APPENDIX D
LONG-TERM SEISMIC SLOPE STABILITY EVALUATION

TECHNICAL MEMORANDUM

Project No: 3612112201

Date: December 5, 2014

To: Mark A. Peters, P.E.

From: Nicholas D. Langlais, EIT; Stephen J. Rabasca, P.E.

Subject: **Seismic Slope Stability Evaluation of the Tailings Impoundment**
Draft Final Design
Callahan Mine Superfund Site
Brooksville, Maine

1.0 INTRODUCTION

This Technical Memorandum summarizes a seismic slope stability evaluation performed to support the Operable Unit 3 (OU 3) Draft Final Design for the Tailings Impoundment at Callahan Mine Superfund Site (Site) in Brooksville, Maine. The Draft Final Design calls for dewatering the impoundment via a series of horizontal drains, crest improvements, and installation of a low-permeability cover system. Groundwater modeling (Appendix A) indicates that the drains will effectively draw impoundment water levels down to the bottom of the tailings/top of the clay.

The evaluation of seismic slope stability was made via two distinct approaches/methods of analysis:

1. Pseudo-static stability analysis. This method simulates earthquake-induced loads via the inclusion of a *static* horizontal force in a limit equilibrium analysis and is considered appropriate based on dewatered tailings within 100 to 150 feet of the perimeter impoundment dam.
2. Post-earthquake stability evaluation. This method applies strength reductions to specific saturated soils to represent/model their behavior immediately after the earthquake.

The evaluations were made utilizing SLOPE/W (GeoStudio 2012, Version 8.12.3.7901), an industry-standard two-dimensional slope stability software program developed and distributed by Geo-Slope International, Ltd. The primary objective of the evaluation was to assess the minimum seismic factor of safety (FOS) for the impoundment relative to global (deep-seated) stability for long-term post-remediation conditions.

This Technical Memorandum constitutes Appendix D of the Draft Final Basis of Design (BOD) Report. The following sections will review Tailings Impoundment background information and present the methodology, assumptions, and results of this seismic slope stability evaluation for long-term post-remediation conditions.

2.0 TAILINGS IMPOUNDMENT BACKGROUND INFORMATION

The Tailings Impoundment is located at the southern end of the Site, adjacent to a Salt Marsh at the edge of South Goose Pond. The coordinates at the crest of the impoundment dam are 44.342^{O} north latitude and 68.805^{O} west longitude.

2.1 Existing Conditions

The Tailings Impoundment encompasses an approximately 17-acre trapezoidal-shaped footprint. The impoundment contains fine sand, silt, and clay-sized rock particles (i.e., tailings) from the Callahan-era mining operations.

The tailings are contained by a three-sided dam constructed against a sloping hillside. This dam configuration is commonly termed a side-hill impoundment (USEPA, 1994). Most of the dam is constructed with angular cobble and boulder-sized waste rock materials. The bottom part of the dam (i.e., the starter dam) is interpreted to either be constructed with waste rock and back-stopped with clay fill/re-work (from site) or constructed with clay fill/re-work and then faced extensively with waste rock. The eastern side of the dam is about 1,000 feet long and 60 feet tall and has an average slope of about 1.3H to 1V (horizontal to vertical).

The existing ground surface elevation is roughly +75 feet along the crest of the dam and about +70 feet in central portions of the impoundment. The impoundment surface is concave and surface water ponds in the middle. The pond covers about 2 to 2.5 acres of the impoundment.

The existing ground surface elevation averages about +15 feet along the eastern toe. East of the toe, the existing ground surface slopes down gradually to the edge of the Salt Marsh/Goose Pond floodplain (at approximately elevation +7 feet). In some areas, the salt marsh/floodplain extends to the east on the order of 1500 feet.

2.1.1 Impoundment Soils

The soils within and/or beneath the Tailings Impoundment consist of the following principal strata:

- Tailings;
- Clay (Fill/Re-Work);
- Clay (Presumpscot Formation); and
- Glacial Till.

The thickness of the tailings ranges from about 5 to 60 feet, and the thickness generally increases from west to east. Tailings “slimes” dominate central portions of the impoundment. The slimes consist almost exclusively of silt and clay-sized particles with trace amounts of fine sand. Conversely, tailings “sands”, consisting primarily of loose silty fine-grained sand, dominate the perimeter of the impoundment (i.e., in close proximity to the dam). A zone of

highly stratified and/or laminated tailings is generally found in between the slimes and the sands.

Clay fill/re-work (interpreted to have been derived from the site) materials were encountered beneath waste rock and/or tailings in explorations performed on or immediately adjacent to the crest of the impoundment dam. The location and depth of the clay fill/re-work materials indicates that the starter dam is constructed of waste rock and back-stopped with clay fill/re-work and/or constructed with clay fill/re-work and then faced extensively with waste rock.

Native clay was identified and/or inferred in most of the explorations and is estimated to be widespread but may not necessarily be continuous across the footprint of the impoundment. The thickness of the clay beneath the impoundment ranges from approximately 1 to 15 feet. The clay is described as very stiff to soft and usually transitions from very stiff/stiff to medium stiff to soft with increasing depth below the ground surface (bgs). The clay is typically underlain by a thin layer of glacial till.

2.1.2 Impoundment Water Levels

The phreatic surface slopes from an elevation of about +70 feet on the west side of the impoundment to an elevation of about +50 feet near the eastern dam face. As a result, most of the tailings are presently saturated. There is a slight downward gradient through the tailings in the eastern two-thirds of the impoundment.

2.1.3 Impoundment Toe Conditions

The principal soil strata along the eastern toe of the impoundment dam typically consist of:

- Organic Silt/Clay, Peat, and Clay (Estuarine);
- Clay (Presumpscot Formation); and
- Glacial Till.

Soft estuarine soils/sediments are found at the ground surface in the Salt Marsh beyond the toe of the impoundment dam. The estuarine deposit ranges from about 1 to 5 feet in thickness beyond the toe. It appears that most of this deposit was removed prior to construction of the starter dam. Test pits excavated at the toe of the dam indicate that waste rock extends about 1 to 2 feet bgs and that the rock at the toe is founded on clay soils and/or fill materials. The native clay along the toe ranges from about 5 to 30 feet in thickness. The clay is described as very stiff to soft and typically transitions from very stiff/stiff to medium stiff to soft with increasing depth bgs. The clay is usually underlain by a thin layer of glacial till.

2.2 Long-Term Post-Remediation Conditions

The Draft Final Design calls for dewatering the impoundment via a series of horizontal drains, crest improvements consisting of extensive cuts along the impoundment perimeter, and installation of a low-permeability cover system.

The Draft Final Design also includes improvements (e.g., Prefabricated vertical drains and a geogrid reinforced working surface) in central portions of the impoundment (i.e., the area dominated by tailings slimes) to facilitate placement of excavated tailings as fill in this area. These improvements will generate strength gain, improve drainage, and provide pore pressure relief in the slimes area. The impacts of strength gain and pore pressure relief from the improvements are conservatively ignored in this evaluation.

Long-term steady-state groundwater levels (following drain installation and capping) are based on the locations and elevations of the proposed horizontal drains and the results of groundwater modeling (Appendix A). The results of the model indicate that the drains will effectively draw impoundment water levels down to the bottom of the tailings/top of the native clay within 100 to 150 feet of the perimeter impoundment dam crest in about 10 years.

3.0 PSEUDO-STATIC STABILITY ANALYSIS

A pseudo-static analysis can be used to evaluate the seismic response of earthen embankments. Numerous studies and field observations indicate that the pseudo-static method can be useful in evaluation of the performance of embankments constructed of (and on) soils that do not lose significant strength during an earthquake (Melo and Sharma, 2004). Such soils include clays, clayey/cohesive soils, unsaturated cohesionless soils, and dense cohesionless soils (Seed, 1979).

The pseudo-static method simulates earthquake-induced inertial forces via the inclusion of a *static* horizontal force in a limit equilibrium analysis. The horizontal force is assumed to be proportional to the weight of the potential sliding mass times a seismic coefficient, k_h, expressed in terms of the acceleration (in units of *g*) of the underlying earth (Abramson et. all, 1995).

The pseudo-static analysis of the Tailings Impoundment was made utilizing SLOPE/W. The primary objective of the analysis is to estimate the minimum pseudo-static FOS relative to global stability for the long-term post-remediation conditions described herein.

3.1 SLOPE/W Model Development

AMEC developed SLOPE/W models for six profiles of interest, S2, E1, E2, E3, E4, and N1, as part of the static slope stability evaluation of long-term post-remediation conditions. Development of the SLOPE/W models is detailed in Appendix C. The same SLOPE/W models were used for the pseudo-static analysis. The model for each profile was modified to include a static horizontal force to simulate the design earthquake loading.

3.1.1 Peak Ground Acceleration

For long-term conditions, the design earthquake loading is based on a peak ground acceleration (PGA) associated with a probability of exceedance (PE) of 2% in 50 years (equivalent to a 10% PE in 250 years). The PGA is the maximum amplitude of the ground acceleration time-history.

According to the United States Geological Survey's (USGS) 2014 seismic hazards mapping data, the applicable PGA for the site is 0.146*g*. Refer to Attachment D-1A for details.

3.1.2 Seismic Coefficient

The PGA only occurs once during a seismic event, and ground motions approaching the peak exist for just a small fraction of a second (Richardson, Kavazanjian, and Matasovi, 1995). Therefore, the ground acceleration applied for a pseudo-static analysis is commonly much less than the peak. Selection of an appropriate seismic coefficient is the most important aspect of a pseudo-static analysis (Melo and Sharma, 2004).

Hynes-Griffin and Franklin (1984) evaluated seismic-induced deformation for more than 350 earthquake records and concluded that earthen dams with pseudo-static FOS greater than 1.0 using k_h equal to 0.5 x PGA would not experience permanent deformations of more than 3 feet (Kramer, 1996). The EPA's "RCRA Subtitle D (258) Seismic Design Guidance for Municipal Solid Waste Facilities" (Richardson, Kavazanjian, and Matasovi, 1995) adopted the work of Hynes-Griffin and Franklin and recommended a seismic coefficient, k_h, of 0.5 x PGA for pseudo-static stability analyses. Other researchers (e.g., Marcuson) have suggested that an even lower seismic coefficient of 0.3 to 0.5 x PGA is appropriate for pseudo-static analyses.

AMEC selected k_h equal to 0.5 x PGA for this pseudo-static stability analysis of long-term post-remediation conditions based on the literature review described herein and engineering judgment. The selected seismic coefficient is considered appropriately conservative [very conservative according to Hynes-Griffin and Franklin (1984)]. This assertion is supported by the work of Melo and Sharma (2004), which concludes that a seismic coefficient equal to 0.5 x PGA appears to define an upper bound in the choice of seismic coefficients for design. Refer to Attachment D-1B for excerpts from selected references.

3.2 Overview of Analyses

The pseudo-static analysis method was employed to assess seismic stability based on the long-term post-remediation conditions described herein. SLOPE/W was used to perform stability analyses using the Spencer method, a limit equilibrium method that evaluates stability with respect to both moment equilibrium and horizontal force equilibrium.

The long-term post-remediation static stability evaluation (Appendix C) yielded the lowest FOS for the impoundment dam crest to impoundment dam toe mode of failure considering composite (i.e., part circular and part planar) failure surfaces. As such, the pseudo-static analysis targeted an impoundment dam crest to toe mode of failure, considering composite failure surfaces. The SLOPE/W output files are provided in Attachment D1-C.

3.3 Summary of Results

The results of the pseudo-static analyses indicate a FOS of 1.12 or greater for long-term post-remediation conditions. The results are summarized in Table D-1 below.

Table D-1
Summary of Pseudo-Static FOS for Long-Term Post-Remediation Conditions

Profile	Estimated Minimum FOS
S2	1.57
E1	1.26
E2	1.14
E3	1.12
E4	1.36 (Shallow failure within waste rock dam face); 1.70 (Deep)
N1	1.31

These results satisfy the applicable regulatory standard FOS (1.00), indicating that the impoundment is expected to remain stable following implementation of the remedy and the resultant long-term steady-state impoundment water levels, as described herein.

4.0 POST-EARTHQUAKE STABILIY ANALYSIS

Post-earthquake stability analyses were performed for Profile E3, which is considered the most critical profile, based on the results of the long-term static slope stability evaluation (Appendix C). With this method, strength reductions are applied to the initial/static strengths of applicable soils (i.e., soils that may be susceptible to liquefaction and/or cyclic softening), as described herein. A seismic coefficient is not applied. Instead, the reduced strengths model the behavior of the applicable soils following the earthquake.

Two distinct scenarios were evaluated:

1. Long-term post-remediation conditions with predicted (Appendix A) steady-state impoundment water levels based on continued operation and maintenance of the horizontal drains.
2. Long-term post-remediation conditions with “rebounded” impoundment water levels based on an assumed failure of the horizontal drains.

The post-earthquake stability evaluation of the Tailings Impoundment was made utilizing SLOPE/W. The primary objective of the analysis is to estimate the minimum post-earthquake FOS, relative to global stability, for the long-term post-remediation conditions described herein.

4.1 SLOPE/W Model Development

AMEC developed a SLOPE/W model for Profile E3 as part of the long-term static slope stability evaluation. Details of the model development are provided in Appendix C. The same SLOPE/W model is used as the starting point for this post-earthquake stability evaluation. For

this evaluation, the model for Profile E3 was modified to apply strength reductions to specific saturated soils to represent their strengths immediately after the earthquake.

4.1.1 Clay Strengths

A 20% reduction in undrained shear strength, S_u, was applied to soft and medium stiff Presumpscot Formation clays and estuarine deposits in all post-earthquake scenarios. This is supported by case studies (Makdisi and Seed, 1978) that concluded that in most cases cohesive soils will retain at least 80% of their static shear strength when exposed to cyclic loading, unless the cohesive soil is sensitive (Abramson et. all, 1995). However, a 20% reduction is considered very conservative based upon cyclic shear strength testing performed on the Presumpscot clay formation for the Ashfill/Balefill landfill in South Portland, Maine (Haley & Aldrich, 1995). This testing indicated that the Presumpscot formation did not experience any strength loss due to this cyclic loading. Samples from this site were subjected to 13 cycles of combined static and cyclic shear stresses in the range of 0.6 to 1.0 times the initial static S_u. Refer to Attachment D-2A for supporting documentation.

4.1.2 Tailings Strengths

Two distinct scenarios were evaluated:

1. Long-term post-remediation conditions with predicted (Appendix A) steady-state impoundment water levels based on continued operation and maintenance of the horizontal drains.
2. Long-term post-remediation conditions with “rebounded” impoundment water levels based on an assumed failure of the horizontal drains.

4.1.2.1 Impoundment Water Levels Based on Continued Operation and Maintenance of Horizontal Drains

For this scenario, two tailings strength cases were considered:

- First, no strength reductions were applied to the tailings. The sand tailings proximate to the perimeter impoundment berm, for a distance of approximately 150 feet back from the crest, will not be saturated based on the continued operation and maintenance of the horizontal drains. As such, the dewatered tailings in this zone will not be susceptible to liquefaction.

- Second, a strength reduction was applied to the tailings. Although the tailings are not expected to be saturated based on continued operation and maintenance of the horizontal drains (and thus, not susceptible to liquefaction and/or strength reduction), they will likely contain some residual moisture. For the purposes of this evaluation, the tailings strength is conservatively reduced, in all zones, based on the application of an R_u factor simulating increased pore pressure, resulting in decreased effective stress and decreased strength according to effective stress (ϕ’) parameters. Based on the results

of a prior site-specific liquefaction and cyclic failure evaluation (Attachment D-2B), R_u in the tailings generally ranges from 0.1 to 0.25. For this evaluation, R_u is very conservatively assumed to be 0.5, resulting in a $\phi'_{post\text{-}eq} = 20°$. The strength reduction is calculated as follows:

- $\phi'_{post\text{-}eq} = \tan^{-1}[\tan(\phi'_{peak}) \times (1-R_u)] = \tan^{-1}[\tan(35°) \times (1-0.5)] = 20°$.

Prefabricated vertical drains will be installed in central portions of the impoundment (i.e., the area dominated by tailings slimes) prior to filling in this area. The drains will improve drainage and provide pore pressure relief. The improved drainage and pore pressure relief are conservatively ignored in this evaluation, but they will mitigate the potential for the slimes to liquefy and lose strength.

4.1.2.2 Impoundment Water Levels Based on Assumed Failure of Horizontal Drains

This “doomsday” scenario assumes that the drains fail due to decreased or discontinued maintenance at some point after long-term steady-state impoundment water levels are achieved (10 years). The groundwater model (Appendix A) indicates that impoundment water levels could rebound back to levels that are about 5 to 10 feet above the bottom of the tailings.

For simplicity, the tailings that become saturated due to this rebound effect are assumed to liquefy during a design earthquake. Based on results of a prior liquefaction and cyclic softening evaluation (MACTEC, 2009a), post-earthquake strengths of the tailings were generally estimated to be between approximately 100 to 300 psf based on recommendations presented in Boulanger and Idriss (2004) for clay-like soils and Youd and Idriss (2001) for sand-like or mixed soils. Refer to Attachment D-2B for supporting documentation. For this doomsday evaluation, we performed a sensitivity analysis to estimate the undrained shear strength necessary to reduce the FOS to 1.00. The analyses indicate that the minimum required shear strength in the liquefied zone would have to be approximately 215 psf for a FOS of 1.00.

4.2 Overview of Analyses

Post-earthquake stability analyses were performed to assess seismic stability based on the long-term post-remediation conditions described herein. SLOPE/W was used to perform stability analyses using the Spencer method.

Multiple runs were evaluated, considering composite (i.e., part circular and part planar) failure surfaces. Selected SLOPE/W output files are provided in Attachments D2-C and D-2D.

4.3 Summary of Results

The results of the post-earthquake stability analyses indicate a FOS of 1.24 or greater for long-term post-remediation conditions, assuming continued operation and maintenance of the horizontal drains. The results satisfy the applicable regulatory standard FOS (1.00), indicating that the impoundment is expected to remain stable during a design-magnitude seismic event

following implementation of the remedy and development of long-term steady-state impoundment water levels, as described herein.

The "doomsday" scenario assumes that the bottom 5 to 10 feet of the tailings slimes becomes saturated due to a failure of the horizontal drains and that this saturated zone liquefies during the design earthquake (2% probability of exceedance in 50 years). The analyses indicate that the liquefied zone would have to maintain an undrained shear strength of 215 psf. We believe that the likelihood that all of the factors that come together to form the doomsday scenario is very remote. Further, the addition of prefabricated vertical drains will provide some benefit in mitigating the generation of excess pore pressures in the event this doomsday scenario were to develop.

5.0 REFERENCES

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ATTACHMENT D-1

PSEUDO-STATIC STABILITY ANALYSIS

ATTACHMENT D-1A

PSEUSO-STATIC STABILITY ANALYSIS

PEAK GROUND ACCELERATION
USGS SEISMIC HAZARDS MAPPING DATA

JOB NO. 3612112201 SHEET 1 OF 6
PHASE — TASK —
JOB NAME Callahan Mine - Tailings Impoundment
BY TCC DATE 07/31/14
CHECKED BY _____ DATE _____

amec
511 Congress Street Suite 200
Portland, ME 04101
+1 (207) 775-5401 Fax +1 (207) 772-4762

PSEUDO-STATIC (SEISMIC) STABILITY EVALUATION

A. Peak Ground Acceleration (PGA)

1. Site-Specific Coordinates (Latitude / Longitude)
   - 44.342° N
   - 68.805° W

   } See Sheet 2

2. USGS Earthquake Hazard Program 2014 Seismic Hazard Mapping Data
   - 2% PE in 50 Years ≡ 10% PE 250 Years
     - See Sheet 3 for map data. (Conterminous US only)
     - Detailed mapping not yet available.
     - Map is inconclusive.
     - ∴ See raw USGS data files
     - See Sheets 4&5
     - From Gridded Hazard Map Data for 2% PE in 50 years:

	W	N	PGA (%g)
→	68.850	44.350	0.149929
	68.800	44.350	0.146623
	68.850	44.300	0.145332
	68.800	44.300	0.142139

3. Interpolate between gridded data to establish PGA for Site-Specific Coordinates.
   - See Sheet 6
   - USGS PGA for Site-Specific Coordinates = **0.146g**

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Sheet 2 of 6

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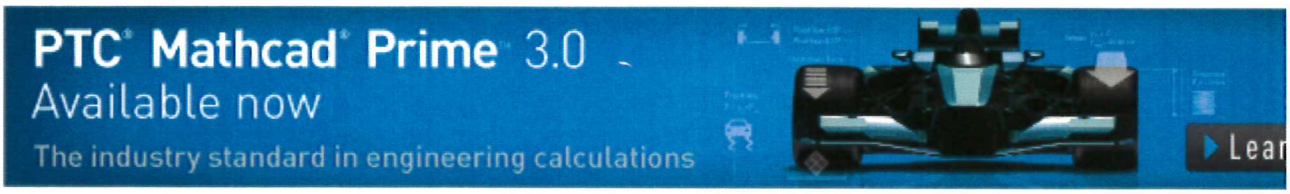

Maine Topo Maps & Topographic Map Data for Maine State

Find Maine topo maps & topographic map data by clicking on the map or searching for maps by state or feature.

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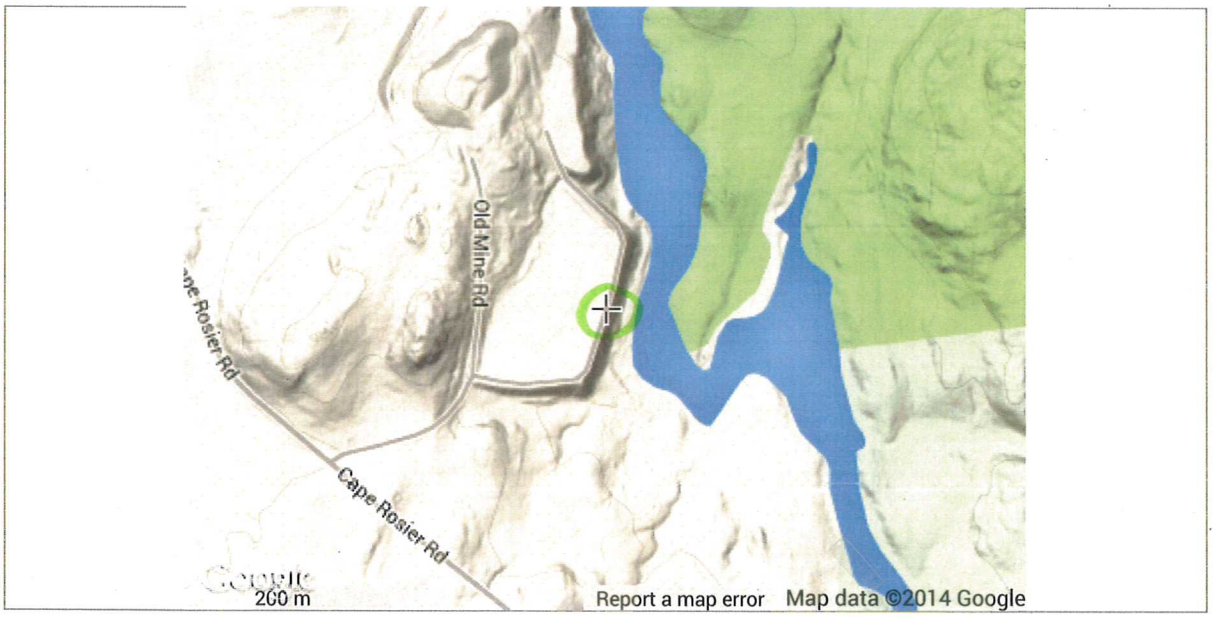

START
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Search Topo

Center: 44.3422°N 68.8047°W
Elevation at center: 59 feet (18 meters)
Quad:
Drg Name:
Drg Source Scale:
Projection: NAD83/WGS84

Display format:
Decimal Degrees
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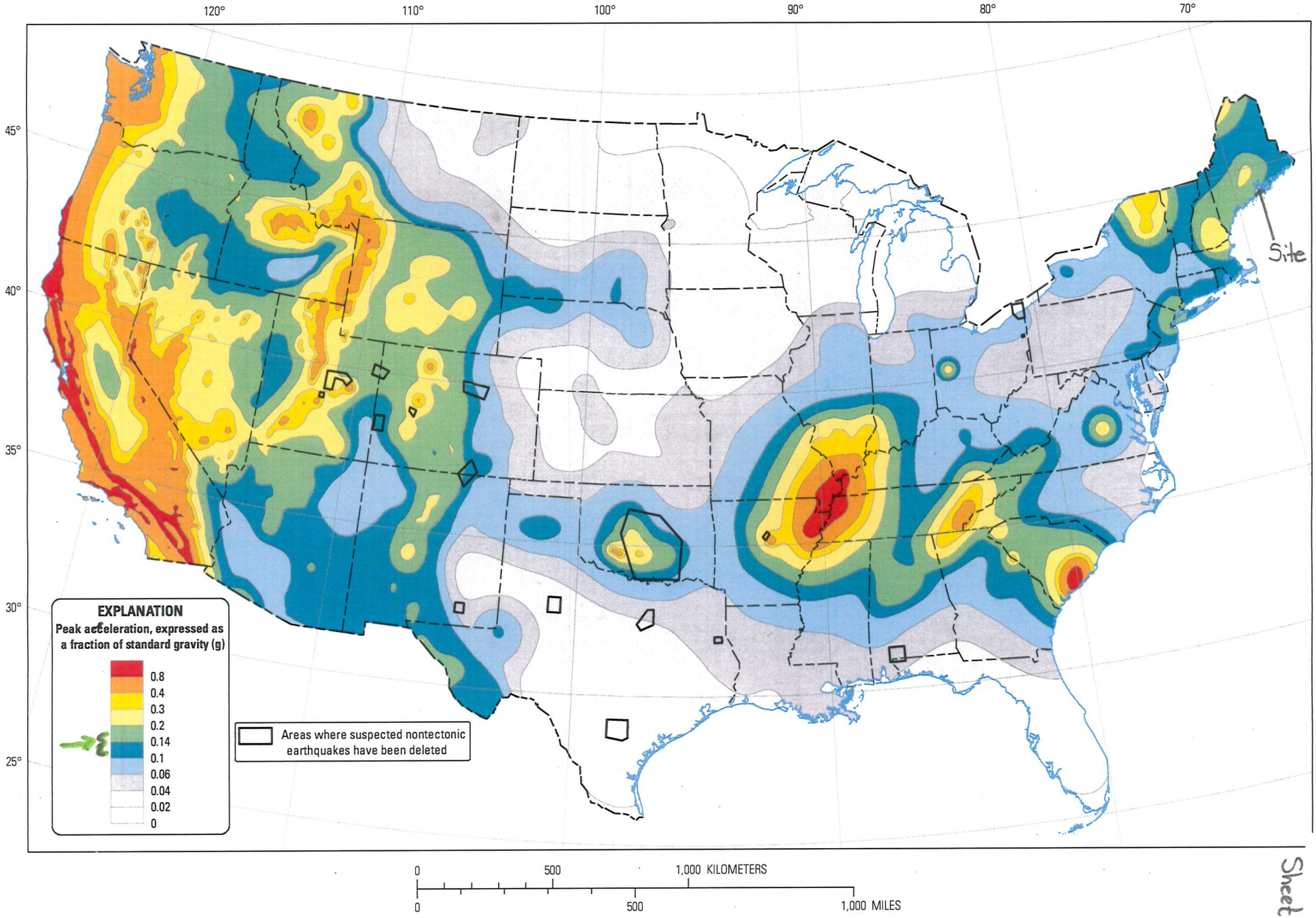


Two-percent probability of exceedance in 50 years map of peak ground acceleration

Sheet 3 of 6

Earthquake Hazards Program

2014 NSHM Gridded Data

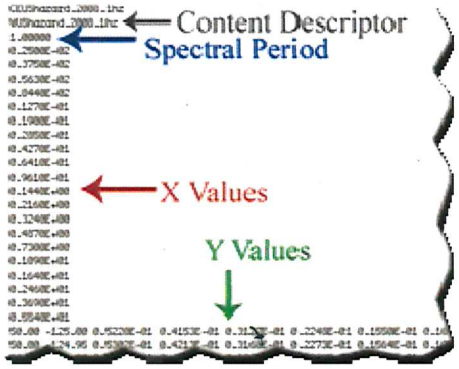
These files contain space-delimited, rectangular gridded data over the Conterminous 48 States in 0.05 degree increments in longitude (x-value) and latitude (y-value). See below for more information about the format of these data files.

Download Data Files

Data Type	Spectral Acceleration	Probability of Exceedance	Download
Gridded Hazard Map	Peak Ground Acceleration	2% in 50 years	Text (3.9MB)
Hazard Curve Data	5 Hz (0.2 sec)	N/A	Text (30.1MB)
Hazard Curve Data	1 Hz (1 sec)	N/A	Text (32.9MB)
Hazard Curve Data	Peak Ground Acceleration	N/A	Text (34.5MB)

Data File Formats

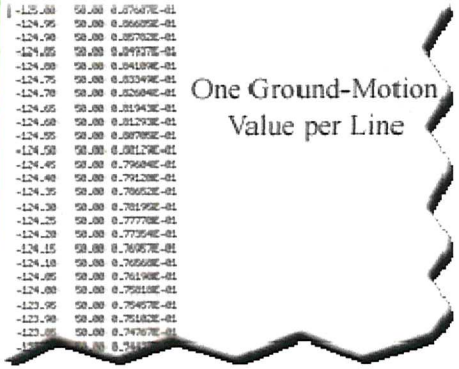
"Hazard Curves" Files



Sheet 4 of 6

These files contain hazard curves for the gridded geographic points as described above. All the hazard curves in the file share the same set of x-values (intensity measure levels). The first two lines tell you that these files contain data for both the western and central and eastern United States. The third line specifies the spectral period (in seconds) used when computing the hazard curves for the file. The following lines (with 1 value per line) contain the x-values (intensity measure levels) for all the curves in the file. Subsequent lines contain hazard curves with a single geographic point per line. The first two values specify the latitude and longitude (respectively) for the curve while subsequent values (on that same line) contain mean annual frequencies of exceedance ordered corresponding to the x-values at the top of the file.

"X% in 50 Years" Files



These files contain ground motion values for the gridded geographic points as described above. The ground motion units are in g where 1g = 980.5 cm/s/s and are defined for the B/C boundary (V_s^{30} = 760 m/s). Data contained in these files specify a single geographic point per line starting with longitude and latitude values (respectively), with the third and final value of each line specifying the ground motion for that geographic point.

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Sheet 5 of 6

2014 USGS SEISMIC HAZARD MAPPING DATA
(From Gridded Data; USGS Website)

Project: Callahan Mine - Tailings Impoundment
Location: Brooksville, Maine

Raw Data (from USGS)			Site-Specific Data (Interpolated)						
Westing	**Northing**	**PGA**	**Westing**	**Northing**	**PGA**	**Westing**	**Northing**	**PGA**	**0.5*PGA**
68.850	44.350	0.150	68.805	44.350	0.147	**68.805**	**44.342**	**0.146**	**0.073**
68.800	44.350	0.147							
68.850	44.300	0.145	68.805	44.300	0.142				
68.800	44.300	0.142							

Prepared By/Date: TCC 0'7/30/14
Checked By/Date: NDL 08/01/14

ATTACHMENT D-1B

PSEUDO-STATIC STABILITY ANALYSIS

BASIS FOR SELECTED SEISMIC COEFFICENT

United States
Environmental Protection
Agency

Office of Research and
Development
Washington DC 20460

EPA/600/R-95/051
April 1995

EPA

RCRA Subtitle D (258) Seismic Design Guidance for Municipal Solid Waste Landfill Facilities

EPA/600/R-95/051
April 1995

RCRA SUBTITLE D (258) SEISMIC DESIGN GUIDANCE FOR MUNICIPAL SOLID WASTE LANDFILL FACILITIES

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Contract No. 68-C3-0315

PROJECT MANAGER

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It is important to realize that the accelerations presented on the USGS maps are not the peak ground surface accelerations unless bedrock is exposed at the ground surface. Section 4.1 of this guidance document reviews methods for calculating the peak ground surface acceleration based on the site specific subgrade profile that exists above the top of lithified earth (rock) and the peak bedrock acceleration from the USGS map.

The peak acceleration is only one characteristic of the earthquake ground motion at a site. The damage potential of seismically-induced ground motions also depends upon the duration of the motion, the frequency content of the motion, and the intensity of the motion at times other than when the peak acceleration occurs. Acceleration, velocity, and displacement time-histories recorded at the top of the OII landfill in Los Angeles during the 17 January 1994 Northridge earthquake (Hushmand Associates, 1994) are shown on Figure 3.5. Note that the peak acceleration occurs only once during the record and that motions approaching the peak acceleration exist for only a small fraction of a second. Use of this peak acceleration for traditional geotechnical stability analyses is very conservative in most cases. Section 6.2 of this guidance document discusses the reduction of this peak ground surface acceleration to an equivalent pseudo-static acceleration for use in slope stability analyses.

3.3 References

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OII landfill. . Observations of the satisfactory performance of the OII landfill slopes in recent earthquakes combined with this plot indicate that the dynamic shear strength of MSW mobilized during seismic loading is greater than the values indicated in Figure 6.3.

6.1.6 Sensitivity Studies

It is strongly recommended that all stability analyses of MSW landfills be performed using parametric studies to clearly identify the sensitivity of the performance of the landfill to the material properties used in the analysis. If performance depends significantly on a given parameter, then additional laboratory or field testing may be required to better define appropriate properties for design.

6.2 Seismic Stability and Deformation Analysis

A prerequisite for performing a seismic slope stability and deformation analysis is performance of a static slope stability analysis. The seismic stability and deformation analysis is carried out using the same basic model(s) of landfill (waste mass and foundation) and containment system used in the static analysis. The following steps are used in a typical seismic slope stability and deformation analysis:

Step 1: Reinterpret the cross-sections analyzed in the static stability analysis and assign appropriate dynamic strength parameters. In cases where it is not clear whether drained or undrained shear strength parameters are appropriate for the dynamic analysis, follow guidelines presented in Duncan (1992).

Step 2: Evaluate the seismic coefficient, k_s. There are many different views on how to define k_s (e.g., Seed and Martin, 1966; Seed, 1979; Marcuson, 1981; Hynes and Franklin, 1984). The most reasonable definition appears to be one that regards the seismic coefficient as an empirical factor. This definition recognizes the limitations of the pseudo-static slope stability analysis in representing the actual effects of an earthquake on the slope. Unfortunately, this definition provides no guidance to selection of an appropriate value of k_s. Seed (1979) reports that clay slopes and embankments designed with a minimum pseudo-static factor of safety of 1.15 using a seismic coefficient of 0.15 have experienced "acceptable" deformations in earthquakes of magnitude less than 7.5 and intensity less than 0.75 g. However, Seed's definition of acceptable deformations appears to include deformations of over one meter in some cases.

Figure 6.5 shows the results of Newmark seismic deformation analyses performed by Hynes and Franklin (1984) using 387 strong motion records and 6 artificial accelerograms. Based upon this data and their experience with seismic response analyses of slopes and embankments, Hynes and Franklin (1984) concluded that slopes and embankments with a yield acceleration equal to half the peak ground acceleration would experience permanent seismic deformations of less than one meter (3 ft) in any earthquake, even for embankments where amplification of acceleration by a factor of three occurs. In the absence of amplification, or if amplification is taken into account in determining the peak acceleration, the Hynes and Franklin data suggest that deformations will remain less than 0.3 m (1 ft) for yield accelerations less than or equal to one-half the peak acceleration. Therefore, based upon the work of Hynes and Franklin, it appears that the maximum value of k_s may be determined as $k_s = 0.5 \cdot a_{max}/g$ to limit permanent seismic deformations to less than 0.3 m (1 ft), where a_{max} is peak horizontal acceleration at the ground surface for analyses of the liner system and at the top of the landfill for analyses of the cover system. a_{max} can be estimated either using the simplified methods presented in Section 4 of this guidance document or from the results of a seismic response analysis.

Step 3: Perform the pseudo-static stability analysis. If the minimum factor of safety, FS_{min}, exceeds 1.0 and 0.3 m (1 ft) of deformation is acceptable, the seismic stability analysis is completed.

Step 4: If the pseudo-static factor of safety is less than 1.0 or the acceptable deformation is less than 0.3 m (1 ft), perform a Newmark deformation analysis. This is done with the following three steps:

1) Calculate the yield acceleration, k_y. The yield acceleration is usually calculated in pseudo-static analyses using a trial and error procedure in which the seismic coefficient is varied until $FS_{min} = 1.0$ is obtained. The lowest yield acceleration for all possible failure surfaces passing through the liner, cover, and/or waste mass should be evaluated.

2) Calculate the permanent seismic deformation. The permanent seismic deformation may be calculated using either simplified design charts (e.g., Hynes and Franklin, 1984; Makdisi and Seed, 1978) or a formal time-history analysis in which the excursions of the average acceleration time history above the yield acceleration are double integrated.

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RATIONALIZING THE SEISMIC COEFFICIENT METHOD

by

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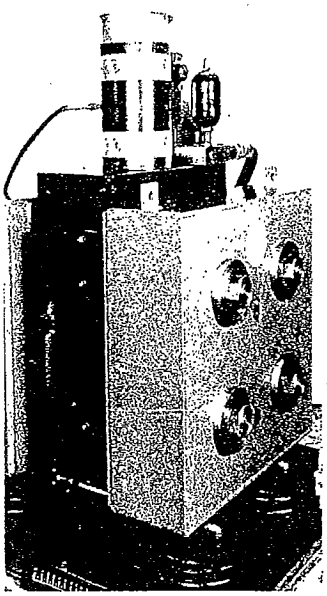

July 1984
Final Report

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Prepared for DEPARTMENT OF THE ARMY
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Under CWIS Work Unit 31145

PART III: CONCLUSIONS

29. The results of analysis of earthquake strong-motion records using a sliding block model and a decoupled elastic response analysis show that permanent displacements for deep-seated sliding surfaces limited to less than 1 m can be assured if the ratio of critical acceleration to peak bedrock acceleration is at least 0.5. This value is considered to be very conservative and subject to downward revision as better understanding of elastic-plastic amplification response of embankments is developed.

30. Furthermore, a pseudostatic, seismic coefficient analysis can serve as a useful screening procedure to separate dams that are clearly safe against earthquake-induced sliding failure from those that require further analysis. The permanent displacement analyses described in this report provide a rational basis for choosing the value of the seismic coefficient.

31. The suggested procedure is as follows:

a. Carry out a conventional pseudostatic stability analysis, using a seismic coefficient equal to one-half the predicted peak bedrock acceleration.

b. Use a composite S-R strength envelope for pervious soils, and the R (undrained) strength for clays, multiplying the shear strength in either case by 0.8.

c. Use a minimum factor of safety of 1.0.

32. This procedure should not be used in the following cases:

a. Where areas are subject to great earthquakes (of magnitude 8.0 or greater).

b. Where materials in either the embankment or foundation are susceptible to liquefaction under the design cyclic loading.

c. Where the available freeboard is small, or where the dam has safety-related features that are vulnerable to small deformations.

Geotechnical Earthquake Engineering

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Prentice-Hall International Series
in Civil Engineering and Engineering Mechanics

Prentice Hall
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Resisting moment:

Section	Length (ft)	c (lb/ft^2)	Force (kips)	Moment Arm (ft)	Moment (kip-ft/ft)
A	11.5	600	6.9	78	538.2
B	129.3	1000	129.3	78	10.085.4
					10.623.6

Factor of safety:

$$\text{Static FS} = \frac{\text{resisting moment}}{\text{static overturning moment}} = \frac{10.623.6}{5925.5} = 1.79$$

$$\text{Pseudostatic FS} = \frac{\text{resisting moment}}{\text{static + pseudostatic overturning moments}}$$

$$= \frac{10.623.6}{8281.1} = 1.28$$

Selection of Pseudostatic Coefficient. The results of pseudostatic analyses are critically dependent on the value of the seismic coefficient, k_h. Selection of an appropriate pseudostatic coefficient is the most important, and most difficult, aspect of a pseudostatic stability analysis. The seismic coefficient controls the pseudostatic force on the failure mass, so its value should be related to some measure of the amplitude of the inertial force induced in the potentially unstable material. If the slope material was rigid, the inertial force induced on a potential slide would be equal to the product of the actual horizontal acceleration and the mass of the unstable material. This inertial force would reach its maximum value when the horizontal acceleration reached its maximum value. In recognition of the fact that actual slopes are not rigid and that the peak acceleration exists for only a very short time, the pseudostatic coefficients used in practice generally correspond to acceleration values well below a_{max}. Terzaghi (1950) originally suggested the use of $k_h = 0.1$ for "severe" earthquakes (Rossi-Forel IX), $k_h = 0.2$ for "violent, destructive" earthquakes (Rossi-Forel X), and $k_h = 0.5$ for "catastrophic" earthquakes. Seed (1979) listed pseudostatic design criteria for 14 dams in 10 seismically active countries; 12 required minimum factors of safety of 1.0 to 1.5 with pseudostatic coefficients of 0.10 to 0.12. Marcuson (1981) suggested that appropriate pseudostatic coefficients for dams should correspond to one-third to one-half of the maximum acceleration, including amplification or deamplification effects, to which the dam is subjected. Using shear beam models, Seed and Martin (1966) and Dakoulas and Gazetas (1986) showed that the inertial force on a potentially unstable slope in an earth dam depends on the response of the dam and that the average seismic coefficient for a deep failure surface is substantially smaller than that of a failure surface that does not extend far below the crest. Seed (1979) also indicated that deformations of earth dams constructed of ductile soils (defined as those that do not generate high pore pressures or show more than 15% strength loss upon cyclic loading) with crest accelerations less than 0.75g would be acceptably small for pseudostatic factors of safety of at least 1.15 with $k_h = 0.10$ ($M = 6.5$) to $k_h = 0.15$ ($M = 8.25$). This criteria would allow the use of pseudostatic accelerations as small as 13 to 20% of the peak crest acceleration. Hynes-Griffin and Franklin (1984) applied the Newmark sliding block analysis described in the following section to over 350 accelerograms and concluded that earth dams with pseudostatic factors of safety greater than 1.0 using $k_h = 0.5a_{max}/g$ would not develop "dangerously large" deformations.

As the preceding discussion indicates, there are no hard and fast rules for selection of a pseudostatic coefficient for design. It seems clear, however, that the pseudostatic coefficient should be based on the actual anticipated level of acceleration in the failure mass (including any amplification or deamplification effects) and that it should correspond to some fraction of the anticipated peak acceleration. Although engineering judgment is required for all cases, the criteria of Hynes-Griffin and Franklin (1984) should be appropriate for most slopes.

Limitations of the Pseudostatic Approach. Representation of the complex, transient, dynamic effects of earthquake shaking by a single constant unidirectional pseudostatic acceleration is obviously quite crude. Even in its infancy, the limitations of the pseudostatic approach were clearly recognized. Terzaghi (1950) stated that "the concept it conveys of earthquake effects on slopes is very inaccurate, to say the least," and that a slope could be unstable even if the computed pseudostatic factor of safety was greater than 1. Detailed analyses of historical and recent earthquake-induced landslides (e.g., Seed et al., 1969, 1975; Marcuson et al., 1979) have illustrated significant shortcomings of the pseudostatic approach. Experience has clearly shown, for example, that pseudostatic analyses can be unreliable for soils that build up large pore pressures or show more than about 15% degradation of strength due to earthquake shaking. As illustrated in Table 10-4, pseudostatic analyses produced factors of safety well above 1 for a number of dams that later failed during earthquakes. These cases illustrate the inability of the pseudostatic method to reliably evaluate the stability of slopes susceptible to weakening instability. Nevertheless, the pseudostatic approach can provide at least a crude index of relative, if not absolute, stability.

Discussion. The pseudostatic approach has a number of attractive features. The analysis is relatively simple and straightforward; indeed, its similarity to the static limit equilibrium analyses routinely conducted by geotechnical engineers makes its computations easy to understand and perform. It produces a scalar index of stability (the factor of safety) that is analogous to that produced by static stability analyses. It must always be recognized, however, that the accuracy of the pseudostatic approach is governed by the accuracy with which the simple pseudostatic inertial forces represent the complex dynamic inertial forces that actually exist in an earthquake. Difficulty in the assignment of appropriate pseudostatic coefficients and in interpretation of pseudostatic factors of safety, coupled with the development of more realistic methods of analysis, have reduced the use of the pseudostatic approach for seismic slope stability analyses. Methods based on evaluation of permanent slope deformation, such as those described in the following sections, are being used increasingly for seismic slope stability analysis.

Table 10-4 Results of Pseudostatic Analyses of Earth Dams That Failed during Earthquakes

Dam	k_h	FS	Effect of Earthquake
Sheffield Dam	0.10	1.2	Complete failure
Lower San Fernando Dam	0.15	1.3	Upstream slope failure
Upper San Fernando Dam	0.15	~2–2.5	Downstream shell, including crest slipped about 6 ft downstream
Tailings dam (Japan)	0.20	~1.3	Failure of dam with release of tailings

Source: After Seed (1979).

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SEISMIC COEFFICIENTS FOR PSEUDOSTATIC SLOPE ANALYSIS

Cristiano MELO[1] and Sunil SHARMA[2]

SUMMARY

Pseudostatic analysis is one of the simplest approaches used in earthquake engineering to analyze the seismic response of soil embankments and slopes. However, the choice of seismic coefficients used in the analysis can be arbitrary and generally lacks rationale. To investigate this, a parametric study was performed on a soil embankment of varied geometric characteristics and soil properties subjected to three different strong ground motions obtained during the 1994 Northridge earthquake. The dynamic response of the embankment model was used to calculate seismic coefficient time histories for critical failure surfaces generated through conventional limit equilibrium analysis. FLAC, a two-dimensional explicit finite difference program developed by the Itasca Consulting Group for engineering mechanics computations, was used for the dynamic analysis. The soil behavior was modeled by the Mohr-Coulomb constitutive relationship. Once the seismic coefficient time histories were obtained, a procedure was used to compute weighted average seismic coefficients for each of the time histories. The weighted average seismic coefficients obtained in this fashion were analyzed for possible correlations with the parameters used in the study. The results obtained should provide a more rational approach for selecting seismic coefficients for pseudostatic analysis.

1.0 INTRODUCTION

Limit equilibrium analysis has traditionally been used to assess the stability of slopes. This procedure consists of analyzing the cross section of the potential slide mass, called the failure surface (refer to line ab in Figure 1), as either a circular or non-circular surface. The area enclosed between the slope face and the failure surface, known as the failure mass, is subdivided into a series of slices which are then analyzed for equilibrium by several computational methods. In earthquake prone areas, horizontal and vertical pseudostatic (seismic) coefficients, k_h and k_v, respectively, are used to compute the horizontal and vertical forces caused by a potential earthquake, as shown in Figure 1. These forces are in turn added to the overall equilibrium computation for the individual slices composing the failure surface. Studies based on Newmark's displacement-type analysis (Newmark [1]) and field observations indicate that the pseudostatic method can be useful in evaluating the performance of embankments constructed of soils that do not lose significant strength during earthquakes. Such soils include clays, clayey soils, dry or moist cohesionless soils, and dense cohesionless soils (Seed [2]).

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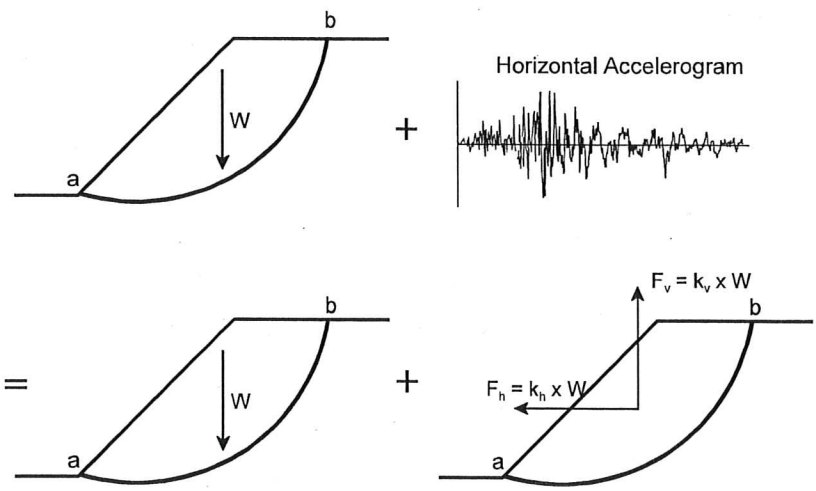


Figure 1 Pseudostatic analysis approach.

Selection of an appropriate seismic coefficient is the most important, and difficult, aspect of a pseudostatic stability analysis. In theory, the seismic coefficient values should depend on some measure of the amplitude of the inertial force induced in the slope by the dynamic forces generated during an earthquake. Because soil slopes are not rigid and the peak acceleration generated during an earthquake last for only a very short period of time, seismic coefficients used in practice generally correspond to acceleration values well below the predicted peak accelerations (Kramer [3]). However, the choice of coefficients used in the slope stability analysis is very subjective and lacks a clear rationale. Table 1 below shows horizontal seismic coefficient values that have been recommended for design.

Table 1 – Recommended Horizontal Seismic Coefficients

Horizontal Seismic Coefficient, k_h	Description	
0.05 - 0.15	In the United States	
0.12 - 0.25	In Japan	
0.1	"severe" earthquakes	Terzaghi [4]
0.2	"violent, destructive" earthquakes	
0.5	"catastrophic" earthquakes	
0.1 - 0.2	Seed [2], FOS ≥ 1.15	
0.10	Major Earthquake, FOS > 1.0	Corps of Engineers [5]
0.15	Great Earthquake, FOS > 1.0	
½ to ⅓ of PHA	Marcuson [6], FOS >1.0	
½ of PHA	Hynes-Griffin [7], FOS > 1.0	
FOS = Factor of Safety. PHA = Peak Horizontal Acceleration, in g's.		

As shown in Table 1, there are no specific rules for selection of an appropriate seismic coefficient for design. However, the different selection criteria suggest that the seismic coefficient should be based on the anticipated level of acceleration within the failure mass and should correspond to some fraction of the anticipated peak acceleration (Kramer [3]).

Due to the limitations in the selection process of seismic coefficients used in design, a parametric study was performed on a soil embankment of varied geometric characteristics and soil properties subjected to three different strong ground motions obtained during the 1994 Northridge earthquake. The two-dimensional explicit finite difference program FLAC was used to perform the static and dynamic analyses of the embankment. Based on the seismic response obtained from FLAC, seismic coefficients were computed for the different embankment slopes analyzed. It is hoped that the results of the study will allow practitioners to choose seismic coefficients based on the specific geometry and properties of a slope, as well as the characteristics of a specific design earthquake.

2.0 NUMERICAL ANALYSIS OF SLOPES

The finite element method has been used extensively to analyze stresses in a variety of man-made and natural slopes, especially embankment slopes where the desired stresses are often located along a curved failure surface through the interior of the embankment. The accuracy of a finite element analysis depends on the type of element used, fineness of mesh, mesh layout, the geometry of the problem, and the constitutive model used to simulate the stress-strain behavior of the soils. The different discretization schemes used in finite element analysis of slopes during the last three decades show great variability in the size and shape of the elements used. For an embankment of height H, element heights range from H/4 to H/25, with H/10 being the most popular value. The most commonly used element is either a three or four node element, but in the last decade, eight and nine node elements have become more common. The element aspect ratios (height/width) have usually been close to one, but ranging from 1/3 to 3 (Ashford [8]).

Several computer programs that are based on either the finite element or the finite difference method have been used to perform seismic analysis of soil embankments. Some examples of programs used to perform seismic analysis of soil embankment slopes include QUAD-4, FLUSH, and FLAC. The set of algebraic equations solved by the finite difference method is identical to that solved with the finite element method for a given number of element shape functions. However, in the finite difference method, the set of algebraic equations is solved using dynamic relaxation, an explicit, time-marching procedure in which the full dynamic equations of motion are integrated step by step. Static solutions are computed by including damping terms that gradually remove kinematic energy from the system (Dawson [9]).

Version 3.3 of FLAC, which stands for Fast Lagrangian Analysis of Continua, was used in the parametric study discussed here (Itasca Consulting Group [10]). FLAC is a time domain, two-dimensional explicit finite difference program used for engineering mechanics computations. This program is primarily intended for geotechnical engineering applications and simulates the behavior of models/structures composed of soil, rock, or other materials that may undergo plastic flow when their yield limits are reached. Materials are represented by quadrilateral elements, which form a mesh or grid that is shaped as the object to be modeled. Elements and grid points are numbered in a row-and-column fashion rather than in a sequential manner. The program uses two dimensional arrays (I,J) and (i,j) to define the elements and nodes, respectively, within its discrete mesh. An uppercase "I" and a lowercase "i" specify the location of an element and a node, respectively, columnwise, from left to right, starting at column one, while an uppercase "J" and a lowercase "j" specify the location of an element and a node, respectively, rowwise, from bottom to top, starting at row one. The grid elements within the mesh behave according to a prescribed linear or non-linear stress/strain behavior in response to the applied forces or boundary restraints. The material can yield and flow, and the mesh can deform and move with the material that is represented. FLAC has ten built-in material models. For dynamic analysis, user-specified acceleration, velocity, or stress waves can be input directly to the model either as an

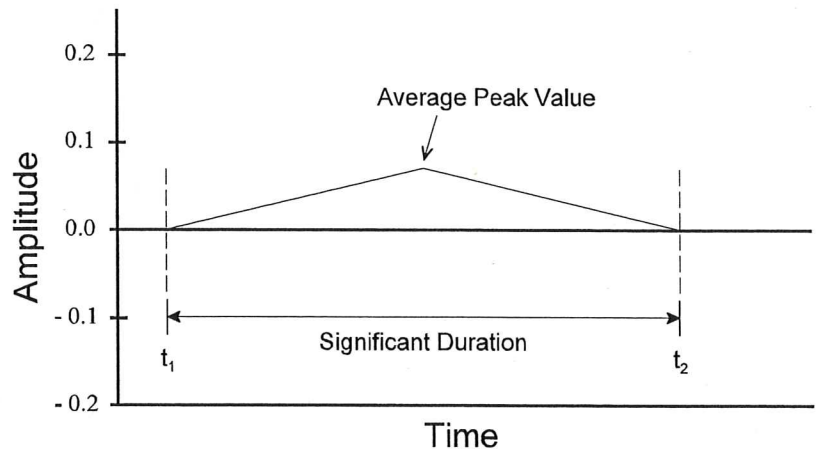


Figure 9 Equivalent single peak.

5.0 RESULTS AND DISCUSSIONS

5.1 Seismic Coefficient Results

Table 5 presents a summary of the 81 k_h and k_v time history results generated using FLAC. The computed absolute peak values of k_h (row 1, column 1) ranged from 0.172 to 0.677. These values are high in comparison to the recommended design coefficients shown in Table 1. By contrast, the weighted average of k_h (row 2, column 1) ranged from 0.054 to 0.213. These values are well within the range of recommended values presented in Table 1, and seem to validate the accuracy and appropriateness of the methodology used in the study. In addition, a mean value of 0.459 was obtained for the ratio of the weighted average of k_h to PHA. This value is, very interestingly, close to the k_h = ½ × PHA recommended by Hynes-Griffin [7] in Table 1.

Table 5 – Summary of the k_h and k_v Time Histories Generated in FLAC

Description			Range (1)	Mean (2)	Standard Deviation (3)
k_h	1	Absolute Peak value	0.172 - 0.677	0.367	0.094
	2	Weighted average	0.054 - 0.213	0.112	0.029
	3	Ratio of weighted average to PHA	0.212 - 0.897	0.459	0.156
	4	Significant Duration (seconds)	10.43 - 27.94	20.84	5.14
k_v	5	Absolute Peak value	0.002 - 0.301	0.091	0.072
	6	Weighted average	0.000 - 0.081	0.027	0.024
	7	Ratio of weighted average to PHA	0.000 - 0.431	0.167	0.079
	8	Significant Duration (seconds)	0.000 - 22.13	5.08	5.83
PHA in units of g's.					

The charts developed show that a linear relationship exists between the parameters used and the computed weighted average values of k_h. However, additional data would be necessary to improve the correlation. Figure 10 shows the correlation chart developed for a 1H:1V slope. If the linear fit (solid line) shown on this chart is extended to the right of the chart, unacceptably high k_h values will result (k_h/PHA > 1.0). Therefore, as the data points in the charts move to the right of the independent axis, the linear trend should increase up to a resonance condition and then drop, as depicted by the dashed lines in Figure 10. This anticipated behavior would resemble a magnification factor plot for the response of linear single degree of freedom systems (for reference, see Kramer [3]).

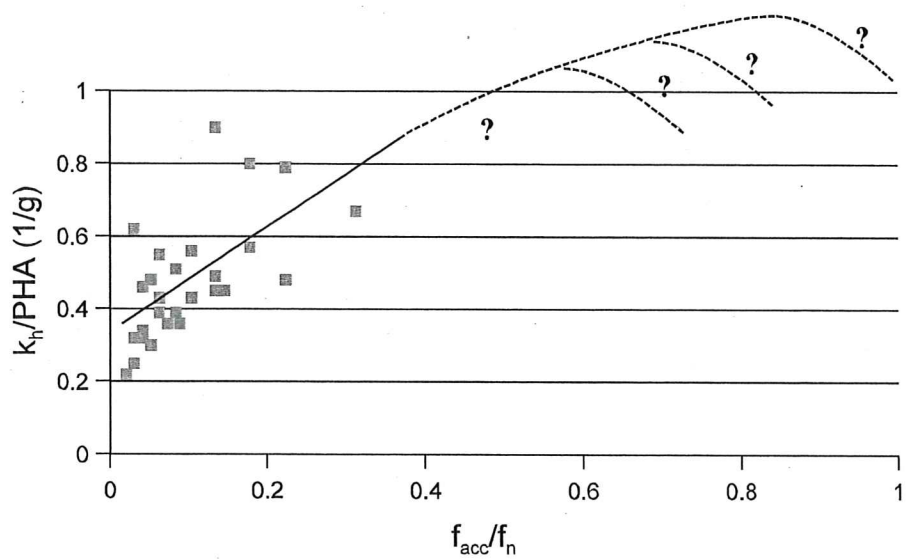


Figure 10 Possible relationship for k_h as the data points move to the right of the suggested charts developed in the study (figure based on the 1H:1V slope).

In addition to the correlations described above, another procedure based on the ratio of the computed weighted average k_h values to PHA was used in the attempt to choose suitable coefficients for design. A solver routine was used to assess the fraction of k_h/PHA that would give the lowest cumulative absolute residual for the 81 analyses performed in the study. The fraction of PHA that yielded the lowest cumulative absolute residual resulted in $k_h = 0.422 \times$ PHA. Based on this result, the k_h value of ½ PHA recommended by Hynes-Griffin [7] appears to define an upper bound in the choice of seismic coefficients for design.

6.0 SUMMARY AND CONCLUSIONS

A parametric study was performed on a soil embankment in order to assess the dependency of seismic coefficients to the geometry and properties of soil slopes, as well as the characteristics of input ground motions. An approach that accounted for the duration of the transient forces applied along the critical failure surface during different earthquakes was developed. The procedure weighted the highest computed seismic coefficient values based on the actual distribution of the energy content within the recorded time history. The approach yielded results that were representative of the overall dynamic forces developed during the earthquakes. The seismic coefficients computed in this fashion were consistent with the current state of practice.

For instance, the mean of the ratio of the weighted average of k_h to PHA was 0.459 and the best linear fit for the ratio of the weighted average of k_h to PHA was 0.422. These results suggest that perhaps k_h values ranging from 40 to 45 % of the PHA should be used in slope stability design, rather than the 50 % of the PHA proposed by Hynes-Griffin [7], whose study was subjective and relied on Newmark's [1] displacement methodology.

Because only horizontal accelerograms were used in the study, the vertical seismic coefficients computed were considerably smaller than the horizontal ones. However, as pointed out by Chopra [15] and Idriss [16], when the effects of the vertical component of ground motions are included in a seismic analysis study, larger vertical seismic coefficients are computed. These larger values, then become relevant to slope stability analysis.

Potential design charts for seismic coefficients were proposed based on the parameters varied in the study. As an added bonus to using the finite difference method in the analyses, potential design charts for horizontal displacements near the slope face were also proposed based on the parameters of interest. It is hoped that these relationships will benefit and add to the expanding database concerning the choice of seismic coefficients for design, as well as the displacements experienced along the slope face of an embankment during an earthquake.

7.0 CLOSURE

Additional details of the study discussed here are presented in the masters of science thesis issued in 2000 by Melo [17]. For instance, correlation charts developed from the seismic coefficients results obtained from FLAC as well as information on the horizontal and vertical displacement obtained from the 81 analyses performed were not presented here due to the space constraints.

As in the case of all scientific models, there are certain limitations associated with this study. The model used relied on the pseudostatic approach, which assumes that the soil embankment behaves as a rigid body, and that the accelerations developed during the earthquake are uniform throughout the embankment section and are equal at all times to the ground acceleration. However, in reality the embankment does not behave as a rigid body because the accelerations developed through the embankment will vary geometrically and temporally.

Furthermore, the study did not take into account pore pressure generation and dissipation (pore water pressures were assumed to be zero). Also, the Mohr-Coulomb soil model used to represent the soil continuum does not account for strength degradation due to cyclic loading. These two conditions are critical when analyzing soil embankments composed of liquefiable materials. Another limitation in the study involved the number of analyses performed. The 81 data points could only provide limited information concerning possible trends in the parametric study.

The study presented here could be expanded in the future to include the contribution of the vertical component of earthquake ground motions, pore pressure generation, and soil strength degradation towards the overall response of soil embankments to earthquake motions. Also, the soil foundation thickness could be varied in the new analysis.

ATTACHMENT D-1C

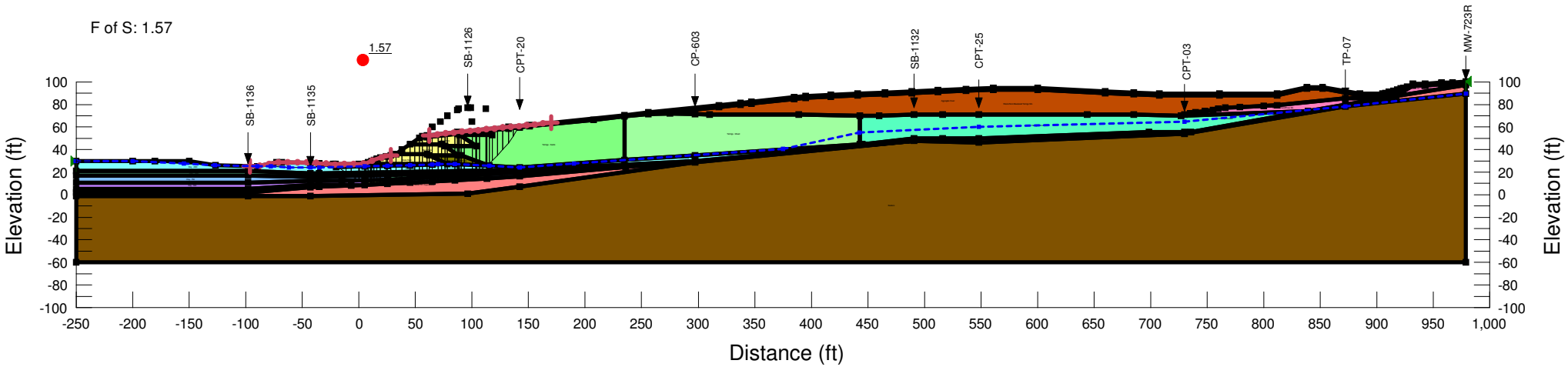
PSEUDO-STATIC STABILITY ANALYSIS

SLOPE/W OUTPUT FOR LONG-TERM POST-REMEDIATION CONDITIONS

Title: Callahan Mine OU3 - Profile S2
Date: 10/16/2014
File Name: Tailings_Profile S2_Proposed Cond_90%.gsz

Name: Profile S2; a2 - Proposed - PseudoStatic - Till Imp - 1/2 PGA
Method: Spencer

Name: Waste Rock Model: Mohr-Coulomb Unit Weight: 120 pcf Cohesion': 0 psf Phi': 42 ° Constant Unit Wt. Above Water Table: 95 pcf Piezometric Line: 1
Name: Tailings - Sands Model: Mohr-Coulomb Unit Weight: 120 pcf Cohesion': 0 psf Phi': 37 ° Constant Unit Wt. Above Water Table: 110 pcf Piezometric Line: 1
Name: Tailings - Mixed Model: Mohr-Coulomb Unit Weight: 117 pcf Cohesion': 0 psf Phi': 36 ° Constant Unit Wt. Above Water Table: 110 pcf Piezometric Line: 1
Name: Tailings - Slimes Model: Mohr-Coulomb Unit Weight: 114 pcf Cohesion': 0 psf Phi': 35 ° Constant Unit Wt. Above Water Table: 110 pcf Piezometric Line: 1
Name: Fill - Rock/Sand/Fines Mix Model: Mohr-Coulomb Unit Weight: 130 pcf Cohesion': 25 psf Phi': 36 ° Constant Unit Wt. Above Water Table: 120 pcf Piezometric Line: 1
Name: Clay - 1250 Model: Undrained (Phi=0) Unit Weight: 122 pcf Cohesion': 1,250 psf Piezometric Line: 1
Name: Bedrock Model: Bedrock (Impenetrable) Piezometric Line: 1
Name: Reworked Clay/Till - Su Model: Undrained (Phi=0) Unit Weight: 125 pcf Cohesion': 2,000 psf Constant Unit Wt. Above Water Table: 120 pcf Piezometric Line: 1
Name: Clay - 750 Model: Undrained (Phi=0) Unit Weight: 121 pcf Cohesion': 750 psf Piezometric Line: 1
Name: Clay - 500 Model: Undrained (Phi=0) Unit Weight: 120 pcf Cohesion': 500 psf Piezometric Line: 1
Name: Waste Rock/Dewatered Tailings Mix Model: Mohr-Coulomb Unit Weight: 125 pcf Cohesion': 0 psf Phi': 38 ° Constant Unit Wt. Above Water Table: 115 pcf Piezometric Line: 1
Name: Glacial Till - Impenetrable Model: Bedrock (Impenetrable) Piezometric Line: 1
Name: Clay - 525 Model: Undrained (Phi=0) Unit Weight: 120 pcf Cohesion': 525 psf Piezometric Line: 1
Name: Clay - 950 Model: Undrained (Phi=0) Unit Weight: 121 pcf Cohesion': 950 psf Piezometric Line: 1
Name: Clay - 1175 Model: Undrained (Phi=0) Unit Weight: 122 pcf Cohesion': 1,175 psf Piezometric Line: 1
Name: Clay - 775 Model: Undrained (Phi=0) Unit Weight: 120 pcf Cohesion': 775 psf Piezometric Line: 1
Name: Clay - 825 Model: Undrained (Phi=0) Unit Weight: 120 pcf Cohesion': 825 psf Piezometric Line: 1
Name: Clay - 400 Model: Undrained (Phi=0) Unit Weight: 118 pcf Cohesion': 400 psf Piezometric Line: 1
Name: Clay - 1500 Model: Undrained (Phi=0) Unit Weight: 122 pcf Cohesion': 1,500 psf Piezometric Line: 1
Name: Clay - 2000 Model: Undrained (Phi=0) Unit Weight: 123 pcf Cohesion': 2,000 psf Piezometric Line: 1
Name: Aggregate Cover Model: Mohr-Coulomb Unit Weight: 100 pcf Cohesion': 0 psf Phi': 41 ° Piezometric Line: 1
Name: Clay - 600 Model: Undrained (Phi=0) Unit Weight: 120 pcf Cohesion': 600 psf Piezometric Line: 1
Name: Clay - 1125 Model: Undrained (Phi=0) Unit Weight: 122 pcf Cohesion': 1,125 psf Piezometric Line: 1
Name: Clay - 975 Model: Undrained (Phi=0) Unit Weight: 121 pcf Cohesion': 975 psf Piezometric Line: 1
Name: Clay - 1150 Model: Undrained (Phi=0) Unit Weight: 122 pcf Cohesion': 1,150 psf Piezometric Line: 1

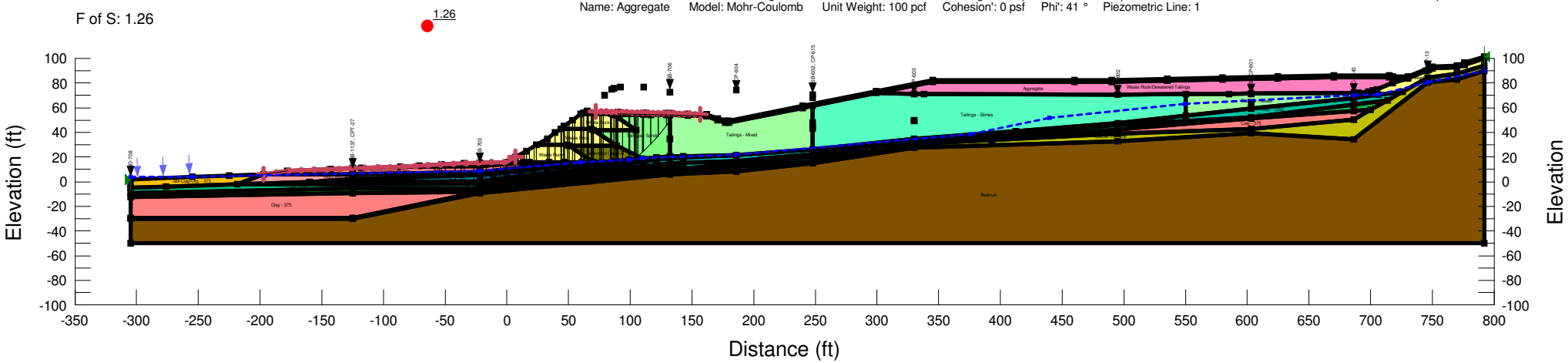


Title: Callahan Mine OU3 - Profile E1
Date: 10/16/2014
File Name: Tailings_Profile E1_Proposed-Cond_90%.gsz

Name: Profile E1; a2a - Proposed - Pseudo-Static - Crest/Toe - Till Imp - 1/2 PGA
Method: Spencer

Name: Waste Rock Model: Mohr-Coulomb Unit Weight: 120 pcf Cohesion': 0 psf Phi': 42 ° Constant Unit Wt. Above Water Table: 95 pcf Piezometric Line: 1
Name: Tailings - Sands Model: Mohr-Coulomb Unit Weight: 120 pcf Cohesion': 0 psf Phi': 37 ° Constant Unit Wt. Above Water Table: 110 pcf Piezometric Line: 1
Name: Tailings - Mixed Model: Mohr-Coulomb Unit Weight: 116 pcf Cohesion': 0 psf Phi': 36 ° Constant Unit Wt. Above Water Table: 110 pcf Piezometric Line: 1
Name: Tailings - Slimes Model: Mohr-Coulomb Unit Weight: 114 pcf Cohesion': 0 psf Phi': 35 ° Constant Unit Wt. Above Water Table: 110 pcf Piezometric Line: 1
Name: Glacial Till - Imp Model: Bedrock (Impenetrable) Piezometric Line: 1
Name: Fill - Rock/Sand/Fines Mix Model: Mohr-Coulomb Unit Weight: 130 pcf Cohesion': 25 psf Phi': 36 ° Constant Unit Wt. Above Water Table: 120 pcf Piezometric Line: 1
Name: Fill - Sand/Fines/Org. Mix Model: Mohr-Coulomb Unit Weight: 120 pcf Cohesion': 25 psf Phi': 32 ° Constant Unit Wt. Above Water Table: 115 pcf Piezometric Line: 1
Name: SM-Clay/Org. - 375 Model: Undrained (Phi=0) Unit Weight: 105 pcf Cohesion': 375 psf Constant Unit Wt. Above Water Table: 85 pcf Piezometric Line: 1
Name: Clay - 2750 Model: Undrained (Phi=0) Unit Weight: 125 pcf Cohesion': 2,750 psf Piezometric Line: 1
Name: Clay - 2250 Model: Undrained (Phi=0) Unit Weight: 124 pcf Cohesion': 2,250 psf Piezometric Line: 1
Name: Clay - 1750 Model: Undrained (Phi=0) Unit Weight: 123 pcf Cohesion': 1,750 psf Piezometric Line: 1
Name: Clay - 1250 Model: Undrained (Phi=0) Unit Weight: 122 pcf Cohesion': 1,250 psf Piezometric Line: 1
Name: Clay - 875 Model: Undrained (Phi=0) Unit Weight: 121 pcf Cohesion': 875 psf Piezometric Line: 1
Name: Clay - 625 Model: Undrained (Phi=0) Unit Weight: 120 pcf Cohesion': 625 psf Piezometric Line: 1
Name: Clay - 475 Model: Undrained (Phi=0) Unit Weight: 119 pcf Cohesion': 475 psf Piezometric Line: 1
Name: Clay - 375 Model: Undrained (Phi=0) Unit Weight: 118 pcf Cohesion': 375 psf Piezometric Line: 1
Name: Bedrock Model: Bedrock (Impenetrable) Piezometric Line: 1
Name: Reworked Clay/Till Model: Undrained (Phi=0) Unit Weight: 125 pcf Cohesion': 2,000 psf Constant Unit Wt. Above Water Table: 120 pcf Piezometric Line: 1
Name: Clay - 1075 Model: Undrained (Phi=0) Unit Weight: 122 pcf Cohesion': 1,075 psf Piezometric Line: 1
Name: SM-Clay-Org. - 750 Model: Undrained (Phi=0) Unit Weight: 105 pcf Cohesion': 750 psf Constant Unit Wt. Above Water Table: 85 pcf Piezometric Line: 1
Name: SM-Clay - 1000 Model: Undrained (Phi=0) Unit Weight: 120 pcf Cohesion': 1,000 psf Constant Unit Wt. Above Water Table: 105 pcf Piezometric Line: 1
Name: Clay - 525 Model: Undrained (Phi=0) Unit Weight: 120 pcf Cohesion': 525 psf Piezometric Line: 1
Name: Clay - 1375 Model: Undrained (Phi=0) Unit Weight: 122 pcf Cohesion': 1,375 psf Piezometric Line: 1
Name: Clay - 1175 Model: Undrained (Phi=0) Unit Weight: 122 pcf Cohesion': 1,175 psf Piezometric Line: 1
Name: Clay - 925 Model: Undrained (Phi=0) Unit Weight: 121 pcf Cohesion': 925 psf Piezometric Line: 1
Name: Clay - 675 Model: Undrained (Phi=0) Unit Weight: 120 pcf Cohesion': 675 psf Piezometric Line: 1
Name: Clay - 1050 Model: Undrained (Phi=0) Unit Weight: 122 pcf Cohesion': 1,050 psf Piezometric Line: 1
Name: Clay - 1200 Model: Undrained (Phi=0) Unit Weight: 122 pcf Cohesion': 1,200 psf Piezometric Line: 1
Name: Clay - 1225 Model: Undrained (Phi=0) Unit Weight: 122 pcf Cohesion': 1,225 psf Piezometric Line: 1
Name: Clay - 950 Model: Undrained (Phi=0) Unit Weight: 121 pcf Cohesion': 950 psf Piezometric Line: 1
Name: Clay - 1325 Model: Undrained (Phi=0) Unit Weight: 122 pcf Cohesion': 1,325 psf Piezometric Line: 1
Name: Waste Rock/Dewatered Tailings Model: Mohr-Coulomb Unit Weight: 125 pcf Cohesion': 0 psf Phi': 38 ° Constant Unit Wt. Above Water Table: 115 pcf Piezometric Line: 1
Name: Aggregate Model: Mohr-Coulomb Unit Weight: 100 pcf Cohesion': 0 psf Phi': 41 ° Piezometric Line: 1

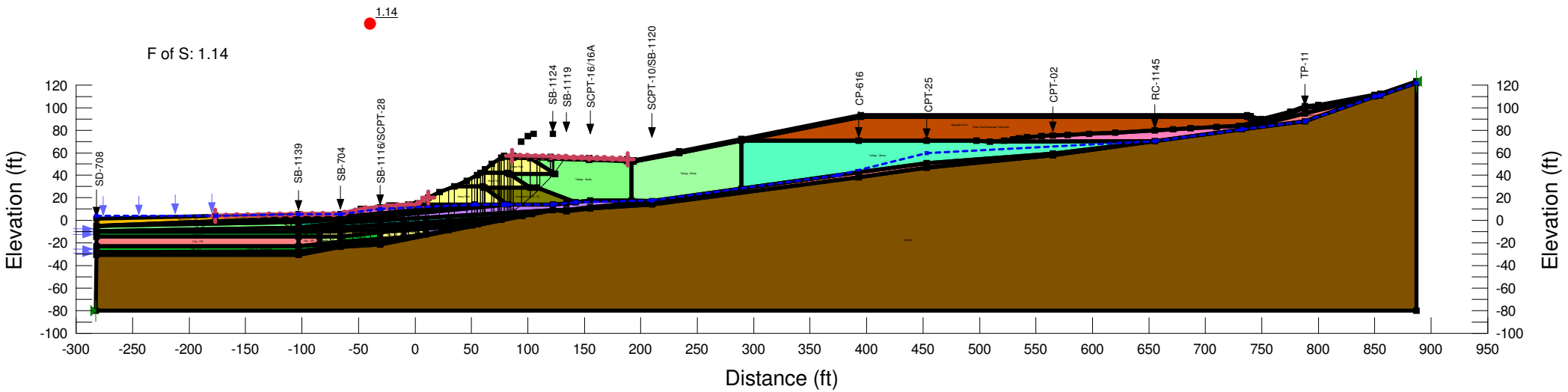
F of S: 1.26



Title: Callahan Mine OU3 - Profile E2
Date: 10/16/2014
File Name: Tailings_Profile E2_Proposed Cond_90%.gsz

Name: Profile E2; a1 - Proposed - Pseudo 1/2 PGA - Crest-Toe - Till Imp
Method: Spencer

Name: Waste Rock Model: Mohr-Coulomb Unit Weight: 120 pcf Cohesion': 0 psf Phi': 42 ° Constant Unit Wt. Above Water Table: 95 pcf Piezometric Line: 1
Name: Tailings - Sands Model: Mohr-Coulomb Unit Weight: 120 pcf Cohesion': 0 psf Phi': 37 ° Constant Unit Wt. Above Water Table: 110 pcf Piezometric Line: 1
Name: Tailings - Mixed Model: Mohr-Coulomb Unit Weight: 117 pcf Cohesion': 0 psf Phi': 36 ° Constant Unit Wt. Above Water Table: 110 pcf Piezometric Line: 1
Name: Tailings - Slimes Model: Mohr-Coulomb Unit Weight: 114 pcf Cohesion': 0 psf Phi': 35 ° Constant Unit Wt. Above Water Table: 110 pcf Piezometric Line: 1
Name: Fill - Rock/Sand/Fines Mix Model: Mohr-Coulomb Unit Weight: 130 pcf Cohesion': 25 psf Phi': 36 ° Constant Unit Wt. Above Water Table: 120 pcf Piezometric Line: 1
Name: SM-Clay/Org. - 375 Model: Undrained (Phi=0) Unit Weight: 105 pcf Cohesion': 375 psf Constant Unit Wt. Above Water Table: 85 pcf Piezometric Line: 1
Name: SM-Clay/Org. - 750 Model: Undrained (Phi=0) Unit Weight: 125 pcf Cohesion': 750 psf Constant Unit Wt. Above Water Table: 105 pcf Piezometric Line: 1
Name: Clay - 2750 Model: Undrained (Phi=0) Unit Weight: 125 pcf Cohesion': 2,750 psf Piezometric Line: 1
Name: Clay - 1750 Model: Undrained (Phi=0) Unit Weight: 123 pcf Cohesion': 1,750 psf Piezometric Line: 1
Name: Clay - 1250 Model: Undrained (Phi=0) Unit Weight: 122 pcf Cohesion': 1,250 psf Piezometric Line: 1
Name: Clay - 625 Model: Undrained (Phi=0) Unit Weight: 120 pcf Cohesion': 625 psf Piezometric Line: 1
Name: Clay - 475 Model: Undrained (Phi=0) Unit Weight: 119 pcf Cohesion': 475 psf Piezometric Line: 1
Name: Clay - 375 Model: Undrained (Phi=0) Unit Weight: 118 pcf Cohesion': 375 psf Piezometric Line: 1
Name: Bedrock Model: Bedrock (Impenetrable) Piezometric Line: 1
Name: Reworked Clay/Till - Su Model: Undrained (Phi=0) Unit Weight: 125 pcf Cohesion': 2,000 psf Constant Unit Wt. Above Water Table: 120 pcf Piezometric Line: 1
Name: Clay - 1075 Model: Undrained (Phi=0) Unit Weight: 122 pcf Cohesion': 1,075 psf Piezometric Line: 1
Name: SM-Clay - 1000 Model: Undrained (Phi=0) Unit Weight: 120 pcf Cohesion': 1,000 psf Constant Unit Wt. Above Water Table: 105 pcf Piezometric Line: 1
Name: Waste Rock/Dewatered Tailings Mix Model: Mohr-Coulomb Unit Weight: 125 pcf Cohesion': 0 psf Phi': 38 ° Constant Unit Wt. Above Water Table: 115 pcf Piezometric Lin
Name: Glacial Till - Impenetrable Model: Bedrock (Impenetrable) Piezometric Line: 1
Name: Clay - 525 Model: Undrained (Phi=0) Unit Weight: 120 pcf Cohesion': 525 psf Piezometric Line: 1
Name: Clay - 675 Model: Undrained (Phi=0) Unit Weight: 120 pcf Cohesion': 675 psf Piezometric Line: 1
Name: Clay - 925 Model: Undrained (Phi=0) Unit Weight: 121 pcf Cohesion': 925 psf Piezometric Line: 1
Name: Clay - 1225 Model: Undrained (Phi=0) Unit Weight: 122 pcf Cohesion': 1,225 psf Piezometric Line: 1
Name: Clay - 825 Model: Undrained (Phi=0) Unit Weight: 120 pcf Cohesion': 825 psf Piezometric Line: 1
Name: Clay - 575 Model: Undrained (Phi=0) Unit Weight: 120 pcf Cohesion': 575 psf Piezometric Line: 1
Name: Clay - 725 Model: Undrained (Phi=0) Unit Weight: 121 pcf Cohesion': 725 psf Piezometric Line: 1
Name: Clay - 700 Model: Undrained (Phi=0) Unit Weight: 121 pcf Cohesion': 700 psf Piezometric Line: 1
Name: Clay - 425 Model: Undrained (Phi=0) Unit Weight: 118 pcf Cohesion': 425 psf Piezometric Line: 1
Name: SM-Clay - 1250 Model: Undrained (Phi=0) Unit Weight: 120 pcf Cohesion': 1,250 psf Constant Unit Wt. Above Water Table: 105 pcf Piezometric Line: 1
Name: Aggregate Cover Model: Mohr-Coulomb Unit Weight: 100 pcf Cohesion': 0 psf Phi': 41 ° Piezometric Line: 1
Name: Clay - 3000 Model: Undrained (Phi=0) Unit Weight: 125 pcf Cohesion': 3,000 psf Piezometric Line: 1
Name: Clay - 975 Model: Undrained (Phi=0) Unit Weight: 121 pcf Cohesion': 975 psf Piezometric Line: 1

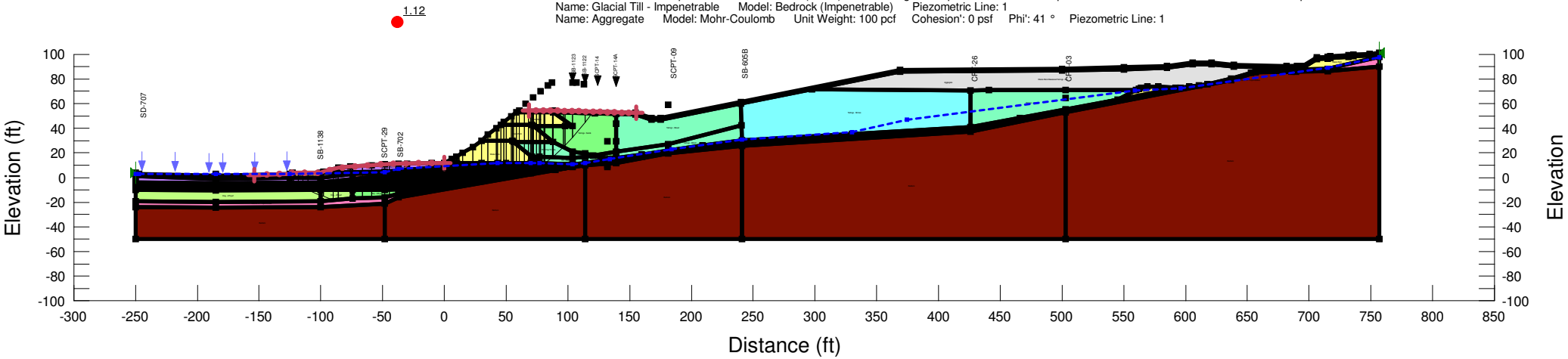


Title: Callahan Mine OU3 - Profile E3
Date: 10/16/2014
File Name: Tailings_Profile-E3_Proposed-Cond_90%.gsz

Name: Profile E-3; a2a - Proposed - Pseudo-Static - Crest/Toe - Till Imp - 1/2 PGA
Method: Spencer

F of S: 1.12

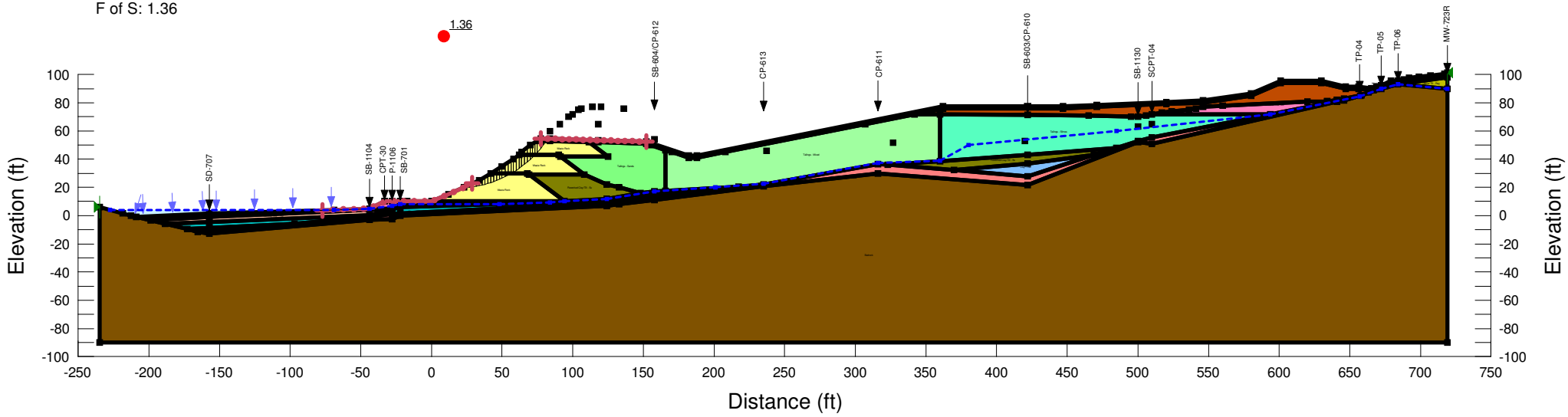
Name: Waste Rock Model: Mohr-Coulomb Unit Weight: 120 pcf Cohesion': 0 psf Phi': 42 ° Constant Unit Wt. Above Water Table: 95 pcf Piezometric Line: 1
Name: Tailings - Sands Model: Mohr-Coulomb Unit Weight: 120 pcf Cohesion': 0 psf Phi': 37 ° Constant Unit Wt. Above Water Table: 110 pcf Piezometric Line: 1
Name: Tailings - Mixed Model: Mohr-Coulomb Unit Weight: 117 pcf Cohesion': 0 psf Phi': 36 ° Constant Unit Wt. Above Water Table: 108 pcf Piezometric Line: 1
Name: Tailings - Slimes Model: Mohr-Coulomb Unit Weight: 114 pcf Cohesion': 0 psf Phi': 35 ° Constant Unit Wt. Above Water Table: 106 pcf Piezometric Line: 1
Name: Fill - Rock/Sand/Fines Mix Model: Mohr-Coulomb Unit Weight: 130 pcf Cohesion': 25 psf Phi': 36 ° Constant Unit Wt. Above Water Table: 125 pcf Piezometric Line: 1
Name: Salt Marsh - 1000 psf Model: Undrained (Phi=0) Unit Weight: 120 pcf Cohesion': 1,000 psf Constant Unit Wt. Above Water Table: 115 pcf Piezometric Line: 1
Name: Salt Marsh - 625 psf Model: Undrained (Phi=0) Unit Weight: 115 pcf Cohesion': 625 psf Constant Unit Wt. Above Water Table: 85 pcf Piezometric Line: 1
Name: Salt Marsh - 375 psf Model: Undrained (Phi=0) Unit Weight: 110 pcf Cohesion': 375 psf Constant Unit Wt. Above Water Table: 105 pcf Piezometric Line: 1
Name: Clay - 2750 psf Model: Undrained (Phi=0) Unit Weight: 125 pcf Cohesion': 2,750 psf Piezometric Line: 1
Name: Clay - 2250 psf Model: Undrained (Phi=0) Unit Weight: 125 pcf Cohesion': 2,250 psf Piezometric Line: 1
Name: Clay - 1750 psf Model: Undrained (Phi=0) Unit Weight: 123 pcf Cohesion': 1,750 psf Piezometric Line: 1
Name: Clay - 1500 psf Model: Undrained (Phi=0) Unit Weight: 123 pcf Cohesion': 1,500 psf Piezometric Line: 1
Name: Clay - 1250 psf Model: Undrained (Phi=0) Unit Weight: 123 pcf Cohesion': 1,250 psf Piezometric Line: 1
Name: Clay - 875 psf Model: Undrained (Phi=0) Unit Weight: 121 pcf Cohesion': 875 psf Piezometric Line: 1
Name: Clay - 750 psf Model: Undrained (Phi=0) Unit Weight: 121 pcf Cohesion': 750 psf Piezometric Line: 1
Name: Clay - 625 psf Model: Undrained (Phi=0) Unit Weight: 121 pcf Cohesion': 625 psf Piezometric Line: 1
Name: Clay - 550 psf Model: Undrained (Phi=0) Unit Weight: 120 pcf Cohesion': 550 psf Piezometric Line: 1
Name: Clay - 475 psf Model: Undrained (Phi=0) Unit Weight: 118 pcf Cohesion': 475 psf Piezometric Line: 1
Name: Clay - 375 psf Model: Undrained (Phi=0) Unit Weight: 118 pcf Cohesion': 375 psf Piezometric Line: 1
Name: Fill - Clay/Till - Su Model: Undrained (Phi=0) Unit Weight: 125 pcf Cohesion': 2,000 psf Constant Unit Wt. Above Water Table: 120 pcf Piezometric Line: 1
Name: Waste Rock/Dewatered Tailings - Mix Model: Mohr-Coulomb Unit Weight: 125 pcf Cohesion': 0 psf Phi': 38 ° Constant Unit Wt. Above Water Table: 115 pcf Piezometric Line: 1
Name: Bedrock Model: Bedrock (Impenetrable) Piezometric Line: 1
Name: Clay - 800 psf Model: Undrained (Phi=0) Unit Weight: 121 pcf Cohesion': 800 psf Piezometric Line: 1
Name: Clay - 1075 psf Model: Undrained (Phi=0) Unit Weight: 122 pcf Cohesion': 1,075 psf Piezometric Line: 1
Name: Clay - 400 psf Model: Undrained (Phi=0) Unit Weight: 120 pcf Cohesion': 400 psf Piezometric Line: 1
Name: Clay - 450 psf Model: Undrained (Phi=0) Unit Weight: 120 pcf Cohesion': 450 psf Piezometric Line: 1
Name: Clay - 700 psf Model: Undrained (Phi=0) Unit Weight: 120 pcf Cohesion': 700 psf Piezometric Line: 1
Name: Clay - 925 psf Model: Undrained (Phi=0) Unit Weight: 120 pcf Cohesion': 925 psf Piezometric Line: 1
Name: Clay - 1350 psf Model: Undrained (Phi=0) Unit Weight: 123 pcf Cohesion': 1,350 psf Piezometric Line: 1
Name: Clay - 1425 psf Model: Undrained (Phi=0) Unit Weight: 123 pcf Cohesion': 1,425 psf Piezometric Line: 1
Name: Salt Marsh - 800 psf Model: Undrained (Phi=0) Unit Weight: 115 pcf Cohesion': 800 psf Constant Unit Wt. Above Water Table: 85 pcf Piezometric Line: 1
Name: Glacial Till - Impenetrable Model: Bedrock (Impenetrable) Piezometric Line: 1
Name: Aggregate Model: Mohr-Coulomb Unit Weight: 100 pcf Cohesion': 0 psf Phi': 41 ° Piezometric Line: 1



Title: Callahan Mine OU3 - Profile E4
Date: 10/16/2014
File Name: Tailings_Profile E4_Proposed-Cond_90%.gsz

Name: Profile E4; a2a - Proposed - Pseudo-Static - Crest/Toe - Till Imp - 1/2 PGA
Method: Spencer

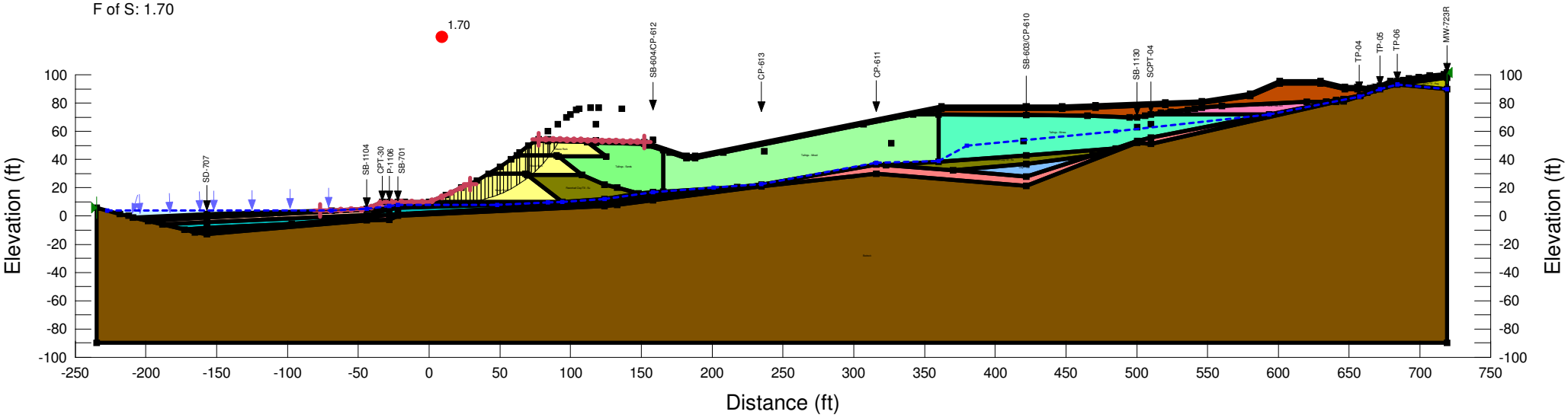
Name: Waste Rock Model: Mohr-Coulomb Unit Weight: 120 pcf Cohesion': 0 psf Phi': 42 ° Constant Unit Wt. Above Water Table: 95 pcf Piezometric Line: 1
Name: Tailings - Sands Model: Mohr-Coulomb Unit Weight: 120 pcf Cohesion': 0 psf Phi': 37 ° Constant Unit Wt. Above Water Table: 110 pcf Piezometric Line: 1
Name: Tailings - Mixed Model: Mohr-Coulomb Unit Weight: 117 pcf Cohesion': 0 psf Phi': 36 ° Constant Unit Wt. Above Water Table: 110 pcf Piezometric Line: 1
Name: Tailings - Slimes Model: Mohr-Coulomb Unit Weight: 114 pcf Cohesion': 0 psf Phi': 35 ° Constant Unit Wt. Above Water Table: 110 pcf Piezometric Line: 1
Name: Glacial Till - Reg Model: Mohr-Coulomb Unit Weight: 135 pcf Cohesion': 50 psf Phi': 36 ° Constant Unit Wt. Above Water Table: 130 pcf Piezometric Line: 1
Name: Fill - Rock/Sand/Fines Mix Model: Mohr-Coulomb Unit Weight: 130 pcf Cohesion': 25 psf Phi': 36 ° Constant Unit Wt. Above Water Table: 120 pcf Piezometric Line: 1
Name: SM-Clay/Org. - 375 Model: Undrained (Phi=0) Unit Weight: 105 pcf Cohesion': 375 psf Constant Unit Wt. Above Water Table: 85 pcf Piezometric Line: 1
Name: SM-Clay/Org. - 750 Model: Undrained (Phi=0) Unit Weight: 125 pcf Cohesion': 750 psf Constant Unit Wt. Above Water Table: 105 pcf Piezometric Line: 1
Name: Clay - 1750 Model: Undrained (Phi=0) Unit Weight: 123 pcf Cohesion': 1,750 psf Piezometric Line: 1
Name: Bedrock Model: Bedrock (Impenetrable) Piezometric Line: 1
Name: Reworked Clay/Till - Su Model: Undrained (Phi=0) Unit Weight: 125 pcf Cohesion': 2,000 psf Constant Unit Wt. Above Water Table: 120 pcf Piezometric Line: 1
Name: SM-Clay - 1000 Model: Undrained (Phi=0) Unit Weight: 120 pcf Cohesion': 1,000 psf Constant Unit Wt. Above Water Table: 105 pcf Piezometric Line: 1
Name: Clay - 750 Model: Undrained (Phi=0) Unit Weight: 121 pcf Cohesion': 750 psf Piezometric Line: 1
Name: Waste Rock/Dewatered Tailings Mix Model: Mohr-Coulomb Unit Weight: 125 pcf Cohesion': 0 psf Phi': 38 ° Constant Unit Wt. Above Water Table: 115 pcf Piezometric Line: 1
Name: Glacial Till - Impenetrable Model: Bedrock (Impenetrable) Piezometric Line: 1
Name: Aggregate Model: Mohr-Coulomb Unit Weight: 100 pcf Cohesion': 0 psf Phi': 41 ° Piezometric Line: 1



Title: Callahan Mine OU3 - Profile E4
Date: 10/16/2014
File Name: Tailings_Profile E4_Proposed-Cond_90%.gsz

Name: Profile E4; a2a - Proposed - Pseudo-Static - Crest/Toe - Till Imp - 1/2 PGA
Method: Spencer

Name: Waste Rock Model: Mohr-Coulomb Unit Weight: 120 pcf Cohesion': 0 psf Phi': 42 ° Constant Unit Wt. Above Water Table: 95 pcf Piezometric Line: 1
Name: Tailings - Sands Model: Mohr-Coulomb Unit Weight: 120 pcf Cohesion': 0 psf Phi': 37 ° Constant Unit Wt. Above Water Table: 110 pcf Piezometric Line: 1
Name: Tailings - Mixed Model: Mohr-Coulomb Unit Weight: 117 pcf Cohesion': 0 psf Phi': 36 ° Constant Unit Wt. Above Water Table: 110 pcf Piezometric Line: 1
Name: Tailings - Slimes Model: Mohr-Coulomb Unit Weight: 114 pcf Cohesion': 0 psf Phi': 35 ° Constant Unit Wt. Above Water Table: 110 pcf Piezometric Line: 1
Name: Glacial Till - Reg Model: Mohr-Coulomb Unit Weight: 135 pcf Cohesion': 50 psf Phi': 36 ° Constant Unit Wt. Above Water Table: 130 pcf Piezometric Line: 1
Name: Fill - Rock/Sand/Fines Mix Model: Mohr-Coulomb Unit Weight: 130 pcf Cohesion': 25 psf Phi': 36 ° Constant Unit Wt. Above Water Table: 120 pcf Piezometric Line: 1
Name: SM-Clay/Org. - 375 Model: Undrained (Phi=0) Unit Weight: 105 pcf Cohesion': 375 psf Constant Unit Wt. Above Water Table: 85 pcf Piezometric Line: 1
Name: SM-Clay/Org. - 750 Model: Undrained (Phi=0) Unit Weight: 125 pcf Cohesion': 750 psf Constant Unit Wt. Above Water Table: 105 pcf Piezometric Line: 1
Name: Clay - 1750 Model: Undrained (Phi=0) Unit Weight: 123 pcf Cohesion': 1,750 psf Piezometric Line: 1
Name: Bedrock Model: Bedrock (Impenetrable) Piezometric Line: 1
Name: Reworked Clay/Till - Su Model: Undrained (Phi=0) Unit Weight: 125 pcf Cohesion': 2,000 psf Constant Unit Wt. Above Water Table: 120 pcf Piezometric Line: 1
Name: SM-Clay - 1000 Model: Undrained (Phi=0) Unit Weight: 120 pcf Cohesion': 1,000 psf Constant Unit Wt. Above Water Table: 105 pcf Piezometric Line: 1
Name: Clay - 750 Model: Undrained (Phi=0) Unit Weight: 121 pcf Cohesion': 750 psf Piezometric Line: 1
Name: Waste Rock/Dewatered Tailings Mix Model: Mohr-Coulomb Unit Weight: 125 pcf Cohesion': 0 psf Phi': 38 ° Constant Unit Wt. Above Water Table: 115 pcf Piezometric Line: 1
Name: Glacial Till - Impenetrable Model: Bedrock (Impenetrable) Piezometric Line: 1
Name: Aggregate Model: Mohr-Coulomb Unit Weight: 100 pcf Cohesion': 0 psf Phi': 41 ° Piezometric Line: 1



Title: Callahan Mine OU3 - Profile N1
Date: 10/16/2014
File Name: Tailings_Profile N1_Proposed-Cond_90%.gsz

Name: Profile N1; a2a - Proposed - Pseudo-Static - Crest/Toe - Till Imp - 1/2 PGA
Method: Spencer

Name: Waste Rock Model: Mohr-Coulomb Unit Weight: 120 pcf Cohesion': 0 psf Phi': 42 ° Constant Unit Wt. Above Water Table: 95 pcf Piezometric Line: 1
Name: Tailings - Sands Model: Mohr-Coulomb Unit Weight: 120 pcf Cohesion': 0 psf Phi': 37 ° Constant Unit Wt. Above Water Table: 110 pcf Piezometric Line: 1
Name: Tailings - Mixed Model: Mohr-Coulomb Unit Weight: 117 pcf Cohesion': 0 psf Phi': 36 ° Constant Unit Wt. Above Water Table: 110 pcf Piezometric Line: 1
Name: Tailings - Slimes Model: Mohr-Coulomb Unit Weight: 114 pcf Cohesion': 0 psf Phi': 35 ° Constant Unit Wt. Above Water Table: 110 pcf Piezometric Line: 1
Name: Fill - Rock/Sand/Fines Mix Model: Mohr-Coulomb Unit Weight: 130 pcf Cohesion': 25 psf Phi': 36 ° Constant Unit Wt. Above Water Table: 120 pcf Piezometric Line: 1
Name: Fill - Sand/Fines/Org. Mix Model: Mohr-Coulomb Unit Weight: 120 pcf Cohesion': 25 psf Phi': 32 ° Constant Unit Wt. Above Water Table: 115 pcf Piezometric Line: 1
Name: SM-Clay/Org. - 750 Model: Undrained (Phi=0) Unit Weight: 125 pcf Cohesion': 750 psf Constant Unit Wt. Above Water Table: 105 pcf Piezometric Line: 1
Name: Clay - 2750 Model: Undrained (Phi=0) Unit Weight: 125 pcf Cohesion': 2,750 psf Piezometric Line: 1
Name: Clay - 2250 Model: Undrained (Phi=0) Unit Weight: 124 pcf Cohesion': 2,250 psf Piezometric Line: 1
Name: Clay - 1750 Model: Undrained (Phi=0) Unit Weight: 123 pcf Cohesion': 1,750 psf Piezometric Line: 1
Name: Clay - 1250 Model: Undrained (Phi=0) Unit Weight: 122 pcf Cohesion': 1,250 psf Piezometric Line: 1
Name: Clay - 475 Model: Undrained (Phi=0) Unit Weight: 119 pcf Cohesion': 475 psf Piezometric Line: 1
Name: Bedrock Model: Bedrock (Impenetrable) Piezometric Line: 1
Name: Reworked Clay/Till - Su Model: Undrained (Phi=0) Unit Weight: 125 pcf Cohesion': 2,000 psf Constant Unit Wt. Above Water Table: 120 pcf Piezometric Line: 1
Name: Clay - 1075 Model: Undrained (Phi=0) Unit Weight: 122 pcf Cohesion': 1,075 psf Piezometric Line: 1
Name: SM-Clay - 1000 Model: Undrained (Phi=0) Unit Weight: 120 pcf Cohesion': 1,000 psf Constant Unit Wt. Above Water Table: 105 pcf Piezometric Line: 1
Name: Clay - 750 Model: Undrained (Phi=0) Unit Weight: 121 pcf Cohesion': 750 psf Piezometric Line: 1
Name: Waste Rock/Dewatered Tailings Mix Model: Mohr-Coulomb Unit Weight: 125 pcf Cohesion': 0 psf Phi': 38 ° Constant Unit Wt. Above Water Table: 115 pcf Piezometric
Name: Glacial Till - Impenetrable Model: Bedrock (Impenetrable) Piezometric Line: 1
Name: Clay - 1375 Model: Undrained (Phi=0) Unit Weight: 122 pcf Cohesion': 1,375 psf Piezometric Line: 1
Name: Clay - 950 Model: Undrained (Phi=0) Unit Weight: 121 pcf Cohesion': 950 psf Piezometric Line: 1
Name: Clay - 1200 Model: Undrained (Phi=0) Unit Weight: 122 pcf Cohesion': 1,200 psf Piezometric Line: 1
Name: Clay - 550 Model: Undrained (Phi=0) Unit Weight: 120 pcf Cohesion': 550 psf Piezometric Line: 1
Name: Clay - 1800 Model: Undrained (Phi=0) Unit Weight: 123 pcf Cohesion': 1,800 psf Piezometric Line: 1
Name: Clay - 825 Model: Undrained (Phi=0) Unit Weight: 120 pcf Cohesion': 825 psf Piezometric Line: 1
Name: Clay - 1875 Model: Undrained (Phi=0) Unit Weight: 123 pcf Cohesion': 1,875 psf Piezometric Line: 1
Name: Clay - 2050 Model: Undrained (Phi=0) Unit Weight: 123 pcf Cohesion': 2,050 psf Piezometric Line: 1
Name: Clay - 1550 Model: Undrained (Phi=0) Unit Weight: 122 pcf Cohesion': 1,550 psf Piezometric Line: 1
Name: Clay - 2150 Model: Undrained (Phi=0) Unit Weight: 124 pcf Cohesion': 2,150 psf Piezometric Line: 1
Name: Clay - 2200 Model: Undrained (Phi=0) Unit Weight: 124 pcf Cohesion': 2,200 psf Piezometric Line: 1
Name: Clay - 1700 Model: Undrained (Phi=0) Unit Weight: 123 pcf Cohesion': 1,700 psf Piezometric Line: 1
Name: Clay - 1450 Model: Undrained (Phi=0) Unit Weight: 122 pcf Cohesion': 1,450 psf Piezometric Line: 1
Name: Clay - 2000 Model: Undrained (Phi=0) Unit Weight: 123 pcf Cohesion': 2,000 psf Piezometric Line: 1
Name: Clay - 1500 Model: Undrained (Phi=0) Unit Weight: 122 pcf Cohesion': 1,500 psf Piezometric Line: 1
Name: Clay - 2500 Model: Undrained (Phi=0) Unit Weight: 124 pcf Cohesion': 2,500 psf Piezometric Line: 1
Name: SM-Clay/Org. - 1500 Model: Undrained (Phi=0) Unit Weight: 125 pcf Cohesion': 1,500 psf Constant Unit Wt. Above Water Table: 105 pcf Piezometric Line: 1
Name: SM-Clay/Org. - 1050 Model: Undrained (Phi=0) Unit Weight: 125 pcf Cohesion': 1,050 psf Constant Unit Wt. Above Water Table: 105 pcf Piezometric Line: 1
Name: SM-Clay/Org. - 1175 Model: Undrained (Phi=0) Unit Weight: 125 pcf Cohesion': 1,175 psf Constant Unit Wt. Above Water Table: 105 pcf Piezometric Line: 1
Name: SM-Clay/Org. - 1200 Model: Undrained (Phi=0) Unit Weight: 125 pcf Cohesion': 1,200 psf Constant Unit Wt. Above Water Table: 105 pcf Piezometric Line: 1
Name: SM-Clay/Org. - 1300 Model: Undrained (Phi=0) Unit Weight: 125 pcf Cohesion': 1,300 psf Constant Unit Wt. Above Water Table: 105 pcf Piezometric Line: 1
Name: SM-Clay/Org. - 1375 Model: Undrained (Phi=0) Unit Weight: 125 pcf Cohesion': 1,375 psf Constant Unit Wt. Above Water Table: 105 pcf Piezometric Line: 1
Name: SM-Clay/Org. - 1450 Model: Undrained (Phi=0) Unit Weight: 125 pcf Cohesion': 1,450 psf Constant Unit Wt. Above Water Table: 105 pcf Piezometric Line: 1
Name: Clay - 1300 Model: Undrained (Phi=0) Unit Weight: 122 pcf Cohesion': 1,300 psf Piezometric Line: 1
Name: Clay - 1950 Model: Undrained (Phi=0) Unit Weight: 123 pcf Cohesion': 1,950 psf Piezometric Line: 1
Name: Clay - 2125 Model: Undrained (Phi=0) Unit Weight: 124 pcf Cohesion': 2,125 psf Piezometric Line: 1
Name: Clay - 1625 Model: Undrained (Phi=0) Unit Weight: 123 pcf Cohesion': 1,625 psf Piezometric Line: 1
Name: Aggregate Model: Mohr-Coulomb Unit Weight: 100 pcf Cohesion': 0 psf Phi': 41 ° Piezometric Line: 1

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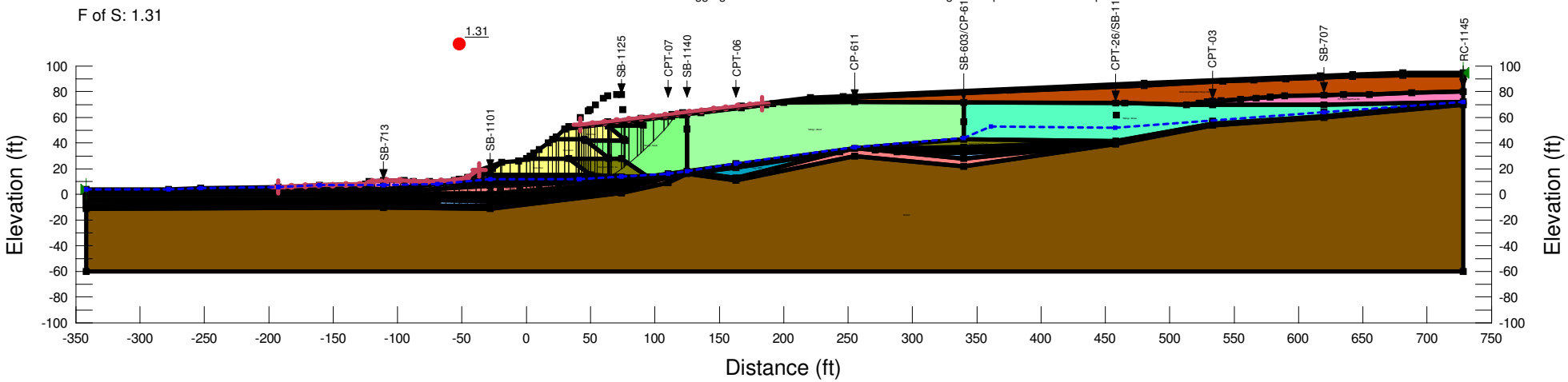

ATTACHMENT D-2

POST-EARTHQUAKE STABILITY ANALYSIS
PROFILE E3

ATTACHMENT D-2A

POST-EARTHQUAKE STABILITY ANALYSIS
PROFILE E3

CYCLIC STRENGTH TESTING OF PRESUMPSCOT CLAY

HALEY & ALDRICH INC.

Geotechnical Engineers &
Environmental Consultants

3 July 1995
File No. 80403-003

Regional Waste Systems, Inc.
64 Blueberry Road
Portland, Maine 04102-1945

Attention: Mr. Eric Root

Subject: Post-Earthquake Slope Stability Analyses
Ashfill/Balefill
South Portland, Maine

Gentlemen:

This report presents the results of cyclic testing and post-earthquake slope stability analyses for the Ashfill/Balefill in South Portland, Maine. This work was completed in accordance with our services agreement dated 10 March 1995.

In summary, results of cyclic testing disclose no loss of strength for clay specimens after application of a static shear stress, 13 cycles of loading and subsequent static stress to failure. Using these results, acceptable factors of safety are calculated for the critical slope section. Specific conclusions and recommendations are presented below.

INTRODUCTION

The Ashfill/Balefill is located in South Portland, as shown on Figure 1, Project Locus. Previous investigations at the site, conducted by ABB Environmental Services, Inc. (ABB), established the estimated static factors of safety for the Ashfill/Balefill slopes. The results of ABB's analyses are provided in their report titled "Report on Stability Analysis of the Ash/Bale Fill Facility, South Portland, Maine", dated 15 December 1993. Subsequently, the Maine Department of Environmental Protection (DEP), required that a "post-earthquake" static stability analysis be performed, which included an evaluation of the potential reduction in shear strength of the clay foundation soil due to cyclic loading.

Peterson-Rabasca Geoengineers (PRG) undertook a supplemental geotechnical field program which included additional field testing, recovery of thin-wall tube samples for laboratory testing and installation of additional field instruments. Results of their work are presented in their report titled "Phase IIA Supplemental Geotechnical Investigation" dated 3 July 1995.

BACKGROUND

The Haley & Aldrich, Inc. (H&A) work plan for the post-earthquake static stability analysis is presented in our letters dated 9 November 1994 and 28 February 1995. Briefly, our analysis consists of performing

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sensitivity analysis for the critical slope section, assessing the behavior of the clay subjected to combined static and cyclic loading and performing post-earthquake slope stability analysis using the shear strengths determined from cyclic testing. This work scope was developed based on discussions with DEP and the following DEP related correspondence:

- Comments on review of ABB December 1993 Report in letter from Robert G. Gerber, Inc. (RGG), dated 27 April 1994, which included recommendation for post-earthquake static stability analysis considering earthquake reduced strengths. RGG acted as technical consultant on behalf of DEP in review of the ABB report.

- Comments on review of H&A proposed seismic stability analysis (H&A letter dated 9 November 1994) in memorandum from RGG, dated 14 December 1994, which included suggestion for at least 10 cycles of loading and testing to exceed the combined static and cyclic shear stresses of 0.87 (87%) of the static direct simple shear strength.

SUBSURFACE EXPLORATIONS

Boring P-3 was drilled during the period 26 September to 18 October 1994 as part of the supplemental geotechnical field program conducted by PRG. Nine 3-in. diameter thin-wall tube samples of the underlying clay were recovered for laboratory soil testing. A discussion of the field and laboratory program is presented in the June 1995 report by PRG. A copy of the log of P-3 is included in Appendix A.

SUBSURFACE CONDITIONS

Subsurface conditions disclosed by the supplemental field program are discussed in the May 1995 report by PRG. In general, conditions consist of up to 2 ft. of fill, underlain by approximately 10 ft. of stiff, brown silty clay, underlain in turn by 35 to 70 ft. of soft, gray silty clay and 10 to 60 ft. of ice contact deposits, glacial till and bedrock.

LABORATORY SOIL TESTING

The laboratory testing program for this investigation consisted of performing three direct simple shear (DSS) tests at the Massachusetts Institute of Technology Geotechnical Laboratory under the direction of Dr. J.T. Germaine. The DSS specimens were selected from tube U7, at an approximate depth of 43 ft. below ground surface (approximately El. 28). Tube U7 was selected because it was obtained from within a zone that demonstrated anomalously low field vane shear strengths. A more complete discussion of field vane shear testing is presented in the May 1995 report by PRG.

The proposed test parameters were as follows:

PROPOSED δ'_{vo} (kg/cm^2)	PRE-CYCLIC SHEAR ζ_{av}/δ'_{vo}	CYCLIC SHEAR ζ_{cy}/δ'_{vo}	NUMBER OF CYCLES	POST-CYCLIC SHEAR TO FAILURE
4.0	0.054	0.054	13	YES
4.0	0.09	0.054	13	YES
4.0	0.126	0.054	13	YES

Each specimen was extruded from the tube, trimmed and enclosed in a wire reinforced membrane. The specimen was then consolidated to the proposed consolidation stress at a constant rate of strain. The maximum consolidation stress was held constant for approximately 24 hours. An initial undrained static (pre-cyclic) shear stress was applied to each specimen, followed by an undrained cyclic shear stress for 13 cycles and then an undrained post-cyclic static shear stress to failure. Based on previous DSS testing, discussed in the PRG report, we anticipated an undrained static strength ratio, s_u/δ'_{vc}, of 0.19. Undrained pre-cyclic shear stress ratios (ζ_{av}/δ'_{vc}) of approximately 0.3, 0.5 and 0.7, equivalent to approximately 30, 50 and 70 percent of the undrained shear strength ratio (s_u/δ'_{vc}), were selected. A cyclic shear stress ratio (ζ_{cy}/δ'_{vc}) of 0.054, equivalent to approximately 30 percent of the undrained shear strength ratio was selected.

The combined static and cyclic shear stresses would then range from approximately 0.6 to 1.0 times the undrained static shear strength. These values were selected because they represent the range in ratios of static stress to static strength and cyclic stress to static strength anticipated beneath the ashfill for Phase II loading. For example, if the static factor of safety is approximately 1.5, it is likely that the ratio of static stress to static strength will be on the order of 0.67 (or the soil is stressed to the ratio of 1.0/1.5 of the shear strength). The anticipated seismic shear stress ratio will be approximately 0.19 (Seed and Idriss, 1971). Thus, static and cyclic stresses would total approximately 0.86, within the range of applied stresses for the cyclic DSS testing.

The DSS tests were run as stress controlled tests. The applied shear stress reached the design value after 3 cycles of loading. By applying 13 cycles of loading, each specimen was subjected to a minimum of 10 cycles of maximum stress. By comparison, the appropriate design earthquake for the site would be associated with approximately six to seven significant cycles of ground shaking (Seed and Idriss, 1971).

Results of the DSS tests are presented in Table I, Summary of DSS Strength Testing . Plots of axial strain, shear strain, shear stress and modulus are included in Appendix B. Individual results for each test are discussed below.

DSS412 - The specimen was consolidated to an effective vertical stress of 4.03 kg. per sq. cm. and an initial pre-cyclic undrained shear stress ratio of 0.065 (34% of the static strength ratio) was applied. A shear strain of approximately 0.1 % was measured. The specimen was then subjected to 13 cycles of undrained loading at an additional shear stress ratio of 0.055 (29% of the strength ratio). A peak cyclic strain of 0.05% was recorded. Following cyclic loading, the specimen was strained to failure. A

maximum post-cyclic shear stress ratio of 0.202 was measured. The specimen exhibited no reduction in shear strength after static and cyclic loading from the estimated static strength ratio of 0.19.

DSS413 - The specimen was consolidated to an effective vertical stress of 4.03 kg. per sq. cm. and an initial pre-cyclic undrained shear stress ratio of 0.086 (45% of the static strength ratio) was applied. A shear strain of approximately 0.21% was measured. The specimen was then subjected to 13 cycles of undrained loading at an additional shear stress ratio of 0.056 (29% of the strength ratio). A peak cyclic strain of 0.06% was measured. Following cyclic loading, the specimen was strained to failure. A maximum post-cyclic shear stress ratio of 0.197 was measured. The specimen exhibited no reduction in shear strength after static and cyclic loading from the estimated static strength ratio of 0.19.

DSS415 - This specimen was consolidated to an effective vertical stress of 4.03 kg. per sq. cm. and initial pre-cyclic undrained shear stress ratio of 0.120 (63% of the static strength ratio) was applied. A shear strain of approximately 0.41% was recorded. The specimen was then subjected to 13 cycles of undrained loading at an additional shear stress ratio of 0.053 (28% of the strength ratio). The peak shear stress ratio applied to this specimen was 0.173, or approximately 91 percent (0.91 times the static shear strength) of the total estimated strength ratio which exceeds the total static and cyclic stresses (0.86) expected for the site. A peak cyclic strain of 0.07% was measured. Following cyclic loading, the specimen was strained to failure. A maximum post-cyclic shear stress ratio of 0.198 was recorded. The specimen exhibited no reduction in shear strength after static and cyclic loading.

Based on the test results discussed above, we conclude that the clay at the site will not undergo significant loss of strength if subjected to the design earthquake for the site.

SLOPE STABILITY ANALYSES

Sensitivity Analyses

Based on results presented in the December 1993 report by ABB and the July 1995 report by PRG, we conclude that the south profile will be the most critical section, i.e., the section with the lowest factor of safety for the Phase II loading. We conducted a sensitivity analysis for slope stability by incrementally lowering the shear strength by uniform percentages to 90%, 80%, 70% and 60% of the initial undrained shear strength for the south slope, which includes a 140 ft. by 10 ft. stability berm.

We concur with PRG that the appropriate shear strength to use for design of the ashfill is that shown as the average lab strength (DSS, s=0.19) on Figure 4-5 of the July 1995 report by PRG. However, for comparison, we also conducted sensitivity analyses using the field vane shear strength profile. Using these as the initial shear strengths, we conducted slope stability analyses with the aid of the computer program XSTABL (originally developed at Purdue University). The Simplified Bishop method of analysis is used

for circular arc failure surfaces and the Modified Janbu method is used for sliding block failure mechanism. Results of the sensitivity analyses are presented in Appendix C and summarized in the following table.

Shear Strength	Factor of Safety	Failure Mode	File No.
Initial DSS	1.70	Circular Arc	80403SS1
Initial DSS	1.56	Sliding Block	80403SS2
(90%) DSS	1.42	Sliding Block	80403SS4
(80%) DSS	1.27	Sliding Block	80403SS6
(70%) DSS	1.13	Sliding Block	80403SS8
(60%) DSS	0.98	Sliding Block	80403S10
Initial Field Vane	1.31	Sliding Block	80403S14
(90%) FV	1.19	Sliding Block	80403S16
(80%) FV	1.07	Sliding Block	80403S18
(70%) FV	0.95	Sliding Block	80403S20

As shown by the results, a factor of safety greater than 1.1 is predicted for the shear strength profile of greater than approximately 68% of the initial DSS strength profile and 82% of the initial FV strength profile.

Post-Earthquake Stability Analyses

Based on the results of cyclic DSS testing discussed above, the clays at the site did not demonstrate any significant loss in strength due to application of pre-cyclic and cyclic shear stresses. In our opinion, the clay soils at the site should not experience significant loss of shear strength due to cyclic loading from the design earthquake. Therefore, post-earthquake slopes will have similar factors of safety as pre-earthquake slopes. Factors of safety greater than 1.5 are calculated for the most critical slope (south slope) for the Phase II loading condition. However, based on our sensitivity analyses, the clays at the site could withstand reduction in strength to as low as 68% of the initial strength and maintain factors of safety greater than 1.1.

If you have any questions or require additional information, please contact us.

Sincerely yours,
HALEY & ALDRICH, INC.

Kenneth L. Recker, P.E.
Vice President

STATE OF MAINE
KENNETH L. RECKER #5435
REGISTERED PROFESSIONAL ENGINEER

KLR:jls:g-rpts

Enclosures:	Table I	- Summary of Direst Simple Shear Tests
	Figure 1	- Project Locus
	Appendix A	- Log of Boring P-3
	Appendix B	- Results of Cyclic Direct Simple Shear Tests
	Appendix C	- Results of Slope Stability Sensitivity Analyses

ATTACHMENT D-2B

POST-EARTHQUAKE STABILITY ANALYSIS
PROFILE E3

RESULTS OF PRIOR LIQUEFACTION/CYCLIC SOFTENING EVALUATION

Soil Metrics LLC Geotechnical Engineering

12 Farms Edge Road
Cape Elizabeth, Maine 04107
Telephone: 207.767.2192
Cell Phone: 207.415.5835
Facsimile: 207.767.1115

TECHNICAL MEMORANDUM

From: Stephen Rabasca

Date: October 2008

Project: Callahan Mining Superfund Site

Brooksville, Maine

Subject: Preliminary Seismic Stability Evaluation

Tailings Impoundment Area

Soil Metrics LLC is pleased to present the results of a preliminary seismic stability evaluation of the tailings impoundment area of the Callahan Mine Superfund Site (Site) located in Brooksville, Maine. The seismic evaluation spreadsheet calculations presented herein were reviewed by Dr. Craig Findlay of Findlay Engineering, Inc. This work was authorized under Mactec PO No MEC 75070225.

The seismic stability of the impoundment may be a significant factor in the overall design of remedial alternatives for final closure of the facility. These preliminary analyses were conducted based on the existing field and laboratory data collected to date using simplified methods of analyses. The analyses include preliminary SPT-based and CPT-based liquefaction analyses for the tailings impoundment soil in accordance with the guidance outlined in Youd and Idriss, (2001). Due to the high fines content and plasticity of much of the tailings soils, additional analyses were also conducted in accordance with recommendations presented in Boulanger and Idriss, (2004)

Site specific dynamic response analyses and static stress analyses were not preformed for these analyses. These analyses would typically be performed to calculate the existing static shear stress and the dynamic response of the soft impoundment soils to the bedrock ground motions under the design earthquake. These parameters were incorporated into the analyses by making simplifying assumptions discussed further in this report.

The following paragraphs summarize the general characteristics of the soft tailings and native clay soils which are considered to be most susceptible to liquefaction or cyclic failure, a discussion of the methods of analysis, input parameters, preliminary conclusions relative to overall seismic stability, and general recommendations for additional analyses.

1.0 General Characterization of Tailings and Soft Clay Soils

A comprehensive characterization of the subsurface conditions within the tailings impoundment area is included in the report titled "Preliminary Geotechnical Evaluation Report, Callahan Mine Superfund Site, Tailings Impoundment Area, by Mactec Engineering and Consulting, dated February, 2007. The reader is referred to that report for a detailed description of the stratigraphy. In general the stratigraphy consists of Mine tailings, Fill/or Native Presumpscot Clay, native dense Glacial Till and Bedrock. The evaluation was based on 16 piezocone penetration tests explorations (CP-601 through CP-616), nine soil Borings (SB-601 through SB 604, SB-605a, SB-605b, SB-702, SB-705 and SB-706), and index and laboratory testing. In situ vane shear testing (VST) was performed in fine-grained tailings and Presumpscot clay strata where possible.

The exploration locations are shown on Figure 3.3 of the main report. Multi-level piezometers were installed in most borings drilled at the site. A description of the piezometric conditions within the tailings is included in the next section. The following description of the subsurface conditions is excerpted from the February, 2007 report. It describes the tailings and Presumpscot Strata that are considered to be most susceptible to seismic loading.

1.1 General Characterization of Mine Tailings:

Dark gray mine tailings comprised of a heterogeneous mixture of fine sand, silt, and clay-sized particles (i.e. ground rock fragments originally discharged in slurry form) were encountered at the ground surface and/or immediately beneath a very thin vegetative layer (i.e. rootmat) at all soil boring and CPTu locations. The thickness of the tailings was observed (soil borings) and/or inferred (CPTu explorations) to range from approximately 12 to 57 feet. The thickness of the tailings increased steadily from west to east across the footprint of the impoundment.

The tailings, as described herein, have been categorized on the basis of their gradation utilizing industry standard terms, including "whole", "sands", and "slimes". "Whole" tailings refer to the composite mixture/gradation of particles produced by the mill. Historical studies/testing (by others) indicates that zinc-copper-lead ore mining operations typically yield "whole" tailings with approximately 40 to 50 percent fine sand sized particles and 50 to 60 percent silt/clay sized particles. Consequently, the term "sands" is often utilized to represent the plus 200 sieve fraction (i.e. sand) of the "whole" tailings, while "slimes" correspond to the minus 200 component (i.e. silt and clay) (Vick, 1990).

Tailing "slimes" were found to dominate the central portions of the tailings impoundment. The "slimes" consisted almost exclusively of silt and clay-sized particles with negligible amounts of fine sand. Occasional partings and/or seams of fine sand were also observed. Typically, the "slimes" exhibited low plasticity. Consequently, the tailings "slimes" were usually described as "dark gray clay with some silt and trace amounts of fine sand". A borderline unified soil classification system (USCS, ASTM D 2487) designation of CL/ML was typically applied.

Conversely, tailings characteristic of typical "whole" tailings and/or "sand" dominated the eastern edge of the deposit near the crest of the impoundment berm. The "whole/sand" tailings were usually described as silty fine sand and/or fine sandy silt. However, the "whole/sand" tailings were stratified with frequent partings and/or seams of tailings "slimes", likely as a result of ponded

decant water periodically encroaching upon the sand "beach" during periods of high precipitation and/or surface water flow.

Overall, SPT N-values of the tailings ranged from 8 to less than 1 (i.e. WH or WR) within the tailings. Within the "slimes" the range of N-values narrowed, from 3 to less than 1. Similarly, N-values of 3 to 5 were typical within the "whole/sand" tailings.

Limited in situ Vane Shear Testing (VST) of the tailings "slimes" yielded "peak" undrained shear strengths, S_u, ranging from approximately 50 to 850 pounds per square foot (psf). The remolded strength ranged from 10 to 330 psf. The sensitivity (the ratio of the peak undrained strength to the remolded strength), ranged from 2 to 19 and averaged about 7.5.

The laboratory index testing of the Mine Tailings is summarized in Table 1 below :

Table 1

Summary of Range in Index Properties for Whole/Sand and Slime Tailings

Index Test	Whole/Sand	Slimes
Particle Size	Fine Sand size: 0 to 65 percent Silt Size" 34 to 76 percent Clay Size: 1 to 49 percent	Fine Sand: 0 to 13 percent Silt Size: 50 to 76 percent Clay Size: 14 to 49 percent
Moisture Content	19 to 30 percent	33 to 60 percent
Atterberg Limits	LL = 17 to 18 PL = 15 to 16 PI = 2	LL = 30 to 46 PL = 19 to 25 PI = 11 to 21 LI = 0.6 to 2.0

The results of seven specific gravity tests ranged from 2.73 to 2.91. Four consolidation tests conducted on slimes, indicated a modified compression index, $C_{c\varepsilon}$ (= $C_c/1+e_0$), ranging from approximately 0.14 to 0.18. The tailings "slimes" are estimated to be normally consolidated to slightly overconsolidated, likely due to historical fluctuations in the "groundwater" level within the tailings and weathering

Three (3) Consolidated Undrained (CU) triaxial compression tests (3-points each) with pore water pressure measurements yielded effective friction angles, Ø', ranging from 30.5° to 38.5°, based on MACTEC's interpretation of the reported data relative to historical/published reference documents. Similarly, an effective cohesion, c', of 0.0 psf was assumed. Total stress parameters ranged from Ø = 7.8 to 20.5° and c = 0 to 424 psf.

Three Consolidated Drained (CD) Triaxial compression tests (3-points each) yielded effective friction angles, Ø', ranging from 29.0° to 39.8° and an effective cohesion, c', or 0 psf.

1.2 General Characterization of Presumpscot Clay:

A relatively thin stratum of Presumpscot Clay was encountered immediately beneath the tailings in soil borings SB-601, SB-602, and SB-605B and beneath the crushed rock/reworked glacial till fill material in soil boring SB-603. Lean clay was also inferred beneath the tailings in CPTu explorations

CP-601, CP-602, CP-603, CP-604, CP-607, CP-608, CP-614, and CP-615. The clay was the uppermost native stratum at the site prior to the construction of the tailings impoundment.

The clay was encountered (soil borings) and/or inferred (CPTu explorations) at depths ranging from approximately 12 to 57 feet bgs, with depths increasing steadily from west to east. Overall, the thickness of the lean clay ranged from approximately 1 to 16 feet. Thicknesses of at least 5 feet were typically observed/inferred across the southern 1/3 of the tailings impoundment.

SPT N-values ranged from 18 to less than 1 (i.e. WH or WR). Limited in-situ VST yielded "peak" undrained shear strengths, S_u, ranging from 350 to 700 pounds psf. Limited testing of in situ split-spoon samples via a hand-held torvane yielded shear strengths ranging from 700 to 900 psf. Similarly, pocket penetrometer testing of split-spoon samples yielded shear strengths of 300 to 1600 psf. Consequently, the lean clay was typically described as stiff to soft, based on the recorded N-values and the S_u values. Typically, the clay transitioned from stiff to medium stiff to soft with increasing depth. The thickness of the stiff to medium stiff "crust" generally ranged from a few to several feet in thickness.

Index Test	Presumpscot Clay
Particle Size	Fine Sand size: 7 percent Silt Size 49 percent Clay Size: 44 percent
Moisture Content	21 to 35 percent
Atterberg Limits	LL = 26 to 36 PL = 14 to 17 PI = 12 to 20 LI = 0.6 to 1.2

One (1) consolidation test of the soft to medium stiff lean clay indicated a $C_{c\varepsilon}$ ranging from 0.12 to 0.20 across the virgin compression portion of the consolidation curve. 0.12. The soft to medium stiff lean clay is estimated to be normally consolidated to slightly over consolidated, at the location of the sample (B-601)

One (1) CU triaxial compression test (3-points) with pore water pressure measurements yielded an effective friction angle, Ø', of 15.4° and an effective cohesion, c', of 457.0 psf. Total stress parameters were reported as Ø = 4.9° and c = 626.0 psf.

1.3 Groundwater

Surface water runoff from the west and from within the footprint of the tailings impoundment collects in an existing shallow depression in the central portion of the tailings impoundment. This area was consistently observed to be under 1 to 2 feet of water during the subsurface exploration program and subsequent groundwater sampling/monitoring events. Measurements conducted in the installed piezometers and monitoring wells indicate that this surface water pond is actively recharging the "groundwater" within the tailings. The measurements also indicate that the "groundwater" observed in the tailings is likely "perched" atop the underlying native clay and/or glacial till.

The depth to groundwater (the upper phreatic surface) ranged from approximately 2.5 feet bgs (PZ-601) to approximately 19 feet bgs (MW-604S), based on measurements taken in the installed piezometers and monitoring wells in August of 2006. The depth to water typically dropped off from the west to the east across the tailings impoundment.

Data collected from the "nested" piezometers and wells typically indicates a distinct downward gradient (i.e. flow) ranging from approximately 0.17 to 0.86 ft/ft within the tailings. The highest downward gradient was measured at the B-604 cluster on the northeast portion of the site.

1.4 Conceptual Model of Impoundment Construction

It is understood that the berm encompassing the tailings impoundment was constructed in multiple stages (i.e. lifts). This type/method of construction is commonly termed a "raised embankment" (Vick, 1990). Typically, the first lift (i.e. a "starter dike") is constructed of natural soil borrow or available fill materials and is sized (vertically) to accommodate the first couple years of the mill's tailings output, with necessary/appropriate allowances for storage of surface water and/or flood inflows. The embankment is then raised in stages to keep pace with the rising elevation of the tailings and surface water/flood water storage requirements (Vick, 1990).

Raised embankments are generally characterized as an upstream, downstream, or centerline embankment, depending on which direction the crest of the embankment moves in relation to the starter dike as subsequent lifts are added (Vick, 1990). For an "upstream" type of embankment, tailings are discharged peripherally from the crest of the starter dike to form an above-water sandy "beach", which then becomes the foundation for second lift of the embankment (Vick, 1990). Historical site photographs of the Callahan Mine operations indicate that the tailings were discharged via a series of spigots spaced along the crest of the embankment. Observations and local anecdotal information indicate that an "upstream" embankment was constructed at the Site. The starter dikes are conceptually depicted as trapezoidal berms staggered in toward the west as the outer embankment was constructed. It is assumed that these starter dikes were constructed primarily out of the angular waste rock, evident on the outer slope. The width of the starter dikes is not known, however MW 604R was drilled in the access road and encountered only 5 to 6 ft of rock fill followed directly by tailings. This indicates that the starter dikes are only of limited width and form a veneer on the outer slope of the impoundment. Anecdotal information also indicates that the inside face of the starter dikes was lined or "chinked" with clay or finer grained soil (possibly glacial till, in order to contain the finer grained tailings. Based on the grain size characteristics of the tailings, it is evident that some form of chinking or sealing of the upstream slope must have occurred; otherwise the tailings would have piped through the large voids in the rockfill.

The formation and competency of the sandy "beach" is critical to the application of the "upstream" embankment construction methods. Consequently, at least 40 to 60 percent sand sized particles are typically required in the "whole" tailings discharge (Vick, 1990). Historical laboratory testing (by others) of "whole" tailings produced by zinc-copper-lead ore mining operations, such as Callahan Mine, usually indicates a sufficient percentage sand-sized particles. This relatively sand-rich "whole" tailings matrix generally results in most of the coarser (i.e. sand sized) tailings particles settling from suspension relatively close to the point of discharge with the remaining coarse particles and fine-grained (i.e. silt, clay, and colloid sized) particles carried to the ponded effluent

(i.e. the decant pond) in central portions of the impoundment where they eventually sediment in standing water (Vick, 1990).

A review of the site-specific subsurface exploration data, geotechnical laboratory testing results, and historical photographs and documents relative to common zinc-copper-lead ore mining operations typical/historical tailings impoundment construction methods suggests that the tailings impoundment at the Callahan Mine was likely constructed as an "upstream" raised embankment with the "whole" tailings slurry discharged via a series of spigots spaced peripherally around the impoundment berm.

1.5 Site-Specific Observations

The subsurface exploration program identified a tailings deposit that generally increases in thickness from west to east. Tailing "slimes" were observed to dominate central portions of the impoundment (e.g. SB-603 and SB-605A). Conversely, tailings representative of "whole" and/or "sand" tailings dominated the eastern edge of the impoundment (e.g. SB-604) in close proximity to the berm. A highly stratified and/or laminated transitional zone was identified (e.g. SB-602 and SB-605B) in between these two "zones". The transitional zone appears to be more characteristic of the tailings "slimes".

Clay was identified and/or inferred in most of the exploration locations and is estimated to be widespread but may not necessarily be continuous across the footprint of the tailings impoundment. CPTu exploration locations CP-605, CP-606, CP-609, CP-611, and CP-613 achieved practical refusal at relatively shallow depths beneath the tailings, suggestive of either a crushed rock/reworked glacial till fill material, isolated ridges of shallow (relative to nearby explorations) glacial till and/or bedrock, or some other obstruction (i.e. drainage/decant piping or structure). If refusal was in crushed rock/reworked glacial till fill material, clay may be present beneath it.

2.0 PRELIMINARY SEISMIC STABILITY EVALUATION

The preliminary seismic stability evaluation involved two general steps. The first step involved evaluating the susceptibility of the Tailings and Presumpscot clay strata to liquefaction or cyclic failure. The second step involved evaluating the stability of the tailings embankment under post earthquake conditions using estimated post earthquake strengths for these soils.

2.1 Liquefaction and Cyclic Failure Evaluation

The Mine Tailings are highly stratified soils consisting of silty sands (SM), sandy silty (ML) and silty clay soils (CL). The engineering behavior of "Sand-Like" and Clay-Like" soils are fundamentally different; therefore different approaches to evaluating their seismic response are necessary. The evaluation of "Sand-Like" soils was performed in accordance with the procedures outline in Youd & Idriss, 2001). Sand-Like soils are susceptible to Liquefaction, which is the onset of high excess pore pressures generated due to earthquake loading. The evaluation of "Clay-Like" soils was performed using procedures outlined in Boulanger and Idriss, (2004). Clay Like soils are susceptible to loss of strength due to earthquake loading. The term "Cyclic Failure" is generally associated with the seismic evaluation of Clay-Like soils. The terms "Sand-Like" and "Clay-Like" (Boulanger and Idriss,(2004)are used in this report to describe the seismic behavior of these two general types.

The evaluations were performed based on the Standard Penetration Tests (SPT) made in the nine soil borings, and the Tip, Sleeve and Pore Pressure measurements at the 16 CPTu locations. Correlations between the SPT and CPTu analyses were made at the six locations where soil borings were made immediately adjacent to CPTu explorations. The analysis steps for the SPT based evaluation are included in the tables in Appendix A. The analysis steps for the CPTu based evaluation are included in Appendix B. Table B-1 provides a complete description of each column in the Appendix B spreadsheets. A graphical summary of each exploration analysis is provided on Figures 2 through 19.

The analyses were first conducted using the methods outlined in Youd and Idriss, (2001) for sand-like soils using SPT and CPT exploration data. The reference also provides guidance for differentiating between Sand-Like and Clay-Like behavior. The two methods are used as follows:

- Soils with a Plasticity Index (PI) of 7 or greater are considered to behave as Clay-Like soils.
- Soils with a Soil Behavior Index I_c, greater than 2.6 are considered Clay-Like soils. Ic is calculated from the CPTu data.

Following the completion of the analyses using the Youd & Idriss procedures, and the determination of the Soil Behavior Index, I_c, it became evident that much of the tailings soil deposit was classified as Clay-Like soils. These soils were subsequently evaluated using the procedures outlined in Boulanger (2004).

2.1.1 Liquefaction Evaluation of Sand-Like Soils using SPT data:

An evaluation of the liquefaction potential was made at borings B-604, B-605b, B-705 and B-706. The remaining borings had measured uncorrected N-values of less than 1 i.e.(weight of hammer or rods), and therefore were too soft for the SPT based analysis.

The borings were drilled using drive and wash techniques and Standard Penetration Test (SPT) samples were obtained in accordance with ASTM Specification D-1556. The number of blows of the 140 pound hammer falling 30 inches that it takes to drive the sampling spoon 12-inches into the soil is referred to as the uncorrected "N" value. For use in liquefaction analysis, these "N" values need to be corrected to the standard of sixty percent hammer energy transfer and normalized to a vertical effective overburden pressure of 1 ton per square foot. An "N" value that is so corrected, along with a few other corrections subsequently discussed, is referred to as an $(N_1)_{60}$ value. The methods that were used for the $(N_1)_{60}$ correction in this geotechnical study are those that have been proposed by Seed and Idriss, 1982, updated with the consensus findings of the 1996 and 1998 NCEER/NSF workshops on evaluation of liquefaction of soils, as summarized by Youd and Idriss (2001). The spreadsheets in Appendix A outline the approach to the analysis and the key assumptions and calculation methods used. Uncorrected SPT "N" values (N) were converted to $(N_1)_{60}$ values using the equation:

$$(N_1)_{60} = N \times C_N \times C_E \times C_B \times C_R \times C_S$$

The correction coefficients (C-values) above include:

Overburden pressure (C_N), hammer energy (C_E), Borehole Diameter (C_B), rod length (C_R), spoon liner (C_S), based on standard procedures outlined in Seed and Harder (1990) and Youd and Idriss (2001). The following paragraphs summarize these corrections:

Overburden Correction Factor (C_N): The N-value is normalized to one ton per square foot effective overburden pressure. The recommended correction factor varies with overburden pressure by the following relationship outlined in Youd & Idriss (2001):

$$C_N = (P_a/\sigma'_{vo})^{0.5}$$

Hammer Energy Correction (C_E): The hammer energy correction normalizes the N-values to a standard 60 percent efficiency, the generally accepted energy delivered with safety hammer system in the United States. The correction factor is the ratio of the actual measured efficiency divided by 60 percent. For example, if the measured efficiency for a system is 80 percent, the correction factor is 80/60, or 1.33. The borings for this study were driven with a standard safety hammer and a rope and cathead, therefore the correction for hammer energy was 60/60, or 1.0. The borings drilled in 2007 (700 series), were driven with a CME automatic hammer, therefore the hammer correction was taken as 72/60 = 1.2.

Borehole Diameter Correction (C_R): The diameter of the borehole for all borings was 4-inches. The correction factor for all samples was 1.0.

Rod Length Correction (C_R): The rod length correction factor is 0.75 for samples less than 10 feet deep and 1.0 for samples at depths greater than 10 feet.

Spoon Liner Correction (C_S): The split barrel samplers for all samples driven had an inside diameter of 1-3/8 inches, and a spoon liner was not used. The correction for split barrel samplers with room for a liner, but no liner used, varies with uncorrected N. If the N-value is between 0 and 5, the spoon liner correction factor is 1.0. If the N-value is between 6 and 10, the spoon liner correction factor is 1.1. If the N-values is greater than 10, the spoon liner correction factor is 1.2.

The uncorrected N-value normalized based on the above applied correction factors is designated $(N_1)_{60}$ and is shown on the correction tables in Appendix A.

Fines Content Correction Factor: This correction factor is applied to the $(N_1)_{60}$ normalized blow count to obtain the $(N_1)_{60\text{-}cs}$ blow count for use in determining the equivalent clean sand Cyclic Resistance Ratio (CRR). The correction factor varies in accordance with the percentage of silt in the sample using the following equation (Youd and Idriss, 2001) as follows:

$$(N_1)_{60cs} = \alpha + \beta (N_1)_{60}$$

Where: $\alpha = \exp[1.76-(190/FC^2)]$

$\beta = [0.99 + (FC^{1.5}/1000)]$

FC = fines content in percent (e.g., 35% = 35)

The fines correction factors are listed on Tables in Appendix A. Silt contents from samples where grain size analyses were performed are shown in bold font. The other silt contents were estimated.

Seismicity of the Project Location

No site-specific assessment of seismicity was conducted for the project since it is in a low to moderate area of seismicity. In such cases at other projects, the the use of seismic hazard as defined by the USGS Seismic Hazard Mapping Project is generally accepted. The USGS indicates that the peak ground acceleration (PGA) with a 2 percent probability of recurrence in 50 years is 0.11g.

Liquefaction Analysis

An evaluation of the liquefaction potential was made for each SPT N-value located below the water table. The summary spreadsheet for the liquefaction analysis is shown the far right of Table. The liquefaction analysis presented herein made two assumptions related to the impoundment configuration:

1. The ground acceleration from the earthquake was amplified through the soft tailings and clay soils, by assuming 0.11g (PGA at the bedrock surface) and amplifying this by a factor of 2 at the surface (0.22g). A lineal interpolation was made between the bedrock (or glacial till), and the ground surface.

2. A finite element analysis of the overburden and shear stresses in the tailings impoundment was not performed for this analysis. Overburden stresses were determined based on the height of soil and water above the sample location. Static shear stresses were also not determined at the sample location. The static shear stress ratio, α , (ratio of the static shear stress to effective overburden stress), was assumed based on the position of the boring in relation to the steep 1.3H: 1V eastern side slope. Estimated values of α ranged from 0.15 for explorations drilled near the crest of the embankment to 0.02 for explorations 175 feet and further from the crest. The correction factor for sloping ground conditions (K-alpha, discussed herein) was based on recommendations in Idriss and Boulanger, (2002).

The liquefaction analysis is a measure of the ability of a particular soil to resist liquefaction and is generally expressed as a factor of safety against liquefaction as follows:

$$FS = (CRR_{7.5}/CSR) \times MSF \times K_{\sigma} \times K_{\alpha}$$

The following paragraphs describe the liquefaction analysis.

Computation of CRR - The Cyclic Resistance Ratio ($CRR_{7.5}$) with respect to the energy from a magnitude (M) 7.5 earthquake event was computed for each blow count based on the corrected SPT value $(N_1)_{60\text{-}CS}$ and the following equation Youd and Idriss, (2001):

$$CRR_{7.5} = \{(1/(34-(N_1)_{60cs})\} + \{(N_1)_{60cs}/135\} + \{50/[10 \times (N_1)_{60cs} + 45]^{2}\} - [1/200]$$

The value of the cyclic resistance ratio obtained from this formula was corrected for the estimated site-specific earthquake magnitude, static overburden stress and static shear stress, to obtain the

CRR specific for the Callahan Mine site. A magnitude 5.5 earthquake has been assumed to be the maximum credible event for the Callahan Mine site, therefore corrections for these effects were made by multiplying the cyclic resistance ratio as follows:

$CRR_{5.5} = CRR_{7.5} * MSF * K_{\sigma} * K_a)$

where:

MSF - Magnitude Scaling Factor (Youd and Idriss, 2001, Table 3); a magnitude 5.5 earthquake has been assumed to be the maximum credible event for the Callahan Mine site, therefore, MSF = 2.2.

K_{σ} - overburden stress correction factor. (Youd and Idriss, 2001)

$$K_{\sigma} = (\sigma'_{vo}/Pa)^{(f-1)},$$

where:

f = 0.7 to 0.8 for relative density of 40 to 60%;

f = 0.6 to 0.7 for relative density of 60 to 80%;

Pa = pressure at 1 atmosphere

K_{α} - The correction for static shear stress K_{α} was estimated based on Figure 7 from Idriss & Boulanger (2002).

The CRR for each SPT test is listed on the tables in Appendix A.

Computation of CSR - The Cyclic Stress Ratio (CSR) induced by the earthquake was computed for each blow count using the following formula:

$$CSR = 0.65 *(a_{max} /g)* (\sigma_{vo}/\sigma'_{vo})* r_d$$

where:

$a_{max/}g$ = PGA = 0.11g (discussed above)

σ_{vo} = Total overburden stress at the sample location

σ'_{vo} = Effective Overburden Stress at the sample location

$r_d = [1.0 - 0.4113z^{0.5} + 0.04052z +0.001753z^{1.5}] / [1 - 0.4177z^{0.5} + 0.05729z - 0.006205z^{1.5} + 0.001210z^2]$ where: z = depth in meters

Liquefaction Factor of Safety using SPT Data: The factor of safety against liquefaction was computed for each blow count as the CRR divided by the CSR. A factor of safety of 1.1 or lower is assumed to liquefy. A factor of safety of between 1.1 and 1.8 is assumed to generate excess pore pressure during the earthquake and a factor of safety above 1.8 is assumed not to experience

significant seismically induced excess pore pressure. A discussion of the strength parameters to be used for the post earthquake stability analysis is included in Section 3.

2.1.2 Liquefaction Evaluation of Sand-Like Soils using CPT Data

The liquefaction evaluation using the CPT data was performed using procedures outlined in Youd & Idriss, (2001). The CPT based analysis is similar to the SPT based analysis, except that the CPT tip resistance is normalized to 1 tsf overburden pressure and then corrected for fines content. The CRR is then calculated based on charts of empirical data compiled from case histories. The CPT data is generally considered to be more consistent that SPT data and the continuous profile allows for a more detailed profile of the soil layers.

The first step in the CPT analysis is to calculate the Soil Behavior Index, I_c. The I_c is estimated based on the CPT friction ratio and will generally increase with increasing fines content and soil plasticity, allowing a rough estimate of the soil type and fines content. A chart developed by Robertson & Wride (1998), (Figure B-1) describes the boundaries between soil types. The boundaries between the soil types 2 through 7 can be approximated by concentric circles and are used to account for the effects of soil characteristics on the normalized cone tip resistance q_{c1N}. and CRR. The radii of the concentric circles are termed the soil behavior type Index I_c, and are calculated from the following equation:

$$I_c = [(3.47 - \log Q)^2 + (1.22 + \log F)^2]^{0.5}$$

Where:

$$Q = [(q_c - \sigma_{vo})/P_a][P_a/\sigma'_{vo}]^n = [(q_c - \sigma_{vo})/\sigma'_{vo}]$$

And

$$F = [f_s/q_c - \sigma_{vo})] \times 100\%$$

n = exponent that varies with soil type

q_c = field cone penetration resistance measured at the tip

Pa = atmospheric pressure in same units as σ'_{vo}

σ_{vo} = total overburden stress

σ'_{vo} = effective overburden stress

f_c = the sleeve resistance

The chart on Figure B1 (Robertson & Wride, (1998), was developed using and exponent n = 1, which is the appropriate value for clays. The first step is to differentiate the soil types characterized as clays from those characterized as sands and silts. This is done by assuming and exponent n=1 (characteristic of clays) and calculating the dimensionless CPT tip resistance, Q, from the equation above. If the I_c calculated with an exponent of 1.0 is > 2.6 the soil is classified as clayey and is considered too clay rich to "Liquefy", and this portion of the analysis is complete. In our case, a cyclic failure analysis as described in the next section was then performed. If the calculated I_c is <

2.6, the soil is most likely granular in nature and therefore Q should be re-calculated using an n=0.5 exponent. I_c is then re-calculated using the revised Q. If the re-calculated Ic (using the n=0.5 exponent for Q), is > 2.6, the soil is likely to be very silty and possibly plastic. In this instance, Q is re-calculated using and n=0.7 exponent, and Ic is recalculated using the recalculated Q.

After this iteration to determine the likely I_c, the normalized tip resistance q_{c1N} was then calculated as:

$$q_{c1N} = C_Q(q_c/P_a)$$

where:

$$C_Q = (P_a/\sigma'_{vo})^n$$

This is the normalized penetration resistance for silty sands. It is then corrected to an equivalent clean sand value $(q_{c1N})_{CS}$, by the following equation:

$$(q_{c1N})_{CS} = q_{c1N} \times K_c$$

Where Kc, the correction factor for grain size characteristics, is defined by:

for $I_c <= 1.64$ $K_c = 1.0$

for $Ic > 1.64$ $K_c = -0.403I_c^4 + 5.58Ic^3 - 21.63I_c^2 + 33.75I_c - 17.88$

The $CRR_{M7.5}$ (Cyclic Resistance Ratio for magnitude 7.5 earthquake) is then calculated using the appropriate $(q_{c1N})_{CS}$ and the following equation:

If $(q_{c1N})_{CS} < 50$ then $CRR_{7.5} = 0.833[(q_{c1N})_{CS}/1000]+0.05$

If $50 <= (q_{c1N})_{CS} = 160$ then $CRR_{7.5} = 93[(q_{c1N})_{CS}/1000]^3+0.08$

The CRR7.5 is then multiplied by the same corrections factors, K_σ, K_a and MSF to determine the $CRR_{M5.5}$ for this site. Note that the correction factor for K_α was based on Figure 9 of Idriss & Boulanger, (2001) based on Normalized CPT Tip resistances.

Liquefaction Factor of Safety using CPT Data for Sand-Like soils

The factor of safety against liquefaction was computed for each CPT test interval as the $CRR_{M5.5}$ divided by the CSR determined earlier from the SPT analyses. A factor of safety of 1.1 or lower is assumed to liquefy. A factor of safety of between 1.1 and 1.8 is assumed to generate excess pore pressure during the earthquake and a factor of safety above 1.8 is assumed not to experience significant seismically induced excess pore pressure. The analysis shows that the majority of the soils were classified as "Clay-Like", with an $I_c > 2.6$. Therefore, the Youd and Idriss procedure for "Sand-Like" soils to determine the susceptibility to liquefaction is not considered to be valid for these soils with an I_c above 2.6. The calculated Factor of Safety is however plotted on Figures A9-1 through A9-1917 for comparison purposes. Where the I_c was less than 2.6, (indicating sand-like behavior), the points of the FS graph are enlarged and filled. Borderline soils close to and slightly above an $I_c = 2.6$ were enlarged and not filled. This assumes that the procedure is based on

relationships from empirical data and may be subject to interpretation. The majority of the soils however were classified as Clay-Like, and therefore these soils were re-evaluated using the procedures for Clay-Like soils below.

2.1.3 Cyclic Failure Evaluation of Clay-Like Soils using Vane Shear Test and CPT Data

Soils that were classified as "Clay-Like" were re-evaluated using procedures outlined in Boulanger and Idriss (2004). This more recent method to evaluate the relative factor of safety against cyclic failure of clays was developed to incorporate several factors that influence the dynamic response of Clay-Like soils. A similar Cyclic Resistance Ratio (CRR) is then calculated as described below using a somewhat different method. Clay-Like soils are influenced by the presence of in situ static shear stresses, and the Over Consolidation Ratio (OCR). Clay soils with a high initial static shear stress, and/or low OCR are more susceptible to cyclic failure than soils with little or no initial static shear stress and/or higher OCR's.

The method used for the Callahan site is Approach B, which uses the estimated undrained shear strength S_u. The undrained shear strength was measured at the site using in-situ vane shear tests (VST) in several of the borings. The results of these tests were tabulated and plotted on the SB-Series boring logs in Appendix A9. The CPTu exploration data was then used to estimate the S_u for the soil profile. The first step was to estimate Su at five locations where CPT data was obtained adjacent to the Soil Borings (Locations SB-601 through SB-603, SB 605a and SB-605b. The undrained shear strength Su was estimated from the CPTu data using the following formula (Lunne, Robertson and Powel, (1997) :

$$S_u = (q_{ct} - \sigma_{vo})/N_{kt}$$

Where

q_{ct} = the corrected tip resistance (corrected for pore pressure effects)

σ_{vo} = total overburden pressure

N_{kt} = the coefficient based on site specific relationships comparing field and lab data

The S_u was calculated and plotted against the VST data for the five comparison locations. The N_{kt} was adjusted to match the VST data as closely as possible. Plots of the comparisons of measured VST Su vs Calculated Su from the CPT_u data are shown on Figures A9-1 through A9-19. The N_{kt} was found to range from 8 to 12 for the tailings and 18 for the soft Presumpscot Clay. The S_u at the 11 other CPTu locations was then calculated using an average N_{kt} of 10.5 for the tailings and 18 for the soft Presumpscot Clay.

The $CRR_{M7.5}$ was calculated using the following equation 3-29 from Boulanger and Idriss (2004). Note that this equation has been reduced by 20 percent (multiplied by 0.8) as recommended by the authors for tailings slimes.

$$CRR_{M7.5} = 0.8 \times 0.8 \times (S_u/\sigma'_{vo}) \times K_a$$

where

S_u = the undrained shear strength estimated from the field calibrated CPTu data as described above,

K_a = the static shear stress correction factor for fine grained soils, equation 2-10 from Boulanger and Idriss (2004)

$$Ka = 1.344 - [0.344/(1-\alpha/0.22 \times OCR^{0.8})^{0.638}]$$

α = the assumed static shear stress ratio described in Section 2.1.1

OCR = 1.1 assumed based on laboratory testing and our understanding of the construction history. This number is considered reasonably conservative for this analysis.

The $CRR_{M7.5}$ was then corrected for the magnitude scaling factor for this site and a Magnitude 5.5 earthquake, by the following equation:

$$CRR_{M5.5} = CRR_{M7.5} \times MSF$$

Where

$$MSF = 1.12 \times e^{(-M/4)} + 0.828$$

Liquefaction Factor of Safety using CPT Data for Sand-Like soils

The factor of safety against liquefaction was computed for each CPT test interval as $CRR_{M5.5}$ divided by the CSR determined earlier from the SPT analyses. The results of the Cyclic Failure analysis are plotted on Figures A9-1 through A9-19 as the blue square data a points.

As discussed in Boulanger and Idriss (2004), a factor of safety of 1.0 calculated using the cyclic failure analysis procedures above, corresponds to the onset of cyclic failure. The post cyclic failure undrained shear strength of the clay-like materials will transition from values near its original static strength to values nearer its residual or fully remolded strength. The undrained shear strength for soils where the FS is greater than 1.0, will generally be less than the original static strength, with the magnitude of the reduction depending on the soil characteristics, the strains imposed by the cyclic loads and the number of loading cycles.

3.0 POST EARTHQUAKE STRENGTHS

The post earthquake strength of the tailings was estimated based on recommendations presented in Boulanger and Idriss, (2004) for clay-like soils and Youd and Idriss, (2001) for Sand-Like or Mixed type soils. A summary of the recommended strengths or strength reductions is presented on Figures A9-1 through A9-19 on the far right of the figures. For the softer Presumpscot Formation clay soils, the post-earthquake strength reduction of 20 percent of the peak undrained strength is recommended based on cyclic strength testing that has been performed on similar Presumpscot Formation soils in the Portland and Norridgewock, Maine areas.

The strength reductions for the Clay-Like tailings soils were applied as follows:

- If the factor of safety against liquefaction was calculated as 1.1 or less, the recommended strength of these soils will approach the residual strength. The residual strength of these soils was estimated by reducing the peak undrained shear strength (determined by the VST or CPTU tests), by a factor of 7.5 which represents the average sensitivity of the clay-like soils from the VST program.
- If the factor of safety against liquefaction was above 1.8, there was no reduction in the undrained shear strength applied.
- If the factor of safety against liquefaction was between 1.1 and 1.8, a linear interpolation of the sensitivity was applied.

The strength reductions for the sand-like soils were applied as follows:

- If the factor of safety against liquefaction was less than 1.1, the soils are assumed to liquefy. In this circumstance, these soils are expected to behave as undrained soils with shear strengths based on the Figure A9-20. This figure related undrained shear strength for post liquefaction soils to the corrected $N1_{60\text{-}cs}$ value.
- If the factor of safety against liquefaction was above 1.8, no reduction in the strength of the soils was applied.
- If the factor of safety against liquefaction was between 1.1 and 1.8, excess pore pressures are assumed to be generated. These excess pore pressures are represented by a pore pressure coefficient R_u, in a stability analysis. The magnitude of the pore pressure coefficient is based on Figure A9-21, and depends on the factor of safety of against liquefaction. This pore pressure coefficient is applied to the soil layer in question in the stability analysis. This pore pressure coefficient will reduce the effective stress on the failure plane, which will reduce the available mobilized shear resistance.

4.0 POST EARTHQUAKE STABILITY ANALYSES

Post earthquake stability analyses should be performed using the above recommended strength reductions applied to the initial static strengths for each soil layer in the stability model. No seismic coefficient is used in the model as the reduced strengths model the behavior of the soil following the earthquake.

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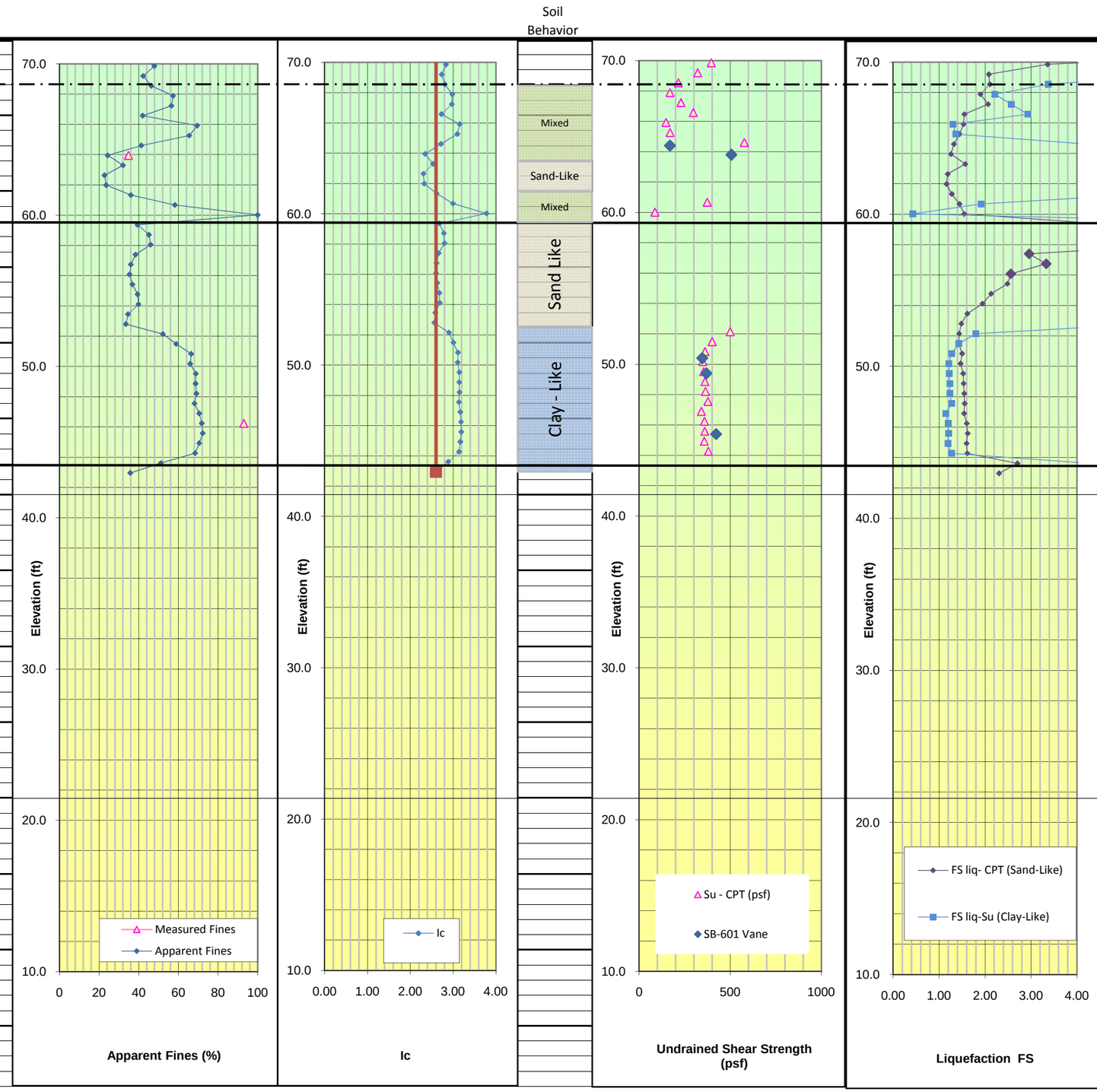
Ground Elev. 71.5

Depth	Elevation	Sample	Stratigraphy	PI	LI
		SS-1	Tailings		
		SS-2			
5.0	66.5	SS-3		11	2
10.0	61.5	SS-5			
		SS-6			
		SS-7	Clay		
15.0	56.5	SS-8			
		SS-9			
20.0	51.5	ST-10			
				18	1.1
		SS-12			
25.0	46.5	ST-13		12	1.2
		SS-15			
30.0	41.5	SS-16			
35.0	36.5				
40.0	31.5				
45.0	26.5				
50.0	21.5				
55.0	16.5				
60.0	11.5				
65.0	6.5				
70.0	-70				



Reduce phi using Ru = 0.2 here

Reduce Phi by Using Ru = 0.45 here

Stiff Clay, No reduction in Strength here

Reduce soft clay strength by 20 percent here.

Soil Metrics LLC Geotechnical Engineering

By:	sjr
Checked	sjr
Date	9/1/2007
Scale:	As Noted

Title: Summary Log of B-601/CPT 601 Liquefaction Analysis

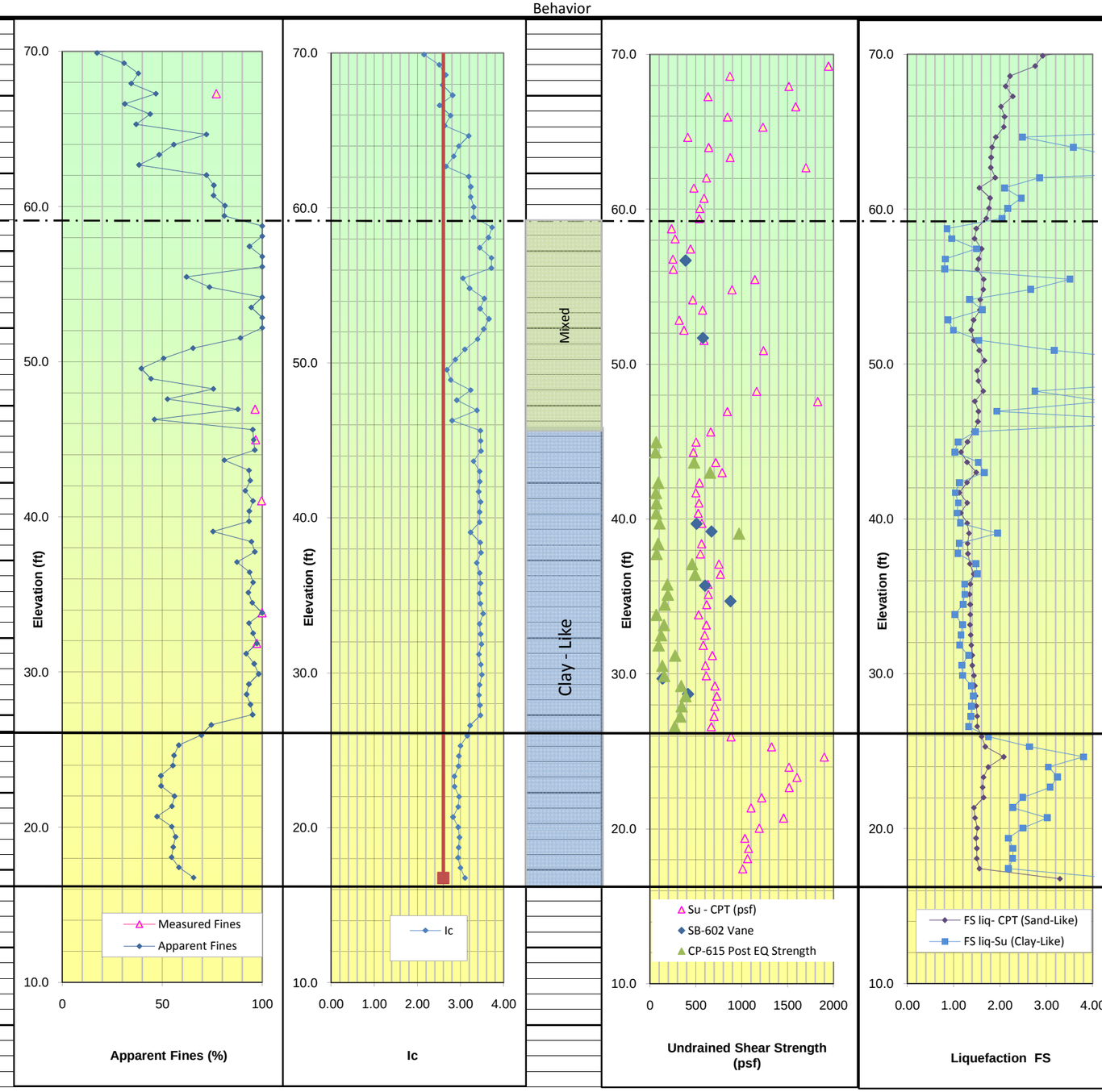
Project: Callahan Mine Project

Client: Macec Engineering and Consulting/ME DOT

Boring No: B601-CPT601

Figure No. A9-1

Depth	Elevation	Sample	Stratigraphy	PI	LI
			Ground Elev.	72.2	
		SS-1	Tailings		
		SS-2			
5.0	67.2	SS-3			
		SS-4			
		SS-5			
10.0	62.2	SS-6			
		ST-7			
15.0	57.2				
		SS-10			
20.0	52.2				
		SS-13			
25.0	47.2	SS-14			
		SS-15			
		SS-16			
30.0	42.2	ST17		16	1.3
35.0	37.2	SS20			
		SS-23			
40.0	32.2	SS-24		17	0.6
45.0	27.2	SS-27			
		SS-28	Clay		
		SS-29		18	0.8
50.0	22.2	SS-30			
		SS-31			
55.0	17.2	SS-32			
		SS-34	Glacial Till		
60.0	12.2				
65.0	7.2				
70.0	2.2				



Reduce phi by using Ru = 0.1 here

Use Post EQ Su = 100 psf top to 300 psf bottom

No Post EQ Reduction here

Soil Metrics LLC Geotechnical Engineering

By:	sjr
Checked	sjr
Date	9/1/2007
Scale:	As Noted

Title: Summary Log of B-602/CPT 615 Liquefaction Analysis

Project: Callahan Mine Project

Client: Maine Department of Transportation

Boring No: B602-CPT615

Figure No. A9-2

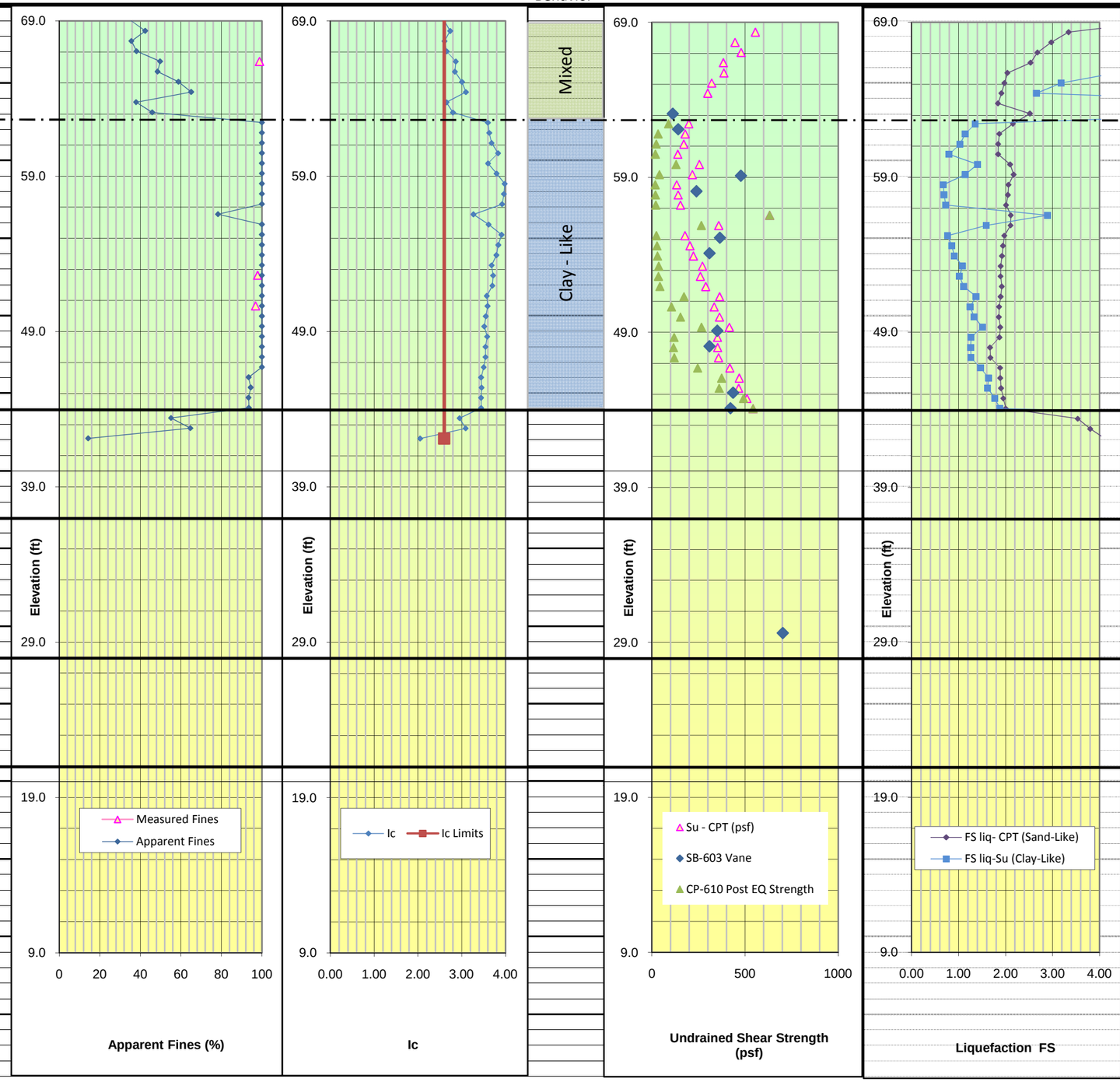
Ground Elev. 70.1

Depth	Elevation	Sample	Stratigraphy	PI	LI
		SS-1	Tailings		
		SS-2			
5.0	65.1	ST-3			
		SS-5			
10.0	60.1				
		SS-7			
15.0	55.1				
		SS-9			
		ST-10		20	0.8
20.0	50.1			16	1.4
		SS-12			
25.0	45.1				
		SS-14	Fill		
		SS-15			
30.0	40.1				
		SS-16			
		SS-17			
35.0	35.1	SS-18	Clay	20	0.6
		SS-19			
		ST-20			
40.0	30.1				
		SS-21			
		SS-22	Glacial Till		
45.0	25.1	SS-23			
		SS-24			
		SS-25			
50.0	20.1				
55.0	15.1				
60.0	10.1				
65.0	5.1				
70.0	0.1				

Soil Behavior

Mixed

Clay - Like



Use Post EQ Su = 20 psf top to 100 psf at elev 48 ft, to 500 psf at bottom

Soil Metrics LLC Geotechnical Engineering

By:	sjr
Checked	sjr
Date	9/1/2007
Scale:	As Noted

Title: Summary Log of B-603/CPT 610 Liquefaction Analysis

Project: Callahan Mine Project

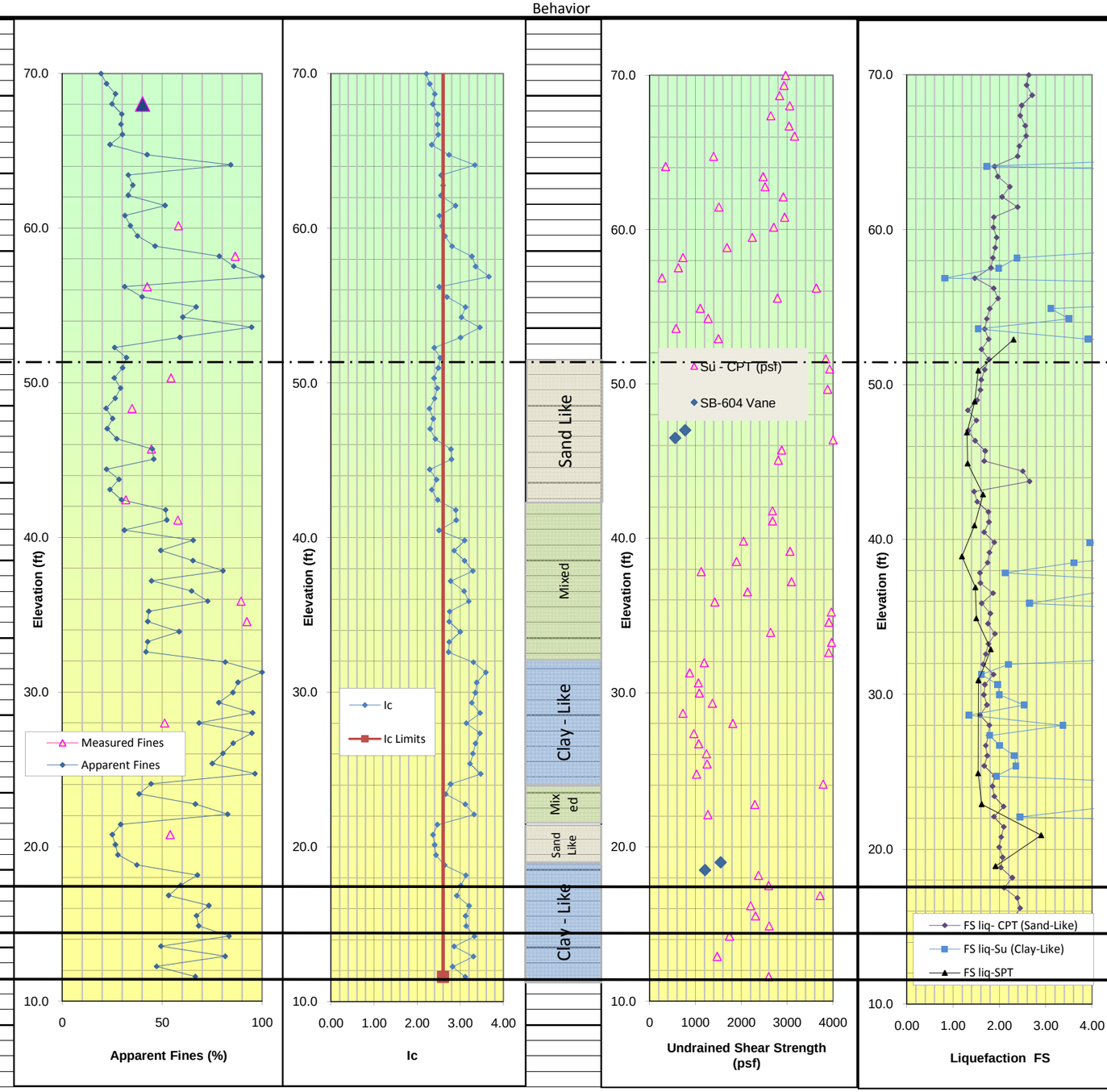
Client: Maine Department of Transportation

Boring No: B603-CPT610

Figure No. A9-3

Ground Elev. 73.9

Depth	Elevation	Sample	Stratigraphy	PI	LI
		SS-1	Tailings		
		SS-2			
5.0	68.9	SS-3			
		SS-4			
10.0	63.9	SS-5			
		SS-6			
		SS-7			
15.0	58.9	SS-8			
				2.0	2.0
20.0	53.9				
		SS-9			
		SS-10			
25.0	48.9	SS-11			
		SS-12			
		SS-13			
30.0	43.9	SS-14			
		SS-15			
35.0	38.9	SS-16			
		SS-17			
		SS-18			
40.0	33.9	SS-19			
		SS-20			
45.0	28.9	ST-2		2	3.0
		SS-21			
50.0	23.9	SS-22		14	1.6
		SS-23			
55.0	18.9	SS-24			
		SS-25	Organic Clay	51	0.3
		SS-26			
60.0	13.9	SS-27	Glacial Till		
65.0	8.9				
70.0	-70				



Reduce phi by using Ru = 0.15 here

Reduce Phi by using Ru = 0.1 here

No reduction in Post EQ strength here

Soil Metrics LLC Geotechnical Engineering

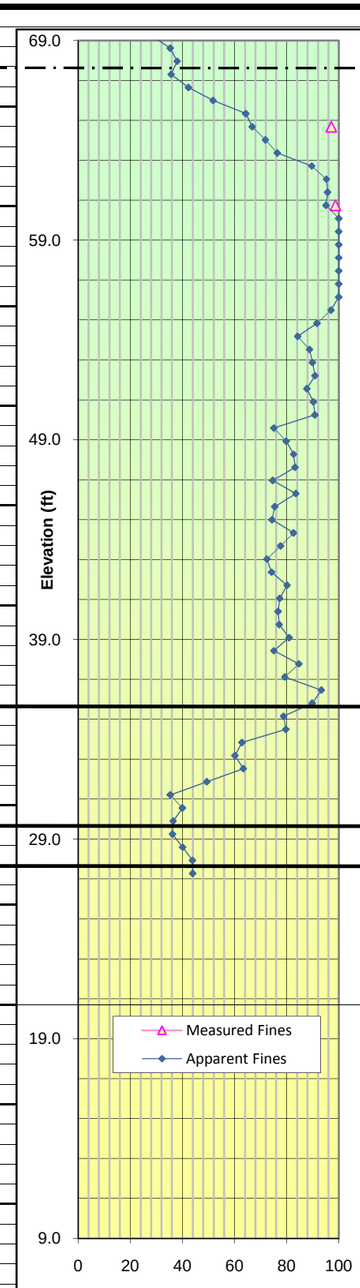
By: sjr
Checked sjr
Date 9/1/2007
Scale: As Noted

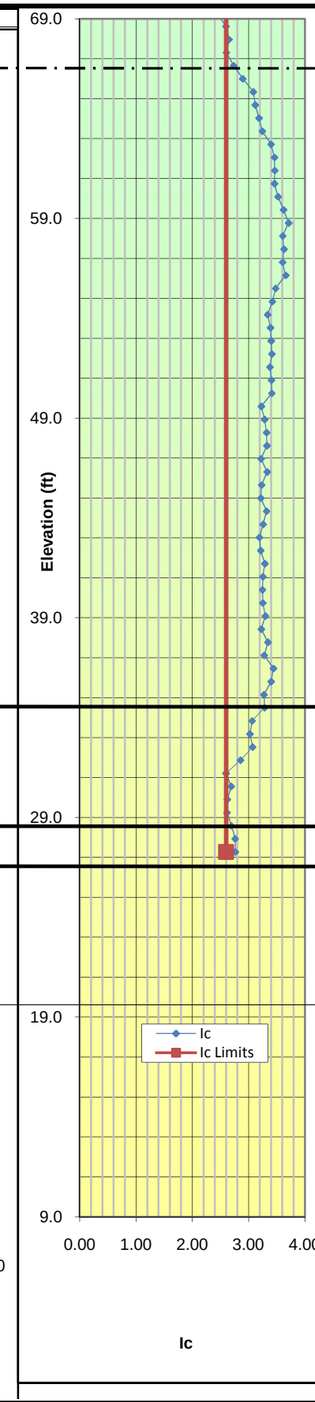
Title Summary Log of B-604/CPT 612 Liquefaction Analysis
Project Callahan Mine Project
Client Maine Department of Transportation

Boring No: B604-CPT612

Figure No. A9-4

Depth	Elevation	Sample	Stratigraphy	PI	LI
			Ground Elev.		69.6
		SS-1			
		SS-2			
5.0	64.6	SS-3		22	1.7
		SS-4			
10.0	59.6	SS-5		19	1.8
15.0	54.6		Tailings		
20.0	49.6				
25.0	44.6				
30.0	39.6				
35.0	34.6				
40.0	29.6		Clay		
			Glacial Till		
45.0	24.6				
50.0	19.6				
55.0	14.6				
60.0	9.6				
65.0	4.6				
70.0	-70				

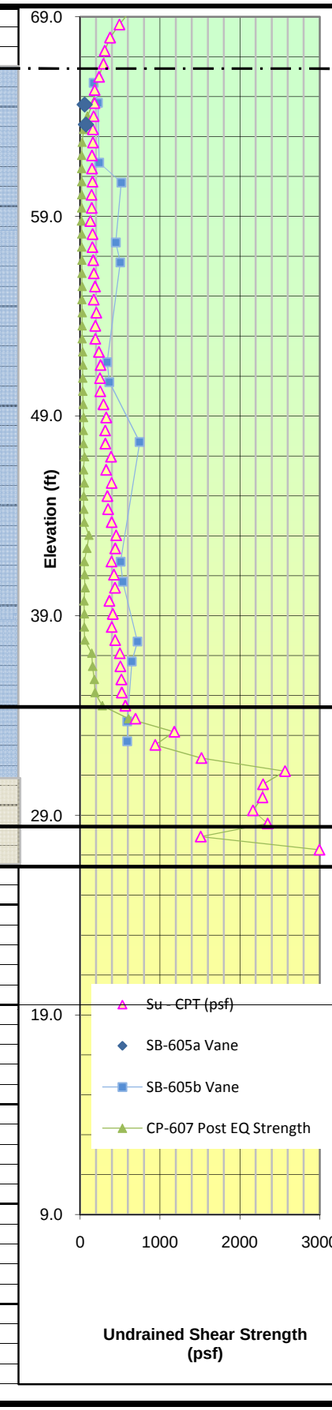


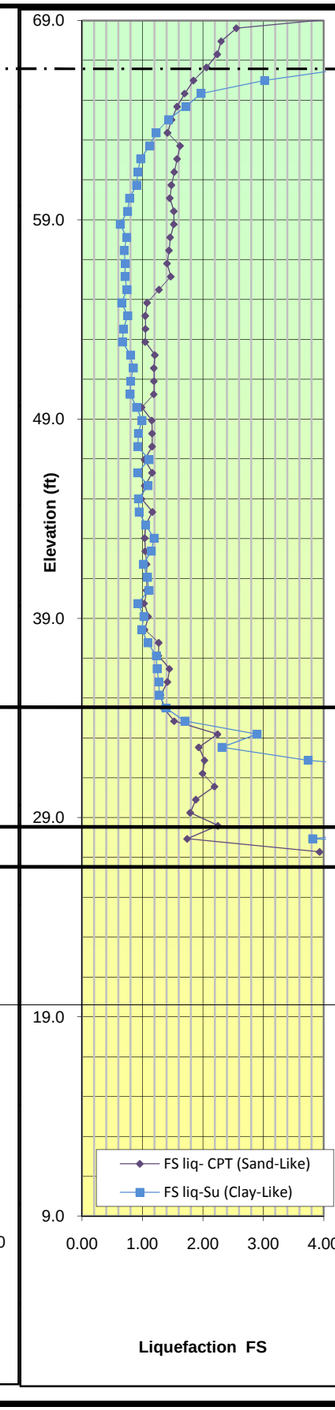


Soil Behavior

Clay - Like

Sand - Like





Use CP=607 Post EQ strength here

No Reduction for Post EQ strength here

Soil Metrics LLC Geotechnical Engineering

By:	sjr
Checked	sjr
Date	9/1/2007
Scale:	As Noted

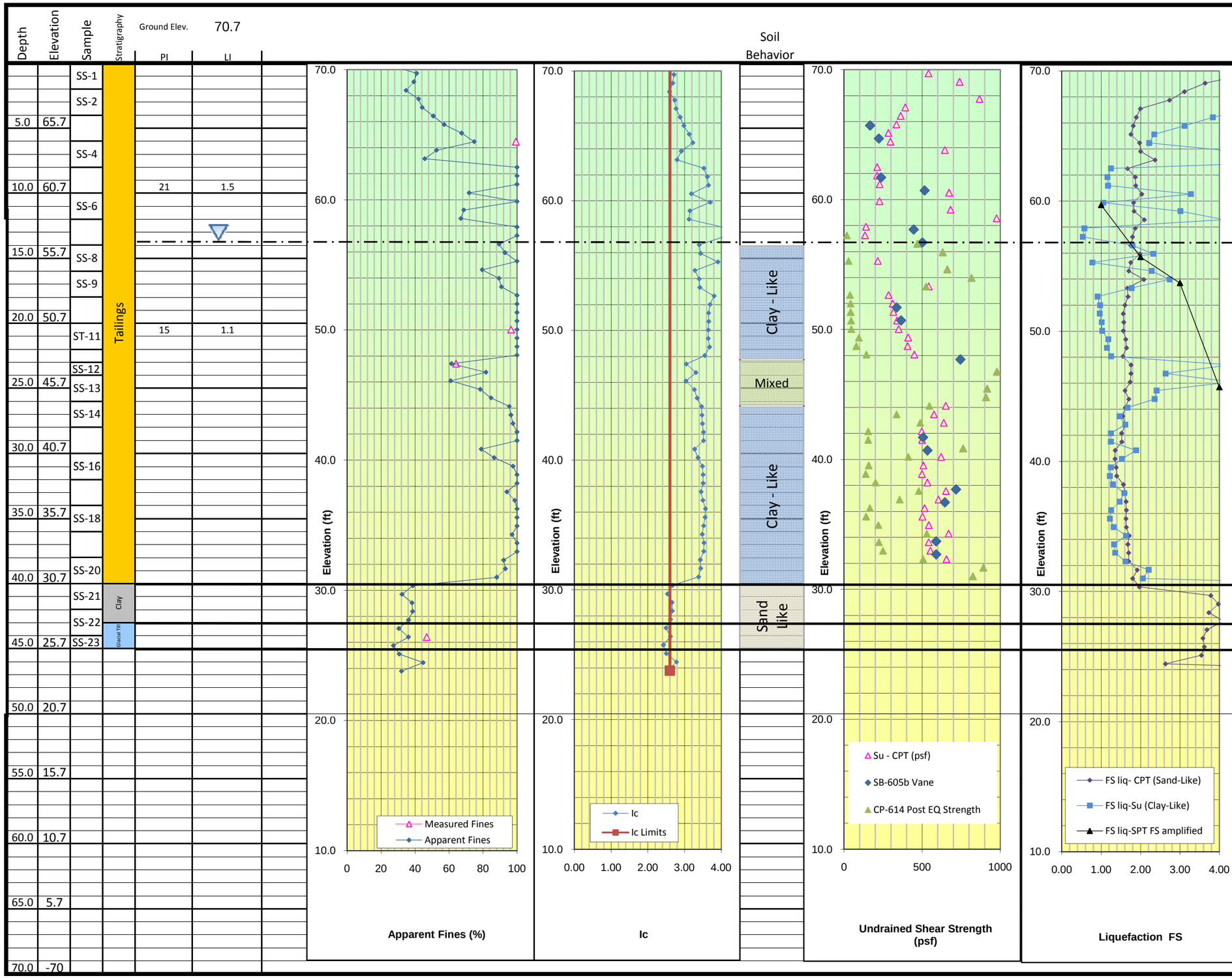
Title: Summary Log of B-605a/CPT 607 Liquefaction Analysis

Project: Callahan Mine Project

Client: Maine Department of Transportation

Boring No: B605a-CPT607

Figure No. A9-5



Soil Metrics LLC Geotechnical Engineering

By:	sjr
Checked	sjr
Date	9/1/2007
Scale:	As Noted

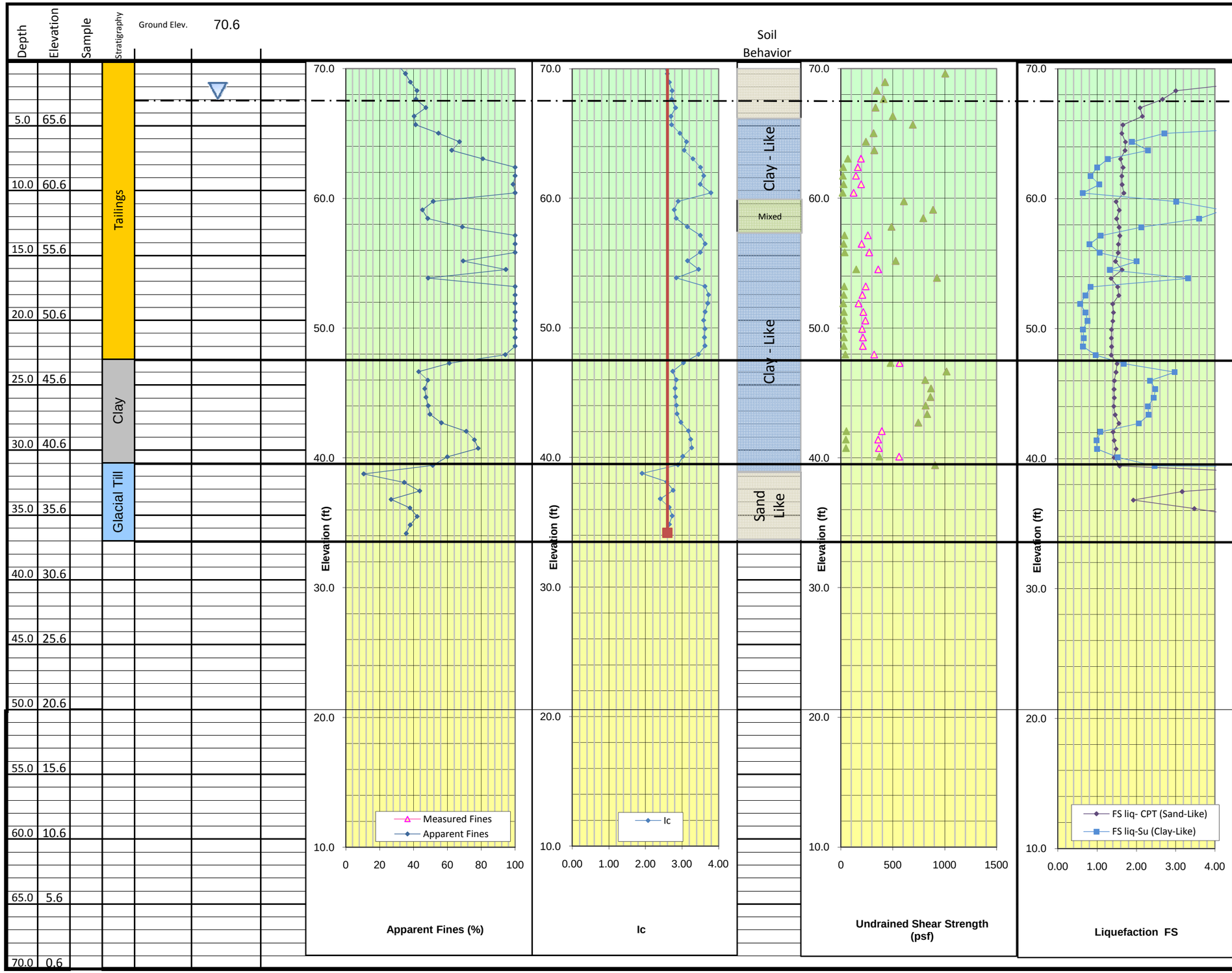
Title: Summary Log of SB-605b/CPT 614 Liquefaction Analysis

Project: Callahan Mine Project

Client: Maine Department of Transportation

Boring No: B605b-CPT614

Figure No. A9-6



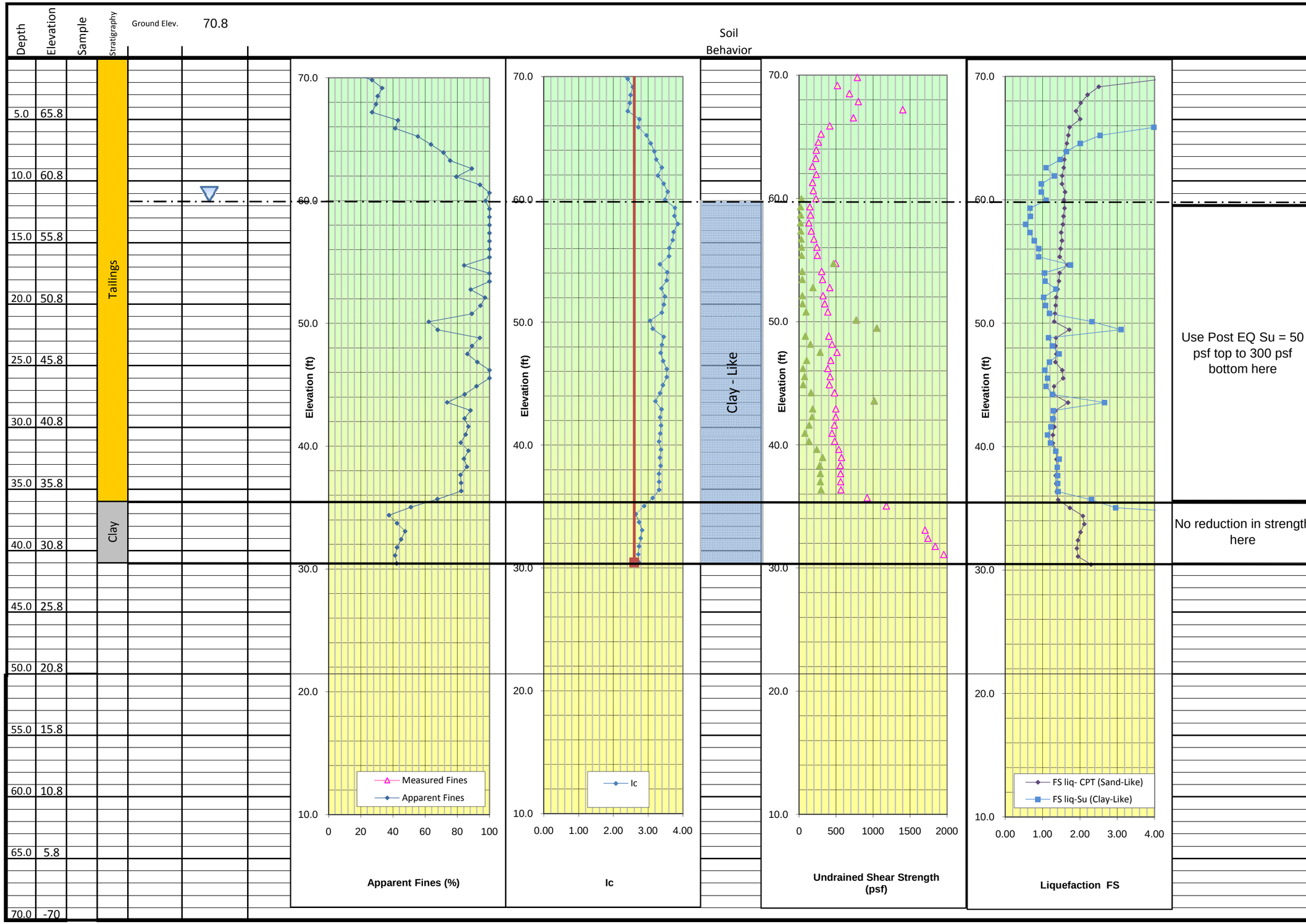
Soil Metrics LLC Geotechnical Engineering

By: sjr
Checked sjr
Date 9/1/2007
Scale: As Noted

Title: Summary Log of CPT 602 Liquefaction Analysis
Project: Callahan Mine Project
Client: Maine Department of Transportation

Boring No: CPT602

Figure No. A9-7



Soil Metrics LLC Geotechnical Engineering

By:	sjr
Checked	sjr
Date	9/1/2007
Scale:	As Noted

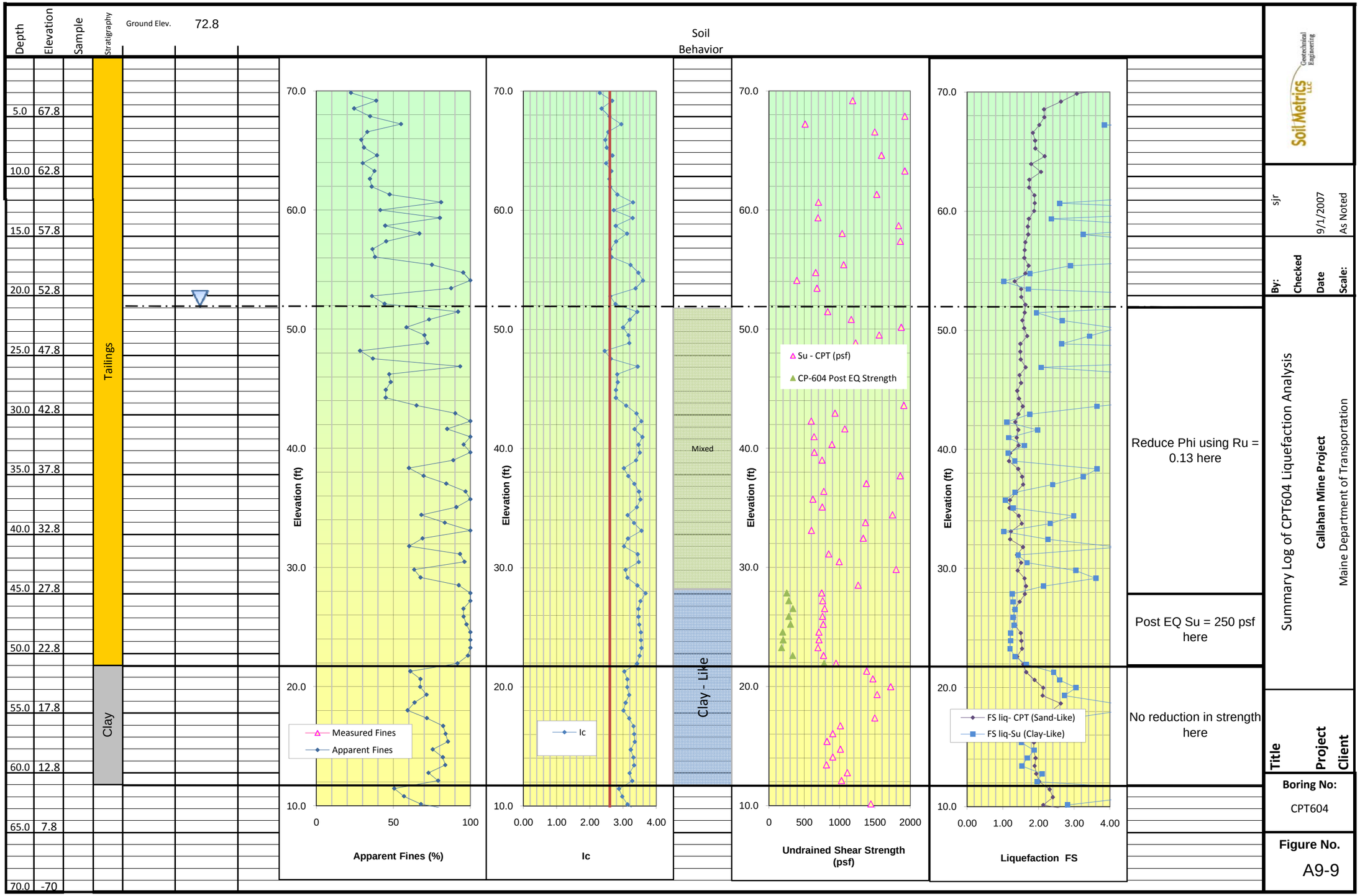
Title: Summary Log CPT 603 Liquefaction Analysis

Project: Callahan Mine Project

Client: Maine Department of Transportation

Boring No: CPT603

Figure No. A9-8



Soil Metrics LLC Geotechnical Engineering

By:	sjr
Checked	
Date	9/1/2007
Scale:	As Noted

Title: Summary Log of CPT604 Liquefaction Analysis

Project: Callahan Mine Project

Client: Maine Department of Transportation

Boring No: CPT604

Figure No. A9-9

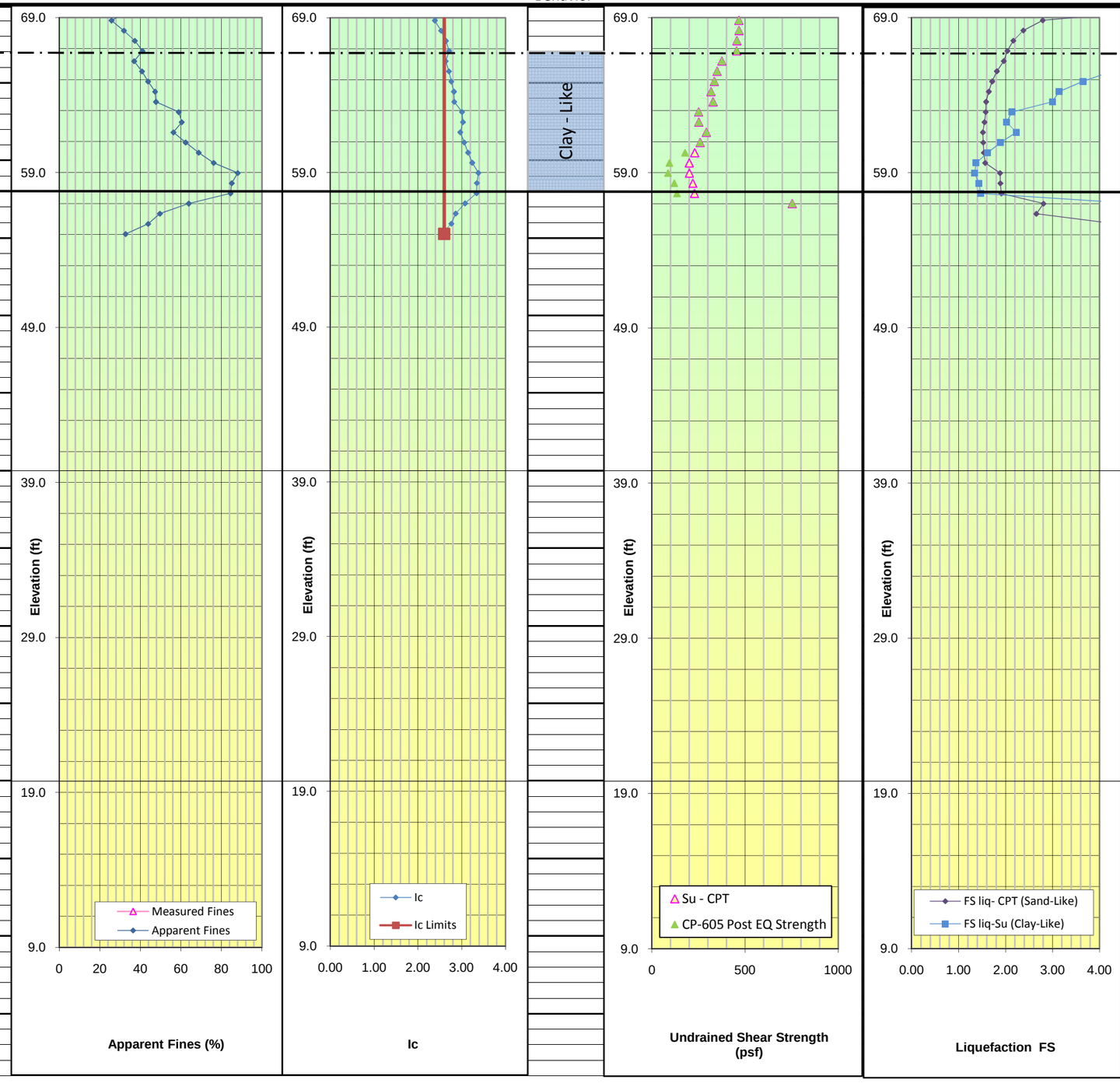
Depth	Elevation	Sample	Stratigraphy
			Ground Elev. 69.8
5.0	64.8		Tailings
10.0	59.8		
15.0	54.8		
20.0	49.8		
25.0	44.8		
30.0	39.8		
35.0	34.8		
40.0	29.8		
45.0	24.8		
50.0	19.8		
55.0	14.8		
60.0	9.8		
65.0	4.8		
70.0	-0.2		

Soil Behavior

Clay - Like

No Post EQ Reduction in strength here

Use Post EQ Su = 100 psf here



Soil Metrics LLC Geotechnical Engineering

By:	sjr
Checked	sjr
Date	9/1/2007
Scale:	As Noted

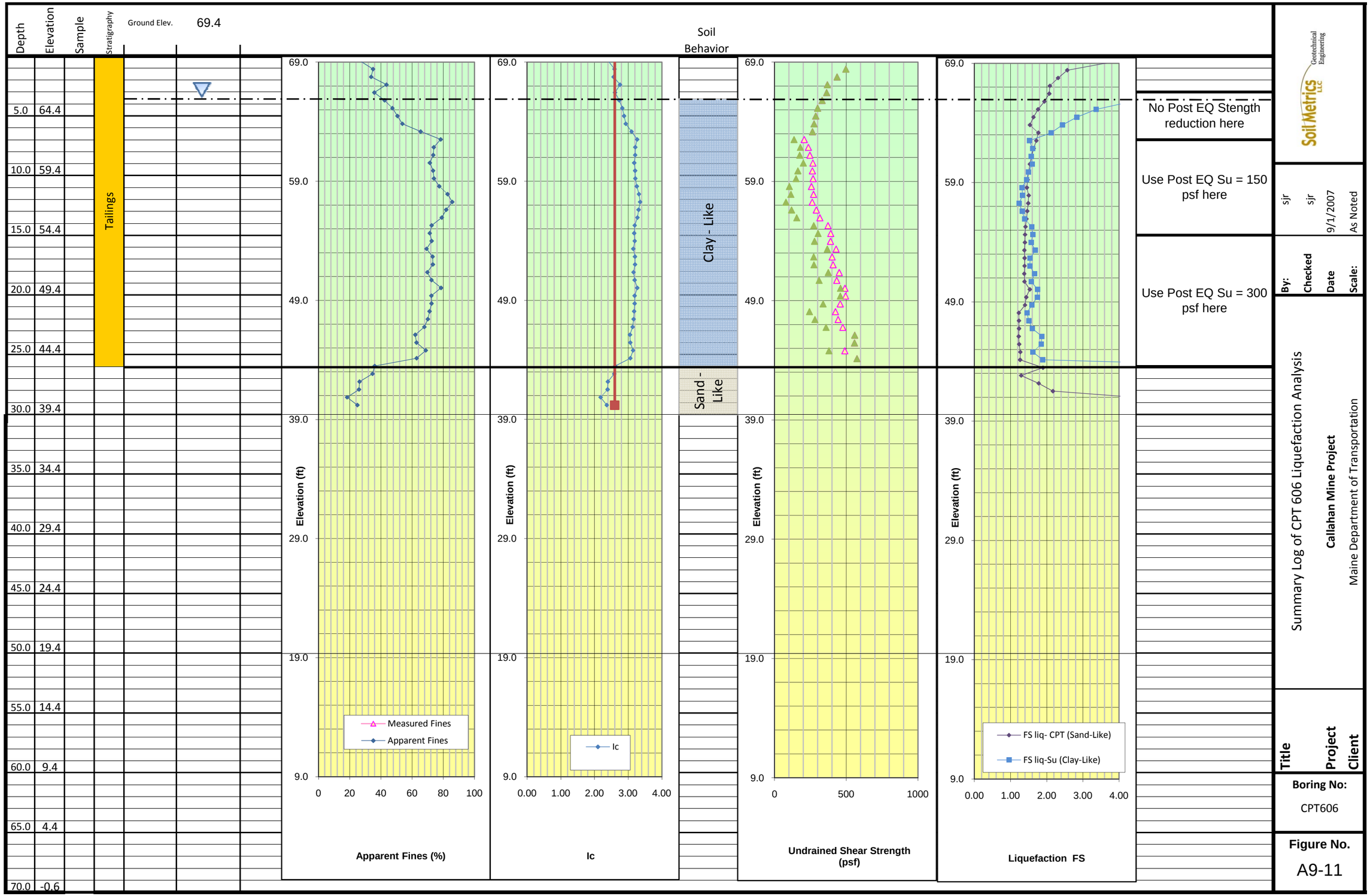
Title: Summary Log of CP 605 Liquefaction Analysis

Project: Callahan Mine Project

Client: Maine Department of Transportation

Boring No: CP-605

Figure No. A9-10



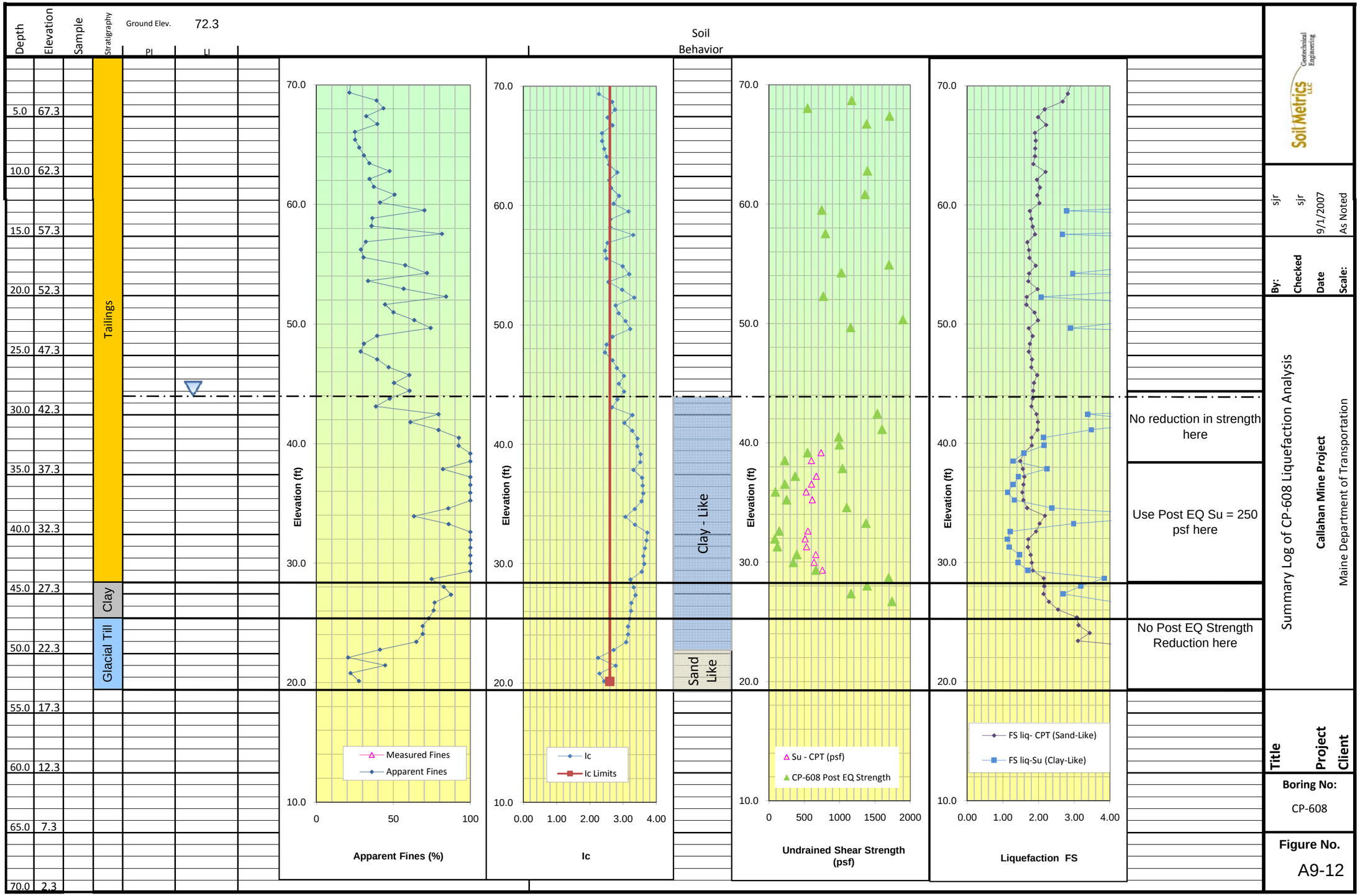
Soil Metrics LLC Geotechnical Engineering

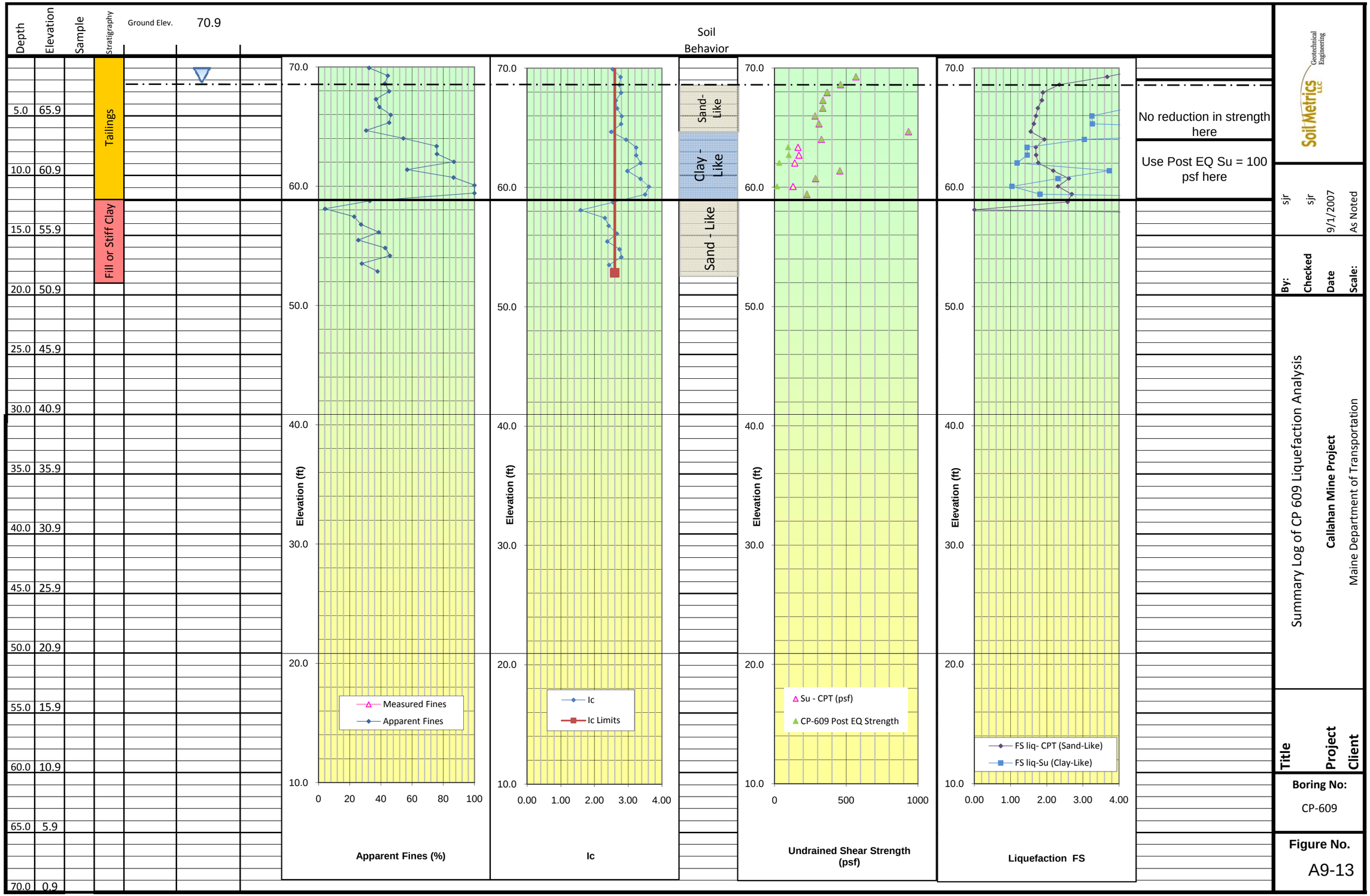
By: sjr
Checked sjr
Date 9/1/2007
Scale: As Noted

Title: Summary Log of CPT 606 Liquefaction Analysis
Project: Callahan Mine Project
Client: Maine Department of Transportation

Boring No: CPT606

Figure No. A9-11


Depth
Elevation
Sample
Stratigraphy
Ground Elev. 72.3
PI
LI
Soil Behavior
5.0 67.3
10.0 62.3
15.0 57.3
20.0 52.3
25.0 47.3
30.0 42.3
35.0 37.3
40.0 32.3
45.0 27.3
50.0 22.3
55.0 17.3
60.0 12.3
65.0 7.3
70.0 2.3
Tailings
Clay
Glacial Till
Clay - Like
Sand Like
Elevation (ft)
Measured Fines
Apparent Fines
Apparent Fines (%)
Ic
Ic Limits
Su - CPT (psf)
CP-608 Post EQ Strength
Undrained Shear Strength (psf)
FS liq- CPT (Sand-Like)
FS liq-Su (Clay-Like)
Liquefaction FS
No reduction in strength here
Use Post EQ Su = 250 psf here
No Post EQ Strength Reduction here
Soil Metrics LLC Geotechnical Engineering
By: sjr
Checked sjr
Date 9/1/2007
Scale: As Noted
Title Summary Log of CP-608 Liquefaction Analysis
Project Callahan Mine Project
Client Maine Department of Transportation
Boring No: CP-608
Figure No. A9-12



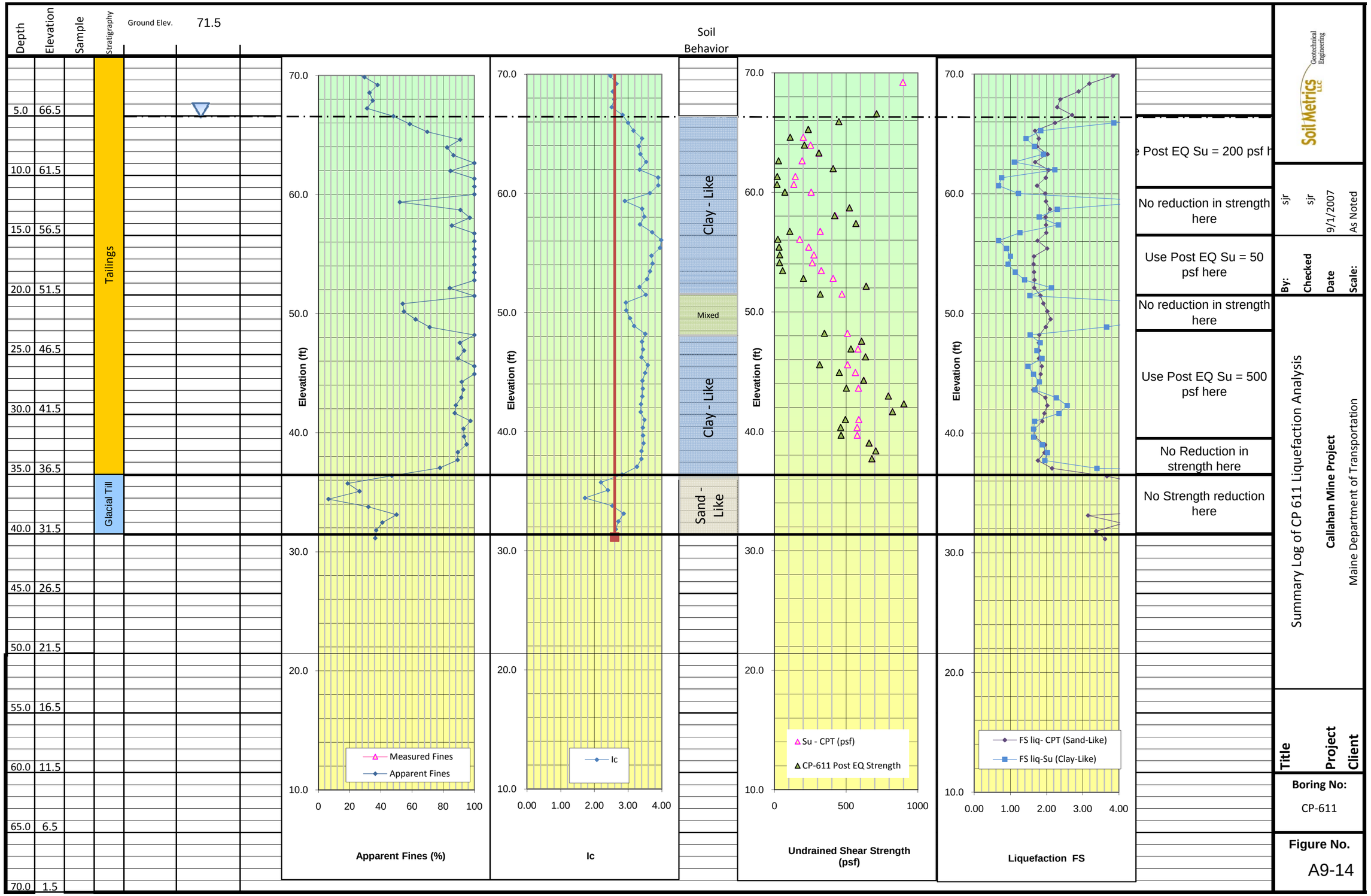
Soil Metrics LLC Geotechnical Engineering

By: sjr
Checked sjr
Date 9/1/2007
Scale: As Noted

Title: Summary Log of CP 609 Liquefaction Analysis
Project: Callahan Mine Project
Client: Maine Department of Transportation

Boring No: CP-609

Figure No. A9-13



Soil Metrics LLC Geotechnical Engineering

By:	sjr
Checked	sjr
Date	9/1/2007
Scale:	As Noted

Summary Log of CP 611 Liquefaction Analysis

Title

Callahan Mine Project

Project

Maine Department of Transportation

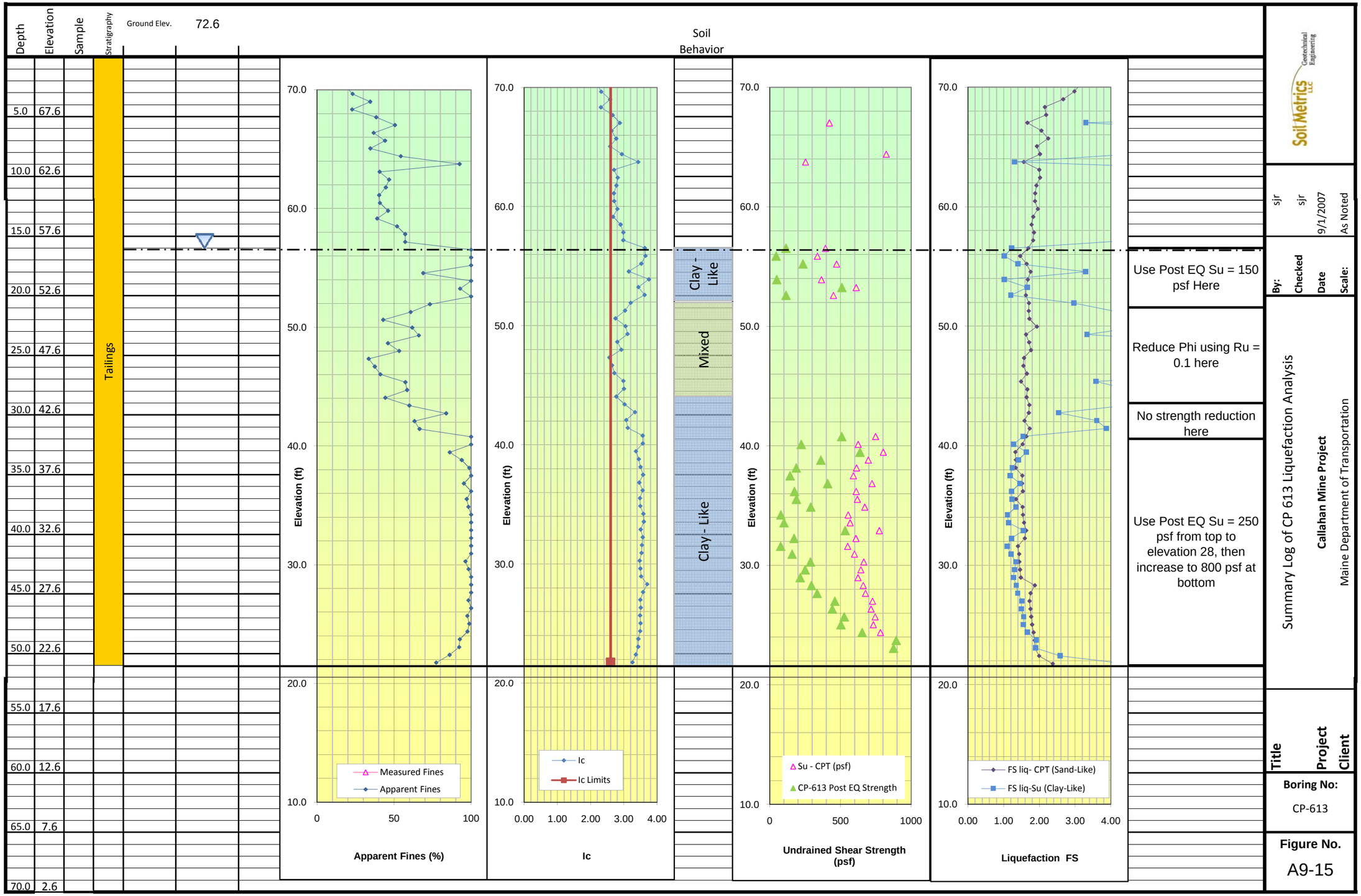
Client

Boring No:

CP-611

Figure No.

A9-14



Soil Metrics LLC Geotechnical Engineering

By:	sjr
Checked	sjr
Date	9/1/2007
Scale:	As Noted

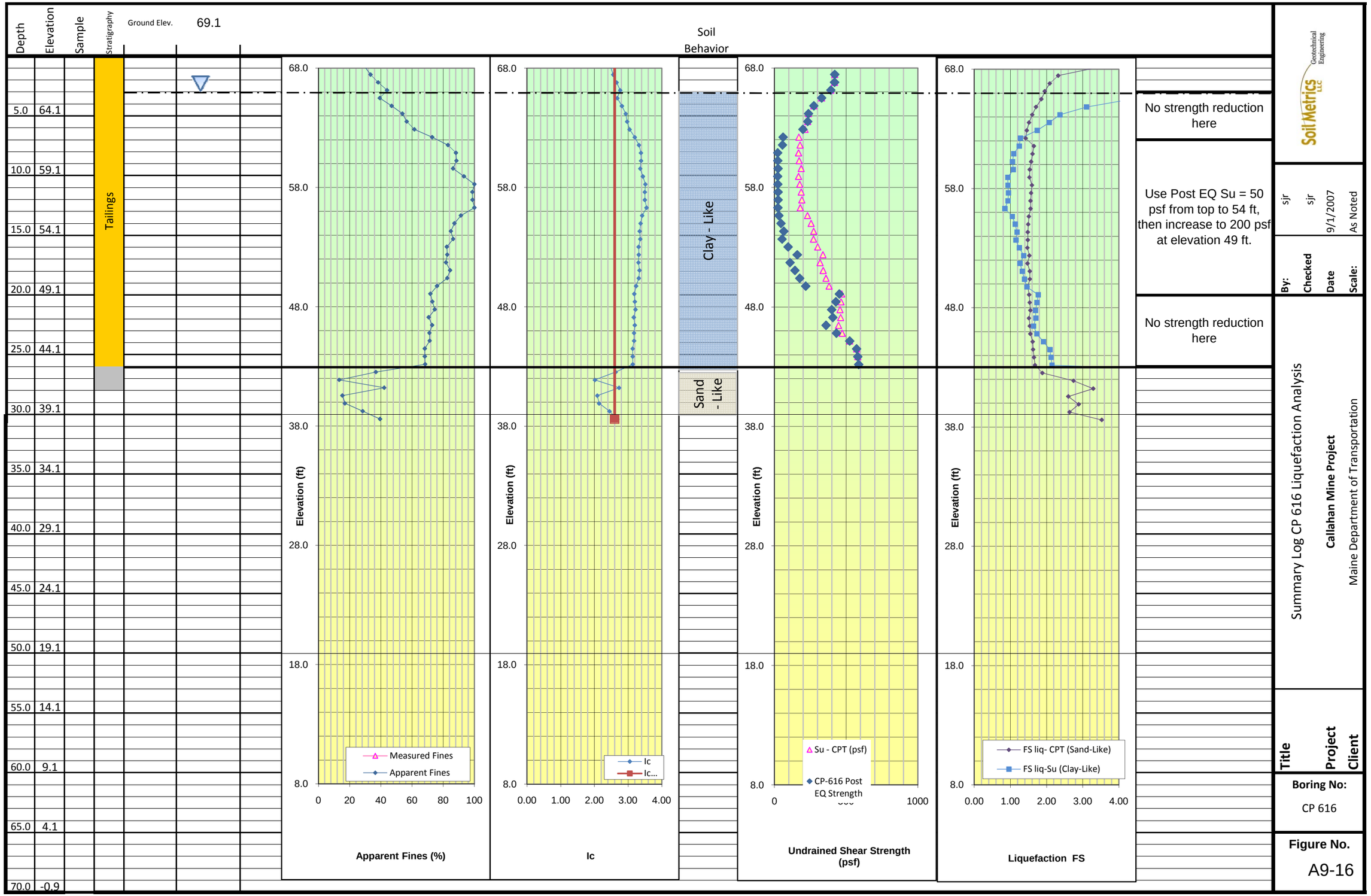
Title: Summary Log of CP 613 Liquefaction Analysis

Project: Callahan Mine Project

Client: Maine Department of Transportation

Boring No: CP-613

Figure No. A9-15



Soil Metrics LLC Geotechnical Engineering

By: sjr
Checked sjr
Date 9/1/2007
Scale: As Noted

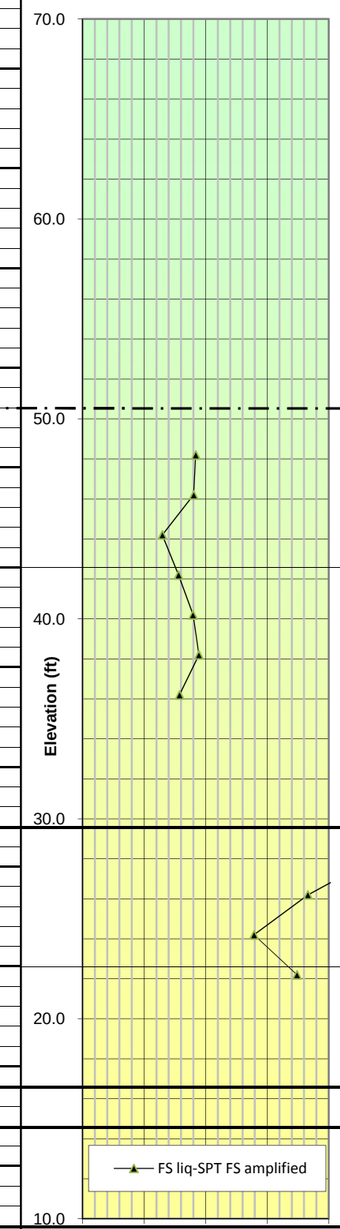
Title Summary Log CP 616 Liquefaction Analysis
Project Callahan Mine Project
Client Maine Department of Transportation

Boring No: CP 616

Figure No. A9-16

Depth	Elevation	Sample	Stratigraphy
		SS-1	Tailings
		SS-2	
5.0	68.2	SS-3	
		SS-4	
10.0	63.2	SS-5	
		SS-6	
		SS-7	
15.0	58.2	SS-8	
		SS-9	
20.0	53.2	SS-10	
		SS-11	
		SS-12	
25.0	48.2	SS-13	
		SS-14	
30.0	43.2	SS-15	
		SS-16	
		SS-17	
35.0	38.2	SS-18	
		SS-19	
40.0	33.2	ST-20	
		SS-21	
		SS-22	Fill
45.0	28.2	SS-23	
		SS-24	
50.0	23.2	SS-25	
		SS-26	
		ST-27	
55.0	18.2	SS-28	
		SS-29	Est. Seds
60.0	13.2	SS-30	Clay
		SS-31	
65.0	8.2		Till
70.0	3.2		

Ground Elev. 73.2



Reduce Phi by using Ru = 0.10 here

No reduction in strength here

Soil Metrics LLC Geotechnical Engineering

By:	sjr
Checked	sjr
Date	9/1/2007
Scale:	As Noted

Title: Summary Log of SB 705 Liquefaction Analysis

Project: Callahan Mine Project

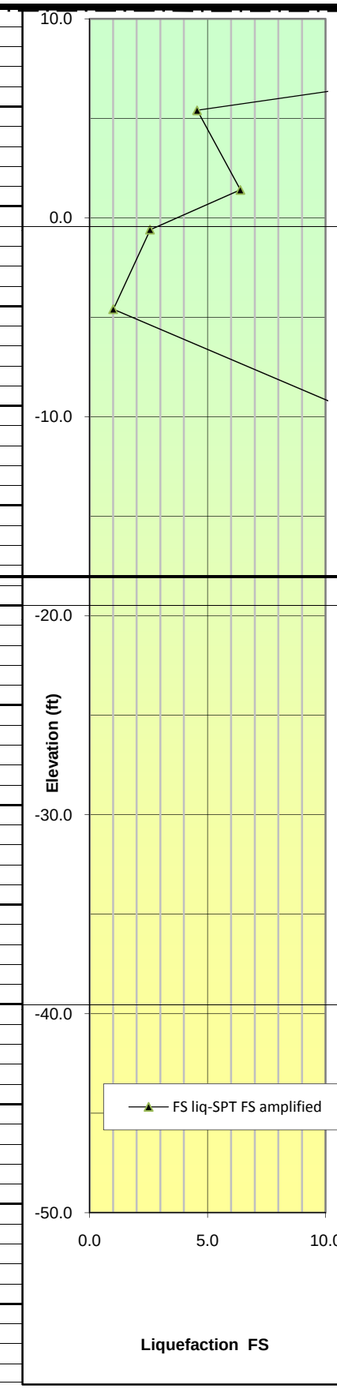
Client: Maine Department of Transportation

Boring No: SB-705

Figure No. A9-17

Depth	Elevation	Sample	Stratigraphy
5.0	5.4		
10.0	0.4		
15.0	-4.6		
20.0	-9.6		
25.0	-14.6		
30.0	-19.6		
35.0	-24.6		
40.0	-29.6		
45.0	-34.6		
50.0	-39.6		
55.0	-44.6		
60.0	-49.6		
65.0	-54.6		
70.0	-59.6		

Ground Elev. 10.4



No reduction in Strength Here

Reduce Clay Su by 20 percent here

No Reduction in Strength Here

Soil Metrics LLC Geotechnical Engineering

By:	sjr
Checked	sjr
Date	9/1/2007
Scale:	As Noted

Title: Summary Log of SB 702 Liquefaction Analysis

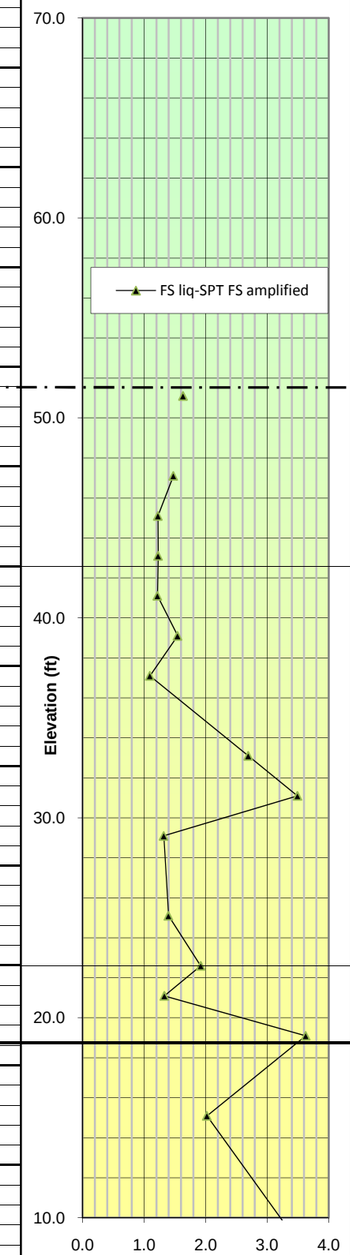
Project: Callahan Mine Project

Client: Maine Department of Transportation

Boring No: SB-702

Figure No. A9-18

Depth	Elevation	Sample	Stratigraphy
			Ground Elev. 73.2
5.0	68.2		Tailings
10.0	63.2		
15.0	58.2		
20.0	53.2		
25.0	48.2		
30.0	43.2		
35.0	38.2		
40.0	33.2		
45.0	28.2		
50.0	23.2		
55.0	18.2		Clay
60.0	13.2		
65.0	8.2		
70.0	3.2		



Reduce Phi by using Ru = 0.45 here

No reduction in strength here

Reduce Phi by Using Ru = 0.15 here

No Reduction in strength here

Soil Metrics LLC Geotechnical Engineering

By: sjr
Checked sjr
Date 9/1/2007
Scale: As Noted

Title Summary Log of SB 706 Liquefaction Analysis
Project Callahan Mine Project
Client Maine Department of Transportation

Boring No: SB-706

Figure No. A9-19

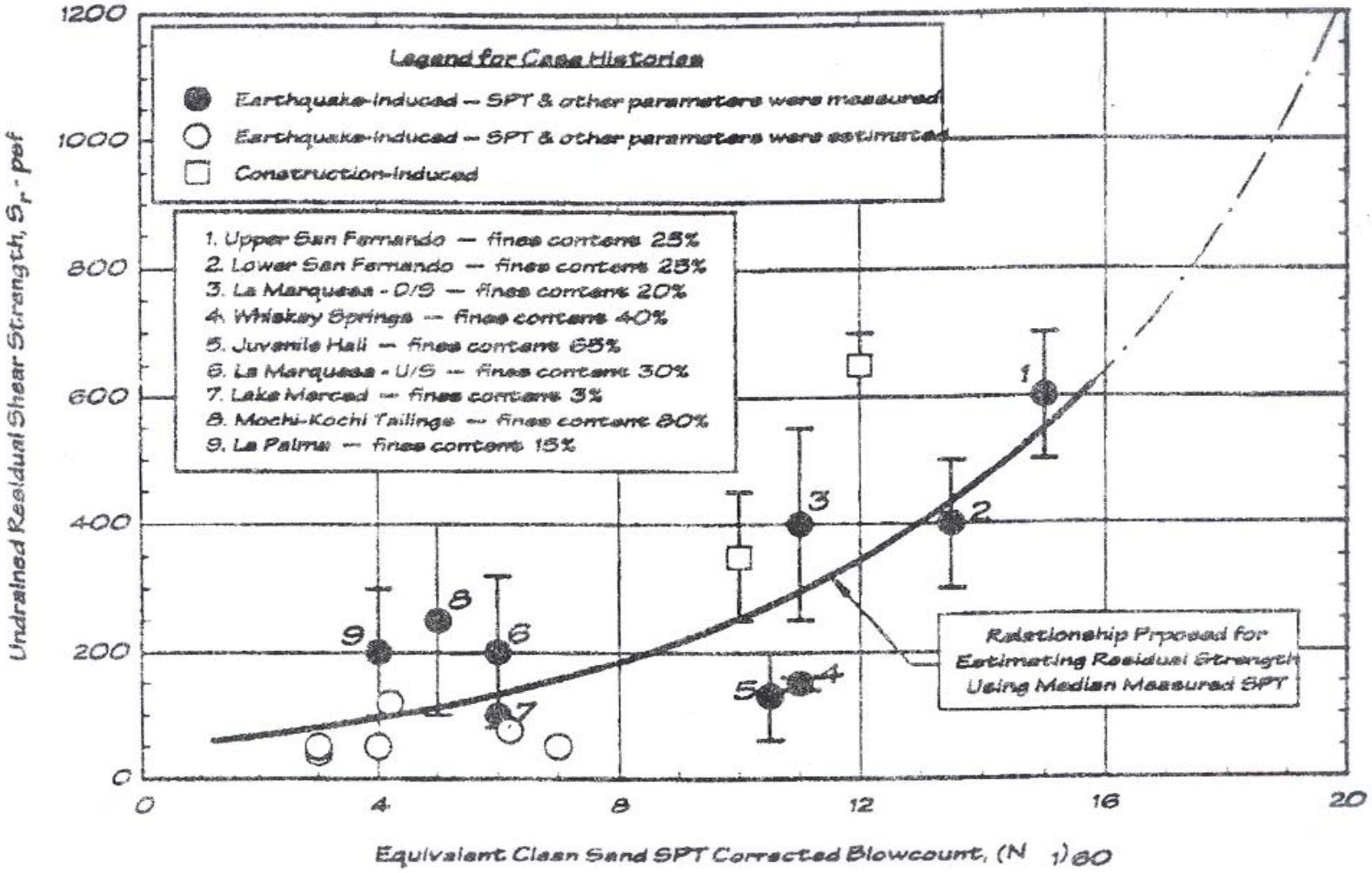


Figure A9-20
Equivalent Clean Sand SPT Corrected Blowcount $(N_1)_{60-CS}$ vs.
Undrained Residual Shear Strength (S_r)
Callahan Mine Seismic Stability Evaluation

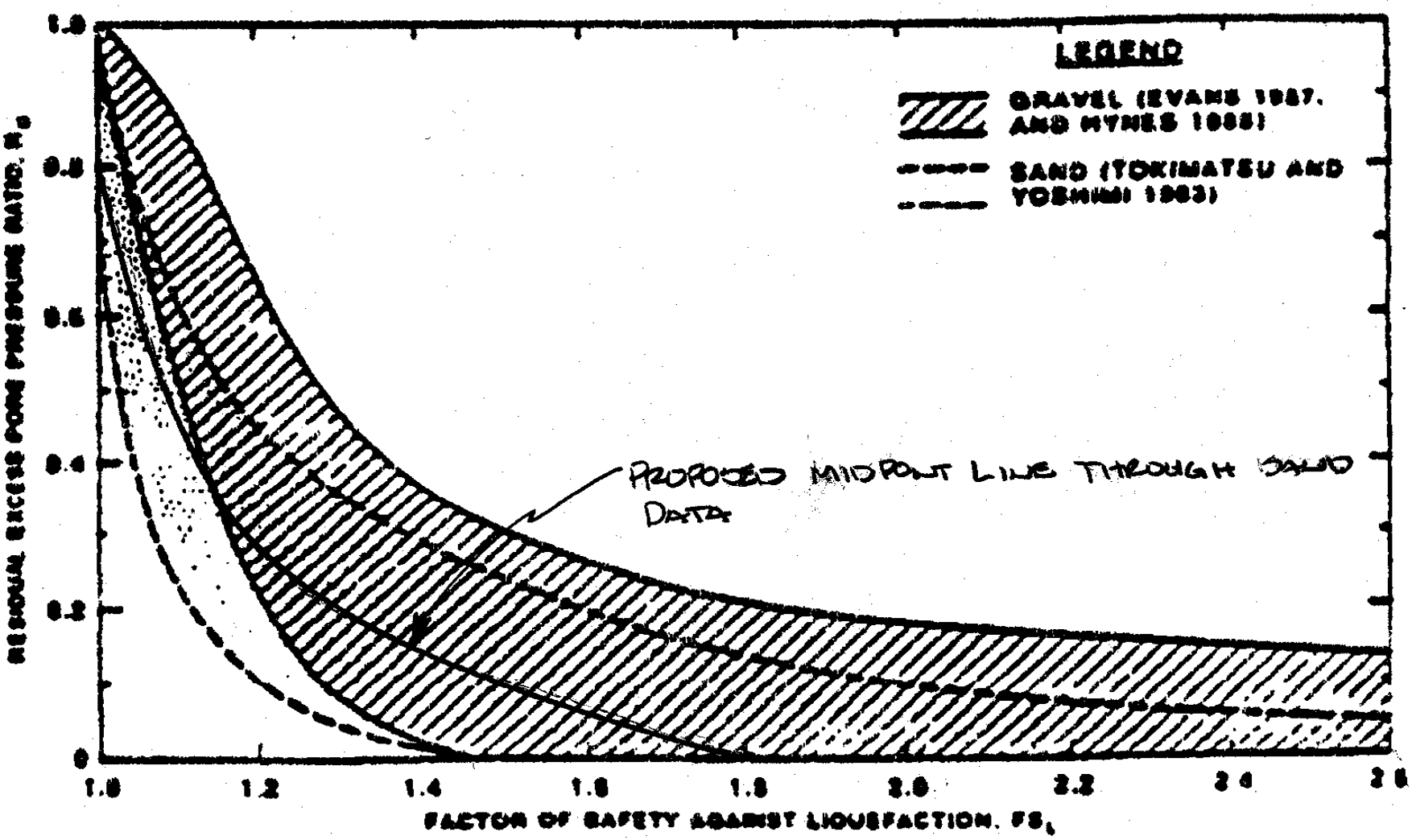


Figure A9-21
Factor of Safety Against Liquefaction vs
Residual Excess Pore Pressure Ratio R_u
Callahan Mine Seismic Stability Report

APPENDIX A9-A

SPT-BASED LIQUEFACTION SPREADSHEETS

STANDARD PENETRATION TEST CORRECTION

Soil Metrics LLC

Callahan Mine
Maine DOT

08/15/07

BORING NO. SB-604
SS-9 to SS-24

Reference: T.L. Youd and I.M. Idriss, (2001), "Liquefaction Resistance of Soils: Summary Report From the 1996 NCEER and 1998 NCEER/NSF Workshopd on Evaluation of Liquefaction Resistance of Soils, ASCE JGGE, April.

Boring Blowcount Corrections: $(N_1)_{60} = N_{RAW} C_N C_E C_B C_R C_S$

Where:

				Recommended by:
1)	Hammer Energy Correction:	C_E =	1 ..... ER/60 – 0.7 to 1.2 (Safety Hammer)	Youd and Idriss, 2001
2)	Borehole Diameter Correction:	C_B =	1 ..... Nw and Hw Sized Borings	Youd and Idriss, 2001
3)	Rod Length Correction:	C_R=	0.75 ..... 0-9.75 ft.	Youd and Idriss, 2001
			0.8 ..... 9.75 to 13 ft.	
			0.85 ..... 13 to 19.5 ft.	
			0.95 ..... 19.5 to 32 ft.	
			1 ..... >32 ft.	
4)	Spoon Liner Correction:	C_S =	If N=0-5 then Cs=1.0; if N=6-10, then Cs=1.1; if N=+10 then Cs=1.2	Hendron from Diversion Dam Project, New York (consistent with Youd and Idriss, 2001)
5)	Overburden:	C_N =	(P_a/σ'_{vo})^0.5	Youd and Idriss, 2001
6)	Correction for Residual Strength:		(N)corr is based on Seed (1986) "Design Problems in Soil Liquefaction"	

Fines Correction: $(N1)_{60cs} = \alpha + \beta (N_1)_{60}$ Where: $\alpha = \exp[1.76-(190/FC^2)]$ and $\beta = [0.99 + (FC^{1.5}/1000)]$ — Youd and Idriss, 2001
FC = fines content in percent (e.g., 35% = 35)

Seed & Harder Clean Sanc — Seed and Harder (1990)

Percent Fines	N Correction (blows/foot
10%	1
25%	2
50%	4
75%	5

Clean Sand $CRR_{7.5}$: $CRR_{7.5} = \{(1/(34-(N_1)_{60cs})\} + \{(N_1)_{60cs}/135\} + \{50/[10 \times (N_1)_{60cs} + 45]^2\} - [1/200]$ — Youd and Idriss, 2001

INPUT:

Moist Overburden Unit Weight (total):	0.115	kcf
Sat. Overburden Unit Weight (total):	0.117	kcf
Depth to Water Table	18.3	feet
Ground Surface Elevation	73.9	
Base Elevation for Amplification	14.9	

Computation of Triggering $CRR_{7.5}$:

Layer Name	Grain Size Distribution Classification*	Plasticity Index, PI	Sample No.	Depth (feet)	Elev. (ft)	% Fines	Static Pore Pres., u (ksf)	Uncorrected Blowcounts 0-6"	6-12"	12-18"	18-24"	Raw SPT N (bpf)	Hammer Type correction C_E	Borehole Dia correction C_B	Rod length correction C_R	Spoon liner correction C_S	Eff. Over-burden σ'_v (ksf)	Over-burden correction C_N	Corrected Blowcount $(N_1)_{60}$ (bpf)	Seed & Harder Clean Sand Correction (bpf)	Seed & Harder Clean Sand $(N_1)_{60}$ (bpf)	Fines Uncorrected $CRR_{7.5}$ **	Fines Correction of $CRR_{7.5}$ α	β	Clean Sand $(N_1)_{60cs}$	Clean Sand $CRR_{7.5}$ **
Tailings			SS-9	21.0	52.9	55	0.2	2	3	3	3	6	1.0	1.0	1.0	1.1	2.3	0.97	6	4	10	0.08	5.00	1.20	12	0.13
			SS-10	23.0	50.9	**54**	0.3	1	2	1	2	3	1.0	1.0	1.0	1.0	2.4	0.95	3	4	7	0.06	5.00	1.20	8	0.10
			SS-11	25.0	48.9	**35**	0.4	1	1	2	3	3	1.0	1.0	1.0	1.0	2.5	0.93	3	2	5	0.06	4.98	1.20	8	0.10
			SS-12	27.0	46.9	**45**	0.5	1	1	1	1	2	1.0	1.0	1.0	1.0	2.6	0.91	2	2	4	0.05	5.00	1.20	7	0.09
Tailings			SS-13	29.0	44.9	55	0.7	1	1	1	2	2	1.0	1.0	1.0	1.0	2.7	0.89	2	4	6	0.05	5.00	1.20	7	0.09
			SS-14	31.0	42.9	**32**	0.8	2	3	2	2	5	1.0	1.0	1.0	1.0	2.8	0.87	4	2	6	0.07	4.83	1.17	10	0.11
			SS-15	33.0	40.9	**58**	0.9	1	1	2	2	3	1.0	1.0	1.0	1.0	2.9	0.85	3	4	7	0.06	5.00	1.20	8	0.10
			SS-16	35.0	38.9	60	1.0	1	1	0	2	1	1.0	1.0	1.0	1.0	3.0	0.84	1	4	5	0.05	5.00	1.20	6	0.08
Tailings			SS-17	37.0	36.9	**88**	1.2	1	1	2	1	3	1.0	1.0	1.0	1.0	3.1	0.82	2	5	7	0.06	5.00	1.20	8	0.10
			SS-18	39.0	34.9	**92**	1.3	1	1	2	1	3	1.0	1.0	1.0	1.0	3.2	0.81	2	5	7	0.06	5.00	1.20	8	0.10
			SS-19	41.0	32.9	55	1.4	2	2	3	2	5	1.0	1.0	1.0	1.0	3.3	0.80	4	4	8	0.06	5.00	1.20	10	0.11
			SS-20	43.0	30.9	55	1.5	1	1	2	1	3	1.0	1.0	1.0	1.0	3.5	0.78	2	4	6	0.05	5.00	1.20	8	0.09
Tailings			SS-21	49.0	24.9	55	1.9	0	0	2	2	2	1.0	1.0	1.0	1.0	3.8	0.75	1	4	5	0.05	5.00	1.20	7	0.09
			SS-22	51.0	22.9	90	2.0	1	1	1	2	2	1.0	1.0	1.0	1.0	3.9	0.74	1	5	6	0.05	5.00	1.20	7	0.09
			SS-23	53.0	20.9	**54**	2.2	2	2	6	6	8	1.0	1.0	1.0	1.1	4.0	0.73	6	4	10	0.08	5.00	1.20	13	0.14
			SS-24	55.0	18.9	75	2.3	2	1	2	2	3	1.0	1.0	1.0	1.0	4.1	0.72	2	5	7	0.05	5.00	1.20	8	0.09

* See boring logs in Appendix A for detailed description.

** CRR is 1.0 if (N1)60 is greater than 30 blows/ft; Youd and Idriss 2001, p. 299 indicate that liquefaction will not occurr for (N1)60 > 30 blow/ft.

BORING NO. SB-604

1) CSR = $0.65*(a_{max}/g)*(\sigma_v/\sigma'_v)*r_d$ Seed & Idriss, 1983, p. 459

a_{max}/g = 0.11 g USGS

σ_v = computed Total Vertical Stress

σ'_v = computed Effective Vertical Stress

$r_d = [1.0 - 0.4113z^{0.5} + 0.04052z + 0.001753z^{1.5}] / [1 - 0.4177z^{0.5} + 0.05729z - 0.006205z^{1.5} + 0.001210z^2]$

z = depth in meters

2) FS = Factor of safety against triggering of liquefaction: FS = (CRR/CSR) x MSF x $K\sigma$ x $K\alpha$ Youd and Idriss, 2001

MSF = magnitude scaling factor; Assume based on range recommended by NCEER Workshop, reiterated in Youd and Idriss, 2001

$K\sigma = (\sigma'_{vo}/P_a)^{(f-1)}$, where f = 0.7 to 0.8 for relative density of 40 to 60%; f = 0.6 to 0.7 for rel density of 60 to 80%; P_a = pressure at 1 atmosphere Youd and Idriss, 2001

1 Atmosphere = 14.7 psi = 2.12 psf

$K\alpha$ = see discussion in text.

Computation of Triggering CSR and Triggering Factor of Safety

Sample No.	Depth (feet)	Static Pore Pres., u (ksf)	Eff. Over-burden σ'_v (ksf)	Tot. Over-burden σ_v (ksf)	Depth z (meters)	r_d	Crest Apmplif 2.0	CSR ampl	CSR level	MSF M5.5	Relative Density Factor, f	$K\sigma$	α	$K\alpha$	FS liq-SPT FS amplified	FS liq-SPT FS level	General Soil Type
SS-9	21.0	0.2	2.3	2.4	6.4	0.95	0.18	0.12	0.07	2.2	0.8	0.99	0.1	0.96	2.3	3.8	0.0
SS-10	23.0	0.3	2.4	2.7	7.0	0.95	0.18	0.12	0.08	2.2	0.8	0.98	0.1	0.90	1.5	2.5	0.0
SS-11	25.0	0.4	2.5	2.9	7.6	0.94	0.17	0.12	0.08	2.2	0.8	0.97	0.1	0.88	1.5	2.3	0.0
SS-12	27.0	0.5	2.6	3.1	8.2	0.93	0.17	0.12	0.08	2.2	0.8	0.96	0.1	0.87	1.3	2.0	0.0
SS-13	29.0	0.7	2.7	3.4	8.8	0.93	0.17	0.12	0.08	2.2	0.8	0.95	0.1	0.89	1.3	2.0	0.0
SS-14	31.0	0.8	2.8	3.6	9.4	0.92	0.16	0.12	0.08	2.2	0.8	0.95	0.1	0.89	1.6	2.4	0.0
SS-15	33.0	0.9	2.9	3.8	10.1	0.90	0.16	0.12	0.09	2.2	0.8	0.94	0.1	0.90	1.5	2.1	0.0
SS-16	35.0	1.0	3.0	4.1	10.7	0.89	0.15	0.12	0.09	2.2	0.8	0.93	0.1	0.88	1.2	1.7	0.0
SS-17	37.0	1.2	3.1	4.3	11.3	0.88	0.15	0.12	0.09	2.2	0.8	0.93	0.1	0.90	1.5	2.0	0.0
SS-18	39.0	1.3	3.2	4.5	11.9	0.86	0.15	0.12	0.09	2.2	0.8	0.92	0.1	0.90	1.5	2.0	0.0
SS-19	41.0	1.4	3.3	4.8	12.5	0.84	0.14	0.11	0.09	2.2	0.8	0.91	0.1	0.91	1.8	2.4	0.0
SS-20	43.0	1.5	3.5	5.0	13.1	0.82	0.14	0.11	0.09	2.2	0.8	0.91	0.1	0.89	1.5	2.0	0.0
SS-21	49.0	1.9	3.8	5.7	14.9	0.76	0.13	0.10	0.08	2.2	0.8	0.89	0.1	0.88	1.5	1.8	0.0
SS-22	51.0	2.0	3.9	5.9	15.5	0.74	0.12	0.09	0.08	2.2	0.8	0.89	0.1	0.89	1.6	1.8	0.0
SS-23	53.0	2.2	4.0	6.2	16.2	0.72	0.12	0.09	0.08	2.2	0.8	0.88	0.1	0.96	2.9	3.2	0.0
SS-24	55.0	2.3	4.1	6.4	16.8	0.70	0.12	0.08	0.08	2.2	0.8	0.88	0.1	0.90	1.9	2.0	0.0

STANDARD PENETRATION TEST CORRECTION

Soil Metrics LLC

Callahan Mine 08/15/07
Maine DOT

BORING NO. SB-604
SS-9 to SS-24

Reference: T.L. Youd and I.M. Idriss, (2001), "Liquefaction Resistance of Soils: Summary Report From the 1996 NCEER and 1998 NCEER/NSF Workshopd on Evaluation of Liquefaction Resistance of Soils, ASCE JGGE, April.

Boring Blowcount Corrections: $(N_1)_{60} = N_{RAW} C_N C_E C_B C_R C_S$

Where: Recommended by:

1) Hammer Energy Correction: C_E = 1 .....ER/60 ~ 0.7 to 1.2 (Safety Hammer) — Youd and Idriss, 2001
2) Borehole Diameter Correction: C_B = 1 .....Nw and Hw Sized Borings — Youd and Idriss, 2001
3) Rod Length Correction: C_R= 0.75 .....0-9.75 ft. — Youd and Idriss, 2001
0.8 .....9.75 to 13 ft.
0.85 .....13 to 19.5 ft.
0.95 .....19.5 to 32 ft.
1 .....>32 ft.
4) Spoon Liner Correction: C_S = If N=0-5 then Cs=1.0; if N=6-10, then Cs=1.1; if N=+10 then Cs=1.2 — Hendron from Diversion Dam Project, New York (consistent with Youd and Idriss, 2001)
5) Overburden: C_N = (P_a/σ'_{vo})^0.5 — Youd and Idriss, 2001
6) Correction for Residual Strength: (N)corr is based on Seed (1986) "Design Problems in Soil Liquefaction"

Fines Correction: $(N1)_{60cs} = \alpha + \beta (N_1)_{60}$ Where: $\alpha = \exp[1.76-(190/FC^2)]$ and $\beta = [0.99 + (FC^{1.5}/1000)]$ — Youd and Idriss, 2001
FC = fines content in percent (e.g., 35% = 35)

Seed & Harder Clean Sanc — Seed and Harder (1990)

Percent Fines	N Correction (blows/foot)
10%	1
25%	2
50%	4
75%	5

Clean Sand $CRR_{7.5}$: $CRR_{7.5} = \{(1/(34-(N_1)_{60cs})\} + \{(N_1)_{60cs}/135\} + \{50/[10 \times (N_1)_{60cs} + 45]^2\} - [1/200]$ — Youd and Idriss, 2001

INPUT:

Moist Overburden Unit Weight (total):	0.115	kcf
Sat. Overburden Unit Weight (total):	0.117	kcf
Depth to Water Table	10	feet
Ground Surface Elevation	70.7	
Base Elevation for Amplification	23.5	

Computation of Triggering $CRR_{7.5}$:

Layer Name	Grain Size Distribution Classification*	Plasticity Index, PI	Sample No.	Depth (feet)	Elev. (ft)	% Fines	Static Pore Pres., u (ksf)	Uncorrected Blowcounts 0-6"	6-12"	12-18"	18-24"	Raw SPT N (bpf)	Hammer Type correction C_E	Borehole Dia correction C_B	Rod length correction C_R	Spoon liner correction C_S	Eff. Over-burden σ'_v (ksf)	Over-burden correction C_N	Corrected Blowcount $(N_1)_{60}$ (bpf)	Seed & Harder Clean Sand Correction (bpf)	Seed & Harder Clean Sand $(N_1)_{60}$ (bpf)	Fines Uncorrected $CRR_{7.5}$ **	Fines Correction of $CRR_{7.5}$ α	β	Clean Sand $(N_1)_{60cs}$	Clean Sand $CRR_{7.5}$ **
Tailings	Tailings		SS-6	11.0	59.7	50	0.1	0	0	0	2	0	1.0	1.0	0.8	1.0	1.2	1.33	0	4	4	0.05	5.00	1.20	5	0.07
	Tailings		SS-8	15.0	55.7	**50**	0.3	0	1	0	0	1	1.0	1.0	0.9	1.0	1.4	1.22	1	4	5	0.05	5.00	1.20	6	0.08
	Tailings		SS-9	17.0	53.7	50	0.4	1	1	0	0	1	1.0	1.0	0.9	1.0	1.5	1.18	1	4	5	0.05	5.00	1.20	6	0.08
	Tailings		SS-13	25.0	45.7	50	0.9	0	1	0	0	1	1.0	1.0	1.0	1.0	2.0	1.04	1	4	5	0.05	5.00	1.20	6	0.08
Tailings	Tailings		SS-14	27.0	43.7	50	1.1	0	1	0	0	1	1.0	1.0	1.0	1.0	2.1	1.01	1	4	5	0.05	5.00	1.20	6	0.08
	Tailings		SS-16	31.0	39.7	50	1.3	0	0	0	0	0	1.0	1.0	1.0	1.0	2.3	0.96	0	4	4	0.05	5.00	1.20	5	0.07
	Tailings		SS-18	35.0	35.7	**50**	1.6	0	0	0	0	0	1.0	1.0	1.0	1.0	2.5	0.92	0	4	4	0.05	5.00	1.20	5	0.07
	Tailings		SS-20	39.0	31.7	50	1.8	0	0	0	0	0	1.0	1.0	1.0	1.0	2.7	0.88	0	4	4	0.05	5.00	1.20	5	0.07
Tailings	Stiff Silty Clay		SS-21	41.0	29.7	**50**	1.9	4	7	11	17	18	1.0	1.0	1.0	1.2	2.8	0.86	19	4	23	0.20	5.00	1.20	27	0.35
	Glacial Till		SS-22	43.0	27.7	50	2.1	6	10	14	26	24	1.0	1.0	1.0	1.2	3.0	0.85	24	4	28	0.28	5.00	1.20	34	1.00
Tailings																										

* See boring logs in Appendix A for detailed description.

** CRR is 1.0 if (N1)60 is greater than 30 blows/ft; Youd and Idriss 2001, p. 299 indicate that liquefaction will not occurr for (N1)60 > 30 blow/ft.

BORING NO. SB-604

1) CSR $= 0.65*(a_{max}/g)*(\sigma_v/\sigma'_v)*r_d$ Seed & Idriss, 1983, p. 459

a_{max}/g = 0.11 g USGS

σ_v = computed Total Vertical Stress

σ'_v = computed Effective Vertical Stress

$r_d = [1.0 - 0.4113z^{0.5} + 0.04052z + 0.001753z^{1.5}] / [1 - 0.4177z^{0.5} + 0.05729z - 0.006205z^{1.5} + 0.001210z^2]$

z = depth in meters

2) FS = Factor of safety against triggering of liquefaction: $FS = (CRR_{7.5}/CSR) \times MSF \times K\sigma \times K\alpha$ Youd and Idriss, 2001

MSF = magnitude scaling factor; Assume based on range recommended by NCEER Workshop, reiterated in Youd and Idriss, 2001

$K\sigma = (\sigma'_{vo}/P_a)^{(f-1)}$, where f = 0.7 to 0.8 for relative density of 40 to 60%; f = 0.6 to 0.7 for rel density of 60 to 80%; P_a= pressure at 1 atmosphere Youd and Idriss, 2001

1 Atmosphere = 14.7 psi = 2.12 psf

$K\alpha$ = see discussion in text.

Computation of Triggering CSR and Triggering Factor of Safety

Sample No.	Depth (feet)	Static Pore Pres., u (ksf)	Eff. Over-burden σ'_v (ksf)	Tot. Over-burden σ_v (ksf)	Depth z (meters)	r_d	amax adj for amplification Apmplif 2.0	CSR ampl	CSR level	MSF M5.5	Relative Density Factor, f	$K\sigma$	α	$K\alpha$	FS liq-SPT FS amplified	FS liq-SPT FS level	General Soil Type
SS-6	11.0	0.1	1.2	1.3	3.4	0.98	0.19	0.13	0.07	2.2	0.8	1.12	0.02	0.96	1.3	2.3	Tailings
SS-8	15.0	0.3	1.4	1.7	4.6	0.97	0.19	0.14	0.08	2.2	0.8	1.08	0.02	0.96	1.3	2.2	Tailings
SS-9	17.0	0.4	1.5	2.0	5.2	0.96	0.18	0.15	0.09	2.2	0.8	1.07	0.02	0.96	1.3	2.1	Tailings
SS-13	25.0	0.9	2.0	2.9	7.6	0.94	0.16	0.15	0.10	2.2	0.8	1.01	0.02	0.96	1.2	1.8	Tailings
SS-14	27.0	1.1	2.1	3.1	8.2	0.93	0.16	0.14	0.10	2.2	0.8	1.00	0.02	0.96	1.2	1.7	Tailings
SS-16	31.0	1.3	2.3	3.6	9.4	0.92	0.15	0.14	0.10	2.2	0.8	0.98	0.02	0.96	1.1	1.5	Tailings
SS-18	35.0	1.6	2.5	4.1	10.7	0.89	0.14	0.13	0.10	2.2	0.8	0.97	0.02	0.96	1.1	1.4	Tailings
SS-20	39.0	1.8	2.7	4.5	11.9	0.86	0.13	0.12	0.10	2.2	0.8	0.95	0.02	0.96	1.2	1.4	Tailings
SS-21	41.0	1.9	2.8	4.8	12.5	0.84	0.12	0.11	0.10	2.2	0.8	0.94	0.02	1.03	6.5	7.4	Stiff Silty Clay
SS-22	43.0	2.1	3.0	5.0	13.1	0.82	0.12	0.11	0.10	2.2	0.8	0.94	0.02	1.03	19.5	21.2	Glacial Till

STANDARD PENETRATION TEST CORRECTION

Soil Metrics LLC

Callahan Mine
Maine DOT

08/15/07

BORING NO. SB-705
SS-9 to SS-24

Reference: T.L. Youd and I.M. Idriss, (2001), "Liquefaction Resistance of Soils: Summary Report From the 1996 NCEER and 1998 NCEER/NSF Workshopd on Evaluation of Liquefaction Resistance of Soils, ASCE JGGE, April.

Boring Blowcount Corrections: $(N_1)_{60} = N_{RAW} C_N C_E C_B C_R C_S$

Where:

				Recommended by:
1)	Hammer Energy Correction:	C_E =	1.2 ..... ER/60 − 0.7 to 1.2 (Safety Hammer)	Youd and Idriss, 2001
2)	Borehole Diameter Correction:	C_B =	1 ..... Nw and Hw Sized Borings	Youd and Idriss, 2001
3)	Rod Length Correction:	C_R=	0.75 ..... 0-9.75 ft.	Youd and Idriss, 2001
			0.8 ..... 9.75 to 13 ft.	
			0.85 ..... 13 to 19.5 ft.	
			0.95 ..... 19.5 to 32 ft.	
			1 ..... >32 ft.	
4)	Spoon Liner Correction:	C_S =	If N=0-5 then Cs=1.0; if N=6-10, then Cs=1.1; if N=+10 then Cs=1.2	Hendron from Diversion Dam Project, New York (consistent with Youd and Idriss, 2001)
5)	Overburden:	C_N =	(P_a/σ'_{vo})^0.5	Youd and Idriss, 2001
6)	Correction for Residual Strength:		(N)corr is based on Seed (1986) "Design Problems in Soil Liquefaction"	

Fines Correction: $(N1)_{60cs} = \alpha + \beta (N_1)_{60}$ Where: $\alpha = \exp[1.76-(190/FC^2)]$ and $\beta = [0.99 + (FC^{1.5}/1000)]$ — Youd and Idriss, 2001
FC = fines content in percent (e.g., 35% = 35)

Seed & Harder Clean Sanc

Percent Fines	N Correction (blows/foot
10%	1
25%	2
50%	4
75%	5

Seed and Harder (1990)

Clean Sand $CRR_{7.5}$: $CRR_{7.5} = \{(1/(34-(N_1)_{60cs})\} + \{(N_1)_{60cs}/135\} + \{50/[10 \times (N_1)_{60cs} + 45]^2\} - [1/200]$ — Youd and Idriss, 2001

INPUT:

Moist Overburden Unit Weight (total):	0.115	kcf
Sat. Overburden Unit Weight (total):	0.117	kcf
Depth to Water Table	22	feet
Ground Surface Elevation	73.2	
Base Elevation for Amplification	9	

Computation of Triggering $CRR_{7.5}$:

Layer Name	Grain Size Distribution Classification*	Plasticity Index, PI	Sample No.	Center Depth (feet)	Elev. (ft)	% Fines	Static Pore Pres., u (ksf)	Uncorrected Blowcounts 0-6"	6-12"	12-18"	18-24"	Raw SPT N (bpf)	Hammer Type correction C_E	Borehole Dia correction C_B	Rod length correction C_R	Spoon liner correction C_S	Eff. Over-burden σ'_v (ksf)	Over-burden correction C_N	Corrected Blowcount $(N_1)_{60}$ (bpf)	Seed & Harder Clean Sand Correction (bpf)	Seed & Harder Clean Sand $(N_1)_{60}$ (bpf)	Fines Uncorrected $CRR_{7.5}$ **	Fines Correction of $CRR_{7.5}$ α	β	Clean Sand $(N_1)_{60cs}$	Clean Sand $CRR_{7.5}$ **
Tailings			SS-13	25.0	48.2	**27**	0.2	2	2	3	0	5	1.2	1.0	1.0	1.0	2.7	0.89	5	2	7.05	0.07	4.48	1.13	10.00	0.11
			SS-14	27.0	46.2	**51**	0.3	1	1	2	2	3	1.2	1.0	1.0	1.0	2.8	0.87	3	4	6.97	0.06	5.00	1.20	10	0.11
	upper portion clay, PI = 8	8	SS-15	29.0	44.2	27	0.4	0	0	2	2	2	1.2	1.0	1.0	1.0	2.9	0.85	2	2	3.94	0.05	4.48	1.13	7	0.09
Tailings	upper portion clay, PI = 22	22	SS-16	31.0	42.2	**59**	0.6	1	0	3	4	3	1.2	1.0	1.0	1.0	3.0	0.84	3	4	6.86	0.06	5.00	1.20	8	0.10
			SS-17	33.0	40.2	**82**	0.7	2	1	3	3	4	1.2	1.0	1.0	1.0	3.1	0.82	4	5	8.95	0.06	5.00	1.20	10	0.11
	upper portion clay, PI = 11	11	SS-18	35.0	38.2	**46**	0.8	1	2	3	3	5	1.2	1.0	1.0	1.0	3.2	0.81	5	2	6.85	0.07	5.00	1.20	11	0.12
			SS-19	37.0	36.2	50	0.9	1	2	1	2	3	1.2	1.0	1.0	1.0	3.3	0.80	3	4	6.86	0.06	5.00	1.20	8	0.10
Tailings																										
	upper portion clay, PI = 19	19	SS-22	43.0	30.2	50	1.3	0	0	37	0	37	1.2	1.0	1.0	1.2	3.7	0.76	40	4	44.43	1.00	5.00	1.20	54	1.00
	upper portion clay, PI = 14	14	SS-23	45.0	28.2	50	1.4	6	7	5	8	12	1.2	1.0	1.0	1.2	3.8	0.75	13	4	16.92	0.14	5.00	1.20	21	0.22
Fill			SS-24	47.0	26.2	50	1.6	4	5	5	0	10	1.2	1.0	1.0	1.1	3.9	0.74	10	4	13.73	0.11	5.00	1.20	17	0.18
			SS-25	49.0	24.2	50	1.7	3	3	4	5	7	1.2	1.0	1.0	1.1	4.0	0.73	7	4	10.72	0.09	5.00	1.20	13	0.14
			SS-26	51.0	22.2	50	1.8	2	4	5	7	9	1.2	1.0	1.0	1.1	4.1	0.72	9	4	12.52	0.10	5.00	1.20	15	0.16
			SS-28	55.0	18.2																					
Clay	Clay	22	SS-29	57.0	16.2	90	2.2	8	9	13	16	22	1.2	1.0	1.0	1.2	4.4	0.69	22	5	26.87	0.24	5.00	1.20	31	1.00
			SS-30	59.0	14.2	90	2.3	3	4	8	12	12	1.2	1.0	1.0	1.2	4.6	0.68	12	5	16.79	0.13	5.00	1.20	19	0.21
			SS-31	57.0	16.2	90	2.2	10	12	14	16	26	1.2	1.0	1.0	1.2	4.4	0.69	26	5	30.85	0.31	5.00	1.20	36	1.00
Till			SS-32	57.0	16.2	75	2.2	7	33	12		45	1.2	1.0	1.0	1.2	4.4	0.69	45	5	49.74	1.00	5.00	1.20	59	1.00

* See boring logs in Appendix A for detailed description.

** CRR is 1.0 if (N1)60 is greater than 30 blows/ft; Youd and Idriss 2001, p. 299 indicate that liquefaction will not occurr for (N1)60 > 30 blow/ft.

BORING NO. SB-705

1) CSR = $0.65*(a_{max}/g)*(\sigma_v/\sigma'_v)*r_d$ Seed & Idriss, 1983, p. 459

a_{max}/g = 0.11 g USGS
σ_v = computed Total Vertical Stress
σ'_v = computed Effective Vertical Stress

$r_d = [1.0 - 0.4113z^{0.5} + 0.04052z + 0.001753z^{1.5}] / [1 - 0.4177z^{0.5} + 0.05729z - 0.006205z^{1.5} + 0.001210z^2]$

z = depth in meters

2) FS = Factor of safety against triggering of liquefaction: $FS = (CRR_7/CSR) \times MSF \times K\sigma \times K\alpha$ Youd and Idriss, 2001

MSF = magnitude scaling factor; Assume based on range recommended by NCEER Workshop, reiterated in Youd and Idriss, 2001

$K\sigma = (\sigma'_{vo}/P_a)^{(f-1)}$, where f = 0.7 to 0.8 for relative density of 40 to 60%; f = 0.6 to 0.7 for rel density of 60 to 80%; P_a = pressure at 1 atmosphere Youd and Idriss, 2001
1 Atmosphere = 14.7 psi = 2.12 psf
$K\alpha$ = see discussion in text.

Computation of Triggering CSR and Triggering Factor of Safety

Sample No.	Depth (feet)	Static Pore Pres., u (ksf)	Eff. Over-burden σ'_v (ksf)	Tot. Over-burden σ_v (ksf)	Depth z (meters)	r_d	Crest Apmplif 2.0	CSR ampl	CSR level	MSF M5.5	Relative Density Factor, f	$K\sigma$	α	$K\alpha$	FS liq-SPT FS amplified	FS liq-SPT FS level	General Soil Type
SS-13	25.0	0.2	2.7	2.9	7.6	0.94	0.18	0.12	0.07	2.2	0.8	0.95	0.1	0.90	1.8	3.0	0.0
SS-14	27.0	0.3	2.8	3.1	8.2	0.93	0.17	0.12	0.07	2.2	0.8	0.95	0.1	0.90	1.8	2.9	0.0
SS-15	29.0	0.4	2.9	3.3	8.8	0.93	0.17	0.12	0.08	2.2	0.8	0.94	0.1	0.87	1.3	2.0	upper portion clay, PI = 8
SS-16	31.0	0.6	3.0	3.6	9.4	0.92	0.17	0.12	0.08	2.2	0.8	0.93	0.1	0.90	1.6	2.4	upper portion clay, PI = 22
SS-17	33.0	0.7	3.1	3.8	10.1	0.90	0.16	0.12	0.08	2.2	0.8	0.92	0.1	0.93	1.8	2.7	0.0
SS-18	35.0	0.8	3.2	4.1	10.7	0.89	0.16	0.12	0.08	2.2	0.8	0.92	0.1	0.90	1.9	2.8	upper portion clay, PI = 11
SS-19	37.0	0.9	3.3	4.3	11.3	0.88	0.16	0.11	0.08	2.2	0.8	0.91	0.1	0.90	1.6	2.2	0.0
													0.1				
SS-22	43.0	1.3	3.7	5.0	13.1	0.82	0.15	0.11	0.08	2.2	0.8	0.90	0.1	1.27	23.5	31.3	upper portion clay, PI = 19
SS-23	45.0	1.4	3.8	5.2	13.7	0.80	0.14	0.10	0.08	2.2	0.8	0.89	0.1	1.15	4.9	6.3	upper portion clay, PI = 14
SS-24	47.0	1.6	3.9	5.5	14.3	0.78	0.14	0.10	0.08	2.2	0.8	0.89	0.1	1.06	3.7	4.6	0.0
SS-25	49.0	1.7	4.0	5.7	14.9	0.76	0.14	0.10	0.08	2.2	0.8	0.88	0.1	0.98	2.8	3.4	0.0
SS-26	51.0	1.8	4.1	5.9	15.5	0.74	0.13	0.09	0.08	2.2	0.8	0.88	0.1	1.03	3.5	4.2	0.0
													0.1				
SS-29	57.0	2.2	4.4	6.6	17.4	0.68	0.12	0.08	0.07	2.2	0.8	0.86	0.1	1.27	29.6	32.9	Clay
SS-30	59.0	2.3	4.6	6.9	18.0	0.67	0.12	0.08	0.07	2.2	0.8	0.86	0.1	1.15	5.7	6.2	0.0
SS-31	57.0	2.2	4.4	6.6	17.4	0.68	0.12	0.08	0.07	2.2	0.8	0.86	0.1	1.27	29.6	32.9	0.0
SS-32	57.0	2.2	4.4	6.6	17.4	0.68	0.12	0.08	0.07	2.2	0.8	0.86	0.1	1.27	29.6	32.9	0.0

STANDARD PENETRATION TEST CORRECTION

Soil Metrics LLC

Callahan Mine
Maine DOT

08/15/07

BORING NO. SB-706
SS-9 to SS-24

Reference: T.L. Youd and I.M. Idriss, (2001), "Liquefaction Resistance of Soils: Summary Report From the 1996 NCEER and 1998 NCEER/NSF Workshopd on Evaluation of Liquefaction Resistance of Soils, ASCE JGGE, April.

Boring Blowcount Corrections: $(N_1)_{60} = N_{RAW} C_N C_E C_B C_R C_S$

Where:

				Recommended by:
1)	Hammer Energy Correction:	C_E =	*1.2* ..... ER/60 – 0.7 to 1.2 (Safety Hammer)	Youd and Idriss, 2001
2)	Borehole Diameter Correction:	C_B =	1 ..... Nw and Hw Sized Borings	Youd and Idriss, 2001
3)	Rod Length Correction:	C_R=	0.75 ..... 0-9.75 ft.	Youd and Idriss, 2001
			0.8 ..... 9.75 to 13 ft.	
			0.85 ..... 13 to 19.5 ft.	
			0.95 ..... 19.5 to 32 ft.	
			1 ..... >32 ft.	
4)	Spoon Liner Correction:	C_S =	If N=0-5 then Cs=1.0; if N=6-10, then Cs=1.1; if N=+10 then Cs=1.2	Hendron from Diversion Dam Project, New York (consistent with Youd and Idriss, 2001)
5)	Overburden:	C_N =	(P_a/σ'_{vo})^0.5	Youd and Idriss, 2001
6)	Correction for Residual Strength:		(N)corr is based on Seed (1986) "Design Problems in Soil Liquefaction"	

Fines Correction: $(N1)_{60cs} = \alpha + \beta (N_1)_{60}$ Where: $\alpha = \exp[1.76-(190/FC^2)]$ and $\beta = [0.99 + (FC^{1.5}/1000)]$ — Youd and Idriss, 2001
FC = fines content in percent (e.g., 35% = 35)

Seed & Harder Clean Sanc — Seed and Harder (1990)

Percent Fines	N Correction (blows/foot
10%	1
25%	2
50%	4
75%	5

Clean Sand $CRR_{7.5}$: $CRR_{7.5} = \{(1/(34-(N_1)_{60cs})\} + \{(N_1)_{60cs}/135\} + \{50/[10 \times (N_1)_{60cs} + 45]^2\} - [1/200]$ — Youd and Idriss, 2001

INPUT:

Moist Overburden Unit Weight (total):	0.115	kcf
Sat. Overburden Unit Weight (total):	0.117	kcf
Depth to Water Table	21	feet
Ground Surface Elevation	74.1	
Base Elevation for Amplification	9	

Computation of Triggering $CRR_{7.5}$:

Layer Name	Grain Size Distribution Classification*	Plasticity Index, PI	Sample No.	Depth (feet)	Elev. (ft)	% Fines	Static Pore Pres., u (ksf)	Uncorrected Blowcounts 0-6"	6-12"	12-18"	18-24"	Raw SPT N (bpf)	Hammer Type correction C_E	Borehole Dia correction C_B	Rod length correction C_R	Spoon liner correction C_S	Eff. Over-burden σ'_v (ksf)	Over-burden correction C_N	Corrected Blowcount $(N_1)_{60}$ (bpf)	Seed & Harder Clean Sand Correction (bpf)	Seed & Harder Clean Sand $(N_1)_{60}$ (bpf)	Fines Uncorrected $CRR_{7.5}$ **	Fines Correction of $CRR_{7.5}$ α	β	Clean Sand $(N_1)_{60cs}$	Clean Sand $CRR_{7.5}$ **
Tailings			SS-12	23.0	51.1	**36**	0.1	1	2	1	2	3	1.2	1.0	1.0	1.0	2.5	0.92	3	2	5	0.06	5.00	1.20	9	0.10
			SS-13			**18**																				
			SS-14	27.0	47.1	**29**	0.4	1	1	2	2	3	1.2	1.0	1.0	1.0	2.7	0.88	3	2	5	0.06	4.63	1.15	8	0.10
			SS-15	29.0	45.1	50	0.5	1	1	0	1	1	1.2	1.0	1.0	1.0	2.9	0.86	1	4	5	0.05	5.00	1.20	6	0.08
Tailings		**18**	SS-16	31.0	43.1	90	0.6	0	0	1	2	1	1.2	1.0	1.0	1.0	3.0	0.85	1	5	6	0.05	5.00	1.20	6	0.08
			SS-17	33.0	41.1	50	0.7	0	0	1	1	1	1.2	1.0	1.0	1.0	3.1	0.83	1	4	5	0.05	5.00	1.20	6	0.08
			SS-18	35.0	39.1	50	0.9	1	1	2	2	3	1.2	1.0	1.0	1.0	3.2	0.82	3	4	7	0.06	5.00	1.20	9	0.10
		15	SS-19	37.0	37.1	**80**	1.0	0	0	0	0	0	1.2	1.0	1.0	1.0	3.3	0.80	0	5	5	0.05	5.00	1.20	5	0.07
Tailings			SS-21	41.0	33.1	**38**	1.2	3	4	4	9	8	1.2	1.0	1.0	1.1	3.5	0.78	8	2	10	0.10	5.00	1.20	15	0.16
			SS-22	43.0	31.1	50	1.4	3	4	6	6	10	1.2	1.0	1.0	1.1	3.6	0.77	10	4	14	0.11	5.00	1.20	17	0.18
			SS-23	45.0	29.1	50	1.5	1	1	0	0	1	1.2	1.0	1.0	1.0	3.7	0.75	1	4	5	0.05	5.00	1.20	6	0.08
			SS-25	49.0	25.1	50	1.7	1	0	1	0	1	1.2	1.0	1.0	1.0	3.9	0.73	1	4	5	0.05	5.00	1.20	6	0.08
Tailings			SS-26	51.5	22.6	**46**	1.9	2	2	2	0	4	1.2	1.0	1.0	1.0	4.1	0.72	3	2	5	0.06	5.00	1.20	9	0.11
			SS-27	53.0	21.1	50	2.0	0	0	0	0	0	1.2	1.0	1.0	1.0	4.2	0.71	0	4	4	0.05	5.00	1.20	5	0.07
		15	SS-28	55.0	19.1	90	2.1	3	4	5	5	9	1.2	1.0	1.0	1.1	4.3	0.70	8	5	13	0.10	5.00	1.20	15	0.16
			SS-30	59.0	15.1	50	2.4	0	0	3	4	3	1.2	1.0	1.0	1.0	4.5	0.69	2	4	6	0.06	5.00	1.20	8	0.10
			SS-33	67.0	7.1	50	2.9	0	6	2		8	1.2	1.0	1.0	1.1	4.9	0.66	7	4	11	0.09	5.00	1.20	13	0.14

* See boring logs in Appendix A for detailed description.

** CRR is 1.0 if (N1)60 is greater than 30 blows/ft; Youd and Idriss 2001, p. 299 indicate that liquefaction will not occurr for (N1)60 > 30 blow/ft.

BORING NO. SB-706

1) CSR = $0.65*(a_{max}/g)*(\sigma_v/\sigma'_v)*r_d$ Seed & Idriss, 1983, p. 459

a_{max}/g = 0.11 g USGS
σ_v = computed Total Vertical Stress
σ'_v = computed Effective Vertical Stress

$r_d = [1.0 - 0.4113z^{0.5} + 0.04052z + 0.001753z^{1.5}] / [1 - 0.4177z^{0.5} + 0.05729z - 0.006205z^{1.5} + 0.001210z^2]$

z = depth in meters

2) FS = Factor of safety against triggering of liquefaction: $FS = (CRR_7/CSR) \times MSF \times K\sigma \times K\alpha$ Youd and Idriss, 2001

MSF = magnitude scaling factor; Assume based on range recommended by NCEER Workshop, reiterated in Youd and Idriss, 2001

$K\sigma = (\sigma'_{vo}/P_a)^{(f-1)}$, where f = 0.7 to 0.8 for relative density of 40 to 60%; f = 0.6 to 0.7 for rel density of 60 to 80%; P_a = pressure at 1 atmosphere Youd and Idriss, 2001
1 Atmosphere = 14.7 psi = 2.12 psf
$K\alpha$ = see discussion in text.

Computation of Triggering CSR and Triggering Factor of Safety

Sample No.	Depth (feet)	Static Pore Pres., u (ksf)	Eff. Over-burden σ'_v (ksf)	Tot. Over-burden σ_v (ksf)	Depth z (meters)	r_d	Crest Apmplif 2.0	CSR ampl	CSR level	MSF M5.5	Relative Density Factor, f	$K\sigma$	α	$K\alpha$	FS liq-SPT FS amplified	FS liq-SPT FS level	General Soil Type
SS-12	23.0	0.1	2.5	2.6	7.0	0.95	0.18	0.12	0.07	2.2	0.8	0.97	0.1	0.88	1.6	2.7	0.0
SS-14	27.0	0.4	2.7	3.1	8.2	0.93	0.17	0.12	0.08	2.2	0.8	0.95	0.1	0.88	1.5	2.3	0.0
SS-15	29.0	0.5	2.9	3.4	8.8	0.93	0.17	0.12	0.08	2.2	0.8	0.94	0.1	0.88	1.2	1.9	0.0
SS-16	31.0	0.6	3.0	3.6	9.4	0.92	0.17	0.12	0.08	2.2	0.8	0.94	0.1	0.89	1.2	1.9	0.0
SS-17	33.0	0.7	3.1	3.8	10.1	0.90	0.16	0.12	0.08	2.2	0.8	0.93	0.1	0.88	1.2	1.8	0.0
SS-18	35.0	0.9	3.2	4.1	10.7	0.89	0.16	0.12	0.08	2.2	0.8	0.92	0.1	0.90	1.5	2.3	0.0
SS-19	37.0	1.0	3.3	4.3	11.3	0.88	0.16	0.12	0.08	2.2	0.8	0.92	0.1	0.88	1.1	1.6	0.0
SS-21	41.0	1.2	3.5	4.8	12.5	0.84	0.15	0.11	0.08	2.2	0.8	0.90	0.1	0.96	2.7	3.7	0.0
SS-22	43.0	1.4	3.6	5.0	13.1	0.82	0.15	0.11	0.08	2.2	0.8	0.90	0.1	1.06	3.5	4.7	0.0
SS-23	45.0	1.5	3.7	5.2	13.7	0.80	0.14	0.11	0.08	2.2	0.8	0.89	0.1	0.88	1.3	1.7	0.0
SS-25	49.0	1.7	3.9	5.7	14.9	0.76	0.14	0.10	0.08	2.2	0.8	0.88	0.1	0.88	1.4	1.7	0.0
SS-26	51.5	1.9	4.1	6.0	15.7	0.74	0.13	0.09	0.08	2.2	0.8	0.88	0.1	0.88	1.9	2.3	0.0
SS-27	53.0	2.0	4.2	6.2	16.2	0.72	0.13	0.09	0.08	2.2	0.8	0.87	0.1	0.87	1.3	1.6	0.0
SS-28	55.0	2.1	4.3	6.4	16.8	0.70	0.13	0.09	0.08	2.2	0.8	0.87	0.1	1.03	3.6	4.2	0.0
SS-30	59.0	2.4	4.5	6.9	18.0	0.67	0.12	0.08	0.07	2.2	0.8	0.86	0.1	0.89	2.0	2.2	0.0
SS-33	67.0	2.9	4.9	7.8	20.4	0.61	0.11	0.07	0.07	2.2	0.8	0.84	0.1	0.98	3.9	3.8	0.0

STANDARD PENETRATION TEST CORRECTION

Soil Metrics LLC

Callahan Mine
Maine DOT

08/15/07

BORING NO. SB-702
SS-9 to SS-24

Reference: T.L. Youd and I.M. Idriss, (2001), "Liquefaction Resistance of Soils: Summary Report From the 1996 NCEER and 1998 NCEER/NSF Workshopd on Evaluation of Liquefaction Resistance of Soils, ASCE JGGE, April.

Boring Blowcount Corrections: $(N_1)_{60} = N_{RAW} C_N C_E C_B C_R C_S$

Where:

					Recommended by:
1)	Hammer Energy Correction:	C_E =	*1.2*	ER/60 – 0.7 to 1.2 (Safety Hammer)	Youd and Idriss, 2001
2)	Borehole Diameter Correction:	C_B =	1	Nw and Hw Sized Borings	Youd and Idriss, 2001
3)	Rod Length Correction:	C_R=	0.75	0-9.75 ft.	Youd and Idriss, 2001
			0.8	9.75 to 13 ft.	
			0.85	13 to 19.5 ft.	
			0.95	19.5 to 32 ft.	
			1	>32 ft.	
4)	Spoon Liner Correction:	C_S =	If N=0-5 then Cs=1.0; if N=6-10, then Cs=1.1; if N=+10 then Cs=1.2		Hendron from Diversion Dam Project, New York (consistent with Youd and Idriss, 2001)
5)	Overburden:	C_N =	(P_a/σ'_{vo})^0.5		Youd and Idriss, 2001
6)	Correction for Residual Strength:	(N)corr is based on Seed (1986) "Design Problems in Soil Liquefaction"			

Fines Correction: $(N1)_{60cs} = \alpha + \beta (N_1)_{60}$ Where: $\alpha = \exp[1.76-(190/FC^2)]$ and $\beta = [0.99 + (FC^{1.5}/1000)]$ — Youd and Idriss, 2001

FC = fines content in percent (e.g., 35% = 35)

Seed & Harder Clean Sanc — Seed and Harder (1990)

Percent Fines	N Correction (blows/foot
10%	1
25%	2
50%	4
75%	5

Clean Sand $CRR_{7.5}$: $CRR_{7.5} = \{(1/(34-(N_1)_{60cs})\} + \{(N_1)_{60cs}/135\} + \{50/[10 \times (N_1)_{60cs} + 45]^2\} - [1/200]$ — Youd and Idriss, 2001

INPUT:

Moist Overburden Unit Weight (total):	0.115	kcf
Sat. Overburden Unit Weight (total):	0.117	kcf
Depth to Water Table	0	feet
Ground Surface Elevation	10.4	
Base Elevation for Amplification	-15	

Computation of Triggering $CRR_{7.5}$:

Layer Name	Grain Size Distribution Classification*	Plasticity Index, PI	Sample No.	Depth (feet)	Elev. (ft)	% Fines	Static Pore Pres., u (ksf)	Uncorrected Blowcounts 0-6"	6-12"	12-18"	18-24"	Raw SPT N (bpf)	Hammer Type correction C_E	Borehole Dia correction C_B	Rod length correction C_R	Spoon liner correction C_S	Eff. Over-burden σ'_v (ksf)	Over-burden correction C_N	Corrected Blowcount $(N_1)_{60}$ (bpf)	Seed & Harder Clean Sand Correction (bpf)	Seed & Harder Clean Sand $(N_1)_{60}$ (bpf)	Fines Uncorrected $CRR_{7.5}$ **	Fines Correction of $CRR_{7.5}$ α	β	Clean Sand $(N_1)_{60cs}$	Clean Sand $CRR_{7.5}$ **
Tailings			SS-1	1.0	9.4	60	0.1	1	4	10	20	14	1.2	1.0	0.8	1.2	0.1	1.70	26	4	30	0.31	5.00	1.20	36	1.00
			SS-2	3.0	7.4	20	0.2	18	19	14	24	33	1.2	1.0	0.8	1.2	0.2	1.70	61	1	62	1.00	3.61	1.08	69	1.00
			SS-3	5.0	5.4	80	0.3	25	7	3	2	10	1.2	1.0	0.8	1.1	0.3	1.70	17	5	22	0.18	5.00	1.20	25	0.30
			SS-5	9.0	1.4	95	0.6	4	5	6	7	11	1.2	1.0	0.8	1.2	0.5	1.70	20	5	25	0.22	5.00	1.20	29	0.42
Tailings		**18**	SS-6	11.0	-0.6	95	0.7	2	2	4	6	6	1.2	1.0	0.8	1.1	0.6	1.70	11	5	16	0.12	5.00	1.20	18	0.19
			SS-8	15.0	-4.6	95	0.9	1	0	1	1	1	1.2	1.0	0.9	1.0	0.8	1.61	2	5	7	0.05	5.00	1.20	7	0.09
			SS-13	25.0	-14.6	35	1.6	2	16	3	3	19	1.2	1.0	1.0	1.2	1.4	1.25	32	2	34	1.00	4.98	1.20	44	1.00
Tailings																										
Tailings																										

* See boring logs in Appendix A for detailed description.

** CRR is 1.0 if (N1)60 is greater than 30 blows/ft; Youd and Idriss 2001, p. 299 indicate that liquefaction will not occurr for (N1)60 > 30 blow/ft.

BORING NO. SB-702

1) CSR = $0.65*(a_{max}/g)*(\sigma_v/\sigma'_v)*r_d$ Seed & Idriss, 1983, p. 459

a_{max}/g = 0.11 g USGS

σ_v = computed Total Vertical Stress

σ'_v = computed Effective Vertical Stress

$r_d = [1.0 - 0.4113z^{0.5} + 0.04052z + 0.001753z^{1.5}] / [1 - 0.4177z^{0.5} + 0.05729z - 0.006205z^{1.5} + 0.001210z^2]$

z = depth in meters

2) FS = Factor of safety against triggering of liquefaction: $FS = (CRR_7/CSR) \times MSF \times K\sigma \times K\alpha$ Youd and Idriss, 2001

MSF = magnitude scaling factor; Assume based on range recommended by NCEER Workshop, reiterated in Youd and Idriss, 2001

$K\sigma = (\sigma'_{vo}/P_a)^{(f-1)}$, where f = 0.7 to 0.8 for relative density of 40 to 60%; f = 0.6 to 0.7 for rel density of 60 to 80%; P_a = pressure at 1 atmosphere Youd and Idriss, 2001

1 Atmosphere = 14.7 psi = 2.12 psf

$K\alpha$ = see discussion in text.

Computation of Triggering CSR and Triggering Factor of Safety

Sample No.	Depth (feet)	Static Pore Pres., u (ksf)	Eff. Over-burden σ'_v (ksf)	Tot. Over-burden σ_v (ksf)	Depth z (meters)	r_d	Crest Apmplif 2.0	CSR ampl	CSR level	MSF M5.5	Relative Density Factor, f	$K\sigma$	α	$K\alpha$	FS liq-SPT FS amplified	FS liq-SPT FS level	General Soil Type
SS-1	1.0	0.1	0.1	0.1	0.3	1.00	0.22	0.30	0.15	2.2	0.8	2.08	0.1	1.27	19.3	37.9	0.0
SS-2	3.0	0.2	0.2	0.4	0.9	0.99	0.21	0.29	0.15	2.2	0.8	1.67	0.1	1.27	16.2	30.5	0.0
SS-3	5.0	0.3	0.3	0.6	1.5	0.99	0.20	0.27	0.15	2.2	0.8	1.51	0.1	1.27	4.6	8.2	0.0
SS-5	9.0	0.6	0.5	1.1	2.7	0.98	0.18	0.25	0.15	2.2	0.8	1.34	0.1	1.27	6.4	10.5	0.0
SS-6	11.0	0.7	0.6	1.3	3.4	0.98	0.17	0.23	0.15	2.2	0.8	1.29	0.1	1.11	2.6	4.0	0.0
SS-8	15.0	0.9	0.8	1.8	4.6	0.97	0.16	0.21	0.15	2.2	0.8	1.21	0.1	0.90	1.0	1.4	0.0
SS-13	25.0	1.6	1.4	2.9	7.6	0.94	0.11	0.15	0.14	2.2	0.8	1.09	0.1	1.27	20.8	21.1	0.0

APPENDIX A9-B

CPTU-BASED LIQUEFACTION SPREADSHEETS

Table B1
Details of CPT Based Analyses

The following table presents a detailed description of the CPT based analyses. The column number refers to the labeled column on the excel spreadsheet contained in Row 33 of the spreadsheets. The two methods used in the spreadsheet are based on recommendations presented in Youd & Idriss, (2001), and Boulanger and Idriss, (2004).

Column Number	Title	Units	Description	Formula
1 through 36	ConeTec Data Files	As noted	This is the data file imported from ConeTec. The data were imported as text and converted to numbers for use in the two CPT based analyses. Refer to the ConeTec report for a description of the column formulas	NA
Col-37	U	psf	The static pore pressure at the CPT depth interval. This pore pressure is based on either the the upper phreatic surface or the lower piezometric surface (if different) as indicated on the spreadsheet.	
Col-38	σ_{vo}	psf	The total stress computed by ConeTec converted to psf.	
Col-39	q_c	psf	The uncorrected tip resistance measured by ConeTec converted to psf.	
Col-40	q_t	psf	The corrected tip resistance computed by ConeTec, corrected for pore pressure as described in the ConTec report	
Col-41	P_a	psf	Atmospheric pressure	
Col-42	σ'_{vo}	psf	Effective stress, computed as Col38 – Col37	
Col-43	f_s	psf	The sleeve friction computed by ConeTec, converted to psf.	
Col-44	$Q_{\text{exp "n" = 1}}$	NA	Dimensionless CPT tip resistance from Equation 17, Youd & Idriss, (2001). In this equation, the exponent n = 1.0 for "Clay–Like" soils. The corrected tip resistance q_t was used instead of the uncorrected tip resistance q_c	$Q = [(q_c - \sigma_{vo})/P_a][P_a/\sigma'_{vo}]^n = [(q_c - \sigma_{vo})/\sigma'_{vo}]$
Col-45	F	NA	The normalized friction ratio Equation 16, Youd & Idriss, (2001). In this equation the corrected tip resistance q_t was used instead of the uncorrected tip resistance q_c	$F = [f_s/q_c - \sigma_{vo})]$ x 100%
Col-46	$I_{c\ Q\ \text{exp "n"=1}}$	NA	Soil Behavior Type Index, I_c, Equation 14 Youd & Idriss, (2001). The Q used in this equation is the Q from Col44, using the N exponent of 1.0 for "clays".	$Ic = [(3.47 - \log Q)^2 + (1.22 + \log F)^2]^{0.5}$
Col-47	$Q_{\text{exp "n" = 0.5}}$	NA	Dimensionless CPT tip resistance from Equation 17, Youd & Idriss, (2001). In this equation the exponent n = 0.5 for "Granular Soils". The corrected tip resistance q_t was used instead of the uncorrected tip resistance q_c	$Q = [(q_c - \sigma_{vo})/P_a][P_a/\sigma'_{vo}]^n = [(q_c - \sigma_{vo})/\sigma'_{vo}]$
Col-48	F		Same as Col 45	Same as Col45
Col-49	$I_{c\ Q\ \text{exp "n"=0.5}}$	NA	Soil Behavior Type Index, I_c, Equation 14 Youd & Idress, (2001).	$Ic = [(3.47 - \log Q)^2 + (1.22 + \log F)^2]^{0.5}$

			The Q used in this equation is the Q from Col47, using the N exponent of 0.5 for "Granular Soils".	
Col-50	$Q_{\text{exp "n" = 0.7}}$	NA	Dimensionless CPT tip resistance from Equation 17, Youd & Idriss, (2001). In this equation, the exponent n = 0.7 for "Intermediate, Very Silty Soils". The corrected tip resistance q_t was used instead of the uncorrected tip resistance q_c	$Q = [(q_c - \sigma_{vo})/P_a][P_a/\sigma'_{vo}]^n = [(q_c - \sigma_{vo})/\sigma'_{vo}]$
Col-51	F	NA	Same as Col 45	Same as Col45
Col-52	$I_{c\ Q\ \text{exp "n"=0.7}}$	NA	Soil Behavior Type Index, I_c, Equation 14 Youd & Idress, (2001). The Q used in this equation is the Q from Col50, using the "n" exponent of 0.7 for "Intermediate, Very Silty Soils".	$Ic = [(3.47 - \log Q)^2 + (1.22 + \log F)^2]^{0.5}$
Col-53	Description	NA	This is the inferred soil type, based on the calculated I_c values. If the initial I_c calculated using the "n" exponent of 1.0 is greater than 2.6, the soil is classified as too clay rich to liquefy, and the analysis is considered complete. In this case the susceptibility to liquefaction is estimated from the Boulanger and Idriss, 2004 method, described in columns 76 to 85 below. If the calculated I_c from column 46 is less than 2.6, the soils are classified as non-plastic and granular and I_c is then re-calculated using an "n" exponent of 0.5. If the re-calculated I_c is greater than 2.6, the soil is likely to be very silty and I_c is re-calculated using an "n" exponent of 0.7. The soils are classified as "Granular", "Clayey", or "Very Silty", depending on the iterative calculations for I_c.	
Col-54	$C_{Q\ (n=1.0)}$	NA	Normalizing factor for cone penetration resistance using "n" exponent of 1.0, Equation 13 Youd & Idriss, (2001). Used in Equation 12 for calculation of normalized cone penetration resistance, (col57).	$C_Q = (P_a/\sigma'_{vo})^n$
Col-55	$C_{Q\ (n=0.5)}$	NA	Normalizing factor for cone penetration resistance using "n" exponent of 0.5, Equation 13 Youd & Idriss, (2001). Used in Equation 12 for calculation of normalized cone penetration resistance, (col57).	$C_Q = (P_a/\sigma'_{vo})^n$
Col-56	$C_{Q\ (n=0.7)}$	NA	Normalizing factor for cone penetration resistance using "n" exponent of 0.7, Equation 13 Youd & Idriss, (2001). Used in Equation 12 for calculation of normalized cone penetration resistance, (col57).	$C_Q = (P_a/\sigma'_{vo})^n$
Col-57	q_{c1N}	NA	Normalized, dimensionless cone penetration resistance. Equation 12, Youd & Idriss, (2001).	$q_{c1N} = C_Q(q_c/P_a)$
Col-58	I_c	NA	The I_c based on the iterative calculations for "Q", and the characterization of "Granular", "Clayey", or "Very Silty", in Col 53.	
Col-59	K_c	NA	Correction Factor for grain size characteristics, Equations 19a and 19b in Youd & Idriss, (2001).	Eqn 19a: for $I_c <= 1.64$ $K_c = 1.0$ Eqn 19b: for Ic> 1.64 $K_c = -0.403I_c^4 + 5.58Ic^3 - 21.63I_c^2 + 33.75I_c - 17.88$

Col-60	$(q_{c1N})_{CS}$	NA	The normalized penetration resistance q_{c1N} fir silty sands corrected to an equivalent clean sand value $(q_{c1N})_{CS}$, Equation 18, Youd and Idriss, (2001)	$(q_{c1N})_{CS} = q_{c1N} \times K_c$
Col-61	CRR7.5	NA	The Cyclic Resistance Ratio, from equations 11a, and 11b, Youd and Idriss, (2001)	If $(q_{c1N})_{CS} < 50$ $CRR_{7.5} = 0.833[(q_{c1N})_{CS}/1000]+0.05$ If $50 <= (q_{c1N})_{CS} = 160$ $CRR_{7.5} = 93[(q_{c1N})_{CS}/1000]^3+0.08$
Col-62	rd	NA	Overburden Correction factor, Equation 3, Youd and Idriss, (2001), Z equals depth in meters.	$rd = [1.0 - 0.4113z^{0.5} + 0.04052z + 0.001753z^{1.5}] / [1 - 0.4177z^{0.5} + 0.05729z - 0.006205z^{1.5} + 0.001210z^2]$
Col-63	a_{max}/g (amplified)		Peak ground acceleration for site in % g from USGS divided by the acceleration of gravity. $a_{max}/g = 0.11$ for this site. A dynamic site response analysis was beyond the scope of these preliminary analyses, therefore the estimated amplification of the peak ground motion was amplified by a factor of 2.0 by a linear interpolation between 0.11 at the bedrock of glacial till surface to 0.22 at the ground surface.	
Col-64	CSR No ampl.		The Cyclic Stress Ratio using $a_{max}/g = 0.11$, assuming no amplification of the ground motion through the soft overburden soils.	
Col-65	CSR amplified		The Cyclic Stress Ratio using $a_{max}/g = 0.11$, and amplified as described in Col63.	
Col-66	f	NA	Relative Density Factor, used in calculation of the overburden Correction Factor Ks. presented in Youd & Idriss, (2001), below equation 31.	For relative den. between 40 and 60%, f = 0.7 to 0.8 For relative den. between 60 and 80%, f = 0.6 to 0.7
Col-67	MSF	NA	Magnitude Scaling Factor, , taken from Table 3, column 3, from Youd & Idriss (2001). For the estimated magnitude 5.5 earthquake at this site, the magnitude scaling factor is 2.2.	
Col-68	K_σ	NA	The overburden Correction factor, from equation 31, Youd & Idriss, (2001).	$K_\sigma = (\sigma'_{vo}/P_a)^{(f-1)}$
Col-69	α	NA	The static shear stress ratio. This was estimated based on position of the exploration within the cross section of the tailings impoundment. A finite analysis static stress analysis of the impoundment was beyond the scope of these preliminary analyses	Definition, if calculated: α = static shear stress τ divided by effective overburden stress σ'_{vo} : τ/σ'_{vo}
Col-70	K_a	NA	Interpolated based on Figure 9 in Idriss & Boulanger,(2002)	See attached Figure 9 from referenced paper
Col-71	$FS_{liq-CPT\ sand\text{-}like}$ (no amplification)	NA	The factor of safety against liquefaction using the CPT data and the sand-like relationships presented in Youd & Idriss. The FS is calculated for all three types of soil characterized in this analysis	$FS = (CRR7.5/CSR) \times MSF \times K_\sigma \times K_\alpha$

			for comparison purposes. The no amplification calculation uses the CSR computed based on the base ground acceleration of 0.11 and no amplification through the soft soils, (Col-64)computed	
Col-72	$FS_{liq-CPT\ sand\text{-}like}$ (amplified by 2.0)		The factor of safety against liquefaction using the CPT data and the sand-like relationships presented in Youd & Idriss. The FS is calculated for all three types of soil characterized in this analysis for comparison purposes. The amplification calculation uses the CSR computed amplified base ground acceleration through the soft soils, (Col-65)	$FS = (CRR7.5/CSR) \times MSF \times K_\sigma \times K_\alpha$
Col-73	Apparent Fines	%	The apparent fines content based on equations 6a, 6b and 6c in Robertson & Wride, (1998). This is an approximate relationship and based on many factors. It is used as a general guide to compare against the lab tested samples.	If: $I_c < 1.26$ apparent fines content AFC= 0 % If: $1.26 = I_c <= 3.5$, $AFC = 1.75 I_c^{3.25} - 3.7$ If $I_c > 3.5$, AFC = 100
Col-74	Measured Fines	%	The measured fines content (% passing the No 200 seive), from laboratory grain size analyses.	
Col 75	Ic limits		Used for graphing	
The columns below were used in the Boulanger and Idriss, 2004, "Approach B" method for determining liquefaction of fine grained soils based on Su profile.				
Col-76	S_{u-CPT}		The undrained shear strength calculated based on formula 3-22, from Boulanger and Idriss, (2004), and others. This is the Total Stress method. The N_{kt} coefficient used was based on site specific comparisons with the Vane shear testing performed at the site in several borings made adjacent to the CPT explorations.	$S_u = (q_{cT} - \sigma_{vo})/N_{kt}$
Col-77	OCR (Assumed)	NA	This is the assumed Over Consolidation Ratio for the tailings, based on laboratory testing which indicated nearly normally consolidated tailings.	
Col-78	OCR - CPT		This column is reserved for OCR relationships based on CPT data and is not used in this analysis	
Col-79	a	NA	The static shear stress ratio described in Col-6 9 above	See column 69
Col-80	Ka	NA	The static shear stress correction factor for fine grained soils, Equation 2-10, from Boulanger and Idriss, (2004).	$Ka = 1.344 - [0.344/(1-\alpha/0.22 \times OCR^{0.8})^{0.638}]$
Col-81	$CRR_{M7.5}$	NA	The Cyclic Stress Ratio for fine grained soils, Equation 3-29 from Boulanger and Idriss, (2004). Note that this equation has been reduced by 20 percent as recommended by the authors for tailings slimes.	$CRR_{M7.5} = 0.8 \times 0.8 \times (S_u/\sigma'_{vo}) \times K_a$
Col-82	MSF	NA	The magnitude scaling factor for fine grained soils, equation 3-16 in Boulanger and Idriss, (2004)	$MSF = 1.12 \times e^{(-M/4)} + 0.828$
Col-83	$CRR_{M5.5}$	NA	The cyclic resistance ratio for a magnitude 5.5 earthquake.	$CRR_{M5.5} = CRR_{M7.5} \times MSF$
Col-84	$FS_{liq-Su\ clay\text{-}like}$ (no amplification)		The factor of safety against liquefaction using the CPT undrained shear strength relationships calibrated using the site-specific	$CRR_{M5.5} = CSR$

			vane shear test data and the clay-like relationships for CRR presented in Boulanger and Idriss, (2004). The no amplification calculation uses the CSR computed based on the base ground acceleration of 0.11 and no amplification through the soft soils, (Col-64)computed	
Col-85	$FS_{liq-Su\ clay\text{-}like}$ (amplified)		The factor of safety against liquefaction using the CPT undrained shear strength relationships calibrated using the site-specific vane shear test data and the clay-like relationships for CRR presented in Boulanger and Idriss, (2004). The "amplified" calculation uses the CSR computed amplified base ground acceleration through the soft soils, (Col-65)	$CRR_{M5.5} = CSR$

CPTU-601 Liquefaction Analysis

ConeTec Inc. - CPT Interpretation
Interpretation Output - Release 1.22 Rev. A - Format: NLI Imperial
Run No: 06-0718-0954-3504
Job No: 02-100
Client: MACTEC Engineering and Consulting Inc.
Project: Former Callahan Mine Site, Brooksville, ME
Site: CP-601
Location: Callahan Mine
Cone: 20 Ton AD179
CPT Date: 06/27/06
CPT Time: 10:46
CPT File: 758CP601.COR
Northing (m): 0
Easting (m): 0
Elevation (m): 0 — 71.5 Elevation For CPT Triggering analysis (feet)

Water Table (m): 0.91 (ft): 3 — 3 Water Table assumed for CPT Analysis
Unit Weight of Water (default): 62.4 pcf
Averaging Increment (m): 0.2
Phi Method : Robertson and Campanella, 1983
Su Nkt used: 15 Su/P' (nc): 0.3 — 0.11 Base acceleration (g)
Dr Method : Jamiolkowski - All Sands
State Parameter M: 1.2
Used Unit Weights Assigned to Soil Zones
N160Ic Calculated using qc1n

1) CSR = $0.65*(a_{max}/g)*(s_v/s'_v)*r_d$ — Seed & Idriss, 1983, p. 459

a_{max}/g = 0.11 g — USGS (base) (amplified from base as discussed in
s_v = computed — Total Vertical Stress
s'_v = computed — Effective Vertical Stress

$r_d = [1.0 - 0.4113z^{0.5} + 0.04052z + 0.001753z^{1.5}] / [1 - 0.4177z^{0.5} + 0.05729z - 0.0$

z = depth in meters

2) FS = Factor of safety against triggering of liquefaction: $FS = (CRR_{7.5}/CSR) \times MSF \times Ks \times Ka$

MSF = magnitude scaling factor; Assume based on range recommended by NCEER Wo

$Ks = (s'_{vo}/P_a)^{(f-1)}$, where f = 0.7 to 0.8 for relative density of 40 to 60%; f = 0.6 to 0.7 for
1 Atmosphere = 14.7 psi = 2.12 ksf

CPTU-601 Liquefaction Analysis

Conetec Data

Col-01	Col-02	Col-03	Col-04	Col-05	Col-06	Col-07	Col-08	Col-09	Col-10	Col-11	Col-12	Col-13	Col-14	Col-15	Col-16	Col-17	Col-18	Col-19	Col-20	Col-21	Col-22	Col-23	Col-24	Col-25	Col-26	Col-27	Col-28	Col-29	Col-30	Col-31	Col-32	Col-33	Col-34	Col-35	Col-36
Depth (m)	Depth (ft)	Elev. (m)	Elev. (ft)	qc (tsf)	qt (tsf)	fs (tsf)	Rf (%)	u (ft)	SBT (Zone)	SBTn (Zone)	SBT-BQ (Zone)	SBT-BQn (Zone)	Perm-k (cm/s)	Unit Wt (pcf)	T Stress (tsf)	U Stress (tsf)	E Stress (tsf)	Cn	N60 (b/ft)	N1(60) (b/ft)	N(60)Ic (b/ft)	N1(60)Ic (b/ft)	Qt	Fr (%)	Bq	Ic	FC (%)	icZone (Zone)	Dr (%)	Phi (deg)	State Par	Es/qt	YoungE (tsf)	Su (tsf)	OCR
0.1	0.328	-0.1	71.2	5.53	5.52	0.13	2.27	-1.23	4	8	4	7	5.00E-08	114.6	0.019	0	0.019	1.7	3.5	6	-9999	-9999	292.83	2.28	-0.01	-9999	-9999	0	-9999	-9999	-9999	-9999	-9999	0.367	10
0.3	0.984	-0.3	70.5	4.15	4.15	0.15	3.62	-0.6	3	4	4	6	5.00E-08	111.4	0.056	0	0.056	1.7	4	6.8	1.5	2.6	73.28	3.67	0	3.19	72	3	-9999	-9999	-9999	-9999	-9999	0.273	10
0.5	1.64	-0.5	69.9	2.46	2.47	0.05	1.93	0.95	1	4	3	5	1.00E-07	111.4	0.092	0	0.092	1.7	1.2	2	0.9	1.6	25.68	2.01	0.01	3.25	76.6	3	-9999	-9999	-9999	-9999	-9999	0.158	10
0.7	2.297	-0.7	69.2	2.03	2.06	0.01	0.49	6.23	1	5	3	4	1.00E-07	111.4	0.129	0	0.129	1.7	1	1.7	0.7	1.2	14.97	0.52	0.1	3.09	64.7	3	-9999	-9999	-9999	-9999	-9999	0.129	4.5
0.9	2.953	-0.9	68.5	1.39	1.46	0.01	0.69	14.93	1	4	3	3	1.00E-07	111.4	0.166	0	0.166	1.7	0.7	1.2	0.4	2.4	7.83	0.77	0.36	2.8	46.3	4	-9999	-9999	-9999	-9999	-9999	0.086	1.8
1.1	3.609	-1.1	67.9	1.13	1.22	0.01	0.82	18.35	1	3	2	3	1.00E-07	111.4	0.202	0.019	0.183	1.7	0.6	1	0.4	1.9	5.54	0.99	0.55	2.98	57.5	3	-9999	-9999	-9999	-9999	-9999	0.068	1.2
1.3	4.265	-1.3	67.2	1.53	1.62	0.02	1.08	19.32	1	4	3	3	1.00E-07	111.4	0.239	0.039	0.199	1.7	0.8	1.3	0.5	2.3	6.96	1.27	0.41	2.94	54.6	4	-9999	-9999	-9999	-9999	-9999	0.092	1.6
1.5	4.921	-1.5	66.6	2.01	2.06	0.01	0.61	10.96	1	4	3	3	1.00E-07	111.4	0.275	0.06	0.215	1.7	1	1.7	0.6	2.5	8.31	0.7	0.16	2.76	43.9	4	-9999	-9999	-9999	-9999	-9999	0.119	2
1.7	5.577	-1.7	65.9	1.09	1.2	0.01	1.04	23.15	1	3	2	3	1.00E-07	111.4	0.312	0.08	0.231	1.7	0.6	1	0.4	1.5	3.85	1.41	0.72	3.19	72.5	3	-9999	-9999	-9999	-9999	-9999	0.059	0.9
1.9	6.234	-1.9	65.3	1.29	1.37	0.01	0.92	15.75	1	3	2	3	1.00E-07	111.4	0.348	0.101	0.247	1.7	0.7	1.1	0.5	1.5	4.12	1.23	0.38	3.14	68.5	3	-9999	-9999	-9999	-9999	-9999	0.068	0.9
2.1	6.89	-2.1	64.6	3.76	3.85	0.02	0.52	18.13	1	5	3	4	1.00E-07	111.4	0.385	0.121	0.263	1.7	1.8	3.1	1.1	1.9	13.15	0.58	0.13	2.85	48.8	4	-9999	-9999	-9999	-9999	-9999	0.231	3.7
2.3	7.546	-2.3	64.0	9.77	9.8	0.03	0.26	6.67	1	6	6	6	1.00E-07	111.4	0.421	0.142	0.279	1.7	4.7	8	2.3	3.9	33.58	0.27	0.01	2.36	5	5	-9999	-9999	-9999	-9999	-9999	0.626	10
2.5	8.202	-2.5	63.3	7.91	7.94	0.07	0.82	7.42	1	5	5	5	1.00E-07	111.4	0.458	0.162	0.295	1.7	3.8	6.5	2.1	3.5	25.33	0.87	0.01	2.63	36.8	4	-9999	-9999	-9999	-9999	-9999	0.499	10
2.7	8.858	-2.7	62.6	11.06	11.07	0.03	0.25	1.01	6	6	6	6	5.00E-05	114.6	0.495	0.183	0.312	1.7	4.2	7.2	2.5	4.2	33.89	0.26	-0.01	2.3	5	5	30	36	0.02	-9999	-9999	0.705	10
2.9	9.514	-2.9	62.0	10.89	10.91	0.03	0.23	2.92	6	6	6	5	5.00E-05	114.6	0.533	0.203	0.329	1.7	4.2	7.1	2.5	4.2	31.51	0.24	-0.01	2.3	5	5	30	36	0.03	-9999	-9999	0.692	10
3.1	10.17	-3.1	61.3	6.8	6.81	0.05	0.74	1.45	1	5	5	5	1.00E-07	111.4	0.57	0.224	0.346	1.7	3.3	5.5	1.8	3.1	18.05	0.8	-0.03	2.67	39	4	-9999	-9999	-9999	-9999	-9999	0.416	6
3.3	10.827	-3.3	60.7	2.79	2.85	0.03	1.05	12.9	1	3	3	3	1.00E-07	111.4	0.606	0.244	0.362	1.66	1.4	2.3	0.9	2.1	6.22	1.34	0.07	3	58.2	3	-9999	-9999	-9999	-9999	-9999	0.15	1.4
3.5	11.483	-3.5	60.0	1	1.16	0.02	1.72	34.25	2	2	-9999	-9999	1.00E-15	79.5	0.637	0.265	0.373	1.64	1.1	1.8	0.7	0.9	1.41	3.82	1.53	3.78	100	2	-9999	-9999	-9999	-9999	-9999	0.035	0.5
3.7	12.139	-3.7	59.4	18.03	18.07	0.73	4.04	7.98	4	4	6	6	5.00E-07	114.6	0.669	0.285	0.384	1.61	11.5	18.6	5	8.5	45.32	4.19	0	2.72	41.5	4	-9999	-9999	-9999	-9999	-9999	1.16	10
3.9	12.795	-3.9	58.7	17.65	17.58	1.24	7.04	-14.58	3	3	6	5	5.00E-08	111.4	0.706	0.306	0.401	1.58	16.8	26.6	5	12.6	42.12	7.34	-0.05	2.78	45.1	4	-9999	-9999	-9999	-9999	-9999	1.125	10
4.1	13.451	-4.1	58.0	13.69	13.71	0.75	5.45	4.77	3	3	6	5	5.00E-08	111.4	0.743	0.326	0.417	1.55	13.1	20.3	3.9	9.3	31.12	5.76	-0.01	2.8	45.9	4	-9999	-9999	-9999	-9999	-9999	0.864	10
4.3	14.107	-4.3	57.4	16.5	16.63	0.51	3.04	28.91	5	4	6	6	5.00E-06	114.6	0.78	0.347	0.433	1.52	8	12.1	4.5	7.6	36.59	3.19	0.04	2.67	38.8	4	-9999	-9999	-9999	-9999	-9999	1.057	10
4.5	14.764	-4.5	56.7	15.17	15.41	0.47	3.06	51.59	5	4	5	5	5.00E-06	114.6	0.818	0.367	0.45	1.49	7.4	11	4	8.8	32.41	3.23	0.09	2.61	36	4	-9999	-9999	-9999	-9999	-9999	0.973	10
4.7	15.42	-4.7	56.1	13.82	14.12	0.35	2.48	65.23	5	4	5	5	5.00E-06	114.6	0.855	0.388	0.467	1.46	6.8	9.9	3.7	7.7	28.38	2.64	0.12	2.6	35.4	4	-9999	-9999	-9999	-9999	-9999	0.884	10
4.9	16.076	-4.9	55.4	13.24	13.65	0.34	2.46	87.52	5	4	4	5	5.00E-06	114.6	0.893	0.408	0.485	1.44	6.5	9.4	3.6	7.2	26.32	2.63	0.18	2.63	36.6	4	-9999	-9999	-9999	-9999	-9999	0.85	10
5.1	16.732	-5.1	54.8	11	11.56	0.26	2.21	117.9	5	4	4	4	5.00E-06	114.6	0.93	0.429	0.502	1.41	5.5	7.8	3.1	6	21.18	2.41	0.31	2.68	39.2	4	-9999	-9999	-9999	-9999	-9999	0.708	7.8
5.3	17.388	-5.3	54.1	10.28	10.93	0.22	2	136.82	5	4	3	3	5.00E-06	114.6	0.968	0.449	0.519	1.39	5.2	7.3	3	5.4	19.2	2.19	0.38	2.69	39.7	4	-9999	-9999	-9999	-9999	-9999	0.664	6.6
5.5	18.044	-5.5	53.5	13.25	13.86	0.19	1.34	130.26	6	5	4	4	5.00E-05	114.6	1.006	0.47	0.536	1.37	5.3	7.3	3.6	5	24	1.44	0.28	2.6	35.3	5	30	34	-0.05	-9999	-9999	0.857	9.4
5.7	18.701	-5.7	52.8	14.63	14.81	0.16	1.08	38.97	6	5	6	5	5.00E-05	114.6	1.043	0.49	0.553	1.34	5.7	7.6	3.7	5.1	24.9	1.16	0.05	2.53	32.1	5	30	34	-0.06	-9999	-9999	0.918	10
5.9	19.357	-5.9	52.1	5.11	5.58	0.06	1.12	99.94	1	4	3	3	1.00E-07	111.4	1.08	0.511	0.57	1.33	2.7	3.5	1.7	2.5	7.89	1.39	0.58	2.91	52.8	4	-9999	-9999	-9999	-9999	-9999	0.3	1.9
6.1	20.013	-6.1	51.5	4.19	4.73	0.05	1.11	116.78	1	3	3	3	1.00E-07	111.4	1.117	0.531	0.586	1.31	2.3	3	1.5	2.1	6.17	1.46	0.86	3.02	59.5	3	-9999	-9999	-9999	-9999	-9999	0.241	1.4
6.3	20.669	-6.3	50.8	3.83	4.41	0.06	1.25	123.3	1	3	3	3	1.00E-07	111.4	1.153	0.552	0.602	1.29	2.1	2.7	1.5	1.9	5.41	1.69	1.01	3.1	65.2	3	-9999	-9999	-9999	-9999	-9999	0.217	1.2
6.5	21.325	-6.5	50.2	3.77	4.34	0.05	1.21	122.67	1	3	3	3	1.00E-07	111.4	1.19	0.572	0.618	1.27	2.1	2.6	1.5	1.9	5.11	1.67	1.03	3.12	66.6	3	-9999	-9999	-9999	-9999	-9999	0.21	1.1
6.7	21.981	-6.7	49.5	3.85	4.42	0.06	1.42	122.72	1	3	3	3	1.00E-07	111.4	1.226	0.593	0.634	1.26	2.1	2.7	1.6	1.9	5.04	1.96	1.01	3.15	69.5	3	-9999	-9999	-9999	-9999	-9999	0.213	1.1
6.9	22.638	-6.9	48.9	3.94	4.52	0.06	1.28	122.89	1	3	3	3	1.00E-07	111.4	1.263	0.613	0.65	1.24	2.2	2.7	1.6	1.9	5.01	1.77	0.99	3.14	68.1	3	-9999	-9999	-9999	-9999	-9999	0.217	1.1
7.1	23.294	-7.1	48.2	4.01	4.58	0.06	1.26	123.29	1	3	3	3	1.00E-07	111.4	1.3	0.634	0.666	1.23	2.2	2.7	1.6	1.8	4.93	1.75	0.98	3.14	68.4	3	-9999	-9999	-9999	-9999	-9999	0.219	1.1
7.3	23.95	-7.3	47.6	4.18	4.74	0.06	1.27	119.48	1	3	3	3	1.00E-07	111.4	1.336	0.654	0.682	1.21	2.3	2.8	1.7	1.8	4.99	1.77	0.9	3.14	68.1	3	-9999	-9999	-9999	-9999	-9999	0.227	1.1
7.5	24.606	-7.5	46.9	3.91	4.45	0.05	1.01	114.96	1	3	3	3	1.00E-07	111.4	1.373	0.675	0.698	1.2	2.1	2.6	1.6	1.6	4.41	1.47	0.95	3.15	69	3	-9999	-9999	-9999	-9999	-9999	0.205	1
7.7	25.262	-7.7	46.2	4.04	4.64	0.06	1.19	128.12	1	3	3	3	1.00E-07	111.4	1.409	0.695	0.714	1.18	2.2	2.6	1.7	1.7	4.52	1.71	1.02	3.17	70.5	3	-9999	-9999	-9999	-9999	-9999	0.215	1
7.9	25.918	-7.9	45.6	4.07	4.69	0.06	1.18	131.48	1	3	3	3	1.00E-07	111.4	1.446	0.716	0.73	1.17	2.2	2.6	1.7	1.7	4.44	1.7	1.05	3.17	70.9	3	-9999	-9999	-9999	-9999	-9999	0.216	1
8.1	26.574	-8.1	44.9	4.1	4.7	0.05	1.12	127.07	1	3	3	3	1.00E-07	111.4	1.482	0.736	0.746	1.16	2.2	2.6	1.7	1.6	4.31	1.64	1	3.18	71.3	3	-9999	-9999	-9999	-9999	-9999	0.214	1
8.3	27.231	-8.3	44.3	4.44	4.94	0.05	1.01	106.51	1	3	3	3	1.00E-07	111.4	1.519	0.757	0.762	1.15	2.4	2.7	1.8	1.7	4.49	1.47	0.75	3.14	68.4	3	-9999	-9999	-9999	-9999	-9999	0.228	1
8.5	27.887	-8.5	43.6	12.73	13.14	0.39	2.99	87.81	5	3	5	4	5.00E-06	114.6	1.556	0.777	0.779	1.13	6.3	7.1	4	4.7	14.87	3.4	0.17	2.89	51.3	4	-9999	-9999	-9999	-9999	-9999	0.772	4.5
8.7	28.543	-8.7	43.0	20.87	21.09	0.39	1.84	45.6	6	4	6	5	5.00E-05	114.6	1.593	0.798	0.796	1.12	8.1	9.1	5.5	6.2	24.49	1.99	0.03	2.6	35.2	5	30	34	-0.11	-9999	-9999	1.3	9.8

Col-37	Col-38	Col-39	Col-40	Col-41	Col-42	Col-43	Col-44	Col-45
U (psf)	s_{vo} (psf)	q_c (psf)	q_t (psf)	P_a (psf)	σ'_{vo} (psf)	f_s (psf)	$Q_{exp=1}$	F
0	38	11060	11040	2116	38	260	289.53	2.36
0	112	8300	8300	2116	112	300	73.11	3.66
0	184	4920	4940	2116	184	100	25.85	2.10
0	258	4060	4120	2116	258	20	14.97	0.52
0	332	2780	2920	2116	332	20	7.80	0.77
38	404	2260	2440	2116	366	20	5.56	0.98
79	478	3060	3240	2116	399	40	6.92	1.45
120	550	4020	4120	2116	430	20	8.30	0.56
161	624	2180	2400	2116	463	20	3.83	1.13
202	696	2580	2740	2116	494	20	4.14	0.98
243	770	7520	7700	2116	527	40	13.14	0.58
284	842	19540	19600	2116	558	60	33.60	0.32
325	916	15820	15880	2116	591	140	25.30	0.94
366	990	22120	22140	2116	624	60	33.87	0.28
406	1066	21780	21820	2116	660	60	31.47	0.29
447	1140	13600	13620	2116	693	100	18.02	0.80
488	1212	5580	5700	2116	724	60	6.20	1.34
529	1274	2000	2320	2116	745	40	1.40	3.82
570	1338	36060	36140	2116	768	1460	45.33	4.20
611	1412	35300	35160	2116	801	2480	42.14	7.35
652	1486	27380	27420	2116	834	1500	31.10	5.78
693	1560	33000	33260	2116	867	1020	36.57	3.22
734	1636	30340	30820	2116	902	940	32.36	3.22
775	1710	27640	28240	2116	935	700	28.37	2.64
816	1786	26480	27300	2116	970	680	26.30	2.67
857	1860	22000	23120	2116	1003	520	21.19	2.45
898	1936	20560	21860	2116	1038	440	19.19	2.21
939	2012	26500	27720	2116	1073	380	23.95	1.48
980	2086	29260	29620	2116	1106	320	24.89	1.16
1021	2160	10220	11160	2116	1139	120	7.90	1.33
1062	2234	8380	9460	2116	1172	100	6.16	1.38
1103	2306	7660	8820	2116	1203	120	5.41	1.84
1143	2380	7540	8680	2116	1237	100	5.09	1.59
1184	2452	7700	8840	2116	1268	120	5.04	1.88
1225	2526	7880	9040	2116	1301	120	5.01	1.84
1266	2600	8020	9160	2116	1334	120	4.92	1.83
1307	2672	8360	9480	2116	1365	120	4.99	1.76
1348	2746	7820	8900	2116	1398	100	4.40	1.62
1389	2818	8080	9280	2116	1429	120	4.52	1.86
1430	2892	8140	9380	2116	1462	120	4.44	1.85
1471	2964	8200	9400	2116	1493	100	4.31	1.55
1512	3038	8880	9880	2116	1526	100	4.48	1.46
1553	3112	25460	26280	2116	1559	780	14.86	3.37
1594	3186	41740	42180	2116	1592	780	24.49	2.00

CPTU-601 Liquefaction Analysis

ext

$06205z^{2.5} + 0.001210z^4]$

Youd and Idriss, 2001

kshop, reiterated in Youd and Idriss, 2001

CPTU-601 Liquefaction Analysis

rel density of 60 to 80%; P_a = pressure at 1 atmosphere Youd and Idriss, 2001

	AT	AU	AV	AW	AX	AY	AZ	BA	BB	BC	BD	BE	BF	BG	BH	BI	BJ	BK	BL	BM	BN	BO	BP	BQ	BR	BS	BT	BU	BV	BW	BX	BY	BZ	CA	CB	CC	CD	CE	CF	CG	CH
34	Col-46	Col-47	Col-48	Col-49	Col-50	Col-51	Col-52	Col-53	Col-54	Col-55	Col-56	Col-57	Col-57a	Col-58	Col-59	Col-60	Col-61	Col-62	Col-63	Col-64	Col-65	Col-66	Col-67	Col-68	Col-69	Col-70	Col-71	Col-72	Col-73	Col-74	Col-75	Col-76	Col-77	Col-78	Col-79	Col-80	Col-81	Col-82	Col-83	Col-84	Col-85
35	Youd & Idriss, 2001 CPT Based Analysis																															Boulanger and Idriss, 2004, "Approach B" method based on Su profile									
36																				Col-53	Rel. Den. Factor																				
37	$I_{c\ Qexp=1}$	$Q_{exp=0.5}$	F	$I_{c\ Qexp=0.5}$	$Q_{exp=0.7}$	F	$I_{c\ Qexp=0.7}$	Description	C_q			q_{c1N}	Lookup	Ic	Kc	$(q_{c1N})_{cs}$	CRR7.5	rd	a_{max}/g =	CSR		f	MSF	K_σ	α	K_α	$FS_{liq-CPT\ (Sand-Like)}$		Apparent Fines	Measured Fines	Ic Limits	Su - CPT (psf)	OCR Assumed	OCR - CPT	α	k_α	$CRR_{M7.5}$	MSF	$CRR_{M5.5}$	$FS_{liq-Su\ (Clay-Like)}$	
38									n=1.0	n=0.5	n=0.7		Col						if crest accel =	No Amplification	if crest accel =						No Amplification	if crest accel =	(%)	(%)		Nkt	1.1							No Amplification	if crest accel =
39																			2.0		2				0.02			2				12			0.02						2
40	1.89	38.80	2.36	2.47	86.69	2.36	2.21	**Granular**	55.68	7.46	16.67	38.93	2.00	2.47	2.60	101.20	0.18	1.00	0.22	0.07	0.14	0.7	2.2	3.34	0.02	0.9600	17.39	8.75	29		2.6	917	1.1		0.02	0.99	15.22	1.11	16.91	236.36	118.87
41	2.40	16.82	3.66	2.87	30.27	3.66	2.67	**Very Silty**	18.89	4.35	7.82	30.69	2.00	2.67	3.80	116.47	0.23	1.00	0.22	0.07	0.14	0.7	2.2	2.41	0.02	0.9600	16.19	8.24	39		2.6	682	1.1		0.02	0.99	3.84	1.11	4.27	59.75	30.40
42	2.57	7.62	2.10	3.01	12.42	2.10	2.83	**Very Silty**	11.50	3.39	5.53	12.90	2.00	2.83	5.07	65.41	0.11	1.00	0.21	0.07	0.14	0.7	2.2	2.08	0.02	0.9600	6.53	3.36	48		2.6	396	1.1		0.02	0.99	1.36	1.11	1.51	21.15	10.89
43	2.48	5.23	0.52	2.91	7.96	0.52	2.73	**Very Silty**	8.20	2.86	4.36	8.49	2.00	2.73	4.25	36.07	0.07	1.00	0.21	0.07	0.14	0.7	2.2	1.88	0.02	0.9600	4.00	2.08	42		2.6	322	1.1		0.02	0.99	0.79	1.11	0.87	12.27	6.40
44	2.81	3.09	0.77	3.18	4.47	0.77	3.03	**Clayey**	6.37	2.52	3.66	8.80	2.00	2.81	4.84	42.54	0.08	1.00	0.21	0.07	0.13	0.7	2.2	1.74	0.02	0.9600	3.99	2.10	46		2.6	216	1.1		0.02	0.99	0.41	1.11	0.46	6.40	3.38
45	2.98	2.31	0.98	3.33	3.29	0.98	3.19	**Clayey**	5.78	2.40	3.42	6.67	2.00	2.98	6.55	43.65	0.08	0.99	0.21	0.08	0.15	0.7	2.2	1.69	0.02	0.9600	3.56	1.90	57		2.6	170	1.1		0.02	0.99	0.29	1.11	0.32	4.14	2.21
46	2.97	3.01	1.45	3.30	4.20	1.45	3.16	**Clayey**	5.30	2.30	3.21	8.12	2.00	2.97	6.42	52.12	0.09	0.99	0.20	0.08	0.16	0.7	2.2	1.65	0.02	0.9600	3.82	2.07	57		2.6	230	1.1		0.02	0.99	0.36	1.11	0.40	4.76	2.57
47	2.73	3.74	0.56	3.05	5.15	0.56	2.92	**Clayey**	4.92	2.22	3.05	9.58	2.00	2.73	4.21	40.31	0.08	0.99	0.20	0.09	0.17	0.7	2.2	1.61	0.02	0.9600	2.83	1.55	42		2.6	298	1.1		0.02	0.99	0.44	1.11	0.48	5.35	2.93
48	3.15	1.79	1.13	3.46	2.43	1.13	3.34	**Clayey**	4.57	2.14	2.90	5.18	2.00	3.15	8.62	44.68	0.08	0.99	0.20	0.10	0.17	0.7	2.2	1.58	0.02	0.9600	2.76	1.53	69		2.6	148	1.1		0.02	0.99	0.20	1.11	0.22	2.35	1.30
49	3.10	2.00	0.98	3.39	2.67	0.98	3.27	**Clayey**	4.28	2.07	2.77	5.54	2.00	3.10	7.92	43.92	0.08	0.99	0.20	0.10	0.18	0.7	2.2	1.55	0.02	0.9600	2.57	1.45	65		2.6	170	1.1		0.02	0.99	0.22	1.11	0.24	2.43	1.37
50	2.55	6.56	0.58	2.83	8.66	0.58	2.72	**Very Silty**	4.01	2.00	2.65	9.63	2.00	2.72	4.11	39.59	0.07	0.99	0.19	0.10	0.18	0.7	2.2	1.52	0.02	0.9600	2.32	1.32	41		2.6	578	1.1		0.02	0.99	0.69	1.11	0.77	7.46	4.25
51	2.07	17.26	0.32	2.35	22.53	0.32	2.24	**Granular**	3.79	1.95	2.54	18.03	2.00	2.35	2.11	38.08	0.07	0.98	0.19	0.11	0.18	0.7	2.2	1.49	0.02	0.9600	2.18	1.26	24	34.8	2.6	1563	1.1		0.02	0.99	1.77	1.11	1.96	18.49	10.67
52	2.39	13.38	0.94	2.63	17.26	0.94	2.53	**Very Silty**	3.58	1.89	2.44	18.32	2.00	2.53	2.93	53.65	0.09	0.98	0.19	0.11	0.19	0.7	2.2	1.47	0.02	0.9600	2.68	1.57	32		2.6	1247	1.1		0.02	0.99	1.33	1.11	1.48	13.58	7.94
53	2.05	18.40	0.28	2.31	23.49	0.28	2.20	**Granular**	3.39	1.84	2.35	19.26	2.00	2.31	1.97	37.88	0.07	0.98	0.19	0.11	0.19	0.7	2.2	1.44	0.02	0.9600	2.00	1.19	23		2.6	1763	1.1		0.02	0.99	1.78	1.11	1.98	17.78	10.55
54	2.09	17.57	0.29	2.33	22.18	0.29	2.23	**Granular**	3.21	1.79	2.26	18.47	2.00	2.33	2.04	37.66	0.07	0.98	0.18	0.11	0.19	0.7	2.2	1.42	0.02	0.9600	1.93	1.16	24		2.6	1730	1.1		0.02	0.99	1.65	1.11	1.84	16.23	9.76
55	2.48	10.31	0.80	2.70	12.89	0.80	2.61	**Very Silty**	3.06	1.75	2.19	14.07	2.00	2.61	3.41	47.99	0.08	0.98	0.18	0.12	0.19	0.7	2.2	1.40	0.02	0.9600	2.09	1.28	36		2.6	1040	1.1		0.02	0.99	0.95	1.11	1.05	9.14	5.57
56	3.00	3.63	1.34	3.21	4.50	1.34	3.12	**Clayey**	2.92	1.71	2.12	7.88	2.00	3.00	6.71	52.84	0.09	0.98	0.18	0.12	0.19	0.7	2.2	1.38	0.02	0.9600	2.33	1.44	58		2.6	374	1.1		0.02	0.99	0.33	1.11	0.36	3.10	1.91
57	3.78	0.83	3.82	3.98	1.03	3.82	3.90	**Clayey**	2.84	1.69	2.08	3.12	2.00	3.78	19.79	61.65	0.10	0.98	0.18	0.12	0.19	0.7	2.2	1.37	0.02	0.9600	2.46	1.55	100		2.6	87	1.1		0.02	0.99	0.07	1.11	0.08	0.69	0.43
58	2.59	27.31	4.20	2.74	33.44	4.20	2.68	**Very Silty**	2.76	1.66	2.03	34.73	2.00	2.68	3.85	133.76	0.30	0.97	0.17	0.12	0.19	0.7	2.2	1.36	0.02	0.9600	7.13	4.54	39		2.6	1933	1.1		0.02	0.99	1.59	1.11	1.77	14.53	9.26
59	2.79	25.93	7.35	2.93	31.49	7.35	2.87	**Clayey**	2.64	1.63	1.97	43.91	2.00	2.79	4.66	204.59	0.88	0.97	0.17	0.12	0.19	0.7	2.2	1.34	0.02	0.9600	20.19	13.06	45		2.6	1875	1.1		0.02	0.99	1.48	1.11	1.64	13.37	8.65
60	2.80	19.52	5.78	2.95	23.52	5.78	2.89	**Clayey**	2.54	1.59	1.92	32.88	2.00	2.80	4.78	157.25	0.44	0.97	0.17	0.12	0.19	0.7	2.2	1.32	0.02	0.9600	9.96	6.54	46		2.6	1441	1.1		0.02	0.99	1.09	1.11	1.21	9.78	6.42
61	2.57	23.41	3.22	2.72	27.98	3.22	2.66	**Very Silty**	2.44	1.56	1.87	29.35	2.00	2.66	3.72	109.12	0.20	0.97	0.17	0.12	0.19	0.7	2.2	1.31	0.02	0.9600	4.44	2.96	38		2.6	1761	1.1		0.02	0.99	1.28	1.11	1.42	11.40	7.60
62	2.61	21.13	3.22	2.75	25.05	3.22	2.70	**Clayey**	2.35	1.53	1.82	34.17	2.00	2.61	3.41	116.43	0.23	0.97	0.16	0.13	0.19	0.7	2.2	1.29	0.02	0.9600	4.92	3.33	36		2.6	1621	1.1		0.02	0.99	1.13	1.11	1.26	10.03	6.79
63	2.60	18.86	2.64	2.74	22.21	2.64	2.68	**Clayey**	2.26	1.50	1.77	30.20	2.00	2.60	3.33	100.57	0.17	0.97	0.16	0.13	0.18	0.7	2.2	1.28	0.02	0.9600	3.72	2.56	35		2.6	1474	1.1		0.02	0.99	0.99	1.11	1.10	8.73	6.01
64	2.63	17.81	2.67	2.76	20.81	2.67	2.71	**Clayey**	2.18	1.48	1.73	28.14	2.00	2.63	3.51	98.73	0.17	0.97	0.16	0.13	0.18	0.7	2.2	1.26	0.02	0.9600	3.56	2.49	37		2.6	1417	1.1		0.02	0.99	0.92	1.11	1.02	8.05	5.63
65	2.68	14.59	2.45	2.81	16.94	2.45	2.76	**Clayey**	2.11	1.45	1.69	23.05	2.00	2.68	3.85	88.82	0.15	0.96	0.15	0.13	0.18	0.7	2.2	1.25	0.02	0.9600	3.00	2.13	39		2.6	1181	1.1		0.02	0.99	0.74	1.11	0.83	6.45	4.59
66	2.69	13.44	2.21	2.82	15.50	2.21	2.76	**Clayey**	2.04	1.43	1.65	21.06	2.00	2.69	3.91	82.42	0.13	0.96	0.15	0.13	0.18	0.7	2.2	1.24	0.02	0.9600	2.69	1.94	40		2.6	1107	1.1		0.02	0.99	0.67	1.11	0.75	5.82	4.21
67	2.51	17.06	1.48	2.63	19.54	1.48	2.58	**Very Silty**	1.97	1.40	1.61	21.07	2.00	2.58	3.23	68.12	0.11	0.96	0.15	0.13	0.18	0.7	2.2	1.23	0.02	0.9600	2.20	1.62	35		2.6	1428	1.1		0.02	0.99	0.84	1.11	0.93	7.24	5.32
68	2.44	18.00	1.16	2.56	20.49	1.16	2.51	**Granular**	1.91	1.38	1.57	19.36	2.00	2.56	3.09	59.91	0.10	0.96	0.15	0.13	0.17	0.7	2.2	1.21	0.02	0.9600	1.98	1.48	33		2.6	1530	1.1		0.02	0.99	0.87	1.11	0.97	7.49	5.60
69	2.90	5.80	1.33	3.02	6.56	1.33	2.97	**Clayey**	1.86	1.36	1.54	9.80	2.00	2.90	5.73	56.08	0.10	0.96	0.14	0.13	0.17	0.7	2.2	1.20	0.02	0.9600	1.89	1.44	52		2.6	500	1.1		0.02	0.99	0.28	1.11	0.31	2.37	1.80
70	3.01	4.59	1.38	3.12	5.16	1.38	3.07	**Clayey**	1.80	1.34	1.51	8.07	2.00	3.01	6.81	54.96	0.10	0.96	0.14	0.13	0.17	0.7	2.2	1.19	0.02	0.9600	1.85	1.43	59		2.6	401	1.1		0.02	0.99	0.22	1.11	0.24	1.84	1.43
71	3.11	4.08	1.84	3.22	4.57	1.84	3.18	**Clayey**	1.76	1.33	1.48	7.33	2.00	3.11	8.10	59.36	0.10	0.96	0.14	0.13	0.17	0.7	2.2	1.18	0.02	0.9600	1.90	1.50	66		2.6	362	1.1		0.02	0.99	0.19	1.11	0.21	1.61	1.27
72	3.11	3.89	1.59	3.21	4.34	1.59	3.17	**Clayey**	1.71	1.31	1.46	7.02	2.00	3.11	8.01	56.23	0.10	0.95	0.14	0.13	0.16	0.7	2.2	1.17	0.02	0.9600	1.83	1.47	66		2.6	350	1.1		0.02	0.99	0.18	1.11	0.20	1.51	1.22
73	3.15	3.90	1.88	3.24	4.32	1.88	3.20	**Clayey**	1.67	1.29	1.43	6.97	2.00	3.15	8.50	59.31	0.10	0.95	0.13	0.13	0.16	0.7	2.2	1.17	0.02	0.9600	1.86	1.52	69		2.6	355	1.1		0.02	0.99	0.18	1.11	0.20	1.49	1.22
74	3.14	3.93	1.84	3.24	4.33	1.84	3.20	**Clayey**	1.63	1.28	1.41	6.95	2.00	3.14	8.48	58.96	0.10	0.95	0.13	0.13	0.16	0.7	2.2	1.16	0.02	0.9600	1.84	1.53	69		2.6	362	1.1		0.02	0.99	0.18	1.11	0.20	1.48	1.23
75	3.15	3.91	1.83	3.24	4.28	1.83	3.20	**Clayey**	1.59	1.26	1.38	6.87	2.00	3.15	8.55	58.76	0.10	0.95	0.13	0.13	0.16	0.7	2.2	1.15	0.02	0.9600	1.82	1.55	69		2.6	364	1.1		0.02	0.99	0.17	1.11	0.19	1.45	1.23
76	3.14	4.01	1.76	3.22	4.37	1.76	3.19	**Clayey**	1.55	1.25	1.36	6.95	2.00	3.14	8.38	58.24	0.10	0.95	0.13	0.13	0.15	0.7	2.2	1.14	0.02	0.9600	1.79	1.56	68		2.6	378	1.1		0.02	0.99	0.17	1.11	0.19	1.47	1.28
77	3.17	3.58	1.62	3.25	3.89	1.62	3.22	**Clayey**	1.51	1.23	1.34	6.37	2.00	3.17	8.81	56.08	0.10	0.94	0.12	0.13	0.15	0.7	2.2	1.13	0.02	0.9600	1.74	1.54	71		2.6	342	1.1		0.02	0.99	0.15	1.11	0.17	1.29	1.15
78	3.18	3.72	1.86	3.26	4.02	1.86	3.23	**Clayey**	1.48	1.22	1.32	6.49	2.00	3.18	9.03	58.65	0.10	0.94	0.12	0.13	0.15	0.7	2.2	1.13	0.02	0.9600	1.77	1.60	72	93	2.6	359	1.1		0.02	0.99	0.16	1.11	0.18	1.33	1.20
79	3.19	3.69	1.85	3.26	3.97	1.85	3.23	**Clayey**	1.45	1.20	1.30	6.42	2.00	3.19	9.12	58.51	0.10	0.94	0.12	0.13	0.14	0.7	2.2	1.12	0.02	0.9600	1.75	1.62	72		2.6	360	1.1		0.02	0.99	0.16	1.11	0.17	1.30	1.20
80	3.17	3.62	1.55	3.24	3.88	1.55	3.21	**Clayey**	1.42	1.19	1.28	6.30	2.00	3.17	8.80	55.41	0.10	0.94	0.12	0.13	0.14	0.7	2.2	1.11	0.02	0.9600	1.69	1.60	70		2.6	358	1.1		0.02	0.99	0.15	1.11	0.17	1.26	1.19
81	3.14	3.81	1.46	3.20	4.06	1.46	3.18	**Clayey**	1.39	1.18	1.26	6.47	2.00	3.14	8.44	54.65	0.10	0.93	0.11	0.13	0.14	0.7	2.2	1.10	0.02	0.9600	1.67	1.61	68		2.6	380	1.1		0.02	0.99	0.16	1.11	0.17	1.31	1.27
82	2.89	12.76	3.37	2.94	13.56	3.37	2.92	**Clayey**	1.36	1.17	1.24	16.86	2.00	2.89	5.57	93.89	0.16	0.93	0.11	0.13	0.13	0.7	2.2	1.10	0.02	0.9600	2.74	2.70	51		2.6	1287	1.1		0.02	0.99	0.52	1.11	0.58	4.36	4.31
83	2.58	21.24	2.00	2.63	22.49	2.00	2.61	**Very Silty**	1.33	1.15	1.22	24.33	2.00	2.61	3.37	82.07	0.13	0.93	0.11	0.13	0.13	0.7	2.2	1.09	0.02	0.9600	2.28	2.30	36		2.6	2166	1.1		0.02	0.99	0.86	1.11	0.95	7.19	7.27

CPTU-602 Liquefaction Analysis

ConeTec Inc. - CPT Interpretation
Interpretation Output - Release 1.22 Rev. A - Format: NLI Imperial
Run No: 06-0718-0954-3465
Job No: 02-100
Client: MACTEC Engineering and Consulting Inc.
Project: Former Callahan Mine Site, Brooksville, ME
Site: CP-602
Location: Callahan Mine
Cone: 20 Ton AD179
CPT Date: 06/27/06
CPT Time: 11:37
CPT File: 758CP602.COR
Northing (m): 0
Easting (m): 0
Elevation (m): 0 — 70.6 — Elevation For CPT Triggering analysis

Water Table (m): 1.04 (ft): 3.4 — 3.4 — Water Table assumed for CPT Analysis
Unit Weight of Water (default): 62.4 pcf
Averaging Increment (m): 0.2
Phi Method : Robertson and Campanella, 1983
Su Nkt used: 15 Su/P' (nc): 0.3 — 0.11 — Base acceleration
Dr Method : Jamiolkowski - All Sands
State Parameter M: 1.2
Used Unit Weights Assigned to Soil Zones
N160lc Calculated using qc1n

1) CSR = $0.65*(a_{max}/g)*(s_v/s'_v)*r_d$ — Seed & Idriss, 1983, p. 459

a_{max}/g = 0.11 g — USGS (base)(amplified from base as discussed in
s_v = computed — Total Vertical Stress
s'_v = computed — Effective Vertical Stress

$r_d = [1.0 - 0.4113z^{0.5} + 0.04052z + 0.001753z^{1.5}] / [1 - 0.4177z^{0.5} + 0.05729z - 0.$

z = depth in meters

2) FS = Factor of safety against triggering of liquefaction: $FS = (CRR_{7.5}/CSR) \times MSF \times Ks \times Ka$

MSF = magnitude scaling factor; Assume based on range recommended by NCEER Wo

CPTU-602 Liquefaction Analysis

$Ks = (s'_{vo}/P_a)^{(f-1)}$, where f = 0.7 to 0.8 for relative density of 40 to 60%; f = 0.6 to 0.7 fo
1 Atmosphere = 14.7 psi = 2.12 ksf

Conetec Data

Col-01 Depth (m)	Col-02 Depth (ft)	Col-03 Elev. (m)	Col-04 Elev. (ft)	Col-05 qc (tsf)	Col-06 qt (tsf)	Col-07 fs (tsf)	Col-08 Rf (%)	Col-09 u (ft)	Col-10 SBT (Zone)	Col-11 SBTn (Zone)	Col-12 SBT-BQ (Zone)	Col-13 SBT-BQn (Zone)	Col-14 Perm-k (cm/s)	Col-15 Unit Wt (pcf)	Col-16 T Stress (tsf)	Col-17 U Stress (tsf)	Col-18 E Stress (tsf)	Col-19 Cn	Col-20 N60 (b/ft)	Col-21 N1(60) (b/ft)	Col-22 N(60)lc (b/ft)	Col-23 N1(60)lc (b/ft)	Col-24 Qt	Col-25 Fr (%)	Col-26 Bq	Col-27 Ic	Col-28 FC (%)	Col-29 IcZone (Zone)	Col-30 Dr (%)	Col-31 Phi (deg)	Col-32 State Par	Col-33 Es/qt	Col-34 YoungE (tsf)	Col-35 Su (tsf)	Col-36 OCR	U (psf)	s_{vo} (psf)	q_c (psf)	q_t (psf)	P_a (psf)	σ'_{vo} (psf)	f_s (psf)	$Q_{exp=1}$	F
0.1	0.328	-0.1	70.3	4.55	4.55	0.23	4.96	-0.76	3	9	4	7	5.00E-08	111.4	0.018	0	0.018	1.7	4.4	7.4	-9999	-9999	247.99	4.98	-0.01	-9999	-9999	0	-9999	-9999	-9999	-9999	-9999	0.302	10	0	36	9100	9100	2116	36	460	251.78	5.08
0.3	0.984	-0.3	69.6	5.34	5.33	0.2	3.76	-2.05	3	5	4	6	5.00E-08	111.4	0.055	0	0.055	1.7	5.1	8.7	1.8	3.1	96.15	3.8	-0.01	3.11	66	3	-9999	-9999	-9999	-9999	-9999	0.351	10	0	110	10680	10660	2116	110	400	95.91	3.79
0.5	1.64	-0.5	69.0	2.3	2.32	0.06	2.59	5.06	3	4	3	5	5.00E-08	111.4	0.091	0	0.091	1.7	2.2	3.8	0.6	6.8	24.44	2.69	0.07	2.66	38.2	4	-9999	-9999	-9999	-9999	-9999	0.149	9.7	0	182	4600	4640	2116	182	120	24.49	2.69
0.7	2.297	-0.7	68.3	1.85	1.94	0.03	1.3	17.76	1	4	3	3	1.00E-07	111.4	0.128	0	0.128	1.7	0.9	1.6	0.5	4	14.13	1.39	0.31	2.69	39.9	4	-9999	-9999	-9999	-9999	-9999	0.12	4.2	0	256	3700	3880	2116	256	60	14.16	1.66
0.9	2.953	-0.9	67.6	2.27	2.32	0.03	1.4	11.49	1	4	3	4	1.00E-07	111.4	0.164	0	0.164	1.7	1.1	1.9	0.6	3.8	13.1	1.51	0.17	2.74	42.5	4	-9999	-9999	-9999	-9999	-9999	0.144	3.7	0	328	4540	4640	2116	328	60	13.15	1.39
1.1	3.609	-1.1	67.0	1.87	1.95	0.02	1.03	18.7	1	4	3	3	1.00E-07	111.4	0.201	0.007	0.194	1.7	0.9	1.6	0.6	2.7	9.02	1.14	0.33	2.82	47.2	4	-9999	-9999	-9999	-9999	-9999	0.117	2.2	13	402	3740	3900	2116	389	40	8.99	1.14
1.3	4.265	-1.3	66.3	2.79	2.86	0.03	0.88	14.31	1	4	3	4	1.00E-07	111.4	0.238	0.027	0.211	1.7	1.4	2.3	0.8	3.5	12.46	0.96	0.16	2.66	38.4	4	-9999	-9999	-9999	-9999	-9999	0.175	3.5	54	476	5580	5720	2116	422	60	12.43	1.14
1.5	4.921	-1.5	65.7	3.88	3.91	0.03	0.83	5.99	1	5	4	5	1.00E-07	111.4	0.274	0.047	0.227	1.7	1.9	3.2	1.2	2	16.03	0.9	0.04	2.91	52.8	4	-9999	-9999	-9999	-9999	-9999	0.242	5	95	548	7760	7820	2116	453	60	16.05	0.83
1.7	5.577	-1.7	65.0	1.85	1.96	0.02	1.15	23.69	1	3	3	3	1.00E-07	111.4	0.311	0.068	0.243	1.7	0.9	1.6	0.6	2.3	6.81	1.37	0.41	2.96	56.1	3	-9999	-9999	-9999	-9999	-9999	0.11	1.5	136	622	3700	3920	2116	486	40	6.78	1.21
1.9	6.234	-1.9	64.4	1.48	1.61	0.02	1.24	27.2	1	3	2	3	1.00E-07	111.4	0.347	0.088	0.259	1.7	0.8	1.3	0.6	1.8	4.88	1.59	0.6	3.12	67.2	3	-9999	-9999	-9999	-9999	-9999	0.084	1.1	177	694	2960	3220	2116	517	40	4.88	1.58
2.1	6.89	-2.1	63.7	1.95	2.07	0.03	1.45	25.92	1	3	3	3	1.00E-07	111.4	0.384	0.109	0.275	1.7	1	1.7	0.7	2.2	6.14	1.78	0.41	3.06	62.5	3	-9999	-9999	-9999	-9999	-9999	0.112	1.4	218	768	3900	4140	2116	550	60	6.13	1.78
2.3	7.546	-2.3	63.1	1.29	1.43	0.02	1.58	28.82	1	3	3	3	1.00E-07	111.4	0.42	0.129	0.291	1.7	0.7	1.2	0.6	1.5	3.47	2.24	0.76	3.32	83.1	3	-9999	-9999	-9999	-9999	-9999	0.067	0.8	259	840	2580	2860	2116	581	40	3.48	1.98
2.5	8.202	-2.5	62.4	1.15	1.31	0.03	2.3	33.75	1	3	1	1	1.00E-07	111.4	0.457	0.15	0.307	1.7	0.6	1.1	0.6	1.4	2.77	3.53	1.06	3.51	100	3	-9999	-9999	-9999	-9999	-9999	0.057	0.7	300	914	2300	2620	2116	614	60	2.78	3.52
2.7	8.858	-2.7	61.7	1.08	1.25	0.03	2.21	34.98	1	3	1	1	1.00E-07	111.4	0.493	0.17	0.323	1.7	0.6	1	0.6	1.2	2.33	3.66	1.22	3.58	100	3	-9999	-9999	-9999	-9999	-9999	0.05	0.6	341	986	2160	2500	2116	645	60	2.35	3.96
2.9	9.514	-2.9	61.1	1.42	1.55	0.04	2.26	28.19	1	3	3	3	1.00E-07	111.4	0.53	0.191	0.339	1.7	0.7	1.3	0.7	1.4	3.02	3.43	0.67	3.47	95.9	3	-9999	-9999	-9999	-9999	-9999	0.068	0.7	382	1060	2840	3100	2116	678	80	3.01	3.92
3.1	10.17	-3.1	60.4	1.03	1.2	0.04	3.14	36.11	2	2	-9999	-9999	1.00E-15	79.5	0.561	0.211	0.35	1.69	1.1	1.9	0.8	1.2	1.82	5.92	1.44	3.78	100	2	-9999	-9999	-9999	-9999	-9999	0.042	0.6	422	1122	2060	2400	2116	700	80	1.83	6.26
3.3	10.827	-3.3	59.8	3.64	3.78	0.05	1.33	30.65	1	4	3	3	1.00E-07	111.4	0.593	0.232	0.361	1.67	1.8	3	1.1	2.8	8.84	1.57	0.23	2.89	51.6	4	-9999	-9999	-9999	-9999	-9999	0.212	2.1	463	1186	7280	7560	2116	723	100	8.82	1.57
3.5	11.483	-3.5	59.1	5.21	5.29	0.08	1.52	17.48	1	4	4	4	1.00E-07	111.4	0.629	0.252	0.377	1.63	2.5	4.1	1.5	3.7	12.37	1.72	0.06	2.79	45.3	4	-9999	-9999	-9999	-9999	-9999	0.311	3.4	504	1258	10420	10580	2116	754	160	12.37	1.72
3.7	12.139	-3.7	58.5	4.73	4.83	0.07	1.51	20.82	1	4	4	4	1.00E-07	111.4	0.666	0.273	0.393	1.6	2.3	3.7	1.4	3.3	10.59	1.75	0.09	2.85	48.9	4	-9999	-9999	-9999	-9999	-9999	0.277	2.7	545	1332	9460	9660	2116	787	140	10.59	1.68
3.9	12.795	-3.9	57.8	3.13	3.26	0.07	2.23	26.9	3	3	3	3	5.00E-08	111.4	0.702	0.293	0.409	1.56	3.1	4.9	1.2	2.3	6.25	2.85	0.21	3.16	69.6	3	-9999	-9999	-9999	-9999	-9999	0.17	1.4	586	1404	6260	6520	2116	818	140	6.26	2.74
4.1	13.451	-4.1	57.1	1.92	2.1	0.06	2.86	39.57	3	3	3	3	5.00E-08	111.4	0.739	0.314	0.425	1.53	2	3.1	1	1.6	3.21	4.41	0.68	3.5	100	3	-9999	-9999	-9999	-9999	-9999	0.091	0.8	627	1478	3840	4200	2116	851	120	3.20	4.41
4.3	14.107	-4.3	56.5	1.58	1.82	0.05	2.62	50.11	3	3	1	1	5.00E-08	111.4	0.775	0.334	0.441	1.51	1.7	2.6	1	1.3	2.36	4.58	1.18	3.62	100	2	-9999	-9999	-9999	-9999	-9999	0.069	0.6	668	1550	3160	3640	2116	882	100	2.37	4.78
4.5	14.764	-4.5	55.8	2.03	2.24	0.06	2.46	44.83	3	3	3	3	5.00E-08	111.4	0.812	0.355	0.457	1.48	2.1	3.2	1	1.5	3.12	3.86	0.73	3.48	97.1	3	-9999	-9999	-9999	-9999	-9999	0.095	0.7	709	1624	4060	4480	2116	915	120	3.12	4.20
4.7	15.42	-4.7	55.2	3.43	3.62	0.07	1.94	40.69	1	3	3	3	1.00E-07	111.4	0.848	0.375	0.473	1.45	1.7	2.5	1.3	2.2	5.86	2.53	0.32	3.15	69.3	3	-9999	-9999	-9999	-9999	-9999	0.185	1.3	750	1696	6860	7240	2116	946	140	5.86	2.53
4.9	16.076	-4.9	54.5	2.59	2.77	0.09	3.35	38.75	3	3	3	3	5.00E-08	111.4	0.885	0.396	0.489	1.43	2.7	3.8	1.3	1.8	3.85	4.92	0.43	3.46	95.2	3	-9999	-9999	-9999	-9999	-9999	0.126	0.9	791	1770	5180	5540	2116	979	180	3.85	4.77
5.1	16.732	-5.1	53.9	5.65	5.78	0.07	1.13	26.67	1	4	4	4	1.00E-07	111.4	0.922	0.416	0.505	1.41	2.8	3.9	1.7	2.9	9.61	1.34	0.09	2.83	47.7	4	-9999	-9999	-9999	-9999	-9999	0.324	2.4	832	1844	11300	11560	2116	1012	140	9.60	1.44
5.3	17.388	-5.3	53.2	1.98	2.21	0.06	2.72	48.56	3	3	3	3	5.00E-08	111.4	0.958	0.437	0.521	1.39	2.1	2.9	1.2	1.3	2.4	4.81	0.86	3.63	100	2	-9999	-9999	-9999	-9999	-9999	0.083	0.6	873	1916	3960	4420	2116	1043	120	2.40	4.79
5.5	18.044	-5.5	52.6	1.85	2.08	0.06	2.65	48.6	3	3	1	1	5.00E-08	111.4	0.995	0.457	0.537	1.36	2	2.7	1.2	1.2	2.01	5.09	0.98	3.71	100	2	-9999	-9999	-9999	-9999	-9999	0.072	0.6	914	1990	3700	4160	2116	1076	120	2.02	5.53
5.7	18.701	-5.7	51.9	1.64	1.92	0.03	1.7	58.42	1	2	-9999	-9999	1.00E-07	111.4	1.031	0.478	0.553	1.34	0.9	1.2	1.1	1	1.6	3.68	1.52	3.72	100	2	-9999	-9999	-9999	-9999	-9999	0.059	0.5	955	2062	3280	3840	2116	1107	60	1.61	3.37
5.9	19.357	-5.9	51.2	1.92	2.2	0.04	1.59	60.84	1	3	1	1	1.00E-07	111.4	1.068	0.498	0.569	1.33	1.1	1.4	1.1	1.1	1.99	3.09	1.24	3.6	100	2	-9999	-9999	-9999	-9999	-9999	0.076	0.6	996	2136	3840	4400	2116	1140	80	1.99	3.53
6.1	20.013	-6.1	50.6	2.03	2.34	0.04	1.5	65.32	1	3	1	1	1.00E-07	111.4	1.104	0.519	0.586	1.31	1.1	1.5	1.2	1.1	2.1	2.85	1.23	3.56	100	3	-9999	-9999	-9999	-9999	-9999	0.082	0.6	1037	2208	4060	4680	2116	1171	80	2.11	3.24
6.3	20.669	-6.3	49.9	1.9	2.21	0.03	1.36	65.92	1	3	-9999	-9999	1.00E-07	111.4	1.141	0.539	0.602	1.29	1.1	1.4	1.2	1	1.78	2.81	1.42	3.63	100	2	-9999	-9999	-9999	-9999	-9999	0.071	0.6	1078	2282	3800	4420	2116	1204	60	1.78	2.81
6.5	21.325	-6.5	49.3	1.96	2.29	0.03	1.31	69.33	1	3	-9999	-9999	1.00E-07	111.4	1.177	0.56	0.618	1.27	1.1	1.4	1.2	1	1.8	2.7	1.44	3.61	100	2	-9999	-9999	-9999	-9999	-9999	0.074	0.6	1119	2354	3920	4580	2116	1235	60	1.80	2.70
6.7	21.981	-6.7	48.6	1.98	2.32	0.03	1.3	71.49	1	3	-9999	-9999	1.00E-07	111.4	1.214	0.58	0.634	1.26	1.1	1.4	1.2	1	1.74	2.73	1.5	3.63	100	2	-9999	-9999	-9999	-9999	-9999	0.074	0.6	1159	2428	3960	4640	2116	1269	60	1.74	2.71
6.9	22.638	-6.9	48.0	2.59	2.93	0.04	1.28	73.83	1	3	3	3	1.00E-07	111.4	1.25	0.601	0.65	1.24	1.4	1.7	1.3	1.2	2.59	2.24	1.01	3.44	93	3	-9999	-9999	-9999	-9999	-9999	0.112	0.7	1200	2500	5180	5860	2116	1300	80	2.59	2.38
7.1	23.294	-7.1	47.3	6.01	6.37	0.12	1.85	76.86	4	3	3	3	5.00E-07	114.6	1.287	0.621	0.666	1.23	4.1	5	2.1	2.6	7.62	2.32	0.35	3.03	60.9	3	-9999	-9999	-9999	-9999	-9999	0.339	1.8	1241	2574	12020	12740	2116	1333	240	7.63	2.36
7.3	23.95	-7.3	46.7	9.95	10.48	0.15	1.46	112.04	5	4	4	3	5.00E-06	114.6	1.325	0.642	0.683	1.21	5	6.1	2.9	3.9	13.39	1.67	0.31	2.75	43.3	4	-9999	-9999	-9999	-9999	-9999	0.61	3.8	1282	2650	19900	20960	2116	1368	300	13.39	1.64
7.5	24.606	-7.5	46.0	7.95	8.67	0.12	1.33	153.73	5	4	3	3	5.00E-06	114.6	1.363	0.662	0.701	1.19	4.2	5	2.5	3.2	10.44	1.58	0.57	2.83	47.9	4	-9999	-9999	-9999	-9999	-9999	0.487	2.7	1323	2726	15900	17340	2116	1403	240	10.42	1.64
7.7	25.262	-7.7	45.3	8.34	9.21	0.12	1.31	185.64	5	4	3	3	5.00E-06	114.6	1.4	0.683	0.718	1.18	4.4	5.2	2.7	3.3	10.88	1.54	0.65	2.81	46.6	4	-9999	-9999	-9999	-9999	-9999	0.52	2.8	1364	2800	16680	18420	2116	1436	240	10.88	1.54
7.9	25.918	-7.9	44.7	8.35	9.2	0.12	1.31	180.75	5	4	3	3	5.00E-06	114.6	1.438	0.703	0.735	1.17	4.4	5.1	2.7	3.2	10.56	1.55	0.64	2.82	47.4	4	-9999	-9999	-9999	-9999	-9999	0.517	2.7	1405	2876	16700	18400	2116	1471	240	10.55	1.55
8.1	26.574	-8.1	44.0	8.03	8.82	0.11	1.22	168.25	5	4	3	3	5.00E-06	114.6	1.475	0.724	0.752	1.15	4.2	4.9	2.6	3	9.77	1.47	0.62	2.84	48.4	4	-9999	-9999	-9999	-9999	-9999	0.49	2.5	1446	2950	16060	17640	2116	1504	220	9.77	1.50
8.3	27.231	-8.3	43.4	8.27	8.99	0.12	1.28	153.77	5	4	3	3	5.00E-06	114.6	1.513	0.744	0.769	1.14	4.3	4.9	2.7	3	9.73	1.54	0.54	2.85	49.1	4	-9999	-9999	-9999	-9999	-9999	0.499	2.4	1487	3026	16540	17980	2116	1539	240	9.72	1.60
8.5	27.887	-8.5	42.7	7.81	8.26	0.14	1.64	96.11	5	3	3	3	5.00E-06	114.6	1.551	0.765	0.786	1.13	4	4.5	2.6	2.8	8.53	2.02	0.33	2.96	55.9	3	-9999	-9999	-9999	-9999	-9999	0.447	2.1	1528	3102	15620	16520	2116	1574	280	8.52	2.09
8.7	28.543	-8.7	42.1	4.55	5.13	0.06	1.22	123.24	1	3	3	3	1.00E-07	111.4	1.588	0.785	0.803	1.12	2.5	2.7	1.9	1.7	4.41	1.77	0.87	3.18	71.8	3	-9999	-9999	-9999	-9999	-9999	0.236	1	1569	3176	9100	10260	2116	1607	120	4.41	1.69
8.9	29.199	-8.9	41.4	4.23	4.85	0.06	1.19	131.25	1	3	3	3	1.00E-07	111.4	1.624	0.806	0.819	1.11	2.3	2.6	1.8	1.6	3.94	1.79	1.02	3.23	75.4	3	-9999	-9999	-9999	-9999	-9999	0.215	0.9	1610	3248	8460	9700	2116	1638	120	3.94	1.86
9.1	29.855	-9.1	40.7	4.36	4.95	0.07	1.32	125.52	1	3	3	3	1.00E-07	111.4	1.661	0.826	0.835	1.09	2.4	2.6	1.9	1.6	3.94	1.98	0.94	3.25	77	3	-9999	-9999	-9999	-9999	-9999	0.219	0.9	1651	3322	8720	9900	2116	1671	140	3.94	2.13
9.3	30.511	-9.3	40.1	6.26	6.74	0.07	0.97	102.63	1	3	3	3	1.00E-07	111.4	1.697	0.846	0.851	1.08	3.2	3.5	2.2	2	5.93	1.29	0.47	3.01	59	3	-9999	-9999	-9999	-9999	-9999	0.336	1.3	1692	3394	12520	13480	2116	1702	140	5.93	1.39
9.5	31.168	-9.5	39.4	9.57	9.9	0.14	1.37	72.4	5	4	4	3	5.00E-06	114.6	1.734	0.867	0.867	1.07	4.7	5.1	3	3	9.42	1.66	0.17	2.88	50.8	4	-9999	-9999	-9999	-9999	-9999	0.545	2.3	1733	3468	19140	19800	2116	1735	280	9.41	1.71
9.7	31.824	-9.7	38.8	122.54	122.49	1.53	1.25	-10.51	6	6	9	6	5.00E-03	120.9	1.773	0.887	0.886	1.06	29.3	31.2	23.5	25.5	136.31	1.27	-0.01	1.3	10.4	6	-74.2	44	-0.24	2.015	246.8	-9999	-9999	1774	3546	245080	244980	2116	1772	3060	136.22	1.27
9.9	32.48	-9.9	38.1	45.75	45.86	1.82	3.98	22.23	5	4	8	6	5.00E-06	114.6	1.812	0.908	0.904	1.05	22	23.1	11.7	12.6	48.74	4.14	0	2.57	33.9	5	-9999	-9999	-9999	-9999	-9999	2.936	10	1815	3624	91500	91720	2116	1809	3640	48.69	4.13
10.1	33.136	-10.1	37.5	22.61	22.7	0.74	3.25	17.19	5	4	7	5	5.00E-06	114.6	1.849	0.928	0.921	1.04	10.9	11.3	6.4	6.6	22.64	3.53	-0.02	2.76	43.6	4	-9999	-9999	-9999	-9999	-9999	1.39	8.6	1856	3698	45220	45400	2116	1842	1480	22.63	3.55
10.3	33.792	-10.3	36.8	32.09	32.23	0.42	1.31	30.36	7	5	7	6	5.00E-04	117.7	1.887	0.949	0.938	1.03	10.3	10.6	7.5	8	32.33	1.4	0	2.39	25.9	5	35.1	36	-0.11	3.658	117.9	-9999	-9999	1896	3774	64180	64460	2116	1878	840	32.32	1.38
10.5	34.448	-10.5	36.2	29.64	29.69	0.9	3.03	11.38	5	4	7	5	5.00E-06	114.6	1.926	0.969	0.956	1.02	14.2	14.5	7.9	8.1	29.04	3.24	-0.02	2.65	37.9	4	-9999	-9999	-9999	-9999	-9999	1.851	10	1937	3852	59280	59380	2116	1915	1800	29.00	3.24
10.7	35.105	-10.7	35.5	30.44	30.54	1.24	4.05	20.59	4	4	7	5	5.00E-07	114.6	1.963	0.99	0.973	1.01	19.5	19.8	8.5	8.5	29.36	4.33	-0.01	2.73	42.1	4	-9999	-9999	-9999	-9999	-9999	1.905	10	1978	3926	60880	61080	2116	1948	2480	29.35	4.34
10.9	35.761	-10.9	34.8	33.22	33.19	1.12	3.38	-5.89	5	4	7	5	5.00E-06	114.6	2.001	1.01	0.99	1	15.9	16	8.8	8.8	31.5	3.59	-0.04	2.65	38	4	-9999	-9999	-9999	-9999	-9999	2.079	10	2019	4002	66440	66380	2116	1983	2240	31.46	3.59
11.1	36.417	-11.1	34.2	39.37	39.29	1.36	3.46	-17.05	5	4	8	5	5.00E-06	114.6	2.038	1.031	1.007	1	18.8	18.7	10.2	10	36.98	3.65	-0.04	2.61	35.7	4	-9999	-9999	-9999	-9999	-9999	2.483	10	2060	4076	78740	78580	2116	2016	2720	36.96	3.65

CPTU-602 Liquefaction Analysis

ext

06205z$^{1.5}$ + 0.001210z^{2}]

Youd and Idriss, 2001

kshop, reiterated in Youd and Idriss, 2001

CPTU-602 Liquefaction Analysis

rel density of 60 to 80%; P_a = pressure at 1 atmosphere Youd and Idriss, 2001

	AT	AU	AV	AW	AX	AY	AZ	BA	BB	BC	BD	BE	BF	BG	BH	BI	BJ	BK	BL	BM	BN	BO	BP	BQ	BR	BS	BT	BU	BV	BW	BX	BY	BZ	CA	CB	CC	CD	CE	CF	CG	CH
34	Col-46	Col-47	Col-48	Col-49	Col-50	Col-51	Col-52	Col-53	Col-54	Col-55	Col-56	Col-57	Col-57a	Col-58	Col-59	Col-60	Col-61	Col-62	Col-63	Col-64	Col-65	Col-66	Col-67	Col-68	Col-69	Col-70	Col-71	Col-72	Col-73	Col-74	Col-75	Col-76	Col-77	Col-78	Col-79	Col-80	Col-81	Col-82	Col-83	Col-84	Col-85
35									Youd & Idriss, 2001 CPT Based Analysis																							Boulanger and Idriss, 2004, "Approach B" method based on Su profile										
36																					Rel. Den. Factor																				
37	$I_{c\ Qexp=1}$	$Q_{exp = 0.5}$	F	$I_{c\ Qexp=0.5}$	$Q_{exp = 0.7}$	F	$I_{c\ Qexp=0.7}$	Description	C_q			q_{c1N}	Lookup	Ic	Kc	$(q_{c1N})_{cs}$	CRR7.5	rd	a_{max}/g =	CSR		f	MSF	K_σ	α	K_{α}	FS liq- CPT (Sand-Like)		Apparent Fines	Measured Fines	Ic Limits	Su - CPT (psf)	OCR Assumed	OCR - CPT	α	k_{α}	$CRR_{M7.5}$	MSF	$CRR_{M5.5}$	FS liq-Su (Clay-Like)	
38									n=1.0	n=0.5	n=0.7		Col						if crest accel	No Amplification	if crest accel = 2						No Amplification	f crest accel = 2	(%)	(%)		Nkt	1.1							No Amplification	if crest accel = 2
39																			2.0						0.02							10.5			0.02						
40	2.20	32.84	5.08	2.74	74.17	5.08	2.50	Very Silty	58.78	7.67	17.32	74.47	6.00	2.50	2.79	207.41	0.91	1.00	0.22	0.07	0.14	0.7	2.2	3.39	0.02	0.9650	91.63	46.03	31		2.6	863	1.1		0.02	0.99	15.13	1.11	16.81	234.91	117.99
41	2.33	21.87	3.79	2.79	39.50	3.79	2.60	Very Silty	19.24	4.39	7.92	39.91	2.00	2.60	3.31	132.09	0.29	1.00	0.22	0.07	0.14	0.7	2.2	2.43	0.02	0.9600	21.12	10.71	35		2.6	1005	1.1		0.02	0.99	5.76	1.11	6.40	89.58	45.41
42	2.66	7.18	2.69	3.09	11.73	2.69	2.91	Clayey	11.63	3.41	5.57	25.49	2.00	2.66	3.69	93.96	0.16	1.00	0.22	0.07	0.14	0.7	2.2	2.09	0.02	0.9600	9.71	4.97	38		2.6	425	1.1		0.02	0.99	1.47	1.11	1.64	22.91	11.72
43	2.73	4.92	1.66	3.13	7.51	1.66	2.97	Clayey	8.27	2.88	4.39	15.16	2.00	2.73	4.21	63.86	0.10	1.00	0.21	0.07	0.14	0.7	2.2	1.88	0.02	0.9600	5.82	3.01	42		2.6	345	1.1		0.02	0.99	0.85	1.11	0.94	13.26	6.85
44	2.72	5.18	1.39	3.07	7.51	1.39	2.93	Clayey	6.45	2.54	3.69	14.15	2.00	2.72	4.13	58.40	0.10	1.00	0.21	0.07	0.14	0.7	2.2	1.75	0.02	0.9600	5.12	2.67	41		2.6	411	1.1		0.02	0.99	0.79	1.11	0.88	12.33	6.43
45	2.82	3.86	1.14	3.15	5.41	1.14	3.02	Clayey	5.44	2.33	3.27	10.03	2.00	2.82	4.98	49.89	0.08	0.99	0.21	0.07	0.14	0.7	2.2	1.66	0.02	0.9600	3.98	2.09	47		2.6	333	1.1		0.02	0.99	0.54	1.11	0.60	8.18	4.30
46	2.70	5.55	1.14	3.01	7.66	1.14	2.88	Clayey	5.01	2.24	3.09	13.55	2.00	2.70	3.98	53.95	0.09	0.99	0.21	0.08	0.15	0.7	2.2	1.62	0.02	0.9600	4.05	2.15	40		2.6	499	1.1		0.02	0.99	0.75	1.11	0.83	10.37	5.51
47	2.53	7.43	0.83	2.84	10.11	0.83	2.71	Very Silty	4.67	2.16	2.94	10.87	2.00	2.71	4.10	44.61	0.08	0.99	0.21	0.09	0.16	0.7	2.2	1.59	0.02	0.9600	3.09	1.66	41		2.6	693	1.1		0.02	0.99	0.96	1.11	1.07	12.51	6.71
48	2.94	3.25	1.21	3.23	4.36	1.21	3.12	Clayey	4.35	2.09	2.80	8.06	2.00	2.94	6.13	49.45	0.08	0.99	0.20	0.09	0.17	0.7	2.2	1.55	0.02	0.9600	3.01	1.63	55		2.6	314	1.1		0.02	0.99	0.41	1.11	0.45	5.01	2.71
49	3.12	2.41	1.58	3.40	3.20	1.58	3.29	Clayey	4.09	2.02	2.68	6.23	2.00	3.12	8.21	51.13	0.09	0.99	0.20	0.09	0.17	0.7	2.2	1.53	0.02	0.9600	3.14	1.72	67		2.6	241	1.1		0.02	0.99	0.29	1.11	0.33	3.44	1.88
50	3.06	3.13	1.78	3.32	4.09	1.78	3.21	Clayey	3.85	1.96	2.57	7.52	2.00	3.06	7.43	55.88	0.10	0.99	0.20	0.10	0.18	0.7	2.2	1.50	0.02	0.9600	3.09	1.71	63		2.6	321	1.1		0.02	0.99	0.37	1.11	0.41	4.16	2.30
51	3.30	1.82	1.98	3.55	2.36	1.98	3.45	Clayey	3.64	1.91	2.47	4.92	2.00	3.30	10.69	52.61	0.09	0.98	0.20	0.10	0.18	0.7	2.2	1.47	0.02	0.9600	2.86	1.60	81		2.6	192	1.1		0.02	0.99	0.21	1.11	0.23	2.28	1.27
52	3.50	1.50	3.52	3.74	1.92	3.52	3.64	Clayey	3.44	1.86	2.38	4.26	2.00	3.50	14.16	60.40	0.10	0.98	0.20	0.10	0.19	0.7	2.2	1.45	0.02	0.9600	2.94	1.66	100		2.6	162	1.1		0.02	0.99	0.17	1.11	0.19	1.77	1.00
53	3.59	1.30	3.96	3.82	1.64	3.96	3.73	Clayey	3.28	1.81	2.30	3.87	2.00	3.59	15.87	61.46	0.10	0.98	0.19	0.11	0.19	0.7	2.2	1.43	0.02	0.9600	2.86	1.63	100		2.6	144	1.1		0.02	0.99	0.14	1.11	0.16	1.46	0.83
54	3.50	1.70	3.92	3.71	2.14	3.92	3.63	Clayey	3.12	1.77	2.22	4.57	2.00	3.50	14.06	64.25	0.10	0.98	0.19	0.11	0.19	0.7	2.2	1.41	0.02	0.9600	2.84	1.64	99		2.6	194	1.1		0.02	0.99	0.18	1.11	0.20	1.83	1.06
55	3.79	1.05	6.26	3.99	1.31	6.26	3.91	Clayey	3.02	1.74	2.17	3.43	2.00	3.79	20.00	68.63	0.11	0.98	0.19	0.11	0.19	0.7	2.2	1.39	0.02	0.9600	2.89	1.68	100		2.6	122	1.1		0.02	0.99	0.11	1.11	0.12	1.09	0.63
56	2.89	5.15	1.57	3.10	6.39	1.57	3.02	Clayey	2.93	1.71	2.12	10.46	2.00	2.89	5.64	59.04	0.10	0.98	0.19	0.11	0.19	0.7	2.2	1.38	0.02	0.9600	2.52	1.48	52		2.6	607	1.1		0.02	0.99	0.53	1.11	0.59	5.13	3.02
57	2.79	7.38	1.72	2.98	9.08	1.72	2.90	Clayey	2.81	1.68	2.06	14.04	2.00	2.79	4.68	65.67	0.11	0.98	0.18	0.12	0.20	0.7	2.2	1.36	0.02	0.9600	2.63	1.56	45		2.6	888	1.1		0.02	0.99	0.74	1.11	0.83	7.09	4.21
58	2.84	6.45	1.68	3.03	7.87	1.68	2.95	Clayey	2.69	1.64	2.00	12.28	2.00	2.84	5.14	63.11	0.10	0.97	0.18	0.12	0.20	0.7	2.2	1.35	0.02	0.9600	2.49	1.50	48		2.6	793	1.1		0.02	0.99	0.64	1.11	0.71	5.99	3.60
59	3.15	3.89	2.74	3.32	4.70	2.74	3.25	Clayey	2.59	1.61	1.95	7.97	2.00	3.15	8.51	67.87	0.11	0.97	0.18	0.12	0.20	0.7	2.2	1.33	0.02	0.9600	2.56	1.56	69		2.6	487	1.1		0.02	0.99	0.38	1.11	0.42	3.50	2.12
60	3.50	2.03	4.41	3.67	2.43	4.41	3.60	Clayey	2.49	1.58	1.89	4.94	2.00	3.50	14.13	69.76	0.11	0.97	0.18	0.12	0.20	0.7	2.2	1.31	0.02	0.9600	2.57	1.58	100		2.6	259	1.1		0.02	0.99	0.19	1.11	0.21	1.77	1.09
61	3.63	1.53	4.78	3.80	1.82	4.78	3.73	Clayey	2.40	1.55	1.85	4.13	2.00	3.63	16.63	68.65	0.11	0.97	0.18	0.12	0.20	0.7	2.2	1.30	0.02	0.9600	2.48	1.54	100		2.6	199	1.1		0.02	0.99	0.14	1.11	0.16	1.30	0.81
62	3.50	2.05	4.20	3.66	2.43	4.20	3.59	Clayey	2.31	1.52	1.80	4.90	2.00	3.50	14.09	69.02	0.11	0.97	0.17	0.12	0.20	0.7	2.2	1.29	0.02	0.9600	2.44	1.53	100		2.6	272	1.1		0.02	0.99	0.19	1.11	0.21	1.69	1.06
63	3.15	3.92	2.53	3.30	4.60	2.53	3.24	Clayey	2.24	1.50	1.76	7.65	2.00	3.15	8.59	65.76	0.11	0.97	0.17	0.12	0.20	0.7	2.2	1.27	0.02	0.9600	2.31	1.47	69		2.6	528	1.1		0.02	0.99	0.35	1.11	0.39	3.15	2.01
64	3.45	2.62	4.77	3.59	3.06	4.77	3.54	Clayey	2.16	1.47	1.72	5.66	2.00	3.45	13.25	74.98	0.12	0.97	0.17	0.12	0.19	0.7	2.2	1.26	0.02	0.9600	2.54	1.63	95		2.6	359	1.1		0.02	0.99	0.23	1.11	0.26	2.06	1.32
65	2.84	6.64	1.44	2.99	7.69	1.44	2.93	Clayey	2.09	1.45	1.68	11.42	2.00	2.84	5.17	59.08	0.10	0.96	0.17	0.13	0.19	0.7	2.2	1.25	0.02	0.9600	2.08	1.35	49		2.6	925	1.1		0.02	0.99	0.58	1.11	0.64	5.10	3.32
66	3.63	1.69	4.79	3.76	1.94	4.79	3.71	Clayey	2.03	1.42	1.64	4.24	2.00	3.63	16.54	70.09	0.11	0.96	0.17	0.13	0.19	0.7	2.2	1.24	0.02	0.9600	2.31	1.52	100		2.6	238	1.1		0.02	0.99	0.14	1.11	0.16	1.27	0.83
67	3.72	1.44	5.53	3.85	1.65	5.53	3.80	Clayey	1.97	1.40	1.61	3.87	2.00	3.72	18.57	71.79	0.11	0.96	0.17	0.13	0.19	0.7	2.2	1.22	0.02	0.9600	2.33	1.55	100		2.6	207	1.1		0.02	0.99	0.12	1.11	0.13	1.06	0.71
68	3.70	1.16	3.37	3.83	1.32	3.37	3.78	Clayey	1.91	1.38	1.57	3.47	2.00	3.70	18.11	62.80	0.10	0.96	0.16	0.13	0.19	0.7	2.2	1.21	0.02	0.9600	2.07	1.40	100		2.6	169	1.1		0.02	0.99	0.10	1.11	0.11	0.84	0.57
69	3.63	1.46	3.53	3.75	1.65	3.53	3.70	Clayey	1.86	1.36	1.54	3.86	2.00	3.63	16.63	64.16	0.10	0.96	0.16	0.13	0.19	0.7	2.2	1.20	0.02	0.9600	2.07	1.41	100		2.6	216	1.1		0.02	0.99	0.12	1.11	0.13	1.03	0.71
70	3.59	1.57	3.24	3.70	1.77	3.24	3.66	Clayey	1.81	1.34	1.51	4.00	2.00	3.59	15.80	63.11	0.10	0.96	0.16	0.13	0.19	0.7	2.2	1.19	0.02	0.9600	2.02	1.40	100		2.6	235	1.1		0.02	0.99	0.13	1.11	0.14	1.09	0.76
71	3.63	1.34	2.81	3.74	1.50	2.81	3.69	Clayey	1.76	1.33	1.48	3.67	2.00	3.63	16.54	60.68	0.10	0.96	0.16	0.13	0.18	0.7	2.2	1.18	0.02	0.9600	1.95	1.36	100		2.6	204	1.1		0.02	0.99	0.11	1.11	0.12	0.92	0.64
72	3.61	1.38	2.70	3.72	1.53	2.70	3.68	Clayey	1.71	1.31	1.46	3.71	2.00	3.61	16.26	60.28	0.10	0.95	0.16	0.13	0.18	0.7	2.2	1.18	0.02	0.9600	1.92	1.36	100		2.6	212	1.1		0.02	0.99	0.11	1.11	0.12	0.93	0.66
73	3.63	1.35	2.71	3.73	1.50	2.71	3.69	Clayey	1.67	1.29	1.43	3.66	2.00	3.63	16.54	60.49	0.10	0.95	0.15	0.13	0.18	0.7	2.2	1.17	0.02	0.9600	1.90	1.37	100		2.6	211	1.1		0.02	0.99	0.10	1.11	0.12	0.89	0.64
74	3.45	2.03	2.38	3.54	2.23	2.38	3.51	Clayey	1.63	1.28	1.41	4.51	2.00	3.45	13.18	59.42	0.10	0.95	0.15	0.13	0.18	0.7	2.2	1.16	0.02	0.9600	1.86	1.36	94		2.6	320	1.1		0.02	0.99	0.16	1.11	0.17	1.32	0.96
75	3.04	6.05	2.36	3.12	6.64	2.36	3.09	Clayey	1.59	1.26	1.38	9.56	2.00	3.04	7.18	68.68	0.11	0.95	0.15	0.13	0.18	0.7	2.2	1.15	0.02	0.9600	2.04	1.51	61		2.6	565	1.1		0.02	0.99	0.27	1.11	0.30	2.27	1.68
76	2.75	10.76	1.64	2.83	11.74	1.64	2.80	Clayey	1.55	1.24	1.36	15.33	2.00	2.75	4.36	66.74	0.11	0.95	0.15	0.13	0.18	0.7	2.2	1.14	0.02	0.9600	1.98	1.48	43		2.6	1017	1.1		0.02	0.99	0.47	1.11	0.52	3.98	2.98
77	2.84	8.48	1.64	2.92	9.21	1.64	2.89	Clayey	1.51	1.23	1.33	12.36	2.00	2.84	5.15	63.63	0.10	0.94	0.15	0.13	0.17	0.7	2.2	1.13	0.02	0.9600	1.90	1.44	48		2.6	812	1.1		0.02	0.99	0.37	1.11	0.41	3.10	2.35
78	2.81	8.96	1.54	2.88	9.68	1.54	2.85	Clayey	1.47	1.21	1.31	12.83	2.00	2.81	4.88	62.55	0.10	0.94	0.14	0.13	0.17	0.7	2.2	1.12	0.02	0.9600	1.86	1.43	47		2.6	868	1.1		0.02	0.99	0.38	1.11	0.42	3.23	2.48
79	2.82	8.80	1.55	2.89	9.46	1.55	2.86	Clayey	1.44	1.20	1.29	12.51	2.00	2.82	4.99	62.38	0.10	0.94	0.14	0.13	0.17	0.7	2.2	1.12	0.02	0.9600	1.84	1.44	47		2.6	862	1.1		0.02	0.99	0.37	1.11	0.41	3.13	2.44
80	2.85	8.23	1.50	2.91	8.82	1.50	2.88	Clayey	1.41	1.19	1.27	11.73	2.00	2.85	5.19	60.84	0.10	0.94	0.14	0.13	0.17	0.7	2.2	1.11	0.02	0.9600	1.80	1.42	49		2.6	816	1.1		0.02	0.99	0.34	1.11	0.38	2.90	2.29
81	2.86	8.29	1.60	2.92	8.83	1.60	2.90	Clayey	1.37	1.17	1.25	11.68	2.00	2.86	5.34	62.41	0.10	0.93	0.14	0.13	0.16	0.7	2.2	1.10	0.02	0.9600	1.82	1.46	50		2.6	831	1.1		0.02	0.99	0.34	1.11	0.38	2.88	2.32
82	2.97	7.35	2.09	3.02	7.80	2.09	3.00	Clayey	1.34	1.16	1.23	10.50	2.00	2.97	6.41	67.29	0.11	0.93	0.13	0.13	0.16	0.7	2.2	1.09	0.02	0.9600	1.91	1.55	56		2.6	745	1.1		0.02	0.99	0.30	1.11	0.33	2.53	2.06
83	3.18	3.84	1.69	3.23	4.06	1.69	3.21	Clayey	1.32	1.15	1.21	6.38	2.00	3.18	8.91	56.90	0.10	0.93	0.13	0.13	0.16	0.7	2.2	1.09	0.02	0.9600	1.70	1.41	71		2.6	394	1.1		0.02	0.99	0.15	1.11	0.17	1.31	1.08
84	3.24	3.47	1.86	3.29	3.65	1.86	3.27	Clayey	1.29	1.14	1.20	5.92	2.00	3.24	9.78	57.94	0.10	0.92	0.13	0.13	0.16	0.7	2.2	1.08	0.02	0.9600	1.71	1.43	76		2.6	358	1.1		0.02	0.99	0.14	1.11	0.15	1.17	0.98
85	3.27	3.50	2.13	3.31	3.67	2.13	3.29	Clayey	1.27	1.13	1.18	5.92	2.00	3.27	10.19	60.36	0.10	0.92	0.13	0.13	0.15	0.7	2.2	1.07	0.02	0.9600	1.74	1.48	78		2.6	365	1.1		0.02	0.99	0.14	1.11	0.15	1.17	1.00
86	3.02	5.31	1.39	3.06	5.55	1.39	3.05	Clayey	1.24	1.11	1.16	7.92	2.00	3.02	6.99	55.36	0.10	0.92	0.13	0.13	0.15	0.7	2.2	1.07	0.02	0.9600	1.65	1.43	60		2.6	560	1.1		0.02	0.99	0.21	1.11	0.23	1.76	1.53
87	2.89	8.52	1.71	2.93	8.87	1.71	2.91	Clayey	1.22	1.10	1.15	11.41	2.00	2.89	5.59	63.80	0.10	0.91	0.12	0.13	0.15	0.7	2.2	1.06	0.02	0.9600	1.79	1.57	51		2.6	907	1.1		0.02	0.99	0.33	1.11	0.37	2.80	2.47
88	1.88	124.67	1.27	1.91	129.17	1.27	1.90	Granular	1.19	1.09	1.13	126.50	17.00	1.91	1.20	151.30	0.40	0.91	0.12	0.13	0.15	0.7	2.2	1.05	0.02	1.0175	7.29	6.52	11		2.6	13413	1.1		0.02	0.99	4.77	1.11	5.30	40.71	36.41
89	2.56	45.02	4.13	2.58	46.45	4.13	2.57	Granular	1.17	1.08	1.12	46.87	2.00	2.58	3.22	151.11	0.40	0.91	0.12	0.13	0.14	0.7	2.2	1.05	0.02	0.9600	6.83	6.21	35		2.6	4894	1.1		0.02	0.99	1.71	1.11	1.90	14.60	13.27
90	2.76	21.12	3.55	2.78	21.71	3.55	2.77	Clayey	1.15	1.07	1.10	24.64	2.00	2.76	4.44	109.40	0.20	0.90	0.12	0.13	0.14	0.7	2.2	1.04	0.02	0.9600	3.43	3.17	44		2.6	2317	1.1		0.02	0.99	0.79	1.11	0.88	6.80	6.29
91	2.39	30.45	1.38	2.41	31.18	1.38	2.40	Granular	1.13	1.06	1.09	32.34	2.00	2.41	2.35	75.86	0.12	0.90	0.12	0.13	0.14	0.7	2.2	1.04	0.02	0.9600	2.04	1.92	27		2.6	3371	1.1		0.02	0.99	1.13	1.11	1.26	9.74	9.16
92	2.65	27.59	3.24	2.67	28.15	3.24	2.66	Clayey	1.11	1.05	1.07	31.01	2.00	2.65	3.65	113.24	0.22	0.89	0.12	0.13	0.13	0.7	2.2	1.03	0.02	0.9600	3.64	3.48	38		2.6	3085	1.1		0.02	0.99	1.02	1.11	1.13	8.78	8.40
93	2.73	28.15	4.34	2.74	28.62	4.34	2.74	Clayey	1.09	1.04	1.06	31.36	2.00	2.73	4.23	132.64	0.30	0.89	0.11	0.13	0.13	0.7	2.2	1.03	0.02	0.9600	5.01	4.88	42		2.6	3175	1.1		0.02	0.99	1.03	1.11	1.14	8.91	8.67
94	2.65	30.45	3.59	2.66	30.85	3.59	2.66	Clayey	1.07	1.03	1.05	33.48	2.00	2.65	3.67	122.89	0.25	0.89	0.11	0.13	0.13	0.7	2.2	1.02	0.02	0.9600	4.26	4.22	38		2.6	3465	1.1		0.02	0.99	1.10	1.11	1.23	9.59	9.50
95	2.61	36.07	3.65	2.61	36.43	3.65	2.61	Clayey	1.05	1.02	1.03	38.98	2.00	2.61	3.37	131.32	0.29	0.88	0.11	0.13	0.13	0.7	2.2	1.01	0.02	0.9600	4.89	4.94	36		2.6	4139	1.1		0.02	0.99	1.30	1.11	1.44	11.31	11.41

CPTU-603 Liquefaction Analysis

ConeTec Inc. - CPT Interpretation				
Interpretation Output - Release	1.22 Rev. A - Format:	NLI	Imperial	
Run No:	06-0718-0954-3333			
Job No:	02-100			
Client:	MACTEC Engineering and Consulting Inc.			
Project:	Former Callahan Mine Site, Brooksville, ME			
Site:	CP-603			
Location:	Callahan Mine			
Cone:	20 Ton AD179			
CPT Date:	06/27/06			
CPT Time:	12:41			
CPT File:	758CP603.COR			
Northing (m):	0			
Easting (m):	0			
Elevation (m):	0		70.8	Elevation For CPT Triggering analysis
Water Table (m):	3.57	(ft): 11.7	11.8	Water Table assumed for CPT Analysis
Unit Weight of Water (default):	62.4 pcf			
Averaging Increment (m):	0.2			
Phi Method :	Robertson and Campanella, 1983			
Su Nkt used:	15	Su/P' (nc): 0.3	0.11	Base acceleration
Dr Method :	Jamiolkowski - All Sands			
State Parameter M:	1.2			
Used Unit Weights Assigned to Soil Zones				
N160Ic Calculated using qc1n				

1) CSR $= 0.65*(a_{max}/g)*(s_v/s'_v)*r_d$ Seed & Idriss, 1983, p. 459

$a_{max}/g =$ 0.11 g USGS (base) (amplified from base as discussed in

$s_v =$ computed Total Vertical Stress

$s'_v =$ computed Effective Vertical Stress

$r_d = [1.0 - 0.4113z^{0.5} + 0.04052z + 0.001753z^{1.5}] / [1 - 0.4177z^{0.5} + 0.05729z - 0.$

z = depth in meters

2) FS = Factor of safety against triggering of liquefaction: $FS = (CRR_{7.5}/CSR) \times MSF \times Ks \times Ka$

MSF = magnitude scaling factor; Assume based on range recommended by NCEER Wo

CPTU-603 Liquefaction Analysis

$Ks = (s'_{vo}/P_a)^{(f-1)}$, where f = 0.7 to 0.8 for relative density of 40 to 60%; f = 0.6 to 0.7 fo

1 Atmosphere = 14.7 psi = 2.12 ksf

Conetec Data

Row	Col-01 Depth (m)	Col-02 Depth (ft)	Col-03 Elev. (m)	Col-04 Elev. (ft)	Col-05 qc (tsf)	Col-06 qt (tsf)	Col-07 fs (tsf)	Col-08 Rf (%)	Col-09 u (ft)	Col-10 SBT (Zone)	Col-11 SBTn (Zone)
40	0.1	0.328	-0.1	70.5	4.63	4.62	0.01	0.27	-1.78	1	7
41	0.3	0.984	-0.3	69.8	4.19	4.19	0.06	1.38	0.6	1	5
42	0.5	1.64	-0.5	69.2	2.75	2.81	0.02	0.8	13.6	1	5
43	0.7	2.297	-0.7	68.5	3.69	3.7	0.02	0.61	2.04	1	5
44	0.9	2.953	-0.9	67.8	4.31	4.37	0.02	0.34	12.62	1	5
45	1.1	3.609	-1.1	67.2	7.57	7.56	0.03	0.36	-2.03	1	6
46	1.3	4.265	-1.3	66.5	4.07	4.09	0.04	0.86	3.17	1	5
47	1.5	4.921	-1.5	65.9	2.37	2.45	0.01	0.51	18.99	1	4
48	1.7	5.577	-1.7	65.2	1.75	1.87	0.01	0.53	25.69	1	4
49	1.9	6.234	-1.9	64.6	1.58	1.71	0.01	0.59	27.86	1	1
50	2.1	6.89	-2.1	63.9	1.47	1.6	0.01	0.63	27.91	1	1
51	2.3	7.546	-2.3	63.3	1.45	1.6	0.01	0.63	31.89	1	1
52	2.5	8.202	-2.5	62.6	1.24	1.4	0.01	0.72	33.04	1	1
53	2.7	8.858	-2.7	61.9	1.56	1.71	0.01	0.59	30.72	1	1
54	2.9	9.514	-2.9	61.3	1.32	1.48	0.01	0.68	33.85	1	1
55	3.1	10.17	-3.1	60.6	1.4	1.57	0.02	1.28	35.61	1	3
56	3.3	10.827	-3.3	60.0	1.63	1.8	0.02	1.11	36.23	1	3
57	3.5	11.483	-3.5	59.3	1.2	1.4	0.02	1.43	43.64	1	2
58	3.7	12.139	-3.7	58.7	1.26	1.48	0.02	1.36	46.06	1	2
59	3.9	12.795	-3.9	58.0	1.2	1.4	0.02	1.43	43.43	1	2
60	4.1	13.451	-4.1	57.3	1.39	1.61	0.02	1.4	47.35	1	2
61	4.3	14.107	-4.3	56.7	1.6	1.83	0.03	1.51	49.19	1	3
62	4.5	14.764	-4.5	56.0	1.84	2.08	0.03	1.2	52.67	1	3
63	4.7	15.42	-4.7	55.4	1.88	2.15	0.03	1.28	56.37	1	3
64	4.9	16.076	-4.9	54.7	3.31	3.49	0.06	1.72	38.56	1	3
65	5.1	16.732	-5.1	54.1	2.25	2.53	0.04	1.49	58.35	1	3
66	5.3	17.388	-5.3	53.4	2.35	2.63	0.04	1.33	59.91	1	3
67	5.5	18.044	-5.5	52.8	2.92	3.18	0.04	1.26	54.37	1	3
68	5.7	18.701	-5.7	52.1	2.43	2.74	0.03	1.19	66.79	1	3
69	5.9	19.357	-5.9	51.4	2.59	2.89	0.03	1.04	65.51	1	3
70	6.1	20.013	-6.1	50.8	2.83	3.15	0.03	0.95	68.79	1	3
71	6.3	20.669	-6.3	50.1	4.89	5.21	0.04	0.82	67.76	1	3
72	6.5	21.325	-6.5	49.5	6.53	6.71	0.14	2.02	38.71	4	3
73	6.7	21.981	-6.7	48.8	2.99	3.33	0.04	1.05	72.58	1	3
74	6.9	22.638	-6.9	48.2	3.26	3.6	0.04	1.04	74.11	1	3
75	7.1	23.294	-7.1	47.5	3.67	3.99	0.05	1.13	68.3	1	3
76	7.3	23.95	-7.3	46.9	3.23	3.58	0.04	0.98	76.22	1	3
77	7.5	24.606	-7.5	46.2	3.05	3.41	0.05	1.32	77.84	1	3
78	7.7	25.262	-7.7	45.5	3.35	3.61	0.06	1.74	54.16	1	3
79	7.9	25.918	-7.9	44.9	3.24	3.59	0.03	0.84	75.37	1	3
80	8.1	26.574	-8.1	44.2	3.59	3.99	0.03	0.75	85.88	1	3
81	8.3	27.231	-8.3	43.6	6.59	6.85	0.14	2.05	55.4	4	3
82	8.5	27.887	-8.5	42.9	3.74	4.16	0.04	1.02	90.83	1	3
83	8.7	28.543	-8.7	42.3	3.77	4.19	0.03	0.78	89.7	1	3
84	8.9	29.199	-8.9	41.6	3.7	4.13	0.03	0.79	90.77	1	3
85	9.1	29.855	-9.1	40.9	3.55	4	0.02	0.5	95.98	1	1
86	9.3	30.511	-9.3	40.3	3.75	4.22	0.02	0.53	100.35	1	1
87	9.5	31.168	-9.5	39.6	4.09	4.55	0.04	0.77	99.38	1	3
88	9.7	31.824	-9.7	39.0	4.35	4.78	0.04	0.84	91.93	1	3
89	9.9	32.48	-9.9	38.3	4.25	4.73	0.04	0.9	102.87	1	3
90	10.1	33.136	-10.1	37.7	4.33	4.79	0.03	0.68	99.72	1	1
91	10.3	33.792	-10.3	37.0	4.34	4.83	0.03	0.67	103.4	1	1
92	10.5	34.448	-10.5	36.4	4.34	4.89	0.03	0.62	116.33	1	1
93	10.7	35.105	-10.7	35.7	6.31	6.79	0.05	0.7	102.07	1	3
94	10.9	35.761	-10.9	35.0	11.98	12.61	0.15	1.21	134.69	6	4
95	11.1	36.417	-11.1	34.4	24.11	25.22	0.4	1.59	236.49	6	4
96	11.3	37.073	-11.3	33.7	20.57	21.65	0.38	1.75	232.18	6	4
97	11.5	37.729	-11.5	33.1	16.34	17.44	0.29	1.67	235.41	6	4
98	11.7	38.385	-11.7	32.4	16.62	17.84	0.25	1.4	260.62	6	4
99	11.9	39.042	-11.9	31.8	17.34	18.76	0.23	1.23	302.51	6	4
100	12.1	39.698	-12.1	31.1	18.38	19.83	0.24	1.21	310.08	6	4
101	12.3	40.354	-12.3	30.4	22.49	23.59	0.42	1.78	234.84	6	4

Row	Col-12 SBT-BQ (Zone)	Col-13 SBT-BQn (Zone)	Col-14 Perm-k (cm/s)	Col-15 Unit Wt (pcf)	Col-16 T Stress (tsf)	Col-17 U Stress (tsf)	Col-18 E Stress (tsf)	Col-19 Cn	Col-20 N60 (b/ft)	Col-21 N1(60) (b/ft)	Col-22 N(60)Ic (b/ft)	Col-23 N1(60)Ic (b/ft)
40	4	7	1.00E-07	111.4	0.018	0	0.018	1.7	2.2	3.8	1.2	2.1
41	4	6	1.00E-07	111.4	0.055	0	0.055	1.7	2	3.4	1.3	2.3
42	3	5	1.00E-07	111.4	0.091	0	0.091	1.7	1.3	2.3	0.9	1.6
43	4	5	1.00E-07	111.4	0.128	0	0.128	1.7	1.8	3	1.1	1.9
44	3	5	1.00E-07	111.4	0.164	0	0.164	1.7	2.1	3.6	1.2	2.1
45	5	6	1.00E-07	111.4	0.201	0	0.201	1.7	3.6	6.2	1.9	3.2
46	4	5	1.00E-07	111.4	0.238	0	0.238	1.7	2	3.3	1.2	2.1
47	3	3	1.00E-07	111.4	0.274	0	0.274	1.7	1.2	2	0.7	2.3
48	2	3	1.00E-07	111.4	0.311	0	0.311	1.7	0.9	1.5	0.6	1.7
49	3	3	1.00E-07	111.4	0.347	0	0.347	1.7	0.8	1.4	-9999	-9999
50	3	3	1.00E-07	111.4	0.384	0	0.384	1.61	0.8	1.2	-9999	-9999
51	3	3	1.00E-07	111.4	0.42	0	0.42	1.54	0.8	1.2	-9999	-9999
52	1	1	1.00E-07	111.4	0.457	0	0.457	1.48	0.7	1	-9999	-9999
53	3	3	1.00E-07	111.4	0.493	0	0.493	1.42	0.8	1.2	-9999	-9999
54	1	1	1.00E-07	111.4	0.53	0	0.53	1.37	0.7	1	-9999	-9999
55	1	1	1.00E-07	111.4	0.566	0	0.566	1.33	0.8	1	0.8	0.9
56	1	3	1.00E-07	111.4	0.603	0	0.603	1.29	0.9	1.1	0.8	1
57	-9999	-9999	1.00E-07	111.4	0.64	0	0.64	1.25	0.7	0.8	0.9	0.8
58	-9999	-9999	1.00E-07	111.4	0.676	0.014	0.662	1.23	0.7	0.9	0.9	0.8
59	-9999	-9999	1.00E-07	111.4	0.713	0.034	0.678	1.21	0.7	0.8	1	0.7
60	-9999	-9999	1.00E-07	111.4	0.749	0.055	0.695	1.2	0.8	0.9	1	0.8
61	1	1	1.00E-07	111.4	0.786	0.075	0.711	1.19	0.9	1	1	0.9
62	1	1	1.00E-07	111.4	0.822	0.096	0.727	1.17	1	1.2	1	0.9
63	1	1	1.00E-07	111.4	0.859	0.116	0.743	1.16	1	1.2	1.1	0.9
64	3	3	1.00E-07	111.4	0.895	0.137	0.759	1.15	1.7	1.9	1.4	1.5
65	1	1	1.00E-07	111.4	0.932	0.157	0.775	1.14	1.2	1.4	1.2	1
66	1	1	1.00E-07	111.4	0.968	0.178	0.791	1.12	1.3	1.4	1.2	1
67	3	3	1.00E-07	111.4	1.005	0.198	0.807	1.11	1.5	1.7	1.4	1.2
68	1	1	1.00E-07	111.4	1.042	0.219	0.823	1.1	1.3	1.4	1.3	1
69	3	3	1.00E-07	111.4	1.078	0.239	0.839	1.09	1.4	1.5	1.3	1
70	3	3	1.00E-07	111.4	1.115	0.26	0.855	1.08	1.5	1.6	1.4	1.1
71	3	3	1.00E-07	111.4	1.151	0.28	0.871	1.07	2.5	2.7	1.8	1.6
72	4	3	5.00E-07	114.6	1.188	0.301	0.888	1.06	4.3	4.5	2.4	2.3
73	3	3	1.00E-07	111.4	1.225	0.321	0.904	1.05	1.6	1.7	1.5	1.1
74	3	3	1.00E-07	111.4	1.262	0.342	0.92	1.04	1.7	1.8	1.5	1.1
75	3	3	1.00E-07	111.4	1.298	0.362	0.936	1.03	1.9	2	1.6	1.2
76	3	3	1.00E-07	111.4	1.335	0.382	0.953	1.02	1.7	1.8	1.6	1.1
77	3	1	1.00E-07	111.4	1.372	0.403	0.969	1.02	1.6	1.7	1.6	1.1
78	3	2	1.00E-07	111.4	1.408	0.423	0.985	1.01	1.7	1.7	1.8	1.1
79	3	3	1.00E-07	111.4	1.445	0.444	1.001	1	1.7	1.7	1.6	1
80	3	3	1.00E-07	111.4	1.481	0.464	1.017	0.99	1.9	1.9	1.6	1.1
81	3	3	5.00E-07	114.6	1.518	0.485	1.033	0.98	4.4	4.3	2.6	2
82	3	3	1.00E-07	111.4	1.555	0.505	1.05	0.98	2	1.9	1.8	1.1
83	3	3	1.00E-07	111.4	1.592	0.526	1.066	0.97	2	1.9	1.7	1.1
84	3	3	1.00E-07	111.4	1.628	0.546	1.082	0.96	2	1.9	1.8	1
85	3	1	1.00E-07	111.4	1.665	0.567	1.098	0.95	1.9	1.8	-9999	-9999
86	3	1	1.00E-07	111.4	1.702	0.587	1.114	0.95	2	1.9	-9999	-9999
87	3	3	1.00E-07	111.4	1.738	0.608	1.13	0.94	2.2	2.1	1.9	1.1
88	3	3	1.00E-07	111.4	1.775	0.628	1.146	0.93	2.3	2.1	2	1.1
89	3	3	1.00E-07	111.4	1.811	0.649	1.162	0.93	2.3	2.1	2	1.1
90	3	3	1.00E-07	111.4	1.848	0.669	1.178	0.92	2.3	2.1	-9999	-9999
91	3	3	1.00E-07	111.4	1.884	0.69	1.194	0.92	2.3	2.1	-9999	-9999
92	3	3	1.00E-07	111.4	1.921	0.71	1.211	0.91	2.3	2.1	-9999	-9999
93	3	3	1.00E-07	111.4	1.957	0.731	1.227	0.9	3.2	2.9	2.4	1.4
94	4	3	5.00E-05	114.6	1.994	0.751	1.243	0.9	4.8	4.3	3.8	2.7
95	5	4	5.00E-05	114.6	2.032	0.772	1.26	0.89	9.7	8.6	6.7	5.1
96	4	3	5.00E-05	114.6	2.07	0.792	1.277	0.88	8.3	7.3	6	4.5
97	4	3	5.00E-05	114.6	2.107	0.813	1.294	0.88	6.7	5.9	5.1	3.6
98	4	3	5.00E-05	114.6	2.145	0.833	1.312	0.87	6.8	6	5.1	3.6
99	4	3	5.00E-05	114.6	2.182	0.854	1.329	0.87	7.2	6.2	5.2	3.6
100	4	3	5.00E-05	114.6	2.22	0.874	1.346	0.86	7.6	6.6	5.5	3.8
101	4	4	5.00E-05	114.6	2.258	0.895	1.363	0.86	9	7.7	6.6	4.5

Row	Col-24 Qt	Col-25 Fr (%)	Col-26 Bq	Col-27 Ic	Col-28 FC (%)	Col-29 IcZone (Zone)	Col-30 Dr (%)	Col-31 Phi (deg)	Col-32 State Par	Col-33 Es/qt	Col-34 YoungE (tsf)	Col-35 Su (tsf)
40	251.98	0.27	-0.01	2.67	39.1	4	-9999	-9999	-9999	-9999	-9999	0.307
41	75.39	1.39	0	2.97	56.4	3	-9999	-9999	-9999	-9999	-9999	0.276
42	29.76	0.83	0.16	3.03	60.6	3	-9999	-9999	-9999	-9999	-9999	0.181
43	27.91	0.63	0.02	2.88	50.6	4	-9999	-9999	-9999	-9999	-9999	0.238
44	25.57	0.36	0.09	2.73	42.1	4	-9999	-9999	-9999	-9999	-9999	0.28
45	36.62	0.37	-0.01	2.51	31.1	5	-9999	-9999	-9999	-9999	-9999	0.491
46	16.21	0.91	0.03	2.9	51.9	4	-9999	-9999	-9999	-9999	-9999	0.257
47	7.96	0.57	0.27	2.75	43.1	4	-9999	-9999	-9999	-9999	-9999	0.145
48	5.03	0.64	0.51	2.95	55.3	3	-9999	-9999	-9999	-9999	-9999	0.104
49	3.93	0.73	0.64	-9999	-9999	0	-9999	-9999	-9999	-9999	-9999	0.091
50	3.17	0.82	0.72	-9999	-9999	0	-9999	-9999	-9999	-9999	-9999	0.081
51	2.81	0.85	0.84	-9999	-9999	0	-9999	-9999	-9999	-9999	-9999	0.079
52	2.06	1.07	1.1	-9999	-9999	0	-9999	-9999	-9999	-9999	-9999	0.063
53	2.46	0.83	0.79	-9999	-9999	0	-9999	-9999	-9999	-9999	-9999	0.081
54	1.8	1.05	1.11	-9999	-9999	0	-9999	-9999	-9999	-9999	-9999	0.063
55	1.77	2	1.11	3.56	100	3	-9999	-9999	-9999	-9999	-9999	0.067
56	1.98	1.68	0.95	3.49	97.6	3	-9999	-9999	-9999	-9999	-9999	0.08
57	1.19	2.63	1.79	3.77	100	2	-9999	-9999	-9999	-9999	-9999	0.051
58	1.21	2.51	1.78	3.75	100	2	-9999	-9999	-9999	-9999	-9999	0.053
59	1.02	2.9	1.91	3.85	100	2	-9999	-9999	-9999	-9999	-9999	0.046
60	1.24	2.62	1.65	3.75	100	2	-9999	-9999	-9999	-9999	-9999	0.057
61	1.47	2.64	1.4	3.69	100	2	-9999	-9999	-9999	-9999	-9999	0.07
62	1.74	1.99	1.23	3.57	100	3	-9999	-9999	-9999	-9999	-9999	0.084
63	1.74	2.14	1.27	3.58	100	3	-9999	-9999	-9999	-9999	-9999	0.086
64	3.42	2.32	0.41	3.34	84.2	3	-9999	-9999	-9999	-9999	-9999	0.173
65	2.06	2.36	1.04	3.54	100	3	-9999	-9999	-9999	-9999	-9999	0.106
66	2.1	2.11	1.02	3.51	100	3	-9999	-9999	-9999	-9999	-9999	0.111
67	2.69	1.85	0.69	3.38	88.3	3	-9999	-9999	-9999	-9999	-9999	0.145
68	2.07	1.92	1.1	3.49	98.4	3	-9999	-9999	-9999	-9999	-9999	0.113
69	2.16	1.66	0.99	3.45	94.2	3	-9999	-9999	-9999	-9999	-9999	0.121
70	2.38	1.48	0.93	3.39	88.9	3	-9999	-9999	-9999	-9999	-9999	0.136
71	4.66	1.05	0.45	3.06	63	3	-9999	-9999	-9999	-9999	-9999	0.27
72	6.22	2.45	0.16	3.12	67.1	3	-9999	-9999	-9999	-9999	-9999	0.368
73	2.32	1.67	0.93	3.42	91.7	3	-9999	-9999	-9999	-9999	-9999	0.14
74	2.55	1.6	0.84	3.38	87.9	3	-9999	-9999	-9999	-9999	-9999	0.156
75	2.88	1.68	0.66	3.34	84.4	3	-9999	-9999	-9999	-9999	-9999	0.18
76	2.36	1.56	0.89	3.4	90.1	3	-9999	-9999	-9999	-9999	-9999	0.15
77	2.11	2.21	0.99	3.51	100	3	-9999	-9999	-9999	-9999	-9999	0.136
78	2.23	2.85	0.58	3.54	100	3	-9999	-9999	-9999	-9999	-9999	0.147
79	2.15	1.4	0.89	3.42	91.7	3	-9999	-9999	-9999	-9999	-9999	0.143
80	2.47	1.2	0.88	3.34	84.4	3	-9999	-9999	-9999	-9999	-9999	0.167
81	5.16	2.63	0.23	3.21	73.6	3	-9999	-9999	-9999	-9999	-9999	0.356
82	2.48	1.63	0.89	3.39	89.1	3	-9999	-9999	-9999	-9999	-9999	0.174
83	2.43	1.26	0.88	3.35	85.6	3	-9999	-9999	-9999	-9999	-9999	0.173
84	2.31	1.3	0.92	3.38	88.1	3	-9999	-9999	-9999	-9999	-9999	0.167
85	2.12	0.86	1.04	-9999	-9999	0	-9999	-9999	-9999	-9999	-9999	0.155
86	2.26	0.9	1.01	-9999	-9999	0	-9999	-9999	-9999	-9999	-9999	0.168
87	2.49	1.25	0.89	3.34	84.7	3	-9999	-9999	-9999	-9999	-9999	0.188
88	2.62	1.34	0.75	3.34	84.1	3	-9999	-9999	-9999	-9999	-9999	0.2
89	2.51	1.46	0.88	3.37	86.8	3	-9999	-9999	-9999	-9999	-9999	0.195
90	2.5	1.11	0.83	-9999	-9999	0	-9999	-9999	-9999	-9999	-9999	0.196
91	2.46	1.11	0.86	-9999	-9999	0	-9999	-9999	-9999	-9999	-9999	0.196
92	2.45	1.01	0.99	-9999	-9999	0	-9999	-9999	-9999	-9999	-9999	0.198
93	3.94	0.99	0.51	3.12	67	3	-9999	-9999	-9999	-9999	-9999	0.322
94	8.54	1.44	0.33	2.89	51.3	4	30	30	0.06	-9999	-9999	0.708
95	18.4	1.73	0.29	2.64	37.5	4	30	32	-0.03	-9999	-9999	1.546
96	15.33	1.93	0.33	2.74	42.4	4	30	32	-0.02	-9999	-9999	1.306
97	11.84	1.9	0.43	2.83	47.5	4	30	30	0.03	-9999	-9999	1.022
98	11.97	1.6	0.47	2.78	45	4	30	30	0.05	-9999	-9999	1.047
99	12.48	1.39	0.52	2.74	42.5	4	30	30	0.06	-9999	-9999	1.105
100	13.09	1.37	0.5	2.72	41.3	4	30	32	0.05	-9999	-9999	1.174
101	15.65	1.97	0.3	2.73	42.3	4	30	32	-0.02	-9999	-9999	1.422

Row	Col-36 OCR	Col-37 U (psf)	Col-38 s_{vo} (psf)	Col-39 q_c (psf)	Col-40 q_t (psf)	Col-41 P_a (psf)	Col-42 σ'_{vo} (psf)	Col-43 f_s (psf)	Col-44 $Q_{exp=1}$	Col-45 F
40	10	0	36	9260	9240	2116	36	20	255.67	0.22
41	10	0	110	8380	8380	2116	110	120	75.18	1.45
42	10	0	182	5500	5620	2116	182	40	29.88	0.74
43	10	0	256	7380	7400	2116	256	40	27.91	0.56
44	10	0	328	8620	8740	2116	328	40	25.65	0.48
45	10	0	402	15140	15120	2116	402	60	36.61	0.41
46	5.1	0	476	8140	8180	2116	476	80	16.18	1.04
47	1.9	0	548	4740	4900	2116	548	20	7.94	0.46
48	1.1	0	622	3500	3740	2116	622	20	5.01	0.64
49	0.9	0	694	3160	3420	2116	694	20	3.93	0.73
50	0.8	0	768	2940	3200	2116	768	20	3.17	0.82
51	0.7	0	840	2900	3200	2116	840	20	2.81	0.85
52	0.6	0	914	2480	2800	2116	914	20	2.06	1.06
53	0.7	0	986	3120	3420	2116	986	20	2.47	0.82
54	0.6	0	1060	2640	2960	2116	1060	20	1.79	1.05
55	0.6	0	1132	2800	3140	2116	1132	40	1.77	1.99
56	0.6	0	1206	3260	3600	2116	1206	40	1.99	1.67
57	0.5	0	1280	2400	2800	2116	1280	40	1.19	2.63
58	0.5	21	1352	2520	2960	2116	1331	40	1.21	2.49
59	0.5	62	1426	2400	2800	2116	1364	40	1.01	2.91
60	0.5	103	1498	2780	3220	2116	1395	40	1.23	2.32
61	0.5	144	1572	3200	3660	2116	1428	60	1.46	2.87
62	0.6	185	1644	3680	4160	2116	1459	60	1.72	2.38
63	0.6	226	1718	3760	4300	2116	1492	60	1.73	2.32
64	0.8	267	1790	6620	6980	2116	1523	120	3.41	2.31
65	0.6	308	1864	4500	5060	2116	1556	80	2.05	2.50
66	0.6	349	1936	4700	5260	2116	1587	80	2.09	2.41
67	0.7	390	2010	5840	6360	2116	1620	80	2.68	1.84
68	0.6	431	2084	4860	5480	2116	1653	60	2.05	1.77
69	0.6	472	2156	5180	5780	2116	1684	60	2.15	1.66
70	0.6	512	2230	5660	6300	2116	1718	60	2.37	1.47
71	1	553	2302	9780	10420	2116	1749	80	4.64	0.99
72	1.4	594	2376	13060	13420	2116	1782	280	6.20	2.54
73	0.6	635	2450	5980	6660	2116	1815	80	2.32	1.90
74	0.7	676	2524	6520	7200	2116	1848	80	2.53	1.71
75	0.7	717	2596	7340	7980	2116	1879	100	2.87	1.86
76	0.6	758	2670	6460	7160	2116	1912	80	2.35	1.78
77	0.6	799	2744	6100	6820	2116	1945	100	2.10	2.45
78	0.6	840	2816	6700	7220	2116	1976	120	2.23	2.72
79	0.6	881	2890	6480	7180	2116	2009	60	2.14	1.40
80	0.7	922	2962	7180	7980	2116	2040	60	2.46	1.20
81	1.1	963	3036	13180	13700	2116	2073	280	5.14	2.63
82	0.7	1004	3110	7480	8320	2116	2106	80	2.47	1.54
83	0.6	1045	3184	7540	8380	2116	2139	60	2.43	1.15
84	0.6	1086	3256	7400	8260	2116	2170	60	2.31	1.20
85	0.6	1127	3330	7100	8000	2116	2203	40	2.12	0.86
86	0.6	1168	3404	7500	8440	2116	2236	40	2.25	0.79
87	0.7	1209	3476	8180	9100	2116	2267	80	2.48	1.42
88	0.7	1249	3550	8700	9560	2116	2301	80	2.61	1.33
89	0.7	1290	3622	8500	9460	2116	2332	80	2.50	1.37
90	0.7	1331	3696	8660	9580	2116	2365	60	2.49	1.02
91	0.7	1372	3768	8680	9660	2116	2396	60	2.46	1.02
92	0.6	1413	3842	8680	9780	2116	2429	60	2.44	1.01
93	0.9	1454	3914	12620	13580	2116	2460	100	3.93	1.03
94	2.1	1495	3988	23960	25220	2116	2493	300	8.52	1.41
95	6.2	1536	4064	48220	50440	2116	2528	800	18.35	1.73
96	4.7	1577	4140	41140	43300	2116	2563	760	15.28	1.94
97	3.2	1618	4214	32680	34880	2116	2596	580	11.81	1.89
98	3.3	1659	4290	33240	35680	2116	2631	500	11.93	1.59
99	3.5	1700	4364	34680	37520	2116	2664	460	12.45	1.39
100	3.7	1741	4440	36760	39660	2116	2699	480	13.05	1.36
101	4.9	1782	4516	44980	47180	2116	2734	840	15.60	1.97

CPTU-603 Liquefaction Analysis

ext

]06205z^{1.5} + 0.001210z^2]

Youd and Idriss, 2001

rkshop, reiterated in Youd and Idriss, 2001

CPTU-603 Liquefaction Analysis

rel density of 60 to 80%; P_a = pressure at 1 atmosphere   Youd and Idriss, 2001

Row	AT	AU	AV	AW	AX	AY	AZ	BA	BB	BC	BD	BE	BF	BG	BH	BI	BJ	BK	BL	BM	BN
34	Col-46	Col-47	Col-48	Col-49	Col-50	Col-51	Col-52	Col-53	Col-54	Col-55	Col-56	Col-57	Col-57a	Col-58	Col-59	Col-60	Col-61	Col-62	Col-63	Col-64	Col-65
35	Youd & Idriss, 2001 CPT Based Analysis																				
36																					Rel. Den. Factor
37	$I_{c\,Qexp=1}$	$Q_{exp=0.5}$	F	$I_{c\,Qexp=0.5}$	$Q_{exp=0.7}$	F	$I_{c\,Qexp=0.7}$	Description	C_q			q_{c1N}	Lookup	Ic	Kc	$(q_{c1N})_{cs}$	CRR7.5	rd	a_{max}/g =	CSR	
38									n=1.0	n=0.5	n=0.7		Col						if crest accel	No	crest accel =
39																			2.0	Amplification	2
40	1.20	33.35	0.22	2.03	75.32	0.22	1.69	Granular	58.78	7.67	17.32	33.48	2.00	2.03	1.33	44.66	0.08	1.00	0.22	0.07	0.14
41	2.11	17.14	1.45	2.63	30.97	1.45	2.41	Very Silty	19.24	4.39	7.92	31.38	2.00	2.41	2.37	74.34	0.12	1.00	0.22	0.07	0.14
42	2.27	8.76	0.74	2.75	14.31	0.74	2.56	Very Silty	11.63	3.41	5.57	14.79	2.00	2.56	3.07	45.44	0.08	1.00	0.22	0.07	0.14
43	2.24	9.71	0.56	2.67	14.81	0.56	2.49	Very Silty	8.27	2.88	4.39	15.34	2.00	2.49	2.74	42.08	0.08	1.00	0.21	0.07	0.14
44	2.25	10.10	0.48	2.62	14.66	0.48	2.47	Very Silty	6.45	2.54	3.69	15.23	2.00	2.47	2.63	40.10	0.08	1.00	0.21	0.07	0.14
45	2.08	15.96	0.41	2.41	22.25	0.41	2.28	Granular	5.26	2.29	3.20	16.39	2.00	2.41	2.37	38.88	0.07	0.99	0.21	0.07	0.14
46	2.58	7.68	1.04	2.87	10.35	1.04	2.75	Very Silty	4.45	2.11	2.84	10.98	2.00	2.75	4.37	47.97	0.08	0.99	0.21	0.07	0.13
47	2.72	4.04	0.46	3.00	5.30	0.46	2.88	Clayey	3.86	1.97	2.57	8.94	2.00	2.72	4.12	36.87	0.07	0.99	0.21	0.07	0.13
48	2.95	2.72	0.64	3.20	3.47	0.64	3.10	Clayey	3.40	1.84	2.36	6.01	2.00	2.95	6.25	37.57	0.07	0.99	0.20	0.07	0.13
49	3.07	2.25	0.73	3.30	2.81	0.73	3.21	Clayey	3.05	1.75	2.18	4.93	2.00	3.07	7.60	37.47	0.07	0.99	0.20	0.07	0.13
50	3.18	1.91	0.82	3.39	2.34	0.82	3.30	Clayey	2.76	1.66	2.03	4.17	2.00	3.18	8.96	37.33	0.07	0.99	0.20	0.07	0.13
51	3.23	1.77	0.85	3.42	2.13	0.85	3.34	Clayey	2.52	1.59	1.91	3.81	2.00	3.23	9.71	36.97	0.07	0.98	0.20	0.07	0.13
52	3.39	1.36	1.06	3.56	1.60	1.06	3.49	Clayey	2.32	1.52	1.80	3.06	2.00	3.39	12.20	37.37	0.07	0.98	0.20	0.07	0.13
53	3.28	1.69	0.82	3.44	1.96	0.82	3.37	Clayey	2.15	1.46	1.71	3.47	2.00	3.28	10.41	36.12	0.07	0.98	0.20	0.07	0.12
54	3.45	1.27	1.05	3.59	1.46	1.05	3.53	Clayey	2.00	1.41	1.62	2.79	2.00	3.45	13.16	36.74	0.07	0.98	0.19	0.07	0.12
55	3.56	1.30	1.99	3.68	1.47	1.99	3.64	Clayey	1.87	1.37	1.55	2.77	2.00	3.56	15.24	42.28	0.08	0.98	0.19	0.07	0.12
56	3.48	1.50	1.67	3.60	1.68	1.67	3.55	Clayey	1.75	1.32	1.48	2.99	2.00	3.48	13.81	41.24	0.08	0.98	0.19	0.07	0.12
57	3.77	0.92	2.63	3.87	1.02	2.63	3.83	Clayey	1.65	1.29	1.42	2.19	2.00	3.77	19.59	42.84	0.08	0.98	0.19	0.07	0.12
58	3.75	0.96	2.49	3.84	1.05	2.49	3.81	Clayey	1.59	1.26	1.38	2.22	2.00	3.75	19.20	42.71	0.08	0.97	0.19	0.07	0.12
59	3.85	0.81	2.91	3.94	0.88	2.91	3.91	Clayey	1.55	1.25	1.36	2.05	2.00	3.85	21.49	44.12	0.08	0.97	0.18	0.07	0.12
60	3.73	1.00	2.32	3.81	1.09	2.32	3.78	Clayey	1.52	1.23	1.34	2.31	2.00	3.73	18.74	43.26	0.08	0.97	0.18	0.07	0.12
61	3.71	1.20	2.87	3.78	1.30	2.87	3.75	Clayey	1.48	1.22	1.32	2.56	2.00	3.71	18.19	46.62	0.08	0.97	0.18	0.08	0.13
62	3.61	1.43	2.38	3.68	1.54	2.38	3.65	Clayey	1.45	1.20	1.30	2.85	2.00	3.61	16.12	45.97	0.08	0.97	0.18	0.08	0.13
63	3.60	1.45	2.32	3.67	1.56	2.32	3.64	Clayey	1.42	1.19	1.28	2.88	2.00	3.60	16.00	46.10	0.08	0.97	0.18	0.08	0.13
64	3.34	2.89	2.31	3.40	3.09	2.31	3.38	Clayey	1.39	1.18	1.26	4.58	2.00	3.34	11.30	51.79	0.09	0.97	0.18	0.08	0.13
65	3.55	1.76	2.50	3.61	1.87	2.50	3.58	Clayey	1.36	1.17	1.24	3.25	2.00	3.55	14.99	48.73	0.08	0.96	0.17	0.08	0.13
66	3.53	1.81	2.41	3.59	1.92	2.41	3.57	Clayey	1.33	1.15	1.22	3.31	2.00	3.53	14.70	48.70	0.08	0.96	0.17	0.08	0.13
67	3.38	2.35	1.84	3.44	2.48	1.84	3.42	Clayey	1.31	1.14	1.21	3.93	2.00	3.38	12.06	47.35	0.08	0.96	0.17	0.09	0.13
68	3.48	1.82	1.77	3.53	1.91	1.77	3.51	Clayey	1.28	1.13	1.19	3.31	2.00	3.48	13.75	45.59	0.08	0.96	0.17	0.09	0.13
69	3.45	1.92	1.66	3.50	2.01	1.66	3.48	Clayey	1.26	1.12	1.17	3.43	2.00	3.45	13.22	45.35	0.08	0.96	0.17	0.09	0.13
70	3.39	2.13	1.47	3.43	2.23	1.47	3.42	Clayey	1.23	1.11	1.16	3.67	2.00	3.39	12.20	44.76	0.08	0.96	0.17	0.09	0.13
71	3.05	4.22	0.99	3.09	4.38	0.99	3.08	Clayey	1.21	1.10	1.14	5.96	2.00	3.05	7.37	43.94	0.08	0.96	0.16	0.09	0.13
72	3.13	5.69	2.54	3.16	5.89	2.54	3.15	Clayey	1.19	1.09	1.13	7.53	2.00	3.13	8.33	62.75	0.10	0.95	0.16	0.09	0.13
73	3.45	2.15	1.90	3.48	2.22	1.90	3.47	Clayey	1.17	1.08	1.11	3.67	2.00	3.45	13.14	48.24	0.08	0.95	0.16	0.09	0.13
74	3.39	2.36	1.71	3.42	2.43	1.71	3.41	Clayey	1.15	1.07	1.10	3.90	2.00	3.39	12.22	47.62	0.08	0.95	0.16	0.09	0.13
75	3.36	2.70	1.86	3.38	2.77	1.86	3.37	Clayey	1.13	1.06	1.09	4.25	2.00	3.36	11.68	49.59	0.08	0.95	0.16	0.09	0.13
76	3.43	2.23	1.78	3.45	2.28	1.78	3.44	Clayey	1.11	1.05	1.07	3.75	2.00	3.43	12.85	48.12	0.08	0.95	0.15	0.09	0.13
77	3.54	2.01	2.45	3.55	2.04	2.45	3.55	Clayey	1.09	1.04	1.06	3.51	2.00	3.54	14.76	51.77	0.09	0.94	0.15	0.10	0.13
78	3.53	2.15	2.72	3.55	2.18	2.72	3.54	Clayey	1.07	1.03	1.05	3.65	2.00	3.53	14.71	53.76	0.09	0.94	0.15	0.10	0.13
79	3.42	2.08	1.40	3.43	2.10	1.40	3.43	Clayey	1.05	1.03	1.04	3.57	2.00	3.42	12.75	45.56	0.08	0.94	0.15	0.10	0.13
80	3.34	2.42	1.20	3.35	2.43	1.20	3.35	Clayey	1.04	1.02	1.03	3.91	2.00	3.34	11.37	44.46	0.08	0.94	0.15	0.10	0.13
81	3.21	5.09	2.63	3.21	5.11	2.63	3.21	Clayey	1.02	1.01	1.01	6.61	2.00	3.21	9.38	61.96	0.10	0.93	0.15	0.10	0.13
82	3.38	2.47	1.54	3.38	2.47	1.54	3.38	Clayey	1.00	1.00	1.00	3.95	2.00	3.38	12.04	47.56	0.08	0.93	0.14	0.10	0.13
83	3.34	2.44	1.15	3.34	2.44	1.15	3.34	Clayey	0.99	0.99	0.99	3.92	2.00	3.34	11.35	44.47	0.08	0.93	0.14	0.10	0.13
84	3.37	2.34	1.20	3.36	2.32	1.20	3.36	Clayey	0.97	0.99	0.98	3.81	2.00	3.37	11.79	44.88	0.08	0.92	0.14	0.10	0.13
85	3.35	2.16	0.86	3.34	2.15	0.86	3.34	Clayey	0.96	0.98	0.97	3.63	2.00	3.35	11.48	41.68	0.08	0.92	0.14	0.10	0.12
86	3.31	2.31	0.79	3.30	2.29	0.79	3.31	Clayey	0.95	0.97	0.96	3.77	2.00	3.31	10.91	41.17	0.08	0.92	0.14	0.10	0.12
87	3.37	2.57	1.42	3.35	2.53	1.42	3.36	Clayey	0.93	0.97	0.95	4.01	2.00	3.37	11.80	47.35	0.08	0.91	0.13	0.10	0.12
88	3.34	2.72	1.33	3.32	2.68	1.33	3.33	Clayey	0.92	0.96	0.94	4.16	2.00	3.34	11.28	46.86	0.08	0.91	0.13	0.10	0.12
89	3.36	2.63	1.37	3.34	2.58	1.37	3.35	Clayey	0.91	0.95	0.93	4.06	2.00	3.36	11.63	47.18	0.08	0.91	0.13	0.10	0.12
90	3.31	2.63	1.02	3.29	2.57	1.02	3.30	Clayey	0.89	0.95	0.93	4.05	2.00	3.31	10.88	44.07	0.08	0.90	0.13	0.10	0.12
91	3.31	2.62	1.02	3.29	2.55	1.02	3.30	Clayey	0.88	0.94	0.92	4.03	2.00	3.31	10.95	44.15	0.08	0.90	0.13	0.10	0.12
92	3.32	2.62	1.01	3.29	2.55	1.01	3.30	Clayey	0.87	0.93	0.91	4.03	2.00	3.32	10.97	44.16	0.08	0.89	0.13	0.10	0.12
93	3.13	4.24	1.03	3.10	4.11	1.03	3.11	Clayey	0.86	0.93	0.90	5.52	2.00	3.13	8.30	45.84	0.08	0.89	0.12	0.10	0.11
94	2.89	9.24	1.41	2.85	8.95	1.41	2.87	Clayey	0.85	0.92	0.89	10.12	2.00	2.89	5.56	56.25	0.10	0.89	0.12	0.10	0.11
95	2.64	20.05	1.73	2.61	19.35	1.73	2.62	Clayey	0.84	0.91	0.88	19.95	2.00	2.64	3.61	71.97	0.11	0.88	0.12	0.10	0.11
96	2.74	16.82	1.94	2.70	16.18	1.94	2.72	Clayey	0.83	0.91	0.87	16.89	2.00	2.74	4.28	72.39	0.12	0.88	0.12	0.10	0.11
97	2.83	13.08	1.89	2.79	12.56	1.89	2.80	Clayey	0.82	0.90	0.87	13.44	2.00	2.83	5.01	67.37	0.11	0.87	0.12	0.10	0.11
98	2.78	13.30	1.59	2.74	12.74	1.59	2.76	Clayey	0.80	0.90	0.86	13.56	2.00	2.78	4.65	63.06	0.10	0.86	0.11	0.10	0.10
99	2.74	13.96	1.39	2.69	13.34	1.39	2.71	Clayey	0.79	0.89	0.85	14.08	2.00	2.74	4.28	60.28	0.10	0.86	0.11	0.10	0.10
100	2.72	14.74	1.36	2.67	14.04	1.36	2.69	Clayey	0.78	0.89	0.84	14.69	2.00	2.72	4.12	60.47	0.10	0.85	0.11	0.10	0.10
101	2.73	17.74	1.97	2.69	16.85	1.97	2.71	Clayey	0.77	0.88	0.84	17.26	2.00	2.73	4.25	73.38	0.12	0.85	0.11	0.10	0.10

Row	BO	BP	BQ	BR	BS	BT	BU	BV	BW	BX	BY	BZ	CA	CB	CC	CD	CE	CF	CG	CH
34	Col-66	Col-67	Col-68	Col-69	Col-70	Col-71	Col-72	Col-73	Col-74	Col-75	Col-76	Col-77	Col-78	Col-79	Col-80	Col-81	Col-82	Col-83	Col-84	Col-85
35											Boulanger and Idriss, 2004, "Approach B" method based on Su profile									
36																				
37	f	MSF	K_σ	α	K_α	FS liq- CPT (Sand-Like)		Apparent Fines	Measured Fines	**Ic Limits**	Su - CPT (psf)	OCR Assumed	OCR - CPT	α	k_α	$CRR_{M7.5}$	MSF	$CRR_{M5.5}$	FS liq-Su (Clay-Like)	
38						No	if crest accel =	(%)	(%)		Nkt	1.1							No	crest accel
39				0.02		Amplification	2				10.5			0.02					Amplification	2
40	0.7	2.2	3.39	0.02	0.9600	7.90	3.97	14		2.6	877	1.1		0.02	0.99	15.36	1.11	17.07	238.54	119.76
41	0.7	2.2	2.43	0.02	0.9600	8.48	4.29	27		2.6	788	1.1		0.02	0.99	4.52	1.11	5.02	70.22	35.55
42	0.7	2.2	2.09	0.02	0.9600	4.91	2.51	33		2.6	518	1.1		0.02	0.99	1.79	1.11	1.99	27.95	14.27
43	0.7	2.2	1.88	0.02	0.9600	4.28	2.21	30		2.6	680	1.1		0.02	0.99	1.68	1.11	1.86	26.14	13.46
44	0.7	2.2	1.75	0.02	0.9600	3.90	2.02	29		2.6	801	1.1		0.02	0.99	1.54	1.11	1.71	24.06	12.49
45	0.7	2.2	1.65	0.02	0.9600	3.62	1.90	27		2.6	1402	1.1		0.02	0.99	2.20	1.11	2.44	34.41	18.01
46	0.7	2.2	1.56	0.02	0.9600	3.80	2.01	43		2.6	734	1.1		0.02	0.99	0.97	1.11	1.08	15.23	8.05
47	0.7	2.2	1.50	0.02	0.9600	3.24	1.72	41		2.6	414	1.1		0.02	0.99	0.48	1.11	0.53	7.49	3.99
48	0.7	2.2	1.44	0.02	0.9600	3.15	1.69	55		2.6	297	1.1		0.02	0.99	0.30	1.11	0.33	4.73	2.54
49	0.7	2.2	1.40	0.02	0.9600	3.05	1.65	64		2.6	260	1.1		0.02	0.99	0.24	1.11	0.26	3.71	2.01
50	0.7	2.2	1.36	0.02	0.9600	2.95	1.62	71		2.6	232	1.1		0.02	0.99	0.19	1.11	0.21	3.00	1.64
51	0.7	2.2	1.32	0.02	0.9600	2.87	1.58	76		2.6	225	1.1		0.02	0.99	0.17	1.11	0.19	2.66	1.47
52	0.7	2.2	1.29	0.02	0.9600	2.81	1.57	89		2.6	180	1.1		0.02	0.99	0.12	1.11	0.14	1.96	1.09
53	0.7	2.2	1.26	0.02	0.9600	2.71	1.53	79		2.6	232	1.1		0.02	0.99	0.15	1.11	0.16	2.35	1.32
54	0.7	2.2	1.23	0.02	0.9600	2.68	1.52	94		2.6	181	1.1		0.02	0.99	0.11	1.11	0.12	1.71	0.97
55	0.7	2.2	1.21	0.02	0.9600	2.80	1.60	100		2.6	191	1.1		0.02	0.99	0.11	1.11	0.12	1.69	0.97
56	0.7	2.2	1.18	0.02	0.9600	2.72	1.57	98		2.6	228	1.1		0.02	0.99	0.12	1.11	0.13	1.90	1.10
57	0.7	2.2	1.16	0.02	0.9600	2.72	1.59	100		2.6	145	1.1		0.02	0.99	0.07	1.11	0.08	1.14	0.66
58	0.7	2.2	1.15	0.02	0.9600	2.65	1.56	100		2.6	153	1.1		0.02	0.99	0.07	1.11	0.08	1.14	0.67
59	0.7	2.2	1.14	0.02	0.9600	2.60	1.55	100		2.6	131	1.1		0.02	0.99	0.06	1.11	0.07	0.92	0.55
60	0.7	2.2	1.13	0.02	0.9600	2.49	1.50	100		2.6	164	1.1		0.02	0.99	0.07	1.11	0.08	1.10	0.66
61	0.7	2.2	1.13	0.02	0.9600	2.50	1.52	100		2.6	199	1.1		0.02	0.99	0.09	1.11	0.10	1.28	0.78
62	0.7	2.2	1.12	0.02	0.9600	2.42	1.48	100		2.6	240	1.1		0.02	0.99	0.10	1.11	0.12	1.47	0.90
63	0.7	2.2	1.11	0.02	0.9600	2.36	1.46	100		2.6	246	1.1		0.02	0.99	0.10	1.11	0.12	1.45	0.90
64	0.7	2.2	1.10	0.02	0.9600	2.67	1.67	84		2.6	494	1.1		0.02	0.99	0.20	1.11	0.23	2.80	1.75
65	0.7	2.2	1.10	0.02	0.9600	2.31	1.46	100		2.6	304	1.1		0.02	0.99	0.12	1.11	0.14	1.66	1.05
66	0.7	2.2	1.09	0.02	0.9600	2.25	1.44	100		2.6	317	1.1		0.02	0.99	0.13	1.11	0.14	1.66	1.06
67	0.7	2.2	1.08	0.02	0.9600	2.18	1.40	88		2.6	414	1.1		0.02	0.99	0.16	1.11	0.18	2.10	1.36
68	0.7	2.2	1.08	0.02	0.9600	2.09	1.37	97		2.6	323	1.1		0.02	0.99	0.12	1.11	0.14	1.58	1.03
69	0.7	2.2	1.07	0.02	0.9600	2.05	1.35	94		2.6	345	1.1		0.02	0.99	0.13	1.11	0.14	1.64	1.08
70	0.7	2.2	1.06	0.02	0.9600	2.00	1.33	89		2.6	388	1.1		0.02	0.99	0.14	1.11	0.16	1.78	1.19
71	0.7	2.2	1.06	0.02	0.9600	1.95	1.31	62		2.6	773	1.1		0.02	0.99	0.28	1.11	0.31	3.45	2.32
72	0.7	2.2	1.05	0.02	0.9600	2.52	1.72	68		2.6	1052	1.1		0.02	0.99	0.37	1.11	0.41	4.55	3.10
73	0.7	2.2	1.05	0.02	0.9600	1.97	1.36	94		2.6	401	1.1		0.02	0.99	0.14	1.11	0.15	1.69	1.16
74	0.7	2.2	1.04	0.02	0.9600	1.93	1.34	89		2.6	445	1.1		0.02	0.99	0.15	1.11	0.17	1.82	1.27
75	0.7	2.2	1.04	0.02	0.9600	1.94	1.37	86		2.6	513	1.1		0.02	0.99	0.17	1.11	0.19	2.04	1.44
76	0.7	2.2	1.03	0.02	0.9600	1.89	1.34	92		2.6	428	1.1		0.02	0.99	0.14	1.11	0.16	1.66	1.18
77	0.7	2.2	1.03	0.02	0.9600	2.11	1.53	100		2.6	388	1.1		0.02	0.99	0.13	1.11	0.14	1.47	1.06
78	0.7	2.2	1.02	0.02	0.9600	2.12	1.55	100		2.6	419	1.1		0.02	0.99	0.13	1.11	0.15	1.55	1.13
79	0.7	2.2	1.02	0.02	0.9600	1.77	1.31	92		2.6	409	1.1		0.02	0.99	0.13	1.11	0.14	1.48	1.09
80	0.7	2.2	1.01	0.02	0.9600	1.73	1.29	85		2.6	478	1.1		0.02	0.99	0.15	1.11	0.16	1.69	1.26
81	0.7	2.2	1.01	0.02	0.9600	2.22	1.68	74		2.6	1016	1.1		0.02	0.99	0.31	1.11	0.34	3.51	2.66
82	0.7	2.2	1.00	0.02	0.9600	1.75	1.34	88		2.6	496	1.1		0.02	0.99	0.15	1.11	0.17	1.68	1.29
83	0.7	2.2	1.00	0.02	0.9600	1.68	1.30	84		2.6	495	1.1		0.02	0.99	0.15	1.11	0.16	1.64	1.28
84	0.7	2.2	0.99	0.02	0.9600	1.67	1.31	87		2.6	477	1.1		0.02	0.99	0.14	1.11	0.15	1.55	1.22
85	0.7	2.2	0.99	0.02	0.9600	1.60	1.28	85		2.6	445	1.1		0.02	0.99	0.13	1.11	0.14	1.42	1.13
86	0.7	2.2	0.98	0.02	0.9600	1.58	1.28	82		2.6	480	1.1		0.02	0.99	0.14	1.11	0.15	1.50	1.22
87	0.7	2.2	0.98	0.02	0.9600	1.67	1.37	87		2.6	536	1.1		0.02	0.99	0.15	1.11	0.17	1.65	1.35
88	0.7	2.2	0.98	0.02	0.9600	1.65	1.37	84		2.6	572	1.1		0.02	0.99	0.16	1.11	0.17	1.74	1.44
89	0.7	2.2	0.97	0.02	0.9600	1.65	1.39	86		2.6	556	1.1		0.02	0.99	0.15	1.11	0.17	1.66	1.40
90	0.7	2.2	0.97	0.02	0.9600	1.59	1.35	82		2.6	560	1.1		0.02	0.99	0.15	1.11	0.17	1.65	1.40
91	0.7	2.2	0.96	0.02	0.9600	1.58	1.37	82		2.6	561	1.1		0.02	0.99	0.15	1.11	0.16	1.62	1.41
92	0.7	2.2	0.96	0.02	0.9600	1.57	1.38	82		2.6	566	1.1		0.02	0.99	0.15	1.11	0.16	1.61	1.42
93	0.7	2.2	0.96	0.02	0.9600	1.59	1.42	68		2.6	921	1.1		0.02	0.99	0.24	1.11	0.26	2.59	2.31
94	0.7	2.2	0.95	0.02	0.9600	1.92	1.73	51		2.6	1180	1.1		0.02	0.99	0.30	1.11	0.33	3.28	2.96
95	0.7	2.2	0.95	0.02	0.9600	2.27	2.08	38		2.6	2576	1.1		0.02	0.99	0.64	1.11	0.71	7.06	6.48
96	0.7	2.2	0.94	0.02	0.9600	2.27	2.12	43		2.6	2176	1.1		0.02	0.99	0.54	1.11	0.59	5.89	5.48
97	0.7	2.2	0.94	0.02	0.9600	2.13	2.02	48		2.6	1704	1.1		0.02	0.99	0.41	1.11	0.46	4.55	4.31
98	0.7	2.2	0.94	0.02	0.9600	2.03	1.95	45		2.6	1744	1.1		0.02	0.99	0.42	1.11	0.46	4.61	4.43
99	0.7	2.2	0.93	0.02	0.9600	1.97	1.92	43		2.6	1842	1.1		0.02	0.99	0.44	1.11	0.48	4.82	4.70
100	0.7	2.2	0.93	0.02	0.9600	1.97	1.95	41		2.6	1957	1.1		0.02	0.99	0.46	1.11	0.51	5.06	5.02
101	0.7	2.2	0.93	0.02	0.9600	2.28	2.30	42		2.6	2370	1.1		0.02	0.99	0.55	1.11	0.61	6.07	6.12

CPTU-604 Liquefaction Analysis

ConeTec Inc. - CPT Interpretation

Interpretation Output - Release	1.22 Rev. A -	Format:	NLI	Imperial
Run No:	06-0718-0954-3180			
Job No:	02-100			
Client:	MACTEC Engineering and Consulting Inc.			
Project:	Former Callahan Mine Site, Brooksville, ME			
Site:	CP-604			
Location:	Callahan Mine			
Cone:	20 Ton AD179			
CPT Date:	06/27/06			
CPT Time:	13:46			
CPT File:	758CP604.COR			
Northing (m):	0			
Easting (m):	0			
Elevation (m):	0		72.8	Elevation For CPT Triggering analysis
Water Table (m):	6.34	(ft):	20.8	20.8 Water Table assumed for CPT Analysis
Unit Weight of Water (default):	62.4 pcf			
Averaging Increment (m):	0.2			
Phi Method :	Robertson and Campanella, 1983			
Su Nkt used:	15	Su/P' (nc):	0.3	0.11 Base acceleration
Dr Method :	Jamiolkowski - All Sands			
State Parameter M:	1.2			
Used Unit Weights Assigned to Soil Zones				
N160lc Calculated using qc1n				

1) CSR = $0.65*(a_{max}/g)*(s_v/s'_v)*r_d$ — Seed & Idriss, 1983, p. 459

a_{max}/g = 0.11 g — USGS (base) (amplified from base as discussed in text

s_v = computed — Total Vertical Stress

s'_v = computed — Effective Vertical Stress

$r_d = [1.0 - 0.4113z^{0.5} + 0.04052z + 0.001753z^{1.5}] / [1 - 0.4177z^{0.5} + 0.05729z - 0.006205z^{1.5} + 0.001210z^2]$

z = depth in meters

2) FS = Factor of safety against triggering of liquefaction: FS = ($CRR_{7.5}$/CSR) x MSF x Ks x Ka — Youd and Idriss, 2001

MSF = magnitude scaling factor; Assume based on range recommended by NCEER Workshop, reiterated in Youd and Idriss, 2001

CPTU-604 Liquefaction Analysis

$Ks = (s'_{vo}/P_a)^{1-f}$, where f = 0.7 to 0.8 for relative density of 40 to 60%; f = 0.6 to 0.7 for rel density of 60 to 80%; P_a = pressure at 1 atmosphere — Youd

1 Atmosphere = 14.7 psi = 2.12 ksf

Conetec Data

Col-01 Depth (m)	Col-02 Depth (ft)	Col-03 Elev. (m)	Col-04 Elev. (ft)	Col-05 qc (tsf)	Col-06 qt (tsf)	Col-07 fs (tsf)	Col-08 Rf (%)	Col-09 u (ft)	Col-10 SBT (Zone)	Col-11 SBTn (Zone)	Col-12 SBT-BQ (Zone)	Col-13 SBT-BQn (Zone)	Col-14 Perm-k (cm/s)	Col-15 Unit Wt (pcf)	Col-16 T Stress (tsf)	Col-17 U Stress (tsf)	Col-18 E Stress (tsf)	Col-19 Cn	Col-20 N60 (b/ft)	Col-21 N1(60) (b/ft)	Col-22 N(60)lc (b/ft)	Col-23 N1(60)lc (b/ft)	Col-24 Qt	Col-25 Fr (%)	Col-26 Bq	Col-27 Ic	Col-28 FC (%)	Col-29 IcZone (Zone)	Col-30 Dr (%)	Col-31 Phi (deg)	Col-32 State Par	Col-33 Es/qt	Col-34 YoungE (tsf)	Col-35 Su (tsf)	Col-36 OCR
0.1	0.328	-0.1	72.5	6.18	6.18	0.04	0.61	0.41	1	6	5	7	1.00E-07	111.4	0.018	0	0.018	1.7	3	5	1.7	2.8	337.3	0.61	0	2.66	38.6	4	-9999	-9999	-9999	-9999	-9999	0.411	10
0.3	0.984	-0.3	71.8	11.89	11.88	0.15	1.27	-2.2	6	6	6	7	5.00E-05	114.6	0.055	0	0.055	1.7	4.5	7.7	3	5.1	213.59	1.27	-0.01	2.55	33.2	5	47.1	46	-0.29	-9999	-9999	0.788	10
0.5	1.64	-0.5	71.2	19.85	19.85	0.2	1.01	-0.69	6	6	7	7	5.00E-05	114.6	0.093	0	0.093	1.7	7.6	12.9	4.5	7.6	212.57	1.01	0	2.31	23	5	54.4	46	-0.28	3.628	72	1.317	10
0.7	2.297	-0.7	70.5	22.88	22.88	0.34	1.47	0.1	6	6	7	7	5.00E-05	114.6	0.131	0	0.131	1.7	8.8	14.9	5.3	9	174.32	1.48	0	2.35	24.5	5	53.6	44	-0.28	3.402	77.9	1.517	10
0.9	2.953	-0.9	69.8	17.32	17.33	0.23	1.33	0.31	6	6	6	6	5.00E-05	114.6	0.168	0	0.168	1.7	6.6	11.3	4.1	7	102.06	1.34	0	2.43	27.6	5	42	42	-0.22	-9999	-9999	1.144	10
1.1	3.609	-1.1	69.2	6.37	6.42	0.12	1.87	9.21	4	5	4	5	5.00E-07	114.6	0.206	0	0.206	1.7	4.1	7	1.9	3.3	30.19	1.94	0.05	2.88	50.6	4	-9999	-9999	-9999	-9999	-9999	0.414	10
1.3	4.265	-1.3	68.5	13.81	13.82	0.12	0.87	0.47	6	5	6	6	5.00E-05	114.6	0.243	0	0.243	1.7	5.3	9	3.3	5.6	55.79	0.89	0	2.42	27.2	5	30.2	40	-0.12	-9999	-9999	0.905	10
1.5	4.921	-1.5	67.9	10.37	10.37	0.14	1.3	0.59	6	5	6	6	5.00E-06	114.6	0.281	0	0.281	1.7	5	8.4	2.7	4.6	35.92	1.34	0	2.62	36.2	4	-9999	-9999	-9999	-9999	-9999	0.673	10
1.7	5.577	-1.7	67.2	2.94	3.01	0.05	1.5	15.74	1	4	3	3	1.00E-07	111.4	0.318	0	0.318	1.7	1.4	2.5	0.9	2.7	8.47	1.68	0.18	2.92	53.5	4	-9999	-9999	-9999	-9999	-9999	0.18	2
1.9	6.234	-1.9	66.6	8.18	8.21	0.07	0.79	6.52	1	5	5	5	1.00E-07	111.4	0.355	0	0.355	1.68	3.9	6.6	2.1	3.6	22.15	0.83	0.03	2.61	35.7	4	-9999	-9999	-9999	-9999	-9999	0.524	8.3
2.1	6.89	-2.1	65.9	14.21	14.22	0.14	0.95	0.97	6	5	6	6	5.00E-05	114.6	0.392	0	0.392	1.6	5.4	8.7	3.4	5.6	35.31	0.98	0	2.44	28.2	5	30	38	-0.09	-9999	-9999	0.922	10
2.3	7.546	-2.3	65.3	14.39	14.39	0.16	1.13	0.8	6	5	6	6	5.00E-05	114.6	0.429	0	0.429	1.53	5.5	8.4	3.5	5.5	32.54	1.17	0	2.5	30.5	5	30	36	-0.09	-9999	-9999	0.931	10
2.5	8.202	-2.5	64.6	8.82	8.82	0.16	1.85	0.66	5	4	5	5	5.00E-06	114.6	0.467	0	0.467	1.46	4.2	6.2	2.4	5.1	17.9	1.95	0	2.68	39.5	4	-9999	-9999	-9999	-9999	-9999	0.557	6
2.7	8.858	-2.7	63.9	15.32	15.32	0.15	0.98	-0.02	6	5	6	5	5.00E-05	114.6	0.504	0	0.504	1.41	5.9	8.3	3.7	5.4	29.37	1.02	0	2.47	29.4	5	30	36	-0.07	-9999	-9999	0.988	10
2.9	9.514	-2.9	63.3	10.62	10.63	0.18	1.67	3.21	5	4	6	5	5.00E-06	114.6	0.542	0	0.542	1.36	5.1	6.9	2.8	5.2	18.62	1.76	0.01	2.64	37.5	4	-9999	-9999	-9999	-9999	-9999	0.673	6.3
3.1	10.17	-3.1	62.6	13.64	13.64	0.15	1.07	0.99	6	5	6	5	5.00E-06	114.6	0.58	0	0.58	1.31	5.2	6.9	3.5	4.7	22.54	1.11	0	2.56	33.5	5	30	34	-0.05	-9999	-9999	0.871	8.6
3.3	10.827	-3.3	62.0	12.25	12.26	0.14	1.16	3.1	6	5	6	5	5.00E-05	114.6	0.617	0	0.617	1.27	4.7	6	3.2	4.7	18.87	1.23	0.01	2.58	34.6	5	30	32	-0.04	-9999	-9999	0.776	6.5
3.5	11.483	-3.5	61.3	8.61	8.66	0.16	1.85	11.59	5	4	5	4	5.00E-06	114.6	0.655	0	0.655	1.24	4.1	5.1	2.5	3.7	12.23	2	0.05	2.83	47.6	4	-9999	-9999	-9999	-9999	-9999	0.534	3.4
3.7	12.139	-3.7	60.7	4.27	4.37	0.15	3.32	23.16	3	3	3	3	5.00E-08	111.4	0.692	0	0.692	1.2	4.2	5	1.7	2.2	5.32	3.95	0.2	3.29	80.3	3	-9999	-9999	-9999	-9999	-9999	0.245	1.2
3.9	12.795	-3.9	60.0	11.88	11.88	0.2	1.65	-0.39	5	4	6	5	5.00E-05	114.6	0.729	0	0.729	1.17	5.7	6.7	3.3	4.4	15.3	1.75	0	2.71	41.2	4	-9999	-9999	-9999	-9999	-9999	0.743	4.7
4.1	13.451	-4.1	59.3	4.38	4.41	0.12	2.79	7.02	3	3	4	3	5.00E-08	111.4	0.766	0	0.766	1.14	4.2	4.8	1.8	2	4.76	3.37	0.06	3.29	80.6	3	-9999	-9999	-9999	-9999	-9999	0.243	1.1
4.3	14.107	-4.3	58.7	10.35	10.43	0.15	1.47	18.02	5	4	5	4	5.00E-06	114.6	0.803	0	0.803	1.12	5	5.6	3	3.6	11.99	1.59	0.06	2.78	44.9	4	-9999	-9999	-9999	-9999	-9999	0.642	3.3
4.5	14.764	-4.5	58.0	6.23	6.28	0.14	2.15	11.33	4	4	5	4	5.00E-07	114.6	0.841	0	0.841	1.09	4	4.4	2.2	2.4	6.47	2.49	0.06	3.11	66.3	3	-9999	-9999	-9999	-9999	-9999	0.363	1.5
4.7	15.42	-4.7	57.4	10.55	10.63	0.14	1.3	17.06	5	4	5	4	5.00E-06	114.6	0.878	0	0.878	1.07	5.1	5.4	3	3.3	11.11	1.41	0.05	2.78	45.1	4	-9999	-9999	-9999	-9999	-9999	0.65	2.9
4.9	16.076	-4.9	56.7	14.85	14.87	0.16	1.05	2.74	6	4	6	5	5.00E-05	114.6	0.916	0	0.916	1.05	5.7	6	3.9	4.2	15.23	1.11	0.01	2.61	36.1	4	30	32	-0.02	-9999	-9999	0.93	4.7
5.1	16.732	-5.1	56.1	14.52	14.51	0.16	1.12	-0.38	6	4	6	5	5.00E-05	114.6	0.953	0	0.953	1.02	5.6	5.7	3.9	4	14.22	1.2	0	2.66	38.2	4	30	32	-0.02	-9999	-9999	0.904	4.2
5.3	17.388	-5.3	55.4	6.52	6.54	0.18	2.76	5.2	4	3	5	4	5.00E-07	114.6	0.991	0	0.991	1	4.2	4.2	2	1.6	3.38	3.97	0.3	3.46	95	3	-9999	-9999	-9999	-9999	-9999	0.37	1.2
5.5	18.044	-5.5	54.8	4.34	4.5	0.14	3.06	33.1	3	3	3	3	5.00E-08	111.4	1.028	0	1.028	0.99	4.3	4.2	2	1.6	2.55	3.35	0.5	3.46	95	3	-9999	-9999	-9999	-9999	-9999	0.231	0.8
5.7	18.701	-5.7	54.1	2.81	3.14	0.06	1.84	70.81	1	3	1	1	1.00E-07	111.4	1.065	0	1.065	0.97	1.5	1.5	1.6	1	1.95	2.78	1.06	3.59	100	3	-9999	-9999	-9999	-9999	-9999	0.138	0.6
5.9	19.357	-5.9	53.4	4.38	4.67	0.09	1.88	62.39	4	3	3	3	5.00E-07	114.6	1.102	0	1.102	0.95	3	2.8	2	1.4	3.24	2.46	0.55	3.37	87	3	-9999	-9999	-9999	-9999	-9999	0.238	0.8
6.1	20.013	-6.1	52.8	16.96	17.03	0.15	0.87	14.26	6	4	6	5	5.00E-05	114.6	1.139	0	1.139	0.94	6.5	6.1	4.4	3.8	13.95	0.93	0.03	2.61	35.9	4	30	32	0.01	-9999	-9999	1.059	4.1
6.3	20.669	-6.3	52.1	15.46	15.47	0.22	1.43	1.95	6	4	6	5	5.00E-05	114.6	1.177	0	1.177	0.92	5.9	5.5	4.4	3.6	12.14	1.54	0	2.77	44.3	4	30	30	-0.02	-9999	-9999	0.953	3.3
6.5	21.325	-6.5	51.5	5.38	5.58	0.17	3.05	42.75	3	3	3	3	5.00E-08	111.4	1.214	0.016	1.197	0.91	5.3	4.9	2.5	1.7	3.65	3.9	0.3	3.43	92	3	-9999	-9999	-9999	-9999	-9999	0.291	0.8
6.7	21.981	-6.7	50.8	7.17	7.36	0.15	2.01	39.83	4	3	4	3	5.00E-07	114.6	1.251	0.037	1.214	0.91	4.7	4.3	2.7	1.9	5.03	2.42	0.2	3.28	73.2	3	-9999	-9999	-9999	-9999	-9999	0.407	1.1
6.9	22.638	-6.9	50.2	10.99	11.11	0.21	1.87	27.11	5	3	5	4	5.00E-07	114.6	1.289	0.057	1.231	0.9	5.3	4.8	3.4	2.3	7.98	2.12	0.08	3	58.3	3	-9999	-9999	-9999	-9999	-9999	0.655	1.9
7.1	23.294	-7.1	49.5	9.44	9.51	0.26	2.73	16.7	4	3	5	4	5.00E-07	114.6	1.326	0.078	1.248	0.9	6.1	5.4	3.4	2.5	6.56	3.15	0.05	3.16	70	3	-9999	-9999	-9999	-9999	-9999	0.546	1.5
7.3	23.95	-7.3	48.9	7.49	7.8	0.15	1.93	66	5	3	5	3	5.00E-04	114.6	1.364	0.098	1.265	0.89	3.7	3.3	2.9	1.9	5.09	2.34	0.3	3.19	72	3	-9999	-9999	-9999	-9999	-9999	0.429	1.1
7.5	24.606	-7.5	48.2	26.32	26.34	0.23	0.86	4.87	7	5	7	5	5.00E-04	117.7	1.402	0.119	1.283	0.88	8.4	7.4	6.3	5.6	19.44	0.9	0	2.42	27.2	5	30	32	-0.02	-9999	-9999	-9999	-9999
7.8	25.262	-7.7	47.5	21.8	21.76	0.25	1.15	-9.67	6	4	7	5	5.00E-05	114.6	1.44	0.139	1.301	0.88	8.3	7.3	5.7	4.3	15.62	1.23	-0.02	2.63	36.7	4	30	32	-0.03	-9999	-9999	1.354	4.8
7.9	25.918	-7.9	46.9	6.74	6.81	0.26	3.79	15.38	3	3	4	3	5.00E-08	111.4	1.477	0.16	1.317	0.87	6.5	5.7	3	1.9	4.05	4.84	0.06	3.44	93.2	3	-9999	-9999	-9999	-9999	-9999	0.356	0.9
8.1	26.574	-8.1	46.2	15.35	15.45	0.21	1.33	22.31	6	3	6	4	5.00E-05	114.6	1.514	0.18	1.334	0.87	5.9	5.1	4.3	3.2	10.45	1.47	0.04	2.82	47	4	30	30	0	-9999	-9999	0.929	2.7
8.3	27.231	-8.3	45.6	16.02	16.11	0.25	1.57	19.69	6	3	6	4	5.00E-05	114.6	1.552	0.201	1.351	0.86	6.2	5.3	4.7	3.3	10.78	1.74	0.03	2.84	48.4	4	30	30	-0.01	-9999	-9999	0.971	2.8
8.5	27.887	-8.5	44.9	15.76	15.9	0.18	1.1	28.43	6	4	6	4	5.00E-05	114.6	1.589	0.221	1.368	0.86	6.1	5.2	4.5	3.1	10.46	1.23	0.05	2.78	44.7	4	30	30	0.02	-9999	-9999	0.954	2.7
8.7	28.543	-8.7	44.3	17.33	17.39	0.23	1.3	13.43	6	4	6	4	5.00E-05	114.6	1.627	0.242	1.385	0.85	6.7	5.7	4.9	3.4	11.38	1.43	0.01	2.78	44.8	4	30	30	0	-9999	-9999	1.051	3
8.9	29.199	-8.9	43.6	11.55	11.68	0.27	2.3	29.57	5	3	5	4	5.00E-06	114.6	1.664	0.262	1.402	0.84	5.6	4.7	4	2.6	7.15	2.68	0.07	3.09	64.9	3	-9999	-9999	-9999	-9999	-9999	0.668	1.6
9.1	29.855	-9.1	42.9	6.26	6.61	0.16	2.39	74.69	4	3	3	3	5.00E-07	114.6	1.702	0.283	1.419	0.84	4.2	3.5	2.9	1.6	3.46	3.22	0.42	3.4	89.9	3	-9999	-9999	-9999	-9999	-9999	0.327	0.8
9.3	30.511	-9.3	42.3	4.41	4.88	0.09	1.85	101.02	4	3	3	3	5.00E-07	114.6	1.74	0.303	1.439	0.83	3.1	2.6	2.4	1.1	2.89	2.87	0.91	3.55	100	3	-9999	-9999	-9999	-9999	-9999	0.209	0.6
9.5	31.168	-9.5	41.6	7.06	7.41	0.17	2.3	75.14	4	3	3	3	5.00E-07	114.6	1.777	0.324	1.454	0.83	4.7	3.9	3.1	1.7	3.88	3.02	0.36	3.35	85	3	-9999	-9999	-9999	-9999	-9999	0.376	0.9
9.7	31.824	-9.7	41.0	4.68	5.17	0.12	2.38	104.95	4	3	3	3	5.00E-07	114.6	1.815	0.344	1.471	0.82	3.3	2.7	2.6	1.2	2.28	3.66	0.87	3.59	100	3	-9999	-9999	-9999	-9999	-9999	0.224	0.6
9.9	32.48	-9.9	40.3	6.13	6.53	0.17	2.57	85.53	4	3	3	3	5.00E-07	114.6	1.852	0.365	1.488	0.82	4.2	3.4	3	1.5	3.15	3.59	0.49	3.46	95.3	3	-9999	-9999	-9999	-9999	-9999	0.312	0.8
10.1	33.136	-10.1	39.7	4.73	5.26	0.08	1.48	113.34	1	3	3	3	1.00E-07	111.4	1.889	0.385	1.504	0.82	2.5	2.1	2.5	1.1	2.24	2.31	0.94	3.5	98.8	3	-9999	-9999	-9999	-9999	-9999	0.225	0.6
10.3	33.792	-10.3	39.0	5.35	5.87	0.07	1.2	110.42	1	3	3	3	1.00E-07	111.4	1.926	0.406	1.52	0.81	2.8	2.3	2.5	1.2	2.59	1.78	0.77	3.39	89	3	-9999	-9999	-9999	-9999	-9999	0.263	0.7
10.5	34.448	-10.5	38.4	12.52	12.81	0.21	1.64	61.01	5	3	5	4	5.00E-06	114.6	1.963	0.426	1.537	0.81	6.1	4.9	4.2	2.4	7.05	1.94	0.14	3.02	60.1	3	-9999	-9999	-9999	-9999	-9999	0.723	1.6
10.7	35.105	-10.7	37.7	11.55	11.75	0.28	2.35	43.36	5	3	5	3	5.00E-06	114.6	2.001	0.447	1.554	0.8	5.6	4.5	4.2	2.2	6.27	2.83	0.09	3.15	69.3	3	-9999	-9999	-9999	-9999	-9999	0.65	1.4
10.9	35.761	-10.9	37.0	8.96	9.27	0.28	3.06	66.14	4	3	4	3	5.00E-07	114.6	2.038	0.467	1.571	0.8	5.9	4.7	3.8	2.2	4.6	3.92	0.22	3.34	84.6	3	-9999	-9999	-9999	-9999	-9999	0.482	1
11.1	36.417	-11.1	36.4	5.64	6.15	0.11	1.79	109.2	4	3	3	3	5.00E-07	114.6	2.076	0.488	1.588	0.79	3.9	3.1	2.8	1.2	2.56	2.71	0.72	3.48	96.9	3	-9999	-9999	-9999	-9999	-9999	0.271	0.7
11.3	37.073	-11.3	35.7	4.95	5.38	0.07	1.35	111.82	1	3	3	3	1.00E-07	111.4	2.113	0.509	1.605	0.79	2.6	2	2.6	1	2.03	2.23	0.91	3.53	100	3	-9999	-9999	-9999	-9999	-9999	0.218	0.6
11.5	37.729	-11.5	35.1	5.57	6.11	0.07	1.15	114.55	1	3	3	3	1.00E-07	111.4	2.149	0.529	1.621	0.79	2.9	2.3	2.7	1.1	2.44	1.77	0.77	3.41	90.9	3	-9999	-9999	-9999	-9999	-9999	0.264	0.6
11.7	38.385	-11.7	34.4	11.03	11.36	0.2	1.74	70.4	5	3	4	3	5.00E-06	114.6	2.187	0.549	1.637	0.78	5.4	4.3	4	2.1	5.6	2.16	0.18	3.13	68	3	-9999	-9999	-9999	-9999	-9999	0.612	1.2
11.9	39.042	-11.9	33.8	9.13	9.39	0.24	2.59	54.92	4	3	4	3	5.00E-07	114.6	2.224	0.57	1.655	0.78	6	4.7	3.8	1.8	4.33	2.39	0.16	3.33	83.6	3	-9999	-9999	-9999	-9999	-9999	0.478	1
12.1	39.698	-12.1	33.1	4.82	5.42	0.07	1.25	126.99	1	3	3	3	1.00E-07	111.4	2.261	0.59	1.671	0.77	2.6	2	2.7	1	1.89	2.14	1.07	3.55	100	3	-9999	-9999	-9999	-9999	-9999	0.21	0.6
12.3	40.354	-12.3	32.4	8.7	9.3	0.09	0.92	127.85	5	3	3	3	5.00E-07	114.6	2.298	0.611	1.688	0.77	4.5	3.4	3.3	1.5	4.15	1.22	0.48	3.14	68.2	3	-9999	-9999	-9999	-9999	-9999	0.467	0.9
12.5	41.01	-12.5	31.8	15.28	15.51	0.3	1.95	48.89	5	3	5	4	5.00E-06	114.6	2.336	0.631	1.705	0.77	7.4	5.7	5.1	2.7	7.3	2.3	0.07	3.03	60.4	3	-9999	-9999	-9999	-9999	-9999	0.879	1.8
12.7	41.666	-12.7	31.1	6.29	6.81	0.1	1.4	111.31	5	3	3	3	5.00E-06	114.6	2.373	0.652	1.722	0.76	3.3	2.5	3.3	1.2	2.58	2.15	0.64	3.43	92.4	3	-9999	-9999	-9999	-9999	-9999	0.296	0.7
12.9	42.322	-12.9	30.5	7.24	7.67	0.18	2.3	85.38	4	3	3	3	5.00E-07	114.6	2.411	0.672	1.739	0.76	4.9	3.7	3.5	1.4	3	3.36	0.38	3.46	95.6	3	-9999	-9999	-9999	-9999	-9999	0.348	0.7
13.1	42.978	-13.1	29.8	11.48	11.89	0.14	1.2	87.34	6	3	4	3	5.00E-05	114.6	2.449	0.692	1.756	0.75	4.6	3.4	4	1.9	5.38	1.51	0.22	3.08	63.8	3	30	30	0.09	-9999	-9999	0.629	1.2
13.3	43.635	-13.3	29.2	13.46	13.69	0.29	2.14	49.93	5	3	5	3	5.00E-06	114.6	2.486	0.713	1.773	0.75	6.6	4.9	4.8	2.3	6.32	2.62	0.08	3.13	67.8	3	-9999	-9999	-9999	-9999	-9999	0.747	1.4
13.5	44.291	-13.5	28.5	8.75	9.15	0.27	2.98	85.41	4	3	4	3	5.00E-07	114.6	2.524	0.733	1.79	0.75	5.8	4.4	4.1	1.7	3.47	2.9	0.29	3.43	92.7	3	-9999	-9999	-9999	-9999	-9999	0.442	0.8
13.7	44.947	-13.7	27.9	5.95	6.48	0.2	3.3	113.22	5	3	3	3	5.00E-08	111.4	2.561	0.754	1.807	0.74	6.2	4.6	3.7	1.3	2.17	3.17	0.71	3.68	100	3	-9999	-9999	-9999	-9999	-9999	0.262	0.6
13.9	45.603	-13.9	27.2	6.08	6.59	0.1	1.48	107.25	5	3	3	3	5.00E-07	114.6	2.598	0.774	1.824	0.74	3.2	2.3	3.2	1.1	2.19	2.45	0.65	3.52	100	3	-9999	-9999	-9999	-9999	-9999	0.266	0.6
14.1	46.259	-14.1	26.5	6.13	6.77	0.08	1.15	135.9	1	3	3	3	1.00E-07	111.4	2.635	0.795	1.84	0.74	3.2	2.4	3.1	1.1

CPTU-604 Liquefaction Analysis

CPTU-604 Liquefaction Analysis

and Idriss, 2001

	AY	AZ	BA	BB	BC	BD	BE	BF	BG	BH	BI	BJ	BK	BL	BM	BN	BO	BP	BQ	BR	BS	BT	BU	BV	BW	BX	BY	BZ	CA	CB	CC	CD	CE	CF	CG	CH
34	Col-51	Col-52	Col-53	Col-54	Col-55	Col-56	Col-57	Col-57a	Col-58	Col-59	Col-60	Col-61	Col-62	Col-63	Col-64	Col-65	Col-66	Col-67	Col-68	Col-69	Col-70	Col-71	Col-72	Col-73	Col-74	Col-75	Col-76	Col-77	Col-78	Col-79	Col-80	Col-81	Col-82	Col-83	Col-84	Col-85
35	Youd & Idriss, 2001 CPT Based Analysis																										Boulanger and Idriss, 2004, "Approach B" method based on Su profile									
36																Rel. Den. Factor																				
37	F	$I_{c\ Qexp=0.7}$	Description	C_q			q_{c1N}	Lookup	Ic	Kc	$(q_{c1N})_{cs}$	CRR7.5	rd	a_{max}/g =	CSR		f	MSF	K_σ	α	K_α	FS $_{liq-CPT\ (Sand-Like)}$		Apparent Fines	Measured Fines	Ic Limits	Su - CPT (psf)	OCR Assumed	OCR - CPT	α	k_α	$CRR_{M7.5}$	MSF	$CRR_{M5.5}$	FS $_{liq-Su\ (Clay-Like)}$	
38				n=1.0	n=0.5	n=0.7		Col						if crest accel =	No Amplification	if crest accel = 2						No Amplification	if crest accel = 2	(%)	(%)		Nkt	1.1							No Amplification	if crest accel = 2
39														2.0						0.1							10.5			0.1						
40	0.65	1.79	Granular	58.78	7.67	17.32	44.78	2.00	2.09	1.44	64.55	0.11	1.00	0.22	0.07	0.14	0.7	2.2	3.39	0.1	0.8800	9.65	4.84	16		2.6	1174	1.1		0.1	0.91	18.94	1.11	21.04	294.14	147.45
41	1.27	2.02	Granular	19.24	4.39	7.92	49.25	2.00	2.22	1.71	84.27	0.14	1.00	0.22	0.07	0.14	0.7	2.2	2.43	0.1	0.8800	8.92	4.50	20		2.6	2252	1.1		0.1	0.91	11.89	1.11	13.22	184.93	93.19
42	1.01	1.91	Granular	11.38	3.37	5.49	63.28	4.00	2.07	1.41	88.98	0.15	1.00	0.22	0.07	0.14	0.7	2.2	2.07	0.1	0.8800	8.19	4.15	15		2.6	3763	1.1		0.1	0.91	11.75	1.11	13.06	182.99	92.69
43	1.49	2.05	Granular	8.08	2.84	4.32	61.46	4.00	2.19	1.63	100.43	0.17	1.00	0.22	0.07	0.14	0.7	2.2	1.87	0.1	0.8800	8.86	4.51	19		2.6	4333	1.1		0.1	0.91	9.61	1.11	10.68	149.81	76.28
44	1.34	2.17	Granular	6.30	2.51	3.63	41.11	2.00	2.30	1.94	79.69	0.13	1.00	0.21	0.07	0.14	0.7	2.2	1.74	0.1	0.8800	6.01	3.07	22		2.6	3269	1.1		0.1	0.91	5.65	1.11	6.28	88.27	45.18
45	1.93	2.67	Very Silty	5.14	2.27	3.14	19.08	2.00	2.67	3.78	72.04	0.11	0.99	0.21	0.07	0.14	0.7	2.2	1.63	0.1	0.8800	5.11	2.63	39		2.6	1184	1.1		0.1	0.91	1.67	1.11	1.85	26.10	13.43
46	0.88	2.24	Granular	4.35	2.09	2.80	27.26	2.00	2.35	2.13	57.96	0.10	0.99	0.21	0.07	0.14	0.7	2.2	1.55	0.1	0.8800	4.16	2.15	24		2.6	2586	1.1		0.1	0.91	3.09	1.11	3.43	48.43	25.05
47	1.39	2.49	Granular	3.77	1.94	2.53	19.02	2.00	2.59	3.27	62.11	0.10	0.99	0.21	0.07	0.14	0.7	2.2	1.49	0.1	0.8800	4.16	2.16	35		2.6	1922	1.1		0.1	0.91	1.99	1.11	2.21	31.17	16.21
48	1.86	3.08	Clayey	3.33	1.82	2.32	9.47	2.00	2.95	6.17	58.36	0.10	0.99	0.21	0.07	0.14	0.7	2.2	1.43	0.1	0.8800	3.87	2.02	55		2.6	513	1.1		0.1	0.91	0.47	1.11	0.52	7.36	3.85
49	0.89	2.55	Very Silty	2.98	1.73	2.15	16.67	2.00	2.55	3.04	50.70	0.09	0.99	0.21	0.07	0.13	0.7	2.2	1.39	0.1	0.8800	3.51	1.84	33		2.6	1496	1.1		0.1	0.91	1.22	1.11	1.36	19.27	10.13
50	1.01	2.39	Granular	2.70	1.64	2.00	22.08	2.00	2.46	2.59	57.29	0.10	0.99	0.21	0.07	0.13	0.7	2.2	1.35	0.1	0.8800	3.61	1.91	29		2.6	2634	1.1		0.1	0.91	1.95	1.11	2.17	30.76	16.26
51	1.15	2.44	Granular	2.47	1.57	1.88	21.36	2.00	2.50	2.79	59.66	0.10	0.98	0.21	0.07	0.13	0.7	2.2	1.31	0.1	0.8800	3.60	1.91	31		2.6	2659	1.1		0.1	0.91	1.80	1.11	2.00	28.42	15.11
52	1.92	2.77	Clayey	2.27	1.51	1.77	18.89	2.00	2.68	3.84	72.56	0.12	0.98	0.21	0.07	0.13	0.7	2.2	1.28	0.1	0.8800	4.07	2.17	39		2.6	1591	1.1		0.1	0.91	0.99	1.11	1.10	15.64	8.36
53	1.01	2.43	Granular	2.10	1.45	1.68	20.98	2.00	2.49	2.70	56.59	0.10	0.98	0.20	0.07	0.13	0.7	2.2	1.25	0.1	0.8800	3.34	1.79	30		2.6	2822	1.1		0.1	0.91	1.63	1.11	1.81	25.75	13.84
54	1.78	2.72	Clayey	1.95	1.40	1.60	19.61	2.00	2.65	3.63	71.12	0.11	0.98	0.20	0.07	0.13	0.7	2.2	1.22	0.1	0.8800	3.83	2.07	38		2.6	1922	1.1		0.1	0.91	1.03	1.11	1.14	16.33	8.82
55	1.15	2.54	Granular	1.82	1.35	1.52	17.41	2.00	2.59	3.25	56.55	0.10	0.98	0.20	0.07	0.13	0.7	2.2	1.20	0.1	0.8800	3.21	1.74	35		2.6	2488	1.1		0.1	0.91	1.25	1.11	1.38	19.78	10.75
56	1.20	2.61	Very Silty	1.71	1.31	1.46	16.90	2.00	2.61	3.40	57.39	0.10	0.98	0.20	0.07	0.13	0.7	2.2	1.18	0.1	0.8800	3.18	1.74	36		2.6	2218	1.1		0.1	0.91	1.04	1.11	1.16	16.60	9.07
57	2.00	2.88	Clayey	1.62	1.27	1.40	13.22	2.00	2.83	5.02	66.33	0.11	0.98	0.20	0.07	0.13	0.7	2.2	1.15	0.1	0.8800	3.43	1.89	48		2.6	1525	1.1		0.1	0.91	0.68	1.11	0.75	10.77	5.92
58	4.08	3.35	Clayey	1.53	1.24	1.35	6.32	2.00	3.30	10.70	67.57	0.11	0.97	0.20	0.07	0.13	0.7	2.2	1.14	0.1	0.8800	3.43	1.90	81		2.6	701	1.1		0.1	0.91	0.29	1.11	0.33	4.69	2.59
59	1.79	2.76	Clayey	1.45	1.20	1.30	16.30	2.00	2.72	4.14	67.45	0.11	0.97	0.20	0.07	0.13	0.7	2.2	1.12	0.1	0.8800	3.38	1.88	41		2.6	2124	1.1		0.1	0.91	0.85	1.11	0.94	13.51	7.51
60	3.29	3.32	Clayey	1.38	1.18	1.25	5.76	2.00	3.29	10.55	60.73	0.10	0.97	0.20	0.07	0.12	0.7	2.2	1.10	0.1	0.8800	3.10	1.73	80		2.6	694	1.1		0.1	0.91	0.26	1.11	0.29	4.21	2.35
61	1.56	2.81	Clayey	1.32	1.15	1.21	12.99	2.00	2.78	4.59	59.68	0.10	0.97	0.20	0.07	0.12	0.7	2.2	1.09	0.1	0.8800	3.02	1.70	45		2.6	1834	1.1		0.1	0.91	0.66	1.11	0.74	10.62	5.97
62	2.57	3.14	Clayey	1.26	1.12	1.17	7.47	2.00	3.12	8.17	61.02	0.10	0.97	0.19	0.07	0.12	0.7	2.2	1.07	0.1	0.8800	3.03	1.71	67		2.6	1036	1.1		0.1	0.91	0.36	1.11	0.40	5.74	3.25
63	1.44	2.81	Clayey	1.21	1.10	1.14	12.11	2.00	2.79	4.68	56.72	0.10	0.97	0.19	0.07	0.12	0.7	2.2	1.06	0.1	0.8800	2.87	1.63	45		2.6	1858	1.1		0.1	0.91	0.61	1.11	0.68	9.87	5.61
64	1.15	2.64	Clayey	1.16	1.07	1.11	16.23	2.00	2.62	3.46	56.10	0.10	0.97	0.19	0.07	0.12	0.7	2.2	1.04	0.1	0.8800	2.82	1.61	36		2.6	2658	1.1		0.1	0.91	0.84	1.11	0.94	13.56	7.76
65	1.18	2.66	Clayey	1.11	1.05	1.08	15.23	2.00	2.65	3.67	55.81	0.10	0.96	0.19	0.07	0.12	0.7	2.2	1.03	0.1	0.8800	2.79	1.60	38		2.6	2582	1.1		0.1	0.91	0.79	1.11	0.87	12.68	7.30
66	3.24	3.23	Clayey	1.07	1.03	1.05	6.60	2.00	3.23	9.61	63.44	0.10	0.96	0.19	0.07	0.12	0.7	2.2	1.02	0.1	0.8800	2.97	1.72	75		2.6	1057	1.1		0.1	0.91	0.31	1.11	0.34	5.00	2.89
67	4.03	3.47	Clayey	1.03	1.01	1.02	4.38	2.00	3.46	13.40	58.66	0.10	0.96	0.19	0.07	0.12	0.7	2.2	1.01	0.1	0.8800	2.80	1.63	95		2.6	661	1.1		0.1	0.91	0.19	1.11	0.21	3.02	1.76
68	2.89	3.60	Clayey	0.99	1.00	1.00	2.95	2.00	3.60	15.94	47.00	0.08	0.96	0.19	0.07	0.12	0.7	2.2	1.00	0.1	0.8800	2.27	1.33	100		2.6	395	1.1		0.1	0.91	0.11	1.11	0.12	1.74	1.02
69	2.52	3.37	Clayey	0.96	0.98	0.97	4.24	2.00	3.37	11.91	50.48	0.09	0.96	0.19	0.07	0.12	0.7	2.2	0.99	0.1	0.8800	2.57	1.51	87		2.6	680	1.1		0.1	0.91	0.18	1.11	0.20	2.90	1.71
70	0.94	2.61	Clayey	0.93	0.96	0.95	14.95	2.00	2.61	3.42	51.08	0.09	0.96	0.19	0.07	0.12	0.7	2.2	0.98	0.1	0.8800	2.56	1.52	36		2.6	3027	1.1		0.1	0.91	0.77	1.11	0.86	12.54	7.44
71	1.54	2.76	Clayey	0.90	0.95	0.93	13.14	2.00	2.77	4.53	59.58	0.10	0.96	0.18	0.07	0.11	0.7	2.2	0.97	0.1	0.8800	2.74	1.63	44		2.6	2722	1.1		0.1	0.91	0.67	1.11	0.75	10.93	6.53
72	3.89	3.41	Clayey	0.88	0.94	0.92	4.66	2.00	3.43	12.77	59.48	0.10	0.95	0.18	0.07	0.12	0.7	2.2	0.96	0.1	0.8800	2.69	1.61	92		2.6	832	1.1		0.1	0.91	0.20	1.11	0.22	3.24	1.95
73	2.46	3.19	Clayey	0.87	0.93	0.91	6.06	2.00	3.20	9.28	56.28	0.10	0.95	0.18	0.07	0.12	0.7	2.2	0.96	0.1	0.8800	2.56	1.55	73		2.6	1164	1.1		0.1	0.91	0.28	1.11	0.31	4.41	2.67
74	2.14	2.98	Clayey	0.86	0.93	0.90	9.02	2.00	3.00	6.74	60.82	0.10	0.95	0.18	0.07	0.12	0.7	2.2	0.96	0.1	0.8800	2.63	1.60	58		2.6	1871	1.1		0.1	0.91	0.44	1.11	0.49	6.90	4.20
75	3.18	3.15	Clayey	0.85	0.92	0.89	7.62	2.00	3.16	8.75	66.63	0.11	0.95	0.18	0.07	0.12	0.7	2.2	0.95	0.1	0.8800	2.75	1.68	70		2.6	1559	1.1		0.1	0.91	0.36	1.11	0.40	5.60	3.43
76	2.33	3.17	Clayey	0.84	0.91	0.88	6.16	2.00	3.19	9.07	55.91	0.10	0.95	0.18	0.07	0.12	0.7	2.2	0.95	0.1	0.8800	2.42	1.49	72		2.6	1226	1.1		0.1	0.91	0.28	1.11	0.31	4.29	2.64
77	0.92	2.46	Granular	0.82	0.91	0.87	22.61	2.00	2.45	2.51	56.71	0.10	0.94	0.18	0.07	0.12	0.7	2.2	0.94	0.1	0.8800	2.40	1.49	28		2.6	4750	1.1		0.1	0.91	1.08	1.11	1.19	16.21	10.05
78	1.23	2.60	Clayey	0.81	0.90	0.87	16.73	2.00	2.63	3.49	58.41	0.10	0.94	0.18	0.07	0.12	0.7	2.2	0.94	0.1	0.8800	2.41	1.50	37		2.6	3870	1.1		0.1	0.91	0.86	1.11	0.96	12.89	8.04
79	4.88	3.42	Clayey	0.80	0.90	0.86	5.17	2.00	3.44	13.02	67.31	0.11	0.94	0.18	0.08	0.12	0.7	2.2	0.94	0.1	0.8800	2.61	1.64	93		2.6	1016	1.1		0.1	0.91	0.22	1.11	0.25	3.31	2.08
80	1.51	2.80	Clayey	0.79	0.89	0.85	11.58	2.00	2.82	4.97	57.59	0.10	0.94	0.17	0.08	0.12	0.7	2.2	0.93	0.1	0.8800	2.32	1.47	47		2.6	2654	1.1		0.1	0.91	0.58	1.11	0.64	8.46	5.34
81	1.72	2.81	Clayey	0.78	0.88	0.84	11.92	2.00	2.84	5.12	61.08	0.10	0.93	0.17	0.08	0.12	0.7	2.2	0.93	0.1	0.8800	2.38	1.51	48		2.6	2773	1.1		0.1	0.91	0.60	1.11	0.66	8.64	5.50
82	1.26	2.75	Clayey	0.77	0.88	0.84	11.62	2.00	2.78	4.64	53.96	0.09	0.93	0.17	0.08	0.12	0.7	2.2	0.93	0.1	0.8800	2.19	1.40	45		2.6	2726	1.1		0.1	0.91	0.58	1.11	0.64	8.32	5.33
83	1.46	2.75	Clayey	0.76	0.87	0.83	12.55	2.00	2.78	4.64	58.22	0.10	0.93	0.17	0.08	0.12	0.7	2.2	0.92	0.1	0.8800	2.25	1.45	45		2.6	3002	1.1		0.1	0.91	0.63	1.11	0.70	8.98	5.79
84	2.70	3.06	Clayey	0.75	0.87	0.82	8.33	2.00	3.09	7.84	65.34	0.11	0.92	0.17	0.08	0.12	0.7	2.2	0.92	0.1	0.8800	2.40	1.56	65		2.6	1908	1.1		0.1	0.91	0.40	1.11	0.44	5.60	3.63
85	3.26	3.37	Clayey	0.75	0.86	0.81	4.66	2.00	3.41	12.42	57.83	0.10	0.92	0.17	0.08	0.12	0.7	2.2	0.92	0.1	0.8800	2.20	1.44	90		2.6	935	1.1		0.1	0.91	0.19	1.11	0.21	2.69	1.76
86	2.87	3.52	Clayey	0.74	0.86	0.81	3.40	2.00	3.55	15.05	51.12	0.09	0.92	0.17	0.08	0.12	0.7	2.2	0.91	0.1	0.8800	2.05	1.35	100		2.6	598	1.1		0.1	0.91	0.12	1.11	0.13	1.69	1.11
87	3.02	3.31	Clayey	0.73	0.85	0.80	5.10	2.00	3.35	11.43	58.29	0.10	0.91	0.17	0.08	0.12	0.7	2.2	0.91	0.1	0.8800	2.17	1.43	85		2.6	1073	1.1		0.1	0.91	0.21	1.11	0.24	2.98	1.97
88	3.58	3.54	Clayey	0.72	0.85	0.79	3.51	2.00	3.58	15.64	54.95	0.10	0.91	0.17	0.08	0.12	0.7	2.2	0.91	0.1	0.8800	2.08	1.39	100		2.6	639	1.1		0.1	0.91	0.13	1.11	0.14	1.75	1.16
89	3.63	3.43	Clayey	0.71	0.84	0.79	4.39	2.00	3.46	13.45	59.05	0.10	0.91	0.16	0.08	0.12	0.7	2.2	0.90	0.1	0.8800	2.15	1.44	96		2.6	891	1.1		0.1	0.91	0.17	1.11	0.19	2.39	1.61
90	2.37	3.46	Clayey	0.70	0.84	0.78	3.50	2.00	3.50	14.16	49.51	0.08	0.90	0.16	0.08	0.12	0.7	2.2	0.90	0.1	0.8800	1.78	1.20	100		2.6	642	1.1		0.1	0.91	0.12	1.11	0.14	1.70	1.15
91	1.77	3.35	Clayey	0.70	0.83	0.78	3.86	2.00	3.39	12.18	47.00	0.08	0.90	0.16	0.08	0.12	0.7	2.2	0.90	0.1	0.8800	1.72	1.17	89		2.6	751	1.1		0.1	0.91	0.14	1.11	0.16	1.96	1.33
92	1.94	2.98	Clayey	0.69	0.83	0.77	8.33	2.00	3.02	7.01	58.43	0.10	0.89	0.16	0.08	0.12	0.7	2.2	0.89	0.1	0.8800	2.09	1.43	60		2.6	2066	1.1		0.1	0.91	0.39	1.11	0.43	5.31	3.64
93	2.87	3.11	Clayey	0.68	0.82	0.76	7.56	2.00	3.16	8.65	65.36	0.11	0.89	0.16	0.08	0.12	0.7	2.2	0.89	0.1	0.8800	2.23	1.54	70		2.6	1857	1.1		0.1	0.91	0.35	1.11	0.39	4.71	3.25
94	3.87	3.30	Clayey	0.67	0.82	0.76	5.90	2.00	3.34	11.32	66.81	0.11	0.89	0.16	0.08	0.12	0.7	2.2	0.89	0.1	0.8800	2.26	1.57	84		2.6	1378	1.1		0.1	0.91	0.25	1.11	0.28	3.45	2.40
95	2.70	3.43	Clayey	0.67	0.82	0.75	3.87	2.00	3.48	13.69	52.99	0.09	0.88	0.16	0.08	0.12	0.7	2.2	0.89	0.1	0.8800	1.96	1.37	97		2.6	776	1.1		0.1	0.91	0.14	1.11	0.16	1.92	1.34
96	2.14	3.47	Clayey	0.66	0.81	0.75	3.35	2.00	3.52	14.48	48.54	0.08	0.88	0.16	0.08	0.12	0.7	2.2	0.88	0.1	0.8800	1.70	1.20	100		2.6	622	1.1		0.1	0.91	0.11	1.11	0.13	1.52	1.07
97	1.77	3.36	Clayey	0.65	0.81	0.74	3.77	2.00	3.41	12.56	47.33	0.08	0.87	0.15	0.08	0.12	0.7	2.2	0.88	0.1	0.8800	1.67	1.19	91		2.6	754	1.1		0.1	0.91	0.14	1.11	0.15	1.82	1.29
98	2.18	3.09	Clayey	0.65	0.80	0.74	6.93	2.00	3.14	8.39	58.19	0.10	0.86	0.15	0.08	0.12	0.7	2.2	0.88	0.1	0.8800	2.02	1.45	68		2.6	1747	1.1		0.1	0.91	0.31	1.11	0.34	4.17	2.99
99	3.35	3.28	Clayey	0.64	0.80	0.73	5.67	2.00	3.33	11.15	63.25	0.10	0.86	0.15	0.08	0.11	0.7	2.2	0.87	0.1	0.8800	2.12	1.53	83		2.6	1365	1.1		0.1	0.91	0.24	1.11	0.27	3.22	2.33
100	2.22	3.50	Clayey	0.63	0.80	0.73	3.24	2.00	3.56	15.15	49.13	0.08	0.85	0.15	0.08	0.11	0.7	2.2	0.87	0.1	0.8800	1.69	1.23	100		2.6	602	1.1		0.1	0.91	0.10	1.11	0.12	1.41	1.02
101	1.29	3.09	Clayey	0.63	0.79	0.72	5.51	2.00	3.15	8.52	46.97	0.08	0.85	0.15	0.08	0.11	0.7	2.2	0.87	0.1	0.8800	1.65	1.21	69		2.6	1334	1.1		0.1	0.91	0.23	1.11	0.26	3.09	2.26
102	2.28	2.97	Clayey	0.62	0.79	0.72	9.09	2.00	3.03	7.04	63.99	0.10	0.84	0.15	0.08	0.11	0.7	2.2	0.87	0.1	0.8800	2.12	1.57	60		2.6	2509	1.1		0.1	0.91	0.43	1.11	0.47	5.76	4.25
103	2.25	3.38	Clayey	0.61	0.78	0.71	3.95	2.00	3.44	13.01	51.44	0.09	0.84	0.15	0.08	0.11	0.7	2.2	0.86	0.1	0.8800	1.88	1.40	93		2.6	845	1.1		0.1	0.91	0.14	1.11	0.16	1.92	1.43
104	3.45	3.42	Clayey	0.61	0.78	0.71	4.39	2.00	3.47	13.56	59.47	0.10	0.83	0.15	0.08	0.11	0.7	2.2	0.86	0.1	0.8800	2.02	1.51	96		2.6	994	1.1		0.1	0.91	0.17	1.11	0.18	2.24	1.68
105	1.48	3.01	Clayey	0.60	0.78	0.70	6.77	2.00	3.07	7.59	51.36	0.09	0.82	0.15	0.08	0.11	0.7	2.2	0.86	0.1	0.8800	1.88	1.42	64		2.6	1798	1.1		0.1	0.91	0.30	1.11	0.33	4.02	3.04
106	2.59	3.07	Clayey	0.60	0.77	0.70	7.72	2.00	3.13	8.30	64.07	0.10	0.82	0.14	0.08	0.11	0.7	2.2	0.86	0.1	0.8800	2.11	1.61	68		2.6	2134	1.1		0.1	0.91	0.35	1.11	0.39	4.74	3.61
107	4.07	3.37	Clayey	0.59	0.77	0.69	5.11	2.00	3.43	12.85	65.67	0.11	0.81	0.14	0.08	0.11	0.7	2.2	0.85	0.1	0.8800	2.15	1.65	92		2.6	1262	1.1		0.1	0.91	0.20	1.11	0.23	2.78	2.13
108	5.10	3.62	Clayey	0.59	0.77	0.69	3.58	2.00	3.68	17.61	63.14	0.10	0.80	0.14	0.08	0.11	0.7	2.2	0.85	0.1	0.8800	2.09	1.62	100		2.6	746	1.1		0.1	0.91	0.12	1.11	0.13	1.64	1.26
109	2.51	3.46	Clayey	0.58	0.76	0.68	3.61	2.00	3.52	14.53	52.48	0.09	0.80	0.14	0.08	0.10	0.7	2.2	0.85	0.1	0.8800	1.89	1.47	100		2.6	760	1.1		0.1	0.91	0.12	1.11	0.13	1.66	1.29
110	1.93	3.40	Clayey	0.57	0.76	0.68	3.68	2.00	3.46	13.43	49.38	0.08	0.79	0.14	0.08	0.10	0.7	2.2	0.85	0.1	0.8800	1.68	1.32	95		2.6	788	1.1		0.1	0.91	0.12	1.11	0.14	1.71	1.34
111	1.76	3.40	Clayey	0.57	0.75	0.67	3.58	2.00	3.46	13.44	48.14	0.08	0.78	0.14	0.08	0.10	0.7	2.2	0.84	0.1	0.8800	1.66	1.31	96		2.6	758	1.1		0.1	0.91	0.12	1.11	0.13	1.63	1.29
112	1.98	3.42	Clayey	0.56	0.75	0.67	3.60	2.00	3.48	13.81	49.70	0.08	0.78	0.14	0.08	0.10	0.7	2.2	0.84	0.1	0.8800	1.69	1.35	97		2.6	768	1.1		0.1	0.91	0.12	1.11	0.13	1.65	1.31
113	2.15	3.47	Clayey	0.56	0.75	0.67	3.42	2.00	3.54	14.75	50.44	0.09	0.77	0.14	0.08	0.10	0.7	2.2	0.84	0.1	0.8800	1.87	1.50	100		2.6	708	1.1		0.1	0.91	0.11	1.11	0.12	1.51	1.22
114	2.15	3.47	Clayey	0.56	0.75	0.66	3.41	2.00	3.54	14.80	50.50	0.09	0.76	0.14	0.08	0.10	0.7	2.2	0.84	0.1	0.8800	1.87	1.52	100		2.6	708	1.1		0.1	0.91	0.11	1.11	0.12	1.50	1.22
115	2.20	3.48	Clayey	0.55	0.74	0.66	3.36	2.00	3.55	15.10	50.75	0.09	0.76	0.13	0.08	0.10	0.7	2.2	0.84	0.1	0.8800	1.88	1.54	100		2.6	694	1.1		0.1	0.91	0.10	1.11	0.12	1.47	1.20
116	1.97	3.42	Clayey	0.55	0.74	0.65	3.57	2.00	3.49	13.99	49.90	0.08	0.75	0.13	0.08	0.10	0.7	2.2	0.83	0.1	0.8800	1.70	1.40	98		2.6	773	1.1		0.1	0.91	0.12	1.11	0.13	1.63	1.34
117	2.01	3.35	Clayey	0.54	0.74	0.65	4.03	2.00	3.42	12.69	51.13	0.09	0.74	0.13	0.08	0.09	0.7	2.2	0.83	0.1	0.8800	1.89	1.57	92		2.6	948	1.1		0.1	0.91	0.14	1.11	0.16	1.99	1.66
118	1.69	2.97	Clayey	0.54	0.73	0.65	7.80	2.00	3.04	7.16	55.87	0.10	0.74	0.13	0.08	0.09	0.7	2.2	0.83	0.1	0.8800	1.97	1.66	61		2.6	1382	1.1		0.1	0.91	0.20	1.11	0.23	2.89	2.43
119	2.80	3.06	Clayey	0.53	0.73	0.64	8.14	2.00	3.13	8.29	67.46	0.11	0.73	0.13	0.08	0.09	0.7	2.2	0.83	0.1	0.8800	2.23	1.89	68		2.6	1469	1.1		0.1	0.91	0.21	1.11	0.24	3.06	2.59
120	3.48	3.06	Clayey	0.53	0.73	0.64	9.23	2.00	3.13	8.26	76.18	0.12	0.72	0.13	0.08	0.09	0.7	2.2	0.83	0.1	0.8800	2.49	2.13	67		2.6	1722	1.1		0.1	0.91	0.25	1.11	0.28	3.57	3.05
121	3.63	3.11	Clayey	0.52	0.72	0.64	8.31	2.00	3.18	9.00	74.77	0.12	0.72	0.13	0.08	0.09	0.7	2.2	0.82	0.1	0.8800	2.45	2.12	72		2.6	1530	1.1		0.1	0.91	0.22	1.11	0.24	3.16	2.73
122	4.20	3.01	Clayey	0.52	0.72	0.63	11.68	2.00	3.08	7.63	89.09	0.15	0.71	0.13	0.08	0.09	0.7	2.2	0.82	0.1	0.8800	3.02	2.62	64		2.6	2303	1.1		0.1	0.91	0.33	1.11	0.36	4.75	4.13
123	3.28	2.94	Clayey	0.51	0.72	0.63	11.75	2.00	3.01	6.86	80.64	0.13	0.71	0.13	0.08	0.09	0.7	2.2	0.82	0.1	0.8800	2.67	2.35	59		2.6	2338	1.1		0.1	0.91	0.33	1.11	0.37	4.80	4.21
124	3.41	3.11	Clayey	0.51	0.71	0.62	8.02	2.00	3.18	9.02	72.34	0.12	0.70	0.12	0.08	0.09	0.7	2.2	0.82	0.1	0.8800	2.40	2.12	72		2.6	1497	1.1		0.1	0.91	0.21	1.11	0.23	3.06	2.71
125	3.19	3.24	Clayey	0.51	0.71	0.62	5.88	2.00	3.31	10.94	64.33	0.10	0.69	0.12	0.08	0.08	0.7	2.2	0.82	0.1	0.8800	2.19	1.95	82		2.6	1011	1.1		0.1	0.91	0.14	1.11	0.16	2.06	1.84
126	2.83	3.26	Clayey	0.50	0.71	0.62	5.39	2.00	3.33	11.24	60.55	0.10	0.69	0.12	0.08	0.08	0.7	2.2	0.81	0.1	0.8800	2.10	1.90	84		2.6	903	1.1		0.1	0.91	0.12	1.11	0.14	1.84	1.66
127	2.57	3.27	Clayey	0.50	0.71	0.61	5.02	2.00	3.35	11.53	57.84	0.10	0.68	0.12	0.07	0.08	0.7	2.2	0.81	0.1	0.8800	2.06	1.87	85		2.6	821	1.1		0.1	0.91	0.11	1.11	0.12	1.67	1.52
128	2.09	3.15	Clayey	0.49	0.70	0.61	5.79	2.00	3.23	9.70	56.19	0.10	0.68	0.12	0.07	0.08	0.7	2.2	0.81	0.1	0.8800	2.03	1.87	76		2.6	1012	1.1		0.1	0.91	0.14	1.11	0.15	2.05	1.88
129	2.46	3.23	Clayey	0.49	0.70	0.61	5.31	2.00	3.31	10.91	57.96	0.10	0.67	0.12	0.07	0.08	0.7	2.2	0.81	0.1	0.8800	2.07	1.92	82		2.6	903	1.1		0.1	0.91	0.12	1.11	0.14	1.82	1.69
130	2.19	3.25	Clayey	0.49	0.70	0.60	4.92	2.00	3.33	11.20	55.06	0.10	0.66	0.12	0.07	0.08	0.7	2.2	0.81	0.1	0.8800	2.02	1.89	84		2.6	813	1.1		0.1	0.91	0.11	1.11	0.12	1.64	1.53
131	2.00	3.11	Clayey	0.48	0.69	0.60	6.11	2.00	3.20	9.21	56.27	0.10	0.66	0.12	0.07	0.08	0.7	2.2	0.80	0.1	0.8800	2.05	1.94	73		2.6	1109	1.1		0.1	0.91	0.15	1.11	0.16	2.22	2.10
132	2.49	3.19	Clayey	0.48	0.69	0.60	5.74	2.00	3.28	10.34	59.39	0.10	0.65	0.12	0.07	0.08	0.7	2.2	0.80	0.1	0.8800	2.11	2.02	79		2.6	1026	1.1		0.1	0.91	0.13	1.11	0.15	2.05	1.96
133	2.19	2.80	Clayey	0.47	0.69	0.59	12.86	2.00	2.88	5.48	70.40	0.11	0.65	0.11	0.07	0.08	0.7	2.2	0.80	0.1	0.8800	2.40	2.31	51		2.6	2794	1.1		0.1	0.91	0.36	1.11	0.40	5.57	5.37
134	2.59	2.89	Clayey	0.47	0.69	0.59	11.19	2.00	2.98	6.48	72.49	0.12	0.64	0.11	0.07	0.07	0.7	2.2	0.80	0.1	0.8800	2.46	2.40	57		2.6	2399	1.1		0.1	0.91	0.31	1.11	0.34	4.77	4.65
135	2.24	3.05	Clayey	0.47	0.68	0.59	7.31	2.00	3.13	8.35	61.03	0.10	0.64	0.11	0.07	0.07	0.7	2.2	0.80	0.1	0.8800	2.16	2.13	68		2.6	1441	1.1		0.1	0.91	0.19	1.11	0.21	2.86	2.81
136	7.84	3.38	Clayey	0.46	0.68	0.58	7.01	2.00	3.46	13.32	93.37	0.16	0.63	0.11	0.07	0.07	0.7	2.2	0.79	0.1	0.8800	3.34	3.32	95		2.6	1374	1.1		0.1	0.91	0.18	1.11	0.19	2.71	2.70
137	0.38	1.32	Granular	0.46	0.68	0.58	302.64	52.00	1.27	1.00	302.64	2.66	0.63	0.11	0.07	0.07	0.7	2.2	0.79	0.1	0.0000	0.00	0.00	0		2.6	89169	1.1		0.1	0.91	11.28	1.11	12.53	175.57	176.48

CPTU-605 Liquefaction Analysis

ConeTec Inc. - CPT Interpretation
Interpretation Output - Release 1.22 Rev. A - Format: NLI Imperial
Run No: 06-0718-0954-3042
Job No: 02-100
Client: MACTEC Engineering and Consulting Inc.
Project: Former Callahan Mine Site, Brooksville, ME
Site: CP-605
Location: Callahan Mine
Cone: 20 Ton AD179
CPT Date: 06/28/06
CPT Time: 16:49
CPT File: 758CP605.COR
Northing (m): 0
Easting (m): 0
Elevation (m): 0 — 69.8 — Elevation For CPT Triggering analysis

Water Table (m): 0.91 (ft): 3.0 — 3 — Water Table assumed for CPT Analysis
Unit Weight of Water (default): 62.4 pcf
Averaging Increment (m): 0.2
Phi Method : Robertson and Campanella, 1983
Su Nkt used: 15 Su/P' (nc): 0.30 — 0.11 — Base acceleration
Dr Method : Jamiolkowski - All Sands
State Parameter M: 1.2
Used Unit Weights Assigned to Soil Zones
N160lc Calculated using qc1n

1) CSR = $0.65*(a_{max}/g)*(s_v/s'_v)*r_d$ — Seed & Idriss, 1983, p. 459

a_{max}/g = 0.11 g — USGS (base)(amplified from base as discussed in
s_v = computed — Total Vertical Stress
s'_v = computed — Effective Vertical Stress

$r_d = [1.0 - 0.4113z^{0.5} + 0.04052z + 0.001753z^{1.5}] / [1 - 0.4177z^{0.5} + 0.05729z - 0.$

z = depth in meters

2) FS = Factor of safety against triggering of liquefaction: $FS = (CRR_{7.5}/CSR) \times MSF \times K_s \times K_a$

MSF = magnitude scaling factor; Assume based on range recommended by NCEER Wo

CPTU-605 Liquefaction Analysis

$K_s = (s'_{vo}/P_a)^{(f-1)}$, where f = 0.7 to 0.8 for relative density of 40 to 60%; f = 0.6 to 0.7 fo
1 Atmosphere = 14.7 psi = 2.12 ksf

Conetec Data

Col-01 Depth (m)	Col-02 Depth (ft)	Col-03 Elev. (m)	Col-04 Elev. (ft)	Col-05 qc (tsf)	Col-06 qt (tsf)	Col-07 fs (tsf)	Col-08 Rf (%)	Col-09 u (ft)	Col-10 SBT (Zone)	Col-11 SBTn (Zone)	Col-12 SBT-BQ (Zone)	Col-13 SBT-BQn (Zone)	Col-14 Perm-k (cm/s)	Col-15 Unit Wt (pcf)	Col-16 T Stress (tsf)	Col-17 U Stress (tsf)	Col-18 E Stress (tsf)	Col-19 Cn	Col-20 N60 (b/ft)	Col-21 N1(60) (b/ft)	Col-22 N(60)lc (b/ft)	Col-23 N1(60)lc (b/ft)	Col-24 Qt	Col-25 Fr (%)	Col-26 Bq	Col-27 Ic	Col-28 FC (%)	Col-29 IcZone (Zone)	Col-30 Dr (%)	Col-31 Phi (deg)	Col-32 State Par	Col-33 Es/qt	Col-34 YoungE (tsf)	Col-35 Su (tsf)	Col-36 OCR	Col-37 U (psf)	Col-38 s_{vo} (psf)	Col-39 q_c (psf)	Col-40 q_t (psf)	Col-41 P_a (psf)	Col-42 σ'_{vo} (psf)	Col-43 f_1 (psf)	Col-44 $Q_{exp=1}$	Col-45 F
0.1	0.328	-0.1	69.5	2.71	2.71	0.04	1.57	-0.3	1	6	3	6	1.00E-07	111.4	0.018	0	0.018	1.7	1.3	2.2	1	1.7	147.45	1.58	0	3.16	70	3	-9999	-9999	-9999	-9999	-9999	0.18	10	0	36	5420	5420	2116	36	80	149.56	1.49
0.3	0.984	-0.3	68.8	2.37	2.39	0.01	0.52	6.12	1	6	3	5	1.00E-07	111.4	0.055	0	0.055	1.7	1.1	1.9	0.8	1.3	42.68	0.54	0.08	3.03	60.6	3	-9999	-9999	-9999	-9999	-9999	0.156	10	0	110	4740	4780	2116	110	20	42.45	0.43
0.5	1.64	-0.5	68.2	2.38	2.43	0.01	0.41	10.75	1	5	3	5	1.00E-07	111.4	0.091	0	0.091	1.7	1.2	2	0.8	1.3	25.58	0.43	0.14	3	58.3	3	-9999	-9999	-9999	-9999	-9999	0.156	10	0	182	4760	4860	2116	182	20	25.70	0.43
0.7	2.297	-0.7	67.5	2.35	2.41	0.01	0.42	13.26	1	5	3	4	1.00E-07	111.4	0.128	0	0.128	1.7	1.2	2	0.8	1.3	17.82	0.44	0.18	3	58.7	3	-9999	-9999	-9999	-9999	-9999	0.152	5.9	0	256	4700	4820	2116	256	20	17.83	0.44
0.9	2.953	-0.9	66.8	2.36	2.44	0.01	0.41	15.64	1	5	3	4	1.00E-07	111.4	0.164	0	0.164	1.7	1.2	2	0.8	1.3	13.82	0.44	0.21	3	58.4	3	-9999	-9999	-9999	-9999	-9999	0.151	4	0	328	4720	4880	2116	328	20	13.88	0.44
1.1	3.609	-1.1	66.2	2	2.08	0.01	0.48	17.69	1	4	3	3	1.00E-07	111.4	0.201	0.019	0.182	1.7	1	1.7	0.5	2.8	10.33	0.53	0.28	2.63	37	4	-9999	-9999	-9999	-9999	-9999	0.125	2.6	38	402	4000	4160	2116	364	20	10.32	0.53
1.3	4.265	-1.3	65.5	1.9	1.99	0.01	0.5	20.14	1	4	3	3	1.00E-07	111.4	0.238	0.039	0.198	1.7	1	1.6	0.5	2.5	8.87	0.57	0.34	2.7	40.7	4	-9999	-9999	-9999	-9999	-9999	0.117	2.2	79	476	3800	3980	2116	397	20	8.82	0.57
1.5	4.921	-1.5	64.9	1.85	1.95	0.01	0.51	21.99	1	4	3	3	1.00E-07	111.4	0.274	0.06	0.214	1.7	0.9	1.6	0.6	2.3	7.85	0.6	0.37	2.76	43.8	4	-9999	-9999	-9999	-9999	-9999	0.112	1.8	120	548	3700	3900	2116	428	20	7.83	0.60
1.7	5.577	-1.7	64.2	1.79	1.9	0.01	0.53	24.41	1	4	3	3	1.00E-07	111.4	0.311	0.08	0.23	1.7	0.9	1.5	0.6	2.1	6.92	0.63	0.43	2.82	47.2	4	-9999	-9999	-9999	-9999	-9999	0.106	1.6	161	622	3580	3800	2116	461	20	6.89	0.63
1.9	6.234	-1.9	63.6	1.87	1.99	0.01	0.5	26.23	1	4	3	3	1.00E-07	111.4	0.347	0.101	0.246	1.7	1	1.6	0.6	2	6.68	0.61	0.44	2.83	47.7	4	-9999	-9999	-9999	-9999	-9999	0.11	1.5	202	694	3740	3980	2116	492	20	6.68	0.61
2.1	6.89	-2.1	62.9	1.5	1.64	0.01	0.61	28.17	1	3	3	3	1.00E-07	111.4	0.384	0.121	0.262	1.7	0.8	1.3	0.5	1.6	4.77	0.8	0.61	3.01	59.1	3	-9999	-9999	-9999	-9999	-9999	0.083	1.1	243	768	3000	3280	2116	525	20	4.78	0.80
2.3	7.546	-2.3	62.3	1.54	1.68	0.01	0.6	30.31	1	3	3	3	1.00E-07	111.4	0.42	0.142	0.278	1.7	0.8	1.4	0.6	1.6	4.52	0.8	0.64	3.03	60.5	3	-9999	-9999	-9999	-9999	-9999	0.084	1	284	840	3080	3360	2116	556	20	4.53	0.79
2.5	8.202	-2.5	61.6	1.79	1.92	0.01	0.52	28.9	1	4	3	3	1.00E-07	111.4	0.457	0.162	0.294	1.7	0.9	1.6	0.6	1.7	4.99	0.68	0.5	2.97	56.2	3	-9999	-9999	-9999	-9999	-9999	0.098	1.1	325	914	3580	3840	2116	589	20	4.96	0.68
2.7	8.858	-2.7	60.9	1.66	1.79	0.01	0.56	28.14	1	3	2	3	1.00E-07	111.4	0.493	0.183	0.31	1.7	0.9	1.5	0.6	1.5	4.19	0.77	0.54	3.06	62.3	3	-9999	-9999	-9999	-9999	-9999	0.087	0.9	366	986	3320	3580	2116	620	20	4.18	0.77
2.9	9.514	-2.9	60.3	1.52	1.68	0.01	0.75	34.17	1	3	3	3	1.00E-07	111.4	0.53	0.203	0.327	1.7	0.8	1.4	0.6	1.3	3.52	1.09	0.75	3.18	71.7	3	-9999	-9999	-9999	-9999	-9999	0.077	0.8	406	1060	3040	3360	2116	654	20	3.52	0.87
3.1	10.17	-3.1	59.6	1.41	1.57	0.01	0.8	35.49	1	3	3	3	1.00E-07	111.4	0.566	0.224	0.343	1.7	0.8	1.3	0.6	1.2	2.94	1.25	0.88	3.28	79.2	3	-9999	-9999	-9999	-9999	-9999	0.067	0.7	447	1132	2820	3140	2116	685	20	2.93	1.00
3.3	10.827	-3.3	59.0	1.44	1.61	0.02	0.93	37.99	1	3	1	3	1.00E-07	111.4	0.603	0.244	0.359	1.67	0.8	1.3	0.7	1.2	2.82	1.49	0.93	3.33	83.2	3	-9999	-9999	-9999	-9999	-9999	0.067	0.7	488	1206	2880	3220	2116	718	40	2.81	1.99
3.5	11.483	-3.5	58.3	1.55	1.74	0.02	0.87	40.16	1	3	3	3	1.00E-07	111.4	0.64	0.265	0.375	1.63	0.8	1.4	0.7	1.2	2.93	1.37	0.9	3.3	80.7	3	-9999	-9999	-9999	-9999	-9999	0.073	0.7	529	1280	3100	3480	2116	751	40	2.93	1.82
3.7	12.139	-3.7	57.7	1.61	1.82	0.02	1.24	43.45	1	3	1	3	1.00E-07	111.4	0.676	0.285	0.391	1.6	0.9	1.4	0.8	1.3	2.92	1.98	0.94	3.37	86.6	3	-9999	-9999	-9999	-9999	-9999	0.076	0.7	570	1352	3220	3640	2116	782	40	2.93	1.75
3.9	12.795	-3.9	57.0	4.38	4.48	0.14	3.02	22.08	3	3	3	4	5.00E-08	111.4	0.713	0.306	0.407	1.57	4.3	6.7	1.5	3.3	9.26	3.59	0.1	3.07	63.3	3	-9999	-9999	-9999	-9999	-9999	0.251	2.3	611	1426	8760	8960	2116	815	280	9.25	3.72
4.1	13.451	-4.1	56.3	6.2	6.26	0.14	2.28	13.74	4	4	5	5	5.00E-07	114.6	0.75	0.326	0.423	1.54	4	6.1	1.9	4.1	13.01	2.59	0.02	2.87	49.9	4	-9999	-9999	-9999	-9999	-9999	0.367	3.7	652	1500	12400	12520	2116	848	280	13.00	2.54
4.3	14.107	-4.3	55.7	10.7	10.76	0.36	3.38	14.18	4	4	6	5	5.00E-07	114.6	0.787	0.347	0.441	1.51	6.9	10.4	3	6.7	22.65	3.64	0.01	2.77	44	4	-9999	-9999	-9999	-9999	-9999	0.665	8.6	693	1574	21400	21520	2116	881	720	22.64	3.61
4.5	14.764	-4.5	55.0	42.05	41.99	1.95	4.64	-13.15	4	9	8	6	5.00E-07	114.6	0.825	0.367	0.458	1.48	26.8	39.6	-9999	-9999	89.95	4.74	-0.02	-9999	-9999	0	-9999	-9999	-9999	-9999	-9999	2.744	10	734	1650	84100	83980	2116	916	3900	89.89	4.74

CPTU-605 Liquefaction Analysis

ext

06205z$^{1.5}$ + 0.001210z^{2}]

Youd and Idriss, 2001

kshop, reiterated in Youd and Idriss, 2001

CPTU-605 Liquefaction Analysis

rel density of 60 to 80%; P_a = pressure at 1 atmosphere Youd and Idriss, 2001

	Col-46	Col-47	Col-48	Col-49	Col-50	Col-51	Col-52	Col-53	Col-54	Col-55	Col-56	Col-57	Col-57a	Col-58	Col-59	Col-60	Col-61	Col-62	Col-63	Col-64	Col-65	Col-66	Col-67	Col-68	Col-69	Col-70	Col-71	Col-72	Col-73	Col-74	Col-75	Col-76	Col-77	Col-78	Col-79	Col-80	Col-81	Col-82	Col-83	Col-84	Col-85
	Youd & Idriss, 2001 CPT Based Analysis																															Boulanger and Idriss, 2004, "Approach B" method based on Su profile									
																					Rel. Den. Factor																				
	$I_{c\ Qexp=1}$	$Q_{exp\ =\ 0.5}$	F	$I_{c\ Qexp=0.5}$	$Q_{exp\ =\ 0.7}$	F	$I_{c\ Qexp=0.7}$	Description	C_{η}			q_{c1N}	Lookup	Ic	Kc	$(q_{c1N})_{cs}$	CRR7.5	rd	a_{max}/g =	CSR		f	MSF	K_{σ}	α	K_{α}	$FS_{liq\text{-}CPT\ (Sand\text{-}Like)}$		Apparent Fines	Measured Fines	Ic Limits	Su - CPT (psf)	OCR Assumed	OCR - CPT	α	k_{α}	$CRR_{M7.5}$	MSF	$CRR_{M5.5}$	$FS_{liq\text{-}Su\ (Clay\text{-}Like)}$	
									n=1.0	n=0.5	n=0.7		Col						if crest accel =	No Amplification	crest accel = 2				0.02		No Amplification	if crest accel = 2	(%)	(%)		Nkt 10	1.1		0.02					No Amplification	crest accel 2
40	1.90	19.51	1.49	2.59	44.06	1.49	2.30	**Granular**	58.78	7.67	17.32	19.64	2.00	2.59	3.24	63.71	0.10	1.00	0.22	0.07	0.14	0.7	2.2	3.39	0.02	0.9600	10.43	5.27	35		2.6	538	1.1		0.02	0.99	9.43	1.11	10.48	146.51	74.10
41	2.03	9.68	0.43	2.63	17.49	0.43	2.38	**Very Silty**	19.24	4.39	7.92	17.90	2.00	2.38	2.25	40.28	0.08	1.00	0.21	0.07	0.14	0.7	2.2	2.43	0.02	0.9600	5.40	2.79	26		2.6	467	1.1		0.02	0.99	2.68	1.11	2.98	41.64	21.55
42	2.23	7.54	0.43	2.73	12.31	0.43	2.53	**Very Silty**	11.63	3.41	5.57	12.79	2.00	2.53	2.91	37.22	0.07	1.00	0.21	0.07	0.13	0.7	2.2	2.09	0.02	0.9600	4.49	2.38	32		2.6	468	1.1		0.02	0.99	1.62	1.11	1.80	25.24	13.38
43	2.38	6.20	0.44	2.81	9.46	0.44	2.64	**Very Silty**	8.27	2.88	4.39	9.99	2.00	2.64	3.57	35.69	0.07	1.00	0.20	0.07	0.13	0.7	2.2	1.88	0.02	0.9600	3.99	2.17	37		2.6	456	1.1		0.02	0.99	1.12	1.11	1.25	17.54	9.53
44	2.48	5.46	0.44	2.87	7.93	0.44	2.71	**Very Silty**	6.45	2.54	3.69	8.50	2.00	2.71	4.08	34.70	0.07	1.00	0.20	0.07	0.13	0.7	2.2	1.75	0.02	0.9600	3.66	2.04	41		2.6	455	1.1		0.02	0.99	0.88	1.11	0.97	13.67	7.61
45	2.61	4.28	0.53	2.99	6.09	0.53	2.85	**Clayey**	5.81	2.41	3.43	11.43	2.00	2.63	3.53	40.33	0.08	0.99	0.19	0.08	0.14	0.7	2.2	1.70	0.02	0.9600	3.43	1.96	37		2.6	376	1.1		0.02	0.99	0.65	1.11	0.72	9.22	5.27
46	2.71	3.82	0.57	3.05	5.34	0.57	2.91	**Clayey**	5.33	2.31	3.23	10.02	2.00	2.71	4.04	40.54	0.08	0.99	0.19	0.09	0.14	0.7	2.2	1.65	0.02	0.9600	3.09	1.82	41		2.6	350	1.1		0.02	0.99	0.56	1.11	0.62	7.27	4.27
47	2.76	3.52	0.60	3.09	4.85	0.60	2.96	**Clayey**	4.94	2.22	3.06	9.11	2.00	2.76	4.47	40.72	0.08	0.99	0.18	0.09	0.15	0.7	2.2	1.62	0.02	0.9600	2.84	1.71	44		2.6	335	1.1		0.02	0.99	0.49	1.11	0.55	6.05	3.65
48	2.82	3.22	0.63	3.13	4.36	0.63	3.01	**Clayey**	4.59	2.14	2.90	8.24	2.00	2.82	4.98	40.99	0.08	0.99	0.18	0.10	0.15	0.7	2.2	1.58	0.02	0.9600	2.65	1.64	47		2.6	318	1.1		0.02	0.99	0.43	1.11	0.48	5.06	3.14
49	2.83	3.22	0.61	3.13	4.31	0.61	3.01	**Clayey**	4.30	2.07	2.78	8.09	2.00	2.83	5.04	40.77	0.08	0.99	0.17	0.10	0.16	0.7	2.2	1.55	0.02	0.9600	2.48	1.58	48		2.6	329	1.1		0.02	0.99	0.42	1.11	0.47	4.70	3.00
50	3.01	2.38	0.80	3.29	3.15	0.80	3.18	**Clayey**	4.03	2.01	2.65	6.24	2.00	3.01	6.82	42.61	0.08	0.99	0.17	0.10	0.16	0.7	2.2	1.52	0.02	0.9600	2.40	1.58	59		2.6	251	1.1		0.02	0.99	0.30	1.11	0.34	3.25	2.14
51	3.03	2.32	0.79	3.30	3.03	0.79	3.19	**Clayey**	3.80	1.95	2.55	6.04	2.00	3.03	7.07	42.68	0.08	0.98	0.16	0.11	0.16	0.7	2.2	1.49	0.02	0.9600	2.29	1.55	60		2.6	252	1.1		0.02	0.99	0.29	1.11	0.32	2.99	2.02
52	2.97	2.62	0.68	3.23	3.38	0.68	3.12	**Clayey**	3.59	1.89	2.45	6.52	2.00	2.97	6.39	41.65	0.08	0.98	0.16	0.11	0.16	0.7	2.2	1.47	0.02	0.9600	2.17	1.52	56		2.6	293	1.1		0.02	0.99	0.31	1.11	0.35	3.19	2.23
53	3.06	2.26	0.77	3.31	2.89	0.77	3.21	**Clayey**	3.41	1.85	2.36	5.77	2.00	3.06	7.39	42.65	0.08	0.98	0.15	0.11	0.15	0.7	2.2	1.44	0.02	0.9600	2.11	1.52	62		2.6	259	1.1		0.02	0.99	0.26	1.11	0.29	2.63	1.90
54	3.15	1.96	0.87	3.38	2.47	0.87	3.29	**Clayey**	3.24	1.80	2.28	5.14	2.00	3.15	8.50	43.72	0.08	0.98	0.15	0.11	0.15	0.7	2.2	1.42	0.02	0.9600	2.06	1.54	69		2.6	230	1.1		0.02	0.99	0.22	1.11	0.25	2.17	1.62
55	3.24	1.67	1.00	3.47	2.09	1.00	3.38	**Clayey**	3.09	1.76	2.20	4.59	2.00	3.24	9.82	45.06	0.08	0.98	0.14	0.12	0.15	0.7	2.2	1.40	0.02	0.9600	2.03	1.57	76		2.6	201	1.1		0.02	0.99	0.19	1.11	0.21	1.78	1.37
56	3.38	1.63	1.99	3.59	2.03	1.99	3.51	**Clayey**	2.95	1.72	2.13	4.49	2.00	3.38	12.02	53.95	0.09	0.98	0.14	0.12	0.15	0.7	2.2	1.38	0.02	0.9600	2.35	1.88	88		2.6	201	1.1		0.02	0.99	0.18	1.11	0.20	1.67	1.34
57	3.35	1.75	1.82	3.55	2.15	1.82	3.47	**Clayey**	2.82	1.68	2.07	4.64	2.00	3.35	11.47	53.16	0.09	0.98	0.13	0.12	0.14	0.7	2.2	1.36	0.02	0.9600	2.28	1.89	85		2.6	220	1.1		0.02	0.99	0.18	1.11	0.21	1.73	1.43
58	3.34	1.78	1.75	3.54	2.17	1.75	3.46	**Clayey**	2.71	1.65	2.01	4.66	2.00	3.34	11.36	52.88	0.09	0.97	0.13	0.12	0.14	0.7	2.2	1.35	0.02	0.9600	2.21	1.91	85		2.6	229	1.1		0.02	0.99	0.18	1.11	0.21	1.70	1.47
59	3.08	5.74	3.72	3.25	6.94	3.72	3.18	**Clayey**	2.60	1.61	1.95	11.00	2.00	3.08	7.66	84.19	0.14	0.97	0.12	0.12	0.14	0.7	2.2	1.33	0.02	0.9600	3.13	2.81	64		2.6	753	1.1		0.02	0.99	0.58	1.11	0.65	5.32	4.78
60	2.86	8.23	2.54	3.03	9.88	2.54	2.96	**Clayey**	2.50	1.58	1.90	14.77	2.00	2.86	5.34	78.81	0.13	0.97	0.12	0.12	0.13	0.7	2.2	1.32	0.02	0.9600	2.84	2.66	50		2.6	1102	1.1		0.02	0.99	0.82	1.11	0.91	7.41	6.94
61	2.76	14.61	3.61	2.91	17.41	3.61	2.85	**Clayey**	2.40	1.55	1.85	24.43	2.00	2.76	4.48	109.36	0.20	0.97	0.11	0.12	0.13	0.7	2.2	1.30	0.02	0.9600	4.47	4.37	44		2.6	1995	1.1		0.02	0.99	1.43	1.11	1.59	12.80	12.52
62	2.43	59.14	4.74	2.54	69.92	4.74	2.50	**Granular**	2.31	1.52	1.80	60.32	4.00	2.54	3.01	181.33	0.63	0.97	0.11	0.12	0.12	0.7	2.2	1.29	0.02	0.9600	13.80	14.12	33		2.6	8233	1.1		0.02	0.99	5.67	1.11	6.30	50.48	51.65

CPTU-606 Liquefaction Analysis

ConeTec Inc. - CPT Interpretation
Interpretation Output - Release 1.22 Rev. A - Format: NLI Imperial
Run No: 06-0718-0954-3015
Job No: 02-100
Client: MACTEC Engineering and Consulting Inc.
Project: Former Callahan Mine Site, Brooksville, ME
Site: CP-606
Location: Callahan Mine
Cone: 20 Ton AD179
CPT Date: 06/28/06
CPT Time: 15:55
CPT File: 758CP606.COR
Northing (m): 0
Easting (m): 0
Elevation (m): 0 — 69.4 Elevation For CPT Triggering analysis

Water Table (m): 1.07 (ft): 3.5 — 3.5 Water Table assumed for CPT Analysis
Unit Weight of Water (default): 62.4 pcf
Averaging Increment (m): 0.2
Phi Method : Robertson and Campanella, 1983
Su Nkt used: 15 Su/P' (nc): 0.3 — 0.11 Base acceleration
Dr Method : Jamiolkowski - All Sands
State Parameter M: 1.2
Used Unit Weights Assigned to Soil Zones
N160c Calculated using qc1n

1) CSR = $0.65*(a_{max}/g)*(s_v/s'_v)*r_d$ — Seed & Idriss, 1983, p. 459

a_{max}/g = 0.11 g — USGS (base) (amplified from base as discussed in
s_v = computed — Total Vertical Stress
s'_v = computed — Effective Vertical Stress

$r_d = [1.0 - 0.4113z^{0.5} + 0.04052z + 0.001753z^{1.5}] / [1 - 0.4177z^{0.5} + 0.05729z - 0.$

z = depth in meters

2) FS = Factor of safety against triggering of liquefaction: FS = $(CRR_{7.5}/CSR) \times MSF \times Ks \times Ka$

MSF = magnitude scaling factor; Assume based on range recommended by NCEER Wo

CPTU-606 Liquefaction Analysis

$Ks = (s'_{vo}/P_a)^{(f-1)}$, where f = 0.7 to 0.8 for relative density of 40 to 60%; f = 0.6 to 0.7 fo
1 Atmosphere = 14.7 psi = 2.12 ksf

Conetec Data

Col-01 Depth (m)	Col-02 Depth (ft)	Col-03 Elev. (m)	Col-04 Elev. (ft)	Col-05 qc (tsf)	Col-06 qt (tsf)	Col-07 fs (tsf)	Col-08 Rf (%)	Col-09 u (ft)	Col-10 SBT (Zone)	Col-11 SBTn (Zone)	Col-12 SBT-BQ (Zone)	Col-13 SBT-BQn (Zone)	Col-14 Perm-k (cm/s)	Col-15 Unit Wt (pcf)	Col-16 T Stress (tsf)	Col-17 U Stress (tsf)	Col-18 E Stress (tsf)	Col-19 Cn	Col-20 N60 (b/ft)	Col-21 N1(60) (b/ft)	Col-22 N(60)Ic (b/ft)	Col-23 N1(60)Ic (b/ft)	Col-24 Qt	Col-25 Fr (%)	Col-26 Bq	Col-27 Ic	Col-28 FC (%)	Col-29 IcZone (Zone)	Col-30 Dr (%)	Col-31 Phi (deg)	Col-32 State Par	Col-33 Es/qt	Col-34 YoungE (tsf)	Col-35 Su (tsf)	Col-36 OCR	Col-37 U (psf)	Col-38 s_{vo} (psf)	Col-39 q_c (psf)	Col-40 q_t (psf)	Col-41 P_a (psf)	Col-42 σ'_{vo} (psf)	Col-43 f_t (psf)	Col-44 $Q_{exp=1}$	Col-45 F
0.1	0.328	-0.1	69.1	2.29	2.29	0.01	0.55	1.27	1	6	3	6	1.00E-07	111.4	0.018	0	0.018	1.7	1.1	1.9	0.8	1.3	124.4	0.55	0.02	3.05	62.2	3	-9999	-9999	-9999	-9999	-9999	0.152	10	0	36	4580	4580	2116	36	20	126.22	0.44
0.3	0.984	-0.3	68.4	2.52	2.54	0.01	0.49	2.78	1	6	3	6	1.00E-07	111.4	0.055	0	0.055	1.7	1.2	2.1	0.8	1.4	45.27	0.5	0.04	3	58.5	3	-9999	-9999	-9999	-9999	-9999	0.165	10	0	110	5040	5080	2116	110	20	45.18	0.40
0.5	1.64	-0.5	67.8	2.24	2.27	0.01	0.44	8.36	1	5	3	5	1.00E-07	111.4	0.091	0	0.091	1.7	1.1	1.9	0.8	1.3	23.89	0.46	0.12	3.03	60.7	3	-9999	-9999	-9999	-9999	-9999	0.146	9.4	0	182	4480	4540	2116	182	20	23.95	0.46
0.7	2.297	-0.7	67.1	1.92	1.97	0.01	0.51	11.68	1	5	3	4	1.00E-07	111.4	0.128	0	0.128	1.7	0.9	1.6	0.7	1.2	14.42	0.54	0.2	3.11	66.5	3	-9999	-9999	-9999	-9999	-9999	0.123	4.3	0	256	3840	3940	2116	256	20	14.39	0.54
0.9	2.953	-0.9	66.4	1.92	1.98	0.01	0.51	13.83	1	4	3	3	1.00E-07	111.4	0.164	0	0.164	1.7	1	1.6	0.5	3	11.07	0.55	0.24	2.61	35.8	4	-9999	-9999	-9999	-9999	-9999	0.121	2.9	0	328	3840	3960	2116	328	20	11.07	0.55
1.1	3.609	-1.1	65.8	1.77	1.86	0.01	0.54	17.64	1	4	3	3	1.00E-07	111.4	0.201	0.003	0.198	1.7	0.9	1.5	0.5	2.4	8.38	0.61	0.33	2.74	42.4	4	-9999	-9999	-9999	-9999	-9999	0.11	2	7	402	3540	3720	2116	395	20	8.40	0.60
1.3	4.265	-1.3	65.1	1.65	1.74	0.01	0.58	19.53	1	4	3	3	1.00E-07	111.4	0.238	0.024	0.214	1.7	0.8	1.4	0.5	2.1	7.02	0.67	0.39	2.82	47.4	4	-9999	-9999	-9999	-9999	-9999	0.1	1.6	48	476	3300	3480	2116	428	20	7.01	0.67
1.5	4.921	-1.5	64.5	1.61	1.71	0.01	0.59	20.68	1	4	3	3	1.00E-07	111.4	0.274	0.044	0.23	1.7	0.8	1.4	0.5	2	6.25	0.7	0.42	2.88	50.6	4	-9999	-9999	-9999	-9999	-9999	0.096	1.4	89	548	3220	3420	2116	459	20	6.25	0.70
1.7	5.577	-1.7	63.8	1.58	1.69	0.01	0.59	22.61	1	4	2	3	1.00E-07	111.4	0.311	0.065	0.246	1.7	0.8	1.4	0.5	1.8	5.6	0.73	0.47	2.93	53.8	4	-9999	-9999	-9999	-9999	-9999	0.092	1.2	130	622	3160	3380	2116	492	20	5.60	0.73
1.9	6.234	-1.9	63.2	1.55	1.67	0.02	0.9	24.51	1	3	2	3	1.00E-07	111.4	0.347	0.085	0.262	1.7	0.8	1.4	0.6	1.8	5.04	1.14	0.52	3.05	61.8	3	-9999	-9999	-9999	-9999	-9999	0.088	1.1	171	694	3100	3340	2116	523	40	5.06	1.51
2.1	6.89	-2.1	62.5	1.3	1.42	0.02	1.42	25.88	1	3	3	3	1.00E-07	111.4	0.384	0.106	0.278	1.7	0.7	1.2	0.6	1.5	3.72	1.94	0.68	3.27	78.5	3	-9999	-9999	-9999	-9999	-9999	0.069	0.8	212	768	2600	2840	2116	556	40	3.72	1.93
2.3	7.546	-2.3	61.9	1.47	1.6	0.02	1.25	28.2	1	3	3	3	1.00E-07	111.4	0.42	0.126	0.294	1.7	0.8	1.3	0.6	1.6	4.02	1.69	0.64	3.21	73.9	3	-9999	-9999	-9999	-9999	-9999	0.079	0.9	252	840	2940	3200	2116	588	40	4.02	1.69
2.5	8.202	-2.5	61.2	1.55	1.69	0.02	1.19	30.06	1	3	3	3	1.00E-07	111.4	0.457	0.147	0.31	1.7	0.8	1.4	0.6	1.5	3.98	1.63	0.64	3.21	73.6	3	-9999	-9999	-9999	-9999	-9999	0.082	0.9	293	914	3100	3380	2116	621	40	3.97	1.62
2.7	8.858	-2.7	60.5	1.68	1.83	0.02	1.1	31.26	1	3	3	3	1.00E-07	111.4	0.493	0.167	0.326	1.7	0.9	1.5	0.7	1.6	4.09	1.5	0.61	3.18	71.5	3	-9999	-9999	-9999	-9999	-9999	0.089	0.9	334	986	3360	3660	2116	652	40	4.10	1.50
2.9	9.514	-2.9	59.9	1.7	1.85	0.02	1.08	33.05	1	3	3	3	1.00E-07	111.4	0.53	0.188	0.342	1.7	0.9	1.5	0.7	1.5	3.86	1.52	0.64	3.21	73.4	3	-9999	-9999	-9999	-9999	-9999	0.088	0.9	375	1060	3400	3700	2116	685	40	3.86	1.52
3.1	10.17	-3.1	59.2	1.76	1.91	0.02	1.18	33.12	1	3	3	3	1.00E-07	111.4	0.566	0.208	0.358	1.67	0.9	1.5	0.7	1.5	3.76	1.68	0.61	3.24	75.8	3	-9999	-9999	-9999	-9999	-9999	0.09	0.9	416	1132	3520	3820	2116	716	40	3.76	1.49
3.3	10.827	-3.3	58.6	1.73	1.89	0.02	1.19	34.97	1	3	3	3	1.00E-07	111.4	0.603	0.229	0.374	1.63	0.9	1.5	0.7	1.4	3.44	1.75	0.67	3.28	79.3	3	-9999	-9999	-9999	-9999	-9999	0.086	0.8	457	1206	3460	3780	2116	749	40	3.44	1.55
3.5	11.483	-3.5	57.9	1.84	2	0.03	1.25	35.22	1	3	3	3	1.00E-07	111.4	0.64	0.249	0.39	1.6	1	1.5	0.8	1.4	3.5	1.84	0.62	3.28	79.5	3	-9999	-9999	-9999	-9999	-9999	0.091	0.8	498	1280	3680	4000	2116	782	60	3.48	2.21
3.7	12.139	-3.7	57.3	1.81	1.99	0.03	1.26	39.34	1	3	3	3	1.00E-07	111.4	0.676	0.27	0.406	1.57	1	1.5	0.8	1.4	3.24	1.91	0.73	3.32	82.6	3	-9999	-9999	-9999	-9999	-9999	0.088	0.8	539	1352	3620	3980	2116	813	60	3.23	2.28
3.9	12.795	-3.9	56.6	1.98	2.17	0.03	1.27	40.96	1	3	3	3	1.00E-07	111.4	0.713	0.29	0.422	1.54	1	1.6	0.9	1.4	3.45	1.89	0.68	3.29	80.4	3	-9999	-9999	-9999	-9999	-9999	0.097	0.8	580	1426	3960	4340	2116	846	60	3.44	2.06
4.1	13.451	-4.1	55.9	2.13	2.33	0.03	1.18	43.54	1	3	3	3	1.00E-07	111.4	0.749	0.311	0.439	1.51	1.1	1.7	0.9	1.5	3.6	1.74	0.66	3.26	77.7	3	-9999	-9999	-9999	-9999	-9999	0.105	0.8	621	1498	4260	4660	2116	877	60	3.61	1.90
4.3	14.107	-4.3	55.3	2.43	2.65	0.03	1.14	46.6	1	3	3	3	1.00E-07	111.4	0.786	0.331	0.455	1.48	1.3	1.9	1	1.6	4.09	1.62	0.6	3.19	72.6	3	-9999	-9999	-9999	-9999	-9999	0.124	0.9	662	1572	4860	5300	2116	910	60	4.10	1.61
4.5	14.764	-4.5	54.6	2.56	2.78	0.03	1.08	47.85	1	3	3	3	1.00E-07	111.4	0.822	0.352	0.471	1.46	1.3	1.9	1	1.6	4.16	1.54	0.58	3.18	71.4	3	-9999	-9999	-9999	-9999	-9999	0.131	0.9	703	1644	5120	5560	2116	941	60	4.16	1.53
4.7	15.42	-4.7	54.0	2.59	2.81	0.03	1.07	48.56	1	3	3	3	1.00E-07	111.4	0.859	0.372	0.487	1.43	1.3	1.9	1	1.5	4.02	1.54	0.58	3.19	72.4	3	-9999	-9999	-9999	-9999	-9999	0.13	0.9	744	1718	5180	5620	2116	974	60	4.01	1.54
4.9	16.076	-4.9	53.3	2.8	3.04	0.03	0.99	51.11	1	3	3	3	1.00E-07	111.4	0.895	0.393	0.503	1.41	1.5	2.1	1.1	1.6	4.26	1.4	0.56	3.15	69.3	3	-9999	-9999	-9999	-9999	-9999	0.143	1	785	1790	5600	6080	2116	1005	60	4.27	1.40
5.1	16.732	-5.1	52.7	2.7	2.94	0.03	0.94	50.67	1	3	3	3	1.00E-07	111.4	0.932	0.413	0.519	1.39	1.4	2	1.1	1.5	3.87	1.37	0.58	3.19	71.9	3	-9999	-9999	-9999	-9999	-9999	0.134	0.9	826	1864	5400	5880	2116	1038	60	3.87	1.49
5.3	17.388	-5.3	52.0	2.76	3.01	0.03	1	53	1	3	3	3	1.00E-07	111.4	0.968	0.434	0.535	1.37	1.4	2	1.1	1.5	3.82	1.47	0.6	3.2	73.3	3	-9999	-9999	-9999	-9999	-9999	0.136	0.9	867	1936	5520	6020	2116	1069	60	3.82	1.47
5.5	18.044	-5.5	51.4	3	3.26	0.03	0.92	54.57	1	3	3	3	1.00E-07	111.4	1.005	0.454	0.551	1.35	1.6	2.1	1.2	1.5	4.09	1.33	0.55	3.16	69.8	3	-9999	-9999	-9999	-9999	-9999	0.15	0.9	908	2010	6000	6520	2116	1102	60	4.09	1.33
5.7	18.701	-5.7	50.7	2.96	3.21	0.03	0.94	54.74	1	3	3	3	1.00E-07	111.4	1.042	0.475	0.567	1.33	1.5	2	1.2	1.5	3.83	1.38	0.57	3.19	72.3	3	-9999	-9999	-9999	-9999	-9999	0.145	0.9	949	2084	5920	6420	2116	1135	60	3.82	1.38
5.9	19.357	-5.9	50.0	3.26	3.53	0.06	1.56	58.17	1	3	3	3	1.00E-07	111.4	1.078	0.495	0.583	1.31	1.7	2.2	1.4	1.7	4.21	2.25	0.54	3.25	77	3	-9999	-9999	-9999	-9999	-9999	0.164	0.9	989	2156	6520	7060	2116	1167	120	4.20	2.45
6.1	20.013	-6.1	49.4	3.36	3.59	0.04	1.19	50.39	1	3	3	3	1.00E-07	111.4	1.115	0.516	0.599	1.29	1.7	2.2	1.3	1.6	4.14	1.72	0.43	3.2	73.2	3	-9999	-9999	-9999	-9999	-9999	0.165	0.9	1030	2230	6720	7180	2116	1200	80	4.13	1.62
6.3	20.669	-6.3	48.7	3.15	3.44	0.03	0.8	62.45	1	3	3	3	1.00E-07	111.4	1.151	0.536	0.615	1.28	1.6	2.1	1.3	1.4	3.72	1.2	0.62	3.18	71.2	3	-9999	-9999	-9999	-9999	-9999	0.153	0.9	1071	2302	6300	6880	2116	1231	60	3.72	1.31
6.5	21.325	-6.5	48.1	3	3.31	0.02	0.61	66.24	1	3	3	3	1.00E-07	111.4	1.188	0.557	0.631	1.26	1.6	2	1.2	1.3	3.37	0.94	0.71	3.18	71.2	3	-9999	-9999	-9999	-9999	-9999	0.142	0.8	1112	2376	6000	6620	2116	1264	40	3.36	0.94
6.7	21.981	-6.7	47.4	3.12	3.44	0.02	0.58	68.81	1	3	3	3	1.00E-07	111.4	1.224	0.577	0.647	1.24	1.6	2	1.2	1.3	3.42	0.91	0.71	3.16	70.2	3	-9999	-9999	-9999	-9999	-9999	0.148	0.8	1153	2448	6240	6880	2116	1295	40	3.42	0.90
6.9	22.638	-6.9	46.8	3.31	3.64	0.02	0.55	70.76	1	1	3	3	1.00E-07	111.4	1.261	0.598	0.663	1.23	1.7	2.1	-9999	-9999	3.58	0.84	0.68	-9999	-9999	0	-9999	-9999	-9999	-9999	-9999	0.158	0.8	1194	2522	6620	7280	2116	1328	40	3.58	0.84
7.1	23.294	-7.1	46.1	3.75	4.09	0.02	0.49	71.91	1	1	3	3	1.00E-07	111.4	1.297	0.618	0.679	1.21	2	2.4	-9999	-9999	4.11	0.72	0.58	-9999	-9999	0	-9999	-9999	-9999	-9999	-9999	0.186	0.9	1235	2594	7500	8180	2116	1359	40	4.11	0.72
7.3	23.95	-7.3	45.5	3.77	4.12	0.02	0.49	74.22	1	1	3	3	1.00E-07	111.4	1.334	0.639	0.695	1.2	2	2.4	-9999	-9999	4	0.72	0.6	-9999	-9999	0	-9999	-9999	-9999	-9999	-9999	0.186	0.9	1276	2668	7540	8240	2116	1392	40	4.00	0.72
7.5	24.606	-7.5	44.8	3.47	3.82	0.02	0.52	76.2	1	1	3	3	1.00E-07	111.4	1.371	0.659	0.712	1.19	1.8	2.2	-9999	-9999	3.45	0.82	0.7	-9999	-9999	0	-9999	-9999	-9999	-9999	-9999	0.163	0.8	1317	2742	6940	7640	2116	1425	40	3.44	0.82
7.7	25.262	-7.7	44.1	3.9	4.28	0.02	0.41	80.32	1	1	3	3	1.00E-07	111.4	1.407	0.679	0.728	1.17	2	2.4	-9999	-9999	3.94	0.61	0.64	-9999	-9999	0	-9999	-9999	-9999	-9999	-9999	0.191	0.9	1358	2814	7800	8560	2116	1456	40	3.95	0.70
7.9	25.918	-7.9	43.5	15.65	15.92	0.24	1.51	57.99	6	4	5	5	5.00E-05	114.6	1.444	0.7	0.744	1.16	6.1	7.1	4.2	5.3	19.46	1.66	0.08	2.61	36	4	30	34	-0.06	-9999	-9999	0.965	6.8	1399	2888	31300	31840	2116	1489	480	19.44	1.66
8.1	26.574	-8.1	42.8	11.83	12.14	0.06	0.5	66.25	6	5	5	4	5.00E-05	114.6	1.482	0.72	0.761	1.15	4.7	5.3	3	3.6	14.01	0.56	0.13	2.53	32	5	30	32	0.05	-9999	-9999	0.711	4.1	1440	2964	23660	24280	2116	1524	120	13.99	0.56
8.3	27.231	-8.3	42.2	25	25.71	0.26	1.01	152.46	7	5	5	5	5.00E-04	117.7	1.52	0.741	0.779	1.13	8.2	9.3	6	6.9	31.06	1.08	0.17	2.37	25.3	5	31.3	36	-0.07	-9999	-9999	-9999	-9999	1481	3040	50000	51420	2116	1559	520	31.03	1.07
8.5	27.887	-8.5	41.5	31.4	32.29	0.45	1.38	189.42	7	5	5	5	5.00E-04	117.7	1.558	0.761	0.797	1.12	10.3	11.5	7.5	8.6	38.55	1.45	0.17	2.37	25.1	5	37.5	38	-0.11	3.488	112.6	-9999	-9999	1522	3116	62800	64580	2116	1594	900	38.55	1.46
8.7	28.543	-8.7	40.9	74.89	74.95	1.43	1.91	13.83	7	5	8	6	5.00E-04	117.7	1.597	0.782	0.815	1.11	23.9	26.5	16	18.1	89.98	1.95	0	2.17	18.1	5	61.3	42	-0.25	2.331	174.7	-9999	-9999	1563	3194	149780	149900	2116	1631	2860	89.93	1.95
8.9	29.199	-8.9	40.2	72.4	72.39	2.37	3.27	-2.56	6	5	8	6	5.00E-05	114.6	1.635	0.802	0.833	1.1	27.7	30.4	16.7	18.7	84.95	3.34	-0.01	2.35	24.6	5	60	42	-0.34	2.38	172.3	4.717	10	1604	3270	144800	144780	2116	1666	4740	84.92	3.35

CPTU-606 Liquefaction Analysis

ext

06205z$^{1.7}$ + 0.001210z^{2}]

Youd and Idriss, 2001

kshop, reiterated in Youd and Idriss, 2001

CPTU-606 Liquefaction Analysis

rel density of 60 to 80%; P_a = pressure at 1 atmosphere Youd and Idriss, 2001

	AT	AU	AV	AW	AX	AY	AZ	BA	BB	BC	BD	BE	BF	BG	BH	BI	BJ	BK	BL
34	Col-46	Col-47	Col-48	Col-49	Col-50	Col-51	Col-52	Col-53	Col-54	Col-55	Col-56	Col-57	Col-57a	Col-58	Col-59	Col-60	Col-61	Col-62	Col-63
35	Youd & Idriss, 2001 CPT Based Analysis																		
36																			
37	$I_{c\ Qexp=1}$	$Q_{exp\ =\ 0.5}$	F	$I_{c\ Qexp=0.5}$	$Q_{exp\ =\ 0.7}$	F	$I_{c\ Qexp=0.7}$	Description	C_q			q_{c1N}	Lookup	Ic	Kc	$(q_{c1N})_{cs}$	CRR7.5	rd	a_{max}/g =
38									n=1.0	n=0.5	n=0.7		Col						if crest accel = 2.0
39																			
40	1.62	16.46	0.44	2.41	37.19	0.44	2.09	**Granular**	58.78	7.67	17.32	16.59	2.00	2.41	2.37	39.28	0.07	1.00	0.22
41	1.99	10.30	0.40	2.59	18.61	0.40	2.35	**Granular**	19.24	4.39	7.92	10.53	2.00	2.59	3.28	34.50	0.07	1.00	0.22
42	2.27	7.02	0.46	2.77	11.47	0.46	2.57	**Very Silty**	11.63	3.41	5.57	11.95	2.00	2.57	3.13	37.38	0.07	1.00	0.21
43	2.50	5.01	0.54	2.93	7.64	0.54	2.76	**Very Silty**	8.27	2.88	4.39	8.17	2.00	2.76	4.44	36.22	0.07	1.00	0.21
44	2.61	4.36	0.55	2.99	6.33	0.55	2.84	**Clayey**	6.45	2.54	3.69	12.07	2.00	2.61	3.38	40.84	0.08	1.00	0.21
45	2.74	3.63	0.60	3.08	5.08	0.60	2.94	**Clayey**	5.35	2.31	3.24	9.41	2.00	2.74	4.26	40.11	0.08	0.99	0.21
46	2.82	3.16	0.67	3.15	4.34	0.67	3.02	**Clayey**	4.94	2.22	3.06	8.13	2.00	2.82	4.99	40.55	0.08	0.99	0.20
47	2.88	2.91	0.70	3.19	3.95	0.70	3.06	**Clayey**	4.61	2.15	2.91	7.45	2.00	2.88	5.48	40.81	0.08	0.99	0.20
48	2.93	2.70	0.73	3.22	3.62	0.73	3.11	**Clayey**	4.30	2.07	2.77	6.86	2.00	2.93	5.98	41.06	0.08	0.99	0.20
49	3.10	2.51	1.51	3.37	3.32	1.51	3.26	**Clayey**	4.04	2.01	2.66	6.38	2.00	3.10	7.93	50.59	0.09	0.99	0.20
50	3.27	1.91	1.93	3.53	2.49	1.93	3.42	**Clayey**	3.80	1.95	2.55	5.10	2.00	3.27	10.21	52.12	0.09	0.99	0.19
51	3.21	2.12	1.69	3.46	2.73	1.69	3.36	**Clayey**	3.60	1.90	2.45	5.45	2.00	3.21	9.41	51.27	0.09	0.98	0.19
52	3.21	2.15	1.62	3.45	2.75	1.62	3.35	**Clayey**	3.41	1.85	2.36	5.45	2.00	3.21	9.35	50.93	0.09	0.98	0.19
53	3.18	2.28	1.50	3.41	2.88	1.50	3.32	**Clayey**	3.25	1.80	2.28	5.62	2.00	3.18	8.96	50.34	0.09	0.98	0.19
54	3.21	2.19	1.52	3.43	2.75	1.52	3.34	**Clayey**	3.09	1.76	2.20	5.40	2.00	3.21	9.33	50.43	0.09	0.98	0.18
55	3.21	2.18	1.49	3.43	2.71	1.49	3.34	**Clayey**	2.96	1.72	2.14	5.34	2.00	3.21	9.43	50.33	0.09	0.98	0.18
56	3.26	2.04	1.55	3.46	2.52	1.55	3.38	**Clayey**	2.83	1.68	2.07	5.05	2.00	3.26	10.05	50.72	0.09	0.98	0.18
57	3.32	2.11	2.21	3.51	2.58	2.21	3.43	**Clayey**	2.71	1.65	2.01	5.12	2.00	3.32	11.02	56.40	0.10	0.98	0.18
58	3.35	2.00	2.28	3.54	2.43	2.28	3.47	**Clayey**	2.60	1.61	1.95	4.90	2.00	3.35	11.58	56.72	0.10	0.97	0.17
59	3.31	2.18	2.06	3.49	2.62	2.06	3.42	**Clayey**	2.50	1.58	1.90	5.13	2.00	3.31	10.87	55.74	0.10	0.97	0.17
60	3.28	2.32	1.90	3.45	2.77	1.90	3.38	**Clayey**	2.41	1.55	1.85	5.31	2.00	3.28	10.35	54.98	0.10	0.97	0.17
61	3.19	2.69	1.61	3.36	3.18	1.61	3.29	**Clayey**	2.32	1.52	1.81	5.82	2.00	3.19	9.17	53.37	0.09	0.97	0.17
62	3.18	2.77	1.53	3.34	3.26	1.53	3.27	**Clayey**	2.25	1.50	1.76	5.91	2.00	3.18	8.95	52.88	0.09	0.97	0.16
63	3.19	2.72	1.54	3.35	3.17	1.54	3.28	**Clayey**	2.17	1.47	1.72	5.77	2.00	3.19	9.16	52.87	0.09	0.97	0.16
64	3.15	2.94	1.40	3.30	3.41	1.40	3.24	**Clayey**	2.10	1.45	1.68	6.05	2.00	3.15	8.59	51.93	0.09	0.97	0.16
65	3.20	2.71	1.49	3.34	3.12	1.49	3.29	**Clayey**	2.04	1.43	1.65	5.66	2.00	3.20	9.28	52.54	0.09	0.96	0.16
66	3.20	2.71	1.47	3.34	3.11	1.47	3.28	**Clayey**	1.98	1.41	1.61	5.63	2.00	3.20	9.30	52.37	0.09	0.96	0.15
67	3.16	2.95	1.33	3.29	3.36	1.33	3.24	**Clayey**	1.92	1.39	1.58	5.91	2.00	3.16	8.68	51.34	0.09	0.96	0.15
68	3.19	2.80	1.38	3.32	3.17	1.38	3.27	**Clayey**	1.86	1.37	1.55	5.65	2.00	3.19	9.15	51.73	0.09	0.96	0.15
69	3.27	3.12	2.45	3.38	3.52	2.45	3.34	**Clayey**	1.81	1.35	1.52	6.05	2.00	3.27	10.25	62.05	0.10	0.96	0.15
70	3.19	3.11	1.62	3.30	3.48	1.62	3.26	**Clayey**	1.76	1.33	1.49	5.99	2.00	3.19	9.14	54.69	0.10	0.96	0.14
71	3.19	2.84	1.31	3.30	3.16	1.31	3.26	**Clayey**	1.72	1.31	1.46	5.59	2.00	3.19	9.15	51.17	0.09	0.96	0.14
72	3.18	2.60	0.94	3.28	2.88	0.94	3.24	**Clayey**	1.67	1.29	1.43	5.24	2.00	3.18	8.93	46.79	0.08	0.95	0.14
73	3.16	2.68	0.90	3.26	2.95	0.90	3.22	**Clayey**	1.63	1.28	1.41	5.31	2.00	3.16	8.73	46.40	0.08	0.95	0.14
74	3.13	2.84	0.84	3.23	3.12	0.84	3.19	**Clayey**	1.59	1.26	1.39	5.48	2.00	3.13	8.34	45.72	0.08	0.95	0.13
75	3.05	3.29	0.72	3.14	3.60	0.72	3.11	**Clayey**	1.56	1.25	1.36	6.02	2.00	3.05	7.34	44.17	0.08	0.95	0.13
76	3.06	3.25	0.72	3.15	3.53	0.72	3.11	**Clayey**	1.52	1.23	1.34	5.92	2.00	3.06	7.47	44.23	0.08	0.95	0.13
77	3.14	2.82	0.82	3.22	3.05	0.82	3.19	**Clayey**	1.48	1.22	1.32	5.36	2.00	3.14	8.50	45.57	0.08	0.94	0.13
78	3.06	3.27	0.70	3.14	3.53	0.70	3.11	**Clayey**	1.45	1.21	1.30	5.88	2.00	3.06	7.48	44.00	0.08	0.94	0.12
79	2.61	16.31	1.66	2.68	17.50	1.66	2.65	**Clayey**	1.42	1.19	1.28	21.38	2.00	2.61	3.41	72.92	0.12	0.94	0.12
80	2.52	11.87	0.56	2.58	12.67	0.56	2.56	**Granular**	1.39	1.18	1.26	13.52	2.00	2.58	3.23	43.73	0.08	0.94	0.12
81	2.34	26.64	1.07	2.40	28.31	1.07	2.37	**Granular**	1.36	1.16	1.24	28.31	2.00	2.40	2.30	65.12	0.11	0.93	0.12
82	2.34	33.46	1.46	2.39	35.41	1.46	2.37	**Granular**	1.33	1.15	1.22	35.16	2.00	2.39	2.27	79.67	0.13	0.93	0.11
83	2.14	78.96	1.95	2.18	83.18	1.95	2.16	**Granular**	1.30	1.14	1.20	80.68	8.00	2.18	1.62	130.66	0.29	0.93	0.11
84	2.33	75.36	3.35	2.36	79.05	3.35	2.35	**Granular**	1.27	1.13	1.18	77.10	7.00	2.36	2.17	167.03	0.51	0.92	0.11

	BM	BN	BO	BP	BQ	BR	BS	BT	BU	BV	BW	BX
34	Col-64	Col-65	Col-66	Col-67	Col-68	Col-69	Col-70	Col-71	Col-72	Col-73	Col-74	Col-75
35												
36		Rel. Den. Factor										
37	CSR		f	MSF	K_σ	α	K_α	$FS_{liq-\ CPT\ (Sand-Like)}$		Apparent Fines	Measured Fines	**Ic** Limits
38	No Amplification	if crest accel = 2						No Amplification	f crest accel = 2	(%)	(%)	
39						0.02						
40	0.07	0.14	0.7	2.2	3.39	0.02	0.9600	7.45	3.75	27		2.6
41	0.07	0.14	0.7	2.2	2.43	0.02	0.9600	5.05	2.57	35		2.6
42	0.07	0.14	0.7	2.2	2.09	0.02	0.9600	4.50	2.31	34		2.6
43	0.07	0.14	0.7	2.2	1.88	0.02	0.9600	4.01	2.09	44		2.6
44	0.07	0.14	0.7	2.2	1.75	0.02	0.9600	3.93	2.07	36		2.6
45	0.07	0.14	0.7	2.2	1.65	0.02	0.9600	3.63	1.94	42		2.6
46	0.08	0.15	0.7	2.2	1.61	0.02	0.9600	3.26	1.76	47		2.6
47	0.08	0.15	0.7	2.2	1.58	0.02	0.9600	2.99	1.63	51		2.6
48	0.09	0.16	0.7	2.2	1.55	0.02	0.9600	2.78	1.54	54		2.6
49	0.09	0.17	0.7	2.2	1.52	0.02	0.9600	3.16	1.77	65		2.6
50	0.10	0.17	0.7	2.2	1.49	0.02	0.9600	3.02	1.71	78		2.6
51	0.10	0.17	0.7	2.2	1.47	0.02	0.9600	2.85	1.64	74		2.6
52	0.10	0.18	0.7	2.2	1.44	0.02	0.9600	2.72	1.59	74		2.6
53	0.11	0.18	0.7	2.2	1.42	0.02	0.9600	2.60	1.54	71		2.6
54	0.11	0.18	0.7	2.2	1.40	0.02	0.9600	2.51	1.50	73		2.6
55	0.11	0.18	0.7	2.2	1.38	0.02	0.9600	2.43	1.47	74		2.6
56	0.11	0.18	0.7	2.2	1.37	0.02	0.9600	2.36	1.45	77		2.6
57	0.11	0.18	0.7	2.2	1.35	0.02	0.9600	2.41	1.50	83		2.6
58	0.12	0.18	0.7	2.2	1.33	0.02	0.9600	2.35	1.49	86		2.6
59	0.12	0.18	0.7	2.2	1.32	0.02	0.9600	2.28	1.46	82		2.6
60	0.12	0.18	0.7	2.2	1.30	0.02	0.9600	2.21	1.44	79		2.6
61	0.12	0.18	0.7	2.2	1.29	0.02	0.9600	2.14	1.41	73		2.6
62	0.12	0.18	0.7	2.2	1.28	0.02	0.9600	2.09	1.40	71		2.6
63	0.12	0.18	0.7	2.2	1.26	0.02	0.9600	2.05	1.40	73		2.6
64	0.12	0.18	0.7	2.2	1.25	0.02	0.9600	2.00	1.38	69		2.6
65	0.12	0.18	0.7	2.2	1.24	0.02	0.9600	1.97	1.39	73		2.6
66	0.12	0.17	0.7	2.2	1.23	0.02	0.9600	1.94	1.39	73		2.6
67	0.13	0.17	0.7	2.2	1.22	0.02	0.9600	1.90	1.38	70		2.6
68	0.13	0.17	0.7	2.2	1.21	0.02	0.9600	1.88	1.39	72		2.6
69	0.13	0.17	0.7	2.2	1.20	0.02	0.9600	2.04	1.53	79		2.6
70	0.13	0.17	0.7	2.2	1.19	0.02	0.9600	1.87	1.43	72		2.6
71	0.13	0.16	0.7	2.2	1.18	0.02	0.9600	1.80	1.40	72		2.6
72	0.13	0.16	0.7	2.2	1.17	0.02	0.9600	1.55	1.23	71		2.6
73	0.13	0.16	0.7	2.2	1.16	0.02	0.9600	1.53	1.23	70		2.6
74	0.13	0.16	0.7	2.2	1.15	0.02	0.9600	1.50	1.24	68		2.6
75	0.13	0.15	0.7	2.2	1.14	0.02	0.9600	1.46	1.23	62		2.6
76	0.13	0.15	0.7	2.2	1.13	0.02	0.9600	1.45	1.24	63		2.6
77	0.13	0.15	0.7	2.2	1.13	0.02	0.9600	1.46	1.27	69		2.6
78	0.13	0.15	0.7	2.2	1.12	0.02	0.9600	1.42	1.26	63		2.6
79	0.13	0.14	0.7	2.2	1.11	0.02	0.9600	2.09	1.90	36		2.6
80	0.13	0.14	0.7	2.2	1.10	0.02	0.9600	1.40	1.30	35		2.6
81	0.13	0.14	0.7	2.2	1.10	0.02	0.9600	1.88	1.78	26		2.6
82	0.13	0.13	0.7	2.2	1.09	0.02	0.9600	2.25	2.17	26		2.6
83	0.13	0.13	0.7	2.2	1.08	0.02	0.9700	5.11	5.05	18		2.6
84	0.13	0.13	0.7	2.2	1.07	0.02	0.9675	9.05	9.15	25		2.6

	BY	BZ	CA	CB	CC	CD	CE	CF	CG	CH
34	Col-76	Col-77	Col-78	Col-79	Col-80	Col-81	Col-82	Col-83	Col-84	Col-85
35	Boulanger and Idriss, 2004, "Approach B" method based on Su profile									
37	Su - CPT (psf)	OCR Assumed	OCR - CPT	α	k_α	$CRR_{M7.5}$	MSF	$CRR_{M5.5}$	$FS_{liq-Su\ (Clay-Like)}$	
38	Nkt	1.1							No Amplification	crest accel 2
39	10			0.02						
40	454	1.1		0.02	0.99	7.96	1.11	8.85	123.65	62.18
41	497	1.1		0.02	0.99	2.85	1.11	3.17	44.31	22.54
42	436	1.1		0.02	0.99	1.51	1.11	1.68	23.52	12.10
43	368	1.1		0.02	0.99	0.91	1.11	1.01	14.15	7.37
44	363	1.1		0.02	0.99	0.70	1.11	0.78	10.91	5.75
45	332	1.1		0.02	0.99	0.53	1.11	0.59	8.14	4.34
46	300	1.1		0.02	0.99	0.44	1.11	0.49	6.24	3.37
47	287	1.1		0.02	0.99	0.39	1.11	0.44	5.19	2.84
48	276	1.1		0.02	0.99	0.35	1.11	0.39	4.40	2.43
49	265	1.1		0.02	0.99	0.32	1.11	0.35	3.79	2.12
50	207	1.1		0.02	0.99	0.23	1.11	0.26	2.68	1.52
51	236	1.1		0.02	0.99	0.25	1.11	0.28	2.80	1.61
52	247	1.1		0.02	0.99	0.25	1.11	0.28	2.69	1.57
53	267	1.1		0.02	0.99	0.26	1.11	0.29	2.71	1.60
54	264	1.1		0.02	0.99	0.24	1.11	0.27	2.49	1.49
55	269	1.1		0.02	0.99	0.24	1.11	0.26	2.38	1.44
56	257	1.1		0.02	0.99	0.22	1.11	0.24	2.14	1.32
57	272	1.1		0.02	0.99	0.22	1.11	0.24	2.13	1.33
58	263	1.1		0.02	0.99	0.20	1.11	0.23	1.96	1.24
59	291	1.1		0.02	0.99	0.22	1.11	0.24	2.06	1.32
60	316	1.1		0.02	0.99	0.23	1.11	0.25	2.13	1.39
61	373	1.1		0.02	0.99	0.26	1.11	0.29	2.40	1.59
62	392	1.1		0.02	0.99	0.26	1.11	0.29	2.41	1.62
63	390	1.1		0.02	0.99	0.25	1.11	0.28	2.30	1.57
64	429	1.1		0.02	0.99	0.27	1.11	0.30	2.43	1.68
65	402	1.1		0.02	0.99	0.24	1.11	0.27	2.19	1.54
66	408	1.1		0.02	0.99	0.24	1.11	0.27	2.15	1.54
67	451	1.1		0.02	0.99	0.26	1.11	0.29	2.29	1.66
68	434	1.1		0.02	0.99	0.24	1.11	0.27	2.12	1.57
69	490	1.1		0.02	0.99	0.27	1.11	0.29	2.33	1.75
70	495	1.1		0.02	0.99	0.26	1.11	0.29	2.27	1.74
71	458	1.1		0.02	0.99	0.23	1.11	0.26	2.04	1.59
72	424	1.1		0.02	0.99	0.21	1.11	0.24	1.84	1.46
73	443	1.1		0.02	0.99	0.22	1.11	0.24	1.87	1.51
74	476	1.1		0.02	0.99	0.23	1.11	0.25	1.95	1.60
75	559	1.1		0.02	0.99	0.26	1.11	0.29	2.23	1.87
76	557	1.1		0.02	0.99	0.25	1.11	0.28	2.17	1.85
77	490	1.1		0.02	0.99	0.22	1.11	0.24	1.86	1.62
78	575	1.1		0.02	0.99	0.25	1.11	0.28	2.13	1.89
79	2895	1.1		0.02	0.99	1.23	1.11	1.36	10.47	9.50
80	2132	1.1		0.02	0.99	0.88	1.11	0.98	7.53	6.98
81	4838	1.1		0.02	0.99	1.96	1.11	2.17	16.72	15.82
82	6146	1.1		0.02	0.99	2.43	1.11	2.70	20.78	20.10
83	14671	1.1		0.02	0.99	5.67	1.11	6.30	48.54	48.00
84	14151	1.1		0.02	0.99	5.36	1.11	5.95	45.89	46.41

CPTU-607 Liquefaction Analysis

ConeTec Inc. - CPT Interpretation
Interpretation Output - Release 1.22 Rev. A - Format: NLI Imperial
Run No: 06-0718-0954-2982
Job No: 02-100
Client: MACTEC Engineering and Consulting Inc.
Project: Former Callahan Mine Site, Brooksville, ME
Site: CP-607
Location: Callahan Mine
Cone: 20 Ton AD179
CPT Date: 06/28/06
CPT Time: 14:26
CPT File: 758CP607.COR
Northing (m): 0
Easting (m): 0
Elevation (m): 0 — 69.6 Elevation For CPT Triggering analysis

Water Table (m): 0.91 (ft): 3 — 3 Water Table assumed for CPT Analysis
Unit Weight of Water (default): 62.4 pcf
Averaging Increment (m): 0.2
Phi Method : Robertson and Campanella, 1983
Su Nkt used: 15 Su/P' (nc): 0.3 — 0.11 Base acceleration
Dr Method : Jamiolkowski - All Sands
State Parameter M: 1.2
Used Unit Weights Assigned to Soil Zones
N160Ic Calculated using qc1n

1) CSR = $0.65*(a_{max}/g)*(s_v/s'_v)*r_d$ — Seed & Idriss, 1983, p. 459

a_{max}/g = 0.11 g — USGS (base) (amplified from base as discussed in
s_v = computed — Total Vertical Stress
s'_v = computed — Effective Vertical Stress

$r_d = [1.0 - 0.4113z^{0.5} + 0.04052z + 0.001753z^{1.5}] / [1 - 0.4177z^{0.5} + 0.05729z - 0.$

z = depth in meters

2) FS = Factor of safety against triggering of liquefaction: $FS = (CRR_{7.5}/CSR) \times MSF \times Ks \times Ka$

MSF = magnitude scaling factor; Assume based on range recommended by NCEER Wo

CPTU-607 Liquefaction Analysis

$Ks = (s'_{vo}/P_a)^{(f-1)}$, where f = 0.7 to 0.8 for relative density of 40 to 60%; f = 0.6 to 0.7 fo
1 Atmosphere = 14.7 psi = 2.12 ksf

Conetec Data

Col-01 Depth (m)	Col-02 Depth (ft)	Col-03 Elev. (m)	Col-04 Elev. (ft)	Col-05 qc (tsf)	Col-06 qt (tsf)	Col-07 fs (tsf)	Col-08 Rf (%)	Col-09 u (ft)	Col-10 SBT (Zone)	Col-11 SBTn (Zone)	Col-12 SBT-BQ (Zone)	Col-13 SBT-BQn (Zone)	Col-14 Perm-k (cm/s)	Col-15 Unit Wt (pcf)	Col-16 T Stress (tsf)	Col-17 U Stress (tsf)	Col-18 E Stress (tsf)	Col-19 Cn	Col-20 N60 (b/ft)	Col-21 N1(60) (b/ft)	Col-22 N(60)Ic (b/ft)	Col-23 N1(60)Ic (b/ft)	Col-24 Qt	Col-25 Fr (%)	Col-26 Bq	Col-27 Ic	Col-28 FC (%)	Col-29 IcZone (Zone)	Col-30 Dr (%)	Col-31 Phi (deg)	Col-32 State Par	Col-33 Es/qt	Col-34 YoungE (tsf)	Col-35 Su (tsf)	Col-36 OCR	Col-37 U (psf)	Col-38 s_{vo} (psf)	Col-39 q_c (psf)	Col-40 q_t (psf)	Col-41 P_a (psf)	Col-42 σ'_{vo} (psf)	Col-43 f_s (psf)	Col-44 $Q_{exp=1}$	Col-45 F
0.1	0.328	-0.1	69.3	3.13	3.14	0.03	1.04	0.7	1	6	3	6	1.00E-07	111.4	0.018	0	0.018	1.7	1.5	2.6	1	1.8	170.61	1.04	0.01	3.03	60.3	3	-9999	-9999	-9999	-9999	-9999	0.208	10	0	36	6260	6280	2116	36	60	173.44	0.96
0.3	0.984	-0.3	68.6	2.51	2.51	0.01	0.5	0.66	1	6	3	6	1.00E-07	111.4	0.055	0	0.055	1.7	1.2	2	0.8	1.4	44.82	0.51	0.01	3.01	58.8	3	-9999	-9999	-9999	-9999	-9999	0.164	10	0	110	5020	5020	2116	110	20	44.64	0.41
0.5	1.64	-0.5	68.0	1.97	1.96	0.01	0.51	-1.32	1	5	-9999	5	1.00E-07	111.4	0.091	0	0.091	1.7	0.9	1.6	0.7	1.2	20.46	0.54	-0.02	3.11	66.5	3	-9999	-9999	-9999	-9999	-9999	0.125	7.3	0	182	3940	3920	2116	182	20	20.54	0.54
0.7	2.297	-0.7	67.3	1.63	1.66	0.01	0.6	7.16	1	4	3	4	1.00E-07	111.4	0.128	0	0.128	1.7	0.8	1.4	0.4	3.3	12	0.65	0.15	2.61	35.6	4	-9999	-9999	-9999	-9999	-9999	0.102	3.3	0	256	3260	3320	2116	256	20	11.97	0.65
0.9	2.953	-0.9	66.6	1.57	1.62	0.01	0.62	11.09	1	4	3	3	1.00E-07	111.4	0.164	0	0.164	1.7	0.8	1.3	0.5	2.6	8.84	0.69	0.24	2.74	42.4	4	-9999	-9999	-9999	-9999	-9999	0.097	2.1	0	328	3140	3240	2116	328	20	8.88	0.69
1.1	3.609	-1.1	66.0	1.31	1.38	0.01	0.73	13.76	1	4	3	3	1.00E-07	111.4	0.201	0.019	0.182	1.7	0.7	1.1	0.4	2.1	6.47	0.85	0.35	2.9	51.8	4	-9999	-9999	-9999	-9999	-9999	0.078	1.5	38	402	2620	2760	2116	364	20	6.48	0.85
1.3	4.265	-1.3	65.3	1.06	1.14	0.01	0.88	15.75	1	3	2	3	1.00E-07	111.4	0.238	0.039	0.198	1.7	0.5	0.9	0.4	1.6	4.54	1.12	0.5	3.09	64.4	3	-9999	-9999	-9999	-9999	-9999	0.06	1	79	476	2120	2280	2116	397	20	4.54	1.11
1.5	4.921	-1.5	64.7	1.09	1.17	0.01	0.86	18.06	1	3	2	3	1.00E-07	111.4	0.274	0.06	0.214	1.7	0.6	1	0.4	1.5	4.18	1.12	0.56	3.12	66.8	3	-9999	-9999	-9999	-9999	-9999	0.06	0.9	120	548	2180	2340	2116	428	20	4.19	1.12
1.7	5.577	-1.7	64.0	1.05	1.15	0.01	0.88	20.32	1	3	2	3	1.00E-07	111.4	0.311	0.08	0.23	1.7	0.5	0.9	0.4	1.4	3.63	1.2	0.66	3.19	72	3	-9999	-9999	-9999	-9999	-9999	0.056	0.8	161	622	2100	2300	2116	461	20	3.64	1.19
1.9	6.234	-1.9	63.4	1.05	1.14	0.01	0.88	20.24	1	3	2	3	1.00E-07	111.4	0.347	0.101	0.246	1.7	0.5	0.9	0.4	1.3	3.24	1.26	0.67	3.24	76.2	3	-9999	-9999	-9999	-9999	-9999	0.053	0.8	202	694	2100	2280	2116	492	20	3.22	1.26
2.1	6.89	-2.1	62.7	1.08	1.18	0.02	1.27	22.68	1	3	2	3	1.00E-07	111.4	0.384	0.121	0.262	1.7	0.6	1	0.5	1.3	3.05	1.88	0.73	3.34	84.3	3	-9999	-9999	-9999	-9999	-9999	0.053	0.7	243	768	2160	2360	2116	525	40	3.03	2.51
2.3	7.546	-2.3	62.1	1.04	1.15	0.02	1.74	24.58	2	3	1	3	1.00E-15	79.5	0.415	0.142	0.273	1.7	1.1	1.9	0.5	1.3	2.7	2.72	0.85	3.46	95.1	3	-9999	-9999	-9999	-9999	-9999	0.049	0.7	284	830	2080	2300	2116	546	40	2.69	2.72
2.5	8.202	-2.5	61.4	1.06	1.18	0.02	1.69	25.75	2	3	1	3	1.00E-15	79.5	0.441	0.162	0.279	1.7	1.1	1.9	0.5	1.3	2.66	2.7	0.86	3.46	95.5	3	-9999	-9999	-9999	-9999	-9999	0.049	0.7	325	882	2120	2360	2116	557	40	2.65	2.71
2.7	8.858	-2.7	60.7	1.1	1.24	0.02	1.62	28.57	1	3	1	3	1.00E-07	111.4	0.473	0.183	0.29	1.7	0.6	1	0.6	1.3	2.64	2.62	0.93	3.46	95.3	3	-9999	-9999	-9999	-9999	-9999	0.051	0.7	366	946	2200	2480	2116	580	40	2.64	2.61
2.9	9.514	-2.9	60.1	1.08	1.22	0.02	1.64	30.39	1	3	1	1	1.00E-07	111.4	0.509	0.203	0.306	1.7	0.6	1	0.6	1.2	2.33	2.81	1.04	3.52	100	3	-9999	-9999	-9999	-9999	-9999	0.048	0.6	406	1018	2160	2440	2116	612	40	2.33	2.81
3.1	10.17	-3.1	59.4	1.12	1.27	0.03	2.17	31.92	1	3	1	1	1.00E-07	111.4	0.546	0.224	0.322	1.7	0.6	1	0.7	1.2	2.26	3.79	1.06	3.6	100	3	-9999	-9999	-9999	-9999	-9999	0.048	0.6	447	1092	2240	2540	2116	645	60	2.25	4.14
3.3	10.827	-3.3	58.8	1.06	1.21	0.03	2.48	31.69	2	2	1	1	1.00E-15	79.5	0.577	0.244	0.333	1.7	1.2	2	0.7	1.2	1.91	4.74	1.17	3.71	100	2	-9999	-9999	-9999	-9999	-9999	0.042	0.6	488	1154	2120	2420	2116	666	60	1.90	4.74
3.5	11.483	-3.5	58.1	1.22	1.38	0.03	2.18	33.27	1	3	1	1	1.00E-07	111.4	0.608	0.265	0.343	1.7	0.7	1.1	0.7	1.2	2.24	3.9	1	3.61	100	2	-9999	-9999	-9999	-9999	-9999	0.051	0.6	529	1216	2440	2760	2116	687	60	2.25	3.89
3.7	12.139	-3.7	57.5	1.25	1.41	0.03	2.13	34.82	1	3	1	1	1.00E-07	111.4	0.645	0.285	0.359	1.67	0.7	1.1	0.8	1.2	2.12	3.94	1.05	3.63	100	2	-9999	-9999	-9999	-9999	-9999	0.051	0.6	570	1290	2500	2820	2116	720	60	2.13	3.92
3.9	12.795	-3.9	56.8	1.33	1.5	0.03	2.01	35.68	1	3	1	3	1.00E-07	111.4	0.681	0.306	0.376	1.63	0.7	1.2	0.8	1.2	2.17	3.69	0.99	3.61	100	2	-9999	-9999	-9999	-9999	-9999	0.054	0.6	611	1362	2660	3000	2116	751	60	2.18	3.66
4.1	13.451	-4.1	56.1	1.39	1.57	0.04	2.24	36.77	1	3	1	3	1.00E-07	111.4	0.718	0.326	0.392	1.6	0.7	1.2	0.8	1.2	2.16	4.14	0.97	3.63	100	2	-9999	-9999	-9999	-9999	-9999	0.057	0.6	652	1436	2780	3140	2116	784	80	2.17	4.69
4.3	14.107	-4.3	55.5	1.55	1.68	0.02	1.04	28.38	1	3	2	2	1.00E-07	111.4	0.754	0.347	0.408	1.57	0.8	1.3	0.8	1.1	2.27	1.89	0.58	3.45	94.6	3	-9999	-9999	-9999	-9999	-9999	0.062	0.6	693	1508	3100	3360	2116	815	40	2.27	2.16
4.5	14.764	-4.5	54.8	1.45	1.64	0.01	0.77	38.81	1	3	1	1	1.00E-07	111.4	0.791	0.367	0.424	1.54	0.8	1.2	0.7	0.9	1.99	1.48	1	3.46	95.4	3	-9999	-9999	-9999	-9999	-9999	0.056	0.6	734	1582	2900	3280	2116	848	20	2.00	1.18
4.7	15.42	-4.7	54.2	1.64	1.84	0.01	0.55	41.04	1	1	3	3	1.00E-07	111.4	0.828	0.388	0.44	1.51	0.9	1.3	-9999	-9999	2.29	0.99	0.89	-9999	-9999	0	-9999	-9999	-9999	-9999	-9999	0.067	0.6	775	1656	3280	3680	2116	881	20	2.30	0.99
4.9	16.076	-4.9	53.5	1.6	1.81	0.01	0.55	46.08	1	1	1	1	1.00E-07	111.4	0.864	0.408	0.456	1.48	0.9	1.3	-9999	-9999	2.09	1.05	1.08	-9999	-9999	0	-9999	-9999	-9999	-9999	-9999	0.063	0.6	816	1728	3200	3620	2116	912	20	2.07	1.06
5.1	16.732	-5.1	52.9	1.63	1.85	0.01	0.54	46.51	1	1	1	1	1.00E-07	111.4	0.901	0.429	0.472	1.46	0.9	1.3	-9999	-9999	2.01	1.06	1.08	-9999	-9999	0	-9999	-9999	-9999	-9999	-9999	0.063	0.6	857	1802	3260	3700	2116	945	20	2.01	1.05
5.3	17.388	-5.3	52.2	1.89	2.11	0.02	0.71	46.95	1	3	3	3	1.00E-07	111.4	0.937	0.449	0.488	1.43	1	1.4	0.9	1	2.4	1.29	0.87	3.36	86.5	3	-9999	-9999	-9999	-9999	-9999	0.078	0.6	898	1874	3780	4220	2116	976	40	2.40	1.71
5.5	18.044	-5.5	51.6	2.01	2.25	0.02	0.89	50.23	1	3	3	3	1.00E-07	111.4	0.974	0.47	0.504	1.41	1.1	1.5	1	1.1	2.53	1.57	0.86	3.38	87.8	3	-9999	-9999	-9999	-9999	-9999	0.085	0.7	939	1948	4020	4500	2116	1009	40	2.53	1.57
5.7	18.701	-5.7	50.9	2	2.25	0.02	0.67	53.09	1	3	3	3	1.00E-07	111.4	1.01	0.49	0.52	1.39	1.1	1.5	0.9	1	2.38	1.22	0.94	3.36	86	3	-9999	-9999	-9999	-9999	-9999	0.082	0.6	980	2020	4000	4500	2116	1040	40	2.38	1.61
5.9	19.357	-5.9	50.2	2.04	2.3	0.02	0.65	54.65	1	3	3	3	1.00E-07	111.4	1.047	0.511	0.536	1.37	1.1	1.5	1	1	2.34	1.2	0.95	3.36	86.3	3	-9999	-9999	-9999	-9999	-9999	0.084	0.6	1021	2094	4080	4600	2116	1073	40	2.33	1.60
6.1	20.013	-6.1	49.6	2.27	2.54	0.01	0.49	56.93	1	1	3	3	1.00E-07	111.4	1.083	0.531	0.552	1.35	1.2	1.6	-9999	-9999	2.63	0.86	0.86	-9999	-9999	0	-9999	-9999	-9999	-9999	-9999	0.097	0.7	1062	2166	4540	5080	2116	1104	20	2.64	0.69
6.3	20.669	-6.3	48.9	2.48	2.75	0.02	0.73	59.3	1	3	3	3	1.00E-07	111.4	1.12	0.552	0.568	1.33	1.3	1.7	1.1	1.2	2.88	1.23	0.8	3.28	79.7	3	-9999	-9999	-9999	-9999	-9999	0.109	0.7	1103	2240	4960	5500	2116	1137	40	2.87	1.23
6.5	21.325	-6.5	48.3	2.43	2.72	0.02	0.74	61.3	1	3	3	3	1.00E-07	111.4	1.156	0.572	0.584	1.31	1.3	1.7	1.1	1.1	2.67	1.29	0.86	3.32	82.9	3	-9999	-9999	-9999	-9999	-9999	0.104	0.7	1143	2312	4860	5440	2116	1169	40	2.68	1.28
6.7	21.981	-6.7	47.6	2.48	2.77	0.02	0.54	63.03	1	1	3	3	1.00E-07	111.4	1.193	0.593	0.6	1.29	1.3	1.7	-9999	-9999	2.63	0.95	0.87	-9999	-9999	0	-9999	-9999	-9999	-9999	-9999	0.105	0.7	1184	2386	4960	5540	2116	1202	40	2.62	1.27
6.9	22.638	-6.9	47.0	2.86	3.16	0.02	0.71	63.73	1	3	3	3	1.00E-07	111.4	1.23	0.613	0.616	1.27	1.5	1.9	1.2	1.2	3.13	1.17	0.71	3.24	76.3	3	-9999	-9999	-9999	-9999	-9999	0.129	0.7	1225	2460	5720	6320	2116	1235	40	3.13	1.04
7.1	23.294	-7.1	46.3	2.59	2.89	0.02	0.52	64.69	1	1	3	3	1.00E-07	111.4	1.266	0.634	0.632	1.26	1.4	1.7	-9999	-9999	2.57	0.93	0.85	-9999	-9999	0	-9999	-9999	-9999	-9999	-9999	0.108	0.7	1266	2532	5180	5780	2116	1266	40	2.57	1.23
7.3	23.95	-7.3	45.7	2.97	3.27	0.02	0.46	63.14	1	1	3	3	1.00E-07	111.4	1.303	0.654	0.649	1.24	1.6	1.9	-9999	-9999	3.03	0.76	0.67	-9999	-9999	0	-9999	-9999	-9999	-9999	-9999	0.131	0.7	1307	2606	5940	6540	2116	1299	40	3.03	1.02
7.5	24.606	-7.5	45.0	2.72	3.04	0.01	0.33	69.16	1	1	3	3	1.00E-07	111.4	1.339	0.675	0.665	1.23	1.5	1.8	-9999	-9999	2.56	0.59	0.87	-9999	-9999	0	-9999	-9999	-9999	-9999	-9999	0.114	0.7	1348	2678	5440	6080	2116	1330	20	2.56	0.59
7.7	25.262	-7.7	44.3	2.78	3.12	0.02	0.48	71.73	1	1	3	3	1.00E-07	111.4	1.376	0.695	0.681	1.21	1.5	1.8	-9999	-9999	2.56	0.86	0.89	-9999	-9999	0	-9999	-9999	-9999	-9999	-9999	0.116	0.7	1389	2752	5560	6240	2116	1363	40	2.56	1.15
7.9	25.918	-7.9	43.7	3.04	3.38	0.02	0.59	72.71	1	1	3	3	1.00E-07	111.4	1.412	0.716	0.697	1.2	1.6	1.9	-9999	-9999	2.82	1.02	0.79	-9999	-9999	0	-9999	-9999	-9999	-9999	-9999	0.131	0.7	1430	2824	6080	6760	2116	1394	40	2.82	1.02
8.1	26.574	-8.1	43.0	3.35	3.7	0.02	0.54	73.06	1	1	3	3	1.00E-07	111.4	1.449	0.736	0.713	1.18	1.8	2.1	-9999	-9999	3.15	0.89	0.69	-9999	-9999	0	-9999	-9999	-9999	-9999	-9999	0.15	0.8	1471	2898	6700	7400	2116	1427	40	3.15	0.89
8.3	27.231	-8.3	42.4	3.32	3.68	0.02	0.55	75.67	1	1	3	3	1.00E-07	111.4	1.485	0.757	0.729	1.17	1.8	2.1	-9999	-9999	3.01	0.91	0.73	-9999	-9999	0	-9999	-9999	-9999	-9999	-9999	0.146	0.7	1512	2970	6640	7360	2116	1458	40	3.01	0.91
8.5	27.887	-8.5	41.7	3.1	3.48	0.02	0.5	80.14	1	1	3	3	1.00E-07	111.4	1.522	0.777	0.745	1.16	1.7	1.9	-9999	-9999	2.62	0.9	0.88	-9999	-9999	0	-9999	-9999	-9999	-9999	-9999	0.13	0.7	1553	3044	6200	6960	2116	1491	40	2.63	1.02
8.7	28.543	-8.7	41.1	3.28	3.67	0.02	0.55	83.83	1	1	3	3	1.00E-07	111.4	1.558	0.798	0.761	1.15	1.8	2	-9999	-9999	2.78	0.95	0.86	-9999	-9999	0	-9999	-9999	-9999	-9999	-9999	0.141	0.7	1594	3116	6560	7340	2116	1522	40	2.78	0.95
8.9	29.199	-8.9	40.4	3.37	3.77	0.02	0.47	84.24	1	1	3	3	1.00E-07	111.4	1.595	0.818	0.777	1.13	1.8	2	-9999	-9999	2.79	0.81	0.83	-9999	-9999	0	-9999	-9999	-9999	-9999	-9999	0.145	0.7	1635	3190	6740	7540	2116	1555	40	2.80	0.92
9.1	29.855	-9.1	39.7	3.07	3.46	0.01	0.29	84.47	1	1	3	3	1.00E-07	111.4	1.632	0.838	0.793	1.12	1.7	1.9	-9999	-9999	2.31	0.55	0.98	-9999	-9999	0	-9999	-9999	-9999	-9999	-9999	0.122	0.6	1676	3264	6140	6920	2116	1588	20	2.30	0.55
9.3	30.511	-9.3	39.1	3.31	3.71	0.02	0.54	85.95	1	1	3	3	1.00E-07	111.4	1.668	0.859	0.809	1.11	1.8	2	-9999	-9999	2.52	0.98	0.89	-9999	-9999	0	-9999	-9999	-9999	-9999	-9999	0.136	0.7	1717	3336	6620	7420	2116	1619	40	2.52	0.98
9.5	31.168	-9.5	38.4	3.26	3.68	0.01	0.34	88.76	1	1	3	3	1.00E-07	111.4	1.705	0.879	0.825	1.1	1.8	1.9	-9999	-9999	2.39	0.64	0.96	-9999	-9999	0	-9999	-9999	-9999	-9999	-9999	0.131	0.6	1758	3410	6520	7360	2116	1652	20	2.39	0.51
9.7	31.824	-9.7	37.8	3.5	3.93	0.03	0.7	90.54	1	3	3	3	1.00E-07	111.4	1.741	0.9	0.841	1.09	1.9	2	1.6	1.1	2.6	1.26	0.88	3.33	83.5	3	-9999	-9999	-9999	-9999	-9999	0.146	0.7	1799	3482	7000	7860	2116	1683	60	2.60	1.37
9.9	32.48	-9.9	37.1	3.84	4.26	0.03	0.76	91.26	1	3	3	3	1.00E-07	111.4	1.778	0.92	0.857	1.08	2	2.2	1.7	1.2	2.9	1.31	0.78	3.29	80.4	3	-9999	-9999	-9999	-9999	-9999	0.166	0.7	1840	3556	7680	8520	2116	1716	60	2.89	1.21
10.1	33.136	-10.1	36.5	3.9	4.33	0.07	1.62	91.56	1	3	3	3	1.00E-07	111.4	1.814	0.941	0.873	1.07	2.1	2.2	1.9	1.3	2.88	2.79	0.76	3.44	93.4	3	-9999	-9999	-9999	-9999	-9999	0.168	0.7	1880	3628	7800	8660	2116	1748	140	2.88	2.78
10.3	33.792	-10.3	35.8	4.14	4.43	0.06	1.25	61.5	1	3	3	3	1.00E-07	111.4	1.851	0.961	0.889	1.06	2.1	2.2	1.9	1.3	2.89	2.14	0.77	3.38	88.3	3	-9999	-9999	-9999	-9999	-9999	0.172	0.7	1921	3702	8280	8860	2116	1781	120	2.90	2.33
10.5	34.448	-10.5	35.2	4.07	4.49	0.03	0.73	89.12	1	3	3	3	1.00E-07	111.4	1.887	0.982	0.905	1.05	2.1	2.3	1.8	1.2	2.87	1.25	0.69	3.29	80	3	-9999	-9999	-9999	-9999	-9999	0.173	0.7	1962	3774	8140	8980	2116	1812	60	2.87	1.15
10.7	35.105	-10.7	34.5	4.31	4.75	0.04	0.79	93.41	1	3	3	3	1.00E-07	111.4	1.924	1.002	0.922	1.04	2.3	2.4	1.9	1.2	3.07	1.33	0.68	3.27	78.7	3	-9999	-9999	-9999	-9999	-9999	0.188	0.7	2003	3848	8620	9500	2116	1845	80	3.06	1.42
10.9	35.761	-10.9	33.8	7.8	8.19	0.13	1.53	84.63	5	3	4	3	5.00E-06	114.6	1.961	1.023	0.938	1.03	3.9	4.1	2.7	2.3	6.64	2.01	0.26	3.05	62.2	3	-9999	-9999	-9999	-9999	-9999	0.415	1.5	2044	3922	15600	16380	2116	1878	260	6.63	2.09
11.1	36.417	-11.1	33.2	12.43	12.61	0.41	3.26	39.73	4	3	6	4	5.00E-06	114.6	1.999	1.043	0.955	1.02	8.1	8.2	4.1	3.8	11.11	3.87	0.02	3.02	60.1	3	-9999	-9999	-9999	-9999	-9999	0.708	2.9	2085	3998	24860	25220	2116	1913	820	11.09	3.86
11.3	37.073	-11.3	32.5	10.22	10.5	0.28	2.63	59.12	5	3	5	4	5.00E-06	114.6	2.036	1.064	0.972	1.01	5	5.1	3.5	3.1	8.7	3.26	0.09	3.07	63.1	3	-9999	-9999	-9999	-9999	-9999	0.564	2.1	2126	4072	20440	21000	2116	1946	560	8.70	3.31
11.5	37.729	-11.5	31.9	15.64	15.74	0.37	2.37	22.78	5	4	6	4	5.00E-06	114.6	2.074	1.084	0.989	1.01	7.5	7.6	4.7	4.3	13.82	2.73	-0.03	2.86	49.4	4	-9999	-9999	-9999	-9999	-9999	0.911	4	2167	4148	31280	31480	2116	1981	740	13.80	2.71

1 CPTU-607 Liquefaction Analysis

12 text

16]06205z$^{1.5}$ + 0.001210z^{2}]

20 Youd and Idriss, 2001

23 rkshop, reiterated in Youd and Idriss, 2001

30 CPTU-607 Liquefaction Analysis

Nkt clay 16

32 rel density of 60 to 80%; P_a = pressure at 1 atmosphere Youd and Idriss, 2001

Row	AT	AU	AV	AW	AX	AY	AZ	BA	BB	BC	BD	BE	BF	BG	BH	BI	BJ	BK	BL	BM
34	Col-46	Col-47	Col-48	Col-49	Col-50	Col-51	Col-52	Col-53	Col-54	Col-55	Col-56	Col-57	Col-57a	Col-58	Col-59	Col-60	Col-61	Col-62	Col-63	Col-64
35	Youd & Idriss, 2001 CPT Based Analysis																			
36																				
37	$I_{c\,Qexp=1}$	$Q_{exp=0.5}$	F	$I_{c\,Qexp=0.5}$	$Q_{exp=0.7}$	F	$I_{c\,Qexp=0.7}$	Description	C_q			q_{c1N}	Lookup	Ic	Kc	$(q_{c1N})_{cs}$	CRR7.5	rd	a_{max}/g =	CSR
38									n=1.0	n=0.5	n=0.7		Col						if crest accel =	No
39																			2.0	Amplification
40	1.72	22.62	0.96	2.43	51.10	0.96	2.13	Granular	58.78	7.67	17.32	22.75	2.00	2.43	2.45	55.84	0.10	1.00	0.22	0.07
41	2.00	10.18	0.41	2.60	18.38	0.41	2.36	Granular	19.24	4.39	7.92	10.41	2.00	2.60	3.32	34.52	0.07	1.00	0.22	0.07
42	2.36	6.02	0.54	2.85	9.84	0.54	2.65	Very Silty	11.63	3.41	5.57	10.32	2.00	2.65	3.66	37.80	0.07	1.00	0.22	0.07
43	2.61	4.16	0.65	3.03	6.35	0.65	2.86	Clayey	8.27	2.88	4.39	12.97	2.00	2.61	3.36	43.64	0.08	1.00	0.21	0.07
44	2.73	3.50	0.69	3.11	5.07	0.69	2.96	Clayey	6.45	2.54	3.69	9.88	2.00	2.73	4.25	42.00	0.08	1.00	0.21	0.07
45	2.90	2.69	0.85	3.25	3.82	0.85	3.11	Clayey	5.81	2.41	3.43	7.58	2.00	2.90	5.66	42.91	0.08	0.99	0.21	0.08
46	3.08	1.97	1.11	3.42	2.75	1.11	3.28	Clayey	5.33	2.31	3.23	5.74	2.00	3.08	7.73	44.37	0.08	0.99	0.21	0.09
47	3.12	1.88	1.12	3.44	2.59	1.12	3.31	Clayey	4.94	2.22	3.06	5.47	2.00	3.12	8.15	44.54	0.08	0.99	0.21	0.09
48	3.18	1.70	1.19	3.49	2.30	1.19	3.37	Clayey	4.59	2.14	2.90	4.99	2.00	3.18	9.04	45.08	0.08	0.99	0.21	0.10
49	3.24	1.55	1.26	3.53	2.08	1.26	3.42	Clayey	4.30	2.07	2.78	4.63	2.00	3.24	9.86	45.68	0.08	0.99	0.20	0.10
50	3.40	1.51	2.51	3.67	2.00	2.51	3.56	Clayey	4.03	2.01	2.65	4.49	2.00	3.40	12.32	55.34	0.10	0.99	0.20	0.10
51	3.46	1.37	2.72	3.72	1.79	2.72	3.62	Clayey	3.87	1.97	2.58	4.21	2.00	3.46	13.39	56.37	0.10	0.98	0.20	0.11
52	3.47	1.36	2.71	3.72	1.78	2.71	3.62	Clayey	3.80	1.95	2.54	4.23	2.00	3.47	13.47	57.03	0.10	0.98	0.20	0.11
53	3.46	1.38	2.61	3.71	1.79	2.61	3.61	Clayey	3.65	1.91	2.47	4.27	2.00	3.46	13.36	57.06	0.10	0.98	0.20	0.11
54	3.52	1.25	2.81	3.76	1.60	2.81	3.67	Clayey	3.46	1.86	2.38	3.99	2.00	3.52	14.53	57.97	0.10	0.98	0.20	0.12
55	3.62	1.24	4.14	3.84	1.57	4.14	3.75	Clayey	3.28	1.81	2.30	3.94	2.00	3.62	16.38	64.56	0.11	0.98	0.19	0.12
56	3.71	1.07	4.74	3.93	1.34	4.74	3.84	Clayey	3.18	1.78	2.25	3.64	2.00	3.71	18.29	66.50	0.11	0.98	0.19	0.12
57	3.61	1.28	3.89	3.82	1.60	3.89	3.73	Clayey	3.08	1.76	2.20	4.02	2.00	3.61	16.10	64.69	0.11	0.98	0.19	0.12
58	3.63	1.24	3.92	3.83	1.54	3.92	3.75	Clayey	2.94	1.71	2.13	3.92	2.00	3.63	16.56	64.88	0.11	0.97	0.19	0.12
59	3.60	1.30	3.66	3.80	1.60	3.66	3.72	Clayey	2.82	1.68	2.07	4.00	2.00	3.60	16.07	64.20	0.10	0.97	0.19	0.13
60	3.66	1.32	4.69	3.85	1.61	4.69	3.77	Clayey	2.70	1.64	2.00	4.01	2.00	3.66	17.20	68.90	0.11	0.97	0.18	0.13
61	3.48	1.41	2.16	3.67	1.71	2.16	3.59	Clayey	2.60	1.61	1.95	4.12	2.00	3.48	13.72	56.58	0.10	0.97	0.18	0.13
62	3.42	1.27	1.18	3.61	1.52	1.18	3.53	Clayey	2.50	1.58	1.90	3.87	2.00	3.42	12.69	49.10	0.08	0.97	0.18	0.13
63	3.34	1.48	0.99	3.52	1.77	0.99	3.44	Clayey	2.40	1.55	1.85	4.18	2.00	3.34	11.31	47.23	0.08	0.97	0.18	0.13
64	3.39	1.36	1.06	3.56	1.61	1.06	3.49	Clayey	2.32	1.52	1.80	3.97	2.00	3.39	12.16	48.24	0.08	0.97	0.18	0.13
65	3.40	1.34	1.05	3.57	1.58	1.05	3.50	Clayey	2.24	1.50	1.76	3.91	2.00	3.40	12.37	48.41	0.08	0.96	0.18	0.13
66	3.41	1.63	1.71	3.57	1.91	1.71	3.50	Clayey	2.17	1.47	1.72	4.32	2.00	3.41	12.55	54.27	0.09	0.96	0.17	0.13
67	3.38	1.75	1.57	3.52	2.03	1.57	3.47	Clayey	2.10	1.45	1.68	4.46	2.00	3.38	11.96	53.32	0.09	0.96	0.17	0.13
68	3.41	1.67	1.61	3.55	1.93	1.61	3.49	Clayey	2.03	1.43	1.64	4.33	2.00	3.41	12.43	53.79	0.09	0.96	0.17	0.13
69	3.41	1.66	1.60	3.55	1.90	1.60	3.49	Clayey	1.97	1.40	1.61	4.29	2.00	3.41	12.54	53.75	0.09	0.96	0.17	0.13
70	3.23	1.91	0.69	3.36	2.17	0.69	3.31	Clayey	1.92	1.38	1.58	4.60	2.00	3.23	9.62	44.27	0.08	0.96	0.17	0.13
71	3.28	2.10	1.23	3.41	2.38	1.23	3.36	Clayey	1.86	1.36	1.54	4.84	2.00	3.28	10.48	50.69	0.09	0.96	0.17	0.13
72	3.32	1.99	1.28	3.44	2.24	1.28	3.39	Clayey	1.81	1.35	1.52	4.66	2.00	3.32	11.01	51.27	0.09	0.95	0.16	0.13
73	3.33	1.98	1.27	3.44	2.22	1.27	3.39	Clayey	1.76	1.33	1.49	4.61	2.00	3.33	11.11	51.24	0.09	0.95	0.16	0.14
74	3.22	2.39	1.04	3.33	2.66	1.04	3.29	Clayey	1.71	1.31	1.46	5.12	2.00	3.22	9.55	48.88	0.08	0.95	0.16	0.14
75	3.33	1.98	1.23	3.43	2.20	1.23	3.39	Clayey	1.67	1.29	1.43	4.57	2.00	3.33	11.18	51.04	0.09	0.95	0.16	0.14
76	3.23	2.37	1.02	3.33	2.62	1.02	3.29	Clayey	1.63	1.28	1.41	5.04	2.00	3.23	9.69	48.78	0.08	0.95	0.16	0.14
77	3.22	2.03	0.59	3.31	2.23	0.59	3.28	Clayey	1.59	1.26	1.38	4.57	2.00	3.22	9.50	43.44	0.08	0.94	0.16	0.14
78	3.32	2.05	1.15	3.41	2.24	1.15	3.37	Clayey	1.55	1.25	1.36	4.58	2.00	3.32	11.00	50.38	0.09	0.94	0.15	0.14
79	3.26	2.29	1.02	3.34	2.49	1.02	3.31	Clayey	1.52	1.23	1.34	4.85	2.00	3.26	10.10	48.97	0.08	0.94	0.15	0.14
80	3.19	2.59	0.89	3.27	2.80	0.89	3.24	Clayey	1.48	1.22	1.32	5.19	2.00	3.19	9.15	47.43	0.08	0.94	0.15	0.14
81	3.22	2.50	0.91	3.29	2.69	0.91	3.26	Clayey	1.45	1.20	1.30	5.05	2.00	3.22	9.47	47.79	0.08	0.93	0.15	0.14
82	3.29	2.20	1.02	3.36	2.36	1.02	3.33	Clayey	1.42	1.19	1.28	4.67	2.00	3.29	10.55	49.23	0.08	0.93	0.15	0.14
83	3.25	2.35	0.95	3.32	2.51	0.95	3.29	Clayey	1.39	1.18	1.26	4.82	2.00	3.25	10.03	48.38	0.08	0.93	0.15	0.14
84	3.25	2.40	0.92	3.31	2.55	0.92	3.28	Clayey	1.36	1.17	1.24	4.85	2.00	3.25	9.92	48.08	0.08	0.92	0.14	0.14
85	3.25	1.99	0.55	3.31	2.11	0.55	3.29	Clayey	1.33	1.15	1.22	4.36	2.00	3.25	10.00	43.56	0.08	0.92	0.14	0.14
86	3.30	2.21	0.98	3.35	2.33	0.98	3.33	Clayey	1.31	1.14	1.21	4.58	2.00	3.30	10.69	49.00	0.08	0.92	0.14	0.14
87	3.23	2.11	0.51	3.28	2.22	0.51	3.26	Clayey	1.28	1.13	1.19	4.45	2.00	3.23	9.63	42.88	0.08	0.91	0.14	0.13
88	3.34	2.32	1.37	3.39	2.43	1.37	3.37	Clayey	1.26	1.12	1.17	4.67	2.00	3.34	11.39	53.17	0.09	0.91	0.14	0.13
89	3.28	2.60	1.21	3.32	2.72	1.21	3.30	Clayey	1.23	1.11	1.16	4.96	2.00	3.28	10.39	51.57	0.09	0.91	0.13	0.13
90	3.44	2.62	2.78	3.48	2.72	2.78	3.46	Clayey	1.21	1.10	1.14	4.96	2.00	3.44	13.02	64.50	0.10	0.90	0.13	0.13
91	3.40	2.66	2.33	3.43	2.75	2.33	3.42	Clayey	1.19	1.09	1.13	4.98	2.00	3.40	12.34	61.42	0.10	0.90	0.13	0.13
92	3.27	2.66	1.15	3.30	2.74	1.15	3.29	Clayey	1.17	1.08	1.11	4.96	2.00	3.27	10.30	51.08	0.09	0.89	0.13	0.13
93	3.28	2.86	1.42	3.31	2.94	1.42	3.30	Clayey	1.15	1.07	1.10	5.15	2.00	3.28	10.47	53.90	0.09	0.89	0.13	0.13
94	3.06	6.25	2.09	3.09	6.40	2.09	3.08	Clayey	1.13	1.06	1.09	8.72	2.00	3.06	7.47	65.20	0.11	0.89	0.13	0.13
95	3.02	10.55	3.86	3.04	10.76	3.86	3.03	Clayey	1.11	1.05	1.07	13.19	2.00	3.02	7.02	92.51	0.15	0.88	0.12	0.13
96	3.07	8.34	3.31	3.09	8.48	3.31	3.08	Clayey	1.09	1.04	1.06	10.79	2.00	3.07	7.57	81.66	0.13	0.88	0.12	0.13
97	2.86	13.35	2.71	2.87	13.53	2.71	2.86	Clayey	1.07	1.03	1.05	15.89	2.00	2.86	5.29	84.01	0.14	0.87	0.12	0.13
98	2.59	22.37	1.95	2.60	22.59	1.95	2.60	Very Silty	1.05	1.03	1.04	24.66	2.00	2.60	3.32	81.95	0.13	0.86	0.12	0.13
99	2.69	19.80	2.38	2.70	19.92	2.38	2.69	Clayey	1.03	1.02	1.02	22.22	2.00	2.69	3.93	87.31	0.14	0.86	0.12	0.13
100	2.62	19.57	1.75	2.62	19.63	1.75	2.62	Clayey	1.02	1.01	1.01	21.82	2.00	2.62	3.46	75.53	0.12	0.85	0.12	0.13
101	2.62	18.39	1.54	2.62	18.39	1.54	2.62	Clayey	1.00	1.00	1.00	20.49	2.00	2.62	3.43	70.26	0.11	0.85	0.11	0.13
102	2.69	19.80	2.32	2.69	19.73	2.32	2.69	Clayey	0.98	0.99	0.99	21.74	2.00	2.69	3.95	85.77	0.14	0.84	0.11	0.13
103	2.76	12.63	1.55	2.76	12.55	1.55	2.76	Clayey	0.97	0.98	0.98	14.53	2.00	2.76	4.47	64.98	0.11	0.84	0.11	0.13
104	2.76	24.88	3.93	2.76	24.64	3.93	2.76	Clayey	0.95	0.98	0.97	26.39	2.00	2.76	4.48	118.35	0.23	0.83	0.11	0.12

Row	BN	BO	BP	BQ	BR	BS	BT	BU	BV	BW	BX	BY	BZ	CA	CB	CC	CD	CE	CF	CG	CH
34	Col-65	Col-66	Col-67	Col-68	Col-69	Col-70	Col-71	Col-72	Col-73	Col-74	Col-75	Col-76	Col-77	Col-78	Col-79	Col-80	Col-81	Col-82	Col-83	Col-84	Col-85
35												Boulanger and Idriss, 2004, "Approach B" method based on Su profile									
36	Rel. Den. Factor											Su - CPT	OCR								
37	CSR	f	MSF	K_σ	α	K_α	FS $_{liq\text{-}CPT\ (Sand\text{-}Like)}$		Apparent Fines	Measured Fines	**Ic** Limits	(psf)	Assumed	OCR - CPT	α	k_α	$CRR_{M7.5}$	MSF	$CRR_{M5.5}$	FS $_{liq\text{-}Su\ (Clay\text{-}Like)}$	
38	if crest accel =						No	if crest accel =	(%)	(%)		Nkt	1.1							No	if crest accel =
39	2				0.02		Amplification	2				10			0.02					Amplification	2
40	0.14	0.7	2.2	3.39	0.02	0.9600	9.64	4.84	28		2.6	624	1.1		0.02	0.99	10.94	1.11	12.16	169.91	85.29
41	0.14	0.7	2.2	2.43	0.02	0.9600	5.05	2.56	35		2.6	491	1.1		0.02	0.99	2.82	1.11	3.13	43.78	22.15
42	0.14	0.7	2.2	2.09	0.02	0.9600	4.52	2.30	38		2.6	374	1.1		0.02	0.99	1.30	1.11	1.44	20.17	10.29
43	0.14	0.7	2.2	1.88	0.02	0.9600	4.36	2.24	36		2.6	306	1.1		0.02	0.99	0.75	1.11	0.84	11.77	6.05
44	0.14	0.7	2.2	1.75	0.02	0.9600	3.98	2.06	42		2.6	291	1.1		0.02	0.99	0.56	1.11	0.62	8.75	4.53
45	0.15	0.7	2.2	1.70	0.02	0.9600	3.53	1.85	52		2.6	236	1.1		0.02	0.99	0.41	1.11	0.45	5.79	3.02
46	0.16	0.7	2.2	1.65	0.02	0.9600	3.23	1.70	64		2.6	180	1.1		0.02	0.99	0.29	1.11	0.32	3.75	1.97
47	0.17	0.7	2.2	1.62	0.02	0.9600	2.96	1.57	67	97.1	2.6	179	1.1		0.02	0.99	0.26	1.11	0.29	3.24	1.72
48	0.18	0.7	2.2	1.58	0.02	0.9600	2.77	1.48	72		2.6	168	1.1		0.02	0.99	0.23	1.11	0.26	2.67	1.43
49	0.18	0.7	2.2	1.55	0.02	0.9600	2.62	1.41	76		2.6	159	1.1		0.02	0.99	0.20	1.11	0.23	2.27	1.23
50	0.19	0.7	2.2	1.52	0.02	0.9600	2.98	1.62	90		2.6	159	1.1		0.02	0.99	0.19	1.11	0.21	2.06	1.12
51	0.19	0.7	2.2	1.50	0.02	0.9600	2.87	1.57	95		2.6	147	1.1		0.02	0.99	0.17	1.11	0.19	1.76	0.97
52	0.20	0.7	2.2	1.49	0.02	0.9600	2.76	1.53	96		2.6	148	1.1		0.02	0.99	0.17	1.11	0.19	1.67	0.93
53	0.20	0.7	2.2	1.47	0.02	0.9600	2.65	1.48	95	98.7	2.6	153	1.1		0.02	0.99	0.17	1.11	0.19	1.62	0.91
54	0.21	0.7	2.2	1.45	0.02	0.9600	2.58	1.45	100		2.6	142	1.1		0.02	0.99	0.15	1.11	0.16	1.40	0.79
55	0.21	0.7	2.2	1.43	0.02	0.9600	2.67	1.52	100		2.6	145	1.1		0.02	0.99	0.14	1.11	0.16	1.33	0.76
56	0.21	0.7	2.2	1.41	0.02	0.9600	2.65	1.52	100		2.6	127	1.1		0.02	0.99	0.12	1.11	0.13	1.10	0.63
57	0.21	0.7	2.2	1.40	0.02	0.9600	2.52	1.46	100		2.6	154	1.1		0.02	0.99	0.14	1.11	0.16	1.28	0.74
58	0.21	0.7	2.2	1.38	0.02	0.9600	2.46	1.44	100		2.6	153	1.1		0.02	0.99	0.13	1.11	0.15	1.19	0.70
59	0.21	0.7	2.2	1.36	0.02	0.9600	2.39	1.41	100		2.6	164	1.1		0.02	0.99	0.14	1.11	0.15	1.21	0.71
60	0.21	0.7	2.2	1.35	0.02	0.9600	2.47	1.47	100		2.6	170	1.1		0.02	0.99	0.14	1.11	0.15	1.20	0.71
61	0.21	0.7	2.2	1.33	0.02	0.9600	2.12	1.27	97		2.6	185	1.1		0.02	0.99	0.14	1.11	0.16	1.24	0.75
62	0.21	0.7	2.2	1.32	0.02	0.9600	1.77	1.08	92		2.6	170	1.1		0.02	0.99	0.13	1.11	0.14	1.09	0.66
63	0.21	0.7	2.2	1.30	0.02	0.9600	1.71	1.05	84		2.6	202	1.1		0.02	0.99	0.14	1.11	0.16	1.24	0.76
64	0.21	0.7	2.2	1.29	0.02	0.9600	1.70	1.05	89		2.6	189	1.1		0.02	0.99	0.13	1.11	0.15	1.11	0.69
65	0.21	0.7	2.2	1.27	0.02	0.9600	1.68	1.05	90		2.6	190	1.1		0.02	0.99	0.13	1.11	0.14	1.07	0.67
66	0.21	0.7	2.2	1.26	0.02	0.9600	1.91	1.21	91		2.6	235	1.1		0.02	0.99	0.15	1.11	0.17	1.27	0.80
67	0.21	0.7	2.2	1.25	0.02	0.9600	1.87	1.19	88		2.6	255	1.1		0.02	0.99	0.16	1.11	0.18	1.34	0.85
68	0.21	0.7	2.2	1.24	0.02	0.9600	1.85	1.19	90		2.6	248	1.1		0.02	0.99	0.15	1.11	0.17	1.25	0.81
69	0.21	0.7	2.2	1.23	0.02	0.9600	1.83	1.19	91		2.6	251	1.1		0.02	0.99	0.15	1.11	0.16	1.22	0.80
70	0.20	0.7	2.2	1.22	0.02	0.9600	1.50	0.99	75		2.6	291	1.1		0.02	0.99	0.17	1.11	0.18	1.38	0.90
71	0.20	0.7	2.2	1.20	0.02	0.9600	1.74	1.16	80		2.6	326	1.1		0.02	0.99	0.18	1.11	0.20	1.49	0.99
72	0.20	0.7	2.2	1.19	0.02	0.9600	1.73	1.16	83		2.6	313	1.1		0.02	0.99	0.17	1.11	0.19	1.39	0.93
73	0.20	0.7	2.2	1.19	0.02	0.9600	1.71	1.16	83		2.6	315	1.1		0.02	0.99	0.17	1.11	0.18	1.36	0.92
74	0.20	0.7	2.2	1.18	0.02	0.9600	1.51	1.03	75		2.6	386	1.1		0.02	0.99	0.20	1.11	0.22	1.62	1.11
75	0.20	0.7	2.2	1.17	0.02	0.9600	1.68	1.16	84		2.6	325	1.1		0.02	0.99	0.16	1.11	0.18	1.33	0.92
76	0.19	0.7	2.2	1.16	0.02	0.9600	1.48	1.04	75		2.6	393	1.1		0.02	0.99	0.19	1.11	0.21	1.57	1.09
77	0.19	0.7	2.2	1.15	0.02	0.9600	1.39	0.98	74		2.6	340	1.1		0.02	0.99	0.16	1.11	0.18	1.32	0.93
78	0.19	0.7	2.2	1.14	0.02	0.9600	1.63	1.17	83		2.6	349	1.1		0.02	0.99	0.16	1.11	0.18	1.32	0.94
79	0.19	0.7	2.2	1.13	0.02	0.9600	1.45	1.05	78		2.6	394	1.1		0.02	0.99	0.18	1.11	0.20	1.46	1.05
80	0.19	0.7	2.2	1.13	0.02	0.9600	1.42	1.04	72		2.6	450	1.1		0.02	0.99	0.20	1.11	0.22	1.63	1.19
81	0.18	0.7	2.2	1.12	0.02	0.9600	1.42	1.05	74		2.6	439	1.1		0.02	0.99	0.19	1.11	0.21	1.55	1.15
82	0.18	0.7	2.2	1.11	0.02	0.9600	1.43	1.07	80		2.6	392	1.1		0.02	0.99	0.17	1.11	0.18	1.36	1.01
83	0.18	0.7	2.2	1.10	0.02	0.9600	1.41	1.07	77		2.6	422	1.1		0.02	0.99	0.18	1.11	0.19	1.43	1.09
84	0.18	0.7	2.2	1.10	0.02	0.9600	1.40	1.07	77		2.6	435	1.1		0.02	0.99	0.18	1.11	0.20	1.45	1.11
85	0.17	0.7	2.2	1.09	0.02	0.9600	1.33	1.03	77		2.6	366	1.1		0.02	0.99	0.15	1.11	0.16	1.19	0.92
86	0.17	0.7	2.2	1.08	0.02	0.9600	1.40	1.10	81		2.6	408	1.1		0.02	0.99	0.16	1.11	0.18	1.31	1.03
87	0.17	0.7	2.2	1.08	0.02	0.9600	1.30	1.04	75		2.6	395	1.1		0.02	0.99	0.15	1.11	0.17	1.24	0.99
88	0.17	0.7	2.2	1.07	0.02	0.9600	1.58	1.27	85		2.6	438	1.1		0.02	0.99	0.16	1.11	0.18	1.35	1.09
89	0.16	0.7	2.2	1.06	0.02	0.9600	1.55	1.27	79		2.6	496	1.1		0.02	0.99	0.18	1.11	0.20	1.51	1.23
90	0.16	0.7	2.2	1.06	0.02	0.9600	1.75	1.45	93		2.6	503	1.1		0.02	0.99	0.18	1.11	0.20	1.51	1.24
91	0.16	0.7	2.2	1.05	0.02	0.9600	1.69	1.41	90		2.6	516	1.1		0.02	0.99	0.18	1.11	0.20	1.52	1.27
92	0.16	0.7	2.2	1.05	0.02	0.9600	1.53	1.30	79		2.6	521	1.1		0.02	0.99	0.18	1.11	0.20	1.51	1.28
93	0.15	0.7	2.2	1.04	0.02	0.9600	1.57	1.35	80		2.6	565	1.1		0.02	0.99	0.19	1.11	0.21	1.62	1.39
94	0.15	0.7	2.2	1.04	0.02	0.9600	1.75	1.53	63		2.6	692	1.1		0.02	0.99	0.23	1.11	0.26	1.95	1.70
95	0.15	0.7	2.2	1.03	0.02	0.9600	2.54	2.24	60		2.6	1179	1.1		0.02	0.99	0.39	1.11	0.43	3.28	2.90
96	0.15	0.7	2.2	1.03	0.02	0.9600	2.16	1.93	63		2.6	940	1.1		0.02	0.99	0.30	1.11	0.34	2.59	2.32
97	0.14	0.7	2.2	1.02	0.02	0.9600	2.23	2.03	49		2.6	1518	1.1		0.02	0.99	0.48	1.11	0.54	4.12	3.74
98	0.14	0.7	2.2	1.01	0.02	0.9600	2.17	2.00	35		2.6	2565	1.1		0.02	0.99	0.80	1.11	0.89	6.89	6.34
99	0.14	0.7	2.2	1.01	0.02	0.9600	2.35	2.19	40		2.6	2290	1.1		0.02	0.99	0.71	1.11	0.78	6.08	5.68
100	0.14	0.7	2.2	1.00	0.02	0.9600	1.99	1.89	36		2.6	2284	1.1		0.02	0.99	0.69	1.11	0.77	6.00	5.68
101	0.13	0.7	2.2	1.00	0.02	0.9600	1.86	1.79	36		2.6	2163	1.1		0.02	0.99	0.64	1.11	0.72	5.62	5.41
102	0.13	0.7	2.2	0.99	0.02	0.9600	2.30	2.25	40		2.6	2348	1.1		0.02	0.99	0.69	1.11	0.76	6.04	5.90
103	0.13	0.7	2.2	0.99	0.02	0.9600	1.76	1.74	44		2.6	1509	1.1		0.02	0.99	0.44	1.11	0.48	3.85	3.82
104	0.12	0.7	2.2	0.99	0.02	0.9600	3.90	3.93	44		2.6	2996	1.1		0.02	0.99	0.85	1.11	0.95	7.57	7.63

CPTU-608 Liquefaction Analysis

ConeTec Inc. - CPT Interpretation

Interpretation Output - Release	1.22 Rev. A - Format:	NLI	Imperial			
Run No:	06-0718-0954-2938					
Job No:	02-100					
Client:	MACTEC Engineering and Consulting Inc.					
Project:	Former Callahan Mine Site, Brooksville, ME					
Site:	CP-608					
Location:	Callahan Mine					
Cone:	20 Ton AD179					
CPT Date:	06/27/06					
CPT Time:	14:59					
CPT File:	758CP608.COR					
Northing (m):	0					
Easting (m):	0					
Elevation (m):	0				72.3	Elevation For CPT Triggering analysis
Water Table (m):	8.72		(ft):	28.6	28.6	Water Table assumed for CPT Analysis
Unit Weight of Water (default):	62.4	pcf				
Averaging Increment (m):	0.2					
Phi Method :	Robertson and Campanella, 1983					
Su Nkt used:	15		Su/P' (nc):	0.3	0.11	Base acceleration
Dr Method :	Jamiolkowski - All Sands					
State Parameter M:	1.2					
Used Unit Weights Assigned to Soil Zones						
N160Ic Calculated using qc1n						

1) CSR = $0.65*(a_{max}/g)*(s_v/s'_v)*r_d$ Seed & Idriss, 1983, p. 459

a_{max}/g = 0.11 g   USGS (base) (amplified from base as discussed in

s_v = computed   Total Vertical Stress

s'_v = computed   Effective Vertical Stress

$r_d = [1.0 - 0.4113z^{0.5} + 0.04052z + 0.001753z^{1.5}] / [1 - 0.4177z^{0.5} + 0.05729z - 0.$

z = depth in meters

2) FS = Factor of safety against triggering of liquefaction: FS = $(CRR_{7.5}/CSR)$ x MSF x Ks x Ka

MSF = magnitude scaling factor; Assume based on range recommended by NCEER Wo

CPTU-608 Liquefaction Analysis

Ks = $(s'_{vo}/P_a)^{(f-1)}$, where f = 0.7 to 0.8 for relative density of 40 to 60%; f = 0.6 to 0.7 fo

1 Atmosphere = 14.7 psi = 2.12 ksf

Conetec Data

Row	Col-01 Depth (m)	Col-02 Depth (ft)	Col-03 Elev. (m)	Col-04 Elev. (ft)	Col-05 qc (tsf)	Col-06 qt (tsf)	Col-07 fs (tsf)	Col-08 Rf (%)	Col-09 u (ft)	Col-10 SBT (Zone)	Col-11 SBTn (Zone)	Col-12 SBT-BQ (Zone)
40	0.1	0.328	-0.1	72.0	7.09	7.09	0.02	0.28	-0.02	1	7	5
41	0.3	0.984	-0.3	71.3	9.71	9.71	0.09	0.96	-0.54	5	6	6
42	0.5	1.64	-0.5	70.7	5.03	5.05	0.12	2.38	4.6	3	5	4
43	0.7	2.297	-0.7	70.0	13.25	13.32	0.14	1.02	13.05	6	6	6
44	0.9	2.953	-0.9	69.3	16.31	16.31	0.18	1.11	-0.38	6	6	6
45	1.1	3.609	-1.1	68.7	6.34	6.35	0.12	1.89	2.81	4	5	5
46	1.3	4.265	-1.3	68.0	3.02	3.11	0.04	1.37	19.05	1	4	3
47	1.5	4.921	-1.5	67.4	9.21	9.24	0.08	0.87	6.26	5	5	5
48	1.7	5.577	-1.7	66.7	7.57	7.57	0.12	1.59	-0.26	5	4	5
49	1.9	6.234	-1.9	66.1	14.39	14.41	0.1	0.66	4	6	5	6
50	2.1	6.89	-2.1	65.4	16.19	16.2	0.13	0.79	0.27	6	5	6
51	2.3	7.546	-2.3	64.8	15.38	15.38	0.14	0.91	0.39	6	5	6
52	2.5	8.202	-2.5	64.1	14.46	14.46	0.15	1.04	0.17	6	5	6
53	2.7	8.858	-2.7	63.4	12.82	12.82	0.14	1.11	-0.12	6	5	6
54	2.9	9.514	-2.9	62.8	7.86	7.86	0.17	2.2	0.3	4	4	5
55	3.1	10.17	-3.1	62.1	15.46	15.46	0.21	1.38	0.62	6	5	6
56	3.3	10.827	-3.3	61.5	13.8	13.8	0.22	1.6	-0.34	6	4	6
57	3.5	11.483	-3.5	60.8	7.78	7.79	0.15	1.9	2.17	5	4	5
58	3.7	12.139	-3.7	60.2	11.55	11.55	0.2	1.71	-0.17	5	4	6
59	3.9	12.795	-3.9	59.5	4.55	4.65	0.09	1.94	20.81	4	3	3
60	4.1	13.451	-4.1	58.8	14.31	14.31	0.17	1.21	-0.97	6	4	6
61	4.3	14.107	-4.3	58.2	15.75	15.75	0.2	1.29	-0.12	6	4	6
62	4.5	14.764	-4.5	57.5	4.98	5.04	0.16	3.13	12.33	3	3	4
63	4.7	15.42	-4.7	56.9	17.22	17.24	0.15	0.86	5.57	6	5	6
64	4.9	16.076	-4.9	56.2	21.3	21.29	0.19	0.88	-2.05	6	5	7
65	5.1	16.732	-5.1	55.6	20.67	20.67	0.2	0.96	0.32	6	5	7
66	5.3	17.388	-5.3	54.9	9.9	9.91	0.22	2.2	1.35	5	3	6
67	5.5	18.044	-5.5	54.3	6.28	6.41	0.13	1.96	27.98	4	3	4
68	5.7	18.701	-5.7	53.6	18.72	18.71	0.18	0.94	-2.1	6	5	6
69	5.9	19.357	-5.9	52.9	11.67	11.69	0.27	2.27	4.3	5	3	6
70	6.1	20.013	-6.1	52.3	5.01	5.18	0.1	1.84	34.63	4	3	3
71	6.3	20.669	-6.3	51.6	12.73	12.93	0.13	1.03	43.08	6	4	5
72	6.5	21.325	-6.5	51.0	14.36	14.39	0.26	1.83	6.4	5	4	6
73	6.7	21.981	-6.7	50.3	11.03	11.2	0.29	2.55	36.44	5	3	5
74	6.9	22.638	-6.9	49.7	7.01	7.36	0.14	1.94	74.98	5	3	3
75	7.1	23.294	-7.1	49.0	20.6	20.64	0.27	1.31	8.84	6	4	6
76	7.3	23.95	-7.3	48.4	23.67	23.66	0.21	0.9	-1.55	7	5	7
77	7.5	24.606	-7.5	47.7	25.01	24.99	0.19	0.74	-4.94	7	5	7
78	7.7	25.262	-7.7	47.0	21.51	21.5	0.26	1.19	-3.04	6	4	7
79	7.9	25.918	-7.9	46.4	16.72	16.78	0.22	1.28	13.42	6	4	6
80	8.1	26.574	-8.1	45.7	13.64	13.74	0.3	2.15	21.97	5	3	5
81	8.3	27.231	-8.3	45.1	16.66	16.76	0.26	1.54	21.77	6	4	6
82	8.5	27.887	-8.5	44.4	12.59	12.77	0.22	1.73	39.12	5	3	5
83	8.7	28.543	-8.7	43.8	17.77	17.85	0.23	1.31	16.2	6	4	6
84	8.9	29.199	-8.9	43.1	23.17	23.18	0.23	1.01	2.35	6	4	7
85	9.1	29.855	-9.1	42.4	9.6	9.76	0.26	2.62	34.23	4	3	4
86	9.3	30.511	-9.3	41.8	14.52	14.72	0.31	2.08	43.82	5	3	5
87	9.5	31.168	-9.5	41.1	9.93	10.18	0.28	2.73	52.39	4	3	4
88	9.7	31.824	-9.7	40.5	6.63	7	0.15	2.15	79.09	4	3	3
89	9.9	32.48	-9.9	39.8	6.72	7.09	0.15	2.09	78.19	4	3	3
90	10.1	33.136	-10.1	39.2	5.33	5.77	0.1	1.7	92.48	4	3	3
91	10.3	33.792	-10.3	38.5	4.62	5.09	0.05	1.03	102.16	1	3	3
92	10.5	34.448	-10.5	37.9	7.01	7.43	0.09	1.25	89.32	5	3	3
93	10.7	35.105	-10.7	37.2	5	5.53	0.09	1.68	112.71	4	3	3
94	10.9	35.761	-10.9	36.5	4.68	5.21	0.07	1.25	114.2	1	3	3
95	11.1	36.417	-11.1	35.9	4.33	4.85	0.05	0.98	112.07	1	3	1
96	11.3	37.073	-11.3	35.2	4.82	5.34	0.06	1.03	109.07	1	3	3
97	11.5	37.729	-11.5	34.6	7.46	7.93	0.12	1.55	101.42	5	3	3
98	11.7	38.385	-11.7	33.9	16.18	16.28	0.37	2.25	21.21	5	3	6
99	11.9	39.042	-11.9	33.3	9.1	9.44	0.22	2.36	71.22	5	3	4
100	12.1	39.698	-12.1	32.6	4.68	5.17	0.1	1.89	104.65	4	2	3
101	12.3	40.354	-12.3	31.9	4.47	5	0.07	1.4	111.7	1	3	1
102	12.5	41.01	-12.5	31.3	4.57	5.14	0.06	1.12	122.32	1	3	1
103	12.7	41.666	-12.7	30.6	5.27	5.86	0.09	1.54	126.87	1	3	3
104	12.9	42.322	-12.9	30.0	5.18	5.77	0.09	1.52	126.58	1	3	3
105	13.1	42.978	-13.1	29.3	5.8	6.42	0.1	1.48	131.68	5	3	3
106	13.3	43.635	-13.3	28.7	11.28	11.38	0.19	1.7	21.83	5	3	6
107	13.5	44.291	-13.5	28.0	9.63	9.82	0.17	1.71	39.03	5	3	5
108	13.7	44.947	-13.7	27.4	8.35	8.66	0.13	1.48	66	5	3	4
109	13.9	45.603	-13.9	26.7	11.36	11.74	0.22	1.84	82.14	5	3	4
110	14.1	46.259	-14.1	26.0	13.43	13.83	0.36	2.63	84.53	5	3	4
111	14.3	46.915	-14.3	25.4	17.9	17.88	0.65	3.66	-6.06	4	3	6
112	14.5	47.572	-14.5	24.7	19.47	19.48	0.66	3.38	1.4	5	3	6
113	14.7	48.228	-14.7	24.1	20.94	21	0.8	3.79	14.47	4	3	7
114	14.9	48.884	-14.9	23.4	20.58	20.77	0.61	2.94	40.11	5	3	6
115	15.1	49.54	-15.1	22.8	58.47	58.37	1.96	3.37	-21.77	6	4	8
116	15.3	50.196	-15.3	22.1	143.91	143.79	3.99	2.77	-24.9	7	5	9
117	15.5	50.852	-15.5	21.4	54.91	54.81	2.06	3.76	-20.37	5	4	8
118	15.7	51.509	-15.7	20.8	132.99	132.93	3.89	2.92	-11.68	7	5	9
119	15.9	52.165	-15.9	20.1	117.69	117.61	4.67	3.97	-16.46	11	4	9

Row	Col-13 SBT-BQn (Zone)	Col-14 Perm-k (cm/s)	Col-15 Unit Wt (pcf)	Col-16 T Stress (tsf)	Col-17 U Stress (tsf)	Col-18 E Stress (tsf)	Col-19 Cn	Col-20 N60 (b/ft)	Col-21 N1(60) (b/ft)	Col-22 N(60)Ic (b/ft)	Col-23 N1(60)Ic (b/ft)	Col-24 Qt
40	7	1.00E-07	111.4	0.018	0	0.018	1.7	3.4	5.8	1.7	3	386.97
41	7	5.00E-06	114.6	0.055	0	0.055	1.7	4.6	7.9	2.5	4.2	174.38
42	6	5.00E-08	111.4	0.092	0	0.092	1.7	4.8	8.2	1.7	2.8	53.66
43	6	5.00E-05	114.6	0.129	0	0.129	1.7	5.1	8.7	3.2	5.5	101.84
44	6	5.00E-05	114.6	0.167	0	0.167	1.7	6.2	10.6	3.9	6.6	96.59
45	5	5.00E-07	114.6	0.205	0	0.205	1.7	4.1	6.9	1.9	3.3	30.04
46	4	1.00E-07	111.4	0.242	0	0.242	1.7	1.5	2.5	0.9	3.5	11.85
47	5	5.00E-06	114.6	0.279	0	0.279	1.7	4.4	7.5	2.4	4	32.16
48	5	5.00E-06	114.6	0.316	0	0.316	1.7	3.6	6.2	2.2	3.7	22.92
49	6	5.00E-05	114.6	0.354	0	0.354	1.68	5.5	9.3	3.3	5.6	39.7
50	6	5.00E-05	114.6	0.392	0	0.392	1.6	6.2	9.9	3.7	6.1	40.36
51	6	5.00E-05	114.6	0.429	0	0.429	1.53	5.9	9	3.7	5.7	34.84
52	6	5.00E-05	114.6	0.467	0	0.467	1.46	5.5	8.1	3.6	5.3	29.97
53	5	5.00E-05	114.6	0.504	0	0.504	1.41	4.9	6.9	3.3	4.7	24.43
54	5	5.00E-07	114.6	0.542	0	0.542	1.36	5	6.8	2.3	4.1	13.5
55	5	5.00E-05	114.6	0.58	0	0.58	1.31	5.9	7.8	3.9	5.3	25.68
56	5	5.00E-05	114.6	0.617	0	0.617	1.27	5.3	6.7	3.6	5.3	21.36
57	4	5.00E-06	114.6	0.655	0	0.655	1.24	3.7	4.6	2.3	3.4	10.9
58	5	5.00E-06	114.6	0.692	0	0.692	1.2	5.5	6.6	3.2	4.5	15.68
59	3	5.00E-07	114.6	0.73	0	0.73	1.17	3	3.5	1.7	2	5.37
60	5	5.00E-05	114.6	0.767	0	0.767	1.14	5.5	6.3	3.7	4.7	17.64
61	5	5.00E-05	114.6	0.805	0	0.805	1.11	6	6.7	4.1	4.9	18.56
62	3	5.00E-08	111.4	0.842	0	0.842	1.09	4.8	5.3	2	2.1	4.99
63	5	5.00E-05	114.6	0.879	0	0.879	1.07	6.6	7	4.3	4.7	18.61
64	5	5.00E-05	114.6	0.917	0	0.917	1.04	8.2	8.5	5.1	5.5	22.23
65	5	5.00E-05	114.6	0.954	0	0.954	1.02	7.9	8.1	5	5.3	20.66
66	4	5.00E-06	114.6	0.992	0	0.992	1	4.7	4.8	3.2	3	8.99
67	3	5.00E-07	114.6	1.03	0	1.03	0.99	4.1	4	2.3	2	5.22
68	5	5.00E-05	114.6	1.067	0	1.067	0.97	7.2	6.9	4.7	4.6	16.53
69	4	5.00E-06	114.6	1.105	0	1.105	0.95	5.6	5.3	3.7	3.2	9.58
70	3	5.00E-07	114.6	1.142	0	1.142	0.94	3.3	3.1	2.1	1.5	3.53
71	4	5.00E-05	114.6	1.18	0	1.18	0.92	5	4.6	3.7	3	9.96
72	4	5.00E-06	114.6	1.218	0	1.218	0.91	6.9	6.2	4.3	3.4	10.82
73	4	5.00E-06	114.6	1.255	0	1.255	0.89	5.4	4.8	3.8	2.8	7.93
74	3	5.00E-06	114.6	1.293	0	1.293	0.88	3.5	3.1	2.8	1.8	4.69
75	5	5.00E-05	114.6	1.33	0	1.33	0.87	7.9	6.9	5.6	4.1	14.52
76	5	5.00E-04	117.7	1.368	0	1.368	0.85	7.6	6.5	5.8	5.1	16.29
77	5	5.00E-04	117.7	1.407	0	1.407	0.84	8	6.7	6	5.1	16.76
78	5	5.00E-05	114.6	1.445	0	1.445	0.83	8.2	6.9	5.8	3.9	13.88
79	4	5.00E-05	114.6	1.483	0	1.483	0.82	6.4	5.3	4.9	3.1	10.32
80	4	5.00E-06	114.6	1.52	0	1.52	0.81	6.6	5.3	4.5	2.8	8.04
81	4	5.00E-05	114.6	1.558	0	1.558	0.8	6.4	5.1	5	3.1	9.76
82	3	5.00E-06	114.6	1.596	0	1.596	0.79	6.1	4.8	4.2	2.4	7
83	4	5.00E-05	114.6	1.633	0	1.633	0.78	6.8	5.4	5.2	3	9.93
84	5	5.00E-05	114.6	1.671	0.019	1.652	0.78	8.9	6.9	6.2	3.6	13.02
85	3	5.00E-07	114.6	1.708	0.039	1.669	0.77	6.2	4.8	3.8	2	4.82
86	4	5.00E-06	114.6	1.746	0.06	1.686	0.77	7	5.4	4.9	2.7	7.7
87	3	5.00E-07	114.6	1.783	0.08	1.703	0.77	6.5	5	4	2	4.93
88	3	5.00E-07	114.6	1.821	0.101	1.72	0.76	4.5	3.4	3.1	1.4	3.01
89	3	5.00E-07	114.6	1.859	0.121	1.738	0.76	4.5	3.4	3.1	1.4	3.01
90	3	5.00E-07	114.6	1.896	0.142	1.755	0.76	3.7	2.8	2.8	1.1	2.21
91	1	1.00E-07	111.4	1.933	0.162	1.771	0.75	2.4	1.8	2.5	0.9	1.78
92	3	5.00E-06	114.6	1.97	0.183	1.788	0.75	3.6	2.7	3	1.3	3.05
93	3	5.00E-07	114.6	2.008	0.203	1.805	0.74	3.5	2.6	2.8	1	1.95
94	1	1.00E-07	111.4	2.045	0.224	1.821	0.74	2.5	1.8	2.6	0.9	1.74
95	1	1.00E-07	111.4	2.082	0.244	1.838	0.74	2.3	1.7	2.5	0.8	1.51
96	1	1.00E-07	111.4	2.118	0.265	1.854	0.73	2.6	1.9	2.6	0.9	1.74
97	3	5.00E-06	114.6	2.155	0.285	1.87	0.73	3.8	2.8	3.3	1.3	3.09
98	4	5.00E-06	114.6	2.193	0.306	1.887	0.73	7.8	5.7	5.5	2.6	7.46
99	3	5.00E-06	114.6	2.23	0.326	1.904	0.72	4.5	3.3	3.9	1.7	3.78
100	1	5.00E-07	114.6	2.268	0.347	1.922	0.72	3.3	2.4	3.1	0.9	1.51
101	1	1.00E-07	111.4	2.305	0.367	1.938	0.72	2.4	1.7	2.9	0.8	1.39
102	1	1.00E-07	111.4	2.342	0.387	1.954	0.72	2.5	1.8	2.8	0.8	1.43
103	1	1.00E-07	111.4	2.378	0.408	1.97	0.71	2.8	2	3.1	1	1.77
104	1	1.00E-07	111.4	2.415	0.428	1.986	0.71	2.8	2	3.1	0.9	1.69
105	3	5.00E-06	114.6	2.452	0.449	2.003	0.71	3.1	2.2	3.2	1	1.98
106	3	5.00E-06	114.6	2.489	0.469	2.02	0.7	5.4	3.8	4.3	1.7	4.4
107	3	5.00E-06	114.6	2.527	0.49	2.037	0.7	4.7	3.3	4	1.5	3.58
108	3	5.00E-06	114.6	2.565	0.51	2.054	0.7	4.1	2.9	3.7	1.3	2.97
109	3	5.00E-06	114.6	2.602	0.531	2.071	0.69	5.6	3.9	4.5	1.8	4.41
110	3	5.00E-06	114.6	2.64	0.551	2.088	0.69	6.6	4.6	5.3	2.1	5.36
111	4	5.00E-07	114.6	2.677	0.572	2.105	0.69	11.4	7.9	6.6	2.8	7.22
112	4	5.00E-06	114.6	2.715	0.592	2.123	0.69	9.3	6.4	7	2.9	7.9
113	4	5.00E-07	114.6	2.753	0.613	2.14	0.68	13.4	9.2	7.5	3.2	8.53
114	4	5.00E-06	114.6	2.79	0.633	2.157	0.68	9.9	6.8	7.1	3	8.34
115	5	5.00E-05	114.6	2.828	0.654	2.174	0.68	22.4	15.2	16.1	7.3	25.55
116	6	5.00E-04	117.7	2.866	0.674	2.192	0.68	45.9	31	31.6	21.8	64.3
117	5	5.00E-06	114.6	2.904	0.695	2.209	0.67	26.2	17.7	15.6	7	23.5
118	6	5.00E-04	117.7	2.942	0.715	2.227	0.67	42.4	28.4	29.7	20.4	58.38
119	6	1.00E-15	130.5	2.983	0.736	2.247	0.67	112.6	75.1	28	19.1	51.01

Row	Col-25 Fr (%)	Col-26 Bq	Col-27 Ic	Col-28 FC (%)	Col-29 IcZone (Zone)	Col-30 Dr (%)	Col-31 Phi (deg)	Col-32 State Par	Col-33 Es/qt	Col-34 YoungE (tsf)	Col-35 Su (tsf)	Col-36 OCR
40	0.28	0	2.5	30.7	5	-9999	-9999	-9999	-9999	-9999	0.471	10
41	0.96	0	2.57	33.9	5	-9999	-9999	-9999	-9999	-9999	0.643	10
42	2.43	0.03	3.02	59.6	3	-9999	-9999	-9999	-9999	-9999	0.331	10
43	1.03	0.03	2.46	29.1	5	38.2	42	-0.19	-9999	-9999	0.879	10
44	1.12	0	2.41	26.7	5	40.3	42	-0.19	-9999	-9999	1.076	10
45	1.96	0.01	2.88	51	4	-9999	-9999	-9999	-9999	-9999	0.41	10
46	1.49	0.21	2.77	44.4	4	-9999	-9999	-9999	-9999	-9999	0.191	3.2
47	0.89	0.02	2.57	34.1	5	-9999	-9999	-9999	-9999	-9999	0.598	10
48	1.66	0	2.78	44.9	4	-9999	-9999	-9999	-9999	-9999	0.483	8.8
49	0.68	0.01	2.35	24.3	5	30	38	-0.07	-9999	-9999	0.937	10
50	0.81	0	2.35	24.6	5	30	38	-0.08	-9999	-9999	1.054	10
51	0.94	0	2.42	27.3	5	30	38	-0.08	-9999	-9999	0.997	10
52	1.07	0	2.49	30.3	5	30	36	-0.08	-9999	-9999	0.933	10
53	1.16	0	2.57	33.8	5	30	34	-0.07	-9999	-9999	0.821	9.7
54	2.36	0	2.83	47.8	4	-9999	-9999	-9999	-9999	-9999	0.488	3.9
55	1.43	0	2.57	34	5	30	34	-0.09	-9999	-9999	0.992	10
56	1.67	0	2.61	36	4	30	34	-0.08	-9999	-9999	0.879	7.9
57	2.07	0.01	2.88	50.6	4	-9999	-9999	-9999	-9999	-9999	0.476	2.9
58	1.82	0	2.71	41.2	4	-9999	-9999	-9999	-9999	-9999	0.724	4.9
59	2.3	0.17	3.16	70.2	3	-9999	-9999	-9999	-9999	-9999	0.261	1.2
60	1.28	0	2.6	35.2	5	30	32	-0.04	-9999	-9999	0.903	5.8
61	1.36	0	2.59	34.8	5	30	32	-0.05	-9999	-9999	0.996	6.3
62	3.76	0.09	3.3	81.3	3	-9999	-9999	-9999	-9999	-9999	0.28	1.1
63	0.9	0.01	2.51	31	5	30	32	-0.02	-9999	-9999	1.091	6.3
64	0.92	0	2.44	28	5	30	34	-0.04	-9999	-9999	1.359	8.4
65	1	0	2.48	29.6	5	30	34	-0.04	-9999	-9999	1.314	7.5
66	2.45	0	2.99	57.6	3	-9999	-9999	-9999	-9999	-9999	0.594	2.2
67	2.33	0.16	3.18	71.2	3	-9999	-9999	-9999	-9999	-9999	0.358	1.2
68	0.99	0	2.53	32.2	5	30	32	-0.02	-9999	-9999	1.176	5.3
69	2.51	0.01	2.97	56.4	3	-9999	-9999	-9999	-9999	-9999	0.706	2.4
70	2.36	0.27	3.33	83.4	3	-9999	-9999	-9999	-9999	-9999	0.269	0.8
71	1.13	0.11	2.78	44.9	4	30	30	0.03	-9999	-9999	0.783	2.5
72	2	0.02	2.87	50.2	4	-9999	-9999	-9999	-9999	-9999	0.878	2.8
73	2.87	0.11	3.07	63.3	3	-9999	-9999	-9999	-9999	-9999	0.663	1.9
74	2.35	0.39	3.22	74.5	3	-9999	-9999	-9999	-9999	-9999	0.405	1
75	1.4	0.01	2.68	39.5	4	30	32	-0.03	-9999	-9999	1.288	4.3
76	0.96	0	2.48	29.9	5	30	32	-0.01	-9999	-9999	-9999	-9999
77	0.79	-0.01	2.43	27.5	5	30	32	0	-9999	-9999	-9999	-9999
78	1.27	0	2.68	39.3	4	30	32	-0.02	-9999	-9999	1.337	4.1
79	1.41	0.03	2.81	46.7	4	30	30	0.01	-9999	-9999	1.02	2.6
80	2.42	0.06	3.02	60.2	3	-9999	-9999	-9999	-9999	-9999	0.815	1.9
81	1.7	0.04	2.87	50.4	4	30	30	0	-9999	-9999	1.013	2.5
82	1.97	0.11	3.03	60.6	3	-9999	-9999	-9999	-9999	-9999	0.745	1.6
83	1.44	0.03	2.83	47.8	4	30	30	0.01	-9999	-9999	1.081	2.5
84	1.08	0	2.67	38.8	4	30	30	0	-9999	-9999	1.434	3.7
85	3.18	0.13	3.28	79.1	3	-9999	-9999	-9999	-9999	-9999	0.537	1.1
86	2.36	0.1	3.03	60.9	3	-9999	-9999	-9999	-9999	-9999	0.865	1.8
87	3.31	0.19	3.28	79.2	3	-9999	-9999	-9999	-9999	-9999	0.56	1.1
88	2.9	0.46	3.43	92.6	3	-9999	-9999	-9999	-9999	-9999	0.345	0.7
89	2.83	0.44	3.43	92.1	3	-9999	-9999	-9999	-9999	-9999	0.349	0.7
90	2.53	0.71	3.52	100	3	-9999	-9999	-9999	-9999	-9999	0.258	0.6
91	1.66	0.96	3.53	100	3	-9999	-9999	-9999	-9999	-9999	0.211	0.6
92	1.7	0.48	3.32	82.6	3	-9999	-9999	-9999	-9999	-9999	0.364	0.7
93	2.63	0.94	3.58	100	3	-9999	-9999	-9999	-9999	-9999	0.235	0.6
94	2.06	1.05	3.57	100	3	-9999	-9999	-9999	-9999	-9999	0.211	0.6
95	1.72	1.17	3.6	100	3	-9999	-9999	-9999	-9999	-9999	0.185	0.5
96	1.71	0.98	3.54	100	3	-9999	-9999	-9999	-9999	-9999	0.214	0.6
97	2.13	0.5	3.36	86	3	-9999	-9999	-9999	-9999	-9999	0.385	0.7
98	2.6	0.03	3.07	63.2	3	-9999	-9999	-9999	-9999	-9999	0.939	1.7
99	3.09	0.26	3.36	86.2	3	-9999	-9999	-9999	-9999	-9999	0.481	0.9
100	3.37	1.01	3.73	100	2	-9999	-9999	-9999	-9999	-9999	0.193	0.5
101	2.61	1.16	3.71	100	2	-9999	-9999	-9999	-9999	-9999	0.179	0.5
102	2.06	1.23	3.65	100	2	-9999	-9999	-9999	-9999	-9999	0.186	0.5
103	2.59	1.02	3.61	100	2	-9999	-9999	-9999	-9999	-9999	0.232	0.6
104	2.62	1.05	3.63	100	2	-9999	-9999	-9999	-9999	-9999	0.224	0.6
105	2.4	0.92	3.55	100	3	-9999	-9999	-9999	-9999	-9999	0.264	0.6
106	2.17	0.02	3.23	75.1	3	-9999	-9999	-9999	-9999	-9999	0.593	1
107	2.3	0.1	3.32	82.6	3	-9999	-9999	-9999	-9999	-9999	0.486	0.8
108	2.1	0.25	3.37	87.1	3	-9999	-9999	-9999	-9999	-9999	0.406	0.7
109	2.36	0.22	3.24	76.4	3	-9999	-9999	-9999	-9999	-9999	0.609	1
110	3.25	0.19	3.24	76.3	3	-9999	-9999	-9999	-9999	-9999	0.746	1.2
111	4.3	-0.05	3.2	73.2	3	-9999	-9999	-9999	-9999	-9999	1.013	1.7
112	3.93	-0.03	3.15	69	3	-9999	-9999	-9999	-9999	-9999	1.117	1.9
113	4.37	-0.01	3.15	69	3	-9999	-9999	-9999	-9999	-9999	1.217	2
114	3.4	0.03	3.09	65	3	-9999	-9999	-9999	-9999	-9999	1.199	2
115	3.54	-0.02	2.72	41.4	4	40.1	34	-0.19	-9999	-9999	3.703	10
116	2.83	-0.01	2.24	20.4	5	65.8	40	-0.27	2.456	353.2	-9999	-9999
117	3.97	-0.03	2.78	44.7	4	-9999	-9999	-9999	-9999	-9999	3.461	9.1
118	2.99	-0.01	2.28	21.9	5	63.3	40	-0.27	2.542	337.9	-9999	-9999
119	4.08	-0.01	2.42	27.3	5	59.7	38	-0.33	2.679	315	-9999	-9999

Row	Col-37 U (psf)	Col-38 s_{vo} (psf)	Col-39 q_c (psf)	Col-40 q_t (psf)	Col-41 P_a (psf)	Col-42 σ'_{vo} (psf)	Col-43 f_s (psf)	Col-44 $Q_{exp=1}$	Col-45 F
40	0	36	14180	14180	2116	36	40	392.89	0.28
41	0	110	19420	19420	2116	110	180	175.55	0.93
42	0	184	10060	10100	2116	184	240	53.89	2.42
43	0	258	26500	26640	2116	258	280	102.26	1.06
44	0	334	32620	32620	2116	334	360	96.66	1.12
45	0	410	12680	12700	2116	410	240	29.98	1.95
46	0	484	6040	6220	2116	484	80	11.85	1.39
47	0	558	18420	18480	2116	558	160	32.12	0.89
48	0	632	15140	15140	2116	632	240	22.96	1.65
49	0	708	28780	28820	2116	708	200	39.71	0.71
50	0	784	32380	32400	2116	784	260	40.33	0.82
51	0	858	30760	30760	2116	858	280	34.85	0.94
52	0	934	28920	28920	2116	934	300	29.96	1.07
53	0	1008	25640	25640	2116	1008	280	24.44	1.14
54	0	1084	15720	15720	2116	1084	340	13.50	2.32
55	0	1160	30920	30920	2116	1160	420	25.66	1.41
56	0	1234	27600	27600	2116	1234	440	21.37	1.67
57	0	1310	15560	15580	2116	1310	300	10.89	2.10
58	0	1384	23100	23100	2116	1384	400	15.69	1.84
59	0	1460	9100	9300	2116	1460	180	5.37	2.30
60	0	1534	28620	28620	2116	1534	340	17.66	1.26
61	0	1610	31500	31500	2116	1610	400	18.57	1.34
62	0	1684	9960	10080	2116	1684	320	4.99	3.81
63	0	1758	34440	34480	2116	1758	300	18.61	0.92
64	0	1834	42600	42580	2116	1834	380	22.22	0.93
65	0	1908	41340	41340	2116	1908	400	20.67	1.01
66	0	1984	19800	19820	2116	1984	440	8.99	2.47
67	0	2060	12560	12820	2116	2060	260	5.22	2.42
68	0	2134	37440	37420	2116	2134	360	16.54	1.02
69	0	2210	23340	23380	2116	2210	540	9.58	2.55
70	0	2284	10020	10360	2116	2284	200	3.54	2.48
71	0	2360	25460	25860	2116	2360	260	9.96	1.11
72	0	2436	28720	28780	2116	2436	520	10.81	1.97
73	0	2510	22060	22400	2116	2510	580	7.92	2.92
74	0	2586	14020	14720	2116	2586	280	4.69	2.31
75	0	2660	41200	41280	2116	2660	540	14.52	1.40
76	0	2736	47340	47320	2116	2736	420	16.30	0.94
77	0	2814	50020	49980	2116	2814	380	16.76	0.81
78	0	2890	43020	43000	2116	2890	520	13.88	1.30
79	0	2966	33440	33560	2116	2966	440	10.31	1.44
80	0	3040	27280	27480	2116	3040	600	8.04	2.45
81	0	3116	33320	33520	2116	3116	520	9.76	1.71
82	0	3192	25180	25540	2116	3192	440	7.00	1.97
83	0	3266	35540	35700	2116	3266	460	9.93	1.42
84	37	3342	46340	46360	2116	3305	460	13.02	1.07
85	78	3416	19200	19520	2116	3338	520	4.82	3.23
86	119	3492	29040	29440	2116	3373	620	7.69	2.39
87	160	3566	19860	20360	2116	3406	560	4.93	3.33
88	201	3642	13260	14000	2116	3441	300	3.01	2.90
89	242	3718	13440	14180	2116	3476	300	3.01	2.87
90	283	3792	10660	11540	2116	3509	200	2.21	2.58
91	324	3866	9240	10180	2116	3542	100	1.78	1.58
92	365	3940	14020	14860	2116	3575	180	3.05	1.65
93	406	4016	10000	11060	2116	3610	180	1.95	2.56
94	447	4090	9360	10420	2116	3643	140	1.74	2.21
95	488	4164	8660	9700	2116	3676	100	1.51	1.81
96	529	4236	9640	10680	2116	3707	120	1.74	1.86
97	570	4310	14920	15860	2116	3740	240	3.09	2.08
98	611	4386	32360	32560	2116	3775	740	7.46	2.63
99	652	4460	18200	18880	2116	3808	440	3.79	3.05
100	693	4536	9360	10340	2116	3843	200	1.51	3.45
101	733	4610	8940	10000	2116	3877	140	1.39	2.60
102	774	4684	9140	10280	2116	3910	120	1.43	2.14
103	815	4756	10540	11720	2116	3941	180	1.77	2.58
104	856	4830	10360	11540	2116	3974	180	1.69	2.68
105	897	4904	11600	12840	2116	4007	200	1.98	2.52
106	938	4978	22560	22760	2116	4040	380	4.40	2.14
107	979	5054	19260	19640	2116	4075	340	3.58	2.33
108	1020	5130	16700	17320	2116	4110	260	2.97	2.13
109	1061	5204	22720	23480	2116	4143	440	4.41	2.41
110	1102	5280	26860	27660	2116	4178	720	5.36	3.22
111	1143	5354	35800	35760	2116	4211	1300	7.22	4.28
112	1184	5430	38940	38960	2116	4246	1320	7.90	3.94
113	1225	5506	41880	42000	2116	4281	1600	8.52	4.38
114	1266	5580	41160	41540	2116	4314	1220	8.34	3.39
115	1307	5656	116940	116740	2116	4349	3920	25.54	3.53
116	1348	5732	287820	287580	2116	4384	7980	64.28	2.83
117	1389	5808	109820	109620	2116	4419	4120	23.49	3.97
118	1430	5884	265980	265860	2116	4454	7780	58.36	2.99
119	1470	5966	235380	235220	2116	4496	9340	51.00	4.07

CPTU-608 Liquefaction Analysis

text

06205z$^{1.5}$ + 0.001210z^{2}]

Youd and Idriss, 2001

rkshop, reiterated in Youd and Idriss, 2001

CPTU-608 Liquefaction Analysis

rel density of 60 to 80%; P_a = pressure at 1 atmosphere Youd and Idriss, 2001

Row	AT	AU	AV	AW	AX	AY	AZ	BA	BB	BC	BD	BE	BF	BG	BH	BI	BJ	BK	BL	BM	BN
34	Col-46	Col-47	Col-48	Col-49	Col-50	Col-51	Col-52	Col-53	Col-54	Col-55	Col-56	Col-57	Col-57a	Col-58	Col-59	Col-60	Col-61	Col-62	Col-63	Col-64	Col-65
35	Youd & Idriss, 2001 CPT Based Analysis																				
36																					
37	$I_{c\ Qexp=1}$	$Q_{exp=0.5}$	F	$I_{c\ Qexp=0.5}$	$Q_{exp=0.7}$	F	$I_{c\ Qexp=0.7}$	Description	C_q			q_{c1N}	Lookup	Ic	Kc	$(q_{c1N})_{cs}$	CRR7.5	rd	a_{max}/g =	CSR	
38									n=1.0	n=0.5	n=0.7		Col						if crest accel	No	if crest accel =
39																			2.0	Amplification	2
40	1.10	51.25	0.28	1.88	115.75	0.28	1.56	Granular	58.78	7.67	17.32	51.38	2.00	1.88	1.17	60.33	0.10	1.00	0.22	0.07	0.14
41	1.71	40.02	0.93	2.21	72.30	0.93	2.00	Granular	19.24	4.39	7.92	40.25	2.00	2.21	1.70	68.53	0.11	1.00	0.22	0.07	0.14
42	2.37	15.89	2.42	2.78	25.90	2.42	2.61	Very Silty	11.50	3.39	5.53	26.38	2.00	2.61	3.38	89.09	0.15	1.00	0.22	0.07	0.14
43	1.92	35.71	1.06	2.29	54.39	1.06	2.14	Granular	8.20	2.86	4.36	36.06	2.00	2.29	1.91	68.73	0.11	1.00	0.21	0.07	0.14
44	1.95	38.40	1.12	2.27	55.56	1.12	2.14	Granular	6.34	2.52	3.64	38.80	2.00	2.27	1.86	72.24	0.12	1.00	0.21	0.07	0.14
45	2.50	13.19	1.95	2.79	18.32	1.95	2.67	Very Silty	5.16	2.27	3.15	18.93	2.00	2.67	3.81	72.22	0.12	0.99	0.21	0.07	0.14
46	2.76	5.67	1.39	3.04	7.61	1.39	2.93	Clayey	4.37	2.09	2.81	12.85	2.00	2.76	4.43	56.99	0.10	0.99	0.21	0.07	0.13
47	2.29	16.49	0.89	2.54	21.53	0.89	2.44	Granular	3.79	1.95	2.54	17.01	2.00	2.54	2.97	50.55	0.09	0.99	0.21	0.07	0.13
48	2.55	12.55	1.65	2.77	15.98	1.65	2.68	Very Silty	3.35	1.83	2.33	16.67	2.00	2.68	3.89	64.77	0.11	0.99	0.21	0.07	0.13
49	2.16	22.97	0.71	2.37	28.59	0.71	2.28	Granular	2.99	1.73	2.15	23.55	2.00	2.37	2.18	51.28	0.09	0.99	0.20	0.07	0.13
50	2.18	24.55	0.82	2.37	29.94	0.82	2.29	Granular	2.70	1.64	2.00	25.16	2.00	2.37	2.19	55.15	0.10	0.99	0.20	0.07	0.13
51	2.27	22.19	0.94	2.44	26.58	0.94	2.37	Granular	2.47	1.57	1.88	22.83	2.00	2.44	2.46	56.20	0.10	0.98	0.20	0.07	0.13
52	2.35	19.91	1.07	2.51	23.44	1.07	2.44	Granular	2.27	1.51	1.77	20.57	2.00	2.51	2.79	57.50	0.10	0.98	0.20	0.07	0.13
53	2.44	16.87	1.14	2.58	19.56	1.14	2.52	Granular	2.10	1.45	1.68	17.56	2.00	2.58	3.21	56.33	0.10	0.98	0.20	0.07	0.13
54	2.83	9.66	2.32	2.95	11.05	2.32	2.90	Clayey	1.95	1.40	1.60	14.50	2.00	2.83	5.01	72.72	0.12	0.98	0.20	0.07	0.12
55	2.47	19.00	1.41	2.58	21.42	1.41	2.54	Granular	1.82	1.35	1.52	19.74	2.00	2.58	3.23	63.77	0.10	0.98	0.19	0.07	0.12
56	2.58	16.32	1.67	2.68	18.17	1.67	2.64	Very Silty	1.71	1.31	1.46	19.03	2.00	2.64	3.58	68.06	0.11	0.98	0.19	0.07	0.12
57	2.88	8.57	2.10	2.97	9.43	2.10	2.93	Clayey	1.62	1.27	1.40	11.89	2.00	2.88	5.51	65.56	0.11	0.98	0.19	0.07	0.12
58	2.72	12.69	1.84	2.79	13.81	1.84	2.76	Clayey	1.53	1.24	1.35	16.69	2.00	2.72	4.12	68.71	0.11	0.97	0.19	0.07	0.12
59	3.16	4.46	2.30	3.23	4.80	2.30	3.21	Clayey	1.45	1.20	1.30	6.37	2.00	3.16	8.75	55.73	0.10	0.97	0.19	0.07	0.12
60	2.58	15.03	1.26	2.65	16.03	1.26	2.62	Very Silty	1.38	1.17	1.25	16.94	2.00	2.62	3.46	58.57	0.10	0.97	0.19	0.07	0.12
61	2.58	16.19	1.34	2.63	17.10	1.34	2.61	Very Silty	1.31	1.15	1.21	18.03	2.00	2.61	3.39	61.18	0.10	0.97	0.18	0.07	0.12
62	3.31	4.45	3.81	3.35	4.66	3.81	3.33	Clayey	1.26	1.12	1.17	5.99	2.00	3.31	10.81	64.69	0.11	0.97	0.18	0.07	0.11
63	2.50	16.97	0.92	2.53	17.61	0.92	2.52	Granular	1.20	1.10	1.14	17.88	2.00	2.53	2.94	52.60	0.09	0.97	0.18	0.07	0.11
64	2.43	20.68	0.93	2.46	21.28	0.93	2.45	Granular	1.15	1.07	1.11	21.61	2.00	2.46	2.58	55.75	0.10	0.97	0.18	0.07	0.11
65	2.48	19.62	1.01	2.50	20.03	1.01	2.49	Granular	1.11	1.05	1.08	20.57	2.00	2.50	2.76	56.83	0.10	0.96	0.18	0.07	0.11
66	2.99	8.71	2.47	3.00	8.82	2.47	3.00	Clayey	1.07	1.03	1.05	9.99	2.00	2.99	6.62	66.09	0.11	0.96	0.18	0.07	0.11
67	3.18	5.15	2.42	3.19	5.18	2.42	3.19	Clayey	1.03	1.01	1.02	6.22	2.00	3.18	9.04	56.27	0.10	0.96	0.17	0.07	0.11
68	2.57	16.61	1.02	2.56	16.58	1.02	2.56	Granular	0.99	1.00	0.99	17.61	2.00	2.56	3.11	54.77	0.10	0.96	0.17	0.07	0.11
69	2.97	9.79	2.55	2.97	9.70	2.55	2.97	Clayey	0.96	0.98	0.97	10.58	2.00	2.97	6.45	68.23	0.11	0.96	0.17	0.07	0.11
70	3.34	3.67	2.48	3.32	3.62	2.48	3.33	Clayey	0.93	0.96	0.95	4.54	2.00	3.34	11.31	51.28	0.09	0.96	0.17	0.07	0.10
71	2.78	10.52	1.11	2.76	10.29	1.11	2.76	Clayey	0.90	0.95	0.93	10.96	2.00	2.78	4.59	50.25	0.09	0.96	0.17	0.07	0.10
72	2.87	11.60	1.97	2.84	11.28	1.97	2.85	Clayey	0.87	0.93	0.91	11.81	2.00	2.87	5.40	63.79	0.10	0.95	0.17	0.07	0.10
73	3.07	8.63	2.92	3.04	8.34	2.92	3.06	Clayey	0.84	0.92	0.89	8.92	2.00	3.07	7.60	67.86	0.11	0.95	0.16	0.07	0.10
74	3.22	5.19	2.31	3.18	4.98	2.31	3.19	Clayey	0.82	0.90	0.87	5.69	2.00	3.22	9.47	53.88	0.09	0.95	0.16	0.07	0.10
75	2.68	16.28	1.40	2.64	15.55	1.40	2.66	Clayey	0.80	0.89	0.85	15.52	2.00	2.68	3.87	59.99	0.10	0.95	0.16	0.07	0.10
76	2.55	18.53	0.94	2.51	17.60	0.94	2.52	Granular	0.77	0.88	0.84	19.67	2.00	2.51	2.79	54.95	0.10	0.95	0.16	0.07	0.10
77	2.51	19.33	0.81	2.46	18.26	0.81	2.48	Granular	0.75	0.87	0.82	20.48	2.00	2.46	2.56	52.45	0.09	0.94	0.16	0.07	0.10
78	2.68	16.22	1.30	2.62	15.24	1.30	2.65	Clayey	0.73	0.86	0.80	14.88	2.00	2.68	3.87	57.56	0.10	0.94	0.15	0.07	0.09
79	2.82	12.21	1.44	2.75	11.41	1.44	2.78	Clayey	0.71	0.84	0.79	11.31	2.00	2.82	4.93	55.74	0.10	0.94	0.15	0.07	0.09
80	3.03	9.64	2.45	2.96	8.96	2.45	2.99	Clayey	0.70	0.83	0.78	9.04	2.00	3.03	7.06	63.86	0.10	0.94	0.15	0.07	0.09
81	2.87	11.84	1.71	2.80	10.96	1.71	2.83	Clayey	0.68	0.82	0.76	10.76	2.00	2.87	5.46	58.70	0.10	0.93	0.15	0.07	0.09
82	3.03	8.60	1.97	2.95	7.92	1.97	2.98	Clayey	0.66	0.81	0.75	8.00	2.00	3.03	7.09	56.71	0.10	0.93	0.15	0.07	0.09
83	2.83	12.34	1.42	2.75	11.31	1.42	2.78	Clayey	0.65	0.80	0.74	10.93	2.00	2.83	5.03	54.95	0.10	0.93	0.15	0.07	0.09
84	2.67	16.27	1.07	2.58	14.88	1.07	2.62	Clayey	0.64	0.80	0.73	14.03	2.00	2.67	3.76	52.70	0.09	0.92	0.14	0.07	0.09
85	3.28	6.06	3.23	3.20	5.53	3.23	3.23	Clayey	0.63	0.80	0.73	5.85	2.00	3.28	10.40	60.83	0.10	0.92	0.14	0.07	0.09
86	3.04	9.71	2.39	2.95	8.85	2.39	2.99	Clayey	0.63	0.79	0.72	8.73	2.00	3.04	7.18	62.67	0.10	0.92	0.14	0.07	0.09
87	3.28	6.26	3.33	3.19	5.69	3.33	3.23	Clayey	0.62	0.79	0.72	5.98	2.00	3.28	10.39	62.13	0.10	0.91	0.14	0.07	0.09
88	3.43	3.84	2.90	3.34	3.48	2.90	3.38	Clayey	0.61	0.78	0.71	4.07	2.00	3.43	12.87	52.37	0.09	0.91	0.14	0.07	0.09
89	3.43	3.86	2.87	3.34	3.49	2.87	3.37	Clayey	0.61	0.78	0.71	4.08	2.00	3.43	12.84	52.36	0.09	0.91	0.14	0.07	0.09
90	3.53	2.84	2.58	3.43	2.57	2.58	3.47	Clayey	0.60	0.78	0.70	3.29	2.00	3.53	14.57	47.93	0.08	0.90	0.13	0.07	0.09
91	3.52	2.31	1.58	3.42	2.08	1.58	3.46	Clayey	0.60	0.77	0.70	2.87	2.00	3.52	14.42	41.45	0.08	0.90	0.13	0.07	0.08
92	3.31	3.97	1.65	3.21	3.57	1.65	3.25	Clayey	0.59	0.77	0.69	4.16	2.00	3.31	10.92	45.38	0.08	0.89	0.13	0.07	0.08
93	3.57	2.55	2.56	3.47	2.29	2.56	3.51	Clayey	0.59	0.77	0.69	3.06	2.00	3.57	15.45	47.32	0.08	0.89	0.13	0.07	0.08
94	3.59	2.28	2.21	3.48	2.05	2.21	3.53	Clayey	0.58	0.76	0.68	2.86	2.00	3.59	15.78	45.13	0.08	0.89	0.13	0.07	0.08
95	3.61	1.98	1.81	3.50	1.78	1.81	3.54	Clayey	0.58	0.76	0.68	2.64	2.00	3.61	16.16	42.63	0.08	0.88	0.13	0.07	0.08
96	3.56	2.30	1.86	3.45	2.06	1.86	3.49	Clayey	0.57	0.76	0.68	2.88	2.00	3.56	15.16	43.66	0.08	0.88	0.12	0.07	0.08
97	3.35	4.11	2.08	3.24	3.66	2.08	3.29	Clayey	0.57	0.75	0.67	4.24	2.00	3.35	11.56	49.03	0.08	0.87	0.12	0.07	0.08
98	3.07	9.97	2.63	2.97	8.88	2.63	3.01	Clayey	0.56	0.75	0.67	8.62	2.00	3.07	7.57	65.30	0.11	0.86	0.12	0.07	0.08
99	3.36	5.08	3.05	3.25	4.52	3.05	3.29	Clayey	0.56	0.75	0.66	4.96	2.00	3.36	11.61	57.57	0.10	0.86	0.12	0.07	0.08
100	3.73	2.04	3.45	3.62	1.81	3.45	3.66	Clayey	0.55	0.74	0.66	2.69	2.00	3.73	18.71	50.33	0.09	0.85	0.12	0.07	0.08
101	3.71	1.88	2.60	3.59	1.67	2.60	3.64	Clayey	0.55	0.74	0.65	2.58	2.00	3.71	18.19	46.92	0.08	0.85	0.12	0.07	0.08
102	3.66	1.95	2.14	3.54	1.72	2.14	3.59	Clayey	0.54	0.74	0.65	2.63	2.00	3.66	17.19	45.21	0.08	0.84	0.11	0.07	0.07
103	3.61	2.41	2.58	3.49	2.13	2.58	3.54	Clayey	0.54	0.73	0.65	2.97	2.00	3.61	16.24	48.31	0.08	0.84	0.11	0.07	0.07
104	3.64	2.31	2.68	3.52	2.04	2.68	3.56	Clayey	0.53	0.73	0.64	2.90	2.00	3.64	16.75	48.63	0.08	0.83	0.11	0.07	0.07
105	3.56	2.73	2.52	3.44	2.40	2.52	3.49	Clayey	0.53	0.73	0.64	3.20	2.00	3.56	15.28	48.97	0.08	0.82	0.11	0.07	0.07
106	3.22	6.08	2.14	3.10	5.34	2.14	3.15	Clayey	0.52	0.72	0.64	5.63	2.00	3.22	9.58	53.97	0.09	0.82	0.11	0.07	0.07
107	3.32	4.97	2.33	3.20	4.36	2.33	3.25	Clayey	0.52	0.72	0.63	4.82	2.00	3.32	11.03	53.17	0.09	0.81	0.11	0.07	0.07
108	3.37	4.13	2.13	3.25	3.62	2.13	3.30	Clayey	0.51	0.72	0.63	4.21	2.00	3.37	11.90	50.15	0.09	0.80	0.10	0.07	0.07
109	3.25	6.17	2.41	3.12	5.40	2.41	3.17	Clayey	0.51	0.71	0.62	5.67	2.00	3.25	9.93	56.29	0.10	0.80	0.10	0.07	0.07
110	3.24	7.53	3.22	3.12	6.57	3.22	3.17	Clayey	0.51	0.71	0.62	6.62	2.00	3.24	9.82	65.01	0.11	0.79	0.10	0.07	0.07
111	3.20	10.19	4.28	3.08	8.88	4.28	3.13	Clayey	0.50	0.71	0.62	8.49	2.00	3.20	9.26	78.65	0.13	0.78	0.10	0.07	0.06
112	3.15	11.19	3.94	3.03	9.73	3.94	3.07	Clayey	0.50	0.71	0.61	9.18	2.00	3.15	8.55	78.45	0.12	0.78	0.10	0.07	0.06
113	3.15	12.12	4.38	3.03	10.53	4.38	3.08	Clayey	0.49	0.70	0.61	9.81	2.00	3.15	8.55	83.92	0.13	0.77	0.10	0.07	0.06
114	3.09	11.90	3.39	2.97	10.32	3.39	3.02	Clayey	0.49	0.70	0.61	9.63	2.00	3.09	7.83	75.39	0.12	0.76	0.09	0.07	0.06
115	2.72	36.62	3.53	2.60	31.70	3.53	2.65	Clayey	0.49	0.70	0.60	26.84	2.00	2.72	4.12	110.53	0.21	0.76	0.09	0.07	0.06
116	2.36	92.53	2.83	2.25	79.99	2.83	2.29	Granular	0.48	0.69	0.60	94.42	10.00	2.25	1.79	169.44	0.53	0.75	0.09	0.07	0.06
117	2.78	33.95	3.97	2.66	29.30	3.97	2.71	Clayey	0.48	0.69	0.60	24.80	2.00	2.78	4.60	113.98	0.22	0.74	0.09	0.07	0.06
118	2.40	84.68	2.99	2.29	72.97	2.99	2.34	Granular	0.48	0.69	0.59	86.60	9.00	2.29	1.92	166.66	0.51	0.74	0.09	0.07	0.06
119	2.54	74.33	4.07	2.43	63.93	4.07	2.47	Granular	0.47	0.69	0.59	76.27	7.00	2.43	2.44	186.04	0.68	0.73	0.09	0.07	0.05

Row	BO	BP	BQ	BR	BS	BT	BU	BV	BW	BX	BY	BZ	CA	CB	CC	CD	CE	CF	CG	CH
34	Col-66	Col-67	Col-68	Col-69	Col-70	Col-71	Col-72	Col-73	Col-74	Col-75	Col-76	Col-77	Col-78	Col-79	Col-80	Col-81	Col-82	Col-83	Col-84	Col-85
35											Boulanger and Idriss, 2004, "Approach B" method based on Su profile									
36	Rel. Den. Factor										Su - CPT	OCR								
37	f	MSF	K_σ	α	K_α	FS liq- CPT (Sand-Like)		Apparent Fines	Measured Fines	Ic Limits	(psf)	Assumed	OCR - CPT	α	k_α	$CRR_{M7.5}$	MSF	$CRR_{M5.5}$	FS liq-Su (Clay-Like)	
38						No	if crest accel =	(%)	(%)		Nkt	1.1							No	if crest accel =
39				0.1		Amplification	2				10.5			0.1					Amplification	2
40	0.7	2.2	3.39	0.1	0.8800	9.22	4.63	10		2.6	1347	1.1		0.1	0.91	21.74	1.11	24.15	337.57	169.44
41	0.7	2.2	2.43	0.1	0.8800	7.23	3.66	19		2.6	1839	1.1		0.1	0.91	9.71	1.11	10.79	150.99	76.38
42	0.7	2.2	2.08	0.1	0.8800	8.23	4.19	36		2.6	944	1.1		0.1	0.91	2.98	1.11	3.31	46.42	23.67
43	0.7	2.2	1.88	0.1	0.8800	5.63	2.89	22		2.6	2513	1.1		0.1	0.91	5.66	1.11	6.29	88.22	45.33
44	0.7	2.2	1.74	0.1	0.8800	5.45	2.82	21		2.6	3075	1.1		0.1	0.91	5.35	1.11	5.94	83.52	43.26
45	0.7	2.2	1.64	0.1	0.8800	5.13	2.68	39		2.6	1170	1.1		0.1	0.91	1.66	1.11	1.84	25.94	13.54
46	0.7	2.2	1.56	0.1	0.8800	4.13	2.17	44		2.6	546	1.1		0.1	0.91	0.66	1.11	0.73	10.27	5.41
47	0.7	2.2	1.49	0.1	0.8800	3.75	1.99	32		2.6	1707	1.1		0.1	0.91	1.78	1.11	1.97	27.88	14.79
48	0.7	2.2	1.44	0.1	0.8800	4.14	2.22	40		2.6	1382	1.1		0.1	0.91	1.27	1.11	1.41	19.96	10.68
49	0.7	2.2	1.39	0.1	0.8800	3.52	1.90	25		2.6	2677	1.1		0.1	0.91	2.20	1.11	2.44	34.57	18.65
50	0.7	2.2	1.35	0.1	0.8800	3.54	1.92	25		2.6	3011	1.1		0.1	0.91	2.23	1.11	2.48	35.17	19.13
51	0.7	2.2	1.31	0.1	0.8800	3.48	1.91	28		2.6	2848	1.1		0.1	0.91	1.93	1.11	2.14	30.44	16.70
52	0.7	2.2	1.28	0.1	0.8800	3.44	1.90	31		2.6	2665	1.1		0.1	0.91	1.66	1.11	1.84	26.21	14.50
53	0.7	2.2	1.25	0.1	0.8800	3.33	1.86	34		2.6	2346	1.1		0.1	0.91	1.35	1.11	1.50	21.40	11.94
54	0.7	2.2	1.22	0.1	0.8800	3.91	2.20	48		2.6	1394	1.1		0.1	0.91	0.75	1.11	0.83	11.84	6.67
55	0.7	2.2	1.20	0.1	0.8800	3.45	1.96	35		2.6	2834	1.1		0.1	0.91	1.42	1.11	1.58	22.54	12.79
56	0.7	2.2	1.18	0.1	0.8800	3.56	2.04	37		2.6	2511	1.1		0.1	0.91	1.18	1.11	1.31	18.80	10.76
57	0.7	2.2	1.15	0.1	0.8800	3.40	1.97	51		2.6	1359	1.1		0.1	0.91	0.60	1.11	0.67	9.60	5.54
58	0.7	2.2	1.14	0.1	0.8800	3.48	2.03	41		2.6	2068	1.1		0.1	0.91	0.87	1.11	0.96	13.84	8.07
59	0.7	2.2	1.12	0.1	0.8800	2.99	1.76	70		2.6	747	1.1		0.1	0.91	0.30	1.11	0.33	4.74	2.79
60	0.7	2.2	1.10	0.1	0.8800	3.03	1.80	36		2.6	2580	1.1		0.1	0.91	0.98	1.11	1.09	15.62	9.27
61	0.7	2.2	1.09	0.1	0.8800	3.07	1.84	36		2.6	2847	1.1		0.1	0.91	1.03	1.11	1.14	16.45	9.85
62	0.7	2.2	1.07	0.1	0.8800	3.15	1.90	82		2.6	800	1.1		0.1	0.91	0.28	1.11	0.31	4.42	2.67
63	0.7	2.2	1.06	0.1	0.8800	2.77	1.69	32		2.6	3116	1.1		0.1	0.91	1.03	1.11	1.14	16.54	10.09
64	0.7	2.2	1.04	0.1	0.8800	2.81	1.73	29		2.6	3881	1.1		0.1	0.91	1.23	1.11	1.37	19.77	12.18
65	0.7	2.2	1.03	0.1	0.8800	2.81	1.75	31		2.6	3755	1.1		0.1	0.91	1.14	1.11	1.27	18.42	11.46
66	0.7	2.2	1.02	0.1	0.8800	3.06	1.92	58		2.6	1699	1.1		0.1	0.91	0.50	1.11	0.55	8.02	5.04
67	0.7	2.2	1.01	0.1	0.8800	2.74	1.74	72		2.6	1025	1.1		0.1	0.91	0.29	1.11	0.32	4.67	2.96
68	0.7	2.2	1.00	0.1	0.8800	2.68	1.72	34		2.6	3361	1.1		0.1	0.91	0.91	1.11	1.02	14.81	9.48
69	0.7	2.2	0.99	0.1	0.8800	3.05	1.98	57		2.6	2016	1.1		0.1	0.91	0.53	1.11	0.59	8.59	5.56
70	0.7	2.2	0.98	0.1	0.8800	2.56	1.67	84		2.6	769	1.1		0.1	0.91	0.20	1.11	0.22	3.18	2.08
71	0.7	2.2	0.97	0.1	0.8800	2.52	1.66	45		2.6	2238	1.1		0.1	0.91	0.55	1.11	0.61	8.96	5.92
72	0.7	2.2	0.96	0.1	0.8800	2.84	1.89	50		2.6	2509	1.1		0.1	0.91	0.60	1.11	0.66	9.75	6.50
73	0.7	2.2	0.95	0.1	0.8800	2.95	1.99	64		2.6	1894	1.1		0.1	0.91	0.44	1.11	0.49	7.16	4.82
74	0.7	2.2	0.94	0.1	0.8800	2.54	1.73	74		2.6	1156	1.1		0.1	0.91	0.26	1.11	0.29	4.25	2.89
75	0.7	2.2	0.93	0.1	0.8800	2.67	1.84	39		2.6	3678	1.1		0.1	0.91	0.80	1.11	0.89	13.17	9.06
76	0.7	2.2	0.93	0.1	0.8800	2.53	1.76	31		2.6	4246	1.1		0.1	0.91	0.90	1.11	1.00	14.82	10.30
77	0.7	2.2	0.92	0.1	0.8800	2.46	1.73	29		2.6	4492	1.1		0.1	0.91	0.93	1.11	1.03	15.28	10.74
78	0.7	2.2	0.91	0.1	0.8800	2.56	1.82	40		2.6	3820	1.1		0.1	0.91	0.77	1.11	0.85	12.68	9.01
79	0.7	2.2	0.90	0.1	0.8800	2.51	1.80	47		2.6	2914	1.1		0.1	0.91	0.57	1.11	0.63	9.45	6.79
80	0.7	2.2	0.90	0.1	0.8800	2.70	1.96	60		2.6	2328	1.1		0.1	0.91	0.44	1.11	0.49	7.39	5.36
81	0.7	2.2	0.89	0.1	0.8800	2.55	1.87	50		2.6	2896	1.1		0.1	0.91	0.54	1.11	0.60	8.99	6.60
82	0.7	2.2	0.88	0.1	0.8800	2.49	1.85	61		2.6	2128	1.1		0.1	0.91	0.39	1.11	0.43	6.47	4.81
83	0.7	2.2	0.88	0.1	0.8800	2.45	1.84	48		2.6	3089	1.1		0.1	0.91	0.55	1.11	0.61	9.21	6.92
84	0.7	2.2	0.87	0.1	0.8800	2.37	1.80	39		2.6	4097	1.1		0.1	0.91	0.72	1.11	0.80	11.97	9.10
85	0.7	2.2	0.87	0.1	0.8800	2.53	1.94	79		2.6	1534	1.1		0.1	0.91	0.27	1.11	0.30	4.40	3.38
86	0.7	2.2	0.87	0.1	0.8800	2.55	1.98	61		2.6	2471	1.1		0.1	0.91	0.43	1.11	0.47	6.96	5.42
87	0.7	2.2	0.87	0.1	0.8800	2.51	1.98	79		2.6	1599	1.1		0.1	0.91	0.27	1.11	0.30	4.43	3.49
88	0.7	2.2	0.86	0.1	0.8800	2.27	1.81	93		2.6	986	1.1		0.1	0.91	0.17	1.11	0.19	2.68	2.14
89	0.7	2.2	0.86	0.1	0.8800	2.25	1.81	92		2.6	996	1.1		0.1	0.91	0.17	1.11	0.19	2.67	2.15
90	0.7	2.2	0.86	0.1	0.8800	1.95	1.59	100		2.6	738	1.1		0.1	0.91	0.12	1.11	0.14	1.95	1.59
91	0.7	2.2	0.86	0.1	0.8800	1.80	1.49	100		2.6	601	1.1		0.1	0.91	0.10	1.11	0.11	1.56	1.29
92	0.7	2.2	0.85	0.1	0.8800	1.86	1.56	82		2.6	1040	1.1		0.1	0.91	0.17	1.11	0.19	2.66	2.23
93	0.7	2.2	0.85	0.1	0.8800	1.89	1.61	100		2.6	671	1.1		0.1	0.91	0.11	1.11	0.12	1.69	1.44
94	0.7	2.2	0.85	0.1	0.8800	1.83	1.58	100		2.6	603	1.1		0.1	0.91	0.10	1.11	0.11	1.50	1.29
95	0.7	2.2	0.85	0.1	0.8800	1.78	1.55	100		2.6	527	1.1		0.1	0.91	0.08	1.11	0.09	1.30	1.13
96	0.7	2.2	0.85	0.1	0.8800	1.79	1.58	100		2.6	614	1.1		0.1	0.91	0.10	1.11	0.11	1.49	1.32
97	0.7	2.2	0.84	0.1	0.8800	1.88	1.68	86		2.6	1100	1.1		0.1	0.91	0.17	1.11	0.19	2.65	2.37
98	0.7	2.2	0.84	0.1	0.8800	2.40	2.18	63		2.6	2683	1.1		0.1	0.91	0.41	1.11	0.46	6.39	5.81
99	0.7	2.2	0.84	0.1	0.8800	2.20	2.03	86		2.6	1373	1.1		0.1	0.91	0.21	1.11	0.23	3.23	2.98
100	0.7	2.2	0.84	0.1	0.8800	2.06	1.93	100		2.6	553	1.1		0.1	0.91	0.08	1.11	0.09	1.29	1.21
101	0.7	2.2	0.83	0.1	0.8800	1.81	1.72	100		2.6	513	1.1		0.1	0.91	0.08	1.11	0.09	1.19	1.13
102	0.7	2.2	0.83	0.1	0.8800	1.77	1.71	100		2.6	533	1.1		0.1	0.91	0.08	1.11	0.09	1.22	1.17
103	0.7	2.2	0.83	0.1	0.8800	1.82	1.78	100		2.6	663	1.1		0.1	0.91	0.10	1.11	0.11	1.51	1.47
104	0.7	2.2	0.83	0.1	0.8800	1.83	1.81	100		2.6	639	1.1		0.1	0.91	0.09	1.11	0.10	1.44	1.43
105	0.7	2.2	0.83	0.1	0.8800	1.83	1.84	100		2.6	756	1.1		0.1	0.91	0.11	1.11	0.12	1.69	1.70
106	0.7	2.2	0.82	0.1	0.8800	2.10	2.15	75		2.6	1694	1.1		0.1	0.91	0.24	1.11	0.27	3.76	3.85
107	0.7	2.2	0.82	0.1	0.8800	2.08	2.16	83		2.6	1389	1.1		0.1	0.91	0.20	1.11	0.22	3.06	3.18
108	0.7	2.2	0.82	0.1	0.8800	2.03	2.14	87		2.6	1161	1.1		0.1	0.91	0.16	1.11	0.18	2.54	2.69
109	0.7	2.2	0.82	0.1	0.8800	2.13	2.29	77		2.6	1741	1.1		0.1	0.91	0.24	1.11	0.27	3.79	4.07
110	0.7	2.2	0.82	0.1	0.8800	2.33	2.55	76		2.6	2131	1.1		0.1	0.91	0.30	1.11	0.33	4.61	5.03
111	0.7	2.2	0.81	0.1	0.8800	2.77	3.07	73		2.6	2896	1.1		0.1	0.91	0.40	1.11	0.44	6.23	6.92
112	0.7	2.2	0.81	0.1	0.8800	2.76	3.12	69		2.6	3193	1.1		0.1	0.91	0.44	1.11	0.49	6.83	7.72
113	0.7	2.2	0.81	0.1	0.8800	2.98	3.43	69		2.6	3476	1.1		0.1	0.91	0.47	1.11	0.52	7.39	8.51
114	0.7	2.2	0.81	0.1	0.8800	2.65	3.11	65		2.6	3425	1.1		0.1	0.91	0.46	1.11	0.51	7.25	8.49
115	0.7	2.2	0.81	0.1	0.8800	4.55	5.43	41		2.6	10579	1.1		0.1	0.91	1.41	1.11	1.57	22.29	26.59
116	0.7	2.2	0.80	0.1	0.9625	12.91	15.69	21		2.6	26843	1.1		0.1	0.91	3.56	1.11	3.95	56.32	68.42
117	0.7	2.2	0.80	0.1	0.8800	4.83	5.98	45		2.6	9887	1.1		0.1	0.91	1.30	1.11	1.44	20.65	25.57
118	0.7	2.2	0.80	0.1	0.9413	12.14	15.32	22		2.6	24760	1.1		0.1	0.91	3.23	1.11	3.59	51.51	65.02
119	0.7	2.2	0.80	0.1	0.9100	15.63	20.12	28		2.6	21834	1.1		0.1	0.91	2.82	1.11	3.13	45.20	58.19

CPTU-609 Liquefaction Analysis

ConeTec Inc. - CPT Interpretation

Interpretation Output - Release	1.22 Rev. A - Format:	NLI	Imperial		
Run No:	06-0718-0954-2910				
Job No:	02-100				
Client:	MACTEC Engineering and Consulting Inc.				
Project:	Former Callahan Mine Site, Brooksville, ME				
Site:	CP-609				
Location:	Callahan Mine				
Cone:	20 Ton AD179				
CPT Date:	06/27/06				
CPT Time:	15:45				
CPT File:	758CP609.COR				
Northing (m):	0				
Easting (m):	0				
Elevation (m):	0			70.9	Elevation For CPT Triggering analysis
Water Table (m):	0.64	(ft):	2.1	2.1	Water Table assumed for CPT Analysis
Unit Weight of Water (default):	62.4 pcf				
Averaging Increment (m):	0.2				
Phi Method :	Robertson and Campanella, 1983				
Su Nkt used:	15	Su/P' (nc):	0.3	0.11	Base acceleration
Dr Method :	Jamiolkowski - All Sands				
State Parameter M:	1.2				

Used Unit Weights Assigned to Soil Zones

N160c Calculated using qc1n

1) CSR = $0.65*(a_{max}/g)*(s_v/s'_v)*r_d$ — Seed & Idriss, 1983, p. 459

a_{max}/g = 0.11 g — USGS (base)(amplified from base as discussed in

s_v = computed — Total Vertical Stress

s'_v = computed — Effective Vertical Stress

$r_d = [1.0 - 0.4113z^{0.5} + 0.04052z + 0.001753z^{1.5}] / [1 - 0.4177z^{0.5} + 0.05729z - 0.$

z = depth in meters

2) FS = Factor of safety against triggering of liquefaction: FS = $(CRR_{7.5}/CSR) \times MSF \times Ks \times Ka$

MSF = magnitude scaling factor; Assume based on range recommended by NCEER Wo

CPTU-609 Liquefaction Analysis

$Ks = (s'_{vo}/P_a)^{(f-1)}$, where f = 0.7 to 0.8 for relative density of 40 to 60%; f = 0.6 to 0.7 fo

1 Atmosphere = 14.7 psi = 2.12 ksf

Conetec Data

Col-01 Depth (m)	Col-02 Depth (ft)	Col-03 Elev. (m)	Col-04 Elev. (ft)	Col-05 qc (tsf)	Col-06 qt (tsf)	Col-07 fs (tsf)	Col-08 Rf (%)	Col-09 u (ft)	Col-10 SBT (Zone)	Col-11 SBTn (Zone)	Col-12 SBT-BQ (Zone)	Col-13 SBT-BQn (Zone)	Col-14 Perm-k (cm/s)	Col-15 Unit Wt (pcf)	Col-16 T Stress (tsf)	Col-17 U Stress (tsf)	Col-18 E Stress (tsf)	Col-19 Cn	Col-20 N60 (b/ft)	Col-21 N1(60) (b/ft)	Col-22 N(60)Ic (b/ft)	Col-23 N1(60)Ic (b/ft)	Col-24 Qt	Col-25 Fr (%)	Col-26 Bq	Col-27 Ic	Col-28 FC (%)	Col-29 IcZone (Zone)	Col-30 Dr (%)	Col-31 Phi (deg)	Col-32 State Par	Col-33 Es/qt	Col-34 YoungE (tsf)	Col-35 Su (tsf)	Col-36 OCR	Col-37 U (psf)	Col-38 s_{vo} (psf)	Col-39 q_c (psf)	Col-40 q_t (psf)	Col-41 P_a (psf)	Col-42 σ'^a_{vo} (psf)	Col-43 f_s (psf)	Col-44 $Q_{exp=1}$	Col-45 F
0.1	0.328	-0.1	70.6	6.91	6.91	0.13	1.89	-0.9	4	6	5	7	5.00E-07	114.6	0.019	0	0.019	1.7	4.4	7.5	2	3.5	366.64	1.89	0	2.84	48.6	4	-9999	-9999	-9999	-9999	-9999	0.459	10	0	38	13820	13820	2116	38	260	362.68	1.89
0.3	0.984	-0.3	69.9	6.44	6.42	0.12	1.84	-4.18	4	5	5	6	5.00E-07	114.6	0.056	0	0.056	1.7	4.1	7	1.9	3.3	112.83	1.85	-0.02	2.87	50	4	-9999	-9999	-9999	-9999	-9999	0.424	10	0	112	12880	12840	2116	112	240	113.64	1.89
0.5	1.64	-0.5	69.3	2.91	2.93	0.06	2.14	4.94	1	4	3	5	1.00E-07	111.4	0.093	0	0.093	1.7	1.4	2.4	1.1	1.8	30.35	2.21	0.05	3.2	73	3	-9999	-9999	-9999	-9999	-9999	0.189	10	0	186	5820	5860	2116	186	120	30.51	2.11
0.7	2.297	-0.7	68.6	2.36	2.43	0.02	0.62	14.11	1	5	3	4	1.00E-07	111.4	0.13	0.006	0.124	1.7	1.2	2	0.8	1.4	18.56	0.65	0.19	3.05	62.2	3	-9999	-9999	-9999	-9999	-9999	0.153	6.3	12	260	4720	4860	2116	248	40	18.57	0.87
0.9	2.953	-0.9	67.9	1.91	2	0.01	0.5	17.45	1	5	3	3	1.00E-07	111.4	0.167	0.027	0.14	1.7	1	1.6	0.7	1.2	13.08	0.55	0.28	3.11	66.2	3	-9999	-9999	-9999	-9999	-9999	0.122	3.7	53	334	3820	4000	2116	281	20	13.06	0.55
1.1	3.609	-1.1	67.3	1.8	1.89	0.01	0.53	17.47	1	4	3	3	1.00E-07	111.4	0.203	0.047	0.156	1.7	0.9	1.5	0.5	3	10.79	0.6	0.3	2.63	37	4	-9999	-9999	-9999	-9999	-9999	0.112	2.8	94	406	3600	3780	2116	312	20	10.82	0.59
1.3	4.265	-1.3	66.6	1.82	1.92	0.01	0.52	19.94	1	4	3	3	1.00E-07	111.4	0.24	0.068	0.172	1.7	0.9	1.6	0.5	2.7	9.74	0.6	0.33	2.67	39.1	4	-9999	-9999	-9999	-9999	-9999	0.112	2.4	135	480	3640	3840	2116	345	20	9.74	0.60
1.5	4.921	-1.5	66.0	1.58	1.69	0.01	0.59	23.06	1	4	3	3	1.00E-07	111.4	0.276	0.088	0.188	1.7	0.8	1.4	0.5	2.3	7.5	0.71	0.45	2.81	46.4	4	-9999	-9999	-9999	-9999	-9999	0.094	1.7	176	552	3160	3380	2116	376	20	7.52	0.71
1.7	5.577	-1.7	65.3	1.75	1.86	0.01	0.54	21.75	1	4	3	3	1.00E-07	111.4	0.313	0.109	0.204	1.7	0.9	1.5	0.5	2.3	7.56	0.65	0.37	2.79	45.4	4	-9999	-9999	-9999	-9999	-9999	0.103	1.8	217	626	3500	3720	2116	409	20	7.56	0.65
1.9	6.234	-1.9	64.7	4.95	5.02	0.02	0.45	15.3	1	5	4	5	1.00E-07	111.4	0.349	0.129	0.22	1.7	2.4	4.1	1.4	2.3	21.23	0.48	0.07	2.71	41.1	4	-9999	-9999	-9999	-9999	-9999	0.312	7.8	258	698	9900	10040	2116	440	40	21.23	0.43
2.1	6.89	-2.1	64.0	1.96	2.02	0.02	1.11	12.41	1	3	3	3	1.00E-07	111.4	0.386	0.15	0.236	1.7	1	1.6	0.6	2.3	6.93	1.38	0.15	2.96	55.8	3	-9999	-9999	-9999	-9999	-9999	0.109	1.6	299	772	3920	4040	2116	473	40	6.91	1.22
2.3	7.546	-2.3	63.4	1.11	1.24	0.01	0.81	28.03	1	3	1	3	1.00E-07	111.4	0.422	0.17	0.252	1.7	0.6	1	0.5	1.3	3.24	1.23	0.86	3.24	75.9	3	-9999	-9999	-9999	-9999	-9999	0.054	0.8	340	844	2220	2480	2116	504	20	3.24	1.22
2.5	8.202	-2.5	62.7	1.15	1.31	0.01	0.77	33.52	1	3	1	3	1.00E-07	111.4	0.459	0.191	0.268	1.7	0.6	1.1	0.5	1.3	3.16	1.18	1.01	3.24	76.1	3	-9999	-9999	-9999	-9999	-9999	0.057	0.8	381	918	2300	2620	2116	537	20	3.17	1.18
2.7	8.858	-2.7	62.0	1.04	1.2	0.01	0.83	34.61	1	3	1	1	1.00E-07	111.4	0.495	0.211	0.284	1.7	0.6	1	0.5	1.1	2.48	1.42	1.23	3.37	86.8	3	-9999	-9999	-9999	-9999	-9999	0.047	0.7	422	990	2080	2400	2116	568	20	2.48	1.42
2.9	9.514	-2.9	61.4	2.71	2.81	0.04	1.51	21.15	1	3	3	3	1.00E-07	111.4	0.532	0.231	0.301	1.7	1.3	2.3	0.9	2.5	7.59	1.87	0.19	2.99	57.7	3	-9999	-9999	-9999	-9999	-9999	0.152	1.8	463	1064	5420	5620	2116	601	80	7.58	1.76
3.1	10.17	-3.1	60.7	1.9	2	0.06	2.88	20.84	3	3	3	3	5.00E-08	111.4	0.569	0.252	0.317	1.7	1.9	3.3	0.8	2	4.52	4.03	0.28	3.35	85.7	3	-9999	-9999	-9999	-9999	-9999	0.095	1	504	1138	3800	4000	2116	634	120	4.51	4.19
3.3	10.827	-3.3	60.1	1.07	1.25	0.02	1.4	39.83	1	3	-9999	-9999	1.00E-07	111.4	0.605	0.272	0.333	1.7	0.6	1	0.6	1	1.95	2.7	1.5	3.58	100	3	-9999	-9999	-9999	-9999	-9999	0.043	0.6	545	1210	2140	2500	2116	665	40	1.94	3.10
3.5	11.483	-3.5	59.4	1.62	1.77	0.05	2.84	30.82	3	3	3	3	5.00E-08	111.4	0.642	0.293	0.349	1.69	1.7	2.9	0.8	1.6	3.22	4.46	0.6	3.5	100	3	-9999	-9999	-9999	-9999	-9999	0.075	0.8	585	1284	3240	3540	2116	699	100	3.23	4.43
3.7	12.139	-3.7	58.8	10.53	10.69	0.13	1.24	35.33	5	5	5	5	5.00E-06	114.6	0.679	0.313	0.365	1.65	5.1	8.5	2.8	4.7	27.41	1.33	0.08	2.6	35.5	4	-9999	-9999	-9999	-9999	-9999	0.667	10	626	1358	21060	21380	2116	732	260	27.37	1.30
3.9	12.795	-3.9	58.1	208.46	208.49	2.33	1.12	6.11	9	6	9	7	5.00E-02	124.1	0.718	0.334	0.384	1.61	39.9	64.5	35.9	59.1	541.14	1.12	0	1.59	4.2	6	95	50	-0.36	-9999	-9999	-9999	-9999	667	1436	416920	416980	2116	769	4660	540.63	1.12
4.1	13.451	-4.1	57.4	56.58	56.59	1.78	3.15	1.34	6	8	8	6	5.00E-05	114.6	0.757	0.354	0.403	1.58	21.7	34.2	-9999	-9999	138.67	3.2	-0.01	-9999	-9999	0	63.4	44	-0.4	2.258	127.8	3.722	10	708	1514	113160	113180	2116	806	3560	138.60	3.19
4.3	14.107	-4.3	56.8	38.84	38.72	1.17	3.02	-25.41	6	5	8	6	5.00E-05	114.6	0.795	0.375	0.42	1.54	14.8	22.9	9.2	14.5	90.36	3.09	-0.03	2.41	26.9	5	51.9	42	-0.33	2.714	105.1	2.528	10	749	1590	77680	77440	2116	841	2340	90.22	3.09
4.5	14.764	-4.5	56.1	23.97	23.88	1.12	4.67	-18.45	3	4	7	6	5.00E-08	111.4	0.832	0.395	0.436	1.51	22.9	34.6	6.4	10.9	52.84	4.84	-0.04	2.68	39.2	4	-9999	-9999	-9999	-9999	-9999	1.537	10	790	1664	47940	47760	2116	874	2240	52.76	4.86
4.7	15.42	-4.7	55.5	37.59	37.54	0.91	2.42	-10.79	6	5	8	6	5.00E-05	114.6	0.869	0.416	0.453	1.49	14.4	21.4	8.7	13.2	80.98	2.48	-0.02	2.37	25.1	5	49.9	42	-0.28	2.811	105.5	2.445	10	831	1738	75180	75080	2116	907	1820	80.88	2.48
4.9	16.076	-4.9	54.8	17.91	17.82	0.94	5.27	-17.75	3	3	6	5	5.00E-08	111.4	0.906	0.436	0.469	1.46	17.1	24.9	5	10.5	36.03	5.56	-0.06	2.74	42.7	4	-9999	-9999	-9999	-9999	-9999	1.128	10	872	1812	35820	35640	2116	940	1880	35.99	5.56
5.1	16.732	-5.1	54.2	12.85	12.84	0.53	4.16	-2.19	3	3	6	5	5.00E-08	111.4	0.942	0.457	0.486	1.44	12.3	17.7	3.7	7.4	24.51	4.49	-0.04	2.8	45.9	4	-9999	-9999	-9999	-9999	-9999	0.793	9.8	913	1884	25700	25680	2116	971	1060	24.51	4.45
5.3	17.388	-5.3	53.5	25.31	25.27	0.42	1.65	-10.08	6	5	7	6	5.00E-05	114.6	0.979	0.477	0.502	1.41	9.7	13.7	6	8.6	48.37	1.71	-0.03	2.41	27	5	37.1	38	-0.17	3.506	88.6	1.619	10	954	1958	50620	50540	2116	1004	840	48.39	1.73
5.5	18.044	-5.5	52.9	13.9	13.8	0.34	2.49	-20.55	5	4	-9999	5	5.00E-06	114.6	1.017	0.498	0.519	1.39	6.6	9.2	3.7	6.8	24.62	2.69	-0.09	2.65	38	4	-9999	-9999	-9999	-9999	-9999	0.852	9.8	995	2034	27800	27600	2116	1039	680	24.60	2.66

CPTU-609 Liquefaction Analysis

ext

06205z$^{1.5}$ + 0.001210z^{2}]

Youd and Idriss, 2001

kshop, reiterated in Youd and Idriss, 2001

CPTU-609 Liquefaction Analysis

rel density of 60 to 80%; P_a = pressure at 1 atmosphere Youd and Idriss, 2001

	AT	AU	AV	AW	AX	AY	AZ	BA	BB	BC	BD	BE	BF	BG	BH	BI	BJ	BK	BL	BM	BN	BO	BP	BQ	BR	BS	BT	BU	BV	BW	BX	BY	BZ	CA	CB	CC	CD	CE	CF	CG	CH
34	Col-46	Col-47	Col-48	Col-49	Col-50	Col-51	Col-52	Col-53	Col-54	Col-55	Col-56	Col-57	Col-57a	Col-58	Col-59	Col-60	Col-61	Col-62	Col-63	Col-64	Col-65	Col-66	Col-67	Col-68	Col-69	Col-70	Col-71	Col-72	Col-73	Col-74	Col-75	Col-76	Col-77	Col-78	Col-79	Col-80	Col-81	Col-82	Col-83	Col-84	Col-85
35	Youd & Idriss, 2001 CPT Based Analysis																															Boulanger and Idriss, 2004, "Approach B" method based on Su profile										
36																					Rel. Den. Factor																				
37	$I_{c\ Qexp=1}$	$Q_{exp\ =\ 0.5}$	F	$I_{c\ Qexp=0.5}$	$Q_{exp\ =\ 0.7}$	F	$I_{c\ Qexp=0.7}$	Description	C_q			q_{c1N}	Lookup	Ic	Kc	$(q_{c1N})_{cs}$	CRR7.5	rd	a_{max}/g =	CSR		f	MSF	K_σ	α	K_α	FS liq- CPT (Sand-Like)		Apparent Fines	Measured Fines	Ic Limits	Su - CPT (psf)	OCR Assumed	OCR - CPT	α	k_α	$CRR_{M7.5}$	MSF	$CRR_{M5.5}$	FS liq-Su (Clay-Like)	
38									n=1.0	n=0.5	n=0.7		Col						if crest accel	No Amplification	if crest accel =						No Amplification	if crest accel =	(%)	(%)		Nkt	1.1							No Amplification	if crest accel
39																			2.0		2				0.02			2				10			0.02						2
40	1.75	48.60	1.89	2.33	108.59	1.89	2.07	**Granular**	55.68	7.46	16.67	48.74	2.00	2.33	2.04	99.43	0.17	1.00	0.22	0.07	0.14	0.7	2.2	3.34	0.02	0.9600	16.90	8.58	24		2.6	1378	1.1		0.02	0.99	22.88	1.11	25.42	355.30	180.30
41	2.06	26.15	1.89	2.54	47.06	1.89	2.34	**Granular**	18.89	4.35	7.82	26.38	2.00	2.54	2.98	78.51	0.13	1.00	0.21	0.07	0.14	0.7	2.2	2.41	0.02	0.9600	8.92	4.67	32		2.6	1273	1.1		0.02	0.99	7.17	1.11	7.97	111.45	58.30
42	2.52	9.04	2.11	2.95	14.71	2.11	2.77	**Very Silty**	11.38	3.37	5.49	15.19	2.00	2.77	4.56	69.25	0.11	1.00	0.20	0.07	0.13	0.7	2.2	2.07	0.02	0.9600	6.81	3.67	44		2.6	567	1.1		0.02	0.99	1.92	1.11	2.14	29.96	16.17
43	2.49	6.35	0.87	2.91	9.76	0.87	2.74	**Very Silty**	8.54	2.92	4.49	10.31	2.00	2.74	4.28	44.15	0.08	1.00	0.20	0.07	0.13	0.7	2.2	1.90	0.02	0.9600	4.21	2.35	43		2.6	460	1.1		0.02	0.99	1.17	1.11	1.30	17.40	9.70
44	2.54	4.76	0.55	2.95	7.12	0.55	2.79	**Very Silty**	7.54	2.75	4.11	7.77	2.00	2.79	4.67	36.32	0.07	1.00	0.19	0.08	0.15	0.7	2.2	1.83	0.02	0.9600	3.29	1.90	45		2.6	367	1.1		0.02	0.99	0.82	1.11	0.92	10.81	6.23
45	2.63	4.15	0.59	3.02	6.09	0.59	2.86	**Clayey**	6.79	2.60	3.82	12.12	2.00	2.63	3.52	42.64	0.08	0.99	0.18	0.09	0.16	0.7	2.2	1.78	0.02	0.9600	3.13	1.87	37		2.6	337	1.1		0.02	0.99	0.68	1.11	0.76	8.20	4.89
46	2.67	3.93	0.60	3.04	5.65	0.60	2.89	**Clayey**	6.14	2.48	3.56	11.13	2.00	2.67	3.81	42.37	0.08	0.99	0.18	0.10	0.16	0.7	2.2	1.72	0.02	0.9600	2.84	1.75	39		2.6	336	1.1		0.02	0.99	0.61	1.11	0.68	6.92	4.28
47	2.81	3.17	0.71	3.16	4.48	0.71	3.01	**Clayey**	5.63	2.37	3.35	8.99	2.00	2.81	4.83	43.44	0.08	0.99	0.17	0.10	0.16	0.7	2.2	1.68	0.02	0.9600	2.65	1.70	46		2.6	283	1.1		0.02	0.99	0.47	1.11	0.53	5.07	3.25
48	2.79	3.33	0.65	3.12	4.62	0.65	2.99	**Clayey**	5.17	2.27	3.16	9.09	2.00	2.79	4.69	42.64	0.08	0.99	0.17	0.11	0.16	0.7	2.2	1.64	0.02	0.9600	2.47	1.64	45		2.6	309	1.1		0.02	0.99	0.48	1.11	0.53	4.90	3.27
49	2.31	9.68	0.43	2.63	13.25	0.43	2.50	**Very Silty**	4.81	2.19	3.00	14.24	2.00	2.50	2.76	39.24	0.07	0.99	0.16	0.11	0.16	0.7	2.2	1.60	0.02	0.9600	2.25	1.56	31		2.6	934	1.1		0.02	0.99	1.34	1.11	1.49	13.29	9.22
50	2.94	3.27	1.22	3.23	4.41	1.22	3.11	**Clayey**	4.47	2.11	2.85	8.54	2.00	2.94	6.08	51.90	0.09	0.99	0.15	0.12	0.16	0.7	2.2	1.57	0.02	0.9600	2.68	1.94	54		2.6	327	1.1		0.02	0.99	0.44	1.11	0.48	4.21	3.04
51	3.23	1.58	1.22	3.52	2.11	1.22	3.41	**Clayey**	4.20	2.05	2.73	4.92	2.00	3.23	9.74	47.92	0.08	0.98	0.15	0.12	0.16	0.7	2.2	1.54	0.02	0.9600	2.25	1.70	76		2.6	164	1.1		0.02	0.99	0.20	1.11	0.23	1.93	1.46
52	3.24	1.60	1.18	3.51	2.10	1.18	3.40	**Clayey**	3.94	1.98	2.61	4.88	2.00	3.24	9.78	47.70	0.08	0.98	0.14	0.12	0.15	0.7	2.2	1.51	0.02	0.9600	2.16	1.71	76		2.6	170	1.1		0.02	0.99	0.20	1.11	0.22	1.85	1.46
53	3.37	1.29	1.42	3.63	1.67	1.42	3.52	**Clayey**	3.72	1.93	2.51	4.22	2.00	3.37	11.79	49.78	0.08	0.98	0.13	0.12	0.15	0.7	2.2	1.48	0.02	0.9600	2.13	1.77	87		2.6	141	1.1		0.02	0.99	0.16	1.11	0.17	1.42	1.18
54	2.98	4.04	1.76	3.22	5.19	1.76	3.12	**Clayey**	3.52	1.88	2.41	9.35	2.00	2.98	6.48	60.55	0.10	0.98	0.13	0.12	0.14	0.7	2.2	1.46	0.02	0.9600	2.50	2.18	57		2.6	456	1.1		0.02	0.99	0.48	1.11	0.53	4.28	3.73
55	3.36	2.47	4.19	3.59	3.14	4.19	3.50	**Clayey**	3.34	1.83	2.32	6.30	2.00	3.36	11.75	74.06	0.12	0.98	0.12	0.13	0.14	0.7	2.2	1.44	0.02	0.9600	2.84	2.61	87		2.6	286	1.1		0.02	0.99	0.28	1.11	0.32	2.52	2.31
56	3.61	1.09	3.10	3.84	1.37	3.10	3.75	**Clayey**	3.18	1.78	2.25	3.76	2.00	3.61	16.26	61.10	0.10	0.98	0.11	0.13	0.13	0.7	2.2	1.41	0.02	0.9600	2.38	2.31	100		2.6	129	1.1		0.02	0.99	0.12	1.11	0.14	1.07	1.04
57	3.50	1.86	4.43	3.71	2.32	4.43	3.62	**Clayey**	3.03	1.74	2.17	5.07	2.00	3.50	14.09	71.41	0.11	0.98	0.11	0.13	0.12	0.7	2.2	1.39	0.02	0.9600	2.61	2.69	100		2.6	226	1.1		0.02	0.99	0.20	1.11	0.23	1.76	1.82
58	2.43	16.09	1.30	2.63	19.90	1.30	2.55	**Very Silty**	2.89	1.70	2.10	21.25	2.00	2.55	3.02	64.23	0.10	0.97	0.10	0.13	0.12	0.7	2.2	1.38	0.02	0.9600	2.35	2.58	33		2.6	2002	1.1		0.02	0.99	1.73	1.11	1.92	14.83	16.26
59	1.47	325.84	1.12	1.59	398.99	1.12	1.54	**Granular**	2.75	1.66	2.03	326.96	57.00	1.59	1.00	326.96	3.33	0.97	0.09	0.13	0.11	0.7	2.2	1.35	0.02	0.0000	0.00	0.00	4		2.6	41554	1.1		0.02	0.99	34.10	1.11	37.89	291.48	341.71
60	2.18	85.52	3.19	2.31	103.74	3.19	2.25	**Granular**	2.63	1.62	1.97	86.68	9.00	2.31	1.98	171.72	0.55	0.97	0.09	0.13	0.10	0.7	2.2	1.34	0.02	0.9725	12.06	15.18	23		2.6	11167	1.1		0.02	0.99	8.74	1.11	9.71	74.40	93.68
61	2.28	56.87	3.09	2.42	68.40	3.09	2.37	**Granular**	2.52	1.59	1.91	58.06	3.00	2.42	2.40	139.45	0.33	0.97	0.08	0.13	0.10	0.7	2.2	1.32	0.02	0.9600	7.05	9.59	27		2.6	7585	1.1		0.02	0.99	5.69	1.11	6.32	48.19	65.53
62	2.59	33.90	4.86	2.72	40.46	4.86	2.67	**Very Silty**	2.42	1.56	1.86	41.92	2.00	2.67	3.75	157.34	0.44	0.97	0.07	0.13	0.09	0.7	2.2	1.30	0.02	0.9600	9.23	13.64	39		2.6	4610	1.1		0.02	0.99	3.33	1.11	3.70	28.02	41.43
63	2.25	52.95	2.48	2.38	62.72	2.48	2.32	**Granular**	2.33	1.53	1.81	54.20	2.00	2.38	2.23	120.65	0.24	0.97	0.07	0.13	0.08	0.7	2.2	1.29	0.02	0.9600	5.00	8.09	26		2.6	7334	1.1		0.02	0.99	5.10	1.11	5.67	42.75	69.21
64	2.74	23.99	5.56	2.87	28.21	5.56	2.82	**Clayey**	2.25	1.50	1.76	37.92	2.00	2.74	4.32	163.78	0.49	0.97	0.06	0.13	0.07	0.7	2.2	1.28	0.02	0.9600	9.88	17.68	43		2.6	3383	1.1		0.02	0.99	2.27	1.11	2.52	18.94	33.89
65	2.80	16.60	4.45	2.92	19.40	4.45	2.87	**Clayey**	2.18	1.48	1.73	26.45	2.00	2.80	4.76	125.80	0.27	0.96	0.06	0.13	0.07	0.7	2.2	1.26	0.02	0.9600	5.29	10.57	46		2.6	2380	1.1		0.02	0.99	1.55	1.11	1.72	12.83	25.67
66	2.30	33.33	1.73	2.43	38.69	1.73	2.38	**Granular**	2.11	1.45	1.69	34.67	2.00	2.43	2.45	84.94	0.14	0.96	0.05	0.13	0.06	0.7	2.2	1.25	0.02	0.9600	2.69	6.11	28		2.6	4858	1.1		0.02	0.99	3.05	1.11	3.39	25.25	57.23
67	2.65	17.24	2.66	2.77	19.88	2.66	2.72	**Clayey**	2.04	1.43	1.65	26.56	2.00	2.65	3.65	97.05	0.16	0.96	0.04	0.13	0.05	0.7	2.2	1.24	0.02	0.9600	3.20	8.38	38		2.6	2557	1.1		0.02	0.99	1.55	1.11	1.72	12.81	33.50

CPTU-610 Liquefaction Analysis

ConeTec Inc. - CPT Interpretation
Interpretation Output - Release 1.22 Rev. A - Format: NLI Imperial
Run No: 06-0718-0954-2872
Job No: 02-100
Client: MACTEC Engineering and Consulting Inc.
Project: Former Callahan Mine Site, Brooksville, ME
Site: CP-610
Location: Callahan Mine
Cone: 20 Ton AD179
CPT Date: 06/28/06
CPT Time: 07:22
CPT File: 758CP610.COR
Northing (m): 0
Easting (m): 0
Elevation (m): 0 — 70 — Elevation For CPT Triggering analysis

Water Table (m): 3.66 (ft): 12 — 12 — Water Table assumed for CPT Analysis
Unit Weight of Water (default): 62.4 pcf
Averaging Increment (m): 0.2
Phi Method : Robertson and Campanella, 1983
Su Nkt used: 15 Su/P' (nc): 0.3 — 0.11 — Base acceleration
Dr Method : Jamiolkowski - All Sands
State Parameter M: 1.2
Used Unit Weights Assigned to Soil Zones
N160c Calculated using qc1n

1) CSR = $0.65*(a_{max}/g)*(s_v/s'_v)*r_d$ — Seed & Idriss, 1983, p. 459

a_{max}/g = 0.11 g — USGS (base)(amplified from base as discussed in
s_v = computed — Total Vertical Stress
s'_v = computed — Effective Vertical Stress

$r_d = [1.0 - 0.4113z^{0.5} + 0.04052z + 0.001753z^{1.5}] / [1 - 0.4177z^{0.5} + 0.05729z - 0.$

z = depth in meters

2) FS = Factor of safety against triggering of liquefaction: $FS = (CRR_{7.5}/CSR) \times MSF \times K_s \times K_a$

MSF = magnitude scaling factor; Assume based on range recommended by NCEER Wo

CPTU-610 Liquefaction Analysis

$K_s = (s'_{vo}/P_a)^{(f-1)}$, where f = 0.7 to 0.8 for relative density of 40 to 60%; f = 0.6 to 0.7 fo
1 Atmosphere = 14.7 psi = 2.12 ksf

Conetec Data

	Col-01	Col-02	Col-03	Col-04	Col-05	Col-06	Col-07	Col-08	Col-09	Col-10	Col-11	Col-12	Col-13	Col-14	Col-15	Col-16	Col-17	Col-18	Col-19	Col-20	Col-21	Col-22	Col-23	Col-24	Col-25	Col-26	Col-27	Col-28	Col-29	Col-30	Col-31	Col-32	Col-33	Col-34	Col-35	Col-36
	Depth (m)	Depth (ft)	Elev. (m)	Elev. (ft)	qc (tsf)	qt (tsf)	fs (tsf)	Rf (%)	u (ft)	SBT (Zone)	SBTn (Zone)	SBT-BQ (Zone)	SBT-BQn (Zone)	Perm-k (cm/s)	Unit Wt (pcf)	T Stress (tsf)	U Stress (tsf)	E Stress (tsf)	Cn	N60 (b/ft)	N1(60) (b/ft)	N(60)Ic (b/ft)	N1(60)Ic (b/ft)	Qt	Fr (%)	Bq	Ic	FC (%)	IcZone (Zone)	Dr (%)	Phi (deg)	State Par	Es/qt	YoungE (tsf)	Su (tsf)	OCR
40	0.1	0.328	-0.1	69.7	2.92	2.91	0.09	3.19	-2.79	3	8	3	6	5.00E-08	111.4	0.018	0	0.018	1.7	2.8	4.7	-9999	-9999	158.06	3.21	-0.03	-9999	-9999	0	-9999	-9999	-9999	-9999	-9999	0.193	10
41	0.3	0.984	-0.3	69.0	3.46	3.48	0.08	2.38	3.86	3	5	3	6	5.00E-08	111.4	0.055	0	0.055	1.7	3.3	5.7	1.2	2.1	62.51	2.41	0.04	3.15	69.5	3	-9999	-9999	-9999	-9999	-9999	0.228	10
42	0.5	1.64	-0.5	68.4	2.84	2.87	0.05	1.75	6	1	5	3	5	1.00E-07	111.4	0.091	0	0.091	1.7	1.4	2.3	1	1.8	30.38	1.81	0.07	3.17	70.4	3	-9999	-9999	-9999	-9999	-9999	0.185	10
43	0.7	2.297	-0.7	67.7	2.28	2.36	0.03	1.38	16.18	1	4	3	4	1.00E-07	111.4	0.128	0	0.128	1.7	1.1	1.9	0.6	4.8	17.42	1.46	0.23	2.62	36.5	4	-9999	-9999	-9999	-9999	-9999	0.149	5.7
44	0.9	2.953	-0.9	67.0	2.49	2.56	0.03	0.98	15.13	1	4	3	4	1.00E-07	111.4	0.164	0	0.164	1.7	1.2	2.1	0.7	4	14.56	1.05	0.2	2.62	36.3	4	-9999	-9999	-9999	-9999	-9999	0.16	4.4
45	1.1	3.609	-1.1	66.4	2.04	2.12	0.03	1.42	17.31	1	4	3	3	1.00E-07	111.4	0.201	0	0.201	1.7	1	1.7	0.6	3	9.56	1.56	0.28	2.86	49.7	4	-9999	-9999	-9999	-9999	-9999	0.128	2.4
46	1.3	4.265	-1.3	65.7	2.09	2.17	0.02	0.92	17.45	1	4	3	3	1.00E-07	111.4	0.238	0	0.238	1.7	1	1.8	0.6	2.5	8.13	1.04	0.28	2.84	48.5	4	-9999	-9999	-9999	-9999	-9999	0.129	1.9
47	1.5	4.921	-1.5	65.1	1.77	1.88	0.02	1.2	23.06	1	3	3	3	1.00E-07	111.4	0.274	0	0.274	1.7	0.9	1.5	0.6	2	5.85	1.41	0.45	3.03	60.5	3	-9999	-9999	-9999	-9999	-9999	0.107	1.3
48	1.7	5.577	-1.7	64.4	1.69	1.81	0.02	0.97	25.23	1	3	2	3	1.00E-07	111.4	0.311	0	0.311	1.7	0.9	1.5	0.6	1.7	4.83	1.17	0.53	3.07	63.3	3	-9999	-9999	-9999	-9999	-9999	0.1	1.1
49	1.9	6.234	-1.9	63.8	5.71	5.8	0.04	0.69	17.88	1	5	4	4	1.00E-07	111.4	0.347	0	0.347	1.7	2.8	4.7	1.6	2.7	15.7	0.74	0.1	2.72	41.6	4	-9999	-9999	-9999	-9999	-9999	0.363	4.9
50	2.1	6.89	-2.1	63.1	5.39	5.43	0.1	1.75	7.63	4	4	4	4	5.00E-07	114.6	0.384	0	0.384	1.61	3.5	5.6	1.6	3.9	13.13	1.89	0.05	2.79	45.3	4	-9999	-9999	-9999	-9999	-9999	0.336	3.7
51	2.3	7.546	-2.3	62.5	1.26	1.41	0.04	2.49	31.89	1	3	1	3	1.00E-07	111.4	0.421	0	0.421	1.54	0.7	1	0.7	1.2	2.35	3.55	1.01	3.57	100	3	-9999	-9999	-9999	-9999	-9999	0.066	0.6
52	2.5	8.202	-2.5	61.8	1.19	1.35	0.03	2.23	33.6	1	3	1	1	1.00E-07	111.4	0.458	0	0.458	1.48	0.6	1	0.7	1.1	1.95	3.37	1.18	3.63	100	2	-9999	-9999	-9999	-9999	-9999	0.059	0.6
53	2.7	8.858	-2.7	61.1	1.19	1.35	0.03	2.23	34.26	1	3	1	1	1.00E-07	111.4	0.494	0	0.494	1.42	0.6	0.9	0.8	1	1.73	3.52	1.25	3.68	100	2	-9999	-9999	-9999	-9999	-9999	0.057	0.6
54	2.9	9.514	-2.9	60.5	1.05	1.22	0.03	2.46	37.66	2	2	-9999	-9999	1.00E-15	79.5	0.526	0	0.526	1.38	1.2	1.6	0.8	0.9	1.32	4.32	1.69	3.83	100	2	-9999	-9999	-9999	-9999	-9999	0.046	0.5
55	3.1	10.17	-3.1	59.8	1.67	1.83	0.05	2.73	34.76	3	3	3	3	5.00E-08	111.4	0.557	0	0.557	1.34	1.8	2.4	1	1.2	2.29	3.92	0.85	3.6	100	3	-9999	-9999	-9999	-9999	-9999	0.085	0.6
56	3.3	10.827	-3.3	59.2	1.56	1.68	0.07	4.17	26.23	3	2	3	3	5.00E-08	111.4	0.594	0	0.594	1.3	1.6	2.1	1.1	1.2	1.84	6.43	0.75	3.79	100	2	-9999	-9999	-9999	-9999	-9999	0.073	0.6
57	3.5	11.483	-3.5	58.5	1.11	1.29	0.04	3.3	38.03	2	2	-9999	-9999	1.00E-15	79.5	0.625	0	0.625	1.27	1.2	1.6	1.1	1	1.07	6.4	1.78	3.99	100	2	-9999	-9999	-9999	-9999	-9999	0.044	0.5
58	3.7	12.139	-3.7	57.9	1.16	1.36	0.04	2.94	43.77	3	2	-9999	-9999	5.00E-08	111.4	0.656	0.004	0.652	1.24	1.3	1.6	1.1	0.9	1.08	5.68	1.93	3.96	100	2	-9999	-9999	-9999	-9999	-9999	0.047	0.5
59	3.9	12.795	-3.9	57.2	1.24	1.46	0.04	2.91	46.78	3	2	-9999	-9999	5.00E-08	111.4	0.693	0.025	0.668	1.22	1.4	1.7	1.1	0.9	1.15	5.54	1.87	3.93	100	2	-9999	-9999	-9999	-9999	-9999	0.051	0.5
60	4.1	13.451	-4.1	56.5	3.75	3.89	0.09	2.19	30.84	3	3	3	3	5.00E-08	111.4	0.729	0.045	0.684	1.21	3.7	4.5	1.5	1.9	4.63	2.69	0.29	3.25	77.3	3	-9999	-9999	-9999	-9999	-9999	0.211	1
61	4.3	14.107	-4.3	55.9	2.4	2.56	0.09	3.52	35.81	3	3	3	3	5.00E-08	111.4	0.766	0.066	0.7	1.2	2.5	2.9	1.3	1.4	2.57	5.02	0.59	3.61	100	2	-9999	-9999	-9999	-9999	-9999	0.12	0.7
62	4.5	14.764	-4.5	55.2	1.45	1.69	0.05	2.96	52.38	3	2	-9999	-9999	5.00E-08	111.4	0.802	0.086	0.716	1.18	1.6	1.9	1.3	1	1.24	5.62	1.74	3.91	100	2	-9999	-9999	-9999	-9999	-9999	0.059	0.5
63	4.7	15.42	-4.7	54.6	1.61	1.86	0.05	2.69	54.02	3	2	-9999	-9999	5.00E-08	111.4	0.839	0.107	0.732	1.17	1.8	2.1	1.3	1	1.4	4.89	1.54	3.83	100	2	-9999	-9999	-9999	-9999	-9999	0.068	0.5
64	4.9	16.076	-4.9	53.9	1.72	1.99	0.05	2.4	56.26	1	2	-9999	-9999	1.00E-07	111.4	0.876	0.127	0.748	1.16	1	1.1	1.3	1	1.48	4.29	1.47	3.78	100	2	-9999	-9999	-9999	-9999	-9999	0.074	0.5
65	5.1	16.732	-5.1	53.3	2.01	2.27	0.05	2.32	54.36	1	2	1	1	1.00E-07	111.4	0.912	0.148	0.764	1.14	1.1	1.2	1.3	1.1	1.77	3.88	1.14	3.69	100	2	-9999	-9999	-9999	-9999	-9999	0.09	0.6
66	5.3	17.388	-5.3	52.6	1.99	2.25	0.05	2.34	55.51	1	2	1	1	1.00E-07	111.4	0.949	0.168	0.78	1.13	1.1	1.2	1.3	1	1.67	4.04	1.2	3.73	100	2	-9999	-9999	-9999	-9999	-9999	0.087	0.6
67	5.5	18.044	-5.5	52.0	2.14	2.43	0.06	2.27	62.19	1	3	1	1	1.00E-07	111.4	0.985	0.189	0.796	1.12	1.2	1.3	1.4	1.1	1.81	3.83	1.22	3.68	100	2	-9999	-9999	-9999	-9999	-9999	0.096	0.6
68	5.7	18.701	-5.7	51.3	2.55	2.84	0.06	2.12	62.52	1	3	3	3	1.00E-07	111.4	1.022	0.209	0.813	1.11	1.4	1.5	1.4	1.2	2.24	3.31	0.96	3.57	100	3	-9999	-9999	-9999	-9999	-9999	0.121	0.6
69	5.9	19.357	-5.9	50.6	2.43	2.73	0.05	1.84	64.62	1	3	1	1	1.00E-07	111.4	1.058	0.23	0.829	1.1	1.3	1.4	1.4	1.1	2.02	3	1.07	3.59	100	3	-9999	-9999	-9999	-9999	-9999	0.111	0.6
70	6.1	20.013	-6.1	50.0	2.62	2.91	0.05	1.72	63.75	1	3	3	3	1.00E-07	111.4	1.095	0.25	0.845	1.09	1.4	1.5	1.4	1.1	2.15	2.75	0.96	3.55	100	3	-9999	-9999	-9999	-9999	-9999	0.121	0.6
71	6.3	20.669	-6.3	49.3	2.9	3.21	0.06	1.8	64.24	1	3	3	3	1.00E-07	111.4	1.131	0.271	0.861	1.08	1.5	1.7	1.5	1.2	2.41	2.78	0.84	3.51	100	3	-9999	-9999	-9999	-9999	-9999	0.138	0.6
72	6.5	21.325	-6.5	48.7	2.6	2.93	0.05	1.71	69.58	1	3	1	1	1.00E-07	111.4	1.168	0.291	0.877	1.07	1.4	1.5	1.5	1.1	2.01	2.85	1.07	3.58	100	3	-9999	-9999	-9999	-9999	-9999	0.117	0.6
73	6.7	21.981	-6.7	48.0	2.62	2.97	0.04	1.44	74.05	1	3	1	1	1.00E-07	111.4	1.204	0.312	0.893	1.06	1.4	1.5	1.5	1	1.97	2.42	1.14	3.56	100	3	-9999	-9999	-9999	-9999	-9999	0.117	0.6
74	6.9	22.638	-6.9	47.4	2.67	3.03	0.04	1.41	77.09	1	3	1	1	1.00E-07	111.4	1.241	0.332	0.909	1.05	1.4	1.5	1.5	1	1.97	2.38	1.16	3.56	100	3	-9999	-9999	-9999	-9999	-9999	0.119	0.6
75	7.1	23.294	-7.1	46.7	3	3.37	0.05	1.49	79.3	1	3	3	1	1.00E-07	111.4	1.278	0.353	0.925	1.04	1.6	1.7	1.6	1.1	2.26	2.39	1.01	3.5	100	3	-9999	-9999	-9999	-9999	-9999	0.14	0.6
76	7.3	23.95	-7.3	46.1	3.27	3.66	0.05	1.44	83.71	1	3	3	3	1.00E-07	111.4	1.314	0.373	0.941	1.03	1.8	1.8	1.7	1.2	2.5	2.24	0.95	3.45	94.3	3	-9999	-9999	-9999	-9999	-9999	0.157	0.7
77	7.5	24.606	-7.5	45.4	3.27	3.68	0.05	1.36	87.15	1	3	3	3	1.00E-07	111.4	1.351	0.394	0.957	1.02	1.8	1.8	1.7	1.1	2.43	2.15	1	3.45	94.5	3	-9999	-9999	-9999	-9999	-9999	0.155	0.6
78	7.7	25.262	-7.7	44.7	3.56	3.94	0.06	1.59	81.61	1	3	3	3	1.00E-07	111.4	1.387	0.414	0.973	1.01	1.9	1.9	1.8	1.2	2.62	2.45	0.84	3.45	94.2	3	-9999	-9999	-9999	-9999	-9999	0.17	0.7
79	7.9	25.918	-7.9	44.1	3.72	4.14	0.07	1.7	90.13	1	3	3	3	1.00E-07	111.4	1.424	0.435	0.989	1.01	2	2	1.9	1.3	2.74	2.58	0.88	3.44	93.6	3	-9999	-9999	-9999	-9999	-9999	0.181	0.7
80	8.1	26.574	-8.1	43.4	15.74	15.81	0.58	3.65	14.72	4	3	6	5	5.00E-07	114.6	1.461	0.455	1.006	1	10.1	10.1	5	4.7	14.27	4.02	0	2.95	55	4	-9999	-9999	-9999	-9999	-9999	0.957	4.2
81	8.3	27.231	-8.3	42.8	13.27	13.28	0.61	4.57	2	3	3	6	4	5.00E-08	111.4	1.498	0.476	1.022	0.99	12.7	12.6	4.5	4.1	11.52	5.15	-0.04	3.09	64.6	3	-9999	-9999	-9999	-9999	-9999	0.785	3.1
82	8.5	27.887	-8.5	42.1	80.47	80.43	0.92	1.14	-9.33	8	6	9	6	5.00E-03	120.9	1.536	0.496	1.04	0.98	19.3	18.9	16.3	16.3	75.86	1.17	-0.01	2.04	14	6	59.8	40	-0.18	2.428	195.3	-9999	-9999

	Col-37	Col-38	Col-39	Col-40	Col-41	Col-42	Col-43	Col-44	Col-45
	U (psf)	s_{vo} (psf)	q_c (psf)	q_t (psf)	P_a (psf)	σ'_{vo} (psf)	f_s (psf)	$Q_{exp=1}$	F
40	0	36	5840	5820	2116	36	180	160.67	3.11
41	0	110	6920	6960	2116	110	160	62.27	2.34
42	0	182	5680	5740	2116	182	100	30.54	1.80
43	0	256	4560	4720	2116	256	60	17.44	1.34
44	0	328	4980	5120	2116	328	60	14.61	1.25
45	0	402	4080	4240	2116	402	60	9.55	1.56
46	0	476	4180	4340	2116	476	40	8.12	1.04
47	0	548	3540	3760	2116	548	40	5.86	1.25
48	0	622	3380	3620	2116	622	40	4.82	1.33
49	0	694	11420	11600	2116	694	80	15.71	0.73
50	0	768	10780	10860	2116	768	200	13.14	1.98
51	0	842	2520	2820	2116	842	80	2.35	4.04
52	0	916	2380	2700	2116	916	60	1.95	3.36
53	0	988	2380	2700	2116	988	60	1.73	3.50
54	0	1052	2100	2440	2116	1052	60	1.32	4.32
55	0	1114	3340	3660	2116	1114	100	2.29	3.93
56	0	1188	3120	3360	2116	1188	140	1.83	6.45
57	0	1250	2220	2580	2116	1250	80	1.06	6.02
58	9	1312	2320	2720	2116	1303	80	1.08	5.68
59	50	1386	2480	2920	2116	1336	80	1.15	5.22
60	91	1458	7500	7780	2116	1367	180	4.62	2.85
61	131	1532	4800	5120	2116	1401	180	2.56	5.02
62	172	1604	2900	3380	2116	1432	100	1.24	5.63
63	213	1678	3220	3720	2116	1465	100	1.39	4.90
64	254	1752	3440	3980	2116	1498	100	1.49	4.49
65	295	1824	4020	4540	2116	1529	100	1.78	3.68
66	336	1898	3980	4500	2116	1562	100	1.67	3.84
67	377	1970	4280	4860	2116	1593	120	1.81	4.15
68	418	2044	5100	5680	2116	1626	120	2.24	3.30
69	459	2116	4860	5460	2116	1657	100	2.02	2.99
70	500	2190	5240	5820	2116	1690	100	2.15	2.75
71	541	2262	5800	6420	2116	1721	120	2.42	2.89
72	582	2336	5200	5860	2116	1754	100	2.01	2.84
73	623	2408	5240	5940	2116	1785	80	1.98	2.27
74	664	2482	5340	6060	2116	1818	80	1.97	2.24
75	705	2556	6000	6740	2116	1851	100	2.26	2.39
76	746	2628	6540	7320	2116	1882	100	2.49	2.13
77	787	2702	6540	7360	2116	1915	100	2.43	2.15
78	828	2774	7120	7880	2116	1946	120	2.62	2.35
79	868	2848	7440	8280	2116	1980	140	2.74	2.58
80	909	2922	31480	31620	2116	2013	1160	14.26	4.04
81	950	2996	26540	26560	2116	2046	1220	11.52	5.18
82	991	3072	160940	160860	2116	2081	1840	75.84	1.17

CPTU-610 Liquefaction Analysis

ext

06205z$^{1.5}$ + 0.001210z^{2}]

Youd and Idriss, 2001

kshop, reiterated in Youd and Idriss, 2001

CPTU-610 Liquefaction Analysis

rel density of 60 to 80%; P_a = pressure at 1 atmosphere Youd and Idriss, 2001

	AT	AU	AV	AW	AX	AY	AZ	BA	BB	BC	BD	BE	BF	BG	BH	BI	BJ	BK	BL	BM	BN	BO	BP	BQ	BR	BS	BT	BU	BV	BW	BX	BY	BZ	CA	CB	CC	CD	CE	CF	CG	CH
34	Col-46	Col-47	Col-48	Col-49	Col-50	Col-51	Col-52	Col-53	Col-54	Col-55	Col-56	Col-57	Col-57a	Col-58	Col-59	Col-60	Col-61	Col-62	Col-63	Col-64	Col-65	Col-66	Col-67	Col-68	Col-69	Col-70	Col-71	Col-72	Col-73	Col-74	Col-75	Col-76	Col-77	Col-78	Col-79	Col-80	Col-81	Col-82	Col-83	Col-84	Col-85
35	Youd & Idriss, 2001 CPT Based Analysis																															Boulanger and Idriss, 2004, "Approach B" method based on Su profile										
36																					Rel. Den. Factor																					
37	$I_{c\ Qexp=1}$	$Q_{exp=0.5}$	F	$I_{c\ Qexp=0.5}$	$Q_{exp=0.7}$	F	$I_{c\ Qexp=0.7}$	Description	C_q			q_{c1N}	Lookup	Ic	Kc	$(q_{c1N})_{cs}$	CRR7.5	rd	a_{max}/g =	CSR		f	MSF	K_σ	α	K_α	$FS_{liq-CPT\ (Sand-Like)}$		Apparent Fines	Measured Fines	Ic Limits	Su - CPT (psf)	OCR Assumed	OCR - CPT	α	$k_{\sigma 1}$	$CRR_{M7.5}$	MSF	$CRR_{M5.5}$	$FS_{liq-Su\ (Clay-Like)}$	
38									n=1.0	n=0.5	n=0.7		Col						if crest accel	No Amplification	if crest accel = 2						No Amplification	if crest accel = 2	(%)	(%)		Nkt	1.1							No Amplification	if crest accel = 2
39																			2.0						0.02							10			0.02						
40	2.13	20.96	3.11	2.75	47.33	3.11	2.48	Very Silty	58.78	7.67	17.32	47.63	2.00	2.48	2.67	127.39	0.27	1.00	0.22	0.07	0.14	0.7	2.2	3.39	0.02	0.9600	27.28	13.72	30		2.6	578	1.1		0.02	0.99	10.13	1.11	11.26	157.40	79.17
41	2.31	14.20	2.34	2.81	25.65	2.34	2.60	Very Silty	19.24	4.39	7.92	26.06	2.00	2.60	3.34	87.02	0.14	1.00	0.22	0.07	0.14	0.7	2.2	2.43	0.02	0.9600	10.14	5.16	35		2.6	685	1.1		0.02	0.99	3.93	1.11	4.36	61.07	31.09
42	2.47	8.96	1.80	2.92	14.63	1.80	2.74	Very Silty	11.63	3.41	5.57	15.11	2.00	2.74	4.27	64.49	0.10	1.00	0.21	0.07	0.14	0.7	2.2	2.09	0.02	0.9600	6.48	3.34	42		2.6	556	1.1		0.02	0.99	1.93	1.11	2.14	29.99	15.46
43	2.60	6.07	1.34	3.01	9.25	1.34	2.84	Clayey	8.27	2.88	4.39	18.44	2.00	2.60	3.36	61.87	0.10	1.00	0.21	0.07	0.14	0.7	2.2	1.88	0.02	0.9600	5.70	2.97	36		2.6	446	1.1		0.02	0.99	1.10	1.11	1.22	17.15	8.95
44	2.66	5.75	1.25	3.01	8.35	1.25	2.87	Clayey	6.45	2.54	3.69	15.61	2.00	2.66	3.68	57.49	0.10	1.00	0.21	0.07	0.13	0.7	2.2	1.75	0.02	0.9600	5.07	2.68	38		2.6	479	1.1		0.02	0.99	0.92	1.11	1.02	14.39	7.60
45	2.86	4.16	1.56	3.18	5.80	1.56	3.05	Clayey	5.26	2.29	3.20	10.55	2.00	2.86	5.35	56.43	0.10	0.99	0.21	0.07	0.13	0.7	2.2	1.65	0.02	0.9600	4.73	2.53	50	98.8	2.6	384	1.1		0.02	0.99	0.60	1.11	0.67	9.42	5.04
46	2.84	3.85	1.04	3.14	5.19	1.04	3.02	Clayey	4.45	2.11	2.84	9.12	2.00	2.84	5.16	47.05	0.08	0.99	0.20	0.07	0.13	0.7	2.2	1.56	0.02	0.9600	3.77	2.04	49		2.6	386	1.1		0.02	0.99	0.51	1.11	0.57	8.02	4.35
47	3.01	2.98	1.25	3.27	3.91	1.25	3.16	Clayey	3.86	1.97	2.57	6.86	2.00	3.01	6.80	46.67	0.08	0.99	0.20	0.07	0.13	0.7	2.2	1.50	0.02	0.9600	3.60	1.98	59		2.6	321	1.1		0.02	0.99	0.37	1.11	0.41	5.80	3.19
48	3.09	2.61	1.33	3.34	3.34	1.33	3.24	Clayey	3.40	1.84	2.36	5.82	2.00	3.09	7.86	45.74	0.08	0.99	0.20	0.07	0.13	0.7	2.2	1.44	0.02	0.9600	3.44	1.91	65		2.6	300	1.1		0.02	0.99	0.30	1.11	0.34	4.78	2.66
49	2.52	9.00	0.73	2.74	11.25	0.73	2.65	Very Silty	3.05	1.75	2.18	11.96	2.00	2.65	3.66	43.73	0.08	0.99	0.20	0.07	0.13	0.7	2.2	1.40	0.02	0.9600	3.26	1.84	38		2.6	1091	1.1		0.02	0.99	0.99	1.11	1.10	15.60	8.80
50	2.80	7.92	1.98	2.99	9.70	1.98	2.91	Clayey	2.76	1.66	2.03	14.14	2.00	2.80	4.77	67.45	0.11	0.99	0.19	0.07	0.12	0.7	2.2	1.36	0.02	0.9600	4.41	2.52	46		2.6	1009	1.1		0.02	0.99	0.83	1.11	0.92	13.07	7.47
51	3.60	1.48	4.04	3.77	1.78	4.04	3.70	Clayey	2.51	1.59	1.91	3.35	2.00	3.60	15.94	53.40	0.09	0.98	0.19	0.07	0.12	0.7	2.2	1.32	0.02	0.9600	3.72	2.16	100		2.6	198	1.1		0.02	0.99	0.15	1.11	0.16	2.34	1.36
52	3.63	1.28	3.36	3.79	1.52	3.36	3.72	Clayey	2.31	1.52	1.80	2.95	2.00	3.63	16.57	48.83	0.08	0.98	0.19	0.07	0.12	0.7	2.2	1.29	0.02	0.9600	3.18	1.87	100		2.6	178	1.1		0.02	0.99	0.12	1.11	0.14	1.94	1.14
53	3.68	1.18	3.50	3.83	1.38	3.50	3.77	Clayey	2.14	1.46	1.70	2.73	2.00	3.68	17.66	48.26	0.08	0.98	0.18	0.07	0.12	0.7	2.2	1.26	0.02	0.9600	3.10	1.84	100		2.6	171	1.1		0.02	0.99	0.11	1.11	0.12	1.73	1.03
54	3.83	0.93	4.32	3.96	1.07	4.32	3.91	Clayey	2.01	1.42	1.63	2.32	2.00	3.83	20.91	48.51	0.08	0.98	0.18	0.07	0.12	0.7	2.2	1.23	0.02	0.9600	3.05	1.84	100		2.6	139	1.1		0.02	0.99	0.08	1.11	0.09	1.32	0.80
55	3.60	1.66	3.93	3.72	1.89	3.93	3.67	Clayey	1.90	1.38	1.57	3.29	2.00	3.60	16.02	52.63	0.09	0.98	0.18	0.07	0.11	0.7	2.2	1.21	0.02	0.9600	3.42	2.10	100		2.6	255	1.1		0.02	0.99	0.14	1.11	0.16	2.29	1.40
56	3.80	1.37	6.45	3.90	1.54	6.45	3.86	Clayey	1.78	1.33	1.50	2.83	2.00	3.80	20.15	56.99	0.10	0.98	0.18	0.07	0.11	0.7	2.2	1.19	0.02	0.9600	3.49	2.17	100		2.6	217	1.1		0.02	0.99	0.12	1.11	0.13	1.83	1.14
57	3.98	0.82	6.02	4.08	0.91	6.02	4.04	Clayey	1.69	1.30	1.45	2.06	2.00	3.98	24.59	50.74	0.09	0.98	0.17	0.07	0.11	0.7	2.2	1.17	0.02	0.9600	3.27	2.06	100		2.6	133	1.1		0.02	0.99	0.07	1.11	0.07	1.07	0.67
58	3.96	0.85	5.68	4.05	0.93	5.68	4.02	Clayey	1.62	1.27	1.40	2.09	2.00	3.96	24.13	50.36	0.09	0.97	0.17	0.07	0.11	0.7	2.2	1.16	0.02	0.9600	3.20	2.05	100		2.6	141	1.1		0.02	0.99	0.07	1.11	0.08	1.08	0.69
59	3.92	0.91	5.22	4.01	1.00	5.22	3.97	Clayey	1.58	1.26	1.38	2.18	2.00	3.92	23.11	50.50	0.09	0.97	0.17	0.07	0.11	0.7	2.2	1.15	0.02	0.9600	3.09	2.01	100		2.6	153	1.1		0.02	0.99	0.07	1.11	0.08	1.11	0.73
60	3.27	3.72	2.85	3.35	4.06	2.85	3.32	Clayey	1.55	1.24	1.36	5.69	2.00	3.27	10.21	58.11	0.10	0.97	0.17	0.07	0.11	0.7	2.2	1.14	0.02	0.9600	3.19	2.11	78		2.6	632	1.1		0.02	0.99	0.29	1.11	0.32	4.37	2.89
61	3.61	2.08	5.02	3.69	2.26	5.02	3.66	Clayey	1.51	1.23	1.33	3.66	2.00	3.61	16.27	59.48	0.10	0.97	0.16	0.08	0.11	0.7	2.2	1.13	0.02	0.9600	3.14	2.11	100		2.6	359	1.1		0.02	0.99	0.16	1.11	0.18	2.37	1.59
62	3.91	1.02	5.63	3.98	1.10	5.63	3.95	Clayey	1.48	1.22	1.31	2.36	2.00	3.91	22.81	53.85	0.09	0.97	0.16	0.08	0.11	0.7	2.2	1.12	0.02	0.9600	2.89	1.97	100		2.6	178	1.1		0.02	0.99	0.08	1.11	0.09	1.12	0.76
63	3.84	1.16	4.90	3.90	1.25	4.90	3.88	Clayey	1.44	1.20	1.29	2.54	2.00	3.84	21.05	53.46	0.09	0.97	0.16	0.08	0.11	0.7	2.2	1.12	0.02	0.9600	2.80	1.95	100		2.6	204	1.1		0.02	0.99	0.09	1.11	0.10	1.23	0.86
64	3.79	1.25	4.49	3.86	1.34	4.49	3.83	Clayey	1.41	1.19	1.27	2.66	2.00	3.79	20.06	53.30	0.09	0.97	0.16	0.08	0.11	0.7	2.2	1.11	0.02	0.9600	2.73	1.93	100		2.6	223	1.1		0.02	0.99	0.09	1.11	0.10	1.29	0.91
65	3.68	1.51	3.68	3.74	1.61	3.68	3.72	Clayey	1.38	1.18	1.26	2.97	2.00	3.68	17.68	52.50	0.09	0.96	0.15	0.08	0.11	0.7	2.2	1.10	0.02	0.9600	2.64	1.90	100		2.6	272	1.1		0.02	0.99	0.11	1.11	0.12	1.51	1.09
66	3.72	1.43	3.84	3.77	1.52	3.84	3.75	Clayey	1.35	1.16	1.24	2.88	2.00	3.72	18.39	52.98	0.09	0.96	0.15	0.08	0.11	0.7	2.2	1.10	0.02	0.9600	2.59	1.89	100	97.9	2.6	260	1.1		0.02	0.99	0.11	1.11	0.12	1.40	1.02
67	3.70	1.57	4.15	3.75	1.67	4.15	3.73	Clayey	1.33	1.15	1.22	3.05	2.00	3.70	18.05	55.07	0.10	0.96	0.15	0.09	0.11	0.7	2.2	1.09	0.02	0.9600	2.58	1.92	100		2.6	289	1.1		0.02	0.99	0.11	1.11	0.13	1.50	1.11
68	3.57	1.96	3.30	3.62	2.07	3.30	3.60	Clayey	1.30	1.14	1.20	3.49	2.00	3.57	15.45	53.97	0.09	0.96	0.15	0.09	0.11	0.7	2.2	1.08	0.02	0.9600	2.51	1.90	100		2.6	364	1.1		0.02	0.99	0.14	1.11	0.16	1.82	1.37
69	3.59	1.79	2.99	3.64	1.88	2.99	3.62	Clayey	1.28	1.13	1.19	3.30	2.00	3.59	15.81	52.10	0.09	0.96	0.14	0.09	0.11	0.7	2.2	1.08	0.02	0.9600	2.42	1.86	100	96.9	2.6	334	1.1		0.02	0.99	0.13	1.11	0.14	1.62	1.25
70	3.55	1.92	2.75	3.59	2.01	2.75	3.58	Clayey	1.25	1.12	1.17	3.44	2.00	3.55	15.02	51.74	0.09	0.96	0.14	0.09	0.11	0.7	2.2	1.07	0.02	0.9600	2.37	1.86	100		2.6	363	1.1		0.02	0.99	0.14	1.11	0.15	1.70	1.33
71	3.51	2.18	2.89	3.55	2.27	2.89	3.54	Clayey	1.23	1.11	1.16	3.73	2.00	3.51	14.36	53.55	0.09	0.96	0.14	0.09	0.11	0.7	2.2	1.06	0.02	0.9600	2.36	1.89	100		2.6	416	1.1		0.02	0.99	0.15	1.11	0.17	1.89	1.51
72	3.58	1.83	2.84	3.62	1.90	2.84	3.60	Clayey	1.21	1.10	1.14	3.34	2.00	3.58	15.63	52.23	0.09	0.95	0.13	0.09	0.11	0.7	2.2	1.06	0.02	0.9600	2.30	1.87	100		2.6	352	1.1		0.02	0.99	0.13	1.11	0.14	1.55	1.27
73	3.54	1.82	2.27	3.58	1.88	2.27	3.56	Clayey	1.19	1.09	1.13	3.33	2.00	3.54	14.89	49.54	0.08	0.95	0.13	0.09	0.11	0.7	2.2	1.05	0.02	0.9600	2.01	1.67	100		2.6	353	1.1		0.02	0.99	0.12	1.11	0.14	1.51	1.26
74	3.54	1.82	2.24	3.57	1.88	2.24	3.56	Clayey	1.16	1.08	1.11	3.33	2.00	3.54	14.88	49.60	0.08	0.95	0.13	0.09	0.11	0.7	2.2	1.05	0.02	0.9600	1.98	1.68	100		2.6	358	1.1		0.02	0.99	0.12	1.11	0.14	1.49	1.26
75	3.50	2.11	2.39	3.53	2.17	2.39	3.52	Clayey	1.14	1.07	1.10	3.64	2.00	3.50	14.12	51.42	0.09	0.95	0.13	0.09	0.11	0.7	2.2	1.04	0.02	0.9600	2.18	1.89	100		2.6	418	1.1		0.02	0.99	0.14	1.11	0.16	1.69	1.47
76	3.44	2.35	2.13	3.46	2.41	2.13	3.46	Clayey	1.12	1.06	1.09	3.89	2.00	3.44	13.04	50.71	0.09	0.95	0.12	0.09	0.11	0.7	2.2	1.04	0.02	0.9600	2.14	1.89	93		2.6	469	1.1		0.02	0.99	0.16	1.11	0.17	1.85	1.64
77	3.45	2.31	2.15	3.47	2.36	2.15	3.46	Clayey	1.10	1.05	1.07	3.84	2.00	3.45	13.23	50.85	0.09	0.94	0.12	0.10	0.11	0.7	2.2	1.03	0.02	0.9600	2.11	1.91	94		2.6	466	1.1		0.02	0.99	0.15	1.11	0.17	1.79	1.62
78	3.44	2.52	2.35	3.46	2.56	2.35	3.45	Clayey	1.09	1.04	1.06	4.05	2.00	3.44	13.03	52.77	0.09	0.94	0.12	0.10	0.10	0.7	2.2	1.03	0.02	0.9600	2.12	1.95	93		2.6	511	1.1		0.02	0.99	0.17	1.11	0.18	1.92	1.77
79	3.44	2.65	2.58	3.46	2.69	2.58	3.45	Clayey	1.07	1.03	1.05	4.18	2.00	3.44	13.06	54.63	0.10	0.94	0.12	0.10	0.10	0.7	2.2	1.02	0.02	0.9600	2.12	2.00	94		2.6	543	1.1		0.02	0.99	0.17	1.11	0.19	1.99	1.88
80	2.95	13.91	4.04	2.96	14.05	4.04	2.95	Clayey	1.05	1.03	1.04	15.71	2.00	2.95	6.20	97.40	0.17	0.94	0.11	0.10	0.10	0.7	2.2	1.02	0.02	0.9600	3.66	3.54	55		2.6	2870	1.1		0.02	0.99	0.90	1.11	1.00	10.29	9.93
81	3.09	11.33	5.18	3.09	11.40	5.18	3.09	Clayey	1.03	1.02	1.02	12.98	2.00	3.09	7.79	101.14	0.18	0.93	0.11	0.10	0.10	0.7	2.2	1.01	0.02	0.9600	3.85	3.80	65		2.6	2356	1.1		0.02	0.99	0.73	1.11	0.81	8.26	8.16
82	2.05	75.20	1.17	2.05	75.45	1.17	2.05	Granular	1.02	1.01	1.01	76.66	7.00	2.05	1.37	104.92	0.19	0.93	0.11	0.10	0.10	0.7	2.2	1.01	0.02	0.9675	4.08	4.13	14		2.6	15779	1.1		0.02	0.99	4.78	1.11	5.32	54.11	54.76

CPTU-611 Liquefaction Analysis

ConeTec Inc. - CPT Interpretation

Interpretation Output - Release	1.22 Rev. A - Format:	NLI	Imperial	
Run No:	06-0718-0954-2839			
Job No:	02-100			
Client:	MACTEC Engineering and Consulting Inc.			
Project:	Former Callahan Mine Site, Brooksville, ME			
Site:	CP-611			
Location:	Callahan Mine			
Cone:	20 Ton AD179			
CPT Date:	06/28/06			
CPT Time:	07:59			
CPT File:	758CP611.COR			
Northing (m):	0			
Easting (m):	0			
Elevation (m):	0		71.5	Elevation For CPT Triggering analysis
Water Table (m):	4.88	(ft):	16	16 Water Table assumed for CPT Analysis
Unit Weight of Water (default):	62.4 pcf			
Averaging Increment (m):	0.2			
Phi Method :	Robertson and Campanella, 1983			
Su Nkt used:	15	Su/P' (nc):	0.3	0.11 Base acceleration
Dr Method :	Jamiolkowski - All Sands			
State Parameter M:	1.2			

Used Unit Weights Assigned to Soil Zones
N160Ic Calculated using qc1n

1) CSR = $0.65*(a_{max}/g)*(s_v/s'_v)*r_d$ — Seed & Idriss, 1983, p. 459

a_{max}/g = 0.11 g — USGS (base)(amplified from base as discussed in
s_v = computed — Total Vertical Stress
s'_v = computed — Effective Vertical Stress

$r_d = [1.0 - 0.4113z^{0.5} + 0.04052z + 0.001753z^{1.5}] / [1 - 0.4177z^{0.5} + 0.05729z - 0.$

z = depth in meters

2) FS = Factor of safety against triggering of liquefaction: $FS = (CRR_{7.5}/CSR) \times MSF \times Ks \times Ka$

MSF = magnitude scaling factor; Assume based on range recommended by NCEER Wo

CPTU-611 Liquefaction Analysis

$Ks = (s'_{vo}/P_a)^{(f-1)}$, where f = 0.7 to 0.8 for relative density of 40 to 60%; f = 0.6 to 0.7 fo

1 Atmosphere = 14.7 psi = 2.12 ksf

Conetec Data

Col-01 Depth (m)	Col-02 Depth (ft)	Col-03 Elev. (m)	Col-04 Elev. (ft)	Col-05 qc (tsf)	Col-06 qt (tsf)	Col-07 fs (tsf)	Col-08 Rf (%)	Col-09 u (ft)	Col-10 SBT (Zone)	Col-11 SBTn (Zone)	Col-12 SBT-BQ (Zone)	Col-13 SBT-BQn (Zone)	Col-14 Perm-k (cm/s)	Col-15 Unit Wt (pcf)	Col-16 T Stress (tsf)	Col-17 U Stress (tsf)	Col-18 E Stress (tsf)	Col-19 Cn	Col-20 N60 (b/ft)	Col-21 N1(60) (b/ft)	Col-22 N(60)Ic (b/ft)	Col-23 N1(60)Ic (b/ft)	Col-24 Qt	Col-25 Fr (%)	Col-26 Bq	Col-27 Ic	Col-28 FC (%)	Col-29 IcZone (Zone)	Col-30 Dr (%)	Col-31 Phi (deg)	Col-32 State Par	Col-33 Es/qt	Col-34 YoungE (tsf)	Col-35 Su (tsf)	Col-36 OCR	Col-37 U (psf)	Col-38 s_{vo} (psf)	Col-39 q_c (psf)	Col-40 q_t (psf)	Col-41 P_a (psf)	Col-42 σ'_{vo} (psf)	Col-43 f_s (psf)	Col-44 $Q_{exp=1}$	Col-45 F
0.1	0.328	-0.1	71.2	7.44	7.44	0.05	0.71	-0.3	1	6	5	7	1.00E-07	111.4	0.018	0	0.018	1.7	3.6	6.1	1.9	3.3	406.24	0.71	0	2.62	36.1	4	-9999	-9999	-9999	-9999	-9999	0.495	10	0	36	14880	14880	2116	36	100	412.33	0.67
0.3	0.984	-0.3	70.5	12.25	12.25	0.1	0.84	-0.59	6	6	6	7	5.00E-05	114.6	0.055	0	0.055	1.7	4.7	8	3	5	220.29	0.84	0	2.45	28.7	5	47.9	46	-0.25	-9999	-9999	0.813	10	0	110	24500	24500	2116	110	200	221.73	0.82
0.5	1.64	-0.5	69.9	9.1	9.1	0.15	1.6	-1.21	5	5	5	6	5.00E-06	114.6	0.093	0	0.093	1.7	4.4	7.4	2.5	4.2	96.91	1.61	0	2.71	40.8	4	-9999	-9999	-9999	-9999	-9999	0.6	10	0	186	18200	18200	2116	186	300	96.85	1.67
0.7	2.297	-0.7	69.2	4.55	4.61	0.08	1.69	11.7	1	5	4	5	1.00E-07	111.4	0.13	0	0.13	1.7	2.2	3.7	1.5	2.5	34.43	1.74	0.08	2.98	57	3	-9999	-9999	-9999	-9999	-9999	0.298	10	0	260	9100	9220	2116	260	160	34.46	1.79
0.9	2.953	-0.9	68.5	6.42	6.39	0.09	1.41	-6.53	1	5	5	5	1.00E-07	111.4	0.167	0	0.167	1.7	3.1	5.2	1.9	3.2	37.38	1.45	-0.03	2.81	46.9	4	-9999	-9999	-9999	-9999	-9999	0.415	10	0	334	12840	12780	2116	334	180	37.26	1.45
1.1	3.609	-1.1	67.9	7.3	7.28	0.07	1	-3.96	1	5	5	6	1.00E-07	111.4	0.203	0	0.203	1.7	3.5	5.9	2	3.4	34.84	1.03	-0.02	2.69	40.1	4	-9999	-9999	-9999	-9999	-9999	0.472	10	0	406	14600	14560	2116	406	140	34.86	0.99
1.3	4.265	-1.3	67.2	9.17	9.17	0.08	0.82	0.71	5	5	5	6	5.00E-06	114.6	0.24	0	0.24	1.7	4.4	7.5	2.3	4	37.18	0.84	0	2.57	33.7	5	-9999	-9999	-9999	-9999	-9999	0.595	10	0	480	18340	18340	2116	480	160	37.21	0.90
1.5	4.921	-1.5	66.6	3.8	3.84	0.08	2.02	8.45	3	4	3	4	5.00E-08	111.4	0.277	0	0.277	1.7	3.7	6.2	1.1	3.9	12.85	2.18	0.07	2.83	47.7	4	-9999	-9999	-9999	-9999	-9999	0.237	3.6	0	554	7600	7680	2116	554	160	12.86	2.25
1.7	5.577	-1.7	65.9	2.51	2.56	0.04	1.37	11.57	1	3	3	3	1.00E-07	111.4	0.314	0	0.314	1.7	1.2	2.1	0.8	2.4	7.17	1.56	0.16	2.97	56.6	3	-9999	-9999	-9999	-9999	-9999	0.15	1.6	0	628	5020	5120	2116	628	80	7.15	1.78
1.9	6.234	-1.9	65.3	1.41	1.53	0.01	0.82	25.98	1	3	3	3	1.00E-07	111.4	0.35	0	0.35	1.69	0.7	1.2	0.6	1.3	3.36	1.06	0.69	3.2	72.8	3	-9999	-9999	-9999	-9999	-9999	0.078	0.8	0	700	2820	3060	2116	700	20	3.37	0.85
2.1	6.89	-2.1	64.6	1.25	1.39	0.02	1.45	29.87	1	3	1	3	1.00E-07	111.4	0.387	0	0.387	1.61	0.7	1.1	0.6	1.2	2.58	2.01	0.93	3.42	91.2	3	-9999	-9999	-9999	-9999	-9999	0.067	0.7	0	774	2500	2780	2116	774	40	2.59	1.99
2.3	7.546	-2.3	64.0	1.53	1.68	0.02	1.19	31.41	1	3	3	3	1.00E-07	111.4	0.423	0	0.423	1.54	0.8	1.2	0.7	1.3	2.96	1.6	0.78	3.32	82.7	3	-9999	-9999	-9999	-9999	-9999	0.084	0.7	0	846	3060	3360	2116	846	40	2.97	1.59
2.5	8.202	-2.5	63.3	1.9	2.01	0.04	1.75	22.97	1	3	3	3	1.00E-07	111.4	0.46	0	0.46	1.47	1	1.4	0.8	1.4	3.37	2.26	0.46	3.34	84.2	3	-9999	-9999	-9999	-9999	-9999	0.103	0.8	0	920	3800	4020	2116	920	80	3.37	2.58
2.7	8.858	-2.7	62.6	1.29	1.46	0.02	1.54	35.79	1	3	1	1	1.00E-07	111.4	0.497	0	0.497	1.42	0.7	1	0.7	1	1.94	2.34	1.16	3.56	100	3	-9999	-9999	-9999	-9999	-9999	0.064	0.6	0	994	2580	2920	2116	994	40	1.94	2.08
2.9	9.514	-2.9	62.0	2.48	2.58	0.06	2.43	22.02	3	3	3	3	5.00E-08	111.4	0.533	0	0.533	1.37	2.5	3.4	1.1	1.7	3.84	3.06	0.34	3.35	85.5	3	-9999	-9999	-9999	-9999	-9999	0.136	0.9	0	1066	4960	5160	2116	1066	120	3.84	2.93
3.1	10.17	-3.1	61.3	1.13	1.29	0.04	2.91	34.95	2	2	-9999	-9999	1.00E-15	79.5	0.564	0	0.564	1.33	1.2	1.6	0.9	1	1.29	5.17	1.5	3.88	100	2	-9999	-9999	-9999	-9999	-9999	0.048	0.5	0	1128	2260	2580	2116	1128	80	1.29	5.51
3.3	10.827	-3.3	60.7	1.09	1.27	0.03	2.37	38.31	1	2	-9999	-9999	1.00E-07	111.4	0.596	0	0.596	1.3	0.6	0.8	0.9	0.9	1.13	4.46	1.77	3.89	100	2	-9999	-9999	-9999	-9999	-9999	0.045	0.5	0	1192	2180	2540	2116	1192	60	1.13	4.45
3.5	11.483	-3.5	60.0	1.77	1.91	0.05	2.36	30.26	1	3	3	3	1.00E-07	111.4	0.632	0	0.632	1.26	0.9	1.2	1	1.1	2.03	3.52	0.74	3.62	100	2	-9999	-9999	-9999	-9999	-9999	0.085	0.6	0	1264	3540	3820	2116	1264	100	2.02	3.91
3.7	12.139	-3.7	59.4	6.09	6.19	0.08	1.34	22.01	1	4	4	4	1.00E-07	111.4	0.669	0	0.669	1.22	3	3.6	1.9	2.6	8.26	1.5	0.12	2.91	52.6	4	-9999	-9999	-9999	-9999	-9999	0.368	2	0	1338	12180	12380	2116	1338	160	8.25	1.45
3.9	12.795	-3.9	58.7	3.27	3.32	0.1	2.94	11.06	3	3	3	3	5.00E-08	111.4	0.705	0	0.705	1.19	3.2	3.8	1.4	1.7	3.71	3.73	0.13	3.41	90.5	3	-9999	-9999	-9999	-9999	-9999	0.175	0.8	0	1410	6540	6640	2116	1410	200	3.71	3.82
4.1	13.451	-4.1	58.0	2.7	2.86	0.07	2.37	34.33	3	3	3	3	5.00E-08	111.4	0.742	0	0.742	1.16	2.7	3.2	1.3	1.4	2.85	3.19	0.51	3.47	96.4	3	-9999	-9999	-9999	-9999	-9999	0.141	0.7	0	1484	5400	5720	2116	1484	140	2.85	3.31
4.3	14.107	-4.3	57.4	3.51	3.62	0.08	2.14	23.28	3	3	3	3	5.00E-08	111.4	0.778	0	0.778	1.13	3.5	3.9	1.5	1.6	3.65	2.73	0.26	3.35	85	3	-9999	-9999	-9999	-9999	-9999	0.19	0.8	0	1556	7020	7240	2116	1556	160	3.65	2.81
4.5	14.764	-4.5	56.7	2.25	2.41	0.08	3.12	33.52	3	2	3	3	5.00E-08	111.4	0.815	0	0.815	1.11	2.3	2.6	1.4	1.2	1.96	4.71	0.66	3.7	100	2	-9999	-9999	-9999	-9999	-9999	0.106	0.6	0	1630	4500	4820	2116	1630	160	1.96	5.02
4.7	15.42	-4.7	56.1	1.5	1.73	0.05	2.9	48.43	3	2	-9999	-9999	5.00E-08	111.4	0.852	0	0.852	1.08	1.7	1.8	1.5	0.9	1.03	5.72	1.72	3.98	100	2	-9999	-9999	-9999	-9999	-9999	0.058	0.5	0	1704	3000	3460	2116	1704	100	1.03	5.69
4.9	16.076	-4.9	55.4	1.92	2.08	0.09	4.09	35.43	3	2	3	1	5.00E-08	111.4	0.888	0.002	0.886	1.06	2	2.1	1.6	1.1	1.35	7.13	0.92	3.93	100	2	-9999	-9999	-9999	-9999	-9999	0.08	0.5	5	1776	3840	4160	2116	1771	180	1.35	7.55
5.1	16.732	-5.1	54.8	2.06	2.3	0.04	1.85	50.95	1	2	1	1	1.00E-07	111.4	0.925	0.023	0.902	1.05	1.1	1.2	1.3	0.9	1.52	3.1	1.14	3.71	100	2	-9999	-9999	-9999	-9999	-9999	0.092	0.5	46	1850	4120	4600	2116	1804	80	1.52	2.91
5.3	17.388	-5.3	54.1	2	2.28	0.04	1.76	59.73	1	2	1	1	1.00E-07	111.4	0.961	0.043	0.918	1.04	1.1	1.1	1.4	0.9	1.43	3.05	1.38	3.73	100	2	-9999	-9999	-9999	-9999	-9999	0.088	0.5	87	1922	4000	4560	2116	1835	80	1.44	3.03
5.5	18.044	-5.5	53.5	2.33	2.63	0.05	1.72	63.59	1	3	1	1	1.00E-07	111.4	0.998	0.064	0.934	1.03	1.3	1.3	1.4	1	1.75	2.77	1.18	3.63	100	2	-9999	-9999	-9999	-9999	-9999	0.109	0.6	128	1996	4660	5260	2116	1868	100	1.75	3.06
5.7	18.701	-5.7	52.8	2.8	3.08	0.06	1.95	61.24	1	3	3	3	1.00E-07	111.4	1.034	0.084	0.95	1.03	1.5	1.5	1.5	1.1	2.16	2.93	0.89	3.56	100	3	-9999	-9999	-9999	-9999	-9999	0.137	0.6	169	2068	5600	6160	2116	1899	120	2.15	2.93
5.9	19.357	-5.9	52.1	4.01	4.27	0.07	1.7	55.31	1	3	3	3	1.00E-07	111.4	1.071	0.105	0.966	1.02	2	2.1	1.8	1.4	3.31	2.27	0.51	3.34	84.9	3	-9999	-9999	-9999	-9999	-9999	0.213	0.8	209	2142	8020	8540	2116	1933	140	3.31	2.19
6.1	20.013	-6.1	51.5	3.13	3.46	0.07	2.1	71.05	3	3	3	3	5.00E-08	111.4	1.107	0.125	0.982	1.01	3.3	3.3	1.7	1.2	2.4	3.09	0.89	3.53	100	3	-9999	-9999	-9999	-9999	-9999	0.157	0.6	250	2214	6260	6920	2116	1964	140	2.40	2.97
6.3	20.669	-6.3	50.8	9.29	9.44	0.14	1.43	31.67	5	4	5	4	5.00E-06	114.6	1.144	0.146	0.999	1	4.5	4.5	2.9	2.7	8.31	1.63	0.1	2.93	53.6	4	-9999	-9999	-9999	-9999	-9999	0.553	2	291	2288	18580	18880	2116	1997	280	8.31	1.69
6.5	21.325	-6.5	50.2	10.3	10.39	0.19	1.83	20.22	5	3	5	4	5.00E-06	114.6	1.182	0.166	1.016	0.99	5	4.9	3.3	3	9.07	2.07	0.05	2.94	54.8	4	-9999	-9999	-9999	-9999	-9999	0.614	2.2	332	2364	20600	20780	2116	2032	380	9.06	2.06
6.7	21.981	-6.7	49.5	9.23	9.4	0.22	2.37	36.57	5	3	4	4	5.00E-06	114.6	1.22	0.187	1.033	0.98	4.5	4.4	3.2	2.8	7.92	2.73	0.12	3.06	62.5	3	-9999	-9999	-9999	-9999	-9999	0.545	1.9	373	2440	18460	18800	2116	2067	440	7.92	2.69
6.9	22.638	-6.9	48.9	7.06	7.21	0.16	2.19	32.66	4	3	4	3	5.00E-07	114.6	1.257	0.207	1.05	0.98	4.6	4.5	2.6	2.2	5.67	2.65	0.14	3.17	71	3	-9999	-9999	-9999	-9999	-9999	0.397	1.3	414	2514	14120	14420	2116	2100	320	5.67	2.69
7.1	23.294	-7.1	48.2	3.51	3.84	0.07	1.76	69.11	1	3	3	3	1.00E-07	111.4	1.294	0.228	1.067	0.97	1.8	1.8	1.8	1.2	2.38	2.66	0.76	3.5	100	3	-9999	-9999	-9999	-9999	-9999	0.17	0.6	455	2588	7020	7680	2116	2133	140	2.39	2.75
7.3	23.95	-7.3	47.6	4.04	4.37	0.07	1.6	71.18	1	3	3	3	1.00E-07	111.4	1.331	0.248	1.083	0.96	2.1	2	1.9	1.3	2.81	2.31	0.65	3.41	90.7	3	-9999	-9999	-9999	-9999	-9999	0.203	0.7	496	2662	8080	8740	2116	2166	140	2.81	2.30
7.5	24.606	-7.5	46.9	3.96	4.28	0.07	1.64	69.46	1	3	3	3	1.00E-07	111.4	1.367	0.269	1.099	0.95	2.1	2	1.9	1.2	2.66	2.41	0.65	3.44	93.4	3	-9999	-9999	-9999	-9999	-9999	0.195	0.7	537	2734	7920	8560	2116	2197	140	2.65	2.40
7.7	25.262	-7.7	46.2	4.24	4.58	0.07	1.53	72.78	1	3	3	3	1.00E-07	111.4	1.404	0.289	1.115	0.95	2.2	2.1	2	1.3	2.85	2.21	0.63	3.4	89.5	3	-9999	-9999	-9999	-9999	-9999	0.211	0.7	578	2808	8480	9160	2116	2230	140	2.85	2.20
7.9	25.918	-7.9	45.6	3.64	3.99	0.09	2.32	74.52	3	3	3	3	5.00E-08	111.4	1.44	0.31	1.131	0.94	3.8	3.6	2	1.2	2.25	3.64	0.79	3.59	100	3	-9999	-9999	-9999	-9999	-9999	0.17	0.6	619	2880	7280	7980	2116	2261	180	2.26	3.53
8.1	26.574	-8.1	44.9	3.93	4.3	0.08	1.86	80.6	1	3	3	3	1.00E-07	111.4	1.477	0.33	1.147	0.93	2.1	1.9	2	1.2	2.47	2.84	0.77	3.5	100	3	-9999	-9999	-9999	-9999	-9999	0.188	0.7	660	2954	7860	8600	2116	2294	160	2.46	2.83
8.3	27.231	-8.3	44.3	4.24	4.63	0.07	1.41	85.14	1	3	3	3	1.00E-07	111.4	1.514	0.351	1.163	0.93	2.2	2.1	2	1.2	2.68	2.09	0.74	3.41	90.5	3	-9999	-9999	-9999	-9999	-9999	0.208	0.7	701	3028	8480	9260	2116	2327	140	2.68	2.25
8.5	27.887	-8.5	43.6	4.06	4.48	0.06	1.4	89.87	1	3	3	3	1.00E-07	111.4	1.55	0.371	1.179	0.92	2.1	2	2	1.2	2.48	2.14	0.83	3.44	93.7	3	-9999	-9999	-9999	-9999	-9999	0.195	0.7	742	3610	8120	8960	2116	2358	120	2.48	2.05
8.7	28.543	-8.7	43.0	5.19	5.56	0.13	2.34	80.25	4	3	3	3	5.00E-07	114.6	1.587	0.392	1.196	0.91	3.6	3.2	2.4	1.5	3.33	3.28	0.53	3.42	91.6	3	-9999	-9999	-9999	-9999	-9999	0.265	0.8	783	3174	10380	11120	2116	2391	260	3.32	3.27
8.9	29.199	-8.9	42.3	5.75	6.14	0.15	2.45	83.03	4	3	3	3	5.00E-07	114.6	1.625	0.412	1.213	0.91	3.9	3.6	2.6	1.7	3.72	3.33	0.48	3.38	88.2	3	-9999	-9999	-9999	-9999	-9999	0.301	0.9	824	3250	11500	12280	2116	2426	300	3.72	3.32
9.1	29.855	-9.1	41.6	5.35	5.78	0.11	1.82	91.71	4	3	3	3	5.00E-07	114.6	1.662	0.433	1.23	0.9	3.7	3.3	2.4	1.5	3.35	2.56	0.59	3.36	86.6	3	-9999	-9999	-9999	-9999	-9999	0.275	0.8	865	3324	10700	11560	2116	2459	220	3.35	2.67
9.3	30.511	-9.3	41.0	4.17	4.64	0.07	1.51	100.47	1	3	3	3	1.00E-07	111.4	1.699	0.453	1.246	0.9	2.2	2	2.2	1.1	2.36	2.39	0.91	3.49	97.5	3	-9999	-9999	-9999	-9999	-9999	0.196	0.6	905	3398	8340	9280	2116	2493	140	2.36	2.38
9.5	31.168	-9.5	40.3	4.12	4.62	0.05	1.14	107.69	1	3	3	3	1.00E-07	111.4	1.736	0.474	1.262	0.89	2.2	2	2.1	1.1	2.29	1.82	1	3.44	93.8	3	-9999	-9999	-9999	-9999	-9999	0.193	0.6	946	3472	8240	9240	2116	2526	100	2.28	1.73
9.7	31.824	-9.7	39.7	4.15	4.66	0.05	1.13	109.39	1	3	3	3	1.00E-07	111.4	1.773	0.494	1.278	0.88	2.2	2	2.1	1.1	2.26	1.82	1.01	3.45	94.2	3	-9999	-9999	-9999	-9999	-9999	0.193	0.6	987	3546	8300	9320	2116	2559	100	2.26	1.73
9.9	32.48	-9.9	39.0	4.62	5.11	0.08	1.52	106.42	1	3	3	3	1.00E-07	111.4	1.809	0.515	1.295	0.88	2.4	2.2	2.3	1.2	2.55	2.35	0.85	3.45	94.4	3	-9999	-9999	-9999	-9999	-9999	0.22	0.7	1028	3618	9240	10220	2116	2590	160	2.55	2.42
10.1	33.136	-10.1	38.4	4.87	5.38	0.07	1.21	108.5	1	3	3	3	1.00E-07	111.4	1.846	0.535	1.311	0.87	2.6	2.2	2.3	1.2	2.69	1.84	0.81	3.38	88.2	3	-9999	-9999	-9999	-9999	-9999	0.235	0.7	1069	3692	9740	10760	2116	2623	140	2.69	1.98
10.3	33.792	-10.3	37.7	4.73	5.28	0.06	1.14	117.31	1	3	3	3	1.00E-07	111.4	1.882	0.556	1.327	0.87	2.5	2.2	2.3	1.2	2.56	1.77	0.91	3.4	89.3	3	-9999	-9999	-9999	-9999	-9999	0.226	0.7	1110	3764	9460	10560	2116	2654	120	2.56	1.77
10.5	34.448	-10.5	37.1	7.39	7.81	0.15	1.89	89.51	5	3	3	3	5.00E-06	114.6	1.919	0.576	1.343	0.86	3.7	3.2	3	1.8	4.39	2.51	0.38	3.26	77.7	3	-9999	-9999	-9999	-9999	-9999	0.393	1	1151	3838	14780	15620	2116	2687	300	4.39	2.55
10.7	35.105	-10.7	36.4	26.6	26.88	0.85	3.17	58.05	5	4	6	5	5.00E-06	114.6	1.957	0.596	1.36	0.86	12.9	11	7.8	5.6	18.32	3.42	0.05	2.82	47.1	4	-9999	-9999	-9999	-9999	-9999	1.661	6.2	1192	3914	53200	53760	2116	2722	1700	18.31	3.41
10.9	35.761	-10.9	35.7	81.59	81.6	1.33	1.62	0.73	7	5	9	6	5.00E-04	117.7	1.995	0.617	1.378	0.85	26	22.2	17.5	15.2	57.77	1.67	-0.01	2.18	18.4	5	56.2	40	-0.18	2.643	215.6	-9999	-9999	1233	3990	163180	163200	2116	2757	2660	57.75	1.67
11.1	36.417	-11.1	35.1	65.75	65.64	1.67	2.55	-22.62	6	5	8	6	5.00E-05	114.6	2.033	0.637	1.396	0.85	25.1	21.3	15.4	13.3	45.58	2.63	-0.02	2.39	25.9	5	49.8	38	-0.22	2.955	194	4.241	10	1274	4066	131500	131280	2116	2792	3340	45.56	2.63
11.3	37.073	-11.3	34.4	214.37	214.24	2.02	0.95	-29.37	9	6	9	6	5.00E-02	124.1	2.072	0.658	1.414	0.84	41	34.5	38.5	33.1	150.02	0.95	-0.01	1.71	6.4	6	83.5	44	-0.22	1.944	416.4	-9999	-9999	1315	4144	428740	428480	2116	2829	4040	149.99	0.95
11.5	37.729	-11.5	33.8	56.41	56.27	1.84	3.28	-29.79	6	4	8	6	5.00E-05	114.6	2.111	0.678	1.433	0.84	21.6

CPTU-611 Liquefaction Analysis

text

[006205z^1.5 + 0.001210z^2]

Youd and Idriss, 2001

rkshop, reiterated in Youd and Idriss, 2001

CPTU-611 Liquefaction Analysis

rel density of 60 to 80%; P_a = pressure at 1 atmosphere   Youd and Idriss, 2001

Youd & Idriss, 2001 CPT Based Analysis

Row	Col-46 $I_{c\ Qexp=1}$	Col-47 $Q_{exp=0.5}$	Col-48 F	Col-49 $I_{c\ Qexp=0.5}$	Col-50 $Q_{exp=0.7}$	Col-51 F	Col-52 $I_{c\ Qexp=0.7}$	Col-53 Description	Col-54 C_q n=1.0	Col-55 C_q n=0.5	Col-56 C_q n=0.7	Col-57 q_{c1N}	Col-57a Lookup Col	Col-58 Ic
40	1.35	53.78	0.67	2.03	121.47	0.67	1.74	**Granular**	58.78	7.67	17.32	53.91	2.00	2.03
41	1.60	50.55	0.82	2.10	91.32	0.82	1.89	**Granular**	19.24	4.39	7.92	50.78	2.00	2.10
42	2.07	28.71	1.67	2.48	46.70	1.67	2.31	**Granular**	11.38	3.37	5.49	29.01	2.00	2.48
43	2.43	12.08	1.79	2.81	18.37	1.79	2.65	**Very Silty**	8.14	2.85	4.34	18.91	2.00	2.65
44	2.35	14.80	1.45	2.68	21.42	1.45	2.55	**Very Silty**	6.34	2.52	3.64	21.99	2.00	2.55
45	2.28	15.27	0.99	2.59	21.24	0.99	2.46	**Granular**	5.21	2.28	3.18	15.71	2.00	2.59
46	2.23	17.72	0.90	2.51	23.84	0.90	2.40	**Granular**	4.41	2.10	2.82	18.20	2.00	2.51
47	2.84	6.58	2.25	3.08	8.60	2.25	2.98	**Clayey**	3.82	1.95	2.56	13.86	2.00	2.84
48	3.00	3.90	1.78	3.23	4.97	1.78	3.14	**Clayey**	3.37	1.84	2.34	8.15	2.00	3.00
49	3.16	1.94	0.85	3.38	2.42	0.85	3.29	**Clayey**	3.02	1.74	2.17	4.37	2.00	3.16
50	3.41	1.57	1.99	3.61	1.92	1.99	3.53	**Clayey**	2.73	1.65	2.02	3.59	2.00	3.41
51	3.32	1.88	1.59	3.50	2.26	1.59	3.43	**Clayey**	2.50	1.58	1.90	3.97	2.00	3.32
52	3.36	2.22	2.58	3.52	2.62	2.58	3.46	**Clayey**	2.30	1.52	1.79	4.37	2.00	3.36
53	3.53	1.33	2.08	3.68	1.54	2.08	3.62	**Clayey**	2.13	1.46	1.70	2.94	2.00	3.53
54	3.34	2.73	2.93	3.47	3.13	2.93	3.42	**Clayey**	1.98	1.41	1.62	4.84	2.00	3.34
55	3.89	0.94	5.51	4.01	1.07	5.51	3.96	**Clayey**	1.88	1.37	1.55	2.29	2.00	3.89
56	3.89	0.85	4.45	4.00	0.95	4.45	3.96	**Clayey**	1.78	1.33	1.49	2.13	2.00	3.89
57	3.65	1.56	3.91	3.74	1.73	3.91	3.70	**Clayey**	1.67	1.29	1.43	3.02	2.00	3.65
58	2.90	6.56	1.45	2.99	7.19	1.45	2.96	**Clayey**	1.58	1.26	1.38	9.25	2.00	2.90
59	3.42	3.03	3.82	3.49	3.28	3.82	3.46	**Clayey**	1.50	1.23	1.33	4.71	2.00	3.42
60	3.48	2.39	3.31	3.55	2.57	3.31	3.52	**Clayey**	1.43	1.19	1.28	3.85	2.00	3.48
61	3.35	3.13	2.81	3.41	3.33	2.81	3.39	**Clayey**	1.36	1.17	1.24	4.65	2.00	3.35
62	3.71	1.72	5.02	3.76	1.81	5.02	3.74	**Clayey**	1.30	1.14	1.20	2.96	2.00	3.71
63	3.98	0.92	5.69	4.02	0.97	5.69	4.01	**Clayey**	1.24	1.11	1.16	2.03	2.00	3.98
64	3.95	1.23	7.55	3.98	1.28	7.55	3.96	**Clayey**	1.19	1.09	1.13	2.35	2.00	3.95
65	3.69	1.41	2.91	3.72	1.45	2.91	3.71	**Clayey**	1.17	1.08	1.12	2.55	2.00	3.69
66	3.72	1.34	3.03	3.75	1.38	3.03	3.74	**Clayey**	1.15	1.07	1.10	2.48	2.00	3.72
67	3.65	1.64	3.06	3.67	1.68	3.06	3.67	**Clayey**	1.13	1.06	1.09	2.82	2.00	3.65
68	3.56	2.04	2.93	3.58	2.09	2.93	3.57	**Clayey**	1.11	1.06	1.08	3.24	2.00	3.56
69	3.34	3.16	2.19	3.35	3.22	2.19	3.35	**Clayey**	1.09	1.05	1.07	4.42	2.00	3.34
70	3.52	2.31	2.97	3.54	2.34	2.97	3.53	**Clayey**	1.08	1.04	1.05	3.52	2.00	3.52
71	2.93	8.07	1.69	2.94	8.17	1.69	2.94	**Clayey**	1.06	1.03	1.04	9.46	2.00	2.93
72	2.94	8.88	2.06	2.95	8.95	2.06	2.95	**Clayey**	1.04	1.02	1.03	10.23	2.00	2.94
73	3.06	7.82	2.69	3.06	7.86	2.69	3.06	**Clayey**	1.02	1.01	1.02	9.10	2.00	3.06
74	3.18	5.65	2.69	3.18	5.66	2.69	3.18	**Clayey**	1.01	1.00	1.01	6.87	2.00	3.18
75	3.51	2.40	2.75	3.51	2.39	2.75	3.51	**Clayey**	0.99	1.00	0.99	3.60	2.00	3.51
76	3.41	2.84	2.30	3.41	2.83	2.30	3.41	**Clayey**	0.98	0.99	0.98	4.04	2.00	3.41
77	3.44	2.70	2.40	3.43	2.68	2.40	3.44	**Clayey**	0.96	0.98	0.97	3.90	2.00	3.44
78	3.40	2.92	2.20	3.39	2.89	2.20	3.39	**Clayey**	0.95	0.97	0.96	4.11	2.00	3.40
79	3.58	2.33	3.53	3.57	2.30	3.53	3.58	**Clayey**	0.94	0.97	0.95	3.53	2.00	3.58
80	3.50	2.56	2.83	3.49	2.52	2.83	3.49	**Clayey**	0.92	0.96	0.94	3.75	2.00	3.50
81	3.42	2.81	2.25	3.41	2.76	2.25	3.41	**Clayey**	0.91	0.95	0.94	3.98	2.00	3.42
82	3.43	2.62	2.05	3.41	2.57	2.05	3.42	**Clayey**	0.90	0.95	0.93	3.80	2.00	3.43
83	3.42	3.53	3.27	3.40	3.45	3.27	3.41	**Clayey**	0.88	0.94	0.92	4.65	2.00	3.42
84	3.38	3.99	3.32	3.36	3.88	3.32	3.37	**Clayey**	0.87	0.93	0.91	5.06	2.00	3.38
85	3.37	3.61	2.67	3.35	3.50	2.67	3.36	**Clayey**	0.86	0.93	0.90	4.70	2.00	3.37
86	3.48	2.56	2.38	3.45	2.48	2.38	3.47	**Clayey**	0.85	0.92	0.89	3.72	2.00	3.48
87	3.44	2.50	1.73	3.40	2.41	1.73	3.42	**Clayey**	0.84	0.92	0.88	3.66	2.00	3.44
88	3.44	2.48	1.73	3.40	2.39	1.73	3.42	**Clayey**	0.83	0.91	0.88	3.64	2.00	3.44
89	3.46	2.82	2.42	3.42	2.71	2.42	3.43	**Clayey**	0.82	0.90	0.87	3.95	2.00	3.46
90	3.40	3.00	1.98	3.36	2.87	1.98	3.37	**Clayey**	0.81	0.90	0.86	4.10	2.00	3.40
91	3.39	2.87	1.77	3.35	2.74	1.77	3.37	**Clayey**	0.80	0.89	0.85	3.98	2.00	3.39
92	3.26	4.94	2.55	3.22	4.71	2.55	3.24	**Clayey**	0.79	0.89	0.85	5.81	2.00	3.26
93	2.82	20.77	3.41	2.78	19.75	3.41	2.79	**Clayey**	0.78	0.88	0.84	19.75	2.00	2.82
94	2.24	65.92	1.67	2.19	62.52	1.67	2.21	**Granular**	0.77	0.88	0.83	67.57	5.00	2.19
95	2.44	52.34	2.63	2.40	49.52	2.63	2.42	**Granular**	0.76	0.87	0.82	54.01	2.00	2.40
96	1.76	173.43	0.95	1.72	163.65	0.95	1.74	**Granular**	0.75	0.86	0.82	175.13	27.00	1.72
97	2.58	43.98	3.40	2.53	41.39	3.40	2.55	**Granular**	0.74	0.86	0.81	45.70	2.00	2.53
98	2.87	16.04	2.82	2.81	15.06	2.82	2.84	**Clayey**	0.73	0.85	0.80	15.18	2.00	2.87
99	2.71	26.66	2.98	2.65	24.97	2.98	2.68	**Clayey**	0.72	0.85	0.80	24.12	2.00	2.71
100	2.63	26.31	2.18	2.58	24.59	2.18	2.60	**Clayey**	0.71	0.84	0.79	23.71	2.00	2.63
101	2.62	28.25	2.27	2.56	26.34	2.27	2.59	**Clayey**	0.70	0.84	0.78	25.22	2.00	2.62

Row	Col-59 Kc	Col-60 $(q_{c1N})_{cs}$	Col-61 CRR7.5	Col-62 rd	Col-63 a_{max}/g = if crest accel 2.0	Col-64 CSR No Amplification	Col-65 CSR if crest accel = 2	Col-66 Rel. Den. Factor f	Col-67 MSF	Col-68 K_σ	Col-69 α 0.02	Col-70 K_α	Col-71 FS liq- CPT (Sand-Like) No Amplification	Col-72 FS liq- CPT (Sand-Like) if crest accel = 2	Col-73 Apparent Fines (%)	Col-74 Measured Fines (%)
40	1.34	72.38	0.12	1.00	0.22	0.07	0.14	0.7	2.2	3.39	0.02	0.9600	11.55	5.80	14	
41	1.45	73.77	0.12	1.00	0.22	0.07	0.14	0.7	2.2	2.43	0.02	0.9600	8.42	4.27	16	
42	2.65	76.74	0.12	1.00	0.21	0.07	0.14	0.7	2.2	2.07	0.02	0.9600	7.49	3.84	30	
43	3.66	69.17	0.11	1.00	0.21	0.07	0.14	0.7	2.2	1.88	0.02	0.9600	6.16	3.19	38	
44	3.01	66.22	0.11	1.00	0.21	0.07	0.14	0.7	2.2	1.74	0.02	0.9600	5.53	2.89	33	
45	3.26	51.22	0.09	0.99	0.21	0.07	0.13	0.7	2.2	1.64	0.02	0.9600	4.51	2.38	35	
46	2.83	51.48	0.09	0.99	0.21	0.07	0.13	0.7	2.2	1.56	0.02	0.9600	4.31	2.30	31	
47	5.10	70.65	0.11	0.99	0.20	0.07	0.13	0.7	2.2	1.49	0.02	0.9600	5.03	2.71	48	
48	6.75	55.04	0.10	0.99	0.20	0.07	0.13	0.7	2.2	1.44	0.02	0.9600	4.11	2.24	59	
49	8.68	37.94	0.07	0.99	0.20	0.07	0.13	0.7	2.2	1.39	0.02	0.9600	3.05	1.68	70	
50	12.56	45.10	0.08	0.99	0.20	0.07	0.13	0.7	2.2	1.35	0.02	0.9600	3.21	1.78	91	
51	10.98	43.62	0.08	0.98	0.20	0.07	0.13	0.7	2.2	1.32	0.02	0.9600	3.08	1.73	83	
52	11.74	51.30	0.09	0.98	0.19	0.07	0.12	0.7	2.2	1.28	0.02	0.9600	3.57	2.03	87	
53	14.73	43.27	0.08	0.98	0.19	0.07	0.12	0.7	2.2	1.25	0.02	0.9600	2.93	1.69	100	
54	11.38	55.11	0.10	0.98	0.19	0.07	0.12	0.7	2.2	1.23	0.02	0.9600	3.54	2.06	85	
55	22.36	51.14	0.09	0.98	0.19	0.07	0.12	0.7	2.2	1.21	0.02	0.9600	3.37	1.98	100	
56	22.44	47.82	0.08	0.98	0.19	0.07	0.12	0.7	2.2	1.19	0.02	0.9600	2.93	1.74	100	
57	16.93	51.17	0.09	0.98	0.18	0.07	0.12	0.7	2.2	1.17	0.02	0.9600	3.27	1.96	100	
58	5.73	52.99	0.09	0.97	0.18	0.07	0.11	0.7	2.2	1.15	0.02	0.9600	3.26	1.98	52	
59	12.59	59.27	0.10	0.97	0.18	0.07	0.11	0.7	2.2	1.13	0.02	0.9600	3.41	2.10	91	
60	13.73	52.91	0.09	0.97	0.18	0.07	0.11	0.7	2.2	1.11	0.02	0.9600	3.17	1.97	97	
61	11.55	53.72	0.09	0.97	0.17	0.07	0.11	0.7	2.2	1.10	0.02	0.9600	3.15	1.99	86	
62	18.33	54.21	0.09	0.97	0.17	0.07	0.11	0.7	2.2	1.08	0.02	0.9600	3.13	1.99	100	
63	24.59	49.93	0.08	0.97	0.17	0.07	0.11	0.7	2.2	1.07	0.02	0.9600	2.71	1.75	100	
64	23.68	55.61	0.10	0.97	0.17	0.07	0.11	0.7	2.2	1.05	0.02	0.9600	3.09	2.02	100	
65	17.90	45.64	0.08	0.96	0.17	0.07	0.11	0.7	2.2	1.05	0.02	0.9600	2.50	1.65	100	
66	18.56	46.11	0.08	0.96	0.16	0.07	0.11	0.7	2.2	1.04	0.02	0.9600	2.45	1.64	100	
67	17.02	47.92	0.08	0.96	0.16	0.07	0.11	0.7	2.2	1.04	0.02	0.9600	2.43	1.65	100	
68	15.25	49.44	0.08	0.96	0.16	0.07	0.11	0.7	2.2	1.03	0.02	0.9600	2.42	1.67	100	
69	11.30	49.93	0.08	0.96	0.16	0.08	0.11	0.7	2.2	1.03	0.02	0.9600	2.38	1.66	84	
70	14.53	51.21	0.09	0.96	0.16	0.08	0.11	0.7	2.2	1.02	0.02	0.9600	2.59	1.83	100	
71	6.02	56.95	0.10	0.96	0.15	0.08	0.11	0.7	2.2	1.02	0.02	0.9600	2.67	1.91	54	
72	6.14	62.84	0.10	0.95	0.15	0.08	0.11	0.7	2.2	1.01	0.02	0.9600	2.78	2.02	55	
73	7.38	67.12	0.11	0.95	0.15	0.08	0.11	0.7	2.2	1.01	0.02	0.9600	2.86	2.11	62	
74	8.95	61.43	0.10	0.95	0.15	0.08	0.11	0.7	2.2	1.00	0.02	0.9600	2.64	1.98	71	
75	14.26	51.33	0.09	0.95	0.14	0.08	0.11	0.7	2.2	1.00	0.02	0.9600	2.37	1.80	100	
76	12.52	50.51	0.09	0.95	0.14	0.08	0.11	0.7	2.2	0.99	0.02	0.9600	2.32	1.79	91	
77	13.04	50.80	0.09	0.94	0.14	0.08	0.11	0.7	2.2	0.99	0.02	0.9600	2.29	1.79	93	
78	12.27	50.40	0.09	0.94	0.14	0.08	0.11	0.7	2.2	0.98	0.02	0.9600	2.26	1.79	89	
79	15.66	55.28	0.10	0.94	0.14	0.09	0.11	0.7	2.2	0.98	0.02	0.9600	2.32	1.87	100	
80	14.16	53.07	0.09	0.94	0.13	0.09	0.11	0.7	2.2	0.98	0.02	0.9600	2.25	1.84	100	
81	12.74	50.69	0.09	0.93	0.13	0.09	0.10	0.7	2.2	0.97	0.02	0.9600	2.18	1.81	92	
82	12.93	49.11	0.08	0.93	0.13	0.09	0.10	0.7	2.2	0.97	0.02	0.9600	1.93	1.63	93	
83	12.69	58.99	0.10	0.93	0.13	0.09	0.10	0.7	2.2	0.96	0.02	0.9600	2.29	1.97	92	
84	12.03	60.88	0.10	0.92	0.13	0.09	0.10	0.7	2.2	0.96	0.02	0.9600	2.31	2.02	88	
85	11.90	55.93	0.10	0.92	0.12	0.09	0.10	0.7	2.2	0.96	0.02	0.9600	2.18	1.94	87	
86	13.80	51.39	0.09	0.92	0.12	0.09	0.10	0.7	2.2	0.95	0.02	0.9600	2.08	1.88	97	
87	12.95	47.39	0.08	0.91	0.12	0.09	0.10	0.7	2.2	0.95	0.02	0.9600	1.81	1.66	93	
88	13.03	47.47	0.08	0.91	0.12	0.09	0.10	0.7	2.2	0.94	0.02	0.9600	1.79	1.68	93	
89	13.34	52.63	0.09	0.91	0.12	0.09	0.09	0.7	2.2	0.94	0.02	0.9600	2.05	1.96	95	
90	12.28	50.37	0.09	0.90	0.11	0.09	0.09	0.7	2.2	0.94	0.02	0.9600	2.00	1.95	89	
91	12.24	48.72	0.08	0.90	0.11	0.09	0.09	0.7	2.2	0.93	0.02	0.9600	1.78	1.76	89	
92	10.14	58.97	0.10	0.89	0.11	0.09	0.09	0.7	2.2	0.93	0.02	0.9600	2.13	2.15	78	
93	4.94	97.65	0.17	0.89	0.11	0.09	0.09	0.7	2.2	0.93	0.02	0.9600	3.57	3.67	47	
94	1.65	111.42	0.21	0.89	0.10	0.09	0.09	0.7	2.2	0.92	0.02	0.9625	4.46	4.68	19	
95	2.31	124.60	0.26	0.88	0.10	0.09	0.09	0.7	2.2	0.92	0.02	0.9600	5.51	5.91	26	
96	1.05	183.89	0.66	0.88	0.10	0.09	0.08	0.7	2.2	0.92	0.02	1.0400	15.06	16.49	6	
97	2.93	133.78	0.30	0.87	0.10	0.09	0.08	0.7	2.2	0.91	0.02	0.9600	6.37	7.12	32	
98	5.40	82.04	0.13	0.86	0.10	0.09	0.08	0.7	2.2	0.91	0.02	0.9600	2.75	3.15	50	
99	4.07	98.18	0.17	0.86	0.09	0.09	0.08	0.7	2.2	0.91	0.02	0.9600	3.51	4.11	41	
100	3.54	84.02	0.14	0.85	0.09	0.09	0.08	0.7	2.2	0.90	0.02	0.9600	2.82	3.37	37	
101	3.46	87.38	0.14	0.85	0.09	0.09	0.07	0.7	2.2	0.90	0.02	0.9600	2.96	3.62	36	

Boulanger and Idriss, 2004, "Approach B" method based on Su profile

Row	Col-75 **Ic** Limits	Col-76 Su - CPT (psf) Nkt 10	Col-77 OCR Assumed 1.1	Col-78 OCR - CPT	Col-79 α 0.02	Col-80 k_α	Col-81 $CRR_{M7.5}$	Col-82 MSF	Col-83 $CRR_{M5.5}$	Col-84 FS liq-Su (Clay-Like) No Amplification	Col-85 FS liq-Su (Clay-Like) if crest accel = 2
40	2.6	1484	1.1		0.02	0.99	26.01	1.11	28.90	403.94	202.95
41	2.6	2439	1.1		0.02	0.99	13.99	1.11	15.54	217.45	110.32
42	2.6	1801	1.1		0.02	0.99	6.11	1.11	6.79	95.12	48.73
43	2.6	896	1.1		0.02	0.99	2.17	1.11	2.42	33.90	17.54
44	2.6	1245	1.1		0.02	0.99	2.35	1.11	2.61	36.71	19.19
45	2.6	1415	1.1		0.02	0.99	2.20	1.11	2.44	34.40	18.16
46	2.6	1786	1.1		0.02	0.99	2.35	1.11	2.61	36.77	19.61
47	2.6	713	1.1		0.02	0.99	0.81	1.11	0.90	12.73	6.86
48	2.6	449	1.1		0.02	0.99	0.45	1.11	0.50	7.09	3.86
49	2.6	236	1.1		0.02	0.99	0.21	1.11	0.24	3.35	1.84
50	2.6	201	1.1		0.02	0.99	0.16	1.11	0.18	2.58	1.43
51	2.6	251	1.1		0.02	0.99	0.19	1.11	0.21	2.96	1.66
52	2.6	310	1.1		0.02	0.99	0.21	1.11	0.24	3.36	1.91
53	2.6	193	1.1		0.02	0.99	0.12	1.11	0.14	1.94	1.11
54	2.6	409	1.1		0.02	0.99	0.24	1.11	0.27	3.84	2.23
55	2.6	145	1.1		0.02	0.99	0.08	1.11	0.09	1.29	0.76
56	2.6	135	1.1		0.02	0.99	0.07	1.11	0.08	1.13	0.67
57	2.6	256	1.1		0.02	0.99	0.13	1.11	0.14	2.03	1.22
58	2.6	1104	1.1		0.02	0.99	0.52	1.11	0.58	8.30	5.05
59	2.6	523	1.1		0.02	0.99	0.23	1.11	0.26	3.74	2.30
60	2.6	424	1.1		0.02	0.99	0.18	1.11	0.20	2.88	1.79
61	2.6	568	1.1		0.02	0.99	0.23	1.11	0.26	3.69	2.33
62	2.6	319	1.1		0.02	0.99	0.12	1.11	0.14	1.98	1.26
63	2.6	176	1.1		0.02	0.99	0.07	1.11	0.07	1.04	0.67
64	2.6	238	1.1		0.02	0.99	0.08	1.11	0.09	1.36	0.89
65	2.6	275	1.1		0.02	0.99	0.10	1.11	0.11	1.51	1.00
66	2.6	264	1.1		0.02	0.99	0.09	1.11	0.10	1.40	0.94
67	2.6	326	1.1		0.02	0.99	0.11	1.11	0.12	1.67	1.13
68	2.6	409	1.1		0.02	0.99	0.14	1.11	0.15	2.02	1.39
69	2.6	640	1.1		0.02	0.99	0.21	1.11	0.23	3.05	2.13
70	2.6	471	1.1		0.02	0.99	0.15	1.11	0.17	2.18	1.54
71	2.6	1659	1.1		0.02	0.99	0.52	1.11	0.58	7.44	5.34
72	2.6	1842	1.1		0.02	0.99	0.57	1.11	0.64	8.01	5.83
73	2.6	1636	1.1		0.02	0.99	0.50	1.11	0.55	6.91	5.10
74	2.6	1191	1.1		0.02	0.99	0.36	1.11	0.40	4.89	3.66
75	2.6	509	1.1		0.02	0.99	0.15	1.11	0.17	2.04	1.55
76	2.6	608	1.1		0.02	0.99	0.18	1.11	0.20	2.37	1.82
77	2.6	583	1.1		0.02	0.99	0.17	1.11	0.19	2.21	1.73
78	2.6	635	1.1		0.02	0.99	0.18	1.11	0.20	2.36	1.87
79	2.6	510	1.1		0.02	0.99	0.14	1.11	0.16	1.85	1.49
80	2.6	565	1.1		0.02	0.99	0.16	1.11	0.17	2.00	1.64
81	2.6	623	1.1		0.02	0.99	0.17	1.11	0.19	2.16	1.80
82	2.6	586	1.1		0.02	0.99	0.16	1.11	0.17	1.99	1.68
83	2.6	795	1.1		0.02	0.99	0.21	1.11	0.23	2.65	2.27
84	2.6	903	1.1		0.02	0.99	0.23	1.11	0.26	2.95	2.57
85	2.6	824	1.1		0.02	0.99	0.21	1.11	0.23	2.64	2.34
86	2.6	588	1.1		0.02	0.99	0.15	1.11	0.17	1.85	1.67
87	2.6	577	1.1		0.02	0.99	0.14	1.11	0.16	1.78	1.64
88	2.6	577	1.1		0.02	0.99	0.14	1.11	0.16	1.75	1.64
89	2.6	660	1.1		0.02	0.99	0.16	1.11	0.18	1.97	1.88
90	2.6	707	1.1		0.02	0.99	0.17	1.11	0.19	2.08	2.02
91	2.6	680	1.1		0.02	0.99	0.16	1.11	0.18	1.97	1.95
92	2.6	1178	1.1		0.02	0.99	0.28	1.11	0.31	3.36	3.40
93	2.6	4985	1.1		0.02	0.99	1.16	1.11	1.28	14.03	14.45
94	2.6	15921	1.1		0.02	0.99	3.64	1.11	4.05	44.19	46.42
95	2.6	12721	1.1		0.02	0.99	2.87	1.11	3.19	34.84	37.35
96	2.6	42434	1.1		0.02	0.99	9.46	1.11	10.51	114.68	125.54
97	2.6	10832	1.1		0.02	0.99	2.38	1.11	2.65	28.90	32.32
98	2.6	3974	1.1		0.02	0.99	0.86	1.11	0.96	10.48	11.98
99	2.6	6645	1.1		0.02	0.99	1.43	1.11	1.59	17.33	20.25
100	2.6	6595	1.1		0.02	0.99	1.40	1.11	1.56	17.03	20.35
101	2.6	7124	1.1		0.02	0.99	1.50	1.11	1.66	18.21	22.28

CPTU-612 Liquefaction Analysis

ConeTec Inc. - CPT Interpretation
Interpretation Output - Release 1.22 Rev. A - Format: NLI Imperial
Run No: 06-0718-0954-2636
Job No: 02-100
Client: MACTEC Engineering and Consulting Inc.
Project: Former Callahan Mine Site, Brooksville, ME
Site: CP-612
Location: Callahan Mine
Cone: 20 Ton AD179
CPT Date: 06/28/06
CPT Time: 09:10
CPT File: 758CP612.COR
Northing (m): 0.000000
Easting (m): 0.000000
Elevation (m): 0.000000 73.6 Elevation For CPT Triggering analysis

Water Table (m): 8.53 (ft): 28.0 18.70 Water Table assumed for CPT Analysis
Unit Weight of Water (default): 62.40 pcf
Averaging Increment (m): 0.20

Phi Method : Robertson and Campanella, 1983
Su Nkt used: 15.00 Su/P' (nc): 0.30 0.11 Base acceleration
Dr Method : Jamiolkowski - All Sands
State Parameter M: 1.20
Used Unit Weights Assigned to Soil Zones
N160lc Calculated using qc1n

0.328 0

1) CSR = 0.65*(a_{max}/g)*(s_v/s'_v)*r_d Seed & Idriss, 1983, p. 459

a_{max}/g = 0.11 g USGS (base) (amplified from base as discussed in text
s_v = computed Total Vertical Stress
s'_v = computed Effective Vertical Stress

r_d = [1.0 - 0.4113$z^{0.5}$ + 0.04052z +0.001753$z^{1.5}$] / [1 - 0.4177$z^{0.5}$ + 0.05729z - 0.006205$z^{1.5}$ + 0.001210z^2]

z = depth in meters

2) FS = Factor of safety against triggering of liquefaction: FS = ($CRR_{7.5}$/CSR) x MSF x Ks x Ka Youd and Idriss, 2001

MSF = magnitude scaling factor; Assume based on range recommended by NCEER Workshop, reiterated in Youd and Idriss, 2001

CPTU-612 Liquefaction Analysis

Ks = $(s'_{vo}/P_a)^{(f-1)}$, where f = 0.7 to 0.8 for relative density of 40 to 60%; f = 0.6 to 0.7 for rel density of 60 to 80%; P_a = pressure at 1 atmosphe
1 Atmosphere = 14.7 psi = 2.12 ksf

Conetec Data

Col-01 Depth (m)	Col-02 Depth (ft)	Col-03 Elev. (m)	Col-04 Elev. (ft)	Col-05 qc (tsf)	Col-06 qt (tsf)	Col-07 fs (tsf)	Col-08 Rf (%)	Col-09 u (ft)	Col-10 SBT (Zone)	Col-11 SBTn (Zone)	Col-12 SBT-BQ (Zone)	Col-13 SBT-BQn (Zone)	Col-14 Perm-k (cm/s)	Col-15 Unit Wt (pcf)	Col-16 ? Stress (tsf)	Col-17 U Stress (tsf)	Col-18 E Stress (tsf)	Col-19 Cn	Col-20 N60 (b/ft)	Col-21 N1(60) (b/ft)	Col-22 N(60)lc (b/ft)	Col-23 N1(60)lc (b/ft)	Col-24 Qt	Col-25 Fr (%)	Col-26 Bq	Col-27 Ic	Col-28 FC (%)	Col-29 icZone (Zone)	Col-30 Dr (%)	Col-31 Phi (deg)	Col-32 State Par	Col-33 Es/qt	Col-34 YoungE (tsf)	Col-35 Su (tsf)	Col-36 OCR
0.1	0.33	-0.1	73.3	19.44	19.44	0.14	0.7	-0.16	6	-9999	7	-9999	5.00E-05	114.6	0.019	0	0.019	1.7	7.4	12.7	-9999	-9999	1033.09	0.7	0	-9999	-9999	0	76.7	50	-9999	3.661	71.1	1.295	10
0.3	0.98	-0.3	72.6	21.51	21.51	0.16	0.76	-0.07	7	6	7	7	5.00E-04	117.7	0.057	0	0.057	1.7	6.9	11.7	4.7	8	377.01	0.76	0	2.22	19.6	5	63.7	48	-0.28	3.501	75.3	-9999	-9999
0.5	1.64	-0.5	72.0	17.24	17.24	0.12	0.7	-0.08	6	6	6	7	5.00E-05	114.6	0.095	0	0.095	1.7	6.6	11.2	3.9	6.6	180.47	0.7	0	2.29	22	5	50	44	-0.21	-9999	-9999	1.143	10
0.7	2.297	-0.7	71.3	15.94	15.94	0.14	0.9	-0.05	6	6	6	6	5.00E-05	114.6	0.133	0	0.133	1.7	6.1	10.4	3.7	6.3	119.21	0.9	0	2.37	25.1	5	43	42	-0.19	-9999	-9999	1.054	10
0.9	2.953	-0.9	70.6	15.68	15.68	0.14	0.86	-0.07	6	6	6	6	5.00E-05	114.6	0.17	0	0.17	1.7	6	10.2	3.6	6.2	91.14	0.87	0	2.37	25.1	5	38.9	42	-0.17	-9999	-9999	1.034	10
1.1	3.609	-1.1	70.0	17.98	17.98	0.15	0.85	-0.07	6	6	6	6	5.00E-05	114.6	0.208	0	0.208	1.7	6.9	11.7	4.1	6.9	85.54	0.86	0	2.31	23	5	40	42	-0.16	-9999	-9999	1.185	10
1.3	4.265	-1.3	69.3	17.81	17.81	0.18	1	0.01	6	6	6	6	5.00E-05	114.6	0.245	0	0.245	1.7	6.8	11.6	4.1	7	71.57	1.01	0	2.35	24.5	5	37.3	40	-0.16	-9999	-9999	1.171	10
1.5	4.921	-1.5	68.7	17.28	17.28	0.24	1.41	-0.59	6	5	6	6	5.00E-05	114.6	0.283	0	0.283	1.7	6.6	11.3	4.2	7.1	60.05	1.43	0	2.44	28.3	5	34.4	40	-0.17	-9999	-9999	1.133	10
1.7	5.577	-1.7	68.0	18.64	18.64	0.22	1.18	0.09	6	5	6	6	5.00E-05	114.6	0.321	0	0.321	1.7	7.1	12.1	4.3	7.4	57.13	1.2	0	2.38	25.4	5	34.8	40	-0.15	3.726	69.4	1.221	10
1.9	6.234	-1.9	67.4	16.21	16.21	0.23	1.44	0.24	6	5	6	6	5.00E-05	114.6	0.358	0	0.358	1.67	6.2	10.4	4	6.7	44.27	1.47	0	2.47	29.5	5	30	38	-0.14	-9999	-9999	1.057	10
2.1	6.89	-2.1	66.7	18.62	18.63	0.29	1.57	1.67	6	5	6	6	5.00E-05	114.6	0.396	0	0.396	1.59	7.1	11.3	4.5	7.3	46.07	1.61	0	2.46	29.1	5	31.8	38	-0.16	-9999	-9999	1.215	10
2.3	7.546	-2.3	66.1	19.39	19.38	0.32	1.66	-1.22	6	5	7	6	5.00E-05	114.6	0.433	0	0.433	1.52	7.4	11.3	4.7	7.3	43.73	1.69	0	2.48	29.7	5	31.6	38	-0.16	-9999	-9999	1.263	10
2.5	8.202	-2.5	65.4	25.42	25.43	0.32	1.25	1.8	6	5	7	6	5.00E-05	114.6	0.471	0	0.471	1.46	9.7	14.2	5.8	8.6	53	1.28	0	2.33	23.5	5	38.2	40	-0.15	3.445	87.6	1.664	10
2.7	8.858	-2.7	64.7	8.85	8.87	0.18	2.03	4.76	5	4	5	5	5.00E-06	114.6	0.509	0	0.509	1.4	4.2	6	2.5	4.8	16.45	2.16	0.02	2.74	42.5	4	-9999	-9999	-9999	-9999	-9999	0.558	5.2
2.9	9.514	-2.9	64.1	2.51	2.64	0.06	2.28	27.87	3	3	3	3	5.00E-08	111.4	0.546	0	0.546	1.35	2.5	3.4	1.1	1.6	3.83	2.88	0.42	3.34	84.4	3	-9999	-9999	-9999	-9999	-9999	0.139	0.9
3.1	10.17	-3.1	63.4	15.38	15.43	0.18	1.14	11.58	6	5	6	5	5.00E-05	114.6	0.583	0	0.583	1.31	5.9	7.7	3.9	5.2	25.49	1.18	0.02	2.53	32	5	30	34	-0.07	-9999	-9999	0.99	10
3.3	10.827	-3.3	62.8	15.72	15.71	0.26	1.64	-0.57	6	4	6	5	5.00E-05	114.6	0.62	0	0.62	1.27	6	7.6	4	5.9	24.33	1.71	0	2.57	34	5	30	34	-0.1	-9999	-9999	1.006	9.7
3.5	11.483	-3.5	62.1	18.14	18.14	0.25	1.35	0.18	6	5	6	5	5.00E-05	114.6	0.658	0	0.658	1.23	7	8.6	4.5	5.7	26.58	1.4	0	2.53	32.1	5	30	36	-0.09	-9999	-9999	1.166	10
3.7	12.139	-3.7	61.5	9.76	9.76	0.26	2.67	0.85	4	3	6	5	5.00E-07	114.6	0.695	0	0.695	1.2	6.2	7.5	3	4.1	13.04	2.87	0	2.89	51.5	4	-9999	-9999	-9999	-9999	-9999	0.604	3.7
3.9	12.795	-3.9	60.8	18.38	18.38	0.2	1.09	-0.13	6	5	6	5	5.00E-05	114.6	0.733	0	0.733	1.17	7	8.2	4.5	5.4	24.08	1.14	0	2.5	30.6	5	30	34	-0.06	-9999	-9999	1.177	9.5
4.1	13.451	-4.1	60.1	17.01	17	0.2	1.19	0.89	6	5	6	5	5.00E-05	114.6	0.771	0	0.771	1.14	6.5	7.7	4.3	5	21.07	1.25	0	2.56	33.3	5	30	34	-0.06	-9999	-9999	1.082	7.7
4.3	14.107	-4.3	59.5	14.23	14.23	0.2	1.43	0.37	6	4	6	5	5.00E-05	114.6	0.808	0	0.808	1.11	5.5	6.1	3.8	4.6	16.61	1.51	0	2.65	37.8	4	30	32	-0.05	-9999	-9999	0.895	5.3
4.5	14.764	-4.5	58.8	10.95	10.96	0.18	1.67	0.98	5	5	4	6	5.00E-06	114.6	0.846	0	0.846	1.09	5.2	5.7	3.2	3.6	11.96	1.81	0	2.81	46.7	4	-9999	-9999	-9999	-9999	-9999	0.674	3.3
4.7	15.42	-4.7	58.2	5.21	5.24	0.14	2.58	6.76	3	3	4	3	5.00E-08	111.4	0.883	0	0.883	1.06	5	5.3	2	2	4.93	3.11	0.05	3.26	78	3	-9999	-9999	-9999	-9999	0.29	1.1
4.9	16.076	-4.9	57.5	4.68	4.68	0.13	2.78	19.36	3	3	3	3	5.00E-08	111.4	0.919	0	0.919	1.04	4.5	4.7	1.9	1.8	4.09	3.4	0.16	3.35	85.5	3	-9999	-9999	-9999	-9999	0.25	0.9
5.1	16.732	-5.1	56.9	2.3	2.57	0.05	2.05	57.09	3	3	3	3	1.00E-07	111.4	0.956	0	0.956	1.02	1.2	1.3	1.4	1	1.69	3.26	1.11	3.68	100	3	-9999	-9999	-9999	-9999	0.107	0.6
5.3	17.388	-5.3	56.2	22.7	22.79	0.27	1.18	19.47	6	5	5	5	5.00E-05	114.6	0.993	0	0.993	1	8.7	8.8	5.6	5.7	21.95	1.23	0.03	2.49	30.3	5	30	34	-0.06	-9999	-9999	1.453	8.2
5.5	18.044	-5.5	55.6	17.74	17.74	0.29	1.62	-1.62	6	5	6	5	5.00E-05	114.6	1.031	0	1.031	0.99	6.8	6.7	4.8	4.6	16.21	1.73	0	2.69	39.9	4	30	32	-0.06	-9999	-9999	1.114	5.1
5.7	18.701	-5.7	54.9	7.65	7.69	0.16	2.12	9.86	4	4	4	4	5.00E-07	111.4	1.068	0	1.068	0.97	4.9	4.8	2.7	2.3	6.2	2.46	0.05	3.12	67.3	3	-9999	-9999	-9999	-9999	-9999	0.442	1.4
5.9	19.357	-5.9	54.2	8.75	8.76	0.15	1.74	2.62	5	3	5	4	5.00E-06	114.6	1.106	0	1.106	0.95	4.2	4	2.9	2.4	6.92	2	0.01	3.04	61	3	-9999	-9999	-9999	-9999	-9999	0.511	1.6
6.1	20.013	-6.1	53.6	4.44	4.6	0.12	2.56	34.31	3	3	3	3	5.00E-08	111.4	1.143	0	1.143	0.94	4.4	4.1	2.1	1.4	3.03	3.41	0.31	3.46	95.6	3	-9999	-9999	-9999	-9999	-9999	0.231	0.7
6.3	20.669	-6.3	52.9	10.12	10.17	0.2	1.97	10.63	5	5	5	4	5.00E-06	114.6	1.18	0	1.18	0.92	4.9	4.5	3.3	2.5	7.62	2.23	0.04	3.03	80.2	3	-9999	-9999	-9999	-9999	0.6	1.8
6.5	21.325	-6.5	52.3	6.11	6.66	0.19	2.92	6.63	5	4	5	4	5.00E-06	114.6	1.217	0	1.218	0.91	3.2	2.9	2.1	1.4	2.9	3.7	0.12	3.7	25.8	5	30	34	-0.02	-9999	-9999	-9999	-9999
6.7	21.981	-6.7	51.6	24.32	24.29	0.3	1.24	-6.07	6	5	4	7	5.00E-05	114.6	1.256	0	1.256	0.89	9.3	8.3	6.1	5.5	18.34	1.31	-0.01	2.53	31.8	5	30	32	-0.05	-9999	-9999	1.536	6.2
6.9	22.638	-6.9	51.0	24.88	24.83	0.26	1.04	-10.87	7	5	7	5	5.00E-04	117.7	1.294	0	1.294	0.88	7.9	7	6.1	5.5	18.19	1.1	-0.01	2.48	30	5	30	32	-0.03	-9999	-9999	-9999	-9999
7.1	23.294	-7.1	50.3	28.14	28.07	0.23	0.8	-14.91	7	5	7	5	5.00E-04	117.7	1.333	0	1.333	0.87	9	7.8	6.6	5.8	20.06	0.84	-0.02	2.39	25.9	5	30	34	-0.02	-9999	-9999	-9999	-9999
7.3	23.95	-7.3	49.7	24.71	24.64	0.22	0.91	-14.37	7	5	7	5	5.00E-04	117.7	1.372	0	1.372	0.85	7.9	6.7	6	5.2	16.97	0.96	-0.02	2.47	29.3	5	30	32	-0.02	-9999	-9999	-9999	-9999
7.5	24.606	-7.5	49.0	25.29	25.7	0.18	0.7	-12.67	7	5	7	5	5.00E-04	117.7	1.41	0	1.41	0.84	8.2	6.9	6.1	5.2	17.22	0.74	-0.02	2.41	26.8	5	30	32	0	-9999	-9999	-9999	-9999
7.7	25.262	-7.7	48.3	29.13	29.05	0.14	0.48	-16.6	7	5	7	5	5.00E-04	117.7	1.449	0	1.449	0.83	9.3	7.7	6.5	5.5	19.05	0.51	-0.02	2.29	22.2	5	30	32	0.02	-9999	-9999	-9999	-9999
7.9	25.918	-7.9	47.7	27.9	27.86	0.19	0.68	-8.65	7	5	7	5	5.00E-04	117.7	1.487	0	1.487	0.82	8.9	7.3	6.5	5.4	17.73	0.72	-0.01	2.38	25.6	5	30	32	0	-9999	-9999	-9999	-9999
8.1	26.574	-8.1	47.0	29.88	29.81	0.16	0.55	-15.58	7	5	7	5	5.00E-04	117.7	1.526	0	1.526	0.81	9.5	7.7	6.8	5.6	18.53	0.58	-0.02	2.31	23.1	5	30	32	0.01	-9999	-9999	-9999	-9999
8.3	27.231	-8.3	46.4	25.63	25.55	0.16	0.62	-17.18	7	5	7	5	5.00E-04	117.7	1.565	0	1.565	0.8	8.2	6.5	6.1	5	15.33	0.76	-0.02	2.43	27.8	5	30	32	0.01	-9999	-9999	-9999	-9999
8.5	27.887	-8.5	45.7	18.93	18.87	0.32	1.67	-11.96	6	4	6	4	5.00E-05	114.6	1.603	0	1.603	0.79	7.2	5.7	5.6	3.3	10.77	1.83	-0.02	2.85	49.1	4	30	30	-0.02	-9999	-9999	1.151	2.8
8.7	28.543	-8.7	45.1	18.43	18.46	0.31	1.66	5.07	6	4	6	4	5.00E-05	114.6	1.64	0.017	1.623	0.78	7.1	5.5	5.5	3.2	10.36	1.82	0.01	2.87	49.9	4	30	30	-0.01	-9999	-9999	1.121	2.7
8.9	29.199	-8.9	44.4	59.39	59.37	0.94	1.58	-4.05	7	5	8	6	5.00E-04	117.7	1.679	0.037	1.641	0.78	19	14.8	13.4	10.7	35.16	1.63	0	2.31	22.9	5	44.6	38	-0.13	3.296	195.7	-9999	-9999
9.1	29.855	-9.1	43.7	47.35	47.25	0.98	2.07	18.3	7	5	8	6	5.00E-04	117.7	1.718	0.053	1.659	0.78	15.1	11.5	9.1	7.2	27.46	2.15	-0.01	2.46	29.1	5	30	34	-0.13	3.684	174.3	3.036	10
9.3	30.511	-9.3	43.1	30.71	30.65	0.19	0.61	-13.71	7	5	7	5	5.00E-04	117.7	1.755	0.078	1.676	0.77	9.8	7.6	7	5.6	17.24	0.64	-0.02	2.34	24.1	5	30	32	0.01	-9999	-9999	-9999	-9999
9.5	31.168	-9.5	42.4	26.62	26.56	0.24	0.9	-12.92	7	4	7	5	5.00E-04	117.7	1.793	0.099	1.695	0.77	8.5	6.5	6.9	4	14.62	0.96	-0.02	2.45	35.4	4	30	32	0	-9999	-9999	-9999	-9999
9.7	31.824	-9.7	41.8	17.9	17.89	0.38	2.11	-1.6	5	3	6	4	5.00E-06	114.6	1.832	0.119	1.712	0.76	8.6	6.5	5.7	3.1	9.38	2.36	-0.01	2.96	56	3	-9999	-9999	-9999	-9999	-9999	1.071	2.3
9.9	32.48	-9.9	41.1	17.78	17.94	0.39	2.19	35.03	5	3	6	4	5.00E-06	114.6	1.869	0.14	1.729	0.76	8.6	6.5	5.7	3.1	9.29	2.45	0.06	2.97	56.8	3	-9999	-9999	-9999	-9999	-9999	1.018	2.6
10.1	33.136	-10.1	40.5	29.34	29.47	0.36	1.23	28.45	7	5	7	5	5.00E-04	117.7	1.907	0.16	1.747	0.76	9.4	7.1	7.8	4.4	15.78	1.32	0.03	2.64	37.2	4	30	32	-0.03	-9999	-9999	-9999	-9999
10.3	33.792	-10.3	39.8	13.93	14.22	0.43	3.01	61.67	5	3	5	3	5.00E-06	114.6	1.945	0.181	1.764	0.75	6.8	5.1	5.1	2.6	6.96	3.49	0.14	3.16	70.3	3	-9999	-9999	-9999	-9999	-9999	0.818	1.6
10.5	34.448	-10.5	39.2	20.12	20.34	0.42	2.06	45.33	6	3	6	4	5.00E-05	114.6	1.983	0.201	1.782	0.75	7.8	5.8	6.3	3.3	10.3	2.28	0.07	2.92	53.3	4	30	34	-0.02	-9999	-9999	1.224	2.6
10.7	35.105	-10.7	38.5	13.12	13.38	0.34	2.57	54.19	5	3	5	3	5.00E-06	114.6	2.021	0.222	1.799	0.75	6.4	4.8	4.8	2.4	6.31	3.02	0.13	3.17	70.3	3	-9999	-9999	-9999	-9999	-9999	0.757	1.4
10.9	35.761	-10.9	37.8	8.34	8.8	0.2	2.31	98.69	5	3	3	3	5.00E-06	114.6	2.058	0.242	1.816	0.74	4.2	3.1	3.7	1.6	3.71	3.01	0.42	3.36	86.3	3	-9999	-9999	-9999	-9999	-9999	0.449	0.8
11.1	36.417	-11.1	37.2	20.36	20.64	0.29	1.4	59.57	6	4	6	4	5.00E-05	114.6	2.096	0.263	1.833	0.74	7.9	5.8	6.1	3.1	10.12	1.55	0.09	2.84	48.4	3	30	30	0.01	-9999	-9999	1.236	2.6
11.3	37.073	-11.3	36.5	14.77	14.93	0.42	2.8	33.65	5	3	5	4	5.00E-06	114.6	2.133	0.283	1.85	0.74	7.1	5.3	5.3	2.6	6.92	3.27	0.06	3.15	69.2	3	-9999	-9999	-9999	-9999	-9999	0.853	1.6
11.5	37.729	-11.5	35.9	10.12	10.69	0.23	2.13	121.62	5	3	3	3	5.00E-06	114.6	2.171	0.304	1.867	0.73	5.1	3.7	4.1	1.8	4.56	2.68	0.41	3.26	77.6	3	-9999	-9999	-9999	-9999	-9999	0.568	1
11.7	38.385	-11.7	35.2	25.97	25.96	0.47	1.81	-1.9	6	5	7	5	5.00E-05	114.6	2.208	0.324	1.884	0.73	9.9	7.2	7.5	3.8	12.61	1.98	-0.02	2.81	46.8	4	30	34	-0.04	-9999	-9999	1.584	3.5
11.9	39.042	-11.9	34.6	25.76	25.69	0.43	1.69	-15.22	6	5	7	4	5.00E-05	114.6	2.246	0.345	1.901	0.73	9.8	7.1	7.4	3.7	12.33	1.85	-0.03	2.81	46.3	4	30	30	-0.04	-9999	-9999	1.563	3.4
12.1	39.698	-12.1	33.9	18.21	18.1	0.46	2.52	-22.72	5	3	6	4	5.00E-06	114.6	2.284	0.365	1.918	0.72	8.7	6.3	6.1	2.9	8.24	2.88	-0.07	3.06	62.4	3	-9999	-9999	-9999	-9999	-9999	1.054	2
12.3	40.354	-12.3	33.2	26.13	26.11	0.43	1.65	-4.13	6	4	7	4	5.00E-05	114.6	2.321	0.386	1.936	0.72	10	7.2	7.5	3.7	12.79	1.81	-0.02	2.8	46	4	30	30	-0.03	-9999	-9999	1.586	3.4
12.5	41.01	-12.5	32.6	25.7	25.72	0.38	1.49	16.05	6	5	7	4	5.00E-05	114.6	2.359	0.406	1.953	0.72	9.9	7.1	7.4	3.6	11.99	1.64	0	2.79	45.3	4	30	30	-0.02	-9999	-9999	1.561	3.3
12.7	41.666	-12.7	31.9	9.12	9.53	0.21	2.21	88.37	5	3	3	3	5.00E-06	114.6	2.396	0.427	1.97	0.71	4.6	3.3	4	1.6	3.62	2.95	0.33	3.37	86.7	3	-9999	-9999	-9999	-9999	-9999	0.476	0.8
12.9	42.322	-12.9	31.3	7.41	7.67	0.32	4.21	55.51	3	2	4	3	5.00E-08	111.4	2.434	0.447	1.986	0.71	7.3	5.2	4.2	1.5	2.64	6.17	0.25	3.65	100	2	-9999	-9999	-9999	-9999	-9999	0.349	0.7
13.1	42.978	-13.1	30.6	8.51	8.85	0.21	2.35	72.97	5	3	3	3	5.00E-06	114.6	2.471	0.468	2.003	0.71	4.2	3	3.9	1.5	3.19	3.26	0.28	3.44	92.9	3	-9999	-9999	-9999	-9999	-9999	0.425	0.8
13.3	43.635	-13.3	30.0	8.56	9	0.19	2.09	93.38	5	3	3	3	5.00E-06	114.6	2.508	0.488	2.02	0.7	4.3	3	3.9	1.5	3.21	2.89	0.37	3.41	90.3	3	-9999	-9999	-9999	-9999	-9999	0.433	0.8
13.5	44.291	-13.5	29.3	10.35	10.75	0.24	2.2	86.66	5	3	3	3	5.00E-06	114.6	2.546	0.509	2.037	0.7	5.1	3.6	4.4	1.7	4.03	2.93	0.27	3.32	83.1	3	-9999	-9999	-9999	-9999	-9999	0.547	0.9
13.7	44.947	-13.7	28.7	6.32	6.93	0.1	1.48	129.62	5	3	3	3	5.00E-06	114.6	2.583	0.529	2.054	0.7	3.3	2.3	3.3	1.1	2.12	2.36	0.81	3.53	100	2	-9999	-9999	-9999	-9999	-9999	0.29	0.6
13.9	45.603	-13.9	28.0	13.11	13.5	0.28	2.1	83.72	5	3	4	3	5.00E-06	114.6	2.621	0.55	2.071	0.69	6.5	4.5	5	2	5.25	2.6	0.19	3.2	72.9	3	-9999	-9999	-9999	-9999	-9999	0.729	1.2
14.1	46.259	-14.1	27.3	7.86	8.44	0.21	2.49	124.13	4	3	3	3	5.00E-07	114.6	2.659	0.57	2.088	0.69	5.4	3.7	4	1.4	2.77	3.64	0.57	3.51	100	3	-9999	-9999	-9999	-9999	-9999	0.385	0.7
14.3	46.915	-14.3	26.7	8.51	9.13	0.16	1.9	127.62	4	3	3	3	5.00E-06	114.6	2.696	0.591	2.106	0.69	4.4	3	3.7	1.4	3.25	2.7	0.53

CPTU-612 Liquefaction Analysis

CPTU-612 Liquefaction Analysis

re Youd and Idriss, 2001

	AX	AY	AZ	BA	BB	BC	BD	BE	BF	BG	BH	BI	BJ	BK	BL	BM	BN	BO	BP	BQ	BR	BS	BT	BU	BV	BW	BX	BY	BZ	CA	CB	CC	CD	CE	CF	CG	CH
34	Col-50	Col-51	Col-52	Col-53	Col-54	Col-55	Col-56	Col-57	Col-57a	Col-58	Col-59	Col-60	Col-61	Col-62	Col-63	Col-64	Col-65	Col-66	Col-67	Col-68	Col-69	Col-70	Col-71	Col-72	Col-73	Col-74	Col-75	Col-76	Col-77	Col-78	Col-79	Col-80	Col-81	Col-82	Col-83	Col-84	Col-85
35	**Youd & Idriss, 2001 CPT Based Analysis**																											**Boulanger and Idriss, 2004, "Approach B" method based on Su profile**									
37	$Q_{exp=0.7}$	F	$I_{c\,Qexp=0.7}$	Description	C_q			q_{c1N}	Lookup	Ic	Kc	$(q_{c1N})_{cs}$	CRR7.5	rd	a_{max}/g =	CSR		Rel. Den. Factor f	MSF	K_σ	α	K_α	$FS_{liq-CPT\ (Sand-Like)}$		Apparent Fines	Measured Fines	**Ic** Limits	Su - CPT (psf)	OCR Assumed	OCR - CPT	α	k_α	$CRR_{M7.5}$	MSF	$CRR_{M5.5}$	$FS_{liq-Su\ (Clay-Like)}$	
38					n=1.0	n=0.5	n=0.7		Col						if crest accel =	No Amplification	if crest accel = 2						No Amplification	if crest accel = 2	(%)	(%)		Nkt	1.1							No Amplification	if crest accel = 2
39															2.0						0.02							12			0.02						
40	306.05	0.72	1.46	**Granular**	55.68	7.46	16.67	137.11	19.00	1.71	1.05	143.64	0.36	1.00	0.22	0.07	0.14	0.7	2.2	3.34	0.02	1.0325	37.71	18.91	6		2.6	3237	1.1		0.02	0.99	53.73	1.11	59.70	834.46	418.34
41	156.69	0.75	1.68	**Granular**	18.56	4.31	7.73	87.59	9.00	1.88	1.17	102.46	0.18	1.00	0.22	0.07	0.14	0.7	2.2	2.40	0.02	0.9725	12.94	6.52	10		2.6	3576	1.1		0.02	0.99	19.78	1.11	21.98	307.59	155.03
42	87.58	0.70	1.86	**Granular**	11.14	3.34	5.40	54.38	2.00	2.04	1.35	73.53	0.12	1.00	0.22	0.07	0.14	0.7	2.2	2.06	0.02	0.9600	7.13	3.61	14		2.6	2858	1.1		0.02	0.99	9.49	1.11	10.54	147.71	74.85
43	63.80	0.89	2.03	**Granular**	7.95	2.82	4.27	42.49	2.00	2.18	1.63	69.15	0.11	1.00	0.22	0.07	0.14	0.7	2.2	1.86	0.02	0.9600	6.11	3.12	18		2.6	2635	1.1		0.02	0.99	6.25	1.11	6.94	97.42	49.63
44	52.72	0.90	2.11	**Granular**	6.22	2.49	3.60	36.97	2.00	2.24	1.77	65.47	0.11	1.00	0.21	0.07	0.14	0.7	2.2	1.73	0.02	0.9600	5.45	2.79	20		2.6	2585	1.1		0.02	0.99	4.80	1.11	5.33	74.90	38.37
45	52.45	0.84	2.09	**Granular**	5.09	2.26	3.12	38.33	2.00	2.21	1.70	65.01	0.11	0.99	0.21	0.07	0.14	0.7	2.2	1.63	0.02	0.9600	5.11	2.63	19		2.6	2962	1.1		0.02	0.99	4.49	1.11	4.99	70.26	36.19
46	46.23	1.02	2.18	**Granular**	4.32	2.08	2.78	34.98	2.00	2.29	1.92	67.15	0.11	0.99	0.21	0.07	0.14	0.7	2.2	1.55	0.02	0.9600	5.00	2.59	22		2.6	2928	1.1		0.02	0.99	3.77	1.11	4.19	59.04	30.58
47	40.44	1.41	2.31	**Granular**	3.74	1.93	2.52	31.58	2.00	2.41	2.34	73.78	0.12	0.99	0.21	0.07	0.14	0.7	2.2	1.49	0.02	0.9600	5.20	2.71	27		2.6	2833	1.1		0.02	0.99	3.16	1.11	3.51	49.54	25.80
48	39.90	1.20	2.28	**Granular**	3.30	1.82	2.30	31.99	2.00	2.36	2.16	69.23	0.11	0.99	0.21	0.07	0.14	0.7	2.2	1.43	0.02	0.9600	4.74	2.48	25	40.2	2.6	3053	1.1		0.02	0.99	3.00	1.11	3.33	47.14	24.69
49	31.99	1.45	2.40	**Granular**	2.96	1.72	2.14	26.34	2.00	2.48	2.67	70.27	0.11	0.99	0.21	0.07	0.13	0.7	2.2	1.38	0.02	0.9600	4.65	2.45	30		2.6	2642	1.1		0.02	0.99	2.33	1.11	2.59	36.63	19.29
50	34.29	1.59	2.40	**Granular**	2.67	1.63	1.99	28.78	2.00	2.47	2.62	75.48	0.12	0.99	0.21	0.07	0.13	0.7	2.2	1.34	0.02	0.9600	4.83	2.56	29		2.6	3039	1.1		0.02	0.99	2.42	1.11	2.69	38.15	20.20
51	33.47	1.69	2.42	**Granular**	2.44	1.56	1.87	28.63	2.00	2.49	2.71	77.49	0.12	0.98	0.21	0.07	0.13	0.7	2.2	1.31	0.02	0.9600	4.84	2.58	30		2.6	3158	1.1		0.02	0.99	2.30	1.11	2.56	36.31	19.34
52	41.57	1.28	2.28	**Granular**	2.25	1.50	1.76	36.02	2.00	2.34	2.07	74.52	0.12	0.98	0.21	0.07	0.13	0.7	2.2	1.27	0.02	0.9600	4.54	2.43	24		2.6	4160	1.1		0.02	0.99	2.79	1.11	3.10	44.04	23.59
53	13.19	2.15	2.82	**Clayey**	2.08	1.44	1.67	17.43	2.00	2.74	4.28	74.55	0.12	0.98	0.20	0.07	0.13	0.7	2.2	1.25	0.02	0.9600	4.44	2.39	42		2.6	1394	1.1		0.02	0.99	0.86	1.11	0.96	13.67	7.36
54	3.14	2.87	3.41	**Clayey**	1.94	1.39	1.59	4.84	2.00	3.34	11.31	54.70	0.10	0.98	0.20	0.07	0.13	0.7	2.2	1.22	0.02	0.9600	3.50	1.90	84		2.6	349	1.1		0.02	0.99	0.20	1.11	0.22	3.20	1.73
55	21.30	1.21	2.51	**Granular**	1.81	1.35	1.52	19.65	2.00	2.55	3.04	59.79	0.10	0.98	0.20	0.07	0.13	0.7	2.2	1.20	0.02	0.9600	3.60	1.96	33		2.6	2475	1.1		0.02	0.99	1.34	1.11	1.49	21.26	11.58
56	20.73	1.72	2.60	**Very Silty**	1.71	1.31	1.45	21.59	2.00	2.60	3.32	71.75	0.11	0.98	0.20	0.07	0.13	0.7	2.2	1.17	0.02	0.9600	4.06	2.22	35		2.6	2515	1.1		0.02	0.99	1.28	1.11	1.42	20.34	11.15
57	23.04	1.43	2.52	**Granular**	1.61	1.27	1.39	21.74	2.00	2.55	3.04	66.12	0.11	0.98	0.20	0.07	0.13	0.7	2.2	1.15	0.02	0.9600	3.73	2.06	33		2.6	2914	1.1		0.02	0.99	1.40	1.11	1.55	22.24	12.26
58	11.50	2.87	2.94	**Clayey**	1.52	1.23	1.34	14.04	2.00	2.89	5.61	78.81	0.13	0.97	0.20	0.07	0.13	0.7	2.2	1.13	0.02	0.9600	4.32	2.39	51		2.6	1511	1.1		0.02	0.99	0.69	1.11	0.76	10.93	6.06
59	21.57	1.13	2.49	**Granular**	1.44	1.20	1.29	20.87	2.00	2.51	2.84	59.38	0.10	0.97	0.20	0.07	0.12	0.7	2.2	1.12	0.02	0.9600	3.37	1.88	31		2.6	2941	1.1		0.02	0.99	1.27	1.11	1.41	20.21	11.27
60	19.14	1.23	2.55	**Granular**	1.37	1.17	1.25	18.82	2.00	2.57	3.17	59.71	0.10	0.97	0.20	0.07	0.12	0.7	2.2	1.10	0.02	0.9600	3.34	1.87	34	58.1	2.6	2705	1.1		0.02	0.99	1.11	1.11	1.23	17.69	9.93
61	15.32	1.49	2.68	**Clayey**	1.31	1.14	1.21	17.61	2.00	2.65	3.62	63.77	0.10	0.97	0.19	0.07	0.12	0.7	2.2	1.08	0.02	0.9600	3.44	1.94	38		2.6	2237	1.1		0.02	0.99	0.87	1.11	0.97	13.98	7.89
62	11.18	1.78	2.83	**Clayey**	1.25	1.12	1.17	12.96	2.00	2.81	4.85	62.88	0.10	0.97	0.19	0.07	0.12	0.7	2.2	1.07	0.02	0.9600	3.36	1.91	46		2.6	1686	1.1		0.02	0.99	0.63	1.11	0.70	10.08	5.72
63	4.67	3.21	3.29	**Clayey**	1.20	1.09	1.13	5.93	2.00	3.27	10.26	60.89	0.10	0.97	0.19	0.07	0.12	0.7	2.2	1.06	0.02	0.9600	3.25	1.86	79	86.5	2.6	726	1.1		0.02	0.99	0.26	1.11	0.29	4.17	2.38
64	3.92	3.46	3.37	**Clayey**	1.15	1.07	1.10	5.09	2.00	3.36	11.60	59.06	0.10	0.97	0.19	0.07	0.12	0.7	2.2	1.04	0.02	0.9600	3.16	1.82	86		2.6	627	1.1		0.02	0.99	0.22	1.11	0.24	3.46	1.99
65	1.64	3.10	3.68	**Clayey**	1.11	1.05	1.07	2.69	2.00	3.67	17.34	46.61	0.08	0.96	0.19	0.07	0.12	0.7	2.2	1.03	0.02	0.9600	2.54	1.47	100		2.6	269	1.1		0.02	0.99	0.09	1.11	0.10	1.43	0.83
66	21.54	1.24	2.51	**Granular**	1.07	1.03	1.05	22.23	2.00	2.51	2.83	63.00	0.10	0.96	0.19	0.07	0.12	0.7	2.2	1.02	0.02	0.9600	3.23	1.88	31	42.5	2.6	3633	1.1		0.02	0.99	1.15	1.11	1.28	18.62	10.84
67	16.08	1.74	2.69	**Clayey**	1.03	1.01	1.02	17.21	2.00	2.69	3.93	67.58	0.11	0.96	0.19	0.07	0.12	0.7	2.2	1.01	0.02	0.9600	3.36	1.97	40		2.6	2785	1.1		0.02	0.99	0.85	1.11	0.95	13.77	8.06
68	6.22	2.42	3.12	**Clayey**	0.99	1.00	0.99	7.20	2.00	3.12	8.19	58.97	0.10	0.96	0.19	0.07	0.12	0.7	2.2	1.00	0.02	0.9600	3.04	1.79	67		2.6	1104	1.1		0.02	0.99	0.33	1.11	0.36	5.28	3.11
69	7.11	1.96	3.02	**Clayey**	0.97	0.99	0.98	8.07	2.00	3.03	7.04	56.85	0.10	0.96	0.19	0.07	0.12	0.7	2.2	0.99	0.02	0.9600	2.91	1.73	60		2.6	1276	1.1		0.02	0.99	0.37	1.11	0.41	5.90	3.50
70	3.18	3.47	3.45	**Clayey**	0.96	0.98	0.97	4.17	2.00	3.46	13.29	55.47	0.10	0.96	0.18	0.07	0.12	0.7	2.2	0.99	0.02	0.9600	2.82	1.68	95		2.6	576	1.1		0.02	0.99	0.16	1.11	0.18	2.58	1.54
71	8.17	2.22	3.00	**Clayey**	0.95	0.97	0.96	9.09	2.00	3.01	6.81	61.91	0.10	0.96	0.18	0.07	0.12	0.7	2.2	0.98	0.02	0.9600	2.94	1.77	59		2.6	1498	1.1		0.02	0.99	0.42	1.11	0.47	6.52	3.91
72	21.98	0.78	2.40	**Granular**	0.93	0.97	0.95	23.40	2.00	2.39	2.29	53.64	0.09	0.95	0.18	0.07	0.12	0.7	2.2	0.98	0.02	0.9600	2.67	1.61	26		2.6	4074	1.1		0.02	0.99	1.13	1.11	1.26	17.20	10.39
73	20.49	1.30	2.54	**Granular**	0.92	0.96	0.94	21.99	2.00	2.53	2.93	64.47	0.10	0.95	0.18	0.07	0.12	0.7	2.2	0.97	0.02	0.9600	2.92	1.77	32		2.6	3839	1.1		0.02	0.99	1.05	1.11	1.17	15.75	9.58
74	20.72	1.10	2.50	**Granular**	0.90	0.95	0.93	22.31	2.00	2.49	2.71	60.55	0.10	0.95	0.18	0.08	0.12	0.7	2.2	0.97	0.02	0.9600	2.75	1.68	30		2.6	3923	1.1		0.02	0.99	1.06	1.11	1.17	15.65	9.58
75	23.28	0.86	2.40	**Granular**	0.89	0.94	0.92	25.02	2.00	2.39	2.27	56.87	0.10	0.95	0.18	0.08	0.12	0.7	2.2	0.97	0.02	0.9600	2.61	1.61	26	54.4	2.6	4456	1.1		0.02	0.99	1.18	1.11	1.31	17.29	10.66
76	20.04	0.95	2.48	**Granular**	0.88	0.94	0.91	21.79	2.00	2.47	2.60	56.70	0.10	0.95	0.18	0.08	0.12	0.7	2.2	0.96	0.02	0.9600	2.56	1.59	29		2.6	3878	1.1		0.02	0.99	1.01	1.11	1.12	14.65	9.09
77	20.71	0.74	2.41	**Granular**	0.86	0.93	0.90	22.57	2.00	2.40	2.32	52.41	0.09	0.94	0.18	0.08	0.12	0.7	2.2	0.96	0.02	0.9600	2.43	1.52	27		2.6	4048	1.1		0.02	0.99	1.04	1.11	1.16	14.92	9.32
78	23.29	0.51	2.30	**Granular**	0.85	0.92	0.89	25.32	2.00	2.28	1.90	48.11	0.08	0.94	0.17	0.08	0.12	0.7	2.2	0.95	0.02	0.9600	2.10	1.32	22	34.9	2.6	4600	1.1		0.02	0.99	1.17	1.11	1.30	16.54	10.40
79	22.04	0.72	2.38	**Granular**	0.84	0.92	0.88	24.11	2.00	2.37	2.20	52.96	0.09	0.94	0.17	0.08	0.12	0.7	2.2	0.95	0.02	0.9600	2.38	1.50	25		2.6	4396	1.1		0.02	0.99	1.10	1.11	1.22	15.44	9.77
80	23.39	0.57	2.32	**Granular**	0.83	0.91	0.88	25.61	2.00	2.30	1.95	49.92	0.08	0.94	0.17	0.08	0.13	0.7	2.2	0.94	0.02	0.9600	2.08	1.33	23		2.6	4714	1.1		0.02	0.99	1.16	1.11	1.29	16.18	10.31
81	19.64	0.75	2.44	**Granular**	0.81	0.90	0.87	21.80	2.00	2.42	2.40	52.32	0.09	0.93	0.17	0.08	0.13	0.7	2.2	0.94	0.02	0.9600	2.30	1.48	27		2.6	3998	1.1		0.02	0.99	0.97	1.11	1.08	13.42	8.61
82	14.01	1.85	2.76	**Clayey**	0.80	0.90	0.86	14.33	2.00	2.78	4.64	66.57	0.11	0.93	0.17	0.08	0.13	0.7	2.2	0.94	0.02	0.9600	2.62	1.69	45	44.6	2.6	2878	1.1		0.02	0.99	0.69	1.11	0.77	9.46	6.11
83	13.52	1.84	2.77	**Clayey**	0.79	0.89	0.85	13.85	2.00	2.80	4.75	65.82	0.11	0.93	0.17	0.08	0.13	0.7	2.2	0.93	0.02	0.9600	2.57	1.67	46		2.6	2803	1.1		0.02	0.99	0.66	1.11	0.74	9.03	5.88
84	45.94	1.63	2.31	**Granular**	0.78	0.88	0.84	49.65	2.00	2.29	1.92	95.12	0.16	0.92	0.17	0.08	0.13	0.7	2.2	0.93	0.02	0.9600	3.82	2.51	22		2.6	9615	1.1		0.02	0.99	2.24	1.11	2.49	30.36	19.89
85	35.94	2.15	2.46	**Granular**	0.77	0.88	0.83	39.27	2.00	2.45	2.52	98.86	0.17	0.92	0.17	0.08	0.13	0.7	2.2	0.93	0.02	0.9600	4.02	2.65	28		2.6	7591	1.1		0.02	0.99	1.75	1.11	1.94	23.52	15.51
86	22.60	0.66	2.36	**Granular**	0.76	0.87	0.83	25.31	2.00	2.34	2.07	52.35	0.09	0.92	0.17	0.08	0.13	0.7	2.2	0.92	0.02	0.9600	2.19	1.45	24		2.6	4816	1.1		0.02	0.99	1.10	1.11	1.22	14.65	9.73
87	19.20	0.97	2.50	**Granular**	0.75	0.87	0.82	21.79	2.00	2.48	2.65	57.73	0.10	0.91	0.16	0.08	0.12	0.7	2.2	0.92	0.02	0.9600	2.27	1.52	30	31.8	2.6	4128	1.1		0.02	0.99	0.93	1.11	1.03	12.34	8.26
88	12.34	2.37	2.86	**Clayey**	0.74	0.86	0.81	12.58	2.00	2.90	5.66	71.13	0.11	0.91	0.16	0.08	0.12	0.7	2.2	0.92	0.02	0.9600	2.61	1.76	52		2.6	2676	1.1		0.02	0.99	0.59	1.11	0.66	7.86	5.30
89	12.25	2.43	2.87	**Clayey**	0.74	0.86	0.81	12.47	2.00	2.91	5.75	71.72	0.11	0.91	0.16	0.08	0.12	0.7	2.2	0.91	0.02	0.9600	2.61	1.77	52	57.8	2.6	2679	1.1		0.02	0.99	0.59	1.11	0.65	7.75	5.26
90	20.83	1.31	2.53	**Granular**	0.73	0.85	0.80	23.74	2.00	2.51	2.81	66.80	0.11	0.90	0.16	0.08	0.12	0.7	2.2	0.91	0.02	0.9600	2.45	1.67	31		2.6	4594	1.1		0.02	0.99	0.99	1.11	1.11	13.08	8.94
91	9.20	3.50	3.07	**Clayey**	0.72	0.85	0.79	9.65	2.00	3.10	7.93	76.52	0.12	0.90	0.16	0.08	0.12	0.7	2.2	0.91	0.02	0.9600	2.74	1.89	66		2.6	2046	1.1		0.02	0.99	0.44	1.11	0.49	5.74	3.95
92	13.64	2.29	2.82	**Clayey**	0.71	0.84	0.79	13.64	2.00	2.86	5.28	72.04	0.11	0.89	0.16	0.09	0.12	0.7	2.2	0.90	0.02	0.9600	2.57	1.78	49		2.6	3060	1.1		0.02	0.99	0.65	1.11	0.72	8.46	5.87
93	8.37	2.99	3.06	**Clayey**	0.70	0.84	0.78	8.87	2.00	3.10	7.91	70.14	0.11	0.89	0.16	0.09	0.12	0.7	2.2	0.90	0.02	0.9600	2.50	1.75	65		2.6	1893	1.1		0.02	0.99	0.40	1.11	0.44	5.16	3.61
94	4.93	2.97	3.25	**Clayey**	0.69	0.83	0.77	5.77	2.00	3.29	10.61	61.17	0.10	0.89	0.16	0.09	0.12	0.7	2.2	0.90	0.02	0.9600	2.25	1.58	80		2.6	1124	1.1		0.02	0.99	0.23	1.11	0.26	3.02	2.13
95	13.46	1.56	2.74	**Clayey**	0.69	0.83	0.77	13.37	2.00	2.78	4.59	61.44	0.10	0.88	0.16	0.09	0.12	0.7	2.2	0.89	0.02	0.9600	2.24	1.59	45		2.6	3091	1.1		0.02	0.99	0.63	1.11	0.70	8.21	5.82
96	9.22	3.28	3.05	**Clayey**	0.68	0.82	0.76	9.57	2.00	3.09	7.80	74.66	0.12	0.88	0.15	0.09	0.12	0.7	2.2	0.89	0.02	0.9600	2.61	1.86	65		2.6	2133	1.1		0.02	0.99	0.43	1.11	0.48	5.60	4.00
97	6.09	2.70	3.15	**Clayey**	0.67	0.82	0.76	6.78	2.00	3.20	9.21	62.41	0.10	0.87	0.15	0.09	0.12	0.7	2.2	0.89	0.02	0.9600	2.24	1.62	73	89.4	2.6	1420	1.1		0.02	0.99	0.28	1.11	0.32	3.68	2.65
98	16.85	1.98	2.71	**Clayey**	0.66	0.81	0.75	16.29	2.00	2.75	4.39	71.54	0.11	0.86	0.15	0.09	0.12	0.7	2.2	0.88	0.02	0.9600	2.49	1.80	43		2.6	3959	1.1		0.02	0.99	0.78	1.11	0.87	10.16	7.38
99	16.51	1.83	2.70	**Clayey**	0.66	0.81	0.74	15.94	2.00	2.74	4.32	68.86	0.11	0.86	0.15	0.09	0.12	0.7	2.2	0.88	0.02	0.9600	2.40	1.76	43	92.3	2.6	3907	1.1		0.02	0.99	0.76	1.11	0.85	9.92	7.26
100	11.05	2.91	2.95	**Clayey**	0.65	0.81	0.74	11.11	2.00	3.00	6.74	74.92	0.12	0.85	0.15	0.09	0.12	0.7	2.2	0.88	0.02	0.9600	2.58	1.90	58		2.6	2636	1.1		0.02	0.99	0.51	1.11	0.57	6.63	4.89
101	16.51	1.81	2.69	**Clayey**	0.64	0.80	0.73	15.87	2.00	2.74	4.31	68.40	0.11	0.85	0.15	0.09	0.12	0.7	2.2	0.88	0.02	0.9600	2.37	1.76	43		2.6	3965	1.1		0.02	0.99	0.76	1.11	0.84	9.88	7.34
102	16.12	1.62	2.68	**Clayey**	0.64	0.80	0.73	15.50	2.00	2.73	4.19	65.01	0.11	0.84	0.15	0.09	0.11	0.7	2.2	0.87	0.02	0.9600	2.28	1.71	42		2.6	3902	1.1		0.02	0.99	0.74	1.11	0.82	9.63	7.21
103	4.88	2.94	3.25	**Clayey**	0.63	0.79	0.72	5.67	2.00	3.31	10.81	61.32	0.10	0.84	0.15	0.09	0.11	0.7	2.2	0.87	0.02	0.9600	2.19	1.65	82		2.6	1189	1.1		0.02	0.99	0.22	1.11	0.25	2.91	2.20
104	3.56	6.11	3.54	**Clayey**	0.62	0.79	0.72	4.52	2.00	3.59	15.85	71.66	0.11	0.83	0.14	0.09	0.11	0.7	2.2	0.87	0.02	0.9600	2.46	1.87	100		2.6	873	1.1		0.02	0.99	0.16	1.11	0.18	2.12	1.61
105	4.30	3.29	3.33	**Clayey**	0.62	0.79	0.71	5.16	2.00	3.38	11.99	61.94	0.10	0.82	0.14	0.08	0.11	0.7	2.2	0.87	0.02	0.9600	2.20	1.69	88		2.6	1063	1.1		0.02	0.99	0.20	1.11	0.22	2.56	1.97
106	4.35	2.93	3.30	**Clayey**	0.61	0.78	0.71	5.20	2.00	3.35	11.52	59.93	0.10	0.82	0.14	0.08	0.11	0.7	2.2	0.86	0.02	0.9600	2.15	1.66	85		2.6	1082	1.1		0.02	0.99	0.20	1.11	0.22	2.59	2.00
107	5.46	2.93	3.21	**Clayey**	0.61	0.78	0.70	6.15	2.00	3.27	10.22	62.86	0.10	0.81	0.14	0.08	0.11	0.7	2.2	0.86	0.02	0.9600	2.22	1.73	78		2.6	1367	1.1		0.02	0.99	0.25	1.11	0.27	3.25	2.53
108	2.87	2.30	3.40	**Clayey**	0.60	0.77	0.70	3.93	2.00	3.46	13.38	52.57	0.09	0.80	0.14	0.08	0.11	0.7	2.2	0.86	0.02	0.9600	2.01	1.58	95		2.6	725	1.1		0.02	0.99	0.13	1.11	0.14	1.71	1.34
109	7.14	2.57	3.08	**Clayey**	0.59	0.77	0.69	7.58	2.00	3.14	8.45	64.01	0.10	0.80	0.14	0.08	0.11	0.7	2.2	0.86	0.02	0.9600	2.25	1.78	68	51.2	2.6	1813	1.1		0.02	0.99	0.32	1.11	0.36	4.25	3.37
110	3.77	3.63	3.40	**Clayey**	0.59	0.77	0.69	4.69	2.00	3.46	13.31	62.43	0.10	0.79	0.14	0.08	0.10	0.7	2.2	0.85	0.02	0.9600	2.21	1.77	95		2.6	964	1.1		0.02	0.99	0.17	1.11	0.19	2.25	1.80
111	4.15	2.65	3.29	**Clayey**	0.58	0.76	0.69	5.02	2.00	3.35	11.54	57.91	0.10	0.78	0.14	0.08	0.10	0.7	2.2	0.85	0.02	0.9600	2.12	1.71	86		2.6	1069	1.1		0.02	0.99	0.19	1.11	0.21	2.48	2.00
112	4.78	2.56	3.23	**Clayey**	0.58	0.76	0.68	5.55	2.00	3.29	10.60	58.79	0.10	0.78	0.14	0.08	0.10	0.7	2.2	0.85	0.02	0.9600	2.14	1.74	80		2.6	1239	1.1		0.02	0.99	0.21	1.11	0.24	2.86	2.33
113	4.80	1.86	3.16	**Clayey**	0.57	0.76	0.68	5.56	2.00	3.23	9.62	53.48	0.09	0.77	0.13	0.08	0.10	0.7	2.2	0.85	0.02	0.9600	2.04	1.67	75		2.6	1252	1.1		0.02	0.99	0.21	1.11	0.24	2.87	2.36
114	3.90	4.07	3.41	**Clayey**	0.57	0.75	0.67	4.79	2.00	3.47	13.61	65.25	0.11	0.76	0.13	0.08	0.10	0.7	2.2	0.84	0.02	0.9600	2.29	1.90	96		2.6	1024	1.1		0.02	0.99	0.17	1.11	0.19	2.34	1.94
115	14.32	1.54	2.71	**Clayey**	0.56	0.75	0.67	13.55	2.00	2.77	4.56	61.84	0.10	0.76	0.13	0.08	0.10	0.7	2.2	0.84	0.02	0.9600	2.21	1.85	44		2.6	3781	1.1		0.02	0.99	0.63	1.11	0.70	8.60	7.18
116	18.30	1.40	2.60	**Clayey**	0.56	0.75	0.66	16.86	2.00	2.66	3.73	62.88	0.10	0.75	0.13	0.08	0.10	0.7	2.2	0.84	0.02	0.9600	2.24	1.89	38		2.6	4866	1.1		0.02	0.99	0.81	1.11	0.90	11.01	9.28
117	8.57	2.98	3.05	**Clayey**	0.55	0.74	0.66	8.69	2.00	3.12	8.12	70.59	0.11	0.74	0.13	0.08	0.10	0.7	2.2	0.84	0.02	0.9600	2.46	2.09	67		2.6	2293	1.1		0.02	0.99	0.38	1.11	0.42	5.17	4.40
118	4.72	2.76	3.25	**Clayey**	0.55	0.74	0.66	5.46	2.00	3.32	11.03	60.25	0.10	0.74	0.13	0.08	0.09	0.7	2.2	0.83	0.02	0.9600	2.19	1.88	83		2.6	1270	1.1		0.02	0.99	0.21	1.11	0.23	2.85	2.45
119	21.50	1.26	2.51	**Granular**	0.54	0.74	0.65	26.39	2.00	2.47	2.61	68.82	0.11	0.73	0.13	0.08	0.09	0.7	2.2	0.83	0.02	0.9600	2.42	2.09	29		2.6	5825	1.1		0.02	0.99	0.94	1.11	1.04	13.03	11.29
120	24.67	1.02	2.41	**Granular**	0.54	0.73	0.65	30.05	2.00	2.37	2.18	65.52	0.11	0.72	0.13	0.08	0.09	0.7	2.2	0.83	0.02	0.9600	2.33	2.04	25	54	2.6	6729	1.1		0.02	0.99	1.08	1.11	1.20	14.99	13.11
121	21.75	0.98	2.45	**Granular**	0.53	0.73	0.64	26.80	2.00	2.40	2.33	62.44	0.10	0.72	0.12	0.08	0.09	0.7	2.2	0.83	0.02	0.9600	2.26	2.00	27		2.6	5969	1.1		0.02	0.99	0.95	1.11	1.05	13.25	11.69
122	21.23	1.08	2.48	**Granular**	0.53	0.73	0.64	26.27	2.00	2.43	2.46	64.63	0.11	0.71	0.12	0.08	0.09	0.7	2.2	0.83	0.02	0.9600	2.32	2.07	28		2.6	5863	1.1		0.02	0.99	0.92	1.11	1.02	12.97	11.55
123	19.09	1.32	2.57	**Clayey**	0.52	0.72	0.63	17.26	2.00	2.64	3.58	61.76	0.10	0.71	0.12	0.08	0.09	0.7	2.2	0.82	0.02	0.9600	2.26	2.03	37		2.6	5306	1.1		0.02	0.99	0.83	1.11	0.92	11.70	10.52
124	8.48	3.02	3.06	**Clayey**	0.52	0.72	0.63	8.52	2.00	3.13	8.30	70.74	0.11	0.70	0.12	0.08	0.09	0.7	2.2	0.82	0.02	0.9600	2.51	2.28	68		2.6	2372	1.1		0.02	0.99	0.37	1.11	0.41	5.21	4.73
125	9.22	2.06	2.94	**Clayey**	0.51	0.72	0.63	9.11	2.00	3.01	6.88	62.65	0.10	0.69	0.12	0.08	0.08	0.7	2.2	0.82	0.02	0.9600	2.29	2.10	59		2.6	2594	1.1		0.02	0.99	0.40	1.11	0.44	5.68	5.21
126	13.13	2.42	2.85	**Clayey**	0.51	0.71	0.62	12.29	2.00	2.92	5.90	72.49	0.12	0.69	0.12	0.08	0.08	0.7	2.2	0.82	0.02	0.9600	2.58	2.39	53		2.6	3714	1.1		0.02	0.99	0.56	1.11	0.63	8.11	7.51
127	7.73	3.56	3.13	**Clayey**	0.50	0.71	0.62	7.88	2.00	3.20	9.31	73.37	0.12	0.68	0.12	0.08	0.08	0.7	2.2	0.81	0.02	0.9600	2.62	2.45	73		2.6	2201	1.1		0.02	0.99	0.33	1.11	0.37	4.79	4.48
128	8.06	2.67	3.05	**Clayey**	0.50	0.71	0.62	8.13	2.00	3.12	8.22	66.86	0.11	0.68	0.12	0.08	0.08	0.7	2.2	0.81	0.02	0.9600	2.42	2.29	67		2.6	2307	1.1		0.02	0.99	0.34	1.11	0.38	5.01	4.73
129	9.05	3.39	3.06	**Clayey**	0.50	0.70	0.61	8.92	2.00	3.14	8.41	75.06	0.12	0.67	0.12	0.08	0.08	0.7	2.2	0.81	0.02	0.9600	2.69	2.57	68		2.6	2605	1.1		0.02	0.99	0.39	1.11	0.43	5.64	5.38
130	6.01	4.03	3.25	**Clayey**	0.49	0.70	0.61	6.45	2.00	3.33	11.16	71.96	0.11	0.66	0.11	0.08	0.08	0.7	2.2	0.81	0.02	0.9600	2.59	2.50	83		2.6	1739	1.1		0.02	0.99	0.26	1.11	0.28	3.75	3.62
131	24.84	4.38	2.79	**Clayey**	0.49	0.70	0.61	21.64	2.00	2.86	5.29	114.57	0.22	0.66	0.11	0.08	0.08	0.7	2.2	0.81	0.02	0.9600	4.98	4.85	49		2.6	7229	1.1		0.02	0.99	1.05	1.11	1.17	15.57	15.17
132	5.03	2.72	3.22	**Clayey**	0.48	0.70	0.60	5.65	2.00	3.31	10.81	61.07	0.10	0.65	0.11	0.07	0.08	0.7	2.2	0.80	0.02	0.9600	2.30	2.26	82		2.6	1473	1.1		0.02	0.99	0.21	1.11	0.24	3.16	3.11
133	13.60	1.62	2.74	**Clayey**	0.48	0.69	0.60	12.53	2.00	2.82	4.97	62.24	0.10	0.65	0.11	0.07	0.07	0.7	2.2	0.80	0.02	0.9600	2.33	2.32	47		2.6	4002	1.1		0.02	0.99	0.57	1.11	0.64	8.57	8.53
134	8.77	2.89	3.03	**Clayey**	0.48	0.69	0.60	8.64	2.00	3.12	8.12	70.16	0.11	0.64	0.11	0.07	0.07	0.7	2.2	0.80	0.02	0.9600	2.56	2.57	67		2.6	2596	1.1		0.02	0.99	0.37	1.11	0.41	5.54	5.57

CPTU-613 Liquefaction Analysis

CP

ConeTec Inc. - CPT Interpretation
Interpretation Output - Release: 1.22 Rev. A - Format: NLI Imperial
Run No: 06-0718-0954-2608
Job No: 02-100
Client: MACTEC Engineering and Consulting Inc.
Project: Former Callahan Mine Site, Brooksville, ME
Site: CP-613
Location: Callahan Mine
Cone: 20 Ton AD179
CPT Date: 06/28/06
CPT Time: 10:41
CPT File: 758CP613.COR
Northing (m): 0
Easting (m): 0
Elevation (m): 0 — 72.6 Elevation For CPT Triggering analysis
Water Table (m): 5.85 (ft): 19.2 — 19.2 Water Table assumed for CPT Analysis
Unit Weight of Water (default): 62.4 pcf
Averaging Increment (m): 0.2
Phi Method : Robertson and Campanella, 1983
Su Nkt used: 15 Su/P' (nc): 0.3 — 0.11 Base acceleration
Dr Method : Jamiolkowski - All Sands
State Parameter M: 1.2
Used Unit Weights Assigned to Soil Zones
N160Ic Calculated using qc1n

1) CSR $= 0.65*(a_{max}/g)*(s_v/s'_v)*r_d$ — Seed & Idriss, 1983, p. 459

a_{max}/g = 0.11 g — USGS (base) (amplified from base as discussed in

s_v = computed — Total Vertical Stress

s'_v = computed — Effective Vertical Stress

$r_d = [1.0 - 0.4113z^{0.5} + 0.04052z + 0.001753z^{1.5}] / [1 - 0.4177z^{0.5} + 0.05729z - 0.$

z = depth in meters

2) FS = Factor of safety against triggering of liquefaction: $FS = (CRR_{7.5}/CSR) \times MSF \times Ks \times Ka$

MSF = magnitude scaling factor; Assume based on range recommended by NCEER Wo

CPTU-613 Liquefaction Analysis

$Ks = (s'_{vo}/P_a)^{(f-1)}$, where f = 0.7 to 0.8 for relative density of 40 to 60%; f = 0.6 to 0.7 fo

1 Atmosphere = 14.7 psi = 2.12 ksf

Conetec Data

Col-01 Depth (m)	Col-02 Depth (ft)	Col-03 Elev. (m)	Col-04 Elev. (ft)	Col-05 qc (tsf)	Col-06 qt (tsf)	Col-07 fs (tsf)	Col-08 Rf (%)	Col-09 u (ft)	Col-10 SBT (Zone)	Col-11 SBTn (Zone)	Col-12 SBT-BQ (Zone)	Col-13 SBT-BQn (Zone)	Col-14 Perm-k (cm/s)	Col-15 Unit Wt (pcf)	Col-16 T Stress (tsf)	Col-17 U Stress (tsf)	Col-18 E Stress (tsf)	Col-19 Cn	Col-20 N60 (b/ft)	Col-21 N1(60) (b/ft)	Col-22 N(60)Ic (b/ft)	Col-23 N1(60)Ic (b/ft)	Col-24 Qt	Col-25 Fr (%)	Col-26 Bq	Col-27 Ic	Col-28 FC (%)	Col-29 IcZone (Zone)	Col-30 Dr (%)	Col-31 Phi (deg)	Col-32 State Par	Col-33 Es/qt	Col-34 YoungE (tsf)	Col-35 Su (tsf)	Col-36 OCR	Col-37 U (psf)	Col-38 s_{vo} (psf)	Col-39 q_c (psf)	Col-40 q_t (psf)	Col-41 P_a (psf)	Col-42 σ'_{vo} (psf)	Col-43 f_s (psf)	Col-44 $Q_{exp = 1}$	Col-45 F
0.1	0.328	-0.1	72.3	9.08	9.08	0.03	0.3	-0.48	1	7	5	7	1.00E-07	111.4	0.018	0	0.018	1.7	4.3	7.4	2.1	3.6	496.02	0.3	0	2.41	26.6	5	-9999	-9999	-9999	-9999	-9999	0.604	10	0	36	18160	18160	2116	36	60	503.44	0.33
0.3	0.984	-0.3	71.6	15.48	15.47	0.14	0.89	-0.87	6	6	6	7	5.00E-05	114.6	0.055	0	0.055	1.7	5.9	10.1	3.6	6.1	278.55	0.89	0	2.38	25.5	5	54.6	46	-0.27	-9999	-9999	1.028	10	0	110	30960	30940	2116	110	280	280.27	0.91
0.5	1.64	-0.5	71.0	17.22	17.21	0.16	0.9	-0.48	6	6	6	7	5.00E-05	114.6	0.093	0	0.093	1.7	6.6	11.2	3.9	6.7	184.23	0.91	0	2.34	24	5	50.3	44	-0.24	-9999	-9999	1.141	10	0	186	34440	34420	2116	186	320	184.05	0.93
0.7	2.297	-0.7	70.3	17.01	17	0.17	1.02	-0.51	6	6	6	6	5.00E-05	114.6	0.131	0	0.131	1.7	6.5	11.1	4	6.7	129.27	1.02	0	2.37	25.3	5	45.1	44	-0.21	-9999	-9999	1.125	10	0	262	34020	34000	2116	262	340	128.77	1.01
0.9	2.953	-0.9	69.6	15.88	15.87	0.2	1.28	-1.76	6	6	6	6	5.00E-05	114.6	0.168	0	0.168	1.7	6.1	10.3	3.8	6.5	93.39	1.29	0	2.45	28.5	5	39.4	42	-0.21	-9999	-9999	1.047	10	0	336	31760	31740	2116	336	400	93.46	1.27
1.1	3.609	-1.1	69.0	10.22	10.23	0.17	1.62	1.71	5	5	6	6	5.00E-06	114.6	0.206	0	0.206	1.7	4.9	8.3	2.7	4.7	48.72	1.65	0.01	2.67	38.8	4	-9999	-9999	-9999	-9999	-9999	0.668	10	0	412	20440	20460	2116	412	340	48.66	1.70
1.3	4.265	-1.3	68.3	13.97	13.97	0.1	0.7	-0.43	6	6	6	6	5.00E-05	114.6	0.243	0	0.243	1.7	5.4	9.1	3.2	5.5	56.43	0.71	0	2.37	25.2	5	30.5	40	-0.1	-9999	-9999	0.915	10	0	486	27940	27940	2116	486	200	56.49	0.73
1.5	4.921	-1.5	67.7	6.69	6.69	0.09	1.35	0.67	1	5	5	5	1.00E-07	111.4	0.28	0	0.28	1.7	3.2	5.4	1.9	3.3	22.88	1.41	0	2.79	45.5	4	-9999	-9999	-9999	-9999	-9999	0.428	8.8	0	560	13380	13380	2116	560	180	22.89	1.40
1.7	5.577	-1.7	67.0	2.46	2.53	0.02	0.79	14.06	1	4	3	3	1.00E-07	111.4	0.317	0	0.317	1.7	1.2	2.1	0.8	2.2	6.97	0.91	0.2	2.88	50.7	4	-9999	-9999	-9999	-9999	-9999	0.147	1.6	0	634	4920	5060	2116	634	40	6.98	0.90
1.9	6.234	-1.9	66.4	5.85	5.91	0.07	1.19	14.18	1	4	4	4	1.00E-07	111.4	0.353	0	0.353	1.68	2.8	4.8	1.6	4.3	15.73	1.26	0.08	2.63	36.8	4	-9999	-9999	-9999	-9999	-9999	0.371	4.9	0	706	11700	11820	2116	706	140	15.74	1.26
2.1	6.89	-2.1	65.7	5.96	5.97	0.11	1.85	2.18	4	4	5	5	5.00E-07	114.6	0.391	0	0.391	1.6	3.8	6.1	1.7	4.2	14.28	1.98	0.01	2.77	44.1	4	-9999	-9999	-9999	-9999	-9999	0.372	4.2	0	782	11920	11940	2116	782	220	14.27	1.97
2.3	7.546	-2.3	65.1	11.72	11.72	0.13	1.13	-1.67	6	5	6	5	5.00E-05	114.6	0.428	0	0.428	1.53	4.5	6.9	3	4.7	26.37	1.18	0	2.57	34.1	5	30	34	-0.07	-9999	-9999	0.752	10	0	856	23440	23440	2116	856	260	26.38	1.15
2.5	8.202	-2.5	64.4	4.79	4.79	0.09	1.88	-0.77	4	3	4	4	5.00E-07	114.6	0.466	0	0.466	1.47	3.1	4.5	1.5	3	9.28	2.09	-0.01	2.94	54.4	4	-9999	-9999	-9999	-9999	-9999	0.288	2.3	0	932	9580	9580	2116	932	180	9.28	2.08
2.7	8.858	-2.7	63.7	1.72	1.83	0.03	1.64	22.45	1	3	2	3	1.00E-07	111.4	0.503	0	0.503	1.41	0.9	1.2	0.8	1.2	2.64	2.27	0.53	3.43	92.6	3	-9999	-9999	-9999	-9999	-9999	0.088	0.7	0	1006	3440	3660	2116	1006	60	2.64	2.26
2.9	9.514	-2.9	63.1	8.56	8.6	0.13	1.52	8.63	5	4	5	5	5.00E-06	114.6	0.54	0	0.54	1.36	4.1	5.6	2.4	4.3	14.93	1.62	0.03	2.7	40.7	4	-9999	-9999	-9999	-9999	-9999	0.537	4.5	0	1080	17120	17200	2116	1080	260	14.93	1.61
3.1	10.17	-3.1	62.4	7.76	7.77	0.14	1.84	0.99	5	4	5	5	5.00E-06	114.6	0.577	0	0.577	1.32	3.7	4.9	2.3	3.8	12.45	1.99	0	2.82	47.1	4	-9999	-9999	-9999	-9999	-9999	0.479	3.5	0	1154	15520	15540	2116	1154	280	12.47	1.95
3.3	10.827	-3.3	61.8	8.35	8.35	0.13	1.53	-0.29	5	4	5	5	5.00E-06	114.6	0.615	0	0.615	1.28	4	5.1	2.4	3.7	12.58	1.65	0	2.77	44.4	4	-9999	-9999	-9999	-9999	-9999	0.516	3.5	0	1230	16700	16700	2116	1230	260	12.58	1.68
3.5	11.483	-3.5	61.1	10.04	10.07	0.14	1.37	5.96	5	4	5	5	5.00E-06	114.6	0.653	0	0.653	1.24	4.8	6	2.7	4.1	14.43	1.46	0.02	2.69	40.1	4	-9999	-9999	-9999	-9999	-9999	0.628	4.3	0	1306	20080	20140	2116	1306	280	14.42	1.49
3.7	12.139	-3.7	60.5	10.54	10.54	0.15	1.45	-0.18	5	4	6	5	5.00E-06	114.6	0.69	0	0.69	1.2	5	6.1	2.9	4.1	14.27	1.55	0	2.71	41.1	4	-9999	-9999	-9999	-9999	-9999	0.657	4.2	0	1380	21080	21080	2116	1380	300	14.28	1.52
3.9	12.795	-3.9	59.8	10.05	10.05	0.18	1.77	-0.08	5	4	6	5	5.00E-06	114.6	0.728	0	0.728	1.17	4.8	5.6	2.9	3.8	12.8	1.91	0	2.8	45.9	4	-9999	-9999	-9999	-9999	-9999	0.621	3.6	0	1456	20100	20100	2116	1456	360	12.80	1.93
4.1	13.451	-4.1	59.1	12.14	12.16	0.16	1.32	5.23	6	4	6	5	5.00E-05	114.6	0.765	0	0.765	1.14	4.7	5.3	3.3	4.2	14.89	1.41	0.01	2.67	39.1	4	30	32	-0.03	-9999	-9999	0.76	4.5	0	1530	24280	24320	2116	1530	320	14.90	1.40
4.3	14.107	-4.3	58.5	8.22	8.24	0.13	1.52	3.11	5	4	5	4	5.00E-06	114.6	0.803	0	0.803	1.12	3.9	4.4	2.5	2.9	9.26	1.68	0.01	2.89	51.5	4	-9999	-9999	-9999	-9999	-9999	0.496	2.3	0	1606	16440	16480	2116	1606	260	9.26	1.75
4.5	14.764	-4.5	57.8	8.01	8.05	0.16	1.93	7.12	5	3	5	4	5.00E-06	114.6	0.841	0	0.841	1.09	3.9	4.2	2.6	2.9	8.57	2.16	0.03	2.97	56.8	3	-9999	-9999	-9999	-9999	-9999	0.48	2.1	0	1682	16020	16100	2116	1682	320	8.57	2.22
4.7	15.42	-4.7	57.2	8.24	8.29	0.16	1.96	10.82	5	3	5	4	5.00E-06	114.6	0.878	0	0.878	1.07	4	4.2	2.7	2.8	8.44	2.2	0.05	2.98	57.5	3	-9999	-9999	-9999	-9999	-9999	0.494	2	0	1756	16480	16580	2116	1756	320	8.44	2.16
4.9	16.076	-4.9	56.5	2.81	2.98	0.09	3.11	36.53	3	3	3	2	5.00E-08	111.4	0.915	0	0.915	1.05	2.9	3	1.6	1.3	2.26	4.49	0.55	3.64	100	2	-9999	-9999	-9999	-9999	-9999	0.138	0.6	0	1830	5620	5960	2116	1830	180	2.26	4.36
5.1	16.732	-5.1	55.9	2.41	2.72	0.06	2.03	66.08	1	3	1	1	1.00E-07	111.4	0.952	0	0.952	1.03	1.3	1.3	1.5	1	1.86	3.12	1.17	3.63	100	2	-9999	-9999	-9999	-9999	-9999	0.118	0.6	0	1904	4820	5440	2116	1904	120	1.86	3.39
5.3	17.388	-5.3	55.2	3.21	3.47	0.08	2.39	54.74	3	3	3	3	5.00E-08	111.4	0.988	0	0.988	1.01	3.3	3.3	1.7	1.3	2.51	3.34	0.69	3.53	100	3	-9999	-9999	-9999	-9999	-9999	0.165	0.7	0	1976	6420	6940	2116	1976	160	2.51	3.22
5.5	18.044	-5.5	54.6	6.9	7.06	0.15	2.1	33.46	4	3	4	3	5.00E-07	114.6	1.025	0	1.025	0.99	4.5	4.4	2.5	2.2	5.88	2.45	0.17	3.14	68.7	3	-9999	-9999	-9999	-9999	-9999	0.402	1.3	0	2050	13800	14120	2116	2050	300	5.89	2.49
5.7	18.701	-5.7	53.9	2.76	2.98	0.1	3.45	46.14	3	2	3	3	5.00E-08	111.4	1.062	0	1.062	0.97	2.9	2.8	1.8	1.2	1.8	5.36	0.75	3.76	100	2	-9999	-9999	-9999	-9999	-9999	0.128	0.6	0	2124	5520	5960	2116	2124	200	1.81	5.21
5.9	19.357	-5.9	53.2	4.06	4.31	0.09	1.97	54.96	4	3	3	3	5.00E-07	114.6	1.1	0.005	1.095	0.96	2.8	2.6	1.9	1.3	2.94	2.65	0.53	3.42	91.7	3	-9999	-9999	-9999	-9999	-9999	0.214	0.7	10	2200	8120	8620	2116	2190	180	2.93	2.80
6.1	20.013	-6.1	52.6	3.21	3.5	0.09	2.58	61.94	3	3	3	3	5.00E-08	111.4	1.137	0.025	1.111	0.95	3.3	3.2	1.9	1.2	2.12	3.82	0.81	3.62	100	2	-9999	-9999	-9999	-9999	-9999	0.157	0.6	51	2274	6420	7000	2116	2223	180	2.13	3.81
6.3	20.669	-6.3	51.9	6.98	7.14	0.16	2.25	34.84	4	3	4	3	5.00E-07	114.6	1.174	0.046	1.128	0.94	4.6	4.3	2.7	2.1	5.29	2.69	0.17	3.2	73.3	3	-9999	-9999	-9999	-9999	-9999	0.398	1.2	92	2348	13960	14280	2116	2256	320	5.29	2.68
6.5	21.325	-6.5	51.3	9.49	9.58	0.18	1.91	19.55	5	3	5	4	5.00E-06	114.6	1.211	0.066	1.145	0.93	4.6	4.3	3.2	2.5	7.31	2.19	0.06	3.04	61	3	-9999	-9999	-9999	-9999	-9999	0.558	1.7	133	2422	18980	19160	2116	2289	360	7.31	2.15
6.7	21.981	-6.7	50.6	16.46	16.5	0.24	1.44	7.66	6	4	6	5	5.00E-05	114.6	1.249	0.087	1.162	0.93	6.3	5.9	4.6	3.8	13.13	1.56	0.01	2.74	42.8	4	30	30	-0.03	-9999	-9999	1.017	3.7	174	2498	32920	33000	2116	2324	480	13.12	1.57
6.9	22.638	-6.9	50.0	11.61	11.68	0.32	2.73	14.35	5	3	5	4	5.00E-06	114.6	1.286	0.107	1.179	0.92	5.6	5.2	3.9	3.1	8.81	3.06	0.03	3.05	61.7	3	-9999	-9999	-9999	-9999	-9999	0.693	2.1	215	2572	23220	23360	2116	2357	640	8.82	3.08
7.1	23.294	-7.1	49.3	8.35	8.59	0.16	1.9	51.34	5	3	4	3	5.00E-06	114.6	1.324	0.128	1.196	0.91	4.1	3.8	3	2.2	6.08	2.24	0.2	3.11	66.3	3	-9999	-9999	-9999	-9999	-9999	0.485	1.4	255	2648	16700	17180	2116	2393	320	6.07	2.20
7.3	23.95	-7.3	48.7	16.04	16.09	0.26	1.64	10.7	6	4	6	5	5.00E-05	114.6	1.362	0.148	1.213	0.91	6.2	5.6	4.6	3.7	12.14	1.79	0.01	2.8	46.2	4	30	30	-0.03	-9999	-9999	0.982	3.3	296	2724	32080	32180	2116	2428	520	12.13	1.77
7.5	24.606	-7.5	48.0	13.85	13.9	0.28	1.98	11.18	5	3	6	4	5.00E-06	114.6	1.399	0.169	1.23	0.9	6.7	6	4.3	3.3	10.16	2.21	0.01	2.92	53.1	4	-9999	-9999	-9999	-9999	-9999	0.833	2.6	337	2798	27700	27800	2116	2461	560	10.16	2.24
7.7	25.262	-7.7	47.3	20.75	20.73	0.2	0.97	-3.42	6	4	7	5	5.00E-05	114.6	1.437	0.189	1.248	0.9	7.9	7.1	5.2	4.8	15.46	1.04	-0.02	2.53	32.2	5	30	32	-0.01	-9999	-9999	1.286	4.8	378	2874	41500	41460	2116	2496	400	15.46	1.04
7.9	25.918	-7.9	46.7	19.35	19.36	0.2	1.02	0.21	6	4	6	5	5.00E-05	114.6	1.474	0.21	1.265	0.89	7.4	6.6	5.1	3.9	14.14	1.11	-0.01	2.64	37.4	4	30	32	-0.01	-9999	-9999	1.192	4.2	419	2948	38700	38720	2116	2529	400	14.15	1.12
8.1	26.574	-8.1	46.0	19.42	19.44	0.27	1.37	4.12	6	4	7	5	5.00E-05	114.6	1.512	0.23	1.282	0.88	7.4	6.6	5.3	4	13.99	1.48	-0.01	2.71	40.9	4	30	32	-0.03	-9999	-9999	1.195	4.1	460	3024	38840	38880	2116	2564	540	13.99	1.51
8.3	27.231	-8.3	45.4	9.92	10.1	0.12	1.22	39.56	5	3	5	3	5.00E-06	114.6	1.55	0.251	1.299	0.88	4.8	4.2	3.2	2.2	6.58	1.44	0.12	2.99	57.7	3	-9999	-9999	-9999	-9999	-9999	0.57	1.5	501	3100	19840	20200	2116	2599	240	6.58	1.40
8.5	27.887	-8.5	44.7	12.18	12.35	0.24	1.91	35.72	5	3	5	4	5.00E-06	114.6	1.587	0.271	1.316	0.87	5.9	5.2	4	2.8	8.18	2.19	0.08	3	58.2	3	-9999	-9999	-9999	-9999	-9999	0.718	1.9	542	3174	24360	24700	2116	2632	480	8.18	2.23
8.7	28.543	-8.7	44.1	18.21	18.29	0.27	1.48	18.29	6	4	6	5	5.00E-05	114.6	1.625	0.292	1.333	0.87	7	6.1	5.2	3.7	12.5	1.62	0.02	2.77	44.3	4	30	30	-0.02	-9999	-9999	1.111	3.5	583	3250	36420	36580	2116	2667	540	12.50	1.62
8.9	29.199	-8.9	43.4	12.71	12.86	0.28	2.2	30.57	5	3	5	4	5.00E-06	114.6	1.662	0.312	1.35	0.86	6.2	5.3	4.2	2.8	8.29	2.53	0.06	3.02	60.1	3	-9999	-9999	-9999	-9999	-9999	0.746	2	624	3324	25420	25720	2116	2700	560	8.29	2.50
9.1	29.855	-9.1	42.7	7.78	8.02	0.24	3	50.46	4	3	4	3	5.00E-07	114.6	1.7	0.333	1.367	0.86	5.1	4.4	3.3	2	4.62	3.81	0.2	3.33	83.9	3	-9999	-9999	-9999	-9999	-9999	0.421	1	665	3400	15560	16040	2116	2735	480	4.62	3.80
9.3	30.511	-9.3	42.1	10.48	10.8	0.19	1.72	68.77	5	3	4	3	5.00E-06	114.6	1.738	0.353	1.384	0.85	5.2	4.4	3.6	2.3	6.55	2.05	0.2	3.06	62.9	3	-9999	-9999	-9999	-9999	-9999	0.604	1.5	706	3476	20960	21600	2116	2770	380	6.54	2.10
9.5	31.168	-9.5	41.4	11.4	11.58	0.28	2.42	37.39	5	3	5	4	5.00E-06	114.6	1.775	0.374	1.401	0.84	5.5	4.7	4	2.5	6.99	2.86	0.08	3.12	66.6	3	-9999	-9999	-9999	-9999	-9999	0.654	1.6	747	3550	22800	23160	2116	2803	560	7.00	2.86
9.7	31.824	-9.7	40.8	5.33	5.74	0.18	3.19	87.22	3	3	3	3	5.00E-08	111.4	1.812	0.394	1.418	0.84	5.5	4.6	2.9	1.5	2.77	4.66	0.59	3.57	100	3	-9999	-9999	-9999	-9999	-9999	0.262	0.7	788	3624	10660	11480	2116	2836	360	2.77	4.58
9.9	32.48	-9.9	40.1	4.85	5.13	0.11	2.05	58.2	4	3	3	3	5.00E-07	114.6	1.849	0.415	1.435	0.83	3.3	2.7	2.6	1.2	2.28	3.21	0.43	3.56	100	3	-9999	-9999	-9999	-9999	-9999	0.219	0.6	829	3698	9700	10260	2116	2869	220	2.29	3.35
10.1	33.136	-10.1	39.5	5.67	6.1	0.08	1.23	92.75	1	3	3	3	1.00E-07	111.4	1.886	0.435	1.451	0.83	2.9	2.4	2.5	1.3	2.91	1.78	0.58	3.35	85.1	3	-9999	-9999	-9999	-9999	-9999	0.281	0.7	870	3772	11340	12200	2116	2902	160	2.90	1.90
10.3	33.792	-10.3	38.8	5.09	5.58	0.08	1.44	103.22	1	3	3	3	1.00E-07	111.4	1.923	0.456	1.467	0.83	2.7	2.2	2.5	1.2	2.49	2.2	0.76	3.45	94	3	-9999	-9999	-9999	-9999	-9999	0.244	0.7	911	3846	10180	11160	2116	2935	160	2.49	2.19
10.5	34.448	-10.5	38.2	4.69	5.18	0.07	1.31	103.77	1	3	3	3	1.00E-07	111.4	1.959	0.476	1.483	0.82	2.5	2	2.4	1.1	2.17	2.1	0.86	3.49	98.2	3	-9999	-9999	-9999	-9999	-9999	0.215	0.6	951	3918	9380	10360	2116	2967	140	2.17	2.17
10.7	35.105	-10.7	37.5	4.6	5.1	0.09	1.82	107.27	4	3	3	3	5.00E-07	114.6	1.997	0.497	1.5	0.82	3.3	2.7	2.6	1.1	2.07	2.99	0.92	3.58	100	3	-9999	-9999	-9999	-9999	-9999	0.207	0.6	992	3994	9200	10200	2116	3002	180	2.07	2.90
10.9	35.761	-10.9	36.8	5.38	5.83	0.09	1.5	95.67	1	3	3	3	1.00E-07	111.4	2.034	0.517	1.517	0.81	2.8	2.3	2.6	1.2	2.5	2.31	0.65	3.46	94.8	3	-9999	-9999	-9999	-9999	-9999	0.253	0.7	1033	4068	10760	11660	2116	3035	180	2.50	2.37
11.1	36.417	-11.1	36.2	4.77	5.28	0.09	1.76	108.42	4	3	3	3	5.00E-07	114.6	2.071	0.538	1.533	0.81	3.4	2.7	2.7	1.1	2.09	2.89	0.89	3.57	100	3	-9999	-9999	-9999	-9999	-9999	0.214	0.6	1074	4142	9540	10560	2116	3068	180	2.09	2.80
11.3	37.073	-11.3	35.5	4.79	5.36	0.06	1.08	120.37	1	3	3	3	1.00E-07	111.4	2.108	0.558	1.55	0.8	2.6	2.1	2.5	1	2.1	1.77	0.99	3.47	96.5	3	-9999	-9999	-9999	-9999	-9999	0.217	0.6	1115	4216	9580	10720	2116	3101	120	2.10	1.85
11.5	37.729	-11.5	34.9	5.19	5.67	0.08	1.46	103.51	1	3	3	3	1.00E-07	111.4	2.144	0.579	1.566	0.8	2.7	2.2	2.7	1.1	2.25	2.34	0.75	3.5	98.9	3	-9999	-9999	-9999	-9999	-9999	0.235	0.6	1156	4288	10380	11340	2116	3132	160	2.25	2.27
11.7	38.385	-11.7	34.2	4.52	5.09	0.07	1.28	121.89	1	3	3	1	1.00E-07	111.4	2.181	0.599	1.582	0.8	2.4	1.9	2.6	1	1.84	2.24	1.1	3.57	100	3	-9999	-9999	-9999	-9999	-9999	0.194	0.6	1197	4362	9040	10180	2116	3165	140	1.84	2.41
11.9	39.042	-11.9	33.6	4.65	5.2	0.08	1.45	116.99	1	3	3	1	1.00E-07	111.4	2.217	0.62	1.598	0.79	2.5	2	2.7	1	1.86	2.52	1.02	3.59	100	3	-9999	-9999	-9999	-9999	-9999	0.199	0.6	1238	4434	9300	10400	2116	3196	160	1.87	2.68
12.1	39.698	-12.1	32.9	5.78	6.32	0.12	1.9	115.29	4	3	3	3	5.00E-07	114.6	2.254	0.64	1.614	0.79	4	3.2	3	1.2	2.52	2.96	0.73	3.5	100	3	-9999	-9999	-9999	-9999	-9999	0.271	0.7	1279	4508	11560	12640	2116	3229	240	2.52	2.95
12.3	40.354	-12.3	32.2	4.87	5.49	0.08	1.46	132.1	1	3	3	1	1.00E-07	111.4	2.291	0.66	1.631	0.78	2.6	2.1	2.8	1	1.96	2.51	1.08	3.57	100	3	-9999	-9999	-9999	-9999	-9999	0.213	0.6	1320	4582	9740	10980	2116	3262	160	1.96	2.50
12.5	41.01	-12.5	31.6	4.58	5.22	0.05	0.96	135.3	1	3	1	1	1.00E-07	111.4	2.328	0.681	1.647	0.78	2.5	1.9	2.6	0.9	1.75	1.73	1.23	3.54	100	3	-9999	-9999	-9999	-9999	-9999	0.193	0.6	1361	4656	9160	10440	2116	3295	100	1.76	1.73
12.7	41.666	-12.7	30.9	4.86	5.51	0.06	1	138.94	1	3	3	1	1.00E-07	111.4	2.365	0.701	1.663	0.78	2.6	2	2.6	0.9	1.89	1.75	1.16	3.51	100	3	-9999	-9999	-9999	-9999	-9999	0.21	0.6	1402	4730	9720	11020	2116	3328	120	1.89	1.91
12.9	42.322	-12.9	30.3	5.26	5.89	0.06	1.02	136.02	1	3	3	1	1.00E-07	111.4	2.401	0.722	1.679	0.77	2.8	2.2	2.7	1	2.08	1.72	1.01	3.47	96.3	3	-9999	-9999	-9999	-9999	-9999	0.233	0.6	1443	4802	10520	11780	2116	3359	120	2.08	1.72
13.1	42.978	-13.1	29.6	5.13	5.82	0.06	0.95	147.34	1	3	3	1	1.00E-07	111.4	2.438	0.742	1.695	0.77	2.8	2.1	2.7	1	1.99	1.63	1.14	3.48	96.9	3	-9999	-9999	-9999	-9999	-9999	0.225	0.6	1484	4876	10260	11640	2116	3392	120	1.99	1.77
13.3	43.635	-13.3	29.0	5.08	5.75	0.06	1.05	142.87	1	3	3	1	1.00E-07	111.4	2.474	0.763	1.711	0.76	2.8	2.1	2.8	1	1.92	1.84	1.13	3.52	100	3	-9999	-9999	-9999	-9999	-9999	0.218	0.6	1525	4948	10160	11500	2116	3423	120	1.91	1.83
13.5	44.291	-13.5	28.3	5.46	5.98	0.17	2.77	110.54	3	2	3	3	5.00E-08	111.4	2.511	0.783	1.727	0.76	5.7	4.4	3.4	1.2	2.01	4.77	0.77	3.69	100	2	-9999	-9999	-9999	-9999	-9999	0.231	0.6	1566	5022	10920	11960	2116	3456	340	2.01	4.90
13.7	44.947	-13.7	27.7	5.7	6.1	0.1	1.64	86.14	4	3	3	2	5.00E-07	114.6	2.548	0.804	1.744	0.76	3.9	3	3.1	1.1	2.04	2.82	0.53	3.57	100	3	-9999	-9999	-9999	-9999	-9999	0.237	0.6	1607	5096	11400	12200	2116	3489	200	2.04	2.82
13.9	45.603	-13.9	27.0	5.74	6.4	0.08	1.21	140.68	1	3	3	3	1.00E-07	111.4	2.585	0.824	1.761	0.75	3.1	2.3	3	1.1	2.16	2.04	0.94	3.49	97.8	3	-9999	-9999	-9999	-9999	-9999	0.254	0.6	1648	5170	11480	12800	2116	3522	160	2.17	2.10
14.1	46.259	-14.1	26.3	5.72	6.38	0.08	1.18	141	1	3	3	3	1.00E-07	111.4	2.621	0.845	1.777	0.75	3.1	2.3	3	1	2.11	2	0.95	3.49	98.3	3	-9999	-9999	-9999	-9999	-9999	0.25	0.6	1688	5242	11440	12760	2116	3554	160	2.12	2.13
14.3	46.915	-14.3	25.7	5.92	6.57	0.08	1.15	137.52	1	3	3	3	1.00E-07	111.4	2.658	0.865	1.793	0.75	3.1	2.3	3	1	2.18	1.92	0.88	3.47	96.5	3	-9999	-9999	-9999	-9999	-9999	0.261	0.6	1729	5316	11840	13140	2116	3587	160	2.18	2.04
14.5	47.572	-14.5	25.0	5.88	6.54	0.08	1.19	142.05	1	3	3	3	1.00E-07	111.4	2.695	0.886	1.809	0.74	3.1	2.3	3.1	1	2.13	2.02	0.92	3.49	98.2	3	-9999	-9999	-9999	-9999	-9999	0.257	0.6	1770	5390	11760	13080	2116	3620	160	2.12	2.08
14.7	48.228	-14.7	24.4	6.1	6.84	0.09	1.32	157.57	1	3	3	3	1.00E-07	111.4	2.731	0.906	1.825	0.74	3.3	2.4	3.2	1.1	2.25	2.2	0.98	3.49	97.7	3	-9999	-9999	-9999	-9999	-9999	0.274	0.6	1811	5462	12200	13680	2116	3651	180	2.25	2.19
14.9	48.884	-14.9	23.7	6.72	7.46	0.1	1.28	157.23	5	3	3	3	5.00E-06	114.6	2.768	0.927	1.841	0.74	3.6	2.6	3.3	1.2	2.55	2.03	0.85	3.42	91.8	3	-9999	-9999	-9999	-9999	-9999	0.313	0.7	1852	5536	13440	14920	2116	3684	200	2.55	2.13
15.1	49.54	-15.1	23.1	6.63	7.4	0.09	1.15	164.79	1	3	3	3	1.00E-07	111.4	2.805	0.947	1.858	0.73	3.5	2.6	3.2	1.1	2.47	1.85	0.91	3.42	91.3	3	-9999	-9999	-9999	-9999	-9999	0.306	0.7	1893	5610	13260	14800	2116	3717	180	2.47	1.96
15.3	50.196	-15.3	22.4	8.29	9.04	0.15	1.61	161.29	4	3	3	3	5.00E-06	114.6	2.842	0.968	1.875	0.73	4.3	3.2	3.8	1.4	3.31	2.34	0.66	3.35	85.4	3	-9999	-9999	-9999	-9999	-9999	0.413	0.8	1934	5684	16580	18080	2116	3750	300	3.31	2.42
15.5	50.852	-15.5	21.7	12.93	13.38	0.38	2.83	94.54	5	3	4	3	5.00E-06	114.6	2.88	0.988	1.892	0.73	6.4	4.7	5.1	2.2	5.55	3.61	0.19	3.25	77.3	3	-9999	-9999	-9999	-9999	-9999	0.7	1.2	1975	5760	25860	26760	2116	3785	760	5.55	3.62

CPTU-613 Liquefaction Analysis

text

...06205z$^{1.5}$ + 0.001210z^{2}]

Youd and Idriss, 2001

...rkshop, reiterated in Youd and Idriss, 2001

CPTU-613 Liquefaction Analysis

...rel density of 60 to 80%; P_a = pressure at 1 atmosphere   Youd and Idriss, 2001

Row	AT	AU	AV	AW	AX	AY	AZ	BA	BB	BC	BD	BE	BF	BG	BH	BI	BJ	BK	BL	BM
34	Col-46	Col-47	Col-48	Col-49	Col-50	Col-51	Col-52	Col-53	Col-54	Col-55	Col-56	Col-57	Col-57a	Col-58	Col-59	Col-60	Col-61	Col-62	Col-63	Col-64
35	Youd & Idriss, 2001 CPT Based Analysis																			
36																				
37	$I_{c\,Qexp=1}$	$Q_{exp=0.5}$	F	$I_{c\,Qexp=0.5}$	$Q_{exp=0.7}$	F	$I_{c\,Qexp=0.7}$	Description	C_q			q_{c1N}	Lookup	Ic	Kc	$(q_{c1N})_{cs}$	CRR7.5	rd	a_{max}/g =	CSR
38									n=1.0	n=0.5	n=0.7		Col						if crest accel	No
39																			2.0	Amplification
40	1.07	65.67	0.33	1.81	148.32	0.33	1.49	Granular	58.78	7.67	17.32	65.80	5.00	1.81	1.11	73.33	0.12	1.00	0.22	0.07
41	1.56	63.90	0.91	2.04	115.44	0.91	1.84	Granular	19.24	4.39	7.92	64.13	4.00	2.04	1.35	86.88	0.14	1.00	0.22	0.07
42	1.69	54.57	0.93	2.10	88.74	0.93	1.93	Granular	11.38	3.37	5.49	54.87	2.00	2.10	1.46	80.08	0.13	1.00	0.22	0.07
43	1.83	45.31	1.01	2.19	68.81	1.01	2.04	Granular	8.08	2.84	4.32	45.66	2.00	2.19	1.64	74.77	0.12	1.00	0.21	0.07
44	2.00	37.24	1.27	2.32	53.81	1.27	2.19	Granular	6.30	2.51	3.63	37.64	2.00	2.32	2.00	75.27	0.12	1.00	0.21	0.07
45	2.30	21.47	1.70	2.58	29.78	1.70	2.47	Granular	5.14	2.27	3.14	21.91	2.00	2.58	3.22	70.66	0.11	0.99	0.21	0.07
46	2.03	27.07	0.73	2.31	36.33	0.73	2.20	Granular	4.35	2.09	2.80	27.55	2.00	2.31	1.97	54.33	0.09	0.99	0.21	0.07
47	2.51	11.78	1.40	2.76	15.36	1.40	2.66	Very Silty	3.78	1.94	2.54	16.04	2.00	2.66	3.73	59.74	0.10	0.99	0.21	0.07
48	2.88	3.82	0.90	3.12	4.86	0.90	3.02	Clayey	3.34	1.83	2.32	7.98	2.00	2.88	5.48	43.74	0.08	0.99	0.21	0.07
49	2.63	9.09	1.26	2.84	11.33	1.26	2.75	Clayey	3.00	1.73	2.16	16.74	2.00	2.63	3.51	58.70	0.10	0.99	0.21	0.07
50	2.77	8.67	1.97	2.95	10.58	1.97	2.88	Clayey	2.71	1.64	2.01	15.27	2.00	2.77	4.51	68.88	0.11	0.99	0.20	0.07
51	2.42	16.78	1.15	2.59	20.11	1.15	2.52	Granular	2.47	1.57	1.88	17.42	2.00	2.59	3.24	56.36	0.10	0.98	0.20	0.07
52	2.94	6.16	2.08	3.09	7.26	2.08	3.03	Clayey	2.27	1.51	1.78	10.28	2.00	2.94	6.07	62.44	0.10	0.98	0.20	0.07
53	3.43	1.82	2.26	3.58	2.11	2.26	3.52	Clayey	2.10	1.45	1.68	3.64	2.00	3.43	12.86	46.79	0.08	0.98	0.20	0.07
54	2.70	10.66	1.61	2.83	12.20	1.61	2.78	Clayey	1.96	1.40	1.60	15.93	2.00	2.70	4.02	64.07	0.10	0.98	0.20	0.07
55	2.81	9.21	1.95	2.93	10.39	1.95	2.88	Clayey	1.83	1.35	1.53	13.47	2.00	2.81	4.90	65.97	0.11	0.98	0.20	0.07
56	2.78	9.59	1.68	2.88	10.69	1.68	2.84	Clayey	1.72	1.31	1.46	13.58	2.00	2.78	4.59	62.28	0.10	0.98	0.20	0.07
57	2.70	11.33	1.49	2.79	12.48	1.49	2.75	Clayey	1.62	1.27	1.40	15.42	2.00	2.70	3.98	61.40	0.10	0.98	0.19	0.07
58	2.71	11.53	1.52	2.79	12.56	1.52	2.75	Clayey	1.53	1.24	1.35	15.28	2.00	2.71	4.05	61.84	0.10	0.97	0.19	0.07
59	2.80	10.62	1.93	2.87	11.45	1.93	2.84	Clayey	1.45	1.21	1.30	13.80	2.00	2.80	4.80	66.24	0.11	0.97	0.19	0.07
60	2.67	12.67	1.40	2.73	13.51	1.40	2.71	Clayey	1.38	1.18	1.25	15.90	2.00	2.67	3.81	60.48	0.10	0.97	0.19	0.07
61	2.90	8.07	1.75	2.95	8.53	1.75	2.93	Clayey	1.32	1.15	1.21	10.26	2.00	2.90	5.69	58.40	0.10	0.97	0.19	0.07
62	2.98	7.64	2.22	3.02	8.00	2.22	3.01	Clayey	1.26	1.12	1.17	9.57	2.00	2.98	6.54	62.60	0.10	0.97	0.19	0.07
63	2.98	7.69	2.16	3.02	7.98	2.16	3.00	Clayey	1.21	1.10	1.14	9.44	2.00	2.98	6.53	61.68	0.10	0.97	0.19	0.07
64	3.63	2.10	4.36	3.66	2.16	4.36	3.65	Clayey	1.16	1.08	1.11	3.26	2.00	3.63	16.57	53.98	0.09	0.97	0.18	0.07
65	3.65	1.76	3.39	3.67	1.80	3.39	3.66	Clayey	1.11	1.05	1.08	2.86	2.00	3.65	16.97	48.49	0.08	0.96	0.18	0.07
66	3.52	2.43	3.22	3.54	2.46	3.22	3.53	Clayey	1.07	1.03	1.05	3.51	2.00	3.52	14.51	50.97	0.09	0.96	0.18	0.07
67	3.15	5.80	2.49	3.15	5.83	2.49	3.15	Clayey	1.03	1.02	1.02	6.89	2.00	3.15	8.52	58.70	0.10	0.96	0.18	0.07
68	3.75	1.81	5.21	3.75	1.81	5.21	3.75	Clayey	1.00	1.00	1.00	2.81	2.00	3.75	19.17	53.79	0.09	0.96	0.18	0.07
69	3.43	2.98	2.80	3.43	2.96	2.80	3.43	Clayey	0.97	0.98	0.98	3.94	2.00	3.43	12.93	50.88	0.09	0.96	0.18	0.07
70	3.62	2.18	3.81	3.61	2.16	3.81	3.62	Clayey	0.95	0.98	0.97	3.15	2.00	3.62	16.43	51.73	0.09	0.96	0.18	0.07
71	3.20	5.46	2.68	3.19	5.39	2.68	3.20	Clayey	0.94	0.97	0.96	6.33	2.00	3.20	9.30	58.84	0.10	0.96	0.17	0.07
72	3.03	7.60	2.15	3.02	7.49	2.15	3.02	Clayey	0.92	0.96	0.95	8.37	2.00	3.03	7.12	59.62	0.10	0.95	0.17	0.07
73	2.75	13.75	1.57	2.73	13.50	1.57	2.74	Clayey	0.91	0.95	0.94	14.20	2.00	2.75	4.34	61.64	0.10	0.95	0.17	0.07
74	3.05	9.31	3.08	3.03	9.11	3.08	3.04	Clayey	0.90	0.95	0.93	9.91	2.00	3.05	7.30	72.32	0.12	0.95	0.17	0.07
75	3.11	6.46	2.20	3.09	6.30	2.20	3.09	Clayey	0.88	0.94	0.92	7.18	2.00	3.11	8.03	57.64	0.10	0.95	0.17	0.07
76	2.80	13.00	1.77	2.78	12.64	1.77	2.79	Clayey	0.87	0.93	0.91	13.26	2.00	2.80	4.79	63.51	0.10	0.95	0.17	0.08
77	2.92	10.96	2.24	2.89	10.63	2.24	2.90	Clayey	0.86	0.93	0.90	11.30	2.00	2.92	5.91	66.73	0.11	0.94	0.17	0.08
78	2.59	16.79	1.04	2.56	16.25	1.04	2.58	Granular	0.85	0.92	0.89	18.04	2.00	2.56	3.10	56.02	0.10	0.94	0.16	0.08
79	2.64	15.46	1.12	2.61	14.92	1.12	2.62	Clayey	0.84	0.91	0.88	15.31	2.00	2.64	3.60	55.19	0.10	0.94	0.16	0.08
80	2.71	15.39	1.51	2.68	14.81	1.51	2.69	Clayey	0.83	0.91	0.87	15.16	2.00	2.71	4.09	61.97	0.10	0.94	0.16	0.08
81	2.98	7.29	1.40	2.94	7.00	1.40	2.96	Clayey	0.81	0.90	0.87	7.77	2.00	2.98	6.56	51.00	0.09	0.93	0.16	0.08
82	3.00	9.12	2.23	2.96	8.73	2.23	2.98	Clayey	0.80	0.90	0.86	9.38	2.00	3.00	6.74	63.28	0.10	0.93	0.16	0.08
83	2.77	14.03	1.62	2.73	13.40	1.62	2.74	Clayey	0.79	0.89	0.85	13.72	2.00	2.77	4.54	62.26	0.10	0.93	0.16	0.08
84	3.02	9.37	2.50	2.98	8.92	2.50	2.99	Clayey	0.78	0.89	0.84	9.53	2.00	3.02	6.98	66.50	0.11	0.92	0.16	0.08
85	3.33	5.25	3.80	3.29	4.99	3.80	3.30	Clayey	0.77	0.88	0.84	5.86	2.00	3.33	11.23	65.85	0.11	0.92	0.15	0.08
86	3.07	7.49	2.10	3.02	7.09	2.10	3.04	Clayey	0.76	0.87	0.83	7.80	2.00	3.07	7.55	58.87	0.10	0.92	0.15	0.08
87	3.11	8.05	2.86	3.06	7.61	2.86	3.08	Clayey	0.75	0.87	0.82	8.26	2.00	3.11	8.11	66.99	0.11	0.91	0.15	0.08
88	3.56	3.21	4.58	3.51	3.02	4.58	3.53	Clayey	0.75	0.86	0.81	4.05	2.00	3.56	15.30	61.92	0.10	0.91	0.15	0.08
89	3.57	2.66	3.35	3.51	2.51	3.35	3.53	Clayey	0.74	0.86	0.81	3.58	2.00	3.57	15.35	54.88	0.10	0.91	0.15	0.08
90	3.36	3.40	1.90	3.30	3.19	1.90	3.32	Clayey	0.73	0.85	0.80	4.20	2.00	3.36	11.66	49.01	0.08	0.90	0.15	0.08
91	3.45	2.93	2.19	3.38	2.75	2.19	3.41	Clayey	0.72	0.85	0.80	3.80	2.00	3.45	13.13	49.93	0.08	0.90	0.15	0.08
92	3.50	2.57	2.17	3.43	2.40	2.17	3.46	Clayey	0.71	0.84	0.79	3.49	2.00	3.50	14.07	49.12	0.08	0.89	0.14	0.08
93	3.58	2.46	2.90	3.51	2.30	2.90	3.54	Clayey	0.70	0.84	0.78	3.40	2.00	3.58	15.51	52.70	0.09	0.89	0.14	0.08
94	3.46	3.00	2.37	3.39	2.79	2.37	3.42	Clayey	0.70	0.84	0.78	3.84	2.00	3.46	13.39	51.43	0.09	0.89	0.14	0.08
95	3.56	2.52	2.80	3.49	2.34	2.80	3.52	Clayey	0.69	0.83	0.77	3.44	2.00	3.56	15.29	52.62	0.09	0.88	0.14	0.08
96	3.48	2.54	1.85	3.41	2.35	1.85	3.44	Clayey	0.68	0.83	0.77	3.46	2.00	3.48	13.75	47.53	0.08	0.88	0.14	0.09
97	3.49	2.74	2.27	3.42	2.53	2.27	3.45	Clayey	0.68	0.82	0.76	3.62	2.00	3.49	13.96	50.55	0.09	0.87	0.14	0.09
98	3.58	2.25	2.41	3.51	2.07	2.41	3.54	Clayey	0.67	0.82	0.75	3.22	2.00	3.58	15.67	50.39	0.09	0.86	0.14	0.09
99	3.60	2.29	2.68	3.52	2.11	2.68	3.55	Clayey	0.66	0.81	0.75	3.25	2.00	3.60	15.97	51.96	0.09	0.86	0.13	0.09
100	3.50	3.11	2.95	3.42	2.86	2.95	3.46	Clayey	0.66	0.81	0.74	3.91	2.00	3.50	14.15	55.39	0.10	0.85	0.13	0.09
101	3.57	2.44	2.50	3.48	2.23	2.50	3.52	Clayey	0.65	0.81	0.74	3.37	2.00	3.57	15.32	51.58	0.09	0.85	0.13	0.09
102	3.54	2.19	1.73	3.45	2.00	1.73	3.49	Clayey	0.64	0.80	0.73	3.17	2.00	3.54	14.83	46.98	0.08	0.84	0.13	0.09
103	3.53	2.37	1.91	3.44	2.16	1.91	3.48	Clayey	0.64	0.80	0.73	3.31	2.00	3.53	14.62	48.40	0.08	0.84	0.13	0.08
104	3.47	2.62	1.72	3.38	2.39	1.72	3.42	Clayey	0.63	0.79	0.72	3.51	2.00	3.47	13.59	47.64	0.08	0.83	0.13	0.08
105	3.49	2.52	1.77	3.40	2.30	1.77	3.44	Clayey	0.62	0.79	0.72	3.43	2.00	3.49	13.98	47.97	0.08	0.82	0.13	0.08
106	3.52	2.43	1.83	3.42	2.21	1.83	3.46	Clayey	0.62	0.79	0.71	3.36	2.00	3.52	14.38	48.32	0.08	0.82	0.12	0.08
107	3.70	2.57	4.90	3.61	2.33	4.90	3.64	Clayey	0.61	0.78	0.71	3.46	2.00	3.70	18.02	62.36	0.10	0.81	0.12	0.08
108	3.58	2.61	2.82	3.48	2.37	2.82	3.52	Clayey	0.61	0.78	0.70	3.50	2.00	3.58	15.50	54.21	0.09	0.80	0.12	0.08
109	3.49	2.79	2.10	3.39	2.52	2.10	3.43	Clayey	0.60	0.78	0.70	3.63	2.00	3.49	13.96	50.72	0.09	0.80	0.12	0.08
110	3.50	2.74	2.13	3.40	2.47	2.13	3.44	Clayey	0.60	0.77	0.70	3.59	2.00	3.50	14.18	50.91	0.09	0.79	0.12	0.08
111	3.49	2.84	2.04	3.38	2.56	2.04	3.42	Clayey	0.59	0.77	0.69	3.66	2.00	3.49	13.82	50.64	0.09	0.78	0.12	0.08
112	3.50	2.78	2.08	3.39	2.50	2.08	3.44	Clayey	0.58	0.76	0.69	3.61	2.00	3.50	14.07	50.84	0.09	0.78	0.12	0.08
113	3.49	2.96	2.19	3.38	2.65	2.19	3.42	Clayey	0.58	0.76	0.68	3.75	2.00	3.49	13.84	51.86	0.09	0.77	0.11	0.08
114	3.43	3.36	2.13	3.33	3.01	2.13	3.37	Clayey	0.57	0.76	0.68	4.05	2.00	3.43	12.89	52.22	0.09	0.76	0.11	0.08
115	3.43	3.28	1.96	3.32	2.93	1.96	3.36	Clayey	0.57	0.75	0.67	3.98	2.00	3.43	12.81	51.01	0.09	0.76	0.11	0.08
116	3.36	4.40	2.42	3.25	3.92	2.42	3.29	Clayey	0.56	0.75	0.67	4.82	2.00	3.36	11.64	56.13	0.10	0.75	0.11	0.08
117	3.25	7.42	3.62	3.15	6.61	3.62	3.19	Clayey	0.56	0.75	0.67	7.07	2.00	3.25	10.03	70.95	0.11	0.74	0.11	0.08

Row	BN	BO	BP	BQ	BR	BS	BT	BU	BV	BW	BX	BY	BZ	CA	CB	CC	CD	CE	CF	CG	CH
34	Col-65	Col-66	Col-67	Col-68	Col-69	Col-70	Col-71	Col-72	Col-73	Col-74	Col-75	Col-76	Col-77	Col-78	Col-79	Col-80	Col-81	Col-82	Col-83	Col-84	Col-85
35												Boulanger and Idriss, 2004, "Approach B" method based on Su profile									
36	Rel. Den. Factor											Su - CPT	OCR								
37		f	MSF	K_σ	α	K_α	FS liq- CPT (Sand-Like)		Apparent Fines	Measured Fines	**Ic** Limits	(psf)	Assumed	OCR - CPT	α	k_α	$CRR_{M7.5}$	MSF	$CRR_{M5.5}$	FS liq-Su (Clay-Like)	
38	f crest accel =						No	f crest accel =	(%)	(%)		Nkt	1.1							No	f crest accel
39	2				0.08		Amplification	2				10.5			0.08					Amplification	2
40	0.14	0.7	2.2	3.39	0.08	0.9075	11.05	5.54	8		2.6	1726	1.1		0.08	0.93	28.57	1.11	31.75	443.73	222.60
41	0.14	0.7	2.2	2.43	0.08	0.9000	9.48	4.79	14		2.6	2936	1.1		0.08	0.93	15.91	1.11	17.67	247.30	124.88
42	0.14	0.7	2.2	2.07	0.08	0.9000	7.35	3.74	16		2.6	3260	1.1		0.08	0.93	10.45	1.11	11.61	162.63	82.67
43	0.14	0.7	2.2	1.87	0.08	0.9000	6.18	3.16	19		2.6	3213	1.1		0.08	0.93	7.31	1.11	8.12	113.96	58.32
44	0.14	0.7	2.2	1.74	0.08	0.9000	5.78	2.98	23		2.6	2991	1.1		0.08	0.93	5.30	1.11	5.89	82.84	42.68
45	0.14	0.7	2.2	1.63	0.08	0.9000	5.14	2.67	35		2.6	1909	1.1		0.08	0.93	2.76	1.11	3.07	43.20	22.41
46	0.14	0.7	2.2	1.55	0.08	0.9000	4.12	2.15	23		2.6	2615	1.1		0.08	0.93	3.21	1.11	3.56	50.23	26.24
47	0.13	0.7	2.2	1.49	0.08	0.9000	4.16	2.19	38		2.6	1221	1.1		0.08	0.93	1.30	1.11	1.44	20.39	10.72
48	0.13	0.7	2.2	1.44	0.08	0.9000	3.14	1.66	51		2.6	422	1.1		0.08	0.93	0.40	1.11	0.44	6.23	3.30
49	0.13	0.7	2.2	1.39	0.08	0.9000	3.85	2.05	37		2.6	1058	1.1		0.08	0.93	0.89	1.11	0.99	14.06	7.50
50	0.13	0.7	2.2	1.35	0.08	0.9000	4.18	2.25	44		2.6	1063	1.1		0.08	0.93	0.81	1.11	0.90	12.76	6.86
51	0.13	0.7	2.2	1.31	0.08	0.9000	3.57	1.93	35		2.6	2151	1.1		0.08	0.93	1.50	1.11	1.66	23.64	12.79
52	0.13	0.7	2.2	1.28	0.08	0.9000	3.70	2.01	54		2.6	824	1.1		0.08	0.93	0.53	1.11	0.59	8.33	4.54
53	0.13	0.7	2.2	1.25	0.08	0.9000	2.84	1.56	93		2.6	253	1.1		0.08	0.93	0.15	1.11	0.17	2.37	1.30
54	0.13	0.7	2.2	1.22	0.08	0.9000	3.61	2.00	41		2.6	1535	1.1		0.08	0.93	0.85	1.11	0.94	13.43	7.42
55	0.13	0.7	2.2	1.20	0.08	0.9000	3.62	2.02	47		2.6	1370	1.1		0.08	0.93	0.71	1.11	0.79	11.23	6.25
56	0.12	0.7	2.2	1.18	0.08	0.9000	3.42	1.92	45		2.6	1473	1.1		0.08	0.93	0.71	1.11	0.79	11.35	6.37
57	0.12	0.7	2.2	1.16	0.08	0.9000	3.33	1.88	40		2.6	1794	1.1		0.08	0.93	0.82	1.11	0.91	13.03	7.36
58	0.12	0.7	2.2	1.14	0.08	0.9000	3.29	1.88	41		2.6	1876	1.1		0.08	0.93	0.81	1.11	0.90	12.92	7.35
59	0.12	0.7	2.2	1.12	0.08	0.9000	3.41	1.95	46		2.6	1776	1.1		0.08	0.93	0.73	1.11	0.81	11.60	6.66
60	0.12	0.7	2.2	1.10	0.08	0.9000	3.16	1.83	39		2.6	2170	1.1		0.08	0.93	0.85	1.11	0.94	13.52	7.81
61	0.12	0.7	2.2	1.09	0.08	0.9000	3.05	1.78	52		2.6	1417	1.1		0.08	0.93	0.53	1.11	0.58	8.42	4.90
62	0.12	0.7	2.2	1.07	0.08	0.9000	3.15	1.85	57		2.6	1373	1.1		0.08	0.93	0.49	1.11	0.54	7.80	4.58
63	0.12	0.7	2.2	1.06	0.08	0.9000	3.08	1.82	57		2.6	1412	1.1		0.08	0.93	0.48	1.11	0.53	7.69	4.55
64	0.12	0.7	2.2	1.04	0.08	0.9000	2.83	1.69	100		2.6	393	1.1		0.08	0.93	0.13	1.11	0.14	2.06	1.23
65	0.11	0.7	2.2	1.03	0.08	0.9000	2.43	1.46	100		2.6	337	1.1		0.08	0.93	0.11	1.11	0.12	1.70	1.02
66	0.11	0.7	2.2	1.02	0.08	0.9000	2.71	1.64	100		2.6	473	1.1		0.08	0.93	0.14	1.11	0.16	2.30	1.39
67	0.11	0.7	2.2	1.01	0.08	0.9000	2.87	1.75	69		2.6	1150	1.1		0.08	0.93	0.33	1.11	0.37	5.40	3.30
68	0.11	0.7	2.2	1.00	0.08	0.9000	2.72	1.67	100		2.6	365	1.1		0.08	0.93	0.10	1.11	0.11	1.66	1.02
69	0.11	0.7	2.2	0.99	0.08	0.9000	2.63	1.63	93		2.6	611	1.1		0.08	0.93	0.17	1.11	0.18	2.69	1.67
70	0.11	0.7	2.2	0.99	0.08	0.9000	2.59	1.62	100		2.6	450	1.1		0.08	0.93	0.12	1.11	0.13	1.92	1.20
71	0.11	0.7	2.2	0.98	0.08	0.9000	2.70	1.71	73		2.6	1136	1.1		0.08	0.93	0.30	1.11	0.33	4.69	2.96
72	0.11	0.7	2.2	0.98	0.08	0.9000	2.67	1.70	61		2.6	1594	1.1		0.08	0.93	0.41	1.11	0.46	6.39	4.07
73	0.11	0.7	2.2	0.97	0.08	0.9000	2.68	1.72	43		2.6	2905	1.1		0.08	0.93	0.74	1.11	0.83	11.32	7.26
74	0.11	0.7	2.2	0.97	0.08	0.9000	2.98	1.93	62		2.6	1980	1.1		0.08	0.93	0.50	1.11	0.56	7.51	4.86
75	0.11	0.7	2.2	0.96	0.08	0.9000	2.49	1.62	66		2.6	1384	1.1		0.08	0.93	0.34	1.11	0.38	5.11	3.33
76	0.12	0.7	2.2	0.96	0.08	0.9000	2.60	1.71	46		2.6	2805	1.1		0.08	0.93	0.69	1.11	0.77	10.09	6.64
77	0.12	0.7	2.2	0.96	0.08	0.9000	2.66	1.76	53		2.6	2381	1.1		0.08	0.93	0.58	1.11	0.64	8.36	5.55
78	0.12	0.7	2.2	0.95	0.08	0.9000	2.34	1.57	34		2.6	3675	1.1		0.08	0.93	0.88	1.11	0.97	12.59	8.43
79	0.12	0.7	2.2	0.95	0.08	0.9000	2.29	1.55	38		2.6	3407	1.1		0.08	0.93	0.80	1.11	0.89	11.40	7.70
80	0.12	0.7	2.2	0.94	0.08	0.9000	2.42	1.65	41		2.6	3415	1.1		0.08	0.93	0.79	1.11	0.88	11.17	7.62
81	0.12	0.7	2.2	0.94	0.08	0.9000	2.16	1.49	57		2.6	1629	1.1		0.08	0.93	0.37	1.11	0.41	5.21	3.59
82	0.12	0.7	2.2	0.94	0.08	0.9000	2.39	1.66	58		2.6	2050	1.1		0.08	0.93	0.46	1.11	0.52	6.43	4.46
83	0.12	0.7	2.2	0.93	0.08	0.9000	2.34	1.64	44		2.6	3174	1.1		0.08	0.93	0.71	1.11	0.79	9.75	6.83
84	0.12	0.7	2.2	0.93	0.08	0.9000	2.43	1.72	60		2.6	2133	1.1		0.08	0.93	0.47	1.11	0.52	6.43	4.54
85	0.11	0.7	2.2	0.93	0.08	0.9000	2.39	1.70	84		2.6	1204	1.1		0.08	0.93	0.26	1.11	0.29	3.56	2.54
86	0.11	0.7	2.2	0.92	0.08	0.9000	2.19	1.58	63		2.6	1726	1.1		0.08	0.93	0.37	1.11	0.41	5.01	3.61
87	0.11	0.7	2.2	0.92	0.08	0.9000	2.37	1.73	67		2.6	1868	1.1		0.08	0.93	0.40	1.11	0.44	5.33	3.87
88	0.11	0.7	2.2	0.92	0.08	0.9000	2.22	1.63	100		2.6	748	1.1		0.08	0.93	0.16	1.11	0.17	2.10	1.54
89	0.11	0.7	2.2	0.91	0.08	0.9000	2.06	1.53	100		2.6	625	1.1		0.08	0.93	0.13	1.11	0.14	1.73	1.28
90	0.11	0.7	2.2	0.91	0.08	0.9000	1.77	1.33	86		2.6	803	1.1		0.08	0.93	0.16	1.11	0.18	2.18	1.63
91	0.11	0.7	2.2	0.91	0.08	0.9000	1.77	1.34	94		2.6	697	1.1		0.08	0.93	0.14	1.11	0.16	1.87	1.41
92	0.11	0.7	2.2	0.90	0.08	0.9000	1.75	1.34	99		2.6	614	1.1		0.08	0.93	0.12	1.11	0.14	1.62	1.24
93	0.11	0.7	2.2	0.90	0.08	0.9000	1.97	1.52	100		2.6	591	1.1		0.08	0.93	0.12	1.11	0.13	1.54	1.19
94	0.11	0.7	2.2	0.90	0.08	0.9000	1.94	1.51	95		2.6	723	1.1		0.08	0.93	0.14	1.11	0.16	1.86	1.45
95	0.11	0.7	2.2	0.89	0.08	0.9000	1.95	1.54	100		2.6	611	1.1		0.08	0.93	0.12	1.11	0.13	1.55	1.22
96	0.11	0.7	2.2	0.89	0.08	0.9000	1.69	1.34	97		2.6	619	1.1		0.08	0.93	0.12	1.11	0.13	1.55	1.24
97	0.11	0.7	2.2	0.89	0.08	0.9000	1.90	1.53	98		2.6	672	1.1		0.08	0.93	0.13	1.11	0.14	1.67	1.34
98	0.10	0.7	2.2	0.89	0.08	0.9000	1.89	1.54	100		2.6	554	1.1		0.08	0.93	0.10	1.11	0.12	1.36	1.11
99	0.10	0.7	2.2	0.88	0.08	0.9000	1.91	1.57	100		2.6	568	1.1		0.08	0.93	0.11	1.11	0.12	1.38	1.13
100	0.10	0.7	2.2	0.88	0.08	0.9000	1.96	1.63	100		2.6	774	1.1		0.08	0.93	0.14	1.11	0.16	1.86	1.55
101	0.10	0.7	2.2	0.88	0.08	0.9000	1.89	1.59	100		2.6	609	1.1		0.08	0.93	0.11	1.11	0.12	1.45	1.22
102	0.10	0.7	2.2	0.88	0.08	0.9000	1.65	1.40	100		2.6	551	1.1		0.08	0.93	0.10	1.11	0.11	1.30	1.11
103	0.10	0.7	2.2	0.87	0.08	0.9000	1.67	1.43	100		2.6	599	1.1		0.08	0.93	0.11	1.11	0.12	1.40	1.20
104	0.10	0.7	2.2	0.87	0.08	0.9000	1.65	1.44	96		2.6	665	1.1		0.08	0.93	0.12	1.11	0.13	1.54	1.34
105	0.10	0.7	2.2	0.87	0.08	0.9000	1.66	1.46	98		2.6	644	1.1		0.08	0.93	0.11	1.11	0.13	1.49	1.31
106	0.10	0.7	2.2	0.87	0.08	0.9000	1.66	1.48	100		2.6	624	1.1		0.08	0.93	0.11	1.11	0.12	1.43	1.27
107	0.09	0.7	2.2	0.86	0.08	0.9000	2.08	1.87	100		2.6	661	1.1		0.08	0.93	0.11	1.11	0.13	1.50	1.35
108	0.09	0.7	2.2	0.86	0.08	0.9000	1.92	1.75	100		2.6	677	1.1		0.08	0.93	0.12	1.11	0.13	1.53	1.39
109	0.09	0.7	2.2	0.86	0.08	0.9000	1.87	1.72	98		2.6	727	1.1		0.08	0.93	0.12	1.11	0.14	1.63	1.50
110	0.09	0.7	2.2	0.86	0.08	0.9000	1.87	1.75	100		2.6	716	1.1		0.08	0.93	0.12	1.11	0.13	1.60	1.49
111	0.09	0.7	2.2	0.85	0.08	0.9000	1.87	1.77	98		2.6	745	1.1		0.08	0.93	0.12	1.11	0.14	1.66	1.56
112	0.09	0.7	2.2	0.85	0.08	0.9000	1.88	1.79	99		2.6	732	1.1		0.08	0.93	0.12	1.11	0.13	1.62	1.55
113	0.09	0.7	2.2	0.85	0.08	0.9000	1.90	1.84	98		2.6	783	1.1		0.08	0.93	0.13	1.11	0.14	1.72	1.67
114	0.08	0.7	2.2	0.85	0.08	0.9000	1.90	1.87	93		2.6	894	1.1		0.08	0.93	0.14	1.11	0.16	1.96	1.92
115	0.08	0.7	2.2	0.84	0.08	0.9000	1.89	1.88	92		2.6	875	1.1		0.08	0.93	0.14	1.11	0.16	1.91	1.90
116	0.08	0.7	2.2	0.84	0.08	0.9000	1.98	1.99	86		2.6	1181	1.1		0.08	0.93	0.19	1.11	0.21	2.56	2.58
117	0.08	0.7	2.2	0.84	0.08	0.9000	2.33	2.37	77		2.6	2000	1.1		0.08	0.93	0.31	1.11	0.35	4.32	4.41

CPTU-614 Liquefaction Analysis

ConeTec Inc. - CPT Interpretation	
Interpretation Output - Release	1.22 Rev. A - Format: NLI Imperial
Run No:	06-0718-0954-2570
Job No:	02-100
Client:	MACTEC Engineering and Consulting Inc.
Project:	Former Callahan Mine Site, Brooksville, ME
Site:	CP-614
Location:	Callahan Mine
Cone:	20 Ton AD179
CPT Date:	06/28/06
CPT Time:	12:21
CPT File:	758CP614.COR
Northing (m):	0
Easting (m):	0
Elevation (m):	0 — 70.7 Elevation For CPT Triggering analysis
Water Table (m):	4.21 (ft): 13.8 — 13.8 Water Table assumed for CPT Analysis
Unit Weight of Water (default):	62.4 pcf
Averaging Increment (m):	0.2
Phi Method :	Robertson and Campanella, 1983
Su Nkt used:	15 Su/P' (nc): 0.3 — 0.11 Base acceleration
Dr Method :	Jamiolkowski - All Sands
State Parameter M:	1.2
Used Unit Weights Assigned to Soil Zones	
N160Ic Calculated using qc1n	

1) CSR $= 0.65*(a_{max}/g)*(s_v/s'_v)*r_d$ Seed & Idriss, 1983, p. 459

$a_{max}/g =$ 0.11 g USGS (base) (amplified from base as discussed in

$s_v =$ computed Total Vertical Stress

$s'_v =$ computed Effective Vertical Stress

$r_d = [1.0 - 0.4113z^{0.5} + 0.04052z + 0.001753z^{1.5}] / [1 - 0.4177z^{0.5} + 0.05729z - 0.$

z = depth in meters

2) FS = Factor of safety against triggering of liquefaction: $FS = (CRR_{7.5}/CSR) \times MSF \times Ks \times Ka$

MSF = magnitude scaling factor; Assume based on range recommended by NCEER Wo

CPTU-614 Liquefaction Analysis

$Ks = (s'_{vo}/P_a)^{(f-1)}$, where f = 0.7 to 0.8 for relative density of 40 to 60%; f = 0.6 to 0.7 fo

1 Atmosphere = 14.7 psi = 2.12 ksf

Conetec Data

Row	Col-01 Depth (m)	Col-02 Depth (ft)	Col-03 Elev. (m)	Col-04 Elev. (ft)	Col-05 qc (tsf)	Col-06 qt (tsf)	Col-07 fs (tsf)	Col-08 Rf (%)	Col-09 u (ft)	Col-10 SBT (Zone)	Col-11 SBTn (Zone)	Col-12 SBT-BQ (Zone)	Col-13 SBT-BQn (Zone)	Col-14 Perm-k (cm/s)	Col-15 Unit Wt (pcf)
40	0.1	0.328	-0.1	70.4	2.71	2.7	0.05	1.67	-3.23	1	6	3	6	1.00E-07	111.4
41	0.3	0.984	-0.3	69.7	2.75	2.76	0.07	2.55	1.95	3	5	3	6	5.00E-08	111.4
42	0.5	1.64	-0.5	69.1	3.77	3.79	0.08	2.18	5.67	3	5	3	6	5.00E-08	111.4
43	0.7	2.297	-0.7	68.4	5.3	5.32	0.09	1.65	3.37	1	5	4	6	1.00E-07	111.4
44	0.9	2.953	-0.9	67.7	4.47	4.5	0.08	1.73	5.21	1	5	4	5	1.00E-07	111.4
45	1.1	3.609	-1.1	67.1	2.09	2.16	0.02	1.04	15.44	1	4	3	3	1.00E-07	111.4
46	1.3	4.265	-1.3	66.4	1.95	2.05	0.02	0.98	21.72	1	4	3	3	1.00E-07	111.4
47	1.5	4.921	-1.5	65.8	1.84	1.95	0.02	1.03	24.74	1	3	3	3	1.00E-07	111.4
48	1.7	5.577	-1.7	65.1	1.6	1.73	0.02	1.16	28.1	1	3	3	3	1.00E-07	111.4
49	1.9	6.234	-1.9	64.5	1.69	1.83	0.03	1.51	28.97	1	3	3	3	1.00E-07	111.4
50	2.1	6.89	-2.1	63.8	3.51	3.61	0.05	1.46	20.15	1	4	3	3	1.00E-07	111.4
51	2.3	7.546	-2.3	63.2	6.34	6.37	0.13	2.01	5.81	4	4	5	5	5.00E-07	114.6
52	2.5	8.202	-2.5	62.5	1.42	1.52	0.03	2.15	21.26	1	3	2	3	1.00E-07	111.4
53	2.7	8.858	-2.7	61.8	1.39	1.55	0.04	2.6	32.91	3	3	1	3	5.00E-08	111.4
54	2.9	9.514	-2.9	61.2	1.52	1.67	0.05	2.7	32.37	3	3	3	3	5.00E-08	111.4
55	3.1	10.17	-3.1	60.5	3.85	3.93	0.1	2.55	16.82	3	3	3	3	5.00E-08	111.4
56	3.3	10.827	-3.3	59.9	1.66	1.74	0.05	3.02	17.09	3	2	2	2	5.00E-08	111.4
57	3.5	11.483	-3.5	59.2	3.9	4.05	0.07	1.73	31.65	1	3	3	3	1.00E-07	111.4
58	3.7	12.139	-3.7	58.6	5.49	5.56	0.15	2.75	14.16	3	3	4	4	5.00E-08	111.4
59	3.9	12.795	-3.9	57.9	1.26	1.41	0.07	4.63	31.68	2	-9999	-9999	-9999	1.00E-15	79.5
60	4.1	13.451	-4.1	57.2	1.2	1.41	0.05	3.56	45.13	3	-9999	-9999	-9999	5.00E-08	111.4
61	4.3	14.107	-4.3	56.6	2.92	3.13	0.06	2	44.42	1	3	3	3	1.00E-07	111.4
62	4.5	14.764	-4.5	55.9	3.85	3.97	0.15	3.66	25.06	3	3	3	3	5.00E-08	111.4
63	4.7	15.42	-4.7	55.3	1.69	1.93	0.07	3.37	51.66	3	2	-9999	-9999	5.00E-08	111.4
64	4.9	16.076	-4.9	54.6	3.94	4.19	0.08	1.97	53.4	3	3	3	3	5.00E-08	111.4
65	5.1	16.732	-5.1	54.0	4.92	5	0.22	4.36	17.01	3	3	4	3	5.00E-08	111.4
66	5.3	17.388	-5.3	53.3	3.48	3.67	0.08	2.05	40.07	3	3	3	3	5.00E-08	111.4
67	5.5	18.044	-5.5	52.7	2.17	2.42	0.08	3.11	52.25	3	2	1	1	5.00E-08	111.4
68	5.7	18.701	-5.7	52.0	2.3	2.59	0.06	2.42	61.06	3	2	1	1	5.00E-08	111.4
69	5.9	19.357	-5.9	51.3	2.35	2.65	0.05	1.99	63.97	1	3	1	1	1.00E-07	111.4
70	6.1	20.013	-6.1	50.7	2.52	2.8	0.06	2.06	59.64	1	3	3	1	1.00E-07	111.4
71	6.3	20.669	-6.3	50.0	2.56	2.89	0.06	2.17	70.43	1	3	1	1	1.00E-07	111.4
72	6.5	21.325	-6.5	49.4	2.89	3.23	0.09	2.8	72.09	3	3	3	3	5.00E-08	111.4
73	6.7	21.981	-6.7	48.7	3.1	3.25	0.1	3.09	31.37	3	2	3	3	5.00E-08	111.4
74	6.9	22.638	-6.9	48.1	3.24	3.5	0.07	1.93	54.42	1	3	3	3	1.00E-07	111.4
75	7.1	23.294	-7.1	47.4	8.96	9.12	0.2	2.17	34.06	5	3	5	4	5.00E-06	114.6
76	7.3	23.95	-7.3	46.8	6.02	6.22	0.18	2.86	43.37	3	3	3	3	5.00E-08	111.4
77	7.5	24.606	-7.5	46.1	9.28	9.46	0.2	2.15	38.55	5	3	5	4	5.00E-06	114.6
78	7.7	25.262	-7.7	45.4	5.72	5.98	0.12	1.97	55.71	4	3	3	3	5.00E-07	114.6
79	7.9	25.918	-7.9	44.8	5.67	5.98	0.16	2.6	64.93	4	3	3	3	5.00E-07	114.6
80	8.1	26.574	-8.1	44.1	4.44	4.73	0.11	2.38	61.76	3	3	3	3	5.00E-08	111.4
81	8.3	27.231	-8.3	43.5	3.99	4.39	0.08	1.77	85.53	1	3	3	3	1.00E-07	111.4
82	8.5	27.887	-8.5	42.8	4.39	4.74	0.11	2.33	74.35	3	3	3	3	5.00E-08	111.4
83	8.7	28.543	-8.7	42.2	3.64	4.07	0.06	1.54	90.58	1	3	3	3	1.00E-07	111.4
84	8.9	29.199	-8.9	41.5	3.64	4.12	0.06	1.34	102.63	1	3	3	1	1.00E-07	111.4
85	9.1	29.855	-9.1	40.8	5.02	5.47	0.06	1.15	96.96	1	3	3	3	1.00E-07	111.4
86	9.3	30.511	-9.3	40.2	4.39	4.8	0.05	0.99	87.12	1	3	3	3	1.00E-07	111.4
87	9.5	31.168	-9.5	39.5	3.77	4.27	0.05	1.23	107.96	1	3	3	1	1.00E-07	111.4
88	9.7	31.824	-9.7	38.9	3.77	4.26	0.05	1.12	105.6	1	3	3	1	1.00E-07	111.4
89	9.9	32.48	-9.9	38.2	3.96	4.47	0.06	1.29	109.42	1	3	3	1	1.00E-07	111.4
90	10.1	33.136	-10.1	37.6	4.63	5.1	0.08	1.52	100.89	1	3	3	3	1.00E-07	111.4
91	10.3	33.792	-10.3	36.9	4.36	4.9	0.08	1.53	115.3	1	3	3	3	1.00E-07	111.4
92	10.5	34.448	-10.5	36.3	3.96	4.49	0.07	1.45	112.52	1	3	3	1	1.00E-07	111.4
93	10.7	35.105	-10.7	35.6	3.91	4.46	0.06	1.29	116.87	1	3	1	1	1.00E-07	111.4
94	10.9	35.761	-10.9	34.9	4.14	4.7	0.06	1.28	119.4	1	3	3	1	1.00E-07	111.4
95	11.1	36.417	-11.1	34.3	4.84	5.37	0.09	1.63	113.64	1	3	3	3	1.00E-07	111.4
96	11.3	37.073	-11.3	33.6	4.2	4.77	0.06	1.16	121.03	1	3	3	1	1.00E-07	111.4
97	11.5	37.729	-11.5	33.0	4.28	4.86	0.06	1.13	124.83	1	3	3	1	1.00E-07	111.4
98	11.7	38.385	-11.7	32.3	4.82	5.41	0.06	1.07	124.75	1	3	3	3	1.00E-07	111.4
99	11.9	39.042	-11.9	31.7	6.13	6.63	0.15	2.19	105.21	4	3	3	3	5.00E-07	114.6
100	12.1	39.698	-12.1	31.0	5.82	6.33	0.09	1.46	110.21	1	3	3	3	1.00E-07	111.4
101	12.3	40.354	-12.3	30.3	22.79	23.32	0.29	1.22	114.06	6	4	5	4	5.00E-05	114.6
102	12.5	41.01	-12.5	29.7	44.54	44.51	1.11	2.49	-6.35	6	4	8	5	5.00E-05	114.6
103	12.7	41.666	-12.7	29.0	42.81	42.71	1.28	3	-21.21	6	4	8	5	5.00E-05	114.6
104	12.9	42.322	-12.9	28.4	40.9	40.81	1.16	2.84	-19.91	6	4	8	5	5.00E-05	114.6
105	13.1	42.978	-13.1	27.7	46.99	46.94	1.34	2.86	-10.01	6	4	8	5	5.00E-05	114.6
106	13.3	43.635	-13.3	27.1	46.44	46.44	1.02	2.2	-1.14	6	4	8	5	5.00E-05	114.6
107	13.5	44.291	-13.5	26.4	43.52	43.5	1.08	2.48	-4.25	6	4	8	5	5.00E-05	114.6
108	13.7	44.947	-13.7	25.8	51.84	51.81	0.99	1.92	-5.83	7	5	8	5	5.00E-04	117.7
109	13.9	45.603	-13.9	25.1	44.05	43.93	0.89	2.03	-24.59	6	4	8	5	5.00E-05	114.6
110	14.1	46.259	-14.1	24.4	25.04	24.92	0.46	1.86	-27.22	6	4	-9999	4	5.00E-05	114.6
111	14.3	46.915	-14.3	23.8	68.05	67.95	2.54	3.74	-21.7	5	4	8	6	5.00E-06	114.6

Row	Col-16 T Stress (tsf)	Col-17 U Stress (tsf)	Col-18 E Stress (tsf)	Col-19 Cn	Col-20 N60 (b/ft)	Col-21 N1(60) (b/ft)	Col-22 N(60)Ic (b/ft)	Col-23 N1(60)Ic (b/ft)	Col-24 Qt	Col-25 Fr (%)	Col-26 Bq	Col-27 Ic	Col-28 FC (%)	Col-29 IcZone (Zone)	Col-30 Dr (%)
40	0.018	0	0.018	1.7	1.3	2.2	1	1.7	146.7	1.68	-0.04	3.18	71.1	3	-9999
41	0.055	0	0.055	1.7	2.6	4.5	1.1	1.8	49.27	2.6	0.02	3.26	77.6	3	-9999
42	0.091	0	0.091	1.7	3.6	6.2	1.3	2.2	40.52	2.23	0.05	3.1	65.8	3	-9999
43	0.128	0	0.128	1.7	2.5	4.3	1.6	2.8	40.56	1.69	0.02	2.92	53.1	4	-9999
44	0.164	0	0.164	1.7	2.2	3.7	1.5	2.5	26.35	1.79	0.04	2.99	58	3	-9999
45	0.201	0	0.201	1.7	1	1.8	0.6	2.9	9.77	1.15	0.25	2.79	45.5	4	-9999
46	0.238	0	0.238	1.7	1	1.7	0.6	2.4	7.63	1.11	0.37	2.88	50.8	4	-9999
47	0.274	0	0.274	1.7	0.9	1.6	0.6	2	6.12	1.19	0.46	2.98	57.1	3	-9999
48	0.311	0	0.311	1.7	0.8	1.4	0.6	1.7	4.57	1.41	0.62	3.13	67.4	3	-9999
49	0.347	0	0.347	1.7	0.9	1.5	0.7	1.7	4.27	1.86	0.61	3.21	73.5	3	-9999
50	0.384	0	0.384	1.61	1.7	2.8	1.1	2.7	8.4	1.63	0.2	2.92	53.3	4	-9999
51	0.421	0	0.421	1.54	4.1	6.3	1.8	4.2	14.13	2.15	0.03	2.79	45.5	4	-9999
52	0.458	0	0.458	1.48	0.7	1.1	0.7	1.2	2.32	3.07	0.63	3.54	100	3	-9999
53	0.494	0	0.494	1.42	1.5	2.1	0.8	1.2	2.12	3.82	0.98	3.62	100	2	-9999
54	0.531	0	0.531	1.37	1.6	2.2	0.9	1.2	2.14	3.97	0.89	3.63	100	2	-9999
55	0.568	0	0.568	1.33	3.8	5	1.4	2.3	5.92	2.99	0.16	3.19	71.9	3	-9999
56	0.604	0	0.604	1.29	1.7	2.1	1	1.1	1.88	4.63	0.47	3.71	100	2	-9999
57	0.641	0	0.641	1.25	1.9	2.4	1.4	2	5.31	2.06	0.29	3.14	68.7	3	-9999
58	0.677	0	0.677	1.22	5.3	6.5	2	2.6	7.21	3.13	0.09	3.13	67.3	3	-9999
59	0.708	0	0.708	1.19	1.3	1.6	-9999	-9999	0.99	9.34	1.42	-9999	-9999	0	-9999
60	0.74	0	0.74	1.16	1.3	1.6	-9999	-9999	0.9	7.52	2.11	-9999	-9999	0	-9999
61	0.776	0.01	0.767	1.14	1.5	1.7	1.4	1.4	3.07	2.66	0.59	3.41	90.3	3	-9999
62	0.813	0.03	0.783	1.13	3.8	4.3	1.8	1.9	4.03	4.61	0.24	3.43	92.3	3	-9999
63	0.849	0.051	0.799	1.12	1.9	2.1	1.4	1	1.36	6.01	1.44	3.89	100	2	-9999
64	0.886	0.071	0.815	1.11	4	4.5	1.7	1.7	4.06	2.5	0.48	3.29	80	3	-9999
65	0.923	0.092	0.831	1.1	4.8	5.3	2.1	2.2	4.91	5.35	0.11	3.39	89.2	3	-9999
66	0.959	0.112	0.847	1.09	3.5	3.8	1.6	1.4	3.2	2.77	0.42	3.4	89.7	3	-9999
67	0.996	0.133	0.863	1.08	2.3	2.5	1.5	1.1	1.65	5.29	1.05	3.79	100	2	-9999
68	1.032	0.153	0.879	1.07	2.5	2.6	1.5	1.1	1.77	4.03	1.13	3.7	100	2	-9999
69	1.069	0.173	0.895	1.06	1.3	1.3	1.5	1	1.76	3.33	1.15	3.66	100	2	-9999
70	1.105	0.194	0.911	1.05	1.3	1.4	1.5	1.1	1.86	3.4	0.98	3.65	100	2	-9999
71	1.142	0.214	0.927	1.04	1.4	1.4	1.6	1.1	1.88	3.59	1.14	3.66	100	2	-9999
72	1.178	0.235	0.943	1.03	3.1	3.2	1.8	1.2	2.17	4.4	0.98	3.65	100	2	-9999
73	1.215	0.255	0.959	1.02	3.1	3.2	1.8	1.2	2.12	4.93	0.36	3.68	100	2	-9999
74	1.251	0.276	0.976	1.01	1.7	1.7	1.7	1.2	2.3	3.01	0.63	3.54	100	3	-9999
75	1.289	0.296	0.992	1	4.4	4.4	3	2.7	7.89	2.53	0.1	3.04	61.4	3	-9999
76	1.326	0.317	1.009	1	6	5.9	2.5	2	4.85	3.63	0.21	3.3	81.4	3	-9999
77	1.363	0.337	1.025	0.99	4.5	4.5	3.1	2.7	7.9	2.51	0.11	3.04	61.2	3	-9999
78	1.4	0.358	1.042	0.98	3.8	3.7	2.3	1.8	4.39	2.57	0.3	3.26	78.1	3	-9999
79	1.438	0.378	1.059	0.97	3.8	3.7	2.5	1.8	4.28	3.42	0.36	3.34	84.2	3	-9999
80	1.475	0.399	1.076	0.96	4.5	4.4	2.2	1.4	3.02	3.46	0.47	3.47	96	3	-9999
81	1.511	0.419	1.092	0.96	2.1	2	2	1.3	2.64	2.7	0.78	3.47	95.8	3	-9999
82	1.548	0.44	1.108	0.95	4.5	4.3	2.2	1.4	2.88	3.46	0.59	3.49	97.7	3	-9999
83	1.585	0.46	1.124	0.94	1.9	1.8	2	1.1	2.21	2.53	0.95	3.52	100	3	-9999
84	1.621	0.481	1.14	0.94	2	1.8	1.9	1.1	2.19	2.2	1.09	3.5	98.7	3	-9999
85	1.658	0.501	1.156	0.93	2.6	2.4	2.2	1.4	3.3	1.64	0.66	3.28	79.6	3	-9999
86	1.694	0.522	1.172	0.92	2.3	2.1	2	1.2	2.65	1.53	0.71	3.36	85.8	3	-9999
87	1.731	0.542	1.188	0.92	2	1.9	2	1	2.14	2.07	1.11	3.5	98.5	3	-9999
88	1.767	0.563	1.205	0.91	2	1.9	2	1	2.07	1.91	1.1	3.49	98.2	3	-9999
89	1.804	0.583	1.221	0.91	2.1	1.9	2.1	1.1	2.19	2.16	1.06	3.5	98.5	3	-9999
90	1.84	0.604	1.237	0.9	2.4	2.2	2.3	1.2	2.64	2.38	0.78	3.44	93.4	3	-9999
91	1.877	0.624	1.253	0.89	2.3	2.1	2.3	1.2	2.41	2.49	0.98	3.48	97.5	3	-9999
92	1.913	0.645	1.269	0.89	2.1	1.9	2.2	1.1	2.03	2.53	1.11	3.56	100	3	-9999
93	1.95	0.665	1.285	0.88	2.1	1.9	2.2	1	1.95	2.29	1.19	3.55	100	3	-9999
94	1.987	0.686	1.301	0.88	2.2	2	2.3	1	2.08	2.22	1.12	3.52	100	3	-9999
95	2.023	0.706	1.317	0.87	2.6	2.2	2.5	1.2	2.54	2.62	0.85	3.48	96.6	3	-9999
96	2.06	0.727	1.333	0.87	2.3	2	2.3	1	2.03	2.04	1.13	3.51	100	3	-9999
97	2.096	0.747	1.349	0.86	2.3	2	2.3	1	2.05	1.99	1.14	3.5	100	3	-9999
98	2.133	0.768	1.365	0.86	2.6	2.2	2.4	1.1	2.4	1.76	0.95	3.42	91.5	3	-9999
99	2.17	0.788	1.382	0.85	4.2	3.6	2.9	1.5	3.23	3.26	0.56	3.43	92.5	3	-9999
100	2.207	0.809	1.398	0.85	3	2.6	2.7	1.3	2.95	2.25	0.64	3.39	88.5	3	-9999
101	2.244	0.829	1.415	0.84	8.9	7.5	6.2	4.2	14.9	1.36	0.13	2.67	38.6	4	30
102	2.282	0.85	1.432	0.84	17.1	14.3	11.1	9.5	29.49	2.62	-0.02	2.52	31.4	5	38.3
103	2.319	0.87	1.449	0.83	16.4	13.6	11.4	7.8	27.88	3.17	-0.04	2.66	38.2	4	37
104	2.357	0.891	1.466	0.83	15.6	12.9	10.9	7.3	26.22	3.01	-0.04	2.66	38.5	4	35.5
105	2.394	0.911	1.483	0.82	18	14.8	12.3	8.2	30.03	3.02	-0.03	2.62	36.3	4	39.3
106	2.432	0.932	1.5	0.82	17.8	14.5	11.3	9.4	29.33	2.32	-0.02	2.47	29.6	5	38.9
107	2.47	0.952	1.518	0.81	16.7	13.5	11.4	7.4	27.04	2.63	-0.03	2.62	36.2	4	36.8
108	2.508	0.972	1.535	0.81	16.5	13.4	12.2	10.1	32.12	2.02	-0.02	2.4	26.6	5	41.7
109	2.546	0.993	1.553	0.8	16.8	13.5	10.7	8.8	26.65	2.16	-0.04	2.48	29.8	5	36.8
110	2.583	1.013	1.57	0.8	9.5	7.6	7.1	4.2	14.23	2.08	-0.08	2.78	44.9	4	30
111	2.621	1.034	1.587	0.79	32.5	25.8	16.9	13.7	41.16	3.89	-0.03	2.52	31.4	5	-9999

Row	Col-31 Phi (deg)	Col-32 State Par	Col-33 Es/qt	Col-34 YoungE (tsf)	Col-35 Su (tsf)	Col-36 OCR	Col-37 U (psf)	Col-38 s_{vo} (psf)	Col-39 q_c (psf)	Col-40 q_t (psf)	Col-41 P_a (psf)	Col-42 σ'_{vo} (psf)	Col-43 f_s (psf)	Col-44 $Q_{exp=1}$	Col-45 F
40	-9999	-9999	-9999	-9999	0.179	10	0	36	5420	5400	2116	36	100	149.00	1.86
41	-9999	-9999	-9999	-9999	0.18	10	0	110	5500	5520	2116	110	140	49.18	2.59
42	-9999	-9999	-9999	-9999	0.247	10	0	182	7540	7580	2116	182	160	40.65	2.16
43	-9999	-9999	-9999	-9999	0.346	10	0	256	10600	10640	2116	256	180	40.56	1.73
44	-9999	-9999	-9999	-9999	0.289	10	0	328	8940	9000	2116	328	160	26.44	1.85
45	-9999	-9999	-9999	-9999	0.131	2.5	0	402	4180	4320	2116	402	40	9.75	1.02
46	-9999	-9999	-9999	-9999	0.121	1.8	0	476	3900	4100	2116	476	40	7.61	1.10
47	-9999	-9999	-9999	-9999	0.112	1.4	0	548	3680	3900	2116	548	40	6.12	1.19
48	-9999	-9999	-9999	-9999	0.095	1	0	622	3200	3460	2116	622	40	4.56	1.41
49	-9999	-9999	-9999	-9999	0.099	1	0	694	3380	3660	2116	694	60	4.27	2.02
50	-9999	-9999	-9999	-9999	0.215	2	0	768	7020	7220	2116	768	100	8.40	1.55
51	-9999	-9999	-9999	-9999	0.396	4.2	0	842	12680	12740	2116	842	260	14.13	2.19
52	-9999	-9999	-9999	-9999	0.071	0.6	0	916	2840	3040	2116	916	60	2.32	2.82
53	-9999	-9999	-9999	-9999	0.07	0.6	0	988	2780	3100	2116	988	80	2.14	3.79
54	-9999	-9999	-9999	-9999	0.076	0.6	0	1062	3040	3340	2116	1062	100	2.15	4.39
55	-9999	-9999	-9999	-9999	0.224	1.3	0	1136	7700	7860	2116	1136	200	5.92	2.97
56	-9999	-9999	-9999	-9999	0.076	0.6	0	1208	3320	3480	2116	1208	100	1.88	4.40
57	-9999	-9999	-9999	-9999	0.227	1.2	0	1282	7800	8100	2116	1282	140	5.32	2.05
58	-9999	-9999	-9999	-9999	0.325	1.7	0	1354	10980	11120	2116	1354	300	7.21	3.07
59	-9999	-9999	-9999	-9999	0.047	0.5	0	1416	2520	2820	2116	1416	140	0.99	9.97
60	-9999	-9999	-9999	-9999	0.044	0.5	0	1480	2400	2820	2116	1480	100	0.91	7.46
61	-9999	-9999	-9999	-9999	0.157	0.7	19	1552	5840	6260	2116	1533	120	3.07	2.55
62	-9999	-9999	-9999	-9999	0.21	0.9	60	1626	7700	7940	2116	1566	300	4.03	4.75
63	-9999	-9999	-9999	-9999	0.072	0.5	101	1698	3380	3860	2116	1597	140	1.35	6.48
64	-9999	-9999	-9999	-9999	0.221	0.9	142	1772	7880	8380	2116	1630	160	4.05	2.42
65	-9999	-9999	-9999	-9999	0.272	1.1	183	1846	9840	10000	2116	1663	440	4.90	5.40
66	-9999	-9999	-9999	-9999	0.181	0.8	224	1918	6960	7340	2116	1694	160	3.20	2.95
67	-9999	-9999	-9999	-9999	0.095	0.6	265	1992	4340	4840	2116	1727	160	1.65	5.62
68	-9999	-9999	-9999	-9999	0.104	0.6	306	2064	4600	5180	2116	1758	120	1.77	3.85
69	-9999	-9999	-9999	-9999	0.105	0.6	347	2138	4700	5300	2116	1791	100	1.77	3.16
70	-9999	-9999	-9999	-9999	0.113	0.6	388	2210	5040	5600	2116	1822	120	1.86	3.54
71	-9999	-9999	-9999	-9999	0.116	0.6	429	2284	5120	5780	2116	1855	120	1.88	3.43
72	-9999	-9999	-9999	-9999	0.137	0.6	470	2356	5780	6460	2116	1886	180	2.18	4.39
73	-9999	-9999	-9999	-9999	0.135	0.6	510	2430	6200	6500	2116	1920	200	2.12	4.91
74	-9999	-9999	-9999	-9999	0.15	0.6	551	2502	6480	7000	2116	1951	140	2.31	3.11
75	-9999	-9999	-9999	-9999	0.522	1.9	592	2578	17920	18240	2116	1986	400	7.89	2.55
76	-9999	-9999	-9999	-9999	0.326	1.1	633	2652	12040	12440	2116	2019	360	4.85	3.68
77	-9999	-9999	-9999	-9999	0.54	1.9	674	2726	18560	18920	2116	2052	400	7.89	2.47
78	-9999	-9999	-9999	-9999	0.305	1	715	2800	11440	11960	2116	2085	240	4.39	2.62
79	-9999	-9999	-9999	-9999	0.302	1	756	2876	11340	11960	2116	2120	320	4.29	3.52
80	-9999	-9999	-9999	-9999	0.217	0.7	797	2950	8880	9460	2116	2153	220	3.02	3.38
81	-9999	-9999	-9999	-9999	0.192	0.7	838	3022	7980	8780	2116	2184	160	2.64	2.78
82	-9999	-9999	-9999	-9999	0.213	0.7	879	3096	8780	9480	2116	2217	220	2.88	3.45
83	-9999	-9999	-9999	-9999	0.165	0.6	920	3170	7280	8140	2116	2250	120	2.21	2.41
84	-9999	-9999	-9999	-9999	0.167	0.6	961	3242	7280	8240	2116	2281	120	2.19	2.40
85	-9999	-9999	-9999	-9999	0.254	0.8	1002	3316	10040	10940	2116	2314	120	3.29	1.57
86	-9999	-9999	-9999	-9999	0.207	0.7	1043	3388	8780	9600	2116	2345	100	2.65	1.61
87	-9999	-9999	-9999	-9999	0.169	0.6	1084	3462	7540	8540	2116	2378	100	2.14	1.97
88	-9999	-9999	-9999	-9999	0.166	0.6	1125	3534	7540	8520	2116	2409	100	2.07	2.01
89	-9999	-9999	-9999	-9999	0.178	0.6	1166	3608	7920	8940	2116	2442	120	2.18	2.25
90	-9999	-9999	-9999	-9999	0.218	0.7	1207	3680	9260	10200	2116	2473	160	2.64	2.45
91	-9999	-9999	-9999	-9999	0.202	0.6	1248	3754	8720	9800	2116	2506	160	2.41	2.65
92	-9999	-9999	-9999	-9999	0.172	0.6	1288	3826	7920	8980	2116	2538	140	2.03	2.72
93	-9999	-9999	-9999	-9999	0.167	0.6	1329	3900	7820	8920	2116	2571	120	1.95	2.39
94	-9999	-9999	-9999	-9999	0.181	0.6	1370	3974	8280	9400	2116	2604	120	2.08	2.21
95	-9999	-9999	-9999	-9999	0.223	0.7	1411	4046	9680	10740	2116	2635	180	2.54	2.69
96	-9999	-9999	-9999	-9999	0.18	0.6	1452	4120	8400	9540	2116	2668	120	2.03	2.21
97	-9999	-9999	-9999	-9999	0.185	0.6	1493	4192	8560	9720	2116	2699	120	2.05	2.17
98	-9999	-9999	-9999	-9999	0.218	0.6	1534	4266	9640	10820	2116	2732	120	2.40	1.83
99	-9999	-9999	-9999	-9999	0.297	0.8	1575	4340	12260	13260	2116	2765	300	3.23	3.36
100	-9999	-9999	-9999	-9999	0.275	0.7	1616	4414	11640	12660	2116	2798	180	2.95	2.18
101	32	-0.02	-9999	-9999	1.405	4.5	1657	4488	45580	46640	2116	2831	580	14.89	1.38
102	36	-0.17	3.607	160.5	2.815	10	1698	4564	89080	89020	2116	2866	2220	29.47	2.63
103	36	-0.19	-9999	-9999	2.693	10	1739	4638	85620	85420	2116	2899	2560	27.86	3.17
104	36	-0.17	-9999	-9999	2.563	10	1780	4714	81800	81620	2116	2934	2320	26.21	3.02
105	36	-0.19	3.935	184.7	2.97	10	1821	4788	93980	93880	2116	2967	2680	30.02	3.01
106	36	-0.15	3.593	166.8	2.934	10	1862	4864	92880	92880	2116	3002	2040	29.32	2.32
107	36	-0.16	-9999	-9999	2.735	10	1903	4940	87040	87000	2116	3037	2160	27.02	2.63
108	36	-0.14	3.439	178.2	-9999	-9999	1944	5016	103680	103620	2116	3072	1980	32.09	2.01
109	36	-0.13	3.727	163.7	2.759	10	1985	5092	88100	87860	2116	3107	1780	26.63	2.15
110	32	-0.06	-9999	-9999	1.489	4.2	2025	5166	50080	49840	2116	3141	920	14.22	2.06
111	-9999	-9999	-9999	-9999	4.355	10	2066	5242	136100	135900	2116	3176	5080	41.14	3.89

CPTU-614 Liquefaction Analysis

text

]06205z[1.5] + 0.001210z[2]]

Youd and Idriss, 2001

rkshop, reiterated in Youd and Idriss, 2001

CPTU-614 Liquefaction Analysis

rel density of 60 to 80%; P_a = pressure at 1 atmosphere   Youd and Idriss, 2001

	AT	AU	AV	AW	AX	AY	AZ	BA	BB	BC	BD	BE	BF	BG	BH	BI	BJ	BK	BL	BM	BN
34	Col-46	Col-47	Col-48	Col-49	Col-50	Col-51	Col-52	Col-53	Col-54	Col-55	Col-56	Col-57	Col-57a	Col-58	Col-59	Col-60	Col-61	Col-62	Col-63	Col-64	Col-65
35	Youd & Idriss, 2001 CPT Based Analysis																				
36																					Rel. Den. Factor
37	$I_{c\ Qexp=1}$	$Q_{exp=0.5}$	F	$I_{c\ Qexp=0.5}$	$Q_{exp=0.7}$	F	$I_{c\ Qexp=0.7}$	Description	C_q			q_{c1N}	Lookup	Ic	Kc	$(q_{c1N})_{cs}$	CRR7.5	rd	a_{max}/g =	CSR	
38									n=1.0	n=0.5	n=0.7		Col						if crest accel	No	f crest accel =
39																			2.0	Amplification	2
40	1.98	19.43	1.86	2.64	43.90	1.86	2.36	Very Silty	58.78	7.67	17.32	44.19	2.00	2.36	2.15	95.02	0.16	1.00	0.22	0.07	0.14
41	2.41	11.21	2.59	2.92	20.26	2.59	2.71	Very Silty	19.24	4.39	7.92	20.67	2.00	2.71	4.07	84.19	0.14	1.00	0.22	0.07	0.14
42	2.43	11.92	2.16	2.85	19.47	2.16	2.68	Very Silty	11.63	3.41	5.57	19.95	2.00	2.68	3.84	76.62	0.12	1.00	0.22	0.07	0.14
43	2.37	14.11	1.73	2.74	21.52	1.73	2.59	Very Silty	8.27	2.88	4.39	22.06	2.00	2.59	3.25	71.71	0.11	1.00	0.21	0.07	0.14
44	2.53	10.41	1.85	2.87	15.11	1.85	2.73	Very Silty	6.45	2.54	3.69	15.68	2.00	2.73	4.22	66.24	0.11	1.00	0.21	0.07	0.14
45	2.77	4.25	1.02	3.10	5.92	1.02	2.96	Clayey	5.26	2.29	3.20	10.75	2.00	2.77	4.53	48.63	0.08	0.99	0.21	0.07	0.14
46	2.88	3.61	1.10	3.17	4.87	1.10	3.06	Clayey	4.45	2.11	2.84	8.61	2.00	2.88	5.51	47.42	0.08	0.99	0.21	0.07	0.13
47	2.98	3.11	1.19	3.25	4.08	1.19	3.14	Clayey	3.86	1.97	2.57	7.12	2.00	2.98	6.53	46.46	0.08	0.99	0.21	0.07	0.13
48	3.13	2.47	1.41	3.37	3.16	1.41	3.27	Clayey	3.40	1.84	2.36	5.56	2.00	3.13	8.26	45.96	0.08	0.99	0.20	0.07	0.13
49	3.22	2.45	2.02	3.44	3.06	2.02	3.35	Clayey	3.05	1.75	2.18	5.27	2.00	3.22	9.58	50.51	0.09	0.99	0.20	0.07	0.13
50	2.91	5.06	1.55	3.10	6.20	1.55	3.03	Clayey	2.76	1.66	2.03	9.40	2.00	2.91	5.80	54.52	0.10	0.99	0.20	0.07	0.13
51	2.80	8.91	2.19	2.96	10.72	2.19	2.90	Clayey	2.51	1.59	1.91	15.13	2.00	2.80	4.74	71.79	0.11	0.98	0.20	0.07	0.13
52	3.53	1.53	2.82	3.69	1.80	2.82	3.62	Clayey	2.31	1.52	1.80	3.32	2.00	3.53	14.57	48.34	0.08	0.98	0.20	0.07	0.13
53	3.62	1.46	3.79	3.76	1.70	3.79	3.71	Clayey	2.14	1.46	1.70	3.14	2.00	3.62	16.36	51.35	0.09	0.98	0.20	0.07	0.12
54	3.65	1.52	4.39	3.78	1.74	4.39	3.73	Clayey	1.99	1.41	1.62	3.15	2.00	3.65	16.99	53.44	0.09	0.98	0.19	0.07	0.12
55	3.19	4.34	2.97	3.30	4.91	2.97	3.25	Clayey	1.86	1.36	1.55	6.92	2.00	3.19	9.04	62.58	0.10	0.98	0.19	0.07	0.12
56	3.70	1.42	4.40	3.80	1.59	4.40	3.76	Clayey	1.75	1.32	1.48	2.88	2.00	3.70	18.03	51.95	0.09	0.98	0.19	0.07	0.12
57	3.14	4.14	2.05	3.24	4.58	2.05	3.20	Clayey	1.65	1.28	1.42	6.32	2.00	3.14	8.48	53.58	0.09	0.98	0.19	0.07	0.12
58	3.12	5.77	3.07	3.20	6.31	3.07	3.17	Clayey	1.56	1.25	1.37	8.21	2.00	3.12	8.19	67.22	0.11	0.97	0.19	0.07	0.12
59	4.12	0.81	9.97	4.20	0.88	9.97	4.17	Clayey	1.49	1.22	1.32	1.99	2.00	4.12	28.25	56.26	0.10	0.97	0.18	0.07	0.12
60	4.09	0.76	7.46	4.16	0.81	7.46	4.13	Clayey	1.43	1.20	1.28	1.91	2.00	4.09	27.38	52.17	0.09	0.97	0.18	0.07	0.12
61	3.40	2.61	2.55	3.46	2.79	2.55	3.43	Clayey	1.38	1.17	1.25	4.08	2.00	3.40	12.28	50.16	0.09	0.97	0.18	0.07	0.12
62	3.44	3.47	4.75	3.49	3.68	4.75	3.47	Clayey	1.35	1.16	1.23	5.07	2.00	3.44	12.94	65.60	0.11	0.97	0.18	0.07	0.12
63	3.91	1.18	6.48	3.96	1.24	6.48	3.94	Clayey	1.33	1.15	1.22	2.42	2.00	3.91	22.77	55.04	0.10	0.97	0.18	0.07	0.12
64	3.28	3.56	2.42	3.33	3.75	2.42	3.31	Clayey	1.30	1.14	1.20	5.14	2.00	3.28	10.43	53.60	0.09	0.97	0.18	0.08	0.12
65	3.40	4.35	5.40	3.44	4.56	5.40	3.42	Clayey	1.27	1.13	1.18	6.01	2.00	3.40	12.27	73.78	0.12	0.96	0.17	0.08	0.12
66	3.41	2.86	2.95	3.45	2.99	2.95	3.44	Clayey	1.25	1.12	1.17	4.33	2.00	3.41	12.54	54.34	0.09	0.96	0.17	0.08	0.12
67	3.80	1.49	5.62	3.84	1.55	5.62	3.83	Clayey	1.23	1.11	1.15	2.80	2.00	3.80	20.30	56.89	0.10	0.96	0.17	0.08	0.12
68	3.69	1.62	3.85	3.73	1.68	3.85	3.71	Clayey	1.20	1.10	1.14	2.95	2.00	3.69	17.90	52.73	0.09	0.96	0.17	0.08	0.12
69	3.65	1.62	3.16	3.69	1.68	3.16	3.67	Clayey	1.18	1.09	1.12	2.96	2.00	3.65	17.07	50.51	0.09	0.96	0.17	0.08	0.12
70	3.66	1.73	3.54	3.69	1.78	3.54	3.67	Clayey	1.16	1.08	1.11	3.07	2.00	3.66	17.14	52.68	0.09	0.96	0.17	0.08	0.12
71	3.65	1.76	3.43	3.67	1.81	3.43	3.66	Clayey	1.14	1.07	1.10	3.12	2.00	3.65	16.91	52.67	0.09	0.96	0.16	0.08	0.12
72	3.64	2.05	4.39	3.67	2.10	4.39	3.66	Clayey	1.12	1.06	1.08	3.42	2.00	3.64	16.88	57.81	0.10	0.95	0.16	0.09	0.12
73	3.68	2.02	4.91	3.70	2.06	4.91	3.69	Clayey	1.10	1.05	1.07	3.39	2.00	3.68	17.61	59.62	0.10	0.95	0.16	0.09	0.12
74	3.55	2.21	3.11	3.56	2.25	3.11	3.56	Clayey	1.08	1.04	1.06	3.59	2.00	3.55	14.99	53.78	0.09	0.95	0.16	0.09	0.12
75	3.04	7.64	2.55	3.06	7.74	2.55	3.05	Clayey	1.07	1.03	1.05	9.19	2.00	3.04	7.25	66.62	0.11	0.95	0.16	0.09	0.12
76	3.31	4.74	3.68	3.32	4.78	3.68	3.31	Clayey	1.05	1.02	1.03	6.16	2.00	3.31	10.84	66.77	0.11	0.95	0.15	0.09	0.12
77	3.04	7.77	2.47	3.04	7.82	2.47	3.04	Clayey	1.03	1.02	1.02	9.22	2.00	3.04	7.16	66.01	0.11	0.94	0.15	0.09	0.12
78	3.27	4.36	2.62	3.27	4.37	2.62	3.27	Clayey	1.01	1.01	1.01	5.74	2.00	3.27	10.22	58.66	0.10	0.94	0.15	0.09	0.12
79	3.34	4.29	3.52	3.34	4.29	3.52	3.34	Clayey	1.00	1.00	1.00	5.64	2.00	3.34	11.39	64.28	0.10	0.94	0.15	0.09	0.12
80	3.46	3.05	3.38	3.46	3.04	3.38	3.46	Clayey	0.98	0.99	0.99	4.39	2.00	3.46	13.43	59.00	0.10	0.94	0.15	0.09	0.12
81	3.47	2.68	2.78	3.47	2.66	2.78	3.47	Clayey	0.97	0.98	0.98	4.02	2.00	3.47	13.61	54.70	0.10	0.93	0.15	0.09	0.12
82	3.49	2.95	3.45	3.48	2.92	3.45	3.48	Clayey	0.95	0.98	0.97	4.28	2.00	3.49	13.83	59.15	0.10	0.93	0.14	0.09	0.12
83	3.51	2.28	2.41	3.50	2.25	2.41	3.51	Clayey	0.94	0.97	0.96	3.62	2.00	3.51	14.32	51.82	0.09	0.93	0.14	0.09	0.12
84	3.51	2.27	2.40	3.50	2.24	2.40	3.51	Clayey	0.93	0.96	0.95	3.61	2.00	3.51	14.36	51.88	0.09	0.92	0.14	0.09	0.12
85	3.27	3.45	1.57	3.26	3.38	1.57	3.26	Clayey	0.91	0.96	0.94	4.73	2.00	3.27	10.33	48.84	0.08	0.92	0.14	0.09	0.12
86	3.36	2.79	1.61	3.34	2.73	1.61	3.35	Clayey	0.90	0.95	0.93	4.09	2.00	3.36	11.74	48.05	0.08	0.92	0.14	0.09	0.12
87	3.49	2.26	1.97	3.46	2.21	1.97	3.47	Clayey	0.89	0.94	0.92	3.59	2.00	3.49	13.84	49.71	0.08	0.91	0.13	0.10	0.12
88	3.50	2.21	2.01	3.48	2.15	2.01	3.49	Clayey	0.88	0.94	0.91	3.54	2.00	3.50	14.13	49.96	0.08	0.91	0.13	0.10	0.12
89	3.50	2.35	2.25	3.48	2.28	2.25	3.49	Clayey	0.87	0.93	0.90	3.66	2.00	3.50	14.15	51.80	0.09	0.91	0.13	0.10	0.11
90	3.45	2.85	2.45	3.42	2.76	2.45	3.43	Clayey	0.86	0.92	0.90	4.12	2.00	3.45	13.15	54.24	0.09	0.90	0.13	0.10	0.11
91	3.50	2.63	2.65	3.46	2.54	2.65	3.48	Clayey	0.84	0.92	0.89	3.91	2.00	3.50	14.04	54.89	0.10	0.90	0.13	0.10	0.11
92	3.57	2.22	2.72	3.53	2.14	2.72	3.55	Clayey	0.83	0.91	0.88	3.54	2.00	3.57	15.38	54.43	0.09	0.89	0.13	0.10	0.11
93	3.56	2.15	2.39	3.52	2.07	2.39	3.54	Clayey	0.82	0.91	0.87	3.47	2.00	3.56	15.19	52.70	0.09	0.89	0.12	0.10	0.11
94	3.52	2.31	2.21	3.48	2.22	2.21	3.49	Clayey	0.81	0.90	0.86	3.61	2.00	3.52	14.42	52.07	0.09	0.89	0.12	0.10	0.11
95	3.48	2.84	2.69	3.44	2.71	2.69	3.46	Clayey	0.80	0.90	0.86	4.08	2.00	3.48	13.74	56.00	0.10	0.88	0.12	0.10	0.11
96	3.53	2.28	2.21	3.48	2.18	2.21	3.50	Clayey	0.79	0.89	0.85	3.58	2.00	3.53	14.61	52.25	0.09	0.88	0.12	0.10	0.10
97	3.52	2.31	2.17	3.47	2.20	2.17	3.49	Clayey	0.78	0.89	0.84	3.60	2.00	3.52	14.48	52.16	0.09	0.87	0.12	0.10	0.10
98	3.43	2.73	1.83	3.38	2.59	1.83	3.40	Clayey	0.77	0.88	0.84	3.96	2.00	3.43	12.79	50.67	0.09	0.86	0.11	0.10	0.10
99	3.44	3.69	3.36	3.39	3.50	3.36	3.41	Clayey	0.77	0.87	0.83	4.80	2.00	3.44	12.98	62.26	0.10	0.86	0.11	0.10	0.10
100	3.38	3.39	2.18	3.33	3.20	2.18	3.35	Clayey	0.76	0.87	0.82	4.52	2.00	3.38	12.02	54.38	0.09	0.85	0.11	0.10	0.10
101	2.67	17.22	1.38	2.61	16.25	1.38	2.64	Clayey	0.75	0.86	0.82	16.47	2.00	2.67	3.77	62.19	0.10	0.85	0.11	0.10	0.10
102	2.59	34.29	2.63	2.54	32.28	2.63	2.56	Granular	0.74	0.86	0.81	36.15	2.00	2.54	2.96	106.92	0.19	0.84	0.11	0.10	0.09
103	2.66	32.62	3.17	2.61	30.62	3.17	2.63	Clayey	0.73	0.85	0.80	29.46	2.00	2.66	3.70	108.93	0.20	0.84	0.11	0.10	0.09
104	2.66	30.86	3.02	2.61	28.91	3.02	2.63	Clayey	0.72	0.85	0.80	27.82	2.00	2.66	3.74	104.09	0.18	0.83	0.10	0.10	0.09
105	2.62	35.55	3.01	2.56	33.23	3.01	2.58	Clayey	0.71	0.84	0.79	31.64	2.00	2.62	3.44	108.81	0.20	0.82	0.10	0.10	0.09
106	2.55	34.92	2.32	2.50	32.56	2.32	2.52	Granular	0.70	0.84	0.78	36.85	2.00	2.50	2.74	101.11	0.18	0.82	0.10	0.09	0.09
107	2.62	32.37	2.63	2.56	30.11	2.63	2.58	Clayey	0.70	0.83	0.78	28.64	2.00	2.62	3.43	98.21	0.17	0.81	0.10	0.09	0.08
108	2.48	38.67	2.01	2.42	35.89	2.01	2.45	Granular	0.69	0.83	0.77	40.64	2.00	2.42	2.40	97.60	0.17	0.80	0.10	0.09	0.08
109	2.57	32.28	2.15	2.50	29.89	2.15	2.53	Granular	0.68	0.83	0.76	34.26	2.00	2.50	2.77	95.08	0.16	0.80	0.09	0.09	0.08
110	2.78	17.33	2.06	2.71	16.01	2.06	2.74	Clayey	0.67	0.82	0.76	15.87	2.00	2.78	4.61	73.08	0.12	0.79	0.09	0.09	0.08
111	2.59	50.40	3.89	2.53	46.47	3.89	2.55	Granular	0.67	0.82	0.75	52.43	2.00	2.53	2.92	153.25	0.41	0.78	0.09	0.09	0.08

	BO	BP	BQ	BR	BS	BT	BU	BV	BW	BX	BY	BZ	CA	CB	CC	CD	CE	CF	CG	CH
34	Col-66	Col-67	Col-68	Col-69	Col-70	Col-71	Col-72	Col-73	Col-74	Col-75	Col-76	Col-77	Col-78	Col-79	Col-80	Col-81	Col-82	Col-83	Col-84	Col-85
35											Boulanger and Idriss, 2004, "Approach B" method based on Su profile									
36																				
37	f	MSF	K_σ	α	K_α	FS liq- CPT (Sand-Like)		Apparent Fines	Measured Fines	Ic Limits	Su - CPT (psf)	OCR Assumed	OCR - CPT	α	k_α	$CRR_{M7.5}$	MSF	$CRR_{M5.5}$	FS liq-Su (Clay-Like)	
38						No	if crest accel =	(%)	(%)		Nkt	1.1							No	if crest accel =
39				0.06		Amplification	2				10			0.06					Amplification	2
40	0.7	2.2	3.39	0.06	0.9100	15.18	7.62	25		2.6	536	1.1		0.06	0.95	9.07	1.11	10.08	140.92	70.75
41	0.7	2.2	2.43	0.06	0.9100	9.21	4.66	41		2.6	541	1.1		0.06	0.95	3.00	1.11	3.33	46.57	23.57
42	0.7	2.2	2.09	0.06	0.9100	7.13	3.64	39		2.6	740	1.1		0.06	0.95	2.48	1.11	2.75	38.54	19.67
43	0.7	2.2	1.88	0.06	0.9100	6.05	3.11	35		2.6	1038	1.1		0.06	0.95	2.47	1.11	2.74	38.52	19.83
44	0.7	2.2	1.75	0.06	0.9100	5.27	2.74	42		2.6	867	1.1		0.06	0.95	1.61	1.11	1.79	25.15	13.05
45	0.7	2.2	1.65	0.06	0.9100	3.81	2.00	44		2.6	392	1.1		0.06	0.95	0.59	1.11	0.66	9.28	4.86
46	0.7	2.2	1.56	0.06	0.9100	3.58	1.89	51		2.6	362	1.1		0.06	0.95	0.46	1.11	0.52	7.26	3.84
47	0.7	2.2	1.50	0.06	0.9100	3.41	1.81	57		2.6	335	1.1		0.06	0.95	0.37	1.11	0.41	5.84	3.11
48	0.7	2.2	1.44	0.06	0.9100	3.27	1.76	67		2.6	284	1.1		0.06	0.95	0.28	1.11	0.31	4.37	2.35
49	0.7	2.2	1.40	0.06	0.9100	3.64	1.98	75	99.3	2.6	297	1.1		0.06	0.95	0.26	1.11	0.29	4.10	2.22
50	0.7	2.2	1.36	0.06	0.9100	3.66	2.00	53		2.6	645	1.1		0.06	0.95	0.51	1.11	0.57	8.06	4.41
51	0.7	2.2	1.32	0.06	0.9100	4.29	2.37	46		2.6	1190	1.1		0.06	0.95	0.86	1.11	0.96	13.58	7.50
52	0.7	2.2	1.29	0.06	0.9100	3.00	1.67	100		2.6	212	1.1		0.06	0.95	0.14	1.11	0.16	2.23	1.24
53	0.7	2.2	1.26	0.06	0.9100	3.32	1.87	100		2.6	211	1.1		0.06	0.95	0.13	1.11	0.14	2.06	1.16
54	0.7	2.2	1.23	0.06	0.9100	3.31	1.88	100		2.6	228	1.1		0.06	0.95	0.13	1.11	0.15	2.07	1.18
55	0.7	2.2	1.21	0.06	0.9100	3.54	2.03	72		2.6	672	1.1		0.06	0.95	0.36	1.11	0.40	5.72	3.28
56	0.7	2.2	1.18	0.06	0.9100	3.15	1.82	100		2.6	227	1.1		0.06	0.95	0.11	1.11	0.13	1.82	1.05
57	0.7	2.2	1.16	0.06	0.9100	3.14	1.84	69		2.6	682	1.1		0.06	0.95	0.32	1.11	0.36	5.16	3.01
58	0.7	2.2	1.14	0.06	0.9100	3.56	2.10	67		2.6	977	1.1		0.06	0.95	0.44	1.11	0.49	7.00	4.13
59	0.7	2.2	1.13	0.06	0.9100	3.13	1.87	100		2.6	140	1.1		0.06	0.95	0.06	1.11	0.07	0.96	0.57
60	0.7	2.2	1.11	0.06	0.9100	2.99	1.80	100		2.6	134	1.1		0.06	0.95	0.06	1.11	0.06	0.88	0.53
61	0.7	2.2	1.10	0.06	0.9100	2.88	1.75	89		2.6	471	1.1		0.06	0.95	0.19	1.11	0.21	2.96	1.80
62	0.7	2.2	1.09	0.06	0.9100	3.24	1.98	93		2.6	631	1.1		0.06	0.95	0.25	1.11	0.27	3.79	2.32
63	0.7	2.2	1.09	0.06	0.9100	2.83	1.75	100		2.6	216	1.1		0.06	0.95	0.08	1.11	0.09	1.25	0.77
64	0.7	2.2	1.08	0.06	0.9100	2.72	1.70	79		2.6	661	1.1		0.06	0.95	0.25	1.11	0.27	3.65	2.29
65	0.7	2.2	1.07	0.06	0.9100	3.30	2.08	89		2.6	815	1.1		0.06	0.95	0.30	1.11	0.33	4.33	2.74
66	0.7	2.2	1.07	0.06	0.9100	2.61	1.66	91		2.6	542	1.1		0.06	0.95	0.19	1.11	0.22	2.78	1.77
67	0.7	2.2	1.06	0.06	0.9100	2.61	1.68	100		2.6	285	1.1		0.06	0.95	0.10	1.11	0.11	1.41	0.91
68	0.7	2.2	1.06	0.06	0.9100	2.46	1.60	100		2.6	312	1.1		0.06	0.95	0.11	1.11	0.12	1.49	0.97
69	0.7	2.2	1.05	0.06	0.9100	2.37	1.56	100		2.6	316	1.1		0.06	0.95	0.11	1.11	0.12	1.46	0.96
70	0.7	2.2	1.05	0.06	0.9100	2.36	1.57	100		2.6	339	1.1		0.06	0.95	0.11	1.11	0.13	1.52	1.01
71	0.7	2.2	1.04	0.06	0.9100	2.32	1.56	100	96.5	2.6	350	1.1		0.06	0.95	0.11	1.11	0.13	1.52	1.02
72	0.7	2.2	1.04	0.06	0.9100	2.38	1.63	100		2.6	410	1.1		0.06	0.95	0.13	1.11	0.15	1.73	1.18
73	0.7	2.2	1.03	0.06	0.9100	2.39	1.64	100		2.6	407	1.1		0.06	0.95	0.13	1.11	0.14	1.67	1.15
74	0.7	2.2	1.02	0.06	0.9100	2.23	1.55	100		2.6	450	1.1		0.06	0.95	0.14	1.11	0.16	1.79	1.25
75	0.7	2.2	1.02	0.06	0.9100	2.49	1.76	62	64.1	2.6	1566	1.1		0.06	0.95	0.48	1.11	0.53	6.07	4.28
76	0.7	2.2	1.01	0.06	0.9100	2.46	1.76	82		2.6	979	1.1		0.06	0.95	0.30	1.11	0.33	3.69	2.64
77	0.7	2.2	1.01	0.06	0.9100	2.41	1.74	61		2.6	1619	1.1		0.06	0.95	0.48	1.11	0.53	5.96	4.30
78	0.7	2.2	1.00	0.06	0.9100	2.20	1.61	78		2.6	916	1.1		0.06	0.95	0.27	1.11	0.30	3.29	2.40
79	0.7	2.2	1.00	0.06	0.9100	2.30	1.70	85		2.6	908	1.1		0.06	0.95	0.26	1.11	0.29	3.19	2.36
80	0.7	2.2	0.99	0.06	0.9100	2.15	1.61	95		2.6	651	1.1		0.06	0.95	0.18	1.11	0.20	2.23	1.67
81	0.7	2.2	0.99	0.06	0.9100	2.05	1.55	96		2.6	576	1.1		0.06	0.95	0.16	1.11	0.18	1.93	1.46
82	0.7	2.2	0.99	0.06	0.9100	2.11	1.62	98		2.6	638	1.1		0.06	0.95	0.18	1.11	0.19	2.10	1.61
83	0.7	2.2	0.98	0.06	0.9100	1.95	1.52	100		2.6	497	1.1		0.06	0.95	0.13	1.11	0.15	1.60	1.24
84	0.7	2.2	0.98	0.06	0.9100	1.94	1.52	100		2.6	500	1.1		0.06	0.95	0.13	1.11	0.15	1.58	1.24
85	0.7	2.2	0.97	0.06	0.9100	1.70	1.36	79		2.6	762	1.1		0.06	0.95	0.20	1.11	0.22	2.36	1.88
86	0.7	2.2	0.97	0.06	0.9100	1.67	1.35	87		2.6	621	1.1		0.06	0.95	0.16	1.11	0.18	1.89	1.53
87	0.7	2.2	0.97	0.06	0.9100	1.69	1.38	98		2.6	508	1.1		0.06	0.95	0.13	1.11	0.14	1.52	1.24
88	0.7	2.2	0.96	0.06	0.9100	1.68	1.39	100		2.6	499	1.1		0.06	0.95	0.13	1.11	0.14	1.47	1.22
89	0.7	2.2	0.96	0.06	0.9100	1.86	1.57	100		2.6	533	1.1		0.06	0.95	0.13	1.11	0.15	1.54	1.30
90	0.7	2.2	0.95	0.06	0.9100	1.89	1.61	94		2.6	652	1.1		0.06	0.95	0.16	1.11	0.18	1.86	1.58
91	0.7	2.2	0.95	0.06	0.9100	1.89	1.63	99		2.6	605	1.1		0.06	0.95	0.15	1.11	0.16	1.70	1.47
92	0.7	2.2	0.95	0.06	0.9100	1.87	1.64	100		2.6	515	1.1		0.06	0.95	0.12	1.11	0.14	1.43	1.25
93	0.7	2.2	0.94	0.06	0.9100	1.83	1.63	100		2.6	502	1.1		0.06	0.95	0.12	1.11	0.13	1.37	1.22
94	0.7	2.2	0.94	0.06	0.9100	1.81	1.64	100		2.6	543	1.1		0.06	0.95	0.13	1.11	0.14	1.46	1.32
95	0.7	2.2	0.94	0.06	0.9100	1.87	1.71	97		2.6	669	1.1		0.06	0.95	0.15	1.11	0.17	1.78	1.63
96	0.7	2.2	0.93	0.06	0.9100	1.80	1.68	100		2.6	542	1.1		0.06	0.95	0.12	1.11	0.14	1.42	1.32
97	0.7	2.2	0.93	0.06	0.9100	1.79	1.70	100		2.6	553	1.1		0.06	0.95	0.12	1.11	0.14	1.43	1.36
98	0.7	2.2	0.93	0.06	0.9100	1.77	1.70	92		2.6	655	1.1		0.06	0.95	0.15	1.11	0.16	1.68	1.62
99	0.7	2.2	0.92	0.06	0.9100	1.96	1.92	93		2.6	892	1.1		0.06	0.95	0.20	1.11	0.22	2.26	2.21
100	0.7	2.2	0.92	0.06	0.9100	1.82	1.80	88		2.6	825	1.1		0.06	0.95	0.18	1.11	0.20	2.07	2.05
101	0.7	2.2	0.92	0.06	0.9100	1.95	1.97	39		2.6	4215	1.1		0.06	0.95	0.91	1.11	1.01	10.48	10.57
102	0.7	2.2	0.91	0.06	0.9100	3.69	3.79	32		2.6	8446	1.1		0.06	0.95	1.79	1.11	1.99	20.80	21.32
103	0.7	2.2	0.91	0.06	0.9100	3.81	3.98	38		2.6	8078	1.1		0.06	0.95	1.70	1.11	1.89	19.72	20.56
104	0.7	2.2	0.91	0.06	0.9100	3.52	3.74	39		2.6	7691	1.1		0.06	0.95	1.60	1.11	1.77	18.61	19.74
105	0.7	2.2	0.90	0.06	0.9100	3.80	4.11	36		2.6	8909	1.1		0.06	0.95	1.83	1.11	2.03	21.38	23.09
106	0.7	2.2	0.90	0.06	0.9100	3.35	3.69	30		2.6	8802	1.1		0.06	0.95	1.79	1.11	1.98	20.96	23.04
107	0.7	2.2	0.90	0.06	0.9100	3.20	3.58	36	46.8	2.6	8206	1.1		0.06	0.95	1.65	1.11	1.83	19.39	21.71
108	0.7	2.2	0.89	0.06	0.9100	3.17	3.62	27		2.6	9860	1.1		0.06	0.95	1.95	1.11	2.17	23.14	26.38
109	0.7	2.2	0.89	0.06	0.9100	3.05	3.55	31		2.6	8277	1.1		0.06	0.95	1.62	1.11	1.80	19.29	22.41
110	0.7	2.2	0.89	0.06	0.9100	2.22	2.63	45		2.6	4467	1.1		0.06	0.95	0.87	1.11	0.96	10.35	12.26
111	0.7	2.2	0.89	0.06	0.9100	7.94	9.59	32		2.6	13066	1.1		0.06	0.95	2.51	1.11	2.78	30.08	36.33

CPTU-615 Liquefaction Analysis

ConeTec Inc. - CPT Interpretation
Interpretation Output - Release 1.22 Rev. A - Format: NLI Imperial
Run No: 06-0718-0954-2433
Job No: 02-100
Client: MACTEC Engineering and Consulting Inc.
Project: Former Callahan Mine Site, Brooksville, ME
Site: CP-615
Location: Callahan Mine
Cone: 20 Ton AD179
CPT Date: 06/28/06
CPT Time: 13:34
CPT File: 758CP615.COR
Northing (m): 0.000000
Easting (m): 0.000000
Elevation (m): 0.000000 — 72.2 — Elevation For CPT Triggering analysis

Water Table (m): 3.96 (ft): 13.0 — 13 — Water Table assumed for CPT Analysis
Unit Weight of Water (default): 62.40 pcf
Averaging Increment (m): 0.20
Phi Method : Robertson and Campanella, 1983
Su Nkt used: 15.00 Su/P' (nc): 0.30 — 0.11 — Base acceleration
Dr Method : Jamiolkowski - All Sands
State Parameter M: 1.20
Used Unit Weights Assigned to Soil Zones
N160lc Calculated using qc1n

1) CSR = $0.65*(a_{max}/g)*(s_v/s'_v)*r_d$ — Seed & Idriss, 1983, p. 459

a_{max}/g = 0.11 g — USGS (base) (amplified from base as discussed in text
s_v = computed — Total Vertical Stress
s'_v = computed — Effective Vertical Stress

$r_d = [1.0 - 0.4113z^{0.5} + 0.04052z + 0.001753z^{1.5}] / [1 - 0.4177z^{0.5} + 0.05729z - 0.006205z^{1.5} +$

z = depth in meters

2) FS = Factor of safety against triggering of liquefaction: $FS = (CRR_{7.5}/CSR) \times MSF \times Ks \times Ka$ — Youd and

MSF = magnitude scaling factor; Assume based on range recommended by NCEER Workshop, reite

CPTU-615 Liquefaction Analysis

$Ks = (s'_{vo}/P_a)^{(f-1)}$, where f = 0.7 to 0.8 for relative density of 40 to 60%; f = 0.6 to 0.7 for rel density
1 Atmosphere = 14.7 psi = 2.12 ksf

Conetec Data

Col-01 Depth (m)	Col-02 Depth (ft)	Col-03 Elev. (m)	Col-04 Elev. (ft)	Col-05 qc (tsf)	Col-06 qt (tsf)	Col-07 fs (tsf)	Col-08 Rf (%)	Col-09 u (ft)	Col-10 SBT (Zone)	Col-11 SBTn (Zone)	Col-12 SBT-BQ (Zone)	Col-13 SBT-BQn (Zone)	Col-14 Perm-k (cm/s)	Col-15 Unit Wt (pcf)	Col-16 T Stress (tsf)	Col-17 U Stress (tsf)	Col-18 E Stress (tsf)	Col-19 Cn	Col-20 N60 (b/ft)	Col-21 N1(60) (b/ft)	Col-22 N(60)lc (b/ft)	Col-23 N1(60)lc (b/ft)	Col-24 Qt	Col-25 Fr (%)	Col-26 Bq	Col-27 Ic	Col-28 FC (%)	Col-29 IcZone (Zone)	Col-30 Dr (%)	Col-31 Phi (deg)	Col-32 State Par	Col-33 Es/qt	Col-34 YoungE (tsf)	Col-35 Su (tsf)	Col-36 OCR
0.1	0.328	-0.1	71.9	10.48	10.48	0.04	0.38	-0.22	6	7	6	7	5.00E-05	114.6	0.019	0	0.019	1.7	4	6.8	2.4	4.2	556.41	0.38	0	2.38	25.5	5	58.9	50	-0.26	-9999	-9999	0.697	10
0.3	0.984	-0.3	71.2	16	16	0.13	0.83	-0.47	6	6	6	7	5.00E-05	114.6	0.056	0	0.056	1.7	6.1	10.4	3.7	6.3	282.78	0.83	0	2.35	24.4	5	55.3	46	-0.27	-9999	-9999	1.063	10
0.5	1.64	-0.5	70.6	8.19	8.2	0.18	2.17	0.95	5	5	5	6	5.00E-06	114.6	0.094	0	0.094	1.7	3.9	6.7	2.4	4.1	86.22	2.2	0	2.82	47	4	-9999	-9999	-9999	-9999	-9999	0.54	10
0.7	2.297	-0.7	69.9	16.32	16.32	0.13	0.81	-0.11	6	6	6	6	5.00E-05	114.6	0.132	0	0.132	1.7	6.3	10.6	3.7	6.4	123.05	0.82	0	2.34	24	5	43.8	42	-0.19	-9999	-9999	1.079	10
0.9	2.953	-0.9	69.2	10.38	10.38	0.15	1.4	-0.32	5	5	6	6	5.00E-06	114.6	0.169	0	0.169	1.7	5	8.4	2.7	4.6	60.34	1.42	0	2.63	36.8	4	-9999	-9999	-9999	-9999	-9999	0.68	10
1.1	3.609	-1.1	68.6	4.74	4.78	0.05	1.05	8.11	1	5	4	5	1.00E-07	111.4	0.206	0	0.206	1.7	2.3	3.9	1.4	2.4	22.19	1.1	0.06	2.87	50.1	4	-9999	-9999	-9999	-9999	-9999	0.305	8.3
1.3	4.265	-1.3	67.9	8.19	8.19	0.08	1.01	0.28	5	5	5	6	5.00E-06	114.6	0.243	0	0.243	1.7	3.9	6.7	2.2	3.7	32.68	1.04	0	2.65	37.9	4	-9999	-9999	-9999	-9999	-9999	0.53	10
1.5	4.921	-1.5	67.3	3.58	3.6	0.06	1.67	5.91	1	4	3	4	1.00E-07	111.4	0.28	0	0.28	1.7	1.7	2.9	1	3.6	11.85	1.81	0.06	2.82	46.9	4	-9999	-9999	-9999	-9999	-9999	0.222	3.2
1.7	5.577	-1.7	66.6	8.64	8.65	0.08	0.96	2.92	5	5	5	5	5.00E-06	114.6	0.317	0	0.317	1.7	4.1	7	2.3	3.9	26.26	0.99	0.01	2.62	36.4	4	-9999	-9999	-9999	-9999	-9999	0.556	10
1.9	6.234	-1.9	66.0	4.74	4.79	0.07	1.46	10.85	1	4	4	4	1.00E-07	111.4	0.355	0	0.355	1.68	2.3	3.9	1.4	3.7	12.52	1.58	0.08	2.76	44	4	-9999	-9999	-9999	-9999	-9999	0.296	3.5
2.1	6.89	-2.1	65.3	6.83	6.85	0.09	1.28	2.57	1	4	5	5	1.00E-07	111.4	0.391	0	0.391	1.6	3.3	5.2	1.8	4.5	16.51	1.36	0.01	2.63	36.7	4	-9999	-9999	-9999	-9999	-9999	0.43	5.3
2.3	7.546	-2.3	64.7	2.51	2.59	0.05	1.84	18.19	1	3	3	3	1.00E-07	111.4	0.428	0	0.428	1.53	1.2	1.9	0.9	1.9	5.07	2.2	0.26	3.18	71.1	3	-9999	-9999	-9999	-9999	-9999	0.144	1.1
2.5	8.202	-2.5	64.0	3.74	3.82	0.05	1.38	18.52	1	3	3	3	1.00E-07	111.4	0.464	0	0.464	1.47	1.8	2.7	1.2	2.4	7.24	1.57	0.17	2.97	56.4	3	-9999	-9999	-9999	-9999	-9999	0.224	1.7
2.7	8.858	-2.7	63.3	5.02	5.09	0.06	1.18	14.53	1	4	4	4	1.00E-07	111.4	0.501	0	0.501	1.41	2.4	3.4	1.5	2.8	9.16	1.31	0.1	2.84	48.5	4	-9999	-9999	-9999	-9999	-9999	0.306	2.2
2.9	9.514	-2.9	62.7	9.46	9.46	0.1	1.06	0.21	5	4	6	5	5.00E-06	114.6	0.538	0	0.538	1.36	4.5	6.2	2.5	4.1	16.58	1.12	0	2.63	36.6	4	-9999	-9999	-9999	-9999	-9999	0.595	5.3
3.1	10.17	-3.1	62.0	3.8	3.81	0.09	2.43	2.59	3	3	4	4	5.00E-08	111.4	0.575	0	0.575	1.32	3.6	4.8	1.4	2.2	5.63	2.86	0.02	3.2	72.6	3	-9999	-9999	-9999	-9999	-9999	0.216	1.2
3.3	10.827	-3.3	61.4	2.99	3.12	0.05	1.69	27.64	1	3	3	3	1.00E-07	111.4	0.611	0	0.611	1.28	1.5	1.9	1.2	1.6	4.1	2.1	0.34	3.25	76.7	3	-9999	-9999	-9999	-9999	-9999	0.167	0.9
3.5	11.483	-3.5	60.7	3.66	3.74	0.08	2.08	17.33	3	3	3	3	5.00E-08	111.4	0.648	0	0.648	1.24	3.6	4.5	1.4	1.9	4.77	2.51	0.17	3.23	75.1	3	-9999	-9999	-9999	-9999	-9999	0.206	1.1
3.7	12.139	-3.7	60.1	3.47	3.53	0.08	2.13	12.63	3	3	3	3	5.00E-08	111.4	0.684	0	0.684	1.21	3.4	4.1	1.4	1.7	4.15	2.65	0.14	3.29	80.3	3	-9999	-9999	-9999	-9999	-9999	0.189	0.9
3.9	12.795	-3.9	59.4	3.45	3.54	0.07	1.98	20.13	1	3	3	3	1.00E-07	111.4	0.721	0	0.721	1.18	1.7	2	1.4	1.6	3.91	2.49	0.22	3.3	81.1	3	-9999	-9999	-9999	-9999	-9999	0.188	0.9
4.1	13.451	-4.1	58.7	1.84	1.99	0.05	2.27	32.45	1	2	3	3	1.00E-07	111.4	0.758	0.014	0.743	1.16	1	1.1	1.2	1	1.66	3.66	0.81	3.71	100	2	-9999	-9999	-9999	-9999	-9999	0.082	0.6
4.3	14.107	-4.3	58.1	2.01	2.23	0.05	2.24	47.31	1	3	1	1	1.00E-07	111.4	0.794	0.035	0.76	1.15	1.1	1.2	1.2	1.1	1.9	3.48	1	3.65	100	2	-9999	-9999	-9999	-9999	-9999	0.096	0.6
4.5	14.764	-4.5	57.4	3.02	3.15	0.07	2.31	27.46	3	3	3	3	5.00E-08	111.4	0.831	0.055	0.776	1.14	3	3.4	1.4	1.4	2.99	3.14	0.35	3.45	94.4	3	-9999	-9999	-9999	-9999	-9999	0.154	0.7
4.7	15.42	-4.7	56.8	1.98	2.18	0.05	2.41	43.24	3	2	3	1	5.00E-08	111.4	0.867	0.076	0.792	1.12	2.1	2.4	1.3	1	1.66	3.99	0.97	3.72	100	2	-9999	-9999	-9999	-9999	-9999	0.088	0.6
4.9	16.076	-4.9	56.1	1.98	2.24	0.05	2.13	55.16	1	2	3	1	1.00E-07	111.4	0.904	0.096	0.808	1.11	1.1	1.2	1.3	1	1.66	3.56	1.22	3.7	100	2	-9999	-9999	-9999	-9999	-9999	0.089	0.6
5.1	16.732	-5.1	55.5	0.79	0.94	0.04	1.99	33.58	1	3	4	3	1.00E-07	114.6	0.941	0.117	0.824	1.1	4.4	4.9	2.3	2.5	2.28	2.3	0.16	3.05	61.9	3	-9999	-9999	-9999	-9999	-9999	0.4	1.7
5.3	17.388	-5.3	54.8	5.54	5.67	0.14	2.39	28.07	4	3	4	3	5.00E-07	114.6	0.978	0.137	0.841	1.09	3.6	3.9	2.1	2.2	5.58	2.88	0.16	3.2	73	3	-9999	-9999	-9999	-9999	-9999	0.313	1.2
5.5	18.044	-5.5	54.2	3.24	3.46	0.11	3.11	46.77	3	3	3	3	5.00E-08	111.4	1.015	0.158	0.858	1.08	3.3	3.6	1.7	1.5	2.85	4.4	0.53	3.54	100	3	-9999	-9999	-9999	-9999	-9999	0.163	0.7
5.7	18.701	-5.7	53.5	3.83	4.06	0.12	3.03	47.88	3	3	3	3	5.00E-08	111.4	1.052	0.178	0.874	1.07	3.9	4.2	1.8	1.6	3.44	4.08	0.44	3.46	95	3	-9999	-9999	-9999	-9999	-9999	0.2	0.8
5.9	19.357	-5.9	52.8	2.44	2.76	0.06	2.09	67.86	1	3	1	1	1.00E-07	111.4	1.089	0.198	0.89	1.06	1.3	1.4	1.5	1.1	1.88	3.45	1.15	3.65	100	2	-9999	-9999	-9999	-9999	-9999	0.112	0.6
6.1	20.013	-6.1	52.2	2.73	3.07	0.05	1.71	72.27	1	3	1	1	1.00E-07	111.4	1.125	0.219	0.906	1.05	1.5	1.5	1.5	1.1	2.15	2.71	1.05	3.55	100	2	-9999	-9999	-9999	-9999	-9999	0.13	0.6
6.3	20.669	-6.3	51.5	3.96	4.25	0.07	2.07	61.36	3	3	3	3	5.00E-08	111.4	1.162	0.239	0.922	1.04	4.1	4.2	1.8	1.5	3.35	2.84	0.54	3.39	88.6	3	-9999	-9999	-9999	-9999	-9999	0.206	0.8
6.5	21.325	-6.5	50.9	7.44	7.69	0.17	2.15	53.61	4	3	4	3	5.00E-07	114.6	1.199	0.26	0.939	1.03	4.9	5.1	2.6	2.5	6.92	2.55	0.22	3.09	64.9	3	-9999	-9999	-9999	-9999	-9999	0.433	1.6
6.7	21.981	-6.7	50.2	12.31	12.41	0.26	2.12	21.54	5	4	6	4	5.00E-06	114.6	1.236	0.28	0.956	1.02	5.9	6.1	3.7	3.7	11.69	2.35	0.04	2.88	50.9	4	-9999	-9999	-9999	-9999	-9999	0.745	3.2
6.9	22.638	-6.9	49.6	15.83	15.96	0.22	1.38	28.36	6	4	6	5	5.00E-05	114.6	1.274	0.301	0.973	1.01	6.1	6.2	4.3	4.3	15.09	1.5	0.04	2.68	39.6	4	30	32	-0.03	-9999	-9999	0.979	4.6
7.1	23.294	-7.1	48.9	14.29	14.33	0.23	1.57	8.73	6	4	6	5	5.00E-05	114.6	1.312	0.322	0.99	1.01	5.5	5.5	4.1	3.9	13.15	1.73	0	2.77	44.1	4	30	32	-0.03	-9999	-9999	0.868	3.7
7.3	23.951	-7.3	48.3	7.27	7.45	0.23	3.13	38.02	3	3	4	3	5.00E-08	111.4	1.349	0.342	1.007	1	7.1	7.1	2.8	2.4	6.06	3.82	0.14	3.24	75.8	3	-9999	-9999	-9999	-9999	-9999	0.406	1.4
7.5	24.606	-7.5	47.6	10.74	10.98	0.18	1.67	52.85	5	4	5	4	5.00E-06	114.6	1.386	0.362	1.023	0.99	5.3	5.2	3.4	3	9.38	1.91	0.13	2.91	52.9	4	-9999	-9999	-9999	-9999	-9999	0.64	2.3
7.7	25.262	-7.7	46.9	5.56	5.85	0.18	3.13	62.93	3	3	3	3	5.00E-08	111.4	1.423	0.383	1.04	0.98	5.6	5.5	2.5	1.9	4.26	4.13	0.36	3.38	88.1	3	-9999	-9999	-9999	-9999	-9999	0.295	1
7.9	25.918	-7.9	46.3	14.66	14.76	0.25	1.66	19.74	6	4	6	5	5.00E-05	114.6	1.46	0.403	1.056	0.97	5.7	5.5	4.2	3.8	12.59	1.85	0.02	2.8	45.9	4	30	30	-0.03	-9999	-9999	0.886	3.5
8.1	26.574	-8.1	45.6	4.68	4.97	0.13	2.52	61.41	3	3	3	3	5.00E-08	111.4	1.497	0.424	1.073	0.97	4.8	4.6	2.2	1.5	3.23	3.61	0.43	3.45	94.5	3	-9999	-9999	-9999	-9999	-9999	0.231	0.8
8.3	27.231	-8.3	45.0	3.79	4.17	0.06	1.38	82.84	1	3	3	3	1.00E-07	111.4	1.533	0.444	1.089	0.96	2	1.9	1.9	1.1	2.43	2.18	0.81	3.46	94.9	3	-9999	-9999	-9999	-9999	-9999	0.176	0.6
8.5	27.887	-8.5	44.3	3.67	4.05	0.06	1.17	81.41	1	3	3	3	1.00E-07	111.4	1.57	0.465	1.105	0.95	1.9	1.8	1.8	1.1	2.25	1.92	0.84	3.46	95.3	3	-9999	-9999	-9999	-9999	-9999	0.166	0.6
8.7	28.543	-8.7	43.7	5.01	5.37	0.07	1.35	75.39	1	3	3	3	1.00E-07	111.4	1.607	0.485	1.121	0.94	2.6	2.4	2.2	1.4	3.35	1.93	0.5	3.31	81.7	3	-9999	-9999	-9999	-9999	-9999	0.251	0.8
8.9	29.199	-8.9	43.0	5.56	5.77	0.17	3	46.37	3	3	3	3	5.00E-08	111.4	1.643	0.506	1.137	0.94	5.5	5.2	2.6	1.7	3.63	4.19	0.23	3.44	93.7	3	-9999	-9999	-9999	-9999	-9999	0.275	0.8
9.1	29.855	-9.1	42.3	4.12	4.51	0.06	1.33	83.69	1	3	3	3	1.00E-07	111.4	1.68	0.526	1.153	0.93	2.2	2	2	1.2	2.45	2.13	0.74	3.45	94	3	-9999	-9999	-9999	-9999	-9999	0.189	0.7
9.3	30.511	-9.3	41.7	3.9	4.34	0.04	0.92	95.59	1	3	3	3	1.00E-07	111.4	1.716	0.547	1.169	0.92	2.1	1.9	1.9	1	2.25	1.53	0.93	3.42	91.5	3	-9999	-9999	-9999	-9999	-9999	0.175	0.6
9.5	31.168	-9.5	41.0	4.1	4.56	0.06	1.21	98.29	1	3	3	3	1.00E-07	111.4	1.753	0.567	1.185	0.92	2.2	2	2	1.1	2.37	1.96	0.89	3.45	93.8	3	-9999	-9999	-9999	-9999	-9999	0.187	0.6
9.7	31.824	-9.7	40.4	4.05	4.55	0.05	1.1	105.27	1	3	3	3	1.00E-07	111.4	1.789	0.588	1.202	0.91	2.2	2	2	1.1	2.29	1.82	0.98	3.44	93.6	3	-9999	-9999	-9999	-9999	-9999	0.184	0.6
9.9	32.48	-9.9	39.7	4.31	4.79	0.06	1.2	102.52	1	3	3	3	1.00E-07	111.4	1.826	0.608	1.218	0.91	2.3	2.1	2.1	1.1	2.44	1.94	0.87	3.43	92.7	3	-9999	-9999	-9999	-9999	-9999	0.198	0.6
10.1	33.136	-10.1	39.1	6.55	6.96	0.1	1.44	88.12	5	3	3	3	5.00E-06	114.6	1.863	0.629	1.234	0.9	3.3	3	2.6	1.6	4.13	1.97	0.42	3.23	75.4	3	-9999	-9999	-9999	-9999	-9999	0.34	0.9
10.3	33.792	-10.3	38.4	4.34	4.85	0.06	1.14	108.32	1	3	3	3	1.00E-07	111.4	1.9	0.649	1.251	0.89	2.3	2.1	2.2	1.1	2.36	1.87	0.93	3.44	93.1	3	-9999	-9999	-9999	-9999	-9999	0.197	0.6
10.5	34.448	-10.5	37.8	4.31	4.82	0.06	1.3	109.02	1	3	3	3	1.00E-07	111.4	1.936	0.67	1.267	0.89	2.3	2.1	2.2	1.1	2.28	2.17	0.95	3.48	97	3	-9999	-9999	-9999	-9999	-9999	0.192	0.6
10.7	35.105	-10.7	37.1	5.45	5.92	0.09	1.52	101.73	1	3	3	3	1.00E-07	111.4	1.973	0.69	1.283	0.88	2.8	2.5	2.5	1.4	3.08	2.28	0.63	3.37	87.4	3	-9999	-9999	-9999	-9999	-9999	0.263	0.7
10.9	35.761	-10.9	36.4	5.64	6.04	0.13	2.12	86.19	4	3	3	3	5.00E-07	114.6	2.01	0.711	1.299	0.88	3.9	3.4	2.7	1.4	3.1	3.17	0.49	3.44	93.3	3	-9999	-9999	-9999	-9999	-9999	0.269	0.7
11.1	36.417	-11.1	35.8	4.82	5.36	0.08	1.45	114.39	1	3	3	3	1.00E-07	111.4	2.047	0.731	1.316	0.87	2.6	2.2	2.4	1.2	2.52	2.35	0.86	3.46	94.9	3	-9999	-9999	-9999	-9999	-9999	0.221	0.7
11.3	37.073	-11.3	35.1	4.88	5.42	0.07	1.3	113.79	1	3	3	3	1.00E-07	111.4	2.084	0.752	1.332	0.87	2.6	2.2	2.4	1.2	2.5	2.1	0.84	3.44	93.1	3	-9999	-9999	-9999	-9999	-9999	0.222	0.7
11.5	37.729	-11.5	34.5	4.84	5.36	0.07	1.31	110.77	1	3	3	3	1.00E-07	111.4	2.12	0.772	1.348	0.86	2.6	2.2	2.4	1.1	2.4	2.17	0.83	3.46	95.1	3	-9999	-9999	-9999	-9999	-9999	0.216	0.6
11.7	38.385	-11.7	33.8	4.39	4.94	0.06	1.22	116.39	1	3	3	3	1.00E-07	111.4	2.157	0.793	1.364	0.86	2.4	2	2.4	1.1	2.04	2.16	1.02	3.52	100	3	-9999	-9999	-9999	-9999	-9999	0.185	0.6
11.9	39.042	-11.9	33.2	4.97	5.42	0.06	1.16	117.08	1	3	3	3	1.00E-07	111.4	2.193	0.813	1.38	0.85	2.6	2.2	2.4	1.1	2.34	1.94	0.88	3.45	94.1	3	-9999	-9999	-9999	-9999	-9999	0.215	0.6
12.1	39.698	-12.1	32.5	4.79	5.36	0.06	1.17	121.38	1	3	3	3	1.00E-07	111.4	2.23	0.834	1.396	0.85	2.6	2.2	2.5	1.1	2.24	2	0.94	3.47	96.2	3	-9999	-9999	-9999	-9999	-9999	0.209	0.6
12.3	40.354	-12.3	31.8	4.77	5.31	0.06	1.18	114.03	1	3	3	3	1.00E-07	111.4	2.266	0.854	1.412	0.84	2.5	2.1	2.5	1.1	2.15	2.06	0.89	3.49	98.1	3	-9999	-9999	-9999	-9999	-9999	0.203	0.6
12.5	41.01	-12.5	31.2	5.37	5.87	0.07	1.11	107.25	1	3	3	3	1.00E-07	111.4	2.303	0.875	1.428	0.84	2.8	2.4	2.6	1.1	2.5	1.83	0.69	3.41	90.7	3	-9999	-9999	-9999	-9999	-9999	0.238	0.7
12.7	41.666	-12.7	30.5	4.93	5.51	0.06	1.09	122.92	1	3	3	3	1.00E-07	111.4	2.34	0.895	1.444	0.83	2.6	2.2	2.5	1	2.19	1.9	0.93	3.47	96	3	-9999	-9999	-9999	-9999	-9999	0.211	0.6
12.9	42.322	-12.9	29.9	5	5.6	0.07	1.3	128.16	1	3	3	3	1.00E-07	111.4	2.376	0.916	1.461	0.83	2.7	2.2	2.6	1.1	2.21	2.26	0.96	3.5	100	3	-9999	-9999	-9999	-9999	-9999	0.215	0.6
13.1	42.978	-13.1	29.2	5.57	6.13	0.08	1.27	119.81	1	3	3	3	1.00E-07	111.4	2.413	0.936	1.477	0.82	2.9	2.4	2.7	1.2	2.52	2.09	0.75	3.43	92.7	3	-9999	-9999	-9999	-9999	-9999	0.248	0.7
13.3	43.635	-13.3	28.6	5.75	6.27	0.08	1.24	111.71	1	3	3	3	1.00E-07	111.4	2.449	0.957	1.493	0.82	3	2.5	2.8	1.2	2.56	2.03	0.66	3.42	91.6	3	-9999	-9999	-9999	-9999	-9999	0.255	0.7
13.5	44.291	-13.5	27.9	5.59	6.2	0.08	1.25	129.93	1	3	3	3	1.00E-07	111.4	2.486	0.977	1.509	0.81	3	2.4	2.8	1.2	2.46	2.09	0.83	3.44	93.6	3	-9999	-9999	-9999	-9999	-9999	0.248	0.7
13.7	44.947	-13.7	27.3	5.57	6.19	0.08	1.29	132.91	1	3	3	3	1.00E-07	111.4	2.522	0.997	1.525	0.81	3	2.4	2.8	1.1	2.41	2.18	0.86	3.46	95.1	3	-9999	-9999	-9999	-9999	-9999	0.245	0.6
13.9	45.603	-13.9	26.6	7.94	8.57	0.1	1.2	135.46	5	3	3	3	5.00E-06	114.6	2.559	1.018	1.541	0.81	4.1	3.3	3.2	1.5	3.9	1.71	0.53	3.22	74.9	3	-9999	-9999	-9999	-9999	-9999	0.401	0.9
14.1	46.259	-14.1	25.9	10.01	10.54	0.16	1.52	112.61	5	3	4	3	5.00E-06	114.6	2.597	1.038	1.558	0.8	5	4	3.8	1.9	5.1	2.02	0.31	3.16	69.6	3	-9999	-9999	-9999	-9999	-9999	0.53	1.1
14.3	46.915	-14.3	25.3	14.07	14.56	0.23	1.55	103.44	6

CPTU-615 Liquefaction Analysis

0.001210z']

Idriss, 2001

rated in Youd and Idriss, 2001

CPTU-615 Liquefaction Analysis

f 60 to 80%; P_a = pressure at 1 atmosphere   Youd and Idriss, 2001

Row	AU	AV	AW	AX	AY	AZ	BA	BB	BC	BD	BE	BF	BG
34	Col-47	Col-48	Col-49	Col-50	Col-51	Col-52	Col-53	Col-54	Col-55	Col-56	Col-57	Col-57a	Col-58
35	Youd & Idriss, 2001 CPT Based Analysis												
37	$Q_{exp = 0.5}$	F	$I_{c\ Qexp=0.5}$	$Q_{exp = 0.7}$	F	$I_{c\ Qexp=0.7}$	Description	C_q			q_{c1N}	Lookup	Ic
38								n=1.0	n=0.5	n=0.7		Col	
39													
40	73.78	0.38	1.79	164.85	0.38	1.49	Granular	55.68	7.46	16.67	73.92	6.00	1.79
41	65.50	0.82	2.00	117.90	0.82	1.80	Granular	18.89	4.35	7.82	65.73	5.00	2.00
42	25.70	2.22	2.59	41.71	2.22	2.42	Granular	11.26	3.35	5.44	26.00	2.00	2.59
43	43.32	0.80	2.15	65.68	0.80	2.00	Granular	8.02	2.83	4.29	43.67	2.00	2.15
44	24.15	1.47	2.51	34.85	1.47	2.37	Granular	6.26	2.50	3.61	24.55	2.00	2.51
45	9.80	1.09	2.78	13.59	1.09	2.65	Very Silty	5.14	2.27	3.14	14.20	2.00	2.65
46	15.67	1.01	2.58	21.03	1.01	2.47	Granular	4.35	2.09	2.80	16.15	2.00	2.58
47	6.10	1.81	3.06	7.96	1.81	2.96	Clayey	3.78	1.94	2.54	12.86	2.00	2.81
48	14.39	0.96	2.61	18.31	0.96	2.51	Very Silty	3.34	1.83	2.32	19.01	2.00	2.51
49	7.24	1.58	2.97	9.00	1.58	2.89	Clayey	2.98	1.73	2.15	13.49	2.00	2.76
50	10.04	1.39	2.82	12.25	1.39	2.74	Clayey	2.71	1.64	2.01	17.52	2.00	2.63
51	3.21	2.31	3.36	3.85	2.31	3.29	Clayey	2.47	1.57	1.88	6.05	2.00	3.19
52	4.79	1.49	3.12	5.65	1.49	3.05	Clayey	2.28	1.51	1.78	8.23	2.00	2.96
53	6.30	1.31	2.99	7.32	1.31	2.93	Clayey	2.11	1.45	1.69	10.16	2.00	2.84
54	11.83	1.12	2.71	13.54	1.12	2.66	Very Silty	1.97	1.40	1.61	14.35	2.00	2.66
55	4.15	2.78	3.30	4.69	2.78	3.26	Clayey	1.84	1.36	1.53	6.63	2.00	3.19
56	3.12	1.99	3.34	3.48	1.99	3.30	Clayey	1.73	1.32	1.47	5.11	2.00	3.24
57	3.73	2.59	3.33	4.12	2.59	3.29	Clayey	1.63	1.28	1.41	5.77	2.00	3.23
58	3.35	2.81	3.39	3.65	2.81	3.35	Clayey	1.55	1.24	1.36	5.16	2.00	3.30
59	3.23	2.48	3.37	3.48	2.48	3.34	Clayey	1.47	1.21	1.31	4.91	2.00	3.30
60	1.39	4.06	3.80	1.49	4.06	3.77	Clayey	1.42	1.19	1.28	2.67	2.00	3.73
61	1.60	3.48	3.71	1.71	3.48	3.68	Clayey	1.39	1.18	1.26	2.94	2.00	3.65
62	2.56	3.02	3.50	2.72	3.02	3.48	Clayey	1.36	1.17	1.24	4.06	2.00	3.44
63	1.43	3.81	3.77	1.52	3.81	3.75	Clayey	1.34	1.16	1.23	2.75	2.00	3.72
64	1.44	3.74	3.76	1.52	3.74	3.74	Clayey	1.31	1.14	1.21	2.77	2.00	3.71
65	6.42	2.33	3.10	6.75	2.33	3.08	Clayey	1.28	1.13	1.19	8.42	2.00	3.05
66	4.97	2.98	3.25	5.21	2.98	3.23	Clayey	1.26	1.12	1.17	6.74	2.00	3.21
67	2.57	4.50	3.59	2.68	4.50	3.57	Clayey	1.23	1.11	1.16	4.03	2.00	3.55
68	3.13	3.99	3.49	3.25	3.99	3.47	Clayey	1.21	1.10	1.14	4.64	2.00	3.45
69	1.72	3.59	3.69	1.78	3.59	3.68	Clayey	1.19	1.09	1.13	3.10	2.00	3.66
70	1.99	2.57	3.57	2.05	2.57	3.55	Clayey	1.17	1.08	1.11	3.39	2.00	3.54
71	3.13	2.91	3.42	3.21	2.91	3.41	Clayey	1.15	1.07	1.10	4.61	2.00	3.39
72	6.51	2.62	3.12	6.67	2.62	3.11	Clayey	1.13	1.06	1.09	8.19	2.00	3.10
73	11.11	2.33	2.90	11.34	2.33	2.89	Clayey	1.11	1.05	1.07	12.98	2.00	2.88
74	14.47	1.50	2.70	14.72	1.50	2.69	Clayey	1.09	1.04	1.06	16.40	2.00	2.68
75	12.71	1.77	2.78	12.88	1.77	2.78	Clayey	1.07	1.03	1.05	14.46	2.00	2.77
76	5.91	3.77	3.24	5.97	3.77	3.24	Clayey	1.05	1.02	1.03	7.40	2.00	3.23
77	9.22	1.88	2.92	9.28	1.88	2.91	Clayey	1.03	1.02	1.02	10.72	2.00	2.91
78	4.22	4.07	3.38	4.23	4.07	3.38	Clayey	1.02	1.01	1.01	5.62	2.00	3.38
79	12.58	1.88	2.80	12.58	1.88	2.80	Clayey	1.00	1.00	1.00	13.96	2.00	2.80
80	3.26	3.74	3.46	3.25	3.74	3.46	Clayey	0.99	0.99	0.99	4.63	2.00	3.46
81	2.46	2.28	3.46	2.44	2.28	3.46	Clayey	0.97	0.99	0.98	3.83	2.00	3.47
82	2.29	2.02	3.46	2.27	2.02	3.47	Clayey	0.96	0.98	0.97	3.66	2.00	3.47
83	3.45	1.86	3.29	3.41	1.86	3.29	Clayey	0.94	0.97	0.96	4.79	2.00	3.30
84	3.76	4.12	3.43	3.71	4.12	3.43	Clayey	0.93	0.96	0.95	5.07	2.00	3.44
85	2.56	2.12	3.43	2.52	2.12	3.44	Clayey	0.92	0.96	0.94	3.91	2.00	3.45
86	2.36	1.52	3.40	2.31	1.52	3.41	Clayey	0.90	0.95	0.93	3.71	2.00	3.42
87	2.51	2.14	3.44	2.45	2.14	3.45	Clayey	0.89	0.94	0.92	3.84	2.00	3.46
88	2.45	1.81	3.42	2.39	1.81	3.43	Clayey	0.88	0.94	0.91	3.79	2.00	3.44
89	2.61	2.02	3.41	2.54	2.02	3.42	Clayey	0.87	0.93	0.91	3.93	2.00	3.44
90	4.46	1.96	3.20	4.32	1.96	3.21	Clayey	0.86	0.93	0.90	5.64	2.00	3.23
91	2.56	2.03	3.42	2.48	2.03	3.43	Clayey	0.85	0.92	0.89	3.88	2.00	3.45
92	2.49	2.08	3.44	2.40	2.08	3.45	Clayey	0.84	0.91	0.88	3.80	2.00	3.47
93	3.39	2.28	3.34	3.26	2.28	3.35	Clayey	0.82	0.91	0.87	4.61	2.00	3.37
94	3.44	3.23	3.41	3.30	3.23	3.42	Clayey	0.81	0.90	0.87	4.65	2.00	3.44
95	2.81	2.41	3.42	2.69	2.41	3.44	Clayey	0.80	0.90	0.86	4.07	2.00	3.46
96	2.81	2.10	3.39	2.68	2.10	3.41	Clayey	0.79	0.89	0.85	4.07	2.00	3.44
97	2.71	2.16	3.41	2.58	2.16	3.43	Clayey	0.78	0.89	0.84	3.97	2.00	3.46
98	2.32	2.16	3.47	2.20	2.16	3.49	Clayey	0.78	0.88	0.84	3.62	2.00	3.52
99	2.67	1.86	3.39	2.53	1.86	3.41	Clayey	0.77	0.88	0.83	3.93	2.00	3.44
100	2.57	1.92	3.41	2.44	1.92	3.43	Clayey	0.76	0.87	0.82	3.84	2.00	3.46
101	2.49	1.97	3.43	2.35	1.97	3.45	Clayey	0.75	0.87	0.82	3.76	2.00	3.48
102	2.90	1.96	3.37	2.73	1.96	3.39	Clayey	0.74	0.86	0.81	4.11	2.00	3.42
103	2.56	1.89	3.41	2.41	1.89	3.43	Clayey	0.73	0.86	0.80	3.81	2.00	3.47
104	2.59	2.17	3.43	2.43	2.17	3.45	Clayey	0.72	0.85	0.80	3.83	2.00	3.49
105	2.97	2.15	3.38	2.78	2.15	3.40	Clayey	0.72	0.85	0.79	4.15	2.00	3.44
106	3.04	2.09	3.36	2.84	2.09	3.39	Clayey	0.71	0.84	0.79	4.20	2.00	3.43
107	2.94	2.15	3.38	2.74	2.15	3.41	Clayey	0.70	0.84	0.78	4.11	2.00	3.45
108	2.89	2.18	3.39	2.68	2.18	3.42	Clayey	0.69	0.83	0.77	4.06	2.00	3.46
109	4.71	1.66	3.15	4.36	1.66	3.18	Clayey	0.69	0.83	0.77	5.56	2.00	3.22
110	6.18	2.01	3.08	5.72	2.01	3.11	Clayey	0.68	0.82	0.76	6.76	2.00	3.16
111	9.23	1.93	2.92	8.52	1.93	2.95	Clayey	0.67	0.82	0.76	9.23	2.00	3.00
112	13.16	2.87	2.89	12.13	2.87	2.92	Clayey	0.66	0.81	0.75	12.40	2.00	2.96
113	10.44	1.91	2.87	9.60	1.91	2.91	Clayey	0.66	0.81	0.75	10.14	2.00	2.95
114	10.98	1.32	2.77	10.08	1.32	2.81	Clayey	0.65	0.81	0.74	10.54	2.00	2.86
115	10.34	1.17	2.77	9.47	1.17	2.81	Clayey	0.64	0.80	0.73	9.99	2.00	2.86
116	8.26	1.28	2.88	7.54	1.28	2.91	Clayey	0.64	0.80	0.73	8.29	2.00	2.96
117	7.44	0.91	2.85	6.78	0.91	2.89	Clayey	0.63	0.79	0.72	7.61	2.00	2.94
118	9.78	0.84	2.73	8.90	0.84	2.77	Clayey	0.62	0.79	0.72	9.43	2.00	2.82
119	7.96	1.03	2.85	7.23	1.03	2.89	Clayey	0.62	0.79	0.71	7.97	2.00	2.94
120	6.88	0.86	2.87	6.23	0.86	2.91	Clayey	0.61	0.78	0.71	7.10	2.00	2.97
121	7.11	0.83	2.86	6.43	0.83	2.90	Clayey	0.61	0.78	0.70	7.25	2.00	2.96
122	7.01	0.73	2.84	6.32	0.73	2.88	Clayey	0.60	0.77	0.70	7.15	2.00	2.94
123	6.62	0.88	2.89	5.97	0.88	2.94	Clayey	0.59	0.77	0.69	6.83	2.00	3.00
124	13.73	4.86	3.01	12.35	4.86	3.05	Clayey	0.59	0.77	0.69	12.26	2.00	3.10

Row	BH	BI	BJ	BK	BL	BM	BN	BO	BP	BQ	BR	BS	BT	BU
34	Col-59	Col-60	Col-61	Col-62	Col-63	Col-64	Col-65	Col-66	Col-67	Col-68	Col-69	Col-70	Col-71	Col-72
36							Rel. Den. Factor							
37	Kc	$(q_{c1N})_{cs}$	CRR7.5	rd	$a_{max}/g =$	CSR		f	MSF	K_σ	α	K_α	$FS_{liq-CPT (Sand-Like)}$	
38					if crest accel =	No Amplification	f crest accel =						No Amplification	f crest accel =
39					2.0		2				0.06			2
40	1.10	81.36	0.13	1.00	0.22	0.07	0.14	0.7	2.2	3.34	0.06	0.9250	12.36	6.20
41	1.30	85.77	0.14	1.00	0.22	0.07	0.14	0.7	2.2	2.41	0.06	0.9175	9.46	4.77
42	3.25	84.60	0.14	1.00	0.22	0.07	0.14	0.7	2.2	2.07	0.06	0.9100	7.91	4.01
43	1.55	67.89	0.11	1.00	0.22	0.07	0.14	0.7	2.2	1.87	0.06	0.9100	5.72	2.92
44	2.80	68.70	0.11	1.00	0.21	0.07	0.14	0.7	2.2	1.73	0.06	0.9100	5.37	2.76
45	3.68	52.20	0.09	0.99	0.21	0.07	0.14	0.7	2.2	1.63	0.06	0.9100	4.29	2.22
46	3.22	52.05	0.09	0.99	0.21	0.07	0.14	0.7	2.2	1.55	0.06	0.9100	4.09	2.13
47	4.91	63.14	0.10	0.99	0.21	0.07	0.14	0.7	2.2	1.49	0.06	0.9100	4.36	2.28
48	2.84	53.94	0.09	0.99	0.21	0.07	0.13	0.7	2.2	1.44	0.06	0.9100	3.84	2.02
49	4.49	60.62	0.10	0.99	0.21	0.07	0.13	0.7	2.2	1.39	0.06	0.9100	3.96	2.10
50	3.53	61.92	0.10	0.99	0.21	0.07	0.13	0.7	2.2	1.35	0.06	0.9100	3.91	2.08
51	9.08	54.97	0.10	0.98	0.20	0.07	0.13	0.7	2.2	1.31	0.06	0.9100	3.56	1.91
52	6.30	51.87	0.09	0.98	0.20	0.07	0.13	0.7	2.2	1.28	0.06	0.9100	3.39	1.83
53	5.15	52.34	0.09	0.98	0.20	0.07	0.13	0.7	2.2	1.25	0.06	0.9100	3.33	1.81
54	3.72	53.40	0.09	0.98	0.20	0.07	0.13	0.7	2.2	1.22	0.06	0.9100	3.29	1.80
55	9.09	60.24	0.10	0.98	0.20	0.07	0.13	0.7	2.2	1.20	0.06	0.9100	3.45	1.90
56	9.75	49.81	0.08	0.98	0.20	0.07	0.13	0.7	2.2	1.18	0.06	0.9100	2.81	1.56
57	9.73	56.16	0.10	0.98	0.20	0.07	0.13	0.7	2.2	1.16	0.06	0.9100	3.21	1.79
58	10.77	55.57	0.10	0.97	0.20	0.07	0.12	0.7	2.2	1.14	0.06	0.9100	3.14	1.77
59	10.72	52.62	0.09	0.97	0.19	0.07	0.12	0.7	2.2	1.12	0.06	0.9100	3.02	1.71
60	18.69	49.98	0.08	0.97	0.19	0.07	0.12	0.7	2.2	1.11	0.06	0.9100	2.62	1.49
61	16.94	49.75	0.08	0.97	0.19	0.07	0.13	0.7	2.2	1.10	0.06	0.9100	2.53	1.45
62	13.07	53.07	0.09	0.97	0.19	0.07	0.13	0.7	2.2	1.10	0.06	0.9100	2.78	1.61
63	18.38	50.63	0.09	0.97	0.19	0.08	0.13	0.7	2.2	1.09	0.06	0.9100	2.65	1.54
64	18.33	50.81	0.09	0.97	0.19	0.08	0.13	0.7	2.2	1.08	0.06	0.9100	2.59	1.52
65	7.36	61.95	0.10	0.96	0.19	0.08	0.13	0.7	2.2	1.08	0.06	0.9100	2.80	1.65
66	9.36	63.08	0.10	0.96	0.19	0.08	0.13	0.7	2.2	1.07	0.06	0.9100	2.77	1.64
67	15.01	60.57	0.10	0.96	0.18	0.08	0.14	0.7	2.2	1.07	0.06	0.9100	2.64	1.58
68	13.23	61.47	0.10	0.96	0.18	0.08	0.14	0.7	2.2	1.06	0.06	0.9100	2.61	1.57
69	17.14	53.10	0.09	0.96	0.18	0.08	0.14	0.7	2.2	1.05	0.06	0.9100	2.36	1.43
70	14.76	50.02	0.09	0.96	0.18	0.08	0.14	0.7	2.2	1.05	0.06	0.9100	2.26	1.38
71	12.21	56.25	0.10	0.96	0.18	0.09	0.14	0.7	2.2	1.04	0.06	0.9100	2.34	1.44
72	7.91	64.78	0.11	0.95	0.18	0.09	0.14	0.7	2.2	1.04	0.06	0.9100	2.51	1.56
73	5.49	71.34	0.11	0.95	0.18	0.09	0.14	0.7	2.2	1.03	0.06	0.9100	2.67	1.67
74	3.87	63.51	0.10	0.95	0.17	0.09	0.14	0.7	2.2	1.03	0.06	0.9100	2.40	1.51
75	4.55	65.78	0.11	0.95	0.17	0.09	0.14	0.7	2.2	1.02	0.06	0.9100	2.42	1.54
76	9.71	71.84	0.11	0.95	0.17	0.09	0.14	0.7	2.2	1.01	0.06	0.9100	2.57	1.64
77	5.80	62.22	0.10	0.94	0.17	0.09	0.14	0.7	2.2	1.01	0.06	0.9100	2.27	1.46
78	11.98	67.35	0.11	0.94	0.17	0.09	0.14	0.7	2.2	1.01	0.06	0.9100	2.37	1.54
79	4.80	67.03	0.11	0.94	0.17	0.09	0.14	0.7	2.2	1.00	0.06	0.9100	2.33	1.53
80	13.38	61.96	0.10	0.94	0.17	0.09	0.14	0.7	2.2	1.00	0.06	0.9100	2.18	1.44
81	13.46	51.56	0.09	0.93	0.17	0.09	0.14	0.7	2.2	0.99	0.06	0.9100	1.96	1.30
82	13.58	49.73	0.08	0.93	0.16	0.09	0.14	0.7	2.2	0.99	0.06	0.9100	1.74	1.16
83	10.71	51.27	0.09	0.93	0.16	0.09	0.14	0.7	2.2	0.98	0.06	0.9100	1.92	1.29
84	13.02	66.05	0.11	0.92	0.16	0.10	0.14	0.7	2.2	0.98	0.06	0.9100	2.19	1.49
85	13.13	51.32	0.09	0.92	0.16	0.10	0.14	0.7	2.2	0.97	0.06	0.9100	1.88	1.29
86	12.67	47.02	0.08	0.92	0.16	0.10	0.14	0.7	2.2	0.97	0.06	0.9100	1.63	1.13
87	13.41	51.53	0.09	0.91	0.16	0.10	0.14	0.7	2.2	0.97	0.06	0.9100	1.86	1.29
88	13.05	49.42	0.08	0.91	0.16	0.10	0.14	0.7	2.2	0.96	0.06	0.9100	1.65	1.16
89	13.03	51.23	0.09	0.91	0.16	0.10	0.14	0.7	2.2	0.96	0.06	0.9100	1.83	1.29
90	9.68	54.56	0.10	0.90	0.15	0.10	0.14	0.7	2.2	0.95	0.06	0.9100	1.87	1.33
91	13.26	51.40	0.09	0.90	0.15	0.10	0.14	0.7	2.2	0.95	0.06	0.9100	1.81	1.30
92	13.58	51.67	0.09	0.89	0.15	0.10	0.13	0.7	2.2	0.95	0.06	0.9100	1.80	1.31
93	11.89	54.86	0.10	0.89	0.15	0.10	0.13	0.7	2.2	0.94	0.06	0.9100	1.84	1.35
94	13.08	60.79	0.10	0.89	0.15	0.10	0.13	0.7	2.2	0.94	0.06	0.9100	1.94	1.44
95	13.41	54.61	0.10	0.88	0.15	0.10	0.13	0.7	2.2	0.94	0.06	0.9100	1.82	1.36
96	12.96	52.70	0.09	0.88	0.15	0.10	0.13	0.7	2.2	0.93	0.06	0.9100	1.79	1.35
97	13.34	53.02	0.09	0.87	0.14	0.10	0.13	0.7	2.2	0.93	0.06	0.9100	1.79	1.36
98	14.49	52.45	0.09	0.86	0.14	0.10	0.13	0.7	2.2	0.93	0.06	0.9100	1.77	1.36
99	13.02	51.12	0.09	0.86	0.14	0.10	0.13	0.7	2.2	0.92	0.06	0.9100	1.75	1.36
100	13.41	51.47	0.09	0.85	0.14	0.10	0.12	0.7	2.2	0.92	0.06	0.9100	1.75	1.37
101	13.78	51.80	0.09	0.85	0.14	0.10	0.12	0.7	2.2	0.92	0.06	0.9100	1.75	1.38
102	12.75	52.39	0.09	0.84	0.14	0.10	0.12	0.7	2.2	0.91	0.06	0.9100	1.76	1.40
103	13.52	51.54	0.09	0.84	0.14	0.10	0.12	0.7	2.2	0.91	0.06	0.9100	1.75	1.40
104	13.95	53.46	0.09	0.83	0.14	0.10	0.12	0.7	2.2	0.91	0.06	0.9100	1.77	1.44
105	13.01	53.98	0.09	0.82	0.13	0.10	0.12	0.7	2.2	0.90	0.06	0.9100	1.78	1.46
106	12.80	53.76	0.09	0.82	0.13	0.10	0.12	0.7	2.2	0.90	0.06	0.9100	1.78	1.47
107	13.17	54.07	0.09	0.81	0.13	0.10	0.11	0.7	2.2	0.90	0.06	0.9100	1.79	1.49
108	13.36	54.24	0.09	0.80	0.13	0.10	0.11	0.7	2.2	0.90	0.06	0.9100	1.79	1.51
109	9.53	52.95	0.09	0.80	0.13	0.09	0.11	0.7	2.2	0.89	0.06	0.9100	1.77	1.51
110	8.64	58.42	0.10	0.79	0.13	0.09	0.11	0.7	2.2	0.89	0.06	0.9100	1.86	1.61
111	6.71	61.94	0.10	0.78	0.13	0.09	0.11	0.7	2.2	0.89	0.06	0.9100	1.94	1.68
112	6.32	78.34	0.12	0.78	0.13	0.09	0.11	0.7	2.2	0.88	0.06	0.9100	2.37	2.08
113	6.23	63.18	0.10	0.77	0.12	0.09	0.10	0.7	2.2	0.88	0.06	0.9100	1.97	1.75
114	5.29	55.73	0.10	0.76	0.12	0.09	0.10	0.7	2.2	0.88	0.06	0.9100	1.83	1.65
115	5.30	52.96	0.09	0.76	0.12	0.09	0.10	0.7	2.2	0.88	0.06	0.9100	1.79	1.63
116	6.36	52.70	0.09	0.75	0.12	0.09	0.10	0.7	2.2	0.87	0.06	0.9100	1.80	1.65
117	6.15	46.79	0.08	0.74	0.12	0.09	0.10	0.7	2.2	0.87	0.06	0.9100	1.55	1.44
118	4.99	47.11	0.08	0.74	0.12	0.09	0.10	0.7	2.2	0.87	0.06	0.9100	1.56	1.46
119	6.14	48.92	0.08	0.73	0.12	0.09	0.09	0.7	2.2	0.87	0.06	0.9100	1.59	1.51
120	6.44	45.73	0.08	0.72	0.11	0.09	0.09	0.7	2.2	0.86	0.06	0.9100	1.55	1.49
121	6.26	45.40	0.08	0.72	0.11	0.09	0.09	0.7	2.2	0.86	0.06	0.9100	1.55	1.50
122	6.13	43.82	0.08	0.71	0.11	0.09	0.09	0.7	2.2	0.86	0.06	0.9100	1.53	1.50
123	6.72	45.91	0.08	0.71	0.11	0.09	0.09	0.7	2.2	0.86	0.06	0.9100	1.57	1.56
124	7.96	97.60	0.17	0.70	0.11	0.09	0.09	0.7	2.2	0.85	0.06	0.9100	3.27	3.29

Row	BV	BW	BX	BY	BZ	CA	CB	CC	CD	CE	CF	CG	CH
34	Col-73	Col-74	Col-75	Col-76	Col-77	Col-78	Col-79	Col-80	Col-81	Col-82	Col-83	Col-84	Col-85
35				Boulanger and Idriss, 2004, "Approach B" method based on Su profile									
37	Apparent Fines	Measured Fines	Ic Limits	Su - CPT (psf)	OCR Assumed	OCR - CPT	α	k_α	$CRR_{M7.5}$	MSF	$CRR_{M5.5}$	$FS_{liq-Su (Clay-Like)}$	
38	(%)	(%)		Nkt	1.1							No Amplification	if crest accel =
39				10.5			0.06						2
40	8		2.6	1993	1.1		0.06	0.95	31.93	1.11	35.48	495.93	248.70
41	13		2.6	3037	1.1		0.06	0.95	16.51	1.11	18.35	256.73	129.52
42	35		2.6	1544	1.1		0.06	0.95	5.00	1.11	5.56	77.87	39.52
43	17		2.6	3083	1.1		0.06	0.95	7.11	1.11	7.90	110.91	56.64
44	31		2.6	1945	1.1		0.06	0.95	3.50	1.11	3.89	54.73	28.12
45	38		2.6	871	1.1		0.06	0.95	1.29	1.11	1.43	20.14	10.41
46	35		2.6	1514	1.1		0.06	0.95	1.90	1.11	2.11	29.72	15.46
47	47	77	2.6	632	1.1		0.06	0.95	0.69	1.11	0.76	10.79	5.65
48	31		2.6	1587	1.1		0.06	0.95	1.52	1.11	1.69	23.96	12.62
49	44		2.6	845	1.1		0.06	0.95	0.72	1.11	0.81	11.40	6.04
50	37		2.6	1230	1.1		0.06	0.95	0.96	1.11	1.06	15.10	8.05
51	72		2.6	412	1.1		0.06	0.95	0.29	1.11	0.33	4.62	2.48
52	56		2.6	639	1.1		0.06	0.95	0.42	1.11	0.47	6.63	3.58
53	48		2.6	874	1.1		0.06	0.95	0.53	1.11	0.59	8.41	4.57
54	38		2.6	1699	1.1		0.06	0.95	0.96	1.11	1.07	15.25	8.35
55	72		2.6	616	1.1		0.06	0.95	0.33	1.11	0.36	5.18	2.85
56	76		2.6	478	1.1		0.06	0.95	0.24	1.11	0.26	3.79	2.10
57	76		2.6	589	1.1		0.06	0.95	0.28	1.11	0.31	4.41	2.46
58	81		2.6	542	1.1		0.06	0.95	0.24	1.11	0.27	3.85	2.16
59	81		2.6	537	1.1		0.06	0.95	0.23	1.11	0.25	3.62	2.05
60	100		2.6	235	1.1		0.06	0.95	0.10	1.11	0.11	1.51	0.86
61	100		2.6	274	1.1		0.06	0.95	0.11	1.11	0.12	1.68	0.96
62	94		2.6	442	1.1		0.06	0.95	0.17	1.11	0.19	2.60	1.50
63	100		2.6	250	1.1		0.06	0.95	0.10	1.11	0.11	1.41	0.82
64	100		2.6	254	1.1		0.06	0.95	0.10	1.11	0.11	1.38	0.81
65	62		2.6	1143	1.1		0.06	0.95	0.42	1.11	0.47	5.96	3.51
66	74		2.6	894	1.1		0.06	0.95	0.32	1.11	0.36	4.49	2.66
67	100		2.6	466	1.1		0.06	0.95	0.17	1.11	0.18	2.26	1.35
68	94		2.6	573	1.1		0.06	0.95	0.20	1.11	0.22	2.68	1.62
69	100		2.6	318	1.1		0.06	0.95	0.11	1.11	0.12	1.44	0.88
70	100		2.6	370	1.1		0.06	0.95	0.12	1.11	0.14	1.63	0.99
71	89		2.6	588	1.1		0.06	0.95	0.19	1.11	0.22	2.51	1.54
72	65		2.6	1236	1.1		0.06	0.95	0.40	1.11	0.45	5.12	3.17
73	51		2.6	2128	1.1		0.06	0.95	0.68	1.11	0.75	8.56	5.35
74	40		2.6	2797	1.1		0.06	0.95	0.88	1.11	0.97	10.94	6.89
75	44		2.6	2480	1.1		0.06	0.95	0.76	1.11	0.85	9.44	5.98
76	76		2.6	1162	1.1		0.06	0.95	0.35	1.11	0.39	4.31	2.75
77	53		2.6	1827	1.1		0.06	0.95	0.54	1.11	0.60	6.61	4.26
78	88	96.4	2.6	843	1.1		0.06	0.95	0.25	1.11	0.27	2.98	1.93
79	46		2.6	2533	1.1		0.06	0.95	0.73	1.11	0.81	8.75	5.72
80	95		2.6	662	1.1		0.06	0.95	0.19	1.11	0.21	2.23	1.47
81	96	96.7	2.6	502	1.1		0.06	0.95	0.14	1.11	0.16	1.66	1.10
82	96		2.6	472	1.1		0.06	0.95	0.13	1.11	0.14	1.53	1.02
83	81		2.6	717	1.1		0.06	0.95	0.19	1.11	0.22	2.28	1.54
84	93		2.6	786	1.1		0.06	0.95	0.21	1.11	0.23	2.45	1.67
85	94		2.6	539	1.1		0.06	0.95	0.14	1.11	0.16	1.65	1.13
86	92		2.6	500	1.1		0.06	0.95	0.13	1.11	0.14	1.50	1.04
87	95	99.6	2.6	535	1.1		0.06	0.95	0.14	1.11	0.15	1.58	1.10
88	94		2.6	526	1.1		0.06	0.95	0.13	1.11	0.15	1.53	1.07
89	93		2.6	565	1.1		0.06	0.95	0.14	1.11	0.16	1.61	1.14
90	75		2.6	971	1.1		0.06	0.95	0.24	1.11	0.27	2.73	1.95
91	95		2.6	562	1.1		0.06	0.95	0.14	1.11	0.15	1.56	1.12
92	96		2.6	549	1.1		0.06	0.95	0.13	1.11	0.15	1.50	1.09
93	87		2.6	752	1.1		0.06	0.95	0.18	1.11	0.20	2.03	1.49
94	94		2.6	768	1.1		0.06	0.95	0.18	1.11	0.20	2.04	1.51
95	95		2.6	631	1.1		0.06	0.95	0.15	1.11	0.16	1.66	1.24
96	93		2.6	635	1.1		0.06	0.95	0.15	1.11	0.16	1.65	1.24
97	95		2.6	617	1.1		0.06	0.95	0.14	1.11	0.15	1.58	1.20
98	100	99.9	2.6	530	1.1		0.06	0.95	0.12	1.11	0.13	1.34	1.03
99	93		2.6	615	1.1		0.06	0.95	0.14	1.11	0.15	1.54	1.19
100	95		2.6	596	1.1		0.06	0.95	0.13	1.11	0.14	1.48	1.16
101	97	97.2	2.6	580	1.1		0.06	0.95	0.12	1.11	0.14	1.43	1.13
102	92		2.6	679	1.1		0.06	0.95	0.14	1.11	0.16	1.66	1.32
103	96		2.6	604	1.1		0.06	0.95	0.13	1.11	0.14	1.46	1.17
104	98		2.6	614	1.1		0.06	0.95	0.13	1.11	0.14	1.47	1.20
105	93		2.6	708	1.1		0.06	0.95	0.15	1.11	0.16	1.69	1.38
106	92		2.6	728	1.1		0.06	0.95	0.15	1.11	0.16	1.72	1.42
107	94		2.6	707	1.1		0.06	0.95	0.14	1.11	0.16	1.66	1.39
108	95		2.6	699	1.1		0.06	0.95	0.14	1.11	0.15	1.63	1.38
109	75		2.6	668	1.1		0.06	0.95	0.13	1.11	0.15	1.55	1.32
110	70		2.6	883	1.1		0.06	0.95	0.17	1.11	0.19	2.03	1.75
111	58		2.6	1325	1.1		0.06	0.95	0.26	1.11	0.28	3.03	2.64
112	56		2.6	1899	1.1		0.06	0.95	0.36	1.11	0.40	4.32	3.80
113	55		2.6	1514	1.1		0.06	0.95	0.29	1.11	0.32	3.43	3.05
114	49		2.6	1601	1.1		0.06	0.95	0.30	1.11	0.33	3.61	3.24
115	49		2.6	1516	1.1		0.06	0.95	0.28	1.11	0.31	3.40	3.09
116	56		2.6	1216	1.1		0.06	0.95	0.22	1.11	0.25	2.72	2.49
117	55		2.6	1101	1.1		0.06	0.95	0.20	1.11	0.22	2.45	2.27
118	47		2.6	1456	1.1		0.06	0.95	0.26	1.11	0.29	3.22	3.03
119	55		2.6	1191	1.1		0.06	0.95	0.21	1.11	0.24	2.63	2.49
120	57		2.6	1034	1.1		0.06	0.95	0.18	1.11	0.20	2.27	2.18
121	56		2.6	1073	1.1		0.06	0.95	0.19	1.11	0.21	2.35	2.28
122	55		2.6	1064	1.1		0.06	0.95	0.18	1.11	0.20	2.32	2.28
123	58		2.6	1010	1.1		0.06	0.95	0.17	1.11	0.19	2.20	2.18
124	66		2.6	2104	1.1		0.06	0.95	0.36	1.11	0.40	4.56	4.59

CPTU-616 Liquefaction Analysis

ConeTec Inc. - CPT Interpretation
Interpretation Output - Release 1.22 Rev. A - Format: NLI Imperial
Run No: 06-0718-0954-2405
Job No: 02-100
Client: MACTEC Engineering and Consulting Inc.
Project: Former Callahan Mine Site, Brooksville, ME
Site: CP-616
Location: Callahan Mine
Cone: 20 Ton AD179
CPT Date: 06/28/06
CPT Time: 17:16
CPT File: 758CP616.COR
Northing (m): 0
Easting (m): 0
Elevation (m): 0 — 69.1 — Elevation For CPT Triggering analysis

Water Table (m): 0.91 (ft): 3 — 3 — Water Table assumed for CPT Analysis
Unit Weight of Water (default): 62.4 pcf
Averaging Increment (m): 0.2
Phi Method : Robertson and Campanella, 1983
Su Nkt used: 15 Su/P' (nc): 0.3 — 0.11 — Base acceleration
Dr Method : Jamiolkowski - All Sands
State Parameter M: 1.2
Used Unit Weights Assigned to Soil Zones
N160c Calculated using qc1n

1) CSR = $0.65*(a_{max}/g)*(s_v/s'_v)*r_d$ — Seed & Idriss, 1983, p. 459

a_{max}/g = 0.11 g — USGS (base) (amplified from base as discussed in
s_v = computed — Total Vertical Stress
s'_v = computed — Effective Vertical Stress

$r_d = [1.0 - 0.4113z^{0.5} + 0.04052z + 0.001753z^{1.5}] / [1 - 0.4177z^{0.5} + 0.05729z - 0.$

z = depth in meters

2) FS = Factor of safety against triggering of liquefaction: $FS = (CRR_{7.5}/CSR) \times MSF \times K_s \times K_a$

MSF = magnitude scaling factor; Assume based on range recommended by NCEER Wo

CPTU-616 Liquefaction Analysis

$K_s = (s'_{vo}/P_a)^{(f-1)}$, where f = 0.7 to 0.8 for relative density of 40 to 60%; f = 0.6 to 0.7 fo
1 Atmosphere = 14.7 psi = 2.12 ksf

Conetec Data

Col-01 Depth (m)	Col-02 Depth (ft)	Col-03 Elev. (m)	Col-04 Elev. (ft)	Col-05 qc (tsf)	Col-06 qt (tsf)	Col-07 fs (tsf)	Col-08 Rf (%)	Col-09 u (ft)	Col-10 SBT (Zone)	Col-11 SBTn (Zone)	Col-12 SBT-BQ (Zone)	Col-13 SBT-BQn (Zone)	Col-14 Perm-k (cm/s)	Col-15 Unit Wt (pcf)	Col-16 T Stress (tsf)	Col-17 U Stress (tsf)	Col-18 E Stress (tsf)	Col-19 Cn	Col-20 N60 (b/ft)	Col-21 N1(60) (b/ft)	Col-22 N(60)Ic (b/ft)	Col-23 N1(60)Ic (b/ft)	Col-24 Qt	Col-25 Fr (%)	Col-26 Bq	Col-27 Ic	Col-28 FC (%)	Col-29 IcZone (Zone)	Col-30 Dr (%)	Col-31 Phi (deg)	Col-32 State Par	Col-33 Es/qt	Col-34 YoungE (tsf)	Col-35 Su (tsf)	Col-36 OCR	Col-37 U (psf)	Col-38 s_{vo} (psf)	Col-39 q_c (psf)	Col-40 q_t (psf)	Col-41 P_a (psf)	Col-42 σ'_{vo} (psf)	Col-43 f_s (psf)	Col-44 $Q_{exp=1}$	Col-45 F
0.1	0.328	-0.1	68.8	2.57	2.57	0.03	1.17	-0.27	1	6	3	6	1.00E-07	111.4	0.018	0	0.018	1.7	1.2	2.1	0.9	1.5	139.78	1.18	0	3.13	67.4	3	-9999	-9999	-9999	-9999	-9999	0.17	10	0	36	5140	5140	2116	36	60	141.78	1.18
0.3	0.984	-0.3	68.1	2.49	2.51	0.02	0.6	4.16	1	6	3	6	1.00E-07	111.4	0.055	0	0.055	1.7	1.2	2	0.8	1.4	44.84	0.61	0.05	3.03	60.5	3	-9999	-9999	-9999	-9999	-9999	0.164	10	0	110	4980	5020	2116	110	40	44.64	0.81
0.5	1.64	-0.5	67.5	2.25	2.3	0.01	0.44	10.52	1	5	3	5	1.00E-07	111.4	0.091	0	0.091	1.7	1.1	1.9	0.8	1.3	24.2	0.45	0.15	3.03	60.2	3	-9999	-9999	-9999	-9999	-9999	0.147	9.6	0	182	4500	4600	2116	182	20	24.27	0.45
0.7	2.297	-0.7	66.8	2.27	2.33	0.01	0.43	12.34	1	5	3	4	1.00E-07	111.4	0.128	0	0.128	1.7	1.1	1.9	0.8	1.3	17.2	0.46	0.18	3.02	60	3	-9999	-9999	-9999	-9999	-9999	0.147	5.6	0	256	4540	4660	2116	256	20	17.20	0.45
0.9	2.953	-0.9	66.1	2.16	2.23	0.01	0.45	15.47	1	5	3	4	1.00E-07	111.4	0.164	0	0.164	1.7	1.1	1.8	0.7	1.3	12.56	0.49	0.23	3.05	61.8	3	-9999	-9999	-9999	-9999	-9999	0.138	3.5	0	328	4320	4460	2116	328	20	12.60	0.48
1.1	3.609	-1.1	65.5	1.85	1.93	0.01	0.52	16.33	1	4	3	3	1.00E-07	111.4	0.201	0.019	0.182	1.7	0.9	1.6	0.5	2.7	9.51	0.58	0.28	2.68	39.3	4	-9999	-9999	-9999	-9999	-9999	0.115	2.4	38	402	3700	3860	2116	364	20	9.50	0.58
1.3	4.265	-1.3	64.8	1.58	1.68	0.01	0.6	20.63	1	4	3	3	1.00E-07	111.4	0.238	0.039	0.198	1.7	0.8	1.4	0.5	2.2	7.26	0.7	0.42	2.82	47	4	-9999	-9999	-9999	-9999	-9999	0.096	1.7	79	476	3160	3360	2116	397	20	7.26	0.69
1.5	4.921	-1.5	64.2	1.42	1.52	0.01	0.66	20.89	1	4	2	3	1.00E-07	111.4	0.274	0.06	0.214	1.7	0.7	1.2	0.5	1.9	5.82	0.8	0.47	2.93	53.9	4	-9999	-9999	-9999	-9999	-9999	0.083	1.3	120	548	2840	3040	2116	428	20	5.82	0.80
1.7	5.577	-1.7	63.5	1.42	1.53	0.01	0.66	22.75	1	4	2	3	1.00E-07	111.4	0.311	0.08	0.23	1.7	0.7	1.2	0.5	1.8	5.3	0.82	0.52	2.97	56.6	3	-9999	-9999	-9999	-9999	-9999	0.081	1.2	161	622	2840	3060	2116	461	20	5.29	0.82
1.9	6.234	-1.9	62.9	1.36	1.47	0.01	0.68	23.48	1	3	2	3	1.00E-07	111.4	0.347	0.101	0.246	1.7	0.7	1.2	0.5	1.6	4.56	0.89	0.56	3.04	61.5	3	-9999	-9999	-9999	-9999	-9999	0.075	1	202	694	2720	2940	2116	492	20	4.56	0.89
2.1	6.89	-2.1	62.2	1.16	1.28	0.01	0.98	26.51	1	3	3	3	1.00E-07	111.4	0.384	0.121	0.262	1.7	0.6	1	0.5	1.4	3.43	1.39	0.78	3.24	75.8	3	-9999	-9999	-9999	-9999	-9999	0.06	0.8	243	768	2320	2560	2116	525	20	3.41	1.12
2.3	7.546	-2.3	61.6	1.23	1.36	0.02	1.47	28.45	1	3	3	3	1.00E-07	111.4	0.42	0.142	0.278	1.7	0.7	1.1	0.6	1.4	3.39	2.13	0.79	3.32	82.9	3	-9999	-9999	-9999	-9999	-9999	0.063	0.8	284	840	2460	2720	2116	556	40	3.38	2.13
2.5	8.202	-2.5	60.9	1.2	1.34	0.02	1.5	29.9	1	3	1	3	1.00E-07	111.4	0.457	0.162	0.294	1.7	0.6	1.1	0.6	1.3	3	2.27	0.87	3.38	88.1	3	-9999	-9999	-9999	-9999	-9999	0.059	0.7	325	914	2400	2680	2116	589	40	3.00	2.27
2.7	8.858	-2.7	60.2	1.25	1.4	0.02	1.43	32.02	1	3	1	3	1.00E-07	111.4	0.493	0.183	0.31	1.7	0.7	1.1	0.6	1.3	2.91	2.22	0.9	3.39	88.7	3	-9999	-9999	-9999	-9999	-9999	0.06	0.7	366	986	2500	2800	2116	620	40	2.92	2.21
2.9	9.514	-2.9	59.6	1.36	1.51	0.02	1.33	32.7	1	3	3	3	1.00E-07	111.4	0.53	0.203	0.327	1.7	0.7	1.2	0.6	1.3	3.01	2.04	0.83	3.36	86.2	3	-9999	-9999	-9999	-9999	-9999	0.065	0.7	406	1060	2720	3020	2116	654	40	3.00	2.04
3.1	10.17	-3.1	58.9	1.3	1.45	0.02	1.55	33.64	1	3	1	3	1.00E-07	111.4	0.566	0.224	0.343	1.7	0.7	1.2	0.7	1.2	2.59	2.54	0.93	3.46	95.4	3	-9999	-9999	-9999	-9999	-9999	0.059	0.7	447	1132	2600	2900	2116	685	40	2.58	2.26
3.3	10.827	-3.3	58.3	1.37	1.53	0.03	1.8	33.8	1	3	3	3	1.00E-07	111.4	0.603	0.244	0.359	1.67	0.7	1.2	0.7	1.3	2.59	2.97	0.87	3.49	98.4	3	-9999	-9999	-9999	-9999	-9999	0.062	0.7	488	1206	2740	3060	2116	718	60	2.58	3.24
3.5	11.483	-3.5	57.6	1.45	1.62	0.03	1.85	36.43	1	3	3	3	1.00E-07	111.4	0.64	0.265	0.375	1.63	0.8	1.3	0.8	1.3	2.63	3.05	0.89	3.49	98.4	3	-9999	-9999	-9999	-9999	-9999	0.066	0.7	529	1280	2900	3240	2116	751	60	2.61	3.06
3.7	12.139	-3.7	57.0	1.5	1.68	0.03	1.78	39.24	1	3	1	3	1.00E-07	111.4	0.676	0.285	0.391	1.6	0.8	1.3	0.8	1.3	2.58	2.98	0.93	3.5	98.6	3	-9999	-9999	-9999	-9999	-9999	0.067	0.7	570	1352	3000	3360	2116	782	60	2.57	2.99
3.9	12.795	-3.9	56.3	1.47	1.66	0.03	1.51	40.44	1	3	1	3	1.00E-07	111.4	0.713	0.306	0.407	1.57	0.8	1.2	0.8	1.2	2.32	2.65	1.01	3.51	100	3	-9999	-9999	-9999	-9999	-9999	0.063	0.6	611	1426	2940	3320	2116	815	60	2.32	3.17
4.1	13.451	-4.1	55.6	1.77	1.96	0.03	1.53	41	1	3	3	3	1.00E-07	111.4	0.749	0.326	0.423	1.54	0.9	1.4	0.9	1.3	2.87	2.48	0.79	3.42	91.2	3	-9999	-9999	-9999	-9999	-9999	0.081	0.7	652	1498	3540	3920	2116	846	60	2.86	2.48
4.3	14.107	-4.3	55.0	1.92	2.13	0.03	1.41	45.96	1	3	3	3	1.00E-07	111.4	0.786	0.347	0.439	1.51	1	1.5	0.9	1.4	3.07	2.23	0.81	3.37	87	3	-9999	-9999	-9999	-9999	-9999	0.09	0.7	693	1572	3840	4260	2116	879	60	3.06	2.23
4.5	14.764	-4.5	54.3	2.03	2.26	0.03	1.33	48.21	1	3	3	3	1.00E-07	111.4	0.822	0.367	0.455	1.48	1.1	1.6	0.9	1.4	3.15	2.1	0.79	3.35	85.1	3	-9999	-9999	-9999	-9999	-9999	0.096	0.8	734	1644	4060	4520	2116	910	60	3.16	2.09
4.7	15.42	-4.7	53.7	2.06	2.29	0.03	1.31	48.6	1	3	3	3	1.00E-07	111.4	0.859	0.388	0.471	1.46	1.1	1.6	1	1.3	3.03	2.1	0.79	3.36	86.4	3	-9999	-9999	-9999	-9999	-9999	0.095	0.7	775	1718	4120	4580	2116	943	60	3.04	2.10
4.9	16.076	-4.9	53.0	2.24	2.48	0.03	1.21	50.74	1	3	3	3	1.00E-07	111.4	0.895	0.408	0.487	1.43	1.2	1.7	1	1.4	3.24	1.9	0.74	3.32	82.5	3	-9999	-9999	-9999	-9999	-9999	0.105	0.8	816	1790	4480	4960	2116	974	60	3.25	1.89
5.1	16.732	-5.1	52.4	2.46	2.71	0.04	1.48	52.18	1	3	3	3	1.00E-07	111.4	0.932	0.429	0.503	1.41	1.3	1.8	1.1	1.5	3.52	2.26	0.68	3.32	82.7	3	-9999	-9999	-9999	-9999	-9999	0.118	0.8	857	1864	4920	5420	2116	1007	80	3.53	2.25
5.3	17.388	-5.3	51.7	2.38	2.64	0.03	1.14	54.94	1	3	3	3	1.00E-07	111.4	0.968	0.449	0.519	1.39	1.3	1.8	1.1	1.3	3.22	1.8	0.76	3.31	81.9	3	-9999	-9999	-9999	-9999	-9999	0.111	0.8	898	1936	4760	5280	2116	1038	60	3.22	1.79
5.5	18.044	-5.5	51.1	2.53	2.79	0.04	1.35	56.77	1	3	3	3	1.00E-07	111.4	1.005	0.47	0.535	1.37	1.3	1.8	1.1	1.4	3.34	2.1	0.73	3.33	83.3	3	-9999	-9999	-9999	-9999	-9999	0.119	0.8	939	2010	5060	5580	2116	1071	80	3.33	2.24
5.7	18.701	-5.7	50.4	2.67	2.93	0.04	1.28	57.18	1	3	3	3	1.00E-07	111.4	1.042	0.49	0.551	1.35	1.4	1.9	1.2	1.4	3.43	1.99	0.68	3.3	81.4	3	-9999	-9999	-9999	-9999	-9999	0.126	0.8	980	2084	5340	5860	2116	1104	80	3.42	2.12
5.9	19.357	-5.9	49.7	2.81	3.08	0.03	1.06	57.42	1	3	3	3	1.00E-07	111.4	1.078	0.511	0.567	1.33	1.5	2	1.2	1.4	3.53	1.63	0.64	3.25	77.3	3	-9999	-9999	-9999	-9999	-9999	0.134	0.8	1021	2156	5620	6160	2116	1135	60	3.53	1.50
6.1	20.013	-6.1	49.1	3.31	3.58	0.04	1.12	59.63	1	3	3	3	1.00E-07	111.4	1.115	0.531	0.583	1.31	1.7	2.2	1.3	1.6	4.23	1.62	0.54	3.18	71.7	3	-9999	-9999	-9999	-9999	-9999	0.165	0.9	1062	2230	6620	7160	2116	1168	80	4.22	1.62
6.3	20.669	-6.3	48.4	3.29	3.59	0.04	1.12	63.89	1	3	3	3	1.00E-07	111.4	1.151	0.552	0.6	1.29	1.7	2.2	1.3	1.6	4.07	1.64	0.59	3.2	73	3	-9999	-9999	-9999	-9999	-9999	0.163	0.9	1103	2302	6580	7180	2116	1199	80	4.07	1.64
6.5	21.325	-6.5	47.8	3.28	3.59	0.04	1.12	66.61	1	3	3	3	1.00E-07	111.4	1.188	0.572	0.616	1.27	1.7	2.2	1.3	1.5	3.9	1.67	0.63	3.22	74.6	3	-9999	-9999	-9999	-9999	-9999	0.16	0.9	1143	2376	6560	7180	2116	1233	80	3.90	1.67
6.7	21.981	-6.7	47.1	3.33	3.65	0.03	0.82	68.31	1	3	3	3	1.00E-07	111.4	1.224	0.593	0.632	1.26	1.7	2.2	1.3	1.5	3.83	1.24	0.64	3.17	70.8	3	-9999	-9999	-9999	-9999	-9999	0.161	0.9	1184	2448	6660	7300	2116	1264	60	3.84	1.24
6.9	22.638	-6.9	46.5	3.28	3.61	0.03	0.83	71.36	1	3	3	3	1.00E-07	111.4	1.261	0.613	0.648	1.24	1.7	2.1	1.3	1.4	3.63	1.28	0.69	3.2	72.9	3	-9999	-9999	-9999	-9999	-9999	0.157	0.8	1225	2522	6560	7220	2116	1297	60	3.62	1.28
7.1	23.294	-7.1	45.8	3.44	3.78	0.03	0.8	73.53	1	3	3	3	1.00E-07	111.4	1.297	0.634	0.664	1.23	1.8	2.2	1.4	1.4	3.74	1.21	0.67	3.18	71.2	3	-9999	-9999	-9999	-9999	-9999	0.166	0.9	1266	2594	6880	7560	2116	1328	60	3.74	1.21
7.3	23.95	-7.3	45.2	3.72	4.09	0.04	0.86	78.52	1	3	3	3	1.00E-07	111.4	1.334	0.654	0.68	1.21	2	2.4	1.5	1.5	4.06	1.27	0.65	3.15	69.4	3	-9999	-9999	-9999	-9999	-9999	0.184	0.9	1307	2668	7440	8180	2116	1361	80	4.05	1.45
7.5	24.606	-7.5	44.5	3.99	4.38	0.04	0.92	81.92	1	3	3	3	1.00E-07	111.4	1.371	0.675	0.696	1.2	2.1	2.5	1.6	1.6	4.32	1.33	0.63	3.14	68.2	3	-9999	-9999	-9999	-9999	-9999	0.2	1	1348	2742	7980	8760	2116	1394	80	4.32	1.33
7.7	25.262	-7.7	43.8	4.04	4.46	0.04	0.9	88.16	1	3	3	3	1.00E-07	111.4	1.407	0.695	0.712	1.19	2.1	2.5	1.6	1.6	4.28	1.32	0.67	3.14	68.3	3	-9999	-9999	-9999	-9999	-9999	0.203	1	1389	2814	8080	8920	2116	1425	80	4.29	1.31
7.9	25.918	-7.9	43.2	4.1	4.53	0.04	0.83	90.23	1	3	3	3	1.00E-07	111.4	1.444	0.716	0.728	1.17	2.2	2.5	1.6	1.6	4.24	1.22	0.68	3.13	67.6	3	-9999	-9999	-9999	-9999	-9999	0.206	0.9	1430	2888	8200	9060	2116	1458	80	4.23	1.30
8.1	26.574	-8.1	42.5	12.89	13.26	0.15	1.11	79.76	6	4	5	4	5.00E-05	114.6	1.481	0.736	0.745	1.16	5.1	5.9	3.5	4.3	15.83	1.25	0.15	2.63	36.6	4	30	32	-0.01	-9999	-9999	0.786	4.9	1471	2962	25780	26520	2116	1491	300	15.80	1.27
8.3	27.231	-8.3	41.9	60.34	60.84	0.51	0.83	108.05	8	6	7	6	5.00E-03	120.9	1.519	0.757	0.763	1.15	14.6	16.7	12.1	14.2	77.78	0.85	0.04	2	13	6	56.3	42	-0.15	2.515	153	-9999	-9999	1512	3038	120680	121680	2116	1526	1020	77.75	0.86
8.5	27.887	-8.5	41.2	18.49	18.37	0.51	2.78	-26.65	5	4	-9999	4	5.00E-06	114.6	1.558	0.777	0.781	1.13	8.8	10	5.1	6.2	21.53	3.04	-0.1	2.73	42.2	4	-9999	-9999	-9999	-9999	-9999	1.121	8	1553	3116	36980	36740	2116	1563	1020	21.51	3.03
8.7	28.543	-8.7	40.6	53.42	53.3	0.47	0.87	-25.38	8	6	8	6	5.00E-03	120.9	1.597	0.798	0.799	1.12	12.8	14.3	10.9	12.5	64.7	0.9	-0.03	2.07	14.9	5	51.8	40	-0.14	2.721	145	-9999	-9999	1594	3194	106840	106600	2116	1600	940	64.62	0.91
8.9	29.199	-8.9	39.9	53.82	53.74	0.58	1.08	-17.98	7	5	8	6	5.00E-04	117.7	1.636	0.818	0.818	1.11	17.2	19	11.3	12.7	63.72	1.12	-0.03	2.12	16.6	5	51.7	40	-0.16	2.729	146.7	-9999	-9999	1635	3272	107640	107480	2116	1637	1160	63.65	1.11
9.1	29.855	-9.1	39.2	29.95	29.93	0.45	1.49	-3.09	6	5	7	5	5.00E-05	114.6	1.674	0.838	0.835	1.09	11.5	12.5	7.1	8	33.83	1.58	-0.03	2.42	27.3	5	34.7	38	-0.13	3.655	109.4	1.884	10	1676	3348	59900	59860	2116	1672	900	33.79	1.59
9.3	30.511	-9.3	38.6	21.48	21.53	0.55	2.55	10.22	5	4	7	5	5.00E-06	114.6	1.711	0.859	0.852	1.08	10.3	11.2	5.8	6.6	23.25	2.77	-0.03	2.68	39.5	4	-9999	-9999	-9999	-9999	-9999	1.321	9	1717	3422	42960	43060	2116	1705	1100	23.24	2.78

CPTU-616 Liquefaction Analysis

ext

06205z$^{1.5}$ + 0.001210z^{2}]

Youd and Idriss, 2001

kshop, reiterated in Youd and Idriss, 2001

CPTU-616 Liquefaction Analysis

rel density of 60 to 80%; P_a = pressure at 1 atmosphere Youd and Idriss, 2001

	AT	AU	AV	AW	AX	AY	AZ	BA	BB	BC	BD	BE	BF	BG	BH	BI	BJ	BK	BL
34	Col-46	Col-47	Col-48	Col-49	Col-50	Col-51	Col-52	Col-53	Col-54	Col-55	Col-56	Col-57	Col-57a	Col-58	Col-59	Col-60	Col-61	Col-62	Col-63
35	Youd & Idriss, 2001 CPT Based Analysis																		
36																			
37	$I_{c\ Qexp=1}$	$Q_{exp\ =\ 0.5}$	F	$I_{c\ Qexp=0.5}$	$Q_{exp\ =\ 0.7}$	F	$I_{c\ Qexp=0.7}$	Description	C_{q1}			q_{c1N}	Lookup	Ic	Kc	$(q_{c1N})_{cs}$	CRR7.5	rd	a_{max}/g =
38									n=1.0	n=0.5	n=0.7		Col						if crest accel
39																			2
40	1.84	18.49	1.18	2.55	41.77	1.18	2.25	**Granular**	58.78	7.67	17.32	18.62	2.00	2.55	3.05	56.82	0.10	1.00	0.22
41	2.14	10.18	0.81	2.71	18.38	0.81	2.48	**Very Silty**	19.24	4.39	7.92	18.80	2.00	2.48	2.66	50.05	0.09	1.00	0.22
42	2.26	7.12	0.45	2.76	11.63	0.45	2.56	**Very Silty**	11.63	3.41	5.57	12.11	2.00	2.56	3.08	37.35	0.07	1.00	0.21
43	2.40	5.98	0.45	2.83	9.13	0.45	2.66	**Very Silty**	8.27	2.88	4.39	9.66	2.00	2.66	3.70	35.78	0.07	1.00	0.21
44	2.54	4.96	0.48	2.92	7.20	0.48	2.76	**Very Silty**	6.45	2.54	3.69	7.77	2.00	2.76	4.49	34.93	0.07	1.00	0.21
45	2.68	3.94	0.58	3.04	5.60	0.58	2.89	**Clayey**	5.81	2.41	3.43	10.60	2.00	2.68	3.84	40.77	0.08	0.99	0.20
46	2.82	3.15	0.69	3.16	4.40	0.69	3.02	**Clayey**	5.33	2.31	3.23	8.46	2.00	2.82	4.93	41.68	0.08	0.99	0.20
47	2.93	2.62	0.80	3.25	3.60	0.80	3.12	**Clayey**	4.94	2.22	3.06	7.10	2.00	2.93	5.99	42.55	0.08	0.99	0.20
48	2.97	2.47	0.82	3.28	3.35	0.82	3.16	**Clayey**	4.59	2.14	2.90	6.63	2.00	2.97	6.43	42.69	0.08	0.99	0.20
49	3.04	2.20	0.89	3.34	2.95	0.89	3.22	**Clayey**	4.30	2.07	2.78	5.97	2.00	3.04	7.25	43.31	0.08	0.99	0.19
50	3.20	1.70	1.12	3.48	2.25	1.12	3.37	**Clayey**	4.03	2.01	2.65	4.87	2.00	3.20	9.23	45.01	0.08	0.99	0.19
51	3.32	1.73	2.13	3.58	2.26	2.13	3.48	**Clayey**	3.80	1.95	2.55	4.89	2.00	3.32	11.08	54.19	0.09	0.98	0.19
52	3.38	1.58	2.27	3.63	2.04	2.27	3.53	**Clayey**	3.59	1.89	2.45	4.55	2.00	3.38	12.04	54.73	0.10	0.98	0.18
53	3.39	1.58	2.21	3.62	2.02	2.21	3.53	**Clayey**	3.41	1.85	2.36	4.51	2.00	3.39	12.10	54.62	0.10	0.98	0.18
54	3.36	1.67	2.04	3.59	2.11	2.04	3.50	**Clayey**	3.24	1.80	2.28	4.62	2.00	3.36	11.69	54.01	0.09	0.98	0.18
55	3.44	1.47	2.26	3.66	1.84	2.26	3.57	**Clayey**	3.09	1.76	2.20	4.24	2.00	3.44	13.01	55.10	0.10	0.98	0.18
56	3.51	1.50	3.24	3.72	1.87	3.24	3.64	**Clayey**	2.95	1.72	2.13	4.26	2.00	3.51	14.33	61.12	0.10	0.98	0.17
57	3.50	1.56	3.06	3.70	1.91	3.06	3.62	**Clayey**	2.82	1.68	2.07	4.32	2.00	3.50	14.04	60.60	0.10	0.98	0.17
58	3.50	1.56	2.99	3.69	1.91	2.99	3.61	**Clayey**	2.71	1.65	2.01	4.30	2.00	3.50	14.06	60.44	0.10	0.97	0.17
59	3.55	1.44	3.17	3.73	1.75	3.17	3.66	**Clayey**	2.60	1.61	1.95	4.07	2.00	3.55	15.00	61.12	0.10	0.97	0.17
60	3.42	1.81	2.48	3.59	2.17	2.48	3.52	**Clayey**	2.50	1.58	1.90	4.63	2.00	3.42	12.64	58.56	0.10	0.97	0.16
61	3.37	1.97	2.23	3.54	2.35	2.23	3.47	**Clayey**	2.41	1.55	1.85	4.85	2.00	3.37	11.86	57.47	0.10	0.97	0.16
62	3.35	2.07	2.09	3.51	2.45	2.09	3.44	**Clayey**	2.33	1.52	1.81	4.97	2.00	3.35	11.43	56.78	0.10	0.97	0.16
63	3.36	2.03	2.10	3.52	2.38	2.10	3.46	**Clayey**	2.24	1.50	1.76	4.86	2.00	3.36	11.70	56.82	0.10	0.97	0.15
64	3.31	2.21	1.89	3.47	2.58	1.89	3.41	**Clayey**	2.17	1.47	1.72	5.09	2.00	3.31	10.95	55.74	0.10	0.97	0.15
65	3.32	2.44	2.25	3.46	2.83	2.25	3.40	**Clayey**	2.10	1.45	1.68	5.38	2.00	3.32	11.00	59.19	0.10	0.96	0.15
66	3.31	2.26	1.79	3.45	2.60	1.79	3.39	**Clayey**	2.04	1.43	1.65	5.09	2.00	3.31	10.85	55.16	0.10	0.96	0.15
67	3.34	2.37	2.24	3.47	2.72	2.24	3.42	**Clayey**	1.98	1.41	1.61	5.21	2.00	3.34	11.34	59.05	0.10	0.96	0.14
68	3.32	2.47	2.12	3.44	2.81	2.12	3.39	**Clayey**	1.92	1.38	1.58	5.31	2.00	3.32	11.00	58.37	0.10	0.96	0.14
69	3.24	2.58	1.50	3.36	2.93	1.50	3.31	**Clayey**	1.86	1.37	1.55	5.43	2.00	3.24	9.80	53.18	0.09	0.96	0.14
70	3.18	3.14	1.62	3.30	3.53	1.62	3.25	**Clayey**	1.81	1.35	1.52	6.13	2.00	3.18	9.03	55.33	0.10	0.96	0.13
71	3.20	3.06	1.64	3.31	3.43	1.64	3.27	**Clayey**	1.76	1.33	1.49	5.99	2.00	3.20	9.26	55.40	0.10	0.96	0.13
72	3.22	2.97	1.67	3.33	3.31	1.67	3.28	**Clayey**	1.72	1.31	1.46	5.83	2.00	3.22	9.53	55.51	0.10	0.95	0.13
73	3.17	2.97	1.24	3.27	3.29	1.24	3.23	**Clayey**	1.67	1.29	1.43	5.78	2.00	3.17	8.84	51.06	0.09	0.95	0.13
74	3.20	2.84	1.28	3.30	3.13	1.28	3.26	**Clayey**	1.63	1.28	1.41	5.57	2.00	3.20	9.23	51.41	0.09	0.95	0.12
75	3.18	2.96	1.21	3.27	3.25	1.21	3.23	**Clayey**	1.59	1.26	1.39	5.69	2.00	3.18	8.92	50.81	0.09	0.95	0.12
76	3.18	3.25	1.45	3.27	3.55	1.45	3.23	**Clayey**	1.56	1.25	1.36	6.01	2.00	3.18	8.95	53.82	0.09	0.95	0.12
77	3.14	3.50	1.33	3.22	3.81	1.33	3.19	**Clayey**	1.52	1.23	1.34	6.29	2.00	3.14	8.40	52.79	0.09	0.94	0.11
78	3.14	3.52	1.31	3.22	3.81	1.31	3.18	**Clayey**	1.49	1.22	1.32	6.26	2.00	3.14	8.40	52.61	0.09	0.94	0.11
79	3.14	3.51	1.30	3.21	3.79	1.30	3.18	**Clayey**	1.45	1.20	1.30	6.21	2.00	3.14	8.44	52.45	0.09	0.94	0.11
80	2.63	13.26	1.27	2.70	14.23	1.27	2.67	**Clayey**	1.42	1.19	1.28	17.79	2.00	2.63	3.51	62.48	0.10	0.94	0.11
81	1.96	66.02	0.86	2.01	70.49	0.86	1.99	**Granular**	1.39	1.18	1.26	67.72	5.00	2.01	1.32	89.29	0.15	0.93	0.10
82	2.73	18.49	3.03	2.78	19.64	3.03	2.76	**Clayey**	1.35	1.16	1.24	23.51	2.00	2.73	4.24	99.58	0.17	0.93	0.10
83	2.04	56.20	0.91	2.09	59.43	0.91	2.07	**Granular**	1.32	1.15	1.22	57.93	3.00	2.09	1.43	82.77	0.13	0.93	0.10
84	2.09	55.99	1.11	2.14	58.94	1.11	2.12	**Granular**	1.29	1.14	1.20	57.75	3.00	2.14	1.53	88.18	0.14	0.92	0.09
85	2.41	30.04	1.59	2.45	31.49	1.59	2.43	**Granular**	1.27	1.12	1.18	31.82	2.00	2.45	2.52	80.13	0.13	0.92	0.09
86	2.68	20.87	2.78	2.72	21.79	2.78	2.70	**Clayey**	1.24	1.11	1.16	25.25	2.00	2.68	3.87	97.61	0.17	0.92	0.09

	BM	BN	BO	BP	BQ	BR	BS	BT	BU	BV	BW	BX
34	Col-64	Col-65	Col-66	Col-67	Col-68	Col-69	Col-70	Col-71	Col-72	Col-73	Col-74	Col-75
35		Rel. Den. Factor										
36												
37	CSR		f	MSF	K_σ	α	K_α	$FS_{\ liq-\ CPT\ (Sand-Like)}$		Apparent Fines	Measured Fines	Ic Limits
38	No Amplification	crest accel =						No Amplification	if crest accel =	(%)	(%)	
39		2				0.02			2			
40	0.07	0.14	0.7	2.2	3.39	0.02	0.9600	9.73	4.89	33		2.6
41	0.07	0.14	0.7	2.2	2.43	0.02	0.9600	6.58	3.35	30		2.6
42	0.07	0.14	0.7	2.2	2.09	0.02	0.9600	4.50	2.32	33		2.6
43	0.07	0.14	0.7	2.2	1.88	0.02	0.9600	3.99	2.09	38		2.6
44	0.07	0.13	0.7	2.2	1.75	0.02	0.9600	3.67	1.95	44		2.6
45	0.08	0.15	0.7	2.2	1.70	0.02	0.9600	3.45	1.86	39		2.6
46	0.09	0.16	0.7	2.2	1.65	0.02	0.9600	3.13	1.71	47		2.6
47	0.09	0.16	0.7	2.2	1.62	0.02	0.9600	2.90	1.60	54		2.6
48	0.10	0.17	0.7	2.2	1.58	0.02	0.9600	2.70	1.52	57		2.6
49	0.10	0.17	0.7	2.2	1.55	0.02	0.9600	2.55	1.45	62		2.6
50	0.10	0.18	0.7	2.2	1.52	0.02	0.9600	2.46	1.42	73		2.6
51	0.11	0.18	0.7	2.2	1.49	0.02	0.9600	2.81	1.65	83		2.6
52	0.11	0.18	0.7	2.2	1.47	0.02	0.9600	2.71	1.61	88		2.6
53	0.11	0.18	0.7	2.2	1.44	0.02	0.9600	2.60	1.57	89		2.6
54	0.11	0.19	0.7	2.2	1.42	0.02	0.9600	2.50	1.54	86		2.6
55	0.12	0.19	0.7	2.2	1.40	0.02	0.9600	2.45	1.53	93		2.6
56	0.12	0.19	0.7	2.2	1.38	0.02	0.9600	2.52	1.60	100		2.6
57	0.12	0.18	0.7	2.2	1.36	0.02	0.9600	2.44	1.57	99		2.6
58	0.12	0.18	0.7	2.2	1.35	0.02	0.9600	2.37	1.56	99		2.6
59	0.12	0.18	0.7	2.2	1.33	0.02	0.9600	2.34	1.56	100		2.6
60	0.12	0.18	0.7	2.2	1.32	0.02	0.9600	2.23	1.51	91		2.6
61	0.12	0.18	0.7	2.2	1.30	0.02	0.9600	2.16	1.49	87		2.6
62	0.13	0.18	0.7	2.2	1.29	0.02	0.9600	2.11	1.48	85		2.6
63	0.13	0.18	0.7	2.2	1.27	0.02	0.9600	2.07	1.48	86		2.6
64	0.13	0.17	0.7	2.2	1.26	0.02	0.9600	2.02	1.47	82		2.6
65	0.13	0.17	0.7	2.2	1.25	0.02	0.9600	2.05	1.52	83		2.6
66	0.13	0.17	0.7	2.2	1.24	0.02	0.9600	1.95	1.47	82		2.6
67	0.13	0.17	0.7	2.2	1.23	0.02	0.9600	1.99	1.54	84		2.6
68	0.13	0.16	0.7	2.2	1.22	0.02	0.9600	1.95	1.54	83		2.6
69	0.13	0.16	0.7	2.2	1.21	0.02	0.9600	1.84	1.48	76		2.6
70	0.13	0.16	0.7	2.2	1.20	0.02	0.9600	1.85	1.52	72		2.6
71	0.13	0.16	0.7	2.2	1.19	0.02	0.9600	1.83	1.54	73		2.6
72	0.13	0.15	0.7	2.2	1.18	0.02	0.9600	1.81	1.55	75		2.6
73	0.13	0.15	0.7	2.2	1.17	0.02	0.9600	1.73	1.51	71		2.6
74	0.13	0.15	0.7	2.2	1.16	0.02	0.9600	1.72	1.54	73		2.6
75	0.13	0.14	0.7	2.2	1.15	0.02	0.9600	1.69	1.55	71		2.6
76	0.13	0.14	0.7	2.2	1.14	0.02	0.9600	1.72	1.62	71		2.6
77	0.13	0.14	0.7	2.2	1.13	0.02	0.9600	1.69	1.63	68		2.6
78	0.13	0.13	0.7	2.2	1.13	0.02	0.9600	1.67	1.65	68		2.6
79	0.13	0.13	0.7	2.2	1.12	0.02	0.9600	1.66	1.68	68		2.6
80	0.13	0.13	0.7	2.2	1.11	0.02	0.9600	1.81	1.88	37		2.6
81	0.13	0.12	0.7	2.2	1.10	0.02	0.9625	2.57	2.75	13		2.6
82	0.13	0.12	0.7	2.2	1.10	0.02	0.9600	3.00	3.29	42		2.6
83	0.13	0.12	0.7	2.2	1.09	0.02	0.9600	2.30	2.60	15		2.6
84	0.13	0.11	0.7	2.2	1.08	0.02	0.9600	2.48	2.89	17		2.6
85	0.13	0.11	0.7	2.2	1.07	0.02	0.9600	2.20	2.64	28		2.6
86	0.13	0.11	0.7	2.2	1.07	0.02	0.9600	2.85	3.53	39		2.6

	BY	BZ	CA	CB	CC	CD	CE	CF	CG	CH
34	Col-76	Col-77	Col-78	Col-79	Col-80	Col-81	Col-82	Col-83	Col-84	Col-85
35	Boulanger and Idriss, 2004, "Approach B" method based on Su profile									
36										
37	Su - CPT (psf)	OCR Assumed	OCR - CPT	α	k_α	$CRR_{M7.5}$	MSF	$CRR_{M5.5}$	$FS_{\ liq-Su\ (Clay-Like)}$	
38	Nkt	1.1							No Amplification	crest accel
39	10.5			0.02						2
40	486	1.1		0.02	0.99	8.52	1.11	9.46	132.28	66.57
41	468	1.1		0.02	0.99	2.68	1.11	2.98	41.69	21.25
42	421	1.1		0.02	0.99	1.46	1.11	1.62	22.71	11.73
43	419	1.1		0.02	0.99	1.03	1.11	1.15	16.12	8.44
44	394	1.1		0.02	0.99	0.76	1.11	0.84	11.82	6.27
45	329	1.1		0.02	0.99	0.57	1.11	0.63	8.08	4.35
46	275	1.1		0.02	0.99	0.44	1.11	0.48	5.70	3.11
47	237	1.1		0.02	0.99	0.35	1.11	0.39	4.29	2.37
48	232	1.1		0.02	0.99	0.32	1.11	0.35	3.70	2.08
49	214	1.1		0.02	0.99	0.27	1.11	0.30	3.06	1.74
50	171	1.1		0.02	0.99	0.20	1.11	0.23	2.21	1.28
51	179	1.1		0.02	0.99	0.20	1.11	0.23	2.12	1.24
52	168	1.1		0.02	0.99	0.18	1.11	0.20	1.84	1.09
53	173	1.1		0.02	0.99	0.18	1.11	0.20	1.75	1.06
54	187	1.1		0.02	0.99	0.18	1.11	0.20	1.76	1.08
55	168	1.1		0.02	0.99	0.16	1.11	0.17	1.49	0.93
56	177	1.1		0.02	0.99	0.16	1.11	0.17	1.47	0.93
57	187	1.1		0.02	0.99	0.16	1.11	0.17	1.46	0.94
58	191	1.1		0.02	0.99	0.15	1.11	0.17	1.42	0.93
59	180	1.1		0.02	0.99	0.14	1.11	0.16	1.27	0.85
60	231	1.1		0.02	0.99	0.17	1.11	0.19	1.55	1.05
61	256	1.1		0.02	0.99	0.18	1.11	0.20	1.65	1.14
62	274	1.1		0.02	0.99	0.19	1.11	0.21	1.69	1.18
63	273	1.1		0.02	0.99	0.18	1.11	0.20	1.61	1.15
64	302	1.1		0.02	0.99	0.20	1.11	0.22	1.71	1.25
65	339	1.1		0.02	0.99	0.21	1.11	0.24	1.85	1.37
66	318	1.1		0.02	0.99	0.19	1.11	0.22	1.67	1.27
67	340	1.1		0.02	0.99	0.20	1.11	0.22	1.72	1.33
68	360	1.1		0.02	0.99	0.21	1.11	0.23	1.76	1.39
69	381	1.1		0.02	0.99	0.21	1.11	0.24	1.81	1.45
70	470	1.1		0.02	0.99	0.25	1.11	0.28	2.16	1.77
71	465	1.1		0.02	0.99	0.24	1.11	0.27	2.07	1.74
72	458	1.1		0.02	0.99	0.23	1.11	0.26	1.98	1.70
73	462	1.1		0.02	0.99	0.23	1.11	0.26	1.94	1.70
74	447	1.1		0.02	0.99	0.22	1.11	0.24	1.83	1.64
75	473	1.1		0.02	0.99	0.22	1.11	0.25	1.89	1.73
76	525	1.1		0.02	0.99	0.24	1.11	0.27	2.04	1.92
77	573	1.1		0.02	0.99	0.26	1.11	0.29	2.17	2.09
78	582	1.1		0.02	0.99	0.26	1.11	0.29	2.15	2.13
79	588	1.1		0.02	0.99	0.25	1.11	0.28	2.13	2.15
80	2244	1.1		0.02	0.99	0.95	1.11	1.05	7.93	8.25
81	11299	1.1		0.02	0.99	4.67	1.11	5.19	39.07	41.74
82	3202	1.1		0.02	0.99	1.29	1.11	1.44	10.83	11.89
83	9848	1.1		0.02	0.99	3.88	1.11	4.31	32.59	36.84
84	9925	1.1		0.02	0.99	3.82	1.11	4.25	32.16	37.44
85	5382	1.1		0.02	0.99	2.03	1.11	2.26	17.11	20.53
86	3775	1.1		0.02	0.99	1.40	1.11	1.55	11.78	14.59

ATTACHMENT D-2C

POST-EARTHQUAKE STABILITY ANALYSIS
PROFILE E3

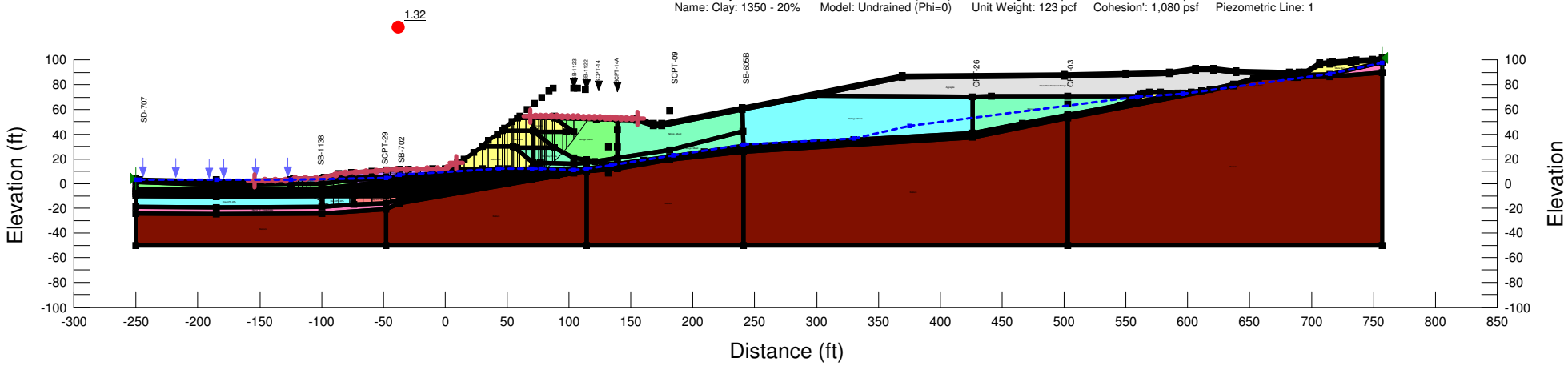
SLOPE/W OUTPUT

Title: Callahan Mine OU3 - Profile E3
Date: 10/17/2014
File Name: Tailings_Profile-E3_Proposed-Cond_90%.gsz

Name: Profile E-3; d1 - Post-EQ - 20% Clay Red. - Crest/Toe - Till Imp
Method: Spencer

Name: Waste Rock Model: Mohr-Coulomb Unit Weight: 120 pcf Cohesion': 0 psf Phi': 42 ° Constant Unit Wt. Above Water Table: 95 pcf Piezometric Line: 1
Name: Tailings - Sands Model: Mohr-Coulomb Unit Weight: 120 pcf Cohesion': 0 psf Phi': 37 ° Constant Unit Wt. Above Water Table: 110 pcf Piezometric Line: 1
Name: Tailings - Mixed Model: Mohr-Coulomb Unit Weight: 117 pcf Cohesion': 0 psf Phi': 36 ° Constant Unit Wt. Above Water Table: 108 pcf Piezometric Line: 1
Name: Tailings - Slimes Model: Mohr-Coulomb Unit Weight: 114 pcf Cohesion': 0 psf Phi': 35 ° Constant Unit Wt. Above Water Table: 106 pcf Piezometric Line: 1
Name: Fill - Rock/Sand/Fines Mix Model: Mohr-Coulomb Unit Weight: 130 pcf Cohesion': 25 psf Phi': 36 ° Constant Unit Wt. Above Water Table: 125 pcf Piezometric Line: 1
Name: Clay - 2750 psf Model: Undrained (Phi=0) Unit Weight: 125 pcf Cohesion': 2,750 psf Piezometric Line: 1
Name: Clay - 2250 psf Model: Undrained (Phi=0) Unit Weight: 125 pcf Cohesion': 2,250 psf Piezometric Line: 1
Name: Clay - 1750 psf Model: Undrained (Phi=0) Unit Weight: 123 pcf Cohesion': 1,750 psf Piezometric Line: 1
Name: Clay - 1500 psf Model: Undrained (Phi=0) Unit Weight: 123 pcf Cohesion': 1,500 psf Piezometric Line: 1
Name: Clay - 1250 psf Model: Undrained (Phi=0) Unit Weight: 123 pcf Cohesion': 1,250 psf Piezometric Line: 1
Name: Fill - Clay/Till - Su Model: Undrained (Phi=0) Unit Weight: 125 pcf Cohesion': 2,000 psf Constant Unit Wt. Above Water Table: 120 pcf Piezometric Line: 1
Name: Waste Rock/Dewatered Tailings - Mix Model: Mohr-Coulomb Unit Weight: 125 pcf Cohesion': 0 psf Phi': 38 ° Constant Unit Wt. Above Water Table: 115 pcf Piezometr
Name: Bedrock Model: Bedrock (Impenetrable) Piezometric Line: 1
Name: Clay - 1350 psf Model: Undrained (Phi=0) Unit Weight: 123 pcf Cohesion': 1,350 psf Piezometric Line: 1
Name: Clay - 1425 psf Model: Undrained (Phi=0) Unit Weight: 123 pcf Cohesion': 1,425 psf Piezometric Line: 1
Name: Glacial Till - Impenetrable Model: Bedrock (Impenetrable) Piezometric Line: 1
Name: Aggregate Model: Mohr-Coulomb Unit Weight: 100 pcf Cohesion': 0 psf Phi': 41 ° Piezometric Line: 1
Name: Salt Marsh: 375 - 20% Model: Undrained (Phi=0) Unit Weight: 110 pcf Cohesion': 300 psf Constant Unit Wt. Above Water Table: 105 pcf Piezometric Line: 1
Name: Clay: 750 - 20% Model: Undrained (Phi=0) Unit Weight: 121 pcf Cohesion': 600 psf Piezometric Line: 1
Name: Salt Marsh: 800 - 20% Model: Undrained (Phi=0) Unit Weight: 115 pcf Cohesion': 640 psf Constant Unit Wt. Above Water Table: 85 pcf Piezometric Line: 1
Name: Clay: 625 - 20% Model: Undrained (Phi=0) Unit Weight: 121 pcf Cohesion': 500 psf Piezometric Line: 1
Name: Clay: 475 - 20% Model: Undrained (Phi=0) Unit Weight: 118 pcf Cohesion': 380 psf Piezometric Line: 1
Name: Salt Marsh: 625 - 20% Model: Undrained (Phi=0) Unit Weight: 115 pcf Cohesion': 500 psf Constant Unit Wt. Above Water Table: 85 pcf Piezometric Line: 1
Name: Salt Marsh: 1000 - 20% Model: Undrained (Phi=0) Unit Weight: 120 pcf Cohesion': 800 psf Constant Unit Wt. Above Water Table: 115 pcf Piezometric Line: 1
Name: Clay: 875 - 20% Model: Undrained (Phi=0) Unit Weight: 121 pcf Cohesion': 700 psf Piezometric Line: 1
Name: Clay: 375 - 20% Model: Undrained (Phi=0) Unit Weight: 118 pcf Cohesion': 300 psf Piezometric Line: 1
Name: Clay: 450 - 20% Model: Undrained (Phi=0) Unit Weight: 120 pcf Cohesion': 360 psf Piezometric Line: 1
Name: Clay: 400 - 20% Model: Undrained (Phi=0) Unit Weight: 120 pcf Cohesion': 320 psf Piezometric Line: 1
Name: Clay: 550 - 20% Model: Undrained (Phi=0) Unit Weight: 120 pcf Cohesion': 440 psf Piezometric Line: 1
Name: Clay: 800 - 20% Model: Undrained (Phi=0) Unit Weight: 121 pcf Cohesion': 640 psf Piezometric Line: 1
Name: Clay: 925 - 20% Model: Undrained (Phi=0) Unit Weight: 120 pcf Cohesion': 740 psf Piezometric Line: 1
Name: Clay: 700 - 20% Model: Undrained (Phi=0) Unit Weight: 120 pcf Cohesion': 560 psf Piezometric Line: 1
Name: Clay: 1075 - 20% Model: Undrained (Phi=0) Unit Weight: 122 pcf Cohesion': 860 psf Piezometric Line: 1
Name: Clay: 1250 - 20% Model: Undrained (Phi=0) Unit Weight: 123 pcf Cohesion': 1,000 psf Piezometric Line: 1
Name: Clay: 1350 - 20% Model: Undrained (Phi=0) Unit Weight: 123 pcf Cohesion': 1,080 psf Piezometric Line: 1

F of S: 1.32

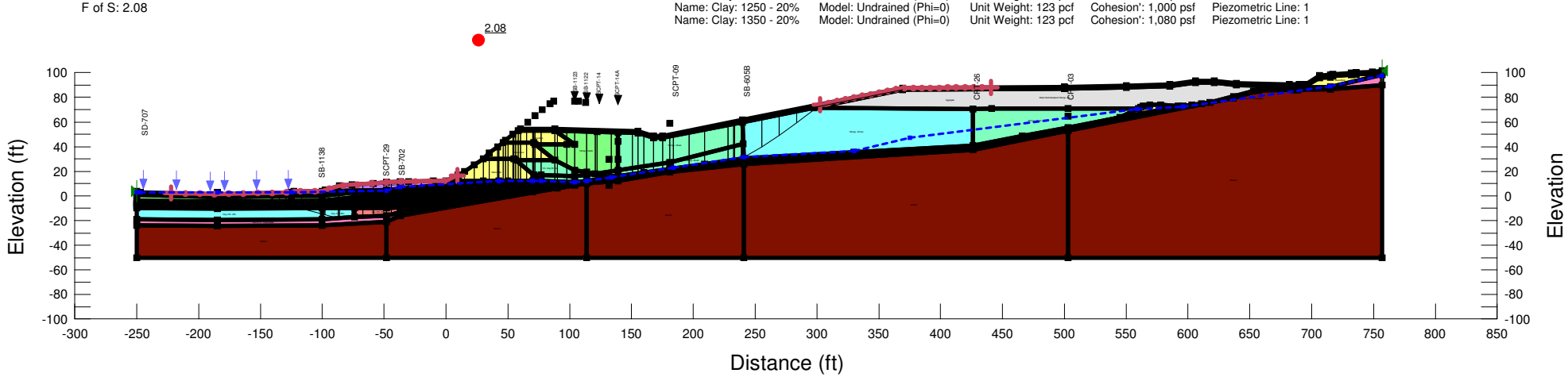


Title: Callahan Mine OU3 - Profile E3
Date: 10/17/2014
File Name: Tailings_Profile-E3_Proposed-Cond_90%.gsz

Name: Profile E-3; d2 - Post-EQ - 20% Clay Red. - Fill/Toe - Till Imp
Method: Spencer

Name: Waste Rock Model: Mohr-Coulomb Unit Weight: 120 pcf Cohesion': 0 psf Phi': 42 ° Constant Unit Wt. Above Water Table: 95 pcf Piezometric Line: 1
Name: Tailings - Sands Model: Mohr-Coulomb Unit Weight: 120 pcf Cohesion': 0 psf Phi': 37 ° Constant Unit Wt. Above Water Table: 110 pcf Piezometric Line: 1
Name: Tailings - Mixed Model: Mohr-Coulomb Unit Weight: 117 pcf Cohesion': 0 psf Phi': 36 ° Constant Unit Wt. Above Water Table: 108 pcf Piezometric Line: 1
Name: Tailings - Slimes Model: Mohr-Coulomb Unit Weight: 114 pcf Cohesion': 0 psf Phi': 35 ° Constant Unit Wt. Above Water Table: 106 pcf Piezometric Line: 1
Name: Fill - Rock/Sand/Fines Mix Model: Mohr-Coulomb Unit Weight: 130 pcf Cohesion': 25 psf Phi': 36 ° Constant Unit Wt. Above Water Table: 125 pcf Piezometric Line: 1
Name: Clay - 2750 psf Model: Undrained (Phi=0) Unit Weight: 125 pcf Cohesion': 2,750 psf Piezometric Line: 1
Name: Clay - 2250 psf Model: Undrained (Phi=0) Unit Weight: 125 pcf Cohesion': 2,250 psf Piezometric Line: 1
Name: Clay - 1750 psf Model: Undrained (Phi=0) Unit Weight: 123 pcf Cohesion': 1,750 psf Piezometric Line: 1
Name: Clay - 1500 psf Model: Undrained (Phi=0) Unit Weight: 123 pcf Cohesion': 1,500 psf Piezometric Line: 1
Name: Clay - 1250 psf Model: Undrained (Phi=0) Unit Weight: 123 pcf Cohesion': 1,250 psf Piezometric Line: 1
Name: Fill - Clay/Till - Su Model: Undrained (Phi=0) Unit Weight: 125 pcf Cohesion': 2,000 psf Constant Unit Wt. Above Water Table: 120 pcf Piezometric Line: 1
Name: Waste Rock/Dewatered Tailings - Mix Model: Mohr-Coulomb Unit Weight: 125 pcf Cohesion': 0 psf Phi': 38 ° Constant Unit Wt. Above Water Table: 115 pcf Piezometr
Name: Bedrock Model: Bedrock (Impenetrable) Piezometric Line: 1
Name: Clay - 1350 psf Model: Undrained (Phi=0) Unit Weight: 123 pcf Cohesion': 1,350 psf Piezometric Line: 1
Name: Clay - 1425 psf Model: Undrained (Phi=0) Unit Weight: 123 pcf Cohesion': 1,425 psf Piezometric Line: 1
Name: Glacial Till - Impenetrable Model: Bedrock (Impenetrable) Piezometric Line: 1
Name: Aggregate Model: Mohr-Coulomb Unit Weight: 100 pcf Cohesion': 0 psf Phi': 41 ° Piezometric Line: 1
Name: Salt Marsh: 375 - 20% Model: Undrained (Phi=0) Unit Weight: 110 pcf Cohesion': 300 psf Constant Unit Wt. Above Water Table: 105 pcf Piezometric Line: 1
Name: Clay: 750 - 20% Model: Undrained (Phi=0) Unit Weight: 121 pcf Cohesion': 600 psf Piezometric Line: 1
Name: Salt Marsh: 800 - 20% Model: Undrained (Phi=0) Unit Weight: 115 pcf Cohesion': 640 psf Constant Unit Wt. Above Water Table: 85 pcf Piezometric Line: 1
Name: Clay: 625 - 20% Model: Undrained (Phi=0) Unit Weight: 121 pcf Cohesion': 500 psf Piezometric Line: 1
Name: Clay: 475 - 20% Model: Undrained (Phi=0) Unit Weight: 118 pcf Cohesion': 380 psf Piezometric Line: 1
Name: Salt Marsh: 625 - 20% Model: Undrained (Phi=0) Unit Weight: 115 pcf Cohesion': 500 psf Constant Unit Wt. Above Water Table: 85 pcf Piezometric Line: 1
Name: Salt Marsh: 1000 - 20% Model: Undrained (Phi=0) Unit Weight: 120 pcf Cohesion': 800 psf Constant Unit Wt. Above Water Table: 115 pcf Piezometric Line: 1
Name: Clay: 875 - 20% Model: Undrained (Phi=0) Unit Weight: 121 pcf Cohesion': 700 psf Piezometric Line: 1
Name: Clay: 375 - 20% Model: Undrained (Phi=0) Unit Weight: 118 pcf Cohesion': 300 psf Piezometric Line: 1
Name: Clay: 450 - 20% Model: Undrained (Phi=0) Unit Weight: 120 pcf Cohesion': 360 psf Piezometric Line: 1
Name: Clay: 400 - 20% Model: Undrained (Phi=0) Unit Weight: 120 pcf Cohesion': 320 psf Piezometric Line: 1
Name: Clay: 550 - 20% Model: Undrained (Phi=0) Unit Weight: 120 pcf Cohesion': 440 psf Piezometric Line: 1
Name: Clay: 800 - 20% Model: Undrained (Phi=0) Unit Weight: 121 pcf Cohesion': 640 psf Piezometric Line: 1
Name: Clay: 925 - 20% Model: Undrained (Phi=0) Unit Weight: 120 pcf Cohesion': 740 psf Piezometric Line: 1
Name: Clay: 700 - 20% Model: Undrained (Phi=0) Unit Weight: 120 pcf Cohesion': 560 psf Piezometric Line: 1
Name: Clay: 1075 - 20% Model: Undrained (Phi=0) Unit Weight: 122 pcf Cohesion': 860 psf Piezometric Line: 1
Name: Clay: 1250 - 20% Model: Undrained (Phi=0) Unit Weight: 123 pcf Cohesion': 1,000 psf Piezometric Line: 1
Name: Clay: 1350 - 20% Model: Undrained (Phi=0) Unit Weight: 123 pcf Cohesion': 1,080 psf Piezometric Line: 1

F of S: 2.08

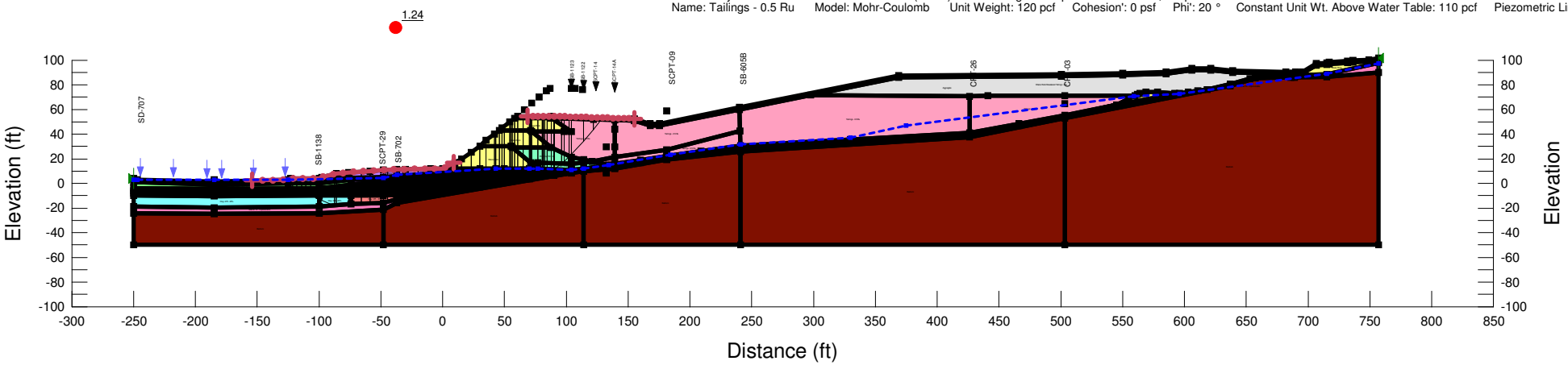


Title: Callahan Mine OU3 - Profile E3
Date: 10/16/2014
File Name: Tailings_Profile-E3_Proposed-Cond_90%.gsz

Name: Profile E-3; g1 - Post-EQ - 20% Clay Red. - Tailings 0.5 Ru - Crest/Toe - Till Imp
Method: Spencer

Name: Waste Rock Model: Mohr-Coulomb Unit Weight: 120 pcf Cohesion': 0 psf Phi': 42 ° Constant Unit Wt. Above Water Table: 95 pcf Piezometric Line: 1
Name: Fill - Rock/Sand/Fines Mix Model: Mohr-Coulomb Unit Weight: 130 pcf Cohesion': 25 psf Phi': 36 ° Constant Unit Wt. Above Water Table: 125 pcf Piezometric Line: 1
Name: Clay - 2750 psf Model: Undrained (Phi=0) Unit Weight: 125 pcf Cohesion': 2,750 psf Piezometric Line: 1
Name: Clay - 2250 psf Model: Undrained (Phi=0) Unit Weight: 125 pcf Cohesion': 2,250 psf Piezometric Line: 1
Name: Clay - 1750 psf Model: Undrained (Phi=0) Unit Weight: 123 pcf Cohesion': 1,750 psf Piezometric Line: 1
Name: Clay - 1500 psf Model: Undrained (Phi=0) Unit Weight: 123 pcf Cohesion': 1,500 psf Piezometric Line: 1
Name: Clay - 1250 psf Model: Undrained (Phi=0) Unit Weight: 123 pcf Cohesion': 1,250 psf Piezometric Line: 1
Name: Fill - Clay/Till - Su Model: Undrained (Phi=0) Unit Weight: 125 pcf Cohesion': 2,000 psf Constant Unit Wt. Above Water Table: 120 pcf Piezometric Line: 1
Name: Waste Rock/Dewatered Tailings - Mix Model: Mohr-Coulomb Unit Weight: 125 pcf Cohesion': 0 psf Phi': 38 ° Constant Unit Wt. Above Water Table: 115 pcf Piezomet
Name: Bedrock Model: Bedrock (Impenetrable) Piezometric Line: 1
Name: Clay - 1350 psf Model: Undrained (Phi=0) Unit Weight: 123 pcf Cohesion': 1,350 psf Piezometric Line: 1
Name: Clay - 1425 psf Model: Undrained (Phi=0) Unit Weight: 123 pcf Cohesion': 1,425 psf Piezometric Line: 1
Name: Glacial Till - Impenetrable Model: Bedrock (Impenetrable) Piezometric Line: 1
Name: Aggregate Model: Mohr-Coulomb Unit Weight: 100 pcf Cohesion': 0 psf Phi': 41 ° Piezometric Line: 1
Name: Salt Marsh: 375 - 20% Model: Undrained (Phi=0) Unit Weight: 110 pcf Cohesion': 300 psf Constant Unit Wt. Above Water Table: 105 pcf Piezometric Line: 1
Name: Clay: 750 - 20% Model: Undrained (Phi=0) Unit Weight: 121 pcf Cohesion': 600 psf Piezometric Line: 1
Name: Salt Marsh: 800 - 20% Model: Undrained (Phi=0) Unit Weight: 115 pcf Cohesion': 640 psf Constant Unit Wt. Above Water Table: 85 pcf Piezometric Line: 1
Name: Clay: 625 - 20% Model: Undrained (Phi=0) Unit Weight: 121 pcf Cohesion': 500 psf Piezometric Line: 1
Name: Clay: 475 - 20% Model: Undrained (Phi=0) Unit Weight: 118 pcf Cohesion': 380 psf Piezometric Line: 1
Name: Salt Marsh: 625 - 20% Model: Undrained (Phi=0) Unit Weight: 115 pcf Cohesion': 500 psf Constant Unit Wt. Above Water Table: 85 pcf Piezometric Line: 1
Name: Salt Marsh: 1000 - 20% Model: Undrained (Phi=0) Unit Weight: 120 pcf Cohesion': 800 psf Constant Unit Wt. Above Water Table: 115 pcf Piezometric Line: 1
Name: Clay: 875 - 20% Model: Undrained (Phi=0) Unit Weight: 121 pcf Cohesion': 700 psf Piezometric Line: 1
Name: Clay: 375 - 20% Model: Undrained (Phi=0) Unit Weight: 118 pcf Cohesion': 300 psf Piezometric Line: 1
Name: Clay: 450 - 20% Model: Undrained (Phi=0) Unit Weight: 120 pcf Cohesion': 360 psf Piezometric Line: 1
Name: Clay: 400 - 20% Model: Undrained (Phi=0) Unit Weight: 120 pcf Cohesion': 320 psf Piezometric Line: 1
Name: Clay: 550 - 20% Model: Undrained (Phi=0) Unit Weight: 120 pcf Cohesion': 440 psf Piezometric Line: 1
Name: Clay: 800 - 20% Model: Undrained (Phi=0) Unit Weight: 121 pcf Cohesion': 640 psf Piezometric Line: 1
Name: Clay: 925 - 20% Model: Undrained (Phi=0) Unit Weight: 120 pcf Cohesion': 740 psf Piezometric Line: 1
Name: Clay: 700 - 20% Model: Undrained (Phi=0) Unit Weight: 120 pcf Cohesion': 560 psf Piezometric Line: 1
Name: Clay: 1075 - 20% Model: Undrained (Phi=0) Unit Weight: 122 pcf Cohesion': 860 psf Piezometric Line: 1
Name: Clay: 1250 - 20% Model: Undrained (Phi=0) Unit Weight: 123 pcf Cohesion': 1,000 psf Piezometric Line: 1
Name: Clay: 1350 - 20% Model: Undrained (Phi=0) Unit Weight: 123 pcf Cohesion': 1,080 psf Piezometric Line: 1
Name: Tailings - 0.5 Ru Model: Mohr-Coulomb Unit Weight: 120 pcf Cohesion': 0 psf Phi': 20 ° Constant Unit Wt. Above Water Table: 110 pcf Piezometric Line: 1

F of S: 1.24

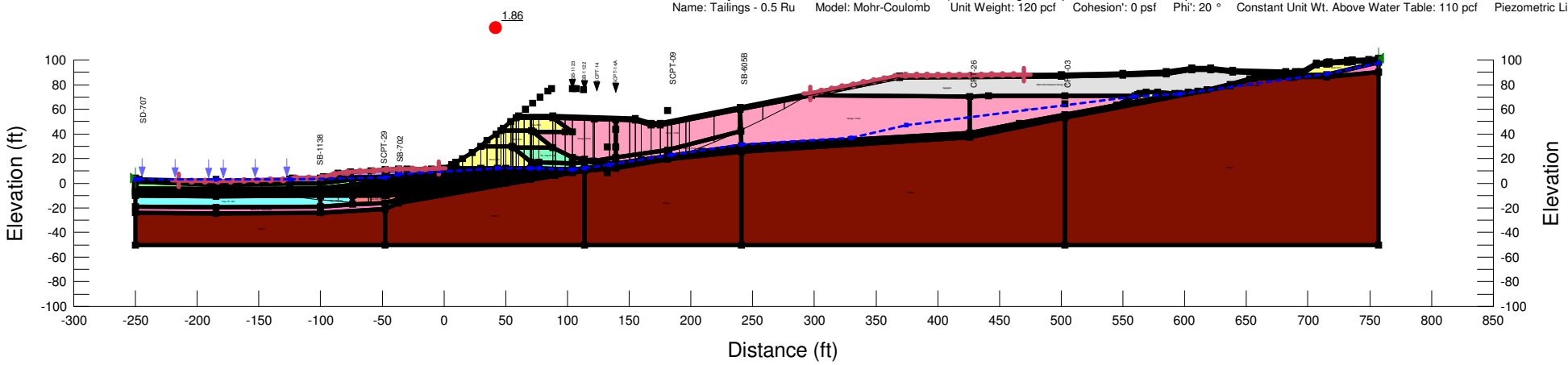


Title: Callahan Mine OU3 - Profile E3
Date: 10/16/2014
File Name: Tailings_Profile-E3_Proposed-Cond_90%.gsz

Name: Profile E-3; g2 - Post-EQ - 20% Clay Red. - Tailings 0.5 Ru - Fill/Toe - Till Imp
Method: Spencer

Name: Waste Rock Model: Mohr-Coulomb Unit Weight: 120 pcf Cohesion': 0 psf Phi': 42 ° Constant Unit Wt. Above Water Table: 95 pcf Piezometric Line: 1
Name: Fill - Rock/Sand/Fines Mix Model: Mohr-Coulomb Unit Weight: 130 pcf Cohesion': 25 psf Phi': 36 ° Constant Unit Wt. Above Water Table: 125 pcf Piezometric Line: 1
Name: Clay - 2750 psf Model: Undrained (Phi=0) Unit Weight: 125 pcf Cohesion': 2,750 psf Piezometric Line: 1
Name: Clay - 2250 psf Model: Undrained (Phi=0) Unit Weight: 125 pcf Cohesion': 2,250 psf Piezometric Line: 1
Name: Clay - 1750 psf Model: Undrained (Phi=0) Unit Weight: 123 pcf Cohesion': 1,750 psf Piezometric Line: 1
Name: Clay - 1500 psf Model: Undrained (Phi=0) Unit Weight: 123 pcf Cohesion': 1,500 psf Piezometric Line: 1
Name: Clay - 1250 psf Model: Undrained (Phi=0) Unit Weight: 123 pcf Cohesion': 1,250 psf Piezometric Line: 1
Name: Fill - Clay/Till - Su Model: Undrained (Phi=0) Unit Weight: 125 pcf Cohesion': 2,000 psf Constant Unit Wt. Above Water Table: 120 pcf Piezometric Line: 1
Name: Waste Rock/Dewatered Tailings - Mix Model: Mohr-Coulomb Unit Weight: 125 pcf Cohesion': 0 psf Phi': 38 ° Constant Unit Wt. Above Water Table: 115 pcf Piezomet
Name: Bedrock Model: Bedrock (Impenetrable) Piezometric Line: 1
Name: Clay - 1350 psf Model: Undrained (Phi=0) Unit Weight: 123 pcf Cohesion': 1,350 psf Piezometric Line: 1
Name: Clay - 1425 psf Model: Undrained (Phi=0) Unit Weight: 123 pcf Cohesion': 1,425 psf Piezometric Line: 1
Name: Glacial Till - Impenetrable Model: Bedrock (Impenetrable) Piezometric Line: 1
Name: Aggregate Model: Mohr-Coulomb Unit Weight: 100 pcf Cohesion': 0 psf Phi': 41 ° Piezometric Line: 1
Name: Salt Marsh: 375 - 20% Model: Undrained (Phi=0) Unit Weight: 110 pcf Cohesion': 300 psf Constant Unit Wt. Above Water Table: 105 pcf Piezometric Line: 1
Name: Clay: 750 - 20% Model: Undrained (Phi=0) Unit Weight: 121 pcf Cohesion': 600 psf Piezometric Line: 1
Name: Salt Marsh: 800 - 20% Model: Undrained (Phi=0) Unit Weight: 115 pcf Cohesion': 640 psf Constant Unit Wt. Above Water Table: 85 pcf Piezometric Line: 1
Name: Clay: 625 - 20% Model: Undrained (Phi=0) Unit Weight: 121 pcf Cohesion': 500 psf Piezometric Line: 1
Name: Clay: 475 - 20% Model: Undrained (Phi=0) Unit Weight: 118 pcf Cohesion': 380 psf Piezometric Line: 1
Name: Salt Marsh: 625 - 20% Model: Undrained (Phi=0) Unit Weight: 115 pcf Cohesion': 500 psf Constant Unit Wt. Above Water Table: 85 pcf Piezometric Line: 1
Name: Salt Marsh: 1000 - 20% Model: Undrained (Phi=0) Unit Weight: 120 pcf Cohesion': 800 psf Constant Unit Wt. Above Water Table: 115 pcf Piezometric Line: 1
Name: Clay: 875 - 20% Model: Undrained (Phi=0) Unit Weight: 121 pcf Cohesion': 700 psf Piezometric Line: 1
Name: Clay: 375 - 20% Model: Undrained (Phi=0) Unit Weight: 118 pcf Cohesion': 300 psf Piezometric Line: 1
Name: Clay: 450 - 20% Model: Undrained (Phi=0) Unit Weight: 120 pcf Cohesion': 360 psf Piezometric Line: 1
Name: Clay: 400 - 20% Model: Undrained (Phi=0) Unit Weight: 120 pcf Cohesion': 320 psf Piezometric Line: 1
Name: Clay: 550 - 20% Model: Undrained (Phi=0) Unit Weight: 120 pcf Cohesion': 440 psf Piezometric Line: 1
Name: Clay: 800 - 20% Model: Undrained (Phi=0) Unit Weight: 121 pcf Cohesion': 640 psf Piezometric Line: 1
Name: Clay: 925 - 20% Model: Undrained (Phi=0) Unit Weight: 120 pcf Cohesion': 740 psf Piezometric Line: 1
Name: Clay: 700 - 20% Model: Undrained (Phi=0) Unit Weight: 120 pcf Cohesion': 560 psf Piezometric Line: 1
Name: Clay: 1075 - 20% Model: Undrained (Phi=0) Unit Weight: 122 pcf Cohesion': 860 psf Piezometric Line: 1
Name: Clay: 1250 - 20% Model: Undrained (Phi=0) Unit Weight: 123 pcf Cohesion': 1,000 psf Piezometric Line: 1
Name: Clay: 1350 - 20% Model: Undrained (Phi=0) Unit Weight: 123 pcf Cohesion': 1,080 psf Piezometric Line: 1
Name: Tailings - 0.5 Ru Model: Mohr-Coulomb Unit Weight: 120 pcf Cohesion': 0 psf Phi': 20 ° Constant Unit Wt. Above Water Table: 110 pcf Piezometric Line: 1

F of S: 1.86

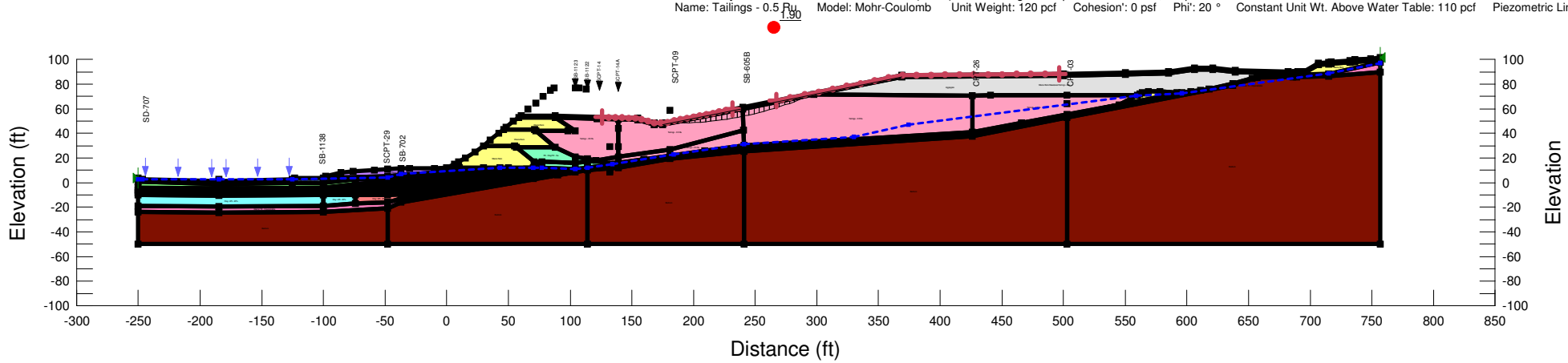


Title: Callahan Mine OU3 - Profile E3
Date: 10/16/2014
File Name: Tailings_Profile-E3_Proposed-Cond_90%.gsz

Name: Profile E-3; g3 - Post-EQ - 20% Clay Red. - Tailings 0.5 Ru - Fill/Slope - Till Imp
Method: Spencer

Name: Waste Rock Model: Mohr-Coulomb Unit Weight: 120 pcf Cohesion': 0 psf Phi': 42 ° Constant Unit Wt. Above Water Table: 95 pcf Piezometric Line: 1
Name: Fill - Rock/Sand/Fines Mix Model: Mohr-Coulomb Unit Weight: 130 pcf Cohesion': 25 psf Phi': 36 ° Constant Unit Wt. Above Water Table: 125 pcf Piezometric Line: 1
Name: Clay - 2750 psf Model: Undrained (Phi=0) Unit Weight: 125 pcf Cohesion': 2,750 psf Piezometric Line: 1
Name: Clay - 2250 psf Model: Undrained (Phi=0) Unit Weight: 125 pcf Cohesion': 2,250 psf Piezometric Line: 1
Name: Clay - 1750 psf Model: Undrained (Phi=0) Unit Weight: 123 pcf Cohesion': 1,750 psf Piezometric Line: 1
Name: Clay - 1500 psf Model: Undrained (Phi=0) Unit Weight: 123 pcf Cohesion': 1,500 psf Piezometric Line: 1
Name: Clay - 1250 psf Model: Undrained (Phi=0) Unit Weight: 123 pcf Cohesion': 1,250 psf Piezometric Line: 1
Name: Fill - Clay/Till - Su Model: Undrained (Phi=0) Unit Weight: 125 pcf Cohesion': 2,000 psf Constant Unit Wt. Above Water Table: 120 pcf Piezometric Line: 1
Name: Waste Rock/Dewatered Tailings - Mix Model: Mohr-Coulomb Unit Weight: 125 pcf Cohesion': 0 psf Phi': 38 ° Constant Unit Wt. Above Water Table: 115 pcf Piezomet
Name: Bedrock Model: Bedrock (Impenetrable) Piezometric Line: 1
Name: Clay - 1350 psf Model: Undrained (Phi=0) Unit Weight: 123 pcf Cohesion': 1,350 psf Piezometric Line: 1
Name: Clay - 1425 psf Model: Undrained (Phi=0) Unit Weight: 123 pcf Cohesion': 1,425 psf Piezometric Line: 1
Name: Glacial Till - Impenetrable Model: Bedrock (Impenetrable) Piezometric Line: 1
Name: Aggregate Model: Mohr-Coulomb Unit Weight: 100 pcf Cohesion': 0 psf Phi': 41 ° Piezometric Line: 1
Name: Salt Marsh: 375 - 20% Model: Undrained (Phi=0) Unit Weight: 110 pcf Cohesion': 300 psf Constant Unit Wt. Above Water Table: 105 pcf Piezometric Line: 1
Name: Clay: 750 - 20% Model: Undrained (Phi=0) Unit Weight: 121 pcf Cohesion': 600 psf Piezometric Line: 1
Name: Salt Marsh: 800 - 20% Model: Undrained (Phi=0) Unit Weight: 115 pcf Cohesion': 640 psf Constant Unit Wt. Above Water Table: 85 pcf Piezometric Line: 1
Name: Clay: 625 - 20% Model: Undrained (Phi=0) Unit Weight: 121 pcf Cohesion': 500 psf Piezometric Line: 1
Name: Clay: 475 - 20% Model: Undrained (Phi=0) Unit Weight: 118 pcf Cohesion': 380 psf Piezometric Line: 1
Name: Salt Marsh: 625 - 20% Model: Undrained (Phi=0) Unit Weight: 115 pcf Cohesion': 500 psf Constant Unit Wt. Above Water Table: 85 pcf Piezometric Line: 1
Name: Salt Marsh: 1000 - 20% Model: Undrained (Phi=0) Unit Weight: 120 pcf Cohesion': 800 psf Constant Unit Wt. Above Water Table: 115 pcf Piezometric Line: 1
Name: Clay: 875 - 20% Model: Undrained (Phi=0) Unit Weight: 121 pcf Cohesion': 700 psf Piezometric Line: 1
Name: Clay: 375 - 20% Model: Undrained (Phi=0) Unit Weight: 118 pcf Cohesion': 300 psf Piezometric Line: 1
Name: Clay: 450 - 20% Model: Undrained (Phi=0) Unit Weight: 120 pcf Cohesion': 360 psf Piezometric Line: 1
Name: Clay: 400 - 20% Model: Undrained (Phi=0) Unit Weight: 120 pcf Cohesion': 320 psf Piezometric Line: 1
Name: Clay: 550 - 20% Model: Undrained (Phi=0) Unit Weight: 120 pcf Cohesion': 440 psf Piezometric Line: 1
Name: Clay: 800 - 20% Model: Undrained (Phi=0) Unit Weight: 121 pcf Cohesion': 640 psf Piezometric Line: 1
Name: Clay: 925 - 20% Model: Undrained (Phi=0) Unit Weight: 120 pcf Cohesion': 740 psf Piezometric Line: 1
Name: Clay: 700 - 20% Model: Undrained (Phi=0) Unit Weight: 120 pcf Cohesion': 560 psf Piezometric Line: 1
Name: Clay: 1075 - 20% Model: Undrained (Phi=0) Unit Weight: 122 pcf Cohesion': 860 psf Piezometric Line: 1
Name: Clay: 1250 - 20% Model: Undrained (Phi=0) Unit Weight: 123 pcf Cohesion': 1,000 psf Piezometric Line: 1
Name: Clay: 1350 - 20% Model: Undrained (Phi=0) Unit Weight: 123 pcf Cohesion': 1,080 psf Piezometric Line: 1
Name: Tailings - 0.5 Ru Model: Mohr-Coulomb Unit Weight: 120 pcf Cohesion': 0 psf Phi': 20 ° Constant Unit Wt. Above Water Table: 110 pcf Piezometric Line: 1

F of S: 1.90



ATTACHMENT D-2D

POST-EARTHQUAKE “DOOMSDAY” STABILITY ANALYSIS PROFILE E3

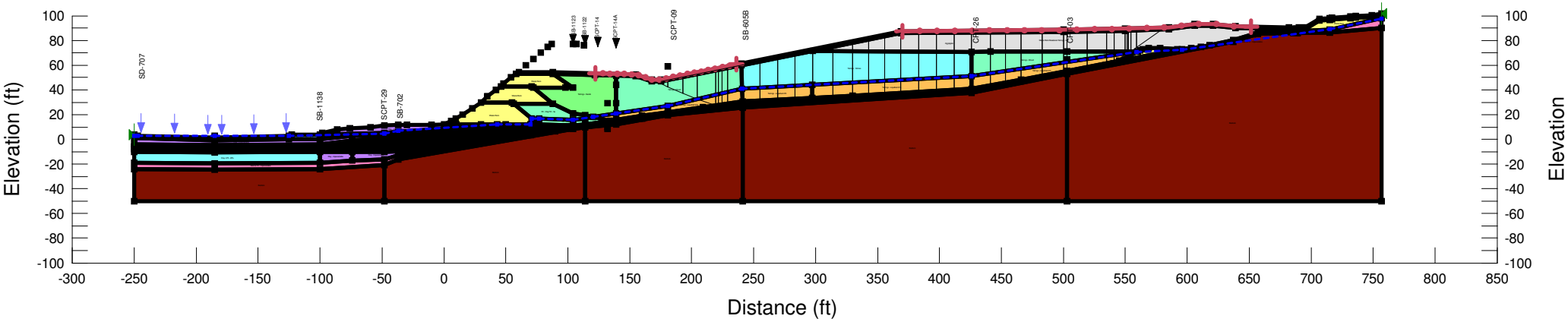
SLOPE/W OUTPUT

Title: Callahan Mine OU3 - Profile E3
Date: 11/3/2014
File Name: Tailings_Profile-E3_Doomsday_90%.gsz

Name: Profile E-3; d1 - Doomsday - Fill/Slope Toe - 215 psf
Method: Spencer

Name: Waste Rock Model: Mohr-Coulomb Unit Weight: 120 pcf Cohesion': 0 psf Phi': 42 ° Constant Unit Wt. Above Water Table: 95 pcf Piezometric Line: 1
Name: Tailings - Sands Model: Mohr-Coulomb Unit Weight: 120 pcf Cohesion': 0 psf Phi': 37 ° Constant Unit Wt. Above Water Table: 110 pcf Piezometric Line: 1
Name: Tailings - Mixed Model: Mohr-Coulomb Unit Weight: 117 pcf Cohesion': 0 psf Phi': 36 ° Constant Unit Wt. Above Water Table: 108 pcf Piezometric Line: 1
Name: Tailings - Slimes Model: Mohr-Coulomb Unit Weight: 114 pcf Cohesion': 0 psf Phi': 35 ° Constant Unit Wt. Above Water Table: 106 pcf Piezometric Line: 1
Name: Fill - Clay/Till - Su Model: Undrained (Phi=0) Unit Weight: 125 pcf Cohesion': 2,000 psf Constant Unit Wt. Above Water Table: 120 pcf Piezometric Line: 1
Name: Waste Rock/Dewatered Tailings - Mix Model: Mohr-Coulomb Unit Weight: 125 pcf Cohesion': 0 psf Phi': 38 ° Constant Unit Wt. Above Water Table: 115 pcf Piezometric Line: 1
Name: Bedrock Model: Bedrock (Impenetrable) Piezometric Line: 1
Name: Clay - 1425 psf Model: Undrained (Phi=0) Unit Weight: 123 pcf Cohesion': 1,425 psf Piezometric Line: 1
Name: Glacial Till - Impenetrable Model: Bedrock (Impenetrable) Piezometric Line: 1
Name: Aggregate Model: Mohr-Coulomb Unit Weight: 100 pcf Cohesion': 0 psf Phi': 41 ° Piezometric Line: 1
Name: Salt Marsh: 375 - 20% Model: Undrained (Phi=0) Unit Weight: 110 pcf Cohesion': 300 psf Constant Unit Wt. Above Water Table: 105 pcf Piezometric Line: 1
Name: Clay: 750 - 20% Model: Undrained (Phi=0) Unit Weight: 121 pcf Cohesion': 600 psf Piezometric Line: 1
Name: Clay: 625 - 20% Model: Undrained (Phi=0) Unit Weight: 121 pcf Cohesion': 500 psf Piezometric Line: 1
Name: Clay: 475 - 20% Model: Undrained (Phi=0) Unit Weight: 118 pcf Cohesion': 380 psf Piezometric Line: 1
Name: Salt Marsh: 625 - 20% Model: Undrained (Phi=0) Unit Weight: 115 pcf Cohesion': 500 psf Constant Unit Wt. Above Water Table: 85 pcf Piezometric Line: 1
Name: Tailings - Liquefied 215 Model: Mohr-Coulomb Unit Weight: 120 pcf Cohesion': 215 psf Phi': 0 ° Constant Unit Wt. Above Water Table: 110 pcf Piezometric Line: 1
Name: Clay - Impenetrable Model: Bedrock (Impenetrable) Piezometric Line: 1

F of S: 1.00

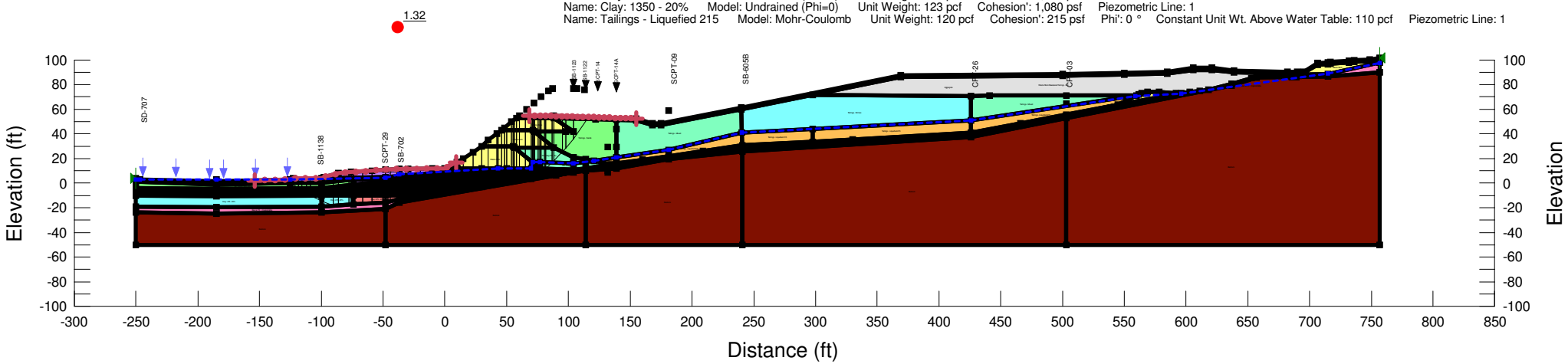


Title: Callahan Mine OU3 - Profile E3
Date: 11/3/2014
File Name: Tailings_Profile-E3_Doomsday_90%.gsz

Name: Profile E-3; a1 - Doomsday - Crest/Toe - 215 psf
Method: Spencer

Name: Waste Rock Model: Mohr-Coulomb Unit Weight: 120 pcf Cohesion': 0 psf Phi': 42 ° Constant Unit Wt. Above Water Table: 95 pcf Piezometric Line: 1
Name: Tailings - Sands Model: Mohr-Coulomb Unit Weight: 120 pcf Cohesion': 0 psf Phi': 37 ° Constant Unit Wt. Above Water Table: 110 pcf Piezometric Line: 1
Name: Tailings - Mixed Model: Mohr-Coulomb Unit Weight: 117 pcf Cohesion': 0 psf Phi': 36 ° Constant Unit Wt. Above Water Table: 108 pcf Piezometric Line: 1
Name: Tailings - Slimes Model: Mohr-Coulomb Unit Weight: 114 pcf Cohesion': 0 psf Phi': 35 ° Constant Unit Wt. Above Water Table: 106 pcf Piezometric Line: 1
Name: Fill - Rock/Sand/Fines Mix Model: Mohr-Coulomb Unit Weight: 130 pcf Cohesion': 25 psf Phi': 36 ° Constant Unit Wt. Above Water Table: 125 pcf Piezometric Line: 1
Name: Clay - 2750 psf Model: Undrained (Phi=0) Unit Weight: 125 pcf Cohesion': 2,750 psf Piezometric Line: 1
Name: Clay - 2250 psf Model: Undrained (Phi=0) Unit Weight: 125 pcf Cohesion': 2,250 psf Piezometric Line: 1
Name: Clay - 1750 psf Model: Undrained (Phi=0) Unit Weight: 123 pcf Cohesion': 1,750 psf Piezometric Line: 1
Name: Clay - 1500 psf Model: Undrained (Phi=0) Unit Weight: 123 pcf Cohesion': 1,500 psf Piezometric Line: 1
Name: Clay - 1250 psf Model: Undrained (Phi=0) Unit Weight: 123 pcf Cohesion': 1,250 psf Piezometric Line: 1
Name: Fill - Clay/Till - Su Model: Undrained (Phi=0) Unit Weight: 125 pcf Cohesion': 2,000 psf Constant Unit Wt. Above Water Table: 120 pcf Piezometric Line: 1
Name: Waste Rock/Dewatered Tailings - Mix Model: Mohr-Coulomb Unit Weight: 125 pcf Cohesion': 0 psf Phi': 38 ° Constant Unit Wt. Above Water Table: 115 pcf Piezometric Line: 1
Name: Bedrock Model: Bedrock (Impenetrable) Piezometric Line: 1
Name: Clay - 1350 psf Model: Undrained (Phi=0) Unit Weight: 123 pcf Cohesion': 1,350 psf Piezometric Line: 1
Name: Clay - 1425 psf Model: Undrained (Phi=0) Unit Weight: 123 pcf Cohesion': 1,425 psf Piezometric Line: 1
Name: Glacial Till - Impenetrable Model: Bedrock (Impenetrable) Piezometric Line: 1
Name: Aggregate Model: Mohr-Coulomb Unit Weight: 100 pcf Cohesion': 0 psf Phi': 41 ° Piezometric Line: 1
Name: Salt Marsh: 375 - 20% Model: Undrained (Phi=0) Unit Weight: 110 pcf Cohesion': 300 psf Constant Unit Wt. Above Water Table: 105 pcf Piezometric Line: 1
Name: Clay: 750 - 20% Model: Undrained (Phi=0) Unit Weight: 121 pcf Cohesion': 600 psf Piezometric Line: 1
Name: Salt Marsh: 800 - 20% Model: Undrained (Phi=0) Unit Weight: 115 pcf Cohesion': 640 psf Constant Unit Wt. Above Water Table: 85 pcf Piezometric Line: 1
Name: Clay: 625 - 20% Model: Undrained (Phi=0) Unit Weight: 121 pcf Cohesion': 500 psf Piezometric Line: 1
Name: Clay: 475 - 20% Model: Undrained (Phi=0) Unit Weight: 118 pcf Cohesion': 380 psf Piezometric Line: 1
Name: Salt Marsh: 625 - 20% Model: Undrained (Phi=0) Unit Weight: 115 pcf Cohesion': 500 psf Constant Unit Wt. Above Water Table: 85 pcf Piezometric Line: 1
Name: Salt Marsh: 1000 - 20% Model: Undrained (Phi=0) Unit Weight: 120 pcf Cohesion': 800 psf Constant Unit Wt. Above Water Table: 115 pcf Piezometric Line: 1
Name: Clay: 875 - 20% Model: Undrained (Phi=0) Unit Weight: 121 pcf Cohesion': 700 psf Piezometric Line: 1
Name: Clay: 375 - 20% Model: Undrained (Phi=0) Unit Weight: 118 pcf Cohesion': 300 psf Piezometric Line: 1
Name: Clay: 450 - 20% Model: Undrained (Phi=0) Unit Weight: 120 pcf Cohesion': 360 psf Piezometric Line: 1
Name: Clay: 400 - 20% Model: Undrained (Phi=0) Unit Weight: 120 pcf Cohesion': 320 psf Piezometric Line: 1
Name: Clay: 550 - 20% Model: Undrained (Phi=0) Unit Weight: 120 pcf Cohesion': 440 psf Piezometric Line: 1
Name: Clay: 800 - 20% Model: Undrained (Phi=0) Unit Weight: 121 pcf Cohesion': 640 psf Piezometric Line: 1
Name: Clay: 925 - 20% Model: Undrained (Phi=0) Unit Weight: 120 pcf Cohesion': 740 psf Piezometric Line: 1
Name: Clay: 700 - 20% Model: Undrained (Phi=0) Unit Weight: 120 pcf Cohesion': 560 psf Piezometric Line: 1
Name: Clay: 1075 - 20% Model: Undrained (Phi=0) Unit Weight: 122 pcf Cohesion': 860 psf Piezometric Line: 1
Name: Clay: 1250 - 20% Model: Undrained (Phi=0) Unit Weight: 123 pcf Cohesion': 1,000 psf Piezometric Line: 1
Name: Clay: 1350 - 20% Model: Undrained (Phi=0) Unit Weight: 123 pcf Cohesion': 1,080 psf Piezometric Line: 1
Name: Tailings - Liquefied 215 Model: Mohr-Coulomb Unit Weight: 120 pcf Cohesion': 215 psf Phi': 0 ° Constant Unit Wt. Above Water Table: 110 pcf Piezometric Line: 1

F of S: 1.32

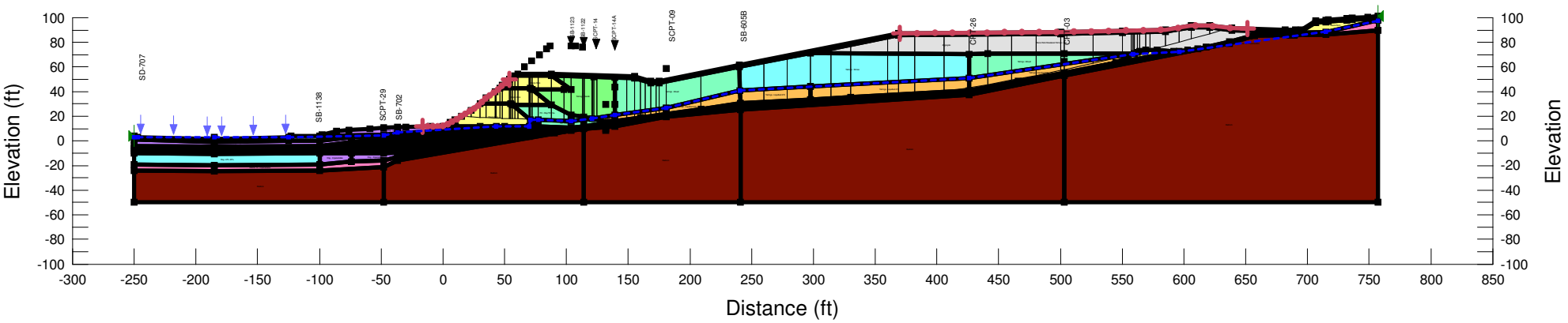


Title: Callahan Mine OU3 - Profile E3
Date: 11/3/2014
File Name: Tailings_Profile-E3_Doomsday_90%.gsz

Name: Profile E-3; b1 - Doomsday - Fill/Face - 215 psf
Method: Spencer

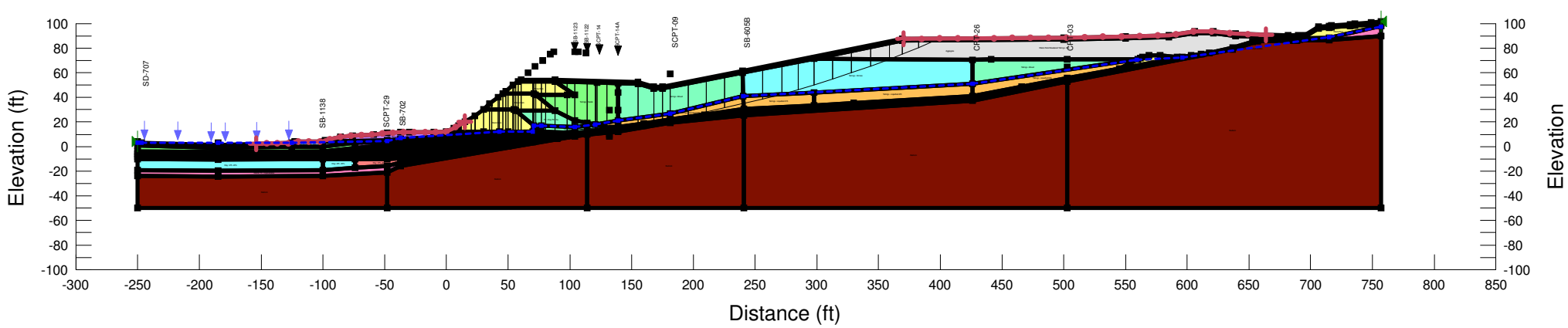
Name: Waste Rock Model: Mohr-Coulomb Unit Weight: 120 pcf Cohesion': 0 psf Phi': 42 ° Constant Unit Wt. Above Water Table: 95 pcf Piezometric Line: 1
Name: Tailings - Sands Model: Mohr-Coulomb Unit Weight: 120 pcf Cohesion': 0 psf Phi': 37 ° Constant Unit Wt. Above Water Table: 110 pcf Piezometric Line: 1
Name: Tailings - Mixed Model: Mohr-Coulomb Unit Weight: 117 pcf Cohesion': 0 psf Phi': 36 ° Constant Unit Wt. Above Water Table: 108 pcf Piezometric Line: 1
Name: Tailings - Slimes Model: Mohr-Coulomb Unit Weight: 114 pcf Cohesion': 0 psf Phi': 35 ° Constant Unit Wt. Above Water Table: 106 pcf Piezometric Line: 1
Name: Fill - Clay/Till - Su Model: Undrained (Phi=0) Unit Weight: 125 pcf Cohesion': 2,000 psf Constant Unit Wt. Above Water Table: 120 pcf Piezometric Line: 1
Name: Waste Rock/Dewatered Tailings - Mix Model: Mohr-Coulomb Unit Weight: 125 pcf Cohesion': 0 psf Phi': 38 ° Constant Unit Wt. Above Water Table: 115 pcf Piezometric Line: 1
Name: Bedrock Model: Bedrock (Impenetrable) Piezometric Line: 1
Name: Clay - 1425 psf Model: Undrained (Phi=0) Unit Weight: 123 pcf Cohesion': 1,425 psf Piezometric Line: 1
Name: Glacial Till - Impenetrable Model: Bedrock (Impenetrable) Piezometric Line: 1
Name: Aggregate Model: Mohr-Coulomb Unit Weight: 100 pcf Cohesion': 0 psf Phi': 41 ° Piezometric Line: 1
Name: Salt Marsh: 375 - 20% Model: Undrained (Phi=0) Unit Weight: 110 pcf Cohesion': 300 psf Constant Unit Wt. Above Water Table: 105 pcf Piezometric Line: 1
Name: Clay: 750 - 20% Model: Undrained (Phi=0) Unit Weight: 121 pcf Cohesion': 600 psf Piezometric Line: 1
Name: Clay: 625 - 20% Model: Undrained (Phi=0) Unit Weight: 121 pcf Cohesion': 500 psf Piezometric Line: 1
Name: Clay: 475 - 20% Model: Undrained (Phi=0) Unit Weight: 118 pcf Cohesion': 380 psf Piezometric Line: 1
Name: Salt Marsh: 625 - 20% Model: Undrained (Phi=0) Unit Weight: 115 pcf Cohesion': 500 psf Constant Unit Wt. Above Water Table: 85 pcf Piezometric Line: 1
Name: Tailings - Liquefied 215 Model: Mohr-Coulomb Unit Weight: 120 pcf Cohesion': 215 psf Phi': 0 ° Constant Unit Wt. Above Water Table: 110 pcf Piezometric Line: 1
Name: Clay - Impenetrable Model: Bedrock (Impenetrable) Piezometric Line: 1

F of S: 1.75



Name: Waste Rock Model: Mohr-Coulomb Unit Weight: 120 pcf Cohesion': 0 psf Phi': 42 ° Constant Unit Wt. Above Water Table: 95 pcf Piezometric Line: 1
Name: Tailings - Sands Model: Mohr-Coulomb Unit Weight: 120 pcf Cohesion': 0 psf Phi': 37 ° Constant Unit Wt. Above Water Table: 110 pcf Piezometric Line: 1
Name: Tailings - Mixed Model: Mohr-Coulomb Unit Weight: 117 pcf Cohesion': 0 psf Phi': 36 ° Constant Unit Wt. Above Water Table: 108 pcf Piezometric Line: 1
Name: Tailings - Slimes Model: Mohr-Coulomb Unit Weight: 114 pcf Cohesion': 0 psf Phi': 35 ° Constant Unit Wt. Above Water Table: 106 pcf Piezometric Line: 1
Name: Fill - Rock/Sand/Fines Mix Model: Mohr-Coulomb Unit Weight: 130 pcf Cohesion': 25 psf Phi': 36 ° Constant Unit Wt. Above Water Table: 125 pcf Piezometric Line: 1
Name: Clay - 2750 psf Model: Undrained (Phi=0) Unit Weight: 125 pcf Cohesion': 2,750 psf Piezometric Line: 1
Name: Clay - 2250 psf Model: Undrained (Phi=0) Unit Weight: 125 pcf Cohesion': 2,250 psf Piezometric Line: 1
Name: Clay - 1750 psf Model: Undrained (Phi=0) Unit Weight: 123 pcf Cohesion': 1,750 psf Piezometric Line: 1
Name: Clay - 1500 psf Model: Undrained (Phi=0) Unit Weight: 123 pcf Cohesion': 1,500 psf Piezometric Line: 1
Name: Clay - 1250 psf Model: Undrained (Phi=0) Unit Weight: 123 pcf Cohesion': 1,250 psf Piezometric Line: 1
Name: Fill - Clay/Till - Su Model: Undrained (Phi=0) Unit Weight: 125 pcf Cohesion': 2,000 psf Constant Unit Wt. Above Water Table: 120 pcf Piezometric Line: 1
Name: Waste Rock/Dewatered Tailings - Mix Model: Mohr-Coulomb Unit Weight: 125 pcf Cohesion': 0 psf Phi': 38 ° Constant Unit Wt. Above Water Table: 115 pcf Piezometric Line: 1
Name: Bedrock Model: Bedrock (Impenetrable) Piezometric Line: 1
Name: Clay - 1350 psf Model: Undrained (Phi=0) Unit Weight: 123 pcf Cohesion': 1,350 psf Piezometric Line: 1
Name: Clay - 1425 psf Model: Undrained (Phi=0) Unit Weight: 123 pcf Cohesion': 1,425 psf Piezometric Line: 1
Name: Glacial Till - Impenetrable Model: Bedrock (Impenetrable) Piezometric Line: 1
Name: Aggregate Model: Mohr-Coulomb Unit Weight: 100 pcf Cohesion': 0 psf Phi': 41 ° Piezometric Line: 1
Name: Salt Marsh: 375 - 20% Model: Undrained (Phi=0) Unit Weight: 110 pcf Cohesion': 300 psf Constant Unit Wt. Above Water Table: 105 pcf Piezometric Line: 1
Name: Clay: 750 - 20% Model: Undrained (Phi=0) Unit Weight: 121 pcf Cohesion': 600 psf Piezometric Line: 1
Name: Salt Marsh: 800 - 20% Model: Undrained (Phi=0) Unit Weight: 115 pcf Cohesion': 640 psf Constant Unit Wt. Above Water Table: 85 pcf Piezometric Line: 1
Name: Clay: 625 - 20% Model: Undrained (Phi=0) Unit Weight: 121 pcf Cohesion': 500 psf Piezometric Line: 1
Name: Clay: 475 - 20% Model: Undrained (Phi=0) Unit Weight: 118 pcf Cohesion': 380 psf Piezometric Line: 1
Name: Salt Marsh: 625 - 20% Model: Undrained (Phi=0) Unit Weight: 115 pcf Cohesion': 500 psf Constant Unit Wt. Above Water Table: 85 pcf Piezometric Line: 1
Name: Salt Marsh: 1000 - 20% Model: Undrained (Phi=0) Unit Weight: 120 pcf Cohesion': 800 psf Constant Unit Wt. Above Water Table: 115 pcf Piezometric Line: 1
Name: Clay: 875 - 20% Model: Undrained (Phi=0) Unit Weight: 121 pcf Cohesion': 700 psf Piezometric Line: 1
Name: Clay: 375 - 20% Model: Undrained (Phi=0) Unit Weight: 118 pcf Cohesion': 300 psf Piezometric Line: 1
Name: Clay: 450 - 20% Model: Undrained (Phi=0) Unit Weight: 120 pcf Cohesion': 360 psf Piezometric Line: 1
Name: Clay: 400 - 20% Model: Undrained (Phi=0) Unit Weight: 120 pcf Cohesion': 320 psf Piezometric Line: 1
Name: Clay: 550 - 20% Model: Undrained (Phi=0) Unit Weight: 120 pcf Cohesion': 440 psf Piezometric Line: 1
Name: Clay: 800 - 20% Model: Undrained (Phi=0) Unit Weight: 121 pcf Cohesion': 640 psf Piezometric Line: 1
Name: Clay: 925 - 20% Model: Undrained (Phi=0) Unit Weight: 120 pcf Cohesion': 740 psf Piezometric Line: 1
Name: Clay: 700 - 20% Model: Undrained (Phi=0) Unit Weight: 120 pcf Cohesion': 560 psf Piezometric Line: 1
Name: Clay: 1075 - 20% Model: Undrained (Phi=0) Unit Weight: 122 pcf Cohesion': 860 psf Piezometric Line: 1
Name: Clay: 1250 - 20% Model: Undrained (Phi=0) Unit Weight: 123 pcf Cohesion': 1,000 psf Piezometric Line: 1
Name: Clay: 1350 - 20% Model: Undrained (Phi=0) Unit Weight: 123 pcf Cohesion': 1,080 psf Piezometric Line: 1
Name: Tailings - Liquefied 215 Model: Mohr-Coulomb Unit Weight: 120 pcf Cohesion': 215 psf Phi': 0 ° Constant Unit Wt. Above Water Table: 110 pcf Piezometric Line: 1

Title: Callahan Mine OU3 - Profile E3
Date: 11/3/2014
File Name: Tailings_Profile-E3_Doomsday_90%.gsz

Name: Profile E-3; c1 - Doomsday - Fill/Toe - 215 psf
Method: Spencer

F of S: 1.97