Solar Mounting Systems
SCHLETTER Inc.

Geotechnical Investigation Report

GROUNDED TEST POSTS FOR PHOTOVOLTAIC PANEL FRAMES

Keystone Site
1067 Lancaster Pike
Quarryville, Pennsylvania 17566
February 8, 2012
Project No. SRP20120035

Prepared For:
Community Energy Solar, LLC
Three Radnor Corporate Center
Suite 300
100 Matsonford Road
Radnor, PA 19087

Prepared By:
Schletter Geotechnical Services
3761 East Farnum Place
Tucson, Arizona 85706

February 8, 2012

Schletter Geotechnical Services
3761 East Farnum Place
Tucson, Arizona 85706

Attn: Community Energy Solar, LLC
Steve Hazel
Director, Solar Technical Services
Three Radnor Corporate Center
Suite 300
100 Matsonford Road
Radnor, PA 19087
Phone: 610-230-0368
E-mail: Steve.Hazel@CommunityEnergyInc.com

RE: Geotechnical Investigation Report
Grounded Posts for Photovoltaic Panel Frames
Keystone Site
1067 Lancaster Pike
Quarryville, Lancaster County, Pennsylvania 17566
Schletter Project No. SRP20120035

Dear Mr. Steve Hazel,

Thank you for retaining Schletter Geotechnical Services (Schletter) for the above referenced project. This letter report presents the findings of our field testing and data acquisition for the proposed ground mounted solar photovoltaic (PV) array located at 1067 Lancaster Pike, Quarryville, Pennsylvania (PA) property (Area Map, Appendix A). The scope of the work is the following:

- Description of Site conditions
- Visual and laboratory classification of selected soil samples
- Description of subsurface soil conditions
- Vertical pull-out capacity tests
- Lateral load capacity tests
- Assessment of corrosion potential

Schletter is pleased to present the results of vertical pull-out capacity tests, lateral load capacity tests, and laboratory analyses of soil samples collected at the Site.

SCOPE

Twenty (20) test posts were advanced at the project Site to observe soil conditions and test for vertical and lateral resistance for support of photovoltaic panels. The services performed for this Site investigation include Site reconnaissance by a trained Schletter Geotechnician/Hydrogeologist and visual as well as laboratory classification observation of soils extracted from posts advanced into the subsurface. Schletter provided the test methods, procedures, and field equipment for the Site investigation. The information gathered at the Site and presented in this report will help determine possible design embedment of production posts.

SITE CONDITIONS

The proposed Site for the PV array is located at 1067 Lancaster Pike, Quarryville, Pennsylvania (PA) property (Latitude: 39°51'45.13" N; Longitude: 76°13'22.02" W). It is an approximately rectangular-shaped parcel, located west of Highway 272 and south of Deaver Street and consists of undeveloped farmland. The Site is accessible via the property service road, exiting off of Deaver Street. Residential and commercial building are located north and south 222

Currently, the Site topography is relatively flat with runoff areas located due west toward Highway 272. There are no structures or evidence of any previous structures observed at the Site. Existing maximum vertical relief across the Site is minimal. The weather was in the 40s and windy.

POST DRIVING AND FIELD TESTING PROCEDURES

Twenty (20) test posts of size FG7 were advanced by Schletter January 18 - 19, 2012 using a rubber tracked GAYK HRE 4000 hydraulic hammer rig. Test Post 1 (KTP1) and Test Post 2 (KTP2), were advanced to a depth of 6.0 ft (72.0 inches) bgs and 7.0 ft (84.0 inches) bgs, respectively. Test Post 3 (KTP3) – Test Post 20 (KTP20) were all advanced to a depth of 8.0 ft bgs. All twenty (20) test post locations are shown on a general Site plan in Appendix A.

Schletter performed a vertical pull-out capacity test for each advanced test post using a hydraulic jack to push upward against a steel head plate. The hydraulic jack was placed in the center of the test post between the steel head plate and a steel platform lying on the ground adjacent to the test post. During each test the pull-out pressure was read from a digital dial indicator attached to a tripod. The vertical displacement was measured at various pressure increments from 0 to 200 bars. The maximum pull-out pressure is defined as the pressure attained immediately before the post-soil interface failed and excessive movement of the post began. The loads and vertical displacements are provided in Appendix B.

Schletter also performed a lateral load capacity test for the advanced test post by positioning the GAYK parallel to the embedded post. The hydraulic jack was oriented horizontally between the GAYK and the test post. A digital displacement indicator was placed on a tripod on the opposite side of the hydraulic jack at the bottom of the test post to measure the horizontal displacement in

millimeters. The horizontal displacement was measured at various pressure increments from 0 to 100 bars. The heights of the hydraulic jack and the digital dial indicator were also measured.

All twenty (20) test posts were removed from the ground after the completion of the testing.

SUBSURFACE CONDITIONS

SOIL CONDITIONS

The observed soil profiles of KTP1, KTP2, KTP3, KTP4, KTP8 and KTP10 encountered approximately 0.4/1.0 ft black brown Organic Topsoil, underlain by approximately 2.0 ft orange brown Sandy lean CLAY, followed by approximately 5.0 ft orange brown Sandy SILT, trace rock pinnacles and some mica.

The observed soil profiles of KTP5, KTP11, KTP12 and KTP13 encountered approximately 0.4/1.0 ft black brown Organic Topsoil, underlain by approximately 1.5 ft fine SAND/CLAY w/fine Gravel, underlain 4.0 ft orange brown Sandy lean CLAY, followed by approximately 1.5 ft orange brown Sandy SILT, trace rock pinnacles and some mica.

The observed soil profiles of KTP6, KTP7, KTP17, KTP18 and KTP20 encountered approximately 0.4/1.0 ft black brown Organic Topsoil, underlain by approximately 2.0 ft Sandy lean CLAY with fine gravel, underlain 3.5 ft orange brown Sandy SILT w/fine Gravel, followed by approximately 1.5 ft orange brown fine Sandy CLAY w/fine Gravel, trace rock pinnacles and trace mica.

The observed soil profiles of KTP9, KTP14, KTP15, KTP16 and KTP19 encountered approximately 0.4/1.0 ft black brown Organic Topsoil, underlain by approximately 4.0 ft highly plastic CLAY w/Silt and fine Sand, followed by 3.0 ft highly weathered rock (Sandy SILT w/Gravel), rock pinnacles and some mica.

These conditions represent Schletter's highly trained Hydrogeologist/Geotechnician's onsite interpretation of the subsurface soil conditions based upon visual examination and subsequent soils classification of the subsoil-filled channels of each post, as well collected soil samples from CTP1, CTP9 and CTP15. These soils observed were classified in accordance with the Unified Soil Classification System (USCS). The general soil conditions and their pertinent characteristics at each post location are assumed to be representative of soil conditions in the direct vicinity of the respective test post.

Table 1: Soil Classification

Test Post Number	Depth (ft)		Soil Description	USCS Classification
	From	To		
KTP1,KTP2, KTP3, KTP4, KTP8 and KTP10	0.0	(.4/1.0)	Organic Topsoil	OL
	1.0	3.0	Sandy lean CLAY	s(CL)
	3.0	8.0	Sandy SILT, rock pinnacles, some mica	ML/SM

KTP5, KTP11, KTP12 and KTP13	0.0	(.4/1.0)	Organic Topsoil	OL
	1.0	2.5	Sandy CLAY w/f Gravel	s(CL)g
	2.5	6.5	Fine SAND/lean CLAY w/f Gravel	(CL)g
	6.5	8.0	Sandy SILT, rock pinnacles, some mica	s(ML)

Table 1 (cont): Soil Classification

Test Post Number	Depth (ft)		Soil Description	USCS Classification
	From	To		
KTP6, KTP7, KTP17, KTP18 and KTP20	0.0	(.4/1.0)	Organic Topsoil	OL
	1.0	3.0	Sandy lean CLAY w/f Gravel	s(CL)g
	3.0	6.5	Sandy SILT w/fine Gravel	s(ML/GM)g
	6.5	8.0	Sandy CLAY w/fine Gravel, rock pinnacles, trace mica	(SC)g
KTP9, KTP14, KTP15, KTP16 and KTP19	0.0	(.4/1.0)	Organic Topsoil	OL
	1.0	5.0	Highly plastic CLAY w/Silt	(CH)
	5.0	8.0	Highly weathered Rock ((Sandy SILT w/Gravel), rock pinnacles and some mica.	S(ML)g

SOIL CORROSIVITY

The measured resistivity for KTP1, KTP9 and KTP15 were 7,436 ohm-cm, 3,380 ohm-cm, and 13,520 ohm-cm, respectively. The pH measurements for KTP1, KTP9 and KTP15 were measured to be at 6.4, 7.4 and 5.7, respectively, which indicate slightly acidic soils. Soluble chlorides were not detected in any of the samples. Soluble sulfates were detected in KTP1 (69 parts per million; ppm) and KTP9 (110 ppm).

Resistivity results indicate a low to very low (mild) potential for corrosion. In order to prevent premature corrosion of the galvanized posts, it is recommended that the ground surface be graded in such a way that water does not pond around posts. Discoloration or localized corrosion of the posts near the ground surface may occur during the design life of the structure.

Table 2: Corrosivity analysis results

Test Post Number	Minimum Resistivity (ohm-cm)	pH	Chlorides (ppm)	Sulfates (ppm)
KTP1	7,436	6.4	ND	69
KTP9	3,380	7.4	ND	110
KTP16	13,520	5.7	ND	ND

ND=Not Detected

GROUNDWATER CONDITIONS

Groundwater was not encountered at any of the post locations at the time of testing. However, seasonal variations in weather may potentially affect groundwater conditions.

RESULTS

FIELD TESTING

Results of the vertical pull-out capacity and lateral load capacity tests are provided in Appendix B.

LABORATORY TESTING

Results of the vertical pull-out capacity and lateral load capacity tests are provided in Appendix C. A representative bulk soil sample was selected of the subsurface profile and sent to the Tucson office of Speedie & Associates for geotechnical classification. Soil samples were tested for gradation, Atterberg Limits, pH, resistivity, soluble sulfate content, and soluble chloride content. The test results, as reported by Speedie & Associates, are provided in Appendix C.

RECOMMENDATIONS

The structural analysis of the proposed solar arrays yields the maximum design loads the system may be subjected to. Based on these loads, the maximum test pressures, both vertical and lateral, are determined to be 200 bar and 100 bar, respectively. This includes a safety factor of 2. Eighteen (18) out of twenty (20) test posts passed both vertical pull-out capacity tests and lateral load capacity tests. KTP1 and KTP2 test post locations failed.

KTP1 was embedded to 6.0 ft (72.0 inches) depth, deflected 24.78 millimeters at the maximum test load which exceeds the allowable deformation of 19.05 millimeters of movement for the vertical pull-out capacity test, and subsequently failed the test. The lateral deformation was measured to be 13.18 millimeters at the maximum test load which is less than the allowable deflection.

KTP2 was embedded to 7.0 ft (84.0 inches) depth, deflected 22.46 millimeters at the maximum test load which exceeds the allowable deformation of 19.05 millimeters of movement for the vertical pull-out capacity test, and subsequently failed the test. The lateral deformation was measured to be 12.98 millimeters at the maximum test load which is less than the allowable deflection.

Based on these results, the recommended post embedment depth is 7.5.

The recommended optimal embedment depths for posts supporting photovoltaic panels are based on current site conditions. Filling, grading, and vegetation removal at the project site may disturb the current soil conditions and render these data and recommendations invalid. If soils conditions are disturbed or change due to project site modifications prior to, during, or after post installation contact Schletter immediately.

LIMITATIONS

This Geotechnical Investigation Report was generated exclusively for Schletter, Inc., 3671 E. Farnum Place, Tucson, AZ 85745, which holds any and all rights to this report. All results presented in this report were obtained with the proprietary post profile manufactured by Schletter. Extrapolation of the data for use with different profile geometries manufactured by others is not possible and may lead to false assumptions for design calculations. If you received this report as basis for calculations for mounting systems other than the ones used by Schletter, please inform Schletter immediately at +1-520-289-8700 and forward all reports and documents you received to Schletter. In case you are using this report for design calculations you are rendering yourself liable to prosecution in accordance with the nondisclosure agreement between Schletter and its clients.

This report was prepared for the exclusive use of Schletter, Inc. and their authorized agents for the construction for a proposed solar panel system, located at the Schletter worksite.

Recommendations contained in this report are based on field observations, subsurface explorations, laboratory tests and present knowledge of the proposed construction as described in this report. Soil conditions may vary between or beyond the points explored. If soil or groundwater conditions are encountered during construction that differ from those described herein, Schletter Inc. should be notified immediately to allow for a review or supplementary recommendations.

The findings, conclusions, and recommendations in this report are presented in a manner consistent with the standards of care and skill ordinarily exercised by members of this profession practicing under similar conditions at the time and location of the services. No warranty or other conditions, expressed or implied, are made.

We appreciate the opportunity to provide the geotechnical engineering services necessary for this project. If you have any questions about this report or any of our testing and design services, please do not hesitate to contact us.

Sincerely,

Schletter Inc.
3761 E Farnum Place
Tucson, Arizona 85706

2-8-12

Wolfgang Fritz, Ph.D., P.E.
Vice President of Engineering

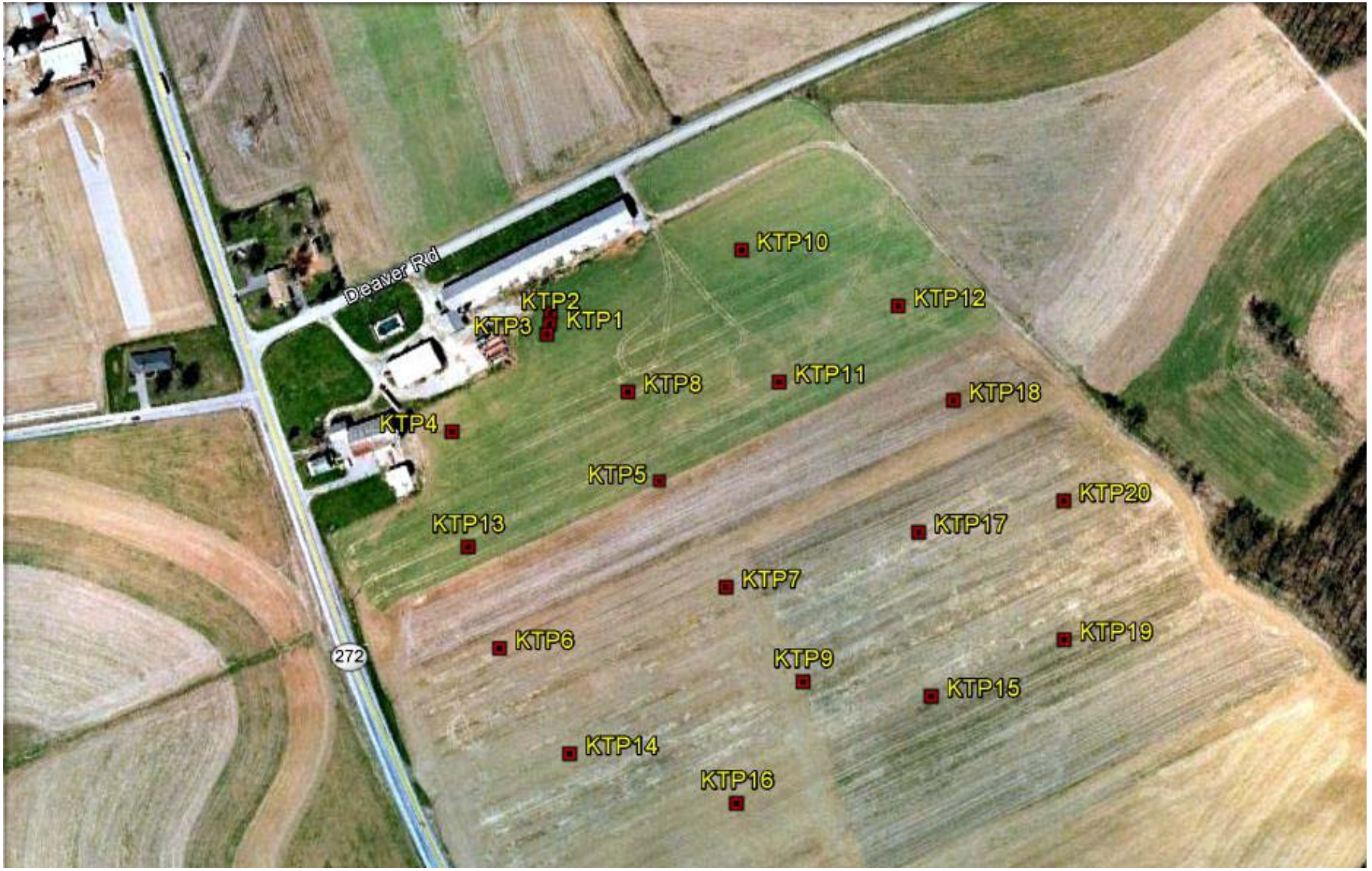
APPENDIX A

Area Map

Site Plan
(Test Post Locations)


SITE
Deaver Rd
Community Energy, Inc., Keystone, Quarryville, PA Site
272

AREA MAP


Deaver Rd
272
KTP1
KTP2
KTP3
KTP4
KTP5
KTP6
KTP7
KTP8
KTP9
KTP10
KTP11
KTP12
KTP13
KTP14
KTP15
KTP16
KTP17
KTP18
KTP19
KTP20

SITE PLAN

APPENDIX B

Vertical Pull-Out Capacity Test Data

Lateral Load Capacity Test Data

Project Name:	**Community Energy Solar, LLC**
Project Location:	**Quarryville, PA**
Project Number:	**SRP20120035**

Pile No. KTP1

Vertical Loading Test Data

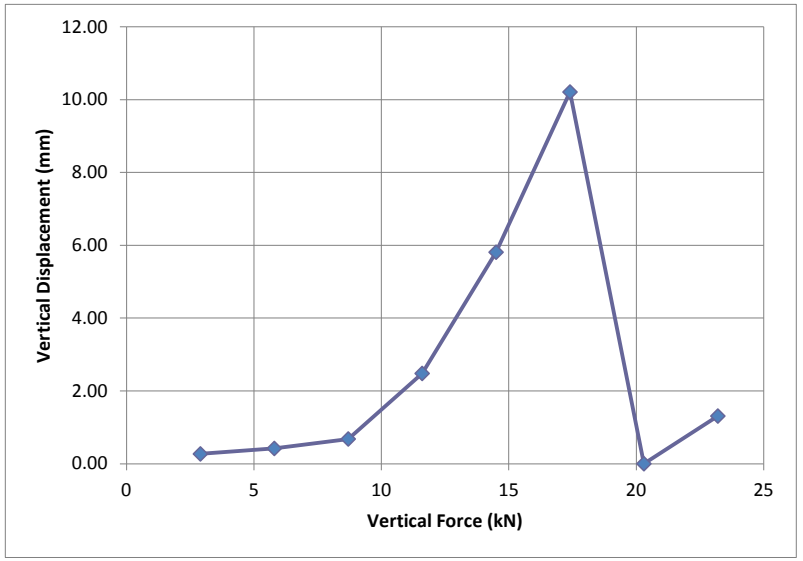
Vertical Pressure (bar)	Vertical Force (kN)	Vertical Displacement (mm)
20	2.9	0.27
40	5.8	0.42
60	8.7	0.68
80	11.6	2.48
100	14.5	5.81
120	17.4	10.21
140	20.3	**24.78; Test Failed**
160	23.2	1.31
180	26.1	2.81
200	29.0	

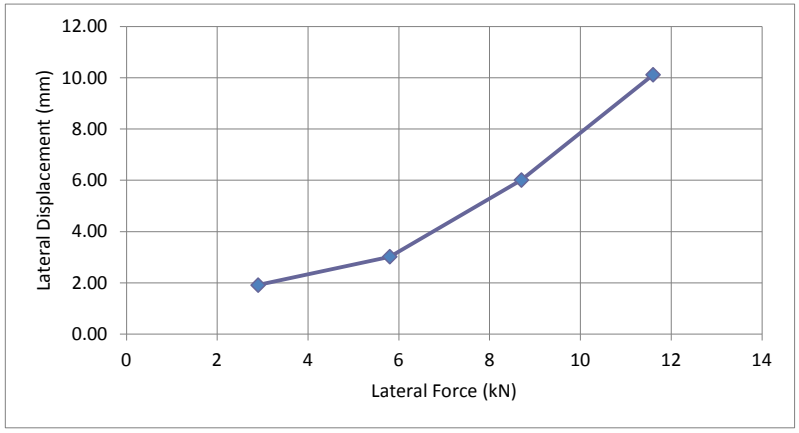
Lateral Resistance Test Data

Lateral Pressure (bar)	Lateral Force (kN)	Lateral Displacement (mm)
20	2.9	1.91
40	5.8	3.02
60	8.7	6.01
80	11.6	10.12
100	14.5	13.18

Surface Conditions

Height of Caliper (mm)	Height of Jack (mm)	Embedment Depth (mm)
88.9	660.4	1828.6



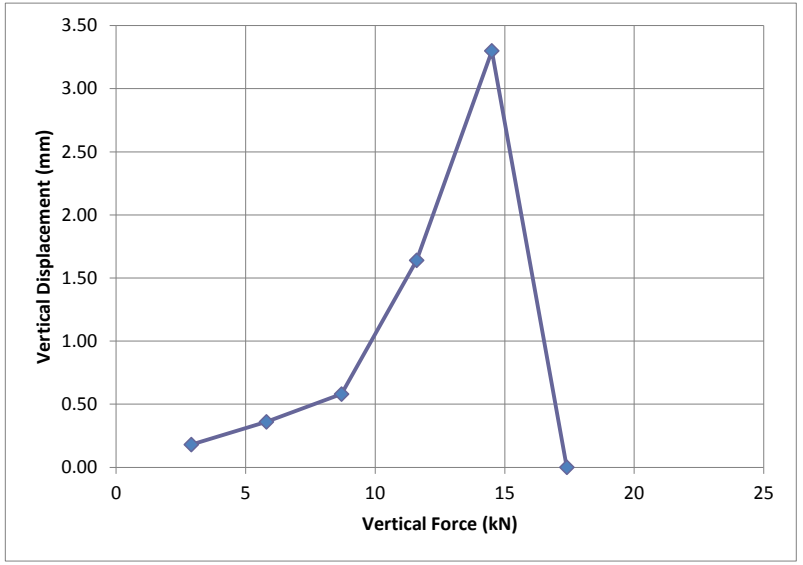


Project Name:	**Community Energy Solar, LLC**
Project Location:	**Quarryville, PA**
Project Number:	**SRP20120035**

Pile No. KTP2

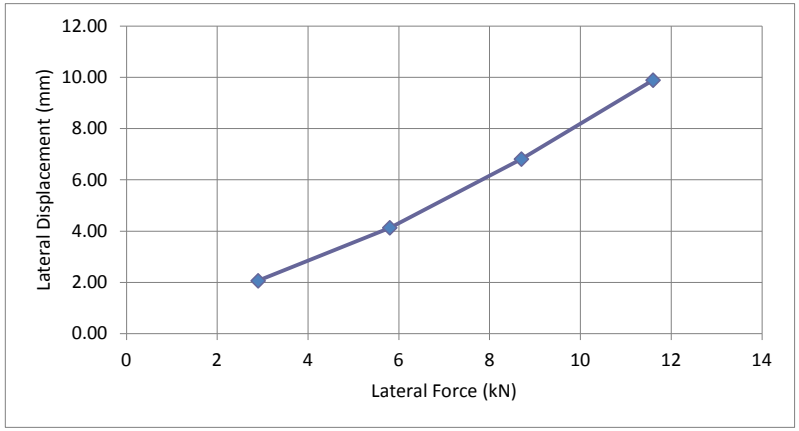
Vertical Loading Test Data

Vertical Pressure (bar)	Vertical Force (kN)	Vertical Displacement (mm)
20	2.9	0.18
40	5.8	0.36
60	8.7	0.58
80	11.6	1.64
100	14.5	3.30
120	17.4	**22.46; Test Failed**
140	20.3	
160	23.2	
180	26.1	
200	29.0	



Lateral Resistance Test Data

Lateral Pressure (bar)	Lateral Force (kN)	Lateral Displacement (mm)
20	2.9	2.06
40	5.8	4.13
60	8.7	6.81
80	11.6	9.89
100	14.5	12.98



Surface Conditions

Height of Caliper (mm)	Height of Jack (mm)	Embedment Depth (mm)
114.3	685.8	2133.6

Project Name:	**Community Energy Solar, LLC**
Project Location:	**Quarryville, PA**
Project Number:	**SRP20120035**

Pile No. KTP3

Vertical Loading Test Data

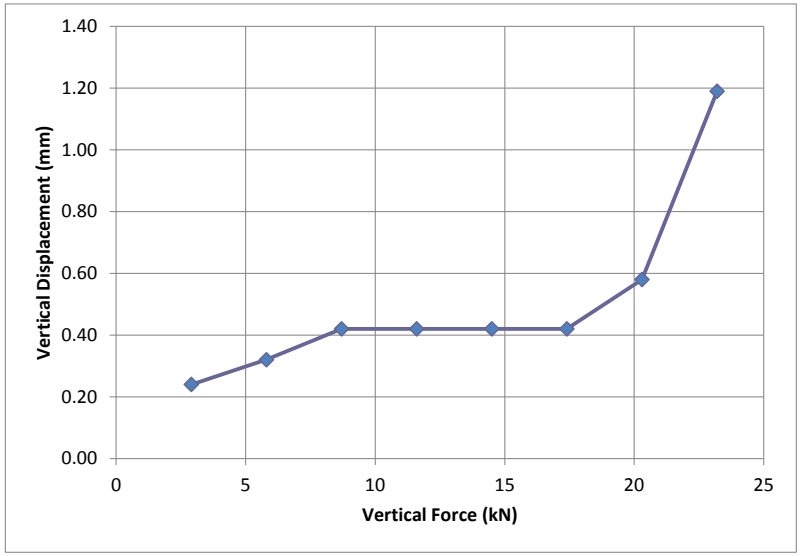
Vertical Pressure (bar)	Vertical Force (kN)	Vertical Displacement (mm)
20	2.9	0.24
40	5.8	0.32
60	8.7	0.42
80	11.6	0.42
100	14.5	0.42
120	17.4	0.42
140	20.3	0.58
160	23.2	1.19
180	26.1	1.19
200	29.0	1.58

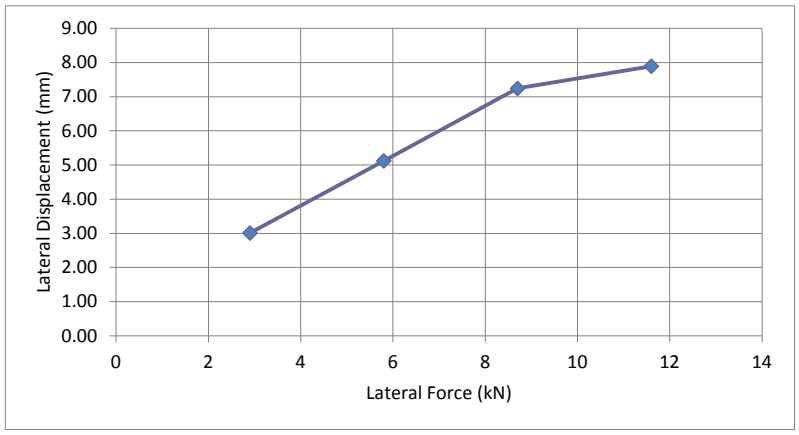
Lateral Resistance Test Data

Lateral Pressure (bar)	Lateral Force (kN)	Lateral Displacement (mm)
20	2.9	3.01
40	5.8	5.12
60	8.7	7.24
80	11.6	7.89
100	14.5	11.19

Surface Conditions

Height of Caliper (mm)	Height of Jack (mm)	Embedment Depth (mm)
107.9	571.5	2438.4



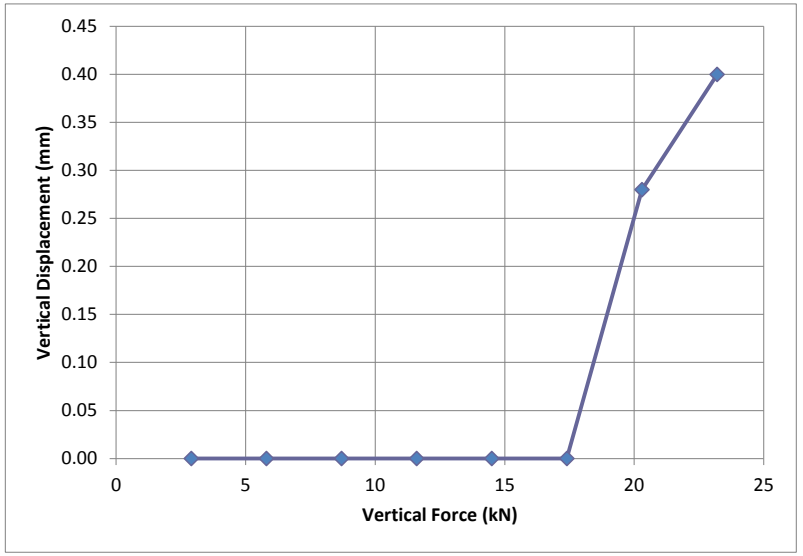


Project Name:	**Community Energy Solar, LLC**
Project Location:	**Quarryville, PA**
Project Number:	**SRP20120035**

Pile No. KTP4

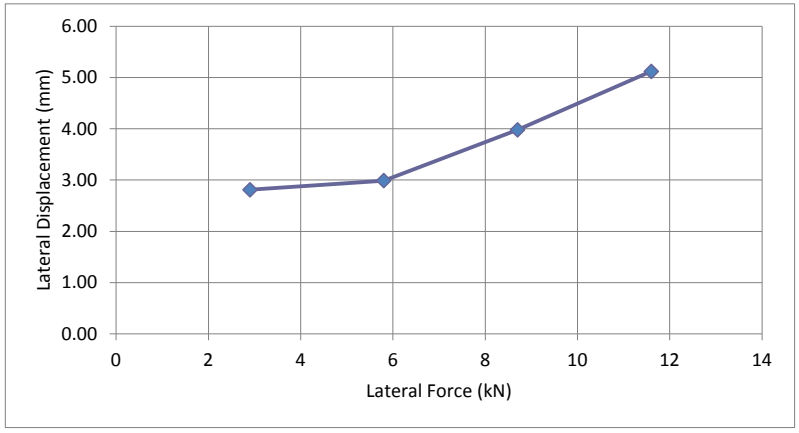
Vertical Loading Test Data

Vertical Pressure (bar)	Vertical Force (kN)	Vertical Displacement (mm)
20	2.9	0.00
40	5.8	0.00
60	8.7	0.00
80	11.6	0.00
100	14.5	0.00
120	17.4	0.00
140	20.3	0.28
160	23.2	0.40
180	26.1	1.09
200	29.0	1.13



Lateral Resistance Test Data

Lateral Pressure (bar)	Lateral Force (kN)	Lateral Displacement (mm)
20	2.9	2.81
40	5.8	2.99
60	8.7	3.98
80	11.6	5.12
100	14.5	6.89



Surface Conditions

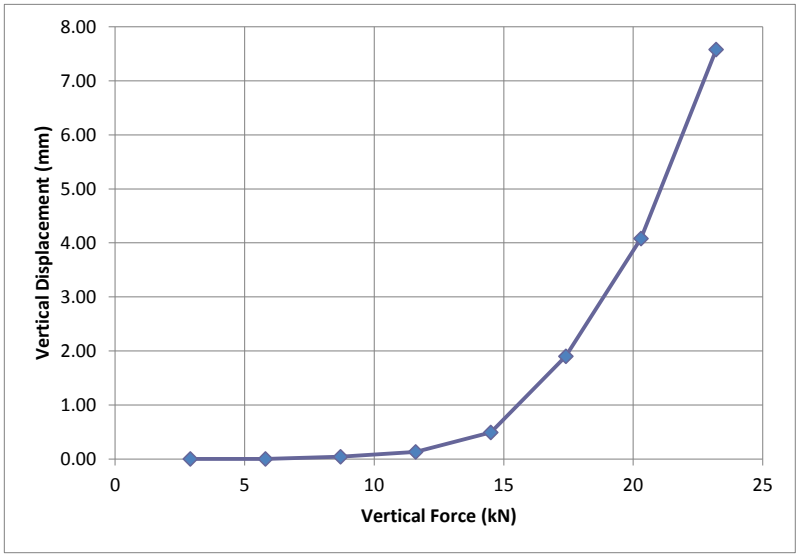
Height of Caliper (mm)	Height of Jack (mm)	Embedment Depth (mm)
120.6	622.3	2438.4

Project Name:	**Community Energy Solar, LLC**
Project Location:	**Quarryville, PA**
Project Number:	**SRP20120035**

Pile No. KTP5

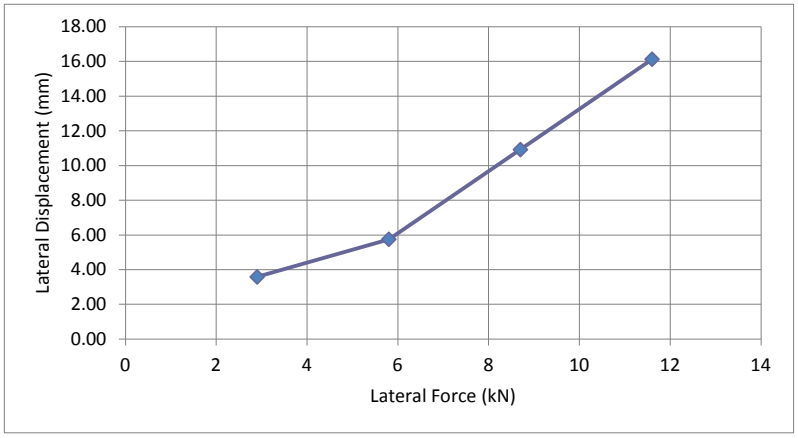
Vertical Loading Test Data

Vertical Pressure (bar)	Vertical Force (kN)	Vertical Displacement (mm)
20	2.9	0.00
40	5.8	0.00
60	8.7	0.04
80	11.6	0.13
100	14.5	0.49
120	17.4	1.90
140	20.3	4.08
160	23.2	7.58
180	26.1	9.39
200	29.0	11.95



Lateral Resistance Test Data

Lateral Pressure (bar)	Lateral Force (kN)	Lateral Displacement (mm)
20	2.9	3.58
40	5.8	5.75
60	8.7	10.92
80	11.6	16.13
100	14.5	**21.55; Test Failed**



Surface Conditions

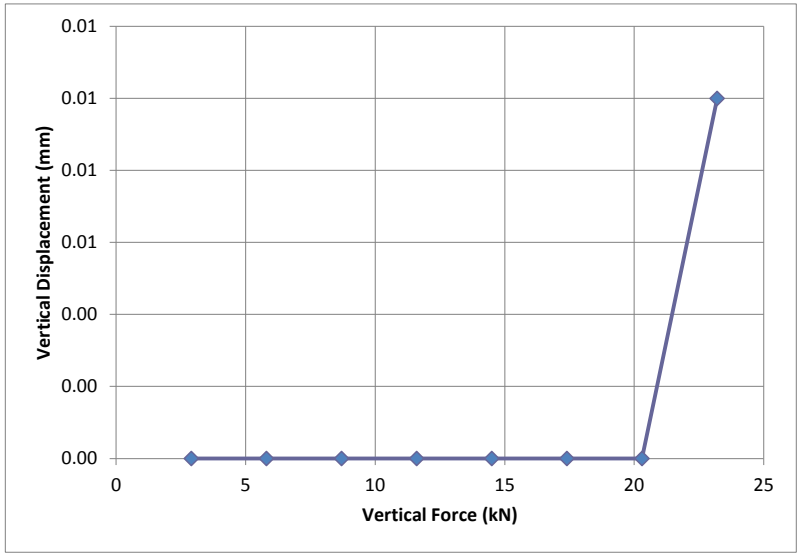
Height of Caliper (mm)	Height of Jack (mm)	Embedment Depth (mm)
88.9	622.3	2438.4

Project Name:	**Community Energy Solar, LLC**
Project Location:	**Quarryville, PA**
Project Number:	**SRP20120035**

Pile No. KTP6

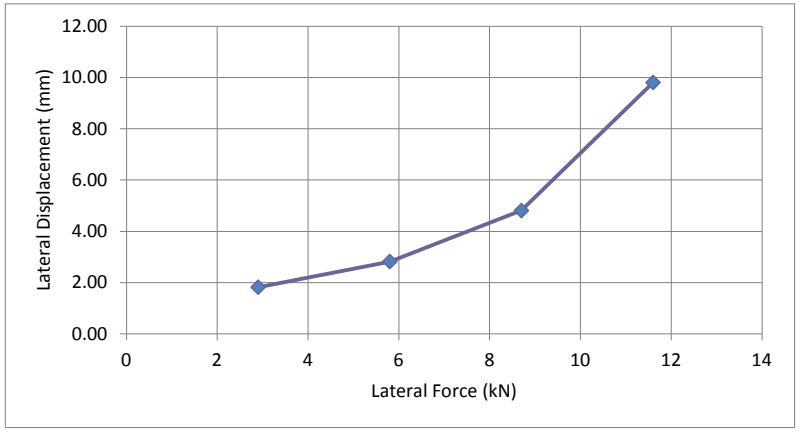
Vertical Loading Test Data

Vertical Pressure (bar)	Vertical Force (kN)	Vertical Displacement (mm)
20	2.9	0.00
40	5.8	0.00
60	8.7	0.00
80	11.6	0.00
100	14.5	0.00
120	17.4	0.00
140	20.3	0.00
160	23.2	0.01
180	26.1	0.02
200	29.0	0.06



Lateral Resistance Test Data

Lateral Pressure (bar)	Lateral Force (kN)	Lateral Displacement (mm)
20	2.9	1.82
40	5.8	2.82
60	8.7	4.81
80	11.6	9.81
100	14.5	15.82



Surface Conditions

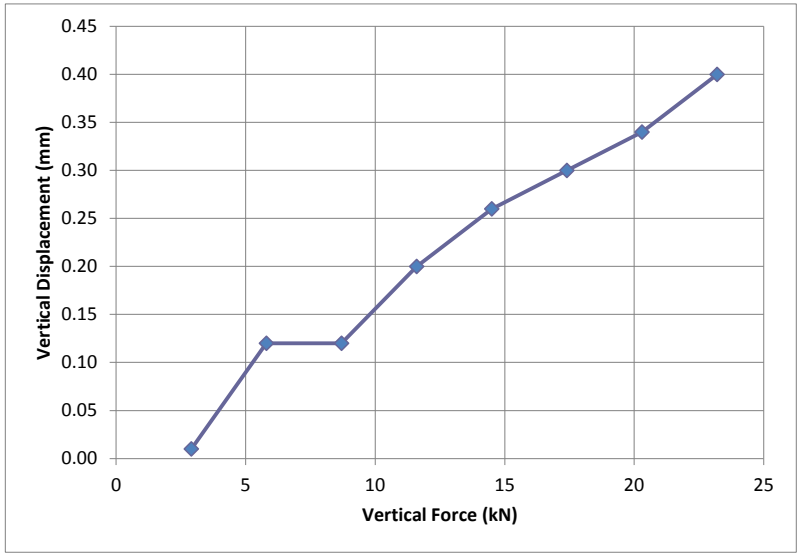
Height of Caliper (mm)	Height of Jack (mm)	Embedment Depth (mm)
101.6	698.5	2438.4

Project Name:	**Community Energy Solar, LLC**
Project Location:	**Quarryville, PA**
Project Number:	**SRP20120035**

Pile No. KTP7

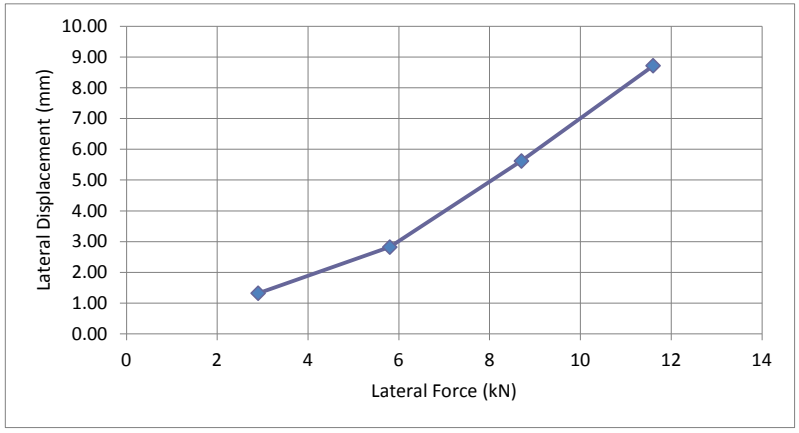
Vertical Loading Test Data

Vertical Pressure (bar)	Vertical Force (kN)	Vertical Displacement (mm)
20	2.9	0.01
40	5.8	0.12
60	8.7	0.12
80	11.6	0.20
100	14.5	0.26
120	17.4	0.30
140	20.3	0.34
160	23.2	0.40
180	26.1	0.49
200	29.0	0.54



Lateral Resistance Test Data

Lateral Pressure (bar)	Lateral Force (kN)	Lateral Displacement (mm)
20	2.9	1.32
40	5.8	2.82
60	8.7	5.62
80	11.6	8.72
100	14.5	11.21



Surface Conditions

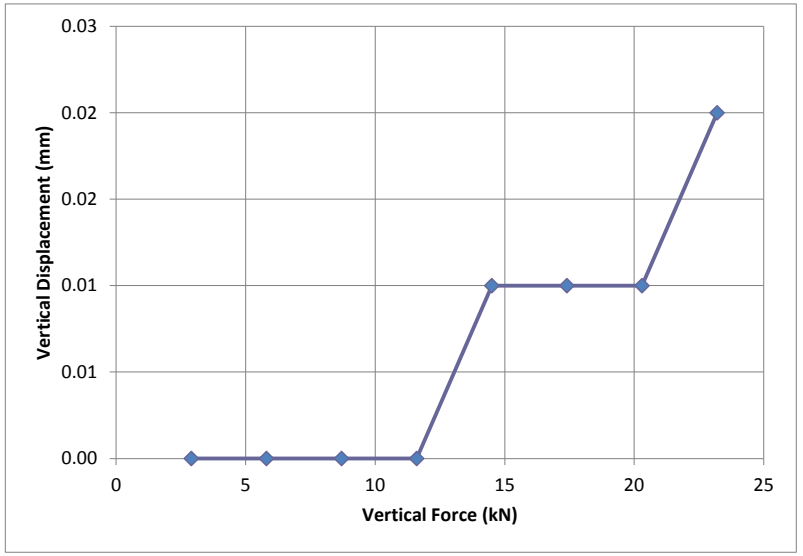
Height of Caliper (mm)	Height of Jack (mm)	Embedment Depth (mm)
114.3	584.2	2438.4

Project Name:	**Community Energy Solar, LLC**
Project Location:	**Quarryville, PA**
Project Number:	**SRP20120035**

Pile No. KTP8

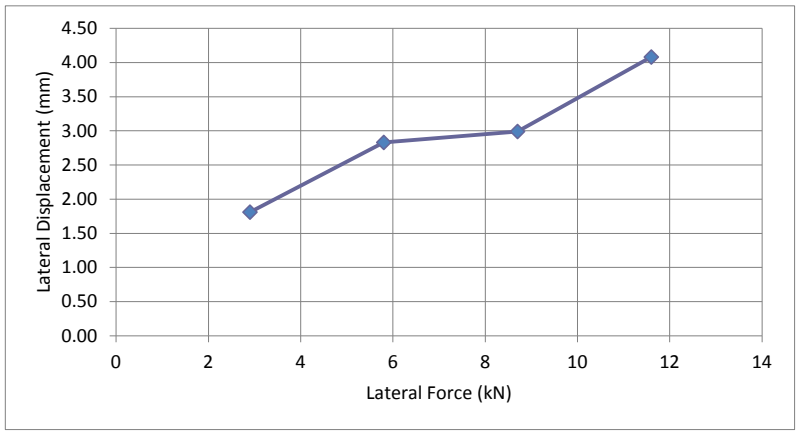
Vertical Loading Test Data

Vertical Pressure (bar)	Vertical Force (kN)	Vertical Displacement (mm)
20	2.9	0.00
40	5.8	0.00
60	8.7	0.00
80	11.6	0.00
100	14.5	0.01
120	17.4	0.01
140	20.3	0.01
160	23.2	0.02
180	26.1	0.02
200	29.0	0.02



Lateral Resistance Test Data

Lateral Pressure (bar)	Lateral Force (kN)	Lateral Displacement (mm)
20	2.9	1.81
40	5.8	2.83
60	8.7	2.99
80	11.6	4.08
100	14.5	5.99



Surface Conditions

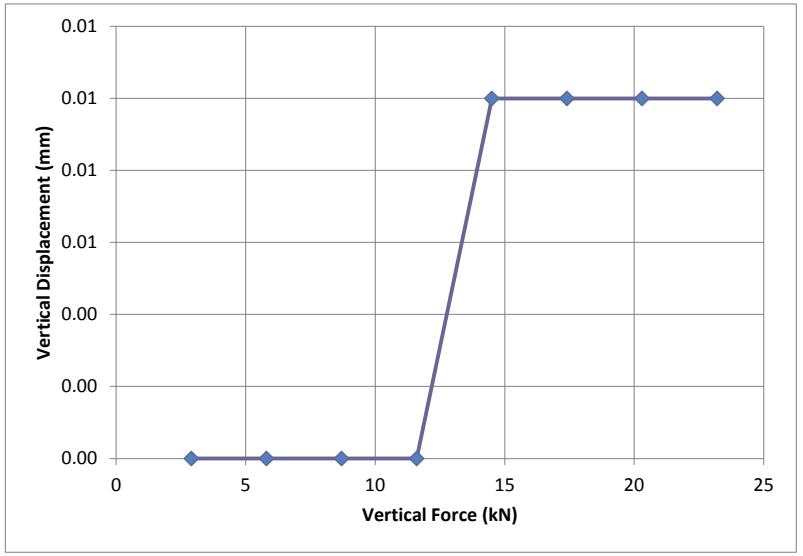
Height of Caliper (mm)	Height of Jack (mm)	Embedment Depth (mm)
88.9	609.6	2438.4

Project Name:	**Community Energy Solar, LLC**
Project Location:	**Quarryville, PA**
Project Number:	**SRP20120035**

Pile No. KTP9

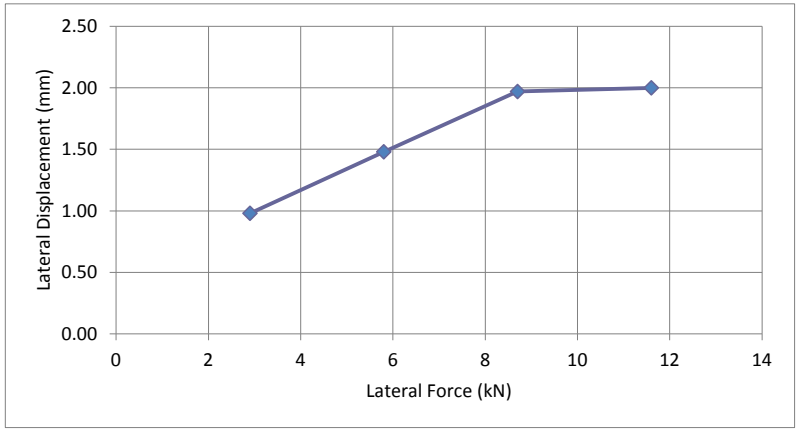
Vertical Loading Test Data

Vertical Pressure (bar)	Vertical Force (kN)	Vertical Displacement (mm)
20	2.9	0.00
40	5.8	0.00
60	8.7	0.00
80	11.6	0.00
100	14.5	0.01
120	17.4	0.01
140	20.3	0.01
160	23.2	0.01
180	26.1	0.01
200	29.0	0.01



Lateral Resistance Test Data

Lateral Pressure (bar)	Lateral Force (kN)	Lateral Displacement (mm)
20	2.9	0.98
40	5.8	1.48
60	8.7	1.97
80	11.6	2.00
100	14.5	5.32



Surface Conditions

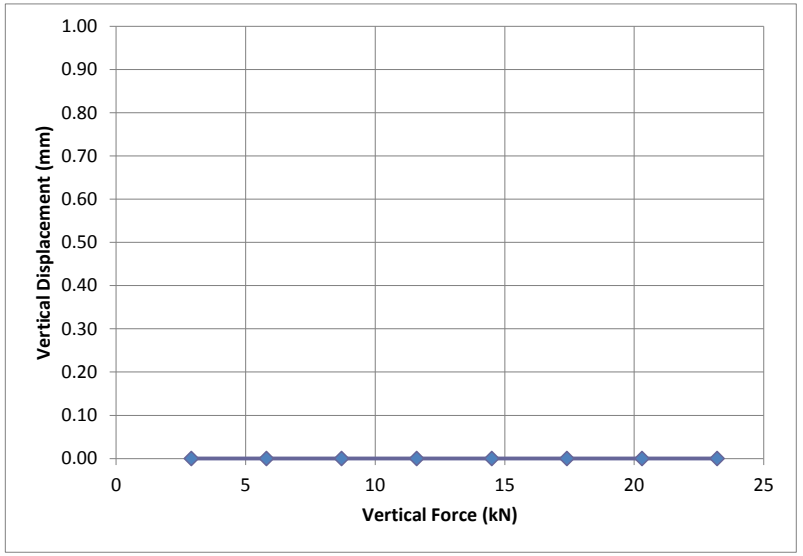
Height of Caliper (mm)	Height of Jack (mm)	Embedment Depth (mm)
101.6	660.4	2438.4

Project Name:	**Community Energy Solar, LLC**
Project Location:	**Quarryville, PA**
Project Number:	**SRP20120035**

Pile No. KTP10

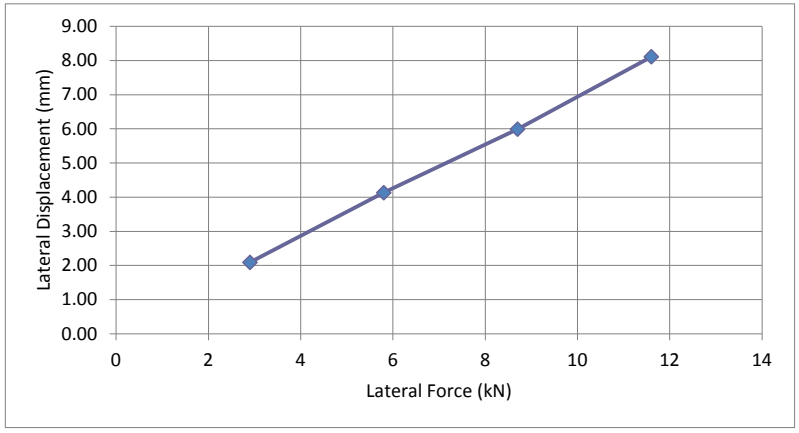
Vertical Loading Test Data

Vertical Pressure (bar)	Vertical Force (kN)	Vertical Displacement (mm)
20	2.9	0.00
40	5.8	0.00
60	8.7	0.00
80	11.6	0.00
100	14.5	0.00
120	17.4	0.00
140	20.3	0.00
160	23.2	0.00
180	26.1	0.00
200	29.0	0.00



Lateral Resistance Test Data

Lateral Pressure (bar)	Lateral Force (kN)	Lateral Displacement (mm)
20	2.9	2.09
40	5.8	4.13
60	8.7	5.99
80	11.6	8.11
100	14.5	9.82



Surface Conditions

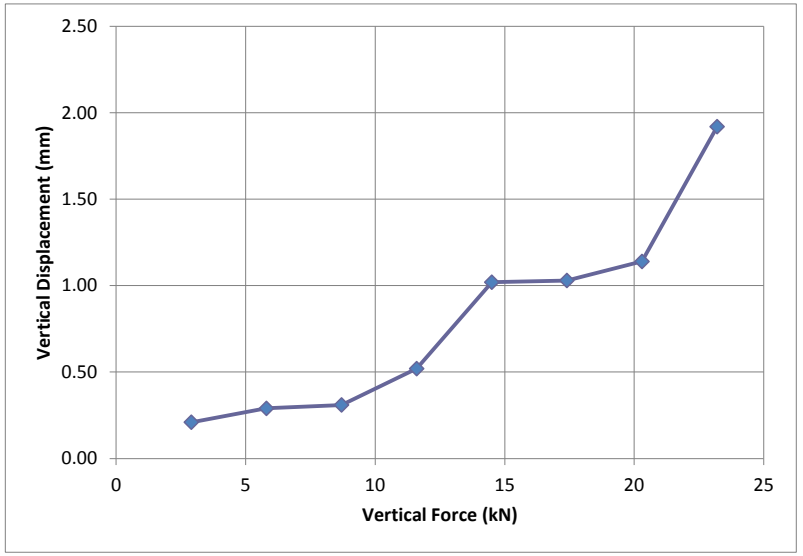
Height of Caliper (mm)	Height of Jack (mm)	Embedment Depth (mm)
95.3	609.6	2438.4

Project Name:	**Community Energy Solar, LLC**
Project Location:	**Quarryville, PA**
Project Number:	**SRP20120035**

Pile No. KTP11

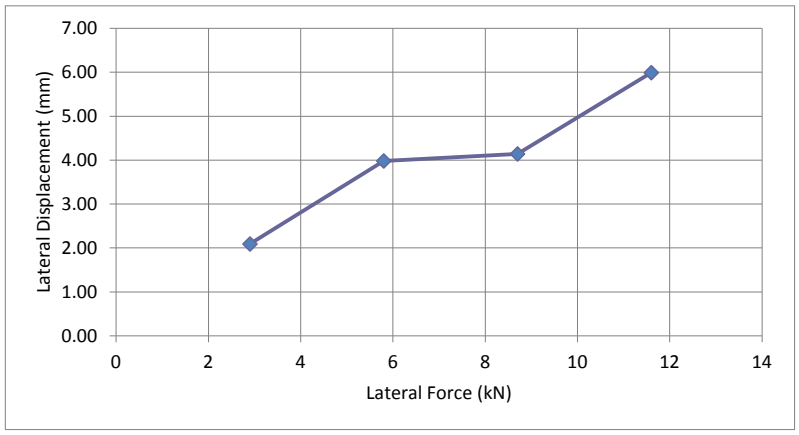
Vertical Loading Test Data

Vertical Pressure (bar)	Vertical Force (kN)	Vertical Displacement (mm)
20	2.9	0.21
40	5.8	0.29
60	8.7	0.31
80	11.6	0.52
100	14.5	1.02
120	17.4	1.03
140	20.3	1.14
160	23.2	1.92
180	26.1	1.99
200	29.0	1.99



Lateral Resistance Test Data

Lateral Pressure (bar)	Lateral Force (kN)	Lateral Displacement (mm)
20	2.9	2.09
40	5.8	3.98
60	8.7	4.14
80	11.6	5.99
100	14.5	8.12



Surface Conditions

Height of Caliper (mm)	Height of Jack (mm)	Embedment Depth (mm)
88.9	698.5	2438.4

Project Name:	**Community Energy Solar, LLC**
Project Location:	**Quarryville, PA**
Project Number:	**SRP20120035**

Pile No. KTP12

Vertical Loading Test Data

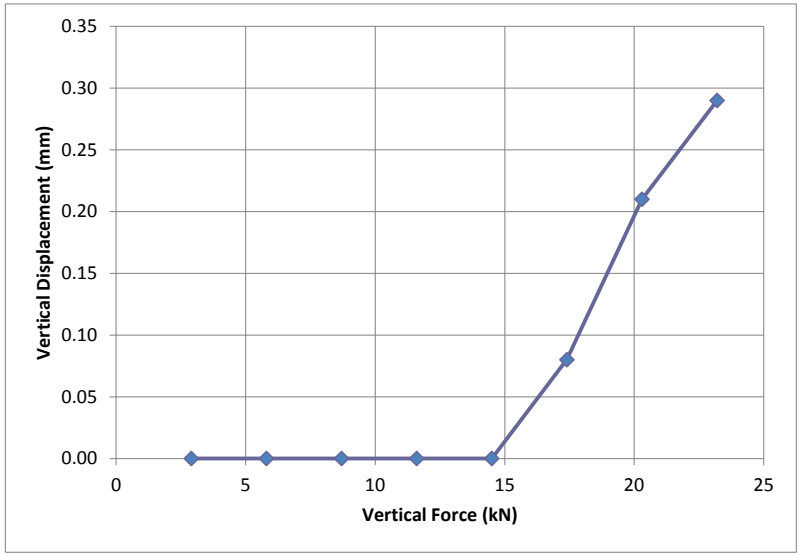
Vertical Pressure (bar)	Vertical Force (kN)	Vertical Displacement (mm)
20	2.9	0.00
40	5.8	0.00
60	8.7	0.00
80	11.6	0.00
100	14.5	0.00
120	17.4	0.08
140	20.3	0.21
160	23.2	0.29
180	26.1	0.40
200	29.0	0.49

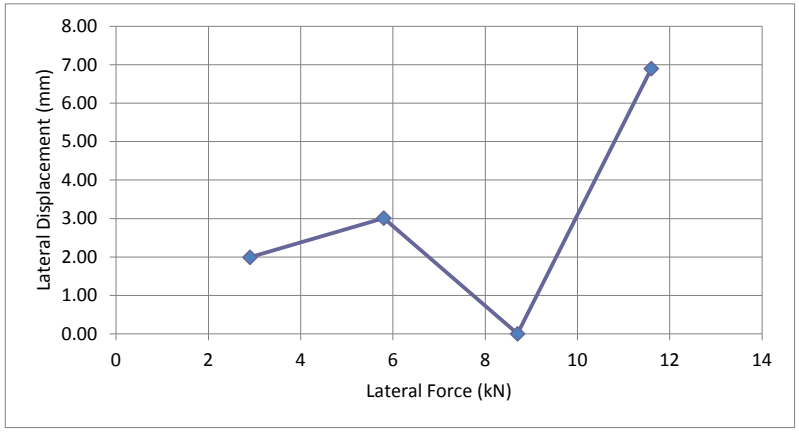
Lateral Resistance Test Data

Lateral Pressure (bar)	Lateral Force (kN)	Lateral Displacement (mm)
20	2.9	1.99
40	5.8	3.01
60	8.7	4.894.90
80	11.6	6.90
100	14.5	11.03

Surface Conditions

Height of Caliper (mm)	Height of Jack (mm)	Embedment Depth (mm)
114.3	622.3	2438.4



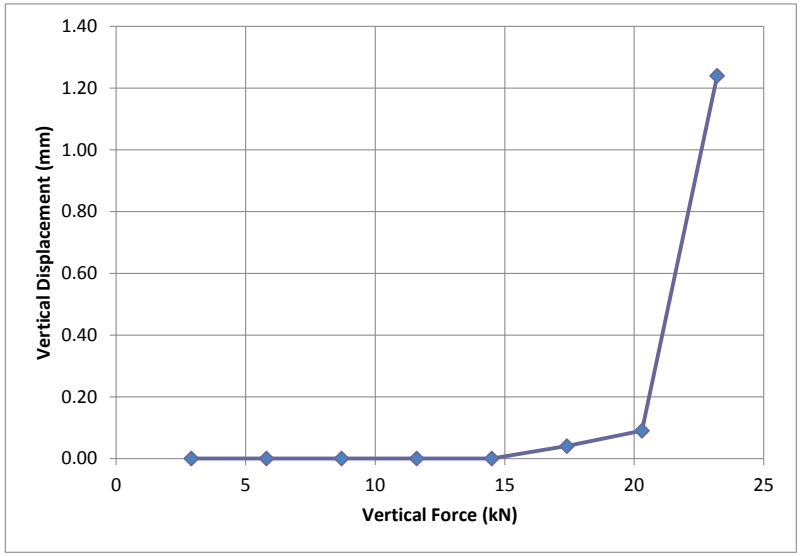


Project Name:	**Community Energy Solar, LLC**
Project Location:	**Quarryville, PA**
Project Number:	**SRP20120035**

Pile No. KTP13

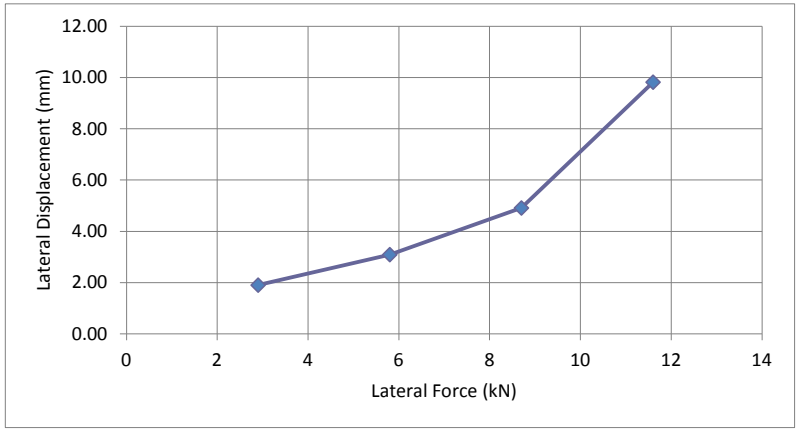
Vertical Loading Test Data

Vertical Pressure (bar)	Vertical Force (kN)	Vertical Displacement (mm)
20	2.9	0.00
40	5.8	0.00
60	8.7	0.00
80	11.6	0.00
100	14.5	0.00
120	17.4	0.04
140	20.3	0.09
160	23.2	1.24
180	26.1	2.01
200	29.0	2.52



Lateral Resistance Test Data

Lateral Pressure (bar)	Lateral Force (kN)	Lateral Displacement (mm)
20	2.9	1.90
40	5.8	3.09
60	8.7	4.91
80	11.6	9.82
100	14.5	14.01



Surface Conditions

Height of Caliper (mm)	Height of Jack (mm)	Embedment Depth (mm)
107.9	565.2	2438.4

Project Name:	**Community Energy Solar, LLC**
Project Location:	**Quarryville, PA**
Project Number:	**SRP20120035**

Pile No. KTP14

Vertical Loading Test Data

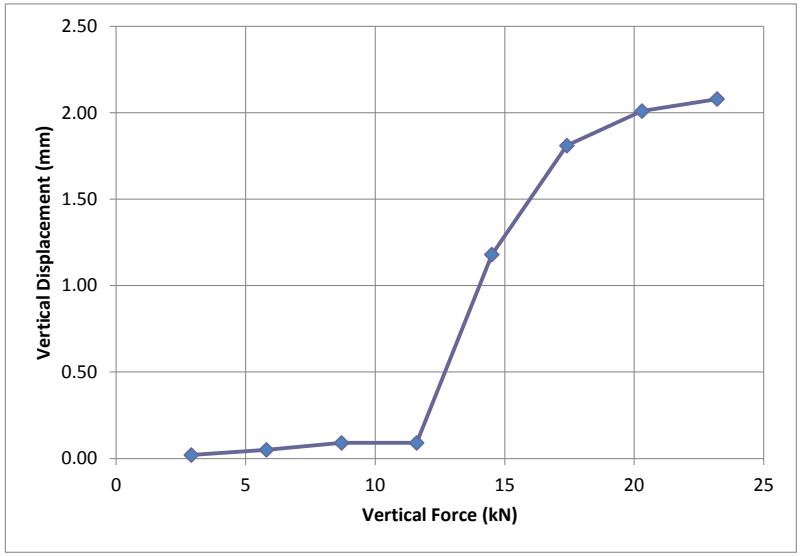
Vertical Pressure (bar)	Vertical Force (kN)	Vertical Displacement (mm)
20	2.9	0.02
40	5.8	0.05
60	8.7	0.09
80	11.6	0.09
100	14.5	1.18
120	17.4	1.81
140	20.3	2.01
160	23.2	2.08
180	26.1	2.18
200	29.0	2.38

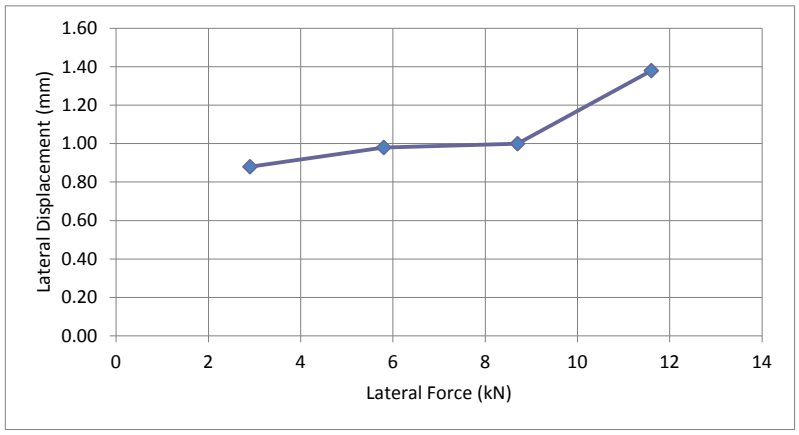
Lateral Resistance Test Data

Lateral Pressure (bar)	Lateral Force (kN)	Lateral Displacement (mm)
20	2.9	0.88
40	5.8	0.98
60	8.7	1.00
80	11.6	1.38
100	14.5	1.48

Surface Conditions

Height of Caliper (mm)	Height of Jack (mm)	Embedment Depth (mm)
95.3	622.3	2438.4



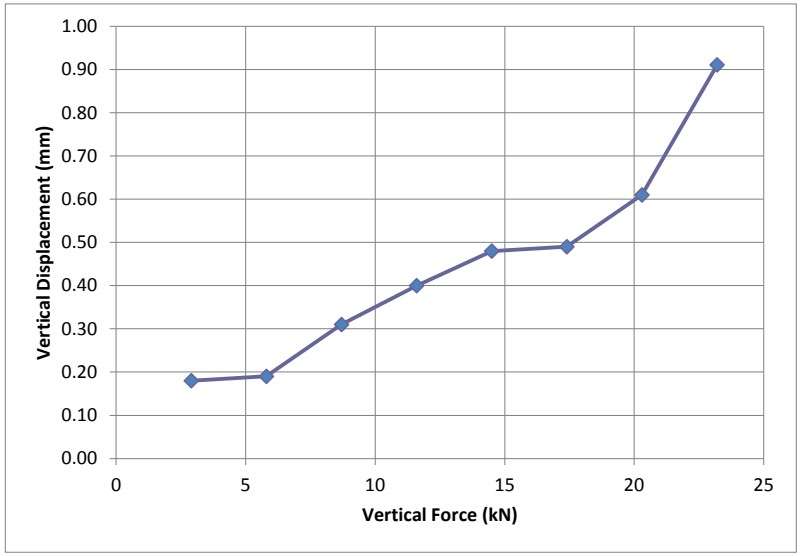


Project Name:	**Community Energy Solar, LLC**
Project Location:	**Quarryville, PA**
Project Number:	**SRP20120035**

Pile No. KTP15

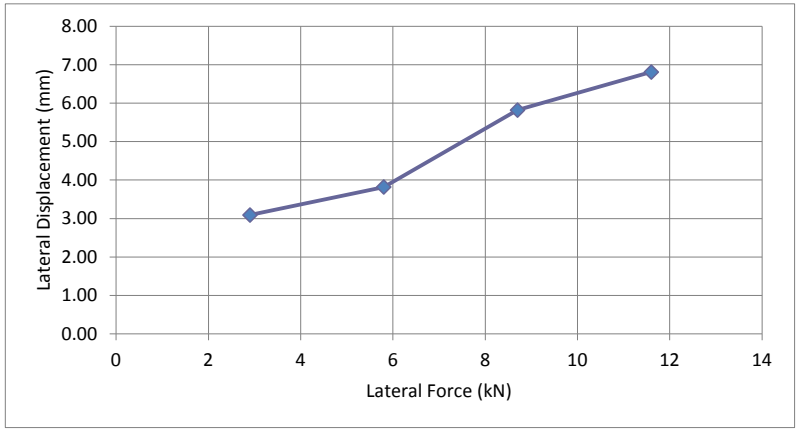
Vertical Loading Test Data

Vertical Pressure (bar)	Vertical Force (kN)	Vertical Displacement (mm)
20	2.9	0.18
40	5.8	0.19
60	8.7	0.31
80	11.6	0.40
100	14.5	0.48
120	17.4	0.49
140	20.3	0.61
160	23.2	0.91
180	26.1	0.99
200	29.0	1.23



Lateral Resistance Test Data

Lateral Pressure (bar)	Lateral Force (kN)	Lateral Displacement (mm)
20	2.9	3.09
40	5.8	3.82
60	8.7	5.82
80	11.6	6.81
100	14.5	8.01



Surface Conditions

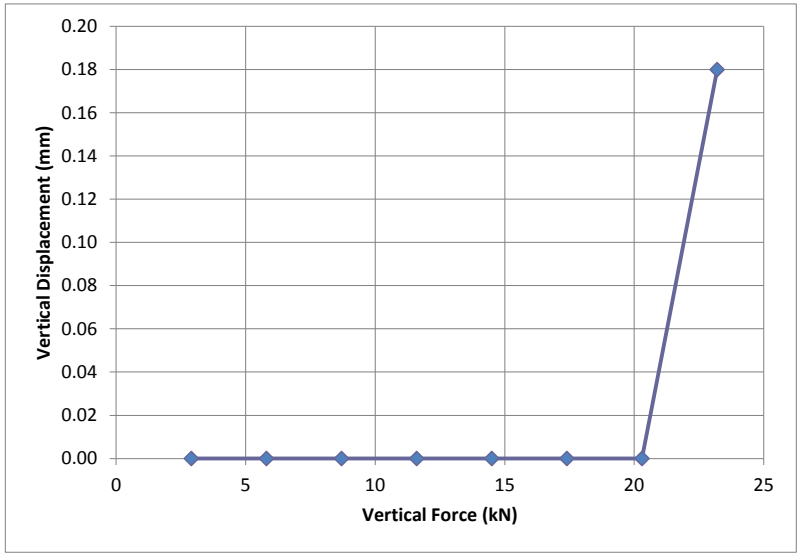
Height of Caliper (mm)	Height of Jack (mm)	Embedment Depth (mm)
107.9	596.9	2438.4

Project Name:	**Community Energy Solar, LLC**
Project Location:	**Quarryville, PA**
Project Number:	**SRP20120035**

Pile No. KTP16

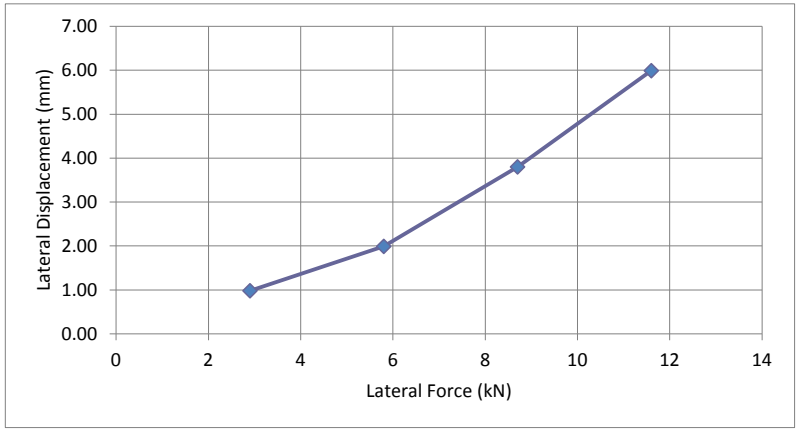
Vertical Loading Test Data

Vertical Pressure (bar)	Vertical Force (kN)	Vertical Displacement (mm)
20	2.9	0.00
40	5.8	0.00
60	8.7	0.00
80	11.6	0.00
100	14.5	0.00
120	17.4	0.00
140	20.3	0.00
160	23.2	0.18
180	26.1	0.38
200	29.0	1.23



Lateral Resistance Test Data

Lateral Pressure (bar)	Lateral Force (kN)	Lateral Displacement (mm)
20	2.9	0.98
40	5.8	1.99
60	8.7	3.80
80	11.6	5.99
100	14.5	11.01



Surface Conditions

Height of Caliper (mm)	Height of Jack (mm)	Embedment Depth (mm)
76.2	609.6	2438.4

Project Name:	**Community Energy Solar, LLC**
Project Location:	**Quarryville, PA**
Project Number:	**SRP20120035**

Pile No. KTP17

Vertical Loading Test Data

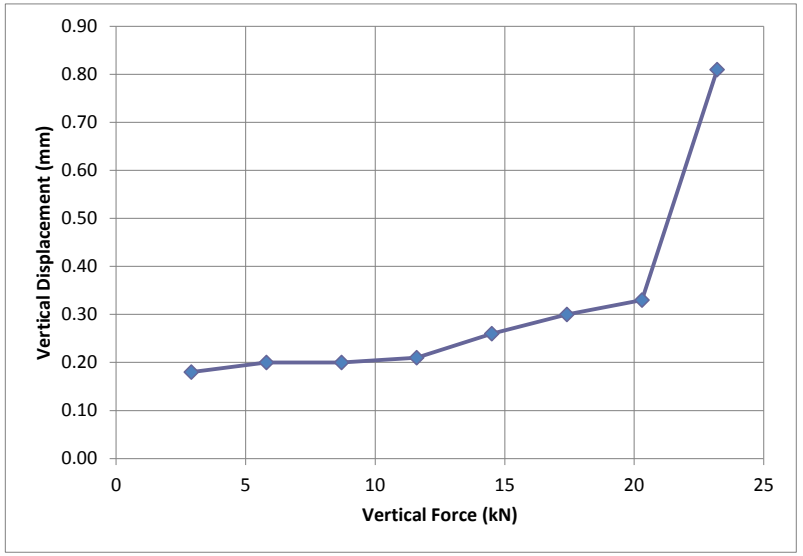
Vertical Pressure (bar)	Vertical Force (kN)	Vertical Displacement (mm)
20	2.9	0.18
40	5.8	0.20
60	8.7	0.20
80	11.6	0.21
100	14.5	0.26
120	17.4	0.30
140	20.3	0.33
160	23.2	0.81
180	26.1	0.92
200	29.0	0.92

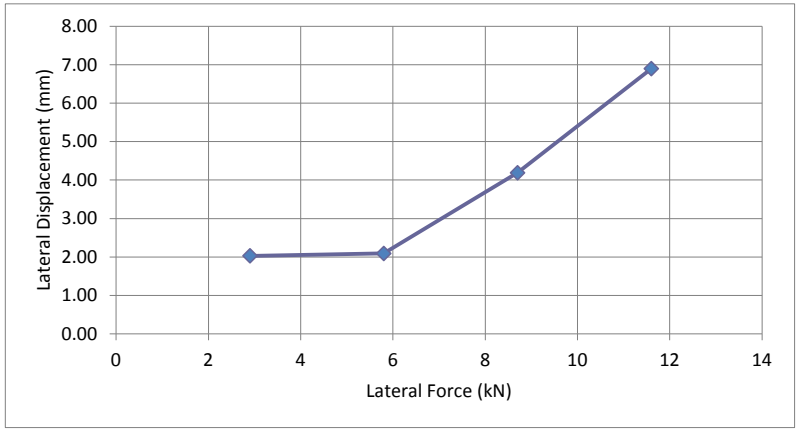
Lateral Resistance Test Data

Lateral Pressure (bar)	Lateral Force (kN)	Lateral Displacement (mm)
20	2.9	2.03
40	5.8	2.09
60	8.7	4.19
80	11.6	6.90
100	14.5	9.98

Surface Conditions

Height of Caliper (mm)	Height of Jack (mm)	Embedment Depth (mm)
120.6	698.5	2438.4



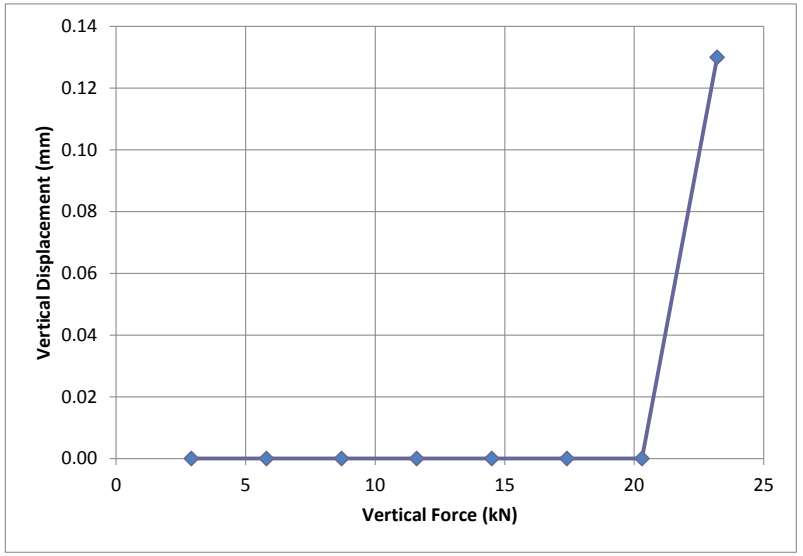


Project Name:	**Community Energy Solar, LLC**
Project Location:	**Quarryville, PA**
Project Number:	**SRP20120035**

Pile No. KTP18

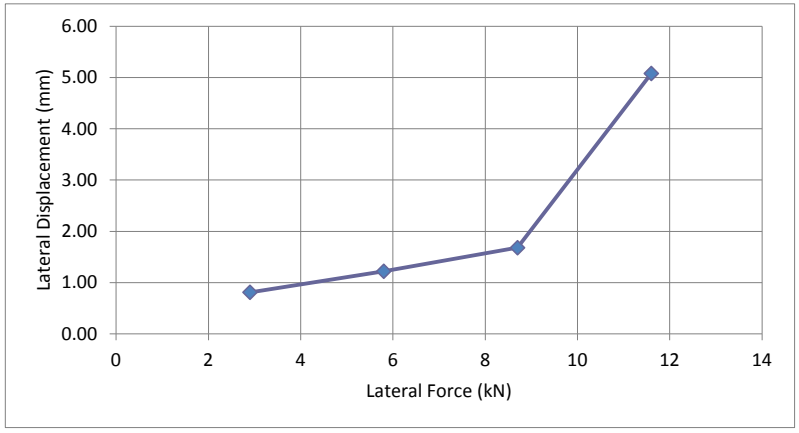
Vertical Loading Test Data

Vertical Pressure (bar)	Vertical Force (kN)	Vertical Displacement (mm)
20	2.9	0.00
40	5.8	0.00
60	8.7	0.00
80	11.6	0.00
100	14.5	0.00
120	17.4	0.00
140	20.3	0.00
160	23.2	0.13
180	26.1	0.13
200	29.0	0.19



Lateral Resistance Test Data

Lateral Pressure (bar)	Lateral Force (kN)	Lateral Displacement (mm)
20	2.9	0.81
40	5.8	1.22
60	8.7	1.68
80	11.6	5.08
100	14.5	6.99



Surface Conditions

Height of Caliper (mm)	Height of Jack (mm)	Embedment Depth (mm)
107.9	666.7	2438.4

Project Name:	**Community Energy Solar, LLC**
Project Location:	**Quarryville, PA**
Project Number:	**SRP20120035**

Pile No. KTP19

Vertical Loading Test Data

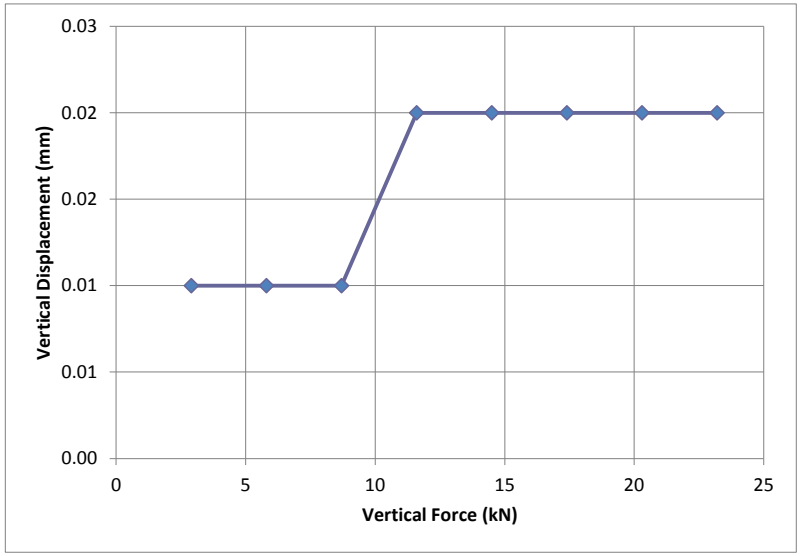
Vertical Pressure (bar)	Vertical Force (kN)	Vertical Displacement (mm)
20	2.9	0.01
40	5.8	0.01
60	8.7	0.01
80	11.6	0.02
100	14.5	0.02
120	17.4	0.02
140	20.3	0.02
160	23.2	0.02
180	26.1	0.05
200	29.0	0.06

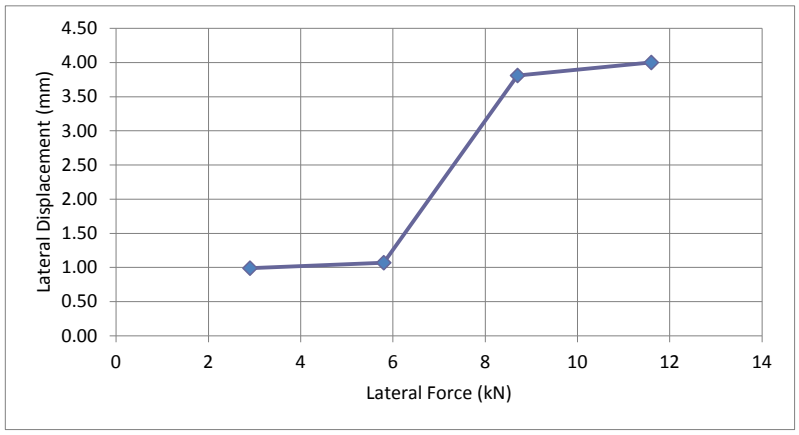
Lateral Resistance Test Data

Lateral Pressure (bar)	Lateral Force (kN)	Lateral Displacement (mm)
20	2.9	0.99
40	5.8	1.07
60	8.7	3.81
80	11.6	4.00
100	14.5	9.82

Surface Conditions

Height of Caliper (mm)	Height of Jack (mm)	Embedment Depth (mm)
127.0	596.9	2438.4





Project Name:	**Community Energy Solar, LLC**
Project Location:	**Quarryville, PA**
Project Number:	**SRP20120035**

Pile No. KTP20

Vertical Loading Test Data

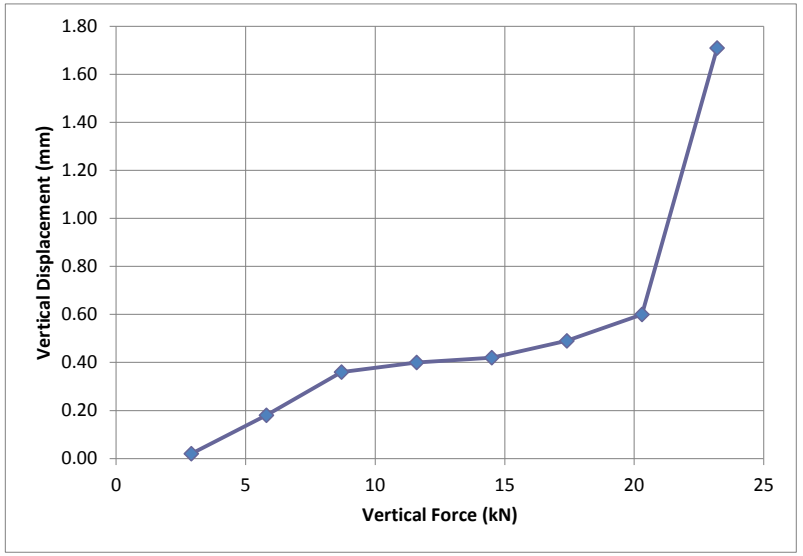
Vertical Pressure (bar)	Vertical Force (kN)	Vertical Displacement (mm)
20	2.9	0.02
40	5.8	0.18
60	8.7	0.36
80	11.6	0.40
100	14.5	0.42
120	17.4	0.49
140	20.3	0.60
160	23.2	1.71
180	26.1	2.01
200	29.0	2.99

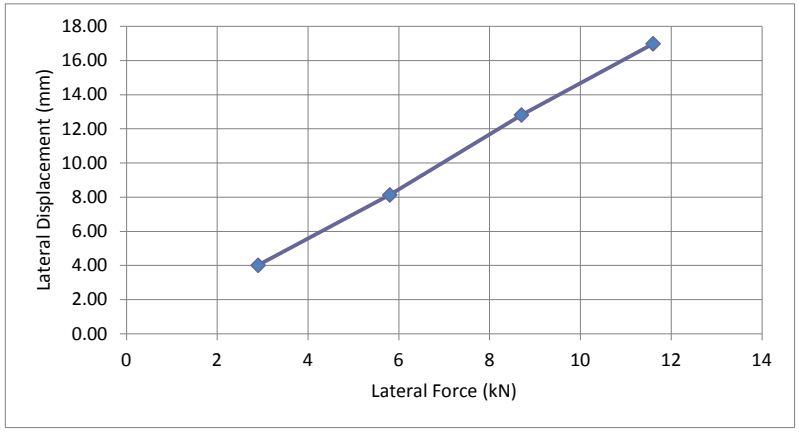
Lateral Resistance Test Data

Lateral Pressure (bar)	Lateral Force (kN)	Lateral Displacement (mm)
20	2.9	4.01
40	5.8	8.13
60	8.7	12.81
80	11.6	16.98
100	14.5	17.82

Surface Conditions

Height of Caliper (mm)	Height of Jack (mm)	Embedment Depth (mm)
101.6	622.3	2438.4





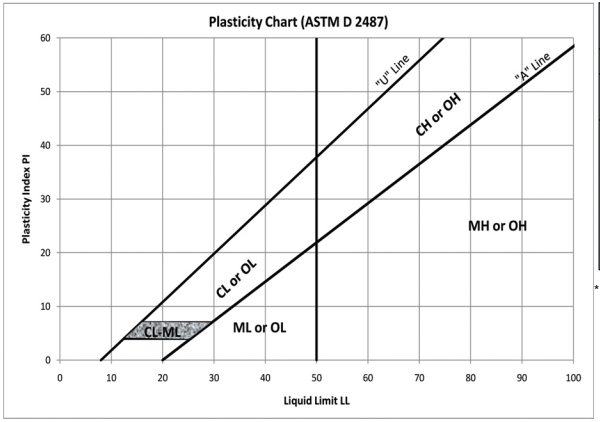
APPENDIX C

Unified Soil Classification System (USCS)
(ASTM 2487-98)

Laboratory Results

UNIFIED SOIL CLASSIFICATION (ASTM D-2487-98)

MATERIAL TYPES	CRITERIA FOR ASSIGNING SOIL GROUP NAMES			GROUP SYMBOL	SOIL GROUP NAMES & LEGEND	
COARSE-GRAINED SOILS >50% RETAINED ON NO. 200 SIEVE	GRAVELS >50% OF COARSE FRACTION RETAINED ON NO 4. SIEVE	CLEAN GRAVELS <5% FINES	$C_u \geq 4$ AND $1 \leq C_c \leq 3$	GW	WELL-GRADED GRAVEL	
			$C_u \geq 4$ AND/OR $1 \geq C_c \geq 3$	GP	POORLY-GRADED GRAVEL	
		GRAVELS WITH FINES >12% FINES	FINES CLASSIFY AS ML OR CL	GM	SILTY GRAVEL	
			FINES CLASSIFY AS CL OR CH	GC	CLAYEY GRAVEL	
	SANDS >50% OF COARSE FRACTION PASSES ON NO 4. SIEVE	CLEAN SANDS <5% FINES	$C_u \geq 6$ AND $1 \leq C_c \leq 3$	SW	WELL-GRADED SAND	
			$C_u \geq 6$ AND/OR $1 \geq Cc \geq 3$	SP	POORLY-GRADED SAND	
		SANDS AND FINES >12% FINES	FINES CLASSIFY AS ML OR MH	SM	SILTY SAND	
			FINES CLASSIFY AS CL OR CH	SC	CLAYEY SAND	
FINE-GRAINED SOILS >50% PASSES NO. 200 SIEVE	SILTS AND CLAYS LIQUID LIMIT<50	INORGANIC	PI>7 AND PLOTS>"A" LINE	CL	LEAN CLAY	
			PI>4 AND PLOTS<"A" LINE	ML	SILT	
		ORGANIC	LL (oven dried)/LL (not dried)<0.75	OL	ORGANIC CLAY OR SILT	
	SILTS AND CLAYS LIQUID LIMIT>50	INORGANIC	PI PLOTS >"A" LINE	CH	FAT CLAY	
			PI PLOTS <"A" LINE	MH	ELASTIC SILT	
		ORGANIC	LL (oven dried)/LL (not dried)<0.75	OH	ORGANIC CLAY OR SILT	
HIGHLY ORGANIC SOILS		PRIMARILY ORGANIC MATTER, DARK IN COLOR, AND ORGANIC ODOR		PT	PEAT	



PENETRATION RESISTANCE
(RECORDED AS BLOWS / 0.5 FT)

SAND & GRAVEL		SILT & CLAY		
RELATIVE DENSITY	BLOWS/FOOT*	CONSISTENCY	BLOWS/FOOT*	COMPRESSIVE STRENGTH (TSF)
VERY LOOSE	0 - 4	VERY SOFT	0 - 2	0 - 0.25
LOOSE	4 - 10	SOFT	2 - 4	0.25 - 0.50
MEDIUM DENSE	10 - 30	FIRM	4 - 8	0.50 - 1.0
DENSE	30 - 50	STIFF	8 - 15	1.0 - 2.0
VERY DENSE	OVER 50	VERY STIFF	15 - 30	2.0 - 4.0
		HARD	OVER 30	OVER 4.0

* NUMBER OF BLOWS OF 140 LB HAMMER FALLING 30 INCHES TO DRIVE A 2 INCH O.D. (1-3/8 INCH I.D.) SPLIT-BARREL SAMPLER THE LAST 12 INCHES OF AN 18-INCH DRIVE (ASTM-1586 STANDARD PENETRATION TEST).

SPEEDIE AND ASSOCIATES
Geotechnical ▪ Environmental ▪ Materials Engineers
3125 E. 47TH STREET ▪ TUCSON, ARIZONA 85713

LABORATORY REPORT

Physical Properties of Soil and Aggregate

Client: Schletter Inc.
ATTN: Robert Pates
3761 E. Farnum Place
Tucson, AZ 85706

Project No. 110589TT
Lab No. 365558
Field No. QSS1
Report Date: 2-03-2012

Project: Keystone Solar Farm
Location: Quarryville, PA
Material: Soil — Sampled By: Client — Date: 1-19-2012
Source: Native — Submitted By: DWH — Date: 1-30-2012
Supplier: n/a — Authorized By: Client — Date: 1-30-2012
Sample Location: TP1

SIEVE ANALYSIS - ASTM C 136 & D 1140 or D 6913

SIEVE SIZE in/mm	CUMULATIVE % PASSING	PROJECT SPECIFICATION
6" / 150	100	
3" / 75	100	
2½" / 62.5	100	
2" / 50	100	
1½" / 37.5	99	
1" / 25	99	
3/4" / 19	97	
½" / 12.5	95	
3/8" / 9.5	94	
1/4" / 6.3	93	
#4 / 4.75	92	
#8 / 2.36	89	
#10 / 2.00	88	
#16 / 1.18	85	
#30 / .600	82	
#40 / .425	80	
#50 / .300	78	
#100 / .150	71	
#200 / .075	63.5	

Comments: NT denotes material not tested for this property.

* denotes material out of specification.

% Gravel	8
% Sand	28
% Silt/clay	64

ADDITIONAL TESTING

PHYSICAL PROPERTIES	TEST RESULTS	TARGET/ SPECIFICATION
LIQUID & PLASTIC PROPERTIES, ASTM D 4318		
Liquid Limit	49	
Plastic Limit	26	
Plasticity Index	23	
SOIL CLASIFICATION, ASTM D 2487	CL, Sandy Lean Clay	
pH & RESISTIVITY OF SOIL & AGGREGATES, Ariz 236b		
Ph Value of Soil and Aggregate	6.4	
Minimum Resistivity of Soil & Aggregate (ohm-cm)	7,436	
Anions by Ion Chromatography E-300		
Chlorides in Soil	Not Detected	
Sulfates in Soil	69	

Copies to: Addressee (1)

Reviewed by
Laboratory Manager

SPEEDIE AND ASSOCIATES
Geotechnical ▪ Environmental ▪ Materials Engineers
3125 E. 47TH STREET ▪ TUCSON, ARIZONA 85713

LABORATORY REPORT

Physical Properties of Soil and Aggregate

Client: Schletter Inc.
ATTN: Robert Pates
3761 E. Farnum Place
Tucson, AZ 85706

Project No. 110589TT
Lab No. 365559
Field No. QSS2
Report Date: 2-03-2012

Project: Keystone Solar Farm
Location: Quarryville, PA
Material: Soil — Sampled By: Client — Date: 12-04-2011
Source: Native — Submitted By: DWH — Date: 1-30-2012
Supplier: n/a — Authorized By: Client — Date: 1-30-2012
Sample Location: TP10

SIEVE ANALYSIS - ASTM C 136 & D 1140 or D 6913

SIEVE SIZE in/mm	CUMULATIVE % PASSING	PROJECT SPECIFICATION
6" / 150	100	
3" / 75	100	
2½" / 62.5	100	
2" / 50	100	
1½" / 37.5	100	
1" / 25	99	
3/4" / 19	98	
½" / 12.5	96	
3/8" / 9.5	96	
1/4" / 6.3	94	
#4 / 4.75	94	
#8 / 2.36	92	
#10 / 2.00	91	
#16 / 1.18	90	
#30 / .600	88	
#40 / .425	87	
#50 / .300	85	
#100 / .150	81	
#200 / .075	76.1	

Comments: NT denotes material not tested for this property.

* denotes material out of specification.

% Gravel	6
% Sand	18
% Silt/clay	76

ADDITIONAL TESTING

PHYSICAL PROPERTIES	TEST RESULTS	TARGET/ SPECIFICATION
LIQUID & PLASTIC PROPERTIES, ASTM D 4318		
Liquid Limit	41	
Plastic Limit	25	
Plasticity Index	16	
SOIL CLASIFICATION, ASTM D 2487	CL, Sandy Lean Clay	
pH & RESISTIVITY OF SOIL & AGGREGATES, Ariz 236b		
Ph Value of Soil and Aggregate	7.4	
Minimum Resistivity of Soil & Aggregate (ohm-cm)	3,380	
Anions by Ion Chromatography E-300		
Chlorides in Soil	Not Detected	
Sulfates in Soil	110	

Copies to: Addressee (1)

Reviewed by
Laboratory Manager

SPEEDIE AND ASSOCIATES
Geotechnical ▪ Environmental ▪ Materials Engineers
3125 E. 47TH STREET ▪ TUCSON, ARIZONA 85713

LABORATORY REPORT

Physical Properties of Soil and Aggregate

Client: Schletter Inc.
ATTN: Bill Shouse
3761 E. Farnum Place
Tucson, AZ 85706

Project No. 110589TT
Lab No. 365560
Field No. 3
Report Date: 2-02-2012

Project: Quarryville
Location: QSS3
Material: Soil — Sampled By: Client — Date: 12-04-2011
Source: Native — Submitted By: DWH — Date: 1-30-2011
Supplier: n/a — Authorized By: Client — Date: 1-30-2011
Sample Location: QSS3

SIEVE ANALYSIS - ASTM C 136 & D 1140 or D 6913

SIEVE SIZE in/mm	CUMULATIVE % PASSING	PROJECT SPECIFICATION
6" / 150	100	
3" / 75	100	
2½" / 62.5	100	
2" / 50	100	
1½" / 37.5	100	
1" / 25	100	
3/4" / 19	100	
½" / 12.5	99	
3/8" / 9.5	98	
1/4" / 6.3	98	
#4 / 4.75	98	
#8 / 2.36	95	
#10 / 2.00	95	
#16 / 1.18	93	
#30 / .600	90	
#40 / .425	89	
#50 / .300	87	
#100 / .150	82	
#200 / .075	74.8	

Comments: NT denotes material not tested for this property.

* denotes material out of specification.

% Gravel	2
% Sand	23
% Silt/clay	75

ADDITIONAL TESTING

PHYSICAL PROPERTIES	TEST RESULTS	TARGET/ SPECIFICATION
LIQUID & PLASTIC PROPERTIES, ASTM D 4318		
Liquid Limit	55	
Plastic Limit	30	
Plasticity Index	25	
SOIL CLASIFICATION, ASTM D 2487	CH, Fat Clay with Sand	
pH & RESISTIVITY OF SOIL & AGGREGATES, Ariz 236b		
Ph Value of Soil and Aggregate	5.7	
Minimum Resistivity of Soil & Aggregate (ohm-cm)	13,520	
Anions by Ion Chromatography E-300		
Chlorides in Soil	Not Detected	
Sulfates in Soil	Not Detected	

Copies to: Addressee (1)

Reviewed by
Laboratory Manager

APPENDIX D

Site Photographs

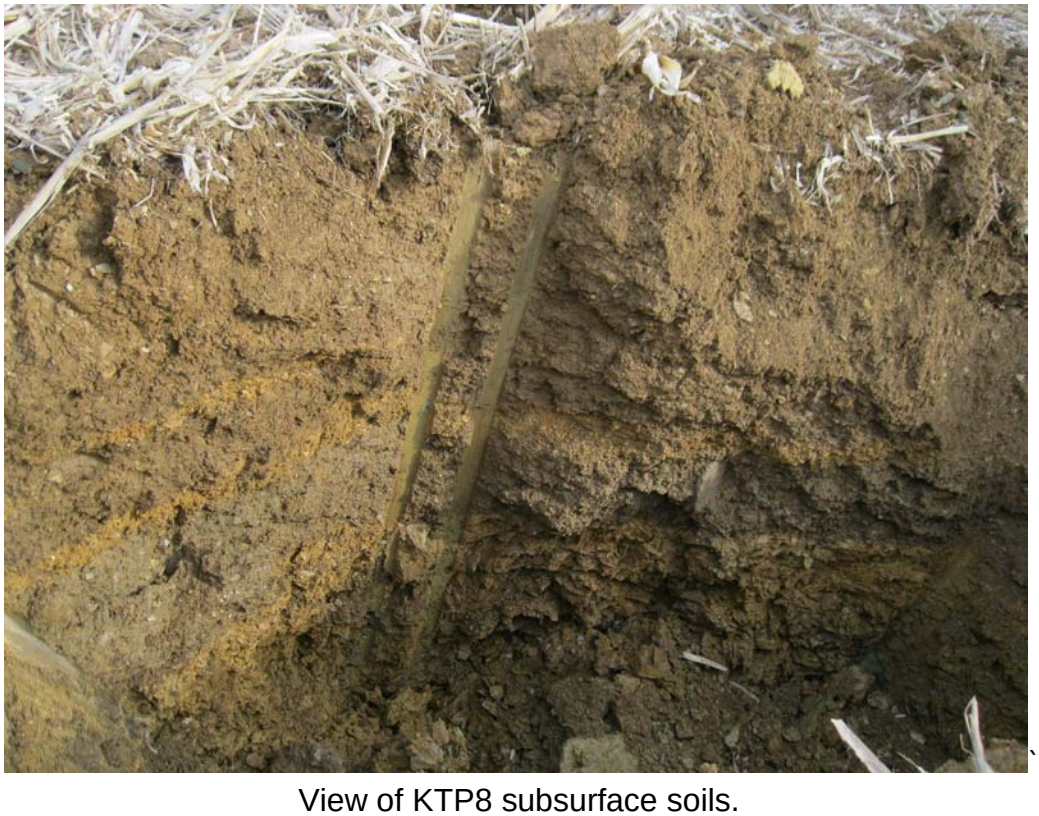
View of the Site and KTP1, KTP2 & KTP3 looking due east.

View of the Site looking southeast.

View of the Site looking south.

View of the Site main entrance and access road, with farm related buildings and a residential building in the background.

View of KTP18 excavation pit and soils pile.



View of KTP8 subsurface soils.