REPORT OF

SUBSURFACE EXPLORATION
AND GEOTECHNICAL ENGINEERING ANALYSIS

PROPOSED LANCASTER SOLAR FARM
EAST DRUMORE TOWNSHIP
LANCASTER COUNTY, PENNSYLVANIA

FOR

LANDCORE ENGINEERING CONSULTANTS, PC

JANUARY 11, 2010

ECS MID-ATLANTIC, LLC
Geotechnical • Construction Materials • Environmental • Facilities

January 11, 2010

Mr. Matthew Rutt, P.E.
LANDCORE Engineering Consultants, P.C.
8614 Montgomery Avenue
Wyndmoor, PA 19038

ECS Job No. 18.1950

Reference: Report of Subsurface Exploration and Geotechnical Engineering Anaylsis, Proposed Lancaster Solar Farm Project, Deaver Road and Lancaster Pike, East Drumore Township, Lancaster County, Pennsylvania

Dear Mr. Rutt:

As authorized by your acceptance of our proposal No. 18.2165-GP, dated November 24, 2009, revised December 14, 2009, ECS Mid-Atlantic, LLC (ECS) has completed the geotechnical evaluation for the above referenced project. A report including the results of our subsurface exploration, boring logs, and a Boring Location Diagram, is enclosed with this letter.

The enclosed report discusses the subsurface exploration procedures, presents the results of our subsurface exploration, and presents our recommendations for the design and construction of the proposed structure and associated site work. Additional information with regard to construction considerations, estimated settlement, as well as other factors which may influence construction at the site, are discussed in detail in the accompanying report.

We have enjoyed being of continued service to LANDCORE Engineering Consultants, P.C., during the design phase of this project. We look forward to the opportunity to work with you on the construction phase of this project as well. If there are any questions regarding the information and geotechnical recommendations contained in this report, please do not hesitate to contact us.

Respectfully submitted,

ECS MID-ATLANTIC, LLC.

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REPORT

PROJECT

Subsurface Exploration
and Geotechnical Engineering Analysis
Proposed Lancaster Solar Farm Project
Lancaster Pike and Deaver Rd, East Drumore Township
Lancaster County, Pennsylvania

CLIENT

Mr. Matthew Rutt, P.E.
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Wyndmoor, PA 19038

PROJECT #18.1950

DATE January 11, 2010

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PROJECT OVERVIEW

Project Location

The project site is located at the intersection of Deaver Road and Lancaster Pike in East Drumore Township, Lancaster County, Pennyslvania. The project site is located at the southeastern corner of this intersection. The site is currently occupied by a cultivated agricultural field. The site also contains a barn and residential housing at the northwest corner of the site.

Scope of Work

The conclusions and recommendations contained in this report are based on field subsurface exploration, laboratory testing, and review of available geologic and/or geotechnical data.

Our subsurface explorations consisted of 12 soil borings across the site. Borings B-1 through B-12 were located in the vicinity of the proposed solar panels. Borings B-1, B-4 and B-11 were scheduled to extend to a depth of 20 feet below the existing ground surface or auger refusal, which ever is less. The remaining borings were scheduled to extend to a depth of 15 feet or auger refusal, which ever is less. During the subsurface exploration, auger refusal was encountered on four of the borings at depths ranging from 7.5 feet to 18.7 feet below the ground surface.

The boring locations were located in the field by a representative of ECS by tape and measurement from existing site features as an approximation of proposed the boring locations.

The results of the subsurface exploration program, along with the Boring Location Diagram and laboratory testing results, are included within the appendix of this report.

Proposed Construction

Based on our information, we understand that the proposed project will consist of the construction of a new Solar Electric Generation Farm to be located on an existing 89.2 acre farm on Deaver Road and Lancaster Pike in East Drumore Township, Lancaster County, Pennsylvania.

It is our understanding that the project will consist of several fields or arrays of solar panels. These will be used to collect and generate electricity which will then be transmitted to the current high power system located along the northern portion of the property. The panels will be supported by helical piers and will primarily function as anchors to resist uplift pressure from wind loads. It is likely that various other small foundation/pads will be constructed throughout the site to support various transmission elements and equipment. Final site plans have not been made available at this time therefore our recommendations are provided as general guidelines to assist the design team in the design and planning of the site.

Purposes of Subsurface Exploration

The purposes of this subsurface exploration were to explore the soil and groundwater conditions at the site and to develop preliminary engineering recommendations to guide design and construction of the project. We accomplished these purposes by:

1. Performing a site reconnaissance to observe and evaluate the existing site conditions.
2. Drilling borings to explore the subsurface soil and groundwater conditions,
3. Performing laboratory tests on selected representative soil samples from the borings to evaluate pertinent engineering properties, and
4. Analyzing the field and laboratory data to develop appropriate engineering recommendations.

EXPLORATION PROCEDURES

Subsurface Exploration Procedures

The soil borings were performed with both an all-terrain vehicle (ATV) and truck mounted auger drill rigs. Both rigs utilized continuous flight, hollow stem augers to advance the boreholes. Drilling fluid was not used during the soil drilling at each boring location. Each boring was backfilled with the spoils generated during the drilling process.

Representative soil samples were obtained by means of the split barrel sampling procedure in accordance with ASTM Specification D-1586. In this procedure, a 2 inch O.D., split-barrel sampler is driven into the soil a distance of 18 inches by a 140 pound hammer falling 30 inches. The number of blows required to drive the sampler through a 12-inch interval is termed the Standard Penetration Test (SPT) value and is indicated for each sample on the boring logs. This value can be used as a qualitative indication of the in place relative density of cohesionless soils. In a less reliable way, it also indicates the consistency of cohesive soils. This indication is qualitative, since many factors can significantly affect the standard penetration resistance value and prevent a direct correlation between drill crews, drill rigs, drilling procedures, and hammer-rod-sampler assemblies.

A field log of the soils encountered in the borings was maintained by the drill crew. After recovery, each sample was removed from the sampler and visually classified. Representative portions of each sample were then sealed and brought to our laboratory for further visual examination and laboratory testing.

Laboratory Testing Program

Representative soil samples were selected and tested in our laboratory to check field classification and to determine pertinent engineering properties. The laboratory testing program included visual classifications, moisture content tests, grain-size distribution and Atterberg limits testing to confirm field classifications and determine the engineering properties of the encountered soil strata.

The encountered soils were classified on the basis of texture and plasticity in accordance with the Unified Soil Classification System (USCS). The group symbols for each soil type are indicated in parentheses following the soil descriptions on the boring logs. A brief explanation of the Unified Soil Classification System is included with this report. The geotechnical engineer grouped the various soil types into the major zones noted on the boring logs. The stratification lines designating the interfaces between earth materials on the boring logs and profiles are approximate; in situ, the transitions may be gradual.

The soil samples will be retained in our laboratory for a period of 60 days, after which, they will be discarded unless other instructions are received as to their disposition. The results of the laboratory testing are included in the Appendix of this report.

EXPLORATION RESULTS

Site Conditions

The project site is located at the intersection of Deaver Road and Lancaster Pike in East Drumore Township, Lancaster County, Pennyslvania. The project site is located at the southeastern corner of this intersection. The site is currently occupied by a cultivated agricultural field. The site also consists of an occupied barn and residence located on the northwestern corner of the site.

Regional Geology

According to the *Atlas of Preliminary Geologic Quadrangle Maps of Pennsylvania, Wakefield Quadrangle,* 1978, the project site is underlain by the Wissahickon Formation. The Wissahickon Formation consists of interbedded chlorite-muscovite meta-graywacke and fine-grained chlorite-muscovite schist.

Soils Mapping

We reviewed the soils mapping of the project site as provided by the United States Department of Agriculture (USDA) for Lancaster County. The soil types on the proposed project site were identified as mapping units Chester Silt Loam (CbA) – 0 to 3% slopes, Chester Silt Loam (CbB) – 3 to 8% slopes, Chester Silt Loam (CbC) – 8 to 15% slopes, and Glenelg Silt Loam (GbC) – 8 to 15% slopes.

According to the USDA soils mapping the Chester Silt Loam (CbA), Chester Silt Loam (CbB), and Chester Silt Loam (CbC) components consist of 0 to 3% slopes, 3 to 8% slopes and 8 to 15% slopes, respectively. The parent material consists of residuum weathered from mica schist. Depth to bedrock is approximately 72 to 99 inches. The natural drainage class is well drained. Water movement in the most restrictive layer is moderately high to high. This soil is not flooded or ponded.

The Chester Glenelg Silt Loam (GbC) component consists of 8 to 15% slopes. The parent material consists of residuum weathered from mica schist. Depth to bedrock is approximately 60 to 120 inches. The natural drainage class is well drained. Water movement in the most restrictive layer is moderately high to high. This soil is not flooded or ponded.

We have included a map indicating the various mapped soils in the Appendix of this report.

Soil Conditions

Topsoil measuring 3 to 4 inches was encountered in each boring. While only 3 to 4 inches of topsoil was encountered, these fields have formerly been used as cultivated crops. Therefore, we anticipate that the upper 12 inches of soil, the “plow zone”, will contain higher percentages of organic materials that will make them less desirable for use as structural fill. Below the topsoil, natural soils consisting of a soft to stiff CLAY (CL) with varying amounts of silt, fine gravel, sand, and mica was encountered in borings B-1 through B-5, B-11 and B-12. This strata continued to depths ranging from 1.5 to 6.5 in borings B-1 through B-5, B-7 and B-11 and continued to the auger refusal depth of 8.0 feet below the ground surface in boring B-12. Below this CLAY strata, a firm to very dense Sandy SILT (ML/SM) with varying amounts of clay, fine gravel, rock fragments and mica was encountered in borings B-1, B-2, B-5, and B-11 and continued to the auger refusal/termination depths ranging from 10.5 feet to 20 feet. Below the CLAY in borings B-3 and B-4, a medium dense to very dense fine SAND (SP) with varying amounts of fine to medium gravel, rock fragments, silt, and mica was encountered to a depth of 4.0 feet in boring B-4 and to the auger refusal depth of 14.8 feet in boring B-3. Below the SAND in boring B-4, a stiff fine Sandy CLAY (CL/SC) with trace amounts of mica was encountered. At a depth of 6.5 feet, this Sandy CLAY transitioned to a very dense fine SAND (SP) with fine to medium gravel and trace amounts of silt and continued to the auger refusal depth of 18.7 feet. Below the topsoil in boring B-7, a soft to medium stiff highly plastic CLAY (CH) with silt, fine sand, gravel and trace amounts of mica was encountered to a depth of 6.5 feet. Below this CLAY, a firm to medium dense Sandy SILT (ML/SM) with fine to medium gravel and trace amounts of clay and rock fragments was encountered and continued to the termination depth of 15.0 feet.

Below the topsoil in borings B-9 and B-10, a soft to medium stiff Silty CLAY (CL/ML) with fine gravel and varying amounts of mica was encountered to depths of 6.5 and 4.0 feet, respectively. Below this Silty CLAY in boring B-9, a very dense Sandy Gravel (GP/SP) with rock fragments was encountered and continued to the auger refusal depth of 8.8 feet. Below the Silty CLAY in boring B-10, a firm to medium dense fine Sandy SILT (ML/SM) with fine to medium gravel and trace amounts of mica and rock fragments was encountered to the termination depth of 15.0 feet.

Below the topsoil in boring B-6, a medium stiff Sandy CLAY (CL/SC) with fine gravel was encountered to a depth of 4.0 feet. Below this strata, a medium dense to very dense fine SAND (SP) with trace amounts of clay, mica and rock fragments was encountered and continued to the auger refusal depth of 14.9 feet.

Groundwater Observations

Groundwater seepage was not encountered in any of the borings during our subsurface exploration. Observations for groundwater were made during sampling and upon completion of the drilling operations at each boring location. In auger drilling operations, water is not introduced into the boreholes during soil drilling and the groundwater position can often be determined by observing water flowing into or out of the boreholes. Furthermore, visual observation of the soil samples retrieved during the auger drilling exploration can often be used in evaluating the groundwater conditions.

The highest groundwater observations are normally encountered in late winter and early spring, and our current groundwater observations are expected to be lower than the seasonal maximum water table. Variations in the location of the long-term water table may also occur as a result of changes in precipitation, evaporation, surface water runoff, and other factors not immediately apparent at the time of this exploration.

Based on the absence of consistent groundwater seepage in the borings, we do not expect that groundwater will present construction difficulties beyond the normal conditions for the construction portion of this project.

For excavations that terminate above the groundwater table, we anticipate that an aggressive sump pit and pumping operation will be sufficient for dewatering the bottoms of the excavations. Also, adequate site drainage away from open excavations will also minimize the impact of water during construction and work areas.

ANALYSIS AND RECOMMENDATIONS

Our recommendations presented in this report are based on our understanding of the project, the assumptions that we have stated in this report, the results of our subsurface exploration and laboratory testing and our experience in geotechnical engineering. If our assumptions or our understanding of the proposed project are not correct we should be notified so that we may alter our recommendations as required.

Rock Excavation

Based on our subsurface exploration and site reconnaissance, the bedrock surface may vary across the site. The bedrock is expected to be shallow on the southern portions of the site and drop off moving north. While it is not expected that bedrock will be encountered in the majority of the site excavating, it is possible that rock pinnacles will be encountered. Increased effort should be anticipated to achieve grades below the auger refusal noted on our logs. In a mass grading operation, large excavation equipment and single tooth rippers will have success at ripping and removing the rock. However, in a trench application, depths below our refusal will only be able to be achieved through blasting and/or hoe ramming. It is anticipated that if large scale excavations below the auger refusal depths noted on our logs are required, blasting will be necessary.

If the shot rock is proposed to be reused as structural fill, supporting either buildings or pavement, it is should be reduced to workable sizes. Any rock excavated from the site and used as earthwork fill should have a well-graded grain size distribution with rock and soil particles ranging from clay or silt size particles to a maximum size of 6 inches in diameter with 2 inch thick plates in the building pad and 6 inch diameter and 4 inch plate in the parking/travelways. Particles larger than this should be decomposed of by mechanical compaction equipment to achieve the desired grain size distribution. A minimum uniformity coefficient of 6 should be used to identify the proper grain size distribution and the samples should have a minimum of 20% passing the #200 sieve and 50% passing the #40 sieve. Variations from these recommendations should be approved by the geotechnical engineer in the field, at the time the samples are prepared.

Subgrade Preparation and Earthwork Operations

The subgrade preparation prior to fill placement, ground improvements or proofrolling should consist of stripping all vegetation, rootmat, topsoil, “plow zone” and any other soft or unsuitable material from the areas of the proposed solar panels and any proposed pavement areas. This includes any undocumented fill that may be encountered. We recommend the earthwork clearing be extended a minimum of 10 feet beyond proposed structure limits.

After stripping to the desired grade, and prior to fill placement, the stripped surface should be observed by an experienced geotechnical engineer or his authorized representative. Proofrolling using a loaded dump truck, having an axle weight of at least 10 tons, may be used at this time to aid in identifying localized soft or unsuitable material which should be removed. Any soft or unsuitable materials encountered during this proofrolling should be removed and replaced with an approved backfill compacted to the criteria given below.

The preparation of fill subgrades, as well as proposed structure subgrades should be observed on a full-time basis by a representative of the geotechnical engineer to document that all unsuitable materials have been removed and that the subgrade is suitable for support of the proposed construction and/or engineered fill placement.

Fill Placement

Fill materials should consist of an approved material, classified as ML, CL, SM, SP, SC or SM, free of organic matter and debris, rocks greater than 6 inches in diameter, and have a Liquid Limit and Plasticity Index less than 40 and 20, respectively. No CH materials should be allowed to be placed as structural fill. It should be noted that one boring, B-7, encountered CH materials to a depth of 6.5 feet. These materials should not be reused as structural fill.

Unacceptable fill materials include topsoil, organic materials (OH, OL) and plastic silts and clays (CH, MH). All such materials removed during grading operations should be either stockpiled for later use in landscape fills, or placed in approved disposal areas either on site or off site.

The on-site materials may be reused as engineered fill provided that they do not contain organics, or foreign debris, are not highly plastic, and conform to the criteria outlined above. Because of the moderately fine-grained and cohesive content of the near surface soils across the project site, it is recommended that the earthwork operations be performed during the warmer and dryer (i.e. late spring, summer, early fall) periods of the year. In the event that the earthwork operations are accomplished during the cooler and wetter periods of the year or even during the warmer periods where rainfall has occurred, delays, and/or additional costs should be anticipated. The reduction of soil moisture and stabilization of the soils may be accomplished by a combination of mechanical manipulation and/or the use of chemical additives such as quicklime, Portland cement and/or other related products to reduce the moisture content of the soils and permit stabilization and compaction. It should be noted that the application of agricultural lime would not be suitable for this application. Other alternatives would be to undercut any excessively moist materials to firm subgrade and replace them with approved on-site and/or off-site fill materials.

Moisture adjustment is anticipated to be required to condition the suitable on-site material before its placement in new structural fill areas. Any materials not considered to be suitable for reuse in structural areas should either be disposed of off-site or stockpiled for later use as fill material in green areas away from any site slopes.

This site is underlain by micaceous silts and clays. These materials are highly moisture and disturbance sensitive. Structural fills constructed of these types of materials can quickly degrade if construction traffic is allowed to conintue over approved fill. Therefore, we recommend that once fills have been placed, construction traffic should be limited. This also applies to any final pavement areas. Gravel drives and/or asphalt pavements should not be completed until the majority of construction is completed. If construction traffic is allowed to traverse pavements and gravel drives, reconstruction of damaged areas should be expected.

Fill materials should be placed in lifts not exceeding 8 inches in loose thickness and moisture conditioned to within +/- 2 percentage points of the optimum moisture content. Fill soils should be compacted to a minimum of 95% of the maximum dry density obtained in accordance with ASTM Specification D-698, Standard Proctor Method. The expanded footprint of the proposed solar panels should be well defined, including the limits of fill zones at the time of fill placement. Grade control should be maintained throughout the fill placement operations.

It is not expected that for general grading, import materials will be required. However, if required, a sample of any proposed borrow materials should be submitted to the Geotechnical Engineer of Record at least five days prior to importing the material to the site for appropriate lab testing to determine if the material meets the criteria outlined above.

All fill operations should be observed on a full-time basis by a qualified soils technician to determine the minimum compaction requirements are being met. A minimum of one compaction test per 2,500 square foot area should be tested in each lift placed. The elevation and location of the tests should be clearly identified at the time of fill placement.

Compaction equipment suitable to the soil type used as fill should be selected to compact the fill. Theoretically, any equipment type can be used as long as the required density is achieved. Ideally, a steel drum roller would be most efficient for sealing the surface soils. All areas receiving fill should be graded to facilitate positive drainage away from the building pad and pavement areas of any free water associated with precipitation and surface run-off.

Fill materials should not be placed on frozen soils. All frozen soils should be removed prior to continuation of fill operations. All frost-heaved soils should be removed prior to placement of fill, stone, concrete, or asphalt. Soil bridging lifts within the expanded building limits should not be used as excessive settlement of the structures will likely occur.

Building Foundations

Based on the subsurface soil conditions, we anticipate that building foundations can be be supported on shallow spread foundations. Provided that the recommendations contained in this report are strictly adhered, the foundations bearing on natural soils may be designed for a net allowable bearing capacity of **2,500** psf. This design bearing pressure is considered the minimum for the site. Since final building/pad layouts have not been provided, we can not provide more detailed foundation recommendations. Once final plans have been developed we can provide additional recommendation based on proposed grading and anticipated foundation bearing elevations. Based on our subsurface exploration, it is likely that final bearing capacities could range from 2,500 psf to as high as 10,000 psf for foundations bearing on the highly weathered schist.

The net allowable soil bearing pressure refers to that pressure which may be transmitted to the foundation bearing soils in excess of the final minimum surrounding overburden pressure. During construction, the bearing capacity at the final footing excavation should be observed in the field by the geotechnical engineer, or his authorized representative to document that the in situ bearing capacity at the bottom of each footing excavation is adequate for the design loads and meets or exceeds the design bearing pressure.

It should be noted that footings bearing within naturally occurring soils may require localized "stepping down " or over excavation of the footings in order to achieve the recommended soil bearing pressure due to potential variations in the soil support characteristics. All footing installations should be observed on a full time basis by a representative of the geotechnical engineer, or his authorized representative.

Any fill placed within the building areas should be placed in accordance with the recommendations provided in the section entitled Fill Placement.

As further precaution with regard to moisture content variations in the soils supporting exterior footings, we recommend that finished grades in the areas of the footings be relatively impervious and should slope downward and away from the structure.

On the basis of design assumptions outlined in this report, settlement of the structure is expected to be within tolerance for the structures, regardless of foundation system utilized. For foundation designs based on any of our recommended options, settlements of up to 1 inch, with differential settlements on the order of one-half this amount are anticipated. These settlement values are based on our engineering experience with these materials and the anticipated structural loading, and are a guide to the structural engineer with his/her design. Final loading and foundation plans should be provided so that we may verify these settlement estimates.

We recommend that continuous footings have a minimum width of 1.5 feet and that isolated column footings have a minimum lateral dimension of 2.5 feet. The minimum dimensions recommended above help reduce the possibility of foundation bearing failure and excessive settlement due to local shear or "punching" action. In addition, footings should be placed at a depth to provide adequate frost cover protection. Therefore, we recommend footings in heated areas be placed at a minimum depth of 2 feet below the finished grade, and perimeter footings subject to climatic variations be located at a minimum depth of 3.0 feet below finished grade.

Exposure to the environment may weaken the materials at the footing bearing level if the foundation excavations remain open for too long a time. Therefore, foundation concrete should be placed the same day that excavations are made. If the bearing materials are softened by surface water intrusion or exposure, the softened materials must be removed from the foundation excavation bottom immediately prior to placement of concrete.

All continuous load-bearing wall foundations should be suitably reinforced. To provide continuity and to reduce the effects of differential settlements, the longitudinal reinforcing steel should be extended into any column footings situated along the wall footings and the foundations should be constructed as a continuous unit through monolithic concrete placement to the extent practical. The reinforcing steel also should be continuous through the building corners. Where top and bottom steel is included in the continuous wall foundations, a minimum footing thickness of 12 inches should be provided. Prior to the placement of any foundation concrete, the steel reinforcement should be observed to document that the bars are properly sized and positioned in accordance with the foundation plans and specifications.

Helical Piles

Based on our subsurface exploration, the use of helical piles to support the proposed panels appears feasible. However, it is our understanding that field load testing will be performed to confirm this. It is likely that installation of helical piles below our auger refusal depths will not be possible. We have provided a soil Design Parameters Chart in the Appendix that outlines our recommended values to be used when designing the helical pile system near each boring location.

Excavation Slopes and Support

For temporary cuts or excavations, side slopes as steep as 1.5H:1V (Horizontal:Vertical) are possible in the natural soils observed at this site. For long-term stability, slopes should be no steeper than 3H:1V in either natural soils or fill soils. Any proposed slopes steeper than 3H:1V should be reviewed by the geotechnical engineer. All temporary and permanent slopes should be aggressively protected, such as by seeding and mulching as soon as possible after placement, to prevent from sloughing and erosion. If slopes steeper that the 3H:1V are needed, we should be contacted to perform a global stability analysis of the slope, prior to construction. Also, once the final building layout and grading plan is completed we should be allowed to review the plans to determine if global stability of the slopes adjacent to the building will be a concern.

Seismic Design Considerations

In accordance with Table 1615.1.1 of the 2000 International Building Code (IBC), Site Class B should be utilized for seismic analysis. This classification is based on the subsurface conditions encountered during our exploration and on our knowledge of the local geology.

Construction Considerations

Exposure to the environment may weaken the soils at the footing bearing level if the foundation excavations remain open for too long a time. Therefore, foundation concrete should be placed the same day that excavations are dug. If the bearing soils are softened by surface water intrusion or exposure, the softened soils must be removed from the foundation excavation bottom immediately prior to placement of concrete. If the excavation must remain open overnight, or if rainfall becomes imminent while the bearing soils are exposed, we recommend that a 1 to 3 inch thick "mud mat" of "lean" concrete be placed on the bearing soils before the placement of reinforcing steel.

The surficial soils contain fines which are considered highly erodible. The Contractor should provide and maintain good site drainage during earthwork operations to help maintain the integrity of the surficial soils. All erosion and sedimentation shall be controlled in accordance with sound engineering practice and current County requirements.

In a dry and undisturbed state, the majority of the soil at the site will provide good subgrade support for fill placement and construction operations. However, when wet, this soil will degrade quickly with disturbance from contractor operations. Therefore, good site drainage should be maintained during earthwork operations which would help maintain the integrity of the soil.

The surface of the site should be kept properly graded in order to enhance drainage of the surface water away from the proposed building areas during the construction phase. We recommend that an attempt be made to enhance the natural drainage without interrupting its pattern.

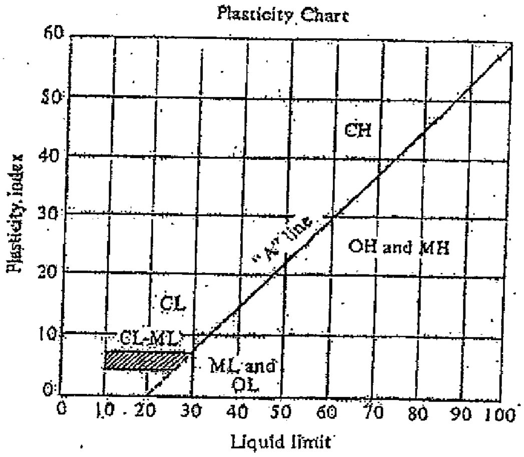
Swales and other drainage features crossing the site are likely to be soft and may require shallow undercutting. In addition, it is anticipated that shallow perched water will be encountered along these drainages.

Closing

We recommend that the construction activities be monitored by a qualified geotechnical engineering firm to provide the necessary overview, to check the suitability of the subgrade soils for supporting the footings and to monitor earthwork operations. We would be most pleased to provide these services.

APPENDIX

Unified Soil Classification System (ASTM D-2487)

Major Divisions			*Group Symbols*		*Typical Names*	*Laboratory Classification Criteria*		
Coarse-grained soils (More than half of material is larger than No. 200 sive size)	Gravels (More than half of coarse fraction is larger than No. 4 sieve size)	Clean Gravels (Little or no fines)	GW		Well-graded gravels, gravel-sand mixtures, little or no fines.	Determine percentages of sand and gravel from grain size curve. Depending on percentage of fines (fraction smaller than No. 200 sieve size), coarse-grained soils are classified as follows: Less than 5 percent GW, GP, SW, SP More than 12 percent GM, GC, SM, SC 5 to 12 percent *Borderline* cases requiring dual symbols[b]	$C_u = D_{60}/D_{10}$ greater than 4; $C_c = (D_{30})^2/D_{10} \times D_{60}$ between 1 and 3	
			GP		Poorly-graded gravels, gravel-sand mixtures, little or no fines		Not meeting all gradation requirements for GW	
		Gravels with fines (Appreciable Amount of fines)	GM[a]	d	Silty gravels, gravel-sand-silt mixtures		Atterberg limits below "A" line or P.I. less than 4	Above "A" line with P.I. between 4 and 7 are *borderline* cases requiring the use of dual symbols
				u				
			GC		Clayey Gravels, gravel-sand-clay mixtures		Atterberg Limits below "A" line with P.I. greater than 7	
	Sands (More than half of coarse fraction is smaller than No. 4 sieve size)	Clean sands (Little or no fines)	SW		Well-graded sands, gravelly sands, little or no fines		$C_u = D_{60}/D_{10}$ greater than 6; $C_c = (D_{30})^2/D_{10} \times D_{60}$ between 1 and 3	
			SP		Poorly-graded sands, gravelly sands, little or no fines		Not meeting all gradation requirements for SW	
		Sands with fines (Appreciable amount of fines)	SM[a]	d	Silty sands, sand-silt mixtures		Atterberg limits above "A" line or P.I. less than 4	Limits plotting in hatched zone with P.I. between 4 and 7 are *borderline* cases requiring the use of dual symbols
				u				
			SC		Clayey sands, sand-clay mixtures		Atterberg limits above "A" line with P.I. greater than 7	
Fine Grained Soils (More than half of material is smaller than No. 200 sieve size)	Silts and clays (Liquid limit less than 50)		ML		Inorganic silts and very fine sands, rock flour, silty or clayey fine sands, or clayey silts with slight plasticity	Plasticity Chart 		
			CL		Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays			
			OL		Organic silts and organic silty clays of low plasticity			
	Silts and clays (Liquid limit greater than 50)		MH		Inorganic silts, micaceous or diatomaceous fine sandy or silty soils, elastic silts			
			CH		Inorganic clays of high plasticity, fat clays			
			OH		Organic clays of medium to high plasticity, organic silts			
	Highly organic soils		Pt		Peat and other highly organic soils			

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[a] Division of GM and SM groups into subdivisions of d and u are for roads and airfields only. Subdivision is based on Atterberg limits; suffix d used when L.L is 28 or less and the P.I. is 6 or less; the suffix u is used when L.L. is greater than 28.

[b] Borderline classifications, used for soils possessing the characteristics of two groups, are designated by combinations of group symbols. For example: GW-GC, well-graded gravel-sand mixture with clay binder.

From Winterkorn and Fang, 1975

REFERENCE NOTES FOR BORING LOGS

I. Drilling Sampling Symbols:

SS	Split Spoon Sampler	ST	Shelby Tube Sampler
RC	Rock Core, NX, BX, AX	PM	Pressuremeter
DC	Dutch Cone Penetrometer	RD	Rock Bit Drilling
BS	Bulk Sample of Cuttings	PA	Power Auger (no sample)
HAS	Hollow Stem Auger	WS	Wash Sample

II. Correlation of Penetration Resistances to Soil Properties:

Standard Penetration (Blows/Ft) refers to the blows per foot of a 140 lb. Hammer falling 30 inches on a 2-inch OD split spoon sampler, as specified in ASTM D-1586. The blow count is commonly referred to as the N value.

A. Non-Cohesive Soils (Silt, Sand, Gravel and Combinations)

Density		*Relative Properties*	
Under 3 blows/ft.	Very Loose	Adjective Form	36% to 49%
4 to 6 blows/ft.	Loose	With	21% to 35%
7 to 10 blows/ft.	Firm	Some	11% to 20%
11 to 30 blows/ft.	Medium Dense	Trace	1% to 10%
31 to 50 blows/ft.	Dense		
51 to 80 blows/ft.	Very Dense		
Over 80 blows/ft.	Extremely Dense		

Particle Size Identification

Boulders		8 inches or larger
Cobbles		3 to 8 inches
Gravel	Coarse	1 to 3 inches
	Medium	½ to 1 inch
	Fine	¼ to ½ inch
Sand	Coarse	2.00mm to ¼ inch (dia. of lead pencil)
	Medium	0.42 to 2.00mm (dia. of broom straw)
	Fine	0.074 to 0.42mm (dia. of human hair)
Silt and Clay		0 .0 to 0.074mm (particles cannot be seen)

B. Cohesive Soils (Clay, Silt, and Combinations)

Blows/Ft	*Consistency*	*Unconfined Comp. Strength Q_P(tsf)*	*Degree of Plasticity*	*Plasticity Index*
Under 4	Very Soft	Under 0.25	None to Slight	0 - 4
4 to 5	Soft	0.25-0.49	Slight	5 - 7
6 to 10	Med. Stiff	0.50-0.99	Medium	8- 22
11 to 15	Stiff	1.00-1.99	High to Very High	Over 22
16 to 30	Very Stiff	2.00-3.00		
31 to 50	Hard	4.00-8.00		
Over 51	Very Hard	Over 8.00		

III. Water Level Measurement Symbols

WL	Water Level	BCR	Before Casing Removal
WS	While Sampling	ACR	After Casing Removal
WD	While Drilling	WCI	Wet Cave-In
		DCI	Dry Cave-In

The water levels are those water levels actually measured in the borehole at the times indicated by the symbol. The measurements are relatively reliable when augering, without adding fluids, in a granular soil. In clay and plastic silts, the accurate determination of water levels may require several days for the water level to stabilize. In such cases, additional methods of measurement are generally applied.

CLIENT	JOB #	BORING #	SHEET
LANDCORE Engineering	18.1950	B-1	1 OF 1

ECS LLC MID-ATLANTIC

PROJECT NAME
Lancaster Solar Farm

ARCHITECT-ENGINEER

SITE LOCATION
Lancaster Pike & Deaver Rd, Quarryville, PA

DESCRIPTION OF MATERIAL ENGLISH UNITS
BOTTOM OF CASING ▶ LOSS OF CIRCULATION 100%
SURFACE ELEVATION

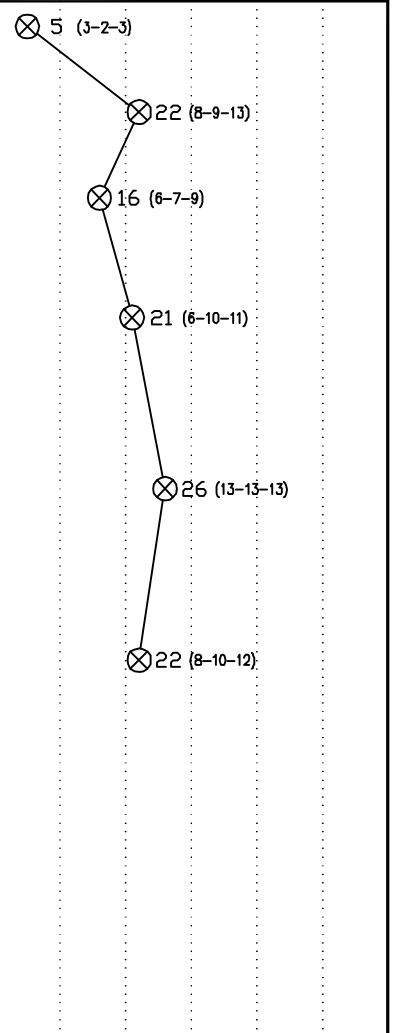
DEPTH (FT)	SAMPLE NO.	SAMPLE TYPE	SAMPLE DIST. (IN)	RECOVERY (IN)	DESCRIPTION OF MATERIAL	WATER LEVELS	ELEVATION (FT)
0	1	SS	18	12	Topsoil Depth 3"		
					CLAY, With Silt and Fine Gravel, Trace Fine Sand, Brown to Orangish Brown, Moist, Soft to Stiff, (CL)		
	2	SS	18	18			
5	3	SS	18	18	Fine Sandy SILT, With Clay and Fine to Medium Gravel, Trace Rock Fragments and Mica, Orangish Brown, Medium Dense, (ML/SM)		
10	4	SS	18	18			
15	5	SS	18	18			
20	6	SS	18	18			
					END OF BORING @ 20.0'		
25							
30							

—○— CALIBRATED PENETROMETER TONS/FT.^{2}
1 2 3 4 5+

PLASTIC LIMIT % X ———— WATER CONTENT % ● ———— LIQUID LIMIT % △

ROCK QUALITY DESIGNATION & RECOVERY
RQD% — — — REC.% ———
20% 40% 60% 80% 100%

⊗ STANDARD PENETRATION BLOWS/FT.
10 20 30 40 50+



THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL TYPES IN-SITU THE TRANSITION MAY BE GRADUAL

▽WL Dry	WS OR WD	BORING STARTED 12/29/09	
▽WL(BCR) Dry	▽WL(ACR) Dry	BORING COMPLETED 12/29/09	CAVE IN DEPTH @ 7.0
▽WL		RIG T-6 FOREMAN S. Breach	DRILLING METHOD 2 1/4" HSA

DKK (01-08-10) DKK (01-08-10) DKK (01-08-10) DKK (01-08-10) DKK (01-08-10) DKK (01-08-10) DKK (01-08-10) DKK (01-08-10) DKK (01-12-10) DKK (01-12-10) DKK (01-12-10) DKK (01-12-10)

JSchaffner(01/08/2010 09:38:29 am)

CLIENT	JOB #	BORING #	SHEET
LANDCORE Engineering	18.1950	B-2	1 OF 1

PROJECT NAME: Lancaster Solar Farm

ARCHITECT-ENGINEER

ECS LLC
MID-ATLANTIC

SITE LOCATION: Lancaster Pike & Deaver Rd, Quarryville, PA

DESCRIPTION OF MATERIAL ENGLISH UNITS

BOTTOM OF CASING ▶ LOSS OF CIRCULATION 100%

SURFACE ELEVATION

SAMPLE NO.	SAMPLE TYPE	SAMPLE DIST. (IN)	RECOVERY (IN)
1	SS	18	16
2	SS	18	18
3	SS	18	18
4	SS	18	18
5	SS	18	18

Topsoil Depth 4"

CLAY, With Fine Sand, Gravel and Silt, Brown to Orangish Brown, Moist, Soft to Stiff, (CL)

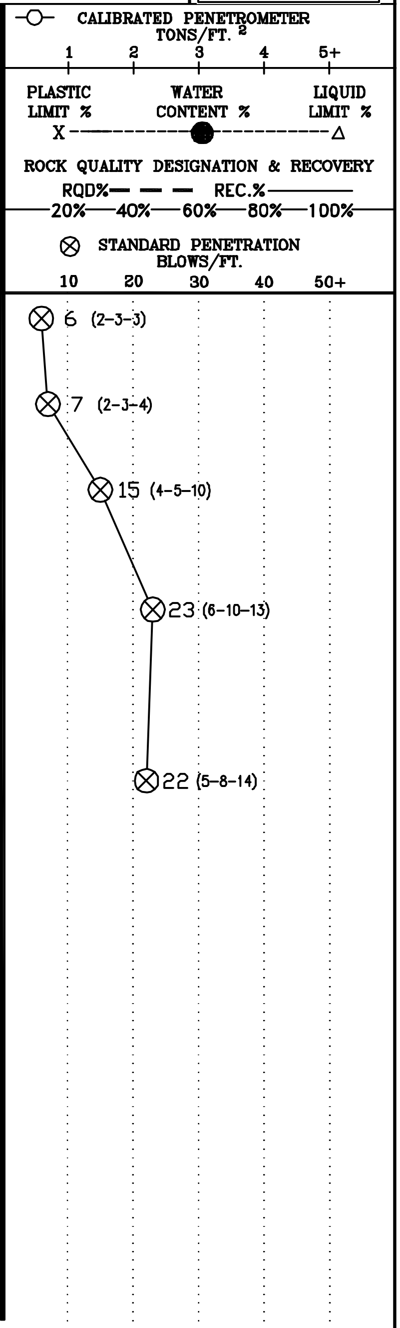
Sandy SILT, With Fine to Medium Gravel, Trace Mica, Clay and Rock Fragments, Orangish Brown, Moist, Medium Dense, (ML/SM)

END OF BORING @ 15.0'

DEPTH (FT): 0, 5, 10, 15, 20, 25, 30

WATER LEVELS

ELEVATION (FT)



THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL TYPES IN-SITU THE TRANSITION MAY BE GRADUAL

WL Dry WS OR WD	BORING STARTED 12/29/09	
WL(BCR) Dry WL(ACR) Dry	BORING COMPLETED 12/29/09	CAVE IN DEPTH @ 8
WL	RIG T-6 FOREMAN S. Breach	DRILLING METHOD 2 1/4" HSA

DKK (01-08-10) DKK (01-08-10) DKK (01-08-10) DKK (01-08-10) DKK (01-08-10) DKK (01-08-10) DKK (01-08-10) DKK (01-08-10) DKK (01-12-10) DKK (01-12-10) DKK (01-12-10) DKK (01-12-10)

JSchaffner(01/08/2010 09:47:50 am)

CLIENT LANDCORE Engineering

JOB # 18.1950

BORING # B-3

SHEET 1 OF 1

PROJECT NAME Lancaster Solar Farm

ARCHITECT-ENGINEER

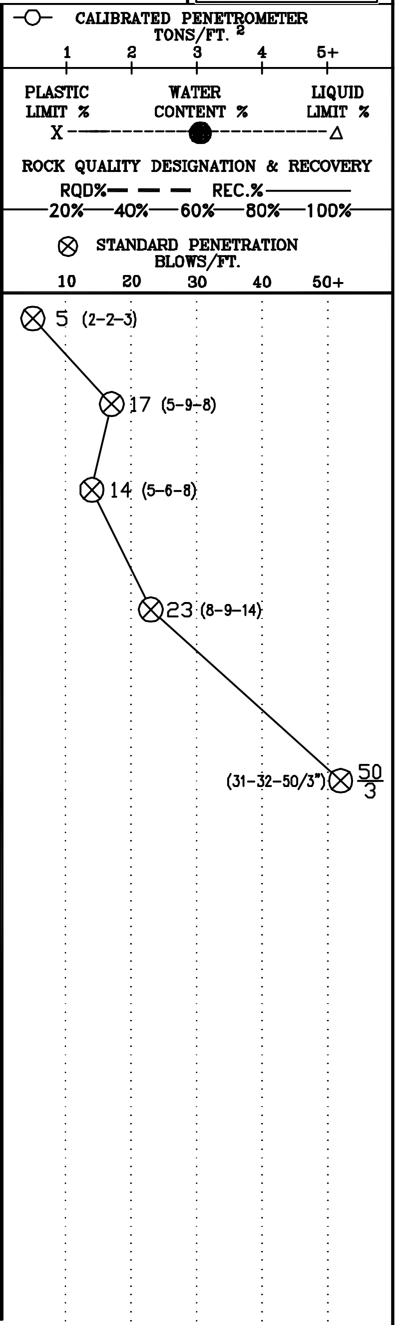
SITE LOCATION Lancaster Pike & Deaver Rd, Quarryville, PA

DESCRIPTION OF MATERIAL ENGLISH UNITS

BOTTOM OF CASING ▶ LOSS OF CIRCULATION 100%

SURFACE ELEVATION

DEPTH (FT)	SAMPLE NO.	SAMPLE TYPE	SAMPLE DIST. (IN)	RECOVERY (IN)	DESCRIPTION OF MATERIAL	WATER LEVELS	ELEVATION (FT)
0	1	SS	18	11	Topsoil Depth 3"		
					CLAY, With Silt, Trace Rock Fragments, Orangish Brown, Moist, Soft to Stiff, (CL)		
	2	SS	18	18			
5	3	SS	18	18	Fine SAND, With Fine to Medium Gravel, Trace Rock Fragments and Silt, Dark Orangish Brown, Moist, Very Dense, (SP)		
10	4	SS	18	14			
	5	SS	18	15			
15					END OF BORING @ 14.8'		
20							
25							
30							



THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL TYPES IN-SITU THE TRANSITION MAY BE GRADUAL

WL Dry WS OR WD	BORING STARTED 12/29/09	
WL(BCR) Dry WL(ACR) Dry	BORING COMPLETED 12/29/09	CAVE IN DEPTH @ 7.0
WL	RIG T-6 FOREMAN S. Breach	DRILLING METHOD 2 1/4" HSA

DKK (01-06-10) DKK (01-06-10) DKK (01-06-10) DKK (01-06-10) DKK (01-08-10) DKK (01-08-10) DKK (01-08-10) DKK (01-12-10) DKK (01-12-10) DKK (01-12-10)

JSchaffner(01/06/2010 10:02:13 am)

CLIENT	JOB #	BORING #	SHEET
LANDCORE Engineering	18.1950	B-4	1 OF 1

ECS LLC MID-ATLANTIC

PROJECT NAME: Lancaster Solar Farm

ARCHITECT-ENGINEER:

SITE LOCATION: Lancaster Pike & Deaver Rd, Quarryville, PA

—○— CALIBRATED PENETROMETER TONS/FT.^{2}: 1 2 3 4 5+

PLASTIC LIMIT % X — WATER CONTENT % ● — LIQUID LIMIT % △

ROCK QUALITY DESIGNATION & RECOVERY: RQD%— — — REC.%——— 20% 40% 60% 80% 100%

⊗ STANDARD PENETRATION BLOWS/FT.: 10 20 30 40 50+

DESCRIPTION OF MATERIAL — ENGLISH UNITS

BOTTOM OF CASING ▶ LOSS OF CIRCULATION 100%

SURFACE ELEVATION

DEPTH (FT)	SAMPLE NO.	SAMPLE TYPE	SAMPLE DIST. (IN)	RECOVERY (IN)	STANDARD PENETRATION BLOWS/FT.
0	1	SS	18	12	4 (2-2-2)
	2	SS	18	18	14 (5-6-8)
5	3	SS	18	18	20 (5-9-11)
	4	SS	18	18	(40-31-42) 73
10					
	5	SS	18	18	(12-30-32) 62
15					
	6	SS	2	2	(50/2") 50/2
20					
25					
30					

Topsoil Depth 4"

CLAY, With Silt, Trace Fine Gravel, Brown, Moist, Soft, (CL)

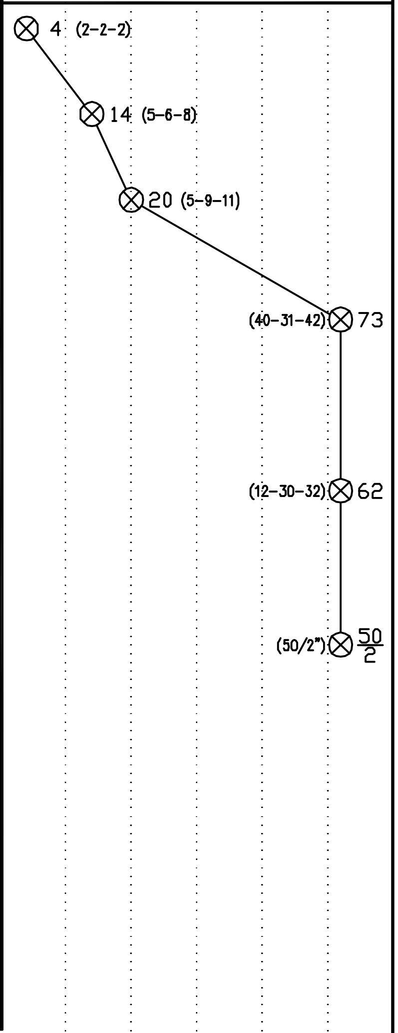
Fine SAND, Trace Mica and Silt, Orangish Brown, Moist, Medium Dense, (SP)

Fine Sandy CLAY, Trace Mica, Orangish Brown, Moist, Stiff, (CL/SC)

Fine SAND, With Fine Medium Gravel, Trace Silt, Dark Orangish Brown, Moist, Very Dense, (SP)

AUGER REFUSAL @ 18.7'

WATER LEVELS | ELEVATION (FT)



THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL TYPES IN-SITU THE TRANSITION MAY BE GRADUAL

▽WL Dry — WS OR WD	BORING STARTED 12/29/09	
▼WL(BCR) Dry ▼WL(ACR) Dry	BORING COMPLETED 12/29/09	CAVE IN DEPTH @ 10
▽WL	RIG T-6 FOREMAN S. Breach	DRILLING METHOD 2 1/4" HSA

DKK (01-06-10) DKK (01-06-10) DKK (01-06-10) DKK (01-06-10) DKK (01-06-10) DKK (01-06-10) DKK (01-06-10) DKK (01-06-10) DKK (01-12-10) DKK (01-12-10) DKK (01-12-10) DKK (01-12-10)

JSchaffner(01/06/2010 09:55:54 am)

CLIENT	JOB #	BORING #	SHEET
LANDCORE Engineering	18.1950	B-5	1 OF 1

PROJECT NAME
Lancaster Solar Farm

ARCHITECT-ENGINEER

ECS LLC MID-ATLANTIC

SITE LOCATION
Lancaster Pike & Deaver Rd, Quarryville, PA

-○- CALIBRATED PENETROMETER TONS/FT.^{2}
1 2 3 4 5+

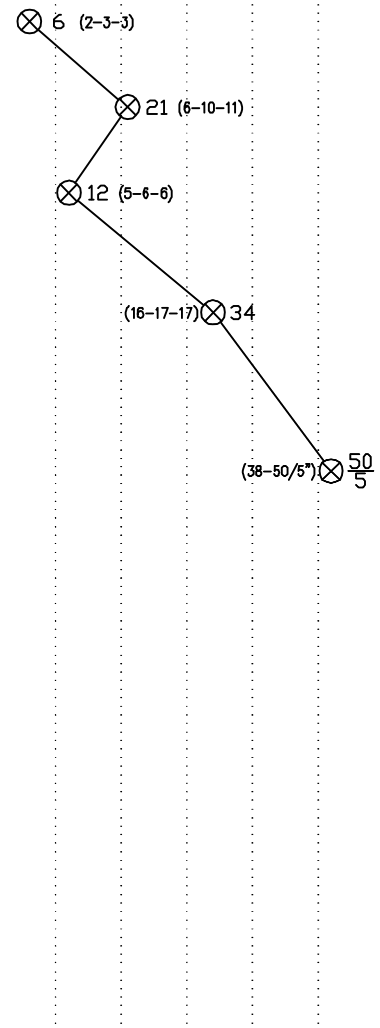
PLASTIC LIMIT % X — WATER CONTENT % ● — LIQUID LIMIT % △

ROCK QUALITY DESIGNATION & RECOVERY
RQD% — — — REC.% ———
20% 40% 60% 80% 100%

⊗ STANDARD PENETRATION BLOWS/FT.
10 20 30 40 50+

DESCRIPTION OF MATERIAL — ENGLISH UNITS
BOTTOM OF CASING ➡ LOSS OF CIRCULATION 100%
SURFACE ELEVATION

DEPTH (FT)	SAMPLE NO.	SAMPLE TYPE	SAMPLE DIST. (IN)	RECOVERY (IN)	DESCRIPTION OF MATERIAL	WATER LEVELS	ELEVATION (FT)
0	1	SS	18	18	CLAY, With Fine Gravel, Sand and Silt, Trace Rock Fragments, Orangish Brown, Moist, Soft to Medium Stiff, (CL)		
	2	SS	18	18			
5	3	SS	18	15	Fine Sandy SILT, With Fine Medium Gravel and Mica, Trace Clay and Rock Fragments, Dark Orangish Brown, Moist, Medium Dense to Very Dense, (ML/SM)		
10	4	SS	18	18			
	5	SS	9	9			
15					AUGER REFUSAL @ 13.9'		
20							
25							
30							



THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL TYPES IN-SITU THE TRANSITION MAY BE GRADUAL

▽WL Dry WS OR (WD)	BORING STARTED 12/29/09	
▼WL(BCR) Dry ▼WL(ACR) Dry	BORING COMPLETED 12/29/09	CAVE IN DEPTH @ 7.5
▽WL	RIG T-6 FOREMAN S. Breach	DRILLING METHOD 2 1/4" HSA

DKK (01-06-10) DKK (01-06-10) DKK (01-06-10) DKK (01-06-10) DKK (01-06-10) DKK (01-08-10) DKK (01-08-10) DKK (01-08-10) DKK (01-08-10) DKK (01-12-10) DKK (01-12-10) DKK (01-12-10) DKK (01-12-10)

JSchaffner(01/08/2010 09:52:41 am)

CLIENT
LANDCORE Engineering

JOB #
18.1950

BORING #
B-6

SHEET
1 OF 1

ECS LLC
MID-ATLANTIC

PROJECT NAME
Lancaster Solar Farm

ARCHITECT-ENGINEER

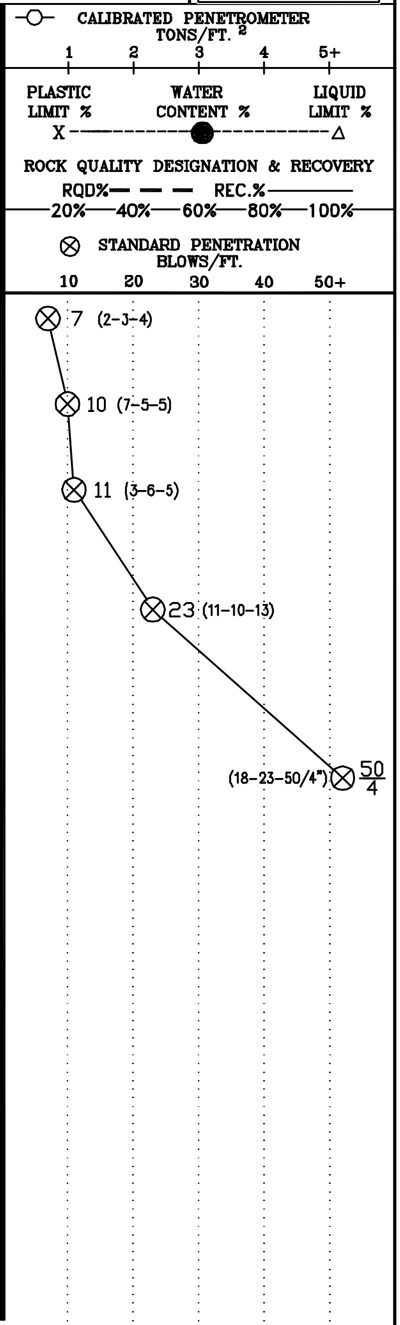
SITE LOCATION
Lancaster Pike & Deaver Rd, Quarryville, PA

DESCRIPTION OF MATERIAL ENGLISH UNITS

BOTTOM OF CASING ▶ LOSS OF CIRCULATION 100%>

SURFACE ELEVATION

DEPTH (FT)	SAMPLE NO.	SAMPLE TYPE	SAMPLE DIST. (IN)	RECOVERY (IN)	DESCRIPTION OF MATERIAL	WATER LEVELS	ELEVATION (FT)
0	1	SS	18	10	Topsoil Depth 3"		
					Sandy CLAY, With Fine Gravel, Orangish Brown, Medium Stiff, (CL/SC)		
	2	SS	18	16			
5	3	SS	18	16	Fine SAND, Trace Clay, Mica and Rock Fragments, Dark Orangish Brown, Moist, Medium Dense to Very Dense, (SP)		
10	4	SS	18	14			
	5	SS	16	16			
15					END OF BORING @ 14.9'		
20							
25							
30							



THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL TYPES IN-SITU THE TRANSITION MAY BE GRADUAL

∇WL Dry WS OR WD	BORING STARTED	12/29/09	
WL(BCR) Dry WL(ACR) Dry	BORING COMPLETED	12/29/09	CAVE IN DEPTH @ 6.5
WL	RIG	FOREMAN S. Breach	DRILLING METHOD 2 1/4" HSA

DKK (01-06-10) DKK (01-06-10) DKK (01-06-10) DKK (01-06-10) DKK (01-08-10) DKK (01-08-10) DKK (01-08-10) DKK (01-12-10) DKK (01-12-10) DKK (01-12-10)

JSchaffner(01/06/2010 10:10:43 am)

CLIENT LANDCORE Engineering	JOB # 18.1950	BORING # B-7	SHEET 1 OF 1
PROJECT NAME Lancaster Solar Farm	ARCHITECT-ENGINEER		
SITE LOCATION Lancaster Pike & Deaver Rd, Quarryville, PA			

ECS LLC
MID-ATLANTIC

-○- CALIBRATED PENETROMETER TONS/FT.^{2}
1 2 3 4 5+

PLASTIC LIMIT % X ——— WATER CONTENT % ● ——— LIQUID LIMIT % △

ROCK QUALITY DESIGNATION & RECOVERY
RQD% — — — REC.% ———
20% 40% 60% 80% 100%

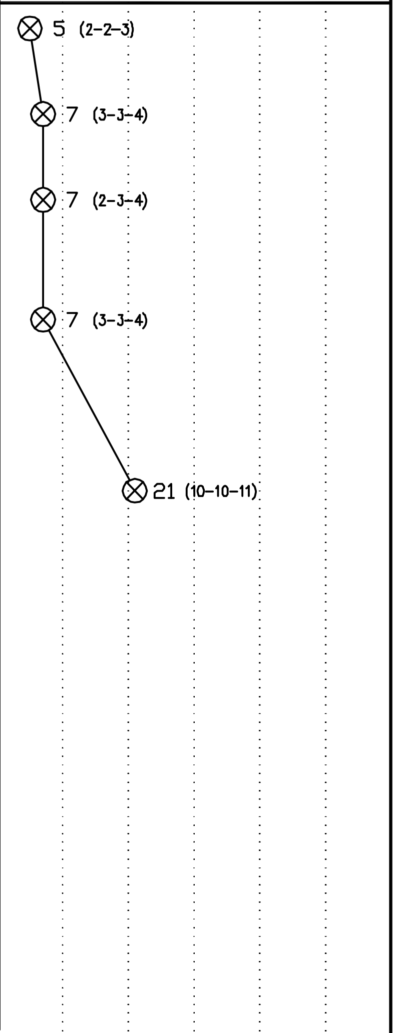
⊗ STANDARD PENETRATION BLOWS/FT.
10 20 30 40 50+

DESCRIPTION OF MATERIAL ENGLISH UNITS

BOTTOM OF CASING ▶ LOSS OF CIRCULATION 100%

SURFACE ELEVATION

DEPTH (FT)	SAMPLE NO.	SAMPLE TYPE	SAMPLE DIST. (IN)	RECOVERY (IN)	DESCRIPTION OF MATERIAL	WATER LEVELS	ELEVATION (FT)	STANDARD PENETRATION BLOWS/FT.
0	1	SS	18	12	Topsoil Depth 4"			5 (2-2-3)
	2	SS	18	16	Highly Plastic CLAY, With Silt and Fine Sand, Trace Fine Gravel and Mica, Brown to Orangish Brown, Moist, Soft to Medium Stiff, (CH)			7 (3-3-4)
5	3	SS	18	12				7 (2-3-4)
	4	SS	18	14	Sandy SILT, With Fine to Medium Gravel, Trace Clay and Rock Fragments, Orangish Brown, Moist, Firm to Medium Dense, (ML/SM)			7 (3-3-4)
10								
	5	SS	18	14				21 (10-10-11)
15					END OF BORING @ 15.0'			
20								
25								
30								



THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL TYPES IN-SITU THE TRANSITION MAY BE GRADUAL

▽WL Dry WS OR WD	BORING STARTED 12/30/09	
▽WL(BCR) Dry ▽WL(ACR) Dry	BORING COMPLETED 12/30/09	CAVE IN DEPTH @ 8.5
▽WL	RIG CME45C FOREMAN M. Ballew	DRILLING METHOD 2 1/4" HSA

DKK (01-08-10) DKK (01-08-10) DKK (01-08-10) DKK (01-08-10) DKK (01-08-10) DKK (01-08-10) DKK (01-08-10) DKK (01-08-10) DKK (01-12-10) DKK (01-12-10) DKK (01-12-10) DKK (01-12-10)

JSchaffner(01/06/2010 09:22:32 am)

CLIENT	JOB #	BORING #	SHEET
LANDCORE Engineering	18.1950	B-8	1 OF 1

ECS LLC
MID-ATLANTIC

PROJECT NAME: Lancaster Solar Farm

ARCHITECT-ENGINEER

SITE LOCATION: Lancaster Pike & Deaver Rd, Quarryville, PA

-○- CALIBRATED PENETROMETER TONS/FT.^{2}
1 2 3 4 5+

PLASTIC LIMIT % X — WATER CONTENT % ● — LIQUID LIMIT % △

ROCK QUALITY DESIGNATION & RECOVERY
RQD% — — — REC.% ——
20% 40% 60% 80% 100%

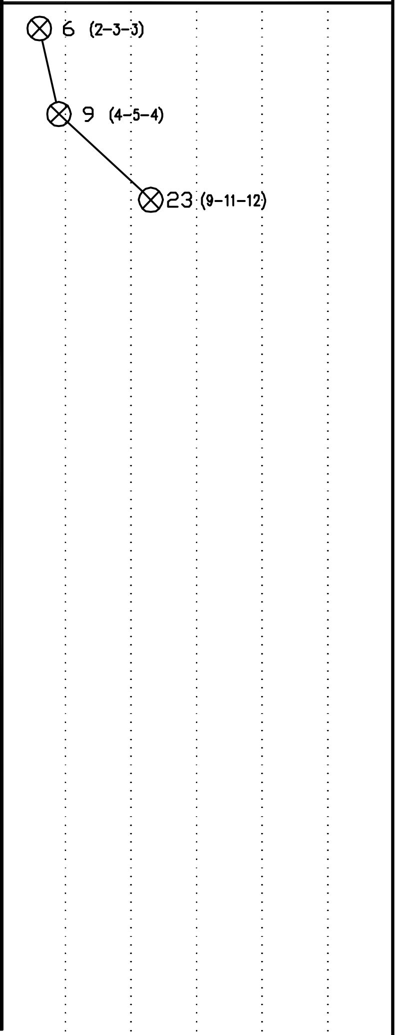
⊗ STANDARD PENETRATION BLOWS/FT.
10 20 30 40 50+

DESCRIPTION OF MATERIAL — ENGLISH UNITS

BOTTOM OF CASING ▶ LOSS OF CIRCULATION 100%>

SURFACE ELEVATION

DEPTH (FT)	SAMPLE NO.	SAMPLE TYPE	SAMPLE DIST. (IN)	RECOVERY (IN)	DESCRIPTION OF MATERIAL	WATER LEVELS	ELEVATION (FT)
0	1	SS	18	14	Topsoil Depth 4"		
					CLAY, With Silt and Fine Gravel, Orangish Brown, Moist, Soft to Medium Stiff, (CL)		
	2	SS	18	14			
5	3	SS	18	12	Silty Fine SAND, With Fine to Medium Gravel and Mica, Trace Rock Fragments, Dark Orangish Brown, Moist, Medium Dense, (SM/ML)		
					AUGER REFUSAL @ 7.5'		
10							
15							
20							
25							
30							



THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL TYPES IN-SITU THE TRANSITION MAY BE GRADUAL

▽WL Dry WS OR (WD)	BORING STARTED 12/30/09	
▼WL(BCR) Dry ▼WL(ACR) Dry	BORING COMPLETED 12/30/09	CAVE IN DEPTH @ 4.0
▽WL	RIG CME45C FOREMAN Ballew	DRILLING METHOD 3 1/4" HSA

DKK (01-08-10) DKK (01-08-10) DKK (01-08-10) DKK (01-08-10) DKK (01-08-10) DKK (01-08-10) DKK (01-08-10) DKK (01-08-10) DKK (01-12-10) DKK (01-12-10) DKK (01-12-10) DKK (01-12-10)

JSchaffner(01/06/2010 09:25:51 am)

CLIENT
LANDCORE Engineering

JOB # 18.1950

BORING # B-9

SHEET 1 OF 1

PROJECT NAME
Lancaster Solar Farm

ARCHITECT-ENGINEER

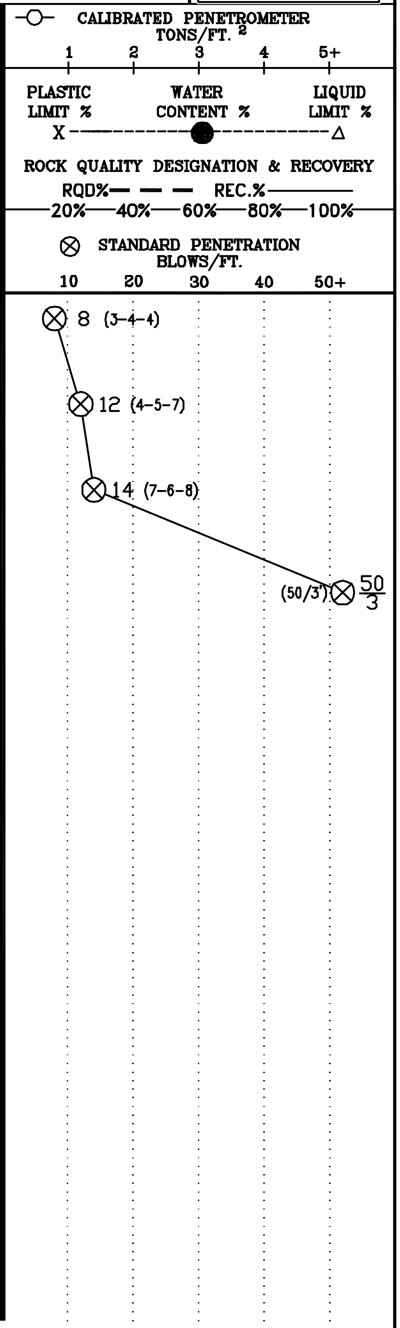
SITE LOCATION
Lancaster Pike & Deaver Rd, Quarryville, PA

DESCRIPTION OF MATERIAL ENGLISH UNITS

BOTTOM OF CASING ▶ LOSS OF CIRCULATION 100%

SURFACE ELEVATION

DEPTH (FT)	SAMPLE NO.	SAMPLE TYPE	SAMPLE DIST. (IN)	RECOVERY (IN)	DESCRIPTION OF MATERIAL	WATER LEVELS	ELEVATION (FT)
0	1	SS	18	18	Topsoil Depth 4"		
	2	SS	18	18	Silty CLAY, With Fine Gravel, Trace Mica, Brown to Orangish Brown, Moist, Medium Stiff, (CL/ML)		
5	3	SS	18	18			
	4	SS	3	3	Sandy GRAVEL, With Rock Fragments, Brown, Moist, Very Dense, (GP/SP)		
10					AUGER REFUSAL @ 8.8'		
15							
20							
25							
30							



THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL TYPES IN-SITU THE TRANSITION MAY BE GRADUAL

WL Dry WS OR WD	BORING STARTED 12/30/09	
WL(BCR) Dry WL(ACR) Dry	BORING COMPLETED 12/30/09	CAVE IN DEPTH @ 4.5
WL	RIG CME45C FOREMAN M. Ballew	DRILLING METHOD 2 1/4" HSA

DKK (01-08-10) DKK (01-08-10) DKK (01-08-10) DKK (01-08-10) DKK (01-08-10) DKK (01-08-10) DKK (01-08-10) DKK (01-08-10) DKK (01-12-10) DKK (01-12-10) DKK (01-12-10) DKK (01-12-10)

JSchaffner

CLIENT	JOB #	BORING #	SHEET
LANDCORE Engineering	18.1950	B-10	1 OF 1

ECS LLC MID-ATLANTIC

PROJECT NAME: Lancaster Solar Farm

ARCHITECT-ENGINEER:

SITE LOCATION: Lancaster Pike & Deaver Rd, Quarryville, PA

-○- CALIBRATED PENETROMETER TONS/FT.^{2}
1 2 3 4 5+

PLASTIC LIMIT % X———— WATER CONTENT % ●———— LIQUID LIMIT % △

ROCK QUALITY DESIGNATION & RECOVERY
RQD%— — — REC.%————
20%—40%—60%—80%—100%

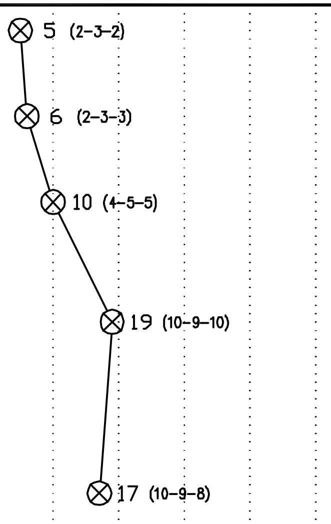
⊗ STANDARD PENETRATION BLOWS/FT.
10 20 30 40 50+

DESCRIPTION OF MATERIAL ENGLISH UNITS

BOTTOM OF CASING ▶ LOSS OF CIRCULATION 100%>

SURFACE ELEVATION

DEPTH (FT)	SAMPLE NO.	SAMPLE TYPE	SAMPLE DIST. (IN)	RECOVERY (IN)	DESCRIPTION OF MATERIAL	WATER LEVELS	ELEVATION (FT)	STANDARD PENETRATION BLOWS/FT.
0								
	1	SS	18	18	Topsoil Depth 4"			5 (2-3-2)
					Silty CLAY, With Fine Gravel, Brown to Orangish Brown, Moist, Soft, (CL/ML)			
	2	SS	18	18				6 (2-3-3)
5	3	SS	18	18	Fine Sandy SILT, With Fine to Medium Gravel, Trace Rock Fragments and Mica, Orangish Brown to Brown, Moist, Firm to Medium Dense, (ML/SM)			10 (4-5-5)
	4	SS	18	18				19 (10-9-10)
10								
	5	SS	18	18				17 (10-9-8)
15					END OF BORING @ 15.0'			
20								
25								
30								



THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL TYPES IN-SITU THE TRANSITION MAY BE GRADUAL

▽WL Dry WS OR (WD)	BORING STARTED 12/30/09	
▽WL(BCR) Dry ▽WL(ACR) Dry	BORING COMPLETED 12/30/09	CAVE IN DEPTH @ 8.0
▽WL	RIG CME45C FOREMAN M. Ballew	DRILLING METHOD 2 1/4" HSA

DKK (01-08-10) DKK (01-08-10) DKK (01-08-10) DKK (01-08-10) DKK (01-08-10) DKK (01-08-10) DKK (01-08-10) DKK (01-12-10) DKK (01-12-10) DKK (01-12-10) DKK (01-12-10)

JSchaffner(01/06/2010 09:20:37 am)

CLIENT	JOB #	BORING #	SHEET
LANDCORE Engineering	18.1950	B-11	1 OF 1

ECS LLC MID-ATLANTIC

PROJECT NAME	ARCHITECT-ENGINEER
Lancaster Solar Farm	

SITE LOCATION
Lancaster Pike & Deaver Rd, Quarryville, PA

-○- CALIBRATED PENETROMETER TONS/FT.^{2}
1 2 3 4 5+

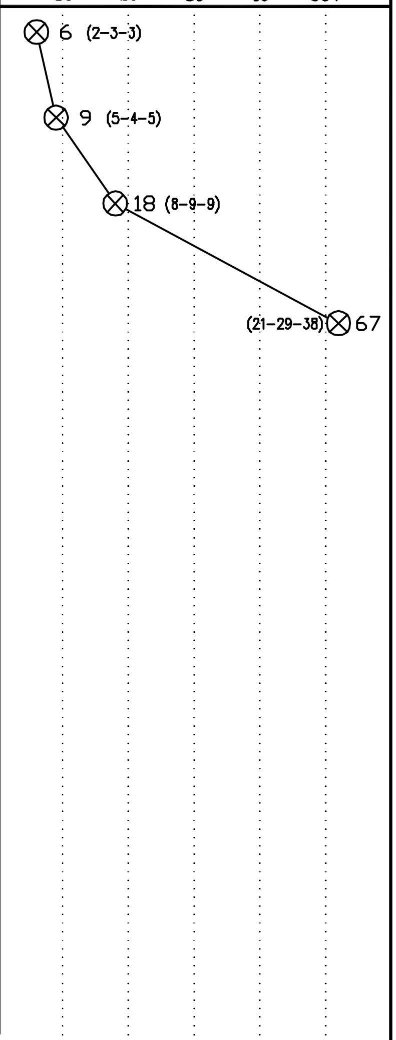
PLASTIC LIMIT % X — WATER CONTENT % ● — LIQUID LIMIT % △

ROCK QUALITY DESIGNATION & RECOVERY
RQD% — — — REC.% ————
20% 40% 60% 80% 100%

⊗ STANDARD PENETRATION BLOWS/FT.
10 20 30 40 50+

DESCRIPTION OF MATERIAL — ENGLISH UNITS
BOTTOM OF CASING ▶ LOSS OF CIRCULATION 100%
SURFACE ELEVATION

DEPTH (FT)	SAMPLE NO.	SAMPLE TYPE	SAMPLE DIST. (IN)	RECOVERY (IN)	DESCRIPTION OF MATERIAL	WATER LEVELS	ELEVATION (FT)
0	1	SS	18	18	Topsoil Depth 4"		
					CLAY, With Silt and Fine Gravel, Trace Rock Fragments, Orangish Brown, Moist, Soft to Stiff, (CL)		
	2	SS	18	18			
5	3	SS	18	18			
					Sandy Fine SILT, With Clay, Fine to Medium Gravel and Mica, Trace Rock Fragments, Dark Orangish Brown, Moist, Very Dense, (ML/SM)		
10	4	SS	18	12			
					AUGER REFUSAL @ 10.5'		
15							
20							
25							
30							



THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL TYPES IN-SITU THE TRANSITION MAY BE GRADUAL

▽WL Dry — WS OR [✓ WD]	BORING STARTED 12/30/09	
▽WL(BCR) Dry ▽WL(ACR) Dry	BORING COMPLETED 12/30/09	CAVE IN DEPTH @ 5.5
▽WL	RIG T-6 FOREMAN M. Ballew	DRILLING METHOD 2 1/4" HSA

CLIENT	JOB #	BORING #	SHEET
LANDCORE Engineering	18.1950	B-12	1 OF 1

ECS LLC MID-ATLANTIC

PROJECT NAME
Lancaster Solar Farm

ARCHITECT-ENGINEER

SITE LOCATION
Lancaster Pike & Deaver Rd, Quarryville, PA

-○- CALIBRATED PENETROMETER TONS/FT.^{2}
1 2 3 4 5+

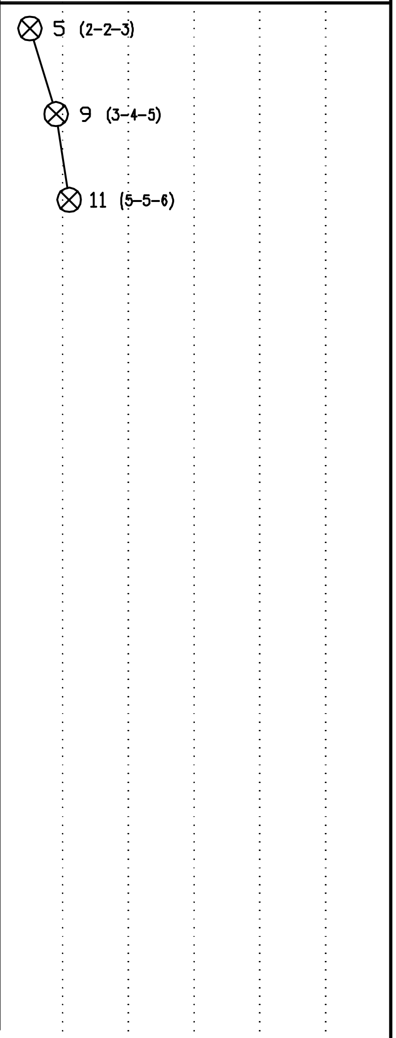
PLASTIC LIMIT % X — WATER CONTENT % ● — LIQUID LIMIT % △

ROCK QUALITY DESIGNATION & RECOVERY
RQD% — — — REC.% ———
20% 40% 60% 80% 100%

⊗ STANDARD PENETRATION BLOWS/FT.
10 20 30 40 50+

DESCRIPTION OF MATERIAL ENGLISH UNITS
BOTTOM OF CASING ▶ LOSS OF CIRCULATION 100%>
SURFACE ELEVATION

DEPTH (FT)	SAMPLE NO.	SAMPLE TYPE	SAMPLE DIST. (IN)	RECOVERY (IN)	DESCRIPTION OF MATERIAL	WATER LEVELS	ELEVATION (FT)	STANDARD PENETRATION BLOWS/FT.
0	1	SS	18	12	Topsoil Depth 3"			5 (2-2-3)
					CLAY, With Silt and Fine Gravel, Trace Mica, Brown to Orangish Brown, Moist, Soft to Medium Stiff, (CL)			
	2	SS	18	18				9 (3-4-5)
5	3	SS	18	18				11 (5-5-6)
					AUGER REFUSAL @ 8.0'			
10								
15								
20								
25								
30								



THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL TYPES IN-SITU THE TRANSITION MAY BE GRADUAL

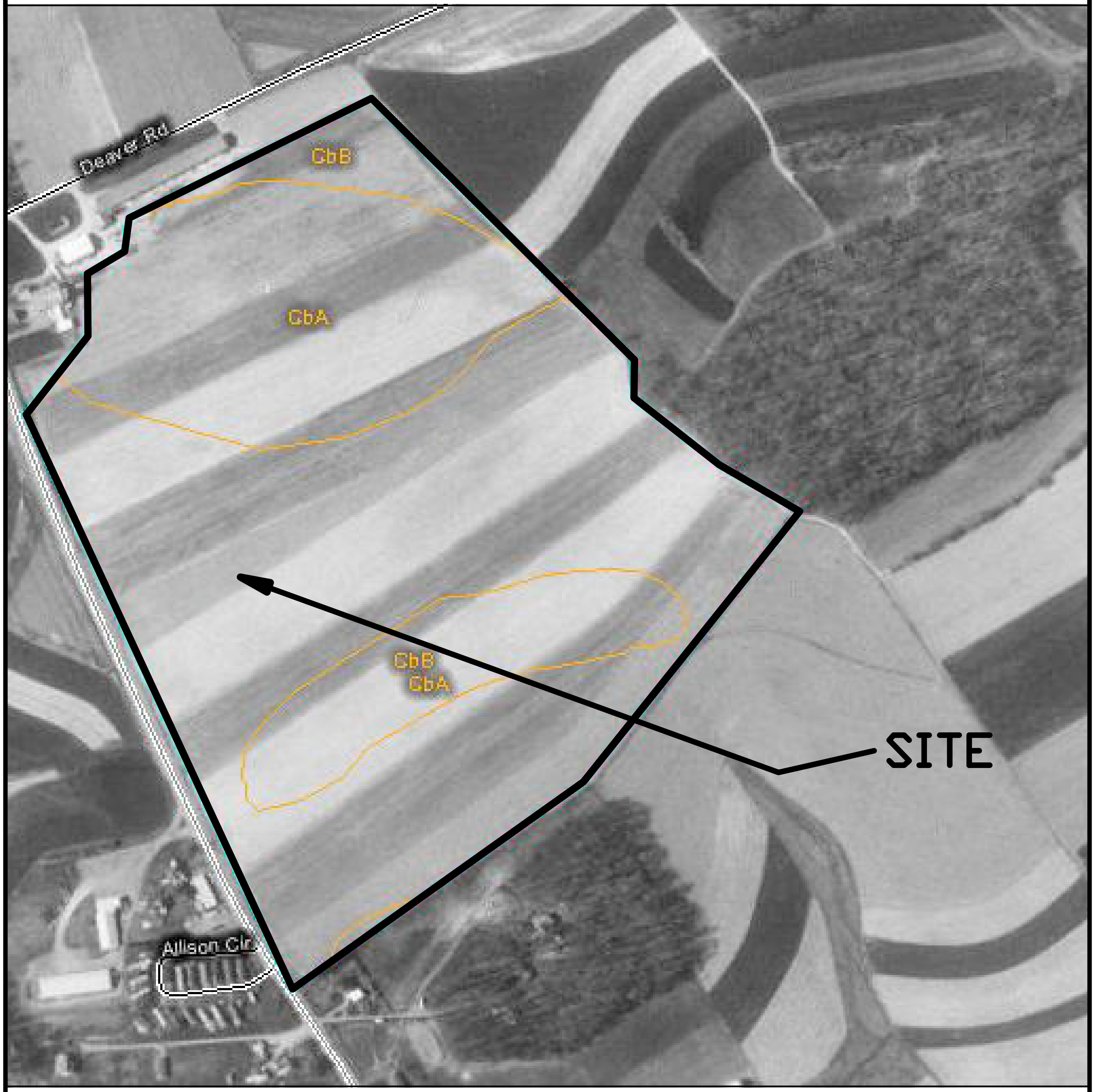
∇WL Dry WS OR [✓ WD]	BORING STARTED 12/30/09	
▼WL(BCR) Dry ▼WL(ACR) Dry	BORING COMPLETED 12/30/09	CAVE IN DEPTH @ 4.0
∇WL	RIG CME45C FOREMAN M. Ballew	DRILLING METHOD 2 1/4" HSA

DKK (01-06-10) DKK (01-06-10) DKK (01-06-10) DKK (01-06-10) DKK (01-08-10) DKK (01-08-10) DKK (01-08-10) DKK (01-12-10) DKK (01-12-10) DKK (01-12-10)

JSchaffner(01/06/2010 09:15:33 am)

Lancaster Solar Farm Project
ECS Project No.: 18.1950
Soil Design Parameters

Boring No.	Strata Depth	USCS Classfication	Internal Angle of Friction (ø)	Cohesion (psf)	Unit Weight (lbs/cf)
B-1	0-4'	CL	26	0	110
	4-20'	ML/SM	30	0	115
B-2	0-4'	CL	26	0	110
	4-15'	ML/SM	32	0	118
B-3	0-4'	CL	26	0	110
	4-14.8'	SP	33	0	120
B-4	0-1.5'	CL	26	0	110
	1.5-4'	SP	30	0	115
	4-6.5'	CL/SC	30	0	115
	6.5-18.7'	SP	34	0	125
B-5	0-4'	CL	26	0	110
	4-13.9'	ML/SM	30	0	115
B-6	0-4'	CL/SC	26	0	110
	4-14.9'	SP	30	0	115
B-7	0-6.5'	CL	15	500	105
	6.5-15'	ML/SM	28	0	112
B-8	0-4'	CL	26	0	110
	4-7.5'	SM/ML	30	0	115
B-9	0-6.5'	CL/ML	28	0	112
	6.5-8.8'	GP/SP	34	0	125
B-10	0-4'	CL/ML	26	0	110
	4-15'	ML/SM	28	0	112
B-11	0-6.5'	CL	26	0	110
	6.5-10.5'	ML/SM	30	0	115
B-12	0-8'	CL	26	0	110



SOILS MAPPING DIAGRAM

LANDCORE Engineering

ECS LLC
MID-ATLANTIC
SETTING THE STANDARD FOR SERVICE

Lancaster Solar Farm
East Drumore Township
Lancaster County, PA

ENGINEER
WDF
DRAFTSMAN
DKK
REVISIONS

SCALE
NTS
PROJECT NO.
18.1950
SHEET
1
DATE
1/8/2010

ECS MID-ATLANTIC, LLC.

York, Pennsylvania

Laboratory Testing Summary

Date: **12-Jan-10**

Project Number: **18.1950** **Project Name:** **Lancaster Solar Farm**

Project Engineer: **DKK** **Principal Engineer:** **WDF** **Summary By:** **DKK**

Boring Number	Sample Number	Depth (feet)	Moisture Content (%)	Soil Description	LL	PL	PI	Percent Passing No. 200 Sieve	Maximum Dry Density (pcf)	Optimum Moisture Content (%)	CBR	Other
B-1	S-1	0-1.5	26.5	O. Brn. CLAY (CL)	35	19	16					
B-2	S-2	2.5-4	32.2	Brn. To O. Brn. CLAY (CL)								
B-3	S-3	5-6.5	35.5	O. Brn. CLAY (CL)								
B-4	S-3	5-6.5	30.9	O. Brn. Sandy CLAY (CL/SC)								
B-5	S-1	0-1.5	24.2	O. Brn. CLAY (CL)								
B-6	S-2	2.5-4	27.5	O. Brn. Sandy CLAY (CL/SC)								
B-7	S-2	2.5-4	31.0	Brn. To O. Brn. Highly Plastic CLAY (CH)	56	24	32					
B-8	S-1	0-1.5	24.2	O. Brn. CLAY (CL)								
B-10	S-3	5-6.5	21.5	O. Brn. To Brn. Silty SAND (SM/ML)				32.1				
B-11	S-3	5-6.5	25.2	O. Brn. CLAY (CL)								

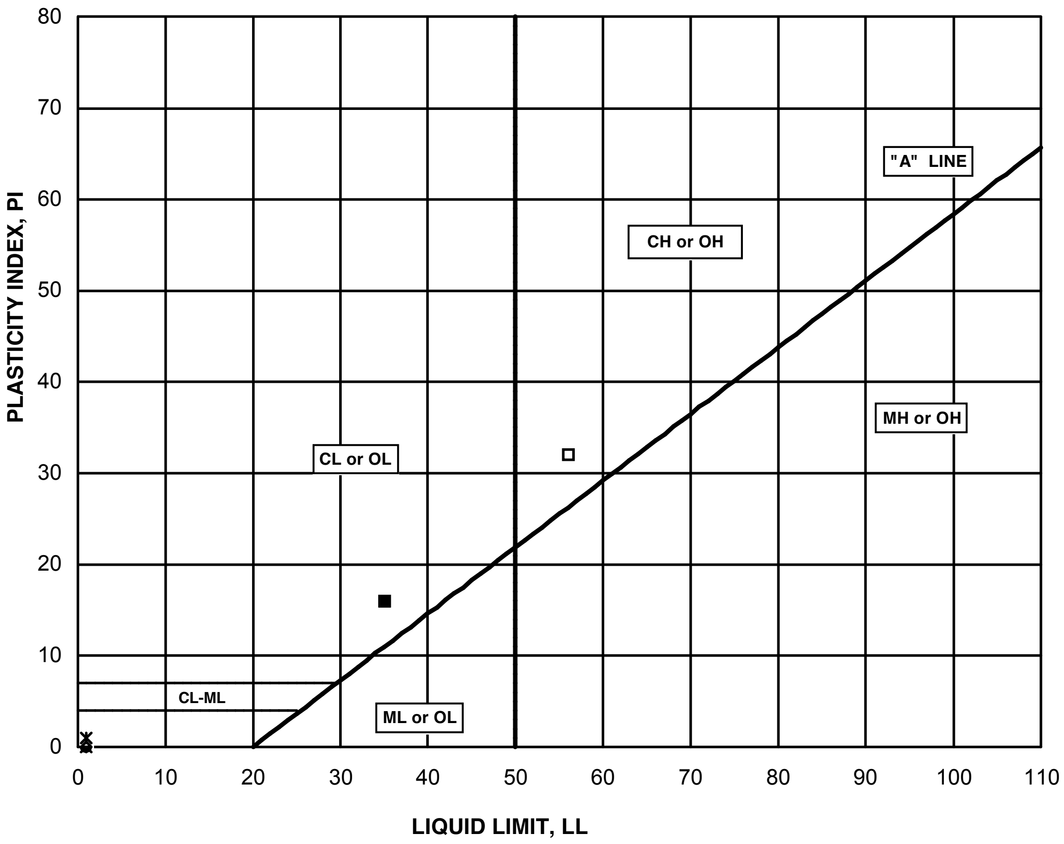
Summary Key:

SA = See Attached
S = Standard Proctor
M= Modified Proctor
V = Virginia Test Method
OC = Organic Content

LL= Liquid Limit
PL= Plastic Limit
PI= Plasticity Index

Hyd = Hydrometer
Con = Consolidation
DS = Direct Shear
GS = Specific Gravity

UCS = Unconfined Compression Soil
UCR = Unconfined Compression Rock
LS = Lime Stabilization
CS = Cement Stabilization



BORING/ SAMPLE No.	DEPTH (feet)	TEST SYMBOL	DESCRIPTION	WATER CONTENT (%)	LL	PL	PI
B-7/S-2	2.5-4.0		O. Brn. Highly Plastic CLAY (CH)	31.0	56	24	32
B-1/S-1	0-1.5		O. Brn. CLAY (CL)	26.5	35	19	16
		△			-	-	-
		▲			-	-	-
		X			-	-	-
		○			-	-	-
		●			-	-	-
		◇			-	-	-
					-	-	-

Project: Lancaster Solar Farm

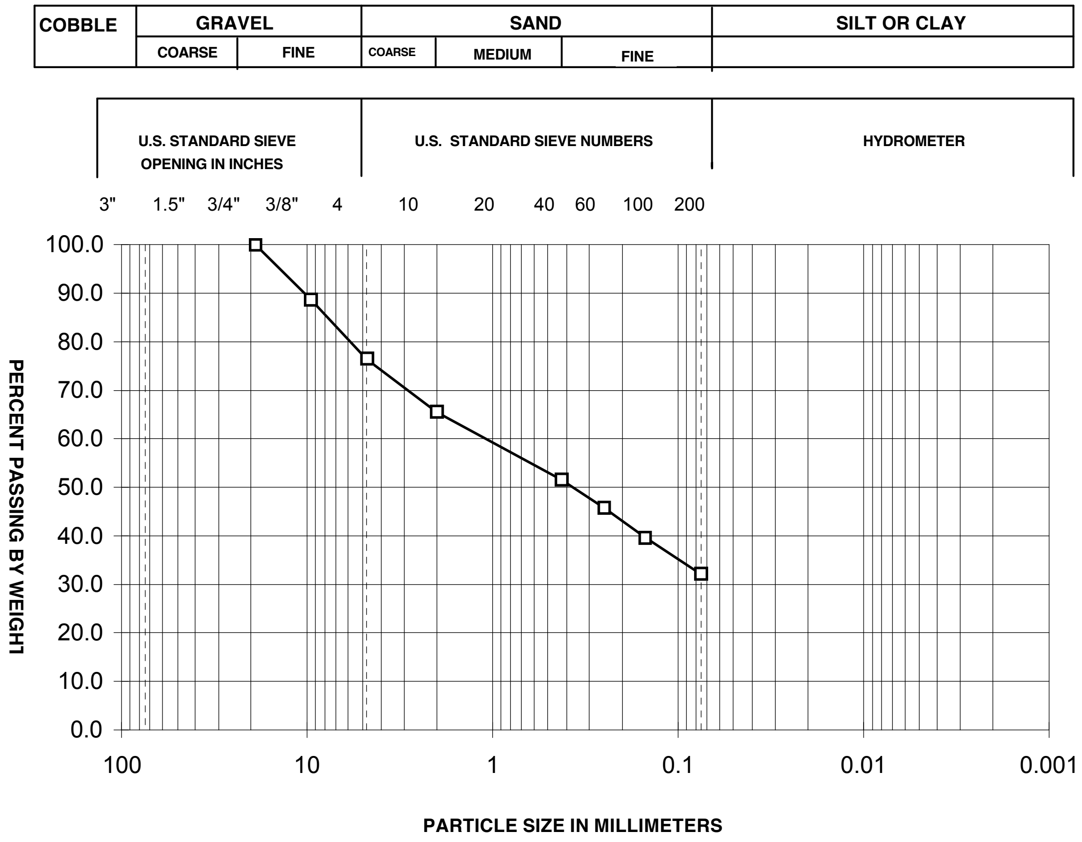
Project No.: 18.1950

Date: Jan 12,2010

ECS Mid-Atlantic, LLC.

York, Pennsylvania

Plasticity Chart



BORING/ SAMPLE	DEPTH (FEET)	SYMBOL	LL	PI	DESCRIPTION
B-10 / S-3	5-6.5	□			O. Brn. To Brn. Silty SAND (SM/ML)
/		■			
/		△			
/		▲			

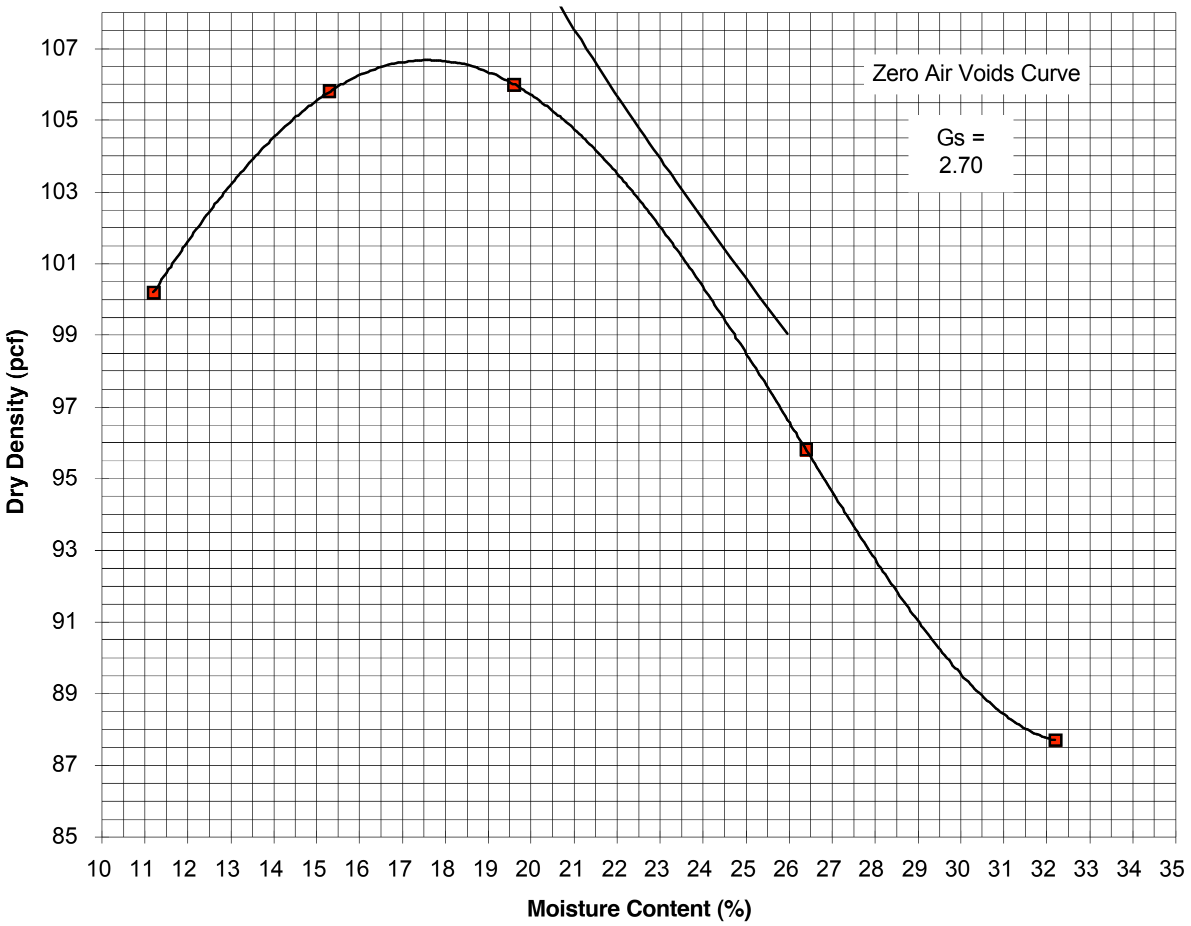
Project: Lancaster Solar Farm

Project No.: 18.1950

Date: 12-Jan-10

ECS Mid-Atlantic, LLC.
York, Pennsylvania

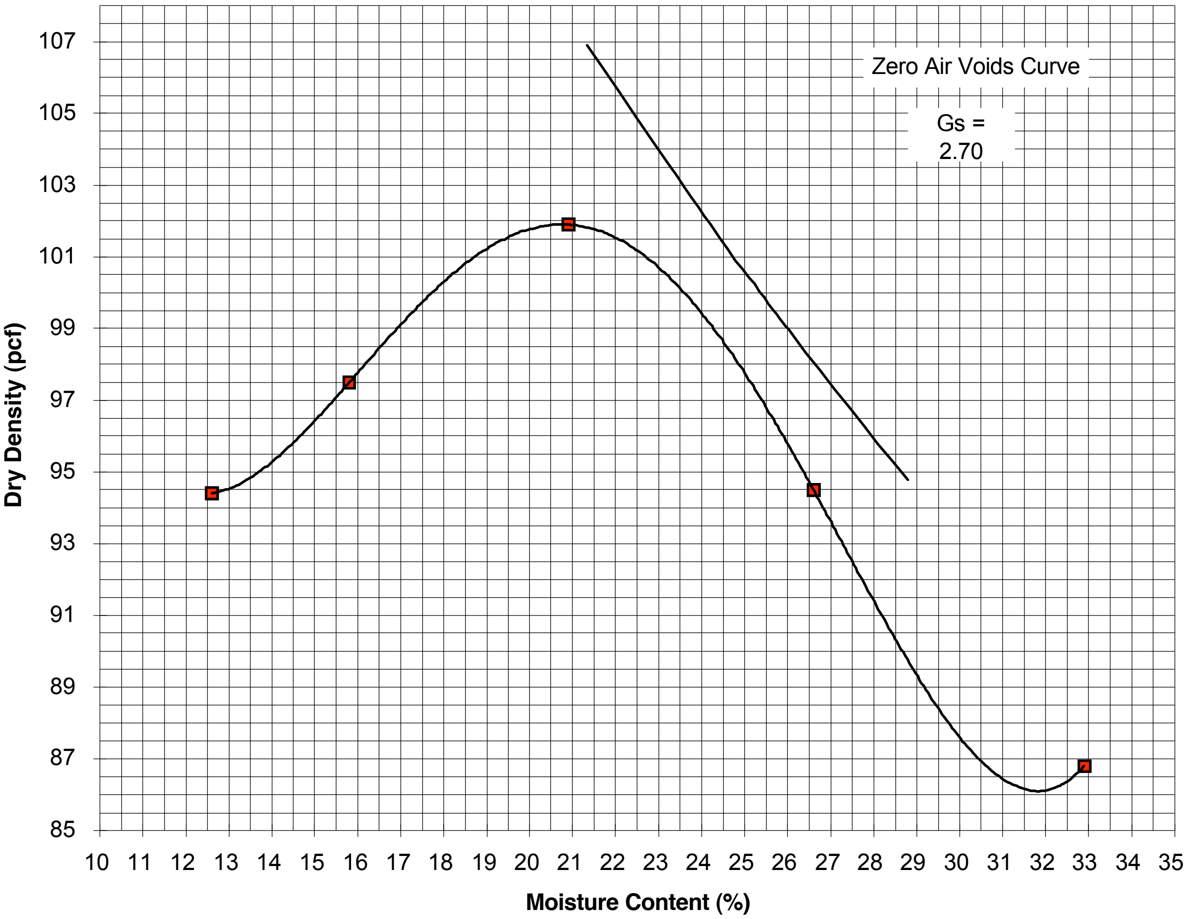
Grain Size Analysis



Sample No.	B-1	Natural Moisture Content	
Street		Percent Passing No. 200 Sieve	
Station		Percent Retained on No. 4 Sieve	0
Liquid Limit (LL)		Percent Retained on 3/4" Sieve	0
Plastic Limit (PL)		Maximum Dry Density (pcf)	106.5
Plasticity Index (PI)		Optimum Moisture Content (%)	17.5
Liquidity Index (LI)		Corr. Maximum Dry Density (pcf)	106.8
Description	Orangish Brown Sandy CLAY with Silt and Gravel	Corr. Optimum Moisture Content (%)	17.4
Classification	CL/SC	Test Method:	B
Specific Gravity	2.70		
Test Standard	D-698		

Project Name: Lancaster Solar Farm
Project No.: **1950**
Date: 12-Jan-10

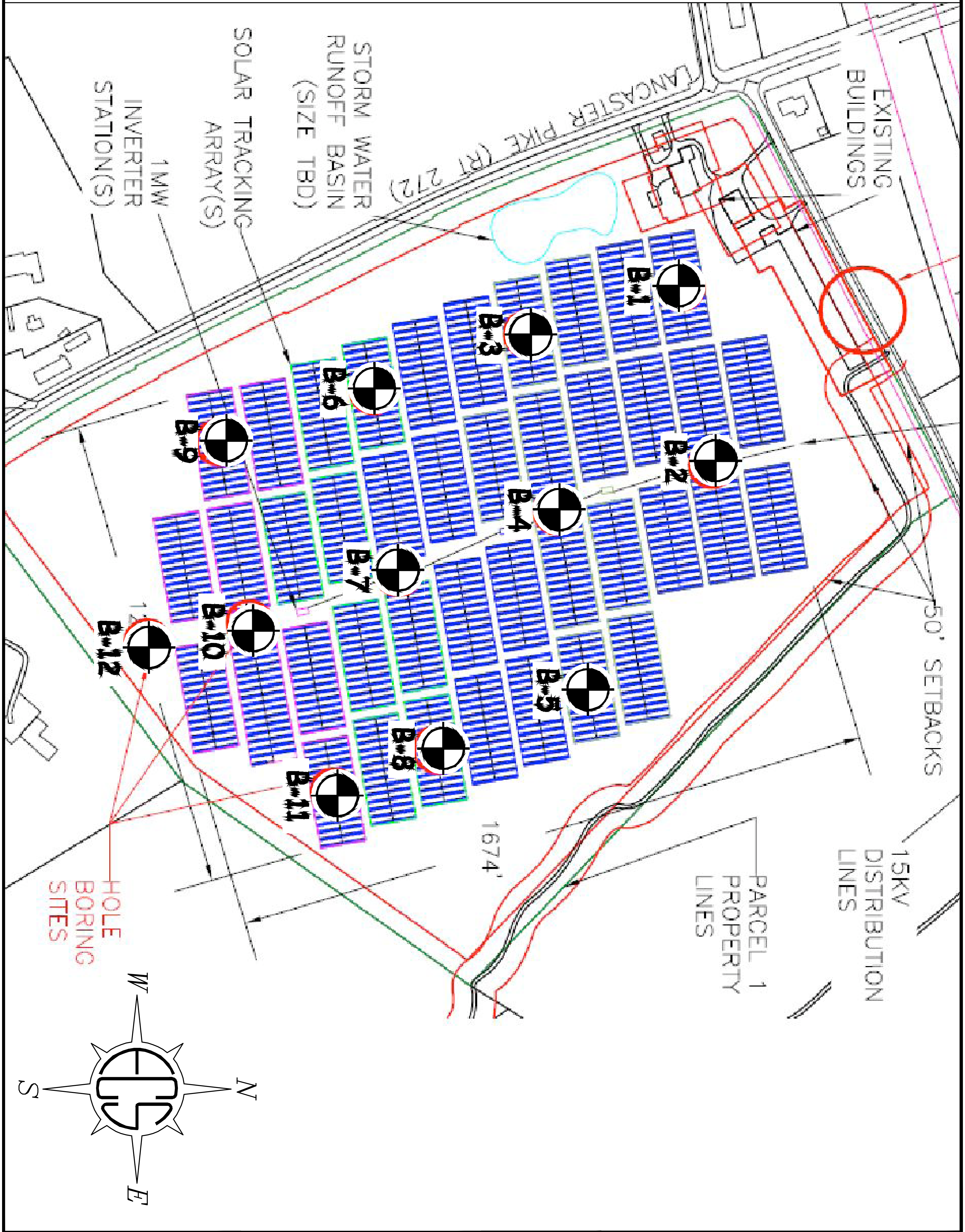
ECS MID-ATLANTIC, LLC
York, PA
Moisture-Density Relationship Curve



Sample No.	B-8	Natural Moisture Content	
Street		Percent Passing No. 200 Sieve	
Station		Percent Retained on No. 4 Sieve	0
Liquid Limit (LL)		Percent Retained on 3/4" Sieve	0.9
Plastic Limit (PL)		Maximum Dry Density (pcf)	101.9
Plasticity Index (PI)		Optimum Moisture Content (%)	20.7
Liquidity Index (LI)		Corr. Maximum Dry Density (pcf)	102.7
Description	Orangish Brown Sandy CLAY with Silt and Gravel	Corr. Optimum Moisture Content (%)	20.3
Classification	CL/SC	Test Method:	B
Specific Gravity	2.70		
Test Standard	D-698		

Project Name: Lancaster Solar Farm
Project No.: **1950**
Date: 12-Jan-10

ECS MID-ATLANTIC, LLC
York, PA
Moisture-Density Relationship Curve



DATE 1/6/10	SHEET 1	PROJECT NO. 18.1950	SCALE NTS	ENGINEER WDF	DRAFTING DKK

ECS REVISIONS

BORING LOCATION DIAGRAM

LANDCORE Engineering

ECS LLC MID-ATLANTIC

Lancaster Solar Farm
Deaver Rd & Lanc. Pike
Lancaster County, PA