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February 11, 2020

Ms. Tanowa Troupe, Secretary
Ohio Power Siting Board
Docketing Division
180 East Broad Street, 11th Floor
Columbus, Ohio 43215-3797

Re: **Case No. 18-1607-EL-BGN -** In the Matter of the Application of Firelands Wind, LLC for a Certificate of Environmental Compatibility and Public Need to Construct a Wind-Powered Electric Generation Facility in Huron and Erie Counties, Ohio.

Response to Sixth Data Request from Staff of the Ohio Power Siting Board

Dear Ms. Troupe:

Attached please find Firelands Wind, LLC's ("Applicant") response to the Sixth Data Request from the staff of the Ohio Power Siting Board ("OPSB Staff"). The Applicant provided this response to OPSB Staff on February 11, 2020.

We are available, at your convenience, to answer any questions you may have.

Respectfully submitted,

/s/ *Christine M.T. Pirik*
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(Counsel is willing to accept service via email.)
Attorneys for Firelands Wind, LLC

Cc: Craig Butler
Jonathan Pawley

CERTIFICATE OF SERVICE

The Ohio Power Siting Board's e-filing system will electronically serve notice of the filing of this document on the parties referenced in the service list of the docket card who have electronically subscribed to these cases. In addition, the undersigned certifies that a copy of the foregoing document is also being served upon the persons below this 11th day of February, 2020.

/s/ Christine M.T. Pirik
Christine M.T. Pirik (0029759)

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4844-1940-8820 v1 [59714-18]

BEFORE
THE OHIO POWER SITING BOARD

In the Matter of the Application of Firelands Wind, LLC for a Certificate of Environmental Compatibility and Public Need to Construct a Wind-Powered Electric Generation Facility in Huron and Erie Counties, Ohio.	)))))	Case No: 18-1607-EL-BGN

FIRELANDS WIND, LLC'S RESPONSE TO THE SIXTH DATA REQUEST FROM THE STAFF OF THE OHIO POWER SITING BOARD

On January 31, 2019, as supplemented on March 18, 2019, April 11, 2019, July 10, 2019, and September 12, 2019, as revised on October 4, 2019, Firelands Wind, LLC ("Applicant") filed an application ("Application") with the Ohio Power Siting Board ("OPSB") proposing to construct a wind-powered electric generation facility in Huron and Erie Counties, Ohio ("Project").

On January 24, 27, and 29, 2020, the Staff of the OPSB ("OPSB Staff") provided the Applicant with OPSB Staff's Sixth Data Request. Now comes the Applicant providing the following responses to the Sixth Data Request from the OPSB Staff.

1. Please submit to staff a copy (screenshot is acceptable) of your inputs from the "Project Data" section of the JEDI model that was used to evaluate the economic impact of this project.

Response: See **Attachment 1.** Portions of this document have been filed under seal because they include confidential, trade secret information.

2. Please update staff on any Geotech studies and results that may have been performed since the application was filed.

Response: A desktop report was finalized by Hull Associates on January 17, 2019, and the field investigation, which includes the turbines, operations and maintenance building, and the substation, was completed the week of January 24, 2020. The final report sharing the findings will be available prior to February 21, 2020, at which time it will be provided to OPSB Staff.

3. **Exhibit M includes a draft complaint resolution plan. However, Staff will need to review a final complaint resolution plan from the Applicant before it can complete its investigation. Please docket a final complaint resolution/plan.**

Response: See **Attachment 2** for the final Complaint Resolution Plan. This document replaces the draft plan submitted in Exhibit M of the January 31, 2019 Application.

4. **Exhibit M includes a sample notification letter. However, Staff will need to review a copy of the Applicant's final plan notifying affected property owners and tenants about its complaint resolution and public information programs at least seven days prior to the start of construction. Please docket this final plan and notification letter.**

Response: See **Attachment 3** for the final sample notification letter. The information not included in this sample (i.e., date construction will commence and the in-service date, the name of the contact person for the project and telephone number/email, the date of the letter, and address and names of the recipient) will not be known until prior to construction. This document replaces the draft sample letter submitted in Exhibit M of the January 31, 2019 Application.

5. **The application at page 39 state that the Applicant's "website will be updated with new information throughout the planning and review process." However, parts of the website do not appear to have been updated since before the application was filed in January 2019. For example, at https://www.emersoncreekwind.com/about_emerson the website states: "Many of the details about the proposed Emerson Creek Wind project are yet to be determined, but should be finalized in the coming months. These details will be available in the Ohio Power Siting Board permit application which will be filed for the project." The same webpage goes on to state: "The Emerson Creek Wind project is preparing to submit its Ohio Power Siting Board permit application in the coming months. This permitting process typically takes seven to ten months, which means the permit will likely be received in late 2019. Construction will commence in early 2020, and commercial operations of the project will occur in late 2020. Between now and the conclusion of construction, Apex will be working closely with Huron, Erie, and Seneca Counties on details of the project and offering opportunities for the public to provide input into the process. A Public Information Meeting held in relation to the Ohio Power Siting Board permit application for the Emerson Creek Wind project will be held on November 15, 2018 from 5:00-7:00 at the Bronson-Norwalk Conservation League at 295 Town Line Rd 151, Norwalk, OH 44857." Further, the "Events" page at states: "Apex Clean Energy will be hosting occasional local events to inform the community and landowners about Emerson Creek Wind. We hope you'll attend, ask questions, and learn more about what this project could mean for Seneca County." The project is located in Erie and Huron counties, not Seneca County.**

Response: The website has been updated. See https://www.emersoncreekwind.com/.

6. Has the Applicant considered providing maps of the project on its website?

Response: The Applicant will have maps of the project uploaded to the website prior to February 14, 2020.

7. Please update any cultural resources studies, findings or recommendations. Meetings with state historic preservation office?

Response: Phase I archaeological surveys were initiated in October 2019 in accordance with the State Historic Preservation Office ("SHPO") -approved study plan and will continue in spring 2020. As of now, approximately 370 acres (23%) of high-probability areas where facilities are proposed have been surveyed. Architectural surveys were initiated in January 2020 in accordance with the SHPO-approved study plan. The Applicant met with SHPO to discuss the surveys plans on September 10, 2019, and has had various communications with SHPO staff to discuss survey timelines and the potential of developing a programmatic agreement.

Safety

8. Please provide the name or resume of the professional engineer(s), structural engineer(s), or engineering firm(s) that will review and approve the project layout and turbine foundation design.

Response: The geotechnical and structural engineer of record is RRC Engineering LLC.

9. If a turbine is automatically shut down for non-emergency reasons (e.g. due to vibration, ice accumulation, lightning storm, collector or feeder line failure, or another issue) please describe your restart procedures to assure that the wind turbine is not a danger to the public upon restart.

Response: Restart procedures for events such as icing, tornadoes, hurricanes, or other natural disasters include visual inspection prior to restart. If a turbine is automatically shut down due to vibration, visual inspection is also required prior to restart. Collection line failures or transmission line outages are not a danger to turbines operationally so a visual inspection prior to restart is not required. Operations and maintenance staff are responsible for inspections prior to restart to ensure safe operation.

10. Please describe your consultation efforts to date with the local emergency service personnel (fire, police, and EMS).

Response: On August 7, 2018, the Applicant representatives met with the following individuals for a consultation meeting, and question and answer session about local wind projects including the Emerson Creek Wind Farm: Willard Fire Chief, Norwalk Fire Chief, Bellevue Fire Chief, Seneca County EMA Director, Seneca County EMS

Director, Huron County EMA Director, and local life flight operators. This meeting was held at the Willard Fire Station and the Huron County EMA Director helped facilitate invites and coordination with the other departments. Erie County EMA/EMS was invited and could not attend. A similar meeting is planned to be held with local first responders in late summer 2020.

Industry Standards

11. For each proposed wind turbine model and in accordance with page 240 of the Application, please provide the certificates of design and compliance obtained by the equipment manufacturers from underwriter laboratories, det Norske veritas, Germanischer Lloyd wind energies, or other similar certifying organization. Please explain if the documents are not currently available and indicate the date when the documents would be provided to the OPSB.

Response: See **Attachment 4** for Vestas, Nordex, and Siemens Gamesa turbine models. The documents for the General Electric turbine models have been requested from the turbine vendor. When a response is provided with either the date the documents will be shared or the documents themselves, we will share that with the OPSB Staff.

Foundations

12. Please list any concrete standards/specifications that Firelands Wind intends to adhere to for its foundation design.

Response: The Applicant intends to use reinforced concrete design in accordance with the International Building Code ("IBC") and American Concrete Institute ("ACI"), including reinforced concrete design of the pedestal and base. Anchor bolt design will be in accordance with the Post-Tension Institute ("PTI"). Embedment plate design will be in accordance with the American Institute of Steel Construction ("AISC").

13. Please describe common problems associated with the design of the spread footer and how are those problems are typically addressed?

Response: Problems associated with the design of spread foundations are not common. In some instances, during the geotechnical investigation it is determined that the soils are unsuitable to support the spread foundation and an engineered solution may be required, such as over excavation or rammed aggregate piers. This same problem with spread foundations can occur during construction when the turbine foundation is being excavated; if during excavation, the soils are determined to be different than the geotech results or the subgrade fails testing, then an engineered solution may be required, such as over excavation or engineered approved fill (suitable soils or aggregate).

14. Please describe common problems associated with the design of the rock-anchored pile foundations and how are those problems are typically addressed?

Response: Problems associated with the design of rock-anchored pile foundations are not common. If a problem occurs with the design of rock-anchored pile foundations, it is often associated with the quality of the rock. The geotechnical investigation is performed to determine if the rock is suitable for using anchors. If poor rock quality is observed, the foundation design is resolved through deeper anchors. If it is determined that a spread foundation is not suitable for a location, and additionally then that a rock-anchored pile foundation is not suitable for a location, a turbine will not be built at that location.

Underground Collection System

15. Please list any electrical standards/specifications that Firelands Wind intends to adhere to when designing the underground collection system.

Response: The underground collection system will adhere to National Electric Code ("NEC"), National Electric Safety Code ("NESC"), and standard industry practices for underground collection system design. Studies will consist of a cable ampacity, load flow, reactive power flow, concentric shield wire induced voltage, short circuit, and annual energy loss study Underground cable will follow appropriate Insulated Cable Engineers Association ("ICEA"), National Electrical Manufacturers Association ("NEMA"), and American Society for Testing and Materials ("ASTM") standards. Association of Edison Illuminating Companies' ("AEIC") CS6 will be followed for Ethylene Propylene Rubber ("EPR") cable and AEIC CS8 will be followed for Tree-Retardant Crosslinked Polyethylene ("TRXLPE") cable. Grounding of the cable for proper operation and safety will follow Institute of Electrical and Electronics Engineers ("IEEE") 80. Lightning arresters will be installed to limit voltage surges on the cable following American National Standards Institute ("ANSI") C29.

Setbacks

16. Please Identify the distance to the closest non-participating property line for each of the 87 proposed wind turbines contemplated for the Proposed Project, stating in each instance the turbine number, street address of the corresponding non-participating parcel, and the owner of the parcel.

Response: See **Attachment 5** for a table of each turbine and the nearest anticipated non-participating property line. This table assumes the anticipated participation status as detailed in Table 08-14 of the Application. Prior to construction, the Applicant will republish this list for the final subset of turbine locations selected for construction, as well as final participation status. No turbines will be constructed within the property line setback distance (1,125 feet + blade length) from a non-participating property line.

17. What is the distance from turbines T4, T15, and T21 to the electric transmission line proposed in OPSB Case No. 19-1073-EL-BTX.

Response: Turbine 4 is 820 feet from the nearest point of the primary and alternate transmission line route. Turbine 15 is 728 feet from the nearest point of the primary transmission line route and 1,058 feet from the nearest point of the alternate route. Turbine 21 is 1,367 feet from the nearest point of the primary transmission line route and 735 feet from the nearest point of the alternate route.

Communications

18. Please submit the Google Earth/KMZ file referenced on page 3 of the Evans Engineering Solutions report (Exhibit Q) and Attachment 2 of the Response to Third Data Request.

Response: This file has been provided to OPSB Staff on a USB drive.

19. What is the distance from the nearest microwave path(s) to the turbines?

Response: Turbine 5 is 313 feet from the center line of microwave path WQRW547/WQRW848. Turbine 24 is 328 feet from the center line of microwave path WQTZ737/WQWF986/WQTQ/663/WQWF971. Turbine 34 is 285 feet from the center line of microwave path WPOQ355/WQVW473. All distances are measured in the horizontal direction.

20. Are any of the microwave paths within the 300-foot radius (as described on page 9 of the Application) of any turbine.

Response: Turbines 5, 24 and 34 are within 300 feet of the Worst Case Fresnel Zones, or a portion thereof, of the microwave paths identified in the response to the prior question regarding the KMZ file. The 300-foot radius workspace referenced on page 9 of the Application is the typical workspace used, but can be adjusted to accommodate environmental concerns such as wetlands and beam paths. Final designs and detailed construction drawings will specify where the crane will be working/located in this workspace. The Applicant will ensure that the crane (besides temporary crossing during transportation) avoids work inside the Worst Case Fresnel Zones as identified to avoid any potential impacts.

Aviation

21. Regarding Exhibit J and Figure 07-1, have you sent a notification letter to Warner Airstrip and Sawmill Creek Resort? If so, please provide a copy of those letters to OPSB.

Response: Warner Airstrip and Sawmill Creek Resort both fall outside of the five-mile distance from the project area required for notice as set forth in Ohio

Administrative Code Rule 4906-4-07(E). If requested, notices can be sent to both of those facilities.

22. The FAA determination letter and Capitol Airspace Group report dated 3/8/2019 indicate that 18 proposed wind turbines will exceed the 14 CFR part 77.17(a)(2) surfaces. Please provide a list of the turbine number, resulting impacted local airport, and whether the impacted local airport authority would agree to that impact.

Response: The Applicant is in the process of finalizing the response to this request and will provide the information to OPSB Staff as soon as possible. Attached is **Attachment 6**, which contains the March 8, 2019 Obstruction Evaluation and Airspace Analysis report from Capitol Airspace Group.

23. Please describe your efforts to address any aviation issues regarding the Aircraft Owners and Pilots Association, local crop-dusters, and Ohio Association of Critical Care Transport, and Willard Airport.

Response: The Applicant has begun coordination efforts with Willard Airport and will continue to coordinate with Willard Airport. Per FAA requirements, during the aeronautical study of the proposed structures, the FAA solicited input from "all known aviation interests such as state, city, and local aviation authorities; airport authorities; various military organizations within the DOD; flying clubs; national, state, and local aviation organizations; flight schools; fixed base operators; air taxi; charter flight offices; and other organizations and individuals that demonstrate a specific aeronautical interest such as county judges and city mayors." The FAA issued Determinations of No Hazard after consideration of any received input and the detailed aeronautical study. The Applicant will issue notices to the Aircraft Owners and Pilots Association, local crop-dusters, Ohio Associated of Critical Care Transport, and Willard Airport that include the final turbine locations and heights 30 days prior to the start of construction.

24. In an email dated 7/2/2019 Firelands Wind had terminated the FAA studies for T40 (ASN 2018-WTE-11940-OE) and T76 (ASN 2018-WTE-11979-OE) to resolve impacts to the Department of Defense. Please confirm that Firelands Wind LLC will not construct the T40 and T76 turbine locations as proposed.

Response: The Applicant will not construct Turbines 40 and 76.

25. Department of Defense has indicated to OPSB that all wind turbines use NVG (night vision goggle) compatible lighting. Please confirm that the lighting system Firelands Wind intends to install is NVG compatible.

Response: The Applicant intends to install night-vision goggle ("NVG") compatible FAA lights

Project Schedule / Plans

26. Please confirm or update the project schedule, detailed project schedule, and preparation of the final design sections on pages 4 and 17 of the Application.

Response: Acquisition of land and land rights began in March 2009 and will continue through January 2021. Public information meetings were held on November 15, 2018 and April 3, 2019, to facilitate public interaction with the Applicant and expert consultants, and included information on visual/aesthetics, ecological studies, and wind turbine technology. This Certificate Application was officially submitted in January 2019, and it is anticipated that the Certificate will be issued in the third quarter of 2020. Construction is anticipated to begin in either the fourth quarter of 2020 or the first quarter of 2021 and be completed within 12 months, at which point the Facility will be placed in service.

It is expected that final designs and detailed construction drawings will be completed in the third or fourth quarter of 2020.

Safety Manuals

27. The Nordex safety manual indicates a requirement for a safety distance of [redacted] feet ([redacted] m) in case of fire. Staff notes that for turbine T86 approximately twenty-six structures are within that temporary clearance area / safety distance and would need to be evacuated during a turbine fire or malfunction. Please explain how Firelands Wind will evacuate these structures because of a turbine malfunction that occurs on a minimally staffed day or during adverse weather.

Response: In the Emergency Action Plan, proper notification procedure for emergency services is provided. Safety drills with emergency services will also be performed for "mock" events. Events that will require structure evacuations and the associated structures will be outlined in the Emergency Action Plan, as well as the emergency responders (fire, police, EMS, etc.) responsible for conducting those evacuations.

28. The Nordex safety manual indicates a requirement for a safety distance of [redacted] feet [redacted] m) in case of fire. Staff notes that Interstate 80 is within that temporary clearance area / safety distance and would need to be evacuated during a turbine fire or malfunction at turbine T3. Please explain how Firelands Wind will evacuate and perform a road closure/detour of Interstate 80 because of a turbine malfunction that occurs on a minimally staffed day or during adverse weather.

Response: In the Emergency Action Plan, proper notification procedure for emergency services is provided. Safety drills with emergency services will also be performed for "mock" events. Events that will require lane or road closures will be outlined in the Emergency Action Plan, as well as the emergency responders party (fire, police, state police, EMS, etc.) responsible for conducting those lane or road closures.

29. Staff notes that the following turbines T8, T13, T26, T39, T43, T47, and T75 are less than [redacted] feet ([redacted] m) from State Route 4. Staff notes that turbines T18, T20, T21, and T22 are less than 1,640 feet from State Route 113. Staff notes that turbine T83 is less than 1,640 feet from US 224. Please explain how Firelands Wind would evacuate and perform a road closure/detour of these state or federal highways on a minimally staffed day or during adverse weather.

Response: In the Emergency Action Plan, proper notification procedure for emergency services is provided. Safety drills with emergency services will also be performed for "mock" events. Events that will require lane or road closures will be outlined in the Emergency Action Plan, as well as the emergency responders party (fire, police, state police, EMS, etc.) responsible for conducting those lane or road closures.

Sound

30. Please update table 3 of the noise report, "TABLE 3: SUMMARY OF BACKGROUND SOUND LEVELS BY LOCATION AND AVERAGED ACROSS THE PROJECT SITE," showing the ambient noise levels rounded to the closest tenth of a dBA.

Response: See **Attachment 7**.

Respectfully submitted,

/s/ *Christine M.T. Pirik*

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(*Counsel agrees to receive service by email.*)
Attorneys for Firelands Wind, LLC

Attachment 1

Inputs from the Project Data section of the JEDI model

The Applicant has requested confidential treatment of a portion of this document in accordance with O.A.C. Rule 4906-2-21.

This document contains critical infrastructure information, confidential research and development information, commercial information, trade secrets, and/or proprietary information and, as such, is entitled to confidential treatment under state and/or federal statutes and regulations.

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/s/ Christine M.T. Pirik
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Project Descriptive Data

Project Location	OHIO
Year of Construction	2020
Total Project Size - Nameplate Capacity (MW)	298
Number of Projects (included in Total Project Size)	1
Turbine Size (kW)	4,518
Number of Turbines	66
Installed Project Cost ($/kW)	$[redacted]
Operations and Maintenance Cost ($/kW)	$[redacted]
Money Value (Dollar Year)	2018

Utilize *Project Cost Data* default values in analysis? Choose "Y" to accept default values below or "N" to over-ride default values and utilize new user defined values as entered below. *See FAQ for related topics.* — N

Modify Project Cost Data (change data below)

Go To Summary Impacts

If desired, default values (in cells below - based on *Project Descriptive Data* entered above) may be restored by pressing the 'Restore Default Values' button. *Note: it is not necessary to restore defaults to incorporate default Project Cost Data in system analysis - simply choose "Y" in cell B24 above.*

Restore Default Values

Project Cost Data

Construction Costs	Cost	Cost Per kW	Percent of Total Cost	Local Share	
Equipment Costs					
Turbines (excluding blades and towers)	$	$	%	0%	
Blades	$	$	%	0%	
Towers	$	$	%	0%	
Transportation	$	$	%	0%	
Equipment Total	$	$	%		
Balance of Plant					
Materials					
Construction (concrete, rebar, equip, roads and site prep)	$	$	%	90%	
Transformer	$	$	%	0%	
Electrical (drop cable, wire,)	$	$	%	100%	
HV line extension	$	$	%	70%	
Materials Subtotal	$	$	%		
Labor	Do not change 'Labor Costs' without changing Construction 'Wages per Hour' below.				
Foundation	$	$	%	95%	See comment - point cursor to
Erection	$	$	%	75%	red triangle in cell corner.
Electrical	$	$	%	70%	
Management/Supervision	$	$	%	0%	
Misc.	$0	$	%	50%	
Labor Subtotal	$	$	%		
Development/Other Costs					
HV Sub/Interconnection					
Materials	$	$	%	90%	
Labor	$	$	%	10%	
Engineering	$	$	%	0%	
Legal Services	$	$	%	100%	
Land Easements	$	$	%	100%	
Site Certificate/Permitting	$	$	%	100%	
Development/Other Subtotal	$	$	%		
Balance of Plant Total	$	$	%		
Subtotal (all cost without taxes)	$	$	%		
Sales Tax (Material and Equipment Purchases)	$	$	%	100%	
Total	$	$	%		

Wind Farm Annual Operating and Maintenance Costs

	Cost	Cost Per kW	Percent of Total Cost	Local Share	
Labor					
Personnel	Do not change 'Labor Personnel Costs' without changing O&M 'Wages per Hour' below.				
Field Salaries	$	$	%	100%	See comment - point cursor to
Administrative	$	$	%	100%	red triangle in cell corner.
Management	$	$	%	100%	
Labor/Personnel Subtotal	$	$	%		
Materials and Services					
Vehicles	$	$	%	100%	
Site Maint/Misc. Services	$	$	%	80%	
Fees, Permits, Licenses	$	$	%	100%	
Utilities	$	$	%	100%	
Insurance	$	$	%	0%	
Fuel (motor vehicle gasoline)	$	$	%	100%	
Consumables/Tools and Misc. Supplies	$	$	%	100%	
Replacement Parts/Equipment/ Spare Parts Inventory	$	$	%	2%	
Materials and Services Subtotal	$	$	%		
Sales Tax (Materials & Equipment Purchases)	$	$	%	100%	
Other Taxes/Payments	$	$	%	100%	
Total O&M Cost	$	$	%		

Other Parameters

		Local Share
Financial Parameters		
Debt Financing		
Percentage financed	[redacted]%	0%
Years financed (term)	[redacted]	
Interest rate	[redacted]%	
Equity Financing/Repayment		
Percentage equity	[redacted]%	
Individual Investors (percent of total equity)	[redacted]%	100%
Corporate Investors (percent of total equity)	[redacted]%	0%
Return on equity (annual interest rate)	[redacted]%	
Repayment term (years)	[redacted]	
Tax Parameters		
Local Property Tax Rate (avg millage rate - $/$1,000)	$[redacted]	
Assessed value (percent of construction cost)	[redacted]%	
Taxable Value	$0	
Taxes Per MW	NA	
Local Taxes	$0	100%
Local Sales Tax Rate	5.75%	100%
Land Lease Parameters		
Land Lease Cost (per turbine)	$[redacted]	
Number of Turbines	66	
Land Lease (total cost)	$[redacted]	
Lease Payment recipient (F = farmer/household, O = Other)	F	100%

Payroll Parameters

Do not change Construction 'Wage per hour' without changing Construction 'Labor Costs' above.

Construction Labor	Wage per hour	Employer Payroll Overhead	
Foundation	$[redacted]	41%	Please review comment - point to red triangle in cell corner.
Erection	$[redacted]	41%	
Electrical	$[redacted]	41%	
Management/Supervision	$[redacted]	41%	
O&M Labor	**Wage per hour**	**Employer Payroll Overhead**	
Field Salaries (technicians, other)	$[redacted]	41%	See comment - point to red triangle in cell corner.
Administrative	$[redacted]	41%	
Management/Supervision	$[redacted]	41%	

Do not change O&M 'Wage per hour' without changing O&M 'Labor Personnel Costs' above.

See comment - point cursor to red triangle in cell corner

Go To Summary Impacts | Return To Top Project Description and Cost Data | Restore Default Values

Attachment 2

Complaint Resolution Plan

/s/ Christine M.T. Pirik
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(Counsel is willing to accept service via email.)

Complaint Resolution Plan

Emerson Creek Wind Farm
Firelands Wind, LLC
Case No. 18-1607-EL-BGN

PURPOSE: To ensure that the Emerson Creek Wind Farm (wind farm) does not make living conditions materially worse for residents of the community by implementing a transparent and effective complaint resolution plan that will address concerns or problems voiced by members of the community.

BACKGROUND: Firelands Wind, LLC (Firelands) is committed to ensuring that an accessible process is in place for community members to voice concerns and for those concerns to be addressed as quickly and effectively as possible.

Maintaining a detailed record of all complaints and the resolutions that follow is an important aspect of the complaint resolution plan.

POLICY: The policy of Firelands is to take all reasonable necessary actions to rectify legitimate interference or disturbances that are a direct result of the wind farm facilities. Where reasonable actions are implemented but do not minimize the interference or disturbance, Firelands will compensate the impacted resident by entering into an agreement with the impacted resident that will provide annual compensation for the life of the wind farm project.

PROCEDURE:

1.) Firelands will establish an 800-phone number prior to the wind farm being commercially operational and will ensure that the phone number is provided to the county commissioners, township trustees, emergency responders, the schools, and public libraries within the project area. A resident who has a complaint about the wind farm may either call the 800# and leave a message 24 hours a day or go to the Operations and Maintenance Facility [address, phone number, e-mail to be provided when known] for the wind farm during regular business hours to register a complaint.

2.) Firelands will be responsible for recording every complaint that is received. These recordings will contain all pertinent information about the person making the complaint, the issues surrounding the complaint and the date that the complaint was received. These recordings will also contain the resolution that Firelands suggests, the date the complaining party agreed to the proposed resolution and the date when the proposed resolution was implemented. Emerson Creek Wind Farm personnel will generate a quarterly report based on the information recorded about the nature and resolution of all complaints received in that quarter and file the report with the Ohio Power Siting Board on the following date of each year (April 15th, July 15th, October. 15th and January 15th).

3.) Residents who register a complaint with Firelands will receive correspondence from the company no later than 48 hours after registering the complaint. The intent of the initial correspondence is to garner more information from the individual's complaint. Within 30 days of the complaint being received, Firelands will initiate reasonable action to resolve the legitimate interference or disturbance that is a direct result of the wind farm facility.

4.) If Firelands and the complaining resident cannot agree to a resolution proposed by Firelands or one negotiated with the complaining resident, Firelands will provide a summary of the complaint and proposed resolution to the complaining resident so that the resident may bring the complaint to the Ohio Power Siting Board.

Attachment 3

Construction Notification Letter

/s/ Christine M.T. Pirik
Christine M.T. Pirik (0029759)
(Counsel of Record)
Terrence O'Donnell (0074213)
William Vorys (0093479)
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todonnell@dickinsonwright.com
wvorys@dickinsonwright.com
jsecrest@dickinsonwright.com
mfleisher@dickinsonwright.com
(Counsel is willing to accept service via email.)

[DATE]

ADDRESS

Dear Property Owner or Tenant:

Firelands Wind, LLC is preparing to construct the Emerson Creek Wind Farm on leased private land in Groton and Oxford Townships (Erie County) and Lyme, Ridgefield, Sherman, Norwich, and Richmond Townships (Huron County). The wind farm will consist of up to 71 wind turbine generators, along with access roads, electric collection cables, a substation, a laydown yard, an operation and maintenance facility, and meteorological tower(s).

Please be assured that during work on the project described above, all applicable federal, state and local laws, regulations and ordinances will be fully adhered to.

Timeline for Construction of the Project
Construction of the Emerson Creek Wind Farm is expected to begin in _____ and is scheduled to be in-service by _____.

Restoration Activities:
Emerson Creek Wind Farm will restore any of your property that is disturbed to the state that it was in prior to the construction activities. Once the work is complete, restoration will begin as soon as weather permits.

Tenants
If you have tenants occupying this parcel, please advise them of this wind energy project.

Questions/Complaints:
Emerson Creek Wind Farm has a complaint resolution process. Should you have any questions concerning this project, please contact _____, at XXX-XXX-XXXX or [email address], who will communicate the information to the appropriate person to address the complaint. If you have a complaint during construction or restoration, your call will be returned in a timely manner. Please be aware that Emerson Creek Wind Farm will make every best effort to resolve issues pertaining to the project. A full description of the complaint process is found as an attachment to this letter.

Sincerely,

_____
On behalf of Firelands Wind, LLC

Attachment 4

Turbine Wind Model Certificates

1. Vestas Certificate
2. Nordex Certificate
3. Siemens Gamesa Certificate

/s/ Christine M.T. Pirik
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Attachment 4

Turbine Wind Model Certificates

1. Vestas Certificate

/s/ Christine M.T. Pirik
Christine M.T. Pirik (0029759)
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(Counsel is willing to accept service via email.)

Certificate No.

IECRE.WE.TC.19.0075-R2

IECRE - IEC System for Certification to Standards Relating to Equipment for Use in Renewable Energy Applications

TYPE CERTIFICATE

Wind Turbine

This certificate is issued to	Vestas Wind Systems A/S Hedeager 42 8200 Aarhus N Denmark
for the wind turbine	Vestas V150-4.0 MW / V150-4.2 MW
wind turbine class (class, standard, year)	Annex 1, IEC 61400-1: 2005+Amd1: 2010

This certificate attests compliance with IEC 61400 Series as specified in subsequent pages. It is based on the following reference documents:

Design basis evaluation conformity statement Dated	DB-DNVGL-SE-0074-05341-2 2019-12-20
Design evaluation conformity statement Dated	DE-DNVGL-SE-0074-04352-4 2019-12-20
Type test conformity statement Dated	TT-DNVGL-SE-0074-05340-2 2019-12-20
Manufacturing evaluation conformity statement Dated	ME-DNVGL-SE-0074-05339-2 2019-12-20
Final evaluation report Dated	FER-TC-DNVGL-SE-0074-05338-2 2019-12-20

The conformity evaluation was carried out in accordance with the rules and procedures of the IECRE System
www.iecre.org

The wind turbine type specification begins on page 2 of this certificate.

Changes in the system design or the manufacturer's quality system are to be approved by DNV GL. Without approval, the certificate loses its validity.

This certificate is valid until:
2024-12-12

Approved for issue on behalf of the IECRE Certification Body:

Nils Kreidelmeyer / Bente Vestergaard
Senior Project Manager / Service Line Leader, Type Certification
Hamburg/Hellerup 2019-12-20

DNV·GL

Renewables Certification
Brooktorkai 18
20457 Hamburg, Germany

Certificate No.

IECRE.WE.TC.19.0075-R2

IECRE - IEC System for Certification to Standards Relating to Equipment for Use in Renewable Energy Applications

TYPE CERTIFICATE

Wind Turbine

Machine parameters:

Power regulation:	pitch-controlled
Rotor orientation:	Upwind
Number of rotor blades:	3
Rotor tilt:	6.0°
Cone angle:	-5.5°
Rated power:	4000 kW / 4200 kW
Rated wind speed V_r:	Annex 1
Rotor diameter:	150 m
Hub height(s):	Annex 1
Hub height operating wind speed range $V_{in} – V_{out}$:	3 m/s – 24.5 m/s (with the following HWO wind speeds: V_HWO1 = 17.5 m/s V_HWO2 = 21.5 m/s V_HWO3 = 24.5 m/s)
Design life time:	20 years
Software version:	2019.01

Wind conditions:

Characteristic turbulence intensity I_{ref} at V_{hub} = 15 m/s:	Annex 1
Annual average wind speed at hub height V_{ave} :	Annex 1
Reference wind speed V_{ref} :	Annex 1
Mean flow inclination:	8°

Electrical network conditions:

Normal supply voltage and range:	720 V
Normal supply frequency and range:	50 or 60 Hz ± 6 % Hz
Voltage imbalance:	IEC 61000-3-6 TR max 2 %
Maximum duration of electrical power network outages:	Two 3 months periods
Number of electrical network outages	Max 52 per year

Certificate No.

IECRE.WE.TC.19.0075-R2

IECRE - IEC System for Certification to Standards Relating to Equipment for Use in Renewable Energy Applications

TYPE CERTIFICATE

Wind Turbine

Other environmental conditions (where taken into account):

Normal and extreme temperature ranges: *de-rating strategy above +30°C for V150-4.0 MW *de-rating strategy above +20°C for V150-4.2 MW	Normal: -20°C to +45°C* Extreme: -40°C to +45°C
Relative humidity of the air:	100% (max 40% of time) and 90% (rest of life time)
Air density:	1.225 kg/m^3 (for normal operation) 1.273 kg/m^3 (for low temperature operation)
Solar radiation:	1000 W/m^2
Lightning protection system (standard and protection class):	Designed acc. to IEC 61400-24, Protection Level 1 and IEC 61312-1

Certificate No.

IECRE.WE.TC.19.0075-R2

IECRE - IEC System for Certification to Standards Relating to Equipment for Use in Renewable Energy Applications

TYPE CERTIFICATE

Wind Turbine

Major components:

**If not otherwise stated, the certificate holder is the manufacturer.

Blade:

Type:	Hybrid / Infused
Material:	Carbon fibre reinforced epoxy and glass fibre reinforced epoxy
Blade length:	73.65 m
Number of blades:	3
Manufacturer:	Vestas Wind Systems A/S
Drawing / Data sheet / Part No.:	0069-0345, Rev. 3

Blade Aero Addons:

Type	STE's and RVG's
Manufacturer	Vestas Wind Systems A/S
Drawing / Data sheet / Part no.	STE Kit: 0072-2639, Rev. 0 RVG: 0073-5893, Rev. 0

Blade bearing:

Type:	Triple row cylinder bearing
Drawing / Data sheet / Part no.:	29110524, Rev. 3
TPS no.:	0023-3088, Rev. 5

Pitch System:

Type:	Hydraulic power unit
Manufacturer:	LJM/HINE/Liebherr/Hengli
Hydraulic Cylinder (140/90x922):	29111326, Rev. 1

Type	Pitch Actuation Module
Manufacturer	Vestas Wind Systems A/S
Drawing / Data sheet / Part no.	29111583, Rev. 1

Certificate No.

IECRE.WE.TC.19.0075-R2

IECRE - IEC System for Certification to Standards Relating to Equipment for Use in Renewable Energy Applications

TYPE CERTIFICATE

Wind Turbine

Main shaft:

Type:	Cast iron
Material:	EN-GJS-500-14
Drawing / Data sheet / Part no.:	29085300, Rev. 4

Main bearing:

Type:	Spherical Roller Bearing
Manufacturer:	FAG
Drawing / Data sheet / Part no.:	F-582562.PRL-WPO 000

Main bearing:

Type:	Spherical Roller Bearing
Manufacturer:	SKF
Drawing / Data sheet / Part no.:	240/950 CA / C3LW33VQ113

Main bearing:

Type:	Spherical Roller Bearing
Manufacturer:	JTKET / KOYO
Drawing / Data sheet / Part no.:	240/950 RHAW33TS1CS

Gearbox:

Type:	2 stage planetary and 1 helical stage gearbox
Manufacturer:	ZF (EH1052A)
Gear ratio:	1:143.37
Drawing / Data sheet / Part no.:	096-EH1052A001, Rev. A

Gearbox:

Type:	2 stage planetary and 1 helical stage gearbox
Manufacturer:	Winergy (PZAB 3580)
Gear ratio:	1:142.76
Drawing / Data sheet / Part no.:	A5E45622888A, rev.2

IECRE - IEC System for Certification to Standards Relating to Equipment for Use in Renewable Energy Applications

Certificate No.

IECRE.WE.TC.19.0075-R2

TYPE CERTIFICATE

Wind Turbine

Yaw System:

Drive type:	8 x 2.7 kW, 400 V, 50 Hz asynchronous motors
Drive manufacturer:	Lafert
Drawing / Data sheet / Part no.:	MZ10/A4A-55337
Drive type:	8 x 3.2 kW, 400 V, 60 Hz asynchronous motors
Drive manufacturer:	Lafert
Drawing / Data sheet / Part no.:	MZ10/A4A-55338
Drive type:	8 x 2.7 kW, 400 V, 50 Hz asynchronous motors
Drive manufacturer:	ABB
Drawing / Data sheet / Part no.:	3GZF500810-23 A 14 AA 100 A
Drive type:	8 x 3.2 kW, 400 V, 60 Hz asynchronous motors
Drive manufacturer:	ABB
Drawing / Data sheet / Part no.:	3GZF500810-23 A 14 AA 100 A
Drive type:	8 x 2.7 kW, 400 V, 50 Hz asynchronous motors
Drive manufacturer:	Bonfiglioli
Drawing / Data sheet / Part no.:	CD00006614-02
Drive type:	8 x 3.2 kW, 400 V, 60 Hz asynchronous motors
Drive manufacturer:	Bonfiglioli
Drawing / Data sheet / Part no.:	CD00007013-01
Gear type:	Bevel stage and three planetary stages, i = 952.3
Gear manufacturer:	Bonfiglioli
Drawing / Data sheet / Part no.:	I7090T010300

Certificate No.

IECRE.WE.TC.19.0075-R2

IECRE - IEC System for Certification to Standards Relating to Equipment for Use in Renewable Energy Applications

TYPE CERTIFICATE

Wind Turbine

Gear type:	Bevel stage and three planetary stages, i = 935
Gear manufacturer:	Comer
Drawing / Data sheet / Part no.:	N07297_01
Bearing type:	Preloaded sliding bearing, PETP pads
Bearing manufacturer:	Vestas Wind Systems A/S
Drawing / Data sheet / Part no.:	29104726, Rev. 0

Generator:

Type:	DASG 560/6M, Induction generator
Manufacturer:	Vestas Nacelles Deutschland (VND)
Rated power:	4450 kW
Rated frequency:	74 Hz
Rated speed:	1485 rpm
Rated voltage:	800 V
Rated current:	3650 A
Insulation class:	H
Degree of protection:	IP54

Converter:

Type:	Full quadrant IGBT
Manufacturer:	Vestas Wind Systems A/S
Rated voltage machine/grid:	720 Vrms / 800 Vrms
Rated current:	3200 A
Degree of protection:	IP54
Drawing / Data sheet / Part no.:	0069-2805, Rev. 0

Transformer:

Type:	Cast-Resin transformer 4GY6781-1EY
Manufacturer:	Siemens
Rated voltage:	33 / 0.72 V

Certificate No.

IECRE.WE.TC.19.0075-R2

IECRE - IEC System for Certification to Standards Relating to Equipment for Use in Renewable Energy Applications

TYPE CERTIFICATE

Wind Turbine

Degree of protection:	IP00
Drawing / Data sheet / Part no.:	0073-7914, Rev. 0
Type:	Cast-Resin transformer DTTH1N 4000/30
Manufacturer:	SGB
Rated voltage:	33 / 0.72 V
Degree of protection:	IP00
Drawing / Data sheet / Part no.:	0073-7915, Rev. 0

Tower:

Type:	Conical steel
Number of sections:	4
Length:	102.6 m (HH 105 m)
Drawing / Data sheet / Part no.:	0074-7302 Rev.0 (T966901)

Tower:

Type:	Conical steel
Number of sections:	5
Length:	102.6 m (HH 105 m)
Drawing / Data sheet / Part no.:	A005-4762, Rev.0 (T966906)

Tower:

Type:	Conical steel
Number of sections:	5
Length:	102.6 m (HH 105 m)
Drawing / Data sheet / Part no.:	0068-6713, Rev.4 (T966900)

Tower:

Type:	Conical steel
Number of sections:	6
Length:	152.6 m (HH 155 m)
Drawing / Data sheet / Part no.:	0078-9884 Rev.2 (T969B00)

Certificate No.

IECRE.WE.TC.19.0075-R2

IECRE - IEC System for Certification to Standards Relating to Equipment for Use in Renewable Energy Applications

TYPE CERTIFICATE

Wind Turbine

Manuals:

Operating manual:	0079-9811, Rev. 1
Transportation and handling manual:	0079-9801, Rev. 2
Installation manual:	0079-9663, Rev. 2
Commissioning manual:	0079-9665, Rev. 0

Service lift:

Manufacturer:	Avanti
Type:	Avanti Shark / Avanti Dolphin / Avanti Beluga
Manufacturer:	Power climber
Type:	Sherpa-SD4

Crane:

Manufacturer:	Star 071/95 Liftket
Maximum lifting capacity:	max 800 kg

Certificate No.

IECRE.WE.TC.19.0075-R2

IECRE - IEC System for Certification to Standards Relating to Equipment for Use in Renewable Energy Applications

TYPE CERTIFICATE

Wind Turbine

Annex 1

Configurations covered by this Type Certificate

ID*	Variants	Hub Height	IEC WT class	Turbulence Intensity Iref	Rated wind speed V_r	Mean wind speed V_{ave}
1.1	V150-4.0 MW	105 (T966901)	IEC 3B	0.14	9.7 m/s	7.5 m/s
1.2	V150-4.2 MW	105 (T966901)	S (based on IEC 3B)	0.14	9.9 m/s	7.0 m/s
1.3	V150-4.0MW	105 (T966900)	IEC 3C	0.12	9.8 m/s	7.5 m/s
1.4	V150-4.2 MW	105 (T966900)	S (based on IEC 3C)	0.12	10.1 m/s	7.0 m/s
1.5	V150-4.0MW	105 (T966906)	IEC 3B	0.14	9.7 m/s	7.5 m/s
1.6	V150-4.2 MW	105 (T966906)	S (based on IEC 3B)	0.14	9.9 m/s	7.0 m/s
2.1	V150-4.0MW	155 (T969B00)	IEC 3B	0.14	9.7 m/s	7.5 m/s
2.2	V150-4.2 MW	155 (T969B00)	S (based on IEC 3B)	0.14	9.9 m/s	7.0 m/s

* The ID follows the hub height with its first digit, the second digit is only consecutive to identify the different configurations within one hub height

Attachment 4

Turbine Wind Model Certificates

2. Nordex Certificate

/s/ Christine M.T. Pirik
Christine M.T. Pirik (0029759)
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(Counsel is willing to accept service via email.)

DEPARTMENT WIND TURBINES

Industrie Service

Add value.
Inspire trust.

Certification Report

Date: 2019-06-11

Report no. **2945919-1-e-1 Rev. 3**

Subject: **Design Evaluation**
Wind Turbines Type Delta4000
Nordex N149/4.0-4.5

Here: variable power curve (VPC)

Normative Reference: IEC 61400-22:2010 in combination with
IEC 61400-1:2005 + A1:2010 and DIBt 2012

Manufacturer, Design and Calculation:
Nordex Energy GmbH
Langenhorner Chaussee 600
22419 Hamburg
Germany

Client:
Nordex Energy GmbH
Langenhorner Chaussee 600
22419 Hamburg
Germany

Our reference:
IS-ESW-MUC/JS

Document:
2945919-1-e-1_Rev.3_Nordex_Delta_4000_VPC.docx

This document consists of 6 Pages.
Page 1 of 6

The test results refer exclusively to the units under test.

swiss safety center ISO 9001 certified system

Industrie Service

Revision	Date	Comments
0	2018-09-10	First release
1	2018-09-25	Condition 1 modified
2	2019-02-13	Revision of document [1] and document [5] included. Parameter space extended.
3	2019-06-11	Editorial changes

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Industrie Service

1. Documents

1.1. Documents reviewed

The following design documents if not specifically indicated all issued by Nordex Energy GmbH were submitted for evaluation:

[1] "Technical Report Delta4000 Variable Power Curve (VPC) Parameter Space Definition and Certification Methodology", 11 pages,
document no. E0004654068, revision 02, dated 2019-01-15

1.2. Documents noted

The following documents if not specifically indicated all issued by Nordex Energy GmbH are related and were used in addition for the evaluation:

[2] "Technical Report Load Reference Document Delta4000", 10 pages,
document no. E0004124272, revision 10, dated 2018-08-31

[3] "Technical Report Controller Concept Delta4000 N133-4800 (IEC S, DIBt S), N149-4000 (IEC 3A, DIBt 2), N149-4380 (IEC 3S, DIBt S),N149-4500 (IEC 3S, DIBt S)", 15 pages,
document no. E0004142241, revision 08, dated 2018-09-07

[4] "DD04-Implementation report Typenspezifische Parameter zum Steuerungs- und Sicherheitskonzept Delta4000", 12 pages,
document no. E0004191282, revision 6, dated 2018-09-07

[5] „Certification Report Design Evaluation – Electrical Components and Lightning Protection Wind Turbine Type Delta4000 N149/4.0-4.5 and N133/4.8, 50/60 Hz Rotor Blade Types NR74.5-1 and NR65.5-3, optional with AIS and Serrations", issued by TÜV SÜD Industrie Service GmbH, 24 pages,
report no. 2740209-54-e-5, revision 3, dated 2018-12-01

2. Basis of the evaluation

The review is based on the following regulations:

/1/ IEC 61400-22:2010 "Wind turbines – Part 22: Conformity testing and certification"

/2/ IEC 61400-1:2005 "Wind turbines – Part 1: Design requirements"

/3/ Amendment 1 (2010) to IEC 61400-1:2005 "Wind turbines – Part 1: Design requirements"

/4/ "Richtlinie für Windenergieanlagen", issued 2012-10 by DIBt – Deutsches Institut für Bautechnik (German institute for civil engineering)

Industrie Service

3. Description

The Delta4000 Nordex N149/4.0-4.5 wind turbines consist of a three-bladed rotor in upwind position and gearbox driven generator units. The turbines run in parallel mains operation and are controlled by pitch control and rotor speed variation.

Besides using a set of fixed parameters (Table 1) the closed-loop control shall also be possible by means of a variable parameter space (Table 2).

Parameter	No.	N149/4000	N149/4380	N149/4500
Rated Power	-	4000 kW	4380 kW	4500 kW
Rated Rotor speed	P35.16	9.8 rpm	10.7 rpm	11.0 rpm
Thrust limit	P42.01	660 kN	710 kN	720 kN
PKI (power knee improvement)	P49.16	4500 kW	4500 kW	4500 kW
IPC gain set point 1	P104.11	7 deg	7 deg	7 deg
IPC gain set point 2	P104.12	11 deg	11 deg	11 deg
IPC tilt moment PropGain	P103.08	1.0 deg/MNm	1.0 deg/MNm	1.0 deg/MNm
IPC yaw moment PropGain	P103.11	1.0 deg/MNm	1.0 deg/MNm	1.0 deg/MNm

Table 1: fixed parameters

Parameter	No.	Lower Limit	Upper Limit
Rated Power	-	2000 kW	4800 kW
Rated Rotor speed	P35.16	-	11.02 rpm
Thrust limit	P42.01	500 kN	710 kN
PKI (power knee improvement)	P49.16	0 kW	4800 kW
IPC gain set point 1	P104.11	0 deg	7 deg
IPC gain set point 2	P104.12	1 deg	11 deg
IPC tilt moment PropGain	P103.08	1.0 deg/MNm	1.5 deg/MNm
IPC yaw moment PropGain	P103.11	1.0 deg/MNm	1.5 deg/MNm

Table 2: variable parameter space

The document for evaluation [1] contains a description of the variable parameter space as well as a statement on the validity of existing load assumptions (based on fixed parameters, Table 1) and results from Type Testing.

Industrie Service

4. Scope of the Evaluation

The submitted document [1] for the wind turbines of type Delta4000 Nordex N149/4.0-4.5 was reviewed for completeness and correctness.

5. Comments

5.1. Variable Parameter Space & Electrical System

The variable parameter space (Table 2) is within the fixed closed-loop parameters (Table 1, documents [3] and [4]) respectively below the minimum trigger levels of the protection system. For rated power, power knee improvement and individual pitch control (IPC) values deviating from the fixed parameters as defined in Table 1 have been chosen. For IPC-control at sites with extreme wind shear a reduction of site-specific loads with these parameters is expected. The wind turbines N149/4.0-4.5 are electrically capable to operate at a nominal power of up to 4800 kW (generator, converter, transformer), see [5].

5.2. Application of the Variable Parameter Space / Operation Modes

One or several new operation modes can be defined by a combination of parameters within the parameter space according to Table 2. For each of such new operation mode, the structural integrity shall be evaluated and documented separately and project specifically, see conditions.

Operating with a random combination of parameters from the variable parameters space is currently not covered by the evaluations within the scope of Type Certification.

5.3. Type Testing

The type testing results are affected as follows:

Safety and Function Test

No influence, since operating the turbine with variable parameters (within the parameter space of Table 2) doesn't occur with modified trigger levels and braking programs of the control- and safety system.

Type Inspection

No influence, since operating the turbine with variable parameters (within the parameter space of Table 2) doesn't occur with modified trigger levels and braking programs of the control- and safety system.

Power Performance Measurement

With good agreement between measurement and simulation (model validation) when operating with fixed operating parameters, no new measurement is required when operating with changed parameters within the parameter space.

Load Measurements

With good agreement between measurement and simulation (model validation) when operating with fixed operating parameters, no new measurement is required when operating with changed parameters within the parameter space.

Industrie Service

Static and dynamic rotor blade test / Witnessing

No influence, as operation with variable parameters takes place within the evaluated range, thus no change in the fatigue and extreme loads. A witnessing of these tests remains valid.

Gearbox Field Test

No influence, as operation with variable parameters takes place within the evaluated range, thus no change in the fatigue and extreme loads.

Resonance

When operating the turbine at a rated rotor speed deviating from the values in Table 1 possible resonance frequencies (e.g. for tower, drive train and rotor blade) shall be analyzed, see conditions.

6. Result of the Evaluation

The submitted document [1] for the wind turbines of type Delta4000 Nordex N149/4.0-4.5 meets the requirements of IEC 61400-1:2005 + A1:2010 and DIBt 2012 and is essentially complete and correct.

The wind turbine loads, and thus the structural integrity under design conditions are only confirmed for the parameter combinations, respectively operation modes according to Table 1.

The wind turbines can also be operated variably with other defined combinations of parameters, respectively new operation modes within the parameter space according to Table 2.

The structural integrity for operating with such other parameter combinations, respectively such new operation modes shall be evaluated separately and project specifically, see conditions.

Results from the type test remain valid for operation within the parameter space according to Table 2.

The following conditions shall be observed:

Conditions

1. A new combination of parameters, respectively a new operation mode shall be within the limits given in Table 2.
2. In case of operation with a combination of parameters, which deviate from Table 1, the structural integrity shall be demonstrated separately and project specifically.
3. When operating the turbine at a rated rotor speed deviating from the values given in Table 1, potential resonances shall be analyzed.
4. The safety-related limit values of the control and safety concept (according to document [4]) shall not be changed.

TÜV SÜD Industrie Service GmbH
Department Wind Turbines

Chief Engineer

M. Schmalstieg

Expert Engineer

J. Stauber

TÜV SÜD Industrie Service GmbH
Certification Body Wind Turbines

Industrie Service

Statement of Compliance

for the Design Evaluation

Registration No.: **014.23.2.03.19.06**

This statement of compliance is issued to:

Nordex Energy GmbH
Langenhorner Chaussee 600
22419 Hamburg
Germany

For the wind turbine:

Nordex N149/4.0-4.5 50/60Hz
Rotor Blade NR74.5-1
(with or without Trailing Edge Serrations, Vortex Generators and Anti-Icing System)
105 m, 120 m, 125 m, 135 m, 145 m, 155 m, 164 m Hub Height
(with extended temperature range and altitude of installation)
IEC WT Class S

This conformity statement attests compliance of the above-mentioned wind turbine with the standard

IEC 61400-1:2005 + A1:2010
'Wind turbines – Part 1: Design requirements'
in combination with
GL Technical Note 067 Rev. 5:2013

concerning the design basis and the design.

The associated certification reports and certificate for the quality management system are listed in annex 1. The wind turbine is specified in annex 2.

The conformity evaluation was carried out according to IEC 61400-22:2010, 'Wind turbines - Part 22: Conformity testing and certification'.

Changes in design may be implemented if assessed by TÜV SÜD Industrie Service GmbH with an additional report. Modifications without approval render this statement invalid.

The validity of the quality management system certificate shall be maintained.

Munich, 2019-08-06

DAkkS Deutsche Akkreditierungsstelle D-ZE-14153-01-02

Certification Body for products according to DIN EN ISO/IEC 17065:2013 accredited by DAkkS. The accreditation is only valid for the scope mentioned in the accreditation certificate.

B. Bartels, M.A.

Certification Body Wind Turbines
TÜV SÜD Industrie Service GmbH

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Certification Body Wind Turbines

Industrie Service

Statement of Compliance
for the Design Evaluation

Registration No.: **014.23.2.03.19.06**

Annex 1

The design basis evaluation and design evaluation of the wind turbine Nordex N149/4.0-4.5 with rotor blade NR74.5-1 (with or without Trailing Edge Serrations, Vortex Generators and Anti-Icing System), 105 m, 120 m, 125 m, 135 m, 145 m, 155 m, 164 m hub height for WTC S was carried out by expert engineers of the accredited certification body TÜV SÜD (accred. no. D-ZE-14153-01-02). The assessment is reported in the following reports:

Report no.	Date issued	Report on assessment / certification reports	Cert. body
2740209-1-e-0 Rev. 2	2019-02-21	Design Basis	TÜV SÜD
2740209-2-e-1	2017-11-09	Tower Loads Hub Height 105 m (TS105)	TÜV SÜD
2740209-130-e-1	2018-12-05	Tower Loads Hub Height 120 m (TH120)	TÜV SÜD
2740209-3-e-1	2017-11-09	Tower Loads Hub Height 125 m (TS125), valid also for TS125-01	TÜV SÜD
2942601-1-e-1	2018-11-30	Tower Loads Hub Height 135 m (TS135)	TÜV SÜD
2886107-1-e-1	2018-04-13	Tower Loads Hub Height 145 m (TS145)	TÜV SÜD
3031378-1-e-1	2019-03-13	Tower Loads Hub Height 145 m (TS145-01)	TÜV SÜD
2942601-2-e-1 Rev. 1	2019-02-01	Tower Loads Hub Height 155 m (TS155)	TÜV SÜD
2740209-4-e-1 Rev. 1	2018-02-26	Tower Loads Hub Height 164 m (TCS164 NV05)	TÜV SÜD
2740209-7-e-1 Rev. 4	2019-04-05	Machinery and Rotor Blade Loads	TÜV SÜD
2740209-131-e-1	2019-02-25	Machinery and Rotor Blade Loads (120 m Hub Height only)	TÜV SÜD
2740209-5-e-1 Rev. 5	2019-04-05	Load Specification	TÜV SÜD

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2740209-115-e-1	2018-04-18	Load Assumptions Design Update	TÜV SÜD
2740209-117-e-1	2018-07-09	Loads with ESCO (Extended Soft Cut Out)	TÜV SÜD
2945919-1-e-1 Rev. 3	2019-06-11	VPC (Variable Power Curve)	TÜV SÜD
2740209-8-e-2 Rev. 7	2019-07-30	Personnel Safety, Control and Protection System and Manuals	TÜV SÜD
2740209-11-e-3 Rev. 3	2019-07-24	Rotor Blade NR74.5-1 Structural Verifications	TÜV SÜD
2740209-83-e-3	2018-09-07	Rotor Blade NR74.5-1 Full-Scale Static Test	TÜV SÜD
2740209-47-e-4 Rev. 8	2019-05-17	Structural Components, Machinery Components, Wind Turbine Housing	TÜV SÜD
2740209-54-e-5 Rev. 3	2018-12-01	Electrical Components and Lightning Protection	TÜV SÜD
2740209-56-e-6 Rev. 1	2018-12-18	Tubular Steel Tower Hub Height 105 m (TS105) Structural Verifications	TÜV SÜD
2740209-65-e-7 Rev. 1	2019-01-07	Anchor Cage for Tower TS105	TÜV SÜD
2740209-132-e-6	2019-02-22	Concrete Tower Hub Height 120 m (TH120) including Internals and Manuals	TÜV SÜD
3021748-1-e-6	2019-03-26	Tubular Steel Tower Hub Height 125 m (TS125-01) Structural Verifications	TÜV SÜD
2740209-67-e-7 Rev. 3	2019-03-26	Anchor Cage for Tower TS125-01	TÜV SÜD
2942601-4-e-6	2018-11-30	Tubular Steel Tower Hub Height 135 m (TS135) Structural Verifications	TÜV SÜD
2942601-6-e-7	2018-11-30	Anchor Cage for Tower TS135	TÜV SÜD
2886107-3-e-6 Rev. 3	2018-11-30	Tubular Steel Tower Hub Height 145 m (TS145) Structural Verifications	TÜV SÜD
3031378-3-e-6	2019-03-27	Tubular Steel Tower Hub Height 145 m (TS145-01) Structural Verifications	TÜV SÜD

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Certification Body Wind Turbines

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Registration No.: **014.23.2.03.19.06**

2886107-4-e-7 Rev. 3	2019-04-08	Anchor Cage for Towers TS145/TS145-01	TÜV SÜD
2942601-5-e-6	2019-02-20	Tubular Steel Tower Hub Height 155 m (TS155) Structural Verifications	TÜV SÜD
2942601-7-e-7	2019-02-21	Anchor Cage for Tower TS155	TÜV SÜD
2740209-58-e-6 Rev. 1	2019-01-07	Hybrid Tower Hub Height 164 m (TCS164 NV05) Structural Verifications	TÜV SÜD
2740209-69-e-6 Rev. 1	2019-01-07	Hybrid Tower Hub Height 164 m (TCS164 NV05) Assembly Concrete Tower	TÜV SÜD
2740209-70-e-8 Rev. 5	2019-05-14	Tower Internals	TÜV SÜD
2740209-55-e-11 Rev. 4	2019-03-26	Tower Top Flange	TÜV SÜD
3005819-1-e-11	2019-01-30	Tower Top Segment for Tower TH120	TÜV SÜD

The quality management system of the manufacturer is certified according to DIN EN ISO 9001:2015 as follows:

Certificate no.	Date issued	Workshop / company	Cert. body
01 100 120889, 01 104 120889, 01 213 120889	2018-05-16	Nordex SE	TÜV Rheinland

End of annex 1

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Statement of Compliance
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Registration No.: **014.23.2.03.19.06**

Annex 2

Characteristic Data Nordex N149/4.0-4.5

General	Design:	Horizontal axis wind turbine with variable rotor speed, gearbox
	Power regulation:	Electro-mechanical pitch
	Main braking system:	3 independent electro-mechanical pitch systems
	Rated electrical power:	4000 kW / 4380 kW / 4500 kW [1]
	Hub heights:	105 m / 120 m[2] / 125 m / 135 m / 145 m / 155 m / 164 m
	Rated rotor speed (4000 kW):	9.8 rpm
	Rated rotor speed (4380 kW):	10.7 rpm
	Rated rotor speed (4500 kW):	11.0 rpm
	Rated wind speed:	11 m/s
	Cut-in wind speed:	3 m/s
	Cut-out wind speed:	20 m/s[3]
	Cut-out wind speed with ESCO:	26 m/s
	Design life time:	20 years for all hub heights (based on FAT[4] class 112 for tubular steel towers TS125-01, TS135 and TS145-01)
	Operating temperature CCV:	-30°C - +40°C
	Operating temperature NCV:	-20°C - +40°C
	Survival temperature:	-40°C - +50°C
	IEC wind turbine class:	S
	Reference wind speed v_{ref}:	37.5 m/s (33.3 m/s for hub height 120 m)
	Turbulence intensity at v_{ref}:	11 %
	Annual average wind speed:	7.5 m/s resp. 7.2 m/s (see tables 3 and 4)
	Weibull form factor k:	2.4
	Wind shear exponent:	0.28 (0.23 for hub height 120 m) (0.25 for hub height 164 m)

[1] The N149/4.0-4.5 can be operated in additional variants if the conditions described in TÜV SÜD report no. 2945919-1-e-1 Rev. 3 are fulfilled.
[2] 4380 kW only
[3] For CCV variants with rated power 4380 kW and 4500 kW the wind speed is reduced linearly to 18 m/s for temperatures between -20°C to -30°C.
[4] Fatigue

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Category of turbulence characteristics:	S (see tables 1 and 2)
Air density power production (ultimate loads, CCV):	1.32 kg/m³
Air density idling / parked (ultimate loads, CCV):	1.29 kg/m³
Air density all modes (ultimate loads, NCV):	1.225 kg/m³ (1.203 kg/m³ for hub height 120 m)
Air density power production (Fatigue loads):	335 days in year: 1.225 kg/m³ (1.203 kg/m³ for hub height 120 m) 30 days in year: 1.367 kg/m³

Earthquake intensity:	TS105	TH120	TS125-01	TS135
	0.2g	-	0.08g	0.08g

	TS145	TS145-01	TS155	TCS164 NV05
	0.08g	0.08g	0.2g	0.08g

Normal supply voltage and range:	660 V / 690 V (depending on generator)
Normal supply frequency and range:	50/60 Hz
Number of electrical network outages:	20 per year

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wind speed [m/s]	4	6	8	10	12	14	16	18	20
IEC 61400-1:2005 category A [%]	34.4	26.9	23.2	21.0	19.5	18.4	17.6	17.0	16.5
Nordex specific IEC S(1) [%]	26.2	21.7	19.6	18.4	17.6	17.0	16.6	16.4	16.3
Nordex specific IEC S(2) [%]	28.2	23.3	20.8	19.3	18.3	17.6	17.1	16.7	16.3
Nordex specific DIBt S(1) [%]	29.9	26.1	22.9	20.2	18.2	16.5	15.1	13.9	12.8
Nordex specific DIBt S(2) [%]	30.4	26.6	23.3	20.4	18.2	16.5	15.1	13.9	12.8
Nordex specific DIBt S(3) [%]	32.8	28.5	24.7	21.5	18.8	16.7	15.3	14.3	13.6

Table 1: Turbulence intensities for N149/4.0-4.5 (except TH120)

wind speed [m/s]	4	6	8	10	12	14	16	18	20
Nordex specific [%]	32.7	22.8	19.8	16.8	14.5	13.6	13.9	13.8	13.1

Table 2: Turbulence intensities for N149/4.38 (TH120 only)

Rated power [kW]	Turbulence category	Annual average wind speed [m/s]	Climatic conditions
4000	NTM A	7.5	CCV[5]
	DIBt S(3)	7.2	NCV
4380	IEC S(2)	7.5	NCV + CCV
	DIBt S(2)	7.2	NCV
4500	IEC S(1)	7.5	NCV + CCV
	DIBt S(1)	7.2	NCV

Table 3: evaluated variants (except TH120)

Rated power [kW]	Turbulence category	Annual average wind speed [m/s]	Climatic conditions
4380	Nordex specific	7.5[6]	NCV

Table 4: evaluated variants (TH120 only)

[5] NCV loads are covered by CCV loads
[6] 9.2 m/s for tower loads

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for the Design Evaluation

Registration No.: **014.23.2.03.19.06**

Rotor	Diameter:	149 m
	Number of rotor blades:	3
	Orientation:	Upwind
	Cone angle:	-3.5°
	Tilt angle:	5°
	Rotor blade type:	NR74.5-1 with or without Trailing Edge Serrations, Vortex Generators and Anti-Icing System
	Designer:	Nordex Energy GmbH
Blade extender	Design:	Cast part
	Designer:	Nordex Energy GmbH
	Material:	EN-GJS-400-18-LT
	Drawing No.:	02011-e0004250310, Rev. 2
Pitch system	Pitch drive design:	Planetary gear with permanent magnet synchronous motor and electromechanical brake
	Manufacturer:	Bonfiglioli Trasmital
	Type:	709T3F
	Manufacturer:	Liebherr
	Type:	DAT 300/3449
	Blade bearing design:	Ball bearing slewing ring
	Manufacturer:	thyssenkrupp Rothe Erde
	Type:	83619220
Hub	Design:	Cast part
	Designer:	Nordex Energy GmbH
	Material:	EN-GJS-400-18-LT
	Drawing No.:	02020-e0003934070, Rev. 2
Main bearing	Design:	Spherical roller bearing
	Manufacturer:	SKF GmbH
	Type:	240/950 BC/CNLVR6461 or 240/950 CA/CNLV026RE10
	Manufacturer:	Schaeffler
	Type:	F-623430.01.PRL-WPOS-CNL
	Manufacturer:	JTEKT (KOYO)
	Type:	240/950RHAW33TS1CSA FYPZA00 B

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Registration No.: **014.23.2.03.19.06**

Main bearing housing	Design:	Cast part
	Designer:	Nordex Energy GmbH
	Material:	EN-GJS-400-18-LT
	Drawing No.	02041-e0004573935, Rev. 0
Rotor shaft	Design:	Forged part
	Designer:	Nordex Energy GmbH
	Material:	42CrMo4 or 34CrNiMo6
	Drawing No.:	NCV: 02030-e0004089604, Rev. 1 CCV: 02030-e0004336109, Rev. 0
Gearbox (50 Hz)	Design:	Planetary helical gearbox
	Manufacturer:	Moventas Gears Oy
	Type / Nominal ratio:	PPLH-4200NXT-10, i=113.571
	Manufacturer:	Flender GmbH
	Type / Nominal ratio:	Winergy PZAB 3600, i=113.612
	Manufacturer:	ZF Wind Power Antwerpen NV
	Type / Nominal ratio:	EH1053A, i=113.44
Gearbox (60 Hz)	Design:	Planetary helical gearbox
	Manufacturer:	Moventas Gears Oy
	Type / Nominal ratio:	PPLH-4200NXT-10, i=135.81
	Manufacturer:	Flender GmbH
	Type / Nominal ratio:	Winergy PZAB 3600, i=135.938
	Manufacturer:	ZF Wind Power Antwerpen NV
	Type / Nominal ratio:	EH1053A, i=135.95
Rotor brake	Design:	Active hydraulic brake
	Manufacturer:	JHS Jungblut
	Type:	JHS-16-LS
	Manufacturer:	KTR
	Type:	KTR-STOP YAW M C-30

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Registration No.: **014.23.2.03.19.06**

Generator coupling	Manufacturer: Type:	KTR RADEX-N 220 NANA 4 Special
	Manufacturer: Type:	CENTA 019W-00036-SS20
Shrink disc	Manufacturer: Type:	Tollok Y2292
	Manufacturer: Type:	Flender FSD-980
	Manufacturer: Type:	Stüwe HSD-980-81-1
Main frame	Design: Designer: Material: Drawing No.:	Cast part Nordex Energy GmbH EN-GJS-400-18-LT 02080-e0004587155, Rev. 0
Generator frame	Design: Designer: Material: Drawing No.:	Welded structure Nordex Energy GmbH S235 / S355 02090-e0004650968, Rev. 1
Generator support	Design: Manufacturer: Type:	Elastomer bearing ESM ML08_001_21_KD
Gearbox support	Design: Manufacturer: Type:	Elastomer bearing ESM UB14_003 or UB99_012_12_001 (design life time 8 years)

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Registration No.: **014.23.2.03.19.06**

Yaw system	Yaw drive design:	Planetary gear with permanent magnet synchronous motor and electromechanical brake
	Manufacturer:	Bongfiglioli
	Type:	714T4W
	Manufacturer:	Liebherr
	Type:	DAT 450/3450
	Yaw bearing design:	Double row ball bearing slewing ring
	Manufacturer:	thyssenkrupp Rothe Erde
	Type:	83760220
Hydraulic system	Design:	Hydraulic unit
	Manufacturer:	HYDAC
	Type:	Hydraulikaggregat Delta4000
	Manufacturer:	HAWE
	Type:	Aggregat 17-070-H-00-00
Nacelle cover	Designer:	Nordex Energy GmbH
	Material:	Glass fiber reinforced plastic
	Design wind speed V_{e50}:	65 m/s
Spinner	Designer:	Nordex Energy GmbH
	Material:	Glass fiber reinforced plastic
	Design wind speed V_{e50}:	65 m/s

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Registration No.: **014.23.2.03.19.06**

Tower 105 m hub height (TS105)	Design:	Tubular steel tower
	Length / No. of sections:	101.488 m / 4
	Tower Drawing No.:	01430-e0004676560, Rev. 1
	Anchor Cage Drawing No.: (Variant 1)	01510-e0004268487, Rev. 2
	Anchor Cage Drawing No.: (Variant 2)	01510-e0004857974, Rev. 0
Tower 120 m hub height (TH120)	Design:	Precast concrete tower
	Length / No. of sections:	117.1 m / 6
	Tower Drawing No.:	DI0148, Rev. B
Tower 125 m hub height (TS125-01)	Design:	Tubular steel tower
	Length / No. of sections:	122.188 m / 6
	Tower Drawing No.:	01430-e0004854592, Rev. 3
	Anchor Cage Drawing No.: (Variant 1)	01510-e0004269181, Rev. 2
	Anchor Cage Drawing No.: (Variant 2)	01510-E0004875559, Rev. 0
Tower 135 m hub height (TS135)	Design:	Tubular steel tower
	Length / No. of sections:	131.788 m / 5
	Tower Drawing No.:	01430-e0004478316, Rev. 1
	Anchor Cage Drawing No.:	01510-e0004653245, Rev. 0
Tower 145 m hub height (TS145)	Design:	Tubular steel tower
	Length / No. of sections:	141.788 m / 6
	Tower Drawing No.:	01430-e0004712653, Rev. 1
	Anchor Cage Drawing No.: (Variant 1)	01510-e0004494731, Rev. 0
	Anchor Cage Drawing No.: (Variant 2)	01510-e0004781076, Rev. 0
	Anchor Cage Drawing No.: (Variant 3)	01510-e0004875225, Rev. 0
Tower 145 m hub height (TS145-01)	Design:	Tubular steel tower
	Length / No. of sections:	141.788 m / 5
	Tower Drawing No.:	01430-e0004873178, Rev. 1
	Anchor Cage Drawing No.: (Variant 1)	01510-e0004494731, Rev. 0
	Anchor Cage Drawing No.: (Variant 2)	01510-e0004781076, Rev. 0
	Anchor Cage Drawing No.: (Variant 3)	01510-e0004875225, Rev. 0

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Registration No.: **014.23.2.03.19.06**

Tower 155 m hub height (TS155)	Design:	Tubular steel tower
	Length / No. of sections:	151.288 m / 6
	Tower Drawing No.:	01430-e0004653808, Rev. 3
	Anchor Cage Drawing No.:	01510-e0004657916, Rev. 0
Tower 164 m hub height (TCS164 NV05)	Design:	Hybrid tower with tubular steel tower part and octagonal concrete part
	Length / No. of sections:	160.8 m
	Drawing No.:	01430-e0004679117, Rev. 0 E0004394319, Rev. d E0004460680, Rev. a
	Transition ring variant 1:	Monolithic
	Transition ring variant 2:	Split in two parts
Control and safety system	Manufacturer:	Nordex Energy GmbH
Generator	Design:	Double fed asynchronous slip ring
	Nominal Operation Point:	4000 kW / 4380 kW / 4500 kW
	Nominal Active Power:	4035 kW / 4415 kW / 4535 kW
	Nominal Speed (50 Hz):	1112 rpm / 1214 rpm / 1250 rpm
	Nominal Speed (60 Hz)	1334 rpm / 1457 rpm / 1500 rpm
	Degree of Protection:	IP54 (IP23 for slip ring)
	Manufacturer:	ELIN Motoren
	Type:	MRM-063 Z06
	Rated power:	4535 kW (660 V) / 4835 kW (690 V)
	Manufacturer:	Siemens
	Type:	JFWA-630MR-06A (steel housing)
	Rated power:	4535 kW (660 V) / 4835 kW (690 V)
	Manufacturer:	Siemens
	Type:	JFCA-630MR-06A (cast housing)
	Rated power:	4535 kW (660 V)
Converter	Manufacturer:	Vertiv/Emerson Network Power Co. Ltd
	Type:	WF1000-06L0450-NPN-A or WF1000-06L0480
	Manufacturer:	Woodward
	Type:	CW1451LD-C0x

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Statement of Compliance
for the Design Evaluation

Registration No.: **014.23.2.03.19.06**

Transformer	Manufacturer:	Siemens and SBG
	Design:	Ester-immersed transformer
	Rated power:	5000 / 5350 kVA
	Rated Voltage HV:	20 kV – 36 kV
	Rated Voltage LV:	0.66 kV / 0.69 kV
	Frequency:	50 / 60 Hz
	Manufacturer / Type:	SGB / DTTH1NG 5000/20
	Design:	Cast-resin transformer
	Rated power:	5000 kVA
	Rated Voltage HV:	20 kV – 22 kV
	Rated Voltage LV:	0.66 kV
	Frequency:	50 Hz

End of annex 2

Attachment 4

Turbine Wind Model Certificates

3. Siemens Gamesa Certificate

/s/ Christine M.T. Pirik
Christine M.T. Pirik (0029759)
(Counsel of Record)
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ZERTIFIKAT ◆ CERTIFICATE ◆ 認證證書 ◆ СЕРТИФИКАТ ◆ CERTIFICADO ◆ CERTIFICAT

Type Certificate

Industrie Service

Subject:	**SG 4.5-145 (50/60Hz) Rated Power 4.0-5.0MW** **SG 4.5-132 (50/60Hz) Rated Power 4.5MW** **WT class I_A/II_B, IEC 61400-1/A1:2010**
Registration no.:	**023.13.2.01.19.02**
Applicant:	**SIEMENS GAMESA RENEWABLE ENERGY** **Ciudad de la Innovación n°2** **31621 Sarriguren (Navarra)** **Spain**
Confirmation:	It is hereby certified that the above-mentioned subject has been assessed by TÜV SÜD Industrie Service GmbH concerning design, prototype testing and manufacturing.
Assessment procedure:	The conformity evaluation was carried out according to IEC 61400-22:2010 'Wind turbines – Part 22: Conformity testing and certification' in combination with IEC 61400-1:2005 including amendment 1:2010 'Wind turbines – Part 1: Design requirements'.

The evaluation is based on the following reference documents:

Registration no.	Date issued	Statements of compliance / reports
023.13.2.03.19.02	2019-12-20	Design Evaluation by TÜV SÜD
023.13.2.04.19.02	2019-12-20	Type Testing by TÜV SÜD
023.13.2.05.19.02	2019-12-20	Manufacturing Evaluation by TÜV SÜD
3076711-51-e Rev2	2019-12-20	Final Evaluation Report by TÜV SÜD

This certificate is valid until: **2024-09-25**

if the validity of incorporated component certificates and the certification of the quality management system is maintaine

Munich, 2019-12-20

DAkkS Deutsche Akkreditierungsstelle D-ZE-14153-01-02

Certification Body for products according to DIN EN ISO/IEC 17065:2013 accredited by DAkkS. The accreditation is only valid for the scope mentioned in the accreditation certificate.

B. Bartels, M.A.

Certification Body Wind Turbines
TÜV SÜD Industrie Service GmbH

Attachment 5

Turbine/Parcel Distance

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Turbine_ID	ParcelID	Auditor_Ac	Auditor_La	Parcel_Add	Parcel_Cit	Parcel_Sta	Parcel_Zip	DistanceFT
T1	27-00164.000	9.6	Kde Holdings Llc	BILLINGS	CASTALIA	OH	44824	1372
T2	29-00072.000	15.3	KAUTZ DANIEL L	SR 4	BELLEVUE	OH	44811	1516
T3	25-00294.000	23.4	WENSINK RICHARD J ET	4415 WOOD	MONROEVILLE	OH	44847	1940
T4	23-00035.000	48.8	LEONHARD MELVIN	3820 STRECKER	MONROEVILLE	OH	44847	1642
T5	23-00126.000	1.1	MEADE JIMMY N	9715 THOMAS	MONROEVILLE	OH	44847	1423
T6	26-00018.000	6.5	Bellew Dean R Bellew	BRAGG RD	BELLEVUE	OH	44811	1541
T7	26-00121.001	4.8	KING ANNA SUE	9401 STRECKER	BELLEVUE	OH	44811	1751
T8	26-00161.000	131.7	NYE FARMS LLC	12008 HAYES	SANDUSKY	OH	44870	1438
T9	26-00121.001	4.8	KING ANNA SUE	9401 STRECKER	BELLEVUE	OH	44811	2627
T10	26-00161.000	131.7	NYE FARMS LLC	12008 HAYES	SANDUSKY	OH	44870	3061
T11	26-00049.000	73.1	Close Linda L	BRAGG	BELLEVUE	OH	44811	1437
T12	26-00134.000	42.4	CLOSE GRAIN FARMS IN	SMITH	BELLEVUE	OH	44811	1386
T13	26-00134.000	42.4	CLOSE GRAIN FARMS IN	SMITH	BELLEVUE	OH	44811	1430
T14	24-00167.000	2.3	BARNHART JOHN C & LO	DELEMATRE	MONROEVILLE	OH	44847	1401
T15	24-00001.000	1.0	CRANE KENNETH E & BE	12015 RANSOM	MONROEVILLE	OH	44847	1789
T16	23-00062.000	47.0	3203 FARMS LLC ETAL	LIVENGOOD	MONROEVILLE	OH	44847	1436
T17	24-00079.000	0.8	CAPUCINI ROSEMARIE F	11101 SKADDEN	MONROEVILLE	OH	44847	2164
T18	26-00064.001	0.0	BROGAN SCOTT D & BEL	SR 113		OH	44857	2078
T19	24-00024.000	1.3	KOCH RICHARD	11611 SR 99	MONROEVILLE	OH	44811	1407
T20	24-00024.000	1.3	KOCH RICHARD	11611 SR 99	MONROEVILLE	OH	44811	1544
T21	20-0020-03-006-0000	62.1	William H Barnard Th	Sandhill Rd	Bellevue	OH	44811	1386
T22	41-0030-03-019-0000	16.3	Chris A Ackerman	St Rt 99	Monroeville	OH	44847	1400
T23	20-0020-03-028-0100	1.1	Kenneth M Didion	4636 Williams Rd	Monroeville	OH	44847	1723
T24	20-0030-01-004-0200	0.6	Ohio Edison Co	State Route 20	Bellevue	OH	44811	1604
T25	20-0030-01-022-0000	0.5	Richard Wobser Jane	Prairie Rd	Bellevue	OH	44811	1529
T26	20-0040-01-028-0200	1.9	Jerrold D Beck Sherr	5670 Young Rd	Bellevue	OH	44811	2146
T27	20-0010-02-048-0000	29.8	Jcs Farm Land Llc	Opperman Rd	Bellevue	OH	44811	1411
T28	20-0020-01-001-0500	0.7	Ohio Edison Co		Monroeville	OH	44847	1945
T29	20-0040-01-031-0000	1.7	William N Dearsman C	5825 Young Rd	Bellevue	OH	44811	1384
T30	20-0010-02-048-0000	29.8	Jcs Farm Land Llc	Opperman Rd	Bellevue	OH	44811	1403
T31	20-0010-01-028-0000	58.0	David G Wilhelm Sher	Williams Rd	Monroeville	OH	44847	1593
T32	20-0040-01-012-0000	28.5	Jcs Farm Land Llc	Opperman Rd	Bellevue	OH	44811	1403
T33	20-0010-01-028-0000	58.0	David G Wilhelm Sher	Williams Rd	Monroeville	OH	44847	1725
T34	20-0040-03-019-0000	5.0	Mark A Mcwilliams Ma	6697 Young Rd	Bellevue	OH	44811	1404
T35	20-0010-02-044-0000	72.2	Jcs Farm Land Llc	Opperman Rd	Bellevue	OH	44811	1721
T36	20-0010-01-036-0000	28.5	Higbee Road II Ltd & Higbee R	0 ST RT 547	Monroeville	OH	44847	1657
T37	20-0040-03-010-0101A	10.6	William K Dillon		Bellevue	OH	44811	1379
T38	20-0040-03-010-0101A	10.6	William K Dillon		Bellevue	OH	44811	1376
T39	20-0040-01-012-0000	36.7	Jcs Farm Land Llc	Opperman Rd	Bellevue	OH	44811	1407
T40	45-0020-01-090-0000	73.8	HAHN IRIS A TRUSTEE	0 SECTION LINE 30 RD		OH	44811	1392
T41	47-0020-01-100-0201	1.0	KELLER MICHAEL J &	2124 SECTION LINE 30		OH	44811	1821
T42	45-0020-01-062-0300	5.8	DANIEL THERESA C	2165 DOGTOWN RD	MONROEVILLE	OH	44847	1866
T43	45-0030-01-095-0000	0.9	HART MICHAEL J	6593 ST RT 547		OH	44811	1401
T44	46-0020-01-086-0000	82.0	DS LAND LLC	0 DOGTOWN RD	MONROEVILLE	OH	44847	1901
T45	46-0020-01-059-0200	5.0	OTT ALLEN P & LAUR	1631 DOGTOWN RD	MONROEVILLE	OH	44847	1473
T46	47-0030-01-007-0300	0.0	SHERMAN TWP TRUSTEES	0 PONTIAC SECTIONLIN		OH	44811	1740
T47	47-0040-01-092-0100	2.4	PEIFFER ROBERT L &	6739 PONTIAC SECTION		OH	44811	1379
T48	47-0040-01-029-0000	58.2	RUFFING VIRGINIA R	0 WOOD RD		OH		1380
T49	47-0010-01-063-0000	73.1	ELMLINGER THERESA A	5105 DOGTOWN RD	MONROEVILLE	OH	44847	1387
T50	47-0040-01-034-0100	1.5	RUFFING ROGER A	119 WOOD RD		OH	44807	1402
T51	47-0040-01-049-0000	2.6	GAYHEART BRANDI A	6206 SHERMAN-NORWICH		OH		1411
T52	K40000635760100	17.3	GEBARD JOHN R & RONNETTE	0 TR 122		OH	44807	1497
T53	35-0030-02-019-0000	50.5	STOCKMASTER STEPHEN	0 NORTH GREENFIELD R		OH	44807	1399
T54	47-0010-01-047-0100	0.9	HALL CHRISTOPHER L	4968 SHERMAN-NORWICH	WILLARD	OH	44890	1412
T55	35-0020-01-009-0000	99.5	MILLER CHARLES ETAL	0 OLD MILITARY RD	WILLARD	OH	44890	1380
T56	35-0020-01-008-0000	1.5	BUMB ROBERT RUSSELL	226 SECTION LINE 3O	WILLARD	OH	44890	1581
T57	35-0030-02-019-0000	50.5	STOCKMASTER STEPHEN	0 NORTH GREENFIELD R		OH	44807	1372
T58	35-0020-01-072-0200	1.1	MCGAHHEY MICHAEL &	4934 NORTH GREENFIEL	WILLARD	OH	44890	1414
T59	35-0030-02-022-0101	3.8	MCCONNELL MICHELE L	463 JENNIFER RD		OH	44807	1696
T60	36-0020-02-038-0000	50.9	ROBINSON JEANETTE M	0 TOWNLINE 26 RD	WILLARD	OH	44890	1393
T61	35-0030-01-046-0100	0.9	HAHLER LINDA J	6244 SCOTTWOOD RD	WILLARD	OH	44890	1415
T62	36-0020-02-032-0100	5.2	SCHAFFER SHERRY L ET	4250 ST RT 162	WILLARD	OH	44890	1699
T63	36-0040-01-033-0000	101.6	B & C FARMS INC	1438 DANIELS RD	WILLARD	OH	44890	1875
T64	35-0040-01-015-0000	101.2	BOGNER GREGORY A &	1537 WURTZ RD	WILLARD	OH	44890	1532
T65	36-0040-01-028-0000	52.7	BEAGLE JOYCE	1927 DANIELS RD	WILLARD	OH	44890	1398
T66	36-0010-01-039-0000	39.6	BEEBE RICHARD SCOTT	0 MILLER RD	WILLARD	OH	44890	1569
T67	36-0010-01-039-0000	39.6	BEEBE RICHARD SCOTT	0 MILLER RD	WILLARD	OH	44890	1392
T68	36-0010-01-007-0100	2.1	WYANDT DAVID A & BER	1872 SECTION LINE 30	WILLARD	OH	44890	1418
T69	36-0010-01-007-0100	2.1	WYANDT DAVID A & BER	1872 SECTION LINE 30	WILLARD	OH	44890	1441
T70	35-0040-01-012-0100	1.9	VOGEL DUANE E & JAN	0 EGYPT RD		OH	44807	1490
T71	36-0010-01-013-0300	5.8	DEANER DAVID EARLE &	5365 EGYPT RD	WILLARD	OH	44890	1446
T72	26-00121.001	4.8	KING ANNA SUE	9401 STRECKER	BELLEVUE	OH	44811	1411
T73	26-00043.000	98.6	Close Grain Farms In	STRECKER	BELLEVUE	OH	44811	1389
T74	26-00223.001	2.4	Dendinger Michael L	11211 KNAUSS RD	BELLEVUE	OH	44811	1400

T75	01-0310-01-004-0600	1.1	Ohio Edison Co	E Main St	Bellevue	OH	44811	1384
T76	46-0020-01-029-0000	50.0	SAND HILL FARM LLC	0 SANDHILL REAR RD	MONROEVILLE	OH	44847	1415
T77	45-0020-01-062-0300	5.8	DANIEL THERESA C	2165 DOGTOWN RD	MONROEVILLE	OH	44847	2013
T78	35-0030-02-019-0000	50.5	STOCKMASTER STEPHEN	0 NORTH GREENFIELD R		OH	44807	1926
T79	14-0030-01-002-0100	1.5	SMITH JOHN L & ALICE	1134 TOWNLINE 26 RD	WILLARD	OH	44890	1404
T80	40-0030-03-034-0000	43.2	SHOOK T JAYNE AKA TH	0 WILLARD WEST RD	WILLARD	OH	44890	1826
T81	40-0030-03-034-0000	43.2	SHOOK T JAYNE AKA TH	0 WILLARD WEST RD	WILLARD	OH	44890	1420
T82	39-0030-03-031-0000	0.7	KOCHEL LLOYD B	6750 US RT 224		OH	44807	1559
T83	40-0030-02-017-0100	5.8	ROWLETT RICHARD V &	3344 WILLOUGHBY RD	WILLARD	OH	44890	1432
T84	25-00172.000	200.4	RO-BERN ACRES INC	POTTER	SANDUSKY	OH	44870	1700
T85	29-00213.000	45.1	BENKO MICHAEL A	HARRIS	SANDUSKY	OH	44870	1423
T86	25-00379.002	0.0	GUNDLACH TERRY W	6708 STRECKER	MONROEVILLE	OH	44847	1390
T87	20-0040-03-025-0100	3.5	Alan K Patricia A Kn		Bellevue	OH	44811	1412

Attachment 6

March 8, 2019 Obstruction Evaluation and Airspace Analysis report from Capitol Airspace Group

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(Counsel is willing to accept service via email.)

Emerson Creek Wind Project

Apex Clean Energy

Erie, Huron, and Sandusky Counties, Ohio

Obstruction Evaluation & Airspace Analysis

March 8, 2019

Capitol Airspace Group

capitolairspace.com

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Summary

Capitol Airspace conducted an obstruction evaluation and airspace analysis for the Emerson Creek wind project in Erie, Huron, and Sandusky Counties, Ohio. The purpose for this analysis was to identify obstacle clearance surfaces established by the Federal Aviation Administration (FAA) that could limit the placement of 605 and 660 foot above ground level (AGL) wind turbines. At the time of this analysis, 87 individual wind turbine locations (black points, ***Figure 1***) had been identified. This analysis assessed height constraints overlying each location as well as an approximately 270 square mile study area (red outline, ***Figure 1***) to aid in identifying optimal wind turbine locations.

14 CFR Part 77.9 requires that that all structures exceeding 200 feet AGL be submitted to the FAA so that an aeronautical study can be conducted. The FAA's objective in conducting aeronautical studies is to ensure that proposed structures do not have an effect on the safety of air navigation and the efficient utilization of navigable airspace by aircraft. The end result of an aeronautical study is the issuance of a determination of 'hazard' or 'no hazard' that can be used by the proponent to obtain necessary local construction permits. It should be noted that the FAA has no control over land use in the United States and cannot enforce the findings of its studies.

Height constraints overlying the Emerson Creek wind project range from 917 to 1,549 feet above mean sea level (AMSL) and are associated with instrument departure and approach procedures, minimum vectoring altitude sectors, and minimum instrument flight rules (IFR) altitude sectors. Proposed structures that exceed these surfaces would require an increase to instrument departure procedure minimum climb gradients, instrument approach procedure minimum altitudes, and minimum vectoring/IFR altitudes. If the FAA determines that these impacts would affect as few as one operation per week, it could result in determinations of hazard.

United States Geological Survey (USGS) elevation data indicates that these surfaces could limit 605 foot AGL wind turbines in the eastern, western, and southern sections of the study area, including five proposed locations. Additionally, these surfaces could limit 660 foot AGL wind turbines in these areas, including 15 proposed locations. Depending on the size of VFR traffic pattern airspace ultimately applied by the FAA, this segment of airspace could further limit wind development in the western and southern sections of the study area. However, none of the proposed wind turbines are located in these areas.

Multiple military slow routes overlie the southwestern corner of the Emerson Creek wind project. Impact on these routes could result in military objections to proposed wind development.

Lastly, the Emerson wind project is located within line of sight of multiple surveillance radar systems. Impact on surveillance radar systems can result in the issuance of determinations of hazard regardless of the lack of impact on the other surfaces described in this report.

This study did not consider electromagnetic interference on FAA communication systems.

Capitol Airspace applies FAA defined rules and regulations applicable to obstacle evaluation, instrument procedures assessment and visual flight rules (VFR) operations to the best of its ability and with the intent to provide the most accurate representation of limiting airspace surfaces as possible. Capitol Airspace maintains datasets obtained from the FAA which are updated on a 56 day cycle. The results of this analysis/map are based on the most recent data available as of the date of this report. Limiting airspace surfaces depicted in this report are subject to change due to FAA rule changes and regular procedure amendments. Therefore, it is of the utmost importance to obtain FAA determinations of no hazard prior to making substantial financial investments in this project.

Methodology

Capitol Airspace studied the proposed project based upon location information provided by Apex Clean Energy. Using this information, Capitol Airspace generated graphical overlays to determine proximity to airports (***Figure 1***), published instrument procedures, enroute airways, FAA minimum vectoring altitude and minimum instrument flight rules (IFR) altitude charts, as well as military airspace and training routes.

Capitol Airspace evaluated all 14 CFR Part 77 imaginary surfaces, published instrument approach and departure procedures, visual flight rules operations, FAA minimum vectoring altitudes, minimum IFR altitudes, and enroute operations. All formulas, headings, altitudes, bearings and coordinates used during this study were derived from the following documents and data sources:

- 14 CFR Part 77 Safe, Efficient Use, and Preservation of the Navigable Airspace
- FAA Order 7400.2M Procedures for Handling Airspace Matters
- FAA Order 8260.3D United States Standard for Terminal Instrument Procedures
- FAA Order 8260.58A United States Standard for Performance Based Navigational (PBN) Instrument Procedure Design
- Technical Operations Evaluation Desk Guide for Obstruction Evaluation/Airport Airspace Analysis (1.3.0)
- United States Government Flight Information Publication, US Terminal Procedures
- National Airspace System Resource Aeronautical Data

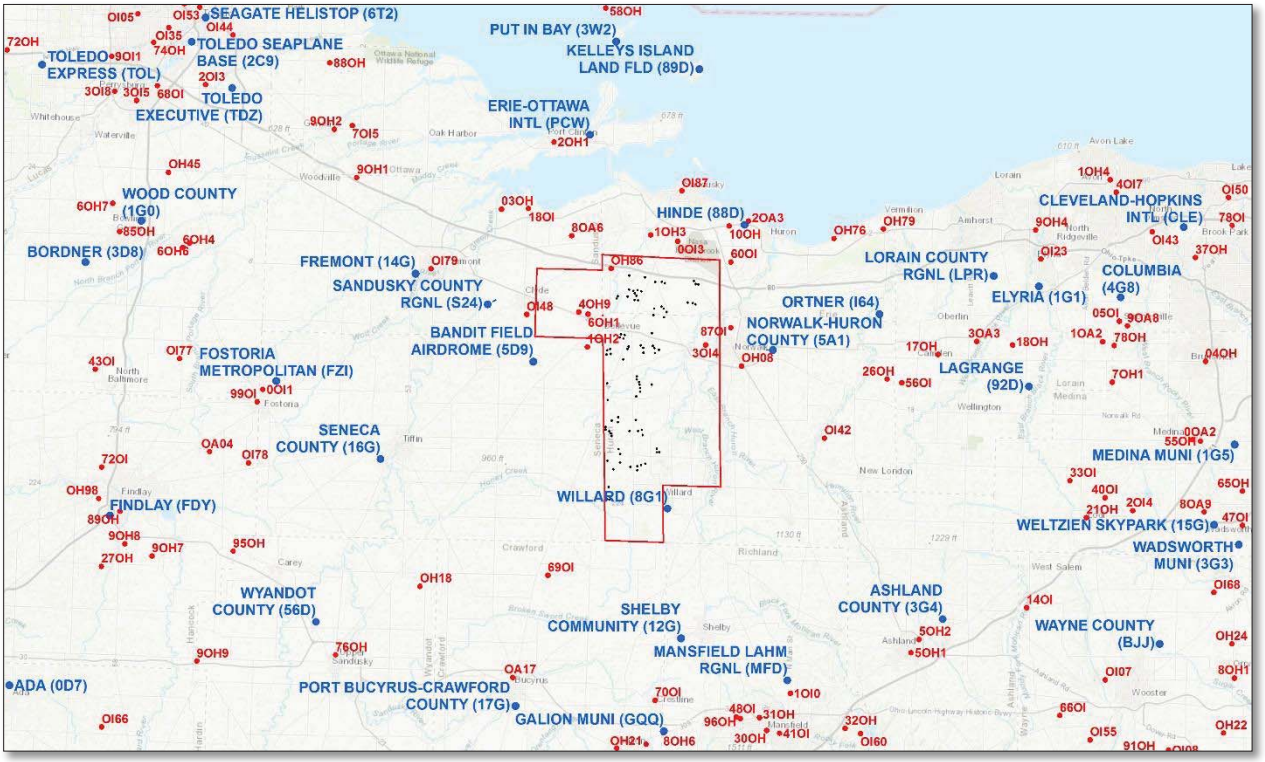

Figure 1: Public-use (blue) and private-use (red) airports in proximity to the Emerson Creek wind project

Study Findings

14 CFR Part 77 Imaginary Surfaces

The FAA uses level and sloping imaginary surfaces to determine if a proposed structure is an obstruction to air navigation. Structures that are identified as obstructions are then subject to a full aeronautical study and increased scrutiny. However, exceeding a Part 77 imaginary surface does not automatically result in the issuance of a determination of hazard. Proposed structures must have airspace impacts that constitute a substantial adverse effect in order to warrant the issuance of determinations of hazard.

14 CFR Part 77 imaginary surfaces (***Figure 2***) overlying the Emerson Creek wind project:

Sandusky County Regional (S24)[1]
77.17(a)(2): 962 to 1,286 feet AMSL

Norwalk-Huron County (5A1)[1]
77.17(a)(2): 1,159 to 1,351 feet AMSL

Willard (8G1)
77.17(a)(2): 1,167 to 1,466 feet AMSL
77.19: 966 to 1,317 feet AMSL

At 605 and 660 feet AGL, proposed wind turbines in the eastern, western, and southern sections of the study area (orange and yellow areas, ***Figure 2***), including 18 proposed locations, will exceed these surfaces and will be identified as obstructions. Additionally, at 605 and 660 feet AGL, all of the proposed wind turbines will exceed 77.17(a)(1) – a height of 499 feet AGL at the site of the object – and will be identified as obstructions regardless of location.

[1] Sandusky County Regional Airport (S24) and Norwalk-Huron County Airport (5A1) plan to extend their existing runways. As a result, the associated 14 CFR Part 77.17(a)(2) imaginary surfaces could differ slightly from those based on the existing airport reference point (ARP).

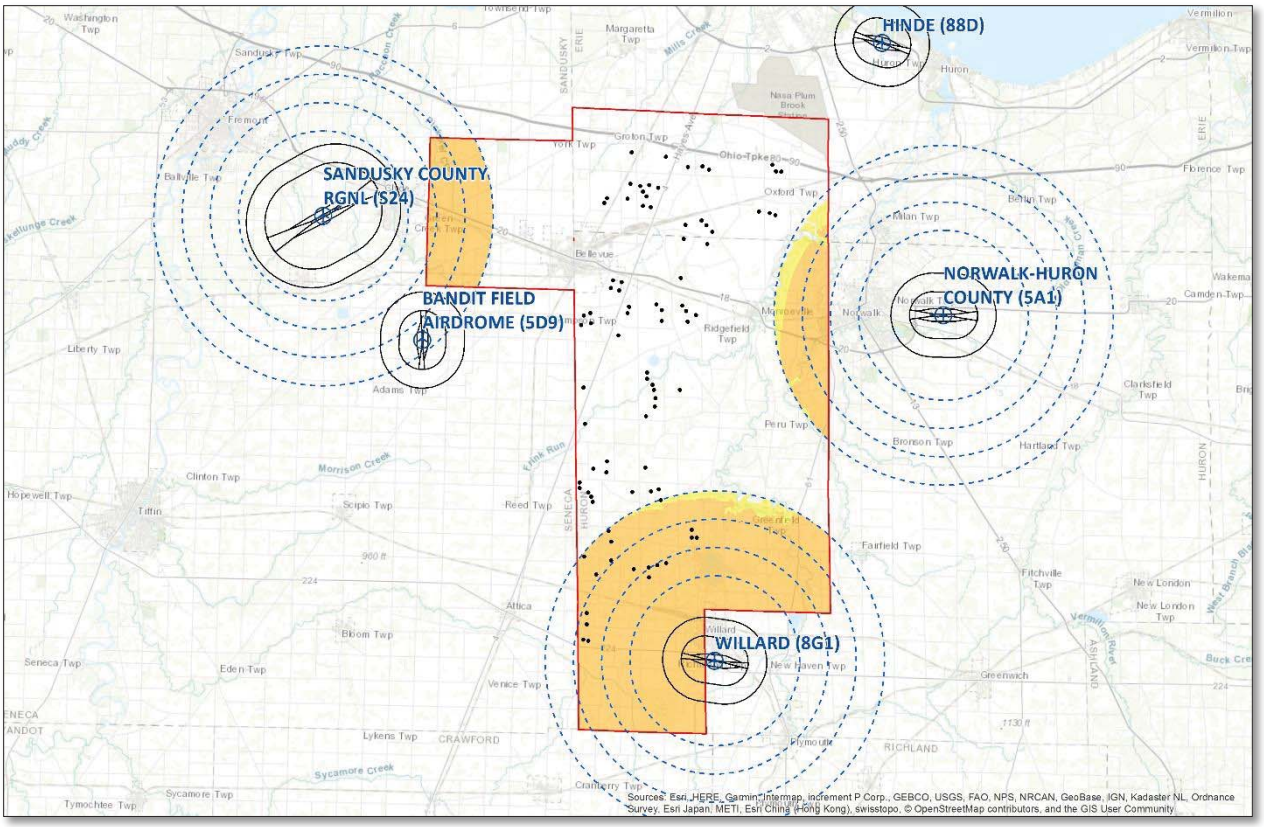

Figure 2: 77.17(a)(2) (dashed blue) and 77.19 (black) imaginary surfaces in proximity to the Emerson Creek wind project

Visual Flight Rules (VFR) Traffic Pattern Airspace

VFR traffic pattern airspace is used by pilots operating during visual meteorological conditions. The airspace dimensions are based upon the category of aircraft which, in turn, is based upon the approach speed of the aircraft. 14 CFR Part 77.17(a)(2) and 77.19 (as applied to a *visual* runway) imaginary surfaces establish the obstacle clearance surface heights within VFR traffic pattern airspace.

VFR traffic pattern airspace overlies the Emerson Creek wind project. While the FAA may initially protect for up to Category D VFR traffic pattern airspace (shaded gray, ***Figure 3***), not all airports are likely to support a significant volume of Category D operations. As a result, the FAA will apply VFR traffic pattern airspace considering the airport's likely operations and runway physical characteristics (***Table 1***).

The likely (solid outline, ***Figure 4***) and potential (dashed outline, ***Figure 4***) VFR traffic pattern airspace applications overlie the western and southern sections of the study area. Due to the height constraints associated with VFR traffic pattern airspace, 605 and 660 foot AGL wind turbines will not be feasible within these boundaries. However, none of the proposed wind turbines are located in these areas.

	Status	Dimensions (Feet)	Weight Bearing Capacity (Pounds)	Surface Type	Potential VFR Traffic Pattern Category	Likely VFR Traffic Pattern Category
Bandit Field Airdrome (5D9)						
Runway 18/36	Current	2,576 x 80	NA - Turf	Turf	-	B
Sandusky County Regional (S24) [2]						
Runway 06/24	Current	5,500 x 100	30,000 [single]	Asphalt	-	C
Runway 06/24	Proposed	7,000 (estimated length)	Unknown	Paved	-	D
Hinde (88D)						
Runway 11/29	Current	2,501 x 70	NA - Turf	Turf	-	B
Willard (8G1)						
Runway 10/28	Current	4,028 x 65	Not Published	Asphalt	C	B

Table 1: Runway physical characteristics and likely VFR traffic pattern application

[2] Sandusky County Regional (S24) plans to extend Runway 06/24 to the northeast. As a result, Capitol Airspace assessed VFR traffic pattern airspace for both the existing and planned runway locations.

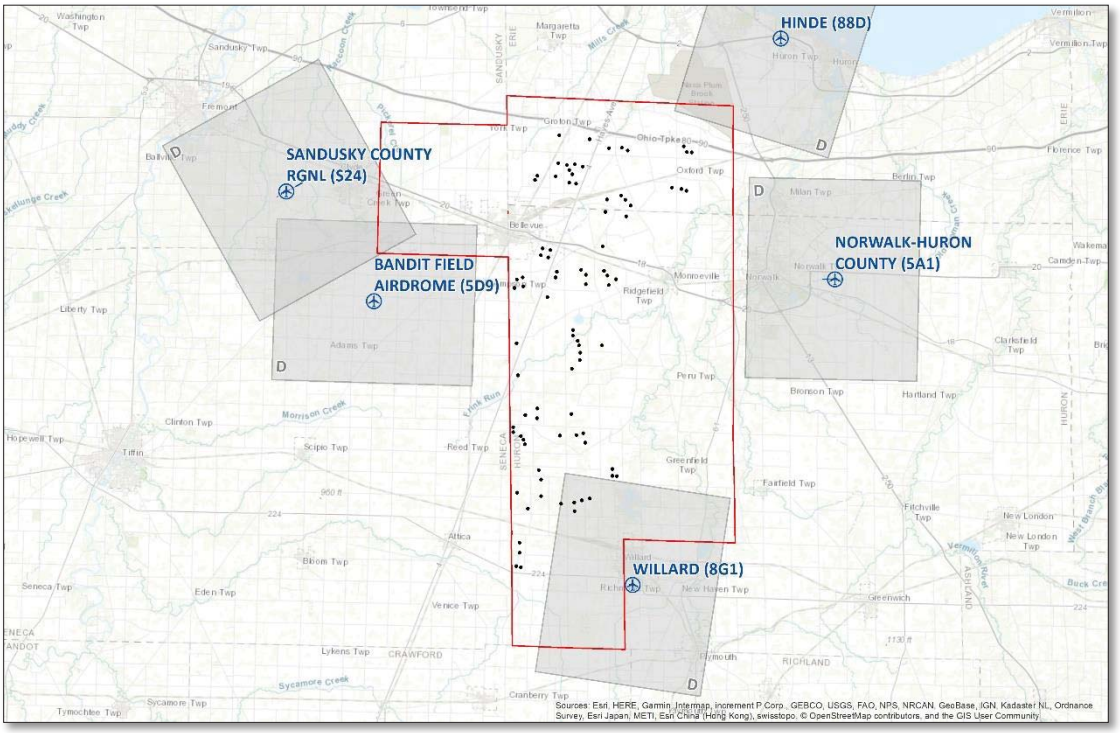

Figure 3: VFR traffic pattern airspace in proximity to the Emerson Creek wind project

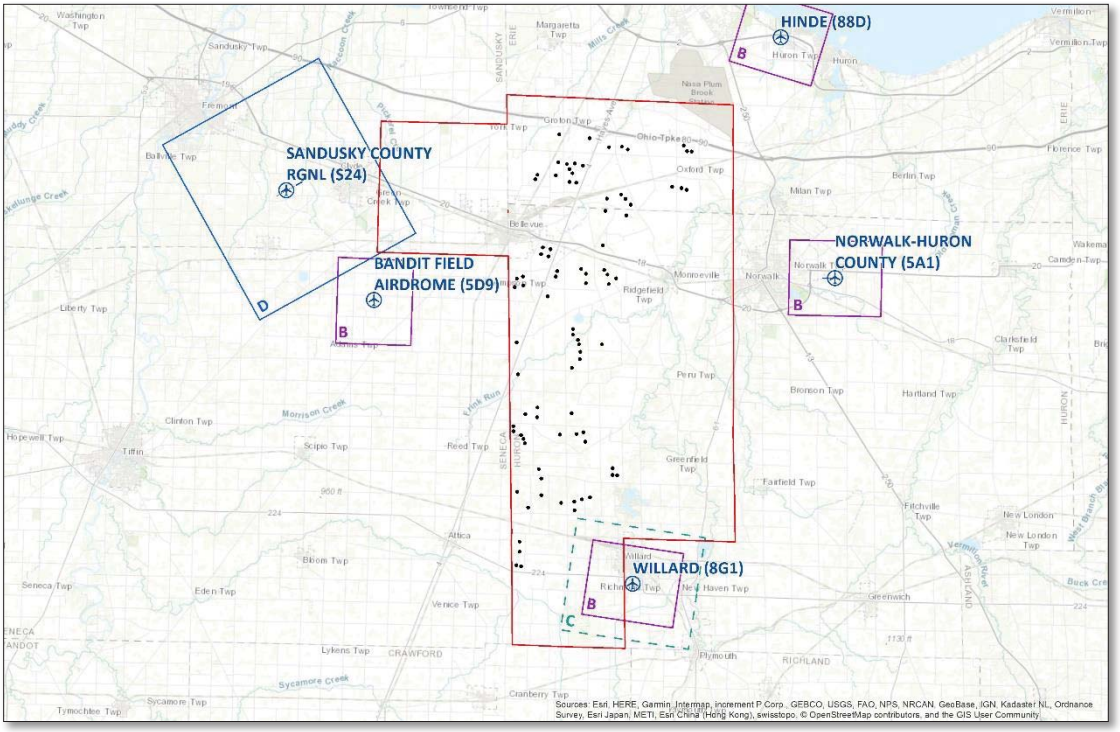

Figure 4: Potential (dashed outline) and likely (solid outline) VFR traffic pattern airspace applications (based on proposed airport configurations)

Visual Flight Rules (VFR) Routes

During periods of marginal Visual Meteorological Conditions (VMC) – low cloud ceilings and one statute mile visibility – pilots often operate below the floor of controlled airspace. Operating under these weather conditions requires pilots to remain within one statute mile of recognizable land marks such as roads, rivers, and railroad tracks. The FAA protects for known and regularly used VFR routes by limiting structure heights within two statute miles of these routes to no greater than 14 CFR Part 77.17(a)(1) – a height of 499 feet AGL at the site of the object.

The Emerson Creek wind project is located in proximity to railroads, highways, and transmission lines that may be used as VFR routes (***Figure 5***). However, operational data describing the usage of these potential routes is not available. If the FAA determines that these potential VFR routes are flown regularly, they could limit wind development in excess of 499 feet AGL and within two statute miles of these landmarks (hatched orange, ***Figure 5***).

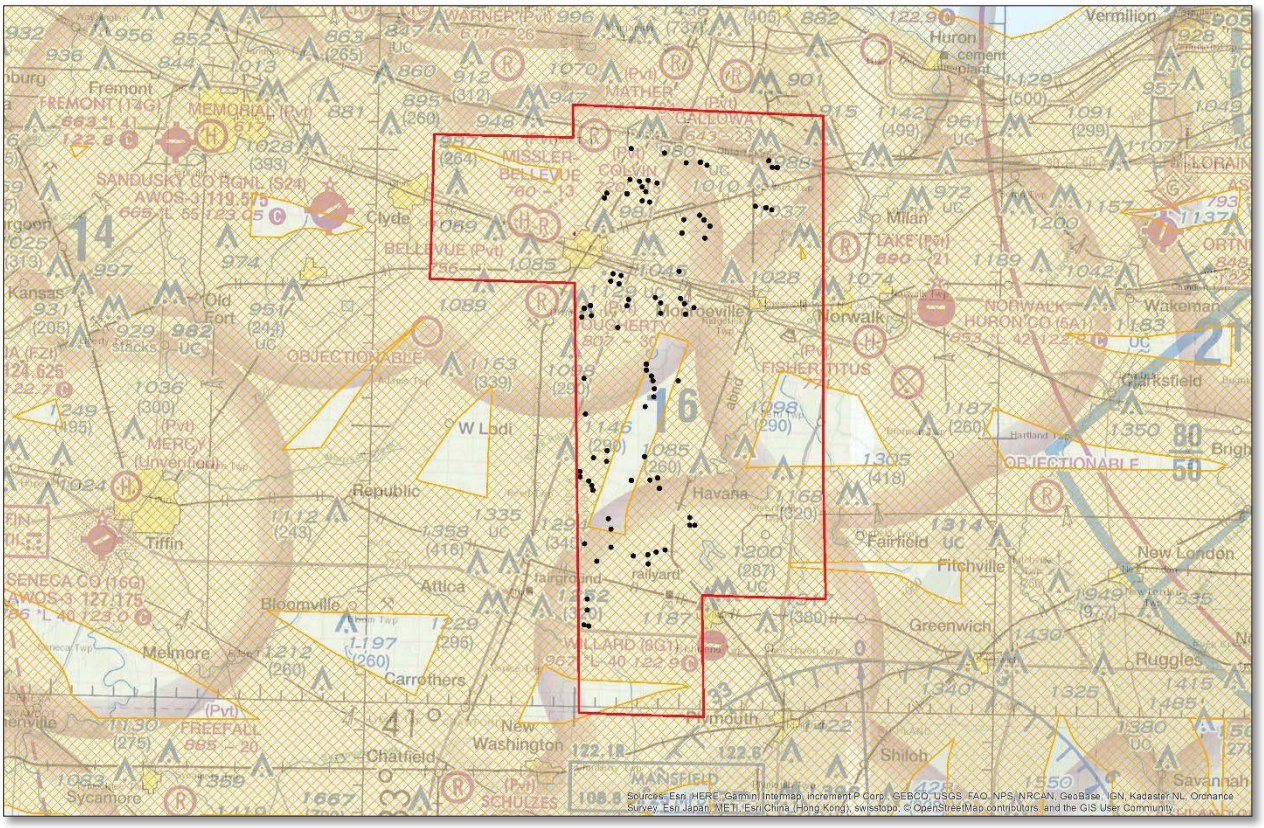

Figure 5: Potential VFR routes in proximity to the Emerson Creek wind project

Instrument Departures

In order to ensure that aircraft departing during marginal weather conditions do not fly into terrain or obstacles, the FAA publishes instrument departure procedures that provide obstacle clearance to pilots as they transition between the terminal and enroute environments. These procedures contain specific routing and minimum climb gradients to ensure clearance from terrain and obstacles.

Proposed structures that exceed instrument departure procedure obstacle clearance surfaces would require an increase to instrument departure procedure minimum climb gradients. If the FAA determines that this impact would affect as few as one operation per week, it could be used as the basis for determinations of hazard. [3]

Sandusky County Regional (S24) - Current

Obstacle Departure Procedure

Obstacle clearance surfaces (red contours, ***Figure 6***) range from 1,152 to 4,295 feet AMSL and are some of the lowest height constraints overlying the western section of the study area. USGS elevation data indicates that these surfaces could limit 605 and 660 foot AGL wind turbines in this area (red and orange areas, ***Figure 6***). However, these surfaces should not limit 605 or 660 foot AGL wind turbines at any of the proposed locations.

Sandusky County Regional (S24) - Planned [4]

Obstacle Departure Procedure

Obstacle clearance surfaces range from 1,120 to 4,293 feet AMSL and would be some of the lowest height constraints overlying the western section of the study area. USGS elevation data indicates that these surfaces could limit 605 and 660 foot AGL wind turbine heights in this area. However, these surfaces should not limit 605 or 660 foot AGL wind turbines at any of the proposed locations.

Willard (8G1)

Obstacle Departure Procedure

Obstacle clearance surfaces (red contours, ***Figure 6***) range from 968 to 4,190 feet AMSL and are some of the lowest height constraints overlying the southern section of the study area. USGS elevation data indicates that these surfaces could limit 605 and 660 foot AGL wind turbines in this area (red and orange areas, ***Figure 6***). Additionally, these surfaces could limit 660 foot AGL wind turbines at one proposed location (*T83*).

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[3] Multiple private hospital heliports in proximity to and within the Emerson Creek wind project boundary have special instrument departure procedures that overlie the project. However, special procedure documentation is the proprietary information of the approved users. Since procedure design specifics were not available, special instrument departure procedures could not be assessed. It is possible that the associated obstacle clearance surfaces are lower than those described in this report and could limit 605 and 660 foot AGL wind turbines.

[4] Sandusky County Regional Airport (S24) plans to extend Runway 06/24 to the northeast. As a result, Capitol Airspace assessed instrument departure procedures from both the existing and planned runway locations.

Norwalk-Huron County (5A1) - Current

Obstacle Departure Procedure

Obstacle clearance surfaces (red contours, ***Figure 6***) range from 1,398 to 3,809 feet AMSL and are some of the lowest height constraints overlying the eastern section of the study area. However, these surfaces should not limit 605 or 660 foot AGL wind turbines within the defined study area.

Norwalk-Huron County (5A1) - Planned [5]

Obstacle Departure Procedure

Obstacle clearance surfaces range from 1,376 to 3,767 feet AMSL and would be some of the lowest height constraints overlying the eastern section of the study area. However, these surfaces should not limit 605 or 660 foot AGL wind turbines within the defined study area

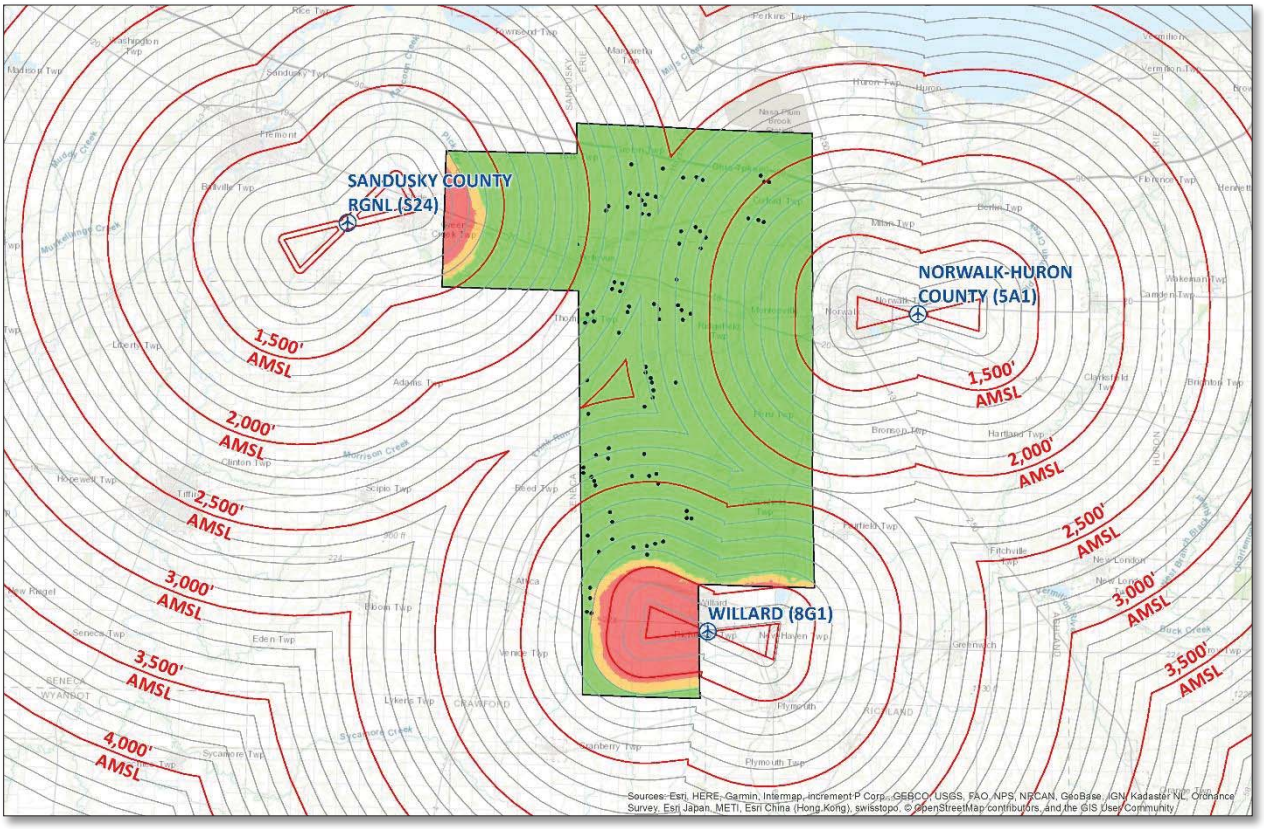


Figure 6: Sandusky County Regional Airport (S24), Willard Airport (8G1), and Norwalk-Huron County Airport (5A1) obstacle departure procedure assessment

[5] Norwalk-Huron County Airport (5A1) plans to extend Runway 10/28 to the west. As a result, Capitol Airspace assessed instrument departure procedures from both the existing and planned runway locations.

Instrument Approaches

Pilots operating during periods of reduced visibility and low cloud ceilings rely on terrestrial and satellite based navigational aids (NAVAIDS) in order to navigate from one point to another and to locate runways. The FAA publishes instrument approach procedures that provide course guidance to on-board avionics that aid the pilot in locating the runway. Capitol Airspace assessed a total of 37 published instrument approach procedures at 15 public-use airports in proximity to the Emerson Creek wind project:

Seneca County (16G)
RNAV (GPS) Approach to Runway 06
RNAV (GPS) Approach to Runway 24
VOR Approach to Runway 06
NDB Approach to Runway 24

Galion Municipal (GQQ)
RNAV (GPS) Approach to Runway 05
RNAV (GPS) Approach to Runway 23
VOR Approach to Runway 23

Port Bucyrus-Crawford County (17G)
RNAV (GPS) Approach to Runway 04
RNAV (GPS) Approach to Runway 22
VOR Approach to Runway 22

Elyria (1G1)
VOR or GPS-A Circling Approach

Ashland County (3G4)
RNAV (GPS) Approach to Runway 19
VOR-A Circling Approach

Sandusky County Regional (S24)
RNAV (GPS) Approach to Runway 06
RNAV (GPS) Approach to Runway 24

Wyandot County (56D)
VOR-A Circling Approach

Fostoria Metropolitan (FZI)
RNAV (GPS) Approach to Runway 09
RNAV (GPS) Approach to Runway 27
VOR-A Circling Approach

Norwalk-Huron County (5A1)
RNAV (GPS) Approach to Runway 28

Willard (8G1)
VOR-A Circling Approach

Mansfield Lahm Regional (MFD)
ILS or Localizer Approach to Runway 32
RNAV (GPS) Approach to Runway 05
RNAV (GPS) Approach to Runway 14
RNAV (GPS) Approach to Runway 23
RNAV (GPS) Approach to Runway 32
VOR Approach to Runway 14
VOR Approach to Runway 32
NDB Approach to Runway 32

Erie-Ottawa International (PCW)
RNAV (GPS) Approach to Runway 09
RNAV (GPS) Approach to Runway 27
NDB Approach to Runway 28

Lorain County Regional (LPR)
ILS or Localizer Approach to Runway 07
RNAV (GPS) Approach to Runway 07
VOR-A Circling Approach

Shelby Community (12G)
VOR-A Circling Approach

Fremont (14G)
RNAV (GPS) Approach to Runway 09

Proposed wind turbines that exceed instrument approach procedure obstacle clearance surfaces would require an increase to their minimum altitudes. Increases to these altitudes, especially critical *decision altitudes (DA)* and *minimum descent altitudes (MDA)*, can directly impact the efficiency of instrument approach procedures. If the FAA determines this impact would affect as few as one operation per week, it could be used as the basis for determinations of hazard. [6]

[6] Multiple private hospital heliports in proximity to and within the Emerson Creek wind project boundary have special instrument approach procedures that overlie the project. However, special procedure documentation is the proprietary information of the approved users. Since procedure design specifics were not available, special instrument approach procedures could not be assessed. It is possible that the associated obstacle clearance surfaces are lower than those described in this report and could limit 605 and 660 foot AGL wind turbines.

Seneca County Airport (16G)

RNAV (GPS) Approach to Runway 06

The *VOBRY* missed approach holding pattern minimum holding altitude (MHA) is 2,400 feet AMSL. The primary area obstacle clearance surface is 1,400 feet AMSL and is one of the lowest height constraints overlying the western section of the study area.

RNAV (GPS) Approach to Runway 24

The *ELIJA* to *VOBRY* initial segment minimum altitude and *VOBRY* hold-in-lieu of procedure turn MHA are 2,400 feet AMSL. The primary area obstacle clearance surfaces (red outline, ***Figure 7***) are 1,400 feet AMSL and are some of the lowest height constraints overlying the majority of the study area.

USGS elevation data indicates that these surfaces could limit 605 foot AGL wind turbines in the western section of the study area (red areas, ***Figure 7***), including three proposed locations. Additionally, these surfaces could limit 660 foot AGL wind turbines in the western section of the study area (red and orange areas, ***Figure 7***), including eight proposed locations. However, it is possible that the FAA would increase the *VOBRY* MHA as well as the RNAV (GPS) Approach to Runway 24 *ELIJA* to *VOBRY* initial segment minimum altitude in order to accommodate 605 and 660 foot AGL wind turbines. This mitigation option is available and is subject to FAA approval.

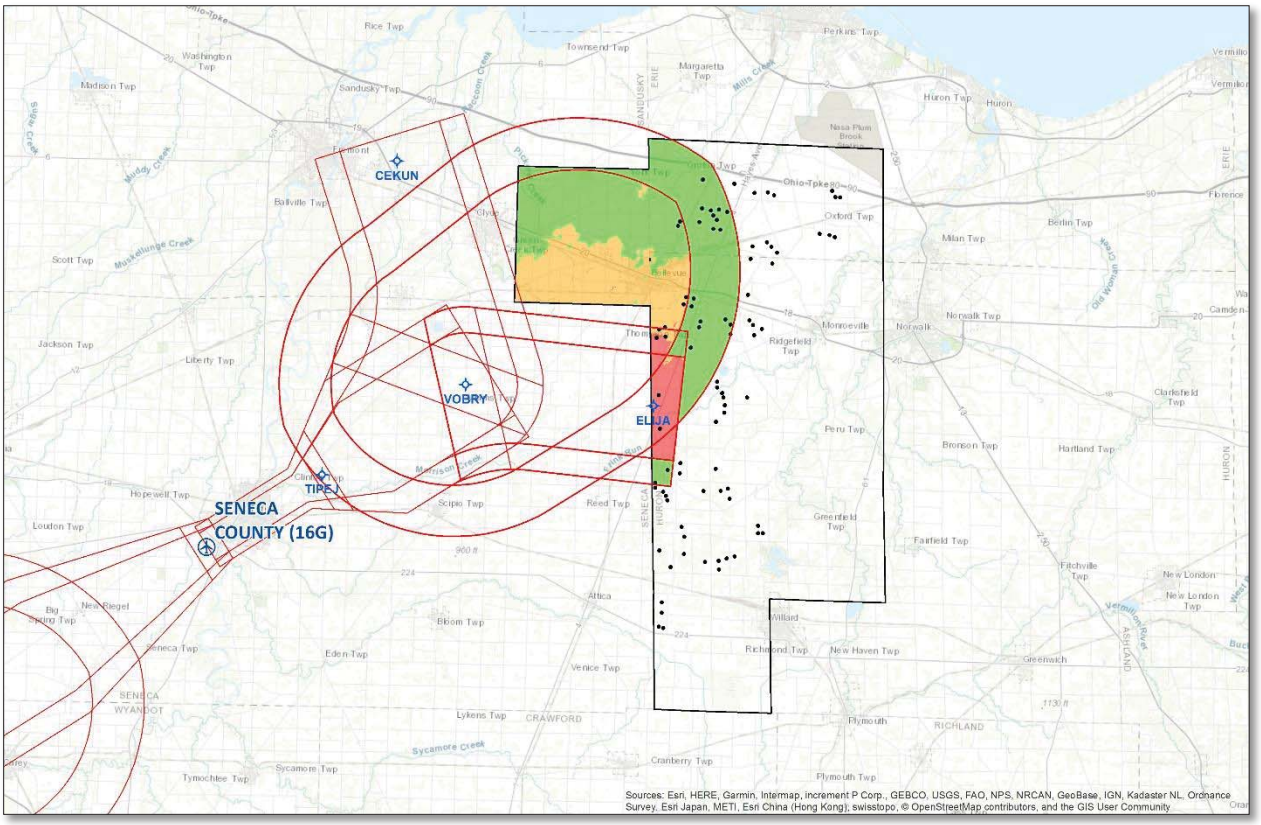


Figure 7: Seneca County Airport (16G) RNAV (GPS) Approach to Runway 24

Seneca County Airport (16G) – continued

NDB Approach to Runway 24

The procedure turn completion altitude is 2,400 feet AMSL. The primary area obstacle clearance surface is 1,400 feet AMSL and is one of the lowest height constraints overlying the western section of the study area. USGS elevation data indicates that this surface could limit 605 and 660 foot AGL wind turbines in this area. However, this surface should not limit 605 or 660 foot AGL wind turbines at any of the proposed locations.

Port Bucyrus-Crawford County Airport (17G)

VOR Approach to Runway 22

The *SONDE* hold-in-lieu of procedure turn and missed approach holding pattern MHA are 2,600 feet AMSL. The primary area obstacle clearance surfaces are 1,600 feet AMSL and are in excess of other lower surfaces. USGS elevation data indicates that these surfaces could still limit 660 foot AGL wind turbines in the southwestern corner of the study area. However, these surfaces should not limit 660 foot AGL wind turbines at any of the proposed locations.

Fostoria Metropolitan Airport (FZI)

RNAV (GPS) Approach to Runway 09

The *ROPPE* missed approach holding pattern MHA is 2,400 feet AMSL. The primary area obstacle clearance surface is 1,400 feet AMSL and is one of the lowest height constraints overlying the western section of the study area.

RNAV (GPS) Approach to Runway 27

The *ROPPE* hold-in-lieu of procedure turn MHA is 2,400 feet AMSL. The primary area obstacle clearance surface is 1,400 feet AMSL and is one of the lowest height constraints overlying the western section of the study area.

USGS elevation data indicates that these surfaces could limit 660 foot AGL wind turbines. However, these surfaces should not limit 660 foot AGL wind turbines at any of the proposed locations.

Lorain County Regional Airport (LPR)

ILS or Localizer Approach to Runway 07

The procedure turn completion altitude is 2,500 feet AMSL. The primary area obstacle clearance surface is 1,500 feet AMSL and is one of the lowest height constraints overlying the eastern section of the study area. However, USGS elevation data indicates that this surface should not limit 605 or 660 foot AGL wind turbines within the defined study area.

Willard Airport (8G1)

VOR-A Circling Approach

The final approach segment MDA is 1,680 feet AMSL. The obstacle clearance surfaces range from 1,346 to 1,680 feet AMSL and are some of the lowest height constraint overlying the southern section of the study area. USGS elevation data indicates that these surfaces could limit 605 and 660 foot AGL wind turbines in this area (red area, ***Figure 8***). However, these surfaces should not limit 605 or 660 foot AGL wind turbines at any of the proposed locations.

The missed approach "climb to" altitude is 2,000 feet AMSL. The obstacle clearance surface ranges from 1,346 to 2,000 feet AMSL and is in excess of other lower surfaces. USGS elevation data indicates that this surface could still limit 605 and 660 foot AGL wind turbines in this area (red area, ***Figure 8***). However, these surfaces should not limit 605 or 660 foot AGL wind turbines at any of the proposed locations.

Circling Approach Areas

The Category A, B, and C circling approach areas (dashed red outline, ***Figure 8***) overlie the Emerson Creek wind project. The Category A, B, and C circling MDA are 1,680, 1,720, and 1,880 feet AMSL, respectively. The associated obstacle clearance surfaces are 1,296, 1,336, and 1,496 feet AMSL, respectively, and are some of the lowest height constraints in the southern section of the study area. USGS elevation data indicates that these surfaces could limit 605 and 660 foot AGL wind turbines in this area (red and orange areas, ***Figure 8***). However, these surfaces should not limit 605 or 660 foot AGL wind turbines at any of the proposed locations.

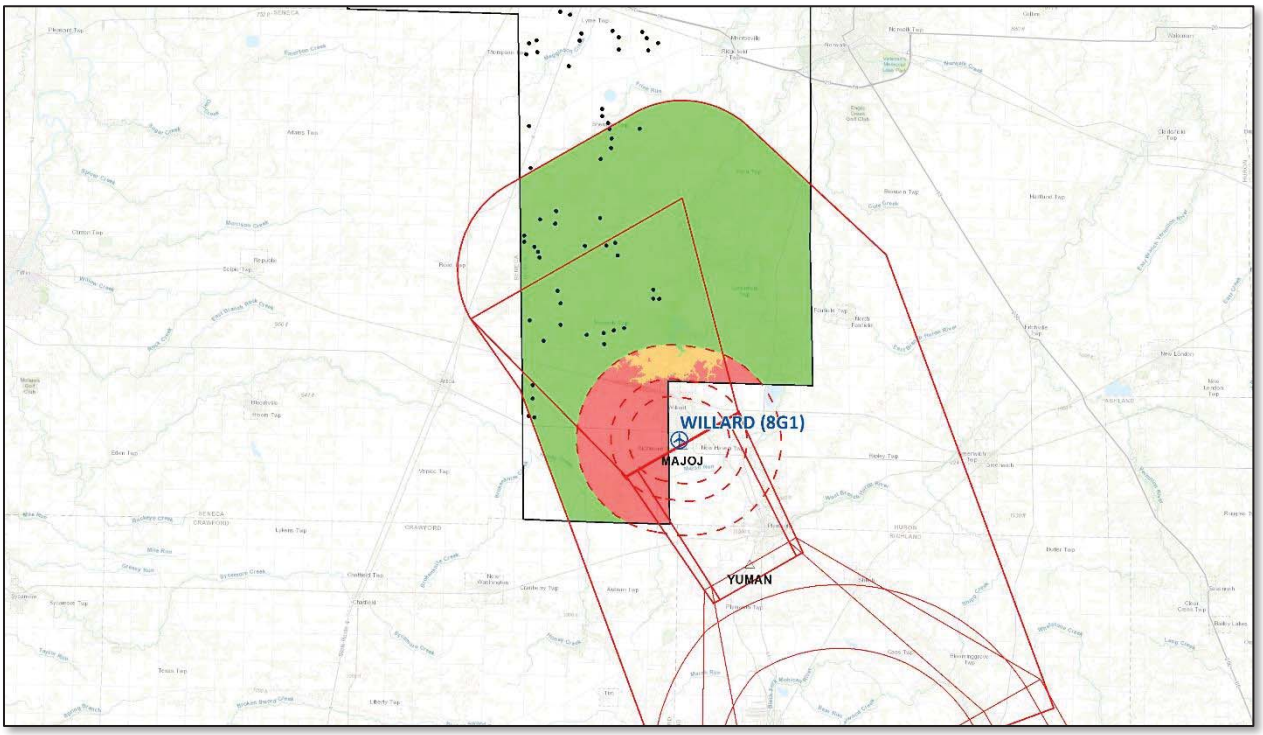


Figure 8: Willard Airport (8G1) VOR-A circling approach (solid red outline) and circling approach areas (dashed red outline)

Sandusky County Regional Airport (S24) [7]

RNAV (GPS) Approach to Runway 24

The LNAV final approach segment obstacle clearance surfaces (including Paragraph 2-9-10 *obstacle identification surface [OIS]*) range from 917 to 1,957 feet AMSL and are the lowest height constraints overlying the northwestern section of the study area. USGS elevation data indicates that these surfaces could limit 605 and 660 foot AGL wind turbines in this area (red area, ***Figure 9***). However, these surfaces should not limit 605 or 660 foot AGL wind turbines at any of the proposed locations.

Circling Approach Areas

The Category D circling approach area overlies the Emerson Creek wind project (dashed red outline, ***Figure 9***). The Category D circling MDA is 1,380 feet AMSL. The obstacle clearance surface is 1,080 feet AMSL and is one of the lowest height constraints overlying the western section of the study area. USGS elevation data indicates that this surface could limit 605 and 660 foot AGL wind turbines in this area (red area, ***Figure 9***). However, this surface should not limit 605 or 660 foot AGL wind turbines at any of the proposed locations.

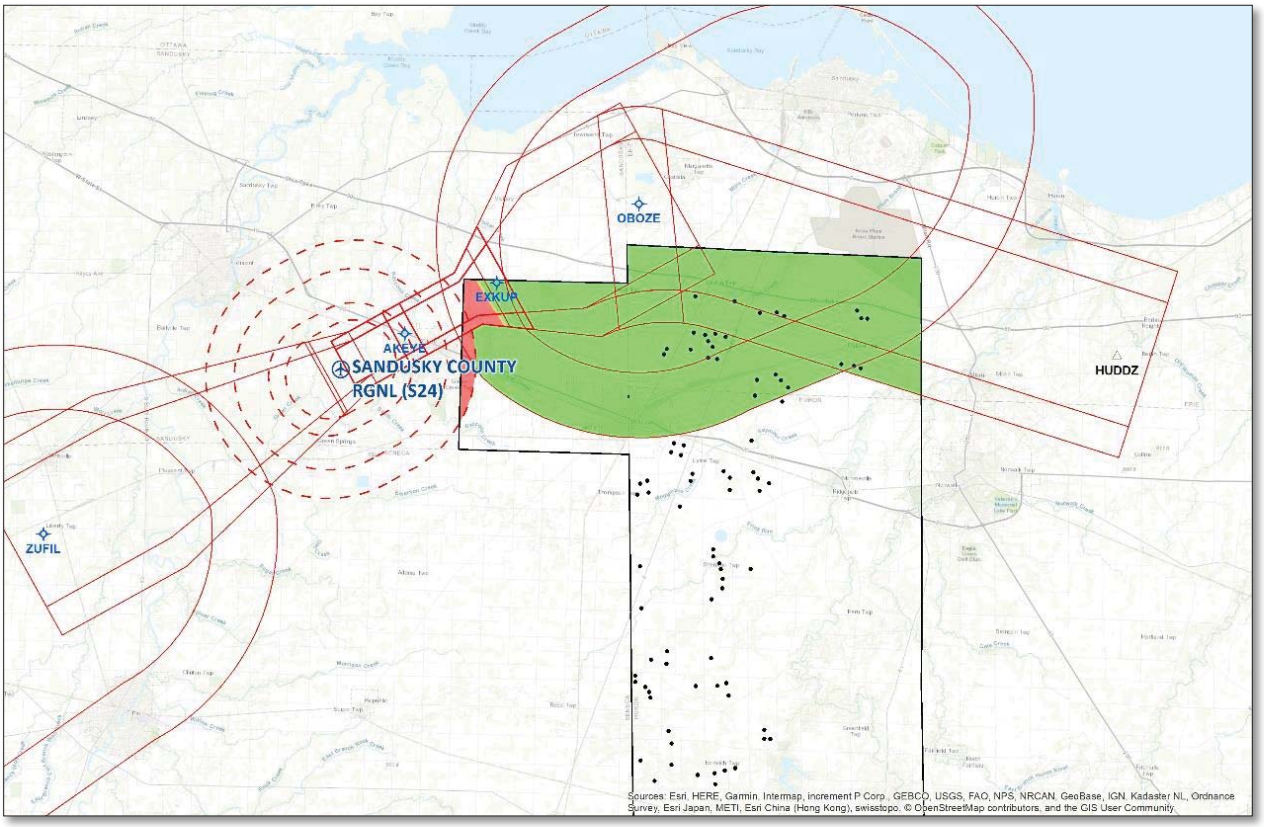


Figure 9: Sandusky County Regional Airport (S24) RNAV (GPS) Approach to Runway 24 (solid red) with circling approach areas (dashed red)

[7] Sandusky County Regional Airport (S24) plans to extend Runway 06/24 to the northeast. As a result, Capitol Airspace assessed instrument approach procedures to both the existing and planned runway locations.

Norwalk-Huron County Airport (5A1)

RNAV (GPS) Approach to Runway 28 – Plan on File

Norwalk-Huron County Airport has a "plan on file" with the FAA to extend Runway 10/28 to the west and add instrument procedures. Since the FAA has not started developing these procedures, proposed wind turbines will be assessed for impact on anticipated minimum descent altitudes.

Capitol Airspace used industry best practice to develop and assess an optimal RNAV (GPS) Approach to Runway 10 with LNAV minimums (***Figure 10***). The LNAV final segment would overlie the eastern section of the study area and would be one of the lowest height constraints overlying this area. USGS elevation data indicates that the final segment obstacle clearance surfaces could limit 605 and 660 foot AGL wind turbines along the northeastern edge of the study area (red area, ***Figure 10***). However, this surface should not limit 605 or 660 foot AGL wind turbines at any of the proposed locations.

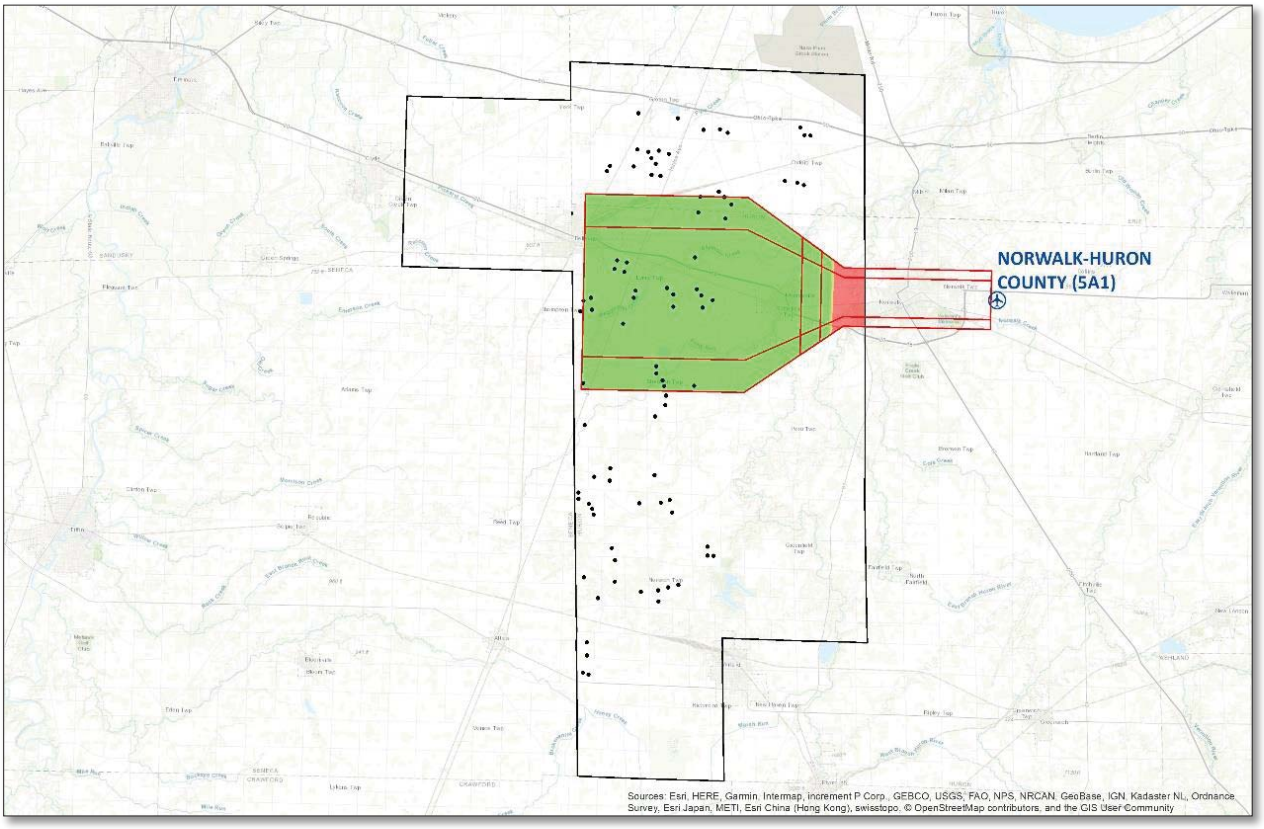


Figure 10: Hypothetical Norwalk-Huron County Airport (5A1)
LNAV final and intermediate segments

Enroute Airways

Enroute airways provide pilots a means of navigation when flying from airport to airport and are defined by radials between VHF omni-directional ranges (VORs). The FAA publishes minimum altitudes for airways to ensure clearance from obstacles and terrain. The FAA requires that each airway have a minimum of 1,000 feet of obstacle clearance in non-mountainous areas and normally 2,000 feet in mountainous areas.

Proposed structures that exceed enroute airway obstacle clearance surfaces would require an increase to their minimum obstruction clearance altitudes (MOCA) and/or minimum enroute altitudes (MEA). If the FAA determines that this impact would affect as few as one operation per week, it could be used as the basis for determinations of hazard.

Low altitude enroute airway obstacle clearance surfaces do not overlie the Emerson Creek wind project (***Figure 11***) and should not limit 605 or 660 foot AGL wind turbines within the defined study area.

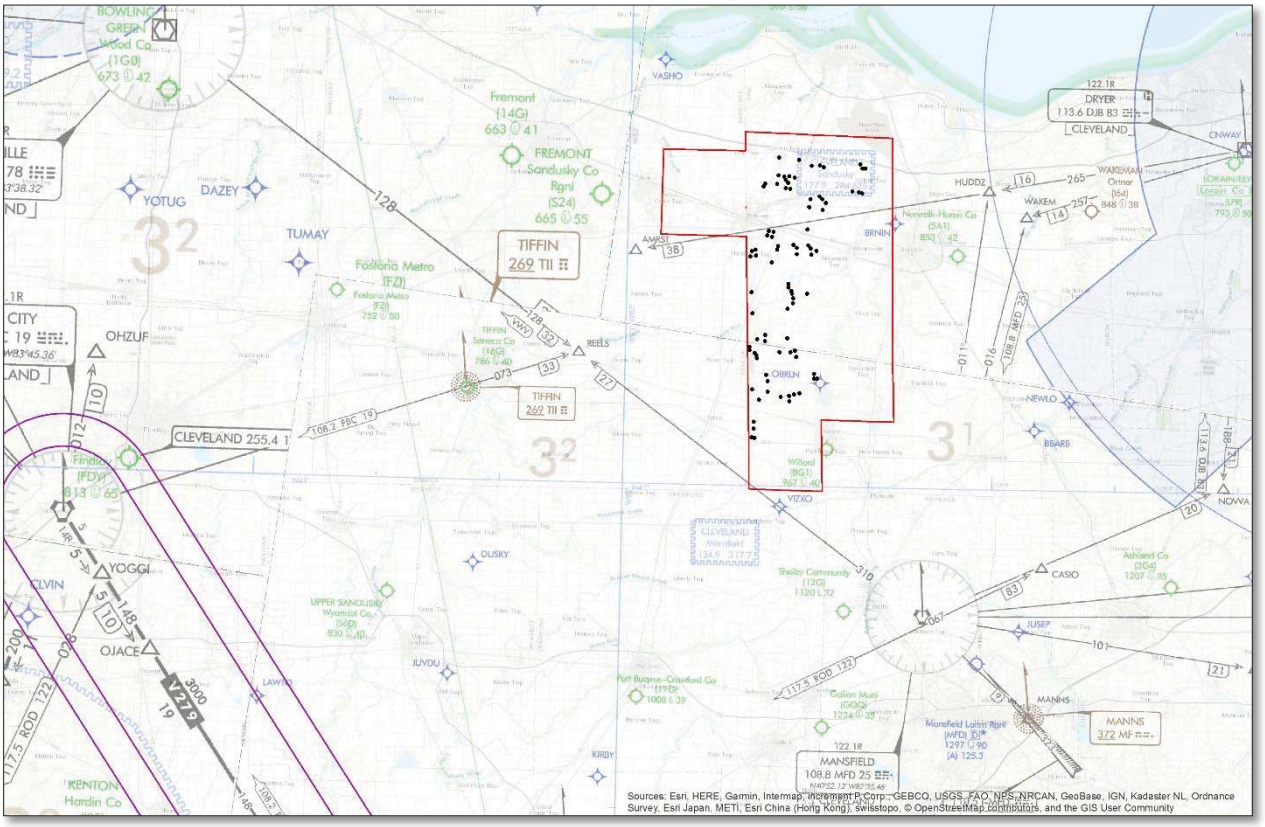


Figure 11: Low altitude enroute chart L-28 with V279 obstacle evaluation areas (purple)

Minimum Vectoring/IFR Altitudes

The FAA publishes minimum vectoring altitude (MVA) and minimum instrument flight rules (IFR) altitude (MIA) charts that define sectors with the lowest altitudes at which air traffic controllers can issue radar vectors to aircraft based on obstacle clearance. The FAA requires that sectors have a minimum of 1,000 feet of obstacle clearance in non-mountainous areas and normally 2,000 feet in mountainous areas.

Proposed structures that exceed MVA/MIA sector obstacle clearance surfaces would require an increase to the altitudes usable by air traffic control for vectoring aircraft. If the FAA determines that this impact would affect as few as one operation per week, it could result in determinations of hazard.

Toledo (TOL) Terminal Radar Approach Control (TRACON)

2,400 foot AMSL Sector (FUSION 3)

The MVA is 2,400 feet AMSL. The obstacle clearance surface (hatched purple, ***Figure 12***) is 1,449 feet AMSL and is in excess of other lower surfaces. However, USGS elevation data indicates that this surface could still limit 660 foot AGL wind turbines in a small western section of the study area (orange areas, ***Figure 12***). However, none of the proposed wind turbines are located in this area.

2,500 foot AMSL Sector (FUSION 3)

The MVA is 2,500 feet AMSL. The obstacle clearance surface (hatched blue, ***Figure 12***) is 1,549 feet AMSL and is one of the lowest height constraints overlying the majority of the study area. USGS elevation data indicates that this surface could limit 605 foot AGL wind turbines in the southern section of the study area (red areas, ***Figure 12***), including two proposed locations (*T80 & T81*). Additionally, this surface could limit 660 foot AGL wind turbines in the southern section of the study area (red and orange areas, ***Figure 12***), including seven proposed locations (*T64, T65, T70, & T80:83*).

Cleveland (ZOB) Air Route Traffic Control Center (ARTCC)

Sector CJOC46

The MIA is 2,500 feet AMSL. The obstacle clearance surface (hatched purple, ***Figure 13***) is 1,549 feet AMSL and is one of the lowest height constraints overlying the central section of the study area. USGS elevation data indicates that this surface could limit 660 foot AGL wind turbines in the western section of the study area (orange area, ***Figure 13***). However, none of the proposed wind turbines are located in this area.

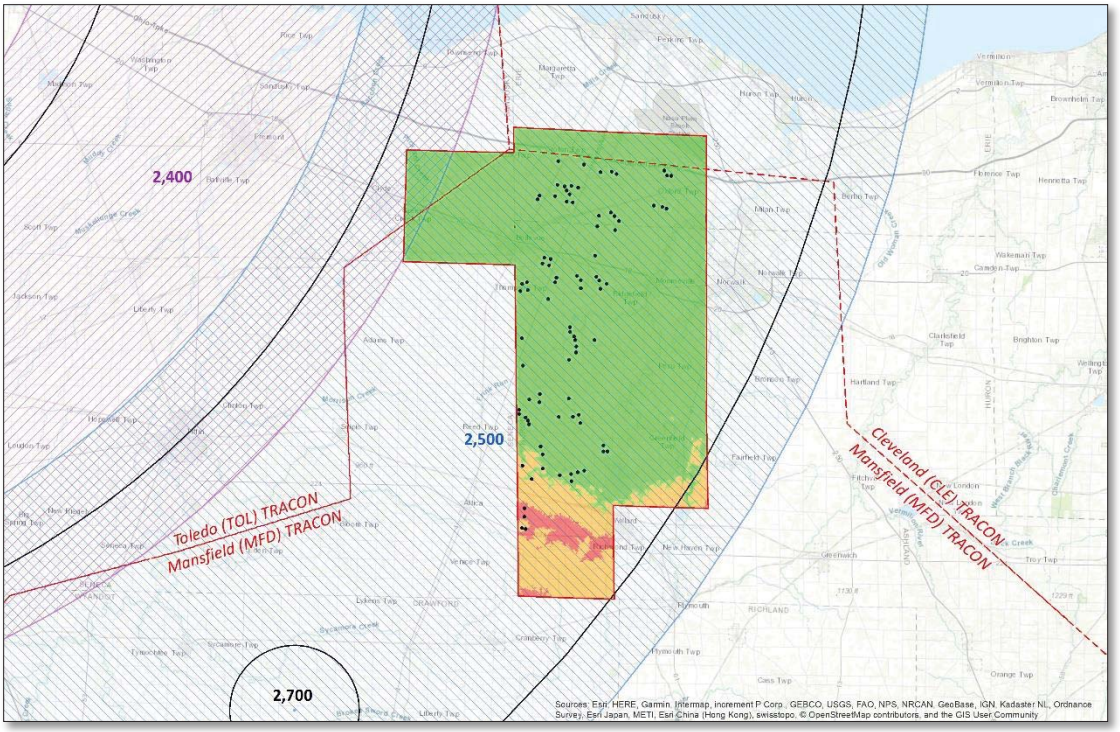


Figure 12: Toledo (TOL) TRACON FUSION 3 MVA sectors (black) with 2,400 foot AMSL Sector (hatched purple) and 2,500 foot AMSL Sector (hatched blue) obstacle evaluation areas

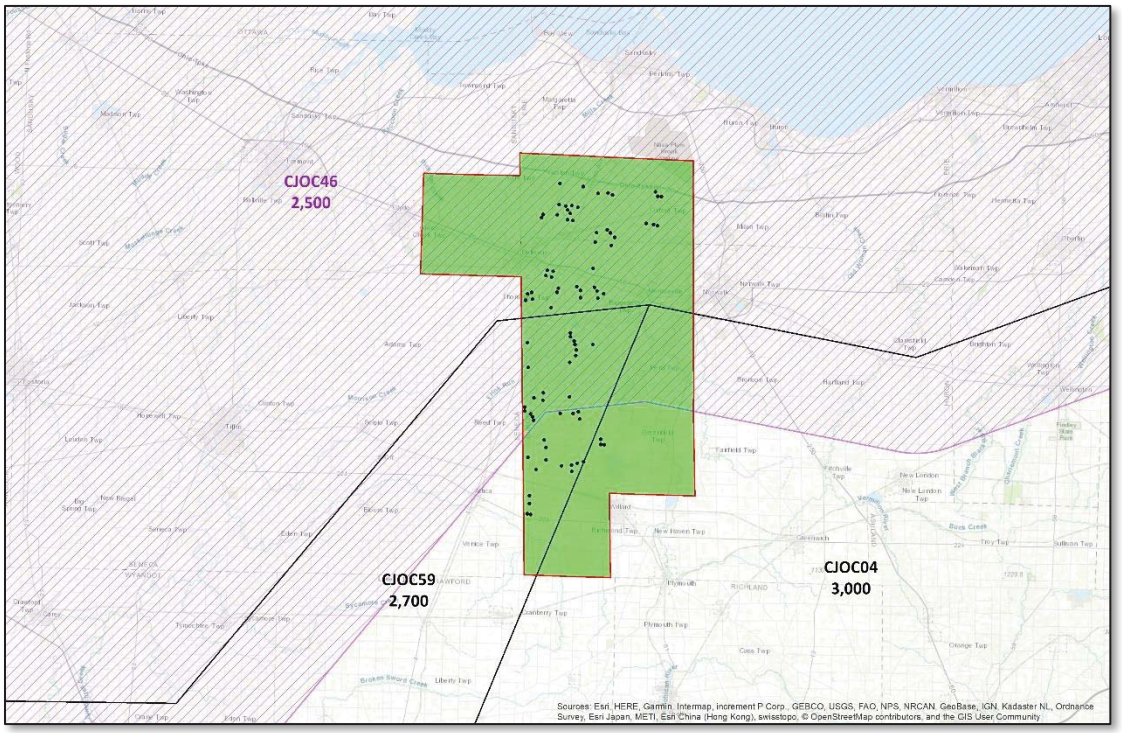


Figure 13: Cleveland (ZOB) ARTCC MIA sectors (black) with Sector CJOC46 obstacle evaluation area (hatched purple)

Terminal and Enroute NAVAIDs

The FAA has established protection areas in order to identify proposed structures that may have a physical and/or electromagnetic effect on navigational aids (NAVAIDs). The protection area dimensions vary based on the proposed structure type as well as the NAVAID type. Proposed structures located within these areas may interfere with NAVAID services and will require further review by FAA Technical Operations. If further review determines that proposed structures would have a significant physical and/or electromagnetic effect on NAVAIDs, it could result in determinations of hazard.

NAVAID protection areas do not overlie the Emerson Creek wind project (***Figure 14***). As a result, it is unlikely that proposed wind turbines would have a physical or electromagnetic effect on terminal or enroute NAVAIDs.

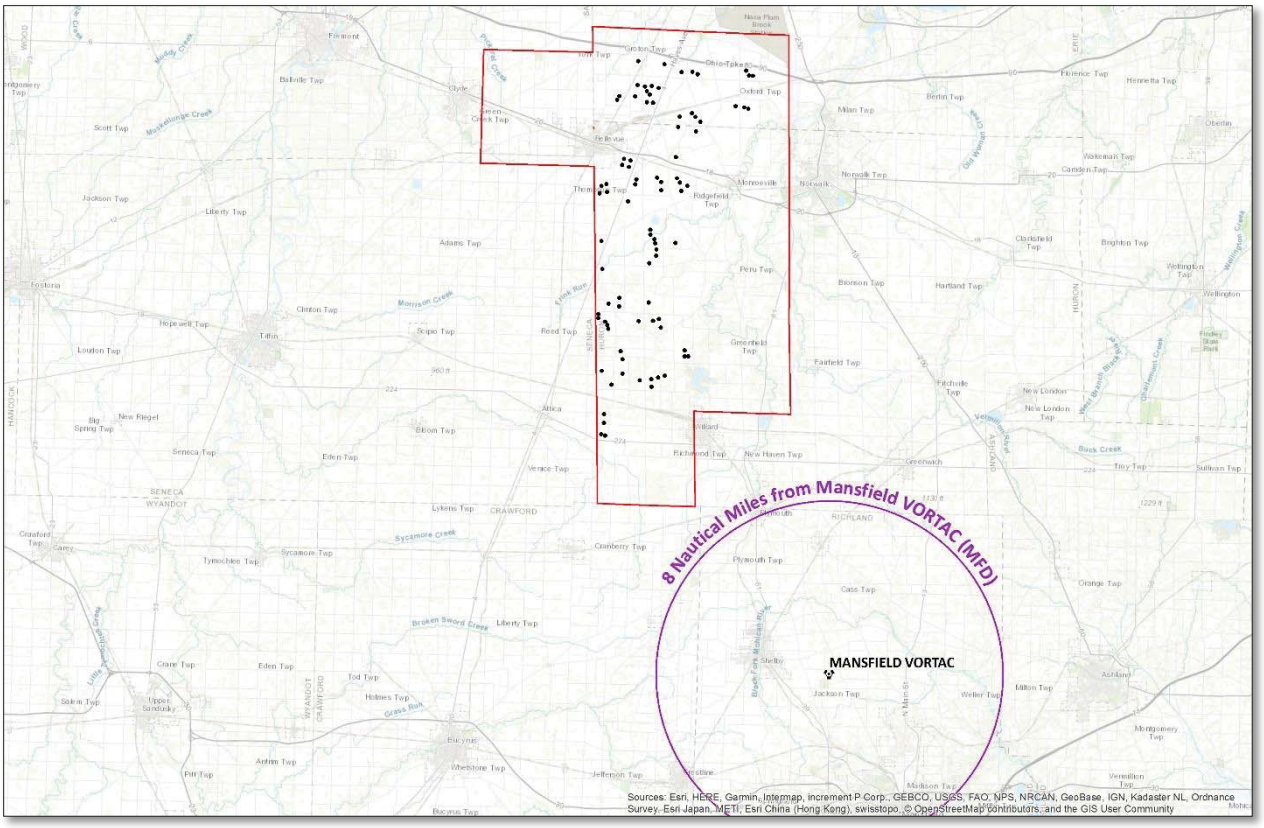


Figure 14: Mansfield VORTAC (MFD) protection area

Military Airspace and Training Routes

Since the FAA does not protect for military airspace or training routes, impact on their operations cannot result in a determination of hazard. However, the FAA will notify the military of proposed wind turbines located within these segments of airspace. If the planned development area is located on federal land, impact on military airspace or training routes may result in the denial of permits by the Bureau of Land Management.

Slow routes (SR) overlying the Emerson Creek wind project (***Figure 15***):

Ohio Air National Guard (ANG)

Route/Airspace	*Minimum Altitude*
SR-708	500 feet AGL
SR-709	500 feet AGL
SR-715	500 feet AGL

Due to the low altitudes associated with these routes, it is possible that wind development could have an impact on their operations. If the Ohio ANG uses these routes regularly, it may result in military objections to proposed wind turbines in the southwestern corner of the study area, including five proposed locations (*T64 & T80:83*).

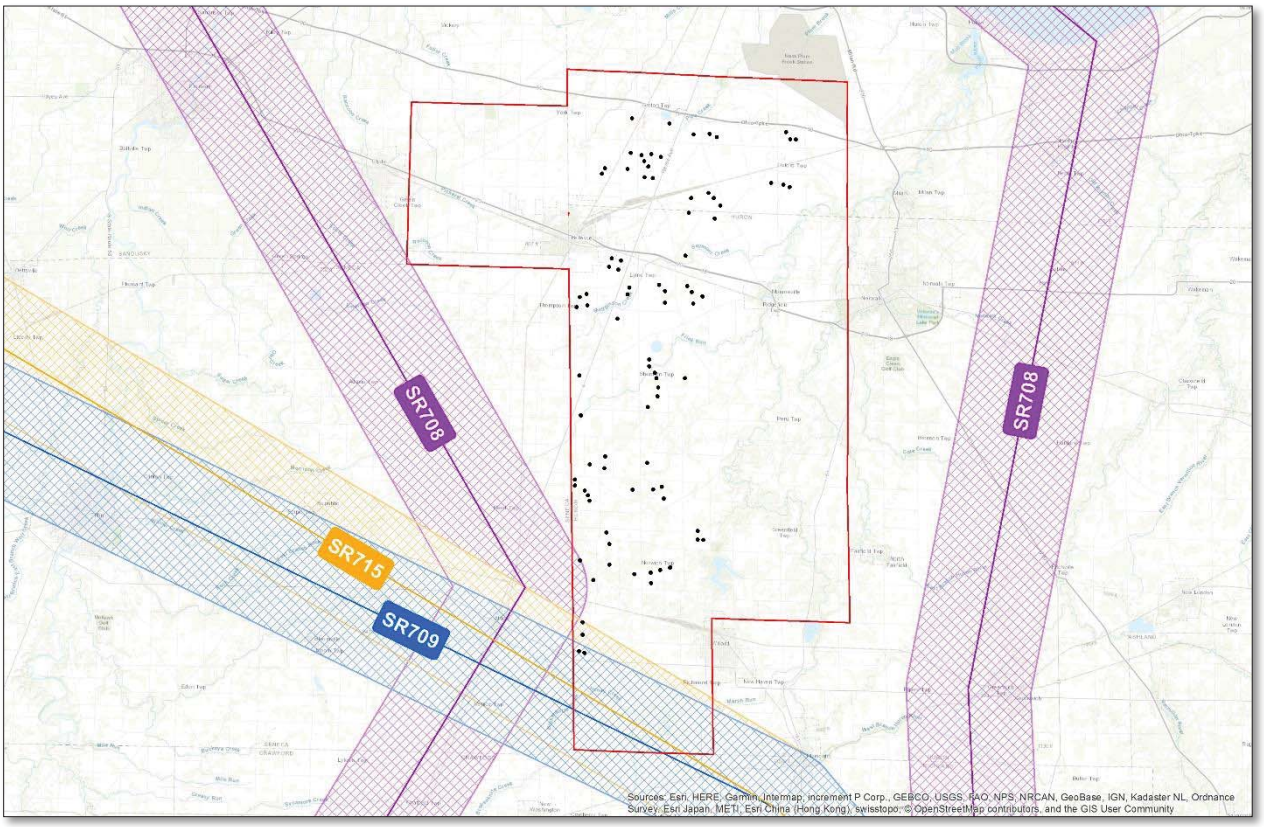


Figure 15: Military slow routes overlying the Emerson Creek wind project

Surveillance Radar Systems

Various radar systems support air traffic control operations as well as weather detection. Proposed wind turbines within radar line of sight (RLOS) are "visible" to radars and could create unwanted clutter resulting in false radar returns and decrease in radar sensitivity. If the FAA determines that these radar effects would impact air traffic control operations, the FAA may conduct further review to identify potential safety hazards and the associated risks to the National Airspace System. The additional analysis may extend the FAA's timeline for review of proposed wind turbines and could ultimately result in determinations of hazard.

Radar System	Visible @ 605 AGL	Visible @ 660 AGL
Mansfield Airport Surveillance Radar Model-8 (ASR-8)	87	87
Cleveland ASR-9	9	20
Columbus ASR-9	0	0
Romulus ASR-9	0	0
Toledo ASR-9	0	0
Akron/Canton ASR-11	0	0
Brecksville Common Air Route Surveillance Radar (CARSR)	73	73
Canton CARSR	0	0
Cleveland Terminal Doppler Weather (TDWR)	86	87
Cleveland Weather Surveillance Radar Model 1988 Doppler (WSR-88D)[8]	0	0
Detroit WSR-88D[8]	0	0

Table 2: Preliminary RLOS analysis results

The preliminary RLOS analysis results indicate that 605 and 660 foot AGL wind turbines would be visible to the Mansfield ASR-8 (left, ***Figure 16***), Brecksville CARSR (right, ***Figure 16***), Cleveland ASR-9 (left, ***Figure 17***), and TDWR (right, ***Figure 17***). Wind turbines within RLOS could create unwanted primary returns (clutter) and dropped primary targets in the vicinity of proposed wind turbines. If the FAA determines that this impact would constitute a substantial adverse effect, it could be used as the basis for determinations of hazard regardless of the lack of impact on the other airspace surfaces described in this report.

[8] The project area falls within a green area established by the National Oceanic and Atmospheric Administration (NOAA) Radar Operations Center (ROC) screening tool. A green area, or "No Impact Zone", indicates that impacts are not likely to WSR-88D operations.

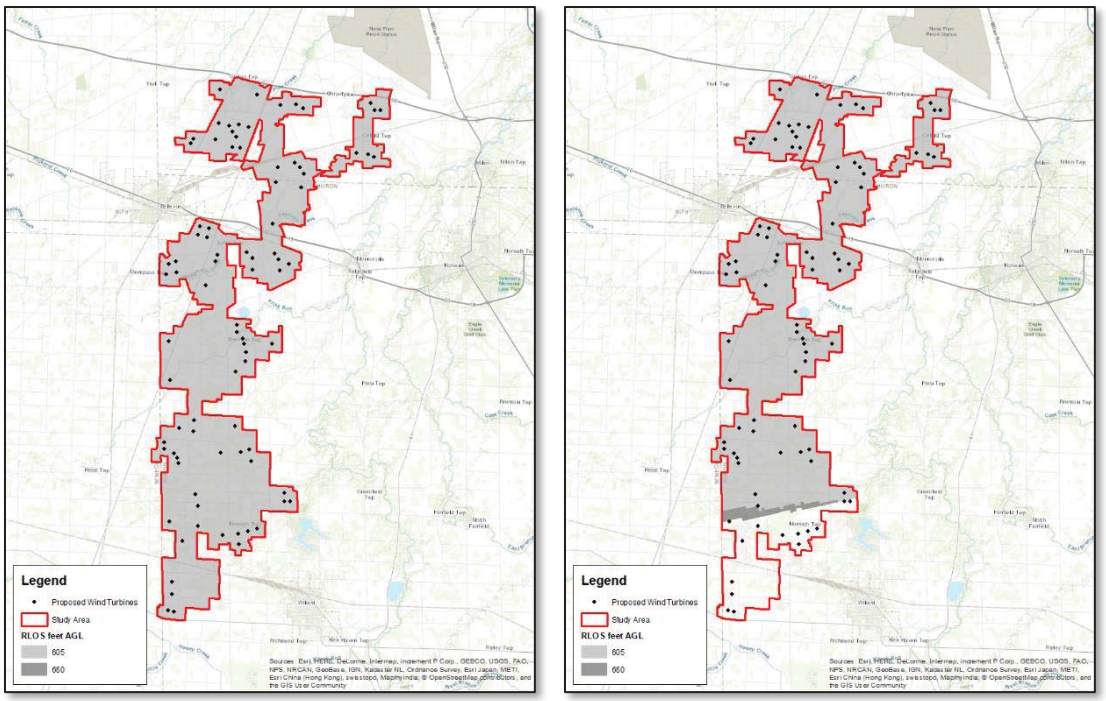


Figure 16: Mansfield ASR-8 (left) and Brecksville CARSR (right) RLOS results at 605 feet AGL (light gray) and 660 feet AGL (light and dark gray)

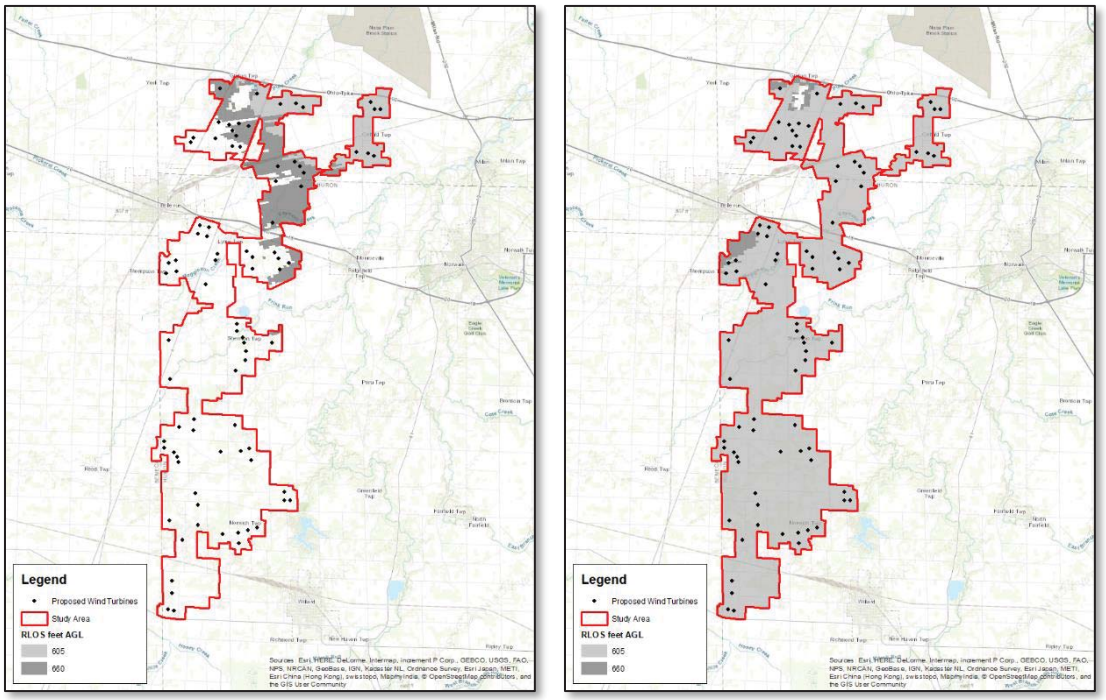


Figure 17: Cleveland ASR-9 (left) and TDWR (right) RLOS results at 605 feet AGL (light gray) and 660 feet AGL (light and dark gray)

Conclusion

At 605 and 660 feet AGL, proposed wind turbines in the eastern, western, and southern sections of the study area will exceed 14 CFR Part 77.17(a)(2) and 77.19 imaginary surfaces (***Figure 2***) and will be identified as obstructions. Additionally, all of the proposed wind turbines will exceed 77.17(a)(1) – a height of 499 feet AGL at the site of the object – and will be identified as obstructions regardless of location. However, heights in excess of these surfaces are feasible provided proposed wind turbines do not exceed FAA obstacle clearance surfaces.

The lowest obstacle clearance surfaces overlying the Emerson Creek wind project range from 917 to 1,549 feet AMSL (***Figure 18***) and are associated with multiple instrument departure procedures and instrument approach procedures, Toledo (TOL) TRACON MVA sectors, and a Cleveland (ZOB) ARTCC MIA sector. Proposed structures that exceed these surfaces would require an increase to instrument departure procedure minimum climb gradients, instrument approach procedure minimum altitudes, and minimum vectoring/IFR altitudes. If the FAA determines that these impacts would affect as few as one operation per week, it could result in determinations of hazard.

USGS elevation data indicates that instrument approach procedure initial and missed approach segment obstacle clearance surfaces (e.g. ***Figure 7***) could limit 605 and 660 foot AGL wind turbines in the northwestern section of the study area (red and orange areas, ***Figure 19***), including up to 15 proposed locations. However, it is possible that the FAA would increase initial and missed approach segment altitudes in order to accommodate wind turbines up to 660 feet AGL. This mitigation option is available and is subject to FAA approval.

Sandusky County Regional Airport and Willard Airport instrument departure procedures (***Figure 6***) could limit 605 and 660 foot AGL wind turbines in the northwestern and southern sections of the study area (red and orange areas, ***Figure 19***), including one proposed location (*T83*). Additionally, Sandusky County Regional Airport (***Figure 9***), Willard Airport (***Figure 8***), and a planned Norwalk-Huron County Airport (***Figure 10***) instrument approach procedure final segment and circling approach areas could limit 605 and 660 foot AGL wind turbines in the northwestern, northeastern, and southern sections of the study area (red and orange areas, ***Figure 19***). However, none of the proposed wind turbines are located in these areas.

Toledo (TOL) TRACON MVA sectors (***Figure 12***) and a Cleveland (ZOB) ARTCC MIA sector (***Figure 13***) could limit 605 and 660 foot AGL wind turbines in the southern section of the study area, including up to seven proposed locations (*T64, T65, T70, & T80:83*). Lastly, depending on the size of Sandusky County Regional Airport and Willard Airport VFR traffic pattern airspace ultimately applied by the FAA (hatched red or hatched orange, ***Figure 18*** & ***Figure 19***), this segment of airspace could further limit wind development in the northwestern and southern sections of the study area. However, none of the proposed wind turbines are located in these areas.

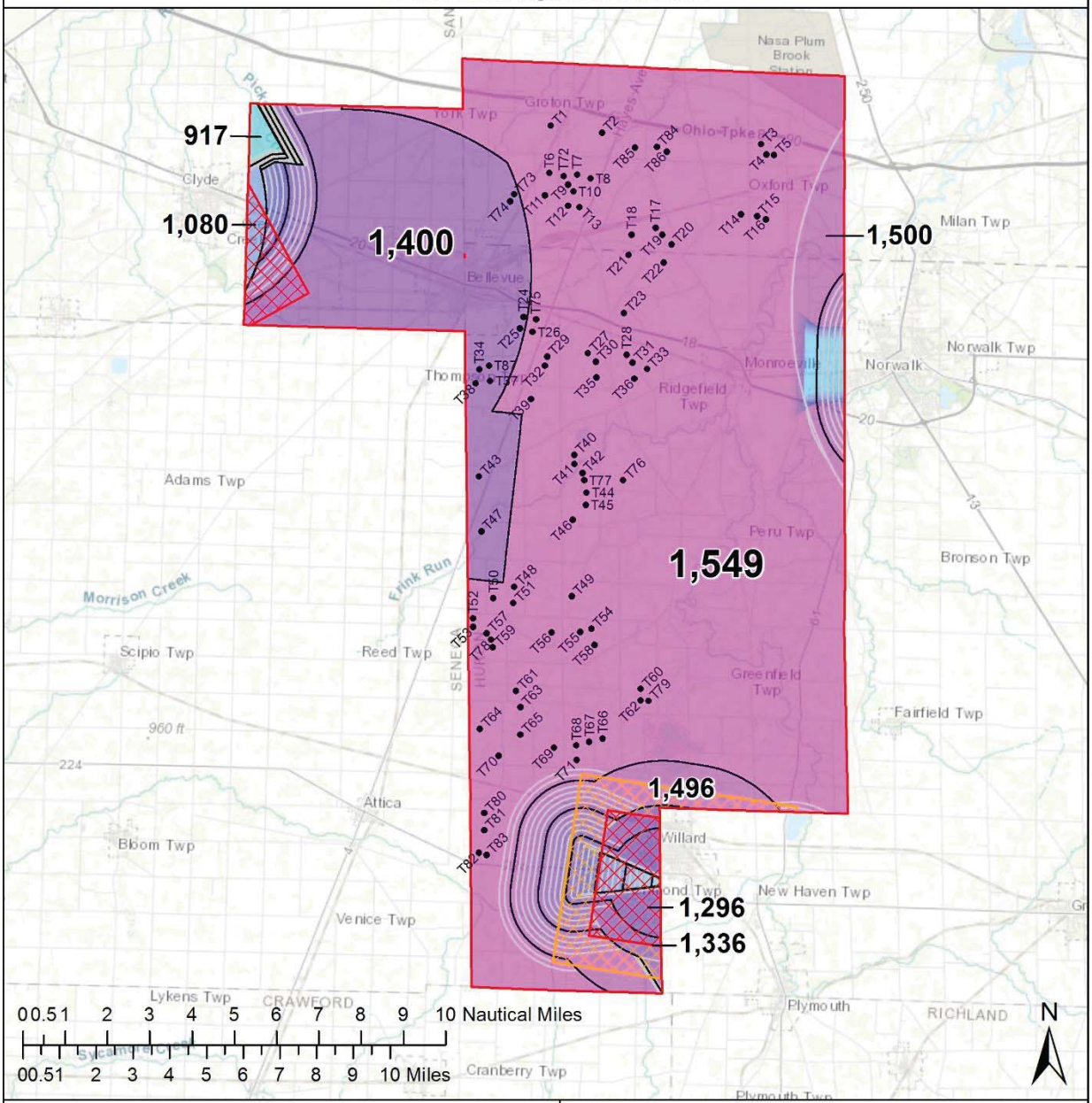
Multiple military slow routes (***Figure 15***) overlie the southwestern corner of the study area, including five proposed locations (*T64 & T80:83*). Impact on these routes could result in military objections to proposed wind development.

Lastly, at 605 and 660 feet AGL, proposed wind turbines will be in line of sight of multiple surveillance radar systems (***Figure 16*** & ***Figure 17***). Impact on surveillance radar systems could be used as the basis for determinations of hazard regardless of the lack of impact on the other airspace surfaces described in this report.

The AGL Clearance Map (***Figure 19***) is based on USGS National Elevation Dataset (NED) 1/3 Arc Second data which has a vertical accuracy of 1.89 meters root-mean-square error (RMSE). Therefore, the AGL Clearance Map should only be used for general planning purposes and not exact structure siting. In order to avoid determinations of hazard, proposed structure heights should adhere to the height constraints depicted in the Composite Map (***Figure 18***).

If you have any questions regarding the findings of this study, please contact ***Rick Coles*** or ***Nick Lee*** at (703) 256-2485.

Proposed structures that exceed 14 CFR Part 77.17(a)(1) - a height of 499 feet AGL at the site of the object - will be identified as obstructions regardless of location.



Obstacle Clearance Surface
Height - AMSL Feet
High : 1,549
Low : 917

20 Foot Contour
100 Foot Contour
Turbine Location (Labeled with ID)

VFR Traffic Pattern Airspace (No Build)
VFR Traffic Pattern Airspace (Potential No Build)

All heights above mean sea level (AMSL)

Emerson Creek Wind Project
Composite Height Constraint Map

Plot Date:
8 March 2019

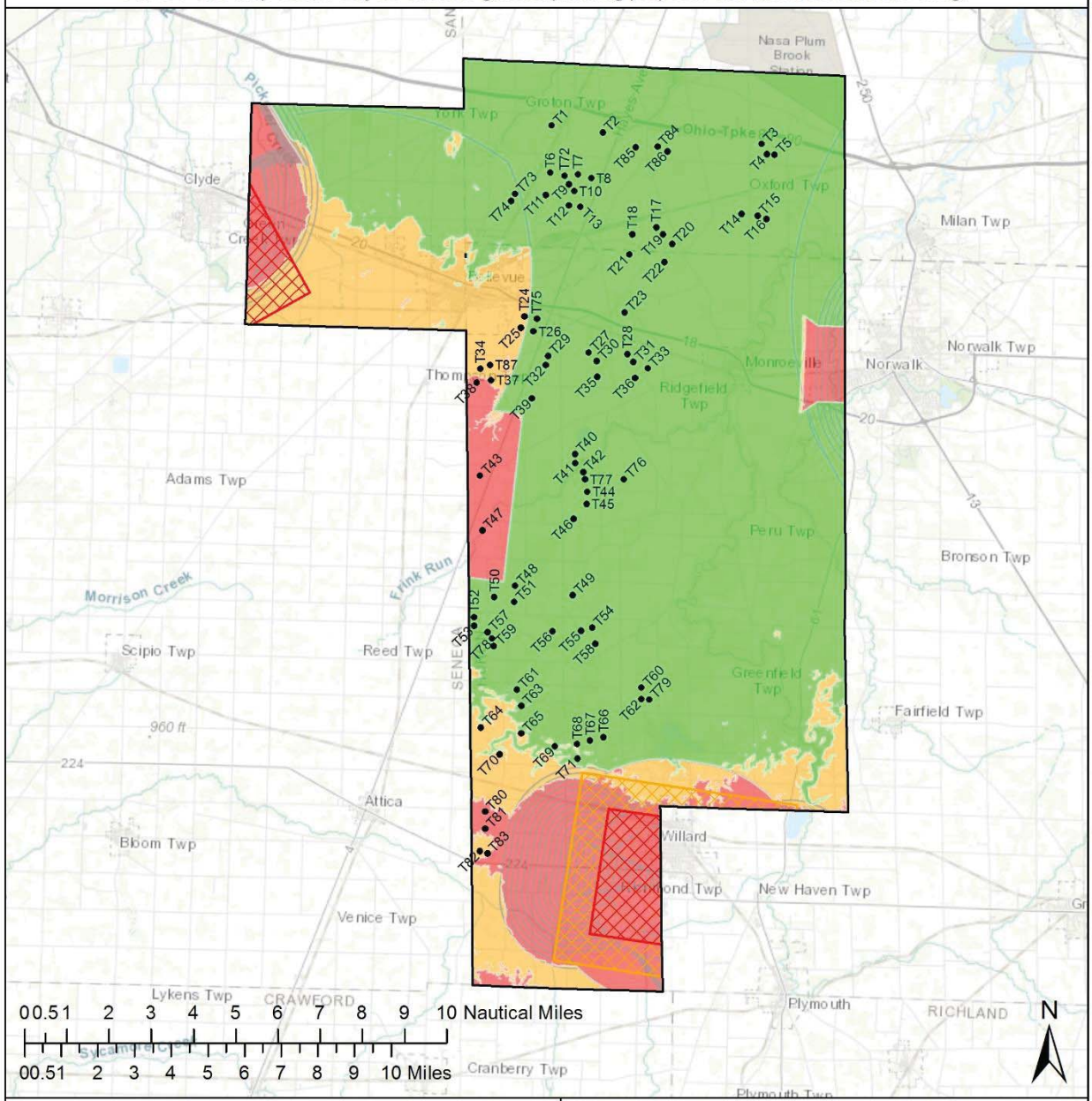
Figure 18

Coordinate System:
NAD 1983 UTM Zone 17N

Nick Lee

Capitol Airspace Group

The USGS 1/3 Arc Second Digital Elevation Model (DEM) data used to create this map has a vertical accuracy of 1.89 meters RMSE. This map should only be used for general planning purposes and not exact structure siting.



Clearance Height - AGL Feet

- < 605
- ≥ 605 < 660
- ≥ 660

- VFR Traffic Pattern Airspace (No Build)
- VFR Traffic Pattern Airspace (Potential No Build)
- Turbine Location (Labeled with ID)

Emerson Creek Wind Project
Above Ground Level (AGL) Clearance Map

Plot Date:
8 March 2019

Coordinate System:
NAD 1983 UTM Zone 17N

Nick Lee

Figure 19

Capitol Airspace Group

Attachment 7

Updated Table 3 to Noise Impact Assessment Exhibit G in Application Summary of Background Sound Levels by Location and Averaged Across the Project Site

/s/ Christine M.T. Pirik
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Attachment 7

Location	Sound Presure Level (dBA)											
	Overall				Day				Night			
	L_{eq}	L_{90}	L_{50}	L_{10}	L_{eq}	L_{90}	L_{50}	L_{10}	L_{eq}	L_{90}	L_{50}	L_{10}
Emerson 1	50.7	42.0	48.9	54.1	51.0	42.3	49.5	54.3	50.1	41.8	48.0	53.6
Emerson 2	45.7	33.0	40.3	49.3	46.7	34.8	42.1	50.4	43.5	31.4	38.1	46.2
Emerson 3	46.1	34.8	42.1	49.4	46.7	36.6	43.0	50.0	45.1	33.1	40.6	48.4
Emerson 4	44.6	34.2	40.5	47.9	45.2	35.4	41.3	48.6	43.4	32.3	39.0	46.3
Emerson 5	42.5	27.6	34.1	45.3	43.5	28.5	35.5	46.6	40.2	26.6	32.3	41.4
Emerson 6	54.8	29.3	43.2	57.7	56.0	33.9	46.4	58.9	51.6	25.1	37.6	53.7
Emerson 7	40.1	21.4	28.6	39.2	41.9	24.0	30.8	41.0	34.6	19.9	25.2	35.2
Emerson 8	39.9	24.4	33.5	39.7	41.3	27.1	34.3	41.1	36.3	22.0	30.6	37.0
Emerson 9	55.0	29.5	50.5	57.7	56.2	34.3	51.1	58.9	51.9	24.7	47.4	53.3
Average					47.6				44.1			

Summary: Response - Fireland Wind, LLC's Response to the Sixth Data Request from the Staff of the Ohio Power Siting Board electronically filed by Christine M.T. Pirik on behalf of Firelands Wind, LLC