THE STATE OF NEW HAMPSHIRE
BEFORE THE
NEW HAMPSHIRE
SITE EVALUATION COMMITTEE

SEC DOCKET NO. 2019-02

APPLICATION OF CHINOOK SOLAR, LLC FOR A CERTIFICATE OF SITE AND FACILITY FOR THE CHINOOK SOLAR PROJECT IN FITZWILLIAM, NEW HAMPSHIRE

PREFILED SUPPLEMENTAL TESTIMONY OF KEITH DELALLO
ON BEHALF OF
CHINOOK SOLAR, LLC
August 31, 2020

Qualifications of Keith Delallo

Q. Please state your name and business address.

A. My name is Keith Delallo. My business address is 700 Universe Boulevard, Juno Beach, Florida 33408.

Q. Who is your current employer and what position do you hold?

A. I am employed by NextEra Energy Resources, Inc. ("NEER") as a Project Engineer.

Q. Please describe your responsibilities at NEER, including those that relate to the Chinook Solar Project that is the subject of this docket.

A. As a Project Engineer, I have oversight and management responsibilities for engineering design of utility-scale solar projects. My primary roles include establishing design criteria for solar projects and supporting procurement of major power plant equipment. I am generally responsible for the engineering activities during the development, design, and construction phases of the Chinook Solar Project ("the Project"). As the result of all of these activities, I am very familiar with the Project.

Q. What are your background and qualifications?

A. I joined NextEra Energy, Inc. in March 2020 and have held this position within Nextera Energy since that time. Within NextEra I am currently the Project Engineer of approximately 130 MW AC in development throughout the central and North East Region, which includes this Project. I also have experience with residential and commercial solar projects through the country. Overall, I have extensive experience designing, engineering, and constructing of over 12MW AC residential solar projects in 19 states and 5MW AC of commercial solar projects in 2 states developed by SolarCity and then Tesla Inc. when SolarCity merged with Tesla.

I hold a Bachelor of Science degree in Mechanical Engineering and a Bachelors of Business Administration in Marking and Sales from the University of Toledo. A copy of my resume is attached to this testimony as Attachment A.

Q. Have you previously testified before this Committee?

A. I have not testified before this Committee.

Purpose of Testimony

Q. What is the purpose of your supplemental testimony?

A. The purpose of my supplemental testimony is to adopt the pre-filed testimony of Paul Callahan submitted in this docket on October 18, 2019. Mr. Callahan retired from NextEra earlier this year and I have replaced him on this Project. The other purpose of this testimony is to update the Site Evaluation Committee ("SEC" or "the Committee") on a few changes to the design of the Project, to provide information relating to subsequent soil borings that have been done in the area of the proposed substation on the Project site, and to discuss certain construction-related issues that are addressed in the Memorandum of Understanding ("MOU") with the Town of Fitzwilliam.

<u>Updates to the Callahan Testimony</u>

Q. Do you have any changes you would like to make to Mr. Callahan's pre-filed testimony?

A. While I adopt Mr. Callahan's testimony in its entirety, I do have a few updates that I would like to convey. As technology changes within the solar industry, NextEra is evaluating these technologies to help provide the best project in terms of project aesthetics, water management, environmental considerations, and increase production. One of these technologies we are evaluating is the use of Bifacial modules. If this Project changes from Monofacical modules to Bifacial modules we will notify the Committee. As Michael Buscher indicates in his supplemental testimony, it is not anticipated that a change to Bifacial modules would have any impact on the Visual Impact Assessment filed by T.J. Boyle Associates. The height of the modules will not exceed 12' above grade and will not be tilted at greater than 25°. The second update to Mr. Callahan's testimony is to provide additional information regarding our request for two partial waivers from the requirement in Admin. Rule Site 301.08(d)(2)d that all underground infrastructure at depths less than four feet below grade be removed from the site during decommissioning. The National Electrical Code (NEC) requires conductors to be installed at a minimum of 36" below grade at certain voltages and conditions. Removing all infrastructure at depths less than four feet would cause significant ground disturbance. Chinook Solar requests that only equipment that is located underground at depths of three feet or less, be removed during decommissioning. The second partial waiver request is a further waiver from the rule when solar racking piles have been concreted into rock. In areas in which there is a presence of shallow rock, predrill will be required prior to driving the solar racking piles. It is anticipated that the site will require approximately 10 percent of the solar racking piles to be predrilled. Chinook Solar is requesting a waiver from having to remove piles at depths shallower than three feet that have been concreted into rock. It is proposed that these piles will be cut off at the interface to the concrete in lieu of removing the pile to a depth of three feet. The equipment that will be left in the ground is inert and is standard building materials in commercial and residential construction projects.

Q. Please describe any design changes that have been made to the Project since the Application was submitted in October of 2019.

A. Since the Application was submitted we have been working with the Department of Environmental Services with regard to the application for an alteration of terrain permit. As of the date of this testimony we are still in discussions with them which could result in some changes to the design of the Project. Joseph Persechino's supplemental testimony will provide more detail on these discussions.

Q. Have soil borings been done on the Project site in the area where the substation is proposed?

A. Yes. Those borings were conducted in June of 2020. These borings indicated that the Geology is consistent throughout the Substation site. Based on the Soil Survey Geographic database (NRCS SSURGO) surficial geology maps, the Project area is comprised of glacial till. United States Geological Survey (USGS) bedrock maps indicate the site is underlain with granite of the Concord Granite geologic unit. There is an average of 1.04' of topsoil, then on average of 30.40' of silty sand below the topsoil, and then on average bedrock is 31.44' below grade. Attached to this testimony is the final Geotechnical Report. See Attachment B.

Q. Are you familiar with the construction-related provisions in the MOU with the Town?

A. Yes. Those provisions include providing the Town with a copy of the New Hampshire Stormwater Pollution Prevention Plan showing the construction layout of the Project; providing an overall schedule for construction activities; providing updates to the Town at least on a monthly basis via in person, conference, telephone, and/or via U.S. Mail or electronic mail; notifying the Town of the start of construction at least twenty-four (24) hours in advance; time limits on construction so that it shall not begin before 7:00 am and not continue after 5:30 pm Monday through Saturday; and a requirement that the start-up and idling of trucks and equipment will conform to all applicable New Hampshire Department of Transportation regulations. It is also my understanding that Chinook Solar has committed to using best management practices to limit noise during construction.

Q. Does this conclude your supplemental testimony?

A. Yes.

2869469_1

Keith DeLallo

Project Engineer

Experienced Project Manager with 8+ years of demonstrated history of working with large teams in the solar engineering field. Skilled in project management, residential and commercial solar design, and technical due diligence.

Personal Info

Address
2656 W Augusta Blvd
Unit 3
Chicago, IL 60622

Phone
440-781-7761

E-mail
keith.delallo@nexteraenergy.com

Education

2009
University of Toledo
Bachelor of Science in Mechanical Engineering Technology

2007
University of Toledo
Bachelor of Business Administration in Marketing and Sales

Software

PVsyst — Very Good

MS Excel - Pivot Tables — Very Good

AutoCAD — Very Good

SQL — Very Good

Skills

Commercial and Residential solar design

Analytical thinking and problem solving

Teamwork and project management

Advanced attention to details

Leading cross-functional teams

Licenses

2009
Engineering in Training (EIT)

Awards

Engineering Leadership Award 2016

Experience

Mar 2020 - present

Project Engineer
NextEra Energy
- Project Engineer for commercial and utility scale solar projects in the Central and North East Region.
- Establishing basis of design, supporting procurement of major power plant equipment, and contracting engineering for detailed design of solar projects.
- Provide support for technical review of new products including inverters, trackers, and modules.

Aug 2019 - Mar 2020

Senior Energy Analyst
DNV GL
- Main responsibility was acting as an Independent Engineer consultant for C&I and Utility scale systems within DNV GL ranging from 100 KWp to 300 MWp.
- Performed solar resource assessments, production analysis, and uncertainty analysis for C&I and Utility solar.
- Completed project technical due diligence reviews for engineering process , major equipment, EPC agreements, and operating system for Utility solar.
- Lead validation studies for NEXTracker TrueCapture uneven terrain and row to row gains.
- Project manage residential portfolios for all aspects of technical due diligence reports.

Mar 2016 - Jun 2019

Associate Manager, Engineering and Design
Tesla, Inc.
- Manage, motivate, and lead a team of eight team leads and up to 70 individual contributors.
- Responsible for identifying process bottlenecks and implementing solutions.
- Collaborate across departments to improve project quality, resulting in increased customer satisfaction.
- Develop departmental strategies and corresponding KPIs.
- Create and maintain teams' dashboards to increase visibility of KPIs.
- Product Manager for Storage Only and Photovoltaic with Storage.

Select Accomplishments
- Built a staffing model based on the distribution of incoming workflow and variable project completion time. Adopted by five different product lines and two separate departments.
- Constructed tools to facilitate communication between sales and design which reduced redesign rates by 10%.
- Reduced cost of designs by 60% over six months by:
  - Reallocating resources and executed process improvements.
  - Decreased project completion time by 40% by optimizing individual contributors' task structure.
  - Using Python to develop a tool to automatically distribute projects to designers.
  - Implementing a plan for variable shift schedules for designers to meet incoming work demand.

Apr 2014 - Mar 2016

Photovoltaic Design Team Lead
SolarCity
- Fostered enthusiasm, motivated, and managed up to 16 designers.
- Collaborated with local utilities to establish protocols for interconnection applications to reduce rejection rates by 20%
- Established department competition to increase productivity by 20%.
- Decreased rejection rates by 5% by facilitating the communication of new regulations to the sales and design teams.
- Hired, trained, and fostered a culture that produced the company's leading talent.

Apr 2012 - Apr 2014

Photovoltaic Designer
SolarCity
- Designed residential and small commercial solar projects
- Reviewed customer expectations, city guidelines, home structural integrity, and electrical interconnection requirements for residential solar projects.
- Acted as lead trainer for new designers joining the Colorado team.
- Designed AutoCAD blocks for solar plan sets that are still used today.

Attachment B

Geotechnical Engineering Report

Chinook Solar Substation
Fitzwilliam, New Hampshire
August 28, 2020
Terracon Project No. J1205036

Prepared for:
NextEra Energy Resources, LLC
Juno Beach, Florida

Prepared by:
Terracon Consultants, Inc.
Manchester, New Hampshire

August 28, 2020

NextEra Energy Resources, LLC
700 Universe Boulevard
Juno Beach, FL 33408

Attn: Mr. Jordan Cohen, Project Manager
P: (415) 755 0197
E: Jordan.cohen@nexteraenergy.com

Re: Geotechnical Engineering Report
Chinook Solar Substation
Fullam Hill Road
Fitzwilliam, New Hampshire
Terracon Project No. J1205036

Dear Mr. Cohen:

We have completed the Geotechnical Engineering services for the above referenced project. This study was performed in general accordance with Terracon Proposal No. PJ1205036 dated June 2, 2020. This report presents the findings of the subsurface exploration and provides geotechnical recommendations concerning earthwork and the design and construction of foundations for the proposed project.

We appreciate the opportunity to be of service to you on this project. If you have any questions concerning this report or if we may be of further service, please contact us.

Sincerely,
Terracon Consultants, Inc.

Marc A. Gullison, P.E.
Senior Staff Engineer

Carl W. Thunberg, P.E.
Geotechnical Department Manager

REPORT TOPICS

INTRODUCTION 1
SITE CONDITIONS 1
PROJECT DESCRIPTION 2
GEOTECHNICAL CHARACTERIZATION 3
GEOTECHNICAL OVERVIEW 6
EARTHWORK 6
SHALLOW FOUNDATIONS 9
REINFORCED CONCRETE MAT 12
DEEP FOUNDATIONS 14
SEISMIC CONSIDERATIONS 15
LATERAL EARTH PRESSURES 16
FROST CONSIDERATIONS 18
GENERAL COMMENTS 19
FIGURES 20

Note: This report was originally delivered in a web-based format. **Orange Bold** text in the report indicates a referenced section heading. The PDF version also includes hyperlinks which direct the reader to that section and clicking on the ***GeoReport*** logo will bring you back to this page. For more interactive features, please view your project online at client.terracon.com.

ATTACHMENTS

EXPLORATION AND TESTING PROCEDURES
SITE LOCATION AND EXPLORATION PLANS
EXPLORATION RESULTS
SUPPORTING INFORMATION

Note: Refer to each individual Attachment for a listing of contents.

Geotechnical Engineering Report

Chinook Solar Substation
Fullam Hill Road
Fitzwilliam, New Hampshire
Terracon Project No. J1205036
August 28, 2020

INTRODUCTION

This report presents the results of our subsurface exploration and geotechnical engineering services performed for the proposed substation to support the proposed solar power plant to be located along Fullam Hill Road in Fitzwilliam, New Hampshire. The purpose of these services is to provide information and geotechnical engineering recommendations relative to:

- Subsurface soil and rock conditions
- Groundwater conditions
- Site preparation and earthwork
- Excavation considerations
- Dewatering considerations
- Foundation design and construction
- Seismic site classification per IBC
- Frost considerations

The geotechnical field Scope of Services for this project included the advancement of eight test borings to depths ranging from approximately 40 to 45 feet below existing site grades. Additionally, electrical resistivity tests, consisting of two mutually perpendicular lines, were performed in the vicinity of the proposed substation. Two additional borings were performed within the proposed substation during the 2018 geotechnical investigation for the solar arrays and are included herein.

Maps showing the site and boring locations are shown in the **Site Location** and **Exploration Plan** sections, respectively. The results of the laboratory testing performed on soil samples obtained from the site during the field exploration are included as separate graphs in the **Exploration Results** section.

SITE CONDITIONS

The following description of site conditions is derived from our site visit in association with the field exploration and our review of publicly available geologic and topographic maps.

Item	Description
Parcel Information	The project is located between State Routes 12 and 119 in Fitzwilliam, New Hampshire, specifically accessed from Fullam Hill Road. The overall site area of the solar power plant is irregularly shaped and is approximately 190 acres. Access to the site is via an unpaved road off Fullam Hill Road. The proposed substation is generally located at the east central portion of the solar arrays and abuts an existing transmission line easement. The approximate center of the substation is at 42.7677°, -72.1007°. See **Site Location**.
Existing Improvements	The area of the substation is mostly unimproved, wooded land, but has been previously forested as evidenced by logging trails. An unpaved road provides access to the southwest end of the proposed substation and a National Grid transmission line runs along its northeast side. The plans indicate delineated wetland areas on three sides of the substation.
Current Ground Cover	Ground vegetation and trees.
Existing Topography	Gently sloping downward from northwest to the southeast. Based on the Chinook Solar 115/34.5kV Substation Boring Plan (Drawing CN1-D-P002-GEO rev A, dated 5/15/2020), site grades vary from approximately Elevation (El.) 1,200 feet to El. 1,186 feet (NAVD88).
Geology	NRCS SSURGO maps indicate the surficial soil consists of glacial till and USGS bedrock maps indicate the site is underlain with granite of the Concord Granite geologic unit.

PROJECT DESCRIPTION

Our initial understanding of the project was provided in our proposal and was discussed during project planning. A period of collaboration has transpired since the project was initiated, and our final understanding of the project conditions is as follows:

Item	Description
Information Provided	NEER provided the following information: ■ Chinook Substation Scope of Work, prepared by Burns & McDonnell, Inc. dated May 15, 2020, which included the following attachments: o Chinook Solar 115/34.5kV Substation Boring Plan (Drawing CN1-D-P002-GEO rev A, dated 5/15/2020 o Sample 4-pin Wenner Test Form ■ .kmz file showing substation location
Project Description	The project consists of a new 115/34.5 kV substation and the adjacent National Grid switchyard supporting the Chinook Solar Project connection to the existing transmission grid.

Item	Description
Proposed Structures	The proposed substation includes an A-Frame Deadend, a control building, miscellaneous supports, transformers, breakers, and static mast. The RFP provided the following anticipated structure foundation types: ■ A-Frame Deadend – 5-foot diameter drilled shaft ■ Control Building – 2.5-foot diameter drilled shafts ■ Miscellaneous supports – 3-foot diameter drilled shafts ■ Transformer – Slab ■ Breaker/Misc. – Slab ■ Static Mast – Direct embedded pole
Maximum Loads (provided by Burns & McDonnell))	The RFP provided the following anticipated loads: ■ A-Frame Deadend: o 300 kips compression o 250 kips uplift o 60 kips shear o 500 kip-ft moment ■ Control Building: o 30 kips compression o 3 kips shear o 20 kip-ft moment ■ Miscellaneous Supports: o 6 kips compression o 3 kips shear o 30 kip-ft moment ■ Transformer: 250 kips compression ■ Breaker/Miscellaneous: 10 kips compression ■ Static Mast: o 10 kips compression o 10 kips shear o 350 kip-ft moment
Grading/Slopes	Minimal grade changes anticipated.

GEOTECHNICAL CHARACTERIZATION

Geology

Based on the NRCS SSURGO surficial geology maps, the project area is comprised of glacial till. USGS bedrock maps indicate the site is underlain with granite of the Concord Granite geologic unit.

According to the USGS Latest Earthquakes tool, 270 earthquakes have occurred within a 100-mile radius of Fitzwilliam between 1974 and 2020, with magnitudes ranging between 0.6 and 4.7. Historical seismic events in the greater region date back to a violent earthquake believed to have an epicenter in central New Hampshire on June 11, 1638. This 1638 earthquake had an estimated Modified Mercalli (MM) intensity of IX and Richter scale magnitude between 6.5 and 7.0. Additionally, the 1755 Cape Ann Earthquake, occurred off the northeast coast of Massachusetts, approximately 90 miles east of Fitzwilliam, New Hampshire and had an estimated magnitude of 5.9. A pair of 5.3 and 5.6 earthquakes occurred in December 1940 near Tamworth, New Hampshire, approximately 85 miles northeast of Fitzwilliam.

The site is in Fitzwilliam, New Hampshire, within the jurisdiction of the Southwest Region Planning Commission (SwRPC). Digital data of flood insurance rate maps prepared by the Federal Emergency Management Agency indicate the site is in an area outside the 0.2% annual chance floodplain.

Subsurface Profile

We have developed a general characterization of the subsurface conditions based upon our review of the subsurface exploration, laboratory data, geologic setting and our understanding of the project. This characterization, termed GeoModel, forms the basis of our geotechnical calculations and evaluation of site preparation and foundation options. Conditions encountered at each exploration point are indicated on the individual logs. The individual logs can be found in the **Exploration Results** section and the GeoModel can be found in the **Figures** section.

As part of our analyses, we identified the following model layers within the subsurface profile. For a more detailed view of the model layer depths at each boring location, refer to the GeoModel.

Model Layer	Layer Name	General Description
1	**Topsoil**	3 to 24 inches of root mat / topsoil, dark brown
2	**Glacial Till**	Silty Sand (SM), trace gravel, occasional boulders and cobbles, grayish brown to gray, medium dense to very dense
3	**Bedrock**	Granite, strong, slightly to moderately weathered, gray to olive

Groundwater Conditions

Groundwater measurements are summarized in the following table and are noted on the boring logs in the **Exploration Results** section. The groundwater levels were measured at the completion of drilling and may not represent stabilized levels.

Boring No.	Approximate Ground Surface Elevation (feet) [1]	Approximate Groundwater Depth (feet)	Approximate Groundwater Elevation (feet) [1]
SB-2	1,194	9.0	1,185
SB-3	1,193	9.0	1,184
SB-4	1,198	Not observed	
SB-5	1,195	9.0	1,186

Boring No.	Approximate Ground Surface Elevation (feet) [1]	Approximate Groundwater Depth (feet)	Approximate Groundwater Elevation (feet) [1]
SB-6	1,197	13.0	1,184
SB-7	1,193	9.5	1,183.5
SB-9	1,195	14.5	1,180.5
SB-10	1,195	9.0	1,186

1. Elevations were estimated by interpolation from the Chinook Solar 115/34.5kV Substation Boring Plan, prepared by Burns & McDonnell, dated May 15, 2020.

Groundwater level fluctuations occur due to seasonal variations in the amount of rainfall, runoff and other factors not evident at the time the borings were performed. Therefore, groundwater levels during construction or at other times in the life of the structure may be higher or lower than the levels indicated on the boring logs. The possibility of groundwater level fluctuations should be considered when developing the design and construction plans for the project.

Corrosivity

The table below lists the results of laboratory soluble sulfate, soluble chloride, electrical resistivity, and pH testing. The values may be used to estimate potential corrosive characteristics of the on-site soils with respect to contact with the various underground materials which will be used for project construction.

Corrosivity Test Results Summary						
Boring	**Sample Depth (feet)**	**Soil Description**	**Soluble Sulfate (mg/kg)**	**Soluble Chloride (mg/kg)**	**Electrical Resistivity (Ω-cm)**	**pH**
SB-2	1 to 4	Silty Sand	28	25	33,500	5.39
SB-9	1 to 4	Silty Sand	35	40	46,230	5.89

Results of water-soluble sulfate testing indicate samples of the on-site soils tested have an exposure class of S0 when classified in accordance with Table 19.3.1.1 of the American Concrete Institute of Concrete (ACI) Design Manual. Concrete should be designed in accordance with the provisions of the ACI Design Manual, Section 318, Chapter 19.

These test results are provided to assist in determining the type and degree of corrosion protection that may be required. For protection against corrosion to buried metals, Terracon recommends that an experienced corrosion engineer be retained to design a suitable corrosion protection system for underground metal structures or components.

GEOTECHNICAL OVERVIEW

The site appears suitable for the proposed substation development based upon geotechnical conditions encountered in the borings provided the recommendations in this report are implemented during design and construction.

The site subsurface generally consists of medium dense to very dense relative density glacial till consisting of silty sand. Boulders and cobbles were encountered throughout the glacial till and caused occasional sampler refusal. Generally, top of bedrock was encountered between 28 and 35 feet below existing ground surface. Groundwater was encountered at depths of about 9 to 14.5 feet below ground surface.

The near surface fine-grained soil will become unstable with typical earthwork and construction traffic, especially after precipitation events. The effective drainage should be completed early in the construction sequence and maintained after construction to avoid potential issues. If possible, the grading should be performed during the warmer and drier times of the year (typically May to October). If grading is performed during the winter months (typically November to April), an increased risk for possible undercutting and replacement of unstable subgrade will persist. Additional site preparation recommendations, including subgrade improvement and fill placement, are provided in the **Earthwork** section.

The **Shallow Foundations** section addresses support of the control house bearing on minimum 12 inches of compacted Structural Fill over proofrolled glacial till. The **Reinforced Concrete Mat** section addresses support of transformer pads and other substation components. The **Deep Foundations** section addresses support of the riser structures on drilled shaft or direct embedment foundations.

The **General Comments** section provides an understanding of the report limitations.

EARTHWORK

Earthwork is anticipated to include clearing and grubbing, excavations, and fill placement. The following sections provide recommendations for use in the preparation of specifications for the work. Recommendations include critical quality criteria, as necessary, to render the site in the state considered in our geotechnical engineering evaluation for foundations and floor slabs.

Site Preparation

Prior to placing fill, existing trees, vegetation, and root mat should be removed. Complete stripping of the topsoil should be performed in the proposed substation and switchyard, as well as parking, driveway, or unpaved access road areas.

The subgrade should be proofrolled with an adequately loaded vehicle such as a fully-loaded tandem-axle dump truck. The proofrolling should be performed under the direction of the Geotechnical Engineer. Areas excessively deflecting under the proofroll should be delineated and subsequently addressed by the Geotechnical Engineer. Such areas should either be removed or modified by stabilizing with Structural Fill. Excessively wet or dry material should either be removed or moisture conditioned and recompacted.

Fill Material Types

Fill used for the project should meet the following material property requirements:

Fill Type [1]	New Hampshire Department of Transportation (NHDOT) Item	Acceptable Location for Placement
General Fill [2]	209.4 – Granular Backfill (Gravel)	General raise in grade fill. General Fill should not be placed within the foundation bearing zone of settlement sensitive structures.
Structural Fill	304.2 – Gravel	Beneath foundations.
Crushed Stone	703 – No. 67 Graded Coarse Aggregate	Backfill of underdrains and over wet subgrades as needed.
Non-Frost Susceptible Fill [3]	304.3 – Crushed Gravel or 703 – No. 67 Graded Coarse Aggregate	Exterior slabs.
Floor Slab Base Course	304.4 – Crushed Stone (Fine)	Below floor slabs as aggregate base course.
Riprap	585.3 – Stone Fill, Class C	Erosion protection for cut and fill slopes.

1. Compacted fill should consist of approved materials that are free of organic matter and debris. Frozen material should not be used. Fill should not be placed on frozen subgrade.
2. General Fill should have a maximum particle size of 6 inches and no more than 25 percent by weight passing the No. 200 sieve.
3. Non-Frost Susceptible (NFS) Fill should contain less than 5 percent material passing No. 200 sieve size.

Fill Compaction Requirements

Fill materials should meet the following compaction requirements.

Item	Description
Maximum Lift Thickness	8 inches or less in loose thickness when heavy, self-propelled compaction equipment is used 4 to 6 inches in loose thickness when hand-guided equipment (i.e. jumping jack or plate compactor) is used
Minimum Compaction Requirements [1, 2]	At least 95% of the material's maximum Modified Proctor dry density (ASTM D1557)
Water Content Range [1]	Workable moisture levels

1. Maximum density and optimum water content as determined by the Modified Proctor test (ASTM D1557, Method C).
2. We recommend testing fill for moisture content and compaction during placement. If the results of in-place density tests indicate the specified moisture or compaction limits have not been met, the area represented by the test should be reworked and retested, as required, until the specified moisture and compaction requirements are achieved.

Utility Trench Backfill

Trench excavations should be made with sufficient working space to permit construction including backfill placement and compaction. Contractors should be advised that trenching may be impacted by boulders. Boulders should not be re-used as trench backfill. If backfilled with relatively clean granular material, utility trenches should be capped with at least 12 inches of cohesive fill in unpaved areas to reduce the infiltration and preferential conveyance of surface water through the trench backfill. Alternatively, trenches should be backfilled with material that approximately matches the permeability characteristics of the surrounding soil. Fill placed as backfill for utilities located below the slab should consist of compacted Structural Fill or suitable bedding material.

Grading and Drainage

All grades must provide effective drainage away from structures during and after construction and should be maintained throughout the life of the structures. Water retained next to structures can result in soil movements greater than those discussed in this report. Greater movements can result in unacceptable differential slab and/or foundation movements, cracked slabs and walls, and roof leaks. The roof should have gutters/drains with downspouts that discharge onto splash blocks at a distance of at least 5 feet from the building.

Earthwork Construction Considerations

Shallow excavations for the proposed structure are anticipated to be accomplished with conventional construction equipment. Upon completion of filling and grading, care should be taken to maintain the subgrade water content prior to construction of slabs. Construction traffic over the completed subgrades should be avoided. The site should also be graded to prevent ponding of surface water on the prepared subgrades or in excavations. Water collecting over or adjacent to construction areas should be removed. If the subgrade freezes, desiccates, saturates, or is disturbed, the affected material should be removed, or the materials should be scarified, moisture conditioned, and recompacted prior to slab construction.

As a minimum, excavations should be performed in accordance with OSHA 29 CFR, Part 1926, Subpart P, "Excavations" and its appendices, and in accordance with any applicable local, and/or state regulations. Construction site safety is the sole responsibility of the contractor who controls the means, methods, and sequencing of construction operations. Under no circumstances shall the information provided herein be interpreted to mean Terracon is assuming responsibility for construction site safety, or the contractor's activities; such responsibility shall neither be implied nor inferred.

Construction Observation and Testing

The earthwork efforts should be monitored under the direction of the Geotechnical Engineer. Monitoring should include documentation of adequate removal of vegetation and topsoil, proofrolling, and mitigation of areas delineated by the proofroll to require mitigation.

Each lift of compacted fill should be tested, evaluated, and reworked, as necessary, until approved by the Geotechnical Engineer prior to placement of additional lifts. Each lift of fill should be tested for density and water content at a frequency of at least one test for every 5,000 square feet in open areas and every 50 linear feet of compacted utility trench backfill.

In areas of foundation excavations, the bearing subgrade should be evaluated under the direction of the Geotechnical Engineer. If unanticipated conditions are encountered, the Geotechnical Engineer should prescribe mitigation options.

In addition to the documentation of the essential parameters necessary for construction, the continuation of the Geotechnical Engineer into the construction phase of the project provides the continuity to maintain the Geotechnical Engineer's evaluation of subsurface conditions, including assessing variations and associated design changes.

SHALLOW FOUNDATIONS

If the site has been prepared in accordance with the requirements noted in the **Earthwork** section, the following design parameters are applicable for shallow foundations, such as for the control house.

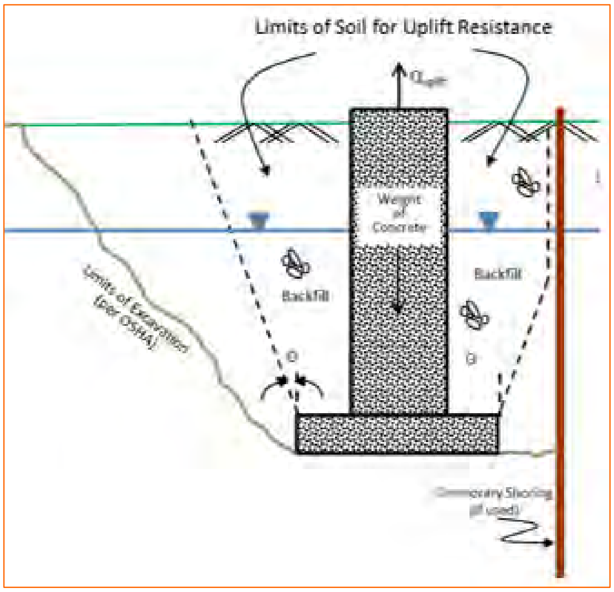
Design Parameters – Compressive Loads

Item	Description
Maximum Net Allowable Bearing Pressure [1, 2]	4,000 psf
Required Bearing Stratum [3]	12 inches of compacted Structural Fill over proofrolled glacial till
Minimum Foundation Dimensions	Columns: 30 inches Continuous: 18 inches
Ultimate Passive Resistance [4] **(Equivalent Fluid Pressures)**	425 pcf (granular backfill)
Ultimate Coefficient of Sliding Friction [5]	0.45 (granular material)
Minimum Embedment below Finished Grade for Frost Protection [6]	48 inches
Estimated Total Settlement from Structural Loads [2]	Less than about 1 inch
Estimated Differential Settlement [2, 7]	About 2/3 of total settlement

1. The maximum net allowable bearing pressure is the pressure in excess of the minimum surrounding overburden pressure at the footing base elevation. An appropriate factor of safety has been applied. Values assume that exterior grades are no steeper than 20% within 10 feet of structure.
2. Values provided are for maximum loads noted in **Project Description**.
3. Unsuitable or soft soils should be over-excavated and replaced per the recommendations presented in the **Earthwork** section.
4. Use of passive earth pressures require the sides of the excavation for the spread footing foundation to be nearly vertical and the concrete placed neat against these vertical faces or that the footing forms be removed and compacted Structural Fill be placed against the vertical footing face.
5. Can be used to compute sliding resistance where foundations are placed on suitable soil/materials. Should be neglected for foundations subject to net uplift conditions.
6. Embedment necessary to minimize the effects of frost and/or seasonal water content variations. For sloping ground, maintain depth below the lowest adjacent exterior grade within 5 horizontal feet of the structure.
7. Differential settlements are as measured over a span of 50 feet.

Design Parameters - Uplift Loads

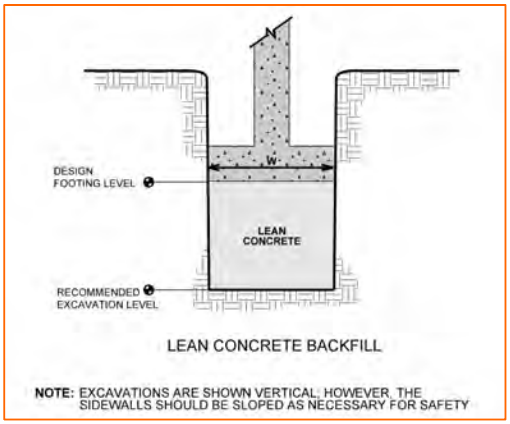
Uplift resistance of spread footings can be developed from the effective weight of the footing and the overlying soils. As illustrated on the subsequent figure, the effective weight of the soil prism defined by diagonal planes extending up from the top of the perimeter of the foundation to the ground surface at an angle, θ, of 20 degrees from the vertical can be included in uplift resistance. The maximum allowable uplift capacity should be taken as a sum of the effective weight of soil plus the dead weight of the foundation, divided by an appropriate factor of safety. A maximum total unit weight of 120 pcf should be used for the backfill. This unit weight should be reduced to 57 pcf for portions of the backfill or natural soils below the groundwater elevation.



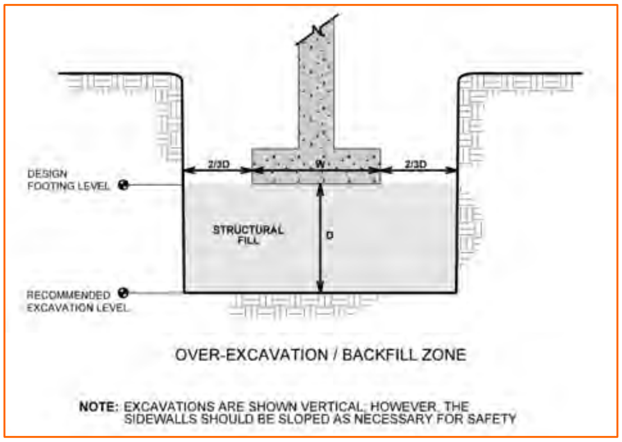
Foundation Construction Considerations

As noted in the **Earthwork** section the footing excavations should be evaluated under the direction of the Geotechnical Engineer. The base of all foundation excavations should be free of water and loose soil, prior to placing concrete. Concrete should be placed soon after excavating to reduce bearing soil disturbance. Care should be taken to prevent wetting or drying of the bearing materials during construction. Excessively wet or dry material or any loose/disturbed material in the bottom of the footing excavations should be removed/reconditioned before foundation concrete is placed.

If unsuitable bearing soils are encountered at the base of the planned footing excavation, the excavation should be extended deeper to suitable soils, and the footings could bear directly on these soils at the lower level or on lean concrete backfill placed in the excavations. This is illustrated on the sketch below.



Over-excavation for Structural Fill placement below footings should be conducted as shown below. The over-excavation should be backfilled up to the footing base elevation, with Structural Fill placed, as recommended in the **Earthwork** section.



REINFORCED CONCRETE MAT

Transformer pads and other substation components will be supported on mats constructed near the finished exterior grade. Design parameters for mats assume the requirements in the **Earthwork** section have been followed. Specific attention should be given to positive drainage away from the structure and positive drainage of the aggregate base beneath the mat.

Design Parameters

Item	Description
Mat Support [1]	Minimum 6 inches of Crushed Stone over 12 inches of NFS Fill [2, 3]

Item	Description
Allowable Bearing Pressure [4]	2,000 psf
Estimated Modulus of Subgrade Reaction [2]	200 pounds per square inch per inch (psi/in) for point loads
Ultimate Coefficient of Sliding Friction [5]	0.45 (granular material)
Estimated Total Settlement from Structural Loads	Less than 1 inch
Estimated Differential Settlement [6]	2/3 of total settlement

1. Mat slabs should be structurally independent of building footings or walls to reduce the possibility of slab cracking caused by differential movements between the slab and foundation.
2. Modulus of subgrade reaction is an estimated value based upon our experience with the subgrade condition, the requirements noted in **Earthwork**, and the mat slab support as noted in this table. It is provided for point loads. For large area loads the modulus of subgrade reaction would be lower.
3. Crushed Stone should have less than 5% fines (material passing the No. 200 sieve). Other design considerations such as cold temperatures and condensation development could warrant more extensive design provisions.
4. The presented allowable bearing pressure is controlled by the service limit state for 1 inch of settlement.
5. Can be used to compute sliding resistance where foundations are placed on suitable soil/materials. Should be neglected for foundations subject to net uplift conditions.
6. Differential settlements are as measured over a span of 50 feet.

Saw-cut control joints should be placed in the slab to help control the location and extent of cracking. For additional recommendations refer to the ACI Design Manual. Joints or cracks should be sealed with a water-proof, non-extruding compressible compound specifically recommended for wet environments.

Mat Foundation Construction Considerations

As noted in the **Earthwork** section the mat excavations should be evaluated under the direction of the Geotechnical Engineer. The base of all mat excavations should be free of water and loose soil, prior to placing concrete. Concrete should be placed soon after excavating to reduce bearing soil disturbance. Care should be taken to prevent wetting or drying of the bearing materials during construction. Excessively wet or dry material or any loose/disturbed material in the bottom of the mat excavations should be removed/reconditioned before concrete is placed. Refer to the **Earthwork** section for additional earthwork considerations.

DEEP FOUNDATIONS

Both drilled shaft and direct embed foundations are proposed for the structures requiring deep foundations. Design parameters are provided for each structure in the **Supporting Information** section. Design and construction considerations are provided in the following sections.

Axial Loading

Compressive axial loads on drilled shafts and direct embedded pole foundations are resisted by both skin friction along the shaft and by end bearing at the base of the shaft, while uplift loads are resisted by skin friction along the shaft, the weight of the shaft, and the dead load acting on the foundation itself.

Attached to this report, we have provided a table of recommended allowable skin friction and end bearing values, along with the lateral load parameters discussed below. Generally, a factor of safety of 3 was applied to end bearing, 2 to side shear (skin friction), and 2 to uplift (tension). The actual factor of safety should be chosen by the foundation designer and will depend on several factors including: the type of structure, location of the structure, intended performance of the structure, use of the structure, and applicable code requirements. In addition, the drilled shafts and/or direct embed poles should not bear in the upper 5 feet of soil.

Provided proper construction practices are followed, drilled shaft or direct embedded pole foundations designed according to the recommendations provided above are expected to experience total settlements on the order of 1 inch, less where established in rock. Please note, though, that settlement response of drilled shafts is impacted more by the quality of construction than by soil-structure interaction. Improper shaft installation could result in total and differential settlements that are significantly greater than we have estimated. In addition, if less suitable subsurface conditions are present at locations not explored as part of this investigation, it must be understood that greater settlements could be experienced.

Lateral Loading

Recommended LPile and MFAD design parameters are provided in the **Supporting Information** section. For direct embedded poles, the lateral load parameters provided assume that the annulus between the pole and the surrounding soil will be filled with lean concrete or compacted backfill to create a direct contact with the soil for lateral and uplift loadings. Use of lean concrete backfill is recommended to provide a foundation that is less subject to tilt, as it can be difficult to uniformly place and compact soil or crushed stone backfill in the excavation annulus for the full depth of the foundation.

Construction Considerations

Drilled shafts should be aligned vertically. The drilling method or combination of methods selected by the contractor should be submitted for review by the Geotechnical Engineer, prior to mobilization of drilling equipment. Temporary casing may be required to reduce the likelihood of caving. If piers extend below the groundwater table, drilling mud may also be required to stabilize the hole. Groundwater should be removed prior to placing concrete. Design and construction of drilled piers is recommended to be in accordance with ACI 336.1, Specification for the Construction of Drilled Piers.

Drilling of foundations to design depths should be possible with conventional drilling equipment using single flight power augers, except in areas with obstructions. Obstructions (i.e. boulders) may also require rock drilling equipment or may potentially be removed by shallow excavation equipment. However, if caving soils are encountered, temporary casing or drilling slurry may be required in order to advance the drilled shafts to design depth. Temporary casing should also be used whenever shafts are installed adjacent to any existing structures or improvements, to reduce the potential for ground loss and movement due to drilled shaft excavation. Casing should be installed for the full shaft depth if downhole inspection and clean out is required.

Where casing is used for drilled shaft construction, it should be withdrawn in a slow continuous manner maintaining a sufficient head of concrete to prevent infiltration of water or the creation of voids in the concrete.

Shaft bearing surfaces should be cleaned prior to concrete placement. A representative of the Geotechnical Engineer should inspect the bearing surface and shaft configuration. If the soil conditions encountered differ significantly from those presented in this report, supplemental recommendations will be required.

The drilled shaft installation process should be performed under the direction of the Geotechnical Engineer. The Geotechnical Engineer should document the shaft installation process including soil and groundwater conditions encountered, consistency with expected conditions, and details of the installed shaft.

SEISMIC CONSIDERATIONS

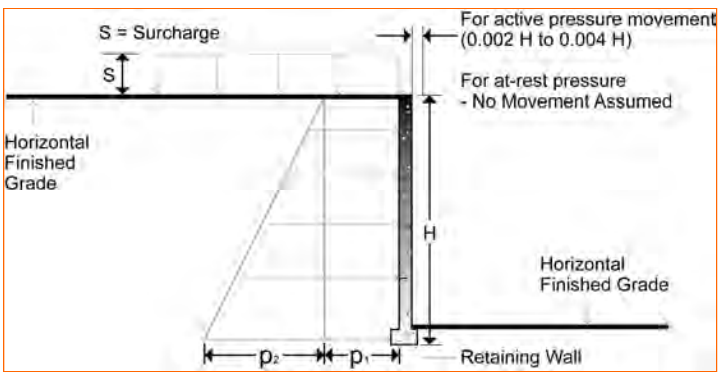
The seismic design requirements for buildings and other structures are based on Seismic Design Category. Site Classification is required to determine the Seismic Design Category for a structure. The Site Classification is based on the upper 100 feet of the site profile defined by a weighted average value of either shear wave velocity, standard penetration resistance, or undrained shear strength in accordance with Section 20.4 of ASCE 7 and the International Building Code (IBC). Based on the soil and bedrock properties encountered at the site and as described on the exploration logs and results, it is our professional opinion that the Seismic Site Classification is C.

Subsurface explorations at this site were extended to a maximum depth of 45 feet. The site properties below the boring depth to 100 feet were estimated based on our experience and knowledge of geologic conditions of the general area. Additional deeper borings or geophysical testing may be performed to confirm the conditions below the current boring depth.

LATERAL EARTH PRESSURES

Design Parameters

Structures with unbalanced backfill levels on opposite sides should be designed for earth pressures at least equal to values indicated in the following table. Earth pressures will be influenced by structural design of the walls, conditions of wall restraint, methods of construction and/or compaction and the strength of the materials being restrained. Two wall restraint conditions are shown in the diagram below. Active earth pressure is commonly used for design of free-standing cantilever retaining walls and assumes wall movement. The "at-rest" condition assumes no wall movement and is commonly used for walls restrained at the top. The recommended design lateral earth pressures do not include a factor of safety and do not provide for possible hydrostatic pressure on the walls (unless stated).



Lateral Earth Pressure Design Parameters				
Earth Pressure Condition [1]	Coefficient for Backfill Type [2]	Surcharge Pressure [3, 4, 5] p_1 (psf)	Effective Fluid Pressures (psf) [2, 4, 5]	
			Unsaturated [6]	Submerged [6]
Active (Ka)	Granular - 0.28	(0.28)S	(34)H	(79)H
At-Rest (Ko)	Granular - 0.44	(0.44)S	(53)H	(88)H
Passive (Kp)	Granular - 3.54	---	(425)H	(266)H

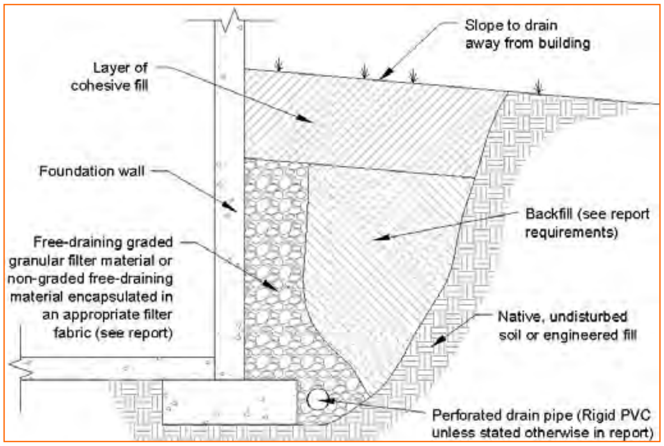
Lateral Earth Pressure Design Parameters				
Earth Pressure Condition [1]	Coefficient for Backfill Type [2]	Surcharge Pressure [3, 4, 5] p_1 (psf)	Effective Fluid Pressures (psf) [2, 4, 5]	
			Unsaturated [6]	Submerged [6]

1. For active earth pressure, wall must rotate about base, with top lateral movements 0.002 H to 0.004 H, where H is wall height. For passive earth pressure, wall must move horizontally to mobilize resistance.
2. Uniform, horizontal backfill, compacted to at least 95% of the ASTM D1557 maximum dry density, rendering a maximum unit weight of 120 pcf.
3. Uniform surcharge, where S is surcharge pressure.
4. Loading from heavy compaction equipment is not included.
5. No safety factor is included in these values.
6. To achieve "Unsaturated" conditions, follow guidelines in **Subsurface Drainage for Below-Grade Walls** below. "Submerged" conditions are recommended when drainage behind walls is not incorporated into the design.

Backfill placed against structures should consist of granular soils. For the granular values to be valid, the granular backfill must extend out and up from the base of the wall at an angle of at least 45 and 60 degrees from vertical for the active and passive cases, respectively.

Subsurface Drainage for Below-Grade Walls

A perforated rigid plastic drain line installed behind the base of walls and extends below adjacent grade is recommended to prevent hydrostatic loading on the walls. The invert of a drain line around a below-grade building area or exterior retaining wall should be placed near foundation bearing level. The drain line should be sloped to provide positive gravity drainage to daylight or to a sump pit and pump. The drain line should be surrounded by clean, free-draining granular material having less than 5% passing the No. 200 sieve, such as Non-Frost Susceptible Fill or Crushed Stone as defined in the **Fill Material Types** table of the **Earthwork** section. The free-draining aggregate should be encapsulated in a filter fabric. The granular fill should extend to within 2 feet of final grade, where it should be capped with compacted cohesive fill to reduce infiltration of surface water into the drain system.



As an alternative to free-draining granular fill, a pre-fabricated drainage structure may be used. A pre-fabricated drainage structure is a plastic drainage core or mesh which is covered with filter fabric to prevent soil intrusion, and is fastened to the wall prior to placing backfill.

FROST CONSIDERATIONS

The soils on this site are frost susceptible, and small amounts of water can affect the performance of slabs on-grade. Exterior slabs should be anticipated to heave during winter months. If frost action needs to be eliminated in critical areas, we recommend the use of Non-Frost Susceptible (NFS) Fill or structural slabs (for instance, structural stoops in front of the control building doors). Acceptable materials for NFS Fill are shown in the **Fill Materials Types** table of the **Earthwork** section. Placement of NFS Fill in large areas may not be feasible; however, the following recommendations are provided to help reduce potential frost heave:

- Provide surface drainage away from the building and slabs, and toward the site storm drainage system.
- Install drains around the perimeter of the building, stoops, and below exterior slabs, and connect them to the storm drainage system.
- Grade subgrades, so potentially perched groundwater in overlying more permeable material, such as sand or aggregate base, will drain toward a site drainage system.
- Place NFS Fill as backfill beneath slabs critical to the project.
- Place a 3 horizontal to 1 vertical (3H:1V) transition zone between NFS Fill and other soils.

As an alternative to extending NFS Fill to the full frost depth, consideration can be made to placing extruded polystyrene or cellular concrete under a buffer of at least 2 feet of NFS Fill.

GENERAL COMMENTS

Our analysis and opinions are based upon our understanding of the project, the geotechnical conditions in the area, and the data obtained from our site exploration. Natural variations will occur between exploration point locations or due to the modifying effects of construction or weather. The nature and extent of such variations may not become evident until during or after construction. Terracon should be retained as the Geotechnical Engineer, where noted in this report, to provide observation and testing services during pertinent construction phases. If variations appear, we can provide further evaluation and supplemental recommendations. If variations are noted in the absence of our observation and testing services on-site, we should be immediately notified so that we can provide evaluation and supplemental recommendations.

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

Our services and any correspondence or collaboration through this system are intended for the sole benefit and exclusive use of our client for specific application to the project discussed and are accomplished in accordance with generally accepted geotechnical engineering practices with no third-party beneficiaries intended. Any third-party access to services or correspondence is solely for information purposes to support the services provided by Terracon to our client. Reliance upon the services and any work product is limited to our client, and is not intended for third parties. Any use or reliance of the provided information by third parties is done solely at their own risk. No warranties, either express or implied, are intended or made.

Site characteristics as provided are for design purposes and not to estimate excavation cost. Any use of our report in that regard is done at the sole risk of the excavating cost estimator as there may be variations on the site that are not apparent in the data that could significantly impact excavation cost. Any parties charged with estimating excavation costs should seek their own site characterization for specific purposes to obtain the specific level of detail necessary for costing. Site safety, and cost estimating including, excavation support, and dewatering requirements/design are the responsibility of others. If changes in the nature, design, or location of the project are planned, our conclusions and recommendations shall not be considered valid unless we review the changes and either verify or modify our conclusions in writing.

FIGURES

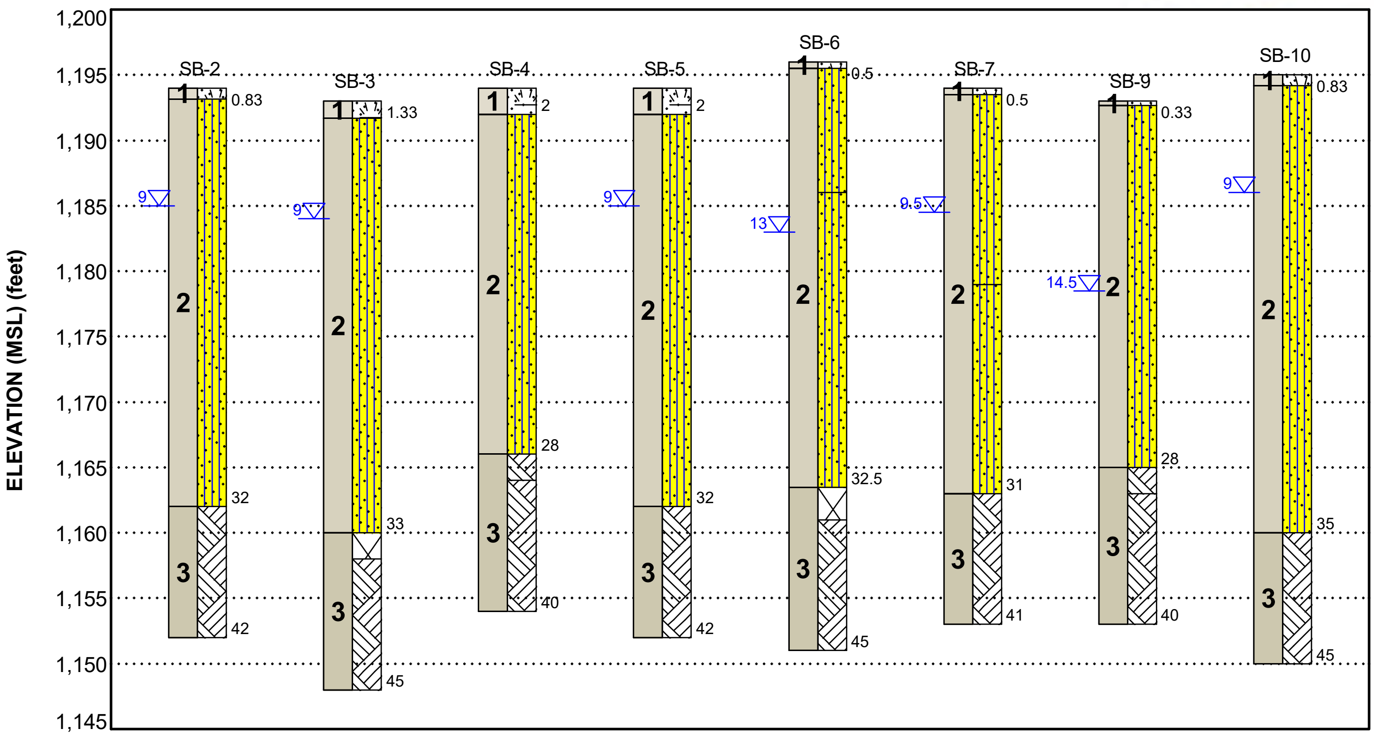
Contents:

GeoModel

GEOMODEL

Chinook Solar Substation ■ Fitzwilliam, NH
Terracon Project No. J1205036

Terracon GeoReport



This is not a cross section. This is intended to display the Geotechnical Model only. See individual logs for more detailed conditions.

Model Layer	Layer Name	General Description
1	**Topsoil**	3 to 24 inches of root mat / topsoil, dark brown
2	**Glacial Till**	Silty Sand (SM), trace gravel, occasional boulders and cobbles, grayish brown to gray, medium dense to very dense
3	**Bedrock**	Granite, strong, slightly to moderately weathered, gray to olive

LEGEND

Topsoil

Silty Sand

Bedrock

Weathered Rock

First Water Observation

Groundwater levels are temporal. The levels shown are representative of the date and time of our exploration. Significant changes are possible over time.
Water levels shown are as measured during and/or after drilling. In some cases, boring advancement methods mask the presence/absence of groundwater. See individual logs for details.

NOTES:
Layering shown on this figure has been developed by the geotechnical engineer for purposes of modeling the subsurface conditions as required for the subsequent geotechnical engineering for this project.
Numbers adjacent to soil column indicate depth below ground surface.

ATTACHMENTS

EXPLORATION AND TESTING PROCEDURES

Field Exploration

Boring Nos.	Boring Depth (feet)	Location
SB-2 through SB-7, SB-9, SB-10	40 to 45	Proposed substation and switchyard
B-6 and B-7 [1]	45 to 50	Proposed substation and switchyard

1. Borings B-6 and B-7 were completed in October 2018 during the site investigation for the greater Chinook solar project.

Boring Layout and Elevations: Unless otherwise noted, Terracon personnel provided the boring layout. Coordinates were obtained with a handheld GPS unit (estimated horizontal accuracy of about ±10 feet) and approximate elevations were obtained by interpolation from the Chinook Solar 115/34.5kV Substation Boring Plan, prepared by Burns & McDonnell, dated May 15, 2020. If elevations and a more precise boring layout are desired, we recommend borings be surveyed following completion of fieldwork.

Subsurface Exploration Procedures: We advanced the borings with a track-mounted rotary drill rig using continuous flight augers and cased drilling methods, as necessary, depending on soil conditions. Four samples were obtained in the upper 10 feet of each boring and at intervals of 5 feet thereafter, until bedrock was encountered, at which point we cored up to 10 feet of rock. In the split-barrel sampling procedure, a standard 2-inch outer diameter split-barrel sampling spoon was driven into the ground by a 140-pound automatic hammer falling a distance of 30 inches. The number of blows required to advance the sampling spoon the last 12 inches of a normal 18-inch penetration is recorded as the Standard Penetration Test (SPT) resistance value. The SPT resistance values, also referred to as N-values, are indicated on the boring logs at the test depths. We observed and recorded groundwater levels during drilling and sampling. For safety purposes, all borings were backfilled with auger cuttings after their completion.

The sampling depths, penetration distances, and other sampling information was recorded on the field boring logs. The samples were placed in appropriate containers and taken to our soil laboratory for testing and classification by a Geotechnical Engineer. Our exploration team prepared field boring logs as part of the drilling operations. These field logs included visual classifications of the materials encountered during drilling and our interpretation of the subsurface conditions between samples. Final boring logs were prepared from the field logs. The final boring logs represent the Geotechnical Engineer's interpretation of the field logs and include modifications based on observations and tests of the samples in our laboratory.

Field Electrical Resistivity: Soil electrical resistivity data was obtained in accordance with ASTM G57 Standard Test Method for Field Measurement of Soil Resistivity Using the Wenner Four-

Electrode Method. For testing, we performed two mutually perpendicular lines within the substation area using electrode "a" spacings of 0.5,1, 2, 5, 10, 20, 40, 80, 120, and 200 feet.

Laboratory Testing

The project engineer reviewed the field data and assigned laboratory tests to understand the engineering properties of the various soil and rock strata, as necessary, for this project. Procedural standards noted below are for reference to methodology in general. In some cases, variations to methods were applied because of local practice or professional judgment. Standards noted below include reference to other, related standards. Such references are not necessarily applicable to describe the specific test performed.

- ASTM D2216 Standard Test Methods for Laboratory Determination of Water (Moisture) Content of Soil and Rock by Mass
- ASTM D422 Standard Test Method for Particle-Size Analysis of Soils
- ASTM D7012 Standard Test Methods for Compressive Strength and Elastic Moduli of Intact Rock Core Specimens under Varying States of Stress and Temperatures
- AWWA 4500 H pH Value in Water by Potentiometry Using a Standard Hydrogen Electrode
- ASTM C1580 Standard Test Method for Water-Soluble Sulfate in Soil
- ASTM D512 Standard Test Methods for Chloride Ion in Water
- ASTM G57 Standard Test Method for Field Measurement of Soil Resistivity Using the Wenner Four-Electrode Method

The laboratory testing program often included examination of soil samples by an engineer. Based on the material's texture and plasticity, we described and classified the soil samples in accordance with the Unified Soil Classification System.

Rock classification was conducted using locally accepted practices for engineering purposes; petrographic analysis may reveal other rock types. Rock core samples typically provide an improved specimen for this classification. Boring log rock classification was determined using the Description of Rock Properties.

SITE LOCATION AND EXPLORATION PLANS

Contents:

Site Location
Exploration Plan

Note: All attachments are one page unless noted above.

SITE LOCATION

Chinook Solar Substation ■ Fitzwilliam, New Hampshire
August 28, 2020 ■ Terracon Project No. J1205036

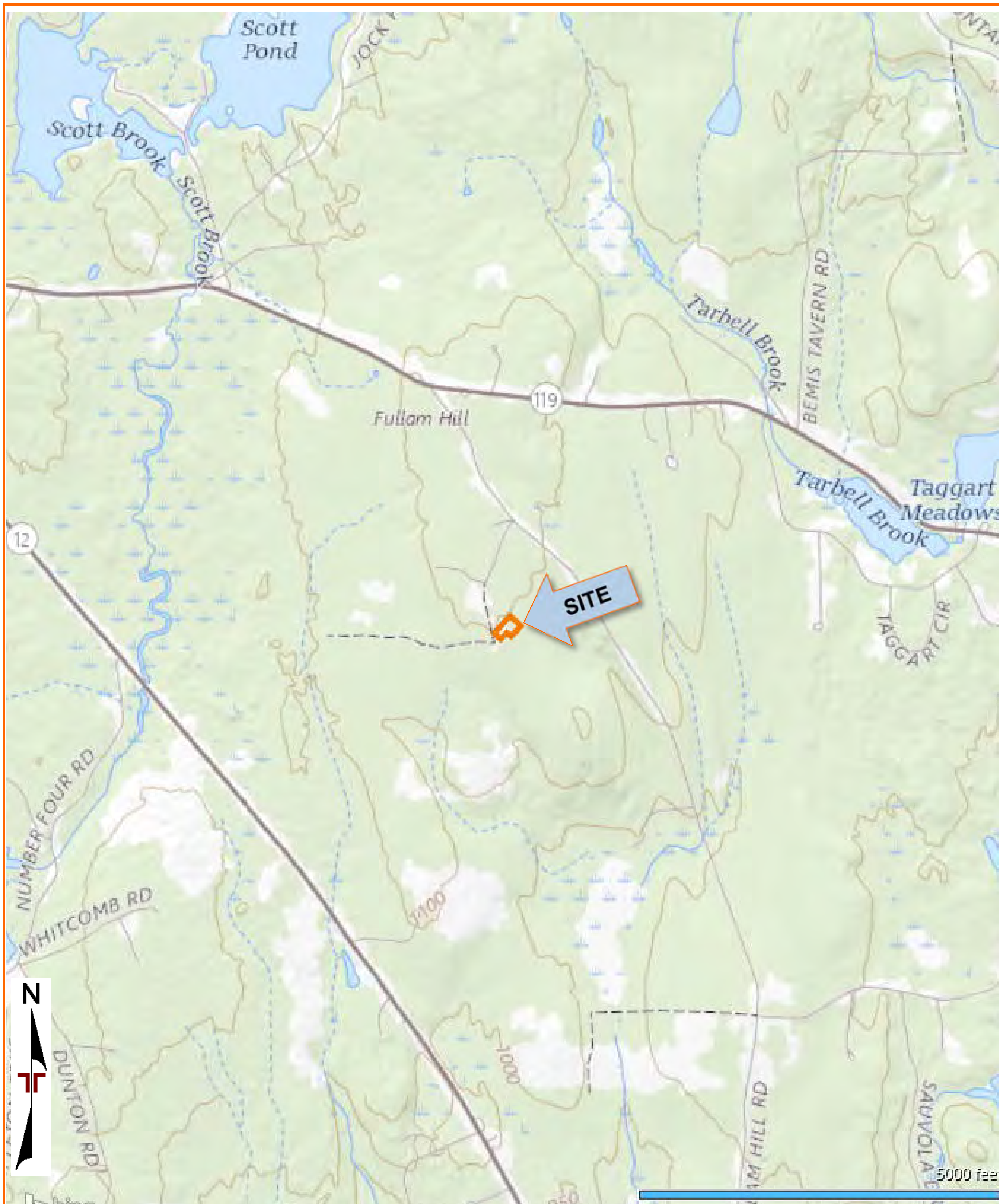


DIAGRAM IS FOR GENERAL LOCATION ONLY, AND IS NOT INTENDED FOR CONSTRUCTION PURPOSES

MAP COURTESY OF THE U.S. GEOLOGICAL SURVEY

EXPLORATION PLAN

Chinook Solar Substation ■ Fitzwilliam, New Hampshire
August 28, 2020 ■ Terracon Project No. J1205036

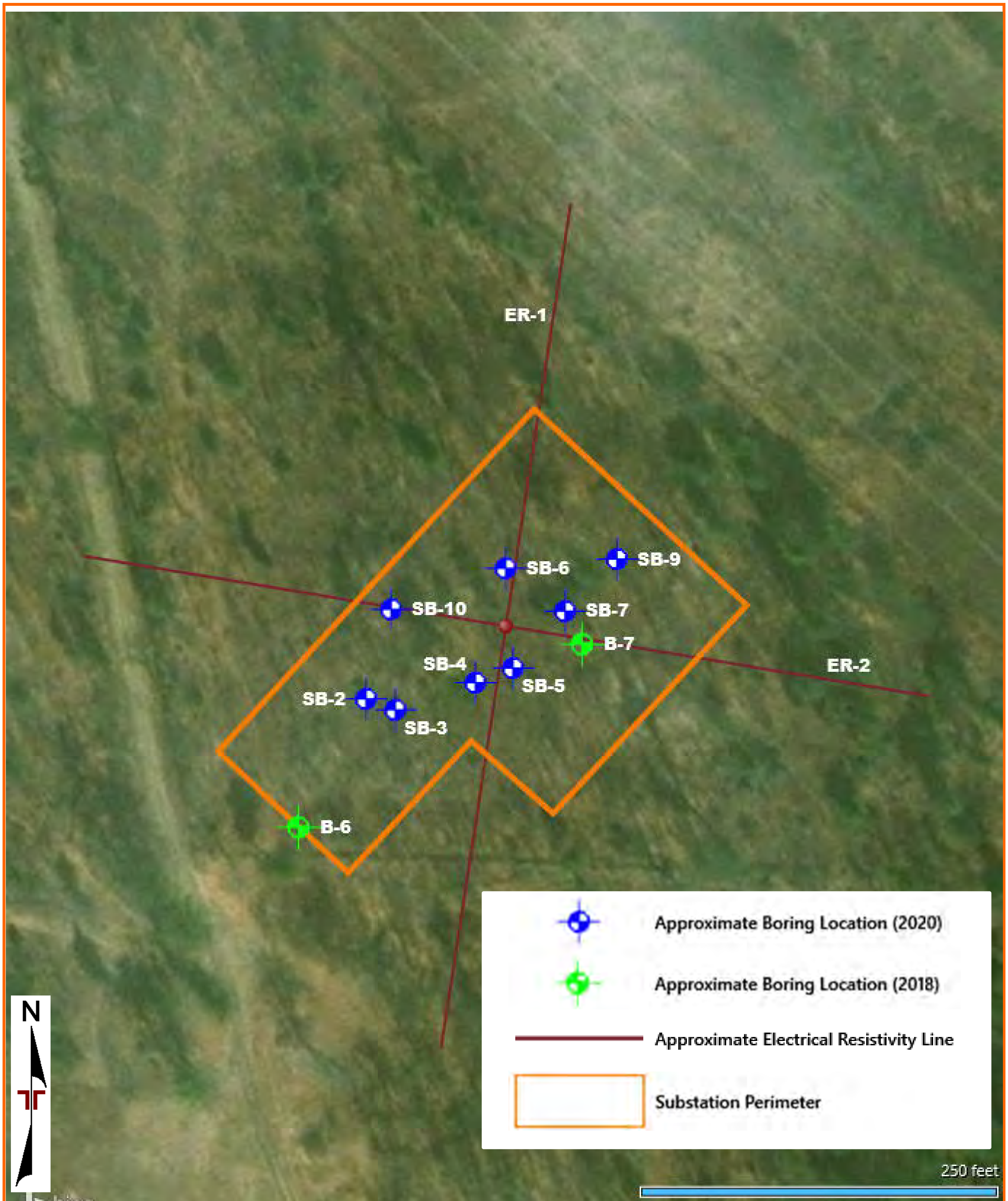


DIAGRAM IS FOR GENERAL LOCATION ONLY, AND IS NOT INTENDED FOR CONSTRUCTION PURPOSES

MAP PROVIDED BY MICROSOFT BING MAPS

EXPLORATION RESULTS

Contents:

2020 Boring Logs (SB-2 through SB-7, SB-9, SB-10)
2018 Boring Logs (B-6 and B-7)
Field Electrical Resistivity
Grain Size Distribution (2 pages)
Compressive Strength of Rock (2 pages)
Corrosivity

Note: All attachments are one page unless noted above.

BORING LOG NO. SB-2

PROJECT: Chinook Solar Substation

CLIENT: NextEra Energy Resources LLC
Juno Beach, FL

SITE: Fullam Hill Road
Fitzwilliam, NH

LOCATION See Exploration Plan

Latitude: 42.7676° Longitude: -72.1011°

Approximate Surface Elev.: 1194 (Ft.) +/-

MODEL LAYER	DEPTH	DESCRIPTION	ELEVATION (Ft.)	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	RECOVERY (In.)	FIELD TEST RESULTS	RQD (%)	Core Rate (min/ft)
1	0.8	10 inches of root mat / topsoil, dark brown	1193+/-			X	17	3-6-8-10 N=14		
2		**SILTY SAND (SM)**, trace gravel, grayish brown to gray, medium dense to very dense				X	20	10-14-25-20 N=39		
				5		X	7	8-6-6-6 N=12		
					▽	X	12	6-8-11-9 N=19		
		Cobbles at 9 feet		10		X	3	11-16-29-25 N=45		
				15		X	16	10-22-22-25 N=44		
				20		X	11	25-28-50/4"		
				25						

Stratification lines are approximate. In-situ, the transition may be gradual.
Samples obtained using a 2" O.D. split spoon sampler

Hammer Type: Automatic

Advancement Method:
3-1/4-inch solid stem augers to 15 feet, then drive and wash methods with 4 inch casing to 32 feet followed by rock coring

Abandonment Method:
Boring backfilled with cement-bentonite grout upon completion.

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Notes:

WATER LEVEL OBSERVATIONS

▽ *9 feet while drilling*

Terracon
77 Sundial Ave, Ste 401W
Manchester, NH

Boring Started: 06-30-2020	Boring Completed: 06-30-2020
Drill Rig: CME-850X	Driller: P. Michaud
Project No.: J1205036	

THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GEO SMART LOG-NO WELL J1205036 CHINOOK SOLAR SUB.GPJ TERRACON_DATATEMPLATE.GDT 8/11/20

BORING LOG NO. SB-2

PROJECT: Chinook Solar Substation

CLIENT: NextEra Energy Resources LLC
Juno Beach, FL

SITE: Fullam Hill Road
Fitzwilliam, NH

LOCATION See Exploration Plan

Latitude: 42.7676° Longitude: -72.1011°

Approximate Surface Elev.: 1194 (Ft.) +/-

MODEL LAYER	GRAPHIC LOG	DEPTH / Description	ELEVATION (Ft.)	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	RECOVERY (In.)	FIELD TEST RESULTS	RQD (%)	Core Rate (min/ft)
2		**SILTY SAND (SM)**, trace gravel, grayish brown to gray, medium dense to very dense *(continued)*					17	18-32-35-37 N=67		
				30			7	23-50/1"		
		32.0	1162+/-							
3		**GRANITE**, strong, slightly weathered, nonfoliated, medium to coarse grained, slightly fractured, moderate-angle, gray		35			57		95	2 1.5 2 2.25 2
		Similar, olive past 38.3 feet		40			60		98	1.75 2 2 2 2
		42.0	1152+/-							
		Boring Terminated at 42 Feet								

Stratification lines are approximate. In-situ, the transition may be gradual.
Samples obtained using a 2" O.D. split spoon sampler

Hammer Type: Automatic

Advancement Method:
3-1/4-inch solid stem augers to 15 feet, then drive and wash methods with 4 inch casing to 32 feet followed by rock coring

Abandonment Method:
Boring backfilled with cement-bentonite grout upon completion.

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Notes:

WATER LEVEL OBSERVATIONS

9 feet while drilling

Terracon
77 Sundial Ave, Ste 401W
Manchester, NH

Boring Started: 06-30-2020	Boring Completed: 06-30-2020
Drill Rig: CME-850X	Driller: P. Michaud
Project No.: J1205036	

BORING LOG NO. SB-3

PROJECT: Chinook Solar Substation

CLIENT: NextEra Energy Resources LLC
Juno Beach, FL

SITE: Fullam Hill Road
Fitzwilliam, NH

LOCATION See Exploration Plan

Latitude: 42.7676° Longitude: -72.101°

Approximate Surface Elev.: 1193 (Ft.) +/-

MODEL LAYER	GRAPHIC LOG	DEPTH	ELEVATION (Ft.)	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	RECOVERY (In.)	FIELD TEST RESULTS	RQD (%)	Core Rate (min/ft)
1		16 inches of root mat / topsoil, dark brown				X	16	1-3-5-10 N=8		
		1.3	1191.5+/-							
2		**SILTY SAND (SM)**, trace gravel, grayish brown to dark gray, medium dense to very dense				X	10	15-15-12-11 N=27		
				5		X	23	5-5-6-6 N=11		
						X	17	6-7-7-7 N=14		
					▽					
				10		X	15	10-11-14-14 N=25		
				15		X	18	11-11-13-30 N=24		
				20		X	10	38-50/5"		
				25						

Stratification lines are approximate. In-situ, the transition may be gradual.
Samples obtained using a 2" O.D. split spoon sampler

Hammer Type: Automatic

Advancement Method:
3-1/4-inch solid stem augers to 15 feet, then drive and wash methods with 4 inch casing to 35 feet followed by rock coring

Abandonment Method:
Boring backfilled with cement-bentonite grout upon completion.

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Notes:

WATER LEVEL OBSERVATIONS

▽ *9 feet while drilling*

Terracon
77 Sundial Ave, Ste 401W
Manchester, NH

Boring Started: 06-29-2020	Boring Completed: 06-29-2020
Drill Rig: CME-850X	Driller: P. Michaud
Project No.: J1205036	

BORING LOG NO. SB-3

PROJECT: Chinook Solar Substation

CLIENT: NextEra Energy Resources LLC
Juno Beach, FL

SITE: Fullam Hill Road
Fitzwilliam, NH

LOCATION See Exploration Plan

Latitude: 42.7676° Longitude: -72.101°

Approximate Surface Elev.: 1193 (Ft.) +/-

MODEL LAYER	DEPTH	DESCRIPTION	ELEVATION (Ft.)	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	RECOVERY (In.)	FIELD TEST RESULTS	RQD (%)	Core Rate (min/ft)
2		**SILTY SAND (SM)**, trace gravel, grayish brown to dark gray, medium dense to very dense *(continued)*				Split spoon	15	25-27-28-40 N=55		
		Cobbles from 29.2 to 30.2 feet		30		Split spoon	10	19-50/5"		
	33.0		1160+/-							
3		**WEATHERED ROCK** Roller bit resistance at 33 feet, started coring rock at 35 feet								
	35.0		1158+/-	35						
		GRANITE, strong, moderately weathered, nonfoliated, medium to coarse grained, highly fractured, open, moderate to high-angle, olive				Rock core	45		40	2 2 3 2 2.75
		Similar, slightly weathered		40		Rock core	30		18	2.25 1.75 2 2 2
	45.0		1148+/-	45						

Boring Terminated at 45 Feet

Stratification lines are approximate. In-situ, the transition may be gradual.
Samples obtained using a 2" O.D. split spoon sampler

Hammer Type: Automatic

Advancement Method:
3-1/4-inch solid stem augers to 15 feet, then drive and wash methods with 4 inch casing to 35 feet followed by rock coring

Abandonment Method:
Boring backfilled with cement-bentonite grout upon completion.

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Notes:

WATER LEVEL OBSERVATIONS

▽ *9 feet while drilling*

Terracon
77 Sundial Ave, Ste 401W
Manchester, NH

Boring Started: 06-29-2020	Boring Completed: 06-29-2020
Drill Rig: CME-850X	Driller: P. Michaud
Project No.: J1205036	

BORING LOG NO. SB-4

PROJECT: Chinook Solar Substation

CLIENT: NextEra Energy Resources LLC
Juno Beach, FL

SITE: Fullam Hill Road
Fitzwilliam, NH

LOCATION See Exploration Plan

Latitude: 42.7676° Longitude: -72.1008°

Approximate Surface Elev.: 1194 (Ft.) +/-

MODEL LAYER	DEPTH	DESCRIPTION	ELEVATION (Ft.)	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	RECOVERY (In.)	FIELD TEST RESULTS	RQD (%)	Core Rate (min/ft)
1	2.0	24 inches of root mat / topsoil, dark brown	1192+/-			X	8	3-2-3-2 N=5		
2		**SILTY SAND (SM)**, trace gravel, grayish brown, medium dense to very dense				X	12	7-7-20-20 N=27		
				5		X	14	7-7-6-6 N=13		
						X	22	6-8-7-9 N=15		
		Boulder at 10 feet		10		X	8	10-50/5"		
				15		X	24	7-7-9-11 N=16		
		Cobbles at 20 feet		20		X	18	22-30-33-32 N=63		
				25						

Stratification lines are approximate. In-situ, the transition may be gradual.
Samples obtained using a 2" O.D. split spoon sampler

Hammer Type: Automatic

Advancement Method:
2-1/4-inch I.D. hollow stem augers to 10 feet, then drive and wash methods with 4 inch casing to 30 feet followed by rock coring

Abandonment Method:
Boring backfilled with cement-bentonite grout upon completion.

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Notes:

WATER LEVEL OBSERVATIONS

Groundwater not observed

Terracon
77 Sundial Ave, Ste 401W
Manchester, NH

Boring Started: 06-26-2020	Boring Completed: 06-26-2020
Drill Rig: CME-850X	Driller: P. Michaud
Project No.: J1205036	

BORING LOG NO. SB-4

PROJECT: Chinook Solar Substation

CLIENT: NextEra Energy Resources LLC
Juno Beach, FL

SITE: Fullam Hill Road
Fitzwilliam, NH

LOCATION See Exploration Plan

Latitude: 42.7676° Longitude: -72.1008°

Approximate Surface Elev.: 1194 (Ft.) +/-

MODEL LAYER	GRAPHIC LOG	DEPTH	DESCRIPTION	ELEVATION (Ft.)	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	RECOVERY (In.)	FIELD TEST RESULTS	RQD (%)	Core Rate (min/ft)
2			**SILTY SAND (SM)**, trace gravel, grayish brown, medium dense to very dense *(continued)*				Split spoon		16-14-16-17 N=30		
		28.0		1166+/-							
3			Roller bit resistance at 28 feet, started coring rock at 30 feet								
		30.0		1164+/-	30						
			GRANITE, strong, slightly weathered, nonfoliated, medium to coarse grained, moderately fractured, open, horizontal and high-angle, light gray				Rock core	60		90	3 3 3 3 3
			Similar, horizontal fractures		35		Rock core	46		76	3 3 3 3 3
		40.0		1154+/-	40						
			Boring Terminated at 40 Feet								

Stratification lines are approximate. In-situ, the transition may be gradual.
Samples obtained using a 2" O.D. split spoon sampler

Hammer Type: Automatic

Advancement Method:
2-1/4-inch I.D. hollow stem augers to 10 feet, then drive and wash methods with 4 inch casing to 30 feet followed by rock coring

Abandonment Method:
Boring backfilled with cement-bentonite grout upon completion.

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Notes:

WATER LEVEL OBSERVATIONS
Groundwater not observed

Terracon
77 Sundial Ave, Ste 401W
Manchester, NH

Boring Started: 06-26-2020	Boring Completed: 06-26-2020
Drill Rig: CME-850X	Driller: P. Michaud
Project No.: J1205036	

BORING LOG NO. SB-5

PROJECT: Chinook Solar Substation

CLIENT: NextEra Energy Resources LLC
Juno Beach, FL

SITE: Fullam Hill Road
Fitzwilliam, NH

LOCATION See Exploration Plan

Latitude: 42.7677° Longitude: -72.1007°

Approximate Surface Elev.: 1194 (Ft.) +/-

MODEL LAYER	DEPTH	DESCRIPTION	ELEVATION (Ft.)
1	2.0	24 inches of root mat / topsoil, dark brown	1192+/-
2		**SILTY SAND (SM)**, trace gravel, grayish brown, medium dense to very dense Cobbles at 10 feet Boulder at 20 feet	

DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	RECOVERY (In.)	FIELD TEST RESULTS	RQD (%)	Core Rate (min/ft)
0–2		Split spoon	3	3-4-6-11 N=10		
2–4		Split spoon	6	35-30-25-18 N=55		
5–7		Split spoon	22	4-4-4-12 N=8		
7–9	▽ (9 ft)	Split spoon	18	12-20-16-12 N=36		
10–12		Split spoon	18	9-14-19-23 N=33		
15–17		Split spoon	20	11-37-25-25 N=62		
20		Split spoon	2	50/4"		

Stratification lines are approximate. In-situ, the transition may be gradual.
Samples obtained using a 2" O.D. split spoon sampler

Hammer Type: Automatic

Advancement Method:
2-1/4-inch I.D. hollow stem augers to 15 feet, then drive and wash methods with 4 inch casing to 32 feet followed by rock coring

Abandonment Method:
Boring backfilled with cement-bentonite grout upon completion.

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Notes:

WATER LEVEL OBSERVATIONS

▽ *9 feet while drilling*

Terracon
77 Sundial Ave, Ste 401W
Manchester, NH

Boring Started: 06-26-2020
Boring Completed: 06-26-2020
Drill Rig: CME-850X
Driller: P. Michaud
Project No.: J1205036

BORING LOG NO. SB-5

PROJECT: Chinook Solar Substation

CLIENT: NextEra Energy Resources LLC Juno Beach, FL

SITE: Fullam Hill Road Fitzwilliam, NH

LOCATION See Exploration Plan

Latitude: 42.7677° Longitude: -72.1007°

Approximate Surface Elev.: 1194 (Ft.) +/-

MODEL LAYER	GRAPHIC LOG	DEPTH / DESCRIPTION	ELEVATION (Ft.)	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	RECOVERY (In.)	FIELD TEST RESULTS	RQD (%)	Core Rate (min/ft)
2		**SILTY SAND (SM)**, trace gravel, grayish brown, medium dense to very dense *(continued)*						12-14-16-24 N=30		
				30			0	50/0"		
		32.0	1162+/-							
3		**GRANITE**, strong, slightly weathered, nonfoliated, medium to coarse grained, moderately fractured, open, horizontal, light gray to gray		35			56		76	4 4 4 4 4
		Similar, gray to olive		40			37		53	4 4 4 4 4
		42.0	1152+/-							
		Boring Terminated at 42 Feet								

Stratification lines are approximate. In-situ, the transition may be gradual.
Samples obtained using a 2" O.D. split spoon sampler

Hammer Type: Automatic

Advancement Method:
2-1/4-inch I.D. hollow stem augers to 15 feet, then drive and wash methods with 4 inch casing to 32 feet followed by rock coring

Abandonment Method:
Boring backfilled with cement-bentonite grout upon completion.

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Notes:

WATER LEVEL OBSERVATIONS

9 feet while drilling

Terracon
77 Sundial Ave, Ste 401W
Manchester, NH

Boring Started: 06-26-2020	Boring Completed: 06-26-2020
Drill Rig: CME-850X	Driller: P. Michaud
Project No.: J1205036	

BORING LOG NO. SB-6

PROJECT: Chinook Solar Substation

CLIENT: NextEra Energy Resources LLC
Juno Beach, FL

SITE: Fullam Hill Road
Fitzwilliam, NH

LOCATION See Exploration Plan

Latitude: 42.7679° Longitude: -72.1007°

Approximate Surface Elev.: 1196 (Ft.) +/-

MODEL LAYER	DEPTH	DESCRIPTION	ELEVATION (Ft.)	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	RECOVERY (In.)	FIELD TEST RESULTS	RQD (%)	Core Rate (min/ft)
1	0.5	6 inches of root mat / topsoil, dark brown	1195.5+/-							
2		**SILTY SAND (SM)**, trace gravel, grayish brown to gray, loose to medium dense				X	15	4-3-3-5 N=6		
						X	13	7-20-20-25 N=40		
				5		X	20	6-5-4-6 N=9		
						X	15	8-12-16-20 N=28		
	10.0		1186+/-	10						
2		**SILTY SAND (SM)**, trace gravel, grayish brown to gray, dense to very dense Cobbles at 11 feet				X	16	9-13-25/0"		
					▽					
				15		X	11	8-50/5"		
				20		X	15	25-25-23-31 N=48		
		Cobbles at 24 feet		25						

Stratification lines are approximate. In-situ, the transition may be gradual.
Samples obtained using a 2" O.D. split spoon sampler

Hammer Type: Automatic

Advancement Method:
3-1/4-inch solid stem augers to 15 feet, then drive and wash methods with 4 inch casing to 35 feet followed by rock coring

Abandonment Method:
Boring backfilled with cement-bentonite grout upon completion.

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Notes:

WATER LEVEL OBSERVATIONS

▽ *13 feet while drilling*

Terracon
77 Sundial Ave, Ste 401W
Manchester, NH

Boring Started: 07-01-2020	Boring Completed: 07-01-2020
Drill Rig: CME-850X	Driller: P. Michaud
Project No.: J1205036	

BORING LOG NO. SB-6

PROJECT: Chinook Solar Substation

CLIENT: NextEra Energy Resources LLC
Juno Beach, FL

SITE: Fullam Hill Road
Fitzwilliam, NH

LOCATION See Exploration Plan

Latitude: 42.7679° Longitude: -72.1007°

Approximate Surface Elev.: 1196 (Ft.) +/-

MODEL LAYER	DEPTH	Description	ELEVATION (Ft.)
2		**SILTY SAND (SM)**, trace gravel, grayish brown to gray, dense to very dense *(continued)*	
	32.5		1163.5+/-
3		**WEATHERED ROCK** Roller bit resistance at 32.5 feet, started coring rock at 35 feet	
	35.0		1161+/-
3		**GRANITE**, strong, moderately weathered, nonfoliated, medium to coarse grained, highly fractured, open, high-angle, olive to gray Similar, slightly weathered, slightly fractured, gray	
	45.0		1151+/-
		Boring Terminated at 45 Feet	

DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	RECOVERY (In.)	FIELD TEST RESULTS	RQD (%)	Core Rate (min/ft)
~28		Split spoon	12	20-20-31-31 N=51		
30		Split spoon	4	19-43-50/1"		
35–40		Rock core	30		45	1 2 2 1.75 2
40–45		Rock core	60		90	1.25 2 1.5 1.5 1.5

Stratification lines are approximate. In-situ, the transition may be gradual.
Samples obtained using a 2" O.D. split spoon sampler

Hammer Type: Automatic

Advancement Method:
3-1/4-inch solid stem augers to 15 feet, then drive and wash methods with 4 inch casing to 35 feet followed by rock coring

Abandonment Method:
Boring backfilled with cement-bentonite grout upon completion.

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Notes:

WATER LEVEL OBSERVATIONS

13 feet while drilling

Terracon
77 Sundial Ave, Ste 401W
Manchester, NH

Boring Started: 07-01-2020	Boring Completed: 07-01-2020
Drill Rig: CME-850X	Driller: P. Michaud
Project No.: J1205036	

BORING LOG NO. SB-7

PROJECT: Chinook Solar Substation

CLIENT: NextEra Energy Resources LLC
Juno Beach, FL

SITE: Fullam Hill Road
Fitzwilliam, NH

LOCATION See Exploration Plan

Latitude: 42.7678° Longitude: -72.1005°

Approximate Surface Elev.: 1194 (Ft.) +/-

MODEL LAYER	DEPTH	DESCRIPTION	ELEVATION (Ft.)	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	RECOVERY (In.)	FIELD TEST RESULTS	RQD (%)	Core Rate (min/ft)
1	0.5	6 inches of root mat / topsoil, dark brown	1193.5+/-							
2		**SILTY SAND (SM)**, trace gravel, grayish brown to gray, medium dense				X	14	2-4-4-9 N=8		
		Cobbles from 2 to 4 feet								
				5		X	20	7-6-6-6 N=12		
						X	15	8-10-15-15 N=25		
					▽					
				10		X	4	9-10-14-15 N=24		
	15.0		1179+/-							
		SILTY SAND (SM), trace gravel, grayish brown to gray, dense to very dense		15		X	15	15-25-50 N=75		
		Cobbles from 18 to 19 feet								
				20		X	19	14-15-24-24 N=39		
				25						

Stratification lines are approximate. In-situ, the transition may be gradual.
Samples obtained using a 2" O.D. split spoon sampler

Hammer Type: Automatic

Advancement Method:
3-1/4-inch solid stem augers to 15 feet, then drive and wash methods with 4 inch casing to 31 feet followed by rock coring

Abandonment Method:
Boring backfilled with cement-bentonite grout upon completion.

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Notes:

WATER LEVEL OBSERVATIONS

▽ *9.5 feet while drilling*

Terracon
77 Sundial Ave, Ste 401W
Manchester, NH

Boring Started: 07-01-2020	Boring Completed: 07-01-2020
Drill Rig: CME-850X	Driller: P. Michaud
Project No.: J1205036	

BORING LOG NO. SB-7

PROJECT: Chinook Solar Substation

CLIENT: NextEra Energy Resources LLC
Juno Beach, FL

SITE: Fullam Hill Road
Fitzwilliam, NH

LOCATION See Exploration Plan

Latitude: 42.7678° Longitude: -72.1005°

Approximate Surface Elev.: 1194 (Ft.) +/-

MODEL LAYER	GRAPHIC LOG	DEPTH	DESCRIPTION	ELEVATION (Ft.)	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	RECOVERY (In.)	FIELD TEST RESULTS	RQD (%)	Core Rate (min/ft)
2		31.0	**SILTY SAND (SM)**, trace gravel, grayish brown to gray, dense to very dense *(continued)*	1163+/-	30		Split spoon	14	16-22-26-50/5" N=48		
3			**GRANITE**, strong, moderately weathered, nonfoliated, medium to coarse grained, open, low-angle, gray		35		Rock core	60		95	1.75, 2, 2, 2.5, 2
		41.0	Similar	1153+/-	40		Rock core	59		85	2, 1.75, 2.5, 2, 2
			Boring Terminated at 41 Feet								

Stratification lines are approximate. In-situ, the transition may be gradual.
Samples obtained using a 2" O.D. split spoon sampler

Hammer Type: Automatic

Advancement Method:
3-1/4-inch solid stem augers to 15 feet, then drive and wash methods with 4 inch casing to 31 feet followed by rock coring

Abandonment Method:
Boring backfilled with cement-bentonite grout upon completion.

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Notes:

WATER LEVEL OBSERVATIONS

▽ *9.5 feet while drilling*

Terracon
77 Sundial Ave, Ste 401W
Manchester, NH

Boring Started: 07-01-2020	Boring Completed: 07-01-2020
Drill Rig: CME-850X	Driller: P. Michaud
Project No.: J1205036	

BORING LOG NO. SB-9

PROJECT: Chinook Solar Substation

CLIENT: NextEra Energy Resources LLC
Juno Beach, FL

SITE: Fullam Hill Road
Fitzwilliam, NH

LOCATION See Exploration Plan

Latitude: 42.7679° Longitude: -72.1004°

Approximate Surface Elev.: 1193 (Ft.) +/-

MODEL LAYER	DEPTH	DESCRIPTION	ELEVATION (Ft.)	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	RECOVERY (In.)	FIELD TEST RESULTS	RQD (%)	Core Rate (min/ft)
1	0.3	4 inches of root mat / topsoil, dark brown	1192.5+/-							
2		**SILTY SAND (SM)**, trace gravel, grayish brown to gray, medium dense to dense				X	14	2-2-2-4 N=4		
		No recovery					0	50/1"		
				5		X	14	9-7-7-7 N=14		
						X	15	10-10-9-10 N=19		
				10		X	24	9-11-30-36 N=41		
					▽					
		Similar, trace cobbles, very dense		15		X	22	22-37-33-32 N=70		
				20		X	21	13-15-24-24 N=39		
				25						

Stratification lines are approximate. In-situ, the transition may be gradual.
Samples obtained using a 2" O.D. split spoon sampler

Hammer Type: Automatic

Advancement Method:
3-1/4-inch solid stem augers to 15 feet, then drive and wash methods with 4 inch casing to 30 feet followed by rock coring

Abandonment Method:
Boring backfilled with cement-bentonite grout upon completion.

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Notes:

WATER LEVEL OBSERVATIONS

▽ *14.5 feet while drilling*

Terracon
77 Sundial Ave, Ste 401W
Manchester, NH

Boring Started: 06-30-2020	Boring Completed: 06-30-2020
Drill Rig: CME-850X	Driller: P. Michaud
Project No.: J1205036	

BORING LOG NO. SB-9

PROJECT: Chinook Solar Substation

CLIENT: NextEra Energy Resources LLC
Juno Beach, FL

SITE: Fullam Hill Road
Fitzwilliam, NH

LOCATION See Exploration Plan

Latitude: 42.7679° Longitude: -72.1004°

Approximate Surface Elev.: 1193 (Ft.) +/-

MODEL LAYER	GRAPHIC LOG	DEPTH	DESCRIPTION	ELEVATION (Ft.)	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	RECOVERY (In.)	FIELD TEST RESULTS	RQD (%)	Core Rate (min/ft)
2			**SILTY SAND (SM)**, trace gravel, grayish brown to gray, medium dense to dense *(continued)*					2	60-50/1"		
		28.0		1165+/-							
3			Roller bit resistance at 28, started coring rock at 30 feet								
		30.0		1163+/-	30						
			GRANITE, strong, moderately weathered, nonfoliated, medium to coarse grained, moderately fractured, open, moderate-angle, olive to gray					54		63	1.75 1.25 1.5 1.25 1
			Similar, gray, vertical joint at 39.5 feet		35			57		71	1.25 1.75 2 2 1.75
		40.0		1153+/-	40						
			Boring Terminated at 40 Feet								

Stratification lines are approximate. In-situ, the transition may be gradual.

Samples obtained using a 2" O.D. split spoon sampler

Hammer Type: Automatic

Advancement Method:
3-1/4-inch solid stem augers to 15 feet, then drive and wash methods with 4 inch casing to 30 feet followed by rock coring

Abandonment Method:
Boring backfilled with cement-bentonite grout upon completion.

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Notes:

WATER LEVEL OBSERVATIONS

14.5 feet while drilling

Terracon
77 Sundial Ave, Ste 401W
Manchester, NH

Boring Started: 06-30-2020	Boring Completed: 06-30-2020
Drill Rig: CME-850X	Driller: P. Michaud
Project No.: J1205036	

BORING LOG NO. SB-10

PROJECT: Chinook Solar Substation

CLIENT: NextEra Energy Resources LLC
Juno Beach, FL

SITE: Fullam Hill Road
Fitzwilliam, NH

LOCATION See Exploration Plan

Latitude: 42.7678° Longitude: -72.101°

Approximate Surface Elev.: 1195 (Ft.) +/-

MODEL LAYER	DEPTH	Description	ELEVATION (Ft.)
1	0.8	10 inches of root mat / topsoil, dark brown	1194+/-
2		**SILTY SAND (SM)**, trace gravel, grayish brown to gray	
		Cobbles at 13 feet	

DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	RECOVERY (In.)	FIELD TEST RESULTS	RQD (%)	Core Rate (min/ft)
0–2		X	11	1-2-3-4 N=5		
2–2.8		X	10	15-50/4"		
5–7		X	20	4-5-4-5 N=9		
7–9	▽ (9 ft)	X	20	4-8-6-6 N=14		
10–12		X	24	5-9-13-15 N=22		
15–17		X	20	8-12-15-20 N=27		
20–22		X	15	20-30-33-28 N=63		

Stratification lines are approximate. In-situ, the transition may be gradual.
Samples obtained using a 2" O.D. split spoon sampler

Hammer Type: Automatic

Advancement Method:
3-1/4-inch solid stem augers to 15 feet, then drive and wash methods with 4 inch casing to 35 feet followed by rock coring

Abandonment Method:
Boring backfilled with cement-bentonite grout upon completion.

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Notes:

WATER LEVEL OBSERVATIONS

▽ *9 feet while drilling*

Terracon
77 Sundial Ave, Ste 401W
Manchester, NH

Boring Started: 06-29-2020	Boring Completed: 06-29-2020
Drill Rig: CME-850X	Driller: P. Michaud
Project No.: J1205036	

BORING LOG NO. SB-10

PROJECT: Chinook Solar Substation

CLIENT: NextEra Energy Resources LLC
Juno Beach, FL

SITE: Fullam Hill Road
Fitzwilliam, NH

LOCATION See Exploration Plan

Latitude: 42.7678° Longitude: -72.101°

Approximate Surface Elev.: 1195 (Ft.) +/-

MODEL LAYER	DEPTH	DESCRIPTION	ELEVATION (Ft.)	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	RECOVERY (In.)	FIELD TEST RESULTS	RQD (%)	Core Rate (min/ft)
2		**SILTY SAND (SM)**, trace gravel, grayish brown to gray *(continued)*					16	17-23-24-26 N=47		
				30			16	20-21-22-25 N=43		
	35.0		1160+/-	35						
3		**GRANITE**, strong, moderately weathered, nonfoliated, medium to coarse grained, moderately fractured, open, moderate-angle, light gray					60		76	1.5 1.5 1.75 1.5 2
		Similar, slightly weathered		40			60		96	1.5 1.75 1.75 1.75 1.75
	45.0		1150+/-	45						
		Boring Terminated at 45 Feet								

Stratification lines are approximate. In-situ, the transition may be gradual.
Samples obtained using a 2" O.D. split spoon sampler

Hammer Type: Automatic

Advancement Method:
3-1/4-inch solid stem augers to 15 feet, then drive and wash methods with 4 inch casing to 35 feet followed by rock coring

Abandonment Method:
Boring backfilled with cement-bentonite grout upon completion.

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Notes:

WATER LEVEL OBSERVATIONS

9 feet while drilling

Terracon
77 Sundial Ave, Ste 401W
Manchester, NH

Boring Started: 06-29-2020	Boring Completed: 06-29-2020
Drill Rig: CME-850X	Driller: P. Michaud
Project No.: J1205036	

BORING LOG NO. B-6

PROJECT: NextEra Chinook Solar	CLIENT: NextEra Energy Resources LLC Juno Beach, FL
SITE: 264 Fullam Hill Rd Fitzwilliam, NH	

LOCATION See Exploration Plan

Latitude: 42.7674° Longitude: -72.1012°

Approximate Surface Elev.: 1194 (Ft.) +/-

MODEL LAYER	DEPTH	MATERIAL DESCRIPTION	ELEVATION (Ft.)	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	RECOVERY (In.)	FIELD TEST RESULTS	RQD (%)	#200 Sieve	WATER CONTENT (%)
	0.4	5-inches of topsoil, roots, leaf litter, dark brown	1193.5+/-								
2		**SILTY SAND (SM)**, olive brown, medium dense to dense		0–2		X	12	1-3-3-5 N=6			
				2–4		X	18	17-18-17-14 N=35		34.2	13
				5	▽						
				5–7		X	12	46-18-10-9 N=28			
	10.0	**SILTY SAND (SM)**, trace gravel, olive brown, dense to very dense	1184+/-	10–12		X	17	14-15-18-25 N=33			
		Color change to gray at 15 feet		15–17		X	12	14-15-18-25 N=33			
				20–22		X	15	14-30-24-50 N=54			
				25–27		X	21	48-28- 50/5"			

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:

Abandonment Method:

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Notes:

WATER LEVEL OBSERVATIONS

▽ *5' While drilling*

Terracon
77 Sundial Ave, Ste 401W
Manchester, NH

Boring Started: 10-03-2018	Boring Completed: 10-03-2018
Drill Rig: CME 550	Driller: Terracon/R. Brown
Project No.: J1175115	

BORING LOG NO. B-6

PROJECT: NextEra Chinook Solar

CLIENT: NextEra Energy Resources LLC Juno Beach, FL

SITE: 264 Fullam Hill Rd Fitzwilliam, NH

LOCATION See Exploration Plan

Latitude: 42.7674° Longitude: -72.1012°

Approximate Surface Elev.: 1194 (Ft.) +/-

MODEL LAYER	DEPTH	DESCRIPTION	ELEVATION (Ft.)	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	RECOVERY (In.)	FIELD TEST RESULTS	RQD (%)	#200 Sieve	WATER CONTENT (%)
2		**SILTY SAND (SM)**, trace gravel, olive brown, dense to very dense *(continued)* No recovery in the 30-32 foot sample. Boulder encountered at 34 feet. Advanced roller bit to 35 feet		30		X	18	21-38-35-50/5"			
	35.0		1159+/-	35							
3		Cored through a 2.5 foot boulder from 35 to 37.5 feet. Resume split spoon sampling at 40 feet.		35		X	0	28-39-50/4"			
	40.0		1154+/-	40							
2		**SILTY SAND WITH GRAVEL (SM)**, gray, very dense Advanced roller bit to 45 feet		40		X	12	30-38-50/4"			
	46.0		1148+/-	45							
3		Cored through boulders from 46 to 50 feet. No recovery in core barrel.									
	50.0		1144+/-	50							
		Boring Terminated at 50 Feet									

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:

Abandonment Method:

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Notes:

WATER LEVEL OBSERVATIONS

5' While drilling

Terracon

77 Sundial Ave, Ste 401W
Manchester, NH

Boring Started: 10-03-2018	Boring Completed: 10-03-2018
Drill Rig: CME 550	Driller: Terracon/R. Brown
Project No.: J1175115	

BORING LOG NO. B-7

PROJECT: NextEra Chinook Solar

CLIENT: NextEra Energy Resources LLC
Juno Beach, FL

SITE: 264 Fullam Hill Rd
Fitzwilliam, NH

LOCATION See Exploration Plan

Latitude: 42.7677° Longitude: -72.1005°

Approximate Surface Elev.: 1191 (Ft.) +/-

MODEL LAYER	DEPTH	DESCRIPTION	ELEVATION (Ft.)	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	RECOVERY (In.)	FIELD TEST RESULTS	RQD (%)	#200 Sieve	WATER CONTENT (%)
	0.8	10-inches of topsoil, roots, leaf litter, dark brown	1190+/-			18	1-1-1-12 N=2			
2		**SILTY SAND (SM)**, olive brown, very loose to very dense				13	22-15-13-10 N=28		49.1	15
				5	▽	5	5-10-8-11 N=18			
		Trace gravel at 10 feet		10		20	17-21-25-29 N=46			
		Color change to gray at 15 feet		15		20	15-22-25-29 N=47			
				20		10	11-23-25-22 N=48			
				25		10	10-26-40-40 N=66			

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:

Abandonment Method:

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Notes:

WATER LEVEL OBSERVATIONS

▽ *5' While drilling*

Terracon
77 Sundial Ave, Ste 401W
Manchester, NH

Boring Started: 10-03-2018	Boring Completed: 10-04-2018
Drill Rig: CME 550	Driller: Terracon/R. Brown
Project No.: J1175115	

BORING LOG NO. B-7

PROJECT: NextEra Chinook Solar

CLIENT: NextEra Energy Resources LLC
Juno Beach, FL

SITE: 264 Fullam Hill Rd
Fitzwilliam, NH

LOCATION See Exploration Plan

Latitude: 42.7677° Longitude: -72.1005°

Approximate Surface Elev.: 1191 (Ft.) +/-

MODEL LAYER	GRAPHIC LOG	DEPTH / DESCRIPTION	ELEVATION (Ft.)	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	RECOVERY (In.)	FIELD TEST RESULTS	RQD (%)	#200 Sieve	WATER CONTENT (%)
2		**SILTY SAND (SM)**, olive brown, very loose to very dense *(continued)* No recovery, roller bit from 30 to 35 feet. Advanced NX rock core from 35 to 45 feet.		30			0	50/0"			
		35.0	1156+/-	35							
4		Run 1 Hard, fresh, light gray, medium grained GRANITE, with horizontal to moderately dipping, widely spaced, rough, slightly open joints					52		80		
		Run 2 Similar		40			60		96		
		45.0	1146+/-	45							

Boring Terminated at 45 Feet

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:

Abandonment Method:

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Notes:

WATER LEVEL OBSERVATIONS

5' While drilling

Terracon
77 Sundial Ave, Ste 401W
Manchester, NH

Boring Started: 10-03-2018	Boring Completed: 10-04-2018
Drill Rig: CME 550	Driller: Terracon/R. Brown
Project No.: J1175115	

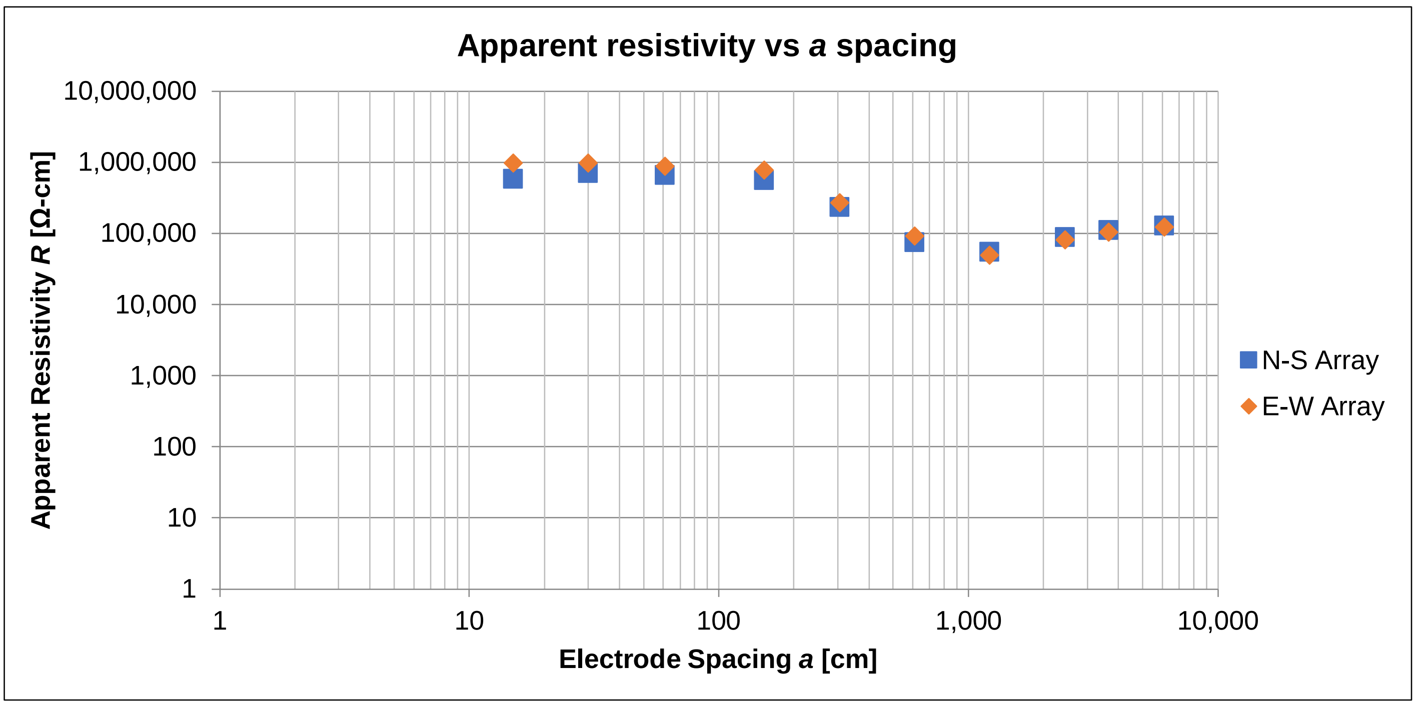
FIELD ELECTRICAL RESISTIVITY TEST DATA
Chinook Solar Substation ■ Fitzwilliam, New Hampshire
August 28, 2020 ■ Terracon Project No. J1205036

Terracon GeoReport

Array Loc.	Test arrays centered at approximate latitude and longitude of 42.7677°, -72.1007°		
Instrument	MingSting R1	**Weather**	70-80° F, Sunny
Serial #	S1804279	**Ground Cond.**	Wooded conditions, relatively dry
Cal. Check	6/25/2021	**Tested By**	M. Gullison
Test Date	8/20/2020	**Method**	Venner 4-pin (ASTM G57-06 (2012); IEEE 81-2012
Notes & Conflicts	Both resistivity lines crossed several stone walls found in the woods. The 'a' spacings were limited to 200 feet due to the tranmission line located to the northeast.		

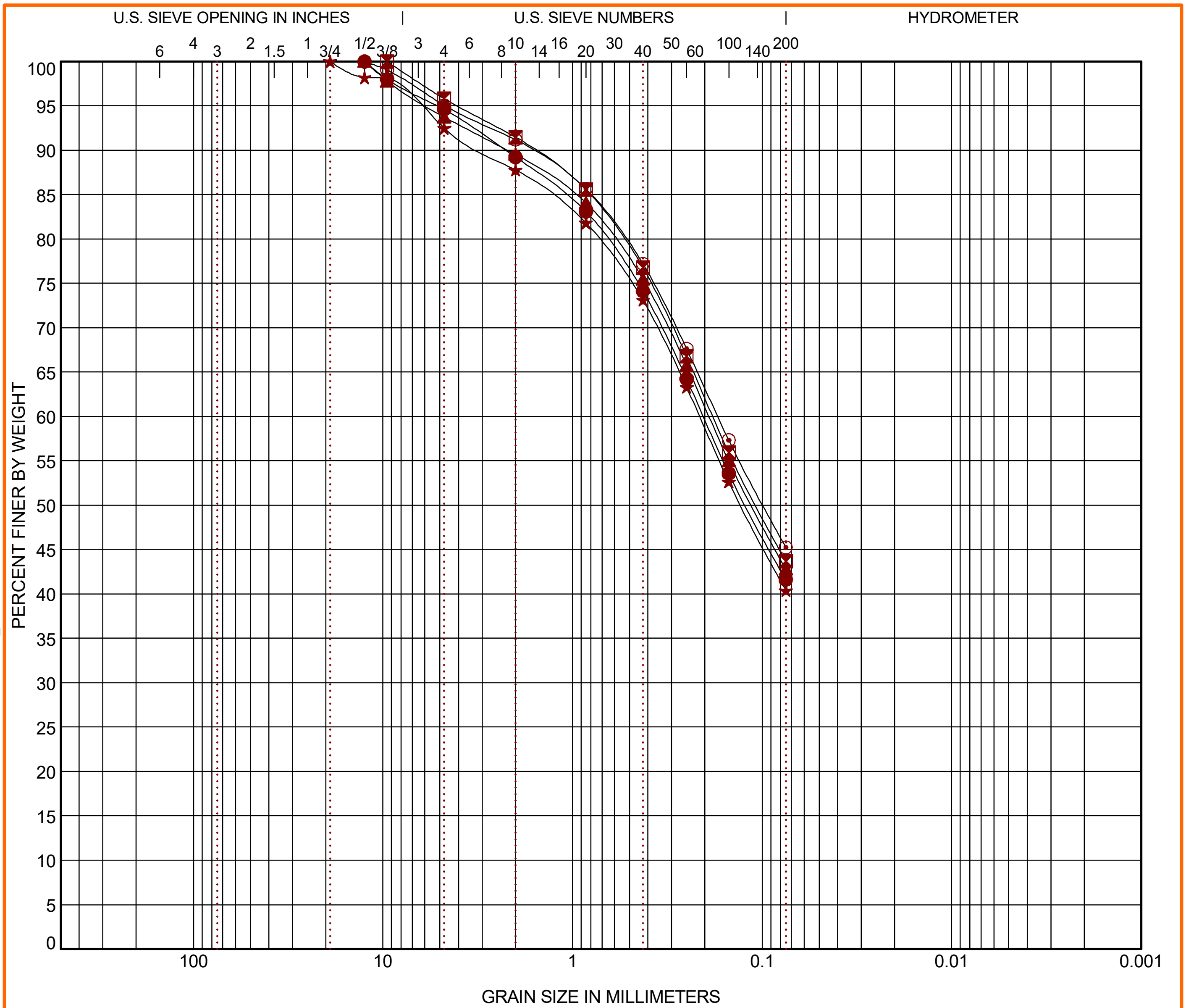
Apparent resistivity ρ is calculated as : $\rho = \dfrac{4\pi a R}{1 + \dfrac{2a}{\sqrt{a^2 + 4b^2}} - \dfrac{a}{\sqrt{a^2 + b^2}}}$

Electrode Spacing *a*		**Electrode Depth *b***		**N-S Test (ER-1)**		**E-W Test (ER-2)**	
[feet]	[centimeters]	[inches]	[centimeters]	Measured Resistance *R* Ω	Apparent Resistivity ρ [Ω-cm]	Measured Resistance *R* Ω	Apparent Resistivity ρ [Ω-cm]
0.5	15	6	15	3,739	593,650	6,310	1,001,810
1	30	6	15	2,907	721,100	4,046	1,003,630
2	61	6	15	1,590	668,200	2,160	908,080
5	152	6	15	591	574,200	817	793,500
10	305	12	30	122	238,280	142	276,660
20	610	12	30	19.9	76,590	24.1	92,930
40	1,219	12	30	7.25	55,560	6.52	49,960
80	2,438	12	30	5.90	90,380	5.46	83,610
120	3,658	12	30	4.88	112,140	4.67	107,260
200	6,096	12	30	3.43	131,220	3.24	124,250



GRAIN SIZE DISTRIBUTION

ASTM D422 / ASTM C136



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

Boring ID	Depth	USCS Classification	WC (%)	LL	PL	PI	Cc	Cu
● SB-2	7 - 9	Silty Sand (SM)	12.2					
⊠ SB-3	10 - 12	Silty Sand (SM)	9.9					
▲ SB-3	15 - 17	Silty Sand (SM)	9.7					
★ SB-4	5 - 7	Silty Sand (SM)	11.5					
⊙ SB-5	7 - 9	Silty Sand (SM)	10.4					

Boring ID	Depth	D_{100}	D_{60}	D_{30}	D_{10}	%Cobbles	%Gravel	%Sand	%Silt	%Fines	%Clay
● SB-2	7 - 9	12.5	0.204			0.0	5.4	53.0		41.6	
⊠ SB-3	10 - 12	9.5	0.182			0.0	4.2	52.1		43.7	
▲ SB-3	15 - 17	12.5	0.19			0.0	6.3	50.9		42.8	
★ SB-4	5 - 7	19	0.213			0.0	7.5	52.1		40.4	
⊙ SB-5	7 - 9	12.5	0.171			0.0	4.9	49.8		45.3	

PROJECT: Chinook Solar Substation

PROJECT NUMBER: J1205036

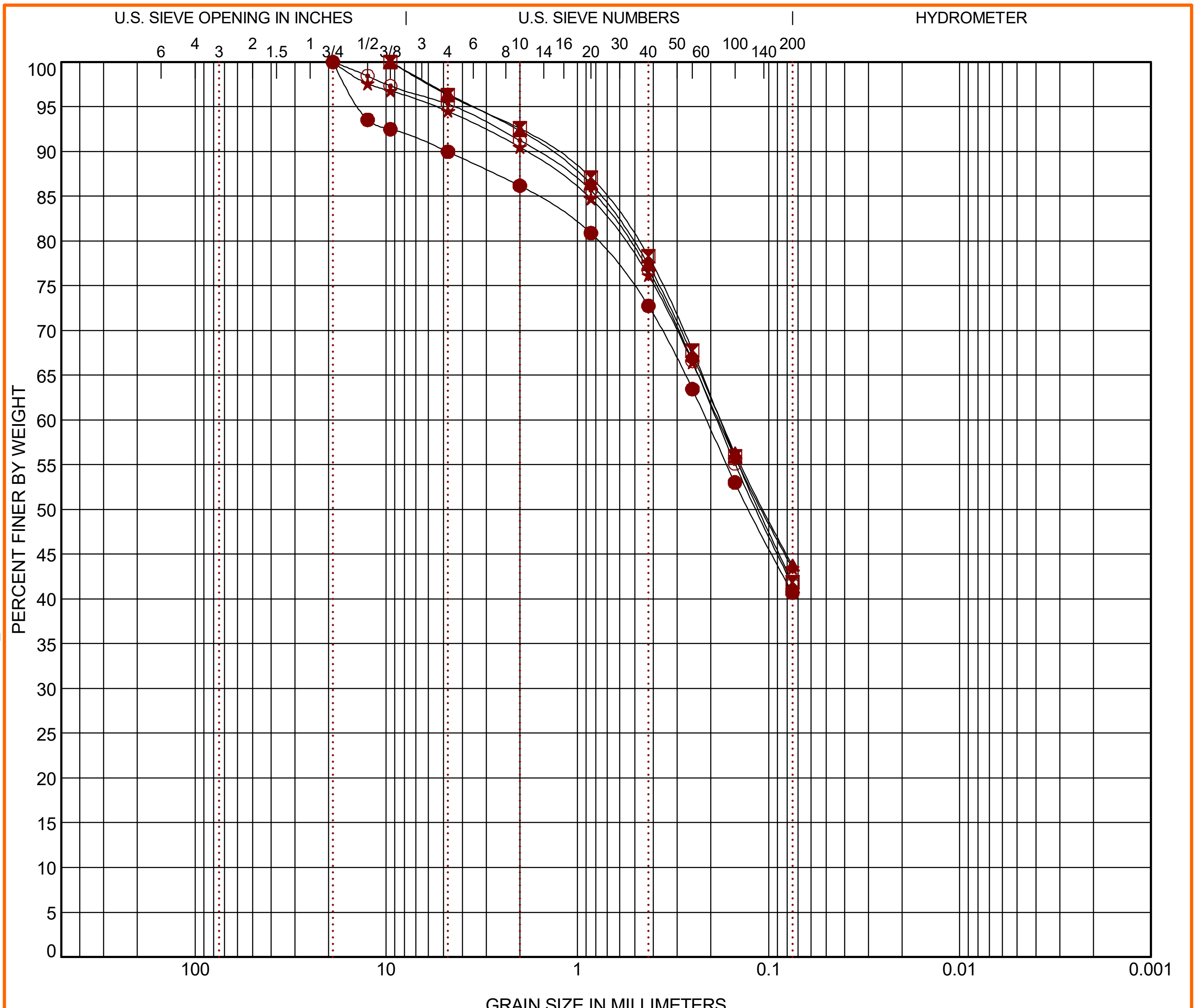
SITE: Fullam Hill Road
Fitzwilliam, NH

Terracon
77 Sundial Ave, Ste 401W
Manchester, NH

CLIENT: NextEra Energy Resources LLC
Juno Beach, FL

GRAIN SIZE DISTRIBUTION

ASTM D422 / ASTM C136



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	Boring ID	Depth	USCS Classification	WC (%)	LL	PL	PI	Cc	Cu
●	SB-6	20 - 22	Silty Sand (SM)	9.3					
⊠	SB-7	15 - 16.5	Silty Sand (SM)	9.7					
▲	SB-9	5 - 7	Silty Sand (SM)	11.6					
★	SB-9	10 - 12	Silty Sand (SM)	8.5					
⊙	SB-10	20 - 22	Silty Sand (SM)	8.5					

	Boring ID	Depth	D_{100}	D_{60}	D_{30}	D_{10}	%Cobbles	%Gravel	%Sand	%Silt	%Fines	%Clay
●	SB-6	20 - 22	19	0.211			0.0	10.0	49.3		40.7	
⊠	SB-7	15 - 16.5	9.5	0.179			0.0	3.7	54.4		41.9	
▲	SB-9	5 - 7	9.5	0.178			0.0	3.5	52.7		43.8	
★	SB-9	10 - 12	19	0.183			0.0	5.5	51.1		43.4	
⊙	SB-10	20 - 22	19	0.186			0.0	4.7	53.7		41.6	

PROJECT: Chinook Solar Substation

SITE: Fullam Hill Road
Fitzwilliam, NH

Terracon
77 Sundial Ave, Ste 401W
Manchester, NH

PROJECT NUMBER: J1205036

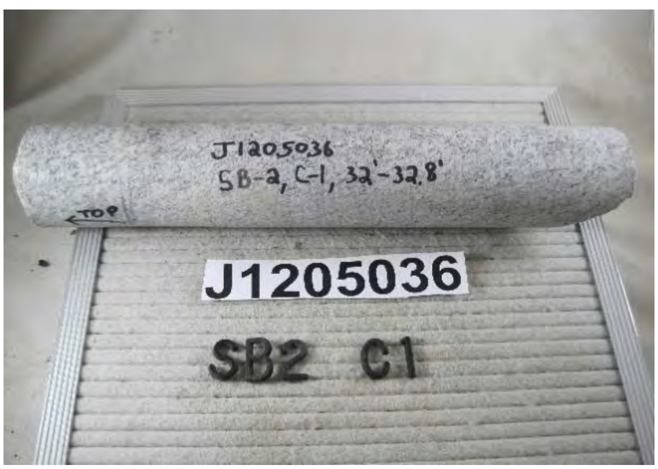
CLIENT: NextEra Energy Resources LLC
Juno Beach, FL

ASTM D7012 (Method C) Standard Test Method for Compressive Strength and Elastic Moduli of Intact Rock Core Specimens

Boring No.:	SB-2	Lithology:	Granite
Sample No.:	C-1	Moisture Content:	As received
Sample Depth:	32'-32.8'	Lab Temperature:	68 F
Sampling Date:	6/30/20	Loading Rate:	80 psi/s
		Time to Failure:	11 min

Diameter:	1.94 in	Maximum Axial Load at Failure:	54,730 lb
Length:	4.47 in	Compressive Strength:	18,515 psi
L/D:	2.3 -	Compressive Strength:	127.66 MPa
End Area:	2.96 in^2	Unit Weight:	169.22 pcf

Before the Test



After the Test

The specimen preparation does not meet the requirement for ASTM D4543 and the results may differ from the specimen that meets the requirement of ASTM D4543.

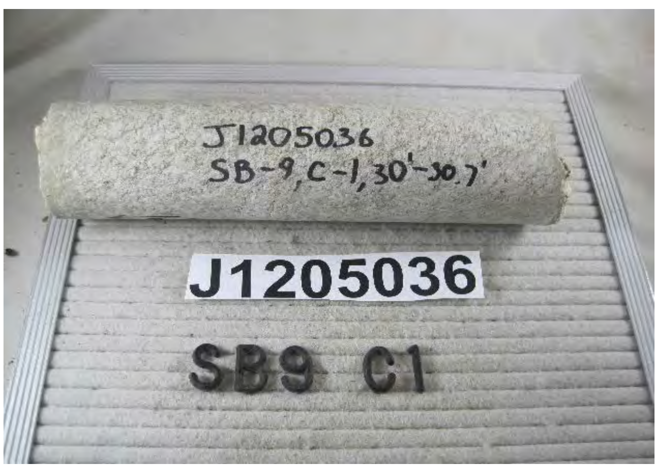
Project:	Chinook Solar S/S	Terracon	Technician:	A. Mendez
Project No.	J1205036		Test Date:	8/7/2020
Location:	Fitzwilliam, NH		Reviewed By :	M. Gullison
Client :	NextEra Energy	77 Sundial Ave., Suite 401 W	Review Date :	8/11/2020
		Manchester, New Hampshire		

ASTM D7012 (Method C) Standard Test Method for Compressive Strength and Elastic Moduli of Intact Rock Core Specimens

Boring No.:	SB-9	Lithology:	Granite
Sample No.:	C-1	Moisture Content:	As received
Sample Depth:	30'-30.7'	Lab Temperature:	68 F
Sampling Date:	6/30/20	Loading Rate:	140 psi/s
		Time to Failure:	3 min

Diameter:	1.943 in	Maximum Axial Load at Failure:	24,880 lb
Length:	4.43 in	Compressive Strength:	8,391 psi
L/D:	2.3 -	Compressive Strength:	57.85 MPa
End Area:	2.97 in^2	Unit Weight:	166.98 pcf

Before the Test



After the Test

The specimen preparation does not meet the requirement for ASTM D4543 and the results may differ from the specimen that meets the requirement of ASTM D4543.

Project:	Chinook Solar S/S	Terracon	Technician:	A. Mendez
Project No.	J1205036		Test Date:	8/7/2020
Location:	Fitzwilliam, NH		Reviewed By :	M. Gullison
Client :	NextEra Energy	77 Sundial Ave., Suite 401 W	Review Date :	8/11/2020
		Manchester, New Hampshire		

750 Pilot Road, Suite F
Las Vegas, Nevada 89119
(702) 597-9393

Client

NextEra Energy Resources LLC
Juno Beach, FL

Project

Chinook Solar Substation

Sample Submitted By: Terracon (J1) **Date Received:** 7/15/2020 **Lab No.: 20-0784**

Results of Corrosion Analysis

Sample Number	--	--
Sample Location	SB-2	SB-9
Sample Depth (ft.)	1.0-4.0	1.0-4.0
pH Analysis, ASTM G 51	5.39	5.89
Water Soluble Sulfate (SO4), ASTM C 1580 (ppm)	28	35
Sulfides, AWWA 4500-S D, (mg/kg)	Nil	Nil
Chlorides, ASTM D 512, (ppm)	25	40
Red-Ox, ASTM G 200, (mV)	+697	+695
Total Salts, AWWA 2540, (mg/kg)	81	81
Resistivity (Saturated), ASTM G 187, (ohm-cm)	33500	46230

Analyzed By: Trisha Campo

Trisha Campo
Chemist

SUPPORTING INFORMATION

Contents:

General Notes
Unified Soil Classification System
Description of Rock Properties
MFAD/LPile Parameter Table

Note: All attachments are one page unless noted above.

GENERAL NOTES

DESCRIPTION OF SYMBOLS AND ABBREVIATIONS

Chinook Solar Substation ■ Fitzwilliam, NH

Terracon Project No. J1205036

SAMPLING	WATER LEVEL	FIELD TESTS
Rock Core Grab Sample Standard Penetration Test	**Water Initially Encountered** **Water Level After a Specified Period of Time** **Water Level After a Specified Period of Time** **Cave In Encountered** Water levels indicated on the soil boring logs are the levels measured in the borehole at the times indicated. Groundwater level variations will occur over time. In low permeability soils, accurate determination of groundwater levels is not possible with short term water level observations.	**N** Standard Penetration Test Resistance (Blows/Ft.) **(HP)** Hand Penetrometer **(T)** Torvane **(DCP)** Dynamic Cone Penetrometer **UC** Unconfined Compressive Strength **(PID)** Photo-Ionization Detector **(OVA)** Organic Vapor Analyzer

DESCRIPTIVE SOIL CLASSIFICATION

Soil classification as noted on the soil boring logs is based Unified Soil Classification System. Where sufficient laboratory data exist to classify the soils consistent with ASTM D2487 "Classification of Soils for Engineering Purposes" this procedure is used. ASTM D2488 "Description and Identification of Soils (Visual-Manual Procedure)" is also used to classify the soils, particularly where insufficient laboratory data exist to classify the soils in accordance with ASTM D2487. In addition to USCS classification, coarse grained soils are classified on the basis of their in-place relative density, and fine-grained soils are classified on the basis of their consistency. See "Strength Terms" table below for details. The ASTM standards noted above are for reference to methodology in general. In some cases, variations to methods are applied as a result of local practice or professional judgment.

LOCATION AND ELEVATION NOTES

Exploration point locations as shown on the Exploration Plan and as noted on the soil boring logs in the form of Latitude and Longitude are approximate. See Exploration and Testing Procedures in the report for the methods used to locate the exploration points for this project. Surface elevation data annotated with +/- indicates that no actual topographical survey was conducted to confirm the surface elevation. Instead, the surface elevation was approximately determined from topographic maps of the area.

STRENGTH TERMS

RELATIVE DENSITY OF COARSE-GRAINED SOILS (More than 50% retained on No. 200 sieve.) Density determined by Standard Penetration Resistance		**CONSISTENCY OF FINE-GRAINED SOILS** (50% or more passing the No. 200 sieve.) Consistency determined by laboratory shear strength testing, field visual-manual procedures or standard penetration resistance		
Descriptive Term (Density)	**Standard Penetration or N-Value Blows/Ft.**	**Descriptive Term (Consistency)**	**Unconfined Compressive Strength Qu, (tsf)**	**Standard Penetration or N-Value Blows/Ft.**
Very Loose	0 - 3	Very Soft	less than 0.25	0 - 1
Loose	4 - 9	Soft	0.25 to 0.50	2 - 4
Medium Dense	10 - 29	Medium Stiff	0.50 to 1.00	4 - 8
Dense	30 - 50	Stiff	1.00 to 2.00	8 - 15
Very Dense	> 50	Very Stiff	2.00 to 4.00	15 - 30
		Hard	> 4.00	> 30

RELEVANCE OF SOIL BORING LOG

The soil boring logs contained within this document are intended for application to the project as described in this document. Use of these soil boring logs for any other purpose may not be appropriate.

UNIFIED SOIL CLASSIFICATION SYSTEM

Terracon GeoReport

Criteria for Assigning Group Symbols and Group Names Using Laboratory Tests [A]				Soil Classification: Group Symbol	Soil Classification: Group Name [B]
Coarse-Grained Soils: More than 50% retained on No. 200 sieve	**Gravels:** More than 50% of coarse fraction retained on No. 4 sieve	**Clean Gravels:** Less than 5% fines [C]	Cu ≥ 4 and 1 ≤ Cc ≤ 3 [E]	GW	Well-graded gravel [F]
			Cu < 4 and/or [Cc<1 or Cc>3.0] [E]	GP	Poorly graded gravel [F]
		Gravels with Fines: More than 12% fines [C]	Fines classify as ML or MH	GM	Silty gravel [F, G, H]
			Fines classify as CL or CH	GC	Clayey gravel [F, G, H]
	Sands: 50% or more of coarse fraction passes No. 4 sieve	**Clean Sands:** Less than 5% fines [D]	Cu ≥ 6 and 1 ≤ Cc ≤ 3 [E]	SW	Well-graded sand [I]
			Cu < 6 and/or [Cc<1 or Cc>3.0] [E]	SP	Poorly graded sand [I]
		Sands with Fines: More than 12% fines [D]	Fines classify as ML or MH	SM	Silty sand [G, H, I]
			Fines classify as CL or CH	SC	Clayey sand [G, H, I]
Fine-Grained Soils: 50% or more passes the No. 200 sieve	**Silts and Clays:** Liquid limit less than 50	**Inorganic:**	PI > 7 and plots on or above "A" line [J]	CL	Lean clay [K, L, M]
			PI < 4 or plots below "A" line [J]	ML	Silt [K, L, M]
		Organic:	Liquid limit - oven dried / Liquid limit - not dried < 0.75	OL	Organic clay [K, L, M, N]
					Organic silt [K, L, M, O]
	Silts and Clays: Liquid limit 50 or more	**Inorganic:**	PI plots on or above "A" line	CH	Fat clay [K, L, M]
			PI plots below "A" line	MH	Elastic Silt [K, L, M]
		Organic:	Liquid limit - oven dried / Liquid limit - not dried < 0.75	OH	Organic clay [K, L, M, P]
					Organic silt [K, L, M, Q]
Highly organic soils:	Primarily organic matter, dark in color, and organic odor			PT	Peat

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

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

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

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

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

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

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

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

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

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

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

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

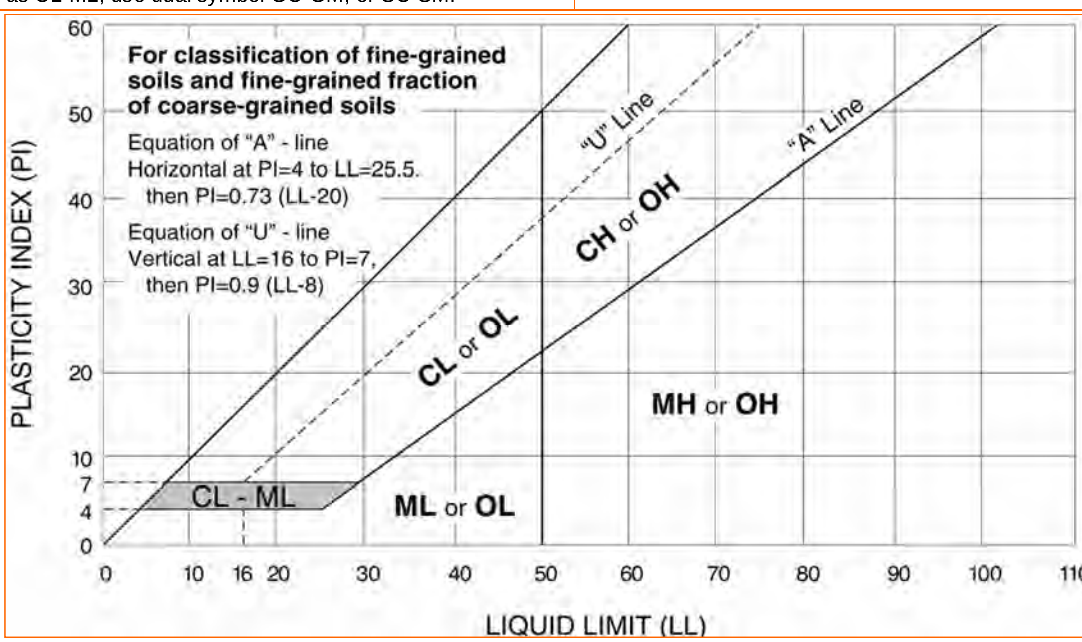
[M] If soil contains ≥ 30% plus No. 200, predominantly gravel, add "gravelly" to group name.

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

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

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

[Q] PI plots below "A" line.



DESCRIPTION OF ROCK PROPERTIES

Terracon GeoReport

WEATHERING	
Term	**Description**
Unweathered	No visible sign of rock material weathering, perhaps slight discoloration on major discontinuity surfaces.
Slightly weathered	Discoloration indicates weathering of rock material and discontinuity surfaces. All the rock material may be discolored by weathering and may be somewhat weaker externally than in its fresh condition.
Moderately weathered	Less than half of the rock material is decomposed and/or disintegrated to a soil. Fresh or discolored rock is present either as a continuous framework or as corestones.
Highly weathered	More than half of the rock material is decomposed and/or disintegrated to a soil. Fresh or discolored rock is present either as a discontinuous framework or as corestones.
Completely weathered	All rock material is decomposed and/or disintegrated to soil. The original mass structure is still largely intact.
Residual soil	All rock material is converted to soil. The mass structure and material fabric are destroyed. There is a large change in volume, but the soil has not been significantly transported.

STRENGTH OR HARDNESS		
Description	**Field Identification**	**Uniaxial Compressive Strength, psi (MPa)**
Extremely weak	Indented by thumbnail	40-150 (0.3-1)
Very weak	Crumbles under firm blows with point of geological hammer, can be peeled by a pocket knife	150-700 (1-5)
Weak rock	Can be peeled by a pocket knife with difficulty, shallow indentations made by firm blow with point of geological hammer	700-4,000 (5-30)
Medium strong	Cannot be scraped or peeled with a pocket knife, specimen can be fractured with single firm blow of geological hammer	4,000-7,000 (30-50)
Strong rock	Specimen requires more than one blow of geological hammer to fracture it	7,000-15,000 (50-100)
Very strong	Specimen requires many blows of geological hammer to fracture it	15,000-36,000 (100-250)
Extremely strong	Specimen can only be chipped with geological hammer	>36,000 (>250)

DISCONTINUITY DESCRIPTION			
Fracture Spacing (Joints, Faults, Other Fractures)		**Bedding Spacing (May Include Foliation or Banding)**	
Description	**Spacing**	**Description**	**Spacing**
Extremely close	< ¾ in (<19 mm)	**Laminated**	< ½ in (<12 mm)
Very close	¾ in – 2-1/2 in (19 - 60 mm)	**Very thin**	½ in – 2 in (12 – 50 mm)
Close	2-1/2 in – 8 in (60 – 200 mm)	**Thin**	2 in – 1 ft. (50 – 300 mm)
Moderate	8 in – 2 ft. (200 – 600 mm)	**Medium**	1 ft. – 3 ft. (300 – 900 mm)
Wide	2 ft. – 6 ft. (600 mm – 2.0 m)	**Thick**	3 ft. – 10 ft. (900 mm – 3 m)
Very Wide	6 ft. – 20 ft. (2.0 – 6 m)	**Massive**	> 10 ft. (3 m)

Discontinuity Orientation (Angle): Measure the angle of discontinuity relative to a plane perpendicular to the longitudinal axis of the core. (For most cases, the core axis is vertical; therefore, the plane perpendicular to the core axis is horizontal.) For example, a horizontal bedding plane would have a 0-degree angle.

ROCK QUALITY DESIGNATION (RQD) [1]	
Description	**RQD Value (%)**
Very Poor	0 - 25
Poor	25 – 50
Fair	50 – 75
Good	75 – 90
Excellent	90 - 100

1. The combined length of all sound and intact core segments equal to or greater than 4 inches in length, expressed as a percentage of the total core run length.

Reference: U.S. Department of Transportation, Federal Highway Administration, Publication No FHWA-NHI-10-034, December 2009 Technical Manual for Design and Construction of Road Tunnels – Civil Elements

MFAD 5.0™ AND LPILE SOIL PARAMETERS

Borings: SB-2 through SB-7, SB-9, SB-10, B-6 and B-7

Layer Number	Layer Description & LPile Soil p-y Model	Depth to Bottom of Layer (feet)	Standard Penetration Resistance, N-Value	Total Unit Weight [1] (pcf)	Friction Angle (degrees)	Deformation Modulus (ksi)	Undrained Shear Strength (Cohesion) (ksf)	Strain, Ɛ50	Static Lateral Subgrade Modulus, K (lb/in^3)	Net Allowable End Bearing Pressure [2] (ksf)	Allowable Compression & Uplift Unit Side Friction [2, 3] (ksf)
1	Silty Sand (Glacial Till) Sand (Reese)	5.0	2 to >50	120	32	0.2	--	--	90	N/A	0.1
2	Silty Sand (Glacial Till) Sand (Reese)	10.0	8 to 36	120	34	0.4	--	--	90	3.0	0.3
3	Silty Sand (Glacial Till) Sand (Reese)	20.0	16 to >50	125	34	1.0	--	--	60	6.0	0.6
4	Silty Sand (Glacial Till) Sand (Reese)	28.0 to 35.0	30 to >50	130	34	2.0	--	--	125	12.0	0.8
5	Granite Strong Rock [4]	--	RQD = 18 to 98	165	35 [4]	700.0	3.1 [4]	0.003	--	800.0	8.0

1. Design depth to groundwater is 9 feet.
2. End bearing values includes a safety factor of 3; side friction values include a safety factor of 2.
3. Straight-sided drilled shafts cast in direct contact with adjacent soil (uncased). Ignore side resistance in upper 5 feet due to disturbance during drilling.
4. Rock Quality Designation (RQD) is provided instead of Standard Penetration Resistance. Effective friction angle and effective cohesion are provided for friction angle and undrained shear strength, respectively.