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Baron Winds Project

Case No. 15-F-0122

1001.21 Exhibit 21

Geology, Seismology, and Soils

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EXHIBIT 21 GEOLOGY, SEISMOLOGY, AND SOILS

(a) Existing Slopes Map

See Figure 21-1 for a map delineating existing slopes (0-3%, 3-8%, 8-15%, 15-25%, 25-35%, 35% and over) on and within the drainage area potentially influenced by the Facility Site and interconnections. This information is derived from digital elevation models produced by the U.S. Geological Survey (USGS) and the New York State Department of Conservation (NYSDEC). According to this source, slopes within the Facility Site range from 0% to 110%. However, the steepest slopes are associated with the electrical collection system, while slopes associated with access roads and turbines range from 0% to 32%.

Existing and proposed grades are also identified in the preliminary design drawings prepared in support of Exhibit 11.

(b) Proposed Site Plan

See the preliminary design drawings included with Exhibit 11, which include proposed and existing contours at two-foot intervals for the Facility Site and interconnections. The contours were created using publicly available 10-meter resolution elevation data.

(c) Cut and Fill

Based on preliminary cut and fill calculations on 2-foot contours interpolated from publicly available 10-meter contour data and preliminary engineering of the proposed Facility, it is anticipated that 8,025,750 cubic feet of material will be excavated for the construction of the proposed Facility. Of this amount, approximately 5,845,986 cubic feet will be topsoil, 2,179,764 cubic feet will be subsoil, and 295,909 cubic feet will be bedrock. For the purposes of these calculations, any depth greater than 132 inches was considered to be bedrock, which was the shallowest depth of bedrock observed by GZA at any of their boring locations. However, the depth to bedrock is greater than 132 inches in many areas based on geotechnical boring results. Soil profiles of the soil map units within the Facility Site were generated from data in the Soil Survey of Steuben County, New York (USDA, 1978). Cut calculations for each soil map unit were generated using ArcGIS software by overlaying a layer containing preliminary cut and fill data with a layer containing the profiles of soils within the Facility Site.

In addition, approximately 4,049,730 cubic feet of fill (of which 3,276,747 cubic feet will be gravel) is anticipated to be utilized for construction of the Facility. With the exception of gravel, fill material will be derived from excavated material, and no fill will need to be imported for construction of the Facility.

Note that these estimates are preliminary only and are based on publicly available 10-meter contour data, which has been interpolated to generate 2-foot contours associated with the Facility. The final footprint of the Facility will not be known until post-Certification and after a turbine model has been determined, which could very well result in fewer turbines (and correspondingly less infrastructure such as access roads) than proposed in this Application. Once the final footprint of the Facility is determined, the Applicant will finalize engineering with the objective of balancing the amount of cut and fill required to construct and operate the Facility, eliminating the need to import/export material to/from the Facility Site other than gravel.

The construction of the access roads, crane pads, collection substation, and laydown yards will require final grades in several areas of the Facility that necessitate cutting and filling. In the initial design process, the Applicant developed a basis of design for these features, as shown in the preliminary design drawings (Exhibit 11). Within these design parameters, the Applicant has aimed to minimize significant areas of cut or fill. However, various scenarios would create areas of cut and fill. These include constructing an access road that traverses an existing grade in excess of the maximum design slope, constructing on a side slope, or needing to flatten the top of an existing high point. Also, creating a minimally sloping area for the crane pad on a steep area will require areas of cut and/or fill.

(d) Fill, Gravel, Asphalt, and Surface Treatment Material

As previously noted, based on preliminary calculations, approximately 4,049,730 cubic feet of fill (of which 3,276,747 cubic feet will be gravel) is anticipated to be utilized for construction and operation of the Facility. Fill will be utilized to create appropriate grades for access roads, crane pads, substations, and laydown areas. With the exception of gravel, fill material will be derived from excavated material. Gravel will be brought into the Facility Site and used as surface material for access roads, crane pads, meteorological tower pads, and other Facility components. As stated above, with the exception of gravel, fill material will be derived from excavated material, and no new fill will need to be imported for the purposes of Facility construction and operation.

(e) Type and Amount of Cut Materials or Spoil to be Removed from the Facility and Interconnection Sites

It will not be necessary for cut materials or spoil to be removed from the Facility Site. Stockpiled soils along the construction corridors will be used in site restoration, and all such materials will be re-graded to approximate pre-construction contours.

Based on the preliminary cut and fill estimates provided above, when accounting for all anticipated cut and fill there will be an excess of approximately 3,976,020 cubic feet of excavation (cut). However, as previously indicated, the preliminary cut and fill calculations are based on publicly available 10-meter contour data, which has been extrapolated to generate 2-foot contours associated with the Facility. The Applicant will require that final engineering efforts maximize the balance of cut and fill, and ultimately any excess cut material will be utilized during site restoration. As stated above, with the exception of gravel, fill material will be derived from excavated material, and no fill will need to be imported for construction of the Facility. Furthermore, it will not be necessary for materials to be removed from the Facility Site. Stockpiled soils along the construction corridors will be used in site restoration, and all such materials will be re-graded to approximate pre-construction contours

With respect to imported material, see Section (d) above.

(f) Excavation Techniques to be Employed

Pending the receipt of all required permits, construction is anticipated to start in the winter of 2019. Facility construction will be performed in several stages and will include the main elements and activities described below.

(1) Pre-Construction Activities

Before construction commences, a site survey will be performed to stake out the exact location of proposed Facility components. To assure compliance with various environmental protection commitments and permit conditions, an Environmental Monitor will oversee Facility construction and restoration activities. Prior to the start of construction at any given site, the Environmental Monitor and a representative of the construction contractor will conduct a walk-over of areas to be affected, or potentially affected, by proposed construction activities. This pre-construction walk-over will focus on previously identified sensitive resources to avoid (e.g., wetlands, archaeological, or agricultural resources), as well as the limits of clearing, location of wetland and stream crossings, location of drainage features (e.g., culverts, ditches), location of underground utilities and tile lines, and layout of sedimentation and erosion control measures. Upon identification of these features, they will be marked in the field (by staking, flagging, fencing, etc.).

(2) Laydown Yard Construction

The construction laydown yard will be developed by stripping and stockpiling the topsoil and grading and compacting the subsoil. Geotextile fabric and gravel will then be installed to create a level working area. Electric and communication lines will be brought in from existing distribution lines to allow connection with construction trailers.

(3) Site Preparation for Construction

Facility construction will be initiated by clearing woody vegetation from all turbine sites, access roads, and electrical collection line routes. Trees cleared from the work area will be removed and disposed of off-site (outside of any wetlands, streams or floodways). Given that Steuben County is included in the emerald ash borer restricted zone, trees cleared from the area will not be disposed of outside of the restricted zone (see Exhibit 22 for additional detail). It is generally assumed that a radius of up to 225 feet will be cleared around each turbine, a 75-foot wide corridor will be cleared along access roads, while clearing along underground electric collection lines not adjacent to access roads is dependent on the number of circuits in parallel, from 20 feet for one circuit up to 60 feet for nine circuits. In addition, a 100-foot-wide corridor will be cleared along overhead sections of the electrical collection lines. Actual clearing impacts of the Facility will be based on final engineering and electrical design.

(4) Public Road Improvements

An appropriate turning radius (typically a 150-foot radius) will be established at the intersection of Facility access roads and public roads to accommodate the flow of construction traffic. Public roadway intersections along the construction and delivery routes may also require spot radii improvements and the construction of short temporary road segments to accommodate the turning radius of over-length delivery vehicles, and minimize disruption of local roads and traffic caused by large construction/delivery vehicles and equipment (see Exhibit 25 for details). These improvements will generally require soil stripping and the temporary placement of gravel over geotextile fabric. It is anticipated that some of these improvements will be removed, and the affected areas restored to their preconstruction condition. In addition, during the operational phase of the Facility, it may be necessary to temporarily re-constitute certain intersection improvements for the purposes of accommodating over-length deliveries associated with Facility maintenance.

(5) Access Road Construction

Wherever feasible, existing roads and farm drives will be upgraded for use as Facility access roads in order to minimize impacts to active agricultural areas, forest, and wetland/stream areas. Where an existing road or farm drive is unavailable or unsuitable, new gravel surfaced access roads will be constructed. Road construction will involve topsoil stripping and grubbing of stumps, as necessary. Stripped topsoil will be stockpiled (and segregated from subsoil) along the road corridor for use in site restoration. Any grubbed stumps will be removed from the site, chipped, or buried in upland areas of the Facility Site. Following removal of topsoil, subsoil will be graded, compacted, and surfaced with gravel or crushed stone. A geotextile fabric or grid will be installed beneath the road surface, if necessary, to provide additional support.

Measures such as culverts and waterbars will be installed to maintain natural drainage patterns and protect slopes. Where access roads must cross wetlands with flowing water or streams with flowing water, a temporary pump-around or coffer dam will be used to install crossings "in the dry." Appropriate sediment and erosion control measures will be installed and maintained according to the Facility-specific Stormwater Pollution Prevention Plan (SWPPP) developed in compliance with the NYSDEC State Pollutant Discharge Elimination System (SPDES) General Permit for Stormwater Discharges from Construction Activity (see the Preliminary SWPPP provided in Appendix II). During construction, roads with a travel surface of up to approximately 40 feet wide will be required to accommodate large cranes and oversized construction vehicles. At the completion of construction, the travel surface of access roads will generally be reduced to 20 feet. During the operational phase of the Facility, it may be necessary to temporarily re-constitute the travel surface of certain access roads to construction widths in order to accommodate over-sized deliveries associated with Facility maintenance. Typical access road details are included in Exhibit 11.

(6) Foundation Construction

Once the roads are complete for a particular group of turbine sites, turbine foundation construction will commence on that completed access road section. Initial activity at each tower site will typically involve clearing and leveling (as needed) up to a 225-foot radius around each tower location. Topsoil will be stripped from the excavation area, and stockpiled for future site restoration. Following topsoil removal, excavators will be used to excavate the foundation hole. Subsoil and rock will be segregated from topsoil and stockpiled for reuse as backfill. Blasting is not anticipated. All stockpiled soils will be located outside of wetlands and streams and will be stabilized in accordance with the final SWPPP. If necessary, dewatering of foundation excavations will involve pumping the water to a discharge point, which will include measures/devices to slow water velocities and trap any suspended sediment. Dewatering activities will not result in the direct discharge of water into any streams or wetlands, and will be conducted in accordance with the final SWPPP.

Turbine foundations will consist of reinforced concrete, approximately 10 feet deep, and 50 to 65 feet in diameter. Any excess concrete and concrete wash water at turbine sites will be properly disposed of either by pouring it into an excavation (either into the foundation excavation or "wash-out pits" created for this purpose) and then burying it or by removing the wash water from the site. No concrete will be buried or otherwise disposed of in wetlands. Once the foundation concrete is sufficiently cured, the excavation area around and over it will be backfilled with the excavated on-site material. The top of the foundation is typically an 18-foot diameter pedestal that extends six to eight inches above grade. The base of each tower will be surrounded by a 6-foot wide gravel skirt, and an area approximately 100 feet by 60 feet will remain as a permanent gravel crane pad.

(7) Electrical Collection System Installation

Direct burial methods utilizing typical industry equipment including, but not limited to, a cable plow, rock saw, rock wheel and/or trencher will be used during installation of the underground electrical collection system whenever possible. Direct burial involves the installation of bundled cable (electrical and fiber optic bundles) directly into a narrow cut or “rip” in the ground. The rip disturbs an area approximately 24 inches wide with bundled cable installed to a minimum depth of 36 inches in most areas, and 48 inches in active agriculture and pasture lands. Where direct burial is not possible, an open trench will be excavated. Using this installation technique, topsoil and subsoil are excavated, segregated, and stockpiled adjacent to the trench. Following cable installation, the trench is backfilled with suitable fill material and any additional spoils are spread out or otherwise properly disposed of. Following installation of the buried collection line, areas will be returned to pre-construction grades. Installation of buried electrical lines will require vegetation clearing dependent on the number of circuits to be installed, from 20 feet for one circuit up to 60 feet for nine circuits. However, in areas where buried electrical lines are collinear with proposed access roads or public roads, no additional vegetation or soil disturbance beyond that anticipated for road construction is typically expected. The cleared area along the buried electrical line will be restored through seeding and mulching. Temporary impacts associated with the buried electrical line will be maintained as a successional community with grasses and shrub woody vegetation allowed to regenerate naturally.

In some places, directional drilling or short sections of overhead line will be used to reduce wetland and stream impacts during construction. At locations where an electrical collection line crosses State-protected streams or State-protected forested wetlands, horizontal directional drilling (HDD) will be used to avoid impacts. In the case of streams, an overhead span may be used instead of HDD. For more information on exact locations where HDD and overhead spanning will be utilized to avoid impacts to streams and wetlands, see Exhibits 22 and 23.

HDD involves installing the cable under the wetland or stream using boring equipment set up on either side of the crossing. No surface disturbance is required between the bore pits, and all existing vegetation along the streams and within the wetlands (including mature trees) can remain in place. The only potential impact associated with directional drilling is a surface release of drilling mud. Such “frac-outs,” or inadvertent returns, are rare, and the contractor will be required to develop a final inadvertent return plan that will be implemented during construction. A Draft Inadvertent Return Plan is included as Appendix JJ.

(8) Wind Turbine Assembly, Erection and Commissioning

Turbine assembly and erection involves mainly the use of large trackmounted cranes, smaller rough terrain cranes, boom trucks, and rough terrain forklifts for loading and off-loading materials. The tower sections, rotor components, and nacelle for each turbine will be delivered to each site by flatbed trucks and unloaded by crane. A large erection crane will set the tower segments on the foundation, place the nacelle on top of the tower, and install the rotor either by individual blade installation or, following ground assembly, by placing the rotor onto the nacelle.

(9) Substation

Substation construction will begin with clearing the site and stockpiling topsoil for later use in site restoration. The site will be graded, and a laydown area for construction equipment, materials, and parking will be prepared. Concrete foundations for major equipment and structural supports will be placed, followed by the installation of various conduits, cable trenches, and grounding grid conductors. Above-ground construction will involve the installation of structural steel, bus conductors and insulators, switches, circuit breakers, transformers, control buildings, etc. The final steps involve laying down crushed stone across the station, erecting a chain link fence, connecting the high voltage links, and testing the control systems. Restoration of the area immediately adjacent to the substation will then be completed.

(10) O&M Building

Construction of the operation and maintenance (O&M) building will begin with clearing the site and stockpiling topsoil for later use in site restoration. The site will be graded, and an area for the building will be prepared. Concrete foundations for the building will be placed. Once the O&M building is constructed, the restoration of the area immediately adjacent will then be completed.

(g) Temporary Cut and Fill Storage Areas

The construction of the access roads, crane pads, and other site features will require final grades of several areas of the Facility that necessitate cutting and/or filling. In the initial design process, the Applicant developed a basis of design for these features. Within these design parameters, the Applicant has aimed to minimize significant areas of cut or fill. However, various scenarios would create areas of cut and fill. As previously noted, these include constructing an access road that traverses an existing grade that is in excess of the maximum design slope, constructing on a side slope, or needing to flatten the top of an existing high point. Also, creating a minimally sloping area for the crane pad on a steep area will require areas of cut and/or fill.

Proper methods for segregating stockpiled and spoil material will be implemented. Excavated soil will be reused to the maximum extent possible on the site from which it was excavated as a means of limiting opportunities for proliferation of non-native flora and other invasive species. Final cut and fill storage areas will be available following Certification, and included in the final construction drawings.

(h) Suitability for Construction

GeoEnvironmental of New York (GZA) conducted a Preliminary Geotechnical Assessment, to evaluate the surface and subsurface soils, bedrock, and groundwater conditions in the vicinity of the Facility (see Appendix KK). As part of this evaluation, GZA conducted a literature review of publicly available data, and made a site visit to observe surficial features and assess general constructability of the proposed Facility at ten test borings in and near the Facility Site. The results of the literature review are provided in detail in Section 2.0 of the Preliminary Geotechnical Assessment. The review of publicly available data includes an assessment of each soil type within the Facility Area with regard to factors such as permeability, pH, water capacity, and risk of corrosion to concrete and steel (see Appendix KK, Table 4).

The preliminary subsurface investigations by GZA included subsurface soil and bedrock sampling and limited geotechnical laboratory testing at 10 boring locations (seven of which are at proposed turbine locations). At the time of the soil boring investigation, all 10 boring locations were at proposed turbine sites. Since the completion of the subsurface investigation, some of the proposed turbine locations were removed. The three borings not at proposed turbine sites were considered turbine locations in the initial layout. The information obtained from these locations are representative of the overall study area. The Preliminary Geotechnical Assessment included borings to test for subsurface soil, bedrock, and groundwater properties. Laboratory tests included tests for moisture content, gradation testing, and Atterberg limits. The soil boring logs and laboratory test results are included in Attachment C of the Preliminary Geotechnical Assessment (Appendix KK).

Based on GZA's findings, the Facility Area is generally suitable for the proposed Facility. However, due to the variability in the soil types, overburden thickness, and groundwater depths across the Facility Area, GZA recommends additional soil borings be performed prior to construction to assess localized subsurface conditions at proposed structure locations. The test results would be used by the foundation designers for consideration of concrete and steel design requirements. The Preliminary Geotechnical Assessment is discussed further in the sections below and is available in full in Appendix KK.

More generally, prior to construction, a detailed geotechnical investigation will be performed to verify subsurface conditions at each turbine location to allow development of final wind turbine foundation and electrical design, and other Facility components as necessary. Construction procedures and recommendations based on the Preliminary Geotechnical Assessment are described in detail in Section 5.0 of Appendix KK.

(i) Preliminary Blasting Plan

According to the Preliminary Geotechnical Assessment (see Appendix KK), based on the depth of bedrock and the weathered and very poor rock quality conditions observed, blasting will likely not be necessary for construction of proposed wind turbine foundations and associated equipment. If bedrock or boulders are encountered and require removal, the bedrock and boulders are assumed to be rippable with an excavator and/or able to be broken with a pneumatic hammer. Therefore, a Preliminary Blasting Plan is not necessary. GZA also indicated that information obtained from the soil borings completed at the Facility Site suggest that shallow mat foundations are feasible for turbines and building structures and that driven piles are not likely to be necessary at the Facility Site.

(j) Potential Blasting Impacts and Proximity to Natural Gas Wells

As indicated above, blasting will not be necessary for this Facility due to the depth of bedrock and very poor rock quality conditions. Therefore, blasting-related impacts will not occur.

With respect to natural gas production, according to the NYSDEC, there are no natural gas or oil wells within the Facility Site and only one natural gas or oil well within the larger Facility Area evaluated in the Preliminary Geotechnical Assessment (NYSDEC, 2017). The Losey 1 – Wittmer oil and gas well (identified in Figures 5A and 5B of Appendix KK) is approximately 2,700 feet from the nearest Facility component. According to NYSDEC, the well is listed as abandoned. All turbines will be sited a minimum of 500 feet from gas wells, which is expected to eliminate potential impacts associated with turbine foundation construction. Figure 4-3 depicts the location of all existing and abandoned oil and gas wells within 5 miles of the Facility Site.

(k) Mitigation Measures for Blasting Impacts

No blasting will be required, and therefore mitigation related to blasting will not be necessary.

(l) Regional Geology, Tectonic Setting, and Seismology

Information regarding geology, tectonic setting, and seismology was obtained from on-site investigations conducted by GZA and from existing published sources, including the Soil Survey of Steuben County (USDA, 1978), 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, 2017). Investigations conducted by GZA included a literature review of publicly available data, a site visit to observe surficial features and assess general constructability of the proposed Facility, and a preliminary subsurface investigation including seven test borings throughout the Facility Area and three test borings in the vicinity of the Facility Area that are representative of the Facility Area (GZA's Preliminary Geotechnical Assessment is provided in Appendix KK).

The Facility is located in the western Finger Lakes region of the Appalachian Plateau physiographic province of New York State. Elevations in the Facility Site range from between 1,400 feet to 2,100 feet above mean sea level (amsl). The Appalachian Plateau in Steuben County is characterized by many broad, deep, flat-bottomed valleys, occupied by meandering streams. The areas between the valleys consist of rolling uplands and some flat-topped hills that formed partly because of the nearly horizontal bedding of the underlying bedrock (USDA, 1978). All of the bedrock in Steuben County is of Devonian age, and is generally formed from deltaic deposits. Most of the beds formed broad and open folds that trend to the northeast, and are about 5 to 10 miles apart. The bedrock underlying the vicinity of the Facility Site consists of members of the Canadaway, Java, and West Falls Group, all of the upper Devonian (Rickard and Fisher, 1970). The formations that comprise the Canadaway Group are chiefly composed of shales, sandstone, and siltstone. The Canadaway Group averages about 1,000 feet in thickness. The Java Group is predominately comprised of sandstone and shale. The West Falls formation has seven members, which are predominately sandstone, shale, and siltstone.

The surficial geology underlying the Facility Site and vicinity is dominated by glacial till, which exhibits a wide range of particle and rock fragment size. The layer of glacial till itself is often of varying thickness and can range from a few feet on some ridge tops to more than 10 feet below higher ridges (USDA, 1978). The surficial geology of the lower portions of the Facility Area such as the Cohocton River Valley is characterized by lacustrine silt and clay of varying thickness as well as proglacial fluvial outwash.

Based on the 2014 New York State Hazard Map (USGS, 2014b), the Facility Site is located in an area of relatively low seismic hazard, with a 2% or less chance that peak ground acceleration in a 50-year window is between 4% and 8% of standard gravity. The only recorded earthquake in Steuben County since 1950 occurred near Bath, New York (about 10 miles southeast of the Facility Site) in 2001 with a Richter scale magnitude of 3.2 (USGS, 2017). The USGS Earthquake Hazards Program does not list any young faults, or faults that have had displacement in the Holocene epoch, in the vicinity of the Facility Site.

(m) Facility Impacts on Regional Geology

GZA concludes that the bedrock encountered in the Facility Area is structurally suitable for support of wind turbines foundations, support buildings, and access roads. GZA indicates that a detailed subsurface survey should be completed in the footprint of each of the turbines prior to Facility construction. The Facility is not anticipated to result in any significant impacts to geology. However, depth to bedrock in the Facility Area is expected to be variable and it is possible that some turbine foundations may be anchored to bedrock (Appendix KK). Based on the weathered and very poor rock quality conditions observed at the ten test boring locations, blasting will not be required. The bedrock encountered at the test boring locations is expected to be rippable using typical construction excavation equipment (i.e., backhoe) and/or broken up using a pneumatic hammer. Based on the Applicant's experience constructing other wind power facilities (including in New York State), only temporary, minor impacts to geology are expected as a result of construction activities. For example, where turbine and access road sites are not located on completely level terrain, some cut and fill will be required; however, the impact to overall topography will be minor. Once operational, Facility impacts to geology will be minimal.

(n) Impacts of Seismic Activity on Facility Operation

As previously indicated, faults in 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 Facility. Therefore, this topic will not be further addressed in this Application.

(o) Soil Types Map

See Figure 21-2 for a map delineating soil types within the Facility Site. Those soils within the Facility Site are discussed in the following subpart. Data from U.S. Department of Agriculture (USDA) Natural Resources Conservation Service (NRCS), Web Soil Survey, was used to map the locations of prime farmland, prime farmland if drained, and farmland of statewide importance.

A plan for protecting agricultural topsoil from mixing with subsoil and other spoil material such as waste rock, and for preserving such soils and avoiding compacting agricultural spoils, will be developed prior to commencing disturbance of farmland. The plan will be submitted to the New York State Department of Agricultural and Markets for approval. The plan may include retention of a full-time agricultural monitor.

(p) Characteristics of Each Soil Type and Suitability for Construction

Information regarding on-site soils was obtained from on-site investigations conducted by GZA during the Preliminary Geotechnical Assessment and from existing published sources, including Soil Survey of Steuben County (USDA, 1978), USDA Web Soil Survey (2016), and USDA Soil Survey Geographic (SSURGO) Database (Soil Survey Staff et al., 2017). Investigations conducted by GZA included a literature review of publicly available data, a site visit to observe surficial features and assess general constructability of the proposed Facility, and a preliminary subsurface investigation (including subsurface soil and bedrock sampling and limited geotechnical laboratory testing). GZA conducted a preliminary subsurface investigation at ten test boring locations. However, since the subsurface investigation was conducted the Facility has been reduced from 116 turbines to 76 turbines, so only seven boring locations (nine percent of the representative turbine locations) occur within the current Facility Area. The additional three boring locations occur just outside the Facility Area, but are still representative of the conditions expected within the smaller Facility Area and so are included in the GZA analysis. The Soil Survey of Steuben County provides surface soil information that can be applied in managing farms and woodlands, as well as selecting sites for roads, ponds, buildings, and other structures and in judging the suitability of tracts of land for potential uses including farming, industry, and recreation (GZA, 2017).

The Soil Survey of Steuben County, New York (USDA, 1978) indicates that the Facility Site predominantly consists of three General Soil Associations: Bath-Lordstown, Freemont-Mardin, and the Lordstown-Arnot associations. Most of the proposed turbine and substation locations are located within the Bath-Lordstown and Fremont-Mardin associations. Table 21-1 lists the soils associations found within the Facility Site and their characteristics. From these associations, there are 23 soil series within the Facility Site, of which there are 38 individual soil map units. However, five soil series, Mardin, Fremont, Lordstown-Arnot, Volusia, and Bath, comprise approximately 79.1% of the soils by area within the Facility Site. General descriptions of these five series are provided in Table 21-2. Additionally, all 38 of the individual soil map units that occur within the Facility Site, as well as their respective areas, are provided in Table 21-3 below.

Table 21-1. Soil Associations within the Facility Site

Soil Association	Main Characteristics
Bath-Lordstown Association	• Gently sloping and sloping, and moderately deep to deep • Well drained • Course textured soils • Found on uplands
Fremont-Mardin	• Nearly level to moderately steep and very deep • Somewhat poorly drained and moderately well drained • Fine and course textured soils • Found on uplands

Soil Association	Main Characteristics
Lordstown-Arnot	• Dominantly nearly level and gently sloping, and very deep • Somewhat poorly drained to very poorly drained • Medium textured soils that have a medium content of lime • Found on broad flats in valleys

Source: Soil Survey of Steuben County (USDA, 1978)

Table 21-2. Dominant Soil Series within the Facility Site

Soil Series	Main Characteristics
Mardin Series	• Moderately well drained, medium textured • Depth to bedrock greater than 78 inches • Gently sloping to moderately steep on upland plateaus • Well expressed fragipan at a depth of 14–23 inches • Rate of water movement is moderate above the fragipan and slow in and below the fragipan
Freemont Series	• Somewhat poorly drained, medium to moderately fine textured • Depth to bedrock greater than 78 inches • Found on broad upland flats, in saddles, and on side slopes (0% to 25% slopes) • Rate of water movement is moderately slow in the surface layers and very slow in the substratum
Lordstown Series	• Well drained • Moderately deep, depth to bedrock 20-40 inches • Found on gently sloping to very steep bedrock-controlled ridges, hilltops, and steep valley sides • Rate of water movement is moderate throughout soil
Volusia Series	• Somewhat poorly drained • Depth to bedrock greater than 78 inches • Found on long uniform slopes that are on valley sides and broad divides on uplands. • Well defined fragipan at a depth of 10-20 inches • Rate of water movement is moderate through both the surface layer and often highly impeded at or below the fragipan layer
Bath Series	• Well drained • Deep, depth to bedrock is 60 inches or more • Gently sloping to steep, found on uplands at higher elevations. • Very firm, brittle fragipan at a depth of 26-36 inches

Source: Soil Survey of Steuben County (USDA, 1978)

Table 21-3. Soil Map Units within the Facility Site

Soil Unit	Area within Facility Site (acres)	Percent of Facility Site Area
Fremont silt loam, 2 to 8 percent slopes	1,809.2	21.2
Mardin channery silt loam, 8 to 15 percent slopes	864.0	10.1
Volusia channery silt loam, 8 to 15 percent slopes	780	9.2
Mardin channery silt loam, 2 to 8 percent slopes	628.7	7.4
Lordstown-Arnot association, steep	557.1	6.5
Lordstown-Arnot association, very steep	558.3	6.6
Bath channery silt loam, 3 to 12 percent slopes	555.5	6.5
Mardin channery silt loam, 15 to 25 percent slopes	351.3	4.1
Lordstown channery silt loam, 12 to 20 percent slopes	328.5	3.9
Arnot channery silt loam, 2 to 20 percent slopes	302.4	3.5
Bath channery silt loam, 12 to 20 percent slopes	296.6	3.5
Lordstown channery silt loam, 3 to 12 percent slopes	214.8	2.5
Howard-Madrid complex, 20 to 30 percent slopes	187.3	2.2
Volusia channery silt loam, 3 to 8 percent slopes	148	1.7
Fluvaquents and Ochrepts	134.6	1.6
Bath channery silt loam, 20 to 30 percent slopes	116.3	1.4
Howard-Madrid complex, undulating	97.6	1.5
Volusia channery silt loam, 15 to 25 percent slopes	86.3	1.0
Ochrepts and Orthents	84.8	1.0
Howard-Madrid complex, rolling	66.0	0.8
Howard gravelly loam, rolling	59.5	0.7
Chenango channery silt loam, fan	56.0	0.7
Bath soils, steep	56.1	0.7
Chippewa channery silt loam	25.8	0.3
Alden silt loam	10.6	0.1
Howard and Alton gravelly soils, 30 to 45 percent slopes	20.0	0.2

Soil Unit	Area within Facility Site (acres)	Percent of Facility Site Area
Wayland soils complex, non-calcareous substratum, 0 to 3 percent slopes, frequently flooded	17.7	0.2
Tuller channery silt loam, 0 to 6 percent slopes	17.4	0.2
Howard gravelly loam, undulating	16.5	0.2
Hornell and Fremont silt loams, 12 to 20 percent slopes	15.2	0.2
Mardin channery silt loam, 8 to 25 percent slopes, severely eroded	14.0	0.2
Middlebury silt loam	10.5	0.1
Hornell-Fremont silt loams, 1 to 6 percent slopes	7.9	0.1
Hornell-Fremont silt loams, 6 to 12 percent slopes	7.0	0.1
Red Hook silt loam	6.3	0.1
Palms muck	5.7	0.1
Braceville gravelly silt loam, 0 to 3 percent slopes	4.4	0.1
Howard and Alton gravelly soils, 20 to 30 percent slopes	0.5	<0.1

Source: (Soil Survey Staff et al., 2017)

The vast majority of soils by area in the Facility vicinity are silt loams and channery silt loams, but textures such as gravelly loam, gravelly, gravelly silt loam, and muck are present in small areas. Soil drainage is generally moderately well drained to somewhat excessively well drained, with approximately 41% of the on-site soils well drained, 23% moderately well drained, 34% somewhat poorly drained, and 2% poorly to very poorly drained (Soil Survey Staff et al., 2017). Soils that are listed as hydric by the NRCS cover approximately 2% of the Facility Site, with Fluvaquents and Ochrepts (map unit FL) being the prominent hydric soil.

Approximately 62% of the Facility Site contains soils classified as either prime farmland soils, prime farmland soils, if drained, or farmland of statewide importance (Soil Survey Staff et al., 2017). None of the soils within the Facility Site were classified as unique farmland or farmland of local importance (Soil Survey Staff et al., 2017). Upon consultation with the Allegany/Steuben County NRCS office (July 28, 2017), the Applicant confirmed that no soils classified as unique farmland or farmland of local significance were present within the Facility Site (Kos, 2017, pers. comm.). For additional information about agricultural resources within the Facility Site, including designated Agricultural District lands, see Exhibits 4 and 22 of this Application.

The primary impact to the physical features of the Facility Site will be the disturbance of soils during construction. Based on the assumptions outlined in Exhibit 22(b), Table 22-1, disturbance to soils from all anticipated construction activities will total approximately 456.2 acres. Of this total, only approximately 126.6 acres will be converted to built facilities (roads, turbine foundations/crane pads, collection substation, and O&M building), while the remainder 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 (e.g., buried collection line within the access road disturbance), and will vary based on the specific construction activity, the construction techniques employed, and soil/weather conditions at the time of construction. Table 21-4 provides a summary of the anticipated temporary and permanent impacts from construction and operation of the facility to each soil map unit.

Table 21-4. Anticipated Impacts to soils

Soil Series Name	Temporary (acres)	Permanent (acres)	Total (acres)
Alden silt loam	0.1	0.0	0.1
Arnot channery silt loam, 2 to 20 percent slopes	16.3	8.4	24.7
Bath channery silt loam, 3 to 12 percent slopes	47.2	17.2	64.4
Bath channery silt loam, 12 to 20 percent slopes	6.1	2.7	8.8
Bath channery silt loam, 20 to 30 percent slopes	2.4	2.1	4.5
Bath soils, steep	0.3	0.0	0.3
Chenango channery silt loam, fan	1.3	0.3	1.6
Chippewa channery silt loam	0.3	0.2	0.5
Fluvaquents and Ochrepts	1.1	0.0	1.1
Fremont silt loam, 2 to 8 percent slopes	96.9	37.9	134.8
Hornell-Fremont silt loams, 1 to 6 percent slopes	1.6	1.3	2.9
Hornell-Fremont silt loams, 6 to 12 percent slopes	2.4	0.8	3.2
Hornell and Fremont silt loams, 12 to 20 percent slopes	0.5	0.9	1.4
Howard-Madrid complex, undulating	2.1	0.3	2.4
Howard-Madrid complex, rolling	1.4	0.0	1.4
Howard-Madrid complex, 20 to 30 percent slopes	0.7	0.0	0.7
Lordstown channery silt loam, 3 to 12 percent slopes	18.6	5.3	23.9
Lordstown channery silt loam, 12 to 20 percent slopes	13.4	7.1	20.5
Lordstown-Arnot association, steep	4.0	1.3	5.3
Lordstown-Arnot association, very steep	1.3	0.3	1.6
Mardin channery silt loam, 2 to 8 percent slopes	54.4	19.4	73.8

Soil Series Name	Temporary (acres)	Permanent (acres)	Total (acres)
Mardin channery silt loam, 8 to 15 percent slopes	20.4	9.5	29.9
Mardin channery silt loam, 15 to 25 percent slopes	3.7	0.4	4.1
Mardin channery silt loam, 8 to 25 percent slopes, severely eroded	0.3	0.0	0.3
Middlebury silt loam	0.2	0.9	1.1
Ochrepts and Orthents	1.6	0.0	1.6
Palms muck	0.1	0.0	0.1
Tuller channery silt loam, 0 to 6 percent slopes	0.3	0.3	0.6
Volusia channery silt loam, 3 to 8 percent slopes	4.2	1.7	5.9
Volusia channery silt loam, 8 to 15 percent slopes	23.0	8.0	31.0
Volusia channery silt loam, 15 to 25 percent slopes	3.2	0.3	3.5
Wayland soils complex, non-calcareous substratum, 0 to 3 percent slopes, frequently flooded	0.2	0.0	0.2
Total	329.6	126.6	456.2

Based on a review of USGS hazard maps, the Facility Site has a low incidence of landslides (USGS, 2014a). The erosion hazard of on-site soils is “slight” for 3% of the Facility Site, “moderate” for 55% of the Facility Site, and ”severe” for 42% of the Facility Site (USDA, 2016). Areas of severe erosion hazard occur throughout the Facility Site, primarily associated with slopes in excess of eight percent. Twelve turbines (T3, T6, T11, T22, T62, T64, T68, T69, T74, T77, T85, and T87) of the 76 proposed Facility turbines are located on soils with a severe erosion hazard rating. Additionally, approximately 3.4 miles of proposed access road (16% of the Facility total) are located on soils with a severe erosion hazard rating. With respect to electrical collection lines, approximately 9.5 miles (26% of the Facility total) are located on soils with a severe erosion hazard rating. By comparison, the O&M building, permanent meteorological towers, and collection substation are not located on soils with a severe erosion hazard rating. Earth moving and general soil disturbance will increase the potential for wind/water erosion and sedimentation into surface waters during construction.

Based on engineering for the Facility and sediment/erosion control procedures, construction on steep slopes (i.e., in excess of 15%) has been avoided to the extent practicable within the Facility Site by siting access roads and wind turbines in a linear fashion along the ridgelines as opposed to traversing the hillsides in multiple locations. Implementing the erosion and sediment control measures outlined in the Preliminary SWPPP in Appendix II 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 Facility-related runoff is concentrated will be armored with rip-rap to dissipate the energy of flowing water and 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 fences, and/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.

Construction procedures for ensuring excavation stability include:

- Excavation will be completed using conventional construction equipment including bulldozers, track hoes, and possible plan excavators.
- Based on the document review and preliminary soil boring investigation, foundations for the proposed turbines are assumed to be constructed on anchored shallow mat foundations. However, prior to construction, it is recommended that additional soil borings be completed at each proposed turbine location to evaluate and design specific foundation requirements and bearing grades.
- Prior to construction, topsoil will be stripped from the excavation area (access roads, crane pads, and foundation areas). Any loose or unstable soils that are encountered during preparation of the subgrade will be removed and replaced with compacted approved granular fill.
- Following topsoil stripping and removal of unsuitable fill soils, the exposed undisturbed soils will be proof-rolled with a drum roller. Weak or soft spots identified during proof rolling will be excavated and replaced with compacted approved granular fill.

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 SPDES General Permit for the Facility. See Exhibit 23 for details. Erosion and sediment control measures will 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 Preliminary SWPPP provided in Appendix II.

With respect to corrosion potential, soil units found within the Facility Site are generally considered to be acidic (having a pH of 3.6 to 8.4) (USDA, 2016). Acidic soils are likely to be corrosive to bare steel or concrete. Bare 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 of the Facility.

Based on information from the Steuben County Soil Survey, construction excavations may encounter areas of perched groundwater if construction occurs during a time when a seasonally high water table may be present (spring and fall). In addition, construction during rainy periods may see an increase in perched groundwater due to the low hydraulic conductivity within the Facility Site. Construction dewatering may be required for surface water control and for excavations that encounter perched groundwater conditions. The determination whether long-term dewatering is necessary will be addressed during final geotechnical investigations to be conducted at each turbine location following Certification. See Exhibit 23(b)(5) for detail on dewatering methods.

Soils within the Facility Site have a moderate to high risk of frost action because of seasonally high water table or perched water table due to low permeability, except Lordstown channery silt loan, Lordstown-Arnot association, Howard gravelly loam, Howard and Alton gravelly soils, and Howard-Madrid complex, which exhibit high water tables greater than six feet below ground surface. GZA recommends that foundations in these areas be constructed at suitable depths below the frost line, assumed to be three to four feet below ground surface.

Specific to the Facility Area, GZA approximated a site class definition for consideration under the New York State Building Code for the proposed turbine locations. Based on test borings taken during the subsurface investigation, GZA recommends an overall site class C, indicating very dense soil and soft rock and determined that a wind power generation facility would be appropriate for this subsurface profile. Excavation and foundation construction is discussed further in Section (r) below.

The subsurface conditions encountered in the test borings were observed to be generally consistent with the mapped surficial and bedrock geology at those locations. Based upon the subsurface conditions encountered at the test borings, conventional shallow anchored mat turbine foundations, direct embedded or drilled pier transmission structure foundations, and shallow spread footing building foundations are appropriate for the subsurface conditions.

During GZA's subsurface investigation, groundwater was encountered at one of the ten boring locations. It is unlikely that foundation construction activities associated with the turbines, support structures, and interconnection lines will encounter or impact subsurface groundwater, which, depending on location, is assumed to be at deeper depths. Additionally, based on at least 1,000-foot setback of turbines from residential structures, it is unlikely that turbine foundation construction activities will have an impact on quality or quantity of shallow aquifers or residential groundwater wells. However, as a check on the potential impacts of nearby construction activities, pre- and post-construction baseline testing of water wells located within 100 feet of Facility components, as well as within 1,000 feet of Facility turbines, should be conducted to determine any surficial impacts to groundwater drinking wells. Groundwater within the Facility Area is further discussed in Exhibit 23(a).

Design and construction of the proposed foundations, roadways, and work pads should anticipate surficial topsoil and subsoil overlying generally poor draining, slightly plastic, and frost-susceptible overburden glacial till, and further soil overlying weathered bedrock. The weathered bedrock may be characterized as soil similar to the glacial till for engineering purposes. To minimize impact to turbine foundations and associated buried collection lines, these components will be constructed on top of well-drained, compacted structural fill, and therefore will not be in direct contact with native soils that are reported as high corrosive and/or high frost risk potential. In addition, foundations and associated buried interconnect are typically placed at depths below the frost zone. Also, the use of structures backfill soil that is less susceptible to frost action around these features will minimize the potential for concrete damage from frost action as they will not be in direct contact with the native soils that are of concern. A technical discussion of additional construction considerations, procedures, and recommendations from an engineering perspective are presented in GZA's report provided in Appendix KK.

Prior to construction, a geotechnical investigation will be completed at each final turbine location. Soil samples will be collected and tested for typical corrosivity parameters (e.g., sulfates, chlorides) for verification. The test results will be used by the foundation designers for consideration of concrete and steel design requirements.

(q) Bedrock Analyses and Maps

Information regarding depth to bedrock, underlying bedrock types, and vertical profiles of soil, bedrock, water table, and seasonal high groundwater within the Facility Area was obtained from on-site investigations conducted by GZA during the Preliminary Geotechnical Assessment and from existing published sources, including the Soil Survey of Steuben County (USDA, 1978), statewide bedrock geology mapping (NYS Museum/NYS Geological Survey, 1999a), New York State surficial geology mapping (NYS Museum/NYS Geological Survey, 1999b), and USDA Web Soil Survey (2016). Investigations conducted by GZA included a literature review of publicly available data, a site visit to observe surficial features and assess general constructability of the proposed Facility, and a preliminary subsurface investigation (including subsurface soil and bedrock sampling and limited geotechnical laboratory testing) at seven test boring locations throughout the Facility Area and three test borings in the vicinity of the Facility Area that are representative of the Facility Area (GZA's Preliminary Geotechnical Assessment is provided in Appendix KK). This section also evaluates the typical foundation depth as it relates to bedrock.

A general discussion of bedrock within the Facility Site is provided in Section (l) above. Bedrock in the region of the Facility Site is typified by stratified beds of shale, siltstone, and sandstone, which gently tilt towards the south-southwest. See Figure 21-3 for a map of depth to bedrock, underlying bedrock types, and depth to water table at the Facility Site. In addition, Figures 1 through 6 of the Preliminary Geotechnical Assessment show all Facility components and test boring locations. The soil boring logs and laboratory test results are included in Attachment C of Appendix KK.

As a preliminary matter, GZA accessed publicly available oil and gas and water well drilling logs from NYSDEC to determine depth to bedrock in wells drilled in the Facility Area (NYSDEC, 2016). These sources indicated that depth to bedrock in wells drilled in the upland areas of the Facility Area generally range from 30 feet to 70 feet below ground surface, with greater depths reported in wells proximate to Loon Lake in the northwestern portion of the Facility Area (NYSDEC, 2016). However, according to GZA's report, most of the proposed turbine and substation locations are not proximate to a completed well. Therefore, bedrock depths at each proposed structure location needed to be confirmed through additional soil boring investigations.

GZA completed a preliminary subsurface investigation, which included subsurface soil and bedrock sampling and geotechnical laboratory testing at ten proposed turbine locations in or near the Facility Area (see Appendix KK). Based on the subsurface soil testing, the majority of values ranged between dense and very dense relative density, for granular soils, or medium to hard consistency for fine-grained cohesive soils. Soils that exhibit a relative density of medium dense and consistency of medium, at a minimum, are suitable for shallow foundation construction. Moderately to severely weathered sedimentary bedrock (shale, siltstone, and/or sandstone) was encountered within 11 to 21 feet below ground surface (bgs) at seven soil boring locations. At the remaining soil borings locations, evidence of severely weathered bedrock was observed at depths typically greater than 30 feet bgs. In general, rock core samples identified medium to thinly-bedded formations consisting of interbedded shale and/or siltstone. The bedrock encountered at the completed test boring locations is identified as soft to hard rock that is expected to be rippable using typical construction excavation equipment and/or easily broken up using a pneumatic hammer. However, excavation at these depths is considered unlikely. According to GZA's report, based on the depth of bedrock and its weathered and very poor rock quality conditions observed, blasting would likely not be necessary for construction of proposed wind turbine foundations and associated equipment.

Based on the Preliminary Geotechnical Assessment, foundation construction most likely will not encounter bedrock that requires removal. As such, blasting of near-surface exposed rock and rock removal is not likely. If encountered and requiring removal at select locations, the bedrock is assumed to be rippable with an excavator or able to be broken by pneumatic hammer. The bedrock encountered is considered to be structurally suitable for support of foundations for wind turbines, support buildings, and access road construction. However, GZA recommends that all turbine locations undergo additional subsurface investigation prior to turbine construction.

With regard to water tables, the county soil survey provides the depth to the seasonally high water table, evaluated to a depth of six feet, for soils within the Facility Site. According to this information, the seasonally high water table is within one foot of the soil surface over approximately 66% of the Facility Site (Soil Survey Staff et al., 2017). For additional information about groundwater and surface waters on the Facility Site, see Exhibit 23 of this Application.

During GZA's subsurface investigation, groundwater was encountered at one of the ten boring locations. It is unlikely that foundation construction activities associated with the turbines, support structures, and collection lines will encounter or impact subsurface groundwater. The generally hard to very dense overburden till soils at select locations are expected to have moderate permeability or hydraulic conductivity allowing for good drainage. In addition, the proposed turbine sites are typically located at the higher elevations for the area and median depth to groundwater is reported as approximately 80 feet on hilltops within the Chemung River Basin (GZA, 2017).

Residential and community groundwater wells within the Facility Area are generally assumed to utilize groundwater wells that are deeper than the proposed wind turbine foundations and associated buried electrical collection lines. Additionally, turbine setbacks from residential structures are more than 1,000 feet. Therefore, based on data reviewed by GZA and setback distance, it is unlikely construction of the proposed turbines will have an impact on shallow aquifer or residential water well groundwater quality or quantity (GZA, 2017). However, as a check on the potential impacts of nearby construction activities, pre- and post-construction baseline testing of water wells located within 100 feet of Facility components, as well as within 1,000 feet of Facility turbines will be conducted to determine any surficial impacts to groundwater drinking wells. Groundwater within the Facility Area is further discussed in Exhibit 23(a).

The complete results of GZA's Preliminary Geotechnical Assessment, including boring logs for all subsurface investigations, are included in Appendix KK.

(r) Foundation Evaluation

Foundation construction occurs in several stages, which typically include 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. In addition, foundations will be constructed and inspected in accordance with relevant portions of the New York State Building Code and in conformance with GZA's Preliminary Geotechnical Assessment report.

(1) Preliminary Engineering Assessment

As previously mentioned, based on GZA's research, the overburden soils and shale, siltstone, and sandstone bedrock encountered is generally considered to be structurally suitable for support of foundations for wind turbines, support buildings, and access road construction. However, GZA recommends additional soil borings be performed prior to construction to assess localized subsurface conditions at proposed structure locations. GZA states that conventional shallow anchored mat foundations for wind turbine support and shallow spread wall foundations for ancillary building support may be used. However, foundations in some locations might require anchoring into bedrock. Very dense or very stiff to hard soil, or shale and/or siltstone bedrock, which is found within the Facility Area, is a suitable bearing surface for the bottom of the foundations. Frost action is generally considered to be moderate to high risk for the soils with seasonally high water or perched water table due to low permeability soil. GZA recommends that foundations in these areas should be constructed at suitable depths below the frost line, assumed 3 to 4 feet below ground surface (bgs) and up to 4.5 feet bgs on hilltops. For footings supported on soil, continuous wall footings should be at least 24 inches wide and isolated footings at least 48 inches wide.

(2) Pile Driving Assessment

The Applicant has concluded that pile driving is not needed for the Facility. As described in Section (i), above, GZA indicated that information obtained from the soil borings completed at the Facility Site suggest that shallow mat foundations are feasible for turbines and building structures and that driven piles do not seem likely to be used at the Facility Site. Therefore, further assessment was not conducted.

(3) Mitigation Measures for Pile Driving Impacts

The Applicant has concluded that pile driving is not needed for the Facility. Therefore, mitigation measures related to pile driving are not necessary.

(s) Vulnerability to Earthquake and Tsunami Events

As previously indicated, the Facility appears to have minimal vulnerability associated with seismic events based on review of publicly available data. In addition, because the Facility is located approximately 60 miles from the nearest large water body (Lake Ontario), there is no vulnerability associated with tsunami events. Therefore, further analysis was not conducted.

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