Obstruction Evaluation Analysis

Ball Hill Wind Project

RES Americas

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Capitol Airspace Group
capitolairspace.com
(703) 256 - 2485

Summary

Capitol Airspace conducted an airspace and obstruction evaluation screening for the Ball Hill wind project in Chautauqua County, New York. The purpose for this study was to identify obstacle clearance surfaces established by the Federal Aviation Administration (FAA) that could limit the height or location of proposed wind turbines. At the time of this study, 54 proposed wind turbine locations had been determined. Additionally, this study assessed height constraints overlying an approximately 28 square mile study area to aid in locating optimal wind turbine sites.

The FAA requires that all structures exceeding 200 feet above ground level (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 study area range from 1,400 to 2,552 feet above mean sea level (AMSL) and are associated with instrument departure and approach procedures as well as low altitude enroute airways. Proposed wind turbines that exceed these surfaces would require an increase to departure procedure minimum climb gradients, instrument approach procedure minimum altitudes, and/or enroute airway minimum altitudes. USGS elevation data indicates that these surfaces would limit typical wind development in northern and western sections of the study area, as well as on higher terrain throughout the study area.

The Ball Hill wind project is located within the lateral boundaries of the Dunkirk VORTAC (DKK) screening surface. 35 of the proposed wind turbines located within, and would likely exceed, this screening surface.

The Ball Hill wind project is also located in an area designated as 'Yellow' by the FAA/DoD long range radar screening tool. Impact on surveillance systems can result in FAA determinations of hazard, regardless of the lack of impact on the physical airspace surfaces described in this report.

This study did not consider electromagnetic interference on communications, navigation or surveillance systems.

Capitol Airspace Group
5400 Shawnee Road, Suite 304
Alexandria, VA 22312
703-256-2485
capitolairspace.com

Methodology

Capitol Airspace studied the proposed project based upon location information provided by RES Americas. Using this information, Capitol Airspace generated graphical overlays to determine proximity to public and military airports (***Figure 1***), published instrument procedures, special use airspace, enroute airways, civil minimum vectoring altitude charts and military training routes.

Capitol Airspace evaluated all 14 CFR Part 77 imaginary surfaces, published instrument approach and departure procedures, visual flight rules operations, civil minimum vectoring 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 7400.2K Procedures for Handling Airspace Matters
- FAA Order 8260.3B United States Standard for Terminal Instrument Approach Procedures
- FAA Order 8260.58 United States Standard for Performance Based Navigation (PBN) Instrument Procedure Design
- United States Government Flight Information Publication, US Terminal Procedures
- National Airspace System Resource Aeronautical Data

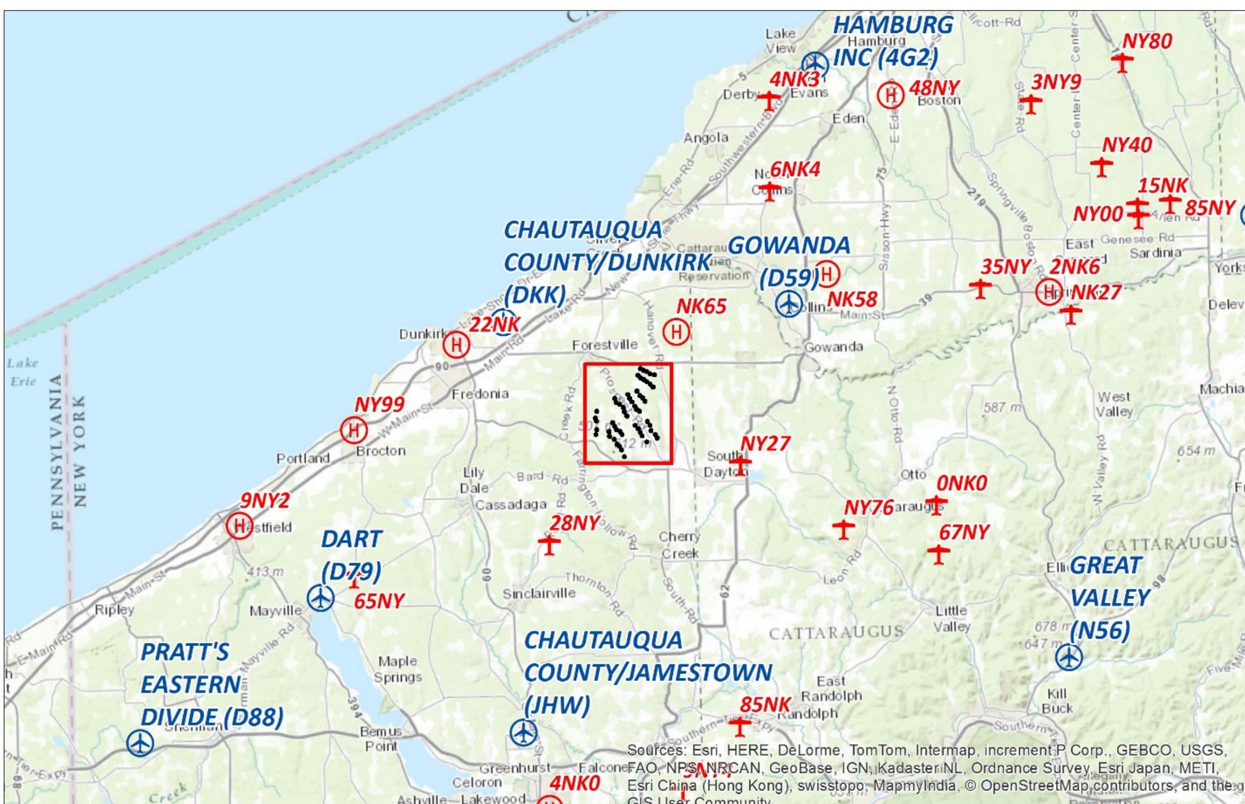


Figure 1: Public-use (blue) and private-use (red) airports in proximity to Ball Hill wind project

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 designated as obstructions are then subject to a full aeronautical study and increased scrutiny. Structures that are not designated obstructions are, in most cases, automatically issued favorable determinations.

The study area is located within the lateral boundaries of the Chautauqua County/Dunkirk Airport (DKK) 14 CFR Part 77.17(a)(2) imaginary surface (dashed blue, ***Figure 2***). The height of this surface ranges from 353 to 499 feet AGL where it overlies the study area. None of the proposed wind turbines are located within the Part 77.17(a)(2) surface. However, planned wind turbines that exceed 14 CFR Part 77.17(a)(1) - a height of 499 feet AGL at the site of the object - will automatically be determined to be obstructions regardless of their location.

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.

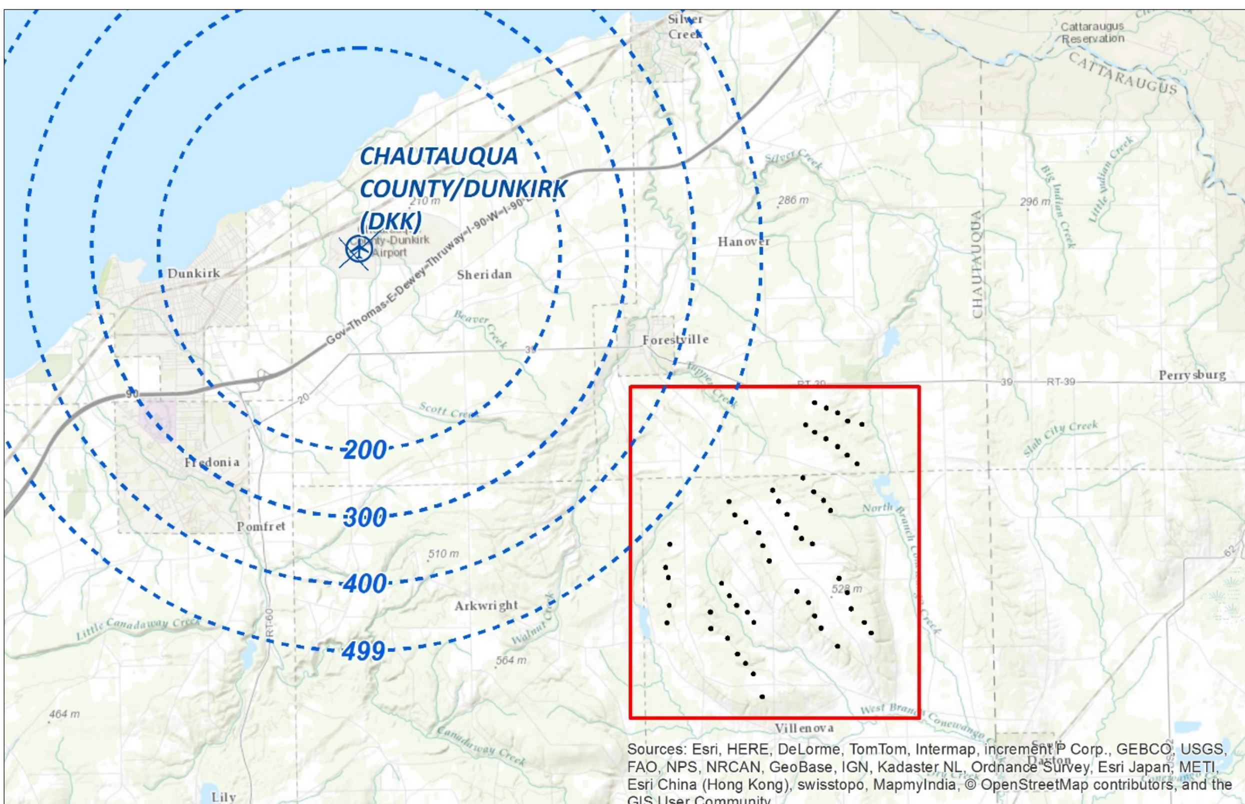


Figure 2: Chautauqua County/Dunkirk Airport (DKK) 14 CFR Part 77.17(a)(2) imaginary surface

Visual Flight Rules (VFR) Traffic Pattern Airspace

VFR traffic patterns are used by pilots operating during visual meteorological conditions. The size and dimensions of these patterns are based upon the category of aircraft which, in turn, is based upon the approach speed of the aircraft. The obstacle clearance surface for these traffic patterns is tied directly to the height of imaginary surfaces defined under 14 CFR Part 77.17 and 77.19 as applied to a visual runway.

The Ball Hill wind project is located outside of VFR traffic pattern airspace (***Figure 3***). Therefore, VFR traffic pattern operations should not limit wind development within the defined study area.

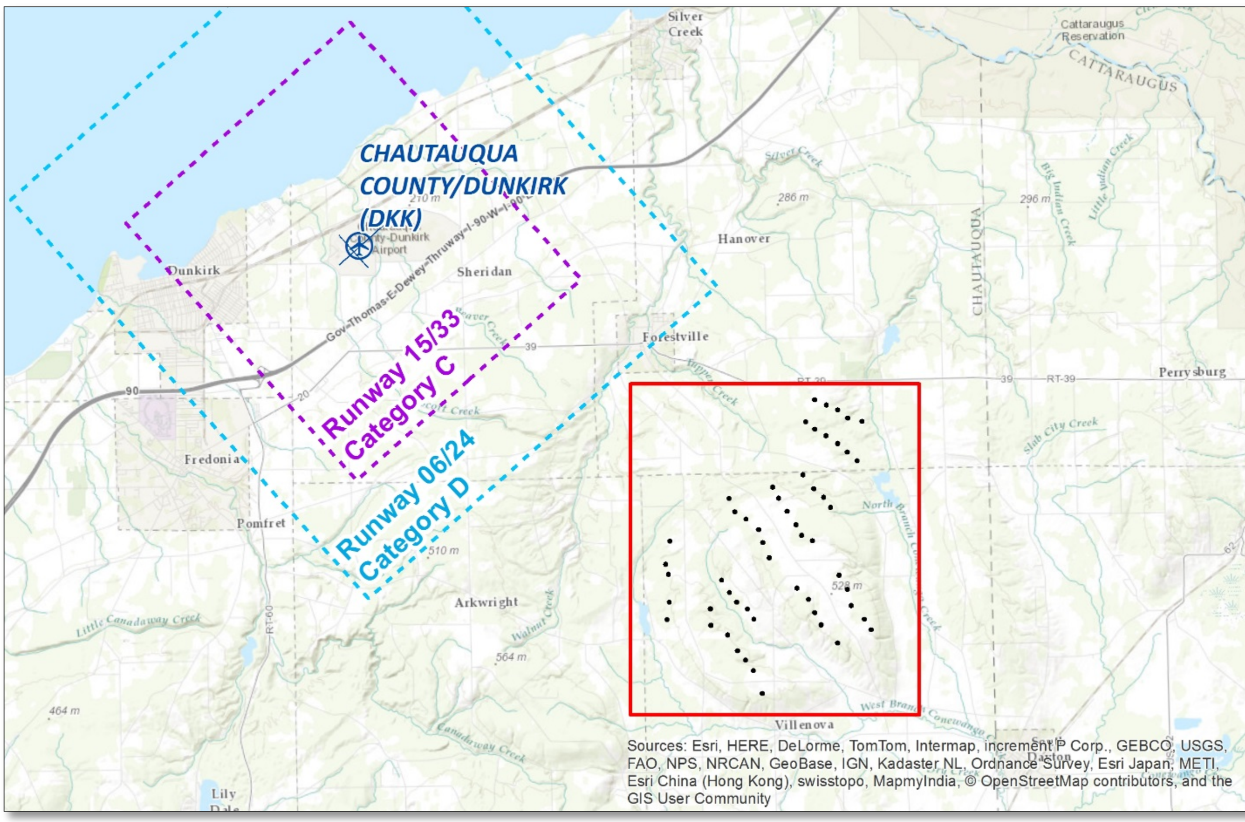


Figure 3: Chautauqua County/Dunkirk Airport (DKK) VFR traffic pattern airspace

Instrument Departures

In order to ensure that aircraft departing during marginal weather conditions do not fly into terrain or obstacles, the FAA has established 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.

The Ball Hill wind project is located within the lateral boundaries of multiple instrument departure procedures. The Chautauqua County/Dunkirk Airport Runway 15 obstacle departure procedure (***Figure 4***) is lowest overlying the study area; the associated obstacle clearance surface ranges from 1,800 to 2,567 feet AMSL and is most limiting in the central section of the study area.

Proposed structures that exceed this surface would require an increase to instrument departure procedure minimum climb gradients. If the FAA determines this impact to constitute a substantial adverse effect, it could be used as the basis for issuance of determinations of hazard. USGS elevation data indicates that this surface may limit wind development in excess of 375 feet AGL (orange, ***Figure 4***) in areas of higher terrain.

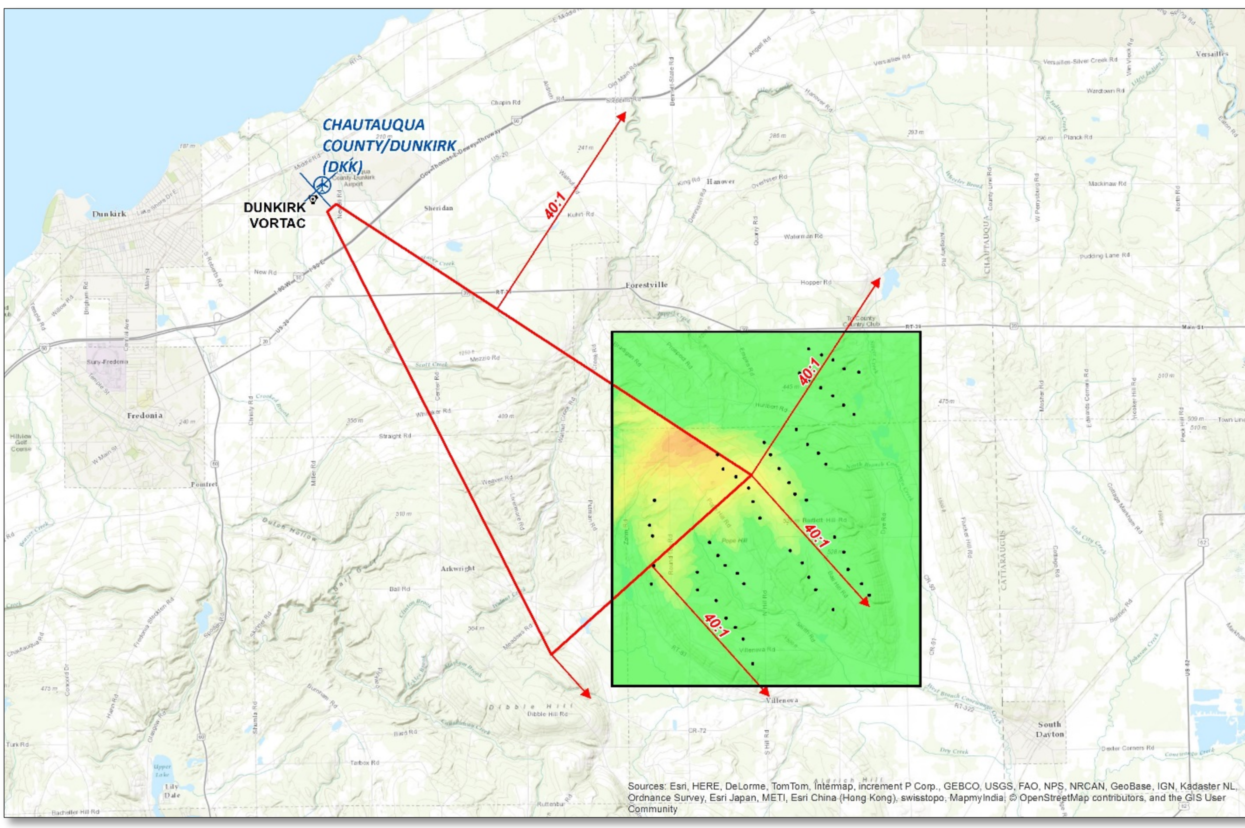


Figure 4: Chautauqua County/Dunkirk Airport (DKK) Runway 15 obstacle departure procedure assessment

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 has established 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 12 published instrument approach procedures at two airports in proximity to the Ball Hill wind project.

The Ball Hill wind project is located within the boundaries of multiple instrument approach procedures. The RNAV (GPS) Approach to Runway 33 at Chautauqua County/Dunkirk Airport (***Figure 5a***) is most limiting in the southern and western sections of the study area; the associated obstacle clearance surfaces range from 1,774 feet AMSL (*2,240 foot minimum altitude - 250 foot required obstacle clearance - 192 foot remote altimeter setting source penalty - 24 foot excessive length of final penalty*) to in excess of other, more limiting surfaces. The VOR Approach to Runway 24 at Chautauqua County/Dunkirk Airport (***Figure 5b***) is most limiting in the northwest majority of the study area; the associated obstacle clearance surfaces range from 1,600 feet AMSL to in excess of other, more limiting surfaces. The VOR Approach to Runway 06 at Chautauqua County/Dunkirk Airport is most limiting in a very small central section of the study area; the associated obstacle clearance surface is 1,900 feet AMSL.

Proposed structures that exceed these obstacle clearance surfaces would require an increase to instrument approach procedure minimum altitudes. If the FAA determines this impact to constitute a substantial adverse effect, it could be used as the basis for the issuance of determinations of hazard. USGS elevation data indicates that these surfaces would limit typical wind development in the northern and western sections of the study area. These surfaces would also limit wind development in excess of 400 feet AGL in areas of higher terrain.

Additionally, the Ball Hill wind project is located in proximity to Dunkirk Fire Training Site (22NK), a private-use heliport that has a special instrument approach procedure. Since special instrument procedure documentation is not publicly available, Capitol Airspace was unable to assess impact on this procedure. If this procedure’s missed approach segment is routed over the study area, associated obstacle clearance surfaces may be more limiting than other obstacle clearance surfaces defined in this report.

Instrument procedures assessed:

Chautauqua County/Dunkirk (DKK)
RNAV (GPS) Approach to Runway 06
RNAV (GPS) Approach to Runway 15
RNAV (GPS) Approach to Runway 24
RNAV (GPS) Approach to Runway 33
VOR Approach to Runway 06
VOR Approach to Runway 24

Chautauqua County/Jamestown (JHW)
ILS or Localizer Approach to Runway 25
RNAV (GPS) Approach to Runway 07
RNAV (GPS) Approach to Runway 13
RNAV (GPS) Approach to Runway 25
RNAV (GPS) Approach to Runway 31
VOR Approach to Runway 25

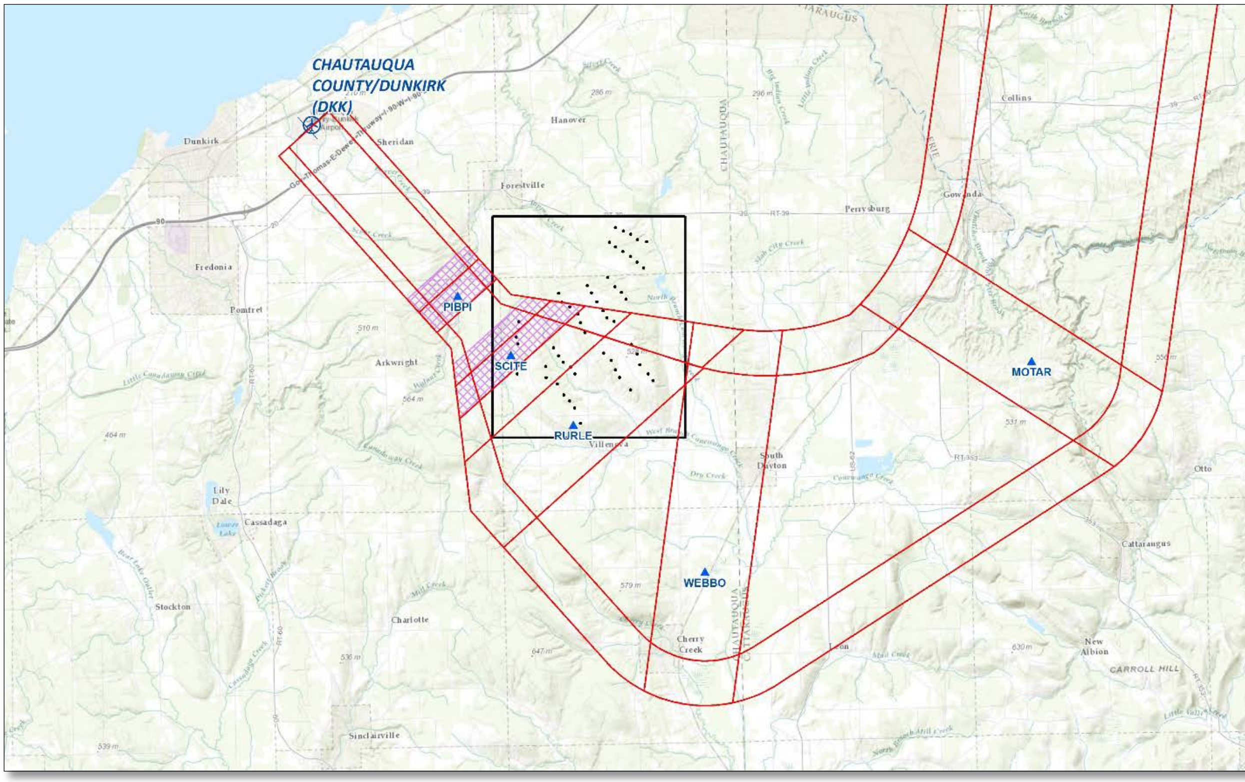


Figure 5a: Chautauqua County/Dunkirk Airport (DKK) RNAV (GPS) Approach to Runway 33 with Paragraph 289 obstacle identification surfaces (hatched purple)

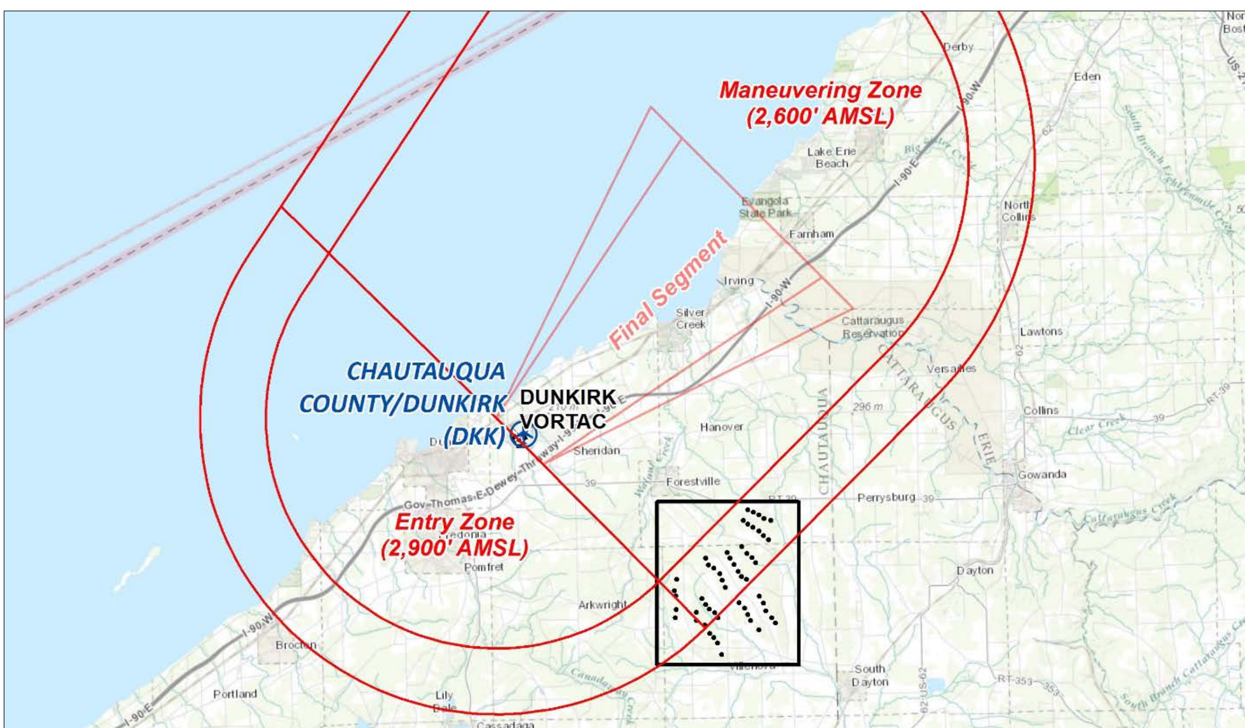


Figure 5b: Chautauqua County/Dunkirk Airport (DKK) VOR Approach to Runway 24

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 enroute 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.

The Ball Hill wind project is located within the lateral boundaries of enroute airways V14, V90, V115, V265, V464, V265, and V522 (***Figure 6***). However, only V115, V464, and V522 are the lowest height constraints overlying the study area. V115 (red, ***Figure 6***) has a 3,900 foot AMSL minimum enroute altitude (MEA); V464 (blue, ***Figure 6***) has a 3,300 foot AMSL MEA. Although V115 and V464 are located in FAA designated mountainous terrain, existing obstacles indicate that the FAA has likely reduced both airways' required obstacle clearance from 2,000 to 1,600 feet. The resulting obstacle clearance surfaces for V115 and V464 are 2,300 and 1,700 feet AMSL, respectively. V522 (purple, ***Figure 6***) has a 2,400 foot AMSL minimum obstruction clearance altitude (MOCA); the associated obstacle clearance surface is 1,400 feet AMSL and is most limiting in a very small northwest section of the study area.

Proposed wind turbines that exceed these obstacle clearance surfaces would require an increase to minimum enroute and/or obstruction clearance altitudes. If either of these impacts would affect a significant volume of operations, they could be used as the basis for issuance of determinations of hazard. However, USGS elevation data indicates that these surfaces should not limit wind development at any of the proposed locations and would only limit wind development in the northern and northwestern sections of the study area.

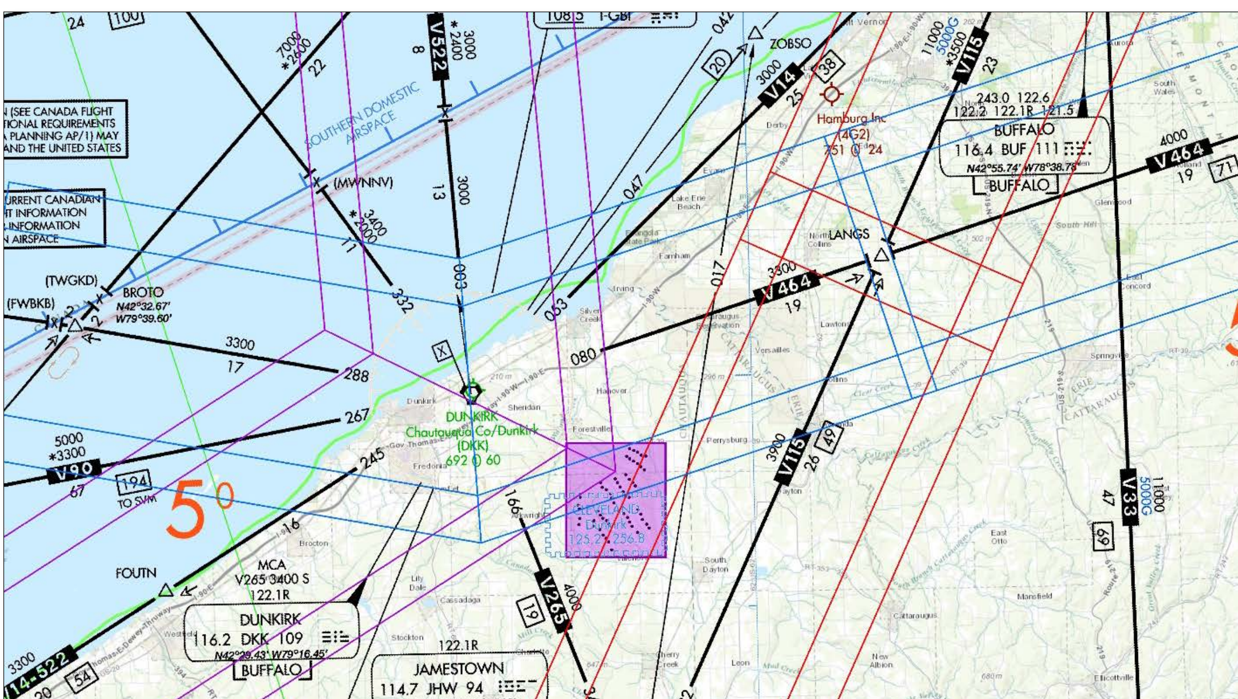


Figure 6: Low altitude enroute chart L-30 and Ball Hill wind project

Minimum Vectoring Altitudes

The FAA has created minimum vectoring altitude (MVA) charts that define sectors with the lowest altitudes at which air traffic controllers can issue radar vectors to an 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.

The Ball Hill wind project is located inside the Erie Terminal Radar Approach Control (TRACON) (***Figure 7***) and Buffalo TRACON minimum vectoring altitude charts. Erie TRACON Sector H (hatched purple, ***Figure 7***) is lowest; the sector's established minimum vectoring altitude is 3,600 feet AMSL. Although the study area is located within FAA designated mountainous terrain, existing obstacles indicate that the FAA has likely reduced the required obstacle clearance from 2,000 to 1,000 feet. The resulting obstacle clearance surface height is 2,649 feet AMSL and is in excess of other more limiting surfaces. Therefore, minimum vectoring altitudes should not limit wind development within the defined study area.

Proposed wind turbines that exceed 2,649 feet AMSL would require an increase to minimum vectoring altitudes. If this impact would affect a significant volume of operations, it could result in determinations of hazard.

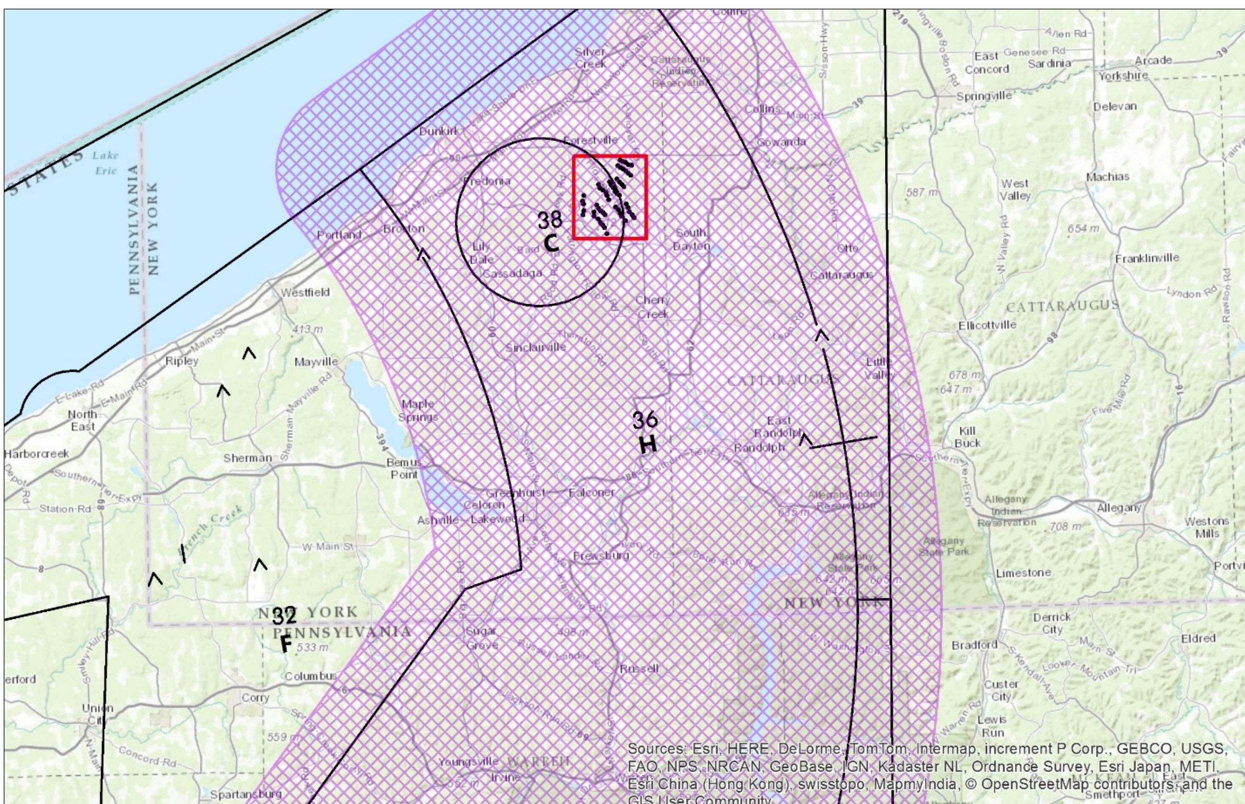


Figure 7: Erie TRACON minimum vectoring altitude chart (black) with Sector H obstacle evaluation area (hatched purple)

Navigational Aids

The FAA has established 0.75° (conventional VOR) and 1.2° (Doppler VOR) screening angles in order to identify proposed structures that may have a negative impact on navigational aids. This surface extends upward and outward from the navigational aid to a distance of up to eight nautical miles. Proposed wind turbines that exceed this surface may interfere with the services provided by the navigational aid. If the FAA determines this impact to be significant it can be used as the basis for a determination of hazard.

The Ball Hill wind project is located within the lateral boundaries of the Dunkirk VORTAC (DKK) 0.75° screening surface (***Figure 8***). The height of the Dunkirk VORTAC screening surface ranges from 1,043 to 1,316 feet AMSL. USGS elevation data indicates that typical wind development located within 8 nautical miles of the Dunkirk VORTAC would likely exceed this screening surface (red, ***Figure 8***); 35 of the proposed wind turbine locations would likely exceed this screening surface.

Proposed structures that have a substantial adverse effect on navigational aids may receive FAA determinations of hazard regardless of impact on other surfaces defined in this report. Wind turbines may still have an impact on a navigational aid even though they do not exceed either of the screening surfaces.

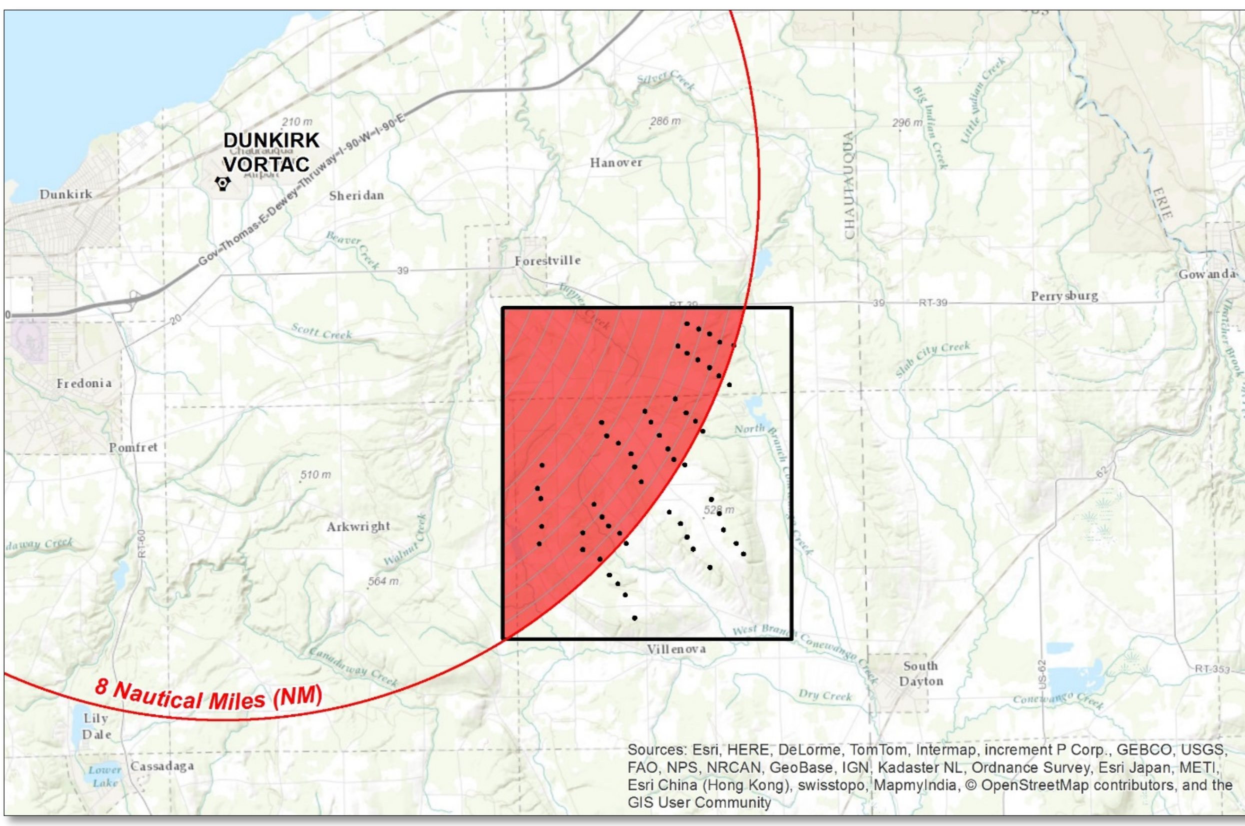


Figure 8: Dunkirk VORTAC 0.75° screening surface

Military Airspace and Training Routes

Since the FAA does not protect for military training routes, proximity to a training route will not likely result in a determination of hazard. However, if the planned development area is located on federal land, proximity to these routes may result in the denial of permits by the Bureau of Land Management.

The Ball Hill wind project is located outside of military training routes and airspace.

Long Range and NEXRAD Radar

While Capitol Airspace did not assess for electromagnetic interference on communications, navigation or surveillance systems, the FAA/DOD preliminary screening tool was utilized to determine likely electromagnetic interference on long range and NEXRAD radars. According to the Long Range Radar tool, the Ball Hill wind project is located in an area designated as 'Yellow' (left, ***Figure 9***). The FAA defines this area as follows:

> Yellow: Impact likely to Air Defense and Homeland Security Radars. Aeronautical study required.

Further, according to the NEXRAD tool, the Ball Hill wind project is located in areas designated as 'Green: No Impact Zone' and 'Dark Green: Notification Zone' (right, ***Figure 9***). The FAA defines these areas as follows:

> Green: **No Impact Zone.** Impacts not likely. NOAA will not perform a detailed analysis, but would still like to know about the project.
>
> Dark Green: **Notification Zone.** Some impacts possible. Consultation with NOAA is optional, but NOAA would still like to know about the project.

The preliminary screening tool does not consider turbine height nor does it consider the cumulative impact of existing or approved turbines in proximity to the area studied.

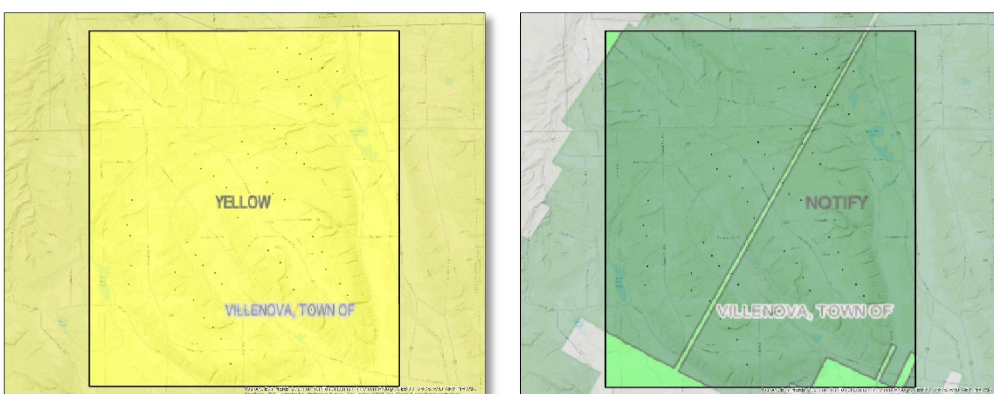


Figure 9: Long range (left)/NEXRAD (right) radar preliminary screening tool results

Conclusion

Height constraints overlying the study area range from 1,400 to 2,552 feet AMSL (***Figure 10a***) and are associated with the instrument departure procedures (***Figure 4***) and instrument approach procedures (***Figures 5a*** & ***5b***) at Chautauqua County/Dunkirk Airport as well as low altitude enroute airways (***Figure 6***). Proposed wind turbines that exceed these obstacle clearance surfaces would require an increase to departure procedure minimum climb gradients, instrument approach procedure minimum altitudes, and/or enroute airway minimum altitudes. If the FAA determines either of these impacts to constitute a substantial adverse effect, it could be used as the basis for the issuance of determinations of hazard. USGS elevation data indicates that these surfaces would limit typical wind development in northern and western sections of the study area (***Figure 10b***), as well as in areas of higher terrain.

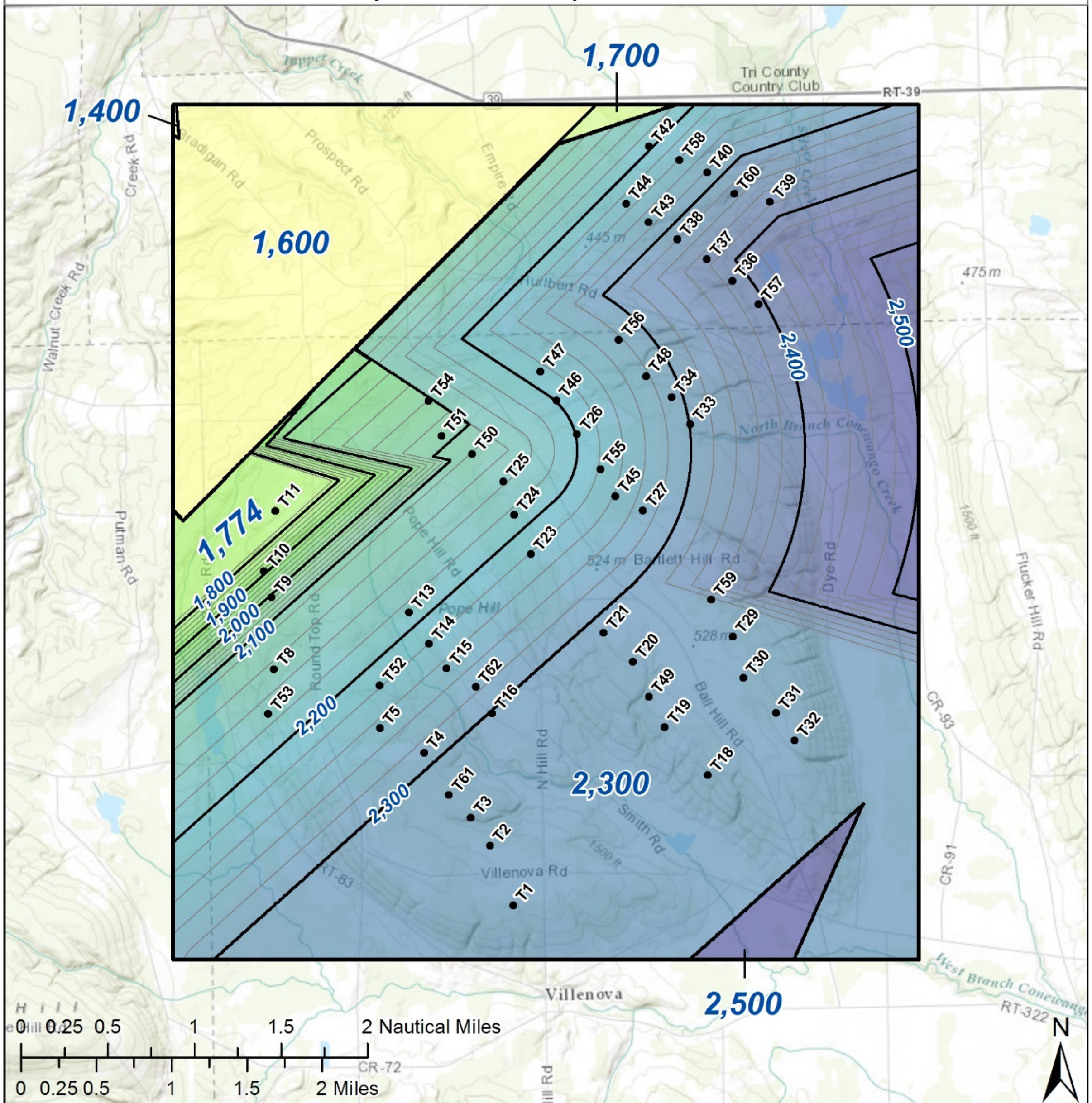
The Ball Hill wind project is located within the lateral boundaries of the Dunkirk VORTAC 0.75° screening surface (***Figure 8***). 35 of the proposed wind turbine locations are located within this screening surface and would likely exceed this screening surface. Proposed structures that have a substantial adverse effect on navigational aids may receive FAA determinations of hazard regardless of impact on other surfaces defined in this report. Wind turbines may still have an impact on a navigational aid even though they do not exceed either of the screening surfaces.

The Ball Hill wind project is located in an area designed as 'Yellow' (left, ***Figure 9***) by the FAA/DoD long range radar screening tool. Impact on surveillance systems can result in determinations of hazard regardless of the lack of impact on the physical airspace surfaces described in this report.

The AGL Clearance Map (***Figure 10b***) is based on USGS National Elevation Dataset (NED) 1/3 Arc Second data which has a vertical accuracy of generally +/- 7 meters. Therefore, the AGL Clearance Map should only be used for general planning purposes and not exact wind turbine siting. In order to avoid the likelihood of a determination of hazard, proposed wind turbine heights must adhere to the height constraints depicted in the Composite Map (***Figure 10a***).

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

Proposed wind turbines that exceed 14 CFR Part 77.17(a)(1) - a height of 499 feet above ground level (AGL) at the site of the object - will automatically be determined to be obstructions.



Legend

Obstacle Clearance Surface

Height - AMSL Feet

High : 2,552

Low : 1,400

• Proposed Wind Turbine Location

Height Contour

100 Foot

20 Foot

All Heights AMSL

Ball Hill Wind Project

Composite Height Constraint Map

Plot Date: 19 May 2015

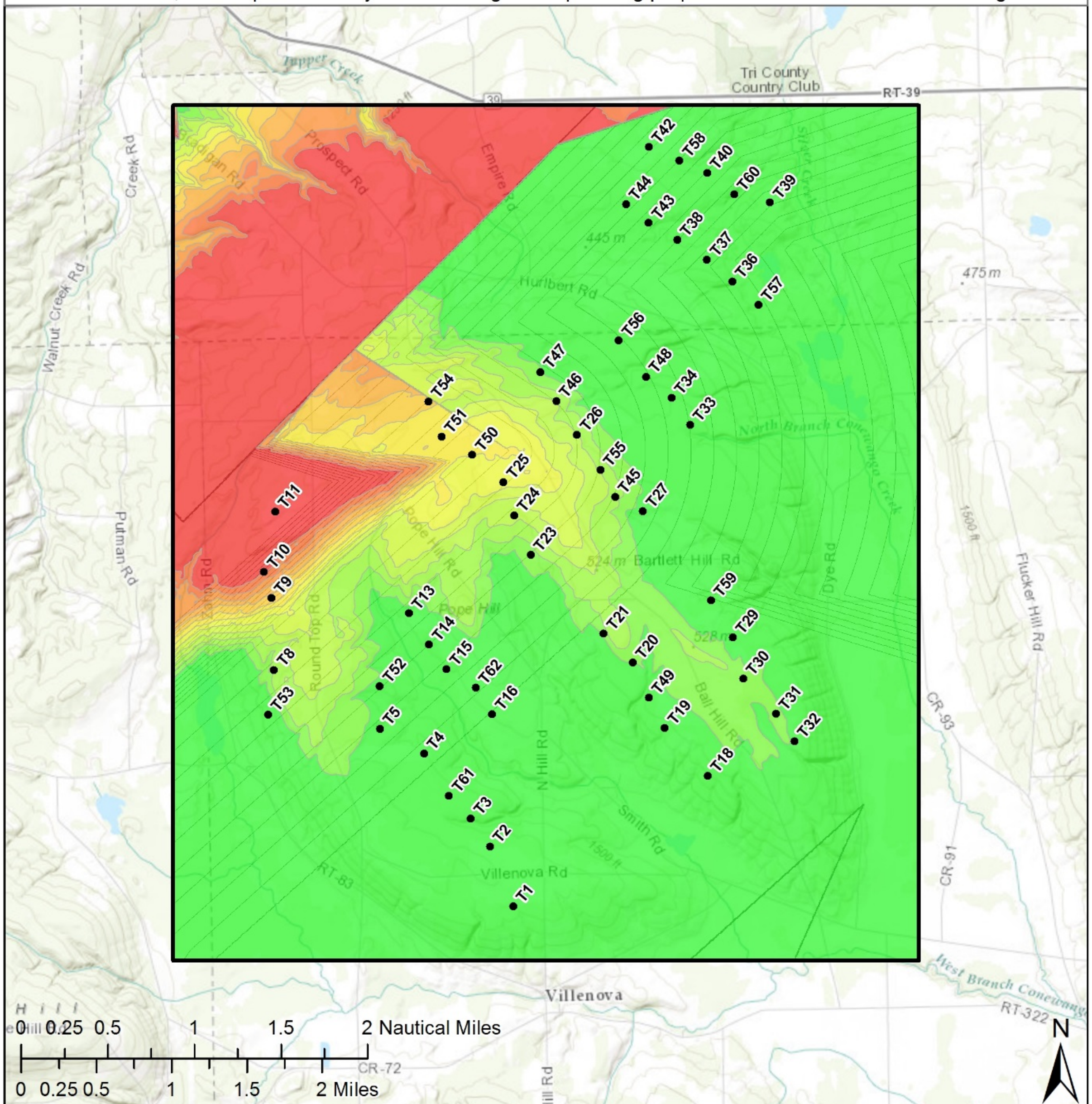
Coordinate System: NAD 1983 UTM Zone 17N

Joe Anderson

Figure 10a

Capitol Airspace Group

The USGS 1/3 Arc Second Digital Elevation Model used to create this map has a vertical accuracy of +/- 7 meters. Therefore, this map should only be used for general planning purposes and not exact structure siting.



Legend

• Proposed Wind Turbine Location

Above Ground Level (AGL) Clearance - Feet

< 350, 350 - 375, 375 - 400, 400 - 425, 425 - 450, 450 - 475, 475 - 500, 500 - 525, 525 - 550, 550 - 575, 575 - 600, ≥ 600

Ball Hill Wind Project

Above Ground Level (AGL) Clearance Map

Plot Date:
19 May 2015

Coordinate System:
NAD 1983 UTM Zone 17N

Joe Anderson

Figure 10b

Capitol Airspace Group