APPENDIX 5.4A

Initial Geotechnical Report

GEOTECHNICAL ENGINEERING REPORT

SOLAR POWER PLANT
IVANPAH VALLEY
SAN BERNARDINO COUNTY, CALIFORNIA

Project No. 64075017
July 11, 2007

Prepared for:

BRIGHT SOURCE ENERGY, INC.
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Prepared by:

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July 11, 2007

Bright Source Energy, Inc.
1999 Harrison Street, Suite 500
Oakland, California 94612

Attention: Mr. John Woolard

Subject: Geotechnical Engineering Report
Solar Power Plant
San Bernardino County, California
Terracon Project No. 64075017

Dear Mr. Woolard:

We are submitting the results of our geotechnical engineering study performed for the proposed Solar Power Plant in San Bernardino County, California. The accompanying report presents the results of our geotechnical exploration, laboratory testing, and engineering analyses, and provides preliminary design parameters for design of the project. The boring location diagram (Site and Exploration Plan) and individual boring logs are enclosed with this report.

Our professional services were performed using that degree of care and skill ordinarily exercised, under similar circumstances, by reputable geotechnical engineers practicing in this or similar localities. No warranties, either expressed or implied are intended or made.

We appreciate the opportunity to be of service to you in this phase of the project and look forward to assisting you during the construction phase. If you have any questions concerning this report, or if we may be of further service to you, please contact us.

Sincerely,
TERRACON CONSULTANTS, INC

Segu I. Ifham, EI
Geotechnical Staff Professional

Les C. Banas, P.E.
Geotechnical Department Manager

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GEOTECHNICAL ENGINEERING REPORT
SOLAR POWER PLANT
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INTRODUCTION

This report presents the results of our geotechnical engineering study performed for the proposed Solar Power Plant project. The project site is located in San Bernardino County, California, in the Ivanpah Valley, about two miles west of Ivanpah Dry Lake, just southwest of Primm. The general location of the project site is shown on Figure 1, Vicinity Map.

The purpose of our services was to explore the subsurface condition encountered in the borings, analyze and evaluate the test data and provide preliminary geotechnical engineering design parameters for the design of the project. The scope of our services did not include any environmental assessment or investigation for the presence or absence of hazardous or toxic material in structures, surface water, groundwater, or air, below or around this site.

PROJECT DESCRIPTION

It is our understanding that the proposed development involves design and construction of a 100MW (Mega Watt) solar power plant using proprietary heliostat and receiver tower technology. The project site will cover an area of approximately 1000 acres of land that is under the jurisdiction of Bureau of Land Management.

No grading or structural plans for the project have been provided to us. However, it is our understanding that the contemplated heliostat and receiver towers will be supported by spread footings and/or shallow cast-in-place piles. It is also our understanding that detailed design of foundations will be performed after a detailed geotechnical investigation.

SITE EXPLORATION PROCEDURES

Field Exploration

The scope of our services for this project included a subsurface exploration program that consisted of drilling 2 borings to a depth of approximately 80 feet below existing grades.

The borings were drilled using an auger-type drill rig (CME-85) with a 6-inch diameter, continuous-flight, hollow-stem auger. Penetration testing and soil sampling were performed using the Standard Penetration Test procedure, and a 2-inch diameter split-spoon sampler, respectively. The penetration value (SPT "N-value") was reported as the number of blows required to advance the sampler 12 inches using a 140-pound hammer free-falling 30 inches. The test refusal criterion of 50 blows for less than 6 inches of penetration was used during field exploration.

The borings were logged by Terracon field personnel during drilling and soil samples were obtained at 2½- to 5-foot intervals to aid in material classification and for laboratory testing. Logs of the borings are presented on Plates A-1 through A-12. A key to the terms used on the boring logs is presented on Plate A-i, General Notes. The soils were classified in general accordance with the Unified Soil Classification System (USCS) as explained on Plate A-ii. The symbols and abbreviations used in the boring logs are defined on Plate A-iii.

The approximate locations of the borings are shown on Figure 2, Site and Exploration Plan. The locations of the borings were determined in the field by measuring from existing features or improvements and should be considered accurate only to the degree implied by the method used.

Laboratory Testing

Laboratory tests were conducted on selected soil samples to characterize relevant physical and engineering properties of the in-situ soils. The test results are presented in Appendix B of this report.

Moisture content tests were performed on representative soil samples as part of our laboratory program, and the test results are presented on the boring logs at the corresponding sampling depths.

Sieve analyses were performed to determine the grain-size distribution, and Atterberg limits test were performed to determine the liquid and plastic limits of the in-situ soil. These tests are generally used to assist in classification of soils, to determine soil consistency, to evaluate liquefaction potential of granular soils, and to provide correlations with engineering properties of the soils such as strength and compressibility. The test results are presented on Plate B-1 in Appendix B.

Direct shear tests were performed to determine the strength parameters of the in-situ soils. Tests were performed at field moisture content and at various surcharge pressures. The test results are used to estimate the internal friction angle and cohesion of the soils and are presented on Plate B-2 in Appendix B.

Atlas Consultants, Inc. performed chemical tests on representative soil samples. The tests were performed to determine the percentage of water-soluble sulfate present in the in-situ soil. The test result indicates the soil to be potentially corrosive to concrete. The chemical test results are presented on Plate B-3 in Appendix B.

The soil samples were classified in the laboratory based on visual observation, texture, plasticity, and the limited laboratory testing described above. The soil descriptions presented on the boring logs for native soils are in accordance with our General Notes and the Unified Soil Classification System (USCS) that are provided in Appendix A. The assigned USCS symbols for the corresponding soil types are also shown on the boring logs.

GEOLOGIC INFORMATION

The project site is located in the Ivanpah Valley, about two miles west of Ivanpah Dry Lake. According to a geologic map[1] of the area, the project site is underlain by Cenozoic non-marine (continental) sedimentary rocks and alluvial deposits. Precambrian rocks of all types including coarse-grained intrusives are present in the west part of the Ivanpah Valley. The north side of the Ivanpah Valley is underlain by Paleozoic sedimentary and volcanic rocks; in places strongly metamorphosed.

The cumulative evidence indicates that fissures are the result of a subsurface erosional process. The erosional process occurs in tensional fractures at or near the surface in uncemented, relatively fine-grained soils. No fissures were observed at the site during our exploration.

Two fault scarps have been mapped east and west of the project site, within 10 miles of the site. The origins of the faults are uncertain. One theory indicates the faults are a phenomena resulting from deep-seated differential consolidation of alluvial materials, with dissimilar grain size and compressibility characteristics, due to prehistoric large scale reductions in groundwater levels. Another theory is that they may have originated from tectonic processes and are part of a valley wide fault system. It is also possible that a combination of these factors could have resulted in these features.

SITE CONDITIONS

Surface

At the time of our exploration, the site was slightly to moderately undulating with moderate brush vegetation on the surface. Ground access to the site was via Colosseum Road which was an unpaved roadway. Colosseum Road extended in the east-west direction through the center of the project site. A limestone outcrop was found in the northeast portion of the site. An overhead power-line stretched across the site in the northeast-southwest direction. Drainage appeared to be by sheet flow to the east.

Subsurface

The native soils encountered in the borings consisted predominantly of coarse-grained soils ranging from medium dense to very dense, silty sand, gravelly sand, clayey sand, and sandy gravel. Very dense to moderately hard partially cemented sand and gravel were also occasionally encountered in the borings.

The moisture content of the tested soil samples was very low, indicating the dry nature of in-situ soils, and possibility of deeper groundwater table.

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[1] James F. Davis, 2002 "Geologic Map of California", California Department of Conservation, California Geological Survey.

Groundwater was not encountered to the depths explored in the borings. It should be noted, however, that groundwater levels can fluctuate due to seasonal variations, irrigation practices, and groundwater withdrawal and recharge. The boring logs and laboratory test results presented in the appendices should be referred to for more detailed information regarding the on-site soils.

CONCLUSIONS AND RECOMMENDATIONS

Geotechnical Considerations

Our recommendations are based on the assumption that the soil conditions throughout the site are similar to those disclosed by the explorations. If variations are noted during the detailed investigation in a later phase of this project, we should be notified so we can supplement our recommendations, as applicable.

In general, the on-site native soils consist of alluvial deposits and are expected to exhibit high to very high shear strength and low to very low compressibility.

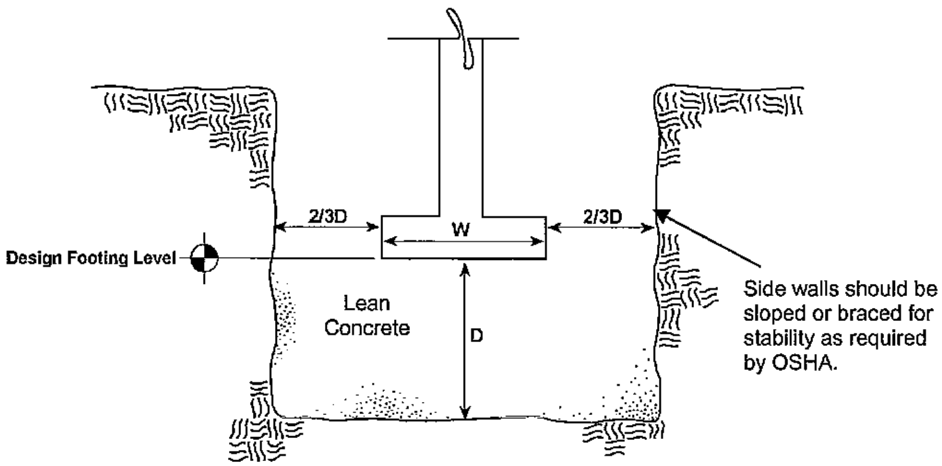
Conventional Foundations

If the grading recommendations presented in the *Earthwork* section of this report are complied with, the lightweight structures may be supported by conventional type foundations (spread footings) established on undisturbed non-cemented natural soils having a consistency of at least medium dense, and/or partially cemented natural deposits, and/or approved, properly compacted fill.

Conventional foundations established on natural non-cemented soils having a consistency of at least medium dense and/or approved, properly compacted fill as recommended should be at least 12 inches wide and the bottom of the footings should be established at least 12 inches below the lowest adjacent final compacted subgrade (generally pad grade). Foundations established as recommended, may be designed to impose a net dead- plus live-load pressure of 2000 pounds per square foot (psf). The bearing value may be increased by 500 psf for each additional 12 inches of embedment. However, the maximum net bearing value should not exceed 4000 psf. A one-third increase may be used for transient conditions such as wind or seismic loading.

If conventional foundations are established on cemented soils having a consistency of at least moderately hard, they should be at least 12 inches wide and the bottom of the footings should be established at least 12 inches below the lowest adjacent final compacted subgrade (generally pad grade). Foundations established as recommended, may be designed to impose a net dead- plus live-load pressure of 3500 pounds per square foot (psf). The bearing value may be increased by 1000 psf for each additional 12 inches of embedment. However, the maximum net bearing value should not exceed 6000 psf. A one-third increase may be used for transient conditions such as wind or seismic loading.

In some instances, cemented soil may be located deeper than the design elevation of the bottom of foundations. Rather than extend the depth of embedment, lean concrete may be used as fill between the planned design bottom of the foundation and the top of the undisturbed cemented soil deposits. Overexcavation for placement of lean concrete below footing base levels should extend laterally beyond all edges of the footings at least 8 inches per foot of overexcavation depth below footing base elevation as shown on the figure below. The overexcavation should then be backfilled up to the footing base elevation with lean concrete having a 20-day compressive strength of at least 1000 psi.



To reduce the effects of possible differential settlement, foundations should not be established partly on cemented deposits and partly on compacted granular fill/undisturbed soil deposits. Foundations for the entire structure should either be supported on cemented deposits/concrete backfill, or on properly compacted granular fill and/or undisturbed soils having a consistency of at least dense.

Without structural loading information, we cannot estimate total and differential settlements of the proposed structures. Once this information become available, we can provide settlement estimates accordingly.

Observation and inspection of foundation excavations and subgrade preparations, as well as field and laboratory testing of subgrade materials should be carried out in accordance with the guidelines provided in Table 1704.7 of the 2006 International Building Code (IBC).

Shallow Drill Shafts

If the grading recommendations presented in the *Earthwork* section of this report are complied with, the proposed heavyweight structures, and structures anticipated to carry considerable lateral loads may be supported on drilled shafts.

Drilled shaft foundations established as recommended should extend to at least 5 diameters below the lowest adjacent final compacted subgrade. The load carrying capacity of a drilled shaft should be derived from its skin friction between cast-in-place concrete and in-situ soils. The skin friction resistance of the upper 3 feet of the shaft should not be included in deriving the load carrying capacity. For preliminary design, the effective ultimate skin friction of the deep foundations may be taken as 2.0 kips per square foot (ksf) in compression at depths greater than 2 diameters below the top of the embedded pile. Recommended factor of safety for skin friction to obtain allowable shaft capacity is 2.5. For example, a two-foot diameter and ten-foot deep drilled shaft should provide an ultimate load carrying capacity of 75 kips and an allowable load carrying capacity of 30 kips in compression.

The uplift capacity of the drilled shafts may be taken as 70 percent of the axial capacity in compression at that depth. The recommended axial capacities may be increased by ⅓ for short-term transient loading conditions such as wind or seismic loading.

The load carrying capacity of a group of drilled shafts may be less than the sum of the individual shaft capacities. Evaluation of the axial capacity of a group of shafts should consider the subsurface soil conditions, spacing between adjacent shafts, and the number of rows and columns in a shaft group.

Once the structural loading is finalized, settlement of the proposed shafts should be estimated, and be within the specified limits. In addition to the settlement by soil movement, there will be movements due to inadequate preparation of the bearing surface and shrinkage of the concrete. Observation and inspection of foundation excavations and subgrade preparations, as well as field and laboratory testing of subgrade materials should be carried out in accordance with the guidelines provided in Table 1704.7 of the 2006 IBC.

Lateral loads for drilled shafts with a slenderness ratio (length to diameter) of less than 10 may be resisted by passive resistance of the adjacent soils. For design purposes, the ultimate passive resistance of native soils may be assumed to be equal to the pressure developed by a fluid with a unit weight of 325 pounds per cubic foot (pcf). The passive resistance of the soils should be ignored in the upper 3 feet below finish grade. The maximum value of passive pressure should not exceed 3,500 pounds per square foot. The recommended values may be increased by one-third for short-term transient conditions such as wind and seismic loading. Appropriate factors of safety should be applied to the ultimate passive pressure values to obtain allowable lateral capacities. Once the structural loads are finalized, further analyses should be carried out to estimate the total lateral deflection of drilled shafts.

Successful installation of drilled shafts depends to a large extent on the suitability of the equipment and installation procedures used. Excavation for drilled shafts on this site may become difficult due to the presence of caliche, cemented sand and gravel, and granular soils containing cobbles. The drilling equipment should be selected and sized accordingly to penetrate the anticipated soil strata to the required depth to develop the adequate design capacity. Methods and equipment used for drilled shaft installation should leave the sides and bottom of the shaft free of loose and disturbed material that would prevent the concrete from contacting undisturbed soil.

The shaft excavation should not be allowed to stand open overnight. The excavation should be filled with concrete as soon as possible after inspection. We recommend that concrete be placed in the bottom of the drilled shaft excavation using a tremie. The end of the tremie should be closed or plugged until it reaches the bottom of the excavated hole. The placement of concrete in the tremie will then open the "valve", and concrete placement can proceed. Steps should be taken to ensure that the tip of the tremie remains at the bottom of the excavation until at least 5 feet of concrete have been placed, and remains at least 5 feet below the top of the concrete thereafter, until placement is complete.

Preliminary Design Parameters

For the purpose of preliminary design, based on the general soil type encountered at the site and laboratory test results, we estimated the following soil design parameters:

- Modulus of Horizontal Subgrade Reaction (K_h)....................................600 pci
- Horizontal Elastic Modulus (E_h)..7000 psi
- Permeability (k) ....0.01 cm/s

It should be noted that presently no well established and generally accepted procedures and standards exist in estimating the K_h and E_h parameters of soils. No standard methods have been put forward to quantify E_h of in-situ soils; however, it has been experimentally proven that the modulus of deformation for horizontal deformation of soil is less than the vertical modulus of deformation.

In addition, permeability can have a wide range of values across the project site. It has been reported by Duncan (2000) that the coefficient of variation (V) of permeability of in-situ soil can be as high as 240 percent. Therefore, the presented values should be considered approximate and average.

In design of laterally loaded piles, instead of using classical methods, we rather suggest using generally accepted state-of-the-art methods such as a computer program LPILE. This is a special purpose program based on rational procedures for analyzing a pile under lateral loading developed by Ensoft, Inc. The program computes deflection, shear, bending moment, and soil response with respect to depth in nonlinear soils. Components of the stiffness matrix at the pile head may be computed internally by the program to help the users in their super-structure analysis.

Considering the large area of the project site (approximately 1000 acres), we recommend pumping well tests be performed across the site to determine the permeability of the in-situ soils more accurately.

Seismic Considerations

The following USGS grid points were used to determine the spectral accelerations at the project site.

Latitude	36.55°
Longitude	-115.46°

On June 19, 2007, the USGS website (Earthquake Hazards Program, Interpolated Probabilistic Ground Motion for the Conterminous 48 States by Latitude Longitude, 2002 Data) indicated the following respective spectral accelerations for 0.2 seconds (SA) and 1.0 second (SA) periods for 2% probability of exceedance (PE) in 50 years.

Period	Spectral Acceleration
0.2 s, S_s	0.36g
1.0 s, S_1	0.17g

For the purpose of seismic design, the Site Class was determined based on the criteria presented on Section 1613.5.2, Site Class Definitions, of the 2006 International Building Code (IBC). Based on our knowledge of the site and its soil conditions, the site should be designated Site Class D.

Adjusting the Site Class B, S_S and S_1 values for Site Class D, the five-percent damped design spectral acceleration at short periods, S_{DS}, is 0.36g, and at 1-second period, S_{D1}, is 0.24g.

Lateral Earth Pressures

For soils above any free water surface, with level backfill and no surcharge loads, we recommend the following equivalent fluid pressures and coefficient of friction:

- Active .... 35 pcf
- At rest .... 55 pcf
- Passive .... 300 pcf
- Coefficient of friction 0.30

Notes:

1. Active pressure assumes unrestrained (cantilever) wall and assumes no loading from heavy compaction equipment.
2. Passive pressure should not exceed a maximum of 3,500 psf. A one-third increase may be used for wind or seismic loads.
3. The passive pressure and the frictional resistance of the soils may be combined without reduction in determining the total lateral resistance.
4. The aforementioned values do not include appropriate safety factors.

The lateral seismic pressure acting on a retaining (yielding) wall can be estimated by the method developed by Seed and Whitman, as noted in the 2000 NEHRP Recommended Provisions for Seismic Regulations for New Buildings and Other Structures, where the total lateral thrust, P_{AE} in terms of its static component, P_A, and the dynamic (seismic) incremental force, ΔP_{AE}, is equal to:

$$P_{AE} = P_A + \Delta P_{AE}$$

Where the dynamic component, $\Delta P_{AE} = {}^3/_8(k_h)H^2\gamma$,

- k_h is equal to $S_{DS}/2.5$
- H is the height of the wall in feet
- γ is equal to the unit weight of the backfill material, in pcf

The resultant dynamic force, ΔP_{AE}, acts at a distance of 0.6H above the base of the wall.

For this site,

- $k_h = 0.15g$
- $\gamma = 130$ pcf
- $\Delta P_{AE} = 7.3\ H^2$ (lb/linear foot of wall)

Because the total lateral force, P_{AE}, is considered a short-term loading condition, a one-third increase in the bearing pressure and passive resistance may be allowed for dynamic (seismic) analysis.

The lateral seismic pressure acting on a rigid, non-yielding wall can be estimated by the method developed by Wood, as noted in the 2000 NEHRP Recommended Provisions for Seismic Regulations for New Buildings and Other Structures, where the dynamic (seismic) thrust, ΔP_E, is approximated at:

$$\Delta P_E = k_h H^2 \gamma,$$

- k_h is equal to $S_{DS}/2.5$
- H is the height of the wall in feet
- γ is equal to the unit weight of the backfill material, in pcf

The resultant dynamic thrust, ΔP_E, acts at a distance of 0.6H above the base of the wall.

For this site,

- $k_h = 0.15g$
- $\gamma = 130$ pcf
- $\Delta P_E = 19.5\ H^2$ (lb/linear foot of wall)

Any surcharge from adjacent loadings should be added to the above pressures using a factor of 0.30. As indicated, the aforementioned pressures assume that there will be no build-up of hydrostatic pressure. Therefore, if walls will be subject to saturated conditions, we recommend that weep holes (if practical) or a wall drainage system be provided, and that the structural fill behind retaining walls be granular and free draining. All walls below grade should be waterproofed.

Fill against foundations, grade beams, basement and retaining walls should be properly placed and compacted. Backfill should be mechanically compacted in layers (6 to 8 inches maximum uncompacted thickness); flooding should not be permitted. Backfill within 2 feet of the back of retaining and basement walls should be compacted to at least 90 percent of the maximum dry density obtainable by the ASTM D1557 method. Care should be taken when placing backfill, so as not to damage the walls. Compaction of each lift adjacent to walls should be accomplished with hand-operated tampers or other lightweight compactors. Overcompaction may cause excessive lateral earth pressures that could result in wall movements.

Earthwork

Site Clearing

- All existing vegetation, debris, uncontrolled fill, disturbed natural soils, and other deleterious materials should be stripped out and removed from proposed structural areas, adjacent walks and slabs.
- All exposed surfaces should be free of mounds and depressions that could prevent uniform compaction.
- If unexpected fills or underground facilities are encountered during site clearing, such features should be removed and the excavation thoroughly cleaned and backfilled. All excavations should be observed by the geotechnical engineer prior to backfill placement.
- Demolition of existing structures, if any, should include removal of any foundation system and utilities. Any excavations performed as a result of demolition and removal should be properly filled and compacted in accordance with recommendations provided in this section.
- All materials derived from the demolition of existing structures should be removed from the site, and not be allowed for use in any fills.

Excavation

- It is anticipated that excavation of the on-site natural non-cemented deposits for the proposed project can be accomplished with conventional earthmoving equipment.
- In cases of hard or very hard cemented soils encountered during excavation, specialized excavating equipment may be required to handle such conditions.
- Contractors should satisfy themselves as to the hardness of materials and equipment required.

- Excavations into the on-site soils may encounter caving soils, depending upon the final depth of excavation. The individual contractor(s) should be made responsible for designing and constructing stable, temporary excavations as required to maintain stability of both the excavation sides and the bottom. All excavations should be sloped or shored in the interest of safety following local and federal regulations, including current OSHA excavation and trench safety standards.

Fill Materials

- Fill containing oversize material should not be used in any utility trenches, behind retaining walls or against foundations or grade beams.
- Imported material should be compatible with on-site soils in addition to being suitable for its intended use. All imported materials should be approved by the geotechnical firm providing testing during construction, prior to importing.
- On site and imported soils used as fill should conform to the following:
    - <u>Gradation (ASTM C136)</u>: <u>Percent Finer by Weight:</u>
      - 6" 100
      - 3" 70-100
      - No. 4 Sieve 35-100
      - No. 200 Sieve 5-30
    - Liquid Limit 30
    - Plasticity Index..15
    - Maximum expansive potential (%)..................................4.0
    - Maximum Sulfate Content (%)..0.09
    - Solubility 0.5
- Soil used as backfill behind retaining walls should conform to the following:
    - <u>Gradation (ASTM C136)</u>: <u>Percent Finer by Weight:</u>
      - 3" 100
      - ¾" 70-100
      - No. 4 Sieve 20-70
      - No. 200 Sieve ....10 (max)
    - Plasticity Index...Non-plastic
    - Maximum expansive potential (%) ....Non-expansive
    - Maximum Sulfate Content (%)................................0.09
    - Maximum solubility (%)...Non-Soluble

Fill Placement and Compaction

- After performing required excavations, the exposed soils should be carefully observed to verify removal of all unsuitable deposits. Exposed soils should then be scarified to a depth of 6 inches, moisture conditioned as necessary, and compacted as recommended.
- Fill materials should be placed on a horizontal plane unless otherwise accepted by the geotechnical engineer.
- All required fill should be placed in loose lifts not over 8 inches in thickness.
- Materials should be compacted to the following:

MATERIAL	PERCENT DENSITY (ASTM D1557)	MOISTURE CONTENT
Granular	95 minimum	-2 to +2 percentage points of optimum
Fine – grained	90 minimum	0 to +2 percentage points over optimum

Note:

1. For the purpose of compaction, fine-grained soils are soils with at least 30 percent passing the No. 200 sieve and/or soils having an expansion greater than 4 percent.
2. All fill placed deeper than 5 feet below final grade should be compacted to a minimum of 95 percent.

- Field density tests should be taken for approximately each 1½ feet in elevation gain after compaction, but not to exceed 3 feet in vertical height between tests. Field density tests may have to be taken at intervals of 6 inches in elevation gain, if required by the Engineer. The locations of the tests in the plan shall be so spaced to give the best possible coverage; however, the tests shall be taken no further apart than 75 feet. The Engineer may take additional tests as considered necessary to check on the uniformity of compaction. Where sheepsfoot rollers are used, the tests shall be taken in the compacted material below the disturbed surface. No additional layers of fill shall be spread until the field density tests indicate that the specified density has been obtained.

Drainage and Moisture Protection

Foundation soils should not be allowed to become saturated during or after construction. Infiltration of water into foundation or utility excavations should be prevented during construction.

Positive drainage away from the structure should be provided during construction and maintained throughout the life of the structure. Any downspouts, roof drains or scuppers should discharge into splash blocks or extensions and away from the structures. Backfill against footings, exterior walls and in utility trenches should be properly compacted and free of all construction debris to reduce the possibility of moisture infiltration.

Performance of the foundation system recommended in this report is dependent on the ability to keep moisture from penetrating the native soils below foundations. Therefore, we recommend the following:

- No landscaping or irrigation should be allowed within 5 feet of the structures.
- Positive drainage of 2 percent minimum should be maintained away from structures, adjoining concrete slabs and block walls at a distance of at least 10 feet, where feasible.
- Landscaping irrigation should be kept to a minimum.
- Any planter areas adjacent to the structures should be sealed.

Floor Slabs

If grading recommendations are complied with, concrete floor slabs may be supported on a 4-inch layer of Type II material. The use of a vapor retarder should be considered beneath concrete slabs-on-grade that will be covered with wood, tile, carpet or other moisture-sensitive or impervious coverings, or when the slab will support equipment sensitive to moisture. When conditions warrant the use of a vapor retarder, the slab designer and slab contractor should refer to ACI 302 for procedures and cautions regarding the use and placement of a vapor retarder.

Recommendations presented by the American Concrete Institute for slabs-on-grade should be complied with for all concrete placement and curing operations. Improper curing techniques and/or excessive slump (water-cement ratio) could cause excessive drying/shrinkage resulting in random cracking and/or slab curling. Concrete slabs should be allowed to cure adequately before placing vinyl or other moisture sensitive floor coverings.

Corrosivity

The results of our laboratory tests indicate that the tested soils have a negligible classification for sulfate exposure in accordance with Table 4.3.1 of the American Concrete Institute (ACI) 318, Section 4.3. However, based on our experience with soils in the general area of the project site, a potential exists for severe sulfate-content soils to be present at the site. Therefore, we recommend that additional tests should be performed in the detailed investigation phase of this project to determine the sulfate exposure classification and appropriate concrete should be selected in accordance with Table 4.3.1 of the American Concrete Institute (ACI) 318, Section 4.3.

GENERAL COMMENTS

Terracon should be retained to review the final design plans and specifications so comments can be made regarding interpretation and implementation of our geotechnical recommendations in the design and specifications. Terracon also should be retained to provide testing and observation during excavation, grading, foundation and construction phases of the project.

The analysis and recommendations presented in this report are based upon the data obtained from the borings performed at the indicated locations and from other information discussed in this report. This report does not reflect variations that may occur between borings, across the site, or due to the modifying effects of weather. The nature and extent of such variations may not become evident until during or after construction. If variations appear, we should be immediately notified so that further evaluation and supplemental recommendations can be provided.

The scope of services for this project does not include either specifically or by implication any environmental or biological (e.g., mold, fungi, bacteria) assessment of the site or identification or prevention of pollutants, hazardous materials or conditions. If the owner is concerned about the potential for such contamination or pollution, other studies should be undertaken.

This report has been prepared for the exclusive use of our client for specific application to the project discussed and has been prepared in accordance with generally accepted geotechnical engineering practices. No warranties, either expressed or implied, are intended or made. Site safety, excavation support, and dewatering requirements are the responsibility of others. In the event that changes in the nature, design, or location of the project as outlined in this report are planned, the conclusions and recommendations contained in this report shall not be considered valid unless Terracon reviews the changes and either verifies or modifies the conclusions of this report in writing.

CLOSURE

Our professional services were performed using that degree of care and skill ordinarily exercised, under similar circumstances, by reputable geotechnical engineers practicing in this or similar localities. No warranties, either expressed or implied, are intended or made. We prepared this report as an aid in design of the proposed project. This report is not a bidding document. Any contractor reviewing this report must draw his own conclusions regarding site conditions and specific construction techniques to be used on this project.

We trust this report provides you with the information you require at this time. If you have any questions, please do not hesitate to contact us.

Sincerely,
TERRACON CONSULTANTS, INC.

Segu I. Ifham, EI
Geotechnical Staff Professional

Les C. Banas, P.E.
Geotechnical Department Manager

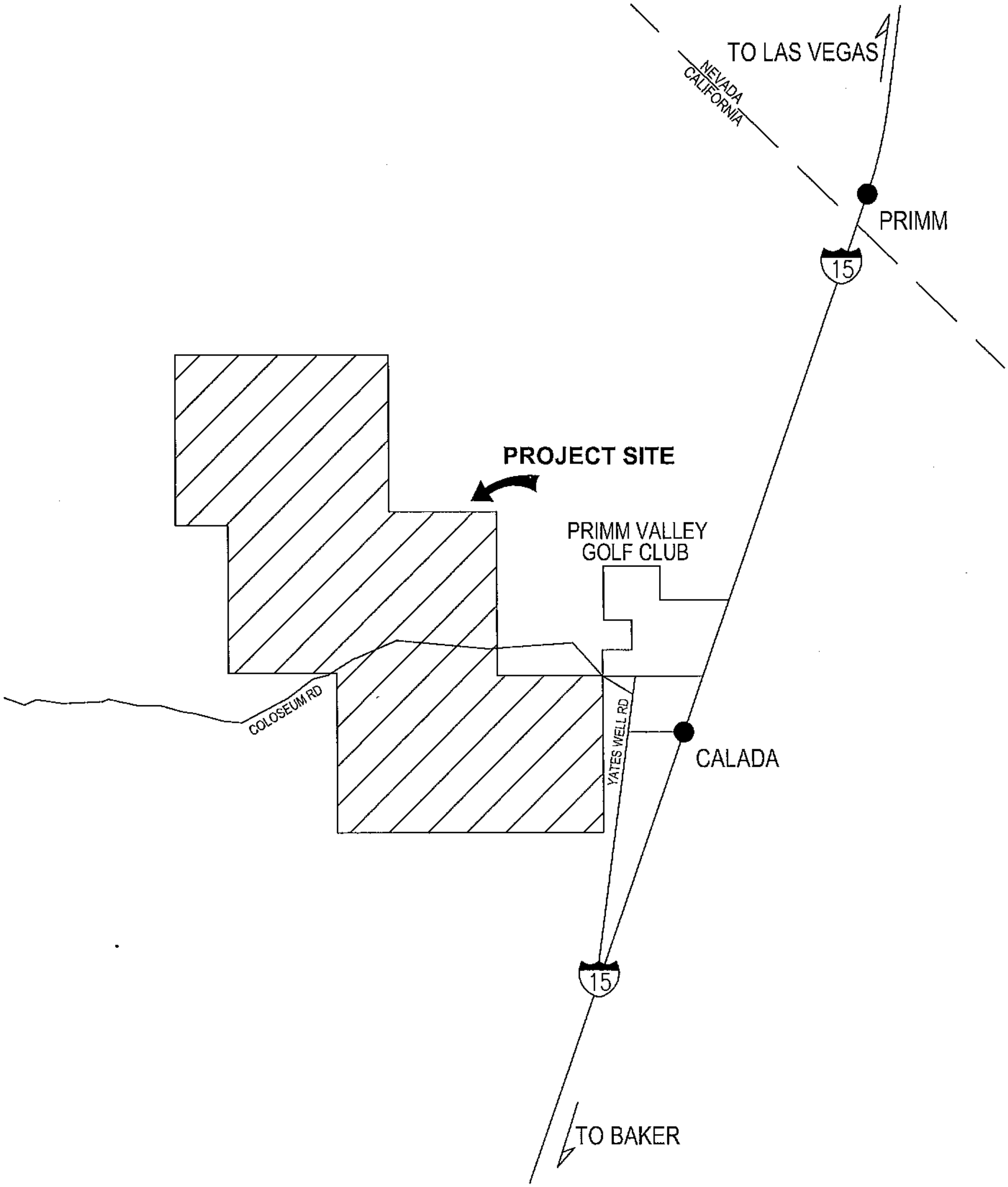
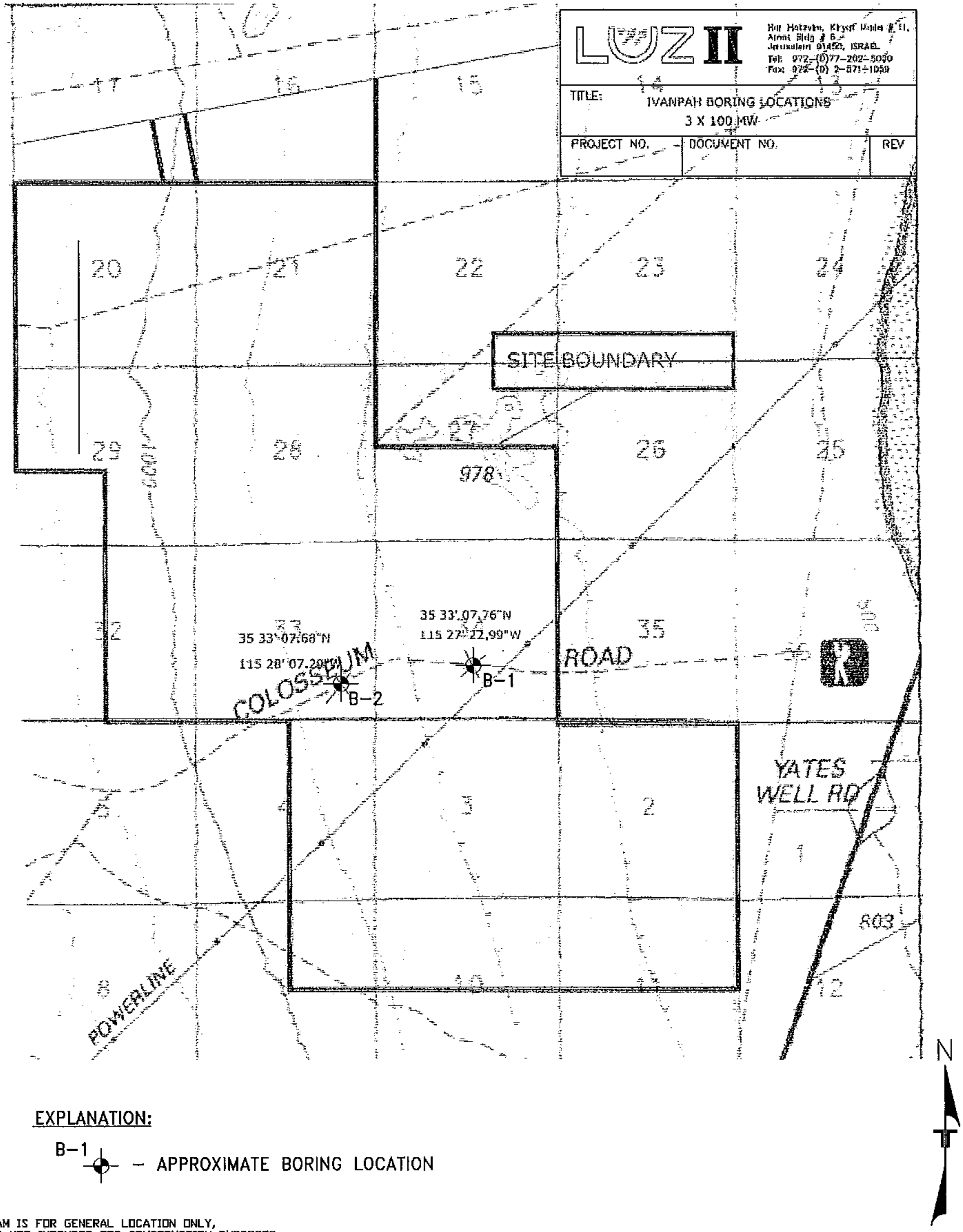


DIAGRAM IS FOR GENERAL LOCATION ONLY,
AND IS NOT INTENDED FOR CONSTRUCTION PURPOSES

Project Mngr: SII	Project No. 64075017	Terracon Consulting Engineers and Scientists	VICINITY MAP
Drawn By: BWB	Scale: N.T.S.	750 PILOT ROAD, SUITE F LAS VEGAS, NV 89119	BRIGHT SOURCE ENERGY, INC. SOLAR POWER PLANT
Checked By: SII	File No. 75017.dwg	PH. (702) 597-9393 FAX. (702) 597-9009	IVANPAH VALLEY
Approved By: SII	Date: 6/20/07		SAN BERNARDINO COUNTY CALIFORNIA

FIGURE 1



EXPLANATION:

B-1 – APPROXIMATE BORING LOCATION

DIAGRAM IS FOR GENERAL LOCATION ONLY, AND IS NOT INTENDED FOR CONSTRUCTION PURPOSES

Project Mngr: SII	Project No. 64075017	Terracon — Consulting Engineers and Scientists	SITE AND EXPLORATION PLAN	FIGURE
Drawn By: BWB	Scale: N.T.S.		BRIGHT SOURCE ENERGY, INC.	
Checked By: SII	File No. 75017.dwg		SOLAR POWER PLANT	2
Approved By: SII	Date: 6/20/07	750 PILOT ROAD, SUITE F LAS VEGAS, NV 89119 PH. (702) 597-9393 FAX. (702) 597-9009	IVANPAH VALLEY SAN BERNARDINO COUNTY CALIFORNIA	

APPENDIX A

Site Explorations

The borings were logged during drilling and soil samples were obtained at 2½- to 5-foot intervals to aid in material classification and for laboratory testing. Logs of the borings are presented on Plates A-1 through A-12. A key to the terms used on the boring logs is presented on Plate A-i, General Notes. The soils were classified in general accordance with the Unified Soil Classification System (USCS) as explained on Plate A-ii. The symbols and abbreviations used in the boring logs are defined on Plate A-iii.

GENERAL NOTES

DRILLING & SAMPLING SYMBOLS:

SS:	Split Spoon - 1-3/8" I.D., 2" O.D., unless otherwise noted	HS:	Hollow Stem Auger
ST:	Thin-Walled Tube - 2" O.D., unless otherwise noted	PA:	Power Auger
RS:	Ring Sampler - 2.42" I.D., 3" O.D., unless otherwise noted	HA:	Hand Auger
DB:	Diamond Bit Coring - 4", N, B	RB:	Rock Bit
BS:	Bulk Sample or Auger Sample	WB:	Wash Boring or Mud Rotary

The number of blows required to advance a standard 2-inch O.D. split-spoon sampler (SS) the last 12 inches of the total 18-inch penetration with a 140-pound hammer falling 30 inches is considered the "Standard Penetration" or "N-value". For 3" O.D. ring samplers (RS) the penetration value is reported as the number of blows required to advance the sampler 12 inches using a 140-pound hammer falling 30 inches, reported as "blows per foot," and is not considered equivalent to the "Standard Penetration"or "N-value".

WATER LEVEL MEASUREMENT SYMBOLS:

WL:	Water Level	WS:	While Sampling	N/E:	Not Encountered
WCI:	Wet Cave in	WD:	While Drilling		
DCI:	Dry Cave in	BCR:	Before Casing Removal		
AB:	After Boring	ACR:	After Casing Removal		

Water levels indicated on the boring logs are the levels measured in the borings at the times indicated. Groundwater levels at other times and other locations across the site could vary. In pervious soils, the indicated levels may reflect the location of groundwater. In low permeability soils, the accurate determination of groundwater levels may not be possible with only short-term observations.

DESCRIPTIVE SOIL CLASSIFICATION: Soil classification is based on the Unified Classification System. Coarse Grained Soils have more than 50% of their dry weight retained on a #200 sieve; their principal descriptors are: boulders, cobbles, gravel or sand. Fine Grained Soils have less than 50% of their dry weight retained on a #200 sieve; they are principally described as clays if they are plastic, and silts if they are slightly plastic or non-plastic. Major constituents may be added as modifiers and minor constituents may be added according to the relative proportions based on grain size. In addition to gradation, coarse-grained soils are defined on the basis of their in-place relative density and fine-grained soils on the basis of their consistency.

CONSISTENCY OF FINE-GRAINED SOILS

Unconfined Compressive Strength, Qu, psf	Standard Penetration or N-value (SS) Blows/Ft.	Consistency
< 500	<2	Very Soft
500 – 1,000	2-3	Soft
1,001 – 2,000	4-6	Medium Stiff
2,001 – 4,000	7-12	Stiff
4,001 – 8,000	13-26	Very Stiff
8,000+	26+	Hard

RELATIVE DENSITY OF COARSE-GRAINED SOILS

Standard Penetration or N-value (SS) Blows/Ft.	Ring Sampler (RS) Blows/Ft.	Relative Density
0 – 3	0-6	Very Loose
4 – 9	7-18	Loose
10 – 29	19-58	Medium Dense
30 – 49	59-98	Dense
50+	99+	Very Dense

RELATIVE PROPORTIONS OF SAND AND GRAVEL

Descriptive Term(s) of other constituents	Percent of Dry Weight
Trace	< 15
With	15 – 29
Modifier	> 30

RELATIVE PROPORTIONS OF FINES

Descriptive Term(s) of other constituents	Percent of Dry Weight
Trace	< 5
With	5 – 12
Modifiers	> 12

GRAIN SIZE TERMINOLOGY

Major Component of Sample	Particle Size
Boulders	Over 12 in. (300mm)
Cobbles	12 in. to 3 in. (300mm to 75 mm)
Gravel	3 in. to #4 sieve (75mm to 4.75 mm)
Sand	#4 to #200 sieve (4.75mm to 0.075mm)
Silt or Clay	Passing #200 Sieve (0.075mm)

PLASTICITY DESCRIPTION

Term	Plasticity Index
Non-plastic	0
Low	1-10
Medium	11-30
High	30+

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UNIFIED SOIL CLASSIFICATION SYSTEM

Criteria for Assigning Group Symbols and Group Names Using Laboratory Tests[A]				Soil Classification: Group Symbol	Soil Classification: Group Name[B]
Coarse Grained Soils More than 50% retained on No. 200 sieve	Gravels More than 50% of coarse fraction retained on No. 4 sieve	Clean Gravels Less than 5% fines[C]	Cu ≥ 4 and 1 ≤ Cc ≤ 3[E]	GW	Well-graded gravel[F]
			Cu < 4 and/or 1 > Cc > 3[E]	GP	Poorly graded gravel[F]
		Gravels with Fines More than 12% fines[C]	Fines classify as ML or MH	GM	Silty gravel[F,G,H]
			Fines classify as CL or CH	GC	Clayey gravel[F,G,H]
	Sands 50% or more of coarse fraction passes No. 4 sieve	Clean Sands Less than 5% fines[D]	Cu ≥ 6 and 1 ≤ Cc ≤ 3[E]	SW	Well-graded sand[I]
			Cu < 6 and/or 1 > Cc > 3[E]	SP	Poorly graded sand[I]
		Sands with Fines More than 12% fines[D]	Fines classify as ML or MH	SM	Silty sand[G,H,I]
			Fines Classify as CL or CH	SC	Clayey sand[G,H,I]
Fine-Grained Soils 50% or more passes the No. 200 sieve	Silts and Clays Liquid limit less than 50	inorganic	PI > 7 and plots on or above "A" line[J]	CL	Lean clay[K,L,M]
			PI < 4 or plots below "A" line[J]	ML	Silt[K,L,M]
		organic	Liquid limit - oven dried / Liquid limit - not dried < 0.75	OL	Organic clay[K,L,M,N]
					Organic silt[K,L,M,O]
	Silts and Clays Liquid limit 50 or more	inorganic	PI plots on or above "A" line	CH	Fat clay[K,L,M]
			PI plots below "A" line	MH	Elastic Silt[K,L,M]
		organic	Liquid limit - oven dried / Liquid limit - not dried < 0.75	OH	Organic clay[K,L,M,P]
					Organic silt[K,L,M,Q]
Highly organic soils	Primarily organic matter, dark in color, and organic odor			PT	Peat

[A] Based on the material passing the 3-in. (75-mm) sieve

[B] If field sample contained cobbles or boulders, or both, add "with cobbles or boulders, or both" to group name.

[C] Gravels with 5 to 12% fines require dual symbols: GW-GM well-graded gravel with silt, GW-GC well-graded gravel with clay, GP-GM poorly graded gravel with silt, GP-GC poorly graded gravel with clay.

[D] Sands with 5 to 12% fines require dual symbols: SW-SM well-graded sand with silt, SW-SC well-graded sand with clay, SP-SM poorly graded sand with silt, SP-SC poorly graded sand with clay

[E] $Cu = D_{60}/D_{10}$ $Cc = \frac{(D_{30})^2}{D_{10} \times D_{60}}$

[F] If soil contains ≥ 15% sand, add "with sand" to group name.

[G] If fines classify as CL-ML, use dual symbol GC-GM, or SC-SM.

[H] If fines are organic, add "with organic fines" to group name.

[I] If soil contains ≥ 15% gravel, add "with gravel" to group name.

[J] If Atterberg limits plot in shaded area, soil is a CL-ML, silty clay.

[K] If soil contains 15 to 29% plus No. 200, add "with sand" or "with gravel," whichever is predominant.

[L] If soil contains ≥ 30% plus No. 200 predominantly sand, add "sandy" to group name.

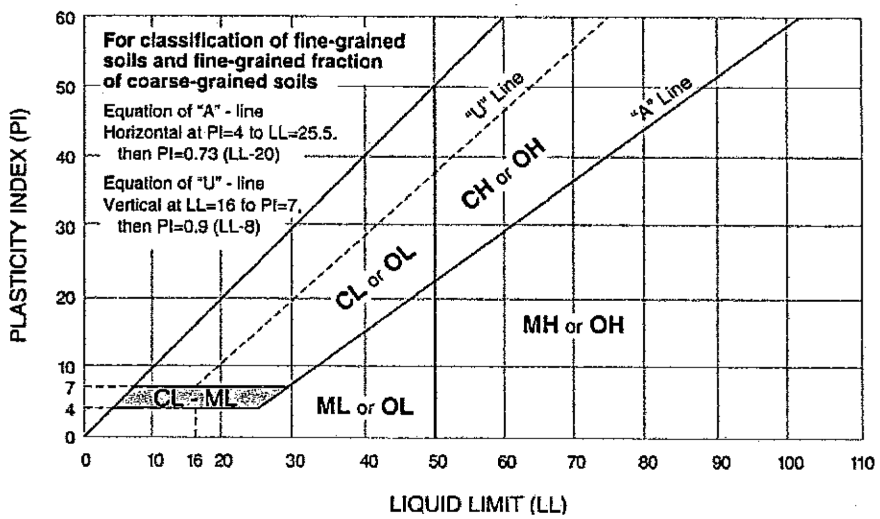
[M] If soil contains ≥ 30% plus No. 200, predominantly gravel, add "gravelly" to group name.

[N] PI ≥ 4 and plots on or above "A" line.

[O] PI < 4 or plots below "A" line.

[P] PI plots on or above "A" line.

[Q] PI plots below "A" line.



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USCS SOIL TYPE (ASTM D-2487-98) & OTHER MATERIAL SYMBOLS

GROUP SYMBOL	SOIL GROUP NAMES & LEGEND	GRAPHICS
AC	ASPHALT CONCRETE	
AB	AGGREGATE BASE	
CAL	CALICHE	
CGC	CEMENTED SAND & GRAVEL	
CH	FAT CLAY	
CL	LEAN CLAY	
CL-ML	SILTY CLAY	
CONC	CONCRETE	
CONG	CONGLOMERATE	
CS	CLAYSTONE	
DOL	DOLOMITE	
FILL	MADE GROUND	
GC	CLAYEY GRAVEL	
GC-GM	SILTY CLAYEY GRAVEL	
GM	SILTY GRAVEL	
GP	POORLY-GRADED GRAVEL	
GP-GC	POORLY-GRADED GRAVEL W/ CLAY	
GP-GM	POORLY-GRADED GRAVEL W/ SILT	
GW	WELL-GRADED GRAVEL	
GW-GC	WELL-GRADED GRAVEL W/ CLAY	
GW-GM	WELL-GRADED GRAVEL W/ SILT	

GROUP SYMBOL	SOIL GROUP NAMES & LEGEND	GRAPHICS
GYPSUM	GYPSUM, ROCKSALT, ECT	
IGNEOUS	IGNEOUS ROCK	
LIM	LIMESTONE	
MH	ELASTIC SILT	
ML	SILT	
OH	HIGH PLASTICITY ORGANIC SILT OR CLAY	
OL	LOW PLASTICITY ORGANIC SILT OR CLAY	
PT	PEAT	
RHY	RHYOLITE	
SAS	SANDSTONE	
SC	CLAYEY SAND	
SC-SM	CLAYEY SILTY SAND	
SIS	SILTSTONE	
SM	SILTY SAND	
SP	POORLY-GRADED SAND	
SP-SC	POORLY-GRADED SAND W/ CLAY	
SP-SM	POORLY-GRADED SAND W/ SILT	
SW	WELL-GRADED SAND	
SW-SC	WELL-GRADED SAND W/ CLAY	
SW-SM	WELL-GRADED SAND W/ SILT	

SAMPLER SYMBOLS, LEGEND & GRAPHICS

SS	STANDARD PENETRATION TEST	
BS	BULK SAMPLE	
RS	RING SAMPLE (3" O.D.)	
PMT	PRESSURE METER TEST	
VS	VANE SHEAR	

ST	SHELBY TUBE	
PS	PISTON SAMPLER	PS
CPT	CONE PENETRATION TEST	
C	CORE	
MC	MODIFIED CALIFORNIA SAMPLER (2" O.D.)	
	NO RECOVERY	

WATER GRAPHICS

▼ WATER LEVEL MEASUREMENT (DURING DRILLING)

▽ WATER LEVEL MEASUREMENT (DATE)

Terracon

LOG OF BORING NO. B- 1

CLIENT: Bright Source Energy, Inc.		PROJECT: Solar Power Plant
BORING LOCATION: See Figure 2.	ELEVATION: Not measured	SITE: Ivanpah Valley, San Bernardino County, CA

SOIL DESCRIPTION	CONSISTENCY	GRAPHIC	USCS SYMBOL	DEPTH (FT.)	SAMPLES: SAMPLE	SAMPLES: BLOWS/FT.	SAMPLES: SMP. TYPE*	TESTS: MOISTURE %	TESTS: DRY DENSITY (pcf)	TESTS: PLASTICITY INDEX (%)
SANDY GRAVEL - with silt and cobbles, dry, light brown	medium dense		GM	0						
- occasional boulders	dense			1						
- trace clay	very dense			2	■	57	SS			
				3						
GRAVELLY SAND - with silt, slightly moist, brown	medium dense to dense		SM	4	■	22	SS			
				5						
				6						
CLAYEY SAND - with silt and gravel, slightly moist, brown	dense		SC	7						
				8						
				9	■	34	SS	2.3		
				10						
	very dense			11						
				12						
				13						
				14	■	38	SS			
				15						

Continued Next Page

THIS SUMMARY APPLIES ONLY AT THIS LOCATION AT THE TIME OF LOGGING. CONDITIONS MAY DIFFER WITH TIME OR AT OTHER LOCATIONS.

THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL AND ROCK TYPES: IN-SITU, THE TRANSITION MAY BE GRADUAL.

*SAMPLE TYPES: RS = Ring BS = Bag CPT = Cone penetration test SS = Standard Penetration Test C = Core ST = Shelby Tube

NOTES: **Groundwater not encountered**	Terracon	DATE DRILLED: 6-15-07	PAGE NUMBER: Page 1 of 6
HAMMER WEIGHT (lbs): 140		PROJECT NO.: 64075017	PLATE: A-1

LOG OF BORING NO. B- 1

CLIENT: Bright Source Energy, Inc.		PROJECT: Solar Power Plant
BORING LOCATION: See Figure 2.	ELEVATION: Not measured	SITE: Ivanpah Valley, San Bernardino County, CA

SOIL DESCRIPTION	CONSISTENCY	GRAPHIC	USCS SYMBOL	DEPTH (FT.)	SAMPLES: SAMPLE	SAMPLES: BLOWS/FT.	SAMPLES: SMP. TYPE*	TESTS: MOISTURE %	TESTS: DRY DENSITY (pcf)	TESTS: PLASTICITY INDEX (%)
SILTY SAND - trace clay and gravel, slightly moist, brown	very dense		SM							
				16						
				17						
- occasional sandy clay lenses				18						
				19		53	SS	2.3		NP
				20						
				21						
PARTIALLY CEMENTED SAND AND GRAVEL - dry to slightly moist, white to light brown	very dense to mod. hard			22						
				23						
				24		50/4"	SS			
				25						
				26						
SILTY SAND - slightly moist, brown	very dense		SM	27						
				28						
- with partially cemented lenses				29		50/5"	SS			
				30						

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THIS SUMMARY APPLIES ONLY AT THIS LOCATION AT THE TIME OF LOGGING. CONDITIONS MAY DIFFER WITH TIME OR AT OTHER LOCATIONS.

THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL AND ROCK TYPES: IN-SITU, THE TRANSITION MAY BE GRADUAL.

*SAMPLE TYPES: RS = Ring BS = Bag CPT = Cone penetration test SS = Standard Penetration Test C = Core ST = Shelby Tube

NOTES: **Groundwater not encountered**

HAMMER WEIGHT (lbs): **140**

Terracon

DATE DRILLED: **6-15-07**

PROJECT NO.: **64075017**

PLATE: **A-2**

LOG OF BORING NO. B- 1

CLIENT: Bright Source Energy, Inc.		PROJECT: Solar Power Plant
BORING LOCATION: See Figure 2.	ELEVATION: Not measured	SITE: Ivanpah Valley, San Bernardino County, CA

SOIL DESCRIPTION	CONSISTENCY	GRAPHIC	USCS SYMBOL	DEPTH (FT.)	SAMPLES: SAMPLE	SAMPLES: BLOWS/FT.	SAMPLES: SMP. TYPE*	TESTS: MOISTURE %	TESTS: DRY DENSITY (pcf)	TESTS: PLASTICITY INDEX (%)
SILTY SAND - occasional partially cemented lenses, slightly moist, brown	very dense		SM	31, 32						
SANDY GRAVEL - with silt and cobbles, slightly moist, brown			GM	33						
PARTIALLY CEMENTED SAND AND GRAVEL - dry to slightly moist, light brown	very dense to mod. hard			34	X	50/3"	SS			
				35, 36, 37, 38, 39	X	50/6"	SS			
				40						
SILTY SAND - trace clay and gravel, slightly moist, brown	very dense		SM	41, 42, 43, 44	X	52	SS			
				45						

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THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL AND ROCK TYPES: IN-SITU, THE TRANSITION MAY BE GRADUAL.

*SAMPLE TYPES: RS = Ring BS = Bag CPT = Cone penetration test SS = Standard Penetration Test C = Core ST = Shelby Tube

THIS SUMMARY APPLIES ONLY AT THIS LOCATION AT THE TIME OF LOGGING. CONDITIONS MAY DIFFER WITH TIME OR AT OTHER LOCATIONS.

NOTES: Groundwater not encountered HAMMER WEIGHT (lbs): **140**	Terracon	DATE DRILLED: **6-15-07** PROJECT NO.: **64075017**	PAGE NUMBER: **Page 3 of 6** PLATE: **A-3**

LOG OF BORING NO. B- 1

CLIENT: Bright Source Energy, Inc.		PROJECT: Solar Power Plant
BORING LOCATION: See Figure 2.	ELEVATION: Not measured	SITE: Ivanpah Valley, San Bernardino County, CA

SOIL DESCRIPTION	CONSISTENCY	GRAPHIC	USCS SYMBOL	DEPTH (FT.)	SAMPLES: SAMPLE	SAMPLES: BLOWS/FT.	SAMPLES: SMP. TYPE*	TESTS: MOISTURE %	TESTS: DRY DENSITY (pcf)	TESTS: PLASTICITY INDEX (%)
SILTY SAND - trace clay and gravel, slightly moist, brown	very dense		SM							
				46						
				47						
				48						
				49		50/4"	SS	2.0		
SANDY GRAVEL - with silt, slightly moist, brown			GM	50						
				51						
				52						
				53						
				54		50/6"	SS			
				55						
				56						
SILTY SAND - trace clay, slightly moist, brown	dense		SM	57						
				58						
				59		48	SS	2.2		NP
				60						

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THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL AND ROCK TYPES: IN-SITU, THE TRANSITION MAY BE GRADUAL.

*SAMPLE TYPES: RS = Ring BS = Bag CPT = Cone penetration test SS = Standard Penetration Test C = Core ST = Shelby Tube

NOTES:
Groundwater not encountered

HAMMER WEIGHT (lbs): **140**

Terracon

DATE DRILLED: **6-15-07**

PROJECT NO.: **64075017**

PLATE: **A-4**

THIS SUMMARY APPLIES ONLY AT THIS LOCATION AT THE TIME OF LOGGING. CONDITIONS MAY DIFFER WITH TIME OR AT OTHER LOCATIONS.

LOG OF BORING NO. B- 1

CLIENT:	PROJECT:
Bright Source Energy, Inc.	**Solar Power Plant**

BORING LOCATION:	ELEVATION:	SITE:
See Figure 2.	**Not measured**	**Ivanpah Valley, San Bernardino County, CA**

SOIL DESCRIPTION	CONSISTENCY	GRAPHIC	USCS SYMBOL	DEPTH (FT.)	SAMPLES: SAMPLE	SAMPLES: BLOWS/FT.	SAMPLES: SMP. TYPE*	TESTS: MOISTURE %	TESTS: DRY DENSITY (pcf)	TESTS: PLASTICITY INDEX (%)
SILTY SAND - trace clay, slightly moist, brown	very dense		SM	61, 62, 63						
SANDY GRAVEL - with silt, occasional cobbles, slightly moist, brown			GM	64		50/2"	SS			
				65, 66, 67						
GRAVELLY SAND - with silt, slightly moist, brown			SM	68						
				69		64	SS			
				70, 71						
SANDY GRAVEL - with silt and cobbles, slightly moist, brown			GM	72, 73						
SILTY SAND - with gravel, slightly moist, brown	very dense		SM	74		50/6"	SS			
				75						

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THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL AND ROCK TYPES: IN-SITU, THE TRANSITION MAY BE GRADUAL.

*SAMPLE TYPES: RS = Ring BS = Bag CPT = Cone penetration test SS = Standard Penetration Test C = Core ST = Shelby Tube

NOTES:
Groundwater not encountered

HAMMER WEIGHT (lbs): **140**

Terracon

DATE DRILLED: **6-15-07**

PROJECT NO.: **64075017**

PLATE: **A-5**

THIS SUMMARY APPLIES ONLY AT THIS LOCATION AT THE TIME OF LOGGING. CONDITIONS MAY DIFFER WITH TIME OR AT OTHER LOCATIONS.

LOG OF BORING NO. B- 1

CLIENT: **Bright Source Energy, Inc.**

PROJECT: **Solar Power Plant**

BORING LOCATION: **See Figure 2.**

ELEVATION: **Not measured**

SITE: **Ivanpah Valley, San Bernardino County, CA**

SOIL DESCRIPTION	CONSISTENCY	GRAPHIC	USCS SYMBOL	DEPTH (FT.)	SAMPLES: SAMPLE	SAMPLES: BLOWS/FT.	SAMPLES: SMP. TYPE*	TESTS: MOISTURE %	TESTS: DRY DENSITY (pcf)	TESTS: PLASTICITY INDEX (%)
SILTY SAND - with gravel, slightly moist, brown	very dense		SM	76						
				77						
				78						
				79	X	50/6"	SS			
Bottom Depth at Approximately 80 feet				80						
				81						
				82						
				83						
				84						
				85						
				86						
				87						
				88						
				89						
				90						

THIS SUMMARY APPLIES ONLY AT THIS LOCATION AT THE TIME OF LOGGING. CONDITIONS MAY DIFFER WITH TIME OR AT OTHER LOCATIONS.

THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL AND ROCK TYPES: IN-SITU, THE TRANSITION MAY BE GRADUAL.

*SAMPLE TYPES: RS = Ring BS = Bag CPT = Cone penetration test SS = Standard Penetration Test C = Core ST = Shelby Tube

NOTES:
Groundwater not encountered

HAMMER WEIGHT (lbs): **140**

Terracon

DATE DRILLED: **6-15-07**

PROJECT NO.: **64075017**

PLATE: **A-6**

LOG OF BORING NO. B- 2

CLIENT: Bright Source Energy, Inc.		PROJECT: Solar Power Plant
BORING LOCATION: See Figure 2.	ELEVATION: Not measured	SITE: Ivanpah Valley, San Bernardino County, CA

SOIL DESCRIPTION	CONSISTENCY	GRAPHIC	USCS SYMBOL	DEPTH (FT.)	SAMPLES: SAMPLE	SAMPLES: BLOWS/FT.	SAMPLES: SMP. TYPE*	TESTS: MOISTURE %	TESTS: DRY DENSITY (pcf)	TESTS: PLASTICITY INDEX (%)
GRAVELLY SAND - with silt, dry, light brown	medium dense		SM	0			BS			
				2		26	SS			
CLAYEY SAND - slightly moist, brown	medium dense to dense		SC	3						
SILTY SAND - trace clay, slightly moist, brown			SM	4		21	SS			
- partially cemented	very dense to mod. hard			7						
				9		50/2"	SS			
- trace gravel and clay	very dense			10.5						
				14		50/3"	SS			
				15						

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THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL AND ROCK TYPES: IN-SITU, THE TRANSITION MAY BE GRADUAL.

*SAMPLE TYPES: RS = Ring BS = Bag CPT = Cone penetration test SS = Standard Penetration Test C = Core ST = Shelby Tube

NOTES:	DATE DRILLED:	PAGE NUMBER:
Groundwater not encountered	**6-15-07**	**Page 1 of 6**
HAMMER WEIGHT (lbs): **140**	PROJECT NO.: **64075017**	PLATE: **A-7**

Terracon

THIS SUMMARY APPLIES ONLY AT THIS LOCATION AT THE TIME OF LOGGING. CONDITIONS MAY DIFFER WITH TIME OR AT OTHER LOCATIONS.

LOG OF BORING NO. B- 2

CLIENT: Bright Source Energy, Inc.		PROJECT: Solar Power Plant
BORING LOCATION: See Figure 2.	ELEVATION: Not measured	SITE: Ivanpah Valley, San Bernardino County, CA

SOIL DESCRIPTION	CONSISTENCY	GRAPHIC	USCS SYMBOL	DEPTH (FT.)	SAMPLES: SAMPLE	SAMPLES: BLOWS/FT.	SAMPLES: SMP. TYPE*	TESTS: MOISTURE %	TESTS: DRY DENSITY (pcf)	TESTS: PLASTICITY INDEX (%)
SAND - with silt, trace clay, occasional cobbles, slightly moist, brown	very dense		SW - SM	16, 17, 18						
				19–20		50/6"	SS			
				21						
SILTY SAND - trace clay and gravel, slightly moist, brown			SM	22, 23						
				24–25		71	SS			
				26						
SANDY GRAVEL - with silt, trace clay, slightly moist, brown			GM	27, 28						
				29–30		50/6"	SS	1.8		

Continued Next Page

THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL AND ROCK TYPES: IN-SITU, THE TRANSITION MAY BE GRADUAL.

*SAMPLE TYPES: RS = Ring BS = Bag CPT = Cone penetration test SS = Standard Penetration Test C = Core ST = Shelby Tube

NOTES:
Groundwater not encountered

HAMMER WEIGHT (lbs): **140**

Terracon

DATE DRILLED: 6-15-07	PAGE NUMBER: Page 2 of 6
PROJECT NO.: 64075017	PLATE: A-8

THIS SUMMARY APPLIES ONLY AT THIS LOCATION AT THE TIME OF LOGGING. CONDITIONS MAY DIFFER WITH TIME OR AT OTHER LOCATIONS.

LOG OF BORING NO. B- 2

CLIENT: Bright Source Energy, Inc.		PROJECT: Solar Power Plant
BORING LOCATION: See Figure 2.	ELEVATION: Not measured	SITE: Ivanpah Valley, San Bernardino County, CA

SOIL DESCRIPTION	CONSISTENCY	GRAPHIC	USCS SYMBOL	DEPTH (FT.)	SAMPLES: SAMPLE	SAMPLES: BLOWS/FT.	SAMPLES: SMP. TYPE*	TESTS: MOISTURE %	TESTS: DRY DENSITY (pcf)	TESTS: PLASTICITY INDEX (%)
SAND - with silt, gravel, and trace clay, slightly moist, brown	very dense		SW - SM	31						
				32						
				33						
				34		54	SS			
				35						
				36						
				37						
				38						
				39		48	SS	1.3		NP
				40						
				41						
SILTY SAND - with gravel, slightly moist, brown	dense to very dense		SM	42						
				43						
				44		31	SS			
				45						

Continued Next Page

THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL AND ROCK TYPES: IN-SITU, THE TRANSITION MAY BE GRADUAL.

*SAMPLE TYPES: RS = Ring BS = Bag CPT = Cone penetration test SS = Standard Penetration Test C = Core ST = Shelby Tube

THIS SUMMARY APPLIES ONLY AT THIS LOCATION AT THE TIME OF LOGGING. CONDITIONS MAY DIFFER WITH TIME OR AT OTHER LOCATIONS.

NOTES:		DATE DRILLED:	PAGE NUMBER:
Groundwater not encountered	Terracon	6-15-07	Page 3 of 6
HAMMER WEIGHT (lbs): **140**		PROJECT NO.: 64075017	PLATE: A-9

LOG OF BORING NO. B- 2

CLIENT: Bright Source Energy, Inc.	PROJECT: Solar Power Plant
BORING LOCATION: See Figure 2. ELEVATION: Not measured	SITE: Ivanpah Valley, San Bernardino County, CA

THIS SUMMARY APPLIES ONLY AT THIS LOCATION AT THE TIME OF LOGGING. CONDITIONS MAY DIFFER WITH TIME OR AT OTHER LOCATIONS.

SOIL DESCRIPTION	CONSISTENCY	GRAPHIC	USCS SYMBOL	DEPTH (FT.)	SAMPLES: SAMPLE	SAMPLES: BLOWS/FT.	SAMPLES: SMP. TYPE*	TESTS: MOISTURE %	TESTS: DRY DENSITY (pcf)	TESTS: PLASTICITY INDEX (%)
SILTY SAND - with gravel, slightly moist, brown	dense to very dense		SM	46, 47						
SANDY GRAVEL - with silt, slightly moist, brown	very dense		GM	48, 49, 50, 51	49–50	50/6"	SS			
SILTY SAND - trace gravel, slightly moist, brown	medium dense to dense		SM	52, 53, 54, 55, 56	54–55.5	26	SS			
SANDY GRAVEL - with silt, slightly moist, brown	very dense		GM	57, 58, 59, 60	59–60	32	SS			

Continued Next Page

THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL AND ROCK TYPES: IN-SITU, THE TRANSITION MAY BE GRADUAL.

*SAMPLE TYPES: RS = Ring BS = Bag CPT = Cone penetration test SS = Standard Penetration Test C = Core ST = Shelby Tube

NOTES:		DATE DRILLED:	PAGE NUMBER:
Groundwater not encountered	Terracon	6-15-07	Page 4 of 6
HAMMER WEIGHT (lbs): **140**		PROJECT NO.: 64075017	PLATE: A-10

LOG OF BORING NO. B- 2

CLIENT: Bright Source Energy, Inc.		PROJECT: Solar Power Plant
BORING LOCATION: See Figure 2.	ELEVATION: Not measured	SITE: Ivanpah Valley, San Bernardino County, CA

SOIL DESCRIPTION	CONSISTENCY	GRAPHIC	USCS SYMBOL	DEPTH (FT.)	SAMPLES: SAMPLE	SAMPLES: BLOWS/FT.	SAMPLES: SMP. TYPE*	TESTS: MOISTURE %	TESTS: DRY DENSITY (pcf)	TESTS: PLASTICITY INDEX (%)
SANDY GRAVEL - with silt, slightly moist, brown	very dense to mod. hard		GM							
- occasional cobbles				64		50/6"	SS			
- with cobbles										
				69		50/4"	SS	1.3		
SILTY SAND - trace gravel, slightly moist, brown			SM	72						
				74		50/4"	SS			
Continued Next Page				75						

THIS SUMMARY APPLIES ONLY AT THIS LOCATION AT THE TIME OF LOGGING. CONDITIONS MAY DIFFER WITH TIME OR AT OTHER LOCATIONS.

THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL AND ROCK TYPES: IN-SITU, THE TRANSITION MAY BE GRADUAL.

*SAMPLE TYPES: RS = Ring BS = Bag CPT = Cone penetration test SS = Standard Penetration Test C = Core ST = Shelby Tube

NOTES:
Groundwater not encountered

HAMMER WEIGHT (lbs): **140**

Terracon

DATE DRILLED:	PAGE NUMBER:
6-15-07	Page 5 of 6
PROJECT NO.: 64075017	PLATE: A-11

LOG OF BORING NO. B- 2

CLIENT: Bright Source Energy, Inc.		PROJECT: Solar Power Plant
BORING LOCATION: See Figure 2.	ELEVATION: Not measured	SITE: Ivanpah Valley, San Bernardino County, CA

SOIL DESCRIPTION	CONSISTENCY	GRAPHIC	USCS SYMBOL	DEPTH (FT.)	SAMPLES: SAMPLE	SAMPLES: BLOWS/FT.	SAMPLES: SMP. TYPE*	TESTS: MOISTURE %	TESTS: DRY DENSITY (pcf)	TESTS: PLASTICITY INDEX (%)
SANDY GRAVEL - with silt, slightly moist, brown	very dense		GM	76, 77						
SAND - with silt and trace gravel, slightly moist, brown			SW - SM	78, 79, 80		57	SS	1.3		NP
Bottom Depth at Approximately 80.5 feet				81, 82, 83, 84, 85, 86, 87, 88, 89, 90						

THIS SUMMARY APPLIES ONLY AT THIS LOCATION AT THE TIME OF LOGGING. CONDITIONS MAY DIFFER WITH TIME OR AT OTHER LOCATIONS.

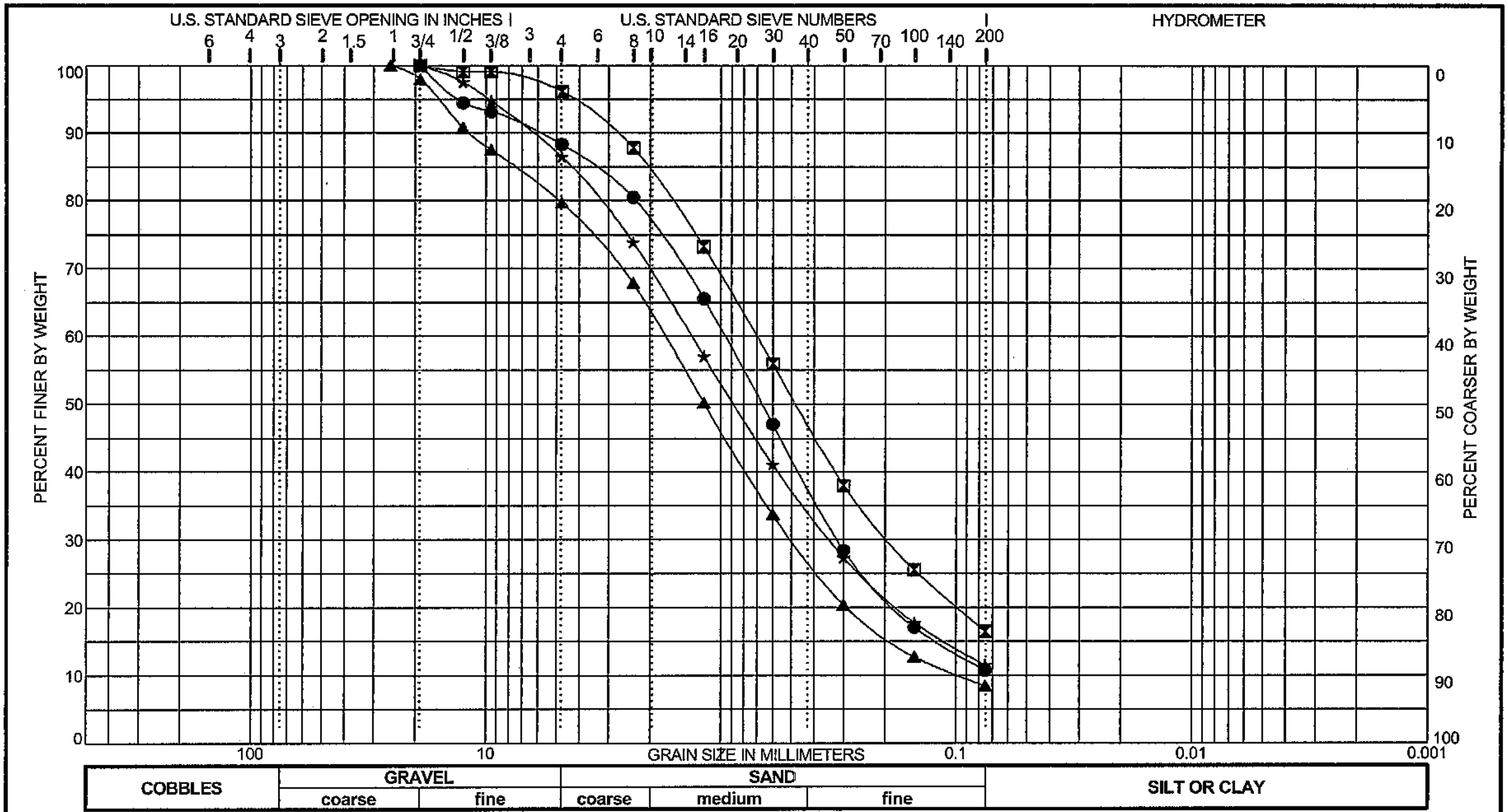
THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL AND ROCK TYPES: IN-SITU, THE TRANSITION MAY BE GRADUAL.

*SAMPLE TYPES: RS = Ring BS = Bag CPT = Cone penetration test SS = Standard Penetration Test C = Core ST = Shelby Tube

NOTES: **Groundwater not encountered**	Terracon	DATE DRILLED: **6-15-07**	PAGE NUMBER: **Page 6 of 6**
HAMMER WEIGHT (lbs): **140**		PROJECT NO.: **64075017**	PLATE: **A-12**

APPENDIX B

Laboratory Testing



	Specimen Identification			Classification	WC%	LL	PL	PI	Cc	Cu
●	B-1	@	19.0 ft.	WELL-GRADED SAND with SILT SW-SM		NP	NP	NP	1.52	13.9
⊠	B-1	@	59.0 ft.	SILTY SAND SM		NP	NP	NP		
▲	B-2	@	39.0 ft.	WELL-GRADED SAND with SILT and GRAVEL SW-SM		NP	NP	NP	1.45	17.9
★	B-2	@	78.5 ft.	WELL-GRADED SAND with SILT SW-SM		NP	NP	NP	1.39	21.0

	Specimen Identification			D100	D85	D50	D15	%Gravel	%Sand	%Silt / %Clay
●	B-1	@	19.0 ft.	19.00	3.54	0.669	0.1200	11.7	77.6	10.7
⊠	B-1	@	59.0 ft.	19.00	2.06	0.477		3.8	79.7	16.4
▲	B-2	@	39.0 ft.	25.40	7.60	1.174	0.1850	20.3	71.3	8.4
★	B-2	@	78.5 ft.	19.00	4.37	0.876	0.1110	13.5	75.0	11.5

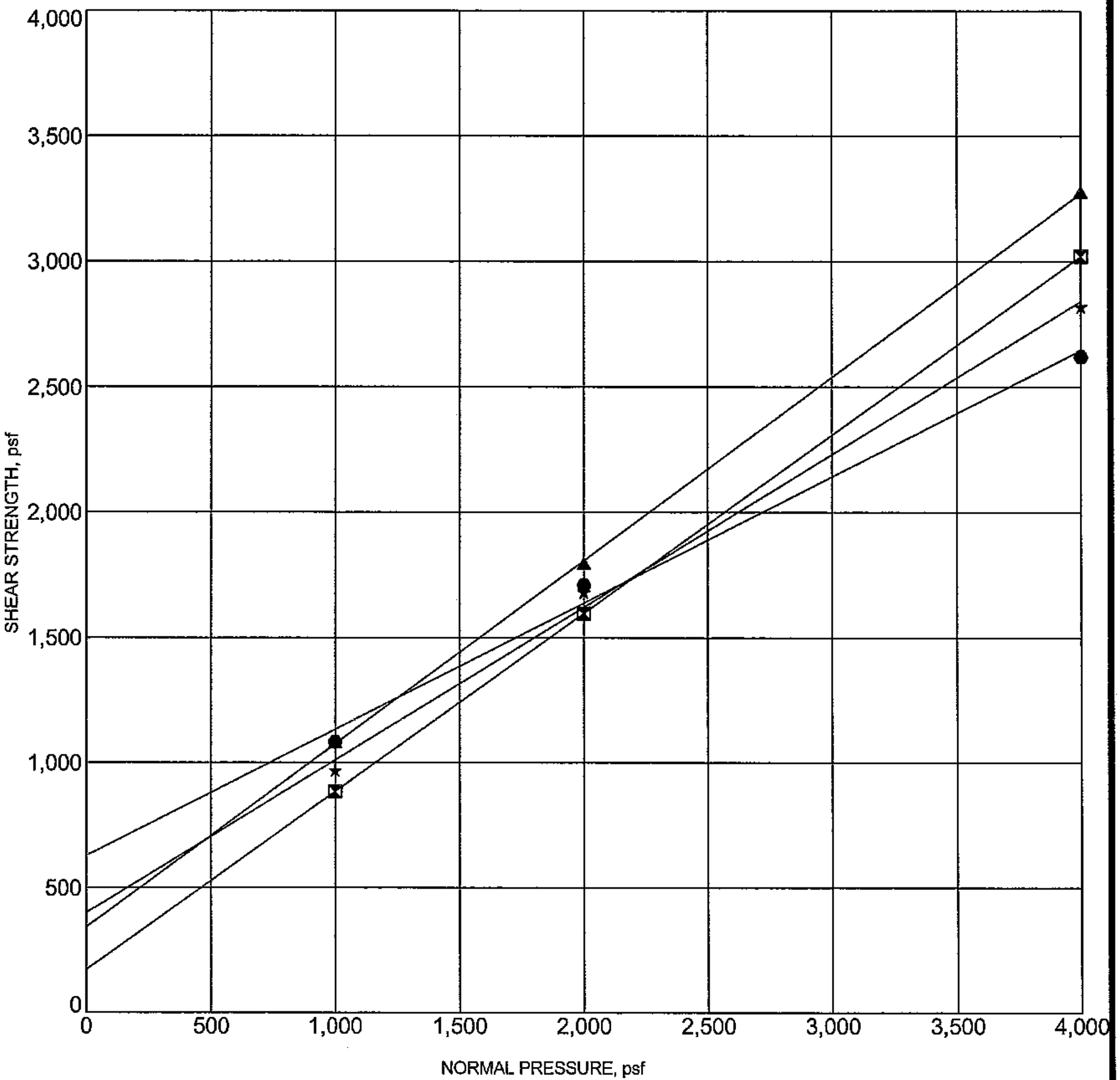
Terracon

Client: *Bright Source Energy, Inc.*
Project: *Solar Power Plant*
Project Site *Ivanpah Valley, San Bernardino County, CA*
Project No. *64075017*

SIEVE ANALYSES

Date *July 2007*

B-1



	Specimen Identification		Classification	c, psf	ϕ°
●	B- 1 @	14.0 ft	Clayey Sand, SC	627	27
⊠	B- 1 @	54.0 ft	Sandy Gravel, GM	172	35
▲	B- 2 @	34.0 ft	Sand with Silt and Gravel, SW-SM	342	36
★	B- 2 @	74.0 ft	Silty Sand, SM	399	31

TC_DIRECT_SHEAR_DEB 75017.GPJ TERRACON.GDT 7/2/07

Terracon

DIRECT SHEAR TEST

Client: Bright Source Energy, Inc.
Project: Solar Power Plant
Site: Ivanpah Valley, San Bernardino County, CA
Job #: 64075017

PLATE: B-2

Atlas Consultants, Inc.

6000 S. Eastern Avenue, Suite 10J • Las Vegas, Nevada 89119
(702) 383-1199 • Fax (702) 383-4983

member of
AMERICAN SOCIETY FOR TESTING MATERIALS

ACT LAB NO:	14475(c)	**DATE:**	June 21, 2007
PROJECT NO:	64075017	**P.O.:**	
ANALYZED BY:	Kurt D. Ergun	**LAB ID:**	

REPORT OF DETERMINATION

AWWA 4500 E

SOIL SIEVE SIZE = -10 MESH

Sample No.	Location	Depth (Feet)	Water Soluble Sulfate (SO_4) in soil Percent By Weight
	B-1	9.0	0.02
	B-2	29.0	0.02

LABORATORY MANAGER

Notes: The results for each constituent denote the percentage of that analyte, at a 1:5 (soil:water) extraction ratio, which is present in the soil.