AMEC Design Calculation or Analysis Cover Sheet

Project: PSEG RAI Support	Calc/Analysis No. Calc 360-RAI-061-10	AMEC Project No. 6468-11-0360
Title: Updated SPT-based Liquefaction Screening Based on GMRS from NUREG-2115 (CEUS SSC) Site Seismicity Analysis	Client Contract Purchase Order	Sheet No. 1 of 13
	Discipline Geotechnical	
Computer Program None (Excel)	Version / Release No. N/A	
Purpose and Objective Previous Standard Penetration Test (SPT) liquefaction screening was performed based on the Ground Motion Response Spectrum (GMRS) developed from an EPRI-SOG seismicity analysis. The purpose of this calculation is to perform SPT liquefaction screening using the CEUS Seismic Source Characterization model.	**Quality Assurance Conditions (e.g. safety classification)** Safety-related	

Summary of Conclusion:
The factors of safety against liquefaction were computed for 257 SPT N-values. Seventeen of the safety factors were less than or equal to 1.1, 15 of the safety factors were greater than 1.1 and less than 1.4, and 225 of the safety factors were greater than or equal to 1.4. Fifteen of the 17 safety factors less than or equal to 1.1 and 13 of the 15 safety factors greater than 1.1 and less than 1.4 occur within the upper portion of the Vincentown Formation.

JAT 1/9/13

Revision Log

Rev. No.	Revision Description
0	Initial issue.
1	Issued to address S&L comments and revise safety factor ranges (FS≤1.1, 1.1<FS<1.4, FS≥1.4).
2	Issued to fix text wording relative to figure contents

Sign Off

Rev. No.	Originator (Print) Sign / Date	Verification Method	Verifier (Print) Sign / Date	Technical Lead (Print) Sign / Date
0	James E. Veith	Review calculations, text, tables and figures.	J. Allan Tice 1/4/13	J. Allan Tice 1/4/13
1	James E. Veith 1/4/13	Review calculations, text, tables and figures.	J. Allan Tice 1/4/13	J. Allan Tice 1/4/13
2	James E Veith 1/9/13	Review text changes JAT 1/9/13	J. Allan Tice 1/9/13	J Allan Tice 1/9/13

Additional Reviewer (Print)	Signature	Date

QAF 3-01A (Rev. 1)

AMEC DESIGN VERIFICATION CHECKLIST

(Excerpted from ANSI N.45.11 [1974 Edition] and ASME NQA-1 [1994 Edition]

Project: PSEG RAI Support	AMEC Project No. 6468-11-0360	Calculation No. 360-RAI-061-10	Rev. No. 2 Page 2 of 13 JAV 1/9/13

Yes	No	N/A	Design Verification Element Note: Any items checked "No" automatically imply the design is not verified.
X			Is the person performing the design verification qualified to originate the document?
X			Is the design verification being performed by someone other than the supervisor of the originator?
X			Were the design inputs correctly selected and incorporated into design?
X			Are assumptions necessary to perform the design activity adequately described and reasonable? Where necessary, are assumptions identified for subsequent re-verifications when the detailed design activities are completed?
X			Are the appropriate quality and quality assurance requirements specified?
X			Are the applicable codes, standards and regulatory requirements including issue and addenda properly identified, and their requirements for design met?
		X	Have applicable construction and operating experiences been considered?
X			Have the design interface requirements been satisfied?
X			Were appropriate design methods and computer programs used?
X			Is the design output reasonable compared to design inputs?
		X	Are the specified parts, equipment, and processes suitable for the required application?
		X	Are the specified materials compatible with each other and the design environmental conditions to which the material will be exposed?
		X	Have adequate maintenance features and requirements been specified?
		X	Are accessibility and other design provisions adequate for performance of needed maintenance and repair?
		X	Have adequate accessibility been provided to perform the in-service inspection expected to be required during the plant life?
		X	Has the design properly considered radiation exposure to the public and plant personnel?
X			Are the acceptance criteria incorporated in the design documents sufficient to allow verification that design requirements have been satisfactorily accomplished?
		X	Have adequate pre-operational and subsequent periodic test requirements been appropriately specified?
		X	Have adequate handling, storage, cleaning, and shipping requirements been specified?
		X	Are adequate identification requirements specified?
		X	Are requirements for record preparation review, acceptance, retention, etc., adequately specified?

Design Verifier: J. Allan Tice Signature: J Allan Tice Date: 1/9/13

Approved by: J. Allan Tice Signature: J Allan Tice Date: 1/9/13

S&L Technical Review

David E. Nochem 1/10/13

1.0 Purpose and Scope

Liquefaction screening using the Standard Penetration Test (SPT) methodology was performed in Calculation 2251-ESP-GT-008, Rev 5 (Project Reference 1) based on the Ground Motion Response Spectrum (GMRS) developed from an EPRI-SOG PSHA seismicity analysis. The GMRS presented in Subsection 2.5.2.6 of the Site Safety Analysis Report (SSAR) had a ground surface acceleration value at 100 Hz (a_{max}) of 0.18g (Existing Reference 1). In RAI 61 (Existing Reference 2), the NRC required the site seismicity be re-evaluated using the CEUS Seismic Source Characterization model of NUREG-2115. The resulting GMRS, developed in Calculation 360-RAI-061-008 (Project Reference 4), has a ground surface acceleration of 0.225g at 100 Hz. The controlling earthquake used in Calculation 2251-ESP-GT-008 was 6.0. The controlling earthquake determined in the CEUS Seismic Source Characterization model is also 6.0.

In Calculation 2251-ESP-GT-008, Rev 5 (Project Reference 1), the SPT-based liquefaction screening safety factors were computed using an upper bound Magnitude Scaling Factor (MSF). In the response to RAI 30 (Existing Reference 3), the effect on factor of safety from using a lower bound MSF was evaluated. Calculation 360-RAI-030-001, Rev 3 (Project Reference 2) showed that use of the lower bound MSF produces lower factors of safety than does the upper bound MSF.

The purpose of this calculation is to re-evaluate the SPT-based liquefaction screening using the current GMRS ground surface acceleration value of 0.225g, the earthquake magnitude, Mw, of 6.0 and the lower bound MSF. The resulting safety factors are then summarized with respect to the geologic formations at the PSEG Site.

This calculation was prepared under Work Instruction No. 123 and in accordance with the AMEC Quality Assurance Project Document (Project Reference 5). Revision 1 was issued to address editorial comments from S&L and to modify ranges of safety factors in summary table 360-RAI-061-10-3. Revision 2 removes references to the upper portion of the Vincentown Formation.

2.0 Summary of Results and Conclusions

The factors of safety against liquefaction were computed for 257 SPT N-values obtained in the eight borings performed on the PSEG Site for the ESPA. The calculations using the higher acceleration value from the GMRS based on the CEUS SSC result in an increase in the number of factors of safety that are less than 1.4. Regulatory Guide 1.198 states that, in general, a liquefaction safety factor less than or equal to 1.1 is generally considered a trigger value, that factors of safety between 1.1 and 1.4 are considered intermediate and that factors of safety greater than or equal to 1.4 are considered high. Seventeen of the safety factors were less than or equal to 1.1, 15 of the safety factors were greater than 1.1 and less than 1.4, and 225 of the safety factors were greater than or equal to 1.4.

The maximum, minimum, average, and distribution of safety factors against liquefaction for each geologic formation are summarized in Table 360-RAI-061-10-4. Fifteen of the 17 safety factors

less than or equal to 1.1 and 13 of the 15 safety factors greater than 1.1 and less than 1.4 occur within the Vincentown Formation. The location and elevation of the safety factors less than or equal to 1.1 and those greater than 1.1 but less than 1.4 in the Vincentown Formation are shown on Figures 360-RAI-061-10-2 and 360-RAI-061-10-3. The potentially liquefiable soils in the Vincentown Formation appear to be isolated zones surrounded by denser materials, not a continuous layer.

3.0 References

3.1 Existing References

1. PSEG Power, LLC, PSEG Site ESP Application Site Safety Analysis Report, Part 2, May 25, 2010.

2. US Nuclear Regulatory Commission, RAI No. 61. SRP Section: 02.05.02 – Vibratory Ground Motion, dated June 7, 2012 (eRAI 6488).

3. PSEG Power, LLC, Letter ND-11-066, Response to Request for Additional Information, RAI No. 30, SRP Section: 02.05.04 – Stability of Subsurface Materials and Foundations, June 28, 2011.

3.2 Project References

1. MACTEC Calculation 2251-ESP-GT-008, Potential Liquefaction Evaluation, Rev 5, August 25, 2011.

2. MACTEC Calculation 360-RAI-030-001, Liquefaction Safety Factor Calculation Using Lower Bound Magnitude Scaling Factor, Rev 3, September 9, 2011.

3. AMEC Calculation 0360-RAI-061-3, Deaggregaton of 10^{-4}, 10^{-5} and 10^{-6} Base Rock Hazard (no CAV) for the PSEG Site, Rev 0, November 7, 2012.

4. AMEC Calculation 0360-RAI-061-8, Smooth Horizontal GMRS for the PSEG Site, Rev. 0, November 27, 2012.

5. AMEC Quality Assurance Project Document (QAPD) for PSEG ESPA Phase 2, Rev 2, March 28, 2012, Nuclear Quality Assurance Procedure (NQAP) 3-01, Rev 1, April, 2012.

4.0 Assumptions

There are no assumptions in this calculation which need to be validated. This calculation uses industry standard methodology and the computational software product Microsoft Excel®. No specialized geotechnical analysis tools are used in this calculation.

5.0 Design Inputs

The GMRS based on use of the NUREG-2115 CEUS Seismic Source Characterization model was developed in Calculation 0360-RAI-061-8 (Project Reference 4). That calculation produced a site-specific GMRS having a ground surface acceleration at the top of the competent layer (elevation -67 ft. North American Vertical Datum, 1988) of 0.225g at 100 Hz. Figure 360-RAI-061-10-1 is a reproduction of Figure 2 of that calculation showing the GMRS. Table 360-RAI-061-10-1 is a reproduction of Table 2 of that calculation showing the amplitudes of the GMRS at varying frequencies.

In Calculation 0360-RAI-061-3 (Project Reference 3), the high frequency controlling earthquake magnitude, Mw, considering all distances R is 5.9 for an Annual Frequency of Exceedance of $1x10^{-4}$ and 6.0 for an Annual Frequency of Exceedance $1x10^{-5}$. Table 360-RAI-061-10-2 is a reproduction of Table 9 of that calculation showing the controlling earthquakes magnitudes, Mw, for the PSEG Site. As noted in RG 1.208, the GMRS is calculated using only Annual Frequencies of Exceedance of $1x10^{-4}$ and $1x10^{-5}$.

In Calculation 2251-ESP-GT-008 (Project Reference 1), Excel® spreadsheets were developed for evaluating liquefaction safety factors for each SPT N-Value below elevation -67 ft measured in borings NB-1 through NB-8. For that calculation, values of ground surface acceleration (a_{max}) of 0.18g and earthquake magnitude (M_W) of 6.0 were used. For this calculation, the spread sheets were revised using a ground surface acceleration value of 0.225g. The earthquake magnitude value was not changed from 6.0.

The safety factors against liquefaction determined in Calculation 2251-ESP-GT-008 (Project Reference 1) were computed using an upper bound Magnitude Scaling Factor (MSF) value. In Calculation 360-RAI-030-001 (Project Reference 2) it was determined that using a lower bound MSF value produced lower safety factors against liquefaction. The safety factors against liquefaction (based on the lower bound MSF value) from Calculation 360-RAI-030-001 were used in this current calculation.

6.0 Methodology

Using the individual spreadsheets developed for borings NB-1 through NB-8 from Calculation 2251-ESP-GT-008 (Project Reference 1), the safety factors against liquefaction were calculated using an a_{max} value of 0.225 and an M_W value of 6.0 for each SPT value measured in the borings. These safety factors were calculated for an upper bound MSF. Individual spreadsheets for each boring are included in Appendix 360-RAI-061-10-A.

In Calculation 360-RAI-030-001 (Project Reference 2) it was determined that using a lower bound MSF value produced lower safety factors against liquefaction. Thus the safety factor against liquefaction for the lower bound MSF was then computed by applying the ratio of the upper bound to lower bound MSF that was determined in Calculation 360-RAI-030-001. The calculated safety factors against liquefaction for the upper bound MSF and lower bound MSF are shown on Table

360-RAI-061-10-3. The safety factors less than or equal to 1.1, and those greater than 1.1 and less than 1.4 are highlighted. At the bottom of the table, the number of safety factors falling within the designated ranges is shown for the upper and lower bound MSFs.

On the spreadsheets for borings NB-1 through NB-8 included in Appendix 360-RAI-061-10-A, the geologic formation for each SPT N-value is shown. The maximum, minimum, average, and distribution of safety factors against liquefaction for each geologic formation are summarized in Table 360-RAI-061-10-4. Fifteen of the 17 safety factors less than or equal to 1.1, and 13 of the 15 safety factors greater than 1.1 and less than 1.4 occur within the Vincentown Formation. The location and elevation of the safety factors less than or equal to 1.1 and those greater than 1.1 but less than 1.4 in the Vincentown Formation are shown on Figures 360-RAI-061-10-2 and 360-RAI-061-10-3.

7.0 Computer Programs

The only computer program used for this calculation was Microsoft Excel®. This program is considered standard commercial software and a specific Software Validation and Verification is not required.

8.0 Calculations

The spreadsheets developed for Calculation 2251-ESP-GT-008 (Project Reference 1) and Calculation 360-RAI-030-001 (Project Reference 2) were revised using the results of the site seismicity evaluation presented in Calculation 0360-RAI-061-3 (Project Reference 3) and Calculation 0360-RAI-061-8. (Project Reference 4). The results are shown on Table 360-RAI-061-10-3 and Table 360-RAI-060-10-4.

9.0 Appendices

Appendix 360-RAI-061-10-A contains spreadsheets for calculation of safety factors against liquefaction for borings NB-1 through NB-8.

Table 360-RAI-061-10-1
Amplitudes for Horizontal GMRS from Calculation 360-RAI-061-8

Frequency (Hz)	Horizontal GMRS (g)
0.1	9.14E-03
0.125	1.49E-02
0.15	2.28E-02
0.2	4.04E-02
0.3	8.98E-02
0.4	1.42E-01
0.5	1.60E-01
0.6	1.54E-01
0.7	1.50E-01
0.8	1.53E-01
0.9	1.60E-01
1	1.72E-01
1.25	1.97E-01
1.5	2.20E-01
2	2.45E-01
2.5	2.59E-01
3	2.84E-01
4	4.17E-01
5	5.26E-01
6	5.67E-01
7	5.72E-01
8	5.59E-01
9	5.39E-01
10	5.23E-01
12.5	5.17E-01
15	5.11E-01
20	4.63E-01
25	4.13E-01
30	3.66E-01
35	3.32E-01
40	3.02E-01
45	2.81E-01
50	2.67E-01
60	2.45E-01
70	2.33E-01
80	2.28E-01
90	2.26E-01
100	2.25E-01

Table 360-RAI-061-10-2
Controlling Earthquakes from Calculation 360-RAI-061-3

Structural Frequency	Annual Frequency of Exceedence	All *R*		R < 100 km		*R* > 100 km	
		M	R, km	M	R, km	M	R, km
5 & 10 Hz	1.00E-04	5.9	27	5.8	22	6.7	180
1 & 2.5 Hz	1.00E-04	6.6	68	6.2	21	7.3	540
5 & 10 Hz	1.00E-05	6.0	12	6.0	12	7.1	144
1 & 2.5 Hz	1.00E-05	6.6	27	6.4	16	7.6	566
5 & 10 Hz	1.00E-06	6.3	9	6.3	9	7.5	130
1 & 2.5 Hz	1.00E-06	6.7	13	6.7	12	7.7	425

Note: Light-gray cells indicate HF controlling earthquakes and dark-gray cells indicate LF controlling earthquakes.

Table 360-RAI-061-10-3
Comparison of Liquefaction Safety Factors Using Upper and Lower Bound Magnitude Scaling Factors

Boring NB-1			Boring NB-2			Boring NB-3			Boring NB-4			Boring NB-5			Boring NB-6			Boring NB-7			Boring NB-8		
Elevation (feet)	Upper Bound Safety Factor [1]	Lower Bound Safety Factor [2]	Elevation (feet)	Upper Bound Safety Factor [1]	Lower Bound Safety Factor [2]	Elevation (feet)	Upper Bound Safety Factor [1]	Lower Bound Safety Factor [2]	Elevation (feet)	Upper Bound Safety Factor [1]	Lower Bound Safety Factor [2]	Elevation (feet)	Upper Bound Safety Factor [1]	Lower Bound Safety Factor [2]	Elevation (feet)	Upper Bound Safety Factor [1]	Lower Bound Safety Factor [2]	Elevation (feet)	Upper Bound Safety Factor [1]	Lower Bound Safety Factor [2]	Elevation (feet)	Upper Bound Safety Factor [1]	Lower Bound Safety Factor [2]
-68.2	1.8	1.6	-68.1	N/A	NA	-68.2	1.3	1.1	-69.5	2.5	2.1	-67.7	6.9	5.8	-69.6	1.4	1.2	-69.5	7.3	6.2	-66.6	1.7	1.4
-73.2	1.7	1.5	-72.8	6.8	5.8	-73.2	6.7	5.7	-72.0	1.5	1.3	-72.7	1.4	1.2	-74.3	1.7	1.4	-74.8	7.1	6.0	-71.6	7.0	5.9
-78.2	1.6	1.4	-77.8	1.6	1.3	-78.2	1.2	1.1	-74.5	6.8	5.8	-77.7	1.4	1.2	-81.3	1.4	1.2	-80.0	2.4	2.0	-76.6	6.7	5.7
-83.2	1.7	1.6	-82.9	1.0	0.8	-83.2	6.5	5.5	-77.0	6.8	5.8	-82.7	6.5	5.5	-85.5	8.7	7.4	-84.7	8.7	7.4	-80.9	9.4	8.0
-88.2	1.5	1.3	-87.9	6.5	5.5	-88.2	6.9	5.8	-79.5	1.5	1.3	-87.7	1.5	1.3	-91.3	2.7	1.9	-90.0	6.6	5.6	-86.6	8.4	7.1
-93.2	1.3	1.1	-92.8	1.5	1.3	-93.2	1.5	1.3	-82.0	1.2	1.0	-92.7	7.6	6.4	-96.3	1.5	1.3	-94.8	1.7	1.4	-91.6	2.3	1.9
-98.2	1.6	1.4	-97.8	1.9	1.6	-98.2	8.3	7.0	-84.5	8.9	7.5	-97.7	6.7	5.7	-101.3	6.4	5.4	-99.9	6.6	5.6	-96.6	7.4	6.3
-103.2	1.4	1.2	-102.8	1.8	1.5	-102.5	8.5	7.2	-87.0	1.3	1.1	-102.7	2.0	1.7	-105.5	8.4	7.1	-104.9	6.6	5.6	-100.7	8.8	7.5
-107.9	8.5	7.2	-107.8	5.3	4.5	-104.2	8.5	7.2	-89.5	1.0	0.8	-107.7	1.9	1.6	-111.3	7.0	5.9	-109.8	1.7	1.4	-106.6	11.8	10.0
-113.2	1.2	1.0	-112.8	1.4	1.2	-108.2	1.4	1.2	-92.0	0.9	0.8	-112.7	2.2	1.9	-116.3	7.6	6.4	-114.8	7.3	6.2	-111.6	7.1	6.0
-118.2	1.6	1.4	-117.8	2.2	1.9	-113.2	7.1	6.0	-97.0	1.2	1.0	-117.7	7.2	6.1	-121.3	7.4	6.3	-119.8	1.6	1.4	-116.6	2.7	2.3
-123.2	2.0	1.7	-122.7	7.5	6.4	-118.2	1.8	1.5	-99.5	8.5	7.2	-122.7	1.8	1.5	-126.3	8.8	7.5	-124.8	1.7	1.4	-121.6	2.0	1.7
-128.2	7.7	6.5	-127.7	8.6	7.3	-123.2	7.4	6.3	-102.0	6.7	5.7	-127.7	8.3	7.0	-131.3	8.3	7.0	-129.8	2.7	2.3	-126.6	8.4	7.1
-133.2	9.0	7.6	-132.8	8.4	7.1	-128.2	8.3	7.0	-104.5	1.5	1.3	-132.7	9.3	7.9	-136.3	8.4	7.1	-134.8	10.1	8.6	-131.6	8.2	7.0
-138.2	3.3	2.8	-137.8	9.0	7.6	-133.2	9.2	7.8	-106.2	8.6	7.3	-137.7	8.8	7.5	-141.3	9.4	8.0	-139.8	9.5	8.1	-136.6	8.6	7.3
-143.2	9.3	7.9	-142.7	9.5	8.1	-138.2	25.3	21.4	-109.5	1.3	1.1	-142.7	10.8	9.2	-146.3	9.6	8.1	-144.8	9.8	8.3	-141.6	9.6	8.1
-148.2	9.9	8.4	-147.1	10.9	9.2	-143.2	10.3	8.7	-111.2	8.8	7.5	-147.7	10.0	8.5	-151.0	11.0	9.3	-149.9	10.0	8.5	-146.6	10.4	8.8
-153.2	10.5	8.9	-151.8	10.9	9.2	-148.2	10.1	8.6	-114.5	1.7	1.4	-152.6	11.2	9.5	-155.4	11.1	9.4	-154.7	10.8	9.2	-151.6	10.1	8.6
-157.4	10.9	9.2	-157.0	11.0	9.3	-153.1	11.1	9.4	-117.0	2.1	1.8	-156.8	11.1	9.4	-160.4	11.2	9.5	-159.4	11.0	9.3	-156.6	10.5	8.9
-162.4	11.0	9.3	-162.0	11.1	9.4	-157.4	10.8	9.2	-119.5	2.3	1.9	-161.8	11.2	9.5	-166.2	11.5	9.7	-164.0	11.2	9.5	-161.5	NL	NL
-167.4	11.2	9.5	-167.8	11.2	9.5	-162.3	10.9	9.2	-121.6	9.6	8.1	-166.9	11.4	9.7	-171.3	10.7	9.1	-169.1	11.2	9.5	-165.7	11.7	9.9
-173.2	9.8	8.3	-172.8	9.6	8.1	-167.4	11.0	9.3	-124.5	3.0	2.5	-172.7	10.4	8.8	-176.3	9.9	8.4	-174.5	11.0	9.3	-170.8	11.5	9.7
-178.2	9.5	8.1	-177.8	9.6	8.1	-173.2	10.8	9.2	-127.0	7.7	6.5	-177.7	9.6	8.1	-181.3	9.9	8.4	-179.8	10.0	8.5	-176.2	11.2	9.5
-183.2	9.2	7.8	-182.6	11.0	9.3	-178.2	9.8	8.3	-129.5	7.9	6.7	-182.7	9.4	8.0	-186.0	10.9	9.2	-184.4	9.9	8.4	-181.6	10.5	9.2
-188.0	10.6	9.0	-187.6	10.8	9.2	-183.2	9.5	8.1	-132.0	8.4	7.1	-187.4	10.8	9.2	-190.5	10.9	9.2	-189.7	10.7	9.1	-186.6	10.1	8.6
-197.8	10.4	8.8	-192.4	10.8	9.2	-187.9	10.4	8.8	-134.5	9.4	8.0	-192.0	10.9	9.2				-194.7	10.7	9.1	-191.6	10.6	9.0
-207.8	10.2	8.6	-202.5	10.4	8.8	-192.8	10.5	8.9	-137.0	9.3	7.9										-201.2	10.7	9.1
-217.9	10.1	8.6	-212.5	10.2	8.6				-139.5	9.4	8.0										-211.2	10.5	8.9
-228.2	9.9	8.4	-222.8	8.6	7.3				-142.0	9.0	7.6										-221.3	10.3	8.7
-238.2	1.7	1.4	-232.8	8.5	7.2				-144.5	9.7	8.2										-231.6	10.2	8.6
-248.2	12.5	10.6	-242.8	2.9	2.5				-147.0	10.3	8.7										-241.6	9.7	8.2
-258.2	NL	NL	-252.8	NL	NL				-149.5	9.8	8.3										-251.6	9.0	7.6
-268.2	8.0	6.8	-262.8	2.8	2.4				-152.0	10.5	8.9										-261.6	NL	NL
-278.2	1.8	1.5	-272.8	NL	NL				-154.5	11.0	9.3										-271.6	1.1	0.9
-288.2	8.8	7.5	-282.8	8.1	6.9				-156.7	NL	NL										-281.6	1.8	1.5
-298.2	2.6	2.2	-292.8	NL	NL				-159.1	11.3	9.6										-291.6	NL	NL
-308.1	NL	NL							-161.1	11.4	9.7												
-318.2	NL	NL							-163.7	11.5	9.7												
-328.2	NL	NL							-166.1	11.5	9.7												
-338.2	NL	NL							-168.8	11.5	9.7												
-348.2	NL	NL							-171.9	11.5	9.7												
-358.2	NL	NL							-174.5	10.2	8.6												
-368.2	NL	NL							-177.0	10.3	8.7												
-378.2	NL	NL							-179.5	10.1	8.6												
-388.2	NL	NL							-182.0	10.0	8.5												
-398.2	NL	NL							-184.5	9.5	8.1												
-407.9	NL	NL							-187.0	10.4	8.8												
-418.2	7.2	6.1							-189.4	11.0	9.3												
-427.9	7.9	6.7																					
-438.0	7.9	6.7																					
-457.5	NL	NL																					
-477.2	7.1	6.0																					
-496.9	7.1	6.0																					
-517.1	6.9	5.8																					
-587.9	NL	NL																					

[1] Upper Bound Safety Factor is calculated using the Upper Bound Magnitude Scaling Factor (2.088)

[2] Lower Bound Safety Factor is calculated using the Lower Bound Magnitude Scaling Factor (1.769)

N/A - not applicable (Kirkwood Formation material above the foundation bearing elevation)

NL - non-liquefiable silts and clays (USCS designations CL, CH, ML, MH, CL-ML, CH-MH)

	FS<=1.1	1.1<FS<1.4	1.4<=FS	Total Samples
With Upper Bound MSF	28	9	240	257
With Lower Bound MSF	17	15.0	225	257

Prepared by: James E. Veith, 1/4/13

Checked by: JGR 1/4/13

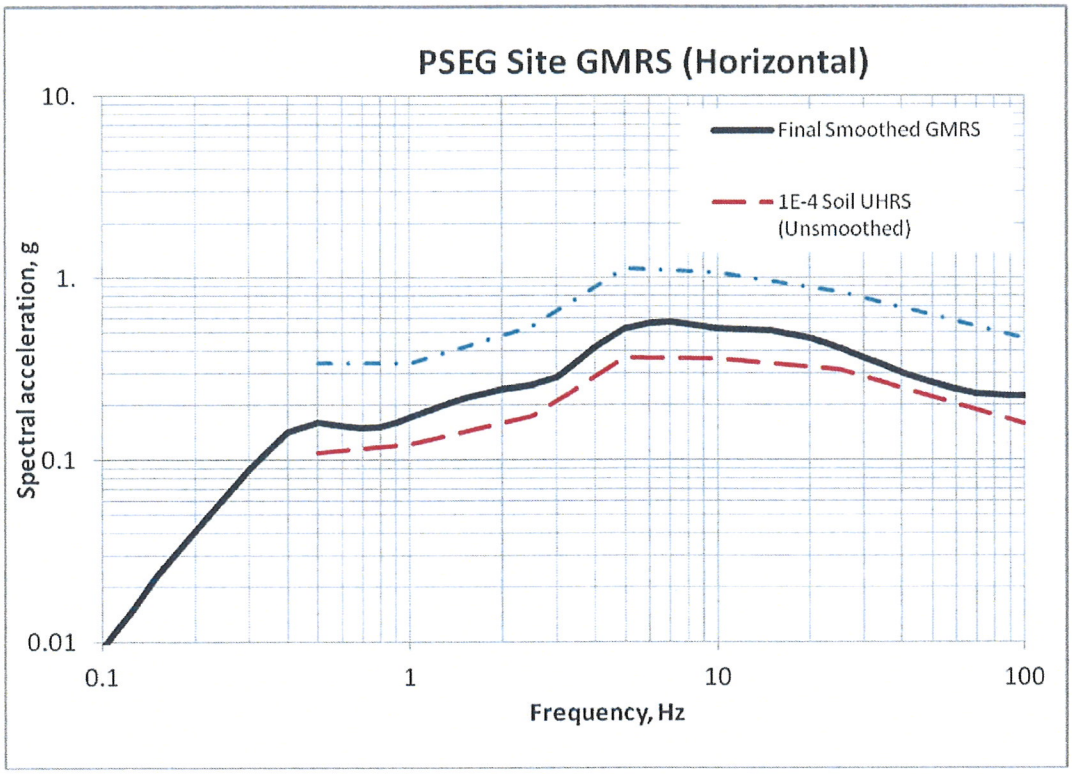
jav 1/9/13

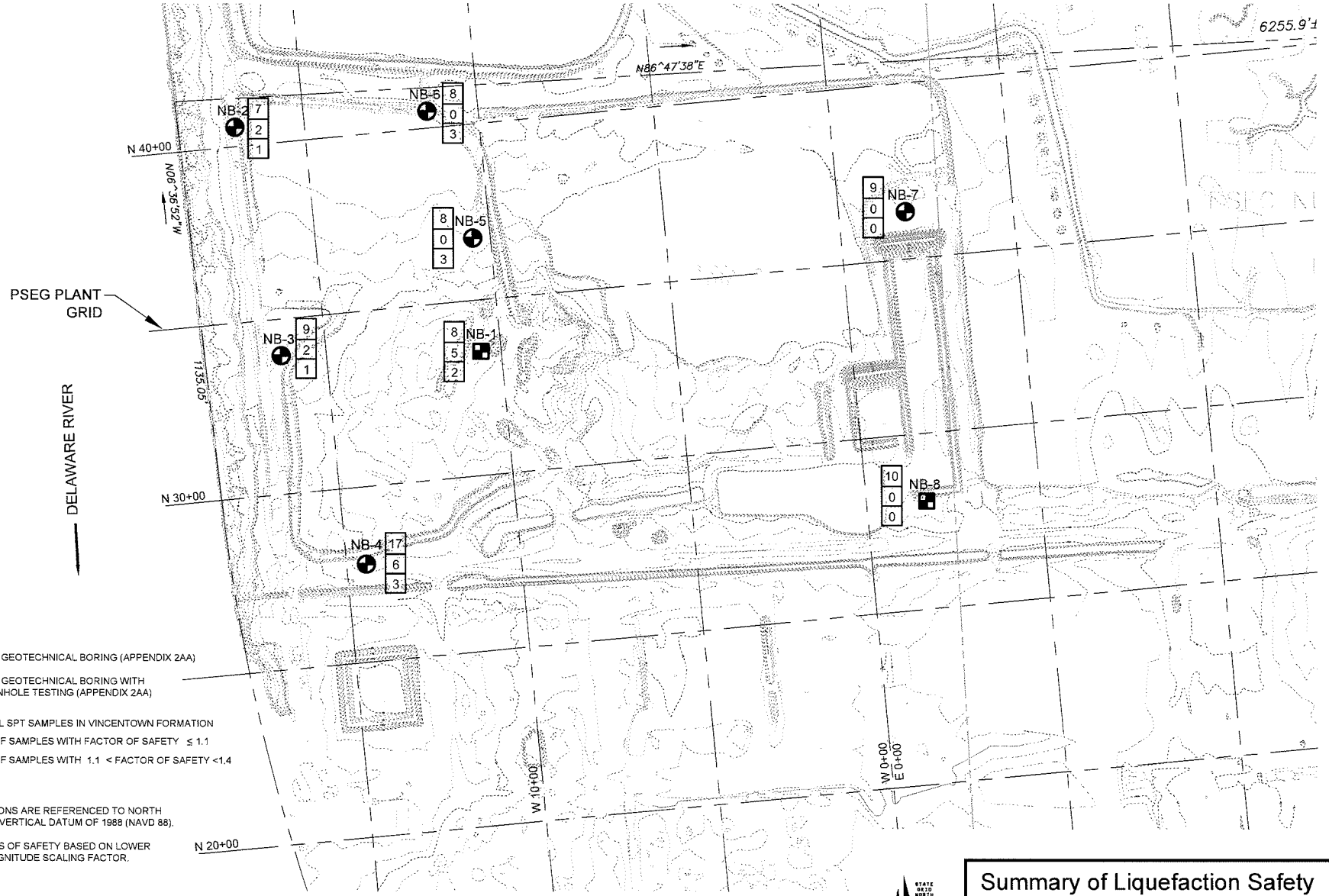
Table 360-RAI-061-10-4
Summary of Liquefaction Safety Factors (FS) for each Geologic Formation

Formation No.	Formation Name	Safety Factor [a], [b]			Distribution of Safety Factors		
		Minimum	Maximum	Average	FS<=1.1	1.1<FS<1.4	1.4>=FS
4	Vincentown	0.8	10.0	3.6	15	13	48
5	Hornerstown	1.0	8.1	3.7	1	2	30
6	Navesink	2.8	21.4	8.1	0	0	44
7	Mount Laurel	1.4	11.6	9.0	0	0	90
8	Wenonah	0.9	2.4	1.7	1	0	1
9	Mashalltown	1.5	7.5	4.5	0	0	5
10	Englishtown	2.6	2.6	3.2	0	0	1
11	Woodbury	NL	NL	NL	0	0	0
12	Merchantville	NL	NL	NL	0	0	0
13	Magothy	6.1	6.7	6.5	0	0	3
14	Potomac	5.8	6.0	6.0	0	0	3
				Total =	17	15	225

a) NL = Non-liquefiable silts and clays (USCS designations CL, CH, ML, MH, CL-ML, CH-MH).
b) Safety factors based on lower bound Magnitude Scaling Factor.

Figure 360-RAI-061-10-1
Horizontal GMRS from Calculation 360-RAI-061-8

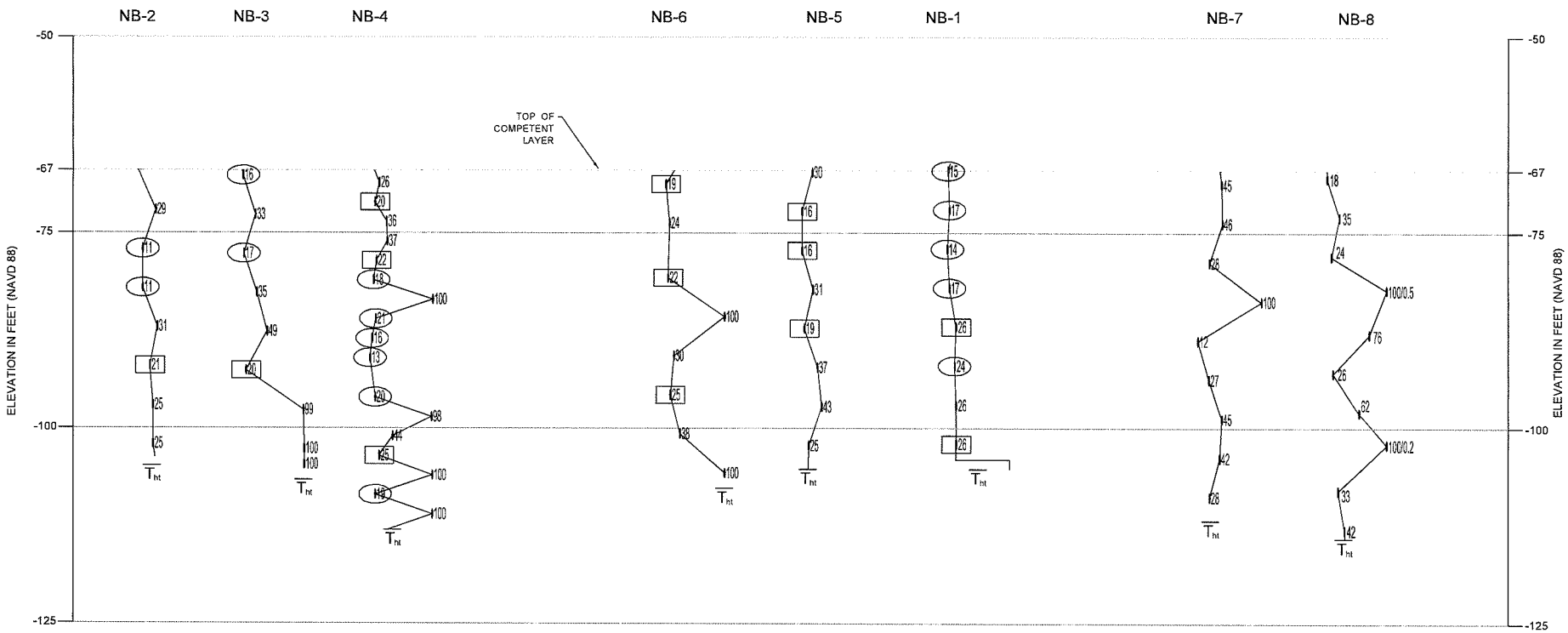




Summary of Liquefaction Safety Factors in Vincentown Formation Below Top of Competent Layer

FIGURE 360-RAI-061-10-2 Rev 1

Increased print resolution for Rev. 2 of Calc



LEGEND:

- SAMPLE WITH FACTOR OF SAFETY ≤ 1.1
- SAMPLE WITH 1.1 < FACTOR OF SAFETY <1.4
- 17 STANDARD PENETRATION TEST (SPT) N-VALUE
- $\overline{T}_{ht}$ TOP OF HORNERSTOWN FORMATION

NOTES:

1. MATERIALS ABOVE TOP OF COMPETENT LAYER WILL BE REMOVED.
2. FACTORS OF SAFETY BASED ON LOWER BOUND MAGNITUDE SCALING FACTOR.

VERTICAL SCALE - IN FEET

20 10 0 20 40

Vertical Distribution of Liquefaction Safety Factors (Vincentown Formation)

FIGURE 360-RAI-061-10-3

Increased print resolution for Rev 2 of Calc

Rev 1

APPENDIX 360-RAI-061-10-A
Liquefaction Potential Evaluation Spreadsheets Using Upper Bound Magnitude Scaling Factor For NB-1 through NB-8

Appendix contents unchanged from Rev. 0

LIQUEFACTION POTENTIAL EVALUATION

Boring **NB-1**

Project Name	PSEG Site ESP Application Project
Project No.	6468-11-0360
Location	Alloways Creek, NJ
Boring No.	NB-1
Depth to Groundwater at time of drilling (ft.)	12
Analysis Groundwater Depth (ft)	12
Ground Elev. (ft)	12.8
Earthquake Magnitude, M_w	6.0
maximum acceleration, a_{max} (g)	0.225

Imported from SPT N-Value Correction, Calculation 001, Rev1.
Input from boring records.
Input from laboratory test results.
Value estimated.

Input by James E. Veith Date 11/27/2012

Checked by MBR Date 12/6/2012

Note: Top of competent layer elevation at -67 ft. Samples above elevation -67 ft. not evaluated.

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
Sample Number	N-Value Depth (ft)	N-Value Elev. (ft)	Formation	N_m (bpf)	USCS	FC (%)	P_o (psf)	P_o' (psf)	$(N_1)_{60}$ (bpf)	Alpha	Beta	$(N_1)_{60CS}$ (bpf)	r_d	f_d	K_{sigma}	P_{atm}' (psf)	CSR	$CRR_{7.5}$	MSF	FS
20	81.0	-68.2	Vincentown	15	SM	15	8,881	4,576	13.7	2.50	1.05	16.9	0.997	0.725	0.81	4,576	0.283	0.180	2.088	1.1
21	86.0	-73.2	Vincentown	17	SM	15	9,484	4,866	15.0	2.50	1.05	18.2	0.986	0.712	0.79	4,866	0.281	0.194	2.088	1.1
22	91.0	-78.2	Vincentown	14	SC-SM	15	10,059	5,129	11.9	2.50	1.05	15.0	0.974	0.746	0.80	5,129	0.279	0.160	2.088	1.0
23	96.0	-83.2	Vincentown	17	SC-SM	24	10,634	5,392	14.0	4.18	1.11	19.7	0.962	0.723	0.77	5,392	0.277	0.212	2.088	1.2
24	101.0	-88.2	Vincentown	26	SC-SM	15	11,209	5,655	20.7	2.50	1.05	24.2	0.951	0.662	0.72	5,655	0.276	0.277	2.088	1.5
25	106.0	-93.2	Vincentown	24	SC-SM	15	11,784	5,918	18.5	2.50	1.05	21.9	0.939	0.680	0.72	5,918	0.273	0.241	2.088	1.3
26	111.0	-98.2	Vincentown	26	SC-SM	23	12,359	6,181	19.4	4.06	1.10	25.4	0.920	0.672	0.70	6,181	0.269	0.300	2.088	1.6
27	116.0	-103.2	Vincentown	26	SC-SM	15	12,934	6,444	18.9	2.50	1.05	22.3	0.879	0.677	0.70	6,444	0.258	0.246	2.088	1.4
28	120.7	-107.9	Hornerstown	100	SM	22	13,486	6,703	70.5	3.93	1.09	81.0	0.841	0.600	0.63	6,703	0.247	1.595	2.088	8.5
29	126.0	-113.2	Hornerstown	18	SM	22	14,122	7,008	12.3	3.93	1.09	17.4	0.798	0.742	0.73	7,008	0.235	0.185	2.088	1.2
30	131.0	-118.2	Hornerstown	26	SM	22	14,722	7,296	17.2	3.93	1.09	22.8	0.757	0.690	0.68	7,296	0.223	0.254	2.088	1.6
31	136.0	-123.2	Hornerstown	31	SM	22	15,322	7,584	20.0	3.93	1.09	25.7	0.717	0.668	0.65	7,584	0.212	0.306	2.088	2.0
32	141.0	-128.2	Navesink	48	SC	16	15,940	7,890	30.0	2.77	1.05	34.4	0.676	0.600	0.59	7,890	0.200	1.250	2.088	7.7
33	146.0	-133.2	Navesink	78	SM	16	16,587	8,225	47.2	2.77	1.05	52.6	0.635	0.600	0.58	8,225	0.187	1.385	2.088	9.0
34	151.0	-138.2	Navesink	44	SC	16	17,235	8,561	25.8	2.77	1.05	30.0	0.595	0.621	0.59	8,561	0.175	0.468	2.088	3.3
35	156.0	-143.2	Navesink	65	SM	16	17,882	8,896	37.1	2.77	1.05	41.8	0.558	0.600	0.56	8,896	0.164	1.305	2.088	9.3
36	161.0	-148.2	Navesink	82	SM	16	18,542	9,244	45.9	2.77	1.05	51.2	0.546	0.600	0.55	9,244	0.160	1.374	2.088	9.9
37	166.0	-153.2	Mount Laurel	78	SC	35	19,200	9,590	43.7	4.98	1.20	57.3	0.534	0.600	0.55	9,590	0.156	1.420	2.088	10.5
38	170.2	-157.4	Mount Laurel	100	SC	22	19,750	9,878	56.0	3.93	1.09	65.1	0.524	0.600	0.54	9,878	0.153	1.477	2.088	10.9
39	175.2	-162.4	Mount Laurel	100	SC	22	20,405	10,221	56.0	3.93	1.09	65.1	0.511	0.600	0.53	10,221	0.149	1.477	2.088	11.0
40	180.2	-167.4	Mount Laurel	100	SC	22	21,060	10,564	56.0	3.93	1.09	65.1	0.500	0.600	0.53	10,564	0.146	1.477	2.088	11.2
41	186.0	-173.2	Mount Laurel	64	SC	22	21,820	10,962	35.8	3.93	1.09	43.1	0.500	0.600	0.52	10,962	0.146	1.314	2.088	9.8
42	191.0	-178.2	Mount Laurel	59	SC	22	22,475	11,305	33.0	3.93	1.09	40.0	0.500	0.600	0.51	11,305	0.145	1.292	2.088	9.5
43	196.0	-183.2	Mount Laurel	51	SC	22	23,130	11,648	28.6	3.93	1.09	35.1	0.500	0.600	0.51	11,648	0.145	1.255	2.088	9.2
44	200.8	-188.0	Mount Laurel	100	SM	22	23,758	11,977	56.0	3.93	1.09	65.1	0.500	0.600	0.50	11,977	0.145	1.477	2.088	10.6
45	210.6	-197.8	Mount Laurel	100	SP-SM	22	25,042	12,649	56.0	3.93	1.09	65.1	0.500	0.600	0.49	12,649	0.145	1.477	2.088	10.4
46	220.6	-207.8	Mount Laurel	100	SP-SM	22	26,352	13,335	56.0	3.93	1.09	65.1	0.500	0.600	0.48	13,335	0.145	1.477	2.088	10.2
47	230.7	-217.9	Mount Laurel	100	SP-SM	22	27,675	14,028	56.0	3.93	1.09	65.1	0.500	0.600	0.47	14,028	0.144	1.477	2.088	10.1
48	241.0	-228.2	Mount Laurel	100	SM	22	29,025	14,735	56.0	3.93	1.09	65.1	0.500	0.600	0.46	14,735	0.144	1.477	2.088	9.9
49	251.0	-238.2	Mount Laurel	23	SC	27	30,335	15,421	12.9	4.48	1.13	19.0	0.500	0.735	0.59	15,421	0.144	0.203	2.088	1.7
50	261.0	-248.2	Mount Laurel	49	SM	22	31,645	16,107	27.4	3.93	1.09	33.4	0.500	0.608	0.45	16,107	0.144	1.909	2.088	12.5
51	271.0	-258.2	Wenonah	26	CL	51														NL
52	281.0	-268.2	Mashalltown	62	SC	15	34,175	17,389	34.7	2.50	1.05	38.9	0.500	0.600	0.43	17,389	0.144	1.283	2.088	8.0
53	291.0	-278.2	Mashalltown	34	SM	15	35,425	18,015	19.0	2.50	1.05	22.5	0.500	0.675	0.50	18,015	0.144	0.249	2.088	1.8
54	301.0	-288.2	Mashalltown	100	SM	15	36,675	18,641	56.0	2.50	1.05	61.2	0.500	0.600	0.42	18,641	0.144	1.448	2.088	8.8
55	311.0	-298.2	Englishtown	34	SC	39	37,925	19,267	19.0	5.00	1.20	27.8	0.500	0.675	0.49	19,267	0.144	0.363	2.088	2.6
56	320.9	-308.1	Englishtown	100	CH															NL
57	331.0	-318.2	Englishtown	25	CH	92														NL
58	341.0	-328.2	Englishtown	46	CH															NL
59	351.0	-338.2	Woodbury	49	CH															NL
60	361.0	-348.2	Woodbury	27	CH															NL
61	371.0	-358.2	Woodbury	21	CH															NL
62	381.0	-368.2	Woodbury	19	CH	94														NL
63	391.0	-378.2	Merchantville	48	CL															NL
64	401.0	-388.2	Merchantville	52	CL															NL
65	411.0	-398.2	Merchantville	31	CL	63														NL
66	420.7	-407.9	Magothy	100	ML															NL
67	431.0	-418.2	Magothy	72	SC	39	52,925	26,779	40.3	5.00	1.20	53.4	0.500	0.600	0.36	26,779	0.145	1.391	2.088	7.2
68	440.7	-427.9	Magothy	100	SC	39	54,137	27,386	56.0	5.00	1.20	72.2	0.500	0.600	0.36	27,386	0.145	1.530	2.088	7.9
69	450.8	-438.0	Magothy	100	SM	39	55,400	28,018	56.0	5.00	1.20	72.2	0.500	0.600	0.36	28,018	0.145	1.530	2.088	7.9

File: NB-1 Liquefaction potential, UB MSFwide columns.xlsx

LIQUEFACTION POTENTIAL EVALUATION

Boring **NB-1**

Project Name	PSEG Site ESP Application Project
Project No.	6468-11-0360
Location	Alloways Creek, NJ
Boring No.	NB-1
Depth to Groundwater at time of drilling (ft.)	12
Analysis Groundwater Depth (ft)	12
Ground Elev. (ft)	12.8
Earthquake Magnitude, M_w	6.0
maximum acceleration, a_{max} (g)	0.225

Imported from SPT N-Value Correction, Calculation 001, Rev1.
Input from boring records.
Input from laboratory test results.
Value estimated.

Input by James E. Veith Date 11/27/2012

Checked by MBL Date 12/6/2012

Note: Top of competent layer elevation at -67 ft. Samples above elevation -67 ft. not evaluated.

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
70	470.3	-457.5	Potomac	80	CL	96										-				NL
71	490.0	-477.2	Potomac	100	SM	15	60,300	30,472	56.0	2.50	1.05	61.2	0.500	0.600	0.34	30,472	0.145	1.448	2.088	7.1
72	509.7	-496.9	Potomac	100	SM	15	62,762	31,706	56.0	2.50	1.05	61.2	0.500	0.600	0.34	31,706	0.145	1.448	2.088	7.1
73	529.9	-517.1	Potomac	100	SP-SM	15	65,287	32,970	56.0	2.50	1.05	61.2	0.500	0.600	0.33	32,970	0.145	1.448	2.088	6.9
74	600.7	-587.9	Potomac	100	CL															NL

NL - not liquefiable, silts and clays (USCS CL, CH, ML, MH, CL-ML, CH-MH)

Column No.	Description
1	SPT Sample number.
2	Depth to SPT N-value (ft).
3	Elevation of SPT N-value (ft).
4	Geologic Formation.
5	Field SPT N-value (blows per foot).
6	USCS designation, input for informational purposes only.
7	FC - fines content, percent passing the number 200 sieve.
8	P_0 - total overburden pressure at time of drilling (psf).
9	P_0' - effective overburden pressure based on groundwater level at time of drilling (psf).
10	$(N_1)_{60}$ - N-value of granular soils corrected for field procedures, and overburden pressure (blows per foot).
11	Alpha - correction factor based on for fines content.
12	Beta - correction factor based on fines content.
13	$(N_1)_{60CS}$ - $(N_1)_{60}$ of granular soils corrected for fines content (blows per foot).
14	r_d - stress reduction factor based on depth
15	f_d - function of site conditions used in calculating K_{sigma}
16	K_{sigma} - overburden correction factor
17	$P_{o(es)}'$ - effective overburden pressure at groundwater analysis depth (psf).
18	CSR - cyclic stress ratio
19	$CRR_{7.5}$ - cyclic resistance ratio for magnitude 7.5 earthquake
20	MSF - magnitude scaling factor. For Mw<7.5 MSF =$(Mw/7.5)^{-2.3}$, Mw>= 7.5 MSF = $10^{2.24/Mw^{2.56}}$
21	FS - Factor of Safety = ($CRR_{7.5}$ * K_{sigma} * MSF) / CSR

N1(60)	f_d
0	0.8
7.1	0.8
16	0.7
28.4	0.6
625	0.6

LIQUEFACTION POTENTIAL EVALUATION

Boring **NB-2**

Project Name	PSEG Site ESP Application Project
Project No.	6468-11-0360
Location	Alloways Creek, NJ
Boring No.	NB-2
Depth to Groundwater at time of drilling (ft.)	8.4
Analysis Groundwater Depth (ft)	8.4
Ground Elev. (ft)	8.2
Earthquake Magnitude, M_w	6.0
maximum acceleration, a_{max} (g)	0.225

Imported from SPT N-Value Correction, Calculation 001, Rev1.
Input from boring records.
Input from laboratory test results.
Value estimated.

Input by James E. Veith Date 11/27/2012

Checked by MBR Date 12/6/2012

Note: Top of competent layer elevation at -67 ft. Samples above elevation -67 ft. not evaluated.

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
Sample Number	N-Value Depth (ft)	N-Value Elev. (ft)	Formation	N_m (bpf)	USCS	FC (%)	P_o (psf)	P_o' (psf)	$(N_1)_{60}$ (bpf)	Alpha	Beta	$(N_1)_{60CS}$ (bpf)	r_d	Γ_d	K_{sigma}	P_{odes}' (psf)	CSR	$CRR_{7.5}$	MSF	FS
16	76.3	-68.1	Kirkwood	5	SM	Note: Materials above the Vincentown Formation will be removed.														
17	81.0	-72.8	Vincentown	29	SM	27	9,062	4,531	28.2	4.48	1.13	36.4	0.986	0.601	0.74	4,531	0.288	1.265	2.088	6.8
18	86.0	-77.8	Vincentown	11	SM	27	9,692	4,849	10.2	4.48	1.13	16.1	0.975	0.765	0.82	4,849	0.285	0.171	2.088	1.0
19	91.1	-82.9	Vincentown	11	SM	27	10,334	5,174	9.8	4.48	1.13	15.6	0.963	0.769	0.81	5,174	0.281	0.166	2.088	1.0
20	96.1	-87.9	Vincentown	31	SM	27	10,964	5,492	26.6	4.48	1.13	34.5	0.951	0.615	0.69	5,492	0.278	1.251	2.088	6.5
21	101.0	-92.8	Vincentown	21	SM	27	11,555	5,776	17.4	4.48	1.13	24.1	0.940	0.689	0.73	5,776	0.275	0.275	2.088	1.5
22	106.0	-97.8	Vincentown	25	SM	27	12,130	6,039	20.1	4.48	1.13	27.1	0.923	0.667	0.71	6,039	0.271	0.341	2.088	1.9
23	111.0	-102.8	Vincentown	25	SM	27	12,705	6,302	19.5	4.48	1.13	26.5	0.883	0.672	0.70	6,302	0.260	0.325	2.088	1.8
24	116.0	-107.8	Hornerstown	33	SM	27	13,292	6,578	24.9	4.48	1.13	32.6	0.842	0.628	0.66	6,578	0.249	0.951	2.088	5.3
25	121.0	-112.8	Hornerstown	24	SM	17	13,892	6,866	17.6	3.01	1.06	21.6	0.801	0.687	0.69	6,866	0.237	0.236	2.088	1.4
26	126.0	-117.8	Hornerstown	33	SM	17	14,492	7,154	23.4	3.01	1.06	27.9	0.761	0.640	0.65	7,154	0.225	0.366	2.088	2.2
27	130.9	-122.7	Navesink	49	SM	17	15,110	7,466	33.7	3.01	1.06	38.7	0.721	0.600	0.60	7,466	0.213	1.282	2.088	7.5
28	135.9	-127.7	Navesink	75	SM	17	15,770	7,814	49.9	3.01	1.06	55.9	0.680	0.600	0.59	7,814	0.201	1.409	2.088	8.6
29	141.0	-132.8	Navesink	56	SM	17	16,443	8,169	36.0	3.01	1.06	41.2	0.639	0.600	0.58	8,169	0.188	1.300	2.088	8.4
30	146.0	-137.8	Navesink	65	SM	17	17,103	8,517	40.5	3.01	1.06	45.9	0.598	0.600	0.57	8,517	0.176	1.335	2.088	9.0
31	150.9	-142.7	Navesink	67	SM	17	17,750	8,858	40.5	3.01	1.06	45.9	0.559	0.600	0.56	8,858	0.164	1.335	2.088	9.5
32	155.3	-147.1	Mount Laurel	100	SC-SM	20	18,328	9,162	59.1	3.61	1.08	67.4	0.549	0.600	0.56	9,162	0.161	1.494	2.088	10.9
33	160.0	-151.8	Mount Laurel	100	SC-SM	20	18,944	9,484	59.1	3.61	1.08	67.4	0.537	0.600	0.55	9,484	0.157	1.494	2.088	10.9
34	165.2	-157.0	Mount Laurel	100	SC-SM	20	19,625	9,841	59.1	3.61	1.08	67.4	0.525	0.600	0.54	9,841	0.153	1.494	2.088	11.0
35	170.2	-162.0	Mount Laurel	100	SC-SM	20	20,280	10,184	59.1	3.61	1.08	67.4	0.512	0.600	0.53	10,184	0.149	1.494	2.088	11.1
36	176.0	-167.8	Mount Laurel	93	SC-SM	20	21,040	10,582	55.0	3.61	1.08	63.0	0.500	0.600	0.53	10,582	0.145	1.462	2.088	11.2
37	181.0	-172.8	Mount Laurel	55	SC-SM	20	21,695	10,925	32.5	3.61	1.08	38.7	0.500	0.600	0.52	10,925	0.145	1.282	2.088	9.6
38	186.0	-177.8	Mount Laurel	59	SC-SM	20	22,350	11,268	34.9	3.61	1.08	41.3	0.500	0.600	0.51	11,268	0.145	1.301	2.088	9.6
39	190.8	-182.6	Mount Laurel	100	SM	20	22,979	11,597	59.1	3.61	1.08	67.4	0.500	0.600	0.51	11,597	0.145	1.494	2.088	11.0
40	195.8	-187.6	Mount Laurel	100	SM	20	23,634	11,940	59.1	3.61	1.08	67.4	0.500	0.600	0.50	11,940	0.145	1.494	2.088	10.8
41	200.6	-192.4	Mount Laurel	100	SM	20	24,262	12,269	59.1	3.61	1.08	67.4	0.500	0.600	0.50	12,269	0.145	1.494	2.088	10.8
42	210.7	-202.5	Mount Laurel	100	SM	20	25,586	12,962	59.1	3.61	1.08	67.4	0.500	0.600	0.48	12,962	0.144	1.494	2.088	10.4
43	220.7	-212.5	Mount Laurel	100	SM	20	26,896	13,648	59.1	3.61	1.08	67.4	0.500	0.600	0.47	13,648	0.144	1.494	2.088	10.2
44	231.0	-222.8	Mount Laurel	55	SM	20	28,245	14,355	32.5	3.61	1.08	38.7	0.500	0.600	0.46	14,355	0.144	1.282	2.088	8.6
45	241.0	-232.8	Mount Laurel	47	SM	20	29,555	15,041	27.8	3.61	1.08	37.0	0.500	0.605	0.46	15,041	0.144	1.269	2.088	8.5
46	251.0	-242.8	Mount Laurel	40	SM	20	30,865	15,727	23.6	3.61	1.08	29.1	0.500	0.638	0.48	15,727	0.144	0.415	2.088	2.9
47	261.0	-252.8	Wenonah	37	CL															NL
48	271.0	-262.8	Wenonah	40	SC-SM	20	33,395	17,009	23.6	3.61	1.08	29.1	0.500	0.638	0.47	17,009	0.144	0.415	2.088	2.8
49	281.0	-272.8	Marshalltown	26	CL															NL
50	291.0	-282.8	Marshalltown	56	SM	37	35,895	18,261	33.1	5.00	1.20	44.7	0.500	0.600	0.42	18,261	0.144	1.326	2.088	8.1
51	301.0	-292.8	Englishtown	28	CL											-				NL

NL - not liquefiable, silts and clays (USCS CL, CH, ML, MH, CL-ML, CH-MH)

LIQUEFACTION POTENTIAL EVALUATION

Boring **NB-2**

Project Name	PSEG Site ESP Application Project
Project No.	6468-11-0360
Location	Alloways Creek, NJ
Boring No.	NB-2
Depth to Groundwater at time of drilling (ft.)	8.4
Analysis Groundwater Depth (ft)	8.4
Ground Elev. (ft)	8.2
Earthquake Magnitude, M_w	6.0
maximum acceleration, a_{max} (g)	0.225

Imported from SPT N-Value Correction, Calculation 001, Rev1.
Input from boring records.
Input from laboratory test results.
Value estimated.

Input by James E. Veith Date 11/27/2012

Checked by MBL Date 12/6/2012

Note: Top of competent layer elevation at -67 ft. Samples above elevation -67 ft. not evaluated.

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21

Column No.	Description
1	SPT Sample number.
2	Depth to SPT N-value (ft).
3	Elevation of SPT N-value (ft).
4	Geologic Formation.
5	Field SPT N-value (blows per foot).
6	USCS designation, input for informational purposes only.
7	FC - fines content, percent passing the number 200 sieve.
8	P_0 - total overburden pressure at time of drilling (psf).
9	P_0' - effective overburden pressure based on groundwater level at time of drilling (psf).
10	$(N_1)_{60}$ - N-value of granular soils corrected for field procedures, and overburden pressure (blows per foot).
11	Alpha - correction factor based on for fines content.
12	Beta - correction factor based on fines content.
13	$(N_1)_{60CS}$ - $(N_1)_{60}$ of granular soils corrected for fines content (blows per foot).
14	r_d - stress reduction factor based on depth
15	f_d - function of site conditions used in calculating K_{sigma}

N1(60)	f_d
0	0.8
7.1	0.8
16	0.7
28.4	0.6
625	0.6

16	K_{sigma} - overburden correction factor
17	P_{ode}' - effective overburden pressure at groundwater analysis depth (psf).
18	CSR - cyclic stress ratio
19	$CRR_{7.5}$ - cyclic resistance ratio for magnitude 7.5 earthquake
20	MSF - magnitude scaling factor. For Mw<7.5 MSF =$(Mw/7.5)^{-3.3}$, Mw>= 7.5 MSF = $10^{2.24}/Mw^{2.56}$
21	FS - Factor of Safety = ($CRR_{7.5}$ * K_{sigma} * MSF) / CSR

LIQUEFACTION POTENTIAL EVALUATION

Boring **NB-3**

Project Name	PSEG Site ESP Application Project
Project No.	6468-11-0360
Location	Alloways Creek, NJ
Boring No.	NB-3
Depth to Groundwater at time of drilling (ft.)	7.6
Analysis Groundwater Depth (ft)	7.6
Ground Elev. (ft)	7.4
Earthquake Magnitude, M_w	6.0
maximum acceleration, a_{max} (g)	0.225

Imported from SPT N-Value Correction, Calculation 001, Rev1.
Input from boring records.
Input from laboratory test results.
Value estimated.

Input by James E. Veith Date 11/27/2012

Checked by NBL Date 12/6/2012

Note: Top of competent layer elevation at -67 ft. Samples above elevation -67 ft. not evaluated.

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
Sample Number	N-Value Depth (ft)	N-Value Elev. (ft)	Formation	N_m (bpf)	USCS	FC (%)	P_o (psf)	P_o' (psf)	$(N_1)_{60}$ (bpf)	Alpha	Beta	$(N_1)_{60CS}$ (bpf)	r_d	f_d	K_{sigma}	P_{odes}' (psf)	CSR	$CRR_{7.5}$	MSF	FS
19	75.6	-68.2	Vincentown	16	SP-SM	21	8,331	4,088	15.7	3.78	1.09	20.9	0.997	0.703	0.82	4,088	0.297	0.227	2.088	1.3
20	80.6	-73.2	Vincentown	33	SP-SM	21	8,841	4,286	31.5	3.78	1.09	38.0	0.986	0.600	0.75	4,286	0.297	1.277	2.088	6.7
21	85.6	-78.2	Vincentown	17	SM	21	9,384	4,517	15.7	3.78	1.09	20.8	0.974	0.703	0.80	4,517	0.296	0.226	2.088	1.3
22	90.6	-83.2	Vincentown	35	SP-SM	21	9,926	4,747	31.3	3.78	1.09	37.8	0.962	0.600	0.72	4,747	0.294	1.275	2.088	6.5
23	95.6	-88.2	Vincentown	49	SM	21	10,469	4,978	42.5	3.78	1.09	49.9	0.951	0.600	0.71	4,978	0.293	1.365	2.088	6.9
24	100.6	-93.2	Vincentown	20	SM	31	11,044	5,241	16.8	4.77	1.16	24.3	0.939	0.694	0.76	5,241	0.289	0.279	2.088	1.5
25	105.6	-98.2	Vincentown	99	SM	21	11,619	5,504	80.2	3.78	1.09	90.9	0.920	0.600	0.68	5,504	0.284	1.668	2.088	8.3
26	109.9	-102.5	Vincentown	100	SP-SM	21	12,085	5,702	79.1	3.78	1.09	89.7	0.885	0.600	0.67	5,702	0.274	1.660	2.088	8.5
27	111.6	-104.2	Vincentown	100	SP-SM	21	12,259	5,769	78.5	3.78	1.09	89.0	0.871	0.600	0.67	5,769	0.271	1.654	2.088	8.5
28	115.6	-108.2	Hornerstown	26	SP-SM	13	12,703	5,964	19.9	1.89	1.04	22.6	0.839	0.668	0.71	5,964	0.261	0.251	2.088	1.4
29	120.6	-113.2	Hornerstown	49	SP-SM	13	13,303	6,252	36.3	1.89	1.04	39.6	0.798	0.600	0.65	6,252	0.248	1.289	2.088	7.1
30	125.6	-118.2	Hornerstown	28	SM	20	13,903	6,540	20.1	3.61	1.08	25.3	0.757	0.667	0.69	6,540	0.235	0.298	2.088	1.8
31	130.6	-123.2	Hornerstown	42	SM	20	14,503	6,828	29.2	3.61	1.08	35.2	0.717	0.600	0.63	6,828	0.223	1.256	2.088	7.4
32	135.6	-128.2	Navesink	61	SC	20	15,120	7,133	41.1	3.61	1.08	48.0	0.676	0.600	0.62	7,133	0.210	1.351	2.088	8.3
33	140.6	-133.2	Navesink	80	SM	20	15,768	7,469	52.1	3.61	1.08	59.9	0.635	0.600	0.60	7,469	0.196	1.439	2.088	9.2
34	145.6	-138.2	Navesink	38	SC	40	16,415	7,804	24.0	5.00	1.20	33.7	0.595	0.636	0.62	7,804	0.183	3.578	2.088	25.3
35	150.6	-143.2	Navesink	89	SM	20	17,063	8,140	54.3	3.61	1.08	62.3	0.558	0.600	0.58	8,140	0.171	1.457	2.088	10.3
36	155.6	-148.2	Navesink	83	SM	20	17,723	8,488	49.1	3.61	1.08	56.6	0.546	0.600	0.57	8,488	0.167	1.414	2.088	10.1
37	160.5	-153.1	Mount Laurel	100	SC	38	18,367	8,826	57.4	5.00	1.20	73.8	0.534	0.600	0.56	8,826	0.163	1.542	2.088	11.1
38	164.8	-157.4	Mount Laurel	100	SM	20	18,930	9,121	56.0	3.61	1.08	64.1	0.524	0.600	0.56	9,121	0.159	1.470	2.088	10.8
39	169.7	-162.3	Mount Laurel	100	SM	20	19,572	9,457	56.0	3.61	1.08	64.1	0.512	0.600	0.55	9,457	0.155	1.470	2.088	10.9
40	174.8	-167.4	Mount Laurel	100	SM	20	20,240	9,807	56.0	3.61	1.08	64.1	0.500	0.600	0.54	9,807	0.151	1.470	2.088	11.0
41	180.6	-173.2	Mount Laurel	100	SC	20	21,000	10,205	56.0	3.61	1.08	64.1	0.500	0.600	0.53	10,205	0.150	1.470	2.088	10.8
42	185.6	-178.2	Mount Laurel	69	SC	20	21,655	10,548	38.6	3.61	1.08	45.3	0.500	0.600	0.53	10,548	0.150	1.331	2.088	9.8
43	190.6	-183.2	Mount Laurel	66	SC	20	22,310	10,891	37.0	3.61	1.08	43.5	0.500	0.600	0.52	10,891	0.150	1.317	2.088	9.5
44	195.3	-187.9	Mount Laurel	100	SM	20	22,926	11,213	56.0	3.61	1.08	64.1	0.500	0.600	0.51	11,213	0.150	1.470	2.088	10.4
45	200.2	-192.8	Mount Laurel	100	SP-SM	20	23,568	11,550	56.0	3.61	1.08	64.1	0.500	0.600	0.51	11,550	0.149	1.470	2.088	10.5

NL - not liquefiable, silts and clays (USCS CL, CH, ML, MH, CL-ML, CH-MH)

LIQUEFACTION POTENTIAL EVALUATION

Boring **NB-3**

Project Name	PSEG Site ESP Application Project
Project No.	6468-11-0360
Location	Alloways Creek, NJ
Boring No.	NB-3
Depth to Groundwater at time of drilling (ft.)	7.6
Analysis Groundwater Depth (ft)	7.6
Ground Elev. (ft)	7.4
Earthquake Magnitude, M_w	6.0
maximum acceleration, a_{max} (g)	0.225

Imported from SPT N-Value Correction, Calculation 001, Rev1.
Input from boring records.
Input from laboratory test results.
Value estimated.

Input by James E. Veith Date 11/27/2012

Checked by NVR Date 12/6/2012

Note: Top of competent layer elevation at -67 ft. Samples above elevation -67 ft. not evaluated.

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21

Column No.	Description
1	SPT Sample number.
2	Depth to SPT N-value (ft).
3	Elevation of SPT N-value (ft).
4	Geologic Formation.
5	Field SPT N-value (blows per foot).
6	USCS designation, input for informational purposes only.
7	FC - fines content, percent passing the number 200 sieve.
8	P_0 - total overburden pressure at time of drilling (psf).
9	P_0' - effective overburden pressure based on groundwater level at time of drilling (psf).
10	$(N_1)_{60}$ - N-value of granular soils corrected for field procedures, and overburden pressure (blows per foot).
11	Alpha - correction factor based on for fines content.
12	Beta - correction factor based on fines content.
13	$(N_1)_{60CS}$ - $(N_1)_{60}$ of granular soils corrected for fines content (blows per foot).
14	r_d - stress reduction factor based on depth
15	f_d - function of site conditions used in calculating K_{sigma}
16	K_{sigma} - overburden correction factor
17	P_{odes}' - effective overburden pressure at groundwater analysis depth (psf).
18	CSR - cyclic stress ratio
19	$CRR_{7.5}$ - cyclic resistance ratio for magnitude 7.5 earthquake
20	MSF - magnitude scaling factor. For Mw<7.5 MSF =$(Mw/7.5)^{-3.3}$, Mw>= 7.5 MSF = $10^{-2.24}/Mw^{2.56}$
21	FS - Factor of Safety = ($CRR_{7.5}$ * K_{sigma} * MSF) / CSR

N1(60)	f_d
0	0.8
7.1	0.8
16	0.7
28.4	0.6
625	0.6

LIQUEFACTION POTENTIAL EVALUATION

Boring NB-4

Project Name	PSEG Site ESP Application Project
Project No.	6468-11-0360
Location	Alloways Creek, NJ
Boring No.	NB-4
Depth to Groundwater at time of drilling (ft.)	11.1
Analysis Groundwater Depth (ft)	11.1
Ground Elev. (ft)	11.5
Earthquake Magnitude, M_w	6.0
maximum acceleration, a_{max} (g)	0.225

Imported from SPT N-Value Correction, Calculation 001, Rev1.
Input from boring records.
Input from laboratory test results.
Value estimated.

Input by James E. Veith Date 11/27/2012

Checked by MBL Date 12/6/2012

Note: Top of competent layer elevation at -67 ft. Samples above elevation -67 ft. not evaluated.

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
Sample Number	N-Value Depth (ft)	N-Value Elev. (ft)	Formation	N_m (bpf)	USCS	FC (%)	P_o (psf)	P_o' (psf)	$(N_1)_{60}$ (bpf)	Alpha	Beta	$(N_1)_{60CS}$ (bpf)	r_d	f_d	K_{sigma}	P_{oles}' (psf)	CSR	$CRR_{7.5}$	MSF	FS
30	81.0	-69.5	Vincentown	26	SM	12	8,844	4,482	27.6	1.55	1.03	30.0	0.994	0.606	0.74	4,482	0.287	0.468	2.088	2.5
31	83.5	-72.0	Vincentown	20	SM	12	9,131	4,613	20.9	1.55	1.03	23.1	0.988	0.661	0.77	4,613	0.286	0.259	2.088	1.5
32	86.0	-74.5	Vincentown	36	SM	12	9,419	4,745	36.9	1.55	1.03	39.6	0.983	0.600	0.72	4,745	0.285	1.289	2.088	6.8
33	88.5	-77.0	Vincentown	37	SM	12	9,706	4,876	37.2	1.55	1.03	39.9	0.977	0.600	0.72	4,876	0.284	1.291	2.088	6.8
34	91.0	-79.5	Vincentown	22	SM	12	9,994	5,008	21.7	1.55	1.03	24.0	0.971	0.654	0.74	5,008	0.283	0.273	2.088	1.5
35	93.5	-82.0	Vincentown	18	SM	12	10,281	5,139	17.5	1.55	1.03	19.6	0.965	0.688	0.76	5,139	0.282	0.210	2.088	1.2
36	96.0	-84.5	Vincentown	100	SM	12	10,569	5,271	95.5	1.55	1.03	100.1	0.959	0.600	0.69	5,271	0.281	1.737	2.088	8.9
37	98.5	-87.0	Vincentown	21	SM	12	10,856	5,402	19.7	1.55	1.03	21.9	0.953	0.670	0.73	5,402	0.280	0.241	2.088	1.3
38	101.0	-89.5	Vincentown	16	SM	12	11,144	5,534	14.8	1.55	1.03	16.8	0.948	0.714	0.76	5,534	0.279	0.179	2.088	1.0
39	103.5	-92.0	Vincentown	13	SM	12	11,431	5,665	11.8	1.55	1.03	13.7	0.942	0.747	0.78	5,665	0.278	0.147	2.088	0.9
40	108.5	-97.0	Vincentown	20	SM	12	12,006	5,928	17.6	1.55	1.03	19.7	0.930	0.687	0.72	5,928	0.275	0.212	2.088	1.2
41	111.0	-99.5	Vincentown	98	SM	12	12,294	6,060	85.0	1.55	1.03	89.3	0.910	0.600	0.66	6,060	0.270	1.657	2.088	8.5
42	113.5	-102.0	Vincentown	44	SM	12	12,581	6,191	37.6	1.55	1.03	40.3	0.889	0.600	0.65	6,191	0.264	1.294	2.088	6.7
43	116.0	-104.5	Vincentown	25	SM	12	12,869	6,323	21.0	1.55	1.03	23.3	0.869	0.659	0.69	6,323	0.259	0.262	2.088	1.5
44	117.7	-106.2	Vincentown	100	SP-SM	12	13,053	6,401	83.4	1.55	1.03	87.6	0.855	0.600	0.64	6,401	0.255	1.644	2.088	8.6
45	121.0	-109.5	Vincentown	19	SM	19	13,411	6,553	15.6	3.43	1.07	20.2	0.828	0.705	0.72	6,553	0.248	0.218	2.088	1.3
46	122.7	-111.2	Vincentown	100	SM	12	13,607	6,643	81.2	1.55	1.03	85.4	0.814	0.600	0.63	6,643	0.244	1.628	2.088	8.8
47	126.0	-114.5	Hornerstown	23	SM	22	13,995	6,825	18.3	3.93	1.09	24.0	0.787	0.681	0.69	6,825	0.236	0.273	2.088	1.7
48	128.5	-117.0	Hornerstown	27	SP-SM	22	14,295	6,969	21.2	3.93	1.09	27.1	0.767	0.658	0.67	6,969	0.230	0.341	2.088	2.1
49	131.0	-119.5	Hornerstown	29	SP-SM	22	14,595	7,113	22.4	3.93	1.09	28.4	0.747	0.648	0.65	7,113	0.224	0.384	2.088	2.3
50	133.1	-121.6	Hornerstown	100	SM	22	14,847	7,234	76.3	3.93	1.09	87.4	0.730	0.600	0.61	7,234	0.219	1.642	2.088	9.6
51	136.0	-124.5	Hornerstown	32	SP-SM	22	15,195	7,401	24.0	3.93	1.09	30.2	0.706	0.635	0.63	7,401	0.212	0.482	2.088	3.0
52	138.5	-127.0	Hornerstown	39	SP-SM	22	15,495	7,545	28.9	3.93	1.09	35.5	0.686	0.600	0.60	7,545	0.206	1.258	2.088	7.7
53	141.0	-129.5	Hornerstown	39	SP-SM	22	15,795	7,689	28.4	3.93	1.09	35.0	0.665	0.600	0.60	7,689	0.200	1.255	2.088	7.9
54	143.5	-132.0	Navesink	54	SC	16	16,103	7,841	38.8	2.77	1.05	43.7	0.645	0.600	0.59	7,841	0.194	1.319	2.088	8.4
55	146.0	-134.5	Navesink	75	SM	16	16,427	8,009	53.0	2.77	1.05	58.7	0.625	0.600	0.59	8,009	0.187	1.430	2.088	9.4
56	148.5	-137.0	Navesink	70	SM	16	16,757	8,183	48.7	2.77	1.05	54.1	0.604	0.600	0.58	8,183	0.181	1.396	2.088	9.3
57	151.0	-139.5	Navesink	63	SM	16	17,087	8,357	43.1	2.77	1.05	48.2	0.584	0.600	0.58	8,357	0.175	1.352	2.088	9.4
58	153.5	-142.0	Navesink	48	SC	16	17,411	8,525	32.4	2.77	1.05	36.9	0.564	0.600	0.57	8,525	0.168	1.269	2.088	9.0
59	156.0	-144.5	Navesink	64	SC	16	17,728	8,686	42.5	2.77	1.05	47.6	0.555	0.600	0.57	8,686	0.166	1.348	2.088	9.7
60	158.5	-147.0	Navesink	83	SM	16	18,052	8,854	54.3	2.77	1.05	60.0	0.549	0.600	0.56	8,854	0.164	1.440	2.088	10.3
61	161.0	-149.5	Navesink	68	SC	16	18,376	9,022	43.9	2.77	1.05	49.0	0.543	0.600	0.56	9,022	0.162	1.358	2.088	9.8
62	163.5	-152.0	Navesink	85	SC	16	18,693	9,183	54.5	2.77	1.05	60.2	0.537	0.600	0.56	9,183	0.160	1.441	2.088	10.5
63	166.0	-154.5	Mount Laurel	93	SC	22	19,016	9,350	59.6	3.93	1.09	69.1	0.531	0.600	0.55	9,350	0.158	1.507	2.088	11.0
64	168.2	-156.7	Mount Laurel	100	CL															NL
65	170.6	-159.1	Mount Laurel	100	SC	22	19,618	9,666	64.1	3.93	1.09	74.0	0.519	0.600	0.54	9,666	0.154	1.543	2.088	11.3
66	172.6	-161.1	Mount Laurel	100	SM	22	19,880	9,803	64.1	3.93	1.09	74.0	0.515	0.600	0.54	9,803	0.153	1.543	2.088	11.4
67	175.2	-163.7	Mount Laurel	100	SM	22	20,221	9,981	64.1	3.93	1.09	74.0	0.508	0.600	0.54	9,981	0.151	1.543	2.088	11.5
68	177.6	-166.1	Mount Laurel	100	SM	22	20,535	10,146	64.1	3.93	1.09	74.0	0.500	0.600	0.53	10,146	0.148	1.543	2.088	11.5
69	180.3	-168.8	Mount Laurel	100	SM	22	20,889	10,331	64.1	3.93	1.09	74.0	0.500	0.600	0.53	10,331	0.148	1.543	2.088	11.5
70	183.4	-171.9	Mount Laurel	100	SM	22	21,295	10,544	64.1	3.93	1.09	74.0	0.500	0.600	0.53	10,544	0.148	1.543	2.088	11.5
71	186.0	-174.5	Mount Laurel	71	SM	22	21,636	10,722	45.5	3.93	1.09	53.7	0.500	0.600	0.52	10,722	0.148	1.393	2.088	10.2
72	188.5	-177.0	Mount Laurel	70	SM	22	21,963	10,893	44.9	3.93	1.09	53.0	0.500	0.600	0.52	10,893	0.147	1.388	2.088	10.3
73	191.0	-179.5	Mount Laurel	65	SC	22	22,291	11,065	41.7	3.93	1.09	49.5	0.500	0.600	0.52	11,065	0.147	1.362	2.088	10.1
74	193.5	-182.0	Mount Laurel	68	SC	22	22,618	11,236	43.6	3.93	1.09	51.6	0.500	0.600	0.51	11,236	0.147	1.377	2.088	10.0
75	196.0	-184.5	Mount Laurel	56	SC	22	22,946	11,408	35.9	3.93	1.09	43.2	0.500	0.600	0.51	11,408	0.147	1.315	2.088	9.5
76	198.5	-187.0	Mount Laurel	78	SC	22	23,273	11,579	50.0	3.93	1.09	58.6	0.500	0.600	0.51	11,579	0.147	1.429	2.088	10.4
77	200.9	-189.4	Mount Laurel	100	SM	22	23,588	11,744	64.1	3.93	1.09	74.0	0.500	0.600	0.50	11,744	0.147	1.543	2.088	11.0

LIQUEFACTION POTENTIAL EVALUATION

Boring **NB-4**

Project Name	PSEG Site ESP Application Project
Project No.	6468-11-0360
Location	Alloways Creek, NJ
Boring No.	NB-4
Depth to Groundwater at time of drilling (ft.)	11.1
Analysis Groundwater Depth (ft)	11.1
Ground Elev. (ft)	11.5
Earthquake Magnitude, M_w	6.0
maximum acceleration, a_{max} (g)	0.225

Imported from SPT N-Value Correction, Calculation 001, Rev1.
Input from boring records.
Input from laboratory test results.
Value estimated.

Input by James E. Veith Date 11/27/2012

Checked by NBL Date 12/6/2012

Note: Top of competent layer elevation at -67 ft. Samples above elevation -67 ft. not evaluated.

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21

NL - not liquefiable, silts and clays (USCS CL, CH, ML, MH, CL-ML, CH-MH)

Column No.	Description
1	SPT Sample number.
2	Depth to SPT N-value (ft).
3	Elevation of SPT N-value (ft).
4	Geologic Formation.
5	Field SPT N-value (blows per foot).
6	USCS designation, input for informational purposes only.
7	FC - fines content, percent passing the number 200 sieve.
8	P_0 - total overburden pressure at time of drilling (psf).
9	P_0' - effective overburden pressure based on groundwater level at time of drilling (psf).
10	$(N_1)_{60}$ - N-value of granular soils corrected for field procedures, and overburden pressure (blows per foot).
11	Alpha - correction factor based on for fines content.
12	Beta - correction factor based on fines content.
13	$(N_1)_{60CS}$ - $(N_1)_{60}$ of granular soils corrected for fines content (blows per foot).
14	r_d - stress reduction factor based on depth
15	f_d - function of site conditions used in calculating K_{sigma}
16	K_{sigma} - overburden correction factor
17	P_{mlsa}' - effective overburden pressure at groundwater analysis depth (psf).
18	CSR - cyclic stress ratio
19	$CRR_{7.5}$ - cyclic resistance ratio for magnitude 7.5 earthquake
20	MSF - magnitude scaling factor. For Mw<7.5 MSF =$(Mw/7.5)^{-3.3}$, Mw>= 7.5 MSF = $10^{2.24}/Mw^{2.56}$
21	FS - Factor of Safety = ($CRR_{7.5}$ * K_{sigma} * MSF) / CSR

N1(60)	f_d
0	0.8
7.1	0.8
16	0.7
28.4	0.6
625	0.6

LIQUEFACTION POTENTIAL EVALUATION

Boring **NB-5**

Project Name	PSEG Site ESP Application Project
Project No.	6468-11-0360
Location	Alloways Creek, NJ
Boring No.	NB-5
Depth to Groundwater at time of drilling (ft.)	5.7
Analysis Groundwater Depth (ft)	5.7
Ground Elev. (ft)	7.8
Earthquake Magnitude, M_w	6.0
maximum acceleration, a_{max} (g)	0.225

Imported from SPT N-Value Correction, Calculation 001, Rev1.
Input from boring records.
Input from laboratory test results.
Value estimated.

Input by James E. Veith Date 11/27/2012

Checked by MAR Date 12/6/2012

Note: Top of competent layer elevation at -67 ft. Samples above elevation -67 ft. not evaluated.

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
Sample Number	N-Value Depth (ft)	N-Value Elev. (ft)	Formation	N_m (bpf)	USCS	FC (%)	P_o (psf)	P_o' (psf)	$(N_1)_{60}$ (bpf)	Alpha	Beta	$(N_1)_{60CS}$ (bpf)	r_d	f_d	K_{sigma}	P_{oder}' (psf)	CSR	$CRR_{7.5}$	MSF	FS
19	75.5	-67.7	Vincentown	30	SM	24	8,224	3,868	33.3	4.18	1.11	41.1	0.998	0.600	0.79	3,868	0.310	1.300	2.088	6.9
20	80.5	-72.7	Vincentown	16	SM	24	8,854	4,186	16.9	4.18	1.11	22.9	0.987	0.693	0.81	4,186	0.305	0.255	2.088	1.4
21	85.5	-77.7	Vincentown	16	SM	24	9,484	4,504	16.2	4.18	1.11	22.1	0.975	0.699	0.80	4,504	0.300	0.243	2.088	1.4
22	90.5	-82.7	Vincentown	31	SM	24	10,086	4,795	30.1	4.18	1.11	37.5	0.963	0.600	0.72	4,795	0.296	1.273	2.088	6.5
23	95.5	-87.7	Vincentown	19	SP-SC	24	10,629	5,025	17.9	4.18	1.11	24.0	0.952	0.685	0.76	5,025	0.294	0.273	2.088	1.5
24	100.5	-92.7	Vincentown	67	SP-SM	24	11,139	5,223	61.4	4.18	1.11	72.2	0.940	0.600	0.70	5,223	0.293	1.530	2.088	7.6
25	105.5	-97.7	Vincentown	43	SP-SM	24	11,649	5,421	38.4	4.18	1.11	46.7	0.924	0.600	0.69	5,421	0.290	1.341	2.088	6.7
26	110.5	-102.7	Vincentown	25	SP-SM	24	12,159	5,619	21.8	4.18	1.11	28.3	0.883	0.653	0.71	5,619	0.279	0.381	2.088	2.0
27	115.5	-107.7	Hornerstown	24	SM	26	12,714	5,862	20.3	4.39	1.12	27.2	0.843	0.665	0.71	5,862	0.267	0.344	2.088	1.9
28	120.5	-112.7	Hornerstown	26	SM	26	13,314	6,150	21.3	4.39	1.12	28.3	0.802	0.657	0.69	6,150	0.254	0.381	2.088	2.2
29	125.5	-117.7	Hornerstown	40	SM	26	13,914	6,438	31.7	4.39	1.12	40.0	0.761	0.600	0.64	6,438	0.241	1.292	2.088	7.2
30	130.5	-122.7	Hornerstown	29	SM	13	14,514	6,726	22.3	1.89	1.04	25.0	0.721	0.649	0.67	6,726	0.228	0.292	2.088	1.8
31	135.5	-127.7	Navesink	54	SP-SM	31	15,144	7,044	40.1	4.77	1.16	51.4	0.680	0.600	0.62	7,044	0.214	1.376	2.088	8.3
32	140.5	-132.7	Navesink	70	SP-SM	31	15,804	7,392	50.2	4.77	1.16	63.1	0.639	0.600	0.61	7,392	0.200	1.463	2.088	9.3
33	145.5	-137.7	Navesink	46	SC	31	16,451	7,728	31.9	4.77	1.16	41.8	0.599	0.600	0.60	7,728	0.186	1.305	2.088	8.8
34	150.5	-142.7	Navesink	85	SP-SM	31	17,099	8,063	57.0	4.77	1.16	71.1	0.559	0.600	0.59	8,063	0.173	1.522	2.088	10.8
35	155.5	-147.7	Navesink	65	SP-SM	31	17,759	8,411	42.2	4.77	1.16	53.9	0.547	0.600	0.58	8,411	0.169	1.394	2.088	10.0
36	160.4	-152.6	Mount Laurel	100	SC	25	18,403	8,750	63.0	4.29	1.12	74.6	0.535	0.600	0.57	8,750	0.165	1.548	2.088	11.2
37	164.6	-156.8	Mount Laurel	100	SC	25	18,953	9,038	61.5	4.29	1.12	72.8	0.525	0.600	0.56	9,038	0.161	1.534	2.088	11.1
38	169.6	-161.8	Mount Laurel	100	SC	25	19,608	9,381	61.1	4.29	1.12	72.4	0.513	0.600	0.55	9,381	0.157	1.531	2.088	11.2
39	174.7	-166.9	Mount Laurel	100	SC	25	20,276	9,731	61.1	4.29	1.12	72.4	0.500	0.600	0.54	9,731	0.152	1.531	2.088	11.4
40	180.5	-172.7	Mount Laurel	79	SC	25	21,036	10,129	48.3	4.29	1.12	58.1	0.500	0.600	0.53	10,129	0.152	1.425	2.088	10.4
41	185.5	-177.7	Mount Laurel	55	SC	25	21,691	10,472	33.6	4.29	1.12	41.8	0.500	0.600	0.53	10,472	0.151	1.305	2.088	9.6
42	190.5	-182.7	Mount Laurel	56	SC	25	22,346	10,815	34.2	4.29	1.12	42.5	0.500	0.600	0.52	10,815	0.151	1.310	2.088	9.4
43	195.2	-187.4	Mount Laurel	100	SC	25	22,962	11,137	61.1	4.29	1.12	72.4	0.500	0.600	0.51	11,137	0.151	1.531	2.088	10.8
44	199.8	-192.0	Mount Laurel	100	SC	25	23,564	11,453	61.1	4.29	1.12	72.4	0.500	0.600	0.51	11,453	0.150	1.531	2.088	10.9

File: NB-5 Liquefaction potential, UB MSF_wide col.xlsx

LIQUEFACTION POTENTIAL EVALUATION

Boring **NB-5**

Project Name	PSEG Site ESP Application Project
Project No.	6468-11-0360
Location	Alloways Creek, NJ
Boring No.	NB-5
Depth to Groundwater at time of drilling (ft.)	5.7
Analysis Groundwater Depth (ft)	5.7
Ground Elev. (ft)	7.8
Earthquake Magnitude, M_w	6.0
maximum acceleration, a_{max} (g)	0.225

Imported from SPT N-Value Correction, Calculation 001, Rev1.
Input from boring records.
Input from laboratory test results.
Value estimated.

Input by James E. Veith Date 11/27/2012

Checked by MRh Date 12/6/2012

Note: Top of competent layer elevation at -67 ft. Samples above elevation -67 ft. not evaluated.

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
												NL								

NL - not liquefiable, silts and clays (USCS CL, CH, ML, MH, CL-ML, CH-MH)

Column No.	Description
1	SPT Sample number.
2	Depth to SPT N-value (ft).
3	Elevation of SPT N-value (ft).
4	Geologic Formation.
5	Field SPT N-value (blows per foot).
6	USCS designation, input for informational purposes only.
7	FC - fines content, percent passing the number 200 sieve.
8	P_0 - total overburden pressure at time of drilling (psf).
9	P_0' - effective overburden pressure based on groundwater level at time of drilling (psf).
10	$(N_1)_{60}$ - N-value of granular soils corrected for field procedures, and overburden pressure (blows per foot).
11	Alpha - correction factor based on for fines content.
12	Beta - correction factor based on fines content.
13	$(N_1)_{60CS}$ - $(N_1)_{60}$ of granular soils corrected for fines content (blows per foot).
14	r_d - stress reduction factor based on depth
15	f_d - function of site conditions used in calculating K_{sigma}

N1(60)	f_d
0	0.8
7.1	0.8
16	0.7
28.4	0.6
625	0.6

Column No.	Description
16	K_{sigma} - overburden correction factor
17	P_{odes}' - effective overburden pressure at groundwater analysis depth (psf).
18	CSR - cyclic stress ratio
19	$CRR_{7.5}$ - cyclic resistance ratio for magnitude 7.5 earthquake
20	MSF - magnitude scaling factor. For Mw<7.5 MSF =$(Mw/7.5)^{-3.3}$, Mw>= 7.5 MSF = $10^{2.24}/Mw^{2.56}$
21	FS - Factor of Safety = ($CRR_{7.5}$ * K_{sigma} * MSF) / CSR

LIQUEFACTION POTENTIAL EVALUATION

Boring **NB-6**

Project Name	PSEG Site ESP Application Project
Project No.	6468-11-0360
Location	Alloways Creek, NJ
Boring No.	NB-6
Depth to Groundwater at time of drilling (ft.)	8.7
Analysis Groundwater Depth (ft)	8.7
Ground Elev. (ft)	9.3
Earthquake Magnitude, M_w	6.0
maximum acceleration, a_{max} (g)	0.225

Imported from SPT N-Value Correction, Calculation 001, Rev1.
Input from boring records.
Input from laboratory test results.
Value estimated.

Input by James E. Veith Date 11/27/2012

Checked by MBR Date 12/6/2012

Note: Top of competent layer elevation at -67 ft. Samples above elevation -67 ft. not evaluated.

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
Sample Number	N-Value Depth (ft)	N-Value Elev. (ft)	Formation	N_m (bpf)	USCS	FC (%)	P_o (psf)	P_o' (psf)	$(N_1)_{60}$ (bpf)	Alpha	Beta	$(N_1)_{60CS}$ (bpf)	r_d	f_d	K_{sigma}	P_{odes}' (psf)	CSR	$CRR_{7.5}$	MSF	FS
19	78.9	-69.6	Vincentown	19	SP-SM	15	9,243	4,862	18.3	2.50	1.05	21.6	0.994	0.682	0.77	4,862	0.276	0.236	2.088	1.4
20	83.6	-74.3	Vincentown	24	SP-SM	15	9,778	5,105	22.3	2.50	1.05	25.9	0.983	0.649	0.73	5,105	0.275	0.311	2.088	1.7
21	90.6	-81.3	Vincentown	22	SP-SM	15	10,492	5,382	19.8	2.50	1.05	23.2	0.967	0.670	0.73	5,382	0.276	0.260	2.088	1.4
22	94.8	-85.5	Vincentown	100	SM	15	10,948	5,575	87.7	2.50	1.05	94.4	0.957	0.600	0.68	5,575	0.275	1.694	2.088	8.7
23	100.6	-91.3	Vincentown	30	SM	15	11,615	5,881	25.4	2.50	1.05	29.1	0.943	0.625	0.68	5,881	0.272	0.415	2.088	2.2
24	105.6	-96.3	Vincentown	25	SM	15	12,190	6,144	20.5	2.50	1.05	24.0	0.932	0.664	0.70	6,144	0.270	0.273	2.088	1.5
25	110.6	-101.3	Vincentown	38	SM	15	12,765	6,407	30.2	2.50	1.05	34.2	0.895	0.600	0.64	6,407	0.261	1.249	2.088	6.4
26	114.8	-105.5	Vincentown	100	SP-SM	15	13,221	6,600	77.9	2.50	1.05	84.1	0.861	0.600	0.63	6,600	0.252	1.618	2.088	8.4
27	120.6	-111.3	Hornerstown	44	SP-SM	22	13,865	6,882	33.2	3.93	1.09	40.3	0.813	0.600	0.62	6,882	0.240	1.294	2.088	7.0
28	125.6	-116.3	Hornerstown	56	SP-SM	22	14,465	7,170	41.0	3.93	1.09	48.8	0.773	0.600	0.61	7,170	0.228	1.357	2.088	7.6
29	130.6	-121.3	Hornerstown	45	SP-SM	22	15,065	7,458	32.0	3.93	1.09	38.9	0.732	0.600	0.60	7,458	0.216	1.283	2.088	7.4
30	135.6	-126.3	Navesink	81	SM	16	15,695	7,776	55.9	2.77	1.05	61.7	0.691	0.600	0.59	7,776	0.204	1.452	2.088	8.8
31	140.6	-131.3	Navesink	56	SM	16	16,355	8,124	37.4	2.77	1.05	42.2	0.651	0.600	0.58	8,124	0.192	1.308	2.088	8.3
32	145.6	-136.3	Navesink	50	SM	16	17,015	8,472	32.3	2.77	1.05	36.8	0.610	0.600	0.57	8,472	0.179	1.268	2.088	8.4
33	150.6	-141.3	Navesink	67	SM	16	17,675	8,820	42.0	2.77	1.05	47.0	0.569	0.600	0.56	8,820	0.167	1.343	2.088	9.4
34	155.6	-146.3	Navesink	63	SC	16	18,322	9,156	38.5	2.77	1.05	43.4	0.551	0.600	0.56	9,156	0.161	1.317	2.088	9.6
35	160.3	-151.0	Mount Laurel	100	SC	22	18,928	9,469	61.1	3.93	1.09	70.7	0.539	0.600	0.55	9,469	0.158	1.519	2.088	11.0
36	164.7	-155.4	Mount Laurel	100	SC	22	19,505	9,770	61.1	3.93	1.09	70.7	0.528	0.600	0.54	9,770	0.154	1.519	2.088	11.1
37	169.7	-160.4	Mount Laurel	100	SC	22	20,160	10,113	61.1	3.93	1.09	70.7	0.516	0.600	0.53	10,113	0.150	1.519	2.088	11.2
38	175.5	-166.2	Mount Laurel	100	SC	22	20,920	10,511	61.1	3.93	1.09	70.7	0.500	0.600	0.53	10,511	0.146	1.519	2.088	11.5
39	180.6	-171.3	Mount Laurel	83	SM	22	21,588	10,861	50.7	3.93	1.09	59.4	0.500	0.600	0.52	10,861	0.145	1.435	2.088	10.7
40	185.6	-176.3	Mount Laurel	65	SC	22	22,243	11,204	39.7	3.93	1.09	47.4	0.500	0.600	0.51	11,204	0.145	1.346	2.088	9.9
41	190.6	-181.3	Mount Laurel	65	SM	22	22,898	11,547	39.7	3.93	1.09	47.4	0.500	0.600	0.51	11,547	0.145	1.346	2.088	9.9
42	195.3	-186.0	Mount Laurel	100	SM	22	23,513	11,870	61.1	3.93	1.09	70.7	0.500	0.600	0.50	11,870	0.145	1.519	2.088	10.9
43	199.8	-190.5	Mount Laurel	100	SM	22	24,103	12,178	61.1	3.93	1.09	70.7	0.500	0.600	0.50	12,178	0.145	1.519	2.088	10.9

File: NB-6 Liquefaction potential, UB MSF_wide col.xlsx

LIQUEFACTION POTENTIAL EVALUATION

Boring **NB-6**

Project Name	PSEG Site ESP Application Project
Project No.	6468-11-0360
Location	Alloways Creek, NJ
Boring No.	NB-6
Depth to Groundwater at time of drilling (ft.)	8.7
Analysis Groundwater Depth (ft)	8.7
Ground Elev. (ft)	9.3
Earthquake Magnitude, M_w	6.0
maximum acceleration, a_{max} (g)	0.225

Imported from SPT N-Value Correction, Calculation 001, Rev1.
Input from boring records.
Input from laboratory test results.
Value estimated.

Input by James E. Veith Date 11/27/2012

Checked by MBR Date 12/6/2012

Note: Top of competent layer elevation at -67 ft. Samples above elevation -67 ft. not evaluated.

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
												NL								

NL - not liquefiable, silts and clays (USCS CL, CH, ML, MH, CL-ML, CH-MH)

Column No.	Description
1	SPT Sample number.
2	Depth to SPT N-value (ft).
3	Elevation of SPT N-value (ft).
4	Geologic Formation.
5	Field SPT N-value (blows per foot).
6	USCS designation, input for informational purposes only.
7	FC - fines content, percent passing the number 200 sieve.
8	P_0 - total overburden pressure at time of drilling (psf).
9	P_0' - effective overburden pressure based on groundwater level at time of drilling (psf).
10	$(N_1)_{60}$ - N-value of granular soils corrected for field procedures, and overburden pressure (blows per foot).
11	Alpha - correction factor based on for fines content.
12	Beta - correction factor based on fines content.
13	$(N_1)_{60CS}$ - $(N_1)_{60}$ of granular soils corrected for fines content (blows per foot).
14	r_d - stress reduction factor based on depth
15	f_d - function of site conditions used in calculating K_{sigma}

N1(60)	f_d
0	0.8
7.1	0.8
16	0.7
28.4	0.6
625	0.6

16	K_{sigma} - overburden correction factor
17	P_{odes}' - effective overburden pressure at groundwater analysis depth (psf).
18	CSR - cyclic stress ratio
19	$CRR_{7.5}$ - cyclic resistance ratio for magnitude 7.5 earthquake
20	MSF - magnitude scaling factor. For Mw<7.5 MSF =$(Mw/7.5)^{-3.3}$, Mw>= 7.5 MSF = $10^{-2.24}/Mw^{2.56}$
21	FS - Factor of Safety = ($CRR_{7.5}$ * K_{sigma} * MSF) / CSR

LIQUEFACTION POTENTIAL EVALUATION

Boring **NB-7**

Project Name	PSEG Site ESP Application Project
Project No.	6468-11-0360
Location	Alloways Creek, NJ
Boring No.	NB-7
Depth to Groundwater at time of drilling (ft.)	5.4
Analysis Groundwater Depth (ft)	5.4
Ground Elev. (ft)	6.2
Earthquake Magnitude, M_w	6.0
maximum acceleration, a_{max} (g)	0.225

Imported from SPT N-Value Correction, Calculation 001, Rev1.
Input from boring records.
Input from laboratory test results.
Value estimated.

Input by James E. Veith Date 11/27/2012

Checked by KJBr Date 12/6/12

Note: Top of competent layer elevation at -67 ft. Samples above elevation -67 ft. not evaluated.

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
Sample Number	N-Value Depth (ft)	N-Value Elev. (ft)	Formation	N_m (bpf)	USCS	FC (%)	P_o (psf)	P_o' (psf)	$(N_1)_{60}$ (bpf)	Alpha	Beta	$(N_1)_{60CS}$ (bpf)	r_d	f_d	K_{sigma}	P_{odes}' (psf)	CSR	$CRR_{7.5}$	MSF	FS
19	76.0	-69.8	Vincentown	45	SM	15	8,917	4,511	43.9	2.50	1.05	48.5	0.993	0.600	0.74	4,511	0.287	1.354	2.088	7.3
20	81.0	-74.8	Vincentown	46	SM	15	9,492	4,774	43.3	2.50	1.05	47.9	0.982	0.600	0.72	4,774	0.286	1.350	2.088	7.1
21	86.2	-80.0	Vincentown	28	SM	17	10,090	5,048	25.4	3.01	1.06	29.9	0.970	0.624	0.72	5,048	0.284	0.461	2.088	2.4
22	90.9	-84.7	Vincentown	100	SM	17	10,630	5,295	87.8	3.01	1.06	96.1	0.959	0.600	0.69	5,295	0.282	1.707	2.088	8.7
23	96.2	-90.0	Vincentown	42	SM	17	11,240	5,574	35.6	3.01	1.06	40.8	0.946	0.600	0.68	5,574	0.279	1.297	2.088	6.6
24	101.0	-94.8	Vincentown	27	SM	17	11,792	5,826	22.2	3.01	1.06	26.6	0.935	0.650	0.70	5,826	0.277	0.328	2.088	1.7
25	106.1	-99.9	Vincentown	45	SM	17	12,378	6,094	35.9	3.01	1.06	41.0	0.906	0.600	0.65	6,094	0.269	1.299	2.088	6.6
26	111.1	-104.9	Vincentown	42	SM	17	12,953	6,357	32.5	3.01	1.06	37.5	0.866	0.600	0.64	6,357	0.258	1.273	2.088	6.6
27	116.0	-109.8	Vincentown	28	SM	17	13,517	6,615	21.1	3.01	1.06	25.3	0.826	0.659	0.68	6,615	0.247	0.298	2.088	1.7
28	121.0	-114.8	Hornerstown	52	SM	22	14,104	6,891	38.0	3.93	1.09	45.4	0.785	0.600	0.62	6,891	0.235	1.331	2.088	7.3
29	126.0	-119.8	Hornerstown	24	SM	22	14,704	7,179	17.0	3.93	1.09	22.5	0.744	0.692	0.69	7,179	0.223	0.249	2.088	1.6
30	131.0	-124.8	Hornerstown	25	SM	22	15,304	7,467	17.2	3.93	1.09	22.7	0.704	0.690	0.68	7,467	0.211	0.252	2.088	1.7
31	136.0	-129.8	Hornerstown	34	SM	22	15,904	7,755	22.7	3.93	1.09	28.8	0.663	0.646	0.63	7,755	0.199	0.401	2.088	2.7
32	141.0	-134.8	Navesink	100	SM	16	16,534	8,073	64.9	2.77	1.05	71.1	0.622	0.600	0.59	8,073	0.186	1.522	2.088	10.1
33	146.0	-139.8	Navesink	70	SM	16	17,194	8,421	44.0	2.77	1.05	49.1	0.582	0.600	0.58	8,421	0.174	1.359	2.088	9.5
34	151.0	-144.8	Navesink	71	SM	16	17,854	8,769	43.2	2.77	1.05	48.3	0.554	0.600	0.57	8,769	0.165	1.353	2.088	9.8
35	156.1	-149.9	Navesink	78	SM	16	18,527	9,124	46.1	2.77	1.05	51.4	0.542	0.600	0.56	9,124	0.161	1.376	2.088	10.0
36	160.9	-154.7	Navesink	100	SM	16	19,161	9,458	59.1	2.77	1.05	65.1	0.530	0.600	0.55	9,458	0.157	1.477	2.088	10.8
37	165.6	-159.4	Mount Laurel	100	SC	20	19,779	9,782	59.1	3.61	1.08	67.4	0.519	0.600	0.54	9,782	0.153	1.494	2.088	11.0
38	170.2	-164.0	Mount Laurel	100	SC	20	20,382	10,098	59.1	3.61	1.08	67.4	0.507	0.600	0.54	10,098	0.150	1.494	2.088	11.2
39	175.3	-169.1	Mount Laurel	100	SC	20	21,050	10,448	59.1	3.61	1.08	67.4	0.500	0.600	0.53	10,448	0.147	1.494	2.088	11.2
40	180.7	-174.5	Mount Laurel	100	SC	20	21,757	10,818	59.1	3.61	1.08	67.4	0.500	0.600	0.52	10,818	0.147	1.494	2.088	11.0
41	186.0	-179.8	Mount Laurel	76	SC	20	22,451	11,182	44.9	3.61	1.08	52.1	0.500	0.600	0.51	11,182	0.147	1.381	2.088	10.0
42	191.0	-184.8	Mount Laurel	72	SC	20	23,106	11,525	42.6	3.61	1.08	49.6	0.500	0.600	0.51	11,525	0.147	1.363	2.088	9.9
43	195.9	-189.7	Mount Laurel	100	SM	20	23,748	11,861	59.1	3.61	1.08	67.4	0.500	0.600	0.50	11,861	0.146	1.494	2.088	10.7
44	200.9	-194.7	Mount Laurel	100	SP-SM	20	24,403	12,204	59.1	3.61	1.08	67.4	0.500	0.600	0.50	12,204	0.146	1.494	2.088	10.7

NL - not liquefiable, silts and clays (USCS CL, CH, ML, MH, CL-ML, CH-MH)

Column No.	Description
1	SPT Sample number.
2	Depth to SPT N-value (ft).
16	K_{sigma} - overburden correction factor
17	P_{odes}' - effective overburden pressure at groundwater analysis depth (psf).

File: NB-7 Liquefaction potential, UB MSF_wide col.xlsx

LIQUEFACTION POTENTIAL EVALUATION

Boring **NB-7**

Project Name	PSEG Site ESP Application Project
Project No.	6468-11-0360
Location	Alloways Creek, NJ
Boring No.	NB-7
Depth to Groundwater at time of drilling (ft.)	5.4
Analysis Groundwater Depth (ft)	5.4
Ground Elev. (ft)	6.2
Earthquake Magnitude, M_w	6.0
maximum acceleration, a_{max} (g)	0.225

Imported from SPT N-Value Correction, Calculation 001, Rev1.
Input from boring records.
Input from laboratory test results.
Value estimated.

Input by James E. Veith Date 11/27/2012

Checked by NPH Date 12/6/12

Note: Top of competent layer elevation at -67 ft. Samples above elevation -67 ft. not evaluated.

1 *2* *3* *4* *5* *6* *7* *8* *9* *10* *11* *12* *13* *14* *15* *16* *17* *18* *19* *20* *21*

3 Elevation of SPT N-value (ft).
4 Geologic Formation.
5 Field SPT N-value (blows per foot).
6 USCS designation, input for informational purposes only.
7 FC - fines content, percent passing the number 200 sieve.
8 P_0 - total overburden pressure at time of drilling (psf).
9 P_0' - effective overburden pressure based on groundwater level at time of drilling (psf).
10 $(N_1)_{60}$ - N-value of granular soils corrected for field procedures, and overburden pressure (blows per foot).
11 Alpha - correction factor based on for fines content.
12 Beta - correction factor based on fines content.
13 $(N_1)_{60CS}$ - $(N_1)_{60}$ of granular soils corrected for fines content (blows per foot).
14 r_d - stress reduction factor based on depth
15 f_d - function of site conditions used in calculating K_{sigma}

N1(60)	f_d
0	0.8
7.1	0.8
16	0.7
28.4	0.6
625	0.6

18 CSR - cyclic stress ratio
19 $CRR_{7.5}$ - cyclic resistance ratio for magnitude 7.5 earthquake
20 MSF - magnitude scaling factor. For Mw<7.5 MSF =$(Mw/7.5)^{-3.3}$, Mw>= 7.5 MSF = $10^{2.24/Mw^{2.56}}$
21 FS - Factor of Safety = ($CRR_{7.5}$ * K_{sigma} * MSF) / CSR

LIQUEFACTION POTENTIAL EVALUATION

Boring **NB-8**

Project Name	PSEG Site ESP Application Project
Project No.	6468-11-0360
Location	Alloways Creek, NJ
Boring No.	NB-8
Depth to Groundwater at time of drilling (ft.)	8.2
Analysis Groundwater Depth (ft)	8.2
Ground Elev. (ft)	8.9
Earthquake Magnitude, M_w	6.0
maximum acceleration, a_{max} (g)	0.225

Imported from SPT N-Value Correction, Calculation 001, Rev1.
Input from boring records.
Input from laboratory test results.
Value estimated.

Input by James E. Veith Date 11/27/2012

Checked by NBL Date 12/6/2012

Note: Top of competent layer elevation at -67 ft. Samples above elevation -67 ft. not evaluated.

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
Sample Number	N-Value Depth (ft)	N-Value Elev. (ft)	Formation	N_m (bpf)	USCS	FC (%)	P_o (psf)	P_o' (psf)	$(N_1)_{60}$ (bpf)	Alpha	Beta	$(N_1)_{60CS}$ (bpf)	r_d	f_d	K_{sigma}	P_{odes}' (psf)	CSR	$CRR_{7.5}$	MSF	FS
19	75.5	-66.6	Vincentown	18	SM	20	8,370	4,170	20.0	3.61	1.08	25.2	1.000	0.668	0.80	4,170	0.294	0.296	2.088	1.7
20	80.5	-71.6	Vincentown	35	SC	20	8,973	4,461	37.3	3.61	1.08	43.9	0.989	0.600	0.74	4,461	0.291	1.320	2.088	7.0
21	85.5	-76.6	Vincentown	24	SC	33	9,548	4,724	24.6	4.88	1.18	34.0	0.978	0.630	0.74	4,724	0.289	1.247	2.088	6.7
22	89.8	-80.9	Vincentown	100	SC	20	10,042	4,950	99.6	3.61	1.08	111.1	0.968	0.600	0.71	4,950	0.287	1.818	2.088	9.4
23	95.5	-86.6	Vincentown	76	SC-SM	26	10,698	5,250	72.8	4.39	1.12	86.1	0.954	0.600	0.70	5,250	0.284	1.633	2.088	8.4
24	100.5	-91.6	Vincentown	26	SC-SM	20	11,273	5,513	24.1	3.61	1.08	29.6	0.943	0.635	0.70	5,513	0.282	0.442	2.088	2.3
25	105.5	-96.6	Vincentown	62	SC-SM	20	11,848	5,776	55.6	3.61	1.08	63.7	0.931	0.600	0.67	5,776	0.279	1.467	2.088	7.4
26	109.6	-100.7	Vincentown	100	SC-SM	20	12,319	5,992	87.4	3.61	1.08	98.0	0.900	0.600	0.66	5,992	0.271	1.721	2.088	8.8
27	115.5	-106.6	Vincentown	33	SC-SM	20	12,998	6,302	27.8	3.61	1.08	33.5	0.852	0.605	0.65	6,302	0.257	2.243	2.088	11.8
28	120.5	-111.6	Vincentown	42	SC-SM	20	13,573	6,565	34.4	3.61	1.08	40.8	0.811	0.600	0.64	6,565	0.245	1.297	2.088	7.1
29	125.5	-116.6	Hornerstown	29	SM	24	14,160	6,840	23.1	4.18	1.11	29.7	0.770	0.643	0.66	6,840	0.233	0.448	2.088	2.7
30	130.5	-121.6	Hornerstown	26	SM	24	14,760	7,128	20.1	4.18	1.11	26.4	0.730	0.667	0.67	7,128	0.221	0.323	2.088	2.0
31	135.5	-126.6	Hornerstown	56	SM	24	15,360	7,416	42.0	4.18	1.11	50.7	0.689	0.600	0.61	7,416	0.209	1.371	2.088	8.4
32	140.5	-131.6	Hornerstown	42	SM	24	15,960	7,704	30.6	4.18	1.11	38.1	0.648	0.600	0.60	7,704	0.196	1.277	2.088	8.2
33	145.5	-136.6	Navesink	47	SM	19	16,590	8,022	33.2	3.43	1.07	39.0	0.608	0.600	0.59	8,022	0.184	1.284	2.088	8.6
34	150.5	-141.6	Navesink	61	SM	19	17,250	8,370	41.7	3.43	1.07	48.2	0.567	0.600	0.58	8,370	0.171	1.352	2.088	9.6
35	155.5	-146.6	Navesink	80	SC-SM	19	17,898	8,706	53.1	3.43	1.07	60.4	0.550	0.600	0.57	8,706	0.165	1.443	2.088	10.4
36	160.5	-151.6	Navesink	75	SC-SM	19	18,533	9,029	48.4	3.43	1.07	55.3	0.538	0.600	0.56	9,029	0.162	1.405	2.088	10.1
37	165.5	-156.6	Navesink	79	SC	25	19,168	9,352	50.6	4.29	1.12	60.7	0.526	0.600	0.55	9,352	0.158	1.445	2.088	10.5
38	170.4	-161.5	Mount Laurel	100	CL															NL
39	174.6	-165.7	Mount Laurel	100	SC	22	20,350	9,966	64.1	3.93	1.09	74.0	0.500	0.600	0.54	9,966	0.149	1.543	2.088	11.7
40	179.7	-170.8	Mount Laurel	100	SC	22	21,018	10,316	64.1	3.93	1.09	74.0	0.500	0.600	0.53	10,316	0.149	1.543	2.088	11.5
41	185.1	-176.2	Mount Laurel	100	SM	22	21,725	10,687	64.1	3.93	1.09	74.0	0.500	0.600	0.52	10,687	0.149	1.543	2.088	11.2
42	190.5	-181.6	Mount Laurel	86	SC	22	22,433	11,057	55.1	3.93	1.09	64.2	0.500	0.600	0.52	11,057	0.148	1.471	2.088	10.8
43	195.5	-186.6	Mount Laurel	74	SC	22	23,088	11,400	47.4	3.93	1.09	55.8	0.500	0.600	0.51	11,400	0.148	1.408	2.088	10.1
44	200.5	-191.6	Mount Laurel	92	SC	22	23,743	11,743	59.0	3.93	1.09	68.4	0.500	0.600	0.50	11,743	0.148	1.502	2.088	10.6
45	210.1	-201.2	Mount Laurel	100	SP-SM	22	25,000	12,402	64.1	3.93	1.09	74.0	0.500	0.600	0.49	12,402	0.147	1.543	2.088	10.7
46	220.1	-211.2	Mount Laurel	100	SP-SM	22	26,310	13,088	64.1	3.93	1.09	74.0	0.500	0.600	0.48	13,088	0.147	1.543	2.088	10.5
47	230.2	-221.3	Mount Laurel	100	SP-SM	22	27,633	13,781	64.1	3.93	1.09	74.0	0.500	0.600	0.47	13,781	0.147	1.543	2.088	10.3
48	240.5	-231.6	Mount Laurel	100	SP-SM	22	28,983	14,487	64.1	3.93	1.09	74.0	0.500	0.600	0.46	14,487	0.146	1.543	2.088	10.2
49	250.5	-241.6	Mount Laurel	92	SP-SM	22	30,293	15,173	59.0	3.93	1.09	68.4	0.500	0.600	0.45	15,173	0.146	1.502	2.088	9.7
50	260.5	-251.6	Mount Laurel	73	SM	22	31,603	15,859	46.8	3.93	1.09	55.1	0.500	0.600	0.45	15,859	0.146	1.403	2.088	9.0
51	270.5	-261.6	Wenonah	18	CH															NL
52	280.5	-271.6	Wenonah	7	SC	37	34,133	17,141	4.5	5.00	1.20	10.4	0.500	0.800	0.66	17,141	0.146	0.117	2.088	1.1
53	290.5	-281.6	Marshalltown	30	SC	15	35,383	17,767	19.2	2.50	1.05	22.6	0.500	0.674	0.50	17,767	0.146	0.251	2.088	1.8
54	300.5	-291.6	Marshalltown	31	CH															NL

NL - not liquefiable, silts and clays (USCS CL, CH, ML, MH, CL-ML, CH-MH)

File: NB-8 Liquefaction potential, UB MSFwide col.xlsx

LIQUEFACTION POTENTIAL EVALUATION

Boring **NB-8**

Project Name	PSEG Site ESP Application Project
Project No.	6468-11-0360
Location	Alloways Creek, NJ
Boring No.	NB-8
Depth to Groundwater at time of drilling (ft.)	8.2
Analysis Groundwater Depth (ft)	8.2
Ground Elev. (ft)	8.9
Earthquake Magnitude, M_w	6.0
maximum acceleration, a_{max} (g)	0.225

Imported from SPT N-Value Correction, Calculation 001, Rev1.
Input from boring records.
Input from laboratory test results.
Value estimated.

Input by James E. Veith Date 11/27/2012

Checked by MBL Date 12/6/2012

Note: Top of competent layer elevation at -67 ft. Samples above elevation -67 ft. not evaluated.

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21

Column No.	Description
1	SPT Sample number.
2	Depth to SPT N-value (ft).
3	Elevation of SPT N-value (ft).
4	Geologic Formation.
5	Field SPT N-value (blows per foot).
6	USCS designation, input for informational purposes only.
7	FC - fines content, percent passing the number 200 sieve.
8	P_0 - total overburden pressure at time of drilling (psf).
9	P_0' - effective overburden pressure based on groundwater level at time of drilling (psf).
10	$(N_1)_{60}$ - N-value of granular soils corrected for field procedures, and overburden pressure (blows per foot).
11	Alpha - correction factor based on for fines content.
12	Beta - correction factor based on fines content.
13	$(N_1)_{60CS}$ - $(N_1)_{60}$ of granular soils corrected for fines content (blows per foot).
14	r_d - stress reduction factor based on depth
15	f_d - function of site conditions used in calculating K_{sigma}
16	K_{sigma} - overburden correction factor
17	P_{odes}' - effective overburden pressure at groundwater analysis depth (psf).
18	CSR - cyclic stress ratio
19	$CRR_{7.5}$ - cyclic resistance ratio for magnitude 7.5 earthquake
20	MSF - magnitude scaling factor. For Mw<7.5 MSF =$(Mw/7.5)^{-3.3}$, Mw>= 7.5 MSF = $10^{-2.24}/Mw^{2.56}$
21	FS - Factor of Safety = ($CRR_{7.5}$ * K_{sigma} * MSF) / CSR

N1(60)	f_d
0	0.8
7.1	0.8
16	0.7
28.4	0.6
625	0.6