GEOTECHNICAL UPDATE REPORT
ENERGY SOLUTIONS CLIVE FACILITY
CLASS A WEST EMBANKMENT
CLIVE, TOOLE COUNTY, UTAH

Submitted to:
Energy*Solutions*, Inc.
423 West 300 South, Suite 200
Salt Lake City, Utah 84101

Submitted by
AMEC Earth & Environmental, Inc.
Salt Lake City, Utah

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EXECUTIVE SUMMARY

Included herein is an update report to a study completed in 2005 by AMEC Earth & Environmental, Inc. (AMEC) that evaluated the geotechnical potential for increasing the height and expanding the footprint of the Class A low level radioactive waste embankment(s) at the Energy*Solutions* facility near Clive, Utah. The 2005 study involved reviewing previous reports to obtain basic geotechnical engineering design parameters, evaluating previous and current seismic design criteria including an updated seismic hazard analysis, completing static and seismic stability calculations, estimating deformations that may result from a design earthquake, and evaluating settlement issues that would be associated with greater embankment heights. The 2005 study concluded that stability and deformations of a combined single embankment incorporating the existing Class A and Class A North embankment footprints is feasible from a geotechnical perspective.

Since the 2005 study was completed the configuration of the enlarged waste embankment has been redesigned with a slightly larger footprint and a reduced overall slope height. This update report was prepared to recognize the current design identified as the Class A West Embankment (CAW) configuration. By observation a reduced embankment height is expected to perform better according to both stability and settlement considerations.

Several key elements presented in the 2005 study included an updated seismic hazard analysis, slope stability analysis and deformation analysis. The seismic hazard analysis indicated that the deterministic maximum considered earthquake for the site is a magnitude M 6.8 earthquake on the Skull Valley fault at less than 30 km, yielding an "average" acceleration of 0.24g for the bedrock site conditions. The probabilistic peak horizontal acceleration of 0.24g for the weighted mean hazard curve corresponds to an average recurrence interval of approximately 8,825 years. This bedrock acceleration is amplified by site conditions to a peak horizontal acceleration value of 0.28g.

The 2005 stability analyses indicated that embankment stability is primarily governed by the height of the outer 5(H):1(V) side-slopes. The 2005 calculations indicated that the Class A Combined (CAC) Embankment height of 50-feet at the 5(H):1(V) slope was geotechnically feasible. The current 38-foot height of the CAW Embankment is lower at the 5(H):1(V) slope break and slope stability calculations included with this update report continue to support our conclusions that the 5(H):1(v) slope configuration is geotechnically feasible.

The 2005 study reviewed available survey monument settlement data and found that the survey data indicated that the majority of embankment settlements will be complete within one to two years after waste placement. It is our understanding that Energy*Solutions,* Inc. is proposing to use an observational approach to monitor embankment settlement prior to final cover placement. The 2005 study concluded that scheduling the final cover placement for when monitoring data indicates the majority of the initial settlements are complete is anticipated to result in manageable settlements of the final cover. Even though the new CAW Embankment is smaller it should be anticipated that this monitoring period will require from one to two years.

1. INTRODUCTION

This update report summarizes our findings regarding the new proposed Class A West Embankment configuration for the combining and expanding of the existing Class A and Class A North Embankments at the Energy*Solutions* Clive Facility near Clive, Utah. AMEC completed the referenced 2005 study[1] of the feasibility to increase the height and footprint of the existing Class A Embankment (identified as the Class A Combined or CAC Embankment) and concluded that side-slope embankment heights up to 50-feet are stable under static and design seismic conditions and that deformations of the embankment associated with the design earthquake are within an acceptable range. Furthermore, the 2005 study concluded that angular distortion of the clay cap will be less than the maximum design criteria of 0.02 provided that final cover placement is delayed until majority of the initial settlements are complete. A survey monitoring program is currently planned to determine when settlements are nearly complete and the clay cap can be constructed.

The current proposed CAW Embankment configuration is depicted on the Energy*Solutions,* Inc. drawing titled Embankment Location & General Layout, dated October 4, 2010 and the drawing titled Embankment Cross Sections, dated October 27, 2010. Energy*Solutions*, Inc. is continuing to propose the combined large embankment which has been identified as the Class A West Embankment or hereinafter CAW Embankment. The footprint of the CAW Embankment is slightly larger in the north direction by 100 feet and the CAW Embankment side-slope height has been favorably reduced from 50 feet to 38 feet with the same protective cover geometries.

The general site location of the Clive Facility is shown on Figure 1, Regional Setting. Figure 2, Vicinity Map, shows the general arrangement of the various embankments at the Energy*Solutions*, Inc. Clive Facility. The locations of the AMEC field explorations completed as a part of the 2005 study and the previous 1999a[2] investigation are shown on Figure 3A, Field Exploration Location Map. An Exploration Location Map of earlier investigations is found in the 1999 investigation report. Cross sections through the proposed embankment are shown on Figure 3B, Embankment Cross-Sections.

1.1 OBJECTIVES

The objectives of this update report were to evaluate the new CAW Embankment configuration, which is a reduction from the 2005 CAC Embankment, considering geotechnical and seismic design considerations. This update utilizes the work of 2005 study that summarized the geotechnical design parameters and site specific data developed in our 1999a and subsequent studies, along with the supplemental subsurface investigations (site characterization) completed within the footprint of the proposed enlarged embankment. The 2005 study identified the key geotechnical design and construction parameters that are required to place the waste materials

1 AMEC (2005), Report, Combined Embankment Study, Envirocare, Tooele County, Utah, AMEC Job No. 4-817-004769, dated December 13, 2005.

2 AMEC (formerly AGRA) (1999a), Report, Geotechnical Site Characterization, Proposed New LARW Embankment, near Clive, Tooele County, Utah," AGRA Job No. 9-817-002586, dated October 26, 1999.

and meet the final cover distortion criteria previously developed. These design and construction parameters remain applicable and should be followed.

The objectives of this update study were to:

- Evaluate the static and seismic stability of the new lower height CAW Embankment.
- Evaluate the potential range in post earthquake deformations of the CAW Embankment.
- Evaluate static and post earthquake cover settlements and displacements of the smaller CAW Embankment.

1.2 EMBANKMENT DESIGN

The proposed Energy*Solutions*, Inc. embankment is located within the northwest quarter of Section 32, T1S, R11W (Salt Lake Base and Meridian). As addressed in the 2005 study the geotechnical design issues involved with the embankment are as follows:

- Stability – The embankment must meet generally accepted standards for static and seismic stability. Slope stability analyses are commonly performed using limit equilibrium techniques where a factor of safety against slope instability is calculated. The generally accepted standard for static stability is a factor of safety of at least 1.5. For seismic stability, the accepted standard is to design for factors of safety ranging from 1.0 to 1.3, depending on the sophistication of the analysis and the certainty of the geotechnical parameters used to calculate the factor of safety.
- Seismic Deformation – Although settlement is a form of deformation, the deformation of interest is deformation following closure due to an earthquake (termed post earthquake deformations). In general, deformations of the final cover tend to increase with embankment height. However, if the calculated static factor of safety of the embankment is reasonably high (above 1.5) and the materials do not loose strength during shaking, deformations under seismic conditions are anticipated to be small.
- Settlement – As embankment height increases, the total settlement of the compressible and incompressible debris within the embankment also increases. The principal item of concern is the potential for differential settlement to occur at the embankment cover due to differences in settlement of the underlying waste materials. In addition, the timing of when settlement occurs (before or after cover placement) is a design issue.

1.3 STEPS IN ANALYSIS

The 2005 study adhered to a sequence of analytical steps in evaluating the proposed enlarged embankment at the Clive Facility. The new CAW Embankment design is smaller than the 2005 CAC Embankment therefore for this update report we have only repeated the steps applicable

to evaluating slope stability and embankment settlement of the reduced overall embankment. The basis for our geotechnical analyses remain the same as was used for the 2005 study.

1.4 SETTLEMENT CONSIDERATIONS

For continuity with previous geotechnical work the following paragraphs essentially reiterate settlement considerations that were stated in the report for the 2005 study.

One of the principal items of interest for the 2005 study was differential settlement of the cover after it has been placed. AMEC's (formerly AGRA) previous work on evaluating settlements included a significant effort on evaluating the total potential magnitude of settlement from individual lifts or zones within the embankment. The difficulty in making such evaluations was that distinguishing between settlements that occur before and after cover placement was difficult since much of the settlement occurs during construction. Such predictions could therefore result in overly conservative predictions of post cover settlements.

Our previous estimates of the settlements at the cover were based on fundamental principals of soil mechanics. In those calculations, we estimated total settlement by assuming a reasonable distribution of each waste constituent, calculating the settlement potential for each lift[3] of waste, and summing these settlements on a per lift basis up to the embankment cover. Potential distortions at the cover were calculated based on the potential different magnitudes of total settlements attributed to each waste type. This methodology is conservative because it ignores the fact that waste is placed at different times and locations in the embankment. For example, waste placed at the base of the embankment may have completed settlement, while more recently placed waste continues to settle.

Subsequent settlement evaluations described in the 2005 study were based on the consideration that EnergySolutions, Inc. is following a plan to monitor the embankment settlements prior to final cover placement; and place the cover only after the rate of settlement at the cover subgrade has decreased to a manageable level. This "observational approach" to final cover settlement significantly reduces the uncertainties in estimating settlements of the waste during construction and prior to the cover being placed. It is well documented that settlements are largest immediately after fill placement and decrease either exponentially or logarithmically over time. The basis for the observational approach is to observe and measure settlement prior to final embankment cover placement. Adjustments can then be made at the top of waste prior to the cover to reduce the impact of these initial differential settlements. The goal of this approach is to permit the majority of the initial waste settlements to be complete prior to final radon barrier and rock cover placement.

The 2005 study of settlement potential, therefore, consisted of a detailed review of the available Vitro (a nearby adjacent waste embankment) and EnergySolutions, Inc. settlement data. The purpose of the review was to obtain field data that defined the length of time necessary for the majority of the initial settlements to be complete. Our review of the observed settlements was

3 A lift could consist of single lifts of compressible debris or a lift of containers / Controlled Low Strength Material (CLSM)

then used to complete predictions of the performance of the increased height embankment. The settlement evaluation also included calculations of the foundation settlements.

The conclusions and recommendations regarding embankment settlement contained in the 2005 study remain applicable and should be followed. The CAW Embankment is reduced and therefore settlements would be favorably less.

2. SITE CHARACTERIZATION DATA

2.1 SEISMIC DESIGN CRITERIA

2.1.1 General

An updated detailed seismic hazard analysis was completed and included in the 2005 study; a copy of the seismic hazard analysis is presented in Appendix A of this update report. The original 2005 Table A-2 of Appendix A was revised following responses to the Round 2 Interrogatories[4]. Within Appendix A of this update report the original Table A-2 has been replaced with the revised Table A-2. For continuity with the 2005 study the following paragraphs essentially reiterate the general summary that was stated in the 2005 study with revisions identified in the Round 2 Interrogatories.

The deterministic peak horizontal acceleration values for fault earthquake sources within about 70 km of the Energy*Solutions*, Inc. site are summarized in Appendix A: Table A-2. Probabilistic peak horizontal acceleration values for the background earthquake source within 100 km of the site are shown on Appendix A: Figure A-5. The largest peak acceleration in Appendix A: Table A-2 corresponds to an M 6.6 earthquake generated by the East Cedar Mountains fault. The peak acceleration corresponding to an M 6.8 earthquake generated by one of the Skull Valley faults is nearly as high. The Skull Valley faults are located no closer to the site than 30 km at the ground surface, but the faults dip toward the site, making the attenuation distance less than 30 km. The 84th percentile values are 0.242g and 0.238g, respectively, as calculated by the attenuation relation of Abrahamson and Silva (1997). For comparison, largest 84th percentile peak accelerations calculated by the Campbell and Bozorgnia (2003) and Pankow and Pechmann (2004) attenuation relations, are 0.198g and 0.181g, respectively, for the M 6.8 earthquake on one of the Skull Valley faults. The expected maximum magnitude of 6.8 comes from Wong and Others (2002), but Swan and Others (2004) report an expected maximum magnitude of 6.5 for the same fault. The lower maximum magnitude for the Skull Valley faults gives 84th percentile accelerations of 0.219, 0.168, and 0.154g for the three attenuation relations, as can be seen in Appendix A: Table A-2.

The second largest peak acceleration in Appendix A: Table A-2 corresponds to two different earthquakes for the three attenuation relations. A maximum magnitude of 7.0 on the Stansbury fault produces 84th percentile peak accelerations of 0.162 and 0.195g for the Pankow and

4 AMEC (2006), Round 2 Interrogatories and Response, Class A Embankment Height Study, Energy Solutions Facility, Near Clive, Tooele County, Utah, AMEC Job No. 4-817-004769, dated April 28, 2006.

Pechmann (2004) and Campbell and Bozorgnia (2003) relations, respectively. A maximum magnitude of 6.6 on the Cedar Mountains fault produces an 84th percentile acceleration of 0.242g for the Abrahamson and Silva (1997) relation.

Based on this review and update of earthquake ground motion at the Energy*Solutions*, Inc. site, a conservative, but reasonable deterministic maximum peak horizontal acceleration is 0.24g for rock site conditions. This maximum acceleration exceeds the 0.181g 84th percentile value predicted by the Pankow and Pechmann (2004) attenuation relation for any of the fault sources in the site region, and is approximately equal to the largest maximum 84th percentile value predicted by Campbell and Bozorgnia (2003) and the second largest 84th percentile value predicted by Abrahamson and Silva (1997). The probabilistic peak horizontal acceleration of 0.24g for the weighted mean hazard curve on Appendix A: Figure A-5 corresponds to an average recurrence interval of approximately 8,825 years.

The 2005 study also evaluated whether the foundation soils and embankment either amplify or attenuate this site acceleration. A one-dimensional response analysis was completed using the software program SHAKE2000. As described in the 2005 study a small amplification of the peak horizontal ground acceleration value was calculated. Based on this consideration, it was found that the free field bedrock accelerations of 0.24g may increase up to a value of 0.28g in the free field through the foundation soil. However, the presence of the embankment tends to attenuate the free field ground motions to slightly above 0.25g. The range appropriate for stability analysis was therefore from 0.25g to 0.28g.

2.2 SITE CONDITIONS

2.2.1 Background

The 2005 study completed supplemental field and laboratory evaluations of the foundation soils below the enlarged CAC Embankment footprint. The findings of the supplemental site characterization are summarized in Appendix B-1 of the 2005 report; a copy is attached in Appendix B-1 of this update report. Previously AMEC (formerly AGRA) completed a geotechnical site characterization for the existing Class A Embankment and submitted our findings in a report dated October 26, 1999. A copy of this site characterization is also included in Appendix B-2 of the report for the 2005 study. This site characterization supplemented the previous hydrogeology site characterization by Bingham Engineering, which included soil engineering property tests and shear wave velocity measurements down to 100 feet. For the purpose of the seismic wave propagation study, the depth to bedrock below the site was estimated at a depth of about 400 to 500 feet, as shown on Figure 4, Hydrogeologic Site Characterization. However, we understand that an exploratory borehole drilled to the north of the Energy*Solutions*, Inc. site in Section 29 did not encounter bedrock within a depth of 700 feet below the ground surface.

2.2.2 Subsurface Conditions

The subsurface conditions encountered in the supplemental explorations completed in 2005 were found to be consistent across the site and similar to the conditions encountered in the previously referenced investigations. The conditions observed are also in general agreement with the hydrogeologic cross sections developed by others across Section 32 and presented in Appendix D of EnergySolutions' (formerly Envirocare) Permit Application previously reviewed[5]. The general stratigraphic conditions are summarized in Table 2.1, Subsurface Characterization. The same geologic unit numbers used in the hydrogeologic characterization are used herein.

The importance of these findings is that subsurface conditions are sufficiently uniform that a single characterization is appropriate for either the individual or combined embankments. Due to the relatively minor footprint increase of the CAW Embankment, no additional subsurface exploration was deemed necessary. A stratigraphic cross section comparing the conditions below the existing embankment and the new (northern) embankment is shown on Figures 5A and 5B, Existing Class A Embankment Foundation Conditions and Class A North Foundation Conditions, respectively.

Table 2.1 – Subsurface Characterization

Unit No.	Depth (ft)	Soil Type	Description
4	0 to 9 +/-	Upper Clays	Silty Clays, classifying as CL in accordance with the Unified Soil Classification System. Contains some fine silt layers and is generally dry and medium stiff to stiff consistency. Considered to represent the deep Lake Bonneville clays. This material is used as both liner below the embankment and to construct the radon barrier.
3	9 to 26 +/-	Silty Sands	Dense to medium dense silty sands and silts containing a few thin clay layers.
2	26 to 64 +/-	Clays and Silts	Interbedded clay and silt layers with a few isolated sand layers up to two feet thick. Sand layers were discontinuous across the site. Clays are generally stiff with a few soft layers. Saturated throughout.
1	64 to max depth	Interbedded Sand, Silt and Clay layers	A sequence of interbedded silty sand, fine sand and coarse to gravelly sand layers with interbedded clay and silt layers. Increasing sand layers beginning at depths of 50-feet and extending to maximum depth investigated, 100 feet. Dense to very dense sands and stiff clays.

For continuity with the 2005 study the following paragraphs essentially reiterate the general summary of the subsurface conditions that was stated in the 2005 study.

5 See AGRA Letter Report, "Technical Appendix Document Review, New LARW Facility, Envirocare of Utah NW 1/4, Section 32, Near Clive, Utah, AGRA Job No. 9-817-002427, July 15, 1999.

Based on detailed geologic studies completed on other projects within the Basin and Range, we expect that the upper clays (Unit 4) represent the lake-bed clay deposited within the deep Lake Bonneville cycle(s) from about 12,000 to 30,000 years before present. The sequence of silty sands (Unit 3) below the upper clays were either alluvial, colluvial or lacustrine deposits which may have occurred during fluctuations in the Lake Bonneville level or during periods when the lake was not present (similar to current conditions). The lower (Unit 2) silts and clays most likely represent an older period of lacustrine deposition, predating 20,000 years before present and termed as the "Cutler Dam Lake cycle" in the geologic literature. The (Unit 1) sands, silts and clays most likely represent pre-Pleistocene deposits from an Interglacial period. These deposits may date as old as 100,000 to 150,000 years before present. The significance of these probable ages is that numerous earthquakes have occurred during this geologic time period surrounding the site vicinity and the probability of liquefaction with depth would be considered to be quite low based on age of the deposits alone.

Based on geologic cross sections developed for the hydrogeologic site conditions, the anticipated depth to bedrock below the site is at least 400 feet (see previous note on bedrock depth). A cross section of these generalized soil/bedrock conditions are shown on Figure 4. The geology of the surrounding area is described in the Utah Geologic Survey (UGS) Map 166 (Doelling, et al, 1994). This map and the accompanying text should be referenced for more detail than the very general description that follows herein.

In general, the bedrock exposed along the Grayback Hills to the north consists of hard, durable limestone of the Triassic Age (180 to 225 million years before present), including the Thaynes, Dinwoody Formations, and volcanoclastic rock (volcanic rock incorporating sediments, some of which contain cobbles; aged about 35 million years before present). These rocks generally form the "basin and range" blocks that have been faulted during the Quaternary (3 million years ago to present). The basin and range faulting created the typical north-south trending mountain ranges filled with thick sequences of sediment in the intervening valleys. From about 10,000 to 30,000 years before present, prehistoric Lake Bonneville covered the entire area. There were numerous lake stages and elevations during this period, along with a few intervening dry periods, similar to conditions today. In a very general manner, the collective "Bonneville" deposits consist of fine sands, silts, and clays along the valley bottoms, and granular sands and gravels deposited along lake benches and spits.

2.2.3 Groundwater

Groundwater was encountered during the 2005 study at a depths ranging from 37.3 feet in Boring B-2 at the time of drilling to a depth of 26 feet indicated by CPT. The depth of 26 feet generally agrees with the levels measured in nearby monitor wells. A depth of 22 feet was used in our analyses and accounts for a possible rise in groundwater.

2.3 EMBANKMENT DESIGN CRITERIA

2.3.1 Existing Embankment Geometry

In general, the Energy*Solutions,* Inc. Class A Embankment(s) has a footprint of about 1,400 by 2,260-feet and a maximum height of about 60 feet at the crest. The embankment includes a 5(H):1(V) exterior slope extending 32 feet in height, and a 4 percent top slope. The embankments are provided with a protective rock cover, filter layers, and a clay radon barrier that total 5.5-feet thick on the top and side slopes.

2.3.2 Proposed CAW Embankment Geometry

Energy*Solutions,* Inc. is considering constructing a combined embankment which includes the partly completed portion of the existing embankment and extending the footprint of the embankment northward and increasing the height of either combined embankment.

The new CAW Embankment is designed with a footprint of about 2,300 (east-west) by 2,600-feet (north-south). The embankment includes a 5(H):1(V) exterior slope extending 38 feet in height, and an approximate 4 to 6 percent top slope. The maximum height of the top cover extends up to about 84 feet, given this general geometry. The embankment is provided with a debris free soil layer, clay radon barrier, filter layers, and protective rock cover that total 8-feet thick on the top and side slopes.

For comparison the 2005 CAC Embankment was designed with a footprint of about 2,300 (east-west) by 2,500-feet (north-south). The embankment included a 5(H):1(V) exterior slope extending 50-feet in height, and an approximate 4 to 6 percent top slope. The maximum height of the top cover extended up to about 92-feet, given this general geometry. The CAC embankment was designed with a debris free soil layer, clay radon barrier, filter layers, and protective rock cover. The geometries of the CAW and CAC Embankments are depicted on Figures 3A and 3B

2.3.3 Geotechnical Design Values

A summary of the geotechnical design criteria used for the existing embankment may be found in Appendix B-1 of AMEC's (formerly AGRA) reply to Interrogatory 1 for the year 2000 amendment to the permit licensure[6], a copy of the appendix is attached in Appendix B-2 of this update report. AMEC's reply letter summarizes the existing, relevant geotechnical design criteria in a summary table format.

For continuity with the 2005 study the following paragraphs essentially reiterate the general summary of the basis for the geotechnical design values that was described in the 2005 study.

6 AMEC (Formerly AGRA) (2000), Letter Report, Comment on Round No.1 Interrogatories, Amendment to Permit-License UT2300249," AGRA Job No. 0-817-002802, dated July 25, 2000.

A 1999a AGRA study evaluated seismic stability, deformations, development of shear strengths for compressible debris, and shear wave velocity data of the embankment materials (for seismic response). Subsequent to that study, additional embankment material types (incompressible debris, controlled low strength material [hereinafter CLSM], containerized waste, oversize debris, large components) were evaluated which generally possessed higher shear strengths. We consider the available characterization to be adequate, but conservative. By conservative, it is meant that the shear strengths used in our calculations envelop the various types of waste placed in the embankments. Less conservative design assumptions could be utilized, however using higher shear strengths may require that limitations be placed on where certain types of waste can be placed within the embankment. We therefore continued to use the lower bound shear strengths to allow flexibility in waste placement and placement methods.

AMEC completed a number of studies regarding the settlement potential of compressible debris, incompressible debris, CLSM pyramids, strong-tight containers (resin liners) placed within concrete cylinders, and large components. In general, these studies supported the placement of the various waste types within the existing embankment design. The settlement calculations were based on predicting the settlement potential from characteristics of the waste type and/or placement method. Such predictive relationships do not include a reduction in settlement over time. However, field observations indicate that a logarithmic or exponential decay in the rate of settlement over time has been observed at municipal and other waste storage sites. Our previous methodology generally calculated the total potential of a "column of waste" to settle. Since the lower portion of this "waste column" may have completed settlement when waste is placed in the upper "column," this method contains inherent conservatism. Considering that actual field performance (settlement) data regarding the rate and magnitude of settlement of materials is available for the Class A Embankment, using this data is a more realistic approach.

Material properties required for stability analysis include the in-place waste and cover density, shear strength, and dynamic properties such as damping, shear wave velocity, and the strain-dependent shear modulus and damping curves. These material properties were previously determined from field measurements (in-place density, shear strength, and shear wave velocity of the Class A Material) and the relationships between soil classification and index properties available in the published literature. The design values previously developed are summarized in Appendix B-2 of this update report. Seismic shear wave velocity data and SASW (Spectral Analysis of Surface Waves, a method used to obtain shear wave velocity data), were presented in Appendix B-4 of the 2005 study.

The stability calculations utilized an 18 degree friction angle for the LARW debris, which is representative of a very high compressible debris percentage. Field tests indicated that the internal friction angle of compressible debris increased from 24 to 34 degrees as the waste percentage increases from 10 to 40 percent, respectively. However, at higher percentages of waste (greater than 50 percent), the friction angle may approach the 18 degree friction angle value. The 18 degree friction angle value conservatively bounds the lowest available shear strength. Higher shear strength values could be justified, even with the available data; that would lead to higher calculated factors of safety for a given design consideration. However,

initial sensitivity and subsequent stability calculations revealed that less conservatism in the shear strength assumptions used in the analysis would not be necessary[7].

3. CALCULATIONS

3.1 GENERAL

Soil parameters that were summarized in Table 3.1 of the 2005 study for the foundation soil and embankment materials have continued to be used for this update report. To evaluate the CAW Embankment based on slope stability, the following sets of calculations were completed for the new reduced embankment design height:

- Static stability was calculated.
- Pseudo-static (seismic) stability was calculated.
- "Yield" accelerations (or the yield coefficient was determined) to estimate deformations.
- Deformations following a seismic event were calculated using a "Newmark Sliding Block" analysis.

The following sections discuss each of these items in further detail.

3.2 ENGINEERING DESIGN PARAMETERS

Soil parameters of the various embankment materials modeled in the slope stability analysis are listed in the following Table 3.1. Drained strength parameters were used in static stability calculations and both drained and undrained parameters were used in seismic stability calculations. Further details and background with regards to the soil parameters are presented in the text and appendices of the 2005 study.

The foundation layers used in the slope stability model were based on the site characterization and stratigraphy described in Section 2.3, Site Conditions; Appendix B-1 of this update; as well as presented in AMEC report dated October 26, 1999.

7 Large scale laboratory shear box testing could be completed that would reduce the shear strength conservatism in the analysis. Similarly, the strength of the radon barrier clay and clay liner was conservatively estimated from published values and laboratory testing. Supplemental testing could support higher strength values and further reduce conservatism in the values used.

Table 3.1 – Summary of Engineering Properties in Slope Stability Analysis (ref AMEC 12/13/05)

Material / Soil Units	Unit Weight, (pcf)	Angle of Internal Friction, (degrees)	Cohesion Intercept, (psf)	Basis / Reference Source
LARW Embankment Properties				
Rip Rap (Cover)	135	40	0	Appendix B-2, Table B
Clay Cover	123	0	1000	AMEC 1999a, Section 3.2.7
Protective Soil Layer (Debris Free Soil) – silty sand	117.5	38	250	AMEC 1999b[8], Figure A-7
Compressible Debris	101	18	130	AMEC 1999b, Figure 9
CLSM	120	0	15200* (equal to 100 psi)	Specification calls for minimum of 150 psi
Clay Liner	123	0 (28)	1000 (100)	Appendix B-2, Table B (AMEC 5/25/99, Figure A-6)
Embankment Foundation Properties				
		Drained / Undrained	Drained / Undrained	
Unit 4- Upper Clays	118	29 / 0	0 / 2000	CPT correlations Appendix B-1 (or AMEC 2005, App B-1) and AMEC 1999a
Unit 3 - Silty Sands	120	34	0	CPT correlations Appendix B-1 (or AMEC 2005, App B-1) and AMEC 1999a
Unit 2 - Clays and Silts	121	29 / 0	1000 / 2000	CPT correlations Appendix B-1 (or AMEC 2005, App B-1) and AMEC 1999a
Unit 1 - Interbedded Sand, Silt and Clay	120	29	0	CPT correlations Appendix B-1 (or AMEC 2005, App B-1) and AMEC 1999a

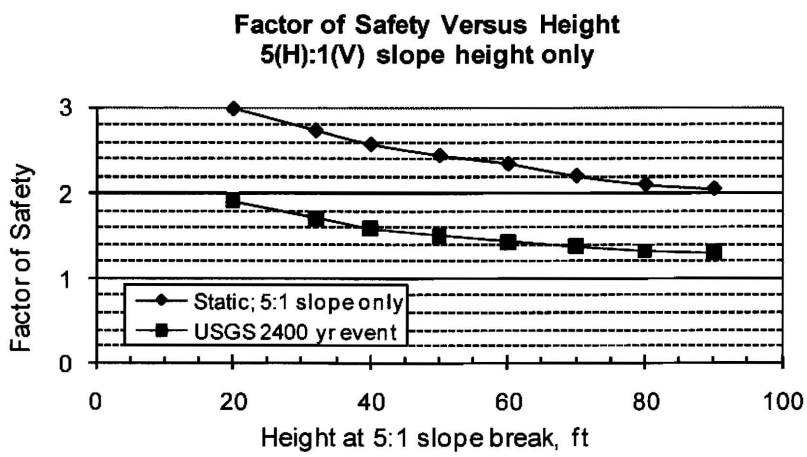
* This strength exceeds the strengths of the other materials by a large margin.

8 AMEC (formerly AGRA) (1999b), Task 2 -Summary of Field Strength Tests, Clive Disposal Facility, 75 Miles West of Salt Lake City, Clive, Utah, AGRA Job No. 8-817-002103, dated June 28, 1999.

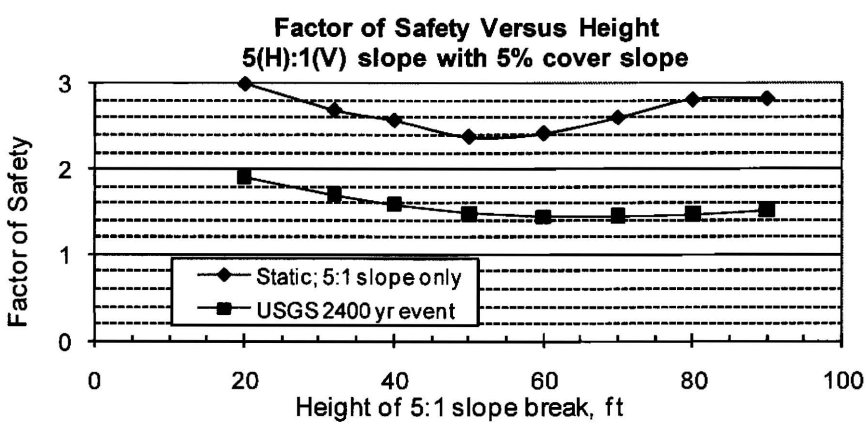
3.3 STABILITY CALCULATIONS

3.3.1 Previous Sensitivity Analysis

The 2005 study presented a slope stability sensitivity analysis to determine the sensitivity of the factor of safety to slope height and gain an understanding of the factors that lead to acceptable stability. The 2005 analysis found that in general slope stability is controlled by the height of the 5(H):1(V) side-slope. Two graphs from the 2005 study are presented below. It is observed from Graph 2 that a minimum static and pseudo static factor of safety is maintained at a height of about 60 feet at the break in slope. This analysis supports the expectation that the lower slope height of the proposed CAW Embankment will have higher factor of safety.



Graph 1 – Factor of Safety versus Height of 5(H):1(V) Side-Slope Only



Graph 2 – Factor of Safety Versus Height Incorporating 5% Top Slope and Top Cover Materials

3.3.2 CAW Embankment Static Stability

Our design slope stability analyses were performed with the microcomputer program GSTABL7[9], utilizing the Spencer's Method[10] for circular modes of movement. The geometry of the slope stability model and tabulation of the analysis is shown in Appendix C. The strength of the embankment and foundation materials was modeled using drained strength parameters.

In general, a static factor of safety greater than 1.5 is desired to meet generally accepted geotechnical design criteria (Kramer, p. 431). Stability is calculated by allowing the computer program to "search for a critical failure surface." Three scenarios or cases were studied for this Update report: Case 1 - stability within the LARW embankment; Case 2 - Stability through the lower clay unit (Unit 2), and Case 3 - stability through the upper clay unit (Unit 4). In each case, stability within the CAW embankment controlled as undrained strength within the foundation material kept the surface with the lowest factor of safety at the toe of the embankment. The minimum factor of safety was at least 2.5, which is well within the acceptable range for static stability. Details of the stability analysis, plots of the lowest 10 failure surfaces, and a tabulation of the analysis completed are found in Appendix C.

3.3.3 CAW Embankment Seismic Stability

Following the static stability calculations, the pseudostatic stability of the CAW Embankment was calculated for each of the cases identified in the section above. "Pseudostatic" stability is calculated by applying a horizontal coefficient equal to 50 percent of the seismic design acceleration to the embankment (Hynes-Griffin, 1984). This factor may be taken as 50 percent of the 0.28g acceleration. In general, factors of safety greater than or equal to 1.2[11] are desired when this method of seismic slope stability is utilized (Kramer, p. 436).

Again, the Spencer's Method for a circular slip surface for each of the three cases was evaluated within the GSTABL7 program. For pseudostatic stability, though, both drained and undrained foundation soil strength parameters were utilized. Stability was calculated by allowing the computer program to "search for a critical failure surface." Plots of the lowest 10 failure surfaces are also included in Appendix C.

The minimum calculated factor of safety was at least 1.2 which is an acceptable factor of safety. As with the 2005 study the critical failure surface extends through the deep clay unit of the foundation soils and remains near the "break in slope." Pseudostatic stability analysis through the CAW embankment determined the lowest factor of safety to be at least 1.7, slightly higher

9 Gregory Geotechnical Software & Harald W. Van Aller, Computer program, GTABL7 with STEDwin, Version 2.004, Copyright 2003.

10 The Spencer's Method of Calculating Slope Stability using the limiting equilibrium method (method of slices) satisfies both force and moment equilibrium. The Bishop's Method used previously satisfies only force equilibrium and is therefore less rigorous.

11 Actual values discussed by Kramer vary from 1.0 to 1.15.

than the 2005 CAC Embankment. This indicates the geotechnical benefits of reducing the embankment height.

In conclusion, the seismic factor of safety was found to be acceptable for the proposed 38-foot CAW Embankment design height using well accepted, conservative methods of slope stability analysis. As discussed in Section 2.3.3, Geotechnical Design Values, the strength parameters utilized for both the foundation and embankment materials were also conservatively selected. Higher factors of safety would be calculated under each of these conditions if less conservative strength values had been selected.

4. SETTLEMENTS AND DEFORMATIONS

4.1 GENERAL

Detailed discussion and estimates of the potential settlement amounts for both the 2005 CAC Embankment and the foundation materials were provided in Section 4, Settlements and Deformations of the 2005 study. The 2005 study addressed estimates of time rates of settlement, secondary settlements, and explained how the uncertainties and variability's of the LARW embankment materials were addressed. An important conclusion in the 2005 study is that the majority of settlement will occur during the waste placement phase of operations and prior to final cover placement. For that reason Energy*Soultions*, Inc. is proposing to monitor the completed embankment to allow the majority of settlement to occur prior to final cover placement, and thereby limiting the future differential potential.

For this update report we have only reevaluated the potential foundation settlement of the smaller CAW Embankment in order to show the embankment foundation settlements are expected to be less with the smaller embankment height.

4.2 FOUNDATION SETTLEMENTS

The subsurface site characterizations described early in this update report provide the information to define material boundaries and soil parameters. Compressibility parameters used in 2005 study and as described in Appendix B-2, Table F were utilized in the calculations.

Settlements of the foundation material were evaluated using the computer program FoSSA (2.0)[12]. FoSSA is an integrated stress and settlement program based on elastic solutions. The program estimates the distribution of stresses due to a variety of embankment geometry/loading conditions and the magnitude of settlement is calculated below a 2-dimensional cross-section of the embankment fills. FoSSA can calculate the magnitude of immediate/elastic settlement, consolidation settlement, and the magnitude of secondary settlement in each layer. The program, FoSSA, was used to evaluate the following settlement aspects:

12 ADAMA Engineering, Inc., Computer program, FoSSA (2.0) Foundation Stress & Settlement Analysis, Copyright 2003-2007.

- Stresses imposed on the foundation soils by the proposed combined embankments.
- The magnitude of settlement of the foundation soils for the CAW Embankment.
- The distribution of elastic/immediate and consolidation settlements by soil type (soil unit) and location.

A profile of the pattern of settlement estimated below the CAW Embankment is provided on Figure 6, CAW Embankment Foundation Settlement. As expected, the settlement profile below the CAW Embankment is slightly less than the larger CAC Embankment. However the difference is within the range of accuracy for settlement calculations and therefore the magnitude of settlement for the CAW Embankment is estimated to be 12 to 16-inches just as was estimated for the CAC Embankment. The maximum magnitude occurs below the center of the embankment. Settlement below the center of the combined embankment is essentially one-dimensional. This results in a "flat" settlement profile below the center of the embankment.

4.2.1 Time Rate of Foundation Settlement

As described in the 2005 study, we anticipate that the embankment is constructed sufficiently slow that drainage (consolidation) of the foundation layers occurs during construction. If one assumes that the CAW Embankment was placed all at once our analysis estimated that 95 percent consolidation will be complete within approximately one year, which is within the time that is required for observation of settlement before the final cover is placed. Again, given the CAW Embankment will receive waste over many years before topping out, this is a worst-case scenario.

4.2.2 Secondary Settlement of Foundation

FoSSA was also used to calculate the magnitude of secondary or "creep" settlements after primary foundation settlements are complete. Secondary settlements were calculated to a period of 500 years. Within this period of time, approximately an additional 8 inches of secondary settlement was calculated. These results of the secondary settlement calculations are presented on Figure 12, Secondary Settlements of the 2005 report. This magnitude of settlement should be incorporated into the final cover design. The relatively small magnitude of secondary settlement is not anticipated to adversely impact cover drainage, if properly incorporated into the final design.

4.2.3 Principal Conclusions of Foundation Settlement

The as described in the 2005 report the following principal conclusions can be gained from the foundation settlement calculations:

- Settlements of the foundation soils due to the embankment loads are anticipated to be relatively small, on the order of 12 to 16 inches.

- The foundation settlements are expected to be complete within a maximum one-year period of time after waste placement. Given the period discussed in the following section to implement the "observational approach," foundation soil settlements are anticipated to be complete by the time that the final cover is placed.

- Monitoring of the embankment cover (at the debris free soil layer) is expected to be primarily a reflection of the embankment settlements and not the foundation settlements.

- The maximum settlement in the foundation soil may be up to 24 inches, or roughly 2 feet. Primary and secondary foundation settlements should be incorporated into the cover design. However, the magnitude is not expected to adversely impact drainage of the final cover.

4.3 EXISTING EMBANKMENT SETTLEMENTS

As described in the 2005 study we consider that the on-going Energy*Solutions*, Inc. embankment field settlement data provides one of the better measures for evaluating the future performance of the Class A cover. The settlement data obtained by Energy*Solutions*, Inc. was evaluated in the 2005 study to determine the magnitude and rate of settlement based on the survey monument data.

In summary, the conclusion of the 2005 study was that the total magnitude of settlement measured over the approximate 4-year period reviewed is less than 0.75 feet (9 inches). Given that the settlement monuments are located approximately 100 feet apart (on average), the distortion[13] measured to date is on the order of 0.0075 (versus the 0.02 criteria). The study revealed a considerable amount of scatter in the actual settlement elevations over time, but the magnitudes of settlement are overall quite low.

Our interpretation of the survey data is that a reduction in the rate of settlement with time is observed. The study revealed that settlement is reducing (slowing down) over time. It was observed that the rate of settlement decreases significantly within a 12-month, arguably 24-month period.

Another constructive interpretation of the field survey data was presented on Figure 14, Variations of Settlement with Embankment Height (elevation), of the 2005 study (see attached as Figure 7 of this update report). This plot compared the variation of observed embankment settlement versus embankment height (or elevation of survey point). It would be expected that there would be an increase in the total settlement of the cover with increased embankment height. Projecting the available settlement survey data to a 100-foot height, one may have up to

13 Distortion is defined as the vertical difference in elevation between two monuments divided by the distance between the two monuments.

0.6 feet of average settlement. This plot reveals that for about a 14-foot increase in the final cover elevation, the expected increase in total settlement is about 0.1 feet. Within a given elevation there is also a range of 0.16 to 0.23 feet of differential settlement between two potentially available settlement points. These values at a given elevation (comparing maximum to minimum settlements) result in a maximum distortion value of 0.0015 to 0.003, which is well below the distortion criteria of 0.02, by a factor of about ten. Comparing the maximum to the average settlement at a given elevation results in distortion values averaging about 0.001 (this may be more realistic since some of the data suggest very little settlement (minimum values). See additional discussion relevant to monitoring settlement of the existing embankments in the following Section 4.4, Available Monitoring Data.

4.3.1 Timing of Settlement

As described in the 2005 study, AMEC considers that the types and timing of the total settlements must be addressed to distinguish between settlements that occur prior to achieving the top of waste and those settlements that may occur following final cover placement. Only those settlements that occur after the cover is placed are important to the performance of the embankment cover. However, it is expected that the majority of settlement will occur during embankment construction and only a small fraction of the total settlement potential will remain after the cover is placed.

Our 2005 study concluded that the magnitude of settlement is a function of the materials (embankment and foundation), the time that the materials are placed and the time period allowed for settlements to be complete prior to final cover placement. Since it would be extremely difficult to predict or control the rates and timing of waste placement, Energy*Solutions*, Inc. is proposing to utilize a combination of quality assurance methods during construction to place waste in a controlled manner and monitor completion of the majority of settlement at the top of waste prior to final cover placement. The intent of this approach is to allow the majority of settlement to occur prior to final cover placement, thereby limiting the future differential potential.

The important understanding concluded from the 2005 study is that the majority of settlement will occur during the waste placement phase of operations. The monitoring program will only measure a fraction of the total settlement that will occur, but will allow grading to be accomplished prior to cover placement to reduce differential settlement. Completing predictions of the total settlement and ultimately the differential settlement is a function of the construction rate, when waste is placed, how long the waste materials have had to settle and a variety of other factors. It was noted in the 2005 study that the predicted measured settlement magnitudes under the current and previous waste placement techniques would be less than 1 foot of total settlement for a 100-foot high embankment. Differential settlements, which are important in meeting the distortion criteria, would be less than the total settlements. If the settlements of the compressible and incompressible waste lifts are largely complete at the time that the final cover is placed, differential settlements between the various waste types will be smaller than the total settlements.

4.4 AVAILABLE MONITORING DATA

To address the potential cover distortion, the 2005 study looked at the historical performance of the existing embankment(s). To gain an appreciation of the magnitude of post cover settlement versus embankment height, a number of settlement survey points were selected and a graph of settlement versus embankment height was prepared. It would be expected that settlements increase with embankment height and the data would exhibit greater scatter with height. Attached Figure 7 (or Figure 14, AMEC 2005), Variation of Settlement with Embankment Height (elevation), presented LARW settlement data in terms of embankment height. It is observed that both the range and magnitude of settlement increase with embankment height. The distortions revealed by the various ranges in the data points are also shown. Based on this data set, the current cover distortions are generally less than 0.004. Given the trend in settlement versus height, the projected settlement for the proposed 84-foot high (at the crest) CAW Embankment would be less than 0.7-feet. For a 100-foot grid spacing, the distortion would be predicted to be less than 0.007, less than half of the 0.02 normal operation target criteria.

Given the fact that Energy*Solutions*, Inc. will be modifying the waste placement methods by shredding wastes, and is now using large, landfill-type compaction equipment, it would be expected that the range in differential settlement should be equal to or less than measured under the prior waste placement techniques. With the improved waste placement methods, the waste lifts will be more uniform in terms of waste distribution, debris size and other factors. Placement of the waste using the proposed methods should result in smaller settlements of the embankment materials. The settlement below the top of the cover will be monitored prior to final cover placement. Each of these factors, along with the expected settlement behavior, will provide reasonable assurance that excessive maintenance of the final cover will not be required following closure.

4.4.1 Settlement Above Different Waste Types

The 2005 study also considered the potential for differential settlement that could occur in the cover due to different waste forms. The 2005 analysis considered three principal types of waste placement methodologies: 1) CLSM pyramids; 2) placement of compressible and incompressible debris in soil lifts; and 3) Containerized Waste Facility (CWF) pyramids. The details and assumptions of this analysis are given in the 2005 study. Additional clarification is described in our response to Interrogatory No. 2 (AMEC, 2006).

Summarizing the 2005 conclusions of the projected cover distortions above compressible debris, CLSM or CWF pyramids. Under the "normal" operating condition, the projected cover distortions were found to be less than 0.005 and 0.01 for the CLSM model and CWF model, respectively. These values are less than the 0.02 distortion targeted for design under normal operations. Under "accidental or abnormal settlement conditions," where settlement was studied as a random process, the distortions in such a "random" selection of settlement were found to also be less than the 0.02 criteria.

4.5 POST EARTHQUAKE DEFORMATIONS

4.5.1 General

Post earthquake deformations may be categorized into two areas: 1) settlement or strength loss of the foundation soils, and 2) deformations of the embankment. Settlement of the foundation soils as related to liquefaction and seismic sand settlement is discussed in the next section. Embankment deformations are discussed in the following section and are based on a "Newmark" type deformation analysis (after, Newmark, 1964)

4.5.2 Liquefaction Susceptibility

Liquefaction is defined as the condition when saturated, loose, fine sand-type soils lose their support capabilities because of excessive pore water pressure, which develops during a seismic event. Clayey soils, even if saturated, will generally not liquefy during a major seismic event due to their cohesive nature. Problems associated with liquefaction include post earthquake settlement and strength loss. Calculations prior to the 2005 study indicated that liquefaction of the soil layers below the site is not a design issue. However, the 2005 study updated the seismic design criteria and new subsurface information become available, so AMEC confirmed the previous findings still apply.

The 2005 study determined that for the design event, the majority of the soils in the upper 30 to 60 feet of the soil profile consist of cohesive deposits, which have a low probability of liquefaction due to their high clay content. It was also found that the interbedded cohesionless silt and silty sand deposits would also be unlikely to liquefy under the design seismic event. Based on the 2005 calculations and the previous calculations, liquefaction below either the combined embankment footprint is unlikely.

4.5.3 Foundation Sand Settlement

The following conclusions of the 2005 study remain applicable. Although liquefaction is unlikely to occur, there may be small seismic settlements in the foundation soils associated with the design earthquake event. Post earthquake (seismic) settlements were calculated from the CPT soundings using the method of Zhang, G., Robertson, P.K., and Brachman, R.W.I., (2002). The range in settlement is a function of a number of variables, including the location of individual layers of cohesionless soils, ground shaking, and other factors and the location of the layer below the embankment. In each case for the design event, the largest sand settlement was calculated to be less than 0.5 inches. This amount of post earthquake sand settlement is considered to be negligible.

4.5.4 Probable Embankment Deformations

The slope stability model described previously in Section 3.3.3 CAW Embankment Seismic Stability, was also used to estimate the potential range of post earthquake deformations of the CAW Embankment. To estimate the post earthquake deformation, the seismic coefficient (acceleration) required to achieve a factor of safety of unity is calculated. This value is termed the "yield acceleration" and is utilized in conjunction with a number of published empirical relationships between yield acceleration and potential post earthquake slope deformations. The minimum yield acceleration for the CAW Embankment was found to be 0.192g.

The probable earthquake deformations were calculated for each of the three cases studied using the simplified Newmark Sliding Block Analysis subroutine in the GSTABL7 program. As was determined in the 2005 study, the probable post earthquake embankment deformations were found to be less than 1 inch. The results are presented in Appendix C. These post earthquake deformations are predicted to be quite small.

5. CONCLUSIONS

Based on the foregoing discussions, the following conclusions have been made for the proposed CAW Embankment:

- As with the 2005 study, the stability of the embankment is governed primarily by the height of the 5(H):1(V) slope. At a height of 38 feet, the static and pseudostatic stability of CAW embankment was found to be acceptable.

- Foundation settlements of a smaller combined embankment will be slightly less than the CAC Embankment yet still higher than the individual embankments. The majority of foundation settlements are anticipated to be complete by the time the final cover is to be placed.

- The study of settlement monitoring data presented in the 2005 report indicated that the majority of the embankment settlements are complete within a 12 to 24 month period after the cover is placed. The available survey data also indicated that the distortion of the existing cover appears to be less by a factor of 10 than the previously selected design criteria of 0.02.

- EnergySolutions, Inc. has proposed an observational approach. In this observational approach, settlements of the debris free soil layer will be monitored prior to the final cover placement. By delaying placement of the final cover, the potential for future differential settlements of the cover is significantly reduced. Based on available monitoring data, we expect that the monitoring period will extend from 1 to 2 years maximum.

- To evaluate the survey monitoring data, we recommend that the survey data be evaluated in terms of settlement rate and differential settlement, in addition to total settlement.

6. LIMITATIONS

This report was prepared within the scope of generally accepted geotechnical engineering practices under the direction of a licensed engineer. No warranty, express or implied is made as to the conclusions and professional advice included in this report. AMEC Earth & Environmental, Inc. disclaims responsibility and liability for problems that may occur if the recommendations contained herein are not followed.

This report was prepared for Energy*Solutions*, Inc and their design consultants solely for the design and construction of the project described herein. It may not contain sufficient information for other uses or the purposes of other parties. These recommendations should not be extrapolated to other areas or used for other facilities with consulting AMEC Earth & Environmental, Inc.

Recommendations herein are based on interpretations of the subsurface conditions concluded from information gained from subsurface explorations. The interpretations may vary horizontally and vertically across the site.

We trust that this report adequately provides the design support for the CAW Embankment height and footprint increase. If you have any questions or comments, please contact the undersigned.

Respectfully submitted,

AMEC Earth & Environmental, Inc.

Reviewed by:

2/15/11

REGISTERED PROFESSIONAL ENGINEER
#358996
ERIC BOONE
EXP. 3/11/11
STATE OF UTAH

Eric A. Boone, State of Utah No. 358996
Professional Engineer

Lawrence A. Hansen, PhD
Chief Technical Officer

EAB/LH:eab

Addressee (4)

c: Sean McCandless (1)
Steve M. Newton (1)

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FIGURES

EnergySolutions, Inc.
Geotechnical Update Report
Job No. 10-817-05290
Class A West Embankment

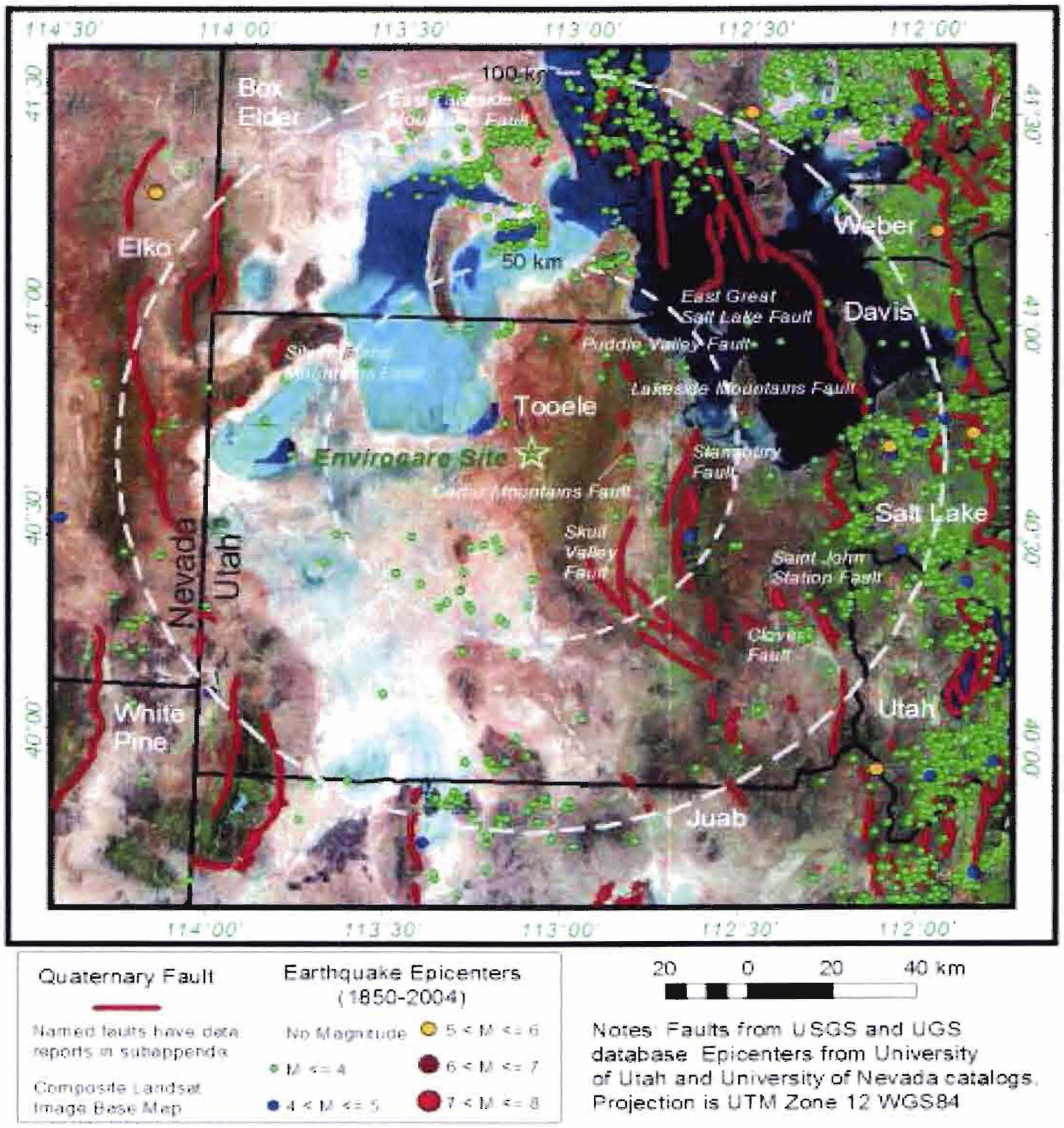
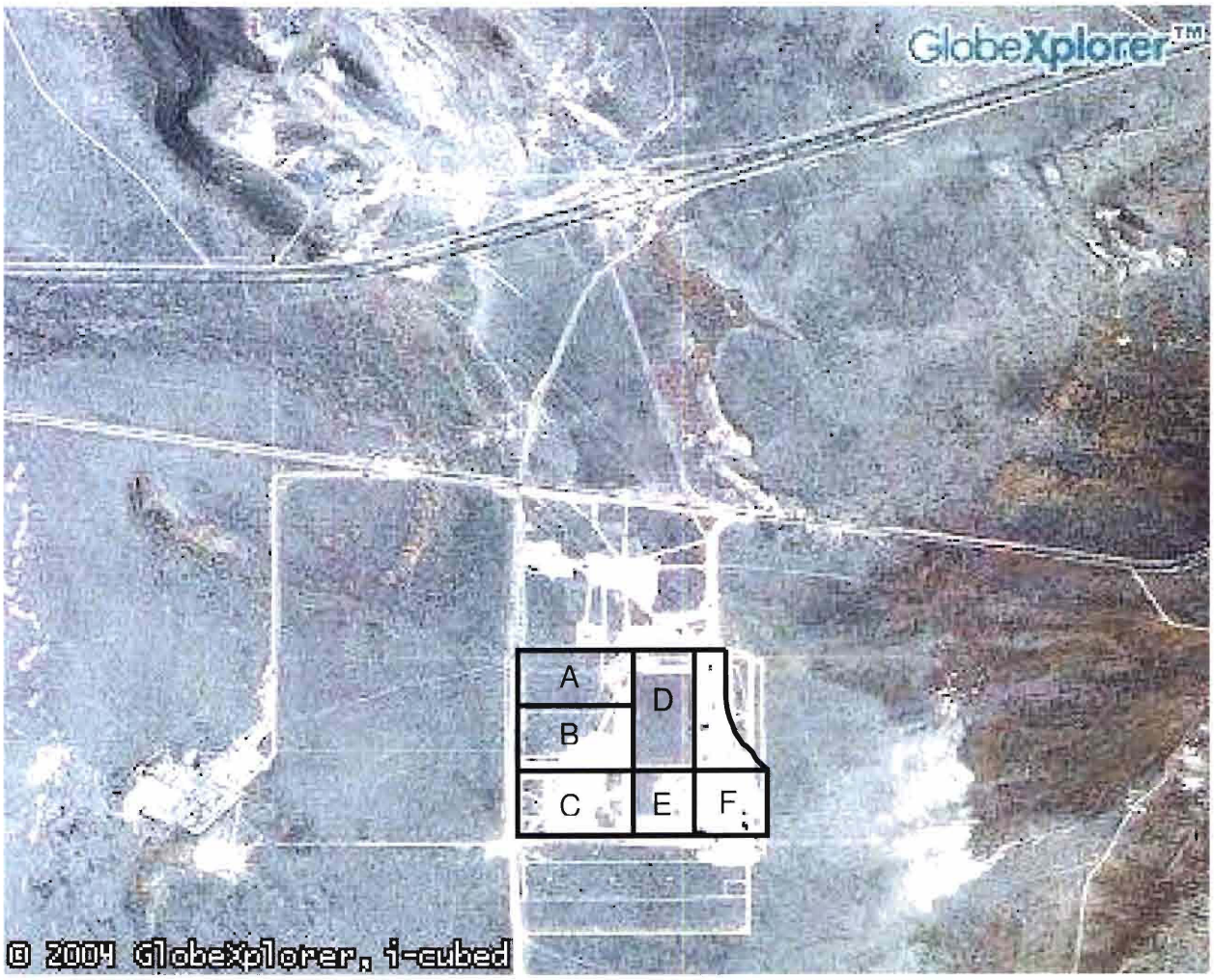


FIGURE 1
REGIONAL SETTING

Reference: Adapted from AMEC 2005, FIGURE 1



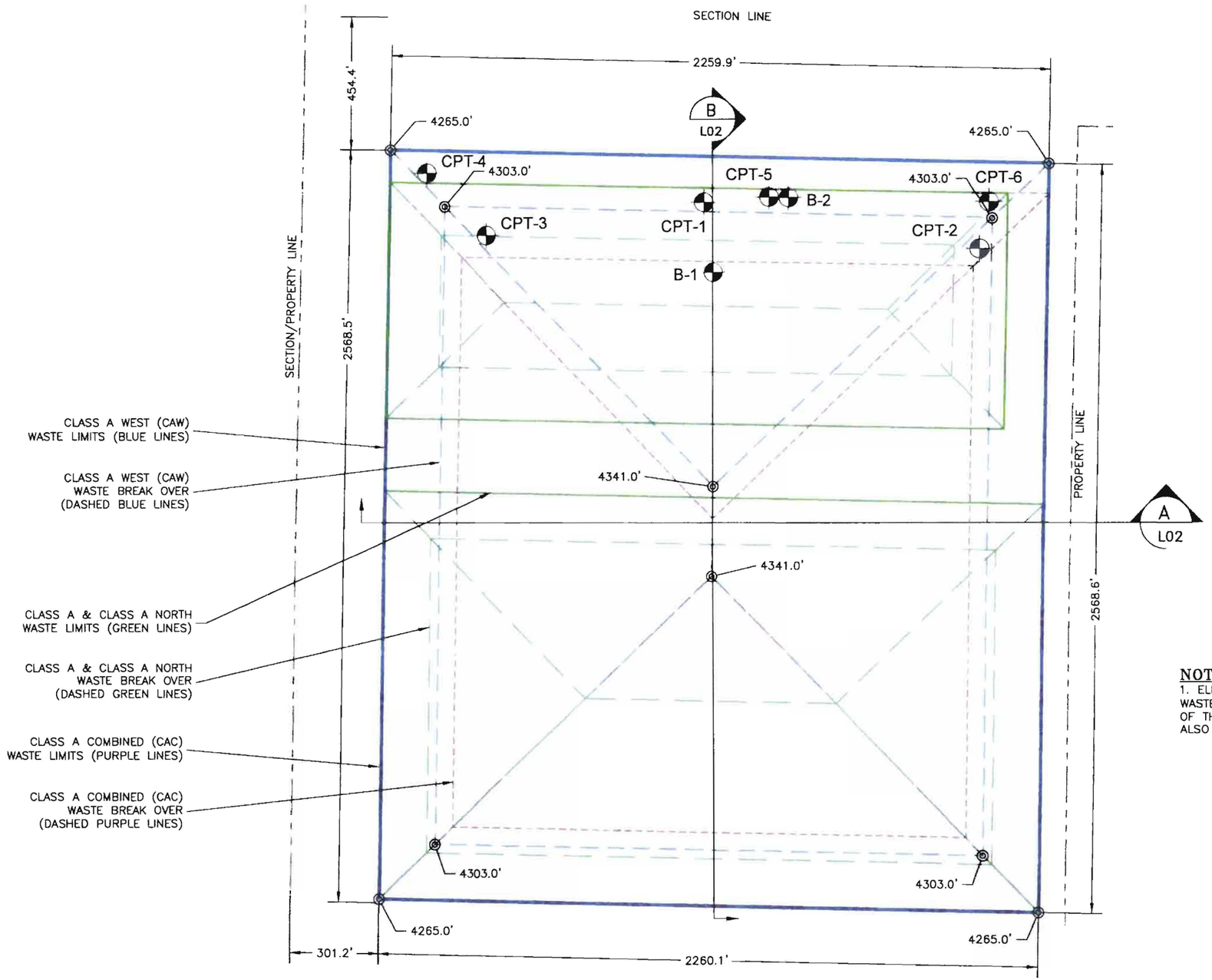
Legend:

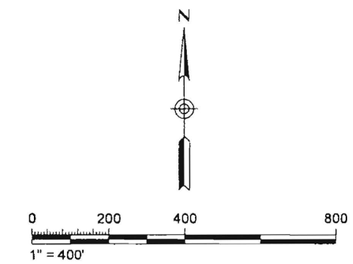
A – 2005 Study Area
B – AGRA 1999 – Existing LARW
C – 11e.(2)
D – Vitro
E – LARW / NORM
F – Mixed Waste

NOT TO SCALE

FIGURE 2
VICINITY MAP

Reference: Adapted from AMEC 2005, Aerial Photograph Map, GlobeXplorer 2004





Legend

B-1 Approximate Location of Exploratory Excavation

CPT-1 Approximate Location of Cone Penetration Test

NOTES:

1. ELEVATIONS SHOWN ARE FOR TOP OF WASTE (CAW ONLY), WITH THE EXCEPTION OF THE PERIMETER POINTS WHICH ARE ALSO TOP OF LINER.

References:

1. AMEC (formerly AGRA), Report, Geotechnical Site Characterization, Proposed New LARW Embankment, near Clive, Tooele County, Utah, AGRA Job No. 9-817-002586, dated October 26, 1999.

2. AMEC, Report, Combined Embankment Study, Envirocare, Tooele County, Utah, AMEC Job No. 4-817-004769, dated December 13, 2005.

3. EnergySolutions, Inc. Clive Facility, Class A West Embankment, Location & General Layout, Drawing 10014-L01, Scale As Noted, Dated October 4, 2010.

JOB NO.	10-817-05290
DESIGN:	EAB
DRAWN:	GWH
DATE:	1/2011
SCALE:	1" = 400'

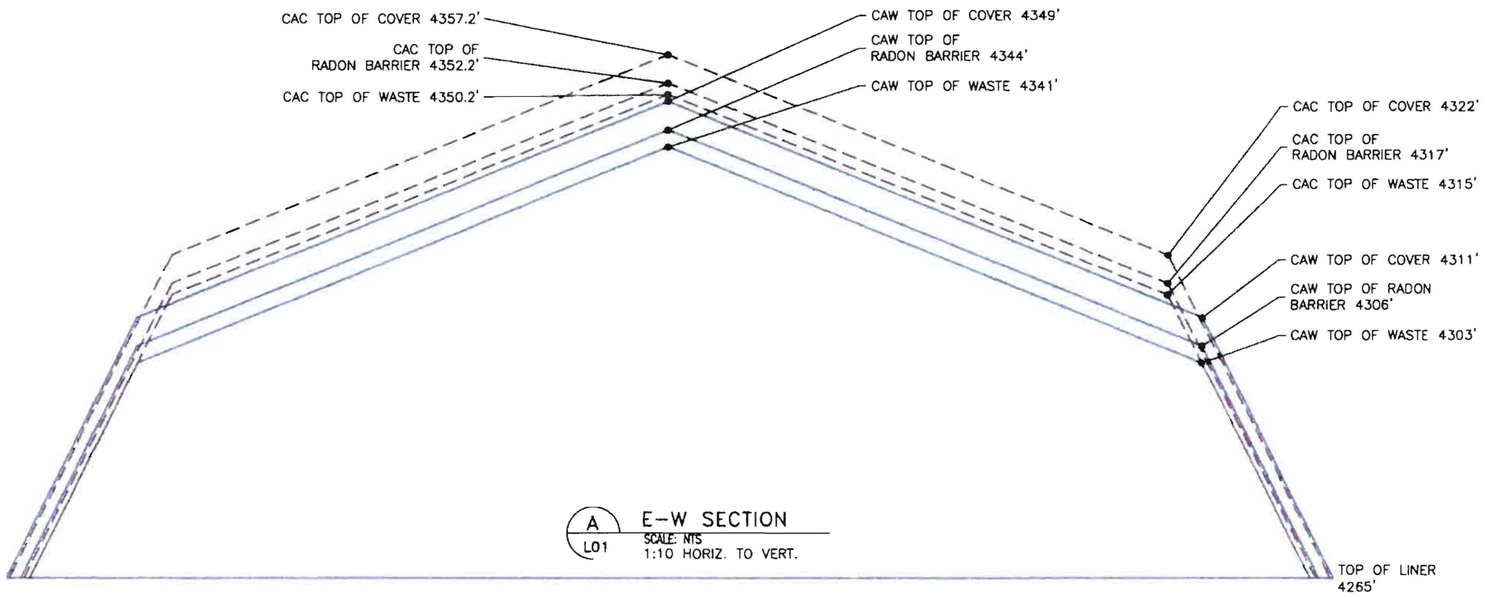
CLIVE FACILITY - CLASS A WEST EMBANKMENT
CLIVE, UTAH

FIELD EXPLORATION LOCATION MAP

FIGURE 3A

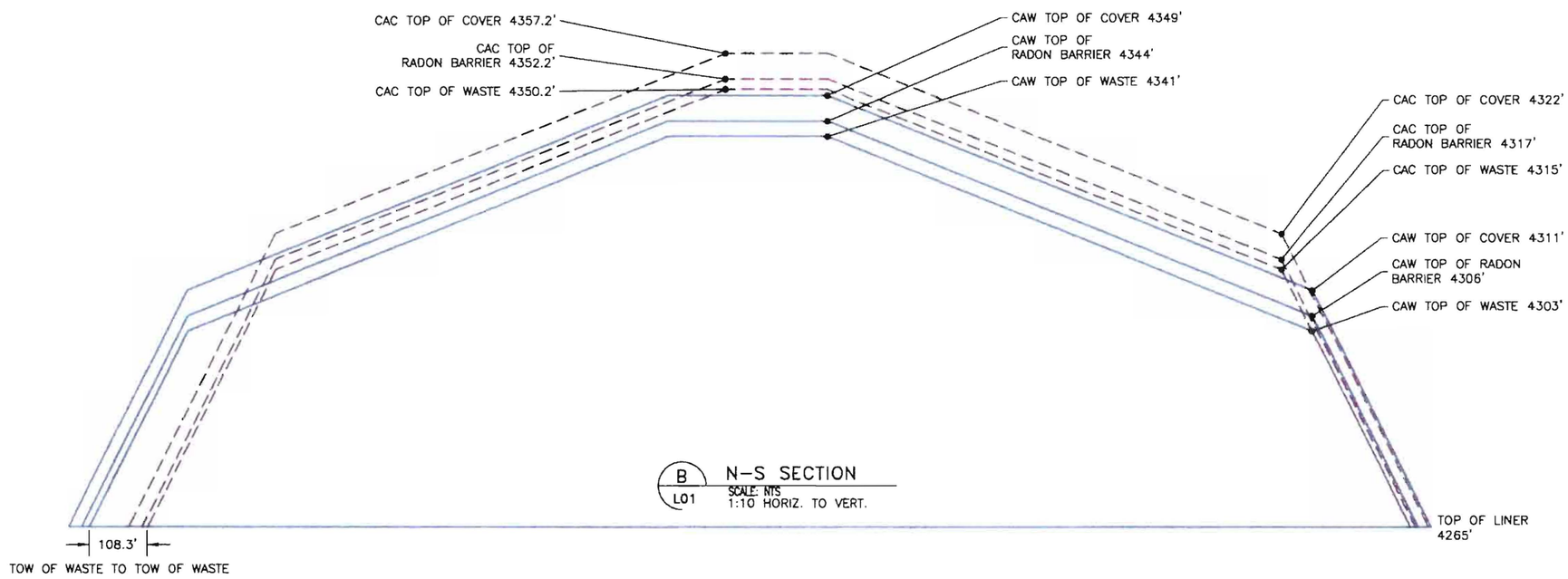
amec

G:\Geotechnical\Salt Lake City Cad\Figure-3 Location Map.dwg



A L01 E-W SECTION
SCALE: NTS
1:10 HORIZ. TO VERT.

NOTE:
1. CAC DESIGN PLACED 1 FT OF TEMPORARY COVER BELOW THE WASTE LIMITS.
2. CAW DESIGN PLACES 1 FT OF TEMPORARY COVER ON TOP OF THE WASTE LIMITS.
3. TEMPORARY COVER IS 1 FT OF NATIVE CLAY COMPACTED TO AT LEAST 90% OF A STD. PROCTOR.



B L01 N-S SECTION
SCALE: NTS
1:10 HORIZ. TO VERT.

References: 1. EnergySolutions, Inc. Clive Facility, Class A West Embankment, Embankment Cross Sections, Drawing 10014-L02, Scale As Noted, Dated October 27, 2010.

JOB NO.	10-817-05290
DESIGN:	EAB
DRAWN:	GWH
DATE:	1/2011
SCALE:	AS NOTED

CLIVE FACILITY - CLASS A WEST EMBANKMENT
CLIVE, UTAH

EMBANKMENT CROSS-SECTIONS

FIGURE 3B

amec

G:\Geotechnical\Salt Lake City Cad\Figure-3 Location Map.dwg

EnergySolutions, Inc.
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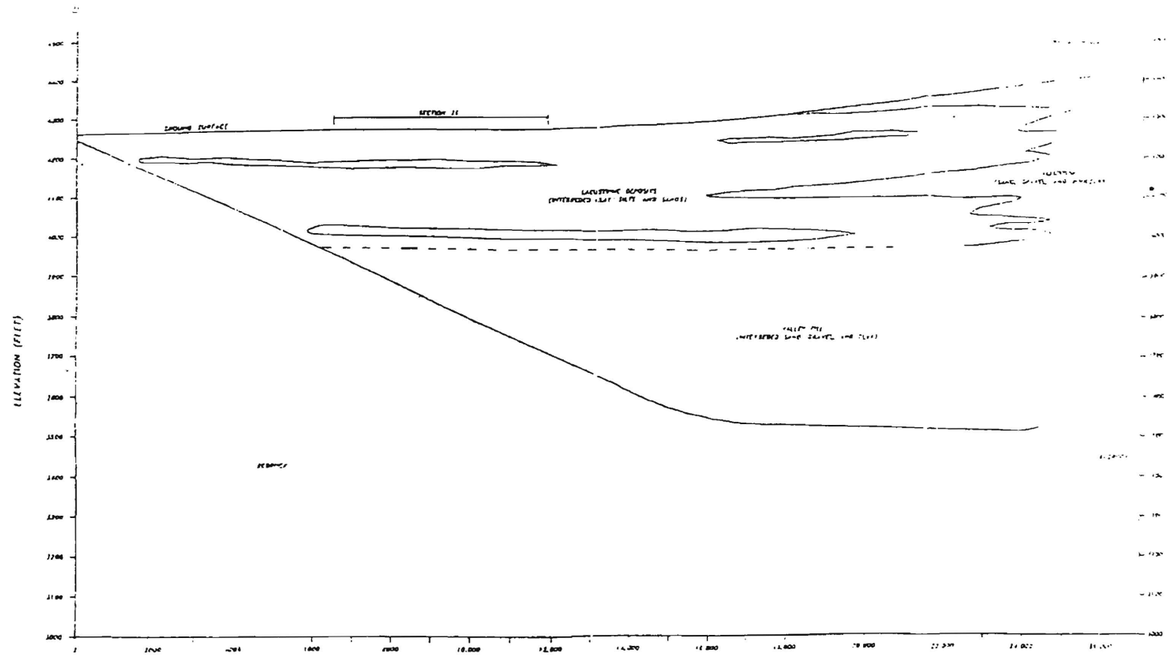
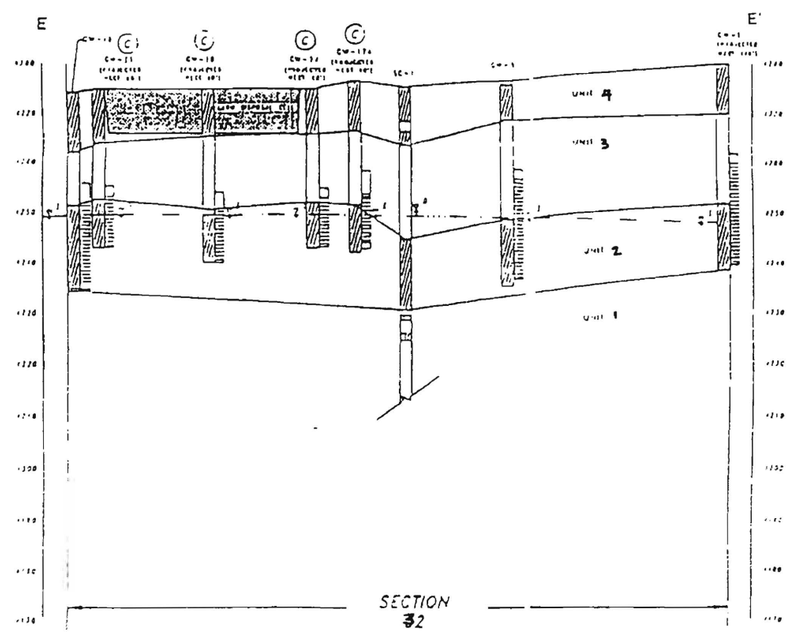
Job No. 10-817-05290
Class A West Embankment





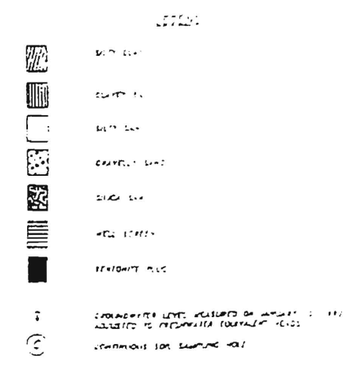


FIGURE 4
HYDROGEOLOGIC SITE CHARACTERIZATION

Reference: Adapted from AMEC 2005, FIGURE 5 Hydrogeologic Site Characterization. Quality of original is very poor.

West to East Cross Section showing CPT Tip Resistence and Friction Ratio Versus Depth

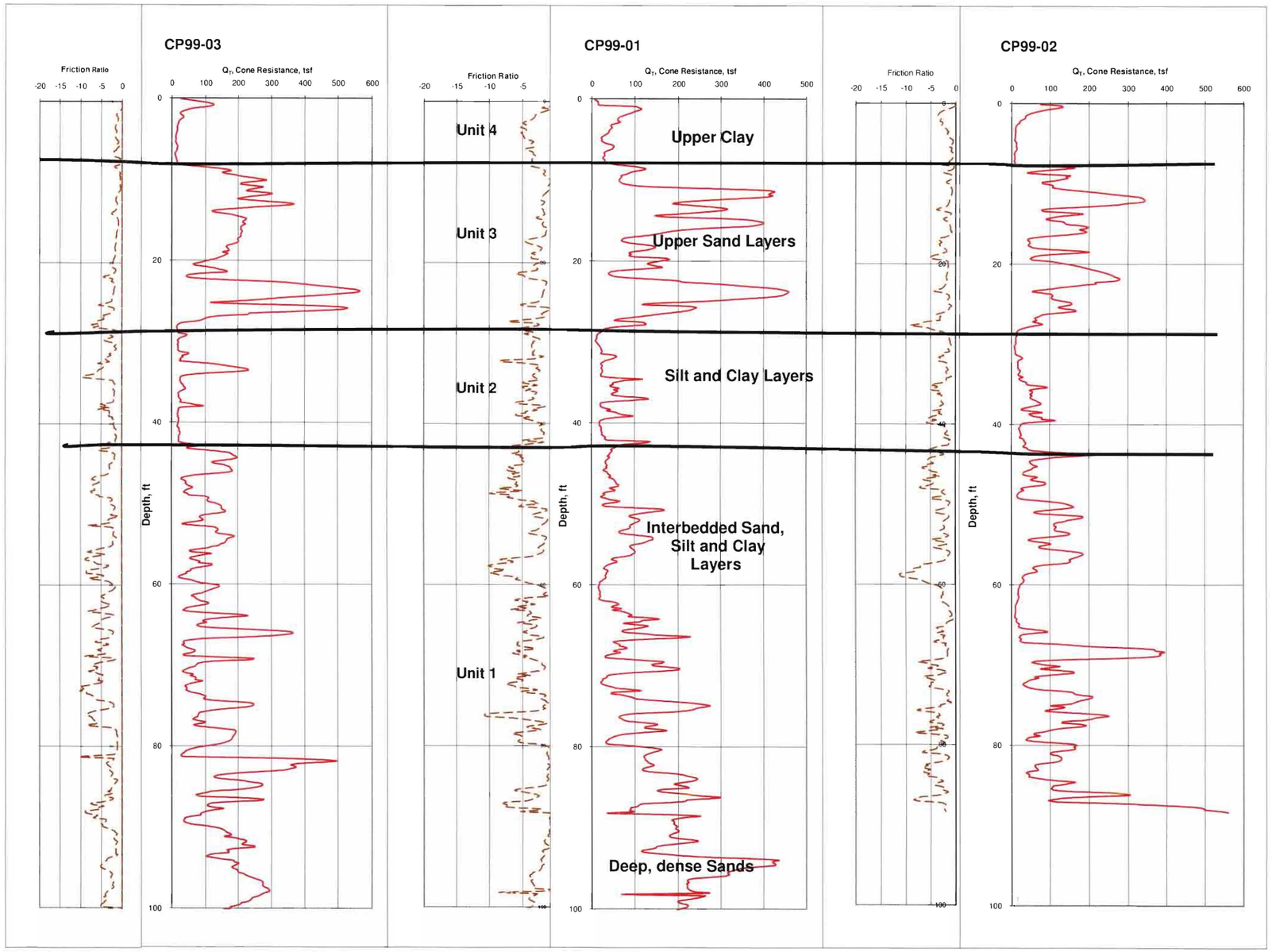


Figure 5A has been adapted from Figure 6a of AMEC 2005.

FIGURE 5A
EXISTING CLASS A EMBANKMENT FOUNDATION CONDITIONS

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West to East Cross Section showing CPT Tip Resistence and Friction Ratio Versus Depth

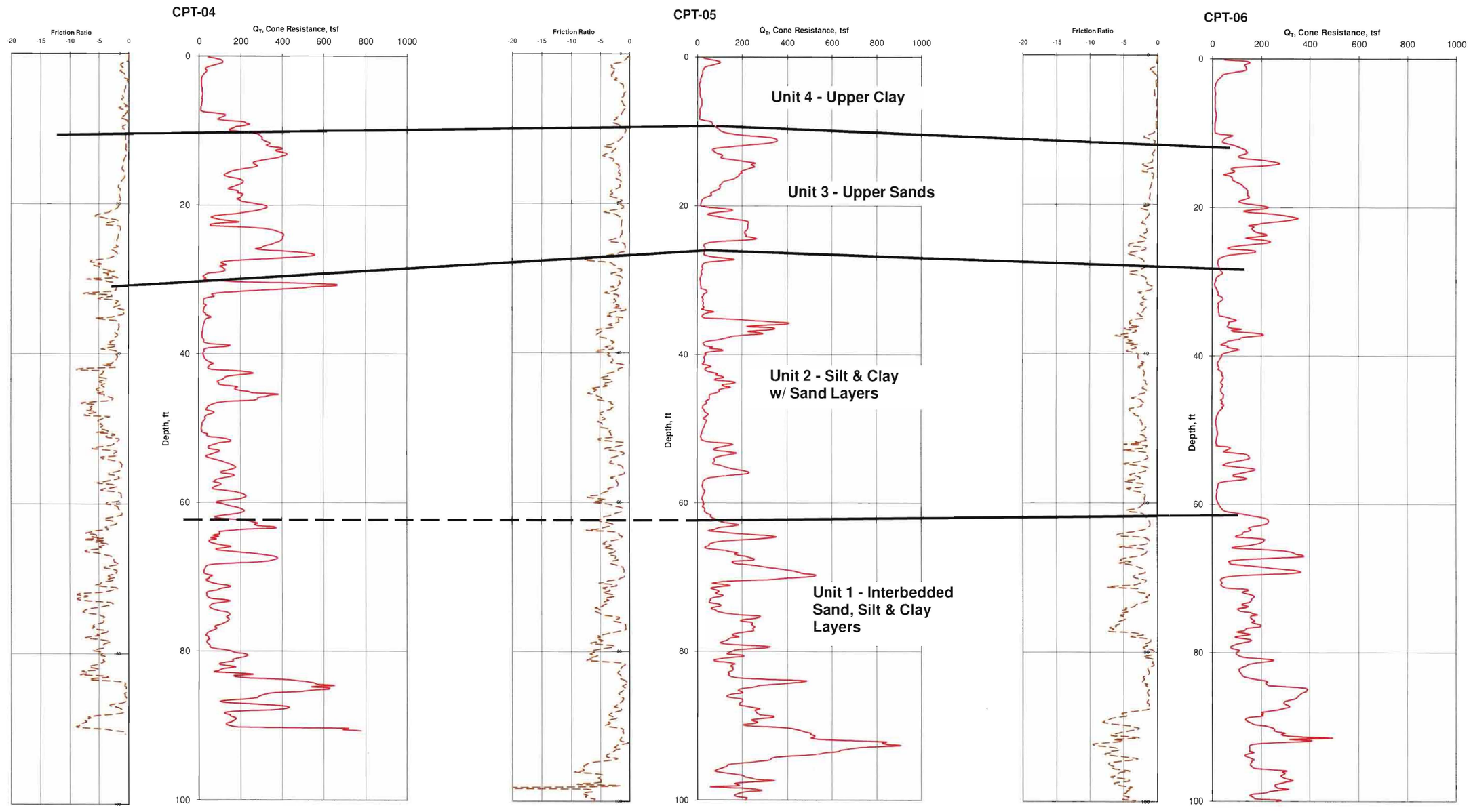

Figure 5B has been adapted from Figure 6b of AMEC 2005.

FIGURE 5B
CLASS A NORTH EMBANKMENT FOUNDATION CONDITIONS

amec

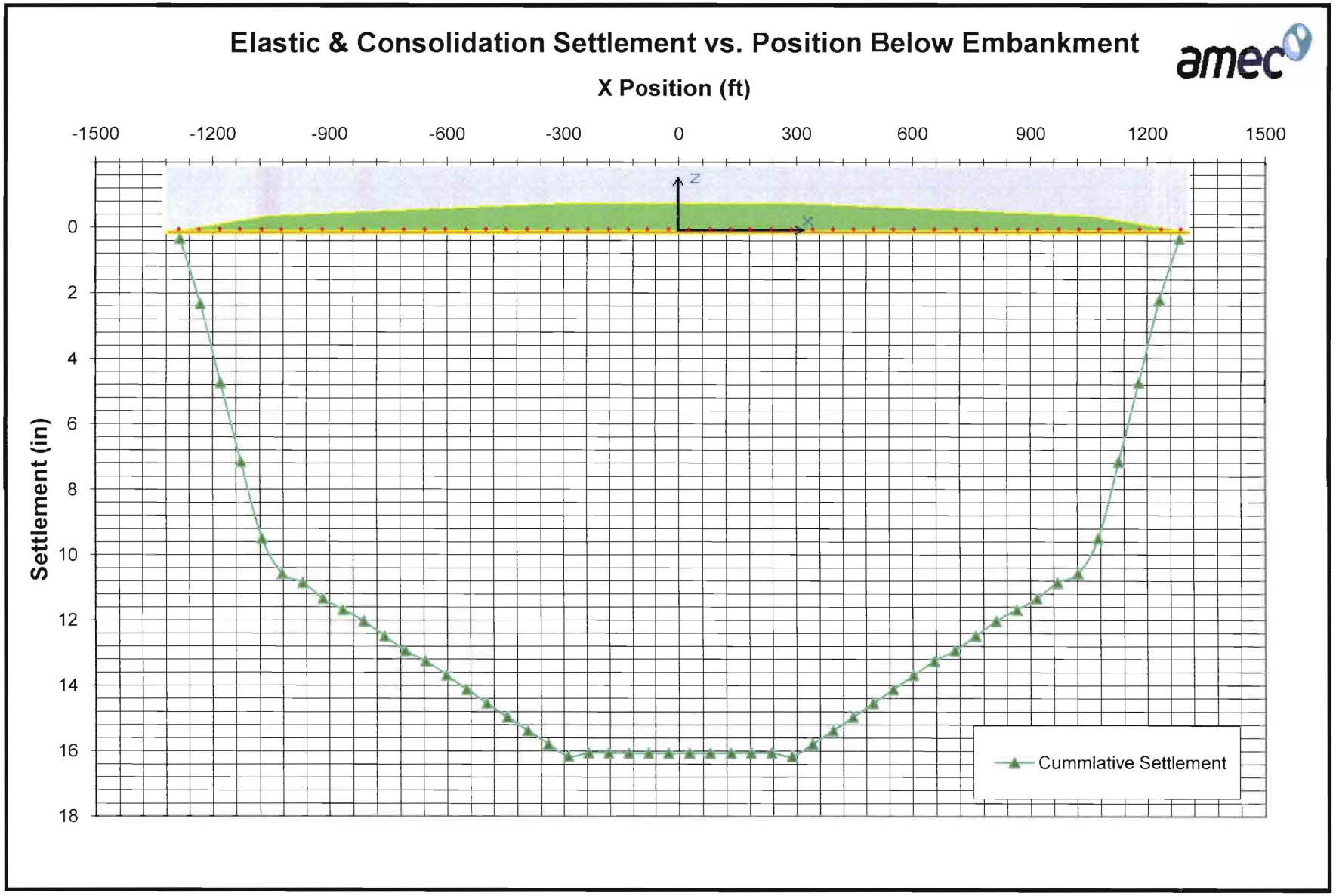

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FIGURE 6

CAW Embankment Foundation Settlement

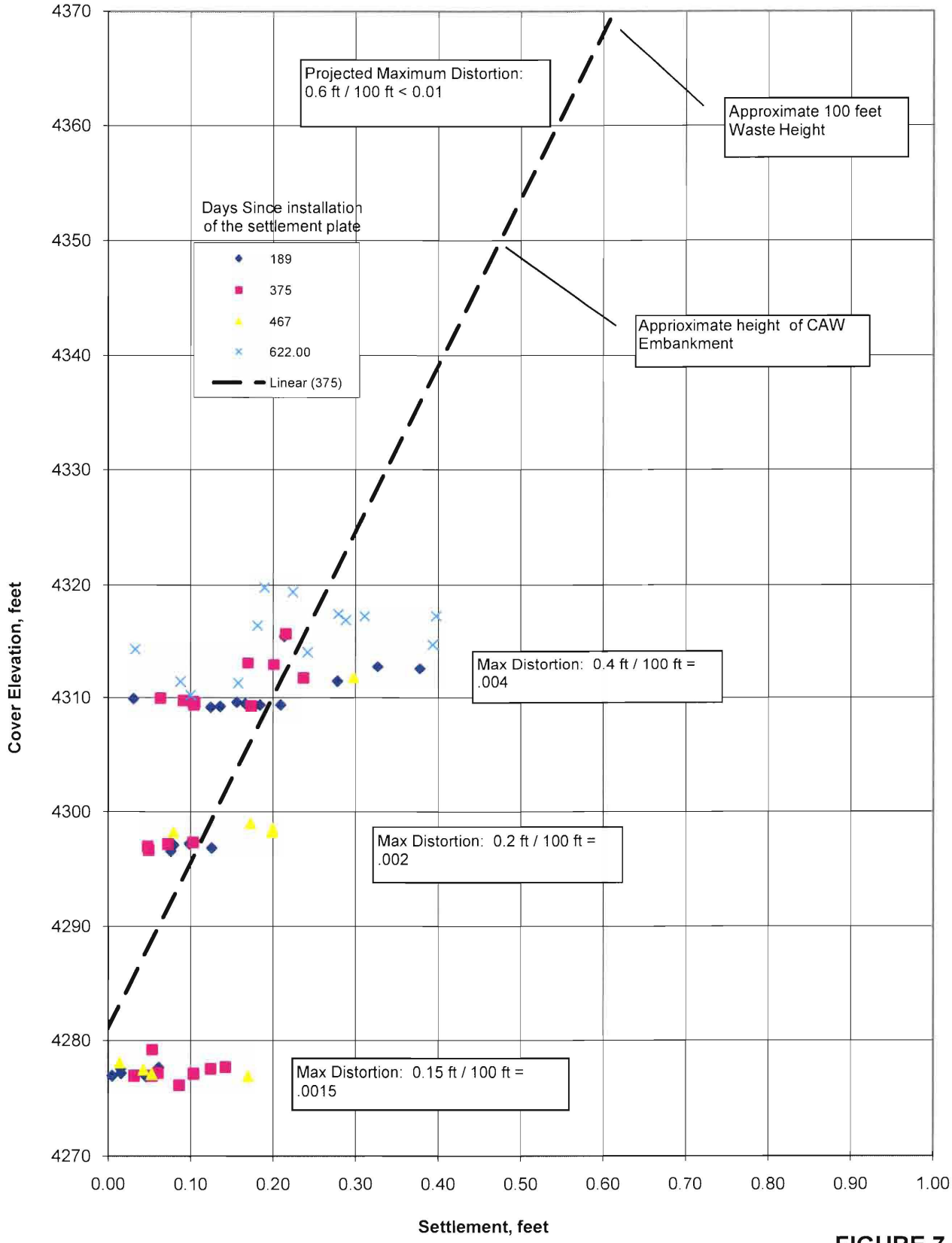

FIGURE 7

Variation of Settlement with Embankment Height (elevation)

Figure 7 has been adapted from Figure 14 of AMEC 2005. Refer to 2005 report for additional infomation on settlement data.

amec

APPENDIX A

APPENDIX A
Seismic Hazard (ref AMEC 12/13/2005)
Quaternary Fault Reports From USGS Website

APPENDIX A

UPDATE OF SEISMIC DESIGN PARAMETERS FOR ENVIROCARE OF UTAH FACILITY

INTRODUCTION

The seismic design philosophy for the Envirocare facility is based a deterministic approach, meaning that sources of ground motion in the site area are located and evaluated for the largest earthquake that could be reasonably expected. The ground motion is attenuated over the distance between the source and the site, and the largest ground motion produced by the different sources is accepted as the design value. The ground motion at sites located near major active faults is dominated by the nearby faults; however, deterministic design at sites located at moderate to large distances from active faults may be dominated by a so-called 'background' or 'random' earthquake that is not associated with a known active fault.

Probabilistic seismic hazard evaluations take into account the rate at which earthquakes of varying magnitude can be generated by area or line sources within a site region. The contributions of each source to the seismic hazard at the site are combined to produce a representation of the ground motion that corresponds to a specific exceedance probability in a fixed number of years. A fundamental assumption is made that the occurrence of each earthquake is independent of earthquakes that precede and follow it. Such an assumption is consistent with Poisson statistics.

Exceedance probabilities and exposure times are used to calculate the annual frequency of the ground motion in the following Poisson formula:

$$AF = \frac{-\ln(1-p)}{t}$$

where AF is annual frequency, ln() is the natural logarithm of the argument inside the parentheses, p is exceedance probability in decimal form, and t is exposure time in years. Recurrence interval is the inverse or reciprocal of annual frequency. The results of probabilistic seismic hazard evaluations can be useful in developing deterministic estimates of ground motion for comparing earthquake magnitudes and distances.

Significant probabilistic seismic hazard evaluations were completed by the United States Geological Survey (USGS) in 1996 and updated in 2002 (Frankel and others, 1996, 2002) and revised twice in 2003 (http://eqhazmaps.usgs.gov/html/data2002.html). For this reason, the results of the USGS probabilistic seismic hazard mapping are indexed to 2003 in this appendix. The 1996 seismic hazard maps were developed to provide the ground motion basis for the International Building Code 2000 (IBC2000), which replaced the Uniform Building Code, the Southern Building Code, and the Standard Building Code. The fundamental difference in approach to ground motion between the older building codes and the IBC2000 is that the older codes used broad seismic zones, whereas the IBC2000 uses a grid of ground motion values spaced at 0.1 degrees of latitude and longitude, except in California, Nevada, and western Utah, where the grid spacing is 0.05 degrees.

The probabilistic seismic hazard evaluation is based on two types of earthquake sources – areas and lines. The area sources are defined by historical earthquake epicenter distributions and clusters, and an understanding of regional geology and tectonic features (seismotectonic provinces). The line sources are faults with evidence of movements during Quaternary time. Only those faults with published information on earthquake recurrence were included in the USGS probabilistic model. Some faults were included in the 2003 update of the ground motion but were not used in the 1996 evaluation. Such is the case with faults in Skull Valley, located approximately 30 km southeast of the Envirocare site. Data reports from the USGS website on fault sources within approximately 70 km of the Envirocare site are contained in the Sub-Appendix A.

The remaining sections of this appendix contain discussions of historical earthquakes, Quaternary faults, results of the USGS seismic hazard mapping project, results of a probabilistic seismic hazard assessment for the background earthquake at the Envirocare site, and recommended earthquake ground motion expressed as peak horizontal acceleration for rock site conditions.

HISTORICAL EARTHQUAKES

Earthquake catalogs for the site region were obtained from the seismological observatories at the University of Utah and the University of Nevada, and plotted using geographic information system (GIS) tools (Figure A-1). The Utah catalog begins in 1850, whereas the Nevada catalog begins in 1852. The two catalogs combined contain 1277 epicenters within 100 km of the Envirocare site. The earliest earthquake occurred in 1915 and the latest in September 2005; the smallest was M 0.0 and the largest M 5.2; the closest was 9.9 km from the site and the farthest was 99.9 km. Selected data for 26 earthquakes are presented in Table A-1, which is sorted by increasing distance from the site. These 26 earthquakes are located within 100 km of the site, but a magnitude and distance filter was applied to the catalogs to produce the data shown in Table A-1 because most of the epicenters represent small earthquakes more than 50 km from the site. Earthquakes of $M \geq 1$ are listed in Table A-1 within 30 km of the site, $M \geq 3$ within 50 km, and $M \geq 4$ within 100 km.

The catalogs probably are reasonably complete for earthquakes of $M \geq 6$; however, completeness for $M \geq 4$ is problematic prior to the 1960s or 1970s. Table A-1 shows that the closest earthquake to the site occurred in 1998 at a distance of nearly 10 km with M 2.0. The closest earthquake of $M \geq 4$ occurred in 1915 at a distance of approximately 44 km. Only one $M \geq 5$ earthquake is reported within 100 km of the site since 1850; it occurred in 1962 at a distance of about 86 km.

QUATERNARY FAULTS

Most of the faults in the site region that cut deposits of Quaternary age were identified a number of years ago. Most of them had not been studied in detail by the time the USGS was conducting their 1996 seismic hazard mapping project, and the USGS omitted them as line sources because key parameters (maximum magnitude and recurrence or slip rate) were not available. Subsequently, a systematic inventory of Quaternary faults was completed in the Western United States, and more complete information was available for the 2002 USGS update. In addition, faults in the Skull Valley were discovered and characterized (Swan and others, 2004).

Ten Quaternary faults are included in the USGS database within about 70 km of the Envirocare site. Quaternary faults are shown on Figure A-1; those with labels are the eleven faults closest to the site. Data reports for ten of these faults from the USGS website (http://qfaults.cr.usgs.gov/) are reproduced in Sub-Appendix A; the Springline fault is not included in the USGS database, but it was used by Wong and others (2002) as one of the earthquake sources for an assessment of ground motion in the Salt Lake City area. The closest Quaternary fault to the Envirocare site is the Cedar Mountains fault at a distance of 23 km to the east.

USGS SEISMIC HAZARD MAPS

The results of the USGS seismic hazard mapping projects are arrays of acceleration values at regular geographic grid spacing. The USGS used a grid spacing of 0.05 degrees of latitude and longitude for the site region in both the 1996 and 2003 seismic hazard mapping projects. Figures A-2 and A-3 are the values representing 2 percent exceedance in 50 years (corresponding to an average recurrence of about 2475 years) on rock for both 1996 and 2003, respectively, displayed as grids interpolated at a spacing of 30 m superimposed on the hillshade relief image calculated from the digital elevation model of the site region. It can be seen on Figures A-2 and A-3 that 0.164g was the peak acceleration value at the site from the 1996 results, whereas 0.153g was the value from the 2003 results. The ratio of the 2003 value to the 1996 value at the site is 0.93.

The comparison of acceleration values shown on Figures A-2 and A-3 shows that the ground motion centered on the Skull Valley area is much higher in 2003 than it was in 1996 because of the addition of the Skull Valley faults and a change in the understanding of the Stansbury fault. Elsewhere in the vicinity of the Envirocare site, the 2003 ground motion is lower than it was in 1996 because of moderation of conservative assumptions used in ground motion attenuation.

DETERMINISTIC GROUND MOTION

Ground motion in terms of peak horizontal acceleration for the Envirocare site was calculated for specific (deterministic) earthquake magnitudes and distances using relations published by Pankow and Pechmann (2004), Campbell and Bozorgnia (2003), and Abrahamson and Silva (1997) for rock site conditions. The deterministic rock motions are the index of seismic hazard at the site and are useful for comparing to the USGS seismic hazard mapping project probabilistic results. The Envirocare site has soil conditions, so the rock motions have been propagated through the soil column to give correlative motions for analysis and design at the site. The site response analysis is described in the body of the report. The deterministic ground motion estimates for the Envirocare site are presented in Table A-2 for both mean and 84th percentile (mean-plus-one standard deviation) levels for eleven faults. Data reports from the USGS website regarding ten of the faults are contained in Sub-Appendix A. The Skull Valley fault is listed twice because of two estimations of the maximum magnitude.

The deterministic design approach used for the Uranium Mill Tailings Reclamation Act Projects (UMTRAP) in the 1980s called for the 84th percentile ground motion to be applied to embankment stability evaluations because of the uncertainty in empirical attenuation relations. Although the confidence in earthquake ground motion attenuation relations has improved, the 84th percentile (1 sigma) ground motion estimated for specific faults remains useful to consider and is reported in Table A-2 along with the mean ground motion values.

Distances listed in Table A-2 were taken from the GIS display of Quaternary faults (Figure A-1). Fault dip is important in the formulation of some attenuation distances, and the symbols in Table A-2 (+, -, 0) denote fault dip toward, away, or neutral to the site. The maximum or characteristic magnitudes for the faults were obtained one of three ways: The magnitude values were 1) taken from published references, 2) based on surface-rupture lengths obtained from the USGS data reports included in Sub-Appendix A and empirical relations published by Wells and Coppersmith (1994), or 3) specified to be the threshold magnitude above which surface rupture would be expected. One of the faults was addressed in two published references (Wong and others, 2002, and Swan and others, 2004), and reported maximum magnitudes are shown in Table A-2.

The three ground motion attenuation relations used in this evaluation consider earthquake source-to-site distances differently. The Pankow and Pechmann (2004) relation uses the Joyner and Boore distance (rjb in Table A-2), which is the horizontal distance from the site to the vertical projection of the fault. Thus, dipping faults can have shorter attenuation distances than the distance to the surface fault trace, but attenuation distances cannot be longer than the distance to the surface fault trace.

The Campbell and Bozorgnia (2003) relation uses the seismogenic distance (rseis in Table A-2), which is the slant distance from the site to the closest point on the fault plane that is below the top of the seismogenic crust. The seismogenic crust in the site region is taken to be 3 km. Thus, dipping faults can have shorter or longer attenuation distances than the distance to the surface fault trace.

The Abrahamson and Silva (1997) relation uses the rupture distance (rrup in Table A-2), which is the slant distance from the site to the closest point on the fault plane. This distance is similar to the seismogenic distance of Campbell and Bozorgnia (2003) except that the geometry takes into account the entire fault plane, not just the part below the top of seismogenic crust.

Inspection of Table A-2 reveals that the results from Campbell and Bozorgnia (2003) and Abrahamson and Silva (1997) exceed results from Pankow and Pechmann (2004). Pankow and Pechmann (2004) is a desirable relation to use because it was developed for extensional tectonic regimes, such as those in the site area. The other two relations were developed from earthquakes and ground motions that are dominated by compressional tectonic regimes, which generate larger ground motions for the same magnitude and distance parameters than Pankow and Pechmann (2004). The Campbell and Bozorgnia (2003) and Abrahamson and Silva (1997) relations were considered in this evaluation because they are widely used in geotechnical earthquake engineering, making the results useful for comparison.

The fault with the closest surface trace to the site is the Cedar Mountains (east side) fault, at 23 km. This fault dips away from the site, in contrast to the Skull Valley faults, which dip toward the site. The closest approach of the surface traces of the Skull Valley faults is 30 km, but the attenuation distance is 19.5 km (rjb) or 24.6 km (rseis and rrup). Wong and others (2002) assigned magnitudes of 6.5, 6.8, and 7.1 in their probabilistic ground motion study of Salt Lake Valley. Swan and others (2004) assigned a maximum magnitude of 6.5 to the faults. Table A-2 has two lines for the Skull Valley faults to reflect maximum magnitudes of 7.1 (after Wong) and 6.5 (after Swan). The largest deterministic ground motions in Table A-2 are associated with the magnitude 7.1 earthquake on the Skull Valley faults for all three attenuation relations. The second largest deterministic ground motions in Table A-2 are associated with the magnitude 7.0 earthquake on the Stansbury fault for the Pankow and Pechmann (2004) and the Campbell and

Bozorgnia (2003) attenuation relations, and with the magnitude 6.6 earthquake on the Cedar Mountains fault for the Abrahamson and Silva (1997) attenuation relation.

The largest values of mean ground motion in Table A-2 are 0.126g (Pankow and Pechmann, 2004), 0.148g (Campbell and Bozorgnia, 2003), and 0.170g (Abrahamson and Silva, 1997). The second largest values of mean ground motion in Table A-2 are 0.097g (Pankow and Pechmann, 2004), 0.118g (Campbell and Bozorgnia, 2003), and 0.149g (Abrahamson and Silva, 1997). The largest values of 84th percentile ground motion in Table A-2 are 0.212g (Pankow and Pechmann, 2004), 0.237g (Campbell and Bozorgnia, 2003), and 0.261g (Abrahamson and Silva, 1997). The second largest values of 84th percentile ground motion in Table A-2 are 0.162g (Pankow and Pechmann, 2004), 0.195g (Campbell and Bozorgnia, 2003), and 0.242g (Abrahamson and Silva, 1997).

PROBABILISTIC GROUND MOTION FOR THE BACKGROUND EARTHQUAKE

The historical earthquake activity within 100 km of the Envirocare site provides some context for the deterministic peak horizontal acceleration values listed in Table A-2 and a rate of seismic activity used in calculating the background earthquake. One set of data points and six curves are plotted on Figure A-4. The data points (gray circles) on Figure A-4 represent earthquakes within 100 km of the site (Figure A-1) from earthquake catalogs maintained by the University of Utah and the University of Nevada-Reno. The catalogs cover a 154-year period from 1850 to present; the most recent earthquake in the available catalog for the Wasatch Front Region was September 29, 2005.

The two lines labeled 'Activity within 100 km of Envirocare site' are truncated exponential regressions based on the actual values for M ≥ 4 and assumed maximum magnitudes of 7.5 (thin solid line) and 6.5 (thin dashed line). The larger value of maximum magnitude is comparable to the maximum magnitude assumed for the larger faults in the region, whereas the smaller value of maximum magnitude is the threshold of surface faulting earthquakes, which makes it appropriate for the background earthquake. The equations for these lines on Figure A-4 are:

$$AF_{7.5,100} = 0.11438 \times 10^{-0.99988(M-4.0)} - 0.000036$$

$$AF_{6.5,100} = 0.11438 \times 10^{-0.99988(M-4.0)} - 0.000362$$

where $AF_{7.5,100}$ and $AF_{6.5,100}$ are the annual frequencies of earthquakes within 100 km of the site truncated at maximum magnitudes of 7.5 and 6.5, and M is earthquake magnitude. The earthquake activity graph (Figure A-4) indicates that one earthquake of M 6.0 corresponds to an approximate annual frequency of 0.001, and should be expected to occur on average once every 1,000 years somewhere within 100 km of the Envirocare site.

The earthquake activity function can be normalized for areas smaller than the area of a circle with a 100-km radius (31,416 km^2). Normalized curves are shown on Figure A-4 corresponding to the two 100-km activity curves: the thin dash-dot line is the earthquake activity normalized to an area of 1,000 km^2 for a maximum magnitude of 7.5, whereas the thin dash-dot-dot line is normalized to an area of 1,000 km^2 for a maximum magnitude of 6.5. A 1,000-km^2 circle has a radius of 17.84 km. The normalized earthquake activity graph (Figure A-4) indicates that one earthquake of M 4.5 corresponds to an approximate annual frequency of 0.001, and should be

expected to occur on average once every 1,000 years somewhere within 17.84 km of the Envirocare site.

The Wasatch Front Region is a rectangular, 86,800-km^2 area studied by Pechmann and Arabasz (1995). The earthquake activity in the Wasatch Front Region is represented by the thick, closely spaced dashed line on Figure A-4. The equation for this line on Figure A-4 is:

$$AF_{7.75,WFR} = (3.2 \pm 0.3) \times 10^{(-0.72 \pm 0.06)(M_L - 3.0)} - 1.2^{+1.4}_{-0.6} \times 10^{-3}$$

where $AF_{7.75,WFR}$ is the annual frequency of earthquakes within the Wasatch Front Region truncated at a maximum magnitude of 7.75, and M_L is earthquake magnitude local scale. Other earthquake magnitudes used in this appendix are generally moment magnitude, which is comparable to local magnitude in the range of magnitudes considered in this study. The thick, widely spaced dashed line on Figure A-4 is the Wasatch Front Region earthquake activity normalized to a 1,000 km^2 area. The normalized activity curves for the Wasatch Front Region and the area within 100 km of the Envirocare site indicates that the site area has a lower level of earthquake activity than the Wasatch Front Region. The normalized earthquake activity graph for the Wasatch Front Region (Figure A-4) indicates that one earthquake of M 5.2 corresponds to an approximate annual frequency of 0.001, and should be expected to occur on average once every 1,000 years within an average 1,000-km^2 area. The normalized activity within 100 km of the site corresponds to one earthquake of M 4.5 occurring on average once every 1,000 years within an average 1,000-km^2 area.

The shaded box on Figure A-4 represents the average annual frequency of surface-faulting earthquakes in the Wasatch Front Region from Hecker (1993) as displayed in Pechmann and Arabasz (1995). The box covers a magnitude range of 6.5 to 7.0 and a range of recurrence intervals of 125 to 300 years. The horizontal line inside the box represents a preferred recurrence estimate of 176 years.

The ground motion at the site generated by the background earthquake was estimated with a Probabilistic Seismic Hazard Analysis (PSHA) using the computer program EZ-FRISK (Risk Engineering, 2005). The PSHA was calculated using the seismicity grids for the background source model generated by the United States Geological Survey (USGS) National Seismic Hazard Mapping Project which are included in EZ-FRISK.

EZ-FRISK uses the USGS seismicity grids to model the variable seismicity background source by placing a pseudo-fault at the latitude and longitude at each of the grid points considered at a range of depths and orientations. All grid points within 100 kilometers are included in the analysis, and processed with the same algorithm.

The peak horizontal accelerations for rock site conditions were developed using the 2002 gridded background earthquake source for the extensional part of the western United States in EZ-FRISK and attenuation relations of Abrahamson and Silva (1997), Campbell and Bozorgnia (2003), and Pankow and Pechmann (2004). Rock site conditions were assumed to have an average shear-wave velocity of 760 m/s in the upper 30 m of the profile. To account for the uncertainty in the ground motion attenuation relationships, each relationship was integrated to three standard deviations beyond the median. Weighting factors were used to develop the mean hazard curve from the EZ-FRISK output. Pankow and Pechmann's relation was developed from earthquakes generated in extensional tectonic regions representative of the Envirocare site, whereas the other two relations were developed from earthquakes generated in

tectonic regimes dominated by compressional tectonic features. Therefore, a weighting factor of 0.6 was applied to results from Pankow and Pechmann (2004). The remaining 0.4 weighting factor was divided evenly between Abrahamson and Silva (1997) and Campbell and Bozorgnia (2003).

The results of the PSHA for background earthquake sources are presented on Figure A-5. A peak horizontal acceleration of 0.146g is estimated from Figure A-5 corresponding to a 2 percent exceedance probability in 50 years, or a recurrence interval of 2,475 years. The value from the US Geological Survey PSHA for the site is 0.153 g, as shown on Figure A-3. The PSHA results on Figure A-5 are for the background source only, whereas those on Figure A-3 include fault sources, too. It can be seen on Figure A-5 that a 5,000-year peak horizontal acceleration on rock at the Envirocare site is approximately 0.2g

RECOMMENDED GROUND MOTION

The deterministic peak horizontal acceleration values for fault earthquake sources within about 70 km of the Envirocare site are summarized in Table A-2. Probabilistic peak horizontal acceleration values for the background earthquake source within 100 km of the site are shown on Figure A-5. The largest peak acceleration in Table A-2 corresponds to an M 7.1 earthquake generated by one of the Skull Valley faults. The faults are located no closer to the site than 30 km at the ground surface, but the fault dips toward the site, making the attenuation distance less than 30 km. The 84th percentile value is 0.261g, as calculated by the attenuation relation of Abrahamson and Silva (1997). For comparison, 84th percentile peak accelerations of 0.237 and 0.212g are calculated for the same earthquake by the Campbell and Bozorgnia (2003) and Pankow and Pechmann (2004) attenuation relations, respectively. The maximum magnitude of 7.1 comes from Wong and others (2002), but Swan and others (2004) report a maximum magnitude of 6.5 for the same fault. The lower maximum magnitude for the Skull Valley faults gives 84th percentile accelerations of 0.219, 0.168, and 0.154g for the three attenuation relations.

The second largest peak acceleration in Table A-2 corresponds to two different earthquakes for the three attenuation relations. A maximum magnitude of 7.0 on the Stansbury fault produces 84th percentile peak accelerations of 0.162 and 0.195g for the Pankow and Pechmann (2004) and Campbell and Bozorgnia (2003) relations, respectively. A maximum magnitude of 6.6 on the Cedar Mountains fault produces an 84th percentile acceleration of 0.242g for the Abrahamson and Silva (1997) relation.

Based on the review and update of earthquake ground motion at the Envirocare site described in this Appendix, A conservative, but reasonable deterministic maximum peak horizontal acceleration is 0.24g for rock site conditions. This maximum acceleration exceeds the 0.212g 84th percentile value predicted by the Pankow and Pechmann (2004) attenuation relation for any of the fault sources in the site region, and is approximately equal to the largest maximum 84th percentile value predicted by Campbell and Bozorgnia (2003) and the second largest 84th percentile value predicted by Abrahamson and Silva (1997). The probabilistic peak horizontal acceleration of 0.24g for the weighted mean hazard curve on Figure A-5 corresponds to an average recurrence interval of approximately 8,825 years.

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Table A-1. Selected data from 26 earthquakes within 100 km of the Envirocare site. Data from catalogs maintained by the University of Utah and the University of Nevada-Reno.

Year	Month	Day	North Latitude	West Longitude	Earthquake Magnitude	Site Distance (km)
1998	04	03	40.7568	-113.1897	2.00	9.87
1976	10	23	40.6723	-112.8315	1.30	23.81
1979	03	29	40.4807	-113.2092	2.20	24.69
1979	11	15	40.8668	-112.9173	2.00	25.58
1975	06	10	40.5408	-112.8650	1.20	26.71
1981	07	11	40.4573	-113.1952	1.70	26.82
2004	04	26	40.4685	-113.2412	1.07	26.95
1996	12	06	40.4627	-113.2773	2.32	28.89
1975	01	04	40.6602	-112.7690	1.20	29.20
1988	08	05	40.9568	-113.0798	1.90	29.71
1915	08	11	40.5000	-112.6500	4.30	44.46
1987	10	23	41.1963	-113.1693	4.20	56.39
1987	09	25	41.1957	-113.2137	4.30	56.77
1987	10	26	41.2008	-113.1777	4.70	56.95
1987	09	25	41.2068	-113.1357	4.10	57.38
1987	09	26	41.2090	-113.1500	4.00	57.68
1987	09	25	41.2135	-113.1318	4.80	58.12
1987	09	28	41.2267	-113.1808	4.00	59.84
1967	02	16	41.2733	-113.3338	4.00	67.37
1962	09	05	40.7153	-112.0888	5.20	86.52
1943	02	22	40.7000	-112.0800	5.00	87.23
1992	04	10	40.7000	-112.0800	4.30	87.23
1992	03	16	40.4702	-112.0448	4.20	93.60
1992	11	04	41.5098	-113.3878	4.80	93.91
1983	10	08	40.7480	-111.9927	4.30	94.78
1915	10	05	40.1000	-114.0000	4.30	99.91

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Table A-2. Deterministic ground motion estimates for rock site conditions at the Envirocare site.

Fault Name (USGS Number)	Horizontal Distance To Site (km)	Fault Dip (+, -, 0)	Maximum/ Characteristic Magnitude	Basis for Magnitude	Pankow & Pechmann, 2004			Campbell & Bozorgnia, 2003			Abrahamson & Silva, 1997		
					Dist (rjb)	PHA (g) Mean	PHA (g) 1 Sigma	Dist (rseis)	PHA (g) Mean	PHA (g) 1 Sigma	Dist (rrup)	PHA (g) Mean	PHA (g) 1 Sigma
Cedar Mountains (east side) (2385)	23	-	6.6	Wong	23.0	0.083	0.139	25.3	0.103	0.173	23.0	0.149	0.242
Puddle Valley (2383)	30	0	6.5	Threshold	30.0	0.061	0.102	30.1	0.080	0.139	30.0	0.107	0.177
Skull Valley (mid-valley) (2387)	30	+	6.8	Wong	19.5	0.108	0.181	24.6	0.120	0.198	24.6	0.150	0.238
Skull Valley (mid-valley) (2387)	30	+	6.5	Swan	19.5	0.092	0.154	24.6	0.099	0.168	24.6	0.133	0.219
Lakeside Mountains (west side) (2384)	31	+	6.5	Threshold	20.5	0.088	0.147	25.4	0.096	0.163	25.4	0.129	0.212
Springline (n/a)	35	+	6.8	Wong	24.5	0.087	0.146	28.7	0.103	0.173	28.7	0.128	0.203
Stansbury (2395)	35	+	7.0	Swan	24.5	0.097	0.162	28.7	0.118	0.195	28.7	0.140	0.215
East Lakeside Mountains (2368)	57	-	6.9	SRL	57.0	0.039	0.065	59.2	0.052	0.092	57.0	0.066	0.102
Silver Island Mountains (west side) (2381)	65	-	6.5	Threshold	65.0	0.028	0.046	67.2	n/a	n/a	65.0	0.046	0.075
Clover (2396)	68	0	6.5	Threshold	68.0	0.026	0.044	68.1	n/a	n/a	68.0	0.043	0.071
Saint John Station (2397)	70	+	6.5	Threshold	59.5	0.030	0.051	61.4	n/a	n/a	61.4	0.049	0.080
East Great Salt Lake (Fremont Island section) (2369b)	75	+	7.5	Wong	64.5	0.047	0.079	66.2	n/a	n/a	66.2	0.079	0.121

Notes: USGS Number: USGS Quaternary Fault and Fold Database; data reports for each fault are included in the Sub-Appendix A
Fault Dip: + = dip toward site; - = dip away from site; 0 = fault strike toward site; dip assumed to be 55 degrees for all faults
Maximum/Characteristic Magnitude: Moment Magnitudes; mean or expected values; minimum surface rupture magnitude assumed to be 6.5
Basis for Magnitude: Wong = Wong et al., 2002; Threshold = fault rupture minimum; Swan = Swan et al., 2004; SRL = surface rupture length (Wells & Coppersmith, 1994)
Dist (rjb): Joyner-Boore distance; horizontal distance to vertical projection of fault; faults assumed to extend to 15 km depth; km
Dist (rseis): Seismogenic distance; shortest distance to fault at or below 'seismogenic' depth, which is taken to be 3 km; km
Dist (rrup): Rupture distance; shortest distance to rupturing part of fault; km

This revised Table A-2 has been obtained from AMEC, April 28, 2006, Round 2 Interrogatories and Response, Class A Embankment Height Study, Energy Solutions Facility, Near Clive, Utah. See Page 4 Section 2 of this update report (AMEC, 2/15/11) for further details regarding seismic hazard analysis.

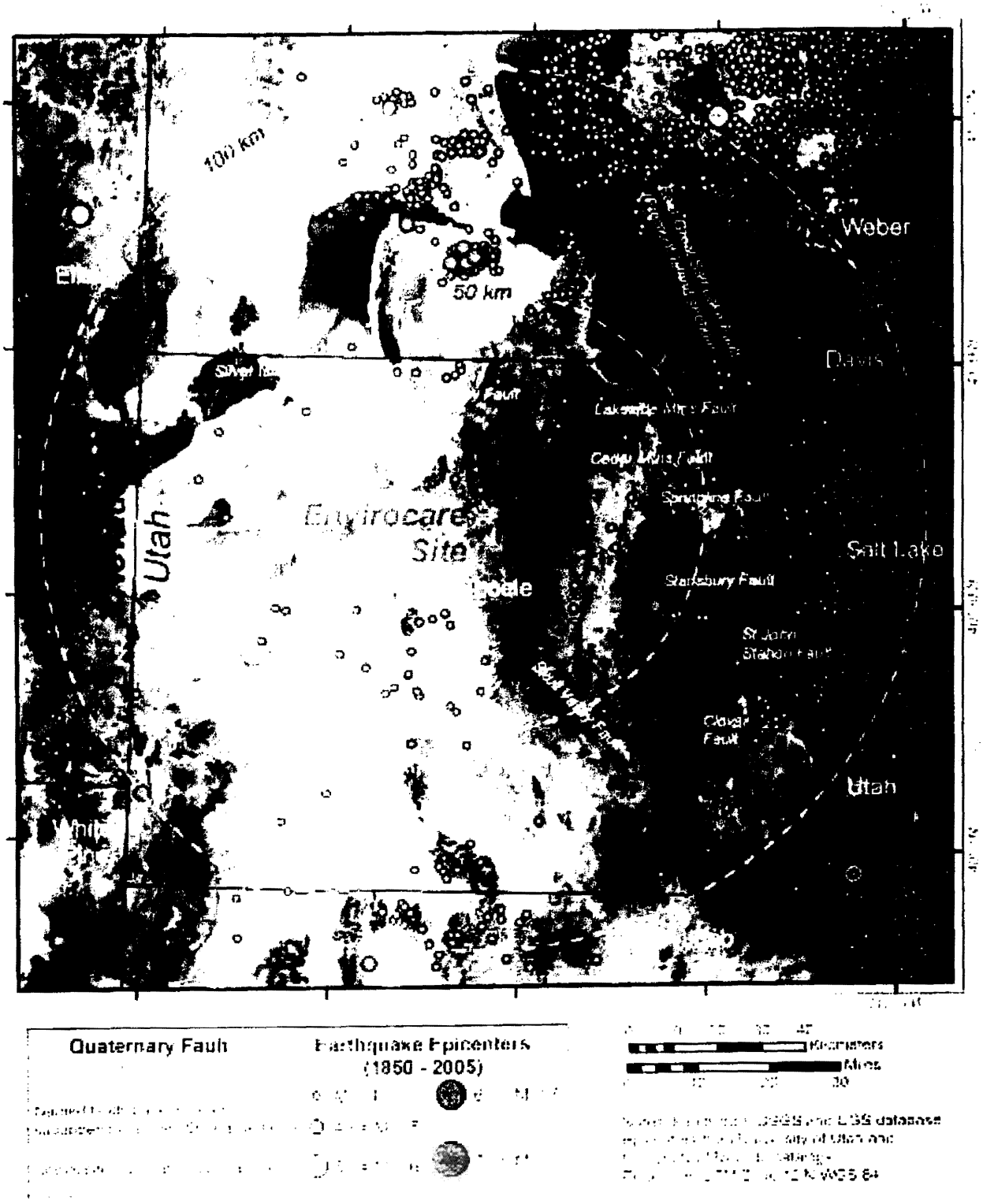

Figure A-1. Earthquake epicenters and Quaternary faults in the Envirocare site region, western Utah and eastern Nevada.

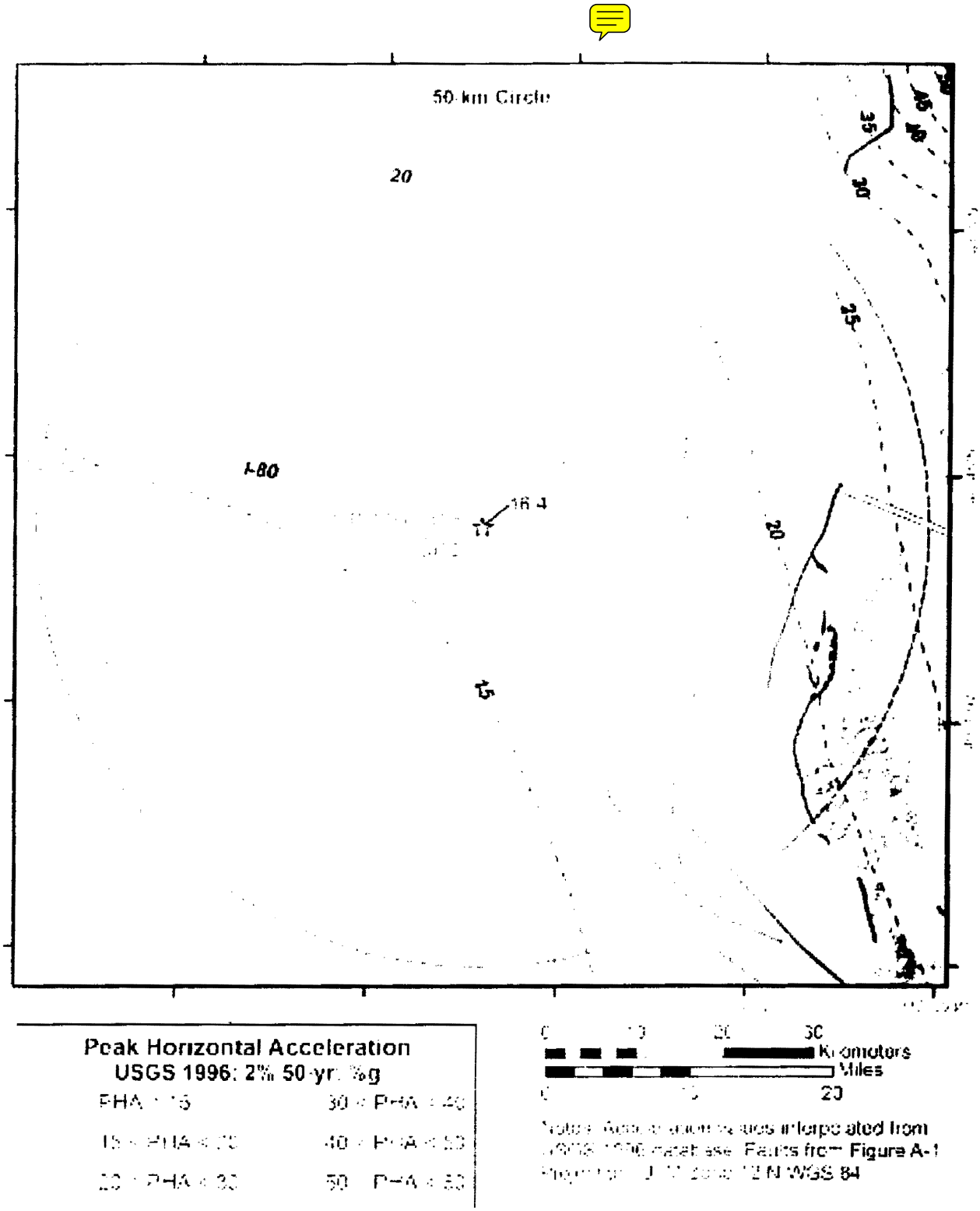

Figure A-2. Peak acceleration values for rock site conditions interpolated from the 1996 US Geological Survey seismic hazard mapping project.

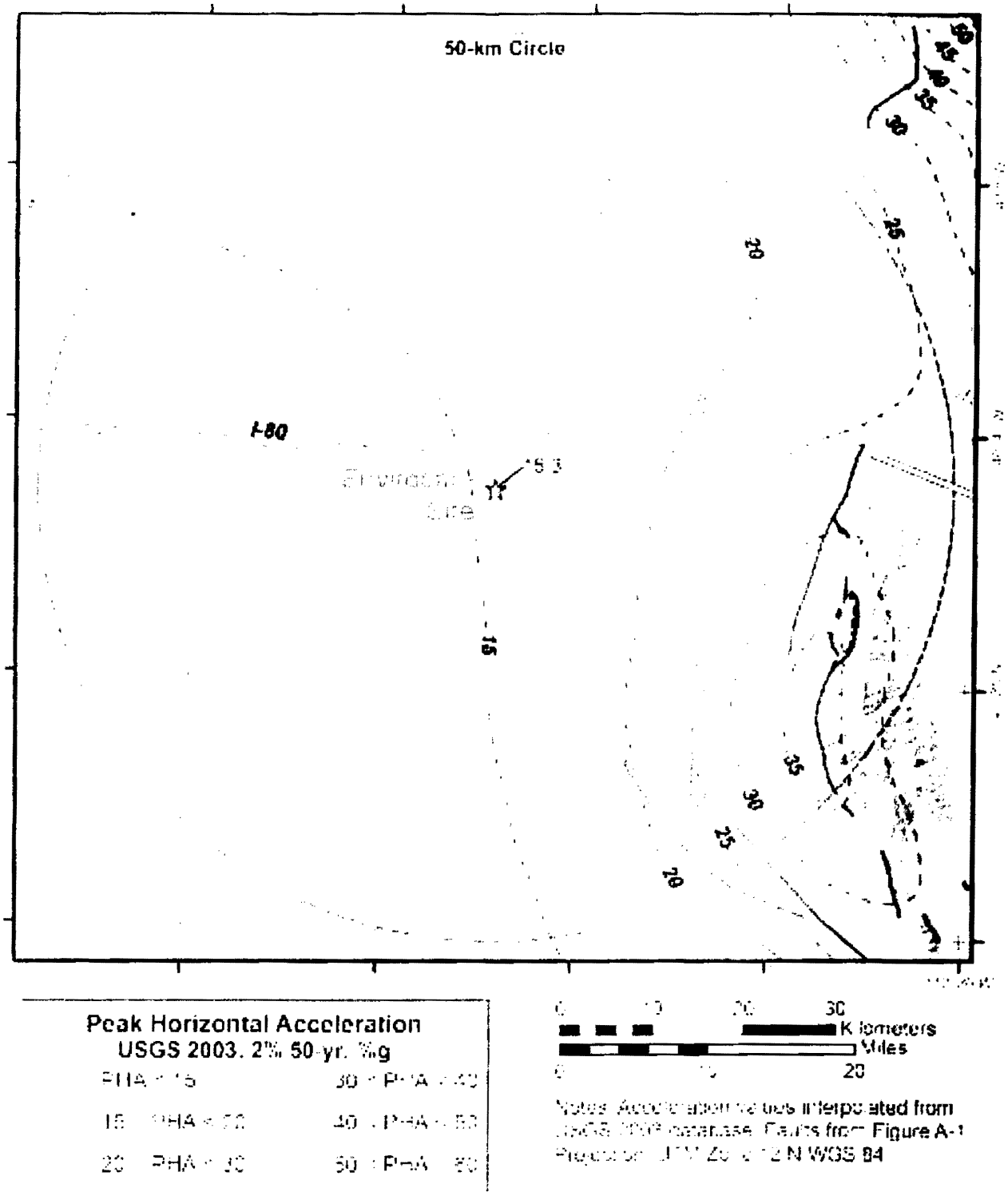

Figure A-3. Peak acceleration values for rock site conditions interpolated from the 2003 US Geological Survey seismic hazard mapping project.

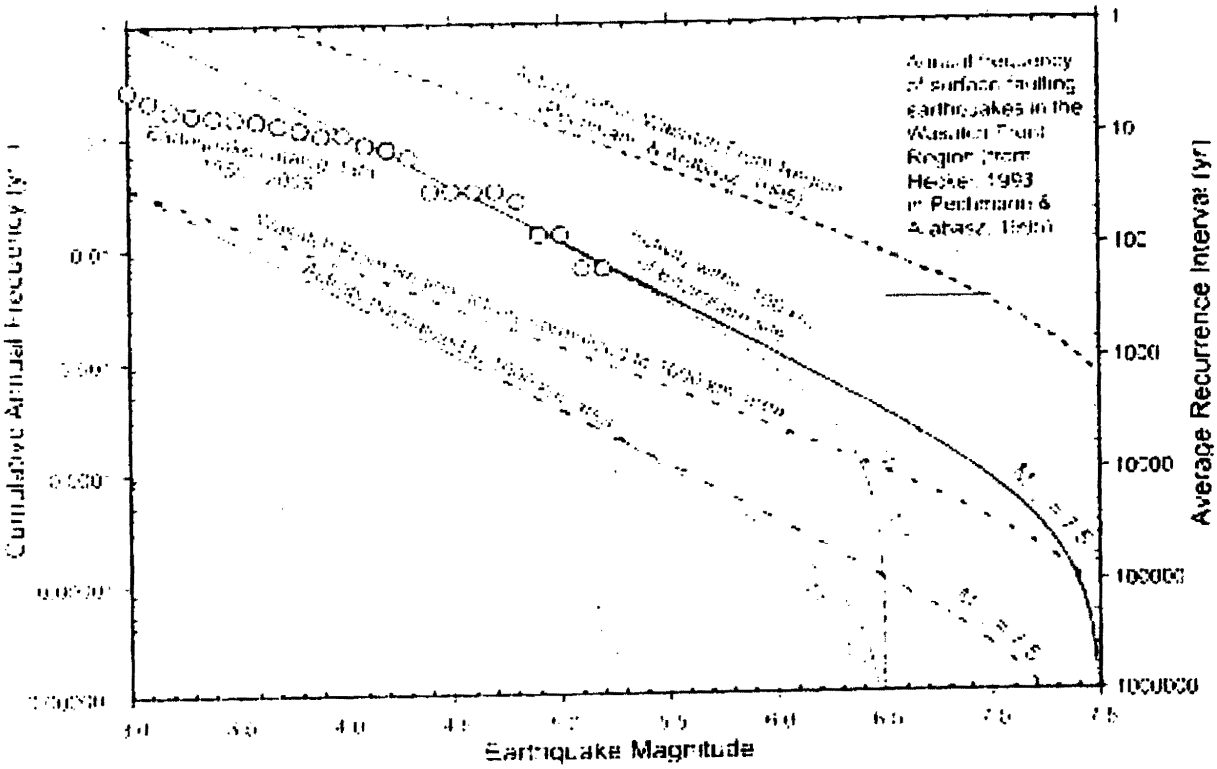

Figure A-4. Earthquake activity within 100 km of the Envirocare site.

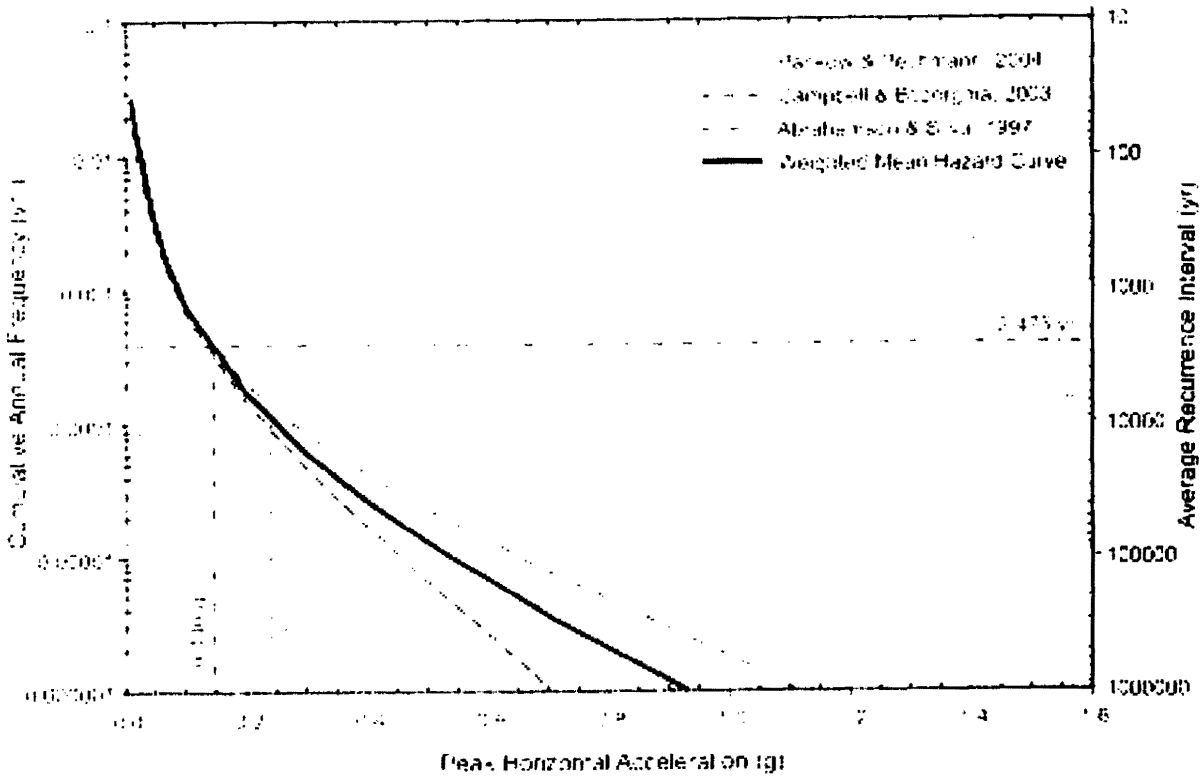

Figure A-5. Probabilistic seismic hazard curve for rock site conditions generated by the background earthquake source at the Envirocare site.

Complete Report for Cedar Mountains (east side) faults (Class A) No. 2385

Brief Report || Partial Report

In cooperation with the Utah Geological Survey

citation for this record: Black, B.D., and Hecker, S., compilers, 1999, Fault number 2385, Cedar Mountains (east side) faults, in Quaternary fault and fold database of the United States, ver 1.0: U.S. Geological Survey Open-File Report 03-417, http://qfaults.cr.usgs.gov.

Synopsis:	Poorly understood Quaternary(?) faults on the east side of the Cedar Mountains.
	Name Comments: **Number Comments:** Refers to fault number 7-9 of Hecker (1993 #642).
State(s):	Utah
County(s)	Tooele
AMS sheet(s):	Tooele view map
Physiographic province(s):	Basin and Range province
Geologic setting:	Short north-trending normal faults along the eastern side of the Cedar Mountains. The Cedar Mountains are the westernmost and lowest of three distinctive north-south mountain ranges in the Basin and Range west of the high central part of the Wasatch Range.

Reliability of location:	Poor. Compiled at 1:250,000 scale. *Comments:* Fault traces from mapping of Barnhard and Dodge (1988 #429). Faults are also included on map in Arabasz and others (1989 #4515) and Geomatrix (1999 #4513).
Length (km):	9.9 *Comments:*
Average strike:	N6°E
Sense of movement:	Normal *Comments:*
Dip:	E *Comments:*
Paleoseismology studies:	
Geomorphic expression:	Barnhard and Dodge (1988 #429) identified photo lineaments that possibly represent fault scarps, but the lineaments were not field checked or investigated. The lineaments were not mapped as faults by Sack (1993 #4514), who shows Lake Bonneville shorelines in the area of the northern traces. Hood and Waddell (1968 #4516) inferred a fault along the eastern margin of the Cedar Mountains, south of the faults mapped by Barnhard and Dodge (1988 #429), and Geomatrix (1999 #4513) inferred a fault along the entire eastern front of the Cedar Mountains.
Age of faulted surficial deposits:	Quaternary (?)
Year of historic deformation:	
Most recent prehistoric deformation:	Quaternary (<1.6 Ma) *Comments:* Geomatrix Consultants, Inc. (1999

	#4513) found no definitive evidence of post-Bonneville (<15 ka) displacement, but could not preclude the possibility of middle or late Pleistocene displacement.
Recurrence interval:	*Comments:*
Slip-rate category:	less than 0.2 mm/yr *Comments:* Poor geomorphic expression and lack of post-Bonneville (<15 ka) displacement indicate a low slip rate.
Compiled or modified by and affiliation:	Bill D. Black, Utah Geological Survey; Suzanne Hecker, U.S. Geological Survey, 1999
References:	#4515 Arabasz, W.J., Pechmann, J.C., and Brown, E.D., 1989, Evaluation of seismicity relevant to the proposed siting of a Superconducting Supercollider (SSC) in Tooele County, Utah: Utah Geological and Mineral Survey Miscellaneous Publication 89-1, p. 107. #429 Barnhard, T.P., and Dodge, R.L., 1988, Map of fault scarps formed on unconsolidated sediments, Tooele 1°x2° quadrangle, northwestern Utah: U.S. Geological Survey Miscellaneous Field Studies Map MF-1990, 1 sheet, scale 1:250,000. #4513 Geomatrix Consultants, I., 1999, Fault evaluation study and seismic hazard assessment, Private Fuel Storage Facility, Skull Valley, Utah: Technical report to Stone and Webster Engineering Corporation, San Francisco, California, under Contract 4790, 118 p., scale 1:100,000. #642 Hecker, S., 1993, Quaternary tectonics of Utah with emphasis on earthquake-hazard characterization: Utah Geological Survey Bulletin 127, 157 p., 6 pls., scale 1:500,000. #4516 Hood, J.W., and Waddell, K.M., 1968, Hydrologic reconnaissance of Skull Valley, Tooele County, Utah: Utah Department of Natural

	Resources Technical Publication No. 18, 57 p. #4514 Sack, D., 1993, Quaternary geologic map of Skull Valley, Tooele County, Utah: Utah Geological Survey Map 150, 16 p. pamphlet, scale 1:100,000.

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Complete Report for Skull Valley (mid-valley) faults (Class A) No. 2387

Brief Report || Partial Report

In cooperation with the Utah Geological Survey

citation for this record: Solomon, B.J., Christenson, G.E., and McDonald, G.N., compilers, 1999, Fault number 2387, Skull Valley (mid-valley) faults, in Quaternary fault and fold database of the United States, ver 1.0: U.S. Geological Survey Open-File Report 03-417, http://qfaults.cr.usgs.gov.

Synopsis:	Poorly understood Quaternary fault zone comprised of northwest-trending normal faults in southern Skull Valley and a northeast-trending normal fault in northern Skull Valley. A detailed geotechnical study at the Skull Valley site [2387-1] includes surface reconnaissance, aerial-photo interpretation, seismic-reflection and gravity surveys, boreholes, test pits, and shallow trenches. The latest movement on the fault zone is younger than the formation of the Provo shoreline (12 ka) of Lake Bonneville.
	Name Comments: **Number Comments:** Not included in Hecker (1993 #642)
State(s):	Utah
County(s):	Tooele
AMS sheet(s):	Tooele view map
Physiographic:	Basin and Range province

[illegible]	
Geologic setting	Northwest-trending normal faults in southern Skull Valley and a northeast-trending normal fault in northern Skull Valley. Surficial geology in the valley is dominated by lake deposits and alluvium. The valley is bounded on the west by the Cedar Mountains and on the east by the Stansbury Mountains, both composed mainly of Paleozoic rocks.
Reliability of location:	Poor. Compiled at 1:100,000 scale. *Comments:* Fault traces from mapping by Geomatrix Consultants, Inc. (1999 #4513).
Length (km):	54.8 *Comments:*
Average strike:	N24°W
Sense of movement:	Normal *Comments:*
Dip:	SW, NW *Comments:*
Paleoseismology studies:	Geomatrix Consultants, Inc. (1999 #4513) conducted a detailed geotechnical study at the Skull Valley site [2387-1] that included surface reconnaissance, aerial-photo interpretation, seismic-reflection and gravity surveys, boreholes, test pits, and shallow trenches. Offset Pleistocene geomorphic surfaces and seismic reflectors were used to estimate fault slip rates.
Geomorphic expression:	Geomatrix Consultants, Inc. (1999 #4513) identified two faults, the east and west faults, in southern Skull Valley from seismic shear-wave and reflection surveys. The east fault coincides, in part, with prominent linear reaches of Indian Hickman Creek and a topographic escarpment along the west flank of Castle Rock Knoll. The

	west fault coincides with linear drainages and tonal lineaments identified on aerial photographs along the western boundary of Hickman Knolls. Small faults identified on seismic lines between the east and west faults, referred to by Geomatrix Consultants, Inc. (1999 #4513) as the zone of distributed faulting, are interpreted to be the result of secondary deformation in the hanging wall of the east fault. A fault in northern Skull Valley is inferred from the linearity of the locations of the warm saline springs between Iosepa and Timpie. Geomatrix Consultants, Inc. (1999 #4513) refers to this as the Springline fault, earlier mapped by Rigby (1958 #4518), Hood and Wadell (1968 #4516), and Helm (1994 #4517).
Age of faulted surficial deposits:	Late Pleistocene-Holocene(?). In the subsurface, the youngest faults in southern Skull Valley offset a reflector interpreted to be at the base of the Bonneville Alloformation (28 ka) (Geomatrix Consultants, 1999 #4513). At the surface, the east fault truncates an alluvial fan of Bull Lake age or older (>160 ka) and lies between the Provo shoreline (12-14.3 ka) at a higher elevation in the footwall than in the hanging wall. The projected trace of the west fault coincides with possible vertical displacements of a Stansbury-age (20-22 ka) cross-valley (Geomatrix Consultants, 1999 #4513). Quaternary activity has not been documented for the springline fault, but it may be a northward extension of the east fault.
Year of historic deformation:	
Most recent prehistoric deformation:	Latest Quaternary (<15 ka) *Comments:* Later than the formation of the Provo shoreline (<12 ka).
Recurrence interval:	*Comments:*
Slip-rate category:	less than 0.2 mm/yr *Comments:* Geomatrix Consultants, Inc. (1999 #4513) estimated slip rates of 0.1-0.3 mm/yr for

	the east fault, and 0.05-0.07 mm/yr for the west fault. The slip rate for the west fault is based on a single event, and Geomatrix considers it to be not very reliable.
Compiled or modified by and affiliation:	Barry J. Solomon, Utah Geological Survey; Gary E. Christenson, Utah Geological Survey; Greg N. McDonald, Utah Geological Survey, 1999
References:	#4513 Geomatrix Consultants, I., 1999, Fault evaluation study and seismic hazard assessment, Private Fuel Storage Facility, Skull Valley, Utah: Technical report to Stone and Webster Engineering Corporation, San Francisco, California, under Contract 4790, 118 p., scale 1:100,000. #642 Hecker, S., 1993, Quaternary tectonics of Utah with emphasis on earthquake-hazard characterization: Utah Geological Survey Bulletin 127, 157 p., 6 pls., scale 1:500,000. #4517 Helm, J.M., 1994, Structure and tectonic geomorphology of the Stansbury fault zone, Tooele County, Utah, and the effect of crustal structure on Cenozoic Faulting patterns: Salt Lake City, University of Utah, unpublished M.S. thesis, 128 p. #4516 Hood, J.W., and Waddell, K.M., 1968, Hydrologic reconnaissance of Skull Valley, Tooele County, Utah: Utah Department of Natural Resources Technical Publication No. 18, 57 p. #4518 Rigby, J.K., 1958, Geology of the Stansbury Mountains, eastern Tooele County, Utah, in J.K., R., ed., Geology of the Stansbury Mountains, Tooele County, Utah: Utah Geological Society Guidebook to the Geology of Utah No. 13, p. 1-134.

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Complete Report for Stansbury fault zone (Class A) No. 2395

Brief Report || Partial Report

In cooperation with the Utah Geological Survey

citation for this record: Black, B.D., and Hecker, S., compilers, 1999, Fault number 2395, Stansbury fault zone, in Quaternary fault and fold database of the United States, ver 1.0: U.S. Geological Survey Open-File Report 03-417, http://qfaults.cr.usgs.gov.

Synopsis:	Moderately to poorly understood Quaternary fault zone along the western side of the Stansbury Mountains.
	Name Comments: **Number Comments:** Refers to fault number 7-10 of Hecker (1993 #642).
State(s):	Utah
County(s):	Tooele
AMS sheet(s):	Tooele view map
Physiographic province(s):	Basin and Range province
Geologic setting:	Generally north-trending normal fault zone bounding the western side of the Stansbury Mountains. The Stansbury Mountains expose mainly Paleozoic rock, and are the centermost of three prominent north-south mountain ranges

	(including the Oquirrh Mountains to the east and Cedar Mountains to the west) west of the high central part of the Wasatch Range. Surficial geology in the valleys between the ranges is dominated by lake deposits and alluvium.
Reliability of location	Good. Compiled at 1:250,000 scale. *Comments:* Mapped or discussed by Everitt and Kaliser (1980 #4524), Barnhard and Dodge (1988 #429), Sack (1993 #4514), Helm (1994 #4517), and Geomatrix Consultants, Inc. (1999 #4513). Fault traces from Sack (1993 #4514) and 1:250,000-scale mapping of Barhard and Dodge (1988 #429) .
Length (km):	49.8 *Comments:*
Average strike:	N17°W
Sense of movement:	Normal *Comments:*
Dip:	W *Comments:*
Paleoseismology studies:	
Geomorphic expression:	The surface trace of the Stansbury fault is simple in the southern half of the fault (south of Pass Canyon) but complex to the north, suggesting the fault may consist of two independent sections. A down-to-the-south cross-fault at Pass Canyon forms the boundary between the sections (Helm, 1994 #4517). In the south, a single fault strand consisting of a main fault and a subsidiary antithetic fault cuts Quaternary alluvial fans and forms a narrow (about 20-m-wide) graben along most of the fault trace (Helm, 1994 #4517). North of Pass Canyon, the trace is a complex fault zone consisting of multiple synthetic and antithetic fault

	traces showing evidence of Quaternary movement. Based on scarp morphology and observation of stream knickpoints a short distance from the fault trace, Everitt and Kaliser (1980 #4524) concluded that the most recent movement was during the Holocene. Helm (1994 #4517) reports maximum scarp angle vs. scarp height plots suggest the Stansbury fault is generally older than the highstand of Lake Bonneville. However, Geomatrix Consultants, Inc. (1999 #4513) states that the southern section of the fault is inferred to have moved in a single event during the early to middle Holocene. From scarp-profile data collected by Geomatrix Consultants, Inc. (1999 #4513), the Stansbury scarps of the southern section appear younger than the Sheeprock [2405], Topliff Hill [2407] and Mercur [2399] fault scarps. Measured scarp heights are from 3.9 to 49.5 m, though net tectonic displacement may be less.
Age of faulted surficial deposits:	Early to middle Holocene and late Pleistocene.
Year of historic deformation:	
Most recent prehistoric deformation:	Latest Quaternary (<15 ka) *Comments:* Helm (1994 #4517) reports scarps in the north section are modified by shoreline processes, indicating a pre-Bonneville age (>16.8 ka). However, Sack (1993 #4514) indicates air-photo evidence for displaced intermediate and Bonneville shorelines, and maps faults in Lake Bonneville and younger deposits in the northern section. Helm (1994 #4517) observed no evidence to indicate an age for the southern section, which may be younger. Geomatrix Consultants, Inc. (1999 #4513) reports that the geomorphic position of a displaced stream terrace and relatively subdued character of the fault scarp suggests early to middle Holocene (6-10 ka) displacement along the southern section.
Recurrence interval:	*Comments:*

[illegible] category	less than 0.2 mm/yr *Comments:* Helm (1994 #4517) estimated an average slip rate of 0.26 mm/yr based on diffusion modeling of the scarps, but notes this rate is tentative and possibly high. Geomatrix Consultants, Inc. (1999 #4513) estimated a slip rate of 0.39 mm/yr, summing slip rates on individual traces across the fault zone in post-35 ka alluvial-fan and post-18 ka lacustrine deposits west of Indian Hickman Canyon. Slip rates on individual traces range from 0.11-0.15 mm/yr.
Compiled or modified by and affiliation:	Bill D. Black, Utah Geological Survey; Suzanne Hecker, U.S. Geological Survey, 1999
References:	#429 Barnhard, T.P., and Dodge, R.L., 1988, Map of fault scarps formed on unconsolidated sediments, Tooele 1° x 2° quadrangle, northwestern Utah: U.S. Geological Survey Miscellaneous Field Studies Map MF-1990, 1 sheet, scale 1:250,000. #4524 Everitt, B.L., and B.N., K., 1980, Geology for assessment of seismic risk in the Tooele and Rush Valleys, Tooele County, Utah: Utah Geological and Mineral Survey Special Studies 51, 33 p. #4513 Geomatrix Consultants, I., 1999 (revised 2001), Fault evaluation study and seismic hazard assessment, Private Fuel Storage Facility, Skull Valley, Utah: Technical report to Stone and Webster Engineering Corporation, San Francisco, California, under Contract 4790, 118 p., scale 1:100,000. #642 Hecker, S., 1993, Quaternary tectonics of Utah with emphasis on earthquake-hazard characterization: Utah Geological Survey Bulletin 127, 157 p., 6 pls., scale 1:500,000. #4517 Helm, J.M., 1994, Structure and tectonic geomorphology of the Stansbury fault zone, Tooele County, Utah, and the effect of crustal structure on Cenozoic Faulting patterns: Salt Lake City, University of Utah, unpublished M.S.

	thesis, 128 p. #4514 Sack, D., 1993, Quaternary geologic map of Skull Valley, Tooele County, Utah: Utah Geological Survey Map 150, 16 p. pamphlet, scale 1:100,000.

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Complete Report for Silver Island Mountains (west side) fault (Class A) No. 2381

Brief Report || Partial Report

In cooperation with the Utah Geological Survey

citation for this record: Black, B.D., and Hecker, S., compilers, 1999, Fault number 2381, Silver Island Mountains (west side) fault, in Quaternary fault and fold database of the United States, ver 1.0: U.S. Geological Survey Open-File Report 03-417, http://qfaults.cr.usgs.gov.

Synopsis:	Poorly understood Quaternary(?) fault along the western side of the Silver Island Mountains, west of the Great Salt Lake Desert in northwestern Utah.
	Name Comments: **Number Comments:** Refers to fault number 7-4 of Hecker (1993 #642).
State(s):	Utah
County(s):	Tooele
AMS sheet(s):	Tooele view map
Physiographic province(s):	Basin and Range province
Geologic setting:	Short, generally northeast-trending normal fault along the western side of the Silver Island Mountains, west of the Great Salt Lake Desert in northwestern Utah.

Reliability of location	Poor. Compiled at 1:250,000 scale. *Comments:* Fault traces from mapping of Moore and Sorensen (1979 #4512)
Length (km)	6.4 *Comments:*
Average strike:	N19°E
Sense of movement:	Normal *Comments:*
Dip:	NW *Comments:*
Paleoseismology studies:	
Geomorphic expression:	Linear range-front contact between bedrock and unconsolidated alluvium.
Age of faulted surficial deposits:	Quaternary (?)
Year of historic deformation:	
Most recent prehistoric deformation:	Quaternary (<1.6 Ma) *Comments:* Based on fault control of the bedrock-alluvium contact.
Recurrence interval:	*Comments:*
Slip-rate category:	less than 0.2 mm/yr *Comments:* Poor geomorphic expression (linear range-front only) indicates a low slip rate.
Compiled by:	Bill D. Black, Utah Geological Survey; Suzanne

modified by date affiliation	Hecker, U.S. Geological Survey, 1999
References	#642 Hecker, S., 1993, Quaternary tectonics of Utah with emphasis on earthquake-hazard characterization: Utah Geological Survey Bulletin 127, 157 p., 6 pls., scale 1:500,000. #4512 Moore, W.J., and Sorensen, M.L., 1979, Geologic map of the Tooele 1° x 2° quadrangle, Utah: U.S. Geological Survey Miscellaneous Investigations Map I-1132, scale 1:250,000.

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Complete Report for Saint John Station fault zone (Class A) No. 2397

Brief Report || Partial Report

In cooperation with the Utah Geological Survey

citation for this record: Black, B.D., and Hecker, S., compilers, 1999, Fault number 2397, Saint John Station fault zone, in Quaternary fault and fold database of the United States, ver 1.0: U.S. Geological Survey Open-File Report 03-417, http://qfaults.cr.usgs.gov.

Synopsis:	Poorly understood zone of late Quaternary faults near Saint John Station in southern Rush Valley.
	Name Comments: **Number Comments:** Refers to fault number 7-13 of Hecker (1993 #642).
State(s):	Utah
County(s):	Tooele
AMS sheet(s):	Tooele view map
Physiographic province(s):	Basin and Range province
Geologic setting:	Several short northwest-trending normal faults in southern Rush Valley. Surficial geology of the valley is dominated by lake deposits and alluvium.
	Good.

Reliability of location	Compiled at 1:250,000 scale. *Comments:* Mapped or discussed by Everitt and Kaliser (1980 #4524), Barnhard and Dodge (1988 #429), and Krinitsky (1989 #4525). Fault traces from 1:250,000-scale mapping of Barnhard and Dodge (1988 #429).
Length (km):	5.2 *Comments:*
Average strike:	N19°W
Sense of movement:	Normal *Comments:*
Dip:	SW and NE *Comments:*
Paleoseismology studies:	
Geomorphic expression:	Wide zone of discontinuous en-echelon scarps in Quaternary alluvium and pre-Bonneville gravel-capped pediments. The scarps are topographically below the Bonneville highstand, and do not deform Lake Bonneville spit deposits crossing the fault scarps (Everitt and B.N., 1980 #4524). Unmapped, small displacement faults in alluvium are also several kilometers to the southeast, within a portion of the Tooele Army Depot, and are buried beneath an unfaulted soil estimated to be older than 125 ka (Krinitzsky, 1989 #4525).
Age of faulted surficial deposits:	Late Pleistocene
Year of historic deformation:	
Most recent prehistoric deformation:	Late Quaternary (<130 ka) *Comments:*

[illegible] interval	*Comments:*
Slip rate category	less than 0.2 mm/yr *Comments:* Lack of post-Bonneville displacement indicates a low slip rate.
Compiled or modified by and affiliation.	Bill D. Black, Utah Geological Survey; Suzanne Hecker, U.S. Geological Survey, 1999
References:	#429 Barnhard, T.P., and Dodge, R.L., 1988, Map of fault scarps formed on unconsolidated sediments, Tooele 1°x2° quadrangle, northwestern Utah: U.S. Geological Survey Miscellaneous Field Studies Map MF-1990, 1 sheet, scale 1:250,000. #4524 Everitt, B.L., and B.N., K., 1980, Geology for assessment of seismic risk in the Tooele and Rush Valleys, Tooele County, Utah: Utah Geological and Mineral Survey Special Studies 51, 33 p. #642 Hecker, S., 1993, Quaternary tectonics of Utah with emphasis on earthquake-hazard characterization: Utah Geological Survey Bulletin 127, 157 p., 6 pls., scale 1:500,000. #4525 Krinitzsky, E.L., 1989, Empirical earthquake ground motions for an engineering site with fault sources–Tooele Army Depot, Utah: Bulletin of the Association of Engineering Geologists, v. 26, no. 3, p. 283-308.

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Complete Report for Puddle Valley fault zone (Class A) No. 2383

Brief Report || Partial Report

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citation for this record: Black, B.D., and Hecker, S., compilers, 1999, Fault number 2383, Puddle Valley fault zone, in Quaternary fault and fold database of the United States, ver 1.0: U.S. Geological Survey Open-File Report 03-417, http://qfaults.cr.usgs.gov.

Synopsis:	Three short faults in Quaternary basin-fill deposits east of the Grassy Mountains in northwestern Utah.
	Name Comments: **Number Comments:** Refers to fault number 7-16 of Hecker (1993 #642).
State(s):	Utah
County(s):	Tooele
AMS sheet(s):	Tooele view map
Physiographic province(s):	Basin and Range province
Geologic setting:	Characeterized by generally north-trending normal faults in Puddle Valley, between the Lakeside and Grassy Mountains in western Utah. Surficial geology of the valley is dominated by deposits of late Pleistocene Lake Bonneville.

Reliability of location:	Good. Compiled at 1:250,000 scale. *Comments:* Fault traces from mapping of Barnhard and Dodge (1988 #429)
Length (km):	6.5 *Comments:*
Average strike:	N10°E
Sense of movement:	Normal *Comments:*
Dip:	E *Comments:*
Paleoseismology studies:	
Geomorphic expression:	The fault zone displaces Quaternary basin-fill (primarily lacustrine) deposits down to the east and is topographically below the Bonneville and Provo shorelines. Barnhard and Dodge (1988 #429) measured eight profiles across scarps in the fault zone; scarp heights range from 1.3 to 4.4 m and maximum scarp slope angles are 6.5°-13.5°; displacement per event is 0.7-2.3 m. Fault-scarp morphology suggests two spatially distinct surface-faulting events; surface faulting associated with scarps in the southern end of the fault zone appears younger than the northern end (Barnhard and Dodge, 1988 #429). Scarps in the northern end have heights greater than 2 m, whereas scarps in the southern end are less than 2 m high.
Age of faulted surficial deposits:	Late Pleistocene basin-fill (primarily lacustrine) deposits
Year of historic deformation:	
Most recent	Latest Quaternary (<15 ka)

[illegible]	*Comments:* Scarps at the north end of the fault zone appear older than the Bonneville shoreline (14.5 ka), whereas those at the south end appear to be younger than the shoreline but older than the Drum Mountains [2432] fault scarps (dated at 9 ka).
Recurrence interval:	*Comments:*
Slip-rate category:	less than 0.2 mm/yr *Comments:* Estimated slip rate is 0.05-0.26 mm/yr. Thus, we categorize the fault as being <0.2 mm/yr.
Compiled or modified by and affiliation:	Bill D. Black, Utah Geological Survey; Suzanne Hecker, U.S. Geological Survey, 1999
References:	#429 Barnhard, T.P., and Dodge, R.L., 1988, Map of fault scarps formed on unconsolidated sediments, Tooele 1°x2° quadrangle, northwestern Utah: U.S. Geological Survey Miscellaneous Field Studies Map MF-1990, 1 sheet, scale 1:250,000. #642 Hecker, S., 1993, Quaternary tectonics of Utah with emphasis on earthquake-hazard characterization: Utah Geological Survey Bulletin 127, 157 p., 6 pls., scale 1:500,000.

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Complete Report for Lakeside Mountains (west side) fault (Class B) No. 2384

Brief Report || Partial Report

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citation for this record: Black, B.D., compiler, 1999, Fault number 2384, Lakeside Mountains (west side) fault, in Quaternary fault and fold database of the United States, ver 1.0: U.S. Geological Survey Open-File Report 03-417, http://qfaults.cr.usgs.gov.

Synopsis:	Poorly understood lineament along the western flank of the Lakeside Mountains west of Great Salt Lake. The feature is either a Quaternary fault or a shoreline feature of Lake Bonneville. Owing to the uncertainity of the origin of this feature, we consider it to be a Class B feature.
	Name Comments: **Number Comments:** Refers to fault number 7-5 of Hecker (1993 #642).
State(s):	Utah
County(s):	Tooele
AMS sheet(s):	Tooele view map
Physiographic province(s):	Basin and Range province
Geologic setting:	Northwest trending range-front fault(?) along the western flank of the Lakeside Mountains and

	southeast side of Puddle Valley in western Utah. Surficial geology of the valley is dominated by deposits of late Pleistocene Lake Bonneville.
Reliability of location:	Good. Compiled at 1:250,000 scale. *Comments:* Mapped or discussed by Young (1955 #5019), Moore and Sorensen (1979 #4512), and Arabasz and others (1989 #4515). Fault trace from mapping of Moore and Sorensen (1979 #4512).
Length (km):	4.7 *Comments:*
Average strike:	N25°W
Sense of movement:	Normal *Comments:*
Dip:	SW *Comments:*
Paleoseismology studies:	
Geomorphic expression:	Lineament is along bedrock-alluvium contact. Arabasz and others (1989 #4515) include the feature as a fault (queried as to activity) in a seismic-source compilation for the region. They referenced T.P. Barnhard as identifying the feature as a lineament that is probably not related to faulting; the lineament parallels topography and thus may be a shoreline feature. Owing to the uncertainity of the origin of this feature, we consider it to be a Class B feature.
Age of faulted surficial deposits:	Deposits of late Pleistocene Lake Bonneville (undifferentiated).
Year of historic deformation:	

Most recent prehistoric deformation:	Late Quaternary (<130 ka) *Comments:* Timing of possible faulting controlled by age of deposits on which the lineament is mapped. These are deposits of late Pleistocene Lake Bonneville (undifferentiated, <130 ka).
Recurrence interval:	*Comments:*
Slip-rate category:	less than 0.2 mm/yr *Comments:*
Compiled or modified by and affiliation:	Bill D. Black, Utah Geological Survey, 1999
References:	#4515 Arabasz, W.J., Pechmann, J.C., and Brown, E.D., 1989, Evaluation of seismicity relevant to the proposed siting of a Superconducting Supercollider (SSC) in Tooele County, Utah: Utah Geological and Mineral Survey Miscellaneous Publication 89-1, p. 107. #642 Hecker, S., 1993, Quaternary tectonics of Utah with emphasis on earthquake-hazard characterization: Utah Geological Survey Bulletin 127, 157 p., 6 pls., scale 1:500,000. #4512 Moore, W.J., and Sorensen, M.L., 1979, Geologic map of the Tooele 1° x 2° quadrangle, Utah: U.S. Geological Survey Miscellaneous Investigations Map I-1132, scale 1:250,000. #5019 Young, J.C., 1955, Geology of the southern Lakeside Mountains, Utah: Utah Geological and Mineral Survey Bulletin 56, 116 p.

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Complete Report for East Lakeside Mountains fault zone (Class A) No. 2368

Brief Report || Partial Report

In cooperation with the Utah Geological Survey

citation for this record: Black, B.D., and Hecker, S., compilers, 1999, Fault number 2368, East Lakeside Mountains fault zone, in Quaternary fault and fold database of the United States, ver 1.0: U.S. Geological Survey Open-File Report 03-417, http://qfaults.cr.usgs.gov.

Synopsis:	Poorly understood zone of Quaternary(?) faults beneath Great Salt Lake. Comprised of two north-trending, east-dipping normal faults that bound the west side of the complexly faulted Great Salt Lake graben and the East Lakeside Mountains.
	Name Comments: **Number Comments:** Refers to fault number 6-14 of Hecker (1993 #642).
State(s):	Utah
County(s):	Box Elder
AMS sheet(s):	Brigham City view map
Physiographic province(s):	Basin and Range province
Geologic setting:	Two north-trending, east-dipping normal faults bound the west side of the complexly faulted

	Great Salt Lake graben and form the East Lakeside Mountains fault zone. The Great Salt Lake graben is bounded on the east by the west-dipping East Great Salt Lake fault zone [2369].
Reliability of location:	Poor. Compiled at 1:700,000 scale. *Comments:* Identified only from gravity (Mikulich and Smith, 1974 #4504) and seismic data (Cook and others, 1980 #4503). Fault traces from Mikulich and Smith (1974 #4504).
Length (km):	36 *Comments:*
Average strike:	N8°W
Sense of movement:	Normal *Comments:*
Dip:	E *Comments:*
Paleoseismology studies:	
Geomorphic expression:	Subaqueous. Seismic-reflection profiles indicate that faulting penetrates upward into the Quaternary section. Gravity data suggest the fault lies along the Lakeside Mountains, extending farther south than mapped.
Age of faulted surficial deposits:	Quaternary(?).
Year of historic deformation:	
Most recent prehistoric deformation:	Quaternary (<1.6 Ma) *Comments:* Based on the depth to faulted sediment and geophysical fault expression.

[illegible]	*Comments:*
Slip rate category	less than 0.2 mm/yr *Comments:* Depth to faulted lake-bottom sediment indicates a low slip rate.
Compiled or modified by and affiliation	Bill D. Black, Utah Geological Survey; Suzanne Hecker, U.S. Geological Survey, 1999
References	#4503 Cook, K.L., Gray, E.F., Iverson, R.M., and Strohmeier, M.T., 1980, Bottom gravity meter regional survey of the Great Salt Lake, Utah, in Gwynn, J.W., ed., Great Salt Lake - A scientific, historical and economic overview: Utah Geological Survey Bulletin, p. 125-143. #642 Hecker, S., 1993, Quaternary tectonics of Utah with emphasis on earthquake-hazard characterization: Utah Geological Survey Bulletin 127, 157 p., 6 pls., scale 1:500,000. #4504 Mikulich, M.J., and Smith, R.B., 1974, Seismic-reflection and aeromagnetic surveys of the Great Salt Lake, Utah: Geological Society of America Bulletin, v. 85, no. 6, p. 991-1002.

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Complete Report for Clover fault zone (Class A) No. 2396

Brief Report || Partial Report

In cooperation with the Utah Geological Survey

citation for this record: Black, B.D., and Hecker, S., compilers, 1999, Fault number 2396, Clover fault zone, in Quaternary fault and fold database of the United States, ver 1.0: U.S. Geological Survey Open-File Report 03-417, http://qfaults.cr.usgs.gov.

Synopsis:	Poorly understood zone of late Quaternary(?) faults near Clover in western Rush Valley.
	Name Comments: **Number Comments:** Hecker's (1993 #642) fault number 7-11Refers to fault number 7-11 of Hecker (1993 #642).
State(s):	Utah
County(s):	Tooele
AMS sheet(s):	Tooele view map
Physiographic province(s):	Basin and Range province
Geologic setting:	Four short northwest-trending faults in western Rush Valley northeast of the Onaqui Mountains. Surficial geology of the valley is dominated by lake deposits and alluvium.
[illegible]	Poor. Compiled at 1:250,000 scale.

[illegible]	*Comments:* Fault traces from 1:250,000-scale mapping of Barnhard and Dodge (1988 #429)
Length (km):	4 *Comments:*
Average strike:	N24°W
Sense of movement:	Normal *Comments:*
Dip:	NE *Comments:*
Paleoseismology studies:	
Geomorphic expression:	Northwest-trending scarps in alluvium. The scarps are modified by agricultural activities and provide no information about the estimated age of faulting.
Age of faulted surficial deposits:	Late Pleistocene to Holocene(?).
Year of historic deformation:	
Most recent prehistoric deformation:	Late Quaternary (<130 ka) *Comments:* Graded profiles of streams that cross the fault zone suggest that faulting occurred more than several thousand years ago.
Recurrence interval:	*Comments:*
Slip-rate category:	less than 0.2 mm/yr *Comments:*
Compiled or verified by and	Bill D. Black, Utah Geological Survey; Suzanne Hecker, U.S. Geological Survey, 1999

[illegible]	
References	#429 Barnhard, T.P., and Dodge, R.L., 1988, Map of fault scarps formed on unconsolidated sediments, Tooele 1° x 2° quadrangle, northwestern Utah: U.S. Geological Survey Miscellaneous Field Studies Map MF-1990, 1 sheet, scale 1:250,000. #642 Hecker, S., 1993, Quaternary tectonics of Utah with emphasis on earthquake-hazard characterization: Utah Geological Survey Bulletin 127, 157 p., 6 pls., scale 1:500,000.

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Complete Report for East Great Salt Lake fault zone, Fremont Island section (Class A) No. 2369b

Brief Report || Partial Report

In cooperation with the Utah Geological Survey

citation for this record: Black, B.D., Hecker, S., and Christenson, G.E., compilers, 1999, Fault number 2369b, East Great Salt Lake fault zone, Fremont Island section, in Quaternary fault and fold database of the United States, ver 1.0: U.S. Geological Survey Open-File Report 03-417, http://qfaults.cr.usgs.gov.

Synopsis:

General:
This is a zone of Holocene faulting beneath Great Salt Lake that was identified from seismic-reflection profiling. Subsidiary faulting is common in the hanging wall west of the main fault in the southern Great Salt Lake. The faults may take a right step and connect with the Oquirrh fault zone [2398] to the south. The entire fault zone appears to have been active in the latest Pleistocene or Holocene (<15 ka).

Sections:
This fault has 3 sections. Dinter and Pechmann (1999 #4526; 1999 #4645; 2000 #4646) indicate the active East Great Salt Lake fault trace west of Antelope Island shows a 2-km-wide left step, suggesting the fault may form two north-northwest trending sections south of Promontory Point: a 35-km-long Antelope Island section and a 30-km-long Fremont Island section. A right step west of Promontory Point suggests that a northern Promontory section probably exists north of the Fremont Island section, although no high-resolution seismic profiles exist for the Promontory section. High-resolution seismic profiles show a sharp westward bend in the southern end of the fault indicating a step-over to the Oquirrh fault zone [2398].

Name Comments:

Number Comments:

	Refers to fault number 6-8 of Hecker (1993 #642).
State(s):	Utah
County(s):	Davis Box Elder Weber
AMS sheet(s):	Brigham City Tooele view map
Physiographic province(s):	Basin and Range province
Geologic setting:	Generally north-trending normal faults beneath Great Salt Lake identified from seismic reflection data. Subsidiary faulting is common in the hanging wall west of the main fault in the southern Great Salt Lake.
Reliability of location:	Good. Compiled at 1:89,700 scale. *Comments:* The mapped traces are from high-resolution seismic reflection lines located using GPS by Dinter and Pechmann (1999 #4526; 1999 #4645; 2000 #4646; unpublished mapping, 1:95,000 scale).
Length (km):	This section is 30.1 km of a total fault length of 102.9 km. *Comments:*
Average strike:	N21°W (for section) versus N29°W (for whole fault)
Sense of movement:	Normal *Comments:*
Up:	W

	Comments: A steeply west-dipping fault is evident on seismic reflection profiles but dips are not reported. Interpretation of reflection data suggests the fault may flatten with depth (Smith and Bruhn, 1984 #4561) and merge into a horizontal detachment at a depth of about 6 km (Viveiros, 1986 #4649). However, the evidence is equivocal.
Paleoseismology studies:	
Geomorphic expression:	Subaqueous. Evidence of repeated displacements in post-Bonneville time (Dinter and Pechmann (1999 #4526; 1999 #4645; 2000 #4646). No scarps are preserved on the lakebed west of Fremont Island where the fault is buried beneath horizontal lake-bottom sediments, indicating that movement on this part of the fault may predate movement on the Antelope Island section [2369c] to the south. Diapiric domes and lake-bottom piercement structures, identified from seismic data, developed at least partly from flowage of the salt deposits during construction of the Southern Pacific Causeway in 1957-1959 (Mikulich, 1974 #4492).
Age of faulted surficial deposits:	Holocene. Cores collected in August 2000 by Dinter and Pechmann (2000 #4646) may yield dates and improve the geologic interpretation.
Year of historic deformation:	
Most recent prehistoric deformation:	Latest Quaternary (<15 ka) *Comments:* High-resolution seismic data show stratigraphic and structural anomalies, including auxiliary faults and tectonically produced angular unconformities and on-lap surfaces, that indicate at least three surface-faulting earthquakes on the Fremont Island section since the disappearance of Lake Bonneville (Dinter and Pechmann, 2000 #4646).
Recurrence interval:	3.8-5.6 ky (<9.2-9.3 ka) *Comments:* Dinter and Pechmann (2000 #4646)

	indicate three events have occurred since 9.2-9.3 ka. Section lengths are comparable to those of the Wasatch fault zone [2351] and suggest comparable earthquake magnitudes. This recurrence interval is preliminary pending dating of deposits obtained from cores collected in August 2000.
Slip-rate category:	between 0.2 and 1.0 mm/yr *Comments:* A preliminary vertical slip rate of 0.67+0.06 mm/yr and a fault-parallel slip rate of 0.9+0.2 mm/yr are estimated by Dinter and Pechmann (2000 #4646). Slip rates are preliminary pending dating of deposits obtained from cores in August 2000.
Compiled or modified by and affiliation:	Bill D. Black, Utah Geological Survey; Suzanne Hecker, U.S. Geological Survey; Gary E. Christenson, Utah Geological Survey, 1999
References:	#4526 Dinter, D.A., and Pechmann, J.C., 1999a, Sublacustrine paleoseismology-Evidence for recent earthquakes on the East Great Salt Lake fault, Utah: Association of Engineering Geologists, 42nd Annual Meeting Abstracts with Program, p. 62-63. #4645 Dinter, D.A., and Pechmann, J.C., 1999b, Multiple Holocene earthquakes on the East Great Salt Lake fault, Utah - Evidence from high-resolution seismic reflection data: EOS, Transactions of the American Geophysical Union, v. 80, no. 46 (supplement), p. F734. #4646 Dinter, D.A., and Pechmann, J.C., 2000, Late Quaternary slip rates and recurrence intervals of large earthquakes on the East Great Salt fault, Utah - Estimates from high-resolution siesmic reflection data: Geological Society of America, Abstracts with Programs, 2000 Annual Meeting, v. 32. #642 Hecker, S., 1993, Quaternary tectonics of Utah with emphasis on earthquake-hazard characterization: Utah Geological Survey Bulletin 127, 157 p., 6 pls., scale 1:500,000.

#4492 Mikulich, M.J., and Smith, R.B., 1974, Seismic-reflection and aeromagnetic surveys of the Great Salt Lake, Utah, in Seismic-Reflection and Aeromagnetic Surveys of the Great Salt Lake, Utah: Geological Society of America Bulletinp. 991-1002, 1 pl.

#4561 Smith, R.B., and Bruhn, R.L., 1984, Intraplate extensional tectonics of the western U.S. Cordillera-Inferences on structural style from seismic-reflection data, regional tectonics and thermal-mechanical models of brittle-ductile deformation: Journal of Geophysical Research, v. 89, no. B7, p. 5733-5762.

#4649 Viveiros, J.J., 1986, Cenozoic tectonics of Great Salt Lake from seismic-reflection data: Salt Lake City, University of Utah, unpublished M.S. thesis, 81 p.

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APPENDIX B - 1

APPENDIX B-1
Geotechnical Site Characterization
(ref AMEC 12/13/2005)

APPENDIX B
GEOTECHNICAL SITE CHARACTERIZATION

1. INTRODUCTION

1.1 GENERAL

This appendix presents the results of our geotechnical site characterization performed for the expanded Low Activity Radioactive Waste (LARW) embankment to be constructed north of the existing LARW embankment at the Envirocare facility near Clive, Utah. AGRA (now AMEC Earth & Environmental, Inc. [AMEC]) previously completed a geotechnical site characterization for the existing embankment and submitted our findings in a report dated October 26, 1999[1]. The site described in that report is presently occupied by the existing LARW embankment with the location of this study being immediately to the north of the existing LARW embankment.

The general location of the site showing major topographic features and existing facilities, as of 1973, is presented on Figure B-1, Vicinity Map. The locations of the previous studies and subsurface investigations are presented on Figure B-2, Exploration Location Map, which was taken from the referenced 1999 AGRA study. The locations of the Cone Penetration Test (CPT) soundings and boring drilled in conjunction with this study are shown on Figure B-3, Supplemental Exploration Location Map.

During the course of this investigation, preliminary findings and recommendations were discussed with representatives of Envirocare of Utah, Inc.

1.2 OBJECTIVES AND SCOPE

The objectives and scope of this phase of our study were planned in discussions between Mr. David Shockey of Envirocare of Utah, Inc., and Mr. Joergen Pilz of AMEC.

In general, the objectives of this phase of our study were to complete supplemental subsurface investigations to evaluate the conditions below the expanded LARW embankment. The investigation work was combined with previous investigations to confirm that the geologic conditions below the new embankment are similar to those used for design of the existing embankments. One boring was drilled to obtain samples for laboratory testing and three CPT soundings were completed to determine stratigraphy and soil properties below the proposed expanded embankment.

---

1 "Report, Geotechnical Site Characterization, Proposed new LARW embankment, near Clive, Tooele County, Utah," AGRA Job no. 9-817-002586.

AMEC Earth & Environmental, Inc.
4137 South 500 West
Salt Lake City, Utah 84070
Tel +1 (801) 266-0720
Fax +1 (801) 266-0727 www.amec.com

In accomplishing this objective, our work scope included the following:

1. Completion of three CPT soundings arranged in an east-to-west alignment along the northern edge of the proposed new LARW embankment footprint. One CPT was a seismic cone sounding to obtain a shear wave velocity profile versus depth below the embankment and compare this result to previous tests.

2. A field program consisting of drilling, logging, and sampling one 100-foot deep boring. The boring was drilled adjacent to the seismic CPT sounding to obtain samples of the materials delineated by the CPT tests.

3. Grouting the CPT soundings and boring with a commercial bentonite grout mixture.

4. A laboratory testing program to measure classification and index properties.

5. An office program consisting of the correlation of available data, engineering analyses, and the preparation of this summary appendix.

1.3 PROFESSIONAL STATEMENTS

Supporting data upon which our recommendations are based, are presented in subsequent sections of this appendix. Recommendations presented in our report are governed by the physical properties of the soils encountered in the boring and CPT soundings, projected groundwater conditions, and the design data discussed in Section 2., Proposed Construction, of the main body of the report. If subsurface conditions other than those described in this appendix are encountered and/or if design and layout changes are implemented, AMEC must be informed so that our recommendations can be reviewed and amended, as appropriate.

2. SITE INVESTIGATIONS

As shown on Figure B-2, extensive geotechnical and hydrogeological investigations have previously been completed for both the Vitro and existing Envirocare embankments; therefore, adequate subsurface data was available to provide a basis for design of the proposed embankment. Based on the extent of existing data and satisfactory performance of the foundation soils below existing embankments, the current field program consisted of drilling one boring near the center of the new embankment and completing three CPT soundings to observe the continuity of subsurface conditions for comparison with adjacent subsurface conditions. As discussed in subsequent sections, relatively uniform conditions were encountered.

3. FIELD PROGRAM

To characterize the subsurface conditions, three CPT soundings were advanced and one exploration boring was drilled and sampled. Three CPT soundings were also completed to depths ranging from 91 to 100 feet. Conetec Investigations Ltd. of Salt Lake City advanced the

CPT soundings using a 20-ton CPT rig. CPT-04 encountered refusal on a dense layer at a depth of approximately 91 feet. The remaining CPTs were advanced their full planned depth of 100 feet. The boring was advanced using a truck-mounted Marl M-10 drill rig, also operated by Conetec Investigations. The boring was advanced using a hollow-stem auger down to a depth of 100 feet.

CPT tests were completed to evaluate liquefaction susceptibility of the soils and determine the stratigraphy of the subsurface profile below the site. The CPT test is an in-situ test that measures three parameters: the tip resistance (Qc) of a 10-square-centimeter conical-shaped tip, the sleeve resistance along a cylindrical sleeve, and the pore water pressure (u) developed during pushing the instrument into the ground at a constant rate. These parameters provide an indication of the soil behavior during either undrained loading (pore water pressures develop but are not allowed to drain) or drained loading (such as penetration through sands).

Based on our experience, the interpretation of the CPT tests provides a reasonably accurate profile of expected subsurface conditions. A report summarizing the investigations completed by Conetec Investigations, Ltd. of Salt Lake City, Utah is included as an attachment at the end of this appendix, following the figures. The report contains the interpretation of the soil types encountered at the CPT locations along with the measured CPT parameters.

Figure B-4, Stratigraphic Cross-Section Based on CPT, presents the results of the CPT soundings. The shear wave velocity profile was also measured at the CPT-04 location. The previous and current shear wave velocity data are presented on Figure B-5, Shear Wave Velocity Measurements.

A single boring was subsequently drilled using a hollow-stem auger and sampled at depths determined by the CPT stratigraphy to obtain samples for laboratory testing. Sampling in the boring was completed using a two and one-half-inch inside diameter drive sampler with brass rings. Locations of the CPT soundings and boring are presented on Figure B-3.

The field portion of our investigation was under the direct control and supervision of our engineering staff. A continuous log of the subsurface conditions encountered in the boring was maintained during the course of the drilling. In addition, representative disturbed and relatively undisturbed samples of the soils encountered were obtained for subsequent laboratory testing and examination. The soils were classified in the field based upon visual and textural examination. These classifications have been supplemented by subsequent observation and testing in our laboratory. Detailed graphical representation of the soils encountered is presented on Figure B-6, Log of Boring. Soils were classified in accordance with the nomenclature described on Figure B-7, Unified Soil Classification System.

The boring and each CPT Soundings were tremie grouted their full depth using a three-quarter-inch diameter pipe and a commercially available product, Enviroplug Grout.

3.1 LABORATORY TESTING

3.1.1 General

A laboratory testing program was completed to provide data necessary for our engineering analyses. The program included engineering classification tests, moisture content, density, partial gradation, and Atterberg limits tests on representative samples. Engineering property tests, including consolidation tests, were also completed to estimate settlements below the proposed embankment and compare to previous test results.

The laboratory tests completed as part of this investigation were compared to the more extensive database of laboratory test results previously completed by others and found as summarized in attached Table 1, Summary of Envirocare Lab Data. The laboratory tests described below are plotted versus depth on Figure B-8, Summary Plot of Laboratory Test Results. Topography of the site is relatively level; therefore, depths are comparable to elevation below ground surface. This plot shows a summary of moisture content, density, over-consolidation ratio, compressibility, and plasticity tests versus depth. The data obtained by AMEC for this investigation are indicated by "X" symbols within each plot. The intent of preparing this plot is to show that soils below the proposed New LARW embankment fall within the range (and variability) of laboratory tests performed by others for the Vitro and existing LARW embankments.

The following paragraphs describe the tests and summarize the test data.

3.1.2 Moisture and Density Tests

Moisture and density tests were performed on selected samples to aid in classifying the soils and to develop the present in-situ moisture content and unit weight of the soils. The results of these tests are presented to the left of the boring log sheets on Figure B-5 and are tabulated in the following table:

Boring No.	Depth (feet)	Soil Type	Dry Density (pcf)	Moisture Content (percent)
B-2	5.0	CL	86	31.5
B-2	10.5	SM	112	3.4
B-2	15.5	SM	128	11.5
B-2	20.5	SM	101	19.1
B-2	23.5	SM	102	12.6
B-2	30.5	CL	65	60.7
B-2	37.5	SC	77	60.7
B-2	49.5	CL	94	28.1
B-2	60.5	CL	92	29.5
B-2	70.5	SC	111	16.6
B-2	80.5	SM	105	22.6
B-2	90.5	SM	103	22.7
B-2	99.0	CL	93	27.8

3.1.3 Partial Gradation Tests

Partial gradation tests were performed on a series of samples to aid in classifying the soils. The results of these tests are tabulated in the following table:

Boring No.	Depth (feet)	No. 200	Soil Classification
B-2	15.5	35.0	SM
B-2	23.5	43.7	SM/ML
B-2	70.5	29.5	SC
B-2	80.5	31.2	SM

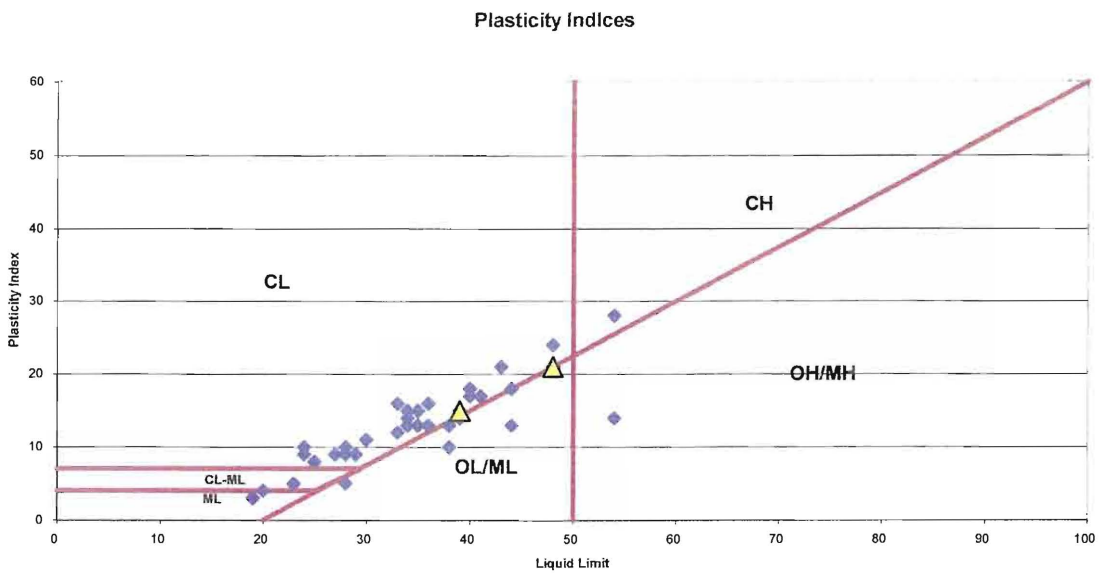
Based on these results, the majority of the sandy soils classify as silty sands with moderate to high percentages of silt and clay.

3.1.4 Atterberg Limits Tests

Atterberg limits tests were performed on representative samples to aid in classifying the finer-grained soils encountered at the site. The test results are tabulated below:

Boring No.	Depth (feet)	Liquid Limit (percent)	Plasticity Index (percent)	Soil Type
B-2	5.0	39	15	CL
B-2	30.5	48	21	ML
B-2	70.5	NP	NP	SM

A summary of all the Atterberg limit tests on at the site (♦) is presented on the following plot on the next page, along with the samples tested during this study (▲).



3.1.5 Consolidation Tests

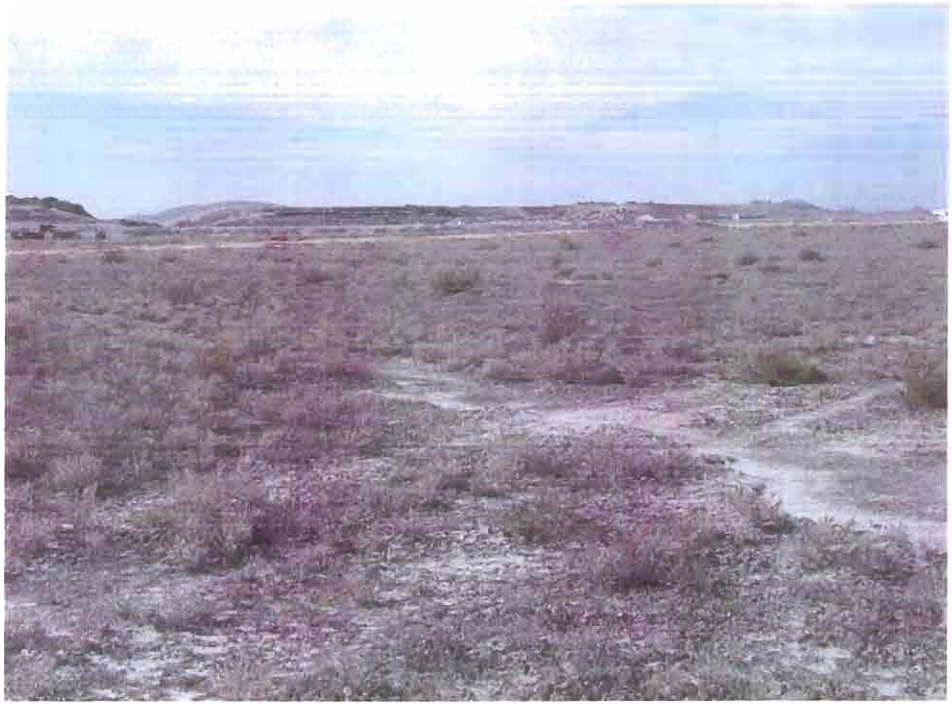
Consolidation tests were performed on representative samples of the clay and silt soils to assess their load-deformation characteristics and estimate their degree of over-consolidation. The data obtained from these tests was used to calculate foundation settlements below the proposed embankment at its ultimate height. Samples from Boring B-2 at depths of 30.5 and 49.5 feet were tested. The samples were each tested under flooded (saturated) conditions to reflect the in-situ conditions. Data obtained from the consolidation tests indicates that the clay and silty clay soils are slightly over-consolidated near the surface. In general, these soils will exhibit low compressibility characteristics under the anticipated loadings. Results of the consolidation tests are presented on Figure B-9, Consolidation Test Results.

4. SITE CONDITIONS

4.1 SURFACE

The location of the proposed new LARW embankment is an undeveloped parcel immediately to the north of the existing LARW class A embankment. The site is relatively flat. Over three-quarters of the site is covered principally by sagebrush, some grass, and poorly vegetated areas.

A photograph of the site is shown on the next page.



The site was surrounded by monitor well pads and a few roadways. Graded access roads connect the monitor well pads. The existing operating LARW embankment and containerized waste facility (CWF) is situated to the south. The area is undeveloped to the north.

4.2 SUBSURFACE SOIL CONDITIONS

The subsurface conditions encountered in the three CPT soundings and boring were found to be consistent across the site and similar to the conditions encountered in our previously referenced investigation. The conditions observed are also in general agreement with the hydrogeologic cross-sections developed by others across Section 32 and presented in Appendix D of the permit application previously reviewed[2]. The general stratigraphic conditions are summarized below. Unit numbers used in the referenced hydrogeologic documents are provided for reference on the next page.

[2] See AGRA Letter Report, "Technical Appendix Document Review, New LARW Facility, Envirocare of Utah NW 1/4, Section 32, Near Clive, Utah," Job No. 9-817-002427, July 15, 1999.

Unit No.	Depth, ft	Soil Type	Description
4	0 to 9+/-	Upper Clays	Silty clays, classifying as CL in accordance with the Unified Classification System. Contains some fine silt, ML, layers and is generally dry and medium to stiff in consistency. Considered to represent the deep Lake Bonneville clays.
3	9 to 26+/-	Silty Sands	Dense to medium dense silty sands and silts containing a few thin clay layers.
2	26 to 64+/-	Clays and Silts	Interbedded clay and silt layers with a few isolated sand layers up to two feet thick. Sand layers were discontinuous across the site. Clays are generally stiff with a few soft layers. Saturated throughout.
1	64 to maximum depth	Interbedded Sand, Silt, and Clay Layers	A sequence of interbedded silty sand, fine sand, and coarse to gravelly sand layers with interbedded clay and silt layers. Increasing sand layers beginning at depths of 50 feet and extending to the maximum depth investigated, 100 feet. Dense to very dense sands and stiff clays.

Based on detailed geologic studies completed on other projects within the Basin and Range, we expect that the upper clays represent the lakebed clay deposits deposited within the deep Lake Bonneville cycle(s) from about 12,000 to 20,000 years before present. The sequence of silty sands below the upper clays were either alluvial, colluvial, or lacustrine deposits, which may have occurred during fluctuations in the Lake Bonneville level. The lower (Unit 2) silts and clays most likely represent an older period of lake deposition predating 20,000 years before present and termed the "Cutler Dam Lake Cycle" in geologic literature. The Unit 1 sands, silts, and clays most likely represent pre-Pleistocene deposits from an Interglacial period. These deposits may date as old as 100,000 to 150,000 years before present. The significance of these probable ages is that numerous earthquakes have occurred during this geologic time period and the probability of liquefaction would be considered quite low based on age of the deposits alone.

4.3 GROUNDWATER

Groundwater was encountered at a depth of 37.3 feet in Boring B-2 at the time of drilling. The appearance of water in the boring appeared to correspond to the presence of a sand layer. The boring was subsequently grouted; therefore, a stabilized groundwater level could not be measured. A pore pressure dissipation test was completed during the CPT investigation. The pore pressure dissipation test was completed in the more permeable silty sand layer by stopping CPT penetration and recording the stabilized reading from the pore pressure sensor on the CPT unit. These readings are similar to electrical piezometer readings. The pore pressure was found to be 42 feet of head at a depth of 68 feet. This indicates a water level of 26 feet below the ground surface. This measurement generally agrees with the levels measured in nearby monitor wells.

5. SUMMARY OF FINDINGS

The field and laboratory portion of this study identified an overall relatively stiff to dense sequence of distinct sand, clay, and silt layers. There are principally two layers which may be

subject to consolidation settlements: the upper clays (Unit 4) and the lower silts and clays (Unit 2). The upper clays are at a percent saturation estimated to range from 50 to 90 percent and of low unit weight. Neither the upper clays nor the sands are expected to contribute significantly to long-term settlements or to seismic instability. Only the lower silts and clays are saturated and of potential concern to seismic stability. The lowermost sequence of sands, silts, and clays are not expected to impact either stability or long-term settlements.

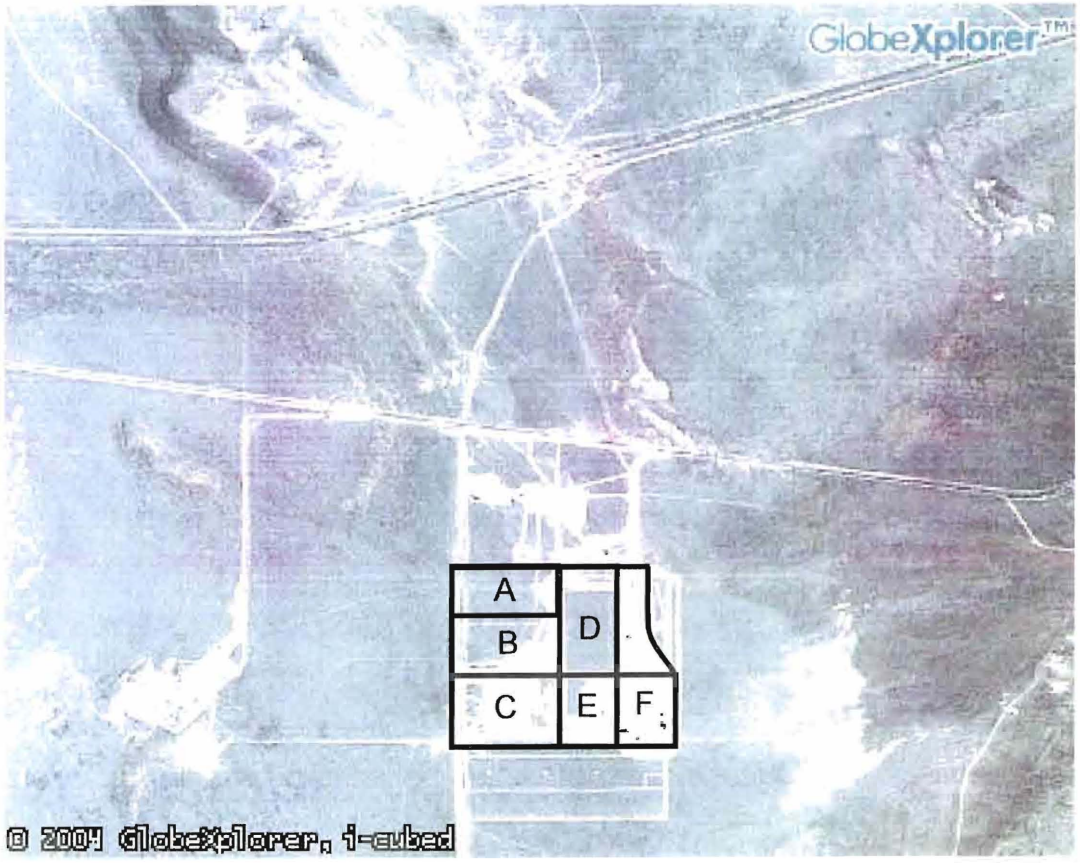
Subsurface conditions at the new LARW site are substantially the same as the adjacent areas underlying existing embankments. Therefore, the site is judged suitable from a geotechnical perspective for the proposed embankment.

Encl. Table 1, Summary of Envirocare Lab Data
Figure B-1, Vicinity Map
Figure B-2, Exploration Location Map
Figure B-3, Supplemental Exploration Location
Figure B-4, Stratigraphic Cross Section Based on CPT
Figure B-5, Shear Wave Velocity Measurements
Figure B-6, Log of Boring
Figure B-7, Unified Soil Classification System.
Figure B-8, Summary Plot of Laboratory Test Results
Figure B-9, Consolidation Test Results
ConeTec, Inc. Investigation Report

Table 1 - Summary of Envirocare Lab Data

Boring No.	Depth ft	Soil Description	USCS	W.C. %	γ_{dry} pcf	γ_{tot} pcf	Gradation % Gravel	% Sand	% Silt-clay	Atterberg Limits LL	PL	PI	$Su_{(lab\ vane)}$ psf	Cc	Cr	Pc psf	OCR	Source / Date
Foundation Soils																		
SC-1	40.0			32%	90	119				24	14	10		0.180	0.040	9500	2.4	D&M, 1984
SC-7	5.0			34%	85.4	114								0.120	0.012	1400	2.5	D&M, 1984
SC-7	35.0			40%	80.9	113								0.216	0.030	6200	1.8	D&M, 1984
SC-8	29.0			67%	60.6	101				54	40	14		0.228	0.034	4000	1.4	D&M, 1984
SC-10	10.0			44%	77.9	112								0.240	0.048	6000	5.4	D&M, 1984
SLC-84	4.0			21%	98.8	119				38	28	10		0.075		4000	8.4	D&M, 1984
SLC-84	8.5			37%	77.6	106				20	16	4		0.239		4000	4.4	D&M, 1984
SLC-84	6.0			42%	65.2	92.3				38	25	13		0.441	0.009	4000	7.2	D&M, 1984
GW-16	4.0	Silty Clay		21%	106	128				34	19	15		0.500	0.007	2000	3.9	Bingham Eng
GW-19A	6.0	Silty Clay		45%	73.2	106				44	26	18		0.160	0.021	4000	6.3	Bingham Eng
GW-19B	23.0	Silty Sand		33%	112	149												Bingham Eng
GW-18	31.0	Silty Clay		46%	79	115				40	22	18		0.100	0.020	6200	1.8	Bingham Eng
GW-17A	8.3	Silty Clay		34%	87.2	117				34	20	14		0.100	0.020	1600	1.7	Bingham Eng
GW-17A	20.0	Silty Sand		16%	104	121												Bingham Eng
GW-17A	28.0	Silty Sand		49%	82.4	123												Bingham Eng
GW-18	5.8									34	21	13						Bingham Eng
GW-18	21.0	Silty Sand		27%	96.7	123												Bingham Eng
GW-16	35.2	Silty Clay		38%	104	143				19	16	3						Bingham Eng
GW-24	6.5									33	21	12						Bingham Eng
GW-24	26.5									30	19	11						Bingham Eng
GW-24	31.5									41	24	17						Bingham Eng
GW-27	9.0									36	23	13						Bingham Eng
GW-27	29.0									36	20	16						Bingham Eng
GW-29	4.0									54	26	28						Bingham Eng
GW-29	9.0									35	22	13						Bingham Eng
GW-29	23.5									28	18	10						Bingham Eng
GW-29	31.5									40	23	17						Bingham Eng
DH-33	4.0									48	24	24						Bingham Eng
DH-33	9.0									39	25	14						Bingham Eng
DH-33	26.5									23	18	5						Bingham Eng
GW-36	5.0									33	21	12						Bingham Eng
GW-36	27.0									44	31	13						Bingham Eng
GW-41	25.0									27	18	9						Bingham Eng
GW-55	7.0									33	21	12						Bingham Eng
DH-51	21.0									24	15	9						Bingham Eng
DH-51	25.0									25	17	8						Bingham Eng
DH-48	26.0									29	20	9						Bingham Eng
DH-1	5		CL-ML	30.9%	87.8	115				35	20	15		0.13	0.01	4600	8	AGRA, 1999
DH-1	12		SM	6.1%			9	77	14									AGRA, 1999
DH-1	22		SM	16.7%				83	17									AGRA, 1999
DH-1	30.5		CL-ML	64.0%	59.9	98.2				43	22	21	920	0.13	0.025	4000	1.4	AGRA, 1999
DH-1	40		CL-ML	30.2%	93.3	121				33	17	16	2800	0.125	0.02	4200	1	AGRA, 1999
DH-1	45		CL-ML	26.1%	98.8	125				28	19	9	1985	0.08	0.02	6000	1.3	AGRA, 1999
DH-1	60		CL-ML	28.6%	92.2	119				28	23	5	1615	0.08	0.02	6000	1.2	AGRA, 1999
DH-1	69		CL-ML	28.0%			1	42	57									AGRA, 1999
DH-1	80		SM	16.7%			13	67	20									AGRA, 1999
DH-1	93		SM	23.1%				57	43									AGRA, 1999
B-2	5		CL	31.5%	85.9	113.0				39	24	15						AMEC, 2004
B-2	10.5		SM	3.4%	112	116.0												AMEC, 2004
B-2	15.5		SM	11.5%	128	142.8												AMEC, 2004
B-2	20.5		SM	19.1%	101	120.8												AMEC, 2004
B-2	23.5		SM	12.6%	102	115.3												AMEC, 2004
B-2	30.5		CL	60.7%	64.6	103.9				48	28	21		0.22	0.01	3200	1.1	AMEC, 2004
B-2	37.5		SC	60.7%	77.2	124.1												AMEC, 2004
B-2	49.5		CL	28.1%	94.1	120.5								0.125	0.004	6000	1.3	AMEC, 2004
B-2	60.5		CL	29.5%	91.8	118.8												AMEC, 2004
B-2	70.5		SC	16.6%	111	129.6												AMEC, 2004
B-2	80.5		SM	22.6%	105	128.5												AMEC, 2004
B-2	90.5		SM	22.7%	103	125.7												AMEC, 2004
B-2	99		CL	27.8%	93.4	119.3												AMEC, 2004

ENVIROCARE OF UTAH, INC.
JOB NO. 4-817-004769



A - This Study
B - AGRA 1999 - Existing LARW
C - 11e.(2)
D - Vitro
E - LARW/NORM
F - Mixed Watse

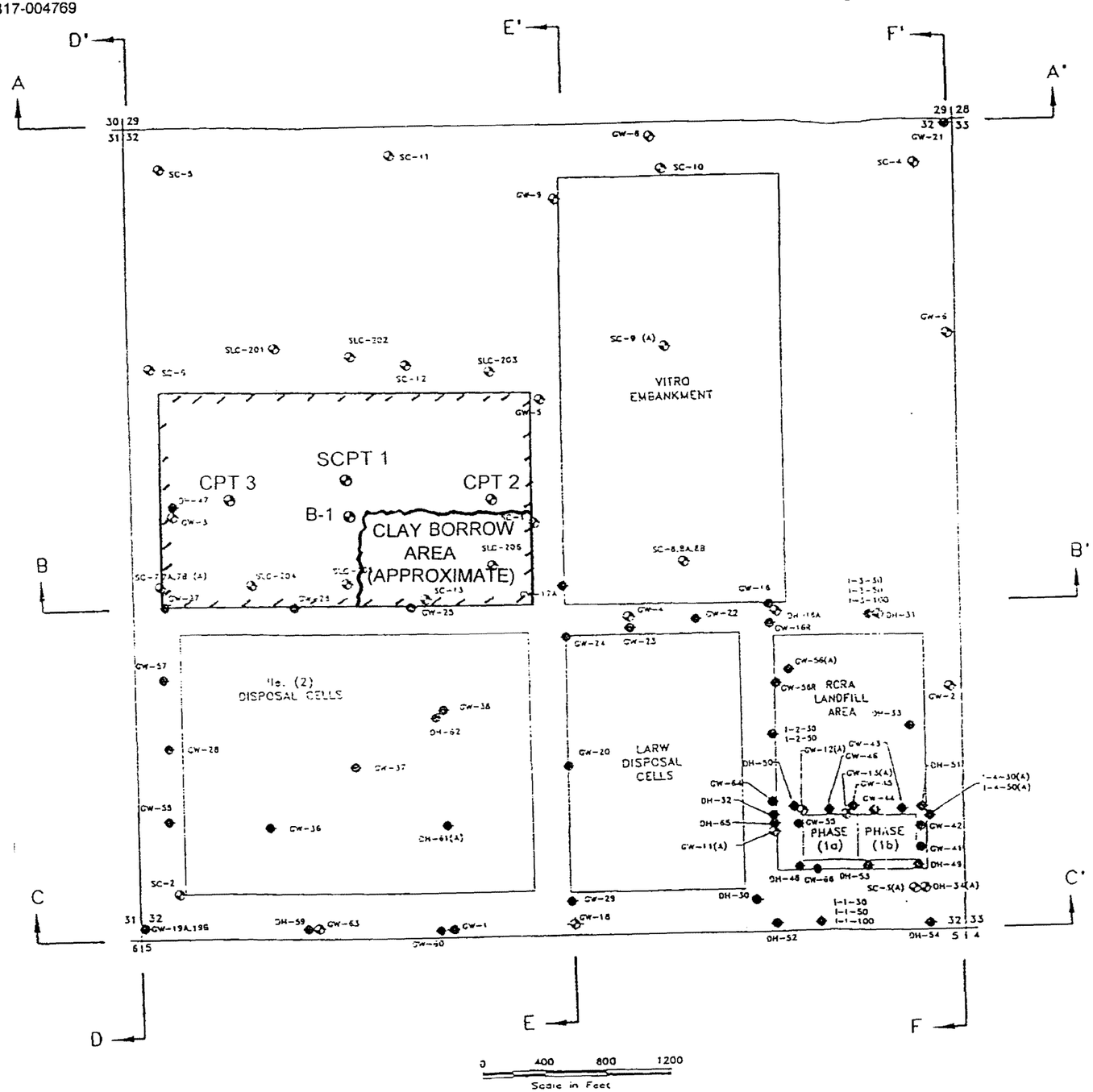
NOT TO SCALE

FIGURE B-1
VICINITY MAP

REFERENCE:
AERIAL PHOTOGRAPH MAP
GLOBECPLORER 2004

amec

JOB NO. 4-817-004769



LEGEND

GW-16 Through GW-66	Monitor Wells-Bingham Environmental (1991-1994)
DH-30 Through DH-65	Exploratory Holes / Piezometers-Bingham Environmental (1991-1993)
1 and other GW's:	Delta Geotechnical Consultants (1988,1990)
SLC-	Jacobs Engineering Group, Inc. (1984)
SC-	Dames & Moore (1981-1982)

SOIL SAMPLING CODE

- Continuous Soil Sampling Hole
- Discontinuous Soil Sampling Hole

NOTES

1. DH- DESIGNATES EXPLORATORY DRILL HOLES WHICH WERE NOT COMPLETED AS MONITOR WELLS. DH-31,DH-32,DH-55,DH-34,DH-59,DH-61 AND DH-62 WERE COMPLETED AS PIEZOMETERS.
2. GW-11,GW-12,GW-13,DH-34,DH-61,GW-56,I-4-30,I-4-50 AND SC-3 WERE ABANDONED IN 1994.
3. (A) INDICATES WELL HAS BEEN ABANDONED

FIGURE B-2
EXPLORATION LOCATION MAP

amec

REFERENCE:
ADAPTED FROM DRAWING ENTITLED
"SITE PLAN, EXPLORATION LOCATION MAP"
BY BINGHAM ENVIRONMENTAL
DATED FEBRUARY 1996

N117726

DATE ____ CHECKED BY ____ DATE ____

ENVIROCARE OF UTAH, INC.
JOB NO. 4-817-004769

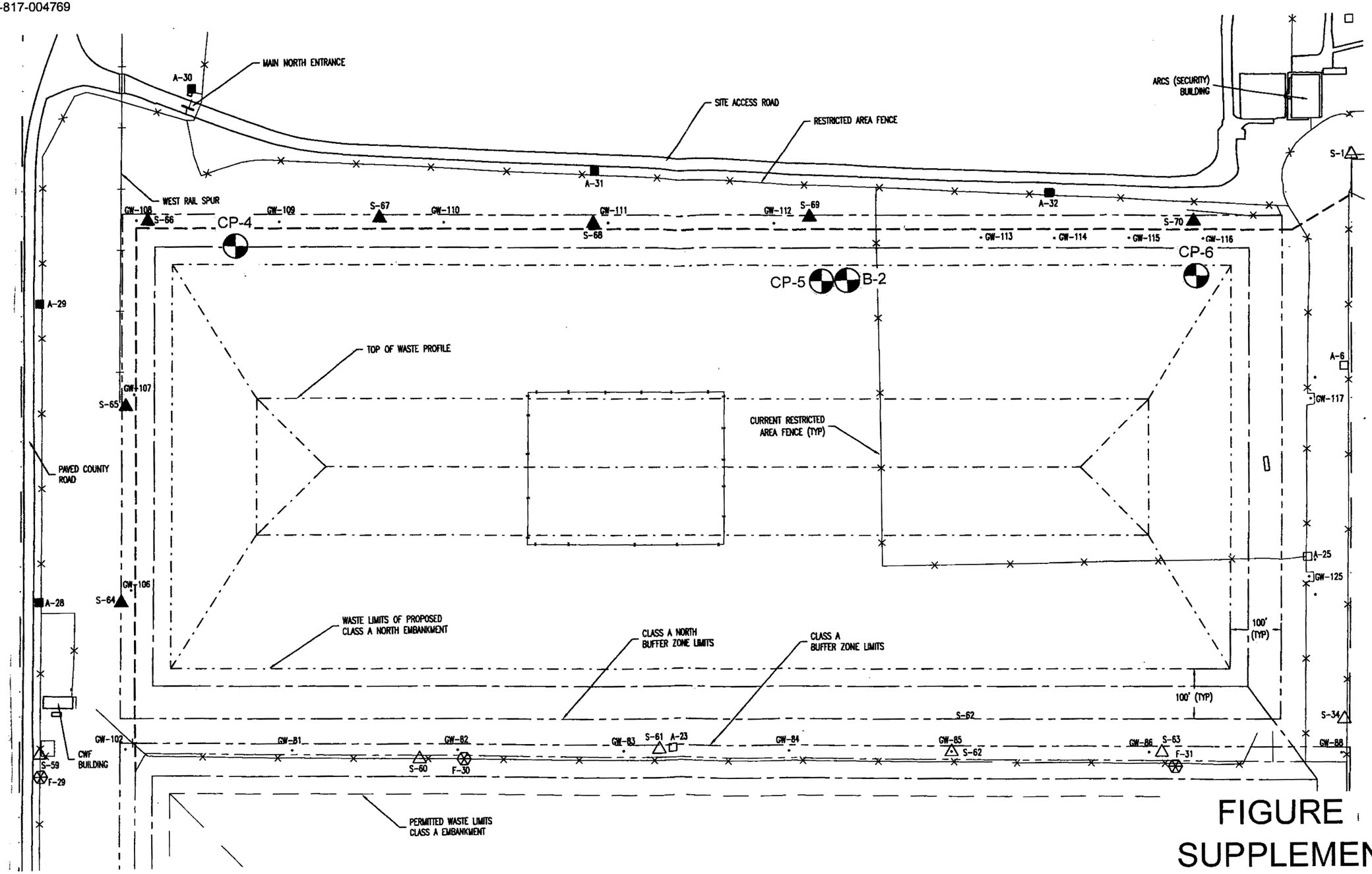


FIGURE 3
SUPPLEMENTAL EXPLORATION LOCATION MAP

REFERENCE:
ADAPTED FROM DRAWING PROVIDED BY
ENVIROCARE OF UTAH
DATED OCTOBER 19, 2004

amec

DATE ____ CHECKED BY ____ DATE ____ BY ____ FILE NO. ____

N117726

ENVIROCARE OF UTAH, INC.
JOB NO. 4-817-004769

West to East Cross Section Showing CPT Tip Resistence and Friction Ratio Versus Depth

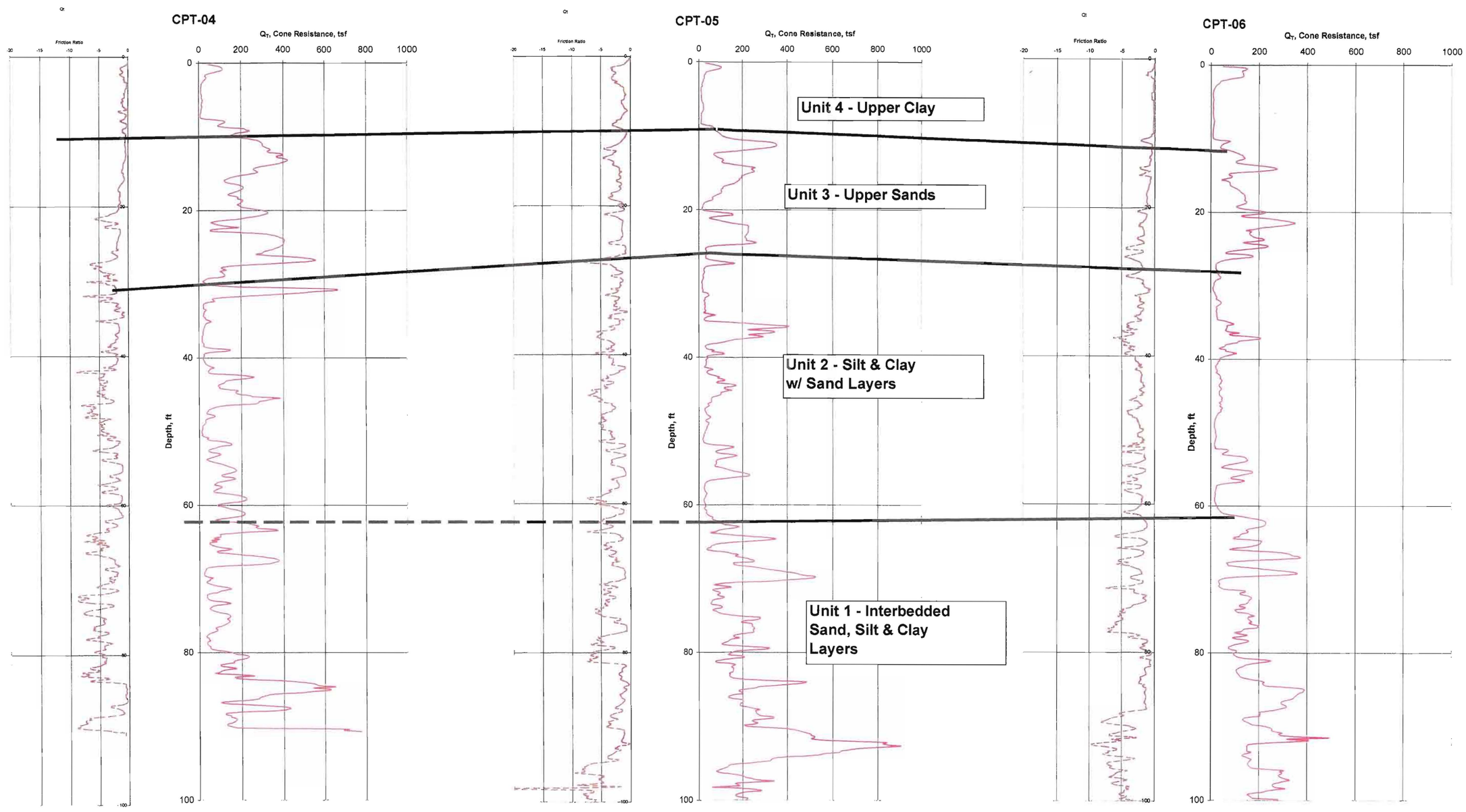


Figure B-4 - Stratigraphic Cross Section Based on CPT

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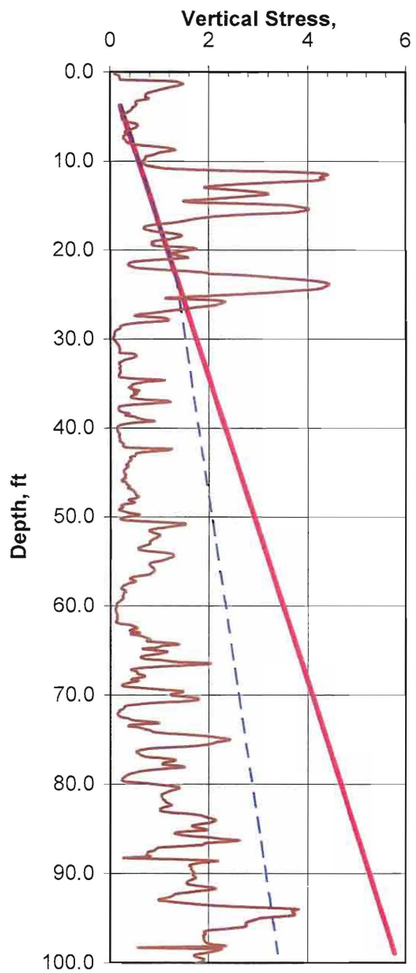
Job No. 4-817-004769

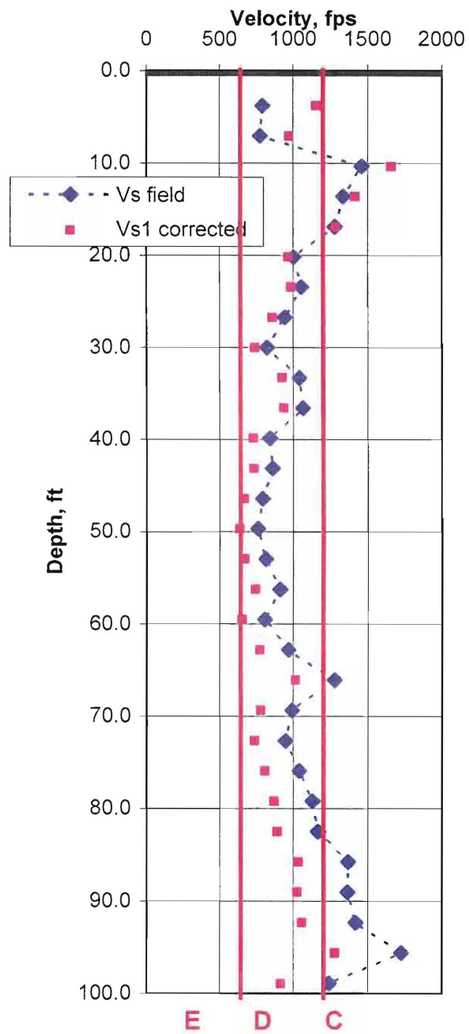
Shear Wave Data Reduction Versus Depth

amec

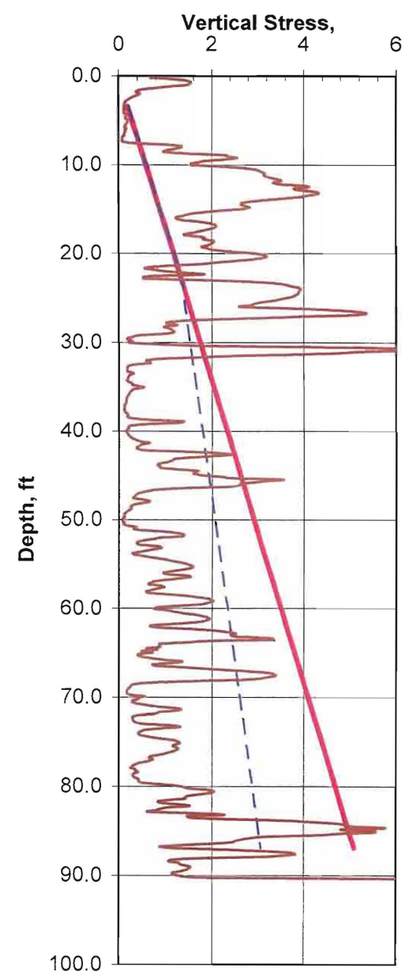
CP01 Stresses Versus Depth



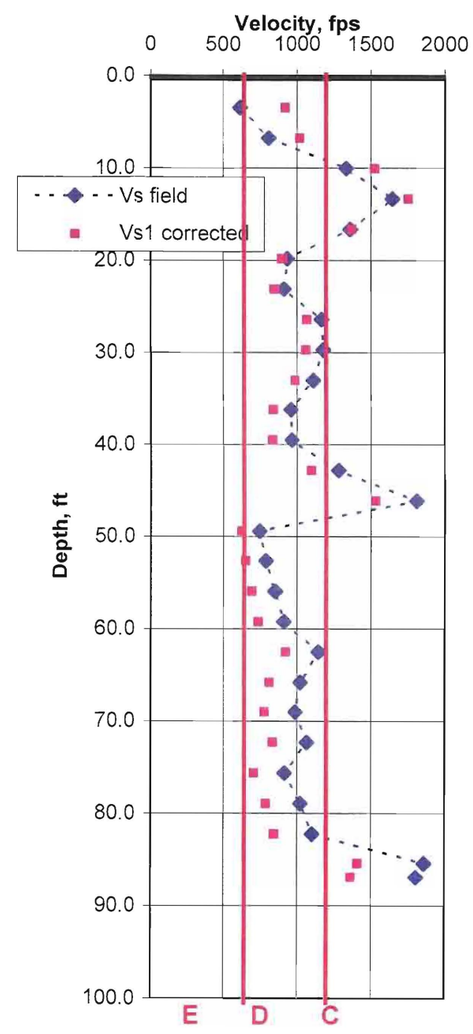
CP01 Vs Versus Depth



CP04 Stresses Versus Depth



CP04 Vs Versus Depth



Seismic Site Class
In accordance with IBC 2003
E- Soft Soil, Vs < 600 fps
D- Stiff Soil, 600 < Vs < 1200 fps
C- Very Dense Soil, 1200 < Vs < 2500 fps

Figure B-5 - Shear Wave Velocity Measurements

Envirocare of Utah, Inc.
Job No. 4-817-004769

amec

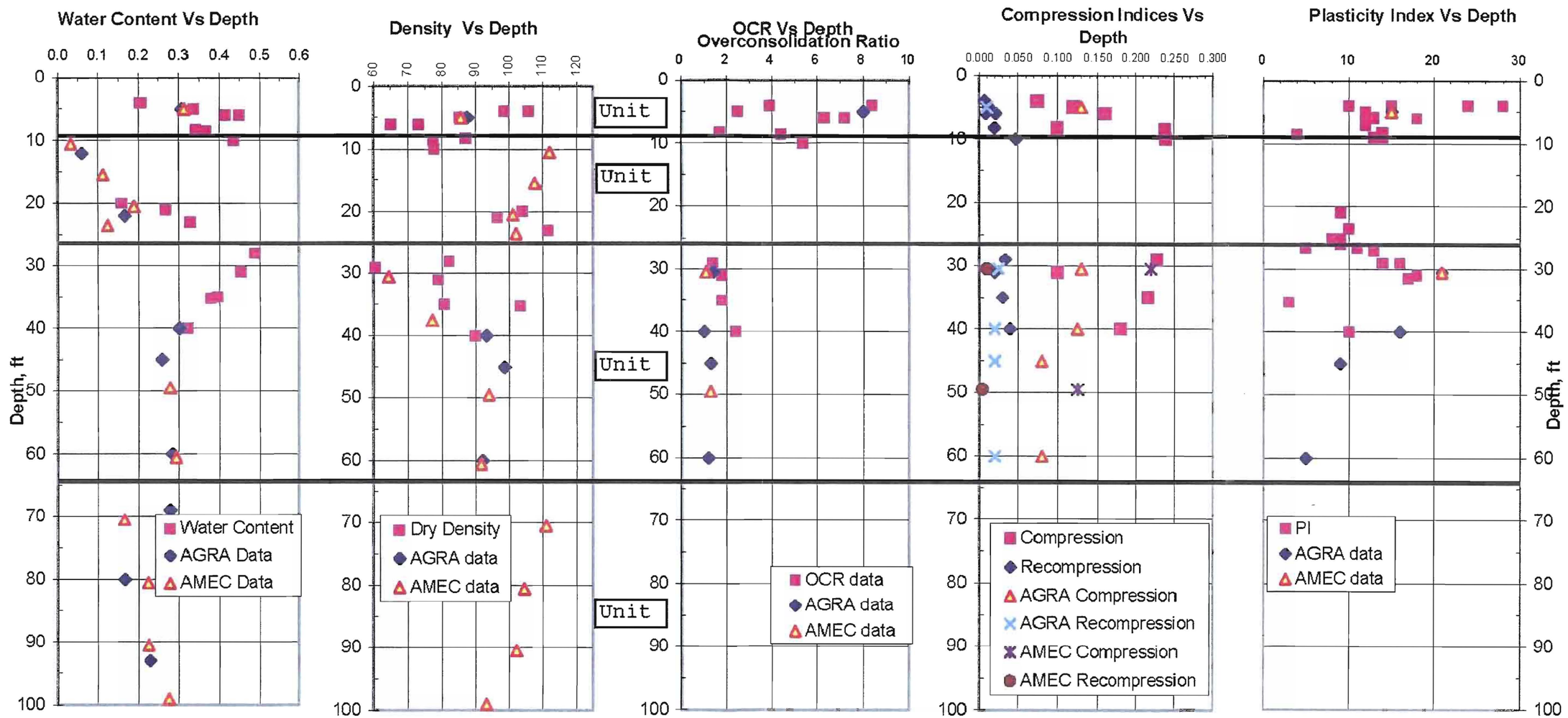


Figure B-8 - Summary Plot of Laboratory Test Results

PROJECT Envirocare Facility
Near Clive, Utah

LOG OF TEST BORING NO. B-2

JOB NO. 4-817-004769 DATE 10-07-04

RIG TYPE Marl M-10
BORING TYPE 4.25" Hollow-Stem Auger
SURFACE ELEV.
DATUM

Depth in Feet	Continuous Penetration Resistance	Graphical Log	Sample	Sample Type	Blows/foot 140 lb. 30" free-fall drop hammer	Dry Density lbs. per cubic foot	Moisture Content Percent of Dry Weight	Unified Soil Classification	REMARKS	VISUAL CLASSIFICATION
0								CL	dry	**SILTY CLAY** with some fine sand; light gravel; no topsoil; roots present; open structure; loose to 6"; desiccated
5				D	7	86	31.5	CL	moist medium stiff	gray with oxidation stains
								SM	slightly moist medium dense	**SILTY SAND** with trace fine gravel; fine to medium sand; light brown
10				D	67	112	3.4			
15				D	54	128	11.5		moist	grades silty fine sand; light brown
20				D	32	101	19.1		slightly moist	occasional silty clay and silt layers
				D	54	102	12.6		moist	
25										

GROUNDWATER

	DEPTH	HOUR	DATE
▽	37.3	11:00	10-07-04
▼			

SAMPLE TYPE
A - Auger cuttings
S - 2" O.D. 1.38" I.D. tube sample.
U - 3" O.D. 2.42" I.D. tube sample.
T - 3" O.D. thin-walled Shelby tube.
D - 3 1/4" O.D. 2.42" I.D. tube sample.
C - California Split Spoon Sample

FIGURE B-6A

amec

PROJECT Envirocare Facility
Near Clive, Utah

LOG OF TEST BORING NO. B-2

JOB NO. 4-817-004769 DATE 10-07-04

RIG TYPE Marl M-10
BORING TYPE 4.25" Hollow-Stem Auger
SURFACE ELEV.
DATUM

Depth in Feet	Continuous Penetration Resistance	Graphical Log	Sample	Sample Type	Blows/foot 140 lb. 30" free-fall drop hammer	Dry Density lbs. per cubic foot	Moisture Content Percent of Dry Weight	Unified Soil Classification	REMARKS	VISUAL CLASSIFICATION
25										
								CL	very moist to wet medium stiff	**SILTY CLAY**; gray
										a few sand layers and stringers throughout
30				D	8	65	60.7			
35										grades slightly cemented with fine sand; greenish-gray
				D	37	77	60.7	SC	saturated very stiff	**CLAYEY SAND** with some silt; fine sand; slightly cement; greenish-gray
40										
								CL	saturated stiff	**SILTY CLAY** with some fine sand layers; light brown
45										
				D	17	94	28.1			
50										

GROUNDWATER

DEPTH	HOUR	DATE
37.3	11:00	10-07-04

SAMPLE TYPE
A - Auger cuttings
S - 2" O.D. 1.38" I.D. tube sample.
U - 3" O.D. 2.42" I.D. tube sample.
T - 3" O.D. thin-walled Shelby tube.
D - 3 1/4" O.D. 2.42" I.D. tube sample.
C - California Split Spoon Sample

FIGURE B-6A
(con't)

amec

PROJECT Envirocare Facility
Near Clive, Utah

LOG OF TEST BORING NO. B-2

JOB NO. 4-817-004769 DATE 10-07-04

RIG TYPE Marl M-10
BORING TYPE 4.25" Hollow-Stem Auger
SURFACE ELEV.
DATUM

Depth in Feet	Continuous Penetration Resistance	Graphical Log	Sample	Sample Type	Blows/foot 140 lb. 30" free-fall drop hammer	Dry Density lbs. per cubic foot	Moisture Content Percent of Dry Weight	Unified Soil Classification	REMARKS	VISUAL CLASSIFICATION
50										
55										
60				D	23	92	29.5		very stiff	grades fine sandy silty clay; brown
								SC	saturated dense	**CLAYEY SAND**; some cemented layers; brown
65										
70				D	80	111	16.6			
75										

GROUNDWATER

DEPTH	HOUR	DATE
37.3	11:00	10-07-04

SAMPLE TYPE

A - Auger cuttings
S - 2" O.D. 1.38" I.D. tube sample.
U - 3" O.D. 2.42" I.D. tube sample.
T - 3" O.D. thin-walled Shelby tube.
D - 3 1/4" O.D. 2.42" I.D. tube sample.
C - California Split Spoon Sample

FIGURE B-6A
(con't)

amec

PROJECT Envirocare Facility
Near Clive, Utah

LOG OF TEST BORING NO. B-2

JOB NO. 4-817-004769 DATE 10-07-04

RIG TYPE Marl M-10
BORING TYPE 4.25" Hollow-Stem Auger
SURFACE ELEV.
DATUM

Depth in Feet	Continuous Penetration Resistance	Graphical Log	Sample	Sample Type	Blows/foot 140 lb. 30" free-fall drop hammer	Dry Density lbs. per cubic foot	Moisture Content Percent of Dry Weight	Unified Soil Classification	REMARKS	VISUAL CLASSIFICATION
75										
								SM	saturated dense	**SILTY SAND**; brown
80				D	93	105	22.6			
85										
						93	27.8			
90				D	29	103	22.7		medium dense	grades with occasional fine gravel
95								CL	saturated hard	**SILTY CLAY** with occasional fine gravel and sand; brown
				D	68					
100										

GROUNDWATER

DEPTH	HOUR	DATE
37.3	11:00	10-07-04

SAMPLE TYPE
A - Auger cuttings
S - 2" O.D. 1.38" I.D. tube sample.
U - 3" O.D. 2.42" I.D. tube sample.
T - 3" O.D. thin-walled Shelby tube.
D - 3 1/4" O.D. 2.42" I.D. tube sample.
C - California Split Spoon Sample

FIGURE B-6A
(con't)

amec

PROJECT Envirocare Facility
Near Clive, Utah

LOG OF TEST BORING NO. B-2

JOB NO. 4-817-004769 DATE 10-07-04

RIG TYPE Marl M-10
BORING TYPE 4.25" Hollow-Stem Auger
SURFACE ELEV.
DATUM

Depth in Feet	Continuous Penetration Resistance	Graphical Log	Sample	Sample Type	Blows/foot 140 lb. 30" free-fall drop hammer	Dry Density lbs. per cubic foot	Moisture Content Percent of Dry Weight	Unified Soil Classification	REMARKS	VISUAL CLASSIFICATION
100										Stopped drilling at 98.5'.
										Stopped sampling at 100.0'.
105										
110										
115										
120										The discussion in the text under the section titled, SUBSURFACE CONDITIONS, is necessary to a proper understanding of the nature of the subsurface materials.
125										

GROUNDWATER

DEPTH	HOUR	DATE
37.3	11:00	10-07-04

SAMPLE TYPE

A - Auger cuttings
S - 2" O.D. 1.38" I.D. tube sample.
U - 3" O.D. 2.42" I.D. tube sample.
T - 3" O.D. thin-walled Shelby tube.
D - 3 1/4" O.D. 2.42" I.D. tube sample.
C - California Split Spoon Sample

FIGURE B-6A
(con't)

amec

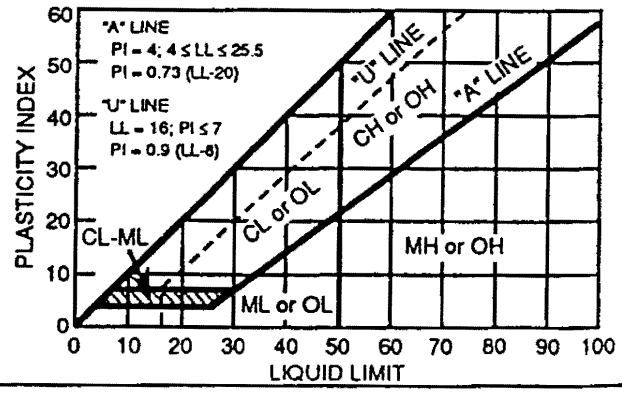
UNIFIED SOIL CLASSIFICATION SYSTEM

Soils are visually classified for engineering purposes by the Unified Soil Classification System. Grain-size analyses and Atterberg Limits tests often are performed on selected samples to aid in classification. The classification system is briefly outlined on this chart. Graphic symbols are used on boring logs presented in this report. For a more detailed description of the system, see "Standard Practice for Description and Identification of Soils (Visual-Manual Procedure)" ASTM Designation: 2488-84 and "Standard Test Method for Classification of Soils for Engineering Purposes" ASTM Designation: 2487-85.

MAJOR DIVISIONS				GRAPHIC SYMBOL	GROUP SYMBOL	TYPICAL NAMES
COARSE-GRAINED SOILS Less than 50% passes No. 200 sieve)	GRAVELS (50% or less of coarse fraction passes No. 4 sieve)	CLEAN GRAVELS (Less than 5% passes No. 200 sieve)			GW	Well graded gravels, gravel-sand mixtures, or sand-gravel-cobble mixtures
					GP	Poorly graded gravels, gravel-sand mixtures, or sand-gravel-cobble mixtures
		GRAVELS WITH FINES (More than 12% passes No. 200 sieve)	Limits plot below "A" line & hatched zone on plasticity chart		GM	Silty gravels, gravel-sand-silt mixtures
			Limits plot above "A" line & hatched zone on plasticity chart		GC	Clayey gravels, gravel-sand-clay mixtures
	SANDS (50% or more of coarse fraction passes No. 4 sieve)	CLEAN SANDS (Less than 5% passes No. 200 sieve)			SW	Well graded sands, gravelly sands
					SP	Poorly graded sands, gravelly sands
		SANDS WITH FINES (More than 12% passes No. 200 sieve)	Limits plot below "A" line & hatched zone on plasticity chart		SM	Silty sands, sand-silt mixtures
			Limits plot above "A" line & hatched zone on plasticity chart		SC	Clayey sands, sand-clay mixtures
FINE-GRAINED SOILS (50% or more passes No. 200 sieve)	SILTS Limits plot below "A" line & hatched zone on plasticity chart	SILTS OF LOW PLASTICITY (Liquid Limit less than 50)			ML	Inorganic silts, clayey silts of low to medium plasticity
		SILTS OF HIGH PLASTICITY (Liquid Limit 50 or more)			MH	Inorganic silts, micaceous or diatomaceous silty soils, elastic silts
	CLAYS Limits plot above "A" line & hatched zone on plasticity chart	CLAYS OF LOW PLASTICITY (Liquid Limit less than 50)			CL	Inorganic clays of low to medium plasticity, gravelly, sandy, and silty clays
		CLAYS OF HIGH PLASTICITY (Liquid Limit 50 or more)			CH	Inorganic clays of high plasticity, fat clays, sandy clays of high plasticity
	ORGANIC SILTS AND CLAYS	ORGANIC SILTS AND CLAYS OF LOW PLASTICITY (Liquid Limit less than 50)			OL	Organic silts and clays of low to medium plasticity, sandy organic silts and clays
		ORGANIC SILTS AND CLAYS OF HIGH PLASTICITY (Liquid Limit 50 or more)			OH	Organic silts and clays of high plasticity, sandy organic silts and clays
ORGANIC SOILS		PRIMARILY ORGANIC MATTER (dark in color and organic odor)			PT	Peat

NOTE: Coarse-grained soils with between 5% and 12% passing the No. 200 sieve and fine-grained soils with limits plotting in the hatched zone on the plasticity chart have dual classifications.

PLASTICITY CHART



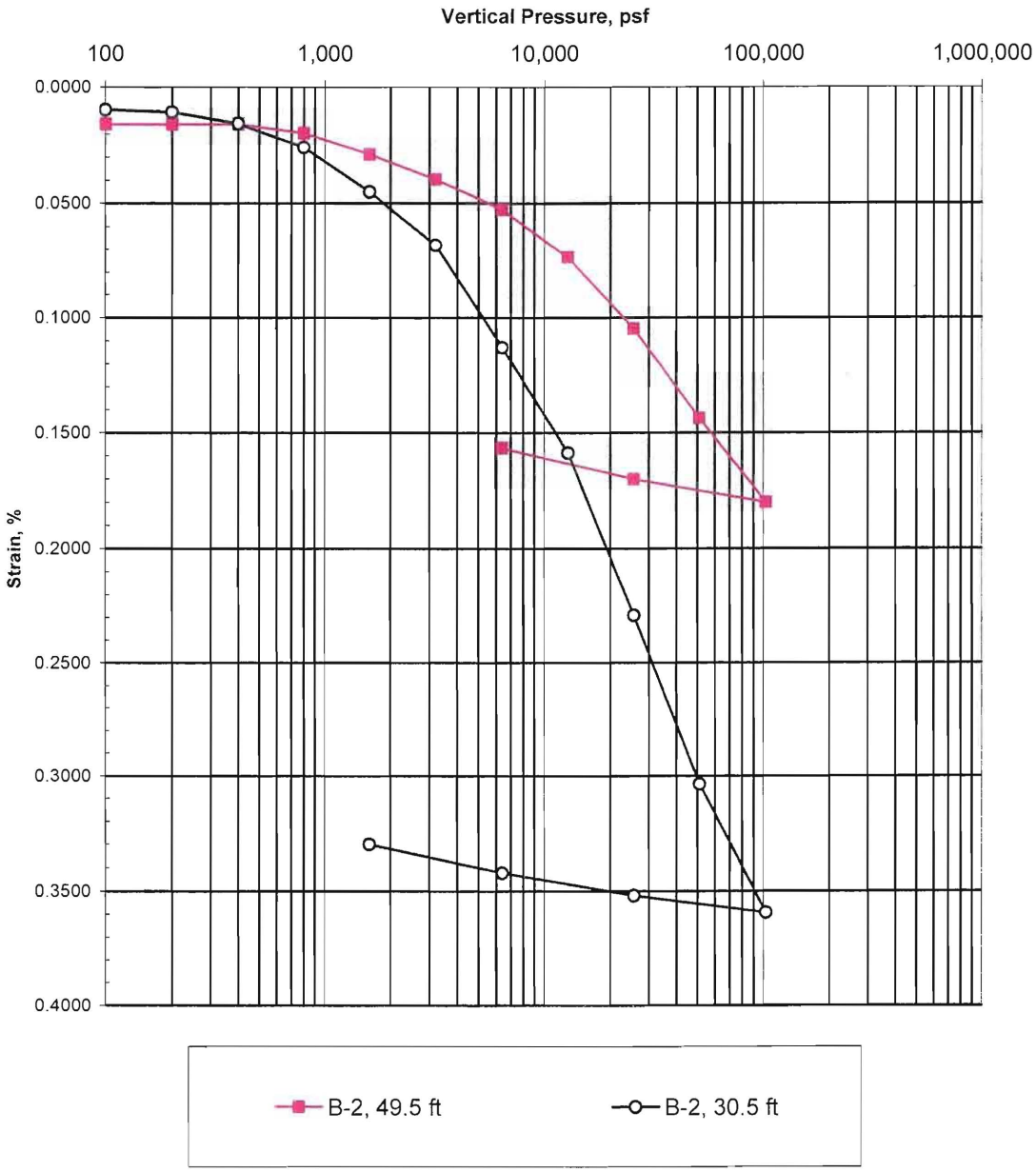
DEFINITION OF SOIL FRACTIONS

SOIL COMPONENT	PARTICLE SIZE RANGE
Boulders	Above 12 in.
Cobbles	12 in. to 3 in.
Gravel	3 in. to No. 4 sieve
Coarse gravel	3 in. to 3/4 in.
Fine gravel	3/4 in. to No. 4 sieve
Sand	No. 4 to No. 200 sieve
Coarse sand	No. 4 to No. 10 sieve
Medium sand	No. 10 to No. 40 sieve
Fine sand	No. 40 to No. 200 sieve
Fines (silt and clay)	Less than No. 200 sieve

FIGURE B-7

amec

Job No. 4-817-004769
Envirocare of Utah, Inc.



	B-2, 30.5 ft		B-2, 49.5 ft	
USCS Class	CL		CL	
	Initial	Final	Initial	Final
Dry Density, pcf	64.4	96.1	93.1	108.3
Water Content, %	62.5%	33.8%	29.9%	23.8%
Total Density, pcf	104.7	128.6	120.9	134.1

Figure B-9
Consolidation Test Results

consols.xls

CONETEC

ConeTec, Inc.

Geotechnical and Environmental Site Investigation Contractors

3589 West 500 South, Suite 3, Salt Lake City, UT 84104 • PO Box 22082, Salt Lake City, UT 84122
Tel: (801) 973-3801 • Fax: (801) 973-3802 • Web: www.conetec.com • Email: saltlakecity@conetec.com

October 19, 2004 Job No.: 04-406

Mr. Joergen Pilz
AMEC Earth & Environmental, Inc.
4137 South 500 West
Salt Lake City, UT 84123

Tel: (801) 266-0720
Fax: (801) 266-0727

Re: CPT Results
Envirocare Site
Tooele, Utah

Dear Joergen,

Per your request, we have completed the CPT investigation for the above referenced project. Enclosed is one set of standard CPT plots, seismic CPT plots, pore pressure dissipation plots and a data diskette. The diskette contains the CPT data files (*.cor files), and the pore pressure dissipation data files (*.ppd files). The "cor" and "ppd" files are text files that can be viewed with any text editor or imported into various programs, such as a spreadsheet. In addition to the data files, we have included digital copies of the CPT plots in PDF format. The following table summarizes the work performed at the site.

CPT Location	CPT Filename	Maximum Depth (ft)	PPD Depth (ft)	PPD Time (sec)	Ueq (ft)	Comments
CPT-04	406CP04	90.71		No PPD		Refusal & Seismic
CPT-05	406CP05	100.06	67.91	600	42.0	
CPT-06	406CP06	100.06				

Many correlations have been developed for design parameters based on CPT data. The interpretations are presented only as a guide for geotechnical use and should be carefully scrutinized for consideration in any geotechnical design.

Assumptions have been made regarding soil unit weights, groundwater level and interpretational methods, which may or may not apply to this site. Additionally, the following table summarizes the values assigned to the specific soil behavior type zones.

Job No.: 04-406

Zone	SPT Qt/N	Unit Wt. (kN/m^3)	Unit Wt. (pcf)	K (cm/s)	Description
0	1.0	19.5	124.1	$1x10^{-15}$	Undefined
1	2.0	12.5	79.6	$1x10^{-7}$	Sensitive Fines
2	1.0	17.5	111.4	$1x10^{-15}$	Organic Soil
3	1.0	17.5	111.4	$5x10^{-8}$	Clay
4	1.5	18.0	114.6	$5x10^{-7}$	Silty Clay
5	2.0	18.0	114.6	$5x10^{-6}$	Clayey Silt
6	2.5	18.0	114.6	$5x10^{-5}$	Silt
7	3.0	18.5	117.8	$5x10^{-4}$	Sandy Silt
8	4.0	19.0	120.9	$5x10^{-3}$	Silty Sand/Sand
9	5.0	19.5	124.1	$5x10^{-2}$	Sand
10	6.0	20.0	127.3	5	Gravelly Sand
11	1.0	20.5	130.5	$1x10^{-15}$	Stiff Fine Grained
12	2.0	19.0	120.9	$1x10^{-5}$	Cemented Sand

We appreciate the opportunity of providing these services to you. If you have any questions regarding the enclosed material or if, we can be of additional assistance, please contact us.

Sincerely,

ConeTec, Inc.

Shawn D. Steiner, P.E.
Manager

Enclosures

CONETEC

Shear Wave Velocity Calculations

Job No.: 04-406
Client: AMEC Earth & Environmental
CPT No.: CPT-04
Location Envirocare
Date: 10/7/04

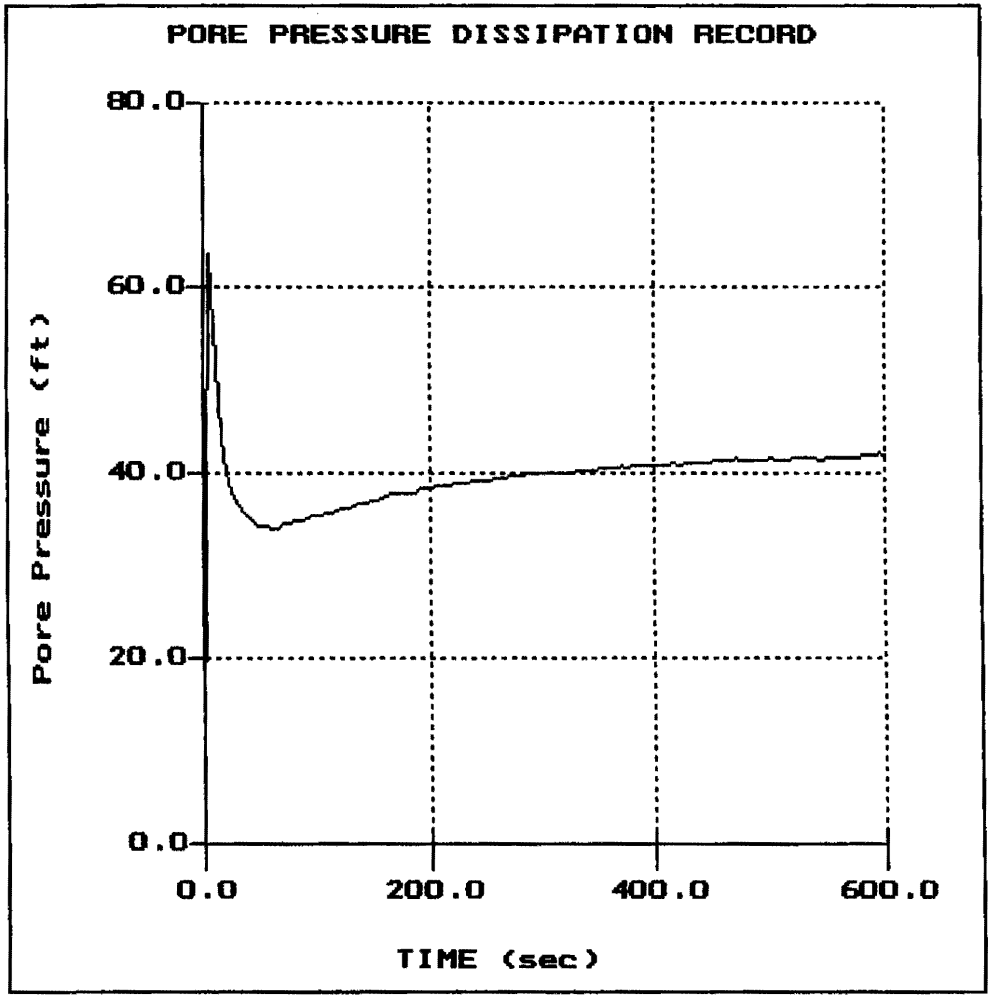
Geophone Offset (m): 0.20
Source Offset (8") (m): 0.20

Test Depth (m)	Geophone Depth (m)	Ray Path (m)	Incremental Distance (m)	Time Interval (ms)	Interval Velocity (m/s)	Interval Depth (m)	Interval Velocity (ft/s)	Interval Depth (ft)
0.75	0.55	0.59						
1.75	1.55	1.56	0.98	5.23	187	1.05	613	3.4
2.75	2.55	2.56	0.99	4.04	246	2.05	807	6.7
3.75	3.55	3.56	1.00	2.45	407	3.05	1334	10.0
4.75	4.55	4.55	1.00	1.99	502	4.05	1646	13.3
5.75	5.55	5.55	1.00	2.41	415	5.05	1361	16.6
6.75	6.55	6.55	1.00	3.52	284	6.05	931	19.8
7.75	7.55	7.55	1.00	3.61	277	7.05	908	23.1
8.75	8.55	8.55	1.00	2.81	356	8.05	1167	26.4
9.75	9.55	9.55	1.00	2.78	359	9.05	1178	29.7
10.75	10.55	10.55	1.00	2.95	339	10.05	1111	33.0
11.75	11.55	11.55	1.00	3.43	292	11.05	956	36.2
12.75	12.55	12.55	1.00	3.41	294	12.05	963	39.5
13.75	13.55	13.55	1.00	2.55	391	13.05	1284	42.8
14.75	14.55	14.55	1.00	1.81	552	14.05	1812	46.1
15.75	15.55	15.55	1.00	4.40	227	15.05	745	49.4
16.75	16.55	16.55	1.00	4.16	240	16.05	788	52.6
17.75	17.55	17.55	1.00	3.86	259	17.05	850	55.9
18.75	18.55	18.55	1.00	3.61	277	18.05	909	59.2
19.75	19.55	19.55	1.00	2.86	350	19.05	1147	62.5
20.75	20.55	20.55	1.00	3.21	311	20.05	1021	65.8
21.75	21.55	21.55	1.00	3.32	301	21.05	987	69.0
22.75	22.55	22.55	1.00	3.08	325	22.05	1066	72.3
23.75	23.55	23.55	1.00	3.59	278	23.05	912	75.6
24.75	24.55	24.55	1.00	3.21	312	24.05	1022	78.9
25.75	25.55	25.55	1.00	2.97	337	25.05	1104	82.2
26.75	26.55	26.55	1.00	1.76	567	26.05	1861	85.4
27.65	27.45	27.45	1.90	3.45	551	26.50	1806	86.9

AMEC

Hole:CPT-05
Location:ENVIROCARE

Cone: 20 Ton St 146
Date:10:07:04 09:17



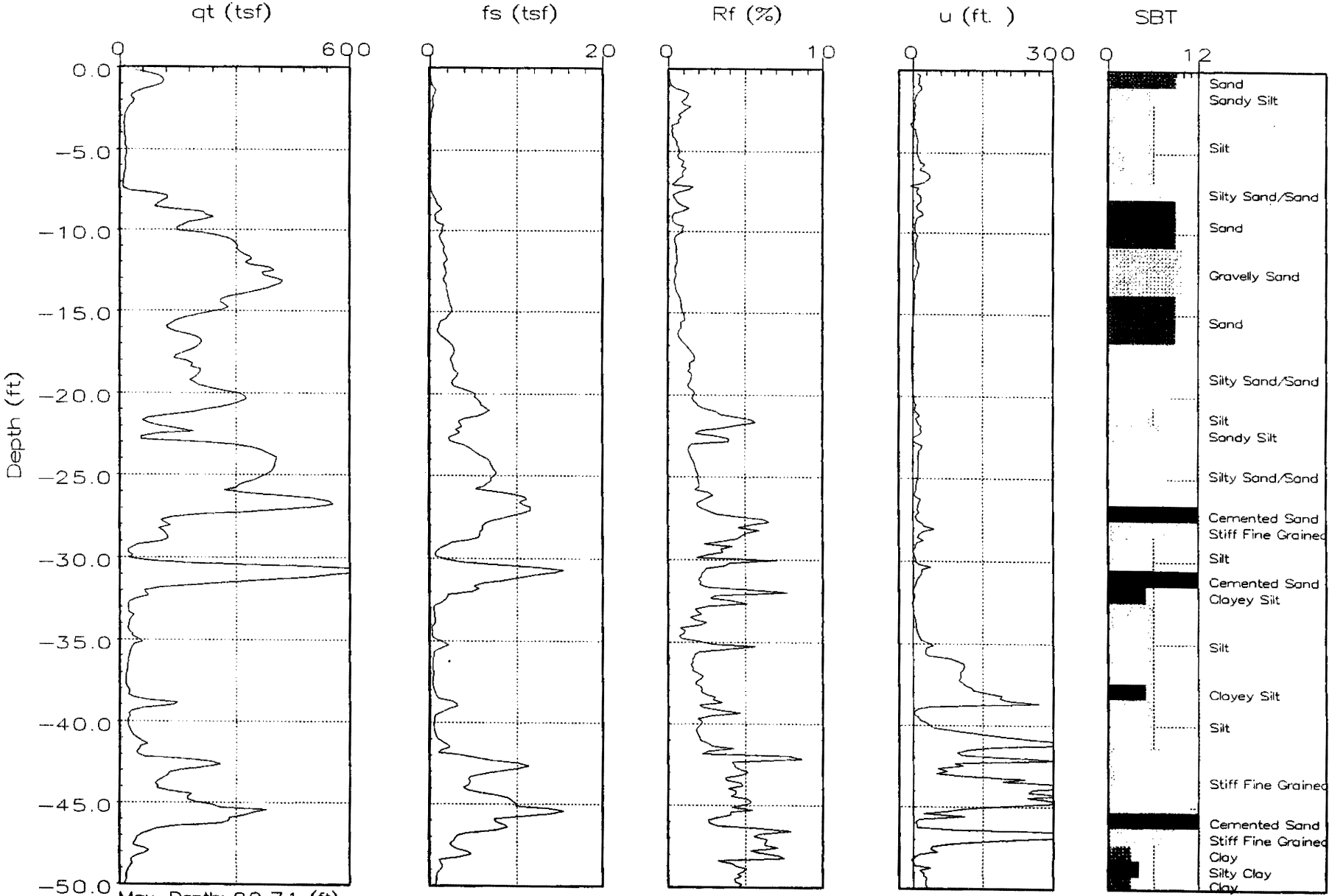
File: 406CP05.PPD
Depth (m): 20.70
(ft): 67.91
Duration : 600.0s
U-min: 5.02 0.0s
U-max: 63.64 5.0s

CONETEC

AMEC

Hole No.:CPT-04
Location:ENVIROCARE

Cone: 20 Ton St 146
Date:10:07:04 10:40



Max. Depth: 90.71 (ft)
Depth Inc.: 0.164 (ft)

SBT: Soil Behavior Type (Robertson 1990)

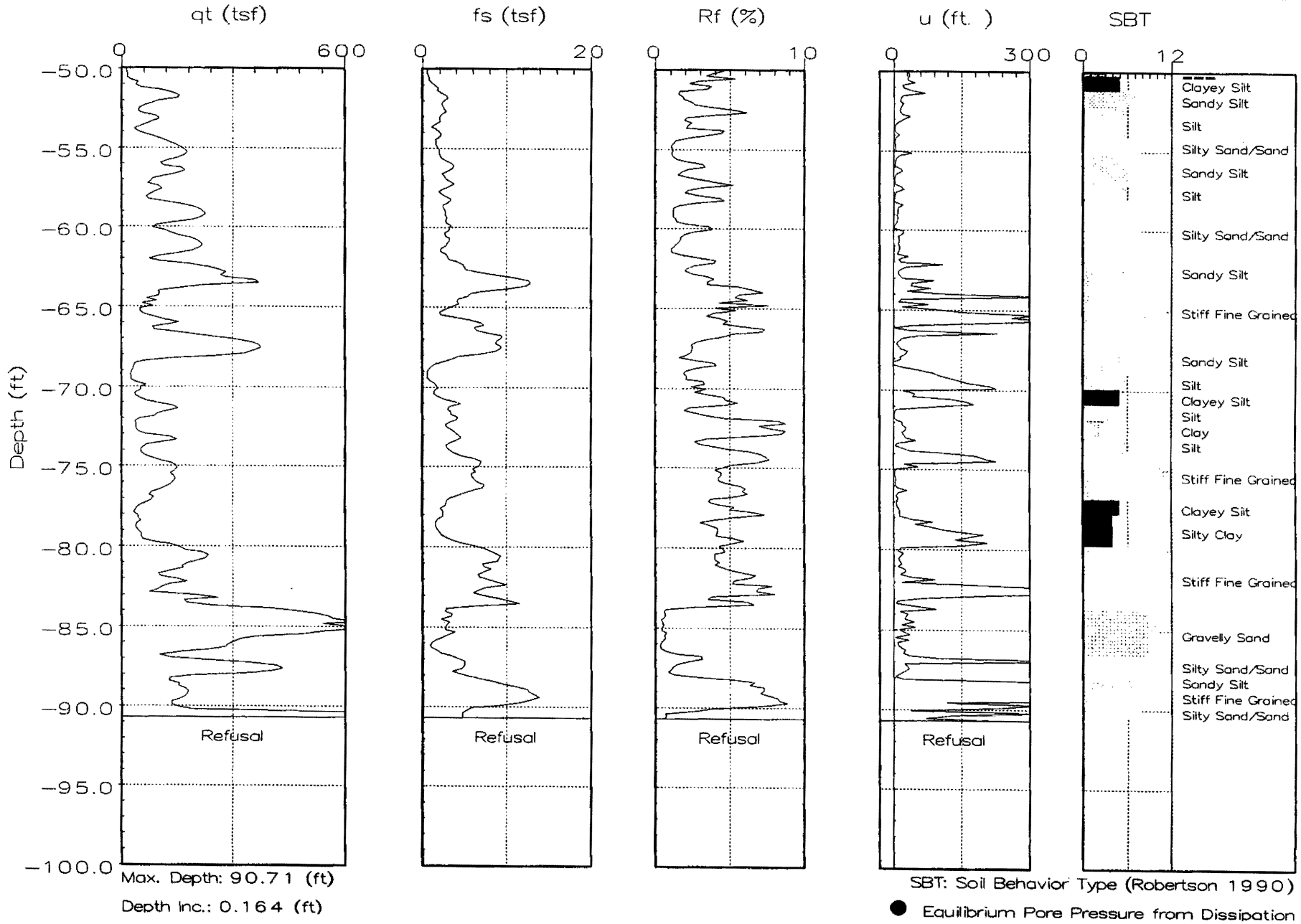
● Equilibrium Pore Pressure from Dissipation

CONETEC

AMEC

Hole No.:CPT-04
Location:ENVIROCARE

Cone: 20 Ton St 146
Date:10:07:04 10:40



Max. Depth: 90.71 (ft)
Depth Inc.: 0.164 (ft)

SBT: Soil Behavior Type (Robertson 1990)

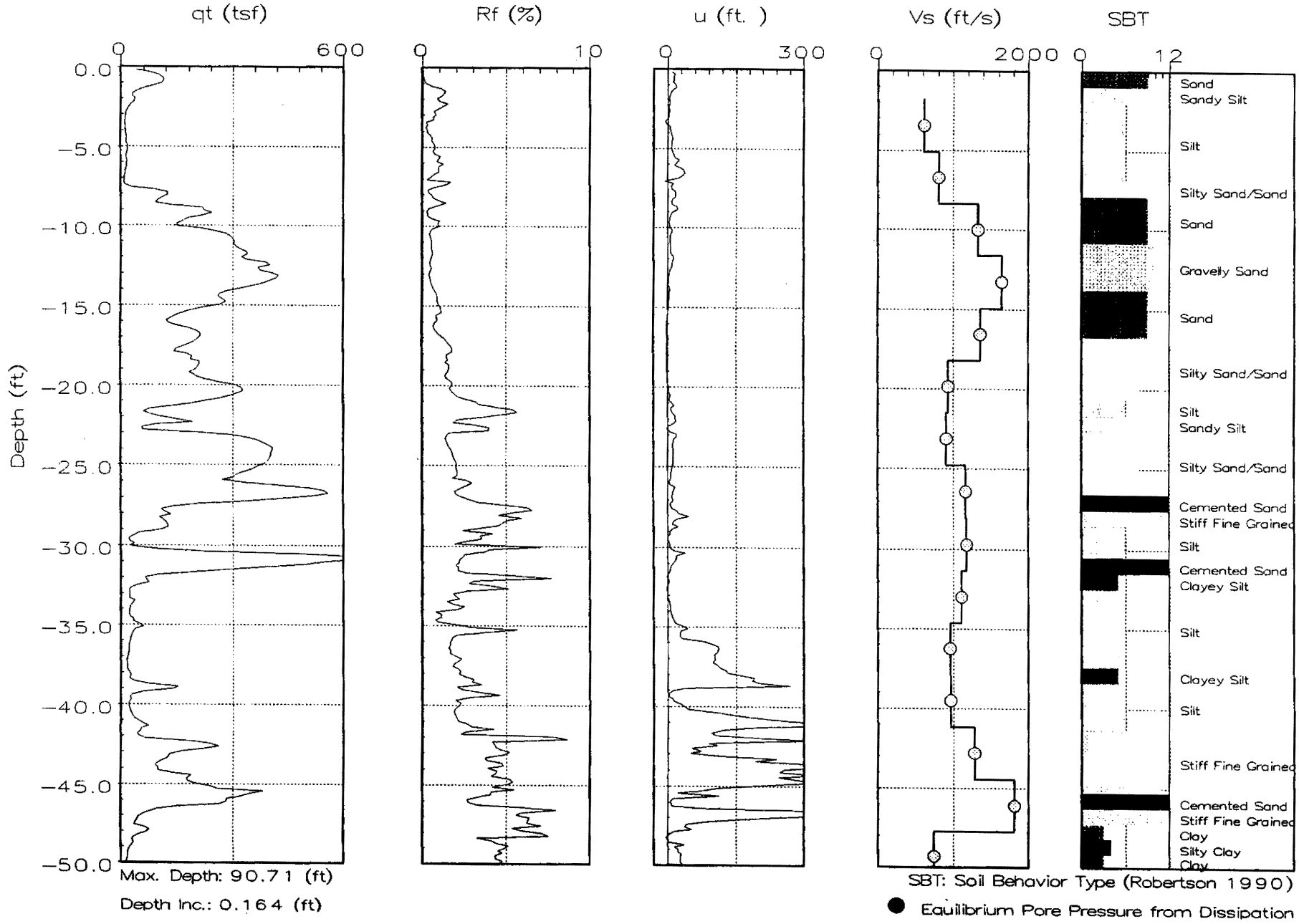
● Equilibrium Pore Pressure from Dissipation

CONETEC

AMEC

Hole No.:CPT-04
Location:ENVIROCARE

Cone: 20 Ton St 146
Date:10:07:04 10:40



Max. Depth: 90.71 (ft)
Depth Inc.: 0.164 (ft)

SBT: Soil Behavior Type (Robertson 1990)

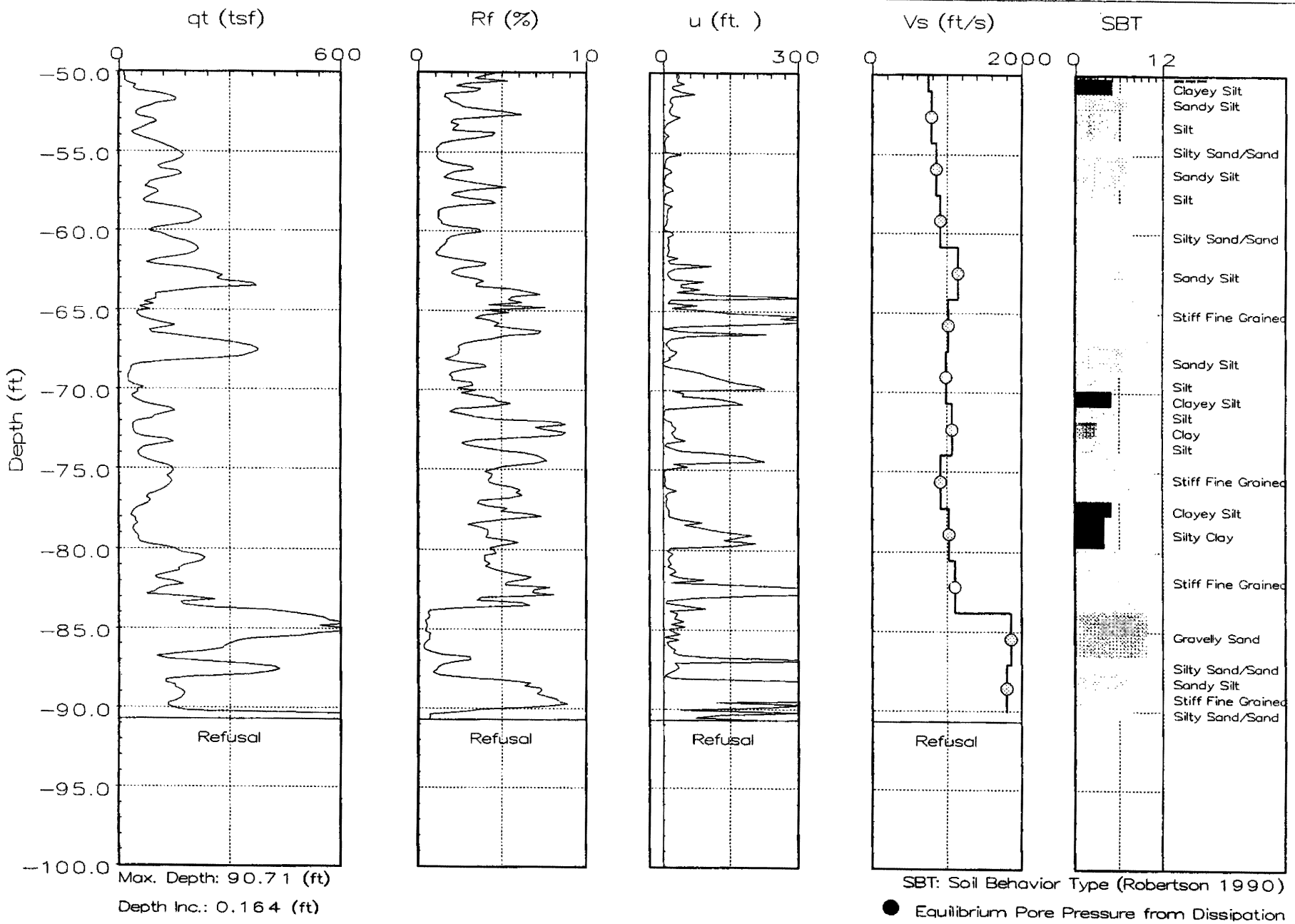
● Equilibrium Pore Pressure from Dissipation

CONETEC

AMEC

Hole No.:CPT-04
Location:ENVIROCARE

Cone: 20 Ton St 146
Date:10:07:04 10:40



Max. Depth: 90.71 (ft)
Depth Inc.: 0.164 (ft)

SBT: Soil Behavior Type (Robertson 1990)

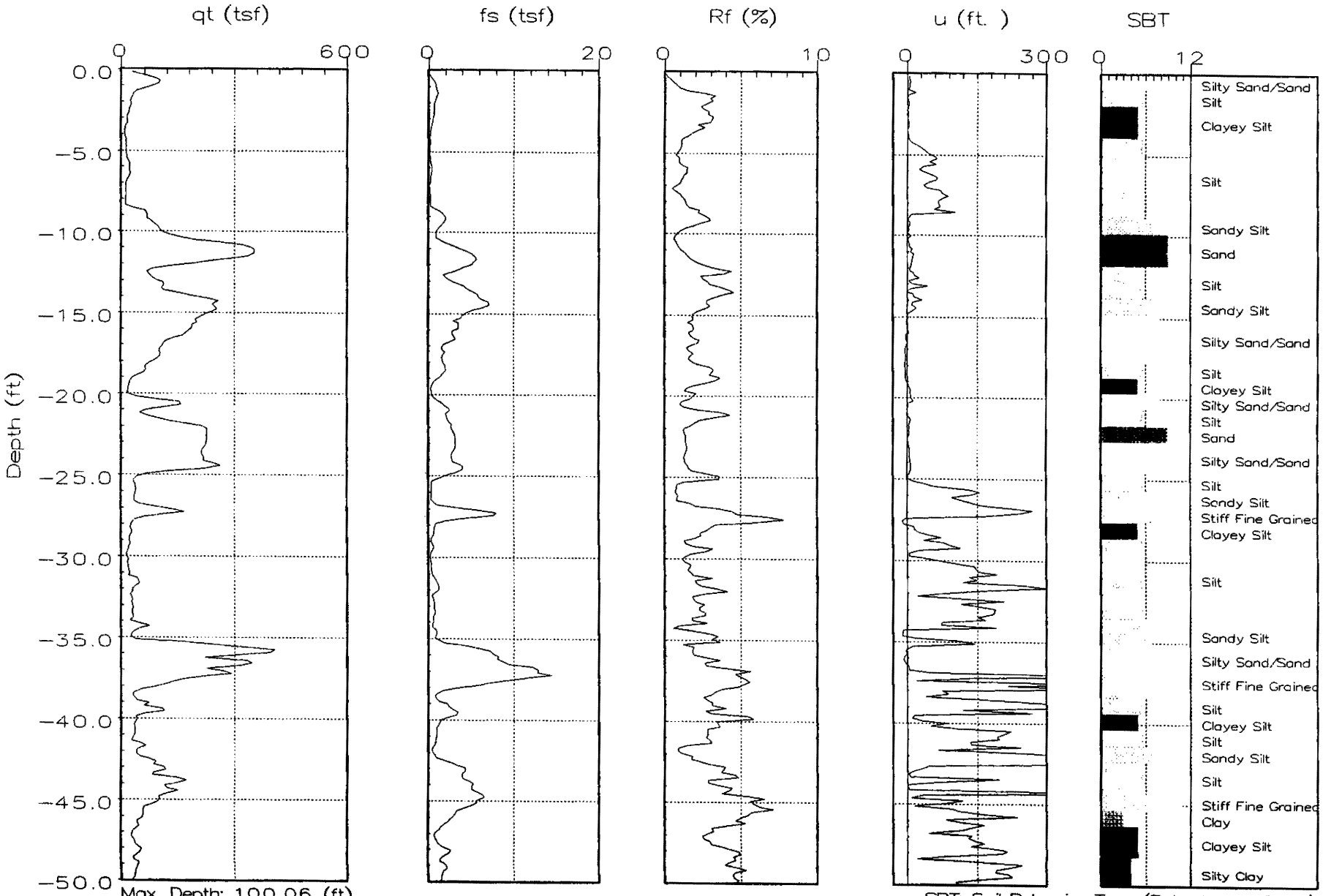
● Equilibrium Pore Pressure from Dissipation

CONETEC

AMEC

Hole No.:CPT-05
Location:ENVIROCARE

Cone: 20 Ton St 146
Date:10:07:04 09:17



Max. Depth: 100.06 (ft)

Depth Inc.: 0.164 (ft)

SBT: Soil Behavior Type (Robertson 1990)

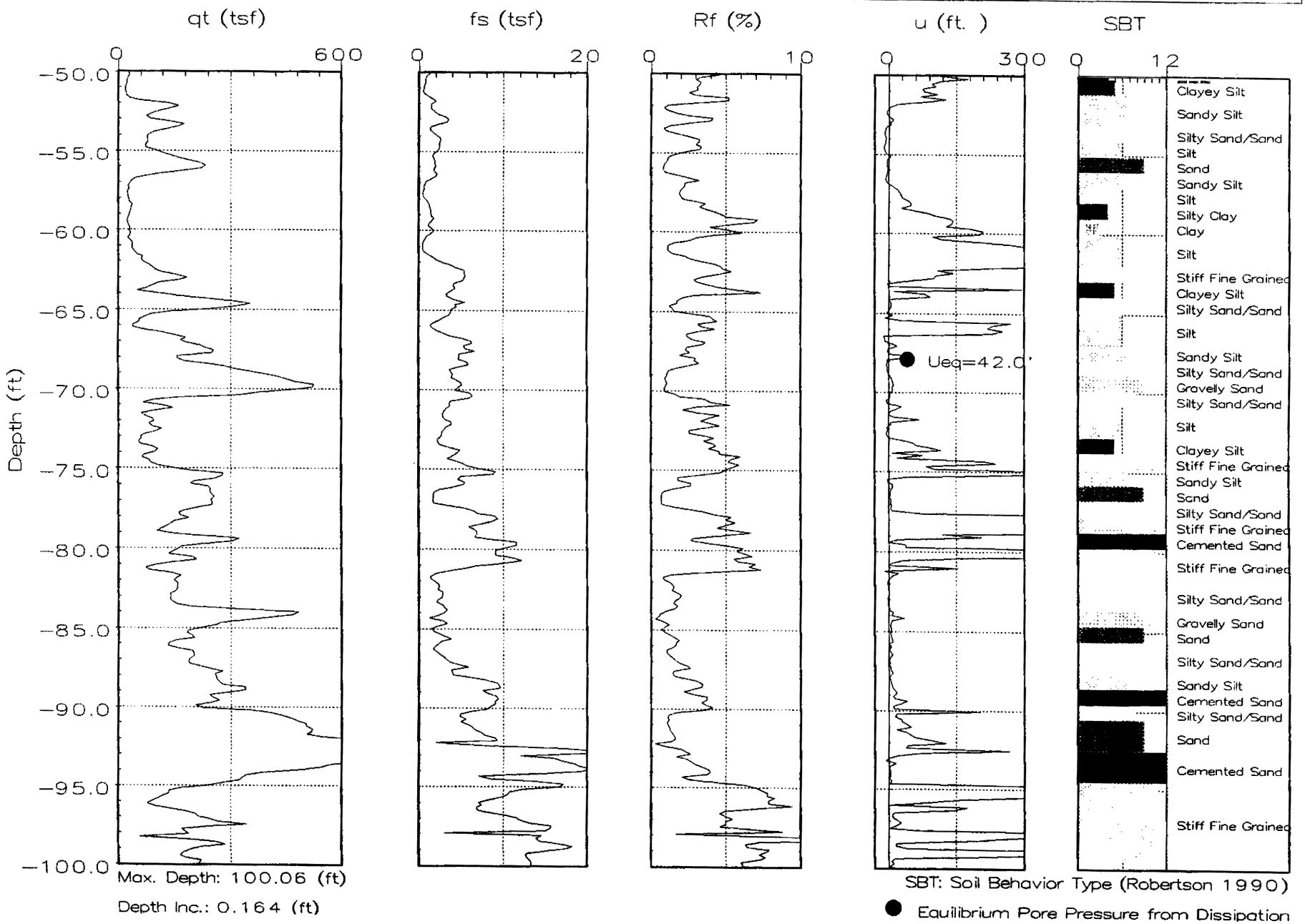
● Equilibrium Pore Pressure from Dissipation

CONETEC

AMEC

Hole No.:CPT-05
Location:ENVIROCARE

Cone: 20 Ton St 146
Date:10:07:04 09:17



Max. Depth: 100.06 (ft)

Depth Inc.: 0.164 (ft)

SBT: Soil Behavior Type (Robertson 1990)

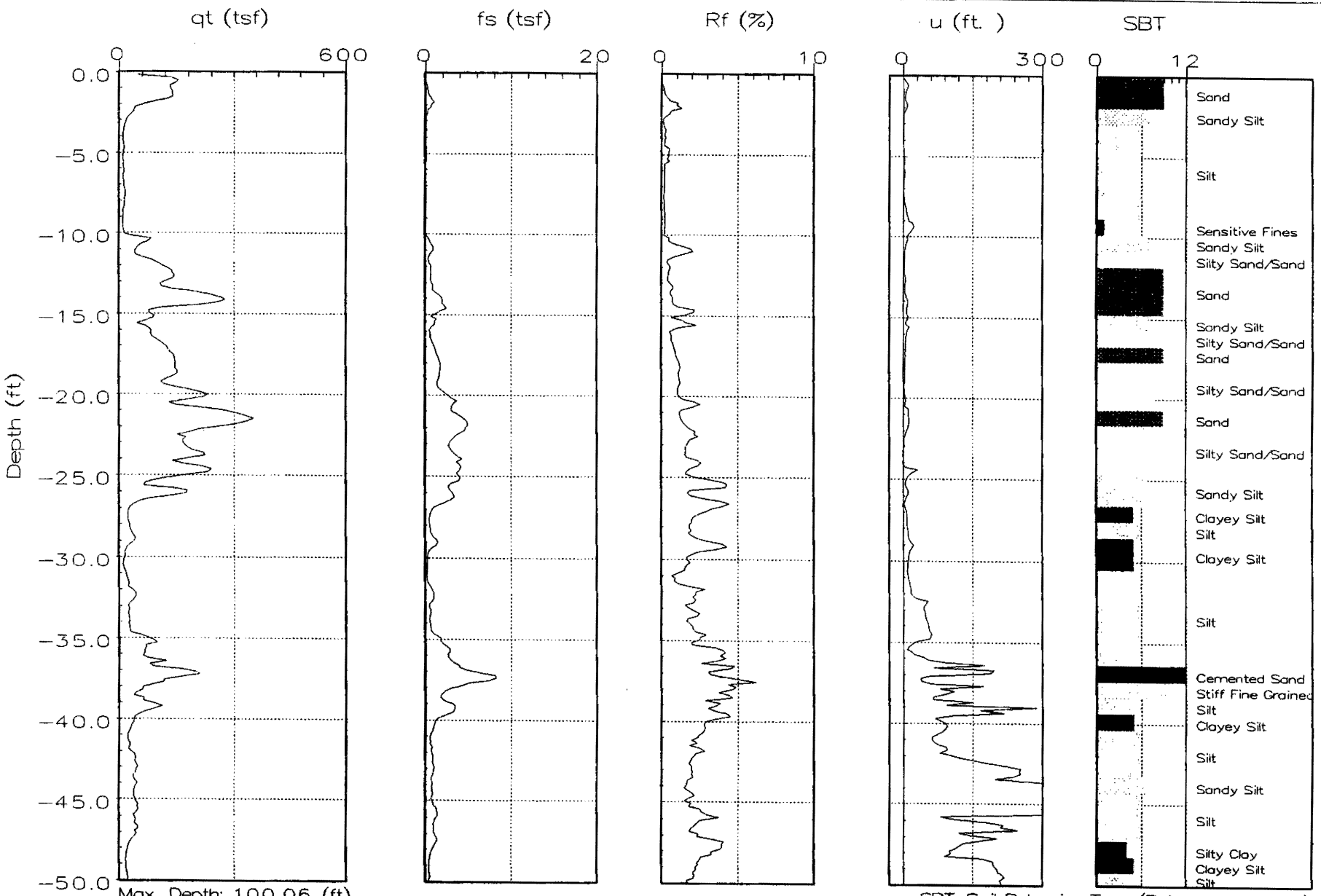
● Equilibrium Pore Pressure from Dissipation

CONETEC

AMEC

Hole No.:CPT-06
Location:ENVIROCARE

Cone: 20 Ton St 146
Date:10:07:04 12:39



Max. Depth: 100.06 (ft)
Depth Inc.: 0.164 (ft)

SBT: Soil Behavior Type (Robertson 1990)

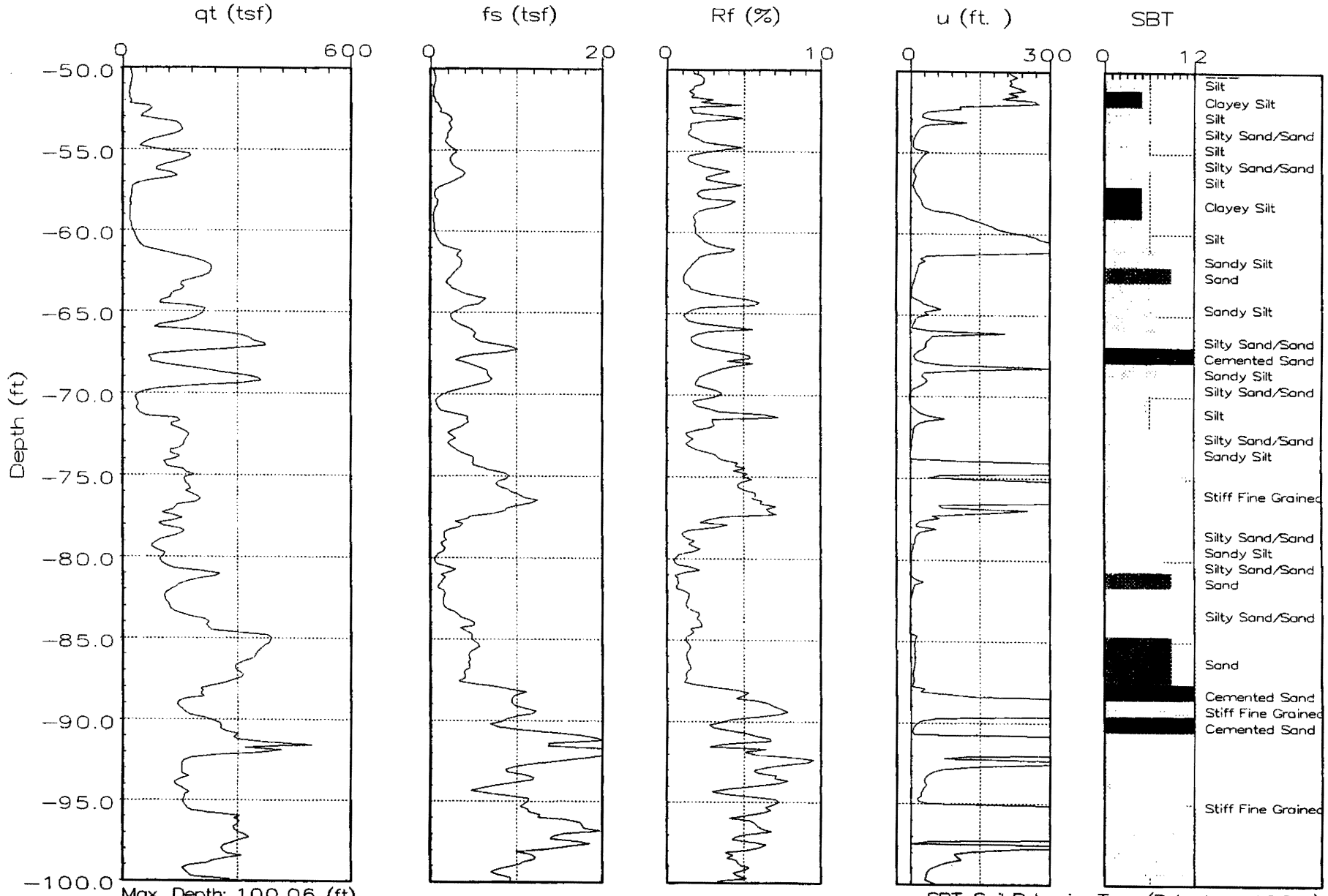
● Equilibrium Pore Pressure from Dissipation

CONETEC

AMEC

Hole No.:CPT-06
Location:ENVIROCARE

Cone: 20 Ton St 146
Date:10:07:04 12:39



Max. Depth: 100.06 (ft)
Depth Inc.: 0.164 (ft)

SBT: Soil Behavior Type (Robertson 1990)

● Equilibrium Pore Pressure from Dissipation

APPENDIX B - 2

APPENDIX B-2
Response to Interrogatory 1, Existing CLASS A EMBANKMENT (ref AMEC 7/25/2000)

Table A - Envirocare of Utah Geotechnical Design Criteria Summary Table

Design Item	Property	Values	Reference, Methodology used for Analysis or Comment
Static Stability	Unit Weight, Friction Angle, Cohesion	See Table 1 below:	Must be based on site specific data
	Factor of Safety	See Table 3 below FS > 1.5 (10% to 25% waste)	Embankment and Embankment dam design normally requires FS > 1.5 for satisfactory bahavior
Seismic Stability	Peak Horizontal Ground Accelerations	M = 6.5[1] Dist = 15 Km PHGA = 0.31 g +/- 0.06g (Mean +/- std deviation)	- Seismic Design Criteria completed for Vitro Embankment, see Appendix J, (same as for existing LARW) - See also 9-817-002103, 7/15/99 (Tab 5, Book 1) for comment on the conservatism of analysis.
	Seismic Coefficient	Seismic Coefficient should be 50% of PHGA	Griffeth and Hynes and Corp of Engineer Procedures
	Factor of Safety, pseudo static	FS > 1.2 (10% to 25% waste)	Factors of Safety near 1.0 are problematic for post earthquake deformations. Post earthquake deformations can be maintained adequately by designing to Factors of Safety greater than 1.2

[1] The seismic hazard attachment H does not stipulate an earthquake magnitude attenuation relationship used to develop the peak acceleration at the site. It is our opinion (based on checking a number of earthquake magnitude recurrence relationships) that the 0.37 g peak acceleration is overly conservative, since only the Campbell 1997 relationship will yield a mean plus one standard deviation peak acceleration of 0.37 g based on a Magnitude 6.5 earthquake at a focal distance of 15 kilometers.

AGRA

Design Item	Property	Values	Reference, Methodology used for Analysis or Comment
Seismic Design	Post Earthquake Cover Deformations	150 to 300 mm	Seed and Bonaparte, 1992. Deformations less than 150 mm desirable

Table B - Material Parameters for Stability Analysis

TABLE 1 (Ref 8-817-002103, 9/1/99) SUMMARY OF MATERIAL PROPERTIES				
Material Description	Depth (feet)	In-place Density (pcf)	Friction Angle (degree)	Cohesion (psf)
Rip-Rap Rock	0 – 2	135	40	0
Clay Cover	2 – 9	123	0	1,000
Protective Layer	9 – 11	117.5	38	250
LARW Debris	11 – 51	101 – 25% Waste	18	130
		113 – 10% Waste	18	130
Sand	51 – 53	117.5	38	250
Clay Liner	53 – 55	123	0	1,000

Basis:
1) Unit weights based on statistical analysis of Field Density and Moisture Content data (no change from 1996)
2) Select Proctor Compaction tests (Supplemental data since 1996 analysis)
3) Laboratory and Field Strength tests (Supplemental data since 1996)

AGRA

Table C - Summary of Strength Parameters Recommended for Stability Analysis (Ref 8-817-002103, 9/1/99)

Description	[illegible]	[illegible]
Lower bound shear strength, waste on waste material	18°	130
Soil shear strength -representative of ratios ranging from 10% to 40% waste to soil	29°	200

Basis:

1) The 1996 stability analysis used published values for frictional values between LDPE (low density polyethylene) on LDPE. These values were used as a conservative assumption since site specific values for the compressible debris were not available. It was recommended in 1996 that supplemental testing be completed to confirm or modify these values.
2) The 1999 stability analysis used results of site specific large scale direct shear testing for the lower bound shear strength. The shear strength was based on placing as close to 100% waste materials along the base of the shear box and using the resulting values as being representative of 10% to 25% waste to soil (loose lift thickness). Actual test results on 10% to 25% waste indicated that the waste materials tended to "reinforce the embankment" and lead to higher shear strength with waste than without the waste.

Table D - Stability Analysis Summary

TABLE 2 (Ref 8-817-002103, 9/1/99) SUMMARY OF STABILITY ANALYSES			
Analysis Scenario	Failure Mode	Minimum Factors of Safety	
		10 % Waste	25 % Waste
Static	Circular	2.4	2.3
Pseudo-static	Circular	1.4	1.3

Based on:

1) Limit Equilibrium Slope stability analysis using modified Bishop's method and SLOPE/W computer software.

AGRA

Table E - Deformation Analysis Summary

TABLE 3 (Ref 8-817-002103, 9/1/99) SUMMARY OF CALCULATED YIELD ACCELERATIONS		
Approximate Block Size (feet)	Approximate Block Height (feet)	Yield Acceleration
50	10 25 45	0.45 0.32 0.30
200	10 25 45	0.40 0.35 0.30
350	10 25 45	0.38 0.34 0.30

TABLE 4 (Ref 8-817-002103, 9/1/99) PERMANENT EMBANKMENT DEFORMATIONS (EMPIRICAL METHODS)		
Direction of Motion	Mammoth Lakes Records	El Centro Records
Horizontal (Makdisi and Seed) Plum et al Bray et al Vertical (all methods)	<1 mm <1 mm <1 mm <1 mm	1 to 80 mm 5 to 40 mm 20 to 60 mm <1 mm

PERMANENT EMBANKMENT DEFORMATIONS (NEWMARK ANALYSIS)		
Direction of Motion	Mammoth Lakes Records	El Centro Records
Horizontal Vertical	< 2 mm <1 mm	8 to 47 mm <1 mm

Basis:

1) Yield Accelerations based on sliding block analysis (limit equilibrium) and SLOPE/W

2) Deformations based on Makdisi Seed analysis and other referenced analysis.

AGRA

Table F - Summary of Engineering Properties used for Settlement Analysis (Ref 6/1/2000, 9-817-002642)

Parameter	1996 Study	Selected for this study		Reference / Basis
	Value	Value	Range	
Classification	CL	CL	CL to SM	Based on clay cover soils (sand soils are considerably less compressible and not subject to creep)
Atterberg Limits	LL = 36 PI = 16	LL = 26 PI = 14	plastic to non-plastic	Laboratory Testing / Field QC tests
Dry Density, pcf	Debris = 40 Soil = 120 10 percent Tot = 112 25 percent Tot = 100	Debris = 40 Soil = 128	Debris = 30 to 40 Soil = 120 to 130	Based on ratio of unit weights of soil to debris
Optimum Water Content, percent	20 percent	20 percent	10 to 25 percent	Field and Laboratory tests
Placement Compaction, percent	90 % D-698	90 % D-698	90 to 95 % D-698	QA program / Project Specifications
Recompression Ratio, RR	0.00312	0.017	.001 to .002	Laboratory Tests
Compression Ratio, CR	0.0854	.097	.07 to 0.10	Laboratory Tests

AGRA

Parameter	1996 Study	Selected for this study		Reference / Basis
	Value	Value	Range	
Preconsolidation Stress due to Compaction	3685 (10 percent) 4324 (25 percent)	3500	3000 to 10,000	Laboratory Tests (settlement of compacted soil samples)
Coefficient of Consolidation, Cv	n.a.	.008 to .0012 $inch^2/min$	not available	Laboratory Tests on Compacted Soil Samples
Coefficient of Secondary Consolidation, Cα	.005	.004	.003 to 0.006	Laboratory Tests on Compacted Soil Samples
Power Curve Parameter, m (Edil)	3 X 10-5 kPa	$9X\ 10^{-6}$	$5\ to\ 9\ X\ 10^{-6}$	Laboratory Tests on Compacted composite soil/waste samples
Power Curve Parameter, n (Edil)	0.3	0.35	0.3 to 0.35	Laboratory Tests on Compacted composite soil/waste samples
Cover Load, psf	10.2 ft X 120 pcf = 1224 psf	1224	1100 to 1300 psf	Calculated based on Unit Weights

Based on:

1) Input required for "Terzaghi type" settlement computations
2) Power fit "curves" by Edil, et al.

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APPENDIX C

APPENDIX C

Slope Stability Analysis

The following table summarizes results of the slope stability calculations. Calculations for each case are attached following this table. Refer to Section 3.3 Stability Calculations, of the report for further details.

Table C.1 -- Summary of Slope Stability Analyses

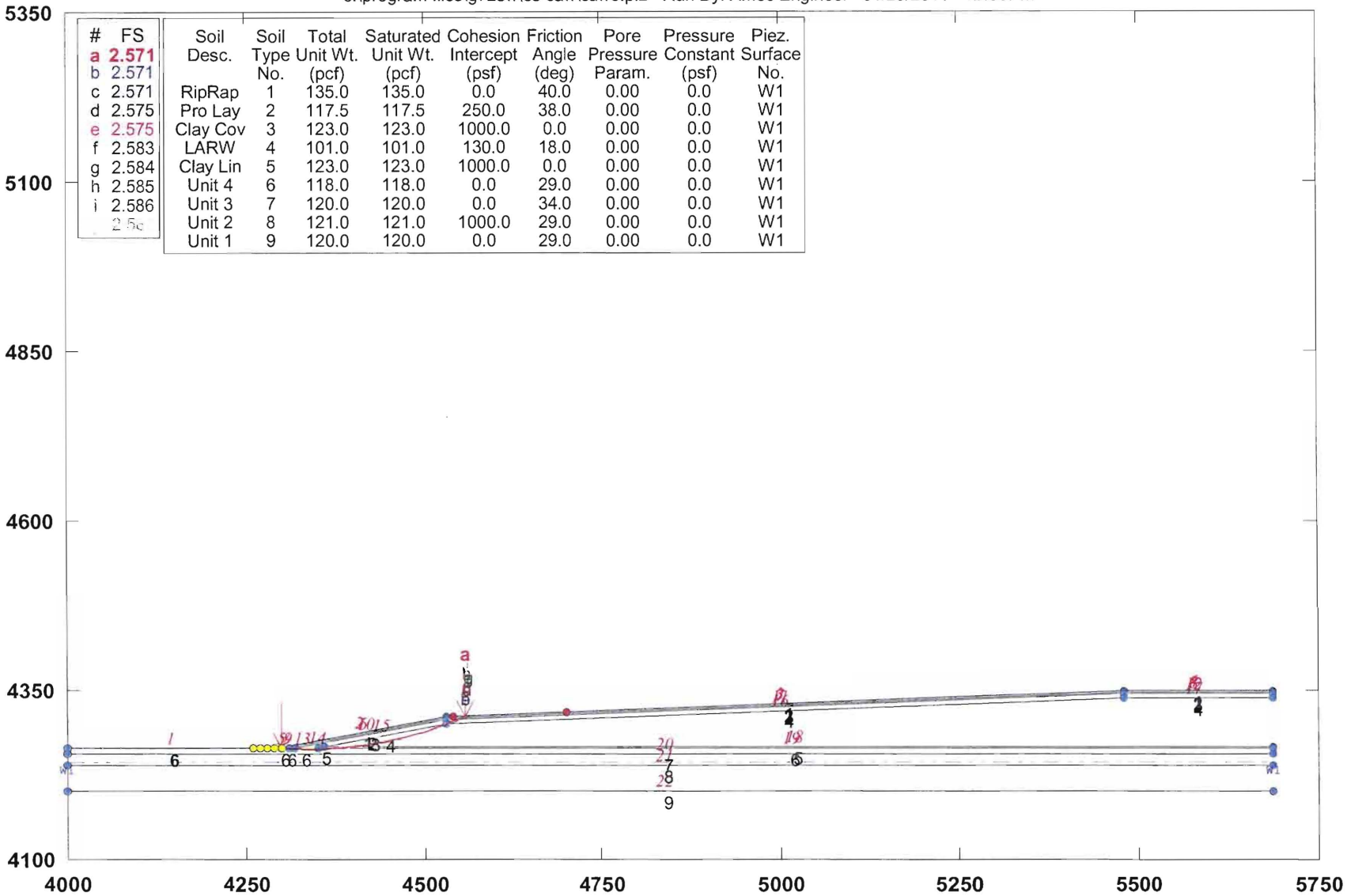
Case	Description of Analysis	Analysis Condition	Factor of Safety	Yield Acceleration / Displacement (in)	Filename
1	Potential failure paths were studied within CAW Embankment above elevation 4260	Static	2.6		CAWE
		Pseudostatic	1.7		CAWES
		Yield Analysis	1.0	0.33g / 0.3	CAWEY
2	Potential failure paths through the lower clay unit (Unit 2) were studied	Static			CAWF
		Pseudostatic	1.2		CAWFS
		Yield Analysis	1.0	0.19g / 0.7	CAWFY
3	Potential failure paths through the upper clay unit (Unit 4) were studied	Static	2.6		CAWP
		Pseudostatic	2.0		CAWPS
		Yield Analysis	1.0	0.36g / 0.2	CAWPY

CAW Emb 38' 5(H):1(V) side-slopes, Static, Embankment 121810 CAWE

c:\program files\g72sw\es caw\cawe.pl2 Run By: Amec Engineer 01/29/2011 12:03PM

#	FS
a	2.571
b	2.571
c	2.571
d	2.575
e	2.575
f	2.583
g	2.584
h	2.585
i	2.586
	2.5c

Soil Desc.	Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Param.	Pressure Constant (psf)	Piez. Surface No.
RipRap	1	135.0	135.0	0.0	40.0	0.00	0.0	W1
Pro Lay	2	117.5	117.5	250.0	38.0	0.00	0.0	W1
Clay Cov	3	123.0	123.0	1000.0	0.0	0.00	0.0	W1
LARW	4	101.0	101.0	130.0	18.0	0.00	0.0	W1
Clay Lin	5	123.0	123.0	1000.0	0.0	0.00	0.0	W1
Unit 4	6	118.0	118.0	0.0	29.0	0.00	0.0	W1
Unit 3	7	120.0	120.0	0.0	34.0	0.00	0.0	W1
Unit 2	8	121.0	121.0	1000.0	29.0	0.00	0.0	W1
Unit 1	9	120.0	120.0	0.0	29.0	0.00	0.0	W1



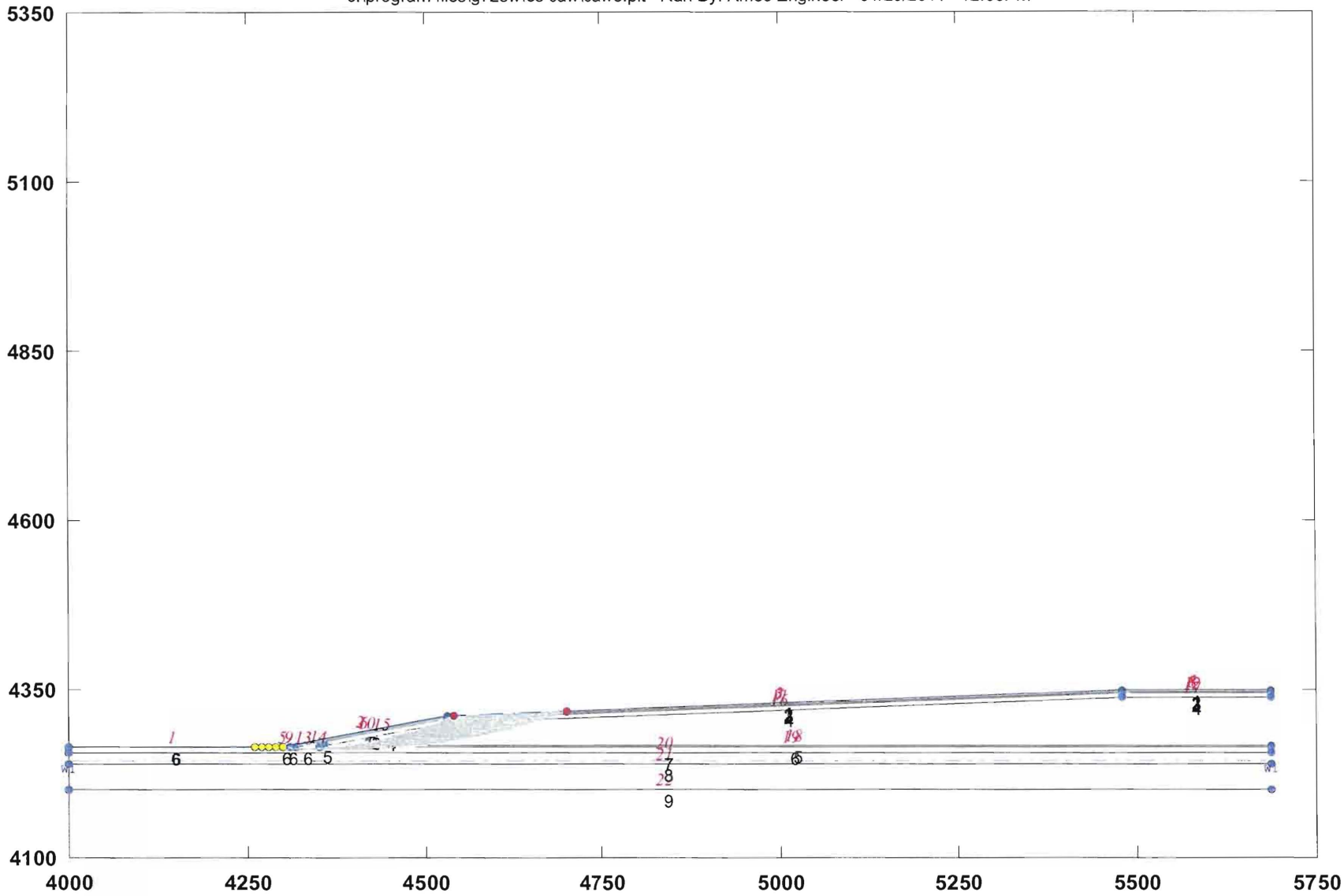
GSTABL7 v.2 FSmin=2.571

Safety Factors Are Calculated By GLE (Spencer`s) Method (0-1)

GSTABL7

CAW Emb 38' 5(H):1(V) side-slopes, Static, Embankment 121810 CAWE

c:\program files\g72sw\es caw\cawe.plt Run By: Amec Engineer 01/29/2011 12:03PM



GSTABL7

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                    ***  GSTABL7  ***

              ** GSTABL7 by Garry H. Gregory, P.E. **

   ** Original Version 1.0, January 1996; Current Version 2.004, June 2003 **
              (All Rights Reserved-Unauthorized Use Prohibited)

*******************************************************************************
                    SLOPE STABILITY ANALYSIS SYSTEM
       Modified Bishop, Simplified Janbu, or GLE Method of Slices.
       (Includes Spencer & Morgenstern-Price Type Analysis)
       Including Pier/Pile, Reinforcement, Soil Nail, Tieback,
       Nonlinear Undrained Shear Strength, Curved Phi Envelope,
       Anisotropic Soil, Fiber-Reinforced Soil, Boundary Loads, Water
       Surfaces, Pseudo-Static & Newmark Earthquake, and Applied Forces.
*******************************************************************************


Analysis Run Date:        01/29/2011
Time of Run:              12:03PM
Run By:                   Amec Engineer
Input Data Filename:      C:\Program Files\G72SW\ES CAW\cawe.
Output Filename:          C:\Program Files\G72SW\ES CAW\cawe.OUT
Unit System:              English

Plotted Output Filename:  C:\Program Files\G72SW\ES CAW\cawe.PLT



PROBLEM DESCRIPTION:  CAW Emb 38' 5(H):1(V) side-slopes,
                      Static, Embankment 121810  CAWE



BOUNDARY COORDINATES

    4 Top   Boundaries
   22 Total Boundaries

Boundary     X-Left     Y-Left     X-Right    Y-Right    Soil Type
   No.        (ft)       (ft)       (ft)       (ft)     Below Bnd

    1       4000.00    4265.00    4300.00    4265.00        6
    2       4300.00    4265.00    4530.00    4311.00        1
    3       4530.00    4311.00    5480.00    4349.00        1
    4       5480.00    4349.00    5689.00    4349.00        1
    5       4300.00    4265.00    4310.00    4265.00        6
    6       4310.00    4265.00    4530.00    4309.00        2
    7       4530.00    4309.00    5480.00    4347.00        2
    8       5480.00    4347.00    5689.00    4347.00        2
    9       4310.00    4265.00    4318.00    4265.00        6
   10       4318.00    4265.00    4530.00    4307.50        3
   11       4530.00    4307.50    5480.00    4345.50        3
   12       5480.00    4345.50    5689.00    4345.50        3
   13       4318.00    4265.00    4353.00    4265.00        6
   14       4353.00    4265.00    4361.00    4267.00        5
   15       4361.00    4267.00    4530.00    4300.50        4
   16       4530.00    4300.50    5480.00    4338.50        4
   17       5480.00    4338.50    5689.00    4338.50        4
   18       4361.00    4267.00    5689.00    4267.00        5
   19       4353.00    4265.00    5689.00    4265.00        6
   20       4000.00    4256.00    5689.00    4256.00        7
   21       4000.00    4239.00    5689.00    4239.00        8
   22       4000.00    4201.00    5689.00    4201.00        9

User Specified Y-Origin =      4100.00(ft)

Default X-Plus Value = 0.00(ft)

Default Y-Plus Value = 0.00(ft)
1


ISOTROPIC SOIL PARAMETERS


 9 Type(s) of Soil


Soil  Total  Saturated  Cohesion  Friction   Pore    Pressure   Piez.
Type Unit Wt. Unit Wt.  Intercept  Angle  Pressure Constant Surface
 No.  (pcf)    (pcf)      (psf)    (deg)   Param.   (psf)     No.

  1   135.0    135.0       0.0     40.0    0.00       0.0      1
  2   117.5    117.5     250.0     38.0    0.00       0.0      1
  3   123.0    123.0    1000.0      0.0    0.00       0.0      1
  4   101.0    101.0     130.0     18.0    0.00       0.0      1
  5   123.0    123.0    1000.0      0.0    0.00       0.0      1
  6   118.0    118.0       0.0     29.0    0.00       0.0      1
```

7	120.0	120.0	0.0	34.0	0.00	0.0	1
8	121.0	121.0	1000.0	29.0	0.00	0.0	1
9	120.0	120.0	0.0	29.0	0.00	0.0	1

1

1 PIEZOMETRIC SURFACE(S) SPECIFIED

Unit Weight of Water = 62.40 (pcf)

Piezometric Surface No. 1 Specified by 2 Coordinate Points
Pore Pressure Inclination Factor = 0.50

Point No.	X-Water (ft)	Y-Water (ft)
1	4000.00	4243.00
2	5689.00	4243.00

1

A Critical Failure Surface Searching Method, Using A Random
Technique For Generating Circular Surfaces, Has Been Specified.

5000 Trial Surfaces Have Been Generated.

1000 Surface(s) Initiate(s) From Each Of 5 Points Equally Spaced
Along The Ground Surface Between X =4260.00(ft)
and X =4300.00(ft)

Each Surface Terminates Between X =4540.00(ft)
and X =4700.00(ft)

Unless Further Limitations Were Imposed, The Minimum Elevation
At Which A Surface Extends Is Y = 4260.00(ft)

8.00(ft) Line Segments Define Each Trial Failure Surface.

Following Are Displayed The Ten Most Critical Of The Trial
Failure Surfaces Evaluated. They Are
Ordered - Most Critical First.

* * Safety Factors Are Calculated By GLE (Spencer`s) Method (0-1) * *

Selected ki function = Constant (1.0)

Selected Lambda Coefficient = 1.00

Forces from Reinforcement, Piers/Piles, Soil Nails, and Applied Forces
(if applicable) have been applied to the slice base(s)
on which they intersect.

Specified Tension Crack Water Force Factor = 0.000

Total Number of Trial Surfaces Attempted = 5000

WARNING! The Factor of Safety Calculation for one or More Trial Surfaces
Did Not Converge in 20 Iterations.

Number of Trial Surfaces with Non-Converged FS = 37

Number of Trial Surfaces With Valid FS = 4963

Percentage of Trial Surfaces With Non-Valid FS Solutions
of the Total Attempted = 0.7 %

Statistical Data On All Valid FS Values:
FS Max = 6.315 FS Min = 2.571 FS Ave = 2.894
Standard Deviation = 0.374 Coefficient of Variation = 12.91 %

((Modified Bishop FS for Critical Surface = 2.566))

Failure Surface Specified By 35 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	4300.000	4265.000
2	4307.979	4264.419
3	4315.966	4263.965
4	4323.959	4263.638
5	4331.957	4263.437
6	4339.957	4263.362
7	4347.957	4263.414
8	4355.955	4263.593
9	4363.949	4263.898
10	4371.937	4264.330
11	4379.917	4264.888
12	4387.888	4265.572
13	4395.847	4266.383
14	4403.792	4267.319
15	4411.721	4268.381
16	4419.632	4269.569
17	4427.524	4270.881
18	4435.394	4272.319
19	4443.240	4273.881
20	4451.060	4275.567
21	4458.853	4277.376
22	4466.616	4279.309
23	4474.347	4281.364
24	4482.045	4283.542
25	4489.708	4285.840
26	4497.333	4288.260
27	4504.919	4290.801
28	4512.464	4293.461
29	4519.966	4296.240
30	4527.422	4299.138
31	4534.833	4302.153
32	4542.194	4305.285
33	4549.505	4308.534
34	4556.763	4311.897
35	4557.154	4312.086

Circle Center At X = 4340.668 ; Y = 4768.680 ; and Radius = 505.319

*** FOS = 2.571 Theta (ki=1.0) = 9.12 ***
Lambda = 0.161

Individual data on the 44 slices

Slice No.	Width (ft)	Weight (lbs)	Water Force Top (lbs)	Water Force Bot (lbs)	Tie Force Norm (lbs)	Tie Force Tan (lbs)	Earthquake Force Hor (lbs)	Earthquake Force Ver (lbs)	Surcharge Load (lbs)
1	8.0	1132.5	0.0	0.0	0.	0.	0.0	0.0	0.0
2	2.0	642.7	0.0	0.0	0.	0.	0.0	0.0	0.0
3	6.0	2638.3	0.0	0.0	0.	0.	0.0	0.0	0.0
4	2.0	1141.1	0.0	0.0	0.	0.	0.0	0.0	0.0
5	6.0	4038.4	0.0	0.0	0.	0.	0.0	0.0	0.0
6	8.0	7002.9	0.0	0.0	0.	0.	0.0	0.0	0.0
7	8.0	8709.2	0.0	0.0	0.	0.	0.0	0.0	0.0
8	8.0	10295.0	0.0	0.0	0.	0.	0.0	0.0	0.0
9	5.0	7250.3	0.0	0.0	0.	0.	0.0	0.0	0.0
10	3.0	4507.0	0.0	0.0	0.	0.	0.0	0.0	0.0
11	5.0	8115.7	0.0	0.0	0.	0.	0.0	0.0	0.0
12	2.9	4961.1	0.0	0.0	0.	0.	0.0	0.0	0.0
13	8.0	14067.3	0.0	0.0	0.	0.	0.0	0.0	0.0
14	8.0	14877.9	0.0	0.0	0.	0.	0.0	0.0	0.0
15	1.3	2508.9	0.0	0.0	0.	0.	0.0	0.0	0.0
16	6.7	13043.1	0.0	0.0	0.	0.	0.0	0.0	0.0
17	8.0	16081.0	0.0	0.0	0.	0.	0.0	0.0	0.0
18	5.2	10818.4	0.0	0.0	0.	0.	0.0	0.0	0.0
19	2.7	5668.6	0.0	0.0	0.	0.	0.0	0.0	0.0
20	7.9	16892.5	0.0	0.0	0.	0.	0.0	0.0	0.0
21	7.9	17223.8	0.0	0.0	0.	0.	0.0	0.0	0.0
22	7.9	17447.5	0.0	0.0	0.	0.	0.0	0.0	0.0
23	7.9	17561.3	0.0	0.0	0.	0.	0.0	0.0	0.0
24	7.8	17568.4	0.0	0.0	0.	0.	0.0	0.0	0.0
25	7.8	17467.9	0.0	0.0	0.	0.	0.0	0.0	0.0
26	7.8	17261.1	0.0	0.0	0.	0.	0.0	0.0	0.0
27	7.8	16951.4	0.0	0.0	0.	0.	0.0	0.0	0.0
28	7.7	16537.2	0.0	0.0	0.	0.	0.0	0.0	0.0
29	7.7	16022.9	0.0	0.0	0.	0.	0.0	0.0	0.0
30	7.7	15408.2	0.0	0.0	0.	0.	0.0	0.0	0.0
31	7.6	14695.4	0.0	0.0	0.	0.	0.0	0.0	0.0
32	7.6	13887.8	0.0	0.0	0.	0.	0.0	0.0	0.0
33	7.5	12986.4	0.0	0.0	0.	0.	0.0	0.0	0.0
34	7.5	11994.3	0.0	0.0	0.	0.	0.0	0.0	0.0
35	7.5	10912.8	0.0	0.0	0.	0.	0.0	0.0	0.0

36	2.6	3520.5	0.0	0.0	0.	0.	0.0	0.0	0.0
37	0.9	1130.6	0.0	0.0	0.	0.	0.0	0.0	0.0
38	4.0	4843.1	0.0	0.0	0.	0.	0.0	0.0	0.0
39	7.4	7016.9	0.0	0.0	0.	0.	0.0	0.0	0.0
40	6.7	4093.9	0.0	0.0	0.	0.	0.0	0.0	0.0
41	0.6	270.4	0.0	0.0	0.	0.	0.0	0.0	0.0
42	2.9	1010.4	0.0	0.0	0.	0.	0.0	0.0	0.0
43	4.3	632.8	0.0	0.0	0.	0.	0.0	0.0	0.0
44	0.4	4.6	0.0	0.0	0.	0.	0.0	0.0	0.0

Failure Surface Specified By 35 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	4300.000	4265.000
2	4307.979	4264.419
3	4315.966	4263.965
4	4323.959	4263.638
5	4331.957	4263.437
6	4339.957	4263.362
7	4347.957	4263.414
8	4355.955	4263.593
9	4363.949	4263.898
10	4371.937	4264.330
11	4379.917	4264.888
12	4387.888	4265.572
13	4395.847	4266.383
14	4403.792	4267.319
15	4411.721	4268.381
16	4419.632	4269.569
17	4427.524	4270.881
18	4435.394	4272.319
19	4443.240	4273.881
20	4451.060	4275.567
21	4458.853	4277.376
22	4466.616	4279.309
23	4474.347	4281.364
24	4482.045	4283.542
25	4489.708	4285.840
26	4497.333	4288.260
27	4504.919	4290.801
28	4512.464	4293.461
29	4519.966	4296.240
30	4527.422	4299.138
31	4534.833	4302.153
32	4542.194	4305.285
33	4549.505	4308.534
34	4556.763	4311.897
35	4557.154	4312.086

Circle Center At X = 4340.668 ; Y = 4768.680 ; and Radius = 505.319

*** FOS = 2.571 Theta (ki=1.0) = 9.12 ***
Lambda = 0.161

1

Failure Surface Specified By 35 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	4300.000	4265.000
2	4307.979	4264.419
3	4315.966	4263.964
4	4323.959	4263.636
5	4331.957	4263.435
6	4339.957	4263.360
7	4347.957	4263.412
8	4355.955	4263.590
9	4363.949	4263.896
10	4371.937	4264.327
11	4379.917	4264.885
12	4387.888	4265.570
13	4395.847	4266.380
14	4403.792	4267.317
15	4411.721	4268.379
16	4419.632	4269.566
17	4427.524	4270.879
18	4435.394	4272.316
19	4443.240	4273.878
20	4451.060	4275.564
21	4458.853	4277.374
22	4466.616	4279.307
23	4474.347	4281.362
24	4482.045	4283.539
25	4489.708	4285.838
26	4497.333	4288.258

27	4504.918	4290.798
28	4512.463	4293.458
29	4519.965	4296.238
30	4527.421	4299.136
31	4534.831	4302.151
32	4542.192	4305.284
33	4549.503	4308.532
34	4556.761	4311.896
35	4557.155	4312.086

Circle Center At X = 4340.681 ; Y = 4768.616 ; and Radius = 505.257

*** FOS = 2.571 Theta (ki=1.0) = 9.12 ***
Lambda = 0.161

Failure Surface Specified By 35 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	4300.000	4265.000
2	4307.984	4264.492
3	4315.975	4264.104
4	4323.970	4263.836
5	4331.969	4263.688
6	4339.969	4263.660
7	4347.968	4263.752
8	4355.965	4263.965
9	4363.958	4264.298
10	4371.946	4264.750
11	4379.925	4265.323
12	4387.896	4266.016
13	4395.854	4266.828
14	4403.800	4267.759
15	4411.730	4268.810
16	4419.645	4269.980
17	4427.540	4271.269
18	4435.416	4272.676
19	4443.269	4274.201
20	4451.098	4275.844
21	4458.902	4277.604
22	4466.678	4279.482
23	4474.426	4281.476
24	4482.143	4283.586
25	4489.827	4285.812
26	4497.477	4288.153
27	4505.090	4290.609
28	4512.667	4293.179
29	4520.203	4295.862
30	4527.699	4298.658
31	4535.151	4301.567
32	4542.560	4304.587
33	4549.921	4307.718
34	4557.235	4310.959
35	4559.919	4312.197

Circle Center At X = 4337.815 ; Y = 4796.207 ; and Radius = 532.551

*** FOS = 2.575 Theta (ki=1.0) = 8.98 ***
Lambda = 0.158

1

Failure Surface Specified By 35 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	4300.000	4265.000
2	4307.984	4264.492
3	4315.975	4264.104
4	4323.970	4263.835
5	4331.969	4263.688
6	4339.969	4263.660
7	4347.968	4263.752
8	4355.965	4263.964
9	4363.958	4264.297
10	4371.946	4264.750
11	4379.925	4265.322
12	4387.896	4266.015
13	4395.854	4266.827
14	4403.800	4267.758
15	4411.730	4268.809
16	4419.645	4269.979
17	4427.540	4271.268

18	4435.416	4272.675
19	4443.269	4274.200
20	4451.098	4275.843
21	4458.902	4277.604
22	4466.678	4279.481
23	4474.426	4281.475
24	4482.143	4283.585
25	4489.827	4285.812
26	4497.477	4288.153
27	4505.090	4290.608
28	4512.667	4293.178
29	4520.203	4295.861
30	4527.699	4298.658
31	4535.151	4301.566
32	4542.560	4304.586
33	4549.921	4307.717
34	4557.235	4310.958
35	4559.920	4312.197

Circle Center At X = 4337.820 ; Y = 4796.183 ; and Radius = 532.527

*** FOS = 2.575 Theta (ki=1.0) = 8.99 ***
Lambda = 0.158

Failure Surface Specified By 35 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	4300.000	4265.000
2	4307.976	4264.382
3	4315.961	4263.889
4	4323.953	4263.520
5	4331.949	4263.276
6	4339.948	4263.158
7	4347.948	4263.164
8	4355.947	4263.295
9	4363.943	4263.552
10	4371.934	4263.933
11	4379.917	4264.439
12	4387.893	4265.070
13	4395.857	4265.825
14	4403.809	4266.705
15	4411.746	4267.709
16	4419.666	4268.837
17	4427.567	4270.088
18	4435.448	4271.463
19	4443.306	4272.960
20	4451.140	4274.581
21	4458.948	4276.323
22	4466.728	4278.188
23	4474.478	4280.173
24	4482.195	4282.280
25	4489.879	4284.507
26	4497.527	4286.854
27	4505.137	4289.319
28	4512.708	4291.904
29	4520.238	4294.606
30	4527.725	4297.426
31	4535.166	4300.363
32	4542.561	4303.415
33	4549.907	4306.583
34	4557.203	4309.864
35	4562.390	4312.295

Circle Center At X = 4343.539 ; Y = 4775.091 ; and Radius = 511.946

*** FOS = 2.583 Theta (ki=1.0) = 8.81 ***
Lambda = 0.155

1

Failure Surface Specified By 35 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	4300.000	4265.000
2	4307.976	4264.382
3	4315.961	4263.889
4	4323.953	4263.520
5	4331.949	4263.276
6	4339.948	4263.158
7	4347.948	4263.164
8	4355.947	4263.295

9	4363.943	4263.552
10	4371.934	4263.933
11	4379.917	4264.439
12	4387.893	4265.070
13	4395.857	4265.825
14	4403.809	4266.705
15	4411.746	4267.709
16	4419.666	4268.837
17	4427.567	4270.088
18	4435.448	4271.463
19	4443.306	4272.960
20	4451.140	4274.581
21	4458.948	4276.323
22	4466.728	4278.188
23	4474.478	4280.173
24	4482.195	4282.280
25	4489.879	4284.507
26	4497.527	4286.854
27	4505.137	4289.319
28	4512.708	4291.904
29	4520.238	4294.606
30	4527.725	4297.426
31	4535.166	4300.363
32	4542.561	4303.415
33	4549.907	4306.583
34	4557.203	4309.864
35	4562.390	4312.295

Circle Center At X = 4343.539 ; Y = 4775.091 ; and Radius = 511.946

*** FOS = 2.584 Theta (ki=1.0) = 9.03 ***
Lambda = 0.159

Failure Surface Specified By 35 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	4300.000	4265.000
2	4307.989	4264.578
3	4315.983	4264.270
4	4323.980	4264.077
5	4331.980	4263.999
6	4339.980	4264.035
7	4347.979	4264.186
8	4355.974	4264.451
9	4363.965	4264.831
10	4371.950	4265.326
11	4379.926	4265.935
12	4387.894	4266.658
13	4395.850	4267.495
14	4403.793	4268.446
15	4411.722	4269.511
16	4419.634	4270.690
17	4427.529	4271.982
18	4435.405	4273.387
19	4443.259	4274.904
20	4451.091	4276.534
21	4458.899	4278.276
22	4466.682	4280.130
23	4474.437	4282.096
24	4482.163	4284.172
25	4489.858	4286.358
26	4497.521	4288.655
27	4505.150	4291.062
28	4512.745	4293.577
29	4520.302	4296.201
30	4527.821	4298.933
31	4535.300	4301.773
32	4542.738	4304.720
33	4550.132	4307.772
34	4557.482	4310.931
35	4560.354	4312.214

Circle Center At X = 4333.454 ; Y = 4822.129 ; and Radius = 558.132

*** FOS = 2.585 Theta (ki=1.0) = 8.92 ***
Lambda = 0.157

1

Failure Surface Specified By 35 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)

1	4300.000	4265.000
2	4307.970	4264.310
3	4315.951	4263.751
4	4323.939	4263.324
5	4331.934	4263.027
6	4339.933	4262.862
7	4347.933	4262.829
8	4355.932	4262.926
9	4363.929	4263.156
10	4371.920	4263.517
11	4379.905	4264.008
12	4387.881	4264.631
13	4395.845	4265.385
14	4403.796	4266.270
15	4411.732	4267.285
16	4419.649	4268.431
17	4427.547	4269.706
18	4435.422	4271.111
19	4443.274	4272.645
20	4451.099	4274.308
21	4458.896	4276.099
22	4466.663	4278.018
23	4474.396	4280.064
24	4482.096	4282.238
25	4489.758	4284.537
26	4497.382	4286.962
27	4504.965	4289.512
28	4512.505	4292.186
29	4520.000	4294.983
30	4527.448	4297.903
31	4534.847	4300.946
32	4542.195	4304.109
33	4549.490	4307.393
34	4556.730	4310.796
35	4559.557	4312.182

Circle Center At X = 4345.974 ; Y = 4749.775 ; and Radius = 486.950

*** FOS = 2.586 Theta (ki=1.0) = 9.14 ***
Lambda = 0.161

Failure Surface Specified By 35 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	4300.000	4265.000
2	4307.970	4264.310
3	4315.951	4263.751
4	4323.939	4263.323
5	4331.934	4263.027
6	4339.933	4262.862
7	4347.933	4262.828
8	4355.932	4262.926
9	4363.929	4263.155
10	4371.920	4263.516
11	4379.905	4264.008
12	4387.881	4264.631
13	4395.845	4265.385
14	4403.796	4266.270
15	4411.732	4267.285
16	4419.649	4268.430
17	4427.547	4269.706
18	4435.422	4271.110
19	4443.274	4272.645
20	4451.099	4274.308
21	4458.896	4276.099
22	4466.663	4278.018
23	4474.396	4280.064
24	4482.096	4282.237
25	4489.758	4284.537
26	4497.382	4286.961
27	4504.965	4289.511
28	4512.505	4292.185
29	4520.000	4294.982
30	4527.448	4297.903
31	4534.847	4300.945
32	4542.195	4304.109
33	4549.490	4307.393
34	4556.730	4310.796
35	4559.558	4312.182

Circle Center At X = 4345.976 ; Y = 4749.769 ; and Radius = 486.944

*** FOS = 2.586 Theta (ki=1.0) = 9.15 ***
Lambda = 0.161

```
**** END OF GSTABL7 OUTPUT ****
```

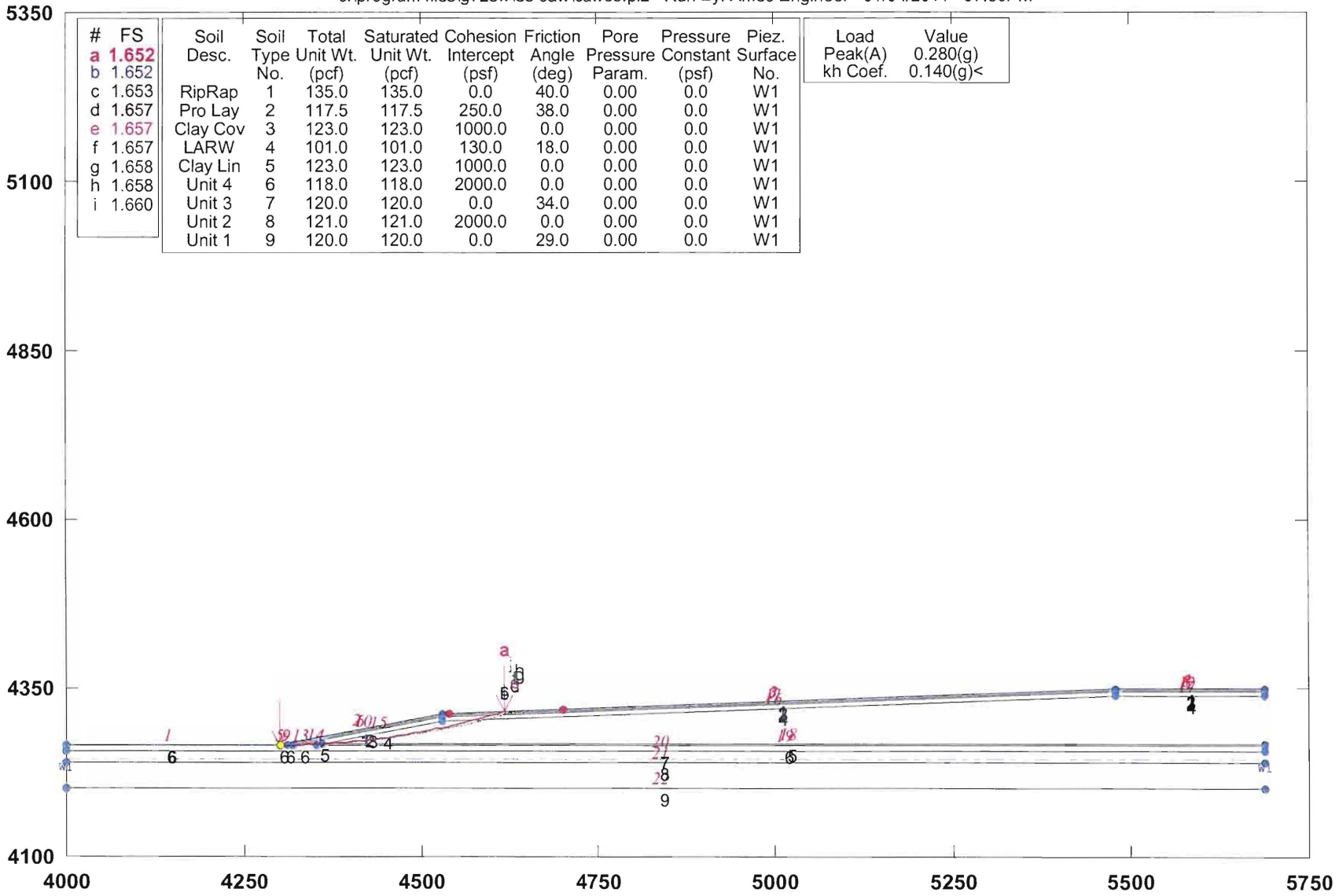
CAW Emb 38' 5(H):1(V) side-slopes, Pseudostatic, Embankmt 121810 CAWES

c:\program files\g72sw\es caw\cawes.pl2 Run By: Amec Engineer 01/04/2011 07:36PM

#	FS
a	1.652
b	1.652
c	1.653
d	1.657
e	1.657
f	1.657
g	1.658
h	1.658
i	1.660

Soil Desc.	Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Param.	Pressure Constant (psf)	Piez. Surface No.
RipRap	1	135.0	135.0	0.0	40.0	0.00	0.0	W1
Pro Lay	2	117.5	117.5	250.0	38.0	0.00	0.0	W1
Clay Cov	3	123.0	123.0	1000.0	0.0	0.00	0.0	W1
LARW	4	101.0	101.0	130.0	18.0	0.00	0.0	W1
Clay Lin	5	123.0	123.0	1000.0	0.0	0.00	0.0	W1
Unit 4	6	118.0	118.0	2000.0	0.0	0.00	0.0	W1
Unit 3	7	120.0	120.0	0.0	34.0	0.00	0.0	W1
Unit 2	8	121.0	121.0	2000.0	0.0	0.00	0.0	W1
Unit 1	9	120.0	120.0	0.0	29.0	0.00	0.0	W1

Load	Value
Peak(A)	0.280(g)
kh Coef.	0.140(g)<



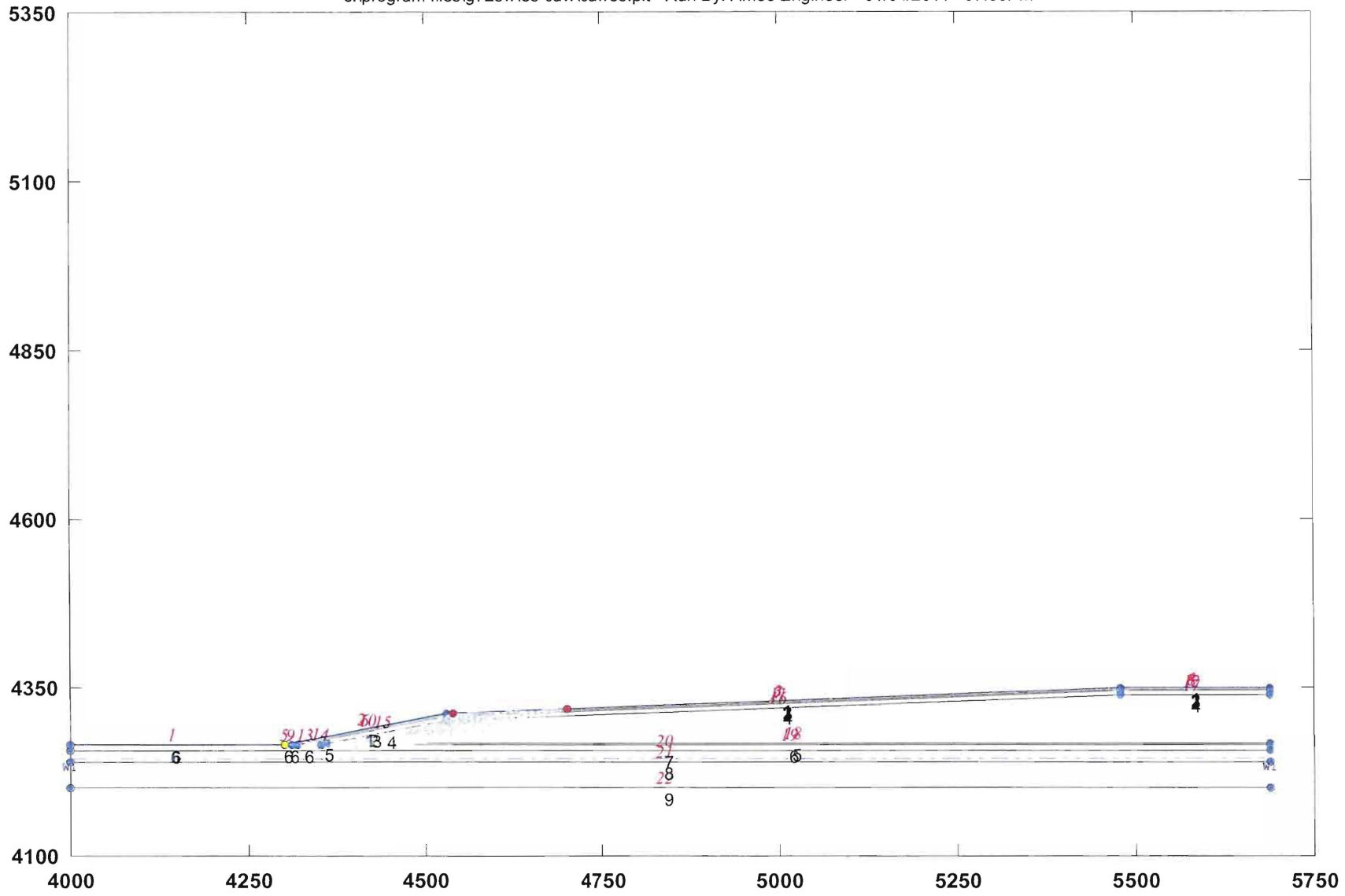
GSTABL7 v.2 FSmin=1.652

Safety Factors Are Calculated By GLE (Spencer`s) Method (0-1)

GSTABL7

CAW Emb 38' 5(H):1(V) side-slopes, Pseudostatic, Embankmt 121810 CAWES

c:\program files\g72sw\es caw\cawes.plt Run By: Amec Engineer 01/04/2011 07:36PM



GSTABL7

```
                    *** GSTABL7 ***

              ** GSTABL7 by Garry H. Gregory, P.E. **

   ** Original Version 1.0, January 1996; Current Version 2.004, June 2003 **
              (All Rights Reserved-Unauthorized Use Prohibited)

*******************************************************************************
                    SLOPE STABILITY ANALYSIS SYSTEM
       Modified Bishop, Simplified Janbu, or GLE Method of Slices.
       (Includes Spencer & Morgenstern-Price Type Analysis)
       Including Pier/Pile, Reinforcement, Soil Nail, Tieback,
       Nonlinear Undrained Shear Strength, Curved Phi Envelope,
       Anisotropic Soil, Fiber-Reinforced Soil, Boundary Loads, Water
       Surfaces, Pseudo-Static & Newmark Earthquake, and Applied Forces.
*******************************************************************************


Analysis Run Date:        01/04/2011
Time of Run:              07:36PM
Run By:                   Amec Engineer
Input Data Filename:      C:\Program Files\G72SW\ES CAW\cawes.
Output Filename:          C:\Program Files\G72SW\ES CAW\cawes.OUT
Unit System:              English

Plotted Output Filename:  C:\Program Files\G72SW\ES CAW\cawes.PLT


PROBLEM DESCRIPTION:  CAW Emb 38' 5(H):1(V) side-slopes,
                      Pseudostatic, Embankmt 121810  CAWES


BOUNDARY COORDINATES

    4 Top   Boundaries
   22 Total Boundaries
```

Boundary No.	X-Left (ft)	Y-Left (ft)	X-Right (ft)	Y-Right (ft)	Soil Type Below Bnd
1	4000.00	4265.00	4300.00	4265.00	6
2	4300.00	4265.00	4530.00	4311.00	1
3	4530.00	4311.00	5480.00	4349.00	1
4	5480.00	4349.00	5689.00	4349.00	1
5	4300.00	4265.00	4310.00	4265.00	6
6	4310.00	4265.00	4530.00	4309.00	2
7	4530.00	4309.00	5480.00	4347.00	2
8	5480.00	4347.00	5689.00	4347.00	2
9	4310.00	4265.00	4318.00	4265.00	6
10	4318.00	4265.00	4530.00	4307.50	3
11	4530.00	4307.50	5480.00	4345.50	3
12	5480.00	4345.50	5689.00	4345.50	3
13	4318.00	4265.00	4353.00	4265.00	6
14	4353.00	4265.00	4361.00	4267.00	5
15	4361.00	4267.00	4530.00	4300.50	4
16	4530.00	4300.50	5480.00	4338.50	4
17	5480.00	4338.50	5689.00	4338.50	4
18	4361.00	4267.00	5689.00	4267.00	5
19	4353.00	4265.00	5689.00	4265.00	6
20	4000.00	4256.00	5689.00	4256.00	7
21	4000.00	4239.00	5689.00	4239.00	8
22	4000.00	4201.00	5689.00	4201.00	9

```
User Specified Y-Origin =       4100.00(ft)

Default X-Plus Value = 0.00(ft)

Default Y-Plus Value = 0.00(ft)
```

1

```
ISOTROPIC SOIL PARAMETERS

 9 Type(s) of Soil
```

Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Param.	Pressure Constant (psf)	Piez. Surface No.
1	135.0	135.0	0.0	40.0	0.00	0.0	1
2	117.5	117.5	250.0	38.0	0.00	0.0	1
3	123.0	123.0	1000.0	0.0	0.00	0.0	1
4	101.0	101.0	130.0	18.0	0.00	0.0	1
5	123.0	123.0	1000.0	0.0	0.00	0.0	1
6	118.0	118.0	2000.0	0.0	0.00	0.0	1
7	120.0	120.0	0.0	34.0	0.00	0.0	1

8	121.0	121.0	2000.0	0.0	0.00	0.0	1
9	120.0	120.0	0.0	29.0	0.00	0.0	1

1

1 PIEZOMETRIC SURFACE(S) SPECIFIED

Unit Weight of Water = 62.40 (pcf)

Piezometric Surface No. 1 Specified by 2 Coordinate Points
Pore Pressure Inclination Factor = 0.50

Point No.	X-Water (ft)	Y-Water (ft)
1	4000.00	4243.00
2	5689.00	4243.00

Specified Peak Ground Acceleration Coefficient (A) = 0.280(g)
Specified Horizontal Earthquake Coefficient (kh) = 0.140(g)
Specified Vertical Earthquake Coefficient (kv) = 0.000(g)

Specified Seismic Pore-Pressure Factor = 0.000

1

A Critical Failure Surface Searching Method, Using A Random
Technique For Generating Circular Surfaces, Has Been Specified.

1000 Trial Surfaces Have Been Generated.

1000 Surface(s) Initiate(s) From Each Of 1 Points Equally Spaced
Along The Ground Surface Between X =4300.00(ft)
and X =4300.00(ft)

Each Surface Terminates Between X =4540.00(ft)
and X =4700.00(ft)

Unless Further Limitations Were Imposed, The Minimum Elevation
At Which A Surface Extends Is Y = 4260.00(ft)

8.00(ft) Line Segments Define Each Trial Failure Surface.

Following Are Displayed The Ten Most Critical Of The Trial
Failure Surfaces Evaluated. They Are
Ordered - Most Critical First.

* * Safety Factors Are Calculated By GLE (Spencer`s) Method (0-1) * *

Selected ki function = Constant (1.0)

Selected Lambda Coefficient = 1.00

Forces from Reinforcement, Piers/Piles, Soil Nails, and Applied Forces
(if applicable) have been applied to the slice base(s)
on which they intersect.

Specified Tension Crack Water Force Factor = 0.000

Total Number of Trial Surfaces Attempted = 1000

WARNING! The Factor of Safety Calculation for one or More Trial Surfaces
Did Not Converge in 20 Iterations.

Number of Trial Surfaces with Non-Converged FS = 41

Number of Trial Surfaces with Misleading FS = 2

Number of Trial Surfaces With Valid FS = 957

Percentage of Trial Surfaces With Non-Valid FS Solutions
of the Total Attempted = 4.3 %

Statistical Data On All Valid FS Values:
FS Max = 4.108 FS Min = 1.652 FS Ave = 2.135
Standard Deviation = 0.327 Coefficient of Variation = 15.29 %

((Modified Bishop FS for Critical Surface = 1.663))

Failure Surface Specified By 42 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	4300.000	4265.000
2	4308.000	4265.048
3	4315.999	4265.156
4	4323.997	4265.325
5	4331.994	4265.555
6	4339.988	4265.844
7	4347.980	4266.194
8	4355.970	4266.605
9	4363.956	4267.076
10	4371.938	4267.607
11	4379.917	4268.198
12	4387.890	4268.850
13	4395.858	4269.562
14	4403.821	4270.334
15	4411.778	4271.166
16	4419.728	4272.058
17	4427.671	4273.010
18	4435.607	4274.022
19	4443.535	4275.095
20	4451.454	4276.227
21	4459.365	4277.418
22	4467.266	4278.670
23	4475.158	4279.981
24	4483.040	4281.352
25	4490.911	4282.782
26	4498.771	4284.271
27	4506.619	4285.820
28	4514.456	4287.429
29	4522.280	4289.096
30	4530.091	4290.823
31	4537.890	4292.608
32	4545.674	4294.453
33	4553.445	4296.356
34	4561.201	4298.318
35	4568.941	4300.338
36	4576.667	4302.417
37	4584.376	4304.554
38	4592.069	4306.750
39	4599.745	4309.003
40	4607.404	4311.314
41	4615.045	4313.683
42	4617.627	4314.505

Circle Center At X = 4297.671 ; Y = 5323.657 ; and Radius = 1058.659

*** FOS = 1.652 Theta (ki=1.0) = 7.63 ***
Lambda = 0.134

Individual data on the 50 slices

Slice No.	Width (ft)	Weight (lbs)	Water Force Top (lbs)	Water Force Bot (lbs)	Tie Force Norm (lbs)	Tie Force Tan (lbs)	Earthquake Force Hor (lbs)	Earthquake Force Ver (lbs)	Surcharge Load (lbs)
1	8.0	837.9	0.0	0.0	0.	0.	117.3	0.0	0.0
2	2.4	576.0	0.0	0.0	0.	0.	80.6	0.0	0.0
3	5.6	1854.5	0.0	0.0	0.	0.	259.6	0.0	0.0
4	3.1	1321.8	0.0	0.0	0.	0.	185.1	0.0	0.0
5	4.9	2502.6	0.0	0.0	0.	0.	350.4	0.0	0.0
6	8.0	5196.2	0.0	0.0	0.	0.	727.5	0.0	0.0
7	8.0	6512.2	0.0	0.0	0.	0.	911.7	0.0	0.0
8	8.0	7767.4	0.0	0.0	0.	0.	1087.4	0.0	0.0
9	8.0	8961.9	0.0	0.0	0.	0.	1254.7	0.0	0.0
10	4.5	5570.9	0.0	0.0	0.	0.	779.9	0.0	0.0
11	0.5	658.7	0.0	0.0	0.	0.	92.2	0.0	0.0
12	1.7	2161.6	0.0	0.0	0.	0.	302.6	0.0	0.0
13	1.3	1686.0	0.0	0.0	0.	0.	236.0	0.0	0.0
14	8.0	10984.3	0.0	0.0	0.	0.	1537.8	0.0	0.0
15	8.0	11814.6	0.0	0.0	0.	0.	1654.0	0.0	0.0
16	8.0	12594.8	0.0	0.0	0.	0.	1763.3	0.0	0.0
17	8.0	13323.4	0.0	0.0	0.	0.	1865.3	0.0	0.0
18	8.0	14001.1	0.0	0.0	0.	0.	1960.2	0.0	0.0
19	8.0	14627.9	0.0	0.0	0.	0.	2047.9	0.0	0.0
20	8.0	15203.4	0.0	0.0	0.	0.	2128.5	0.0	0.0
21	7.9	15728.5	0.0	0.0	0.	0.	2202.0	0.0	0.0

22	7.9	16200.9	0.0	0.0	0.	0.	2268.1	0.0	0.0
23	7.9	16623.5	0.0	0.0	0.	0.	2327.3	0.0	0.0
24	7.9	16995.0	0.0	0.0	0.	0.	2379.3	0.0	0.0
25	7.9	17315.5	0.0	0.0	0.	0.	2424.2	0.0	0.0
26	7.9	17584.6	0.0	0.0	0.	0.	2461.8	0.0	0.0
27	7.9	17802.8	0.0	0.0	0.	0.	2492.4	0.0	0.0
28	7.9	17971.9	0.0	0.0	0.	0.	2516.1	0.0	0.0
29	7.9	18089.0	0.0	0.0	0.	0.	2532.5	0.0	0.0
30	7.9	18155.2	0.0	0.0	0.	0.	2541.7	0.0	0.0
31	7.8	18172.9	0.0	0.0	0.	0.	2544.2	0.0	0.0
32	7.8	18139.1	0.0	0.0	0.	0.	2539.5	0.0	0.0
33	7.8	18056.2	0.0	0.0	0.	0.	2527.9	0.0	0.0
34	7.7	17716.0	0.0	0.0	0.	0.	2480.2	0.0	0.0
35	0.1	208.7	0.0	0.0	0.	0.	29.2	0.0	0.0
36	7.8	17239.2	0.0	0.0	0.	0.	2413.5	0.0	0.0
37	7.8	16026.6	0.0	0.0	0.	0.	2243.7	0.0	0.0
38	7.8	14771.1	0.0	0.0	0.	0.	2068.0	0.0	0.0
39	7.8	13472.6	0.0	0.0	0.	0.	1886.2	0.0	0.0
40	7.7	12132.0	0.0	0.0	0.	0.	1698.5	0.0	0.0
41	7.5	10463.2	0.0	0.0	0.	0.	1464.8	0.0	0.0
42	0.2	286.6	0.0	0.0	0.	0.	40.1	0.0	0.0
43	7.7	9163.3	0.0	0.0	0.	0.	1282.9	0.0	0.0
44	7.7	7385.6	0.0	0.0	0.	0.	1034.0	0.0	0.0
45	7.7	5559.2	0.0	0.0	0.	0.	778.3	0.0	0.0
46	4.9	2583.2	0.0	0.0	0.	0.	361.6	0.0	0.0
47	2.7	1108.1	0.0	0.0	0.	0.	155.1	0.0	0.0
48	2.9	915.2	0.0	0.0	0.	0.	128.1	0.0	0.0
49	4.7	870.7	0.0	0.0	0.	0.	121.9	0.0	0.0
50	2.6	125.4	0.0	0.0	0.	0.	17.6	0.0	0.0

Failure Surface Specified By 42 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	4300.000	4265.000
2	4308.000	4265.048
3	4315.999	4265.156
4	4323.997	4265.325
5	4331.994	4265.554
6	4339.988	4265.844
7	4347.980	4266.194
8	4355.970	4266.604
9	4363.956	4267.075
10	4371.938	4267.606
11	4379.917	4268.198
12	4387.890	4268.850
13	4395.858	4269.562
14	4403.821	4270.333
15	4411.778	4271.166
16	4419.728	4272.058
17	4427.671	4273.010
18	4435.607	4274.022
19	4443.535	4275.094
20	4451.454	4276.226
21	4459.365	4277.418
22	4467.266	4278.669
23	4475.158	4279.980
24	4483.040	4281.351
25	4490.911	4282.781
26	4498.771	4284.271
27	4506.619	4285.820
28	4514.456	4287.428
29	4522.280	4289.096
30	4530.091	4290.822
31	4537.890	4292.608
32	4545.674	4294.452
33	4553.445	4296.355
34	4561.201	4298.317
35	4568.941	4300.338
36	4576.667	4302.417
37	4584.376	4304.554
38	4592.069	4306.749
39	4599.745	4309.002
40	4607.404	4311.313
41	4615.045	4313.683
42	4617.629	4314.505

Circle Center At X = 4297.677 ; Y = 5323.622 ; and Radius = 1058.624

*** FOS = 1.652 Theta (ki=1.0) = 6.63 ***
Lambda = 0.116

1

Failure Surface Specified By 42 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)

1	4300.000	4265.000
2	4308.000	4265.048
3	4315.999	4265.156
4	4323.997	4265.325
5	4331.994	4265.555
6	4339.988	4265.844
7	4347.980	4266.194
8	4355.970	4266.605
9	4363.956	4267.076
10	4371.938	4267.607
11	4379.917	4268.198
12	4387.890	4268.850
13	4395.858	4269.562
14	4403.821	4270.334
15	4411.778	4271.166
16	4419.728	4272.058
17	4427.671	4273.010
18	4435.607	4274.022
19	4443.535	4275.095
20	4451.454	4276.227
21	4459.365	4277.418
22	4467.266	4278.670
23	4475.158	4279.981
24	4483.040	4281.352
25	4490.911	4282.782
26	4498.771	4284.271
27	4506.619	4285.820
28	4514.456	4287.429
29	4522.280	4289.096
30	4530.091	4290.823
31	4537.890	4292.608
32	4545.674	4294.453
33	4553.445	4296.356
34	4561.201	4298.318
35	4568.941	4300.338
36	4576.667	4302.417
37	4584.376	4304.554
38	4592.069	4306.750
39	4599.745	4309.003
40	4607.404	4311.314
41	4615.045	4313.683
42	4617.627	4314.505

Circle Center At X = 4297.671 ; Y = 5323.657 ; and Radius = 1058.659

*** FOS = 1.653 Theta (ki=1.0) = 5.68 ***
Lambda = 0.099

Failure Surface Specified By 44 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	4300.000	4265.000
2	4308.000	4265.045
3	4316.000	4265.146
4	4323.998	4265.303
5	4331.995	4265.515
6	4339.991	4265.784
7	4347.984	4266.108
8	4355.976	4266.488
9	4363.964	4266.923
10	4371.949	4267.415
11	4379.930	4267.962
12	4387.907	4268.565
13	4395.880	4269.224
14	4403.848	4269.938
15	4411.811	4270.708
16	4419.769	4271.534
17	4427.720	4272.415
18	4435.665	4273.351
19	4443.603	4274.343
20	4451.534	4275.390
21	4459.458	4276.493
22	4467.374	4277.650
23	4475.282	4278.863
24	4483.181	4280.131
25	4491.070	4281.455
26	4498.951	4282.833
27	4506.821	4284.266
28	4514.682	4285.754
29	4522.531	4287.297
30	4530.370	4288.895
31	4538.198	4290.547
32	4546.014	4292.254
33	4553.817	4294.016
34	4561.608	4295.832
35	4569.387	4297.702
36	4577.152	4299.626
37	4584.903	4301.605

38	4592.641	4303.638
39	4600.364	4305.724
40	4608.072	4307.865
41	4615.766	4310.059
42	4623.443	4312.307
43	4631.105	4314.608
44	4632.731	4315.109

Circle Center At X = 4297.546 ; Y = 5411.033 ; and Radius = 1146.035

*** FOS = 1.657 Theta (ki=1.0) = 5.48 ***
Lambda = 0.096

1

Failure Surface Specified By 44 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	4300.000	4265.000
2	4308.000	4265.045
3	4316.000	4265.146
4	4323.998	4265.303
5	4331.995	4265.515
6	4339.991	4265.784
7	4347.984	4266.108
8	4355.976	4266.488
9	4363.964	4266.923
10	4371.949	4267.415
11	4379.930	4267.962
12	4387.907	4268.565
13	4395.880	4269.224
14	4403.848	4269.938
15	4411.811	4270.708
16	4419.769	4271.534
17	4427.720	4272.415
18	4435.665	4273.351
19	4443.603	4274.343
20	4451.534	4275.390
21	4459.458	4276.493
22	4467.374	4277.650
23	4475.282	4278.863
24	4483.181	4280.131
25	4491.070	4281.455
26	4498.951	4282.833
27	4506.821	4284.266
28	4514.682	4285.754
29	4522.531	4287.297
30	4530.370	4288.895
31	4538.198	4290.547
32	4546.014	4292.254
33	4553.817	4294.016
34	4561.608	4295.832
35	4569.387	4297.702
36	4577.152	4299.626
37	4584.903	4301.605
38	4592.641	4303.638
39	4600.364	4305.724
40	4608.072	4307.865
41	4615.766	4310.059
42	4623.443	4312.307
43	4631.105	4314.608
44	4632.731	4315.109

Circle Center At X = 4297.546 ; Y = 5411.033 ; and Radius = 1146.035

*** FOS = 1.657 Theta (ki=1.0) = 5.48 ***
Lambda = 0.096

Failure Surface Specified By 44 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	4300.000	4265.000
2	4308.000	4265.045
3	4316.000	4265.146
4	4323.998	4265.303
5	4331.995	4265.515
6	4339.991	4265.784
7	4347.984	4266.108
8	4355.976	4266.488
9	4363.964	4266.923
10	4371.949	4267.415
11	4379.930	4267.962
12	4387.907	4268.565

13	4395.880	4269.224
14	4403.848	4269.938
15	4411.811	4270.708
16	4419.769	4271.534
17	4427.720	4272.415
18	4435.665	4273.351
19	4443.603	4274.343
20	4451.534	4275.390
21	4459.458	4276.493
22	4467.374	4277.650
23	4475.282	4278.863
24	4483.181	4280.131
25	4491.070	4281.455
26	4498.951	4282.833
27	4506.821	4284.266
28	4514.682	4285.754
29	4522.531	4287.297
30	4530.370	4288.895
31	4538.198	4290.547
32	4546.014	4292.254
33	4553.817	4294.016
34	4561.608	4295.832
35	4569.387	4297.702
36	4577.152	4299.626
37	4584.903	4301.605
38	4592.641	4303.638
39	4600.364	4305.724
40	4608.072	4307.865
41	4615.766	4310.059
42	4623.443	4312.307
43	4631.105	4314.608
44	4632.731	4315.109

Circle Center At X = 4297.546 ; Y = 5411.033 ; and Radius = 1146.035

*** FOS = 1.657 Theta (ki=1.0) = 5.28 ***
Lambda = 0.092

1

Failure Surface Specified By 44 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	4300.000	4265.000
2	4308.000	4265.005
3	4316.000	4265.066
4	4323.999	4265.184
5	4331.997	4265.357
6	4339.994	4265.586
7	4347.989	4265.871
8	4355.981	4266.212
9	4363.972	4266.609
10	4371.959	4267.062
11	4379.943	4267.571
12	4387.923	4268.136
13	4395.899	4268.756
14	4403.870	4269.433
15	4411.836	4270.165
16	4419.797	4270.952
17	4427.753	4271.796
18	4435.702	4272.695
19	4443.645	4273.650
20	4451.581	4274.660
21	4459.510	4275.726
22	4467.431	4276.848
23	4475.344	4278.024
24	4483.249	4279.256
25	4491.144	4280.544
26	4499.031	4281.887
27	4506.908	4283.285
28	4514.775	4284.738
29	4522.631	4286.246
30	4530.477	4287.809
31	4538.312	4289.426
32	4546.135	4291.099
33	4553.947	4292.826
34	4561.746	4294.607
35	4569.532	4296.444
36	4577.305	4298.335
37	4585.065	4300.280
38	4592.811	4302.280
39	4600.543	4304.333
40	4608.260	4306.441
41	4615.963	4308.603
42	4623.650	4310.819
43	4631.321	4313.088
44	4638.779	4315.351

Circle Center At X = 4303.255 ; Y = 5407.979 ; and Radius = 1142.984

*** FOS = 1.658 Theta (ki=1.0) = 5.54 ***
Lambda = 0.097

Failure Surface Specified By 44 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	4300.000	4265.000
2	4308.000	4265.005
3	4316.000	4265.066
4	4323.999	4265.184
5	4331.997	4265.357
6	4339.994	4265.586
7	4347.989	4265.871
8	4355.981	4266.212
9	4363.972	4266.609
10	4371.959	4267.062
11	4379.943	4267.571
12	4387.923	4268.135
13	4395.899	4268.756
14	4403.870	4269.432
15	4411.836	4270.164
16	4419.797	4270.952
17	4427.753	4271.795
18	4435.702	4272.695
19	4443.645	4273.649
20	4451.581	4274.660
21	4459.510	4275.726
22	4467.431	4276.847
23	4475.344	4278.024
24	4483.249	4279.256
25	4491.144	4280.543
26	4499.031	4281.886
27	4506.908	4283.284
28	4514.775	4284.737
29	4522.631	4286.245
30	4530.477	4287.808
31	4538.312	4289.426
32	4546.135	4291.098
33	4553.946	4292.825
34	4561.745	4294.607
35	4569.531	4296.443
36	4577.305	4298.334
37	4585.064	4300.280
38	4592.811	4302.279
39	4600.542	4304.333
40	4608.260	4306.441
41	4615.962	4308.603
42	4623.649	4310.818
43	4631.321	4313.088
44	4638.780	4315.351

Circle Center At X = 4303.261 ; Y = 5407.955 ; and Radius = 1142.960

*** FOS = 1.658 Theta (ki=1.0) = 5.31 ***
Lambda = 0.093

1

Failure Surface Specified By 43 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	4300.000	4265.000
2	4308.000	4265.085
3	4315.998	4265.226
4	4323.996	4265.423
5	4331.992	4265.675
6	4339.986	4265.983
7	4347.978	4266.347
8	4355.966	4266.767
9	4363.952	4267.241
10	4371.935	4267.771
11	4379.913	4268.357
12	4387.887	4268.999
13	4395.857	4269.696
14	4403.821	4270.449
15	4411.780	4271.257
16	4419.733	4272.120
17	4427.681	4273.039
18	4435.621	4274.013
19	4443.555	4275.042
20	4451.481	4276.127
21	4459.399	4277.267

22	4467.310	4278.461
23	4475.211	4279.711
24	4483.104	4281.016
25	4490.988	4282.376
26	4498.862	4283.791
27	4506.726	4285.260
28	4514.580	4286.784
29	4522.422	4288.363
30	4530.254	4289.996
31	4538.074	4291.684
32	4545.882	4293.426
33	4553.677	4295.223
34	4561.460	4297.074
35	4569.230	4298.979
36	4576.986	4300.938
37	4584.729	4302.951
38	4592.458	4305.018
39	4600.171	4307.138
40	4607.870	4309.312
41	4615.554	4311.541
42	4623.222	4313.822
43	4626.644	4314.866

Circle Center At X = 4291.756 ; Y = 5413.925 ; and Radius = 1148.954

*** FOS = 1.660 Theta (ki=1.0) = 5.53 ***
Lambda = 0.097

Failure Surface Specified By 43 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	4300.000	4265.000
2	4308.000	4265.085
3	4315.998	4265.226
4	4323.996	4265.423
5	4331.992	4265.675
6	4339.986	4265.983
7	4347.978	4266.347
8	4355.966	4266.767
9	4363.952	4267.241
10	4371.935	4267.771
11	4379.913	4268.357
12	4387.887	4268.999
13	4395.857	4269.696
14	4403.821	4270.449
15	4411.780	4271.257
16	4419.733	4272.120
17	4427.681	4273.039
18	4435.621	4274.013
19	4443.555	4275.042
20	4451.481	4276.127
21	4459.399	4277.267
22	4467.310	4278.461
23	4475.211	4279.711
24	4483.104	4281.016
25	4490.988	4282.376
26	4498.862	4283.791
27	4506.726	4285.260
28	4514.580	4286.784
29	4522.422	4288.363
30	4530.254	4289.996
31	4538.074	4291.684
32	4545.882	4293.426
33	4553.677	4295.223
34	4561.460	4297.074
35	4569.230	4298.979
36	4576.986	4300.938
37	4584.729	4302.951
38	4592.458	4305.018
39	4600.171	4307.139
40	4607.870	4309.313
41	4615.554	4311.541
42	4623.222	4313.822
43	4626.642	4314.866

Circle Center At X = 4291.757 ; Y = 5413.904 ; and Radius = 1148.933

*** FOS = 1.660 Theta (ki=1.0) = 5.44 ***
Lambda = 0.095

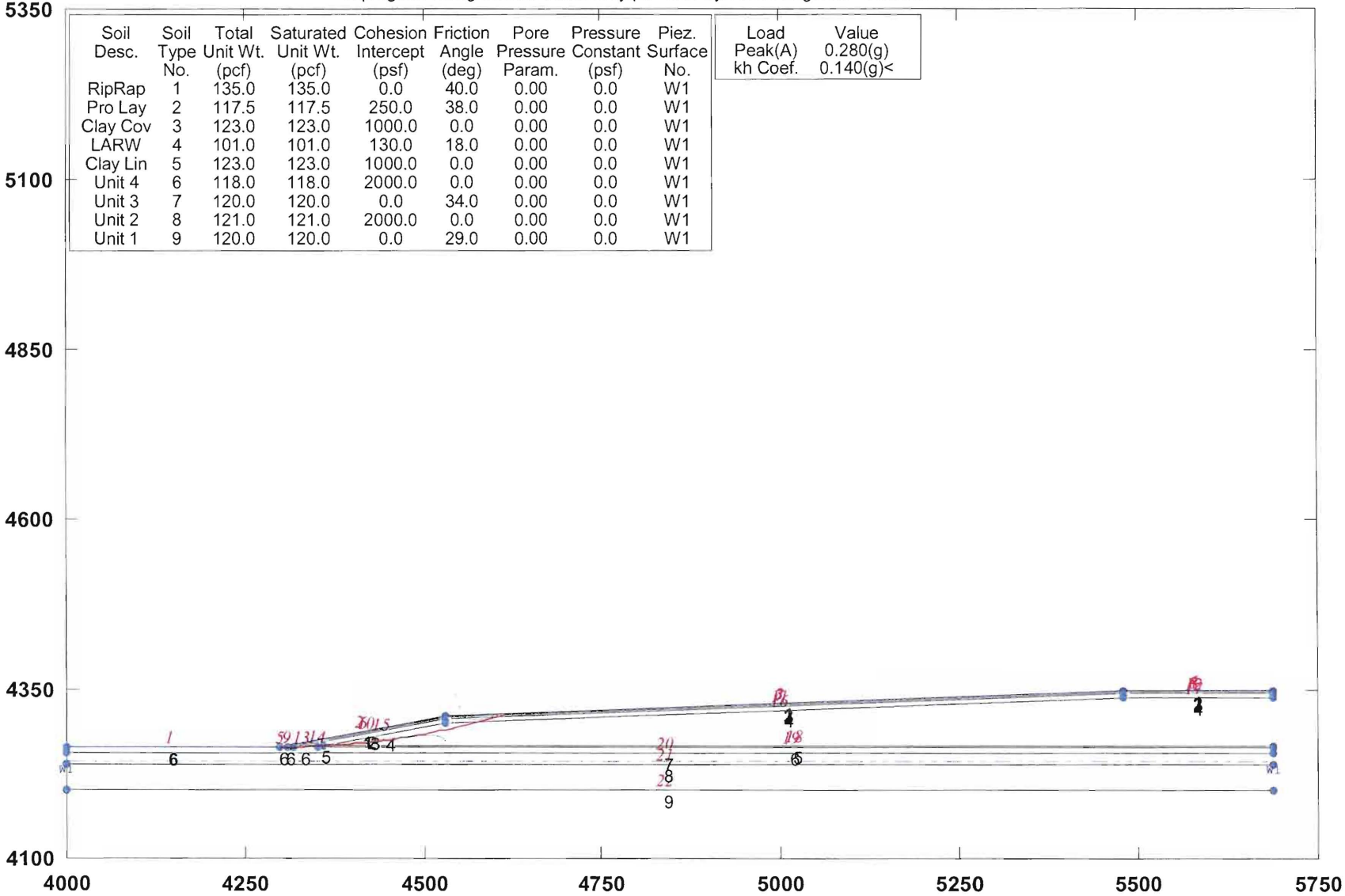
**** END OF GSTABL7 OUTPUT ****

CAW Emb 38' 5(H):1(V) side-slopes, Yield/Deform, Embankmt 121810 CAWEY

c:\program files\g72sw\es caw\cawey.plt Run By: Amec Engineer 01/04/2011 07:41PM

Soil Desc.	Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Param.	Pressure Constant (psf)	Piez. Surface No.
RipRap	1	135.0	135.0	0.0	40.0	0.00	0.0	W1
Pro Lay	2	117.5	117.5	250.0	38.0	0.00	0.0	W1
Clay Cov	3	123.0	123.0	1000.0	0.0	0.00	0.0	W1
LARW	4	101.0	101.0	130.0	18.0	0.00	0.0	W1
Clay Lin	5	123.0	123.0	1000.0	0.0	0.00	0.0	W1
Unit 4	6	118.0	118.0	2000.0	0.0	0.00	0.0	W1
Unit 3	7	120.0	120.0	0.0	34.0	0.00	0.0	W1
Unit 2	8	121.0	121.0	2000.0	0.0	0.00	0.0	W1
Unit 1	9	120.0	120.0	0.0	29.0	0.00	0.0	W1

Load	Value
Peak(A)	0.280(g)
kh Coef.	0.140(g)<



GSTABL7 v.2 FSmin=1.653

Factor Of Safety Is Calculated By GLE (Spencer`s) Method (0-1)

GSTABL7

*** GSTABL7 ***

** GSTABL7 by Garry H. Gregory, P.E. **

** Original Version 1.0, January 1996; Current Version 2.004, June 2003 **
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****
SLOPE STABILITY ANALYSIS SYSTEM
Modified Bishop, Simplified Janbu, or GLE Method of Slices.
(Includes Spencer & Morgenstern-Price Type Analysis)
Including Pier/Pile, Reinforcement, Soil Nail, Tieback,
Nonlinear Undrained Shear Strength, Curved Phi Envelope,
Anisotropic Soil, Fiber-Reinforced Soil, Boundary Loads, Water
Surfaces, Pseudo-Static & Newmark Earthquake, and Applied Forces.
****

Analysis Run Date: 01/04/2011
Time of Run: 07:41PM
Run By: Amec Engineer
Input Data Filename: C:\Program Files\G72SW\ES CAW\cawey.
Output Filename: C:\Program Files\G72SW\ES CAW\cawey.OUT
Unit System: English

Plotted Output Filename: C:\Program Files\G72SW\ES CAW\cawey.PLT

PROBLEM DESCRIPTION: CAW Emb 38' 5(H):1(V) side-slopes,
Yield/Deform, Embankmt 121810 CAWEY

BOUNDARY COORDINATES

4 Top Boundaries
22 Total Boundaries

Boundary No.	X-Left (ft)	Y-Left (ft)	X-Right (ft)	Y-Right (ft)	Soil Type Below Bnd
1	4000.00	4265.00	4300.00	4265.00	6
2	4300.00	4265.00	4530.00	4311.00	1
3	4530.00	4311.00	5480.00	4349.00	1
4	5480.00	4349.00	5689.00	4349.00	1
5	4300.00	4265.00	4310.00	4265.00	6
6	4310.00	4265.00	4530.00	4309.00	2
7	4530.00	4309.00	5480.00	4347.00	2
8	5480.00	4347.00	5689.00	4347.00	2
9	4310.00	4265.00	4318.00	4265.00	6
10	4318.00	4265.00	4530.00	4307.50	3
11	4530.00	4307.50	5480.00	4345.50	3
12	5480.00	4345.50	5689.00	4345.50	3
13	4318.00	4265.00	4353.00	4265.00	6
14	4353.00	4265.00	4361.00	4267.00	5
15	4361.00	4267.00	4530.00	4300.50	4
16	4530.00	4300.50	5480.00	4338.50	4
17	5480.00	4338.50	5689.00	4338.50	4
18	4361.00	4267.00	5689.00	4267.00	5
19	4353.00	4265.00	5689.00	4265.00	6
20	4000.00	4256.00	5689.00	4256.00	7
21	4000.00	4239.00	5689.00	4239.00	8
22	4000.00	4201.00	5689.00	4201.00	9

User Specified Y-Origin = 4100.00(ft)

Default X-Plus Value = 0.00(ft)

Default Y-Plus Value = 0.00(ft)

1

ISOTROPIC SOIL PARAMETERS

9 Type(s) of Soil

Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Param.	Pressure Constant (psf)	Piez. Surface No.
1	135.0	135.0	0.0	40.0	0.00	0.0	1
2	117.5	117.5	250.0	38.0	0.00	0.0	1
3	123.0	123.0	1000.0	0.0	0.00	0.0	1
4	101.0	101.0	130.0	18.0	0.00	0.0	1

5	123.0	123.0	1000.0	0.0	0.00	0.0	1
6	118.0	118.0	2000.0	0.0	0.00	0.0	1
7	120.0	120.0	0.0	34.0	0.00	0.0	1
8	121.0	121.0	2000.0	0.0	0.00	0.0	1
9	120.0	120.0	0.0	29.0	0.00	0.0	1

1

1 PIEZOMETRIC SURFACE(S) SPECIFIED

Unit Weight of Water = 62.40 (pcf)

Piezometric Surface No. 1 Specified by 2 Coordinate Points
Pore Pressure Inclination Factor = 0.50

Point No.	X-Water (ft)	Y-Water (ft)
1	4000.00	4243.00
2	5689.00	4243.00

Specified Peak Ground Acceleration Coefficient (A) = 0.280(g)
Specified Horizontal Earthquake Coefficient (kh) = 0.140(g)
Specified Vertical Earthquake Coefficient (kv) = 0.000(g)

Specified Seismic Pore-Pressure Factor = 0.000

1

Trial Failure Surface Specified By 42 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	4300.000	4265.000
2	4308.000	4265.048
3	4315.999	4265.156
4	4323.997	4265.325
5	4331.994	4265.555
6	4339.988	4265.844
7	4347.980	4266.194
8	4355.970	4266.605
9	4363.956	4267.076
10	4371.938	4267.607
11	4379.917	4268.198
12	4387.890	4268.850
13	4395.857	4269.562
14	4403.821	4270.333
15	4411.778	4271.166
16	4419.728	4272.058
17	4427.671	4273.010
18	4435.607	4274.022
19	4443.535	4275.095
20	4451.454	4276.227
21	4459.365	4277.417
22	4467.266	4278.670
23	4475.158	4279.981
24	4483.040	4281.352
25	4490.911	4282.782
26	4498.771	4284.271
27	4506.619	4285.820
28	4514.456	4287.429
29	4522.280	4289.096
30	4530.091	4290.823
31	4537.890	4292.608
32	4545.674	4294.453
33	4553.445	4296.355
34	4561.201	4298.317
35	4568.941	4300.337
36	4576.667	4302.417
37	4584.375	4304.554
38	4592.069	4306.750
39	4599.745	4309.003
40	4607.404	4311.313
41	4615.045	4313.683
42	4617.627	4314.505

DEFLECTION ANGLE & SEGMENT DATA FOR SPECIFIED SURFACE(Excluding Last Segment)

Angle/Segment No.	Deflection(Deg)	Segment Length(ft)
1	0.43	8.00
2	0.44	8.00
3	0.44	8.00

4	0.42	8.00
5	0.44	8.00
6	0.44	8.00
7	0.43	8.00
8	0.43	8.00
9	0.43	8.00
10	0.44	8.00
11	0.44	8.00
12	0.42	8.00
13	0.44	8.00
14	0.43	8.00
15	0.44	8.00
16	0.43	8.00
17	0.44	8.00
18	0.43	8.00
19	0.42	8.00
20	0.45	8.00
21	0.43	8.00
22	0.43	8.00
23	0.44	8.00
24	0.42	8.00
25	0.44	8.00
26	0.44	8.00
27	0.43	8.00
28	0.44	8.00
29	0.42	8.00
30	0.44	8.00
31	0.43	8.00
32	0.44	8.00
33	0.43	8.00
34	0.43	8.00
35	0.43	8.00
36	0.44	8.00
37	0.42	8.00
38	0.43	8.00
39	0.44	8.00

Circle Center At X = 4297.684(ft) ; Y = 5323.575(ft); and Radius = 1058.577(ft)

Theta (deg) (ki=1.0)	FOS (Moment) (Equil.)	FOS (Force) (Equil.)	Lambda
5.68	1.656	1.652	0.099
8.51	1.475	1.652	0.150
5.76	1.653	1.652	0.101

((Modified Bishop FS for Specified Surface = 1.663))

Factor Of Safety For The Preceding Specified Surface = 1.653
Theta (ki = 1.0) = 5.76 Deg Lambda = 0.101

Factor Of Safety Is Calculated By GLE (Spencer`s) Method (0-1)

Forces from Reinforcement, Piers/Piles, Applied Forces, and Soil Nails
(if applicable) have been applied to the slice base(s)
on which they intersect.

Selected ki function = Constant (1.0)

Selected Lambda Coefficient = 1.00

Tension Crack Water Force = 0.00(lbs)

Specified Tension Crack Water Force Factor = 0.000

Depth of Tension Crack (zo) at Center of Last Slice = 0.000(ft)

*** Line of Thrust and Slice Force Data ***

Slice No.	X Coord.	Y Coord.	L/H	Side Force (lbs)	ki	Force Angle (Deg)	Vert. Shear Force(lbs)
1	4308.00	4265.43	0.245	320.	1.000	5.76	32.2
2	4310.40	4265.48	0.198	533.	1.000	5.76	53.8
3	4316.00	4265.57	0.135	2038.	1.000	5.76	205.6
4	4319.10	4265.71	0.137	2955.	1.000	5.76	298.1
5	4324.00	4265.89	0.126	5520.	1.000	5.76	557.0
6	4331.99	4266.34	0.134	9495.	1.000	5.76	958.0
7	4339.99	4266.85	0.141	13196.	1.000	5.76	1331.5
8	4347.98	4267.40	0.144	16616.	1.000	5.76	1676.5
9	4355.97	4267.99	0.144	19747.	1.000	5.76	1992.5
10	4360.48	4268.33	0.143	21378.	1.000	5.76	2157.1
11	4361.00	4268.37	0.143	21560.	1.000	5.76	2175.4
12	4362.67	4268.50	0.142	22144.	1.000	5.76	2234.4
13	4363.96	4268.62	0.144	22240.	1.000	5.76	2244.0
14	4371.94	4269.39	0.151	22744.	1.000	5.76	2294.9
15	4379.92	4270.16	0.154	23145.	1.000	5.76	2335.4
16	4387.89	4270.94	0.152	23432.	1.000	5.76	2364.3
17	4395.86	4271.73	0.148	23593.	1.000	5.76	2380.6
18	4403.82	4272.53	0.142	23624.	1.000	5.76	2383.7
19	4411.78	4273.35	0.135	23513.	1.000	5.76	2372.5
20	4419.73	4274.17	0.125	23257.	1.000	5.76	2346.7
21	4427.67	4275.01	0.114	22848.	1.000	5.76	2305.4
22	4435.61	4275.86	0.101	22283.	1.000	5.76	2248.4
23	4443.53	4276.71	0.087	21559.	1.000	5.76	2175.3
24	4451.45	4277.58	0.071	20675.	1.000	5.76	2086.2
25	4459.36	4278.44	0.052	19635.	1.000	5.76	1981.2
26	4467.27	4279.28	0.031	18430.	1.000	5.76	1859.6
27	4475.16	4280.11	0.006	17070.	1.000	5.76	1722.3
28	4483.04	4280.89	-0.023	15555.	1.000	5.76	1569.5
29	4490.91	4281.59	-0.058	13888.	1.000	5.76	1401.3
30	4498.77	4282.15	-0.103	12079.	1.000	5.76	1218.8
31	4506.62	4282.46	-0.164	10130.	1.000	5.76	1022.1
32	4514.46	4282.28	-0.252	8047.	1.000	5.76	812.0
33	4522.28	4280.96	-0.400	5844.	1.000	5.76	589.7
34	4530.00	4276.19	-0.723	3552.	1.000	5.76	358.4
35	4530.09	4276.09	-0.730	3525.	1.000	5.76	355.7
36	4537.89	4247.05	-2.435	1192.	1.000	5.76	120.2
37	4545.67	4345.98	3.000	-1055.	1.000	5.76	-106.5
38	4553.45	4312.67	1.047	-3186.	1.000	5.76	-321.5
39	4561.20	4307.41	0.653	-5177.	1.000	5.76	-522.3
40	4568.94	4305.99	0.462	-6997.	1.000	5.76	-706.0
41	4576.45	4305.82	0.330	-8579.	1.000	5.76	-865.7
42	4576.67	4305.85	0.329	-8555.	1.000	5.76	-863.2
43	4584.38	4307.06	0.291	-7382.	1.000	5.76	-744.8
44	4592.07	4308.44	0.251	-5534.	1.000	5.76	-558.3
45	4599.75	4310.05	0.218	-2961.	1.000	5.76	-298.8
46	4604.66	4311.78	0.371	-908.	1.000	5.76	-91.6
47	4607.40	4312.92	0.578	-493.	1.000	5.76	-49.8
48	4610.30	4321.94	4.862	-64.	1.000	5.76	-6.5
49	4615.04	4329.28	21.684	-37.	1.000	5.76	-3.7
50	4617.63	4330.88	0.000	-34.	1.000	5.76	-3.4

Table 1 - Individual data on the 50 slices

Slice No.	Width (ft)	Weight (lbs)	Water Force Top (lbs)	Water Force Bot (lbs)	Tie Force Norm (lbs)	Tie Force Tan (lbs)	Earthquake Force Hor (lbs)	Earthquake Force Ver (lbs)	Surcharge Load (lbs)
1	8.0	837.9	0.0	0.0	0.0	0.0	117.3	0.0	0.0
2	2.4	575.9	0.0	0.0	0.0	0.0	80.6	0.0	0.0
3	5.6	1854.5	0.0	0.0	0.0	0.0	259.6	0.0	0.0
4	3.1	1320.8	0.0	0.0	0.0	0.0	184.9	0.0	0.0
5	4.9	2503.9	0.0	0.0	0.0	0.0	350.5	0.0	0.0
6	8.0	5197.0	0.0	0.0	0.0	0.0	727.6	0.0	0.0
7	8.0	6512.2	0.0	0.0	0.0	0.0	911.7	0.0	0.0
8	8.0	7768.4	0.0	0.0	0.0	0.0	1087.6	0.0	0.0
9	8.0	8962.5	0.0	0.0	0.0	0.0	1254.7	0.0	0.0

10	4.5	5570.9	0.0	0.0	0.0	0.0	779.9	0.0	0.0
11	0.5	658.7	0.0	0.0	0.0	0.0	92.2	0.0	0.0
12	1.7	2160.9	0.0	0.0	0.0	0.0	302.5	0.0	0.0
13	1.3	1686.0	0.0	0.0	0.0	0.0	236.0	0.0	0.0
14	8.0	10983.6	0.0	0.0	0.0	0.0	1537.7	0.0	0.0
15	8.0	11816.4	0.0	0.0	0.0	0.0	1654.3	0.0	0.0
16	8.0	12594.4	0.0	0.0	0.0	0.0	1763.2	0.0	0.0
17	8.0	13322.1	0.0	0.0	0.0	0.0	1865.1	0.0	0.0
18	8.0	14002.4	0.0	0.0	0.0	0.0	1960.3	0.0	0.0
19	8.0	14628.8	0.0	0.0	0.0	0.0	2048.0	0.0	0.0
20	8.0	15203.8	0.0	0.0	0.0	0.0	2128.5	0.0	0.0
21	7.9	15727.9	0.0	0.0	0.0	0.0	2201.9	0.0	0.0
22	7.9	16202.7	0.0	0.0	0.0	0.0	2268.4	0.0	0.0
23	7.9	16623.5	0.0	0.0	0.0	0.0	2327.3	0.0	0.0
24	7.9	16993.6	0.0	0.0	0.0	0.0	2379.1	0.0	0.0
25	7.9	17316.5	0.0	0.0	0.0	0.0	2424.3	0.0	0.0
26	7.9	17584.6	0.0	0.0	0.0	0.0	2461.8	0.0	0.0
27	7.9	17802.8	0.0	0.0	0.0	0.0	2492.4	0.0	0.0
28	7.9	17973.0	0.0	0.0	0.0	0.0	2516.2	0.0	0.0
29	7.9	18087.4	0.0	0.0	0.0	0.0	2532.2	0.0	0.0
30	7.9	18156.7	0.0	0.0	0.0	0.0	2541.9	0.0	0.0
31	7.8	18171.0	0.0	0.0	0.0	0.0	2543.9	0.0	0.0
32	7.8	18140.6	0.0	0.0	0.0	0.0	2539.7	0.0	0.0
33	7.8	18058.2	0.0	0.0	0.0	0.0	2528.1	0.0	0.0
34	7.7	17714.8	0.0	0.0	0.0	0.0	2480.1	0.0	0.0
35	0.1	207.6	0.0	0.0	0.0	0.0	29.1	0.0	0.0
36	7.8	17240.3	0.0	0.0	0.0	0.0	2413.6	0.0	0.0
37	7.8	16025.9	0.0	0.0	0.0	0.0	2243.6	0.0	0.0
38	7.8	14772.0	0.0	0.0	0.0	0.0	2068.1	0.0	0.0
39	7.8	13473.9	0.0	0.0	0.0	0.0	1886.3	0.0	0.0
40	7.7	12130.9	0.0	0.0	0.0	0.0	1698.3	0.0	0.0
41	7.5	10468.3	0.0	0.0	0.0	0.0	1465.6	0.0	0.0
42	0.2	283.4	0.0	0.0	0.0	0.0	39.7	0.0	0.0
43	7.7	9162.6	0.0	0.0	0.0	0.0	1282.8	0.0	0.0
44	7.7	7386.0	0.0	0.0	0.0	0.0	1034.0	0.0	0.0
45	7.7	5559.2	0.0	0.0	0.0	0.0	778.3	0.0	0.0
46	4.9	2583.7	0.0	0.0	0.0	0.0	361.7	0.0	0.0
47	2.7	1107.8	0.0	0.0	0.0	0.0	155.1	0.0	0.0
48	2.9	915.6	0.0	0.0	0.0	0.0	128.2	0.0	0.0
49	4.7	870.8	0.0	0.0	0.0	0.0	121.9	0.0	0.0
50	2.6	125.4	0.0	0.0	0.0	0.0	17.6	0.0	0.0

- TABLE 2 - Base Stress Data on the 50 Slices -

Slice No. *	Alpha (deg)	X-Coord. Slice Cntr (ft)	Base Leng. (ft)	Total Normal Stress (psf)	Total Vert. Stress (psf)	Mobilized Shear Stress (psf)
1	0.34	4304.00	8.00	108.42	104.74	55.05
2	0.77	4309.20	2.40	247.05	239.79	125.43
3	0.77	4313.20	5.60	354.02	331.30	318.63
4	1.21	4317.55	3.11	447.28	425.21	362.72
5	1.21	4321.55	4.89	551.64	511.66	605.07
6	1.65	4328.00	8.00	682.36	649.60	605.07
7	2.07	4335.99	8.00	839.23	814.09	605.07
8	2.51	4343.98	8.00	988.45	971.07	605.07
9	2.95	4351.97	8.00	1129.95	1120.27	605.07
10	3.37	4358.23	4.52	1234.57	1231.82	605.07
11	3.37	4360.74	0.52	1277.31	1275.35	605.07
12	3.37	4361.84	1.67	1292.34	1290.66	605.07
13	3.37	4363.31	1.29	1300.68	1310.66	334.37
14	3.81	4367.95	8.00	1359.37	1373.02	345.91
15	4.23	4375.93	8.00	1458.93	1476.89	365.49

16	4.67	4383.90	8.00	1551.84	1574.35	383.75
17	5.11	4391.87	8.00	1638.21	1665.36	400.73
18	5.53	4399.84	8.00	1718.39	1750.16	416.50
19	5.97	4407.80	8.00	1791.99	1828.50	430.96
20	6.40	4415.75	8.00	1859.33	1900.47	444.21
21	6.84	4423.70	8.00	1920.28	1966.05	456.19
22	7.27	4431.64	8.00	1974.96	2025.26	466.94
23	7.71	4439.57	8.00	2023.24	2077.95	476.43
24	8.14	4447.49	8.00	2065.42	2124.33	484.72
25	8.56	4455.41	8.00	2101.67	2164.51	491.85
26	9.01	4463.32	8.00	2131.32	2198.07	497.68
27	9.43	4471.21	8.00	2155.15	2225.42	502.36
28	9.86	4479.10	8.00	2172.91	2246.46	505.86
29	10.30	4486.98	8.00	2184.47	2261.04	508.13
30	10.72	4494.84	8.00	2190.35	2269.57	509.28
31	11.16	4502.69	8.00	2190.03	2271.65	509.22
32	11.60	4510.54	8.00	2183.79	2267.47	507.99
33	12.03	4518.37	8.00	2171.85	2257.19	505.65
34	12.47	4526.14	7.91	2153.91	2240.63	502.12
35	12.47	4530.05	0.09	2145.56	2231.97	500.48
36	12.89	4533.99	8.00	2069.46	2154.90	485.52
37	13.33	4541.78	8.00	1921.63	2003.30	456.45
38	13.76	4549.56	8.00	1768.97	1846.37	426.44
39	14.19	4557.32	8.00	1611.35	1684.10	395.45
40	14.63	4565.07	8.00	1448.85	1516.54	363.51
41	15.06	4572.70	7.78	1283.90	1346.25	331.08
42	15.06	4576.56	0.23	1152.69	1259.38	605.07
43	15.50	4580.52	8.00	1036.15	1145.43	605.07
44	15.93	4588.22	8.00	811.43	923.17	605.07
45	16.36	4595.91	8.00	580.26	694.89	605.07

46	16.79	4602.20	5.14	384.78	503.01	605.07
47	16.79	4606.03	2.86	327.06	386.91	305.88
48	17.23	4608.85	3.03	247.66	301.83	268.35
49	17.23	4612.67	4.97	159.11	175.34	80.78
50	17.65	4616.34	2.71	41.92	46.29	21.28

```
        *** SEISMIC SLOPE DISPLACEMENT DATA ***
(Note: kv is set = zero for displacement calculations)
Seismic Yield Coefficient (ky) =  0.3296(g)
Calculated Newmark Seismic Displacement =   0.020(ft)

Non-Symmetrical Sliding Resistance Has Been Specified
for Downhill Sliding.

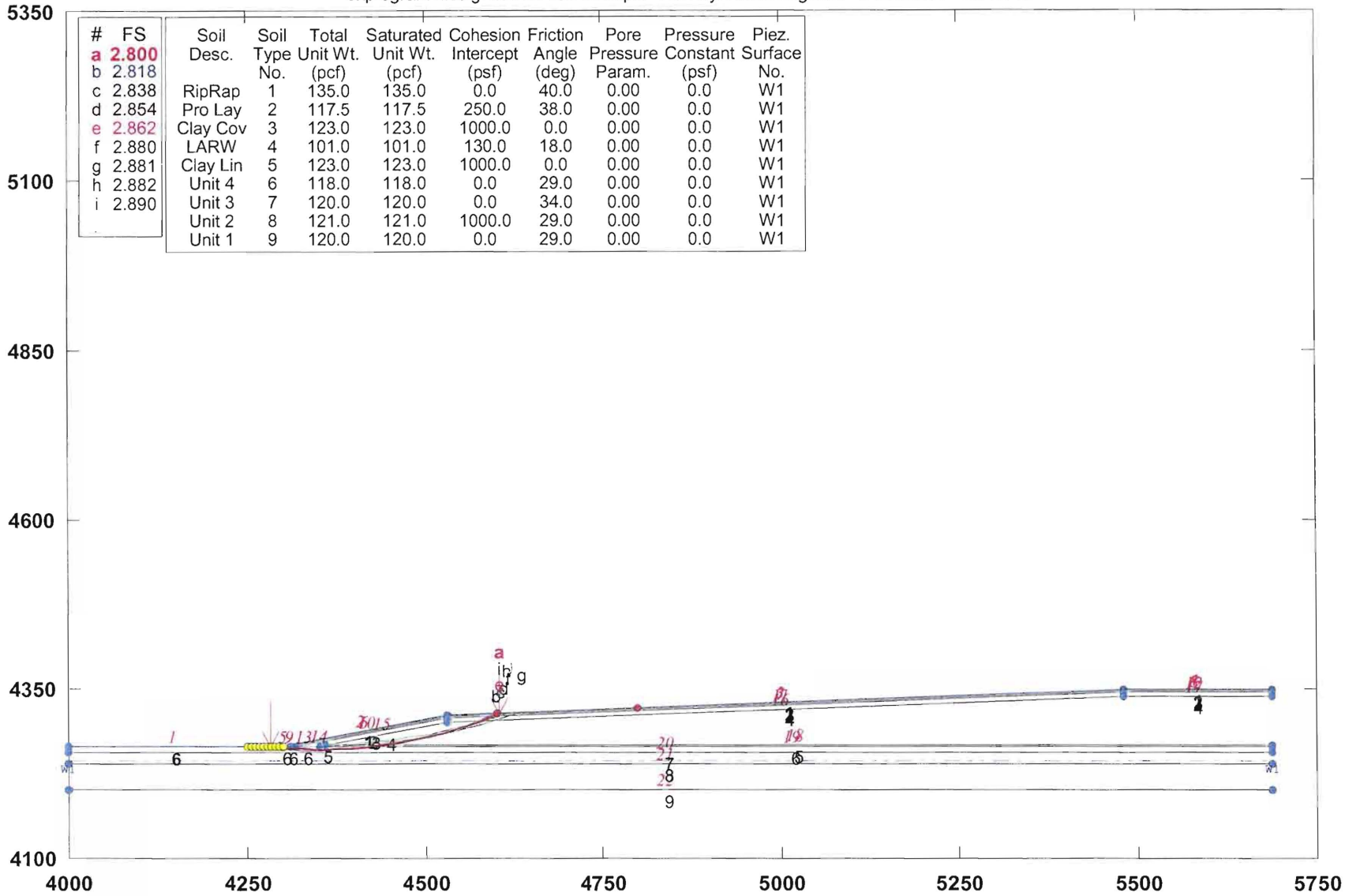
                **** END OF GSTABL7 OUTPUT ****
```

CAW Emb 38' 5(H):1(V) side-slopes, Static, Deep Surf 121810 CAWF.DTA

c:\program files\g72sw\es caw\cawf.pl2 Run By: Amec Engineer 01/29/2011 12:47PM

#	FS
a	2.800
b	2.818
c	2.838
d	2.854
e	2.862
f	2.880
g	2.881
h	2.882
i	2.890

Soil Desc.	Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Param.	Pressure Constant (psf)	Piez. Surface No.
RipRap	1	135.0	135.0	0.0	40.0	0.00	0.0	W1
Pro Lay	2	117.5	117.5	250.0	38.0	0.00	0.0	W1
Clay Cov	3	123.0	123.0	1000.0	0.0	0.00	0.0	W1
LARW	4	101.0	101.0	130.0	18.0	0.00	0.0	W1
Clay Lin	5	123.0	123.0	1000.0	0.0	0.00	0.0	W1
Unit 4	6	118.0	118.0	0.0	29.0	0.00	0.0	W1
Unit 3	7	120.0	120.0	0.0	34.0	0.00	0.0	W1
Unit 2	8	121.0	121.0	1000.0	29.0	0.00	0.0	W1
Unit 1	9	120.0	120.0	0.0	29.0	0.00	0.0	W1



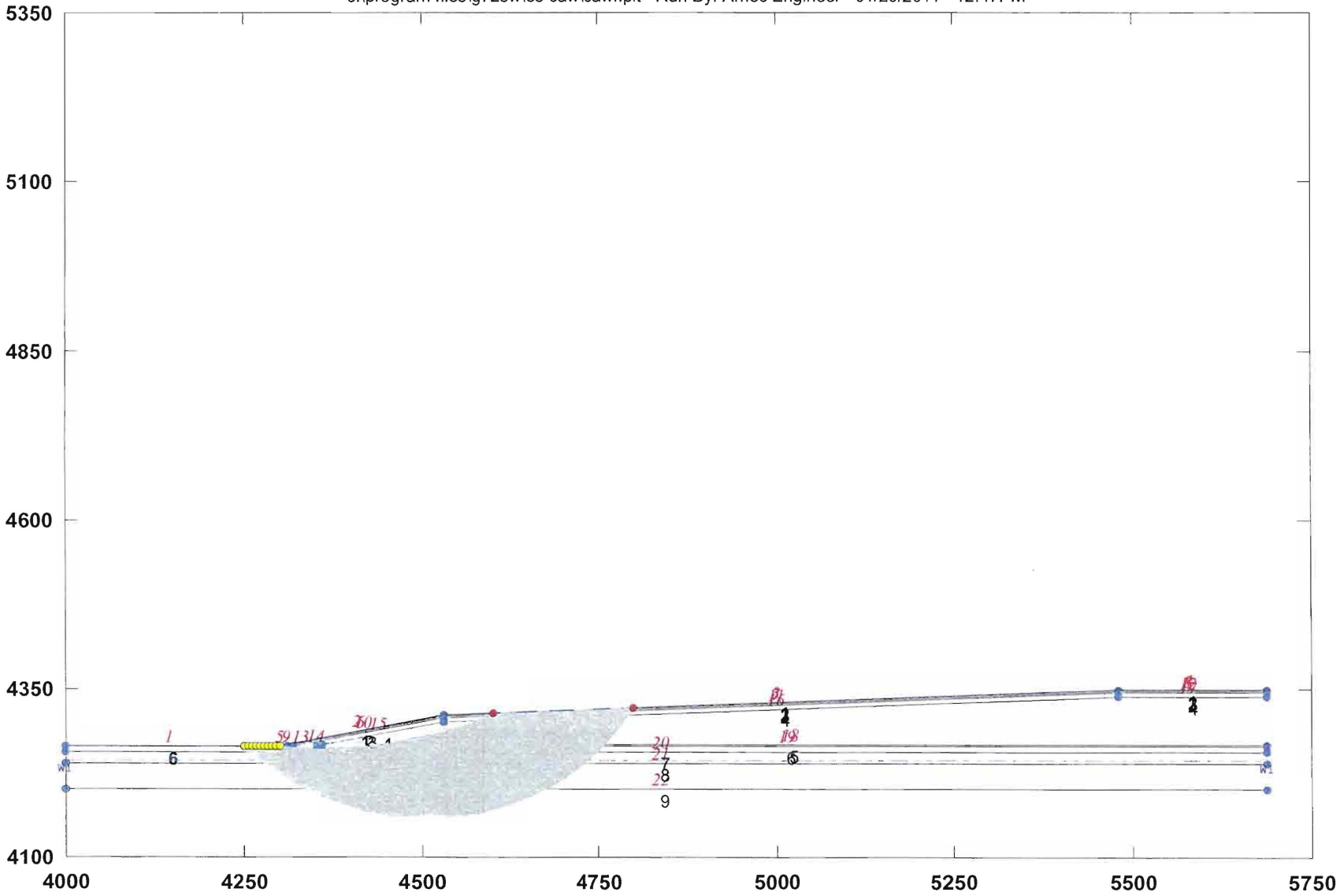
GSTABL7 v.2 FSmin=2.800

Safety Factors Are Calculated By GLE (Spencer`s) Method (0-2)

GSTABL7

CAW Emb 38' 5(H):1(V) side-slopes, Static, Deep Surf 121810 CAWF.DTA

c:\program files\g72sw\es caw\cawf.plt Run By: Amec Engineer 01/29/2011 12:47PM



GSTABL7

*** GSTABL7 ***

** GSTABL7 by Garry H. Gregory, P.E. **

** Original Version 1.0, January 1996; Current Version 2.004, June 2003 **
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****
SLOPE STABILITY ANALYSIS SYSTEM
Modified Bishop, Simplified Janbu, or GLE Method of Slices.
(Includes Spencer & Morgenstern-Price Type Analysis)
Including Pier/Pile, Reinforcement, Soil Nail, Tieback,
Nonlinear Undrained Shear Strength, Curved Phi Envelope,
Anisotropic Soil, Fiber-Reinforced Soil, Boundary Loads, Water
Surfaces, Pseudo-Static & Newmark Earthquake, and Applied Forces.
****

Analysis Run Date: 01/29/2011
Time of Run: 12:47PM
Run By: Amec Engineer
Input Data Filename: C:\Program Files\G72SW\ES CAW\cawf.
Output Filename: C:\Program Files\G72SW\ES CAW\cawf.OUT
Unit System: English

Plotted Output Filename: C:\Program Files\G72SW\ES CAW\cawf.PLT

PROBLEM DESCRIPTION: CAW Emb 38' 5(H):1(V) side-slopes,
Static, Deep Surf 121810 CAWF.DTA

BOUNDARY COORDINATES

4 Top Boundaries
22 Total Boundaries

Boundary No.	X-Left (ft)	Y-Left (ft)	X-Right (ft)	Y-Right (ft)	Soil Type Below Bnd
1	4000.00	4265.00	4300.00	4265.00	6
2	4300.00	4265.00	4530.00	4311.00	1
3	4530.00	4311.00	5480.00	4349.00	1
4	5480.00	4349.00	5689.00	4349.00	1
5	4300.00	4265.00	4310.00	4265.00	6
6	4310.00	4265.00	4530.00	4309.00	2
7	4530.00	4309.00	5480.00	4347.00	2
8	5480.00	4347.00	5689.00	4347.00	2
9	4310.00	4265.00	4318.00	4265.00	6
10	4318.00	4265.00	4530.00	4307.50	3
11	4530.00	4307.50	5480.00	4345.50	3
12	5480.00	4345.50	5689.00	4345.50	3
13	4318.00	4265.00	4353.00	4265.00	6
14	4353.00	4265.00	4361.00	4267.00	5
15	4361.00	4267.00	4530.00	4300.50	4
16	4530.00	4300.50	5480.00	4338.50	4
17	5480.00	4338.50	5689.00	4338.50	4
18	4361.00	4267.00	5689.00	4267.00	5
19	4353.00	4265.00	5689.00	4265.00	6
20	4000.00	4256.00	5689.00	4256.00	7
21	4000.00	4239.00	5689.00	4239.00	8
22	4000.00	4201.00	5689.00	4201.00	9

User Specified Y-Origin = 4100.00(ft)

Default X-Plus Value = 0.00(ft)

Default Y-Plus Value = 0.00(ft)

1

ISOTROPIC SOIL PARAMETERS

9 Type(s) of Soil

Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Param.	Pressure Constant (psf)	Piez. Surface No.
1	135.0	135.0	0.0	40.0	0.00	0.0	1
2	117.5	117.5	250.0	38.0	0.00	0.0	1
3	123.0	123.0	1000.0	0.0	0.00	0.0	1
4	101.0	101.0	130.0	18.0	0.00	0.0	1
5	123.0	123.0	1000.0	0.0	0.00	0.0	1
6	118.0	118.0	0.0	29.0	0.00	0.0	1
7	120.0	120.0	0.0	34.0	0.00	0.0	1
8	121.0	121.0	1000.0	29.0	0.00	0.0	1

```
  9   120.0    120.0       0.0     29.0    0.00       0.0      1
1

1 PIEZOMETRIC SURFACE(S) SPECIFIED

Unit Weight of Water =  62.40 (pcf)

Piezometric Surface No.  1 Specified by  2 Coordinate Points
Pore Pressure Inclination Factor =  0.50

  Point       X-Water      Y-Water
   No.          (ft)         (ft)

    1        4000.00      4243.00
    2        5689.00      4243.00
1

A Critical Failure Surface Searching Method, Using A Random
Technique For Generating Circular Surfaces, Has Been Specified.

4000 Trial Surfaces Have Been Generated.

 400 Surface(s) Initiate(s) From Each Of    10 Points Equally Spaced
Along The Ground Surface Between  X =4250.00(ft)
                              and  X =4300.00(ft)

Each Surface Terminates Between   X =4600.00(ft)
                              and   X =4800.00(ft)

Unless Further Limitations Were Imposed, The Minimum Elevation
At Which A Surface Extends Is  Y =       0.00(ft)

20.00(ft) Line Segments Define Each Trial Failure Surface.



Following Are Displayed The Ten Most Critical Of The Trial
Failure Surfaces Evaluated. They Are
Ordered - Most Critical First.

* * Safety Factors Are Calculated By GLE (Spencer`s) Method (0-2) * *


Selected ki function = Bi-linear

Selected Lambda Coefficient =  1.00

Forces from Reinforcement, Piers/Piles, Soil Nails, and Applied Forces
(if applicable) have been applied to the slice base(s)
on which they intersect.


Specified Tension Crack Water Force Factor =   0.000

Total Number of Trial Surfaces Attempted =  4000

WARNING! The Factor of Safety Calculation for one or More Trial Surfaces
Did Not Converge in 20 Iterations.

Number of Trial Surfaces with Non-Converged FS =   12

Number of Trial Surfaces With Valid FS = 3988

Percentage of Trial Surfaces With Non-Valid FS Solutions
of the Total Attempted =   0.3 %

Statistical Data On All Valid FS Values:
   FS Max =   6.700   FS Min =   2.800   FS Ave =   5.375
   Standard Deviation =    0.708   Coefficient of Variation =   13.18 %


          ((Modified Bishop FS for Critical Surface =  2.789))

Failure Surface Specified By 18 Coordinate Points
```

Point No.	X-Surf (ft)	Y-Surf (ft)
1	4283.334	4265.000
2	4303.247	4263.140
3	4323.209	4261.914
4	4343.201	4261.323
5	4363.201	4261.368
6	4383.189	4262.049
7	4403.146	4263.365
8	4423.050	4265.314
9	4442.883	4267.896
10	4462.624	4271.106
11	4482.252	4274.943
12	4501.749	4279.401
13	4521.094	4284.478
14	4540.268	4290.166
15	4559.251	4296.461
16	4578.025	4303.356
17	4596.570	4310.845
18	4603.591	4313.944

Circle Center At X = 4351.804 ; Y = 4889.227 ; and Radius = 627.971

*** FOS = 2.800 Theta (ki=1.0) = 8.29 ***
Lambda = 0.146

Individual data on the 28 slices

Slice No.	Width (ft)	Weight (lbs)	Water Force Top (lbs)	Water Force Bot (lbs)	Tie Force Norm (lbs)	Tie Force Tan (lbs)	Earthquake Force Hor (lbs)	Earthquake Force Ver (lbs)	Surcharge Load (lbs)
1	16.7	1530.6	0.0	0.0	0.	0.	0.0	0.0	0.0
2	3.2	796.8	0.0	0.0	0.	0.	0.0	0.0	0.0
3	6.8	2855.0	0.0	0.0	0.	0.	0.0	0.0	0.0
4	8.0	5291.2	0.0	0.0	0.	0.	0.0	0.0	0.0
5	5.2	4518.4	0.0	0.0	0.	0.	0.0	0.0	0.0
6	20.0	24611.1	0.0	0.0	0.	0.	0.0	0.0	0.0
7	9.8	15983.5	0.0	0.0	0.	0.	0.0	0.0	0.0
8	8.0	14781.7	0.0	0.0	0.	0.	0.0	0.0	0.0
9	2.2	4328.8	0.0	0.0	0.	0.	0.0	0.0	0.0
10	20.0	42998.2	0.0	0.0	0.	0.	0.0	0.0	0.0
11	20.0	48646.8	0.0	0.0	0.	0.	0.0	0.0	0.0
12	16.7	43980.5	0.0	0.0	0.	0.	0.0	0.0	0.0
13	3.2	8732.7	0.0	0.0	0.	0.	0.0	0.0	0.0
14	12.9	35747.6	0.0	0.0	0.	0.	0.0	0.0	0.0
15	6.9	19358.7	0.0	0.0	0.	0.	0.0	0.0	0.0
16	19.7	56746.1	0.0	0.0	0.	0.	0.0	0.0	0.0
17	19.6	57258.0	0.0	0.0	0.	0.	0.0	0.0	0.0
18	19.5	56427.0	0.0	0.0	0.	0.	0.0	0.0	0.0
19	19.3	54278.6	0.0	0.0	0.	0.	0.0	0.0	0.0
20	8.9	24064.1	0.0	0.0	0.	0.	0.0	0.0	0.0
21	10.3	25931.4	0.0	0.0	0.	0.	0.0	0.0	0.0
22	19.0	40110.6	0.0	0.0	0.	0.	0.0	0.0	0.0
23	15.9	24993.0	0.0	0.0	0.	0.	0.0	0.0	0.0
24	2.9	3571.6	0.0	0.0	0.	0.	0.0	0.0	0.0
25	16.7	13655.8	0.0	0.0	0.	0.	0.0	0.0	0.0
26	1.9	761.8	0.0	0.0	0.	0.	0.0	0.0	0.0
27	2.0	647.8	0.0	0.0	0.	0.	0.0	0.0	0.0
28	5.0	672.6	0.0	0.0	0.	0.	0.0	0.0	0.0

Failure Surface Specified By 19 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	4261.111	4265.000
2	4281.007	4262.958
3	4300.955	4261.514
4	4320.937	4260.670
5	4340.935	4260.426
6	4360.932	4260.782
7	4380.909	4261.739
8	4400.849	4263.294
9	4420.732	4265.448
10	4440.542	4268.197
11	4460.261	4271.540
12	4479.871	4275.473
13	4499.353	4279.993
14	4518.691	4285.095
15	4537.867	4290.776
16	4556.864	4297.030
17	4575.665	4303.851
18	4594.252	4311.233
19	4600.208	4313.808

Circle Center At X = 4339.066 ; Y = 4926.646 ; and Radius = 666.223

*** FOS = 2.818 Theta (ki=1.0) = 8.24 ***
Lambda = 0.145

1

Failure Surface Specified By 17 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	4300.001	4265.000
2	4319.905	4263.044
3	4339.866	4261.788
4	4359.858	4261.231
5	4379.857	4261.376
6	4399.839	4262.222
7	4419.779	4263.768
8	4439.653	4266.012
9	4459.436	4268.951
10	4479.103	4272.581
11	4498.631	4276.899
12	4517.997	4281.898
13	4537.174	4287.574
14	4556.142	4293.918
15	4574.875	4300.923
16	4593.351	4308.581
17	4605.252	4314.010

Circle Center At X = 4365.726 ; Y = 4831.679 ; and Radius = 570.477

*** FOS = 2.838 Theta (ki=1.0) = 8.32 ***
Lambda = 0.146

Failure Surface Specified By 18 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	4288.890	4265.000
2	4308.794	4263.045
3	4328.751	4261.736
4	4348.740	4261.074
5	4368.740	4261.059
6	4388.730	4261.691
7	4408.689	4262.970
8	4428.597	4264.894
9	4448.431	4267.462
10	4468.172	4270.670
11	4487.799	4274.516
12	4507.292	4278.995
13	4526.628	4284.103
14	4545.790	4289.833
15	4564.755	4296.182
16	4583.506	4303.140
17	4602.021	4310.702
18	4609.836	4314.193

Circle Center At X = 4359.225 ; Y = 4877.673 ; and Radius = 616.697

*** FOS = 2.854 Theta (ki=1.0) = 8.24 ***
Lambda = 0.145

1

Failure Surface Specified By 18 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	4277.778	4265.000
2	4297.644	4262.685
3	4317.577	4261.043
4	4337.553	4260.077
5	4357.551	4259.787
6	4377.547	4260.174
7	4397.519	4261.237
8	4417.443	4262.976
9	4437.297	4265.388
10	4457.059	4268.471
11	4476.704	4272.220
12	4496.211	4276.631
13	4515.558	4281.701

14	4534.722	4287.422
15	4553.682	4293.788
16	4572.415	4300.792
17	4590.901	4308.427
18	4603.025	4313.921

Circle Center At X = 4356.115 ; Y = 4849.832 ; and Radius = 590.055

*** FOS = 2.862 Theta (ki=1.0) = 8.47 ***
Lambda = 0.149

Failure Surface Specified By 18 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	4300.001	4265.000
2	4320.000	4264.754
3	4339.999	4264.952
4	4359.988	4265.593
5	4379.959	4266.677
6	4399.901	4268.204
7	4419.804	4270.172
8	4439.658	4272.581
9	4459.454	4275.429
10	4479.182	4278.716
11	4498.833	4282.439
12	4518.396	4286.597
13	4537.861	4291.187
14	4557.221	4296.208
15	4576.464	4301.657
16	4595.582	4307.531
17	4614.565	4313.827
18	4616.320	4314.453

Circle Center At X = 4321.118 ; Y = 5166.305 ; and Radius = 901.553

*** FOS = 2.880 Theta (ki=1.0) = 7.40 ***
Lambda = 0.130

1

Failure Surface Specified By 19 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	4300.001	4265.000
2	4319.992	4264.415
3	4339.992	4264.272
4	4359.989	4264.571
5	4379.976	4265.312
6	4399.940	4266.495
7	4419.875	4268.119
8	4439.768	4270.183
9	4459.610	4272.687
10	4479.393	4275.628
11	4499.106	4279.006
12	4518.739	4282.819
13	4538.283	4287.065
14	4557.729	4291.742
15	4577.066	4296.848
16	4596.286	4302.380
17	4615.378	4308.336
18	4634.335	4314.712
19	4635.771	4315.231

Circle Center At X = 4336.459 ; Y = 5168.918 ; and Radius = 904.653

*** FOS = 2.881 Theta (ki=1.0) = 7.19 ***
Lambda = 0.126

Failure Surface Specified By 18 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	4300.001	4265.000
2	4319.915	4263.144
3	4339.878	4261.942
4	4359.871	4261.396
5	4379.871	4261.507
6	4399.856	4262.275

7	4419.805	4263.698
8	4439.697	4265.775
9	4459.510	4268.504
10	4479.223	4271.882
11	4498.814	4275.905
12	4518.263	4280.569
13	4537.548	4285.870
14	4556.648	4291.800
15	4575.544	4298.354
16	4594.214	4305.525
17	4612.639	4313.305
18	4615.014	4314.400

Circle Center At X = 4366.504 ; Y = 4870.004 ; and Radius = 608.648

*** FOS = 2.882 Theta (ki=1.0) = 8.08 ***
Lambda = 0.142

1

Failure Surface Specified By 20 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	4250.000	4265.000
2	4269.866	4262.685
3	4289.792	4260.961
4	4309.760	4259.832
5	4329.752	4259.296
6	4349.752	4259.355
7	4369.742	4260.010
8	4389.703	4261.258
9	4409.618	4263.100
10	4429.469	4265.533
11	4449.240	4268.556
12	4468.912	4272.165
13	4488.467	4276.358
14	4507.890	4281.130
15	4527.161	4286.479
16	4546.265	4292.397
17	4565.185	4298.882
18	4583.903	4305.926
19	4602.403	4313.524
20	4603.319	4313.933

Circle Center At X = 4337.755 ; Y = 4931.399 ; and Radius = 672.152

*** FOS = 2.890 Theta (ki=1.0) = 8.17 ***
Lambda = 0.143

Failure Surface Specified By 20 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	4255.556	4265.000
2	4275.468	4263.133
3	4295.423	4261.784
4	4315.406	4260.952
5	4335.403	4260.638
6	4355.402	4260.843
7	4375.389	4261.567
8	4395.351	4262.809
9	4415.273	4264.567
10	4435.143	4266.842
11	4454.948	4269.631
12	4474.673	4272.933
13	4494.307	4276.745
14	4513.834	4281.065
15	4533.244	4285.890
16	4552.521	4291.216
17	4571.654	4297.041
18	4590.630	4303.360
19	4609.435	4310.168
20	4620.834	4314.633

Circle Center At X = 4337.502 ; Y = 5030.872 ; and Radius = 770.244

*** FOS = 2.910 Theta (ki=1.0) = 7.78 ***
Lambda = 0.137

**** END OF GSTABL7 OUTPUT ****

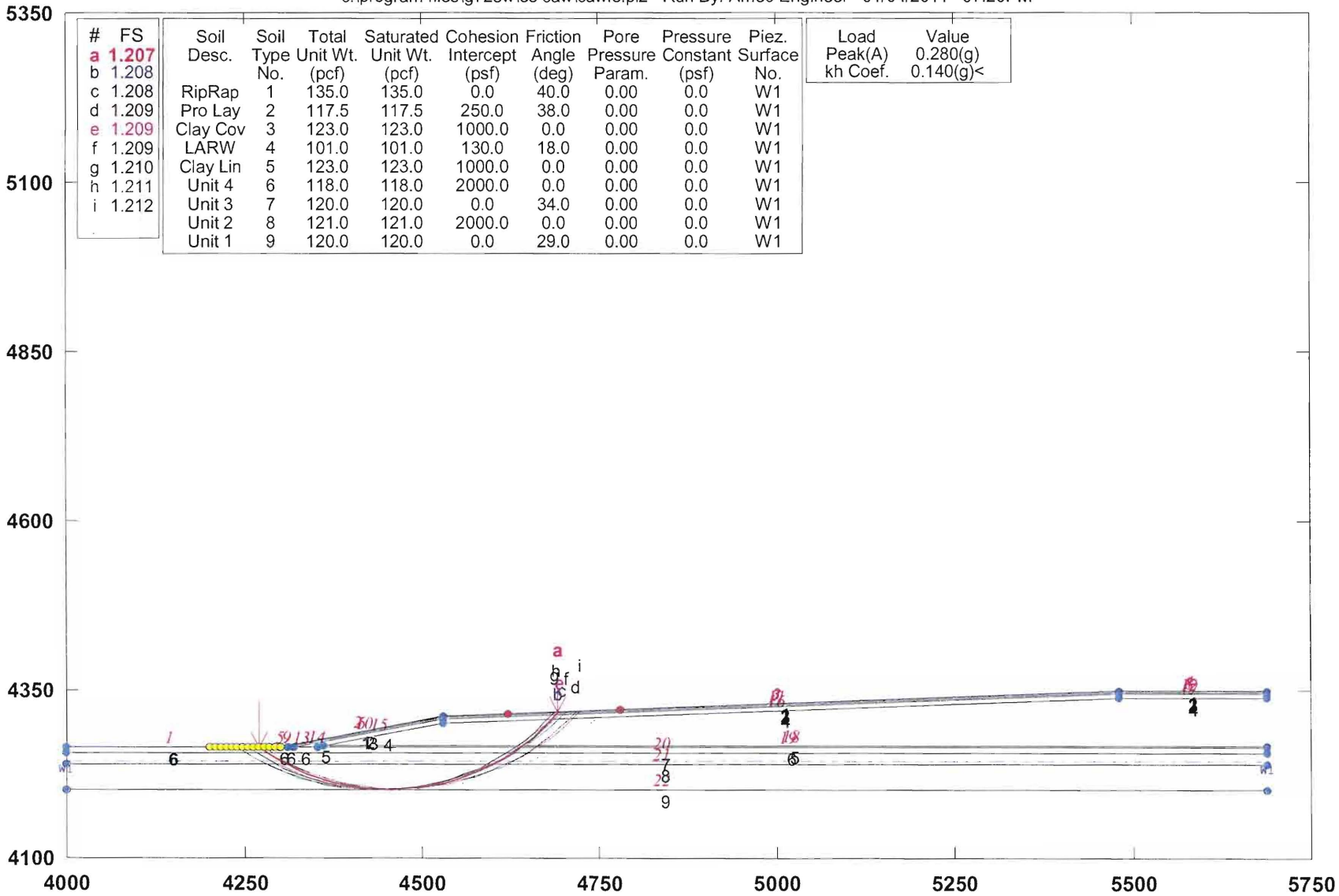
CAW Emb 38' 5(H):1(V) side-slopes, Pseudostatic, Deep Surf 121810 CAWFS.DTA

c:\program files\g72sw\es caw\cawfs.pl2 Run By: Amec Engineer 01/04/2011 07:20PM

#	FS
a	1.207
b	1.208
c	1.208
d	1.209
e	1.209
f	1.209
g	1.210
h	1.211
i	1.212

Soil Desc.	Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Param.	Pressure Constant (psf)	Piez. Surface No.
RipRap	1	135.0	135.0	0.0	40.0	0.00	0.0	W1
Pro Lay	2	117.5	117.5	250.0	38.0	0.00	0.0	W1
Clay Cov	3	123.0	123.0	1000.0	0.0	0.00	0.0	W1
LARW	4	101.0	101.0	130.0	18.0	0.00	0.0	W1
Clay Lin	5	123.0	123.0	1000.0	0.0	0.00	0.0	W1
Unit 4	6	118.0	118.0	2000.0	0.0	0.00	0.0	W1
Unit 3	7	120.0	120.0	0.0	34.0	0.00	0.0	W1
Unit 2	8	121.0	121.0	2000.0	0.0	0.00	0.0	W1
Unit 1	9	120.0	120.0	0.0	29.0	0.00	0.0	W1

Load	Value
Peak(A)	0.280(g)
kh Coef.	0.140(g)<



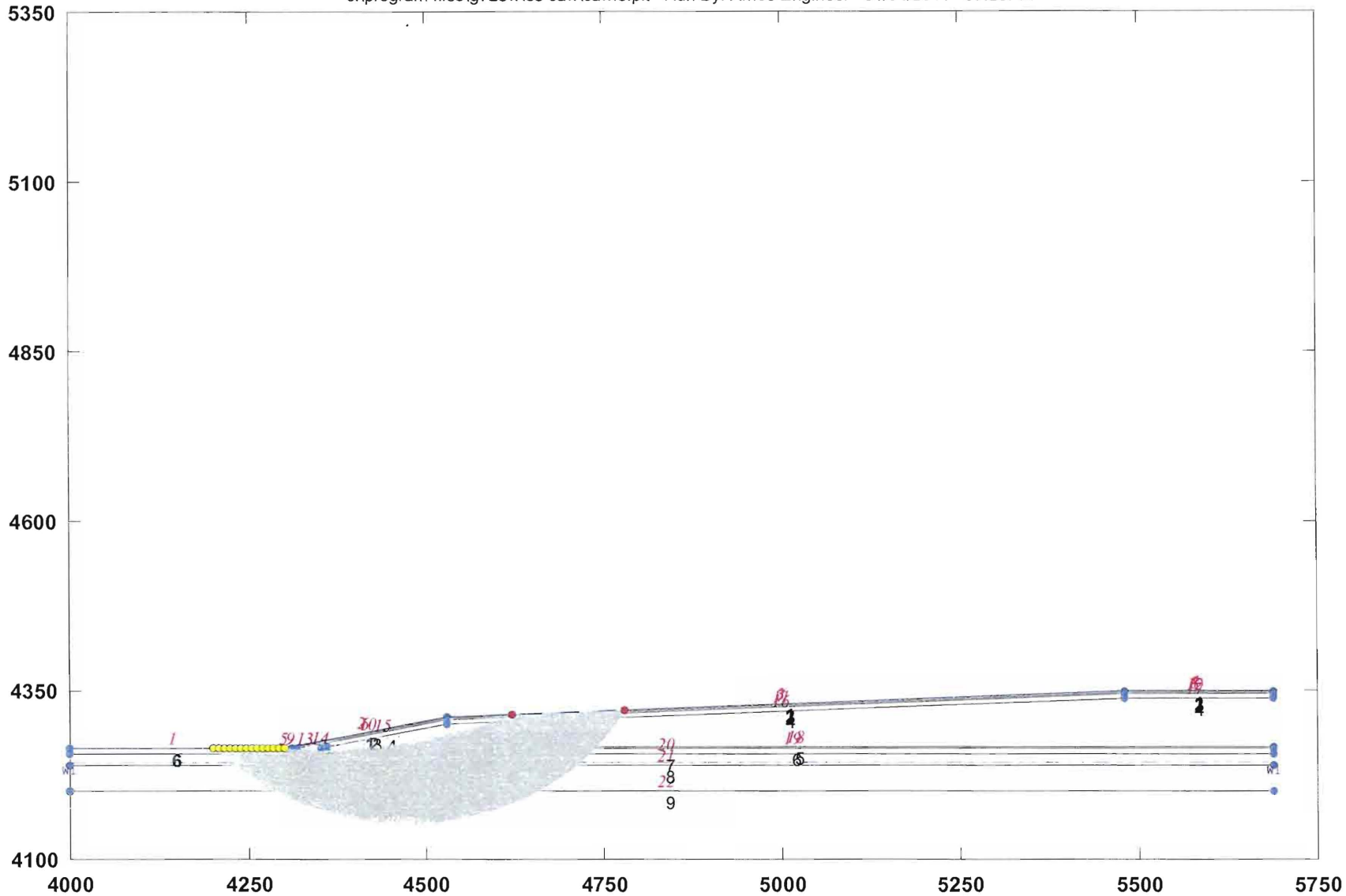
GSTABL7 v.2 FSmin=1.207

Safety Factors Are Calculated By GLE (Spencer`s) Method (0-1)

GSTABL7

CAW Emb 38' 5(H):1(V) side-slopes, Pseudostatic, Deep Surf 121810 CAWFS.DTA

c:\program files\g72sw\es caw\cawfs.plt Run By: Amec Engineer 01/04/2011 07:20PM



GSTABL7

*** GSTABL7 ***

** GSTABL7 by Garry H. Gregory, P.E. **

** Original Version 1.0, January 1996; Current Version 2.004, June 2003 **
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****
SLOPE STABILITY ANALYSIS SYSTEM
Modified Bishop, Simplified Janbu, or GLE Method of Slices.
(Includes Spencer & Morgenstern-Price Type Analysis)
Including Pier/Pile, Reinforcement, Soil Nail, Tieback,
Nonlinear Undrained Shear Strength, Curved Phi Envelope,
Anisotropic Soil, Fiber-Reinforced Soil, Boundary Loads, Water
Surfaces, Pseudo-Static & Newmark Earthquake, and Applied Forces.
****

Analysis Run Date: 01/04/2011
Time of Run: 07:20PM
Run By: Amec Engineer
Input Data Filename: C:\Program Files\G72SW\ES CAW\cawfs.
Output Filename: C:\Program Files\G72SW\ES CAW\cawfs.OUT
Unit System: English

Plotted Output Filename: C:\Program Files\G72SW\ES CAW\cawfs.PLT

PROBLEM DESCRIPTION: CAW Emb 38' 5(H):1(V) side-slopes,
Pseudostatic, Deep Surf 121810 CAWFS.DTA

BOUNDARY COORDINATES

4 Top Boundaries
22 Total Boundaries

Boundary No.	X-Left (ft)	Y-Left (ft)	X-Right (ft)	Y-Right (ft)	Soil Type Below Bnd
1	4000.00	4265.00	4300.00	4265.00	6
2	4300.00	4265.00	4530.00	4311.00	1
3	4530.00	4311.00	5480.00	4349.00	1
4	5480.00	4349.00	5689.00	4349.00	1
5	4300.00	4265.00	4310.00	4265.00	6
6	4310.00	4265.00	4530.00	4309.00	2
7	4530.00	4309.00	5480.00	4347.00	2
8	5480.00	4347.00	5689.00	4347.00	2
9	4310.00	4265.00	4318.00	4265.00	6
10	4318.00	4265.00	4530.00	4307.50	3
11	4530.00	4307.50	5480.00	4345.50	3
12	5480.00	4345.50	5689.00	4345.50	3
13	4318.00	4265.00	4353.00	4265.00	6
14	4353.00	4265.00	4361.00	4267.00	5
15	4361.00	4267.00	4530.00	4300.50	4
16	4530.00	4300.50	5480.00	4338.50	4
17	5480.00	4338.50	5689.00	4338.50	4
18	4361.00	4267.00	5689.00	4267.00	5
19	4353.00	4265.00	5689.00	4265.00	6
20	4000.00	4256.00	5689.00	4256.00	7
21	4000.00	4239.00	5689.00	4239.00	8
22	4000.00	4201.00	5689.00	4201.00	9

User Specified Y-Origin = 4100.00(ft)

Default X-Plus Value = 0.00(ft)

Default Y-Plus Value = 0.00(ft)

1

ISOTROPIC SOIL PARAMETERS

9 Type(s) of Soil

Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Param.	Pressure Constant (psf)	Piez. Surface No.
1	135.0	135.0	0.0	40.0	0.00	0.0	1
2	117.5	117.5	250.0	38.0	0.00	0.0	1
3	123.0	123.0	1000.0	0.0	0.00	0.0	1
4	101.0	101.0	130.0	18.0	0.00	0.0	1
5	123.0	123.0	1000.0	0.0	0.00	0.0	1
6	118.0	118.0	2000.0	0.0	0.00	0.0	1
7	120.0	120.0	0.0	34.0	0.00	0.0	1
8	121.0	121.0	2000.0	0.0	0.00	0.0	1
9	120.0	120.0	0.0	29.0	0.00	0.0	1

1

1 PIEZOMETRIC SURFACE(S) SPECIFIED

Unit Weight of Water = 62.40 (pcf)

Piezometric Surface No. 1 Specified by 2 Coordinate Points
Pore Pressure Inclination Factor = 0.50

Point No.	X-Water (ft)	Y-Water (ft)
1	4000.00	4243.00
2	5689.00	4243.00

Specified Peak Ground Acceleration Coefficient (A) = 0.280(g)
Specified Horizontal Earthquake Coefficient (kh) = 0.140(g)
Specified Vertical Earthquake Coefficient (kv) = 0.000(g)

Specified Seismic Pore-Pressure Factor = 0.000

1

A Critical Failure Surface Searching Method, Using A Random
Technique For Generating Circular Surfaces, Has Been Specified.

4200 Trial Surfaces Have Been Generated.

300 Surface(s) Initiate(s) From Each Of 14 Points Equally Spaced
Along The Ground Surface Between X =4200.00(ft)
and X =4300.00(ft)

Each Surface Terminates Between X =4620.00(ft)
and X =4780.00(ft)

Unless Further Limitations Were Imposed, The Minimum Elevation
At Which A Surface Extends Is Y = 0.00(ft)

20.00(ft) Line Segments Define Each Trial Failure Surface.

Following Are Displayed The Ten Most Critical Of The Trial
Failure Surfaces Evaluated. They Are
Ordered - Most Critical First.

* * Safety Factors Are Calculated By GLE (Spencer`s) Method (0-1) * *

Selected ki function = Constant (1.0)

Selected Lambda Coefficient = 1.00

Forces from Reinforcement, Piers/Piles, Soil Nails, and Applied Forces
(if applicable) have been applied to the slice base(s)
on which they intersect.

Specified Tension Crack Water Force Factor = 0.000

Total Number of Trial Surfaces Attempted = 4200

WARNING! The Factor of Safety Calculation for one or More Trial Surfaces
Did Not Converge in 20 Iterations.

Number of Trial Surfaces with Non-Converged FS = 90

Number of Trial Surfaces With Valid FS = 4110

Percentage of Trial Surfaces With Non-Valid FS Solutions
of the Total Attempted = 2.1 %

Statistical Data On All Valid FS Values:
FS Max = 2.972 FS Min = 1.207 FS Ave = 1.765
Standard Deviation = 0.308 Coefficient of Variation = 17.45 %

((Modified Bishop FS for Critical Surface = 1.262))

Failure Surface Specified By 25 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	4269.231	4265.000
2	4285.429	4253.268
3	4302.371	4242.639
4	4319.982	4233.160
5	4338.185	4224.874
6	4356.898	4217.817
7	4376.040	4212.021
8	4395.525	4207.511
9	4415.267	4204.307
10	4435.178	4202.423
11	4455.170	4201.868
12	4475.155	4202.645
13	4495.044	4204.749
14	4514.749	4208.171
15	4534.183	4212.896
16	4553.259	4218.904
17	4571.893	4226.168
18	4590.003	4234.655
19	4607.508	4244.328
20	4624.332	4255.144
21	4640.398	4267.055
22	4655.636	4280.008
23	4669.979	4293.947
24	4683.363	4308.809
25	4690.125	4317.405

Circle Center At X = 4453.506 ; Y = 4502.351 ; and Radius = 300.487

*** FOS = 1.207 Theta (ki=1.0) = 1.78 ***
Lambda = 0.031

Individual data on the 41 slices

Slice No.	Width (ft)	Weight (lbs)	Water Force Top (lbs)	Water Force Bot (lbs)	Tie Force Norm (lbs)	Tie Force Tan (lbs)	Earthquake Force Hor (lbs)	Earthquake Force Ver (lbs)	Surcharge Load (lbs)
1	12.4	6597.6	0.0	0.0	0.	0.	923.7	0.0	0.0
2	3.8	4624.8	0.0	0.0	0.	0.	647.5	0.0	0.0
3	14.6	28244.8	0.0	0.0	0.	0.	3954.3	0.0	0.0
4	1.8	4627.3	0.0	0.0	0.	0.	647.8	0.0	0.0
5	0.6	1555.6	0.0	7.7	0.	0.	217.8	0.0	0.0
6	6.8	20545.8	0.0	1044.7	0.	0.	2876.4	0.0	0.0
7	0.9	2943.4	0.0	260.6	0.	0.	412.1	0.0	0.0
8	8.0	30264.1	0.0	3753.0	0.	0.	4237.0	0.0	0.0
9	2.0	8376.6	0.0	1307.1	0.	0.	1172.7	0.0	0.0
10	18.2	91751.8	0.0	17450.6	0.	0.	12845.3	0.0	0.0
11	14.8	93131.5	0.0	20668.9	0.	0.	13038.4	0.0	0.0
12	3.9	27067.7	0.0	6356.0	0.	0.	3789.5	0.0	0.0
13	4.1	29554.7	0.0	6900.3	0.	0.	4137.7	0.0	0.0
14	15.0	116696.3	0.0	28144.4	0.	0.	16337.5	0.0	0.0
15	19.5	168676.9	0.0	41476.0	0.	0.	23614.8	0.0	0.0
16	19.7	187952.8	0.0	46290.0	0.	0.	26313.4	0.0	0.0
17	19.9	203685.7	0.0	49464.9	0.	0.	28516.0	0.0	0.0
18	20.0	215537.9	0.0	50986.1	0.	0.	30175.3	0.0	0.0
19	20.0	223276.6	0.0	50847.9	0.	0.	31258.7	0.0	0.0
20	19.9	226768.1	0.0	49050.8	0.	0.	31747.5	0.0	0.0
21	19.7	225977.4	0.0	45602.1	0.	0.	31636.8	0.0	0.0
22	15.3	173714.0	0.0	32295.1	0.	0.	24320.0	0.0	0.0
23	4.2	47126.4	0.0	8222.4	0.	0.	6597.7	0.0	0.0
24	19.1	207724.9	0.0	33820.1	0.	0.	29081.5	0.0	0.0
25	18.6	189370.9	0.0	25538.8	0.	0.	26511.9	0.0	0.0
26	18.1	168128.2	0.0	15710.2	0.	0.	23537.9	0.0	0.0
27	7.9	67313.7	0.0	3460.7	0.	0.	9423.9	0.0	0.0
28	7.2	58543.9	0.0	1032.1	0.	0.	8196.1	0.0	0.0
29	2.4	18711.8	0.0	0.0	0.	0.	2619.7	0.0	0.0
30	16.8	119405.4	0.0	0.0	0.	0.	16716.8	0.0	0.0
31	1.2	7432.5	0.0	0.0	0.	0.	1040.6	0.0	0.0
32	12.1	71357.6	0.0	0.0	0.	0.	9990.1	0.0	0.0
33	2.7	14174.0	0.0	0.0	0.	0.	1984.4	0.0	0.0
34	0.1	378.5	0.0	0.0	0.	0.	53.0	0.0	0.0
35	15.2	68692.4	0.0	0.0	0.	0.	9616.9	0.0	0.0
36	14.3	46034.3	0.0	0.0	0.	0.	6444.8	0.0	0.0
37	11.4	21807.6	0.0	0.0	0.	0.	3053.1	0.0	0.0
38	2.0	2383.8	0.0	0.0	0.	0.	333.7	0.0	0.0
39	3.9	2912.7	0.0	0.0	0.	0.	407.8	0.0	0.0
40	1.2	436.3	0.0	0.0	0.	0.	61.1	0.0	0.0
41	1.6	219.3	0.0	0.0	0.	0.	30.7	0.0	0.0

Failure Surface Specified By 26 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	4238.462	4265.000
2	4255.004	4253.759
3	4272.186	4243.522
4	4289.946	4234.325
5	4308.221	4226.200
6	4326.947	4219.176
7	4346.058	4213.278
8	4365.485	4208.527
9	4385.161	4204.939
10	4405.015	4202.527
11	4424.977	4201.300
12	4444.977	4201.263
13	4464.944	4202.414
14	4484.807	4204.751
15	4504.496	4208.265
16	4523.941	4212.943
17	4543.074	4218.769
18	4561.826	4225.722
19	4580.132	4233.778
20	4597.926	4242.909
21	4615.146	4253.081
22	4631.731	4264.258
23	4647.622	4276.403
24	4662.763	4289.471
25	4677.100	4303.416
26	4689.857	4317.395

Circle Center At X = 4435.595 ; Y = 4537.291 ; and Radius = 336.160

*** FOS = 1.208 Theta (ki=1.0) = 1.71 ***
Lambda = 0.030

1

Failure Surface Specified By 27 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	4238.462	4265.000
2	4255.112	4253.920
3	4272.376	4243.822
4	4290.195	4234.740
5	4308.509	4226.703
6	4327.258	4219.739
7	4346.377	4213.872
8	4365.805	4209.120
9	4385.474	4205.499
10	4405.320	4203.022
11	4425.276	4201.698
12	4445.276	4201.530
13	4465.251	4202.519
14	4485.136	4204.661
15	4504.864	4207.951
16	4524.368	4212.375
17	4543.584	4217.921
18	4562.447	4224.569
19	4580.894	4232.296
20	4598.862	4241.078
21	4616.293	4250.885
22	4633.127	4261.683
23	4649.309	4273.437
24	4664.784	4286.107
25	4679.500	4299.651
26	4693.407	4314.024
27	4696.541	4317.662

Circle Center At X = 4438.179 ; Y = 4547.084 ; and Radius = 345.627

*** FOS = 1.208 Theta (ki=1.0) = 1.71 ***
Lambda = 0.030

Failure Surface Specified By 26 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	4269.231	4265.000
2	4285.852	4253.875
3	4303.107	4243.763
4	4320.936	4234.700
5	4339.274	4226.718

6	4358.057	4219.846
7	4377.216	4214.109
8	4396.684	4209.526
9	4416.391	4206.115
10	4436.266	4203.887
11	4456.239	4202.851
12	4476.239	4203.010
13	4496.193	4204.363
14	4516.031	4206.906
15	4535.681	4210.630
16	4555.074	4215.521
17	4574.140	4221.562
18	4592.811	4228.731
19	4611.020	4237.003
20	4628.703	4246.348
21	4645.795	4256.732
22	4662.237	4268.120
23	4677.969	4280.469
24	4692.936	4293.736
25	4707.082	4307.874
26	4716.478	4318.459

Circle Center At X = 4463.521 ; Y = 4537.145 ; and Radius = 334.381

*** FOS = 1.209 Theta (ki=1.0) = 1.77 ***
Lambda = 0.031

1

Failure Surface Specified By 26 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	4253.847	4265.000
2	4270.308	4253.641
3	4287.441	4243.324
4	4305.182	4234.090
5	4323.461	4225.974
6	4342.209	4219.007
7	4361.353	4213.217
8	4380.818	4208.625
9	4400.531	4205.248
10	4420.416	4203.101
11	4440.395	4202.191
12	4460.392	4202.522
13	4480.331	4204.093
14	4500.133	4206.897
15	4519.723	4210.924
16	4539.026	4216.158
17	4557.968	4222.579
18	4576.475	4230.162
19	4594.475	4238.878
20	4611.900	4248.694
21	4628.684	4259.572
22	4644.760	4271.470
23	4660.067	4284.341
24	4674.547	4298.138
25	4688.143	4312.806
26	4691.964	4317.479

Circle Center At X = 4444.996 ; Y = 4524.244 ; and Radius = 322.095

*** FOS = 1.209 Theta (ki=1.0) = 1.80 ***
Lambda = 0.031

Failure Surface Specified By 27 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	4238.462	4265.000
2	4255.222	4254.086
3	4272.569	4244.133
4	4290.449	4235.171
5	4308.805	4227.229
6	4327.578	4220.333
7	4346.710	4214.504
8	4366.139	4209.761
9	4385.805	4206.119
10	4405.644	4203.588
11	4425.594	4202.178
12	4445.592	4201.893
13	4465.575	4202.733
14	4485.478	4204.697
15	4505.239	4207.777
16	4524.796	4211.964

17	4544.086	4217.245
18	4563.048	4223.603
19	4581.623	4231.017
20	4599.751	4239.465
21	4617.375	4248.920
22	4634.439	4259.351
23	4650.889	4270.726
24	4666.673	4283.009
25	4681.741	4296.160
26	4696.045	4310.138
27	4703.166	4317.927

Circle Center At X = 4440.659 ; Y = 4557.174 ; and Radius = 355.316

*** FOS = 1.209 Theta (ki=1.0) = 1.72 ***
Lambda = 0.030

1

Failure Surface Specified By 26 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	4253.847	4265.000
2	4270.202	4253.489
3	4287.258	4243.043
4	4304.945	4233.707
5	4323.191	4225.517
6	4341.922	4218.506
7	4361.062	4212.704
8	4380.533	4208.134
9	4400.255	4204.814
10	4420.149	4202.758
11	4440.134	4201.975
12	4460.128	4202.467
13	4480.050	4204.233
14	4499.819	4207.265
15	4519.354	4211.551
16	4538.577	4217.074
17	4557.408	4223.811
18	4575.771	4231.734
19	4593.592	4240.812
20	4610.798	4251.008
21	4627.319	4262.280
22	4643.088	4274.582
23	4658.041	4287.864
24	4672.116	4302.072
25	4685.257	4317.149
26	4685.306	4317.212

Circle Center At X = 4442.417 ; Y = 4515.542 ; and Radius = 313.576

*** FOS = 1.210 Theta (ki=1.0) = 1.80 ***
Lambda = 0.031

Failure Surface Specified By 25 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	4276.924	4265.000
2	4292.993	4253.092
3	4309.843	4242.319
4	4327.396	4232.732
5	4345.567	4224.377
6	4364.271	4217.293
7	4383.418	4211.514
8	4402.917	4207.067
9	4422.677	4203.974
10	4442.602	4202.249
11	4462.599	4201.899
12	4482.573	4202.928
13	4502.428	4205.330
14	4522.071	4209.094
15	4541.408	4214.201
16	4560.347	4220.628
17	4578.799	4228.344
18	4596.675	4237.312
19	4613.892	4247.490
20	4630.367	4258.829
21	4646.021	4271.276
22	4660.782	4284.771
23	4674.578	4299.251
24	4687.344	4314.647
25	4689.303	4317.372

Circle Center At X = 4457.664 ; Y = 4492.106 ; and Radius = 290.249

*** FOS = 1.211 Theta (ki=1.0) = 1.75 ***
Lambda = 0.030

1

Failure Surface Specified By 26 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	4269.231	4265.000
2	4285.961	4254.040
3	4303.299	4244.071
4	4321.188	4235.127
5	4339.567	4227.240
6	4358.374	4220.436
7	4377.545	4214.736
8	4397.015	4210.162
9	4416.718	4206.728
10	4436.587	4204.445
11	4456.555	4203.323
12	4476.555	4203.364
13	4496.519	4204.568
14	4516.379	4206.932
15	4536.067	4210.447
16	4555.518	4215.102
17	4574.665	4220.879
18	4593.444	4227.761
19	4611.791	4235.724
20	4629.643	4244.741
21	4646.940	4254.780
22	4663.624	4265.809
23	4679.638	4277.790
24	4694.928	4290.682
25	4709.443	4304.442
26	4722.842	4318.714

Circle Center At X = 4465.844 ; Y = 4546.835 ; and Radius = 343.639

*** FOS = 1.212 Theta (ki=1.0) = 1.79 ***
Lambda = 0.031

Failure Surface Specified By 28 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	4261.539	4265.000
2	4278.767	4254.841
3	4296.476	4245.547
4	4314.624	4237.141
5	4333.165	4229.643
6	4352.055	4223.071
7	4371.247	4217.443
8	4390.693	4212.771
9	4410.348	4209.068
10	4430.161	4206.342
11	4450.085	4204.600
12	4470.071	4203.845
13	4490.069	4204.081
14	4510.032	4205.306
15	4529.909	4207.518
16	4549.653	4210.710
17	4569.214	4214.875
18	4588.545	4220.004
19	4607.599	4226.083
20	4626.329	4233.098
21	4644.688	4241.031
22	4662.632	4249.863
23	4680.118	4259.572
24	4697.101	4270.135
25	4713.541	4281.525
26	4729.397	4293.714
27	4744.630	4306.674
28	4758.978	4320.159

Circle Center At X = 4475.305 ; Y = 4607.802 ; and Radius = 403.991

*** FOS = 1.213 Theta (ki=1.0) = 1.74 ***
Lambda = 0.030

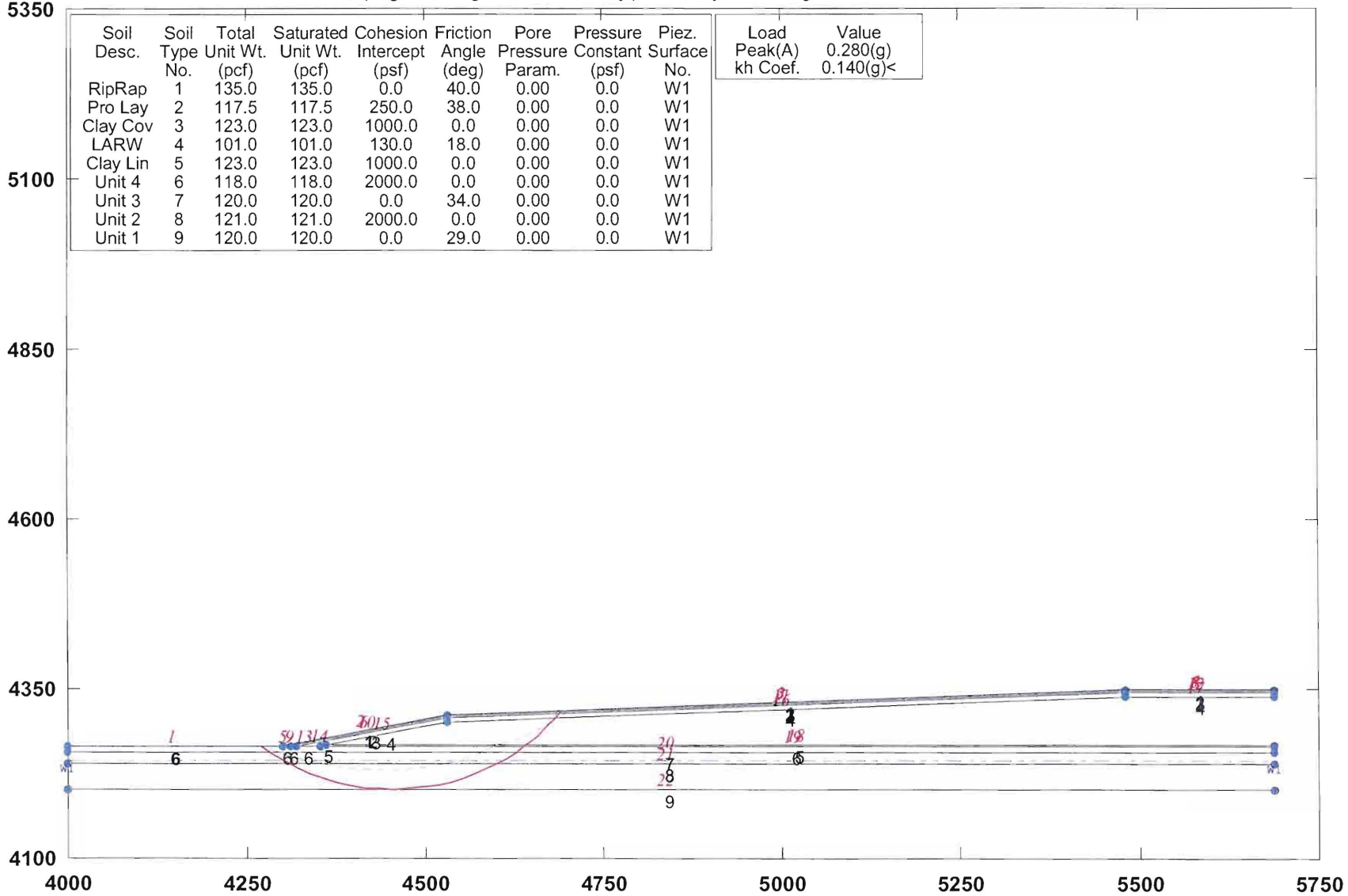
**** END OF GSTABL7 OUTPUT ****

CAW Emb 38' 5(H):1(V) side-slopes, Yield/Deform, Deep Surf 121810 CAWFY.DTA

c:\program files\g72sw\es caw\cawfy.plt Run By: Amec Engineer 01/04/2011 07:17PM

Soil Desc.	Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Param.	Pressure Constant (psf)	Piez. Surface No.
RipRap	1	135.0	135.0	0.0	40.0	0.00	0.0	W1
Pro Lay	2	117.5	117.5	250.0	38.0	0.00	0.0	W1
Clay Cov	3	123.0	123.0	1000.0	0.0	0.00	0.0	W1
LARW	4	101.0	101.0	130.0	18.0	0.00	0.0	W1
Clay Lin	5	123.0	123.0	1000.0	0.0	0.00	0.0	W1
Unit 4	6	118.0	118.0	2000.0	0.0	0.00	0.0	W1
Unit 3	7	120.0	120.0	0.0	34.0	0.00	0.0	W1
Unit 2	8	121.0	121.0	2000.0	0.0	0.00	0.0	W1
Unit 1	9	120.0	120.0	0.0	29.0	0.00	0.0	W1

Load	Value
Peak(A)	0.280(g)
kh Coef.	0.140(g)<



GSTABL7 v.2 FSmin=1.207

Factor Of Safety Is Calculated By GLE (Spencer`s) Method (0-1)

GSTABL7

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                    *** GSTABL7 ***

              ** GSTABL7 by Garry H. Gregory, P.E. **

   ** Original Version 1.0, January 1996; Current Version 2.004, June 2003 **
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*******************************************************************************
                    SLOPE STABILITY ANALYSIS SYSTEM
       Modified Bishop, Simplified Janbu, or GLE Method of Slices.
       (Includes Spencer & Morgenstern-Price Type Analysis)
       Including Pier/Pile, Reinforcement, Soil Nail, Tieback,
       Nonlinear Undrained Shear Strength, Curved Phi Envelope,
       Anisotropic Soil, Fiber-Reinforced Soil, Boundary Loads, Water
       Surfaces, Pseudo-Static & Newmark Earthquake, and Applied Forces.
*******************************************************************************

Analysis Run Date:        01/04/2011
Time of Run:              07:17PM
Run By:                   Amec Engineer
Input Data Filename:      C:\Program Files\G72SW\ES CAW\cawfy.
Output Filename:          C:\Program Files\G72SW\ES CAW\cawfy.OUT
Unit System:              English

Plotted Output Filename:  C:\Program Files\G72SW\ES CAW\cawfy.PLT


PROBLEM DESCRIPTION:  CAW Emb 38' 5(H):1(V) side-slopes,
                      Yield/Deform, Deep Surf 121810 CAWFY.DTA


BOUNDARY COORDINATES

    4 Top   Boundaries
   22 Total Boundaries
```

Boundary No.	X-Left (ft)	Y-Left (ft)	X-Right (ft)	Y-Right (ft)	Soil Type Below Bnd
1	4000.00	4265.00	4300.00	4265.00	6
2	4300.00	4265.00	4530.00	4311.00	1
3	4530.00	4311.00	5480.00	4349.00	1
4	5480.00	4349.00	5689.00	4349.00	1
5	4300.00	4265.00	4310.00	4265.00	6
6	4310.00	4265.00	4530.00	4309.00	2
7	4530.00	4309.00	5480.00	4347.00	2
8	5480.00	4347.00	5689.00	4347.00	2
9	4310.00	4265.00	4318.00	4265.00	6
10	4318.00	4265.00	4530.00	4307.50	3
11	4530.00	4307.50	5480.00	4345.50	3
12	5480.00	4345.50	5689.00	4345.50	3
13	4318.00	4265.00	4353.00	4265.00	6
14	4353.00	4265.00	4361.00	4267.00	5
15	4361.00	4267.00	4530.00	4300.50	4
16	4530.00	4300.50	5480.00	4338.50	4
17	5480.00	4338.50	5689.00	4338.50	4
18	4361.00	4267.00	5689.00	4267.00	5
19	4353.00	4265.00	5689.00	4265.00	6
20	4000.00	4256.00	5689.00	4256.00	7
21	4000.00	4239.00	5689.00	4239.00	8
22	4000.00	4201.00	5689.00	4201.00	9

```
User Specified Y-Origin =      4100.00(ft)

Default X-Plus Value = 0.00(ft)

Default Y-Plus Value = 0.00(ft)
```

1

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ISOTROPIC SOIL PARAMETERS

 9 Type(s) of Soil
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Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Param.	Pressure Constant (psf)	Piez. Surface No.
1	135.0	135.0	0.0	40.0	0.00	0.0	1
2	117.5	117.5	250.0	38.0	0.00	0.0	1
3	123.0	123.0	1000.0	0.0	0.00	0.0	1
4	101.0	101.0	130.0	18.0	0.00	0.0	1
5	123.0	123.0	1000.0	0.0	0.00	0.0	1
6	118.0	118.0	2000.0	0.0	0.00	0.0	1

7	120.0	120.0	0.0	34.0	0.00	0.0	1
8	121.0	121.0	2000.0	0.0	0.00	0.0	1
9	120.0	120.0	0.0	29.0	0.00	0.0	1

1

1 PIEZOMETRIC SURFACE(S) SPECIFIED

Unit Weight of Water = 62.40 (pcf)

Piezometric Surface No. 1 Specified by 2 Coordinate Points
Pore Pressure Inclination Factor = 0.50

Point No.	X-Water (ft)	Y-Water (ft)
1	4000.00	4243.00
2	5689.00	4243.00

Specified Peak Ground Acceleration Coefficient (A) = 0.280(g)
Specified Horizontal Earthquake Coefficient (kh) = 0.140(g)
Specified Vertical Earthquake Coefficient (kv) = 0.000(g)

Specified Seismic Pore-Pressure Factor = 0.000

1

Trial Failure Surface Specified By 25 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	4269.231	4265.000
2	4285.429	4253.268
3	4302.371	4242.639
4	4319.982	4233.160
5	4338.185	4224.874
6	4356.897	4217.816
7	4376.040	4212.021
8	4395.525	4207.511
9	4415.267	4204.307
10	4435.178	4202.423
11	4455.170	4201.868
12	4475.155	4202.645
13	4495.044	4204.749
14	4514.749	4208.171
15	4534.183	4212.896
16	4553.259	4218.904
17	4571.893	4226.168
18	4590.003	4234.655
19	4607.508	4244.328
20	4624.332	4255.144
21	4640.397	4267.055
22	4655.636	4280.008
23	4669.979	4293.947
24	4683.363	4308.809
25	4690.125	4317.405

DEFLECTION ANGLE & SEGMENT DATA FOR SPECIFIED SURFACE(Excluding Last Segment)

Angle/Segment No.	Deflection(Deg)	Segment Length(ft)
1	3.81	20.00
2	3.81	20.00
3	3.81	20.00
4	3.81	20.00
5	3.82	20.00
6	3.81	20.00
7	3.81	20.00
8	3.81	20.00
9	3.81	20.00
10	3.82	20.00
11	3.81	20.00
12	3.81	20.00
13	3.81	20.00
14	3.82	20.00

15	3.81	20.00
16	3.81	20.00
17	3.82	20.00
18	3.81	20.00
19	3.81	20.00
20	3.81	20.00
21	3.82	20.00
22	3.81	20.00

Circle Center At X = 4453.506(ft) ; Y = 4502.353(ft); and Radius = 300.489(ft)

Theta (deg) (ki=1.0)	FOS (Moment) (Equil.)	FOS (Force) (Equil.)	Lambda
12.63	1.083	1.261	0.224
18.95	0.944	1.309	0.343
4.58	1.200	1.211	0.080
0.00	1.248	1.185	0.000
3.68	1.210	1.206	0.064
4.07	1.206	1.208	0.071
3.95	1.207	1.207	0.069

((Modified Bishop FS for Specified Surface = 1.305))

Factor Of Safety For The Preceding Specified Surface = 1.207
Theta (ki = 1.0) = 3.95 Deg Lambda = 0.069

Factor Of Safety Is Calculated By GLE (Spencer`s) Method (0-1)

Forces from Reinforcement, Piers/Piles, Applied Forces, and Soil Nails
(if applicable) have been applied to the slice base(s)
on which they intersect.

Selected ki function = Constant (1.0)

Selected Lambda Coefficient = 0.45

Tension Crack Water Force = 0.00(lbs)

Specified Tension Crack Water Force Factor = 0.000

Depth of Tension Crack (zo) at Center of Last Slice = 0.000(ft)

*** Line of Thrust and Slice Force Data ***

Slice No.	X Coord.	Y Coord.	L/H	Side Force (lbs)	ki	Force Angle (Deg)	Vert. Shear Force(lbs)
1	4281.66	4260.69	0.521	36070.	0.450	1.78	504.4
2	4285.43	4259.48	0.530	46062.	0.450	1.78	644.1
3	4300.00	4254.18	0.481	96582.	0.450	1.78	1350.5
4	4301.79	4253.39	0.465	104862.	0.450	1.78	1466.3
5	4302.37	4253.14	0.460	107633.	0.450	1.78	1505.0
6	4309.13	4250.65	0.419	137508.	0.450	1.78	1922.8
7	4310.00	4250.41	0.417	140590.	0.450	1.78	1965.9
8	4318.00	4248.20	0.406	170244.	0.450	1.78	2380.5
9	4319.98	4247.63	0.404	177946.	0.450	1.78	2488.2
10	4338.19	4243.07	0.381	244248.	0.450	1.78	3415.3
11	4353.00	4239.88	0.366	294986.	0.450	1.78	4124.8
12	4356.90	4239.03	0.362	308949.	0.450	1.78	4320.0
13	4361.00	4238.32	0.359	321302.	0.450	1.78	4492.8
14	4376.04	4235.71	0.347	367957.	0.450	1.78	5145.1
15	4395.52	4233.18	0.335	417779.	0.450	1.78	5841.8
16	4415.27	4231.50	0.325	455749.	0.450	1.78	6372.7
17	4435.18	4230.69	0.315	479868.	0.450	1.78	6710.0
18	4455.17	4230.78	0.307	488838.	0.450	1.78	6835.4
19	4475.15	4231.81	0.299	482059.	0.450	1.78	6740.6
20	4495.04	4233.81	0.293	459705.	0.450	1.78	6428.0
21	4514.75	4236.84	0.287	422638.	0.450	1.78	5909.7
22	4530.00	4240.11	0.285	383125.	0.450	1.78	5357.2
23	4534.18	4241.03	0.286	372484.	0.450	1.78	5208.4
24	4553.26	4246.43	0.296	313265.	0.450	1.78	4380.4
25	4571.89	4253.22	0.313	249239.	0.450	1.78	3485.1
26	4590.00	4261.91	0.346	184415.	0.450	1.78	2578.7
27	4597.87	4266.88	0.373	155288.	0.450	1.78	2171.4
28	4605.10	4268.59	0.360	146859.	0.450	1.78	2053.5
29	4607.51	4269.11	0.355	144325.	0.450	1.78	2018.1

30	4624.33	4273.56	0.309	120247.	0.450	1.78	1681.4
31	4625.49	4273.90	0.304	118255.	0.450	1.78	1653.5
32	4637.63	4279.11	0.280	87229.	0.450	1.78	1219.7
33	4640.32	4280.67	0.282	78398.	0.450	1.78	1096.2
34	4640.40	4280.71	0.282	78209.	0.450	1.78	1093.6
35	4655.64	4288.65	0.240	38976.	0.450	1.78	545.0
36	4669.98	4294.75	0.036	9762.	0.450	1.78	136.5
37	4681.33	4310.77	0.401	-5024.	0.450	1.78	-70.2
38	4683.36	4311.38	0.309	-4273.	0.450	1.78	-59.7
39	4687.28	4322.50	2.488	-54.	0.450	1.78	-0.8
40	4688.50	4310.08	-2.628	96.	0.450	1.78	1.3
41	4690.12	4937.58	0.000	-1.	0.450	1.78	0.0

Table 1 - Individual data on the 41 slices

Slice No.	Width (ft)	Weight (lbs)	Water Force Top (lbs)	Water Force Bot (lbs)	Tie Force Norm (lbs)	Tie Force Tan (lbs)	Earthquake Force Hor (lbs)	Earthquake Force Ver (lbs)	Surcharge Load (lbs)
1	12.4	6598.1	0.0	0.0	0.0	0.0	923.7	0.0	0.0
2	3.8	4624.2	0.0	0.0	0.0	0.0	647.4	0.0	0.0
3	14.6	28243.9	0.0	0.0	0.0	0.0	3954.2	0.0	0.0
4	1.8	4628.6	0.0	0.0	0.0	0.0	648.0	0.0	0.0
5	0.6	1554.3	0.0	7.7	0.0	0.0	217.6	0.0	0.0
6	6.8	20545.8	0.0	1044.7	0.0	0.0	2876.4	0.0	0.0
7	0.9	2943.4	0.0	260.6	0.0	0.0	412.1	0.0	0.0
8	8.0	30264.1	0.0	3753.0	0.0	0.0	4237.0	0.0	0.0
9	2.0	8376.6	0.0	1307.1	0.0	0.0	1172.7	0.0	0.0
10	18.2	91756.5	0.0	17451.8	0.0	0.0	12845.9	0.0	0.0
11	14.8	93130.2	0.0	20669.6	0.0	0.0	13038.2	0.0	0.0
12	3.9	27061.4	0.0	6354.8	0.0	0.0	3788.6	0.0	0.0
13	4.1	29562.0	0.0	6902.1	0.0	0.0	4138.7	0.0	0.0
14	15.0	116697.2	0.0	28144.3	0.0	0.0	16337.6	0.0	0.0
15	19.5	168676.9	0.0	41476.0	0.0	0.0	23614.8	0.0	0.0
16	19.7	187957.5	0.0	46291.1	0.0	0.0	26314.0	0.0	0.0
17	19.9	203680.7	0.0	49463.7	0.0	0.0	28515.3	0.0	0.0
18	20.0	215537.9	0.0	50986.1	0.0	0.0	30175.3	0.0	0.0
19	20.0	223276.6	0.0	50848.0	0.0	0.0	31258.7	0.0	0.0
20	19.9	226766.9	0.0	49050.2	0.0	0.0	31747.4	0.0	0.0
21	19.7	225977.4	0.0	45601.9	0.0	0.0	31636.8	0.0	0.0
22	15.3	173714.9	0.0	32295.1	0.0	0.0	24320.1	0.0	0.0
23	4.2	47132.4	0.0	8223.5	0.0	0.0	6598.5	0.0	0.0
24	19.1	207721.8	0.0	33820.7	0.0	0.0	29081.1	0.0	0.0
25	18.6	189366.0	0.0	25538.5	0.0	0.0	26511.2	0.0	0.0
26	18.1	168133.8	0.0	15711.1	0.0	0.0	23538.7	0.0	0.0
27	7.9	67309.6	0.0	3460.5	0.0	0.0	9423.3	0.0	0.0
28	7.2	58544.3	0.0	1032.4	0.0	0.0	8196.2	0.0	0.0
29	2.4	18711.7	0.0	0.0	0.0	0.0	2619.6	0.0	0.0
30	16.8	119407.9	0.0	0.0	0.0	0.0	16717.1	0.0	0.0
31	1.2	7429.3	0.0	0.0	0.0	0.0	1040.1	0.0	0.0
32	12.1	71357.0	0.0	0.0	0.0	0.0	9990.0	0.0	0.0
33	2.7	14174.0	0.0	0.0	0.0	0.0	1984.4	0.0	0.0
34	0.1	378.5	0.0	0.0	0.0	0.0	53.0	0.0	0.0
35	15.2	68692.4	0.0	0.0	0.0	0.0	9616.9	0.0	0.0
36	14.3	46034.3	0.0	0.0	0.0	0.0	6444.8	0.0	0.0
37	11.4	21808.5	0.0	0.0	0.0	0.0	3053.2	0.0	0.0
38	2.0	2383.8	0.0	0.0	0.0	0.0	333.7	0.0	0.0
39	3.9	2912.6	0.0	0.0	0.0	0.0	407.8	0.0	0.0
40	1.2	436.5	0.0	0.0	0.0	0.0	61.1	0.0	0.0
41	1.6	219.2	0.0	0.0	0.0	0.0	30.7	0.0	0.0

- TABLE 2 - Base Stress Data on the 41 Slices -

Slice No. *	Alpha (deg)	X-Coord. Slice Cntr (ft)	Base Leng. (ft)	Total Normal Stress (psf)	Total Vert. Stress (psf)	Mobilized Shear Stress (psf)
1	-35.92	4275.44	15.34	1821.11	430.05	1656.72
2	-35.92	4283.54	4.66	2197.55	992.87	1227.85
3	-32.10	4292.71	17.20	3150.39	1641.92	1760.24
4	-32.10	4300.90	2.12	4191.19	2184.37	2341.77
5	-32.10	4302.08	0.68	4381.43	2287.04	2441.77
6	-28.29	4305.75	7.68	4483.59	2676.02	2429.12
7	-28.29	4309.57	0.99	4390.33	2983.80	1656.72
8	-28.29	4314.00	9.09	4789.79	3331.19	1656.72

9	-28.29	4318.99	2.25	5238.87	3721.71	1656.72
10	-24.48	4329.08	20.00	5908.01	4587.70	1656.72
11	-20.66	4345.59	15.83	7017.42	5881.84	1656.72
12	-20.66	4354.95	4.17	7679.41	6496.67	1656.72
13	-16.84	4358.95	4.29	7800.88	6896.65	1656.72
14	-16.84	4368.52	15.71	8357.02	7426.23	1656.72
15	-13.03	4385.78	20.00	9119.72	8433.82	1656.72
16	-9.22	4405.40	20.00	9849.21	9397.63	1656.72
17	-5.40	4425.22	20.00	10424.11	10184.26	1656.72
18	-1.59	4445.17	20.00	10841.04	10776.95	1656.72
19	2.23	4465.16	20.00	11097.31	11163.84	1656.72
20	6.04	4485.10	20.00	11191.37	11338.27	1656.72
21	9.85	4504.90	20.00	11121.86	11298.88	1656.72
22	13.66	4522.37	15.70	10907.18	11068.03	1656.72
23	13.66	4532.09	4.30	10785.55	10948.44	1656.72
24	17.48	4543.72	20.00	10271.12	10386.33	1656.72
25	21.30	4562.58	20.00	9409.93	9468.46	1656.72
26	25.11	4580.95	20.00	8396.31	8406.58	1656.72
27	28.92	4593.93	8.98	7529.47	7492.22	1656.72
28	28.92	4601.49	8.27	6181.47	7078.76	3384.07
29	28.92	4606.31	2.75	5925.21	6815.95	3310.63
30	32.74	4615.92	20.00	5189.08	5970.15	2899.33
31	36.55	4624.91	1.44	4511.25	5168.16	2520.60
32	36.55	4631.56	15.11	4570.41	4721.92	1656.72
33	36.55	4638.97	3.36	4538.22	4220.63	828.36
34	36.55	4640.36	0.09	4146.78	4124.12	1223.80
35	40.37	4648.02	20.00	3528.99	3434.67	1057.52
36	44.18	4662.81	20.00	2411.01	2301.69	756.61
37	47.99	4675.66	16.96	1355.74	1285.50	472.59
38	47.99	4682.35	3.04	265.24	785.35	828.36
39	51.81	4685.32	6.34	0.00	459.45	828.36
40	51.81	4687.89	1.97	54.15	221.42	242.13

41	51.81	4689.31	2.63	70.69	83.47	49.13

```
        *** SEISMIC SLOPE DISPLACEMENT DATA ***
(Note: kv is set = zero for displacement calculations)
Seismic Yield Coefficient (ky) =  0.1922(g)
Calculated Newmark Seismic Displacement =   0.058(ft)

Non-Symmetrical Sliding Resistance Has Been Specified
for Downhill Sliding.

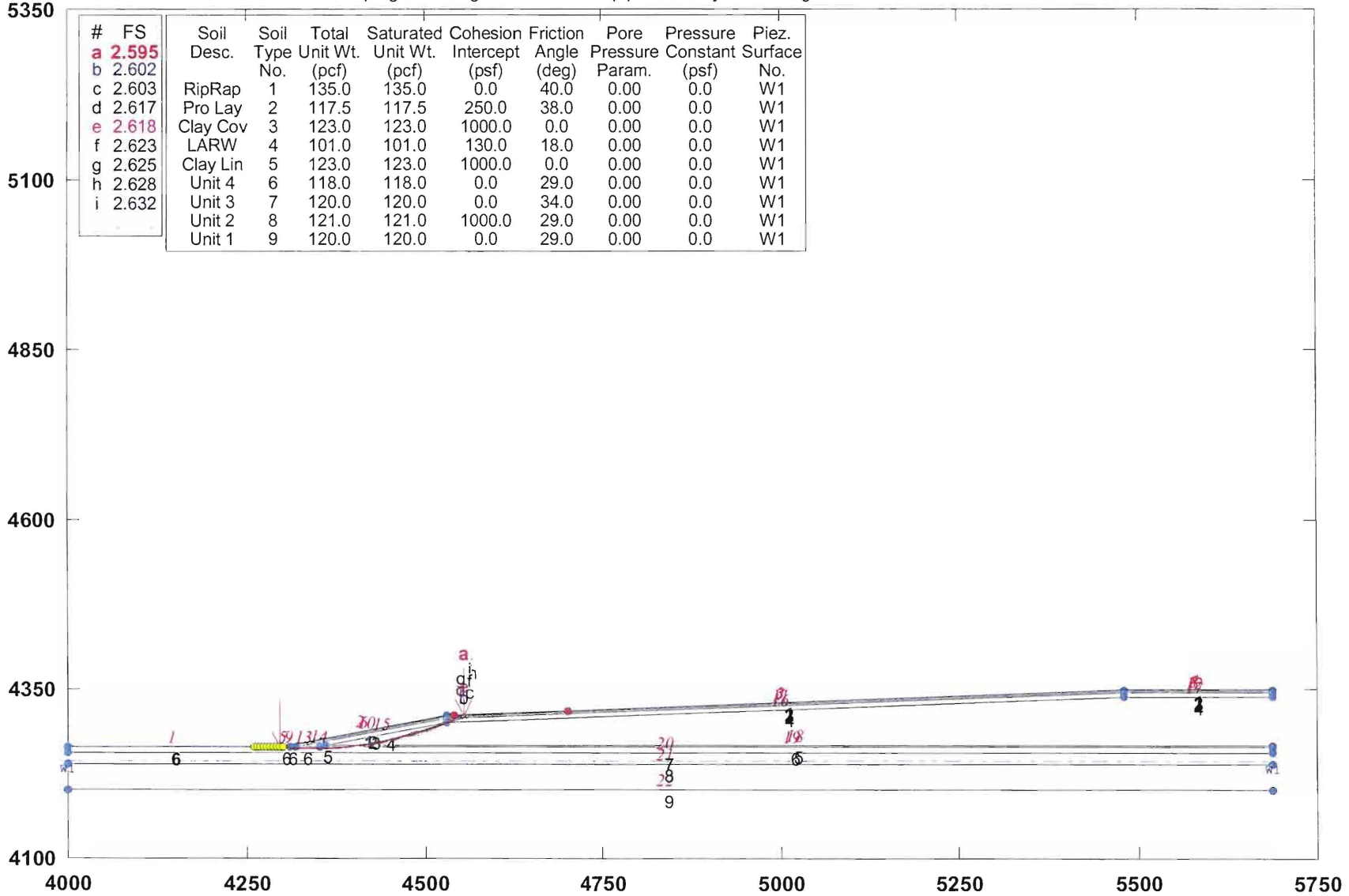
              **** END OF GSTABL7 OUTPUT ****
```

CAW Emb 38' 5(H):1(V) side-slopes, Static, Shallow Clay unit 121810 CAWP

c:\program files\g72sw\es caw\cawp.pl2 Run By: Amec Engineer 01/04/2011 07:55PM

#	FS
a	2.595
b	2.602
c	2.603
d	2.617
e	2.618
f	2.623
g	2.625
h	2.628
i	2.632

Soil Desc.	Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Param.	Pressure Constant (psf)	Piez. Surface No.
RipRap	1	135.0	135.0	0.0	40.0	0.00	0.0	W1
Pro Lay	2	117.5	117.5	250.0	38.0	0.00	0.0	W1
Clay Cov	3	123.0	123.0	1000.0	0.0	0.00	0.0	W1
LARW	4	101.0	101.0	130.0	18.0	0.00	0.0	W1
Clay Lin	5	123.0	123.0	1000.0	0.0	0.00	0.0	W1
Unit 4	6	118.0	118.0	0.0	29.0	0.00	0.0	W1
Unit 3	7	120.0	120.0	0.0	34.0	0.00	0.0	W1
Unit 2	8	121.0	121.0	1000.0	29.0	0.00	0.0	W1
Unit 1	9	120.0	120.0	0.0	29.0	0.00	0.0	W1



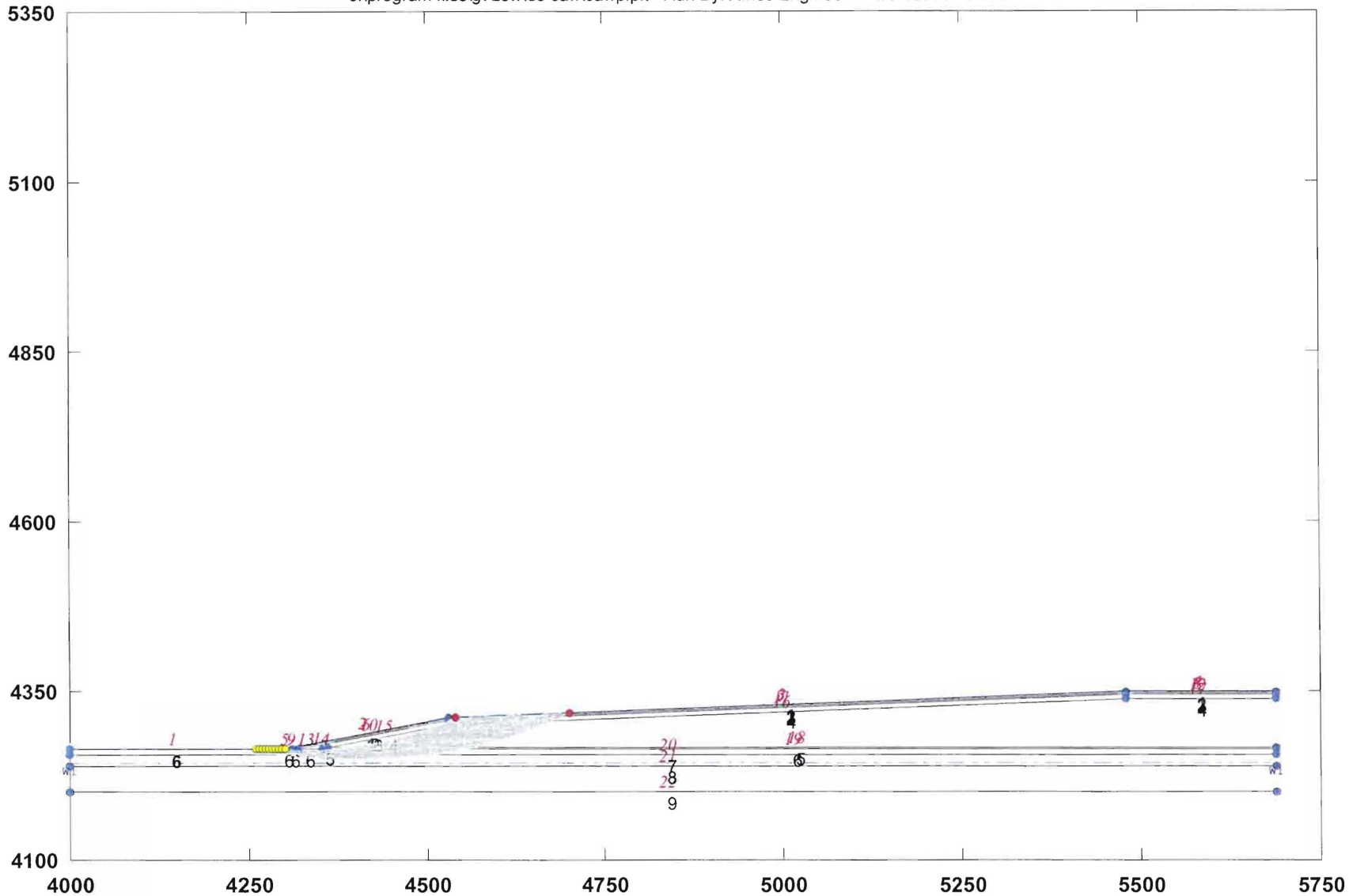
GSTABL7 v.2 FSmin=2.595

Safety Factors Are Calculated By GLE (Spencer`s) Method (0-1)

GSTABL7

CAW Emb 38' 5(H):1(V) side-slopes, Static, Shallow Clay unit 121810 CAWP

c:\program files\g72sw\es caw\cawp.plt Run By: Amec Engineer 01/04/2011 07:55PM



GSTABL7

*** GSTABL7 ***

** GSTABL7 by Garry H. Gregory, P.E. **

** Original Version 1.0, January 1996; Current Version 2.004, June 2003 **
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****
SLOPE STABILITY ANALYSIS SYSTEM
Modified Bishop, Simplified Janbu, or GLE Method of Slices.
(Includes Spencer & Morgenstern-Price Type Analysis)
Including Pier/Pile, Reinforcement, Soil Nail, Tieback,
Nonlinear Undrained Shear Strength, Curved Phi Envelope,
Anisotropic Soil, Fiber-Reinforced Soil, Boundary Loads, Water
Surfaces, Pseudo-Static & Newmark Earthquake, and Applied Forces.
****

Analysis Run Date: 01/04/2011
Time of Run: 07:55PM
Run By: Amec Engineer
Input Data Filename: C:\Program Files\G72SW\ES CAW\cawp.
Output Filename: C:\Program Files\G72SW\ES CAW\cawp.OUT
Unit System: English

Plotted Output Filename: C:\Program Files\G72SW\ES CAW\cawp.PLT

PROBLEM DESCRIPTION: CAW Emb 38' 5(H):1(V) side-slopes,
Static, Shallow Clay unit 121810 CAWP

BOUNDARY COORDINATES

4 Top Boundaries
22 Total Boundaries

Boundary No.	X-Left (ft)	Y-Left (ft)	X-Right (ft)	Y-Right (ft)	Soil Type Below Bnd
1	4000.00	4265.00	4300.00	4265.00	6
2	4300.00	4265.00	4530.00	4311.00	1
3	4530.00	4311.00	5480.00	4349.00	1
4	5480.00	4349.00	5689.00	4349.00	1
5	4300.00	4265.00	4310.00	4265.00	6
6	4310.00	4265.00	4530.00	4309.00	2
7	4530.00	4309.00	5480.00	4347.00	2
8	5480.00	4347.00	5689.00	4347.00	2
9	4310.00	4265.00	4318.00	4265.00	6
10	4318.00	4265.00	4530.00	4307.50	3
11	4530.00	4307.50	5480.00	4345.50	3
12	5480.00	4345.50	5689.00	4345.50	3
13	4318.00	4265.00	4353.00	4265.00	6
14	4353.00	4265.00	4361.00	4267.00	5
15	4361.00	4267.00	4530.00	4300.50	4
16	4530.00	4300.50	5480.00	4338.50	4
17	5480.00	4338.50	5689.00	4338.50	4
18	4361.00	4267.00	5689.00	4267.00	5
19	4353.00	4265.00	5689.00	4265.00	6
20	4000.00	4256.00	5689.00	4256.00	7
21	4000.00	4239.00	5689.00	4239.00	8
22	4000.00	4201.00	5689.00	4201.00	9

User Specified Y-Origin = 4100.00(ft)

Default X-Plus Value = 0.00(ft)

Default Y-Plus Value = 0.00(ft)

1

ISOTROPIC SOIL PARAMETERS

9 Type(s) of Soil

Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Param.	Pressure Constant (psf)	Piez. Surface No.
1	135.0	135.0	0.0	40.0	0.00	0.0	1
2	117.5	117.5	250.0	38.0	0.00	0.0	1
3	123.0	123.0	1000.0	0.0	0.00	0.0	1
4	101.0	101.0	130.0	18.0	0.00	0.0	1
5	123.0	123.0	1000.0	0.0	0.00	0.0	1
6	118.0	118.0	0.0	29.0	0.00	0.0	1

7	120.0	120.0	0.0	34.0	0.00	0.0	1
8	121.0	121.0	1000.0	29.0	0.00	0.0	1
9	120.0	120.0	0.0	29.0	0.00	0.0	1

1

1 PIEZOMETRIC SURFACE(S) SPECIFIED

Unit Weight of Water = 62.40 (pcf)

Piezometric Surface No. 1 Specified by 2 Coordinate Points
Pore Pressure Inclination Factor = 0.50

Point No.	X-Water (ft)	Y-Water (ft)
1	4000.00	4243.00
2	5689.00	4243.00

1

A Critical Failure Surface Searching Method, Using A Random
Technique For Generating Circular Surfaces, Has Been Specified.

2000 Trial Surfaces Have Been Generated.

200 Surface(s) Initiate(s) From Each Of 10 Points Equally Spaced
Along The Ground Surface Between X =4260.00(ft)
and X =4300.00(ft)

Each Surface Terminates Between X =4540.00(ft)
and X =4700.00(ft)

Unless Further Limitations Were Imposed, The Minimum Elevation
At Which A Surface Extends Is Y = 4250.00(ft)

6.00(ft) Line Segments Define Each Trial Failure Surface.

Following Are Displayed The Ten Most Critical Of The Trial
Failure Surfaces Evaluated. They Are
Ordered - Most Critical First.

* * Safety Factors Are Calculated By GLE (Spencer`s) Method (0-1) * *

Selected ki function = Constant (1.0)

Selected Lambda Coefficient = 1.00

Forces from Reinforcement, Piers/Piles, Soil Nails, and Applied Forces
(if applicable) have been applied to the slice base(s)
on which they intersect.

Specified Tension Crack Water Force Factor = 0.000

Total Number of Trial Surfaces Attempted = 2000

Number of Trial Surfaces With Valid FS = 2000

Statistical Data On All Valid FS Values:
FS Max = 4.532 FS Min = 2.595 FS Ave = 3.359
Standard Deviation = 0.385 Coefficient of Variation = 11.46 %

((Modified Bishop FS for Critical Surface = 2.585))

Failure Surface Specified By 46 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	4295.555	4265.000
2	4301.523	4264.385
3	4307.499	4263.849

4	4313.481	4263.390
5	4319.469	4263.010
6	4325.461	4262.708
7	4331.457	4262.485
8	4337.455	4262.340
9	4343.455	4262.274
10	4349.455	4262.286
11	4355.454	4262.376
12	4361.452	4262.545
13	4367.447	4262.792
14	4373.438	4263.118
15	4379.424	4263.522
16	4385.405	4264.004
17	4391.378	4264.565
18	4397.344	4265.204
19	4403.301	4265.920
20	4409.249	4266.714
21	4415.185	4267.586
22	4421.109	4268.536
23	4427.021	4269.563
24	4432.918	4270.667
25	4438.801	4271.848
26	4444.668	4273.106
27	4450.518	4274.440
28	4456.349	4275.852
29	4462.162	4277.338
30	4467.955	4278.901
31	4473.727	4280.540
32	4479.477	4282.254
33	4485.204	4284.043
34	4490.907	4285.907
35	4496.585	4287.845
36	4502.238	4289.857
37	4507.864	4291.943
38	4513.462	4294.102
39	4519.031	4296.334
40	4524.571	4298.639
41	4530.080	4301.016
42	4535.557	4303.465
43	4541.002	4305.985
44	4546.414	4308.577
45	4551.791	4311.239
46	4553.133	4311.925

Circle Center At X = 4345.539 ; Y = 4721.033 ; and Radius = 458.764

*** FOS = 2.595 Theta (ki=1.0) = 9.33 ***
Lambda = 0.164

Individual data on the 56 slices

Slice No.	Width (ft)	Weight (lbs)	Water Force Top (lbs)	Water Force Bot (lbs)	Tie Force Norm (lbs)	Tie Force Tan (lbs)	Earthquake Force Hor (lbs)	Earthquake Force Ver (lbs)	Surcharge Load (lbs)
1	4.4	120.1	0.0	0.0	0.	0.	0.0	0.0	0.0
2	1.5	127.7	0.0	0.0	0.	0.	0.0	0.0	0.0
3	6.0	1350.5	0.0	0.0	0.	0.	0.0	0.0	0.0
4	2.5	958.9	0.0	0.0	0.	0.	0.0	0.0	0.0
5	3.5	1689.0	0.0	0.0	0.	0.	0.0	0.0	0.0
6	4.5	2764.4	0.0	0.0	0.	0.	0.0	0.0	0.0
7	1.5	1036.4	0.0	0.0	0.	0.	0.0	0.0	0.0
8	6.0	4916.4	0.0	0.0	0.	0.	0.0	0.0	0.0
9	6.0	5988.8	0.0	0.0	0.	0.	0.0	0.0	0.0
10	6.0	7006.4	0.0	0.0	0.	0.	0.0	0.0	0.0
11	6.0	7968.5	0.0	0.0	0.	0.	0.0	0.0	0.0
12	6.0	8874.0	0.0	0.0	0.	0.	0.0	0.0	0.0
13	3.5	5646.3	0.0	0.0	0.	0.	0.0	0.0	0.0
14	2.5	4076.3	0.0	0.0	0.	0.	0.0	0.0	0.0
15	5.5	9694.6	0.0	0.0	0.	0.	0.0	0.0	0.0
16	0.5	817.9	0.0	0.0	0.	0.	0.0	0.0	0.0
17	6.0	11155.5	0.0	0.0	0.	0.	0.0	0.0	0.0
18	6.0	11672.9	0.0	0.0	0.	0.	0.0	0.0	0.0
19	6.0	12131.1	0.0	0.0	0.	0.	0.0	0.0	0.0
20	6.0	12531.0	0.0	0.0	0.	0.	0.0	0.0	0.0
21	6.0	12871.7	0.0	0.0	0.	0.	0.0	0.0	0.0
22	4.1	8931.2	0.0	0.0	0.	0.	0.0	0.0	0.0
23	1.9	4221.7	0.0	0.0	0.	0.	0.0	0.0	0.0
24	6.0	13360.3	0.0	0.0	0.	0.	0.0	0.0	0.0
25	5.9	13502.1	0.0	0.0	0.	0.	0.0	0.0	0.0
26	1.9	4440.5	0.0	0.0	0.	0.	0.0	0.0	0.0
27	4.0	9168.9	0.0	0.0	0.	0.	0.0	0.0	0.0
28	5.9	13741.1	0.0	0.0	0.	0.	0.0	0.0	0.0
29	5.9	13829.8	0.0	0.0	0.	0.	0.0	0.0	0.0
30	5.9	13867.1	0.0	0.0	0.	0.	0.0	0.0	0.0
31	5.9	13854.9	0.0	0.0	0.	0.	0.0	0.0	0.0
32	5.9	13792.1	0.0	0.0	0.	0.	0.0	0.0	0.0
33	5.8	13679.7	0.0	0.0	0.	0.	0.0	0.0	0.0

34	5.8	13518.4	0.0	0.0	0.	0.	0.0	0.0	0.0
35	5.8	13309.7	0.0	0.0	0.	0.	0.0	0.0	0.0
36	5.8	13052.1	0.0	0.0	0.	0.	0.0	0.0	0.0
37	5.8	12747.2	0.0	0.0	0.	0.	0.0	0.0	0.0
38	5.8	12395.8	0.0	0.0	0.	0.	0.0	0.0	0.0
39	5.7	11998.6	0.0	0.0	0.	0.	0.0	0.0	0.0
40	5.7	11556.3	0.0	0.0	0.	0.	0.0	0.0	0.0
41	5.7	11069.5	0.0	0.0	0.	0.	0.0	0.0	0.0
42	5.7	10539.8	0.0	0.0	0.	0.	0.0	0.0	0.0
43	5.6	9968.4	0.0	0.0	0.	0.	0.0	0.0	0.0
44	5.6	9355.0	0.0	0.0	0.	0.	0.0	0.0	0.0
45	5.6	8701.1	0.0	0.0	0.	0.	0.0	0.0	0.0
46	5.5	8008.2	0.0	0.0	0.	0.	0.0	0.0	0.0
47	3.4	4527.8	0.0	0.0	0.	0.	0.0	0.0	0.0
48	2.1	2638.4	0.0	0.0	0.	0.	0.0	0.0	0.0
49	0.1	99.2	0.0	0.0	0.	0.	0.0	0.0	0.0
50	5.5	6064.0	0.0	0.0	0.	0.	0.0	0.0	0.0
51	5.4	4509.9	0.0	0.0	0.	0.	0.0	0.0	0.0
52	4.5	2523.2	0.0	0.0	0.	0.	0.0	0.0	0.0
53	1.0	403.7	0.0	0.0	0.	0.	0.0	0.0	0.0
54	2.4	791.3	0.0	0.0	0.	0.	0.0	0.0	0.0
55	3.0	533.9	0.0	0.0	0.	0.	0.0	0.0	0.0
56	1.3	57.3	0.0	0.0	0.	0.	0.0	0.0	0.0

Failure Surface Specified By 47 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	4286.666	4265.000
2	4292.634	4264.385
3	4298.610	4263.845
4	4304.592	4263.378
5	4310.579	4262.985
6	4316.571	4262.667
7	4322.566	4262.423
8	4328.563	4262.252
9	4334.562	4262.156
10	4340.562	4262.134
11	4346.562	4262.187
12	4352.561	4262.314
13	4358.558	4262.515
14	4364.551	4262.790
15	4370.541	4263.139
16	4376.526	4263.562
17	4382.505	4264.060
18	4388.478	4264.631
19	4394.443	4265.276
20	4400.400	4265.995
21	4406.347	4266.788
22	4412.284	4267.654
23	4418.210	4268.593
24	4424.124	4269.606
25	4430.025	4270.692
26	4435.912	4271.851
27	4441.784	4273.082
28	4447.641	4274.386
29	4453.480	4275.763
30	4459.303	4277.211
31	4465.107	4278.732
32	4470.892	4280.324
33	4476.656	4281.988
34	4482.400	4283.723
35	4488.122	4285.528
36	4493.821	4287.405
37	4499.496	4289.352
38	4505.147	4291.369
39	4510.772	4293.455
40	4516.372	4295.611
41	4521.944	4297.836
42	4527.488	4300.130
43	4533.003	4302.493
44	4538.489	4304.923
45	4543.944	4307.421
46	4549.368	4309.987
47	4553.356	4311.934

Circle Center At X = 4339.319 ; Y = 4747.050 ; and Radius = 484.917

*** FOS = 2.602 Theta (ki=1.0) = 9.26 ***
Lambda = 0.163

1

Failure Surface Specified By 48 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)

1	4291.110	4265.000
2	4297.082	4264.412
3	4303.059	4263.895
4	4309.042	4263.449
5	4315.031	4263.076
6	4321.023	4262.774
7	4327.019	4262.544
8	4333.017	4262.386
9	4339.016	4262.299
10	4345.016	4262.285
11	4351.016	4262.342
12	4357.014	4262.471
13	4363.011	4262.671
14	4369.004	4262.944
15	4374.995	4263.288
16	4380.980	4263.704
17	4386.960	4264.191
18	4392.934	4264.750
19	4398.901	4265.380
20	4404.860	4266.082
21	4410.810	4266.855
22	4416.750	4267.699
23	4422.680	4268.614
24	4428.599	4269.600
25	4434.505	4270.657
26	4440.398	4271.784
27	4446.277	4272.982
28	4452.142	4274.250
29	4457.990	4275.588
30	4463.823	4276.997
31	4469.638	4278.475
32	4475.435	4280.022
33	4481.213	4281.639
34	4486.971	4283.324
35	4492.709	4285.079
36	4498.425	4286.901
37	4504.120	4288.792
38	4509.791	4290.752
39	4515.438	4292.779
40	4521.061	4294.873
41	4526.658	4297.035
42	4532.229	4299.263
43	4537.772	4301.558
44	4543.289	4303.919
45	4548.776	4306.346
46	4554.234	4308.839
47	4559.662	4311.396
48	4561.433	4312.257

Circle Center At X = 4343.251 ; Y = 4763.522 ; and Radius = 501.241

*** FOS = 2.603 Theta (ki=1.0) = 9.16 ***
Lambda = 0.161

Failure Surface Specified By 46 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	4291.110	4265.000
2	4297.082	4264.414
3	4303.060	4263.904
4	4309.044	4263.472
5	4315.034	4263.117
6	4321.027	4262.839
7	4327.024	4262.639
8	4333.022	4262.515
9	4339.022	4262.469
10	4345.022	4262.500
11	4351.021	4262.608
12	4357.019	4262.794
13	4363.013	4263.057
14	4369.003	4263.396
15	4374.988	4263.813
16	4380.968	4264.308
17	4386.940	4264.879
18	4392.905	4265.527
19	4398.861	4266.251
20	4404.808	4267.053
21	4410.743	4267.931
22	4416.667	4268.885
23	4422.578	4269.916
24	4428.475	4271.022
25	4434.357	4272.205
26	4440.224	4273.463
27	4446.074	4274.797
28	4451.906	4276.206
29	4457.719	4277.689
30	4463.513	4279.248

31	4469.287	4280.881
32	4475.039	4282.589
33	4480.768	4284.370
34	4486.474	4286.225
35	4492.156	4288.153
36	4497.812	4290.155
37	4503.442	4292.229
38	4509.045	4294.375
39	4514.620	4296.594
40	4520.166	4298.884
41	4525.681	4301.245
42	4531.166	4303.677
43	4536.619	4306.180
44	4542.040	4308.752
45	4547.426	4311.395
46	4548.075	4311.723

Circle Center At X = 4339.614 ; Y = 4728.219 ; and Radius = 465.751

*** FOS = 2.617 Theta (ki=1.0) = 9.22 ***
Lambda = 0.162

1

Failure Surface Specified By 49 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	4277.777	4265.000
2	4283.746	4264.385
3	4289.721	4263.841
4	4295.702	4263.367
5	4301.688	4262.962
6	4307.679	4262.628
7	4313.673	4262.365
8	4319.670	4262.171
9	4325.669	4262.048
10	4331.669	4261.996
11	4337.669	4262.014
12	4343.668	4262.102
13	4349.667	4262.261
14	4355.662	4262.490
15	4361.655	4262.789
16	4367.644	4263.159
17	4373.627	4263.599
18	4379.606	4264.109
19	4385.578	4264.689
20	4391.542	4265.339
21	4397.499	4266.059
22	4403.447	4266.849
23	4409.385	4267.708
24	4415.312	4268.638
25	4421.229	4269.636
26	4427.133	4270.704
27	4433.024	4271.841
28	4438.902	4273.047
29	4444.765	4274.322
30	4450.612	4275.666
31	4456.444	4277.078
32	4462.258	4278.559
33	4468.055	4280.107
34	4473.833	4281.724
35	4479.592	4283.409
36	4485.331	4285.161
37	4491.049	4286.979
38	4496.745	4288.865
39	4502.418	4290.818
40	4508.068	4292.837
41	4513.694	4294.922
42	4519.295	4297.073
43	4524.871	4299.290
44	4530.420	4301.571
45	4535.942	4303.918
46	4541.436	4306.330
47	4546.901	4308.805
48	4552.337	4311.345
49	4553.580	4311.943

Circle Center At X = 4333.145 ; Y = 4773.446 ; and Radius = 511.452

*** FOS = 2.618 Theta (ki=1.0) = 9.18 ***
Lambda = 0.162

Failure Surface Specified By 51 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	4273.333	4265.000
2	4279.304	4264.412
3	4285.281	4263.888
4	4291.264	4263.428
5	4297.250	4263.033
6	4303.241	4262.703
7	4309.235	4262.437
8	4315.232	4262.235
9	4321.230	4262.099
10	4327.230	4262.026
11	4333.230	4262.019
12	4339.229	4262.076
13	4345.228	4262.198
14	4351.225	4262.385
15	4357.220	4262.636
16	4363.211	4262.952
17	4369.199	4263.332
18	4375.183	4263.777
19	4381.161	4264.286
20	4387.134	4264.860
21	4393.100	4265.498
22	4399.059	4266.200
23	4405.009	4266.967
24	4410.952	4267.797
25	4416.885	4268.692
26	4422.808	4269.650
27	4428.720	4270.672
28	4434.621	4271.758
29	4440.509	4272.908
30	4446.385	4274.121
31	4452.248	4275.396
32	4458.097	4276.735
33	4463.931	4278.137
34	4469.749	4279.602
35	4475.551	4281.129
36	4481.337	4282.719
37	4487.105	4284.371
38	4492.855	4286.085
39	4498.586	4287.861
40	4504.298	4289.698
41	4509.989	4291.597
42	4515.660	4293.558
43	4521.310	4295.579
44	4526.937	4297.661
45	4532.541	4299.804
46	4538.122	4302.006
47	4543.679	4304.269
48	4549.211	4306.592
49	4554.718	4308.974
50	4560.199	4311.415
51	4562.095	4312.284

Circle Center At X = 4330.913 ; Y = 4818.819 ; and Radius = 556.804

*** FOS = 2.623 Theta (ki=1.0) = 8.99 ***
Lambda = 0.158

1

Failure Surface Specified By 46 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	4286.666	4265.000
2	4292.637	4264.414
3	4298.615	4263.902
4	4304.599	4263.465
5	4310.588	4263.104
6	4316.582	4262.817
7	4322.578	4262.605
8	4328.576	4262.469
9	4334.576	4262.408
10	4340.576	4262.422
11	4346.575	4262.512
12	4352.573	4262.676
13	4358.568	4262.915
14	4364.560	4263.229
15	4370.547	4263.619
16	4376.529	4264.083
17	4382.504	4264.623
18	4388.473	4265.237
19	4394.433	4265.926
20	4400.384	4266.690
21	4406.326	4267.528
22	4412.256	4268.440

23	4418.174	4269.427
24	4424.080	4270.488
25	4429.971	4271.623
26	4435.848	4272.831
27	4441.709	4274.112
28	4447.555	4275.467
29	4453.382	4276.896
30	4459.191	4278.396
31	4464.981	4279.970
32	4470.751	4281.616
33	4476.500	4283.334
34	4482.226	4285.125
35	4487.930	4286.986
36	4493.610	4288.919
37	4499.265	4290.923
38	4504.895	4292.998
39	4510.499	4295.143
40	4516.075	4297.358
41	4521.623	4299.643
42	4527.142	4301.997
43	4532.630	4304.420
44	4538.088	4306.912
45	4543.515	4309.471
46	4548.144	4311.726

Circle Center At X = 4336.458 ; Y = 4741.340 ; and Radius = 478.936

*** FOS = 2.625 Theta (ki=1.0) = 9.16 ***
Lambda = 0.161

Failure Surface Specified By 47 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	4299.999	4265.000
2	4305.967	4264.383
3	4311.943	4263.841
4	4317.925	4263.374
5	4323.912	4262.981
6	4329.904	4262.664
7	4335.899	4262.420
8	4341.896	4262.252
9	4347.896	4262.159
10	4353.896	4262.140
11	4359.896	4262.196
12	4365.894	4262.328
13	4371.891	4262.534
14	4377.884	4262.814
15	4383.874	4263.170
16	4389.858	4263.601
17	4395.836	4264.106
18	4401.809	4264.686
19	4407.773	4265.340
20	4413.729	4266.068
21	4419.674	4266.871
22	4425.610	4267.748
23	4431.534	4268.699
24	4437.446	4269.724
25	4443.344	4270.823
26	4449.229	4271.995
27	4455.098	4273.241
28	4460.951	4274.560
29	4466.788	4275.951
30	4472.606	4277.416
31	4478.406	4278.952
32	4484.186	4280.561
33	4489.946	4282.242
34	4495.684	4283.995
35	4501.400	4285.819
36	4507.093	4287.715
37	4512.761	4289.681
38	4518.405	4291.718
39	4524.022	4293.826
40	4529.613	4296.003
41	4535.177	4298.250
42	4540.711	4300.566
43	4546.217	4302.952
44	4551.692	4305.405
45	4557.137	4307.927
46	4562.549	4310.517
47	4566.483	4312.459

Circle Center At X = 4352.380 ; Y = 4742.837 ; and Radius = 480.700

*** FOS = 2.628 Theta (ki=1.0) = 9.09 ***
Lambda = 0.160

1

Failure Surface Specified By 52 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	4268.889	4265.000
2	4274.860	4264.412
3	4280.837	4263.886
4	4286.819	4263.423
5	4292.806	4263.023
6	4298.796	4262.687
7	4304.790	4262.413
8	4310.786	4262.202
9	4316.784	4262.054
10	4322.784	4261.969
11	4328.784	4261.947
12	4334.784	4261.988
13	4340.783	4262.093
14	4346.780	4262.260
15	4352.776	4262.491
16	4358.769	4262.784
17	4364.758	4263.141
18	4370.743	4263.560
19	4376.724	4264.042
20	4382.699	4264.587
21	4388.668	4265.195
22	4394.630	4265.865
23	4400.585	4266.598
24	4406.532	4267.394
25	4412.471	4268.251
26	4418.400	4269.172
27	4424.319	4270.154
28	4430.227	4271.199
29	4436.124	4272.306
30	4442.009	4273.475
31	4447.882	4274.706
32	4453.741	4275.998
33	4459.586	4277.351
34	4465.417	4278.766
35	4471.232	4280.242
36	4477.032	4281.779
37	4482.815	4283.377
38	4488.582	4285.036
39	4494.330	4286.755
40	4500.060	4288.535
41	4505.771	4290.375
42	4511.462	4292.275
43	4517.133	4294.234
44	4522.783	4296.253
45	4528.412	4298.332
46	4534.018	4300.469
47	4539.602	4302.665
48	4545.162	4304.919
49	4550.698	4307.232
50	4556.210	4309.603
51	4561.696	4312.032
52	4562.265	4312.291

Circle Center At X = 4327.858 ; Y = 4832.822 ; and Radius = 570.876

*** FOS = 2.632 Theta (ki=1.0) = 8.93 ***
Lambda = 0.157

Failure Surface Specified By 48 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	4291.110	4265.000
2	4297.073	4264.329
3	4303.043	4263.732
4	4309.020	4263.209
5	4315.003	4262.761
6	4320.992	4262.386
7	4326.984	4262.086
8	4332.980	4261.860
9	4338.978	4261.708
10	4344.978	4261.631
11	4350.978	4261.628
12	4356.977	4261.700
13	4362.975	4261.846
14	4368.971	4262.066
15	4374.964	4262.360
16	4380.953	4262.729

17	4386.936	4263.172
18	4392.914	4263.689
19	4398.884	4264.280
20	4404.847	4264.945
21	4410.802	4265.684
22	4416.747	4266.496
23	4422.681	4267.382
24	4428.604	4268.342
25	4434.514	4269.375
26	4440.411	4270.480
27	4446.294	4271.660
28	4452.162	4272.912
29	4458.014	4274.236
30	4463.849	4275.633
31	4469.667	4277.102
32	4475.465	4278.643
33	4481.245	4280.256
34	4487.003	4281.940
35	4492.741	4283.695
36	4498.456	4285.522
37	4504.148	4287.419
38	4509.817	4289.386
39	4515.460	4291.424
40	4521.078	4293.531
41	4526.669	4295.708
42	4532.233	4297.954
43	4537.769	4300.269
44	4543.275	4302.652
45	4548.752	4305.104
46	4554.198	4307.623
47	4559.612	4310.208
48	4563.974	4312.359

Circle Center At X = 4348.213 ; Y = 4745.746 ; and Radius = 484.125

*** FOS = 2.632 Theta (ki=1.0) = 9.19 ***
Lambda = 0.162

**** END OF GSTABL7 OUTPUT ****

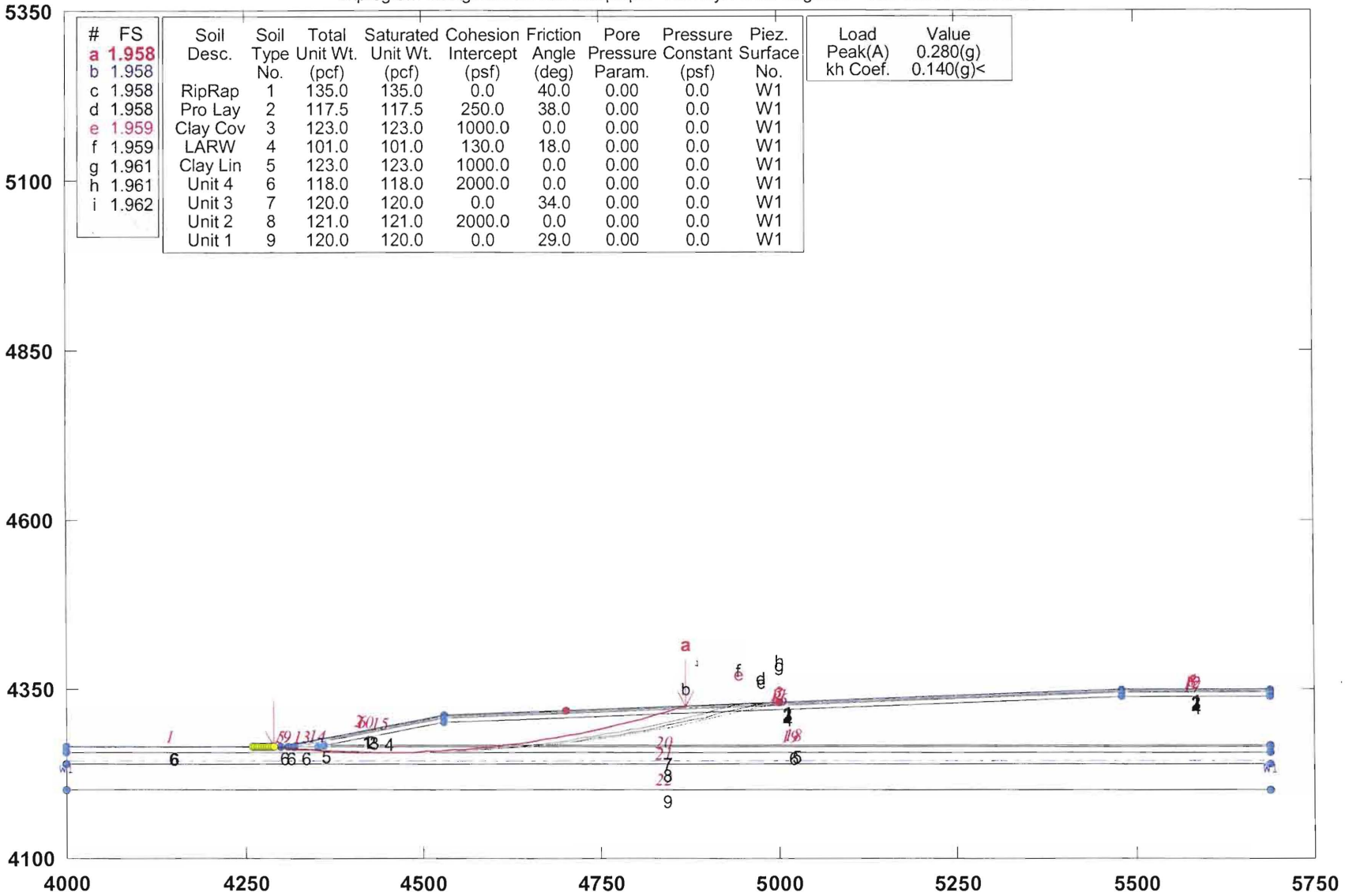
CAW Emb 38' 5(H):1(V) side-slopes, Pseudostatic, ShalClay unit 121810 CAWPS

c:\program files\g72sw\es caw\cawps.pl2 Run By: Amec Engineer 01/04/2011 08:41PM

#	FS
a	1.958
b	1.958
c	1.958
d	1.958
e	1.959
f	1.959
g	1.961
h	1.961
i	1.962

Soil Desc.	Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Param.	Pressure Constant (psf)	Piez. Surface No.
RipRap	1	135.0	135.0	0.0	40.0	0.00	0.0	W1
Pro Lay	2	117.5	117.5	250.0	38.0	0.00	0.0	W1
Clay Cov	3	123.0	123.0	1000.0	0.0	0.00	0.0	W1
LARW	4	101.0	101.0	130.0	18.0	0.00	0.0	W1
Clay Lin	5	123.0	123.0	1000.0	0.0	0.00	0.0	W1
Unit 4	6	118.0	118.0	2000.0	0.0	0.00	0.0	W1
Unit 3	7	120.0	120.0	0.0	34.0	0.00	0.0	W1
Unit 2	8	121.0	121.0	2000.0	0.0	0.00	0.0	W1
Unit 1	9	120.0	120.0	0.0	29.0	0.00	0.0	W1

Load	Value
Peak(A)	0.280(g)
kh Coef.	0.140(g)<



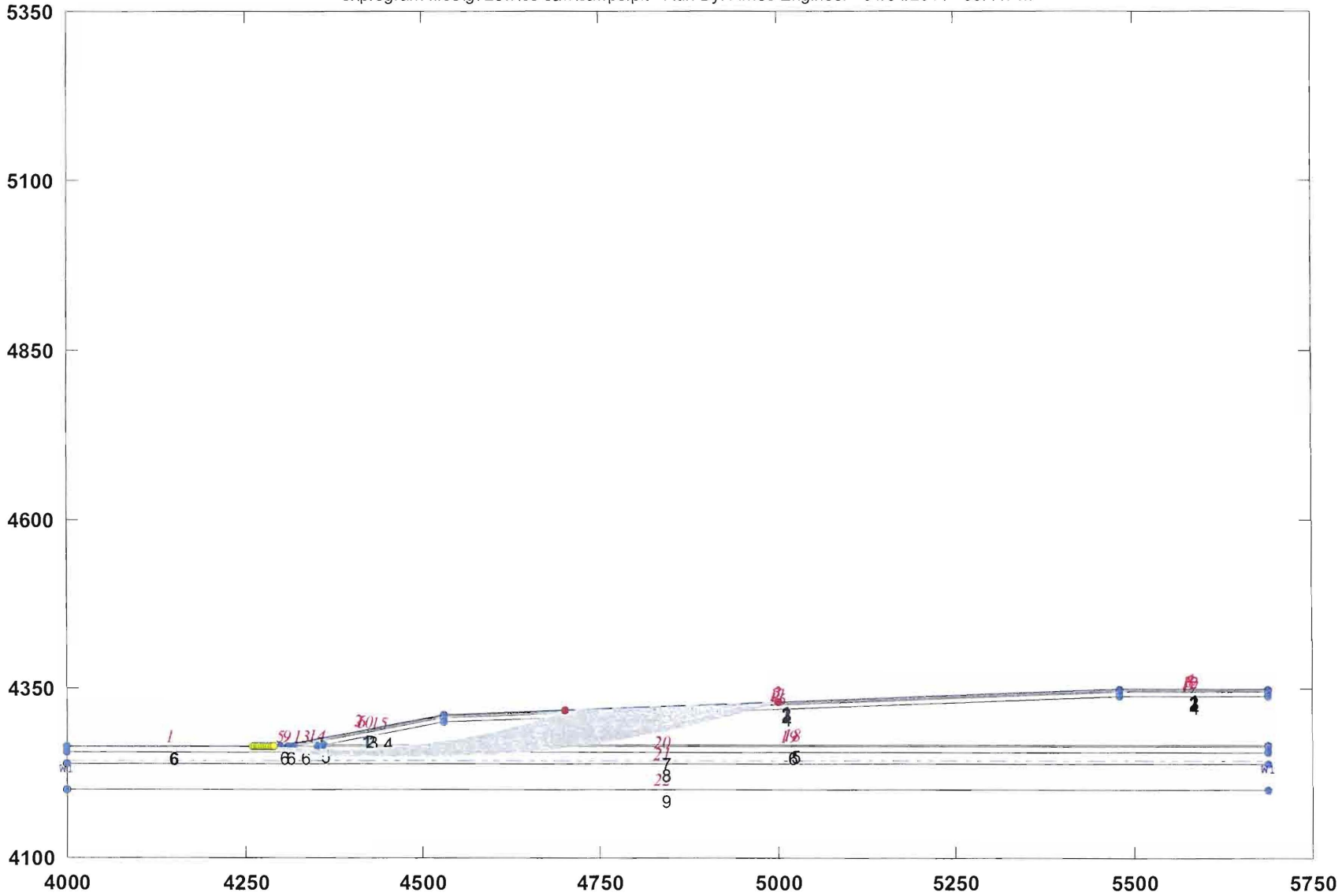
GSTABL7 v.2 FSmin=1.958

Safety Factors Are Calculated By GLE (Spencer`s) Method (0-1)

GSTABL7

CAW Emb 38' 5(H):1(V) side-slopes, Pseudostatic, ShalClay unit 121810 CAWPS

c:\program files\g72sw\es caw\cawps.plt Run By: Amec Engineer 01/04/2011 08:41PM



GSTABL7

*** GSTABL7 ***

** GSTABL7 by Garry H. Gregory, P.E. **

** Original Version 1.0, January 1996; Current Version 2.004, June 2003 **
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****
SLOPE STABILITY ANALYSIS SYSTEM
Modified Bishop, Simplified Janbu, or GLE Method of Slices.
(Includes Spencer & Morgenstern-Price Type Analysis)
Including Pier/Pile, Reinforcement, Soil Nail, Tieback,
Nonlinear Undrained Shear Strength, Curved Phi Envelope,
Anisotropic Soil, Fiber-Reinforced Soil, Boundary Loads, Water
Surfaces, Pseudo-Static & Newmark Earthquake, and Applied Forces.
****

Analysis Run Date: 01/04/2011
Time of Run: 08:41PM
Run By: Amec Engineer
Input Data Filename: C:\Program Files\G72SW\ES CAW\cawps.
Output Filename: C:\Program Files\G72SW\ES CAW\cawps.OUT
Unit System: English

Plotted Output Filename: C:\Program Files\G72SW\ES CAW\cawps.PLT

PROBLEM DESCRIPTION: CAW Emb 38' 5(H):1(V) side-slopes,
Pseudostatic, ShalClay unit 121810 CAWPS

BOUNDARY COORDINATES

4 Top Boundaries
22 Total Boundaries

Boundary No.	X-Left (ft)	Y-Left (ft)	X-Right (ft)	Y-Right (ft)	Soil Type Below Bnd
1	4000.00	4265.00	4300.00	4265.00	6
2	4300.00	4265.00	4530.00	4311.00	1
3	4530.00	4311.00	5480.00	4349.00	1
4	5480.00	4349.00	5689.00	4349.00	1
5	4300.00	4265.00	4310.00	4265.00	6
6	4310.00	4265.00	4530.00	4309.00	2
7	4530.00	4309.00	5480.00	4347.00	2
8	5480.00	4347.00	5689.00	4347.00	2
9	4310.00	4265.00	4318.00	4265.00	6
10	4318.00	4265.00	4530.00	4307.50	3
11	4530.00	4307.50	5480.00	4345.50	3
12	5480.00	4345.50	5689.00	4345.50	3
13	4318.00	4265.00	4353.00	4265.00	6
14	4353.00	4265.00	4361.00	4267.00	5
15	4361.00	4267.00	4530.00	4300.50	4
16	4530.00	4300.50	5480.00	4338.50	4
17	5480.00	4338.50	5689.00	4338.50	4
18	4361.00	4267.00	5689.00	4267.00	5
19	4353.00	4265.00	5689.00	4265.00	6
20	4000.00	4256.00	5689.00	4256.00	7
21	4000.00	4239.00	5689.00	4239.00	8
22	4000.00	4201.00	5689.00	4201.00	9

User Specified Y-Origin = 4100.00(ft)

Default X-Plus Value = 0.00(ft)

Default Y-Plus Value = 0.00(ft)

1

ISOTROPIC SOIL PARAMETERS

9 Type(s) of Soil

Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Param.	Pressure Constant (psf)	Piez. Surface No.
1	135.0	135.0	0.0	40.0	0.00	0.0	1
2	117.5	117.5	250.0	38.0	0.00	0.0	1
3	123.0	123.0	1000.0	0.0	0.00	0.0	1
4	101.0	101.0	130.0	18.0	0.00	0.0	1
5	123.0	123.0	1000.0	0.0	0.00	0.0	1
6	118.0	118.0	2000.0	0.0	0.00	0.0	1

7	120.0	120.0	0.0	34.0	0.00	0.0	1
8	121.0	121.0	2000.0	0.0	0.00	0.0	1
9	120.0	120.0	0.0	29.0	0.00	0.0	1

1

1 PIEZOMETRIC SURFACE(S) SPECIFIED

Unit Weight of Water = 62.40 (pcf)

Piezometric Surface No. 1 Specified by 2 Coordinate Points
Pore Pressure Inclination Factor = 0.50

Point No.	X-Water (ft)	Y-Water (ft)
1	4000.00	4243.00
2	5689.00	4243.00

Specified Peak Ground Acceleration Coefficient (A) = 0.280(g)
Specified Horizontal Earthquake Coefficient (kh) = 0.140(g)
Specified Vertical Earthquake Coefficient (kv) = 0.000(g)

Specified Seismic Pore-Pressure Factor = 0.000

1

A Critical Failure Surface Searching Method, Using A Random
Technique For Generating Circular Surfaces, Has Been Specified.

3800 Trial Surfaces Have Been Generated.

380 Surface(s) Initiate(s) From Each Of 10 Points Equally Spaced
Along The Ground Surface Between X =4260.00(ft)
and X =4290.00(ft)

Each Surface Terminates Between X =4700.00(ft)
and X =5000.00(ft)

Unless Further Limitations Were Imposed, The Minimum Elevation
At Which A Surface Extends Is Y = 4250.00(ft)

18.00(ft) Line Segments Define Each Trial Failure Surface.

Following Are Displayed The Ten Most Critical Of The Trial
Failure Surfaces Evaluated. They Are
Ordered - Most Critical First.

* * Safety Factors Are Calculated By GLE (Spencer`s) Method (0-1) * *

Selected ki function = Constant (1.0)

Selected Lambda Coefficient = 1.00

Forces from Reinforcement, Piers/Piles, Soil Nails, and Applied Forces
(if applicable) have been applied to the slice base(s)
on which they intersect.

Specified Tension Crack Water Force Factor = 0.000

Total Number of Trial Surfaces Attempted = 3800

WARNING! The Factor of Safety Calculation for one or More Trial Surfaces
Did Not Converge in 20 Iterations.

Number of Trial Surfaces with Non-Converged FS = 281

Number of Trial Surfaces with Misleading FS = 31

Number of Trial Surfaces With Valid FS = 3488

Percentage of Trial Surfaces With Non-Valid FS Solutions
of the Total Attempted = 8.2 %

Statistical Data On All Valid FS Values:
FS Max = 20.250 FS Min = 1.958 FS Ave = 2.233
Standard Deviation = 0.601 Coefficient of Variation = 26.93 %

((Modified Bishop FS for Critical Surface = 1.975))

Failure Surface Specified By 34 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	4290.001	4265.000
2	4307.895	4263.042
3	4325.812	4261.324
4	4343.751	4259.845
5	4361.709	4258.607
6	4379.681	4257.609
7	4397.665	4256.851
8	4415.658	4256.334
9	4433.656	4256.058
10	4451.656	4256.022
11	4469.655	4256.228
12	4487.649	4256.674
13	4505.636	4257.361
14	4523.612	4258.288
15	4541.574	4259.456
16	4559.519	4260.864
17	4577.443	4262.512
18	4595.344	4264.400
19	4613.218	4266.527
20	4631.062	4268.893
21	4648.873	4271.497
22	4666.646	4274.339
23	4684.381	4277.419
24	4702.073	4280.736
25	4719.719	4284.290
26	4737.315	4288.079
27	4754.860	4292.103
28	4772.349	4296.361
29	4789.779	4300.853
30	4807.148	4305.578
31	4824.452	4310.534
32	4841.688	4315.722
33	4858.854	4321.140
34	4869.232	4324.569

Circle Center At X = 4445.295 ; Y = 5600.881 ; and Radius = 1344.877

*** FOS = 1.958 Theta (ki=1.0) = 3.68 ***
Lambda = 0.064

Individual data on the 44 slices

Slice No.	Width (ft)	Weight (lbs)	Water Force Top (lbs)	Water Force Bot (lbs)	Tie Force Norm (lbs)	Tie Force Tan (lbs)	Earthquake Force Hor (lbs)	Earthquake Force Ver (lbs)	Surcharge Load (lbs)
1	10.0	645.2	0.0	0.0	0.	0.	90.3	0.0	0.0
2	7.9	2262.9	0.0	0.0	0.	0.	316.8	0.0	0.0
3	2.1	1020.2	0.0	0.0	0.	0.	142.8	0.0	0.0
4	8.0	5312.8	0.0	0.0	0.	0.	743.8	0.0	0.0
5	7.8	7372.8	0.0	0.0	0.	0.	1032.2	0.0	0.0
6	17.9	24969.8	0.0	0.0	0.	0.	3495.8	0.0	0.0
7	9.2	17121.1	0.0	0.0	0.	0.	2397.0	0.0	0.0
8	8.0	17068.4	0.0	0.0	0.	0.	2389.6	0.0	0.0
9	0.7	1612.7	0.0	0.0	0.	0.	225.8	0.0	0.0
10	18.0	45387.6	0.0	0.0	0.	0.	6354.3	0.0	0.0
11	18.0	53823.9	0.0	0.0	0.	0.	7535.4	0.0	0.0
12	18.0	61754.4	0.0	0.0	0.	0.	8645.6	0.0	0.0
13	18.0	69172.0	0.0	0.0	0.	0.	9684.1	0.0	0.0
14	18.0	76068.9	0.0	0.0	0.	0.	10649.6	0.0	0.0
15	18.0	82441.3	0.0	0.0	0.	0.	11541.8	0.0	0.0
16	18.0	88285.3	0.0	0.0	0.	0.	12359.9	0.0	0.0
17	18.0	93595.1	0.0	0.0	0.	0.	13103.3	0.0	0.0
18	18.0	98369.7	0.0	0.0	0.	0.	13771.8	0.0	0.0
19	6.4	36024.3	0.0	0.0	0.	0.	5043.4	0.0	0.0
20	11.6	65495.4	0.0	0.0	0.	0.	9169.4	0.0	0.0
21	17.9	100326.8	0.0	0.0	0.	0.	14045.8	0.0	0.0
22	17.9	98278.2	0.0	0.0	0.	0.	13759.0	0.0	0.0
23	17.9	95712.0	0.0	0.0	0.	0.	13399.7	0.0	0.0
24	5.0	26457.3	0.0	0.0	0.	0.	3704.0	0.0	0.0
25	12.8	66120.7	0.0	0.0	0.	0.	9256.9	0.0	0.0
26	3.6	18069.8	0.0	0.0	0.	0.	2529.8	0.0	0.0
27	14.3	71012.1	0.0	0.0	0.	0.	9941.7	0.0	0.0
28	17.8	85710.8	0.0	0.0	0.	0.	11999.5	0.0	0.0

29	17.8	81922.4	0.0	0.0	0.	0.	11469.1	0.0	0.0
30	17.7	77708.2	0.0	0.0	0.	0.	10879.1	0.0	0.0
31	17.7	73074.0	0.0	0.0	0.	0.	10230.4	0.0	0.0
32	17.6	68021.6	0.0	0.0	0.	0.	9523.0	0.0	0.0
33	17.6	62559.5	0.0	0.0	0.	0.	8758.3	0.0	0.0
34	17.5	56696.2	0.0	0.0	0.	0.	7937.5	0.0	0.0
35	17.5	50439.2	0.0	0.0	0.	0.	7061.5	0.0	0.0
36	17.4	43798.7	0.0	0.0	0.	0.	6131.8	0.0	0.0
37	17.4	36780.2	0.0	0.0	0.	0.	5149.2	0.0	0.0
38	17.3	29395.9	0.0	0.0	0.	0.	4115.4	0.0	0.0
39	6.7	9323.1	0.0	0.0	0.	0.	1305.2	0.0	0.0
40	10.6	12009.4	0.0	0.0	0.	0.	1681.3	0.0	0.0
41	15.4	10894.1	0.0	0.0	0.	0.	1525.2	0.0	0.0
42	1.8	736.4	0.0	0.0	0.	0.	103.1	0.0	0.0
43	3.5	1150.7	0.0	0.0	0.	0.	161.1	0.0	0.0
44	6.9	929.8	0.0	0.0	0.	0.	130.2	0.0	0.0

Failure Surface Specified By 34 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	4290.001	4265.000
2	4307.895	4263.042
3	4325.812	4261.324
4	4343.751	4259.845
5	4361.709	4258.607
6	4379.681	4257.609
7	4397.665	4256.851
8	4415.658	4256.334
9	4433.656	4256.058
10	4451.656	4256.022
11	4469.655	4256.228
12	4487.649	4256.674
13	4505.636	4257.361
14	4523.612	4258.288
15	4541.574	4259.456
16	4559.519	4260.864
17	4577.443	4262.512
18	4595.344	4264.400
19	4613.218	4266.527
20	4631.062	4268.893
21	4648.873	4271.497
22	4666.646	4274.339
23	4684.381	4277.419
24	4702.073	4280.736
25	4719.719	4284.290
26	4737.315	4288.079
27	4754.860	4292.103
28	4772.349	4296.361
29	4789.779	4300.853
30	4807.148	4305.578
31	4824.452	4310.534
32	4841.688	4315.722
33	4858.854	4321.140
34	4869.232	4324.569

Circle Center At X = 4445.295 ; Y = 5600.881 ; and Radius = 1344.877

*** FOS = 1.958 Theta (ki=1.0) = 3.68 ***
Lambda = 0.064

1

Failure Surface Specified By 40 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	4290.001	4265.000
2	4307.925	4263.344
3	4325.864	4261.865
4	4343.817	4260.563
5	4361.782	4259.438
6	4379.757	4258.490
7	4397.740	4257.720
8	4415.730	4257.126
9	4433.726	4256.710
10	4451.724	4256.472
11	4469.724	4256.411
12	4487.724	4256.528
13	4505.721	4256.822
14	4523.715	4257.293
15	4541.703	4257.942
16	4559.684	4258.768
17	4577.656	4259.771
18	4595.618	4260.952
19	4613.566	4262.309
20	4631.501	4263.843

21	4649.419	4265.554
22	4667.320	4267.442
23	4685.202	4269.506
24	4703.062	4271.746
25	4720.898	4274.162
26	4738.711	4276.754
27	4756.497	4279.521
28	4774.255	4282.464
29	4791.983	4285.582
30	4809.679	4288.874
31	4827.342	4292.340
32	4844.970	4295.980
33	4862.562	4299.794
34	4880.114	4303.781
35	4897.627	4307.941
36	4915.098	4312.274
37	4932.525	4316.778
38	4949.907	4321.455
39	4967.242	4326.302
40	4975.983	4328.839

Circle Center At X = 4466.906 ; Y = 6081.588 ; and Radius = 1825.181

*** FOS = 1.958 Theta (ki=1.0) = 5.68 ***
Lambda = 0.099

Failure Surface Specified By 40 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	4290.001	4265.000
2	4307.925	4263.344
3	4325.864	4261.865
4	4343.817	4260.563
5	4361.782	4259.438
6	4379.757	4258.490
7	4397.740	4257.720
8	4415.730	4257.126
9	4433.726	4256.710
10	4451.724	4256.472
11	4469.724	4256.411
12	4487.724	4256.528
13	4505.721	4256.822
14	4523.715	4257.293
15	4541.703	4257.942
16	4559.684	4258.768
17	4577.656	4259.771
18	4595.618	4260.952
19	4613.566	4262.309
20	4631.501	4263.843
21	4649.419	4265.554
22	4667.320	4267.442
23	4685.202	4269.506
24	4703.062	4271.746
25	4720.898	4274.162
26	4738.711	4276.754
27	4756.497	4279.521
28	4774.255	4282.464
29	4791.983	4285.582
30	4809.679	4288.874
31	4827.342	4292.340
32	4844.970	4295.980
33	4862.562	4299.794
34	4880.114	4303.781
35	4897.627	4307.941
36	4915.098	4312.274
37	4932.525	4316.778
38	4949.907	4321.455
39	4967.242	4326.302
40	4975.983	4328.839

Circle Center At X = 4466.906 ; Y = 6081.588 ; and Radius = 1825.181

*** FOS = 1.958 Theta (ki=1.0) = 5.68 ***
Lambda = 0.099

1

Failure Surface Specified By 38 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	4290.001	4265.000

2	4307.918	4263.271
3	4325.853	4261.735
4	4343.802	4260.391
5	4361.766	4259.240
6	4379.740	4258.281
7	4397.724	4257.516
8	4415.715	4256.943
9	4433.711	4256.563
10	4451.710	4256.376
11	4469.710	4256.383
12	4487.709	4256.583
13	4505.705	4256.975
14	4523.695	4257.561
15	4541.678	4258.339
16	4559.651	4259.311
17	4577.614	4260.475
18	4595.562	4261.832
19	4613.496	4263.381
20	4631.411	4265.123
21	4649.307	4267.057
22	4667.181	4269.182
23	4685.031	4271.500
24	4702.855	4274.008
25	4720.652	4276.708
26	4738.418	4279.598
27	4756.153	4282.678
28	4773.853	4285.949
29	4791.517	4289.410
30	4809.143	4293.060
31	4826.729	4296.898
32	4844.273	4300.925
33	4861.772	4305.140
34	4879.226	4309.542
35	4896.631	4314.132
36	4913.986	4318.908
37	4931.289	4323.870
38	4943.603	4327.544

Circle Center At X = 4460.103 ; Y = 5933.819 ; and Radius = 1677.466

*** FOS = 1.959 Theta (ki=1.0) = 2.92 ***
Lambda = 0.051

Failure Surface Specified By 38 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	4290.001	4265.000
2	4307.918	4263.271
3	4325.853	4261.735
4	4343.802	4260.391
5	4361.766	4259.240
6	4379.740	4258.281
7	4397.724	4257.516
8	4415.715	4256.943
9	4433.711	4256.563
10	4451.710	4256.376
11	4469.710	4256.383
12	4487.709	4256.583
13	4505.705	4256.975
14	4523.695	4257.561
15	4541.678	4258.339
16	4559.651	4259.311
17	4577.614	4260.475
18	4595.562	4261.832
19	4613.496	4263.381
20	4631.411	4265.123
21	4649.307	4267.057
22	4667.181	4269.182
23	4685.031	4271.500
24	4702.855	4274.008
25	4720.652	4276.708
26	4738.418	4279.598
27	4756.153	4282.678
28	4773.853	4285.949
29	4791.517	4289.410
30	4809.143	4293.060
31	4826.729	4296.898
32	4844.273	4300.925
33	4861.772	4305.140
34	4879.226	4309.542
35	4896.631	4314.132
36	4913.986	4318.908
37	4931.289	4323.870
38	4943.603	4327.544

Circle Center At X = 4460.103 ; Y = 5933.819 ; and Radius = 1677.466

*** FOS = 1.959 Theta (ki=1.0) = 2.92 ***
Lambda = 0.051

1

Failure Surface Specified By 41 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	4290.001	4265.000
2	4307.931	4263.411
3	4325.875	4261.988
4	4343.831	4260.731
5	4361.798	4259.640
6	4379.774	4258.715
7	4397.758	4257.957
8	4415.748	4257.364
9	4433.743	4256.938
10	4451.741	4256.677
11	4469.741	4256.583
12	4487.741	4256.656
13	4505.739	4256.895
14	4523.735	4257.300
15	4541.726	4257.872
16	4559.710	4258.609
17	4577.688	4259.513
18	4595.656	4260.583
19	4613.614	4261.819
20	4631.559	4263.221
21	4649.491	4264.788
22	4667.407	4266.521
23	4685.307	4268.419
24	4703.188	4270.483
25	4721.049	4272.712
26	4738.889	4275.106
27	4756.707	4277.665
28	4774.500	4280.388
29	4792.267	4283.276
30	4810.006	4286.328
31	4827.716	4289.543
32	4845.396	4292.922
33	4863.044	4296.464
34	4880.659	4300.169
35	4898.239	4304.037
36	4915.782	4308.066
37	4933.287	4312.258
38	4950.752	4316.612
39	4968.177	4321.126
40	4985.560	4325.802
41	4999.877	4329.795

Circle Center At X = 4470.889 ; Y = 6204.602 ; and Radius = 1948.019

*** FOS = 1.961 Theta (ki=1.0) = 5.67 ***
Lambda = 0.099

Failure Surface Specified By 41 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	4290.001	4265.000
2	4307.931	4263.411
3	4325.875	4261.988
4	4343.831	4260.731
5	4361.798	4259.640
6	4379.774	4258.715
7	4397.758	4257.957
8	4415.748	4257.364
9	4433.743	4256.938
10	4451.741	4256.677
11	4469.741	4256.583
12	4487.741	4256.656
13	4505.739	4256.895
14	4523.735	4257.300
15	4541.726	4257.872
16	4559.710	4258.609
17	4577.688	4259.513
18	4595.656	4260.583
19	4613.614	4261.819
20	4631.559	4263.221
21	4649.491	4264.788
22	4667.407	4266.521
23	4685.307	4268.419

24	4703.188	4270.483
25	4721.049	4272.712
26	4738.889	4275.106
27	4756.707	4277.665
28	4774.500	4280.388
29	4792.267	4283.276
30	4810.006	4286.328
31	4827.716	4289.543
32	4845.396	4292.922
33	4863.044	4296.464
34	4880.659	4300.169
35	4898.239	4304.037
36	4915.782	4308.066
37	4933.287	4312.258
38	4950.752	4316.612
39	4968.177	4321.126
40	4985.560	4325.802
41	4999.877	4329.795

Circle Center At X = 4470.889 ; Y = 6204.602 ; and Radius = 1948.019

*** FOS = 1.961 Theta (ki=1.0) = 5.71 ***
Lambda = 0.100

1

Failure Surface Specified By 35 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	4290.001	4265.000
2	4307.903	4263.120
3	4325.827	4261.466
4	4343.770	4260.039
5	4361.730	4258.837
6	4379.704	4257.863
7	4397.688	4257.116
8	4415.681	4256.595
9	4433.678	4256.302
10	4451.678	4256.235
11	4469.678	4256.396
12	4487.673	4256.784
13	4505.663	4257.398
14	4523.643	4258.240
15	4541.611	4259.309
16	4559.564	4260.604
17	4577.500	4262.126
18	4595.415	4263.875
19	4613.307	4265.848
20	4631.172	4268.047
21	4649.008	4270.472
22	4666.812	4273.122
23	4684.581	4275.996
24	4702.312	4279.094
25	4720.003	4282.415
26	4737.650	4285.959
27	4755.252	4289.726
28	4772.805	4293.715
29	4790.306	4297.924
30	4807.752	4302.354
31	4825.141	4307.004
32	4842.470	4311.874
33	4859.736	4316.961
34	4876.937	4322.266
35	4886.189	4325.248

Circle Center At X = 4447.936 ; Y = 5682.764 ; and Radius = 1426.534

*** FOS = 1.962 Theta (ki=1.0) = 3.60 ***
Lambda = 0.063

Failure Surface Specified By 35 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	4290.001	4265.000
2	4307.903	4263.120
3	4325.827	4261.466
4	4343.770	4260.039
5	4361.730	4258.837
6	4379.704	4257.863
7	4397.688	4257.116
8	4415.681	4256.595

9	4433.678	4256.302
10	4451.678	4256.235
11	4469.678	4256.396
12	4487.673	4256.784
13	4505.663	4257.398
14	4523.643	4258.240
15	4541.611	4259.309
16	4559.564	4260.604
17	4577.500	4262.126
18	4595.415	4263.875
19	4613.307	4265.848
20	4631.172	4268.047
21	4649.008	4270.472
22	4666.812	4273.122
23	4684.581	4275.996
24	4702.312	4279.094
25	4720.003	4282.415
26	4737.650	4285.959
27	4755.252	4289.726
28	4772.805	4293.715
29	4790.306	4297.924
30	4807.752	4302.354
31	4825.141	4307.004
32	4842.470	4311.874
33	4859.736	4316.961
34	4876.937	4322.266
35	4886.189	4325.248

Circle Center At X = 4447.936 ; Y = 5682.764 ; and Radius = 1426.534

*** FOS = 1.962 Theta (ki=1.0) = 3.60 ***
Lambda = 0.063

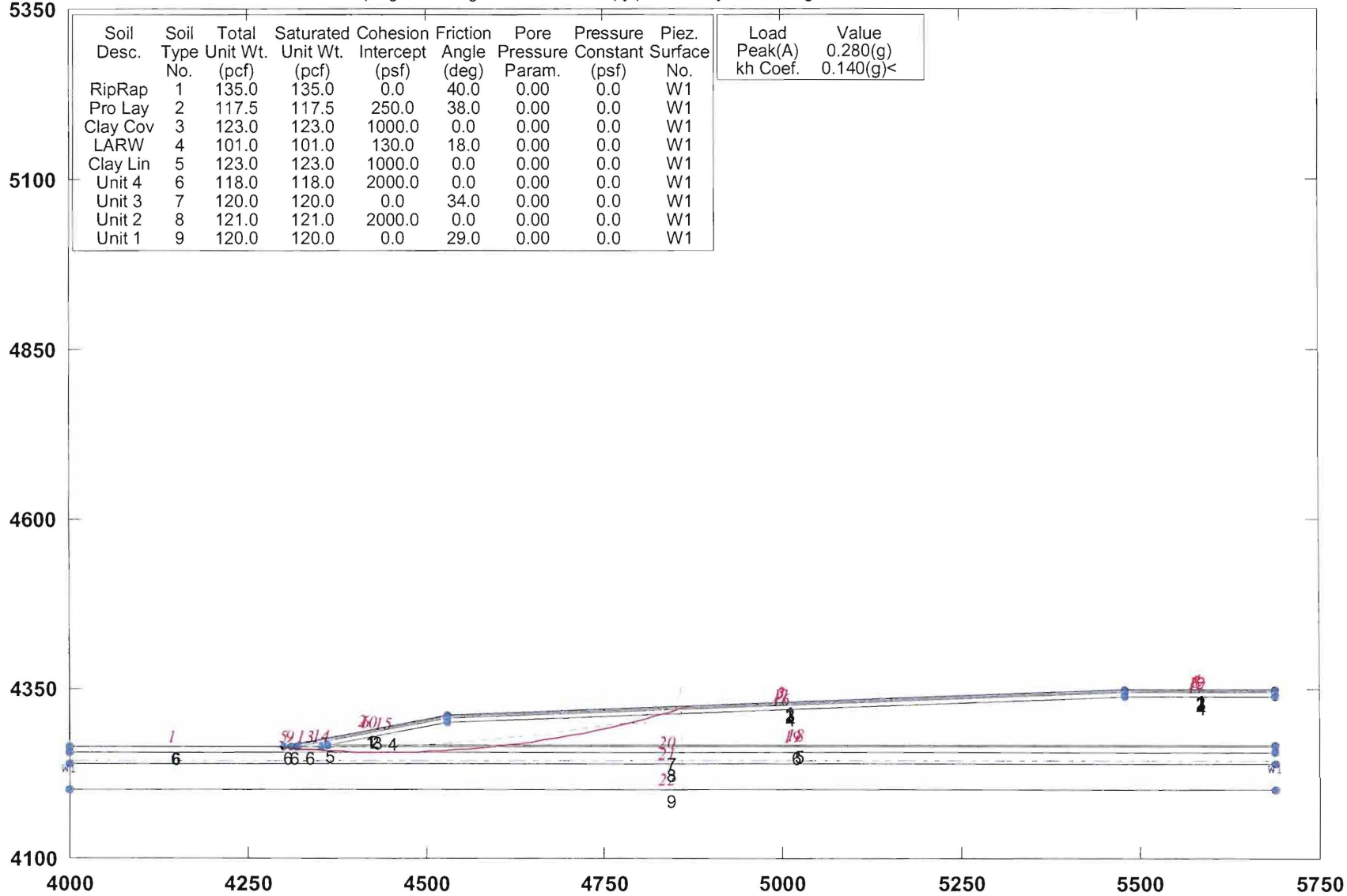
**** END OF GSTABL7 OUTPUT ****

CAW Emb 38' 5(H):1(V) side-slopes, Yield/Deform, ShalClay unit 121810 CAWPY

c:\program files\g72sw\es caw\cawpy.plt Run By: Amec Engineer 01/04/2011 08:43PM

Soil Desc.	Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Param.	Pressure Constant (psf)	Piez. Surface No.
RipRap	1	135.0	135.0	0.0	40.0	0.00	0.0	W1
Pro Lay	2	117.5	117.5	250.0	38.0	0.00	0.0	W1
Clay Cov	3	123.0	123.0	1000.0	0.0	0.00	0.0	W1
LARW	4	101.0	101.0	130.0	18.0	0.00	0.0	W1
Clay Lin	5	123.0	123.0	1000.0	0.0	0.00	0.0	W1
Unit 4	6	118.0	118.0	2000.0	0.0	0.00	0.0	W1
Unit 3	7	120.0	120.0	0.0	34.0	0.00	0.0	W1
Unit 2	8	121.0	121.0	2000.0	0.0	0.00	0.0	W1
Unit 1	9	120.0	120.0	0.0	29.0	0.00	0.0	W1

Load	Value
Peak(A)	0.280(g)
kh Coef.	0.140(g)<



GSTABL7 v.2 FSmin=1.958

Factor Of Safety Is Calculated By GLE (Spencer`s) Method (0-1)

GSTABL7

*** GSTABL7 ***

** GSTABL7 by Garry H. Gregory, P.E. **

** Original Version 1.0, January 1996; Current Version 2.004, June 2003 **
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****
SLOPE STABILITY ANALYSIS SYSTEM
Modified Bishop, Simplified Janbu, or GLE Method of Slices.
(Includes Spencer & Morgenstern-Price Type Analysis)
Including Pier/Pile, Reinforcement, Soil Nail, Tieback,
Nonlinear Undrained Shear Strength, Curved Phi Envelope,
Anisotropic Soil, Fiber-Reinforced Soil, Boundary Loads, Water
Surfaces, Pseudo-Static & Newmark Earthquake, and Applied Forces.
****

Analysis Run Date: 01/04/2011
Time of Run: 08:43PM
Run By: Amec Engineer
Input Data Filename: C:\Program Files\G72SW\ES CAW\cawpy.
Output Filename: C:\Program Files\G72SW\ES CAW\cawpy.OUT
Unit System: English

Plotted Output Filename: C:\Program Files\G72SW\ES CAW\cawpy.PLT

PROBLEM DESCRIPTION: CAW Emb 38' 5(H):1(V) side-slopes,
Yield/Deform, ShalClay unit 121810 CAWPY

BOUNDARY COORDINATES

4 Top Boundaries
22 Total Boundaries

Boundary No.	X-Left (ft)	Y-Left (ft)	X-Right (ft)	Y-Right (ft)	Soil Type Below Bnd
1	4000.00	4265.00	4300.00	4265.00	6
2	4300.00	4265.00	4530.00	4311.00	1
3	4530.00	4311.00	5480.00	4349.00	1
4	5480.00	4349.00	5689.00	4349.00	1
5	4300.00	4265.00	4310.00	4265.00	6
6	4310.00	4265.00	4530.00	4309.00	2
7	4530.00	4309.00	5480.00	4347.00	2
8	5480.00	4347.00	5689.00	4347.00	2
9	4310.00	4265.00	4318.00	4265.00	6
10	4318.00	4265.00	4530.00	4307.50	3
11	4530.00	4307.50	5480.00	4345.50	3
12	5480.00	4345.50	5689.00	4345.50	3
13	4318.00	4265.00	4353.00	4265.00	6
14	4353.00	4265.00	4361.00	4267.00	5
15	4361.00	4267.00	4530.00	4300.50	4
16	4530.00	4300.50	5480.00	4338.50	4
17	5480.00	4338.50	5689.00	4338.50	4
18	4361.00	4267.00	5689.00	4267.00	5
19	4353.00	4265.00	5689.00	4265.00	6
20	4000.00	4256.00	5689.00	4256.00	7
21	4000.00	4239.00	5689.00	4239.00	8
22	4000.00	4201.00	5689.00	4201.00	9

User Specified Y-Origin = 4100.00(ft)

Default X-Plus Value = 0.00(ft)

Default Y-Plus Value = 0.00(ft)

1

ISOTROPIC SOIL PARAMETERS

9 Type(s) of Soil

Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Param.	Pressure Constant (psf)	Piez. Surface No.
1	135.0	135.0	0.0	40.0	0.00	0.0	1
2	117.5	117.5	250.0	38.0	0.00	0.0	1
3	123.0	123.0	1000.0	0.0	0.00	0.0	1
4	101.0	101.0	130.0	18.0	0.00	0.0	1
5	123.0	123.0	1000.0	0.0	0.00	0.0	1
6	118.0	118.0	2000.0	0.0	0.00	0.0	1

7	120.0	120.0	0.0	34.0	0.00	0.0	1
8	121.0	121.0	2000.0	0.0	0.00	0.0	1
9	120.0	120.0	0.0	29.0	0.00	0.0	1

1

1 PIEZOMETRIC SURFACE(S) SPECIFIED

Unit Weight of Water = 62.40 (pcf)

Piezometric Surface No. 1 Specified by 2 Coordinate Points
Pore Pressure Inclination Factor = 0.50

Point No.	X-Water (ft)	Y-Water (ft)
1	4000.00	4243.00
2	5689.00	4243.00

Specified Peak Ground Acceleration Coefficient (A) = 0.280(g)
Specified Horizontal Earthquake Coefficient (kh) = 0.140(g)
Specified Vertical Earthquake Coefficient (kv) = 0.000(g)

Specified Seismic Pore-Pressure Factor = 0.000

1

Trial Failure Surface Specified By 34 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	4290.001	4265.000
2	4307.895	4263.042
3	4325.812	4261.324
4	4343.751	4259.845
5	4361.709	4258.607
6	4379.681	4257.609
7	4397.665	4256.851
8	4415.658	4256.333
9	4433.656	4256.058
10	4451.656	4256.022
11	4469.655	4256.228
12	4487.649	4256.674
13	4505.636	4257.361
14	4523.612	4258.288
15	4541.574	4259.456
16	4559.519	4260.864
17	4577.443	4262.512
18	4595.344	4264.400
19	4613.218	4266.527
20	4631.062	4268.893
21	4648.873	4271.497
22	4666.646	4274.338
23	4684.381	4277.418
24	4702.073	4280.736
25	4719.719	4284.290
26	4737.314	4288.079
27	4754.860	4292.103
28	4772.349	4296.361
29	4789.779	4300.853
30	4807.148	4305.578
31	4824.452	4310.534
32	4841.688	4315.722
33	4858.854	4321.140
34	4869.232	4324.569

DEFLECTION ANGLE & SEGMENT DATA FOR SPECIFIED SURFACE(Excluding Last Segment)

Angle/Segment No.	Deflection(Deg)	Segment Length(ft)
1	0.77	18.00
2	0.76	18.00
3	0.77	18.00
4	0.76	18.00
5	0.76	18.00
6	0.77	18.00
7	0.77	18.00
8	0.76	18.00
9	0.77	18.00

10	0.76	18.00
11	0.77	18.00
12	0.77	18.00
13	0.77	18.00
14	0.77	18.00
15	0.77	18.00
16	0.77	18.00
17	0.76	18.00
18	0.77	18.00
19	0.77	18.00
20	0.77	18.00
21	0.77	18.00
22	0.77	18.00
23	0.77	18.00
24	0.76	18.00
25	0.77	18.00
26	0.76	18.00
27	0.77	18.00
28	0.77	18.00
29	0.76	18.00
30	0.77	18.00
31	0.76	18.00

Circle Center At X = 4445.297(ft) ; Y = 5600.861(ft); and Radius = 1344.857(ft)

Theta (deg) (ki=1.0)	FOS (Moment) (Equil.)	FOS (Force) (Equil.)	Lambda
14.20	1.697	1.960	0.253
21.30	0.000	1.963	0.390
12.74	1.790	1.959	0.226
8.81	1.969	1.957	0.155
7.82	2.002	1.957	0.137
9.57	1.940	1.958	0.169
9.08	1.958	1.958	0.160

{(Modified Bishop FS for Specified Surface = 1.980)}

Factor Of Safety For The Preceding Specified Surface = 1.958
Theta (ki = 1.0) = 9.08 Deg Lambda = 0.160

Factor Of Safety Is Calculated By GLE (Spencer`s) Method (0-1)

Forces from Reinforcement, Piers/Piles, Applied Forces, and Soil Nails
(if applicable) have been applied to the slice base(s)
on which they intersect.

Selected ki function = Constant (1.0)

Selected Lambda Coefficient = 0.40

Tension Crack Water Force = 0.00(lbs)

Specified Tension Crack Water Force Factor = 0.000

Depth of Tension Crack (zo) at Center of Last Slice = 0.000(ft)

*** Line of Thrust and Slice Force Data ***

Slice No.	X Coord.	Y Coord.	L/H	Side Force (lbs)	ki	Force Angle (Deg)	Vert. Shear Force(lbs)
1	4300.00	4264.77	0.792	10412.	0.400	3.66	266.3
2	4307.89	4264.60	0.439	18579.	0.400	3.66	475.2

3	4310.00	4264.55	0.412	20722.	0.400	3.66	530.0
4	4318.00	4264.40	0.357	28802.	0.400	3.66	736.6
5	4325.81	4264.27	0.334	36595.	0.400	3.66	936.0
6	4343.75	4264.06	0.303	53735.	0.400	3.66	1374.3
7	4353.00	4264.00	0.293	62066.	0.400	3.66	1587.4
8	4361.00	4263.97	0.287	69111.	0.400	3.66	1767.6
9	4361.71	4263.97	0.286	69728.	0.400	3.66	1783.4
10	4379.68	4264.00	0.274	84394.	0.400	3.66	2158.5
11	4397.67	4264.16	0.264	97597.	0.400	3.66	2496.1
12	4415.66	4264.44	0.255	109168.	0.400	3.66	2792.1
13	4433.66	4264.87	0.247	118966.	0.400	3.66	3042.7
14	4451.66	4265.43	0.239	126874.	0.400	3.66	3244.9
15	4469.65	4266.14	0.232	132787.	0.400	3.66	3396.2
16	4487.65	4267.01	0.225	136638.	0.400	3.66	3494.7
17	4505.64	4268.02	0.219	138362.	0.400	3.66	3538.8
18	4523.61	4269.21	0.212	137931.	0.400	3.66	3527.8
19	4530.00	4269.68	0.210	137102.	0.400	3.66	3506.5
20	4541.57	4270.55	0.213	135553.	0.400	3.66	3466.9
21	4559.52	4271.98	0.217	132091.	0.400	3.66	3378.4
22	4577.44	4273.49	0.218	127780.	0.400	3.66	3268.1
23	4595.34	4275.07	0.217	122800.	0.400	3.66	3140.8
24	4600.39	4275.53	0.216	121182.	0.400	3.66	3099.4
25	4613.22	4277.31	0.226	110762.	0.400	3.66	2832.9
26	4616.79	4277.84	0.228	107711.	0.400	3.66	2754.8
27	4631.06	4279.44	0.229	101006.	0.400	3.66	2583.4
28	4648.87	4281.56	0.227	91811.	0.400	3.66	2348.2
29	4666.65	4283.80	0.225	81983.	0.400	3.66	2096.8
30	4684.38	4286.16	0.220	71685.	0.400	3.66	1833.4
31	4702.07	4288.61	0.212	61101.	0.400	3.66	1562.7
32	4719.72	4291.15	0.200	50427.	0.400	3.66	1289.7
33	4737.31	4293.74	0.181	39881.	0.400	3.66	1020.0
34	4754.86	4296.31	0.151	29681.	0.400	3.66	759.1
35	4772.35	4298.69	0.096	20072.	0.400	3.66	513.4
36	4789.78	4300.30	-0.027	11303.	0.400	3.66	289.1
37	4807.15	4296.43	-0.554	3640.	0.400	3.66	93.1
38	4824.45	4323.91	1.092	-2635.	0.400	3.66	-67.4
39	4831.13	4318.86	0.601	-4666.	0.400	3.66	-119.3
40	4841.69	4320.24	0.583	-4092.	0.400	3.66	-104.7
41	4857.09	4341.12	5.867	-470.	0.400	3.66	-12.0
42	4858.85	4353.02	10.577	-297.	0.400	3.66	-7.6
43	4862.35	4136.31	-93.001	50.	0.400	3.66	1.3
44	4869.23	52433.00	0.000	0.	0.400	3.66	0.0

Table 1 - Individual data on the 44 slices

Slice No.	Width (ft)	Weight (lbs)	Water Force Top (lbs)	Water Force Bot (lbs)	Tie Force Norm (lbs)	Tie Force Tan (lbs)	Earthquake Force Hor (lbs)	Earthquake Force Ver (lbs)	Surcharge Load (lbs)
1	10.0	645.2	0.0	0.0	0.0	0.0	90.3	0.0	0.0
2	7.9	2262.9	0.0	0.0	0.0	0.0	316.8	0.0	0.0
3	2.1	1020.2	0.0	0.0	0.0	0.0	142.8	0.0	0.0
4	8.0	5312.8	0.0	0.0	0.0	0.0	743.8	0.0	0.0
5	7.8	7371.9	0.0	0.0	0.0	0.0	1032.1	0.0	0.0
6	17.9	24970.5	0.0	0.0	0.0	0.0	3495.9	0.0	0.0
7	9.2	17122.6	0.0	0.0	0.0	0.0	2397.2	0.0	0.0
8	8.0	17068.4	0.0	0.0	0.0	0.0	2389.6	0.0	0.0
9	0.7	1612.7	0.0	0.0	0.0	0.0	225.8	0.0	0.0
10	18.0	45387.6	0.0	0.0	0.0	0.0	6354.3	0.0	0.0
11	18.0	53823.9	0.0	0.0	0.0	0.0	7535.4	0.0	0.0
12	18.0	61755.4	0.0	0.0	0.0	0.0	8645.8	0.0	0.0
13	18.0	69173.0	0.0	0.0	0.0	0.0	9684.2	0.0	0.0
14	18.0	76068.9	0.0	0.0	0.0	0.0	10649.6	0.0	0.0
15	18.0	82441.3	0.0	0.0	0.0	0.0	11541.8	0.0	0.0
16	18.0	88282.1	0.0	0.0	0.0	0.0	12359.5	0.0	0.0
17	18.0	93594.0	0.0	0.0	0.0	0.0	13103.2	0.0	0.0
18	18.0	98368.6	0.0	0.0	0.0	0.0	13771.6	0.0	0.0
19	6.4	36027.0	0.0	0.0	0.0	0.0	5043.8	0.0	0.0
20	11.6	65492.7	0.0	0.0	0.0	0.0	9169.0	0.0	0.0
21	17.9	100327.9	0.0	0.0	0.0	0.0	14045.9	0.0	0.0
22	17.9	98280.3	0.0	0.0	0.0	0.0	13759.2	0.0	0.0
23	17.9	95712.0	0.0	0.0	0.0	0.0	13399.7	0.0	0.0
24	5.0	26457.3	0.0	0.0	0.0	0.0	3704.0	0.0	0.0
25	12.8	66120.7	0.0	0.0	0.0	0.0	9256.9	0.0	0.0
26	3.6	18070.0	0.0	0.0	0.0	0.0	2529.8	0.0	0.0
27	14.3	71014.6	0.0	0.0	0.0	0.0	9942.0	0.0	0.0
28	17.8	85711.7	0.0	0.0	0.0	0.0	11999.6	0.0	0.0
29	17.8	81921.9	0.0	0.0	0.0	0.0	11469.1	0.0	0.0
30	17.7	77712.1	0.0	0.0	0.0	0.0	10879.7	0.0	0.0
31	17.7	73074.9	0.0	0.0	0.0	0.0	10230.5	0.0	0.0
32	17.6	68021.6	0.0	0.0	0.0	0.0	9523.0	0.0	0.0
33	17.6	62554.3	0.0	0.0	0.0	0.0	8757.6	0.0	0.0
34	17.5	56699.3	0.0	0.0	0.0	0.0	7937.9	0.0	0.0
35	17.5	50439.2	0.0	0.0	0.0	0.0	7061.5	0.0	0.0
36	17.4	43798.4	0.0	0.0	0.0	0.0	6131.8	0.0	0.0
37	17.4	36782.0	0.0	0.0	0.0	0.0	5149.5	0.0	0.0
38	17.3	29395.1	0.0	0.0	0.0	0.0	4115.3	0.0	0.0
39	6.7	9325.1	0.0	0.0	0.0	0.0	1305.5	0.0	0.0
40	10.6	12007.7	0.0	0.0	0.0	0.0	1681.1	0.0	0.0
41	15.4	10894.5	0.0	0.0	0.0	0.0	1525.2	0.0	0.0
42	1.8	736.4	0.0	0.0	0.0	0.0	103.1	0.0	0.0
43	3.5	1150.7	0.0	0.0	0.0	0.0	161.1	0.0	0.0

44 6.9 929.7 0.0 0.0 0.0 0.0 130.2 0.0 0.0

- TABLE 2 - Base Stress Data on the 44 Slices -

Slice No. *	Alpha (deg)	X-Coord. Slice Cntr (ft)	Base Leng. (ft)	Total Normal Stress (psf)	Total Vert. Stress (psf)	Mobilized Shear Stress (psf)
1	-6.24	4295.00	10.06	0.00	64.15	1021.66
2	-6.24	4303.95	7.94	464.45	284.94	1021.66
3	-5.48	4308.95	2.12	647.50	482.35	1021.66
4	-5.48	4314.00	8.04	826.53	661.07	1021.66
5	-5.48	4321.91	7.85	1105.36	939.41	1021.66
6	-4.71	4334.78	18.00	1537.13	1387.22	1021.66
7	-3.94	4348.38	9.27	1979.18	1846.90	1021.66
8	-3.94	4357.00	8.02	2260.16	2128.51	1021.66
9	-3.94	4361.35	0.71	2400.56	2269.21	1021.66
10	-3.18	4370.70	18.00	2634.25	2521.55	1021.66
11	-2.41	4388.67	18.00	3082.82	2990.24	1021.66
12	-1.65	4406.66	18.00	3502.65	3430.84	1021.66
13	-0.88	4424.66	18.00	3893.76	3842.91	1021.66
14	-0.11	4442.66	18.00	4256.10	4226.04	1021.66
15	0.66	4460.66	18.00	4589.59	4580.02	1021.66
16	1.42	4478.65	18.00	4894.50	4904.65	1021.66
17	2.19	4496.64	18.00	5170.57	5199.69	1021.66
18	2.95	4514.62	18.00	5417.97	5464.93	1021.66
19	3.72	4526.81	6.40	5564.94	5627.76	1021.66
20	3.72	4535.79	11.60	5583.79	5646.82	1021.66
21	4.49	4550.55	18.00	5498.42	5573.77	1021.66
22	5.25	4568.48	18.00	5373.79	5460.04	1021.66
23	6.02	4586.39	18.00	5221.26	5317.28	1021.66
24	6.79	4597.87	5.08	5104.33	5209.63	1021.66
25	6.79	4606.80	12.92	5040.57	5117.08	510.83
26	7.55	4615.00	3.60	4941.00	5019.35	510.83
27	7.55	4623.92	14.40	4829.57	4931.47	868.01
28	8.32	4639.97	18.00	4656.75	4761.79	839.33
29	9.08	4657.76	18.00	4445.36	4551.42	804.24

30	9.85	4675.51	18.00	4211.88	4317.26	765.49
31	10.62	4693.23	18.00	3956.65	4059.67	723.13
32	11.39	4710.90	18.00	3679.79	3778.90	677.18
33	12.15	4728.52	18.00	3381.70	3475.44	627.70
34	12.92	4746.09	18.00	3062.65	3149.78	574.74
35	13.68	4763.60	18.00	2722.84	2802.24	518.34
36	14.45	4781.06	18.00	2362.52	2433.29	458.54
37	15.22	4798.46	18.00	1981.96	2043.40	395.37
38	15.98	4815.80	18.00	1581.43	1633.11	328.89
39	16.75	4827.79	6.98	1291.42	1336.11	280.76
40	16.75	4836.41	11.02	987.52	1089.53	510.83
41	17.52	4849.39	16.15	561.10	674.52	510.83
42	17.52	4857.97	1.85	340.70	398.31	263.68
43	18.28	4860.60	3.68	259.49	312.91	231.27
44	18.28	4865.79	7.25	117.84	128.18	50.51

```
        *** SEISMIC SLOPE DISPLACEMENT DATA ***
(Note: kv is set = zero for displacement calculations)
Seismic Yield Coefficient (ky) =  0.3636(g)
Calculated Newmark Seismic Displacement =   0.016(ft)

Non-Symmetrical Sliding Resistance Has Been Specified
for Downhill Sliding.

                 **** END OF GSTABL7 OUTPUT ****
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