

Wind Power GeoPlanner™

Government RADAR Systems Analysis

Bluestone Wind Project



Prepared on Behalf of
Bluestone Wind, LLC

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1. Introduction

Comsearch was contracted by Bluestone Wind LLC to determine if there would be any significant degradation to the operational coverage of Government RADAR systems located near the proposed Bluestone Wind Energy Project in Broome County, New York. Figures 1A and 1B show the location of the entire Bluestone Wind project area and individual wind turbines, respectively. Table 1 lists all of the wind turbines within the Bluestone Project and their geographic coordinates.



Figure 1A: Bluestone Wind Project Area

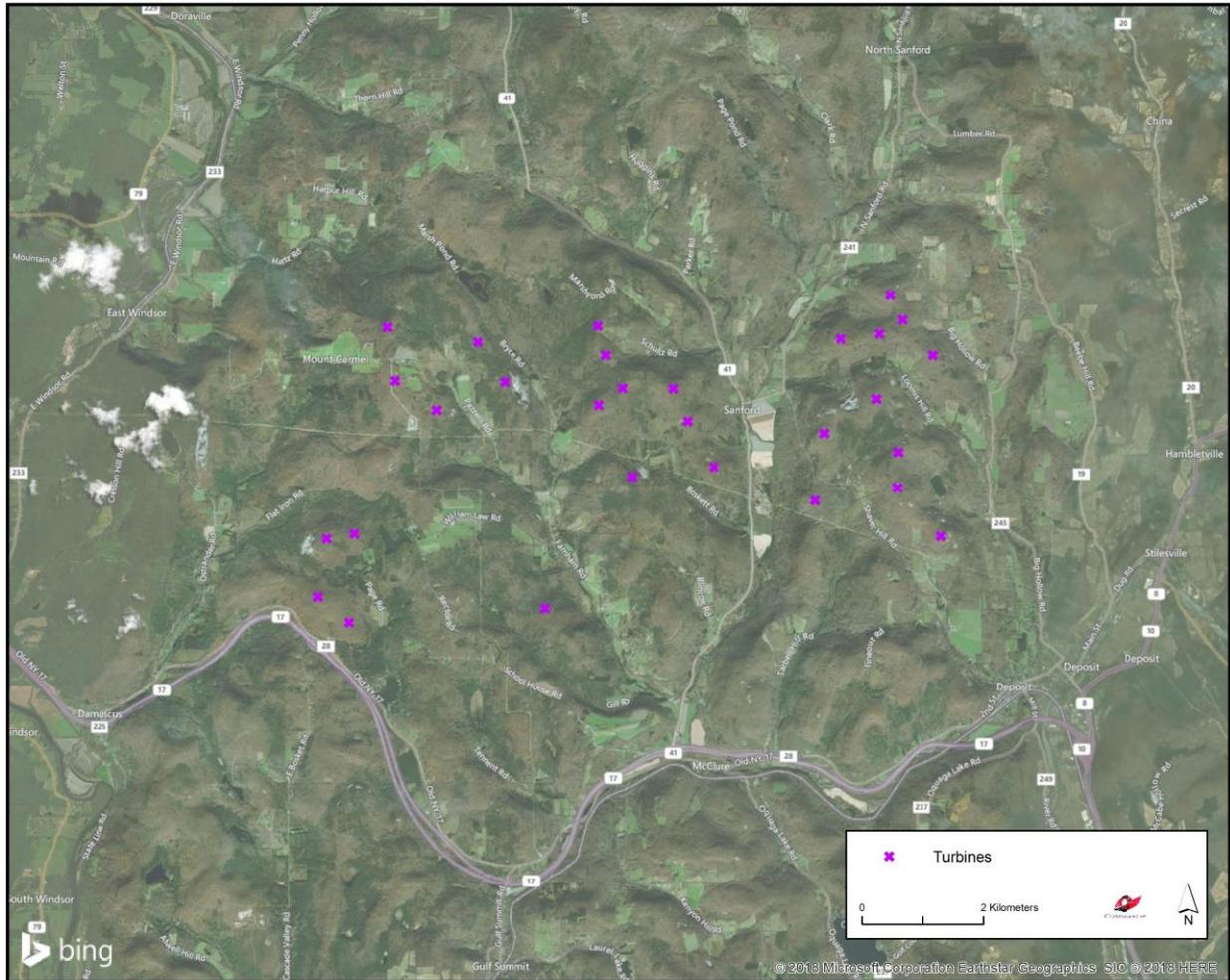


Figure 1B: Bluestone Wind Energy Turbine Array

Turbine ID	Type	Latitude (NAD83)	Longitude (NAD83)
1	Primary	42.11331413	-75.55414866
3	Primary	42.10108553	-75.54429457
4	Primary	42.10542415	-75.55253944
5	Primary	42.08275194	-75.56039936
6	Primary	42.08195034	-75.56589336
7	Primary	42.07333194	-75.56755756
13	Primary	42.10534623	-75.53070037
14	Primary	42.10936413	-75.51063128
15	Primary	42.10199073	-75.51199918
16	Primary	42.09140193	-75.50526348
20	Primary	42.09969943	-75.49434838
21	Primary	42.10448843	-75.50729038
22	Primary	42.10452333	-75.49726428
23	Primary	42.11368903	-75.51225058
24	Primary	42.09295823	-75.48906009
25	Primary	42.08808903	-75.46884219
26	Primary	42.09802503	-75.46714074
27	Primary	42.11487137	-75.45175269
28	Primary	42.11279923	-75.4563234
29	Primary	42.11203629	-75.46393687
30	Primary	42.10963843	-75.44549207
31	Primary	42.10311523	-75.45684649
32	Primary	42.11854376	-75.45418999
34	Primary	42.09004397	-75.4526
35	Primary	42.08289273	-75.443801
36	Primary	42.11120603	-75.53611527
37	Primary	42.06957402	-75.56132222
40	Primary	42.09530467	-75.45248252
38	Primary	42.07188934	-75.52237078

Table 1: Wind Turbine Coordinates for the Bluestone Wind Energy Project

2. Summary of Screening Results

There are three types of radar systems that Comsearch examined as part of this analysis: Department of Defense (DoD) military systems, Federal Aviation Administration (FAA) long range radar systems, and National Weather Service (NWS) NEXRAD WSR-88D systems.

Comsearch used the DoD RADAR screening tool to determine whether potential coverage issues were anticipated for the above systems. The geographical coordinates for each individual wind turbine listed in Table 1 were used as an input parameter for the screening tool. The results of the screening showed that there were no potential issues with the Department of Defense (DoD) military operations, FAA long range radar systems, nor to the National Weather Service (NWS) NEXRAD WSR-88D systems. In support of these findings, three figures and statements were captured from the DoD screening tool and are presented below.

Figure 2 shows the screening results for the DoD military system which is basically a sectional aeronautical chart that is centered on the wind turbines within the project area.



Figure 2: Screening Tool Diagram for DoD Military Systems

According to the DoD screening tool, there are no likely impacts to military airspace. The following contacts were provided for confirmation and documentation if required:

- David Brentzel (404) 562-4211
USAF Regional Environmental Coordinator
- US Navy Representative, FAA Eastern Service Area (404) 305-6908
USN Regional Environmental Coordinator
- LTC Jeffrey Martuscelli (404) 305-6915
USA Regional Environmental Coordinator
- US Marine Corps Representative, FAA Eastern Service Area (404) 305-6907
USMC Regional Environmental Coordinator

Formal project approval is granted as a result of the FAA review of the Form 7460-1 that is required for each individual wind turbine to be installed in the project. No issues are anticipated based on the preliminary screening tool results.

Figure 3 shows the screening results for the NEXRAD weather service systems. The screening tool map shows that all of the wind turbines (shown as individual “x” on map) for the Bluestone Wind Energy project will be located in the green “Notify” zone of the NEXRAD system near the project area. The green designation of the zone signifies that no obstruction to the radar line-of-sight (RLOS) is predicted for the nearby radar system. Since NEXRAD can detect wind turbines occasionally at great distances, NOAA would still like to know the location of all wind farm projects so that corrupted radar data can be flagged. All information regarding the wind project can be sent directly to NOAA at wind.energy.matters@noaa.gov or through the NTIA.

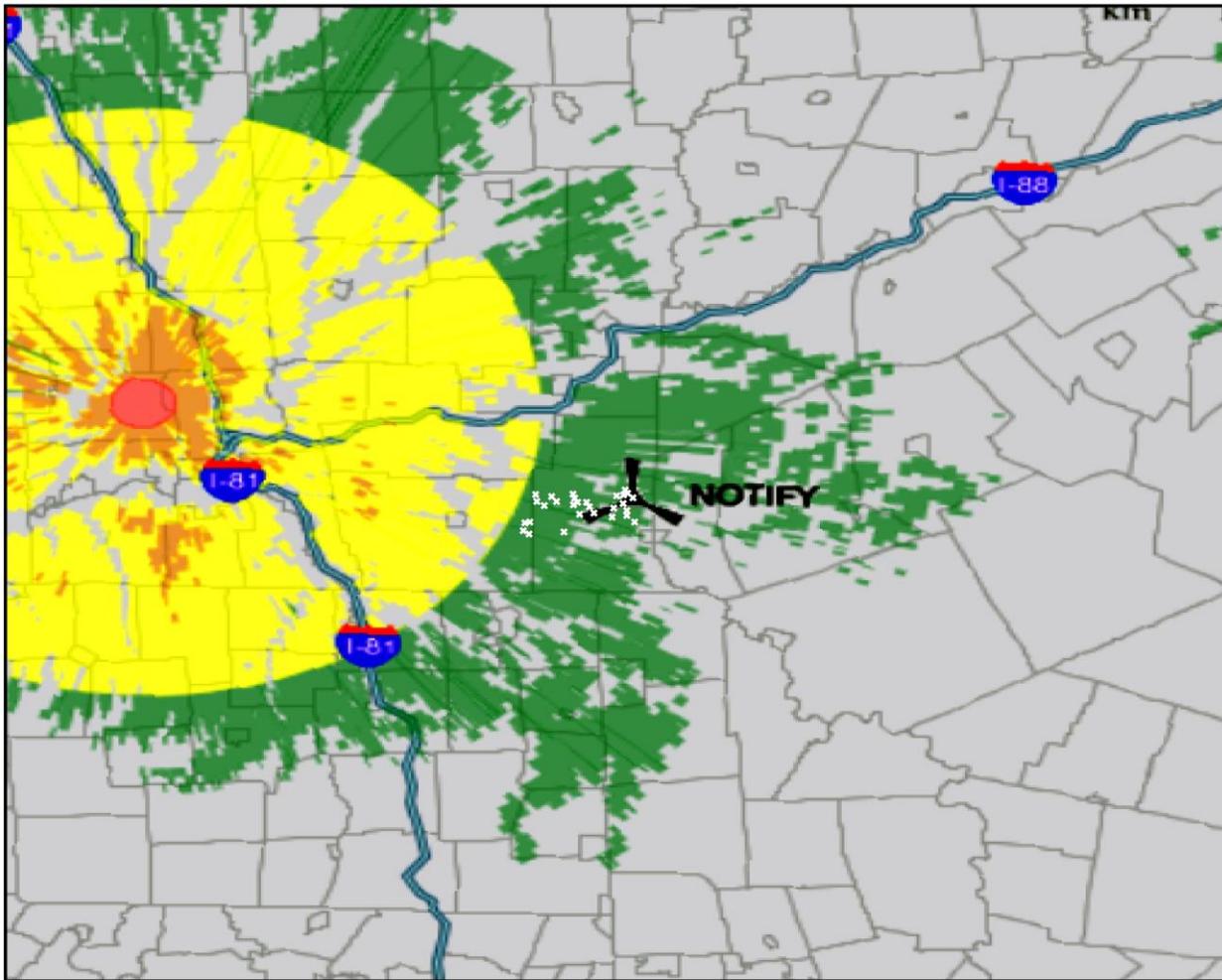


Figure 3: Screening Tool Diagram for Weather Service RADAR Coverage

Figure 4 shows the screening results for the FAA long range radar system. According to the map diagram, there are four FAA radar systems in the surrounding area, and based on the individual wind turbine locations (shown as purple “x” on map), no impacts to the radar coverage are anticipated. Hence, the screening tool returned the “Green” designation for the Bluestone Wind Energy Project as shown in Figure 4.

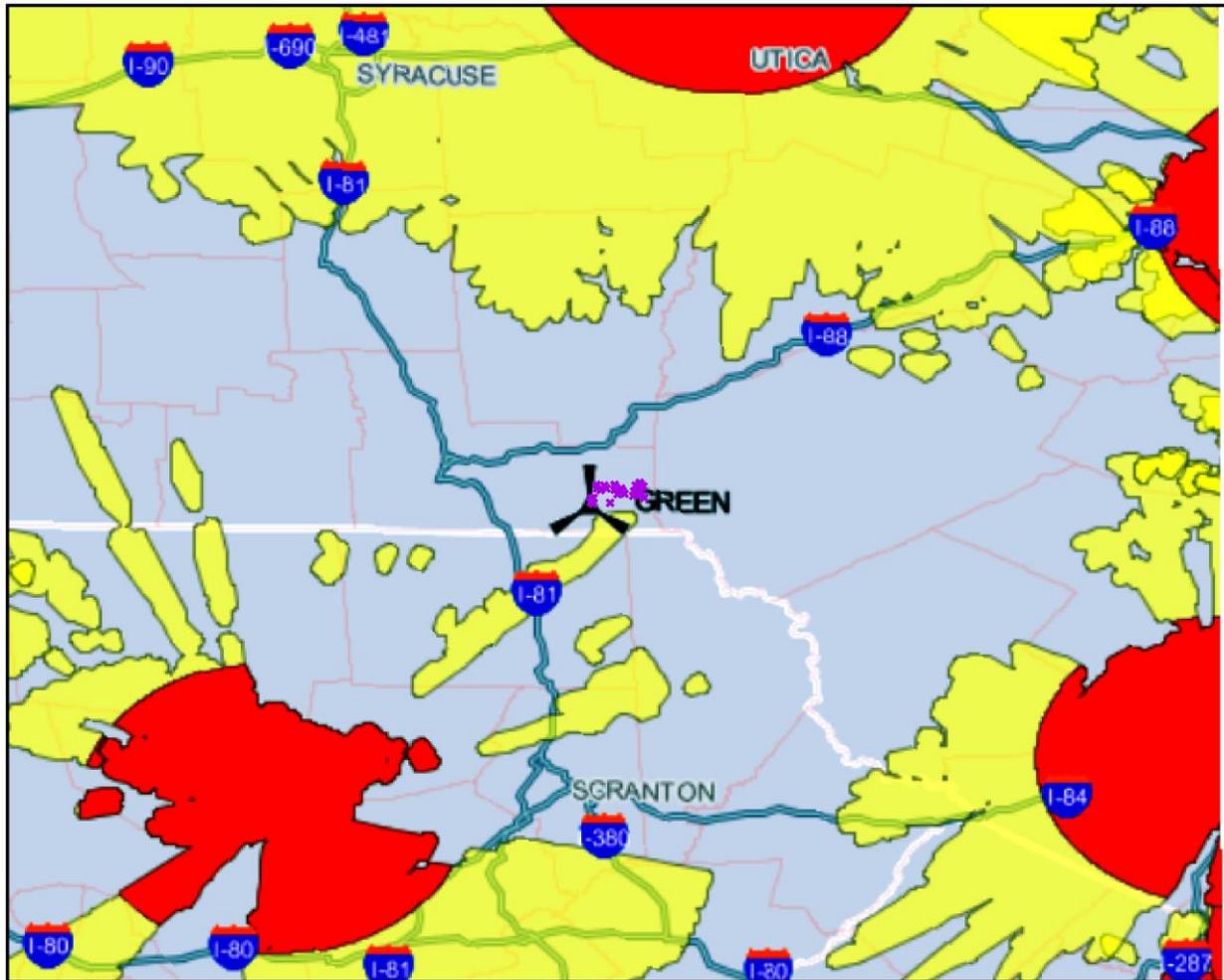


Figure 4: Screening Tool Diagram for FAA Long Range Radar Coverage

3. Analysis

To determine the potential impact of the proposed wind turbines on the FAA radar systems around the Bluestone wind energy project, the line-of-sight (LOS) distance between a given radar and wind turbine is calculated. If the physical separation distance between a radar and wind turbine is within the LOS distance, then the wind turbine would have the potential to obstruct coverage and produce false targets for that particular radar. Otherwise, the wind turbine would be located over the horizon and beyond line-of-sight. The separation distance between a radar and wind turbine is based on their geographical coordinates, whereas the LOS distance is determined based on the sum of the horizon distances associated with a particular radar antenna and wind turbine.

The distance to the horizon for a radar antenna is a function of its height and is given by:

$$D_1 = (2 \cdot H_R)^{1/2} \quad \text{(Equation 1)}$$

Where:

- D_1 = Distance from radar to horizon in miles
- H_R = Height of radar antenna above sea level in feet

Likewise, the distance to the horizon for a wind turbine is a function of the maximum height reached by the tip of the rotating blade and is given by:

$$D_2 = (2 \cdot H_{WT})^{1/2} \quad \text{(Equation 2)}$$

$$H_{WT} = (H_h + R/2) \quad \text{(Equation 3)}$$

Where:

- D_2 = Distance from wind turbine to horizon in miles
- H_{WT} = Max height of wind turbine blade tip above sea level in feet
- H_h = Hub height above sea level in feet
- R = Rotor diameter in feet

The LOS distance, in miles, is simply the sum of horizon distances as follows:

$$D_{LOS} = (D_1 + D_2) \quad \text{(Equation 4)}$$

From Equation 2 and Equation 3, the horizon distance for each wind turbine is determined, and the results are shown in Table 2. If the geographical coordinates and heights for each FAA radar is provided, then their corresponding horizon distance as well as LOS distance can be calculated using Equation 1 and Equation 4, respectively.

Turbine ID	Ground Elevation (ft MSL)	Hub Height (ft AGL)	Rotor Diameter (ft)	H_{WT} (ft MSL)	D₂ (mi)
1	1830.2	426.5	492.1	2502.8	70.7
3	1770.1	426.5	492.1	2442.7	69.9
4	1855.3	426.5	492.1	2527.9	71.1
5	1848.0	426.5	492.1	2520.6	71.0
6	1845.4	426.5	492.1	2517.9	71.0
7	1910.8	426.5	492.1	2583.4	71.9
13	1837.9	426.5	492.1	2510.5	70.9
14	1979.8	426.5	492.1	2652.4	72.8
15	1928.3	426.5	492.1	2600.9	72.1
16	1932.2	426.5	492.1	2604.7	72.2
20	1873.2	426.5	492.1	2545.8	71.4
21	2014.2	426.5	492.1	2686.8	73.3
22	2006.6	426.5	492.1	2679.2	73.2
23	1916.5	426.5	492.1	2589.1	72.0
24	1810.2	426.5	492.1	2482.8	70.5
25	1801.6	426.5	492.1	2474.1	70.3
26	1920.3	426.5	492.1	2592.9	72.0
27	1982.8	426.5	492.1	2655.4	72.9
28	1918.5	426.5	492.1	2591.1	72.0
29	1868.1	426.5	492.1	2540.6	71.3
30	1865.2	426.5	492.1	2537.8	71.2
31	1951.0	426.5	492.1	2623.6	72.4
32	1924.6	426.5	492.1	2597.2	72.1
34	1930.6	426.5	492.1	2603.2	72.2
35	1840.3	426.5	492.1	2512.8	70.9
36	1825.8	426.5	492.1	2498.3	70.7
37	1811.2	426.5	492.1	2483.8	70.5
40	1929.9	426.5	492.1	2602.5	72.1
38	1756.6	426.5	492.1	2429.2	69.7

Table 2: Wind Turbine Dimensions and Overall Height Above Sea Level

4. Conclusions

Potential issues involving military operations in the same area as the Bluestone Winds Energy Project were examined. Based on the DoD screening tool, no issues were identified.

Similarly, no issues were identified with the Weather Service's NEXRAD Radar Systems. The Weather Service can be informed of the project through the NTIA notification process.

The FAA will be informed of the wind project through the submission of the FAA Form 7460-1 that will be required for each of the proposed wind turbines. The FAA may respond each with a determination of no hazard or that an individual wind turbine is a presumed hazard to aviation because of its obstruction of radar signal or degradation to the radar operation.

Potentially, there are three reasons that the FAA may object to the installation of wind turbines in the at-risk area depicted in Figure 4: (1) the wind turbines may create shadow zones which may prevent target detection, (2) there may be target loss because of clutter return (reflections from the wind turbines), and (3) the creation of false targets due to the reflections from the wind turbines.

In order to receive approval for a wind turbine that is declared as a presumed hazard to aviation operations, it is possible to show using the technical approach in Section 3 that the wind turbine would not be a hazard. Otherwise, the hazard finding could be mitigated by modifying the wind turbine dimensions and/or changing its location.

5. Contact

For questions or information regarding the Government RADAR System Analysis report, please contact:

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