HILLIS-CARNES
ENGINEERING ASSOCIATES

Geotechnical Engineering Study
Jersey Shore Communication Tower
Jersey Shore, Lycoming County, Pennsylvania
HCEA Project No. T20106

Prepared For:

PennCore Consulting, LLC
328 Quiet Valley Road
Cogan Station, PA 17728

Prepared By:

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Date:

December 18, 2020

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December 17, 2020

PennCore Consulting, LLC
328 Quiet Valley Road
Cogan Station, PA 17728

Attention: Mr. Ryan Frenya

Re: Geotechnical Engineering Study
Jersey Shore Communication Tower
Piatt Township, Lycoming County, Pennsylvania
HCEA Project No.: T20106

Dear Mr. Frenya;

Hillis-Carnes Engineering Associates, Inc. (HCEA) is pleased to submit this report concerning the subsurface exploration and geotechnical evaluation for the three-leg lattice communication tower that is to be located in Piatt Township, Jersey Shore, Pennsylvania.

The report explains the exploration procedures, describes the general site and subsurface conditions, and presents estimated soil parameters to aid in the foundation design for the project.

We wish to advise you that the boring samples will be stored at our State College, PA office for a period of 30 days from the date of this letter. Should you wish the samples to be stored for a longer period of time or to be delivered to you or another party, please advise us in writing prior to the end of the 30-day period. Otherwise, the samples will be discarded at the end of the 30-day storage period.

We appreciate having been of service to you in the subsurface exploration phase of this project and are prepared to assist you during the construction phase as well. If you have any questions concerning this report or any of our consulting, design, testing and inspection services, please contact this Office.

Very truly yours,
HILLIS-CARNES ENGINEERING ASSOCIATES, INC.

COMMONWEALTH OF PENNSYLVANIA
REGISTERED PROFESSIONAL
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GEOTECHNICAL ENGINEERING STUDY
JERSEY SHORE COMMUNICATION TOWER
JERSEY SHORE, LYCOMING COUNTY, PENNSYLVANIA
HCEA PROJECT NO. H20106

1.0 PURPOSE AND SCOPE

The purpose of this study was to evaluate the subsurface conditions at the test boring locations with respect to the geotechnical aspects of the project. More specifically, the purpose of this study included the following objectives:

1. To determine the general subsurface conditions at the boring locations, including soil and groundwater conditions.

2. Provide applicable estimated soil strength parameters to aid in the design of the required foundation system.

3. Provide allowable bearing capacity for the design of the foundation for the proposed communications building.

The evaluations and recommendations presented in this report were based on our understanding of the proposed construction and on the general subsurface conditions encountered at the boring locations. Should the project characteristics be altered from those discussed or should different subsurface conditions be encountered during construction, this office should be consulted, as the evaluations and recommendations presented may no longer be valid. Also, we emphasize that this exploration and evaluation was performed only at the specific boring locations. Subsurface conditions in other areas may be different. An Appendix contains a summary of the field work for this project.

2.0 PROJECT DESCRIPTION

The project site is located north of 1200 Hesker Hill Road, Jersey Shore, Pennsylvania. The proposed construction is to take place in the field north of the existing farm buildings. Construction at the site is to include the installation of a 250-foot tall wireless communication, three-leg lattice tower and associated communication building. Additional project details were provided on drawings dated October 20, 2020 and prepared by PennCore Consulting, LLC. The project location is also shown on the Project Location Maps in the Appendix.

3.0 FIELD EXPLORATION

In order to determine the soil types and to develop design parameters, three (3) Standard Penetration Test (SPT) borings were drilled in the area of the proposed three-leg lattice tower and communications building. All locations were staked in the field by others. The borings were to be advanced to a maximum depth of 50 feet below the existing site surface grade or until competent rock was encountered. The approximate tower location is shown on the Test Boring Location Plan in the Appendix.

The borings were advanced with hollow-stem augers, and the subsurface soils were continuously to a depth of 10 feet and at 5 feet intervals thereafter until auger refusal was achieved. Samples were taken by driving a 1-3/8 inch I.D. (2 inch O.D.) split-spoon sampler in accordance with ASTM D-1586 specifications. The sampler was first seated 6 inches from the surface to penetrate any loose cuttings and then was driven an additional foot with blows of a 140-pound hammer falling 30 inches. The number of hammer blows required to drive the sampler the following 12 inches is designated as the "Penetration Resistance" or "N" value. The penetration resistance, when properly evaluated, is an index to the soil strength and compression characteristics.

Boring location B-1 was advanced to a depth of 10.0 feet below the existing site grade at which point auger refusal was encountered. Rock coring was then performed to a depth of 14.0 feet resulting in a total borehole depth of 14.0 feet. The next boring location, B-2 produced similar findings with respect to soil and rock characteristics and was terminated at a depth of 19.5 feet below existing site grades. The last boring B-3 was advanced to a depth of 8.8 feet below the existing site grade at which point auger refusal was encountered. The boring was terminated, and no rock was cored.

The soil samples were visually classified in accordance with the Unified Soil Classification System. Records of Soil Exploration that indicates the subsurface conditions encountered are included in the Appendix.

4.0 SUBSURFACE CONDITIONS

4.1 Project Site Geology

The Geologic Map of Pennsylvania (1980) shows that the project site is located within the Appalachian Plateau physiographic region where the parent bedrock formation includes materials from the Pennsylvanian-aged Lock Haven Formation. The following is a description of the aforementioned geologic formation:

Lock Haven Formation
Interbedded light-olive-gray, very fine grained, fossiliferous sandstone, light-gray siltstone, and gray silty shale; locally hematitic; contains angular shale pebbles; a few conglomerate beds oc cur near top; "Chemung" of earlier workers; approximately 4,000 feet thick; reference section is along the east side of Pa. Route 44 at Torbert Lycoming County.

4.2 Subsurface Materials

The natural soil materials at the boring locations consist primarily of residual soils that are the product of the weathering and in-situ decomposition of parent bedrock.

Materials specifically identified as man-placed fill materials were not encountered in the samples obtained during this study. Since the size of the samples obtained is relatively small in comparison to the areal extent of the site and since the fill materials could be of similar composition to the natural soils encountered at the site, it is possible that man-placed fill materials may be present at other locations at the site.

The soils encountered in the borings mainly consisted of sandy SILT (ML/SM) with varying amounts silt and sand. Siltstone rock fragments were observed within a majority of the soil samples. "N" values from the Standard Penetration Test (SPT) borings generally indicated relative densities to be loose to dense for the materials encountered. In general, as depth increased the stiffness of the soil also increased. It should be noted that soil comprised primarily of silt experience significant reduction in load carrying capacity with increased moisture content.

Auger refusal was encountered in the test borings at relatively shallow depths ranging from 8.8 feet to 14.5 feet. Refusal is a designation typically applied to material having a penetration resistance in excess of 50 blows per inch or material that cannot be penetrated with power auger. Refusal, thus indicated, may result from hard cemented soil, soft weathered rock, coarse gravel or boulders, thin rock seams, or the upper surface of sound continuous rock.

Where coring was performed, rock consisted of gray to grayish-brown siltstone with a rock core recovery value of 83 percent and Rock Quality Designation (RQD) of 0 percent. The bedrock was described as medium hard to hard and highly to slightly weathered. The fracturing was classified as very broken to broken resulting in the low RQD value observed.

4.3 Groundwater

Groundwater was not encountered in any of the borings at the time of drilling. A more accurate determination of the hydrostatic water table would require the installation of perforated pipes or piezometers that could be monitored over an extended period of time. The actual level of the hydrostatic water table and the amount and level of perched water should be anticipated to fluctuate throughout the year, depending on variations in precipitation, surface run-off, infiltration, site topography, and drainage.

During construction, if is recommended that any water infiltration resulting from precipitation, surface run-off, or perched water be controlled by means of sump pits and pumps, or by gravity ditching procedures. The groundwater should be maintained a minimum of 2 feet below the bottom of all excavations during construction. If conditions are encountered that cannot be handled in such a manner, the contractor may determine that a more elaborate dewatering system is required.

Adequate drainage should be provided at the site to minimize any increases in the moisture contents of the foundation soils. Grades should be sloped away from the structure to prevent the ponding of water. The site drainage should also be such that run-off onto adjacent properties is controlled properly.

5.0 EVALUATIONS

Our findings indicate that the proposed communication tower can be supported utilizing a structural slab and pier foundation or with a concrete drilled caisson foundation. It is anticipated, if selected, the structural slab foundation will utilize a concrete pier that will extend from the top of the structural slab to the ground surface in order to make the connection to the tower.

Special consideration should be given to the proper monitoring of fill operations, footing excavations and concrete placement in all structural areas.

The following recommendations have been developed on the basis of the previously described project characteristics and subsurface conditions. If there are any changes to the project characteristics or if different subsurface conditions are encountered during construction, HCEA should be consulted so that the recommendations of this report can be reviewed and revised accordingly.

5.1 Tower Foundation Soil Parameters – Drilled Caisson Alternative

HCEA has assigned soil parameters to the soil profile of the drilled borings as indicated below. It should be noted that these soil parameter values have been estimated based on the boring data and correlations of soil properties with strength parameters from published literature. These values were not obtained from actual measurements in the field or from laboratory test results and should therefore be considered approximate.

Additionally, the following design parameters are based on the assumption that the tower foundation will be supported on a deep foundation system. The deep foundations should be located at a minimum depth of 4 feet below existing site grades and within the sandy SILT (ML/SM) materials encountered in Boring B-1. Should the design foundation type change, this Office should be notified immediately so that the analysis and recommendation can be reviewed and/or revised as necessary.

The following table summarizes the engineering characteristics of the soils encountered in the borings:

Boring No.	Approx. Depth (ft)	Unified Soil Classification	Effective Total Unit Weight (pcf)	Internal Angle of Friction (ϕ)	Cohesion (psf)	Allowable End Bearing (tsf)
B-1	0.0 – 2.0	ML	120.0	28.0	--	1.0
	2.0 – 10.0	ML	125.0	32.0	--	1.5
	>10.0	SILTSTONE	140.0	36.0	--	3.0
B-2	0.0 - 2.0	ML	120.0	28.0	--	1.0
	2.0 – 14.5	ML	125.0	32.0	--	1.5
	>14.5	SILTSTONE	140.0	36.0		3.0
B-3	0.0 - 2.0	ML	120.0	28.0	--	1.0
	2.0 - 8.8	ML	125.0	32.0	--	1.5
	>8.8	SILTSTONE	140.0	36.0		3.0

A factor of safety of 3 was applied to the net end bearing values that were calculated. The given allowable end bearing capacities may need to be adjusted where strata changes occur within the zone of influence below the foundation base, depending on the diameter of the proposed foundation.

It is our opinion that the surficial 3.5 feet of material should not be included in the analyses for the design of the foundations. These materials may be affected by freeze-thaw cycles during the winter months and could lose significant confining capability.

5.2 Tower Foundation Soil Parameters – Structural Slab and Pier Foundation Alternative

Based on the tower boring information, our findings indicate that a structural slab and pier foundation can be utilized for support of the proposed tower. The bottom of the proposed structural slab should be located at a minimum depth of 3.5 feet below final exterior grades for frost consideration. The structural slab should bear on natural soils and sized for vertical compression loading using an allowable bearing pressure of 3,000 lbs/sq ft.

Uplift loading can be resisted by the weight of the structural slab and pier and overburden pressure of soils above the structural slab. Lateral forces can be resisted by the sliding resistance along the base of the structural slab and passive pressure along the outside face of the structural slab. Structural fills above the structural slab should be placed in relatively horizontal 8-inch (maximum) loose lifts and should be compacted to a minimum of 95% of the Standard Proctor (ASTM D698) maximum dry density. For soils compacted to 95% of the maximum dry unit weight of a Standard Proctor, a moist unit weight of 125 pcf can be utilized for overburden pressure determination. It is understood that the depth of the structural slab will be driven by lateral and/or sliding resistance so greater embedment depth may be required. It should be noted that the passive earth pressure coefficient given below assumes the sides of the concrete slab will be earth-formed and concrete will be poured against the soils within the side walls of the excavation.

For an earth formed structural slab, refer to the table below for parameters for sizing of the slab/mat foundation.

Properties for Concrete Slab/Mat Foundation Design	
Lateral Loading/Resistance	
Effective Angle of Internal Friction, Φ'	32 degrees
Moist Unit Weight of Soil, γ_{moist}	125 pounds per cubic foot
Rankine Passive Earth Pressure Coefficient, K_p	3.25
Coefficient of Friction – Soil/Concrete Interface	0.41

The structural slab and pier foundation should not be placed on any existing fill materials that may be encountered unless they are specifically observed, tested, and approved by the Geotechnical Engineer or his designated representative in the field during construction. The excavation for the structural slab and pier foundation should be observed by a Geotechnical Engineer or experienced Soils Inspector prior to the placement of reinforcing steel. The purpose of the observation would be to verify that the exposed materials will be capable of supporting the design bearing pressure.

The structural slab and pier foundation excavation should be backfilled as soon as practical to limit exposure to atmospheric conditions and surface runoff. Surface water should be diverted away from foundation excavations. Foundation excavations should be free of saturated and otherwise unsuitable material prior to foundation construction. Some delay time is anticipated from when the excavation is completed to the time of concrete placement due to the time associated with installation of the reinforcing steel. Therefore, a "mud mat" consisting of 2 to 4 inches of 1,200 psi lean concrete is recommended within the bottom of the excavation to protect the bearing soils from degradation and provide a level working platform for rebar installation.

5.3 Communication Building

HCEA has been asked by the Client to provide recommendations concerning the foundations for the proposed communication building based on the information collected at the tower boring locations. Subsurface conditions encountered in the pad area, particularly shallow soil conditions, may differ from those observed in the tower boring. If different soil conditions are encountered during construction, then HCEA should be contacted in order to evaluate the subsoils.

Based on the tower boring information, our findings indicate that the proposed pad can be supported on natural soils based on an allowable soil bearing pressure of 3,000 lbs/sq ft. Footings should not be placed on any existing fill materials that may be encountered unless they are specifically observed, tested, and approved by the Geotechnical Engineer or his designated representative in the field during construction.

All footing excavations should be inspected by a Geotechnical Engineer or experienced Soils Inspector prior to the placement of concrete. The purpose of the inspection would be to verify that the exposed materials will be capable of supporting the design bearing pressure.

Footings should be located at depths of at least 3.5 ft below final exterior grades so as to provide adequate protection from frost heave.

6.0 REMARKS

This report has been prepared to aid in the evaluation of the site for the construction of the monopole tower. Additional recommendations can be provided as needed.

These analyses and recommendations are, of necessity, based on the information made available to us at the time of the actual writing of the report and the on-site conditions, surface and subsurface, which existed at the time the exploratory boring was drilled. Further assumption has been made that the limited exploratory boring, in relation both to the areal extent of the site and to depth, is representative of conditions across the site. If subsurface conditions are encountered which differ from those reported herein, this Office should be notified immediately so that the analyses and recommendations can be reviewed and/or revised as necessary. It is also recommended that:

1. We are given the opportunity to review any plans and specifications in order to comment on the interaction of the soil conditions as described herein and the design requirements.

2. A Geotechnical Engineer be present at the site during the construction phase to verify installation according to the approved plans and specifications.

Our professional services have been performed, our findings obtained, and our recommendations prepared in accordance with generally accepted engineering principles and practices. This warranty is in lieu of all other warranties either implied or expressed. Hillis-Carnes Engineering Associates, Inc. assumes no responsibility for interpretations made by others based on work or recommendations made by HCEA.

APPENDIX

APPENDIX A

GENERAL GEOTECHNICAL NOTES

Important Information about This

Geotechnical-Engineering Report

Subsurface problems are a principal cause of construction delays, cost overruns, claims, and disputes.

While you cannot eliminate all such risks, you can manage them. The following information is provided to help.

The Geoprofessional Business Association (GBA) has prepared this advisory to help you – assumedly a client representative – interpret and apply this geotechnical-engineering report as effectively as possible. In that way, you can benefit from a lowered exposure to problems associated with subsurface conditions at project sites and development of them that, for decades, have been a principal cause of construction delays, cost overruns, claims, and disputes. If you have questions or want more information about any of the issues discussed herein, contact your GBA-member geotechnical engineer. Active engagement in GBA exposes geotechnical engineers to a wide array of risk-confrontation techniques that can be of genuine benefit for everyone involved with a construction project.

Understand the Geotechnical-Engineering Services Provided for this Report

Geotechnical-engineering services typically include the planning, collection, interpretation, and analysis of exploratory data from widely spaced borings and/or test pits. Field data are combined with results from laboratory tests of soil and rock samples obtained from field exploration (if applicable), observations made during site reconnaissance, and historical information to form one or more models of the expected subsurface conditions beneath the site. Local geology and alterations of the site surface and subsurface by previous and proposed construction are also important considerations. Geotechnical engineers apply their engineering training, experience, and judgment to adapt the requirements of the prospective project to the subsurface model(s). Estimates are made of the subsurface conditions that will likely be exposed during construction as well as the expected performance of foundations and other structures being planned and/or affected by construction activities.

The culmination of these geotechnical-engineering services is typically a geotechnical-engineering report providing the data obtained, a discussion of the subsurface model(s), the engineering and geologic engineering assessments and analyses made, and the recommendations developed to satisfy the given requirements of the project. These reports may be titled investigations, explorations, studies, assessments, or evaluations. Regardless of the title used, the geotechnical-engineering report is an engineering interpretation of the subsurface conditions within the context of the project and does not represent a close examination, systematic inquiry, or thorough investigation of all site and subsurface conditions.

Geotechnical-Engineering Services are Performed for Specific Purposes, Persons, and Projects, and At Specific Times

Geotechnical engineers structure their services to meet the specific needs, goals, and risk management preferences of their clients. A geotechnical-engineering study conducted for a given civil engineer will not likely meet the needs of a civil-works constructor or even a different civil engineer. Because each geotechnical-engineering study is unique, each geotechnical-engineering report is unique, prepared *solely* for the client.

Likewise, geotechnical-engineering services are performed for a specific project and purpose. For example, it is unlikely that a geotechnical-engineering study for a refrigerated warehouse will be the same as one prepared for a parking garage; and a few borings drilled during a preliminary study to evaluate site feasibility will not be adequate to develop geotechnical design recommendations for the project.

Do not rely on this report if your geotechnical engineer prepared it:

- for a different client;
- for a different project or purpose;
- for a different site (that may or may not include all or a portion of the original site); or
- before important events occurred at the site or adjacent to it; e.g., man-made events like construction or environmental remediation, or natural events like floods, droughts, earthquakes, or groundwater fluctuations.

Note, too, the reliability of a geotechnical-engineering report can be affected by the passage of time, because of factors like changed subsurface conditions; new or modified codes, standards, or regulations; or new techniques or tools. *If you are the least bit uncertain* about the continued reliability of this report, contact your geotechnical engineer before applying the recommendations in it. A minor amount of additional testing or analysis after the passage of time – if any is required at all – could prevent major problems.

Read this Report in Full

Costly problems have occurred because those relying on a geotechnical-engineering report did not read the report in its entirety. Do not rely on an executive summary. Do not read selective elements only. *Read and refer to the report in full.*

You Need to Inform Your Geotechnical Engineer About Change

Your geotechnical engineer considered unique, project-specific factors when developing the scope of study behind this report and developing the confirmation-dependent recommendations the report conveys. Typical changes that could erode the reliability of this report include those that affect:

- the site's size or shape;
- the elevation, configuration, location, orientation, function or weight of the proposed structure and the desired performance criteria;
- the composition of the design team; or
- project ownership.

As a general rule, *always* inform your geotechnical engineer of project or site changes – even minor ones – and request an assessment of their impact. *The geotechnical engineer who prepared this report cannot accept* *responsibility or liability for problems that arise because the geotechnical engineer was not informed about developments the engineer otherwise would have considered.*

Most of the "Findings" Related in This Report Are Professional Opinions

Before construction begins, geotechnical engineers explore a site's subsurface using various sampling and testing procedures. *Geotechnical engineers can observe actual subsurface conditions only at those specific locations where sampling and testing is performed.* The data derived from that sampling and testing were reviewed by your geotechnical engineer, who then applied professional judgement to form opinions about subsurface conditions throughout the site. Actual sitewide-subsurface conditions may differ – maybe significantly – from those indicated in this report. Confront that risk by retaining your geotechnical engineer to serve on the design team through project completion to obtain informed guidance quickly, whenever needed.

This Report's Recommendations Are Confirmation-Dependent

The recommendations included in this report – including any options or alternatives – are confirmation-dependent. In other words, they are <u>not</u> final, because the geotechnical engineer who developed them relied heavily on judgement and opinion to do so. Your geotechnical engineer can finalize the recommendations *only after observing actual subsurface conditions* exposed during construction. If through observation your geotechnical engineer confirms that the conditions assumed to exist actually do exist, the recommendations can be relied upon, assuming no other changes have occurred. *The geotechnical engineer who prepared this report cannot assume responsibility or liability for confirmation-dependent recommendations if you fail to retain that engineer to perform construction observation.*

This Report Could Be Misinterpreted

Other design professionals' misinterpretation of geotechnical-engineering reports has resulted in costly problems. Confront that risk by having your geotechnical engineer serve as a continuing member of the design team, to:

- confer with other design-team members;
- help develop specifications;
- review pertinent elements of other design professionals' plans and specifications; and
- be available whenever geotechnical-engineering guidance is needed.

You should also confront the risk of constructors misinterpreting this report. Do so by retaining your geotechnical engineer to participate in prebid and preconstruction conferences and to perform construction-phase observations.

Give Constructors a Complete Report and Guidance

Some owners and design professionals mistakenly believe they can shift unanticipated-subsurface-conditions liability to constructors by limiting the information they provide for bid preparation. To help prevent the costly, contentious problems this practice has caused, include the complete geotechnical-engineering report, along with any attachments or appendices, with your contract documents, *but be certain to note conspicuously that you've included the material for information purposes only.* To avoid misunderstanding, you may also want to note that "informational purposes" means constructors have no right to rely on the interpretations, opinions, conclusions, or recommendations in the report. Be certain that constructors know they may learn about specific project requirements, including options selected from the report, *only* from the design drawings and specifications. Remind constructors that they may perform their own studies if they want to, and *be sure to allow enough time* to permit them to do so. Only then might you be in a position to give constructors the information available to you, while requiring them to at least share some of the financial responsibilities stemming from unanticipated conditions. Conducting prebid and preconstruction conferences can also be valuable in this respect.

Read Responsibility Provisions Closely

Some client representatives, design professionals, and constructors do not realize that geotechnical engineering is far less exact than other engineering disciplines. This happens in part because soil and rock on project sites are typically heterogeneous and not manufactured materials with well-defined engineering properties like steel and concrete. That lack of understanding has nurtured unrealistic expectations that have resulted in disappointments, delays, cost overruns, claims, and disputes. To confront that risk, geotechnical engineers commonly include explanatory provisions in their reports. Sometimes labeled "limitations," many of these provisions indicate where geotechnical engineers' responsibilities begin and end, to help others recognize their own responsibilities and risks. *Read these provisions closely.* Ask questions. Your geotechnical engineer should respond fully and frankly.

Geoenvironmental Concerns Are <u>Not</u> Covered

The personnel, equipment, and techniques used to perform an environmental study – e.g., a "phase-one" or "phase-two" environmental site assessment – differ significantly from those used to perform a geotechnical-engineering study. For that reason, a geotechnical-engineering report does not usually provide environmental findings, conclusions, or recommendations; e.g., about the likelihood of encountering underground storage tanks or regulated contaminants. *Unanticipated subsurface environmental problems have led to project failures.* If you have not obtained your own environmental information about the project site, ask your geotechnical consultant for a recommendation on how to find environmental risk-management guidance.

Obtain Professional Assistance to Deal with Moisture Infiltration and Mold

While your geotechnical engineer may have addressed groundwater, water infiltration, or similar issues in this report, the engineer's services were not designed, conducted, or intended to prevent migration of moisture – including water vapor – from the soil through building slabs and walls and into the building interior, where it can cause mold growth and material-performance deficiencies. Accordingly, ***proper implementation of the geotechnical engineer's recommendations will <u>not</u> of itself be sufficient to prevent moisture infiltration. Confront the risk of moisture infiltration*** by including building-envelope or mold specialists on the design team. ***Geotechnical engineers are <u>not</u> building-envelope or mold specialists.***

GEOPROFESSIONAL BUSINESS ASSOCIATION

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HILLIS-CARNES ENGINEERING ASSOCIATES, Inc.
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Description of Soils – per ASTM D2487

Major Component	Component Type	Component Description	Symbol	Group Name
Coarse-Grained Soils, More than 50% is retained on the No. 200 sieve	**Gravels** – More than 50% of the coarse fraction is retained on the No. 4 sieve. Coarse = 1" to 3" Medium = ½" to 1" Fine = ¼" to ½"	Clean Gravels <5% Passing No. 200 sieve	**GW**	Well Graded Gravel
			GP	Poorly Graded Gravel
		Gravels with fines, >12% Passing the No. 200 sieve	**GM**	Silty Gravel
			GC	Clayey Gravel
	Sands – More than 50% of the coarse fraction passes the No. 4 sieve. Coarse = No.10 to No.4 Medium = No. 10 to No. 40 Fine = No. 40 to No. 200	Clean Sands <5% Passing No. 200 sieve	**SW**	Well Graded Sand
			SP	Poorly Graded Sand
		Sands with fines, >12% Passing the No. 200 sieve	**SM**	Silty Sand
			SC	Clayey Sand
Fine Grained Soils, More than 50% passes the No. 200 sieve	Silts and Clays Liquid Limit is less than 50 Low to medium plasticity	Inorganic	**ML**	Silt
			CL	Lean Clay
		Organic	**OL**	Organic silt
				Organic Clay
	Silts and Clays Liquid Limit of 50 or greater Medium to high plasticity	Inorganic	**MH**	Elastic Silt
			CH	Fat Clay
		Organic	**OH**	Organic Silt
				Organic Clay
Highly Organic Soils	Primarily Organic matter, dark color, organic odor		**PT**	Peat

Proportions of Soil Components

Component Form	Description	Approximate percent by weight
Noun	Sand, Gravel, Silt, Clay, etc.	50% or more
Adjective	Sandy, silty, clayey, etc.	35% to 49%
Some	Some sand, some silt, etc.	12% to 34%
Trace	Trace sand, trace mica, etc.	1% to 11%
With	With sand, with mica, etc.	Presence only

Particle Size Identification

Particle Size	Particle dimension
Boulder	12" diameter or more
Cobble	3" to 12" diameter
Gravel	¼" to 3" diameter
Sand	0.005" to ¼" diameter
Silt/Clay (fines)	Cannot see particle

Cohesive Soils

Field Description	Consistency
Easily Molded in Hands	Very Soft
Easily penetrated several inches by thumb	Soft
Penetrated by thumb with moderate effort	Medium
Penetrated by thumb with great effort	Stiff
Indented by thumb only with great effort	Hard

Granular Soils

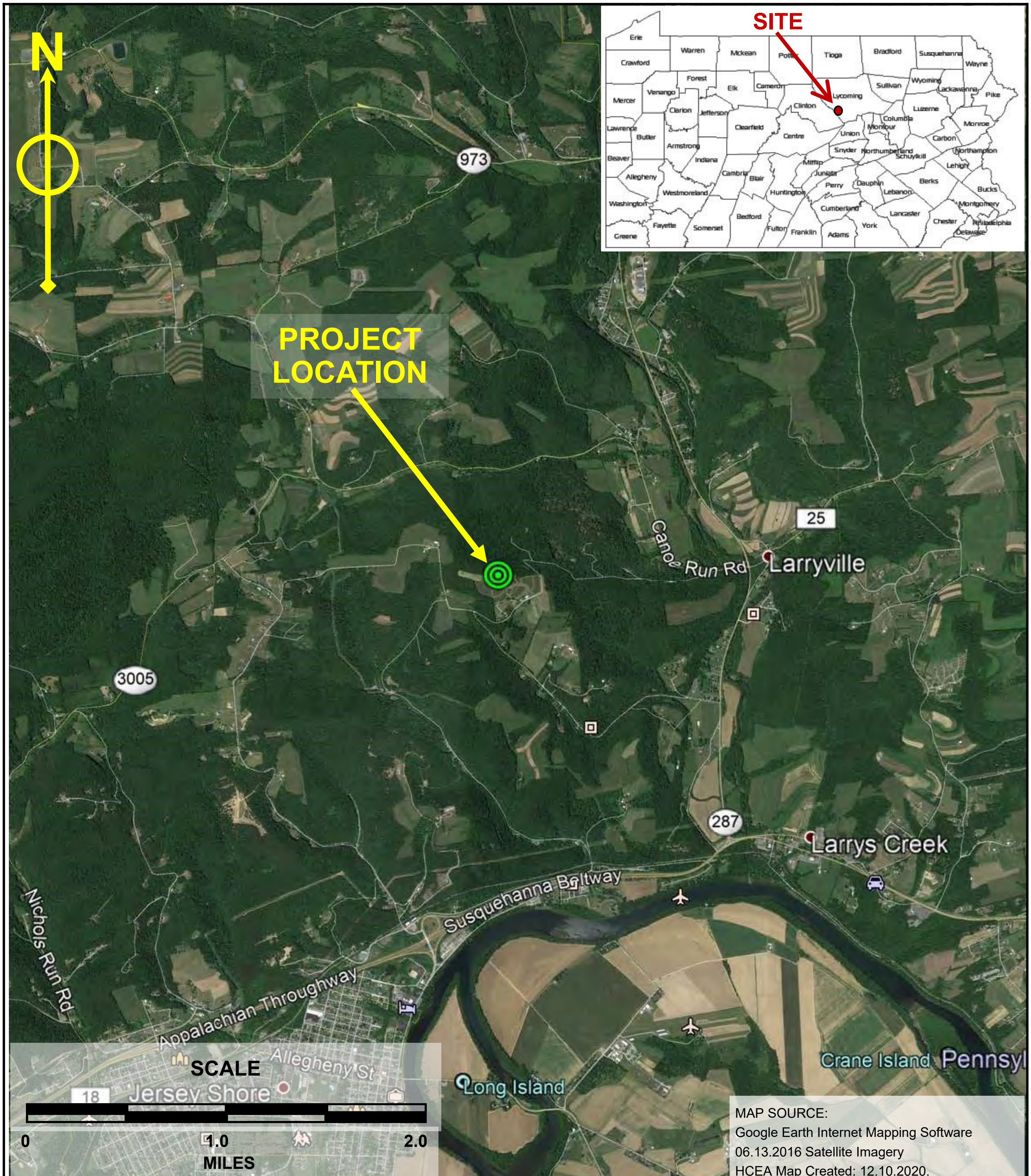
No. of SPT Blows/ft	Relative Density
0 – 4	Very Loose
5 – 10	Loose
11 – 30	Medium Dense
31 – 50	Dense
Greater than 50	Very Dense

Other Definitions:

- **Fill:** Encountered soils that were placed by man. Fill soils may be controlled (engineered structural fill) or uncontrolled fills that may contain rubble and/or debris.
- **Saprolite**: Soil material derived from the in-place chemical and physical weathering of the parent rock material. May contain relic structure. Also called residual soils. Occurs in Piedmont soils, found west of the fall line.
- **Disintegrated Roc**k: Residual soil material with rock-like properties, very dense, N = 60 to 51/0".
- **Karst:** Descriptive term which denotes the potential for solutioning of the limestone rock and the development of sinkholes.
- **Alluvium:** Recently deposited soils placed by water action, typically stream or river floodplain soils.
- **Groundwater Level**: Depth within borehole where water is encountered either during drilling, or after a set period of time to allow groundwater conditions to reach equilibrium.
- **Caved Depth:** Depth at which borehole collapsed after removal of augers/casing. Indicative of loose soils and/or groundwater conditions.

APPENDIX B

PROJECT LOCATION PLAN



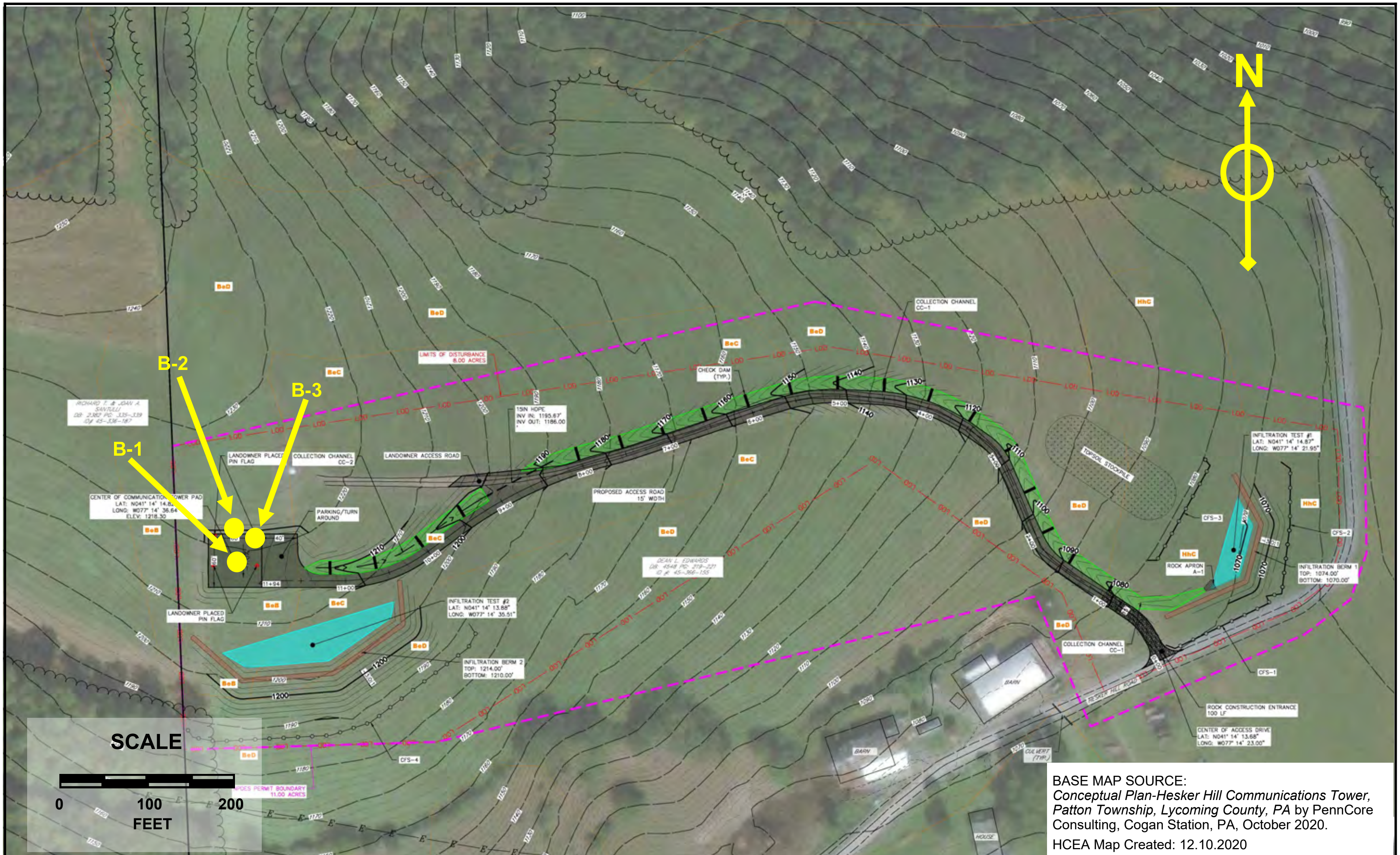
PROJECT LOCATION PLAN

GEOTECHINCAL INVESTIGATION REPORT
JERSEY SHORE COMMUNICATIONS TOWER
JERSEY SHORE, PATTON TOWNSHIP
LYCOMING COUNTY, PENNSYLVANIA
HCEA PROJECT NO: T20106

HILLIS-CARNES
ENGINEERING ASSOCIATES, INC.
2929 Stewart Drive, Suite 302, State College, PA 16801 Local
814-231-0552 Fax 814-231-0695 www.hcea.com

APPENDIX C

TEST BORING LOCATION PLAN



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TEST BORING LOCATION PLAN

GEOTECHINCAL INVESTIGATION REPORT
JERSEY SHORE COMMUNICATIONS TOWER
JERSEY SHORE, PATTON TOWNSHIP
LYCOMING COUNTY, PENNSYLVANIA
HCEA PROJECT NO: T20106

2929 Stewart Drive
Suite 302
State College, PA 16801
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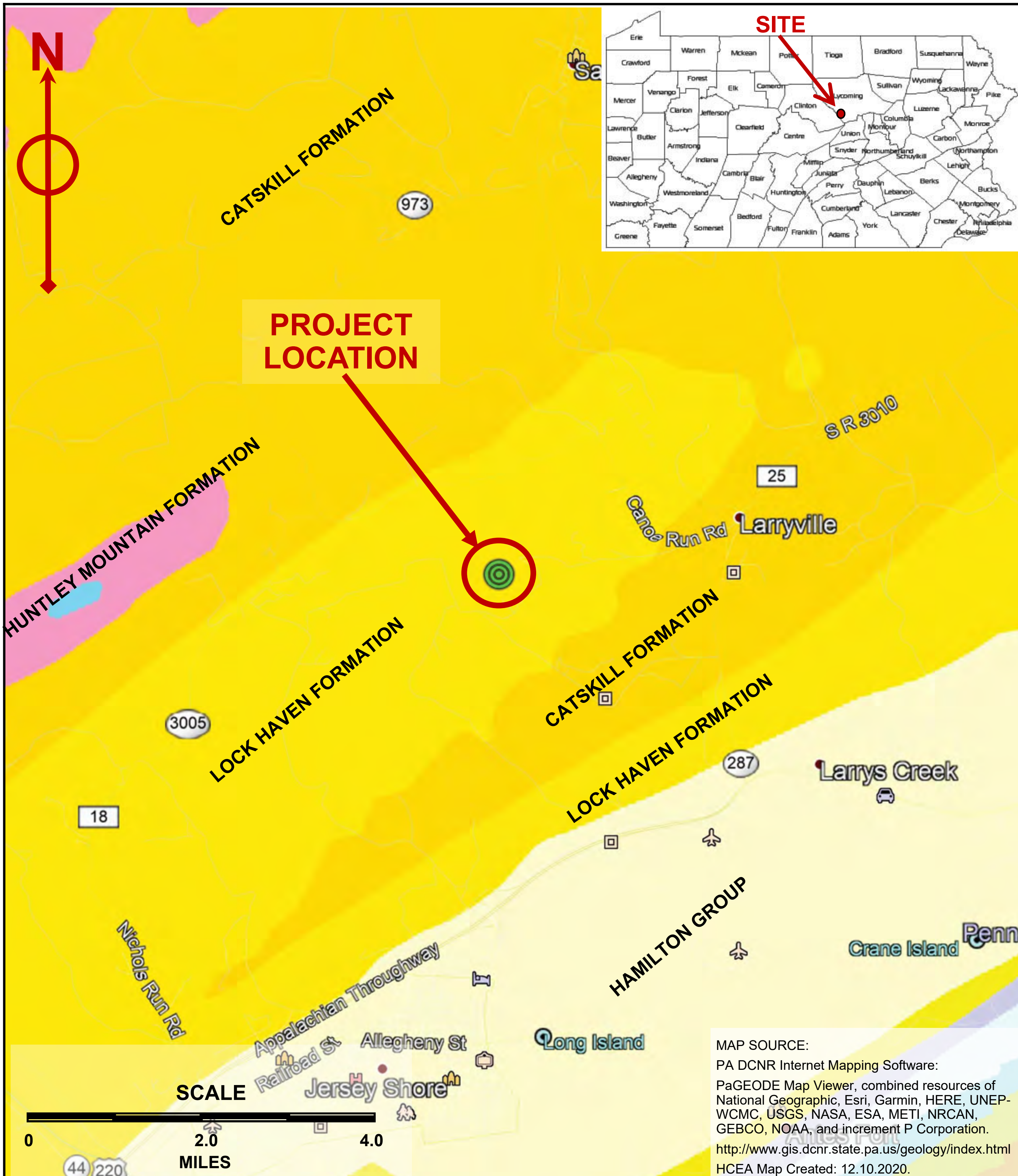
APPENDIX D

PROJECT GEOLOGIC

MAP



PROJECT GEOLOGIC MAP

GEOTECHINCAL INVESTIGATION REPORT
JERSEY SHORE COMMUNICATIONS TOWER
JERSEY SHORE, PATTON TOWNSHIP
LYCOMING COUNTY, PENNSYLVANIA
HCEA PROJECT NO: T20106

HILLIS-CARNES
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APPENDIX E

TEST BORING LOGS

HILLIS - CARNES
ENGINEERING ASSOCIATES, INC.

RECORD OF SOIL EXPLORATION

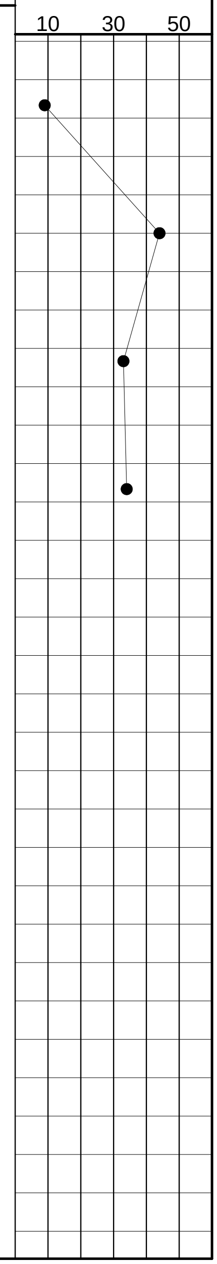
Project Name	**Jersey Shore Communications Tower**	Boring No.	B-1
Location	Jersey Shore, Lycoming County, PA	Job #	T20106

SAMPLER

Datum	MSL	Hammer Wt.	130 lbs.	Hole Diameter	8	Foreman	M. Williams
Surf. Elev.	Ft.	Hammer Drop	30 in.	Rock Core Diameter	NA	Classified By	S. Narehood
Date Started	11.12.2020	Pipe Size	N/A in.	Boring Method	HSA + NQ2 Core	Date Completed	11.12.2020

Elevation/ Depth	SOIL SYMBOLS/ SAMPLE CONDITIONS	Description	Boring and Sampling Notes	Rec.	NM %	SPT Blows	N
0	I	0.0' to 2.0': SILT (ml) with trace clay and some weathered silstone fragments, tan to light brown, damp, medium stiff, low plasticity.	S-1	23"		3-4-5-6	9
3	I	2.0' to 4.0': SILT (ml) and weathered siltstone fragments, light orange-tan, dry to damp, hard, no plasticity.	S-2	19"		15-21-23-22	44
	I	4.0' to 6.0': SILT (ml) and weathered siltstone fragments, light orange-brown, dry, very stiff to hard, no plasticity, friable.	S-3	18"		13-17-16-12	33
6	I	6.0' to 8.0': SILT (ml) and weathered siltstone fragments, light to medium brown, dry, medium stiff to hard, no plasticity, friable.	S-4	24"		29-21-13-13	34
9	I	8.0' to 10.0': SILT (ml) and weathered siltstone fragments, light to medium brown, dry, hard, no plasticity, friable.	S-5	9" 19"		31-50/4"	--
12	I	10.0' to 14.0': SILTSTONE, gray and gray-brown, medium hard to hard, moderately to slightly weathered, intense to thin bedding, RD 0-15 degrees, very broken to broken, orange oxidiation on fracture planes.	Auger refusal encountered and start coring rock at 10.0 feet. R-1 REC: 83% RQD: 0%	40"			
15		End of boring at 14.0 feet.	No groundwater encountered.				
18							

SPT Blows/Foot Curve



SAMPLER TYPE
DRIVEN SPLIT SPOON UNLESS OTHERWISE
PT - PRESSED SHELBY TUBE
CA - CONTINUOUS FLIGHT AUGER
RC - ROCK CORE

SAMPLE CONDITIONS
D - DISINTEGRATED
I - INTACT
U - UNDISTURBED
L - LOST

	GROUND WATER	CAVE IN DEPTH
AT COMPLETION	NGW ft.	8.5 ft.
AFTER 24 HRS.	N/A ft.	N/A ft.
AFTER ___ HRS.	N/A ft.	N/A ft.

BORING METHOD
HSA - HOLLOW STEM AUGERS
CFA - CONTINUOUS FLIGHT AUGERS
DC - DRIVING CASING
MD - MUD DRILLING

STANDARD PENETRATION TEST-DRIVING 2" O.D. SAMPLER 1' WITH 140# HAMMER FALLING 30": COUNT MADE AT 6" INTERVALS.

HILLIS - CARNES
ENGINEERING ASSOCIATES, INC.

RECORD OF SOIL EXPLORATION

Project Name: **Jersey Shore Communications Tower** Boring No.: B-2

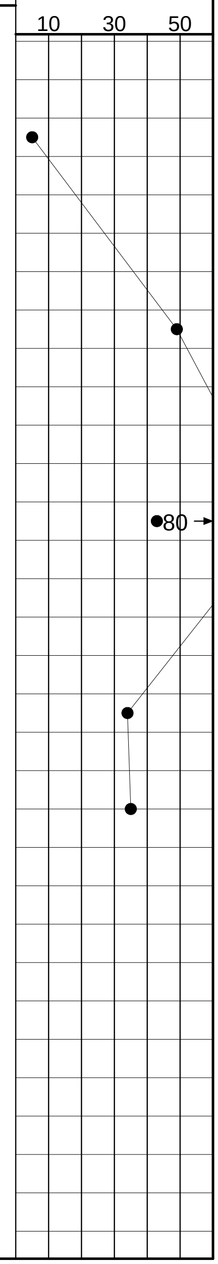
Location: Jersey Shore, Lycoming County, PA Job #: T20106

SAMPLER

Datum	MSL	Hammer Wt.	130 lbs.	Hole Diameter	8	Foreman	M. Williams
Surf. Elev.	Ft.	Hammer Drop	30 in.	Rock Core Diameter	NA	Classified By	S. Narehood
Date Started	11.12.2020	Pipe Size	N/A in.	Boring Method	HSA + NQ2 Core	Date Completed	11.12.2020

Elevation/ Depth	SOIL SYMBOLS/ SAMPLE CONDITIONS	Description	Boring and Sampling Notes	Rec.	NM %	SPT Blows	N
0	I	0.0' to 2.0': SILT (ml) with trace clay, orange-tan, damp, medium stiff, low plasticity.	S-1	20"		2-2-3-6	5
2	I	2.0' to 4.0': SILT (ml) and weathered siltstone fragments, orange-tan, dry, hard, low plasticity, friable.	S-2	20"		15-23-26-27	49
4	I	4.0' to 6.0': SILT (ml) and weathered siltstone fragments, orange-brown, dry, hard, no plasticity, friable.	S-3	23"		24-26-44-40	80
6	I	6.0' to 8.0': SILT (ml) and weathered siltstone fragments, light to medium brown, dry, medium stiff to hard, no plasticity, friable.	S-4	24"		29-21-13-13	34
8	I	8.0' to 13.0': SILT (ml) and weathered siltstone fragments, tan to medium brown, dry, medium stiff to hard, no plasticity, friable.	S-5	19"		8-16-19-26	35
10			Begin SPT at 5-foot intervals.				
12							

SPT Blows/Foot Curve



SAMPLER TYPE
DRIVEN SPLIT SPOON UNLESS OTHERWISE
PT - PRESSED SHELBY TUBE
CA - CONTINUOUS FLIGHT AUGER
RC - ROCK CORE

SAMPLE CONDITIONS
D - DISINTEGRATED
I - INTACT
U - UNDISTURBED
L - LOST

	GROUND WATER	CAVE IN DEPTH
AT COMPLETION	NGW ft.	6.8' ft.
AFTER 24 HRS.	N/A ft.	N/A ft.
AFTER ___ HRS.	N/A ft.	N/A ft.

BORING METHOD
HSA - HOLLOW STEM AUGERS
CFA - CONTINUOUS FLIGHT AUGERS
DC - DRIVING CASING
MD - MUD DRILLING

STANDARD PENETRATION TEST-DRIVING 2" O.D. SAMPLER 1' WITH 140# HAMMER FALLING 30": COUNT MADE AT 6" INTERVALS.

HILLIS - CARNES
ENGINEERING ASSOCIATES, INC.

RECORD OF SOIL EXPLORATION

Project Name: **Jersey Shore Communications Tower** — Boring No.: B-2
Location: Jersey Shore, Lycoming County, PA — Job #: T20106

SAMPLER

Datum: MSL	Hammer Wt.: 130 lbs.	Hole Diameter: 8	Foreman: M. Williams
Surf. Elev.: Ft.	Hammer Drop: 30 in.	Rock Core Diameter: NA	Classified By: S. Narehood
Date Started: 11.12.2020	Pipe Size: N/A in.	Boring Method: HSA + NQ2 Core	Date Completed: 11.12.2020

Elevation/ Depth	SOIL SYMBOLS/ SAMPLE CONDITIONS	Description	Boring and Sampling Notes	Rec.	NM %	SPT Blows	N	SPT Blows/Foot Curve (10 30 50)
	I	13.0' to 13.1': Moderately weathered siltstone, brown-gray, dry, moderately hard.		1"		50/1"	--	
14								
		14.5' to 19.5': SILTSTONE with shale partitions, gray-brown to light brown, soft to very hard, highly to slightly weathered, thin bedding, RD 0-15 degrees, very broken to broken, orange oxidiation on fracture planes.	Auger refusal encountered and start coring rock at 14.5'.					
16								
	I		R-1 REC: 83% RQD: 0%	50"				
18								
		End of boring at 19.5 feet.	No groundwater encountered.					
20								
22								
24								

SAMPLER TYPE
DRIVEN SPLIT SPOON UNLESS OTHERWISE
PT - PRESSED SHELBY TUBE
CA - CONTINUOUS FLIGHT AUGER
RC - ROCK CORE

SAMPLE CONDITIONS
D - DISINTEGRATED
I - INTACT
U - UNDISTURBED
L - LOST

	GROUND WATER	CAVE IN DEPTH
AT COMPLETION	NGW ft.	6.8' ft.
AFTER 24 HRS.	N/A ft.	N/A ft.
AFTER ___ HRS.	N/A ft.	N/A ft.

BORING METHOD
HSA - HOLLOW STEM AUGERS
CFA - CONTINUOUS FLIGHT AUGERS
DC - DRIVING CASING
MD - MUD DRILLING

STANDARD PENETRATION TEST-DRIVING 2" O.D. SAMPLER 1' WITH 140# HAMMER FALLING 30": COUNT MADE AT 6" INTERVALS.

HILLIS - CARNES
ENGINEERING ASSOCIATES, INC.

RECORD OF SOIL EXPLORATION

Project Name: **Jersey Shore Communications Tower** Boring No.: B-3

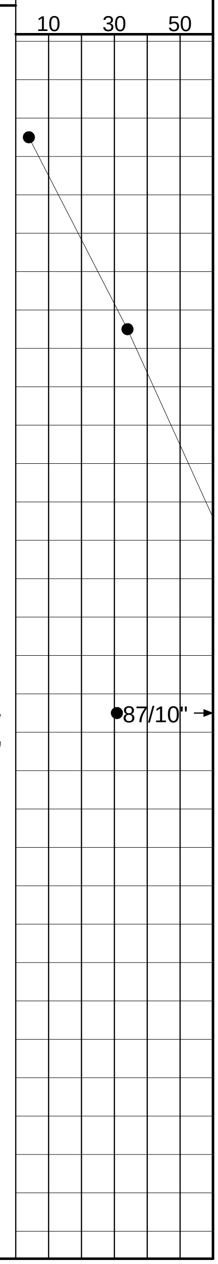
Location: Jersey Shore, Lycoming County, PA Job #: T20106

SAMPLER

Datum	MSL	Hammer Wt.	130 lbs.	Hole Diameter	8	Foreman	M. Williams
Surf. Elev.	Ft.	Hammer Drop	30 in.	Rock Core Diameter	NA	Classified By	S. Narehood
Date Started	11.12.2020	Pipe Size	N/A in.	Boring Method	HSA + NQ2 Core	Date Completed	11.12.2020

Elevation/ Depth	SOIL SYMBOLS/ SAMPLE CONDITIONS	Description	Boring and Sampling Notes	Rec.	NM %	SPT Blows	N
0		0.0' to 2.0': SILT (ml) with trace clay and trace weathered siltstone gravel, orange-tan, damp to moist, soft to medium stiff, low plasticity.					
	I		S-1	23"		1-2-2-7	4
2		2.0' to 4.0': SILT (ml) and weathered siltstone fragments, orange-tan, dry, hard, no plasticity, friable.					
	I		S-2	24"		40-14-20-34	34
4		4.0' to 8.8': SILT (ml) and weathered siltstone fragments, orange-brown, dry, hard, no plasticity, friable.					
	I		S-3	11"		31-50/4"	--
6							
	I			17"		29-37-50/4"	87/ 10"
8						50-50/3"	--
	I						
		End of boing at 8.8 feet.	No groundwater encountered.				
10							
12							

SPT Blows/Foot Curve



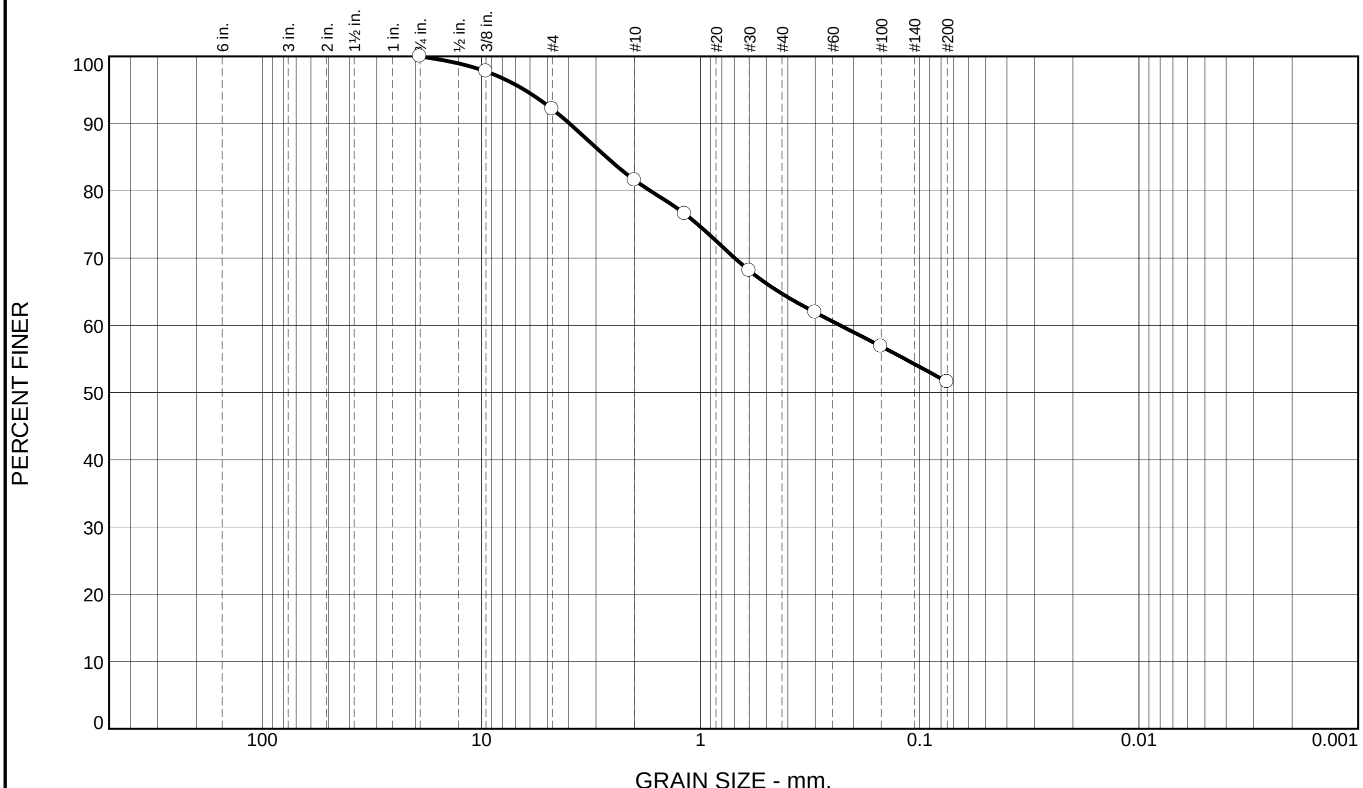
SAMPLER TYPE	SAMPLE CONDITIONS		GROUND WATER	CAVE IN DEPTH	BORING METHOD
DRIVEN SPLIT SPOON UNLESS OTHERWISE	D - DISINTEGRATED	AT COMPLETION	NGW ft.	6.0' ft.	HSA - HOLLOW STEM AUGERS
PT - PRESSED SHELBY TUBE	I - INTACT	AFTER 24 HRS.	N/A ft.	N/A ft.	CFA - CONTINUOUS FLIGHT AUGERS
CA - CONTINUOUS FLIGHT AUGER	U - UNDISTURBED	AFTER ___ HRS.	N/A ft.	N/A ft.	DC - DRIVING CASING
RC - ROCK CORE	L - LOST				MD - MUD DRILLING

STANDARD PENETRATION TEST-DRIVING 2" O.D. SAMPLER 1' WITH 140# HAMMER FALLING 30": COUNT MADE AT 6" INTERVALS.

APPENDIX F

PARTICLE SIZE DISTRIBUTION REPORTS

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	7.8	10.6	16.9	13.1	51.6	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
3/4	100.0		
3/8	97.8		
#4	92.2		
#10	81.6		
#16	76.6		
#30	68.1		
#50	61.9		
#100	56.9		
#200	51.6		

* (no specification provided)

Soil Description

Medium Brown Sandy Lean Clay

Atterberg Limits

PL= 20 LL= 31 PI= 11

Coefficients

D_{90}= 3.9618 D_{85}= 2.6836 D_{60}= 0.2309
D_{50}= D_{30}= D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= CL AASHTO= A-6(3)

Remarks

As Received Moisture = 9.1%

Location: B1, Auger Cuttings
Sample Number: L20117

Date: 12-16-2020

HILLIS-CARNES ENGINEERING ASSOCIATES

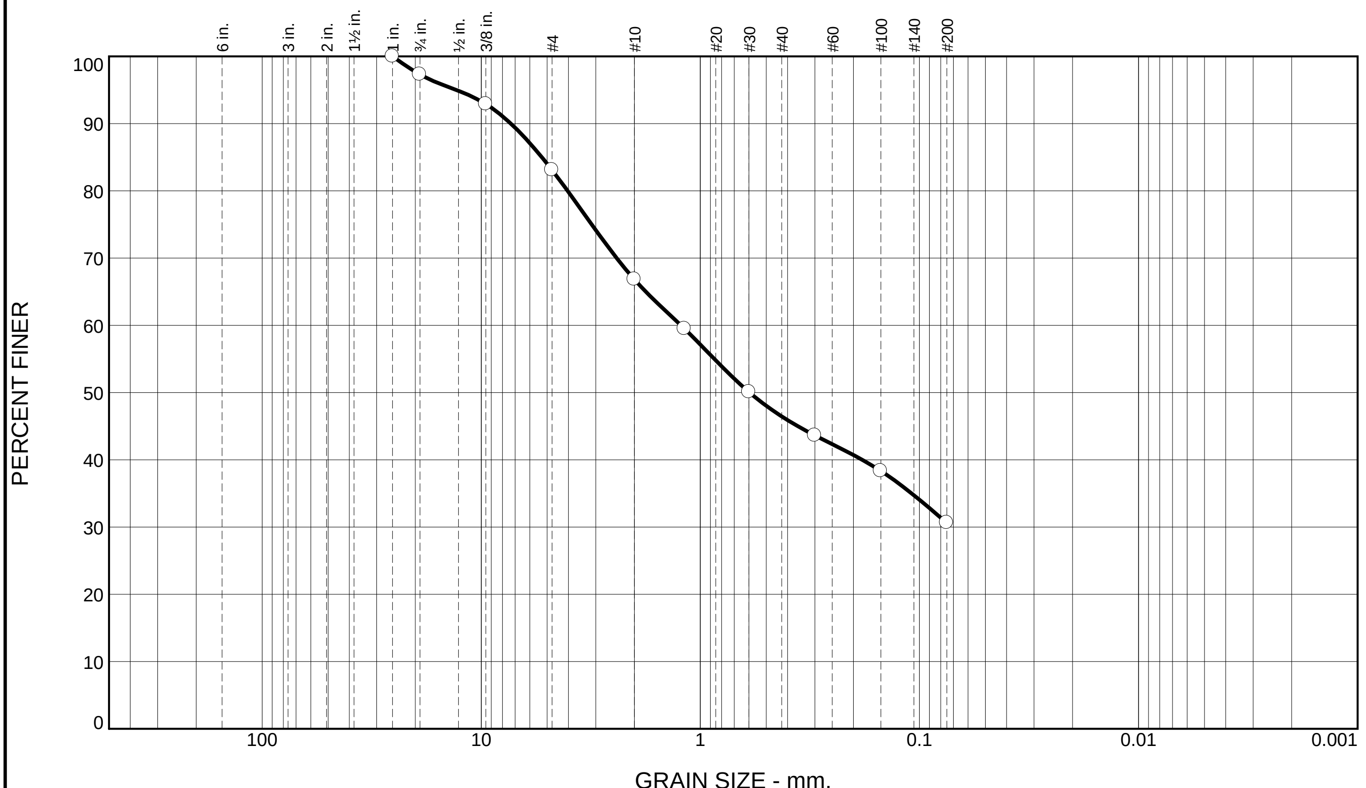
STATE COLLEGE, PA

Client: PennCore Consulting, LLC
Project: Jersey Shore Communications Tower

Project No: T20106 **Figure**

Tested By: RAS

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	2.7	14.2	16.3	20.4	15.8	30.6	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
1	100.0		
3/4	97.3		
3/8	92.9		
#4	83.1		
#10	66.8		
#16	59.5		
#30	50.1		
#50	43.6		
#100	38.3		
#200	30.6		

* (no specification provided)

Soil Description

Medium to Light Brown Clayey Sand with Gravel

Atterberg Limits

PL= 18 LL= 26 PI= 8

Coefficients

D_{90}= 7.3292 D_{85}= 5.2907 D_{60}= 1.2267
D_{50}= 0.5964 D_{30}= D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= SC AASHTO= A-2-4(0)

Remarks

As Received Moisture = 7.8%

Location: B3, Auger Cuttings
Sample Number: L20118

Date: 12-16-2020

HILLIS-CARNES ENGINEERING ASSOCIATES

STATE COLLEGE, PA

Client: PennCore Consulting, LLC
Project: Jersey Shore Communications Tower
Project No: T20106 **Figure**

Tested By: RAS