.

Job No. : 22235583	SECTIONS A, B, C, AND D TP-1 ELIZABETH MINE, VERMONT
Prepared By : CNH	
Date : 3/28/03	

ELIZ-01

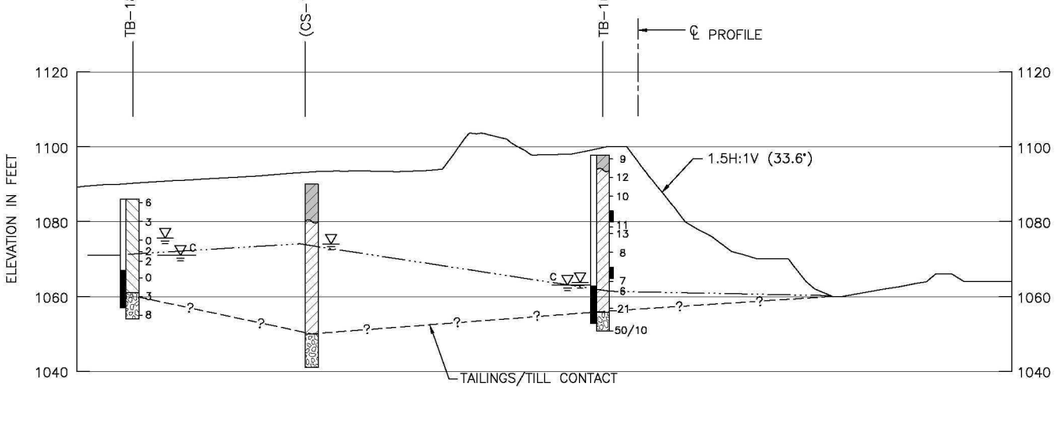
FIG. 4-3



PROFILE P2 (4-1)

0 40 80 120 HORIZONTAL SCALE IN FEET

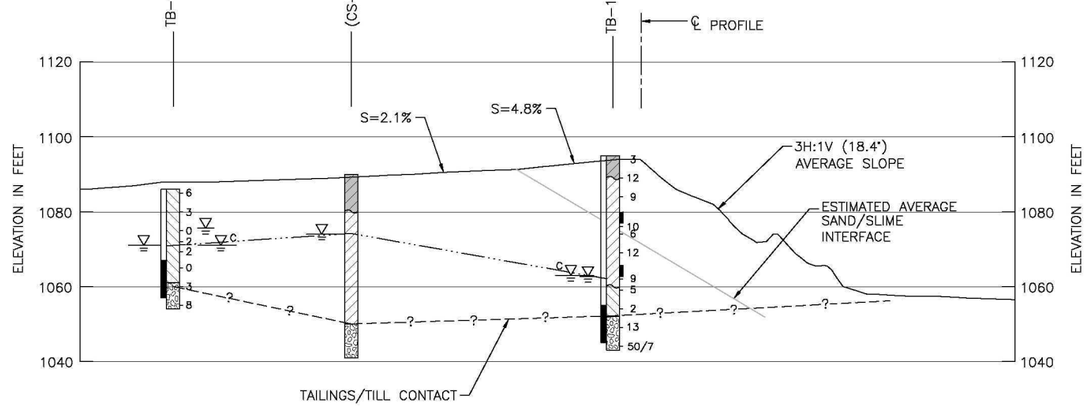
0 20 40 60 VERTICAL SCALE IN FEET



SECTION E (4-1)

0 40 80 120 HORIZONTAL SCALE IN FEET

0 20 40 60 VERTICAL SCALE IN FEET



SECTION F (4-1)

0 40 80 120 HORIZONTAL SCALE IN FEET

0 20 40 60 VERTICAL SCALE IN FEET

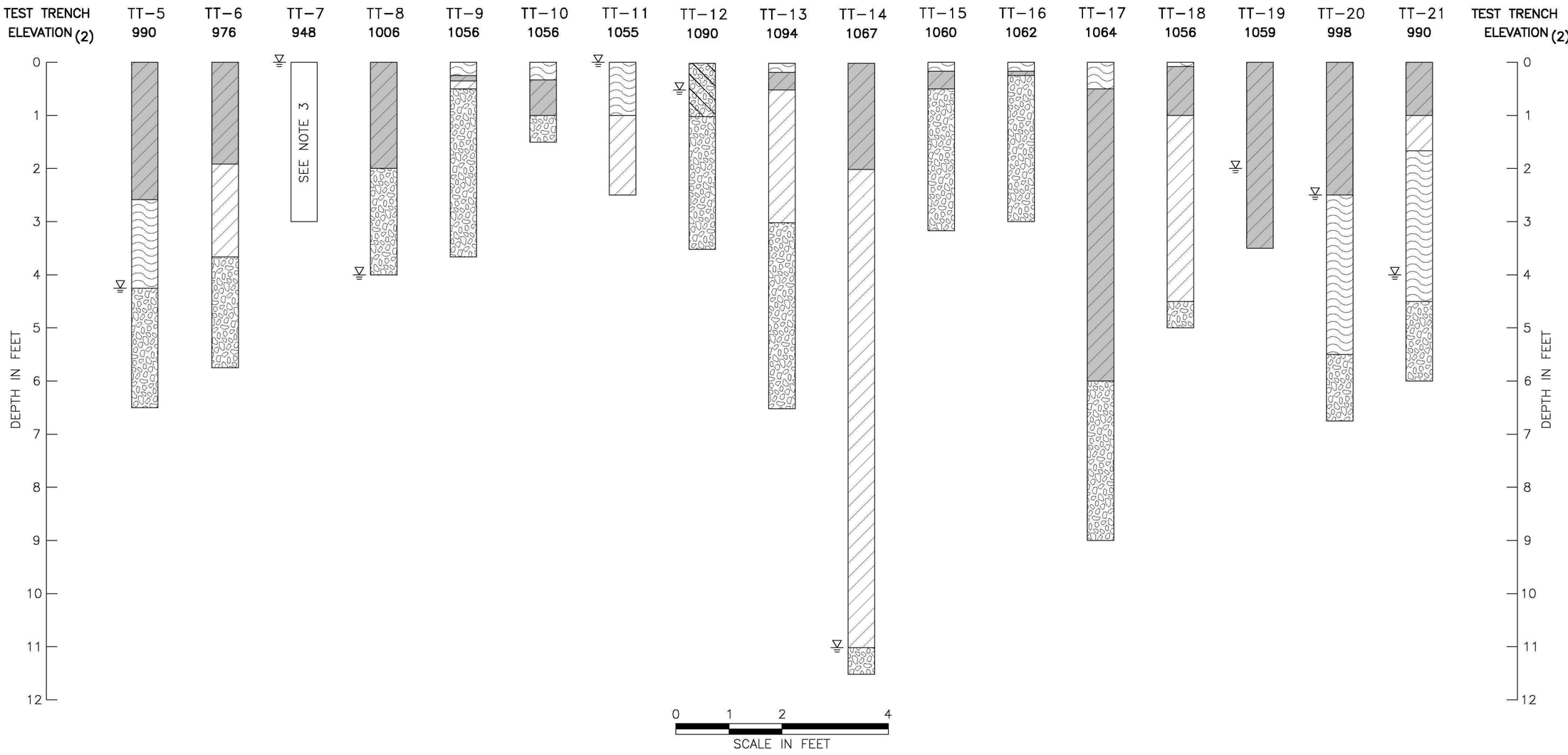
NOTES:

1. SEE FIGURE 4-2 FOR GENERAL LEGEND AND NOTES.
2. ESTIMATED AVERAGE SAND/SLIME INTERFACE SHOWN IS BASED ON INTERPRETATION OF CPT SOUNDINGS AND TEST BOREHOLES DATA.

Job No. : 22235583	PROFILE 2 AND SECTIONS E AND F TP-2 ELIZABETH MINE, VERMONT
Prepared By : CNH	
Date : 3/28/03	

ELIZ-01

FIG. 4-4



NOTES

1. REFER TO FIGURE 4-2 FOR GENERAL LEGEND AND NOTES.
2. TEST TRENCH ELEVATIONS SHOWN ARE APPROXIMATE.
3. TEST TRENCH TT-7 COLLAPSED DURING EXCAVATION. PRIOR TO COLLAPSE LAYERS OF PEAT, SAND, AND TAILING WERE OBSERVED.

Job No. : 22235583	TEST TRENCH SUMMARY LOGS
Prepared By : CNH	
Date : 03/28/03	

TEST PIT.DWG

FIG. 4-5

LEGEND:

q_c	Tip resistance
f_s	Sleeve friction
u_2	Pore pressure
ϕ'	Effective stress friction angle
———	Residual undrained strength ratio, Jefferies (1990)
———	Residual undrained strength ratio, Stark and Mesri (1992)
———	Residual undrained strength ratio, Olson (1996)
———	Peak undrained strength ratio, Olson [in press] (2003)
— — — — —	Friction angle used in URS 2003 Stability Analysis
▒	Range of effective stress friction angles from CPT and laboratory data
◆	Corrected blow counts from SPTs in noted collocated test boreholes
⊠	Dissipated pore pressure

NOTES:

(1) CPT soundings were performed by Applied Research Associates on November 20 through 23, 2002.

(2) The strength correlations noted were developed for saturated soils and may not strictly apply to unsaturated soils. Actual values may be lower.

(3) Robertson & Campanella (1983) method was used to estimate ϕ'.

(4) Jefferies and Davies method was used to estimate SPT $N1(60)_{CS}$.

(5) Refer to Figure 4-1 for CPT soundings locations.

Project No.: 22235583 Elizabeth Mine Strafford, VT URS	LEGEND AND NOTES FOR CPT RESULTS TAILING PILES 1 AND 2	Figure 4-6

LEGEND:

q_c	Tip resistance
f_s	Sleeve friction
u_2	Pore pressure
ϕ'	Effective stress friction angle
———	Residual undrained strength ratio, Jefferies (1990)
———	Residual undrained strength ratio, Stark and Mesri (1992)
———	Residual undrained strength ratio, Olson (1996)
———	Peak undrained strength ratio, Olson [in press] (2003)
— — — — —	Friction angle used in URS 2003 Stability Analysis
▒	Range of effective stress friction angles from CPT and laboratory data
◆	Corrected blow counts from SPTs in noted collocated test boreholes
⊠	Dissipated pore pressure

NOTES:

(1) CPT soundings were performed by Applied Research Associates on November 20 through 23, 2002.

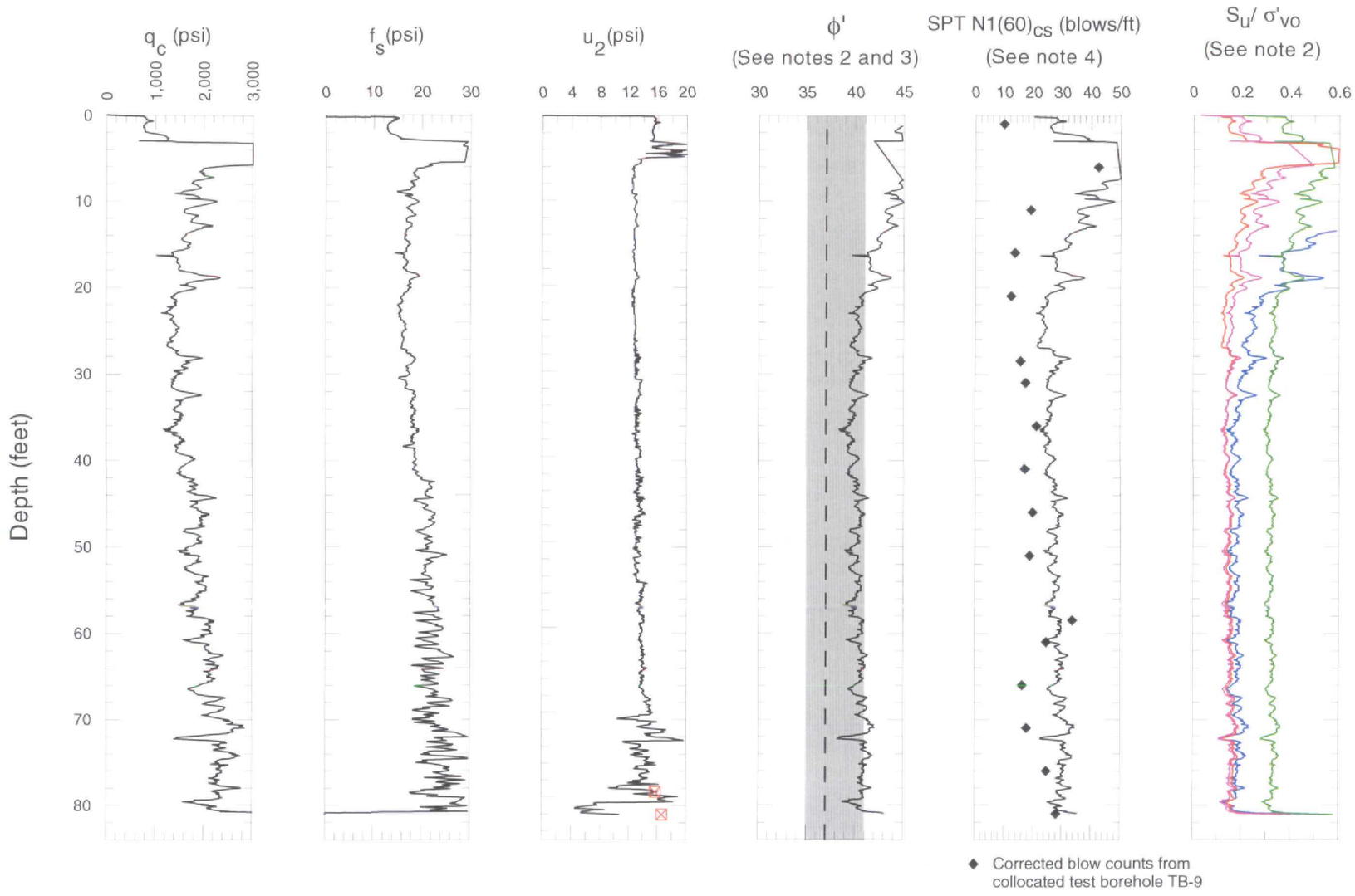
(2) The strength correlations noted were developed for saturated soils and may not strictly apply to unsaturated soils. Actual values may be lower.

(3) Robertson & Campanella (1983) method was used to estimate ϕ'.

(4) Jefferies and Davies method was used to estimate SPT $N1(60)_{CS}$.

(5) Refer to Figure 4-1 for CPT soundings locations.

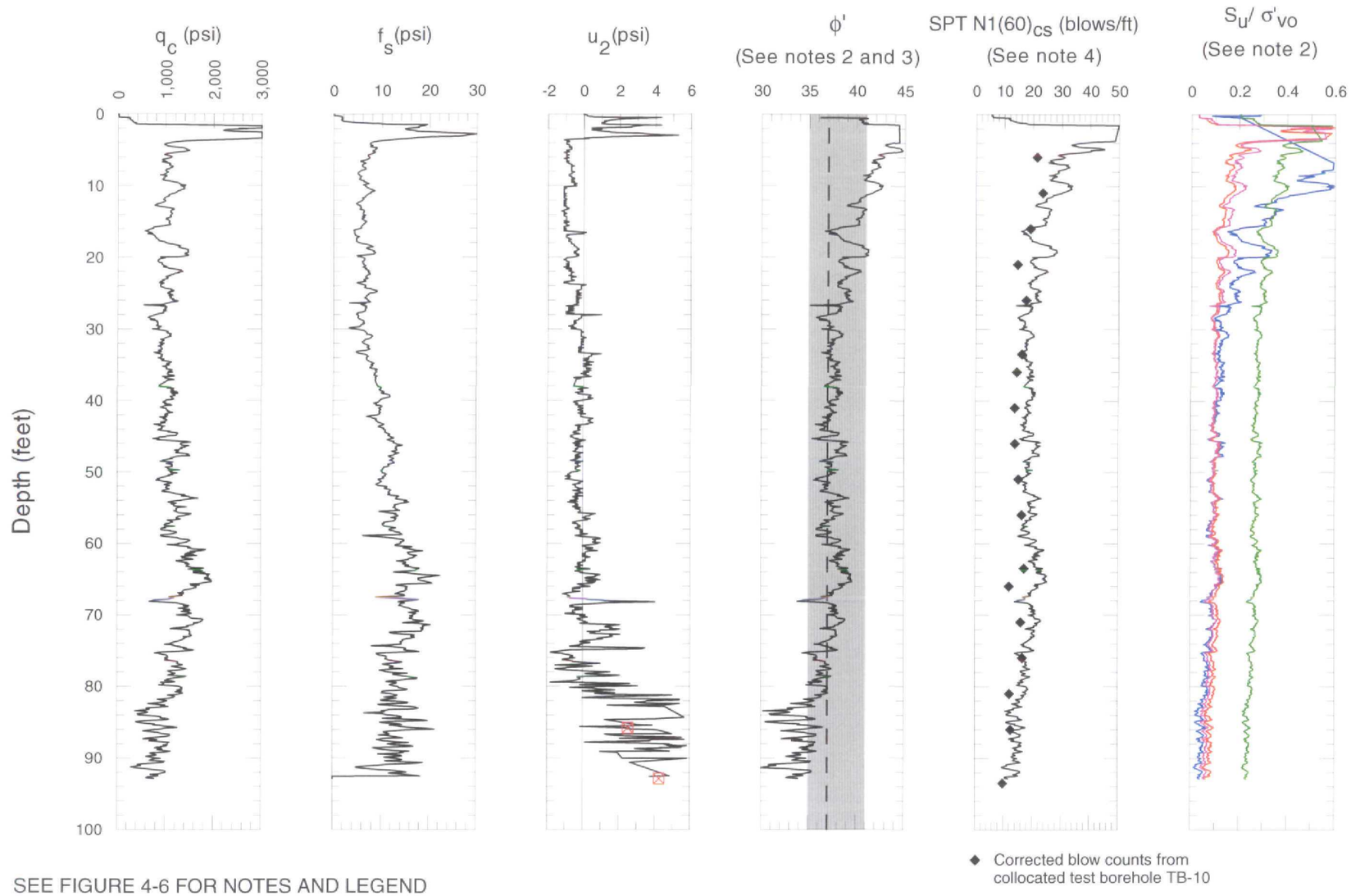
Project No.: 22235583 Elizabeth Mine Strafford, VT URS	LEGEND AND NOTES FOR CPT RESULTS TAILING PILES 1 AND 2	Figure 4-6



SEE FIGURE 4-6 FOR NOTES AND LEGEND

Project No. 22235583	Elizabeth Mine Strafford, VT	**Tailing Pile 1 CS-1**	Figure 4-7
URS			

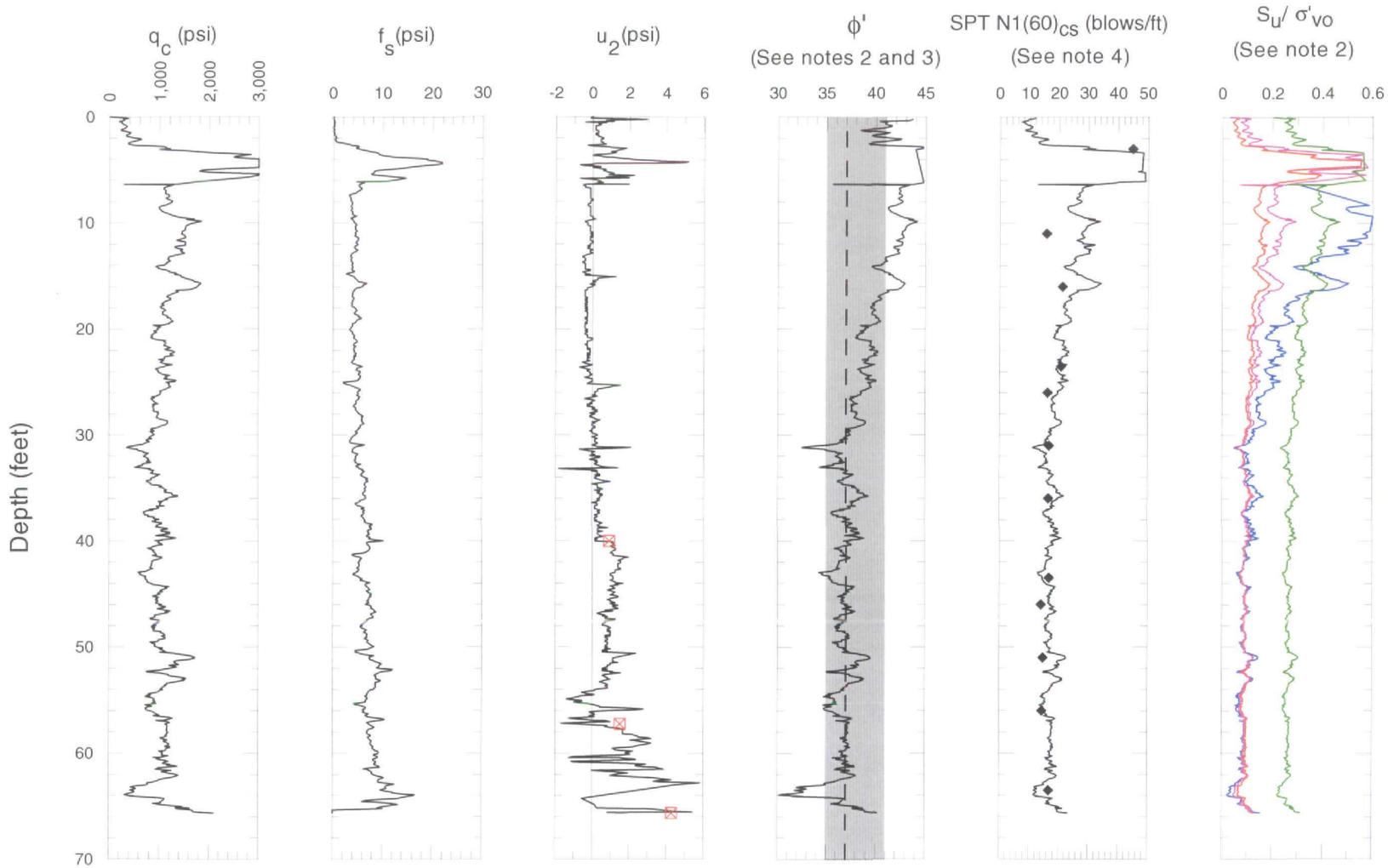
CS-01.GRF with CS-01.xls / 2/20/03 / JGC



SEE FIGURE 4-6 FOR NOTES AND LEGEND

Project No. 22235583	Elizabeth Mine Strafford, VT	**Tailing Pile 1 CS-2**	Figure 4-8
URS			

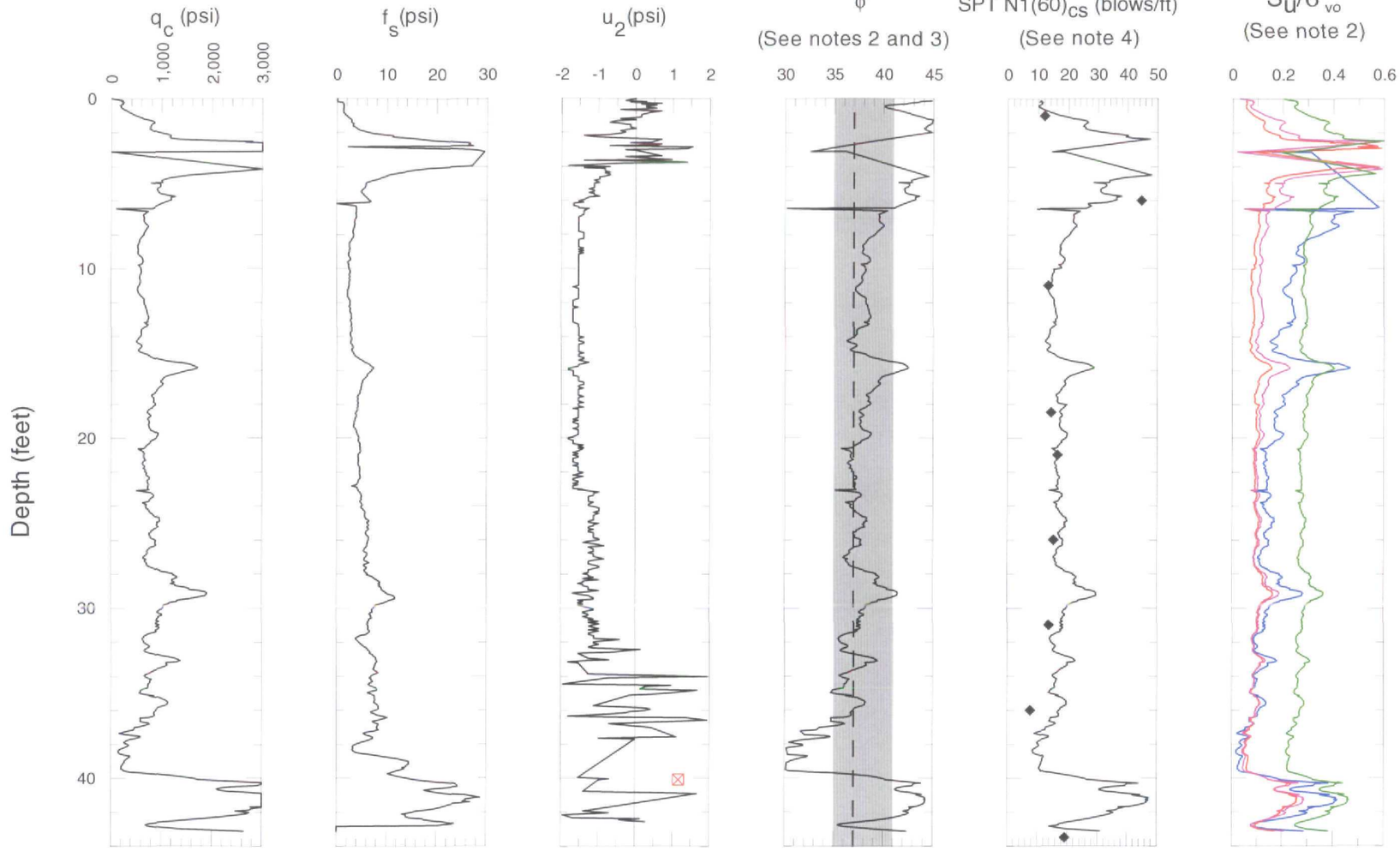
CS-02_2nd.GRF with CS-02_2nd.xls / 2/20/03 / JGC



SEE FIGURE 4-6 FOR NOTES AND LEGEND

Project No. 22235583	Elizabeth Mine Strafford, VT	**Tailing Pile 1 CS-3**	Figure 4-9
URS			

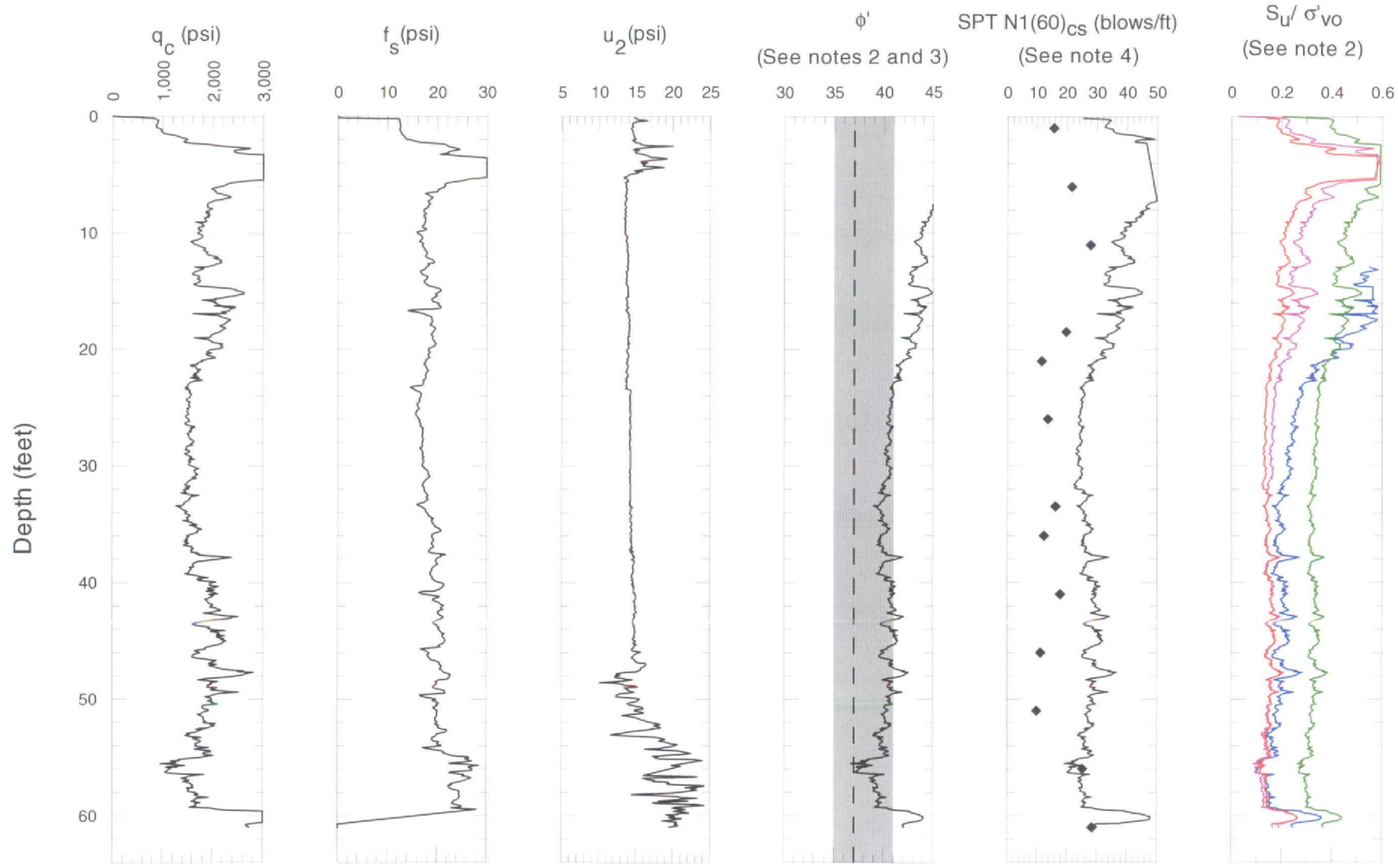
CS-03.GRF with CS-03.xls / 2/20/03 / JGC



SEE FIGURE 4-6 FOR NOTES AND LEGEND

Project No. 22235583	Elizabeth Mine Strafford, VT	**Tailing Pile 1 CS-4**	Figure 4-10
URS			

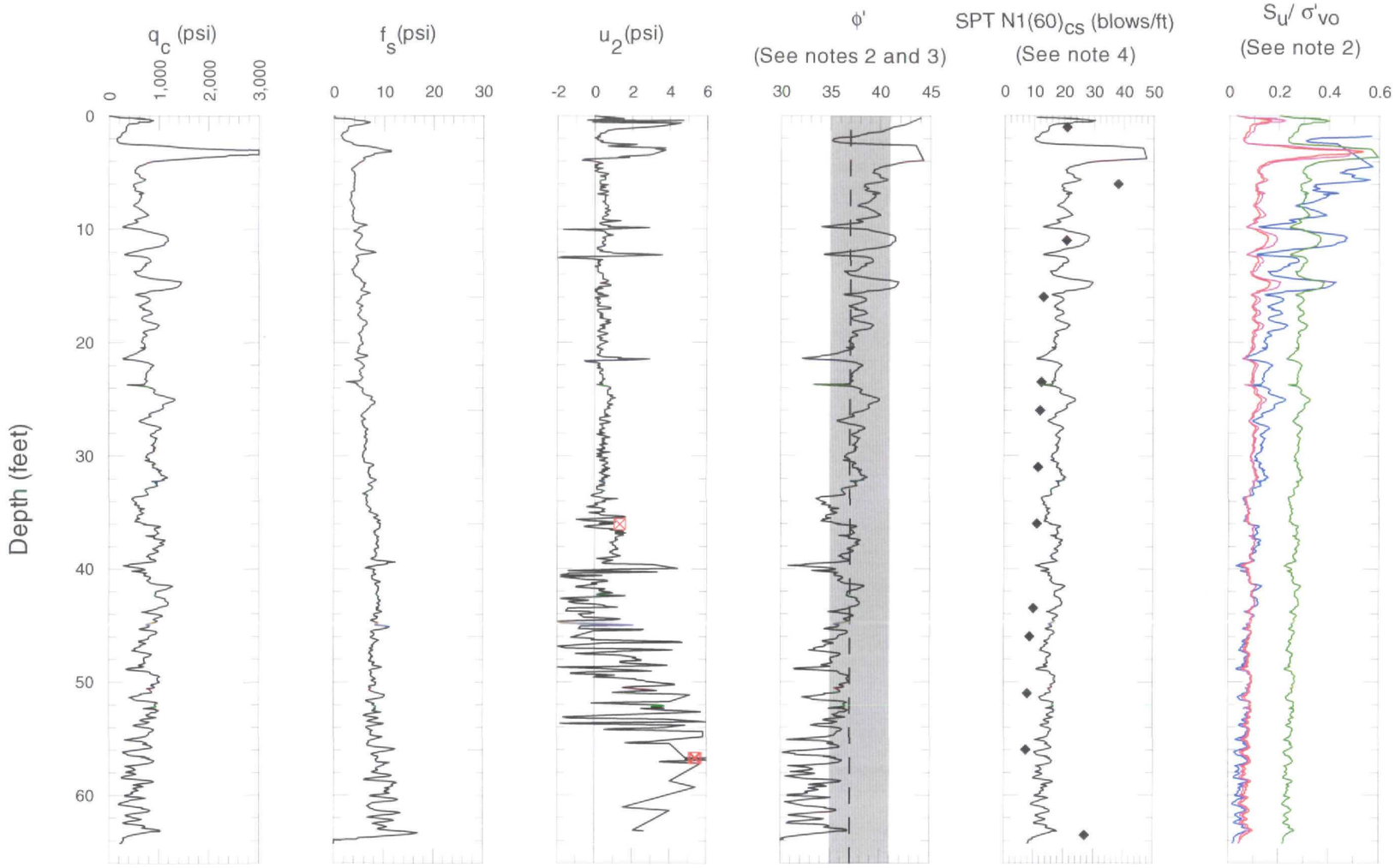
CS-04.GRF with CS-04.xls / 2/20/03 / JGC



SEE FIGURE 4-6 FOR NOTES AND LEGEND

Project No. 22235583	Elizabeth Mine Strafford, VT	**Tailing Pile 1 CS-5**	Figure 4-11
URS			

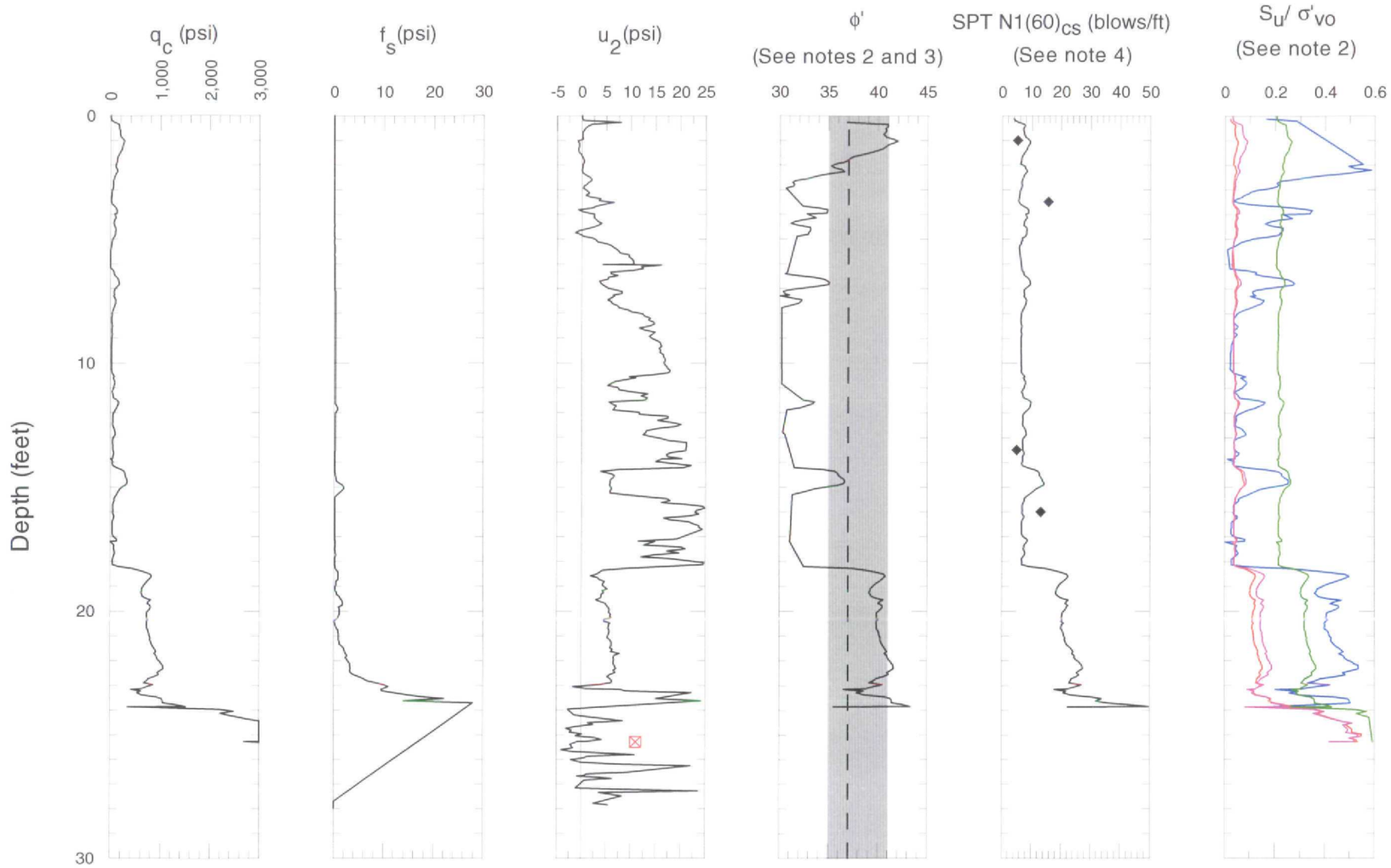
CS-05.GRF with CS-05.xls / 2/20/03 / JGC



SEE FIGURE 4-6 FOR NOTES AND LEGEND

Project No. 22235583	Elizabeth Mine Strafford, VT	**Tailing Pile 1 CS-6**	Figure 4-12
URS			

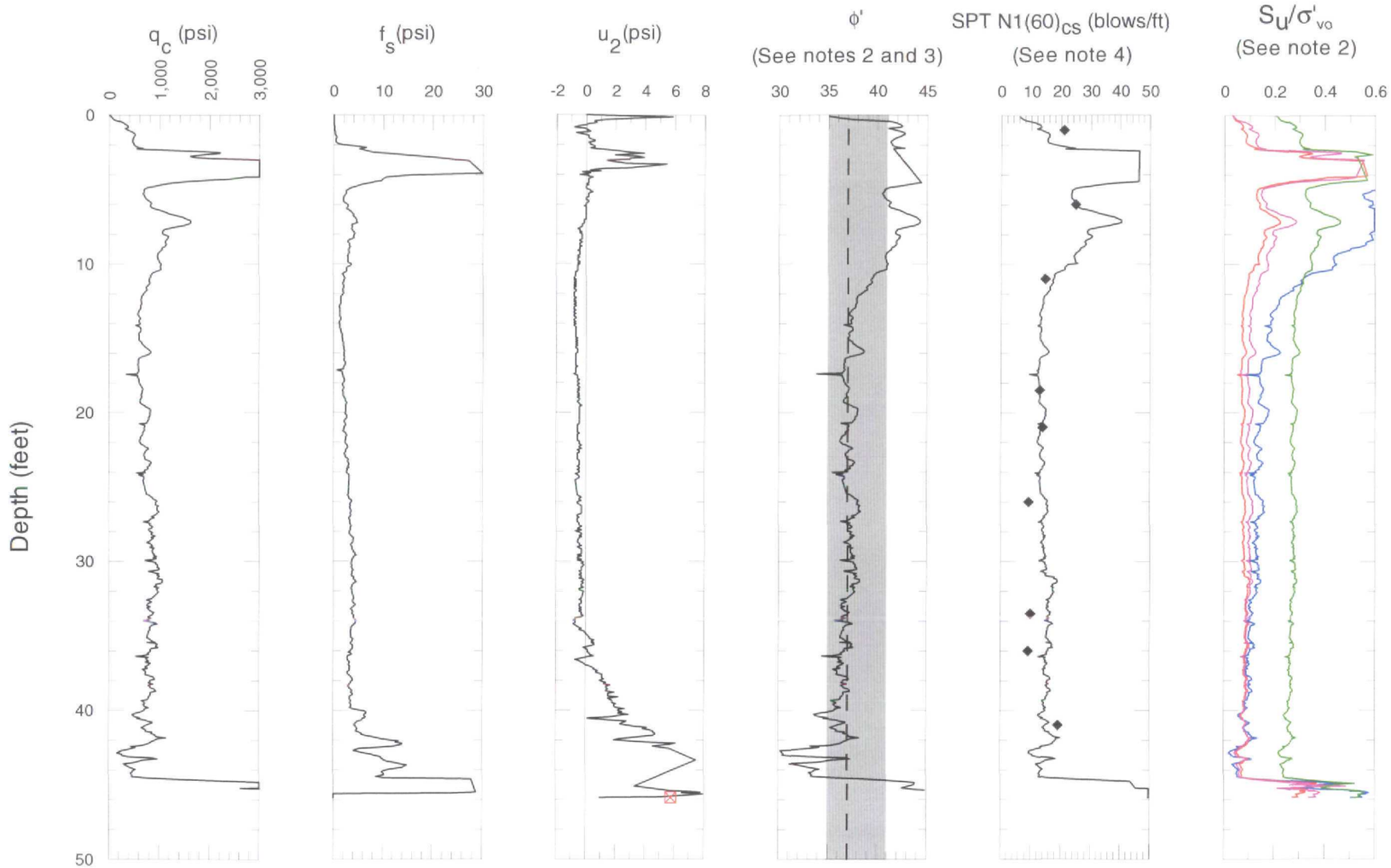
CS-06.GRF with CS-06.xls / 2/20/03 / JGC



SEE FIGURE 4-6 FOR NOTES AND LEGEND

Project No. 22235583	Elizabeth Mine Strafford, VT	**Tailing Pile 1 CS-7**	Figure 4-13
URS			

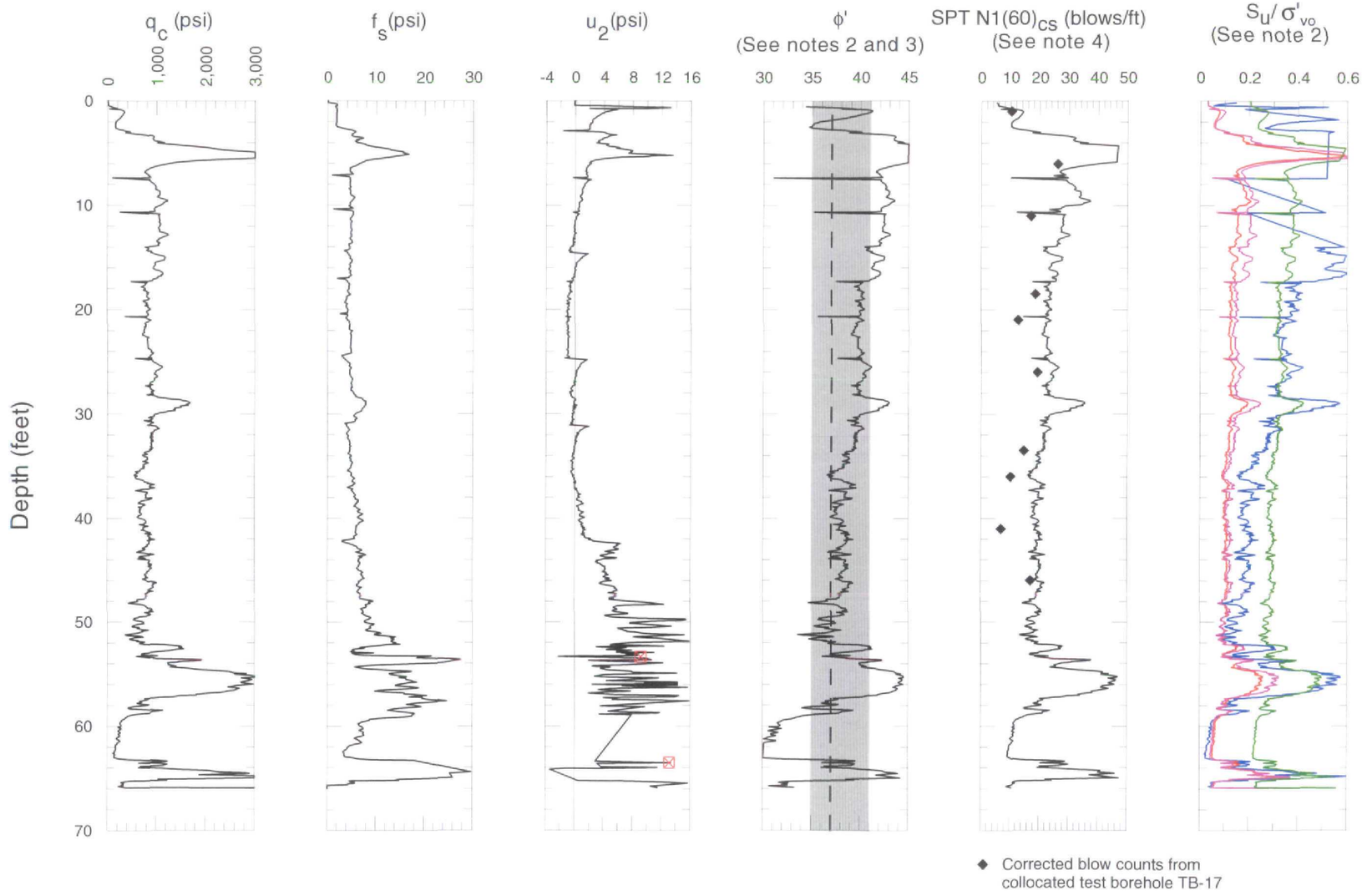
CS-07.GRF with CS-07.xls / 2/20/03 / JGC



SEE FIGURE 4-6 FOR NOTES AND LEGEND

Project No. 22235583	Elizabeth Mine Strafford, VT	**Tailing Pile 2 CS-8**	Figure 4-14
URS			

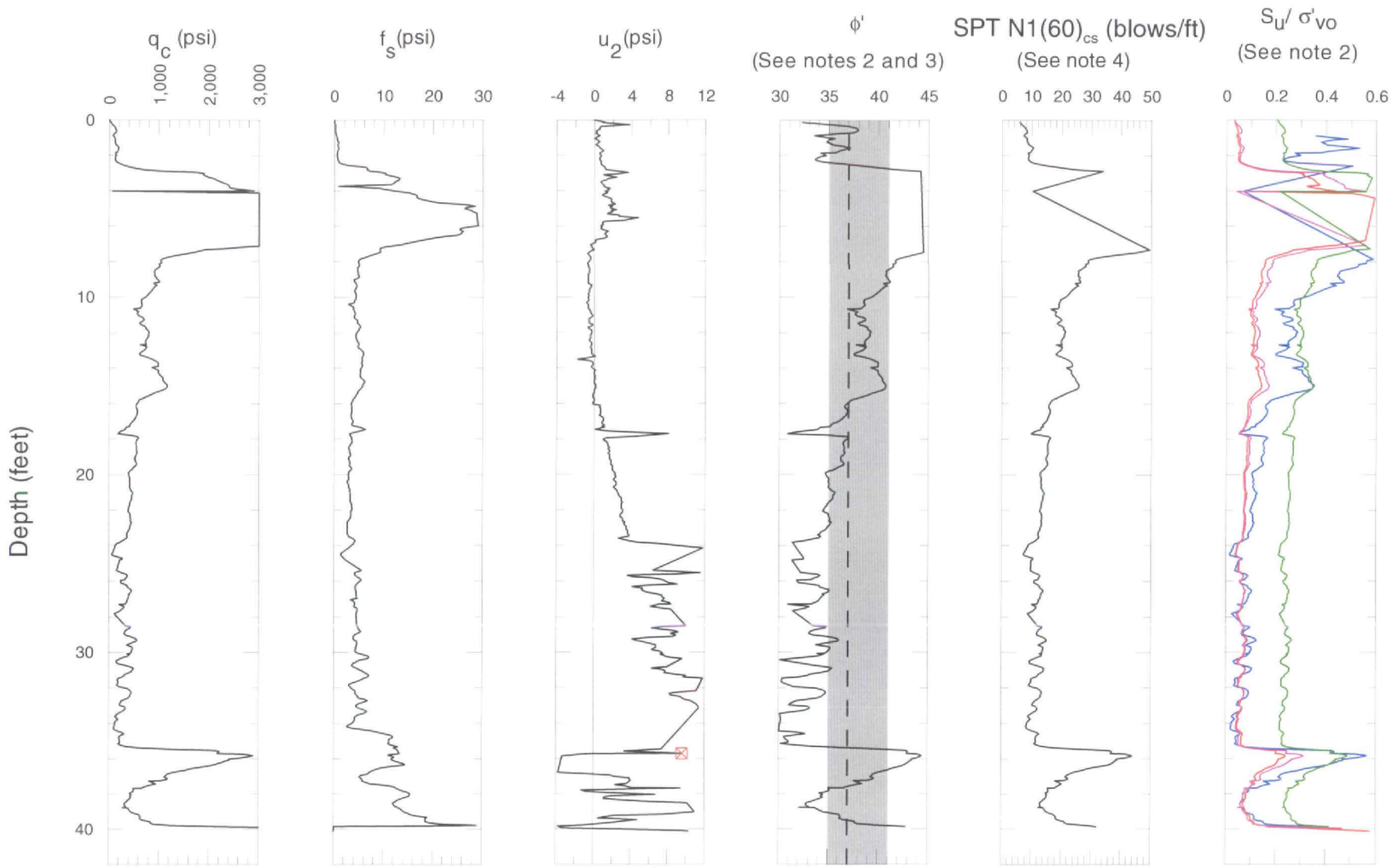
CS-08.GRF with CS-08.xls / 2/20/03 / JGC



SEE FIGURE 4-6 FOR NOTES AND LEGEND

Project No. 22235583	Elizabeth Mine Strafford, VT	**Tailing Pile 2 CS-9**	Figure 4-15
URS			

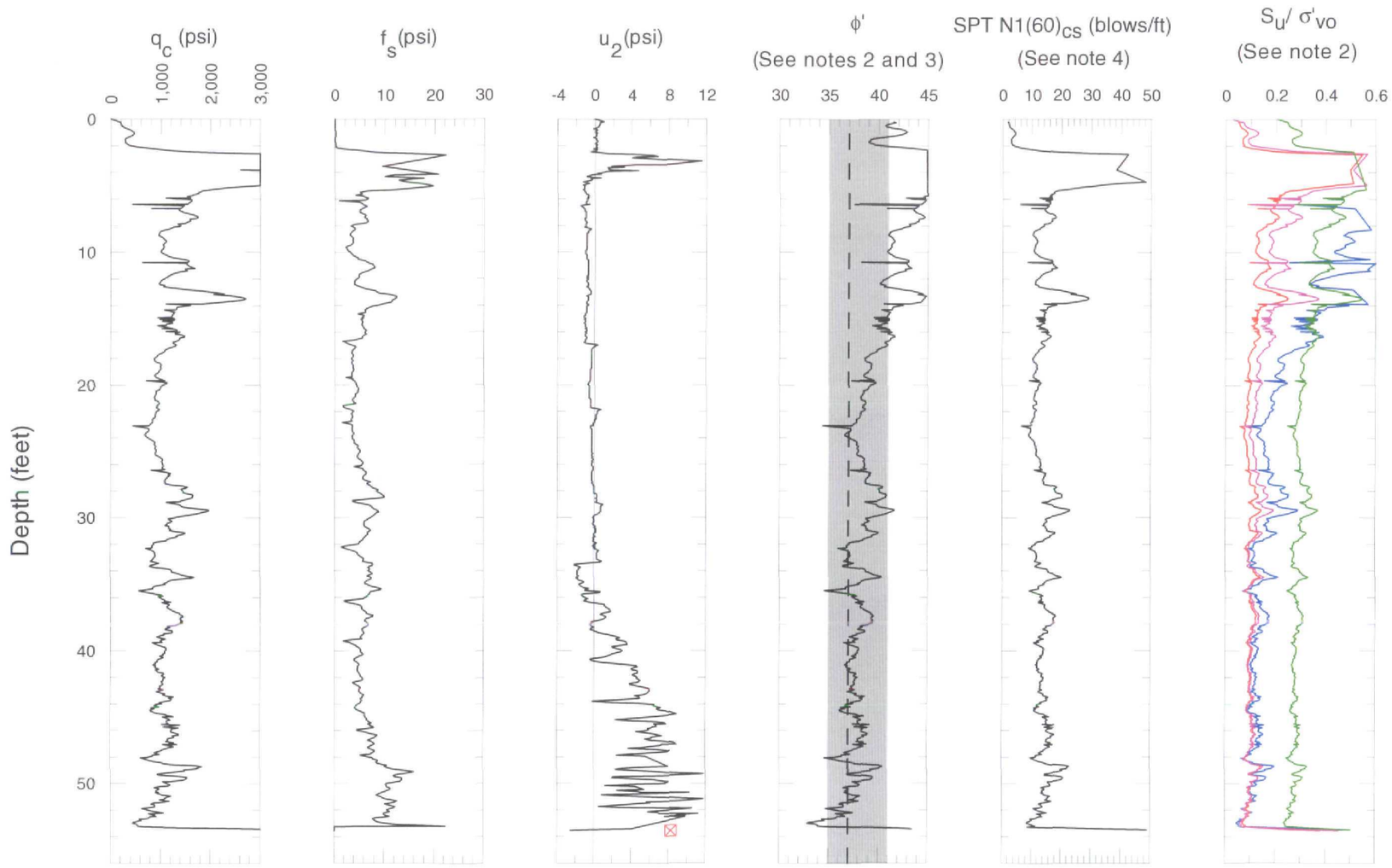
CS-09.GRF with CS-09.xls / 2/20/03 / JGC



SEE FIGURE 4-6 FOR NOTES AND LEGEND

Project No. 22235583	Elizabeth Mine Strafford, VT	**Tailing Pile 2 CS-10**	Figure 4-16
URS			

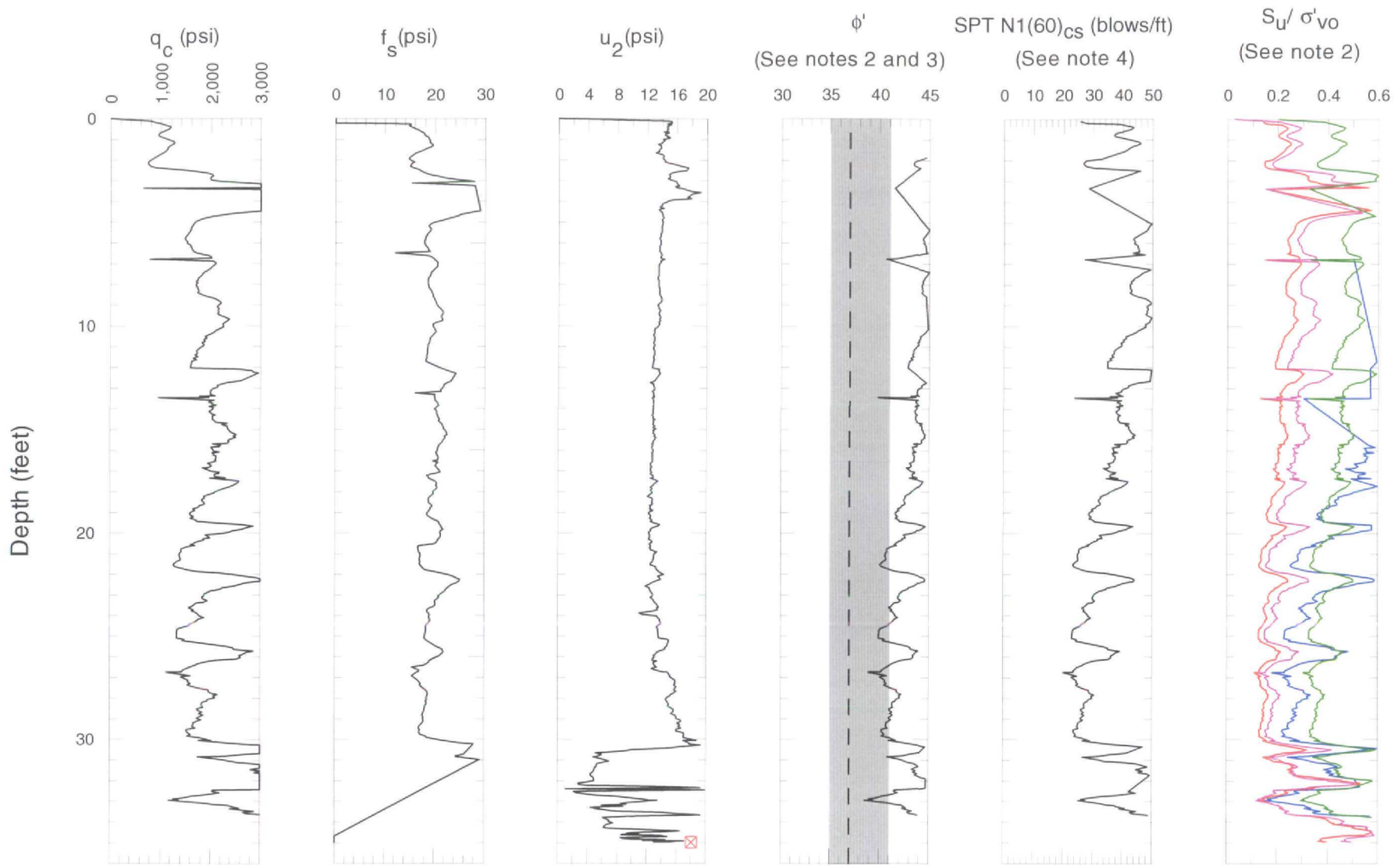
CS-10.GRF with CS-10.xls / 2/20/03 / JGC



SEE FIGURE 4-6 FOR NOTES AND LEGEND

Project No. 22235583	Elizabeth Mine Strafford, VT	**Tailing Pile 1 CS-11**	Figure 4-17
URS			

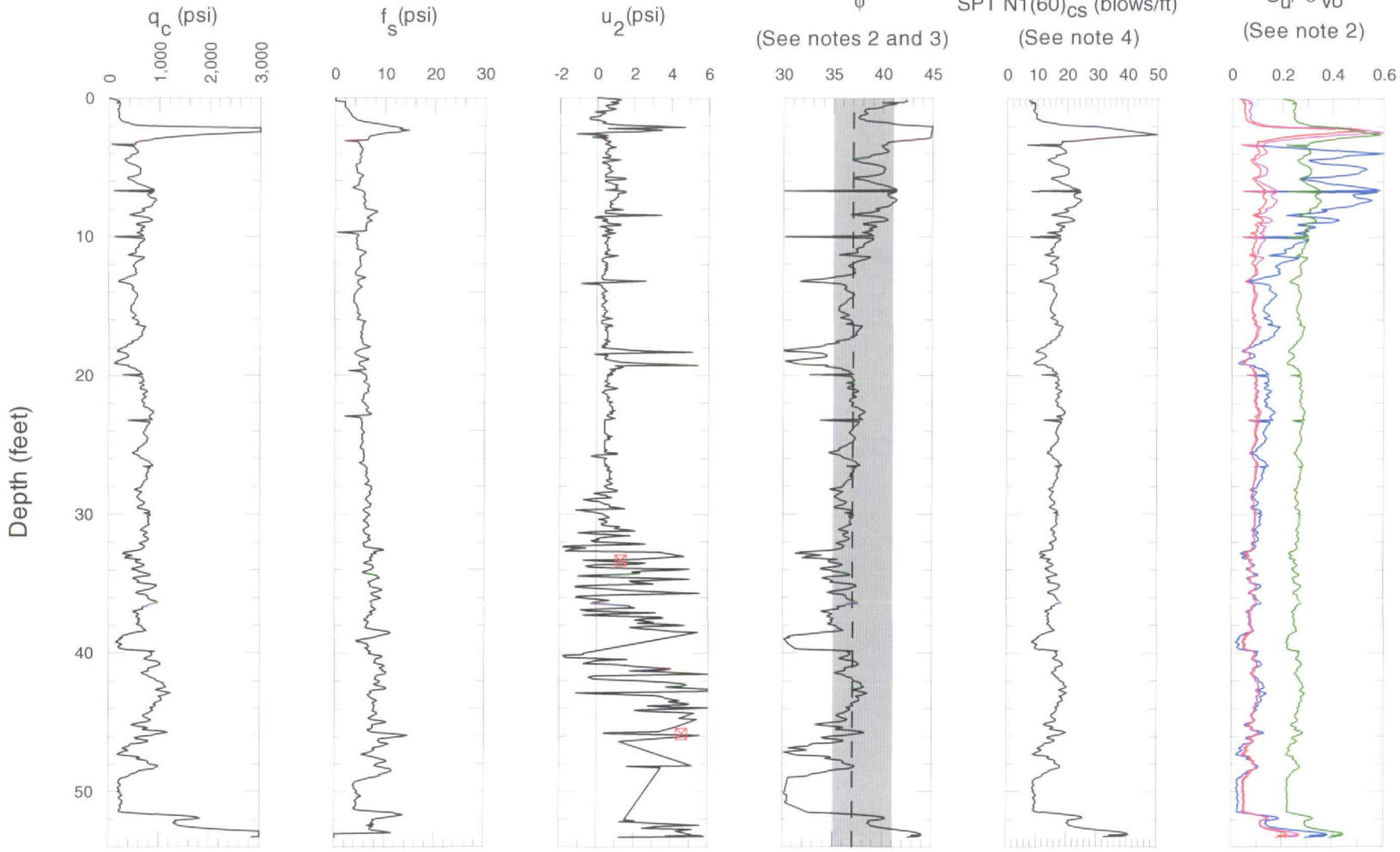
CS-11.GRF with CS-11.xls / 2/20/03 / JGC



SEE FIGURE 4-6 FOR NOTES AND LEGEND

Project No. 22235583	Elizabeth Mine Strafford, VT	**Tailing Pile 1 CS-12**	Figure 4-18
URS			

CS-12.GRF with CS-12.xls / 2/20/03 / JGC



SEE FIGURE 4-6 FOR NOTES AND LEGEND

Project No. 22235583	Elizabeth Mine Strafford, VT	**Tailing Pile 1 CS-13**	Figure 4-19
URS			

CS-13.GRF with CS-13.xls /2/20/03 / JGC

Geotechnical laboratory tests were performed on selected samples from the boreholes. The laboratory program was designed to classify the soils, measure the engineering properties, and confirm observations made in the field. Subsurface samples were collected from 10 boreholes. The locations of the boreholes are presented on the Figure 4-1 and a summary of the laboratory testing completed and a data summary are presented in Table 5-1.

Presented below is a summary of the laboratory testing results, including material classification and engineering properties.

Material Classification and Index Properties

Laboratory tests were conducted to identify index properties and classify materials according to the Unified Soil Classification System (USCS). The index property tests completed on samples collected during the field investigation consisted of gradation analyses, Atterberg limits, natural water content, dry unit weight, and specific gravity determinations.

The Elizabeth Mine site was constructed using a process that depends on hydraulic separation and sorting of the sand, silt, and clay to produce the desired dam cross section. The tailing dam is expected to have a fine sand shell that impounds the tailing slimes (silts and clay). Index properties test results presented below are grouped by their location consisting of either the dam crest or the decant pond area of TP-1 and TP-2.

Graphics showing the index testing result properties versus depth were developed. Percent fines, water content, dry unit, specific gravity, permeability and void ratio versus depth are presented in Figures 5-1 through 5-6. Gradation analyses completed for each test borehole are summarized in Figures 5-7 through 5-16, and the results of the soil classification and index property tests are summarized in Table 5-1. Individual gradation analyses are presented in Appendix B, Section B.1.

TP-1 Crest Samples

Samples collected and tested from near the TP-1 crest generally consisted of silty sands (SM) with gradually increasing fines (finer than the No. 200 sieve size) with depth and changing to a sandy, low-plasticity silt (ML) at depths of 35 to 65 feet. One sample from TB-11 also indicated a poorly graded sand to silty sand (SP-SM). The dry unit weight of the material ranged from 84.8 to 115.3 pounds per cubic foot (pcf) at moisture contents ranging from 4.7 to 21.6 percent. The measured specific gravity ranged from 3.16 to 3.8, with an average value of 3.3. The calculated void ratios ranged from 0.74 to 1.12.

Gradation analyses completed for boreholes located on the crest are summarized in Figures 5-7 through 5-11. Results indicated that the percent fines ranged from 7.3 to 42.3 percent at shallower depths (less than 35 feet), increasing to 83.6 percent at greater depths as the material transitioned to an ML. Some silty sand (SM) layers with a percent fines ranging from 31.2 to 41.4 percent were also observed at depths up to approximately 60 feet. All of the fines tested were found to be non-plastic.

TP-1 Pond Samples

Samples collected from the decant pond area of TP-1 generally consisted of silty sands (SM) changing to a sandy silt (ML) at depths of 10 to 30 feet. Dry unit weight of the material ranged from 86.7 to 110.4 pcf with moisture contents ranging from 21.9 to 30.0 percent. Specific gravity values ranged from 3.18 to 3.22, with an average value of 3.2. The calculated void ratios ranged from 0.95 to 1.18.

Gradation analyses completed for boreholes located in the decant pond area are presented on Figures 5-12 and 5-13. The results of the gradations analyses indicated the percent fines ranged from 23.3 to 34.7 percent at shallower depths (less than 12 feet), increasing from 71.1 to 91.2 percent at depths greater than 12 feet. However, one sample tested from TB-14 at 25 feet indicated a silty sand layer with percent fines of 33.1 percent. All of the fines tested were found to be non-plastic.

TP-2 Crest Samples

Samples collected from the crest of TP-2 generally consisted of silty sands (SM) gradually changing to a sandy silt (ML) at depths greater than 35 feet. However, one sample collected from TB-17 at a depth of 16.35 feet consisted of a poorly graded sand to silty sand (SP-SM). Dry unit weight of the material ranged from 89.3 to 94.2 pcf with moisture contents ranging from 4.8 to 11.5 percent. A specific gravity value of 3.14 was calculated from a sample in TB-17. The calculated void ratio ranged from 0.89 to 1.19.

Gradation analyses completed for boreholes located near the crest are presented in Figures 5-14 and 5-15. Results of the gradations analyses indicate the percent fines ranged from 11.1 to 44.8 percent at shallower depths (less than 19.5 feet), increasing up to 66.8 percent at greater depths. All of the fines tested were found to be non-plastic.

TP-2 Pond Samples

Samples collected from the pond of TP-2 generally consisted of sandy silts (ML), except for one sample collected, which consisted of a silty sand (SM). A specific gravity value of 3.0 was calculated from a sample in TB-18. Gradation analyses completed for test borehole TB-18 located in the decant pond are presented in Figure 5-16. Results of the gradation analyses indicated the percent fines ranged 40.3 to 85.4 percent. All of the fines tested were found to be non-plastic.

5.1 ENGINEERING PROPERTIES

Laboratory tests were conducted to measure the engineering properties of the tailing. Testing completed included permeability, consolidation, and shear strength. Results of these tests are presented in Appendix B, Section B.2 and are summarized in Table 5-1.

Measured permeabilities of the TP-1 silty sand materials range from approximately 1.0×10^{-3} to 6.7×10^{-4} centimeters per second (cm/sec) for samples up to a depth of 40.3 feet. One silty sand (SM) sample tested from TB-10 at a depth of about 60.4 feet had a measured permeability of 1.4×10^{-7} cm/sec. This sample was estimated to be close to a sand/slime interface.

A permeability measured for a TP-1 decant pond sandy silt (ML) sample, TB-14, was 7.4 x 10^{-6} cm/sec. A silty sand sample tested from borehole TB-16, located on TP-2 crest, had a permeability of 1.3 x 10^{-4} cm/sec.

Consolidation Tests

Consolidation tests were conducted on six samples from TP-1 and TP-2, including TB-10 at a depth of approximately 62.2 feet, TB-11 at a depth of approximately 41.5 feet, TB-13 at a depth of approximately 32.2 feet, TB-14 at a depth of approximately 22.2 feet, TB-14 at a depth of approximately 42.3 feet, and TB-17 at a depth of approximately 16.4 feet.

Consolidation samples were initially loaded to an initial setting pressure of between 0.75 and 0.5 tons per square foot (tsf), without adding water. The samples were then saturated, loaded, unloaded, and reloaded as described below.

The consolidation program was originally designed to measure the preconsolidation history of the tailing to develop an understanding of the normalized undrained strength versus the over-consolidation ratio (OCR). Samples experienced collapse settlement upon wetting. The collapse settlement appeared to destroy the "natural" structure and sample stress history. As a result, the stress history curve is indicative of a disturbed sample. This disturbance made it difficult to estimate preconsolidation and in-situ effective stresses. The results below are presented with this understanding. Test results are presented in Appendix B, Section B.3.

The silty sand (SM) sample from TB-10 at 62.2 feet was loaded in increments to about 2.5 tsf, unloaded to 0.25 tsf, reloaded to 16.0 tsf, and unloaded again. The resulting consolidation curve showed that the sample had an estimated preconsolidation stress in the range of 1.6 to 2.9 tsf; and a compression index of 0.214.

The silty sand (SM) sample from TB-11 at 41.5 feet was loaded in increments to 8.0 tsf, unloaded to 1.0 tsf, reloaded to 32.0 tsf, and unloaded again. The resulting consolidation curve showed that the sample had an estimated preconsolidation stress in the range of 1.8 to 4.5 tsf and a compression index of 0.218.

The silty sand (SM) sample from TB-13 at 32.2 feet was loaded in increments to about 5.0 tsf, unloaded to 0.5 tsf, reloaded to 32.0 tsf, and unloaded again. The resulting consolidation curve showed that the sample had an estimated preconsolidation stress in the range of 1.4 to 6.0 tsf and a compression index of 0.206.

The silty sand (ML) sample from TB-14 at 22.2 feet was loaded in increments to 8.0 tsf, unloaded to 1.0 tsf, reloaded to 32.0 tsf, and unloaded again. The resulting consolidation curve showed that the sample had an estimated preconsolidation stress in the range of 1.3 to 5.6 tsf and a compression index of 0.246.

The silty sand (SM) sample from TB-14 at 42.3 feet was loaded in increments to 16.0 tsf, unloaded to 2.0 tsf, reloaded to 64.0 tsf, and unloaded again. The resulting consolidation curve showed that the sample had an estimated preconsolidation stress in the range of 3.4 to 12.3 tsf and a compression index of 0.189.

The poorly graded sand to silty sand (SP-SM) sample from TB-17 at 16.4 feet was loaded in increments to 16.0 tsf, unloaded to 2.0 tsf, reloaded to 64.0 tsf, and unloaded again. The

resulting consolidation curve showed that the sample had an estimated preconsolidation stress in the range of 11.5 to 12.4 tsf and a compression index of 0.263.

Shear Strength Tests

Isotropically consolidated undrained triaxial compression tests (CIU') with pore pressure measurements were performed to measure the undrained strength characteristics and the effective stress friction angle of the tailing material. Three CIU' triaxial test envelopes (three tests each) were developed from tests on undisturbed samples from test boreholes TB-10 and TB-11, TB-14, and TB-13 and TB-16. Two other CIU' envelopes were performed on a composite, remolded samples from TB-10 and TB-11, and TB-14. The remolded samples were prepared using a slurry-sedimented procedure. Results and plots of the undisturbed CIU' tests are presented in Appendix B, Section B.4. Results and plots of the remolded CIU' tests are presented in Appendix B, Section B.5. A summary of the CIU' tests are presented in Table 5-1.

Undisturbed samples from TB-11 at a depth of 41.2 feet, TB-11 at 40.3 feet, and TB-10 at 60.9 feet were tested at effective confining stresses of 5 kips per square foot (ksf), 10 ksf, and 15 ksf. The resulting shear strength envelope for the sample has an effective stress friction angle of 40.1 degrees with no cohesion. The calculated S_u/σ'_c for the samples ranged from 0.64 to 1.41.

The CIU' test using undisturbed samples from TB-14 at a depth of 20.3 feet, TB-14 at 20.8 feet, and TB-14 at 40.3 feet were tested at effective confining stresses of 2.8 ksf, 5.8 ksf, and 14.4 ksf. The resulting shear strength envelope for the sample has an effective stress friction angle of 36.5 degrees with a cohesion value of 3.44 pounds per square inch (psi). The calculated S_u/σ'_c for the samples ranged from 0.56 to 1.21.

The CIU' tests using undisturbed samples from TB-13 at a depth of 30.3 feet, TB-13 at 30.8 feet, and TB-16 at 30.3 feet were tested at effective confining stresses of 3.6 ksf, 7.2 ksf, and 14.4 ksf. The resulting shear strength envelope for the sample has an effective stress friction angle of 37.0 degrees with no cohesion. The calculated S_u/σ'_c for the samples ranged from 0.34 to 1.25. It should be noted that the TB-13 samples are from TP-1 and the TB-16 sample is from TP-2. It was initially planned to combine the three samples to develop a single strength envelope because the samples showed similar grain size curves, densities, and moisture contents. However, the material from TP-2 behaved differently in the CIU' test and as a result only the samples from TP-1 were used to develop the effective stress shear strength envelope.

The CIU' tests using the composite remolded sample from TB-10 and TB-11 were tested at effective confining stresses of 5 ksf, 10.1 ksf, and 15.1 ksf. The resulting shear strength envelope for the sample has an effective stress friction angle of 34.6 degrees with zero cohesion. The calculated S_u/σ'_c for the samples ranged from 0.46 to 1.10.

The CIU' tests using the composite remolded sample from TB-14 were tested at effective confining stresses of 2.9 ksf, 5.8 ksf, and 14.4 ksf. The resulting shear strength envelope for the sample has an effective stress of 34.6 degrees with a cohesion valve of 0.17 psi. The calculated S_u/σ'_c for the samples ranged from 0.51 to 1.05.

Table 5-1
SUMMARY OF LABORATORY TEST RESULTS
ELIZABETH MINE, VERMONT

TEST BOREHOLE NO.	DEPTH (ft)	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	TOTAL UNIT WEIGHT (pcf)	PLASTIC LIMIT (-)	GRADATION ANALYSIS			USCS SYMBOL	SPECIFIC GRAVITY (-)	PERMEABILITY TEST (cm/sec)	CONSOLIDATION TEST			TRIAXIAL TEST [1]			
															Undisturbed		Remolded	
						GRAVEL (%)	SAND (%)	FINES (%)				INITIAL VOID RATIO (-)	COMPRESSION INDEX (-)	RECOMPRESSION INDEX (-)	c' (psi)	ϕ' (degrees)	c' (psi)	ϕ' (degrees)
TB-9	0-2				NP	3.5	62.5	34.0	SM									
TB-9	15-17				NP		73.5	26.5	SM									
TB-9	27	17.4																
TB-9	27.3	21.6	110.2	133.9	NP		72.7	27.3	SM	3.23 [2]	6.7E-4	0.83 [3]						
TB-9	30-32				NP		62.9	37.1	SM	3.23								
TB-9	50-52				NP		47.2	52.8	ML									
TB-9	65-67				NP		33.3	66.7	ML									
TB-10	5-7				NP		81.3	18.7	SM									
TB-10	20-22				NP		64.0	36.0	SM	3.16								
TB-10	31.9	17.7																
TB-10	32.2	19.9	115.3	138.3	NP		68.0	32.0	SM	3.21 [2]	1.0E-3	0.74 [3]						
TB-10	50-52				NP		62.0	38.0	SM	3.21								
TB-10	60.2	8.6		116.6														
TB-10	60.85	13.0 [4]	99.0 [4]	111.8			64.1	35.9	SM		1.4E-7							
TB-10	61.9	17.8																
TB-10	62.2	14.6	85.1	97.5					SM			1.12	0.214	0.013				
TB-10	65-67				NP		21.2	78.8	ML									
TB-10	80-82				NP		32.8	67.2	ML									
TB-10	92-94.5				NP		28.9	71.1	ML									
TB-10	100-102				NP		21.6	78.4	ML									
TB-11	2-4				NP		74.9	25.1	SM									
TB-11	10-12				NP		92.7	7.3	SP-SM									
TB-11	25-27				NP		57.7	42.3	SM									
TB-11	40.25	14.0	108.5	123.7		1.3	50.0	48.7	SM		1.5E-4							
TB-11	40.95	9.0		129.5														
TB-11	41.2	19.7	108.0	129.4					ML									
TB-11	41.5	21.7	97.2	118.3					SM			0.95	0.218	0.010				
TB-11	42.5-44.5				NP		31.0	69.0	ML									
TB-11	55-57				NP		50.6	49.4	SM									
TB-12	0-2				NP	2.5	58.3	39.2	SM									
TB-12	10-12				NP		82.9	17.1	SM	3.18								
TB-12	16.9	6.5																
TB-12	17.2	4.7	113.7	119.1	NP		87.3	12.7	SM	3.18 [2]	6.2E-3	0.75 [3]						
TB-12	25-27				NP		62.6	37.4	SM									
TB-12	35-37				NP		22.8	77.2	ML									

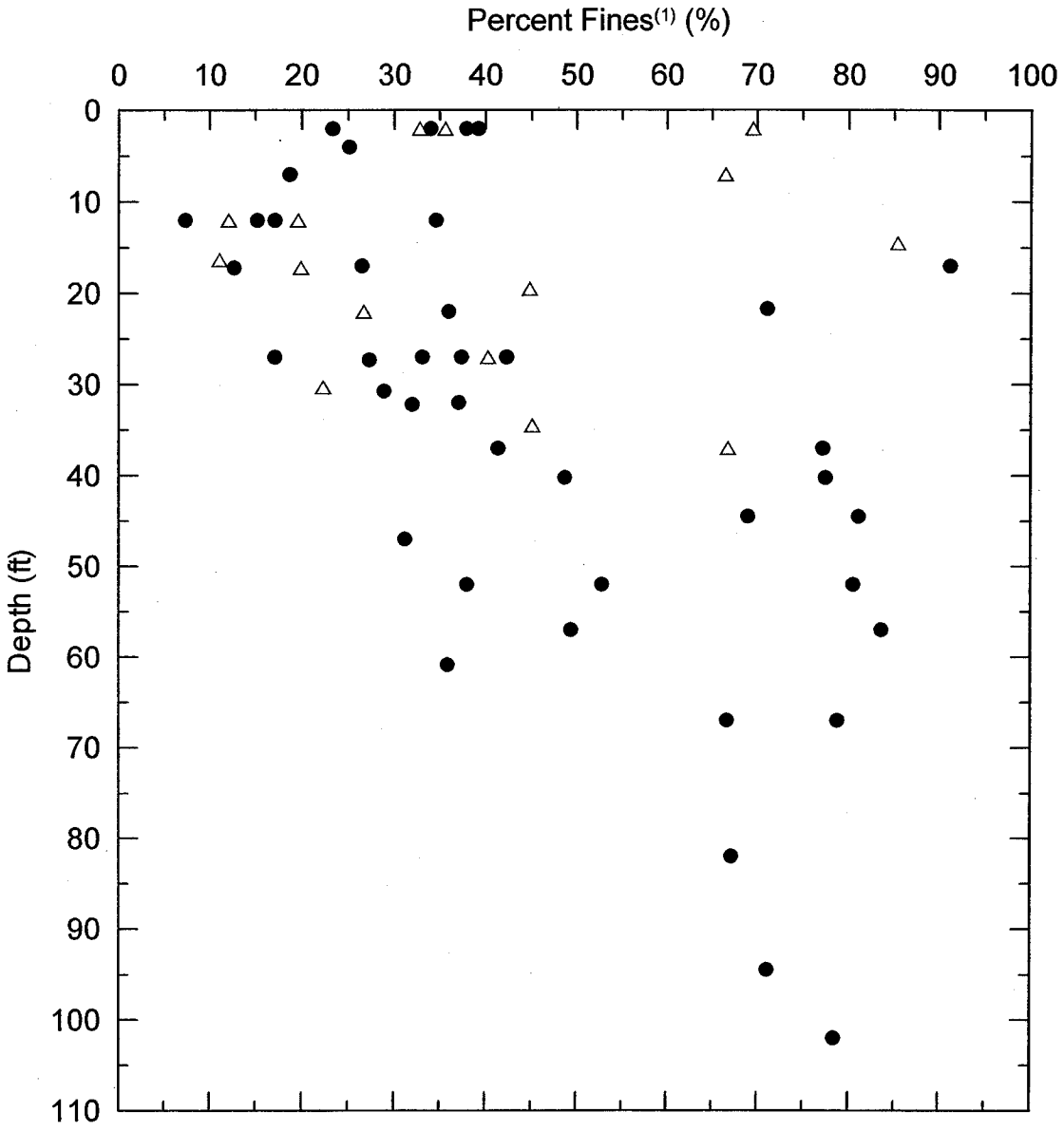
Table 5-1 (cont.)
SUMMARY OF LABORATORY TEST RESULTS
ELIZABETH MINE, VERMONT

TEST BORHHOLE NO.	DEPTH (ft)	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	TOTAL UNIT WEIGHT (pcf)	PLASTIC LIMIT (-)	GRADATION ANALYSIS			USCS SYMBOL	SPECIFIC GRAVITY (-)	PERMEABILITY TEST (cm/sec)	CONSOLIDATION TEST			TRIAXIAL TEST [1]			
															Undisturbed		Remolded	
						GRAVEL (%)	SAND (%)	FINES (%)				INITIAL VOID RATIO (-)	COMPRESSION INDEX (-)	RECOMPRESSION INDEX (-)	c' (psi)	ϕ' (degrees)	c' (psi)	ϕ' (degrees)
TB-13	0-2				NP		62.1	37.9	SM									
TB-13	10-12				NP		84.8	15.2	SM									
TB-13	25-27				NP		82.9	17.1	SM	3.27								
TB-13	30.25	8.1	93.4	100.9					SM									
TB-13	30.75	7.9	97.3	105.0		0.2	70.9	28.9	SM									
TB-13	31.9	5.4																
TB-13	32.2	5.0	84.8	89.1					SM			0.95	0.206	0.019				
TB-13	35-37				NP		58.6	41.4	SM									
TB-13	45-47				NP		68.8	31.2	SM									
TB-13	55-57				NP		16.4	83.6	ML	3.80								
TB-14	10-12				NP		65.3	34.7	SM									
TB-14	20.25	23.3	101.1	124.6					ML									
TB-14	20.75	25.3	99.1	124.2					ML									
TB-14	21.7	25.5	90.9	114.1	NP		28.9	71.1	ML	3.18 [2]	7.4E-6	1.18 [3]						
TB-14	22	30.0		142.2														
TB-14	22.2	21.9	86.7	105.7					ML			1.09	0.246	0.023				
TB-14	25-27				NP		66.9	33.1	SM	3.18								
TB-14	40.25	27.0	106.2	134.9			22.5	77.5	ML									
TB-14	42.3	25.6	110.4	138.7					SM			0.95	0.189	0.016				
TB-14	42.5-44.5				NP		18.9	81.1	ML									
TB-14	50-52				NP		19.5	80.5	ML	3.22								
TB-15	0-2				NP		76.7	23.3	SM									
TB-15	15-17				NP		8.8	91.2	ML									
TB-16	0-2				NP		67.2	32.8	SM									
TB-16	10-12				NP		80.4	19.6	SM									
TB-16	16.9	4.8																
TB-16	17.2	7.7	89.3	96.2	NP		80.1	19.9	SM	3.14 [2]	1.3E-4	1.19 [3]						
TB-16	20-22				NP		73.3	26.7	SM									
TB-16	30.05	11.1		108.1														
TB-16	30.3	11.5	94.2	105.1			77.7	22.3	SM									
TB-16	32.5-34.5				NP		54.9	45.1	SM									
TB-17	0-2				NP		64.5	35.5	SM									
TB-17	10-12				NP		87.9	12.1	SM	3.14								
TB-17	16.35	4.9	92.8	97.4			88.9	11.1	SP-SM			0.89	0.263	0.021				
TB-17	17.5-19.5				NP		55.2	44.8	SM									
TB-17	35-37				NP		33.2	66.8	ML									

Table 5-1 (cont.)
SUMMARY OF LABORATORY TEST RESULTS
ELIZABETH MINE, VERMONT

TEST BOREHOLE NO.	DEPTH (ft)	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	TOTAL UNIT WEIGHT (pcf)	PLASTIC LIMIT (-)	GRADATION ANALYSIS			USCS SYMBOL	SPECIFIC GRAVITY (-)	PERMEABILITY TEST (cm/sec)	CONSOLIDATION TEST			TRIAXIAL TEST (1)			
															Undisturbed		Remolded	
						GRAVEL (%)	SAND (%)	FINES (%)				INITIAL VOID RATIO (-)	COMPRESSION INDEX (-)	RECOMPRESSION INDEX (-)	c' (psi)	ϕ' (degrees)	c' (psi)	ϕ' (degrees)
TB-18	0-2				NP	0.7	29.8	69.5	ML									
TB-18	5-7				NP		33.5	66.5	ML	3.00								
TB-18	12.5-14.5				NP		14.6	85.4	ML									
TB-18	25-27				NP	5.6	54.1	40.3	SM									
TB-10,11 (5)						0.3 (8)	43.9 (8)	55.8 (8)	ML (5)						0	40.1	0	34.6
TB-14 (6)							28.3 (8)	71.7 (8)	ML (6)						3.4	36.5	0.2	34.6
TB-13,16 (7)															0	37		

NOTES:
(1) Isotropically consolidated undrained triaxial compression tests (CIU') with pore pressure measurements were performed. Cohesion (c') and friction angles (ϕ') presented are based on the effective stress strength envelope using peak deviator stress failure criteria.
(2) Specific gravity presented is assumed from the sample's closest measured valve.
(3) Void ratio is calculated.
(4) Water content and dry unit presented are from permeability tests.
(5) Undisturbed samples tested include TB-11 at a depth of 40.25 feet, TB-11 at a depth of 41.2 feet, and TB-10 at a depth of 60.85 feet. The remolded samples tested were a composite of samples from TB-10 and TB-11.
(6) Undisturbed samples tested include TB-14 at a depth of 20.25 feet, TB-14 at a depth of 20.75 feet, and TB-14 at a depth of 40.25 feet. The remolded samples tested were a composite of samples from TB-14.
(7) Undisturbed samples tested include TB-13 at a depth of 30.25 feet, TB-13 at a depth of 30.75 feet, and TB-16 at a depth of 30.3 feet.
(8) Gradation analyses presented are for the remolded sample.



LEGEND:

● TP-1

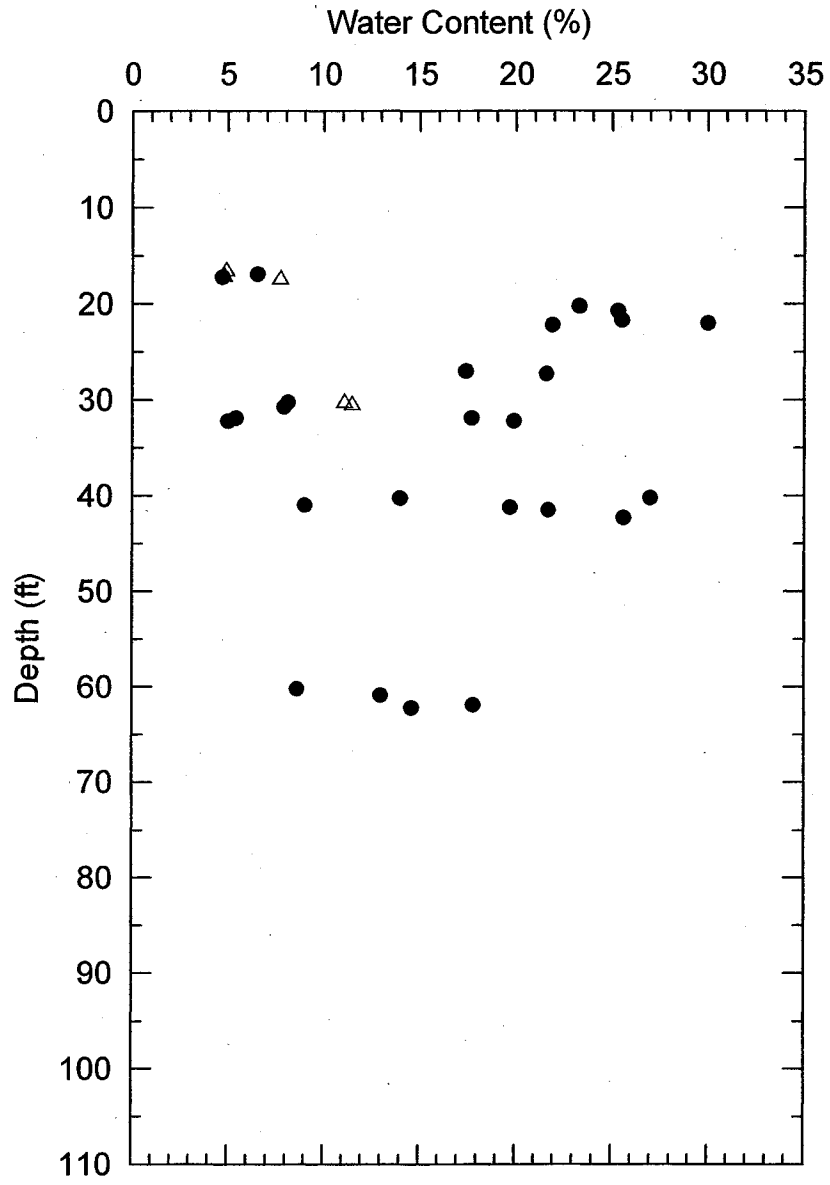
△ TP-2

NOTE:

(1) Percent fines refers to the percent passing the No. 200 sieve by dry weight.

Project No.: 22235583 Elizabeth Mine Strafford, VT URS	**Percent Fines vs. Depth Tailing Piles 1 and 2**	Figure 5-1

Percent Fines vs. Depth.GRF w/Elizabeth Materials PLots (bd).XLS



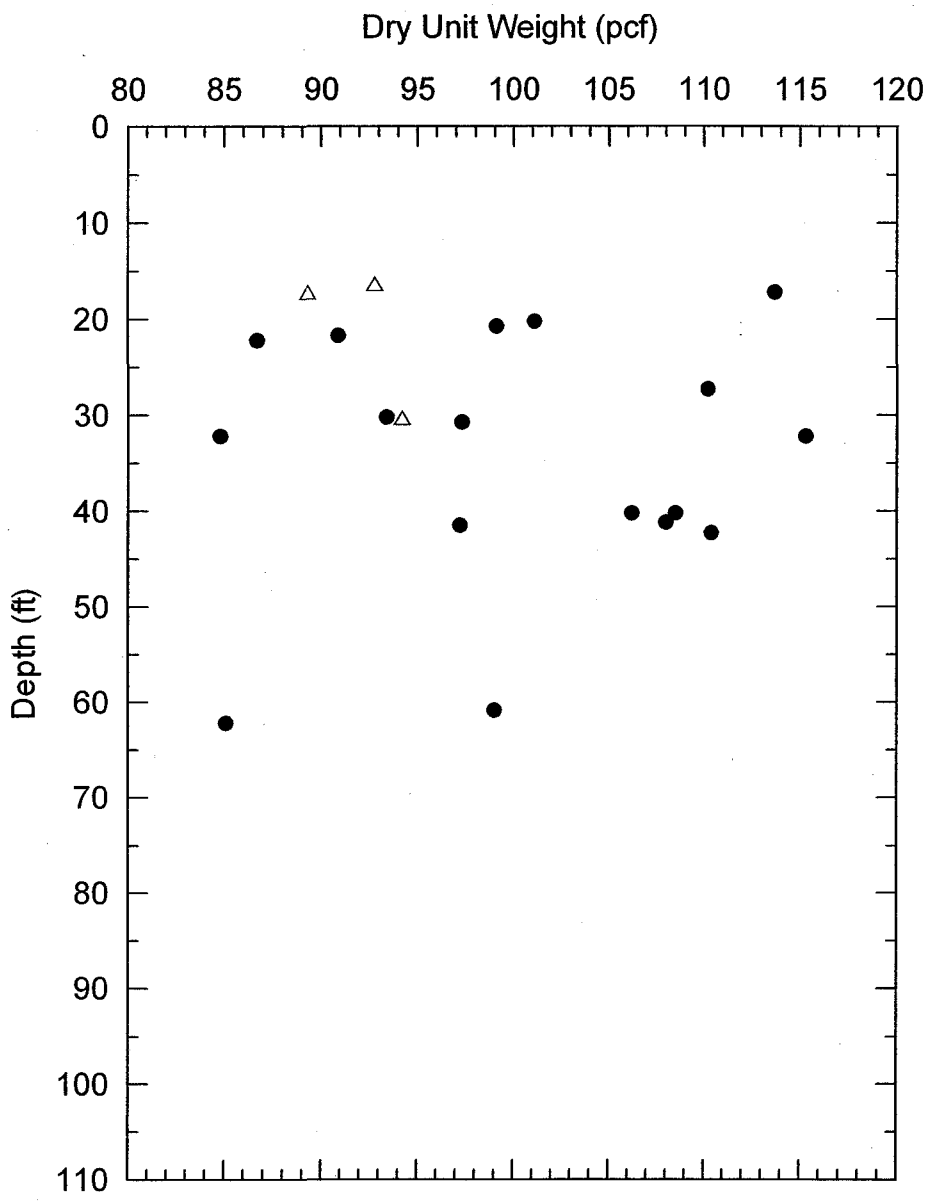
LEGEND:

● TP-1

△ TP-2

Project No.: 22235583 Elizabeth Mine Strafford, VT URS	**Water Content vs. Depth Tailing Piles 1 and 2**	Figure 5-2

Water Content vs. Depth..GRF w/Elizabeht Materials Plots (bd).XLS



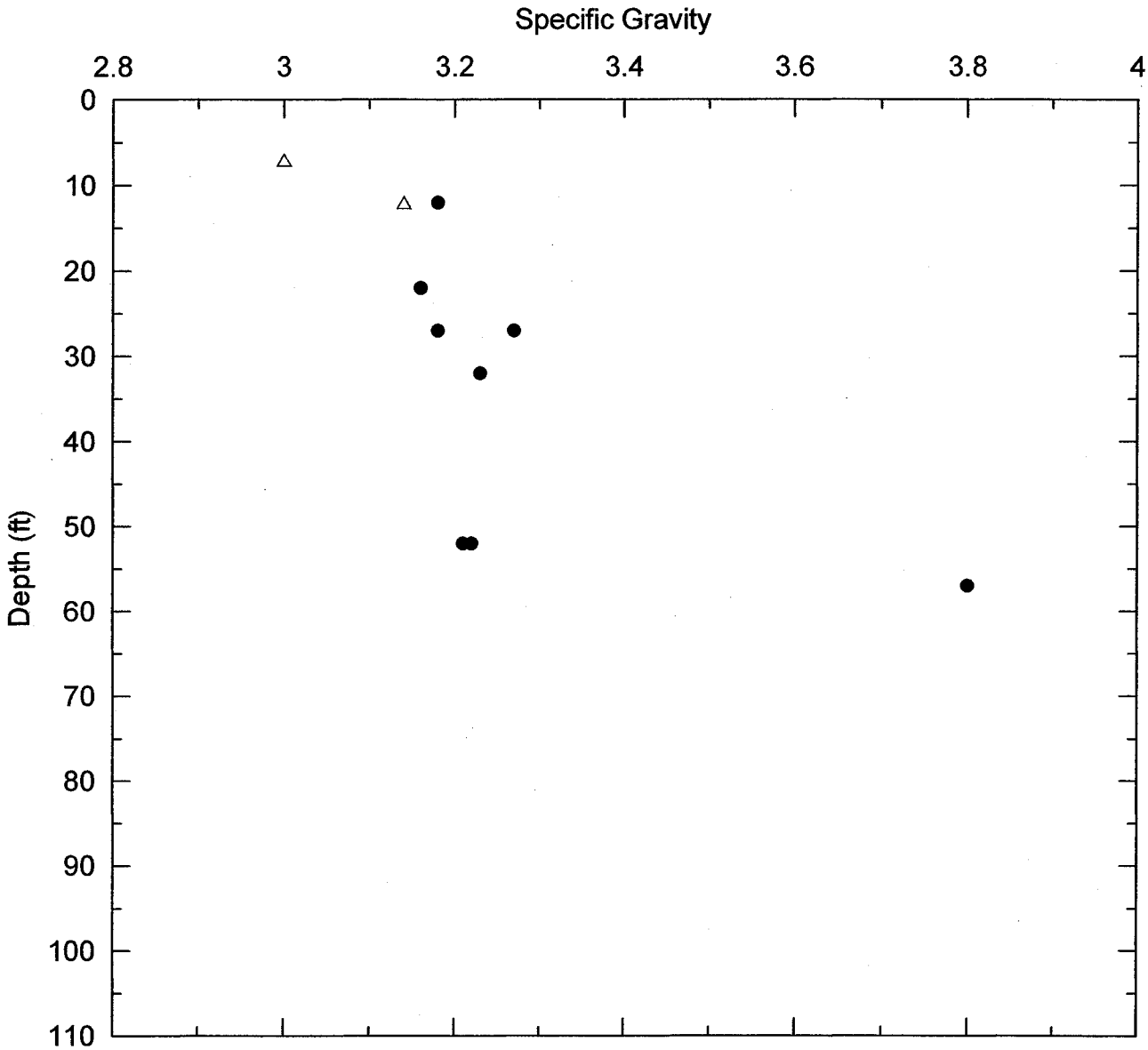
LEGEND:

● TP-1

△ TP-2

Project No.: 22235583 Elizabeth Mine Strafford, VT URS	**Dry Unit Weight vs. Depth Tailing Piles 1 and 2**	Figure 5-3

Dry Unit Weight vs. Depth.GRF w/Elizabeth Materials Plots (bd).XLS



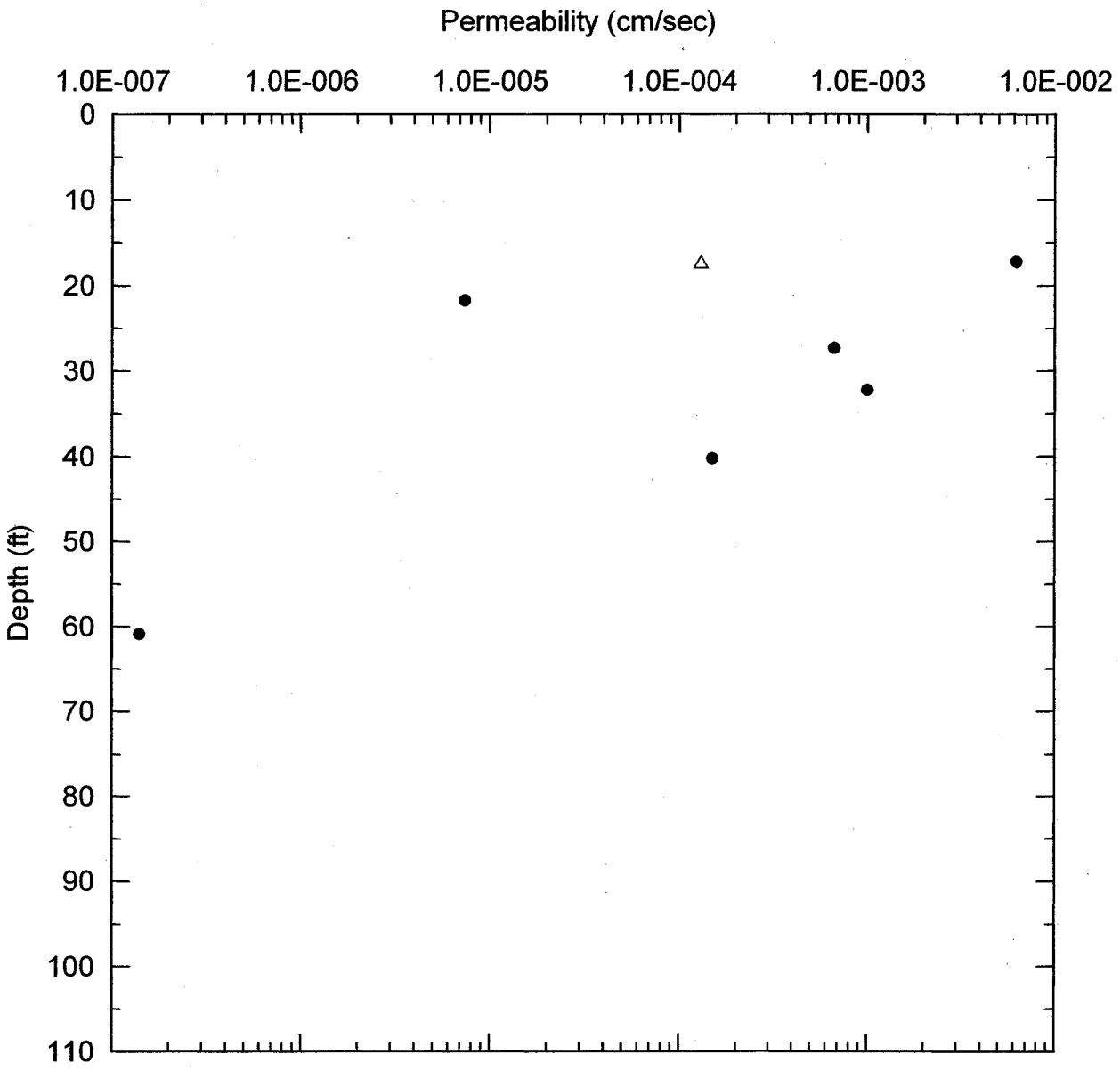
LEGEND:

● TP-1

△ TP-2

Project No.: 22235583 Elizabeth Mine Strafford, VT URS	**Specific Gravity vs. Depth Tailing Piles 1 and 2**	Figure 5-4

Specific Gravity vs. Depth.GRF w/Elizabeth Materials Plots (bd).XLS



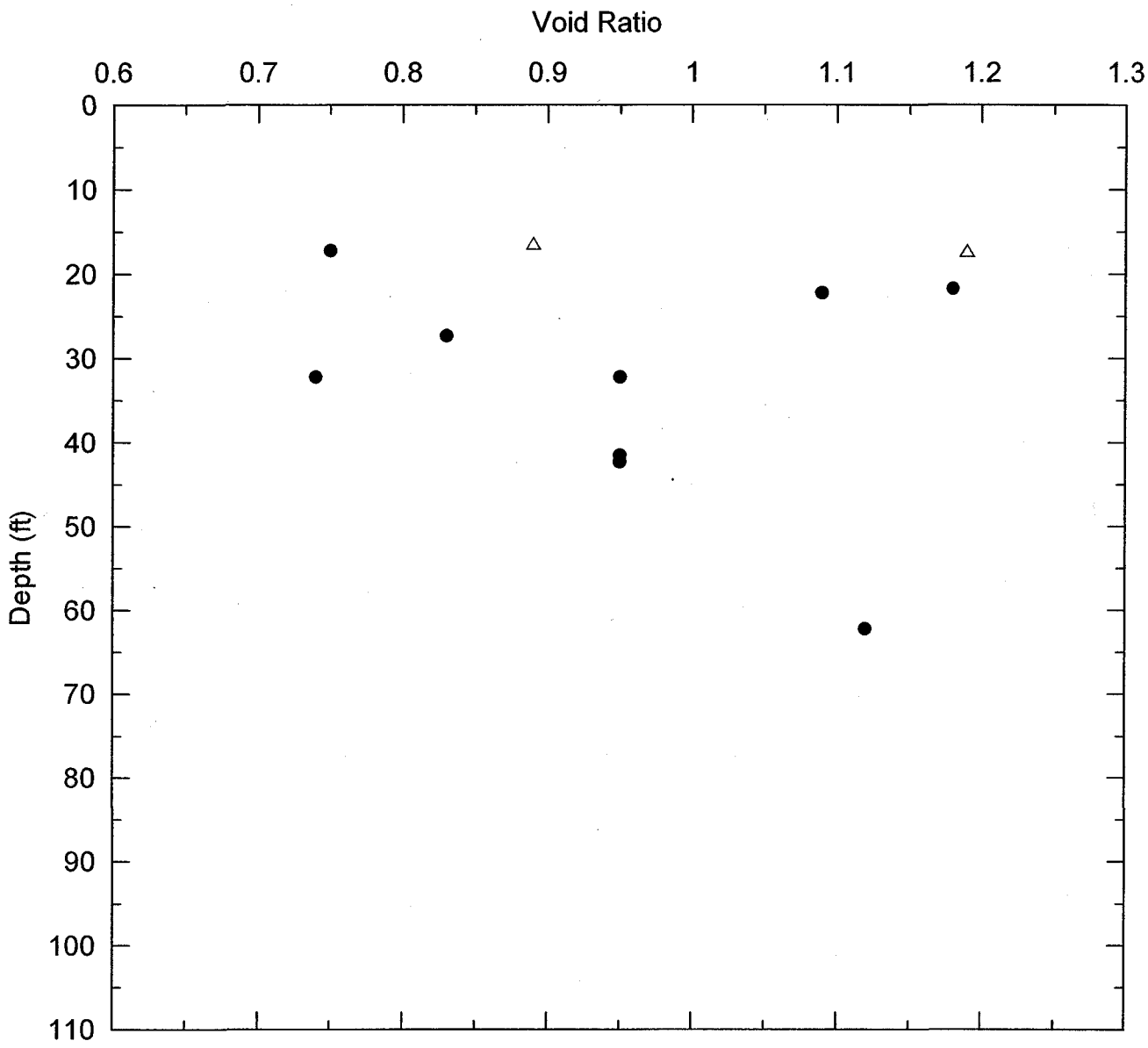
LEGEND:

● TP-1

△ TP-2

Project No.: 22235583 Elizabeth Mine Strafford, VT URS	**Permeability vs. Depth Tailing Piles 1 and 2**	Figure 5-5

Permeability vs. Depth.GRF w/Elizabeth Materials Plots (bd).XLS



LEGEND:

● TP-1

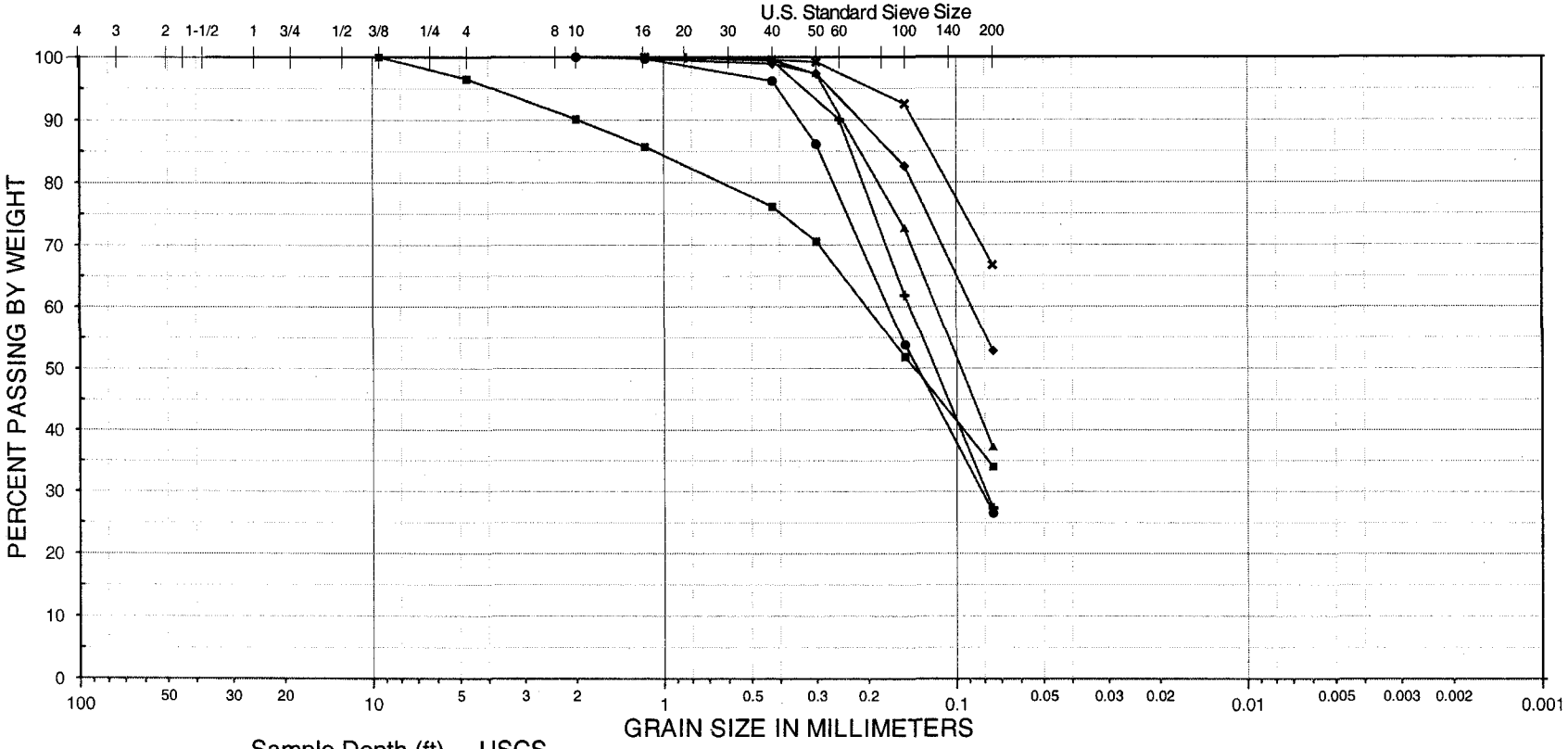
△ TP-2

Project No.: 22235583 Elizabeth Mine Strafford, VT URS	**Void Ratio vs. Depth Tailing Piles 1 and 2**	Figure 5-6

Void Ratio vs. Depth.GRF w/Elizabeth Materials Plots (bd).XLS

PARTICLE SIZE DISTRIBUTION

GRAVEL		SAND			SILT OR CLAY
COARSE	FINE	COARSE	MEDIUM	FINE	

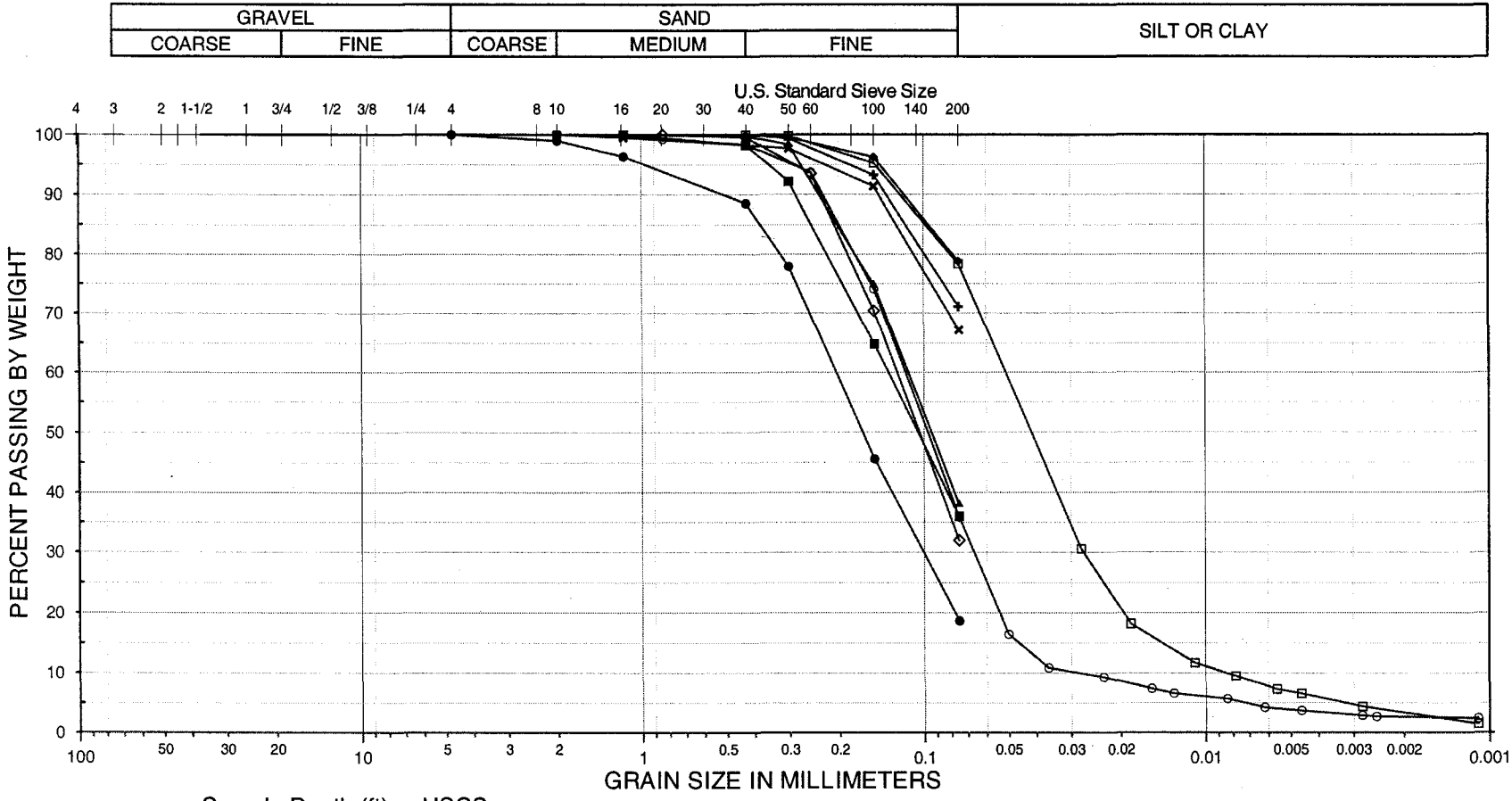


Sample Depth (ft)	USCS
0-2	SM
15-17	SM
27.3	SM
30-32	SM
50-52	ML
65-67	ML

Project No. 22235583	Elizabeth Mine Strafford, VT	**Particle Size Distribution Test Borehole TB-9**	Figure 5-7
URS			

Grad_TB_09.grf 3/27/03

PARTICLE SIZE DISTRIBUTION

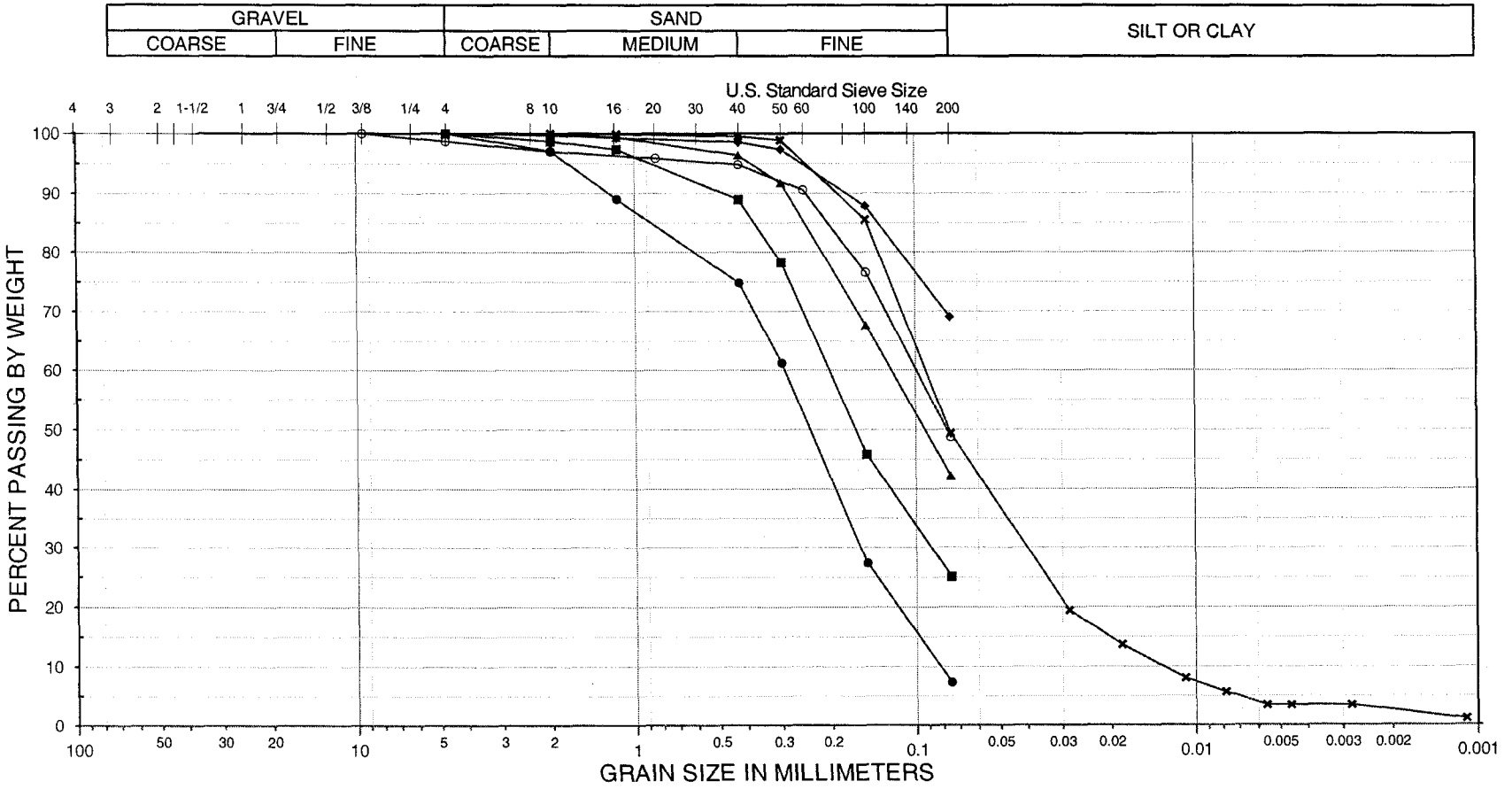


Sample Depth (ft)	USCS
5-7	SM
20-22	SM
32.2	SM
50-52	SM
60.85	SM
65-67	ML
80-82	ML
92-94.5	ML
100-102	ML

Project No. 22235583	Elizabeth Mine Strafford, VT	**Particle Size Distribution Test Borehole TB-10**
URS		Figure 5-8

Grad_TB_10.grf / 3/27/03

PARTICLE SIZE DISTRIBUTION

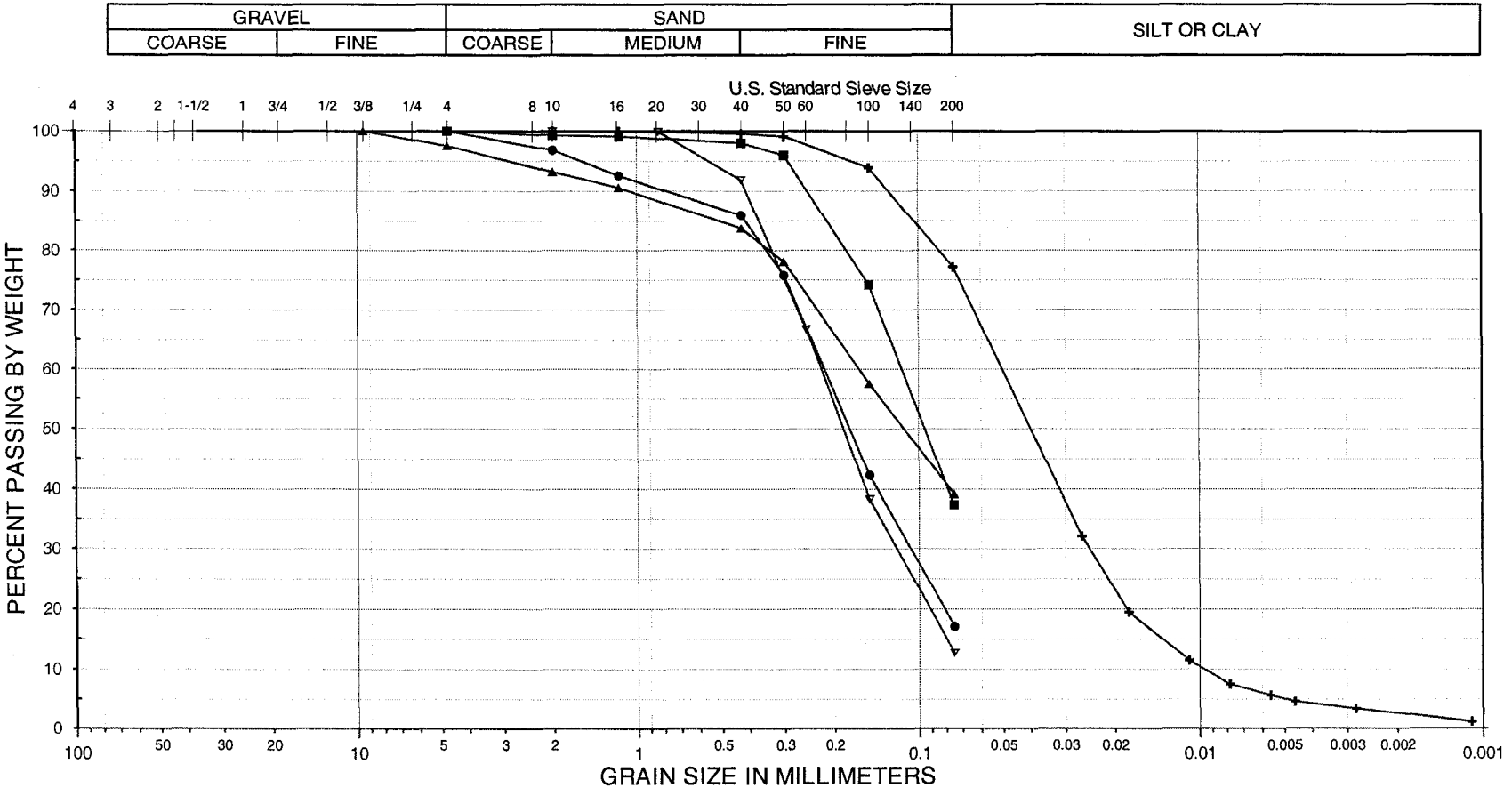


Sample Depth (ft)	USCS
2-4	SM
10-12	SP-SM
25-27	SM
40.25	SM
42.5-44.5	ML
55-57	SM

Project No. 22235583	Elizabeth Mine Strafford, VT	**Particle Size Distribution Test Borehole TB-11**
URS		Figure 5-9

Grad_TB_11.grf / 3/27/03

PARTICLE SIZE DISTRIBUTION

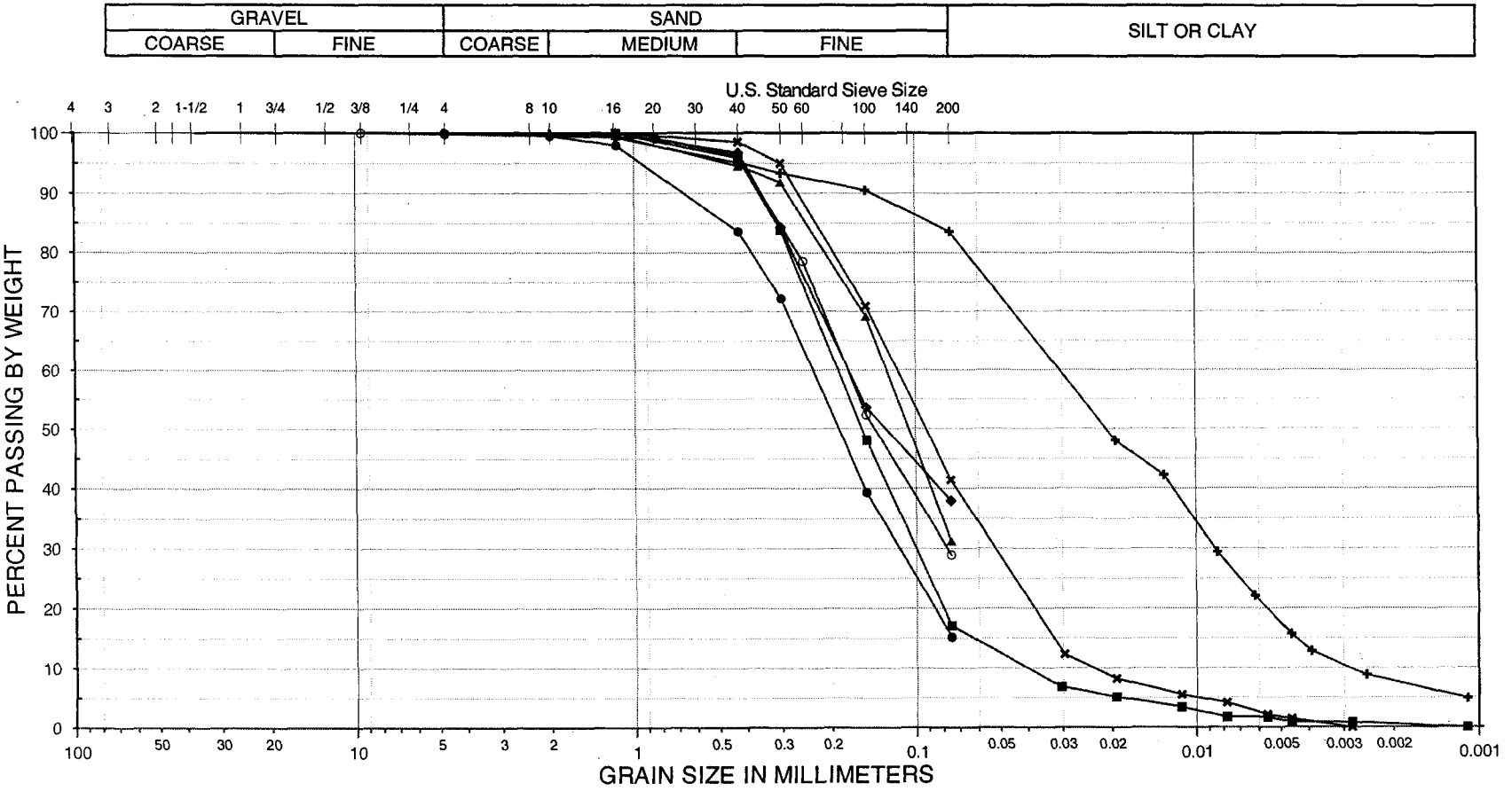


Sample Depth (ft)	USCS
0-2	SM
10-12	SM
17.2	SM
25-27	SM
35-37	ML

Project No. 22235583	Elizabeth Mine Strafford, VT	**Particle Size Distribution Test Borehole TB-12**
URS		Figure 5-10

Grad_TB_12.grf / 3/27/03

PARTICLE SIZE DISTRIBUTION

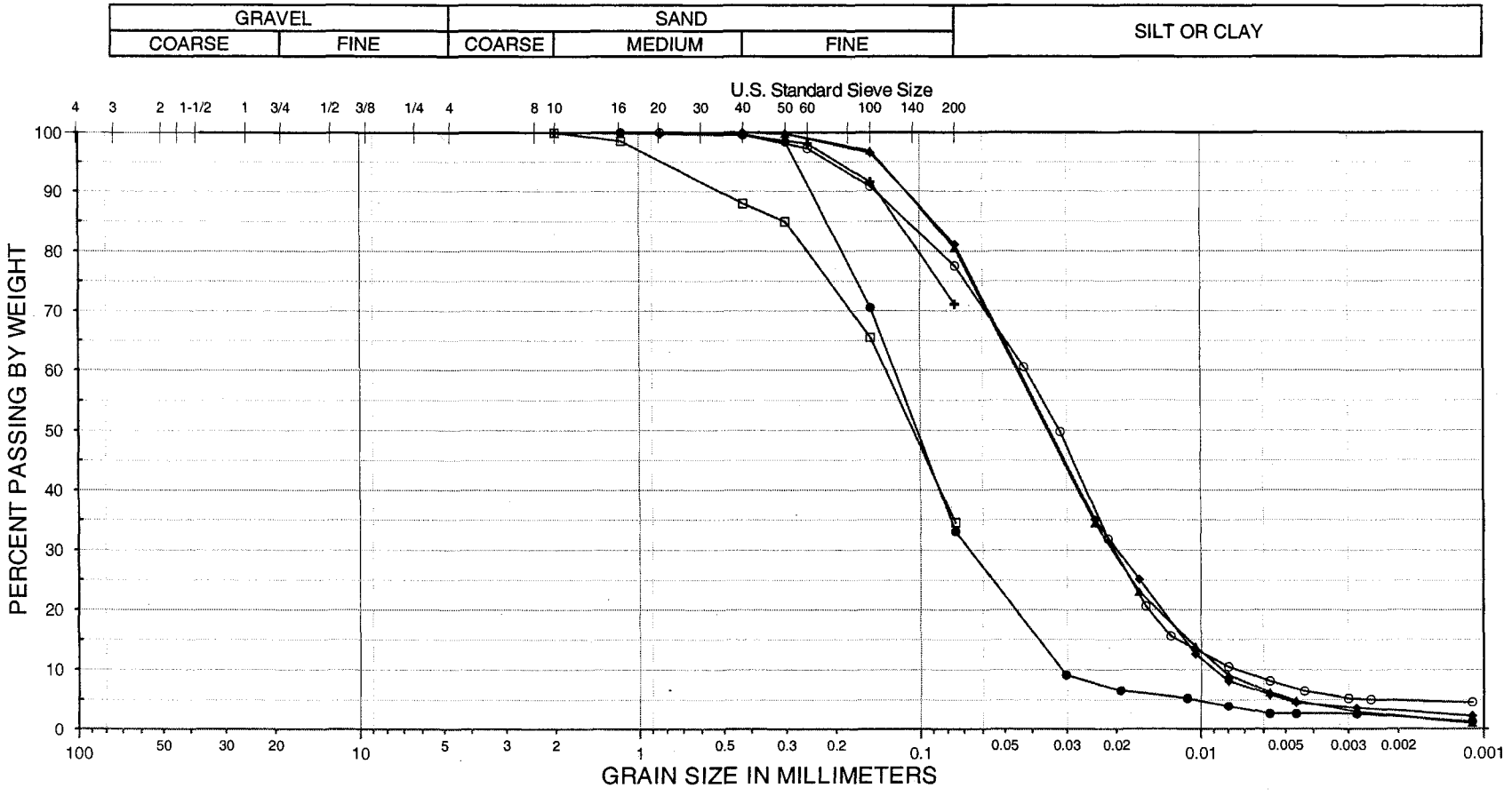


Sample Depth (ft)	USCS
0-2	SM
10-12	SM
25-27	SM
30.75	SM
35-37	SM
45-47	SM
55-57	ML

Project No. 22235583	Elizabeth Mine Strafford, VT	**Particle Size Distribution Test Borehole TB-13**
URS		Figure 5-11

Grad_TB_13.grf / 3/27/03

PARTICLE SIZE DISTRIBUTION

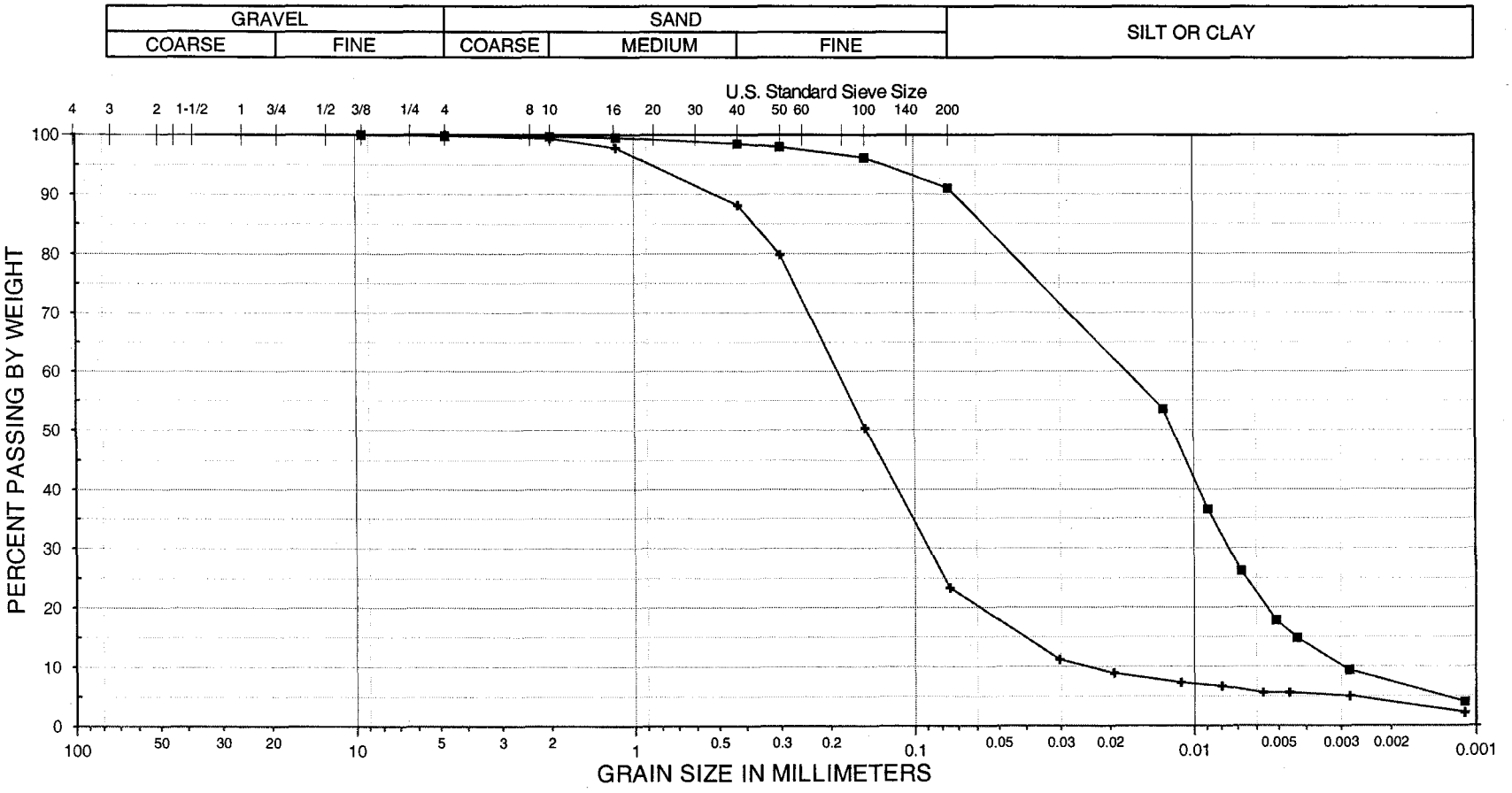


Sample Depth (ft)	USCS
10-12	SM
21.7	ML
25-27	SM
40.25	ML
42.5-44.5	ML
50-52	ML

Project No. 22235583	Elizabeth Mine Strafford, VT	**Particle Size Distribution Test Borehole TB-14**
URS		Figure 5-12

Grad_TB_14.grf / 3/27/03

PARTICLE SIZE DISTRIBUTION



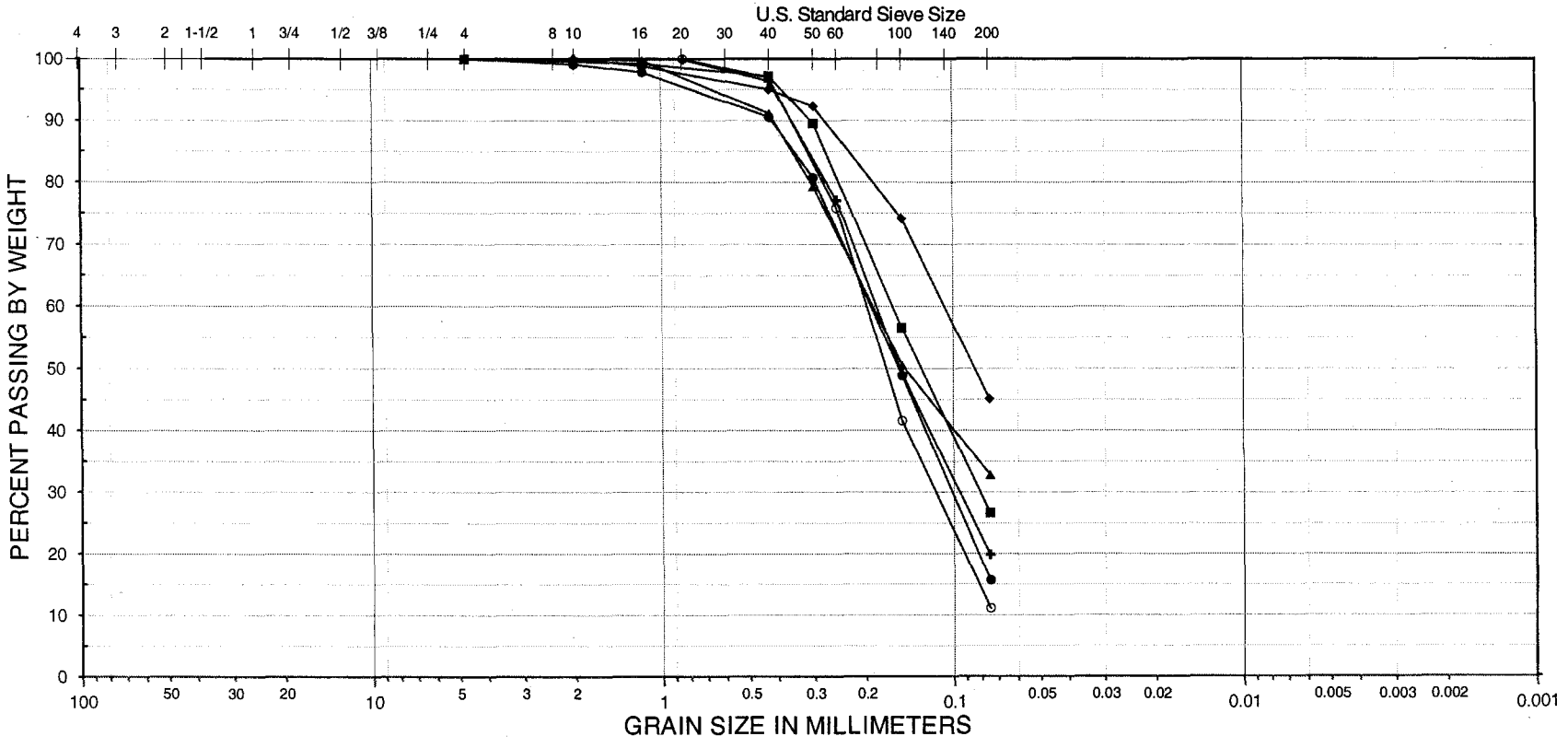
Sample Depth (ft)	USCS
0-2	SM
15-17	ML

Project No. 22235583	Elizabeth Mine Strafford, VT	**Particle Size Distribution Test Borehole TB-15**	Figure 5-13
URS			

Grad_TB_15.grf / 3/27/03

PARTICLE SIZE DISTRIBUTION

GRAVEL		SAND			SILT OR CLAY
COARSE	FINE	COARSE	MEDIUM	FINE	

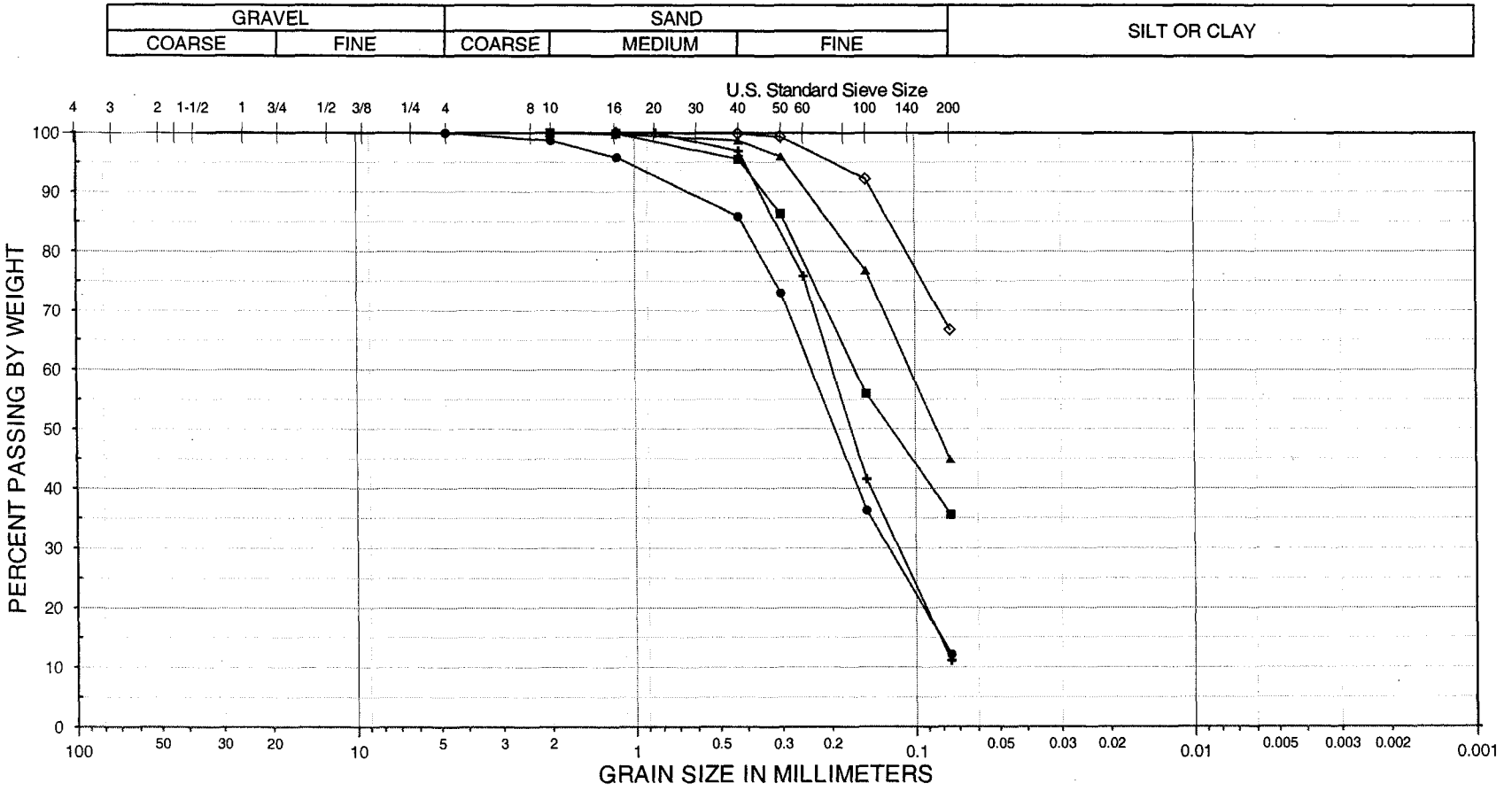


Sample Depth (ft)	USCS
0-2	SM
10-12	SM
17.2	SM
20-22	SM
30.3	SM
32.5-34.5	SM

Project No. 22235583	Elizabeth Mine Strafford, VT	**Particle Size Distribution Test Borehole TB-16**	Figure 5-14
URS			

Grad_TB_16.grf / 3/27/03

PARTICLE SIZE DISTRIBUTION

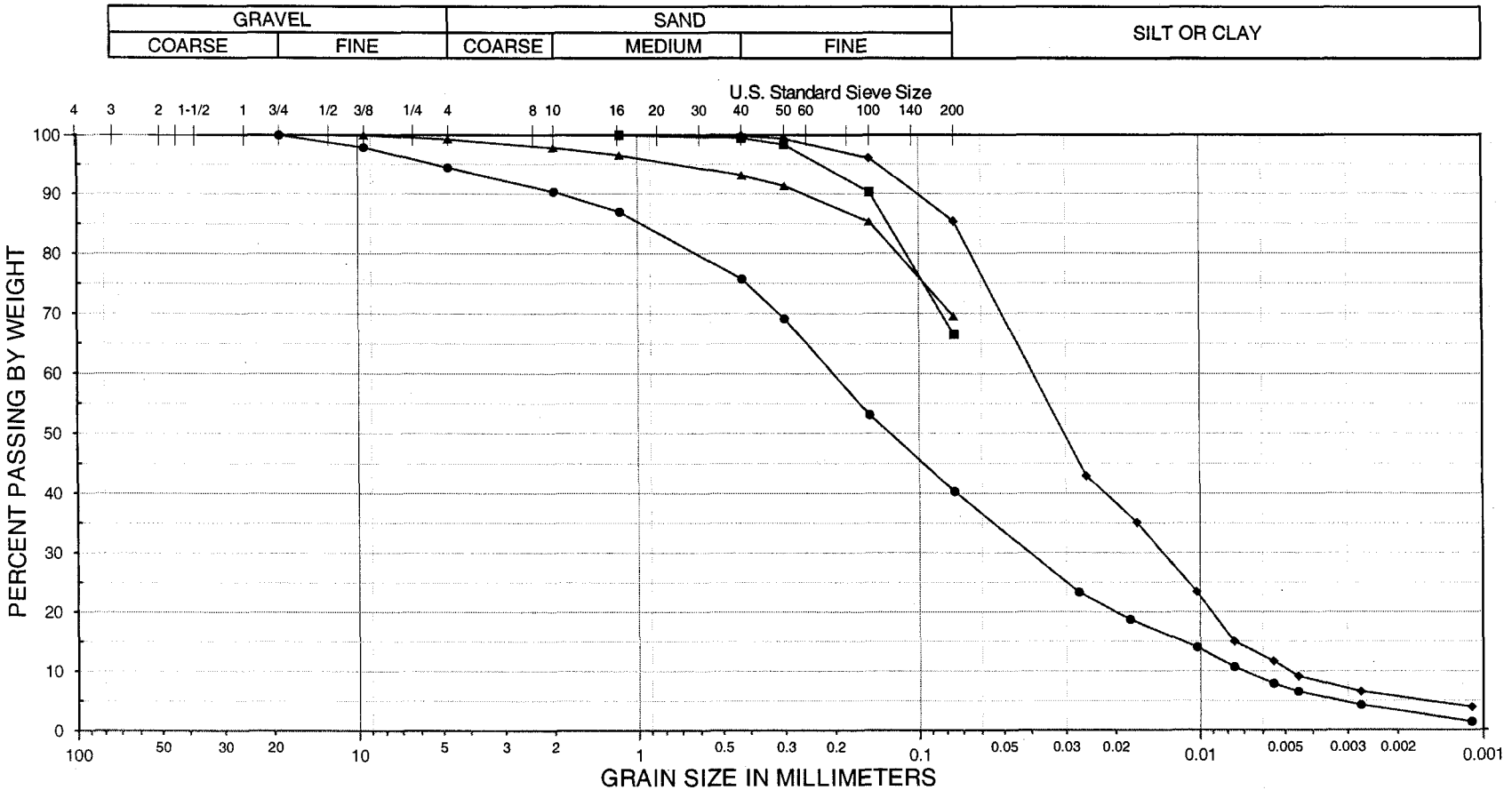


Sample Depth (ft)	USCS
0-2	SM
10-12	SM
16.35	SP-SM
17.5-19.5	SM
35-37	ML

Project No. 22235583	Elizabeth Mine Strafford, VT	**Particle Size Distribution Test Borehole TB-17**	Figure 5-15
URS			

Grad_TB_17.grf / 3/27/03

PARTICLE SIZE DISTRIBUTION



Sample Depth (ft)	USCS
0-2	ML
5-7	ML
12.5-14.5	ML
25-27	SM

Project No. 22235583	Elizabeth Mine Strafford, VT	**Particle Size Distribution Test Borehole TB-18**
URS		Figure 5-16

Grad_TB_18.grf / 3/27/03

Section 6

An interpretation of the subsurface conditions of tailing dams TP-1 and TP-2 was developed based on the results of field investigations completed in Fall 2002. The subsurface material classifications and interpreted material contacts for the sand shell and impounded tailing were based on:

- Visual classification in the field
- Results obtained from laboratory testing
- Results of CPT soundings
- Observations during test trenches
- Observations and in-situ measurements obtained during drilling

Also included in the subsurface descriptions are the results of the TP-1 decant inspection conducted by a remote video recording. Presented below is a general discussion of the tailing subsurface profile followed by detailed subsurface descriptions for tailing dams TP-1 and TP-2 and the TP-1 decant structure.

6.1 GENERAL SUBSURFACE PROFILE

CPT soundings and test boreholes were advanced through the tailing and into the native foundation soils from the dam crest and from areas within the decant ponds of TP-1 and TP-2. In general, the boreholes and CPT soundings encountered several feet of oxidized tailing consisting of very loose sand to silty sand to silt tailing. The material ranged from clean to very silty or clean to slightly clayey. The material was oxidized, with colors ranging from dark orange to orange near the surface and light orange to yellow to tan with depth. At the bottom of the oxidized zone, a cemented tailing layer was encountered at depths ranging from approximately 2 to 4 feet. This layer was identified by a very high tip resistance and high skin friction. The cementation is believed to be the result of iron precipitant (ferricrete) formation.

The test borings and CPT soundings encountered unoxidized sand and silt tailing for the remainder of the boring or sounding until foundation soils were encountered. The tailing material was loose to medium dense, clean to very silty or slightly sandy to very sandy, and moist to wet. The unoxidized tailing is noted by dark color ranging from gray to black to dark green.

The unoxidized tailing was underlain by glacial till consisting of a mixture of loose to very dense sands and gravels. The materials generally ranged from clean to very silty, clean to clayey, slightly gravelly to gravelly, slightly sandy to very sandy, with occasional cobbles and boulders up to 3 feet in diameter. The till was moist to wet and light brown to brown in color.

A detailed discussion of the subsurface conditions encountered for each test borehole and CPT sounding are presented below. The results are presented by site location including the tailing dam TP-1 downstream toe, sand shell, decant pond, and decant pond perimeter; and tailing dam TP-2 sand shell, decant pond, and pond perimeter.

6.2 TAILING DAM TP-1

The geotechnical field investigation completed for TP-1 consisted of drilling seven test boreholes, excavating 14 test trenches, and performing 10 CPT soundings. Sample locations,

shown in Figure 4-1, were selected to characterize the depth, lateral extent, and in-situ properties of the tailing material.

Test boreholes and CPT soundings show that the sand shell was relatively clean with occasional layers of fine tailing. The sand shell was estimated to have a horizontal width of approximately 70 to 120 feet. Beyond this width, CPT soundings show that the tailing becomes progressively more layered, typical of transitional tailing. The tailing contained within the decant pond was very loose, saturated, and unconsolidated.

The phreatic surface was estimated from the initial development of positive pore pressures during the CPT sounding process. Below the estimated phreatic surface, dissipation tests were performed to measure the pore water pressure conditions and then compared to equivalent hydrostatic pore water pressure conditions. In general, the results show that the pore water pressure conditions within the tailing are near hydrostatic. The exception was an observation made in cone sounding CS-3, located on the right abutment of the dam. This sounding identified a perched water zone at a depth between 40 and 54 feet below the tailing surface. Specific water elevations are shown on Figures 4-2 through 4-5 and are described below.

6.2.1 Tailing Dam TP-1 Downstream Toe

Six test trenches, TT-5 through TT-8 and TT-20 through TT-21, were excavated near the TP-1 toe. Test trenches TT-5 and TT-6 were located near the intersection of the west and north dam slopes, to the west of the starter dam, and test trench TT-7 was located at the base of the starter dam. Test trenches TT-8, TT-20, and TT-21 were located east of the starter dam, along the north dam toe.

The test trenches, excluding test trench TT-7, encountered approximately a 1.5- to 2.5-foot layer of tailing. The oxidized tailing material was loose to very loose, moist to wet, yellow to orange or gray, sand silty to very silty, and silt slightly sandy to sandy. In test trench TT-8, a very thin layer of organics material was found overlying the tailing material. Organics were also encountered in the test trench TT-21 tailing material.

A layer of ferricrete was encountered in test trenches TT-6 and TT-8 underlying the tailing material. The ferricrete was very hard and difficult to excavate. The ferricrete layer in test trench TT-6 was approximately 0.2-foot thick, and a 0.5-foot-thick ferricrete layer was encountered in test trench TT-8. The ferricrete was underlain by tailing consisting of loose to very loose, moist to very moist, black to greenish gray, slightly silty to very silty sand.

The tailing in trench TT-5 and TT-21 was underlain by a peat layer ranging from approximately 1.7 to 2.3 feet thick. The material was loose, very moist to wet, and black. The material contained some sand and was silty to very silty. The material also contained vegetation, including tree roots up to 0.5-inch diameter.

Test trench TT-7 was excavated at the starter dam toe near a sand boil. The test trench was excavated approximately 3 feet below ground surface (bgs) and encountered layers of tailing, sand, and peat. The test trench collapsed quickly because of an inflow of water estimated to be greater than 100 gallons per minute (gpm) at the base of the excavation. Suspended tailing was noted in the flow. After collapse of the trench, the remaining trench was backfilled with surrounding sands and gravels.

The tailing in these test trenches was underlain by a glacial till that was dense, moist, gray to brownish gray, sand, very gravelly to slightly gravelly, and a gravel very sandy to sandy, slightly silty to very silty, with cobbles and boulders up to 3 feet in diameter.

Summary logs for the test trenches are shown on Figure 4-5 and water levels observed during excavation are shown on each log.

6.2.2 TP-1 Sand Shell

Five test boreholes, TB-9 through TB-13, and five collocated CPT soundings, CS-1 through CS-5, were located near the dam crest and were advanced through the sand shell. Two other CPT soundings, CS-11 and CS-12, were also located on the dam crest. Test borehole TB-10 and cone sounding CS-2 were located in the area of tailing dam TP-1 where the maximum thickness of tailing is believed to be.

Generally, a 0.5- to 1.0-foot layer of topsoil was encountered overlying the tailing material in test boreholes on the western side of tailing dam TP-1. The bottom of the tailing material ranged from 39 to 110 feet bgs. The tailing material was loose to medium dense, moist to wet, reddish orange, medium gray to dark gray to black, slightly silty to silty, fine-grained sand. The material generally became siltier with depth. Some pyrite and traces of mica were also encountered in the tailing. A near-surface cemented tailing layer was encountered in all borings and CPT soundings. Occasional hard layers or lenses were also noted during drilling and were encountered during CPT soundings.

Water was encountered during drilling in each of the test boreholes ranging from approximately 38 to 95 feet bgs. The water levels encountered were similar to those interpolated from the CPT soundings, except for test boreholes TB-10 and TB-11. The CPT water level was approximately 11 feet higher at test borehole TB-10 and 18 feet higher at test borehole TB-11 because of an apparently perched water table not discerned in field observations during boring advancement.

Below the tailing material a dense to very dense, moist, greenish gray to brown to gray, silty, clayey, gravelly, sandy glacial till material was encountered. Bedrock was not encountered in any test boreholes.

CS-1/TB-9

CS-1 and TB-9 encountered relatively high-strength tailing material from the tailing surface down to a depth of approximately 14 feet bgs. Below this elevation and to the base of the sounding, the tailing was generally consistently sandy becoming progressively finer with depth. Foundation soils were encountered at approximately 80 feet bgs. Uncorrected SPT blow counts per foot in the tailing ranged from four near the surface to a maximum of 49.

CS-2/TB-10

CS-2 and TB-10 are located in the area of tailing dam TP-1 where the maximum thickness of tailing is believed to be present. Relatively high shear strength sands were encountered in the top 14 feet bgs. Below this depth, the tailing material became noticeably more layered and transitional tailing was encountered at approximately 26 feet bgs. Soft zones consisting of fine tailing layers were encountered at approximately 68 and 76 feet bgs and from 82 feet bgs down

to the bottom of the push at approximately 94 feet bgs. Uncorrected SPT blow counts per foot ranged from 11 to 40 with some of the lower values encountered at greater depths. The material encountered at approximately 82 feet bgs was at the same elevation as the starter dam. The material at that depth was loose and saturated, and the foundation glacial till was encountered at approximately 110 feet bgs. The CPT sounding did not reach the foundation soils or bedrock.

CS-3/TB-11

High shear strength material was also encountered to a depth of approximately 16 feet bgs in CS-3 and TB-11. Transitional tailing was encountered at approximately 30 feet bgs, and soft layers of tailing were encountered at approximately 31, 33, 62 and 64 feet bgs. The foundation glacial till was encountered at approximately 65 feet bgs. Uncorrected SPT blow counts per foot ranged from 11 to 26, excluding a higher value of 51 in the ferricrete layer.

CS-4/TB-12

CS-4 and TB-12 encountered relatively high shear strength material to approximately 6 feet bgs. Soft layers were encountered at depths of approximately 3 and 7 feet bgs and then again at approximately 36 to 40 feet bgs. Uncorrected SPT blow counts per foot ranged from four to 13, excluding a higher value of 24 in the ferricrete layer. The foundation tills were encountered at approximately 40 feet bgs.

CS-5/TB-13

Relatively higher shear strength material was encountered from ground surface to a depth of approximately 20 feet bgs in CS-5 and TB-13. The deeper material appears to consist of transitional tailing. Soft material was encountered near the foundation contact at 55 to 57 feet bgs, and the foundation contact was encountered at approximately 59 feet bgs. Uncorrected SPT blow counts per foot ranged from six to 22, excluding a higher value of 50 in the ferricrete layer.

CS-11

CS-11 encountered relatively low shear strength material that contained layers of very soft tailing, as well as very sandy material. The foundation contact was encountered at approximately 53 feet bgs.

CS-12

Relatively soft tailing material was encountered for the entire length of the sounding with numerous layers of relatively coarse tailing at depth. Fine layers and soft tailing material were encountered at approximately 7 and 13 feet bgs, and the foundation contact was encountered at approximately 30 feet bgs.

6.2.3 TP-1 Decant Pond

Two test boreholes, TB-14 and TB-15, were drilled in the tailing pond area, and two CPT soundings, CS-6 and CS-7, respectively, were completed adjacent to these test holes. Test borehole TB-14 and cone sounding CS-6 are located approximately 250 feet southwest of the

crest, and test borehole TB-15 and cone sounding CS-7 are located approximately 840 feet southwest of the crest. Another CPT sounding, CS-13, was completed approximately 300 feet east of test borehole TB-14.

Water was encountered in test borehole TB-14 at approximately 45 feet bgs. The CPT sounding indicated a higher water level at 35 feet bgs. The water level for test borehole TB-15 was noted at approximately 7 feet bgs during drilling and CPT sounding CS-7 indicated a water level at approximately 1 foot bgs. A detailed summary by test borehole and sounding is presented below.

CS-6/TB-14

Test borehole TB-14 and cone sounding CS-6 encountered an approximate 20-foot-thick layer of tailing. The tailing material was loose to medium dense, moist, reddish brown to gray to black, silty, fine-grained sand. Some pyrite and traces of mica were noted in the tailing material. Underlying the sand was a 12-foot layer of silty tailing. The silty tailing was a very loose, moist to wet, dark gray to black, slightly sandy to sandy silt. Underlying the silt was a dense to very dense, moist, gray, sandy, gravelly glacial till with occasional cobbles. Uncorrected SPT blow counts per foot ranged from four to 20.

Cone sounding CS-6 encountered variable material with interbedded layers of coarse tailing and fine tailing throughout the entire length of the CPT sounding, and soft layers identified at depths of 2, 10, 12, 21, 24, 34 to 36, and 48 feet bgs.

CS-7/TB-15

Test borehole TB-15 and cone sounding CS-7 encountered an approximate 3-foot layer of tailing. The tailing material was very loose, moist, orange, fine-grained sand and included traces of silt. Underlying the tailing was a 9-foot layer of silty tailing. The silty tailing was very loose, wet, dark gray to black, and included traces of sand. Underlying the silt was a very dense, moist, gray, sandy, gravelly glacial till with occasional cobbles. Uncorrected SPT blow counts per foot ranged from zero to six.

Cone sounding CS-7 encountered very soft tailing. Almost no tip resistance was present to approximately 10 feet bgs. Some relatively firmer material was encountered from 18 feet bgs down to the foundation contact at approximately 24 feet bgs.

CS-13

Relatively soft material was encountered throughout the entire depth of CS-13. The foundation contact was encountered at approximately 51 feet bgs, and soft layers were encountered at various depths including 3, 7, 10, 18 to 20, 38 to 40, 47, and from 50 feet bgs to the foundation contact at approximately 51 bgs.

6.2.4 TP-1 Pond Perimeter

Eight test trenches, TT-9 through TT-11 and TT-14 through TT-18, were excavated around the perimeter of the pond to characterize the lateral extents of the tailing material.

TT-9

Test trench TT-9 was located approximately 50 feet east of Decant Tower 2. An approximately 0.3-foot-thick layer of topsoil was overlying tailing material. Tailing material was encountered to 0.5 foot bgs and consisted of very soft, orange to black with occasional white layers, slightly sandy to sandy silt to clay. Till was below this layer to the bottom of the excavation at approximately 3.7 feet bgs. The till consisted of loose, slightly silty to very silty, coarse- to fine-grained sand with occasional boulders.

TT-10

Test trench TT-10 was located approximately 930 feet southwest of the crest. There was an approximately 0.3-foot-thick layer of topsoil overlying an approximately 0.7-foot-thick layer of very soft to soft, wet, orange, no sand to slightly sandy silt or clay material. Till was below the tailing material to the bottom of the excavation at 1.5 feet bgs. The till consisted of loose to medium dense, slightly moist to wet, coarse- to medium-grained sand with occasional gravels, cobbles, and boulders 2 to 3 feet in diameter.

TT-11

Test trench TT-11 was located on the southeast corner of TP-1 near TP-2. An approximately 1-foot-thick layer of peat was encountered overlying a 1.5-foot-thick layer of tailing material. This test trench was excavated to only 2.5 feet bgs because the trench collapsed. The tailing material consisted of very loose to loose, gray with traces of orange, silty sand or very soft sandy silt. Water was encountered at approximately the surface of this test trench.

TT-14

Test trench TT-14 was located on the southwest corner of TP-1 pond. This test trench encountered an approximately 11-foot-thick layer of tailing material. This tailing material consisted of very loose to loose, slightly moist to very moist, orange to light yellow to black to dark gray, slightly silty to very silty sand. The tailing became less oxidized with depth. At approximately 2 feet bgs, a 0.5-foot-thick layer of cemented tailing was encountered. A glacial till was encountered at 11 feet bgs to the bottom of the excavation at 11.5 foot bgs. This glacial till material was dense, wet, black to dark gray, very cobbly, sandy, silty gravel. The cobbles were 6 to 8 inches in diameter. Water was encountered in the trench at 11 feet bgs.

TT-15 through TT-18

Test trenches TT-15, TT-16, TT-17, and TT-18 were located near the east corner of the impoundment near the crest. These test trenches encountered a layer of topsoil, which ranged from 0.1- to 0.5-foot thick. The topsoil was loose to very loose, moist to very moist, black, no silt to silty sand, and no clay to slightly clayey sand. The topsoil contained some organic and root matter. Below the topsoil, a tailing layer ranging from 0.3- to 4.5-feet thick was encountered, except in test trench TT-16, where a tailing layer less than 1-inch thick was observed. The tailing material consisted of very loose to medium dense, slightly moist to moist, orange to gray to dark gray, no clay to clayey sand, and clean to very silty sand. Green sand lenses were also observed in test trench TT-18.

Underlying the tailing material was a glacial till material, except in test trench TT-17, where a 1-foot layer of cemented tailing was encountered below the tailing, which was hard to excavate. Underlying this cemented tailing was the glacial till material. The glacial till material consisted of very loose to medium dense, slightly moist to moist, brownish gray to gray, no clay to clayey, silty to very silty, fine- to coarse-grained sand with occasional cobbles and boulders.

6.3 DAM TP-2

The geotechnical field investigation completed for TP-2 consisted of three test boreholes, five test trenches, and two CPT soundings. Sample locations, shown on Figure 4-1, were selected to characterize the subsurface material and/or identify the lateral extents of the tailing material. Discussion of the subsurface conditions for TP-2 by sample location are provided below.

6.3.1 TP-2 Sand Shell

The field investigation for the embankment consisted of test boreholes TB-16 and TB-17, adjacent CPT soundings CS-8 and CS-9, and test trench TT-19.

CS-8/TB-16

TB-16 encountered 42 feet of tailing. The tailing material for the first 2 feet bgs was oxidized and yellow to orange in color. Below this, the color changed from gray to black and was unoxidized. The tailing was very loose to loose, moist to wet, silty, fine-grained sand. Some pyrite and traces of mica were observed in the tailing. Water was encountered at 35 feet bgs. Uncorrected SPT blow counts per foot in the tailing ranged from six to 13.

A glacial till material was observed below the tailing material. The glacial till consisted of medium-dense to dense, moist, gray to brown, clayey, silty, and gravelly sand with occasional cobbles.

CS-8 encountered relatively high shear strength tailing material to approximately 11 feet bgs. Below this elevation, tailing was encountered with soft layers at 17 and 40 feet bgs. The foundation contact was encountered at approximately 45 feet bgs.

CS-9/TB-17

TB-17 encountered 45 feet of tailing. The tailing material for the first 6 feet bgs was oxidized and yellow to orange in color. The color changed to gray to dark gray, indicating unoxidized tailing, below 6 feet. The tailing to 20 feet bgs was very loose to medium-dense, moist to wet, sand and included traces of silt. At approximately 20 feet bgs, the tailing material changed to silt. The tailing material at depths greater than 20 feet bgs was very loose to loose, moist to wet, sandy, clayey, silt. Some pyrite and traces of mica were also observed for the entire tailing depth. Water was encountered at a depth of 29 feet bgs. Uncorrected SPT blow counts per foot in the tailing ranged from two to 12.

Relatively high shear strength tailing material was encountered to a sounding depth of approximately 18 feet bgs. Transitional tailing was encountered at approximately 32 feet bgs. This sounding showed that the tailing material had significant layers of very fine, soft material at

2, 7, 10, 20, and 48 to 52 feet bgs, and a very soft layer was encountered at approximately 57 to 63 feet bgs. The foundation contact was encountered at approximately 64 feet bgs.

A glacial till material was observed below the tailing material. The glacial till consisted of medium-dense to dense, moist, gray to brown, clayey, silty, and gravelly sand with occasional cobbles.

TT-19

Test trench TT-19 was excavated in the toe area of TP-2 where the dam was breached. The test trench was excavated to 3.5 feet bgs, where two separate inflows of water, measuring approximately 10 gpm each, were observed prior to the trench collapsing. Tailing material encountered consisted of very loose silty sand to very soft sandy silt. The material was orange to yellow in color and occasional wood debris was observed.

6.3.2 TP-2 Decant Pond

One test borehole, TB-18, and one cone sounding, CS-10, were completed in the TP-2 decant pond area.

TB-18

TB-18 encountered tailing, yellow to orange in color and oxidized for 2 feet. The tailing color changed to gray to black, and the tailing was unoxidized below this depth. The tailing material was approximately 27 feet bgs. The tailing is very loose, moist to wet, sandy clay. Uncorrected SPT blow counts per foot in the tailing ranged from zero to six. Some pyrite and traces of mica were observed in the tailing, and water was encountered at 10 feet bgs. A glacial till material was encountered below the tailing material. The glacial till consisted of loose, moist to wet clayey, silty, sand, with occasional organics and cobbles.

CS-10

Relatively soft material was encountered for the entire cone sounding. The foundation contact was encountered at approximately 38 feet bgs.

6.3.3 TP-2 Perimeter

Two test trenches, TT-12 and TT-13, were excavated around the pond perimeter to characterize the lateral extent of the tailing material.

TT-12

Test trench TT-12 was excavated at the inlet of TP-2 in the alluvium and alluvial fan. In general, the material consisted of sediment wash from the upland area, including TP-3. The material was layered gravel and sand and was silty. A flow was observed entering the excavation from the valley's west side, and it was unclear if this flow was from bank storage.

TT-13

Test trench TT-13 was excavated approximately 250 feet southwest of the crest. The first 0.1 feet bgs was a very moist, black peat layer. Below this to 0.5 feet bgs, the topsoil changed to a loose to very loose, moist, red, silty to very silty, slightly clayey, sand material with some organics. Underlying this topsoil was 2.5 feet of tailing. The tailing was loose, moist, and transitioned from a yellow orange to black within the first 0.7 feet. The tailing material was clean to slightly silty sand.

A glacial till material was below the tailing in TT-13 to the final excavation depth of 6.5 feet bgs. The till was medium-dense to dense, moist, gray to gray brown, silty to very silty, trace of gravel to gravelly sand with occasional boulders.

6.4 DECANT STRUCTURE

The TP-1 decant system consists of three vertical inlets (i.e., decant towers) connected by horizontal discharge pipes. The towers are numbered for reference in this report, beginning from the downstream end, as Decant Towers 1, 2, and 3. Currently, the towers and piping associated with Decant Towers 1 and 2 are actively transmitting flow. Upstream, Decant Tower 3 inlet is located at the edge of the TP-1 decant pond, and the inlet is elevated several feet above the existing ground surface.

Structural Design

The decant system discharge pipes consist of 5-foot-long sections of 24-inch-diameter reinforced concrete pipe with bell and spigot joints. The vertical towers consist of 3-foot-diameter reinforced concrete pipe, with barrel lengths of approximately 1 foot.

The intake to each of the decant towers is covered with a grated reinforced concrete cover. The openings in the pre-cast cover measure approximately 4-inches by 4-inches. The base of each decant tower appears to be founded on concrete. The upstream decant discharge pipe enters at a higher elevation than the outflow, and as a result, the towers also serve as a drop structure.

The existing decant system is believed to be surrounded by tailing and the tops of each tower and the decant outfall are exposed. In addition, the crown of the discharge pipe entering Decant Tower 2 is collapsed and surface water enters the discharge pipe at the Decant Tower 2 connection. The top of Decant Tower 1 is several feet above the tailing surface, and the tower serves as a drop structure between Decant Tower 2 and the outfall. The Decant Tower 3 inlet is located several feet above the existing ground surface.

The decant system outfall is located in the groin of the right abutment at an approximate elevation of 1,017 feet.

The system features include:

- An approximately 360-foot-long horizontal pipe section between the system outfall and Decant Tower 1, which has a total depth of approximately 25 feet.
- An approximately 250-foot-long horizontal pipe section between Decant Towers 1 and 2, and Decant Tower 2 has a total depth of approximately 12 feet.

- An approximately 210-foot-long horizontal pipe section between Decant Towers 2 and 3. Decant Tower 3 has a total depth of approximately 4 feet.

The section of decant pipe between the broken crown at Decant Towers 2 and 3 appears not to have been used.

6.4.1 Inspection Results

The decant towers were generally observed to be in poor condition. Sulfate and acidic pore fluids have attacked the reinforced concrete pipe, eroding the cement paste, and leaving a surface of exposed aggregate. Sections of the decant risers are cracked and exposed reinforcement is showing signs of corrosion.

At the time of this inspection, no flow was entering the decant pipe and the area upstream of the inlet was dry. There was a significant amount of woody debris consisting of lumber (e.g., 2x4s) and dead trees up to 4 inches in diameter collected around the decant system inlet (i.e., the section of pipe with a broken crown located immediately upgradient of Decant Tower 2).

The decant outfall was partially blocked by several large rocks and wood boards resulting in the creation of backwater within the outlet pipe. The blockage was partially removed with a pick and shovel prior to inserting the video camera. The downstream end of the decant pipe between Decant Tower 1 and the outfall has apparently been mostly filled with water for extended periods.

Wood debris was wedged in the decant pipe between Decant Tower 1 and the outfall. This wood debris was dislodged by the camera during video inspection and consisted of lumber and small trees up to approximately 4 inches in diameter. This material could potentially block flow.

The observable discharge pipe between Decant Tower 1 and the outfall is generally in poor condition. The video inspection equipment accessed approximately two-thirds of the pipe length between Decant Tower 1 and the outfall. An estimated 135 feet of the discharge pipe could not be accessed due to a restriction created by thick, hard iron precipitants. This length of pipe was located beneath the dam crest where the tailing fill is the thickest, corresponding to an area that would be considered relatively critical to the operation of the system.

Significant quantities of hard iron precipitants (the result of water infiltration) have formed at the pipe joints and along the bottom of the decant pipe. The precipitate thickness varies with location. The thickest accumulation occurs in the lower sections of pipe near the decant outfall. It was postulated that backwater created by blocking the outfall has resulted in the formation of the thick iron precipitants coating within the pipe, thus constricting flow. Based on visual observations, it was estimated that pipe flow in the lower reaches of the discharge pipe between Decant Tower 1 and the outfall is restricted to approximately one-half of the available flow area.

Cracking was noted in numerous pipe sections and were both longitudinal along the pipe crown (aligned parallel to the flow) and lateral extending around the pipe circumference. Lateral cracks at the pipe crown are probably the result of overburden loads. Although cracking of the pipe is not uncommon or unusual, it is an indication that the loads may be sufficient to exceed the tensile strength of the concrete. Under these conditions, the excess tensile loads are transferred to the steel reinforcement. Additionally, the cracks expose reinforcing steel and the interior concrete to the surrounding tailing pore fluids, known to be corrosive and cause deterioration.

Evidence of deterioration was observed in the pipe crown as indicated by dark iron precipitants along the crack. Cracking of the pipe crown appears to be worse at the downstream end of the decant pipe, beneath the dam crest where the tailing fill is the thickest and the overburden loads are potentially the greatest. The worst areas of cracking could not be viewed up close because of restricted camera travel in this area.

There is a risk that the deteriorated concrete and corroded reinforcement could result in a pipe collapse. Based on current observations, there is no indication of imminent failure; however, conditions can change quickly and deterioration of the concrete and reinforcing will continue. Small changes in either loading or pipe support conditions can result in a sudden collapse.

Cracks around the pipe circumference are likely the result of differential settlement. This type of cracking is less frequent but still leaves the reinforcement and interior concrete exposed to corrosion and deterioration where the cracks occur.

Section 7

A series of geotechnical analyses of the field and laboratory data collected from tailing dams TP-1 and TP-2 has been performed, including material characterization, data correlation between collection and testing methods, liquefaction evaluation, and slope stability analysis. Presented below is a summary of our approach to these analyses followed by the results of the analyses.

7.1 APPROACH TO ANALYSIS

The subsurface tailing materials were characterized for use in both the stability analyses and liquefaction analyses. The in-situ tailing properties were measured during field investigations conducted in November 2002. These results were compared with subsequent laboratory testing and URS' experience with similar tailing dams. The geotechnical laboratory program was designed to measure the engineering properties of both the undisturbed and remolded tailing. The results of the SPT blow counts and CPT soundings were correlated with laboratory results to develop the final engineering properties for use in the stability analysis.

A steady-state seepage stability analysis was performed for the estimated cross-section located across the downstream slope of tailing dam TP-1. A factor-of-safety (FOS) against slope movement for drained loading conditions for the current seepage condition of tailing dam TP-1 was calculated. A stability analysis was not performed for tailing dam TP-2 since the dam is currently not considered a critical structure. The phreatic surface estimated for the analyses was based primarily on CPT sounding interpretations and was subsequently correlated with piezometer measurements.

A sensitivity analysis was then performed to evaluate the impacts of changes in the phreatic surface on dam stability. The phreatic surface was incrementally raised and the FOS calculated. The phreatic surface elevation was increased until the steady-state FOS was approximately equal to 1.0.

The liquefaction potential of tailing in the sand shell was evaluated for both tailing dams TP-1 and TP-2. Empirical procedures described by Youd et al. (2001) were used to complete the analysis. The procedure uses the measured SPT blow counts and an estimated level of ground shaking, along with published empirical charts, to assess the liquefaction potential (potential for substantial loss in strength from earthquake shaking). The results were then used to complete a post-earthquake stability analysis.

7.2 MATERIAL CHARACTERIZATION

Nine of the 13 CPT soundings performed at tailing dams TP-1 and TP-2 were collocated with test boreholes. This allowed for the results of the geotechnical laboratory testing (Section 5) to be compared with the SPT blow counts $(N_1)_{60\text{-}CS}$ (corrected for overburden, fines content, drill rod length, sampler energy ratio, borehole diameter, and sampling method) and the CPT sounding data. The CPT data were also used to estimate effective stress friction angles, and the results were compared with laboratory measured values. Comparisons, as applicable, are presented graphically on Figures 4-6 to 4-19.

7.2.1 Cone Penetration Test Sounding Results

Piezocone sounding results from tailing dams TP-1 and TP-2 were evaluated and used to estimate soil types, internal pore pressures in the dams, and engineering properties.

Analysis

CPT soundings penetrated the sand shell and the relatively clean fine sands that form the dam beach. These materials are identified in the CPT sounding logs by a high tip resistance and moderate to low sleeve friction. The results also show a few intermittent silt or clay lenses. Silts and clays are identified by a spike in the sleeve friction and a drop in the tip resistance. These results provide an understanding of how the dam was constructed and the potential variability of the material properties. Ideal beach construction should result in a uniform sand beach with no silt or clay lenses.

The beach sands are underlain by transition tailing. Transition tailing is characterized by more frequent lenses of clay and silt fines. The transition zone is identified by more frequent spikes as the cone tip passes through these softer and finer layers. Transition tailing is created when the tailing meanders and braids during deposition, resulting in layering. In general, the transition tailing is composed of materials with a lower shear strength and lower permeability than the shell.

The depth to the transition zone is used to estimate the thickness of the sand shell. The estimates are used in the slope stability models to represent the idealized condition. The sand beach width was estimated to range from 70 to 120 feet.

The results of piezocone soundings were also used to estimate material shear strengths, as discussed below, and the location of the phreatic surface, as discussed in Section 7.5.

Material Strength

The equivalent SPT blow counts for the CPT soundings were calculated using a correlation recommended by Jefferies and Davies (1993). The blow count N was calculated as follows:

$$N = \frac{q_c \text{Mpa}}{0.85(1 - I_c/4.75)}$$

Where I_c is a soil classification index calculated based on material properties.

The blow counts (N) are then normalized and corrected for depth and fines content. The calculated, corrected blow counts $(N_1)_{60\text{-}CS}$ were compared with the corrected blow counts $(N_1)_{60\text{-}CS}$ measured in the field using the SPT. The results are shown on the CPT logs on Figures 4-6 through 4-19.

Effective Stress Friction Angle

It is generally accepted that fine tailing exhibits an effective stress cohesion of zero ($c' = 0$) (Volpe 1979; Vick 1983). The effective stress friction angle (ϕ') can be interpreted from the cone tip resistance (q_c) using an equation proposed by Robertson and Campanella (1983), as follows:

$$\phi' = \tan^{-1} (0.1 + 0.38 \log q_c/\sigma'_{vo})$$

Where σ'_{vo} is the effective overburden pressure.

This method was used to calculate a ϕ'. This method is suitable for layers where the pore pressure measurements were negligible and the test is essentially drained. This correlation is typically applied to sands and silty sands. The calculation above is not applicable for approximately the upper 10 to 15 feet of each sounding where high tip resistances (q_c) result in unrealistically high values for the effective stress friction angle.

Undrained Shear Strength

The undrained strength of the tailing was also estimated from the CPT data. The results were then used in a post-earthquake stability analysis assuming the tailing would liquefy and reach undrained loading conditions. Subsequently, liquefaction calculations (discussed below) indicated that the tailing would not liquefy and, as a result, undrained strengths were not used. The measured undrained strength is used in later sections of this report to estimate breach volumes and will be used in the final Non-Time-Critical Removal Action (NTCRA) design.

The permeability of the finer silty tailing was relatively low, and the cone readings reflect undrained conditions at the standard rate of testing (2 cm/s). The undrained shear strength (S_u), a normalized peak undrained strength, and the liquefied undrained strength were calculated.

The peak undrained strength is equivalent to the undrained strength measured in the laboratory for undisturbed samples. The liquefied (residual) undrained strength is considered equivalent to the undrained strength as measured in the laboratory for a remolded sample.

The normalized peak undrained strength ratio, S_u/σ'_{vo}, was calculated from the CPT data using the procedure proposed by Olson (2003) where:

$$S_u/\sigma'_{vo\ (peak)} = 0.205 + (0.0143\ q_{T1}\ \text{mPa})$$

The normalized liquefied (residual) undrained strength was calculated using one of three procedures. Jefferies et al. (1990) recommends that it be calculated as:

$$S_u/\sigma'_{vo} = 0.003\ q_c/\sigma'_{vo}$$

Stark and Mesri (1992) suggest:

$$S_u/\sigma'_{vo} = 0.0055\ (N_1)_{60\text{-}CS}$$

Where $(N1)_{60\text{-}CS}$ is the corrected blow count.

Olson (2003) proposes:

$$S_u/\sigma'_{vo} = 0.03 + (0.0143\ q_{T1}\ \text{mPa})$$

Where $q_{T1}\ \text{mPa} = q_c \left(\frac{1.8}{0.8} + \sigma'_v/\text{Pa}\right)$.

The results of the calculated liquefied and peak undrained strength ratios are plotted versus depth on Figures 4-6 through 4-19.

7.3 DATA CORRELATION

Blow counts, effective stress friction angles, and undrained strength ratios calculated using CPT soundings were compared with values measured in the field and in the laboratory.

Blow Counts

Correlations for the corrected blow counts $(N_1)_{60\text{-}CS}$ for the subsurface tailing material were compared with actual corrected measured blow counts observed during field drilling activities. In general, most of the cone sounding-calculated blow counts correlated well with the test borehole $(N_1)_{60\text{-}CS}$ values, except for cone soundings CS-1 and CS-5. Sounding CS-1 over-estimated the borehole $(N_1)_{60\text{-}CS}$ in the upper tailing depth and sounding CS-5 over-estimated the borehole $(N_1)_{60\text{-}CS}$ for the majority of the borehole length.

Effective Friction Angle

CPT cone soundings were compared to laboratory test results for consolidated undrained shear strength testing with pore water pressure measurements. The laboratory shear strength testing provided effective stress strength envelopes with a corresponding ϕ' based on peak deviator stress. Each of these shear strengths was then compared with results of the CPT calculated ϕ' at about the equivalent sample depth.

The results show that the actual laboratory measured friction angles were approximately 1 to 2 degrees higher than those estimated by the CPT at equivalent depths. The results of these comparisons and the variations between the ϕ' interpolated from the cone sounding versus the laboratory calculated values are presented on Table 7-1. The CPT results were adjusted based on the location and depth. The data also showed that the actual shear strength could vary over a range of values, generally between about 35 degrees and 41 degrees with an average of approximately 37 degrees. A shear strength of approximately 37 degrees was selected for use in the slope stability model for the sand shell material. This friction angle generally correlates with most of the shear strengths calculated by the CPT. However, the CPT results show that ϕ' can vary significantly, as discussed in Section 7.6.

7.4 LIQUEFACTION EVALUATION

A liquefaction analysis was completed to estimate the potential for significant shear strength loss during earthquake shaking. Ground accelerations and earthquake magnitudes used in the liquefaction analyses were calculated from the site-specific PSHA completed for the site, as discussed in Section 3.0. A peak soil horizontal ground acceleration of 0.24g, which corresponds to an earthquake return period of approximately 2,500 years, was selected for the analysis. Two earthquake magnitudes, a median earthquake magnitude of 5.7 and a larger earthquake magnitude of 6.5, were considered.

The tailing liquefaction potential was evaluated using water elevations estimated from recent piezometer readings. In test boreholes TB-9 and TB-10, the collocated CPT soundings (CS-1 and CS-2) showed a perched water table, and the higher water table was modeled at hydrostatic head.

7.5 SLOPE STABILITY ANALYSES

Steady-state drained stability and post-earthquake slope stability analyses were completed for four cross sections at TP-1. The existing phreatic surface estimated as described below was used for both loading conditions. A parametric analysis was performed by raising the phreatic surface until the calculated steady-state drained FOS was equal to approximately 1.0.

Cross-Section Geometry

Four study sections located along TP-1, identified as Sections A through D, were modeled. The section locations are shown on Figure 4-1. The study sections are located at the maximum-height section (Study Section B) and other critical embankment sections on the north and west sides of the dam.

The internal geometry, such as the shell and slime interface, tailing embankment section, starter dam, and foundation contact, were based on information collected during the recent field investigation.

Phreatic Surface

The existing water table (phreatic surface) was initially approximated with water-level elevations estimated at the time of drilling. These were then compared with CPT soundings and more recent measurements of piezometric elevations. The phreatic surface measured during CPT soundings dissipation tests was selected for the slope stability analysis because of the ability to measure multiple water tables as discussed below. The piezometers installed during the field investigation were screened for a relatively short 10-foot-interval, and as such, piezometer elevations may not be representative of the actual free water surface conditions in perched water table conditions.

For Study Sections B and C, the water-level elevations estimated from the CPT soundings were approximately 10 to 15 feet higher than those measured by the piezometers. The CPT data suggest that a potential perched water table exists in an area of the right abutment. For the slope stability analyses, it was assumed that the top of the perched water table was the phreatic surface and hydrostatic conditions existed below this elevation. In Study Section B, the phreatic surface was assumed to exit at the starter dam crest based on visual observations made in the field and piezometric elevations recorded during the field sampling program. The existing phreatic surfaces used in the analyses are presented in Figures 7-1 through 7-4.

A review of piezometric data calculated by ADL from July 2000 through November 2001 shows that the phreatic surface in TP-1 fluctuated by more than 3 feet during the observation period. This was a period of lower than normal precipitation, which suggests that greater fluctuations and higher phreatic surface levels may be possible.

Material Properties

Material characteristics using the results of SPT data, CPT soundings, and laboratory-measured shear strength values found that a ϕ' of 37 degrees, with a cohesion intercept of 0 psf was representative of an average material strength for the sand shell. The data also showed that the

actual shear strength could vary over a range of values, generally between approximately 35 and 41 degrees.

Table 7-2 contains a summary of the material properties used for the slope stability analyses. The initial slope stability analysis showed that the critical failure surface did not intersect the fine tailing and is confined only to the sand shell. Therefore, for the drained steady-state seepage slope stability analysis, a ϕ' of 37 degrees with a cohesion intercept of 0 psf was used for both the tailing shell and tailing slimes.

Due to inaccessible conditions during field activities, sample collection and testing from the starter dam could not be performed. Material properties for the starter dam used in this analysis were based on published data assuming the starter dam was constructed with local material and consists of a matrix of silty sandy gravel material. Material properties for the foundation soils (glacial till) were also based on typical published data. Table 7-2 presents a summary of the materials properties used for the slope stability analysis.

Analysis Procedure

The limit-equilibrium slope stability analysis method was used to evaluate the stability at each study section using the computer program UTEXAS3 (Wright 1991). An automatic search procedure was first applied using Spencer's method of slices to find critical circular shear surfaces (i.e., the shear surface corresponding to the lowest factor-of-safety). The material properties of the tailing and the steep slopes caused the automatic search procedures to produce a shallow critical failure. The shallow failure plane was indicative of an infinite slope type failure, which is not critical for overall stability of the dam.

The analysis procedure was modified and a manual search method was applied to force a more reasonable critical failure surface. As a result, the failure surfaces analyzed were manually selected and may not represent the theoretical minimum FOS. Noncircular shear surfaces were not analyzed because that type of potential failure surface is not expected to be critical for the configurations of these study sections.

Post Earthquake Stability

A post-earthquake stability analysis was completed for selected study sections. The results of the liquefaction analysis found that the tailing has a low potential for liquefaction for the design earthquake return period.

Although liquefaction is not expected to occur during the 2,500-year return period seismic event, some reduction in shear strength may occur. For the post-earthquake analysis, the drained shear strength was reduced by 20 percent, and the analysis was repeated using the same critical failure surface identified for the steady-state seepage analysis.

7.6 RESULTS

Liquefaction Results

The results of the liquefaction analysis show a low potential for liquefaction of the TP-1 and TP-2 embankments under the existing seepage conditions for both earthquake magnitudes (5.7

and 6.5) with a peak horizontal acceleration of 0.24 g. The results of the liquefaction analysis are presented in Appendix C. Although liquefaction is not expected to occur for the 2,500-year return period, a reduction in the tailing shear strength may occur.

Slope Stability Results

The calculated FOS for the steady-state seepage and post-earthquake stability at selected study sections are summarized in Table 7-3. The failure surfaces are presented graphically in Figures 7-1 through 7-4. The stability model computer-generated output files for all study sections and cases are presented in Appendix D.

The failure surfaces generally encompass the entire embankment slope and tend to terminate in a thin section at the crest of the dam. Two failure surfaces were analyzed for Study Section B, as shown on Figure 7-2. One of the failure surfaces encompasses a portion of the starter dam and the other failure surface encompasses the slope above the starter dam. Both failure surfaces resulted in an FOS of 1.2.

The stability analysis results indicate an FOS for steady-state seepage loading conditions below or well below 1.5 for Study Sections A through D. An FOS of 1.5 is generally recommended as the minimum for steady-state seepage conditions.

The post-earthquake stability results calculated an FOS between 1.1 and 0.9. Recommended FOS for post-earthquake loading conditions range from 1.0 to 1.3, depending on the approach applied and the regulatory organizations. A post-earthquake stability FOS below 1.0 does not necessarily indicate a slope failure, but does suggest that large earthquake-induced deformations are possible.

Parametric Analysis

The study sections were analyzed for a raised phreatic condition to evaluate what phreatic level would correspond to an FOS of 1.0 (unity) for steady-state seepage conditions. An FOS of 1.0 was calculated after raising the phreatic surface approximately 14 feet for Study Sections B through D and approximately 24 feet for Study Section A. Figures 7-5 through 7-8 show the raised phreatic surfaces for the four sections.

To evaluate the FOS for variations in both the ϕ' and the phreatic surface, it was estimated that a rise in phreatic surface of 8 feet reduced the FOS to 1.0 for Sections B through D assuming a ϕ' of 35 degrees. When ϕ' is further reduced to 33 degrees and the existing phreatic is used, the FOS equals approximately 1.0 at Study Sections B through D.

As previously stated, piezometer elevations measured in tailing dam TP-1 by ADL over approximately 1.5 years show that the phreatic surface in the tailing can fluctuate more than 3 feet. These readings were taken during a period of reduced precipitation, and as a result, those fluctuations could be greater. In addition, the phreatic surface encountered during the observation period corresponded to a period of below-normal precipitation levels, and the phreatic surface could generally be higher during years of normal precipitation.

Table 7-1

SUMMARY OF DATA COMPARISON

Shear Strength Envelope Samples[1]	Cone Sounding	Depth[1] (ft)	ϕ'_{Lab}[1,2] (degrees)	ϕ_{CS}[3] (degrees)	Δ_{cs}[4] (degrees)
TB-11	CS-3	41.2	38.9	37	-1.9
TB-11	CS-3	40.25	40.9	39	-1.9
TB-10	CS-2	60.85	40.2	40	-0.2
					Avg = -1.33
TB-14	CS-6	20.25	39.1	37.5	-1.6
TB-14	CS-6	20.75	41.0	37.5	-3.5
TB-14	CS-6	40.25	38.0	36.0	-2.0
					Avg = -2.36
TB-13	CS-5	30.25	37.3	40	+2.7
TB-13	CS-5	30.75	37.5	40	+2.5
TB-16	CS-8	30.30	36.0	36	0
					Avg = +1.73
				AVERAGE OF ALL =	**-0.65°**

NOTES:

[1] From laboratory results, shown on Table 5-1.

[2] ϕ_{Lab}' Effective stress friction angle based on peak deviation stress failure criteria.

[3] ϕ'_{CS} Estimated from CPT logs.

[4] Δ_{cs} Difference between ϕ'_{cs} and ϕ'_{Lab}.

Avg = Average

Table 7-2

SUMMARY OF STABILITY ANALYSES MATERIAL PROPERTIES

Material Description	Unit Weight (pcf)	Steady-State Seepage Conditions Friction Angle (deg)	Post-Earthquake Analysis Friction Angle (deg)	Cohesion (psf)
Tailing Slime and Sand	120	37	29.6	0
Glacial Till (Foundation)	140	40	40	500
Starter Dam	130	38	38	0

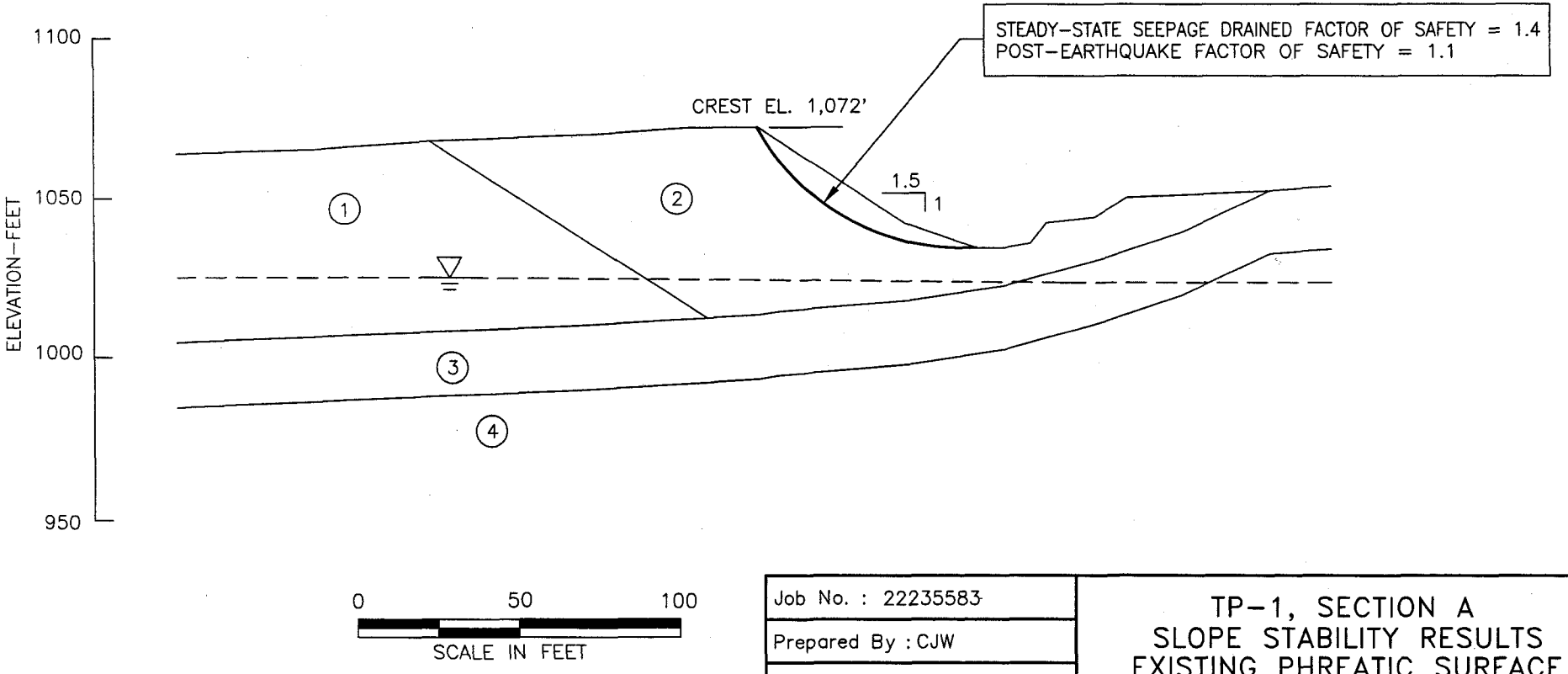
NOTES:
pcf = pounds per cubic foot
deg = degrees
psf = pounds per square foot

Table 7-3
SUMMARY OF STABILITY RESULTS

Study Section	Steady-State Factor-of-Safety	Post-Earthquake Factor-of-Safety
A	1.4	1.1
B	1.2	1.0
C	1.2	0.9
D	1.3	1.0

URS

NO.	MATERIAL DESCRIPTION	UNIT WEIGHT (pcf)	STEADY-STATE SEEPAGE DRAINED		POST-EARTHQUAKE	
			FRICTION ANGLE (degrees)	COHESION (psf)	FRICTION ANGLE (degrees)	COHESION (psf)
1	TAILING SLIME	120	37	0	29.6	0
2	TAILING SAND	120	37	0	29.6	0
3	GLACIAL TILL	140	40	500	40	500
4	ABLASIAL TILL	140	40	500	40	500



Job No. : 22235583	TP-1, SECTION A SLOPE STABILITY RESULTS EXISTING PHREATIC SURFACE
Prepared By : CJW	
Date : 3/28/03	

FIG. 7-1

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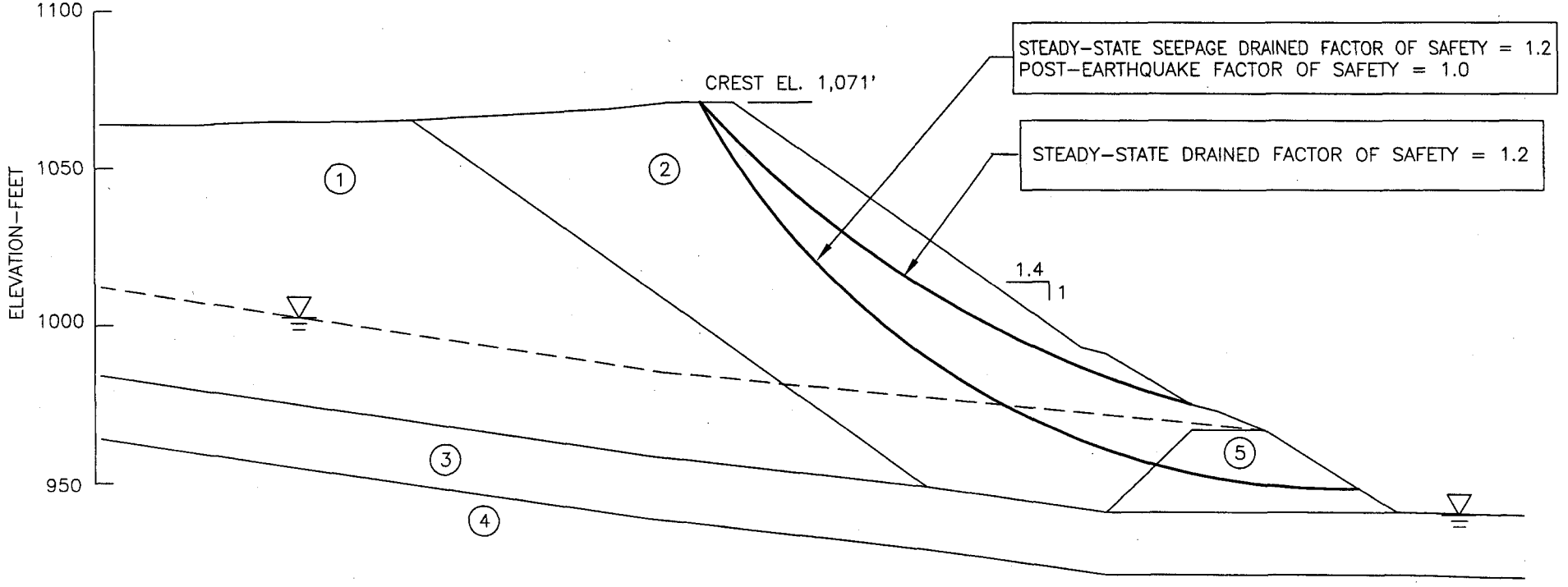
URS

NO.	MATERIAL DESCRIPTION	UNIT WEIGHT (pcf)	STEADY-STATE SEEPAGE DRAINED		POST-EARTHQUAKE	
			FRICTION ANGLE (degrees)	COHESION (psf)	FRICTION ANGLE (degrees)	COHESION (psf)
1	TAILING SLIME	120	37	0	29.6	0
2	TAILING SAND	120	37	0	29.6	0
3	GLACIAL TILL	140	40	500	40	500
4	ABLASIAL TILL	140	40	500	40	500
5	STARTER DAM	130	38	0	38	0



Job No. : 22235583	TP-1, SECTION B SLOPE STABILITY RESULTS EXISTING PHREATIC SURFACE
Prepared By : CJW	
Date : 3/28/03	

FIG. 7-2

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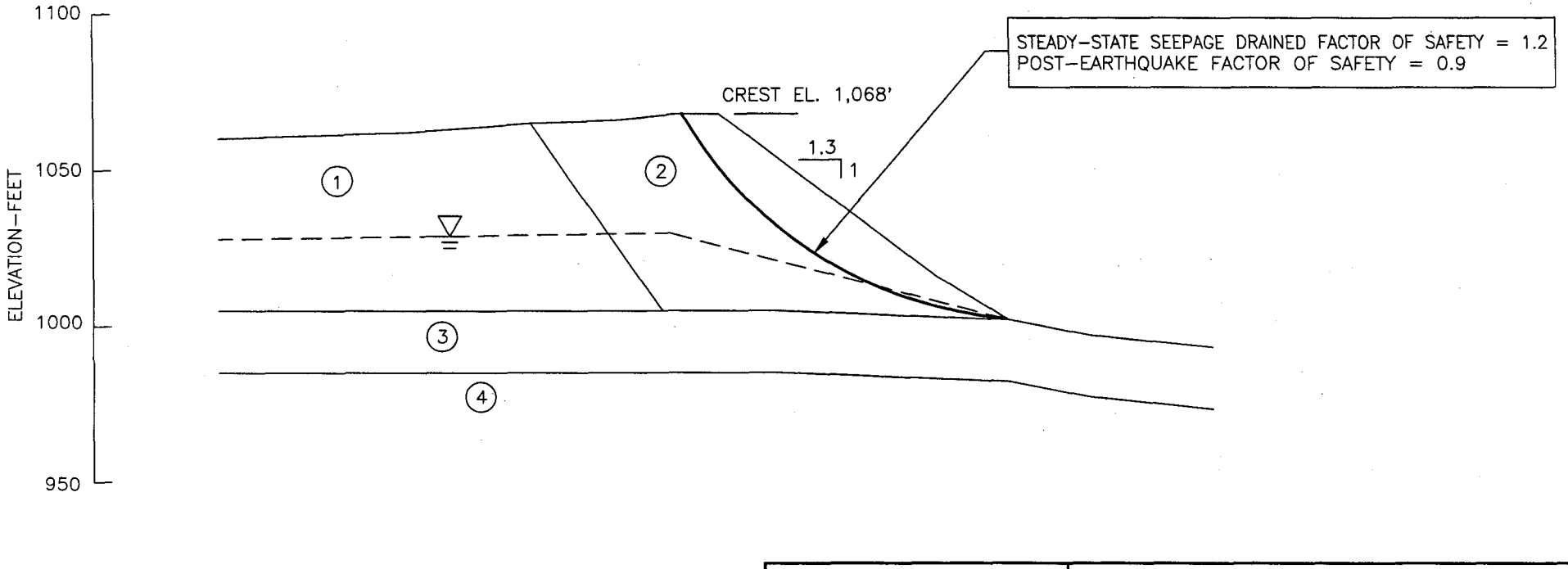
URS

NO.	MATERIAL DESCRIPTION	UNIT WEIGHT (pcf)	STEADY-STATE SEEPAGE DRAINED		POST-EARTHQUAKE	
			FRICTION ANGLE (degrees)	COHESION (psf)	FRICTION ANGLE (degrees)	COHESION (psf)
1	TAILING SLIME	120	37	0	29.6	0
2	TAILING SAND	120	37	0	29.6	0
3	GLACIAL TILL	140	40	500	40	500
4	ABLASIAL TILL	140	40	500	40	500



Job No. : 22235583	TP-1, SECTION C SLOPE STABILITY RESULTS EXISTING PHREATIC SURFACE
Prepared By : CJW	
Date : 3/28/03	

FIG. 7-3

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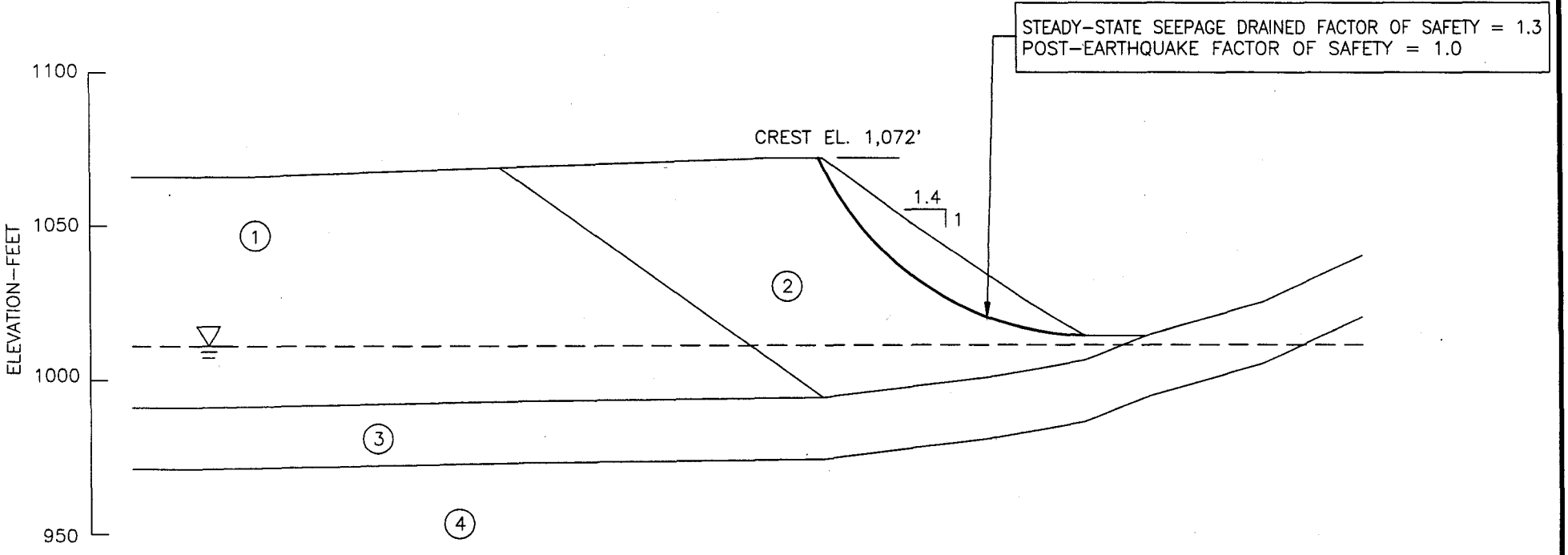
URS

NO.	MATERIAL DESCRIPTION	UNIT WEIGHT (pcf)	STEADY-STATE SEEPAGE DRAINED		POST-EARTHQUAKE	
			FRICTION ANGLE (degrees)	COHESION (psf)	FRICTION ANGLE (degrees)	COHESION (psf)
1	TAILING SLIME	120	37	0	29.6	0
2	TAILING SAND	120	37	0	29.6	0
3	GLACIAL TILL	140	40	500	40	500
4	ABLASIAL TILL	140	40	500	40	500



0 50 100

SCALE IN FEET

Job No. :	22235583
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Date :	3/28/03

TP-1, SECTION D
SLOPE STABILITY RESULTS
EXISTING PHREATIC SURFACE

FIG. 7-4

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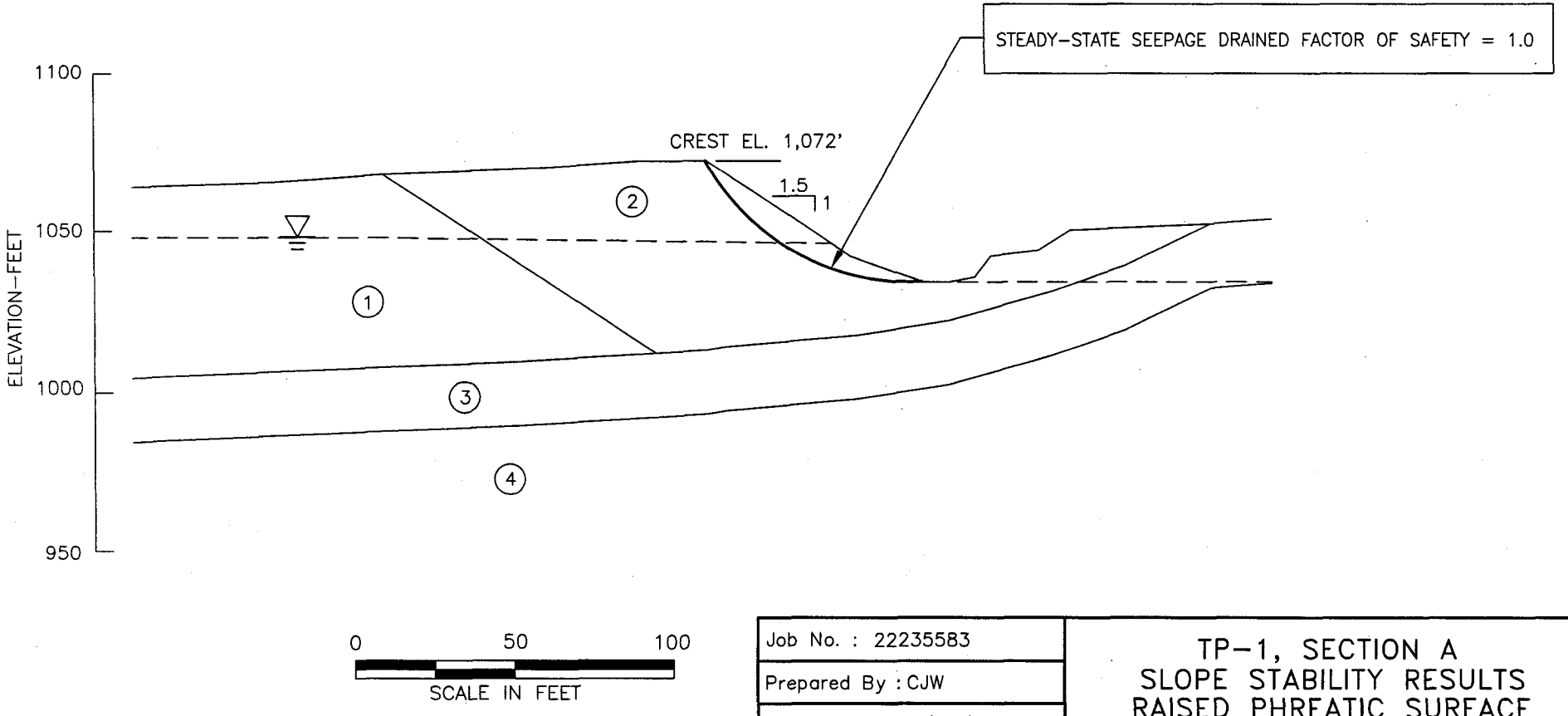
URS

NO.	MATERIAL DESCRIPTION	UNIT WEIGHT (pcf)	STEADY-STATE SEEPAGE DRAINED	
			FRICTION ANGLE (degrees)	COHESION (psf)
1	TAILING SLIME	120	37	0
2	TAILING SAND	120	37	0
3	GLACIAL TILL	140	40	500
4	ABLASIAL TILL	140	40	500



Job No. : 22235583	TP-1, SECTION A SLOPE STABILITY RESULTS RAISED PHREATIC SURFACE
Prepared By : CJW	
Date : 3/28/03	

FIG. 7-5

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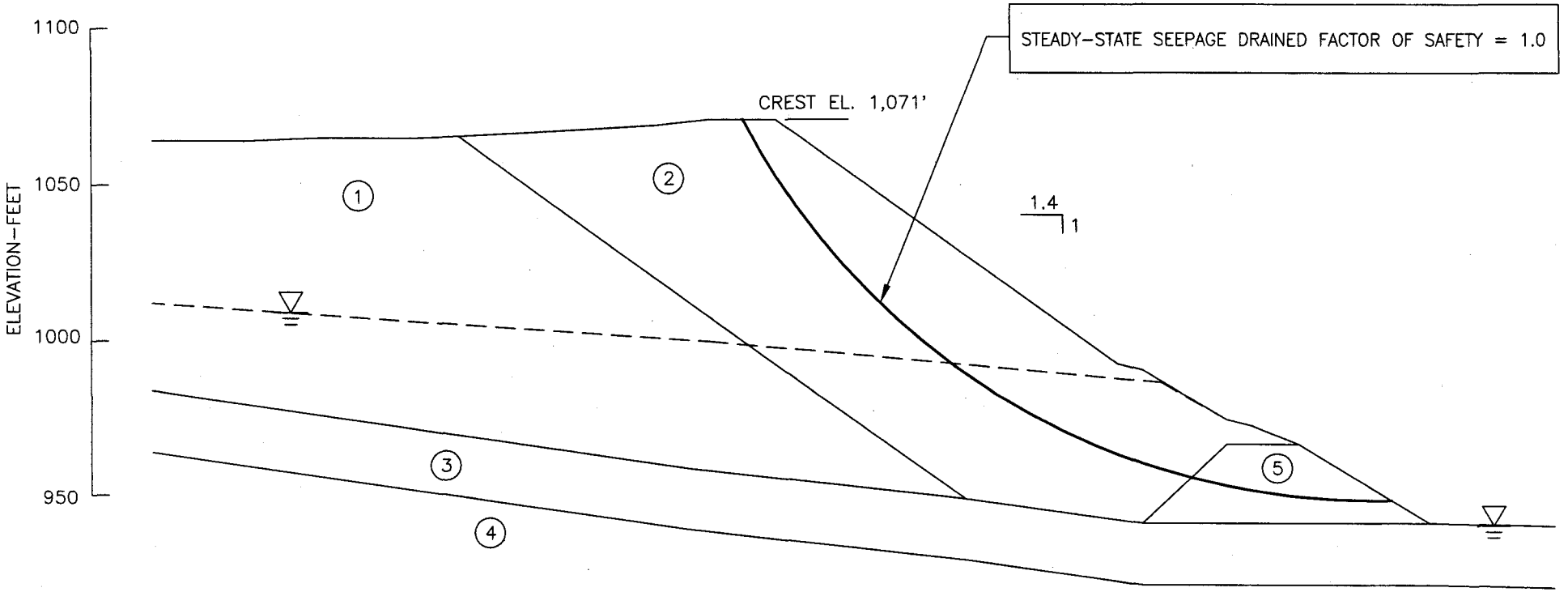
URS

NO.	MATERIAL DESCRIPTION	UNIT WEIGHT (pcf)	STEADY-STATE SEEPAGE DRAINED FRICTION ANGLE (degrees)	STEADY-STATE SEEPAGE DRAINED COHESION (psf)
1	TAILING SLIME	120	37	0
2	TAILING SAND	120	37	0
3	GLACIAL TILL	140	40	500
4	ABLASIAL TILL	140	40	500
5	STARTER DAM	130	38	0



0 50 100
SCALE IN FEET

Job No. :	22235583
Prepared By :	CJW
Date :	3/28/03

TP-1, SECTION B
SLOPE STABILITY RESULTS
RAISED PHREATIC SURFACE

FIG. 7-6

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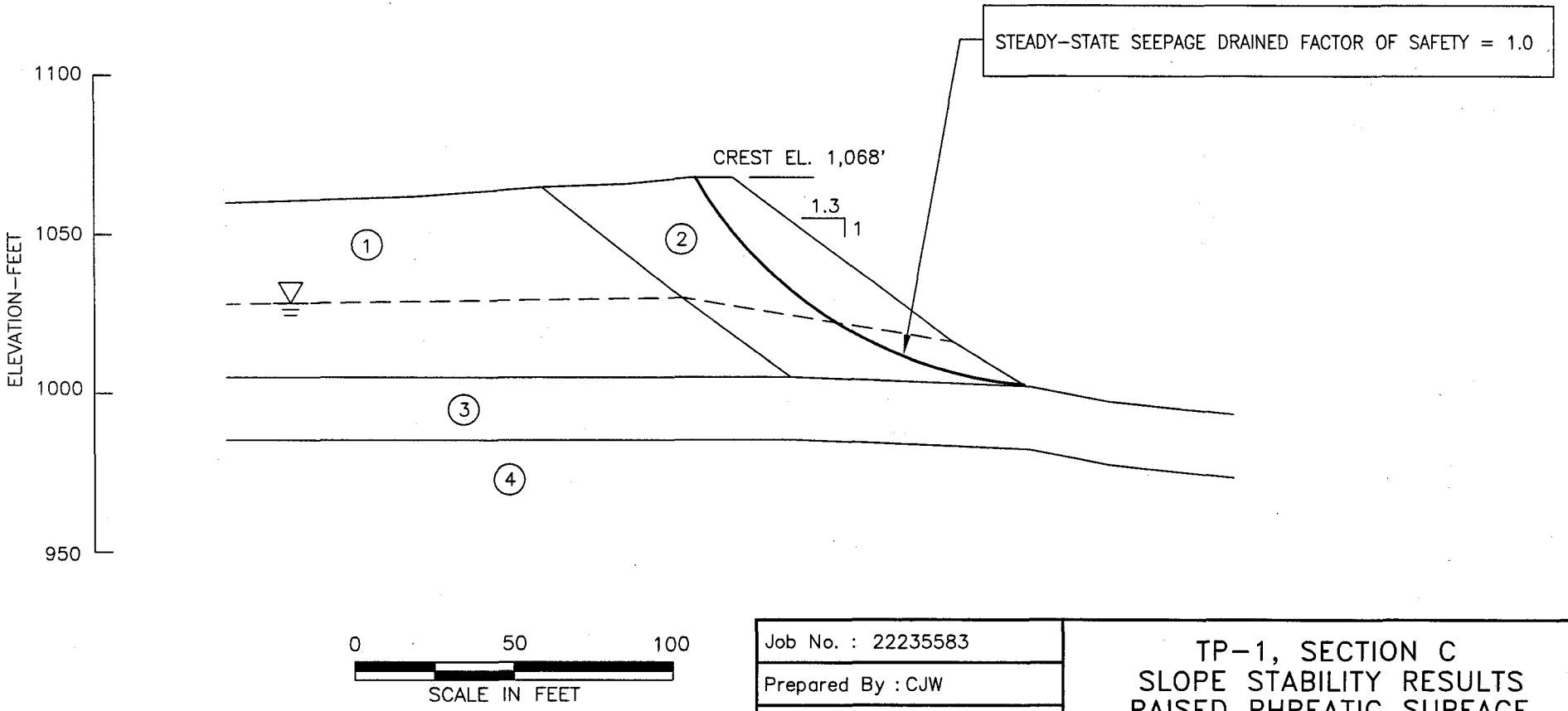
URS

NO.	MATERIAL DESCRIPTION	UNIT WEIGHT (pcf)	STEADY-STATE SEEPAGE DRAINED	
			FRICTION ANGLE (degrees)	COHESION (psf)
1	TAILING SLIME	120	37	0
2	TAILING SAND	120	37	0
3	GLACIAL TILL	140	40	500
4	ABLASIAL TILL	140	40	500



Job No. : 22235583	TP-1, SECTION C SLOPE STABILITY RESULTS RAISED PHREATIC SURFACE
Prepared By : CJW	
Date : 3/28/03	

FIG. 7-7

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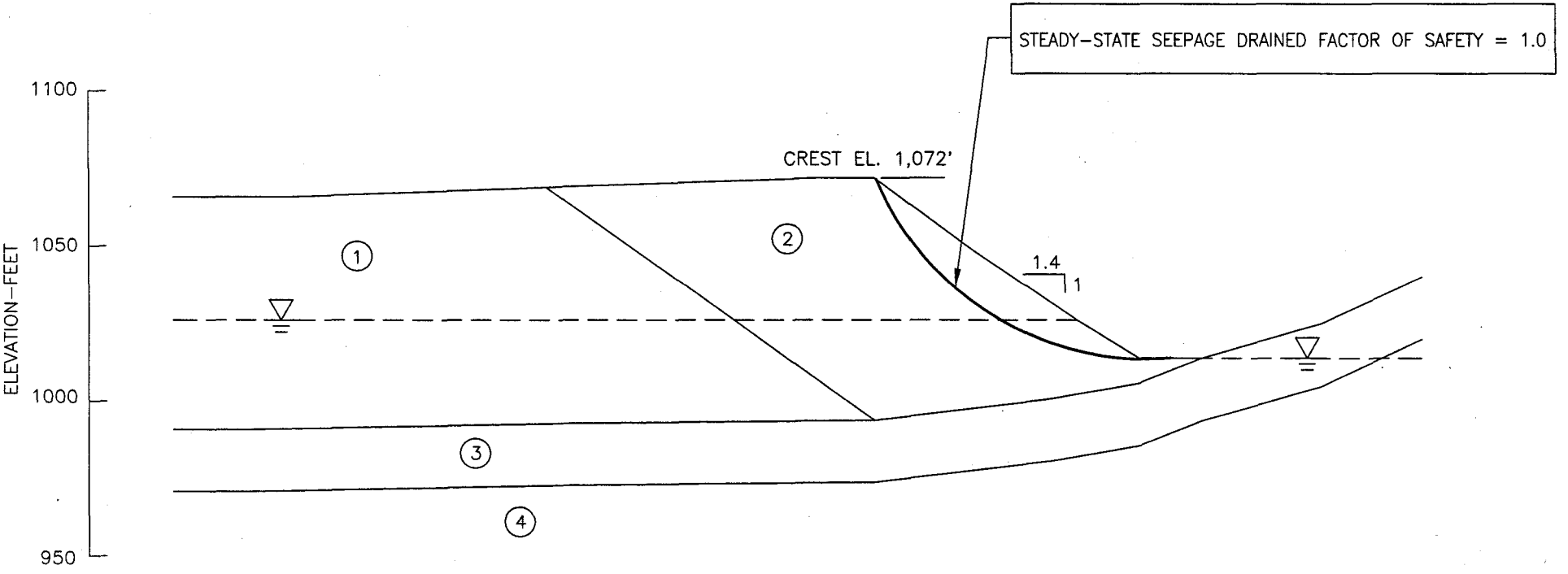
URS

NO.	MATERIAL DESCRIPTION	UNIT WEIGHT (pcf)	STEADY-STATE SEEPAGE DRAINED	
			FRICTION ANGLE (degrees)	COHESION (psf)
1	TAILING SLIME	120	37	0
2	TAILING SAND	120	37	0
3	GLACIAL TILL	140	40	500
4	ABLASIAL TILL	140	40	500



0 50 100
SCALE IN FEET

Job No. : 22235583	
Prepared By : CJW	
Date : 3/28/03	

TP-1, SECTION D
SLOPE STABILITY RESULTS
RAISED PHREATIC SURFACE

FIG. 7-8

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Section 8

A dam failure and runout analysis was completed for tailing dam TP-1 at the Elizabeth Mine site. The analysis was performed to evaluate the potential impacts of tailing released to areas downstream of the site. Two tailing dam failure scenarios were modeled. The first scenario assumed a hydraulic dam failure in which the breach discharge was a combination of tailing mixed with ponded water contained within the decant pond. The second scenario assumed a tailing debris flow-type failure where the tailing was saturated, but there was no water contained in the decant pond (i.e., the released tailing behaves as a debris flow). Both scenarios assume a hypothetical sunny-day failure where the breach is initiated by piping at the toe of the starter dam and not by an external precipitation event.

The runout analysis consisted of evaluating the routed outflows from both failures of tailing dam TP-1 to estimate the inundated area downstream of the dam. The inundation maps presented at the end of this section show areas potentially impacted in the event of either failure scenario. A parametric analysis was performed to evaluate the sensitivity of the estimated inundated areas to variations in several model parameters. Parameters such as the breach formation time, decant water quantity, tailing quantity released, the breach initiation elevation, and fluid properties were analyzed.

The actual breach parameters for a tailing dam failure are difficult to predict and may be different during extreme flood conditions where the dam crest is overtopped. An extreme flood with failure of TP-1 would likely result in higher downstream discharges and a larger inundation area than indicated by the sunny-day failure models considered in this analysis.

This section presents a discussion of tailing properties, an estimate of the tailing volume that could be released, discussions of the model components and methods for both a hydraulic and debris flow failure, and the model results.

8.1 TAILING PROPERTIES

Since 1980, there have been more than 44 recorded tailing dam failures worldwide, more than the number of recorded failures of engineered water storage dams. Tailing dams are unique structures because a tailing dam failure can result in flood damage and can create significant environmental impacts.

The tailing impounded by the tailing dam TP-1 sand shell consists of saturated silts and clays. The material properties during a failure are difficult to predict, and therefore, failure models may result in under-estimation of the potential impacts of a tailing release. For example, the fine tailing contained in tailing dam TP-1 has remained saturated since initial deposition. The tailing is fine, loose, and normally consolidated. A surface crust has formed from continued cycles of surface desiccation and wetting. The dry crust allows for light vehicle and foot traffic and gives an illusion of stability. However, the material is actually thixotropic. That is, it appears to be solid, but when disturbed, the material will lose its strength, liquefy, and flow like a fluid.

A breach in the tailing dam shell can cause a loss in containment and may create sufficient disturbance such that the tailing will be released as a slurry flow. At volumetric concentrations below 45 percent, these slurry flows behave as non-Newtonian fluids, traveling in turbulent flows at a velocity slower than clear water, but capable of being transported for long distances. At higher solids concentrations (volumetric concentration greater than 50 percent), the slurry

flow will have more laminar characteristics. The tailing will move more like a debris flow, and the downstream movement is limited to much shorter distances.

8.2 ESTIMATED TAILING RELEASE VOLUME

A model was developed for tailing dam TP-1 to estimate the geometric volume of material that could potentially be released in the event of a dam failure. The breach geometry was based on the undrained tailing shear strength and the geometry of historic tailing impoundment failures at other sites.

Total Tailing Volume

An initial estimate of the tailing volume contained within tailing dam TP-1 was developed using existing topographic base maps and historic USGS site surveys. Topographic contours from 1890 (ADL 2002) were utilized to estimate the subsurface topography prior to placement of tailing at tailing dam TP-1. This historical topography is defined by a contour interval of approximately 40 feet. The estimated initial base tailing elevation varied by 10 feet from the elevation that was recently surveyed, thus indicating the tailing volume actually contained within TP-1 may vary from the calculated value. The total tailing volume was estimated using horizontal slices and the average end area method. The estimated volume of tailing contained within tailing dam TP-1 was approximately 2.4 million cubic yards, or approximately 1,500 acre-feet.

Breach Geometry – Sand Shell

The breach geometry for TP-1 was assumed to have a 20-foot bottom width and 2:1 (horizontal: vertical) side slopes. This breach geometry is consistent with that observed at tailing pile TP-2. It was assumed that the breach will occur above the starter dam crest with a final breach elevation of approximately 970 feet. The breach starts above the starter dam crest and progresses horizontally through the sand shell until the breach base intersects the contact between the tailing and glacial till. The glacial till was assumed to be erosion resistant.

Breach Geometry – Fine Tailing

The majority of tailing released from tailing dam TP-1 consists of fine silt and clay size tailing. The geometry of the fine tailing release was estimated using the calculated undrained shear strength. The undrained strength is measured from laboratory tests and calculated using the peak deviator stress from an isotropically consolidated undrained triaxial shear test. The sand shell was estimated to be approximately 120 feet thick with the upgradient embankment slopes flattening to the undrained shear strength. For the analysis, an equivalent friction angle of 17 degrees was used (this value could be lower for the finer tailing based on the CPT data and failures observed in similar tailing dams).

A conical failure surface was assumed upstream of the initial breach with the cone tip located at the base of the erosional breach. An area of the conical slope transitions from 17 degrees to the 2:1 slopes at the area between the sand shell and the fine tailing. This breach scenario results in a total estimated volume release of approximately 500,000 cubic yards, or 310 acre-feet. Varying the interior breach slopes can increase the potential breach value to 1 million cubic

yards, or approximately 620 acre-feet. Therefore, for purposes of estimating the volume of tailing that could potentially be released from a failure of tailing dam TP-1, a range of between 500,000 and 1 million cubic yards was assumed.

8.3 MODEL COMPONENTS

The analyses estimate the potential downstream impacts from a failure of tailing dam TP-1. The analyses have been completed using methodologies that are accepted practices for water and tailing dam failure modeling. The Vermont Office of State Engineer Dam Safety, USACE, and other state and federal agencies for jurisdictional water storage dams use the same analytical procedures.

Dam Section

The breach model was developed using the geometry described above. The dam failure model assumes containment by the sand shell and the fluid released was modeled as a slurry; a complete mixture of saturated tailings with decant water. The volume released during a dam failure depends on the mix of tailing and water.

The dam was modeled with a crest elevation of 1,070 feet and a bottom elevation of 970 feet. This bottom elevation was coincident with the approximate starter dam crest and is an average bottom elevation where a piping failure could initiate. URS assumes that the starter dam would not erode during a piping failure. There is already evidence of piping at the starter dam crest at elevation 970, at the starter dam toe at elevation 940, and at a seep on the right abutment at elevation 990. The selected bottom elevation was chosen since it is an intermediate elevation.

For the model, it was assumed that the erosional pipe extended from the base elevation of the tailing dam to the bottom of decant pond (initial piping elevation). The tailing release would consist of a liquefied mixture of tailing and water that would cause erosion of the dam. For the parametric analysis, the initial piping elevation was lowered up to 30 feet.

A sudden release of tailing was assumed for the tailing flow model.

Decant Pond

The tailing dam TP-1 decant pond has limited water storage capacity and is normally drained to low water levels as a result of a breach in a lateral section of decant pipe immediately upgradient of Decant Tower 2, which drains water from the pond into the decant system at an elevation near grade-level. A detailed description of the decant system is presented in Section 6. A historic spillway is located at the right dam abutment at elevation 1,062. The left abutment will also overtop at elevation 1,062, and the maximum pond elevation was assumed not to exceed elevation 1,063. The decant pond will hold an estimated 140 acre-feet of water at elevation 1,062. At the dam crest elevation of 1,070, the impoundment would theoretically hold 390 acre-feet of water. An elevation storage curve used to estimate tailing volume and water volume for the dam breach analysis is presented on Figure 8-1.

The drainage area above tailing dam TP-1 was estimated to be approximately 275 acres (ADL 2002) as shown in Figure 8-2. Preliminary hydrology studies completed by ADL suggest that the 100-year storm could produce sufficient surface runoff to fill the decant pond above the

spillway elevation. However, this storm would likely not generate sufficient runoff to overtop the dam crest.

Downstream Channel Profile

A visual inspection of the site was performed in October 2002 to observe the tailing dam condition, identify downstream structures, and downstream channel characteristics. The downstream banks in the floodplain are well vegetated with trees, bushes, and shrubs.

Combined flows resulting from a failure of tailing dam TP-1 are carried by Copperas Brook for a distance of approximately 1,800 feet to the confluence with WBOR. At the confluence, combined flows are carried by WBOR approximately 4.5 miles to the confluence of East Branch of the Ompompanoosuc River (EBOR). Both branches combine to form the Ompompanoosuc River (OR), which discharges to the Connecticut River 5 miles further downstream.

The latest available USGS 7.5-minute topographic maps were used to develop downstream channel cross-sections and a channel profile. A field survey was conducted by URS in March 2003 to verify bank elevations of the WBOR at select locations between Copperas Brook and Rice's Mills.

Copperas Brook, downstream of tailing dam TP-1, has an average channel slope of 11 to 12 percent. Below the confluence of Copperas Brook, the WBOR channel slope decreases to an average slope of about 1.5 percent for the next 7 miles. The channel slope of OR flattens to less than 0.3 percent approximately 2 miles from the confluence with the Connecticut River.

Union Village Dam

Approximately 0.5 miles downstream of the WBOR and EBOR confluence is the Union Village Flood Control Dam. Union Village Dam is an earth embankment approximately 164 feet high and 1,100 feet long. It was constructed by USACE in 1950. Union Village Dam has a design storage capacity of approximately 38,000 acre-feet at a spillway elevation of 564.

The dam has a large outlet works consisting of a 13-foot-diameter horseshoe tunnel with an inlet invert elevation of 420. The outlet works is gated and no pool is maintained during the summer. A 20-foot-deep pool is maintained during the winter to protect the gates from ice damage. When fully open and the reservoir level at elevation 564, the outlet works has a capacity of 7,860 cubic ft/sec (cfs).

Given the location and function of Union Village Dam, a breach flood resulting from a failure of tailing dam TP-1 would be substantially attenuated and could possibly be fully contained by Union Village Dam if the gates were closed. For this reason, the dam breach and runout analysis focused on areas upstream of the Union Village Dam.

Other Downstream Structures

Several residential structures have been identified along WBOR between tailing dam TP-1 and the Union Village Dam. Houses are located along the north bank of WBOR approximately 1.4 miles downstream of tailing dam TP-1. Union Village Road (State Route 132) crosses WBOR at Rice's Mills, approximately 4.2 miles downstream of tailing dam TP-1. Union Village Dam is located approximately 5.4 miles downstream of tailing dam TP-1.

8.4 DESCRIPTIONS OF MODELING METHODS

The two tailing dam failure scenarios were evaluated using two different models to predict the downstream effects of tailing released during a failure of tailing dam TP-1. The hydraulic dam failure scenario (i.e., a breach discharge with decant pond storage) was simulated using a hydrodynamic model with a limited time for dam failure propagation. The tailing debris flow scenario was modeled as a sudden high solids debris flow.

Hydraulic Flow Failure Modeling

The National Weather Service Dam Break Flood Forecasting Program (DAMBRK), created by D.L. Fread in 1988, was used to model the tailing dam hydraulic flow failure and route the outflow of tailings downstream. This program has proved to be a reliable tool for estimating dam failure floods and flood impacts downstream of a dam. A PC version of DAMBRK was developed by the National Weather Service based on direct conversion of the mainframe DAMBRK Program. The Boss International Corporation (BOSS 1995) converted the program into a graphical version with added graphics input and output options. The numerical solution routines of the two programs are identical, and the input data files are interchangeable. The commercial version of the BOSS DAMBRK Program was used to model a TP-1 dam breach and routing of the failure flood.

The DAMBRK Program consists of two basic elements: one element simulates the outflow hydrograph resulting from a dam failure, and the second element routes the resultant dam failure hydrograph through a downstream channel.

An orifice opening is assumed to model outflow in the case of a piping failure and a time-dependent, erosion-type dam breach is modeled as a hydraulic weir. The outflow hydrograph is routed through the downstream channel using an implicit finite difference solution of the complete one-dimensional equation of unsteady shallow-water flow. The program can model either Newtonian or non-Newtonian fluids.

For TP-1, a sunny-day, piping dam failure was modeled and the resultant flood was routed downstream to Union Village Dam. The breach analysis of tailing dam TP-1 assumed a standing pond of water with no pond inflow. The modeled failure is a water and tailing release resulting from piping or internal erosion of tailing. The tailing and decant pond depletion curve is presented in Figure 8-3. The TP-1 outflow hydrograph is presented in Figure 8-4.

Two separate input files representing the channel reaches were used to simulate channel flows within the inundation area. Two reaches were necessary because attempting to use one input file for the entire reach resulted in computational convergence problems. The first modeled reach extends from TP-1 to an area approximately 3.5 miles downstream. The second modeled reach covers the remaining channel, downstream to the confluence with the Connecticut River. However, because Union Village Dam attenuates the downstream flow, only results for the channel upstream of the dam are presented. Data used in the input files are summarized in Table 8-1.

Tailing Debris Flow Failure Modeling

A second set of analyses were performed to estimate how far downstream saturated tailing would be carried if there were a sudden embankment failure with no water in the decant pond (i.e., a debris flow). The procedure developed by Jeyapalan (1982, 1983a, 1983b) was utilized for these analyses.

The methodology is based on solving the equation for laminar, one-dimensional flow down a constantly sloped plane, with the tailing assumed to behave as Bingham plastic fluid. The model predicts the tailing flood surface profiles at various time intervals and calculates a final profile to estimate when the mass will stop moving.

8.5 HYDRAULIC MODEL DEVELOPMENT

The following documents were used to estimate the tailing dam breach parameters for the inundation analysis:

- USBR. 1983. *Planning Instruction No. 83-05 (7114)- Guidelines for Defining Inundated Areas Downstream from Bureau of Reclamation Dams*. From USBR Chief, Division of Planning Technical Services.
- Wahl, Tony L. 1998. *Prediction of Embankment Dam Breach Parameters, Draft.*
- Froehlich, D.C. 1995. "Peak Outflow from Breached Embankment Dam," *Journal of Water Resources Planning and Management*. Vol. 121, No. 1, pp. 90-97.

According to Wahl (1998), several empirical equations or procedures are typically used to estimate the breach parameters for various types of dams. These equations are based on documented historical dam failures within the U.S. and throughout the world. However, most of these empirical equations were developed from breach of traditional water storage dams (Newtonian fluid). Thus, there are inherent limitations in determining breach parameters for tailing dams using these equations. Nevertheless, in selecting the breach parameters for the Elizabeth Mine tailing dam, the empirical equations by USBR, Federal Energy Regulatory Commission (FERC) (1987), Froehlich (1995), and Von Thun & Gillette (1990) were considered.

Initial Assumptions

For the initial model, tailing dam TP-1 and the decant pond were modeled assuming a sunny-day failure of the main dam with a decant pond elevation at the spillway crest, or 140 acre-feet of water in storage. It was assumed that for all model runs the decant structure was restricted and flow to the decant pond had caused an elevated pool. Thus, decant flows were neglected.

The tailing volume released (Case 1) was initially estimated to be approximately 470 acre-feet (at about 758,000 cubic yards [cy]). The initial tailing volume was calculated using a model algorithm assuming an undrained equivalent friction angle of 17 degrees for the tailing. The tailing volume released versus elevation is based on site topographic information, and this amount of tailing was mixed with the water held in storage within the decant pond providing the total slurry volume available for analysis. The total tailing/water mixture volume-rating curve is presented on Figure 8-5.

The breach formation time was assumed to be 0.5 hour. Before this time of failure was selected, the sediment erosion model BREACH, developed by the National Weather Service, was used to estimate the time to establish the breach, assuming an erosional piping failure. The BREACH Model is based on sediment transport mechanisms and calculates the time for an erosional pipe to form. The results calculated a long breach time of more than 3 hours. The calculated breach time is dependent on the length of the erosional pipe, and the model does not consider the resultant effects such as slope instability created by the collapse of material into the erosional void. Because of slope instability and other considerations, the time for failure is expected to occur over a shorter period.

Tailing Properties

The rheological parameters for the breached tailing and water flows were calculated assuming the material behaved as a Bingham plastic fluid. Two different ranges of solids concentrations were evaluated for the first two initial conditions (Case 1 and Case 2). For Case 1, a complete mix of decant water (140 acre-feet) with the saturated tailing (470 acre-feet), was initially assumed resulting in a volumetric sediment concentration (C_v) of 38.5 percent.

$$C_v = \frac{0.5(470)}{470+140} = 0.385 = 38.5\%$$

For Case 2, a total of 93 acre-feet of tailing was assumed to have mixed with a decant pond water volume of 140 acre-feet, resulting in a solids volumetric concentration of 20 percent.

A third case (Case 3) was evaluated for a decant pond of 54.5 acre-feet resulting in a volumetric solids concentration of approximately 45 percent (representing the high end of a hydraulic fluid flow).

For each case, the Bingham plastic viscosity was estimated from the empirical equation developed by O'Brien and Julien (1986):

$$\eta = 0.001357e^{16.18C_v} = 0.69 \quad lb - \sec^2/ft^2$$

Where η is the Bingham plastic viscosity and C_v is the volumetric concentration of solids.

The Bingham Yield Stress (τ_y) was initially estimated to be 1.38 pounds per square foot (psf) according to the empirical equation developed by O'Brien and Julien (1986):

$$\tau_y = 0.00886e^{13.11C_v}$$

The Bingham Plastic Yield Stress is a function of solid concentration, a parameter that generally varies as a function of the solids suspended or entrained within the flow. At less than 20 percent solids by volume, the yield stress is close to that of water, or a yield stress of 0.0 psf. At solids concentrations greater than 40 percent by volume, the yield stress can be greater than 0.5 psf.

As discussed in Section 7, laboratory testing has found that the tailing within tailing dam TP-1 consists primarily of sands and non-plastic silts. The tailing is nearly cohesionless and, as a result, may have a yield stress close to 0.0 psf.. A yield stress value of 0.05 psf was selected instead of zero in order to maintain convergence of the BOSS DAMBRK Program. A parametric analysis was also performed, as described below, to evaluate the sensitivity to changes in the Bingham Yield Stress.

Channel Base Flow

The observed channel base flow in Copperas Brook downstream of tailing dam TP-1 is often quite small compared to the peak flood breach flow. Therefore, the base flow in Copperas Brook was assumed to be negligible for this analysis.

USGS stream gauge records at Union Village showed a base flow of approximately 110 to 120 cfs in January and February. In August and September, the base flow in OR at Union Village decreased to between 40 and 80 cfs. The average annual mean stream flow at the Union Village gauge was approximately 194 cfs. For this study, a relatively small base flow of 50 to 300 cfs was used to keep the program numerically stable. A summary of the breach parameters and initial conditions are presented in Table 8-2.

Manning's Friction Coefficients

The Manning's friction coefficient was estimated based on field observations and experience. The composite Manning's "n" value was assumed to be 0.04, representing flow over well-vegetated banks.

River Channel Routing

Composite cross sections were used in this study, but were not divided into main channels and floodplains. This technique often improves the numerical stability of the model through steeper channel reaches.

Twenty cross sections were initially developed for the model using cross sections obtained from USGS mapping. The initial model profile extended from tailing dam TP-1 to the confluence with the Connecticut River. As discussed above, Union Village Dam will attenuate the downstream flow and the numbered model cross sections are only shown for the channel reaches between TP-1 and Union Village Dam, as illustrated in the inundation maps provided on Figures 8-6 and 8-7. Cross-section locations are summarized in Table 8-3.

Union Village Dam

The flood resulting from the failure of tailing dam TP-1 was initially routed through Union Village Dam. The model runs for this report are shown only up to Union Village Dam.

8.6 TAILING DEBRIS FLOW MODEL DEVELOPMENT

The empirical equations developed by O'Brien and Julien (1986) are generally used for hyperconcentrated flow, mudflow, mud flood, and debris flow with volumetric concentrations less than 50 percent. For mudslides with volumetric concentrations higher than 50 percent, the flow may not be turbulent. For these laminar flow conditions, the viscosity and yield stresses are much higher than those incorporated into the O'Brien and Julien empirical relationships, and they cannot be applied. These conditions are anticipated to occur for the tailing-only (debris flow) failure scenario. For a debris flow failure, the literature indicates that the Bingham plastic viscosity will vary (2 to 100 lb-sec^2/ft^2), and the Bingham Yield Stress will vary (20 to 150 psf). No field measurements or laboratory testing of the rheological properties have been completed to date.

For the analysis of the debris flow tailing release, the method developed by Jeyapalan (1982) was used. A weighted average channel slope downstream of the tailing dam was applied because the methodology does not allow for channel slope variations. The weighted average channel slope downstream of the tailing dam is shown on Figure 8-8. The dynamic viscosity for the tailing flow failure was varied for a range of values as shown on Figure 8-9. The slope used in the simulation approximates the weighted average channel slope within the first 5 miles downstream of TP-1.

8.7 RESULTS

The initial breach and runout analysis for a hydraulic and tailing flow failure are presented below. The computer-generated output files for each case are presented in Appendix E.

Hydraulic Flow Failure

For the initial scenario, Case 1, with 470 acre-feet of saturated tailing and 140 acre-feet of decant pond storage, the estimated outflow and stage hydrographs at the Elizabeth Mine tailing dam location are shown in Figures 8-4 and 8-12, respectively. The modeled failure of tailing dam TP-1 resulted in a calculated peak outflow of approximately 31,370 cfs. Attenuation of the breach outflow results in a peak discharge of approximately 16,740 cfs entering Union Village Dam. Figure 8-10 shows the peak flow discharge profile for the entire model reach. The time to peak stage is shown on Figure 8-11. A summary of flow characteristics at all cross sections used in the model along the river is provided in Table 8-5.

The Union Village Dam has a large detention capacity and the peak flow discharge decreases dramatically downstream of the dam. The outflow from Union Village Dam is confined within the main channel of the OR, and flows are within the normal channel capacity reported at approximately 2,500 cfs.

The estimated inundation limits downstream of the site are presented on Figures 8-6 and 8-7. The figures illustrate the inundation areas under a variety of conditions.

The resulting flood could impact several hydraulic structures, homes, and businesses downstream of the dam, including several residences along WBOR, and several major road/highway crossings. The first residential structure to be affected is located approximately 1.4 miles downstream near Campbell Corner. This location was selected as a point on the runout profile where results from the three cases selected could be compared. For the initial Case 1.0 through Case 3.0 (with the solids concentration varying as noted previously), the flow velocity at this location could range from 10 to 15 fps, and the flow depth from 8 to 9.7 feet.

Tailing Flow Failure

A debris flow could produce a mudslide with a maximum flow depth of between 20 and 40 feet that could travel between 1,000 and 12,000 feet downstream, depending on the dynamic viscosity of the tailing at saturation. The model does not consider lateral dispersion of the mudflow, however it is generally expected that the actual travel distance will be diminished if lateral dispersion is considered (in the range of less than 10,000 feet).

8.8 SENSITIVITY ANALYSIS

The dam breach analysis is based on a set of initial conditions as described above. Other possible conditions were modeled and an evaluation of the effects of variations in selected parameters was completed. The estimated inundation area has a degree of uncertainty directly related to the breach parameters assumed and the inherent limitations resulting from the topographic maps used (10-meter ground contour intervals). A sensitivity analysis was performed to analyze the input parameter variability and the resultant variability of model results. A summary of the alternatives analyzed is presented in Table 8-4. The computer-generated output files for each case are presented in Appendix E.

Initial Case and Breach Volume Sensitivity

Literature cases and model results specific to tailing dam TP-1 show that water volume influences the peak dam outflows during a breach. Larger decant pond storage will increase peak outflow because the elevated water level decreases more slowly, providing more hydraulic head and erosional energy at the breach opening. Froehlich (1987, 1995), MacDonald and Langridge-Monopolis (1984), and Singh and Scarlatos (1988) established empirical equations that relate the peak outflow discharge to the reservoir volume. Other cases evaluated are shown on Table 8-4 and include:

- **Case 1.0** – A total mixed volume of 610 acre-feet, with 470 acre-feet of saturated tailing and 140 acre-feet of decant water at elevation 1,062. This is the base condition as reported in the previous sections. The mixed slurry from the dam would have a volumetric sediment concentration of 38.5 percent.
- **Case 2.0** – A total mixed volume of 233 acre-feet, with 93 acre-feet of saturated tailing and 140 acre-feet of decant water at elevation 1,062. The mixed slurry from the dam would have a volumetric sediment concentration of 20 percent.
- **Case 3.0** – A total mixed volume of 474.5 acre-feet, with 420 acre-feet of saturated tailing and 54.5 acre-feet of decant water at elevation 1,058. The complete mixed slurry from the dam would have a volumetric sediment concentration of approximately 45 percent.

The results indicate dramatic changes in peak flow profiles for these three scenarios. Figure 8-12 illustrates the simulated peak flood stage profiles for these three scenarios. For Case 1.0 the depth of flow and velocity is 9.7 feet and 13.6 fps. For Case 2 the values increase to 7.9 feet and 15.2 fps and for Case 3.0 the values drop to 9.5 feet and 9.6 fps, respectively

Breach Time Sensitivity (Case 4.1, 1.0, and 4.2)

A sensitivity analysis was conducted to evaluate the impact of breach formation time on the peak outflow and flood stage profiles. The breach formation time is generally the most sensitive parameter. The time for failure was analyzed for 15-, 30-, and 60-minute periods, identified as Case 4.1, 1.0, and 4.2, respectively in Table 8-4.

The results show the peak outflow increases to 55,100 cfs for a 15-minute failure and decreases to a peak outflow of approximately 17,740 cfs for a 60-minute failure. A comparison of downstream profiles is present on Figure 8-13. Downstream of Union Village Dam, the time of

failure has very limited impact on the profiles because of attenuation through the flood control structure. The flow depth and velocity for these three cases is shown on Table 8-4.

Tailing Volume Sensitivity (Case 5.1, 3.0, and 5.2)

A sensitivity analysis was conducted to evaluate the effects of varying the volume of tailing released on the flow velocity and flow depth predicted for a location downstream. Tailing release volumes of 500,000 to 1 million cubic yards were evaluated. The flow depth and velocity for these three cases (Case 5.1, 3.0, and 5.2) is shown on Table 8-4. For Case 5.1, the depth of flow and velocity is 7.3 feet and 7.1 fps, respectively. For Case 3.0, the values increase to 9.5 feet and 9.6 fps, and for Case 5.2, the flow depth increase to 10.1 feet and the velocity drops to 9.0 fps.

Initial Piping Elevation Sensitivity (Case 3.0, 6.1, and 6.2)

A sensitivity analysis was conducted to evaluate the effects of varying the initial breach elevation (970 feet) on the peak discharge outflow. Higher peak flows are normally produced by a lower initial breach elevation. Thus, the largest peak flow would result from a piping failure that is introduced at the dam base. The sensitivity analysis showed that for the condition of 54.5 acre-feet of water stored in the decant pond (Case 6.1) and the initial piping failure lowered to elevation at 1,040 would result in a peak outflow discharge of approximately 23,060 cfs. If the initial piping failure elevation were lowered by an additional 20 feet, to elevation 1,020, the resultant peak discharge outflow for Case 6.2 would increase almost two-fold to 43,470 cfs.

Bingham Yield Stress Sensitivity (Case 5.1 and 7.1)

The Bingham Yield Stress is a parameter that generally varies as a function of the solids suspended or entrained within the flow. A yield stress of 0.0 psf is equivalent to water. A parametric analysis was performed to estimate the impacts of varying the yield stress on the model results. Yield stresses of 0.05 and 1.38 psf were considered, identified as Case 5.1 and 7.1, respectively. The results showed that at a higher yield stress, the peak flow is slowed slightly and the flow depth increases a modest amount. The flow depth and velocity for these two cases is shown on Table 8-4.

8.9 RESULTS SUMMARY

The results of the dam breach and runout analysis show that the channel between tailing dam TP-1 and the Union Village Dam could be impacted in the event of a sunny-day dam failure. The inundation area will depend on the type of failure, the breach rate, the water volume contained in the decant, breach geometry, and the material properties. The Union Village Dam outlet works is expected to attenuate flows downstream. The release will discharge sand and silt tailing into WBOR, OR, and the Connecticut River.

Table 8-1

DATA ON ELIZABETH MINE TP-1

TP-1 Embankment	
Crest elevation	1070 ft (approx.)
Crest length	"L" shape, 2,100 ft total length and about 1,250 ft along the North slope.
Crest width	< 10 ft
Base elevation	970 ft (top of starter dam)
Structural height	100 ft
Hydraulic height (normal W.L.)	None (the pool is normally dry)
Volume (normal W. L.)	None
Spillway	
Description	Natural grassed open channel spillway.
Crest elevation	1062 ft (approx.)
Crest length	12 ft (bottom width) (approx.)
Downstream chute length	None (abutment groin)
Decant Structure	
General Description	• 24-inch diameter reinforced concrete pipe with horizontal drop towers (existing capacity reduced) • Ungated inlet. Decant pond generally low and drained under normal conditions

W.L. = Water Level

Table 8-2

ELIZABETH MINE TP-1 HYDRAULIC BREACH PARAMETERS AND INITIAL CONDITIONS

Item	Number
TP-1 Initial Water Surface Elevation in Reservoir, ft	1062
TP-1 Water Level at Time of Breach, ft	1062
TP-1 Uncontrolled Spillway Crest Elevation, ft	1062
TP-1 Uncontrolled Spillway Discharge Coeff.	3.0
TP-1 Breach Side Slope, ft/ft	2.00
TP-1 Breach Bottom Elevation, ft	970
TP-1 Breach final Base Width, ft	20.
TP-1 Time of Failure, hours	0.5
Base Flow Through Dams, cfs	50
Number of Cross Sections Used	20
Total Reach Length (Main Channel), miles	9.45
Manning's n	0.04

Table 8-3
DAMBRK MODEL CROSS SECTIONS
ELIZABETH MINE; TP-1

Cross Section No.	Location	Distance from Dam Along River (miles)
1	TP-1	0
2	Downstream of Dam Toe	0.02
3	EL 900	0.27
4	Downstream of Confluence with WBOR	0.70
5	First group of homes	1.45
6	--	1.72
7	Grove Hill Road	2.49
8	Rices Mills	2.91
9	Downstream Tucker Hill Road	3.49
10	Bridge	4.12
11	Confluence with EBOR	4.85
12	Upstream Union Village Dam	5.41
13	Union Village Dam	5.60
14	Union Village	5.97

WBOR = West Branch Ompompanoosuc River

Table 8-4
BREACH AND RUNOUT ANALYSIS RESULTS
ELIZABETH MINE TP-1

Initial Conditions Modeled

Case 1.0 Initial Condition Modeled

- Decant Water Surface -- El. 1062
- Decant Volume -- 140 AF
- Tailing Volume -- 470 AF
- Initial Piping -- El. 1050
- Breach Time -- 0.5 Hours
- Bingham Yield Stress -- 0.05 psf

Case 1.0 Results 1.4 Miles Downstream

Peak Velocity = 13.6 fps
Peak Flow Depth = 9.7 feet

Case 2.0 Reduced Tailing Volume (93 AF)

- Decant Water Surface -- El. 1062
- Decant Volume -- 140 AF
- Tailing Volume -- 93 AF
- Initial Piping -- El. 1050
- Bingham Yield Stress -- 0.05 psf

Case 2.0 Results 1.4 Miles Downstream

Peak Velocity = 15.2 fps
Peak Flow Depth = 7.9 feet

Case 3.0 Reduced Decant Pond Volume (45.5 AF)

- Decant Water Surface -- El. 1058
- Decant Volume -- 54.5 AF
- Tailing Volume -- 470 AF
- Initial Piping -- El. 1050
- Breach Time -- 0.5 Hours
- Bingham Yield Stress -- 0.05 psf

Case 3.0 Results 1.4 Miles Downstream

Peak Velocity = 9.6 fps
Peak Flow Depth = 9.5 feet

Parametric Analysis Results (Scenario No. 3)

Case 4.0 Varied Breach Time

- Decant Water Surface -- El. 1062
- Decant Volume -- 140 AF
- Tailing Volume -- 470 AF
- Initial Piping -- El. 1050
- Bingham Yield Stress -- 0.05 psf

Case 4.0 Results 1.4 Miles Downstream

Case 4.1 Breach Time 0.25 Hour

Peak Velocity = 17.1 fps
Peak Flow Depth = 13.1 feet

Case 1.0 Breach Time 0.5 Hour

Peak Velocity = 13.6 fps
Peak Flow Depth = 9.7 feet

Case 4.2 Breach Time 1.0 Hour

Peak Velocity = 10.5 fps
Peak Flow Depth = 7.9 feet

Table 8-4 (Cont.)

SUMMARY OF BREACH AND RUNOUT ANALYSIS MODELING

Parametric Analysis Results (Scenario No. 3 cont.)

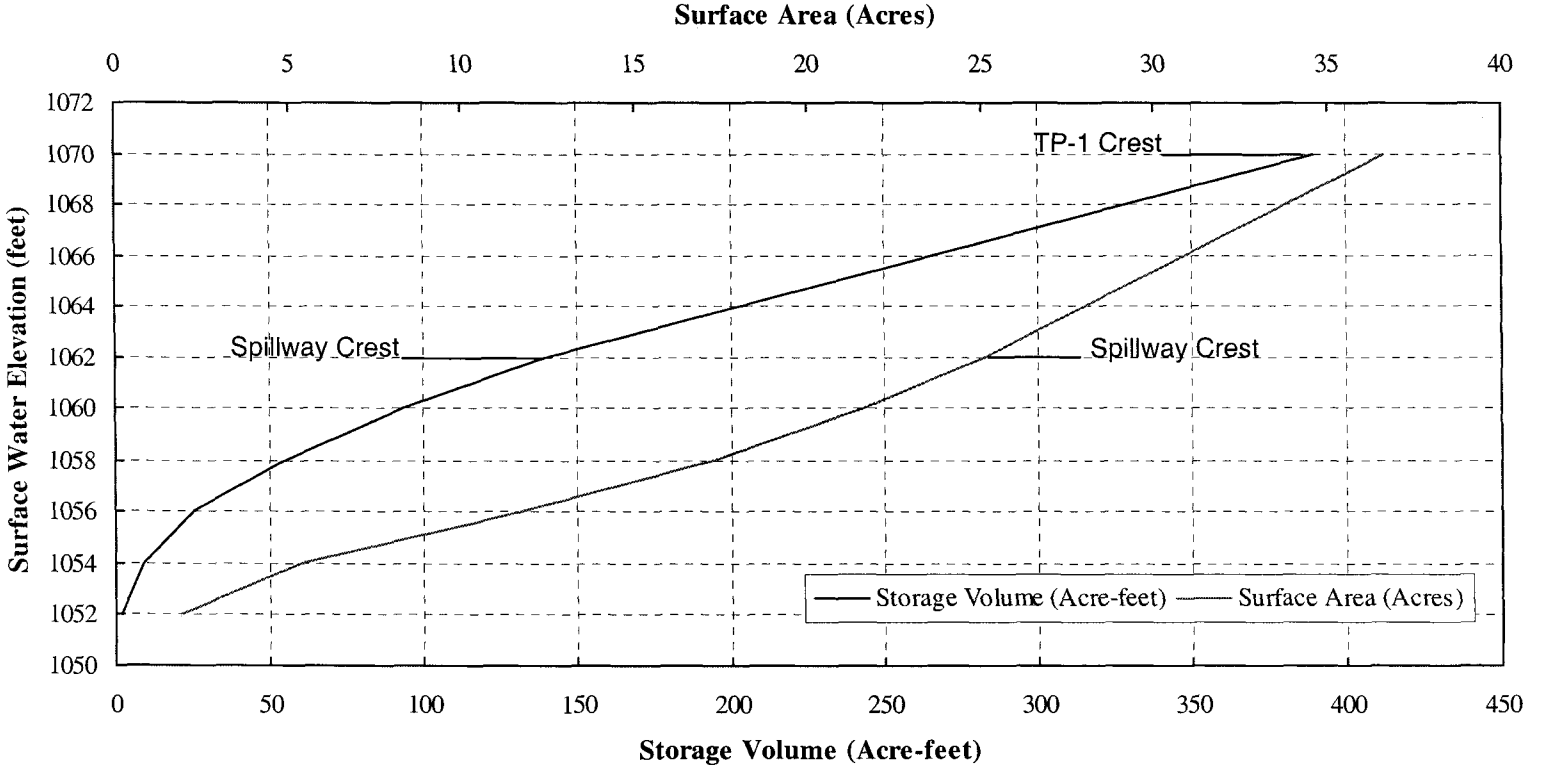
Case 5.0	Variation of Tailing Volume (500,000 to 1 mcy)			Case 5.0 Results 1.4 Miles Downstream
➢	Decant Water Surface	--	El. 1058	Case 5.1 Tailing Volume 500,000 cy
➢	Decant Volume	--	54.5 AF	*Peak Velocity = 7.1 fps*
➢	Initial Piping	--	El. 1050	*Peak Flow Depth = 7.3 feet*
➢	Breach Time	--	0.5 Hour	Case 3.0 Tailing Volume 758,000 cy
➢	Bingham Yield Stress	--	0.05 psf	*Peak Velocity = 9.6 fps*
				Peak Flow Depth = 9.5 feet
				Case 5.2 Tailing Volume 1,000,000 cy
				Peak Velocity = 9.0 fps
				Peak Flow Depth = 10.1 feet
Case 6.0	Variation of Breach Elevation			Case 6.0 Results 1.4 Miles Downstream
➢	Decant Water Surface	--	El. 1058	Case 3.0 Piping Elevation El 1050
➢	Decant Volume	--	54.5 AF	*Peak Velocity = 9.6 fps*
➢	Tailing Volume	--	470 AF	*Peak Flow Depth = 9.5 feet*
➢	Breach Time	--	0.5 Hour	Case 6.1 Piping Elevation El 1040
➢	Bingham Yield Stress	--	0.05 psf	*Peak Velocity = 9.6 fps*
				Peak Flow Depth = 9.5 feet
				Case 6.2 Piping Elevation El 1020
				Peak velocity = 11.7 fps
				Peak Flow Depth = 10.7 feet
Case 7.0	Variation in Bingham Yield Stress			Case 7.0 Results 1.4 Miles Downstream
➢	Decant Water Surface	--	El. 1058	Case 5.1 Bingham Yield Stress 0.05 psf
➢	Decant Volume	--	54.5 AF	*Peak Velocity = 7.1 fps*
➢	Tailing Volume	--	310 AF	*Peak Flow Depth = 7.3 feet*
➢	Initial Piping	--	El. 1050	Case 7.1 Bingham Yield Stress 1.38 psf
➢	Breach Time	--	0.05	*Peak Velocity = 6.4 fps*
				Peak Flow Depth = 7.7 feet

Table 8-5

HYDRAULIC FLOW RESULTS FOR CASE 1.0

Location	Cross Section Number in Model	Floodway Distance from Elizabeth Mine TP-1 (miles)	Peak Flow Discharge (cfs)	Peak Flow Stage (ft)	Maximum Flow Velocity (ft/s)	Time to Peak Stage (hrs)	Flood Arrival Time (hrs)
TP-1	1	0	31,400	1,062.0	4.9	0.00	0.00
Downstream of TP-1 Toe	2	0.02	31,400	951.7	34.7	0.17	0.02
EL 900	3	0.27	30,750	844.0	36.3	0.18	0.02
Downstream of Confluence with WBOR	4	0.66	29,800	746.7	26.4	0.20	0.06
First Houses	5	1.45	27,600	684.7	13.6	0.25	0.15
	6	1.72	27,100	661.5	11.30	0.27	0.20
Grove Hill Road	7	2.49	24,400	589.8	13.0	0.34	0.28
Rices Mills	8	2.91	22,250	556.30	10.0	0.40	0.30
Downstream of Tucker Road	9	3.49	19,350	521.4	8.2	0.51	0.39
Bridge	10	4.12	17,550	493.5	12.9	0.58	0.44
Confluence w/ EBOR	11	4.85	16,750	446.0	7.5	0.68	0.58
Upstream Union Village Dam	12	5.41	11,300	444.8	8.3	1.22	0.63
Union Village Dam	13	5.30	2,800	444.7	1.7	1.22	0.68
Union Village	14	5.97	2,800	422.6	3.1	1.27	0.68

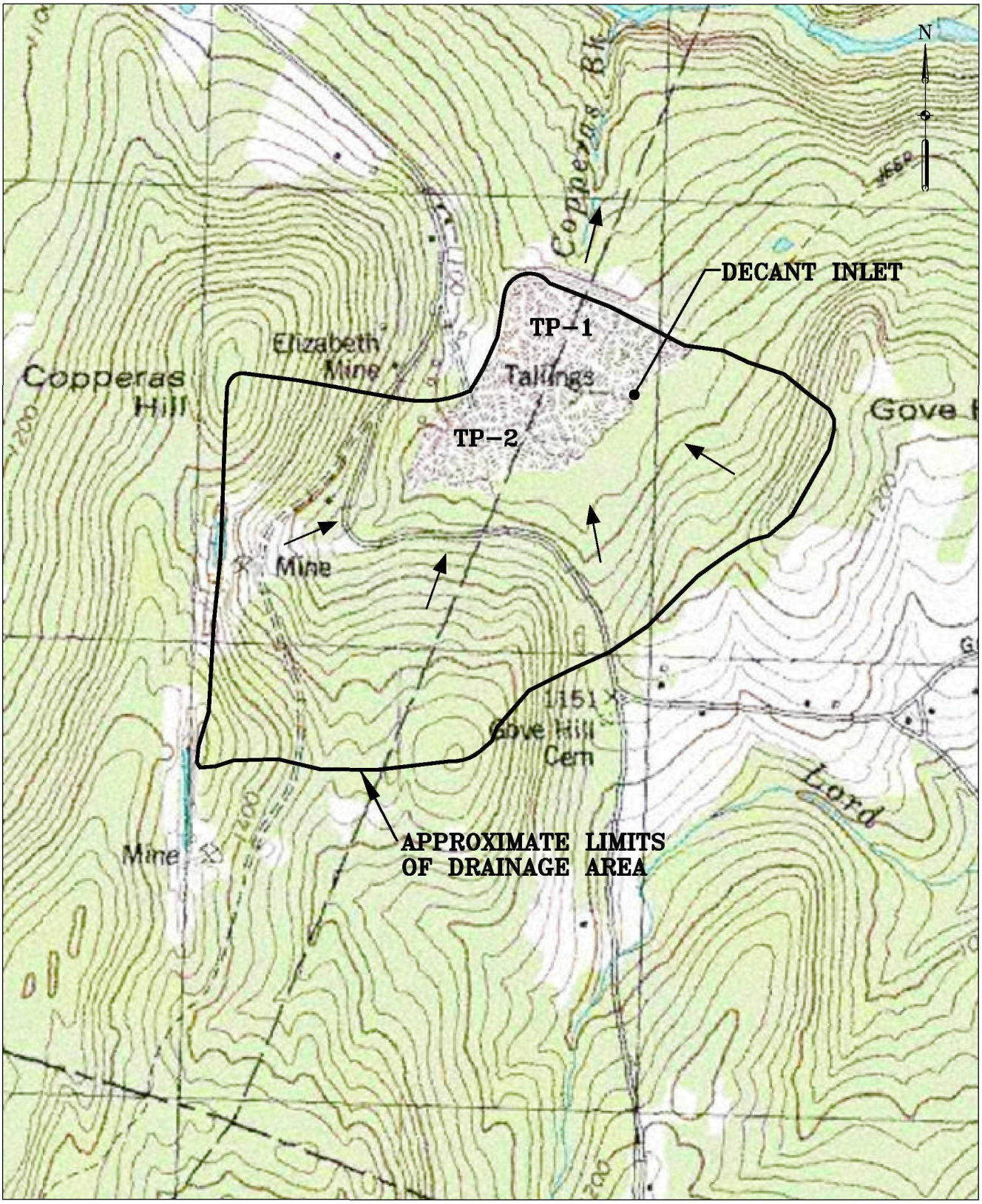
WBOR = West Branch Ompompanoosuc River
EBOR = East Branch Ompompanoosuc River



Project No. 22235583	Elizabeth Mine Strafford, VT	**Elevation Storage Curve TP-1**	Figure 8-1
URS			

8-1.GRF 4/10/03

URS



0 500 1000 2000

SCALE IN FEET

LEGEND

FLOW DIRECTION

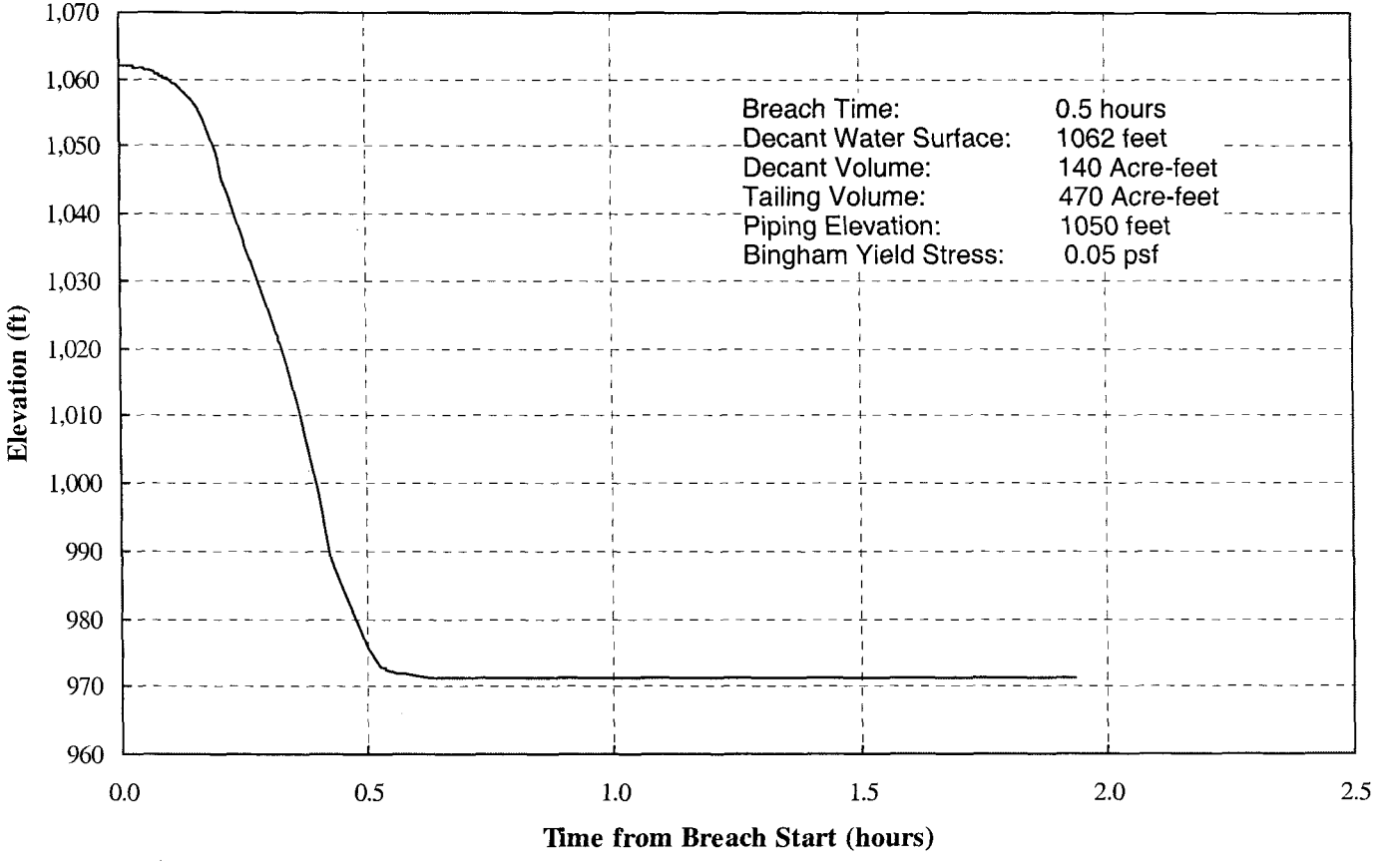
Job No. :	22235583
Prepared By :	CNH
Date :	4/3/03

WATERSHED AREA

ELIZABETH MINE, VERMONT

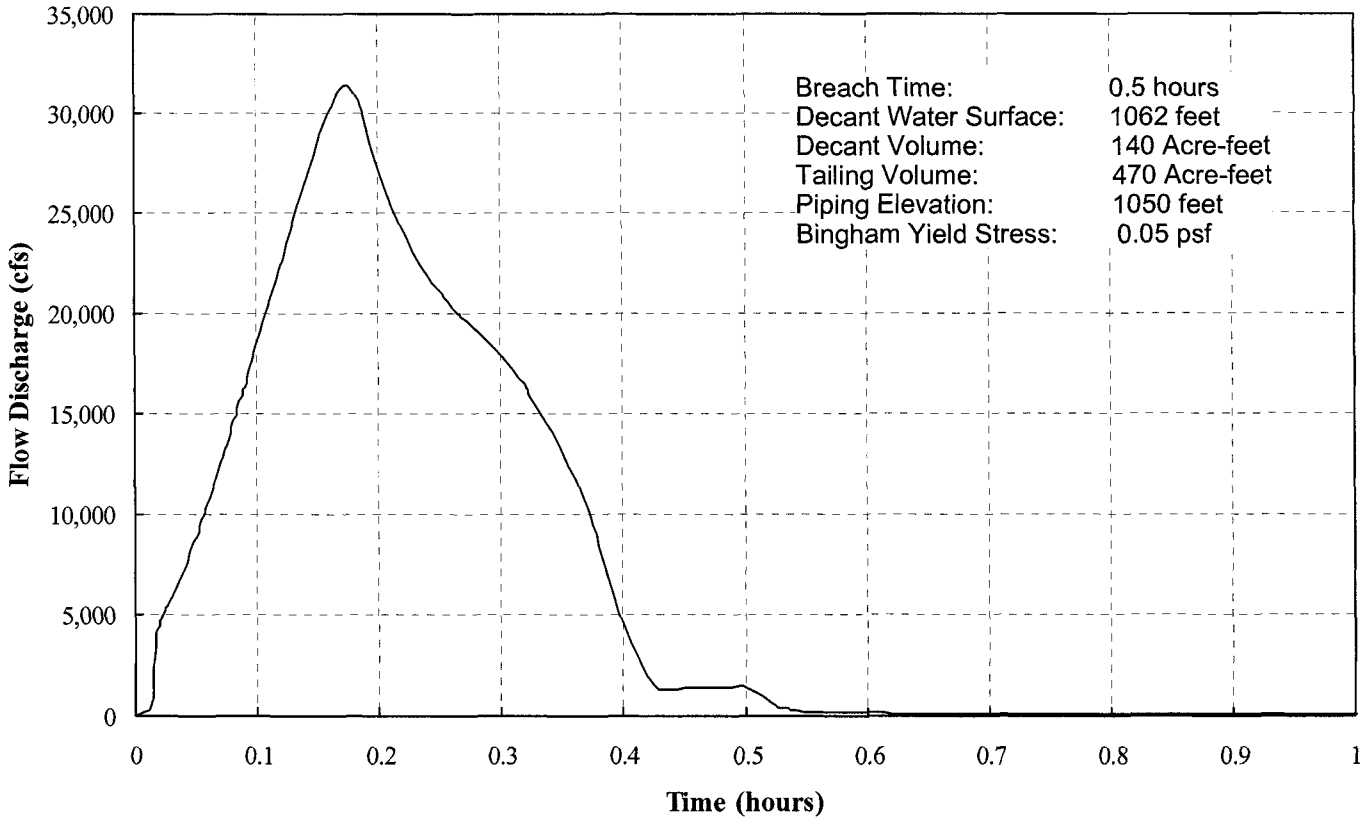
FIG. 8–2

FLOOD MAPS_NEW.DWG



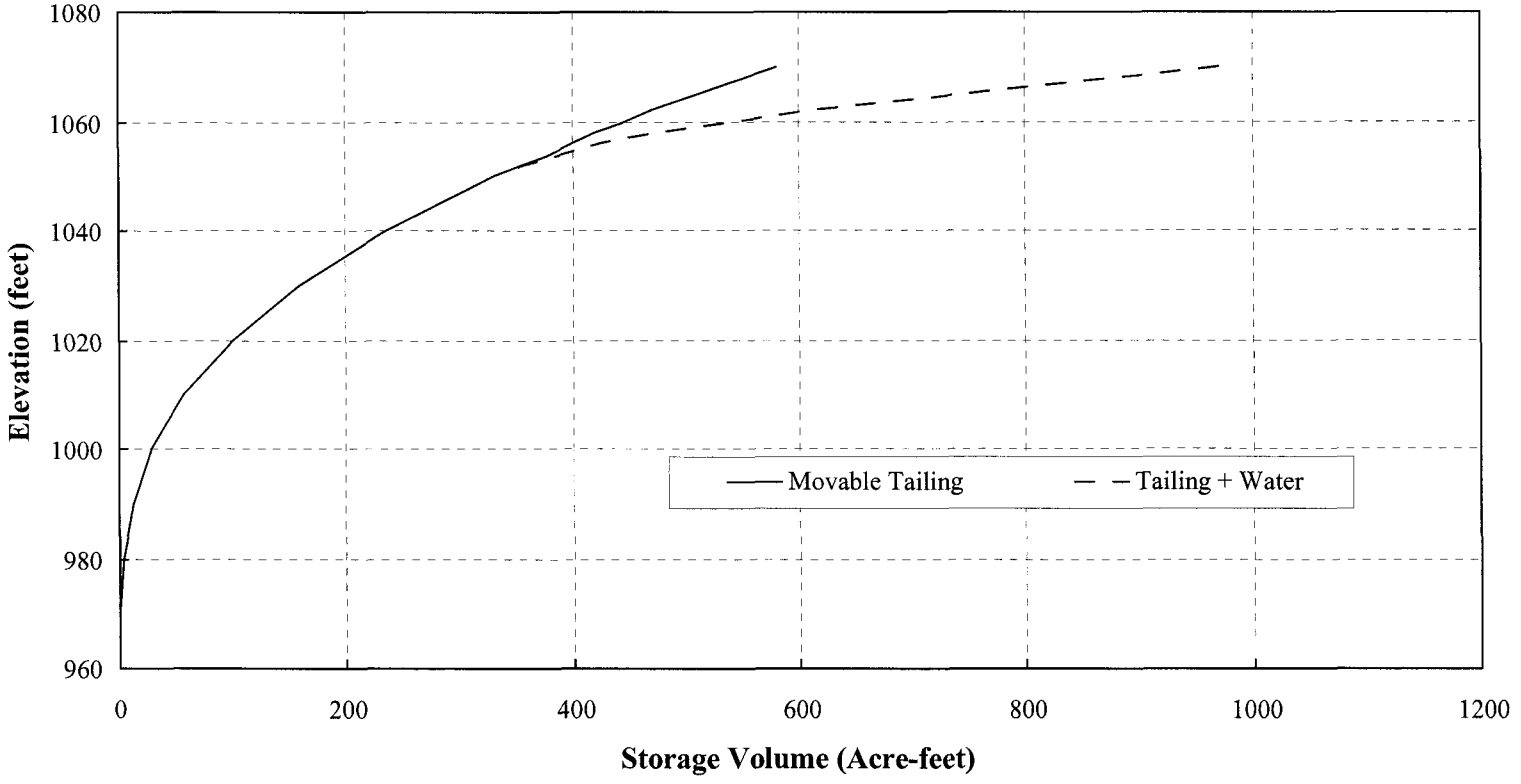
Project No. 22235583	Elizabeth Mine Strafford, VT	**Case 1 Tailing and Decant Pond Depletion Curve**	Figure 8-3
URS			

8-2.grf 4/10/03



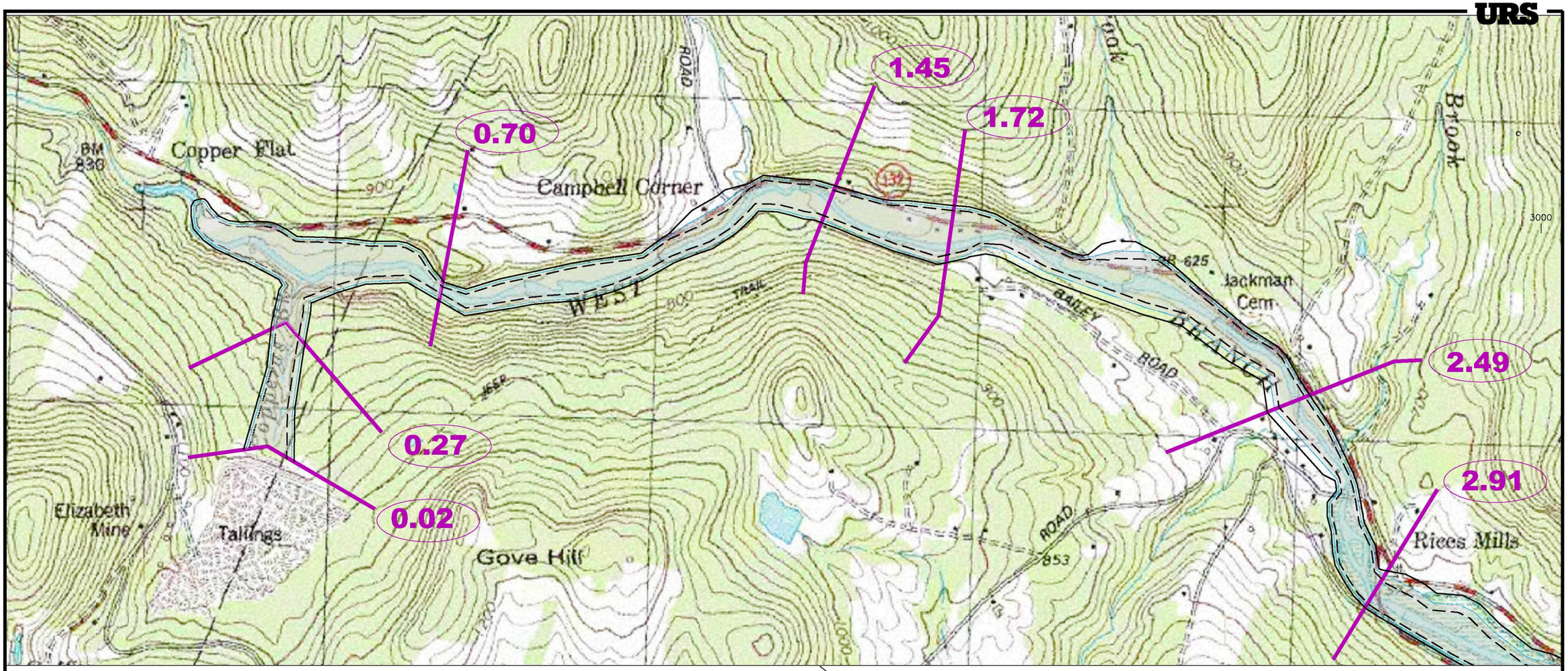
Project No. 22235583	Elizabeth Mine Strafford, VT	**Case 1 Outflow Hydrograph at TP-1**	Figure 8-4
URS			

8-3.GRF 4/10/03



Project No. 22235583	Elizabeth Mine Strafford, VT	**Hypothetical Stage Water Storage Curve TP-1**	Figure 8-5
URS			

8-4.GRF 4/10/03



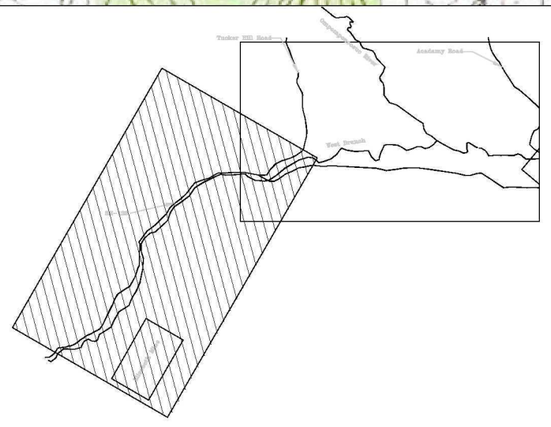
LEGEND

APPROXIMATE LIMIT OF FLOODING BASED ON BREACH OF THE DAM DURING NORMAL RIVER FLOWS (CASE 1.0)

X.XX — CROSS SECTION NUMBER

MAXIMUM INUNDATION (CASE 4.1)

MINIMUM INUNDATION (CASE 3.0)



N

PLAN

0 500 1000 1500

SCALE IN FEET

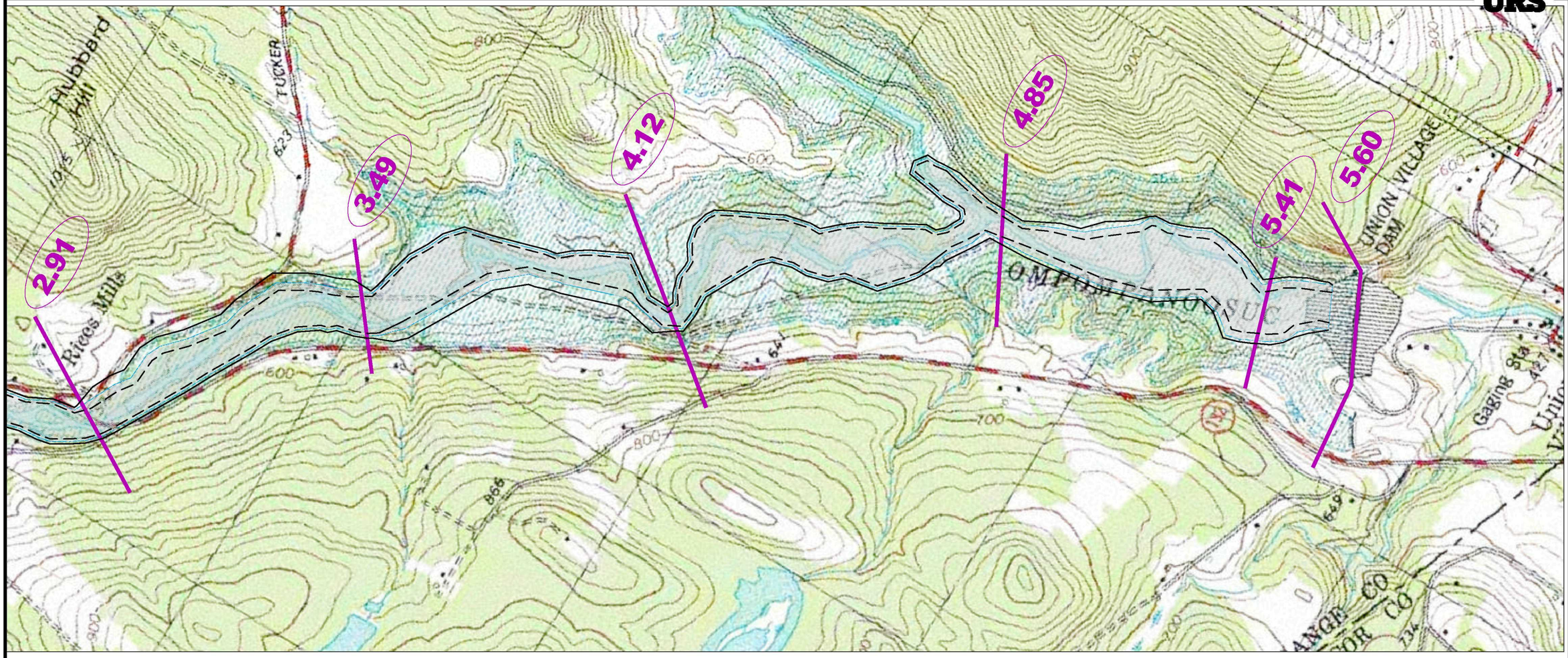
Because of the method, procedures, and assumptions used to develop the flodded areas, the limits of the flooding shown and flood wave travel times are aproximate and should only be used as a guidline for establishing evacuation zones. Actual areas inundated will depend on actual failure conditions and may differ from areas shown on the maps.

Job No. :	22235583
Prepared By :	GGG
Date :	3/28/03

POTENTIAL RANGE OF INUNDATION
ELIZABETH MINE, VERMONT

FLOOD MAPS

FIG. 8–6



LEGEND

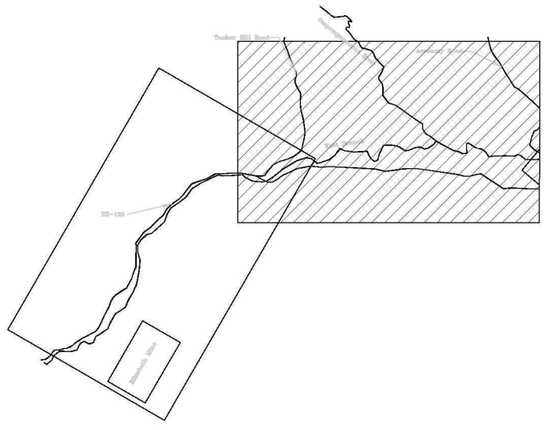
APPROXIMATE LIMIT OF FLOODING BASED ON BREACH OF THE DAM DURING NORMAL RIVER FLOWS (CASE 1.0)

X.XX — **CROSS SECTION NUMBER**

MAXIMUM INUNDATION (CASE 4.1)

MINIMUM INUNDATION (CASE 3.0)

Because of the method, procedures, and assumptions used to develop the flodded areas, the limits of the flooding shown and flood wave travel times are aproximate and should only be used as a guidline for establishing evacuation zones. Actual areas inundated will depend on actual failure conditions and may differ from areas shown on the maps.



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PLAN

0 500 1000 1500

SCALE IN FEET

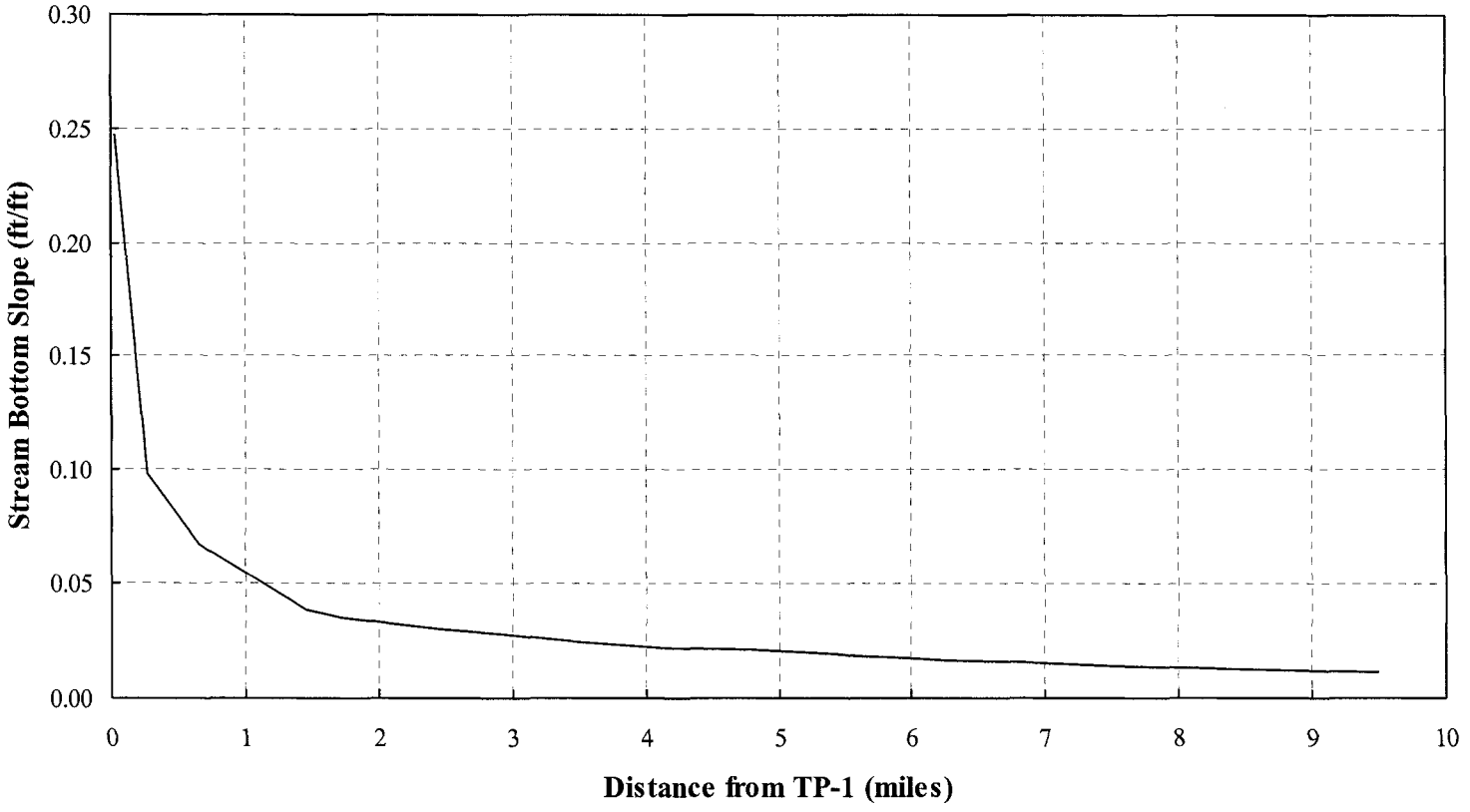
Job No. :	22235583
Prepared By :	GGG
Date :	3/28/03

POTENTIAL RANGE OF INUNDATION

ELIZABETH MINE, VERMONT

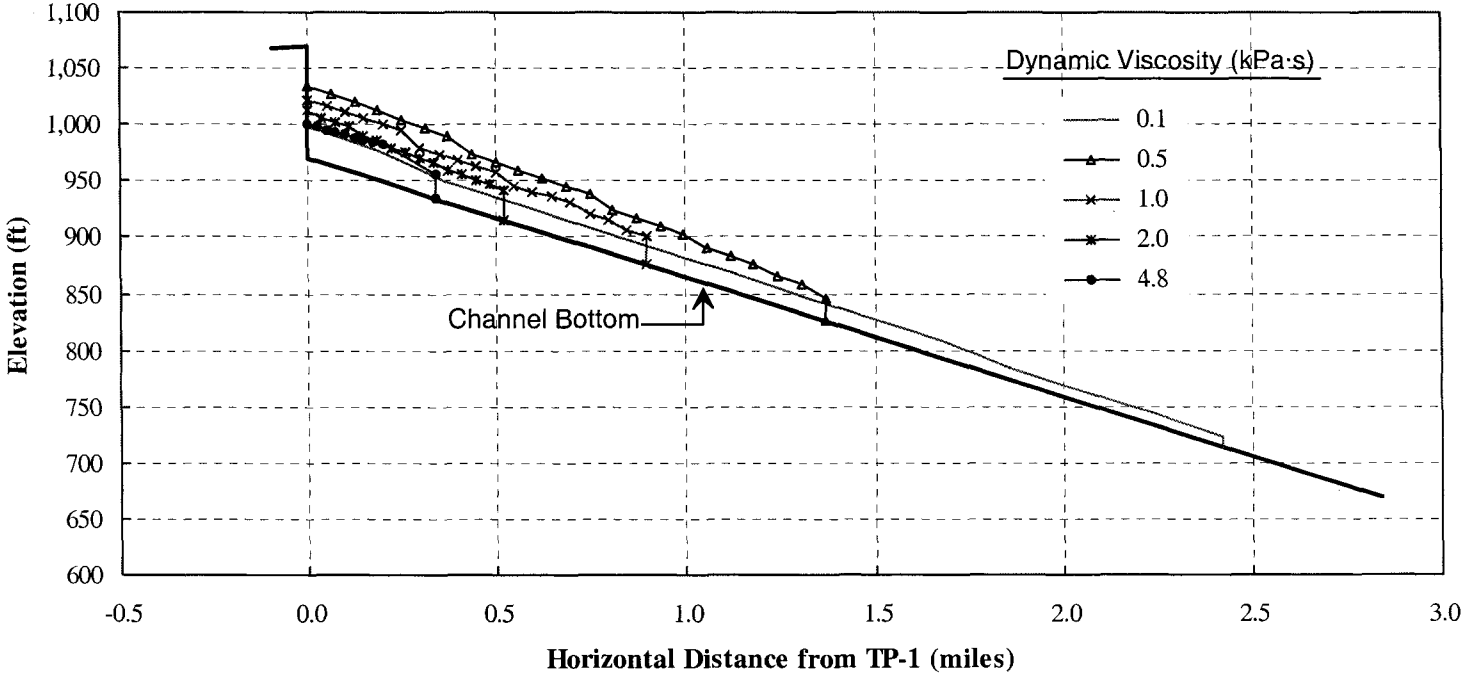
FLOOD MAPS

FIG. 8–7



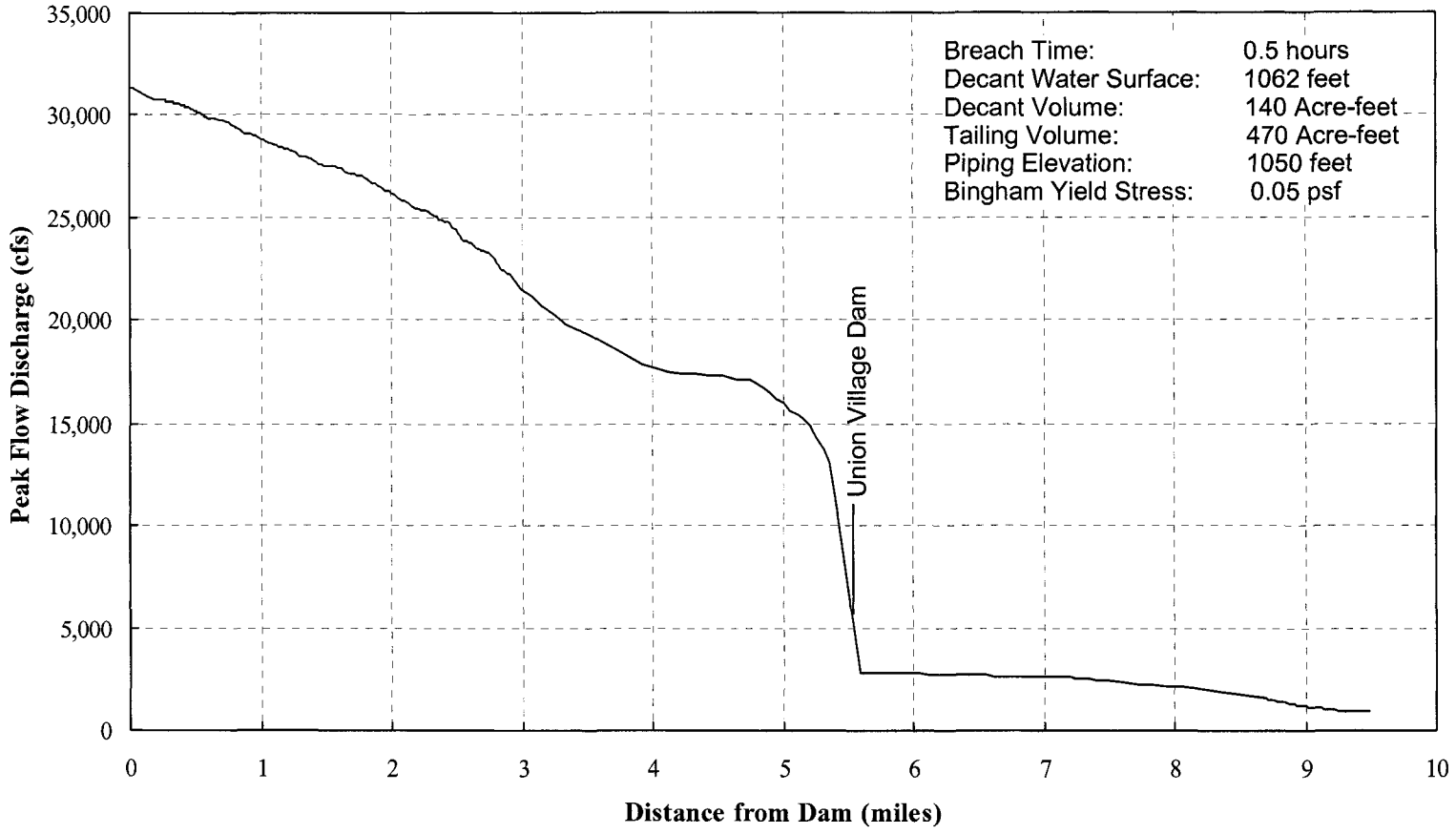
Project No. 22235583	Elizabeth Mine Strafford, VT	Weighted Average Channel Slope	Figure 8-8
URS			

8-7.grf 4/10/03



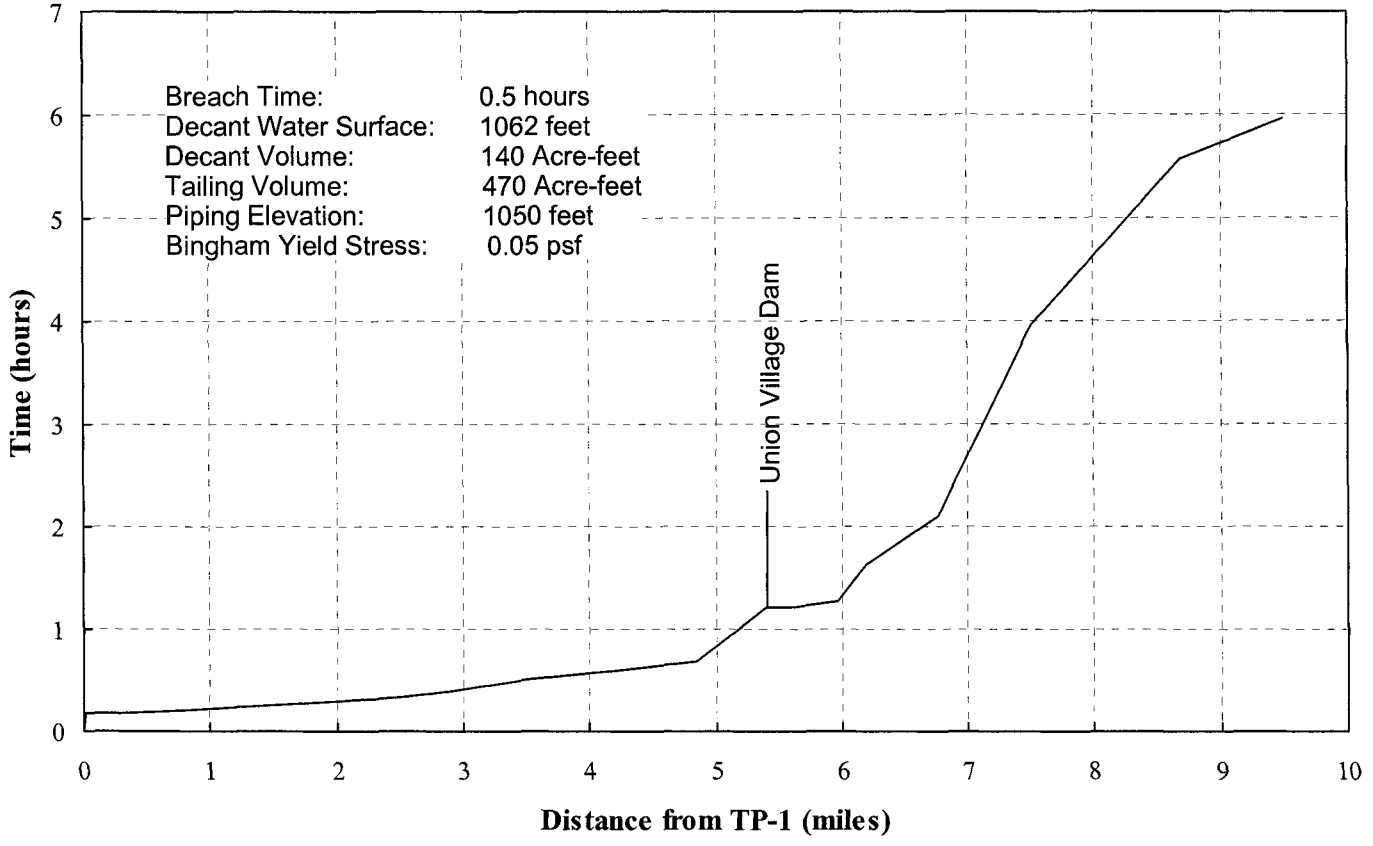
Project No. 22235583	Elizabeth Mine Strafford, VT	**Predicted Equilibrium Surface Profile Tailing Flow Failure**	Figure 8-9
URS			

8-8.grf 4/10/03



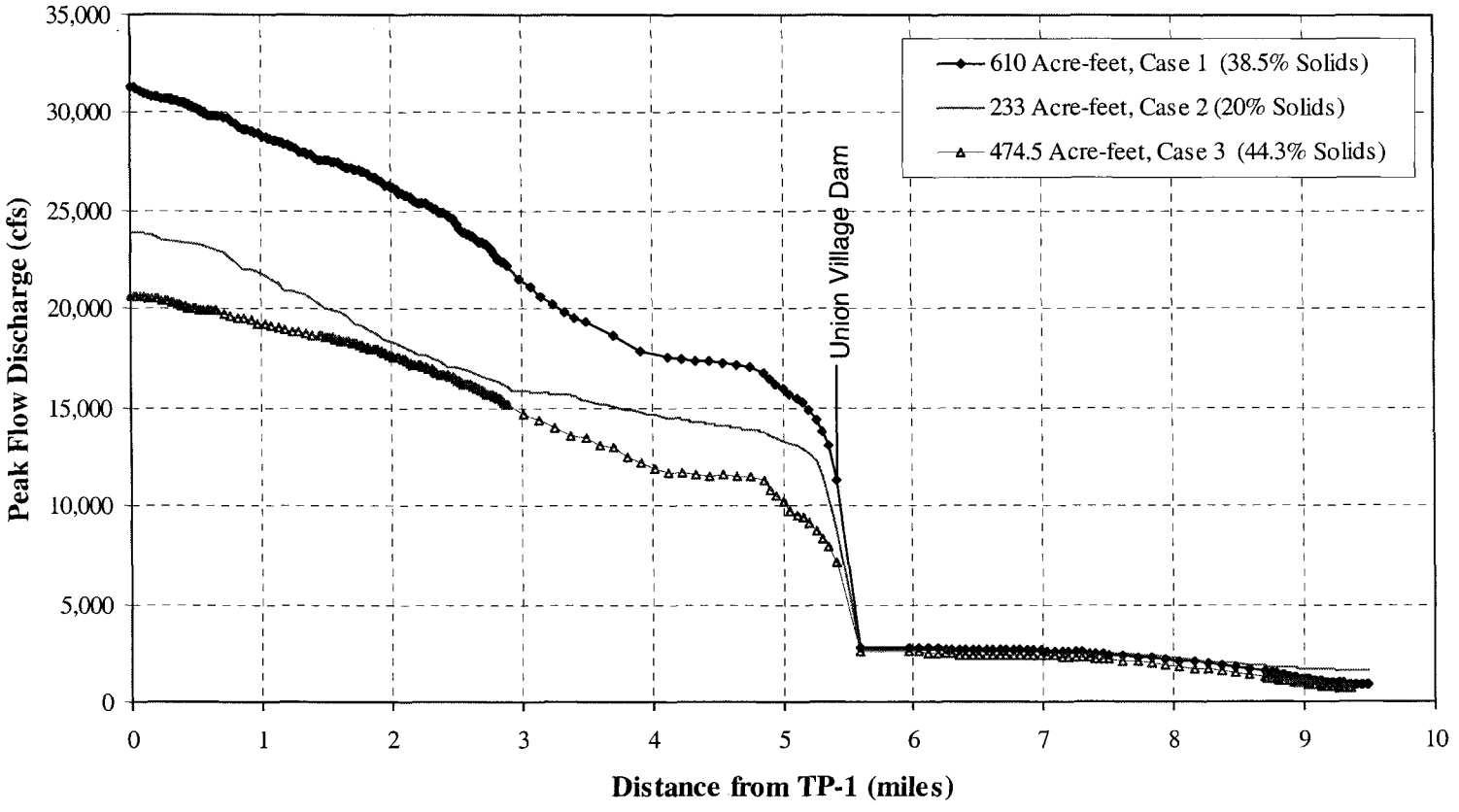
Project No. 22235583	Elizabeth Mine Strafford, VT	**Case 1 Simulated Peak Flow Discharge Profile**	Figure 8-10
	URS		

8-9.grf 4/10/03



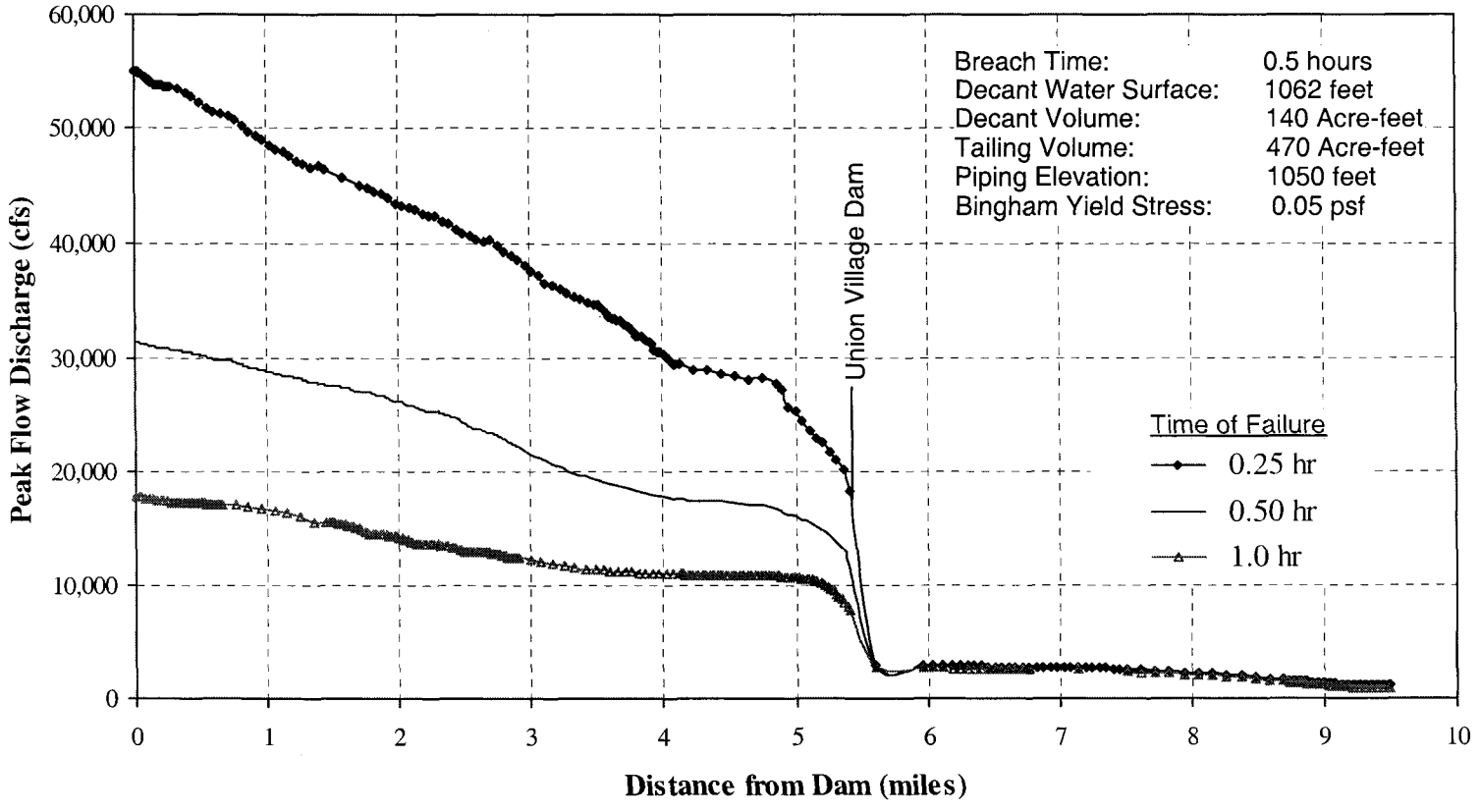
Project No. 22235583	Elizabeth Mine Strafford, VT	**Case 1 Simulated Time to Flood Peak**	Figure 8-11
URS			

8-10.grf 4/10/03



Project No. 22235583	Elizabeth Mine Strafford, VT	**Discharge Profile for Hydraulic Flow Failure**	Figure 8-12
URS			

8-11.grf 4/10/03



Project No. 22235583	Elizabeth Mine Strafford, VT	**Case 1 Peak Flow Discharge Profile for Various Failure Times**	Figure 8-13
URS			

8-12.grf 4/10/03

A geotechnical investigation of tailing dams TP-1 and TP-2 was completed as part of the ongoing remedial investigation (RI) activities for the Elizabeth Mine site. Field investigations included excavating test trenches, drilling test bore holes, and performing CPT soundings to characterize the insitu properties and collect samples of the subsurface tailing. Geotechnical laboratory testing was performed on selected samples to estimate the engineering properties of the tailing and to verify soil descriptions logged during field observations.

Using the field and laboratory data collected above, analyses were performed to evaluate the stability of TP-1 for steady-state seepage conditions. In addition, a PSHA, liquefaction analysis, and post-earthquake stability analysis were completed to evaluate the seismic stability of TP-1. The results were compared to current state-of-the-practice values for closure of tailing dams.

Dam breach and runout analyses were performed for TP-1 to evaluate the downstream impacts from a modeled failure. The analyses conducted considered a range of dam breach scenarios and parametric analyses, varying selected modeling parameters, were completed to evaluate the sensitivity of the downstream inundation results.

Conclusions and recommendations were developed based on the results of the analyses above and on URS past experience with mine reclamation and closure of tailing dams. Key finds of this report include:

- Internal dam erosion (piping) is occurring at critical areas of the dam. The rate of piping is intermittent with sporadic periods of tailing discharge. Tailing discharges appear to be increasing.
- Tailing dam TP-1 is marginally stable and the results show that the dam does not meet the accepted state-of-the-practice for safe tailing dam operation.
- The decant structure shows sign of structural deterioration from sulfate and acid attack, and the flow capacity is reduced by approximately one-half due to iron precipitates. The inlet is prone to plugging with debris.
- Three viable dam failure scenarios were identified that include:
  - Internal dam erosion (piping) resulting from on-going dam drainage, increase in surface water infiltration resulting from ponded water, or changes in pore pressure conditions.
  - Slope failure caused by an increase in pore water pressures and the resultant rise in phreatic surface or internal dam erosion (piping) and collapse of the resultant internal void.
  - Overtopping the result of a reduction in the decant pipeline flow capacity from a debris plug, pipe collapse, or an extreme storm event.

Presented below is a summary of conclusions followed by recommendations for further actions.

9.1 CONCLUSIONS

The conclusions presented below are based on the analyses completed for this report. Conclusions are presented separately for tailing dam TP-1, tailing dam TP-2, the tailing dam TP-1 decant structure, and the dam breach and runout analysis.

Tailing Dam TP-1

An October 2002 inspection of tailing dam TP-1 indicated that active piping is occurring. The majority of the piping is observed at the downstream starter dam toe at about elevation 945 and at the starter dam crest near elevation 970. Based on these observations, it appears that seepage is passing over the starter dam crest and exiting through the starter dam foundation. Although field samples could not be collected at the time of the investigations, it appears that the starter dam consists of relatively low permeability materials. A third smaller area of piping was observed near the middle of the north slope toe, approximately 270 feet east of the starter dam right abutment contact, near elevation 990.

Piping at the site is occurring and currently is observed to be intermittent. A small volume estimated to be several cubic feet of material has discharged to date. Piping may resume or increase with changes in embankment pore pressures and in response to changes in the phreatic surface or other minor perturbations.

Laboratory test results show that the tailing dam shell consists of poorly graded sands and sandy silts. The materials appear to be relatively loose in some areas. Laboratory test results also show that the sand shell has a relatively high drained shear strength and a relatively low fines content.

The results of CPT testing correlated with laboratory test results show that the effective friction angle (ϕ') can range from approximately 35 degrees to as high as 41 degrees, depending on location and depth. A ϕ' of 37 degrees represents an average value and was selected for the slope stability analyses. A low shear strength layer was also noted just upstream of the starter dam in CS-2 within the saturated portion of the tailing shell. This layer is outside of the critical failure surface assumed in the slope stability analysis described below.

A PSHA was completed for the site. The result shows that an earthquake with a 1,000-year return period may result in a PGA at the tailing dam base of 0.14 g. For a return period of 2,500 years, a PGA of 0.24 g was estimated, and for a return period of 5,000 years, a PGA of 0.3 g was estimated.

Tailing dam TP-1 has very steep downstream slope ranging from 1.38:1 to 1.5:1 (horizontal:vertical). The majority of the slopes are close to the steeper 1.38 to 1.0. Four study sections were analyzed, and the calculated FOS for steady-state seepage conditions were less than 1.5 for all of the sections evaluated. The current state of practice for safety of tailing dams considers an FOS of 1.5 and above to represent stable conditions. The most critical slope had a calculated FOS of approximately 1.25.

The calculated FOS is dependent on the elevation of the phreatic surface within the shell and the tailing shear strength. The laboratory results as discussed above show that the shear strength can vary by several degrees. Limited piezometric elevation records show that the phreatic surface can vary seasonally by as much as 3 feet. It is believed that fluctuations could be higher because the observations were made during a below-normal precipitation period. These fluctuations and the variability of the tailing shear strength suggest that the calculated steady-state FOS could be less than 1.25. In general, the tailing slopes do not meet the acceptable guidelines for short-term or long-term stability based on current engineering practices.

Liquefaction analyses suggest that the tailing will not liquefy during a 2,500-year return period seismic event. A post-earthquake stability analysis shows that critical slopes may have an FOS

of less than 1.0. This suggests that large deformations in the embankment slopes resulting from seismic loading could occur and should be addressed in the final closure design.

Laboratory test results show that the tailing material contained in the sand shell has a relatively high permeability with permeabilities as high as $6x10^{-3}$ cm/sec measured. The results also show that the tailing contained in the decant area has a lower permeability of approximately $1x10^{-5}$ cm/sec.

Collapse settlement upon wetting was observed in some samples during consolidation testing. These results suggest that the tailing has a meta-stable structure. Collapse settlements were limited to approximately 0.5 to 2 percent.

Tailing Dam TP-2

Tailing dam TP-2 is composed of tailing material with similar index properties to TP-1, but with differing shear strength properties. Few undisturbed samples were successfully collected from TP-2 in the field because of recovery difficulties. Samples collected experienced disturbance during transport and laboratory sample preparation. As a result, the quantity of material available for testing was limited.

The results do show that the material has a relatively low dry unit weight and is also prone to collapse settlements upon wetting. Limited shear strength test results suggest that the material has a lower shear strength than the material contained in TP-1. It may be necessary to collect further samples in order to complete the final closure design.

TP-1 Decant Structure

The decant structure located in tailing dam TP-1 is in generally poor condition. The structure was constructed in the 1940s and 1950s, and was likely not designed with consideration for long-term sulfate or acid exposure. The structure has not been maintained over the last 50 years, and signs of continued deterioration and restriction in the flow capacity were observed during a remote camera inspection.

The exterior of the decant structure shows that the exposed concrete is being subjected to sulfate and acid attack as evidenced by spalling of the cement paste at the exposed concrete surface. The wire reinforcement is exposed in some areas and completely corroded in others. A portion of the pipe inlet into Decant Tower 2 has collapsed, and this inlet is prone to debris plugging.

An inspection of the decant structure interior shows, signs of both recent and historic cracking within the pipe. Recent cracks were denoted by a fresh, white texture, and historic cracks were denoted by a red precipitate that had formed around the cracks, likely as the result of corroding wire reinforcement. Cracks are both longitudinal along the crown of the pipe and extend around the circumference of the pipe, suggesting both buckling and differential movement.

Flow within the decant pipe is restricted at the inlet and within the pipe because of precipitants and debris consisting of tree branches and timbers. Some of this debris was cleared during the decant inspection, but will likely reoccur without intervention. The downstream end of the decant structure is partially plugged with a firm, dense iron precipitant, and the pipe cross section is restricted by about one-half in this section.

Dam Breach and Runout

A dam breach and runout analysis shows that in the event of a tailing release from TP-1, occurring in conjunction with a pool in the decant pond, a potential floodwave ranging in height from approximately 7 feet to more than 10 feet traveling at a velocity between 7 ft/sec and more than 13 ft/sec could occur. A combination of tailing and impounded water would be released and would likely flow to the Connecticut River. Union Village Dam will attenuate flows in the channel downstream of that dam. An estimated 500,000 to 1 million cubic yards of tailing could potentially be released during a tailing dam failure at TP-1.

In the event of a tailing-only failure (i.e., a condition in which there is no water ponded on the dam), a tailing flow could result with characteristics similar to a debris flow or mudflow. The flow depth could be more than 20 feet high, and the flow mass could travel distances ranging from 5,000 to 10,000 feet downstream, depending on the material properties.

After the occurrence of either of these events, additional erosion of the tailing material would carry tailing into the Connecticut River.

9.2 RECOMMENDATIONS

Based on the results and conclusions presented in this report, URS recommends actions be implemented to stabilize three site conditions. These site conditions include the ongoing piping, marginal stability at the downstream slope of TP-1, and the deterioration of the decant structure.

Piping

Several measures are recommended to address the observed piping at the TP-1 starter dam toe. Piping should be temporarily controlled by the installation of a filter and drain blanket in the near future. The blanket should be designed to prevent movement of tailing particles, while allowing for drainage. Until the filter and drain blanket is in place, frequent monitoring of piping and frequent measurements of the piezometric elevations within TP-1 should be performed. Once the piping is controlled, horizontal drains should be installed in the vicinity of the starter dam at the lowest point of the dam to dewater the tailing shell and reduce the hydraulic head on the starter dam. The installation of horizontal drains should be completed this summer (2003). The permanent closure of TP-1 should include design details to address potential piping.

Stabilizing Downstream Slope

The downstream slopes of TP-1 and TP-2 should be buttressed with permanent stabilizing earth fills. The buttresses should be designed to stabilize the existing slopes, reduce surface erosion, and provide additional passive resistance. The designs should include a sand filter and drain system to prevent piping. The buttresses should be sized and sloped such that the steady-state FOS is greater than 1.5 and the structure has acceptable seismic resistance. An earthquake with a 2,500-year return period is recommended for the final design analysis, based on USACE and state of Vermont requirements.

Design of a final buttress should be implemented as soon as funding can be made available with construction initiated within the year following the design. The longer the downstream slopes are not properly closed, the greater the risk that the situation will continue to deteriorate.

Deterioration of Decant Structure

The existing decant system should be replaced by rerouting surface water runon away from tailing dam TP-1 and then abandoning the existing system. The existing decant structure should be replaced when field conditions allow placement of an open diversion channel or buried temporary diversion pipe(s) located on the right dam abutment. The conveyance should be of suitable size and have a greater capacity than the existing decant system. Once the conveyance is in place, the existing decant structure should be sealed with a grout plug. Permanent site closure should include construction of a large channel, designed to divert surface runon around TP-1 and TP-2. The diversion channel should be designed with sufficient capacity to carry a large frequency storm event.

As an interim measure until the decant system can be abandoned this summer, observations of the decant system should be performed frequently to monitor flow rates and potential discharge of tailing in the outflow. A temporary trash rack should also be installed around the decant inlet to prevent debris from entering the decant structure or plugging the intake. Additionally, temporary pumps should be installed to collect and convey water from the decant pond until a new, permanent conveyance system can be constructed. The temporary pumps would assist in draining the decant pond during high flow periods in the event the decant system cannot sufficiently drain upstream runon to TP-1.

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Appendix A
Probabilistic Seismic Hazard Analysis

TABLE OF CONTENTS

Appendix A Seismic Hazard Evaluation 1

A.1 Seismic Hazard Analysis Methodology 1
A.1.1 Seismic Source Characterization 2
A.1.2 Attenuation Relationships 4
A.2 Seismotectonic Setting and Historical Seismicity 4
A.2.1 Geologic and Seismotectonic Setting 4
A.2.2 Historical Seismicity 6
A.3 Input to Analysis 9
A.3.1 Seismic Sources 9
A.3.2 Gaussian Smoothing 16
A.3.3 Ground Motion Attenuation 17
A.4 Probabilistic Seismic Hazard Analysis 17
A.5 Site Response Analysis 18
A.5.1 Time Histories 19
A.5.2 Sensitivity Analysis 19
A.6 References 20

Tables

Table A-1 Geologic Time Scale

Table A-2 Abridged Modified Mercali Intensity Scale

Table A-3 Northeastern North America Seismic Source Zones

Table A-4 Mean Probabilistic PGAs on Rock

Table A-5 Controlling Earthquakes

Table A-6 Site Shear-Wave Velocity Profile

Table A-7 Mean Probabilistic PGAs on Soil and Amplification Ratios

Table A-8 Summary of PGAs and Amplification Factors from Sensitivity Analysis

Figures

Figure A-1 Historical Seismicity of the Site Region (1700-2003)

Figure A-2 Seismic Hazard Model Logic Tree

Figure A-3 Isoseismal Map for the New York City Earthquake of 10 August 1884

Figure A-4 Isoseismal Map for the Attica Earthquake of 12 August 1929

Figure A-5 Isoseismal Map for the New Hampshire Earthquake of 20 December 1940

Figure A-6 Isoseismal Map for the Massena Earthquake of 5 September 1944

TABLE OF CONTENTS

Figure A-7 Isoseismal Map for the Blue Mountain Lake Earthquake of 7 October 1983

Figure A-8 Seismic Sources Included in the Hazard Analysis

Figure A-9 Seismic Hazard Curves for Peak Horizontal Acceleration

Figure A-10 Seismic Source Contributions to Mean Peak Horizontal Acceleration Hazard

Figure A-11 Magnitude and Distance Contributions to the Mean Peak Acceleration Hazard at 500 Year Return Period

Figure A-12 Magnitude and Distance Contributions to the Mean Peak Acceleration Hazard at 1000 Year Return Period

Figure A-13 Magnitude and Distance Contributions to the Mean Peak Acceleration Hazard at 2500 Year Return Period

Figure A-14 Magnitude and Distance Contributions to the Mean Peak Acceleration Hazard at 5000 Year Return Period

Figure A-15 Uniform Hazard Spectra

Figure A-16 Spectral Match with Uniform Hazard Spectra

Figure A-17 Spectrally – Matched and Surface Time Histories for Return Period of 500 Years

Figure A-18 Spectrally – Matched and Surface Time Histories for Return Period of 1000 Years

Figure A-19 Spectrally – Matched and Surface Time Histories for Return Period of 2500 Years

Figure A-20 Spectrally – Matched and Surface Time Histories for Return Period of 5000 Years

This section presents the results of probabilistic seismic hazard and site response analyses of the Elizabeth Mine site. The objective of this study is to estimate the levels of ground motions that could be exceeded at specified annual frequencies (or return periods) at the site for the purposes of evaluating the potential for liquefaction. The evaluation is based upon available geologic and seismologic data; no field investigations were carried out as part of this study.

Elizabeth Mine site is located in east-central Vermont, near the New Hampshire border (Figure A-1). Although the eastern margin of the U.S. is currently a passive margin, the region has a complex tectonic history including several major orogenies. There has been significant historical seismicity in the region (Figure A-1) though there is a marked absence of mapped Quaternary faults and almost all known earthquakes cannot be associated with a specific geologic structure.

In this evaluation, geologic and seismologic data were used to evaluate and characterize potential seismic source zones, the likelihood of earthquakes of various magnitudes occurring within those sources, and the likelihood of the earthquakes producing ground motions over a specified level. The probabilistic seismic hazard analysis methodology used in this study allows for the explicit inclusion of the range of possible interpretations in components of the seismic hazard model, including seismic source characterization and ground motion estimation. Uncertainties in models and parameters are incorporated into the hazard analysis through the use of logic trees (Figure A-2). This section describes the seismotectonic setting and the historical seismicity of the site region in an effort to quantify the seismic hazard at the Elizabeth Mine site. The following also presents the seismic source characterization, the attenuation relationships used in the probabilistic analysis, and the hazard calculations. We conclude with a discussion of the estimated earthquake ground motions at the site based on a site response analysis, which incorporates the effects of the site subsurface geology.

A.1 SEISMIC HAZARD ANALYSIS METHODOLOGY

The seismic hazard approach used in this study is based on the model developed principally by Cornell (1968). The occurrence of earthquakes on a fault is assumed to be a Poisson process. The Poisson model is widely used and is a reasonable assumption in regions where data are sufficient to provide only an estimate of average recurrence rate (Cornell, 1968). When there are sufficient data to permit a real-time estimate of the occurrence of earthquakes, the probability of exceeding a given value can be modeled as an equivalent Poisson process in which a variable average recurrence rate is assumed. The occurrence of ground motions at the site in excess of a specified level is also a Poisson process, if (1) the occurrence of earthquakes is a Poisson process, and (2) the probability that any one event will result in ground motions at the site in excess of a specified level is independent of the occurrence of other events.

The probability that a ground motion parameter "Z" exceeds a specified value "z" in a time period "t" is given by:

$$p(Z > z) = 1\text{-}e^{-\nu(z)\cdot t} \qquad (1)$$

where $\nu(z)$ is the annual mean number (or rate) of events in which Z exceeds z. It should be noted that the assumption of a Poisson process for the number of events is not critical. This is because the mean number of events in time t, $\nu(z)\cdot t$, can be shown to be a close upper bound on the probability $p(Z > z)$ for small probabilities (less than 0.10) that generally are of interest for

engineering applications. The annual mean number of events is obtained by summing the contributions from all sources, that is:

$$\nu(z) = \sum_{n} \nu_n(z) \quad (2)$$

where $\nu_n(z)$ is the annual mean number (or rate) of events on source n for which Z exceeds z at the site. The parameter $\nu_n(z)$ is given by the expression:

$$\nu_n(z) = \sum_{i}\sum_{j} ß_n(m_i) \cdot p(R=r_j|m_i) \cdot p(Z>z|m_i,r_j) \quad (3)$$

where:

$ß_n(m_i)$ = annual mean rate of recurrence of earthquakes of magnitude increment m_i on source n;

$p(R=r_j|m_i)$ = probability that given the occurrence of an earthquake of magnitude m_i on source n, r_j is the closest distance increment from the rupture surface to the site;

$p(Z > z|m_i,r_j)$ = probability that given an earthquake of magnitude m_i at a distance of r_j, the ground motion exceeds the specified level z.

The calculations were made using the computer program HAZ20 developed by N. Abrahamson.

A.1.1 Seismic Source Characterization

Two types of earthquake sources are characterized in this seismic hazard analysis: (1) fault sources; and (2) arial source zones (Section 3.3.1). Fault sources are modeled as three-dimensional fault surfaces and details of their behavior are incorporated into the source characterization. Arial source zones are regions where earthquakes are assumed to occur randomly with no clear association with any of the faults that might be included in the seismic source model. In this analysis, all seismic sources were modeled as arial source zones with the exception of the fault source for the 1886 Charleston, South Carolina, earthquake (Section 3.3.1). All seismic sources are modeled in the hazard analysis in terms of geometry and earthquake recurrence.

In addition to the traditional approach of using arial source zones (assuming uniformly distributed seismicity), Gaussian smoothing was used. In this approach, we smoothed the historical background seismicity to incorporate a degree of stationarity, using a spatial window of 25 km. The version of Gaussian smoothing adopted in this study (Frankel, 1995) is the same approach used in the national hazard maps (Frankel *et al.*, 1996).

The basic geometric source parameters for faults include fault location, dip, and thickness of the seismogenic zone. The recurrence parameters include recurrence model, recurrence rate (slip rate or average recurrence interval for the maximum event), slope of the recurrence curve (*b*-value), and maximum magnitude. For arial source zones, only the areas, seismogenic depth, maximum magnitude, and recurrence parameters (based on the historical earthquake record) need to be defined.

Uncertainties in the source parameters are included in the hazard model using logic trees (Figure A-2). In the logic tree approach, discrete values of the source input parameters have been included along with our estimate of the likelihood that the discrete value represents the actual value. In this probabilistic analysis, generally all input parameters have been represented by three values; the values represent a distribution about our best estimate (Figure A-2).

A.1.1.1 Source Geometry

In the probabilistic analysis, it is assumed that earthquakes of a certain magnitude may occur randomly along the length of a given fault. The distance from an earthquake to the site is dependent on the source geometry, the size and shape of the rupture on the fault plane, and the likelihood of the earthquake occurring at different points along the fault length. The distance to the fault is defined to be consistent with the specific attenuation relationship used to calculate the ground motions. The distance, therefore, is dependent on both the dip and depth of the fault plane, and a separate distance function is calculated for each geometry and each attenuation relationship. The size and shape of the rupture on the fault plane are dependent on the magnitude of the earthquake, with larger events rupturing longer and wider portions of the fault plane. We modeled the rupture dimensions following the magnitude-rupture length relationship of Wells and Coppersmith (1994).

Arial source zones are modeled as a volume of uniformly distributed point sources with a spacing of 2 km. The source zone extends from the surface to a depth of 20 km.

A.1.1.2 Recurrence

We have used the general approach of Molnar (1979) and Anderson (1979) to arrive at the recurrence for the exponentially truncated model, which was used to characterize the frequency of earthquake as a function of magnitude for the arial source zones. The number of events exceeding a given magnitude, *N(m)*, for the truncated exponential relationship is

$$N(m) = \alpha(m^o)\frac{10^{-b(m-m^o)} - 10^{-b(m^u-m^o)}}{1-10^{-b(m^u-m^o)}} \qquad (4)$$

where $\alpha(m^o)$ is the annual frequency of occurrence of earthquakes greater than the minimum magnitude, m^o; b is the Gutenberg-Richter parameter defining the slope of the recurrence curve; and m^u is the upper-bound magnitude event that can occur on the source. A m^o of moment magnitude (**M**) 5 was used for the hazard calculations because smaller events are not considered likely to produce ground motions with sufficient energy to damage well-designed structures.

For the Charleston Seismic Zone, we used only the maximum magnitude recurrence model. This model can be regarded as an extreme version of the characteristic model (Schwartz and Coppersmith, 1984). We adopted the model proposed by Wesnousky (1986). In the maximum magnitude model, there is no exponential portion of the recurrence curve, i.e., no events can occur between the minimum magnitude of **M** 5.0 and the distribution about the maximum magnitude.

A.1.2 Attenuation Relationships

The traditional approach in estimating ground motions in seismic hazard analysis utilizes empirical attenuation relationships, which are derived from strong motion data. Attenuation is defined as the decrease in amplitude or intensity of seismic waves with distance. This decrease results from a number of factors including geometrical spreading, damping or absorption by the earth, scattering, reflection, refraction, diffraction, and wave conversion.

Empirical attenuation relations have been developed in regions where there are numerous strong ground motion recordings by applying statistical regression methods to these data. Because the data correspond to geologic conditions and earthquakes typical of the region, they are generally applicable only in that region. However, they may also be used in another area with similar seismotectonic characteristics.

Crustal attenuation relationships for the western U.S. are derived for the most part from California strong motion records. In contrast, few useable strong motion records exist for earthquakes in the central and eastern U.S. (CEUS). Thus attenuation relationships for the eastern U.S. (or eastern North America) have been developed, in large part, using seismological-based numerical models. During the past decade, ground motion attenuation relationships for the CEUS have been derived using three different approaches: the stochastic method, the Green's function method, and the hybrid method. In addition, expert opinion has been used to derive ground motion estimates based on these ground motion methods.

The relationships used in this study were selected on the basis of the appropriateness of the site conditions and tectonic environment for which they were developed (Figure A-2 and Section 3.3.3). The uncertainty in ground motion attenuation was included in the probabilistic analysis by using the log-normal distribution about the median values as defined by the standard error associated with each attenuation relationship. Three standard deviations about the median value were included in the analysis.

A.2 SEISMOTECTONIC SETTING AND HISTORICAL SEISMICITY

A.2.1 Geologic and Seismotectonic Setting

The Elizabeth Mine site is located within the northern Appalachian Mountain belt (see Figure A-1). The Appalachian Mountains consist of an eroded core of a Paleozoic mountain chain that extends at least 3,000 kilometers (km) from the southeastern U.S. to Newfoundland (see Table A-1 for geologic time scale). The structural history of this portion of the U.S. is reflected in the major tectonic stages of the Appalachian orogenic belt. Major tectonic events include: late Precambrian-early Paleozoic rifting to form the Iapetan Sea (proto-Atlantic Ocean); middle to late Paleozoic closure of the Iapetan ocean basin accompanied by westward subduction of Iapetan crust and multiple arc-continent and continent-continent collisional episodes; and Mesozoic rifting to form the present Atlantic Ocean.

The oldest rocks in eastern North America belong to the Precambrian Grenville Province, older basement metasediments that were extensively intruded during the emplacement of large volumes of plutonic rock during the Grenville Orogeny. This ancient mountain-building event was initiated when the oceanic plate was entirely consumed in a west-dipping subduction zone

under the east coast of present-day North America, resulting in a continent-continent collision (Bartholomew, 1984). This collision created the Grenville supercontinent. During the late Precambrian, the Grenville supercontinent was subsequently rifted along the original suture zone; this rifting event gave rise to the Iapetus Ocean (proto-Atlantic Ocean) (Rankin, 1976).

The Ordovician was marked by a transition from extension to compression, as a subduction zone re-established, closing the Iapetus Ocean and transporting a series of island arcs westward, towards the proto-North American continent (Read, 1989). The Ordovician Taconian orogeny was caused by the collision of one of these arcs with the continent. The west-verging compression caused extensive folding and faulting. During the Taconian orogeny, a series of east-dipping thrust faults placed metamorphosed pelitic and carbonate rocks from the continental margin directly on top of Grenvillian basement rocks (Drake *et al.*, 1989). In the Devonian, a microcontinent called Avalon collided with the eastern edge of proto-North America, triggering the Acadian orogeny. Deformation and metamorphism associated with the Acadian Orogeny was extensive and overprinted structural and metamorphic fabrics that developed during the Taconian orogeny (Osberg *et al.*, 1989).

During the late Paleozoic, the Iapetus Ocean finally closed when the African continent collided with the North American continent during the Alleghanian orogeny. The supercontinent Pangea resulted from this collision, which was the last orogeny recorded in eastern North America (Hatcher *et al.*, 1989). The Alleghanian orogeny caused the formation of the Appalachian Mountains; today the eroded remnants of this northeast-trending range still dominate the topography of eastern North America, from Newfoundland to Alabama (Taylor, 1989).

Rifting during the Triassic and Jurassic caused the break-up of Pangea, and the development of the Atlantic Ocean. Evidence of this extensional event can be seen in a broad band of rift basins along the coast of the eastern U.S., many of these basins are filled with thick sediment packages (LeToumeau and Olson, 2003).

The current tectonic setting of eastern North America on a passive margin, several thousand kilometers from any active plate boundary, makes it difficult to explain the seismic activity in the region in terms of a simple plate-tectonic model (Ebel and Kafka 1991). In fact, the last major tectonic activity in the eastern U.S. took place during the Mesozoic. The occurrence of seismicity in the absence of significant tectonic activity in this region is further complicated by a dearth of individual structures that can be mapped at the surface. The regional seismicity generally does not delineate any clear active structural boundaries to serve as a guide in mapping active faults that may be correlated with seismic activity (with a few local exceptions) (Ebel and Kafka, 1991).

The most widely accepted interpretation of the cause of seismicity in the northeastern U.S. is that earthquakes result from the reactivation of ancient structures in the present-day stress field (Ebel and Kafka, 1991). The central and eastern United States are part of a broad mid-plate compressive stress province that includes most of Canada (Zoback and Zoback, 1991). Based on a compilation of focal mechanism data, Ebel and Kafka (1991) report that the current stress field over this large region is in a relatively uniform east-northeast direction of maximum horizontal compression. This direction of maximum horizontal compression corresponds well to the direction of absolute plate motion of the North American Plate. This suggests that a far-field tectonic source such as ridge-push or basal drag at the Mid-Atlantic Ridge may be the primary source of stress in the mid-plate region (Zoback and Zoback, 1991). Most of the ancient

structures and zones of weakness in the eastern U.S. trend approximately north-northeast, largely resulting from east-west directed continental collision and rifting events.

A.2.2 Historical Seismicity

The Elizabeth Mine site is located in the northeastern U.S., a region that includes New York, Vermont, New Hampshire, Maine, Massachusetts, Connecticut and Rhode Island (Figure A-1). Significant historical earthquakes have occurred in New England. The northeastern U.S. has also been strongly affected by large earthquakes originating in adjacent southeastern Canada, particularly from the St. Lawrence River region. Ebel and Kafka (1991) note that seismicity tends to reoccur in certain places; they suggest that this may indicate preferential reactivation of older structures within the present stress field in these locations.

Significant earthquakes within the study region include the 1755 body-wave magnitude (m_b) 5.8 earthquake east of Cape Ann, Massachusetts, with a reported Modified Mercalli (MM) intensity of VIII (Table A-2); the 1929 m_b 5.2 earthquake near Attica, New York, with a reported MM VIII; the 1929 **M** 7.2 Grand Banks earthquake; the 1940 m_b 5.5 earthquakes near Ossipee Lake, New Hampshire; the 1944 m_b 5.8 earthquake near Massena, New York; and the 1983 m_b 5.2 earthquake near Blue Mountain Lake, New York (Figure A-1).

1638 and 1663 Trois-Rivieres, Quebec

Devastating earthquakes in the St. Lawrence Valley region, near Trois-Rivieres, Quebec, Canada, on 11 June 1638 and 5 February 1663 were reported felt throughout New England.

1727 Newbury, Massachusetts

On 9 November 1727, Newbury, Massachusetts, was strongly shaken by a m_b 5.1 earthquake described as "tremendous" in one report and "violent" in another (von Hake, 1973b). This Newbury earthquake was felt from the Keenebec River to the Delaware River and from ships at sea to the extreme western settlements. Several strong aftershocks were reported from the area through February 1728.

1732 Montreal

Another significant earthquake in western Quebec, a Richter local magnitude (M_L) 5.8 earthquake originated near Montreal on 16 September 1732. This earthquake caused extensive damage to approximately 300 homes and may have caused one fatality (Leblanc, 1981).

1755 Cape Ann, Massachusetts

On 18 November 1755, a m_b 5.8 earthquake occurred east of Cape Ann, Massachusetts. This event was one of the most significant earthquakes in the northeastern region of the U.S., and affected a large area (about 777,000 km^2). In Boston, walls and chimneys were thrown down and stone fences were knocked down (MM VIII). This earthquake was felt from Lake George, New York, to a point at sea 320 km east of Cape Ann, and from Providence, Rhode Island, to Kennebunk, Maine. Reports of a seismic sea wave reaching the West Indies following the earthquake appear to be erroneous (von Hake, 1973b). A tsunami had occurred in the West Indies on November 1755, following the great Lisbon earthquake, which apparently led to a report of its association with the Cape Ann earthquake.

1867 St. Lawrence Valley

18 December 1867, a MM V earthquake awakened people in Burlington, Vermont, Odgensburg and Syracuse, New York, and Hamilton, Ontario, Canada. The tremor was also reported felt as far as east as Sackville, New Brunswick, Canada. Previously listed as centered in Vermont, this earthquake may have had its origin in the St. Lawrence Valley region (von Hake, 1973c).

1884 New York City

On 10 August 1884, a m_b 5.2, MM VII earthquake near New York City was felt from southern Maine to central Virginia and west as far as Cleveland, Ohio (Figure A-3). Three shocks, the second of which was the most violent, caused moderate damage in Connecticut, Pennsylvania, New York and New Jersey (Stover and Coffman, 1993).

1925 St. Lawrence River Region

The St. Lawrence River region has a high rate of seismicity and some of the deepest earthquakes in northeastern North America have occurred in this region (Ebel and Kafka, 1991). On 28 February 1925 a strong earthquake, M_L 6.7, in the St. Lawrence River region produced an extensive felt area. The total affected area of 5,180,000 km^2, including eastern Canada, all of the northeastern United States, points south to Virginia and west to the Mississippi River, makes the shock among the most widely felt earthquakes in North America. Severe damage from this earthquake was reported along both shores of the St. Lawrence in the vicinity of the epicenter, in Quebec City, and in the Trois-Rivieres-Shawingan Falls regions (Lamontagne and Bruneau, 1993).

1929 Attica, NY

Extensive damage occurred in the Attica, New York area from a m_b 5.2, MM VIII earthquake on 12 August 1929. This earthquake was felt throughout most of New York and the New England states, northeastern Ohio, northern Pennsylvania, and southern Ontario, Canada; a total area of about 250,000 km^2 (Figure A-4). Strong aftershocks were felt at Attica on December 2 and 3.

1929 Grand Banks

Several significant earthquakes have occurred in the Laurentian Slope seismic zone, off the southeastern continental margin of Canada. These events are generally associated with thrust faulting along reactivated Mesozoic rift faults that were formed during the opening of the Atlantic (Adams and Basham, 1991). The famous 18 November 1929 **M** 7.2 earthquake in the vicinity of the Grand Banks of Newfoundland ranks among these events. This submarine earthquake occurred about 400 km from shore and was felt throughout the New England States. The Grand Banks event triggered a submarine slump that caused the fracture of 12 trans-Atlantic cables and generated a tsunami that caused considerable damage and 27 deaths on the south coast of Newfoundland (Adams and Basham, 1991). Small seawaves were recorded along the east coast of the U.S. as far south as Charleston, South Carolina. The area of maximum intensity in the U.S. was the southeastern half of Maine. The total area affected in the U.S. was approximately 207,000 km^2.

1935 Lake Timiskaming

On 1 November 1935, a M (unknown magnitude scale) 6.2 event with a reported MM VII near Lake Timiskaming in western Quebec affected an estimated 2,500,000 km^2 of Canada and the United States. The shock from this event was felt as far south as Washington, D.C., and as far west as Wisconsin (von Hake, 1975b). Damage from this earthquake included damage to chimneys and minor rock falls in the epicentral region (Lamontagne and Bruneau, 1993).

1940 Lake Ossipee, New Hampshire

Near Lake Ossipee, New Hampshire, on 20 and 24 December 1940 two earthquakes caused damage over a broad area (Figure A-5). Since the shocks were both of approximately the same magnitude (m_b 5.5), the damage and felt reports were combined. Damage resulting from the second tremor was greater because of the weakening effects of the earlier shock. The earthquakes were felt as far as 550 km from the epicentral area and affected a total land area in the U.S. of approximately 390,000 km^2. This included Connecticut, Maine, Massachusetts, New Hampshire, Rhode Island, and Vermont and also parts of New Jersey, New York, and Pennsylvania. A large number of aftershocks were reported in the epicentral area through 31 January 1941.

1944 Massena, New York

On 4 September 1944, the largest earthquake in New York, a m_b 5.8, was centered about midway between Massena, New York, and Cornwall, Ontario, Canada, and caused an estimated $2,000,000 combined damage in the two cities. The shock destroyed or damaged about 90 percent of the chimneys in Massena (MM VIII), with similar effects at Cornwall. This earthquake was felt over approximately 450,000 km^2 in the U.S., including all the New England states, Delaware, Maryland, New Jersey, Pennsylvania, and portions of Michigan and Ohio (Figure A-6). A few points in Illinois, Indiana, Virginia, West Virginia, and Wisconsin also reported feeling the tremor.

1962 Southern Quebec Province

On 20 June 1962, a large portion of Vermont experienced MM V effects from a shock in southern Quebec Province, Canada.

1983 Blue Mountain Lake, New York

On 7 October 1983, a m_b 5.2 earthquake near Blue Mountain Lake, New York with a reported MM VI caused minor damage and several landslides. This earthquake was felt over 12 states and in two Canadian Provinces (Figure A-7).

2002 Au Sable Forks, New York

On 20 April 2002, a **M** 5 earthquake in the northeastern Adirondacks near the town of Au Sable Forks, New York caused moderate damage in the epicentral region (Kim *et al.*, 2002). The earthquake was recorded by broadband seismographic stations up to 2,000 km away from the epicenter.

A.2.2.1 Local Seismicity and Historical Effects at Site

We estimate that the Elizabeth Mine site may have been subject to high intensity ground shaking (MM V) during the 1940 earthquakes near Ossipee Lake New Hampshire, and the 1983 earthquake near Blue Mountain Lake, New York. There have been 6 earthquakes within 50 km of the site in the historical record (Figure A-1). The nearest event was a m_b 3.3 that occurred on 20 December 1800, 12 km southeast of the site. The largest event within 50 km was a m_b 3.6 that occurred on 11 April 1934, 35 km west-northwest of the site.

A.3 INPUT TO ANALYSIS

The following section discusses the characterization of the seismic sources considered in the probabilistic seismic hazard analyses and the attenuation relationships selected and used.

A.3.1 Seismic Sources

Seismic source characterization is concerned with three fundamental elements: (1) the identification and characterization of significant sources of future earthquakes; (2) the maximum size of these earthquakes; and (3) the rate at which different size earthquakes occur. Fifteen arial source zones that represent earthquakes probably associated with buried and generally unknown faults (background) were characterized and used in the probabilistic analysis.

In order to characterize the seismic parameters for each seismic source, we relied on the available published and unpublished data for the region. In addition to published regional-scale geologic and fault maps and other publications, we reviewed relevant parts of several unpublished seismic hazard reports for sites in the region (e.g., Geomatrix Consultants, 1996; 1997) and also recent seismic hazard reports by the Canadian Geological Survey (Adams and Halchuk, 2003).

The major challenge in understanding the earthquake potential in the CEUS has been the attempt to associate the observed seismicity with specific geologic structures. Few active faults are known east of the Rockies. Thus the traditional approach in addressing the seismic hazard in the CEUS has relied on the historical earthquake record and the use of seismic source zones which separate regions of different seismotectonic characteristics and hence possibly different earthquake potential. In this analysis of the site, we have characterized 15 seismic source zones and one fault to be included in the probabilistic analysis (Figure A-8). Each seismic source zone was defined and characterized according to geologic, tectonic, and seismicity data. The zones represent regions having a common geologic history that distinguishes them from neighboring areas. They may have a similar structure (e.g., faults or fractures of similar age, type, orientation), a similar pattern of seismicity, and/or a homogeneous stress regime. Figure A-8 shows the location of each seismic source zone relative to Elizabeth Mine site and Table A-3 summarizes the source zone parameters used in the analysis. The seismogenic crust was assumed to be 20 km thick in the site region based on an analysis of historical seismicity (e.g., Ebel and Kafka, 1991). In almost all cases, the recurrence parameters and maximum magnitudes were adopted from Adams and Halchuk (2003) (Table A-3).

The estimates of the recurrence parameters *b*-values and rates of $m_b \geq 5.0$ per 10^6 km^2 calculated by Adams and Halchuk (2003) used the maximum likelihood technique of Weichert (1980). The

upper and lower bound values (Table A-3) generally correspond to plus and minus one standard error estimated from the recurrence calculations. In some cases, a regional value for *b* was adopted rather than calculated because of an inadequate seismicity database (Adams and Halchuk, 2003).

We have not included any faults or fault zones as potential seismic sources except for the Charleston Seismic Zone. With the exception of the 1989 **M** 6.1 Ungava, Quebec, earthquake, no historical examples of surface faulting have been reported in eastern North America (Adams *et al.*, 1991). The following section describes the potential seismic sources that may contribute to the hazard at the site and that were characterized in the probabilistic analysis.

A.3.1.1 Northern Adirondacks (ADR)

The Northern Adirondack zone (ADR) is an elevated region of non-extended Precambrian crust, comprising predominantly crystaline metamorphic rocks. The ADR is interpreted to be the eroded core of an uplifted dome on the margin of the North American craton (Weiner *et al.*, 1984). This is one of the most seismically-active regions of non-extended crust in eastern North America. Seismicity is concentrated in the northern part of the dome and appears to be relatively diffuse, although some east-west alignments of epicenters have been inferred and attributed to Precambrian (Grenville) structural trends (Armbruster and Seeber, 1987). The largest historic earthquake in this zone was the 1983 m_b 5.1 Goodnow event. The focal mechanism for this event indicated reverse faulting on a north- to northwest-striking structure.

A.3.1.2 Atlantic Offshore Background (AOB)

The Atlantic Offshore Background zone (AOB) of Adams and Halchuk (2003) has the same characteristics of the Extended Continental Crust Source Zone (ECC) defined by URS (2001). This is a region of crust that experienced significant extension during Mesozoic rifting associated with the splitting of the North American and African plates. This zone includes exposed rift basins along the Atlantic seaboard situated landward of the hinge zone of the continental margin. This region experienced considerably less crustal thinning than did the region seaward of the hinge zone that includes the deeper marginal sedimentary basins. The AOB includes Paleozoic basement of part of the eastern North America as well as the eastern continental shelf. The western boundary of this domain, which is defined by the Piedmont gravity gradient (Bollinger and Wheeler, 1988) generally follows the western edge of the Triassic-Jurassic onshore basins or the structural block boundaries.

Within the AOB source zone, several northeast-trending reverse fault zones in fault systems up to 100-km-long have experienced Cenozoic activity (Prowell, 1988; Wentworth and Mergner-Keefer, 1983). These faults typically strike north to northeast, dip steeply, and displace sedimentary rocks of Late Cretaceous to Miocene age. Displacements are generally dip-slip, but some strike-slip movement may have also occurred (Prowell, 1988).

A.3.1.3 Cochrane (COC)

The Cochrane seismic source zone (COC), defined by Adams and Halchuk (2003), is the northwest extension of the Timiskaming arm of the Iapetan Rifted Margin (IRM). This is a zone

of incipient rifting within the eastern North American craton that contains the mining districts of Rouyn-Noranda, Abitibi, and Cochrane. It is flanked by the Kapuskasing uplift to the southwest. This zone has had persistent, but diffuse seismicity during historic time. Small faults offseting polished glacial surfaces indicate that this region has undergone at least some glacio-isostatic adjustment (Fenton, 1994).

A.3.1.4 Coastal Maine – Fundy (CMF)

The Coastal Maine – Fundy source zone (CMF) is an area of Paleozoic fold and thrust belts at the northern end of the Appalachian chain, located between the extended crust of the Atlantic Offshore Background zone and the Iapetan rift. This zone approximates the extent of the Merrimac synclinorium, a major northeast-trending structure extending from eastern Connecticut through Maine and into New Brunswick (Taylor, 1989). A thick sequence of Ordovician and Devonian have been metamorphosed to sillimanite grade and intruded by Lower and Middle Devonian granites. The CMF is separated from the Atlantic Offshore background zone by a major zone of northeast-striking thrusts that mark the plate suture between North America and Avalonia. The boundary between the CMF and the Northern Appalachian Interior (NAI) is marked by a series of metavolcanic gneissic domes along the Bronson Hill anticlinorium (Taylor, 1989).

A.3.1.5 Gatineau (GAT)

The Gatineau source zone (GAT) is a region of uplifted and faulted continental crust located along the northern margin of the IRM. The southern boundary of the zone is marked by down-to-the south rift flank normal faults. This is one of the most seismicially active areas in eastern Canada. There is little or no post-Mesozoic deformation in this region. Adams and Halchuk (2003) identify this as a separate source zone because of its elevated levels of seismicity compared with the surrounding Iapetan Rift Background zone (IRC) and its different geologic character from the IRM to the south.

A.3.1.6 Iapetan Rift Background (IRB)

Adams and Halchuk (2003) define the Iapetan Rift Background zone (IRB) as a transitional zone between the Iapetan Rift margin (IRM) and the eastern North American craton. Although this zone does not contain any through-going rift-related faults, it does appear to have undergone at least localized uplift during and following rifting, e.g., the Kapuskasing uplift in northwestern Ontario. This region has elevated levels of seismicity relative to the surrounding craton.

A.3.1.7 Iapetan Rift Margin (IRM)

The Iapetan Rift Margin source zone (IRM) comprises the branches of the St. Lawrence rift fault system (Adams and Halchuk, 2003). This zone lies along the margin of the faulted edge of the Grenville continental margin that was originally rifted and thinned during the opening of the Iapetus Ocean (Sanford and Grant, 1990). Further faulting occurred during the Ordovician (Boyer *et al.*, 1985) when the rift margin and transverse faults were reactivated.

Historical seismicity along the IRM is concentrated in a number of well-known seismicity clusters (Charlevoix, Lower St. Lawrence, and Montreal) that are separated by regions of lower seismicity. Adams *et al.* (1995) considered the 1925 Charlevoix **M** 6.2 earthquake to be a typical event for the IRM, although the great seismogenic thickness of the crust (≥ 30 km at Charlevoix) and the length of the rift fault segments indicates that significantly larger earthquakes are possible.

The Adams and Halchuk (2003) model of the IRM, adopted herein, includes the northwest-trending Timiskaming arm, extending from Ottawa to Lake Timiskaming. This was the source of the 1935 **M** 6.2 Timiskaming earthquake (Doig, 1991).

A.3.1.8 James Bay (JMS)

The James Bay zone (JMS) encompasses a small area at the southern end of Hudson Bay, within the SCI. Adams and Halchuk (2003) define this as a separate seismic zone based on its elevated level of seismicity relative to the remainder of the SCI. This zone roughly corresponds to the center of maximum contemporary glacio-isostatic uplift in eastern Canada (Andrews, 1991). This area has been an uplift center during the entire postglacial period and, as such, the elevated seismicity observed in this region is likely a product of glacio-isostacy (Wu, 1998; Wu and Johnston, 2000).

A.3.1.9 Southern Labrador (LAB)

The Southern Labrador seismic source zone (LAB) extends from the eastern termination of the Iapetan Rift margin through the southern part of Labrador, extending to the coast to the south of Goose Bay. Similar to the Cochrane source zone at the western end of the rift, this is not an area of through-going faults. Seismicity is diffuse and does not appear to be associated with any major structures (the eastern Labrador fold belts cross this zone at almost 90°). This zone may be defined by deep-seated, cryptic faults that are related to Iapetan rifting.

A.3.1.10 Northern Appalachian Interior (NAI)

Elizabeth Mine is situated in the Northern Appalachian Interior (NAI), a region of the northern Appalachians underlain by Grenville crust. Elizabeth Mine is located in the Connecticut Valley synclinorium, a thick sequence of Ordovician metasedimentary rocks located between the thrust stacks of the Taconic Mountains to the west and the gneissic domes of the Bronson Hill anticlinorium to the east (Taylor, 1989).

A.3.1.11 Southern Great Lakes (SGL)

The Southern Great Lakes seismic source zone (SGL) is a possible west-southwest extension of the Iapetan Rift Margin (IRM) through the area of Lakes Ontario and Erie (Adams and Basham, 1991). The presence of rift bounding faults beneath the Great Lakes is speculative. The area is covered by a relatively underformed series of Paleozoic platform carbonates. The Lake Ontario basin was an area of ice accumulation and downwarping during the last glaciation (Eyles *et al.*, 1993). Halchuk and Adams (2003) have defined this as a discrete seismic zone in a manner similar to Ebel and Tuttle (2002). Earthquakes in this zone occur primarily in the underlying

Precambrian crust rather than in the Paleozoic cover (Ebel and Tuttle, 2002). Although there have been several claims associating individual earthquakes with large-scale geologic structures (e.g., Wallach and Heginbottom, 1993), the seismicity in the SGL appears to be diffuse and its association with crustal structure is not clear (Ebel and Tuttle, 2002; Stevens, 1996).

A.3.1.12 Ontario Background Zone (OBGR)

The Ontario Background seismic source zone (OBGR) is defined by Adams and Halchuk (2003). This is a transitional zone between the Southern Great Lakes (SGL) and the North American craton. Seismicity is generally lower and more diffuse than in the SGL (Ebel and Tuttle, 2002; Stevens, 1996).

A.3.1.13 Eastern Continental Margin (ECM)

The eastern Continental Margin (ECM) includes all of the marginal sedimentary basins that are underlain by rift-stage and transitional crust (extended and thinned continental crust). This is the transition zone between attenuated continental crust and true oceanic crust. The ECM crust is thinner and has undergone greater extension than the crust in the Atlantic Offshore Background zone. The crustal thickness of the ECM varies between 25 to 30 km in continental crust to 5 to 10 km in oceanic crust. Stresses from the density contrast across the transitional zone and loading stresses from the thick accumulation of sediments along this passive margin acting in conjunction with far-field ridge-push stress are the most likely the driving forces for seismicity in this zone (Stein *et al.*, 1989). The ECM has been the source of two of the largest earthquakes in eastern North America: the 1929 **M** 7.2 Grand Banks and 1933 surface wave magnitude (M_S) 7.3 Baffin Bay earthquakes (Bent, 1995, 2002).

A.3.1.14 Stable Continental Interior (SCI)

The Canadian Stable Continental Interior (SCI) comprises Precambrian bedrock, generally medium- to high-grade metamorphic assemblages of silicic continental and mafic oceanic affinities. With the exception of glacio-isostatic rebound following late Pleistocene glaciation in high latitude areas, this region has undergone little or no significant tectonism during the Phanerozoic (since 500 Ma). It is far removed from plate boundaries, including passive margins, and contains no imbedded rift structures.

Seismicity has been monitored in the area of northern Ontario and eastern Manitoba since 1979 (Wetmiller and Cajka 1989). Over 124 events, of which 26 exceeded **M** 3.0, have been located, the largest being **M** 3.9 near Sioux Lookout in 1984. Historical records for this region are relatively poor, extending for only the last 100 years at most (Wetmiller and Cajka, 1989).

Stable cratonic interior (SCI) regions have the lowest rates of seismic activity of any part of the Earth's crust. Although SCI regions also show much geological evidence for long-term stability, they are nevertheless capable of producing large, damaging earthquakes (Johnston *et al.*, 1994), leading to the conclusion that SCI regions are populated by many potentially seismogenic faults (Seeber *et al.*, 1996), albeit each with extremely long time intervals between large earthquakes. Crone *et al.* (1997) show that stable continental interior regions may be characterized by faults

that have long periods of quiescence, of 10,000 to 100,000 years or more, punctuated by brief episodes of activity.

An estimate of SCI seismicity rates was made by Fenton and Adams (1997; *in press*) by combining the World SCI data. The rate of $m_b \geq 6$ earthquakes is 0.18 per annum, with the uncertainty being less than a factor of 2. Assuming that the worldwide regions have comparable geological and seismological characteristics to the Canadian SCI, the World SCI seismicity rate (0.004 $m_b \geq 6$ per annum per 10^6 km^2) provides us with our best estimate for the long term seismic behavior.

A.3.1.15 Iapetan Rift - U.S. (IRUS)

The Iapetan Rifted Margin (IRUS) is noted for the presence of large normal faults that were formed along the passive margin of the Late Proterozoic to early Paleozoic (~1000 to 500 Ma) Iapetus Ocean. This region contains areas of historic seismicity including the Giles County, Virginia, Seismic Zone (Bollinger and Wheeler, 1983) and the Eastern Tennessee Seismic Zone (Bollinger et al., 1991). It is hypothesized that these recent zones of seismicity are the result of the reactivation of normal faults that are experiencing contemporary compressional stresses (Bollinger and Wheeler, 1983).

We adopt much of the convention established by Geomatrix Consultants (1997) for the external geographical boundaries of the IRUS, with modifications in the area of the Great Lakes based on Adams and Halchuk (2003). The IRUS has been delineated largely based on the interpretation of geophysical data. For example, Bollinger and Wheeler (1988) identify the eastern extent of faults of the Iapetan Rift by the steep rise in the unfiltered Bouguer anomaly field towards the east known as the Appalachian gravity gradient. This rise may mark the change from thick continental crust in the west to relatively thin crust in the east. The southeastern boundary of the IRUS may be indicated by a narrow zone of thinning Grenville crust that coincides with the Appalachian gravity gradient. Bollinger and Wheeler (1988) indicate that the size, number, and amount of slip on Iapetan normal faults decrease to the northwest towards the North American craton. The northwestern boundary of the IRUS is also delineated on the basis of the presence of Iapetan normal faults and the transition from the relatively stable continental interior to the more seismically active continental edge (Wheeler, 1995). We define the northern extent of the IRUS as bounded by the northern and western limits of the Northern Adirondacks and Ontario Background zones. The southern limit of the IRUS is truncated arbitrarily because of its great distance (> 100 km) from Elizabeth Mine.

Geomatrix Consultants (1997) subdivided the IRUS into five alternative subzones to provide a range of possible tectonic models for this region. We have reviewed these postulated alternative subzones and have concluded that the available geological, geophysical, and seismological data do not warrant such a complex model. However, although we chose to model the IRUS as one zone in this analysis, we believe that the IRUS could be subdivided into two large subzones, the eastern Iapetan Rift Margin (IRM) and the western Iapetan Rift Margin, separated by the Appalachian Front Boundary. There are also gravity and magnetic data that suggest that the greatest deformation of basement rocks is to the southeast. In addition, there are higher historical seismicity rates in the region to the east (eastern IRM) of the Appalachian Front Boundary than to the west (western IRM).

It appears that the eastern IRM is underlain by a low-angle, southeast-dipping detachment surface. The eastern IRM is the more deformed region as it makes up the upper plate of the detachment. It consists of allocthonous rocks which overlie the Precambrian continental margin of North America. This region is characterized by a negative Bouguer gravity field and a pattern of low wavelength magnetic anomalies. The higher seismicity rates in the eastern IRM appear to be related to faults that lie beneath the detachment (Johnston *et al.,* 1985).

In contrast, the western IRM lies within the Appalachian Plateau Province, and is underlain by less deformed Grenville rocks. Although Iapetan normal faults also exist in this subzone, they do not appear to have been subjected to the significant loading experienced by the eastern IRM basement rocks which underlie the detachment. Additionally, the normal faults in this subzone are far enough from the Atlantic margin that they were not reactivated during Mesozoic extension.

Despite some significant distinctions between the eastern and western IRM, we believe that it is appropriate to model the IRUS as one zone for the purpose of this analysis. It is evident that within the short span of time that seismicity has been monitored or reported in the eastern U.S. there have been zones of more active seismicity in the IRUS. It is not clear whether these zones of seismicity are ephemeral or represent areas of persistent activity.

A.3.1.16 Charleston Seismic Zone (CSZ)

The Charleston, South Carolina, earthquake of 31 August 1886, occurred in the Coastal Plain of South Carolina. The magnitude of this earthquake is estimated to have been **M** 7.3 ± 0.26 (Johnston, 1996) or in the range of m_b 6.6 to 6.9 (Nuttli, 1983). Most data on this earthquake and on the seismicity of the South Carolina Coastal Plain consistently indicate that the source of this earthquake had dimensions of tens of kilometers and was situated about 30 km west of Charleston, close to the region of maximum intensity (Bollinger, 1992; Bollinger *et al.*, 1993).

Although there have been extensive multidisciplinary studies aimed at understanding the seismotectonics of the region (Dewey, 1985), significant uncertainty and lack of agreement remain regarding the cause and nature of seismicity in this region (Dewey, 1985). Previous investigations have supported different, potentially contradictory models. For example, Behrendt and Yuan (1986) interpreted nearly a thousand kilometers of multichannel seismic reflection data that support their theory that seismicity in the Charleston area is associated with Triassic basin boundary extensional fault zones that have been reactivated as strike-slip faults.

Based on an evaluation of Landsat imagery, aerial photography, potential field data, and topographic maps, (Marple and Talwani, 2000) postulated the presence of a linear approximately 200 to 600-km-long, north-northeast-trending fault system in the Coastal Plain of South Carolina, North Carolina, and Virginia. They suggested that the southern end of this zone may be the surface expression of a seismogenic strike-slip fault system that produced the 1886 Charleston earthquake (Figure A-1, Table A-2). The Woodstock fault is part of this fault system. In a recent analysis, Silva *et al.* (in preparation) have simulated the ground shaking and liquefaction from the 1886 earthquake by modeling a 100-km-long north-northeast-trending right-lateral strike-slip fault coincident with the Woodstock fault. This fault geometry was adopted in the hazard analysis.

The distribution and timing of paleoliquefaction features has added considerable data to constrain the source location and recurrence of 1886-like earthquakes and possibly other seismic sources. In a recent study by Talwani and Schaeffer (2001), they offer two models to explain the distribution of paleoliquefaction features based on a reanalysis of 15 years of data. In Model 1, three seismic sources exist along the Coastal Plain of South Carolina: at Charleston where the events are **M** 7 ± and sources near Georgetown and Bluffton with **M** ~ 6. In Model 2, the only source is at Charleston with **M** 7 +. They estimate the recurrence time for 1886-like earthquakes is 500 to 600 years based on analyzing the timing of the past three episodes of paleoliquefaction in the last 2000 years. Earthquakes prior to 1886 at Charleston occurred about 546 ± 17 and 1021 ± 30 years before present (Talwani and Schaeffer, 2001). Based on these values, we adopted recurrence intervals of 550 ± 200 years (Table A-3).

A.3.2 Gaussian Smoothing

As described above, regional-scale seismic source zones were incorporated into the analysis to account for the hazard from earthquakes that are not definitively associated with known or mapped faults. In the case of most of the CEUS, this is the majority of the historical record. In the western U.S., we describe this seismicity as "background earthquakes." This seems somewhat misleading for the CEUS because it suggests that mapped fault-related seismicity is discernible when in fact it rarely is.

A potential disadvantage in the traditional use of seismic source zones is the assumption that seismicity is distributed homogeneously and randomly within each zone thus displaying non-stationary behavior. It has been argued, however, that seismicity in the CEUS is non-random and that samples of the short-term historical record resemble the long-term record. Thus, in addition to the use of seismic source zones, Gaussian smoothing of the historical seismicity was also used in the hazard analysis.

Earthquake recurrence estimates in the site region are required in order to assess the hazard from background seismicity. A catalog was compiled for the national seismic hazard maps (Mueller *et al.*, 1997), and was used in our analysis. The catalog includes data from the following catalogs: the National Center for Earthquake Engineering Research (Seeber and Armbruster, 1991); Seismicity of the United States (Stover and Coffman, 1993); Stover, Reagor, and Algermissen; the National Earthquake Information Center's (NEIC) Preliminary Determination of Epicenters (PDE); and the Decade of North American Geology. The CEUS catalog from Mueller *et al.* (1997) contains 2,738 events and is complete down to magnitude 3. This catalog was subsequently updated with more recent data (through 2003) from the NEIC PDE catalog. All of the events in the Mueller *et al.* (1997) catalog are m_b values. M_n (Nuttli magnitude) was considered to be equivalent to m_b.

The two approaches of Gaussian smoothing (Frankel, 1995) and the seismotectonic province approach using arial source zones were weighted equally at 0.5. This scheme addresses both the spatial stationarity of seismicity and its randomness. We smoothed the historical background seismicity to incorporate a degree of stationarity, using a spatial window of 25 km.

A.3.3 Ground Motion Attenuation

For this study, we have selected two ground motion attenuation relationships that are applicable to the eastern North America: the Toro *et al.* (1997) model and the "fitted" Atkinson and Boore model. Both relationships are stochastic-based models. Both relationships employ the m_b scale and both assume hard rock site conditions. The Toro *et al.* (1997) model was developed as part of the Electric Power Research Institute Guidelines Project (EPRI, 1993) by a large team of researchers. Although it was based mainly on the stochastic model, a more rigorous seismological model guided its development. Considerable work was done in characterizing the uncertainty in ground motion predictions.

The fitted Atkinson and Boore model was developed by Youngs (1998) by fitting the mathematical equations of Toro *et al.* (1997) to point estimates generated by the stochastic model of Atkinson and Boore (1995). The Atkinson and Boore (1995) model was derived using a stochastic model having a two-corner spectral model of the earthquake source obtained from recorded seismograms. The model was originally developed in the form of point estimates (Atkinson and Boore, 1995), to which quadratic equations were subsequently fitted (Atkinson and Boore, 1997). The mathematical representations of Toro *et al.* (1997) model are considered to be more accurate than the representations of the original model (Youngs, 1998). The fitted Atkinson and Boore relationship was preferred over the smooth quadratic form of Atkinson and Boore (1997) because the latter does not incorporate the effects of anelastic attenuation of spectral acceleration at long distances.

These two relationships are considered the most reliable and applicable relations developed for hard rock conditions in the eastern North America. In the probabilistic analysis, the relationship of Toro *et al.* (1997) was assigned a weight of 0.67, while the fitted was given a weight of 0.33 (Figure A-2). This weighting is based on our judgment of the applicability of the two relationships (URS Corporation, 2001). For reference, the ground motion attenuation relationships used by the USGS in preparing the 2002 versions of the National Seismic Hazard Maps, included the Toro *et al.* (1997) and Atkinson and Boore (1995) relationships along with three other models.

The standard deviations for the fitted Atkinson and Boore relationship were taken to be the same as those developed for Toro *et al.* (1997). In the probabilistic analysis, the epistemic and aleatory uncertainties for the attenuation models were combined into a total uncertainty. This modeling of attenuation uncertainty permitted incorporating the complexity of the source models into the probabilistic analysis in a cost-effective and practical way. While it is recognized that this approximation in the modeling of uncertainty can result in slightly different estimates of the site hazard and associated uncertainty than those obtained by modeling the epistemic and aleatory uncertainties separately, the likely differences are very small and thus are judged of no practical significance.

A.4 PROBABILISTIC SEISMIC HAZARD ANALYSIS

The results of the probabilistic seismic hazard analysis of Elizabeth Mine site are presented in terms of ground motion as a function of annual exceedance probability. This probability is the reciprocal of the average return period. Figure A-9 shows the mean, median (50th percentile), 5th, 15th, 85th, and 95th percentile hazard curves for peak horizontal ground acceleration (PGA).

These fractiles indicate the range of uncertainties about the mean hazard. At the specified return periods of 500, 1,000, 2,500, and 5,000 years, the values for mean PGA are listed in Table A-4. For comparison, the probabilistic PGAs for a soft rock (Class B/C) site condition taken from the national hazard maps (Frankel *et al.*, 1996) are 0.06, 0.09, and 0.16 g for 500, 1,000, and 2,500 years, respectively. The USGS values are slightly higher even given the differences in site conditions, i.e., Class B/C versus Class A (hard rock). This may be due to the difference in attenuation relationships used.

The contributions of the various seismic sources to the mean peak horizontal hazard are shown on Figure A-10. The largest contributor to the hazard at the site was the NAI source zone where the site is located (Figure A-8).

By deaggregating the peak acceleration hazard by magnitude and distance bins, Figures 3-11 to 3-14 illustrate the contributions by events at each respective return period. As illustrated, the PGA hazard is controlled by a wide range of earthquakes from m_b 5.0 to 7.5 at distances of less than 100 km. Based on the magnitude and distance bins (Figures 3-11 to 3-14), the controlling earthquakes as defined by the mean magnitude $\overline{M}$ and mean distance $\overline{D}$ can be calculated. Table A-5 lists the $\overline{M}$ and $\overline{D}$ for all return periods for PGA.

Shown on Figure A-15 is the Uniform Hazard Spectra on rock for all four return periods. These spectra have been slightly smoothed to remove sharp peaks due to a limited number of calculated spectral values.

A.5 SITE RESPONSE ANALYSIS

To evaluate the potential amplification of ground motions due to the presence of glacial till beneath the tailings dams, a site response analysis was conducted. The analysis was performed using one-dimensional wave propagation methods through the computer program SHAKE (Schnabel *et al.*, 1972), to calculate the PGA values at the ground surface. The soil behavior is modeled using the equivalent-linear method proposed by Seed and Idriss (1970). The analysis is performed in iterations until the shear modulus and damping values used in the analysis are compatible with the computed shear strain. The modified time histories were input at the top of the rock of the idealized profile to calculate the PGAs at the ground surface.

The analysis method for horizontal motions is based on the assumption of vertically propagating shear waves. While this assumption clearly represents an approximation, it is commonly used, and has been shown to provide a reasonable analytical representation of site response at soil sites for engineering purposes.

The analysis approach can be summarized in the following steps:

- Develop idealized soil profile for analysis, including the dynamic properties;
- Select a set of time histories based on the $\overline{M}$ and $\overline{D}$ values calculated in the probabilistic seismic hazard analysis (Table A-5) and spectrally match them to the UHS; and
- Input these time histories into SHAKE and perform the site response analyses for the site profile.

The idealized soil profile used in the analysis consists of 60 ft (18 m) of glacial till deposits underlain by silaceous/mica-quartz of the Giles Mountain Formation (Table A-6). The glacial till varies in thickness beneath the dams from 45 to 74 ft thick (14 to 23 m).

No site-specific shear-wave velocities were available for the site. However, standard penetration test blow counts have been measured at the site, range from the mid-50's to 100 plus. In the National Earthquake Hazard Reduction Program (NEHRP) site categorization for very dense soil and soft rock (Site Class C), which is appropriate for till, the range of shear-wave velocity (V_S) is 1,200 to 2,500 ft/sec (366 to 762 m/sec) for standard penetration blow counts greater than 50 per foot. Therefore we adopted the V_S range of 1,200 ft to 2,500 ft/sec for the 60 ft (18 m) of till. These velocities are varied in the following sensitivity analysis. For bedrock, we adopt a lower V_S of 8,000 ft/sec (2,438 m/sec) based on values of 9184 ft/sec (2,799 m/sec) from Atkinson and Boore (1997) and Pacific Engineering and Analysis (PE&A) of 9,300 ft/sec (2,835 m/sec). The lower value represents our judgment that the top layer of the bedrock is probably weathered/fractured to some small degree.

The softening of the soil stiffness is specified using the shear modulus degradation (G/G_{max}) and damping vs. shear strain curves. The shear modulus degradation (G/G_{max}) and damping curves for generic cohensionless soils from EPRI (1993) were applied for the glacial till.

A.5.1 Time Histories

The horizontal-component time histories of the 25 December 1985 1543 UTC **M** 5.7 (m_b 5.3) Nahanni, Canada, earthquake recorded at the Northwest Territories station were selected for analyses. These time histories were selected because their overall characteristics are consistent with those controlling the probabilistic hazard at the site. Characteristics considered included magnitude, and recording distance. The results of the probabilistic hazard analysis indicate that ground motions at the project site are controlled by earthquake events with average m_b 5.3 to 5.9 at an average distance of about 25 km (Table A-5).

To develop acceleration time histories with response spectra that match those of the rock target spectra, the selected time histories were modified using the method proposed by Lilhanand and Tseng (1988) and modified by Abrahamson (1993). In this method, the time history is adjusted in time domain by adding wavelets in iterations until a satisfactory match to the target spectrum is obtained. The method has been shown to preserve the non-stationary characteristics of the recorded time histories. A plot of the spectrally-matched rock UHS is presented on Figure A-16.

The calculated acceleration time histories at the ground surface and spectrally matched to the rock UHS are presented on Figures 3-17 to 3-20. The calculated PGAs at the ground surface are tabulated on Table A-8. Calculated amplification factors are also presented in Table A-8. The amplification factors decrease with decreasing PGA as expected due to soil nonlinearity.

A.5.2 Sensitivity Analysis

In addition to the site response analysis for the idealized profile, additional analyses were performed to evaluate the sensitivity of the site response to uncertainties in the assumed idealized profile. Sensitivity analyses were conducted by varying the V_S of the glacial till and underlying bedrock and the thickness of the till. The results are presented in Table A-8. These analyses

indicate that the changes in the idealized profile can result in uncertainties of more than 20%. Given that the site properties have been estimated based on generic rather than site-specific values, the PGA values recommended in Table A-8 for use in the liquefaction analysis should be placed in the context of these uncertainties and considered only as best estimates.

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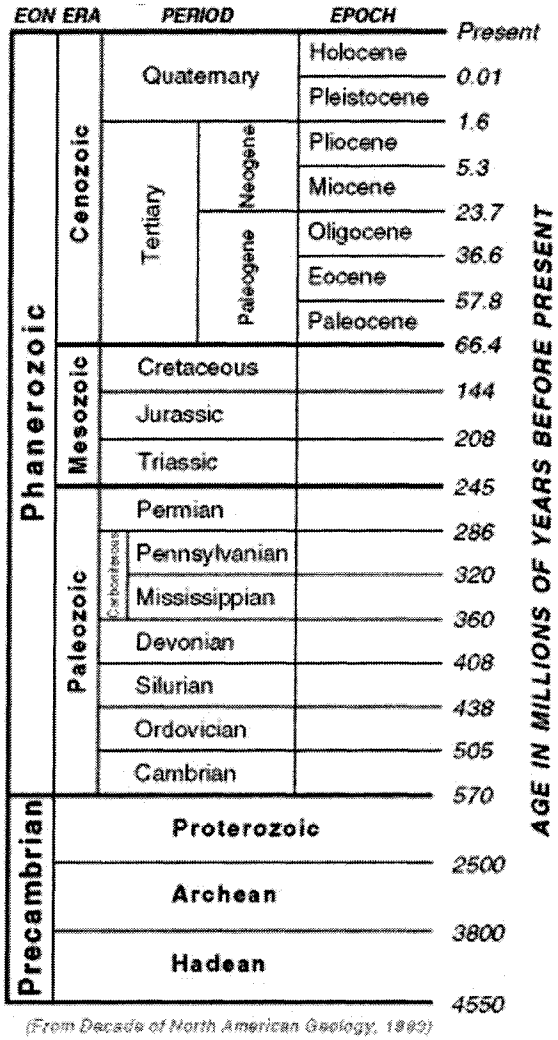
Table A-1

GEOLOGIC TIME SCALE



(From Decade of North American Geology, 1983)

Table A-2

ABRIDGED MODIFIED MERCALLI INTENSITY SCALE

I	Not felt except by a few under especially favorable circumstances (RF* I)
II	Felt only by a few persons at rest, especially on upper floors of buildings. Delicately suspended objects may swing. (RF I to II)
III	Felt quite noticeably indoors, especially on upper floor of buildings, but many people do not recognize it as an earthquake. Standing motorcars may rock slightly. Vibration like passing of truck. Duration estimated. (RF III)
IV	Felt indoors by many, outdoors by few during the day. Some awakened at night. Dishes, windows, door disturbed; walls make creaking sound. Sensation like heavy truck striking building. Standing motorcars rocked noticeably. (RF IV to V).
V	Felt by nearly everyone, many awakened. Some dishes, windows, and other fragile objects broken; cracked plaster in a few places; unstable objects overturned. Disturbances of trees, poles, and other tall objects sometimes noticed. Pendulum clocks may stop. (RF V to VI)
VI	Felt by all, many frightened and run outdoors. Some heavy furniture moved; a few instances of fallen plaster and damaged chimneys. Damage slight. (RF VI to VII)
VII	Everybody runs outdoors. Damage negligible in buildings of good design and construction; slight to moderate in well built ordinary structures; considerable in poorly built or badly designed structures; some chimneys broken. Noticed by persons driving cars. (RF VIII)
VIII	Damage slight in specially designed structures; considerable in ordinary substantial buildings with partial collapse; great in poorly built structures. Panel wall thrown out of frame structures. Fall of chimneys, factory stacks, columns, monuments, walls. Heavy furniture overturned. Sand and mud ejected in small amounts. Changes in well water levels. Persons driving cars disturbed. (RF VIII + to IX)
IX	Damage considerable in specially designed structures; well designed frame structures thrown out of plumb; great in substantial buildings; with partial collapse. Buildings shifted off foundations. Ground cracked conspicuously. Underground pipes broken. (RF IX +)
X	Some well built structures destroyed; most masonry and frame structures destroyed with foundations; ground badly cracked. Rails bent. Landslides considerable from river banks and steep slopes. Shifted sand and mud. Water splashed, slopped over banks. (RF X)
XI	Few, if any, [masonry] structures remain standing. Bridges destroyed. Broad fissures in ground. Underground pipelines completely out of service. Earth slumps and land slips in soft ground. Rails bent greatly.
XII	Damage total. Waves seen on ground surface. Lines of sight and level distorted. Objects thrown into the air.

* Equivalent Rossi-Forel (RF) intensities.

Table A-3

Northeastern North America Seismic Source Zones

Zone	M ≥ 5 Rate per 10^6 km^2	b Lower (0.16)	b Best (0.68)	b Upper (0.16)	M_{max} Lower (0.3)	M_{max} Best (0.6)	M_{max} Upper (0.1)	Maximum Depth (km)	Area[1] (km^2)
Northern Adirondacks (ADR)	0.454	0.95	0.80	0.65	6.0	7.0	7.5	20	30,400
Atlantic Offshore Background (AOBGR)	0.047	0.96	0.87	0.78	6.0	7.0	7.5	20	553,000
Cochraine (COC)	0.111	0.91	0.87*	0.83	6.0	7.5	7.7	20	31,000
Coastal Maine- Fundy (CMF)	0.122	0.99	0.88	0.77	6.5	7.0	7.5	20	138,000
Gatineau (GAT)	1.170	0.97	0.90	0.83	6.5	7.0	7.5	20	32,300
Iapetan Rift Background (IRB)	0.030	0.91	0.87*	0.83	6.0	7.0	7.5	20	932,000
Iapetan Rifted Margin (IRM)	0.942	0.90	0.86	0.82	7.2	7.5	7.7	20	120,000
James Bay (JMS)	0.055	0.91	0.87*	0.83	6.0	6.5	6.7	20	132,000
Southern Labrador (LAB)	0.101	0.91	0.87*	0.83	6.0	7.5	7.7	20	69,300
Northern Appalachian Interior (NAI)	0.366	0.73	0.66	0.58	6.0	7.0	7.0	20	155,000
Ontario Background R Model (OBGR)	0.011	0.96	0.87*	0.78	6.0	6.5	6.7	20	547,000
Southern Great Lakes (SGL)	0.121	0.97	0.86	0.76	6.0	7.0	7.5	20	175,000
Eastern Continental Margin (ECM)	0.434	0.83	0.74*	0.65	7.2	7.3	7.6	20	848,000
Stable Continental Interior (SCI)	0.025	0.90	0.80	0.70	6.8	7.0	7.2	20	50,600,000[2]
Iapetan Rift - U.S. (IRUS)	0.038	1.17	1.10	1.03	6.0 (0.2)	6.5 (0.6)	7.0 (0.2)	20	442,998
Charleston Seismic Zone (CSZ)	–	350[3]	550[3]	750[3]	6.7 (0.2)	7.0 (0.6)	7.5 (0.2)	20	–

Notes:

1) Parameters from Adams and Halchuk (2003) except IRUS and CSZ. IRUS from revision of Geomatrix Consultants (1997).

2) Weights for Mmax differ for IRUS and CSZ.

3) Magnitudes are m_b

* Slope imposed rather than derived from a maximum likelihood fit of data.

[1] Area for which recurrence parameters calculated

[2] Area of global SCI (Fenton and Adams, 1997)

[3] Recurrence intervals in years for maximum earthquakes

Table A-4
MEAN PROBABILISTIC PGAS ON ROCK

Return Period (yrs)	Rock PGA (g's)
500	0.04
1,000	0.07
2,500	0.12
5,000	0.18

Table A-5
CONTROLLING EARTHQUAKES

Return Periods	500 yrs	1,000 yrs	2,500 yrs	5,000 yrs
$\overline{M}$ (m_b)	5.2	5.5	5.7	5.9
$\overline{D}$ (km)	25	25	25	25

Table A-6

SITE SHEAR-WAVE VELOCITY PROFILE

Depths (ft)	V_S (ft/sec)	Lithology
0 - 20	1200	Glacial Till
20 - 40	1600 - 1850	Glacial Till
40 - 60	2000 - 2500	Glacial Till
> 60	8000	Bedrock

Table A-7

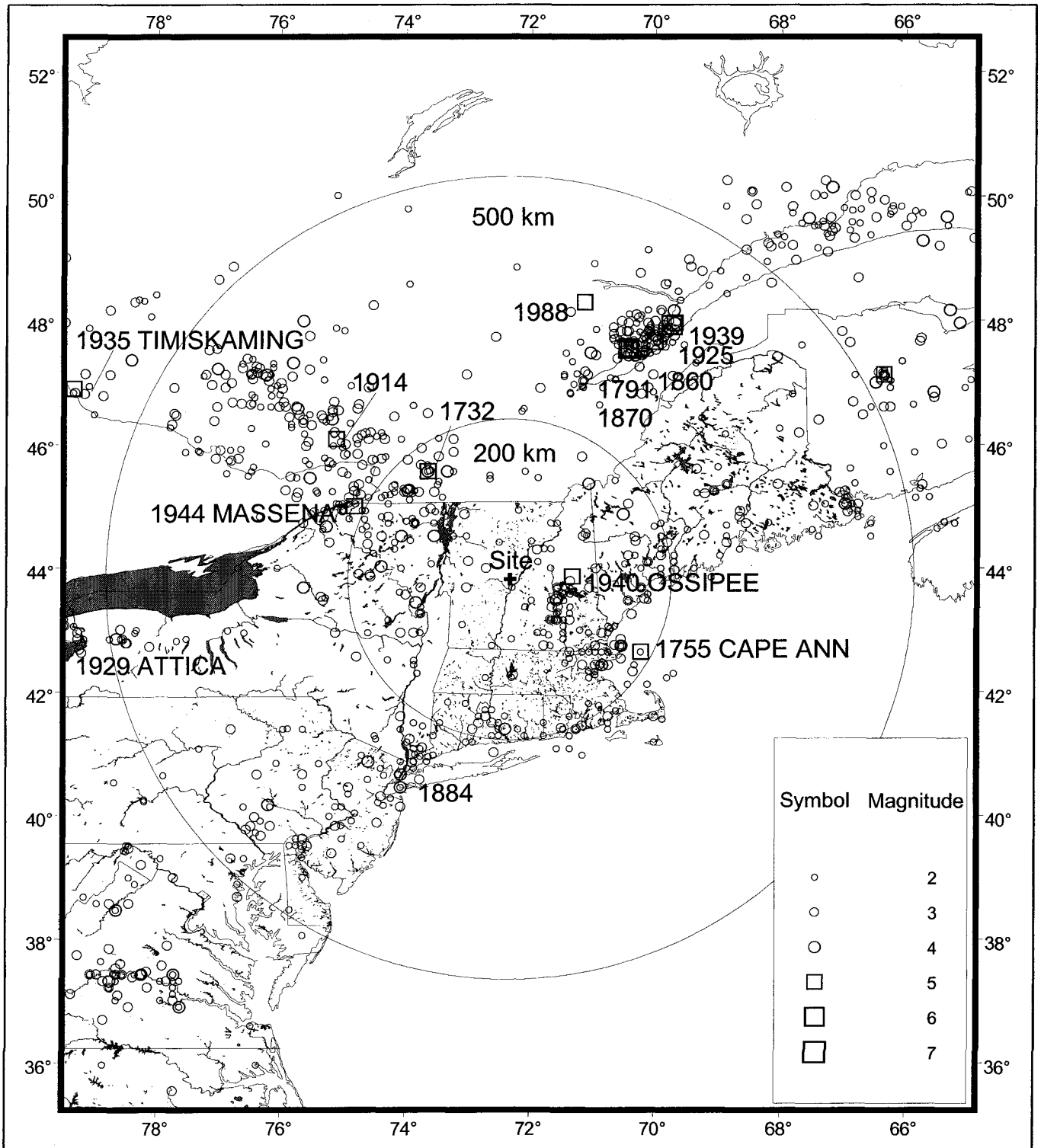
MEAN PROBABILISTIC PGAS ON SOIL AND AMPLIFICATION RATIOS

Return Period (yrs)	Soil PGA (g's)	Soil PGA / Rock PGA
500	0.10	2.5
1,000	0.14	2.0
2,500	0.24	2.0
5,000	0.31	1.7

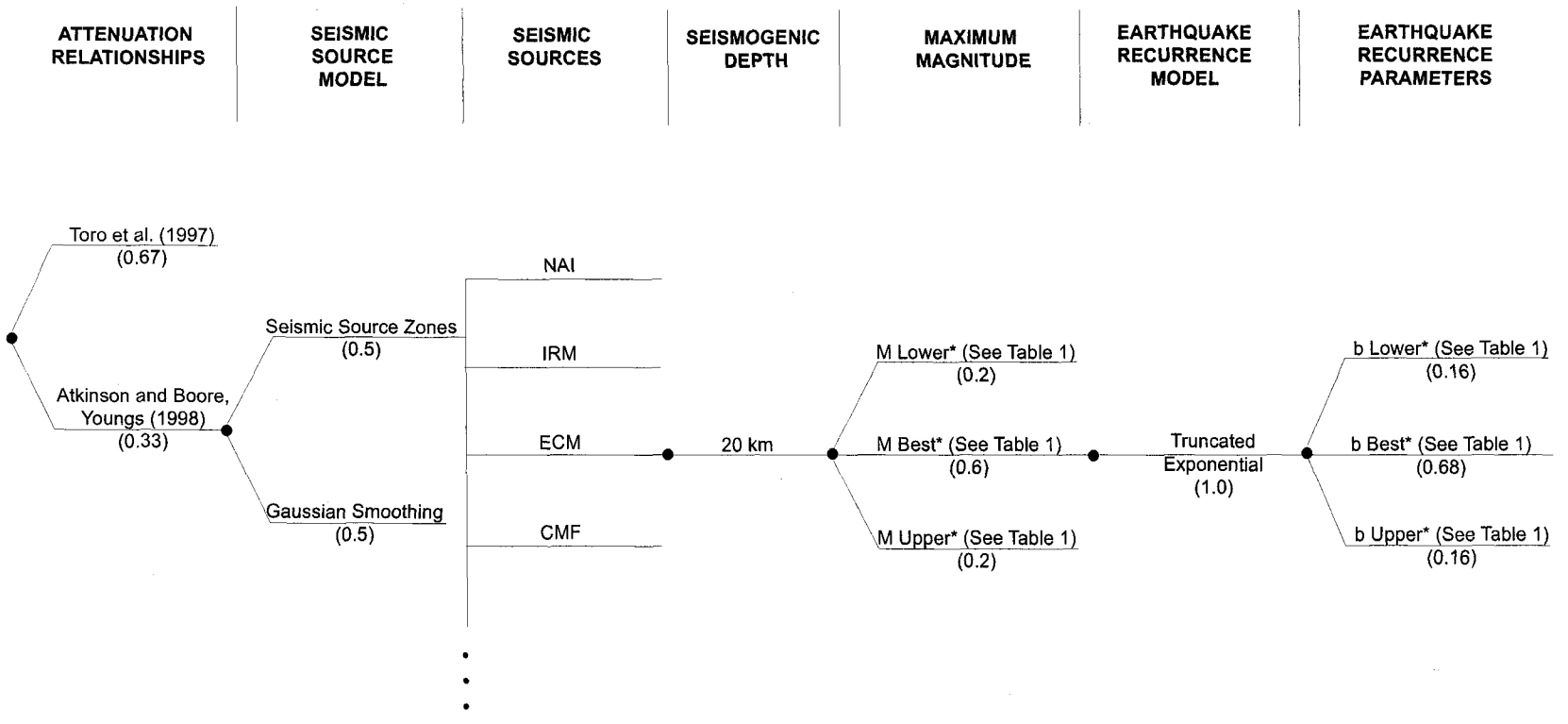
TABLE A-8

SUMMARY OF PGAS AND AMPLIFICATION FACTORS FROM SENSITIVITY ANALYSIS

Return Period (yrs)	Profile Variations	Rock PGA	Soil PGA	Amplification Factor
500	Soil Vs of 3000 ft/sec	0.04	0.06	1.50
500	Rock Vs of 9000 ft/sec	0.04	0.11	2.75
2500	Soil Vs of 3000 ft/sec	0.12	0.16	1.33
2500	Soil Thickness of 80ft	0.12	0.26	2.17
5000	Soil Vs of 3000 ft/sec	0.18	0.23	1.28
5000	Soil Thickness of 40ft	0.18	0.38	2.11

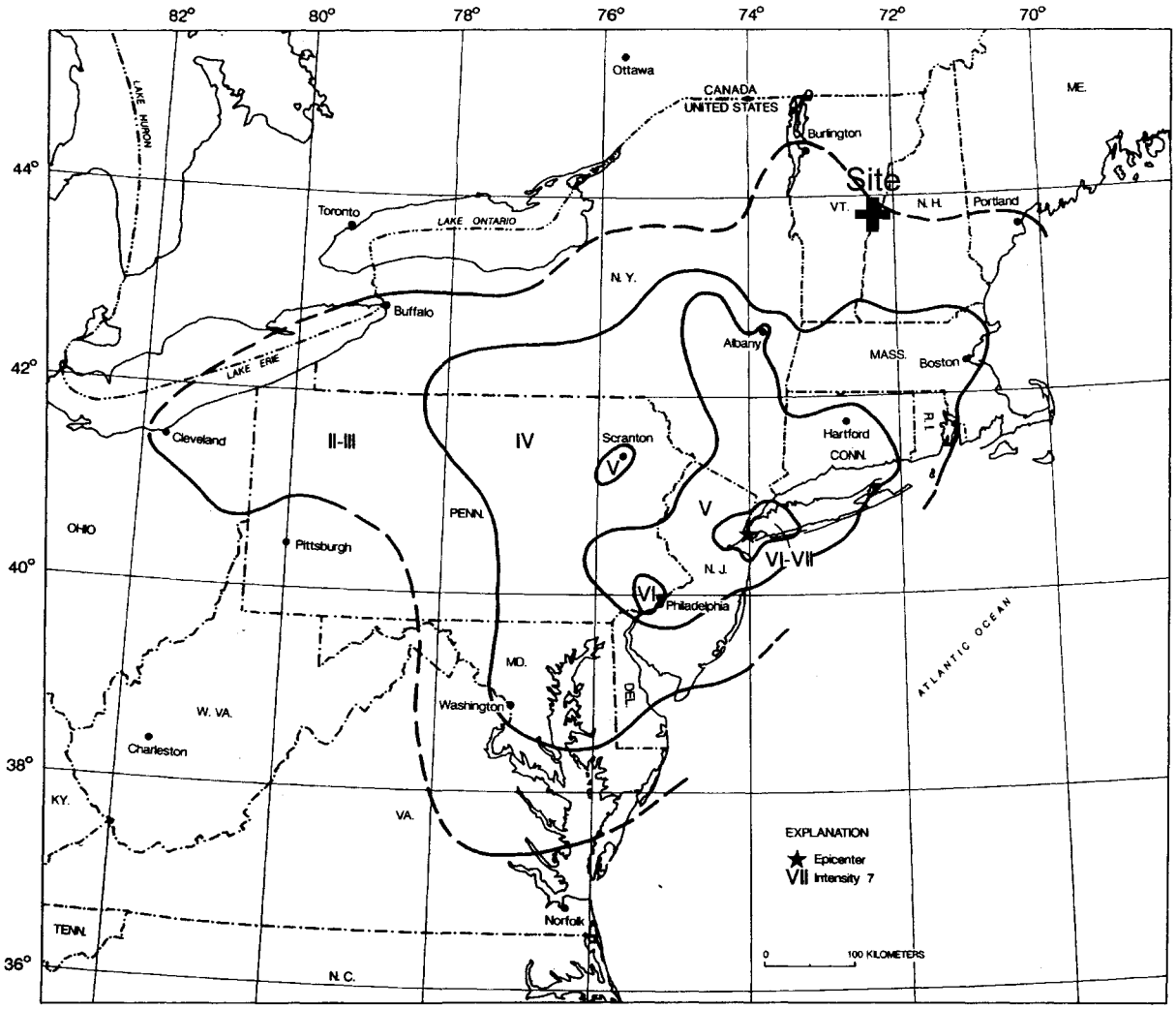


Project No. 22235583 Elizabeth Mine, Strafford, VT URS	**Historical Seismicity of the Site Region (1700-2003)**	Figure A-1



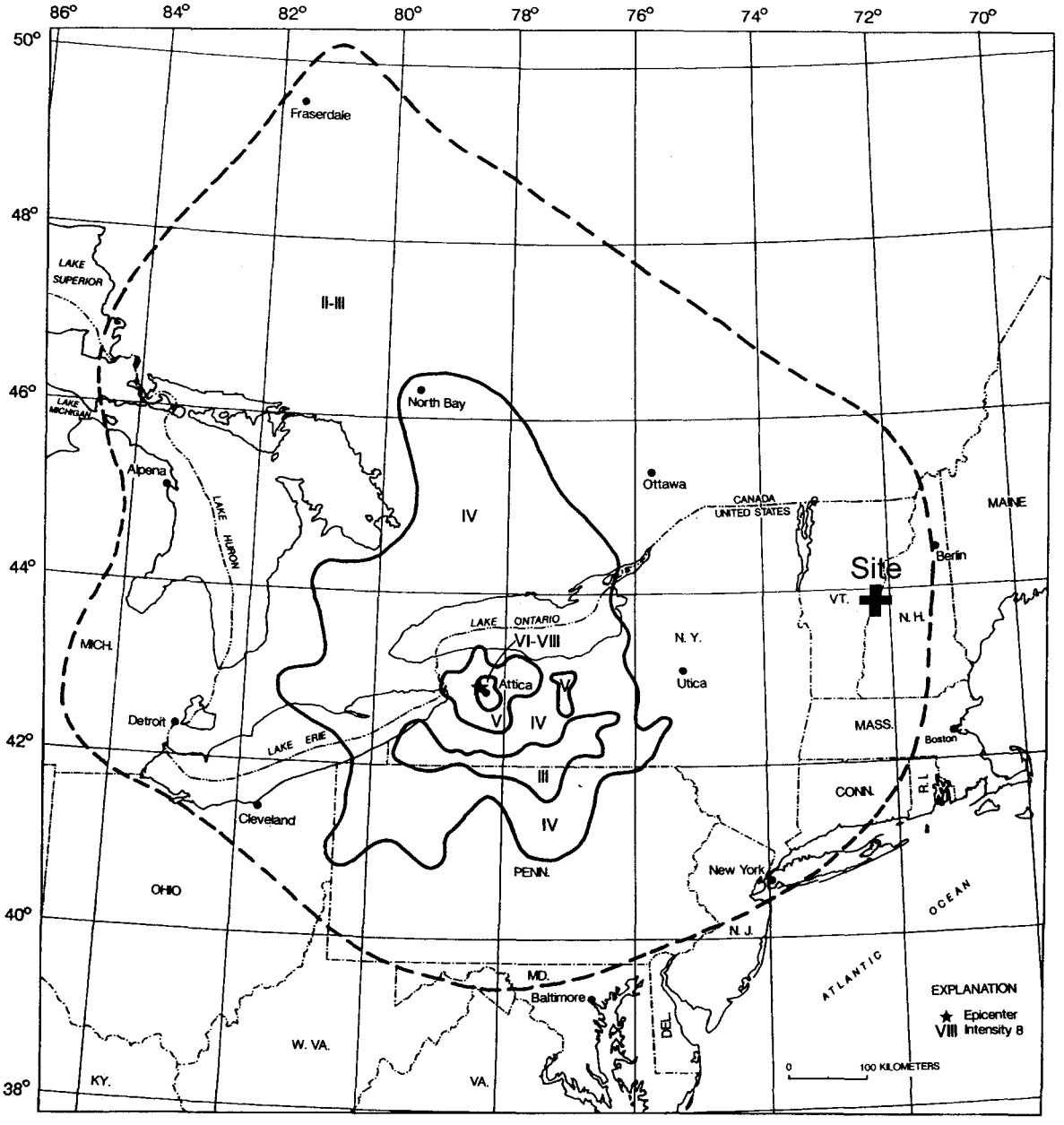
*Upper refers to upper bound
Lower refers to lower bound
Best refers to best estimate

Project No. 22235583.005020	Elizabeth Mine, VT	**Seismic Hazard Model Logic Tree**	Figure A-2
URS			



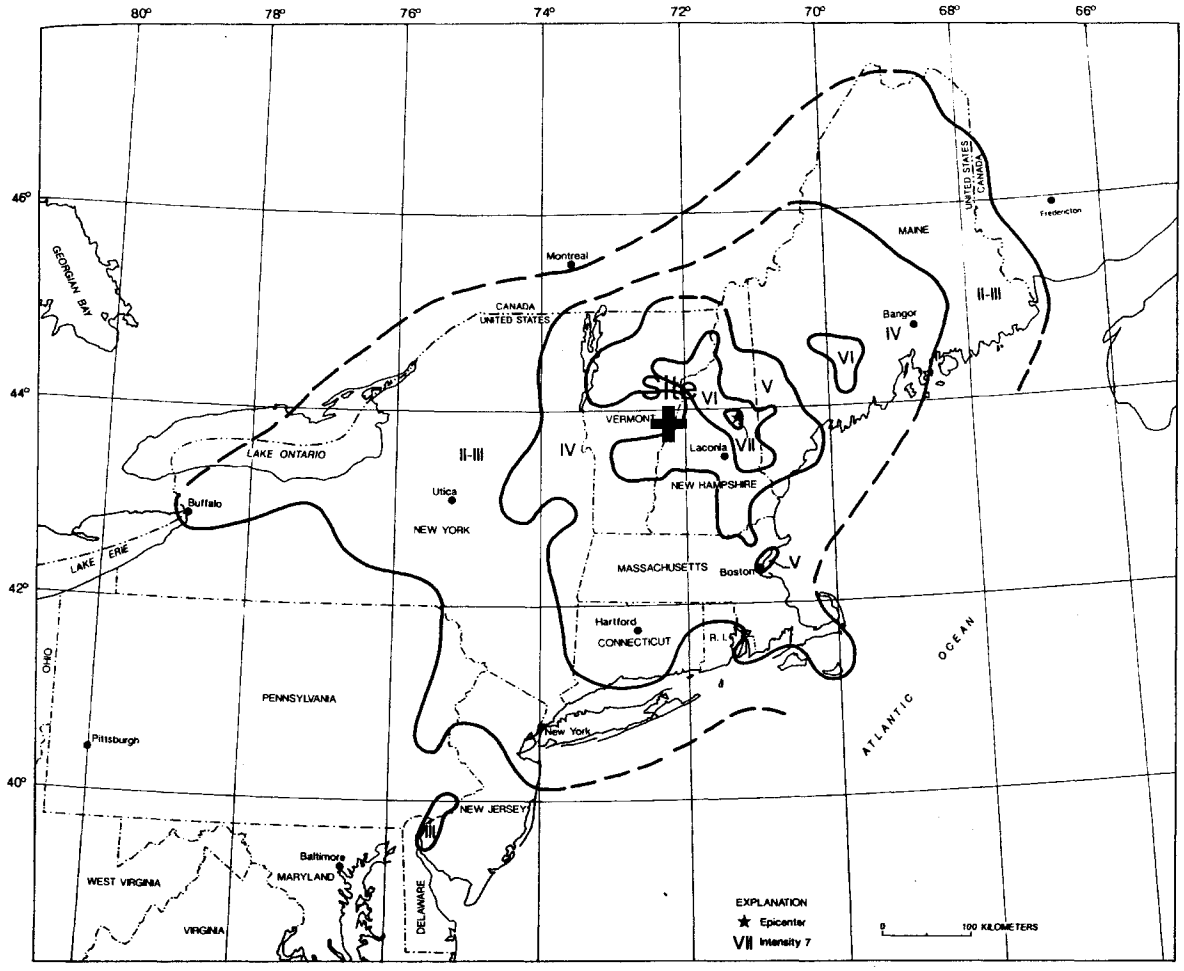
SOURCE: STOVER AND COFFMAN (1993)

Project No. 22235583 Elizabeth Mine, Strafford, VT URS	**Isoseismal Map For the New York City Earthquake of 10 August 1884**	Figure A-3



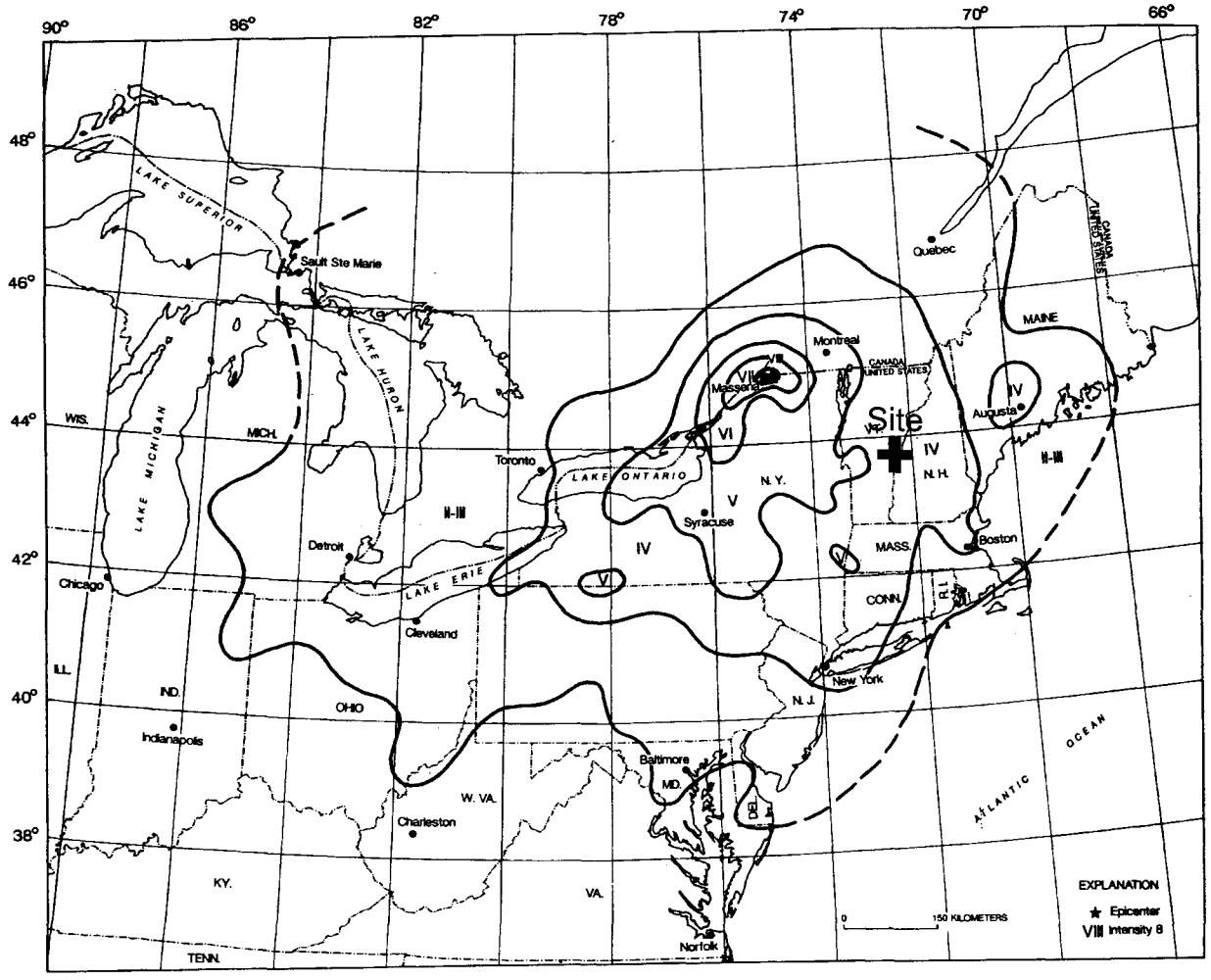
SOURCE: STOVER AND COFFMAN (1993)

Project No. 22235583 Elizabeth Mine, Strafford, VT URS	**Isoseismal Map For the Attica Earthquake of 12 August 1929**	Figure A-4



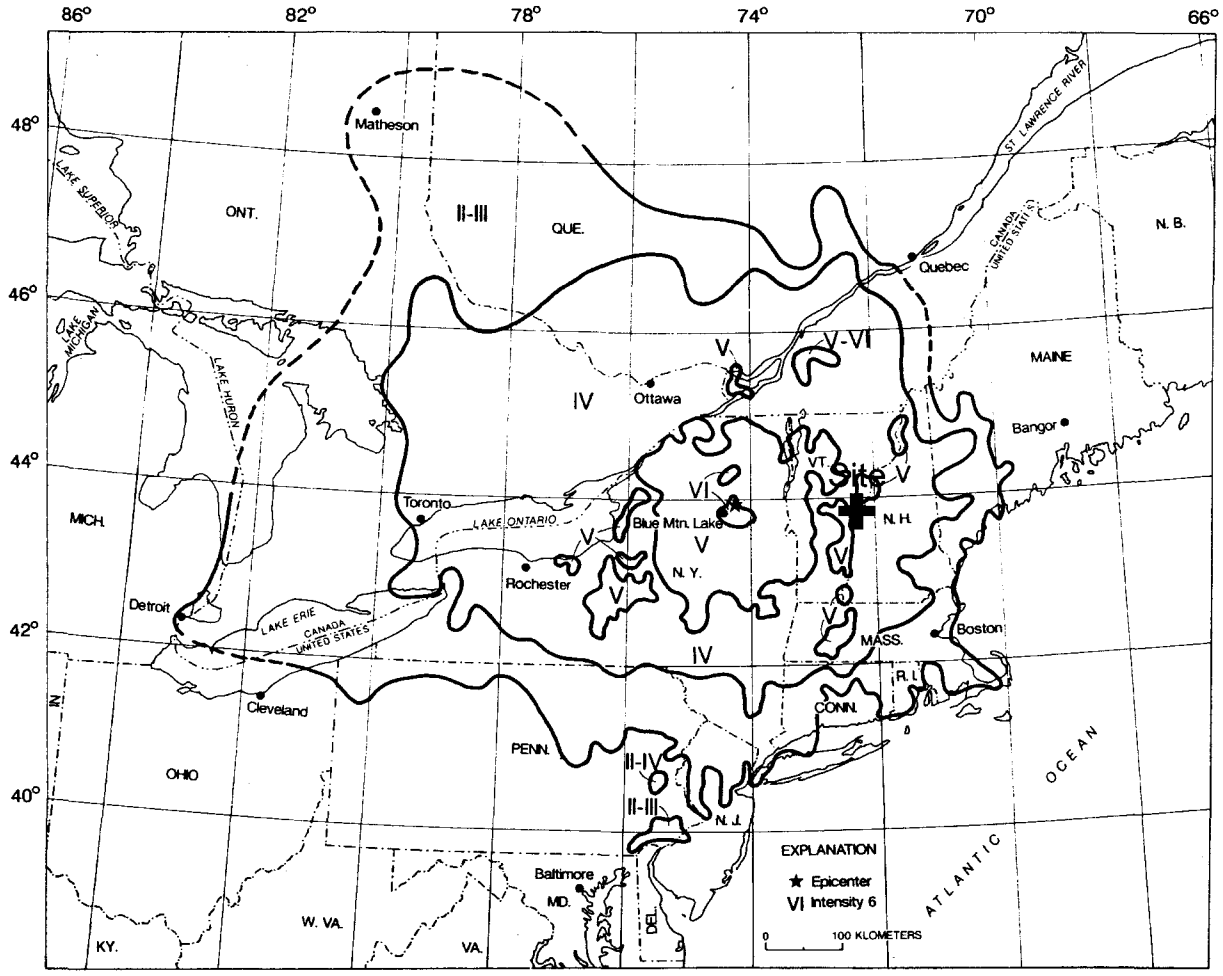
SOURCE: STOVER AND COFFMAN (1993)

Project No. 22235583 Elizabeth Mine, Strafford, VT URS	**Isoseismal Map For the New Hampshire Earthquake of 20 December 1940**	Figure A-5



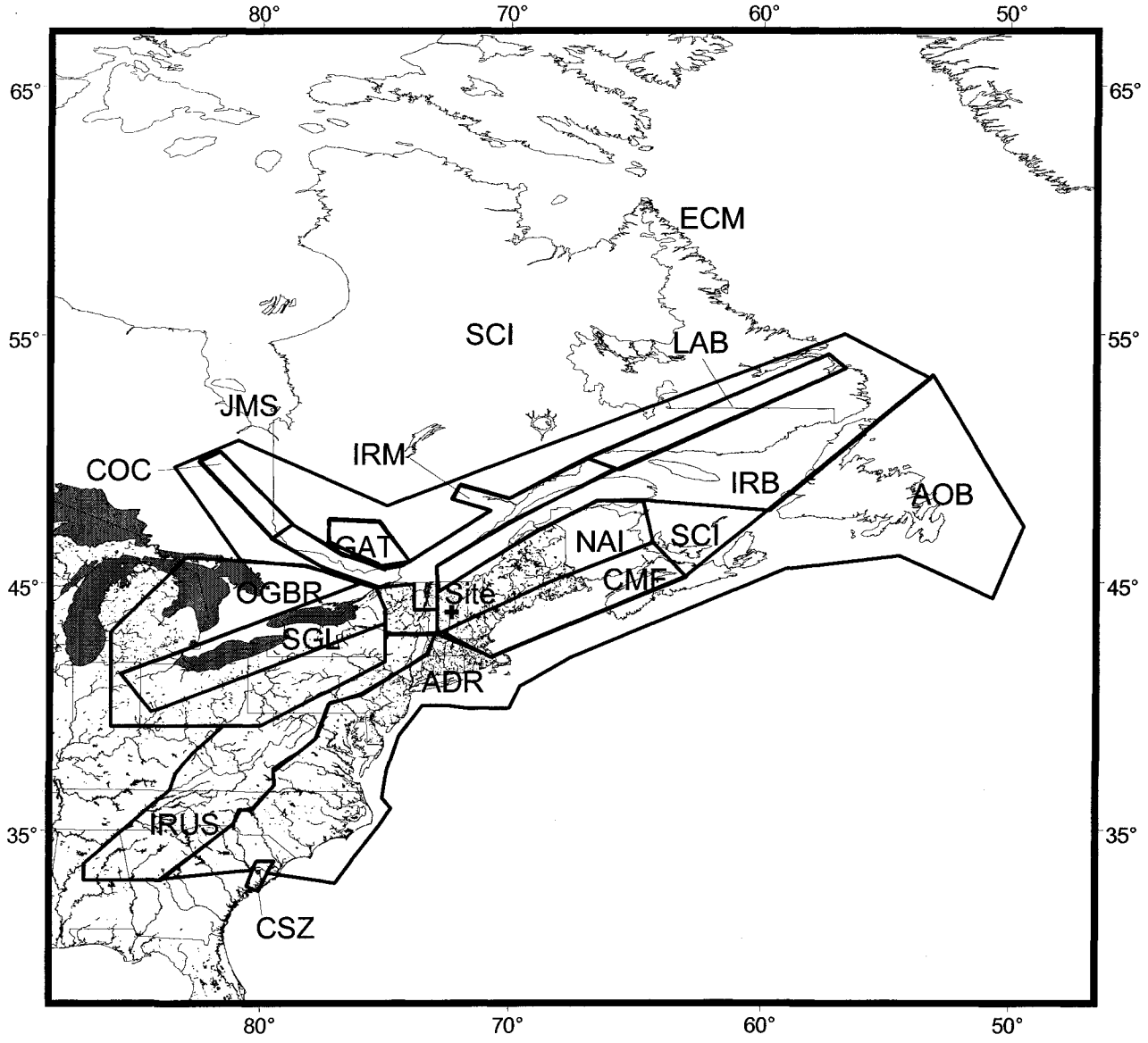
SOURCE: STOVER AND COFFMAN (1993)

Project No. 22235583 Elizabeth Mine, Strafford, VT URS	**Isoseismal Map For the Massena Earthquake of 5 September 1944**	Figure A-6



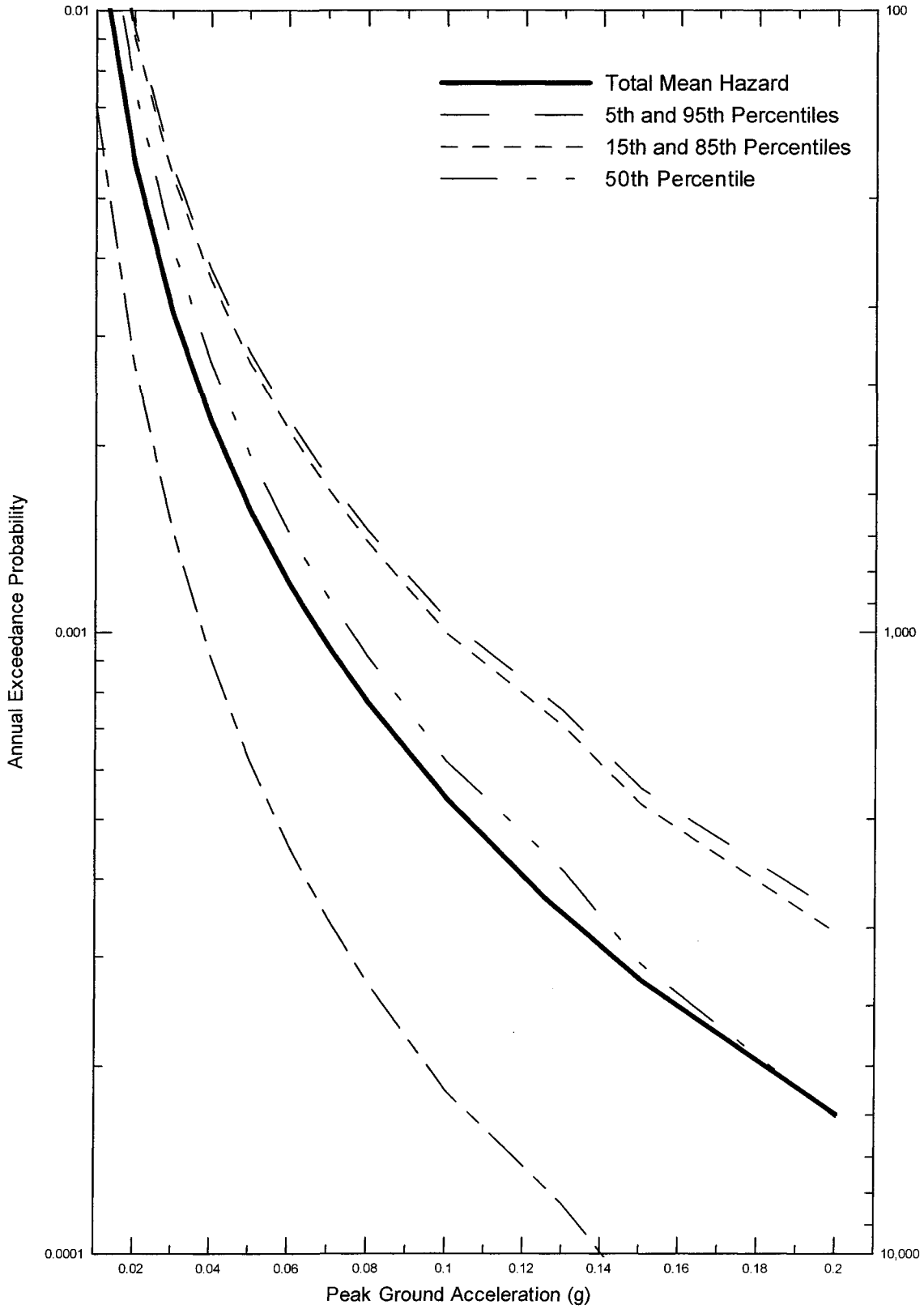
SOURCE: STOVER AND COFFMAN (1993)

Project No. 22235583 Elizabeth Mine, Strafford, VT URS	**Isoseismal Map For The Blue Mountain Lake Earthquake of 7 October 1983**	Figure A-7

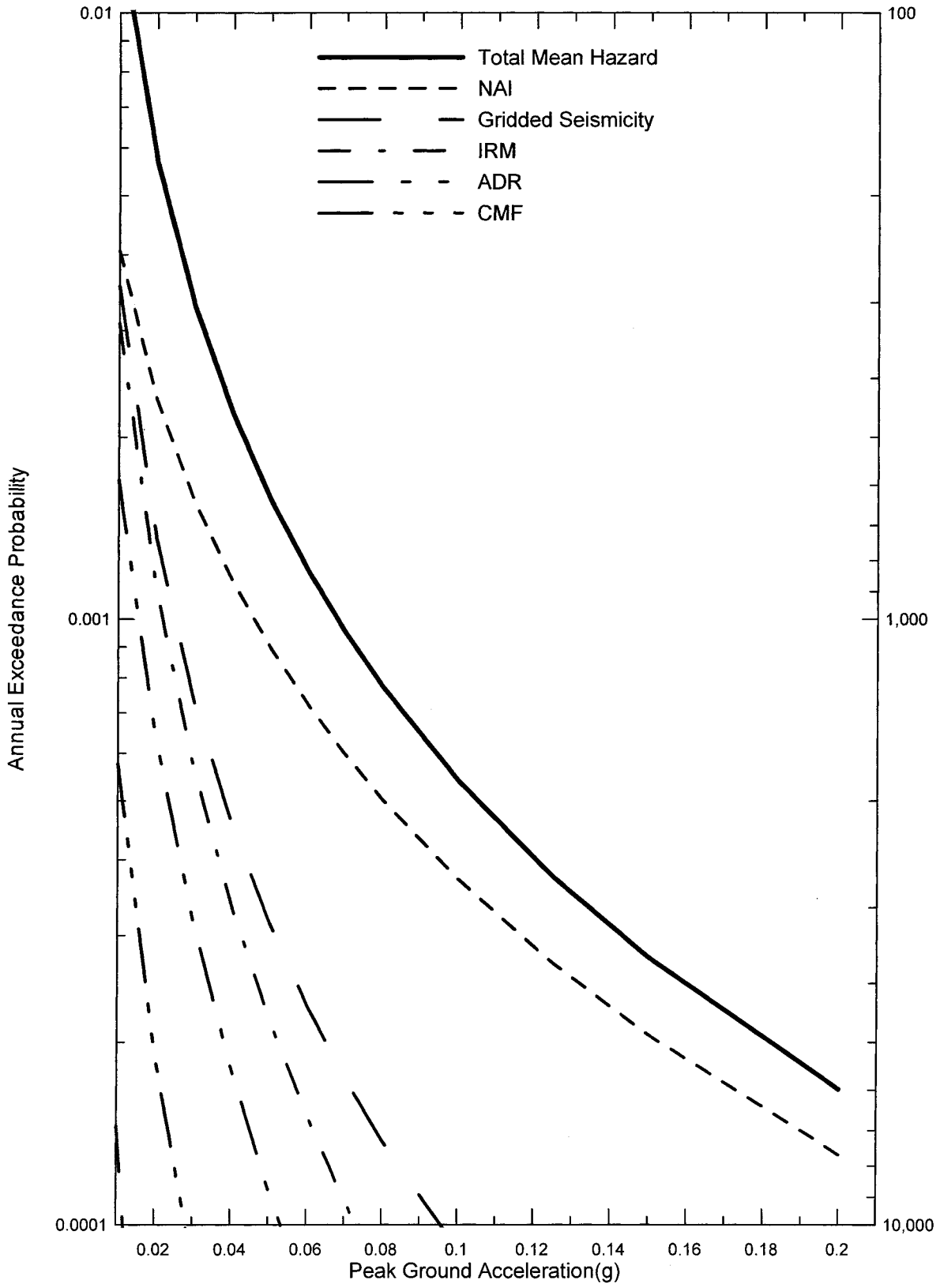


ADR	Northern Adirondacks	IRM	Iapetan Rift Margin
AOB	Atlantic Offshore Background	IRUS	Iapetan Rift- U.S.
CMF	Coastal Maine- Fundy	JMS	James Bay
COC	Cochrane	LAB	Southern Labrador
CSZ	Charleston Seismic Zone	NAI	Northern Appalachian Interior
ECM	Eastern Continental Margin	OBGR	Ontario Background Zone
GAT	Gatineau	SCI	Stable Continental Interior
IRB	Iapetan Rift Background	SGL	Southern Great Lakes

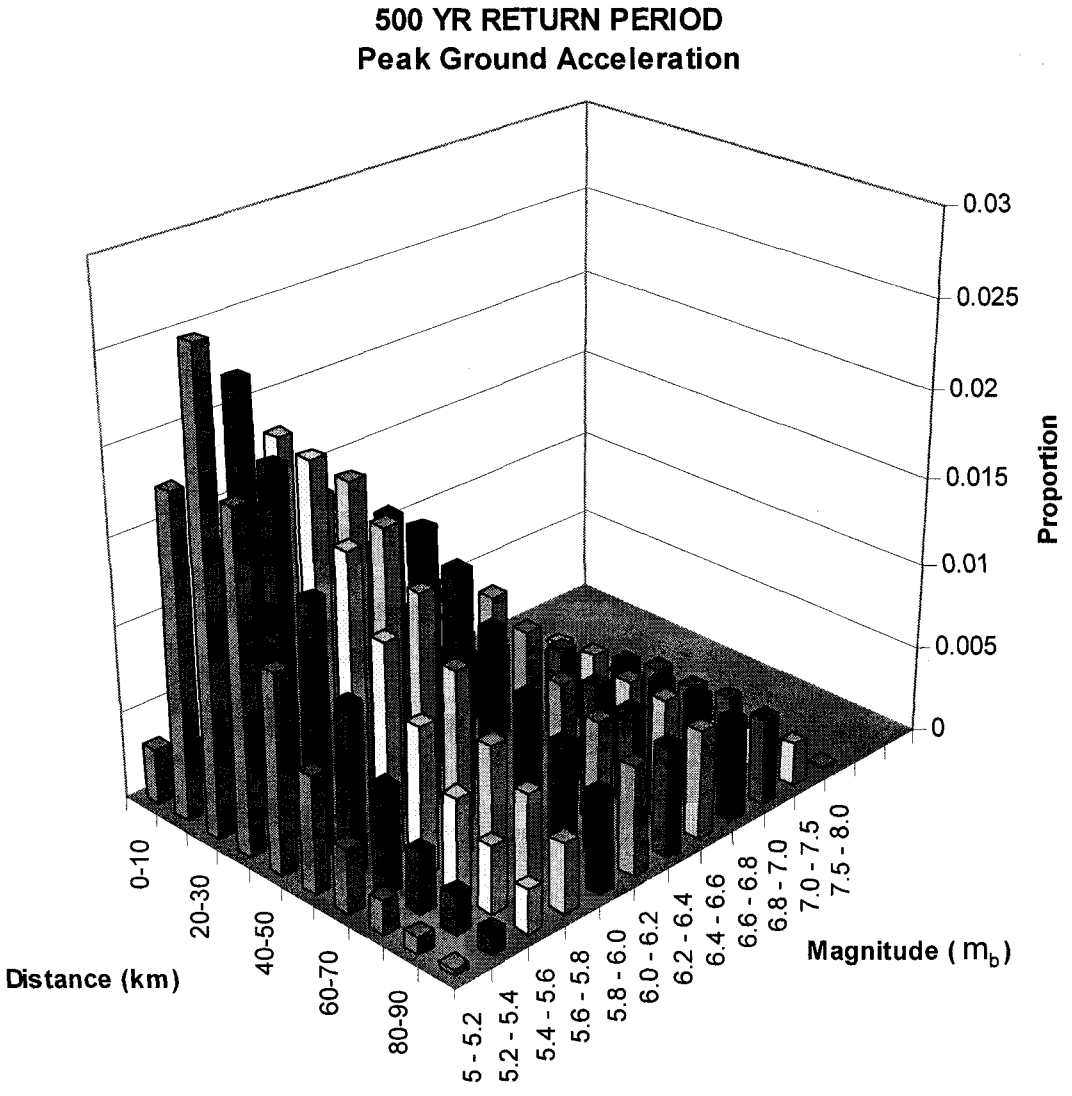
Project No. 22235583 Elizabeth Mine, Strafford, VT URS	**Seismic Sources Included In the Hazard Analysis**	Figure A-8



Project No.: 22235583 Elizabeth Mine Strafford, VT URS	**Seismic Hazard Curves For Peak Horizontal Acceleration**	Figure A-9

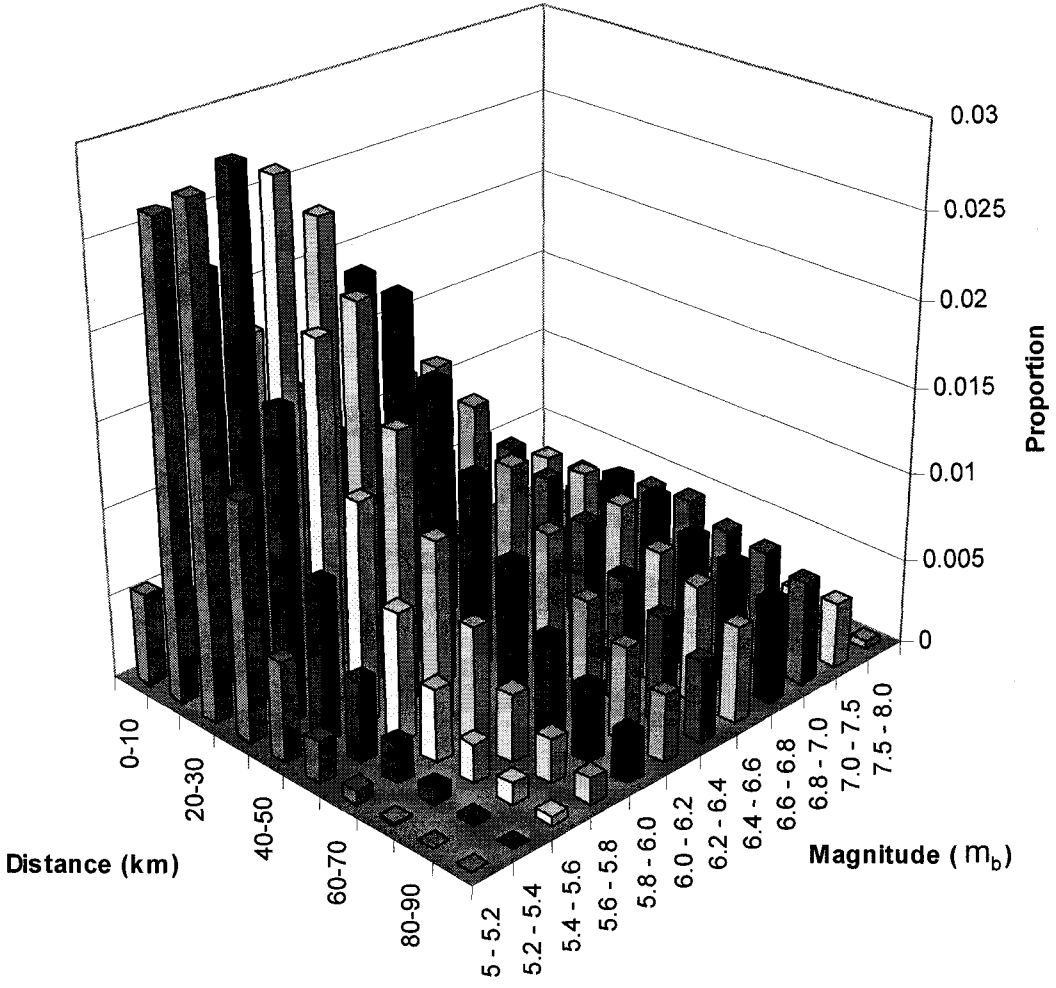


Project No.: 22235583 Elizabeth Mine Strafford, VT URS	**Seismic Source Contributions to Mean Peak Horizontal Acceleration Hazard**	Figure A-10



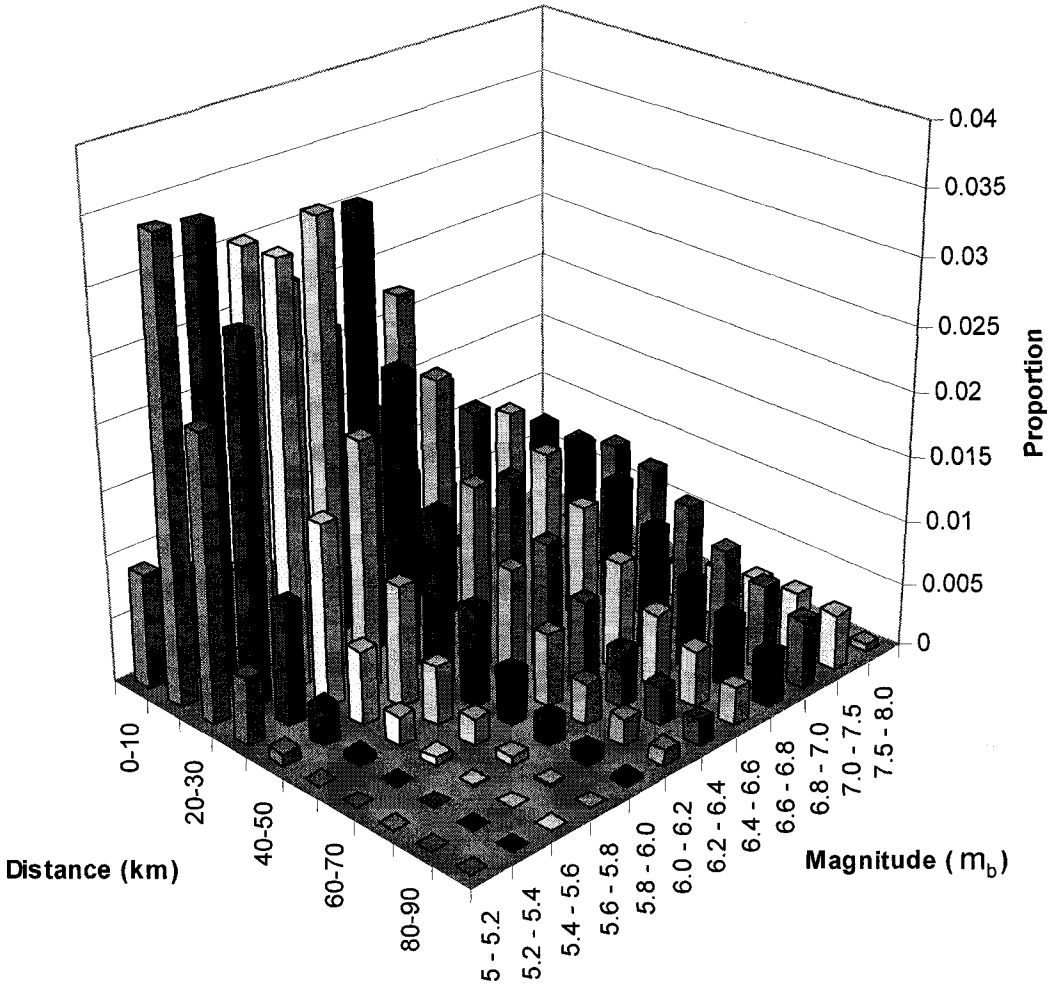
Project No. 22235583	Elizabeth Mine Strafford, VT	**Magnitude and Distance Contributions to the Mean Peak Acceleration Hazard at 500 Year Return Period**	Figure A-11
URS			

1000 YR RETURN PERIOD
Peak Ground Acceleration



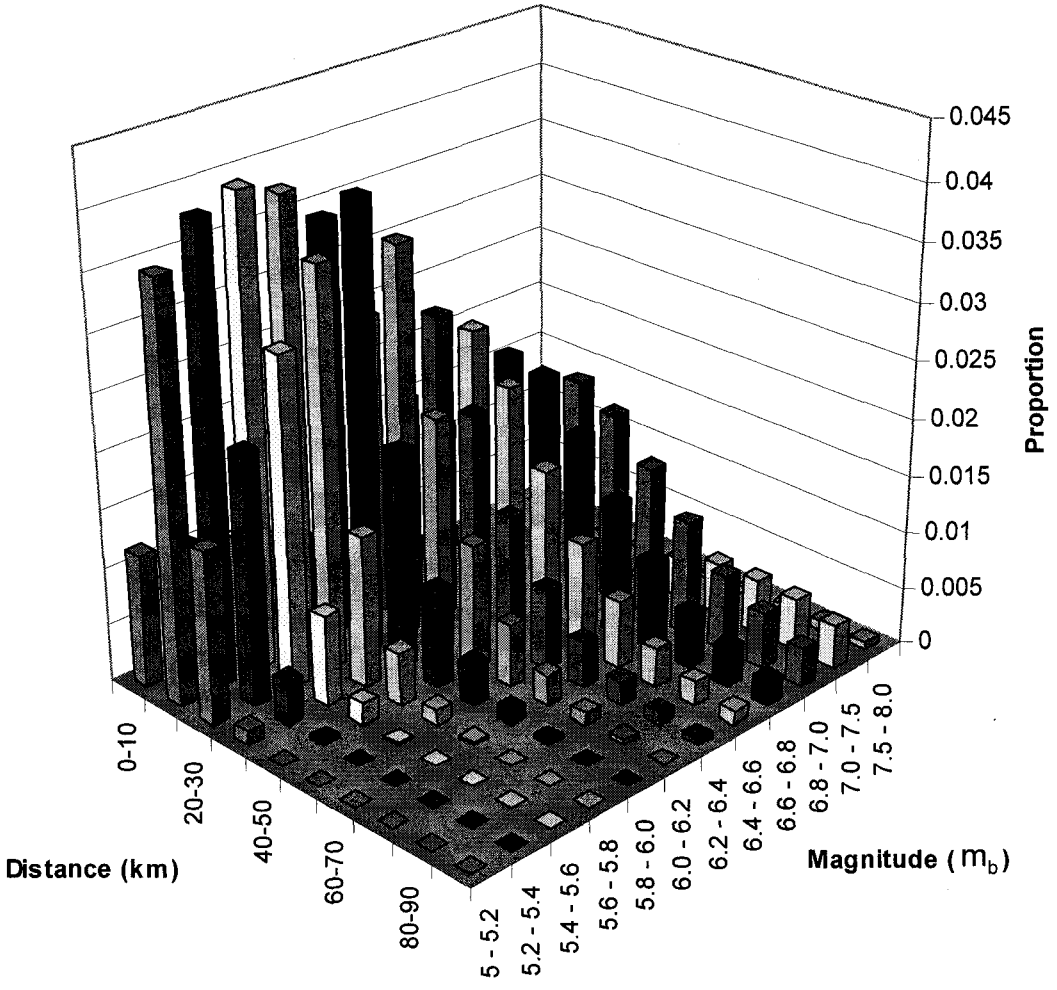
Project No. 22235583	Elizabeth Mine Strafford, VT	**Magnitude and Distance Contributions to the Mean Peak Acceleration Hazard at 1000 Year Return Period**	Figure A-12
URS			

2500 YR RETURN PERIOD
Peak Ground Acceleration

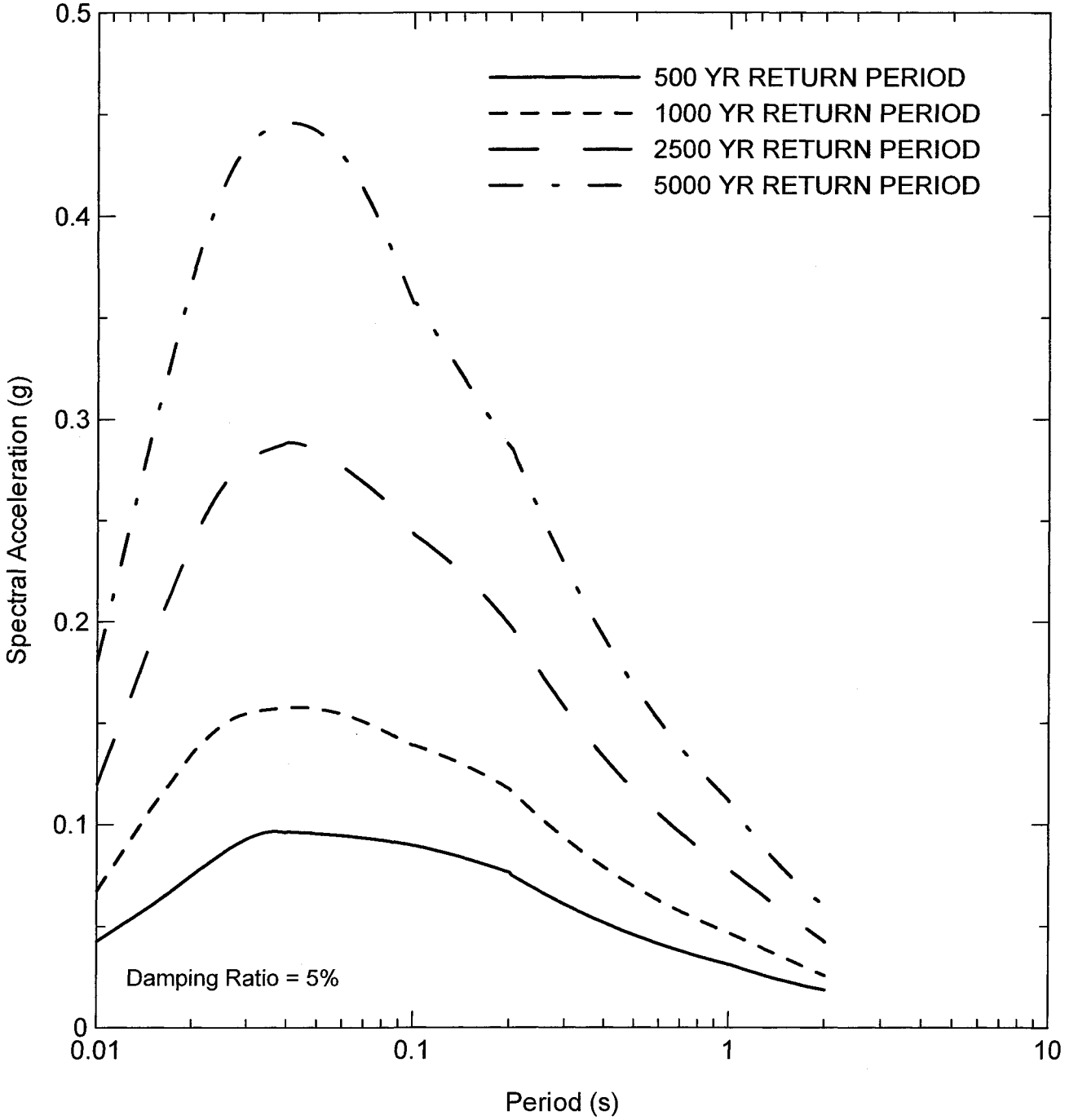


Project No. 22235583	Elizabeth Mine Strafford, VT	**Magnitude and Distance Contributions to the Mean Peak Acceleration Hazard at 2500 Year Return Period**	Figure A-13
URS			

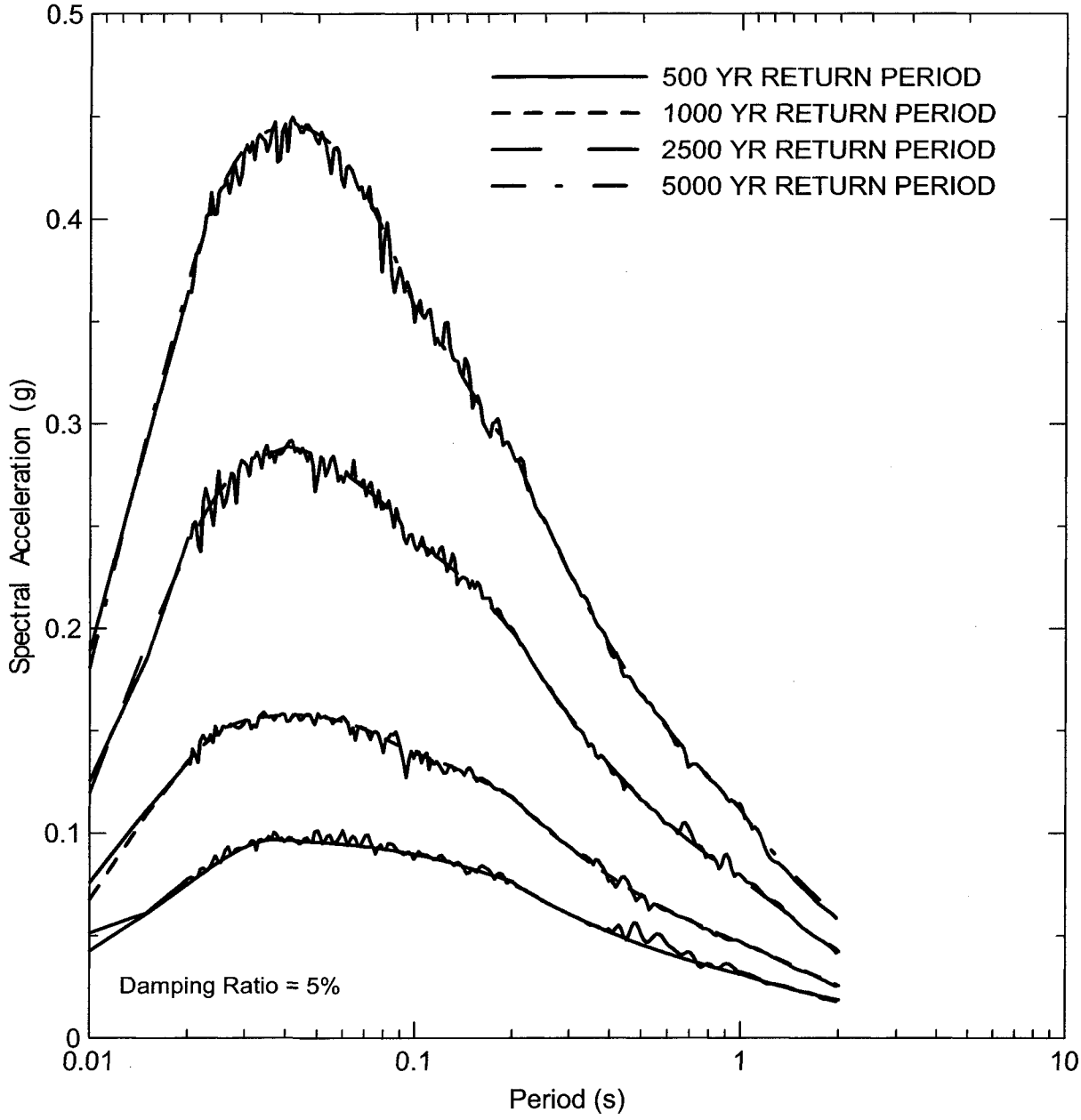
5000 YR RETURN PERIOD
Peak Ground Acceleration



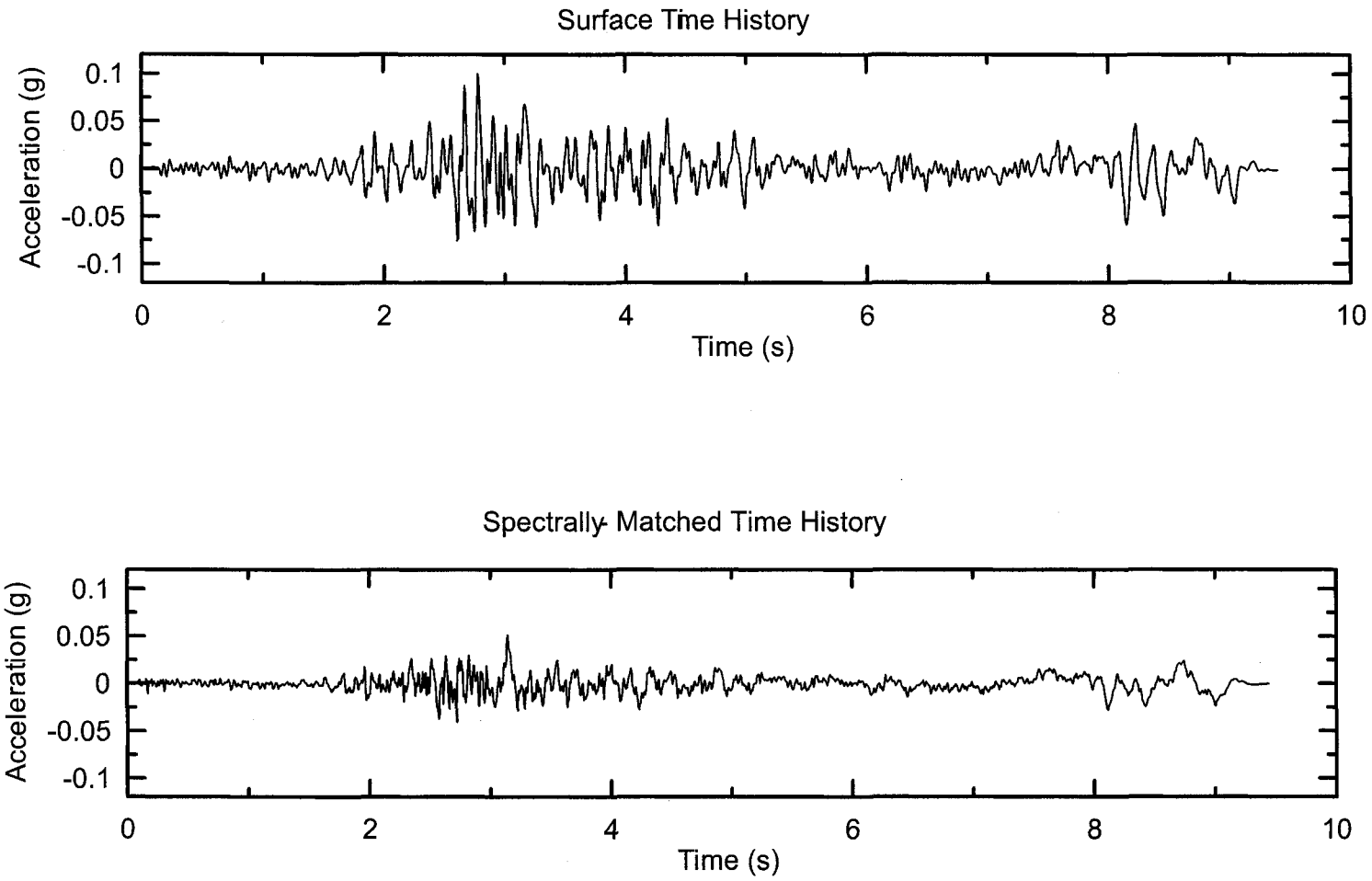
Project No. 22235583	Elizabeth Mine Strafford, VT	**Magnitude and Distance Contributions to the Mean Peak Acceleration Hazard at 5000 Year Return Period**	Figure A-14
URS			



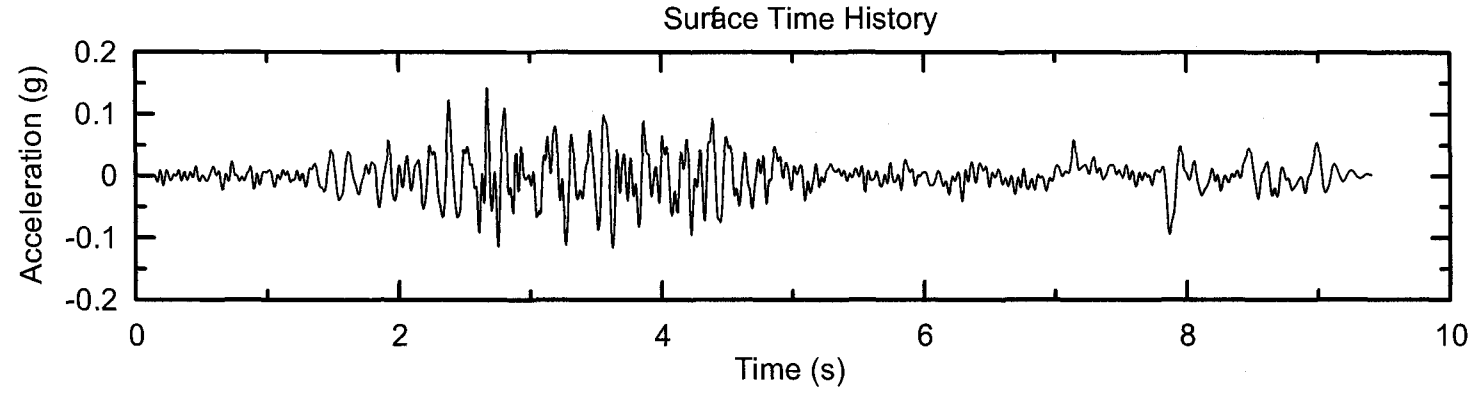
Project No.: 22235583 Elizabeth Mine Strafford, VT URS	**Uniform Hazard Spectra**	Figure A-15

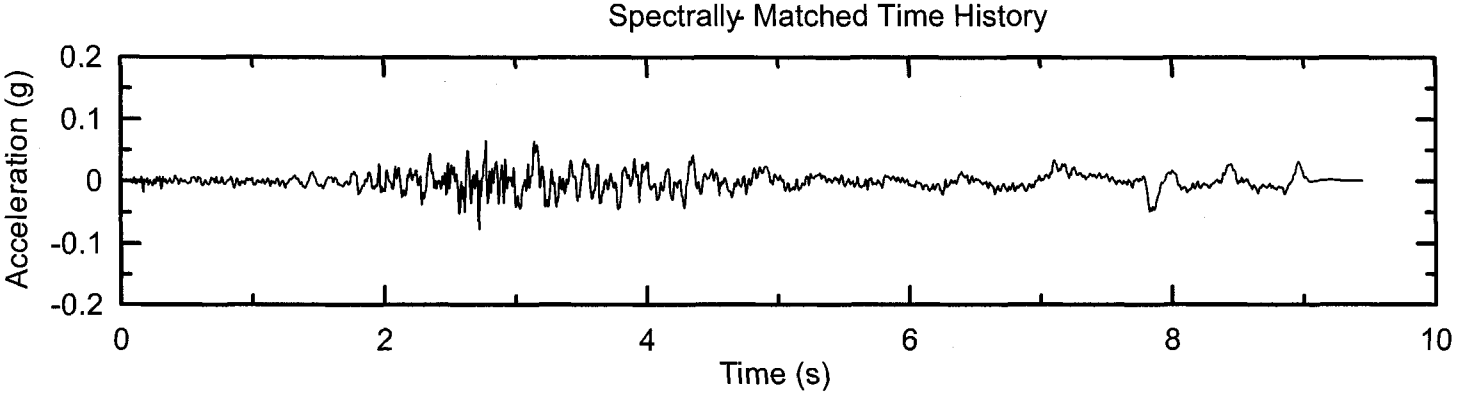


Project No.: 22235583 Elizabeth Mine Strafford, VT URS	**Spectral Match with Uniform Hazard Spectra**	Figure A-16

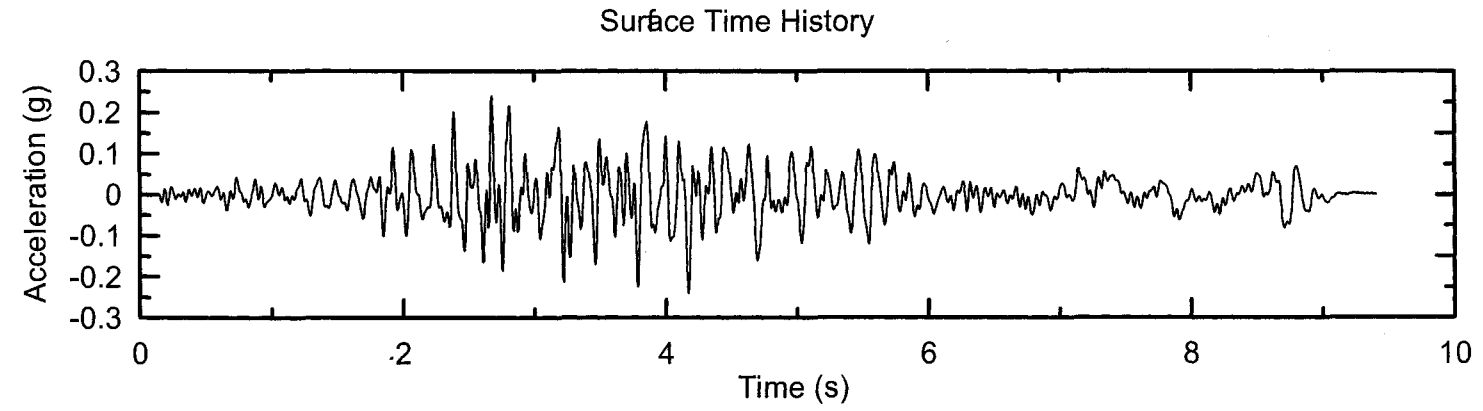


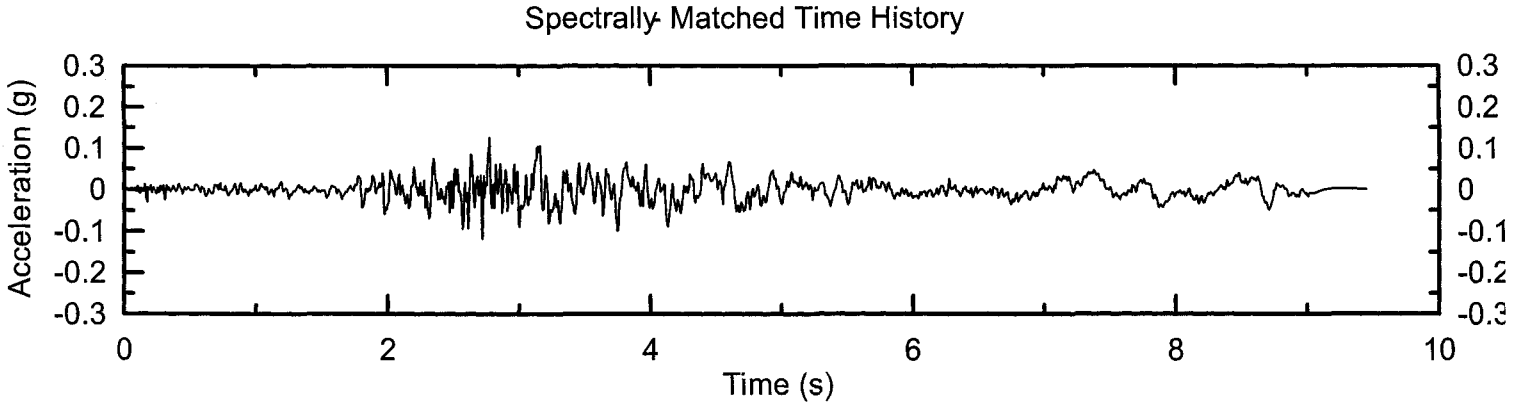
Project No. 22235583	Elizabeth Mine Strafford, VT	**Spectrally – Matched and Surface Time Histories for Return Period of 500 Years**	Figure A-17
URS			



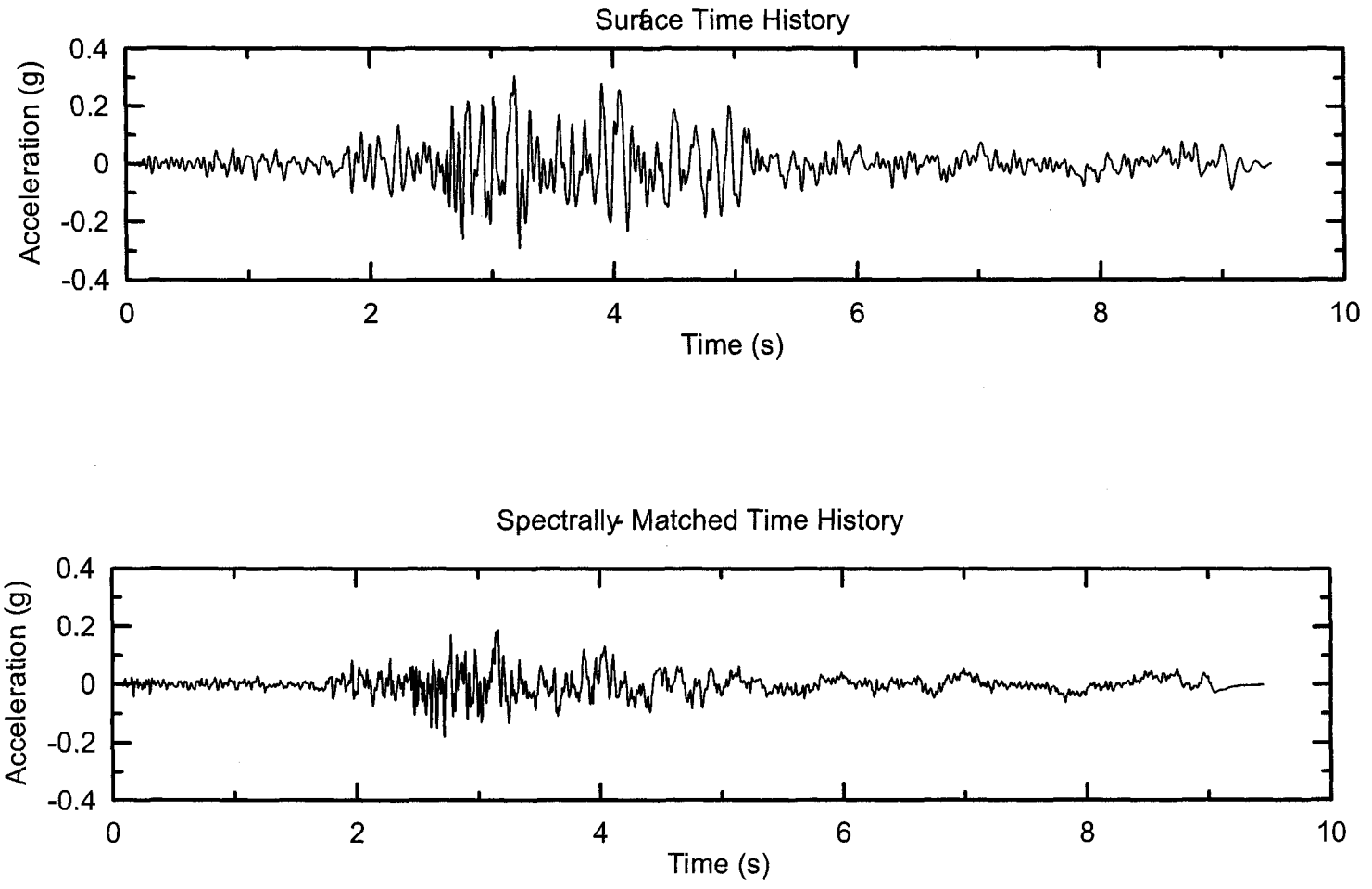


Project No. 22235583	Elizabeth Mine Strafford, VT	**Spectrally – Matched and Surface Time Histories for Return Period of 1000 Years**	Figure A-18
URS			





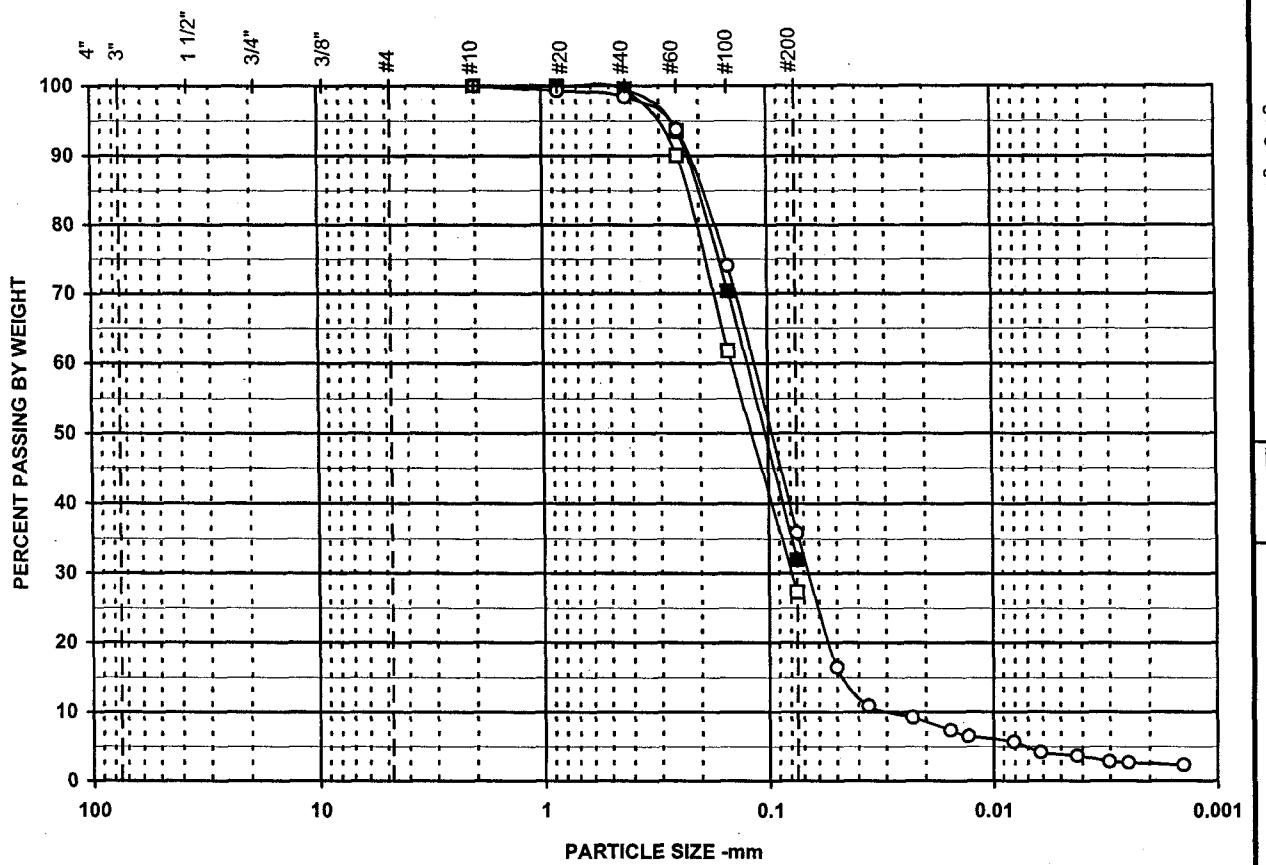
Project No. 22235583	Elizabeth Mine Strafford, VT	**Spectrally – Matched and Surface Time Histories for Return Period of 2500 Years**	Figure A-19
URS			



Project No. 22235583	Elizabeth Mine Strafford, VT	**Spectrally – Matched and Surface Time Histories for Return Period of 5000 Years**	Figure A-20
URS			

Appendix B
Laboratory Results

COBBLES	GRAVEL		SAND			SILT OR CLAY
	COARSE	FINE	COARSE	MEDIUM	FINE	



SYMBOL	DESCRIPTION AND REMARKS
□	gray f. SAND, some silt.
■	gray silty f. SAND.
○	dark brown silty f. SAND.

Symbol	□	■	○
Boring	TB-9	TB-10	TB-10
Sample			
Spec	BOT	BOT	B
Depth	27.3	32.2	60.85
% +3"			
% Gravel			
% SAND	72.7	68.0	64.1
% FINES	27.3	32.0	35.9
% -2μ			3
Cc			
Cu			
LL			
PL	np	np	
PI			
USCS	SM	SM	SM
w (%)			

Particle Size	PERCENT FINER		
(Sieve #)	□	■	○
4"			
3"			
1 1/2"			
3/4"			
3/8"			
4			
10	100.0		100.0
20	99.9	100.0	99.3
40	99.4	99.6	98.4
60	90.0	93.5	93.7
100	61.8	70.4	74.1
200	27.3	32.0	35.9

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Elizabeth Mine

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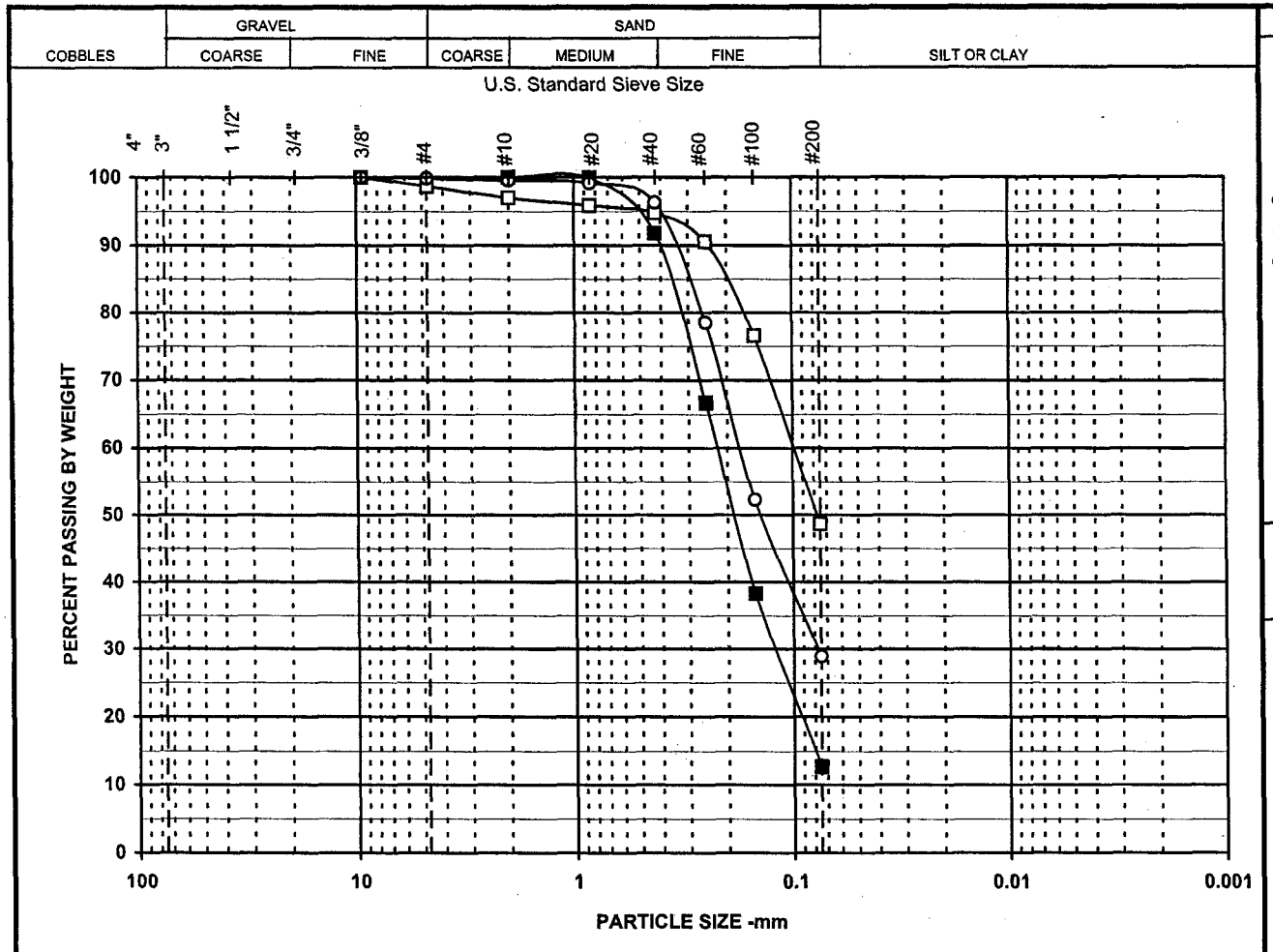

Symbol	□	■	○
Boring	TB-11	TB-12	TB-13
Sample			
Spec	A	BOT	B
Depth	40.25	17.2	30.75
% +3"			
% Gravel	1.3		0.2
% SAND	50.0	87.3	70.9
% FINES	48.7	12.7	28.9
% -2μ			
Cc			
Cu			
LL			
PL		np	
PI			
USCS	SM	SM	SM
w (%)			27.8

Particle Size	PERCENT FINER		
(Sieve #)	□	■	○
4"			
3"			
1 1/2"			
3/4"			
3/8"	100.0		100.0
4	98.7		99.8
10	97.0	100.0	99.5
20	95.9	99.9	99.2
40	94.8	91.8	96.3
60	90.5	66.7	78.5
100	76.6	38.3	52.3
200	48.7	12.7	28.9

SYMBOL	DESCRIPTION AND REMARKS
□	gray silty c-f SAND.
■	gray f. SAND, some silt, tr. m. sand.
○	dark brown f. SAND, some silt, trace m. sand.

PARTICLE SIZE DISTRIBUTION

Elizabeth Mine

Project No.		
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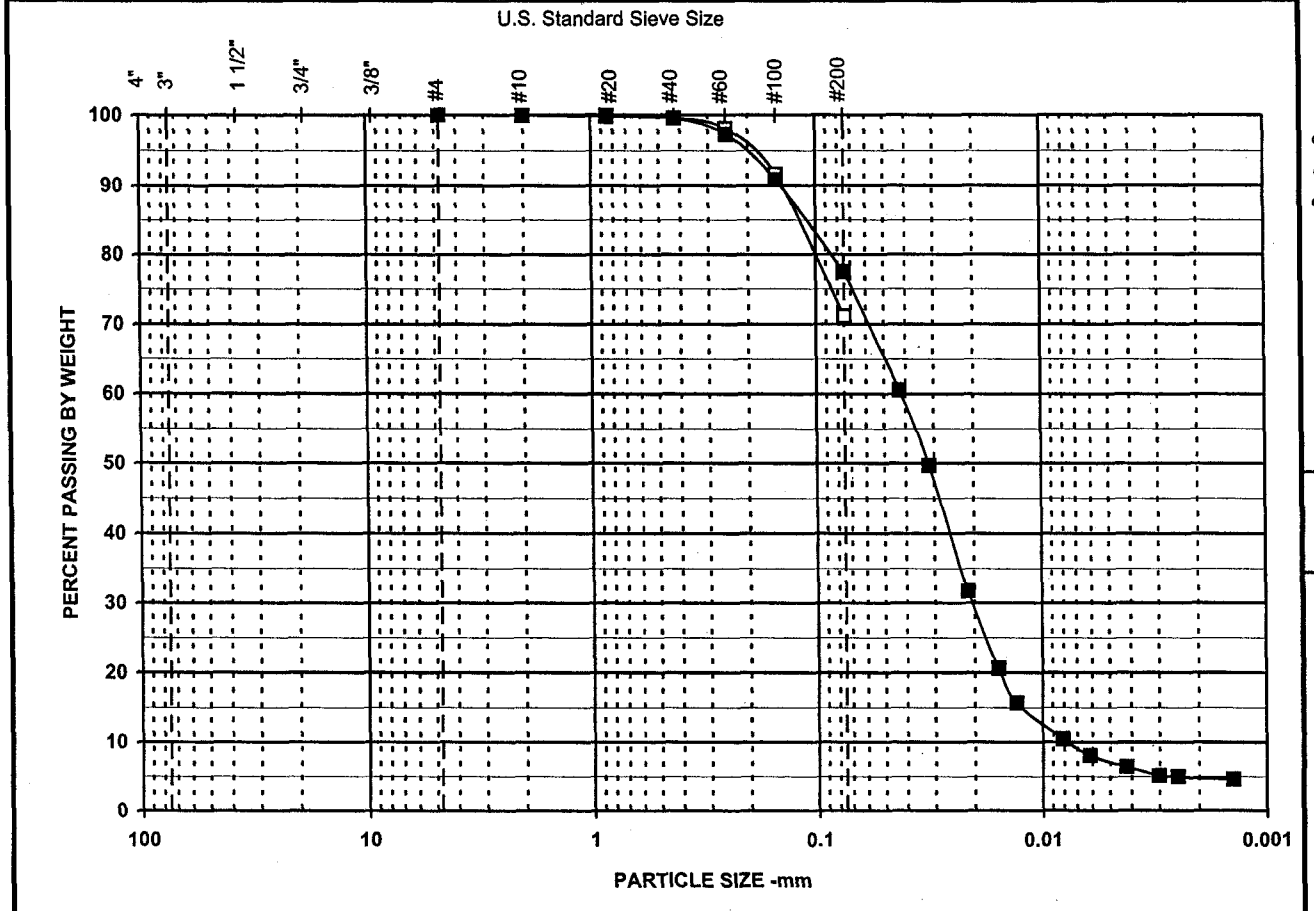

SYMBOL	DESCRIPTION AND REMARKS
□	gray SILT, some f. sand
■	dark brown gray SILT, some f. sand.
○	

Symbol	□	■	○
Boring	TB-14	TB-14	
Sample			
Spec		A	
Depth	21.7	40.25	
% +3"			
% Gravel			
% SAND	28.9	22.5	
% FINES	71.1	77.5	
% -2μ		5	
Cc			
Cu			
LL			
PL	np		
PI			
USCS	ML	ML	
w (%)			

Particle Size	PERCENT FINER		
(Sieve #)	□	■	○
4"			
3"			
1 1/2"			
3/4"			
3/8"			
4			
10	100.0		
20	99.8	100.0	
40	99.6	99.6	
60	98.1	97.3	
100	91.6	90.8	
200	71.1	77.5	

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Elizabeth Mine

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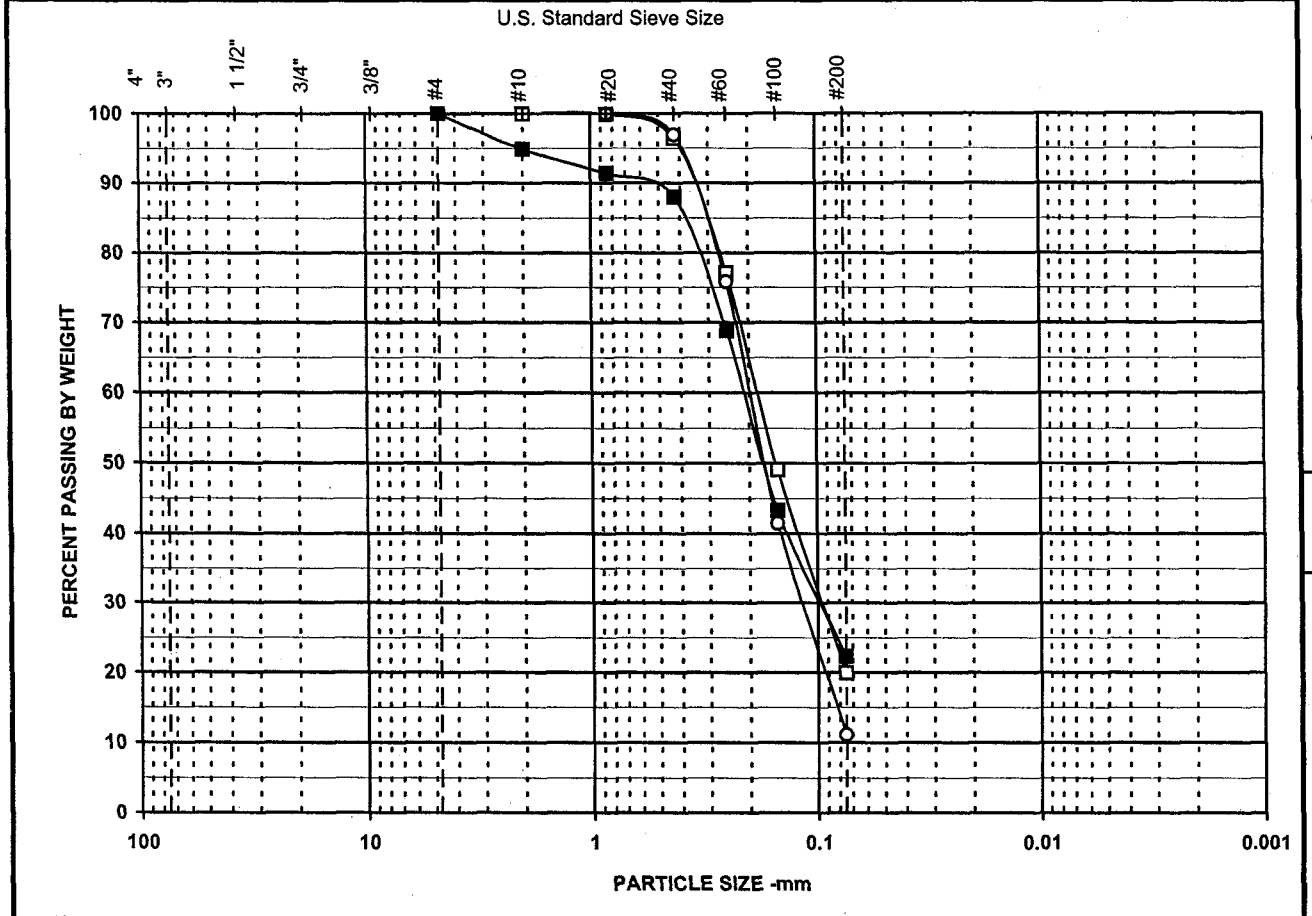

SYMBOL	DESCRIPTION AND REMARKS
□	gray f. SAND, some silt, trace m. sand.
■	brown c-f SAND, some silt.
○	gray f. SAND, trace m. sand, silt.

Symbol	□	■	○
Boring	TB-16	TB-16	TB-17
Sample			
Spec	BOT	A	B
Depth	17.2	30.3	16.35
% +3"			
% Gravel			
% SAND	80.1	77.7	88.9
% FINES	19.9	22.3	11.1
% -2μ			
Cc			1.0
Cu			2.8
LL			
PL	np		
PI			
USCS	SM	SM	SP-SM
w (%)			

Particle Size	PERCENT FINER		
(Sieve #)	□	■	○
4"			
3"			
1 1/2"			
3/4"			
3/8"			
4	100.0	100.0	
10	100.0	94.9	
20	99.9	91.4	100.0
40	96.4	88.0	96.9
60	77.1	68.8	75.8
100	49.1	43.3	41.5
200	19.9	22.3	11.1

PARTICLE SIZE DISTRIBUTION
Elizabeth Mine

Project No.		Figure
13846-066	March 2003	

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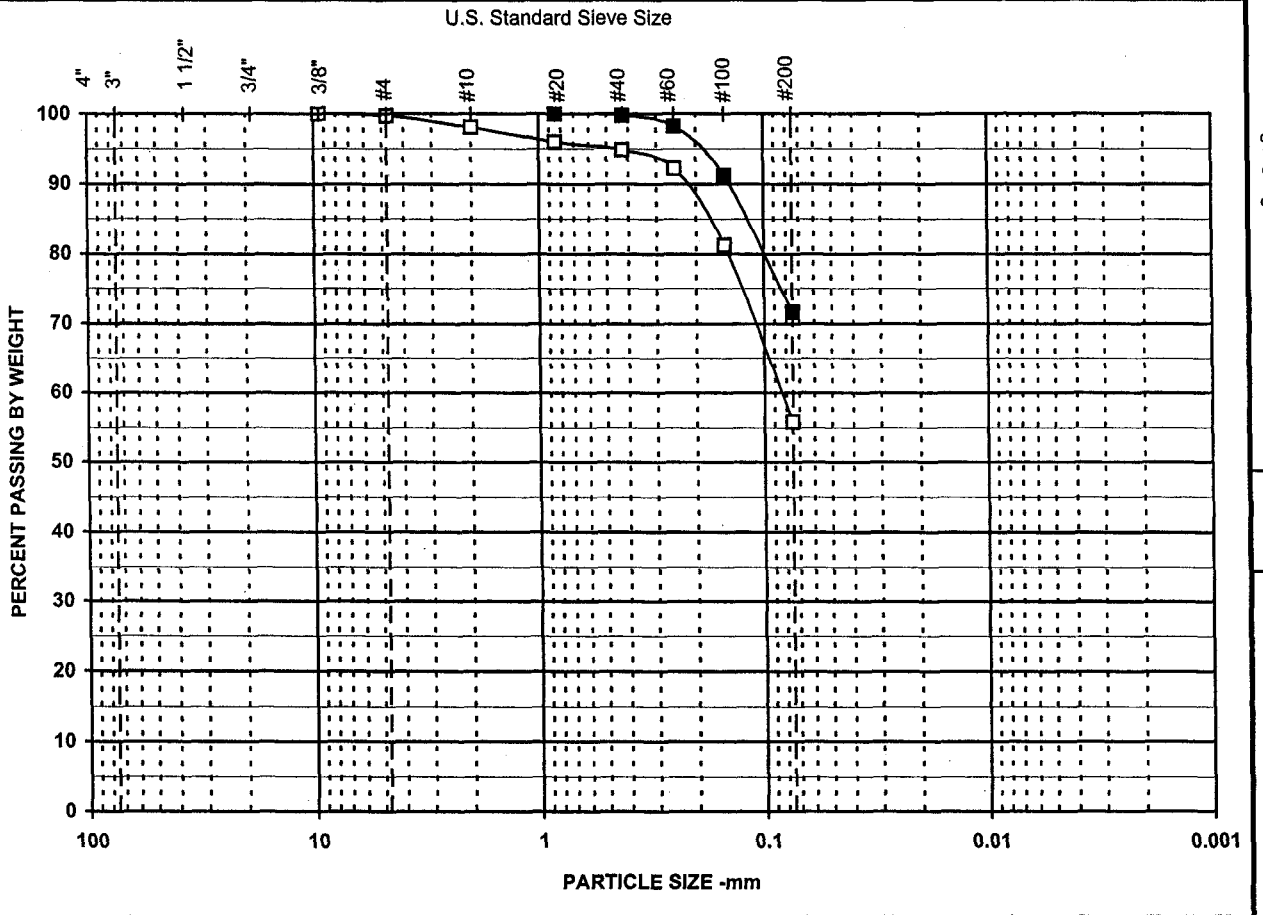

SYMBOL	DESCRIPTION AND REMARKS
□	gray c-f sandy SILT.
■	gray SILT, some f. sand.
○	

Symbol	□	■	○
Boring	Composite	Composite	
Sample	TB-10&11	TB-14	
Spec			
Depth	60'&40'	20'	
% +3"			
% Gravel	0.3		
% SAND	43.9	28.3	
% FINES	55.8	71.7	
% -2μ			
Cc			
Cu			
LL			
PL			
PI			
USCS	ML	ML	
w (%)		31.6	

Particle Size	PERCENT FINER		
(Sieve #)	□	■	○
4"			
3"			
1 1/2"			
3/4"			
3/8"	100.0		
4	99.7		
10	98.1		
20	96.0	100.0	
40	94.8	99.8	
60	92.2	98.2	
100	81.3	91.2	
200	55.8	71.7	

PARTICLE SIZE DISTRIBUTION
Elizabeth Mine

Project No.		Figure
13846-066	March 2003	

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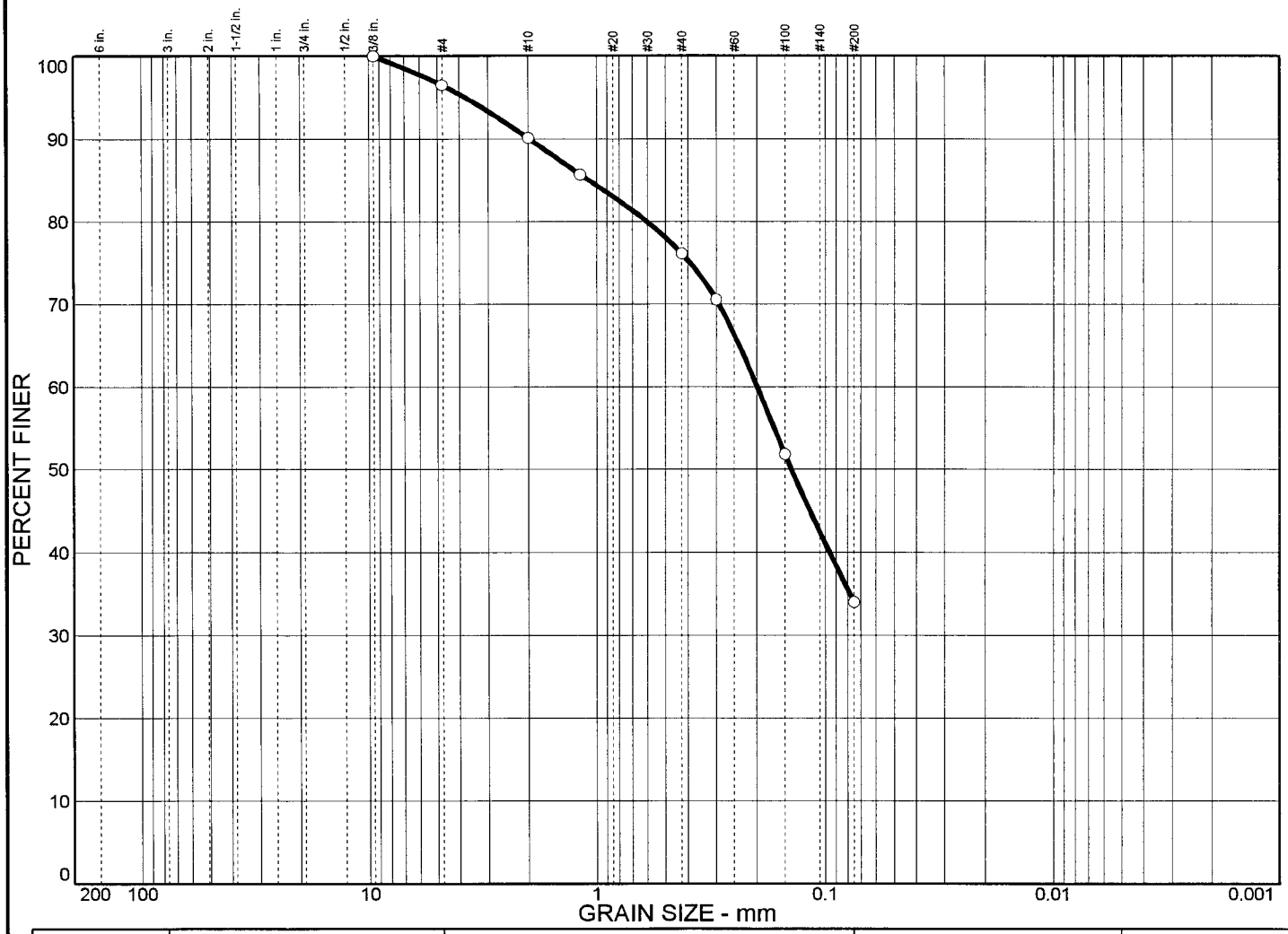
Siev2e.xls 03/07/2003

Particle Size Distribution Report



	% + 3"	% GRAVEL	% SAND	% SILT	% CLAY
○	0.0	3.5	62.5	34.0	

	LL	PL	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
○	N/P	N/P	1.08	0.199	0.141					

MATERIAL DESCRIPTION	USCS	AASHTO
○ Silty sand	SM	

Project No. 22235583 **Client:**

Project: ELIZABETH MINE

○ **Source:** TB-9 **Elev./Depth:** 0-2'

Remarks:

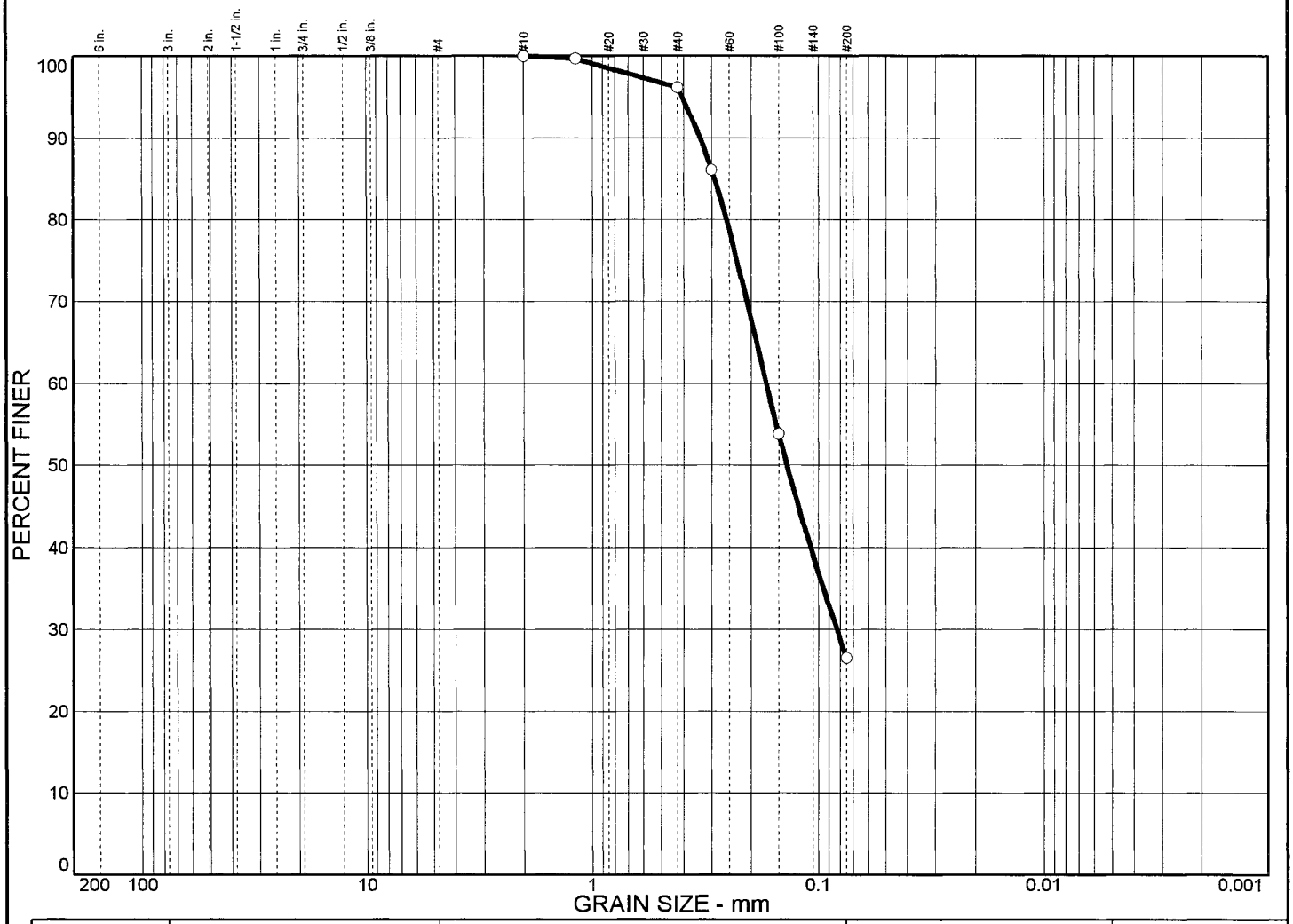
○

Particle Size Distribution Report

URS CORPORATION

Fig.

Particle Size Distribution Report



	% + 3"	% GRAVEL	% SAND	% SILT	% CLAY
○	0.0	0.0	73.5	26.5	

	LL	PL	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
○	N/P	N/P	0.291	0.171	0.138	0.0827				

MATERIAL DESCRIPTION	USCS	AASHTO
○ Silty sand	SM	

Project No. 22235583 **Client:**

Project: ELIZABETH MINE

○ **Source:** TB-9 **Elev./Depth:** 15-17'

Remarks:

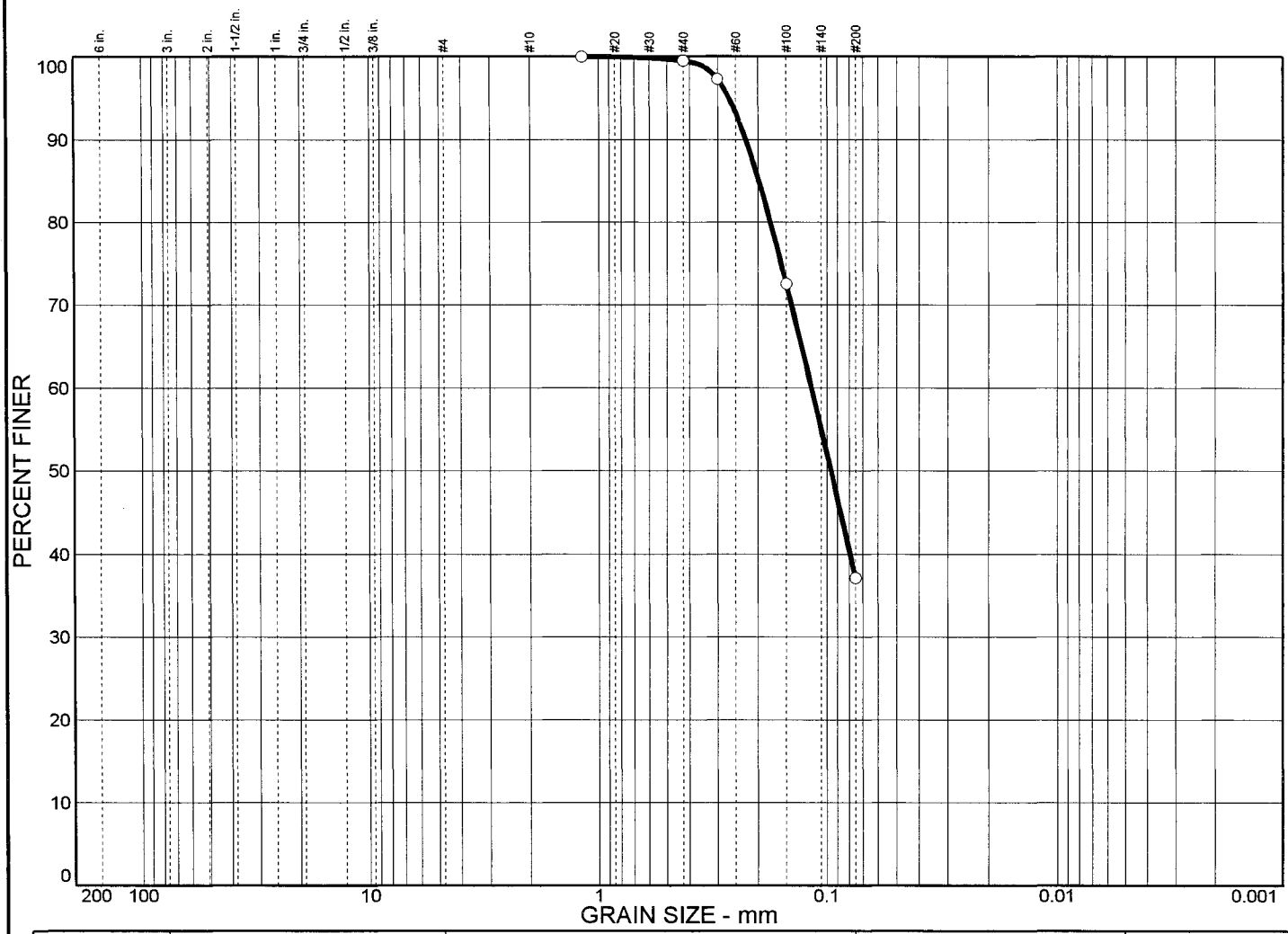
○

Particle Size Distribution Report

URS CORPORATION

Fig.

Particle Size Distribution Report



	% + 3"	% GRAVEL	% SAND	% SILT	% CLAY
○	0.0	0.0	62.9	37.1	

	LL	PL	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
○	N/P	N/P	0.198	0.117	0.0959					

MATERIAL DESCRIPTION	USCS	AASHTO
○ Silty sand	SM	

Project No. 22235583 **Client:**

Project: ELIZABETH MINE

○ **Source:** TB-9 **Elev./Depth:** 30-32'

Remarks:

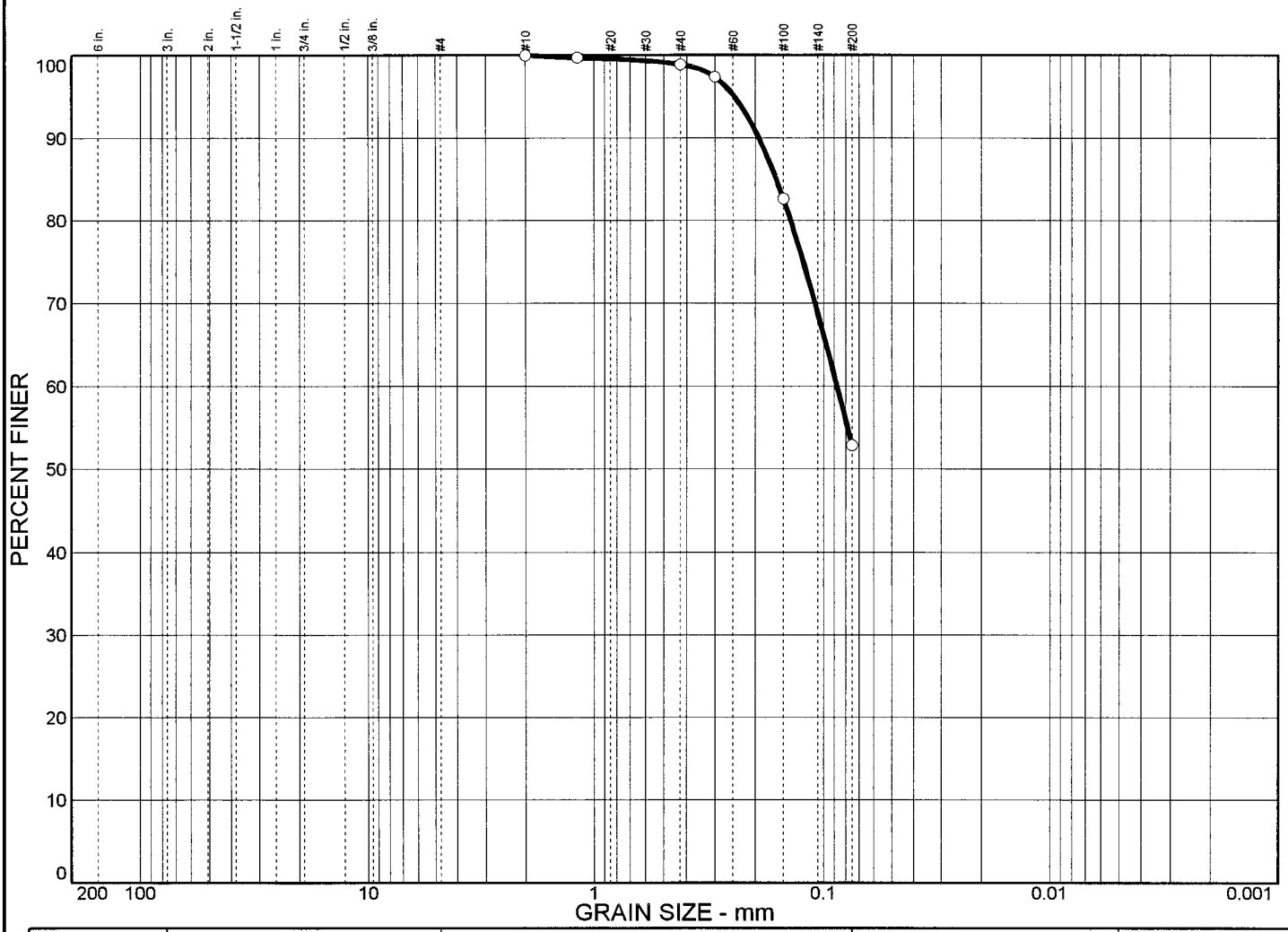
○

Particle Size Distribution Report

URS CORPORATION

Fig.

Particle Size Distribution Report



	% + 3"	% GRAVEL	% SAND	% SILT	% CLAY
○	0.0	0.0	47.2	52.8	

	LL	PL	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
○	N/P	N/P	0.161	0.0874						

MATERIAL DESCRIPTION	USCS	AASHTO
○ Sandy silt	ML	

Project No. 22235583 **Client:**

Project: ELIZABETH MINE

○ **Source:** TB-9 **Elev./Depth:** 50-52'

Remarks:

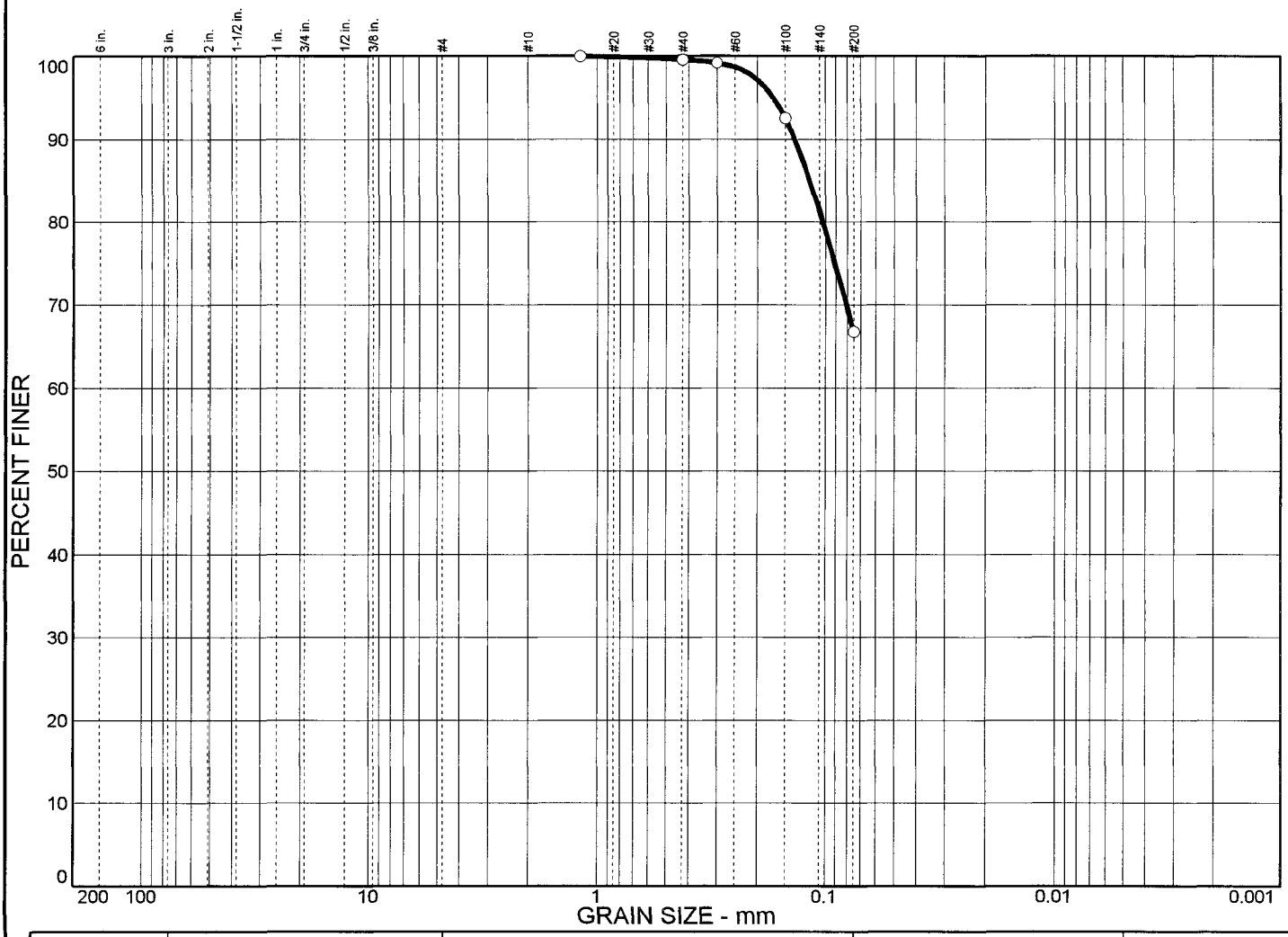
○

Particle Size Distribution Report

URS CORPORATION

Fig.

Particle Size Distribution Report



	% + 3"	% GRAVEL	% SAND	% SILT	% CLAY
○	0.0	0.0	33.3	66.7	

	LL	PL	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
○	N/P	N/P	0.117							

MATERIAL DESCRIPTION	USCS	AASHTO
○ Sandy silt	ML	

Project No. 22235583 **Client:**

Project: ELIZABETH MINE

○ **Source:** TB-9 **Elev./Depth:** 65-67'

Remarks:

○

Particle Size Distribution Report

URS CORPORATION

Fig.

Particle Size Distribution Report

	% + 3"	% GRAVEL	% SAND	% SILT	% CLAY
○	0.0	0.0	81.3	18.7	

	LL	PL	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
○	N/P	N/P	0.370	0.203	0.165	0.103				

MATERIAL DESCRIPTION	USCS	AASHTO
○ Silty sand	SM	

Project No. 22235583 **Client:**

Project: ELIZABETH MINE

○ **Source:** TB-10 **Elev./Depth:** 5-7'

Remarks:

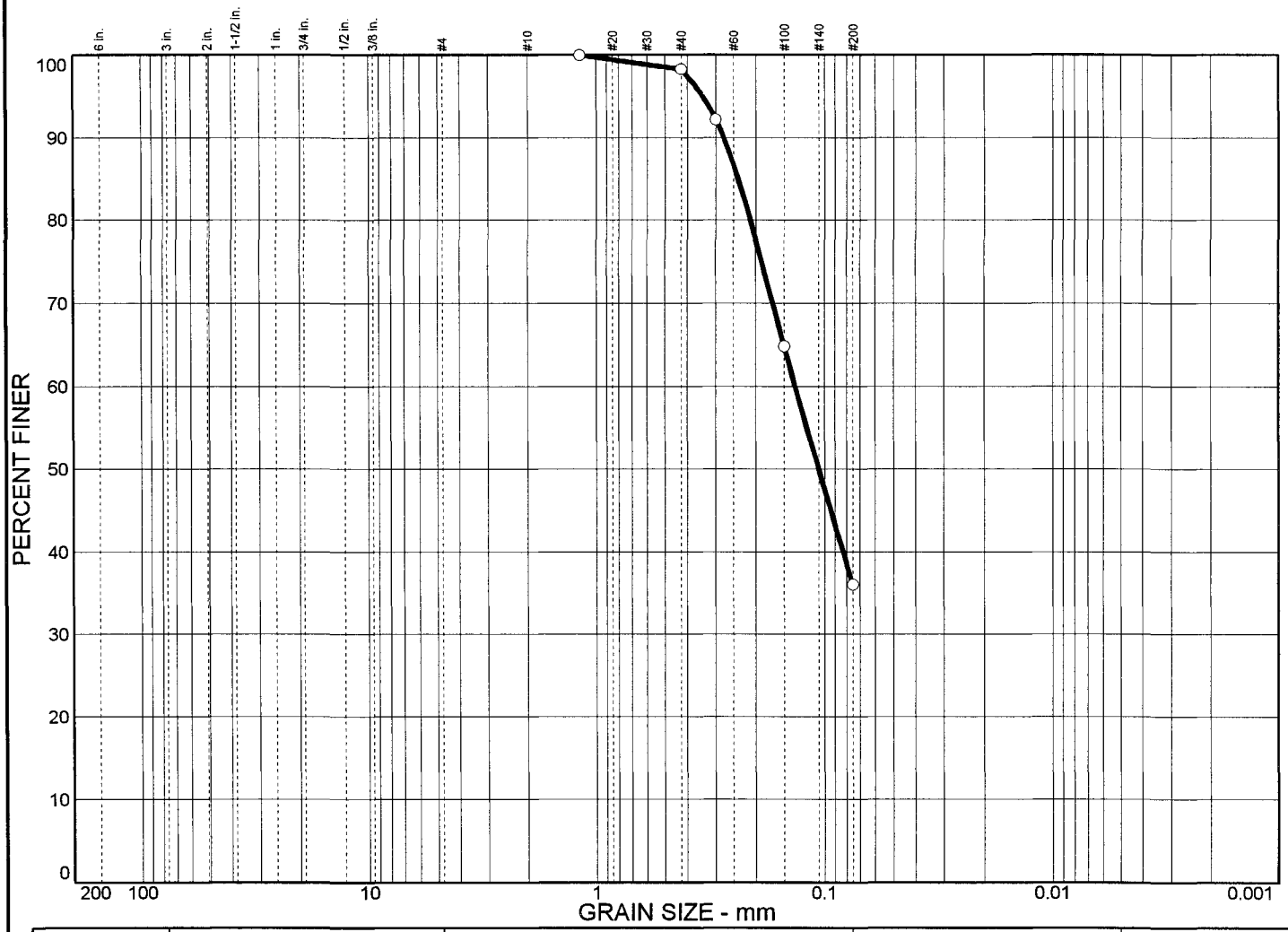
○

Particle Size Distribution Report

URS CORPORATION

Fig.

Particle Size Distribution Report



	% + 3"	% GRAVEL	% SAND	% SILT	% CLAY
○	0.0	0.0	64.0	36.0	

	LL	PL	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
○	N/P	N/P	0.240	0.134	0.106					

MATERIAL DESCRIPTION	USCS	AASHTO
○ Silty sand	SM	

Project No. 22235583 **Client:**

Project: ELIZABETH MINE

○ **Source:** TB-10 **Elev./Depth:** 20-22'

Remarks:

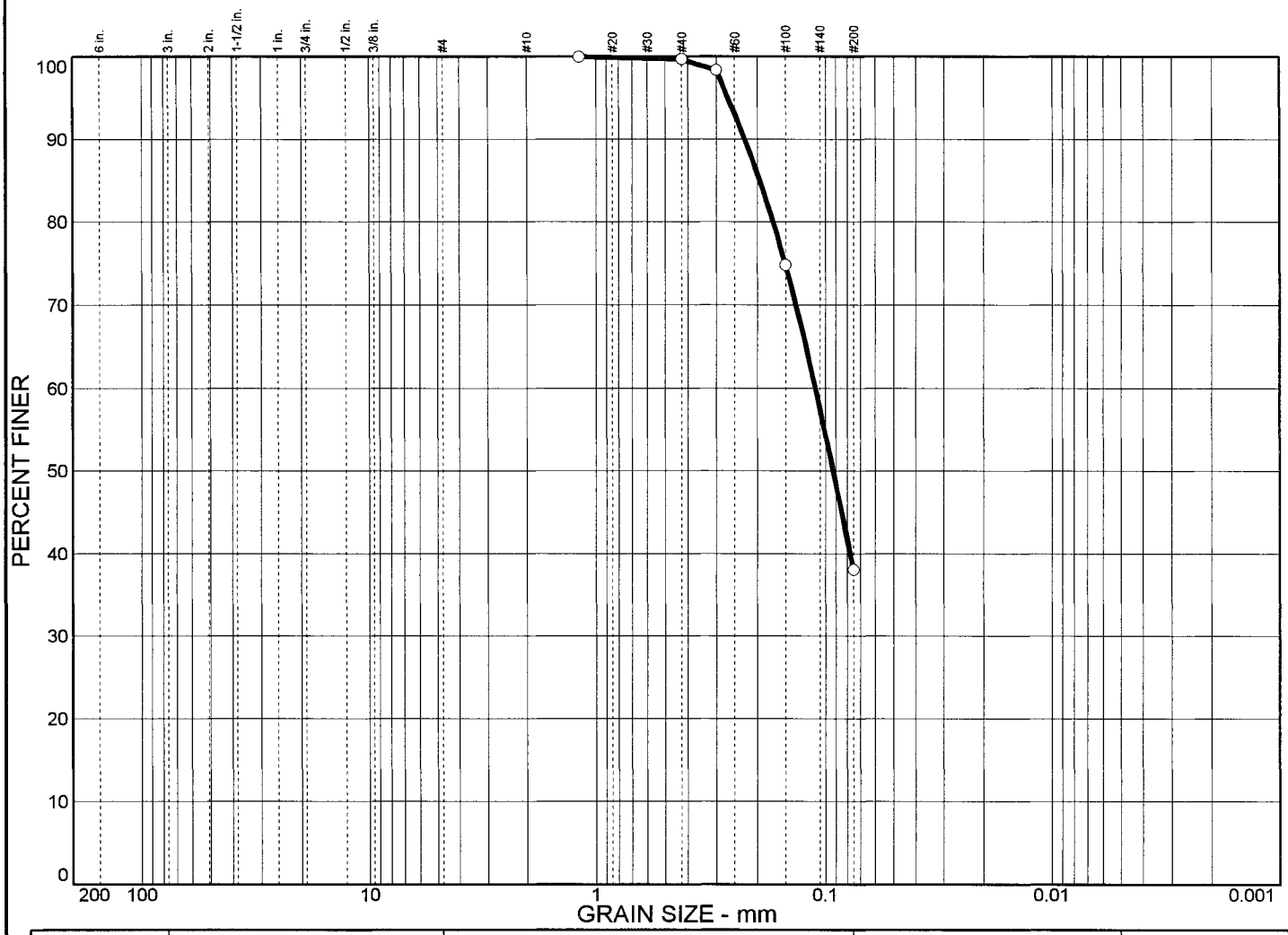
○

Particle Size Distribution Report

URS CORPORATION

Fig.

Particle Size Distribution Report



	% + 3"	% GRAVEL	% SAND	% SILT	% CLAY
○	0.0	0.0	62.0	38.0	

	LL	PL	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
○	N/P	N/P	0.195	0.111	0.0924					

MATERIAL DESCRIPTION	USCS	AASHTO
○ Silty sand	SM	

Project No. 22235583 **Client:**

Project: ELIZABETH MINE

○ **Source:** TB-10 **Elev./Depth:** 50-52'

Remarks:

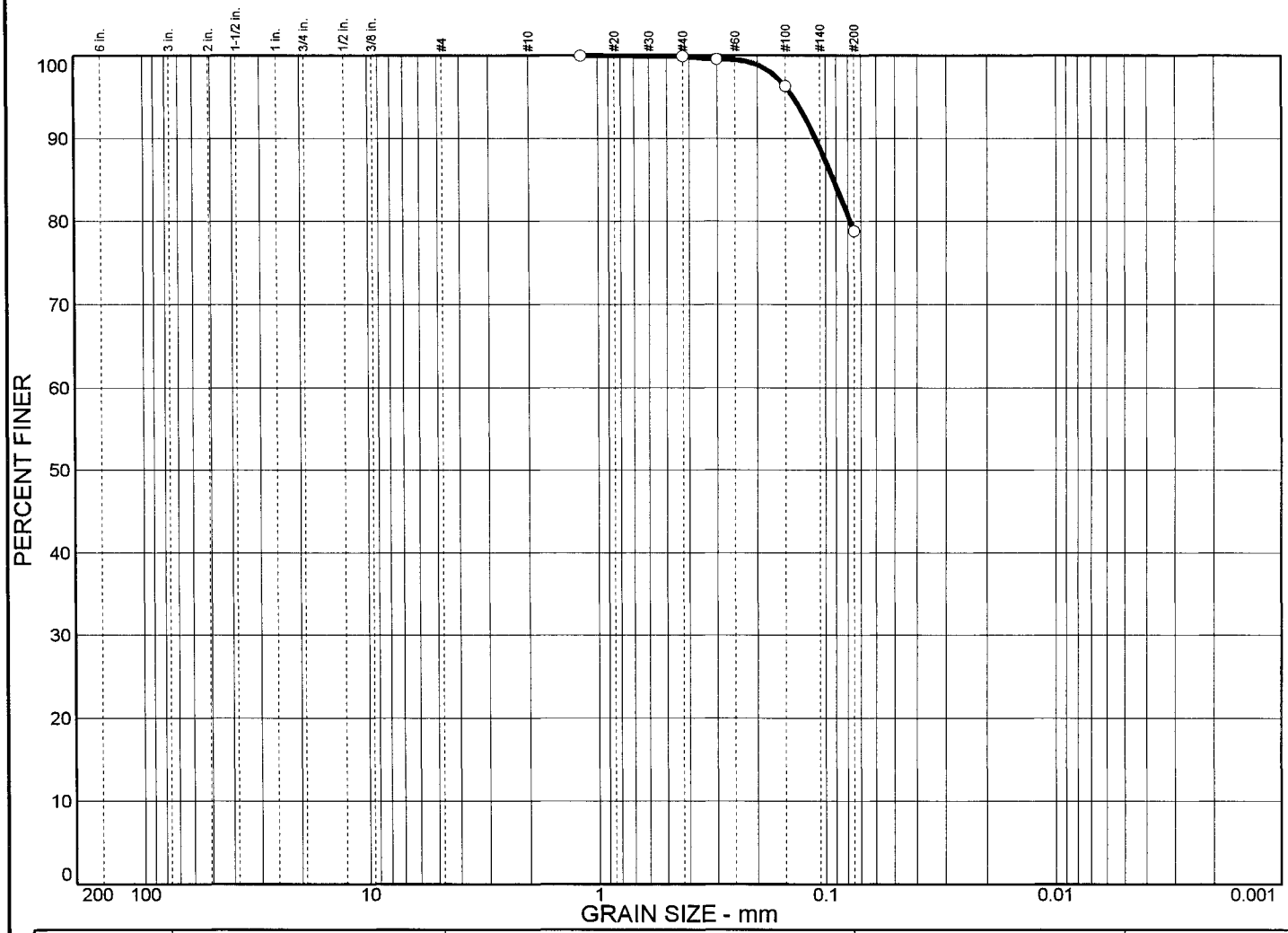
○

Particle Size Distribution Report

URS CORPORATION

Fig.

Particle Size Distribution Report



	% + 3"	% GRAVEL	% SAND	% SILT	% CLAY
○	0.0	0.0	21.2	78.8	

	LL	PL	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
○	N/P	N/P	0.0922							

MATERIAL DESCRIPTION	USCS	AASHTO
○ Silt with sand	ML	

Project No. 22235583 **Client:**

Project: ELIZABETH MINE

○ **Source:** TB-10 **Elev./Depth:** 65-67'

Remarks:

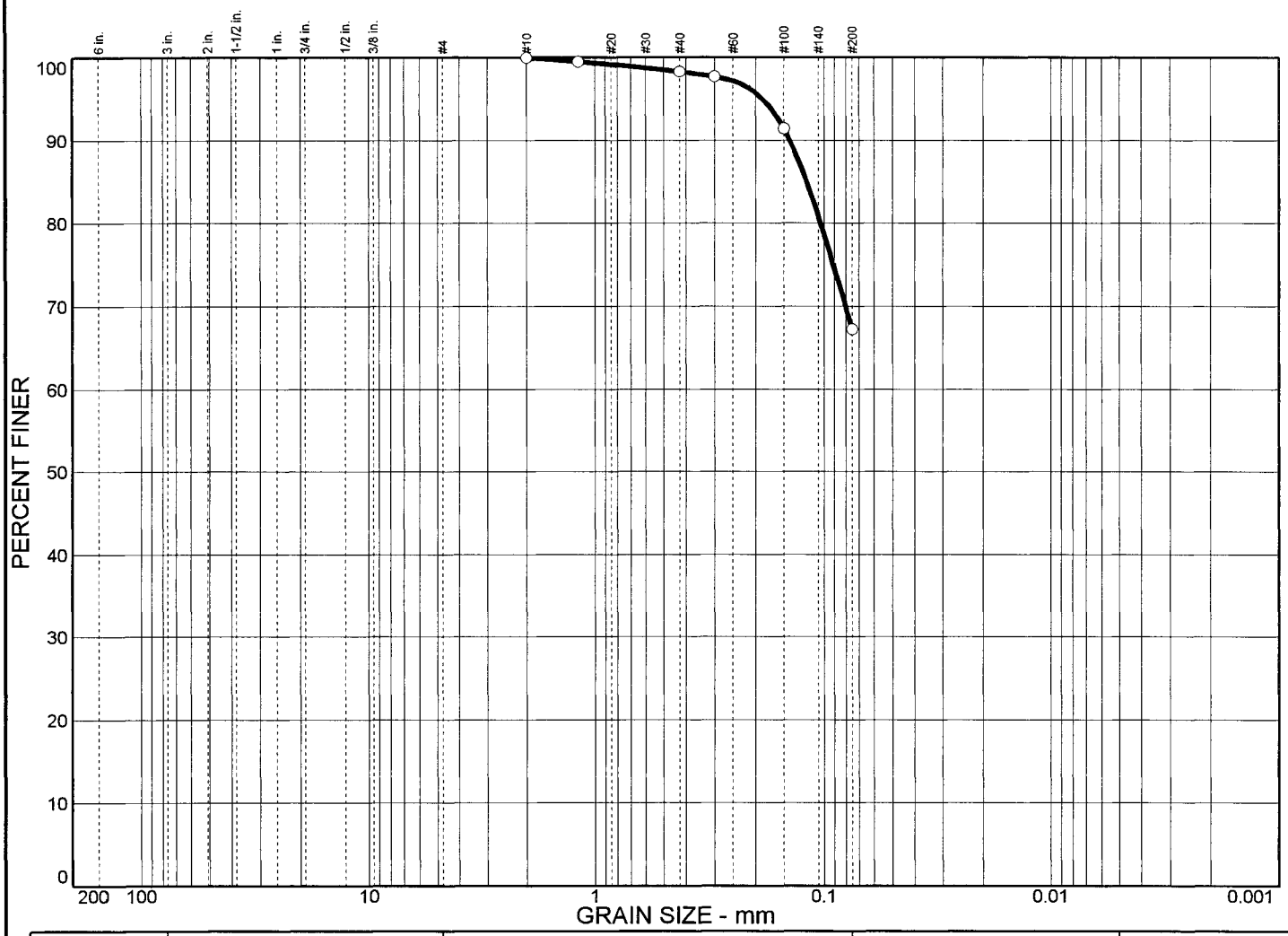
○

Particle Size Distribution Report

URS CORPORATION

Fig.

Particle Size Distribution Report



	% + 3"	% GRAVEL	% SAND	% SILT	% CLAY
○	0.0	0.0	32.8	67.2	

	LL	PL	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
○	N/P	N/P	0.119							

MATERIAL DESCRIPTION	USCS	AASHTO
○ Sandy silt	ML	

Project No. 22235583 **Client:**

Project: ELIZABETH MINE

○ **Source:** TB-10 **Elev./Depth:** 80-82'

Remarks:

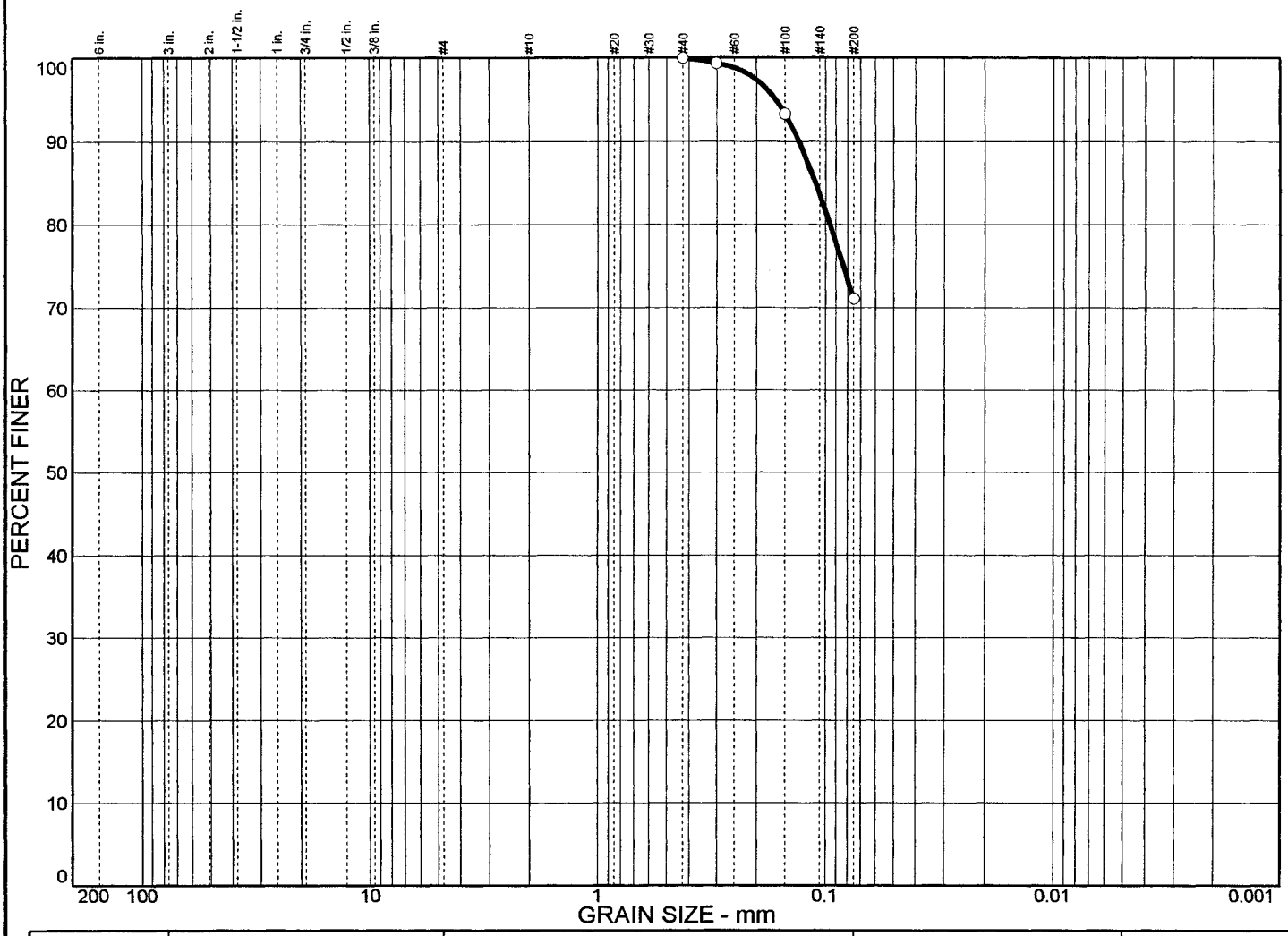
○

Particle Size Distribution Report

URS CORPORATION

Fig.

Particle Size Distribution Report



	% + 3"	% GRAVEL	% SAND	% SILT	% CLAY
○	0.0	0.0	28.9	71.1	

	LL	PL	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
○	N/P	N/P	0.110							

MATERIAL DESCRIPTION	USCS	AASHTO
○ Silt with sand	ML	

Project No. 22235583 **Client:**

Project: ELIZABETH MINE

○ **Source:** TB-10 **Elev./Depth:** 92-94.5'

Remarks:

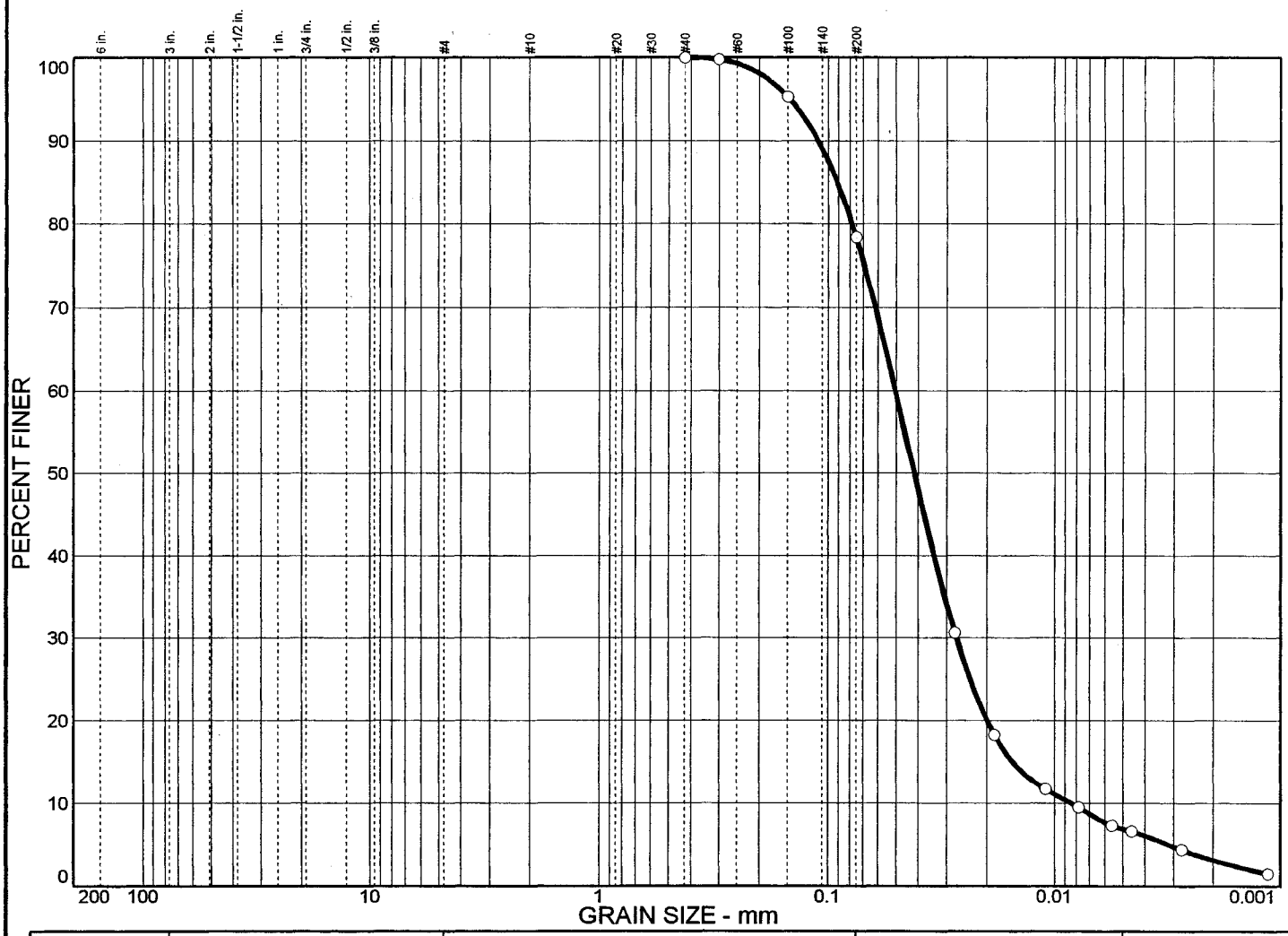
○

Particle Size Distribution Report

URS CORPORATION

Fig.

Particle Size Distribution Report



	% + 3"	% GRAVEL	% SAND	% SILT	% CLAY
○	0.0	0.0	21.6	71.5	6.9

	LL	PL	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
○	N/P	N/P	0.0910	0.0504	0.0416	0.0272	0.0153	0.0084	1.74	5.99

MATERIAL DESCRIPTION	USCS	AASHTO
○ Silt with sand	ML	

Project No. 22235583 **Client:**

Project: ELIZABETH MINE

○ **Source:** TB-10 **Elev./Depth:** 100-102'

Remarks:

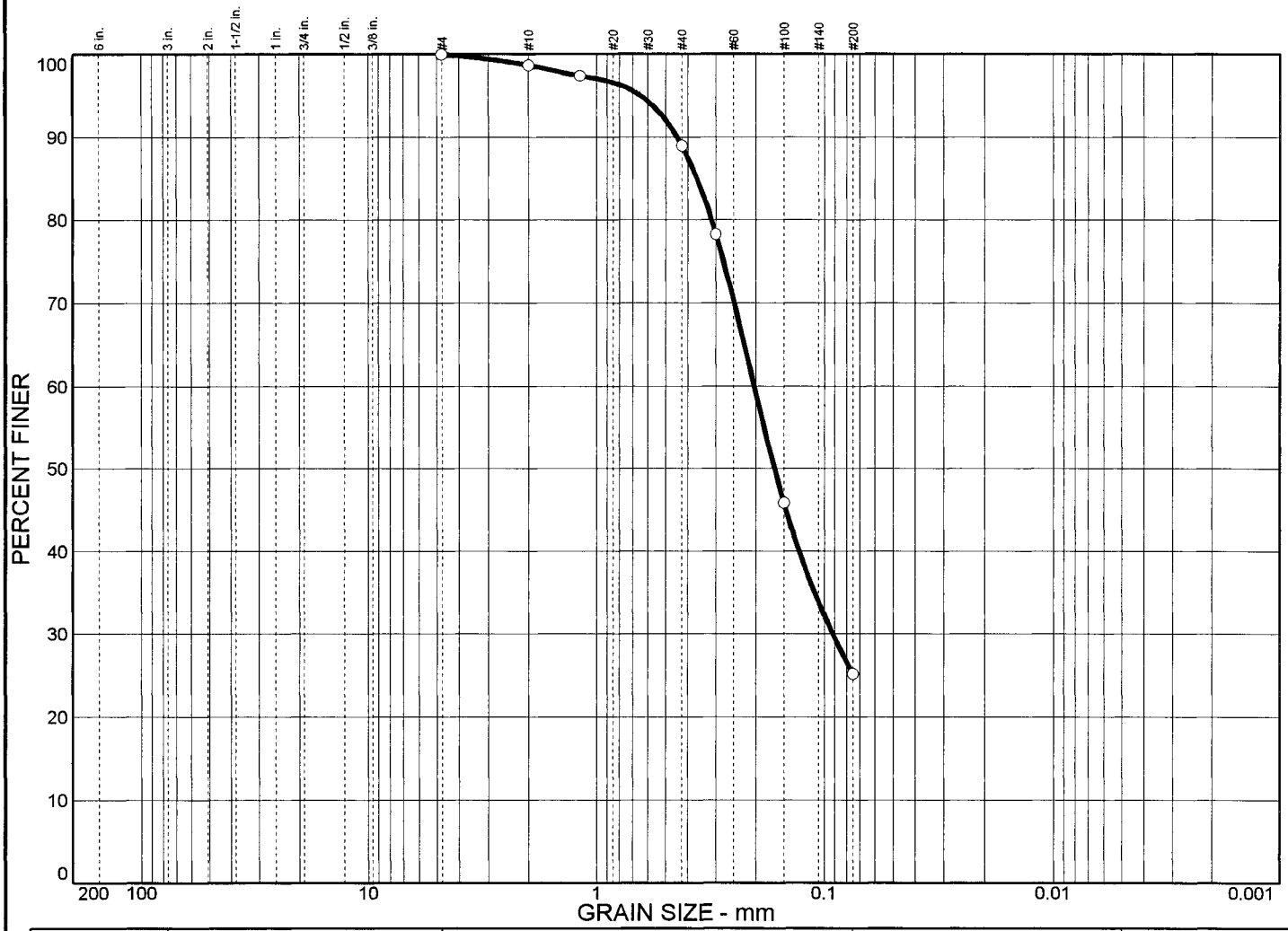
○

Particle Size Distribution Report

URS CORPORATION

Fig.

Particle Size Distribution Report



	% + 3"	% GRAVEL	% SAND	% SILT	% CLAY
○	0.0	0.0	74.9	25.1	

	LL	PL	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
○	N/P	N/P	0.365	0.203	0.165	0.0916				

MATERIAL DESCRIPTION	USCS	AASHTO
○ Silty sand	SM	

Project No. 22235583 **Client:**

Project: ELIZABETH MINE

○ **Source:** TB-11 **Elev./Depth:** 2-4'

Remarks:

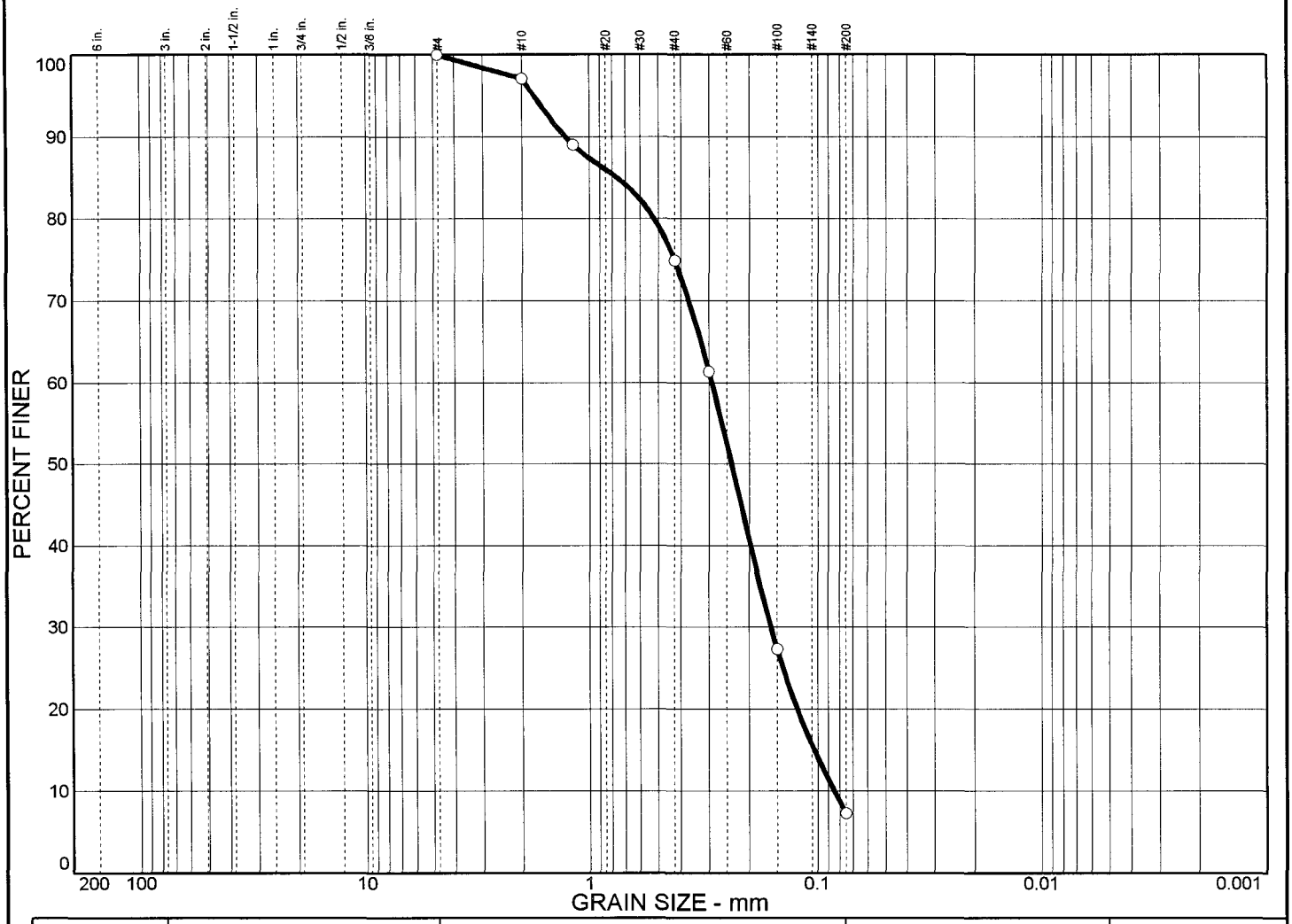
○

Particle Size Distribution Report

URS CORPORATION

Fig.

Particle Size Distribution Report



	% + 3"	% GRAVEL	% SAND	% SILT	% CLAY
○	0.0	0.0	92.7	7.3	

	LL	PL	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
○	N/P	N/P	0.758	0.292	0.239	0.160	0.103	0.0844	1.04	3.46

MATERIAL DESCRIPTION	USCS	AASHTO
○ Poorly graded sand with silt	SP-SM	

Project No. 22235583 **Client:**

Project: ELIZABETH MINE

○ **Source:** TB-11 **Elev./Depth:** 10-12'

Remarks:

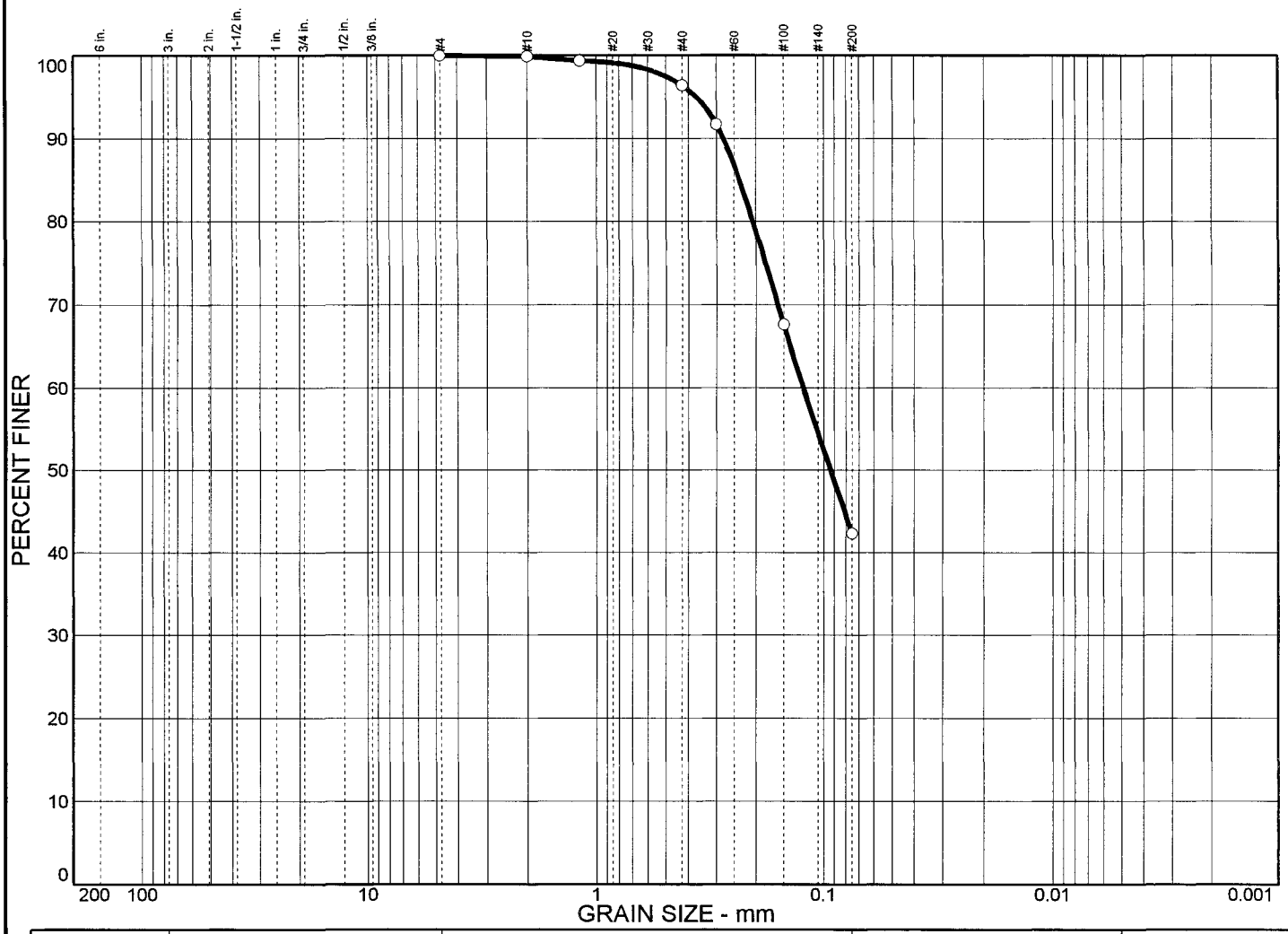
○

Particle Size Distribution Report

URS CORPORATION

Fig.

Particle Size Distribution Report



	% + 3"	% GRAVEL	% SAND	% SILT	% CLAY
○	0.0	0.0	57.7	42.3	

	LL	PL	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
○	N/P	N/P	0.236	0.123	0.0933					

MATERIAL DESCRIPTION	USCS	AASHTO
○ Silty sand	SM	

Project No. 22235583 **Client:**

Project: ELIZABETH MINE

○ **Source:** TB-11 **Elev./Depth:** 25-27'

Remarks:

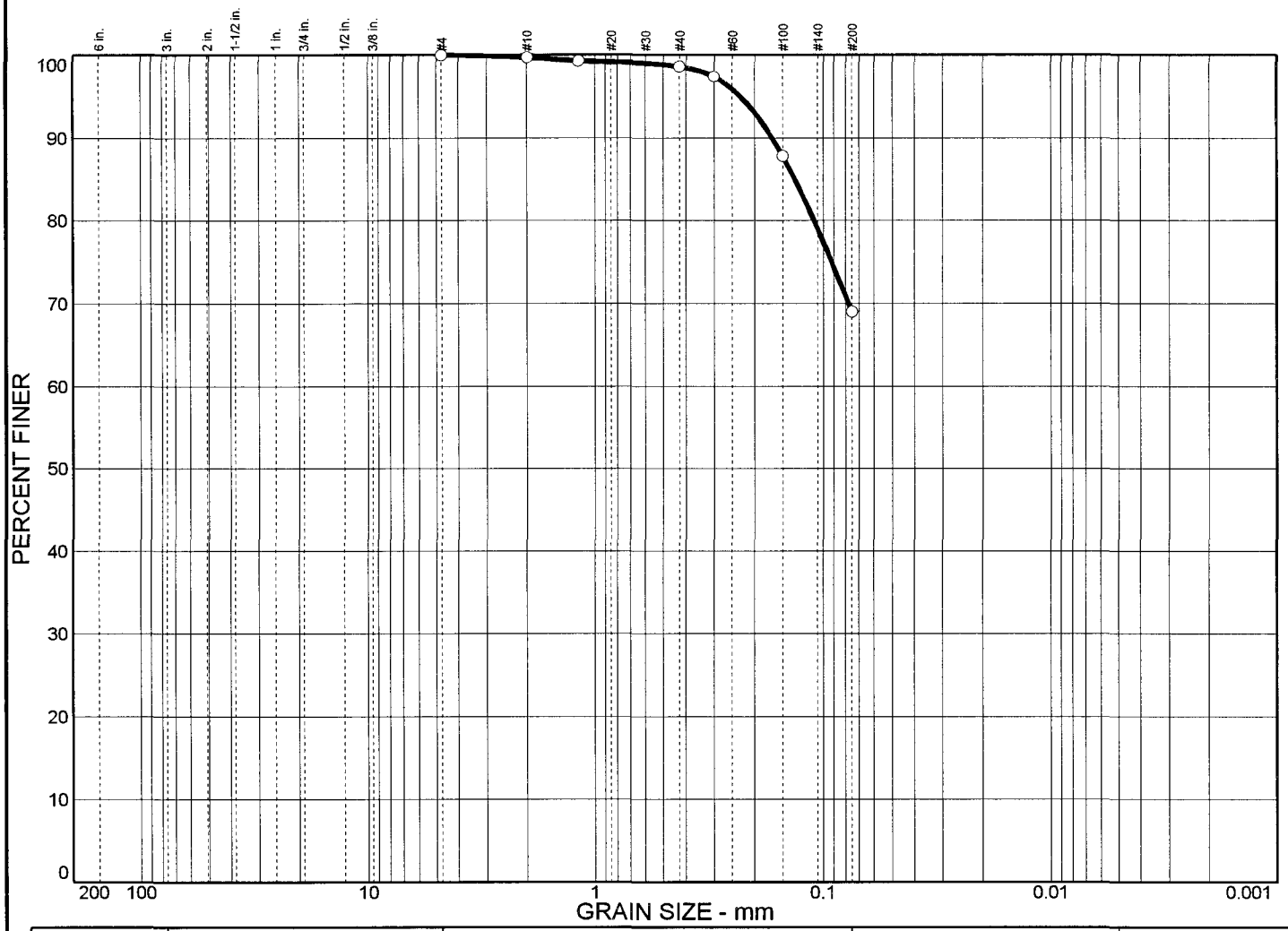
○

Particle Size Distribution Report

URS CORPORATION

Fig.

Particle Size Distribution Report



	% + 3"	% GRAVEL	% SAND	% SILT	% CLAY
○	0.0	0.0	31.0	69.0	

	LL	PL	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
○	N/P	N/P	0.133							

MATERIAL DESCRIPTION	USCS	AASHTO
○ Sandy silt	ML	

Project No. 22235583 **Client:**

Project: ELIZABETH MINE

○ **Source:** TB-11 **Elev./Depth:** 42.5-44.5'

Remarks:

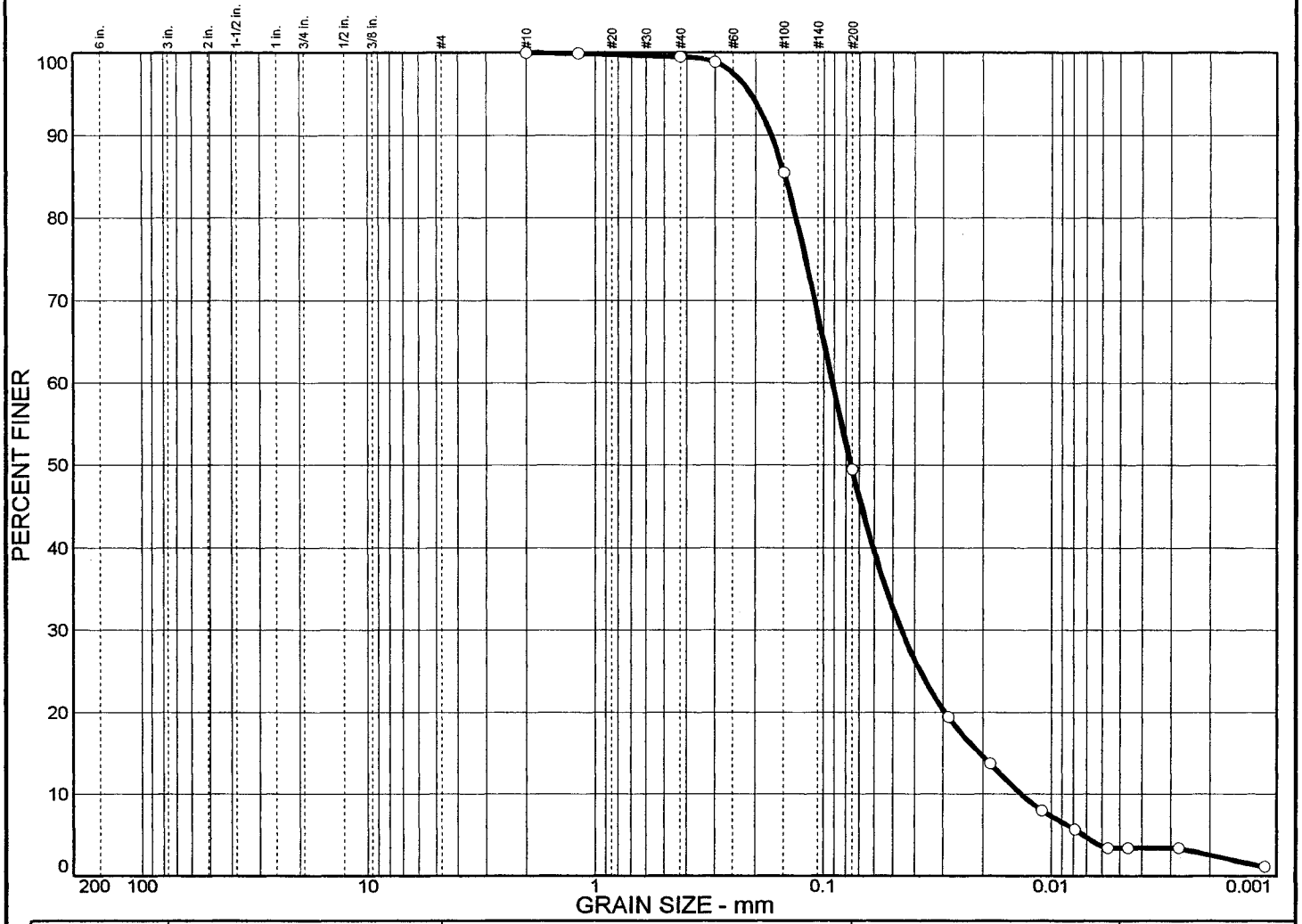
○

Particle Size Distribution Report

URS CORPORATION

Fig.

Particle Size Distribution Report



	% + 3"	% GRAVEL	% SAND	% SILT	% CLAY
○	0.0	0.0	50.6	46.0	3.4

	LL	PL	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
○	N/P	N/P	0.148	0.0915	0.0759	0.0456	0.0206	0.0135	1.68	6.75

MATERIAL DESCRIPTION	USCS	AASHTO
○ Silty sand	SM	

Project No. 22235583 **Client:**

Project: ELIZABETH MINE

○ **Source:** TB-11 **Elev./Depth:** 55-57'

Remarks:

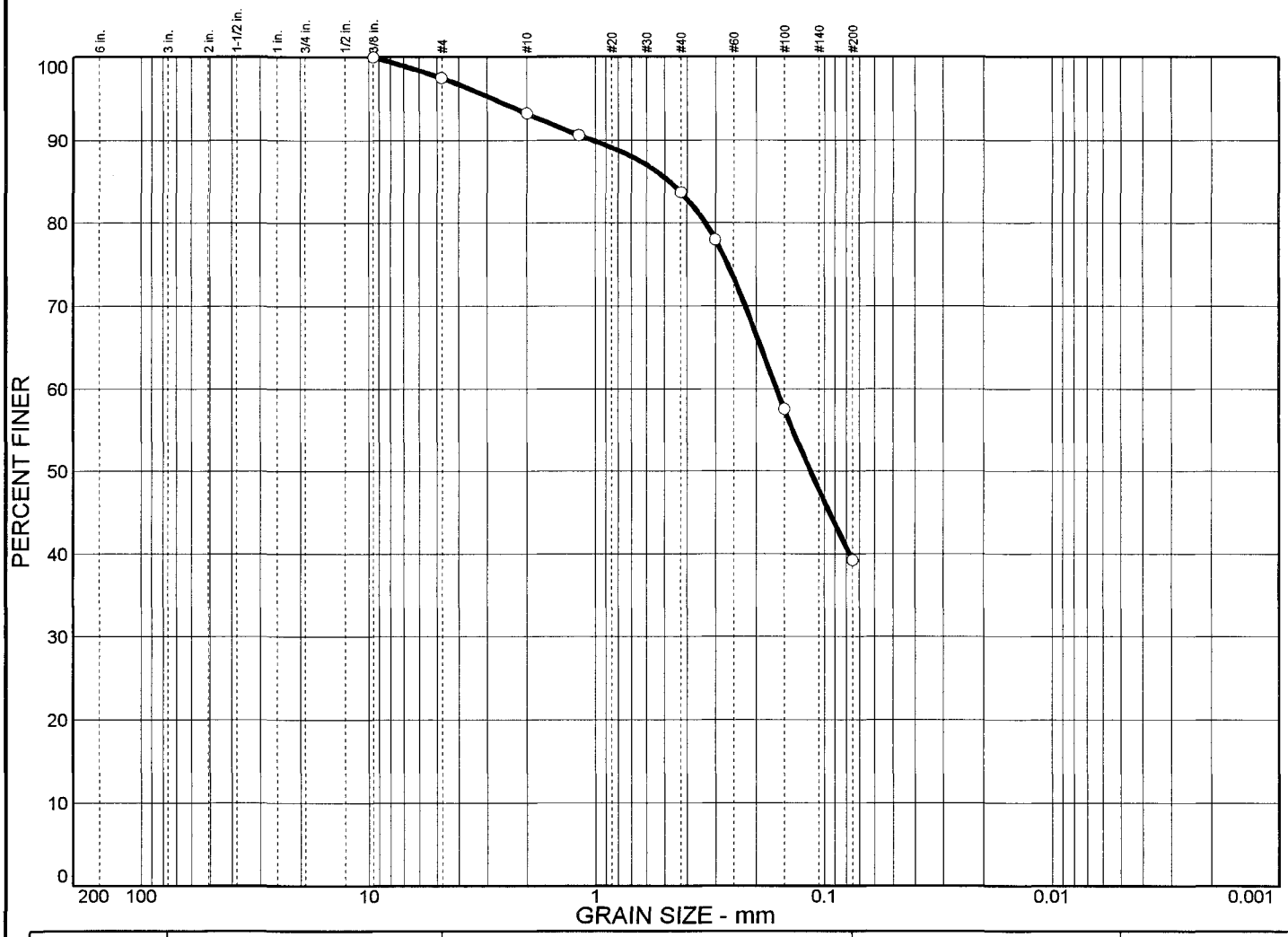
○

Particle Size Distribution Report

URS CORPORATION

Fig.

Particle Size Distribution Report



	% + 3"	% GRAVEL	% SAND	% SILT	% CLAY
○	0.0	2.5	58.3	39.2	

	LL	PL	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
○	N/P	N/P	0.478	0.163	0.115					

MATERIAL DESCRIPTION	USCS	AASHTO
○ Silty sand	SM	

Project No. 22235583 **Client:**

Project: ELIZABETH MINE

○ **Source:** TB-12 **Elev./Depth:** 0-2'

Remarks:

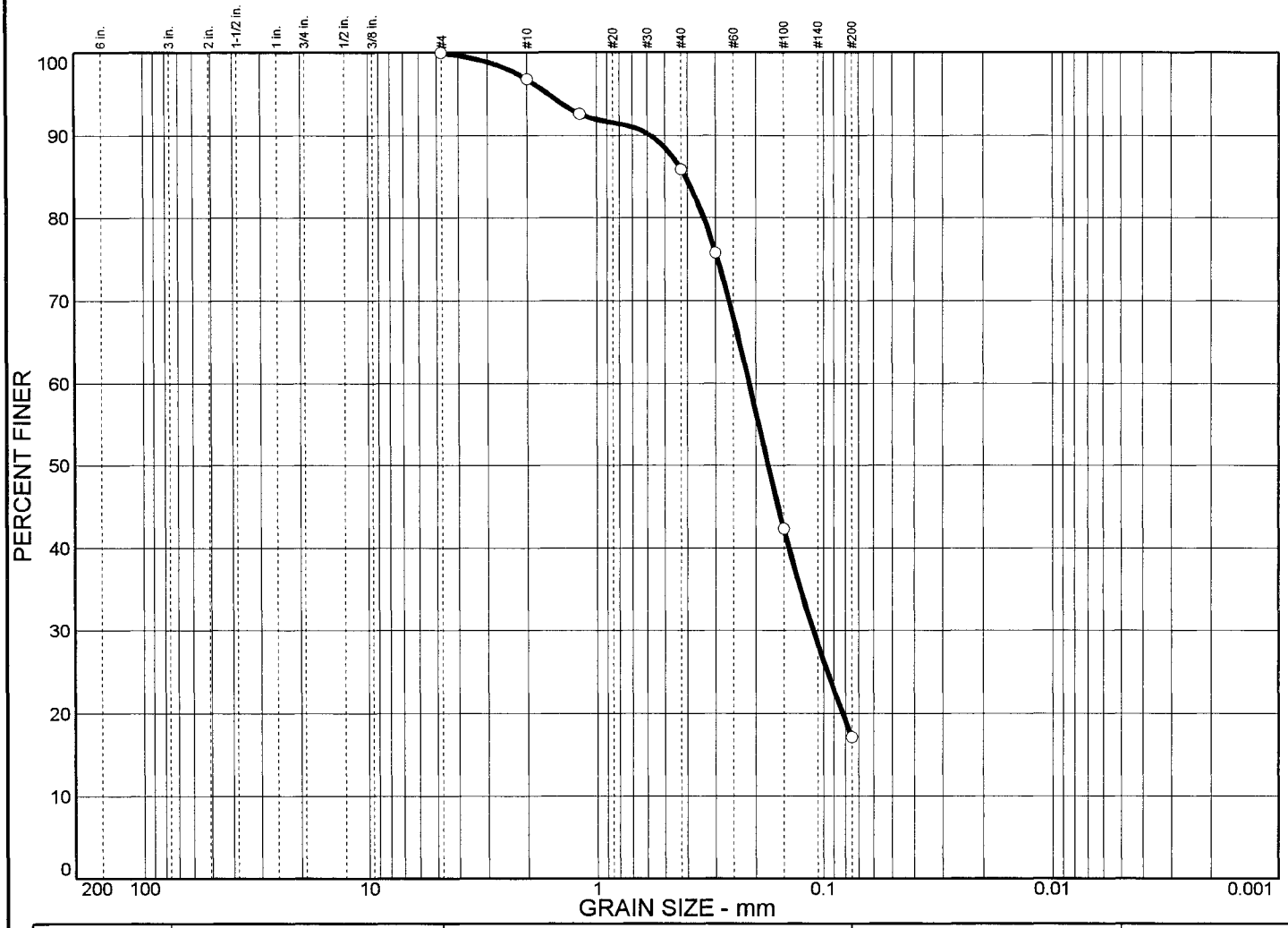
○

Particle Size Distribution Report

URS CORPORATION

Fig.

Particle Size Distribution Report



	% + 3"	% GRAVEL	% SAND	% SILT	% CLAY
○	0.0	0.0	82.9	17.1	

	LL	PL	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
○	N/P	N/P	0.407	0.214	0.176	0.111				

MATERIAL DESCRIPTION	USCS	AASHTO
○ Silty sand	SM	

Project No. 22235583 **Client:**

Project: ELIZABETH MINE

○ **Source:** TB-12 **Elev./Depth:** 10-12'

Remarks:

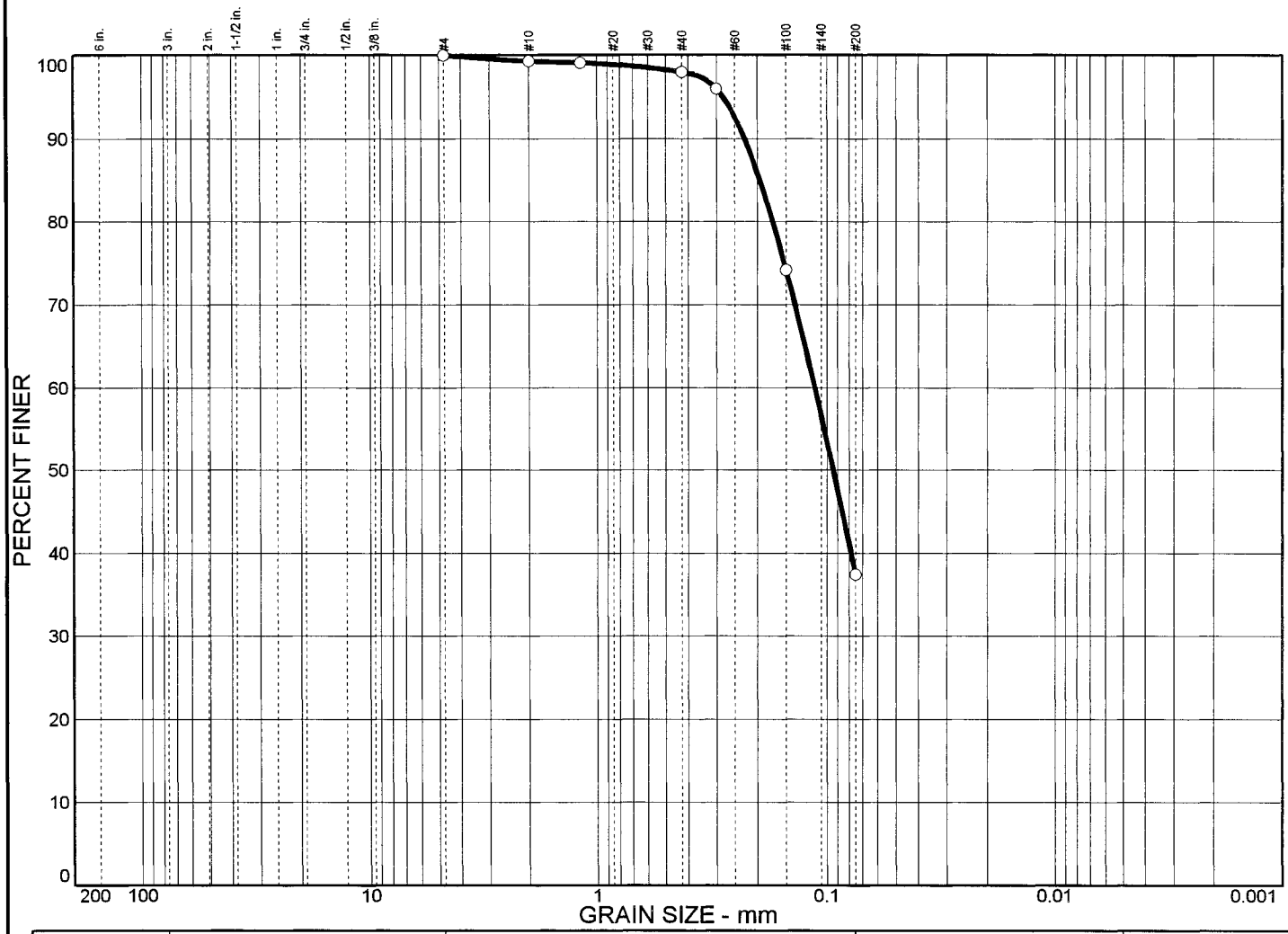
○

Particle Size Distribution Report

URS CORPORATION

Fig.

Particle Size Distribution Report



	% + 3"	% GRAVEL	% SAND	% SILT	% CLAY
○	0.0	0.0	62.6	37.4	

	LL	PL	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
○	N/P	N/P	0.195	0.113	0.0938					

MATERIAL DESCRIPTION	USCS	AASHTO
○ Silty sand	SM	

Project No. 22235583 **Client:**

Project: ELIZABETH MINE

○ **Source:** TB-12 **Elev./Depth:** 25-27'

Remarks:

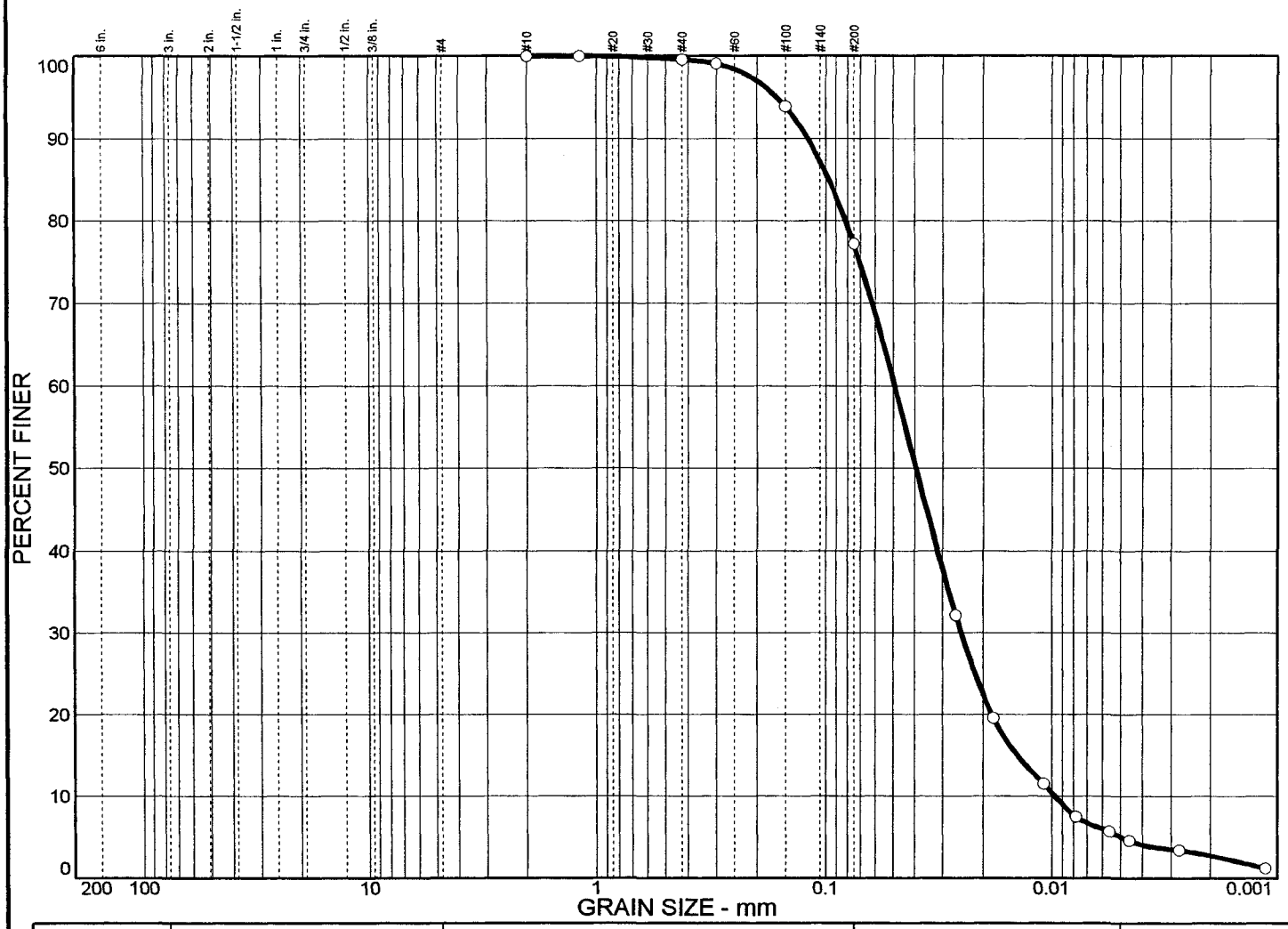
○

Particle Size Distribution Report

URS CORPORATION

Fig.

Particle Size Distribution Report



	% + 3"	% GRAVEL	% SAND	% SILT	% CLAY
○	0.0	0.0	22.8	72.1	5.1

	LL	PL	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
○	N/P	N/P	0.0966	0.0492	0.0394	0.0248	0.0141	0.0097	1.30	5.08

MATERIAL DESCRIPTION	USCS	AASHTO
○ Silt with sand	ML	

Project No. 22235583 **Client:**

Project: ELIZABETH MINE

○ **Source:** TB-12 **Elev./Depth:** 35-37'

Remarks:

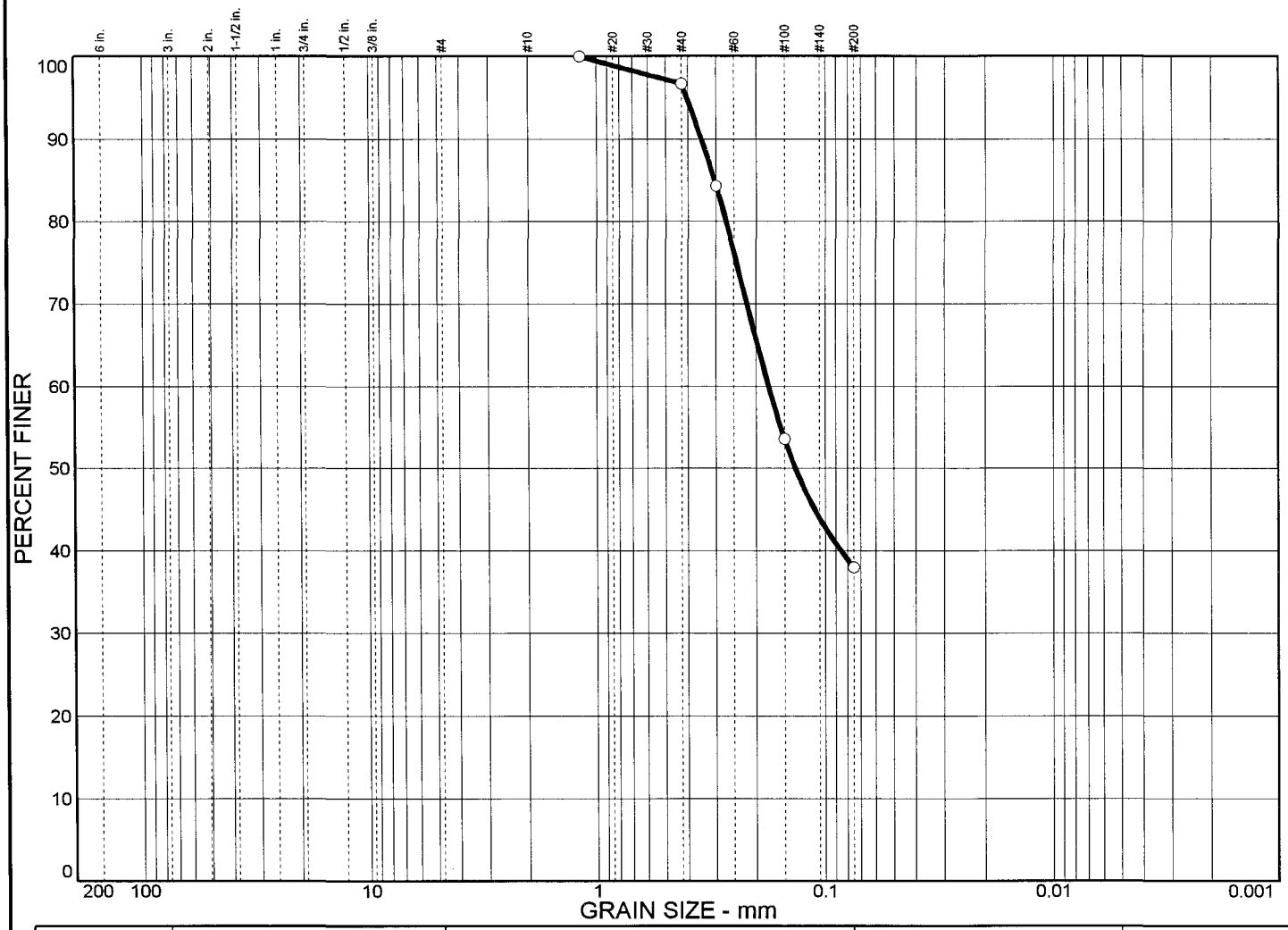
○

Particle Size Distribution Report

URS CORPORATION

Fig.

Particle Size Distribution Report



	% + 3"	% GRAVEL	% SAND	% SILT	% CLAY
○	0.0	0.0	62.1	37.9	

	LL	PL	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
○	N/P	N/P	0.305	0.176	0.135					

MATERIAL DESCRIPTION	USCS	AASHTO
○ Silty sand	SM	

Project No. 22235583 **Client:**

Project: ELIZABETH MINE

○ **Source:** TB-13 **Elev./Depth:** 0-2'

Remarks:

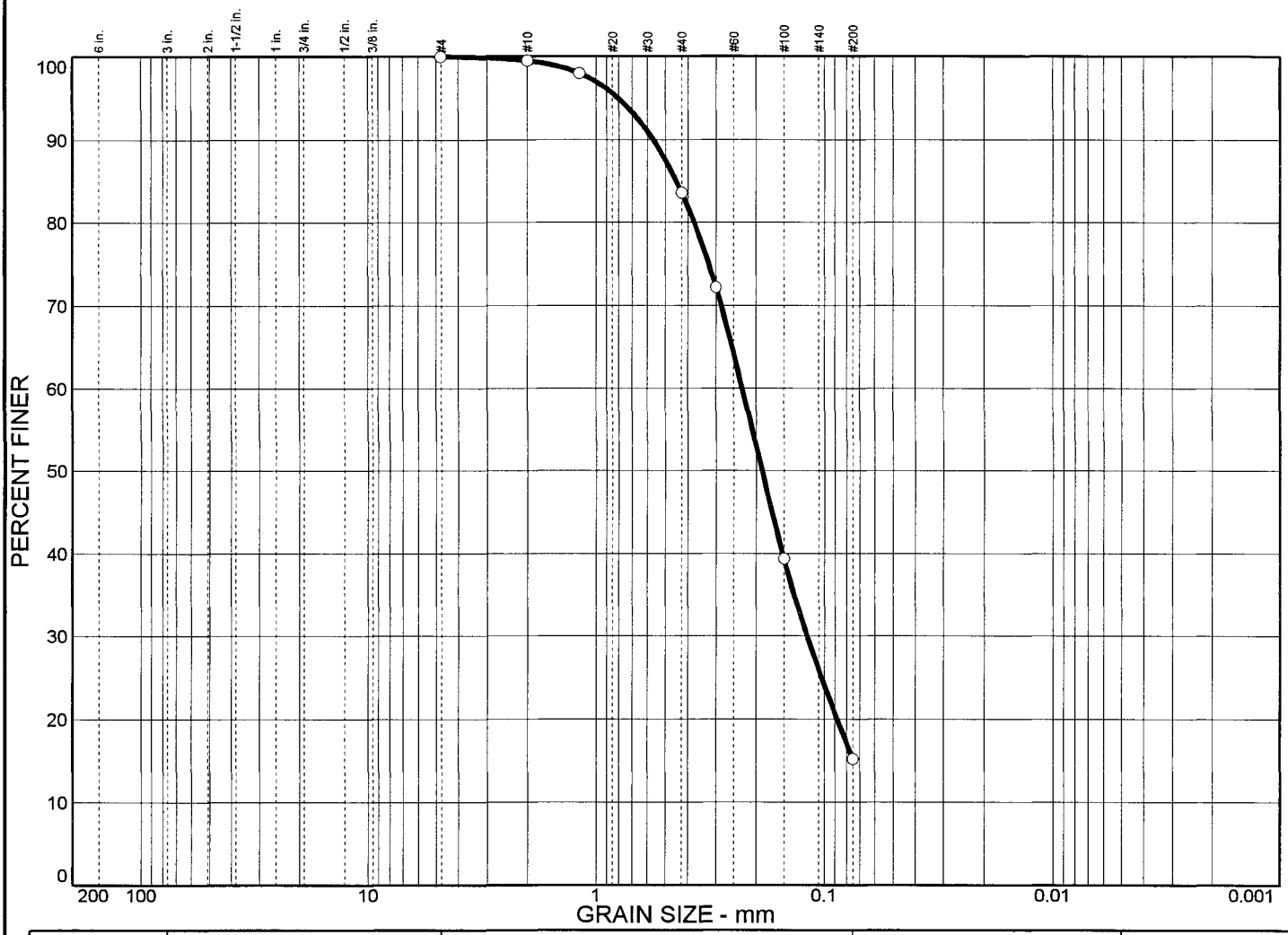
○

Particle Size Distribution Report

URS CORPORATION

Fig.

Particle Size Distribution Report



	% + 3"	% GRAVEL	% SAND	% SILT	% CLAY
○	0.0	0.0	84.8	15.2	

	LL	PL	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
○	N/P	N/P	0.449	0.230	0.188	0.119				

MATERIAL DESCRIPTION	USCS	AASHTO
○ Silty sand	SM	

Project No. 22235583 **Client:**

Project: ELIZABETH MINE

○ **Source:** TB-13 **Elev./Depth:** 10-12'

Remarks:

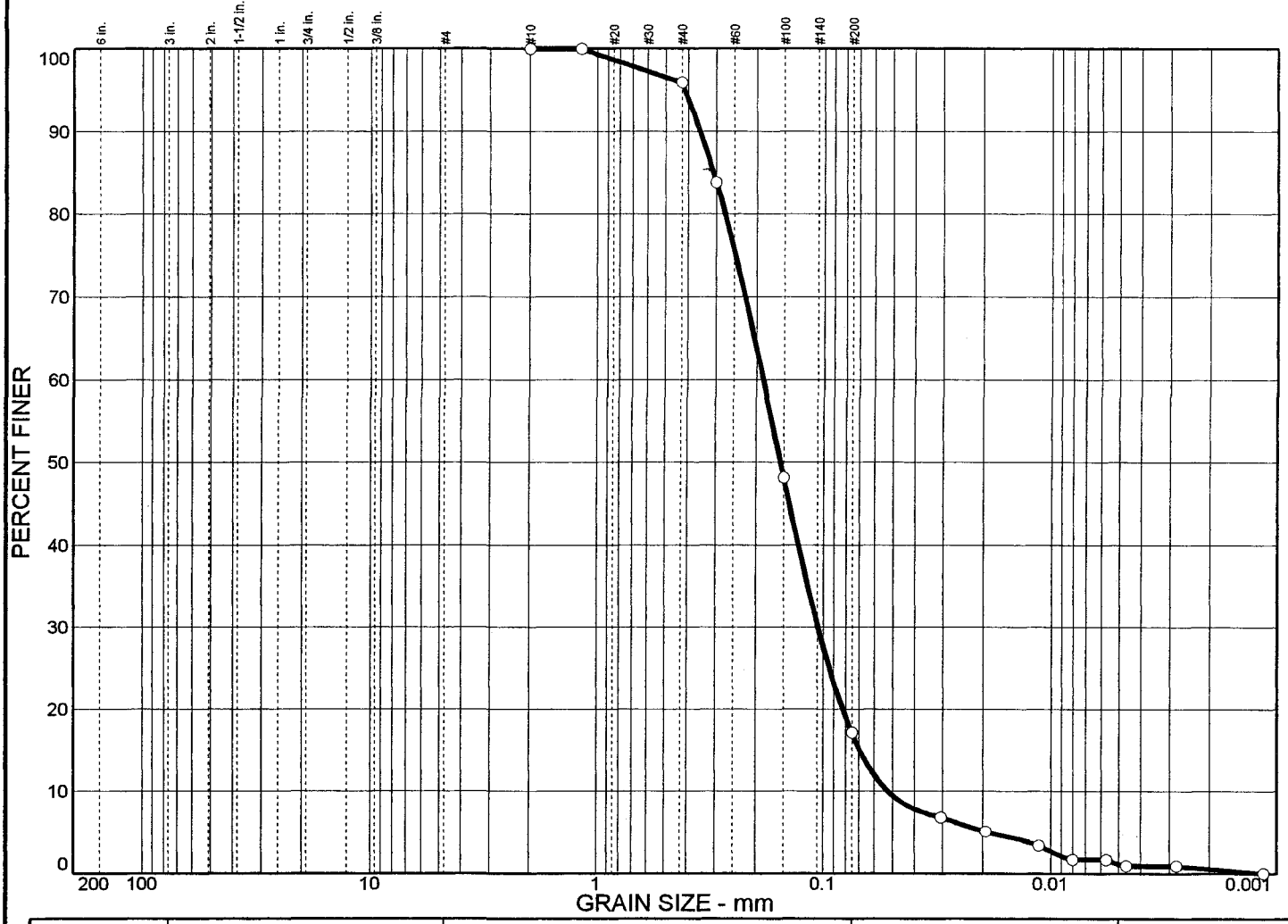
○

Particle Size Distribution Report

URS CORPORATION

Fig.

Particle Size Distribution Report



	% + 3"	% GRAVEL	% SAND	% SILT	% CLAY
○	0.0	0.0	82.9	15.9	1.2

	LL	PL	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
○	N/P	N/P	0.309	0.186	0.155	0.105	0.0694	0.0523	1.14	3.56

MATERIAL DESCRIPTION	USCS	AASHTO
○ Silty sand	SM	

Project No. 22235583 **Client:**

Project: ELIZABETH MINE

○ **Source:** TB-13 **Elev./Depth:** 25-27'

Remarks:

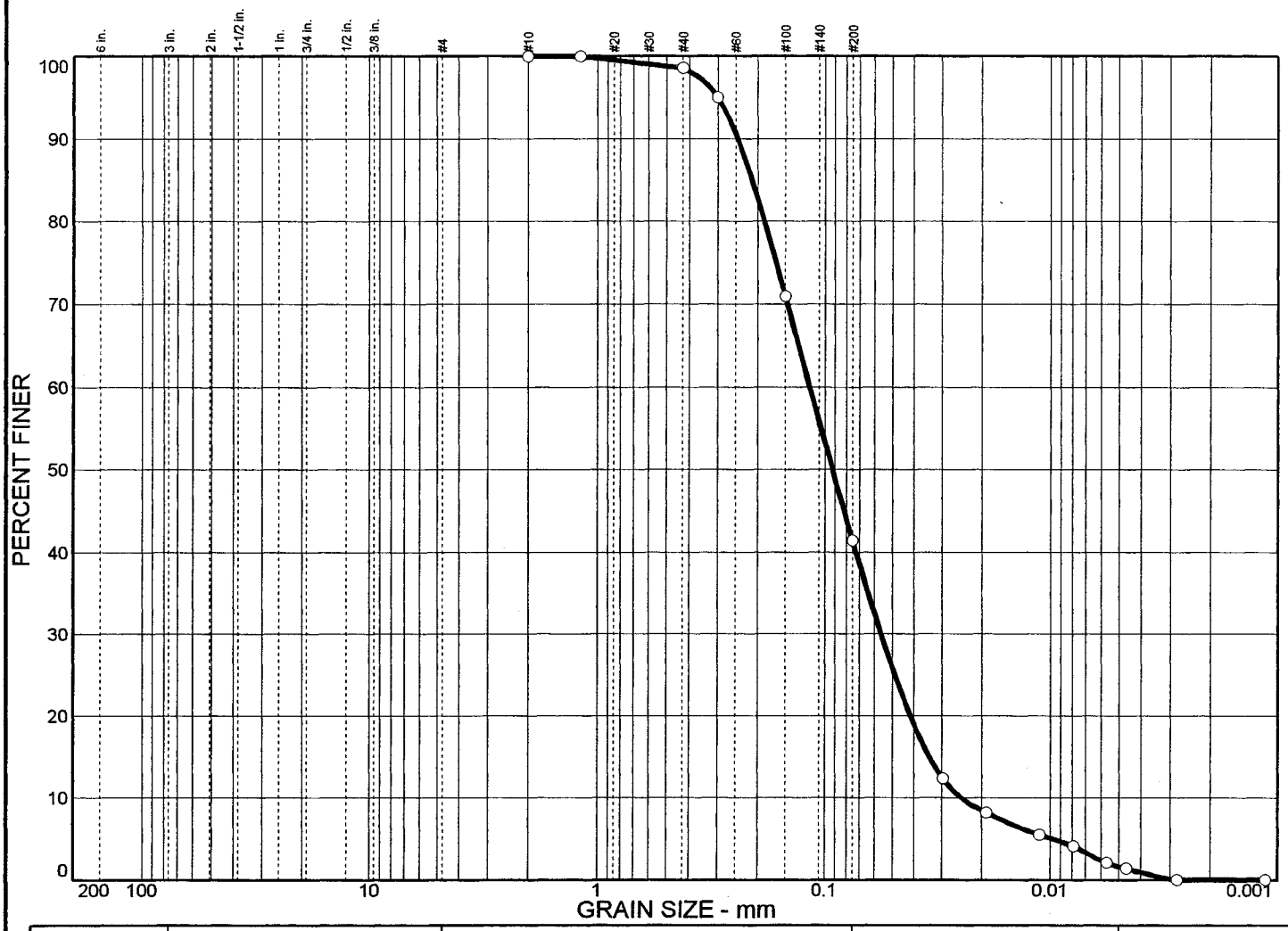
○

Particle Size Distribution Report

URS CORPORATION

Fig.

Particle Size Distribution Report



	% + 3"	% GRAVEL	% SAND	% SILT	% CLAY
○	0.0	0.0	58.6	39.8	1.6

	LL	PL	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
○	N/P	N/P	0.212	0.117	0.0922	0.0560	0.0341	0.0246	1.09	4.74

MATERIAL DESCRIPTION	USCS	AASHTO
○ Silty sand	SM	

Project No. 22235583 **Client:**

Project: ELIZABETH MINE

○ **Source:** TB-13 **Elev./Depth:** 35-37'

Remarks:

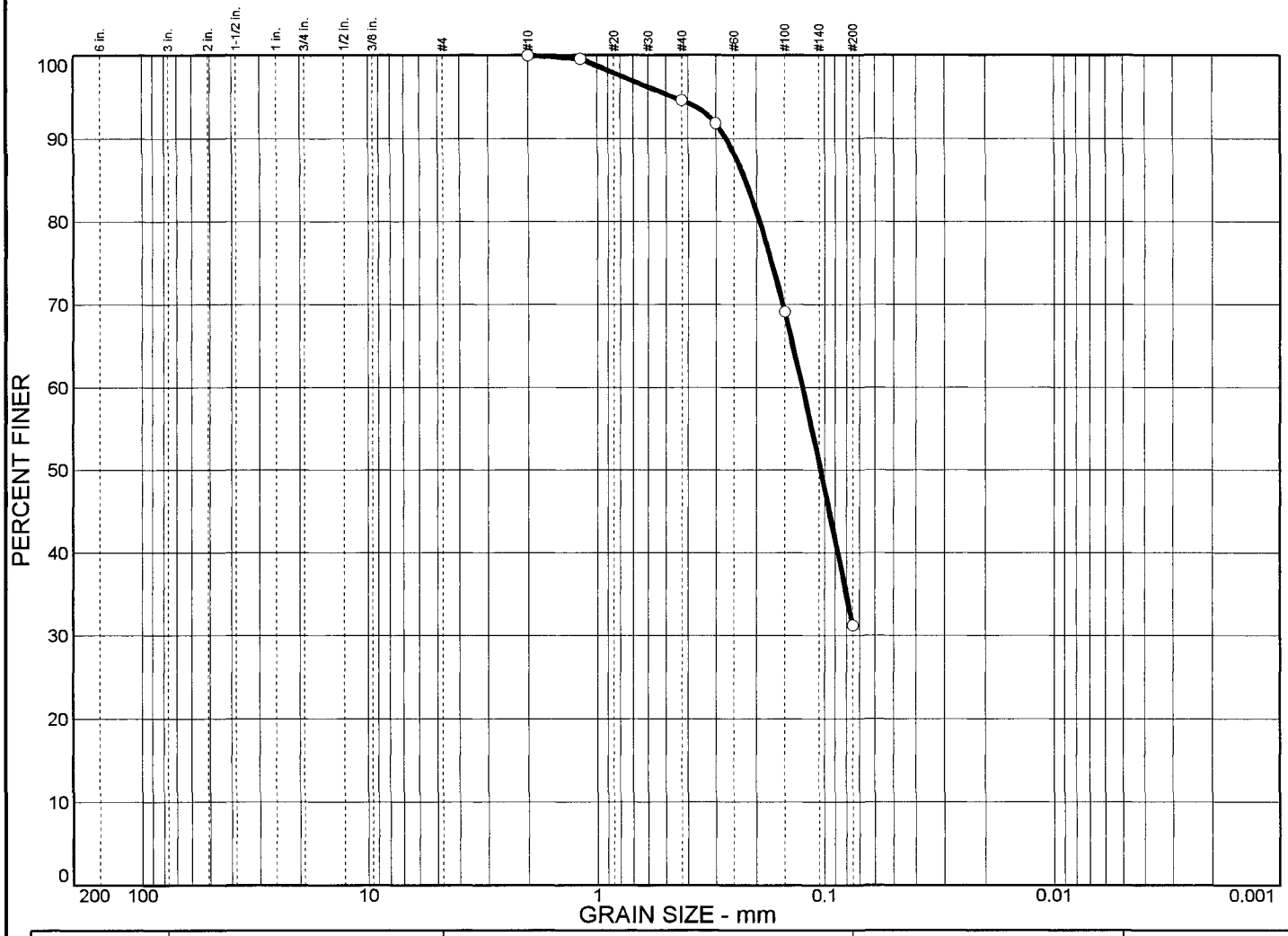
○

Particle Size Distribution Report

URS CORPORATION

Fig.

Particle Size Distribution Report



	% + 3"	% GRAVEL	% SAND	% SILT	% CLAY
○	0.0	0.0	68.8	31.2	

	LL	PL	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
○	N/P	N/P	0.224	0.125	0.104					

MATERIAL DESCRIPTION	USCS	AASHTO
○ Silty sand	SM	

Project No. 22235583 **Client:**

Project: ELIZABETH MINE

○ **Source:** TB-13 **Elev./Depth:** 45-47'

Remarks:

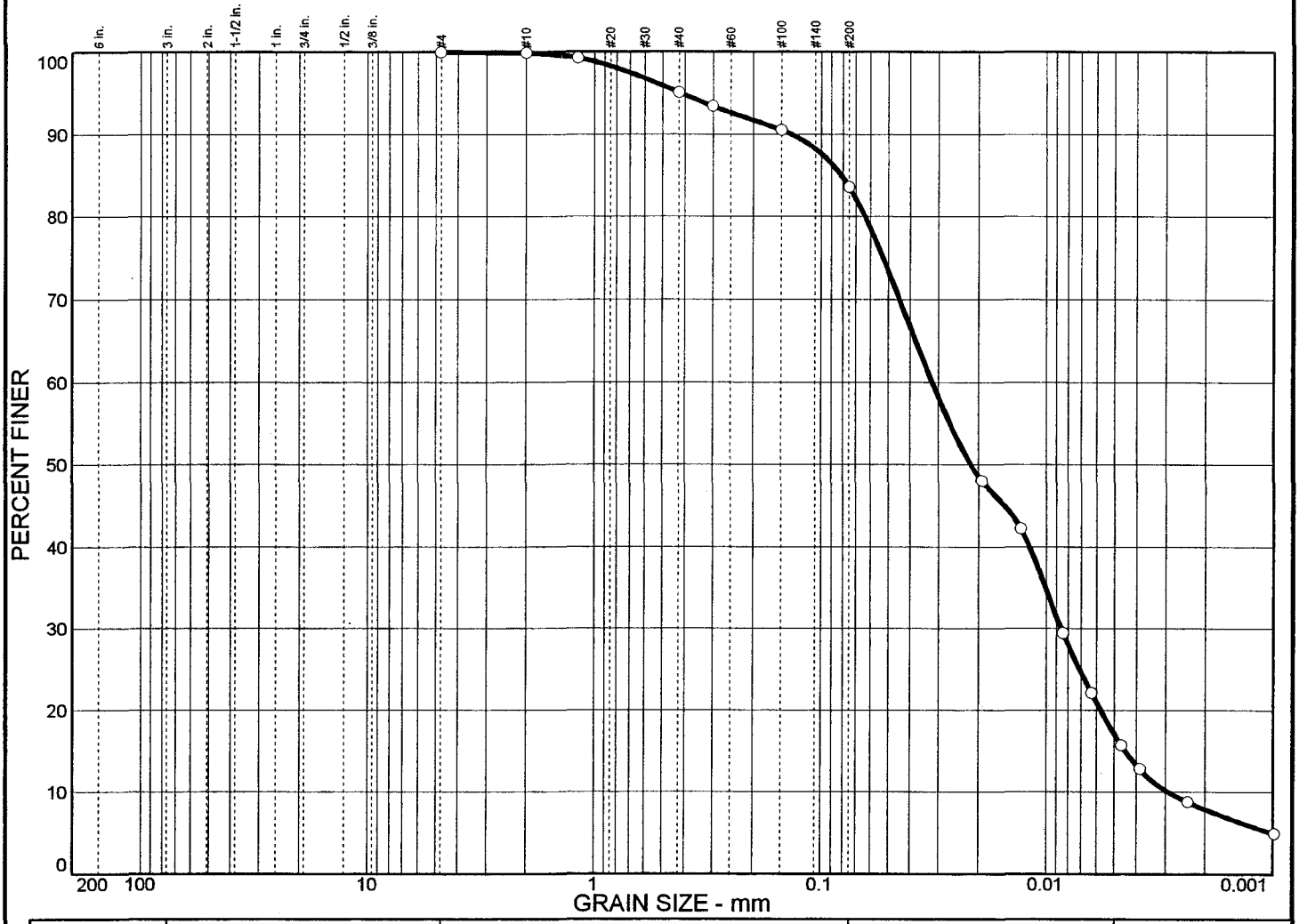
○

Particle Size Distribution Report

URS CORPORATION

Fig.

Particle Size Distribution Report



	% + 3"	% GRAVEL	% SAND	% SILT	% CLAY
○	0.0	0.0	16.4	66.5	17.1

	LL	PL	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
○	N/P	N/P	0.0812	0.0320	0.0216	0.0086	0.0045	0.0029	0.79	11.03

MATERIAL DESCRIPTION	USCS	AASHTO
○ Silt with sand	ML	

Project No. 22235583 **Client:**

Project: ELIZABETH MINE

○ **Source:** TB-13 **Elev./Depth:** 55-57'

Remarks:

○

Particle Size Distribution Report

URS CORPORATION

Fig.

Particle Size Distribution Report

	% + 3"	% GRAVEL	% SAND	% SILT	% CLAY
○	0.0	0.0	65.3	34.7	

	LL	PL	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
○	N/P	N/P	0.302	0.131	0.104					

MATERIAL DESCRIPTION	USCS	AASHTO
○ Silty sand	SM	

Project No. 22235583 **Client:**

Project: ELIZABETH MINE

○ **Source:** TB-14 **Elev./Depth:** 10-12'

Remarks:

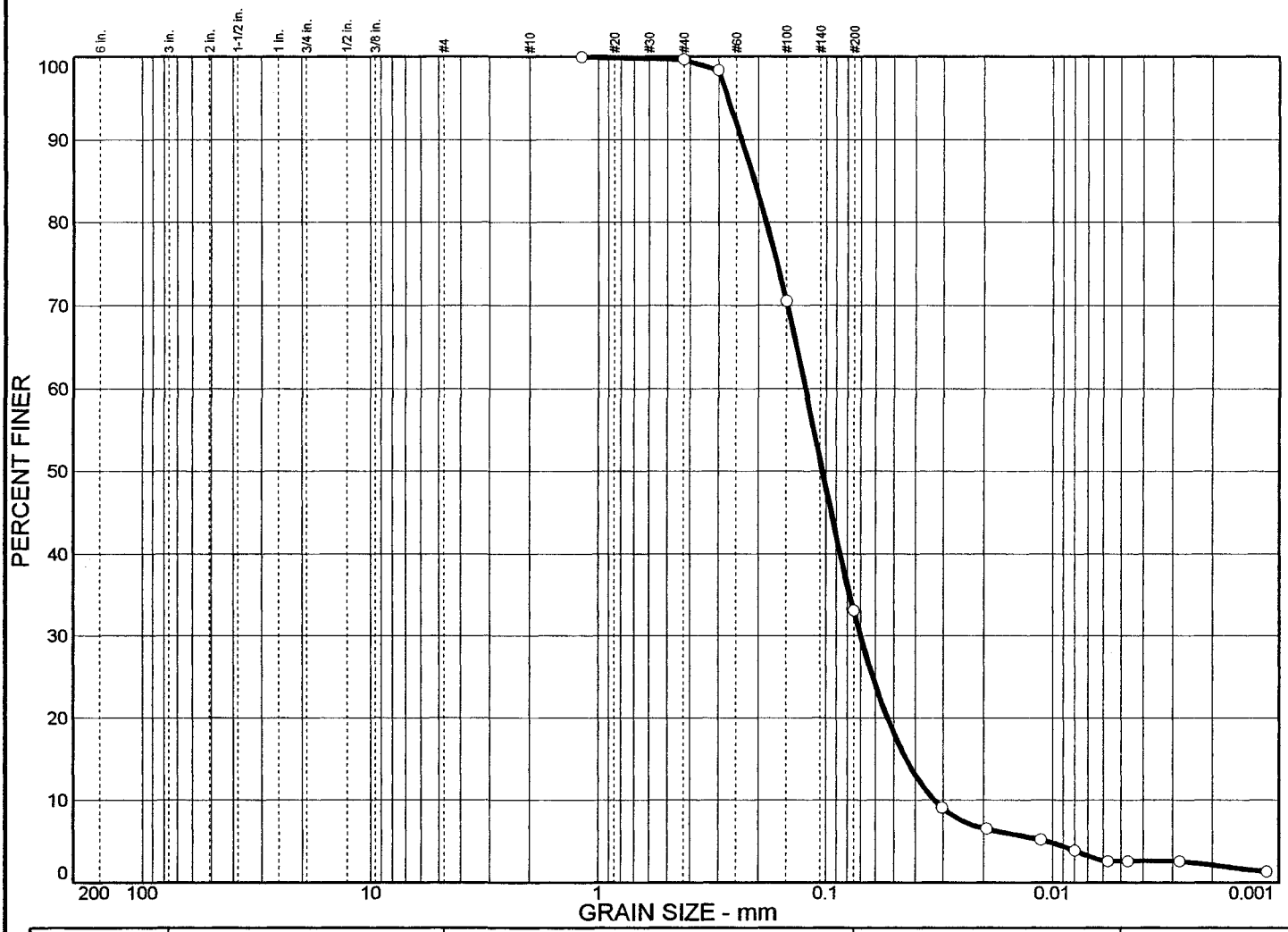
○

Particle Size Distribution Report

URS CORPORATION

Fig.

Particle Size Distribution Report



	% + 3"	% GRAVEL	% SAND	% SILT	% CLAY
○	0.0	0.0	66.9	30.5	2.6

	LL	PL	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
○	N/P	N/P	0.208	0.123	0.103	0.0700	0.0439	0.0328	1.21	3.76

MATERIAL DESCRIPTION	USCS	AASHTO
○ Silty sand	SM	

Project No. 22235583 **Client:**

Project: ELIZABETH MINE

○ **Source:** TB-14 **Elev./Depth:** 25-27'

Remarks:

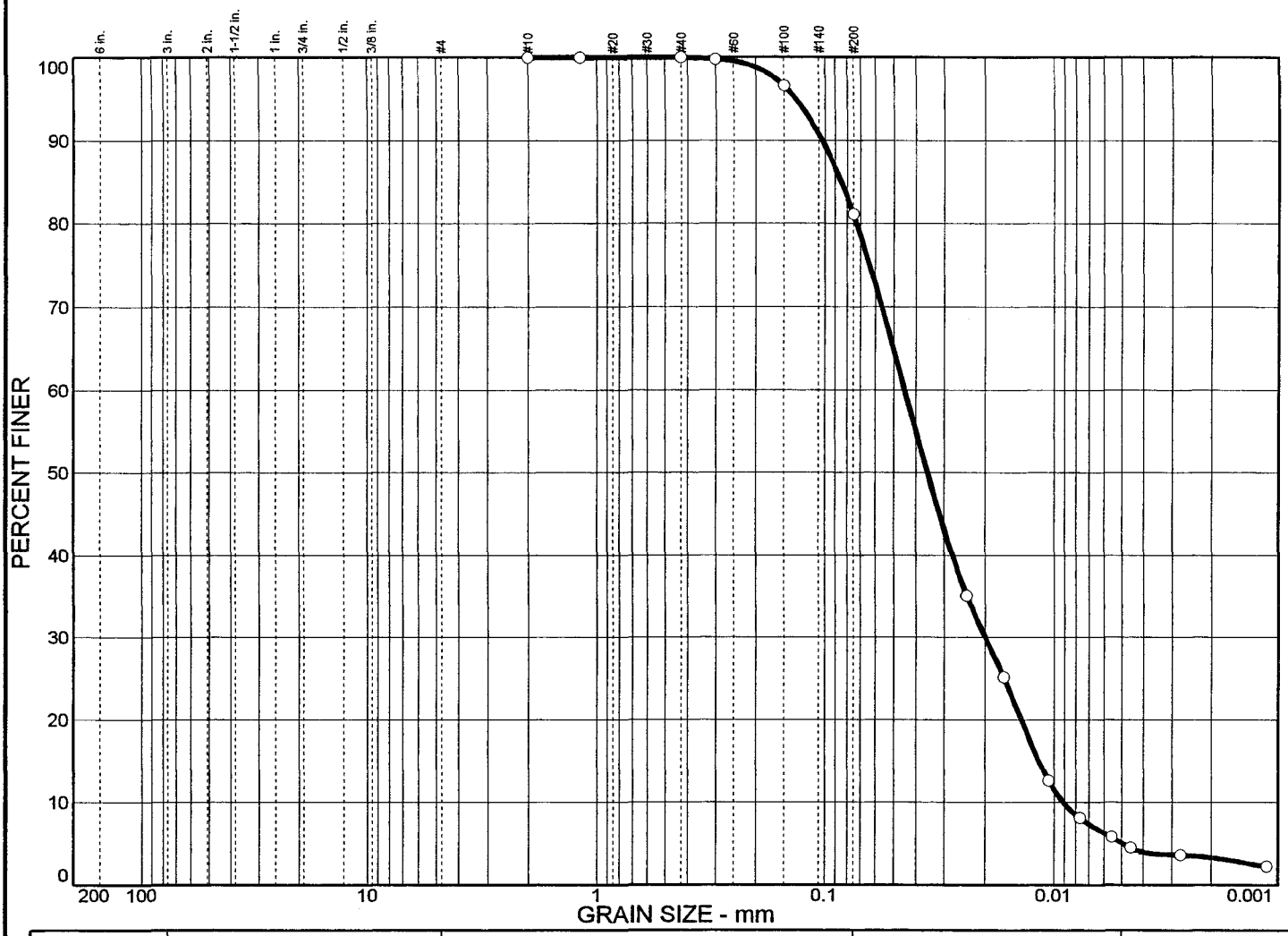
○

Particle Size Distribution Report

URS CORPORATION

Fig.

Particle Size Distribution Report



	% + 3"	% GRAVEL	% SAND	% SILT	% CLAY
○	0.0	0.0	18.9	76.0	5.1

	LL	PL	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
○	N/P	N/P	0.0847	0.0447	0.0355	0.0199	0.0117	0.0091	0.98	4.91

MATERIAL DESCRIPTION	USCS	AASHTO
○ Silt with sand	ML	

Project No. 22235583 **Client:**

Project: ELIZABETH MINE

○ **Source:** TB-14 **Elev./Depth:** 42.5-44.5

Remarks:

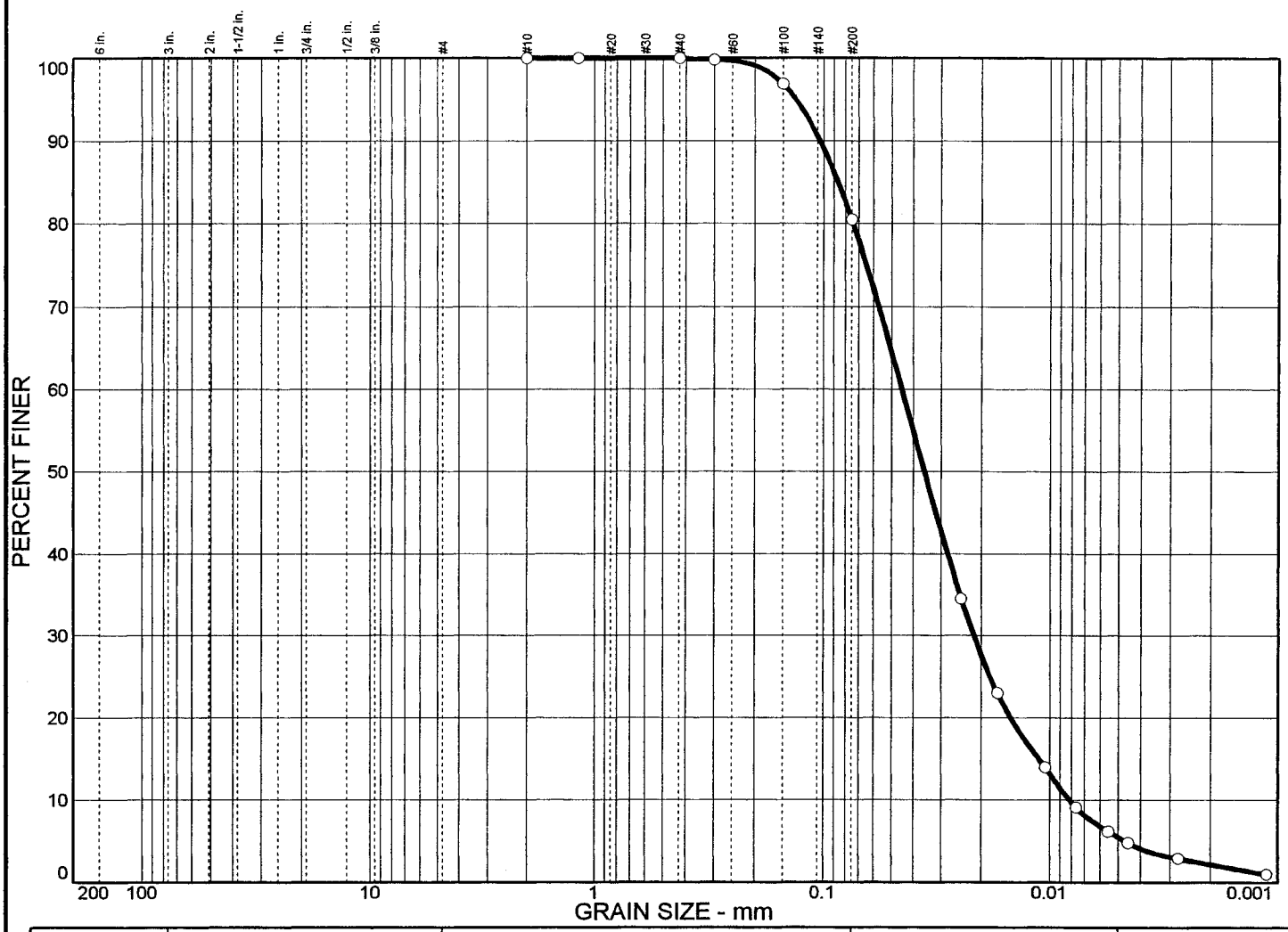
○

Particle Size Distribution Report

URS CORPORATION

Fig.

Particle Size Distribution Report



	% + 3"	% GRAVEL	% SAND	% SILT	% CLAY
○	0.0	0.0	19.5	75.0	5.5

	LL	PL	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
○	N/P	N/P	0.0862	0.0449	0.0357	0.0215	0.0112	0.0082	1.26	5.49

MATERIAL DESCRIPTION	USCS	AASHTO
○ Silt with sand	ML	

Project No. 22235583 **Client:**

Project: ELIZABETH MINE

○ **Source:** TB-14 **Elev./Depth:** 50-52'

Remarks:

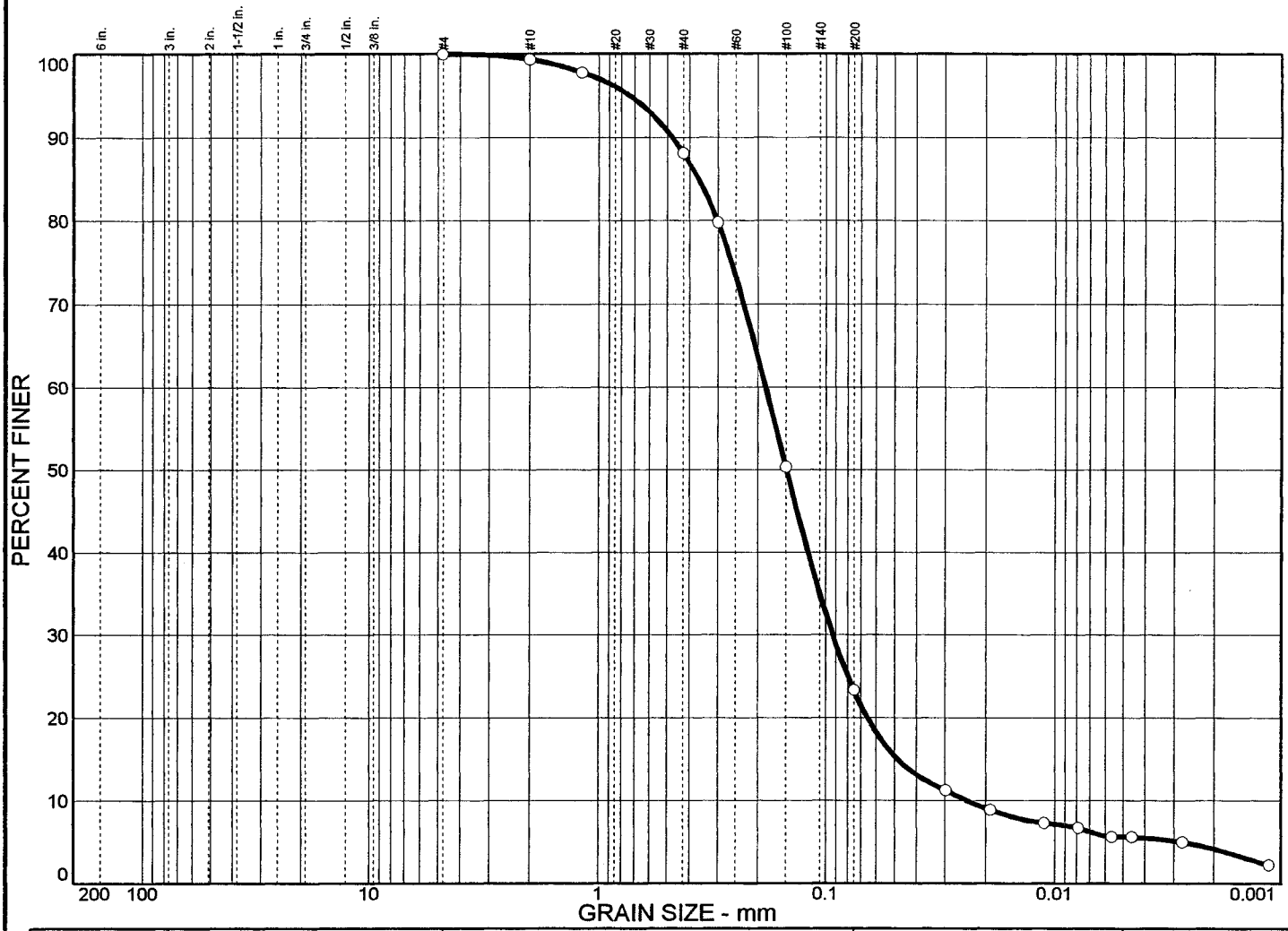
○

Particle Size Distribution Report

URS CORPORATION

Fig.

Particle Size Distribution Report



	% + 3"	% GRAVEL	% SAND	% SILT	% CLAY
○	0.0	0.0	76.7	17.7	5.6

	LL	PL	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
○	N/P	N/P	0.364	0.185	0.149	0.0926	0.0483	0.0240	1.94	7.70

MATERIAL DESCRIPTION	USCS	AASHTO
○ Silty sand	SM	

Project No. 22235583 **Client:**

Project: ELIZABETH MINE

○ **Source:** TB-15 **Elev./Depth:** 0-2'

Remarks:

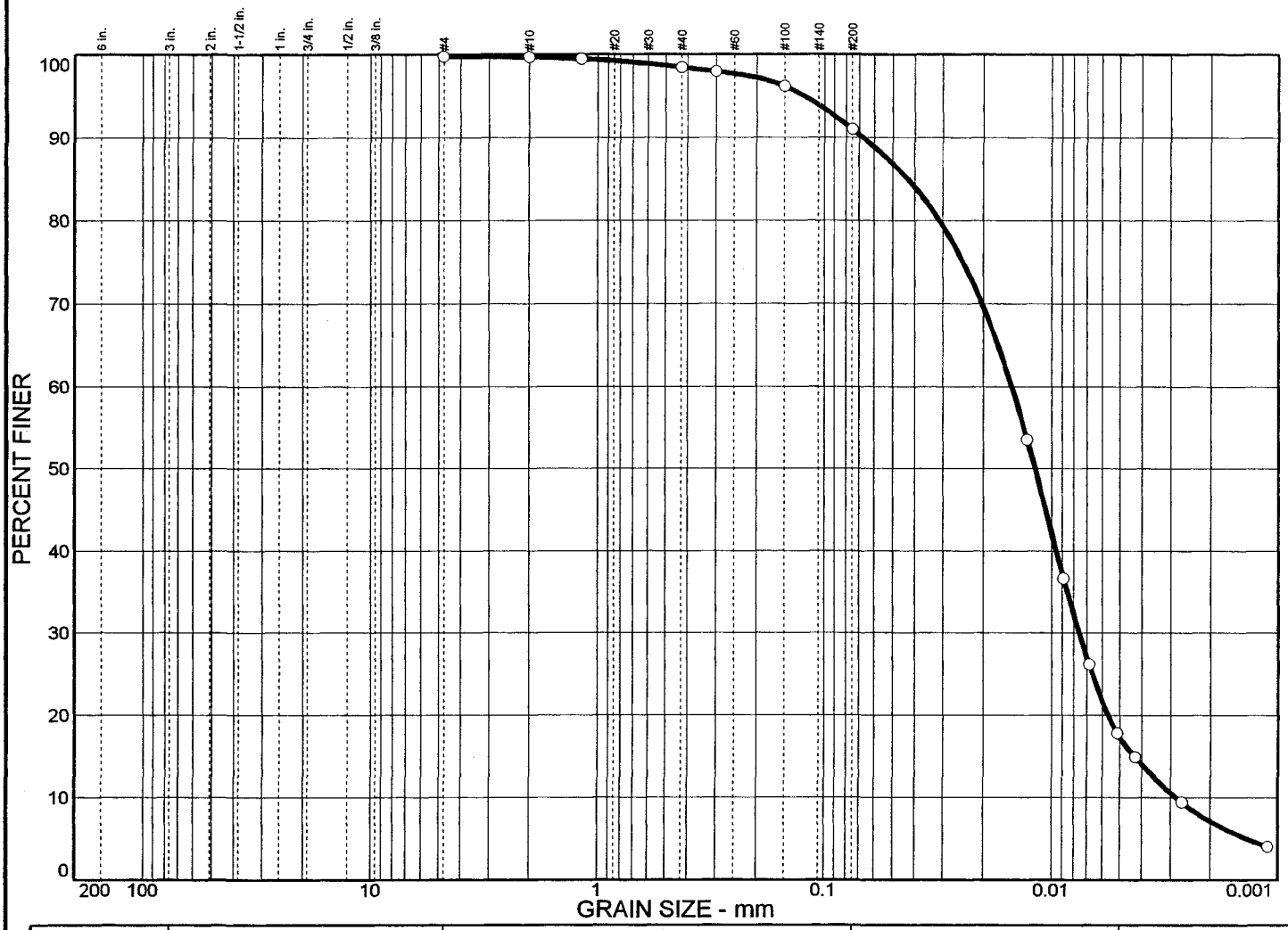
○

Particle Size Distribution Report

URS CORPORATION

Fig.

Particle Size Distribution Report



	% + 3"	% GRAVEL	% SAND	% SILT	% CLAY
○			8.8	73.7	17.5

	LL	PL	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
○	N/P	N/P	0.0428	0.0150	0.0118	0.0076	0.0043	0.0028	1.35	5.30

	MATERIAL DESCRIPTION	USCS	AASHTO
○	Silt	ML	

Project No. 22235583 **Client:**

Project: ELIZABETH MINE

○ **Source:** TB-15 **Elev./Depth:** 15-17'

Remarks:

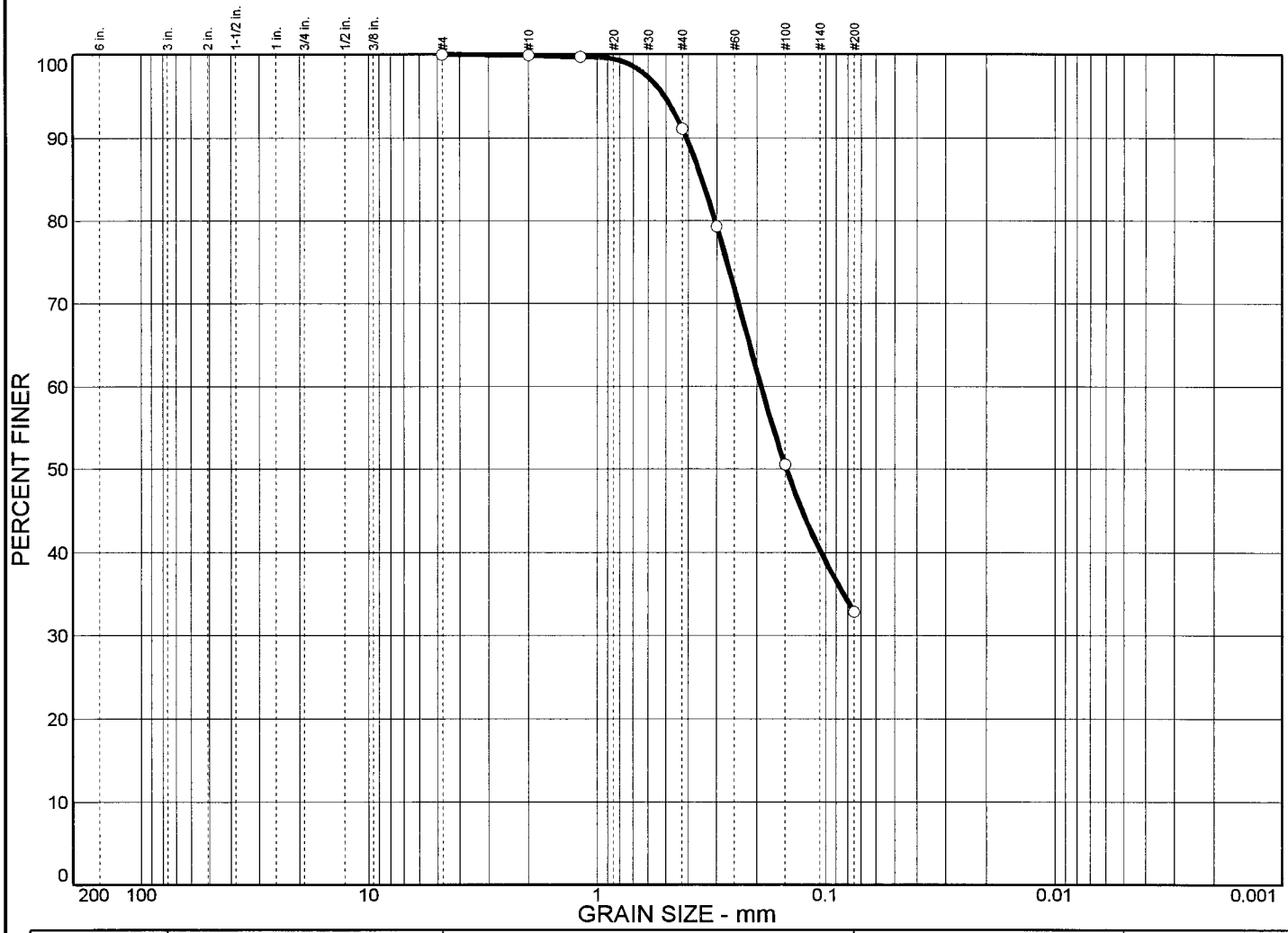
○

Particle Size Distribution Report

URS CORPORATION

Fig.

Particle Size Distribution Report



	% + 3"	% GRAVEL	% SAND	% SILT	% CLAY
○	0.0	0.0	67.2	32.8	

	LL	PL	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
○	N/P	N/P	0.349	0.191	0.148					

MATERIAL DESCRIPTION	USCS	AASHTO
○ Silty sand	SM	

Project No. 22235583 **Client:**

Project: ELIZABETH MINE

○ **Source:** TB-16 **Elev./Depth:** 0-2'

Remarks:

○

Particle Size Distribution Report

URS CORPORATION

Fig.

Particle Size Distribution Report

	% + 3"	% GRAVEL	% SAND	% SILT	% CLAY
○	0.0	0.0	80.4	19.6	

	LL	PL	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
○	N/P	N/P	0.341	0.189	0.154	0.0973				

MATERIAL DESCRIPTION	USCS	AASHTO
○ Silty sand	SM	

Project No. 22235583 **Client:**

Project: ELIZABETH MINE

○ **Source:** TB-16 **Elev./Depth:** 10-12'

Remarks:

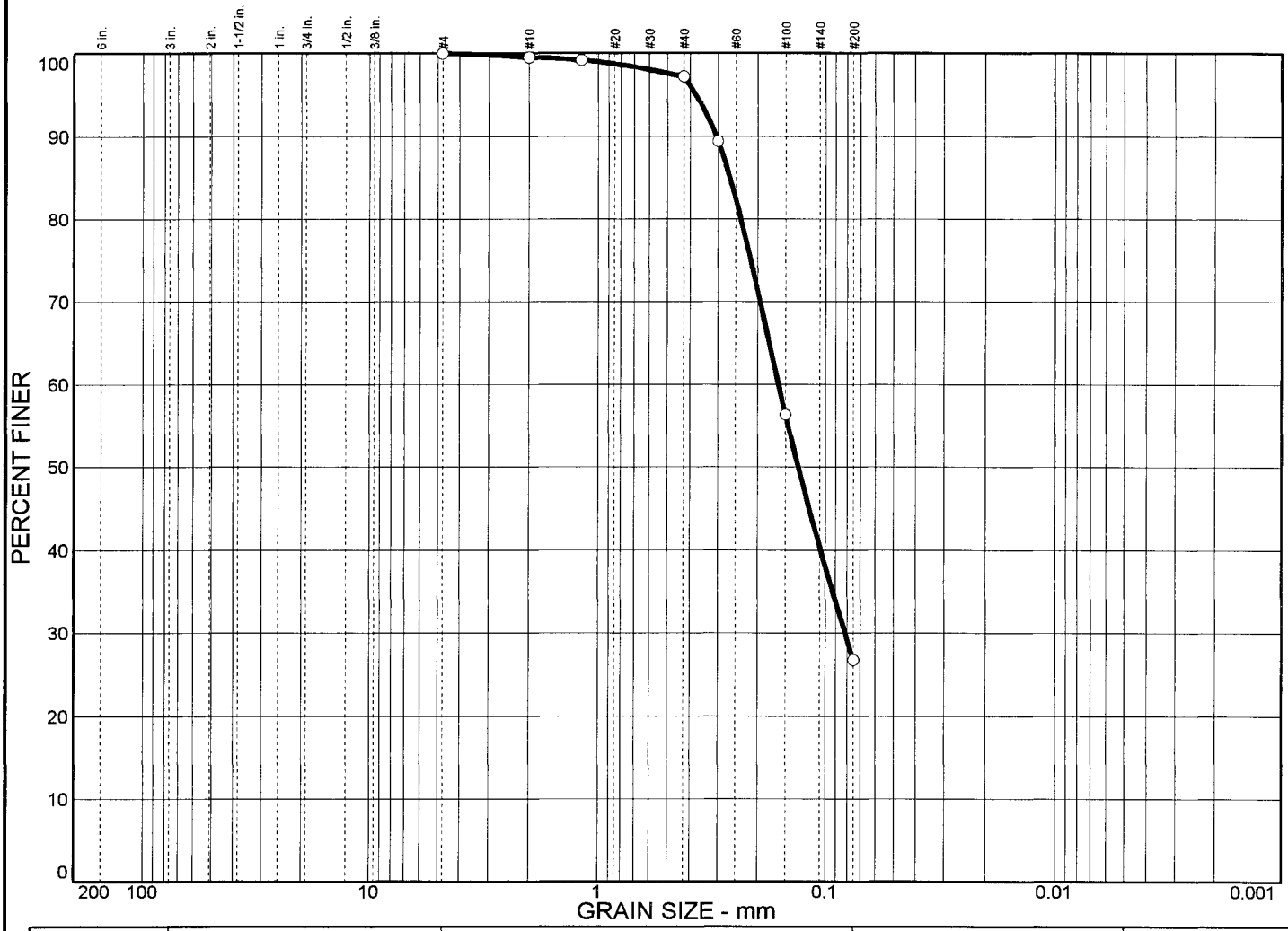
○

Particle Size Distribution Report

URS CORPORATION

Fig.

Particle Size Distribution Report



	% + 3"	% GRAVEL	% SAND	% SILT	% CLAY
○	0.0	0.0	73.3	26.7	

	LL	PL	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
○	N/P	N/P	0.266	0.161	0.132	0.0816				

MATERIAL DESCRIPTION	USCS	AASHTO
○ Silty sand	SM	

Project No. 22235583 **Client:**

Project: ELIZABETH MINE

○ **Source:** TB-16 **Elev./Depth:** 20-22'

Remarks:

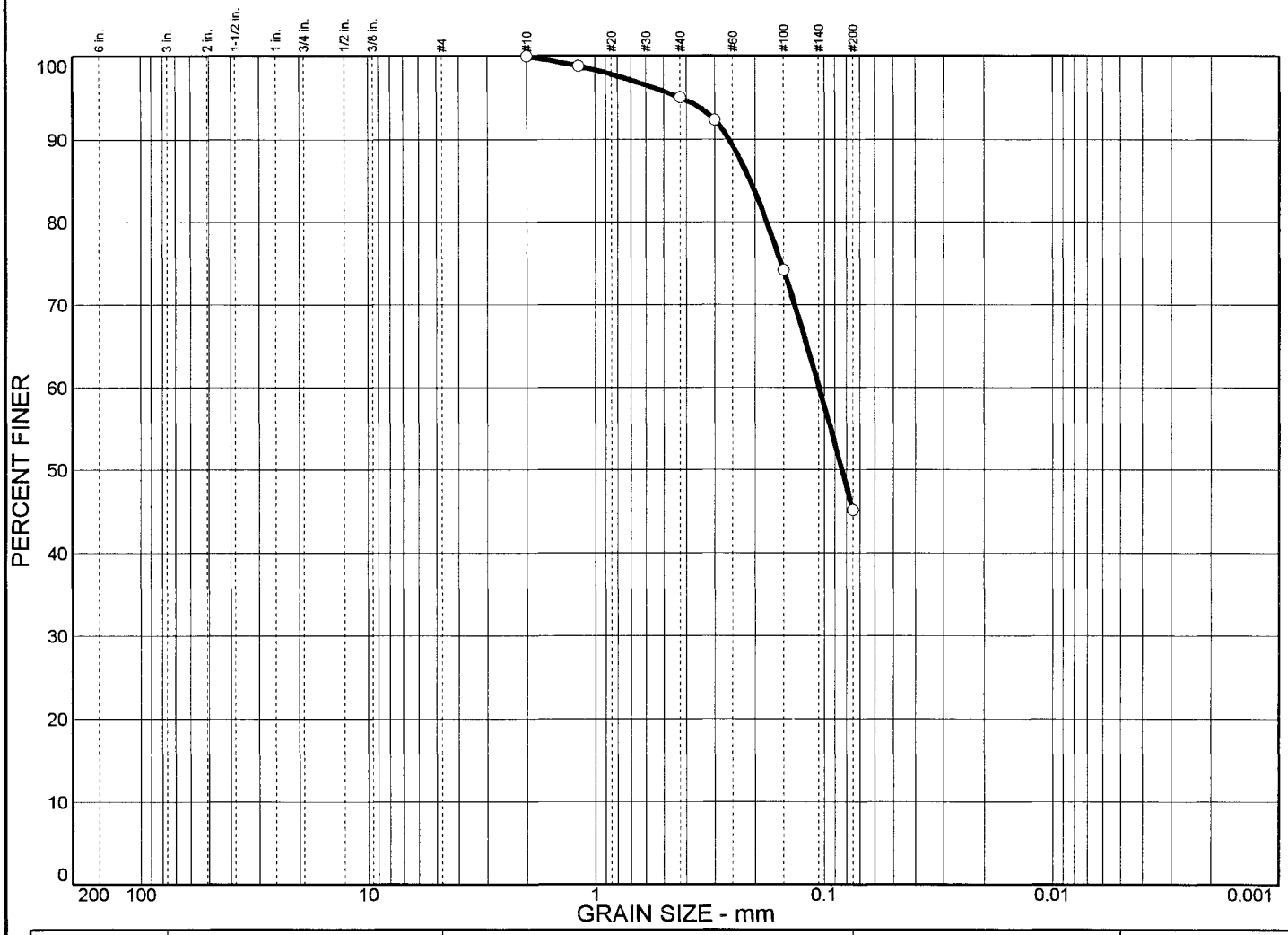
○

Particle Size Distribution Report

URS CORPORATION

Fig.

Particle Size Distribution Report



	% + 3"	% GRAVEL	% SAND	% SILT	% CLAY
○	0.0	0.0	54.9	45.1	

	LL	PL	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
○	N/P	N/P	0.210	0.105	0.0837					

MATERIAL DESCRIPTION	USCS	AASHTO
○ Silty sand	SM	

Project No. 22235583 **Client:**

Project: ELIZABETH MINE

○ **Source:** TB-16 **Elev./Depth:** 32.5-34.5'

Remarks:

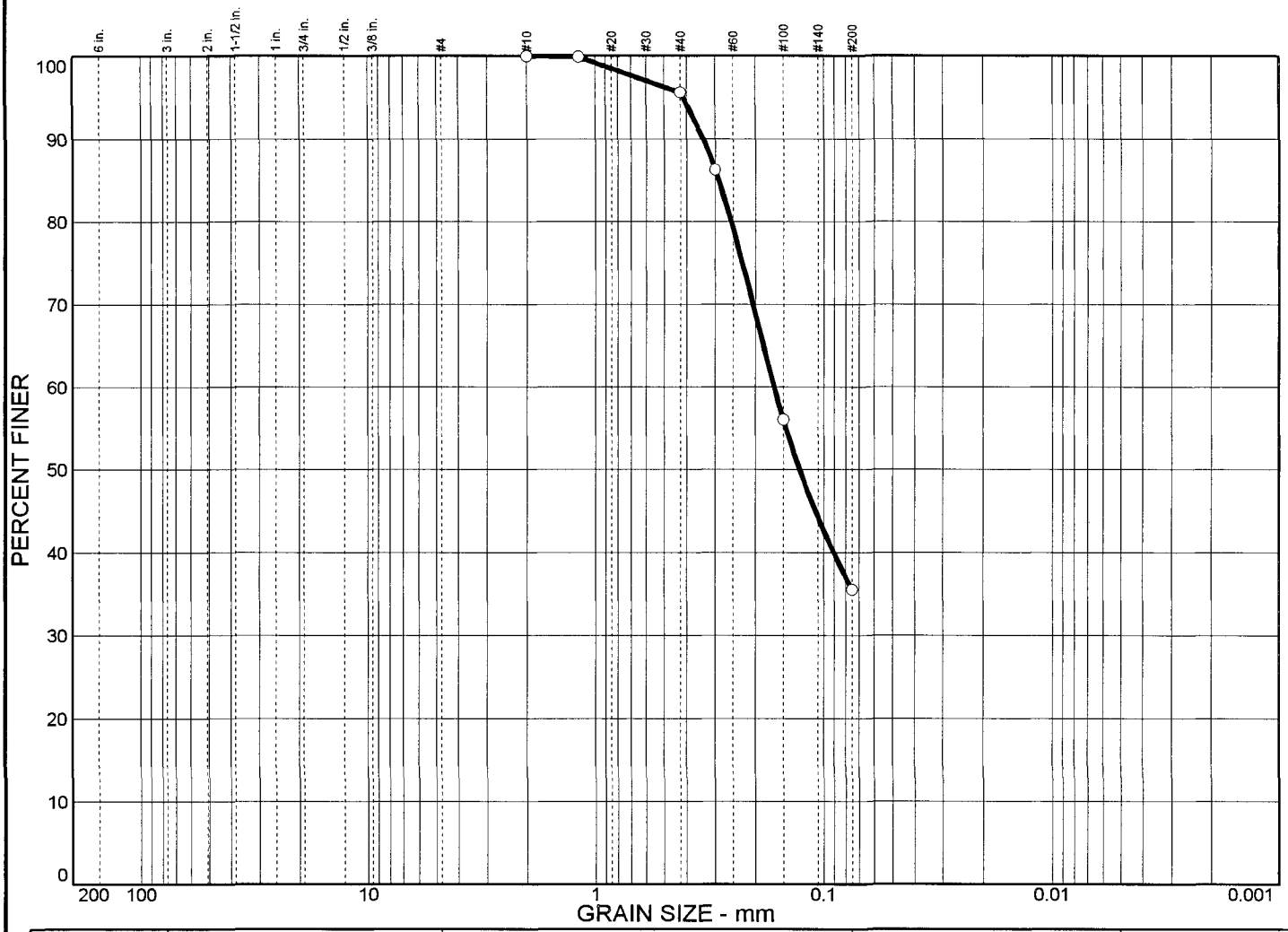
○

Particle Size Distribution Report

URS CORPORATION

Fig.

Particle Size Distribution Report



	% + 3"	% GRAVEL	% SAND	% SILT	% CLAY
○	0.0	0.0	64.5	35.5	

	LL	PL	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
○	N/P	N/P	0.289	0.165	0.127					

MATERIAL DESCRIPTION	USCS	AASHTO
○ Silty sand	SM	

Project No. 22235583 **Client:**

Project: ELIZABETH MINE

○ **Source:** TB-17 **Elev./Depth:** 0-2'

Remarks:

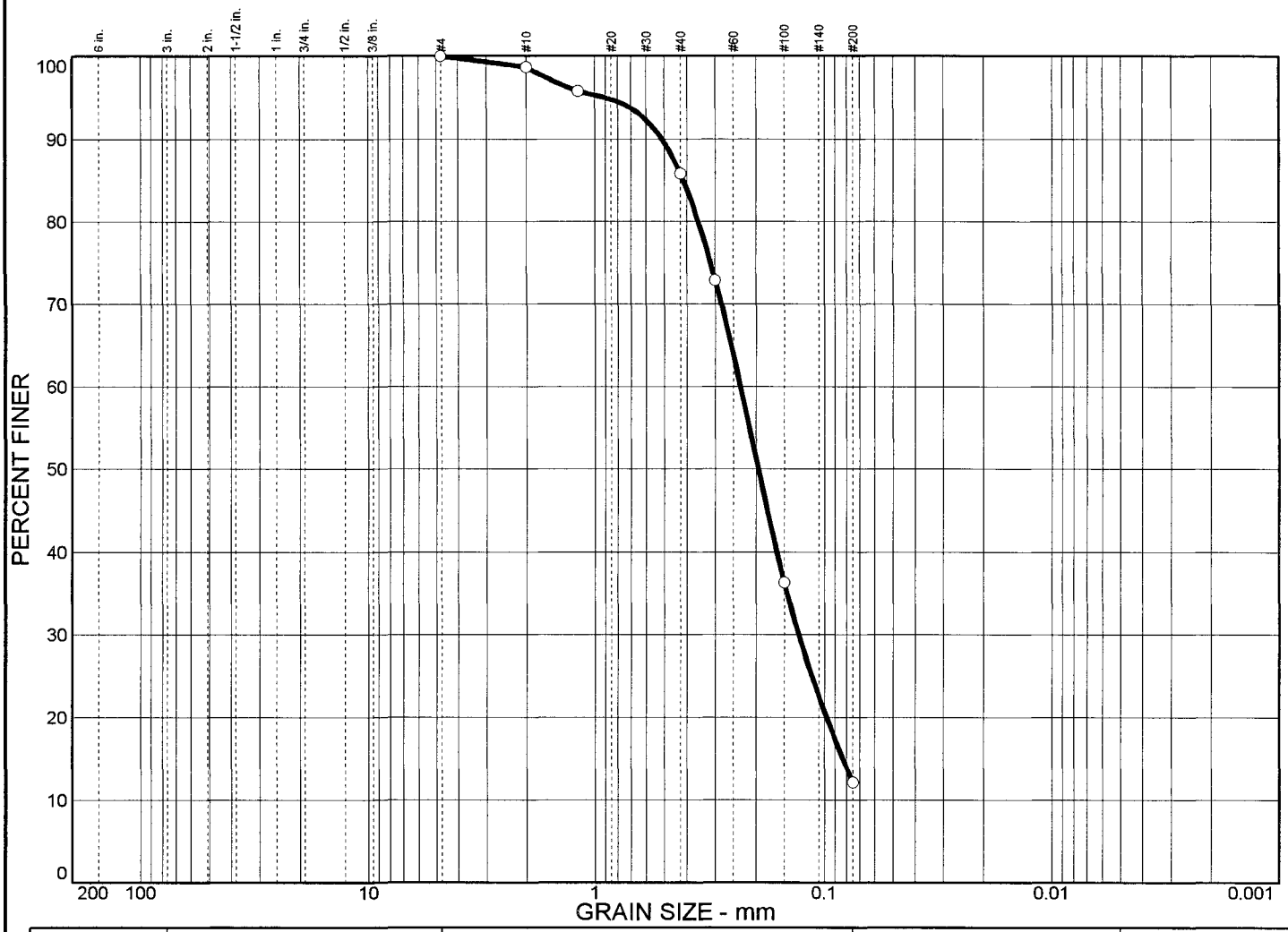
○

Particle Size Distribution Report

URS CORPORATION

Fig.

Particle Size Distribution Report



	% + 3"	% GRAVEL	% SAND	% SILT	% CLAY
○	0.0	0.0	87.9	12.1	

	LL	PL	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
○	N/P	N/P	0.413	0.234	0.195	0.130	0.0829			

MATERIAL DESCRIPTION	USCS	AASHTO
○ Silty sand	SM	

Project No. 22235583 **Client:**

Project: ELIZABETH MINE

○ **Source:** TB-17 **Elev./Depth:** 10-12'

Remarks:

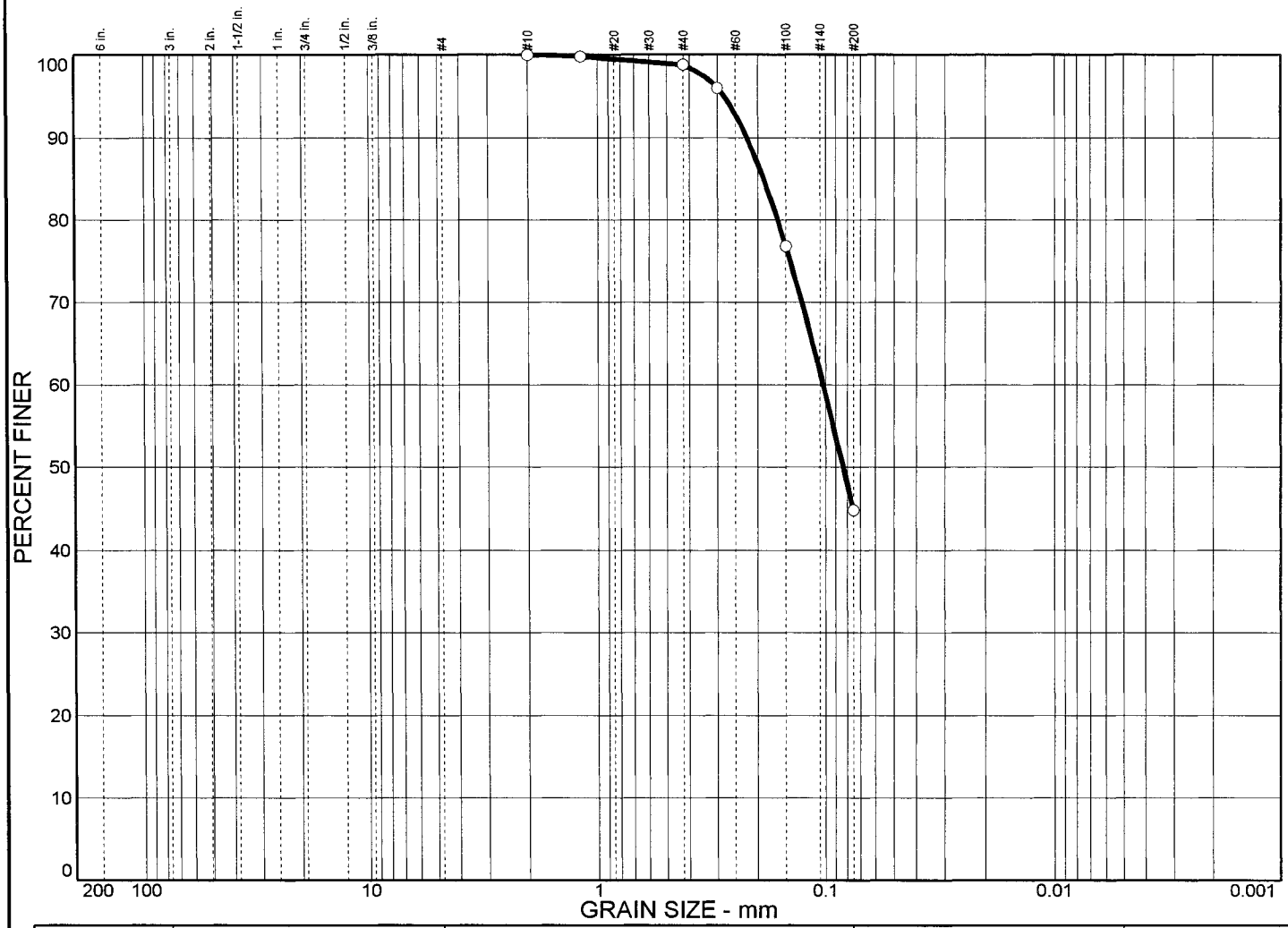
○

Particle Size Distribution Report

URS CORPORATION

Fig.

Particle Size Distribution Report



	% + 3"	% GRAVEL	% SAND	% SILT	% CLAY
○	0.0	0.0	55.2	44.8	

	LL	PL	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
○	N/P	N/P	0.188	0.102	0.0833					

MATERIAL DESCRIPTION	USCS	AASHTO
○ Silty sand	SM	

Project No. 22235583 **Client:**

Project: ELIZABETH MINE

○ **Source:** TB-17 **Elev./Depth:** 17.5-19.5'

Remarks:

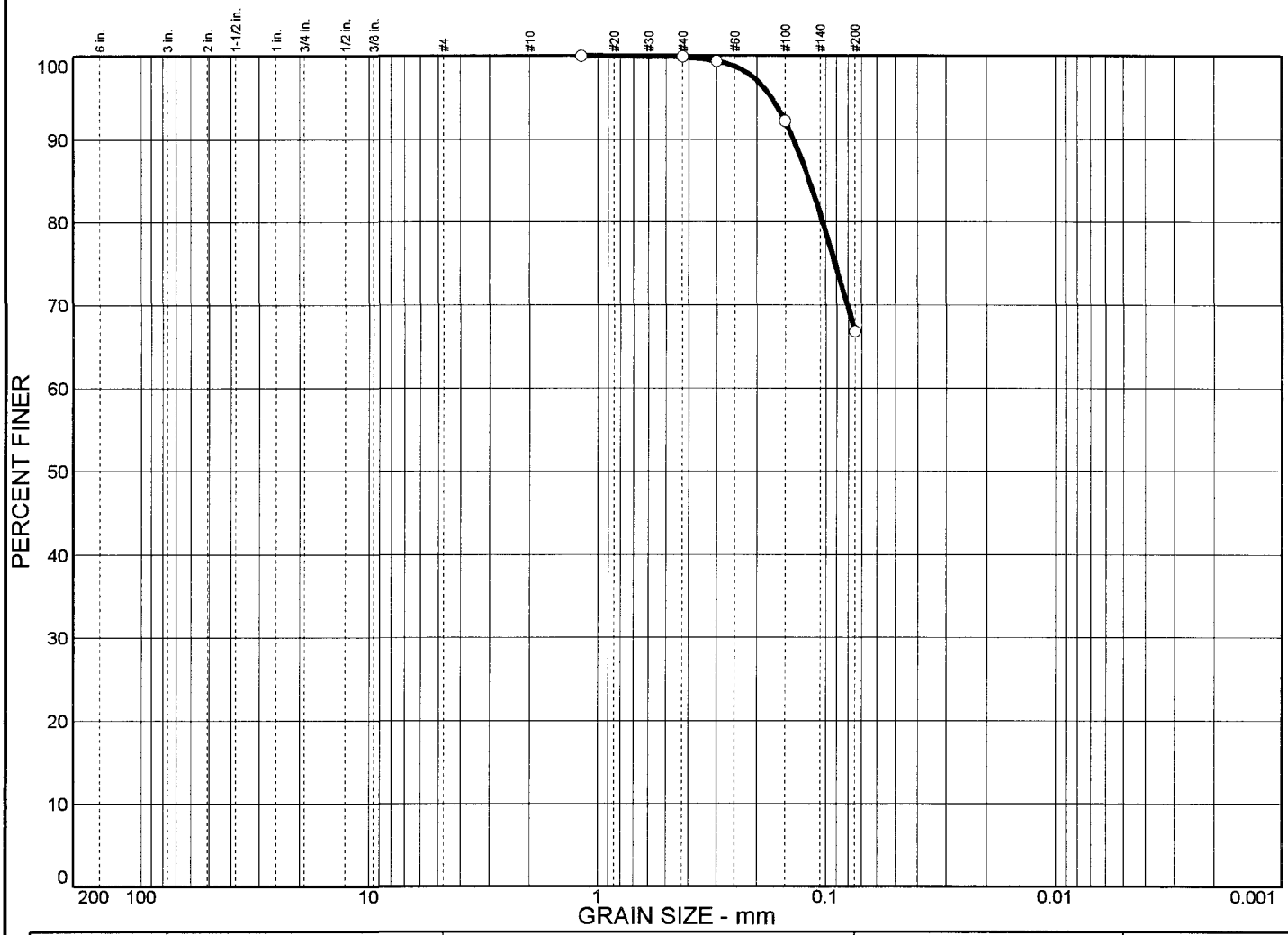
○

Particle Size Distribution Report

URS CORPORATION

Fig.

Particle Size Distribution Report



	% + 3"	% GRAVEL	% SAND	% SILT	% CLAY
○	0.0	0.0	33.2	66.8	

	LL	PL	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
○	N/P	N/P	0.118							

MATERIAL DESCRIPTION	USCS	AASHTO
○ Sandy silt	ML	

Project No. 22235583 **Client:**

Project: ELIZABETH MINE

○ **Source:** TB-17 **Elev./Depth:** 35-37'

Remarks:

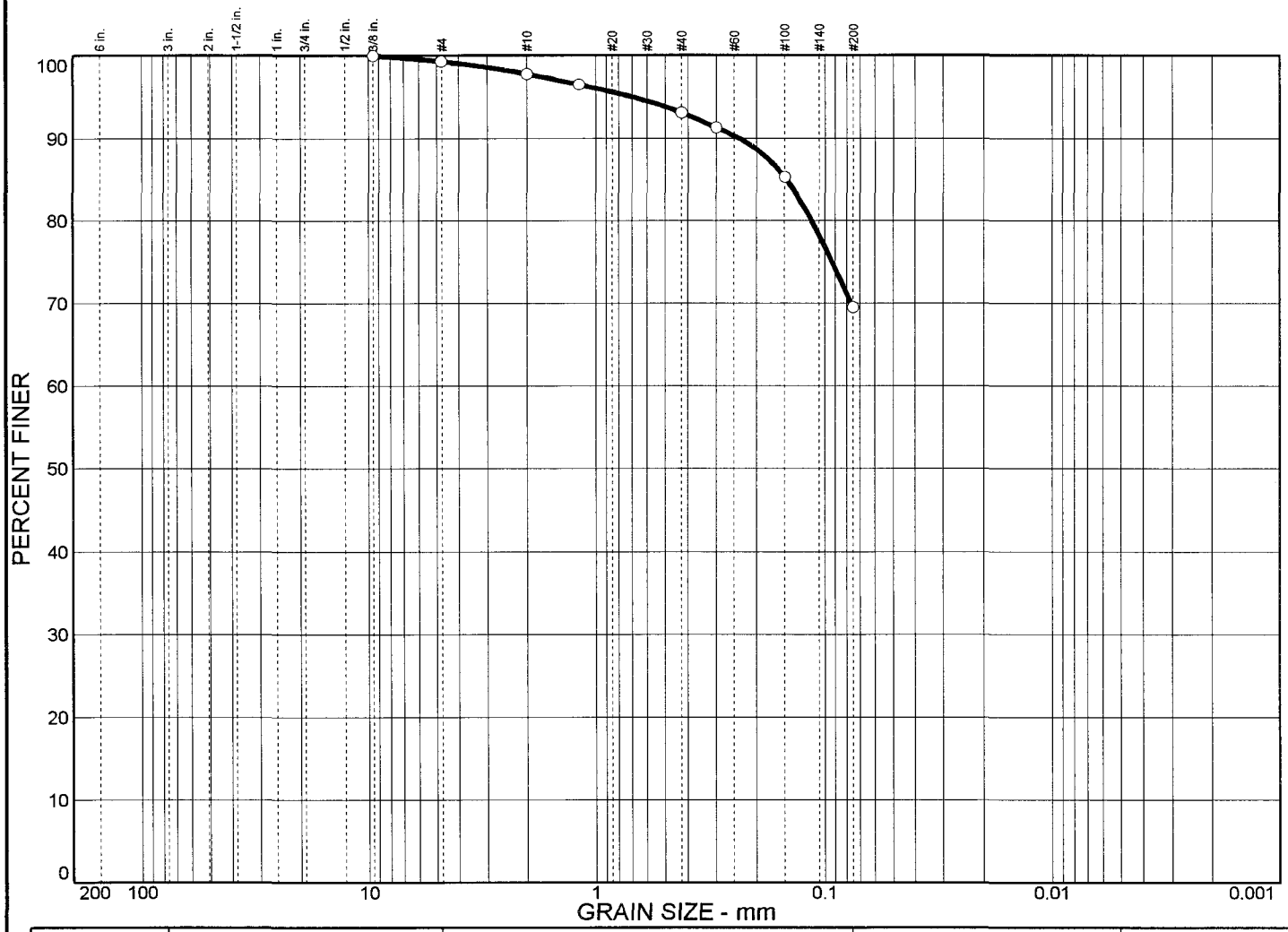
○

Particle Size Distribution Report

URS CORPORATION

Fig.

Particle Size Distribution Report



	% + 3"	% GRAVEL	% SAND	% SILT	% CLAY
○	0.0	0.7	29.8	69.5	

	LL	PL	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
○	N/P	N/P	0.147							

MATERIAL DESCRIPTION	USCS	AASHTO
○ Sandy silt	ML	

Project No. 22235583 **Client:**

Project: ELIZABETH MINE

○ **Source:** TB-18 **Elev./Depth:** 0-2'

Remarks:

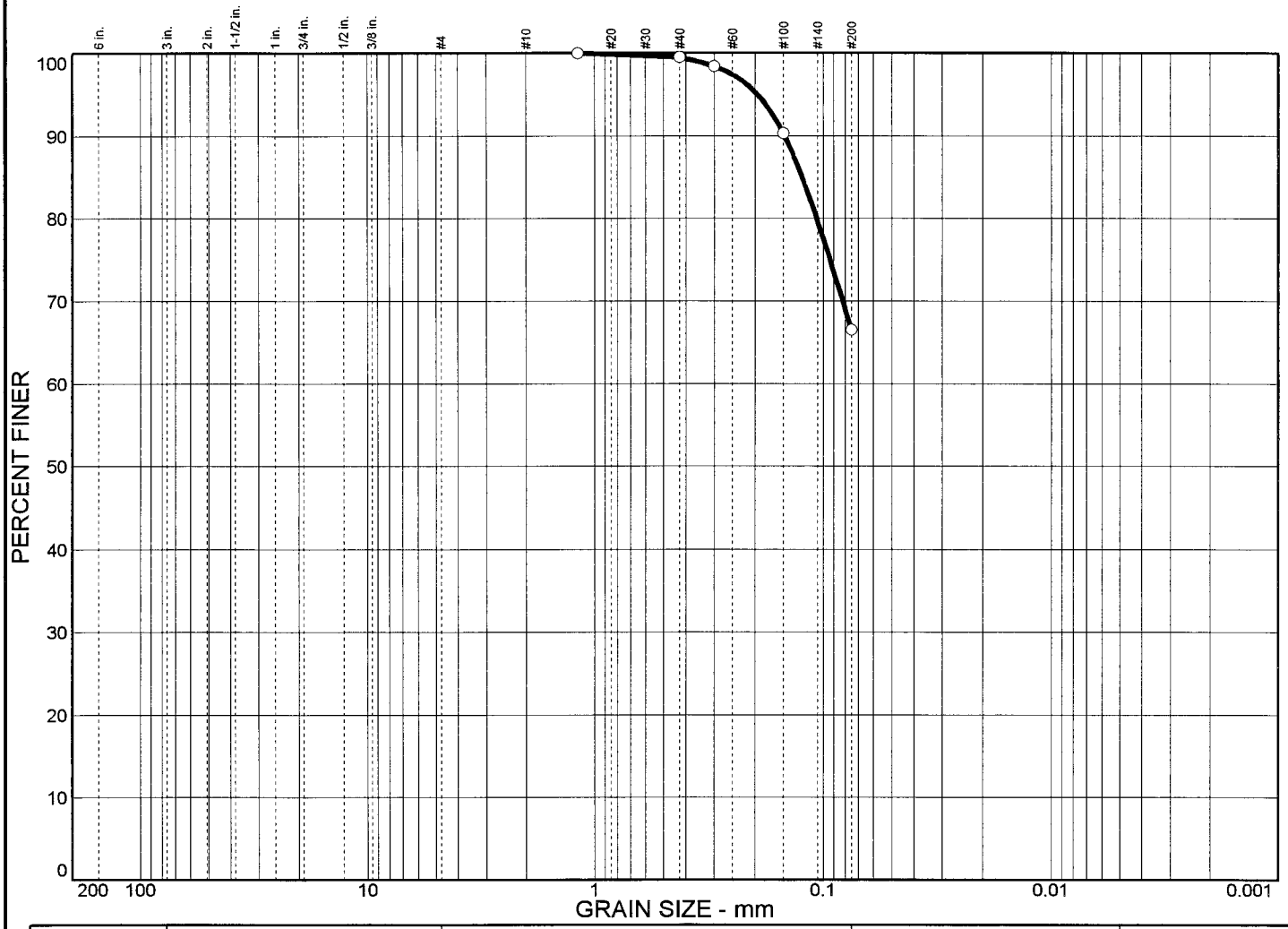
○

Particle Size Distribution Report

URS CORPORATION

Fig.

Particle Size Distribution Report



	% + 3"	% GRAVEL	% SAND	% SILT	% CLAY
○	0.0	0.0	33.5	66.5	

	LL	PL	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
○	N/P	N/P	0.124							

MATERIAL DESCRIPTION	USCS	AASHTO
○ Sandy silt	ML	

Project No. 22235583 **Client:**

Project: ELIZABETH MINE

○ **Source:** TB-18 **Elev./Depth:** 5-7'

Remarks:

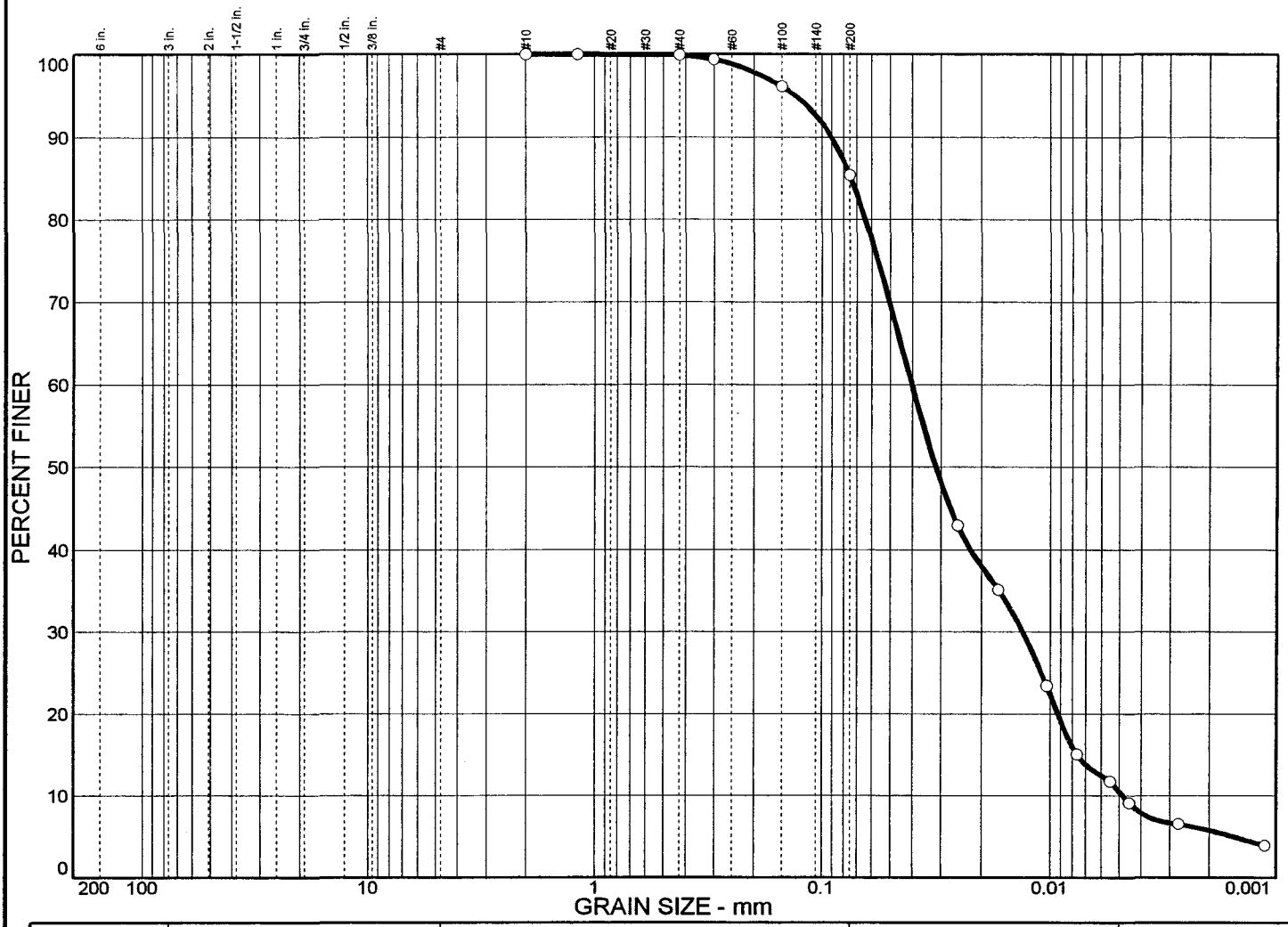
○

Particle Size Distribution Report

URS CORPORATION

Fig.

Particle Size Distribution Report



	% + 3"	% GRAVEL	% SAND	% SILT	% CLAY
○	0.0	0.0	14.6	74.9	10.5

	LL	PL	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
○	N/P	N/P	0.0740	0.0402	0.0316	0.0132	0.0076	0.0048	0.90	8.32

	MATERIAL DESCRIPTION	USCS	AASHTO
○	Silt	ML	

Project No. 22235583 **Client:**

Project: ELIZABETH MINE

○ **Source:** TB-18 **Elev./Depth:** 12.5-14.5

Remarks:

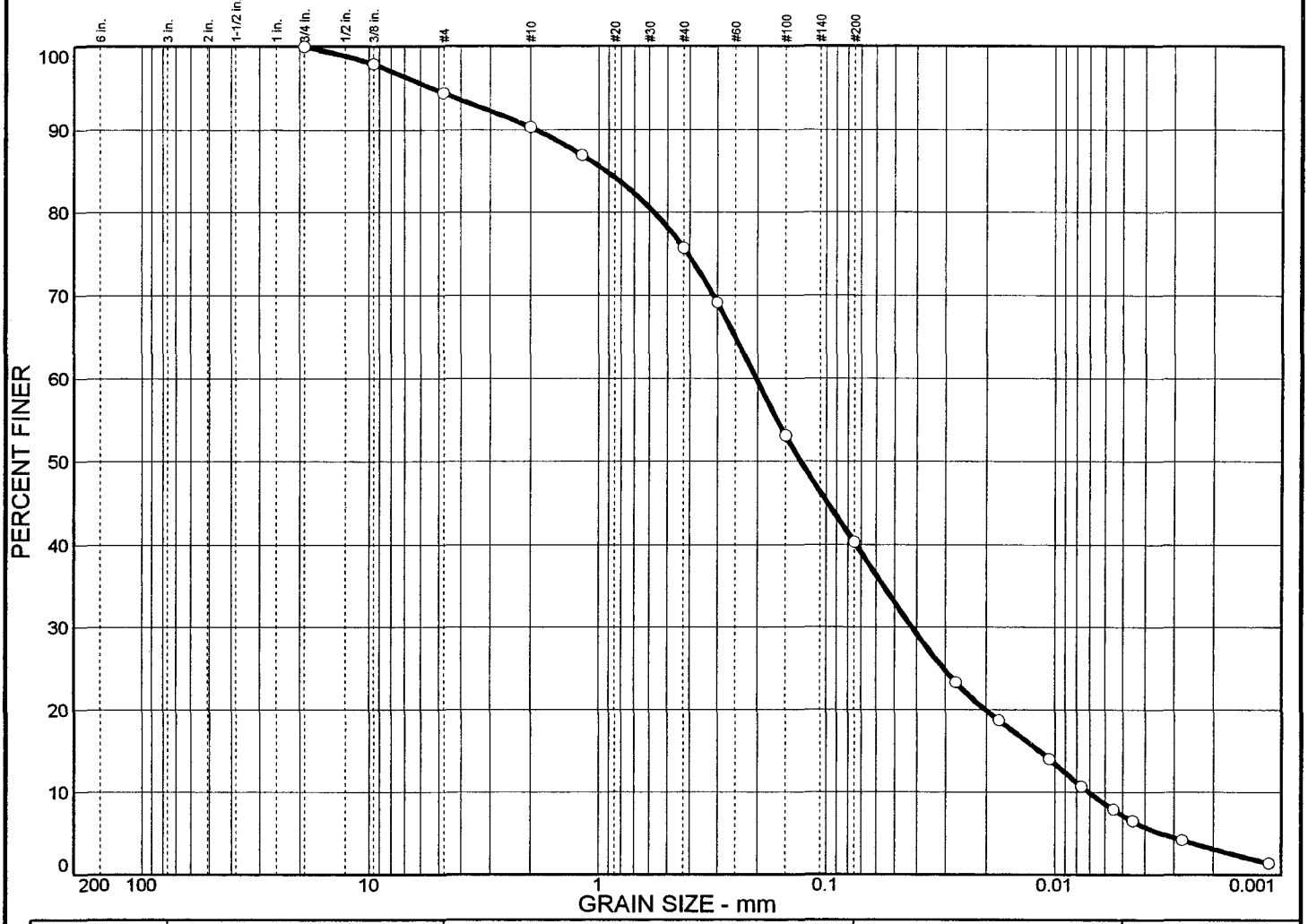
○

Particle Size Distribution Report

URS CORPORATION

Fig.

Particle Size Distribution Report



	% + 3"	% GRAVEL	% SAND	% SILT	% CLAY
○	0.0	5.6	54.1	33.1	7.2

	LL	PL	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
○	N/P	NP	0.927	0.203	0.129	0.0419	0.0117	0.0071	1.23	28.66

MATERIAL DESCRIPTION	USCS	AASHTO
○ Silty sand	SM	

Project No. 22235583 **Client:**

Project: ELIZABETH MINE

○ **Source:** TB-18 **Elev./Depth:** 25-27'

Remarks:

○

Particle Size Distribution Report

URS CORPORATION

Fig.

CONSTANT HEAD HYDRAULIC CONDUCTIVITY TEST
ASTM D 5084 - 90

Project No. **13846-066** BORING: TB-9
Project Name: **Elizabeth Mine** SAMPLE: DEPTH (ft): 27.3 Test No.: **P6581**

Specimen - Apparatus set-up - Test Information Apparatus No. C-2 Cell No. P-1 Stage 5

1) Specimen Tested in :	x	Triaxial Cell or		Compaction Mold or		
		with stones or		Stones with filter paper or		top + bottom
2) Specimen orientation for:	x	Vertical or		Horizontal permeability determination		
3) During saturation: Water flushed up sides of specimen to remove air:			x	No		Yes
4) During consolidation:	x	Top and bottom drainage or		Top		Bottom only
5) Direction of permeant :	x	Up during or		Down during permeation		
6) Permeant: water used	x	Tap		Distilled		
		Demineralized		0.005 N calcium sulfate (CaSO4)		

Consol Stage-Trial No.	Temp. °C	Date	Time hr	min	sec	Initial σ_c psi	Ub psi	Dial Indicator in	Pressure Head Reading Mercury (inch)	Gage (psi)	Flow Reading (cm)	Flow Vol (cm3) Rate (cm3/sec)	Fluid Head Reading Head (cm)	Tail (cm)	Total Head Uncorrected / Correction / Corrected (cm)	Gradient	Permeability Preliminary / Final at 20°C cm/sec
initial	21.7	12/19/02	14	00	00	120.0	100.0	0.726			3.30	49.632	71.45	36.35	35.10		
final	21.7	12/19/02	14	08	48						5.70	0.0940	71.45	36.35	1.83		6.93E-04
1	RT = 0.959	dT =		8.80 min		σ'_c =	2.9 ksf						71.45	36.35	33.27	3.28	6.68E-04
initial	21.7	12/19/02	14	10	00	120.0	100.0	0.726			3.90	47.564	71.45	36.35	35.10		
final	21.7	12/19/02	14	18	30						6.20	0.0933	71.45	36.35	1.82		6.87E-04
2	RT = 0.959	dT =		8.50 min		σ'_c =	2.9 ksf						71.45	36.35	33.28	3.29	6.62E-04
initial	21.7	12/19/02	14	20	00	120.0	100.0	0.726			3.50	82.72	71.45	36.35	35.10		
final	21.7	12/19/02	14	34	37						7.50	0.0943	71.45	36.35	1.84		6.95E-04
3	RT = 0.959	dT =		14.62 min		σ'_c =	2.9 ksf						71.45	36.35	33.26	3.28	6.70E-04
initial	21.7	12/19/02	14	40	00	120.0	100.0	0.726			4.00	68.244	71.45	36.35	35.10		
final	21.7	12/19/02	14	52	00						7.30	0.0948	71.45	36.35	1.85		6.99E-04
4	RT = 0.959	dT =		12.00 min		σ'_c =	2.9 ksf						71.45	36.35	33.25	3.28	6.74E-04

Preliminary Length/Area Calculations

Lo =	4.014	in	Lo=	10.195	cm
Ao=	6.486	in^2	Ao =	41.84	cm^2
Vo=	26.031	in^3	Vo =	426.58	cm^3
Lc =	10.129	cm	Vc =	418.29	cm^3
Ac=	41.298	cm^2			

Tested By: BB Reviewed By: G. Thomas

TEST SUMMARY

Final Specimen and Test Conditions

Lc = 10.129 cm ε_{axial} = 0.6%
Ac = 41.068 cm^2
Vc= 415.96 cm^3 ε_{vol} = 2.5%

	w (%)	γ_t (pcf)	γ_d (pcf)	S (%)
Initial	21.56	133.9	110.2	81.4
PreTest	25.07	141.3	113.0	100.0

HYDRAULIC CONDUCTIVITY SUMMARY

Averages for trials: 1-4
ave K @ 20 °C: **6.69E-04** cm/sec
(i_o)ave = 3.28

HYDRAULIC CONDUCTIVITY TEST

CONSTANT HEAD HYDRAULIC CONDUCTIVITY TEST
ASTM D 5084 - 90

Project No. **13846-066** BORING: TB-10
Project Name: **Elizabeth Mine** SAMPLE: DEPTH (ft): 32.2 Test No.: **P6582**

Specimen - Apparatus set-up - Test Information Apparatus No. C-2 Cell No. H-7 Stage 5

1) Specimen Tested in :	x	Triaxial Cell or		Compaction Mold or		
		with stones or		Stones with filter paper or		top + bottom
2) Specimen orientation for:	x	Vertical or		Horizontal permeability determination		
3) During saturation: Water flushed up sides of specimen to remove air:			x	No		Yes
4) During consolidation:	x	Top and bottom drainage or		Top		Bottom only
5) Direction of permeant :	x	Up during or		Down during permeation		
6) Permeant: water used	x	Tap		Distilled		
		Demineralized		0.005 N calcium sulfate (CaSO4)		

Consol Stage-Trial No.	Temp. °C	Date	Time hr	Time min	Time sec	Initial σ_c psi	Initial Ub psi	Dial Indicator in	Pressure Head Reading Mercury (inch)	Pressure Head Reading Gage (psi)	Flow Reading (cm)	Flow Vol (cm3) Rate (cm3/sec)	Fluid Head Reading Head (cm)	Fluid Head Reading Tail (cm)	Total Head Uncorrected / Correction / Corrected (cm)	Gradient	Permeability Preliminary / Final at 20°C cm/sec
initial	21.3	12/19/02	15	00	00	125.0	100.0	0.726			4.00	117.876	65.90	36.15	29.75		
final	21.3	12/19/02	15	24	50						9.70	0.0791	65.90	36.15	10.46		1.04E-03
1	RT = 0.968	dT =		24.83 min		σ'_c =	3.6 ksf						65.9	36.15	19.29	1.90	1.01E-03
initial	21.3	12/19/02	15	30	00	125.0	100.0	0.726			3.80	103.4	65.90	36.15	29.75		
final	21.3	12/19/02	15	51	50						8.80	0.0789	65.90	36.15	10.43		1.03E-03
2	RT = 0.968	dT =		21.83 min		σ'_c =	3.6 ksf						65.9	36.15	19.32	1.90	1.01E-03
initial	21.3	12/19/02	16	00	00	125.0	100.0	0.726			3.30	66.176	65.90	36.15	29.75		
final	21.3	12/19/02	16	14	06						6.50	0.0782	65.90	36.15	10.34		1.02E-03
3	RT = 0.968	dT =		14.10 min		σ'_c =	3.6 ksf						65.9	36.15	19.41	1.91	9.96E-04
initial	21.3	12/19/02	16	20	00	125.0	100.0	0.726			3.90	64.108	65.90	36.15	29.75		
final	21.3	12/19/02	16	33	50						7.00	0.0772	65.90	36.15	10.21		9.98E-04
4	RT = 0.968	dT =		13.83 min		σ'_c =	3.6 ksf						65.9	36.15	19.54	1.93	9.77E-04

Preliminary Length/Area Calculations

Lo =	4.024	in	Lo=	10.221	cm
Ao=	6.324	in^2	Ao =	40.80	cm^2
Vo=	25.447	in^3	Vo =	417.01	cm^3
Lc =	10.145	cm	Vc =	407.68	cm^3
Ac=	40.184	cm^2			

Tested By: BB Reviewed By: G. Thomas

TEST SUMMARY

Final Specimen and Test Conditions

Lc =	10.145 cm	ε_{axial} =	0.7%
Ac =	39.734 cm^2		
Vc=	403.11 cm^3	ε_{vol} =	3.3%

	w (%)	γ_t (pcf)	γ_d (pcf)	S (%)
Initial	19.88	138.3	115.3	81.9
PreTest	22.48	146.1	119.3	100.0

HYDRAULIC CONDUCTIVITY SUMMARY

Averages for trials: 1-4

ave K @ 20 °C: **9.99E-04** cm/sec

(i_o)ave = 1.91

HYDRAULIC CONDUCTIVITY TEST

PERMEABILITY TEST: FALLING HEAD - CONSTANT VOLUME U-TUBE
ASTM D 5084 - 90

Project No.: 13846066 | BORING: TB-10 | Test No.: T2138

Project Name: Elizabeth Mine | SAMPLE: B | DEPTH: 60.85

Specimen - Apparatus set-up - Test Information | Cell No. H-7 | Apparatus No. 1 | Stage No.: 5

Preliminary Length/Area Calculations

Lo =	6.004	in	Lo=	15.250	cm
dLc=	0.100	in	Ao =	41.84	cm^2
Lc=	5.904	in	Vo =	638.03	cm^3
			Lc=	14.996	cm
dVc = 3 Vo * (dLc/Lo)			dVc=	31.88	cm^3
			Vc =	606.15	cm^3
Sc =	0.371	cm^{-1}	Ac=	40.421	cm^2

1) Specimen Tested in :	x	Triaxial Cell or		Compaction Mold or			
	x	with stones or		Stones with filter paper or			top + bottom
2) Specimen orientation for:	x	Vertical or		Horizontal permeability determination			
3) During saturation: Water flushed up sides of specimen to remove a			x	No		Yes	
4) During consolidation:	x	Top and bottom drainage or		Top		Bottom only	
5) Direction of permeant :	x	Up during or		Down during permeation			
6) Permeant: water used	x	Tap		Distilled			
or		Demineralized		0.005 N calcium sulfate (CaSO4)			Permeability

Equations Used

Kt = - 0.0000760 * Sc/dT(min) * ln (ho/hf)

RT = (-0.02452*(ave. temp in C) + 1.495)

K @ 20 °C = RT * Kt TubeC= 1.319

Consol Stage-Trial No.	Temp. °C	Date	Time hr	Time min	Time sec	Initial σ_c psi	Initial Ub psi	U-tube Reading Head (cm) (cc)	U-tube Reading Tail (cm) (cc)	Flow in/out gradient	Preliminary Final at 20°C cm/sec Dev. from Ave.
initial	20.4	01/22/03	11	51	00	110.0	60.0	58.05	40.74	0.98	1.55E-07
final	20.6	01/22/03	12	32	00			55.40	41.60		1.63E-07
3	RT = 0.992	dT =	41.00 min			σ'_c =	50 psi	0.200	0.204	io= 14.5	14%
initial	20.6	01/22/03	12	33	00	110.0	60.0	58.08	40.73	0.94	1.62E-07
final	20.8	01/22/03	12	59	00			56.25	41.35		1.70E-07
4	RT = 0.987	dT =	26.00 min			σ'_c =	50 psi	0.138	0.147	io= 14.5	19%
initial	20.8	01/22/03	13	00	00	110.0	60.0	58.00	40.76	0.99	1.50E-07
final	21.0	01/22/03	13	33	00			55.90	41.44		1.56E-07
5	RT = 0.983	dT =	33.00 min			σ'_c =	50 psi	0.159	0.161	io= 14.5	9%
initial	21.0	01/22/03	13	34	00	110.0	60.0	58.00	40.76	1.07	1.32E-07
final	21.0	01/22/03	14	36	00			54.70	41.74		1.37E-07
6	RT = 0.980	dT =	62.00 min			σ'_c =	50 psi	0.250	0.232	io= 14.5	-4%
initial	21.0	01/22/03	14	38	00	110.0	60.0	58.10	40.74	1.00	1.42E-07
final	21.3	01/22/03	15	19	00			55.65	41.52		1.47E-07
7	RT = 0.976	dT =	41.00 min			σ'_c =	50 psi	0.185	0.185	io= 14.6	3%
initial	21.3	01/22/03	15	20	00	110.0	60.0	58.10	40.74	0.99	1.28E-07
final	21.5	01/22/03	15	58	00			56.02	41.41		1.31E-07
8	RT = 0.970	dT =	38.00 min			σ'_c =	50 psi	0.157	0.159	io= 14.6	-8%

TEST SUMMARY

Final Specimen and Test Conditions

Lc = 14.996 cm ε_{axial} = 1.7%

Ac = 38.157 cm^2

Vc= 572.19 cm^3 ε_{vol} = 10.3%

Sc = 0.393 cm^{-1} Sc = Lc / Ac , final

	w (%)	γ_τ (pcf)	γ_d (pcf)	S (%)
Initial	13.00	111.8	99.0	39.7
PreTest	26.26	139.3	110.4	100.0

HYDRAULIC CONDUCTIVITY SUMMARY

Averages for trials: 3-6

ave K @ 20 °C: **1.43E-07** cm/sec

(i_o)ave = 14.5

Tested By: DT Reviewed By: GET

PERMEABILITY TEST: FALLING HEAD - CONSTANT VOLUME U-TUBE
ASTM D 5084 - 90

Project No.: 13846066 | BORING: TB-11 | Test No.: T2133

Project Name: Elizabeth Mine | SAMPLE: A | DEPTH: 40.25

Specimen - Apparatus set-up - Test Information | Cell No. H-3 | Apparatus No. 1 | Stage No.: 5

Preliminary Length/Area Calculations

Lo =	6.004	in	Lo=	15.250	cm
dLc=	0.141	in	Ao =	41.15	cm^2
Lc=	5.863	in	Vo =	627.49	cm^3
			Lc=	14.892	cm
dVc = 3 Vo * (dLc/Lo)			dVc=	44.21	cm^3
			Vc =	583.28	cm^3
Sc =	0.380	cm^{-1}	Ac=	39.168	cm^2

1) Specimen Tested in :	x	Triaxial Cell or		Compaction Mold or			
	x	with stones or		Stones with filter paper or			top + bottom
2) Specimen orientation for:	x	Vertical or		Horizontal permeability determination			
3) During saturation: Water flushed up sides of specimen to remove a			x	No		Yes	
4) During consolidation:	x	Top and bottom drainage or		Top		Bottom only	
5) Direction of permeant :	x	Up during or		Down during permeation			
6) Permeant: water used	x	Tap		Distilled			
or		Demineralized		0.005 N calcium sulfate (CaSO4)			

Equations Used

Kt = - 0.0000760 * Sc/dT(min) * ln (ho/hf)

RT = (-0.02452*(ave. temp in C) + 1.495)

K @ 20 °C = RT * Kt TubeC= 1.319

Consol Stage-Trial No.	Temp. ° C	Date	Time hr	Time min	Time sec	Initial σ_c psi	Initial Ub psi	U-tube Reading Head (cm) (cc)	U-tube Reading Tail (cm) (cc)	Flow in/out gradient	Permeability Preliminary Final at 20°C cm/sec Dev. from Ave.
initial	20.9	01/17/03	00	00	00	115.0	80.0	52.00	42.67	1.01	1.52E-04
final	20.9	01/17/03	00	00	14			47.00	44.25		1.49E-04
1	RT = 0.983	dT =		0.23 min		σ'_c =	35 psi	0.378	0.375	io= 7.9	0%
initial	20.9	01/17/03	00	00	00	115.0	80.0	52.00	42.67	1.01	1.52E-04
final	20.9	01/17/03	00	00	14			47.00	44.25		1.49E-04
2	RT = 0.983	dT =		0.23 min		σ'_c =	35 psi	0.378	0.375	io= 7.9	0%
initial	20.9	01/17/03	00	00	00	115.0	80.0	52.00	42.67	1.01	1.52E-04
final	20.9	01/17/03	00	00	14			47.00	44.25		1.49E-04
3	RT = 0.983	dT =		0.23 min		σ'_c =	35 psi	0.378	0.375	io= 7.9	0%
initial	20.9	01/17/03	00	00	00	115.0	80.0	52.00	42.67	1.01	1.52E-04
final	20.9	01/17/03	00	00	14			47.00	44.25		1.49E-04
4	RT = 0.983	dT =		0.23 min		σ'_c =	35 psi	0.378	0.375	io= 7.9	0%
initial											
final											
5											
initial											
final											
6											

TEST SUMMARY

Final Specimen and Test Conditions

Lc =	14.892	cm	ε_{axial} =	2.3%
Ac =	39.376	cm^2		
Vc=	586.36	cm^3	ε_{vol} =	6.6%
Sc =	0.378	cm	Sc = Lc / Ac , final	

	w (%)	γ_τ (pcf)	γ_d (pcf)	S (%)
Initial	13.97	123.7	108.5	51.4
PreTest	23.44	143.4	116.2	100.0

HYDRAULIC CONDUCTIVITY SUMMARY

Averages for trials: 1-4

ave K @ 20 °C: **1.49E-04** cm/sec

(i_o)ave = 7.9

Tested By: DT Reviewed By: GET

CONSTANT HEAD HYDRAULIC CONDUCTIVITY TEST
ASTM D 5084 - 90

Project No. **13846-066** BORING: TB-12
Project Name: **Elizabeth Mine** SAMPLE: DEPTH (ft): 17.2 Test No.: **P6580**

Specimen - Apparatus set-up - Test Information Apparatus No. C-2 Cell No. P-1 Stage 3

1) Specimen Tested in :	x	Triaxial Cell or		Compaction Mold or		
		with stones or		Stones with filter paper or		top + bottom
2) Specimen orientation for:	x	Vertical or		Horizontal permeability determination		
3) During saturation: Water flushed up sides of specimen to remove air:			x	No		Yes
4) During consolidation:	x	Top and bottom drainage or		Top		Bottom only
5) Direction of permeant :	x	Up during or		Down during permeation		
6) Permeant: water used	x	Tap		Distilled		
		Demineralized		0.005 N calcium sulfate (CaSO4)		

Consol Stage- Trial No.	Temp. °C	Date	Time hr	min	sec	Initial σ_c psi	Ub psi	Dial Indicator in	Pressure Head Reading Mercury (inch)	Gage (psi)	Flow Reading (cm)	Flow Vol (cm3) Rate (cm3/sec)	Fluid Head Reading Head (cm)	Tail (cm)	Total Head Uncorrected Correction Corrected (cm)	Gradient	Permeability Preliminary Final at 20°C cm/sec
initial	21.3	12/26/02	14	31	00	112.0	100.0	0.626			4.30	47.564	50.00	41.60	8.40		
final	21.3	12/26/02	14	36	34						6.60	0.1424	50.00	41.60	2.78		6.20E-03
1	RT = 0.968	dT =		5.57 min		σ'_c =	1.7 ksf						50	41.6	5.62	0.55	5.98E-03
initial	21.3	12/26/02	14	41	00	112.0	100.0	0.626			4.60	55.836	50.00	41.60	8.40		
final	21.3	12/26/02	14	47	16						7.30	0.1485	50.00	41.60	2.90		6.61E-03
2	RT = 0.968	dT =		6.27 min		σ'_c =	1.7 ksf						50	41.6	5.50	0.54	6.37E-03
initial	21.3	12/26/02	14	50	00	112.0	100.0	0.626			4.00	62.04	50.00	41.60	8.40		
final	21.3	12/26/02	14	57	06						7.00	0.1456	50.00	41.60	2.84		6.41E-03
3	RT = 0.968	dT =		7.10 min		σ'_c =	1.7 ksf						50	41.6	5.56	0.55	6.19E-03
initial	21.3	12/26/02	15	01	00	112.0	100.0	0.626			4.70	78.584	50.00	41.60	8.40		
final	21.3	12/26/02	15	09	52						8.50	0.1477	50.00	41.60	2.88		6.55E-03
4	RT = 0.968	dT =		8.87 min		σ'_c =	1.7 ksf						50	41.6	5.52	0.54	6.32E-03

Preliminary Length/Area Calculations

Lo =	4.017	in	Lo=	10.203	cm
Ao=	6.504	in^2	Ao =	41.96	cm^2
Vo=	26.125	in^3	Vo =	428.11	cm^3
Lc =	10.137	cm	Vc =	419.79	cm^3
Ac=	41.414	cm^2			

Tested By: DT Reviewed By: G. Thomas

TEST SUMMARY

Final Specimen and Test Conditions

Lc =	10.137	cm	ε_{axial} =	0.6%
Ac =	41.541	cm^2		
Vc=	421.08	cm^3	ε_{vol} =	1.6%

	w (%)	γ_t (pcf)	γ_d (pcf)	S (%)
Initial	4.74	119.1	113.7	18.9
PreTest	24.19	143.5	115.6	100.0

HYDRAULIC CONDUCTIVITY SUMMARY

Averages for trials: 1-4
ave K @ 20 °C: **6.22E-03** cm/sec
(i_c)ave = 0.55

HYDRAULIC CONDUCTIVITY TEST

PERMEABILITY TEST: FALLING HEAD - CONSTANT VOLUME U-TUBE

ASTM D 5084 - 90

Project No.: 13846-066 | BORING: TB-14 | Test No.: P6577

Project Name: Elizabeth Mine | SAMPLE: | DEPTH (ft): 21.7

Specimen - Apparatus set-up - Test Information | Cell No. H-2 | Apparatus No. 2 | Stage No.: 3

Preliminary Length/Area Calculations

Lo =	4.001	in	Lo=	10.162	cm
dLc=	0.047	in	Ao =	40.79	cm^2
Lc=	3.954	in	Vo =	414.53	cm^3
			Lc=	10.043	cm
dVc = 3 Vo * (dLc/Lo)			dVc=	14.61	cm^3
			Vc =	399.92	cm^3
Sc =	0.252	cm^{-1}	Ac=	39.822	cm^2

Equations Used

Kt = - 0.0000752 * Sc/dT(min) * ln (ho/hf)

RT = (-0.02452*(ave. temp in C) + 1.495)

K @ 20 °C = RT * Kt TubeC= 1.322

1) Specimen Tested in :	x	Triaxial Cell or		Compaction Mold or	
	x	with stones or		Stones with filter paper or	top + bottom
2) Specimen orientation for:	x	Vertical or		Horizontal permeability determination	
3) During saturation: Water flushed up sides of specimen to remove ai			x	No	Yes
4) During consolidation:	x	Top and bottom drainage or		Top	Bottom only
5) Direction of permeant :	x	Up during or		Down during permeation	
6) Permeant: water used	x	Tap		Distilled	
or		Demineralized		0.005 N calcium sulfate (CaSO4)	

TEST SUMMARY

Final Specimen and Test Conditions

Lc =	10.043	cm	ε_{axial} =	1.2%
Ac =	39.345	cm^2		
Vc=	395.13	cm^3	ε_{vol} =	4.7%
Sc =	0.255	cm^{-1}	Sc = Lc / Ac , final	

	w (%)	γ_τ (pcf)	γ_d (pcf)	S (%)
Initial	25.53	114.1	90.9	68.0
PreTest	34.35	128.1	95.4	100.0

HYDRAULIC CONDUCTIVITY SUMMARY

Averages for trials: 1-4

ave K @ 20 °C: **7.38E-06** cm/sec

(i_o)ave = 18.0

Tested By: DT Reviewed By: G. Thomas

Consol Stage-Trial No.	Temp. °C	Date	Time hr	Time min	Time sec	Initial σ_c psi	Initial Ub psi	U-tube Reading Head (cm) (cc)	U-tube Reading Tail (cm) (cc)	Flow in/out gradient	Permeability Preliminary Final at 20°C cm/sec Dev. from Ave.
initial	21.5	12/26/02	00	00	00	115.0	100.0	60.00	45.62	1.01	7.56E-06
final	21.5	12/26/02	00	01	09			56.00	46.90		7.41E-06
1	RT = 0.968	dT =		1.15 min		σ'_c =	2.2 ksf	0.300	0.298	io= 18.0	0%
initial	21.5	12/26/02	00	00	00	115.0	100.0	60.00	45.62	1.01	7.56E-06
final	21.5	12/26/02	00	01	09			56.00	46.90		7.41E-06
2	RT = 0.968	dT =		1.15 min		σ'_c =	2.2 ksf	0.300	0.298	io= 18.0	0%
initial	21.5	12/26/02	00	00	00	115.0	100.0	60.00	45.62	1.01	7.45E-06
final	21.5	12/26/02	00	01	10			56.00	46.90		7.30E-06
3	RT = 0.968	dT =		1.17 min		σ'_c =	2.2 ksf	0.300	0.298	io= 18.0	-1%
initial	21.5	12/26/02	00	00	00	115.0	100.0	60.00	45.62	1.01	7.56E-06
final	21.5	12/26/02	00	01	09			56.00	46.90		7.41E-06
4	RT = 0.968	dT =		1.15 min		σ'_c =	2.2 ksf	0.300	0.298	io= 18.0	0%
initial											
final											
initial											
final											

CONSTANT HEAD HYDRAULIC CONDUCTIVITY TEST
ASTM D 5084 - 90

Project No. **13846-066** BORING: TB-16
Project Name: **Elizabeth Mine** SAMPLE: DEPTH (ft): 17.2 Test No.: **P6583**

Specimen - Apparatus set-up - Test Information Apparatus No. C-2 Cell No. H-2 Stage 4

1) Specimen Tested in :	x	Triaxial Cell or		Compaction Mold or	
		with stones or		Stones with filter paper or	top + bottom
2) Specimen orientation for:	x	Vertical or		Horizontal permeability determination	
3) During saturation: Water flushed up sides of specimen to remove air:			x	No	Yes
4) During consolidation:	x	Top and bottom drainage or		Top	Bottom only
5) Direction of permeant :	x	Up during or		Down during permeation	
6) Permeant: water used	x	Tap		Distilled	
		Demineralized		0.005 N calcium sulfate (CaSO4)	

Consol Stage-Trial No.	Temp. °C	Date	Time hr	min	sec	Initial σ_c psi	Ub psi	Dial Indicator in	Pressure Head Reading Mercury (inch)	Gage (psi)	Flow Reading (cm)	Flow Vol (cm3) Rate (cm3/sec)	Fluid Head Reading Head (cm)	Tail (cm)	Total Head Uncorrected / Correction / Corrected (cm)	Gradient	Permeability Preliminary / Final at 20°C cm/sec
initial	21.9	12/19/02	10	30	00	112.0	100.0	0.567			3.20	37.224	84.40	36.05	48.35		
final	21.9	12/19/02	10	55	23						5.00	0.0244	84.40	36.05	3.23		1.36E-04
1	RT = 0.954	dT =		25.38 min		σ'_c =	1.7 ksf						84.4	36.05	45.12	4.50	1.29E-04
initial	21.9	12/19/02	11	00	00	112.0	100.0	0.567			3.60	39.292	84.40	36.05	48.35		
final	21.9	12/19/02	11	26	54						5.50	0.0243	84.40	36.05	3.22		1.35E-04
2	RT = 0.954	dT =		26.90 min		σ'_c =	1.7 ksf						84.4	36.05	45.13	4.50	1.29E-04
initial	21.9	12/19/02	12	00	00	112.0	100.0	0.567			4.00	33.088	84.40	36.05	48.35		
final	21.9	12/19/02	12	22	33						5.60	0.0245	84.40	36.05	3.23		1.36E-04
3	RT = 0.954	dT =		22.55 min		σ'_c =	1.7 ksf						84.4	36.05	45.12	4.50	1.29E-04
initial	21.9	12/19/02	13	00	00	112.0	100.0	0.567			3.50	53.768	84.40	36.05	48.35		
final	21.9	12/19/02	13	36	48						6.10	0.0244	84.40	36.05	3.22		1.35E-04
4	RT = 0.954	dT =		36.80 min		σ'_c =	1.7 ksf						84.4	36.05	45.13	4.50	1.29E-04

Preliminary Length/Area Calculations

Lo =	4.016	in	Lo=	10.200	cm
Ao=	6.420	in^2	Ao =	41.42	cm^2
Vo=	25.783	in^3	Vo =	422.51	cm^3
Lc =	10.030	cm	Vc =	401.37	cm^3
Ac=	40.017	cm^2			

Tested By: BB Reviewed By: G. Thomas

TEST SUMMARY

Final Specimen and Test Conditions

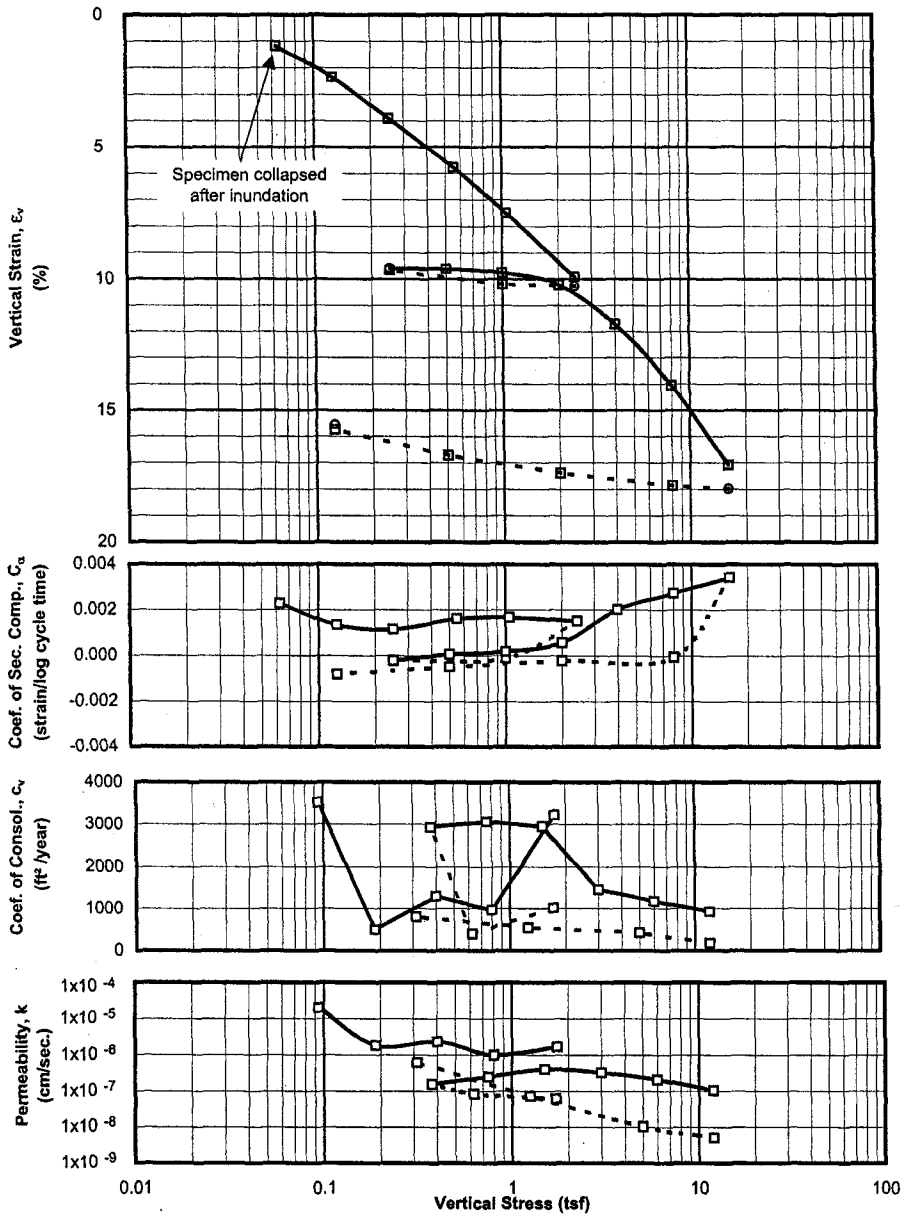
Lc =	10.030 cm	ε_{axial} =	1.7%
Ac =	40.072 cm^2		
Vc=	401.92 cm^3	ε_{vol} =	4.9%

	w (%)	γ_τ (pcf)	γ_d (pcf)	S (%)
Initial	7.66	96.2	89.3	21.9
PreTest	31.63	123.6	93.9	100.0

HYDRAULIC CONDUCTIVITY SUMMARY

Averages for trials: 1-4
ave K @ 20 °C: **1.29E-04** cm/sec
(i_o)ave = 4.50

HYDRAULIC CONDUCTIVITY TEST



SAMPLE INFORMATION

Boring:	TB-10
Sample:	
Depth:	62.20 feet
Elevation:	
Type:	3-inch thin wall tube
Description:	SM
	gray m-f SAND, some silt.

SPECIMEN INFORMATION

(NOTE: Initial and final states refer to beginning and end of test)

Initial height:	0.62	inch
Diameter:	2.50	inch

Initial water content:	14.6	%
Initial total unit weight:	97.5	pcf
Initial dry unit weight:	85.1	pcf
Initial void ratio:	1.120	
Initial degree of saturation:	38	%
Final water content:	29.4	%
Final total unit weight:	126.3	pcf
Final dry unit weight:	97.6	pcf
Final void ratio:	0.848	
Final degree of saturation:	100	% (assumed specific gravity = 2.89)

TEST SUMMARY

Construction Method:	Casagrande (Log)
Estimated preconsolidation stress (tsf):	2.7 (Range: 1.6 to 2.9)
Estimated in situ effective overburden stress (tsf):	
Compression Ratio (strain per log cycle stress):	0.101
Compression Index (void ratio per log cycle stress):	0.214
Swell Ratio (strain per log cycle stress):	0.009
Swell Index (void ratio per log cycle stress):	0.019
Recompression Ratio (strain per log cycle stress):	0.006
Recompression Index (void ratio per log cycle stress):	0.013
Remarks:	

LEGEND: □ End of primary ○ End of Stage ——— Loading - - - - - - - Unloading

Test Date: 12/19/02 Tested By: RV/CMJ Checked By:

	Elizabeth Mine	ONE DIMENSIONAL CONSOLIDATION TEST Boring: TB-10 Depth: 62.20 feet
URS	Project No. 138646-066	January 2003 Fig.

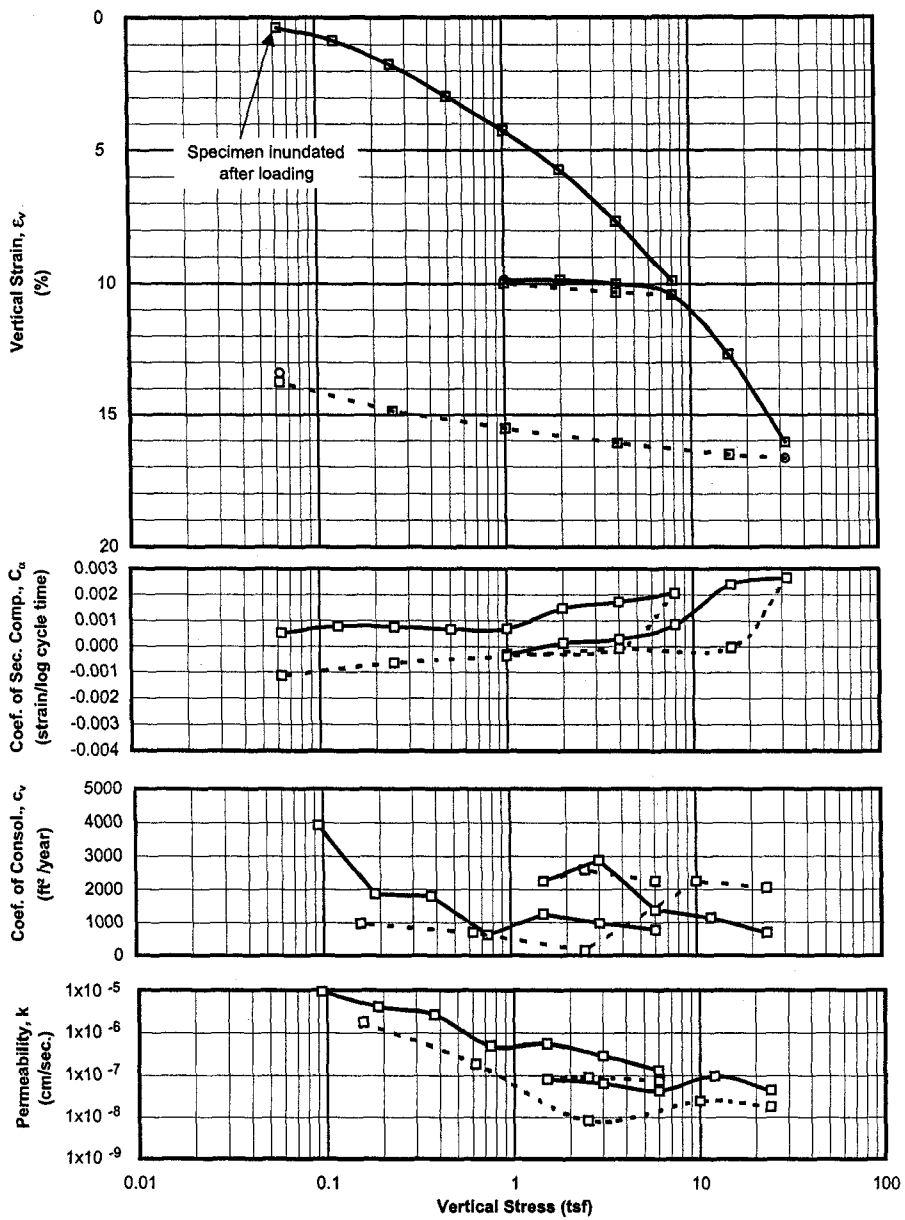
PROJECT:	Elizabeth Mine						
PROJECT NO.:	138646-066	Initial height:	0.623	inch	Final height:	0.543	inch
BORING:	TB-10	Initial water content:	14.6	%	Final water content:	29.4	%
SAMPLE:		Initial dry density:	85.1	pcf	Final dry density:	97.6	pcf
TEST:	C02228	Initial total density:	97.5	pcf	Final total density:	126.3	pcf
DEPTH, feet:	62.2	Initial saturation:	38	%	Final saturation:	100	%
BY:	RV/CMJ	Initial void ratio:	1.120		Final void ratio:	0.848	
TEST DATE:	12/19/2002				Final strain:	12.8	%

EQUIPMENT:
Load Frame No.: 1
Ring Diameter: 2.5 inch

SPECIMEN DESCRIPTION: SM
gray m-f SAND, some silt.

G	LL	PL	PI
2.89			

Load No.	Load (tsf)	d_{100} (inch)	t_{100} Strain (%)	t_{100} Void Ratio (-)	Final Strain (%)	Final Void Ratio (-)	c_v (ft^2/year)	C_α (strain/logt)	Constrained Modulus (tsf)	Permeability (cm/sec)
1	0.063	0.0072	1.162	1.096	1.713	1.084	348.00	0.0023	5.38	1.95E-06
2	0.125	0.0147	2.350	1.070	2.752	1.062	3518.07	0.0013	5.26	2.02E-05
3	0.250	0.0244	3.919	1.037	4.166	1.032	491.79	0.0011	7.97	1.86E-06
4	0.550	0.0359	5.765	0.998	6.172	0.989	1294.42	0.0016	16.26	2.40E-06
5	1.05	0.0467	7.497	0.961	7.920	0.952	968.84	0.0017	28.89	1.01E-06
6	2.43	0.0618	9.912	0.910	10.273	0.902	3228.16	0.0015	57.10	1.71E-06
7	1.00	0.0636	10.198	0.904	10.174	0.904	1019.48	-0.0001	499.35	6.16E-08
8	0.250	0.0603	9.666	0.915	9.589	0.917	391.99	-0.0002	141.01	8.39E-08
9	0.500	0.0600	9.622	0.916	9.639	0.916	2935.60	0.0001	570.57	1.55E-07
10	1.00	0.0608	9.759	0.913	9.864	0.911	3064.83	0.0002	366.32	2.52E-07
11	2.00	0.0637	10.219	0.904	10.392	0.900	2952.61	0.0006	217.22	4.10E-07
12	4.00	0.0730	11.715	0.872	12.257	0.860	1455.52	0.0020	133.76	3.28E-07
13	8.00	0.0876	14.058	0.822	14.762	0.807	1177.40	0.0027	170.69	2.08E-07
14	16.0	0.1066	17.093	0.758	17.990	0.739	926.46	0.0034	263.61	1.06E-07
15	8.00	0.1114	17.872	0.741	17.860	0.742	173.80	-0.0001	1027.03	5.11E-09
16	2.00	0.1084	17.390	0.751	17.344	0.752	420.92	-0.0002	1244.72	1.02E-08
17	0.500	0.1042	16.721	0.766	16.600	0.768	539.91	-0.0005	224.18	7.27E-08
18	0.125	0.0982	15.747	0.786	15.546	0.791	805.92	-0.0008	38.53	6.31E-07
19										
20										
21										



SAMPLE INFORMATION

Boring:	TB-11
Sample:	
Depth:	41.50 feet
Elevation:	
Type:	3-inch thin wall tube
Description:	SM
	gray silty m-f SAND.

SPECIMEN INFORMATION

(NOTE: Initial and final states refer to beginning and end of test)

Initial height:	0.62	inch
Diameter:	2.50	inch

Initial water content:	21.7	%
Initial total unit weight:	118.3	pcf
Initial dry unit weight:	97.2	pcf
Initial void ratio:	0.946	
Initial degree of saturation:	70	%
Final water content:	26.0	%
Final total unit weight:	133.3	pcf
Final dry unit weight:	105.8	pcf
Final void ratio:	0.787	
Final degree of saturation:	100	% (assumed specific gravity = 3.03)

TEST SUMMARY

Construction Method:	Casagrande (Log)
Estimated preconsolidation stress (tsf):	3.1 (Range: 1.8 to 4.5)
Estimated in situ effective overburden stress (tsf):	
Compression Ratio (strain per log cycle stress):	0.112
Compression Index (void ratio per log cycle stress):	0.218
Swell Ratio (strain per log cycle stress):	0.006
Swell Index (void ratio per log cycle stress):	0.012
Recompression Ratio (strain per log cycle stress):	0.005
Recompression Index (void ratio per log cycle stress):	0.010
Remarks:	

LEGEND: □ End of primary o End of Stage ——— Loading - - - - - - - Unloading

Test Date: 12/17/02 Tested By: RV/CMJ Checked By:

	Elizabeth Mine	ONE DIMENSIONAL CONSOLIDATION TEST Boring: TB-11 Depth: 41.50 feet
URS	Project No. 138646-066	January 2003 Fig.

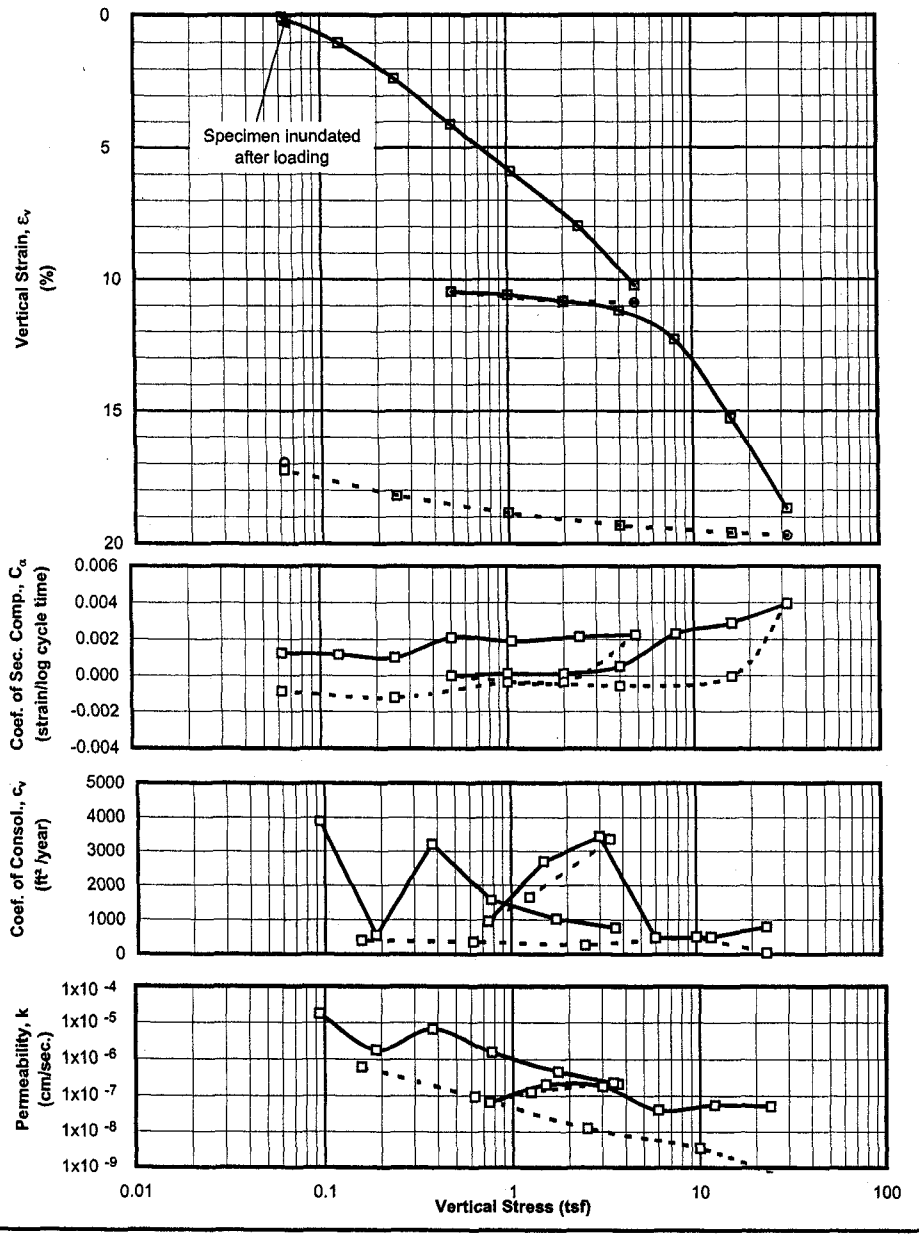
PROJECT:	Elizabeth Mine				
PROJECT NO.:	138646-066	Initial height:	0.617 inch	Final height:	0.567 inch
BORING:	TB-11	Initial water content:	21.7 %	Final water content:	26.0 %
SAMPLE:		Initial dry density:	97.2 pcf	Final dry density:	105.8 pcf
TEST:	C02226	Initial total density:	118.3 pcf	Final total density:	133.3 pcf
DEPTH, feet:	41.5	Initial saturation:	70 %	Final saturation:	100 %
BY:	RV/CMJ	Initial void ratio:	0.946	Final void ratio:	0.787
TEST DATE:	12/17/2002			Final strain:	8.2 %

EQUIPMENT:
Load Frame No.: 4
Ring Diameter: 2.5 inch

SPECIMEN DESCRIPTION: SM
gray silty m-f SAND.

G	LL	PL	PI
3.03			

Load No.	Load (tsf)	d_{100} (inch)	t_{100} Strain (%)	t_{100} Void Ratio (-)	Final Strain (%)	Final Void Ratio (-)	c_v (ft^2/year)	C_α (strain/logt)	Constrained Modulus (tsf)	Permeability (cm/sec)
1	0.063	0.0022	0.360	0.939	0.427	0.938	36.91	0.0005	17.36	6.41E-08
2	0.125	0.0052	0.849	0.930	1.204	0.923	3914.56	0.0008	12.78	9.24E-06
3	0.250	0.0108	1.752	0.912	1.975	0.908	1870.08	0.0008	13.84	4.08E-06
4	0.500	0.0182	2.957	0.889	3.149	0.885	1799.96	0.0007	20.76	2.62E-06
5	1.00	0.0262	4.248	0.864	4.431	0.860	628.53	0.0007	38.73	4.90E-07
6	2.00	0.0353	5.716	0.835	6.111	0.827	1254.83	0.0015	68.10	5.56E-07
7	4.00	0.0473	7.661	0.797	8.079	0.789	982.41	0.0017	102.85	2.88E-07
8	8.00	0.0610	9.886	0.754	10.409	0.744	783.32	0.0021	179.80	1.31E-07
9	4.00	0.0637	10.327	0.745	10.317	0.745	2258.32	-0.0001	906.83	7.51E-08
10	1.00	0.0616	9.983	0.752	9.858	0.754	2591.04	-0.0003	873.50	8.95E-08
11	2.00	0.0609	9.863	0.754	9.908	0.753	2251.14	0.0001	833.93	8.14E-08
12	4.00	0.0618	10.010	0.751	10.101	0.750	2880.26	0.0003	1366.96	6.36E-08
13	8.00	0.0643	10.419	0.743	10.630	0.739	1375.38	0.0008	976.20	4.25E-08
14	16.0	0.0783	12.686	0.699	13.297	0.687	1139.48	0.0024	353.01	9.74E-08
15	32.0	0.0990	16.053	0.634	16.664	0.622	695.62	0.0027	475.14	4.42E-08
16	16.0	0.1019	16.516	0.625	16.507	0.625	2058.50	0.0000	3457.99	1.80E-08
17	4.00	0.0993	16.086	0.633	16.078	0.633	2252.86	-0.0001	2792.46	2.43E-08
18	1.00	0.0957	15.518	0.644	15.420	0.646	144.28	-0.0004	527.79	8.25E-09
19	0.250	0.0917	14.863	0.657	14.704	0.660	702.79	-0.0006	114.66	1.85E-07
20	0.063	0.0848	13.744	0.679	13.390	0.686	980.87	-0.0011	16.74	1.77E-06
21										



SAMPLE INFORMATION

Boring:	TB-13
Sample:	
Depth:	32.20 feet
Elevation:	
Type:	3-inch thin wall tube
Description:	SM
	gray m-f SAND, some silt.

SPECIMEN INFORMATION

(NOTE: Initial and final states refer to beginning and end of test)

Initial height:	0.62	inch
Diameter:	2.50	inch

Initial water content:	5.0	%
Initial total unit weight:	89.1	pcf
Initial dry unit weight:	84.8	pcf
Initial void ratio:	0.946	
Initial degree of saturation:	14	%
Final water content:	22.5	%
Final total unit weight:	126.9	pcf
Final dry unit weight:	103.6	pcf
Final void ratio:	0.594	
Final degree of saturation:	100	% (assumed specific gravity = 2.65)

TEST SUMMARY

Construction Method:	Casagrande (Log)
Estimated preconsolidation stress (tsf):	3.4 (Range: 1.4 to 6.0)
Estimated in situ effective overburden stress (tsf):	
Compression Ratio (strain per log cycle stress):	0.106
Compression Index (void ratio per log cycle stress):	0.206
Swell Ratio (strain per log cycle stress):	0.006
Swell Index (void ratio per log cycle stress):	0.012
Recompression Ratio (strain per log cycle stress):	0.010
Recompression Index (void ratio per log cycle stress):	0.019
Remarks:	

LEGEND: □ End of primary ○ End of Stage ——— Loading - - - - - - - Unloading

Test Date: 12/19/02 Tested By: RV Checked By:

	Elizabeth Mine	ONE DIMENSIONAL CONSOLIDATION TEST Boring: TB-13 Depth: 32.20 feet
URS	Project No. 13846-066	January 2003 Fig.

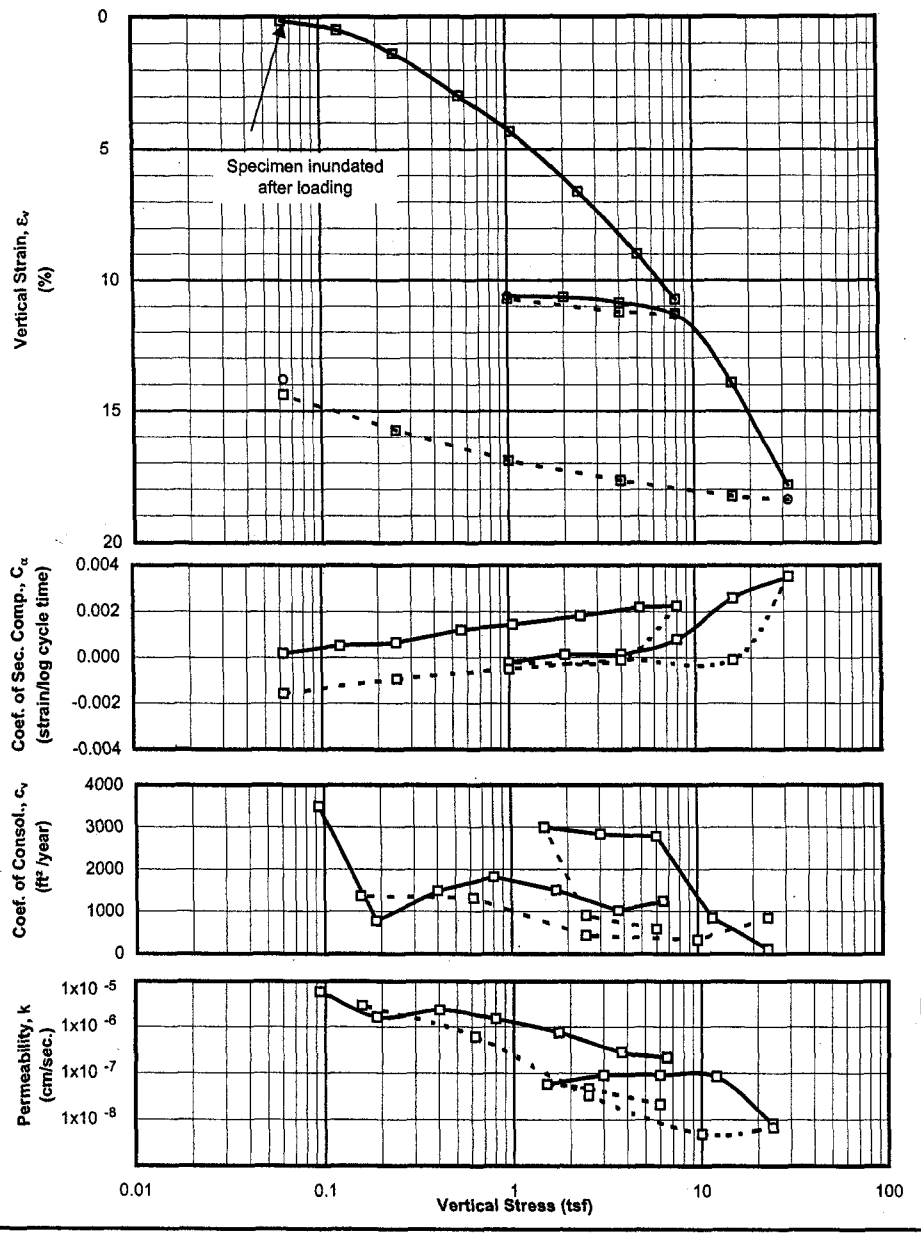
PROJECT:	Elizabeth Mine						
PROJECT NO.:	13846-066	Initial height:	0.624	inch	Final height:	0.511	inch
BORING:	TB-13	Initial water content:	5.0	%	Final water content:	22.5	%
SAMPLE:		Initial dry density:	84.8	pcf	Final dry density:	103.6	pcf
TEST:	C02229	Initial total density:	89.1	pcf	Final total density:	126.9	pcf
DEPTH, feet:	32.2	Initial saturation:	14	%	Final saturation:	100	%
BY:	RV	Initial void ratio:	0.946		Final void ratio:	0.594	
TEST DATE:	12/19/2002				Final strain:	18.1	%

EQUIPMENT:
Load Frame No.: 2
Ring Diameter: 2.5 inch

SPECIMEN DESCRIPTION: SM
gray m-f SAND, some silt.

G	LL	PL	PI
2.645			

Load No.	Load (tsf)	d_{100} (inch)	t_{100} Strain (%)	t_{100} Void Ratio (-)	Final Strain (%)	Final Void Ratio (-)	c_v (ft^2/year)	C_α (strain/logt)	Constrained Modulus (tsf)	Permeability (cm/sec)
1	0.063	0.0004	0.069	0.945	0.663	0.934	16096.86	0.0012	89.97	5.40E-06
2	0.125	0.0063	1.012	0.927	1.364	0.920	3874.24	0.0012	6.63	1.76E-05
3	0.250	0.0147	2.356	0.901	2.611	0.896	553.77	0.0010	9.31	1.80E-06
4	0.500	0.0256	4.103	0.867	4.666	0.856	3212.42	0.0021	14.31	6.77E-06
5	1.05	0.0368	5.891	0.832	6.426	0.821	1577.14	0.0019	30.78	1.55E-06
6	2.43	0.0497	7.971	0.791	8.553	0.780	1025.73	0.0021	66.30	4.67E-07
7	4.86	0.0638	10.217	0.748	10.884	0.735	760.90	0.0023	108.44	2.12E-07
8	2.00	0.0678	10.861	0.735	10.752	0.737	3349.53	-0.0003	444.39	2.27E-07
9	0.500	0.0654	10.480	0.742	10.465	0.743	1653.10	0.0000	393.79	1.27E-07
10	1.00	0.0661	10.594	0.740	10.640	0.739	952.42	0.0001	439.86	6.53E-08
11	2.00	0.0676	10.840	0.735	10.939	0.734	2697.20	0.0001	406.08	2.00E-07
12	4.00	0.0698	11.187	0.729	11.346	0.726	3422.59	0.0005	577.03	1.79E-07
13	8.00	0.0768	12.304	0.707	12.844	0.696	477.37	0.0023	358.15	4.02E-08
14	16.0	0.0952	15.256	0.650	15.921	0.637	497.65	0.0029	271.01	5.54E-08
15	32.0	0.1165	18.669	0.583	19.695	0.563	794.74	0.0040	468.70	5.12E-08
16	16.0	0.1222	19.589	0.565	19.586	0.565	40.00	0.0000	1740.32	6.93E-10
17	4.00	0.1205	19.315	0.571	19.213	0.573	507.45	-0.0006	4383.46	3.49E-09
18	1.00	0.1176	18.849	0.580	18.715	0.582	265.67	-0.0004	643.33	1.25E-08
19	0.250	0.1136	18.200	0.592	17.960	0.597	359.47	-0.0012	115.57	9.38E-08
20	0.063	0.1076	17.238	0.611	16.943	0.617	394.93	-0.0009	19.51	6.11E-07
21										



SAMPLE INFORMATION

Boring:	TB-14
Sample:	
Depth:	22.20 feet
Elevation:	
Type:	3-inch thin wall tube
Description:	ML gray sandy SILT.

SPECIMEN INFORMATION

(NOTE: Initial and final states refer to beginning and end of test)

Initial height:	0.62	inch
Diameter:	2.50	inch

Initial water content:	21.9	%
Initial total unit weight:	105.7	pcf
Initial dry unit weight:	86.7	pcf
Initial void ratio:	1.088	
Initial degree of saturation:	59	%
Final water content:	30.1	%
Final total unit weight:	125.6	pcf
Final dry unit weight:	96.5	pcf
Final void ratio:	0.875	
Final degree of saturation:	100	% (assumed specific gravity = 2.90)

TEST SUMMARY

Construction Method:	Casagrande (Log)
Estimated preconsolidation stress (tsf):	4.0 (Range: 1.3 to 5.6)
Estimated in situ effective overburden stress (tsf):	
Compression Ratio (strain per log cycle stress):	0.118
Compression Index (void ratio per log cycle stress):	0.246
Swell Ratio (strain per log cycle stress):	0.008
Swell Index (void ratio per log cycle stress):	0.017
Recompression Ratio (strain per log cycle stress):	0.011
Recompression Index (void ratio per log cycle stress):	0.023
Remarks:	

LEGEND: □ End of primary o End of Stage ——— Loading - - - - - - - Unloading

Test Date: 12/19/02 Tested By: RV Checked By:

	Elizabeth Mine	ONE DIMENSIONAL CONSOLIDATION TEST Boring: TB-14 Depth: 22.20 feet
URS	Project No. 13846-066	January 2003 Fig.

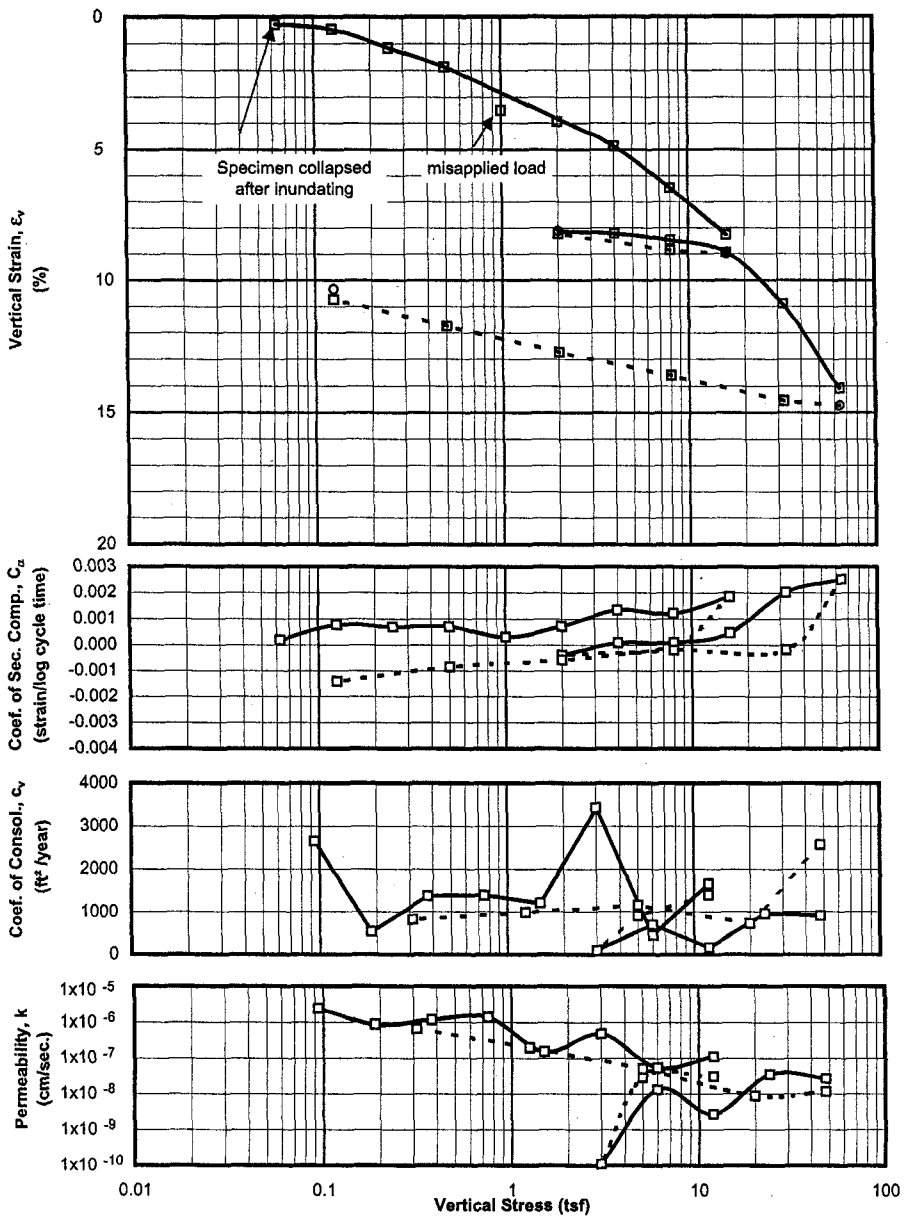
PROJECT:	Elizabeth Mine				
PROJECT NO.:	13846-066	Initial height:	0.623 inch	Final height:	0.559 inch
BORING:	TB-14	Initial water content:	21.9 %	Final water content:	30.1 %
SAMPLE:		Initial dry density:	86.7 pcf	Final dry density:	96.5 pcf
TEST:	C02230	Initial total density:	105.7 pcf	Final total density:	125.6 pcf
DEPTH, feet:	22.2	Initial saturation:	59 %	Final saturation:	100 %
BY:	RV	Initial void ratio:	1.088	Final void ratio:	0.875
TEST DATE:	12/19/2002			Final strain:	10.2 %

EQUIPMENT:
Load Frame No.: 3
Ring Diameter: 2.5 inch

SPECIMEN DESCRIPTION: ML
gray sandy SILT.

G	LL	PL	PI
2.9			

Load No.	Load (tsf)	d_{100} (inch)	t_{100} Strain (%)	t_{100} Void Ratio (-)	Final Strain (%)	Final Void Ratio (-)	c_v (ft²/year)	C_α (strain/logt)	Constrained Modulus (tsf)	Permeability (cm/sec)
1	0.063	0.0009	0.146	1.085	0.233	1.083	3647.25	0.0002	42.84	2.57E-06
2	0.125	0.0031	0.502	1.077	0.648	1.074	3493.37	0.0005	17.57	6.00E-06
3	0.250	0.0086	1.374	1.059	1.536	1.056	777.05	0.0006	14.33	1.64E-06
4	0.557	0.0185	2.972	1.026	3.276	1.019	1482.91	0.0012	19.19	2.33E-06
5	1.05	0.0269	4.321	0.998	4.758	0.989	1824.20	0.0014	36.60	1.50E-06
6	2.43	0.0411	6.606	0.950	7.082	0.940	1504.43	0.0018	60.34	7.52E-07
7	5.04	0.0560	9.001	0.900	9.538	0.889	1016.99	0.0022	109.20	2.81E-07
8	8.00	0.0668	10.729	0.864	11.327	0.851	1240.12	0.0022	171.02	2.19E-07
9	4.00	0.0698	11.214	0.854	11.147	0.855	581.68	-0.0001	825.27	2.13E-08
10	1.00	0.0667	10.709	0.864	10.609	0.866	908.68	-0.0002	594.06	4.61E-08
11	2.00	0.0663	10.646	0.866	10.702	0.864	2998.99	0.0001	1582.71	5.72E-08
12	4.00	0.0676	10.855	0.861	10.899	0.860	2837.48	0.0001	954.48	8.97E-08
13	8.00	0.0703	11.290	0.852	11.520	0.847	2782.02	0.0008	920.82	9.11E-08
14	16.0	0.0867	13.923	0.797	14.531	0.784	841.39	0.0026	303.77	8.36E-08
15	32.0	0.1110	17.833	0.716	18.391	0.704	111.30	0.0035	409.27	8.20E-09
16	16.0	0.1136	18.252	0.707	18.223	0.707	842.91	-0.0001	3819.10	6.66E-09
17	4.00	0.1099	17.657	0.719	17.635	0.720	325.46	-0.0001	2019.23	4.86E-09
18	1.00	0.1052	16.899	0.735	16.776	0.738	432.70	-0.0005	395.50	3.30E-08
19	0.250	0.0980	15.737	0.759	15.482	0.765	1318.93	-0.0010	64.54	6.16E-07
20	0.063	0.0896	14.387	0.787	13.804	0.800	1353.32	-0.0016	13.89	2.94E-06
21										



SAMPLE INFORMATION

Boring:	TB-14
Sample:	
Depth:	42.30 feet
Elevation:	
Type:	3-inch thin wall tube
Description:	SM
	gray silty m-f SAND.

SPECIMEN INFORMATION

(NOTE: Initial and final states refer to beginning and end of test)

Initial height:	0.60	inch
Diameter:	2.50	inch

Initial water content:	25.6	%
Initial total unit weight:	138.7	pcf
Initial dry unit weight:	110.4	pcf
Initial void ratio:	0.946	
Initial degree of saturation:	93	%
Final water content:	23.2	%
Final total unit weight:	147.0	pcf
Final dry unit weight:	119.3	pcf
Final void ratio:	0.800	
Final degree of saturation:	100	%

(assumed specific gravity = 3.44)

TEST SUMMARY

Construction Method:	Casagrande (Log)
Estimated preconsolidation stress (tsf):	6.8 (Range: 3.4 to 12.3)
Estimated in situ effective overburden stress (tsf):	
Compression Ratio (strain per log cycle stress):	0.097
Compression Index (void ratio per log cycle stress):	0.189
Swell Ratio (strain per log cycle stress):	0.010
Swell Index (void ratio per log cycle stress):	0.019
Recompression Ratio (strain per log cycle stress):	0.008
Recompression Index (void ratio per log cycle stress):	0.016
Remarks:	

LEGEND: □ End of primary ○ End of Stage ——— Loading - - - - - - - Unloading

Test Date: 12/17/02 Tested By: RV/CMJ Checked By:

	Elizabeth Mine	ONE DIMENSIONAL CONSOLIDATION TEST Boring: TB-14 Depth: 42.30 feet
URS	Project No. 13846-066	January 2003 Fig.

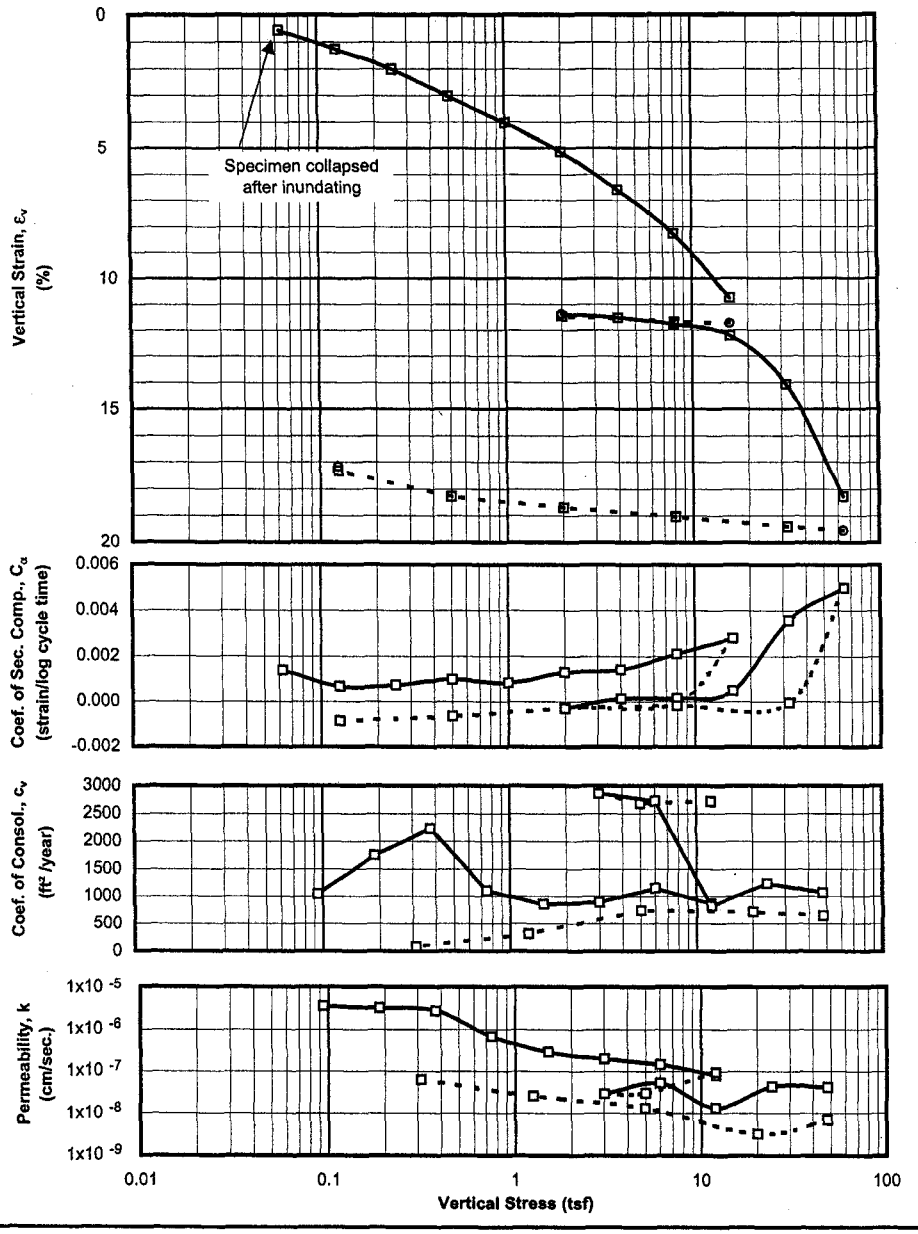
PROJECT:	Elizabeth Mine				
PROJECT NO.:	13846-066	Initial height:	0.605 inch	Final height:	0.560 inch
BORING:	TB-14	Initial water content:	25.6 %	Final water content:	23.2 %
SAMPLE:		Initial dry density:	110.4 pcf	Final dry density:	119.3 pcf
TEST:	C02227	Initial total density:	138.7 pcf	Final total density:	147.0 pcf
DEPTH, feet:	42.3	Initial saturation:	93 %	Final saturation:	100 %
BY:	RV/CMJ	Initial void ratio:	0.946	Final void ratio:	0.800
TEST DATE:	12/17/2002			Final strain:	7.5 %

EQUIPMENT:
Load Frame No.: 6
Ring Diameter: 2.5 inch

SPECIMEN DESCRIPTION: SM
gray silty m-f SAND.

G	LL	PL	PI
3.44			

Load No.	Load (tsf)	d_{100} (inch)	t_{100} Strain (%)	t_{100} Void Ratio (-)	Final Strain (%)	Final Void Ratio (-)	c_v (ft^2/year)	C_α (strain/logt)	Constrained Modulus (tsf)	Permeability (cm/sec)
1	0.063	0.0017	0.281	0.940	0.354	0.939	284.32	0.0002	22.25	3.86E-07
2	0.125	0.0028	0.470	0.936	0.731	0.931	2652.58	0.0008	33.07	2.42E-06
3	0.250	0.0070	1.155	0.923	1.315	0.920	530.01	0.0007	18.24	8.77E-07
4	0.500	0.0113	1.868	0.909	2.177	0.903	1373.72	0.0007	35.10	1.18E-06
5	1.00	0.0212	3.513	0.877	3.680	0.874	1391.17	0.0003	30.40	1.38E-06
6	2.00	0.0238	3.928	0.869	4.202	0.864	1207.42	0.0007	240.67	1.51E-07
7	4.00	0.0294	4.859	0.851	5.311	0.842	3428.11	0.0013	214.74	4.82E-07
8	8.00	0.0391	6.466	0.820	6.795	0.813	449.93	0.0012	248.99	5.45E-08
9	16.0	0.0500	8.268	0.785	9.001	0.770	1659.36	0.0018	444.01	1.13E-07
10	8.00	0.0535	8.854	0.773	8.849	0.773	1397.91	0.0000	1365.52	3.09E-08
11	2.00	0.0498	8.227	0.785	8.120	0.788	908.82	-0.0004	957.24	2.86E-08
12	4.00	0.0497	8.219	0.786	8.232	0.785	93.41	0.0001	25291.09	1.11E-10
13	8.00	0.0512	8.470	0.781	8.517	0.780	700.23	0.0001	1595.31	1.32E-08
14	16.0	0.0541	8.941	0.772	9.038	0.770	153.66	0.0005	1698.07	2.73E-09
15	32.0	0.0659	10.903	0.733	11.418	0.723	963.89	0.0020	815.27	3.57E-08
16	64.0	0.0851	14.078	0.672	14.734	0.659	913.11	0.0025	1008.01	2.73E-08
17	32.0	0.0880	14.556	0.662	14.498	0.663	2571.80	-0.0002	6692.76	1.16E-08
18	8.00	0.0822	13.596	0.681	13.524	0.682	727.12	-0.0002	2500.97	8.77E-09
19	2.00	0.0770	12.728	0.698	12.564	0.701	1156.95	-0.0006	691.31	5.05E-08
20	0.500	0.0710	11.739	0.717	11.561	0.721	992.39	-0.0009	151.54	1.98E-07
21	0.125	0.0649	10.730	0.737	10.339	0.744	823.67	-0.0014	37.19	6.68E-07



SAMPLE INFORMATION

Boring:	TB-17
Sample:	
Depth:	16.35 feet
Elevation:	
Type:	3-inch thin wall tube
Description:	SP-SM gray f. SAND, trace m. sand, silt.

SPECIMEN INFORMATION

(NOTE: Initial and final states refer to beginning and end of test)

Initial height:	0.62	inch
Diameter:	2.50	inch

Initial water content:	4.9	%
Initial total unit weight:	97.4	pcf
Initial dry unit weight:	92.8	pcf
Initial void ratio:	0.890	
Initial degree of saturation:	16	%
Final water content:	20.3	%
Final total unit weight:	134.5	pcf
Final dry unit weight:	111.8	pcf
Final void ratio:	0.569	
Final degree of saturation:	100	% (assumed specific gravity = 2.81)

TEST SUMMARY

Construction Method:	Casagrande (Log)
Estimated preconsolidation stress (tsf):	12.0 (Range: 11.5 to 12.4)
Estimated in situ effective overburden stress (tsf):	
Compression Ratio (strain per log cycle stress):	0.139
Compression Index (void ratio per log cycle stress):	0.263
Swell Ratio (strain per log cycle stress):	0.004
Swell Index (void ratio per log cycle stress):	0.008
Recompression Ratio (strain per log cycle stress):	0.011
Recompression Index (void ratio per log cycle stress):	0.021
Remarks:	

LEGEND: □ End of primary ○ End of Stage ——— Loading - - - - - - - Unloading

Test Date: 12/16/02 Tested By: RV/CMJ Checked By:

	Elizabeth Mine	ONE DIMENSIONAL CONSOLIDATION TEST Boring: TB-17 Depth: 16.35 feet
URS	Project No. 138646-066	January 2003 Fig.

PROJECT:	Elizabeth Mine				
PROJECT NO.:	138646-066	Initial height:	0.622 inch	Final height:	0.511 inch
BORING:	TB-17	Initial water content:	4.9 %	Final water content:	20.3 %
SAMPLE:		Initial dry density:	92.8 pcf	Final dry density:	111.8 pcf
TEST:	C02225	Initial total density:	97.4 pcf	Final total density:	134.5 pcf
DEPTH, feet:	16.35	Initial saturation:	16 %	Final saturation:	100 %
BY:	RV/CMJ	Initial void ratio:	0.890	Final void ratio:	0.569
TEST DATE:	12/16/02			Final strain:	17.9 %

EQUIPMENT:
Load Frame No.: 5
Ring Diameter: 2.5 inch

SPECIMEN DESCRIPTION: SP-SM
gray f. SAND, trace m. sand, silt.

G	LL	PL	PI
2.81			

Load No.	Load (tsf)	d100 (inch)	t100 Strain (%)	t100 Void Ratio (-)	Final Strain (%)	Final Void Ratio (-)	cv (ft^2/year)	Ca (strain/logt)	Constrained Modulus (tsf)	Permeability (cm/sec)
1	0.063	0.0035	0.561	0.880	0.827	0.875	25.41	0.0014	11.14	6.88E-08
2	0.125	0.0078	1.260	0.866	1.434	0.863	1040.50	0.0007	8.94	3.51E-06
3	0.250	0.0125	2.013	0.852	2.238	0.848	1750.23	0.0007	16.61	3.18E-06
4	0.500	0.0188	3.032	0.833	3.309	0.828	2231.16	0.0010	24.53	2.74E-06
5	1.00	0.0251	4.037	0.814	4.275	0.809	1100.86	0.0008	49.74	6.68E-07
6	2.00	0.0319	5.140	0.793	5.443	0.787	855.10	0.0013	90.73	2.84E-07
7	4.00	0.0410	6.595	0.766	6.890	0.760	891.74	0.0014	137.42	1.96E-07
8	8.00	0.0514	8.275	0.734	8.817	0.724	1145.20	0.0021	238.10	1.45E-07
9	16.0	0.0669	10.756	0.687	11.737	0.668	866.01	0.0028	322.48	8.10E-08
10	8.00	0.0726	11.680	0.669	11.679	0.669	2718.60	0.0000	865.88	9.47E-08
11	2.00	0.0712	11.452	0.674	11.375	0.675	2679.32	-0.0003	2631.22	3.07E-08
12	4.00	0.0716	11.519	0.672	11.562	0.672	2855.63	0.0001	2948.46	2.92E-08
13	8.00	0.0732	11.777	0.668	11.819	0.667	2722.46	0.0002	1553.53	5.29E-08
14	16.0	0.0759	12.207	0.659	12.342	0.657	826.20	0.0005	1857.74	1.34E-08
15	32.0	0.0875	14.072	0.624	15.044	0.606	1232.62	0.0036	858.17	4.33E-08
16	64.0	0.1135	18.263	0.545	19.548	0.521	1067.09	0.0050	763.59	4.22E-08
17	32.0	0.1206	19.401	0.523	19.384	0.524	648.52	0.0000	2812.09	6.96E-09
18	8.00	0.1184	19.040	0.530	18.987	0.531	716.24	-0.0002	6647.97	3.25E-09
19	2.00	0.1162	18.686	0.537	18.614	0.538	738.50	-0.0003	1696.02	1.31E-08
20	0.500	0.1136	18.276	0.545	18.151	0.547	314.58	-0.0006	365.67	2.60E-08
21	0.125	0.1077	17.325	0.563	17.175	0.566	82.49	-0.0009	39.46	6.31E-08

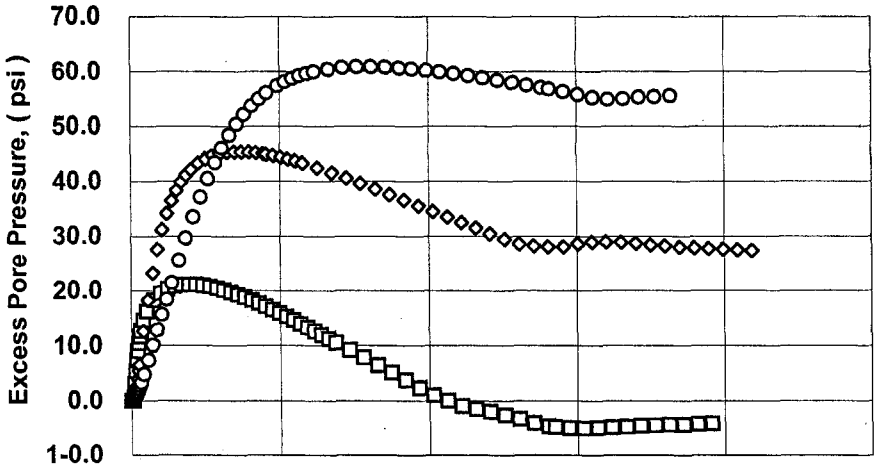
SUMMARY FOR STATIC CIU' TRIAXIAL TESTS SPECIMENS

Test No	Boring No	Sample Section No	Depth	USCS Group Symbol	w_o	$\gamma_{t,o}$	$\gamma_{d,o}$	$\sigma'_{c,max}$	$\sigma'_{v,c}$	$\varepsilon_{a,c}$	B factor (%)	at Peak Deviator Stress					
												at Peak Obliquity					
			Elev	Gs	w_c	$\gamma_{t,c}$	$\gamma_{d,c}$	OCR	$K_c = \frac{\sigma'_{v,c}}{\sigma'_{h,c}}$	$\varepsilon_{v,c}$	ε_{rate}	ε_a	$\frac{\sigma_1 - \sigma_3}{2}$	$\frac{\sigma'_1 + \sigma'_3}{2}$	σ'_1 / σ'_3	A factor	ϕ' for c'=0
			(ft)		(%)	(pcf)	(pcf)		(psi)	(%)	(%/hr)	(%)	(psi)	(psi)			
T2132	TB-11	B	41.2	ML	19.7	129.4	108.0	35.00	35.00	1.7		12.5	63.60	101.24	4.38	-0.021	38.9
				(3.30)	24.7	141.5	113.5	1.0	1.00	4.8	1.2	5.9	45.03	66.80	5.14	0.147	42.4
T2133	TB-11	A	40.25	SM	24.9	123.7	99.1	70.00	70.00	3.2		12.1	75.06	114.58	4.80	0.203	40.9
				(3.30)	22.7	144.5	117.8	1.0	1.00	15.9	1.2	7.7	62.20	92.58	5.09	0.319	42.2
T2138	TB-10	B	60.85	SM	8.9	111.8	102.7	105.00	105.00	3.0		13.8	87.38	135.34	4.64	0.326	40.2
				(3.30)	21.0	147.2	121.6	1.0	1.00	15.6	1.2	11.3	85.28	131.05	4.73	0.347	40.6

Test No	Description of Material Tested and Remarks
T2132	ML, black non-plastic SILT, some f. sand
T2133	SM, gray silty f. SAND
T2138	SM, gray silty f. SAND

Strength Envelope Summary						
Test Series	Failure Criteria	ϕ' (deg)	c' (psi)	α' (deg)	a' (psi)	Correlation Coefficient
1	1	40.1	0.000	32.8	0.000	--
	2	38.6	4.775	32.0	3.730	1.000
Failure Criteria:	1 - Peak Deviator Stress 2 - Peak Obliquity					

Project No. 13846066	**Elizabeth Mine**	CONSOLIDATED UNDRAINED TRIAXIAL COMPRESSION with Pore Pressure Measurements TB-10 TB-11 SUMMARY	January 2003
URS Corporation			

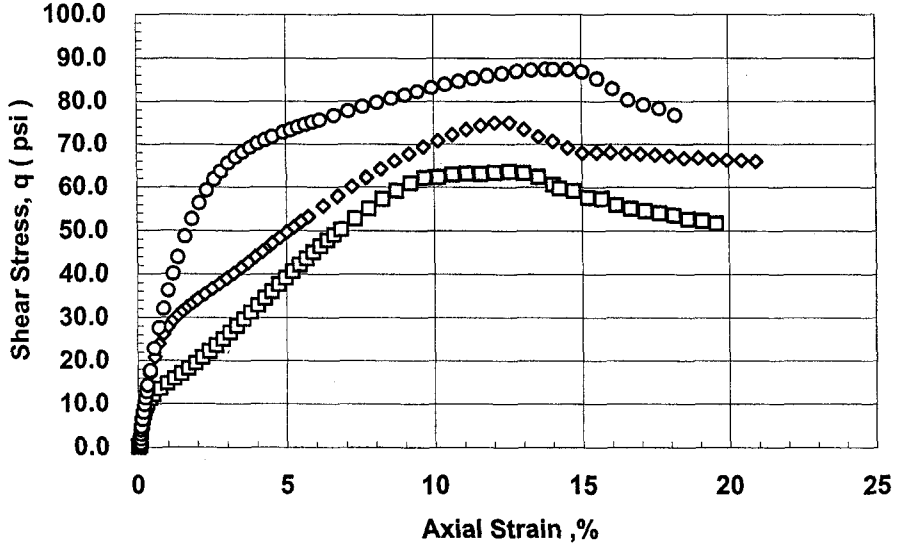


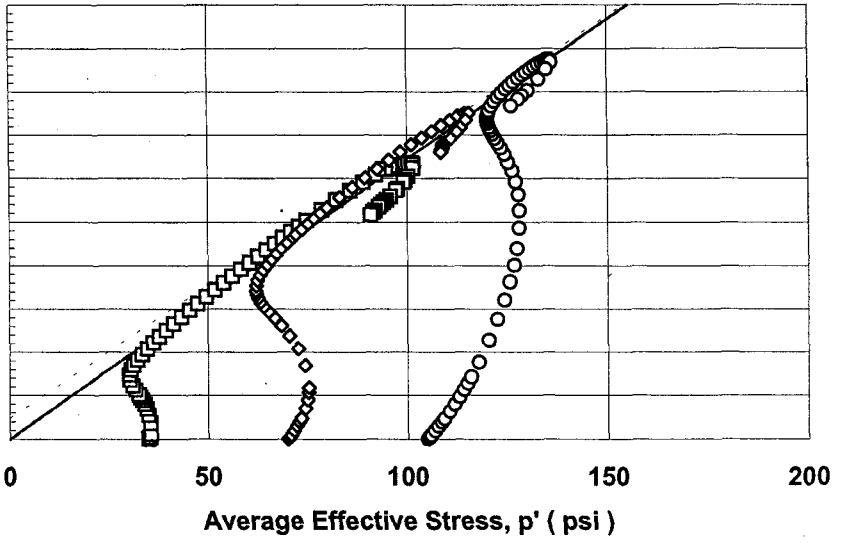
LEGEND AND SUMMARY INFORMATION

Symbol	Test	Boring	Sample	Depth (ft)	w_o (%)	γ_{to} (pcf)	σ'_c (psi)
□	T2132	TB-11	B	41.2	19.7	129.4	35.00
◊	T2133	TB-11	A	40.3	24.9	123.7	70.00
○	T2138	TB-10	B	60.9	8.9	111.8	105.00

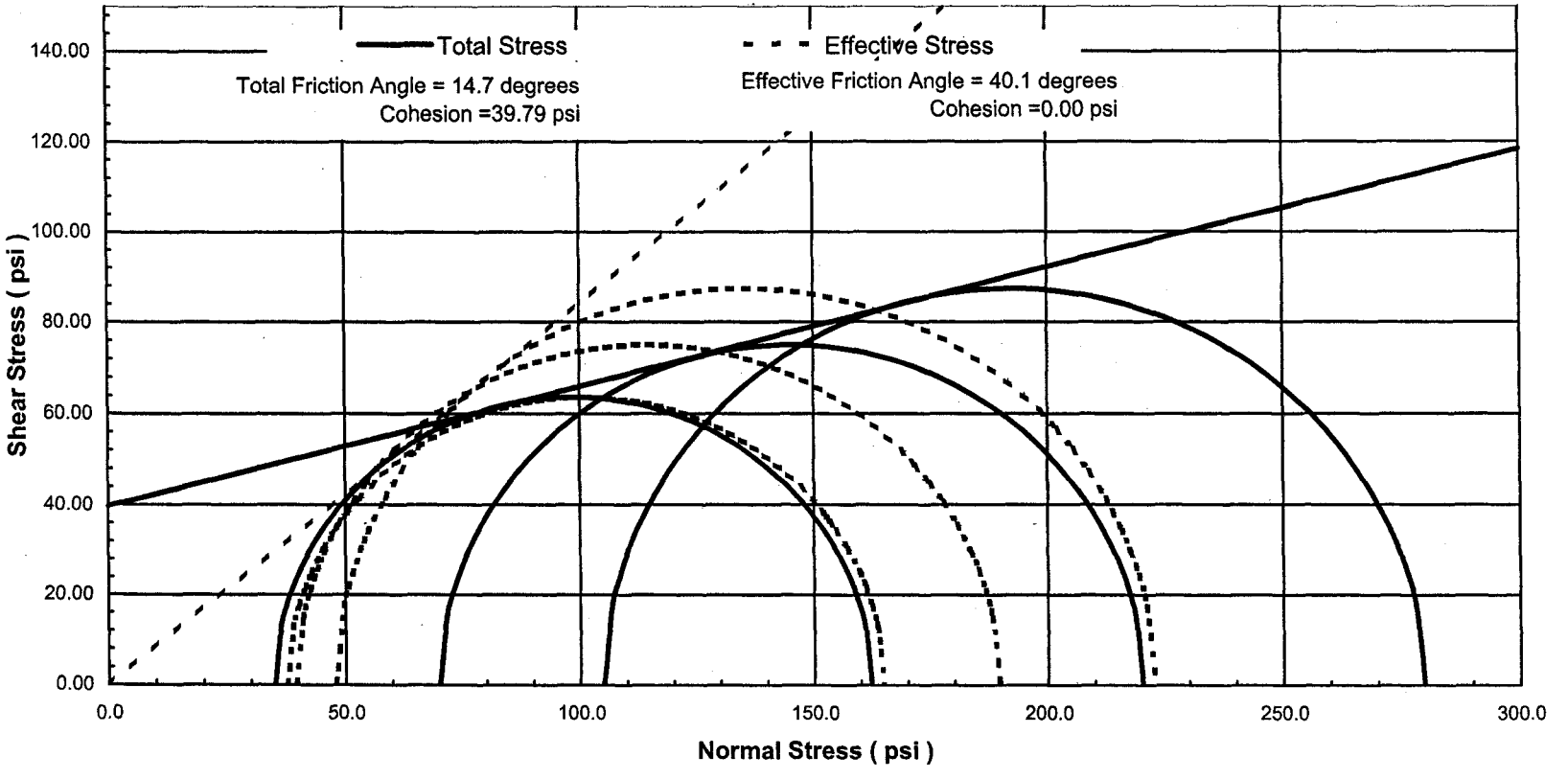
SERIES SUMMARY

Notation	Failure Criteria	c' (psi)	Φ' (degrees)
———	Peak Deviator Stress	0.00	40.1
———	Peak Obliquity	4.78	38.6





Prepared by: C. Jordan Checked by: G. Thomas	Project No. 13846066	**Elizabeth Mine**	CONSOLIDATED UNDRAINED TRIAXIAL COMPRESSION with Pore Pressure Measurements TB-10 TB-11 SUMMARY	Figure 1
	URS Corporation			January 2003



Project No. 13846066	Elizabeth Mine	Mohr Circles of Total and Effective Stresses at Peak CIU' Triaxial Test	Figure 2
URS Corporation		TB-10 TB-11 SUMMARY	January 2003

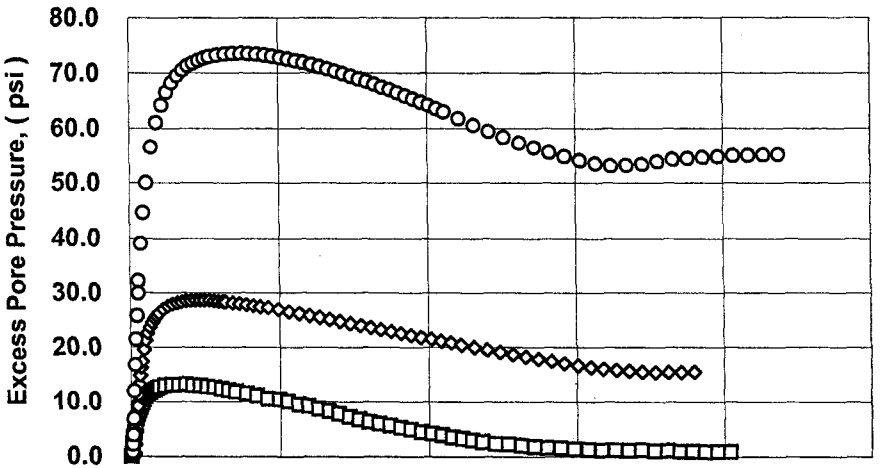
SUMMARY FOR STATIC CIU' TRIAXIAL TESTS SPECIMENS

Test No	Boring No	Sample Section No	Depth	USCS Group Symbol	w_o	$\gamma_{t,o}$	$\gamma_{d,o}$	$\sigma'_{c,max}$	$\sigma'_{v,c}$	$\varepsilon_{a,c}$	B factor (%)	at Peak Deviator Stress					
												at Peak Obliquity					
			Elev	Gs	w_c	$\gamma_{t,c}$	$\gamma_{d,c}$	OCR	$K_c = \frac{\sigma'_{v,c}}{\sigma'_{h,c}}$	$\varepsilon_{v,c}$	ε_{rate}	ε_a	$\frac{\sigma_1 - \sigma_3}{2}$	$\frac{\sigma'_1 + \sigma'_3}{2}$	σ'_1 / σ'_3	A factor	ϕ' for c'=0
			(ft)		(%)	(pcf)	(pcf)		(psi)	(%)	(%/hr)	(%)	(psi)	(psi)			
T2156	TB-14	A	20.25	ML	23.3	124.6	101.1	20.00	20.00	1.6	98.2	13.5	31.08	49.26	4.42	0.029	39.1
				(3.30)	27.0	138.4	109.0	1.0	1.00	7.3	1.2	4.2	19.59	28.51	5.39	0.283	43.4
T2157	TB-14	B	20.75	ML	25.3	124.2	99.1	40.00	40.00	1.9	97.6	15.5	45.30	69.00	4.82	0.180	41.0
				(3.30)	28.8	136.1	105.7	1.0	1.00	6.2	1.1	6.7	32.65	47.55	5.38	0.384	43.4
T2164	TB-14	A	40.25	ML	27.0	134.9	106.2	100.00	100.00	3.3	96.8	14.1	71.08	115.47	4.20	0.391	38.0
				(3.30)	23.8	142.8	115.3	1.0	1.00	7.9	1.3	8.8	58.69	91.71	4.55	0.571	39.8

Test No	Description of Material Tested and Remarks
T2156	ML, gray SILT, some f. sand.
T2157	ML, gray SILT, some f. sand.
T2164	ML, dark brown gray SILT, some f. SAND.

Strength Envelope Summary						
Test Series	Failure Criteria	ϕ' (deg)	c' (psi)	α' (deg)	a' (psi)	Correlation Coefficient
1	1	36.5	3.442	30.8	2.765	0.998
	2	37.8	3.375	31.5	2.665	0.999
Failure Criteria:	1 - Peak Deviator Stress 2 - Peak Obliquity					

Project No. 13846066	**Elizabeth Mine**	CONSOLIDATED UNDRAINED TRIAXIAL COMPRESSION with Pore Pressure Measurements TB-14 A SUMMARY	January 2003
URS Corporation			

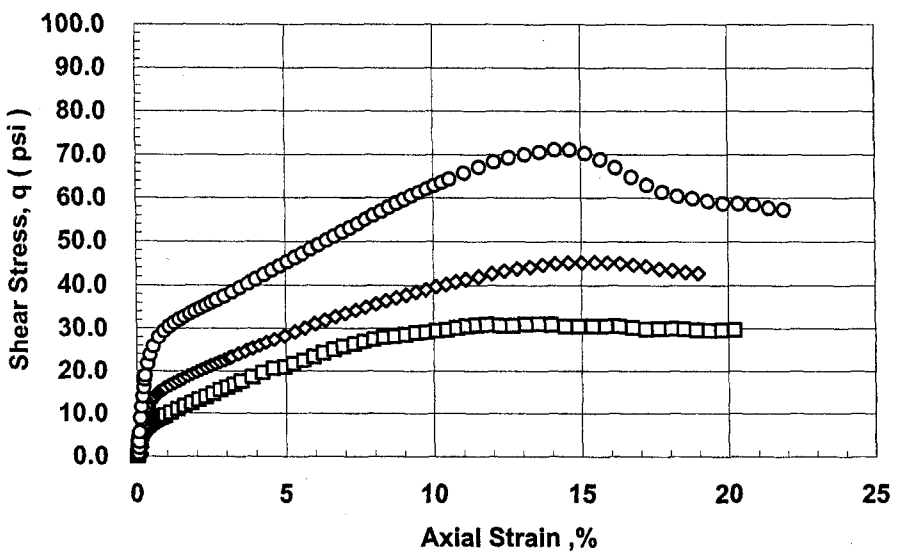


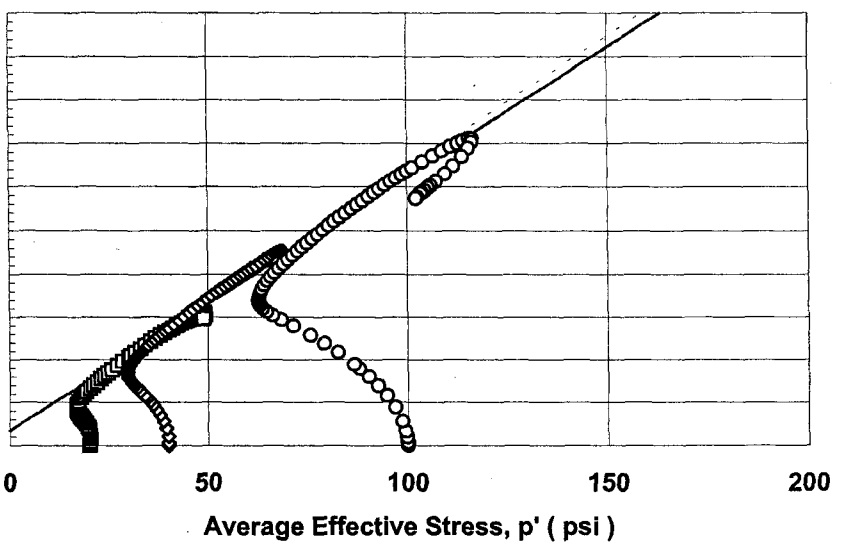
LEGEND AND SUMMARY INFORMATION

Symbol	Test	Boring	Sample	Depth (ft)	w_o (%)	γ_{to} (pcf)	σ'_c (psi)
□	T2156	TB-14	A	20.3	23.3	124.6	20.00
◊	T2157	TB-14	B	20.8	25.3	124.2	40.00
○	T2164	TB-14	A	40.3	27.0	134.9	100.00

SERIES SUMMARY

Notation	Failure Criteria	c' (psi)	Φ' (degrees)
———	Peak Deviator Stress	3.44	36.5
———	Peak Obliquity	3.38	37.8

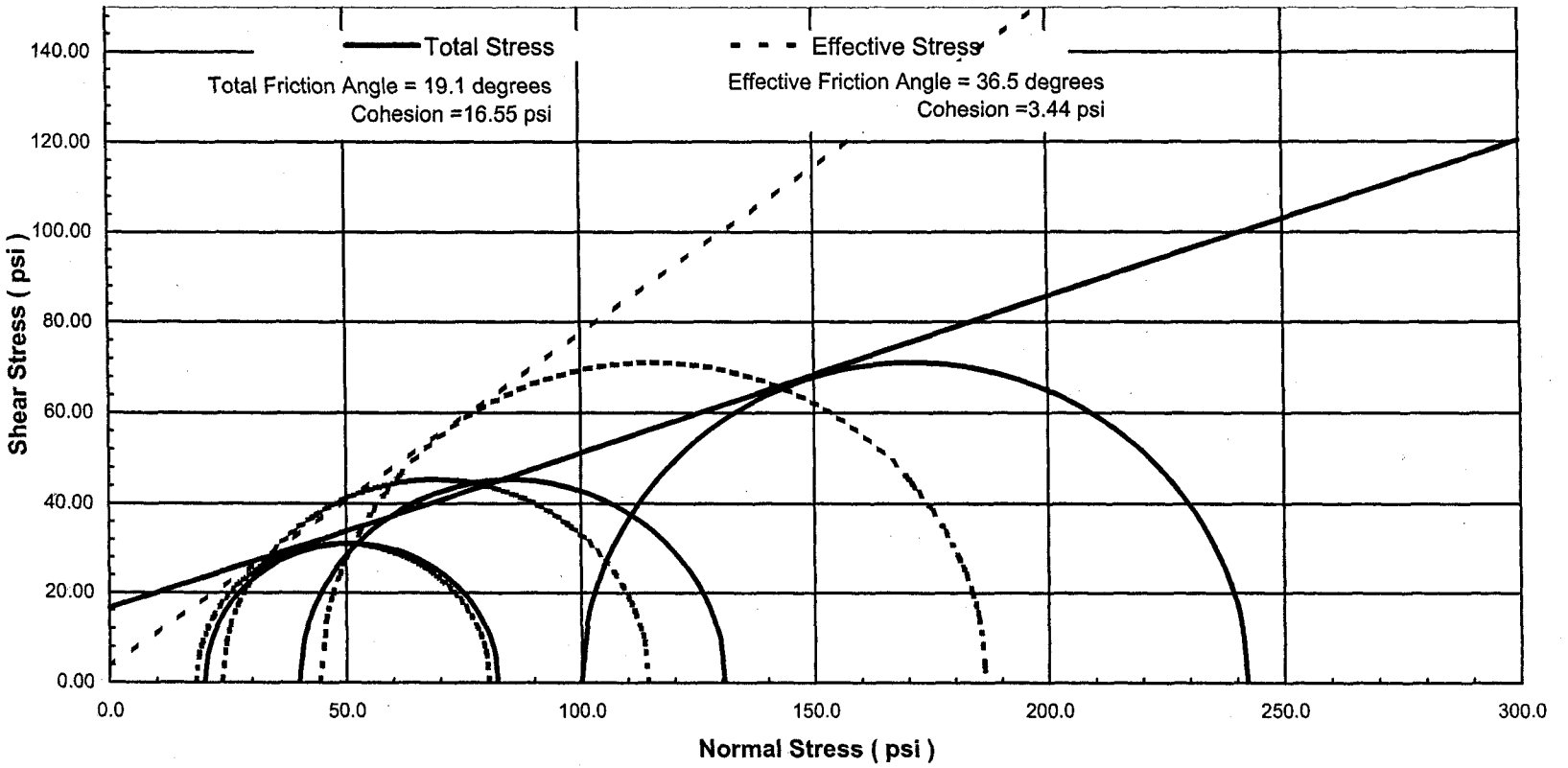




Project No. 13846066	**Elizabeth Mine**	CONSOLIDATED UNDRAINED TRIAXIAL COMPRESSION with Pore Pressure Measurements TB-14 A SUMMARY	Figure 1
URS Corporation			January 2003

Prepared by: C. Jordan

Checked by: G. Thomas



Project No. 13846066	Elizabeth Mine	Mohr Circles of Total and Effective Stresses at Peak CIU' Triaxial Test	Figure 2
URS Corporation		TB-14 A SUMMARY	January 2003

SUMMARY FOR STATIC CIU' TRIAXIAL TESTS SPECIMENS

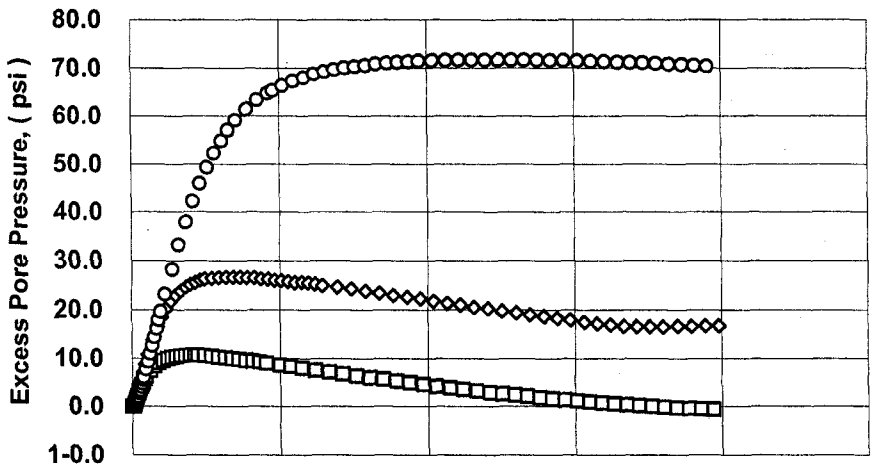
Test No	Boring No	Sample Section No	Depth	USCS Group Symbol	w_o	$\gamma_{t,o}$	$\gamma_{d,o}$	$\sigma'_{c,max}$	$\sigma'_{v,c}$	$\varepsilon_{a,c}$	B factor (%)	at Peak Deviator Stress					
												at Peak Obliquity					
			Elev	Gs	w_c	$\gamma_{t,c}$	$\gamma_{d,c}$	OCR	$K_c = \frac{\sigma'_{v,c}}{\sigma'_{h,c}}$	$\varepsilon_{v,c}$	ε_{rate}	ε_a	$\frac{\sigma_1 - \sigma_3}{2}$	$\frac{\sigma'_1 + \sigma'_3}{2}$	σ'_1 / σ'_3	A factor	ϕ' for c'=0
			(ft)		(%)	(pcf)	(pcf)			(%)	(%/hr)	(%)	(psi)	(psi)			
T2160	TB-13	A	30.25	SP-SM	8.1	100.9	93.4	25.00	25.00	1.0	96.2	19.3	39.16	64.70	4.07	-0.007	37.3
				(2.86)	29.2	124.2	96.1	1.0	1.00	2.9	1.1	11.2	34.96	56.43	4.26	0.050	38.3
T2161	TB-13	B	30.75	SP-SM	7.9	105.0	97.3	50.00	50.00	1.0	96.7	15.7	51.17	84.01	4.12	0.168	37.5
				(2.86)	27.8	128.4	100.5	1.0	1.00	3.1	1.2	9.8	45.71	73.48	4.29	0.243	38.5
T2158	TB-16	A	30.3	SM	11.5	105.1	94.2	100.00	100.00	4.1	95.5	19.5	42.24	71.88	3.85	0.833	36.0
				(3.30)	24.1	142.5	114.8	1.0	1.00	17.9	1.2	19.5	42.24	71.88	3.85	0.833	36.0

Test No	Description of Material Tested and Remarks
T2160	SP-SM, dark brown f. SAND, trace silt
T2161	SP-SM, dark brown f. SAND, tr. silt
T2158	SM, brown f. SAND, some silt, trace c-m sand.

Strength Envelope Summary						
Test Series	Failure Criteria	ϕ' (deg)	c' (psi)	α' (deg)	a' (psi)	Correlation Coefficient
1	1	37.0	0.000	31.0	0.000	--
	2	34.5	3.473	29.5	2.862	0.972

Failure Criteria: 1 - Peak Deviator Stress; 2 - Peak Obliquity

Project No. 13846066	**Elizabeth Mine**	CONSOLIDATED UNDRAINED TRIAXIAL COMPRESSION with Pore Pressure Measurements TB-16 A SUMMARY	January 2003
URS Corporation			

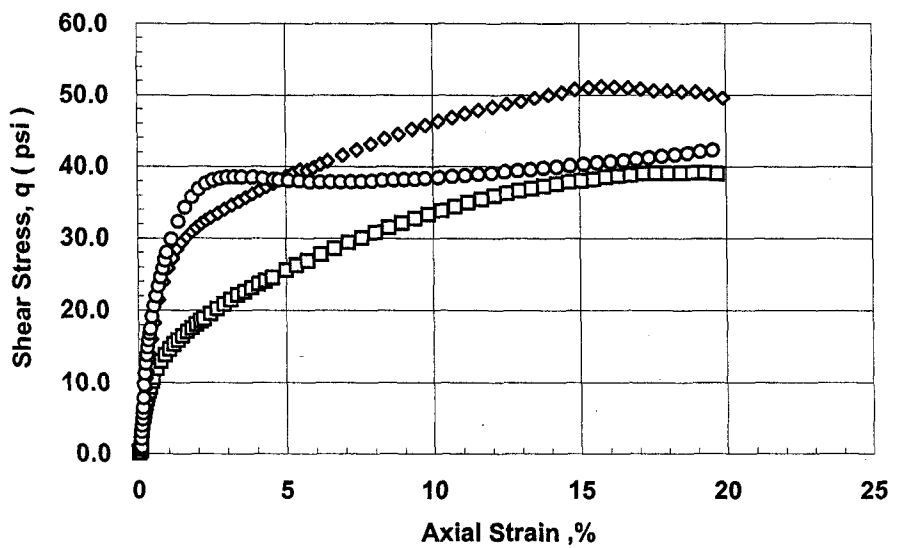


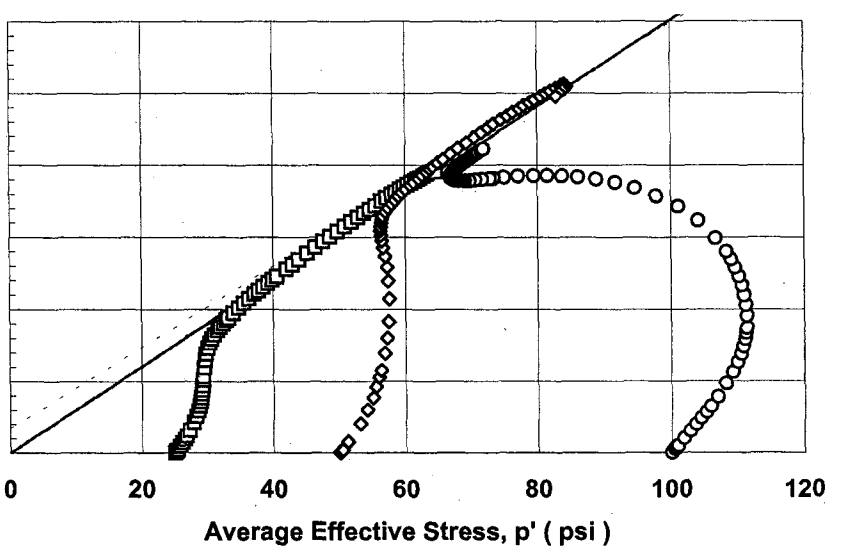
LEGEND AND SUMMARY INFORMATION

Symbol	Test	Boring	Sample	Depth (ft)	w_o (%)	γ_{to} (pcf)	σ'_c (psi)
□	T2160	TB-13	A	30.3	8.1	100.9	25.00
◊	T2161	TB-13	B	30.8	7.9	105.0	50.00
○	T2158	TB-16	A	30.3	11.5	105.1	100.00

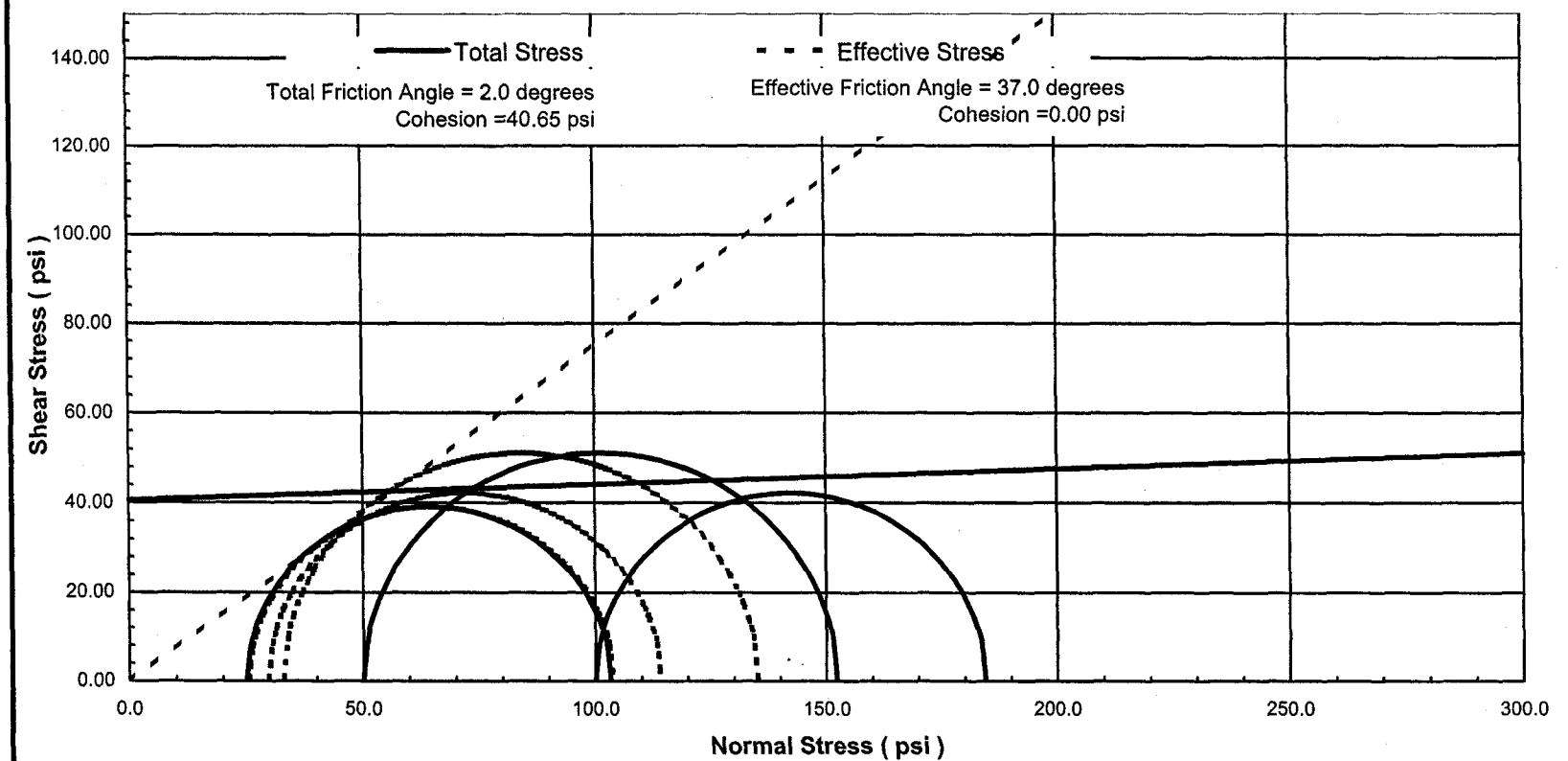
SERIES SUMMARY

Notation	Failure Criteria	c' (psi)	Φ' (degrees)
	Peak Deviator Stress	0.00	37.0
	Peak Obliquity	3.47	34.5





Project No. 13846066	**Elizabeth Mine**	CONSOLIDATED UNDRAINED TRIAXIAL COMPRESSION with Pore Pressure Measurements TB-16 A SUMMARY	Figure 1
Prepared by: C. Jordan Checked by: G. Thomas	**URS Corporation**		January 2003



Project No. 13846066	Elizabeth Mine	Mohr Circles of Total and Effective Stresses at Peak CIU' Triaxial Test	Figure 2
URS Corporation		TB-16 A SUMMARY	January 2003

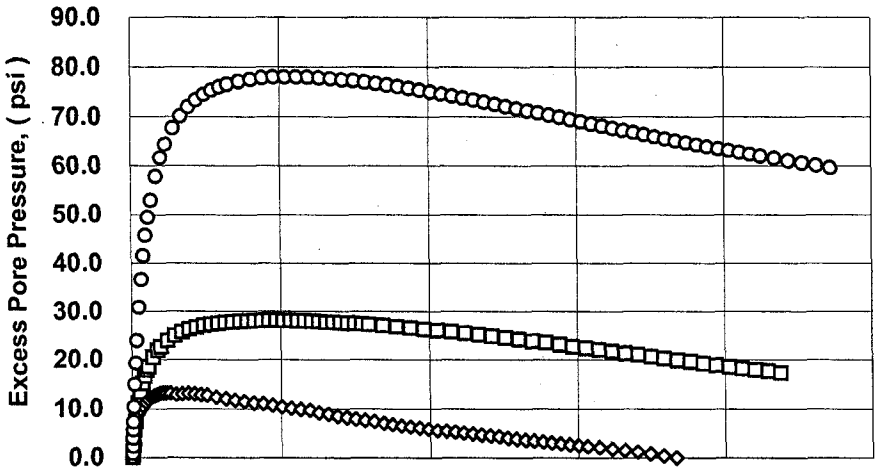
SUMMARY FOR STATIC CIU' TRIAXIAL TESTS SPECIMENS

Test No	Boring No	Sample Section No	Depth	USCS Group Symbol	w_o	$\gamma_{t,o}$	$\gamma_{d,o}$	$\sigma'_{c,max}$	$\sigma'_{v,c}$	$\varepsilon_{a,c}$	B factor (%)	at Peak Deviator Stress					
												at Peak Obliquity					
			Elev	Gs	w_c	$\gamma_{t,c}$	$\gamma_{d,c}$	OCR	$K_c = \frac{\sigma'_{v,c}}{\sigma'_{h,c}}$	$\varepsilon_{v,c}$	ε_{rate}	ε_a	$\frac{\sigma_1 - \sigma_3}{2}$	$\frac{\sigma'_1 + \sigma'_3}{2}$	σ'_1 / σ'_3	A factor	ϕ' for c'=0
			(ft)		(%)	(pcf)	(pcf)		(psi)	(%)	(%/hr)	(%)	(psi)	(psi)			
T2154	Composite	TB 10&11		ML	38.5	125.1	90.4	35.00	35.00	3.8	98.9	21.9	23.28	40.93	3.64	0.373	34.7
				(3.30)	25.5	140.4	111.9	1.0	1.00	19.3	1.2	13.0	15.63	26.40	3.90	0.775	36.3
T2168	Composite	TB-10&11		ML	40.6	126.1	89.7	70.00	70.00	5.9	99.2	20.5	93.56	164.30	3.65	-0.004	34.7
				(3.30)	23.1	143.9	116.9	1.0	1.00	23.2	1.0	19.6	93.53	164.07	3.65	-0.003	34.8
T2153	Composite	TB 10&11		ML	38.1	128.4	93.0	105.00	105.00	7.6	97.1	23.6	58.82	104.22	3.59	0.507	34.4
				(3.30)	23.0	144.1	117.2	1.0	1.00	20.7	1.2	16.9	51.52	89.72	3.70	0.648	35.0

Test No	Description of Material Tested and Remarks
T2154	ML, gray c-f sandy SILT.
T2168	ML, gray c-f sandy SILT.
T2153	ML, gray c-f sandy SILT.

Strength Envelope Summary						
Test Series	Failure Criteria	ϕ' (deg)	c' (psi)	α' (deg)	a' (psi)	Correlation Coefficient
1	1	34.6	0.000	29.6	0.000	--
	2	34.5	0.865	29.5	0.713	1.000
Failure Criteria:	1 - Peak Deviator Stress 2 - Peak Obliquity					

Project No. 13846066	**Elizabeth Mine**	CONSOLIDATED UNDRAINED TRIAXIAL COMPRESSION with Pore Pressure Measurements Composite TB 10&11 SUMMARY	January 2003
URS Corporation			

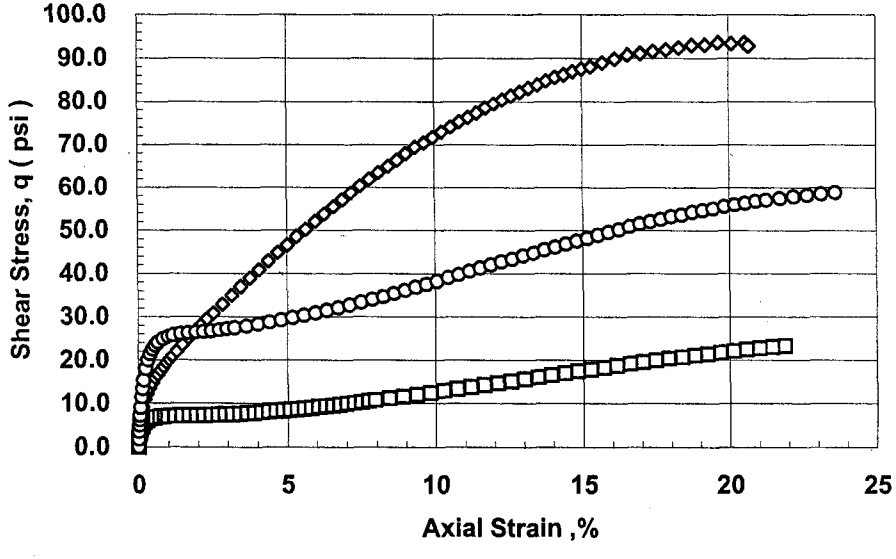


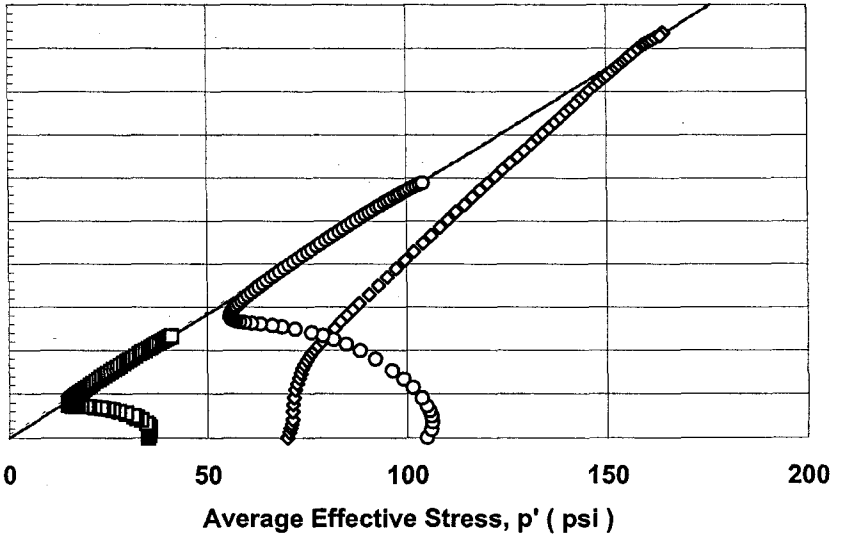
LEGEND AND SUMMARY INFORMATION

Symbol	Test	Boring	Sample	Depth (ft)	w_o (%)	γ_{to} (pcf)	σ'_c (psi)
□	T2154	Composite	TB 10&11		38.5	125.1	35.00
◊	T2168	Composite	TB-10&11		40.6	126.1	70.00
○	T2153	Composite	TB 10&11		38.1	128.4	105.00

SERIES SUMMARY

Notation	Failure Criteria	c' (psi)	Φ' (degrees)
———	Peak Deviator Stress	0.00	34.6
———	Peak Obliquity	0.86	34.5

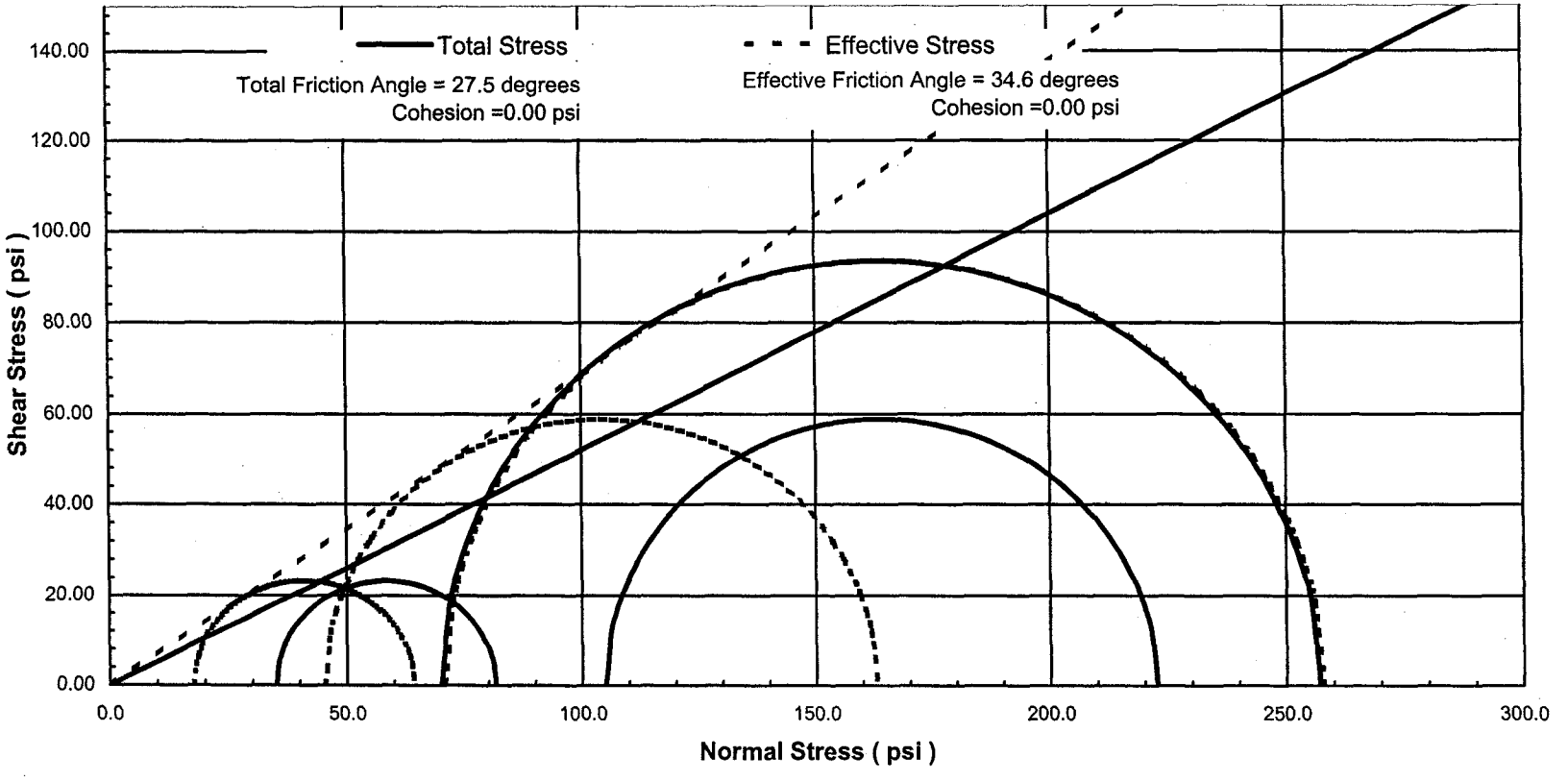




Project No. 13846066	**Elizabeth Mine**	CONSOLIDATED UNDRAINED TRIAXIAL COMPRESSION with Pore Pressure Measurements Composite TB 10&11 SUMMARY	Figure 1
URS Corporation			January 2003

Prepared by: C. Jordan

Checked by: G. Thomas



Project No. 13846066	Elizabeth Mine	Mohr Circles of Total and Effective Stresses at Peak CIU' Triaxial Test	Figure 2
URS Corporation		Composite TB 10&11 SUMMARY	January 2003

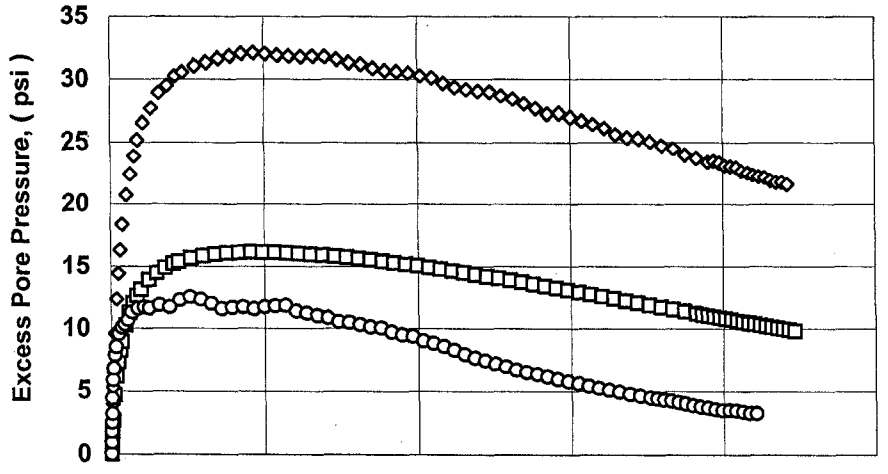
SUMMARY FOR STATIC CIU' TRIAXIAL TESTS SPECIMENS

Test No	Boring No	Sample Section No	Depth	USCS Group Symbol	w_o	$\gamma_{t,o}$	$\gamma_{d,o}$	$\sigma'_{c,max}$	$\sigma'_{v,c}$	$\varepsilon_{a,c}$	B factor (%)	at Peak Deviator Stress					
												at Peak Obliquity					
			Elev	Gs	w_c	$\gamma_{t,c}$	$\gamma_{d,c}$	OCR	$K_c = \frac{\sigma'_{v,c}}{\sigma'_{h,c}}$	$\varepsilon_{v,c}$	ε_{rate}	ε_a	$\frac{\sigma_1 - \sigma_3}{2}$	$\frac{\sigma'_1 + \sigma'_3}{2}$	σ'_1 / σ'_3	A factor	ϕ' for c'=0
			(ft)		(%)	(pcf)	(pcf)		(psi)	(%)	(%/hr)	(%)	(psi)	(psi)			
T2165	Composite	TB-14	20	ML	41.0	117.7	83.5	20	20	4.0	99.8	22.3	13.1	23.2	3.57	0.376	34.2
		A&B		(3.30)	24.9	141.2	113.1	1.0	1.00	26.1	1.9	10.3	7.15	12.2	3.81	1.043	35.7
T2166	Composite	TB-14	20	ML	39.9	122.3	87.5	40	40	4.2	96.4	22.1	25.1	43.5	3.72	0.431	35.2
		A&B		(3.30)	24.1	142.5	114.8	1.0	1.00	23.8	1.9	12.4	16.7	27.7	4.04	0.867	37.1
T2167	Composite	TB-14	20	ML	39.1	124.7	89.6	100	100	6.4	96.8	20.8	127	224	3.63	0.013	34.6
		A&B		(3.30)	19.3	150.2	125.9	1.0	1.00	28.8	1.1	20.4	127	223	3.63	0.014	34.6

Test No	Description of Material Tested and Remarks
T2165	ML, gray SILT, some f. sand.
T2166	ML, gray SILT, some f. sand.
T2167	ML, gray SILT, some f. sand.

Strength Envelope Summary						
Test Series	Failure Criteria	ϕ' (deg)	c' (psi)	α' (deg)	a' (psi)	Correlation Coefficient
1	1	34.6	0.166	29.6	0.136	1.000
	2	34.4	0.750	29.5	0.619	1.000
Failure Criteria:	1 - Peak Deviator Stress 2 - Peak Obliquity					

Project No. 13846066	**Elizabeth Mine**	CONSOLIDATED UNDRAINED TRIAXIAL COMPRESSION with Pore Pressure Measurements Composite TB-14 A&B SUMMARY	January 2003
URS Corporation			

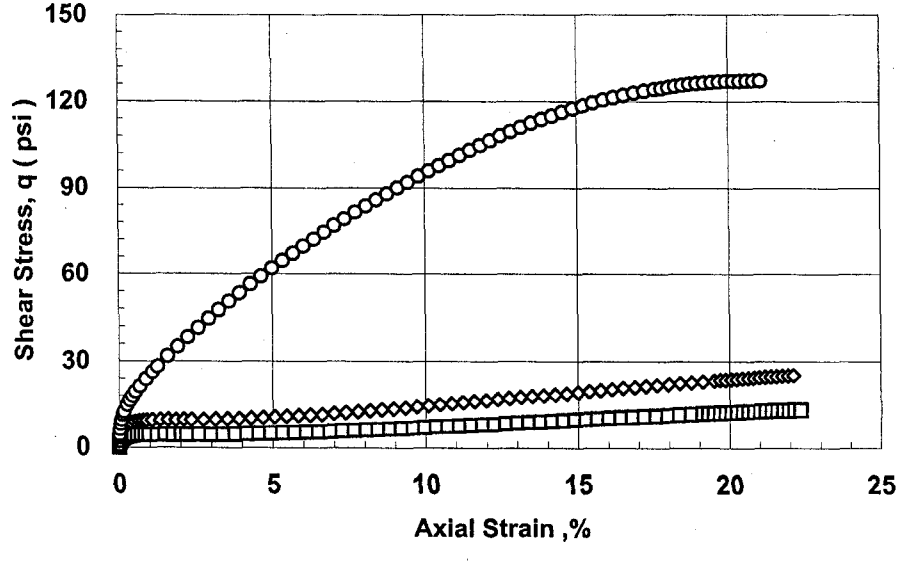


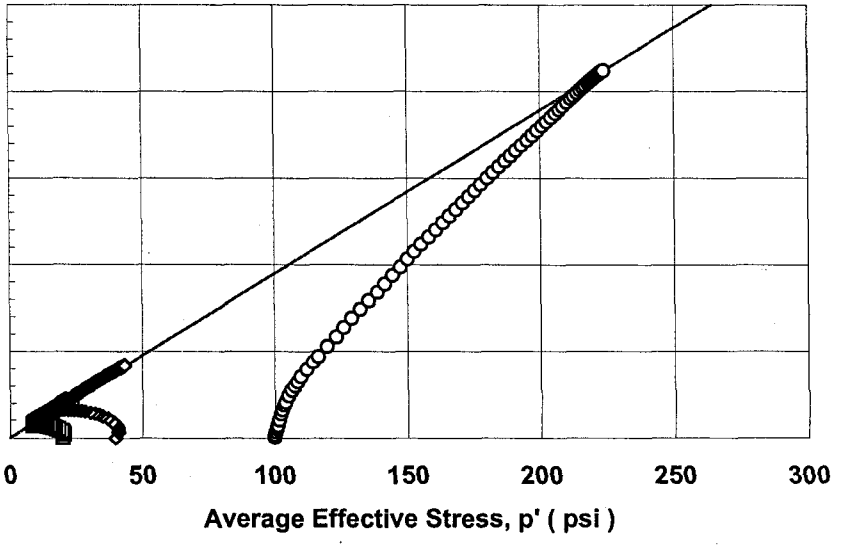
LEGEND AND SUMMARY INFORMATION

Symbol	Test	Boring	Sample	Depth (ft)	w_o (%)	γ_{to} (pcf)	σ'_c (psi)
□	T2165	Composite	TB-14 A&B	20.0	41.0	117.7	20.00
◊	T2166	Composite	TB-14 A&B	20.0	39.9	122.3	40.00
○	T2167	Composite	TB-14 A&B	20.0	39.1	124.7	100.00

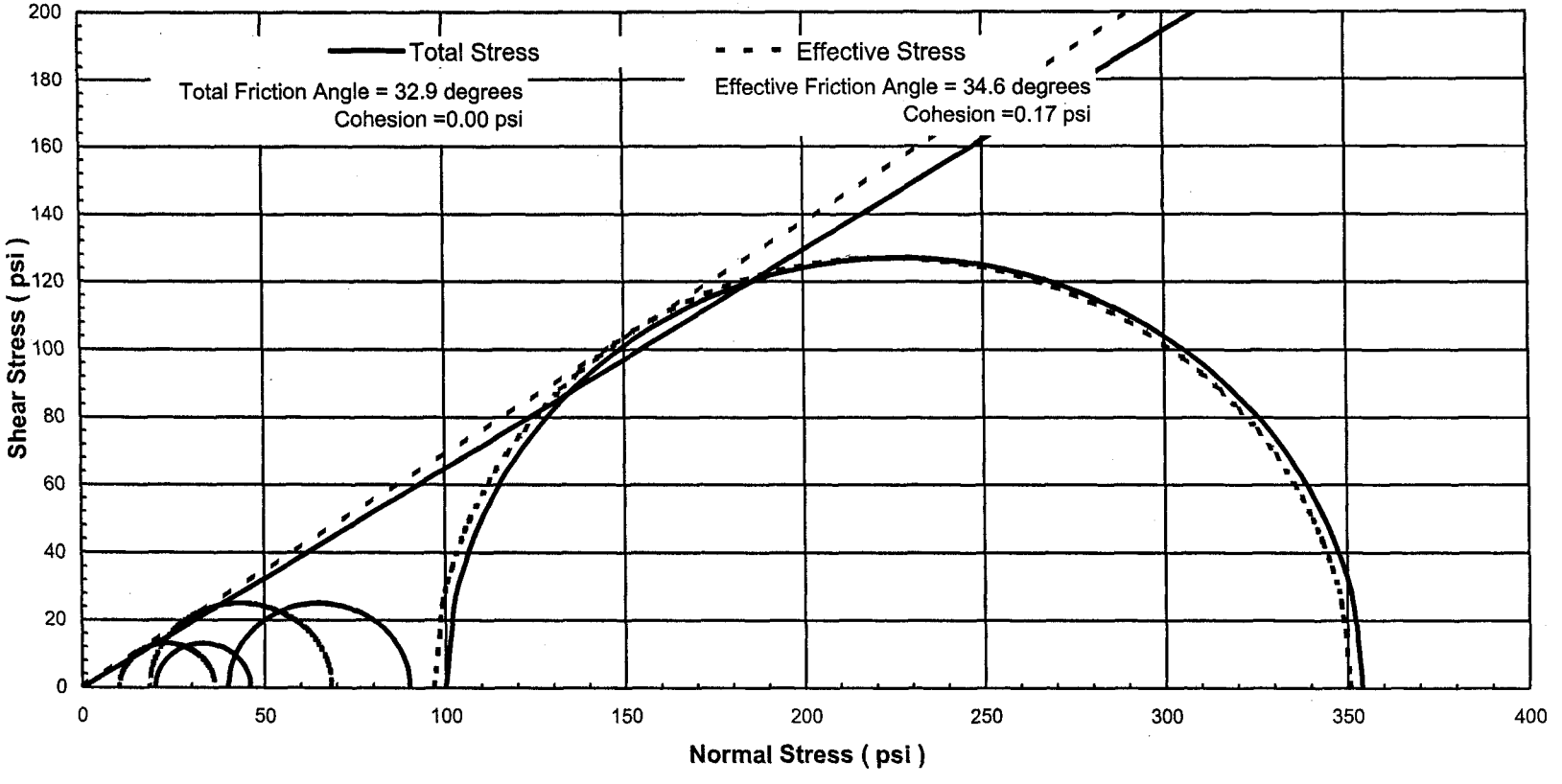
SERIES SUMMARY

Notation	Failure Criteria	c' (psi)	Φ' (degrees)
———	Peak Deviator Stress	0.17	34.6
———	Peak Obliquity	0.75	34.4





Prepared by: C. Jordan Checked by: G. Thomas	Project No. 13846066	**Elizabeth Mine**	CONSOLIDATED UNDRAINED TRIAXIAL COMPRESSION with Pore Pressure Measurements Composite TB-14 A&B SUMMARY	Figure 1
	URS Corporation			January 2003



Project No. 13846066	Elizabeth Mine	Mohr Circles of Total and Effective Stresses at Peak CIU' Triaxial Test	Figure 2
URS Corporation		Composite TB-14 A&B SUMMARY	January 2003

Appendix C
Liquefaction Results

Liquefaction Analysis - Elizabeth Mine, Strafford, VT

Test Borehole TB-9

Over burden (tsf) =	0												EQ Magnitude =			5.7
Water depth (ft) =	65												amax =			0.24
Depth (feet)	N_{60}	% Fines	Dr (%)	Sigma v (tsf)	Sigma v' (tsf)	C_N	$(N_1)_{60}$	Fines Correction Alpha	Fines Correction Beta	$(N_1)_{60cs}$	K_{sigma}	$CRR_{7.5}$		rd	CSR	FS
1	4	34	20.0	0.06	0.06	1.75	7.00	4.93	1.19	13.25	1.77	0.143		1.00	0.156	3.28
6	26	31.3	50.5	0.36	0.36	1.42	37.03	4.79	1.17	47.94	1.31	0.279		0.99	0.154	Non-Liq.
11	14	28.5	44.0	0.66	0.66	1.20	16.82	4.60	1.14	23.81	1.11	0.270		0.98	0.152	3.96
16	11	26.5	41.0	0.96	0.96	1.04	11.42	4.43	1.13	17.30	1.02	0.184		0.97	0.151	2.51
21	11	30.0	41.0	1.26	1.26	0.91	10.06	4.71	1.15	16.32	0.96	0.174		0.95	0.149	2.26
28.5	14	35.0	44.0	1.71	1.71	0.78	10.86	5.00	1.20	18.03	0.90	0.192		0.93	0.145	2.40
31	17	37.1	46.0	1.86	1.86	0.74	12.55	5.00	1.20	20.06	0.88	0.216		0.92	0.143	2.68
36	24	40	49.5	2.16	2.16	0.67	16.16	5.00	1.20	24.39	0.84	0.280		0.88	0.138	3.43
41	19	45	47.0	2.46	2.46	0.62	11.76	5.00	1.20	19.11	0.82	0.205		0.84	0.131	2.57
46	24	48	49.5	2.76	2.76	0.57	13.75	5.00	1.20	21.50	0.79	0.235		0.79	0.124	3.01
51	23	52.8	49.0	3.06	3.06	0.53	12.26	5.00	1.20	19.71	0.77	0.212		0.74	0.116	2.84
58.5	49	60	62.0	3.51	3.51	0.48	23.65	5.00	1.20	33.38	0.69	1.844		0.67	0.105	Non-Liq.
61	34	62	54.5	3.66	3.66	0.47	15.91	5.00	1.20	24.09	0.71	0.275		0.65	0.102	3.88
66	20	66.7	47.5	3.96	3.96	0.44	8.82	5.00	1.20	15.58	0.73	0.166		0.62	0.096	2.54
71	23	67	49.0	4.26	4.17	0.42	9.76	5.00	1.20	16.71	0.71	0.178		0.59	0.094	2.73
76	36	67	20.0	4.56	4.31	0.41	14.87	5.00	1.20	22.85	0.75	0.255		0.56	0.093	4.16
81	43	67	20.0	4.86	4.45	0.40	17.32	5.00	1.20	25.78	0.75	0.308		0.54	0.093	5.02
85	100	67	20.0	5.10	4.57	0.39	39.48	5.00	1.20	52.37	0.74	0.329		0.53	0.093	Non-Liq.

Liquefaction Analysis - Elizabeth Mine, Strafford, VT

Test Borehole TB-10

Over burden (tsf) =		0												EQ Magnitude =		5.7
Water depth (ft) =		84												amax =		0.24
Depth (feet)	N_{60}	% Fines	Dr (%)	Sigma v (tsf)	Sigma v' (tsf)	C_N	$(N_1)_{60}$	Fines Correction Alpha	Fines Correction Beta	$(N_1)_{60cs}$	K_{sigma}	$CRR_{7.5}$		rd	CSR	FS
6	12	18.7	42.0	0.36	0.36	1.42	17.09	3.38	1.07	21.68	1.25	0.237		0.99	0.154	3.89
11	15	25	45.0	0.66	0.66	1.20	18.02	4.29	1.12	24.38	1.11	0.280		0.98	0.152	4.11
16	14	30	44.0	0.96	0.96	1.04	14.54	4.71	1.15	21.49	1.02	0.235		0.97	0.151	3.20
21	11	36	41.0	1.26	1.26	0.91	10.06	5.00	1.20	17.07	0.96	0.182		0.95	0.149	2.37
26	16	36	45.5	1.56	1.56	0.82	13.07	5.00	1.20	20.69	0.91	0.224		0.94	0.146	2.82
33.5	16	36	45.5	2.01	2.01	0.70	11.27	5.00	1.20	18.52	0.86	0.198		0.90	0.141	2.45
36	14	38	44.0	2.16	2.16	0.67	9.43	5.00	1.20	16.31	0.85	0.174		0.88	0.138	2.17
41	14	38	44.0	2.46	2.46	0.62	8.67	5.00	1.20	15.40	0.83	0.164		0.84	0.131	2.09
46	15	38	45.0	2.76	2.76	0.57	8.59	5.00	1.20	15.31	0.80	0.163		0.79	0.124	2.14
51	18	38	46.5	3.06	3.06	0.53	9.59	5.00	1.20	16.51	0.78	0.176		0.74	0.116	2.38
56	21	50	48.0	3.36	3.36	0.50	10.46	5.00	1.20	17.56	0.76	0.187		0.69	0.108	2.63
63.5	24	75	49.5	3.81	3.81	0.45	10.90	5.00	1.20	18.07	0.73	0.193		0.63	0.099	2.86
66	14	78.8	44.0	3.96	3.96	0.44	6.17	5.00	1.20	12.41	0.75	0.135		0.62	0.096	2.12
71	23	75	49.0	4.26	4.26	0.42	9.59	5.00	1.20	16.51	0.71	0.176		0.59	0.092	2.74
76	25	70	50.0	4.56	4.56	0.40	9.89	5.00	1.20	16.86	0.69	0.179		0.56	0.088	2.85
81	16	67.2	45.5	4.86	4.86	0.38	6.02	5.00	1.20	12.22	0.70	0.133		0.54	0.085	2.23
86	17	70	46.0	5.16	5.10	0.36	6.15	5.00	1.20	12.38	0.69	0.135		0.53	0.084	2.26
93.5	11	71.1	41.0	5.61	5.31	0.35	3.85	5.00	1.20	9.62	0.72	0.110		0.51	0.084	1.88
96	14	75	44.0	5.76	5.39	0.35	4.85	5.00	1.20	10.82	0.70	0.120		0.51	0.084	2.01
101	29	78.4	52.0	6.06	5.53	0.34	9.83	5.00	1.20	16.79	0.65	0.179		0.50	0.085	2.75
106	40	78	57.5	6.36	5.67	0.33	13.27	5.00	1.20	20.93	0.61	0.227		0.49	0.085	3.30
111	46	78	60.5	6.66	5.82	0.33	14.95	5.00	1.20	22.95	0.59	0.256		0.48	0.086	3.58
116	64	78	69.5	6.96	5.96	0.32	20.39	5.00	1.20	29.47	0.55	0.434		0.47	0.086	5.54
120.5	94	78	80.0	7.23	6.09	0.31	29.42	5.00	1.20	40.31	0.49	0.135		0.47	0.087	Non-Liq.

Liquefaction Analysis - Elizabeth Mine, Strafford, VT

Test Borehole TB-11

Over burden (tsf) =	0												EQ Magnitude =		5.7
Water depth (ft) =	41												amax =		0.24
Depth (feet)	N_{60}	% Fines	Dr (%)	Sigma v (tsf)	Sigma v' (tsf)	C_N	$(N_1)_{60}$	Fines Correction Alpha	Beta	$(N_1)_{60cs}$	K_{sigma}	$CRR_{7.5}$		rd	CSR	FS
3	26	25.1	50.5	0.18	0.18	1.60	41.68	4.30	1.12	50.81	1.56	0.312		0.99	0.155	Non-Liq.
6	51	15	63.0	0.36	0.36	1.42	72.64	2.50	1.05	78.64	1.40	0.555		0.99	0.154	Non-Liq.
11	11	7.3	41.0	0.66	0.66	1.20	13.21	0.16	1.01	13.51	1.10	0.145		0.98	0.152	2.12
16	16	20	45.5	0.96	0.96	1.04	16.61	3.61	1.08	21.55	1.02	0.236		0.97	0.151	3.22
23.5	19	30	47.0	1.41	1.41	0.86	16.40	4.71	1.15	23.63	0.93	0.267		0.95	0.148	3.40
26	14	42.3	44.0	1.56	1.56	0.82	11.44	5.00	1.20	18.73	0.92	0.200		0.94	0.146	2.53
31	16	50	45.5	1.86	1.86	0.74	11.81	5.00	1.20	19.17	0.88	0.205		0.92	0.143	2.55
36	17	60	46.0	2.16	2.16	0.67	11.45	5.00	1.20	18.74	0.85	0.200		0.88	0.138	2.48
43.5	19	69	47.0	2.61	2.50	0.61	11.63	5.00	1.20	18.96	0.81	0.203		0.82	0.133	2.50
46	15	60	45.0	2.76	2.57	0.60	9.01	5.00	1.20	15.81	0.82	0.168		0.79	0.133	2.09
51	17	50	46.0	3.06	2.72	0.58	9.84	5.00	1.20	16.81	0.80	0.179		0.74	0.131	2.22
56	17	49.4	46.0	3.36	2.86	0.56	9.50	5.00	1.20	16.40	0.79	0.174		0.69	0.127	2.20
63.5	22	50	48.5	3.81	3.08	0.53	11.68	5.00	1.20	19.01	0.77	0.203		0.63	0.122	2.59
66	39	50	57.0	3.96	3.15	0.52	20.36	5.00	1.20	29.44	0.73	0.433		0.62	0.121	5.28
71	83	50	79.0	4.26	3.29	0.51	41.97	5.00	1.20	55.36	0.64	0.358		0.59	0.118	Non-Liq.

Liquefaction Analysis - Elizabeth Mine, Strafford, VT

Test Borehole TB-12

Over burden (tsf) =		0												EQ Magnitude =		5.7
Water depth (ft) =		35												amax =		0.24
Depth (feet)	N_{60}	% Fines	Dr (%)	Sigma v (tsf)	Sigma v' (tsf)	C_N	$(N_1)_{60}$	Fines Correction Alpha	Beta	$(N_1)_{60cs}$	K_{sigma}	$CRR_{7.5}$		rd	CSR	FS
1	4	39.2	20.0	0.06	0.06	1.75	7.00	5.00	1.20	13.40	1.77	0.144		1.00	0.156	3.31
6	24	20	49.5	0.36	0.36	1.42	34.19	3.61	1.08	40.52	1.30	0.142		0.99	0.154	Non-Liq.
11	9	17.1	36.6	0.66	0.66	1.20	10.81	3.04	1.06	14.50	1.10	0.155		0.98	0.152	2.25
18.5	10	24	40.0	1.11	1.11	0.97	9.73	4.18	1.11	14.95	0.99	0.160		0.96	0.150	2.12
21	13	31	43.0	1.26	1.26	0.91	11.89	4.77	1.16	18.59	0.96	0.199		0.95	0.149	2.59
26	13	37.4	43.0	1.56	1.56	0.82	10.62	5.00	1.20	17.74	0.92	0.189		0.94	0.146	2.39
31	12	50	42.0	1.86	1.86	0.74	8.86	5.00	1.20	15.63	0.89	0.166		0.92	0.143	2.08
36	4	77.2	20.0	2.16	2.10	0.69	2.74	5.00	1.20	8.29	0.87	0.098		0.88	0.142	1.22
43.5	22	77	48.5	2.61	2.31	0.64	14.18	5.00	1.20	22.01	0.82	0.242		0.82	0.144	2.80
46	57	77	20.0	2.76	2.39	0.63	36.00	5.00	1.20	48.21	0.85	0.282		0.79	0.143	Non-Liq.

Liquefaction Analysis - Elizabeth Mine, Strafford, VT

Test Borehole TB-13

Over burden (tsf) =		0												EQ Magnitude =		5.7
Water depth (ft) =		47												amax =		0.24
Depth (feet)	N_{60}	% Fines	Dr (%)	Sigma v (tsf)	Sigma v' (tsf)	C_N	$(N_1)_{60}$	Fines Correction Alpha	Beta	$(N_1)_{60cs}$	K_{sigma}	$CRR_{7.5}$		rd	CSR	FS
1	6	37.9	26.6	0.06	0.06	1.75	10.50	5.00	1.20	17.60	1.77	0.187		1.00	0.156	4.29
6	69	25	72.0	0.36	0.36	1.42	98.28	4.29	1.12	113.88	1.47	0.826		0.99	0.154	Non-Liq.
11	12	15.2	42.0	0.66	0.66	1.20	14.41	2.55	1.05	17.68	1.10	0.188		0.98	0.152	2.74
18.5	22	16	48.5	1.11	1.11	0.97	21.40	2.77	1.05	25.32	0.99	0.298		0.96	0.150	3.96
21	19	16	47.0	1.26	1.26	0.91	17.38	2.77	1.05	21.08	0.96	0.229		0.95	0.149	2.98
26	10	17.1	40.0	1.56	1.56	0.82	8.17	3.04	1.06	11.70	0.92	0.128		0.94	0.146	1.63
33.5	14	30	44.0	2.01	2.01	0.70	9.86	4.71	1.15	16.09	0.87	0.171		0.90	0.141	2.13
36	16	41.4	45.5	2.16	2.16	0.67	10.77	5.00	1.20	17.93	0.85	0.191		0.88	0.138	2.37
41	11	35	41.0	2.46	2.46	0.62	6.81	5.00	1.20	13.17	0.84	0.142		0.84	0.131	1.83
46	20	31.2	47.5	2.76	2.76	0.57	11.45	4.78	1.16	18.12	0.79	0.193		0.79	0.124	2.50
51	10	50	40.0	3.06	2.90	0.55	5.53	5.00	1.20	11.63	0.82	0.128		0.74	0.122	1.72
56	8	83.6	33.3	3.36	3.05	0.53	4.28	5.00	1.20	10.13	0.81	0.114		0.69	0.119	1.56
61	34	83	54.5	3.66	3.19	0.52	17.58	5.00	1.20	26.10	0.74	0.315		0.65	0.117	4.03
63	40	83	57.5	3.78	3.25	0.51	20.42	5.00	1.20	29.50	0.72	0.436		0.64	0.115	5.50

Liquefaction Analysis - Elizabeth Mine, Strafford, VT

Test Borehole TB-16

Over burden (tsf) =	0												EQ Magnitude =		5.7
Water depth (ft) =	34												amax =		0.24
Depth (feet)	N_{60}	% Fines	Dr (%)	Sigma v (tsf)	Sigma v' (tsf)	C_N	$(N_1)_{60}$	Fines Correction Alpha	Fines Correction Beta	$(N_1)_{60cs}$	K_{sigma}	$CRR_{7.5}$	rd	CSR	FS
1	9	32.8	36.6	0.06	0.06	1.75	15.75	4.87	1.18	23.42	1.77	0.264	1.00	0.156	6.04
6	12	25	42.0	0.36	0.36	1.42	17.09	4.29	1.12	23.35	1.25	0.262	0.99	0.154	4.30
11	10	19.6	40.0	0.66	0.66	1.20	12.01	3.54	1.08	16.48	1.10	0.175	0.98	0.152	2.54
18.5	11	22	41.0	1.11	1.11	0.97	10.70	3.93	1.09	15.62	0.99	0.166	0.96	0.150	2.21
21	13	26.7	43.0	1.26	1.26	0.91	11.89	4.45	1.13	17.86	0.96	0.190	0.95	0.149	2.48
26	8	30	33.3	1.56	1.56	0.82	6.54	4.71	1.15	12.25	0.92	0.134	0.94	0.146	1.70
33.5	7	45.1	30.0	2.01	2.01	0.70	4.93	5.00	1.20	10.92	0.88	0.121	0.90	0.141	1.53
36	6	45	26.6	2.16	2.13	0.68	4.08	5.00	1.20	9.89	0.87	0.112	0.88	0.140	1.40
41	21	45	48.0	2.46	2.27	0.65	13.69	5.00	1.20	21.43	0.83	0.234	0.84	0.142	2.76
46	60	45	67.5	2.76	2.42	0.63	37.58	5.00	1.20	50.09	0.75	0.304	0.79	0.141	Non-Liq.

Liquefaction Analysis - Elizabeth Mine, Strafford, VT

Test Borehole TB-17

Over burden (tsf) =		0												EQ Magnitude =		5.7
Water depth (ft) =		32												amax =		0.24
Depth (feet)	N_{60}	% Fines	Dr (%)	Sigma v (tsf)	Sigma v' (tsf)	C_N	$(N_1)_{60}$	Fines Correction Alpha	Fines Correction Beta	$(N_1)_{60}cs$	K_{sigma}	$CRR_{7.5}$		rd	CSR	FS
1	3	35.5	20.0	0.06	0.06	1.75	5.25	5.00	1.20	11.30	1.77	0.125		1.00	0.156	2.86
6	12	20	42.0	0.36	0.36	1.42	17.09	3.61	1.08	22.07	1.25	0.243		0.99	0.154	3.98
11	9	12.1	36.6	0.66	0.66	1.20	10.81	1.59	1.03	12.74	1.10	0.138		0.98	0.152	2.01
18.5	10	44.8	40.0	1.11	1.11	0.97	9.73	5.00	1.20	16.67	0.99	0.177		0.96	0.150	2.36
21	6	45	26.6	1.26	1.26	0.91	5.49	5.00	1.20	11.58	0.96	0.127		0.95	0.149	1.66
26	12	45	42.0	1.56	1.56	0.82	9.80	5.00	1.20	16.76	0.92	0.178		0.94	0.146	2.26
33.5	9	45	36.6	2.01	1.96	0.71	6.43	5.00	1.20	12.72	0.88	0.138		0.90	0.144	1.71
36	5	66.8	23.3	2.16	2.04	0.70	3.49	5.00	1.20	9.19	0.88	0.106		0.88	0.146	1.28
41	2	67	20.0	2.46	2.18	0.67	1.34	5.00	1.20	6.61	0.86	0.085		0.84	0.148	0.99
46	13	67	43.0	2.76	2.32	0.64	8.35	5.00	1.20	15.03	0.84	0.160		0.79	0.147	1.85
51	86	67	80.0	3.06	2.47	0.62	53.13	5.00	1.20	68.76	0.71	0.476		0.74	0.144	Non-Liq.

Liquefaction Analysis - Elizabeth Mine, Strafford, VT

Test Borehole TB-9

Over burden (tsf) =		0												EQ Magnitude =		6.5
Water depth (ft) =		65												amax =		0.24
Depth (feet)	N_{60}	% Fines	Dr (%)	Sigma v (tsf)	Sigma v' (tsf)	C_N	$(N_1)_{60}$	Fines Correction Alpha	Fines Correction Beta	$(N_1)_{60cs}$	K_{sigma}	$CRR_{7.5}$		rd	CSR	FS
1	4	34	20.0	0.06	0.06	1.75	7.00	4.93	1.19	13.25	1.77	0.143		1.00	0.156	2.34
6	26	31.3	50.5	0.36	0.36	1.42	37.03	4.79	1.17	47.94	1.31	0.279		0.99	0.154	Non-Liq.
11	14	28.5	44.0	0.66	0.66	1.20	16.82	4.60	1.14	23.81	1.11	0.270		0.98	0.152	2.83
16	11	26.5	41.0	0.96	0.96	1.04	11.42	4.43	1.13	17.30	1.02	0.184		0.97	0.151	1.79
21	11	30.0	41.0	1.26	1.26	0.91	10.06	4.71	1.15	16.32	0.96	0.174		0.95	0.149	1.62
28.5	14	35.0	44.0	1.71	1.71	0.78	10.86	5.00	1.20	18.03	0.90	0.192		0.93	0.145	1.72
31	17	37.1	46.0	1.86	1.86	0.74	12.55	5.00	1.20	20.06	0.88	0.216		0.92	0.143	1.91
36	24	40	49.5	2.16	2.16	0.67	16.16	5.00	1.20	24.39	0.84	0.280		0.88	0.138	2.45
41	19	45	47.0	2.46	2.46	0.62	11.76	5.00	1.20	19.11	0.82	0.205		0.84	0.131	1.84
46	24	48	49.5	2.76	2.76	0.57	13.75	5.00	1.20	21.50	0.79	0.235		0.79	0.124	2.15
51	23	52.8	49.0	3.06	3.06	0.53	12.26	5.00	1.20	19.71	0.77	0.212		0.74	0.116	2.03
58.5	49	60	62.0	3.51	3.51	0.48	23.65	5.00	1.20	33.38	0.69	1.844		0.67	0.105	Non-Liq.
61	34	62	54.5	3.66	3.66	0.47	15.91	5.00	1.20	24.09	0.71	0.275		0.65	0.102	2.77
66	20	66.7	47.5	3.96	3.96	0.44	8.82	5.00	1.20	15.58	0.73	0.166		0.62	0.096	1.82
71	23	67	49.0	4.26	4.17	0.42	9.76	5.00	1.20	16.71	0.71	0.178		0.59	0.094	1.95
76	36	67	20.0	4.56	4.31	0.41	14.87	5.00	1.20	22.85	0.75	0.255		0.56	0.093	2.97
81	43	67	20.0	4.86	4.45	0.40	17.32	5.00	1.20	25.78	0.75	0.308		0.54	0.093	3.59
85	100	67	20.0	5.10	4.57	0.39	39.48	5.00	1.20	52.37	0.74	0.329		0.53	0.093	Non-Liq.

Liquefaction Analysis - Elizabeth Mine, Strafford, VT

Test Borehole TB-10

Over burden (tsf) =		0												EQ Magnitude =		6.5
Water depth (ft) =		84												amax =		0.24
Depth (feet)	N_{60}	% Fines	Dr (%)	Sigma v (tsf)	Sigma v' (tsf)	C_N	$(N_1)_{60}$	Fines Correction Alpha	Beta	$(N_1)_{60}cs$	K_{sigma}	$CRR_{7.5}$		rd	CSR	FS
6	12	18.7	42.0	0.36	0.36	1.42	17.09	3.38	1.07	21.68	1.25	0.237		0.99	0.154	2.78
11	15	25	45.0	0.66	0.66	1.20	18.02	4.29	1.12	24.38	1.11	0.280		0.98	0.152	2.94
16	14	30	44.0	0.96	0.96	1.04	14.54	4.71	1.15	21.49	1.02	0.235		0.97	0.151	2.29
21	11	36	41.0	1.26	1.26	0.91	10.06	5.00	1.20	17.07	0.96	0.182		0.95	0.149	1.69
26	16	36	45.5	1.56	1.56	0.82	13.07	5.00	1.20	20.69	0.91	0.224		0.94	0.146	2.02
33.5	16	36	45.5	2.01	2.01	0.70	11.27	5.00	1.20	18.52	0.86	0.198		0.90	0.141	1.75
36	14	38	44.0	2.16	2.16	0.67	9.43	5.00	1.20	16.31	0.85	0.174		0.88	0.138	1.55
41	14	38	44.0	2.46	2.46	0.62	8.67	5.00	1.20	15.40	0.83	0.164		0.84	0.131	1.49
46	15	38	45.0	2.76	2.76	0.57	8.59	5.00	1.20	15.31	0.80	0.163		0.79	0.124	1.53
51	18	38	46.5	3.06	3.06	0.53	9.59	5.00	1.20	16.51	0.78	0.176		0.74	0.116	1.70
56	21	50	48.0	3.36	3.36	0.50	10.46	5.00	1.20	17.56	0.76	0.187		0.69	0.108	1.88
63.5	24	75	49.5	3.81	3.81	0.45	10.90	5.00	1.20	18.07	0.73	0.193		0.63	0.099	2.04
66	14	78.8	44.0	3.96	3.96	0.44	6.17	5.00	1.20	12.41	0.75	0.135		0.62	0.096	1.51
71	23	75	49.0	4.26	4.26	0.42	9.59	5.00	1.20	16.51	0.71	0.176		0.59	0.092	1.96
76	25	70	50.0	4.56	4.56	0.40	9.89	5.00	1.20	16.86	0.69	0.179		0.56	0.088	2.04
81	16	67.2	45.5	4.86	4.86	0.38	6.02	5.00	1.20	12.22	0.70	0.133		0.54	0.085	1.59
86	17	70	46.0	5.16	5.10	0.36	6.15	5.00	1.20	12.38	0.69	0.135		0.53	0.084	1.61
93.5	11	71.1	41.0	5.61	5.31	0.35	3.85	5.00	1.20	9.62	0.72	0.110		0.51	0.084	1.35
96	14	75	44.0	5.76	5.39	0.35	4.85	5.00	1.20	10.82	0.70	0.120		0.51	0.084	1.43
101	29	78.4	52.0	6.06	5.53	0.34	9.83	5.00	1.20	16.79	0.65	0.179		0.50	0.085	1.97
106	40	78	57.5	6.36	5.67	0.33	13.27	5.00	1.20	20.93	0.61	0.227		0.49	0.085	2.36
111	46	78	60.5	6.66	5.82	0.33	14.95	5.00	1.20	22.95	0.59	0.256		0.48	0.086	2.56
116	64	78	69.5	6.96	5.96	0.32	20.39	5.00	1.20	29.47	0.55	0.434		0.47	0.086	3.96
120.5	94	78	80.0	7.23	6.09	0.31	29.42	5.00	1.20	40.31	0.49	0.135		0.47	0.087	Non-Liq.

Liquefaction Analysis - Elizabeth Mine, Strafford, VT

Test Borehole TB-11

Over burden (tsf) =		0												EQ Magnitude =		6.5
Water depth (ft) =		41												amax =		0.24
Depth (feet)	N_{60}	% Fines	Dr (%)	Sigma v (tsf)	Sigma v' (tsf)	C_N	$(N_1)_{60}$	Fines Correction Alpha	Beta	$(N_1)_{60cs}$	K_{sigma}	$CRR_{7.5}$		rd	CSR	FS
3	26	25.1	50.5	0.18	0.18	1.60	41.68	4.30	1.12	50.81	1.56	0.312		0.99	0.155	Non-Liq.
6	51	15	63.0	0.36	0.36	1.42	72.64	2.50	1.05	78.64	1.40	0.555		0.99	0.154	Non-Liq.
11	11	7.3	41.0	0.66	0.66	1.20	13.21	0.16	1.01	13.51	1.10	0.145		0.98	0.152	1.51
16	16	20	45.5	0.96	0.96	1.04	16.61	3.61	1.08	21.55	1.02	0.236		0.97	0.151	2.30
23.5	19	30	47.0	1.41	1.41	0.86	16.40	4.71	1.15	23.63	0.93	0.267		0.95	0.148	2.43
26	14	42.3	44.0	1.56	1.56	0.82	11.44	5.00	1.20	18.73	0.92	0.200		0.94	0.146	1.81
31	16	50	45.5	1.86	1.86	0.74	11.81	5.00	1.20	19.17	0.88	0.205		0.92	0.143	1.82
36	17	60	46.0	2.16	2.16	0.67	11.45	5.00	1.20	18.74	0.85	0.200		0.88	0.138	1.77
43.5	19	69	47.0	2.61	2.50	0.61	11.63	5.00	1.20	18.96	0.81	0.203		0.82	0.133	1.79
46	15	60	45.0	2.76	2.57	0.60	9.01	5.00	1.20	15.81	0.82	0.168		0.79	0.133	1.49
51	17	50	46.0	3.06	2.72	0.58	9.84	5.00	1.20	16.81	0.80	0.179		0.74	0.131	1.59
56	17	49.4	46.0	3.36	2.86	0.56	9.50	5.00	1.20	16.40	0.79	0.174		0.69	0.127	1.57
63.5	22	50	48.5	3.81	3.08	0.53	11.68	5.00	1.20	19.01	0.77	0.203		0.63	0.122	1.85
66	39	50	57.0	3.96	3.15	0.52	20.36	5.00	1.20	29.44	0.73	0.433		0.62	0.121	3.77
71	83	50	79.0	4.26	3.29	0.51	41.97	5.00	1.20	55.36	0.64	0.358		0.59	0.118	Non-Liq.

Liquefaction Analysis - Elizabeth Mine, Strafford, VT

Test Borehole TB-12

Over burden (tsf) =	0												EQ Magnitude =		6.5
Water depth (ft) =	35												amax =		0.24
Depth (feet)	N_{60}	% Fines	Dr (%)	Sigma v (tsf)	Sigma v' (tsf)	C_N	$(N_1)_{60}$	Fines Correction Alpha	Fines Correction Beta	$(N_1)_{60cs}$	K_{sigma}	$CRR_{7.5}$		rd	CSR	FS
1	4	39.2	20.0	0.06	0.06	1.75	7.00	5.00	1.20	13.40	1.77	0.144		1.00	0.156	2.36
6	24	20	49.5	0.36	0.36	1.42	34.19	3.61	1.08	40.52	1.30	0.142		0.99	0.154	Non-Liq.
11	9	17.1	36.6	0.66	0.66	1.20	10.81	3.04	1.06	14.50	1.10	0.155		0.98	0.152	1.61
18.5	10	24	40.0	1.11	1.11	0.97	9.73	4.18	1.11	14.95	0.99	0.160		0.96	0.150	1.52
21	13	31	43.0	1.26	1.26	0.91	11.89	4.77	1.16	18.59	0.96	0.199		0.95	0.149	1.85
26	13	37.4	43.0	1.56	1.56	0.82	10.62	5.00	1.20	17.74	0.92	0.189		0.94	0.146	1.71
31	12	50	42.0	1.86	1.86	0.74	8.86	5.00	1.20	15.63	0.89	0.166		0.92	0.143	1.49
36	4	77.2	20.0	2.16	2.10	0.69	2.74	5.00	1.20	8.29	0.87	0.098		0.88	0.142	0.87
43.5	22	77	48.5	2.61	2.31	0.64	14.18	5.00	1.20	22.01	0.82	0.242		0.82	0.144	2.00
46	57	77	20.0	2.76	2.39	0.63	36.00	5.00	1.20	48.21	0.85	0.282		0.79	0.143	Non-Liq.

Liquefaction Analysis - Elizabeth Mine, Strafford, VT

Test Borehole TB-13

Over burden (tsf) =		0												EQ Magnitude =		6.5
Water depth (ft) =		47												amax =		0.24
Depth (feet)	N_{60}	% Fines	Dr (%)	Sigma v (tsf)	Sigma v' (tsf)	C_N	$(N_1)_{60}$	Fines Correction Alpha	Fines Correction Beta	$(N_1)_{60cs}$	K_{sigma}	$CRR_{7.5}$		rd	CSR	FS
1	6	37.9	26.6	0.06	0.06	1.75	10.50	5.00	1.20	17.60	1.77	0.187		1.00	0.156	3.07
6	69	25	72.0	0.36	0.36	1.42	98.28	4.29	1.12	113.88	1.47	0.826		0.99	0.154	Non-Liq.
11	12	15.2	42.0	0.66	0.66	1.20	14.41	2.55	1.05	17.68	1.10	0.188		0.98	0.152	1.96
18.5	22	16	48.5	1.11	1.11	0.97	21.40	2.77	1.05	25.32	0.99	0.298		0.96	0.150	2.83
21	19	16	47.0	1.26	1.26	0.91	17.38	2.77	1.05	21.08	0.96	0.229		0.95	0.149	2.13
26	10	17.1	40.0	1.56	1.56	0.82	8.17	3.04	1.06	11.70	0.92	0.128		0.94	0.146	1.17
33.5	14	30	44.0	2.01	2.01	0.70	9.86	4.71	1.15	16.09	0.87	0.171		0.90	0.141	1.52
36	16	41.4	45.5	2.16	2.16	0.67	10.77	5.00	1.20	17.93	0.85	0.191		0.88	0.138	1.69
41	11	35	41.0	2.46	2.46	0.62	6.81	5.00	1.20	13.17	0.84	0.142		0.84	0.131	1.31
46	20	31.2	47.5	2.76	2.76	0.57	11.45	4.78	1.16	18.12	0.79	0.193		0.79	0.124	1.79
51	10	50	40.0	3.06	2.90	0.55	5.53	5.00	1.20	11.63	0.82	0.128		0.74	0.122	1.23
56	8	83.6	33.3	3.36	3.05	0.53	4.28	5.00	1.20	10.13	0.81	0.114		0.69	0.119	1.11
61	34	83	54.5	3.66	3.19	0.52	17.58	5.00	1.20	26.10	0.74	0.315		0.65	0.117	2.88
63	40	83	57.5	3.78	3.25	0.51	20.42	5.00	1.20	29.50	0.72	0.436		0.64	0.115	3.93

Liquefaction Analysis - Elizabeth Mine, Strafford, VT

Test Borehole TB-16

Over burden (tsf) =	0												EQ Magnitude =		6.5
Water depth (ft) =	34												amax =		0.24
Depth (feet)	N_{60}	% Fines	Dr (%)	Sigma v (tsf)	Sigma v' (tsf)	C_N	$(N_1)_{60}$	Fines Correction Alpha	Fines Correction Beta	$(N_1)_{60cs}$	K_{sigma}	$CRR_{7.5}$	rd	CSR	FS
1	9	32.8	36.6	0.06	0.06	1.75	15.75	4.87	1.18	23.42	1.77	0.264	1.00	0.156	4.32
6	12	25	42.0	0.36	0.36	1.42	17.09	4.29	1.12	23.35	1.25	0.262	0.99	0.154	3.07
11	10	19.6	40.0	0.66	0.66	1.20	12.01	3.54	1.08	16.48	1.10	0.175	0.98	0.152	1.82
18.5	11	22	41.0	1.11	1.11	0.97	10.70	3.93	1.09	15.62	0.99	0.166	0.96	0.150	1.58
21	13	26.7	43.0	1.26	1.26	0.91	11.89	4.45	1.13	17.86	0.96	0.190	0.95	0.149	1.77
26	8	30	33.3	1.56	1.56	0.82	6.54	4.71	1.15	12.25	0.92	0.134	0.94	0.146	1.21
33.5	7	45.1	30.0	2.01	2.01	0.70	4.93	5.00	1.20	10.92	0.88	0.121	0.90	0.141	1.09
36	6	45	26.6	2.16	2.13	0.68	4.08	5.00	1.20	9.89	0.87	0.112	0.88	0.140	1.00
41	21	45	48.0	2.46	2.27	0.65	13.69	5.00	1.20	21.43	0.83	0.234	0.84	0.142	1.97
46	60	45	67.5	2.76	2.42	0.63	37.58	5.00	1.20	50.09	0.75	0.304	0.79	0.141	Non-Liq.

Liquefaction Analysis - Elizabeth Mine, Strafford, VT

Test Borehole TB-17

Over burden (tsf) =	0												EQ Magnitude =		6.5
Water depth (ft) =	32												amax =		0.24
Depth (feet)	N_{60}	% Fines	Dr (%)	Sigma v (tsf)	Sigma v' (tsf)	C_N	$(N_1)_{60}$	Fines Correction Alpha	Beta	$(N_1)_{60cs}$	K_{sigma}	$CRR_{7.5}$	rd	CSR	FS
1	3	35.5	20.0	0.06	0.06	1.75	5.25	5.00	1.20	11.30	1.77	0.125	1.00	0.156	2.04
6	12	20	42.0	0.36	0.36	1.42	17.09	3.61	1.08	22.07	1.25	0.243	0.99	0.154	2.84
11	9	12.1	36.6	0.66	0.66	1.20	10.81	1.59	1.03	12.74	1.10	0.138	0.98	0.152	1.43
18.5	10	44.8	40.0	1.11	1.11	0.97	9.73	5.00	1.20	16.67	0.99	0.177	0.96	0.150	1.69
21	6	45	26.6	1.26	1.26	0.91	5.49	5.00	1.20	11.58	0.96	0.127	0.95	0.149	1.19
26	12	45	42.0	1.56	1.56	0.82	9.80	5.00	1.20	16.76	0.92	0.178	0.94	0.146	1.61
33.5	9	45	36.6	2.01	1.96	0.71	6.43	5.00	1.20	12.72	0.88	0.138	0.90	0.144	1.22
36	5	66.8	23.3	2.16	2.04	0.70	3.49	5.00	1.20	9.19	0.88	0.106	0.88	0.146	0.92
41	2	67	20.0	2.46	2.18	0.67	1.34	5.00	1.20	6.61	0.86	0.085	0.84	0.148	0.71
46	13	67	43.0	2.76	2.32	0.64	8.35	5.00	1.20	15.03	0.84	0.160	0.79	0.147	1.32
51	86	67	80.0	3.06	2.47	0.62	53.13	5.00	1.20	68.76	0.71	0.476	0.74	0.144	Non-Liq.

Appendix D
Stability Analyses Output Files

```
1       UTEXAS3 - VER. 1.208 -  2/22/98 - (C) 1985-1998 S. G. WRIGHT
        Ten (10) copies licensed to Woodward-Clyde Int'l - Denver, CO
        Date:  3: 7:2003   Time: 10: 3:23   Input file: adc1.in


        TABLE NO. 1
        ****************************************
        * COMPUTER PROGRAM DESIGNATION - UTEXAS3 *
        * Originally Coded By Stephen G. Wright  *
        * Version No. 1.208                      *
        * Last Revision Date  2/22/98            *
        * (C) Copyright 1985-1998 S. G. Wright   *
        * All Rights Reserved                    *
        ****************************************

        ************************************************************
        *                                                          *
        *      RESULTS OF COMPUTATIONS PERFORMED USING THIS COMPUTER *
        * PROGRAM SHOULD NOT BE USED FOR DESIGN PURPOSES UNLESS THEY *
        * HAVE BEEN VERIFIED BY INDEPENDENT ANALYSES, EXPERIMENTAL   *
        * DATA OR FIELD EXPERIENCE. THE USER SHOULD UNDERSTAND THE   *
        * ALGORITHMS AND ANALYTICAL PROCEDURES USED IN THE COMPUTER  *
        * PROGRAM AND MUST HAVE READ ALL DOCUMENTATION FOR THIS      *
        * PROGRAM BEFORE ATTEMPTING ITS USE.                         *
        *                                                          *
        *      NEITHER SHINOAK SOFTWARE NOR STEPHEN G. WRIGHT        *
        * MAKE OR ASSUME LIABILITY FOR ANY WARRANTIES, EXPRESSED OR  *
        * IMPLIED, CONCERNING THE ACCURACY, RELIABILITY, USEFULNESS  *
        * OR ADAPTABILITY OF THIS COMPUTER PROGRAM.                  *
        *                                                          *
        ************************************************************
1       UTEXAS3 - VER. 1.208 -  2/22/98 - (C) 1985-1998 S. G. WRIGHT
        Ten (10) copies licensed to Woodward-Clyde Int'l - Denver, CO
        Date:  3: 7:2003   Time: 10: 3:23   Input file: adc1.in
         Elizabeth Mine, Steady-State Drained, Existing Phreatic Surface
         Section A, Origin Crest,Units lbs-ft
         By CJCW,  March, 2003

        TABLE NO.  2
        ************************
        * NEW PROFILE LINE DATA *
        ************************

        PROFILE LINE  1 - MATERIAL TYPE =  1
        Slime

             Point       X             Y

               1      -180.000      1064.000
               2      -136.000      1065.500
               3      -102.000      1068.000
               4       -16.000      1012.000

        PROFILE LINE  2 - MATERIAL TYPE =  2
        Sand

             Point       X             Y

               1      -102.000      1068.000
               2       -50.500      1070.000
               3       -21.000      1072.000
               4          .000      1072.000
               5        45.000      1042.000
               6        67.500      1034.000
               7        76.000      1034.000
               8        84.000      1035.500
               9        89.000      1042.000
              10       104.000      1043.800
              11       114.000      1050.000
              12       158.000      1052.000

        PROFILE LINE  3 - MATERIAL TYPE =  3
        Glacial Till

             Point       X             Y

               1      -180.000      1004.500
               2      -100.000      1008.000
               3       -60.000      1009.500
               4       -16.000      1012.000
               5          .000      1013.000
               6         6.000      1014.000
               7        47.000      1017.500
               8        76.000      1022.000
               9       108.000      1031.000
              10       131.000      1039.000
              11       158.000      1052.000
              12       170.000      1053.000
              13       177.000      1053.500

        PROFILE LINE  4 - MATERIAL TYPE =  4
        Ablasial Till (20' below Glacial)

             Point       X             Y

               1      -180.000       984.500
               2      -100.000       988.000
               3       -60.000       989.500
               4       -16.000       992.000
               5          .000       993.000
               6         6.000       994.000
               7        47.000       997.500
               8        76.000      1002.000
               9       108.000      1011.000
              10       131.000      1019.000
              11       158.000      1032.000
              12       170.000      1033.000
              13       177.000      1033.500

        All new profile lines defined - No old lines retained
1       UTEXAS3 - VER. 1.208 -  2/22/98 - (C) 1985-1998 S. G. WRIGHT
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        Date:  3: 7:2003   Time: 10: 3:23   Input file: adc1.in
         Elizabeth Mine, Steady-State Drained, Existing Phreatic Surface
         Section A, Origin Crest,Units lbs-ft
         By CJCW,  March, 2003

        TABLE NO.  3
        ************************************************************************
        * NEW MATERIAL PROPERTY DATA - CONVENTIONAL/FIRST-STAGE COMPUTATIONS *
        ************************************************************************

        DATA FOR MATERIAL TYPE  1
        Slime

             Unit weight of material =  120.000

             CONVENTIONAL (ISOTROPIC) SHEAR STRENGTHS
             Cohesion - - - - - - - -         .000
             Friction angle - - - - -  37.000 degrees

             Pore water pressures defined by piezometric line
```


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```
     Number of the piezometric line used =  1
     Negative pore pressures set to zero

DATA FOR MATERIAL TYPE  2
Sand

     Unit weight of material =  120.000

     CONVENTIONAL (ISOTROPIC) SHEAR STRENGTHS
     Cohesion - - - - - - - -        .000
     Friction angle - - - - -  37.000 degrees

     Pore water pressures defined by piezometric line
     Number of the piezometric line used =  1
     Negative pore pressures set to zero

DATA FOR MATERIAL TYPE  3
Glacial Till

     Unit weight of material =  140.000

     CONVENTIONAL (ISOTROPIC) SHEAR STRENGTHS
     Cohesion - - - - - - - -     500.000
     Friction angle - - - - -  40.000 degrees

     Pore water pressures defined by piezometric line
     Number of the piezometric line used =  1
     Negative pore pressures set to zero

DATA FOR MATERIAL TYPE  4
Ablasial

     Unit weight of material =  140.000

     CONVENTIONAL (ISOTROPIC) SHEAR STRENGTHS
     Cohesion - - - - - - - -     500.000
     Friction angle - - - - -  40.000 degrees

     Pore water pressures defined by piezometric line
     Number of the piezometric line used =  1
     Negative pore pressures set to zero

All new material properties defined - No old data retained
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Date:  3: 7:2003   Time: 10: 3:23   Input file: adc1.in
 Elizabeth Mine, Steady-State Drained, Existing Phreatic Surface
 Section A, Origin Crest,Units lbs-ft
 By CJCW,  March, 2003

TABLE NO.  5
**********************************************************************
* NEW PIEZOMETRIC LINE DATA - CONVENTIONAL/FIRST-STAGE COMPUTATIONS *
**********************************************************************

Line
 No.    Point       X          Y

  1 - Unit weight of water =   62.40
  1        1    -180.000    1025.000
  1        2    -100.000    1025.000
  1        3      94.000    1023.000
  1        4     177.000    1023.000

All new piezometric lines defined - No old lines retained
1    UTEXAS3 - VER. 1.208 -  2/22/98 - (C) 1985-1998 S. G. WRIGHT
```



```
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Date:  3: 7:2003   Time: 10: 3:23   Input file: adc1.in
 Elizabeth Mine, Steady-State Drained, Existing Phreatic Surface
 Section A, Origin Crest,Units lbs-ft
 By CJCW,  March, 2003

TABLE NO. 15
**********************************
* NEW ANALYSIS/COMPUTATION DATA *
**********************************

Circular Shear Surface(s)

Computations Performed for Single Shear Surface

Center Coordinates for Center of Circle -
                                                X =      63.000
                                                Y =    1106.000

Circle is Tangent to Horizontal Line at -
                                                Y =    1034.000
                                                Radius =      72.000

----------------------------------------------------------------------
THE FOLLOWING REPRESENT EITHER DEFAULT OR PREVIOUSLY DEFINED VALUES:

Initial trial estimate for the factor of safety =   3.000

Initial trial estimate for side force inclination =  15.000 degrees
(Applicable to Spencer's procedure only)

Maximum number of iterations allowed for
calculating the factor of safety =   40

Allowed force imbalance for convergence =     100.000

Allowed moment imbalance for convergence =     100.000

Maximum subtended angle to be used for subdivision of the
circle into slices =   3.00 degrees

Depth of crack =        .000

Depth of water in crack =        .000

Unit weight of water in crack =    62.400

Seismic coefficient =  .000

Conventional (single-stage) computations to be performed

Procedure used to compute the factor of safety: SPENCER
1    UTEXAS3 - VER. 1.208 -  2/22/98 - (C) 1985-1998 S. G. WRIGHT
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Date:  3: 7:2003   Time: 10: 3:23   Input file: adc1.in
 Elizabeth Mine, Steady-State Drained, Existing Phreatic Surface
 Section A, Origin Crest,Units lbs-ft
 By CJCW,  March, 2003

TABLE NO. 16
**************************
* NEW SLOPE GEOMETRY DATA *
**************************

NOTE - NO DATA WERE INPUT, SLOPE GEOMETRY DATA
WERE GENERATED BY THE PROGRAM
```

K/A 4PRINT

Slope Coordinates -

Point	X	Y
1	-180.000	1064.000
2	-136.000	1065.500
3	-102.000	1068.000
4	-50.500	1070.000
5	-21.000	1072.000
6	.000	1072.000
7	45.000	1042.000
8	67.500	1034.000
9	76.000	1034.000
10	84.000	1035.500
11	89.000	1042.000
12	104.000	1043.800
13	114.000	1050.000
14	158.000	1052.000
15	170.000	1053.000
16	177.000	1053.500

1 UTEXAS3 - VER. 1.208 - 2/22/98 - (C) 1985-1998 S. G. WRIGHT
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Date: 3: 7:2003 Time: 10: 3:23 Input file: adc1.in
Elizabeth Mine, Steady-State Drained, Existing Phreatic Surface
Section A, Origin Crest,Units lbs-ft
By CJCW, March, 2003

TABLE NO. 26

****
* Coordinate, Weight, Strength and Pore Water Pressure *
* Information for Individual Slices for Conventional *
* Computations or First Stage of Multi-Stage Computations. *
* (Information is for the Critical Shear Surface in the *
* Case of an Automatic Search.) *
****

Slice No.	X	Y	Slice Weight	Matl. Type	Cohesion	Friction Angle	Pore Pressure
	-.5	1072.0					
1	-.2	1071.6	24.0	2	.00	37.00	.0
	.0	1071.1					
2	1.0	1069.5	422.9	2	.00	37.00	.0
	1.9	1067.9					
3	2.9	1066.3	925.7	2	.00	37.00	.0
	4.0	1064.7					
4	5.0	1063.4	1276.9	2	.00	37.00	.0
	6.0	1062.0					
5	7.2	1060.5	1901.4	2	.00	37.00	.0
	8.4	1059.1					
6	9.6	1057.7	2391.9	2	.00	37.00	.0
	10.9	1056.3					
7	12.2	1055.0	2845.0	2	.00	37.00	.0
	13.6	1053.6					
8	15.0	1052.4	3245.1	2	.00	37.00	.0
	16.4	1051.1					
9	17.9	1049.9	3577.5	2	.00	37.00	.0
	19.3	1048.8					
10	20.9	1047.7	3829.1	2	.00	37.00	.0
	22.4	1046.6					
11	24.0	1045.5	3988.2	2	.00	37.00	.0
	25.6	1044.5					
12	27.2	1043.6	4044.6	2	.00	37.00	.0
	28.8	1042.6					
13	30.5	1041.8	3990.2	2	.00	37.00	.0
	32.2	1040.9					
14	33.9	1040.2	3818.3	2	.00	37.00	.0
	35.6	1039.4					
15	37.4	1038.7	3524.7	2	.00	37.00	.0
	39.2	1038.1					
16	40.9	1037.5	3106.8	2	.00	37.00	.0
	42.7	1036.9					
17	43.9	1036.6	1667.9	2	.00	37.00	.0
	45.0	1036.3					
18	46.0	1036.0	1344.3	2	.00	37.00	.0
	47.0	1035.8					
19	48.8	1035.4	2307.2	2	.00	37.00	.0
	50.7	1035.1					
20	52.6	1034.8	2025.6	2	.00	37.00	.0
	54.4	1034.5					

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Section A, Origin Crest,Units lbs-ft
By CJCW, March, 2003

TABLE NO. 26

****
* Coordinate, Weight, Strength and Pore Water Pressure *
* Information for Individual Slices for Conventional *
* Computations or First Stage of Multi-Stage Computations. *
* (Information is for the Critical Shear Surface in the *
* Case of an Automatic Search.) *
****

Slice No.	X	Y	Slice Weight	Matl. Type	Cohesion	Friction Angle	Pore Pressure
	54.4	1034.5					
21	56.3	1034.3	1641.4	2	.00	37.00	.0
	58.2	1034.2					
22	60.1	1034.1	1157.0	2	.00	37.00	.0
	61.9	1034.0					
23	62.5	1034.0	225.8	2	.00	37.00	.0
	63.0	1034.0					
24	64.9	1034.0	398.3	2	.00	37.00	.0
	66.8	1034.1					
25	67.0	1034.1	3.8	2	.00	37.00	.0
	67.2	1034.1					

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Section A, Origin Crest,Units lbs-ft
By CJCW, March, 2003

TABLE NO. 27

****
* Seismic Forces and Forces Due to Surface Pressures for *
* Individual Slices for Conventional Computations or the *
* First Stage of Multi-Stage Computations. *
* (Information is for the Critical Shear Surface in the *
* Case of an Automatic Search.) *
****

				FORCES DUE TO SURFACE PRESSURES			
Slice No.	X	Seismic Force	Y for Seismic Force	Normal Force	Shear Force	X	Y

1-2-14PRINT

1	-.2	0.	1071.8	0.	0.	.0	.0
2	1.0	0.	1070.4	0.	0.	.0	.0
3	2.9	0.	1068.2	0.	0.	.0	.0
4	5.0	0.	1066.0	0.	0.	.0	.0
5	7.2	0.	1063.9	0.	0.	.0	.0
6	9.6	0.	1061.6	0.	0.	.0	.0
7	12.2	0.	1059.4	0.	0.	.0	.0
8	15.0	0.	1057.2	0.	0.	.0	.0
9	17.9	0.	1055.0	0.	0.	.0	.0
10	20.9	0.	1052.9	0.	0.	.0	.0
11	24.0	0.	1050.8	0.	0.	.0	.0
12	27.2	0.	1048.7	0.	0.	.0	.0
13	30.5	0.	1046.7	0.	0.	.0	.0
14	33.9	0.	1044.8	0.	0.	.0	.0
15	37.4	0.	1042.9	0.	0.	.0	.0
16	40.9	0.	1041.1	0.	0.	.0	.0
17	43.9	0.	1039.7	0.	0.	.0	.0
18	46.0	0.	1038.8	0.	0.	.0	.0
19	48.8	0.	1038.0	0.	0.	.0	.0
20	52.6	0.	1037.0	0.	0.	.0	.0
21	56.3	0.	1036.2	0.	0.	.0	.0
22	60.1	0.	1035.4	0.	0.	.0	.0
23	62.5	0.	1034.9	0.	0.	.0	.0
24	64.9	0.	1034.5	0.	0.	.0	.0
25	67.0	0.	1034.1	0.	0.	.0	.0

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Section A, Origin Crest,Units lbs-ft
By CJCW, March, 2003

TABLE NO. 29

****
* Information Generated During Iterative Solution for the Factor *
* of Safety and Side Force Inclination by Spencer's Procedure *
****

Iteration	Trial Factor of Safety	Trial Side Force Inclination (degrees)	Force Imbalance (lbs.)	Moment Imbalance (ft.-lbs.)	Delta-F	Delta Theta (degrees)
1	3.00000	-15.0000	-.1411E+05	.1441E+08		
First-order corrections to F and THETA					-.323E+01	-.842E+00
Values factored by .155E+00 - Deltas too large					-.500E+00	-.131E+00
2	2.50000	-15.1305	-.1152E+05	.1176E+08		
First-order corrections to F and THETA					-.187E+01	-.103E+01
Values factored by .267E+00 - Deltas too large					-.500E+00	-.274E+00
3	2.00000	-15.4045	-.7739E+04	.7912E+07		
First-order corrections to F and THETA					-.828E+00	-.146E+01
Values factored by .604E+00 - Deltas too large					-.500E+00	-.880E+00
4	1.50000	-16.2841	-.1654E+04	.1725E+07		
First-order corrections to F and THETA					-.872E-01	-.444E+01
Second-order correction - Iteration 1					-.808E-01	-.444E+01
Second-order correction - Iteration 2					-.808E-01	-.444E+01
5	1.41923	-20.7273	.1804E+02	.1564E+05		
First-order corrections to F and THETA					.346E-01	-.767E+01
Second-order correction - Iteration 1					.370E-01	-.767E+01
Second-order correction - Iteration 2					.370E-01	-.767E+01
6	1.45626	-28.4002	.9129E+01	-.1168E+05		
First-order corrections to F and THETA					-.277E-02	.625E+00
Second-order correction - Iteration 1					-.274E-02	.625E+00
Second-order correction - Iteration 2					-.274E-02	.625E+00
7	1.45352	-27.7747	-.8732E-02	.3517E+02		
First-order corrections to F and THETA					.268E-04	-.533E-02

Factor of Safety - - - - - - - - 1.454
Side Force Inclination - - - - - -27.77
Number of Iterations - - - - - - 7

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Section A, Origin Crest,Units lbs-ft
By CJCW, March, 2003

TABLE NO. 38

****
* Final Results for Stresses Along the Shear Surface *
* (Results for Critical Shear Surface in Case of a Search.) *
****

SPENCER'S PROCEDURE USED TO COMPUTE FACTOR OF SAFETY
Factor of Safety = 1.454 Side Force Inclination = -27.77 Degrees

-------- VALUES AT CENTER OF BASE OF SLICE---------

Slice No.	X-center	Y-center	Total Normal Stress	Effective Normal Stress	Shear Stress
1	-.2	1071.6	19.4	19.4	10.1
2	1.0	1069.5	88.4	88.4	45.8
3	2.9	1066.3	193.0	193.0	100.0
4	5.0	1063.4	295.4	295.4	153.1
5	7.2	1060.5	397.4	397.4	206.0
6	9.6	1057.7	502.5	502.5	260.5
7	12.2	1055.0	602.7	602.7	312.4
8	15.0	1052.4	695.0	695.0	360.3
9	17.9	1049.9	776.8	776.8	402.7
10	20.9	1047.7	845.6	845.6	438.4
11	24.0	1045.5	898.5	898.5	465.8
12	27.2	1043.6	932.5	932.5	483.5
13	30.5	1041.8	944.7	944.7	489.8
14	33.9	1040.2	931.6	931.6	483.0
15	37.4	1038.7	889.5	889.5	461.1
16	40.9	1037.5	814.3	814.3	422.1
17	43.9	1036.6	727.7	727.7	377.3
18	46.0	1036.0	685.2	685.2	355.2
19	48.8	1035.4	666.6	666.6	345.6
20	52.6	1034.8	617.1	617.1	319.9
21	56.3	1034.3	530.3	530.3	274.9
22	60.1	1034.1	399.1	399.1	206.9
23	62.5	1034.0	291.4	291.4	151.1
24	64.9	1034.0	151.1	151.1	78.3
25	67.0	1034.1	14.5	14.5	7.5

CHECK SUMS - (ALL SHOULD BE SMALL)
SUM OF FORCES IN VERTICAL DIRECTION = .00 (= .106E-02)
SHOULD NOT EXCEED .100E+03
SUM OF FORCES IN HORIZONTAL DIRECTION = .00 (= .192E-02)
SHOULD NOT EXCEED .100E+03
SUM OF MOMENTS ABOUT COORDINATE ORIGIN = -34.66 (= -.347E+02)
SHOULD NOT EXCEED .100E+03

1C714PRINT

SHEAR STRENGTH/SHEAR FORCE CHECK-SUM = .00 (= .831E-03)
SHOULD NOT EXCEED .100E+03

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Section A, Origin Crest,Units lbs-ft
By CJCW, March, 2003

TABLE NO. 39

****
* Final Results for Side Forces and Stresses Between Slices. *
* (Results for Critical Shear Surface in Case of a Search.) *
****

SPENCER'S PROCEDURE USED TO COMPUTE FACTOR OF SAFETY
Factor of Safety = 1.454 Side Force Inclination = -27.77 Degrees

---------- VALUES AT RIGHT SIDE OF SLICE ----------

Slice No.	X-Right	Side Force	Y-Coord. of Side Force Location	Fraction of Height	Sigma at Top	Sigma at Bottom
1	.0	14.	1071.4	.357	1.9	25.9
2	1.9	239.	1069.1	.424	40.8	108.6
3	4.0	690.	1066.5	.391	46.3	219.6
4	6.0	1256.	1064.3	.382	54.2	316.9
5	8.4	2014.	1061.9	.380	67.7	418.9
6	10.9	2856.	1059.5	.380	84.6	514.8
7	13.6	3723.	1057.2	.383	105.6	602.1
8	16.4	4554.	1055.0	.387	131.6	678.4
9	19.3	5294.	1052.8	.394	163.9	740.6
10	22.4	5889.	1050.8	.402	204.3	785.7
11	25.6	6298.	1048.8	.413	255.4	810.0
12	28.8	6488.	1047.0	.428	321.2	809.3
13	32.2	6444.	1045.2	.448	407.8	778.0
14	35.6	6166.	1043.6	.475	525.9	708.2
15	39.2	5678.	1042.1	.514	695.7	586.9
16	42.7	5029.	1040.7	.571	961.0	388.1
17	45.0	4578.	1039.8	.620	1218.5	199.3
18	47.0	4151.	1039.1	.603	1082.3	256.2
19	50.7	3266.	1037.9	.577	859.9	316.0
20	54.4	2299.	1036.8	.560	667.5	316.1
21	58.2	1343.	1035.9	.557	506.8	247.1
22	61.9	532.	1035.2	.617	406.4	71.8
23	63.0	354.	1035.1	.710	442.6	-51.0
24	66.8	4.	1042.1	ABOVE	5983.7	-5943.1
25	67.2	0.	3895.0	ABOVE	.0	.0

CHECK SUMS - (ALL SHOULD BE SMALL)
SUM OF FORCES IN VERTICAL DIRECTION = .00 (= .106E-02)
SHOULD NOT EXCEED .100E+03
SUM OF FORCES IN HORIZONTAL DIRECTION = .00 (= .192E-02)
SHOULD NOT EXCEED .100E+03
SUM OF MOMENTS ABOUT COORDINATE ORIGIN = -34.66 (= -.347E+02)
SHOULD NOT EXCEED .100E+03
SHEAR STRENGTH/SHEAR FORCE CHECK-SUM = .00 (= .831E-03)
SHOULD NOT EXCEED .100E+03

***** CAUTION ***** SOME OF THE FORCES BETWEEN SLICES ACT AT POINTS
ABOVE THE SURFACE OF THE SLOPE OR BELOW THE
SHEAR SURFACE - EITHER A TENSION CRACK MAY BE
NEEDED OR THE SOLUTION MAY NOT BE A VALID SOLUTION

=> .

END-OF-FILE ENCOUNTERED WHILE READING COMMAND
WORDS - END OF PROBLEM(S) ASSUMED

1/3+PRINT

```
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        TABLE NO. 1
        ****************************************
        * COMPUTER PROGRAM DESIGNATION - UTEXAS3 *
        * Originally Coded By Stephen G. Wright  *
        * Version No. 1.208                      *
        * Last Revision Date  2/22/98            *
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        * All Rights Reserved                    *
        ****************************************

        ************************************************************
        *                                                          *
        *      RESULTS OF COMPUTATIONS PERFORMED USING THIS COMPUTER *
        * PROGRAM SHOULD NOT BE USED FOR DESIGN PURPOSES UNLESS THEY *
        * HAVE BEEN VERIFIED BY INDEPENDENT ANALYSES, EXPERIMENTAL   *
        * DATA OR FIELD EXPERIENCE. THE USER SHOULD UNDERSTAND THE   *
        * ALGORITHMS AND ANALYTICAL PROCEDURES USED IN THE COMPUTER  *
        * PROGRAM AND MUST HAVE READ ALL DOCUMENTATION FOR THIS      *
        * PROGRAM BEFORE ATTEMPTING ITS USE.                         *
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        * OR ADAPTABILITY OF THIS COMPUTER PROGRAM.                  *
        *                                                          *
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          Elizabeth Mine.  Steady-State Drained, Existing Phreatic Surfac
          Section B, Origin Crest, Units lbs-ft
          By CJCW; Date March, 2003

        TABLE NO.  2
        ************************
        * NEW PROFILE LINE DATA *
        ************************

        PROFILE LINE  1 - MATERIAL TYPE =  1
        Slime Line

             Point       X             Y

               1      -200.000      1064.000
               2      -170.000      1064.000
               3      -146.000      1065.000
               4      -116.000      1065.000
               5      -102.000      1065.500
               6        61.000       949.000

        PROFILE LINE  2 - MATERIAL TYPE =  2
        Sand Line

             Point       X             Y

               1      -102.000      1065.500
               2       -39.000      1069.000
               3       -21.000      1071.000
               4          .000      1071.000
               5       110.000       993.000
               6       118.000       991.000
               7       145.000       975.000
               8       153.000       973.000
               9       168.000       967.000

        PROFILE LINE  3 - MATERIAL TYPE =  3
        Glacial Till Line

             Point       X             Y

               1      -200.000      984.000
               2       -28.000      959.000
               3        61.000      949.000
               4       118.000      941.000
               5       210.000      941.000
               6       250.000      940.000

        PROFILE LINE  4 - MATERIAL TYPE =  4
        Ablasial Till Line (20' below Glacial)

             Point       X             Y

               1      -200.000      964.000
               2       -28.000      939.000
               3        61.000      929.000
               4       118.000      921.000
               5       210.000      921.000
               6       250.000      920.000

        PROFILE LINE  6 - MATERIAL TYPE =  6
        Starter Dam

             Point       X             Y

               1       118.000      941.000
               2       145.000      967.000
               3       168.000      967.000
               4       210.000      941.000

        All new profile lines defined - No old lines retained
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          Section B, Origin Crest, Units lbs-ft
          By CJCW; Date March, 2003

        TABLE NO.  3
        ************************************************************************
        * NEW MATERIAL PROPERTY DATA - CONVENTIONAL/FIRST-STAGE COMPUTATIONS *
        ************************************************************************

        DATA FOR MATERIAL TYPE  1
        Slime

             Unit weight of material =  120.000

             CONVENTIONAL (ISOTROPIC) SHEAR STRENGTHS
             Cohesion - - - - - - - -       .000
             Friction angle - - - - -  37.000 degrees

             Pore water pressures defined by piezometric line
             Number of the piezometric line used =  1
             Negative pore pressures set to zero

        DATA FOR MATERIAL TYPE  2
        Sand
```


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Unit weight of material = 120.000

CONVENTIONAL (ISOTROPIC) SHEAR STRENGTHS
Cohesion - - - - - - - - .000
Friction angle - - - - - 37.000 degrees

Pore water pressures defined by piezometric line
Number of the piezometric line used = 1
Negative pore pressures set to zero

DATA FOR MATERIAL TYPE 3
Glacial Till

Unit weight of material = 140.000

CONVENTIONAL (ISOTROPIC) SHEAR STRENGTHS
Cohesion - - - - - - - - 500.000
Friction angle - - - - - 40.000 degrees

Pore water pressures defined by piezometric line
Number of the piezometric line used = 1
Negative pore pressures set to zero

DATA FOR MATERIAL TYPE 4
Ablasial Till

Unit weight of material = 140.000

CONVENTIONAL (ISOTROPIC) SHEAR STRENGTHS
Cohesion - - - - - - - - 500.000
Friction angle - - - - - 40.000 degrees

Pore water pressures defined by piezometric line
Number of the piezometric line used = 1
Negative pore pressures set to zero

DATA FOR MATERIAL TYPE 6
Starter Dam

Unit weight of material = 130.000

CONVENTIONAL (ISOTROPIC) SHEAR STRENGTHS
Cohesion - - - - - - - - .000
Friction angle - - - - - 38.000 degrees

Pore water pressures defined by piezometric line
Number of the piezometric line used = 1
Negative pore pressures set to zero

All new material properties defined - No old data retained
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Section B, Origin Crest, Units lbs-ft
By CJCW; Date March, 2003

TABLE NO. 5
****
* NEW PIEZOMETRIC LINE DATA - CONVENTIONAL/FIRST-STAGE COMPUTATIONS *
****

Line No.	Point	X	Y
1	- Unit weight of water =	62.40	
1	1	-200.000	1012.000
1	2	-21.000	985.000
1	3	168.000	967.000
1	4	210.000	941.000
1	5	250.000	940.000

All new piezometric lines defined - No old lines retained
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Elizabeth Mine. Steady-State Drained, Existing Phreatic Surfac
Section B, Origin Crest, Units lbs-ft
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TABLE NO. 15
****
* NEW ANALYSIS/COMPUTATION DATA *
****

Circular Shear Surface(s)

Computations Performed for Single Shear Surface

Center Coordinates for Center of Circle -
X = 192.000
Y = 1177.000

Circle is Tangent to Horizontal Line at -
Y = 948.500
Radius = 228.500

THE FOLLOWING REPRESENT EITHER DEFAULT OR PREVIOUSLY DEFINED VALUES:

Initial trial estimate for the factor of safety = 3.000

Initial trial estimate for side force inclination = 15.000 degrees
(Applicable to Spencer's procedure only)

Maximum number of iterations allowed for
calculating the factor of safety = 40

Allowed force imbalance for convergence = 100.000

Allowed moment imbalance for convergence = 100.000

Maximum subtended angle to be used for subdivision of the
circle into slices = 3.00 degrees

Depth of crack = .000

Depth of water in crack = .000

Unit weight of water in crack = 62.400

Seismic coefficient = .000

Conventional (single-stage) computations to be performed

Procedure used to compute the factor of safety: SPENCER
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Section B, Origin Crest, Units lbs-ft

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TABLE NO. 16
****
* NEW SLOPE GEOMETRY DATA *
****

NOTE - NO DATA WERE INPUT, SLOPE GEOMETRY DATA
WERE GENERATED BY THE PROGRAM

Slope Coordinates -

Point	X	Y
1	-200.000	1064.000
2	-170.000	1064.000
3	-146.000	1065.000
4	-116.000	1065.000
5	-102.000	1065.500
6	-39.000	1069.000
7	-21.000	1071.000
8	.000	1071.000
9	110.000	993.000
10	118.000	991.000
11	145.000	975.000
12	153.000	973.000
13	168.000	967.000
14	210.000	941.000
15	250.000	940.000

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Elizabeth Mine. Steady-State Drained, Existing Phreatic Surfac
Section B, Origin Crest, Units lbs-ft
By CJCW; Date March, 2003

TABLE NO. 26
****
* Coordinate, Weight, Strength and Pore Water Pressure *
* Information for Individual Slices for Conventional *
* Computations or First Stage of Multi-Stage Computations. *
* (Information is for the Critical Shear Surface in the *
* Case of an Automatic Search.) *
****

Slice No.	X	Y	Slice Weight	Matl. Type	Cohesion	Friction Angle	Pore Pressure
	-10.4	1071.0					
1	-7.5	1065.8	3651.8	2	.00	37.00	.0
	-4.6	1060.6					
2	-2.3	1056.8	7822.5	2	.00	37.00	.0
	.0	1053.1					
3	3.4	1048.2	16545.1	2	.00	37.00	.0
	6.7	1043.2					
4	10.4	1038.5	21908.9	2	.00	37.00	.0
	14.0	1033.7					
5	17.9	1029.2	27097.5	2	.00	37.00	.0
	21.7	1024.6					
6	25.8	1020.3	31937.1	2	.00	37.00	.0
	30.0	1015.9					
7	34.3	1011.8	36263.4	2	.00	37.00	.0
	38.6	1007.6					
8	43.1	1003.7	39923.1	2	.00	37.00	.0
	47.7	999.8					
9	52.4	996.2	42775.7	2	.00	37.00	.0
	57.2	992.5					
10	59.1	991.2	17534.2	2	.00	37.00	.0
	61.0	989.8					
11	66.0	986.5	45172.6	2	.00	37.00	.0
	71.0	983.2					
12	76.1	980.1	45611.6	2	.00	37.00	.0
	81.3	977.1					
13	83.4	976.0	17941.4	2	.00	37.00	.0
	85.5	974.9					
14	90.8	972.2	44262.8	2	.00	37.00	133.5
	96.2	969.6					
15	101.7	967.2	41808.6	2	.00	37.00	381.9
	107.2	964.8					
16	108.6	964.3	10112.1	2	.00	37.00	523.1
	110.0	963.7					
17	114.0	962.3	28543.4	2	.00	37.00	616.2
	118.0	960.8					
18	123.7	959.0	39167.1	2	.00	37.00	760.8
	129.4	957.2					
19	131.5	956.7	13389.0	2	.00	37.00	862.2
	133.7	956.1					
20	139.3	954.7	32946.0	6	.00	38.00	936.0
	145.0	953.4					

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Section B, Origin Crest, Units lbs-ft
By CJCW; Date March, 2003

TABLE NO. 26
****
* Coordinate, Weight, Strength and Pore Water Pressure *
* Information for Individual Slices for Conventional *
* Computations or First Stage of Multi-Stage Computations. *
* (Information is for the Critical Shear Surface in the *
* Case of an Automatic Search.) *
****

Slice No.	X	Y	Slice Weight	Matl. Type	Cohesion	Friction Angle	Pore Pressure
	145.0	953.4					
21	149.0	952.6	21675.8	6	.00	38.00	1010.3
	153.0	951.9					
22	158.9	951.0	29800.9	6	.00	38.00	1053.2
	164.8	950.1					
23	166.4	949.9	7254.5	6	.00	38.00	1073.8
	168.0	949.8					
24	168.0	949.8	.3	6	.00	38.00	1075.5
	168.0	949.8					
25	174.0	949.3	21731.0	6	.00	38.00	874.7
	179.9	948.8					
26	185.9	948.7	11280.9	6	.00	38.00	452.8
	191.9	948.5					
27	191.9	948.5	55.4	6	.00	38.00	229.6
	192.0	948.5					
28	194.9	948.5	1365.6	6	.00	38.00	113.7
	197.8	948.6					

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TABLE NO. 27

****
* Seismic Forces and Forces Due to Surface Pressures for *
* Individual Slices for Conventional Computations or the *
* First Stage of Multi-Stage Computations. *
* (Information is for the Critical Shear Surface in the *
* Case of an Automatic Search.) *
****

Slice No.	X	Seismic Force	Y for Seismic Force	Normal Force	Shear Force	FORCES DUE TO SURFACE PRESSURES X	Y
1	-7.5	0.	1068.4	0.	0.	.0	.0
2	-2.3	0.	1063.9	0.	0.	.0	.0
3	3.4	0.	1058.4	0.	0.	.0	.0
4	10.4	0.	1051.1	0.	0.	.0	.0
5	17.9	0.	1043.7	0.	0.	.0	.0
6	25.8	0.	1036.5	0.	0.	.0	.0
7	34.3	0.	1029.2	0.	0.	.0	.0
8	43.1	0.	1022.1	0.	0.	.0	.0
9	52.4	0.	1015.0	0.	0.	.0	.0
10	59.1	0.	1010.1	0.	0.	.0	.0
11	66.0	0.	1005.3	0.	0.	.0	.0
12	76.1	0.	998.6	0.	0.	.0	.0
13	83.4	0.	993.9	0.	0.	.0	.0
14	90.8	0.	989.4	0.	0.	.0	.0
15	101.7	0.	983.1	0.	0.	.0	.0
16	108.6	0.	979.1	0.	0.	.0	.0
17	114.0	0.	977.1	0.	0.	.0	.0
18	123.7	0.	973.3	0.	0.	.0	.0
19	131.5	0.	969.8	0.	0.	.0	.0
20	139.3	0.	966.3	0.	0.	.0	.0
21	149.0	0.	963.1	0.	0.	.0	.0
22	158.9	0.	960.7	0.	0.	.0	.0
23	166.4	0.	958.8	0.	0.	.0	.0
24	168.0	0.	958.4	0.	0.	.0	.0
25	174.0	0.	956.3	0.	0.	.0	.0
26	185.9	0.	952.3	0.	0.	.0	.0
27	191.9	0.	950.3	0.	0.	.0	.0
28	194.9	0.	949.4	0.	0.	.0	.0

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TABLE NO. 29

****
* Information Generated During Iterative Solution for the Factor *
* of Safety and Side Force Inclination by Spencer's Procedure *
****

Iteration	Trial Factor of Safety	Trial Side Force Inclination (degrees)	Force Imbalance (lbs.)	Moment Imbalance (ft.-lbs.)	Delta-F	Delta Theta (degrees)
1	3.00000	-15.0000	-.1932E+06	.1901E+09		
First-order corrections to F and THETA					-.407E+01	-.233E+01
Values factored by .123E+00 - Deltas too large					-.500E+00	-.287E+00
2	2.50000	-15.2869	-.1652E+06	.1626E+09		
First-order corrections to F and THETA					-.249E+01	-.267E+01
Values factored by .201E+00 - Deltas too large					-.500E+00	-.537E+00
3	2.00000	-15.8234	-.1246E+06	.1228E+09		
First-order corrections to F and THETA					-.125E+01	-.327E+01
Values factored by .401E+00 - Deltas too large					-.500E+00	-.131E+01
4	1.50000	-17.1332	-.6003E+05	.5968E+08		
First-order corrections to F and THETA					-.349E+00	-.491E+01
Second-order correction - Iteration 1					-.294E+00	-.491E+01
Second-order correction - Iteration 2					-.293E+00	-.491E+01
Second-order correction - Iteration 3					-.293E+00	-.491E+01
5	1.20722	-22.0438	.3138E+04	-.1847E+07		
First-order corrections to F and THETA					.433E-01	-.959E+01
Values factored by .896E+00 - Deltas too large					.388E-01	-.859E+01
6	1.24607	-30.6381	.1064E+04	-.1077E+07		
First-order corrections to F and THETA					.477E-03	.856E+00
Second-order correction - Iteration 1					.569E-03	.856E+00
Second-order correction - Iteration 2					.569E-03	.856E+00
7	1.24663	-29.7820	-.7342E+00	.5751E+04		
First-order corrections to F and THETA					.124E-03	-.326E-01
Second-order correction - Iteration 1					.124E-03	-.326E-01
8	1.24676	-29.8145	.5676E-02	-.2362E+02		
First-order corrections to F and THETA					-.440E-06	.118E-03

Factor of Safety - - - - - - - - 1.247
Side Force Inclination - - - - - -29.81
Number of Iterations - - - - - - 8

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TABLE NO. 38

****
* Final Results for Stresses Along the Shear Surface *
* (Results for Critical Shear Surface in Case of a Search.) *
****

SPENCER'S PROCEDURE USED TO COMPUTE FACTOR OF SAFETY
Factor of Safety = 1.247 Side Force Inclination = -29.81 Degrees

-------- VALUES AT CENTER OF BASE OF SLICE---------

Slice No.	X-center	Y-center	Total Normal Stress	Effective Normal Stress	Shear Stress
1	-7.5	1065.8	226.7	226.7	137.0
2	-2.3	1056.8	664.8	664.8	401.8
3	3.4	1048.2	1031.4	1031.4	623.4
4	10.4	1038.5	1374.3	1374.3	830.6
5	17.9	1029.2	1715.2	1715.2	1036.7
6	25.8	1020.3	2045.7	2045.7	1236.5
7	34.3	1011.8	2357.5	2357.5	1424.9
8	43.1	1003.7	2642.1	2642.1	1596.9
9	52.4	996.2	2890.8	2890.8	1747.2
10	59.1	991.2	3044.8	3044.8	1840.3
11	66.0	986.5	3160.6	3160.6	1910.3
12	76.1	980.1	3285.2	3285.2	1985.6
13	83.4	976.0	3339.2	3339.2	2018.3

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14	90.8	972.2	3335.4	3202.0	1935.3
15	101.7	967.2	3250.2	2868.3	1733.6
16	108.6	964.3	3147.2	2624.1	1586.0
17	114.0	962.3	3227.2	2611.0	1578.1
18	123.7	959.0	3238.5	2477.7	1497.6
19	131.5	956.7	3074.6	2212.5	1337.2
20	139.3	954.7	2925.5	1989.5	1246.7
21	149.0	952.6	2834.2	1823.9	1143.0
22	158.9	951.0	2738.6	1685.4	1056.1
23	166.4	949.9	2556.0	1482.2	928.8
24	168.0	949.8	2893.5	1818.0	1139.3
25	174.0	949.3	2108.3	1233.6	773.1
26	185.9	948.7	1171.5	718.7	450.3
27	191.9	948.5	617.6	388.0	243.2
28	194.9	948.5	311.7	198.1	124.1

CHECK SUMS - (ALL SHOULD BE SMALL)
SUM OF FORCES IN VERTICAL DIRECTION = .02 (= .164E-01)
SHOULD NOT EXCEED .100E+03
SUM OF FORCES IN HORIZONTAL DIRECTION = .01 (= .140E-01)
SHOULD NOT EXCEED .100E+03
SUM OF MOMENTS ABOUT COORDINATE ORIGIN = 23.72 (= .237E+02)
SHOULD NOT EXCEED .100E+03
SHEAR STRENGTH/SHEAR FORCE CHECK-SUM = .01 (= .103E-01)
SHOULD NOT EXCEED .100E+03

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Section B, Origin Crest, Units lbs-ft
By CJCW; Date March, 2003

TABLE NO. 39
****
* Final Results for Side Forces and Stresses Between Slices. *
* (Results for Critical Shear Surface in Case of a Search.) *
****

SPENCER'S PROCEDURE USED TO COMPUTE FACTOR OF SAFETY
Factor of Safety = 1.247 Side Force Inclination = -29.81 Degrees

---------- VALUES AT RIGHT SIDE OF SLICE ----------

Slice No.	X-Right	Side Force	Y-Coord. of Side Force Location	Fraction of Height	Sigma at Top	Sigma at Bottom
1	-4.6	1810.	1064.1	.340	6.3	294.3
2	.0	5379.	1057.5	.246	-136.3	658.1
3	6.7	12275.	1049.5	.272	-170.2	1096.9
4	14.0	20396.	1041.8	.294	-151.0	1445.1
5	21.7	29173.	1034.2	.310	-113.7	1747.7
6	30.0	37991.	1026.8	.322	-64.7	2011.7
7	38.6	46223.	1019.6	.333	-3.6	2232.6
8	47.7	53262.	1012.7	.343	73.3	2401.5
9	57.2	58549.	1006.0	.355	171.9	2505.9
10	61.0	60047.	1003.4	.360	218.8	2525.8
11	71.0	62119.	997.3	.375	363.3	2512.0
12	81.3	61501.	991.5	.397	559.3	2385.0
13	85.5	60476.	989.3	.408	656.9	2295.5
14	96.2	56924.	984.1	.437	921.5	2050.4
15	107.2	52691.	978.9	.466	1202.7	1827.1
16	110.0	51541.	977.6	.473	1279.3	1775.3
17	118.0	47799.	974.0	.437	853.6	1894.2
18	129.4	41445.	969.3	.445	893.3	1770.6

19	133.7	39034.	967.5	.447	897.2	1743.7
20	145.0	31797.	963.2	.454	924.7	1628.1
21	153.0	26266.	960.4	.402	446.3	1709.1
22	164.8	17326.	956.7	.361	136.2	1520.8
23	168.0	14990.	955.8	.348	65.8	1443.3
24	168.0	14990.	955.8	.348	65.8	1443.3
25	179.9	6660.	952.7	.363	96.3	974.0
26	191.9	884.	950.2	.452	147.2	265.6
27	192.0	851.	950.2	.460	154.2	251.3
28	197.8	0.	1872.2	ABOVE	.0	.0

CHECK SUMS - (ALL SHOULD BE SMALL)
SUM OF FORCES IN VERTICAL DIRECTION = .02 (= .164E-01)
SHOULD NOT EXCEED .100E+03
SUM OF FORCES IN HORIZONTAL DIRECTION = .01 (= .140E-01)
SHOULD NOT EXCEED .100E+03
SUM OF MOMENTS ABOUT COORDINATE ORIGIN = 23.72 (= .237E+02)
SHOULD NOT EXCEED .100E+03
SHEAR STRENGTH/SHEAR FORCE CHECK-SUM = .01 (= .103E-01)
SHOULD NOT EXCEED .100E+03

END-OF-FILE ENCOUNTERED WHILE READING COMMAND
WORDS - END OF PROBLEM(S) ASSUMED

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```
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        TABLE NO. 1
        ****************************************
        * COMPUTER PROGRAM DESIGNATION - UTEXAS3 *
        * Originally Coded By Stephen G. Wright  *
        * Version No. 1.208                      *
        * Last Revision Date  2/22/98            *
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        * All Rights Reserved                    *
        ****************************************

        ************************************************************
        *                                                          *
        *      RESULTS OF COMPUTATIONS PERFORMED USING THIS COMPUTER *
        * PROGRAM SHOULD NOT BE USED FOR DESIGN PURPOSES UNLESS THEY *
        * HAVE BEEN VERIFIED BY INDEPENDENT ANALYSES, EXPERIMENTAL   *
        * DATA OR FIELD EXPERIENCE. THE USER SHOULD UNDERSTAND THE   *
        * ALGORITHMS AND ANALYTICAL PROCEDURES USED IN THE COMPUTER  *
        * PROGRAM AND MUST HAVE READ ALL DOCUMENTATION FOR THIS      *
        * PROGRAM BEFORE ATTEMPTING ITS USE.                         *
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          Section B, Shallow Failure, Origin Crest, Units lbs-ft
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        TABLE NO.  2
        ************************
        * NEW PROFILE LINE DATA *
        ************************

        PROFILE LINE  1 - MATERIAL TYPE =  1
        Slime Line

             Point       X             Y

               1      -200.000      1064.000
               2      -170.000      1064.000
               3      -146.000      1065.000
               4      -116.000      1065.000
               5      -102.000      1065.500
               6        61.000       949.000

        PROFILE LINE  2 - MATERIAL TYPE =  2
        Sand Line

             Point       X             Y

               1      -102.000      1065.500
               2       -39.000      1069.000
               3       -21.000      1071.000
               4          .000      1071.000
               5       110.000       993.000
               6       118.000       991.000
```



```
               7       145.000       975.000
               8       153.000       973.000
               9       168.000       967.000

        PROFILE LINE  3 - MATERIAL TYPE =  3
        Glacial Till Line

             Point       X             Y

               1      -200.000      984.000
               2       -28.000      959.000
               3        61.000      949.000
               4       118.000      941.000
               5       210.000      941.000
               6       250.000      940.000

        PROFILE LINE  4 - MATERIAL TYPE =  4
        Ablasial Till Line (20' below Glacial)

             Point       X             Y

               1      -200.000      964.000
               2       -28.000      939.000
               3        61.000      929.000
               4       118.000      921.000
               5       210.000      921.000
               6       250.000      920.000

        PROFILE LINE  6 - MATERIAL TYPE =  6
        Starter Dam

             Point       X             Y

               1       118.000      941.000
               2       145.000      967.000
               3       168.000      967.000
               4       210.000      941.000

        All new profile lines defined - No old lines retained
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          Section B, Shallow Failure, Origin Crest, Units lbs-ft
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        TABLE NO.  3
        ************************************************************************
        * NEW MATERIAL PROPERTY DATA - CONVENTIONAL/FIRST-STAGE COMPUTATIONS *
        ************************************************************************

        DATA FOR MATERIAL TYPE  1
        Slime

             Unit weight of material =  120.000

             CONVENTIONAL (ISOTROPIC) SHEAR STRENGTHS
             Cohesion - - - - - - - -        .000
             Friction angle - - - - -  37.000 degrees

             Pore water pressures defined by piezometric line
             Number of the piezometric line used =  1
             Negative pore pressures set to zero

        DATA FOR MATERIAL TYPE  2
        Sand
```

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Unit weight of material = 120.000

CONVENTIONAL (ISOTROPIC) SHEAR STRENGTHS
Cohesion - - - - - - - - .000
Friction angle - - - - - 37.000 degrees

Pore water pressures defined by piezometric line
Number of the piezometric line used = 1
Negative pore pressures set to zero

DATA FOR MATERIAL TYPE 3
Glacial Till

Unit weight of material = 140.000

CONVENTIONAL (ISOTROPIC) SHEAR STRENGTHS
Cohesion - - - - - - - - 500.000
Friction angle - - - - - 40.000 degrees

Pore water pressures defined by piezometric line
Number of the piezometric line used = 1
Negative pore pressures set to zero

DATA FOR MATERIAL TYPE 4
Ablasial Till

Unit weight of material = 140.000

CONVENTIONAL (ISOTROPIC) SHEAR STRENGTHS
Cohesion - - - - - - - - 500.000
Friction angle - - - - - 40.000 degrees

Pore water pressures defined by piezometric line
Number of the piezometric line used = 1
Negative pore pressures set to zero

DATA FOR MATERIAL TYPE 6
Starter Dam

Unit weight of material = 130.000

CONVENTIONAL (ISOTROPIC) SHEAR STRENGTHS
Cohesion - - - - - - - - .000
Friction angle - - - - - 38.000 degrees

Pore water pressures defined by piezometric line
Number of the piezometric line used = 1
Negative pore pressures set to zero

All new material properties defined - No old data retained
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TABLE NO. 5
****
* NEW PIEZOMETRIC LINE DATA - CONVENTIONAL/FIRST-STAGE COMPUTATIONS *
****

Line No.	Point	X	Y
1	- Unit weight of water =	62.40	
1	1	-200.000	1012.000
1	2	-21.000	985.000
1	3	168.000	967.000
1	4	210.000	941.000
1	5	250.000	940.000

All new piezometric lines defined - No old lines retained
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TABLE NO. 15
****
* NEW ANALYSIS/COMPUTATION DATA *
****

Circular Shear Surface(s)

Computations Performed for Single Shear Surface

Center Coordinates for Center of Circle -
X = 228.000
Y = 1283.000

Circle Passes Throught the Point at -
X = 153.000
Y = 973.000
Radius = 318.944

THE FOLLOWING REPRESENT EITHER DEFAULT OR PREVIOUSLY DEFINED VALUES:

Initial trial estimate for the factor of safety = 3.000

Initial trial estimate for side force inclination = 15.000 degrees
(Applicable to Spencer's procedure only)

Maximum number of iterations allowed for
calculating the factor of safety = 40

Allowed force imbalance for convergence = 100.000

Allowed moment imbalance for convergence = 100.000

Maximum subtended angle to be used for subdivision of the
circle into slices = 3.00 degrees

Depth of crack = .000

Depth of water in crack = .000

Unit weight of water in crack = 62.400

Seismic coefficient = .000

Conventional (single-stage) computations to be performed

Procedure used to compute the factor of safety: SPENCER
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Section B, Shallow Failure, Origin Crest, Units lbs-ft
By CJCW; Date March, 2003

TABLE NO. 16
****
* NEW SLOPE GEOMETRY DATA *
****

NOTE - NO DATA WERE INPUT, SLOPE GEOMETRY DATA
WERE GENERATED BY THE PROGRAM

Slope Coordinates -

Point	X	Y
1	-200.000	1064.000
2	-170.000	1064.000
3	-146.000	1065.000
4	-116.000	1065.000
5	-102.000	1065.500
6	-39.000	1069.000
7	-21.000	1071.000
8	.000	1071.000
9	110.000	993.000
10	118.000	991.000
11	145.000	975.000
12	153.000	973.000
13	168.000	967.000
14	210.000	941.000
15	250.000	940.000

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Elizabeth Mine. Steady-State Drained, Existing Phreatic Surfac
Section B, Shallow Failure, Origin Crest, Units lbs-ft
By CJCW; Date March, 2003

TABLE NO. 26
****
* Coordinate, Weight, Strength and Pore Water Pressure *
* Information for Individual Slices for Conventional *
* Computations or First Stage of Multi-Stage Computations. *
* (Information is for the Critical Shear Surface in the *
* Case of an Automatic Search.) *
****

Slice No.	X	Y	Slice Weight	Matl. Type	Cohesion	Friction Angle	Pore Pressure
	-10.3	1071.0					
1	-5.1	1065.5	6806.4	2	.00	37.00	.0
	.0	1060.0					
2	6.0	1054.2	18108.3	2	.00	37.00	.0
	12.0	1048.3					
3	18.3	1042.9	22922.6	2	.00	37.00	.0
	24.6	1037.4					
4	31.1	1032.2	26352.4	2	.00	37.00	.0
	37.7	1027.1					
5	44.5	1022.2	28154.9	2	.00	37.00	.0
	51.4	1017.4					
6	56.2	1014.4	19459.7	2	.00	37.00	.0
	61.0	1011.3					
7	68.2	1007.1	26935.8	2	.00	37.00	.0
	75.5	1002.9					
8	82.9	999.1	23414.0	2	.00	37.00	.0
	90.3	995.3					
9	97.9	991.9	17658.4	2	.00	37.00	.0
	105.6	988.5					
10	107.8	987.6	3717.2	2	.00	37.00	.0
	110.0	986.7					
11	114.0	985.2	6569.6	2	.00	37.00	.0
	118.0	983.6					
12	125.9	981.0	10175.8	2	.00	37.00	.0
	133.8	978.3					
13	139.3	976.7	2217.1	2	.00	37.00	.0
	144.9	975.1					

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Elizabeth Mine. Steady-State Drained, Existing Phreatic Surfac
Section B, Shallow Failure, Origin Crest, Units lbs-ft
By CJCW; Date March, 2003

TABLE NO. 27
****
* Seismic Forces and Forces Due to Surface Pressures for *
* Individual Slices for Conventional Computations or the *
* First Stage of Multi-Stage Computations. *
* (Information is for the Critical Shear Surface in the *
* Case of an Automatic Search.) *
****

Slice No.	X	Seismic Force	Y for Seismic Force	Normal Force	Shear Force	FORCES DUE TO SURFACE PRESSURES X	Y
1	-5.1	0.	1068.2	0.	0.	.0	.0
2	6.0	0.	1060.5	0.	0.	.0	.0
3	18.3	0.	1050.4	0.	0.	.0	.0
4	31.1	0.	1040.6	0.	0.	.0	.0
5	44.5	0.	1030.8	0.	0.	.0	.0
6	56.2	0.	1022.8	0.	0.	.0	.0
7	68.2	0.	1014.9	0.	0.	.0	.0
8	82.9	0.	1005.7	0.	0.	.0	.0
9	97.9	0.	996.7	0.	0.	.0	.0
10	107.8	0.	991.1	0.	0.	.0	.0
11	114.0	0.	988.6	0.	0.	.0	.0
12	125.9	0.	983.6	0.	0.	.0	.0
13	139.3	0.	977.5	0.	0.	.0	.0

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Section B, Shallow Failure, Origin Crest, Units lbs-ft
By CJCW; Date March, 2003

TABLE NO. 29
****
* Information Generated During Iterative Solution for the Factor *
* of Safety and Side Force Inclination by Spencer's Procedure *
****

Iteration	Trial Factor of Safety	Trial Side Force Inclination (degrees)	Force Imbalance (lbs.)	Moment Imbalance (ft.-lbs.)	Delta-F	Delta Theta (degrees)
1	3.00000	-15.0000	-.6910E+05	.6930E+08		
First-order corrections to F and THETA					-.417E+01	-.123E+01
Values factored by .120E+00 - Deltas too large					-.500E+00	-.147E+00

```
   2   2.50000   -15.1472   -.5931E+05    .5949E+08
First-order corrections to F and THETA .........   -.256E+01 -.143E+01
Values factored by  .195E+00 - Deltas too large    -.500E+00 -.279E+00

   3   2.00000   -15.4264   -.4518E+05    .4535E+08
First-order corrections to F and THETA .........   -.131E+01 -.184E+01
Values factored by  .382E+00 - Deltas too large    -.500E+00 -.702E+00

   4   1.50000   -16.1283   -.2294E+05    .2313E+08
First-order corrections to F and THETA .........   -.400E+00 -.314E+01
Second-order correction - Iteration   1 ........   -.336E+00 -.314E+01
Second-order correction - Iteration   2 ........   -.334E+00 -.314E+01
Second-order correction - Iteration   3 ........   -.334E+00 -.314E+01

   5   1.16589   -19.2681    .1127E+04  -.8112E+06
First-order corrections to F and THETA .........    .319E-01 -.195E+02
Values factored by  .442E+00 - Deltas too large     .141E-01 -.859E+01

   6   1.17999   -27.8625    .6714E+03  -.5185E+06
First-order corrections to F and THETA .........    .134E-01 -.551E+01
Second-order correction - Iteration   1 ........    .134E-01 -.551E+01
Second-order correction - Iteration   2 ........    .134E-01 -.551E+01

   7   1.19344   -33.3676    .9170E+00  -.3591E+05
First-order corrections to F and THETA .........   -.161E-02  .131E+01
Second-order correction - Iteration   1 ........   -.158E-02  .131E+01
Second-order correction - Iteration   2 ........   -.158E-02  .131E+01

   8   1.19186   -32.0528   -.1121E+00  -.4385E+03
First-order corrections to F and THETA .........   -.259E-04  .208E-01
Second-order correction - Iteration   1 ........   -.259E-04  .208E-01

   9   1.19183   -32.0320   -.5737E-02   .4776E+01
First-order corrections to F and THETA .........   -.747E-07  .134E-04

Factor of Safety - - - - - - - -     1.192
Side Force Inclination - - - - -    -32.03
Number of Iterations - - - - - -     9
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      Section B, Shallow Failure, Origin Crest, Units lbs-ft
      By CJCW; Date March, 2003

TABLE NO. 38
**********************************************************************
*  Final Results for Stresses Along the Shear Surface                *
*  (Results for Critical Shear Surface in Case of a Search.)  *
**********************************************************************

SPENCER'S PROCEDURE USED TO COMPUTE FACTOR OF SAFETY
Factor of Safety =  1.192     Side Force Inclination = -32.03 Degrees

        -------- VALUES AT CENTER OF BASE OF SLICE---------

                                    Total      Effective
Slice                               Normal     Normal        Shear
 No.    X-center   Y-center        Stress     Stress        Stress

   1       -5.1     1065.5         338.8      338.8         214.2
   2        6.0     1054.2         828.0      828.0         523.5
   3       18.3     1042.9        1070.2     1070.2         676.7
   4       31.1     1032.2        1260.4     1260.4         796.9
   5       44.5     1022.2        1384.1     1384.1         875.1
   6       56.2     1014.4        1431.5     1431.5         905.1
   7       68.2     1007.1        1398.6     1398.6         884.3
   8       82.9      999.1        1262.4     1262.4         798.2
   9       97.9      991.9         993.0      993.0         627.8
  10      107.8      987.6         750.6      750.6         474.6
  11      114.0      985.2         756.2      756.2         478.1
  12      125.9      981.0         624.8      624.8         395.0
  13      139.3      976.7         207.3      207.3         131.1

CHECK SUMS - (ALL SHOULD BE SMALL)
SUM OF FORCES IN VERTICAL DIRECTION    =          .00  (=  .256E-02)
     SHOULD NOT EXCEED      .100E+03
SUM OF FORCES IN HORIZONTAL DIRECTION  =          .00  (=  .474E-02)
     SHOULD NOT EXCEED      .100E+03
SUM OF MOMENTS ABOUT COORDINATE ORIGIN =        -6.89  (= -.689E+01)
     SHOULD NOT EXCEED      .100E+03
SHEAR STRENGTH/SHEAR FORCE CHECK-SUM   =          .00  (=  .404E-02)
     SHOULD NOT EXCEED      .100E+03
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      Elizabeth Mine.  Steady-State Drained, Existing Phreatic Surfac
      Section B, Shallow Failure, Origin Crest, Units lbs-ft
      By CJCW; Date March, 2003

TABLE NO. 39
**********************************************************************
*  Final Results for Side Forces and Stresses Between Slices.  *
*  (Results for Critical Shear Surface in Case of a Search.)  *
**********************************************************************

SPENCER'S PROCEDURE USED TO COMPUTE FACTOR OF SAFETY
Factor of Safety =  1.192     Side Force Inclination = -32.03 Degrees

        ---------- VALUES AT RIGHT SIDE OF SLICE ----------

                                    Y-Coord. of   Fraction      Sigma       Sigma
Slice                      Side     Side Force       of          at          at
 No.    X-Right           Force    Location       Height        Top         Bottom

   1         .0           1807.     1062.3         .208       -104.4        382.3
   2        12.0           5763.     1051.8         .242       -188.2        878.4
   3        24.6           9590.     1041.9         .281       -157.9       1160.3
   4        37.7          12573.     1032.4         .309        -90.6       1328.6
   5        51.4          14164.     1023.2         .334          3.1       1397.7
   6        61.0          14283.     1017.1         .353         86.3       1383.9
   7        75.5          13016.     1008.6         .389        251.5       1260.6
   8        90.3          10334.     1000.5         .448        518.5        985.3
   9       105.6           7022.      992.8         .564       1077.0        478.7
  10       110.0           6137.      990.6         .618       1406.4        242.1
  11       118.0           4356.      986.8         .428        283.0        718.6
  12       133.8            926.      980.1         .554        310.7        158.3
  13       144.9              0.      851.9        BELOW           .0          .0

CHECK SUMS - (ALL SHOULD BE SMALL)
SUM OF FORCES IN VERTICAL DIRECTION    =          .00  (=  .256E-02)
     SHOULD NOT EXCEED      .100E+03
SUM OF FORCES IN HORIZONTAL DIRECTION  =          .00  (=  .474E-02)
     SHOULD NOT EXCEED      .100E+03
SUM OF MOMENTS ABOUT COORDINATE ORIGIN =        -6.89  (= -.689E+01)
     SHOULD NOT EXCEED      .100E+03
SHEAR STRENGTH/SHEAR FORCE CHECK-SUM   =          .00  (=  .404E-02)
     SHOULD NOT EXCEED      .100E+03
```

LAFARGE

```
END-OF-FILE ENCOUNTERED WHILE READING COMMAND
WORDS - END OF PROBLEM(S) ASSUMED
```


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```
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        TABLE NO. 1
        ****************************************
        * COMPUTER PROGRAM DESIGNATION - UTEXAS3 *
        * Originally Coded By Stephen G. Wright  *
        * Version No. 1.208                      *
        * Last Revision Date  2/22/98            *
        * (C) Copyright 1985-1998 S. G. Wright   *
        * All Rights Reserved                    *
        ****************************************

        ************************************************************
        *                                                          *
        *      RESULTS OF COMPUTATIONS PERFORMED USING THIS COMPUTER *
        * PROGRAM SHOULD NOT BE USED FOR DESIGN PURPOSES UNLESS THEY *
        * HAVE BEEN VERIFIED BY INDEPENDENT ANALYSES, EXPERIMENTAL   *
        * DATA OR FIELD EXPERIENCE. THE USER SHOULD UNDERSTAND THE   *
        * ALGORITHMS AND ANALYTICAL PROCEDURES USED IN THE COMPUTER  *
        * PROGRAM AND MUST HAVE READ ALL DOCUMENTATION FOR THIS      *
        * PROGRAM BEFORE ATTEMPTING ITS USE.                         *
        *                                                          *
        *      NEITHER SHINOAK SOFTWARE NOR STEPHEN G. WRIGHT      *
        * MAKE OR ASSUME LIABILITY FOR ANY WARRANTIES, EXPRESSED OR  *
        * IMPLIED, CONCERNING THE ACCURACY, RELIABILITY, USEFULNESS  *
        * OR ADAPTABILITY OF THIS COMPUTER PROGRAM.                  *
        *                                                          *
        ************************************************************
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          Elizabeth Mine.  Steady-State Drained, Existing Phreatic Surfac
          Section C, Origin Crest, Units lbs-ft
          By CJCW; Date, March 2003.

        TABLE NO.  2
        **************************
        * NEW PROFILE LINE DATA *
        **************************

        PROFILE LINE  1 - MATERIAL TYPE =  1
        Slime Tailing

             Point      X            Y

               1      -159.000     1060.000
               2      -100.000     1062.000
               3       -60.000     1065.000
               4       -18.000     1005.000

        PROFILE LINE  2 - MATERIAL TYPE =  2
        Sand Tailing

             Point      X            Y

               1       -60.000     1065.000
               2       -33.000     1066.000
               3       -13.000     1068.000
               4          .000     1068.000
               5        69.000     1016.000
               6        87.000     1005.000
               7        92.000     1002.000
```



```
        PROFILE LINE  3 - MATERIAL TYPE =  3
        Glacial Till

             Point      X            Y

               1      -159.000     1005.000
               2      -100.000     1005.000
               3        18.000     1005.000
               4        92.000     1002.000
               5       118.000      997.000
               6       157.000      993.000

        PROFILE LINE  4 - MATERIAL TYPE =  4
        Ablasial Till (20' below Glacial)

             Point      X            Y

               1      -159.000      985.000
               2        18.000      985.000
               3        92.000      982.000
               4       118.000      977.000
               5       157.000      973.000

        All new profile lines defined - No old lines retained
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        Date:  3: 7:2003   Time: 13: 9:42   Input file: cdc1.in
          Elizabeth Mine.  Steady-State Drained, Existing Phreatic Surfac
          Section C, Origin Crest, Units lbs-ft
          By CJCW; Date, March 2003.

        TABLE NO.  3
        ************************************************************************
        * NEW MATERIAL PROPERTY DATA - CONVENTIONAL/FIRST-STAGE COMPUTATIONS *
        ************************************************************************

        DATA FOR MATERIAL TYPE  1
        Slime Tailing

             Unit weight of material =  120.000

             CONVENTIONAL (ISOTROPIC) SHEAR STRENGTHS
             Cohesion - - - - - - - - -        .000
             Friction angle - - - - -  37.000 degrees

             Pore water pressures defined by piezometric line
             Number of the piezometric line used =  1
             Negative pore pressures set to zero

        DATA FOR MATERIAL TYPE  2
        Sand Tailing

             Unit weight of material =  120.000

             CONVENTIONAL (ISOTROPIC) SHEAR STRENGTHS
             Cohesion - - - - - - - - -        .000
             Friction angle - - - - -  37.000 degrees

             Pore water pressures defined by piezometric line
             Number of the piezometric line used =  1
             Negative pore pressures set to zero

        DATA FOR MATERIAL TYPE  3
        Glacial Till

             Unit weight of material =  140.000
```

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```
     CONVENTIONAL (ISOTROPIC) SHEAR STRENGTHS
     Cohesion - - - - - - - -    500.000
     Friction angle - - - - -  40.000 degrees

     Pore water pressures defined by piezometric line
     Number of the piezometric line used =  1
     Negative pore pressures set to zero

DATA FOR MATERIAL TYPE  4
Ablasial Till

     Unit weight of material =  140.000

     CONVENTIONAL (ISOTROPIC) SHEAR STRENGTHS
     Cohesion - - - - - - - -    500.000
     Friction angle - - - - -  40.000 degrees

     Pore water pressures defined by piezometric line
     Number of the piezometric line used =  1
     Negative pore pressures set to zero

All new material properties defined - No old data retained
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  Elizabeth Mine.  Steady-State Drained, Existing Phreatic Surfac
  Section C, Origin Crest, Units lbs-ft
  By CJCW; Date, March 2003.

TABLE NO.  5
**************************************************************************
* NEW PIEZOMETRIC LINE DATA - CONVENTIONAL/FIRST-STAGE COMPUTATIONS *
**************************************************************************

Line
 No.    Point       X          Y

  1 - Unit weight of water =   62.40
  1        1    -159.000    1028.000
  1        2     -16.000    1030.000
  1        3      92.000    1002.000
  1        4     118.000     997.000
  1        5     157.000     993.000

All new piezometric lines defined - No old lines retained
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Date:  3: 7:2003   Time: 13: 9:42   Input file: cdc1.in
  Elizabeth Mine.  Steady-State Drained, Existing Phreatic Surfac
  Section C, Origin Crest, Units lbs-ft
  By CJCW; Date, March 2003.

TABLE NO. 15
*********************************
* NEW ANALYSIS/COMPUTATION DATA *
*********************************

Circular Shear Surface(s)

Computations Performed for Single Shear Surface

Center Coordinates for Center of Circle -
                                          X =     102.000
                                          Y =    1133.000
```



```
Circle is Tangent to Horizontal Line at -
                                          Y =    1002.000
                                          Radius =     131.000

-------------------------------------------------------------------------
THE FOLLOWING REPRESENT EITHER DEFAULT OR PREVIOUSLY DEFINED VALUES:

Initial trial estimate for the factor of safety =   3.000

Initial trial estimate for side force inclination =  15.000 degrees
(Applicable to Spencer's procedure only)

Maximum number of iterations allowed for
calculating the factor of safety =   40

Allowed force imbalance for convergence =     100.000

Allowed moment imbalance for convergence =     100.000

Maximum subtended angle to be used for subdivision of the
circle into slices =   3.00 degrees

Depth of crack =        .000

Depth of water in crack =        .000

Unit weight of water in crack =    62.400

Seismic coefficient =  .000

Conventional (single-stage) computations to be performed

Procedure used to compute the factor of safety: SPENCER
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  Elizabeth Mine.  Steady-State Drained, Existing Phreatic Surfac
  Section C, Origin Crest, Units lbs-ft
  By CJCW; Date, March 2003.

TABLE NO. 16
**************************
* NEW SLOPE GEOMETRY DATA *
**************************

NOTE - NO DATA WERE INPUT, SLOPE GEOMETRY DATA
WERE GENERATED BY THE PROGRAM

Slope Coordinates -

     Point       X          Y

       1    -159.000    1060.000
       2    -100.000    1062.000
       3     -60.000    1065.000
       4     -33.000    1066.000
       5     -13.000    1068.000
       6        .000    1068.000
       7      69.000    1016.000
       8      87.000    1005.000
       9      92.000    1002.000
      10     118.000     997.000
      11     157.000     993.000
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```


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Elizabeth Mine. Steady-State Drained, Existing Phreatic Surfac
Section C, Origin Crest, Units lbs-ft
By CJCW; Date, March 2003.

TABLE NO. 26

****
* Coordinate, Weight, Strength and Pore Water Pressure *
* Information for Individual Slices for Conventional *
* Computations or First Stage of Multi-Stage Computations. *
* (Information is for the Critical Shear Surface in the *
* Case of an Automatic Search.) *
****

Slice No.	X	Y	Slice Weight	Matl. Type	Cohesion	Friction Angle	Pore Pressure
	-11.7	1068.0					
1	-10.0	1065.1	1251.6	2	.00	37.00	.0
	-8.2	1062.1					
2	-6.2	1059.3	4028.6	2	.00	37.00	.0
	-4.3	1056.5					
3	-2.2	1053.7	7104.5	2	.00	37.00	.0
	-.2	1051.0					
4	-.1	1050.9	344.7	2	.00	37.00	.0
	.0	1050.8					
5	2.2	1048.2	9669.0	2	.00	37.00	.0
	4.4	1045.6					
6	6.8	1043.1	11187.9	2	.00	37.00	.0
	9.2	1040.6					
7	11.6	1038.2	12515.8	2	.00	37.00	.0
	14.1	1035.9					
8	16.1	1034.2	10132.4	2	.00	37.00	.0
	18.0	1032.5					
9	20.7	1030.3	14232.9	2	.00	37.00	.0
	23.4	1028.2					
10	26.2	1026.2	14791.4	2	.00	37.00	.0
	29.0	1024.2					
11	31.9	1022.4	14996.2	2	.00	37.00	.0
	34.8	1020.6					
12	37.7	1018.9	14817.0	2	.00	37.00	.0
	40.7	1017.2					
13	43.8	1015.7	14230.1	2	.00	37.00	.0
	46.9	1014.2					
14	48.1	1013.6	5240.2	2	.00	37.00	.0
	49.3	1013.1					
15	52.5	1011.8	12713.5	2	.00	37.00	29.6
	55.6	1010.5					
16	58.9	1009.4	11098.4	2	.00	37.00	77.3
	62.1	1008.2					
17	65.4	1007.3	9046.4	2	.00	37.00	101.9
	68.7	1006.3					
18	68.8	1006.3	359.7	2	.00	37.00	108.4
	69.0	1006.2					
19	72.3	1005.4	6822.5	2	.00	37.00	102.9
	75.7	1004.7					
20	79.1	1004.1	4686.7	2	.00	37.00	80.2
	82.4	1003.5					

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By CJCW; Date, March 2003.

TABLE NO. 26

****
* Coordinate, Weight, Strength and Pore Water Pressure *
* Information for Individual Slices for Conventional *
* Computations or First Stage of Multi-Stage Computations. *
* (Information is for the Critical Shear Surface in the *
* Case of an Automatic Search.) *
****

Slice No.	X	Y	Slice Weight	Matl. Type	Cohesion	Friction Angle	Pore Pressure
	82.4	1003.5					
21	84.7	1003.2	1770.4	2	.00	37.00	45.1
	87.0	1002.9					
22	88.4	1002.7	485.9	2	.00	37.00	13.6
	89.8	1002.6					
23	90.5	1002.5	65.4	2	.00	37.00	.0
	91.3	1002.4					

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Section C, Origin Crest, Units lbs-ft
By CJCW; Date, March 2003.

TABLE NO. 27

****
* Seismic Forces and Forces Due to Surface Pressures for *
* Individual Slices for Conventional Computations or the *
* First Stage of Multi-Stage Computations. *
* (Information is for the Critical Shear Surface in the *
* Case of an Automatic Search.) *
****

Slice No.	X	Seismic Force	Y for Seismic Force	Normal Force	Shear Force	FORCES DUE TO SURFACE PRESSURES X	Y
1	-10.0	0.	1066.5	0.	0.	.0	.0
2	-6.2	0.	1063.7	0.	0.	.0	.0
3	-2.2	0.	1060.9	0.	0.	.0	.0
4	-.1	0.	1059.5	0.	0.	.0	.0
5	2.2	0.	1057.3	0.	0.	.0	.0
6	6.8	0.	1053.0	0.	0.	.0	.0
7	11.6	0.	1048.7	0.	0.	.0	.0
8	16.1	0.	1045.0	0.	0.	.0	.0
9	20.7	0.	1041.4	0.	0.	.0	.0
10	26.2	0.	1037.3	0.	0.	.0	.0
11	31.9	0.	1033.2	0.	0.	.0	.0
12	37.7	0.	1029.2	0.	0.	.0	.0
13	43.8	0.	1025.3	0.	0.	.0	.0
14	48.1	0.	1022.7	0.	0.	.0	.0
15	52.5	0.	1020.1	0.	0.	.0	.0
16	58.9	0.	1016.5	0.	0.	.0	.0
17	65.4	0.	1013.0	0.	0.	.0	.0
18	68.8	0.	1011.2	0.	0.	.0	.0
19	72.3	0.	1009.7	0.	0.	.0	.0
20	79.1	0.	1007.0	0.	0.	.0	.0
21	84.7	0.	1004.8	0.	0.	.0	.0
22	88.4	0.	1003.4	0.	0.	.0	.0
23	90.5	0.	1002.7	0.	0.	.0	.0

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TABLE NO. 29

****
* Information Generated During Iterative Solution for the Factor *
* of Safety and Side Force Inclination by Spencer's Procedure *
****

Iteration	Trial Factor of Safety	Trial Side Force Inclination (degrees)	Force Imbalance (lbs.)	Moment Imbalance (ft.-lbs.)	Delta-F	Delta Theta (degrees)
1	3.00000	-15.0000	-.5950E+05	.5976E+08		
First-order corrections to F and THETA					-.414E+01	-.109E+01
Values factored by .121E+00 - Deltas too large					-.500E+00	-.132E+00
2	2.50000	-15.1319	-.5103E+05	.5126E+08		
First-order corrections to F and THETA					-.255E+01	-.129E+01
Values factored by .196E+00 - Deltas too large					-.500E+00	-.253E+00
3	2.00000	-15.3847	-.3879E+05	.3899E+08		
First-order corrections to F and THETA					-.129E+01	-.167E+01
Values factored by .386E+00 - Deltas too large					-.500E+00	-.646E+00
4	1.50000	-16.0305	-.1949E+05	.1968E+08		
First-order corrections to F and THETA					-.387E+00	-.294E+01
Second-order correction - Iteration 1					-.326E+00	-.294E+01
Second-order correction - Iteration 2					-.324E+00	-.294E+01
Second-order correction - Iteration 3					-.324E+00	-.294E+01
5	1.17573	-18.9739	.9200E+03	-.6451E+06		
First-order corrections to F and THETA					.588E-01	-.200E+02
Values factored by .430E+00 - Deltas too large					.253E-01	-.859E+01
6	1.20102	-27.5683	.6468E+03	-.5035E+06		
First-order corrections to F and THETA					.249E-01	-.612E+01
Second-order correction - Iteration 1					.258E-01	-.612E+01
Second-order correction - Iteration 2					.258E-01	-.612E+01
7	1.22680	-33.6856	.1151E+02	-.4907E+05		
First-order corrections to F and THETA					-.518E-02	.168E+01
Second-order correction - Iteration 1					-.505E-02	.168E+01
Second-order correction - Iteration 2					-.505E-02	.168E+01
8	1.22176	-32.0056	-.5640E+00	-.1272E+03		
First-order corrections to F and THETA					-.914E-04	.280E-01
Second-order correction - Iteration 1					-.914E-04	.280E-01
9	1.22166	-31.9775	.4932E-02	-.6451E+01		
First-order corrections to F and THETA					-.220E-06	.927E-04

Factor of Safety - - - - - - - - 1.222
Side Force Inclination - - - - - -31.98
Number of Iterations - - - - - - 9

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TABLE NO. 38

****
* Final Results for Stresses Along the Shear Surface *
* (Results for Critical Shear Surface in Case of a Search.) *

****

SPENCER'S PROCEDURE USED TO COMPUTE FACTOR OF SAFETY
Factor of Safety = 1.222 Side Force Inclination = -31.98 Degrees

-------- VALUES AT CENTER OF BASE OF SLICE---------

Slice No.	X-center	Y-center	Total Normal Stress	Effective Normal Stress	Shear Stress
1	-10.0	1065.1	132.2	132.2	81.6
2	-6.2	1059.3	428.1	428.1	264.1
3	-2.2	1053.7	761.6	761.6	469.8
4	-.1	1050.9	950.8	950.8	586.5
5	2.2	1048.2	1049.0	1049.0	647.1
6	6.8	1043.1	1231.6	1231.6	759.7
7	11.6	1038.2	1402.2	1402.2	864.9
8	16.1	1034.2	1539.4	1539.4	949.5
9	20.7	1030.3	1656.7	1656.7	1021.9
10	26.2	1026.2	1767.8	1767.8	1090.4
11	31.9	1022.4	1846.7	1846.7	1139.1
12	37.7	1018.9	1887.2	1887.2	1164.1
13	43.8	1015.7	1882.1	1882.1	1161.0
14	48.1	1013.6	1852.5	1852.5	1142.7
15	52.5	1011.8	1781.1	1751.5	1080.4
16	58.9	1009.4	1623.1	1545.8	953.5
17	65.4	1007.3	1385.9	1284.0	792.0
18	68.8	1006.3	1232.3	1123.8	693.2
19	72.3	1005.4	1102.9	1000.0	616.8
20	79.1	1004.1	804.1	723.8	446.5
21	84.7	1003.2	479.3	434.2	267.8
22	88.4	1002.7	226.7	213.2	131.5
23	90.5	1002.5	61.9	61.9	38.2

CHECK SUMS - (ALL SHOULD BE SMALL)
SUM OF FORCES IN VERTICAL DIRECTION = .00 (= .279E-02)
SHOULD NOT EXCEED .100E+03
SUM OF FORCES IN HORIZONTAL DIRECTION = .00 (= .399E-02)
SHOULD NOT EXCEED .100E+03
SUM OF MOMENTS ABOUT COORDINATE ORIGIN = 4.05 (= .405E+01)
SHOULD NOT EXCEED .100E+03
SHEAR STRENGTH/SHEAR FORCE CHECK-SUM = .00 (= .280E-02)
SHOULD NOT EXCEED .100E+03

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Section C, Origin Crest, Units lbs-ft
By CJCW; Date, March 2003.

TABLE NO. 39

****
* Final Results for Side Forces and Stresses Between Slices. *
* (Results for Critical Shear Surface in Case of a Search.) *
****

SPENCER'S PROCEDURE USED TO COMPUTE FACTOR OF SAFETY
Factor of Safety = 1.222 Side Force Inclination = -31.98 Degrees

---------- VALUES AT RIGHT SIDE OF SLICE ----------

Slice No.	X-Right	Side Force	Y-Coord. of Side Force Location	Fraction of Height	Sigma at Top	Sigma at Bottom

1	-8.2	572.	1064.0	.311	-11.3	176.8
2	-4.3	2232.	1059.0	.218	-113.6	441.9
3	-.2	4834.	1054.3	.192	-205.2	687.8
4	.0	4952.	1054.1	.191	-208.9	697.3
5	4.4	8027.	1049.6	.210	-264.0	977.7
6	9.2	11048.	1045.3	.228	-288.7	1202.3
7	14.1	13810.	1041.1	.242	-297.3	1386.7
8	18.0	15592.	1038.0	.251	-297.0	1501.6
9	23.4	17433.	1034.0	.261	-289.2	1623.4
10	29.0	18521.	1030.2	.270	-273.5	1706.7
11	34.8	18740.	1026.5	.278	-248.8	1746.3
12	40.7	18025.	1023.0	.287	-212.6	1734.6
13	46.9	16379.	1019.7	.298	-159.8	1661.0
14	49.3	15511.	1018.5	.303	-133.0	1612.8
15	55.6	12872.	1015.5	.320	-55.7	1456.2
16	62.1	9915.	1012.6	.341	31.6	1265.1
17	68.7	6898.	1010.0	.372	136.7	1042.4
18	69.0	6765.	1009.9	.374	142.1	1031.9
19	75.7	3927.	1007.4	.377	119.7	799.7
20	82.4	1512.	1005.1	.386	94.3	499.2
21	87.0	413.	1003.7	.413	77.9	249.9
22	89.8	56.	1003.0	.519	71.4	56.6
23	91.3	0.	1049.9	ABOVE	.0	.0

```
CHECK SUMS - (ALL SHOULD BE SMALL)
SUM OF FORCES IN VERTICAL DIRECTION    =          .00  (=  .279E-02)
     SHOULD NOT EXCEED     .100E+03
SUM OF FORCES IN HORIZONTAL DIRECTION  =          .00  (=  .399E-02)
     SHOULD NOT EXCEED     .100E+03
SUM OF MOMENTS ABOUT COORDINATE ORIGIN =         4.05  (=  .405E+01)
     SHOULD NOT EXCEED     .100E+03
SHEAR STRENGTH/SHEAR FORCE CHECK-SUM   =          .00  (=  .280E-02)
     SHOULD NOT EXCEED     .100E+03


END-OF-FILE ENCOUNTERED WHILE READING COMMAND
WORDS - END OF PROBLEM(S) ASSUMED
```


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```
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        TABLE NO. 1
        ****************************************
        * COMPUTER PROGRAM DESIGNATION - UTEXAS3 *
        * Originally Coded By Stephen G. Wright  *
        * Version No. 1.208                      *
        * Last Revision Date  2/22/98            *
        * (C) Copyright 1985-1998 S. G. Wright   *
        * All Rights Reserved                    *
        ****************************************

        ************************************************************
        *                                                          *
        *      RESULTS OF COMPUTATIONS PERFORMED USING THIS COMPUTER *
        * PROGRAM SHOULD NOT BE USED FOR DESIGN PURPOSES UNLESS THEY *
        * HAVE BEEN VERIFIED BY INDEPENDENT ANALYSES, EXPERIMENTAL   *
        * DATA OR FIELD EXPERIENCE. THE USER SHOULD UNDERSTAND THE   *
        * ALGORITHMS AND ANALYTICAL PROCEDURES USED IN THE COMPUTER  *
        * PROGRAM AND MUST HAVE READ ALL DOCUMENTATION FOR THIS      *
        * PROGRAM BEFORE ATTEMPTING ITS USE.                         *
        *                                                          *
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        * MAKE OR ASSUME LIABILITY FOR ANY WARRANTIES, EXPRESSED OR  *
        * IMPLIED, CONCERNING THE ACCURACY, RELIABILITY, USEFULNESS  *
        * OR ADAPTABILITY OF THIS COMPUTER PROGRAM.                  *
        *                                                          *
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          Section D, Origin Crest, Units lbs-ft
          By CJCW; Date March 2003

        TABLE NO.  2
        ************************
        * NEW PROFILE LINE DATA *
        ************************

        PROFILE LINE  1 - MATERIAL TYPE =  1
        Slime Line

             Point       X             Y

               1      -224.000      1066.000
               2      -187.000      1066.000
               3      -105.000      1069.000
               4          .000       994.000

        PROFILE LINE  2 - MATERIAL TYPE =  2
        Sand Line

             Point       X             Y

               1      -105.000      1069.000
               2       -17.000      1072.000
               3          .000      1072.000
               4        31.000      1049.000
               5        65.000      1026.000
               6        85.000      1014.000
               7       105.000      1014.000
```



```
        PROFILE LINE  3 - MATERIAL TYPE =  3
        Glacial Till Line

             Point       X             Y

               1      -224.000       991.000
               2      -200.000       991.000
               3      -100.000       993.000
               4          .000       994.000
               5        57.000      1001.000
               6        85.000      1006.000
               7       105.000      1014.000
               8       143.000      1025.000
               9       175.000      1040.000

        PROFILE LINE  4 - MATERIAL TYPE =  4
        Ablasial Till Line (20' below Glacial)

             Point       X             Y

               1      -224.000       971.000
               2      -200.000       971.000
               3      -100.000       973.000
               4          .000       974.000
               5        57.000       981.000
               6        85.000       986.000
               7       105.000       994.000
               8       143.000      1005.000
               9       175.000      1020.000

        All new profile lines defined - No old lines retained
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          Section D, Origin Crest, Units lbs-ft
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        TABLE NO.  3
        ************************************************************************
        * NEW MATERIAL PROPERTY DATA - CONVENTIONAL/FIRST-STAGE COMPUTATIONS *
        ************************************************************************

        DATA FOR MATERIAL TYPE  1
        Slime

             Unit weight of material =  120.000

             CONVENTIONAL (ISOTROPIC) SHEAR STRENGTHS
             Cohesion - - - - - - - -         .000
             Friction angle - - - - -  37.000 degrees

             Pore water pressures defined by piezometric line
             Number of the piezometric line used =  1
             Negative pore pressures set to zero

        DATA FOR MATERIAL TYPE  2
        Sand

             Unit weight of material =  120.000

             CONVENTIONAL (ISOTROPIC) SHEAR STRENGTHS
             Cohesion - - - - - - - -         .000
             Friction angle - - - - -  37.000 degrees

             Pore water pressures defined by piezometric line
```


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```
     Number of the piezometric line used =  1
     Negative pore pressures set to zero

DATA FOR MATERIAL TYPE  3
Glacial Till

     Unit weight of material =  140.000

     CONVENTIONAL (ISOTROPIC) SHEAR STRENGTHS
     Cohesion - - - - - - - -     500.000
     Friction angle - - - - -  40.000 degrees

     Pore water pressures defined by piezometric line
     Number of the piezometric line used =  1
     Negative pore pressures set to zero

DATA FOR MATERIAL TYPE  4
Ablasial Till

     Unit weight of material =  140.000

     CONVENTIONAL (ISOTROPIC) SHEAR STRENGTHS
     Cohesion - - - - - - - -     500.000
     Friction angle - - - - -  40.000 degrees

     Pore water pressures defined by piezometric line
     Number of the piezometric line used =  1
     Negative pore pressures set to zero

All new material properties defined - No old data retained
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TABLE NO.  5
**********************************************************************
* NEW PIEZOMETRIC LINE DATA - CONVENTIONAL/FIRST-STAGE COMPUTATIONS *
**********************************************************************

Line
 No.    Point       X           Y

  1 - Unit weight of water =   62.40
  1        1    -224.000    1011.000
  1        2     175.000    1011.000

All new piezometric lines defined - No old lines retained
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  Section D, Origin Crest, Units lbs-ft
  By CJCW; Date March 2003

TABLE NO. 15
*********************************
* NEW ANALYSIS/COMPUTATION DATA *
*********************************

Circular Shear Surface(s)

Computations Performed for Single Shear Surface
```



```
Center Coordinates for Center of Circle -
                                        X =      87.000
                                        Y =    1110.000

Circle Passes Throught the Point at -
                                        X =      85.000
                                        Y =    1014.000
                                   Radius =      96.021

------------------------------------------------------------------------
THE FOLLOWING REPRESENT EITHER DEFAULT OR PREVIOUSLY DEFINED VALUES:

Initial trial estimate for the factor of safety =   3.000

Initial trial estimate for side force inclination =  15.000 degrees
(Applicable to Spencer's procedure only)

Maximum number of iterations allowed for
calculating the factor of safety =   40

Allowed force imbalance for convergence =     100.000

Allowed moment imbalance for convergence =     100.000

Maximum subtended angle to be used for subdivision of the
circle into slices =   3.00 degrees

Depth of crack =         .000

Depth of water in crack =        .000

Unit weight of water in crack =    62.400

Seismic coefficient =  .000

Conventional (single-stage) computations to be performed

Procedure used to compute the factor of safety: SPENCER
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  Section D, Origin Crest, Units lbs-ft
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TABLE NO. 16
***************************
* NEW SLOPE GEOMETRY DATA *
***************************

NOTE - NO DATA WERE INPUT, SLOPE GEOMETRY DATA
WERE GENERATED BY THE PROGRAM

Slope Coordinates -

     Point       X           Y

       1    -224.000    1066.000
       2    -187.000    1066.000
       3    -105.000    1069.000
       4     -17.000    1072.000
       5        .000    1072.000
       6      31.000    1049.000
       7      65.000    1026.000
       8      85.000    1014.000
       9     105.000    1014.000
```

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10 143.000 1025.000
11 175.000 1040.000

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Section D, Origin Crest, Units lbs-ft
By CJCW; Date March 2003

TABLE NO. 26

****
* Coordinate, Weight, Strength and Pore Water Pressure *
* Information for Individual Slices for Conventional *
* Computations or First Stage of Multi-Stage Computations. *
* (Information is for the Critical Shear Surface in the *
* Case of an Automatic Search.) *
****

Slice No.	X	Y	Slice Weight	Matl. Type	Cohesion	Friction Angle	Pore Pressure
	-1.2	1072.0					
1	-.6	1070.7	186.6	2	.00	37.00	.0
	.0	1069.4					
2	1.1	1067.1	1090.9	2	.00	37.00	.0
	2.2	1064.9					
3	3.5	1062.7	2001.7	2	.00	37.00	.0
	4.7	1060.5					
4	6.1	1058.4	2957.3	2	.00	37.00	.0
	7.4	1056.3					
5	8.9	1054.2	3924.3	2	.00	37.00	.0
	10.3	1052.2					
6	11.9	1050.2	4870.1	2	.00	37.00	.0
	13.5	1048.2					
7	15.1	1046.4	5763.2	2	.00	37.00	.0
	16.8	1044.5					
8	18.6	1042.7	6573.5	2	.00	37.00	.0
	20.3	1040.9					
9	22.2	1039.2	7272.4	2	.00	37.00	.0
	24.0	1037.5					
10	26.0	1035.9	7833.9	2	.00	37.00	.0
	27.9	1034.3					
11	29.5	1033.1	6260.6	2	.00	37.00	.0
	31.0	1032.0					
12	33.1	1030.6	8486.8	2	.00	37.00	.0
	35.2	1029.2					
13	37.3	1027.9	8700.2	2	.00	37.00	.0
	39.5	1026.6					
14	41.7	1025.4	8716.3	2	.00	37.00	.0
	43.9	1024.2					
15	46.2	1023.1	8522.1	2	.00	37.00	.0
	48.4	1022.1					
16	50.8	1021.1	8108.2	2	.00	37.00	.0
	53.1	1020.2					
17	55.0	1019.5	6210.7	2	.00	37.00	.0
	57.0	1018.8					
18	59.4	1018.1	6771.5	2	.00	37.00	.0
	61.8	1017.3					
19	63.4	1016.9	3875.7	2	.00	37.00	.0
	65.0	1016.5					
20	67.5	1016.0	5021.2	2	.00	37.00	.0
	69.9	1015.5					

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Section D, Origin Crest, Units lbs-ft
By CJCW; Date March 2003

TABLE NO. 26

****
* Coordinate, Weight, Strength and Pore Water Pressure *
* Information for Individual Slices for Conventional *
* Computations or First Stage of Multi-Stage Computations. *
* (Information is for the Critical Shear Surface in the *
* Case of an Automatic Search.) *
****

Slice No.	X	Y	Slice Weight	Matl. Type	Cohesion	Friction Angle	Pore Pressure
	69.9	1015.5					
21	72.4	1015.1	3832.8	2	.00	37.00	.0
	74.9	1014.7					
22	77.4	1014.5	2443.4	2	.00	37.00	.0
	79.9	1014.2					
23	82.4	1014.1	865.3	2	.00	37.00	.0
	84.9	1014.0					
24	85.0	1014.0	.3	2	.00	37.00	.0
	85.0	1014.0					

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Section D, Origin Crest, Units lbs-ft
By CJCW; Date March 2003

TABLE NO. 27

****
* Seismic Forces and Forces Due to Surface Pressures for *
* Individual Slices for Conventional Computations or the *
* First Stage of Multi-Stage Computations. *
* (Information is for the Critical Shear Surface in the *
* Case of an Automatic Search.) *
****

Slice No.	X	Seismic Force	Y for Seismic Force	FORCES DUE TO SURFACE PRESSURES Normal Force	Shear Force	X	Y
1	-.6	0.	1071.3	0.	0.	.0	.0
2	1.1	0.	1069.1	0.	0.	.0	.0
3	3.5	0.	1066.0	0.	0.	.0	.0
4	6.1	0.	1062.9	0.	0.	.0	.0
5	8.9	0.	1059.8	0.	0.	.0	.0
6	11.9	0.	1056.7	0.	0.	.0	.0
7	15.1	0.	1053.6	0.	0.	.0	.0
8	18.6	0.	1050.4	0.	0.	.0	.0
9	22.2	0.	1047.4	0.	0.	.0	.0
10	26.0	0.	1044.3	0.	0.	.0	.0
11	29.5	0.	1041.6	0.	0.	.0	.0
12	33.1	0.	1039.1	0.	0.	.0	.0
13	37.3	0.	1036.3	0.	0.	.0	.0
14	41.7	0.	1033.6	0.	0.	.0	.0
15	46.2	0.	1030.9	0.	0.	.0	.0
16	50.8	0.	1028.4	0.	0.	.0	.0
17	55.0	0.	1026.1	0.	0.	.0	.0
18	59.4	0.	1023.9	0.	0.	.0	.0
19	63.4	0.	1022.0	0.	0.	.0	.0
20	67.5	0.	1020.3	0.	0.	.0	.0
21	72.4	0.	1018.3	0.	0.	.0	.0

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22	77.4	0.	1016.5	0.	0.	.0	.0
23	82.4	0.	1014.8	0.	0.	.0	.0
24	85.0	0.	1014.0	0.	0.	.0	.0

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Section D, Origin Crest, Units lbs-ft
By CJCW; Date March 2003

TABLE NO. 29

****
* Information Generated During Iterative Solution for the Factor *
* of Safety and Side Force Inclination by Spencer's Procedure *
****

Iteration	Trial Factor of Safety	Trial Side Force Inclination (degrees)	Force Imbalance (lbs.)	Moment Imbalance (ft.-lbs.)	Delta-F	Delta Theta (degrees)
1	3.00000	-15.0000	-.3774E+05	.3818E+08		
First-order corrections to F and THETA					-.382E+01	-.122E+01
Values factored by .131E+00 - Deltas too large					-.500E+00	-.159E+00
2	2.50000	-15.1592	-.3192E+05	.3230E+08		
First-order corrections to F and THETA					-.231E+01	-.144E+01
Values factored by .216E+00 - Deltas too large					-.500E+00	-.312E+00
3	2.00000	-15.4709	-.2349E+05	.2379E+08		
First-order corrections to F and THETA					-.113E+01	-.190E+01
Values factored by .441E+00 - Deltas too large					-.500E+00	-.839E+00
4	1.50000	-16.3101	-.1012E+05	.1032E+08		
First-order corrections to F and THETA					-.282E+00	-.363E+01
Second-order correction - Iteration 1					-.245E+00	-.363E+01
Second-order correction - Iteration 2					-.244E+00	-.363E+01
Second-order correction - Iteration 3					-.244E+00	-.363E+01
5	1.25596	-19.9387	.3253E+03	-.1560E+06		
First-order corrections to F and THETA					.599E-01	-.148E+02
Values factored by .580E+00 - Deltas too large					.348E-01	-.859E+01
6	1.29073	-28.5331	.2643E+03	-.1983E+06		
First-order corrections to F and THETA					.208E-01	-.364E+01
Second-order correction - Iteration 1					.213E-01	-.364E+01
Second-order correction - Iteration 2					.213E-01	-.364E+01
7	1.31207	-32.1705	.2555E+01	-.1192E+05		
First-order corrections to F and THETA					-.278E-02	.609E+00
Second-order correction - Iteration 1					-.275E-02	.609E+00
Second-order correction - Iteration 2					-.275E-02	.609E+00
8	1.30931	-31.5618	-.1911E-01	-.3419E+02		
First-order corrections to F and THETA					-.154E-04	.328E-02

Factor of Safety - - - - - - - - 1.309
Side Force Inclination - - - - - -31.56
Number of Iterations - - - - - - 8

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Section D, Origin Crest, Units lbs-ft
By CJCW; Date March 2003

TABLE NO. 38

****
* Final Results for Stresses Along the Shear Surface *
* (Results for Critical Shear Surface in Case of a Search.) *
****

SPENCER'S PROCEDURE USED TO COMPUTE FACTOR OF SAFETY
Factor of Safety = 1.309 Side Force Inclination = -31.56 Degrees

-------- VALUES AT CENTER OF BASE OF SLICE---------

Slice No.	X-center	Y-center	Total Normal Stress	Effective Normal Stress	Shear Stress
1	-.6	1070.7	47.9	47.9	27.6
2	1.1	1067.1	160.4	160.4	92.3
3	3.5	1062.7	294.1	294.1	169.3
4	6.1	1058.4	435.5	435.5	250.7
5	8.9	1054.2	580.9	580.9	334.3
6	11.9	1050.2	726.5	726.5	418.1
7	15.1	1046.4	869.0	869.0	500.1
8	18.6	1042.7	1004.7	1004.7	578.2
9	22.2	1039.2	1130.0	1130.0	650.4
10	26.0	1035.9	1241.4	1241.4	714.5
11	29.5	1033.1	1326.2	1326.2	763.3
12	33.1	1030.6	1403.1	1403.1	807.6
13	37.3	1027.9	1480.4	1480.4	852.0
14	41.7	1025.4	1532.1	1532.1	881.8
15	46.2	1023.1	1553.6	1553.6	894.1
16	50.8	1021.1	1539.4	1539.4	886.0
17	55.0	1019.5	1491.8	1491.8	858.6
18	59.4	1018.1	1401.4	1401.4	806.6
19	63.4	1016.9	1283.5	1283.5	738.7
20	67.5	1016.0	1141.4	1141.4	656.9
21	72.4	1015.1	930.0	930.0	535.2
22	77.4	1014.5	637.6	637.6	367.0
23	82.4	1014.1	245.0	245.0	141.0
24	85.0	1014.0	4.5	4.5	2.6

CHECK SUMS - (ALL SHOULD BE SMALL)
SUM OF FORCES IN VERTICAL DIRECTION = .00 (= .271E-02)
SHOULD NOT EXCEED .100E+03
SUM OF FORCES IN HORIZONTAL DIRECTION = .00 (= .428E-02)
SHOULD NOT EXCEED .100E+03
SUM OF MOMENTS ABOUT COORDINATE ORIGIN = 34.82 (= .348E+02)
SHOULD NOT EXCEED .100E+03
SHEAR STRENGTH/SHEAR FORCE CHECK-SUM = .00 (= .174E-02)
SHOULD NOT EXCEED .100E+03

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Section D, Origin Crest, Units lbs-ft
By CJCW; Date March 2003

TABLE NO. 39

****
* Final Results for Side Forces and Stresses Between Slices. *
* (Results for Critical Shear Surface in Case of a Search.) *
****

SPENCER'S PROCEDURE USED TO COMPUTE FACTOR OF SAFETY
Factor of Safety = 1.309 Side Force Inclination = -31.56 Degrees

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---------- VALUES AT RIGHT SIDE OF SLICE ----------

Slice No.	X-Right	Side Force	Y-Coord. of Side Force Location	Fraction of Height	Sigma at Top	Sigma at Bottom
1	.0	110.	1070.3	.362	6.1	64.9
2	2.2	713.	1066.8	.356	15.2	207.2
3	4.7	1730.	1063.3	.352	20.6	348.1
4	7.4	3101.	1059.8	.350	25.4	491.1
5	10.3	4744.	1056.4	.349	30.6	634.5
6	13.5	6560.	1053.0	.348	36.7	775.5
7	16.8	8441.	1049.7	.349	44.4	911.2
8	20.3	10274.	1046.5	.350	54.2	1038.6
9	24.0	11944.	1043.4	.352	67.0	1154.5
10	27.9	13345.	1040.3	.354	83.6	1255.9
11	31.0	14173.	1038.1	.357	99.2	1321.5
12	35.2	14881.	1035.2	.355	96.3	1394.5
13	39.5	15102.	1032.5	.354	94.4	1446.4
14	43.9	14784.	1029.9	.353	94.7	1472.2
15	48.4	13909.	1027.4	.354	98.5	1467.1
16	53.1	12497.	1025.1	.357	107.5	1425.9
17	57.0	10976.	1023.3	.360	120.2	1361.3
18	61.8	8795.	1021.3	.368	143.6	1242.4
19	65.0	7250.	1020.1	.375	164.9	1140.2
20	69.9	4826.	1018.3	.376	141.0	950.3
21	74.9	2539.	1016.8	.390	137.7	675.7
22	79.9	762.	1015.6	.477	197.6	262.4
23	84.9	0.	796.1	BELOW	-120597.5	120606.8
24	85.0	0.	-1982.1	BELOW	.0	.0

CHECK SUMS - (ALL SHOULD BE SMALL)
SUM OF FORCES IN VERTICAL DIRECTION = .00 (= .271E-02)
SHOULD NOT EXCEED .100E+03
SUM OF FORCES IN HORIZONTAL DIRECTION = .00 (= .428E-02)
SHOULD NOT EXCEED .100E+03
SUM OF MOMENTS ABOUT COORDINATE ORIGIN = 34.82 (= .348E+02)
SHOULD NOT EXCEED .100E+03
SHEAR STRENGTH/SHEAR FORCE CHECK-SUM = .00 (= .174E-02)
SHOULD NOT EXCEED .100E+03

***** CAUTION ***** SOME OF THE FORCES BETWEEN SLICES ACT AT POINTS
ABOVE THE SURFACE OF THE SLOPE OR BELOW THE
SHEAR SURFACE - EITHER A TENSION CRACK MAY BE
NEEDED OR THE SOLUTION MAY NOT BE A VALID SOLUTION

=> .

END-OF-FILE ENCOUNTERED WHILE READING COMMAND
WORDS - END OF PROBLEM(S) ASSUMED

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TABLE NO. 1
```
*****************************************
* COMPUTER PROGRAM DESIGNATION - UTEXAS3 *
* Originally Coded By Stephen G. Wright  *
* Version No. 1.208                      *
* Last Revision Date 2/22/98             *
* (C) Copyright 1985-1998 S. G. Wright   *
* All Rights Reserved                    *
*****************************************

*************************************************************
*                                                           *
*      RESULTS OF COMPUTATIONS PERFORMED USING THIS COMPUTER *
* PROGRAM SHOULD NOT BE USED FOR DESIGN PURPOSES UNLESS THEY *
* HAVE BEEN VERIFIED BY INDEPENDENT ANALYSES, EXPERIMENTAL   *
* DATA OR FIELD EXPERIENCE. THE USER SHOULD UNDERSTAND THE   *
* ALGORITHMS AND ANALYTICAL PROCEDURES USED IN THE COMPUTER  *
* PROGRAM AND MUST HAVE READ ALL DOCUMENTATION FOR THIS      *
* PROGRAM BEFORE ATTEMPTING ITS USE.                         *
*                                                           *
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* MAKE OR ASSUME LIABILITY FOR ANY WARRANTIES, EXPRESSED OR  *
* IMPLIED, CONCERNING THE ACCURACY, RELIABILITY, USEFULNESS  *
* OR ADAPTABILITY OF THIS COMPUTER PROGRAM.                  *
*                                                           *
*************************************************************
```
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Elizabeth Mine. Post-Earthquake, Existing Phreatic Surface
Section A, Origin Crest, Units lbs-ft
By CJCW; Date March, 2003

TABLE NO. 2
```
*************************
* NEW PROFILE LINE DATA *
*************************
```
PROFILE LINE 1 - MATERIAL TYPE = 1
Slime

Point	X	Y
1	-180.000	1064.000
2	-136.000	1065.500
3	-102.000	1068.000
4	-16.000	1012.000

PROFILE LINE 2 - MATERIAL TYPE = 2
Sand

Point	X	Y
1	-102.000	1068.000
2	-50.500	1070.000
3	-21.000	1072.000
4	.000	1072.000
5	45.000	1042.000
6	67.500	1034.000
7	76.000	1034.000
8	84.000	1035.500
9	89.000	1042.000
10	104.000	1043.800
11	114.000	1050.000
12	158.000	1052.000

PROFILE LINE 3 - MATERIAL TYPE = 3
Glacial Till

Point	X	Y
1	-180.000	1004.500
2	-100.000	1008.000
3	-60.000	1009.500
4	-16.000	1012.000
5	.000	1013.000
6	6.000	1014.000
7	47.000	1017.500
8	76.000	1022.000
9	108.000	1031.000
10	131.000	1039.000
11	158.000	1052.000
12	170.000	1053.000
13	177.000	1053.500

PROFILE LINE 4 - MATERIAL TYPE = 4
Ablasial Till (20' below Glacial)

Point	X	Y
1	-180.000	984.500
2	-100.000	988.000
3	-60.000	989.500
4	-16.000	992.000
5	.000	993.000
6	6.000	994.000
7	47.000	997.500
8	76.000	1002.000
9	108.000	1011.000
10	131.000	1019.000
11	158.000	1032.000
12	170.000	1033.000
13	177.000	1033.500

All new profile lines defined - No old lines retained
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Section A, Origin Crest, Units lbs-ft
By CJCW; Date March, 2003

TABLE NO. 3
```
**********************************************************************
* NEW MATERIAL PROPERTY DATA - CONVENTIONAL/FIRST-STAGE COMPUTATIONS *
**********************************************************************
```
DATA FOR MATERIAL TYPE 1
Slime

Unit weight of material = 120.000

CONVENTIONAL (ISOTROPIC) SHEAR STRENGTHS
Cohesion - - - - - - - - .000
Friction angle - - - - - 29.600 degrees

Pore water pressures defined by piezometric line

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```
     Number of the piezometric line used =  1
     Negative pore pressures set to zero

DATA FOR MATERIAL TYPE  2
Sand

     Unit weight of material =  120.000

     CONVENTIONAL (ISOTROPIC) SHEAR STRENGTHS
     Cohesion - - - - - - - -        .000
     Friction angle - - - - -  29.600 degrees

     Pore water pressures defined by piezometric line
     Number of the piezometric line used =  1
     Negative pore pressures set to zero

DATA FOR MATERIAL TYPE  3
Glacial Till

     Unit weight of material =  140.000

     CONVENTIONAL (ISOTROPIC) SHEAR STRENGTHS
     Cohesion - - - - - - - -     500.000
     Friction angle - - - - -  40.000 degrees

     Pore water pressures defined by piezometric line
     Number of the piezometric line used =  1
     Negative pore pressures set to zero

DATA FOR MATERIAL TYPE  4
Ablasial

     Unit weight of material =  140.000

     CONVENTIONAL (ISOTROPIC) SHEAR STRENGTHS
     Cohesion - - - - - - - -     500.000
     Friction angle - - - - -  40.000 degrees

     Pore water pressures defined by piezometric line
     Number of the piezometric line used =  1
     Negative pore pressures set to zero

All new material properties defined - No old data retained
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 Section A, Origin Crest, Units lbs-ft
 By CJCW;  Date March, 2003

TABLE NO.  5
**********************************************************************
* NEW PIEZOMETRIC LINE DATA - CONVENTIONAL/FIRST-STAGE COMPUTATIONS *
**********************************************************************

Line
 No.    Point       X           Y

  1 - Unit weight of water =   62.40
  1        1    -180.000    1025.000
  1        2    -100.000    1025.000
  1        3      94.000    1023.000
  1        4     177.000    1023.000

All new piezometric lines defined - No old lines retained
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```



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 Elizabeth Mine. Post-Earthquake, Existing Phreatic Surface
 Section A, Origin Crest, Units lbs-ft
 By CJCW;  Date March, 2003

TABLE NO. 15
*********************************
* NEW ANALYSIS/COMPUTATION DATA *
*********************************

Circular Shear Surface(s)

Computations Performed for Single Shear Surface

Center Coordinates for Center of Circle -
                                          X =      63.000
                                          Y =    1106.000

Circle is Tangent to Horizontal Line at -
                                          Y =    1034.000
                                          Radius =      72.000

-----------------------------------------------------------------------
THE FOLLOWING REPRESENT EITHER DEFAULT OR PREVIOUSLY DEFINED VALUES:

Initial trial estimate for the factor of safety =   3.000

Initial trial estimate for side force inclination =  15.000 degrees
(Applicable to Spencer's procedure only)

Maximum number of iterations allowed for
calculating the factor of safety =   40

Allowed force imbalance for convergence =     100.000

Allowed moment imbalance for convergence =     100.000

Maximum subtended angle to be used for subdivision of the
circle into slices =   3.00 degrees

Depth of crack =        .000

Depth of water in crack =        .000

Unit weight of water in crack =    62.400

Seismic coefficient =  .000

Conventional (single-stage) computations to be performed

Procedure used to compute the factor of safety: SPENCER
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 Elizabeth Mine. Post-Earthquake, Existing Phreatic Surface
 Section A, Origin Crest, Units lbs-ft
 By CJCW;  Date March, 2003

TABLE NO. 16
**************************
* NEW SLOPE GEOMETRY DATA *
**************************

NOTE - NO DATA WERE INPUT, SLOPE GEOMETRY DATA
WERE GENERATED BY THE PROGRAM
```

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Slope Coordinates -

Point	X	Y
1	-180.000	1064.000
2	-136.000	1065.500
3	-102.000	1068.000
4	-50.500	1070.000
5	-21.000	1072.000
6	.000	1072.000
7	45.000	1042.000
8	67.500	1034.000
9	76.000	1034.000
10	84.000	1035.500
11	89.000	1042.000
12	104.000	1043.800
13	114.000	1050.000
14	158.000	1052.000
15	170.000	1053.000
16	177.000	1053.500

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Elizabeth Mine. Post-Earthquake, Existing Phreatic Surface
Section A, Origin Crest, Units lbs-ft
By CJCW; Date March, 2003

TABLE NO. 26

****
* Coordinate, Weight, Strength and Pore Water Pressure *
* Information for Individual Slices for Conventional *
* Computations or First Stage of Multi-Stage Computations. *
* (Information is for the Critical Shear Surface in the *
* Case of an Automatic Search.) *
****

Slice No.	X	Y	Slice Weight	Matl. Type	Cohesion	Friction Angle	Pore Pressure
	-.5	1072.0					
1	-.2	1071.6	24.0	2	.00	29.60	.0
	.0	1071.1					
2	1.0	1069.5	422.9	2	.00	29.60	.0
	1.9	1067.9					
3	2.9	1066.3	925.7	2	.00	29.60	.0
	4.0	1064.7					
4	5.0	1063.4	1276.9	2	.00	29.60	.0
	6.0	1062.0					
5	7.2	1060.5	1901.4	2	.00	29.60	.0
	8.4	1059.1					
6	9.6	1057.7	2391.9	2	.00	29.60	.0
	10.9	1056.3					
7	12.2	1055.0	2845.0	2	.00	29.60	.0
	13.6	1053.6					
8	15.0	1052.4	3245.1	2	.00	29.60	.0
	16.4	1051.1					
9	17.9	1049.9	3577.5	2	.00	29.60	.0
	19.3	1048.8					
10	20.9	1047.7	3829.1	2	.00	29.60	.0
	22.4	1046.6					
11	24.0	1045.5	3988.2	2	.00	29.60	.0
	25.6	1044.5					
12	27.2	1043.6	4044.6	2	.00	29.60	.0
	28.8	1042.6					
13	30.5	1041.8	3990.2	2	.00	29.60	.0
	32.2	1040.9					
14	33.9	1040.2	3818.3	2	.00	29.60	.0
	35.6	1039.4					
15	37.4	1038.7	3524.7	2	.00	29.60	.0
	39.2	1038.1					
16	40.9	1037.5	3106.8	2	.00	29.60	.0
	42.7	1036.9					
17	43.9	1036.6	1667.9	2	.00	29.60	.0
	45.0	1036.3					
18	46.0	1036.0	1344.3	2	.00	29.60	.0
	47.0	1035.8					
19	48.8	1035.4	2307.2	2	.00	29.60	.0
	50.7	1035.1					
20	52.6	1034.8	2025.6	2	.00	29.60	.0
	54.4	1034.5					

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Section A, Origin Crest, Units lbs-ft
By CJCW; Date March, 2003

TABLE NO. 26

****
* Coordinate, Weight, Strength and Pore Water Pressure *
* Information for Individual Slices for Conventional *
* Computations or First Stage of Multi-Stage Computations. *
* (Information is for the Critical Shear Surface in the *
* Case of an Automatic Search.) *
****

Slice No.	X	Y	Slice Weight	Matl. Type	Cohesion	Friction Angle	Pore Pressure
	54.4	1034.5					
21	56.3	1034.3	1641.4	2	.00	29.60	.0
	58.2	1034.2					
22	60.1	1034.1	1157.0	2	.00	29.60	.0
	61.9	1034.0					
23	62.5	1034.0	225.8	2	.00	29.60	.0
	63.0	1034.0					
24	64.9	1034.0	398.3	2	.00	29.60	.0
	66.8	1034.1					
25	67.0	1034.1	3.8	2	.00	29.60	.0
	67.2	1034.1					

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TABLE NO. 27

****
* Seismic Forces and Forces Due to Surface Pressures for *
* Individual Slices for Conventional Computations or the *
* First Stage of Multi-Stage Computations. *
* (Information is for the Critical Shear Surface in the *
* Case of an Automatic Search.) *
****

				FORCES DUE TO SURFACE PRESSURES			
Slice No.	X	Seismic Force	Y for Seismic Force	Normal Force	Shear Force	X	Y

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1	-.2	0.	1071.8	0.	0.	.0	.0
2	1.0	0.	1070.4	0.	0.	.0	.0
3	2.9	0.	1068.2	0.	0.	.0	.0
4	5.0	0.	1066.0	0.	0.	.0	.0
5	7.2	0.	1063.9	0.	0.	.0	.0
6	9.6	0.	1061.6	0.	0.	.0	.0
7	12.2	0.	1059.4	0.	0.	.0	.0
8	15.0	0.	1057.2	0.	0.	.0	.0
9	17.9	0.	1055.0	0.	0.	.0	.0
10	20.9	0.	1052.9	0.	0.	.0	.0
11	24.0	0.	1050.8	0.	0.	.0	.0
12	27.2	0.	1048.7	0.	0.	.0	.0
13	30.5	0.	1046.7	0.	0.	.0	.0
14	33.9	0.	1044.8	0.	0.	.0	.0
15	37.4	0.	1042.9	0.	0.	.0	.0
16	40.9	0.	1041.1	0.	0.	.0	.0
17	43.9	0.	1039.7	0.	0.	.0	.0
18	46.0	0.	1038.8	0.	0.	.0	.0
19	48.8	0.	1038.0	0.	0.	.0	.0
20	52.6	0.	1037.0	0.	0.	.0	.0
21	56.3	0.	1036.2	0.	0.	.0	.0
22	60.1	0.	1035.4	0.	0.	.0	.0
23	62.5	0.	1034.9	0.	0.	.0	.0
24	64.9	0.	1034.5	0.	0.	.0	.0
25	67.0	0.	1034.1	0.	0.	.0	.0

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Section A, Origin Crest, Units lbs-ft
By CJCW; Date March, 2003

TABLE NO. 29

****
* Information Generated During Iterative Solution for the Factor *
* of Safety and Side Force Inclination by Spencer's Procedure *
****

Iteration	Trial Factor of Safety	Trial Side Force Inclination (degrees)	Force Imbalance (lbs.)	Moment Imbalance (ft.-lbs.)	Delta-F	Delta Theta (degrees)
1	3.00000	-15.0000	-.1738E+05	.1773E+08		
First-order corrections to F and THETA					-.511E+01	-.663E+00
Values factored by .978E-01 - Deltas too large					-.500E+00	-.648E-01
2	2.50000	-15.0648	-.1536E+05	.1567E+08		
First-order corrections to F and THETA					-.320E+01	-.759E+00
Values factored by .156E+00 - Deltas too large					-.500E+00	-.119E+00
3	2.00000	-15.1835	-.1240E+05	.1266E+08		
First-order corrections to F and THETA					-.170E+01	-.943E+00
Values factored by .294E+00 - Deltas too large					-.500E+00	-.278E+00
4	1.50000	-15.4610	-.7641E+04	.7810E+07		
First-order corrections to F and THETA					-.610E+00	-.146E+01
Values factored by .819E+00 - Deltas too large					-.500E+00	-.120E+01
5	1.00000	-16.6591	.1442E+04	-.1404E+07		
First-order corrections to F and THETA					-.796E-02	.197E+02
Values factored by .436E+00 - Deltas too large					-.347E-02	.859E+01
6	.99653	-8.0648	.8861E+03	-.8343E+06		
First-order corrections to F and THETA					.149E+00	-.417E+02
Values factored by .206E+00 - Deltas too large					.306E-01	-.859E+01
7	1.02715	-16.6591	.7452E+03	-.7009E+06		
First-order corrections to F and THETA					.256E+00	-.725E+02
Values factored by .118E+00 - Deltas too large					.304E-01	-.859E+01
8	1.05754	-25.2535	.7203E+03	-.6772E+06		
First-order corrections to F and THETA					-.887E-01	.310E+02
Values factored by .277E+00 - Deltas too large					-.246E-01	.859E+01
9	1.03294	-16.6591	.6010E+03	-.5554E+06		
First-order corrections to F and THETA					.139E+00	-.369E+02
Values factored by .233E+00 - Deltas too large					.324E-01	-.859E+01
10	1.06536	-25.2535	.5206E+03	-.4860E+06		
First-order corrections to F and THETA					.651E-01	-.119E+02
Values factored by .720E+00 - Deltas too large					.468E-01	-.859E+01
11	1.11219	-33.8479	.2365E+03	-.2422E+06		
First-order corrections to F and THETA					-.341E-01	.922E+01
Values factored by .932E+00 - Deltas too large					-.318E-01	.859E+01
12	1.08044	-25.2535	.1440E+03	-.1254E+06		
First-order corrections to F and THETA					.179E-01	-.330E+01
Second-order correction - Iteration 1					.184E-01	-.330E+01
Second-order correction - Iteration 2					.184E-01	-.330E+01
13	1.09879	-28.5581	.6126E+00	-.4547E+04		
First-order corrections to F and THETA					-.302E-02	.773E+00
Second-order correction - Iteration 1					-.299E-02	.773E+00
Second-order correction - Iteration 2					-.299E-02	.773E+00
14	1.09580	-27.7851	-.1677E-01	-.1135E+02		
First-order corrections to F and THETA					-.213E-04	.535E-02

Factor of Safety - - - - - - - - 1.096
Side Force Inclination - - - - - -27.79
Number of Iterations - - - - - - 14

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Section A, Origin Crest, Units lbs-ft
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TABLE NO. 38

****
* Final Results for Stresses Along the Shear Surface *
* (Results for Critical Shear Surface in Case of a Search.) *
****

SPENCER'S PROCEDURE USED TO COMPUTE FACTOR OF SAFETY
Factor of Safety = 1.096 Side Force Inclination = -27.79 Degrees

-------- VALUES AT CENTER OF BASE OF SLICE---------

Slice No.	X-center	Y-center	Total Normal Stress	Effective Normal Stress	Shear Stress
1	-.2	1071.6	19.4	19.4	10.1
2	1.0	1069.5	88.4	88.4	45.8
3	2.9	1066.3	192.9	192.9	100.0
4	5.0	1063.4	295.3	295.3	153.1
5	7.2	1060.5	397.3	397.3	206.0
6	9.6	1057.7	502.5	502.5	260.5
7	12.2	1055.0	602.6	602.6	312.4

8	15.0	1052.4	694.9	694.9	360.3
9	17.9	1049.9	776.8	776.8	402.7
10	20.9	1047.7	845.6	845.6	438.4
11	24.0	1045.5	898.5	898.5	465.8
12	27.2	1043.6	932.5	932.5	483.4
13	30.5	1041.8	944.7	944.7	489.7
14	33.9	1040.2	931.6	931.6	483.0
15	37.4	1038.7	889.5	889.5	461.1
16	40.9	1037.5	814.3	814.3	422.1
17	43.9	1036.6	727.7	727.7	377.3
18	46.0	1036.0	685.3	685.3	355.3
19	48.8	1035.4	666.6	666.6	345.6
20	52.6	1034.8	617.1	617.1	319.9
21	56.3	1034.3	530.4	530.4	275.0
22	60.1	1034.1	399.2	399.2	206.9
23	62.5	1034.0	291.4	291.4	151.1
24	64.9	1034.0	151.1	151.1	78.3
25	67.0	1034.1	14.5	14.5	7.5

CHECK SUMS - (ALL SHOULD BE SMALL)
SUM OF FORCES IN VERTICAL DIRECTION = .00 (= .129E-02)
SHOULD NOT EXCEED .100E+03
SUM OF FORCES IN HORIZONTAL DIRECTION = .00 (= .149E-02)
SHOULD NOT EXCEED .100E+03
SUM OF MOMENTS ABOUT COORDINATE ORIGIN = 12.03 (= .120E+02)
SHOULD NOT EXCEED .100E+03
SHEAR STRENGTH/SHEAR FORCE CHECK-SUM = .00 (= .758E-03)
SHOULD NOT EXCEED .100E+03

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Section A, Origin Crest, Units lbs-ft
By CJCW; Date March, 2003

TABLE NO. 39
****
* Final Results for Side Forces and Stresses Between Slices. *
* (Results for Critical Shear Surface in Case of a Search.) *
****

SPENCER'S PROCEDURE USED TO COMPUTE FACTOR OF SAFETY
Factor of Safety = 1.096 Side Force Inclination = -27.79 Degrees

---------- VALUES AT RIGHT SIDE OF SLICE ----------

Slice No.	X-Right	Side Force	Y-Coord. of Side Force Location	Fraction of Height	Sigma at Top	Sigma at Bottom
1	.0	14.	1071.4	.356	1.9	26.0
2	1.9	239.	1069.1	.424	40.8	108.6
3	4.0	690.	1066.5	.391	46.2	219.7
4	6.0	1256.	1064.3	.382	54.1	317.0
5	8.4	2014.	1061.9	.380	67.5	419.1
6	10.9	2856.	1059.5	.380	84.4	515.0
7	13.6	3723.	1057.2	.383	105.3	602.5
8	16.4	4555.	1055.0	.387	131.1	678.8
9	19.3	5294.	1052.8	.393	163.2	741.2
10	22.4	5890.	1050.8	.402	203.5	786.4
11	25.6	6298.	1048.8	.413	254.4	811.0
12	28.8	6489.	1047.0	.428	319.8	810.6
13	32.2	6444.	1045.2	.447	406.0	779.8
14	35.6	6167.	1043.6	.475	523.4	710.7
15	39.2	5679.	1042.1	.513	692.1	590.5
16	42.7	5030.	1040.7	.569	955.4	393.7
17	45.0	4579.	1039.8	.618	1210.7	207.3
18	47.0	4152.	1039.1	.601	1073.4	265.1
19	50.7	3267.	1037.9	.574	848.1	327.8
20	54.4	2299.	1036.8	.554	650.1	333.6
21	58.2	1343.	1035.9	.544	475.9	278.1
22	61.9	532.	1035.1	.560	325.7	152.6
23	63.0	354.	1035.0	.606	320.4	71.3
24	66.8	4.	1026.1	BELOW	-6051.0	6091.7
25	67.2	0.	-772.0	BELOW	.0	.0

CHECK SUMS - (ALL SHOULD BE SMALL)
SUM OF FORCES IN VERTICAL DIRECTION = .00 (= .129E-02)
SHOULD NOT EXCEED .100E+03
SUM OF FORCES IN HORIZONTAL DIRECTION = .00 (= .149E-02)
SHOULD NOT EXCEED .100E+03
SUM OF MOMENTS ABOUT COORDINATE ORIGIN = 12.03 (= .120E+02)
SHOULD NOT EXCEED .100E+03
SHEAR STRENGTH/SHEAR FORCE CHECK-SUM = .00 (= .758E-03)
SHOULD NOT EXCEED .100E+03

***** CAUTION ***** SOME OF THE FORCES BETWEEN SLICES ACT AT POINTS
ABOVE THE SURFACE OF THE SLOPE OR BELOW THE
SHEAR SURFACE - EITHER A TENSION CRACK MAY BE
NEEDED OR THE SOLUTION MAY NOT BE A VALID SOLUTION

=> .

END-OF-FILE ENCOUNTERED WHILE READING COMMAND
WORDS - END OF PROBLEM(S) ASSUMED

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        TABLE NO. 1
        ****************************************
        * COMPUTER PROGRAM DESIGNATION - UTEXAS3 *
        * Originally Coded By Stephen G. Wright  *
        * Version No. 1.208                      *
        * Last Revision Date  2/22/98            *
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        * All Rights Reserved                    *
        ****************************************

        ************************************************************
        *                                                          *
        *      RESULTS OF COMPUTATIONS PERFORMED USING THIS COMPUTER *
        * PROGRAM SHOULD NOT BE USED FOR DESIGN PURPOSES UNLESS THEY *
        * HAVE BEEN VERIFIED BY INDEPENDENT ANALYSES, EXPERIMENTAL   *
        * DATA OR FIELD EXPERIENCE. THE USER SHOULD UNDERSTAND THE   *
        * ALGORITHMS AND ANALYTICAL PROCEDURES USED IN THE COMPUTER  *
        * PROGRAM AND MUST HAVE READ ALL DOCUMENTATION FOR THIS      *
        * PROGRAM BEFORE ATTEMPTING ITS USE.                         *
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          Section B, Origin Crest, Units lbs-ft.
          By CJCW; Date March, 2003

        TABLE NO.  2
        ************************
        * NEW PROFILE LINE DATA *
        ************************

        PROFILE LINE  1 - MATERIAL TYPE =  1
        Slime Line

             Point       X            Y

               1      -200.000     1064.000
               2      -170.000     1064.000
               3      -146.000     1065.000
               4      -116.000     1065.000
               5      -102.000     1065.500
               6        61.000      949.000

        PROFILE LINE  2 - MATERIAL TYPE =  2
        Sand Line

             Point       X            Y

               1      -102.000     1065.500
               2       -39.000     1069.000
               3       -21.000     1071.000
               4          .000     1071.000
               5       110.000      993.000
               6       118.000      991.000
```



```
               7       145.000      975.000
               8       153.000      973.000
               9       168.000      967.000

        PROFILE LINE  3 - MATERIAL TYPE =  3
        Glacial Till Line

             Point       X            Y

               1      -200.000      984.000
               2       -28.000      959.000
               3        61.000      949.000
               4       118.000      941.000
               5       210.000      941.000
               6       250.000      940.000

        PROFILE LINE  4 - MATERIAL TYPE =  4
        Ablasial Till Line (20' below Glacial)

             Point       X            Y

               1      -200.000      964.000
               2       -28.000      939.000
               3        61.000      929.000
               4       118.000      921.000
               5       210.000      921.000
               6       250.000      920.000

        PROFILE LINE  6 - MATERIAL TYPE =  6
        Starter Dam

             Point       X            Y

               1       118.000      941.000
               2       145.000      967.000
               3       168.000      967.000
               4       210.000      941.000

        All new profile lines defined - No old lines retained
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          Section B, Origin Crest, Units lbs-ft.
          By CJCW; Date March, 2003

        TABLE NO.  3
        ************************************************************************
        * NEW MATERIAL PROPERTY DATA - CONVENTIONAL/FIRST-STAGE COMPUTATIONS *
        ************************************************************************

        DATA FOR MATERIAL TYPE  1
        Slime

             Unit weight of material =  120.000

             CONVENTIONAL (ISOTROPIC) SHEAR STRENGTHS
             Cohesion - - - - - - - -        .000
             Friction angle - - - - -  29.600 degrees

             Pore water pressures defined by piezometric line
             Number of the piezometric line used =  1
             Negative pore pressures set to zero

        DATA FOR MATERIAL TYPE  2
        Sand
```

Unit weight of material = 120.000

CONVENTIONAL (ISOTROPIC) SHEAR STRENGTHS
Cohesion - - - - - - - - .000
Friction angle - - - - - 29.600 degrees

Pore water pressures defined by piezometric line
Number of the piezometric line used = 1
Negative pore pressures set to zero

DATA FOR MATERIAL TYPE 3
Glacial Till

Unit weight of material = 140.000

CONVENTIONAL (ISOTROPIC) SHEAR STRENGTHS
Cohesion - - - - - - - - 500.000
Friction angle - - - - - 40.000 degrees

Pore water pressures defined by piezometric line
Number of the piezometric line used = 1
Negative pore pressures set to zero

DATA FOR MATERIAL TYPE 4
Ablasial Till

Unit weight of material = 140.000

CONVENTIONAL (ISOTROPIC) SHEAR STRENGTHS
Cohesion - - - - - - - - 500.000
Friction angle - - - - - 40.000 degrees

Pore water pressures defined by piezometric line
Number of the piezometric line used = 1
Negative pore pressures set to zero

DATA FOR MATERIAL TYPE 6
Starter Dam

Unit weight of material = 130.000

CONVENTIONAL (ISOTROPIC) SHEAR STRENGTHS
Cohesion - - - - - - - - .000
Friction angle - - - - - 38.000 degrees

Pore water pressures defined by piezometric line
Number of the piezometric line used = 1
Negative pore pressures set to zero

All new material properties defined - No old data retained
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Section B, Origin Crest, Units lbs-ft.
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TABLE NO. 5
****
* NEW PIEZOMETRIC LINE DATA - CONVENTIONAL/FIRST-STAGE COMPUTATIONS *
****

Line No.	Point	X	Y
1	- Unit weight of water =	62.40	
1	1	-200.000	1012.000
1	2	-21.000	985.000
1	3	168.000	967.000
1	4	210.000	941.000
1	5	250.000	940.000

All new piezometric lines defined - No old lines retained
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Section B, Origin Crest, Units lbs-ft.
By CJCW; Date March, 2003

TABLE NO. 15
****
* NEW ANALYSIS/COMPUTATION DATA *
****

Circular Shear Surface(s)

Computations Performed for Single Shear Surface

Center Coordinates for Center of Circle -
X = 192.000
Y = 1177.000

Circle is Tangent to Horizontal Line at -
Y = 948.500
Radius = 228.500

THE FOLLOWING REPRESENT EITHER DEFAULT OR PREVIOUSLY DEFINED VALUES:

Initial trial estimate for the factor of safety = 3.000

Initial trial estimate for side force inclination = 15.000 degrees
(Applicable to Spencer's procedure only)

Maximum number of iterations allowed for
calculating the factor of safety = 40

Allowed force imbalance for convergence = 100.000

Allowed moment imbalance for convergence = 100.000

Maximum subtended angle to be used for subdivision of the
circle into slices = 3.00 degrees

Depth of crack = .000

Depth of water in crack = .000

Unit weight of water in crack = 62.400

Seismic coefficient = .000

Conventional (single-stage) computations to be performed

Procedure used to compute the factor of safety: SPENCER
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TABLE NO. 16
****
* NEW SLOPE GEOMETRY DATA *
****

NOTE - NO DATA WERE INPUT, SLOPE GEOMETRY DATA
WERE GENERATED BY THE PROGRAM

Slope Coordinates -

Point	X	Y
1	-200.000	1064.000
2	-170.000	1064.000
3	-146.000	1065.000
4	-116.000	1065.000
5	-102.000	1065.500
6	-39.000	1069.000
7	-21.000	1071.000
8	.000	1071.000
9	110.000	993.000
10	118.000	991.000
11	145.000	975.000
12	153.000	973.000
13	168.000	967.000
14	210.000	941.000
15	250.000	940.000

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Section B, Origin Crest, Units lbs-ft.
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TABLE NO. 26
****
* Coordinate, Weight, Strength and Pore Water Pressure *
* Information for Individual Slices for Conventional *
* Computations or First Stage of Multi-Stage Computations. *
* (Information is for the Critical Shear Surface in the *
* Case of an Automatic Search.) *
****

Slice No.	X	Y	Slice Weight	Matl. Type	Cohesion	Friction Angle	Pore Pressure
	-10.4	1071.0					
1	-7.5	1065.8	3651.8	2	.00	29.60	.0
	-4.6	1060.6					
2	-2.3	1056.8	7822.5	2	.00	29.60	.0
	.0	1053.1					
3	3.4	1048.2	16545.1	2	.00	29.60	.0
	6.7	1043.2					
4	10.4	1038.5	21908.9	2	.00	29.60	.0
	14.0	1033.7					
5	17.9	1029.2	27097.5	2	.00	29.60	.0
	21.7	1024.6					
6	25.8	1020.3	31937.1	2	.00	29.60	.0
	30.0	1015.9					
7	34.3	1011.8	36263.4	2	.00	29.60	.0
	38.6	1007.6					
8	43.1	1003.7	39923.1	2	.00	29.60	.0
	47.7	999.8					
9	52.4	996.2	42775.7	2	.00	29.60	.0
	57.2	992.5					
10	59.1	991.2	17534.2	2	.00	29.60	.0
	61.0	989.8					
11	66.0	986.5	45172.6	2	.00	29.60	.0
	71.0	983.2					
12	76.1	980.1	45611.6	2	.00	29.60	.0
	81.3	977.1					
13	83.4	976.0	17941.4	2	.00	29.60	.0
	85.5	974.9					
14	90.8	972.2	44262.8	2	.00	29.60	133.5
	96.2	969.6					
15	101.7	967.2	41808.6	2	.00	29.60	381.9
	107.2	964.8					
16	108.6	964.3	10112.1	2	.00	29.60	523.1
	110.0	963.7					
17	114.0	962.3	28543.4	2	.00	29.60	616.2
	118.0	960.8					
18	123.7	959.0	39167.1	2	.00	29.60	760.8
	129.4	957.2					
19	131.5	956.7	13389.0	2	.00	29.60	862.2
	133.7	956.1					
20	139.3	954.7	32946.0	6	.00	38.00	936.0
	145.0	953.4					

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Section B, Origin Crest, Units lbs-ft.
By CJCW; Date March, 2003

TABLE NO. 26
****
* Coordinate, Weight, Strength and Pore Water Pressure *
* Information for Individual Slices for Conventional *
* Computations or First Stage of Multi-Stage Computations. *
* (Information is for the Critical Shear Surface in the *
* Case of an Automatic Search.) *
****

Slice No.	X	Y	Slice Weight	Matl. Type	Cohesion	Friction Angle	Pore Pressure
	145.0	953.4					
21	149.0	952.6	21675.8	6	.00	38.00	1010.3
	153.0	951.9					
22	158.9	951.0	29800.9	6	.00	38.00	1053.2
	164.8	950.1					
23	166.4	949.9	7254.5	6	.00	38.00	1073.8
	168.0	949.8					
24	168.0	949.8	.3	6	.00	38.00	1075.5
	168.0	949.8					
25	174.0	949.3	21731.0	6	.00	38.00	874.7
	179.9	948.8					
26	185.9	948.7	11280.9	6	.00	38.00	452.8
	191.9	948.5					
27	191.9	948.5	55.4	6	.00	38.00	229.6
	192.0	948.5					
28	194.9	948.5	1365.6	6	.00	38.00	113.7
	197.8	948.6					

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Section B, Origin Crest, Units lbs-ft.
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TABLE NO. 27

****
* Seismic Forces and Forces Due to Surface Pressures for *
* Individual Slices for Conventional Computations or the *
* First Stage of Multi-Stage Computations. *
* (Information is for the Critical Shear Surface in the *
* Case of an Automatic Search.) *
****

Slice No.	X	Seismic Force	Y for Seismic Force	Normal Force	Shear Force	FORCES DUE TO SURFACE PRESSURES X	Y
1	-7.5	0.	1068.4	0.	0.	.0	.0
2	-2.3	0.	1063.9	0.	0.	.0	.0
3	3.4	0.	1058.4	0.	0.	.0	.0
4	10.4	0.	1051.1	0.	0.	.0	.0
5	17.9	0.	1043.7	0.	0.	.0	.0
6	25.8	0.	1036.5	0.	0.	.0	.0
7	34.3	0.	1029.2	0.	0.	.0	.0
8	43.1	0.	1022.1	0.	0.	.0	.0
9	52.4	0.	1015.0	0.	0.	.0	.0
10	59.1	0.	1010.1	0.	0.	.0	.0
11	66.0	0.	1005.3	0.	0.	.0	.0
12	76.1	0.	998.6	0.	0.	.0	.0
13	83.4	0.	993.9	0.	0.	.0	.0
14	90.8	0.	989.4	0.	0.	.0	.0
15	101.7	0.	983.1	0.	0.	.0	.0
16	108.6	0.	979.1	0.	0.	.0	.0
17	114.0	0.	977.1	0.	0.	.0	.0
18	123.7	0.	973.3	0.	0.	.0	.0
19	131.5	0.	969.8	0.	0.	.0	.0
20	139.3	0.	966.3	0.	0.	.0	.0
21	149.0	0.	963.1	0.	0.	.0	.0
22	158.9	0.	960.7	0.	0.	.0	.0
23	166.4	0.	958.8	0.	0.	.0	.0
24	168.0	0.	958.4	0.	0.	.0	.0
25	174.0	0.	956.3	0.	0.	.0	.0
26	185.9	0.	952.3	0.	0.	.0	.0
27	191.9	0.	950.3	0.	0.	.0	.0
28	194.9	0.	949.4	0.	0.	.0	.0

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Section B, Origin Crest, Units lbs-ft.
By CJCW; Date March, 2003

TABLE NO. 29

****
* Information Generated During Iterative Solution for the Factor *
* of Safety and Side Force Inclination by Spencer's Procedure *
****

Iteration	Trial Factor of Safety	Trial Side Force Inclination (degrees)	Force Imbalance (lbs.)	Moment Imbalance (ft.-lbs.)	Delta-F	Delta Theta (degrees)
1	3.00000	-15.0000	-.2238E+06	.2200E+09		
First-order corrections to F and THETA					-.575E+01	-.217E+01
Values factored by .869E-01 - Deltas too large					-.500E+00	-.189E+00
2	2.50000	-15.1888	-.2008E+06	.1974E+09		
First-order corrections to F and THETA					-.366E+01	-.241E+01
Values factored by .137E+00 - Deltas too large					-.500E+00	-.329E+00
3	2.00000	-15.5175	-.1671E+06	.1644E+09		
First-order corrections to F and THETA					-.201E+01	-.280E+01
Values factored by .249E+00 - Deltas too large					-.500E+00	-.696E+00
4	1.50000	-16.2138	-.1131E+06	.1115E+09		
First-order corrections to F and THETA					-.793E+00	-.363E+01
Values factored by .630E+00 - Deltas too large					-.500E+00	-.229E+01
5	1.00000	-18.5020	-.9226E+04	.1054E+08		
First-order corrections to F and THETA					-.575E-04	-.906E+01
Values factored by .948E+00 - Deltas too large					-.545E-04	-.859E+01
6	.99995	-27.0964	.1393E+04	-.9916E+06		
First-order corrections to F and THETA					.115E-01	-.163E+01
Second-order correction - Iteration 1					.116E-01	-.163E+01
Second-order correction - Iteration 2					.116E-01	-.163E+01
7	1.01158	-28.7258	.2118E+01	-.2293E+05		
First-order corrections to F and THETA					-.517E-03	.110E+00
Second-order correction - Iteration 1					-.516E-03	.110E+00
8	1.01106	-28.6156	-.1282E-01	-.2118E+02		
First-order corrections to F and THETA					-.853E-06	.173E-03

Factor of Safety - - - - - - - - 1.011
Side Force Inclination - - - - - - -28.62
Number of Iterations - - - - - - 8

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Section B, Origin Crest, Units lbs-ft.
By CJCW; Date March, 2003

TABLE NO. 38

****
* Final Results for Stresses Along the Shear Surface *
* (Results for Critical Shear Surface in Case of a Search.) *
****

SPENCER'S PROCEDURE USED TO COMPUTE FACTOR OF SAFETY
Factor of Safety = 1.011 Side Force Inclination = -28.62 Degrees

Slice No.	X-center	Y-center	VALUES AT CENTER OF BASE OF SLICE--------- Total Normal Stress	Effective Normal Stress	Shear Stress
1	-7.5	1065.8	233.9	233.9	131.4
2	-2.3	1056.8	684.4	684.4	384.6
3	3.4	1048.2	1059.3	1059.3	595.2
4	10.4	1038.5	1407.6	1407.6	790.9
5	17.9	1029.2	1751.8	1751.8	984.3
6	25.8	1020.3	2083.4	2083.4	1170.6
7	34.3	1011.8	2393.9	2393.9	1345.0
8	43.1	1003.7	2674.8	2674.8	1502.9
9	52.4	996.2	2917.4	2917.4	1639.2
10	59.1	991.2	3065.8	3065.8	1722.6
11	66.0	986.5	3175.0	3175.0	1783.9
12	76.1	980.1	3288.6	3288.6	1847.8
13	83.4	976.0	3334.1	3334.1	1873.3
14	90.8	972.2	3323.4	3189.9	1792.3
15	101.7	967.2	3230.3	2848.5	1600.4

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16	108.6	964.3	3123.4	2600.4	1461.0
17	114.0	962.3	3198.6	2582.4	1450.9
18	123.7	959.0	3202.2	2441.4	1371.8
19	131.5	956.7	3035.4	2173.3	1221.1
20	139.3	954.7	3009.2	2073.1	1602.0
21	149.0	952.6	2927.8	1917.6	1481.8
22	158.9	951.0	2842.7	1789.5	1382.8
23	166.4	949.9	2660.8	1586.9	1226.3
24	168.0	949.8	3089.9	2014.4	1556.6
25	174.0	949.3	2207.0	1332.3	1029.5
26	185.9	948.7	1241.5	788.7	609.4
27	191.9	948.5	659.5	429.9	332.2
28	194.9	948.5	334.2	220.6	170.4

CHECK SUMS - (ALL SHOULD BE SMALL)
SUM OF FORCES IN VERTICAL DIRECTION = .02 (= .193E-01)
SHOULD NOT EXCEED .100E+03
SUM OF FORCES IN HORIZONTAL DIRECTION = .02 (= .217E-01)
SHOULD NOT EXCEED .100E+03
SUM OF MOMENTS ABOUT COORDINATE ORIGIN = 26.30 (= .263E+02)
SHOULD NOT EXCEED .100E+03
SHEAR STRENGTH/SHEAR FORCE CHECK-SUM = .01 (= .118E-01)
SHOULD NOT EXCEED .100E+03

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Section B, Origin Crest, Units lbs-ft.
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TABLE NO. 39
****
* Final Results for Side Forces and Stresses Between Slices. *
* (Results for Critical Shear Surface in Case of a Search.) *
****

SPENCER'S PROCEDURE USED TO COMPUTE FACTOR OF SAFETY
Factor of Safety = 1.011 Side Force Inclination = -28.62 Degrees

---------- VALUES AT RIGHT SIDE OF SLICE ----------

Slice No.	X-Right	Side Force	Y-Coord. of Side Force Location	Fraction of Height	Sigma at Top	Sigma at Bottom
1	-4.6	1912.	1064.2	.348	14.1	307.2
2	.0	5697.	1057.6	.252	-136.0	695.2
3	6.7	13043.	1049.7	.279	-161.0	1157.4
4	14.0	21759.	1042.0	.303	-126.4	1523.2
5	21.7	31276.	1034.5	.320	-69.9	1842.4
6	30.0	40981.	1027.2	.334	1.2	2123.7
7	38.6	50248.	1020.1	.345	87.6	2364.1
8	47.7	58467.	1013.2	.357	192.9	2555.8
9	57.2	65080.	1006.5	.369	323.0	2688.5
10	61.0	67142.	1004.0	.374	383.2	2721.8
11	71.0	70734.	997.8	.390	563.2	2749.4
12	81.3	71767.	992.0	.410	796.6	2679.6
13	85.5	71428.	989.8	.419	908.8	2619.3
14	96.2	69592.	984.3	.443	1212.4	2463.5
15	107.2	66968.	978.9	.465	1535.0	2361.1
16	110.0	66205.	977.5	.469	1621.6	2348.3
17	118.0	63571.	973.6	.425	1016.3	2681.2
18	129.4	58779.	968.4	.412	898.2	2924.4
19	133.7	56905.	966.4	.402	802.7	3092.6
20	145.0	45417.	962.4	.415	906.8	2782.4
21	153.0	37026.	959.7	.372	352.4	2721.6
22	164.8	23992.	956.2	.337	26.5	2295.0
23	168.0	20653.	955.4	.326	-43.7	2147.5
24	168.0	20653.	955.4	.326	-43.7	2147.5
25	179.9	9042.	952.5	.344	48.5	1421.6
26	191.9	1191.	950.1	.423	150.8	412.3
27	192.0	1147.	950.1	.430	159.9	393.1
28	197.8	0.	-3566.1	BELOW	.0	.0

CHECK SUMS - (ALL SHOULD BE SMALL)
SUM OF FORCES IN VERTICAL DIRECTION = .02 (= .193E-01)
SHOULD NOT EXCEED .100E+03
SUM OF FORCES IN HORIZONTAL DIRECTION = .02 (= .217E-01)
SHOULD NOT EXCEED .100E+03
SUM OF MOMENTS ABOUT COORDINATE ORIGIN = 26.30 (= .263E+02)
SHOULD NOT EXCEED .100E+03
SHEAR STRENGTH/SHEAR FORCE CHECK-SUM = .01 (= .118E-01)
SHOULD NOT EXCEED .100E+03

END-OF-FILE ENCOUNTERED WHILE READING COMMAND
WORDS - END OF PROBLEM(S) ASSUMED

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        TABLE NO. 1
        ****************************************
        * COMPUTER PROGRAM DESIGNATION - UTEXAS3 *
        * Originally Coded By Stephen G. Wright  *
        * Version No. 1.208                      *
        * Last Revision Date  2/22/98            *
        * (C) Copyright 1985-1998 S. G. Wright   *
        * All Rights Reserved                    *
        ****************************************

        ************************************************************
        *                                                          *
        *      RESULTS OF COMPUTATIONS PERFORMED USING THIS COMPUTER *
        * PROGRAM SHOULD NOT BE USED FOR DESIGN PURPOSES UNLESS THEY *
        * HAVE BEEN VERIFIED BY INDEPENDENT ANALYSES, EXPERIMENTAL   *
        * DATA OR FIELD EXPERIENCE. THE USER SHOULD UNDERSTAND THE   *
        * ALGORITHMS AND ANALYTICAL PROCEDURES USED IN THE COMPUTER  *
        * PROGRAM AND MUST HAVE READ ALL DOCUMENTATION FOR THIS      *
        * PROGRAM BEFORE ATTEMPTING ITS USE.                         *
        *                                                          *
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        * MAKE OR ASSUME LIABILITY FOR ANY WARRANTIES, EXPRESSED OR  *
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        *                                                          *
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          Section C, Origin Crest, Units lbs-ft
          By CJCW; Date, March 2003

        TABLE NO.  2
        ************************
        * NEW PROFILE LINE DATA *
        ************************

        PROFILE LINE  1 - MATERIAL TYPE =  1
        Slime Tailing

             Point       X             Y

               1      -159.000      1060.000
               2      -100.000      1062.000
               3       -60.000      1065.000
               4       -18.000      1005.000

        PROFILE LINE  2 - MATERIAL TYPE =  2
        Sand Tailing

             Point       X             Y

               1       -60.000      1065.000
               2       -33.000      1066.000
               3       -13.000      1068.000
               4          .000      1068.000
               5        69.000      1016.000
               6        87.000      1005.000
               7        92.000      1002.000
```



```
        PROFILE LINE  3 - MATERIAL TYPE =  3
        Glacial Till

             Point       X             Y

               1      -159.000      1005.000
               2      -100.000      1005.000
               3        18.000      1005.000
               4        92.000      1002.000
               5       118.000       997.000
               6       157.000       993.000

        PROFILE LINE  4 - MATERIAL TYPE =  4
        Ablasial Till (20' below Glacial)

             Point       X             Y

               1      -159.000       985.000
               2        18.000       985.000
               3        92.000       982.000
               4       118.000       977.000
               5       157.000       973.000

        All new profile lines defined - No old lines retained
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          Section C, Origin Crest, Units lbs-ft
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        TABLE NO.  3
        ************************************************************************
        * NEW MATERIAL PROPERTY DATA - CONVENTIONAL/FIRST-STAGE COMPUTATIONS *
        ************************************************************************

        DATA FOR MATERIAL TYPE  1
        Slime Tailing

             Unit weight of material =  120.000

             CONVENTIONAL (ISOTROPIC) SHEAR STRENGTHS
             Cohesion - - - - - - - - -        .000
             Friction angle - - - - -  29.600 degrees

             Pore water pressures defined by piezometric line
             Number of the piezometric line used =  1
             Negative pore pressures set to zero

        DATA FOR MATERIAL TYPE  2
        Sand Tailing

             Unit weight of material =  120.000

             CONVENTIONAL (ISOTROPIC) SHEAR STRENGTHS
             Cohesion - - - - - - - - -        .000
             Friction angle - - - - -  29.600 degrees

             Pore water pressures defined by piezometric line
             Number of the piezometric line used =  1
             Negative pore pressures set to zero

        DATA FOR MATERIAL TYPE  3
        Glacial Till

             Unit weight of material =  140.000
```

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```
     CONVENTIONAL (ISOTROPIC) SHEAR STRENGTHS
     Cohesion - - - - - - - -     500.000
     Friction angle - - - - -  40.000 degrees

     Pore water pressures defined by piezometric line
     Number of the piezometric line used =  1
     Negative pore pressures set to zero

DATA FOR MATERIAL TYPE  4
Ablasial Till

     Unit weight of material =  140.000

     CONVENTIONAL (ISOTROPIC) SHEAR STRENGTHS
     Cohesion - - - - - - - -     500.000
     Friction angle - - - - -  40.000 degrees

     Pore water pressures defined by piezometric line
     Number of the piezometric line used =  1
     Negative pore pressures set to zero

All new material properties defined - No old data retained
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TABLE NO.  5
**************************************************************************
* NEW PIEZOMETRIC LINE DATA - CONVENTIONAL/FIRST-STAGE COMPUTATIONS *
**************************************************************************

Line
 No.    Point       X          Y

  1 - Unit weight of water =   62.40
  1        1    -159.000    1028.000
  1        2     -16.000    1030.000
  1        3      92.000    1002.000
  1        4     118.000     997.000
  1        5     157.000     993.000

All new piezometric lines defined - No old lines retained
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TABLE NO. 15
**********************************
* NEW ANALYSIS/COMPUTATION DATA *
**********************************

Circular Shear Surface(s)

Computations Performed for Single Shear Surface

Center Coordinates for Center of Circle -
                                          X =     102.000
                                          Y =    1133.000
```



```
Circle Passes Throught the Point at -
                                          X =      92.000
                                          Y =    1002.000
                                     Radius =     131.381

------------------------------------------------------------------------
THE FOLLOWING REPRESENT EITHER DEFAULT OR PREVIOUSLY DEFINED VALUES:

Initial trial estimate for the factor of safety =   3.000

Initial trial estimate for side force inclination =  15.000 degrees
(Applicable to Spencer's procedure only)

Maximum number of iterations allowed for
calculating the factor of safety =   40

Allowed force imbalance for convergence =     100.000

Allowed moment imbalance for convergence =     100.000

Maximum subtended angle to be used for subdivision of the
circle into slices =   3.00 degrees

Depth of crack =        .000

Depth of water in crack =       .000

Unit weight of water in crack =    62.400

Seismic coefficient =  .000

Conventional (single-stage) computations to be performed

Procedure used to compute the factor of safety: SPENCER
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TABLE NO. 16
**************************
* NEW SLOPE GEOMETRY DATA *
**************************

NOTE - NO DATA WERE INPUT, SLOPE GEOMETRY DATA
WERE GENERATED BY THE PROGRAM

Slope Coordinates -

     Point       X          Y

       1    -159.000    1060.000
       2    -100.000    1062.000
       3     -60.000    1065.000
       4     -33.000    1066.000
       5     -13.000    1068.000
       6        .000    1068.000
       7      69.000    1016.000
       8      87.000    1005.000
       9      92.000    1002.000
      10     118.000     997.000
      11     157.000     993.000
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```


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Section C, Origin Crest, Units lbs-ft
By CJCW; Date, March 2003

TABLE NO. 26

****
* Coordinate, Weight, Strength and Pore Water Pressure *
* Information for Individual Slices for Conventional *
* Computations or First Stage of Multi-Stage Computations. *
* (Information is for the Critical Shear Surface in the *
* Case of an Automatic Search.) *
****

Slice No.	X	Y	Slice Weight	Matl. Type	Cohesion	Friction Angle	Pore Pressure
	-12.2	1068.0					
1	-10.4	1065.1	1256.7	2	.00	29.60	.0
	-8.6	1062.1					
2	-6.7	1059.3	4046.4	2	.00	29.60	.0
	-4.8	1056.4					
3	-2.7	1053.7	7138.2	2	.00	29.60	.0
	-.6	1050.9					
4	-.3	1050.6	1258.1	2	.00	29.60	.0
	.0	1050.2					
5	2.2	1047.6	10056.8	2	.00	29.60	.0
	4.5	1045.0					
6	6.8	1042.5	11586.1	2	.00	29.60	.0
	9.2	1040.0					
7	11.7	1037.6	12919.4	2	.00	29.60	.0
	14.2	1035.3					
8	16.1	1033.6	10117.9	2	.00	29.60	.0
	18.0	1032.0					
9	20.7	1029.9	14616.7	2	.00	29.60	.0
	23.4	1027.7					
10	26.2	1025.7	15173.5	2	.00	29.60	.0
	29.0	1023.8					
11	31.9	1021.9	15372.1	2	.00	29.60	.0
	34.8	1020.1					
12	37.8	1018.4	15182.5	2	.00	29.60	.0
	40.8	1016.7					
13	43.9	1015.2	14581.2	2	.00	29.60	.0
	47.0	1013.7					
14	47.1	1013.7	191.2	2	.00	29.60	.0
	47.1	1013.6					
15	50.3	1012.3	13534.1	2	.00	29.60	33.4
	53.4	1010.9					
16	56.6	1009.7	12059.5	2	.00	29.60	88.7
	59.9	1008.6					
17	63.2	1007.5	10143.8	2	.00	29.60	121.0
	66.4	1006.5					
18	67.7	1006.2	3313.9	2	.00	29.60	132.2
	69.0	1005.8					
19	72.4	1005.1	7154.9	2	.00	29.60	127.3
	75.7	1004.3					
20	79.1	1003.7	5004.5	2	.00	29.60	104.2
	82.5	1003.1					

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TABLE NO. 26

****
* Coordinate, Weight, Strength and Pore Water Pressure *
* Information for Individual Slices for Conventional *
* Computations or First Stage of Multi-Stage Computations. *
* (Information is for the Critical Shear Surface in the *
* Case of an Automatic Search.) *
****

Slice No.	X	Y	Slice Weight	Matl. Type	Cohesion	Friction Angle	Pore Pressure
	82.5	1003.1					
21	84.7	1002.8	1958.2	2	.00	29.60	69.0
	87.0	1002.5					
22	89.5	1002.2	756.6	2	.00	29.60	25.5
	92.0	1002.0					

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TABLE NO. 27

****
* Seismic Forces and Forces Due to Surface Pressures for *
* Individual Slices for Conventional Computations or the *
* First Stage of Multi-Stage Computations. *
* (Information is for the Critical Shear Surface in the *
* Case of an Automatic Search.) *
****

				FORCES DUE TO SURFACE PRESSURES			
Slice No.	X	Seismic Force	Y for Seismic Force	Normal Force	Shear Force	X	Y
1	-10.4	0.	1066.5	0.	0.	.0	.0
2	-6.7	0.	1063.6	0.	0.	.0	.0
3	-2.7	0.	1060.8	0.	0.	.0	.0
4	-.3	0.	1059.3	0.	0.	.0	.0
5	2.2	0.	1056.9	0.	0.	.0	.0
6	6.8	0.	1052.7	0.	0.	.0	.0
7	11.7	0.	1048.4	0.	0.	.0	.0
8	16.1	0.	1044.7	0.	0.	.0	.0
9	20.7	0.	1041.1	0.	0.	.0	.0
10	26.2	0.	1037.0	0.	0.	.0	.0
11	31.9	0.	1032.9	0.	0.	.0	.0
12	37.8	0.	1028.9	0.	0.	.0	.0
13	43.9	0.	1025.1	0.	0.	.0	.0
14	47.1	0.	1023.1	0.	0.	.0	.0
15	50.3	0.	1021.2	0.	0.	.0	.0
16	56.6	0.	1017.5	0.	0.	.0	.0
17	63.2	0.	1014.0	0.	0.	.0	.0
18	67.7	0.	1011.6	0.	0.	.0	.0
19	72.4	0.	1009.5	0.	0.	.0	.0
20	79.1	0.	1006.8	0.	0.	.0	.0
21	84.7	0.	1004.6	0.	0.	.0	.0
22	89.5	0.	1002.9	0.	0.	.0	.0

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Section C, Origin Crest, Units lbs-ft
By CJCW; Date, March 2003

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TABLE NO. 29

****

* Information Generated During Iterative Solution for the Factor *
* of Safety and Side Force Inclination by Spencer's Procedure *

****

Iteration	Trial Factor of Safety	Trial Side Force Inclination (degrees)	Force Imbalance (lbs.)	Moment Imbalance (ft.-lbs.)	Delta-F	Delta Theta (degrees)
1	3.00000	-15.0000	-.7232E+05	.7255E+08		
First-order corrections to F and THETA					-.625E+01	-.879E+00
Values factored by .799E-01 - Deltas too large					-.500E+00	-.703E-01
2	2.50000	-15.0703	-.6547E+05	.6569E+08		
First-order corrections to F and THETA					-.403E+01	-.993E+00
Values factored by .124E+00 - Deltas too large					-.500E+00	-.123E+00
3	2.00000	-15.1935	-.5552E+05	.5571E+08		
First-order corrections to F and THETA					-.227E+01	-.119E+01
Values factored by .221E+00 - Deltas too large					-.500E+00	-.263E+00
4	1.50000	-15.4569	-.3967E+05	.3985E+08		
First-order corrections to F and THETA					-.963E+00	-.166E+01
Values factored by .519E+00 - Deltas too large					-.500E+00	-.863E+00
5	1.00000	-16.3199	-.1029E+05	.1052E+08		
First-order corrections to F and THETA					-.116E+00	-.484E+01
Second-order correction - Iteration 1					-.104E+00	-.484E+01
Second-order correction - Iteration 2					-.104E+00	-.484E+01
6	.89566	-21.1627	.2091E+03	.2021E+05		
First-order corrections to F and THETA					.249E-01	-.127E+02
Values factored by .677E+00 - Deltas too large					.168E-01	-.859E+01
7	.91250	-29.7570	.2162E+03	-.1470E+06		
First-order corrections to F and THETA					.719E-02	-.243E+01
Second-order correction - Iteration 1					.731E-02	-.243E+01
Second-order correction - Iteration 2					.731E-02	-.243E+01
8	.91981	-32.1837	.9430E+00	-.6660E+04		
First-order corrections to F and THETA					-.566E-03	.251E+00
Second-order correction - Iteration 1					-.564E-03	.251E+00
9	.91924	-31.9324	-.8087E-02	-.1303E+02		
First-order corrections to F and THETA					-.206E-05	.877E-03

Factor of Safety - - - - - - - - .919
Side Force Inclination - - - - - -31.93
Number of Iterations - - - - - - 9

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Section C, Origin Crest, Units lbs-ft
By CJCW; Date, March 2003

TABLE NO. 38

****

* Final Results for Stresses Along the Shear Surface *
* (Results for Critical Shear Surface in Case of a Search.) *

****

SPENCER'S PROCEDURE USED TO COMPUTE FACTOR OF SAFETY
Factor of Safety = .919 Side Force Inclination = -31.93 Degrees

-------- VALUES AT CENTER OF BASE OF SLICE---------

Slice No.	X-center	Y-center	Total Normal Stress	Effective Normal Stress	Shear Stress
1	-10.4	1065.1	132.4	132.4	81.8
2	-6.7	1059.3	428.7	428.7	264.9
3	-2.7	1053.7	762.7	762.7	471.4
4	-.3	1050.6	970.7	970.7	599.9
5	2.2	1047.6	1088.9	1088.9	672.9
6	6.8	1042.5	1273.1	1273.1	786.8
7	11.7	1037.6	1445.1	1445.1	893.0
8	16.1	1033.6	1581.7	1581.7	977.5
9	20.7	1029.9	1698.4	1698.4	1049.6
10	26.2	1025.7	1810.6	1810.6	1118.9
11	31.9	1021.9	1890.3	1890.3	1168.2
12	37.8	1018.4	1931.4	1931.4	1193.6
13	43.9	1015.2	1926.6	1926.6	1190.6
14	47.1	1013.7	1909.4	1909.4	1180.0
15	50.3	1012.3	1863.0	1829.6	1130.7
16	56.6	1009.7	1730.3	1641.6	1014.5
17	63.2	1007.5	1521.7	1400.7	865.6
18	67.7	1006.2	1331.8	1199.7	741.4
19	72.4	1005.1	1149.0	1021.7	631.4
20	79.1	1003.7	850.8	746.6	461.4
21	84.7	1002.8	528.2	459.3	283.8
22	89.5	1002.2	194.9	169.4	104.7

CHECK SUMS - (ALL SHOULD BE SMALL)
SUM OF FORCES IN VERTICAL DIRECTION = .01 (= .533E-02)
SHOULD NOT EXCEED .100E+03
SUM OF FORCES IN HORIZONTAL DIRECTION = .00 (= .285E-02)
SHOULD NOT EXCEED .100E+03
SUM OF MOMENTS ABOUT COORDINATE ORIGIN = 12.60 (= .126E+02)
SHOULD NOT EXCEED .100E+03
SHEAR STRENGTH/SHEAR FORCE CHECK-SUM = .00 (= .272E-02)
SHOULD NOT EXCEED .100E+03

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Section C, Origin Crest, Units lbs-ft
By CJCW; Date, March 2003

TABLE NO. 39

****

* Final Results for Side Forces and Stresses Between Slices. *
* (Results for Critical Shear Surface in Case of a Search.) *

****

SPENCER'S PROCEDURE USED TO COMPUTE FACTOR OF SAFETY
Factor of Safety = .919 Side Force Inclination = -31.93 Degrees

---------- VALUES AT RIGHT SIDE OF SLICE ----------

Slice No.	X-Right	Side Force	Y-Coord. of Side Force Location	Fraction of Height	Sigma at Top	Sigma at Bottom
1	-8.6	575.	1063.9	.312	-10.8	176.6
2	-4.8	2245.	1059.0	.219	-113.1	442.2
3	-.6	4865.	1054.2	.192	-204.6	688.5
4	.0	5293.	1053.6	.189	-217.7	722.3

5	4.5	8450.	1049.1	.208	-273.7	1003.2
6	9.2	11531.	1044.7	.226	-299.5	1228.4
7	14.2	14326.	1040.5	.240	-309.0	1412.5
8	18.0	16066.	1037.6	.248	-309.1	1523.6
9	23.4	17906.	1033.6	.258	-301.6	1643.9
10	29.0	18967.	1029.7	.267	-285.5	1724.2
11	34.8	19134.	1026.1	.276	-259.5	1758.7
12	40.8	18340.	1022.6	.285	-220.5	1739.0
13	47.0	16590.	1019.3	.297	-162.3	1652.9
14	47.1	16560.	1019.3	.297	-161.4	1651.2
15	53.4	14087.	1016.2	.313	-88.7	1510.9
16	59.9	11214.	1013.3	.331	-9.0	1337.8
17	66.4	8160.	1010.6	.357	85.9	1128.4
18	69.0	7009.	1009.6	.370	128.3	1041.6
19	75.7	4126.	1007.1	.374	111.1	807.2
20	82.5	1647.	1004.9	.393	107.5	488.9
21	87.0	507.	1003.8	.505	176.0	165.3
22	92.0	0.	-1443.2	BELOW	.0	.0

CHECK SUMS - (ALL SHOULD BE SMALL)
SUM OF FORCES IN VERTICAL DIRECTION = .01 (= .533E-02)
SHOULD NOT EXCEED .100E+03
SUM OF FORCES IN HORIZONTAL DIRECTION = .00 (= .285E-02)
SHOULD NOT EXCEED .100E+03
SUM OF MOMENTS ABOUT COORDINATE ORIGIN = 12.60 (= .126E+02)
SHOULD NOT EXCEED .100E+03
SHEAR STRENGTH/SHEAR FORCE CHECK-SUM = .00 (= .272E-02)
SHOULD NOT EXCEED .100E+03

END-OF-FILE ENCOUNTERED WHILE READING COMMAND
WORDS - END OF PROBLEM(S) ASSUMED

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```
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        TABLE NO. 1
        ****************************************
        * COMPUTER PROGRAM DESIGNATION - UTEXAS3 *
        * Originally Coded By Stephen G. Wright  *
        * Version No. 1.208                      *
        * Last Revision Date  2/22/98            *
        * (C) Copyright 1985-1998 S. G. Wright   *
        * All Rights Reserved                    *
        ****************************************

        ************************************************************
        *                                                          *
        *      RESULTS OF COMPUTATIONS PERFORMED USING THIS COMPUTER *
        * PROGRAM SHOULD NOT BE USED FOR DESIGN PURPOSES UNLESS THEY *
        * HAVE BEEN VERIFIED BY INDEPENDENT ANALYSES, EXPERIMENTAL   *
        * DATA OR FIELD EXPERIENCE. THE USER SHOULD UNDERSTAND THE   *
        * ALGORITHMS AND ANALYTICAL PROCEDURES USED IN THE COMPUTER  *
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          Elizabeth Mine.  Post-Earthquake, Existing Phreatic Surface
          Section D, Origin: Crest, Units: lbs-ft
          By: CJCW, Date: March, 2003

        TABLE NO.  2
        *************************
        * NEW PROFILE LINE DATA *
        *************************

        PROFILE LINE  1 - MATERIAL TYPE =  1
        Slime Line

             Point      X            Y

               1     -224.000     1066.000
               2     -187.000     1066.000
               3     -105.000     1069.000
               4         .000      994.000

        PROFILE LINE  2 - MATERIAL TYPE =  2
        Sand Line

             Point      X            Y

               1     -105.000     1069.000
               2      -17.000     1072.000
               3         .000     1072.000
               4        31.000     1049.000
               5        65.000     1026.000
               6        85.000     1014.000
               7       105.000     1014.000
```



```
        PROFILE LINE  3 - MATERIAL TYPE =  3
        Glacial Till Line

             Point      X            Y

               1     -224.000      991.000
               2     -200.000      991.000
               3     -100.000      993.000
               4         .000      994.000
               5        57.000     1001.000
               6        85.000     1006.000
               7       105.000     1014.000
               8       143.000     1025.000
               9       175.000     1040.000

        PROFILE LINE  4 - MATERIAL TYPE =  4
        Ablasial Till Line (20' below Glacial)

             Point      X            Y

               1     -224.000      971.000
               2     -200.000      971.000
               3     -100.000      973.000
               4         .000      974.000
               5        57.000      981.000
               6        85.000      986.000
               7       105.000      994.000
               8       143.000     1005.000
               9       175.000     1020.000

        All new profile lines defined - No old lines retained
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          Section D, Origin: Crest, Units: lbs-ft
          By: CJCW, Date: March, 2003

        TABLE NO.  3
        ************************************************************************
        * NEW MATERIAL PROPERTY DATA - CONVENTIONAL/FIRST-STAGE COMPUTATIONS *
        ************************************************************************

        DATA FOR MATERIAL TYPE  1
        Slime

             Unit weight of material =  120.000

             CONVENTIONAL (ISOTROPIC) SHEAR STRENGTHS
             Cohesion - - - - - - - -        .000
             Friction angle - - - - -  29.600 degrees

             Pore water pressures defined by piezometric line
             Number of the piezometric line used =  1
             Negative pore pressures set to zero

        DATA FOR MATERIAL TYPE  2
        Sand

             Unit weight of material =  120.000

             CONVENTIONAL (ISOTROPIC) SHEAR STRENGTHS
             Cohesion - - - - - - - -        .000
             Friction angle - - - - -  29.600 degrees

             Pore water pressures defined by piezometric line
```

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```
     Number of the piezometric line used =  1
     Negative pore pressures set to zero

DATA FOR MATERIAL TYPE  3
Glacial Till

     Unit weight of material =  140.000

     CONVENTIONAL (ISOTROPIC) SHEAR STRENGTHS
     Cohesion - - - - - - - -     500.000
     Friction angle - - - - -  40.000 degrees

     Pore water pressures defined by piezometric line
     Number of the piezometric line used =  1
     Negative pore pressures set to zero

DATA FOR MATERIAL TYPE  4
Ablasial Till

     Unit weight of material =  140.000

     CONVENTIONAL (ISOTROPIC) SHEAR STRENGTHS
     Cohesion - - - - - - - -     500.000
     Friction angle - - - - -  40.000 degrees

     Pore water pressures defined by piezometric line
     Number of the piezometric line used =  1
     Negative pore pressures set to zero

All new material properties defined - No old data retained
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  Section D, Origin: Crest, Units: lbs-ft
  By: CJCW, Date: March, 2003

TABLE NO.  5
**********************************************************************
* NEW PIEZOMETRIC LINE DATA - CONVENTIONAL/FIRST-STAGE COMPUTATIONS *
**********************************************************************

Line
 No.    Point       X           Y

  1 - Unit weight of water =   62.40
  1        1    -224.000    1011.000
  1        2     175.000    1011.000

All new piezometric lines defined - No old lines retained
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TABLE NO. 15
********************************
* NEW ANALYSIS/COMPUTATION DATA *
********************************

Circular Shear Surface(s)

Computations Performed for Single Shear Surface
```



```
Center Coordinates for Center of Circle -
                                        X =      87.000
                                        Y =    1110.000

Circle Passes Throught the Point at -
                                        X =      95.000
                                        Y =    1014.000
                                   Radius =      96.333

------------------------------------------------------------------------
THE FOLLOWING REPRESENT EITHER DEFAULT OR PREVIOUSLY DEFINED VALUES:

Initial trial estimate for the factor of safety =   3.000

Initial trial estimate for side force inclination =  15.000 degrees
(Applicable to Spencer's procedure only)

Maximum number of iterations allowed for
calculating the factor of safety =   40

Allowed force imbalance for convergence =     100.000

Allowed moment imbalance for convergence =     100.000

Maximum subtended angle to be used for subdivision of the
circle into slices =   3.00 degrees

Depth of crack =        .000

Depth of water in crack =        .000

Unit weight of water in crack =    62.400

Seismic coefficient =  .000

Conventional (single-stage) computations to be performed

Procedure used to compute the factor of safety: SPENCER
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  Section D, Origin: Crest, Units: lbs-ft
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TABLE NO. 16
**************************
* NEW SLOPE GEOMETRY DATA *
**************************

NOTE - NO DATA WERE INPUT, SLOPE GEOMETRY DATA
WERE GENERATED BY THE PROGRAM

Slope Coordinates -

     Point       X           Y

       1    -224.000    1066.000
       2    -187.000    1066.000
       3    -105.000    1069.000
       4     -17.000    1072.000
       5        .000    1072.000
       6      31.000    1049.000
       7      65.000    1026.000
       8      85.000    1014.000
       9     105.000    1014.000
```

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10	143.000	1025.000
11	175.000	1040.000

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Section D, Origin: Crest, Units: lbs-ft
By: CJCW, Date: March, 2003

TABLE NO. 26

****
* Coordinate, Weight, Strength and Pore Water Pressure *
* Information for Individual Slices for Conventional *
* Computations or First Stage of Multi-Stage Computations. *
* (Information is for the Critical Shear Surface in the *
* Case of an Automatic Search.) *
****

Slice No.	X	Y	Slice Weight	Matl. Type	Cohesion	Friction Angle	Pore Pressure
	-1.5	1072.0					
1	-.8	1070.3	307.1	2	.00	29.60	.0
	.0	1068.6					
2	1.1	1066.4	1306.1	2	.00	29.60	.0
	2.3	1064.1					
3	3.5	1062.0	2239.9	2	.00	29.60	.0
	4.8	1059.8					
4	6.2	1057.7	3214.1	2	.00	29.60	.0
	7.5	1055.5					
5	9.0	1053.5	4195.1	2	.00	29.60	.0
	10.5	1051.5					
6	12.1	1049.5	5150.3	2	.00	29.60	.0
	13.7	1047.5					
7	15.4	1045.7	6048.0	2	.00	29.60	.0
	17.0	1043.8					
8	18.8	1042.0	6858.0	2	.00	29.60	.0
	20.6	1040.2					
9	22.5	1038.5	7552.0	2	.00	29.60	.0
	24.3	1036.8					
10	26.3	1035.2	8104.1	2	.00	29.60	.0
	28.3	1033.6					
11	29.6	1032.6	5713.0	2	.00	29.60	.0
	31.0	1031.6					
12	33.1	1030.2	8716.8	2	.00	29.60	.0
	35.2	1028.8					
13	37.3	1027.5	8928.5	2	.00	29.60	.0
	39.5	1026.2					
14	41.7	1025.0	8940.5	2	.00	29.60	.0
	44.0	1023.8					
15	46.2	1022.8	8739.9	2	.00	29.60	.0
	48.5	1021.7					
16	50.9	1020.7	8317.4	2	.00	29.60	.0
	53.2	1019.8					
17	55.1	1019.1	6196.9	2	.00	29.60	.0
	57.0	1018.5					
18	59.4	1017.7	6982.5	2	.00	29.60	.0
	61.8	1017.0					
19	63.4	1016.6	3975.8	2	.00	29.60	.0
	65.0	1016.2					
20	67.5	1015.7	5225.1	2	.00	29.60	.0
	69.9	1015.2					

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Section D, Origin: Crest, Units: lbs-ft
By: CJCW, Date: March, 2003

TABLE NO. 26

****
* Coordinate, Weight, Strength and Pore Water Pressure *
* Information for Individual Slices for Conventional *
* Computations or First Stage of Multi-Stage Computations. *
* (Information is for the Critical Shear Surface in the *
* Case of an Automatic Search.) *
****

Slice No.	X	Y	Slice Weight	Matl. Type	Cohesion	Friction Angle	Pore Pressure
	69.9	1015.2					
21	72.4	1014.8	4027.7	2	.00	29.60	.0
	74.9	1014.4					
22	77.4	1014.2	2627.7	2	.00	29.60	.0
	79.9	1013.9					
23	82.5	1013.8	1037.4	2	.00	29.60	.0
	85.0	1013.7					
24	85.0	1013.7	.8	2	.00	29.60	.0
	85.0	1013.7					
25	86.0	1013.7	77.4	2	.00	29.60	.0
	87.0	1013.7					
26	89.5	1013.7	161.4	2	.00	29.60	.0
	92.0	1013.8					
27	93.5	1013.9	35.6	2	.00	29.60	.0
	95.0	1014.0					

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Section D, Origin: Crest, Units: lbs-ft
By: CJCW, Date: March, 2003

TABLE NO. 27

****
* Seismic Forces and Forces Due to Surface Pressures for *
* Individual Slices for Conventional Computations or the *
* First Stage of Multi-Stage Computations. *
* (Information is for the Critical Shear Surface in the *
* Case of an Automatic Search.) *
****

						FORCES DUE TO SURFACE PRESSURES	
Slice No.	X	Seismic Force	Y for Seismic Force	Normal Force	Shear Force	X	Y
1	-.8	0.	1071.2	0.	0.	.0	.0
2	1.1	0.	1068.8	0.	0.	.0	.0
3	3.5	0.	1065.7	0.	0.	.0	.0
4	6.2	0.	1062.5	0.	0.	.0	.0
5	9.0	0.	1059.4	0.	0.	.0	.0
6	12.1	0.	1056.3	0.	0.	.0	.0
7	15.4	0.	1053.1	0.	0.	.0	.0
8	18.8	0.	1050.0	0.	0.	.0	.0
9	22.5	0.	1046.9	0.	0.	.0	.0
10	26.3	0.	1043.9	0.	0.	.0	.0
11	29.6	0.	1041.3	0.	0.	.0	.0
12	33.1	0.	1038.9	0.	0.	.0	.0
13	37.3	0.	1036.1	0.	0.	.0	.0
14	41.7	0.	1033.4	0.	0.	.0	.0
15	46.2	0.	1030.7	0.	0.	.0	.0

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16	50.9	0.	1028.2	0.	0.	.0	.0
17	55.1	0.	1025.9	0.	0.	.0	.0
18	59.4	0.	1023.8	0.	0.	.0	.0
19	63.4	0.	1021.8	0.	0.	.0	.0
20	67.5	0.	1020.1	0.	0.	.0	.0
21	72.4	0.	1018.2	0.	0.	.0	.0
22	77.4	0.	1016.4	0.	0.	.0	.0
23	82.5	0.	1014.7	0.	0.	.0	.0
24	85.0	0.	1013.8	0.	0.	.0	.0
25	86.0	0.	1013.8	0.	0.	.0	.0
26	89.5	0.	1013.9	0.	0.	.0	.0
27	93.5	0.	1013.9	0.	0.	.0	.0

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Section D, Origin: Crest, Units: lbs-ft
By: CJCW, Date: March, 2003

TABLE NO. 29

****
* Information Generated During Iterative Solution for the Factor *
* of Safety and Side Force Inclination by Spencer's Procedure *
****

Iteration	Trial Factor of Safety	Trial Side Force Inclination (degrees)	Force Imbalance (lbs.)	Moment Imbalance (ft.-lbs.)	Delta-F	Delta Theta (degrees)
1	3.00000	-15.0000	-.4647E+05	.4697E+08		
First-order corrections to F and THETA					-.580E+01	-.996E+00
Values factored by .863E-01 - Deltas too large					-.500E+00	-.859E-01
2	2.50000	-15.0859	-.4173E+05	.4217E+08		
First-order corrections to F and THETA					-.370E+01	-.113E+01
Values factored by .135E+00 - Deltas too large					-.500E+00	-.153E+00
3	2.00000	-15.2385	-.3481E+05	.3520E+08		
First-order corrections to F and THETA					-.204E+01	-.137E+01
Values factored by .245E+00 - Deltas too large					-.500E+00	-.335E+00
4	1.50000	-15.5731	-.2378E+05	.2407E+08		
First-order corrections to F and THETA					-.824E+00	-.194E+01
Values factored by .607E+00 - Deltas too large					-.500E+00	-.118E+01
5	1.00000	-16.7525	-.3101E+04	.3306E+07		
First-order corrections to F and THETA					-.321E-01	-.780E+01
Second-order correction - Iteration 1					-.289E-01	-.780E+01
Second-order correction - Iteration 2					-.289E-01	-.780E+01
6	.97115	-24.5490	.7271E+02	.3574E+05		
First-order corrections to F and THETA					.237E-01	-.739E+01
Second-order correction - Iteration 1					.253E-01	-.739E+01
Second-order correction - Iteration 2					.253E-01	-.739E+01
7	.99650	-31.9357	.2395E+02	-.3288E+05		
First-order corrections to F and THETA					-.215E-02	.681E+00
Second-order correction - Iteration 1					-.212E-02	.681E+00
Second-order correction - Iteration 2					-.212E-02	.681E+00
8	.99437	-31.2542	-.3397E-01	.8573E+02		
First-order corrections to F and THETA					.113E-04	-.329E-02

Factor of Safety - - - - - - - - .994
Side Force Inclination - - - - - -31.25

Number of Iterations - - - - - - 8

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Elizabeth Mine. Post-Earthquake, Existing Phreatic Surface
Section D, Origin: Crest, Units: lbs-ft
By: CJCW, Date: March, 2003

TABLE NO. 38

****
* Final Results for Stresses Along the Shear Surface *
* (Results for Critical Shear Surface in Case of a Search.) *
****

SPENCER'S PROCEDURE USED TO COMPUTE FACTOR OF SAFETY
Factor of Safety = .994 Side Force Inclination = -31.25 Degrees

-------- VALUES AT CENTER OF BASE OF SLICE---------

Slice No.	X-center	Y-center	Total Normal Stress	Effective Normal Stress	Shear Stress
1	-.8	1070.3	61.9	61.9	35.4
2	1.1	1066.4	192.4	192.4	109.9
3	3.5	1062.0	329.7	329.7	188.4
4	6.2	1057.7	474.2	474.2	270.9
5	9.0	1053.5	622.0	622.0	355.3
6	12.1	1049.5	769.5	769.5	439.6
7	15.4	1045.7	913.3	913.3	521.7
8	18.8	1042.0	1049.6	1049.6	599.7
9	22.5	1038.5	1175.0	1175.0	671.3
10	26.3	1035.2	1285.7	1285.7	734.5
11	29.6	1032.6	1366.2	1366.2	780.5
12	33.1	1030.2	1439.2	1439.2	822.2
13	37.3	1027.5	1516.6	1516.6	866.4
14	41.7	1025.0	1568.1	1568.1	895.8
15	46.2	1022.8	1589.0	1589.0	907.8
16	50.9	1020.7	1574.1	1574.1	899.3
17	55.1	1019.1	1526.6	1526.6	872.2
18	59.4	1017.7	1437.1	1437.1	821.0
19	63.4	1016.6	1319.9	1319.9	754.1
20	67.5	1015.7	1179.1	1179.1	673.6
21	72.4	1014.8	969.2	969.2	553.7
22	77.4	1014.2	679.2	679.2	388.0
23	82.5	1013.8	290.5	290.5	166.0
24	85.0	1013.7	56.2	56.2	32.1
25	86.0	1013.7	58.1	58.1	33.2
26	89.5	1013.7	51.4	51.4	29.4
27	93.5	1013.9	21.0	21.0	12.0

CHECK SUMS - (ALL SHOULD BE SMALL)
SUM OF FORCES IN VERTICAL DIRECTION = .00 (= .296E-02)
SHOULD NOT EXCEED .100E+03
SUM OF FORCES IN HORIZONTAL DIRECTION = .00 (= .387E-02)
SHOULD NOT EXCEED .100E+03
SUM OF MOMENTS ABOUT COORDINATE ORIGIN = -88.43 (= -.884E+02)
SHOULD NOT EXCEED .100E+03
SHEAR STRENGTH/SHEAR FORCE CHECK-SUM = .00 (= .131E-02)
SHOULD NOT EXCEED .100E+03

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Elizabeth Mine. Post-Earthquake, Existing Phreatic Surface
Section D, Origin: Crest, Units: lbs-ft

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By: CJCW, Date: March, 2003

TABLE NO. 39

****
* Final Results for Side Forces and Stresses Between Slices. *
* (Results for Critical Shear Surface in Case of a Search.) *
****

SPENCER'S PROCEDURE USED TO COMPUTE FACTOR OF SAFETY
Factor of Safety = .994 Side Force Inclination = -31.25 Degrees

---------- VALUES AT RIGHT SIDE OF SLICE ----------

Slice No.	X-Right	Side Force	Y-Coord. of Side Force Location	Fraction of Height	Sigma at Top	Sigma at Bottom
1	.0	181.	1069.9	.363	8.1	83.8
2	2.3	899.	1066.3	.343	7.0	242.2
3	4.8	2030.	1062.8	.345	13.4	386.9
4	7.5	3509.	1059.3	.346	20.2	531.8
5	10.5	5251.	1055.9	.346	27.5	676.2
6	13.7	7153.	1052.5	.347	36.0	817.4
7	17.0	9104.	1049.2	.349	46.4	952.7
8	20.6	10990.	1046.0	.351	59.4	1078.8
9	24.3	12695.	1042.9	.353	76.0	1192.5
10	28.3	14112.	1039.8	.357	97.2	1290.7
11	31.0	14857.	1037.9	.359	114.6	1346.6
12	35.2	15591.	1035.0	.359	117.0	1416.7
13	39.5	15825.	1032.3	.359	121.4	1464.8
14	44.0	15510.	1029.7	.360	129.7	1485.6
15	48.5	14626.	1027.3	.363	143.6	1473.7
16	53.2	13194.	1025.0	.368	166.1	1423.4
17	57.0	11698.	1023.3	.375	193.0	1350.9
18	61.8	9485.	1021.3	.389	243.2	1213.9
19	65.0	7926.	1020.2	.403	290.9	1093.8
20	69.9	5446.	1018.5	.423	320.4	866.2
21	74.9	3082.	1017.2	.488	433.9	503.9
22	79.9	1202.	1016.4	.801	927.1	-266.0
23	85.0	305.	1016.5	ABOVE	40918.5	-39308.1
24	85.0	304.	1016.5	ABOVE	43863.1	-42197.4
25	87.0	228.	1016.1	ABOVE	24166.4	-22996.6
26	92.0	46.	1016.2	ABOVE	13528.0	-13132.1
27	95.0	0.	2711.6	ABOVE	.0	.0

CHECK SUMS - (ALL SHOULD BE SMALL)
SUM OF FORCES IN VERTICAL DIRECTION = .00 (= .296E-02)
SHOULD NOT EXCEED .100E+03
SUM OF FORCES IN HORIZONTAL DIRECTION = .00 (= .387E-02)
SHOULD NOT EXCEED .100E+03
SUM OF MOMENTS ABOUT COORDINATE ORIGIN = -88.43 (= -.884E+02)
SHOULD NOT EXCEED .100E+03
SHEAR STRENGTH/SHEAR FORCE CHECK-SUM = .00 (= .131E-02)
SHOULD NOT EXCEED .100E+03

***** CAUTION ***** SOME OF THE FORCES BETWEEN SLICES ACT AT POINTS
ABOVE THE SURFACE OF THE SLOPE OR BELOW THE
SHEAR SURFACE - EITHER A TENSION CRACK MAY BE
NEEDED OR THE SOLUTION MAY NOT BE A VALID SOLUTION

=> .

END-OF-FILE ENCOUNTERED WHILE READING COMMAND
WORDS - END OF PROBLEM(S) ASSUMED

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```
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        Date:  3: 7:2003   Time: 12:23:31   Input file: adc1a.in


        TABLE NO. 1
        ****************************************
        * COMPUTER PROGRAM DESIGNATION - UTEXAS3 *
        * Originally Coded By Stephen G. Wright  *
        * Version No. 1.208                      *
        * Last Revision Date  2/22/98            *
        * (C) Copyright 1985-1998 S. G. Wright   *
        * All Rights Reserved                    *
        ****************************************

        ************************************************************
        *                                                          *
        *      RESULTS OF COMPUTATIONS PERFORMED USING THIS COMPUTER *
        * PROGRAM SHOULD NOT BE USED FOR DESIGN PURPOSES UNLESS THEY *
        * HAVE BEEN VERIFIED BY INDEPENDENT ANALYSES, EXPERIMENTAL   *
        * DATA OR FIELD EXPERIENCE. THE USER SHOULD UNDERSTAND THE   *
        * ALGORITHMS AND ANALYTICAL PROCEDURES USED IN THE COMPUTER  *
        * PROGRAM AND MUST HAVE READ ALL DOCUMENTATION FOR THIS      *
        * PROGRAM BEFORE ATTEMPTING ITS USE.                         *
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         Elizabeth Mine. Steady-State Drained, Raised Phreatic Surface
         Section A, Origin: Crest, Units lbs-ft
         By CJCW;  Date March, 2003

        TABLE NO.  2
        *************************
        * NEW PROFILE LINE DATA *
        *************************

        PROFILE LINE  1 - MATERIAL TYPE =  1
        Slime

             Point       X             Y

               1      -180.000      1064.000
               2      -136.000      1065.500
               3      -102.000      1068.000
               4       -16.000      1012.000

        PROFILE LINE  2 - MATERIAL TYPE =  2
        Sand

             Point       X             Y

               1      -102.000      1068.000
               2       -50.500      1070.000
               3       -21.000      1072.000
               4          .000      1072.000
               5        45.000      1042.000
               6        67.500      1034.000
               7        76.000      1034.000
               8        84.000      1035.500
               9        89.000      1042.000
              10       104.000      1043.800
              11       114.000      1050.000
              12       158.000      1052.000

        PROFILE LINE  3 - MATERIAL TYPE =  3
        Glacial Till

             Point       X             Y

               1      -180.000      1004.500
               2      -100.000      1008.000
               3       -60.000      1009.500
               4       -16.000      1012.000
               5          .000      1013.000
               6         6.000      1014.000
               7        47.000      1017.500
               8        76.000      1022.000
               9       108.000      1031.000
              10       131.000      1039.000
              11       158.000      1052.000
              12       170.000      1053.000
              13       177.000      1053.500

        PROFILE LINE  4 - MATERIAL TYPE =  4
        Ablasial Till (20' below Glacial)

             Point       X             Y

               1      -180.000       984.500
               2      -100.000       988.000
               3       -60.000       989.500
               4       -16.000       992.000
               5          .000       993.000
               6         6.000       994.000
               7        47.000       997.500
               8        76.000      1002.000
               9       108.000      1011.000
              10       131.000      1019.000
              11       158.000      1032.000
              12       170.000      1033.000
              13       177.000      1033.500

        All new profile lines defined - No old lines retained
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        TABLE NO.  3
        ************************************************************************
        * NEW MATERIAL PROPERTY DATA - CONVENTIONAL/FIRST-STAGE COMPUTATIONS *
        ************************************************************************

        DATA FOR MATERIAL TYPE  1
        Slime

             Unit weight of material =  120.000

             CONVENTIONAL (ISOTROPIC) SHEAR STRENGTHS
             Cohesion - - - - - - - - -        .000
             Friction angle - - - - -  37.000 degrees

             Pore water pressures defined by piezometric line
```


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```
     Number of the piezometric line used =  1
     Negative pore pressures set to zero

DATA FOR MATERIAL TYPE  2
Sand

     Unit weight of material =  120.000

     CONVENTIONAL (ISOTROPIC) SHEAR STRENGTHS
     Cohesion - - - - - - - -        .000
     Friction angle - - - - -  37.000 degrees

     Pore water pressures defined by piezometric line
     Number of the piezometric line used =  1
     Negative pore pressures set to zero

DATA FOR MATERIAL TYPE  3
Glacial Till

     Unit weight of material =  140.000

     CONVENTIONAL (ISOTROPIC) SHEAR STRENGTHS
     Cohesion - - - - - - - -     500.000
     Friction angle - - - - -  40.000 degrees

     Pore water pressures defined by piezometric line
     Number of the piezometric line used =  1
     Negative pore pressures set to zero

DATA FOR MATERIAL TYPE  4
Ablasial

     Unit weight of material =  140.000

     CONVENTIONAL (ISOTROPIC) SHEAR STRENGTHS
     Cohesion - - - - - - - -     500.000
     Friction angle - - - - -  40.000 degrees

     Pore water pressures defined by piezometric line
     Number of the piezometric line used =  1
     Negative pore pressures set to zero

All new material properties defined - No old data retained
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TABLE NO.  5
**********************************************************************
* NEW PIEZOMETRIC LINE DATA - CONVENTIONAL/FIRST-STAGE COMPUTATIONS *
**********************************************************************

Line
 No.     Point       X           Y

  1 - Unit weight of water =   62.40
  1         1    -180.000    1048.000
  1         2    -100.000    1048.000
  1         3      39.000    1046.000
  1         4      45.000    1042.000
  1         5      67.500    1034.000
  1         6      76.000    1034.000
  1         7      94.000    1034.000
  1         8     177.000    1034.000

All new piezometric lines defined - No old lines retained
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TABLE NO. 15
********************************
* NEW ANALYSIS/COMPUTATION DATA *
********************************

Circular Shear Surface(s)

Computations Performed for Single Shear Surface

Center Coordinates for Center of Circle -
                                          X =      63.000
                                          Y =    1106.000

Circle is Tangent to Horizontal Line at -
                                          Y =    1034.000
                                          Radius =      72.000

------------------------------------------------------------------------
THE FOLLOWING REPRESENT EITHER DEFAULT OR PREVIOUSLY DEFINED VALUES:

Initial trial estimate for the factor of safety =   3.000

Initial trial estimate for side force inclination =  15.000 degrees
(Applicable to Spencer's procedure only)

Maximum number of iterations allowed for
calculating the factor of safety =   40

Allowed force imbalance for convergence =     100.000

Allowed moment imbalance for convergence =     100.000

Maximum subtended angle to be used for subdivision of the
circle into slices =   3.00 degrees

Depth of crack =        .000

Depth of water in crack =        .000

Unit weight of water in crack =    62.400

Seismic coefficient =  .000

Conventional (single-stage) computations to be performed

Procedure used to compute the factor of safety: SPENCER
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TABLE NO. 16
**************************
* NEW SLOPE GEOMETRY DATA *
```

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****

NOTE - NO DATA WERE INPUT, SLOPE GEOMETRY DATA
WERE GENERATED BY THE PROGRAM

Slope Coordinates -

Point	X	Y
1	-180.000	1064.000
2	-136.000	1065.500
3	-102.000	1068.000
4	-50.500	1070.000
5	-21.000	1072.000
6	.000	1072.000
7	45.000	1042.000
8	67.500	1034.000
9	76.000	1034.000
10	84.000	1035.500
11	89.000	1042.000
12	104.000	1043.800
13	114.000	1050.000
14	158.000	1052.000
15	170.000	1053.000
16	177.000	1053.500

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TABLE NO. 26

****
* Coordinate, Weight, Strength and Pore Water Pressure *
* Information for Individual Slices for Conventional *
* Computations or First Stage of Multi-Stage Computations. *
* (Information is for the Critical Shear Surface in the *
* Case of an Automatic Search.) *
****

Slice No.	X	Y	Slice Weight	Matl. Type	Cohesion	Friction Angle	Pore Pressure
	-.5	1072.0					
1	-.2	1071.6	24.0	2	.00	37.00	.0
	.0	1071.1					
2	1.0	1069.5	422.9	2	.00	37.00	.0
	1.9	1067.9					
3	2.9	1066.3	925.7	2	.00	37.00	.0
	4.0	1064.7					
4	5.0	1063.4	1276.9	2	.00	37.00	.0
	6.0	1062.0					
5	7.2	1060.5	1901.4	2	.00	37.00	.0
	8.4	1059.1					
6	9.6	1057.7	2391.9	2	.00	37.00	.0
	10.9	1056.3					
7	12.2	1055.0	2845.0	2	.00	37.00	.0
	13.6	1053.6					
8	15.0	1052.4	3245.1	2	.00	37.00	.0
	16.4	1051.1					
9	17.9	1049.9	3577.5	2	.00	37.00	.0
	19.3	1048.8					
10	20.9	1047.7	3829.1	2	.00	37.00	.0
	22.4	1046.6					
11	22.6	1046.4	593.3	2	.00	37.00	.0
	22.9	1046.2					
12	24.4	1045.2	4003.5	2	.00	37.00	61.6
	26.0	1044.2					
13	27.7	1043.3	4043.7	2	.00	37.00	179.4
	29.3	1042.4					
14	31.0	1041.5	3972.0	2	.00	37.00	286.4
	32.7	1040.7					
15	34.4	1039.9	3782.0	2	.00	37.00	382.3
	36.2	1039.2					
16	37.6	1038.7	2830.1	2	.00	37.00	459.6
	39.0	1038.1					
17	40.8	1037.5	3127.4	2	.00	37.00	453.6
	42.6	1037.0					
18	43.8	1036.6	1791.8	2	.00	37.00	385.9
	45.0	1036.3					
19	46.0	1036.0	1344.3	2	.00	37.00	349.5
	47.0	1035.8					
20	48.8	1035.4	2307.2	2	.00	37.00	324.6
	50.7	1035.1					

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By CJCW; Date March, 2003

TABLE NO. 26

****
* Coordinate, Weight, Strength and Pore Water Pressure *
* Information for Individual Slices for Conventional *
* Computations or First Stage of Multi-Stage Computations. *
* (Information is for the Critical Shear Surface in the *
* Case of an Automatic Search.) *
****

Slice No.	X	Y	Slice Weight	Matl. Type	Cohesion	Friction Angle	Pore Pressure
	50.7	1035.1					
21	52.6	1034.8	2025.6	2	.00	37.00	282.4
	54.4	1034.5					
22	56.3	1034.3	1641.4	2	.00	37.00	227.4
	58.2	1034.2					
23	60.1	1034.1	1157.0	2	.00	37.00	159.7
	61.9	1034.0					
24	62.5	1034.0	225.8	2	.00	37.00	111.3
	63.0	1034.0					
25	64.9	1034.0	398.3	2	.00	37.00	55.0
	66.8	1034.1					
26	67.0	1034.1	3.8	2	.00	37.00	5.0
	67.2	1034.1					

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TABLE NO. 27

****
* Seismic Forces and Forces Due to Surface Pressures for *
* Individual Slices for Conventional Computations or the *
* First Stage of Multi-Stage Computations. *
* (Information is for the Critical Shear Surface in the *
* Case of an Automatic Search.) *
****

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FORCES DUE TO SURFACE PRESSURES

Slice No.	X	Seismic Force	Y for Seismic Force	Normal Force	Shear Force	X	Y
1	-.2	0.	1071.8	0.	0.	.0	.0
2	1.0	0.	1070.4	0.	0.	.0	.0
3	2.9	0.	1068.2	0.	0.	.0	.0
4	5.0	0.	1066.0	0.	0.	.0	.0
5	7.2	0.	1063.9	0.	0.	.0	.0
6	9.6	0.	1061.6	0.	0.	.0	.0
7	12.2	0.	1059.4	0.	0.	.0	.0
8	15.0	0.	1057.2	0.	0.	.0	.0
9	17.9	0.	1055.0	0.	0.	.0	.0
10	20.9	0.	1052.9	0.	0.	.0	.0
11	22.6	0.	1051.7	0.	0.	.0	.0
12	24.4	0.	1050.5	0.	0.	.0	.0
13	27.7	0.	1048.4	0.	0.	.0	.0
14	31.0	0.	1046.4	0.	0.	.0	.0
15	34.4	0.	1044.5	0.	0.	.0	.0
16	37.6	0.	1042.8	0.	0.	.0	.0
17	40.8	0.	1041.2	0.	0.	.0	.0
18	43.8	0.	1039.7	0.	0.	.0	.0
19	46.0	0.	1038.8	0.	0.	.0	.0
20	48.8	0.	1038.0	0.	0.	.0	.0
21	52.6	0.	1037.0	0.	0.	.0	.0
22	56.3	0.	1036.2	0.	0.	.0	.0
23	60.1	0.	1035.4	0.	0.	.0	.0
24	62.5	0.	1034.9	0.	0.	.0	.0
25	64.9	0.	1034.5	0.	0.	.0	.0
26	67.0	0.	1034.1	0.	0.	.0	.0

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Section A, Origin: Crest, Units lbs-ft
By CJCW; Date March, 2003

TABLE NO. 29

****
* Information Generated During Iterative Solution for the Factor *
* of Safety and Side Force Inclination by Spencer's Procedure *
****

Iteration	Trial Factor of Safety	Trial Side Force Inclination (degrees)	Force Imbalance (lbs.)	Moment Imbalance (ft.-lbs.)	Delta-F	Delta Theta (degrees)
1	3.00000	-15.0000	-.1722E+05	.1755E+08		
First-order corrections to F and THETA					-.517E+01	-.291E+00
Values factored by .967E-01 - Deltas too large					-.500E+00	-.281E-01
2	2.50000	-15.0281	-.1525E+05	.1555E+08		
First-order corrections to F and THETA					-.328E+01	-.352E+00
Values factored by .152E+00 - Deltas too large					-.500E+00	-.536E-01
3	2.00000	-15.0818	-.1241E+05	.1265E+08		
First-order corrections to F and THETA					-.178E+01	-.465E+00
Values factored by .280E+00 - Deltas too large					-.500E+00	-.130E+00
4	1.50000	-15.2121	-.7926E+04	.8088E+07		
First-order corrections to F and THETA					-.685E+00	-.768E+00
Values factored by .730E+00 - Deltas too large					-.500E+00	-.561E+00
5	1.00000	-15.7726	.2825E+03	-.2578E+06		
First-order corrections to F and THETA					.846E-01	-.383E+02
Values factored by .224E+00 - Deltas too large					.190E-01	-.859E+01
6	1.01898	-24.3669	.2687E+03	-.2498E+06		
First-order corrections to F and THETA					.462E-01	-.145E+02
Values factored by .594E+00 - Deltas too large					.274E-01	-.859E+01
7	1.04639	-32.9613	.2031E+03	-.1977E+06		
First-order corrections to F and THETA					-.275E-01	.101E+02
Values factored by .854E+00 - Deltas too large					-.235E-01	.859E+01
8	1.02290	-24.3669	.1715E+03	-.1561E+06		
First-order corrections to F and THETA					.237E-01	-.698E+01
Second-order correction - Iteration 1					.253E-01	-.698E+01
Second-order correction - Iteration 2					.253E-01	-.698E+01
9	1.04821	-31.3463	.1160E+02	-.2135E+05		
First-order corrections to F and THETA					-.102E-01	.340E+01
Second-order correction - Iteration 1					-.925E-02	.340E+01
Second-order correction - Iteration 2					-.924E-02	.340E+01
10	1.03897	-27.9450	-.3099E+01	.2515E+04		
First-order corrections to F and THETA					-.483E-03	.134E+00
Second-order correction - Iteration 1					-.482E-03	.134E+00
11	1.03848	-27.8105	-.4709E-03	-.3516E+01		
First-order corrections to F and THETA					-.371E-05	.139E-02

Factor of Safety - - - - - - - - 1.038
Side Force Inclination - - - - - -27.81
Number of Iterations - - - - - - 11

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Section A, Origin: Crest, Units lbs-ft
By CJCW; Date March, 2003

TABLE NO. 38

****
* Final Results for Stresses Along the Shear Surface *
* (Results for Critical Shear Surface in Case of a Search.) *
****

SPENCER'S PROCEDURE USED TO COMPUTE FACTOR OF SAFETY
Factor of Safety = 1.038 Side Force Inclination = -27.81 Degrees

-------- VALUES AT CENTER OF BASE OF SLICE---------

Slice No.	X-center	Y-center	Total Normal Stress	Effective Normal Stress	Shear Stress
1	-.2	1071.6	17.6	17.6	12.8
2	1.0	1069.5	80.5	80.5	58.4
3	2.9	1066.3	177.2	177.2	128.6
4	5.0	1063.4	273.3	273.3	198.3
5	7.2	1060.5	370.5	370.5	268.8
6	9.6	1057.7	472.4	472.4	342.8
7	12.2	1055.0	571.2	571.2	414.5
8	15.0	1052.4	664.4	664.4	482.1
9	17.9	1049.9	749.2	749.2	543.7
10	20.9	1047.7	823.1	823.1	597.3
11	22.6	1046.4	861.8	861.8	625.3
12	24.4	1045.2	894.0	832.4	604.0

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13	27.7	1043.3	934.1	754.7	547.6
14	31.0	1041.5	944.1	657.7	477.3
15	34.4	1039.9	920.3	538.0	390.4
16	37.6	1038.7	866.9	407.3	295.5
17	40.8	1037.5	786.7	333.2	241.7
18	43.8	1036.6	696.9	311.0	225.7
19	46.0	1036.0	650.9	301.4	218.7
20	48.8	1035.4	630.1	305.5	221.6
21	52.6	1034.8	580.7	298.2	216.4
22	56.3	1034.3	498.0	270.6	196.3
23	60.1	1034.1	375.2	215.4	156.3
24	62.5	1034.0	274.6	163.3	118.5
25	64.9	1034.0	143.1	88.1	63.9
26	67.0	1034.1	13.8	8.8	6.4

CHECK SUMS - (ALL SHOULD BE SMALL)
SUM OF FORCES IN VERTICAL DIRECTION = .00 (= .129E-02)
SHOULD NOT EXCEED .100E+03
SUM OF FORCES IN HORIZONTAL DIRECTION = .00 (= .977E-03)
SHOULD NOT EXCEED .100E+03
SUM OF MOMENTS ABOUT COORDINATE ORIGIN = 3.65 (= .365E+01)
SHOULD NOT EXCEED .100E+03
SHEAR STRENGTH/SHEAR FORCE CHECK-SUM = .00 (= .890E-03)
SHOULD NOT EXCEED .100E+03

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By CJCW; Date March, 2003

TABLE NO. 39
****
* Final Results for Side Forces and Stresses Between Slices. *
* (Results for Critical Shear Surface in Case of a Search.) *
****

SPENCER'S PROCEDURE USED TO COMPUTE FACTOR OF SAFETY
Factor of Safety = 1.038 Side Force Inclination = -27.81 Degrees

---------- VALUES AT RIGHT SIDE OF SLICE ----------

Slice No.	X-Right	Side Force	Y-Coord. of Side Force Location	Fraction of Height	Sigma at Top	Sigma at Bottom
1	.0	10.	1071.4	.356	1.5	19.8
2	1.9	180.	1069.1	.425	30.8	81.6
3	4.0	508.	1066.6	.395	36.1	159.5
4	6.0	903.	1064.3	.389	44.6	222.1
5	8.4	1404.	1062.0	.392	59.3	279.7
6	10.9	1916.	1059.7	.399	79.5	322.4
7	13.6	2380.	1057.5	.412	107.0	345.3
8	16.4	2738.	1055.4	.432	144.3	342.4
9	19.3	2936.	1053.6	.463	195.5	305.9
10	22.4	2926.	1052.0	.514	266.4	225.3
11	22.9	2904.	1051.8	.524	279.4	208.4
12	26.0	2772.	1050.3	.588	359.4	110.7
13	29.3	2692.	1048.8	.638	431.1	40.8
14	32.7	2658.	1047.1	.674	504.8	-10.6
15	36.2	2688.	1045.2	.691	585.9	-39.6
16	39.0	2790.	1043.5	.682	654.7	-28.6
17	42.6	2844.	1041.5	.684	795.0	-38.8
18	45.0	2755.	1040.4	.715	975.7	-122.7
19	47.0	2618.	1039.5	.676	868.7	-24.8
20	50.7	2220.	1038.1	.623	694.1	104.9
21	54.4	1666.	1036.9	.586	539.6	173.0
22	58.2	1031.	1035.9	.566	404.4	174.0
23	61.9	430.	1035.2	.592	300.5	86.6
24	63.0	291.	1035.0	.650	306.6	15.6
25	66.8	3.	1032.8	BELOW	-846.5	881.2
26	67.2	0.	-6306.7	BELOW	.0	.0

CHECK SUMS - (ALL SHOULD BE SMALL)
SUM OF FORCES IN VERTICAL DIRECTION = .00 (= .129E-02)
SHOULD NOT EXCEED .100E+03
SUM OF FORCES IN HORIZONTAL DIRECTION = .00 (= .977E-03)
SHOULD NOT EXCEED .100E+03
SUM OF MOMENTS ABOUT COORDINATE ORIGIN = 3.65 (= .365E+01)
SHOULD NOT EXCEED .100E+03
SHEAR STRENGTH/SHEAR FORCE CHECK-SUM = .00 (= .890E-03)
SHOULD NOT EXCEED .100E+03

***** CAUTION ***** SOME OF THE FORCES BETWEEN SLICES ACT AT POINTS
ABOVE THE SURFACE OF THE SLOPE OR BELOW THE
SHEAR SURFACE - EITHER A TENSION CRACK MAY BE
NEEDED OR THE SOLUTION MAY NOT BE A VALID SOLUTION

=> .

END-OF-FILE ENCOUNTERED WHILE READING COMMAND
WORDS - END OF PROBLEM(S) ASSUMED

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```
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        TABLE NO. 1
        ****************************************
        * COMPUTER PROGRAM DESIGNATION - UTEXAS3 *
        * Originally Coded By Stephen G. Wright  *
        * Version No. 1.208                      *
        * Last Revision Date  2/22/98            *
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        * All Rights Reserved                    *
        ****************************************

        ************************************************************
        *                                                          *
        *      RESULTS OF COMPUTATIONS PERFORMED USING THIS COMPUTER *
        * PROGRAM SHOULD NOT BE USED FOR DESIGN PURPOSES UNLESS THEY *
        * HAVE BEEN VERIFIED BY INDEPENDENT ANALYSES, EXPERIMENTAL   *
        * DATA OR FIELD EXPERIENCE. THE USER SHOULD UNDERSTAND THE   *
        * ALGORITHMS AND ANALYTICAL PROCEDURES USED IN THE COMPUTER  *
        * PROGRAM AND MUST HAVE READ ALL DOCUMENTATION FOR THIS      *
        * PROGRAM BEFORE ATTEMPTING ITS USE.                         *
        *                                                          *
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        * IMPLIED, CONCERNING THE ACCURACY, RELIABILITY, USEFULNESS  *
        * OR ADAPTABILITY OF THIS COMPUTER PROGRAM.                  *
        *                                                          *
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          Section B, Origin Crest, Units lbs-ft
          By CJCW; Date March, 2003

        TABLE NO.  2
        *************************
        *.NEW PROFILE LINE DATA *
        *************************

        PROFILE LINE  1 - MATERIAL TYPE =  1
        Slime Line

             Point       X             Y

               1      -200.000      1064.000
               2      -170.000      1064.000
               3      -146.000      1065.000
               4      -116.000      1065.000
               5      -102.000      1065.500
               6        61.000       949.000

        PROFILE LINE  2 - MATERIAL TYPE =  2
        Sand Line

             Point       X             Y

               1      -102.000      1065.500
               2       -39.000      1069.000
               3       -21.000      1071.000
               4          .000      1071.000
               5       110.000       993.000
               6       118.000       991.000
               7       145.000       975.000
               8       153.000       973.000
               9       168.000       967.000

        PROFILE LINE  3 - MATERIAL TYPE =  3
        Glacial Till Line

             Point       X             Y

               1      -200.000      984.000
               2       -28.000      959.000
               3        61.000      949.000
               4       118.000      941.000
               5       210.000      941.000
               6       250.000      940.000

        PROFILE LINE  4 - MATERIAL TYPE =  4
        Ablasial Till Line (20' below Glacial)

             Point       X             Y

               1      -200.000      964.000
               2       -28.000      939.000
               3        61.000      929.000
               4       118.000      921.000
               5       210.000      921.000
               6       250.000      920.000

        PROFILE LINE  6 - MATERIAL TYPE =  6
        Starter Dam

             Point       X             Y

               1       118.000      941.000
               2       145.000      967.000
               3       168.000      967.000
               4       210.000      941.000

        All new profile lines defined - No old lines retained
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          Section B, Origin Crest, Units lbs-ft
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        TABLE NO.  3
        ************************************************************************
        * NEW MATERIAL PROPERTY DATA - CONVENTIONAL/FIRST-STAGE COMPUTATIONS *
        ************************************************************************

        DATA FOR MATERIAL TYPE  1
        Slime

             Unit weight of material =  120.000

             CONVENTIONAL (ISOTROPIC) SHEAR STRENGTHS
             Cohesion - - - - - - - -       .000
             Friction angle - - - - -  37.000 degrees

             Pore water pressures defined by piezometric line
             Number of the piezometric line used =  1
             Negative pore pressures set to zero

        DATA FOR MATERIAL TYPE  2
        Sand
```


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Unit weight of material = 120.000

CONVENTIONAL (ISOTROPIC) SHEAR STRENGTHS
Cohesion - - - - - - - - .000
Friction angle - - - - - 37.000 degrees

Pore water pressures defined by piezometric line
Number of the piezometric line used = 1
Negative pore pressures set to zero

DATA FOR MATERIAL TYPE 3
Glacial Till

Unit weight of material = 140.000

CONVENTIONAL (ISOTROPIC) SHEAR STRENGTHS
Cohesion - - - - - - - - 500.000
Friction angle - - - - - 40.000 degrees

Pore water pressures defined by piezometric line
Number of the piezometric line used = 1
Negative pore pressures set to zero

DATA FOR MATERIAL TYPE 4
Ablasial Till

Unit weight of material = 140.000

CONVENTIONAL (ISOTROPIC) SHEAR STRENGTHS
Cohesion - - - - - - - - 500.000
Friction angle - - - - - 40.000 degrees

Pore water pressures defined by piezometric line
Number of the piezometric line used = 1
Negative pore pressures set to zero

DATA FOR MATERIAL TYPE 6
Starter Dam

Unit weight of material = 130.000

CONVENTIONAL (ISOTROPIC) SHEAR STRENGTHS
Cohesion - - - - - - - - .000
Friction angle - - - - - 38.000 degrees

Pore water pressures defined by piezometric line
Number of the piezometric line used = 1
Negative pore pressures set to zero

All new material properties defined - No old data retained
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Section B, Origin Crest, Units lbs-ft
By CJCW; Date March, 2003

TABLE NO. 5
****
* NEW PIEZOMETRIC LINE DATA - CONVENTIONAL/FIRST-STAGE COMPUTATIONS *
****

Line No.	Point	X	Y
1 - Unit weight of water = 62.40			
1	1	-200.000	1012.000
1	2	-21.000	1000.000
1	3	124.000	987.000
1	4	145.000	975.000
1	5	153.000	973.000
1	6	168.000	967.000
1	7	210.000	941.000
1	8	250.000	940.000

All new piezometric lines defined - No old lines retained
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Section B, Origin Crest, Units lbs-ft
By CJCW; Date March, 2003

TABLE NO. 15
****
* NEW ANALYSIS/COMPUTATION DATA *
****

Circular Shear Surface(s)

Computations Performed for Single Shear Surface

Center Coordinates for Center of Circle -
X = 192.000
Y = 1177.000

Circle is Tangent to Horizontal Line at -
Y = 948.500
Radius = 228.500

THE FOLLOWING REPRESENT EITHER DEFAULT OR PREVIOUSLY DEFINED VALUES:

Initial trial estimate for the factor of safety = 3.000

Initial trial estimate for side force inclination = 15.000 degrees
(Applicable to Spencer's procedure only)

Maximum number of iterations allowed for
calculating the factor of safety = 40

Allowed force imbalance for convergence = 100.000

Allowed moment imbalance for convergence = 100.000

Maximum subtended angle to be used for subdivision of the
circle into slices = 3.00 degrees

Depth of crack = .000

Depth of water in crack = .000

Unit weight of water in crack = 62.400

Seismic coefficient = .000

Conventional (single-stage) computations to be performed

Procedure used to compute the factor of safety: SPENCER
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Section B, Origin Crest, Units lbs-ft
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TABLE NO. 16
****
* NEW SLOPE GEOMETRY DATA *
****

NOTE - NO DATA WERE INPUT, SLOPE GEOMETRY DATA
WERE GENERATED BY THE PROGRAM

Slope Coordinates -

Point	X	Y
1	-200.000	1064.000
2	-170.000	1064.000
3	-146.000	1065.000
4	-116.000	1065.000
5	-102.000	1065.500
6	-39.000	1069.000
7	-21.000	1071.000
8	.000	1071.000
9	110.000	993.000
10	118.000	991.000
11	145.000	975.000
12	153.000	973.000
13	168.000	967.000
14	210.000	941.000
15	250.000	940.000

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Section B, Origin Crest, Units lbs-ft
By CJCW; Date March, 2003

TABLE NO. 26
****
* Coordinate, Weight, Strength and Pore Water Pressure *
* Information for Individual Slices for Conventional *
* Computations or First Stage of Multi-Stage Computations. *
* (Information is for the Critical Shear Surface in the *
* Case of an Automatic Search.) *
****

Slice No.	X	Y	Slice Weight	Matl. Type	Cohesion	Friction Angle	Pore Pressure
	-10.4	1071.0					
1	-7.5	1065.8	3651.8	2	.00	37.00	.0
	-4.6	1060.6					
2	-2.3	1056.8	7822.5	2	.00	37.00	.0
	.0	1053.1					
3	3.4	1048.2	16545.1	2	.00	37.00	.0
	6.7	1043.2					
4	10.4	1038.5	21908.9	2	.00	37.00	.0
	14.0	1033.7					
5	17.9	1029.2	27097.5	2	.00	37.00	.0
	21.7	1024.6					
6	25.8	1020.3	31937.1	2	.00	37.00	.0
	30.0	1015.9					
7	34.3	1011.8	36263.4	2	.00	37.00	.0
	38.6	1007.6					
8	43.1	1003.7	39923.1	2	.00	37.00	.0
	47.7	999.8					
9	52.1	996.5	39544.6	2	.00	37.00	.0
	56.4	993.1					
10	58.7	991.4	20777.4	2	.00	37.00	89.5
	61.0	989.8					
11	66.0	986.5	45172.6	2	.00	37.00	357.0
	71.0	983.2					
12	76.1	980.1	45611.6	2	.00	37.00	695.4
	81.3	977.1					
13	86.6	974.4	44886.2	2	.00	37.00	998.5
	91.9	971.6					
14	97.3	969.1	42931.9	2	.00	37.00	1265.2
	102.8	966.6					
15	106.4	965.2	26292.1	2	.00	37.00	1460.2
	110.0	963.7					
16	114.0	962.3	28543.4	2	.00	37.00	1599.3
	118.0	960.8					
17	121.0	959.8	21159.9	2	.00	37.00	1712.0
	124.0	958.9					
18	128.8	957.5	31419.5	2	.00	37.00	1670.9
	133.7	956.1					
19	139.3	954.7	32946.0	6	.00	38.00	1467.1
	145.0	953.4					
20	149.0	952.6	21675.8	6	.00	38.00	1334.2
	153.0	951.9					

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Section B, Origin Crest, Units lbs-ft
By CJCW; Date March, 2003

TABLE NO. 26
****
* Coordinate, Weight, Strength and Pore Water Pressure *
* Information for Individual Slices for Conventional *
* Computations or First Stage of Multi-Stage Computations. *
* (Information is for the Critical Shear Surface in the *
* Case of an Automatic Search.) *
****

Slice No.	X	Y	Slice Weight	Matl. Type	Cohesion	Friction Angle	Pore Pressure
	153.0	951.9					
21	158.9	951.0	29800.9	6	.00	38.00	1225.9
	164.8	950.1					
22	166.4	949.9	7254.5	6	.00	38.00	1103.9
	168.0	949.8					
23	168.0	949.8	.3	6	.00	38.00	1075.5
	168.0	949.8					
24	174.0	949.3	21731.0	6	.00	38.00	874.7
	179.9	948.8					
25	185.9	948.7	11280.9	6	.00	38.00	452.8
	191.9	948.5					
26	191.9	948.5	55.4	6	.00	38.00	229.6
	192.0	948.5					
27	194.9	948.5	1365.6	6	.00	38.00	113.7
	197.8	948.6					

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Section B, Origin Crest, Units lbs-ft
By CJCW; Date March, 2003

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TABLE NO. 27

```
************************************************************
*  Seismic Forces and Forces Due to Surface Pressures for  *
*  Individual Slices for Conventional  Computations or the *
*  First Stage of Multi-Stage Computations.                *
*  (Information is for the Critical Shear Surface in the   *
*  Case of an Automatic Search.)                           *
************************************************************
```

Slice No.	X	Seismic Force	Y for Seismic Force	FORCES DUE TO SURFACE PRESSURES: Normal Force	Shear Force	X	Y
1	-7.5	0.	1068.4	0.	0.	.0	.0
2	-2.3	0.	1063.9	0.	0.	.0	.0
3	3.4	0.	1058.4	0.	0.	.0	.0
4	10.4	0.	1051.1	0.	0.	.0	.0
5	17.9	0.	1043.7	0.	0.	.0	.0
6	25.8	0.	1036.5	0.	0.	.0	.0
7	34.3	0.	1029.2	0.	0.	.0	.0
8	43.1	0.	1022.1	0.	0.	.0	.0
9	52.1	0.	1015.3	0.	0.	.0	.0
10	58.7	0.	1010.4	0.	0.	.0	.0
11	66.0	0.	1005.3	0.	0.	.0	.0
12	76.1	0.	998.6	0.	0.	.0	.0
13	86.6	0.	992.0	0.	0.	.0	.0
14	97.3	0.	985.5	0.	0.	.0	.0
15	106.4	0.	980.4	0.	0.	.0	.0
16	114.0	0.	977.1	0.	0.	.0	.0
17	121.0	0.	974.5	0.	0.	.0	.0
18	128.8	0.	971.0	0.	0.	.0	.0
19	139.3	0.	966.3	0.	0.	.0	.0
20	149.0	0.	963.1	0.	0.	.0	.0
21	158.9	0.	960.7	0.	0.	.0	.0
22	166.4	0.	958.8	0.	0.	.0	.0
23	168.0	0.	958.4	0.	0.	.0	.0
24	174.0	0.	956.3	0.	0.	.0	.0
25	185.9	0.	952.3	0.	0.	.0	.0
26	191.9	0.	950.3	0.	0.	.0	.0
27	194.9	0.	949.4	0.	0.	.0	.0

```
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  Section B, Origin Crest, Units lbs-ft
  By CJCW; Date March, 2003
```

TABLE NO. 29

```
************************************************************************
*  Information Generated During Iterative Solution for the Factor      *
*  of Safety and Side Force Inclination by Spencer's Procedure         *
************************************************************************
```

Iteration	Trial Factor of Safety	Trial Side Force Inclination (degrees)	Force Imbalance (lbs.)	Moment Imbalance (ft.-lbs.)	Delta-F	Delta Theta (degrees)
1	3.00000	-15.0000	-.2126E+06	.2087E+09		
First-order corrections to F and THETA					-.518E+01	-.130E+01
Values factored by .965E-01 - Deltas too large					-.500E+00	-.126E+00
2	2.50000	-15.1257	-.1884E+06	.1850E+09		
First-order corrections to F and THETA					-.329E+01	-.154E+01
Values factored by .152E+00 - Deltas too large					-.500E+00	-.233E+00
3	2.00000	-15.3591	-.1534E+06	.1507E+09		
First-order corrections to F and THETA					-.179E+01	-.194E+01
Values factored by .279E+00 - Deltas too large					-.500E+00	-.540E+00
4	1.50000	-15.8992	-.9832E+05	.9682E+08		
First-order corrections to F and THETA					-.689E+00	-.285E+01
Values factored by .726E+00 - Deltas too large					-.500E+00	-.207E+01
5	1.00000	-17.9653	.4181E+04	-.2905E+07		
First-order corrections to F and THETA					.479E-01	-.140E+02
Values factored by .613E+00 - Deltas too large					.294E-01	-.859E+01
6	1.02939	-26.5597	.2372E+04	-.1993E+07		
First-order corrections to F and THETA					.129E-01	-.172E+01
Second-order correction - Iteration 1					.130E-01	-.172E+01
Second-order correction - Iteration 2					.130E-01	-.172E+01
7	1.04240	-28.2762	.8903E+00	-.3268E+05		
First-order corrections to F and THETA					-.785E-03	.243E+00
Second-order correction - Iteration 1					-.781E-03	.243E+00
8	1.04161	-28.0328	-.3296E-02	-.1333E+03		
First-order corrections to F and THETA					-.338E-05	.105E-02
Second-order correction - Iteration 1					-.338E-05	.105E-02
9	1.04161	-28.0317	-.1770E-01	.5113E+01		
First-order corrections to F and THETA					-.328E-06	.846E-04

```
Factor of Safety - - - - - - - -     1.042
Side Force Inclination - - - - -    -28.03
Number of Iterations - - - - - -     9
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  Section B, Origin Crest, Units lbs-ft
  By CJCW; Date March, 2003
```

TABLE NO. 38

```
************************************************************************
*  Final Results for Stresses Along the Shear Surface                  *
*  (Results for Critical Shear Surface in Case of a Search.)           *
************************************************************************
```

SPENCER'S PROCEDURE USED TO COMPUTE FACTOR OF SAFETY
Factor of Safety = 1.042 Side Force Inclination = -28.03 Degrees

Slice No.	-------- VALUES AT CENTER OF BASE OF SLICE--------- X-center	Y-center	Total Normal Stress	Effective Normal Stress	Shear Stress
1	-7.5	1065.8	218.6	218.6	158.2
2	-2.3	1056.8	642.7	642.7	465.0
3	3.4	1048.2	999.4	999.4	723.0
4	10.4	1038.5	1335.4	1335.4	966.1
5	17.9	1029.2	1671.3	1671.3	1209.1
6	25.8	1020.3	1999.1	1999.1	1446.3
7	34.3	1011.8	2310.7	2310.7	1671.7
8	43.1	1003.7	2597.6	2597.6	1879.2
9	52.1	996.5	2843.5	2843.5	2057.2
10	58.7	991.4	3009.9	2920.4	2112.8
11	66.0	986.5	3155.1	2798.2	2024.3

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12	76.1	980.1	3288.3	2592.9	1875.8
13	86.6	974.4	3328.3	2329.8	1685.5
14	97.3	969.1	3263.6	1998.3	1445.7
15	106.4	965.2	3127.3	1667.1	1206.1
16	114.0	962.3	3148.6	1549.3	1120.9
17	121.0	959.8	3191.0	1479.1	1070.0
18	128.8	957.5	3030.8	1359.9	983.8
19	139.3	954.7	2850.8	1383.7	1037.9
20	149.0	952.6	2798.2	1464.1	1098.2
21	158.9	951.0	2743.2	1517.3	1138.1
22	166.4	949.9	2611.4	1507.5	1130.8
23	168.0	949.8	3015.4	1939.8	1455.0
24	174.0	949.3	2171.5	1296.8	972.7
25	185.9	948.7	1215.3	762.5	571.9
26	191.9	948.5	643.6	414.0	310.5
27	194.9	948.5	325.6	212.0	159.0

CHECK SUMS - (ALL SHOULD BE SMALL)
SUM OF FORCES IN VERTICAL DIRECTION = .02 (= .150E-01)
SHOULD NOT EXCEED .100E+03
SUM OF FORCES IN HORIZONTAL DIRECTION = .02 (= .151E-01)
SHOULD NOT EXCEED .100E+03
SUM OF MOMENTS ABOUT COORDINATE ORIGIN = -14.85 (= -.149E+02)
SHOULD NOT EXCEED .100E+03
SHEAR STRENGTH/SHEAR FORCE CHECK-SUM = .01 (= .118E-01)
SHOULD NOT EXCEED .100E+03

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Section B, Origin Crest, Units lbs-ft
By CJCW; Date March, 2003

TABLE NO. 39
****
* Final Results for Side Forces and Stresses Between Slices. *
* (Results for Critical Shear Surface in Case of a Search.) *
****

SPENCER'S PROCEDURE USED TO COMPUTE FACTOR OF SAFETY
Factor of Safety = 1.042 Side Force Inclination = -28.03 Degrees

---------- VALUES AT RIGHT SIDE OF SLICE ----------

Slice No.	X-Right	Side Force	Y-Coord. of Side Force Location	Fraction of Height	Sigma at Top	Sigma at Bottom
1	-4.6	1544.	1064.2	.352	14.3	246.6
2	.0	4537.	1057.7	.257	-102.8	550.6
3	6.7	10196.	1049.8	.287	-109.8	893.0
4	14.0	16646.	1042.3	.314	-62.2	1136.6
5	21.7	23307.	1035.0	.336	11.7	1316.5
6	30.0	29565.	1028.0	.357	109.1	1432.3
7	38.6	34799.	1021.3	.379	234.9	1472.3
8	47.7	38423.	1015.0	.407	399.0	1417.3
9	56.4	39880.	1009.8	.441	598.2	1258.2
10	61.0	40132.	1007.2	.460	707.8	1158.4
11	71.0	40839.	1001.6	.492	912.9	1010.2
12	81.3	41536.	995.8	.516	1106.9	916.0
13	91.9	42085.	989.9	.535	1312.9	856.9
14	102.8	42582.	983.9	.549	1542.8	845.2
15	110.0	43054.	979.9	.552	1702.9	893.0
16	118.0	43261.	975.5	.488	1175.1	1355.0
17	124.0	43079.	972.4	.474	1125.1	1534.8
18	133.7	41858.	967.6	.451	1014.8	1866.3
19	145.0	37202.	962.8	.437	945.4	2093.1
20	153.0	32109.	959.9	.378	362.4	2318.1
21	164.8	22231.	956.1	.329	-27.0	2190.0
22	168.0	19233.	955.2	.317	-93.6	2063.5
23	168.0	19233.	955.2	.317	-93.6	2063.5
24	179.9	8415.	952.4	.336	11.1	1364.7
25	191.9	1107.	950.1	.424	142.7	383.1
26	192.0	1066.	950.1	.431	152.0	364.5
27	197.8	0.	949.9	ABOVE	.0	.0

CHECK SUMS - (ALL SHOULD BE SMALL)
SUM OF FORCES IN VERTICAL DIRECTION = .02 (= .150E-01)
SHOULD NOT EXCEED .100E+03
SUM OF FORCES IN HORIZONTAL DIRECTION = .02 (= .151E-01)
SHOULD NOT EXCEED .100E+03
SUM OF MOMENTS ABOUT COORDINATE ORIGIN = -14.85 (= -.149E+02)
SHOULD NOT EXCEED .100E+03
SHEAR STRENGTH/SHEAR FORCE CHECK-SUM = .01 (= .118E-01)
SHOULD NOT EXCEED .100E+03

END-OF-FILE ENCOUNTERED WHILE READING COMMAND
WORDS - END OF PROBLEM(S) ASSUMED

```
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        TABLE NO. 1
        ****************************************
        * COMPUTER PROGRAM DESIGNATION - UTEXAS3 *
        * Originally Coded By Stephen G. Wright  *
        * Version No. 1.208                      *
        * Last Revision Date  2/22/98            *
        * (C) Copyright 1985-1998 S. G. Wright   *
        * All Rights Reserved                    *
        ****************************************

        ************************************************************
        *                                                          *
        *      RESULTS OF COMPUTATIONS PERFORMED USING THIS COMPUTER *
        * PROGRAM SHOULD NOT BE USED FOR DESIGN PURPOSES UNLESS THEY *
        * HAVE BEEN VERIFIED BY INDEPENDENT ANALYSES, EXPERIMENTAL   *
        * DATA OR FIELD EXPERIENCE. THE USER SHOULD UNDERSTAND THE   *
        * ALGORITHMS AND ANALYTICAL PROCEDURES USED IN THE COMPUTER  *
        * PROGRAM AND MUST HAVE READ ALL DOCUMENTATION FOR THIS      *
        * PROGRAM BEFORE ATTEMPTING ITS USE.                         *
        *                                                          *
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        * MAKE OR ASSUME LIABILITY FOR ANY WARRANTIES, EXPRESSED OR  *
        * IMPLIED, CONCERNING THE ACCURACY, RELIABILITY, USEFULNESS  *
        * OR ADAPTABILITY OF THIS COMPUTER PROGRAM.                  *
        *                                                          *
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          Section C, Origin Crest, Units lbs-ft
          By CJCW; Date March, 2003

        TABLE NO.  2
        ************************
        * NEW PROFILE LINE DATA *
        ************************

        PROFILE LINE  1 - MATERIAL TYPE =  1
        Slime Tailing

             Point      X            Y

               1      -159.000     1060.000
               2      -100.000     1062.000
               3       -60.000     1065.000
               4       -16.000     1030.000
               5        18.000     1005.000

        PROFILE LINE  2 - MATERIAL TYPE =  2
        Sand Tailing

             Point      X            Y

               1       -60.000     1065.000
               2       -33.000     1066.000
               3       -13.000     1068.000
               4          .000     1068.000
               5        69.000     1016.000
               6        87.000     1005.000
               7        92.000     1002.000
```



```
        PROFILE LINE  3 - MATERIAL TYPE =  3
        Glacial Till

             Point      X            Y

               1      -159.000     1005.000
               2      -100.000     1005.000
               3        18.000     1005.000
               4        92.000     1002.000
               5       118.000      997.000
               6       157.000      993.000

        PROFILE LINE  4 - MATERIAL TYPE =  4
        Ablasial Till (20' below Glacial)

             Point      X            Y

               1      -159.000      985.000
               2      -100.000      985.000
               3        18.000      985.000
               4        92.000      982.000
               5       118.000      977.000
               6       157.000      973.000

        All new profile lines defined - No old lines retained
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          Section C, Origin Crest, Units lbs-ft
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        TABLE NO.  3
        ************************************************************************
        * NEW MATERIAL PROPERTY DATA - CONVENTIONAL/FIRST-STAGE COMPUTATIONS *
        ************************************************************************

        DATA FOR MATERIAL TYPE  1
        Slime

             Unit weight of material =  120.000

             CONVENTIONAL (ISOTROPIC) SHEAR STRENGTHS
             Cohesion - - - - - - - -        .000
             Friction angle - - - - -  37.000 degrees

             Pore water pressures defined by piezometric line
             Number of the piezometric line used =  1
             Negative pore pressures set to zero

        DATA FOR MATERIAL TYPE  2
        Sands

             Unit weight of material =  120.000

             CONVENTIONAL (ISOTROPIC) SHEAR STRENGTHS
             Cohesion - - - - - - - -        .000
             Friction angle - - - - -  37.000 degrees

             Pore water pressures defined by piezometric line
             Number of the piezometric line used =  1
             Negative pore pressures set to zero

        DATA FOR MATERIAL TYPE  3
        Glacial Till
```


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```
     Unit weight of material =  140.000

     CONVENTIONAL (ISOTROPIC) SHEAR STRENGTHS
     Cohesion - - - - - - - -     500.000
     Friction angle - - - - -  40.000 degrees

     Pore water pressures defined by piezometric line
     Number of the piezometric line used =  1
     Negative pore pressures set to zero

DATA FOR MATERIAL TYPE  4
Ablasial Till

     Unit weight of material =  140.000

     CONVENTIONAL (ISOTROPIC) SHEAR STRENGTHS
     Cohesion - - - - - - - -     500.000
     Friction angle - - - - -  40.000 degrees

     Pore water pressures defined by piezometric line
     Number of the piezometric line used =  1
     Negative pore pressures set to zero

All new material properties defined - No old data retained
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  Section C, Origin Crest, Units lbs-ft
  By CJCW; Date March, 2003

TABLE NO.  5
**********************************************************************
* NEW PIEZOMETRIC LINE DATA - CONVENTIONAL/FIRST-STAGE COMPUTATIONS *
**********************************************************************

Line
 No.    Point       X          Y

  1 - Unit weight of water =   62.40
  1        1    -159.000    1028.000
  1        2     -16.000    1030.000
  1        3      69.000    1016.000
  1        4      87.000    1005.000
  1        5      92.000    1002.000
  1        6     118.000     997.000
  1        7     157.000     993.000

All new piezometric lines defined - No old lines retained
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TABLE NO. 15
**********************************
* NEW ANALYSIS/COMPUTATION DATA *
**********************************

Circular Shear Surface(s)

Computations Performed for Single Shear Surface
```



```
Center Coordinates for Center of Circle -
                                        X =     102.000
                                        Y =    1133.000

Circle is Tangent to Horizontal Line at -
                                        Y =    1002.000
                                   Radius =     131.000

------------------------------------------------------------------------
THE FOLLOWING REPRESENT EITHER DEFAULT OR PREVIOUSLY DEFINED VALUES:

Initial trial estimate for the factor of safety =   3.000

Initial trial estimate for side force inclination =  15.000 degrees
(Applicable to Spencer's procedure only)

Maximum number of iterations allowed for
calculating the factor of safety =   40

Allowed force imbalance for convergence =      100.000

Allowed moment imbalance for convergence =     100.000

Maximum subtended angle to be used for subdivision of the
circle into slices =   3.00 degrees

Depth of crack =         .000

Depth of water in crack =        .000

Unit weight of water in crack =    62.400

Seismic coefficient =  .000

Conventional (single-stage) computations to be performed

Procedure used to compute the factor of safety: SPENCER
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TABLE NO. 16
**************************
* NEW SLOPE GEOMETRY DATA *
**************************

NOTE - NO DATA WERE INPUT, SLOPE GEOMETRY DATA
WERE GENERATED BY THE PROGRAM

Slope Coordinates -

     Point       X          Y

       1    -159.000    1060.000
       2    -100.000    1062.000
       3     -60.000    1065.000
       4     -33.000    1066.000
       5     -13.000    1068.000
       6        .000    1068.000
       7      69.000    1016.000
       8      87.000    1005.000
       9      92.000    1002.000
      10     118.000     997.000
```


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11 157.000 993.000

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By CJCW; Date March, 2003

TABLE NO. 26

****
* Coordinate, Weight, Strength and Pore Water Pressure *
* Information for Individual Slices for Conventional *
* Computations or First Stage of Multi-Stage Computations. *
* (Information is for the Critical Shear Surface in the *
* Case of an Automatic Search.) *
****

Slice No.	X	Y	Slice Weight	Matl. Type	Cohesion	Friction Angle	Pore Pressure
	-11.7	1068.0					
1	-10.0	1065.1	1251.6	2	.00	37.00	.0
	-8.2	1062.1					
2	-6.2	1059.3	4028.6	2	.00	37.00	.0
	-4.3	1056.5					
3	-2.2	1053.7	7104.5	2	.00	37.00	.0
	-.2	1051.0					
4	-.1	1050.9	344.7	2	.00	37.00	.0
	.0	1050.8					
5	2.2	1048.2	9669.0	2	.00	37.00	.0
	4.4	1045.6					
6	6.8	1043.1	11187.9	2	.00	37.00	.0
	9.2	1040.6					
7	11.6	1038.2	12515.8	2	.00	37.00	.0
	14.1	1035.9					
8	16.1	1034.2	10132.4	2	.00	37.00	.0
	18.0	1032.5					
9	20.7	1030.3	14232.9	2	.00	37.00	.0
	23.4	1028.2					
10	26.2	1026.2	14791.4	2	.00	37.00	.0
	29.0	1024.2					
11	30.7	1023.1	8902.4	2	.00	37.00	.0
	32.4	1022.0					
12	35.3	1020.3	14938.0	2	.00	37.00	78.6
	38.3	1018.5					
13	41.3	1017.0	14519.5	2	.00	37.00	225.1
	44.4	1015.4					
14	47.5	1013.9	13682.3	2	.00	37.00	350.1
	50.6	1012.5					
15	53.8	1011.2	12413.4	2	.00	37.00	453.1
	57.0	1010.0					
16	60.2	1008.9	10707.3	2	.00	37.00	534.0
	63.5	1007.8					
17	66.2	1007.0	7345.2	2	.00	37.00	589.4
	69.0	1006.2					
18	72.3	1005.4	6822.5	2	.00	37.00	531.1
	75.7	1004.7					
19	79.1	1004.1	4686.7	2	.00	37.00	360.9
	82.4	1003.5					
20	84.7	1003.2	1770.4	2	.00	37.00	201.6
	87.0	1002.9					

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Section C, Origin Crest, Units lbs-ft

By CJCW; Date March, 2003

TABLE NO. 26

****
* Coordinate, Weight, Strength and Pore Water Pressure *
* Information for Individual Slices for Conventional *
* Computations or First Stage of Multi-Stage Computations. *
* (Information is for the Critical Shear Surface in the *
* Case of an Automatic Search.) *
****

Slice No.	X	Y	Slice Weight	Matl. Type	Cohesion	Friction Angle	Pore Pressure
	87.0	1002.9					
21	89.1	1002.7	547.3	2	.00	37.00	66.7
	91.3	1002.4					

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TABLE NO. 27

****
* Seismic Forces and Forces Due to Surface Pressures for *
* Individual Slices for Conventional Computations or the *
* First Stage of Multi-Stage Computations. *
* (Information is for the Critical Shear Surface in the *
* Case of an Automatic Search.) *
****

Slice No.	X	Seismic Force	Y for Seismic Force	Normal Force	Shear Force	FORCES DUE TO SURFACE PRESSURES X	Y
1	-10.0	0.	1066.5	0.	0.	.0	.0
2	-6.2	0.	1063.7	0.	0.	.0	.0
3	-2.2	0.	1060.9	0.	0.	.0	.0
4	-.1	0.	1059.5	0.	0.	.0	.0
5	2.2	0.	1057.3	0.	0.	.0	.0
6	6.8	0.	1053.0	0.	0.	.0	.0
7	11.6	0.	1048.7	0.	0.	.0	.0
8	16.1	0.	1045.0	0.	0.	.0	.0
9	20.7	0.	1041.4	0.	0.	.0	.0
10	26.2	0.	1037.3	0.	0.	.0	.0
11	30.7	0.	1034.0	0.	0.	.0	.0
12	35.3	0.	1030.8	0.	0.	.0	.0
13	41.3	0.	1026.9	0.	0.	.0	.0
14	47.5	0.	1023.1	0.	0.	.0	.0
15	53.8	0.	1019.4	0.	0.	.0	.0
16	60.2	0.	1015.8	0.	0.	.0	.0
17	66.2	0.	1012.5	0.	0.	.0	.0
18	72.3	0.	1009.7	0.	0.	.0	.0
19	79.1	0.	1007.0	0.	0.	.0	.0
20	84.7	0.	1004.8	0.	0.	.0	.0
21	89.1	0.	1003.2	0.	0.	.0	.0

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Section C, Origin Crest, Units lbs-ft
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TABLE NO. 29

```
**********************************************************************
*  Information Generated During Iterative Solution for the Factor    *
*  of Safety and Side Force Inclination by Spencer's Procedure       *
**********************************************************************
```

Iteration	Trial Factor of Safety	Trial Side Force Inclination (degrees)	Force Imbalance (lbs.)	Moment Imbalance (ft.-lbs.)	Delta-F	Delta Theta (degrees)
1	3.00000	-15.0000	-.6425E+05	.6446E+08		
First-order corrections to F and THETA					-.503E+01	-.634E+00
Values factored by .994E-01 - Deltas too large					-.500E+00	-.630E-01
2	2.50000	-15.0630	-.5672E+05	.5691E+08		
First-order corrections to F and THETA					-.319E+01	-.752E+00
Values factored by .157E+00 - Deltas too large					-.500E+00	-.118E+00
3	2.00000	-15.1807	-.4589E+05	.4606E+08		
First-order corrections to F and THETA					-.174E+01	-.971E+00
Values factored by .288E+00 - Deltas too large					-.500E+00	-.280E+00
4	1.50000	-15.4603	-.2895E+05	.2910E+08		
First-order corrections to F and THETA					-.665E+00	-.156E+01
Values factored by .752E+00 - Deltas too large					-.500E+00	-.117E+01
5	1.00000	-16.6307	.1670E+04	-.1449E+07		
First-order corrections to F and THETA					.137E+00	-.868E+02
Values factored by .990E-01 - Deltas too large					.135E-01	-.859E+01
6	1.01352	-25.2250	.1589E+04	-.1382E+07		
First-order corrections to F and THETA					.633E+00	-.384E+03
Values factored by .224E-01 - Deltas too large					.142E-01	-.859E+01
7	1.02768	-33.8194	.1714E+04	-.1487E+07		
First-order corrections to F and THETA					.124E-01	.228E+01
Second-order correction - Iteration 1					.135E-01	.228E+01
Second-order correction - Iteration 2					.135E-01	.228E+01
8	1.04114	-31.5358	-.7457E+01	.4249E+05		
First-order corrections to F and THETA					.444E-02	-.266E+01
Second-order correction - Iteration 1					.461E-02	-.266E+01
Second-order correction - Iteration 2					.461E-02	-.266E+01
9	1.04574	-34.1996	.1602E+01	-.2520E+04		
First-order corrections to F and THETA					-.128E-03	.786E-01
Second-order correction - Iteration 1					-.128E-03	.786E-01
10	1.04562	-34.1210	-.3525E-02	.2445E+01		
First-order corrections to F and THETA					-.114E-06	.425E-04

Factor of Safety - - - - - - - - 1.046
Side Force Inclination - - - - - -34.12
Number of Iterations - - - - - - 10

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Section C, Origin Crest, Units lbs-ft
By CJCW; Date March, 2003

TABLE NO. 38

```
**********************************************************************
*  Final Results for Stresses Along the Shear Surface                *
*  (Results for Critical Shear Surface in Case of a Search.)         *
**********************************************************************
```

SPENCER'S PROCEDURE USED TO COMPUTE FACTOR OF SAFETY
Factor of Safety = 1.046 Side Force Inclination = -34.12 Degrees

-------- VALUES AT CENTER OF BASE OF SLICE---------

Slice No.	X-center	Y-center	Total Normal Stress	Effective Normal Stress	Shear Stress
1	-10.0	1065.1	124.9	124.9	90.0
2	-6.2	1059.3	406.8	406.8	293.2
3	-2.2	1053.7	728.1	728.1	524.7
4	-.1	1050.9	911.8	911.8	657.1
5	2.2	1048.2	1009.3	1009.3	727.4
6	6.8	1043.1	1192.6	1192.6	859.5
7	11.6	1038.2	1366.8	1366.8	985.0
8	16.1	1034.2	1509.6	1509.6	1088.0
9	20.7	1030.3	1635.0	1635.0	1178.3
10	26.2	1026.2	1758.0	1758.0	1266.9
11	30.7	1023.1	1838.2	1838.2	1324.8
12	35.3	1020.3	1886.6	1808.0	1303.0
13	41.3	1017.0	1902.1	1676.9	1208.5
14	47.5	1013.9	1856.6	1506.5	1085.7
15	53.8	1011.2	1740.9	1287.8	928.1
16	60.2	1008.9	1543.3	1009.3	727.4
17	66.2	1007.0	1278.5	689.0	496.6
18	72.3	1005.4	1016.9	485.8	350.1
19	79.1	1004.1	741.8	380.9	274.5
20	84.7	1003.2	442.1	240.6	173.4
21	89.1	1002.7	154.6	87.9	63.4

CHECK SUMS - (ALL SHOULD BE SMALL)
SUM OF FORCES IN VERTICAL DIRECTION = .00 (= .377E-02)
SHOULD NOT EXCEED .100E+03
SUM OF FORCES IN HORIZONTAL DIRECTION = .00 (= .303E-02)
SHOULD NOT EXCEED .100E+03
SUM OF MOMENTS ABOUT COORDINATE ORIGIN = -2.28 (= -.228E+01)
SHOULD NOT EXCEED .100E+03
SHEAR STRENGTH/SHEAR FORCE CHECK-SUM = .00 (= .276E-02)
SHOULD NOT EXCEED .100E+03

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Section C, Origin Crest, Units lbs-ft
By CJCW; Date March, 2003

TABLE NO. 39

```
**********************************************************************
*  Final Results for Side Forces and Stresses Between Slices.        *
*  (Results for Critical Shear Surface in Case of a Search.)         *
**********************************************************************
```

SPENCER'S PROCEDURE USED TO COMPUTE FACTOR OF SAFETY
Factor of Safety = 1.046 Side Force Inclination = -34.12 Degrees

---------- VALUES AT RIGHT SIDE OF SLICE ----------

Slice No.	X-Right	Side Force	Y-Coord. of Side Force Location	Fraction of Height	Sigma at Top	Sigma at Bottom
1	-8.2	498.	1063.9	.294	-16.4	157.0

2	-4.3	1917.	1058.8	.206	-105.4	380.6
3	-.2	4087.	1054.1	.180	-183.4	581.6
4	.0	4184.	1053.9	.179	-186.4	589.2
5	4.4	6652.	1049.3	.196	-237.6	814.9
6	9.2	8946.	1044.9	.212	-263.0	985.0
7	14.1	10853.	1040.7	.225	-272.3	1107.9
8	18.0	11908.	1037.6	.233	-270.2	1168.1
9	23.4	12667.	1033.6	.244	-253.6	1199.8
10	29.0	12542.	1029.9	.257	-215.5	1162.8
11	32.4	12001.	1027.8	.269	-177.9	1099.3
12	38.3	10667.	1024.5	.290	-110.2	967.2
13	44.4	9096.	1021.4	.312	-49.5	833.6
14	50.6	7322.	1018.4	.341	15.5	682.7
15	57.0	5483.	1015.8	.385	92.9	509.0
16	63.5	3851.	1013.4	.451	181.6	333.8
17	69.0	2959.	1011.0	.486	230.1	271.1
18	75.7	2042.	1007.9	.448	161.1	305.4
19	82.4	880.	1005.4	.449	116.9	220.1
20	87.0	248.	1004.1	.575	139.2	52.7
21	91.3	0.	526.5	BELOW	.0	.0

```
CHECK SUMS - (ALL SHOULD BE SMALL)
SUM OF FORCES IN VERTICAL DIRECTION    =         .00  (=  .377E-02)
     SHOULD NOT EXCEED     .100E+03
SUM OF FORCES IN HORIZONTAL DIRECTION  =         .00  (=  .303E-02)
     SHOULD NOT EXCEED     .100E+03
SUM OF MOMENTS ABOUT COORDINATE ORIGIN =       -2.28  (= -.228E+01)
     SHOULD NOT EXCEED     .100E+03
SHEAR STRENGTH/SHEAR FORCE CHECK-SUM   =         .00  (=  .276E-02)
     SHOULD NOT EXCEED     .100E+03


END-OF-FILE ENCOUNTERED WHILE READING COMMAND
WORDS - END OF PROBLEM(S) ASSUMED
```


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```
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        TABLE NO. 1
        ****************************************
        * COMPUTER PROGRAM DESIGNATION - UTEXAS3 *
        * Originally Coded By Stephen G. Wright  *
        * Version No. 1.208                      *
        * Last Revision Date  2/22/98            *
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        * All Rights Reserved                    *
        ****************************************

        ************************************************************
        *                                                          *
        *      RESULTS OF COMPUTATIONS PERFORMED USING THIS COMPUTER *
        * PROGRAM SHOULD NOT BE USED FOR DESIGN PURPOSES UNLESS THEY *
        * HAVE BEEN VERIFIED BY INDEPENDENT ANALYSES, EXPERIMENTAL   *
        * DATA OR FIELD EXPERIENCE. THE USER SHOULD UNDERSTAND THE   *
        * ALGORITHMS AND ANALYTICAL PROCEDURES USED IN THE COMPUTER  *
        * PROGRAM AND MUST HAVE READ ALL DOCUMENTATION FOR THIS      *
        * PROGRAM BEFORE ATTEMPTING ITS USE.                         *
        *                                                          *
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          Section D, Origin: Crest, Units: lbs-ft
          By: CJCW, Date: March, 2003

        TABLE NO.  2
        *************************
        * NEW PROFILE LINE DATA *
        *************************

        PROFILE LINE  1 - MATERIAL TYPE =  1
        Slime

             Point      X            Y

               1      -224.000      1066.000
               2      -187.000      1066.000
               3      -105.000      1069.000
               4          .000       994.000

        PROFILE LINE  2 - MATERIAL TYPE =  2
        Sand

             Point      X            Y

               1      -105.000      1069.000
               2       -17.000      1072.000
               3          .000      1072.000
               4        31.000      1049.000
               5        63.500      1027.000
               6        65.000      1026.000
               7        68.300      1024.000
               8        85.000      1014.000
```



```
               9       105.000      1014.000

        PROFILE LINE  3 - MATERIAL TYPE =  3
        Glacial Till

             Point      X            Y

               1      -224.000       991.000
               2      -200.000       991.000
               3      -100.000       993.000
               4          .000       994.000
               5        57.000      1001.000
               6        85.000      1006.000
               7       105.000      1014.000
               8       143.000      1025.000
               9       175.000      1040.000

        PROFILE LINE  4 - MATERIAL TYPE =  4
        Ablasial Till Line (20' below Glacial)

             Point      X            Y

               1      -224.000       971.000
               2      -200.000       971.000
               3      -100.000       973.000
               4          .000       974.000
               5        57.000       981.000
               6        85.000       986.000
               7       105.000       994.000
               8       143.000      1005.000
               9       175.000      1020.000

        All new profile lines defined - No old lines retained
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          Section D, Origin: Crest, Units: lbs-ft
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        TABLE NO.  3
        ************************************************************************
        * NEW MATERIAL PROPERTY DATA - CONVENTIONAL/FIRST-STAGE COMPUTATIONS *
        ************************************************************************

        DATA FOR MATERIAL TYPE  1
        Slime

             Unit weight of material =  120.000

             CONVENTIONAL (ISOTROPIC) SHEAR STRENGTHS
             Cohesion - - - - - - - -          .000
             Friction angle - - - - -  37.000 degrees

             Pore water pressures defined by piezometric line
             Number of the piezometric line used =  1
             Negative pore pressures set to zero

        DATA FOR MATERIAL TYPE  2
        Sand

             Unit weight of material =  120.000

             CONVENTIONAL (ISOTROPIC) SHEAR STRENGTHS
             Cohesion - - - - - - - -          .000
             Friction angle - - - - -  37.000 degrees
```

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Pore water pressures defined by piezometric line
Number of the piezometric line used = 1
Negative pore pressures set to zero

DATA FOR MATERIAL TYPE 3
Glacial Till

Unit weight of material = 140.000

CONVENTIONAL (ISOTROPIC) SHEAR STRENGTHS
Cohesion - - - - - - - - - 500.000
Friction angle - - - - - 40.000 degrees

Pore water pressures defined by piezometric line
Number of the piezometric line used = 1
Negative pore pressures set to zero

DATA FOR MATERIAL TYPE 4
Ablasial Till

Unit weight of material = 140.000

CONVENTIONAL (ISOTROPIC) SHEAR STRENGTHS
Cohesion - - - - - - - - - 500.000
Friction angle - - - - - 40.000 degrees

Pore water pressures defined by piezometric line
Number of the piezometric line used = 1
Negative pore pressures set to zero

All new material properties defined - No old data retained
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TABLE NO. 5
****
* NEW PIEZOMETRIC LINE DATA - CONVENTIONAL/FIRST-STAGE COMPUTATIONS *
****

Line No.	Point	X	Y
1 - Unit weight of water = 62.40			
1	1	-224.000	1026.000
1	2	65.000	1026.000
1	3	85.000	1014.000
1	4	175.000	1014.000

All new piezometric lines defined - No old lines retained
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TABLE NO. 15
****
* NEW ANALYSIS/COMPUTATION DATA *
****

Circular Shear Surface(s)

Computations Performed for Single Shear Surface

Center Coordinates for Center of Circle -
X = 87.000
Y = 1107.000

Circle Passes Throught the Point at -
X = 95.000
Y = 1014.000
Radius = 93.343

THE FOLLOWING REPRESENT EITHER DEFAULT OR PREVIOUSLY DEFINED VALUES:

Initial trial estimate for the factor of safety = 3.000

Initial trial estimate for side force inclination = 15.000 degrees
(Applicable to Spencer's procedure only)

Maximum number of iterations allowed for
calculating the factor of safety = 40

Allowed force imbalance for convergence = 100.000

Allowed moment imbalance for convergence = 100.000

Maximum subtended angle to be used for subdivision of the
circle into slices = 3.00 degrees

Depth of crack = .000

Depth of water in crack = .000

Unit weight of water in crack = 62.400

Seismic coefficient = .000

Conventional (single-stage) computations to be performed

Procedure used to compute the factor of safety: SPENCER
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TABLE NO. 16
****
* NEW SLOPE GEOMETRY DATA *
****

NOTE - NO DATA WERE INPUT, SLOPE GEOMETRY DATA
WERE GENERATED BY THE PROGRAM

Slope Coordinates -

Point	X	Y
1	-224.000	1066.000
2	-187.000	1066.000
3	-105.000	1069.000
4	-17.000	1072.000
5	.000	1072.000

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6	31.000	1049.000
7	63.500	1027.000
8	65.000	1026.000
9	68.300	1024.000
10	85.000	1014.000
11	105.000	1014.000
12	143.000	1025.000
13	175.000	1040.000

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Section D, Origin: Crest, Units: lbs-ft
By: CJCW, Date: March, 2003

TABLE NO. 26

****
* Coordinate, Weight, Strength and Pore Water Pressure *
* Information for Individual Slices for Conventional *
* Computations or First Stage of Multi-Stage Computations. *
* (Information is for the Critical Shear Surface in the *
* Case of an Automatic Search.) *
****

Slice No.	X	Y	Slice Weight	Matl. Type	Cohesion	Friction Angle	Pore Pressure
	.7	1071.5					
1	1.7	1069.3	356.1	2	.00	37.00	.0
	2.6	1067.0					
2	3.7	1064.9	1156.0	2	.00	37.00	.0
	4.9	1062.7					
3	6.1	1060.6	2026.5	2	.00	37.00	.0
	7.3	1058.4					
4	8.6	1056.4	2935.8	2	.00	37.00	.0
	9.9	1054.3					
5	11.4	1052.3	3852.5	2	.00	37.00	.0
	12.8	1050.4					
6	14.3	1048.5	4745.9	2	.00	37.00	.0
	15.9	1046.6					
7	17.5	1044.7	5586.3	2	.00	37.00	.0
	19.1	1042.9					
8	20.8	1041.2	6345.2	2	.00	37.00	.0
	22.6	1039.5					
9	24.4	1037.8	6996.1	2	.00	37.00	.0
	26.2	1036.2					
10	28.1	1034.6	7514.5	2	.00	37.00	.0
	30.0	1033.1					
11	30.5	1032.7	2033.2	2	.00	37.00	.0
	31.0	1032.3					
12	33.0	1030.9	8007.6	2	.00	37.00	.0
	35.0	1029.5					
13	37.0	1028.2	8282.4	2	.00	37.00	.0
	39.1	1026.9					
14	39.9	1026.4	2976.4	2	.00	37.00	.0
	40.6	1026.0					
15	42.8	1024.8	8362.9	2	.00	37.00	72.3
	44.9	1023.7					
16	47.1	1022.6	8190.0	2	.00	37.00	209.7
	49.3	1021.6					
17	51.6	1020.7	7809.3	2	.00	37.00	332.7
	53.9	1019.7					
18	55.4	1019.2	5019.6	2	.00	37.00	425.9
	57.0	1018.6					
19	59.3	1017.9	6684.8	2	.00	37.00	506.4
	61.7	1017.2					
20	62.6	1016.9	2355.3	2	.00	37.00	567.1
	63.5	1016.7					

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By: CJCW, Date: March, 2003

TABLE NO. 26

****
* Coordinate, Weight, Strength and Pore Water Pressure *
* Information for Individual Slices for Conventional *
* Computations or First Stage of Multi-Stage Computations. *
* (Information is for the Critical Shear Surface in the *
* Case of an Automatic Search.) *
****

Slice No.	X	Y	Slice Weight	Matl. Type	Cohesion	Friction Angle	Pore Pressure
	63.5	1016.7					
21	64.3	1016.5	1804.6	2	.00	37.00	594.4
	65.0	1016.3					
22	66.7	1015.9	3596.7	2	.00	37.00	567.4
	68.3	1015.5					
23	70.7	1015.1	4294.3	2	.00	37.00	465.1
	73.1	1014.7					
24	75.5	1014.4	3067.8	2	.00	37.00	329.6
	78.0	1014.1					
25	80.4	1013.9	1657.0	2	.00	37.00	177.1
	82.8	1013.7					
26	83.9	1013.7	242.5	2	.00	37.00	58.4
	85.0	1013.7					
27	86.0	1013.7	79.9	2	.00	37.00	20.8
	87.0	1013.7					
28	89.4	1013.7	163.8	2	.00	37.00	17.4
	91.9	1013.8					
29	93.4	1013.9	40.3	2	.00	37.00	6.7
	95.0	1014.0					

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TABLE NO. 27

****
* Seismic Forces and Forces Due to Surface Pressures for *
* Individual Slices for Conventional Computations or the *
* First Stage of Multi-Stage Computations. *
* (Information is for the Critical Shear Surface in the *
* Case of an Automatic Search.) *
****

						FORCES DUE TO SURFACE PRESSURES	
Slice No.	X	Seismic Force	Y for Seismic Force	Normal Force	Shear Force	X	Y
1	1.7	0.	1070.0	0.	0.	.0	.0
2	3.7	0.	1067.0	0.	0.	.0	.0
3	6.1	0.	1064.0	0.	0.	.0	.0
4	8.6	0.	1061.0	0.	0.	.0	.0
5	11.4	0.	1058.0	0.	0.	.0	.0

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6	14.3	0.	1054.9	0.	0.	.0	.0
7	17.5	0.	1051.9	0.	0.	.0	.0
8	20.8	0.	1048.9	0.	0.	.0	.0
9	24.4	0.	1045.9	0.	0.	.0	.0
10	28.1	0.	1042.9	0.	0.	.0	.0
11	30.5	0.	1041.0	0.	0.	.0	.0
12	33.0	0.	1039.3	0.	0.	.0	.0
13	37.0	0.	1036.5	0.	0.	.0	.0
14	39.9	0.	1034.7	0.	0.	.0	.0
15	42.8	0.	1032.9	0.	0.	.0	.0
16	47.1	0.	1030.4	0.	0.	.0	.0
17	51.6	0.	1027.9	0.	0.	.0	.0
18	55.4	0.	1025.8	0.	0.	.0	.0
19	59.3	0.	1023.9	0.	0.	.0	.0
20	62.6	0.	1022.3	0.	0.	.0	.0
21	64.3	0.	1021.5	0.	0.	.0	.0
22	66.7	0.	1020.5	0.	0.	.0	.0
23	70.7	0.	1018.8	0.	0.	.0	.0
24	75.5	0.	1017.0	0.	0.	.0	.0
25	80.4	0.	1015.3	0.	0.	.0	.0
26	83.9	0.	1014.2	0.	0.	.0	.0
27	86.0	0.	1013.8	0.	0.	.0	.0
28	89.4	0.	1013.9	0.	0.	.0	.0
29	93.4	0.	1013.9	0.	0.	.0	.0

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Section D, Origin: Crest, Units: lbs-ft
By: CJCW, Date: March, 2003

TABLE NO. 29
****
* Information Generated During Iterative Solution for the Factor *
* of Safety and Side Force Inclination by Spencer's Procedure *
****

Iteration	Trial Factor of Safety	Trial Side Force Inclination (degrees)	Force Imbalance (lbs.)	Moment Imbalance (ft.-lbs.)	Delta-F	Delta Theta (degrees)
1	3.00000	-15.0000	-.4010E+05	.4050E+08		
First-order corrections to F and THETA					-.491E+01	-.703E+00
Values factored by .102E+00 - Deltas too large					-.500E+00	-.716E-01
2	2.50000	-15.0716	-.3528E+05	.3564E+08		
First-order corrections to F and THETA					-.310E+01	-.835E+00
Values factored by .161E+00 - Deltas too large					-.500E+00	-.134E+00
3	2.00000	-15.2061	-.2836E+05	.2865E+08		
First-order corrections to F and THETA					-.168E+01	-.108E+01
Values factored by .298E+00 - Deltas too large					-.500E+00	-.322E+00
4	1.50000	-15.5278	-.1751E+05	.1772E+08		
First-order corrections to F and THETA					-.626E+00	-.174E+01
Values factored by .799E+00 - Deltas too large					-.500E+00	-.139E+01
5	1.00000	-16.9189	.2245E+04	-.2101E+07		
First-order corrections to F and THETA					-.478E-01	.407E+02
Values factored by .211E+00 - Deltas too large					-.101E-01	.859E+01
6	.98989	-8.3245	.1865E+04	-.1718E+07		
First-order corrections to F and THETA					.167E+00	-.723E+02
Values factored by .119E+00 - Deltas too large					.199E-01	-.859E+01

7	1.00980	-16.9189	.1701E+04	-.1559E+07		
First-order corrections to F and THETA					-.311E+00	.161E+03
Values factored by .532E-01 - Deltas too large					-.165E-01	.859E+01
8	.99327	-8.3245	.1684E+04	-.1533E+07		
First-order corrections to F and THETA					.148E+00	-.636E+02
Values factored by .135E+00 - Deltas too large					.200E-01	-.859E+01
9	1.01325	-16.9189	.1512E+04	-.1371E+07		
First-order corrections to F and THETA					.990E+01	-.471E+04
Values factored by .183E-02 - Deltas too large					.181E-01	-.859E+01
10	1.03133	-25.5132	.1611E+04	-.1452E+07		
First-order corrections to F and THETA					-.274E-01	.216E+02
Values factored by .398E+00 - Deltas too large					-.109E-01	.859E+01
11	1.02041	-16.9189	.1123E+04	-.9828E+06		
First-order corrections to F and THETA					.175E+00	-.747E+02
Values factored by .115E+00 - Deltas too large					.201E-01	-.859E+01
12	1.04054	-25.5132	.1082E+04	-.9515E+06		
First-order corrections to F and THETA					.441E+00	-.170E+03
Values factored by .506E-01 - Deltas too large					.223E-01	-.859E+01
13	1.06283	-34.1076	.1200E+04	-.1056E+07		
First-order corrections to F and THETA					.347E-01	-.476E+01
Second-order correction - Iteration 1					.352E-01	-.476E+01
Second-order correction - Iteration 2					.352E-01	-.476E+01
14	1.09805	-38.8712	.6082E+01	-.6313E+05		
First-order corrections to F and THETA					-.176E-01	.484E+01
Second-order correction - Iteration 1					-.154E-01	.484E+01
Second-order correction - Iteration 2					-.154E-01	.484E+01
15	1.08265	-34.0334	-.2668E+02	.1868E+05		
First-order corrections to F and THETA					-.179E-02	.451E+00
Second-order correction - Iteration 1					-.179E-02	.451E+00
Second-order correction - Iteration 2					-.179E-02	.451E+00
16	1.08086	-33.5821	-.7542E-02	-.1390E+03		
First-order corrections to F and THETA					-.430E-04	.146E-01
Second-order correction - Iteration 1					-.430E-04	.146E-01
17	1.08082	-33.5676	.2083E-02	.4712E+00		
First-order corrections to F and THETA					.714E-06	-.231E-03

Factor of Safety - - - - - - - - 1.081
Side Force Inclination - - - - - -33.57
Number of Iterations - - - - - - 17

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Elizabeth Mine. Steady-State Drained, Raised Phreatic Surface
Section D, Origin: Crest, Units: lbs-ft
By: CJCW, Date: March, 2003

TABLE NO. 38
****
* Final Results for Stresses Along the Shear Surface *
* (Results for Critical Shear Surface in Case of a Search.) *
****

SPENCER'S PROCEDURE USED TO COMPUTE FACTOR OF SAFETY
Factor of Safety = 1.081 Side Force Inclination = -33.57 Degrees

-------- VALUES AT CENTER OF BASE OF SLICE---------

KAL4PRINT

Slice No.	X-center	Y-center	Total Normal Stress	Effective Normal Stress	Shear Stress
1	1.7	1069.3	49.8	49.8	34.8
2	3.7	1064.9	162.4	162.4	113.2
3	6.1	1060.6	286.4	286.4	199.7
4	8.6	1056.4	418.7	418.7	291.9
5	11.4	1052.3	556.1	556.1	387.7
6	14.3	1048.5	695.3	695.3	484.7
7	17.5	1044.7	833.1	833.1	580.8
8	20.8	1041.2	966.3	966.3	673.7
9	24.4	1037.8	1091.5	1091.5	761.0
10	28.1	1034.6	1205.2	1205.2	840.3
11	30.5	1032.7	1272.2	1272.2	887.0
12	33.0	1030.9	1336.7	1336.7	932.0
13	37.0	1028.2	1433.5	1433.5	999.4
14	39.9	1026.4	1490.4	1490.4	1039.1
15	42.8	1024.8	1525.4	1453.1	1013.1
16	47.1	1022.6	1546.5	1336.8	932.0
17	51.6	1020.7	1523.0	1190.3	829.9
18	55.4	1019.2	1465.7	1039.8	724.9
19	59.3	1017.9	1362.4	856.0	596.8
20	62.6	1016.9	1246.8	679.7	473.9
21	64.3	1016.5	1173.9	579.5	404.0
22	66.7	1015.9	1088.4	521.1	363.3
23	70.7	1015.1	943.6	478.5	333.6
24	75.5	1014.4	720.5	390.8	272.5
25	80.4	1013.9	420.8	243.7	169.9
26	83.9	1013.7	148.4	90.1	62.8
27	86.0	1013.7	55.2	34.5	24.0
28	89.4	1013.7	50.1	32.7	22.8
29	93.4	1013.9	21.4	14.7	10.3

CHECK SUMS - (ALL SHOULD BE SMALL)
SUM OF FORCES IN VERTICAL DIRECTION = .00 (= .210E-02)
SHOULD NOT EXCEED .100E+03
SUM OF FORCES IN HORIZONTAL DIRECTION = .00 (= .374E-02)
SHOULD NOT EXCEED .100E+03
SUM OF MOMENTS ABOUT COORDINATE ORIGIN = -1.61 (= -.161E+01)
SHOULD NOT EXCEED .100E+03
SHEAR STRENGTH/SHEAR FORCE CHECK-SUM = .00 (= .243E-02)
SHOULD NOT EXCEED .100E+03

1 UTEXAS3 - VER. 1.208 - 2/22/98 - (C) 1985-1998 S. G. WRIGHT
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Date: 3: 7:2003 Time: 13:39:22 Input file: ddc1a.in
Elizabeth Mine. Steady-State Drained, Raised Phreatic Surface
Section D, Origin: Crest, Units: lbs-ft
By: CJCW, Date: March, 2003

TABLE NO. 39
****
* Final Results for Side Forces and Stresses Between Slices. *
* (Results for Critical Shear Surface in Case of a Search.) *
****

SPENCER'S PROCEDURE USED TO COMPUTE FACTOR OF SAFETY
Factor of Safety = 1.081 Side Force Inclination = -33.57 Degrees

---------- VALUES AT RIGHT SIDE OF SLICE ----------

Slice No.	X-Right	Side Force	Y-Coord. of Side Force Location	Fraction of Height	Sigma at Top	Sigma at Bottom
1	2.6	185.	1068.6	.526	59.2	43.4
2	4.9	735.	1064.9	.386	33.7	180.1
3	7.3	1609.	1061.4	.358	24.3	304.3
4	9.9	2743.	1057.9	.347	18.3	425.6
5	12.8	4055.	1054.5	.342	13.9	542.9
6	15.9	5447.	1051.2	.339	11.1	653.1
7	19.1	6814.	1048.0	.338	10.5	752.2
8	22.6	8045.	1044.8	.339	13.4	835.3
9	26.2	9032.	1041.8	.341	21.7	896.8
10	30.0	9673.	1038.9	.346	38.2	929.3
11	31.0	9771.	1038.1	.348	44.4	931.8
12	35.0	9851.	1035.4	.354	60.2	916.4
13	39.1	9401.	1033.0	.367	95.7	846.2
14	40.6	9100.	1032.2	.375	115.6	803.8
15	44.9	8110.	1030.1	.401	172.4	677.7
16	49.3	7044.	1028.0	.429	224.3	558.5
17	53.9	5931.	1026.1	.463	278.9	437.8
18	57.0	5183.	1024.9	.491	319.4	355.8
19	61.7	4209.	1023.1	.532	377.3	255.8
20	63.5	3910.	1022.3	.542	393.9	236.4
21	65.0	3714.	1021.5	.541	397.9	239.3
22	68.3	3238.	1020.0	.529	375.4	263.1
23	73.1	2278.	1018.2	.549	382.3	208.8
24	78.0	1211.	1017.0	.694	530.8	-40.7
25	82.8	392.	1016.7	ABOVE	1981.0	-1558.7
26	85.0	241.	1016.6	ABOVE	33327.4	-32077.9
27	87.0	185.	1016.0	ABOVE	17693.5	-16794.9
28	91.9	44.	1015.0	ABOVE	5336.2	-4997.0
29	95.0	0.	-54.7	BELOW	.0	.0

CHECK SUMS - (ALL SHOULD BE SMALL)
SUM OF FORCES IN VERTICAL DIRECTION = .00 (= .210E-02)
SHOULD NOT EXCEED .100E+03
SUM OF FORCES IN HORIZONTAL DIRECTION = .00 (= .374E-02)
SHOULD NOT EXCEED .100E+03
SUM OF MOMENTS ABOUT COORDINATE ORIGIN = -1.61 (= -.161E+01)
SHOULD NOT EXCEED .100E+03
SHEAR STRENGTH/SHEAR FORCE CHECK-SUM = .00 (= .243E-02)
SHOULD NOT EXCEED .100E+03

***** CAUTION ***** SOME OF THE FORCES BETWEEN SLICES ACT AT POINTS
ABOVE THE SURFACE OF THE SLOPE OR BELOW THE
SHEAR SURFACE - EITHER A TENSION CRACK MAY BE
NEEDED OR THE SOLUTION MAY NOT BE A VALID SOLUTION

=> .

END-OF-FILE ENCOUNTERED WHILE READING COMMAND
WORDS - END OF PROBLEM(S) ASSUMED

KG14PRINT

Appendix E
Dam Breach and Runout Analysis Output Files

Appendix E
Dam Breach and Runout Analysis Output Files

FLOOD CREST SUMMARY :

Cross Section Location (mi)	Maximum Stage Elevation (ft MSL)	Maximum Flow (cfs)	Time To Maximum Stage (hr)	Maximum Flow Velocity (ft/sec)	Flood Elevation (ft MSL)	Time To Flood Elevation (hr)	Flood Wave Arrival Time (hr)
0.000	1062.01	31371	0.000	4.91	0.00	0.00	0.00
0.023	951.66	31371	0.172	34.70	0.00	0.00	0.02
0.051	939.59	31276	0.172	34.50	0.00	0.00	0.02
0.078	927.49	31178	0.172	34.56	0.00	0.00	0.02
0.106	915.39	31077	0.172	34.73	0.00	0.00	0.02
0.133	903.32	30973	0.172	34.97	0.00	0.00	0.02
0.161	891.28	30866	0.172	35.27	0.00	0.00	0.02
0.188	879.30	30802	0.184	35.63	0.00	0.00	0.02
0.216	867.43	30794	0.184	35.99	0.00	0.00	0.02
0.243	855.67	30779	0.184	36.21	0.00	0.00	0.02
0.271	844.04	30757	0.184	36.30	0.00	0.00	0.02
0.276	856.93	30745	0.184	9.21	0.00	0.00	0.02
0.281	840.31	30733	0.184	42.24	0.00	0.00	0.02
0.286	839.24	30726	0.184	40.84	0.00	0.00	0.02
0.291	838.16	30719	0.184	39.56	0.00	0.00	0.02
0.296	837.06	30711	0.184	38.40	0.00	0.00	0.02
0.301	835.96	30704	0.184	37.35	0.00	0.00	0.02
0.306	834.84	30696	0.184	36.40	0.00	0.00	0.02
0.311	833.71	30688	0.184	35.54	0.00	0.00	0.03
0.316	832.56	30680	0.184	34.76	0.00	0.00	0.03
0.321	831.41	30672	0.184	34.06	0.00	0.00	0.03
0.326	830.24	30664	0.184	33.42	0.00	0.00	0.03
0.331	829.06	30655	0.184	32.85	0.00	0.00	0.03
0.336	827.87	30646	0.184	32.34	0.00	0.00	0.03
0.341	826.67	30638	0.184	31.88	0.00	0.00	0.03
0.346	825.46	30629	0.184	31.46	0.00	0.00	0.03
0.351	824.24	30619	0.184	31.09	0.00	0.00	0.03
0.356	823.01	30610	0.184	30.76	0.00	0.00	0.03
0.361	821.78	30600	0.184	30.46	0.00	0.00	0.03
0.366	820.54	30590	0.184	30.20	0.00	0.00	0.03
0.371	819.29	30580	0.184	29.95	0.00	0.00	0.03
0.376	818.04	30570	0.184	29.74	0.00	0.00	0.03
0.382	816.78	30559	0.184	29.54	0.00	0.00	0.03
0.387	815.53	30548	0.184	29.36	0.00	0.00	0.03
0.392	814.26	30537	0.184	29.19	0.00	0.00	0.03
0.397	813.00	30525	0.184	29.04	0.00	0.00	0.04
0.402	811.73	30514	0.184	28.90	0.00	0.00	0.04
0.407	810.46	30502	0.184	28.77	0.00	0.00	0.04
0.412	809.18	30489	0.184	28.65	0.00	0.00	0.04
0.417	807.91	30477	0.184	28.54	0.00	0.00	0.04
0.422	806.64	30464	0.184	28.43	0.00	0.00	0.04
0.427	805.36	30451	0.184	28.33	0.00	0.00	0.04
0.432	804.08	30438	0.184	28.23	0.00	0.00	0.04
0.437	802.81	30424	0.184	28.13	0.00	0.00	0.04
0.442	801.53	30411	0.184	28.04	0.00	0.00	0.04
0.447	800.25	30397	0.184	27.95	0.00	0.00	0.04
0.452	798.97	30382	0.184	27.87	0.00	0.00	0.04
0.457	797.69	30368	0.184	27.78	0.00	0.00	0.04

FLOOD CREST SUMMARY :

Cross Section Location (mi)	Maximum Stage Elevation (ft MSL)	Maximum Flow (cfs)	Time To Maximum Stage (hr)	Maximum Flow Velocity (ft/sec)	Flood Elevation (ft MSL)	Time To Flood Elevation (hr)	Flood Wave Arrival Time (hr)
0.462	796.41	30353	0.184	27.70	0.00	0.00	0.04
0.467	795.14	30338	0.184	27.62	0.00	0.00	0.04
0.472	793.86	30323	0.184	27.54	0.00	0.00	0.04
0.477	792.58	30307	0.184	27.46	0.00	0.00	0.04
0.482	791.30	30292	0.184	27.38	0.00	0.00	0.04
0.487	790.02	30276	0.184	27.31	0.00	0.00	0.04
0.492	788.75	30260	0.184	27.23	0.00	0.00	0.04
0.497	787.47	30243	0.184	27.15	0.00	0.00	0.04
0.503	786.19	30227	0.184	27.08	0.00	0.00	0.04
0.508	784.91	30210	0.184	27.00	0.00	0.00	0.04
0.513	783.64	30193	0.184	26.93	0.00	0.00	0.04
0.518	782.36	30176	0.184	26.85	0.00	0.00	0.04
0.523	781.08	30158	0.184	26.78	0.00	0.00	0.04
0.528	779.81	30141	0.184	26.71	0.00	0.00	0.04
0.533	778.53	30123	0.184	26.63	0.00	0.00	0.05
0.538	777.26	30105	0.184	26.56	0.00	0.00	0.05
0.543	775.98	30087	0.184	26.49	0.00	0.00	0.05
0.548	774.71	30068	0.184	26.41	0.00	0.00	0.05
0.553	773.43	30050	0.184	26.34	0.00	0.00	0.05
0.558	772.16	30031	0.184	26.27	0.00	0.00	0.05
0.563	770.88	30012	0.184	26.20	0.00	0.00	0.05
0.568	769.61	29992	0.184	26.13	0.00	0.00	0.05
0.573	768.34	29973	0.184	26.05	0.00	0.00	0.05
0.578	767.06	29953	0.184	25.98	0.00	0.00	0.05
0.583	765.79	29933	0.184	25.91	0.00	0.00	0.05
0.588	764.51	29913	0.184	25.84	0.00	0.00	0.05
0.593	763.24	29893	0.184	25.77	0.00	0.00	0.05
0.598	761.97	29873	0.184	25.70	0.00	0.00	0.05
0.603	760.70	29852	0.184	25.63	0.00	0.00	0.05
0.608	759.43	29831	0.197	25.56	0.00	0.00	0.05
0.613	758.16	29828	0.197	25.49	0.00	0.00	0.05
0.618	756.89	29827	0.197	25.42	0.00	0.00	0.05
0.624	755.62	29826	0.197	25.36	0.00	0.00	0.05
0.629	754.35	29825	0.197	25.30	0.00	0.00	0.06
0.634	753.08	29823	0.197	25.24	0.00	0.00	0.06
0.639	751.81	29821	0.197	25.18	0.00	0.00	0.06
0.644	750.54	29819	0.197	25.11	0.00	0.00	0.06
0.649	749.28	29817	0.197	25.05	0.00	0.00	0.06
0.654	748.01	29814	0.197	24.99	0.00	0.00	0.06
0.659	746.74	29811	0.197	26.37	0.00	0.00	0.06
0.679	746.61	29798	0.197	32.75	0.00	0.00	0.07
0.699	746.36	29800	0.184	21.67	0.00	0.00	0.07
0.719	744.78	29763	0.197	16.90	0.00	0.00	0.07
0.740	742.96	29700	0.197	16.38	0.00	0.00	0.07
0.760	741.39	29643	0.197	16.07	0.00	0.00	0.07
0.780	739.60	29568	0.197	16.17	0.00	0.00	0.07
0.800	738.00	29486	0.197	15.93	0.00	0.00	0.07
0.821	736.24	29386	0.209	15.98	0.00	0.00	0.07

FLOOD CREST SUMMARY :

Cross Section Location (mi)	Maximum Stage Elevation (ft MSL)	Maximum Flow (cfs)	Time To Maximum Stage (hr)	Maximum Flow Velocity (ft/sec)	Flood Elevation (ft MSL)	Time To Flood Elevation (hr)	Flood Wave Arrival Time (hr)
0.841	734.63	29285	0.197	15.73	0.00	0.00	0.07
0.861	732.91	29176	0.209	15.76	0.00	0.00	0.07
0.881	731.27	29124	0.209	15.54	0.00	0.00	0.08
0.901	729.58	29101	0.209	15.55	0.00	0.00	0.09
0.922	727.94	29068	0.209	15.39	0.00	0.00	0.09
0.942	726.28	29026	0.222	15.34	0.00	0.00	0.10
0.962	724.61	28976	0.209	15.49	0.00	0.00	0.09
0.982	723.12	28925	0.222	15.15	0.00	0.00	0.10
1.002	721.27	28858	0.209	15.51	0.00	0.00	0.10
1.023	719.93	28802	0.222	14.92	0.00	0.00	0.10
1.043	717.91	28728	0.209	15.67	0.00	0.00	0.11
1.063	716.44	28668	0.222	14.61	0.00	0.00	0.11
1.083	717.08	28668	0.252	12.01	0.00	0.00	0.12
1.103	711.20	28563	0.209	29.01	0.00	0.00	0.12
1.124	712.91	28509	0.222	11.88	0.00	0.00	0.12
1.144	707.91	28488	0.222	27.33	0.00	0.00	0.12
1.164	708.45	28451	0.222	13.56	0.00	0.00	0.12
1.184	708.54	28401	0.252	11.21	0.00	0.00	0.15
1.205	702.61	28349	0.222	30.00	0.00	0.00	0.15
1.225	703.08	28292	0.222	14.09	0.00	0.00	0.15
1.245	701.42	28216	0.222	14.01	0.00	0.00	0.15
1.265	699.77	28130	0.234	13.92	0.00	0.00	0.15
1.285	698.13	28032	0.234	13.83	0.00	0.00	0.15
1.306	696.49	28007	0.234	13.74	0.00	0.00	0.15
1.326	694.84	27981	0.234	13.65	0.00	0.00	0.15
1.346	693.20	27946	0.234	13.56	0.00	0.00	0.15
1.366	691.55	27899	0.234	13.51	0.00	0.00	0.15
1.386	689.93	27841	0.234	13.37	0.00	0.00	0.15
1.407	688.22	27772	0.234	13.42	0.00	0.00	0.15
1.427	686.73	27688	0.234	13.03	0.00	0.00	0.15
1.447	684.74	27596	0.247	13.64	0.00	0.00	0.15
1.468	682.95	27577	0.247	13.37	0.00	0.00	0.15
1.489	681.17	27555	0.250	13.13	0.00	0.00	0.17
1.510	679.38	27539	0.252	12.90	0.00	0.00	0.17
1.530	677.60	27525	0.252	12.68	0.00	0.00	0.17
1.551	675.82	27506	0.252	12.47	0.00	0.00	0.17
1.572	674.04	27476	0.252	12.27	0.00	0.00	0.17
1.593	672.26	27433	0.252	12.07	0.00	0.00	0.17
1.614	670.49	27376	0.252	11.88	0.00	0.00	0.17
1.634	668.70	27304	0.252	11.69	0.00	0.00	0.17
1.655	666.93	27213	0.264	11.48	0.00	0.00	0.17
1.676	665.14	27135	0.264	11.34	0.00	0.00	0.17
1.697	663.41	27121	0.267	11.11	0.00	0.00	0.17
1.718	661.48	27107	0.267	11.27	0.00	0.00	0.20
1.738	659.58	27089	0.267	11.29	0.00	0.00	0.20
1.759	657.68	27058	0.267	11.32	0.00	0.00	0.20
1.779	655.78	27010	0.267	11.34	0.00	0.00	0.20
1.799	653.87	26943	0.267	11.36	0.00	0.00	0.20

FLOOD CREST SUMMARY :

Cross Section Location (mi)	Maximum Stage Elevation (ft MSL)	Maximum Flow (cfs)	Time To Maximum Stage (hr)	Maximum Flow Velocity (ft/sec)	Flood Elevation (ft MSL)	Time To Flood Elevation (hr)	Flood Wave Arrival Time (hr)
1.820	651.97	26849	0.267	11.38	0.00	0.00	0.20
1.840	650.06	26724	0.280	11.43	0.00	0.00	0.20
1.861	648.15	26689	0.280	11.47	0.00	0.00	0.20
1.881	646.23	26647	0.280	11.52	0.00	0.00	0.20
1.902	644.32	26584	0.280	11.58	0.00	0.00	0.20
1.922	642.41	26499	0.280	11.64	0.00	0.00	0.22
1.942	640.49	26387	0.292	11.69	0.00	0.00	0.22
1.963	638.59	26282	0.292	11.74	0.00	0.00	0.22
1.983	636.69	26251	0.292	11.78	0.00	0.00	0.22
2.004	634.78	26201	0.292	11.84	0.00	0.00	0.22
2.024	632.88	26129	0.292	11.90	0.00	0.00	0.22
2.045	630.97	26033	0.292	11.95	0.00	0.00	0.22
2.065	629.07	25911	0.305	12.01	0.00	0.00	0.22
2.086	627.18	25850	0.305	12.06	0.00	0.00	0.22
2.106	625.29	25810	0.305	12.10	0.00	0.00	0.22
2.126	623.40	25750	0.305	12.16	0.00	0.00	0.25
2.147	621.50	25667	0.305	12.23	0.00	0.00	0.25
2.167	619.61	25559	0.317	12.27	0.00	0.00	0.25
2.188	617.72	25445	0.319	12.35	0.00	0.00	0.25
2.208	615.87	25419	0.320	12.35	0.00	0.00	0.25
2.229	613.95	25392	0.323	12.52	0.00	0.00	0.25
2.249	612.18	25364	0.323	12.33	0.00	0.00	0.25
2.269	610.09	25337	0.323	12.88	0.00	0.00	0.25
2.290	608.77	25281	0.323	11.83	0.00	0.00	0.25
2.310	608.43	25194	0.323	9.48	0.00	0.00	0.25
2.331	602.26	25125	0.323	31.88	0.00	0.00	0.25
2.351	602.76	25044	0.336	12.80	0.00	0.00	0.27
2.372	600.91	24930	0.336	12.85	0.00	0.00	0.27
2.392	599.06	24895	0.336	12.91	0.00	0.00	0.27
2.412	597.21	24841	0.336	12.94	0.00	0.00	0.27
2.433	595.35	24766	0.336	13.00	0.00	0.00	0.27
2.453	593.51	24668	0.336	13.02	0.00	0.00	0.27
2.474	591.63	24543	0.336	13.14	0.00	0.00	0.27
2.494	589.84	24392	0.336	13.04	0.00	0.00	0.28
2.509	588.53	24263	0.336	12.96	0.00	0.00	0.28
2.525	587.24	24116	0.361	12.88	0.00	0.00	0.28
2.540	585.96	23950	0.361	12.79	0.00	0.00	0.28
2.555	584.68	23894	0.361	12.71	0.00	0.00	0.28
2.570	583.40	23867	0.361	12.62	0.00	0.00	0.28
2.586	582.12	23830	0.361	12.52	0.00	0.00	0.28
2.601	580.84	23782	0.361	12.43	0.00	0.00	0.28
2.616	579.56	23723	0.361	12.35	0.00	0.00	0.28
2.631	578.28	23651	0.375	12.29	0.00	0.00	0.28
2.647	577.02	23566	0.375	12.22	0.00	0.00	0.28
2.662	575.75	23468	0.375	12.15	0.00	0.00	0.30
2.677	574.49	23448	0.375	12.09	0.00	0.00	0.30
2.692	573.23	23417	0.375	12.02	0.00	0.00	0.30
2.708	571.96	23376	0.375	11.95	0.00	0.00	0.30

FLOOD CREST SUMMARY :

Cross Section Location (mi)	Maximum Stage Elevation (ft MSL)	Maximum Flow (cfs)	Time To Maximum Stage (hr)	Maximum Flow Velocity (ft/sec)	Flood Elevation (ft MSL)	Time To Flood Elevation (hr)	Flood Wave Arrival Time (hr)
2.723	570.70	23323	0.375	11.88	0.00	0.00	0.30
2.738	569.43	23258	0.375	11.82	0.00	0.00	0.30
2.753	568.16	23179	0.375	11.77	0.00	0.00	0.30
2.769	566.89	23086	0.375	11.72	0.00	0.00	0.30
2.784	565.62	22975	0.375	11.66	0.00	0.00	0.30
2.799	564.35	22848	0.400	11.61	0.00	0.00	0.30
2.814	563.10	22700	0.400	11.55	0.00	0.00	0.30
2.830	561.84	22541	0.400	11.54	0.00	0.00	0.30
2.845	560.73	22503	0.400	11.35	0.00	0.00	0.30
2.860	560.00	22440	0.400	10.32	0.00	0.00	0.30
2.875	559.58	22361	0.400	10.05	0.00	0.00	0.30
2.891	554.16	22314	0.400	26.07	0.00	0.00	0.30
2.906	556.29	22253	0.400	9.99	0.00	0.00	0.30
2.990	551.12	21542	0.425	9.93	0.00	0.00	0.32
3.074	545.95	21150	0.425	9.86	0.00	0.00	0.34
3.158	540.85	20639	0.450	9.79	0.00	0.00	0.32
3.242	535.71	20274	0.450	9.73	0.00	0.00	0.34
3.326	530.64	19843	0.475	9.58	0.00	0.00	0.32
3.410	525.55	19570	0.487	9.57	0.00	0.00	0.37
3.494	520.53	19365	0.487	9.42	0.00	0.00	0.37

FLOOD CREST SUMMARY :

Cross Section Location (mi)	Maximum Stage Elevation (ft MSL)	Maximum Flow (cfs)	Time To Maximum Stage (hr)	Maximum Flow Velocity (ft/sec)	Flood Elevation (ft MSL)	Time To Flood Elevation (hr)	Flood Wave Arrival Time (hr)
3.494	521.38	19365	0.511	8.24	0.00	0.00	0.39
3.704	512.60	18615	0.511	9.33	0.00	0.00	0.44
3.914	504.69	17854	0.560	8.89	0.00	0.00	0.05
4.124	493.46	17535	0.584	12.93	0.00	0.00	0.44
4.228	486.45	17434	0.609	12.29	0.00	0.00	0.44
4.332	478.75	17385	0.584	12.62	0.00	0.00	0.49
4.436	472.31	17329	0.609	11.08	0.00	0.00	0.49
4.540	464.07	17295	0.584	12.59	0.00	0.00	0.54
4.645	458.53	17132	0.633	9.71	0.00	0.00	0.54
4.749	449.10	17095	0.584	13.62	0.00	0.00	0.54
4.853	445.98	16741	0.682	7.46	0.00	0.00	0.58
4.904	445.30	16456	1.169	7.52	0.00	0.00	0.58
4.954	445.20	16165	1.193	7.53	0.00	0.00	0.58
5.005	445.12	15990	1.193	7.65	0.00	0.00	0.58
5.055	445.05	15643	1.193	7.80	0.00	0.00	0.58
5.106	445.00	15457	1.218	7.79	0.00	0.00	0.63
5.156	444.95	15228	1.218	7.90	0.00	0.00	0.63
5.207	444.91	14840	1.218	8.08	0.00	0.00	0.63
5.257	444.87	14341	1.218	8.14	0.00	0.00	0.63
5.308	444.84	13790	1.218	8.01	0.00	0.00	0.63
5.358	444.81	13079	1.218	7.95	0.00	0.00	0.63
5.408	444.78	11321	1.218	8.29	0.00	0.00	0.63
5.597	444.68	2774	1.218	1.74	0.00	0.00	0.68
5.965	422.64	2774	1.266	3.08	0.00	0.00	0.68
6.041	420.96	2770	1.364	2.46	0.00	0.00	0.68
6.116	419.35	2760	1.510	1.94	0.00	0.00	0.73
6.192	418.17	2737	1.631	1.28	0.00	0.00	0.78
6.244	417.48	2721	1.680	1.30	0.00	0.00	0.78
6.297	416.76	2707	1.729	1.34	0.00	0.00	0.83
6.349	416.03	2697	1.778	1.39	0.00	0.00	0.88
6.402	415.28	2688	1.826	1.46	0.00	0.00	0.93
6.454	414.51	2680	1.875	1.53	0.00	0.00	0.93
6.506	413.73	2673	1.899	1.61	0.00	0.00	0.97
6.559	412.95	2668	1.948	1.69	0.00	0.00	1.02
6.611	412.17	2663	1.972	1.76	0.00	0.00	1.02
6.664	411.42	2659	2.021	1.82	0.00	0.00	1.07
6.716	410.71	2654	2.070	1.85	0.00	0.00	1.07
6.768	410.06	2651	2.094	1.85	0.00	0.00	1.07
6.821	409.47	2646	2.143	1.69	0.00	0.00	1.12
6.874	408.90	2641	2.192	1.56	0.00	0.00	1.17
6.927	408.34	2635	2.240	1.44	0.00	0.00	1.22
6.980	407.81	2628	2.338	1.34	0.00	0.00	1.27
7.032	407.29	2620	2.435	1.25	0.00	0.00	1.31
7.085	406.80	2609	2.581	1.17	0.00	0.00	1.36
7.138	406.34	2596	2.971	1.09	0.00	0.00	1.46
7.191	405.93	2579	3.336	1.01	0.00	0.00	1.51
7.243	405.56	2559	3.579	0.93	0.00	0.00	1.56
7.296	405.24	2535	3.750	0.85	0.00	0.00	1.61

FLOOD CREST SUMMARY :

Cross Section Location (mi)	Maximum Stage Elevation (ft MSL)	Maximum Flow (cfs)	Time To Maximum Stage (hr)	Maximum Flow Velocity (ft/sec)	Flood Elevation (ft MSL)	Time To Flood Elevation (hr)	Flood Wave Arrival Time (hr)
7.349	404.97	2507	3.847	0.76	0.00	0.00	1.66
7.402	404.75	2476	3.896	0.68	0.00	0.00	1.66
7.455	404.57	2444	3.945	0.59	0.00	0.00	1.66
7.507	404.42	2412	3.969	0.52	0.00	0.00	1.61
7.615	404.15	2349	4.066	0.46	0.00	0.00	1.70
7.723	403.89	2291	4.139	0.42	0.00	0.00	1.80
7.831	403.64	2236	4.237	0.38	0.00	0.00	1.90
7.939	403.41	2178	4.359	0.34	0.00	0.00	2.00
8.047	403.20	2115	4.480	0.31	0.00	0.00	2.09
8.155	402.99	2045	4.627	0.29	0.00	0.00	2.19
8.263	402.81	1966	4.846	0.26	0.00	0.00	2.29
8.371	402.64	1878	5.040	0.24	0.00	0.00	2.39
8.479	402.48	1778	5.260	0.21	0.00	0.00	2.48
8.586	402.34	1667	5.430	0.19	0.00	0.00	2.58
8.694	402.20	1544	5.576	0.17	0.00	0.00	2.68
8.717	402.17	1518	5.601	0.17	0.00	0.00	2.68
8.739	402.14	1492	5.601	0.16	0.00	0.00	2.73
8.761	402.12	1465	5.649	0.16	0.00	0.00	2.73
8.783	402.09	1439	5.649	0.16	0.00	0.00	2.73
8.806	402.06	1413	5.674	0.16	0.00	0.00	2.78
8.828	402.04	1387	5.698	0.16	0.00	0.00	2.78
8.850	402.01	1362	5.722	0.15	0.00	0.00	2.78
8.872	401.98	1336	5.722	0.15	0.00	0.00	2.82
8.894	401.96	1311	5.747	0.15	0.00	0.00	2.82
8.917	401.93	1286	5.771	0.15	0.00	0.00	2.82
8.939	401.90	1261	5.771	0.15	0.00	0.00	2.87
8.961	401.88	1236	5.795	0.14	0.00	0.00	2.87
8.983	401.85	1212	5.795	0.14	0.00	0.00	2.87
9.006	401.82	1188	5.820	0.14	0.00	0.00	2.87
9.028	401.80	1165	5.820	0.14	0.00	0.00	2.92
9.050	401.77	1142	5.844	0.14	0.00	0.00	2.92
9.072	401.74	1120	5.844	0.14	0.00	0.00	2.92
9.094	401.71	1098	5.868	0.14	0.00	0.00	2.97
9.117	401.69	1077	5.868	0.13	0.00	0.00	2.97
9.139	401.66	1056	5.868	0.13	0.00	0.00	2.97
9.161	401.63	1037	5.893	0.13	0.00	0.00	2.97
9.183	401.60	1018	5.893	0.13	0.00	0.00	3.02
9.206	401.58	1001	5.893	0.13	0.00	0.00	3.02
9.228	401.55	985	5.917	0.13	0.00	0.00	3.02
9.250	401.52	970	5.917	0.13	0.00	0.00	3.02
9.272	401.49	957	5.917	0.13	0.00	0.00	3.07
9.294	401.46	946	5.941	0.13	0.00	0.00	3.07
9.317	401.43	937	5.941	0.13	0.00	0.00	3.07
9.339	401.40	930	5.941	0.13	0.00	0.00	3.07
9.361	401.37	924	5.941	0.13	0.00	0.00	3.12
9.383	401.34	920	5.966	0.13	0.00	0.00	3.12
9.406	401.31	917	5.941	0.13	0.00	0.00	3.12
9.428	401.27	915	5.966	0.14	0.00	0.00	3.17

FLOOD CREST SUMMARY :

Cross Section Location (mi)	Maximum Stage Elevation (ft MSL)	Maximum Flow (cfs)	Time To Maximum Stage (hr)	Maximum Flow Velocity (ft/sec)	Flood Elevation (ft MSL)	Time To Flood Elevation (hr)	Flood Wave Arrival Time (hr)
9.450	401.24	913	5.966	0.14	0.00	0.00	3.17
9.472	401.20	912	5.966	0.14	0.00	0.00	3.17
9.495	401.17	912	5.966	0.15	0.00	0.00	3.21

FLOOD CREST SUMMARY :

Cross Section Location (mi)	Maximum Stage Elevation (ft MSL)	Maximum Flow (cfs)	Time To Maximum Stage (hr)	Maximum Flow Velocity (ft/sec)	Flood Elevation (ft MSL)	Time To Flood Elevation (hr)	Flood Wave Arrival Time (hr)
0.000	1062.01	23863	0.000	5.36	0.00	0.00	0.00
0.001	969.22	23863	0.575	3185.55	0.00	0.00	0.55
0.002	967.57	23863	0.575	1955.15	0.00	0.00	0.25
0.004	965.92	23863	0.575	1412.08	0.00	0.00	0.05
0.005	964.27	23863	0.575	1105.26	0.00	0.00	0.05
0.006	962.62	23863	0.575	907.13	0.00	0.00	0.05
0.008	961.02	23863	0.550	768.26	0.00	0.00	0.05
0.009	959.50	23863	0.500	665.32	0.00	0.00	0.05
0.010	958.00	23863	0.400	585.89	0.00	0.00	0.05
0.012	956.49	23863	0.350	522.68	0.00	0.00	0.05
0.013	954.98	23863	0.275	471.20	0.00	0.00	0.05
0.014	953.47	23863	0.250	428.45	0.00	0.00	0.05
0.016	951.96	23863	0.200	392.39	0.00	0.00	0.05
0.017	950.45	23863	0.150	361.59	0.00	0.00	0.05
0.018	948.93	23863	0.150	334.98	0.00	0.00	0.05
0.020	947.42	23863	0.150	311.77	0.00	0.00	0.05
0.021	945.90	23863	0.150	291.36	0.00	0.00	0.05
0.022	944.38	23863	0.150	273.28	0.00	0.00	0.05
0.023	942.86	23863	0.150	257.17	0.00	0.00	0.05
0.034	939.17	23863	0.150	175.64	0.00	0.00	0.05
0.044	935.45	23863	0.150	130.78	0.00	0.00	0.05
0.054	931.68	23863	0.150	103.07	0.00	0.00	0.05
0.065	927.87	23862	0.150	84.64	0.00	0.00	0.05
0.075	924.02	23861	0.150	71.79	0.00	0.00	0.05
0.085	920.11	23859	0.150	62.54	0.00	0.00	0.05
0.096	916.14	23855	0.150	55.75	0.00	0.00	0.05
0.106	912.11	23849	0.150	50.72	0.00	0.00	0.05
0.116	908.01	23841	0.150	46.98	0.00	0.00	0.05
0.126	903.85	23829	0.150	44.20	0.00	0.00	0.05
0.137	899.62	23814	0.150	42.16	0.00	0.00	0.05
0.147	895.33	23796	0.150	40.66	0.00	0.00	0.05
0.157	890.99	23774	0.150	39.56	0.00	0.00	0.05
0.168	886.61	23750	0.150	38.76	0.00	0.00	0.05
0.178	882.20	23723	0.150	38.20	0.00	0.00	0.05
0.188	877.77	23693	0.150	37.82	0.00	0.00	0.05
0.199	873.31	23662	0.150	37.57	0.00	0.00	0.05
0.209	868.84	23630	0.150	37.43	0.00	0.00	0.05
0.219	864.35	23596	0.150	37.35	0.00	0.00	0.05
0.229	859.86	23562	0.150	37.33	0.00	0.00	0.05
0.240	855.37	23527	0.150	37.35	0.00	0.00	0.05
0.250	850.87	23491	0.150	37.40	0.00	0.00	0.05
0.260	846.37	23471	0.175	37.48	0.00	0.00	0.05
0.271	841.88	23471	0.175	37.57	0.00	0.00	0.05
0.400	810.63	23417	0.175	28.27	0.00	0.00	0.05
0.529	777.76	23267	0.175	27.19	0.00	0.00	0.05
0.659	745.29	23015	0.175	47.97	0.00	0.00	0.05
0.711	743.29	22871	0.175	16.67	0.00	0.00	0.05
0.764	738.86	22633	0.175	41.86	0.00	0.00	0.05

FLOOD CREST SUMMARY :

Cross Section Location (mi)	Maximum Stage Elevation (ft MSL)	Maximum Flow (cfs)	Time To Maximum Stage (hr)	Maximum Flow Velocity (ft/sec)	Flood Elevation (ft MSL)	Time To Flood Elevation (hr)	Flood Wave Arrival Time (hr)
0.816	734.48	22324	0.175	16.26	0.00	0.00	0.05
0.869	730.13	22037	0.200	15.98	0.00	0.00	0.05
0.922	725.83	21986	0.200	38.28	0.00	0.00	0.05
0.974	721.51	21882	0.200	15.56	0.00	0.00	0.05
1.027	717.20	21731	0.200	15.34	0.00	0.00	0.05
1.079	712.88	21529	0.200	15.13	0.00	0.00	0.05
1.132	708.57	21273	0.200	14.90	0.00	0.00	0.10
1.184	704.27	20964	0.225	14.66	0.00	0.00	0.10
1.237	700.02	20913	0.225	14.41	0.00	0.00	0.10
1.289	695.75	20826	0.225	14.67	0.00	0.00	0.10
1.342	691.49	20690	0.225	14.02	0.00	0.00	0.10
1.395	687.21	20502	0.225	14.68	0.00	0.00	0.10
1.447	682.92	20229	0.225	38.24	0.00	0.00	0.10
1.501	678.09	20013	0.250	16.65	0.00	0.00	0.10
1.555	673.68	19949	0.250	12.63	0.00	0.00	0.10
1.609	668.97	19819	0.250	13.67	0.00	0.00	0.15
1.664	664.47	19605	0.250	11.80	0.00	0.00	0.15
1.718	659.78	19255	0.275	13.88	0.00	0.00	0.15
1.773	654.46	19124	0.275	12.06	0.00	0.00	0.15
1.829	649.32	18983	0.275	41.68	0.00	0.00	0.15
1.884	644.01	18759	0.275	12.26	0.00	0.00	0.15
1.940	638.84	18449	0.300	14.24	0.00	0.00	0.15
1.995	633.60	18366	0.300	12.45	0.00	0.00	0.15
2.050	628.45	18261	0.300	14.25	0.00	0.00	0.15
2.106	623.23	18089	0.300	42.99	0.00	0.00	0.15
2.161	618.06	17844	0.300	14.24	0.00	0.00	0.15
2.217	612.90	17694	0.325	13.02	0.00	0.00	0.20
2.272	607.78	17621	0.325	14.22	0.00	0.00	0.20
2.328	602.65	17494	0.325	13.37	0.00	0.00	0.20
2.383	597.55	17306	0.325	50.34	0.00	0.00	0.20
2.439	592.48	17091	0.350	13.69	0.00	0.00	0.20
2.494	587.45	17044	0.350	13.85	0.00	0.00	0.20
2.597	578.93	16829	0.350	13.13	0.00	0.00	0.20
2.700	570.28	16520	0.375	18.46	0.00	0.00	0.25
2.803	561.87	16368	0.375	12.56	0.00	0.00	0.25
2.906	553.19	16021	0.400	15.92	0.00	0.00	0.25

FLOOD CREST SUMMARY :

Cross Section Location (mi)	Maximum Stage Elevation (ft MSL)	Maximum Flow (cfs)	Time To Maximum Stage (hr)	Maximum Flow Velocity (ft/sec)	Flood Elevation (ft MSL)	Time To Flood Elevation (hr)	Flood Wave Arrival Time (hr)
2.906	553.87	16021	0.381	15.80	0.00	0.00	0.25
2.916	553.29	15995	0.400	12.56	0.00	0.00	0.25
2.926	552.62	15888	0.400	11.14	0.00	0.00	0.25
2.936	552.01	15875	0.400	11.13	0.00	0.00	0.25
2.947	551.41	15882	0.400	11.13	0.00	0.00	0.25
2.957	550.80	15887	0.400	11.12	0.00	0.00	0.25
2.967	550.19	15890	0.400	11.12	0.00	0.00	0.25
2.977	549.58	15891	0.400	11.11	0.00	0.00	0.25
2.987	548.98	15889	0.400	11.11	0.00	0.00	0.25
2.997	548.37	15885	0.400	11.10	0.00	0.00	0.25
3.007	547.76	15879	0.400	11.10	0.00	0.00	0.25
3.018	547.15	15871	0.400	11.09	0.00	0.00	0.25
3.028	546.54	15860	0.400	11.08	0.00	0.00	0.25
3.038	545.93	15847	0.419	11.08	0.00	0.00	0.25
3.048	545.32	15832	0.419	11.08	0.00	0.00	0.25
3.058	544.72	15815	0.419	11.08	0.00	0.00	0.25
3.068	544.11	15797	0.419	11.08	0.00	0.00	0.25
3.078	543.51	15801	0.419	11.08	0.00	0.00	0.25
3.089	542.90	15805	0.419	11.07	0.00	0.00	0.25
3.099	542.29	15807	0.419	11.07	0.00	0.00	0.25
3.109	541.68	15808	0.419	11.07	0.00	0.00	0.25
3.119	541.08	15807	0.419	11.07	0.00	0.00	0.25
3.129	540.47	15805	0.419	11.06	0.00	0.00	0.25
3.139	539.86	15801	0.419	11.06	0.00	0.00	0.25
3.149	539.25	15796	0.419	11.06	0.00	0.00	0.28
3.160	538.64	15789	0.419	11.05	0.00	0.00	0.28
3.170	538.03	15781	0.419	11.05	0.00	0.00	0.28
3.180	537.42	15771	0.419	11.04	0.00	0.00	0.28
3.190	536.81	15759	0.419	11.04	0.00	0.00	0.28
3.200	536.20	15745	0.419	11.04	0.00	0.00	0.28
3.210	535.59	15730	0.438	11.04	0.00	0.00	0.28
3.220	534.99	15712	0.438	11.03	0.00	0.00	0.28
3.231	534.38	15693	0.438	11.03	0.00	0.00	0.28
3.241	533.77	15676	0.438	11.03	0.00	0.00	0.28
3.251	533.17	15681	0.438	11.03	0.00	0.00	0.28
3.261	532.56	15685	0.438	11.03	0.00	0.00	0.28
3.271	531.95	15687	0.438	11.02	0.00	0.00	0.28
3.281	531.35	15687	0.438	11.02	0.00	0.00	0.28
3.291	530.74	15686	0.438	11.02	0.00	0.00	0.28
3.302	530.13	15684	0.438	11.01	0.00	0.00	0.28
3.312	529.52	15680	0.438	11.01	0.00	0.00	0.31
3.322	528.91	15674	0.438	11.01	0.00	0.00	0.31
3.332	528.30	15667	0.438	11.00	0.00	0.00	0.31
3.342	527.69	15657	0.438	11.00	0.00	0.00	0.31
3.352	527.08	15647	0.438	10.99	0.00	0.00	0.31
3.362	526.47	15634	0.438	10.99	0.00	0.00	0.31
3.373	525.86	15620	0.438	10.99	0.00	0.00	0.31
3.383	525.25	15603	0.438	10.99	0.00	0.00	0.31

FLOOD CREST SUMMARY :

Cross Section Location (mi)	Maximum Stage Elevation (ft MSL)	Maximum Flow (cfs)	Time To Maximum Stage (hr)	Maximum Flow Velocity (ft/sec)	Flood Elevation (ft MSL)	Time To Flood Elevation (hr)	Flood Wave Arrival Time (hr)
3.393	524.64	15585	0.438	10.99	0.00	0.00	0.31
3.403	524.03	15565	0.438	10.98	0.00	0.00	0.31
3.413	523.41	15544	0.438	10.98	0.00	0.00	0.31
3.423	522.80	15520	0.438	10.98	0.00	0.00	0.31
3.433	522.19	15494	0.456	10.98	0.00	0.00	0.31
3.444	521.58	15466	0.456	10.97	0.00	0.00	0.31
3.454	520.97	15437	0.456	10.97	0.00	0.00	0.31
3.464	520.37	15413	0.456	10.98	0.00	0.00	0.34
3.474	519.84	15402	0.456	10.86	0.00	0.00	0.34
3.484	519.50	15385	0.475	10.35	0.00	0.00	0.34
3.494	519.30	15365	0.475	9.47	0.00	0.00	0.34
3.547	517.14	15249	0.475	9.61	0.00	0.00	0.34
3.599	514.97	15216	0.475	9.76	0.00	0.00	0.34
3.652	512.80	15121	0.494	9.92	0.00	0.00	0.34
3.704	510.62	15047	0.494	10.07	0.00	0.00	0.34
3.757	508.43	14991	0.513	10.22	0.00	0.00	0.38
3.809	506.25	14879	0.513	10.39	0.00	0.00	0.38
3.861	504.06	14840	0.513	10.58	0.00	0.00	0.38
3.914	501.86	14771	0.531	10.76	0.00	0.00	0.38
3.966	499.65	14672	0.531	10.96	0.00	0.00	0.38
4.019	497.45	14631	0.531	11.30	0.00	0.00	0.38
4.071	495.58	14554	0.550	10.71	0.00	0.00	0.38
4.124	491.56	14513	0.550	14.24	0.00	0.00	0.42
4.134	490.82	14508	0.550	14.35	0.00	0.00	0.42
4.144	490.12	14502	0.550	14.26	0.00	0.00	0.42
4.154	489.42	14496	0.550	14.21	0.00	0.00	0.42
4.164	488.71	14488	0.550	14.16	0.00	0.00	0.42
4.174	488.01	14480	0.550	14.11	0.00	0.00	0.42
4.184	487.31	14470	0.550	14.05	0.00	0.00	0.42
4.195	486.61	14460	0.550	14.00	0.00	0.00	0.42
4.205	485.91	14450	0.550	13.95	0.00	0.00	0.42
4.215	485.21	14438	0.550	13.89	0.00	0.00	0.42
4.225	484.51	14425	0.550	13.85	0.00	0.00	0.42
4.235	483.81	14412	0.550	18.82	0.00	0.00	0.42
4.245	483.11	14397	0.550	14.54	0.00	0.00	0.42
4.255	482.41	14381	0.550	13.70	0.00	0.00	0.42
4.266	481.71	14365	0.550	13.65	0.00	0.00	0.42
4.276	481.02	14348	0.569	13.60	0.00	0.00	0.42
4.286	480.33	14329	0.569	13.55	0.00	0.00	0.42
4.296	479.63	14310	0.569	13.51	0.00	0.00	0.42
4.306	478.94	14300	0.569	13.50	0.00	0.00	0.42
4.316	478.25	14297	0.569	13.41	0.00	0.00	0.42
4.326	477.55	14293	0.569	13.36	0.00	0.00	0.42
4.336	476.86	14289	0.569	13.31	0.00	0.00	0.42
4.347	476.17	14283	0.569	13.26	0.00	0.00	0.42
4.357	475.47	14277	0.569	13.21	0.00	0.00	0.46
4.367	474.78	14270	0.569	14.55	0.00	0.00	0.46
4.377	474.09	14262	0.569	13.12	0.00	0.00	0.46

FLOOD CREST SUMMARY :

Cross Section Location (mi)	Maximum Stage Elevation (ft MSL)	Maximum Flow (cfs)	Time To Maximum Stage (hr)	Maximum Flow Velocity (ft/sec)	Flood Elevation (ft MSL)	Time To Flood Elevation (hr)	Flood Wave Arrival Time (hr)
4.387	473.40	14253	0.569	13.07	0.00	0.00	0.46
4.397	472.70	14243	0.569	13.03	0.00	0.00	0.46
4.407	472.01	14233	0.569	12.98	0.00	0.00	0.46
4.417	471.32	14222	0.569	12.94	0.00	0.00	0.46
4.428	470.63	14209	0.569	12.89	0.00	0.00	0.46
4.438	469.93	14196	0.569	12.85	0.00	0.00	0.46
4.448	469.24	14181	0.569	14.67	0.00	0.00	0.46
4.458	468.55	14165	0.569	12.77	0.00	0.00	0.46
4.468	467.86	14149	0.569	12.73	0.00	0.00	0.46
4.478	467.17	14131	0.588	12.68	0.00	0.00	0.46
4.488	466.48	14113	0.588	12.63	0.00	0.00	0.46
4.499	465.79	14101	0.588	12.60	0.00	0.00	0.46
4.509	465.10	14097	0.588	14.85	0.00	0.00	0.46
4.519	464.41	14093	0.588	12.51	0.00	0.00	0.46
4.529	463.73	14088	0.588	12.53	0.00	0.00	0.46
4.539	463.08	14083	0.620	12.43	0.00	0.00	0.46
4.549	462.35	14077	0.588	12.65	0.00	0.00	0.46
4.559	461.83	14070	0.620	12.37	0.00	0.00	0.46
4.569	460.98	14061	0.588	12.96	0.00	0.00	0.46
4.580	460.27	14052	0.588	12.29	0.00	0.00	0.46
4.590	459.61	14042	0.588	12.18	0.00	0.00	0.46
4.600	458.88	14032	0.588	12.24	0.00	0.00	0.46
4.610	458.25	14021	0.588	12.08	0.00	0.00	0.46
4.620	457.50	14009	0.609	12.22	0.00	0.00	0.46
4.630	456.91	13994	0.588	11.99	0.00	0.00	0.46
4.640	456.12	13987	0.611	12.23	0.00	0.00	0.46
4.650	455.47	13987	0.588	12.00	0.00	0.00	0.46
4.661	454.78	13971	0.588	11.96	0.00	0.00	0.46
4.671	454.09	13953	0.588	11.92	0.00	0.00	0.46
4.681	453.40	13935	0.606	11.89	0.00	0.00	0.46
4.691	452.72	13915	0.606	11.85	0.00	0.00	0.46
4.701	452.03	13909	0.606	11.81	0.00	0.00	0.49
4.711	451.35	13906	0.609	11.77	0.00	0.00	0.49
4.721	450.66	13903	0.609	11.73	0.00	0.00	0.49
4.732	449.98	13900	0.609	11.70	0.00	0.00	0.49
4.742	449.29	13897	0.611	11.66	0.00	0.00	0.49
4.752	448.61	13893	0.611	11.63	0.00	0.00	0.49
4.762	447.92	13891	0.611	11.60	0.00	0.00	0.49
4.772	447.24	13888	0.611	11.57	0.00	0.00	0.49
4.782	446.55	13883	0.611	11.54	0.00	0.00	0.49
4.792	445.87	13879	0.611	11.50	0.00	0.00	0.49
4.802	445.18	13872	0.620	11.51	0.00	0.00	0.49
4.813	444.52	13867	0.609	11.44	0.00	0.00	0.49
4.823	443.83	13857	0.639	11.62	0.00	0.00	0.49
4.833	443.73	13825	0.639	10.76	0.00	0.00	0.49
4.843	443.71	13784	0.639	9.24	0.00	0.00	0.49
4.853	443.72	13757	0.630	7.99	0.00	0.00	0.49
4.904	442.89	13602	1.129	8.06	0.00	0.00	0.49

FLOOD CREST SUMMARY :

Cross Section Location (mi)	Maximum Stage Elevation (ft MSL)	Maximum Flow (cfs)	Time To Maximum Stage (hr)	Maximum Flow Velocity (ft/sec)	Flood Elevation (ft MSL)	Time To Flood Elevation (hr)	Flood Wave Arrival Time (hr)
4.954	442.84	13459	1.129	8.13	0.00	0.00	0.49
5.005	442.80	13316	1.129	8.22	0.00	0.00	0.49
5.055	442.76	13183	1.129	8.34	0.00	0.00	0.53
5.106	442.73	13043	1.129	8.46	0.00	0.00	0.53
5.156	442.71	12889	1.129	8.62	0.00	0.00	0.53
5.207	442.68	12684	1.129	8.80	0.00	0.00	0.53
5.257	442.66	12316	1.129	9.00	0.00	0.00	0.57
5.308	442.64	11506	1.129	9.20	0.00	0.00	0.57
5.358	442.61	10349	1.129	8.94	0.00	0.00	0.57
5.408	442.59	8817	1.129	7.74	0.00	0.00	0.57
5.597	442.52	2632	1.129	1.72	0.00	0.00	0.61
5.965	420.87	2632	1.129	4.73	0.00	0.00	0.61
6.041	419.08	2632	1.148	4.21	0.00	0.00	0.61
6.116	417.20	2631	1.204	3.81	0.00	0.00	0.61
6.192	416.00	2628	1.260	2.74	0.00	0.00	0.63
6.384	413.27	2618	1.373	2.95	0.00	0.00	0.68
6.576	410.32	2611	1.448	3.48	0.00	0.00	0.77
6.768	407.97	2606	1.504	3.08	0.00	0.00	0.81
7.015	405.45	2599	1.598	2.35	0.00	0.00	0.96
7.261	403.58	2573	3.041	1.62	0.00	0.00	1.30
7.507	402.98	2507	3.154	0.74	0.00	0.00	1.19
7.626	402.78	2463	3.191	0.65	0.00	0.00	1.26
7.745	402.60	2411	3.229	0.58	0.00	0.00	1.30
7.863	402.41	2352	3.266	0.52	0.00	0.00	1.37
7.982	402.24	2282	3.323	0.47	0.00	0.00	1.41
8.101	402.06	2203	3.360	0.42	0.00	0.00	1.49
8.220	401.90	2114	3.398	0.38	0.00	0.00	1.52
8.338	401.73	2016	3.454	0.34	0.00	0.00	1.56
8.457	401.57	1949	3.491	0.30	0.00	0.00	1.60
8.576	401.41	1896	3.510	0.26	0.00	0.00	1.64
8.694	401.26	1841	3.548	0.23	0.00	0.00	1.67
8.717	401.23	1831	3.548	0.23	0.00	0.00	1.67
8.739	401.20	1821	3.548	0.23	0.00	0.00	1.67
8.761	401.17	1811	3.548	0.23	0.00	0.00	1.67
8.783	401.14	1801	3.566	0.23	0.00	0.00	1.67
8.806	401.11	1791	3.566	0.23	0.00	0.00	1.67
8.828	401.08	1781	3.566	0.23	0.00	0.00	1.67
8.850	401.05	1772	3.566	0.23	0.00	0.00	1.67
8.872	401.02	1763	3.566	0.23	0.00	0.00	1.67
8.894	401.00	1753	3.566	0.24	0.00	0.00	1.67
8.917	400.97	1744	3.566	0.24	0.00	0.00	1.67
8.939	400.94	1736	3.585	0.24	0.00	0.00	1.67
8.961	400.91	1727	3.585	0.24	0.00	0.00	1.67
8.983	400.88	1718	3.585	0.24	0.00	0.00	1.67
9.006	400.85	1710	3.585	0.24	0.00	0.00	1.67
9.028	400.82	1702	3.585	0.24	0.00	0.00	1.67
9.050	400.79	1694	3.585	0.24	0.00	0.00	1.67
9.072	400.77	1686	3.604	0.24	0.00	0.00	1.67

FLOOD CREST SUMMARY :

Cross Section Location (mi)	Maximum Stage Elevation (ft MSL)	Maximum Flow (cfs)	Time To Maximum Stage (hr)	Maximum Flow Velocity (ft/sec)	Flood Elevation (ft MSL)	Time To Flood Elevation (hr)	Flood Wave Arrival Time (hr)
9.094	400.74	1678	3.585	0.25	0.00	0.00	1.67
9.117	400.71	1671	3.604	0.25	0.00	0.00	1.67
9.139	400.68	1664	3.604	0.25	0.00	0.00	1.67
9.161	400.65	1657	3.604	0.25	0.00	0.00	1.67
9.183	400.62	1651	3.604	0.26	0.00	0.00	1.67
9.206	400.59	1644	3.604	0.26	0.00	0.00	1.67
9.228	400.56	1638	3.604	0.26	0.00	0.00	1.67
9.250	400.53	1633	3.604	0.26	0.00	0.00	1.67
9.272	400.50	1628	3.623	0.27	0.00	0.00	1.67
9.294	400.47	1623	3.604	0.27	0.00	0.00	1.67
9.317	400.44	1619	3.623	0.28	0.00	0.00	1.67
9.339	400.40	1615	3.623	0.28	0.00	0.00	1.67
9.361	400.37	1611	3.623	0.29	0.00	0.00	1.71
9.383	400.34	1609	3.623	0.29	0.00	0.00	1.71
9.406	400.31	1606	3.623	0.30	0.00	0.00	1.71
9.428	400.27	1604	3.623	0.31	0.00	0.00	1.71
9.450	400.24	1603	3.623	0.31	0.00	0.00	1.71
9.472	400.20	1602	3.623	0.32	0.00	0.00	1.71
9.494	400.17	1602	3.623	0.33	0.00	0.00	1.71

FLOOD CREST SUMMARY :

Cross Section Location (mi)	Maximum Stage Elevation (ft MSL)	Maximum Flow (cfs)	Time To Maximum Stage (hr)	Maximum Flow Velocity (ft/sec)	Flood Elevation (ft MSL)	Time To Flood Elevation (hr)	Flood Wave Arrival Time (hr)
0.000	1058.00	20611	0.000	4.97	0.00	0.00	0.00
0.023	950.44	20611	0.175	27.61	0.00	0.00	0.03
0.051	938.36	20608	0.175	27.48	0.00	0.00	0.03
0.078	926.23	20600	0.175	27.66	0.00	0.00	0.03
0.106	914.11	20587	0.175	27.90	0.00	0.00	0.03
0.133	902.01	20570	0.175	28.19	0.00	0.00	0.03
0.161	889.94	20549	0.175	28.54	0.00	0.00	0.03
0.188	877.91	20523	0.175	28.95	0.00	0.00	0.03
0.216	865.94	20494	0.175	29.44	0.00	0.00	0.03
0.243	854.09	20460	0.175	29.90	0.00	0.00	0.03
0.271	842.41	20421	0.175	30.13	0.00	0.00	0.03
0.291	837.95	20387	0.175	26.75	0.00	0.00	0.03
0.311	833.17	20350	0.175	24.87	0.00	0.00	0.03
0.332	828.16	20309	0.175	23.90	0.00	0.00	0.03
0.352	823.04	20263	0.175	23.33	0.00	0.00	0.03
0.373	817.88	20214	0.175	22.92	0.00	0.00	0.03
0.393	812.72	20161	0.175	22.55	0.00	0.00	0.03
0.414	807.55	20106	0.175	22.20	0.00	0.00	0.03
0.434	802.39	20048	0.175	24.20	0.00	0.00	0.03
0.454	797.24	19986	0.200	21.53	0.00	0.00	0.03
0.475	792.10	19983	0.200	24.06	0.00	0.00	0.06
0.495	786.97	19980	0.200	20.92	0.00	0.00	0.06
0.516	781.83	19974	0.200	29.99	0.00	0.00	0.06
0.536	776.70	19966	0.200	20.36	0.00	0.00	0.06
0.557	771.58	19955	0.200	20.62	0.00	0.00	0.06
0.577	766.45	19943	0.200	19.82	0.00	0.00	0.06
0.598	761.33	19928	0.200	25.24	0.00	0.00	0.06
0.618	756.21	19911	0.200	19.31	0.00	0.00	0.06
0.638	751.09	19891	0.200	21.80	0.00	0.00	0.06
0.659	748.92	19891	0.200	12.27	0.00	0.00	0.06
0.711	744.55	19768	0.200	12.06	0.00	0.00	0.06
0.764	740.19	19603	0.225	11.84	0.00	0.00	0.06
0.816	735.87	19537	0.225	11.62	0.00	0.00	0.06
0.869	731.56	19486	0.225	11.43	0.00	0.00	0.06
0.922	727.25	19399	0.225	11.23	0.00	0.00	0.06
0.974	722.95	19274	0.250	11.02	0.00	0.00	0.10
1.027	718.68	19186	0.250	10.80	0.00	0.00	0.10
1.079	714.41	19146	0.250	10.61	0.00	0.00	0.10
1.132	710.14	19073	0.250	10.42	0.00	0.00	0.10
1.184	705.88	18964	0.275	10.22	0.00	0.00	0.15
1.237	701.63	18888	0.275	10.02	0.00	0.00	0.15
1.289	697.39	18849	0.275	9.84	0.00	0.00	0.15
1.342	693.13	18779	0.275	9.68	0.00	0.00	0.15
1.395	688.93	18668	0.300	9.42	0.00	0.00	0.15
1.447	684.47	18608	0.300	9.57	0.00	0.00	0.15
1.468	682.71	18597	0.300	9.37	0.00	0.00	0.15
1.489	680.94	18582	0.300	9.17	0.00	0.00	0.15
1.510	679.18	18561	0.300	8.99	0.00	0.00	0.20

FLOOD CREST SUMMARY :

Cross Section Location (mi)	Maximum Stage Elevation (ft MSL)	Maximum Flow (cfs)	Time To Maximum Stage (hr)	Maximum Flow Velocity (ft/sec)	Flood Elevation (ft MSL)	Time To Flood Elevation (hr)	Flood Wave Arrival Time (hr)
1.530	677.41	18536	0.300	8.81	0.00	0.00	0.20
1.551	675.65	18504	0.300	8.64	0.00	0.00	0.20
1.572	673.88	18466	0.300	8.48	0.00	0.00	0.20
1.593	672.12	18419	0.300	8.31	0.00	0.00	0.20
1.614	670.36	18364	0.325	8.15	0.00	0.00	0.20
1.634	668.60	18328	0.325	8.00	0.00	0.00	0.20
1.655	666.84	18320	0.325	7.86	0.00	0.00	0.20
1.676	665.07	18306	0.325	7.74	0.00	0.00	0.20
1.697	663.28	18287	0.325	7.66	0.00	0.00	0.20
1.718	661.38	18261	0.325	7.74	0.00	0.00	0.20
1.738	659.47	18227	0.325	7.76	0.00	0.00	0.20
1.759	657.57	18185	0.325	7.77	0.00	0.00	0.20
1.779	655.66	18131	0.325	7.78	0.00	0.00	0.20
1.799	653.75	18063	0.350	7.80	0.00	0.00	0.20
1.820	651.84	18003	0.350	7.83	0.00	0.00	0.20
1.840	649.92	17991	0.350	7.87	0.00	0.00	0.20
1.861	648.00	17971	0.350	7.92	0.00	0.00	0.20
1.881	646.08	17942	0.350	7.97	0.00	0.00	0.25
1.902	644.17	17904	0.350	8.02	0.00	0.00	0.25
1.922	642.25	17856	0.350	8.07	0.00	0.00	0.25
1.942	640.33	17797	0.350	8.11	0.00	0.00	0.25
1.963	638.41	17726	0.350	8.16	0.00	0.00	0.25
1.983	636.50	17641	0.375	8.20	0.00	0.00	0.25
2.004	634.60	17607	0.375	8.24	0.00	0.00	0.25
2.024	632.69	17591	0.375	8.28	0.00	0.00	0.25
2.045	630.79	17566	0.375	8.34	0.00	0.00	0.25
2.065	628.88	17532	0.375	8.39	0.00	0.00	0.25
2.086	626.98	17489	0.375	8.44	0.00	0.00	0.25
2.106	625.07	17435	0.375	8.49	0.00	0.00	0.25
2.126	623.17	17369	0.375	8.54	0.00	0.00	0.25
2.147	621.26	17291	0.375	8.58	0.00	0.00	0.25
2.167	619.37	17201	0.400	8.62	0.00	0.00	0.25
2.188	617.48	17168	0.400	8.66	0.00	0.00	0.25
2.208	615.59	17150	0.400	8.71	0.00	0.00	0.30
2.229	613.71	17123	0.400	8.77	0.00	0.00	0.30
2.249	611.82	17088	0.400	8.82	0.00	0.00	0.30
2.269	609.94	17042	0.400	8.87	0.00	0.00	0.30
2.290	608.05	16986	0.400	8.92	0.00	0.00	0.30
2.310	606.17	16918	0.400	8.97	0.00	0.00	0.30
2.331	604.29	16839	0.400	9.02	0.00	0.00	0.30
2.351	602.42	16747	0.425	9.06	0.00	0.00	0.30
2.372	600.56	16696	0.425	9.10	0.00	0.00	0.30
2.392	598.70	16678	0.425	9.14	0.00	0.00	0.30
2.412	596.84	16651	0.425	9.19	0.00	0.00	0.30
2.433	594.99	16615	0.425	9.24	0.00	0.00	0.30
2.453	593.14	16570	0.425	9.28	0.00	0.00	0.30
2.474	591.31	16514	0.425	9.29	0.00	0.00	0.30
2.494	589.55	16447	0.425	9.21	0.00	0.00	0.30

FLOOD CREST SUMMARY :

Cross Section Location (mi)	Maximum Stage Elevation (ft MSL)	Maximum Flow (cfs)	Time To Maximum Stage (hr)	Maximum Flow Velocity (ft/sec)	Flood Elevation (ft MSL)	Time To Flood Elevation (hr)	Flood Wave Arrival Time (hr)
2.509	588.26	16391	0.425	9.14	0.00	0.00	0.30
2.525	586.98	16327	0.450	9.07	0.00	0.00	0.30
2.540	585.70	16257	0.450	9.01	0.00	0.00	0.30
2.555	584.43	16202	0.450	8.94	0.00	0.00	0.30
2.570	583.16	16190	0.450	8.87	0.00	0.00	0.30
2.586	581.89	16173	0.450	8.80	0.00	0.00	0.35
2.601	580.62	16151	0.450	8.74	0.00	0.00	0.35
2.616	579.35	16124	0.450	8.68	0.00	0.00	0.35
2.631	578.09	16090	0.450	8.63	0.00	0.00	0.35
2.647	576.82	16051	0.450	8.58	0.00	0.00	0.35
2.662	575.55	16005	0.450	8.52	0.00	0.00	0.35
2.677	574.29	15952	0.450	8.47	0.00	0.00	0.35
2.692	573.02	15891	0.450	8.42	0.00	0.00	0.35
2.708	571.76	15823	0.475	8.36	0.00	0.00	0.35
2.723	570.51	15746	0.475	8.31	0.00	0.00	0.35
2.738	569.26	15695	0.475	8.26	0.00	0.00	0.35
2.753	568.01	15680	0.475	8.20	0.00	0.00	0.35
2.769	566.75	15659	0.475	8.15	0.00	0.00	0.35
2.784	565.50	15631	0.475	8.10	0.00	0.00	0.35
2.799	564.25	15596	0.475	8.06	0.00	0.00	0.35
2.814	562.99	15554	0.475	8.02	0.00	0.00	0.35
2.830	561.75	15502	0.475	7.97	0.00	0.00	0.35
2.845	560.51	15441	0.475	7.90	0.00	0.00	0.35
2.860	559.31	15368	0.500	7.80	0.00	0.00	0.35
2.875	558.18	15282	0.500	7.62	0.00	0.00	0.35
2.891	557.15	15180	0.500	7.31	0.00	0.00	0.35
2.906	556.26	15142	0.500	6.85	0.00	0.00	0.35
3.024	549.03	14665	0.528	6.82	0.00	0.00	0.40
3.141	541.85	14377	0.528	6.79	0.00	0.00	0.40
3.259	534.74	13994	0.553	6.68	0.00	0.00	0.45
3.377	527.59	13608	0.575	6.62	0.00	0.00	0.45
3.494	520.58	13530	0.600	6.52	0.00	0.00	0.45

FLOOD CREST SUMMARY :

Cross Section Location (mi)	Maximum Stage Elevation (ft MSL)	Maximum Flow (cfs)	Time To Maximum Stage (hr)	Maximum Flow Velocity (ft/sec)	Flood Elevation (ft MSL)	Time To Flood Elevation (hr)	Flood Wave Arrival Time (hr)
3.494	521.41	13530	0.600	5.72	0.00	0.00	0.48
3.599	517.08	13133	0.630	5.90	0.00	0.00	0.48
3.704	512.71	12958	0.630	6.11	0.00	0.00	0.54
3.809	508.33	12531	0.660	6.35	0.00	0.00	0.06
3.914	503.90	12204	0.690	6.65	0.00	0.00	0.06
4.019	499.36	11933	0.690	6.88	0.00	0.00	0.06
4.124	493.11	11697	0.720	9.11	0.00	0.00	0.60
4.228	485.87	11722	0.720	8.80	0.00	0.00	0.60
4.332	478.66	11586	0.720	8.47	0.00	0.00	0.66
4.436	471.64	11505	0.750	8.14	0.00	0.00	0.66
4.540	464.28	11600	0.750	8.06	0.00	0.00	0.66
4.645	457.68	11501	0.780	7.17	0.00	0.00	0.72
4.749	449.73	11533	0.750	8.30	0.00	0.00	0.72
4.853	445.74	11348	0.840	5.10	0.00	0.00	0.72
4.904	444.55	10793	0.870	5.28	0.00	0.00	0.72
4.954	443.38	10482	0.870	5.27	0.00	0.00	0.78
5.005	442.45	10199	1.410	5.14	0.00	0.00	0.78
5.055	442.20	9759	1.440	5.28	0.00	0.00	0.78
5.106	442.01	9553	1.470	5.24	0.00	0.00	0.78
5.156	441.85	9382	1.470	5.25	0.00	0.00	0.78
5.207	441.72	9082	1.470	5.36	0.00	0.00	0.84
5.257	441.61	8725	1.500	5.31	0.00	0.00	0.84
5.308	441.52	8353	1.500	5.20	0.00	0.00	0.84
5.358	441.44	7907	1.500	5.07	0.00	0.00	0.84
5.408	441.37	7172	1.500	4.84	0.00	0.00	0.84
5.597	441.13	2541	1.500	1.72	0.00	0.00	0.90
5.965	423.86	2541	1.650	2.34	0.00	0.00	0.90
6.041	422.18	2535	1.770	1.72	0.00	0.00	0.90
6.116	420.58	2517	2.100	1.31	0.00	0.00	0.96
6.192	419.42	2480	2.280	0.83	0.00	0.00	0.96
6.244	418.75	2453	2.370	0.83	0.00	0.00	1.02
6.297	418.05	2431	2.430	0.85	0.00	0.00	1.08
6.349	417.34	2418	2.520	0.88	0.00	0.00	1.08
6.402	416.61	2408	2.550	0.92	0.00	0.00	1.14
6.454	415.86	2401	2.610	0.97	0.00	0.00	1.20
6.506	415.10	2394	2.670	1.02	0.00	0.00	1.26
6.559	414.32	2389	2.730	1.08	0.00	0.00	1.32
6.611	413.54	2384	2.790	1.14	0.00	0.00	1.38
6.664	412.78	2380	2.820	1.19	0.00	0.00	1.38
6.716	412.04	2376	2.880	1.24	0.00	0.00	1.38
6.768	411.35	2373	2.940	1.27	0.00	0.00	1.38
6.821	410.71	2369	3.000	1.17	0.00	0.00	1.44
6.874	410.11	2364	3.090	1.08	0.00	0.00	1.56
6.927	409.52	2358	3.180	1.00	0.00	0.00	1.62
6.980	408.96	2351	3.270	0.93	0.00	0.00	1.68
7.032	408.43	2343	3.360	0.87	0.00	0.00	1.80
7.085	407.92	2334	3.420	0.81	0.00	0.00	1.86
7.138	407.44	2322	3.510	0.75	0.00	0.00	1.92

FLOOD CREST SUMMARY :

Cross Section Location (mi)	Maximum Stage Elevation (ft MSL)	Maximum Flow (cfs)	Time To Maximum Stage (hr)	Maximum Flow Velocity (ft/sec)	Flood Elevation (ft MSL)	Time To Flood Elevation (hr)	Flood Wave Arrival Time (hr)
7.191	407.00	2307	3.570	0.70	0.00	0.00	2.04
7.243	406.61	2290	3.630	0.64	0.00	0.00	2.10
7.296	406.26	2270	3.690	0.59	0.00	0.00	2.16
7.349	405.96	2247	3.750	0.53	0.00	0.00	2.22
7.402	405.71	2222	3.810	0.48	0.00	0.00	2.22
7.455	405.49	2195	3.870	0.43	0.00	0.00	2.16
7.507	405.32	2167	3.930	0.38	0.00	0.00	2.10
7.615	405.00	2105	4.050	0.34	0.00	0.00	2.22
7.723	404.69	2038	4.170	0.31	0.00	0.00	2.34
7.831	404.41	1967	4.290	0.28	0.00	0.00	2.46
7.939	404.15	1891	4.440	0.25	0.00	0.00	2.58
8.047	403.90	1811	4.650	0.23	0.00	0.00	2.76
8.155	403.67	1728	4.860	0.21	0.00	0.00	2.88
8.263	403.46	1641	5.190	0.19	0.00	0.00	3.00
8.371	403.28	1551	5.640	0.17	0.00	0.00	3.12
8.479	403.12	1455	6.060	0.15	0.00	0.00	3.24
8.586	402.97	1355	6.420	0.13	0.00	0.00	3.36
8.694	402.84	1248	6.660	0.12	0.00	0.00	3.42
8.717	402.81	1226	6.690	0.12	0.00	0.00	3.48
8.739	402.78	1204	6.720	0.12	0.00	0.00	3.48
8.761	402.76	1181	6.780	0.11	0.00	0.00	3.54
8.783	402.73	1159	6.810	0.11	0.00	0.00	3.54
8.806	402.70	1137	6.840	0.11	0.00	0.00	3.54
8.828	402.68	1116	6.870	0.11	0.00	0.00	3.60
8.850	402.65	1094	6.900	0.11	0.00	0.00	3.60
8.872	402.63	1073	6.930	0.11	0.00	0.00	3.60
8.894	402.60	1051	6.960	0.11	0.00	0.00	3.66
8.917	402.57	1030	6.990	0.10	0.00	0.00	3.66
8.939	402.55	1009	7.020	0.10	0.00	0.00	3.66
8.961	402.52	988	7.050	0.10	0.00	0.00	3.66
8.983	402.49	968	7.050	0.10	0.00	0.00	3.72
9.006	402.47	947	7.080	0.10	0.00	0.00	3.72
9.028	402.44	927	7.080	0.10	0.00	0.00	3.72
9.050	402.41	907	7.110	0.10	0.00	0.00	3.78
9.072	402.39	888	7.140	0.10	0.00	0.00	3.78
9.094	402.36	868	7.140	0.10	0.00	0.00	3.78
9.117	402.33	849	7.170	0.09	0.00	0.00	3.78
9.139	402.31	831	7.200	0.09	0.00	0.00	3.84
9.161	402.28	813	7.200	0.09	0.00	0.00	3.84
9.183	402.25	796	7.200	0.09	0.00	0.00	3.84
9.206	402.22	779	7.230	0.09	0.00	0.00	3.90
9.228	402.20	763	7.260	0.09	0.00	0.00	3.90
9.250	402.17	749	7.260	0.09	0.00	0.00	3.90
9.272	402.14	737	7.260	0.09	0.00	0.00	3.90
9.294	402.11	727	7.290	0.09	0.00	0.00	3.96
9.317	402.08	719	7.260	0.09	0.00	0.00	3.96
9.339	402.05	713	7.290	0.09	0.00	0.00	3.96
9.361	402.02	709	7.320	0.09	0.00	0.00	4.02

FLOOD CREST SUMMARY :

Cross Section Location (mi)	Maximum Stage Elevation (ft MSL)	Maximum Flow (cfs)	Time To Maximum Stage (hr)	Maximum Flow Velocity (ft/sec)	Flood Elevation (ft MSL)	Time To Flood Elevation (hr)	Flood Wave Arrival Time (hr)
9.383	401.99	706	7.290	0.09	0.00	0.00	4.02
9.406	401.95	704	7.290	0.09	0.00	0.00	4.02
9.428	401.92	702	7.320	0.09	0.00	0.00	4.08
9.450	401.89	701	7.320	0.09	0.00	0.00	4.08
9.472	401.85	701	7.320	0.10	0.00	0.00	4.08
9.495	401.82	701	7.320	0.10	0.00	0.00	4.14

FLOOD CREST SUMMARY :

Cross Section Location (mi)	Maximum Stage Elevation (ft MSL)	Maximum Flow (cfs)	Time To Maximum Stage (hr)	Maximum Flow Velocity (ft/sec)	Flood Elevation (ft MSL)	Time To Flood Elevation (hr)	Flood Wave Arrival Time (hr)
0.000	1062.00	55083	0.000	5.22	0.00	0.00	0.00
0.001	980.01	55083	0.112	62.07	0.00	0.00	0.00
0.008	970.53	55031	0.112	61.98	0.00	0.00	0.02
0.016	961.05	54978	0.112	61.81	0.00	0.00	0.02
0.023	951.57	54924	0.112	61.57	0.00	0.00	0.02
0.034	947.52	54850	0.112	57.27	0.00	0.00	0.00
0.044	943.42	54773	0.112	53.81	0.00	0.00	0.02
0.054	939.27	54694	0.112	51.04	0.00	0.00	0.00
0.065	935.07	54612	0.112	48.83	0.00	0.00	0.02
0.075	930.83	54527	0.112	47.07	0.00	0.00	0.00
0.085	926.54	54438	0.112	45.69	0.00	0.00	0.02
0.096	922.22	54346	0.112	44.61	0.00	0.00	0.00
0.106	917.86	54249	0.112	43.78	0.00	0.00	0.02
0.116	913.48	54149	0.112	43.15	0.00	0.00	0.00
0.126	909.08	54045	0.112	42.68	0.00	0.00	0.02
0.137	904.66	53938	0.112	42.33	0.00	0.00	0.00
0.147	900.23	53828	0.112	42.08	0.00	0.00	0.02
0.157	895.81	53766	0.125	41.87	0.00	0.00	0.00
0.168	891.39	53763	0.125	41.71	0.00	0.00	0.02
0.178	886.98	53757	0.125	41.57	0.00	0.00	0.00
0.188	882.56	53749	0.125	41.46	0.00	0.00	0.02
0.199	878.15	53737	0.125	41.37	0.00	0.00	0.00
0.209	873.75	53723	0.125	41.31	0.00	0.00	0.02
0.219	869.36	53706	0.125	41.27	0.00	0.00	0.00
0.229	864.97	53686	0.125	41.25	0.00	0.00	0.02
0.240	860.60	53664	0.125	41.25	0.00	0.00	0.00
0.250	856.24	53639	0.125	41.27	0.00	0.00	0.02
0.260	851.90	53611	0.125	41.29	0.00	0.00	0.00
0.271	847.58	53581	0.125	41.32	0.00	0.00	0.02
0.326	834.18	53369	0.125	36.29	0.00	0.00	0.00
0.382	820.16	53071	0.125	34.26	0.00	0.00	0.02
0.437	805.93	52686	0.125	33.25	0.00	0.00	0.00
0.492	791.68	52220	0.125	32.47	0.00	0.00	0.02
0.548	777.47	51681	0.125	31.72	0.00	0.00	0.00
0.603	763.34	51348	0.137	30.97	0.00	0.00	0.04
0.659	749.26	51258	0.137	34.38	0.00	0.00	0.00
0.711	747.72	51105	0.137	21.73	0.00	0.00	0.02
0.764	744.40	50761	0.137	20.09	0.00	0.00	0.02
0.816	739.53	50129	0.150	19.64	0.00	0.00	0.02
0.869	735.28	49597	0.150	21.14	0.00	0.00	0.06
0.922	730.81	49377	0.150	18.83	0.00	0.00	0.06
0.974	726.43	49003	0.150	22.72	0.00	0.00	0.06
1.027	721.99	48483	0.162	18.28	0.00	0.00	0.06
1.079	717.66	48100	0.162	25.21	0.00	0.00	0.06
1.132	713.28	47889	0.162	17.72	0.00	0.00	0.09
1.184	708.92	47542	0.162	21.10	0.00	0.00	0.09
1.237	704.68	47053	0.244	17.21	0.00	0.00	0.09
1.289	700.23	46845	0.175	20.62	0.00	0.00	0.09

FLOOD CREST SUMMARY :

Cross Section Location (mi)	Maximum Stage Elevation (ft MSL)	Maximum Flow (cfs)	Time To Maximum Stage (hr)	Maximum Flow Velocity (ft/sec)	Flood Elevation (ft MSL)	Time To Flood Elevation (hr)	Flood Wave Arrival Time (hr)
1.342	696.36	46614	0.244	16.69	0.00	0.00	0.09
1.395	691.99	46678	0.162	20.37	0.00	0.00	0.09
1.447	688.05	46302	0.244	17.14	0.00	0.00	0.11
1.582	674.76	45679	0.187	19.75	0.00	0.00	0.11
1.718	664.25	44947	0.244	14.39	0.00	0.00	0.14
1.769	658.02	44772	0.200	18.42	0.00	0.00	0.14
1.821	654.89	44443	0.244	13.78	0.00	0.00	0.14
1.873	648.37	44229	0.200	22.23	0.00	0.00	0.14
1.925	645.37	43925	0.244	14.33	0.00	0.00	0.14
1.977	638.80	43522	0.212	24.23	0.00	0.00	0.16
2.028	635.84	43328	0.237	13.78	0.00	0.00	0.16
2.080	629.07	43028	0.212	21.19	0.00	0.00	0.16
2.132	626.26	42856	0.237	14.63	0.00	0.00	0.16
2.184	619.48	42584	0.253	20.15	0.00	0.00	0.16
2.235	616.77	42482	0.275	13.98	0.00	0.00	0.19
2.287	610.26	42339	0.253	19.79	0.00	0.00	0.19
2.339	607.36	41908	0.275	14.36	0.00	0.00	0.19
2.391	601.09	41684	0.253	19.49	0.00	0.00	0.19
2.442	598.01	41255	0.275	14.84	0.00	0.00	0.19
2.494	591.90	40807	0.253	19.15	0.00	0.00	0.19
2.546	588.81	40663	0.275	14.96	0.00	0.00	0.19
2.597	583.06	40272	0.253	18.03	0.00	0.00	0.21
2.649	579.51	40244	0.275	15.34	0.00	0.00	0.21
2.700	575.33	40342	0.281	13.80	0.00	0.00	0.21
2.752	570.16	39885	0.281	15.19	0.00	0.00	0.21
2.803	566.86	39360	0.281	12.98	0.00	0.00	0.21
2.855	561.43	38977	0.294	15.16	0.00	0.00	0.21
2.906	558.78	38585	0.301	11.96	0.00	0.00	0.21
2.959	555.43	38089	0.302	12.08	0.00	0.00	0.24
3.013	552.11	37613	0.309	12.18	0.00	0.00	0.24
3.066	548.77	37218	0.309	12.28	0.00	0.00	0.24
3.120	545.48	36555	0.323	12.34	0.00	0.00	0.24
3.173	542.19	36311	0.329	12.38	0.00	0.00	0.24
3.227	538.91	35996	0.329	12.39	0.00	0.00	0.25
3.280	535.64	35685	0.336	12.44	0.00	0.00	0.25
3.334	532.38	35410	0.342	12.43	0.00	0.00	0.27
3.387	529.10	35174	0.348	12.47	0.00	0.00	0.27
3.441	525.85	34894	0.354	12.48	0.00	0.00	0.27

FLOOD CREST SUMMARY :

Cross Section Location (mi)	Maximum Stage Elevation (ft MSL)	Maximum Flow (cfs)	Time To Maximum Stage (hr)	Maximum Flow Velocity (ft/sec)	Flood Elevation (ft MSL)	Time To Flood Elevation (hr)	Flood Wave Arrival Time (hr)
3.494	523.73	34681	0.354	10.96	0.00	0.00	0.28
3.515	522.90	34574	0.354	10.96	0.00	0.00	0.28
3.535	522.09	34409	0.372	10.96	0.00	0.00	0.28
3.555	521.29	34201	0.372	11.04	0.00	0.00	0.28
3.576	520.49	33952	0.372	11.11	0.00	0.00	0.28
3.596	519.67	33668	0.372	11.17	0.00	0.00	0.28
3.616	518.85	33496	0.372	11.23	0.00	0.00	0.28
3.636	518.02	33412	0.372	11.29	0.00	0.00	0.28
3.657	517.19	33314	0.372	11.34	0.00	0.00	0.31
3.677	516.37	33214	0.389	11.39	0.00	0.00	0.31
3.697	515.57	33105	0.389	11.44	0.00	0.00	0.31
3.718	514.76	32973	0.389	11.51	0.00	0.00	0.31
3.738	513.95	32806	0.389	11.58	0.00	0.00	0.31
3.758	513.13	32589	0.389	11.61	0.00	0.00	0.31
3.779	512.31	32296	0.389	11.60	0.00	0.00	0.31
3.799	511.48	31975	0.389	11.65	0.00	0.00	0.31
3.819	510.66	31912	0.407	11.71	0.00	0.00	0.31
3.839	509.86	31839	0.407	11.78	0.00	0.00	0.31
3.860	509.06	31736	0.407	11.87	0.00	0.00	0.04
3.880	508.24	31593	0.407	11.95	0.00	0.00	0.04
3.900	507.43	31398	0.407	12.01	0.00	0.00	0.04
3.921	506.60	31129	0.407	12.03	0.00	0.00	0.04
3.941	505.78	30772	0.425	12.03	0.00	0.00	0.04
3.961	504.99	30536	0.425	12.01	0.00	0.00	0.04
3.982	504.19	30438	0.425	12.04	0.00	0.00	0.04
4.002	503.38	30311	0.425	12.13	0.00	0.00	0.04
4.022	502.57	30144	0.425	12.22	0.00	0.00	0.04
4.042	501.73	29927	0.425	12.29	0.00	0.00	0.04
4.063	500.84	29645	0.425	12.36	0.00	0.00	0.04
4.083	499.86	29429	0.425	12.38	0.00	0.00	0.04
4.103	498.70	29424	0.425	12.50	0.00	0.00	0.04
4.124	496.46	29433	0.425	15.11	0.00	0.00	0.37
4.228	489.29	29051	0.460	14.84	0.00	0.00	0.37
4.332	481.15	28963	0.425	15.74	0.00	0.00	0.37
4.436	474.92	28536	0.460	14.13	0.00	0.00	0.41
4.541	466.05	28493	0.442	16.17	0.00	0.00	0.41
4.645	461.04	28150	0.478	12.34	0.00	0.00	0.41
4.749	450.76	28318	0.460	17.91	0.00	0.00	0.44
4.853	448.13	27820	0.513	9.94	0.00	0.00	0.44
4.904	447.70	27250	1.009	9.83	0.00	0.00	0.44
4.954	447.64	25693	1.009	9.92	0.00	0.00	0.44
5.005	447.59	25319	1.009	9.94	0.00	0.00	0.44
5.055	447.55	24534	1.009	9.72	0.00	0.00	0.48
5.106	447.51	23581	1.009	9.90	0.00	0.00	0.48
5.156	447.47	22994	1.009	9.94	0.00	0.00	0.48
5.207	447.44	22534	1.009	9.74	0.00	0.00	0.48
5.257	447.42	21788	1.009	9.98	0.00	0.00	0.48
5.308	447.39	20967	1.009	9.96	0.00	0.00	0.51

FLOOD CREST SUMMARY :

Cross Section Location (mi)	Maximum Stage Elevation (ft MSL)	Maximum Flow (cfs)	Time To Maximum Stage (hr)	Maximum Flow Velocity (ft/sec)	Flood Elevation (ft MSL)	Time To Flood Elevation (hr)	Flood Wave Arrival Time (hr)
5.358	447.36	20132	1.009	9.43	0.00	0.00	0.51
5.408	447.34	18227	1.027	10.91	0.00	0.00	0.48
5.597	447.26	2942	1.027	2.93	0.00	0.00	0.04
5.965	422.81	2942	1.080	3.27	0.00	0.00	0.14
6.041	421.15	2939	1.186	2.51	0.00	0.00	0.55
6.116	419.53	2927	1.363	1.98	0.00	0.00	0.58
6.192	418.36	2900	1.487	1.27	0.00	0.00	0.58
6.244	417.68	2882	1.540	1.29	0.00	0.00	0.62
6.297	416.97	2869	1.593	1.33	0.00	0.00	0.65
6.349	416.25	2859	1.646	1.39	0.00	0.00	0.69
6.402	415.50	2851	1.681	1.46	0.00	0.00	0.73
6.454	414.73	2844	1.735	1.54	0.00	0.00	0.76
6.506	413.94	2838	1.770	1.63	0.00	0.00	0.80
6.559	413.14	2833	1.805	1.72	0.00	0.00	0.83
6.611	412.35	2829	1.841	1.80	0.00	0.00	0.87
6.664	411.57	2825	1.876	1.87	0.00	0.00	0.90
6.716	410.85	2822	1.929	1.92	0.00	0.00	0.90
6.768	410.19	2818	1.965	1.92	0.00	0.00	0.90
6.821	409.59	2814	2.018	1.75	0.00	0.00	0.94
6.874	409.01	2810	2.071	1.61	0.00	0.00	0.97
6.927	408.46	2805	2.142	1.49	0.00	0.00	1.04
6.980	407.92	2798	2.212	1.39	0.00	0.00	1.08
7.032	407.40	2790	2.319	1.30	0.00	0.00	1.15
7.085	406.91	2780	2.443	1.21	0.00	0.00	1.19
7.138	406.45	2767	2.584	1.13	0.00	0.00	1.26
7.191	406.02	2752	2.797	1.05	0.00	0.00	1.33
7.243	405.64	2733	3.752	0.97	0.00	0.00	1.36
7.296	405.33	2710	4.089	0.88	0.00	0.00	1.43
7.349	405.07	2683	4.301	0.80	0.00	0.00	1.47
7.402	404.86	2654	4.372	0.71	0.00	0.00	1.47
7.455	404.69	2622	4.425	0.62	0.00	0.00	1.47
7.507	404.55	2589	4.460	0.55	0.00	0.00	1.43
7.615	404.29	2522	4.549	0.49	0.00	0.00	1.50
7.723	404.05	2455	4.637	0.44	0.00	0.00	1.61
7.831	403.82	2388	4.726	0.40	0.00	0.00	1.68
7.939	403.60	2319	4.832	0.36	0.00	0.00	1.79
8.047	403.40	2248	4.956	0.33	0.00	0.00	1.86
8.155	403.21	2171	5.080	0.30	0.00	0.00	1.96
8.263	403.04	2088	5.239	0.28	0.00	0.00	2.07
8.371	402.87	1994	5.399	0.25	0.00	0.00	2.18
8.479	402.72	1890	5.558	0.23	0.00	0.00	2.28
8.586	402.58	1776	5.682	0.20	0.00	0.00	2.35
8.694	402.45	1657	5.788	0.18	0.00	0.00	2.46
8.717	402.42	1633	5.806	0.17	0.00	0.00	2.46
8.739	402.39	1610	5.823	0.17	0.00	0.00	2.50
8.761	402.36	1587	5.841	0.17	0.00	0.00	2.50
8.783	402.34	1564	5.859	0.17	0.00	0.00	2.53
8.806	402.31	1542	5.876	0.17	0.00	0.00	2.53

FLOOD CREST SUMMARY :

Cross Section Location (mi)	Maximum Stage Elevation (ft MSL)	Maximum Flow (cfs)	Time To Maximum Stage (hr)	Maximum Flow Velocity (ft/sec)	Flood Elevation (ft MSL)	Time To Flood Elevation (hr)	Flood Wave Arrival Time (hr)
8.828	402.28	1520	5.894	0.16	0.00	0.00	2.57
8.850	402.26	1498	5.912	0.16	0.00	0.00	2.57
8.872	402.23	1476	5.912	0.16	0.00	0.00	2.60
8.894	402.20	1455	5.947	0.16	0.00	0.00	2.60
8.917	402.18	1435	5.947	0.16	0.00	0.00	2.60
8.939	402.15	1414	5.947	0.15	0.00	0.00	2.64
8.961	402.12	1394	5.965	0.15	0.00	0.00	2.64
8.983	402.10	1374	5.983	0.15	0.00	0.00	2.67
9.006	402.07	1355	6.000	0.15	0.00	0.00	2.67
9.028	402.04	1337	6.000	0.15	0.00	0.00	2.67
9.050	402.02	1318	6.018	0.15	0.00	0.00	2.71
9.072	401.99	1300	6.036	0.15	0.00	0.00	2.71
9.094	401.96	1283	6.036	0.15	0.00	0.00	2.74
9.117	401.94	1267	6.053	0.15	0.00	0.00	2.74
9.139	401.91	1251	6.036	0.15	0.00	0.00	2.74
9.161	401.88	1235	6.053	0.15	0.00	0.00	2.78
9.183	401.85	1221	6.071	0.15	0.00	0.00	2.78
9.206	401.83	1208	6.071	0.15	0.00	0.00	2.78
9.228	401.80	1195	6.071	0.15	0.00	0.00	2.81
9.250	401.77	1184	6.089	0.15	0.00	0.00	2.81
9.272	401.74	1173	6.089	0.15	0.00	0.00	2.81
9.294	401.71	1164	6.089	0.15	0.00	0.00	2.85
9.317	401.68	1157	6.107	0.15	0.00	0.00	2.85
9.339	401.65	1150	6.107	0.15	0.00	0.00	2.89
9.361	401.62	1145	6.107	0.15	0.00	0.00	2.89
9.383	401.59	1141	6.124	0.15	0.00	0.00	2.89
9.406	401.56	1137	6.107	0.16	0.00	0.00	2.92
9.428	401.52	1135	6.124	0.16	0.00	0.00	2.92
9.450	401.49	1134	6.124	0.16	0.00	0.00	2.96
9.472	401.45	1133	6.124	0.17	0.00	0.00	2.96
9.495	401.42	1133	6.124	0.17	0.00	0.00	2.96

FLOOD CREST SUMMARY :

Cross Section Location (mi)	Maximum Stage Elevation (ft MSL)	Maximum Flow (cfs)	Time To Maximum Stage (hr)	Maximum Flow Velocity (ft/sec)	Flood Elevation (ft MSL)	Time To Flood Elevation (hr)	Flood Wave Arrival Time (hr)
0.000	1062.01	17738	0.000	4.62	0.00	0.00	0.00
0.023	949.23	17738	0.250	29.33	0.00	0.00	0.03
0.051	937.13	17689	0.250	29.15	0.00	0.00	0.03
0.078	924.98	17639	0.250	29.27	0.00	0.00	0.03
0.106	912.85	17589	0.250	29.46	0.00	0.00	0.03
0.133	900.73	17539	0.250	29.71	0.00	0.00	0.03
0.161	888.63	17488	0.250	30.00	0.00	0.00	0.03
0.188	876.58	17438	0.250	30.36	0.00	0.00	0.03
0.216	864.57	17388	0.250	30.80	0.00	0.00	0.03
0.243	852.65	17338	0.250	31.34	0.00	0.00	0.03
0.271	840.90	17287	0.250	31.82	0.00	0.00	0.03
0.278	839.34	17273	0.250	30.62	0.00	0.00	0.03
0.285	837.74	17259	0.250	29.59	0.00	0.00	0.03
0.292	836.12	17245	0.250	28.72	0.00	0.00	0.03
0.299	834.48	17231	0.250	27.98	0.00	0.00	0.03
0.306	832.81	17216	0.300	27.35	0.00	0.00	0.03
0.313	831.12	17201	0.300	26.83	0.00	0.00	0.03
0.320	829.42	17201	0.300	26.38	0.00	0.00	0.03
0.327	827.70	17201	0.300	26.01	0.00	0.00	0.03
0.334	825.96	17200	0.300	25.68	0.00	0.00	0.03
0.341	824.22	17200	0.300	25.41	0.00	0.00	0.03
0.348	822.47	17199	0.300	25.17	0.00	0.00	0.03
0.355	820.72	17199	0.300	24.96	0.00	0.00	0.03
0.362	818.96	17198	0.300	24.77	0.00	0.00	0.03
0.369	817.19	17197	0.300	24.60	0.00	0.00	0.03
0.376	815.43	17196	0.300	24.44	0.00	0.00	0.03
0.384	813.66	17195	0.300	24.28	0.00	0.00	0.03
0.391	811.89	17194	0.300	24.14	0.00	0.00	0.03
0.398	810.13	17193	0.300	24.00	0.00	0.00	0.03
0.405	808.36	17192	0.300	23.86	0.00	0.00	0.03
0.412	806.59	17191	0.300	23.73	0.00	0.00	0.03
0.419	804.82	17189	0.300	23.60	0.00	0.00	0.04
0.426	803.05	17188	0.300	23.47	0.00	0.00	0.04
0.433	801.28	17186	0.300	23.35	0.00	0.00	0.04
0.440	799.51	17184	0.300	23.22	0.00	0.00	0.04
0.447	797.74	17183	0.300	23.10	0.00	0.00	0.04
0.454	795.98	17181	0.300	22.98	0.00	0.00	0.04
0.461	794.21	17179	0.300	22.87	0.00	0.00	0.04
0.468	792.44	17177	0.300	22.75	0.00	0.00	0.04
0.475	790.67	17175	0.300	22.63	0.00	0.00	0.04
0.482	788.91	17172	0.300	22.52	0.00	0.00	0.04
0.489	787.14	17170	0.300	22.41	0.00	0.00	0.04
0.496	785.37	17168	0.300	22.30	0.00	0.00	0.04
0.504	783.61	17165	0.300	22.19	0.00	0.00	0.06
0.511	781.84	17163	0.300	22.08	0.00	0.00	0.06
0.518	780.07	17160	0.300	21.97	0.00	0.00	0.06
0.525	778.31	17157	0.300	21.87	0.00	0.00	0.06
0.532	776.54	17154	0.300	21.76	0.00	0.00	0.06

FLOOD CREST SUMMARY :

Cross Section Location (mi)	Maximum Stage Elevation (ft MSL)	Maximum Flow (cfs)	Time To Maximum Stage (hr)	Maximum Flow Velocity (ft/sec)	Flood Elevation (ft MSL)	Time To Flood Elevation (hr)	Flood Wave Arrival Time (hr)
0.539	774.78	17152	0.300	21.66	0.00	0.00	0.06
0.546	773.01	17149	0.300	21.56	0.00	0.00	0.06
0.553	771.25	17145	0.300	21.46	0.00	0.00	0.06
0.560	769.48	17142	0.300	21.36	0.00	0.00	0.06
0.567	767.72	17139	0.300	21.26	0.00	0.00	0.06
0.574	765.95	17136	0.300	21.16	0.00	0.00	0.06
0.581	764.19	17132	0.300	21.06	0.00	0.00	0.06
0.588	762.42	17129	0.300	20.97	0.00	0.00	0.06
0.595	760.66	17125	0.300	20.87	0.00	0.00	0.06
0.602	758.89	17121	0.300	20.78	0.00	0.00	0.07
0.609	757.13	17117	0.300	20.69	0.00	0.00	0.07
0.616	755.37	17113	0.300	20.59	0.00	0.00	0.07
0.624	753.60	17109	0.300	20.50	0.00	0.00	0.07
0.631	751.84	17105	0.300	20.41	0.00	0.00	0.07
0.638	750.08	17101	0.300	20.32	0.00	0.00	0.07
0.645	748.31	17097	0.300	20.24	0.00	0.00	0.07
0.652	746.55	17092	0.300	20.15	0.00	0.00	0.07
0.659	744.79	17088	0.300	73.87	0.00	0.00	0.07
0.757	739.12	17088	0.300	12.93	0.00	0.00	0.15
0.856	730.98	16962	0.300	12.67	0.00	0.00	0.07
0.954	723.00	16791	0.300	12.14	0.00	0.00	0.15
1.053	714.88	16574	0.300	11.92	0.00	0.00	0.07
1.151	706.98	16302	0.300	11.30	0.00	0.00	0.15
1.250	698.85	15968	0.300	11.13	0.00	0.00	0.07
1.349	691.06	15552	0.350	10.36	0.00	0.00	0.15
1.447	682.91	15505	0.350	10.46	0.00	0.00	0.15
1.468	681.17	15487	0.350	10.24	0.00	0.00	0.15
1.489	679.42	15465	0.350	10.03	0.00	0.00	0.15
1.510	677.68	15439	0.350	9.83	0.00	0.00	0.15
1.530	675.93	15409	0.350	9.64	0.00	0.00	0.15
1.551	674.18	15375	0.350	9.46	0.00	0.00	0.15
1.572	672.43	15336	0.350	9.28	0.00	0.00	0.15
1.593	670.68	15292	0.350	9.11	0.00	0.00	0.15
1.614	668.93	15241	0.350	8.95	0.00	0.00	0.25
1.634	667.17	15183	0.350	8.79	0.00	0.00	0.25
1.655	665.42	15117	0.350	8.63	0.00	0.00	0.25
1.676	663.66	15041	0.350	8.49	0.00	0.00	0.25
1.697	661.93	14954	0.350	8.29	0.00	0.00	0.25
1.718	660.02	14850	0.350	8.45	0.00	0.00	0.25
1.738	658.07	14736	0.350	8.48	0.00	0.00	0.25
1.759	656.13	14614	0.400	8.51	0.00	0.00	0.25
1.779	654.21	14541	0.400	8.53	0.00	0.00	0.25
1.799	652.28	14532	0.400	8.57	0.00	0.00	0.25
1.820	650.35	14519	0.400	8.62	0.00	0.00	0.25
1.840	648.43	14501	0.400	8.68	0.00	0.00	0.25
1.861	646.50	14478	0.400	8.73	0.00	0.00	0.25
1.881	644.58	14449	0.400	8.78	0.00	0.00	0.25
1.902	642.65	14415	0.400	8.84	0.00	0.00	0.25

FLOOD CREST SUMMARY :

Cross Section Location (mi)	Maximum Stage Elevation (ft MSL)	Maximum Flow (cfs)	Time To Maximum Stage (hr)	Maximum Flow Velocity (ft/sec)	Flood Elevation (ft MSL)	Time To Flood Elevation (hr)	Flood Wave Arrival Time (hr)
1.922	640.73	14376	0.400	8.89	0.00	0.00	0.25
1.942	638.80	14331	0.400	8.94	0.00	0.00	0.25
1.963	636.88	14280	0.400	8.99	0.00	0.00	0.25
1.983	634.95	14224	0.400	9.04	0.00	0.00	0.25
2.004	633.03	14163	0.400	9.09	0.00	0.00	0.25
2.024	631.11	14095	0.400	9.13	0.00	0.00	0.25
2.045	629.18	14022	0.400	9.18	0.00	0.00	0.25
2.065	627.26	13944	0.400	9.23	0.00	0.00	0.25
2.086	625.33	13859	0.400	9.27	0.00	0.00	0.25
2.106	623.41	13769	0.400	9.31	0.00	0.00	0.25
2.126	621.50	13693	0.450	9.36	0.00	0.00	0.25
2.147	619.60	13688	0.450	9.40	0.00	0.00	0.25
2.167	617.70	13679	0.450	9.47	0.00	0.00	0.25
2.188	615.79	13666	0.450	9.54	0.00	0.00	0.25
2.208	613.89	13650	0.450	9.61	0.00	0.00	0.25
2.229	612.00	13630	0.450	9.68	0.00	0.00	0.25
2.249	610.10	13606	0.450	9.74	0.00	0.00	0.25
2.269	608.20	13578	0.450	9.81	0.00	0.00	0.25
2.290	606.31	13546	0.450	9.87	0.00	0.00	0.25
2.310	604.42	13509	0.450	9.94	0.00	0.00	0.25
2.331	602.53	13469	0.450	10.00	0.00	0.00	0.25
2.351	600.64	13424	0.450	10.07	0.00	0.00	0.25
2.372	598.75	13375	0.450	10.13	0.00	0.00	0.25
2.392	596.87	13322	0.450	10.19	0.00	0.00	0.25
2.412	594.99	13265	0.450	10.25	0.00	0.00	0.25
2.433	593.11	13203	0.450	10.31	0.00	0.00	0.25
2.453	591.24	13136	0.450	10.35	0.00	0.00	0.35
2.474	589.35	13065	0.500	10.45	0.00	0.00	0.35
2.494	587.62	13004	0.500	10.26	0.00	0.00	0.35
2.509	586.35	13001	0.500	10.19	0.00	0.00	0.35
2.525	585.07	12996	0.500	10.11	0.00	0.00	0.35
2.540	583.80	12989	0.500	10.05	0.00	0.00	0.35
2.555	582.54	12981	0.500	10.00	0.00	0.00	0.35
2.570	581.27	12971	0.500	9.94	0.00	0.00	0.35
2.586	580.00	12959	0.500	9.89	0.00	0.00	0.35
2.601	578.74	12945	0.500	9.84	0.00	0.00	0.35
2.616	577.48	12930	0.500	9.79	0.00	0.00	0.35
2.631	576.22	12912	0.500	9.74	0.00	0.00	0.35
2.647	574.96	12892	0.500	9.69	0.00	0.00	0.35
2.662	573.70	12870	0.500	9.64	0.00	0.00	0.35
2.677	572.44	12845	0.500	9.59	0.00	0.00	0.35
2.692	571.18	12818	0.500	9.55	0.00	0.00	0.35
2.708	569.92	12789	0.500	9.50	0.00	0.00	0.35
2.723	568.66	12757	0.500	9.46	0.00	0.00	0.35
2.738	567.40	12722	0.500	9.42	0.00	0.00	0.35
2.753	566.14	12683	0.500	9.39	0.00	0.00	0.35
2.769	564.87	12642	0.500	9.37	0.00	0.00	0.35
2.784	563.60	12598	0.500	9.34	0.00	0.00	0.35

FLOOD CREST SUMMARY :

Cross Section Location (mi)	Maximum Stage Elevation (ft MSL)	Maximum Flow (cfs)	Time To Maximum Stage (hr)	Maximum Flow Velocity (ft/sec)	Flood Elevation (ft MSL)	Time To Flood Elevation (hr)	Flood Wave Arrival Time (hr)
2.799	562.34	12550	0.500	9.32	0.00	0.00	0.35
2.814	561.07	12499	0.550	9.30	0.00	0.00	0.35
2.830	559.81	12445	0.550	9.29	0.00	0.00	0.35
2.845	558.55	12424	0.550	9.27	0.00	0.00	0.35
2.860	557.30	12419	0.550	9.25	0.00	0.00	0.35
2.875	556.09	12411	0.550	9.16	0.00	0.00	0.35
2.891	555.01	12400	0.550	8.82	0.00	0.00	0.35
2.906	554.21	12384	0.550	8.02	0.00	0.00	0.35
2.990	549.14	12249	0.550	7.98	0.00	0.00	0.35
3.074	544.04	12025	0.600	7.94	0.00	0.00	0.35
3.158	539.01	11867	0.600	7.87	0.00	0.00	0.35
3.242	533.95	11769	0.600	7.82	0.00	0.00	0.35
3.326	528.87	11598	0.600	7.78	0.00	0.00	0.45
3.410	523.81	11419	0.650	7.75	0.00	0.00	0.45
3.494	518.80	11358	0.650	7.64	0.00	0.00	0.45

FLOOD CREST SUMMARY :

Cross Section Location (mi)	Maximum Stage Elevation (ft MSL)	Maximum Flow (cfs)	Time To Maximum Stage (hr)	Maximum Flow Velocity (ft/sec)	Flood Elevation (ft MSL)	Time To Flood Elevation (hr)	Flood Wave Arrival Time (hr)
3.494	519.65	11358	0.650	6.47	0.00	0.00	0.45
3.547	517.45	11307	0.650	6.61	0.00	0.00	0.45
3.599	515.27	11218	0.683	6.76	0.00	0.00	0.45
3.652	513.07	11212	0.683	6.92	0.00	0.00	0.45
3.704	510.86	11187	0.683	7.08	0.00	0.00	0.45
3.757	508.65	11139	0.715	7.24	0.00	0.00	0.45
3.809	506.43	11079	0.715	7.43	0.00	0.00	0.45
3.861	504.21	11075	0.715	7.62	0.00	0.00	0.45
3.914	501.96	11050	0.715	7.82	0.00	0.00	0.45
3.966	499.71	11000	0.748	8.04	0.00	0.00	0.06
4.019	497.44	10966	0.748	8.29	0.00	0.00	0.06
4.071	495.04	10968	0.748	8.68	0.00	0.00	0.06
4.124	491.42	10960	0.748	10.99	0.00	0.00	0.52
4.144	490.03	10954	0.748	10.90	0.00	0.00	0.52
4.164	488.65	10946	0.748	10.80	0.00	0.00	0.59
4.184	487.26	10938	0.748	10.70	0.00	0.00	0.59
4.205	485.88	10929	0.748	10.60	0.00	0.00	0.59
4.225	484.50	10919	0.748	10.51	0.00	0.00	0.59
4.245	483.12	10909	0.780	10.41	0.00	0.00	0.59
4.266	481.75	10898	0.780	10.32	0.00	0.00	0.59
4.286	480.37	10901	0.780	10.22	0.00	0.00	0.59
4.306	479.00	10904	0.780	10.13	0.00	0.00	0.59
4.326	477.63	10907	0.780	10.04	0.00	0.00	0.59
4.347	476.26	10908	0.780	9.96	0.00	0.00	0.59
4.367	474.88	10909	0.780	9.88	0.00	0.00	0.59
4.387	473.51	10909	0.780	9.80	0.00	0.00	0.59
4.407	472.14	10909	0.780	9.72	0.00	0.00	0.59
4.428	470.77	10908	0.780	9.64	0.00	0.00	0.59
4.448	469.40	10908	0.780	9.56	0.00	0.00	0.59
4.468	468.04	10908	0.780	9.49	0.00	0.00	0.59
4.488	466.67	10907	0.780	9.41	0.00	0.00	0.59
4.509	465.30	10908	0.780	9.34	0.00	0.00	0.65
4.529	463.93	10908	0.780	9.27	0.00	0.00	0.65
4.549	462.57	10907	0.780	9.20	0.00	0.00	0.65
4.569	461.20	10906	0.780	9.13	0.00	0.00	0.65
4.590	459.83	10903	0.780	9.06	0.00	0.00	0.65
4.610	458.46	10897	0.780	9.00	0.00	0.00	0.65
4.630	457.10	10888	0.780	8.93	0.00	0.00	0.65
4.650	455.73	10874	0.813	8.86	0.00	0.00	0.65
4.671	454.37	10868	0.813	8.79	0.00	0.00	0.65
4.691	453.01	10879	0.813	8.73	0.00	0.00	0.65
4.711	451.64	10891	0.813	8.67	0.00	0.00	0.65
4.732	450.28	10904	0.813	8.62	0.00	0.00	0.65
4.752	448.92	10915	0.813	8.56	0.00	0.00	0.65
4.772	447.58	10924	0.813	8.48	0.00	0.00	0.65
4.792	446.32	10928	0.813	8.25	0.00	0.00	0.65
4.813	445.34	10924	0.845	7.76	0.00	0.00	0.72
4.833	444.74	10904	0.845	6.84	0.00	0.00	0.72

FLOOD CREST SUMMARY :

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4.853	444.38	10861	0.845	5.71	0.00	0.00	0.65
4.874	444.22	10799	1.430	5.75	0.00	0.00	0.72
4.894	444.14	10730	1.463	5.80	0.00	0.00	0.72
4.915	444.07	10735	1.463	5.85	0.00	0.00	0.72
4.935	444.01	10735	1.463	5.89	0.00	0.00	0.72
4.956	443.96	10725	1.463	5.93	0.00	0.00	0.72
4.977	443.91	10703	1.495	5.93	0.00	0.00	0.72
4.997	443.87	10668	1.495	5.93	0.00	0.00	0.72
5.018	443.83	10617	1.495	6.01	0.00	0.00	0.72
5.038	443.80	10550	1.495	6.08	0.00	0.00	0.72
5.059	443.77	10486	1.495	6.16	0.00	0.00	0.72
5.079	443.74	10478	1.495	6.22	0.00	0.00	0.72
5.100	443.71	10460	1.495	6.27	0.00	0.00	0.72
5.121	443.68	10431	1.495	6.30	0.00	0.00	0.72
5.141	443.66	10386	1.495	6.31	0.00	0.00	0.78
5.162	443.64	10323	1.495	6.36	0.00	0.00	0.78
5.182	443.62	10240	1.495	6.45	0.00	0.00	0.78
5.203	443.60	10134	1.495	6.53	0.00	0.00	0.78
5.223	443.58	10002	1.495	6.60	0.00	0.00	0.78
5.244	443.56	9839	1.495	6.66	0.00	0.00	0.78
5.265	443.54	9640	1.495	6.70	0.00	0.00	0.78
5.285	443.52	9399	1.495	6.71	0.00	0.00	0.78
5.306	443.51	9108	1.495	6.68	0.00	0.00	0.78
5.326	443.49	8915	1.495	6.59	0.00	0.00	0.78
5.347	443.48	8713	1.495	6.45	0.00	0.00	0.78
5.367	443.47	8473	1.495	6.24	0.00	0.00	0.78
5.388	443.45	8180	1.495	6.00	0.00	0.00	0.78
5.409	443.44	7809	1.495	5.74	0.00	0.00	0.78
5.597	443.33	2685	1.495	1.72	0.00	0.00	0.85
5.965	422.64	2685	1.560	3.01	0.00	0.00	0.85
6.041	421.00	2683	1.625	2.37	0.00	0.00	0.85
6.116	419.39	2676	1.755	1.86	0.00	0.00	0.91
6.192	418.22	2660	1.853	1.20	0.00	0.00	0.91
6.244	417.53	2647	1.918	1.21	0.00	0.00	0.98
6.297	416.82	2636	1.950	1.25	0.00	0.00	0.98
6.349	416.09	2628	1.983	1.31	0.00	0.00	1.04
6.402	415.35	2622	2.015	1.39	0.00	0.00	1.04
6.454	414.58	2617	2.048	1.46	0.00	0.00	1.11
6.506	413.80	2614	2.080	1.54	0.00	0.00	1.17
6.559	413.02	2612	2.080	1.62	0.00	0.00	1.17
6.611	412.24	2611	2.113	1.70	0.00	0.00	1.24
6.664	411.50	2611	2.113	1.75	0.00	0.00	1.24
6.716	410.82	2612	2.080	1.78	0.00	0.00	1.24
6.769	410.21	2613	2.080	1.76	0.00	0.00	1.24
7.138	405.96	2550	3.218	1.20	0.00	0.00	1.76
7.507	404.38	2370	3.933	0.51	0.00	0.00	1.76
7.615	404.10	2312	3.998	0.46	0.00	0.00	1.82
7.723	403.84	2257	4.095	0.41	0.00	0.00	1.95

FLOOD CREST SUMMARY :

Cross Section Location (mi)	Maximum Stage Elevation (ft MSL)	Maximum Flow (cfs)	Time To Maximum Stage (hr)	Maximum Flow Velocity (ft/sec)	Flood Elevation (ft MSL)	Time To Flood Elevation (hr)	Flood Wave Arrival Time (hr)
7.831	403.59	2201	4.193	0.37	0.00	0.00	2.02
7.939	403.36	2142	4.290	0.34	0.00	0.00	2.15
8.047	403.14	2078	4.453	0.31	0.00	0.00	2.21
8.155	402.93	2007	4.615	0.28	0.00	0.00	2.34
8.263	402.74	1929	4.810	0.26	0.00	0.00	2.47
8.371	402.56	1840	5.037	0.23	0.00	0.00	2.54
8.479	402.41	1740	5.265	0.21	0.00	0.00	2.67
8.586	402.26	1628	5.460	0.19	0.00	0.00	2.73
8.694	402.12	1504	5.590	0.17	0.00	0.00	2.86
8.717	402.10	1477	5.622	0.16	0.00	0.00	2.86
8.739	402.07	1450	5.655	0.16	0.00	0.00	2.86
8.761	402.04	1424	5.687	0.16	0.00	0.00	2.86
8.783	402.01	1397	5.687	0.16	0.00	0.00	2.93
8.806	401.99	1371	5.720	0.16	0.00	0.00	2.93
8.828	401.96	1344	5.752	0.15	0.00	0.00	2.93
8.850	401.93	1318	5.752	0.15	0.00	0.00	2.93
8.872	401.91	1292	5.785	0.15	0.00	0.00	2.99
8.894	401.88	1266	5.785	0.15	0.00	0.00	2.99
8.917	401.85	1240	5.817	0.15	0.00	0.00	2.99
8.939	401.83	1215	5.817	0.14	0.00	0.00	2.99
8.961	401.80	1190	5.850	0.14	0.00	0.00	3.06
8.983	401.77	1165	5.850	0.14	0.00	0.00	3.06
9.006	401.75	1140	5.882	0.14	0.00	0.00	3.06
9.028	401.72	1116	5.882	0.14	0.00	0.00	3.06
9.050	401.69	1092	5.882	0.13	0.00	0.00	3.06
9.072	401.67	1069	5.915	0.13	0.00	0.00	3.12
9.094	401.64	1046	5.915	0.13	0.00	0.00	3.12
9.117	401.61	1024	5.915	0.13	0.00	0.00	3.12
9.139	401.58	1002	5.947	0.13	0.00	0.00	3.12
9.161	401.56	982	5.947	0.13	0.00	0.00	3.12
9.183	401.53	962	5.947	0.13	0.00	0.00	3.19
9.206	401.50	944	5.947	0.12	0.00	0.00	3.19
9.228	401.47	926	5.980	0.12	0.00	0.00	3.19
9.250	401.44	911	5.980	0.12	0.00	0.00	3.19
9.272	401.41	897	5.980	0.12	0.00	0.00	3.19
9.294	401.39	886	5.980	0.12	0.00	0.00	3.25
9.317	401.36	876	6.012	0.12	0.00	0.00	3.25
9.339	401.32	869	6.012	0.12	0.00	0.00	3.25
9.361	401.29	863	6.012	0.12	0.00	0.00	3.25
9.383	401.26	859	6.012	0.12	0.00	0.00	3.25
9.406	401.23	856	6.012	0.13	0.00	0.00	3.32
9.428	401.20	854	6.012	0.13	0.00	0.00	3.32
9.450	401.16	852	6.012	0.13	0.00	0.00	3.32
9.472	401.13	851	6.012	0.13	0.00	0.00	3.32
9.495	401.09	851	6.012	0.14	0.00	0.00	3.38

FLOOD CREST SUMMARY :

Cross Section Location (mi)	Maximum Stage Elevation (ft MSL)	Maximum Flow (cfs)	Time To Maximum Stage (hr)	Maximum Flow Velocity (ft/sec)	Flood Elevation (ft MSL)	Time To Flood Elevation (hr)	Flood Wave Arrival Time (hr)
0.000	1058.00	9643	0.000	4.96	0.00	0.00	0.00
0.023	947.56	9643	0.175	22.25	0.00	0.00	0.03
0.051	935.44	9642	0.175	22.16	0.00	0.00	0.03
0.078	923.26	9641	0.175	23.45	0.00	0.00	0.03
0.106	911.10	9639	0.175	22.59	0.00	0.00	0.03
0.133	898.96	9636	0.175	22.85	0.00	0.00	0.03
0.161	886.82	9633	0.175	23.16	0.00	0.00	0.03
0.188	874.72	9629	0.175	23.53	0.00	0.00	0.03
0.216	862.64	9624	0.175	23.98	0.00	0.00	0.03
0.243	850.62	9618	0.175	24.56	0.00	0.00	0.06
0.271	838.69	9612	0.175	25.30	0.00	0.00	0.03
0.291	834.40	9606	0.175	21.74	0.00	0.00	0.03
0.311	829.60	9600	0.175	20.34	0.00	0.00	0.03
0.332	824.62	9592	0.175	19.63	0.00	0.00	0.03
0.352	819.61	9586	0.200	23.69	0.00	0.00	0.03
0.373	814.58	9585	0.200	18.55	0.00	0.00	0.03
0.393	809.54	9584	0.200	20.26	0.00	0.00	0.03
0.414	804.49	9583	0.200	17.67	0.00	0.00	0.03
0.434	799.44	9581	0.200	28.34	0.00	0.00	0.03
0.454	794.38	9579	0.200	16.91	0.00	0.00	0.03
0.475	789.32	9576	0.200	22.18	0.00	0.00	0.06
0.495	784.26	9573	0.200	16.23	0.00	0.00	0.06
0.516	779.19	9569	0.200	38.52	0.00	0.00	0.06
0.536	774.13	9565	0.200	15.63	0.00	0.00	0.06
0.557	769.06	9560	0.200	25.37	0.00	0.00	0.06
0.577	763.99	9554	0.200	15.08	0.00	0.00	0.06
0.598	758.92	9547	0.200	27.92	0.00	0.00	0.06
0.618	753.84	9540	0.200	14.58	0.00	0.00	0.06
0.638	748.77	9532	0.200	24.44	0.00	0.00	0.08
0.659	745.81	9532	0.225	9.28	0.00	0.00	0.06
0.711	741.53	9518	0.225	9.09	0.00	0.00	0.06
0.764	737.25	9503	0.225	8.92	0.00	0.00	0.06
0.816	732.98	9478	0.225	8.75	0.00	0.00	0.06
0.869	728.72	9448	0.250	8.58	0.00	0.00	0.06
0.922	724.48	9439	0.250	8.43	0.00	0.00	0.08
0.974	720.23	9420	0.250	8.27	0.00	0.00	0.12
1.027	716.00	9388	0.275	8.12	0.00	0.00	0.12
1.079	711.78	9374	0.275	7.97	0.00	0.00	0.12
1.132	707.56	9358	0.275	7.83	0.00	0.00	0.12
1.184	703.34	9331	0.275	7.68	0.00	0.00	0.12
1.237	699.14	9306	0.300	7.53	0.00	0.00	0.12
1.289	694.94	9293	0.300	7.38	0.00	0.00	0.17
1.342	690.74	9266	0.300	7.25	0.00	0.00	0.17
1.395	686.58	9234	0.325	7.05	0.00	0.00	0.17
1.447	682.28	9223	0.325	7.07	0.00	0.00	0.17
1.468	680.56	9215	0.325	6.90	0.00	0.00	0.17
1.489	678.84	9204	0.325	6.74	0.00	0.00	0.17
1.510	677.12	9191	0.325	6.59	0.00	0.00	0.17

FLOOD CREST SUMMARY :

Cross Section Location (mi)	Maximum Stage Elevation (ft MSL)	Maximum Flow (cfs)	Time To Maximum Stage (hr)	Maximum Flow Velocity (ft/sec)	Flood Elevation (ft MSL)	Time To Flood Elevation (hr)	Flood Wave Arrival Time (hr)
1.530	675.39	9174	0.350	6.45	0.00	0.00	0.17
1.551	673.67	9162	0.350	6.31	0.00	0.00	0.17
1.572	671.94	9158	0.350	6.18	0.00	0.00	0.17
1.593	670.21	9153	0.350	6.07	0.00	0.00	0.22
1.614	668.48	9143	0.350	5.95	0.00	0.00	0.22
1.634	666.75	9129	0.350	5.84	0.00	0.00	0.22
1.655	665.01	9109	0.350	5.74	0.00	0.00	0.22
1.676	663.27	9082	0.375	5.64	0.00	0.00	0.22
1.697	661.50	9075	0.375	5.59	0.00	0.00	0.22
1.718	659.59	9061	0.375	5.74	0.00	0.00	0.22
1.738	657.66	9040	0.375	5.77	0.00	0.00	0.22
1.759	655.74	9011	0.400	5.79	0.00	0.00	0.22
1.779	653.82	8985	0.400	5.81	0.00	0.00	0.22
1.799	651.89	8977	0.400	5.83	0.00	0.00	0.22
1.820	649.96	8965	0.400	5.87	0.00	0.00	0.22
1.840	648.03	8949	0.400	5.91	0.00	0.00	0.22
1.861	646.10	8929	0.400	5.95	0.00	0.00	0.22
1.881	644.17	8903	0.425	5.99	0.00	0.00	0.22
1.902	642.24	8895	0.425	6.03	0.00	0.00	0.27
1.922	640.31	8889	0.425	6.08	0.00	0.00	0.27
1.942	638.38	8880	0.425	6.13	0.00	0.00	0.27
1.963	636.46	8866	0.425	6.17	0.00	0.00	0.27
1.983	634.53	8849	0.425	6.22	0.00	0.00	0.27
2.004	632.60	8827	0.450	6.27	0.00	0.00	0.27
2.024	630.68	8808	0.450	6.31	0.00	0.00	0.27
2.045	628.76	8804	0.450	6.36	0.00	0.00	0.27
2.065	626.84	8797	0.450	6.42	0.00	0.00	0.27
2.086	624.92	8787	0.450	6.47	0.00	0.00	0.27
2.106	623.00	8773	0.450	6.52	0.00	0.00	0.27
2.126	621.08	8756	0.450	6.58	0.00	0.00	0.27
2.147	619.16	8734	0.475	6.63	0.00	0.00	0.32
2.167	617.25	8719	0.475	6.68	0.00	0.00	0.32
2.188	615.34	8715	0.475	6.74	0.00	0.00	0.32
2.208	613.43	8708	0.475	6.80	0.00	0.00	0.32
2.229	611.52	8698	0.475	6.86	0.00	0.00	0.32
2.249	609.61	8684	0.475	6.92	0.00	0.00	0.32
2.269	607.71	8667	0.475	6.98	0.00	0.00	0.32
2.290	605.80	8646	0.500	7.04	0.00	0.00	0.32
2.310	603.91	8630	0.500	7.10	0.00	0.00	0.32
2.331	602.01	8626	0.500	7.16	0.00	0.00	0.32
2.351	600.12	8619	0.500	7.22	0.00	0.00	0.32
2.372	598.23	8609	0.500	7.29	0.00	0.00	0.32
2.392	596.34	8597	0.500	7.35	0.00	0.00	0.37
2.412	594.45	8580	0.500	7.41	0.00	0.00	0.37
2.433	592.57	8560	0.525	7.48	0.00	0.00	0.37
2.453	590.70	8540	0.525	7.53	0.00	0.00	0.37
2.474	588.85	8536	0.525	7.56	0.00	0.00	0.37
2.494	587.11	8529	0.525	7.43	0.00	0.00	0.37

FLOOD CREST SUMMARY :

Cross Section Location (mi)	Maximum Stage Elevation (ft MSL)	Maximum Flow (cfs)	Time To Maximum Stage (hr)	Maximum Flow Velocity (ft/sec)	Flood Elevation (ft MSL)	Time To Flood Elevation (hr)	Flood Wave Arrival Time (hr)
2.509	585.84	8523	0.525	7.38	0.00	0.00	0.37
2.525	584.57	8514	0.525	7.33	0.00	0.00	0.37
2.540	583.30	8504	0.525	7.28	0.00	0.00	0.37
2.555	582.04	8492	0.525	7.24	0.00	0.00	0.37
2.570	580.77	8478	0.525	7.19	0.00	0.00	0.37
2.586	579.51	8462	0.550	7.15	0.00	0.00	0.37
2.601	578.26	8446	0.550	7.10	0.00	0.00	0.37
2.616	577.00	8443	0.550	7.06	0.00	0.00	0.37
2.631	575.75	8438	0.550	7.01	0.00	0.00	0.37
2.647	574.49	8432	0.550	6.98	0.00	0.00	0.37
2.662	573.24	8424	0.550	6.94	0.00	0.00	0.37
2.677	571.98	8414	0.550	6.91	0.00	0.00	0.37
2.692	570.73	8402	0.550	6.88	0.00	0.00	0.37
2.708	569.47	8387	0.550	6.86	0.00	0.00	0.42
2.723	568.21	8369	0.575	6.84	0.00	0.00	0.42
2.738	566.95	8349	0.575	6.82	0.00	0.00	0.42
2.753	565.69	8345	0.575	6.80	0.00	0.00	0.42
2.769	564.44	8340	0.575	6.78	0.00	0.00	0.42
2.784	563.18	8332	0.575	6.77	0.00	0.00	0.42
2.799	561.91	8322	0.575	6.76	0.00	0.00	0.42
2.814	560.65	8310	0.575	6.76	0.00	0.00	0.42
2.830	559.39	8295	0.575	6.75	0.00	0.00	0.42
2.845	558.14	8277	0.600	6.72	0.00	0.00	0.42
2.860	556.92	8254	0.600	6.67	0.00	0.00	0.42
2.875	555.75	8240	0.600	6.54	0.00	0.00	0.42
2.891	554.69	8231	0.600	6.27	0.00	0.00	0.42
2.906	553.78	8219	0.600	5.81	0.00	0.00	0.42
3.024	546.70	8080	0.625	5.74	0.00	0.00	0.47
3.141	539.62	7944	0.650	5.69	0.00	0.00	0.47
3.259	532.55	7819	0.675	5.62	0.00	0.00	0.47
3.377	525.46	7685	0.725	5.60	0.00	0.00	0.52
3.494	518.44	7584	0.725	5.49	0.00	0.00	0.52

FLOOD CREST SUMMARY :

Cross Section Location (mi)	Maximum Stage Elevation (ft MSL)	Maximum Flow (cfs)	Time To Maximum Stage (hr)	Maximum Flow Velocity (ft/sec)	Flood Elevation (ft MSL)	Time To Flood Elevation (hr)	Flood Wave Arrival Time (hr)
0.000	1058.00	19727	0.000	5.95	0.00	0.00	0.00
0.023	950.59	19727	0.275	25.77	0.00	0.00	0.04
0.051	938.52	19726	0.275	25.65	0.00	0.00	0.04
0.078	926.38	19726	0.275	25.86	0.00	0.00	0.04
0.106	914.26	19725	0.275	26.12	0.00	0.00	0.04
0.133	902.16	19724	0.275	26.43	0.00	0.00	0.04
0.161	890.09	19723	0.275	26.78	0.00	0.00	0.04
0.188	878.06	19721	0.275	27.21	0.00	0.00	0.04
0.216	866.08	19720	0.275	27.74	0.00	0.00	0.04
0.243	854.25	19718	0.275	28.18	0.00	0.00	0.04
0.271	842.58	19715	0.275	28.37	0.00	0.00	0.04
0.291	838.27	19713	0.275	24.74	0.00	0.00	0.04
0.311	833.53	19711	0.275	22.96	0.00	0.00	0.04
0.332	828.49	19708	0.275	22.17	0.00	0.00	0.04
0.352	823.35	19705	0.275	21.75	0.00	0.00	0.04
0.373	818.19	19702	0.275	21.40	0.00	0.00	0.04
0.393	813.03	19698	0.275	21.08	0.00	0.00	0.04
0.414	807.87	19695	0.275	20.77	0.00	0.00	0.04
0.434	802.72	19691	0.275	20.93	0.00	0.00	0.04
0.454	797.57	19686	0.275	20.18	0.00	0.00	0.04
0.475	792.43	19682	0.275	20.66	0.00	0.00	0.04
0.495	787.29	19677	0.275	19.61	0.00	0.00	0.07
0.516	782.16	19672	0.275	20.31	0.00	0.00	0.07
0.536	777.03	19666	0.275	19.07	0.00	0.00	0.07
0.557	771.90	19660	0.275	20.53	0.00	0.00	0.07
0.577	766.77	19654	0.275	18.56	0.00	0.00	0.07
0.598	761.65	19648	0.275	19.94	0.00	0.00	0.07
0.618	756.53	19641	0.275	18.08	0.00	0.00	0.07
0.638	751.41	19634	0.275	24.53	0.00	0.00	0.07
0.659	749.43	19634	0.275	11.37	0.00	0.00	0.07
0.711	745.08	19599	0.300	11.19	0.00	0.00	0.07
0.764	740.75	19593	0.300	11.01	0.00	0.00	0.07
0.816	736.44	19580	0.300	10.83	0.00	0.00	0.07
0.869	732.13	19561	0.300	10.65	0.00	0.00	0.07
0.922	727.84	19534	0.300	10.47	0.00	0.00	0.07
0.974	723.55	19499	0.300	10.28	0.00	0.00	0.04
1.027	719.28	19454	0.325	10.10	0.00	0.00	0.12
1.079	715.01	19427	0.325	9.92	0.00	0.00	0.12
1.132	710.75	19414	0.325	9.75	0.00	0.00	0.12
1.184	706.50	19391	0.325	9.58	0.00	0.00	0.12
1.237	702.24	19357	0.325	9.41	0.00	0.00	0.17
1.289	697.99	19311	0.325	9.24	0.00	0.00	0.17
1.342	693.75	19251	0.350	9.08	0.00	0.00	0.17
1.395	689.54	19236	0.350	8.88	0.00	0.00	0.17
1.447	685.07	19215	0.350	9.02	0.00	0.00	0.17
1.468	683.30	19203	0.350	8.83	0.00	0.00	0.17
1.489	681.52	19190	0.350	8.65	0.00	0.00	0.17
1.510	679.75	19174	0.350	8.47	0.00	0.00	0.17

FLOOD CREST SUMMARY :

Cross Section Location (mi)	Maximum Stage Elevation (ft MSL)	Maximum Flow (cfs)	Time To Maximum Stage (hr)	Maximum Flow Velocity (ft/sec)	Flood Elevation (ft MSL)	Time To Flood Elevation (hr)	Flood Wave Arrival Time (hr)
1.530	677.98	19156	0.350	8.31	0.00	0.00	0.17
1.551	676.22	19134	0.350	8.14	0.00	0.00	0.17
1.572	674.45	19110	0.350	7.99	0.00	0.00	0.17
1.593	672.68	19082	0.350	7.84	0.00	0.00	0.22
1.614	670.92	19050	0.375	7.69	0.00	0.00	0.22
1.634	669.15	19045	0.375	7.56	0.00	0.00	0.22
1.655	667.38	19040	0.375	7.45	0.00	0.00	0.22
1.676	665.59	19033	0.375	7.36	0.00	0.00	0.22
1.697	663.78	19022	0.375	7.29	0.00	0.00	0.22
1.718	661.89	19009	0.375	7.35	0.00	0.00	0.22
1.738	659.98	18992	0.375	7.37	0.00	0.00	0.22
1.759	658.08	18972	0.375	7.38	0.00	0.00	0.22
1.779	656.18	18948	0.375	7.40	0.00	0.00	0.22
1.799	654.28	18919	0.375	7.42	0.00	0.00	0.22
1.820	652.38	18884	0.375	7.43	0.00	0.00	0.22
1.840	650.48	18842	0.400	7.45	0.00	0.00	0.22
1.861	648.59	18829	0.400	7.47	0.00	0.00	0.22
1.881	646.68	18820	0.400	7.51	0.00	0.00	0.22
1.902	644.77	18805	0.400	7.56	0.00	0.00	0.27
1.922	642.86	18785	0.400	7.61	0.00	0.00	0.27
1.942	640.96	18760	0.400	7.66	0.00	0.00	0.27
1.963	639.05	18728	0.400	7.71	0.00	0.00	0.27
1.983	637.14	18689	0.400	7.75	0.00	0.00	0.27
2.004	635.23	18643	0.400	7.80	0.00	0.00	0.27
2.024	633.33	18588	0.425	7.84	0.00	0.00	0.27
2.045	631.44	18565	0.425	7.88	0.00	0.00	0.27
2.065	629.54	18554	0.425	7.93	0.00	0.00	0.27
2.086	627.64	18537	0.425	7.98	0.00	0.00	0.27
2.106	625.75	18513	0.425	8.03	0.00	0.00	0.27
2.126	623.86	18484	0.425	8.08	0.00	0.00	0.27
2.147	621.97	18446	0.425	8.13	0.00	0.00	0.27
2.167	620.07	18402	0.425	8.17	0.00	0.00	0.32
2.188	618.18	18348	0.450	8.22	0.00	0.00	0.32
2.208	616.31	18286	0.450	8.26	0.00	0.00	0.32
2.229	614.43	18267	0.450	8.31	0.00	0.00	0.32
2.249	612.56	18252	0.450	8.35	0.00	0.00	0.32
2.269	610.68	18232	0.450	8.40	0.00	0.00	0.32
2.290	608.81	18205	0.450	8.45	0.00	0.00	0.32
2.310	606.94	18170	0.450	8.50	0.00	0.00	0.32
2.331	605.07	18128	0.450	8.55	0.00	0.00	0.32
2.351	603.21	18078	0.450	8.59	0.00	0.00	0.32
2.372	601.35	18018	0.475	8.64	0.00	0.00	0.32
2.392	599.50	17951	0.475	8.68	0.00	0.00	0.32
2.412	597.66	17939	0.475	8.71	0.00	0.00	0.32
2.433	595.82	17922	0.475	8.75	0.00	0.00	0.32
2.453	593.99	17897	0.475	8.78	0.00	0.00	0.32
2.474	592.18	17865	0.475	8.78	0.00	0.00	0.32
2.494	590.42	17826	0.475	8.73	0.00	0.00	0.32

FLOOD CREST SUMMARY :

Cross Section Location (mi)	Maximum Stage Elevation (ft MSL)	Maximum Flow (cfs)	Time To Maximum Stage (hr)	Maximum Flow Velocity (ft/sec)	Flood Elevation (ft MSL)	Time To Flood Elevation (hr)	Flood Wave Arrival Time (hr)
2.509	589.14	17792	0.475	8.67	0.00	0.00	0.37
2.525	587.85	17753	0.475	8.61	0.00	0.00	0.37
2.540	586.57	17708	0.500	8.55	0.00	0.00	0.37
2.555	585.30	17658	0.500	8.48	0.00	0.00	0.37
2.570	584.03	17606	0.500	8.42	0.00	0.00	0.37
2.586	582.76	17597	0.500	8.36	0.00	0.00	0.37
2.601	581.49	17584	0.500	8.30	0.00	0.00	0.37
2.616	580.23	17567	0.500	8.24	0.00	0.00	0.37
2.631	578.96	17546	0.500	8.19	0.00	0.00	0.37
2.647	577.70	17520	0.500	8.14	0.00	0.00	0.37
2.662	576.44	17489	0.500	8.08	0.00	0.00	0.37
2.677	575.17	17452	0.500	8.03	0.00	0.00	0.37
2.692	573.91	17410	0.500	7.98	0.00	0.00	0.37
2.708	572.65	17362	0.525	7.93	0.00	0.00	0.37
2.723	571.40	17307	0.525	7.88	0.00	0.00	0.37
2.738	570.15	17249	0.525	7.83	0.00	0.00	0.37
2.753	568.91	17237	0.525	7.78	0.00	0.00	0.37
2.769	567.66	17221	0.525	7.73	0.00	0.00	0.37
2.784	566.41	17200	0.525	7.67	0.00	0.00	0.37
2.799	565.17	17173	0.525	7.62	0.00	0.00	0.37
2.814	563.92	17139	0.525	7.57	0.00	0.00	0.37
2.830	562.69	17097	0.525	7.51	0.00	0.00	0.37
2.845	561.48	17047	0.550	7.42	0.00	0.00	0.42
2.860	560.32	16987	0.550	7.30	0.00	0.00	0.42
2.875	559.21	16914	0.550	7.11	0.00	0.00	0.42
2.891	558.18	16850	0.550	6.83	0.00	0.00	0.42
2.906	557.27	16824	0.550	6.45	0.00	0.00	0.42
3.024	550.00	16433	0.575	6.54	0.00	0.00	0.42
3.141	542.79	16112	0.600	6.59	0.00	0.00	0.42
3.259	535.63	15870	0.600	6.59	0.00	0.00	0.47
3.377	528.48	15572	0.625	6.57	0.00	0.00	0.47
3.494	521.42	15319	0.652	6.48	0.00	0.00	0.52

FLOOD CREST SUMMARY :

Cross Section Location (mi)	Maximum Stage Elevation (ft MSL)	Maximum Flow (cfs)	Time To Maximum Stage (hr)	Maximum Flow Velocity (ft/sec)	Flood Elevation (ft MSL)	Time To Flood Elevation (hr)	Flood Wave Arrival Time (hr)
0.000	1058.00	23060	0.000	4.89	0.00	0.00	0.00
0.023	950.90	23060	0.125	28.68	0.00	0.00	0.03
0.051	938.83	23042	0.125	28.53	0.00	0.00	0.03
0.078	926.71	23021	0.125	28.70	0.00	0.00	0.03
0.106	914.59	22997	0.125	28.94	0.00	0.00	0.03
0.133	902.50	22969	0.125	29.23	0.00	0.00	0.03
0.161	890.44	22938	0.125	29.57	0.00	0.00	0.03
0.188	878.42	22905	0.125	29.98	0.00	0.00	0.03
0.216	866.46	22868	0.125	30.48	0.00	0.00	0.03
0.243	854.65	22828	0.125	30.85	0.00	0.00	0.03
0.271	842.99	22783	0.125	30.97	0.00	0.00	0.03
0.278	841.47	22770	0.125	29.65	0.00	0.00	0.03
0.285	839.92	22757	0.125	28.55	0.00	0.00	0.03
0.292	838.32	22744	0.125	27.63	0.00	0.00	0.03
0.299	836.69	22730	0.125	26.88	0.00	0.00	0.03
0.306	835.02	22716	0.125	26.27	0.00	0.00	0.03
0.313	833.33	22702	0.125	25.78	0.00	0.00	0.03
0.320	831.61	22686	0.125	25.37	0.00	0.00	0.03
0.327	829.87	22671	0.125	25.05	0.00	0.00	0.03
0.334	828.12	22655	0.125	24.78	0.00	0.00	0.03
0.341	826.36	22638	0.125	24.55	0.00	0.00	0.03
0.348	824.58	22621	0.125	24.36	0.00	0.00	0.03
0.355	822.81	22604	0.125	24.18	0.00	0.00	0.03
0.362	821.02	22586	0.125	24.03	0.00	0.00	0.03
0.369	819.24	22567	0.125	23.89	0.00	0.00	0.03
0.376	817.45	22548	0.125	23.75	0.00	0.00	0.03
0.384	815.66	22529	0.125	23.62	0.00	0.00	0.03
0.391	813.87	22509	0.125	23.50	0.00	0.00	0.05
0.398	812.08	22489	0.125	23.38	0.00	0.00	0.05
0.405	810.30	22469	0.125	23.26	0.00	0.00	0.05
0.412	808.51	22448	0.125	23.14	0.00	0.00	0.05
0.419	806.72	22427	0.125	23.03	0.00	0.00	0.05
0.426	804.93	22405	0.125	22.91	0.00	0.00	0.05
0.433	803.15	22383	0.125	22.80	0.00	0.00	0.05
0.440	801.36	22361	0.125	22.69	0.00	0.00	0.05
0.447	799.58	22338	0.125	22.57	0.00	0.00	0.05
0.454	797.79	22315	0.125	22.46	0.00	0.00	0.05
0.461	796.01	22291	0.125	22.35	0.00	0.00	0.05
0.468	794.23	22267	0.125	22.24	0.00	0.00	0.05
0.475	792.44	22243	0.125	22.13	0.00	0.00	0.05
0.482	790.66	22218	0.125	22.02	0.00	0.00	0.05
0.489	788.88	22192	0.125	21.91	0.00	0.00	0.05
0.496	787.10	22166	0.125	21.80	0.00	0.00	0.05
0.504	785.32	22139	0.125	21.69	0.00	0.00	0.05
0.511	783.53	22112	0.125	21.59	0.00	0.00	0.05
0.518	781.75	22085	0.125	21.48	0.00	0.00	0.05
0.525	779.97	22057	0.125	21.37	0.00	0.00	0.05
0.532	778.20	22028	0.125	21.27	0.00	0.00	0.05

FLOOD CREST SUMMARY :

Cross Section Location (mi)	Maximum Stage Elevation (ft MSL)	Maximum Flow (cfs)	Time To Maximum Stage (hr)	Maximum Flow Velocity (ft/sec)	Flood Elevation (ft MSL)	Time To Flood Elevation (hr)	Flood Wave Arrival Time (hr)
0.539	776.42	21999	0.125	21.16	0.00	0.00	0.05
0.546	774.64	21969	0.125	21.06	0.00	0.00	0.05
0.553	772.86	21938	0.125	20.95	0.00	0.00	0.05
0.560	771.08	21907	0.125	20.85	0.00	0.00	0.05
0.567	769.30	21875	0.125	20.75	0.00	0.00	0.05
0.574	767.53	21843	0.125	20.65	0.00	0.00	0.05
0.581	765.75	21810	0.125	20.54	0.00	0.00	0.05
0.588	763.97	21776	0.125	20.44	0.00	0.00	0.05
0.595	762.19	21741	0.125	20.34	0.00	0.00	0.05
0.602	760.42	21706	0.125	20.24	0.00	0.00	0.05
0.609	758.64	21670	0.125	20.14	0.00	0.00	0.05
0.616	756.87	21633	0.150	21.49	0.00	0.00	0.05
0.624	755.10	21620	0.150	19.94	0.00	0.00	0.05
0.631	753.33	21619	0.150	19.86	0.00	0.00	0.05
0.638	751.56	21618	0.150	19.78	0.00	0.00	0.06
0.645	749.83	21616	0.402	46.65	0.00	0.00	0.06
0.652	748.02	21612	0.150	33.55	0.00	0.00	0.06
0.659	754.24	21612	0.150	7.61	0.00	0.00	0.05
0.711	740.44	21542	0.411	46.15	0.00	0.00	0.07
0.764	740.53	21368	0.150	12.34	0.00	0.00	0.09
0.816	736.14	21067	0.150	12.10	0.00	0.00	0.07
0.869	731.80	20651	0.175	11.82	0.00	0.00	0.09
0.922	727.48	20572	0.175	11.55	0.00	0.00	0.09
0.974	723.16	20411	0.175	11.33	0.00	0.00	0.09
1.027	718.83	20151	0.175	11.10	0.00	0.00	0.09
1.079	714.54	19828	0.200	10.85	0.00	0.00	0.09
1.132	710.26	19747	0.200	10.61	0.00	0.00	0.09
1.184	705.98	19587	0.200	10.40	0.00	0.00	0.09
1.237	701.68	19329	0.225	10.18	0.00	0.00	0.12
1.289	697.44	19138	0.225	9.93	0.00	0.00	0.12
1.342	693.16	19040	0.225	9.76	0.00	0.00	0.12
1.395	688.95	18857	0.225	9.48	0.00	0.00	0.12
1.447	684.46	18593	0.250	9.60	0.00	0.00	0.12
1.468	682.70	18581	0.250	9.37	0.00	0.00	0.12
1.489	680.93	18559	0.250	9.17	0.00	0.00	0.17
1.510	679.17	18528	0.250	8.99	0.00	0.00	0.17
1.530	677.40	18485	0.250	8.81	0.00	0.00	0.17
1.551	675.63	18429	0.250	8.63	0.00	0.00	0.17
1.572	673.86	18357	0.250	8.46	0.00	0.00	0.17
1.593	672.09	18267	0.250	8.29	0.00	0.00	0.17
1.614	670.32	18156	0.275	8.12	0.00	0.00	0.17
1.634	668.56	18089	0.275	7.95	0.00	0.00	0.17
1.655	666.81	18069	0.275	7.80	0.00	0.00	0.17
1.676	665.04	18038	0.275	7.68	0.00	0.00	0.17
1.697	663.24	17995	0.275	7.60	0.00	0.00	0.17
1.718	661.34	17936	0.275	7.67	0.00	0.00	0.17
1.738	659.42	17860	0.275	7.68	0.00	0.00	0.17
1.759	657.50	17762	0.275	7.68	0.00	0.00	0.17

FLOOD CREST SUMMARY :

Cross Section Location (mi)	Maximum Stage Elevation (ft MSL)	Maximum Flow (cfs)	Time To Maximum Stage (hr)	Maximum Flow Velocity (ft/sec)	Flood Elevation (ft MSL)	Time To Flood Elevation (hr)	Flood Wave Arrival Time (hr)
1.779	655.60	17637	0.300	7.68	0.00	0.00	0.17
1.799	653.69	17603	0.300	7.69	0.00	0.00	0.17
1.820	651.77	17576	0.300	7.73	0.00	0.00	0.17
1.840	649.84	17534	0.300	7.78	0.00	0.00	0.17
1.861	647.92	17475	0.300	7.82	0.00	0.00	0.17
1.881	645.99	17400	0.300	7.86	0.00	0.00	0.22
1.902	644.06	17305	0.300	7.90	0.00	0.00	0.22
1.922	642.14	17190	0.325	7.94	0.00	0.00	0.22
1.942	640.23	17113	0.325	7.97	0.00	0.00	0.22
1.963	638.32	17092	0.325	8.00	0.00	0.00	0.22
1.983	636.41	17059	0.325	8.05	0.00	0.00	0.22
2.004	634.49	17012	0.325	8.10	0.00	0.00	0.22
2.024	632.58	16951	0.325	8.15	0.00	0.00	0.22
2.045	630.66	16875	0.325	8.19	0.00	0.00	0.22
2.065	628.74	16781	0.325	8.23	0.00	0.00	0.22
2.086	626.84	16668	0.350	8.27	0.00	0.00	0.22
2.106	624.94	16617	0.350	8.30	0.00	0.00	0.22
2.126	623.04	16595	0.350	8.34	0.00	0.00	0.22
2.147	621.14	16562	0.350	8.40	0.00	0.00	0.22
2.167	619.24	16516	0.350	8.45	0.00	0.00	0.22
2.188	617.34	16457	0.350	8.50	0.00	0.00	0.22
2.208	615.44	16385	0.350	8.55	0.00	0.00	0.27
2.229	613.54	16296	0.350	8.59	0.00	0.00	0.27
2.249	611.65	16192	0.375	8.63	0.00	0.00	0.27
2.269	609.77	16125	0.375	8.67	0.00	0.00	0.27
2.290	607.89	16105	0.375	8.70	0.00	0.00	0.27
2.310	606.01	16075	0.375	8.76	0.00	0.00	0.27
2.331	604.13	16034	0.375	8.81	0.00	0.00	0.27
2.351	602.26	15981	0.375	8.86	0.00	0.00	0.27
2.372	600.38	15915	0.375	8.91	0.00	0.00	0.27
2.392	598.50	15836	0.375	8.96	0.00	0.00	0.27
2.412	596.64	15742	0.400	9.00	0.00	0.00	0.27
2.433	594.79	15634	0.402	9.04	0.00	0.00	0.27
2.453	592.95	15620	0.405	9.06	0.00	0.00	0.27
2.474	591.13	15604	0.405	9.06	0.00	0.00	0.27
2.494	589.38	15588	0.408	8.97	0.00	0.00	0.27
2.509	588.11	15573	0.411	8.92	0.00	0.00	0.27
2.525	586.83	15561	0.411	8.86	0.00	0.00	0.27
2.540	585.55	15546	0.411	8.80	0.00	0.00	0.27
2.555	584.28	15533	0.411	8.74	0.00	0.00	0.27
2.570	583.01	15514	0.411	8.69	0.00	0.00	0.27
2.586	581.74	15490	0.411	8.63	0.00	0.00	0.32
2.601	580.47	15459	0.411	8.58	0.00	0.00	0.32
2.616	579.20	15422	0.411	8.53	0.00	0.00	0.32
2.631	577.93	15378	0.411	8.47	0.00	0.00	0.32
2.647	576.66	15326	0.411	8.42	0.00	0.00	0.32
2.662	575.39	15266	0.411	8.36	0.00	0.00	0.32
2.677	574.12	15197	0.436	8.31	0.00	0.00	0.32

FLOOD CREST SUMMARY :

Cross Section Location (mi)	Maximum Stage Elevation (ft MSL)	Maximum Flow (cfs)	Time To Maximum Stage (hr)	Maximum Flow Velocity (ft/sec)	Flood Elevation (ft MSL)	Time To Flood Elevation (hr)	Flood Wave Arrival Time (hr)
2.692	572.87	15119	0.436	8.25	0.00	0.00	0.32
2.708	571.61	15052	0.436	8.19	0.00	0.00	0.32
2.723	570.36	15037	0.436	8.14	0.00	0.00	0.32
2.738	569.11	15016	0.436	8.08	0.00	0.00	0.32
2.753	567.85	14989	0.436	8.03	0.00	0.00	0.32
2.769	566.59	14954	0.436	7.99	0.00	0.00	0.32
2.784	565.34	14911	0.450	7.95	0.00	0.00	0.32
2.799	564.10	14859	0.450	7.91	0.00	0.00	0.32
2.814	562.85	14831	0.450	7.87	0.00	0.00	0.32
2.830	561.61	14810	0.450	7.82	0.00	0.00	0.32
2.845	560.38	14779	0.450	7.76	0.00	0.00	0.32
2.860	559.17	14738	0.450	7.66	0.00	0.00	0.32
2.875	558.02	14684	0.450	7.48	0.00	0.00	0.32
2.891	556.97	14615	0.450	7.18	0.00	0.00	0.32
2.906	556.08	14530	0.475	6.72	0.00	0.00	0.32
2.990	550.93	14178	0.475	6.68	0.00	0.00	0.37
3.074	545.79	13774	0.500	6.66	0.00	0.00	0.37
3.158	540.66	13543	0.500	6.59	0.00	0.00	0.37
3.242	535.58	13231	0.525	6.50	0.00	0.00	0.37
3.326	530.47	12895	0.550	6.44	0.00	0.00	0.40
3.410	525.38	12641	0.550	6.34	0.00	0.00	0.41
3.494	520.35	12365	0.575	6.20	0.00	0.00	0.45

FLOOD CREST SUMMARY :

Cross Section Location (mi)	Maximum Stage Elevation (ft MSL)	Maximum Flow (cfs)	Time To Maximum Stage (hr)	Maximum Flow Velocity (ft/sec)	Flood Elevation (ft MSL)	Time To Flood Elevation (hr)	Flood Wave Arrival Time (hr)
3.494	521.15	12365	0.575	5.47	0.00	0.00	0.46
3.547	518.97	12269	0.604	5.55	0.00	0.00	0.46
3.599	516.82	12103	0.604	5.68	0.00	0.00	0.46
3.652	514.64	12022	0.604	5.78	0.00	0.00	0.46
3.704	512.44	11929	0.632	5.85	0.00	0.00	0.46
3.757	510.26	11645	0.632	5.99	0.00	0.00	0.06
3.809	508.01	11606	0.632	6.12	0.00	0.00	0.06
3.861	505.81	11426	0.661	6.26	0.00	0.00	0.06
3.914	503.55	11213	0.661	6.39	0.00	0.00	0.06
3.966	501.24	11124	0.690	6.58	0.00	0.00	0.06
4.019	498.87	10943	0.690	6.79	0.00	0.00	0.06
4.071	496.28	10884	0.690	7.25	0.00	0.00	0.06
4.124	492.77	10884	0.690	8.87	0.00	0.00	0.57
4.228	485.56	10733	0.719	8.49	0.00	0.00	0.57
4.332	478.38	10762	0.719	8.20	0.00	0.00	0.63
4.436	471.35	10661	0.719	7.74	0.00	0.00	0.63
4.540	464.11	10590	0.748	7.72	0.00	0.00	0.69
4.645	457.43	10637	0.748	6.89	0.00	0.00	0.69
4.749	449.45	10690	0.748	7.87	0.00	0.00	0.69
4.853	445.49	10279	0.848	4.89	0.00	0.00	0.75
5.131	441.64	9076	1.452	5.12	0.00	0.00	0.75
5.408	441.09	6332	1.481	4.38	0.00	0.00	0.79
5.597	440.85	2523	1.481	1.81	0.00	0.00	0.75
5.965	423.84	2523	1.596	2.23	0.00	0.00	0.75
6.041	422.17	2517	1.739	1.68	0.00	0.00	0.85
6.116	420.58	2501	2.056	1.29	0.00	0.00	0.91
6.192	419.42	2468	2.228	0.80	0.00	0.00	0.91
6.244	418.75	2444	2.314	0.81	0.00	0.00	0.96
6.297	418.05	2425	2.372	0.84	0.00	0.00	1.02
6.349	417.34	2414	2.429	0.87	0.00	0.00	1.08
6.402	416.61	2406	2.516	0.91	0.00	0.00	1.08
6.454	415.86	2399	2.544	0.96	0.00	0.00	1.14
6.506	415.10	2393	2.602	1.01	0.00	0.00	1.19
6.559	414.32	2388	2.659	1.07	0.00	0.00	1.25
6.611	413.55	2383	2.717	1.13	0.00	0.00	1.31
6.664	412.78	2379	2.774	1.19	0.00	0.00	1.31
6.716	412.05	2375	2.832	1.24	0.00	0.00	1.37
6.768	411.36	2372	2.889	1.27	0.00	0.00	1.31
6.821	410.73	2368	2.947	1.16	0.00	0.00	1.42
6.874	410.12	2364	3.004	1.07	0.00	0.00	1.48
6.927	409.54	2358	3.091	0.99	0.00	0.00	1.54
6.980	408.99	2352	3.177	0.92	0.00	0.00	1.65
7.032	408.46	2344	3.292	0.86	0.00	0.00	1.77
7.085	407.96	2335	3.378	0.80	0.00	0.00	1.83
7.138	407.50	2324	3.436	0.74	0.00	0.00	1.94
7.191	407.07	2310	3.522	0.69	0.00	0.00	2.00
7.243	406.69	2294	3.579	0.63	0.00	0.00	2.11
7.296	406.36	2276	3.637	0.57	0.00	0.00	2.17

FLOOD CREST SUMMARY :

Cross Section Location (mi)	Maximum Stage Elevation (ft MSL)	Maximum Flow (cfs)	Time To Maximum Stage (hr)	Maximum Flow Velocity (ft/sec)	Flood Elevation (ft MSL)	Time To Flood Elevation (hr)	Flood Wave Arrival Time (hr)
7.349	406.07	2255	3.694	0.52	0.00	0.00	2.17
7.402	405.83	2233	3.752	0.47	0.00	0.00	2.17
7.455	405.62	2209	3.809	0.42	0.00	0.00	2.11
7.507	405.45	2184	3.867	0.37	0.00	0.00	2.00
7.615	405.15	2130	3.982	0.33	0.00	0.00	2.11
7.723	404.86	2072	4.097	0.30	0.00	0.00	2.23
7.831	404.59	2010	4.212	0.28	0.00	0.00	2.40
7.939	404.34	1943	4.384	0.25	0.00	0.00	2.52
8.047	404.10	1872	4.557	0.23	0.00	0.00	2.63
8.155	403.89	1797	4.787	0.21	0.00	0.00	2.80
8.263	403.69	1718	5.074	0.19	0.00	0.00	2.92
8.371	403.52	1634	5.419	0.17	0.00	0.00	3.03
8.479	403.36	1544	5.764	0.15	0.00	0.00	3.15
8.586	403.22	1449	6.023	0.14	0.00	0.00	3.26
8.694	403.08	1347	6.224	0.12	0.00	0.00	3.32
8.717	403.06	1326	6.253	0.12	0.00	0.00	3.32
8.739	403.03	1305	6.282	0.12	0.00	0.00	3.32
8.761	403.00	1284	6.339	0.12	0.00	0.00	3.38
8.783	402.98	1262	6.368	0.12	0.00	0.00	3.38
8.806	402.95	1242	6.397	0.12	0.00	0.00	3.38
8.828	402.93	1221	6.426	0.11	0.00	0.00	3.38
8.850	402.90	1200	6.454	0.11	0.00	0.00	3.44
8.872	402.87	1180	6.483	0.11	0.00	0.00	3.44
8.894	402.85	1160	6.483	0.11	0.00	0.00	3.44
8.917	402.82	1140	6.512	0.11	0.00	0.00	3.49
8.939	402.79	1120	6.541	0.11	0.00	0.00	3.49
8.961	402.77	1100	6.569	0.11	0.00	0.00	3.49
8.983	402.74	1081	6.569	0.11	0.00	0.00	3.49
9.006	402.72	1062	6.598	0.11	0.00	0.00	3.55
9.028	402.69	1043	6.627	0.11	0.00	0.00	3.55
9.050	402.66	1024	6.627	0.10	0.00	0.00	3.55
9.072	402.64	1006	6.656	0.10	0.00	0.00	3.55
9.094	402.61	988	6.656	0.10	0.00	0.00	3.55
9.117	402.58	970	6.684	0.10	0.00	0.00	3.61
9.139	402.55	953	6.684	0.10	0.00	0.00	3.61
9.161	402.53	937	6.713	0.10	0.00	0.00	3.61
9.183	402.50	921	6.713	0.10	0.00	0.00	3.61
9.206	402.47	907	6.742	0.10	0.00	0.00	3.67
9.228	402.44	893	6.742	0.10	0.00	0.00	3.67
9.250	402.41	881	6.742	0.10	0.00	0.00	3.67
9.272	402.39	870	6.771	0.10	0.00	0.00	3.67
9.294	402.36	861	6.771	0.10	0.00	0.00	3.72
9.317	402.33	853	6.771	0.10	0.00	0.00	3.72
9.339	402.30	848	6.771	0.10	0.00	0.00	3.72
9.361	402.27	844	6.771	0.10	0.00	0.00	3.78
9.383	402.23	841	6.799	0.10	0.00	0.00	3.78
9.406	402.20	838	6.799	0.10	0.00	0.00	3.78
9.428	402.17	837	6.799	0.10	0.00	0.00	3.84

FLOOD CREST SUMMARY :

Cross Section Location (mi)	Maximum Stage Elevation (ft MSL)	Maximum Flow (cfs)	Time To Maximum Stage (hr)	Maximum Flow Velocity (ft/sec)	Flood Elevation (ft MSL)	Time To Flood Elevation (hr)	Flood Wave Arrival Time (hr)
9.450	402.14	836	6.799	0.11	0.00	0.00	3.84
9.472	402.10	835	6.799	0.11	0.00	0.00	3.84
9.495	402.07	835	6.799	0.11	0.00	0.00	3.90

FLOOD CREST SUMMARY :

Cross Section Location (mi)	Maximum Stage Elevation (ft MSL)	Maximum Flow (cfs)	Time To Maximum Stage (hr)	Maximum Flow Velocity (ft/sec)	Flood Elevation (ft MSL)	Time To Flood Elevation (hr)	Flood Wave Arrival Time (hr)
0.000	1058.00	43566	0.000	4.77	0.00	0.00	0.00
0.023	953.91	43566	0.150	35.31	0.00	0.00	0.04
0.051	941.87	43354	0.150	35.09	0.00	0.00	0.04
0.078	929.78	43133	0.150	35.14	0.00	0.00	0.04
0.106	917.70	42906	0.150	35.31	0.00	0.00	0.04
0.133	905.65	42673	0.150	35.55	0.00	0.00	0.04
0.161	893.65	42434	0.150	35.81	0.00	0.00	0.04
0.188	881.72	42186	0.150	35.95	0.00	0.00	0.04
0.216	869.88	41925	0.150	35.98	0.00	0.00	0.04
0.243	858.12	41656	0.150	36.03	0.00	0.00	0.04
0.271	846.49	41382	0.150	36.12	0.00	0.00	0.04
0.278	844.88	41311	0.150	35.05	0.00	0.00	0.04
0.285	843.25	41239	0.150	34.13	0.00	0.00	0.04
0.292	841.59	41166	0.150	33.32	0.00	0.00	0.04
0.299	839.91	41092	0.150	32.62	0.00	0.00	0.04
0.306	838.21	41017	0.150	32.02	0.00	0.00	0.04
0.313	836.50	40942	0.150	31.50	0.00	0.00	0.04
0.320	834.76	40865	0.150	31.05	0.00	0.00	0.04
0.327	833.01	40787	0.150	30.67	0.00	0.00	0.04
0.334	831.24	40708	0.150	30.33	0.00	0.00	0.04
0.341	829.46	40627	0.150	30.04	0.00	0.00	0.04
0.348	827.68	40546	0.150	29.79	0.00	0.00	0.04
0.355	825.89	40463	0.150	29.57	0.00	0.00	0.04
0.362	824.09	40380	0.150	29.37	0.00	0.00	0.04
0.369	822.28	40295	0.150	29.19	0.00	0.00	0.04
0.376	820.47	40209	0.150	29.02	0.00	0.00	0.04
0.384	818.66	40123	0.150	28.87	0.00	0.00	0.04
0.391	816.85	40035	0.150	28.73	0.00	0.00	0.04
0.398	815.04	39947	0.150	28.59	0.00	0.00	0.04
0.405	813.22	39859	0.150	28.46	0.00	0.00	0.04
0.412	811.41	39769	0.150	28.34	0.00	0.00	0.04
0.419	809.59	39679	0.150	28.22	0.00	0.00	0.04
0.426	807.78	39589	0.150	28.10	0.00	0.00	0.04
0.433	805.96	39497	0.150	27.98	0.00	0.00	0.04
0.440	804.15	39406	0.150	27.87	0.00	0.00	0.04
0.447	802.34	39313	0.150	27.75	0.00	0.00	0.04
0.454	800.52	39221	0.150	27.64	0.00	0.00	0.04
0.461	798.71	39127	0.150	27.52	0.00	0.00	0.04
0.468	796.90	39034	0.150	27.41	0.00	0.00	0.04
0.475	795.09	38940	0.150	27.30	0.00	0.00	0.04
0.482	793.28	38845	0.150	27.18	0.00	0.00	0.04
0.489	791.47	38750	0.150	27.07	0.00	0.00	0.04
0.496	789.66	38654	0.150	26.96	0.00	0.00	0.04
0.504	787.86	38558	0.150	26.85	0.00	0.00	0.05
0.511	786.05	38461	0.150	26.73	0.00	0.00	0.05
0.518	784.24	38364	0.150	26.62	0.00	0.00	0.05
0.525	782.44	38266	0.150	26.51	0.00	0.00	0.05
0.532	780.63	38168	0.150	26.39	0.00	0.00	0.06

FLOOD CREST SUMMARY :

Cross Section Location (mi)	Maximum Stage Elevation (ft MSL)	Maximum Flow (cfs)	Time To Maximum Stage (hr)	Maximum Flow Velocity (ft/sec)	Flood Elevation (ft MSL)	Time To Flood Elevation (hr)	Flood Wave Arrival Time (hr)
0.539	778.83	38069	0.150	26.28	0.00	0.00	0.06
0.546	777.03	37970	0.150	26.17	0.00	0.00	0.06
0.553	775.23	37870	0.150	26.06	0.00	0.00	0.06
0.560	773.43	37770	0.150	25.94	0.00	0.00	0.06
0.567	771.62	37669	0.150	25.83	0.00	0.00	0.06
0.574	769.82	37568	0.150	25.72	0.00	0.00	0.06
0.581	768.03	37466	0.150	25.61	0.00	0.00	0.06
0.588	766.23	37363	0.150	25.49	0.00	0.00	0.06
0.595	764.43	37260	0.150	25.38	0.00	0.00	0.06
0.602	762.63	37156	0.150	25.27	0.00	0.00	0.07
0.609	760.83	37052	0.150	25.16	0.00	0.00	0.07
0.616	759.04	36947	0.150	25.05	0.00	0.00	0.07
0.624	757.24	36841	0.150	24.93	0.00	0.00	0.07
0.631	755.45	36735	0.150	24.82	0.00	0.00	0.07
0.638	753.65	36628	0.150	24.71	0.00	0.00	0.08
0.645	751.85	36516	0.150	44.21	0.00	0.00	0.08
0.652	750.05	36395	0.150	32.91	0.00	0.00	0.08
0.659	756.50	36395	0.150	10.56	0.00	0.00	0.08
0.711	742.17	35053	0.150	45.04	0.00	0.00	0.08
0.764	742.93	34609	0.175	15.21	0.00	0.00	0.08
0.816	738.51	34308	0.175	14.92	0.00	0.00	0.08
0.869	734.08	33852	0.175	14.66	0.00	0.00	0.12
0.922	729.64	33237	0.175	14.37	0.00	0.00	0.12
0.974	725.19	32456	0.175	14.04	0.00	0.00	0.12
1.027	720.72	31503	0.175	13.69	0.00	0.00	0.12
1.079	716.38	30697	0.200	13.31	0.00	0.00	0.12
1.132	712.05	30487	0.200	12.99	0.00	0.00	0.12
1.184	707.70	30113	0.200	12.74	0.00	0.00	0.12
1.237	703.32	29562	0.200	12.48	0.00	0.00	0.12
1.289	698.94	28812	0.200	12.16	0.00	0.00	0.12
1.342	694.58	27883	0.225	11.87	0.00	0.00	0.12
1.395	690.39	27716	0.225	11.38	0.00	0.00	0.17
1.447	685.74	27405	0.225	11.69	0.00	0.00	0.17
1.468	683.93	27241	0.225	11.43	0.00	0.00	0.17
1.489	682.11	27047	0.225	11.18	0.00	0.00	0.17
1.510	680.29	26820	0.225	10.94	0.00	0.00	0.17
1.530	678.47	26557	0.225	10.70	0.00	0.00	0.17
1.551	676.65	26255	0.225	10.45	0.00	0.00	0.17
1.572	674.84	25911	0.250	10.21	0.00	0.00	0.17
1.593	673.06	25639	0.250	9.97	0.00	0.00	0.17
1.614	671.28	25593	0.250	9.75	0.00	0.00	0.17
1.634	669.49	25521	0.250	9.59	0.00	0.00	0.17
1.655	667.69	25420	0.250	9.45	0.00	0.00	0.17
1.676	665.88	25289	0.250	9.31	0.00	0.00	0.17
1.697	664.07	25123	0.250	9.19	0.00	0.00	0.17
1.718	662.14	24918	0.250	9.23	0.00	0.00	0.17
1.738	660.21	24674	0.250	9.21	0.00	0.00	0.17
1.759	658.27	24382	0.250	9.18	0.00	0.00	0.17

FLOOD CREST SUMMARY :

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1.779	656.34	24040	0.275	9.15	0.00	0.00	0.17
1.799	654.44	23727	0.275	9.10	0.00	0.00	0.17
1.820	652.54	23684	0.275	9.07	0.00	0.00	0.17
1.840	650.63	23609	0.275	9.09	0.00	0.00	0.17
1.861	648.73	23498	0.275	9.11	0.00	0.00	0.17
1.881	646.81	23347	0.275	9.12	0.00	0.00	0.17
1.902	644.88	23153	0.275	9.14	0.00	0.00	0.22
1.922	642.94	22920	0.275	9.17	0.00	0.00	0.22
1.942	640.99	22646	0.275	9.18	0.00	0.00	0.22
1.963	639.05	22331	0.300	9.19	0.00	0.00	0.22
1.983	637.14	21973	0.300	9.19	0.00	0.00	0.22
2.004	635.24	21932	0.300	9.18	0.00	0.00	0.22
2.024	633.33	21864	0.300	9.22	0.00	0.00	0.22
2.045	631.42	21767	0.300	9.26	0.00	0.00	0.22
2.065	629.50	21641	0.300	9.30	0.00	0.00	0.22
2.086	627.58	21482	0.300	9.34	0.00	0.00	0.22
2.106	625.66	21292	0.300	9.37	0.00	0.00	0.22
2.126	623.73	21068	0.300	9.40	0.00	0.00	0.22
2.147	621.80	20810	0.300	9.42	0.00	0.00	0.22
2.167	619.92	20518	0.325	9.43	0.00	0.00	0.22
2.188	618.03	20433	0.328	9.43	0.00	0.00	0.22
2.208	616.15	20387	0.328	9.45	0.00	0.00	0.22
2.229	614.27	20346	0.331	9.50	0.00	0.00	0.22
2.249	612.39	20305	0.334	9.55	0.00	0.00	0.22
2.269	610.52	20270	0.336	9.60	0.00	0.00	0.22
2.290	608.65	20237	0.337	9.65	0.00	0.00	0.22
2.310	606.78	20203	0.339	9.70	0.00	0.00	0.27
2.331	604.92	20169	0.342	9.76	0.00	0.00	0.27
2.351	603.06	20120	0.342	9.81	0.00	0.00	0.27
2.372	601.20	20083	0.345	9.86	0.00	0.00	0.27
2.392	599.34	20037	0.345	9.90	0.00	0.00	0.27
2.412	597.49	19992	0.345	9.95	0.00	0.00	0.27
2.433	595.63	19924	0.345	10.00	0.00	0.00	0.27
2.453	593.78	19832	0.345	10.04	0.00	0.00	0.27
2.474	591.95	19716	0.358	10.05	0.00	0.00	0.27
2.494	590.20	19576	0.358	9.97	0.00	0.00	0.27
2.509	588.91	19550	0.358	9.89	0.00	0.00	0.27
2.525	587.62	19513	0.358	9.81	0.00	0.00	0.27
2.540	586.33	19465	0.358	9.73	0.00	0.00	0.27
2.555	585.04	19404	0.358	9.67	0.00	0.00	0.27
2.570	583.76	19330	0.358	9.60	0.00	0.00	0.27
2.586	582.47	19242	0.358	9.54	0.00	0.00	0.27
2.601	581.18	19140	0.358	9.47	0.00	0.00	0.27
2.616	579.89	19022	0.358	9.40	0.00	0.00	0.27
2.631	578.60	18888	0.358	9.33	0.00	0.00	0.27
2.647	577.31	18736	0.383	9.25	0.00	0.00	0.27
2.662	576.05	18567	0.383	9.18	0.00	0.00	0.27
2.677	574.79	18401	0.383	9.10	0.00	0.00	0.27

FLOOD CREST SUMMARY :

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2.692	573.53	18373	0.383	9.02	0.00	0.00	0.27
2.708	572.26	18333	0.383	8.94	0.00	0.00	0.27
2.723	571.00	18280	0.383	8.85	0.00	0.00	0.27
2.738	569.73	18214	0.383	8.81	0.00	0.00	0.27
2.753	568.46	18132	0.383	8.76	0.00	0.00	0.32
2.769	567.19	18035	0.383	8.70	0.00	0.00	0.32
2.784	565.94	17921	0.400	8.65	0.00	0.00	0.32
2.799	564.69	17788	0.400	8.60	0.00	0.00	0.32
2.814	563.44	17742	0.400	8.55	0.00	0.00	0.32
2.830	562.19	17698	0.400	8.48	0.00	0.00	0.32
2.845	560.95	17637	0.400	8.41	0.00	0.00	0.32
2.860	559.73	17556	0.400	8.30	0.00	0.00	0.32
2.875	558.57	17450	0.400	8.11	0.00	0.00	0.32
2.891	557.50	17316	0.400	7.78	0.00	0.00	0.32
2.906	556.61	17153	0.425	7.27	0.00	0.00	0.32
2.990	551.39	16462	0.425	7.22	0.00	0.00	0.32
3.074	546.19	15704	0.450	7.16	0.00	0.00	0.32
3.158	541.01	15327	0.450	7.05	0.00	0.00	0.34
3.242	535.88	14782	0.475	6.92	0.00	0.00	0.40
3.326	530.73	14291	0.500	6.83	0.00	0.00	0.40
3.410	525.62	13883	0.500	6.70	0.00	0.00	0.40
3.494	520.56	13430	0.525	6.50	0.00	0.00	0.40

FLOOD CREST SUMMARY :

Cross Section Location (mi)	Maximum Stage Elevation (ft MSL)	Maximum Flow (cfs)	Time To Maximum Stage (hr)	Maximum Flow Velocity (ft/sec)	Flood Elevation (ft MSL)	Time To Flood Elevation (hr)	Flood Wave Arrival Time (hr)
3.494	521.56	13431	0.525	6.16	0.00	0.00	0.42
3.704	512.57	12759	0.551	38.04	0.00	0.00	0.47
3.914	504.03	11905	0.604	6.39	0.00	0.00	0.05
4.124	492.97	11314	0.630	9.10	0.00	0.00	0.47
4.228	485.74	11412	0.630	8.74	0.00	0.00	0.47
4.332	478.56	11338	0.656	8.39	0.00	0.00	0.52
4.436	471.48	11158	0.683	7.91	0.00	0.00	0.52
4.540	464.20	11146	0.683	7.85	0.00	0.00	0.58
4.645	457.62	11075	0.683	6.98	0.00	0.00	0.58
4.749	449.54	11087	0.709	8.14	0.00	0.00	0.63
4.853	445.65	10671	0.761	4.93	0.00	0.00	0.63
4.904	444.46	10374	0.788	5.00	0.00	0.00	0.63
4.954	443.29	10112	0.788	4.95	0.00	0.00	0.68
5.005	442.12	9907	1.313	5.09	0.00	0.00	0.68
5.055	441.85	9655	1.365	5.10	0.00	0.00	0.68
5.106	441.64	9471	1.365	5.14	0.00	0.00	0.68
5.156	441.47	9184	1.391	5.24	0.00	0.00	0.74
5.207	441.33	9001	1.391	5.22	0.00	0.00	0.74
5.257	441.22	8667	1.418	5.34	0.00	0.00	0.74
5.308	441.12	8255	1.418	5.24	0.00	0.00	0.74
5.358	441.03	7791	1.418	5.00	0.00	0.00	0.74
5.408	440.96	7014	1.418	5.01	0.00	0.00	0.74
5.597	440.71	2514	1.418	2.01	0.00	0.00	0.79
5.965	423.83	2514	1.549	2.36	0.00	0.00	0.79
6.041	422.15	2507	1.706	1.73	0.00	0.00	0.84
6.116	420.56	2488	2.074	1.33	0.00	0.00	0.84
6.192	419.40	2448	2.257	0.85	0.00	0.00	0.89
6.244	418.72	2421	2.336	0.85	0.00	0.00	0.95
6.297	418.03	2406	2.389	0.86	0.00	0.00	1.00
6.349	417.32	2394	2.467	0.89	0.00	0.00	1.05
6.402	416.59	2384	2.520	0.93	0.00	0.00	1.10
6.454	415.84	2377	2.572	0.97	0.00	0.00	1.16
6.506	415.07	2370	2.651	1.02	0.00	0.00	1.21
6.559	414.29	2364	2.677	1.07	0.00	0.00	1.26
6.611	413.51	2359	2.730	1.13	0.00	0.00	1.31
6.664	412.75	2355	2.782	1.19	0.00	0.00	1.31
6.716	412.01	2351	2.835	1.24	0.00	0.00	1.37
6.768	411.32	2347	2.914	1.27	0.00	0.00	1.31
6.821	410.68	2342	2.966	1.16	0.00	0.00	1.42
6.874	410.06	2337	3.045	1.07	0.00	0.00	1.47
6.927	409.48	2331	3.124	1.00	0.00	0.00	1.52
6.980	408.91	2324	3.202	0.93	0.00	0.00	1.63
7.032	408.37	2316	3.255	0.87	0.00	0.00	1.68
7.085	407.85	2305	3.334	0.81	0.00	0.00	1.79
7.138	407.36	2293	3.386	0.76	0.00	0.00	1.89
7.191	406.90	2277	3.439	0.70	0.00	0.00	1.94
7.243	406.48	2258	3.517	0.65	0.00	0.00	2.05
7.296	406.12	2236	3.596	0.60	0.00	0.00	2.10

FLOOD CREST SUMMARY :

Cross Section Location (mi)	Maximum Stage Elevation (ft MSL)	Maximum Flow (cfs)	Time To Maximum Stage (hr)	Maximum Flow Velocity (ft/sec)	Flood Elevation (ft MSL)	Time To Flood Elevation (hr)	Flood Wave Arrival Time (hr)
7.349	405.80	2210	3.649	0.54	0.00	0.00	2.15
7.402	405.53	2181	3.727	0.49	0.00	0.00	2.15
7.455	405.30	2150	3.806	0.43	0.00	0.00	2.15
7.507	405.12	2116	3.859	0.38	0.00	0.00	2.10
7.615	404.78	2041	3.964	0.34	0.00	0.00	2.20
7.723	404.46	1960	4.095	0.31	0.00	0.00	2.31
7.831	404.16	1875	4.252	0.28	0.00	0.00	2.47
7.939	403.88	1785	4.436	0.25	0.00	0.00	2.62
8.047	403.62	1693	4.646	0.23	0.00	0.00	2.73
8.155	403.37	1600	4.882	0.20	0.00	0.00	2.89
8.263	403.15	1504	5.250	0.18	0.00	0.00	3.04
8.371	402.96	1408	5.775	0.16	0.00	0.00	3.20
8.479	402.79	1309	6.379	0.15	0.00	0.00	3.31
8.586	402.64	1206	6.825	0.13	0.00	0.00	3.46
8.694	402.50	1099	7.140	0.11	0.00	0.00	3.57
8.717	402.48	1077	7.192	0.11	0.00	0.00	3.57
8.739	402.45	1055	7.219	0.11	0.00	0.00	3.62
8.761	402.42	1032	7.297	0.11	0.00	0.00	3.62
8.783	402.40	1011	7.324	0.11	0.00	0.00	3.67
8.806	402.37	989	7.376	0.10	0.00	0.00	3.67
8.828	402.34	967	7.402	0.10	0.00	0.00	3.73
8.850	402.32	946	7.455	0.10	0.00	0.00	3.73
8.872	402.29	924	7.481	0.10	0.00	0.00	3.73
8.894	402.26	903	7.507	0.10	0.00	0.00	3.78
8.917	402.24	882	7.534	0.10	0.00	0.00	3.78
8.939	402.21	861	7.586	0.10	0.00	0.00	3.83
8.961	402.18	840	7.586	0.09	0.00	0.00	3.83
8.983	402.16	820	7.639	0.09	0.00	0.00	3.88
9.006	402.13	799	7.665	0.09	0.00	0.00	3.88
9.028	402.11	779	7.691	0.09	0.00	0.00	3.88
9.050	402.08	759	7.691	0.09	0.00	0.00	3.94
9.072	402.05	739	7.717	0.09	0.00	0.00	3.94
9.094	402.03	719	7.744	0.09	0.00	0.00	3.99
9.117	402.00	700	7.744	0.08	0.00	0.00	3.99
9.139	401.97	681	7.770	0.08	0.00	0.00	3.99
9.161	401.94	662	7.796	0.08	0.00	0.00	4.04
9.183	401.92	643	7.822	0.08	0.00	0.00	4.04
9.206	401.89	626	7.822	0.08	0.00	0.00	4.09
9.228	401.86	609	7.849	0.08	0.00	0.00	4.09
9.250	401.83	593	7.849	0.08	0.00	0.00	4.09
9.272	401.80	580	7.875	0.08	0.00	0.00	4.15
9.294	401.77	568	7.875	0.07	0.00	0.00	4.15
9.317	401.74	560	7.901	0.07	0.00	0.00	4.20
9.339	401.71	554	7.927	0.07	0.00	0.00	4.20
9.361	401.68	549	7.901	0.07	0.00	0.00	4.20
9.383	401.65	547	7.954	0.07	0.00	0.00	4.25
9.406	401.62	545	7.927	0.07	0.00	0.00	4.25
9.428	401.59	543	7.927	0.08	0.00	0.00	4.30

FLOOD CREST SUMMARY :

Cross Section Location (mi)	Maximum Stage Elevation (ft MSL)	Maximum Flow (cfs)	Time To Maximum Stage (hr)	Maximum Flow Velocity (ft/sec)	Flood Elevation (ft MSL)	Time To Flood Elevation (hr)	Flood Wave Arrival Time (hr)
9.450	401.55	543	7.954	0.08	0.00	0.00	4.30
9.472	401.52	542	7.954	0.08	0.00	0.00	4.30
9.495	401.48	542	7.954	0.08	0.00	0.00	4.36

FLOOD CREST SUMMARY :

Cross Section Location (mi)	Maximum Stage Elevation (ft MSL)	Maximum Flow (cfs)	Time To Maximum Stage (hr)	Maximum Flow Velocity (ft/sec)	Flood Elevation (ft MSL)	Time To Flood Elevation (hr)	Flood Wave Arrival Time (hr)
0.000	1058.00	9691	0.000	4.96	0.00	0.00	0.00
0.023	947.66	9691	0.150	21.87	0.00	0.00	0.03
0.051	935.54	9678	0.150	21.77	0.00	0.00	0.03
0.078	923.36	9676	0.175	22.00	0.00	0.00	0.03
0.106	911.20	9675	0.175	22.20	0.00	0.00	0.03
0.133	899.06	9673	0.175	22.46	0.00	0.00	0.03
0.161	886.93	9670	0.175	22.77	0.00	0.00	0.03
0.188	874.82	9667	0.175	23.15	0.00	0.00	0.03
0.216	862.75	9663	0.175	23.60	0.00	0.00	0.03
0.243	850.73	9658	0.175	24.18	0.00	0.00	0.06
0.271	838.80	9653	0.175	24.93	0.00	0.00	0.03
0.291	834.56	9648	0.175	21.26	0.00	0.00	0.03
0.311	829.79	9643	0.175	19.81	0.00	0.00	0.03
0.332	824.81	9635	0.175	19.08	0.00	0.00	0.03
0.352	819.79	9627	0.175	20.99	0.00	0.00	0.03
0.373	814.75	9617	0.200	18.03	0.00	0.00	0.03
0.393	809.71	9614	0.200	17.58	0.00	0.00	0.03
0.414	804.66	9614	0.200	17.17	0.00	0.00	0.03
0.434	799.60	9613	0.200	25.21	0.00	0.00	0.06
0.454	794.54	9611	0.200	16.43	0.00	0.00	0.06
0.475	789.48	9609	0.200	18.03	0.00	0.00	0.06
0.495	784.42	9606	0.200	15.77	0.00	0.00	0.06
0.516	779.35	9603	0.200	31.27	0.00	0.00	0.06
0.536	774.28	9599	0.200	15.17	0.00	0.00	0.06
0.557	769.21	9595	0.200	14.90	0.00	0.00	0.06
0.577	764.14	9590	0.200	14.64	0.00	0.00	0.06
0.598	759.07	9584	0.200	14.39	0.00	0.00	0.06
0.618	753.99	9577	0.200	14.15	0.00	0.00	0.06
0.638	748.92	9570	0.200	13.92	0.00	0.00	0.08
0.659	746.29	9570	0.225	8.59	0.00	0.00	0.06
0.711	742.00	9544	0.225	8.41	0.00	0.00	0.06
0.764	737.73	9531	0.225	8.25	0.00	0.00	0.06
0.816	733.46	9505	0.225	8.08	0.00	0.00	0.06
0.869	729.20	9468	0.250	7.92	0.00	0.00	0.06
0.922	724.95	9459	0.250	7.76	0.00	0.00	0.06
0.974	720.71	9438	0.250	7.61	0.00	0.00	0.03
1.027	716.47	9404	0.275	7.46	0.00	0.00	0.03
1.079	712.25	9388	0.275	7.31	0.00	0.00	0.03
1.132	708.03	9370	0.275	7.17	0.00	0.00	0.03
1.184	703.82	9338	0.300	7.02	0.00	0.00	0.03
1.237	699.62	9315	0.300	6.87	0.00	0.00	0.12
1.289	695.42	9298	0.300	6.73	0.00	0.00	0.12
1.342	691.22	9266	0.300	6.59	0.00	0.00	0.17
1.395	687.04	9239	0.325	6.43	0.00	0.00	0.17
1.447	682.73	9223	0.325	6.44	0.00	0.00	0.17
1.468	681.01	9213	0.325	6.28	0.00	0.00	0.17
1.489	679.29	9200	0.325	6.13	0.00	0.00	0.17
1.510	677.56	9184	0.350	5.99	0.00	0.00	0.17

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1.530	675.84	9166	0.350	5.85	0.00	0.00	0.17
1.551	674.11	9163	0.350	5.72	0.00	0.00	0.17
1.572	672.38	9157	0.350	5.60	0.00	0.00	0.17
1.593	670.65	9149	0.350	5.48	0.00	0.00	0.22
1.614	668.92	9137	0.350	5.37	0.00	0.00	0.22
1.634	667.19	9120	0.350	5.26	0.00	0.00	0.22
1.655	665.45	9097	0.375	5.16	0.00	0.00	0.22
1.676	663.71	9082	0.375	5.07	0.00	0.00	0.22
1.697	661.94	9075	0.375	5.02	0.00	0.00	0.22
1.718	660.05	9063	0.375	5.12	0.00	0.00	0.22
1.738	658.11	9045	0.375	5.16	0.00	0.00	0.22
1.759	656.17	9022	0.375	5.20	0.00	0.00	0.22
1.779	654.24	8994	0.400	5.23	0.00	0.00	0.22
1.799	652.31	8989	0.400	5.27	0.00	0.00	0.22
1.820	650.38	8979	0.400	5.31	0.00	0.00	0.22
1.840	648.44	8965	0.400	5.35	0.00	0.00	0.22
1.861	646.51	8946	0.400	5.39	0.00	0.00	0.22
1.881	644.58	8920	0.425	5.43	0.00	0.00	0.22
1.902	642.65	8898	0.425	5.46	0.00	0.00	0.22
1.922	640.72	8892	0.425	5.50	0.00	0.00	0.22
1.942	638.80	8883	0.425	5.55	0.00	0.00	0.27
1.963	636.87	8868	0.425	5.59	0.00	0.00	0.27
1.983	634.94	8849	0.425	5.64	0.00	0.00	0.27
2.004	633.02	8823	0.450	5.68	0.00	0.00	0.27
2.024	631.10	8801	0.450	5.72	0.00	0.00	0.27
2.045	629.18	8796	0.450	5.77	0.00	0.00	0.27
2.065	627.26	8787	0.450	5.82	0.00	0.00	0.27
2.086	625.34	8773	0.450	5.86	0.00	0.00	0.27
2.106	623.42	8755	0.450	5.91	0.00	0.00	0.32
2.126	621.50	8732	0.450	5.96	0.00	0.00	0.32
2.147	619.59	8704	0.475	6.01	0.00	0.00	0.32
2.167	617.67	8699	0.475	6.05	0.00	0.00	0.32
2.188	615.76	8691	0.475	6.11	0.00	0.00	0.32
2.208	613.85	8680	0.475	6.16	0.00	0.00	0.32
2.229	611.95	8664	0.475	6.22	0.00	0.00	0.32
2.249	610.04	8644	0.475	6.27	0.00	0.00	0.32
2.269	608.14	8619	0.500	6.32	0.00	0.00	0.32
2.290	606.24	8601	0.500	6.37	0.00	0.00	0.32
2.310	604.34	8596	0.500	6.42	0.00	0.00	0.37
2.331	602.45	8586	0.500	6.48	0.00	0.00	0.37
2.351	600.56	8573	0.500	6.54	0.00	0.00	0.37
2.372	598.66	8556	0.500	6.60	0.00	0.00	0.37
2.392	596.78	8535	0.500	6.65	0.00	0.00	0.37
2.412	594.90	8509	0.525	6.71	0.00	0.00	0.37
2.433	593.03	8497	0.525	6.75	0.00	0.00	0.37
2.453	591.17	8490	0.525	6.78	0.00	0.00	0.37
2.474	589.35	8479	0.525	6.78	0.00	0.00	0.37
2.494	587.61	8465	0.525	6.67	0.00	0.00	0.37

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2.509	586.34	8451	0.525	6.62	0.00	0.00	0.37
2.525	585.07	8436	0.525	6.57	0.00	0.00	0.37
2.540	583.80	8417	0.550	6.52	0.00	0.00	0.37
2.555	582.54	8396	0.550	6.47	0.00	0.00	0.37
2.570	581.28	8390	0.550	6.43	0.00	0.00	0.37
2.586	580.02	8384	0.550	6.38	0.00	0.00	0.37
2.601	578.77	8377	0.550	6.33	0.00	0.00	0.37
2.616	577.51	8367	0.550	6.29	0.00	0.00	0.42
2.631	576.25	8355	0.550	6.26	0.00	0.00	0.42
2.647	575.00	8341	0.550	6.22	0.00	0.00	0.42
2.662	573.74	8324	0.575	6.18	0.00	0.00	0.42
2.677	572.49	8304	0.575	6.14	0.00	0.00	0.42
2.692	571.24	8282	0.575	6.11	0.00	0.00	0.42
2.708	569.99	8277	0.575	6.08	0.00	0.00	0.42
2.723	568.74	8270	0.575	6.04	0.00	0.00	0.42
2.738	567.49	8260	0.575	6.01	0.00	0.00	0.42
2.753	566.23	8247	0.575	5.99	0.00	0.00	0.42
2.769	564.97	8231	0.575	5.97	0.00	0.00	0.42
2.784	563.72	8211	0.600	5.96	0.00	0.00	0.42
2.799	562.47	8188	0.600	5.94	0.00	0.00	0.42
2.814	561.22	8161	0.600	5.91	0.00	0.00	0.42
2.830	559.99	8153	0.600	5.87	0.00	0.00	0.47
2.845	558.78	8141	0.600	5.80	0.00	0.00	0.47
2.860	557.61	8125	0.600	5.69	0.00	0.00	0.47
2.875	556.50	8104	0.625	5.51	0.00	0.00	0.47
2.891	555.48	8076	0.625	5.25	0.00	0.00	0.47
2.906	554.57	8043	0.625	4.89	0.00	0.00	0.42
3.024	547.47	7842	0.650	4.82	0.00	0.00	0.47
3.141	540.37	7668	0.675	4.74	0.00	0.00	0.47
3.259	533.28	7500	0.725	4.68	0.00	0.00	0.52
3.377	526.22	7325	0.750	4.61	0.00	0.00	0.52
3.494	519.20	7280	0.750	4.52	0.00	0.00	0.57