Foundation Design, P.C.

SOIL • BEDROCK • GROUNDWATER

October 26, 2020

Norbut Solar
1241 University Avenue
Rochester, New York 14607

Attention: Mr. Dan Huntington, Business Development Manager

Reference: NSF - Enfield Solar Array
Applegate Road South, Enfield, New York
Geotechnical Evaluation, 4640.0

Dear Mr. Huntington:

This letter report summarizes our geotechnical evaluation for the referenced project. The 25 mW solar array will be located on a 249 acre parcel south of Mecklenburg Road in Enfield, New York. The racking system type has yet to be determined. We base this report on our review of U.S.G.S. topographic mapping, National Resource Conservation Service mapping, soil boring exploration; field and laboratory testing; and consultation with the design team. Norbut Solar retained Foundation Design, P.C. to perform the services outlined in our August 14, 2020 *Geotechnical Services Proposal, P4586.0*. We intend this report for exclusive use on this project.

The Enfield Solar Array will be located southeast of the Applegate Road South and Mecklenburg Road intersection in Enfield, New York. We understand that the 25mW array will be constructed on roughly 125 acres of the 249 acre parcel. A *General Location Plan*, on 2019 U.S.G.S. topographic mapping, is attached to this report. Open farm fields with planted corn with intermixed hedge rows and tree-covered patches occupy the parcel. Existing solar panels are currently to the northeast of the site, with a remote-controlled airplane runway to the east of the site. Residential housing lines Mecklenburg Road to the north.

We completed soil borings B20-1 through B20-19 between October 2 and October 7, 2020 to assess the subsurface conditions on the parcel. Target Drilling provided a CME-75 truck-mounted drill rig equipped with an auto hammer for the SPT soil sampling. They advanced the soil borings using hollow stem auger casings, recovering split spoon soil samples in accordance with ASTM D-1586 continuously to 10 feet and at five foot intervals after that to auger refusal or a 15 foot depth, whichever was shallower. Due to the shallow bedrock at boring B20-12, five feet of NX size rock core was recovered in accordance with ASTM D-2113. The soil borings terminated at depths between 8.2 to 15.0 feet below grade. A *Boring Location Plan* and the soil boring logs are enclosed.

Upon completion of the fieldwork, we selected representative soil samples for laboratory testing. The testing program consisted of three pH determinations, three lab resistivity tests, three soluble chlorides tests, three soluble sulfates tests, six sieve analysis, and six moisture content tests. The test results are discussed below. The laboratory reports are enclosed.

We encountered a subsurface profile consisting of surface topsoil, glacial till, then shale bedrock. Where definable from the underlying soil, the surface topsoil ranges from four to twelve inches thick. The upper soil consists of silty sand/sandy silt with gravel and clay. Tested samples classify as a SM or ML in the Unified Soil Classification System.

The till transitions to a moderately to highly weathered shale bedrock within fifteen feet of the surface. The shale rock has weathered to the point of a soil consistency in most locations. Solid, more intact rock, while over eight feet below grade across most of the parcel, was encountered as shallow as three feet deep at soil boring B20-12. We recovered NX size rock core at soil boring B20-12, recovering 95 percent of the five foot core run. The RQD measurement, an indication of the rock quality was 24 percent or poor quality. Geologic mapping indicates that the bedrock is of the Enfield and Kattel Formations of the Sonyea Group. These formations consist of sandstone, shale, and siltstone.

As part of this evaluation, we performed laboratory testing to assess the corrosive environment on-site. This testing consisted of soluble chloride concentrations, soluble sulfates concentrations, pH determinations, and lab resistivity testing. Table No. 1 below summarizes the test results. Chloride and sulfate levels were very low. The pH value is close to neutral. The NRSC soil mapping indicates a high potential exists for the soils to present a corrosive environment for steel. However, based on the site-specific testing, we conclude that the on-site soil presents a low potential for a corrosive environment to develop.

| Table No. 1 - Corrosion Test Results | | | | |
|---|---|---|---|---|
| **Boring Location** | **Lab Resistivity (ohm-cm)** | **pH** | **Soluble Chlorides (mg/L)** | **Soluble Sulfates (mg/L)** |
| B20-2 S-1 | 5,900 | 6.4 | 34 | 34 |
| B20-11 S-1 | 6,100 | 7.5 | 33 | 33 |
| B20-19 S-1 | 5,700 | 7.4 | 33 | 33 |
| Criteria for Potential Corrosive Environment: | | | | |
| pH | < 5.5 | Chlorides | > 500 mg/L | |
| Resistivity | < 5,000 ohm-cm | Sulfates | >2,000 mg/L | |

Based on the above, we make the following specific recommendations:

1. Clear and grub the solar array area. If re-grading is required, remove the surface topsoil prior to starting the grading operations. The contractor should provide a loaded ten-wheel truck or similar heavy construction equipment for the proof-rolling. Rework or replace as directed areas that rut, weave, quake, or are otherwise deemed unsuitable prior to starting the filling operations.

2. The near surface on-site soils are silty, will tend to be moisture sensitive, and are frost susceptible. If planning to reuse the on-site soil as structural fill, plan for the earthwork/utility backfilling to be performed during the drier summer months. Place and moisture condition structural fill to within two percent of optimum moisture. Compact structural fill to at least 95 percent of maximum dry density as determined by the Standard Proctor method, ASTM D-698. Place fill in loose lifts not exceeding twelve inches thick. Maintain good surface drainage.

3. We understand that the preferred foundation system would consist of the light-weight steel I-beams (W5x7) or C-channel (GC 5 x 6). It is our opinion that this type of system is viable for most of the soil conditions expected. Due to the dense soil conditions on the east side of the site, pre-augering of 25 to 40 percent of the piles should be expected. The racking system design should account for frost action.

   For preliminary estimating, assume the soil properties outlined in Table No. 2 below. We recommend performing uplift and lateral load tests to confirm that the required design resistance is developed and that production piles be installed using equipment and methods similar as those used during the test pile installation process.

| Table No. 2– Soil Properties | | |
|---|---|---|
| **Soil Property** | **Upper Three Feet** | **Deeper Soil Conditions** |
| Unit Weight (Moist) | 125 pcf | 140 pcf |
| Friction Angle | 30º | 36º |
| Cohesion | 50 psf | 50 psf |
| Unit Skin Friction | 155 psf/ft | 500 psf/ft |
| Vertical Subgrade Modulus | 20 psi/in | 200 psi/in |

Where load testing is performed, remove the test pile on completion. Backfill the test pits excavated for the pile extraction with the on-site native soil, placed in loose lifts not exceeding 12-inches in thickness, and compacted with at least four passes of an excavator mounted hoe-pack or walk-behind vibratory plate tamper of similar size as a Wacker-Nuesen WP1550AW per lift on backfill installed. Slope the surface of the backfill to shed water away from the test pit location.

Due to the shallow, intact bedrock conditions encountered at soil boring B20-12, we suggest avoiding this area with the array, if possible. The current design has limited construction in this area. If more definition of the shallow bedrock condition is required, we suggest performing a series of auger probes using hollow stem augers to define where the intact bedrock is within eight feet of the surface. Alternatively, plan to use a ballasted foundation in this area. A ballasted system could be developed several ways:

- Vertical posts could be connected horizontally at the base, forming a continuous beam. The base beam could be set at-grade, using concrete blocks, paving stones or another weight/ballast to hold down the array.
- Vertical posts could be connected horizontally at the base, forming a continuous beam. The base beam could be set below-grade, using poured concrete as weight/ballast to hold down the array.
- Large concrete pads (mat foundations) could be cast supporting two or more vertical posts, using the mass of the concrete pad to hold down the array.

Excavations for the ballasted foundations should frost impacts on the foundations. One approach would be to remove the overburden soil and any weathered/decomposed shale rock down to a frost-free 42-inch depth. A non-frost susceptible N.Y.S.D.O.T. subbase material could be placed as backfill under the foundations to raise grade to the bottom of the new foundation/concrete pad. Another approach would be to install Type VII rigid XPS insulation board under/around the foundations.

We recommend using an allowable bearing pressure of 5,000 psf on new structurally compact fill material (see Paragraph 2. above for compaction requirements) and 10,000 if bearing directly on rock. The pressures are both in bearing and overturning loads when designing the spread footings. The footings should be at least 24-inches square (minimum to develop the allowable bearing pressure).

It is our opinion that the use of light-weight steel screw piles are a viable foundation option. A Krinner Ground Screw type-system may require pre-drilling to create a pilot hole in order to penetrate into the dense native soil/weathered rock. We point out that material could wedge under the screw helix as the soil heaves/thaws, resulting in small amounts of differential movement developing. These small amounts of differential movement over time could compound and impact performance.

Due to the dense soil conditions, it is our opinion that light-weight helical piles are not a viable foundation option. The helical piles would prove difficult to install in the compact/dense soil conditions expected and penetration depths would be limited.

4. The testing indicates that soils present a low potential for a corrosive soil environment. We feel that corrosion protection measures are not nessecary for the site.

5. Based on the weather values from the nearby Ithaca Cornell Univeristy Station (elev. 960), we recommend designing the solar array based on mean annual temperature of 46.1°F, and the Air Freezing Index Return Periods (°F-Days) tabulated below:

| **Table No. 3 – Air Freezing Index Return Periods (°F-Days)** | | |
|---|---|---|
| **5-Year** | **10-Year** | **20-Year** |
| 1042 | 1143 | 1223 |

Based on these Air Freeze values and assuming a clear, turf surface condition, we recommend using a site specific frost depth of 42 inches below the surface in assessing soil ad-freeze values and frost uplift forces. For the on-site soils, we recommend using an ad-freeze value of 32 psi for the silty loam soil within the frost zone.

6. Construct the transformer pad and other support equipment on mat foundations. We recommend placing at least 12-inches of granular material under the mat slabs. N.Y.S.D.O.T. Items 304.12 (crusher-run stone) or 304.14 (crushed Item No. 4 gravel) meets this criterion. Rework and re-compact the underlying native soil to structural fill standards outlined in Paragraph No. 2 above prior to installing the stone base course. Design the mat foundations based on a uncorrected Modulus of Subgrade Reaction, $K_d$, of 175 psi/in at the bottom of slab/top of stone; the structural engineer should adjust this subgrade value for the size of the mat.

Frost may heave the pad, potentially separating pipe conduit at joints. To protect the pad, we suggest 1.) undercutting the pad to a 42-inch depth and backfilling with a non-frost susceptible material such crusher-run stone or crushed Item No. 4 gravel or 2.) installing a high density insulation board under the pad. Under the insultation approach, extend the board horizontally 42-inches in each direction beyond the edge of the pad. Cover the board with a minimum of six inches of soil. If insulation board is used, we suggest using a 2-inch thick, Type IV, V, VI or VII XPS board.

7. The NYS Building Code identifies various seismic design criteria for this project. We identify the site as having a Site Classification of C (Dense Soil and Soft Rock). Based on ASCE 7-16 guidelines and using a Risk Category IV, we recommend using the following seismic design parameters.

**Table No. 4 – Seismic Design Parameters**

| Spectral Response Acceleration | | Soil Factors | | Design Spectral Response Acceleration | |
|---|---|---|---|---|---|
| $S_s$ | $S_1$ | $S_{MS}$ | $S_{M1}$ | $SD_s$ | $SD_1$ |
| 0.120g | 0.045g | 0.156g | 0.068g | 0.104g | 0.045g |

8. Perform the trenching and excavating work in accordance with NYS Building Code and OSHA safety standards. The contractor is responsible for determining what measures are required to meet these standards. Under no circumstances should slopes be steeper than 1 horizontal on 1 vertical. It is our opinion that the foundation and utility excavation work can be achieved with 'normal' excavating equipment capable of achieving the desired depths, except for where the shallow rock was encountered at B20-12. If grades are required to be cut in this area, a hoe ram may be required to achieve grades that are deeper than three feet below grade. Remove water that accumulates in open excavations using sumps and pumps.

9. Due to the on-site surface silty soil, we suggest budgeting for the following minimum pavement sections for your access roadway. If N.Y.S.D.O.T. Item 304.12 (crusher-run stone) subbase material is used, the subbase thickness may be decreased to 9-inches thick. Thicken this section as needed if used as the construction haul road for the material deliveries expected.

**Table No. 5 –Pavement Section**

| | | |
|---|---|---|
| 12.0" | Crushed Item 4 Gravel Subbase | NYSDOT Item 304.14 |
| | Geogrid | Tensar T-130 |
| | Subgrade | Approved Proof Roll |

10. Establish site drainage to keep water from ponding. Ponding water will result in more significant frost heave developing during the winter months and may impact rack performance in areas nearby.

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Attached is a Geoscience Business Council paper entitled *Important Information about your Geotechnical Engineering Report*. It describes how we intend this report to be used. We will continue to work cooperatively with you, other project principals, and interested parties to achieve win/win solutions that benefit all.

This concludes our geotechnical consultation services; call if you have questions or if you require additional design information. Forward a copy of the near final plans and specifications for our review and comment. It has been a pleasure to work with you on this project and we look forward to hearing from you again in the future.

Very truly yours,

**FOUNDATION DESIGN, P.C.**

Jeffrey D. Netzband, P.E., P.G.
Vice President
Enc.

STATE OF NEW YORK
JEFFREY D. NETZBAND
074888
LICENSED PROFESSIONAL ENGINEER

# 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 not 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 Not 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 not 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 not building-envelope or mold specialists.***

GEOPROFESSIONAL BUSINESS ASSOCIATION

Telephone: 301/565-2733
e-mail: info@geoprofessional.org www.geoprofessional.org


**Foundation Design, P.C.**

46A Sager Drive
Rochester, New York 14607
Phone (585) 458-0824
FAX (585) 458-3323

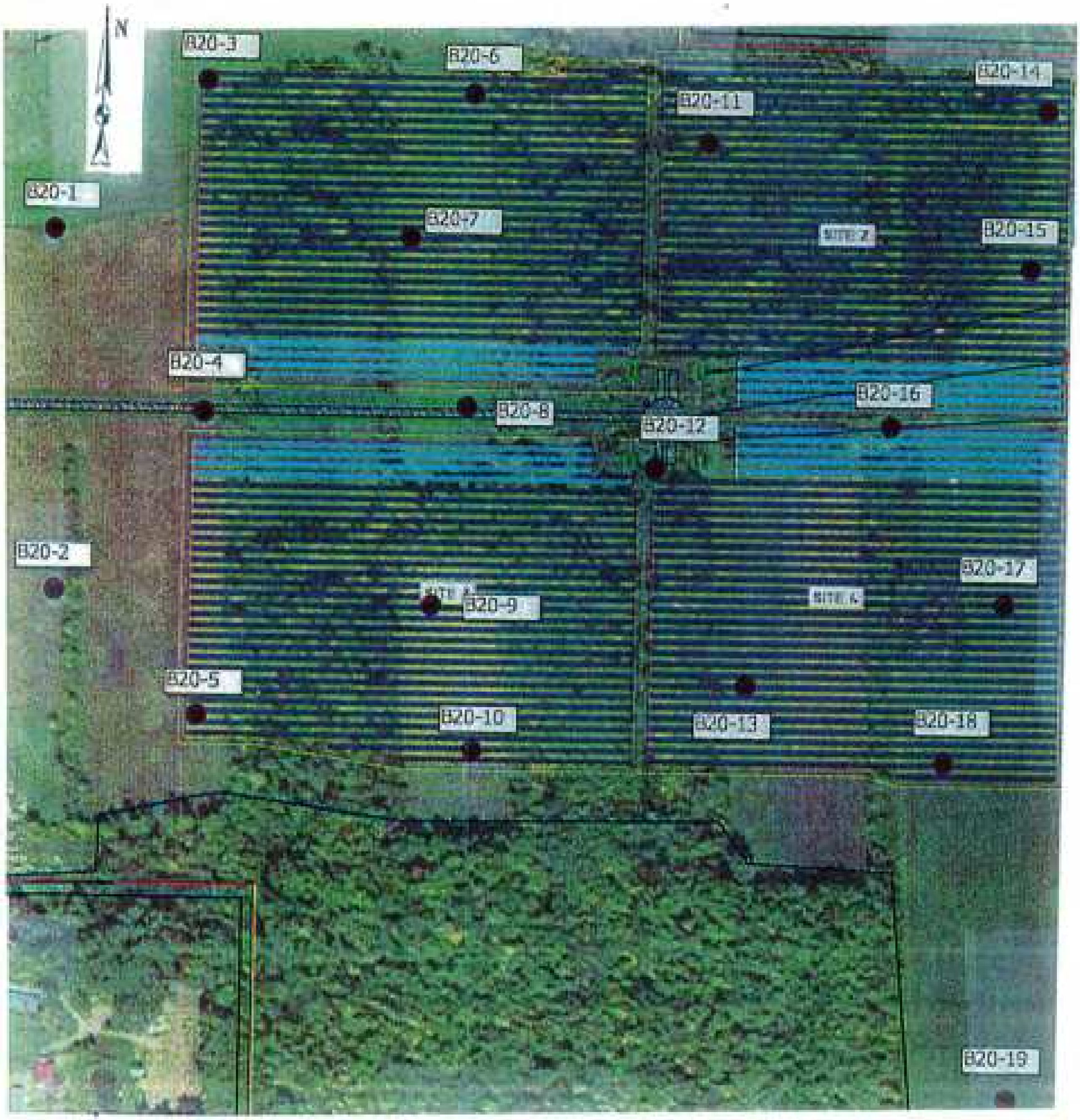
**NSF Enfield Solar Array**

Applegate Road South, Enfield, New York

**General Location Plan**

Adapted from: USGS Topographic Mapping
*2019 Mecklenburg and Ithaca West Quadrangle*

| | | |
|---|---|---|
| **CHECKED BY:** JDN | Scale 1"= 2000' | **DATE:** 9/24/20 |
| **DRAWN BY:** JCS | | **JOB NO.:** 4840.0 |




**Foundation Design, P.C.**

46A Sager Drive
Rochester, New York 14607
Phone (585) 458-0824
FAX (585) 458-3323

**NSF Enfield Solar Array**
Applegate Road South, Enfield, New York

**Boring Location Plan**

Adapted from: Namaste Solar
*Master Site Plan*

| | | | |
|---|---|---|---|
| CHECKED BY: | JDN | Scale 1"= 400' | DATE: 9/24/20 |
| DRAWN BY: | JCS | | JOB NO.: 4840.0 |

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# SOIL DESCRIPTIONS

## COHESIVE SOIL

Very fine grained soils. Plastic soils that can be rolled into a thin thread if moist. Clays and silty clays show cohesion.

| DESCRIPTION | STP –BLOWS/FOOT |
|---|---|
| Very Soft | 0-2 |
| Soft | 3-5 |
| Medium | 6-15 |
| Stiff | 16-25 |
| Hard | 26 or more |

## NON-COHESIVE SOIL

Soils composed of silt, sand and gravel, showing no cohesion or very slight cohesion

| DESCRIPTION | STP –BLOWS/FOOT |
|---|---|
| Loose | 0-10 |
| Firm | 11-25 |
| Compact | 26-40 |
| Dense | 41-50 |
| Very Dense | 51 or more |

## SOIL COMPOSITION

| DESCRIPTION | ESTIMATED PERCENTAGE |
|---|---|
| and | 50 |
| some | 30-49 |
| little | 11-29 |
| trace | 0-10 |

**MOISTURE CONDITIONS** Dry, Damp, Moist, Wet, Saturated
Groundwater measured in the boring or test pit may not have reached equilibrium

## SOIL STRATA:

| TERM | DESCRIPTION |
|---|---|
| layer | Soil deposit more than 6" thick |
| seam | Soil deposit less than 6" thick |
| parting | Soil deposit less than 1/8" thick |
| varved | Horizontal uniform layers or seams of soil |

## GRAIN SIZE

| MATERIAL | | SIEVE SIZE |
|---|---|---|
| Boulder | | Larger than 12 inches |
| Cobble | | 3 inches to 12 inches |
| Gravel | - coarse | 1 inch to 3 inches |
| | - medium | 3/8 inch to 1 inch |
| | - fine | No. 4 to 3/8 inch |
| Sand | - coarse | No. 10 to No. 4 |
| | - medium | No. 40 to No. 10 |
| | - fine | No. 200 to No. 40 |
| Silt and Clay | | Less than No. 200 |

Standard Penetration Test: The number of blows required to drive a split spoon sampler into the soil with a 140 pound hammer dropped 30 inches. The number of blows required for each 6-inches of penetration is recorded. The total number of blows required for the second and third 6-inches of penetration is termed the penetration resistance, or the "N" value.

Split Spoon Sampler: Typically a 2-foot long, 2-inch diameter hollow steel tube that breaks apart or splits in two down the tube length.

Refusal: Depth in the boring where more than 100 blows per 5-inches are needed to advance the sample spoon.

Core Recovery (%): The total length of rock core recovered divided by the total core run.

RQD (%): Rock Quality Designation – the total length of all the pieces of the rock core longer than 4-inches divided by the total length of the rock core run.