EIGHT POINT WIND ENERGY CENTER

Case No. 16-F-0062

1001.21 Exhibit 21

Geology, Seismology, and Soils

Contents

Tables

Figures

Appendices

Exhibit 21: Geology, Seismology, and Soils

This exhibit contains a comprehensive summary of the geology, seismology, and soil character impacts resulting from proposed construction of the Eight Point Wind Energy Center. Within this exhibit is an identification and mapping of existing geological and surficial soil conditions, an impact analysis and definition of constraints resulting from these geological conditions, and a discussion on potential impact avoidance and mitigation measures.

Conclusions made within this exhibit are based on the findings of a preliminary geotechnical investigation performed by Kenney Geotechnical Services completed on September 1, 2017 and updated on October 26, 2017. A total of 22 borings were completed at wind turbine locations during a preliminary site survey. A summary of the borings completed to date is presented in the following table.

Table 21-1. Summary of Test Borings during Preliminary Site Survey

Test Boring No.	Surface Elevation (feet)	Depth of Boring (feet)	Date Completed
Alt 1	2369.0	30.5	7/14/17
Alt2	2302.2	40.5	6/23/17
T-1	2258.0	41.0	7/21/17
T-3	2300.0	32.0	7/12/17
T-4	2360.0	40.0	7/19/17
T-5	2293.0	30.9	7/19/17
T-6	2365.0	40.5	7/18/17
T-7	2344.0	40.0	7/17/17
T-9	2346.7	42.1	6/6/17
T-10	2351.0	30.3	7/13/17
T-11	2317.0	40.0	7/12/17
T-14	2327.5	40.0	6/5/17
T-16	2396.0	40.5	7/5/17
T-17	2273.8	40.2	6/29/17
T-18	2282.0	40.0	7/6/17
T-21	2303.7	40.2	6/1/17
T-22	2345.5	40.0	6/22/17
T-23	2343.6	40.5	6/21/17
T-24	2278.5	40.5	6/21/17
T-28	2266.6	41.5	6/20/17
T-30	2237.7	40.0	5/31/17
T-31	2261.0	40.5	7/11/17

21(a) Existing Slopes Map

Utilizing the USGS National Elevation Dataset and ESRI ArcGIS software, Figure 21-1 was created and demarcates predetermined existing slope ranges (0-3%, 3-8%, 8-15%, 15-25%, 25-35%, 35% and over) on and within a mapped drainage area which has the potential to be influenced by the Project. Slopes within this area range from 0-3% to >35%. Table 21-2 below presents the percent coverage that each slope range encompasses within the influenced drainage area.

Table 21-2. Percent Coverage of Slope Ranges within Drainage Area

Percent Slope Ranges (%)	Percent Area (%)
0 – 3	2.97
3 – 8	13.78
8 – 15	24.44
15 – 25	26.88
25 – 35	14.11
> 35	17.83
Total	**100**

21(b) Proposed Site Plan

A proposed site plan was prepared and included within the preliminary design drawings presented in Exhibit 11. The site plan shows existing and proposed contours at two-foot intervals for the Project Site and on-site non-Article VII interconnections. The site plan also identifies locations of proposed operation and maintenance buildings, wind turbine locations, access roads, electrical collection line routes, and non-Article VII interconnections.

21(c) Preliminary Calculation of Cut and Fill

A preliminary calculation was performed utilizing existing and proposed three dimensional surfaces generated from two-foot contour data to estimate the quantity of cut and fill necessary for Project construction. The cut and fill volumes stated below are differences calculated between the existing ground conditions, which was based off of contemporary, and Project specific, Light Detection and Ranging (LiDAR) data, and the presumed ground surface character which will be left as a direct result of Project development. Specifically, earthwork quantity calculations were prepared using AutoCAD Civil 3-D software. An existing conditions surface was created based on 2-foot contours generated from a LiDAR survey of the Project Area. From that data set, a proposed conditions surface was created from the Project grading plan. Differences between these two surface designs indicated the amount of material which will be excavated for construction. These calculations do not take into account the collection line trenching operation as part of the equation. It is presumed that collection line trenching would return soils to near existing conditions with the backfilling of the trench after collection line placement, negating any net change in the soil strata (similar to how it was done on operational wind farms across New York State). The calculated difference between the surface layers indicates that 780,771 cubic yards of material will be excavated for the construction of the proposed wind turbines and associated facility infrastructure. Of this, approximately 201,243 cubic yards will be topsoil (based on an assumed eight inch depth), 350,920 cubic yards will be subsoil, and 228,608 cubic yards will be bedrock.

It should be noted that the calculation of cut and fill assumed that depths greater than 78 inches were to be considered as indicating bedrock. However, in reference to Figure 21-3, actual depth to bedrock is greater than 78 inches in some instances. More specifically, this figure shows that approximately 47% of total wind turbine locations have bedrock greater than 78 inches, about 18% of the locations contain bedrock ranging between 41 and 60 inches in depth, and 35% have bedrock ranging between 1 and 20 inches in depth.

In the initial design process, the Applicant made necessary assumptions as a basis of design for these features in order to minimize significant areas of cut or fill within the Project. A multitude of scenarios would potentially require areas of cut and/or fill including access roads constructed on a side slope, grading out work areas which are naturally undulatory or crowned (high points in the local topography where a majority of the turbines are placed), and access roads traversing an existing grade that exceeds the maximum design slope. No fill materials will be removed from the Project Area. It is anticipated that approximately 732,346 cubic yards will be fill derived from excavated materials with the exception of gravel for the access roads. It should be noted, however, that the initial design is likely conservative and overstates the amount of cut and fill that will actually be necessary during construction of the Project, as the design was done in accordance with GE standards that the BOP contractor may deem excessive or unwarranted in some areas.

Invasive Species Control Plan

In order to identify the presence of invasive species in spoil material, and prevent the spread of invasive species by the transportation of materials to and from the Project Site, an Invasive Species Control Plan (ISCP) has been developed and is included as Appendix 22-3. The primary purpose of the ISCP is to control the spread or introduction of invasive species in the excavated materials, and avoid spreading and/or transporting invasive species by vectors (mechanisms of species transfer) directly correlated to the construction and operation of the Project. The ISCP will be appended to the Project construction contract, requiring the BOP Contractor to implement the control measures outlined within the ISCP. The principal construction-related control measures contained within the ISCP are to prevent introduction and spread of all New York listed invasive species. No fill material other than gravel will be transported from outside the Project Site, nor will any fill be transported offsite from the Project Site. This action will minimize the potential for introduction and/or transport of invasive species to uncolonized regions. More detailed information on the ISCP can be derived in the aforementioned appendix.

Management actions are grouped into four main categories including: material inspection, targeted species treatment and removal, sanitation, and restoration. Within each category, specific actions or combinations thereof can be taken depending on characteristics of a particular species and its density within the target area. Monitoring for invasive species will be conducted throughout the duration of the

Project to ensure that the ISCP is being implemented appropriately and that the goals outlined in it are being met. Of note, it should be stated that invasive species identified on site prior to construction are likely to spread even in the absence of further human intervention. It is therefore necessary to distinguish between natural movement of invasive species and anthropogenic movement caused by Project related construction activities. The ISCP goal of a zero net increase in the number of invasive species present and their distribution in the Project Area is based on actions related specifically to Project construction and operation.

Post construction monitoring will be conducted for a period of two (2) years following completion of Project related activities on site. This is to ensure that ISCP goals are met, as germination and spread of invasive species can continue long after construction activities have concluded. Failure to meet the goals of the ISCP will result in revision of the control plan and extension of the post construction monitoring phase for a period of two years from implementation of the revised plan.

For a more detailed review of the ISCP for the Project please refer to Appendix 22-3 of this Application.

21(d) Description and Preliminary Calculation of Imported Fill, Gravel, Asphalt, and Surface Treatment Material

The existing site topography is derived from LiDAR survey data of the Project Site. Proposed topography/final grade was developed based on the design criteria and constraints required for the anticipated delivery of Project components and construction of the Project facility. As stated previously, a preliminary calculation was performed utilizing existing and proposed three dimensional surfaces generated from two-foot contour data to estimate the quantity of cut and fill necessary for Project construction.

The fill material will be used for several purposes including grading for access roads, substations, and laydown areas. Based on the calculation of cut and fill, the material excavated from the site will be utilized for fill for a majority of the turbine sites. Therefore, importing additional graded fill material is only required for construction of the permanent access roads, the collection substation yard, and the Operations & Maintenance yards. It is anticipated that approximately 47,300 cubic yards of gravel fill will be required for construction and operation of the Project Site. Gravel fill will be supplemented from off-site gravel to the extent needed. Excavated material (cut) from the Project Site totaling 732,346 cubic yards will be used as fill material as necessary throughout the Project Site.

Additional fill materials of surface material and concrete pavement will also constitute as fill for the Project. The quantity of gravel, asphalt and surface treatment materials was estimated based on the preliminary site plan. The estimated quantity of each imported material is presented in the following Table 21-3.

Table 21-3. Estimated Quantity of Imported Material

Imported Material	Quantity (yd^3)
Gravel	47,300
Surface Material	325
Concrete Pavement	75
TOTAL	**47,700**

At this time, it is assumed that large off-road dump trucks with an approximate capacity of 22 cubic yards will be the primary truck used to transport materials throughout the site. As such, it is presumed that approximately 2,150 truckloads would be required to transport imported gravel fill material into the Project Site. Additionally, 15 truckloads of surface material will also be brought into the Project Site utilizing these truck types. Cement truck designs which are presumed to be utilized for this Project will carry approximately 8 cubic yards and weigh 70,000 lbs. With the calculated requirement of 75 cubic yards of concrete pavement for this Project, an additional 9 to 10 cement truckloads will also be necessary to transport concrete fill materials on-site.

As mentioned above, it should be noted that the initial design is likely conservative and overstates the amount of cut and fill that will actually be necessary during construction of the Project, as the design was done in accordance with GE standards that the BOP contractor may deem excessive or unwarranted in some areas.

21(e) Description and Preliminary Calculation of Cut Material or Spoil to be removed

Based on the preliminary cut and fill calculation performed in Section 21(c), it is not expected that any on-site material will be removed during construction. There will be an excess of approximately 148,400 cubic yards topsoil stripped from ground surfaces under the permanent fills. This material will be temporarily stockpiled and controlled through E&SC guidelines outlined in the SWPPP along the construction corridors and incorporated in the site restoration where applicable. During restoration of the Project, all excess topsoil materials will be re-graded to approximate pre-construction conditions in order for the site character and drainage areas to be returned to existing conditions to the maximum practical extent.

21(f) Construction Methodology and Excavation Techniques

The proposed start date in the construction of the Project is currently in the middle of 2019. However, this initiation date is subject to the receipt of all required permits from associated agencies and is subject to change concurrently. Project excavation and construction will be performed in several stages and will include the main elements and activities described below.

Location and Extent of Horizontal Directional Drilling (HDD) Methods

The Applicant is proposing to utilize trenchless excavation techniques, otherwise known as horizontal directional drilling (HDD), on the Project to route 34.5 kV collection circuits under obstacles including roads and state-protected streams (at a minimum). The HDD method was chosen because it has proven to be a safe and efficient method of crossing roads, railroads, streams, wetlands, and other environmentally sensitive areas with minimal surface impact. The Applicant is currently locating and designing all specific target HDD locations. Other areas may also be included where topographical or environmental constraints dictate that HDD installation methodology is the best construction practice. Upon finalization of the target HDD locations, site conditions, sensitive site avoidance and mitigation, installation technique, and staging area descriptions will be thoroughly summarized and communicated to the appropriate agency personnel. No HDD operations will be undergone without agency review and approval.

Inadvertent Return Plan for Horizontal Directional Drilling (HDD)

The HDD process involves the use of water and bentonite (a naturally occurring clay) slurry as a coolant and lubricant for the advancing drill head. The slurry also helps to stabilize the bore and aids in the removal of cuttings during the drilling process. Bentonite is nontoxic; however, if released into waterbodies, has the potential to adversely impact fish, fish eggs, aquatic plants, and benthic invertebrates. Therefore, to protect these natural resources, Eight Point Wind, LLC has prepared an Inadvertent Return Plan which outlines operational procedures and responsibilities for the prevention, containment, and cleanup of inadvertent releases associated with the HDD process. The objective of this Plan is to:

1. Minimize the potential for an inadvertent release of drilling fluids associated with HDD activities;
2. Provide for the timely detection of inadvertent returns;
3. Protect environmentally sensitive areas (streams, wetlands) while responding to an inadvertent release;
4. Ensure an organized, timely and “minimum-impact” response in the event of an inadvertent return and release of drilling fluids; and, ensure that all appropriate notifications are made immediately.

A detailed Inadvertent Return Plan was created for the Project and is included in Appendix 21-1 of this Application. Details within the Plan indicate:

- Site personnel responsibilities
- Effective training regimes for handling an inadvertent return
- Measures to prevent inadvertent releases
- Equipment and containment materials which will be utilized in the event of an inadvertent return
- An outline on effective responses to an inadvertent release
- A list of parties to be notified at the unlikely event of an inadvertent return
- Details outlining an effective clean up and restoration strategy
- Steps on construction restart and avoidance of future inadvertent returns
- Effective documentation of the incident

Although HDD has proven to be a safe and reliable method of crossing surface features with very minimal impact, the potential still exists for inadvertent releases of drilling fluid to the surface, which can have a detrimental impact on the environment. These releases typically occur as a result of seeps which can form when pressure in the drill hole exceeds the capability of the overburden to contain it, or when fluids find a preexisting fault in the overburden. The likelihood of these situations occurring can be minimized by taking into consideration the soil type and bedrock composition. Bore depth should be determined based on these site specific factors; however, a minimum depth of 25 feet in sound soils should be sufficient to prevent an inadvertent release.

Please refer to Appendix 21-1 for more detail on the Inadvertent Return Plan for this Project.

Construction Phases

Pre-Construction Survey and Environmental Monitoring

Prior to the commencement of Project related construction, an overall site survey will be performed in order to effectively locate and demarcate the exact location of Project components and routes in order to facilitate assembly strategy and construction efficiency. An Environmental Monitor will be implemented during the construction phase of the Project to oversee all construction and restoration activities in order to ensure compliance with all applicable environmental conditions and permit guidelines. Prior to the start of construction at specific sites, the Environmental Monitor, with support of construction management personnel, will conduct site reviews in locations to be impacted, or potentially impacted, by associated construction activities. Pre-construction site review will direct attention to previously identified sensitive resources to avoid (e.g., wetlands and waterbodies, archaeological, or agricultural resources), as well as the limits of clearing, location of drainage features (e.g., culverts, ditches), location of agricultural tile lines, and layout of sedimentation and erosion control measures. Work area limits will be defined by flagging, staking, and/or fencing prior to construction.

The pre-construction walk over will also aid in the identification of any specific landowner preferences and concerns. The placement of erosion and sediment control features will also be located during this site review in order to mitigate potential impacts to sensitive sites and also uphold erosion and sediment control Sate-wide initiatives. The pre-construction site review will serve as a critical means of identifying any required changes in the construction of the Project in a timely manner in order to avoid future delays to project construction timeframes. Changes may require an agency notification period and take time for approval to be received.

Site Clearing and Preparation

After the initial site review, Project related construction will be initiated by clearing all brush and woody vegetation within the LOD established for each specific turbine site, access road, electrical collection line route, and other supporting infrastructure (collection substation, met tower, laydown yard, O&M facility etc.). Vegetation cleared within this LOD will be removed, organized, and disposed of on-site and outside of any indicated sensitive sites. The definitive clearing impacts which will occur as a result of the

Project will be based on final engineering design. For more information on clearing impacts including their description and quantification, please refer to Exhibit 22 of this Application.

Laydown Yard Construction

All laydown yard areas were selected for ease of accessibility, strategic location in the construction work flow, relatively flat ground surface, occurrence outside of sensitive resources (wetlands, waterbodies, cultural areas etc.), and containing limited shrubby or woody vegetation in order to reduce impacts to natural vegetation areas. Most sites are situated within agricultural areas or within old fields left fallow.

Laydown yards will be developed by stripping and stockpiling the topsoil (stockpiles will be stabilized per the SWPPP) and grading the subsoil (as necessary). Geotextile fabric and will then be put in place to create level working areas for the staging of temporary construction trailers, equipment and materials.

Upon completion of the construction phase of the Project, the gravel fill will be removed and topsoil stock piles will be utilized to return laydown areas to existing grades and conditions. For any laydown yards staged in active agricultural areas, subsoils will be “ripped” to reduce compaction caused by construction of the Project. Active agricultural lands will be restored in accordance with the New York State Department of Agriculture & Markets Guidelines.

Access Road Construction

During the early development and component siting phase of this Project, existing road ways were located and utilized to the maximum practical extent in order to minimize impacts to sensitive resource areas. In some instances, existing road ways were noted to require improvements in order to meet size and grading constrains indicated for the Project. In other occurrences, new gravel access roads will need to be constructed in order to reach proposed turbine locations safely and effectively. During the construction phase, roads may maintain a temporary width of 50 feet wide in order to accommodate cranes used in turbine erection and also oversized construction vehicles. Post-construction, the permanent access roads will be reduced to approximately 16 feet of gravel. The remaining materials will be removed and the areas will be restored to preexisting conditions to the maximum extent practicable.

Road construction will initially involve the stripping of topsoil and grubbing of stumps, as necessary, after removal of vegetation. All topsoil will be segregated from subsoil and stockpiled (windrowed) along the access road corridor for use in site restoration and soil surface grading. Following removal of topsoil, exposed subsoils will be graded to specifications outlined in the site design, compacted for constructability, and surfaced with gravel or crushed stone for intended use as an established Project access road. Geotextile fabric or grid have the potential to be installed beneath the road surface where needed in order to provide additional stability support to the access road.

The use of temporary pump-around techniques or coffer dams will be used during the installation of all access road waterbody crossings. Appropriate sediment and erosion control measures will be installed and maintained according to the NYSDEC-approved final Project SWPPP, which will be finalized during final engineering and prior to construction. In order to facilitate effective draining and surface water management within the access road, culverts and/or water bars will also be utilized where necessary.

Turbine Foundation Construction

The construction of turbine foundations will occur after associated access roads to the predefined turbine site have been completed or are substantially in place. Upon access to the predetermined turbine location, strictly adhering to guidance from the site grading plan, the grading and leveling of the turbine site location will occur. In keeping with conventional topsoil preservation methods, topsoil will be stripped from the excavation area as in the access road construction operation. Topsoil will be stockpiled and stabilized in accordance with SWPPP guidelines for future use in site restoration efforts. Following topsoil removal, excavation will occur by heavy equipment in order to excavate the foundation area.

Gravity spread foot foundation design involves supporting a turbine on a large inverted “T” concrete pour. This is a conventional method of turbine foundation construction. In a conventional spread footing, the vertical loads and overturning moments applied at the top of the foundation are resisted by the weight of the spread footing and bearing on the base of the foundation, and the horizontal loads are resisted by friction at the base of the spread footing. See drawing D-5 of Appendix 11-3 for a standard design of gravity spread foot foundations.

Depending on the site soil characteristics and specific depths to bedrock, foundations may be designed with gravity-spread shallow concrete “inverted T” mat foundations or in the form of Patrick & Henderson (P&H) Tensionless Pier (PHTP) design. The PHTP design is a patented, proprietary foundation to support wind turbines on monopole towers. The foundation consists of a large diameter, cast-in-place annular pier (typically 14 to 16-feet in diameter and 25 to 35-feet deep). Corrugated metal pipes (CMP) provide a “stay in place” form for the interior and exterior of the concrete annular pier. The hollow interior of the P&H pier is normally backfilled with a three-foot thick concrete plug at the base, followed by un-compacted soils (comprised of spoil from the foundation excavation process), and a 12-inch thick structural slab across the top of the annular. The embedded depth of the P&H pier varies depending on the applied loading from the wind turbine and subsurface conditions witnessed on-site. The anchor bolts of the wind turbine tower are post-tensioned to ensure that the concrete that comprises the pier remains in compression, even when subjected to extreme wind loading.

The PHTP differs from a conventional gravity spread foundation often used for support of wind turbines in the way the foundation loads are transferred to and resisted by the supporting soil materials. However, the P&H pier resists the applied horizontal loads and overturning moment mainly by horizontal resistance of the soil that surrounds the annular pier and to a much lesser extent by bearing on the base of the pier. See Appendix 11-1 and 11-2 for a standard design of PHTP foundations for the 2.3 MW and 3.4 MW turbines, respectively.

During excavation, subsoil and bedrock will also be segregated and stockpiled for reuse as backfill and also in access road development. As stated previously, stockpiled soils will be located outside of sensitive resource areas and will be stabilized in accordance with the final Project SWPPP. If necessary, dewatering of foundation excavations may occur in order to keep the foundation free of standing water and permit safe and constructible environment. Dewatering methods will involve pumping the water to a predetermined well-vegetated discharge point, away from wetlands, waterbodies, and other sensitive resources. Discharge of water will include measures/devices to slow water velocities and trap any suspended sediment (sediment bags). All dewatering activities will also be conducted in accordance with the final Project SWPPP. Where blasting is deemed necessary, all blasting operations will adhere to applicable New York State statutes and regulations governing the use of explosives, see section (h) below for more information on the predetermined Project Blasting Plan.

34.5 kV Electrical Collection Line Construction

The construction of 34.5 kV collection circuit interconnect between turbines will involve multiple methods including, direct burial, open trench, and overhead construction methods utilizing equipment such as, a rock saw, cable plow, rock wheel and/or trencher. Direct burial methods involve the installation of a bundle of electric and fiber optic cable directly into a narrow trench in the ground. Where direct burial is not possible due to site specific constraints, an open trench will be utilized. Open trench operations involve the excavation, segregation, and stockpiling of topsoil and subsoil adjacent to the cutting of an open trench. Cable bundles are laid at the base of the trench and the trench is backfilled with suitable fill material and any additional spoils are spread out to match existing grades.

Trench breakers will be put into place as necessary along trench lines in order to prevent erosion caused by the lateral movement of runoff of soil strata in the open trench. These breakers will be located within the trench on steep slopes above agricultural, cultural, or wetland/waterbody areas to avoid erosion, sediment build up, and the deposition of sediment into any of the predetermined sensitive resources in the Project Site. Note that trench breaker locations will be finalized and located in the final site plan after Application submittal and upon receipt of the Certificate.

Overhead construction will involve the placement of 34.5 kV collection circuits along monopole structures where collection line spans overhead within a corridor cleared and de-limbed of any shrubby and woody vegetation. Overhead collection routes will do little to impact ground layers with only the placement of shallow monopole structures into the substratum. The use of this design will only occur in areas constrained by topographical extremes or steep slopes (along the County Route 248 corridor specifically).

Following installation of the 34.5 kV collection line route, areas will utilize strategically positioned topsoil and subsoil piles to return disturbed areas to pre-construction grades. Installation of buried electrical lines would typically require a width of up to 50 feet of vegetation clearing for this Project. However, in areas where buried electrical lines have been routed collinear with proposed access roads, there will be no additional vegetation or soil disturbance beyond what is expected for the predetermined access road construction. All cleared areas along the buried electrical line routes will be restored through seeding and mulching, and allowed to regenerate naturally. Areas along overhead collection routes will be maintained in order to sustain the integrity of the monopole structure and reduce risk of damage to the exposed collection line. Horizontal Directional Drilling (HDD) will also be employed in select areas in order to navigate collection line around, and prevent damage to, existing roadways and sensitive natural resources including wetlands and perennial streams. For more information on HDD drilling see the subsection on *Inadvertent Return in Horizontal Directional Drilling (HDD)* below and also the Inadvertent Return Plan located in Appendix 21-1.

Turbine Construction

The turbine tower segments, rotor components, and nacelle will be delivered to the designated construction locations through use of large big-rigs utilizing flatbeds and offloaded by crane equipment. The utilization of a large tower erection crane will lift the associated tower segments and be guided by operators onto the established foundation area (gravity spread foot and/or PHTP designs). After the tower segments are placed and connected, the nacelle will be placed on top of the tower. Rotor installation will be installed either by individual blade installation after the nacelle is placed on top of the tower or, following ground assembly, the rotor will be placed onto the nacelle. No excavation of soil strata or disturbance of bedrock is proposed to occur during this stage of the construction.

Collection Substation Construction

Much like the clearing of laydown areas, substation construction will commence with clearing of any woody or shrubby vegetation within the substation footprint. After clearing, the topsoil will be stripped and stockpiled for later use in site restoration. Exposed subsoil will then be graded to specifications outlined in the Project grading plan and foundation areas will be excavated using standard excavation equipment. Construction staging areas for equipment and materials will also be graded and created. At this stage concrete foundations will be poured. After the foundations have set, installation of electrical infrastructure (structural steel skeleton, conduits, cables, bus conductors, insulators, switches, circuit breakers, transformers, control buildings, etc.) will occur.

During substation site finalization, gravel fill/crushed stone will be spread throughout the substation surface and a perimeter of chain link fence will be erected for security and safety precautions. Finally, the high voltage link-ups will be connected and tested for charge and integrity through electrical control systems in the control house on-site. Restoration of the adjacent areas impacted by construction back to existing conditions in direct vicinity to the substation will be completed using stockpiled topsoil, and the appropriate seed and mulch.

Blasting Operations

As stated previously, this Project involves excavation of soil for the installation of foundations for the placement of wind turbines. The excavation consists of drilling holes of various sizes and depths for the installation of foundations to support steel structures. However, there is a possibility that the sub-soil may consist of weathered rock or solid bedrock.

If rock or bedrock is encountered during excavation, the construction crews will extract and excavate it using a backhoe or other appropriate equipment. However, if the bedrock cannot be extracted with a backhoe, other means may be used for excavation (e.g. pneumatic jacking and/or hydraulic fracturing). Consequently no blasting will be required if the above procedures are used for the excavation. However, if the rock cannot be excavated using above equipment it may be necessary to use a blasting method to remove bedrock/rock laden foundation sites. In such cases a blasting plan shall be used. See 21(h) below for more details on the Project blasting plan.

Subsurface Drain Tile Repair Impact and Repair

The Applicant is committed to minimize impacts to agricultural operations and will work with landowners/farm operators to address unanticipated post-construction impacts. The Applicant will work with affected landowners/farmers regarding potential drainage issues on their properties, and will utilize trench breakers in areas of moderate to steep slopes on active agricultural land if deemed prudent to ensure that the deposition of impacted or stockpiled soils do not occur over agricultural lands. Note, some trench breaker locations will be finalized and located in the final site plan after Application submittal and upon receipt of the Certificate.

Existing drain tiles will be identified and located before construction as much as is reasonably possible with based primarily on consultation the landowner. During and after construction operations, any existing drain tiles within the area of disturbance will be checked for damage, and damaged drain tiles will be repaired by qualified drain-tile specialists. The Applicant will coordinate with the landowner to continue to monitor drain tiles post-construction to ensure repairs are properly functioning.

The Applicant is currently working with industry professionals experienced in agricultural construction best practices in New York State. When preliminary design is complete, and upon receipt of the Certificate, the Applicant will coordinate with New York State DPS and Ag & Markets staff as necessary to minimize construction impacts and fix and damaged tile.

Temporary Cut or Fill Storage Areas

In the initial siting and design process, the strategic placement and design of these components was undergone with the direct strategy of minimizing the amount of areas which require cut and fill operations to occur. As stated previously, the construction and placement of Project infrastructure will require minor cut or fill to achieve the final grades within the Project Site. A multitude of scenarios would potentially require areas of cut and/or fill including access roads constructed on a side slope, grading out work areas which are naturally undulatory or crowned (high points in the local topography where a majority of the turbines are placed), and access roads traversing an existing grade that exceeds the maximum design slope. It is anticipated that approximately 732,346 cubic yards will be fill derived from excavated materials with the exception of gravel for the access roads.

Following the turbine manufacturer's recommendations, turbine foundation founded on soil will be constructed no less than 8 feet and 7.5 feet below the finished grade for the 3.4 and 2.3 MW turbines, respectively. Permanent access roads will be constructed using 12 inches of crushed gravel over native sub-soils which will be stock-piled for this said use. Where necessary, the native soils will be reinforced with geo-synthetic fabric. Other travel ways subject to light vehicle traffic, such as those around the turbine tower base, will be constructed of 8 inches of crushed gravel.

Proper methods for segregating stockpiled and spoil material will be implemented. All excavated soils will be reused in close proximity to where it was unearthed to the maximum extent possible. This technique will aide in reducing the proliferation of non-native flora to uncolonized areas within Project. Final cut and fill storage areas will be available following Certification, and will be included in the final site construction drawings.

21(g) Characteristics and Suitability of Material Excavated for Construction

Kenney Geotechnical Services conducted a Preliminary Desktop Geotechnical Study to evaluate the subsurface conditions within the Project Site. This study consisted of a literature review of publicly available data as well as recommendations established on this information. This study was supplemented with a preliminary geotechnical investigation that included the performance of test borings at 22 wind turbine locations.

Based on the findings of these studies, the subsurface materials that would be encountered within the Project Site are suitable for construction of the proposed structures. Laboratory corrosion series testing was performed on six site samples during the preliminary geotechnical investigation. Results are as follows:

Table 21-4. Results of Laboratory Corrosion Testing (reproduced from Preliminary Geotechnical Investigation Report, Appendix 21-2)

Boring	Depth	Sulfates (ppm)	Chlorides (ppm)
T-4	2-4'	<50	<50
T-9	0-2'	<50	<50
T-18	4-6'	<50	<50
T-24	4-6'	<50	<50
T-29	2-4'	<50	<50
ALT-2	4-6'	<50	<100

In general, a chloride concentration greater than 500 parts per million (ppm), or a sulfate concentration greater than 2,000 ppm is considered to be indicative of a corrosive environment for most structures. Based on the test results it appears that a corrosive environment does not exist and standard Type I/II cement may be utilized on this Project.

Frost depth in the Project Area is 48 inches. The foundations for new site structures will bear below this depth to prevent frost heave.

Organic-laden soil was only encountered at the ground surface during the preliminary investigation. The depth of organic material in the topsoil was no more than approximately 12 inches. This material will be stripped during earthwork so that new structures do no bear on organic-laden soil.

The preliminary geotechnical investigation findings suggest that the four primary strata to be encountered at boring locations are:

- Stratum A -- Glaciofluvial Soil
- Stratum B – Glacial Till

- Stratum C – Transition Zone Rock, and
- Stratum D – Bedrock

Stratum A – Glaciofluvial Soil was encountered at the ground surface at some locations and extended to depths of up to 6 feet. This stratum was primarily composed of loose to medium dense silty sand with gravel. Standard Penetration Testing "N" values in this stratum were typically less than 20 blows per foot.

Stratum B – Glacial Till was typically encountered from the ground surface to depths of up to 40 feet and consisted of very stiff to hard silt and lean clay with sand, gravel, cobbles and boulders. With the exception of the uppermost two feet, which was softened by weathering, Standard Penetration Testing "N" values in this stratum typically ranged between 20 to 100 blows per foot.

Stratum C – Transition Zone Rock was encountered at the interface of Strata B and D. This stratum consisted of bedrock that had been altered by glaciation and/or weathering. In some areas the Transition Zone Rock consisted of large slabs of detached competent bedrock with interbedded soil zones. In other areas the Transition Zone Rock consisted of highly weathered bedrock. The detached bedrock typically consisted of the local sandstone and siltstone. The interbedded soil zones typically consisted of red clay with angular green sandstone fragments the size of gravel. The red clay was derived from the weathering of the local red shale. This stratum typically had to be cored for sample recovery. At locations where augers could penetrate into this stratum the Standard Penetration Testing "N" values typically exceeded 100 blow per foot.

Stratum D -- Bedrock was encountered below Stratum C. The bedrock encountered consisted of fresh sandstone, siltstone, conglomerate, shale and slate. This stratum was sampled by coring. The recovered bedrock core were typically fresh, medium hard to hard rock with horizontal bedding planes.

21(h) Preliminary Plan for Blasting Operations

It is presumed that the blasting of bedrock may be required for the construction of turbine foundations and potentially in portions of the electrical connection line routes where excavation of bedrock by other means has been exhausted. Bedrock which is excavated will be reused where applicable as fill material for grading and/or as fill for access roads. A Preliminary Blasting Plan is included in the application under Appendix 21-3. The Blasting Plan sets forth procedures and best management practices (BMPs) which will be utilized to ensure that blasting, if required, is conducted safely and conscientiously while making every effort to reduce any environmental impacts to the maximum extent practicable.

The Preliminary Blasting Plan is intended to serve as an overall guidance and procedures for all the blasting required for the Project. However, it should be stated that the blasting contractor shall be responsible for generating an overall Contractor Blasting Plan and also a written site-specific blasting plan if there are differences in selected blasting sites including the subsoil and bedrock conditions. This specification shall also be used for pre-blast surveys, notifications, use of explosives, security, monitoring, and documentation.

Potential Blasting Impacts

Impacts to bedrock could be anticipated as a result of blasting operations which may be required in limited areas during construction of the Project. The bedrock encountered in the preliminary geotechnical survey consisted of fresh sandstone, siltstone, conglomerate, shale and slate. Stratums were sampled by coring. The recovered bedrock core were typically fresh, medium hard to hard rock with horizontal bedding planes. Some type of blasting and/or rock excavation techniques may be necessary at certain locations based on the depth of rock encountered and to facilitate the construction of turbine foundation areas and along buried collection line routes. The method or combination of methods required will specifically be tailored to the structural integrity, depth, and robustness of rock/bedrock encountered. As part of the blasting plan, blasting is not anticipated to occur near existing water or gas wells, buildings, or other existing structures. No impacts to gas or water wells are anticipated although present within the Project Area.

All blasting operations will be strictly coordinated with Eight-Point Wind's on-site representatives and with the local Fire Department, emphasizing the safe and efficient removal of rock without impact to surrounding structures. Blasts will be developed to minimize ground vibrations and to maximize protection for surrounding structures.

Mitigation Measures for Blasting Operations

Blasting will be conducted in accordance with the Blasting Plan located in Appendix 21-3 of this application. All blasting will receive oversight by the appointed Environmental Monitor to the Project.

In order to mitigate any adverse impacts as a result of blasting operations, blasts will comply with the following requirements:

1. Blasting will occur only during the hours of 9:00 am to 5:00 pm on Monday through Friday. No blasting will occur on state or federal holidays.

2. Blasting will occur only as set forth in the blasting schedule, except in emergency situations, such as electrical storms or where public safety requires an unscheduled detonation.

3. Warning signals will be sounded before and after each blast to warn of the impending blast and to indicate all clear. The warning and all-clear signals shall be audible within a quarter-mile radius, and will be distinguishable from one another. All individuals within the project site will be instructed on what the signals mean. The project site will be posted with signs explaining the signals, and similar signs shall be made available to property owners within a half-mile radius of the blasting site. All people including contractor's and sub-contractor's workers within the safety zone around the blast site shall be evacuated prior to each detonation.

4. Access to blasting area shall be restricted. Eight-Point Wind or its contractor shall actively control access to the blasting before and after each blast, until it has been determined that no unusual circumstances exist and that access to and travel in or through the area can safely resume.

5. Areas in which charged holes are awaiting firing shall be guarded, barricaded, and posted or flagged against unauthorized entry.

6. All blasts shall be made in the direction of the stress relieved face of the rock being blasted that has been previously marked out or previously blasted.

7. All stemming shall use clean, dry 3/8" crushed stone.

8. All rock-drilling operations shall be equipped with emission controls to control fugitive particulate matter. Blasting mats will be also used where needed to limit the occurrence of fly rock.

9. The Blasting Contractor shall insure that extra safety and judgment is exercised by the blaster to prevent the simultaneous blasting of numerous holes.

As stated previously, all blasting operations in close proximity to sensitive resources, structures, utilities, or other facilities will be independently reviewed for potential hazards and operators along with the appointed Environmental Monitor will address all potential hazards prior to any blasting actions taking place. Rubber tire blasting mats and backfill shall be used to control excessive rock movement when blasting.

In order to mitigate potential hazards, the predetermined minimum amount of blasting material will be utilized to effectively fracture rock to achieve predetermined excavation depths. If the minimum amount is determined to not be suitable for blasting in a particular scenario, safe incremental increases in blasting material will occur until the predetermined excavation depth is achieved or the obstructive rock/bedrock is fully removed. Independent monitoring of vibration and air concussion levels will be also carried out by the contractor during all blasting operations.

It is presumed that no blasting activities will occur in close proximity to structures listed on the State/National Register of Historic Places. However, if blasting does need to occur in close proximity to a registered historic place, the certified blasting professional will review the structure and determine if blasting will have any adverse impact to the structural integrity of the place or damage the area in any way. If the appointed professional determines that blasting may result in damage to the listed structures, alternative excavation techniques or other measures to address the impacts will be reviewed and a new course of action will be undertaken.

21(i) Regional Geology, Tectonic Setting, and Seismology

In addition to the preliminary geotechnical study, several existing published sources were used to better understand regional geology, tectonic setting and seismology within the Project Area. The sources include the Soil Survey of Steuben County (USDA, 1994), statewide bedrock geology mapping (NYS Museum/NYS Geological Survey, 1999a), New York State surficial geology mapping (NYS Museum/NYS Geological Survey, 1999b), 2014 New York State Hazard Map (USGS, 2014b), and USGS Earthquake Hazards Program (USGS, 2015).

The Project Area is located within the south central part of New York State in the glaciated portion of the Allegheny Plateau physiographic section of the Appalachian Plateau physiographic province. Major topographic and geologic features in this area were formed during the last glacial advance and retreat, which ended approximately 12,000 years ago. The Project is located just south of the most recent glacial maximum advance.

Numerous “through” valleys and troughs are found in this province (NYSDOT Geotechnical Design Manual, 2013). Some contain large lakes, such as the Finger Lakes, others only small ponds or streams. The valley walls found within this province are rather steep. The Project Area is a hilly highland area dissected by creeks and rivers. Elevations within the Project Area range approximately between 1,800 feet and 2,300 feet according to the USGS web topographic maps.

Publically available geologic mapping suggests that Oswayo and Cattaraugus formation shale, siltstone and sandstone underlies soils at the site. The bedrock may be located within close proximity to the ground surface in many upland areas. The shale and sandstone is typically horizontally bedded with near-vertical orthogonal stress fractures.

The transition to bedrock from the overlying glacial till is chaotic in the Project Area. During glaciation large sections of rock were moved short distances or not at all but were detached from the bedrock below. When they weathered, they settled and tilted. Sometimes just the layers that are chemically weaker weather (iron rich, mica rich, feldspars or layers that are cemented with calcite). The rock pops open along bedding planes and clay rich minerals swell, mechanically breaking down the rock. This allows more surface area for chemical weathering creating void and allowing sediment from above to wash into the open voids over the past 30-40 thousand years. The result is that soil zones are encountered below what appears to be solid bedrock.

Groundwater aquifers are located in the glacial outwash in the valley areas. Upland areas typically do not have a true water table above a depth of approximately 70 to 80 feet. However upland areas are subject to perched groundwater conditions during wetter periods as infiltrating water becomes trapped within the soil above undisturbed clayey glacial till and bedrock.

Oil and natural gas wells are located in the vicinity of the Project Area. The local oil and gas wells typically draw from bedrock formations located 4,000 to 5,000 feet below the ground surface.

According to USGS Seismic Hazards database, the Project Area is located in an area of relatively low seismic activity with a 0.74% chance of a magnitude 5.0 earthquake occurring in the next 50 years (Kenney, 2016). In addition, the USGS Earthquake Hazards Program does not list any faults within the vicinity of the Project Area. The upland areas have a dense soil cover and will not provide much amplification of seismic waves (Site Class B soils under the New York State Building Code). Glacial outwash and alluvial sediment in the valleys are looser and typically are classified as Site Class D.

Based upon correlations with Standard Penetration Testing “N” values obtained during the preliminary geotechnical investigation and New York State Building Code guidelines the available data suggests that Site Class C is appropriate at wind turbine locations. The estimated design spectral response acceleration parameters are S_{DS} = .101g and S_{D1} = .060g. Liquefaction, surface rupture from faulting or lateral spreading is estimated to have a low probability of occurrence given the soil conditions encountered and typical regional seismicity.

21(j) Facility Construction and Operation Impacts to Regional Geology

A Preliminary Geotechnical Investigation Report has been completed and is included as Appendix 21-2. In general the conditions encountered are favorable for the proposed wind farm. The available information suggests that the wind turbine foundations will be underlain by hard glacial till, transition zone rock with soil infill, and potential bedrock. It is therefore anticipated that the turbines can utilize a gravity shallow foundation system or a Patrick & Henderson tensionless pier system. The glacial till, transition zone rock, and bedrock typically provides high bearing strength and good short term excavation stability.

Based on the subsurface conditions encountered during the investigation performed to date, it appears that the primary geotechnical issues will be:

- Excavation of the glacial till, transition zone rock, and potential bedrock (limited);
- Possible deterioration of the glacial till and transition zone rock upon excavation and exposure to the elements and construction traffic.

The glacial till encountered in the area typically consists of a binder of hard, low-plasticity silty clay that encapsulates particles ranging in size from fine sand to boulders the size of automobiles. The transition zone rock appears to include large slabs of intact medium hard to hard bedrock with weathered seams that are infilled with soil.

The glacial till, transition zone rock, and bedrock will provide high bearing strength and good short term excavation stability if left undisturbed. However, the strength of the glacial till and transition zone strata will deteriorate if they are allowed to saturate or if they are disturbed by over-excavation. The stability of slopes and excavations in these strata will also decrease over time. Typically permanent slopes in the glacial till are graded no more steeply than 33% (18.4 degrees) unless they are reinforced.

21(k) Seismic Activity Impacts on Facility Location and Operation

Faults within the vicinity of the Facility are not associated with any historic earthquakes. In addition, the USGS Earthquakes Hazards Program does not identify any young faults within the vicinity of the Project Site. Therefore, the impact due to seismic activity is considered to be negligible. Also, the design of current wind turbine technology allows for operational control and emergency shut off in case of an emergency such as a significant seismic event.

21(l) Soil Types Map

Figure 21-2 was prepared to delineate soil types within the Project Area. In addition, a soil map for each wind turbine was prepared using USDA NRCS Web Soil Survey application. A detailed discussion of each soil type is prepared in Section 21(m) below.

21(m) Soil Type Characteristics and Suitability for Construction

Information regarding on-site soils was obtained from on-site investigations conducted by Kenny Geotechnical Services and from existing published sources, including Soil Survey of Steuben County (USDA, 1994), USDA Web Soil Survey (2013), and Soil Survey Geographic (SSURGO, 2016).

The Soil Survey of Steuben County, New York (USDA, 1994) indicates that all wind turbines are sited within the Oquaga-Morris-Wellsboro association, which is on plateau areas where the underlying glacial till is derived mainly from red sandstone and shale in the southwest corner of the county. It is about 35% Oquaga soils, 30% Morris soils, 20% Wellsboro soils, and 15% minor soils. There are six 6 soil series among the wind turbine locations, of which there are 10 individual soil map units. Each soil series is described in detail below:

Lackawanna series consists of deep, well drained soils that formed in glacial till that was derived mainly from red sandstone. These soils are gently sloping to moderately steep on uplands. The typical soil profile of this series consists of dark brown channery silt loam about 7 inches thick and the subsoil extends to a depth of 60 inches. In the upper 20 inches the subsoil is reddish brown channery silt loam, and in the lower part it is a very firm dense fragipan of dark reddish brown flaggy silt loam. The available water capacity is moderate. After heavy precipitation, the water table is perched above the slowly permeable dense fragipan for brief periods. The fragipan restricts infiltration to a depth of about 27 inches. The soils of this series are strongly acid or very strongly acid.

> **LaB** is Lackawanna channery silt loam with 3 to 12 percent slopes on hill crests or upper valley sides where water does not accumulate. The areas conform in shape to the hill crests and generally range from 10 to 20 acres in size. Surface soil erosion control should be considered due to its slow permeability.

Mardin series consists of deep, moderately well drained soils that formed in glacial till that was derived mainly from sandstone and shale. These soils are gently sloping to moderately steep on upland plateaus. They have a well expressed fragipan at a depth of 14 to 23 inches below ground surface.

> **MdB** is Mardin channery silt loam with 2 to 8 percent slopes in high areas where little or no runoff accumulates. The areas are oval and are about 5 to 50 acres in size. This soil generally features a slow infiltration rate, which may result in drainage issue after considerable precipitation.

> **MdD** is Mardin channery silt loam with 15 to 25 percent slopes on hillsides and narrow dissected valleys. It is generally part of an overall long side slope. The areas range from 10 to 100 acres in size. This soil generally features low permeability and surface erosion may become an issue without ground protection or proper vegetation.

Morris series consists of deep, somewhat poorly drained soils that formed in dense glacial till that was derived mainly from red sandstone, siltstone, and shale. These soils are on uniform valley sides and have a fragipan.

MrB is Morris channery silt loam with 2 to 8 percent slopes on broad upland saddles near the plateau summits. After heavy precipitation these areas are waterlogged above the fragipan. They receive large amounts of seepage water and runoff from nearby slightly higher landscapes. The permeability of the soil is low due to size of soil particle and shallow depth to the fragipan. Poor drainage is a common characteristic of this soil.

Oquaga series consists of moderately deep, well drained soils that formed in glacial till that is 20 to 40 inches thick over the underlying reddish sandstone bedrock. These soils are on gently sloping to steep uplands mostly in the northern part of the Project Area. In general, the soil profile of this series is black channery silt loam about 2 inches thick. It is underlain by a thin leached layer of reddish gray channery silt loam about 3 inches thick. The subsoil extends to a depth of 26 inches. In the upper 12 inches it is strong brown channery silt loam; in the lower 9 inches it is brown very channery silt loam. The substratum is brown to dark brown very channery silt loam that extends to a depth of 32 inches. Underlying this layer is sandstone and shale bedrock. The available water capacity is low and its permeability is moderate. Without soil improvement, the surface soil within this soil series is expected to be very strongly acid.

OgB is Oquaga channery silt loam with 3 to 12 percent slopes on slightly convex side slopes and consists of long narrow strips on hillsides. It generally receives very little runoff from other areas. This soil has cracks in the bedrock that allow water to drain freely through it.

OgC is Oquaga channery silt loam with 12 to 20 percent slopes on long narrow strips along the upper valley walls just below the crests of the hills. The areas are 10 to 50 acres in size. The characteristics of this soil are similar to those described as representative of the series.

OgD is Oquaga channery silt loam with 20 to 30 percent slopes on valley sides. The areas of this soil consist of bands along the valley sides and continue in in places for several thousand feet. The areas generally range from 50 to 100 acres in size. This soil is too steep for safe use of machinery. Steep slopes and depth to bedrock are two major limitations to construction.

Volusia series consists of deep, somewhat poorly soils that formed in dense glacial till that was derived mainly from sandstone, siltstone, and shale. These soils have long uniform slopes that are on valley sides and broad divides on uplands. A well-defined fragipan at a depth of 10 to 20 inches greatly impedes the movement of water. The typical surface soil is dark grayish brown channery silt loam about 7 inches thick. The upper part of the subsoil is mottled yellowish brown channery silt loam about 5 inches thick. A subsurface or leached layer of mottled gray channery silt loam about 3 inches thick separates the upper layer of subsoil and the fragipan. The underlying firm fragipan is channery silt loam about 31 inches thick; in the upper 16 inches it is brown and in the lower 15 inches it is dark grayish brown. The underlying material to a depth of 62 inches is olive firm channery loam. The available water capacity is low to moderate. The seasonal high water table is generally perched above the very slowly permeable fragipan. The surface soil is strongly acid.

VoaB is Volusia channery silt loam with 3 to 8 percent slopes on undulating hilltops or uniformly gently sloping hillsides. The areas are generally oblong and are 10 to 40 acres or more in size. In many places this soil is adjacent to the higher lying Mardin soils and receives runoff from them.

Wellsboro series consists of deep, moderately well drained soils that formed in glacial till that was derived mainly from reddish sandstone, siltstone, and shale. These soils are on gently sloping to moderately steep on uplands mostly in the southern portion of the Project Area. The surface layer is dark reddish brown channery silt loam about 7 inches thick. The upper part of the subsoil is mottled reddish brown channery silt loam about 9 inches thick. This is underlain by a leached subsurface layer of mottled, light reddish brown channery loam about 2 inches thick. The underlying fragipan is 42 inches thick; in the upper 12 inches it is reddish brown firm channery silt loam and in the lower 30 inches it is dark reddish brown very firm channery loam. The water capacity to a depth of 14 to 24 inches is low to moderate. In general, the temporary high water table is perched above the slowly permeable fragipan. The infiltration is limited to a depth of 14 to 24 inches. The soils are very strongly acid. Surface wetness can be a considerable restriction for construction.

WoB is Wellsboro channery silt loam with 2 to 8 percent slopes on slightly convex, uniform side slopes on the plateau. It is gently undulating at the higher elevations. These areas are generally 5 to 20 acres in size.

WoC is Wellsboro channery silt loam with 8 to 15 percent slopes on side slopes of the plateau. The areas are generally oblong in shape and 10 to 50 acres in size.

Table 21-5. Summary of Soil Types

Turbine Locations.	Map Unit Symbol	Map Unit Name
T1	MrB	Morris channery silt loam, 2-8% slopes
T2	MrB	Morris channery silt loam, 2-8% slopes
T3	OgC	Oquaga channery silt loam, 12-20% slopes
T4	OgB	Oquaga channery silt loam, 3-12% slopes
T5	OgC	Oquaga channery silt loam, 12-20% slopes
T6	OgB	Oquaga channery silt loam, 3-12% slopes
T7	MdB	Mardin channery silt loam, 2-8% slopes
T8	OgB	Oquaga channery silt loam, 3-12% slopes
T9	OgB	Oquaga channery silt loam, 3-12% slopes
T10	OgB	Oquaga channery silt loam, 3-12% slopes
T11	OgB	Oquaga channery silt loam, 3-12% slopes
T12	MdB	Mardin channery silt loam, 2-8% slopes
T13	MrB	Morris channery silt loam, 2-8% slopes
T14	MdB	Mardin channery silt loam, 2-8% slopes
T15	MrB	Morris channery silt loam, 2-8% slopes
T16	WoB	Wellsboro channery silt loam, 2-8% slopes
T17	MdD	Mardin channery silt loam, 15-25% slopes

Turbine Locations.	Map Unit Symbol	Map Unit Name
T18	MdB	Mardin channery silt loam, 2-8% slopes
T19	WoB	Wellsboro channery silt loam, 2-8% slopes
T20	WoB	Wellsboro channery silt loam, 2-8% slopes
T21	LaB	Lackawanna channery silt loam, 3-12% slopes
T22	LaB	Lackawanna channery silt loam, 3-12% slopes
T23	WoB	Wellsboro channery silt loam, 2-8% slopes
T24	WoB	Wellsboro channery silt loam, 2-8% slopes
T25	WoB	Wellsboro channery silt loam, 2-8% slopes
T26	WoB	Wellsboro channery silt loam, 2-8% slopes
T27	WoB	Wellsboro channery silt loam, 2-8% slopes
T28	WoC	Wellsboro channery silt loam, 8-15% slopes
T29	MrB	Morris channery silt loam, 2-8% slopes
T30	OgB	Oquaga channery silt loam, 3-12% slopes
T31	OgB	Oquaga channery silt loam, 3-12% slopes
ALT1	WoB	Wellsboro channery silt loam, 2-8% slopes
ALT2	VoB	Volusia channery silt loam, 3-8% slopes
ALT3	OgD	Oquaga channery silt loam, 20-30% slopes
ALT4	WoB	Wellsboro channery silt loam, 2-8% slopes

The vast majority of soils in the Project Area are channery silt loam. Soil drainage is predominantly classified as moderately well drained, and approximately 16 percent of the turbines are located on soils are classified as somewhat poorly to poorly drained. For additional information about agricultural resources within the Project Area, including designated Agricultural District lands, see Exhibits 4 and 22 of this Application.

The primary impact to the physical features of the Project Area will be the disturbance of soils during construction. Based on the assumptions outlined in Table 22-2, disturbance to soils from all anticipated construction activities will total approximately 531.3 acres. Of this total, only approximately 30.1 acres will be converted to access roads, turbine foundations, structures, and etc., while the remaining will be restored and stabilized following completion of construction. The area of disturbance calculations presented above assume that significant soil disturbance will occur in all areas in which construction occurs. Actual disturbance will include overlap of some components will be highly variable based on the specific construction activity, the construction techniques employed, and soil/weather conditions at the time of construction.

Earth moving and general soil disturbance will increase the potential for wind/water erosion and sedimentation into surface waters. Implementing the erosion and sediment control measures outlined in the Preliminary Stormwater Pollution Prevention Plan (SWPPP) will minimize impacts to steep slopes and highly erodible soils that may occur in the event of extreme rainfall or other event that could potentially lead to severe erosion and downstream water quality issues. In addition, impacts to soils will be further minimized by the following means:

- Public road ditches and other locations where Project-related runoff is concentrated will be armored with rip- rap to dissipate the energy of flowing water and to hold the soils in place.
- Prior to commencing construction activities, erosion control devices will be installed between the work areas and downslope areas, to reduce the risk of soil erosion and siltation. Erosion control devices will be monitored continuously throughout construction and restoration for function and effectiveness.
- During construction activities, hay bales, silt fence, or other appropriate erosion control measures will be placed as needed around disturbed areas and stockpiled soils.
- Following construction, all temporarily disturbed areas will be stabilized and restored in accordance with approved plans.

Impacts to soil resources will be minimized by adherence to best management practices that are designed to avoid or control erosion and sedimentation and stabilize disturbed areas. In addition, erosion and sedimentation impacts during construction will be minimized by the implementation of an erosion and sedimentation control plan developed as part of the State Pollution Discharge Elimination System (SPDES) General Permit for the Facility. Erosion and sediment control measures shall be constructed and implemented in accordance with a SWPPP to be prepared and approved prior to construction, and at a minimum will include the measures set forth in the Final SWPPP.

Some soil units found within the Project Area are considered to be acidic. Acidic soils are likely to be corrosive to steel and concrete. Steel may need a protective coating and concrete may require additives in the mixture to protect against corrosion. Detailed design requirements will be determined during the final engineering phase. In addition, construction excavations may encounter areas of perched groundwater if construction occurs during a time when a seasonally high water table may be present. In addition, construction during rainy periods may see an increase in perched groundwater due to the low hydraulic conductivity and soil permeability within the Project Area. Temporary de-watering may be required during the construction if perched water, groundwater or seepage is encountered. Open sump pumping method is the most common and economical method of dewatering, and is anticipated to be sufficient based on relatively low permeability soils anticipated at the site. As stated previously, the water will be discharged properly to an area identified with Final SWPPP. Dewatering methods will involve pumping the water to a predetermined well-vegetated discharge point, away from wetlands, waterbodies, and other sensitive resources. Discharge of water will include measures/devices to slow water velocities and trap any suspended sediment.

21(n) Bedrock and Underlying Bedrock Maps, Figures, and Analyses

A map detailing the anticipated depth to bedrock within the Project Area can be seen in Figure 21-3. According to this Figure, depth to bedrock within the Project Area will range anywhere from one inch to more than 78 inches below the ground surface. However, the mapping seems to indicate that 47% of the proposed turbine locations will have bedrock at a depth of greater than 78 inches below the ground surface.

Results of test borings performed to date by Kenney Geotechnical Services 22 wind turbine locations indicate that the majority of bedrock is sandstone with occasional layers of shale and conglomerate. The depth to rock, as identified on the available logs, varies across these 22 locations and ranges from one foot below ground surface (bgs) to over 40 feet bgs. At most locations where rock was encountered at shallow depths it consisted of Transition Zone Rock. This stratum consisted of bedrock that had been altered by glaciation and/or weathering. In some areas the Transition Zone Rock consisted of large slabs of detached competent bedrock with interbedded soil zones. In other areas the Transition Zone Rock consisted of highly weathered bedrock. The detached bedrock typically consisted of the local sandstone and siltstone. The interbedded soil zones typically consisted of red clay with angular green sandstone fragments the size of gravel. The red clay was derived from the weathering of the local red shale. This stratum typically had to be cored for sample recovery. At locations where augers could penetrate into this stratum the Standard Penetration Testing "N" values typically exceeded 100 blow per foot.

The majority of the bedrock encountered (either directly below glacial till or below the Transition Zone Bedrock described above) consists primarily of moderately hard fine-grained sandstone with occasional layers of soft red and green shale and moderately hard conglomerate, which was sampled using rock coring techniques. Based on available information from the test boring logs, the top of the coreable rock surface varies from approximately 6 feet (Test Borings T-16 and T-23) to greater than 40 feet (Test Boring T-22).

The Rock Quality Designation (RQD) of the coreable rock ranges from 0% to 87%, indicating "poor" to "good" condition using a standard RQD classification. In general, the RQD less than 50% appears to be within the depth of 25 feet bgs and the RQD becomes greater than 50% once the depth is more than 30 feet bgs. The unconfined compressive strength of the intact coreable ranges from 5,710 pounds per square inch (psi) to approximately 14,990 psi.

Based on available test boring information shale and sandstone in the Project Area is typically rippable to depths of up to 10 feet bgs using large hydraulic excavators equipped with rock teeth. However, pre-splitting is typically necessary if a neat excavation line is required. Below a depth of 10 feet it is likely that rock removal will involve the use of drills, hydraulic rock breakers and rock hammers, rock saws, and possible blasting.

Groundwater aquifers are located in the glacial outwash in the valley areas. Upland areas are subject to perched groundwater conditions during wetter period as infiltrating water becomes trapped within the soil above undisturbed clayey glacial till and bedrock. Figure 21-3 also depicts the anticipated depth to seasonal high water table (SHWT). Depth to SHWT is shown as ranging from the surface to more than 50 inches below the ground surface. With conditions being so variable across the site, it is not readily known if the proposed turbine locations will encounter or impact groundwater in the area. Test boring preformed to date did not encounter groundwater within overburden soils prior to introducing water for use in rock coring. However, as indicated, this could vary seasonally as perched water conditions could potentially develop. A more detailed geotechnical investigation will need to be completed prior to any site improvements to determine the actual elevations of groundwater in the area of the proposed turbines.

21(o) Evaluation of Suitable Building and Equipment Foundations

Foundation construction occurs in several stages, which typically includes excavation, pouring of concrete mud mat, rebar and bolt cage assembly, outer form setting, casting and finishing of the concrete, removal of the forms, backfilling and compacting, and site restoration. Excavation and foundation construction will be conducted in a manner that will minimize the size and duration of excavated areas required to install foundations.

(1) Preliminary Engineering Assessment

The available information suggests that the wind turbine foundations will be underlain by hard glacial till, transition zone rock with soil infill, and bedrock. It is therefore anticipated that the turbines can utilize a gravity shallow foundation system or a Patrick & Henderson Tensionless Pier (PHTP) foundation system. Design frost depth is four feet in the Project Area, and foundations must bear below this depth to prevent movement due to frost heave.

The glacial till typically provides high bearing strength and good short term excavation stability if it is left undisturbed. The glacial till contains a significant percentage of silt and clay and loses strength rapidly if saturated and subjected to dynamic loading such as that imparted by construction equipment.

Assuming the foundation excavations are properly managed during construction, an allowable bearing pressure of 5,000 pounds per square foot is appropriate for shallow foundations bearing on undisturbed glacial till. An allowable bearing pressure of 6,500 pounds per square foot is estimated for foundations bearing on Stratum C-Transition Zone Rock materials. An allowable bearing pressure of 10,000 pounds per square foot is estimated for foundations bearing on Stratum D – Bedrock. The turbine foundations excavations must be reviewed by geotechnical personnel to verify these allowable bearing pressures are appropriate during construction.

Settlement estimates will require more detailed information concerning turbine loading and will be prepared after the geotechnical investigation is completed. Based upon the borings performed to date, Table 21-6 outlines suggested geotechnical parameters for preliminary turbine foundation design.

Table 21-6. Suggested Geotechnical Parameters for Preliminary Turbine Foundation Design (Reproduced from Preliminary Geotechnical Investigation Report, Appendix 21-2)

Stratum	Avg Thickness (ft)	Unit Weight (pcf)	Total Stress		Effective Stress		k (pci)	ε50	Allow. Skin Friction (ksf)	Kp
			ϕ	Cohesion c (psf)	ϕ'	c' (psf)				
Stratum B-Glacial Till	15	135	0	2500	34	300	1000	0.005	1	9
Stratum C-Transition Zone	30	140			32	2500	1000	0.005	6	18
Stratum D-Bedrock	n/a	145			36	3500	2000	0.004	10	32

Therefore, the wind turbines can be supported by a gravity spread inverted "T" foundation system sized for over-turning, or a Patrick & Henderson Tensionless Pier system, as presented in Appendix 21-2 (Preliminary Geotechnical Report). The design frost depth is 4 feet below the ground surface in the Project Area. The shallow foundations of the wind turbines must bear below the frost depth to prevent movement due to frost heave. In general, the embedment of the shallow foundation was proposed to be at a minimum depth of 8 and 7.5 feet for the 3.4 and 2.3 MW units, respectively.

Instead of thick and/or deeply buried footing foundations, anchorage systems may be considered to resist overturning loads. Therefore, it is anticipated that turbines may be anchored at some locations. The anchor can be in soil stratum of glacial till or in bedrocks of shale and/or sandstone. Drilled, grouted, and pre-stressed high strength steel bars are typically the most effective anchorage systems in the anticipated ground conditions. These anchors should be designed in accordance with the "Recommendations for Pre-stressed Rock and Soil Anchors" published by the Post-Tensioning Institute.

Drilled shafts can be utilized to support the transmission line monopoles, although it may be necessary to core through boulders, detached rock slabs, and hard bedrock. It is assumed the drilled shafts may require using temporary steel casing to support the drilled hole above competent rock.

(2) Pile Driving During Construction

According to the subsurface condition within the Project Site, it is not anticipated that wind turbines will require pile foundation system in regard to bearing and overturning capability. Therefore, further assessment on pile foundation system was not performed.

Mitigation Measure for Pile Driving

As mentioned in Section 21(o)(2), pile foundation systems are not considered to support wind turbine structures. No mitigation measures are required.

21(p) Evaluation of Earthquake and Tsunami Event Vulnerability at the Facility Site

The Project Area is located in an area of relatively low seismic activity. The USGS Seismic Hazards database indicates a 0.74% chance of a magnitude 5.0 earthquake occurring in the next 50 years in the Project Area. The site has a dense soil cover and will not provide significant amplification of seismic waves. Geophysical surveys are part of the overall scope of services but were not authorized for this phase of the investigation and no site-specific shear wave velocity data is available. Based upon correlations with Standard Penetration Testing “N” values and New York State Building Code guidelines the available data suggests that Site Class C is appropriate. The estimated design spectral response acceleration parameters are S_{DS} = .101g and S_{D1} = .060g. Liquefaction, surface rupture from faulting or lateral spreading is estimated to have a low probability of occurrence given the soil conditions encountered and typical regional seismicity. The Project Area appears to have minimal vulnerability associated with seismic events based on review of publicly available data. The findings were provided in Section 21(k) above. Therefore, further analysis was not conducted.

21(q) Preliminary Geotechnical Investigation Report

The Preliminary Geotechnical Investigation Report is attached as Appendix 21-2. The key findings of this investigation are stated herein and in the aforementioned headings in this Exhibit. For a detailed review of the Preliminary Geotechnical Investigation Report please refer to the text above or specifically to Appendix 21-2.

In addition to the report mentioned above, Kenney also completed a Geotechnical Report specifically focused on the proposed location for the collection substation and the Operations and Maintenance (O&M) building (see Appendix 21-4), and a Preliminary Thermal and Electrical Resistivity Testing Report that is included as Appendix 21-5. Lastly, a Desktop Geotechnical Report was completed by Kenney prior to undertaking the geotechnical work at the Project, and is included as Appendix 21-6.