APPENDIX N – AIRSPACE AND COMMUNICATIONS SYSTEMS

Wind Power GeoPlanner™

AM and FM Radio Report

Sweetland Wind Farm

Prepared on Behalf of
Sweetland Wind Farm,
LLC

February 15, 2019

COMSEARCH
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Table of Contents

1. Introduction

Comsearch analyzed AM and FM radio broadcast stations whose service could potentially be affected by the proposed Sweetland Wind Farm project in Hand County, South Dakota.

2. Summary of Results

AM Radio Analysis

Comsearch found four database records[1] for AM stations within approximately 50 kilometers of the project, as shown in Table 1 and Figure 1. These records represent two distinct stations, KIJV and KOKK, which broadcast out of Huron, South Dakota, to the east of the project. Both stations are licensed separately for daytime and nighttime operations.

ID	Call Sign	Status[2]	Frequency (kHz)	Transmit ERP[3] (kW)	Operation Time	Latitude (NAD 27)	Longitude (NAD 27)	Required Separation Distance[4] (km)	Distance to Nearest Turbine (km)
1	KIJV	LIC	1340	1.0	Daytime	44.345833	-98.209722	0.22	42.65
2	KIJV	LIC	1340	1.0	Nighttime	44.345833	-98.209722	0.22	42.65
3	KOKK	LIC	1210	5.0	Daytime	44.362222	-98.152500	2.48	47.21
4	KOKK	LIC	1210	0.87	Nighttime	44.362222	-98.152500	2.48	47.21

Table 1: AM Radio Stations within 50 Kilometers of Project Area

[1] Comsearch makes no warranty as to the accuracy of the data included in this report beyond the date of the report. The data presented in this report is derived from the AM/FM station's FCC license and governed by Comsearch's data license notification and agreement located at http://www.comsearch.com/files/data_license.pdf. The coordinates provided for AM station KVWC were adjusted slightly based on aerial imagery.

[2] LIC = Licensed and operational station; APP = Application for construction permit; CP=Construction permit granted; CP MOD = Modification of construction permit.

[3] ERP = Transmit Effective Radiated Power.

[4] The required separation distance is based on the lesser of 10 wavelengths or 3 kilometers for directional antennas and 1 wavelength for non-directional antennas.

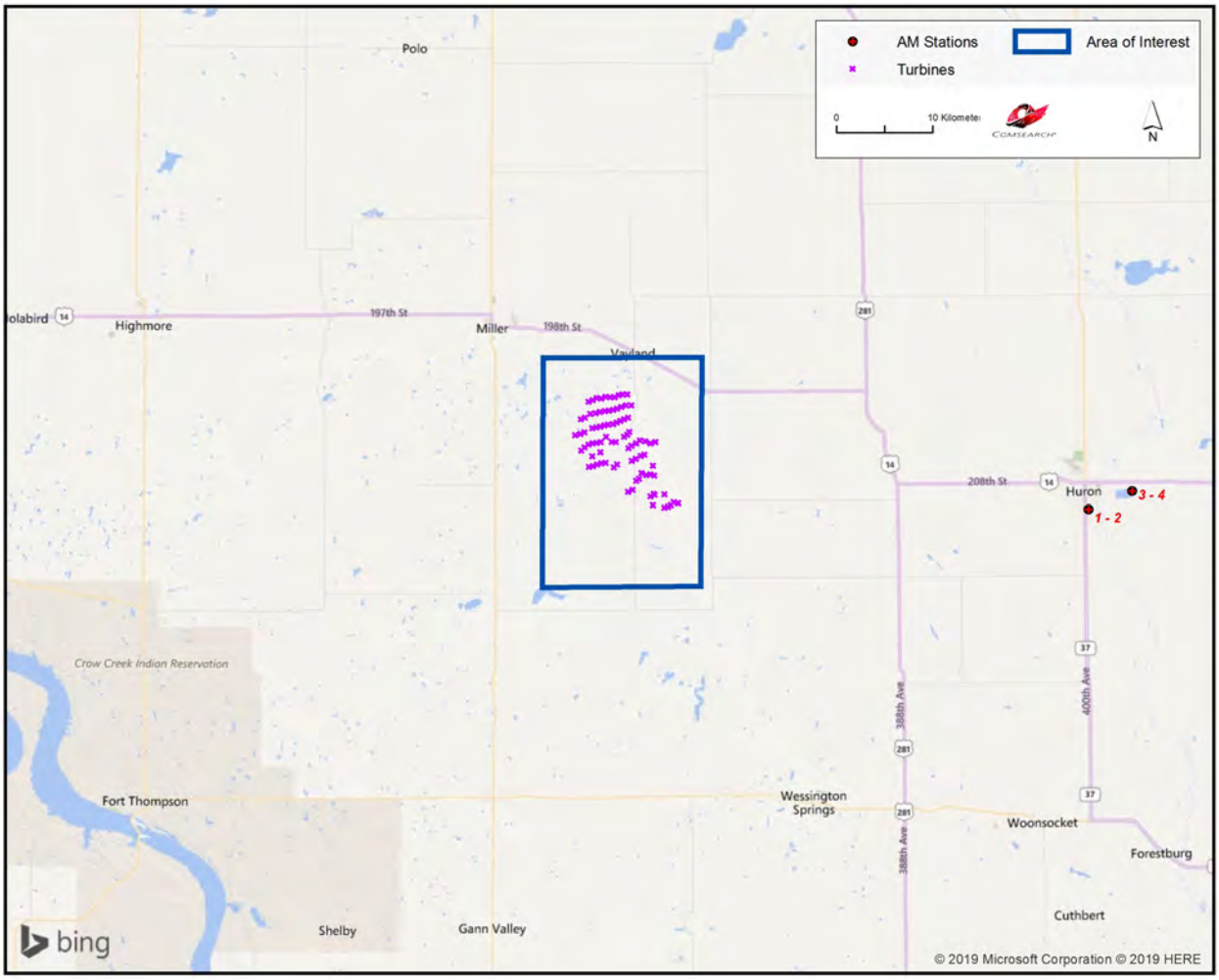

Figure 1: AM Radio Stations within 50 Kilometers of Project Area

FM Radio Analysis

Comsearch determined that there were nine database records for FM stations within approximately 50 kilometers of the Sweetland Wind Farm project, as shown in Table 2 and Figure 2. Only six of these stations are currently licensed and operational, four of which are translators that broadcast with limited range.

ID	Call Sign	Status[5]	Service[6]	Frequency (MHz)	Transmit ERP[7] (kW)	Latitude (NAD 27)	Longitude (NAD 27)	Distance to Nearest Turbine (km)
1	KVCH	LIC	FM	88.7	60.0	44.194167	-98.318056	38.37
2	KJRV	LIC	FM	93.3	65.0	44.194167	-98.318056	38.37
3	K209EM	CP MOD	FX	89.1	0.25	44.342500	-98.243889	39.94
4	K209EM	LIC	FX	89.7	0.25	44.342500	-98.243889	39.94
5	K217CE	LIC	FX	91.3	0.007	44.361111	-98.225000	41.43
6	K237EL	CP	FX	95.3	0.25	44.345833	-98.209722	42.65
7	K286CU	CP	FX	105.1	0.25	44.345833	-98.209722	42.65
8	K213CL	LIC	FX	90.5	0.25	44.369167	-98.172500	45.63
9	K237EL	LIC	FX	95.3	0.17	44.303889	-98.154722	47.37

Table 2: FM Radio Stations within 50 Kilometers of Project Area

[5] LIC = Licensed and operational station; APP = Application for construction permit; CP=Construction permit granted; CP MOD = Modification of construction permit.

[6] FM = FM broadcast station; FX = FM translator station; FL = Low-power FM station; FS = FM auxiliary (backup) station; FB = FM booster station.

[7] ERP = Transmit Effective Radiated Power.

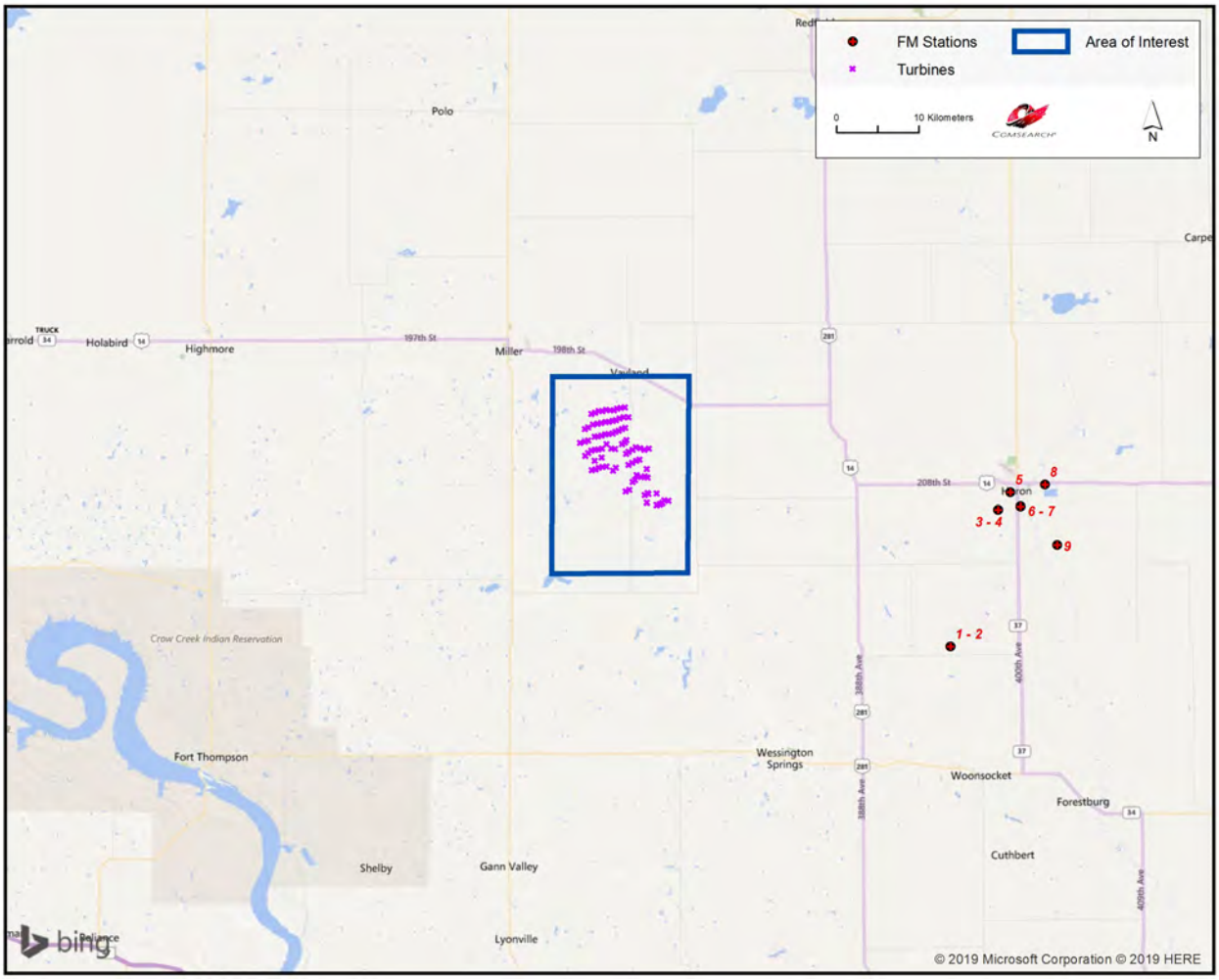

Figure 2: FM Radio Stations within 50 Kilometers of Project Area

3. Impact Assessment

The exclusion distance for AM broadcast stations varies as a function of the antenna type and broadcast frequency. For directional antennas, the exclusion distance is calculated by taking the lesser of 10 wavelengths or 3 kilometers. For non-directional antennas, the exclusion distance is simply equal to 1 wavelength. Potential problems with AM broadcast coverage are only anticipated when AM broadcast stations are located within their respective exclusion distance limit from wind turbine towers. The closest operational AM station to the Sweetland Wind Farm project, KIJV, is more than 42.6 kilometers from the nearest wind turbine. As there were no stations found within 3 kilometers of project, which is the maximum possible exclusion distance based on a directional AM antenna broadcasting at 1000 KHz or less, the project should not impact the coverage of local AM stations.

The coverage of FM stations is generally not susceptible to interference caused by wind turbines, especially when large objects, such as wind turbines, are sited in the *far field* region of the radiating FM antenna in order to avoid the risk of distorting the antenna's radiation pattern. However, within a station's *near field*, radiation pattern distortion can become a factor. Signal attenuation is also possible but is difficult to quantify without precise field measurements. The closest FM station to the Sweetland Wind Farm project, KVCH, is more than 38.7 kilometers from the nearest turbine, which should provide adequate separation to avoid radiation pattern distortion.

4. Recommendations

Since no impact on the licensed and operational AM or FM broadcast stations was identified in our analysis, no recommendations or mitigation techniques are required for this project.

5. Contact

For questions or information regarding the AM and FM Radio Report, please contact:

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Wind Power GeoPlanner™

Microwave Study

Sweetland Wind Farm

Prepared on Behalf of
Sweetland Wind Farm,
LLC

May 4, 2017

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1. Introduction

Microwave bands that may be affected by the installation of wind turbine facilities operate over a wide frequency range (900 MHz – 23 GHz). Comsearch has developed and maintains comprehensive technical databases containing information on licensed microwave networks throughout the United States. These systems are the telecommunication backbone of the country, providing long-distance and local telephone service, backhaul for cellular and personal communication service, data interconnects for mainframe computers and the Internet, network controls for utilities and railroads, and various video services. This report focuses on the potential impact of wind turbines on licensed, proposed and applied non-federal government microwave systems.

2. Project Overview

Project Information

Name: Sweetland Wind Farm

County: Hand

State: South Dakota

Number of Turbines: TBD

Blade Diameter: 140 meters

Hub Height: 90 meters

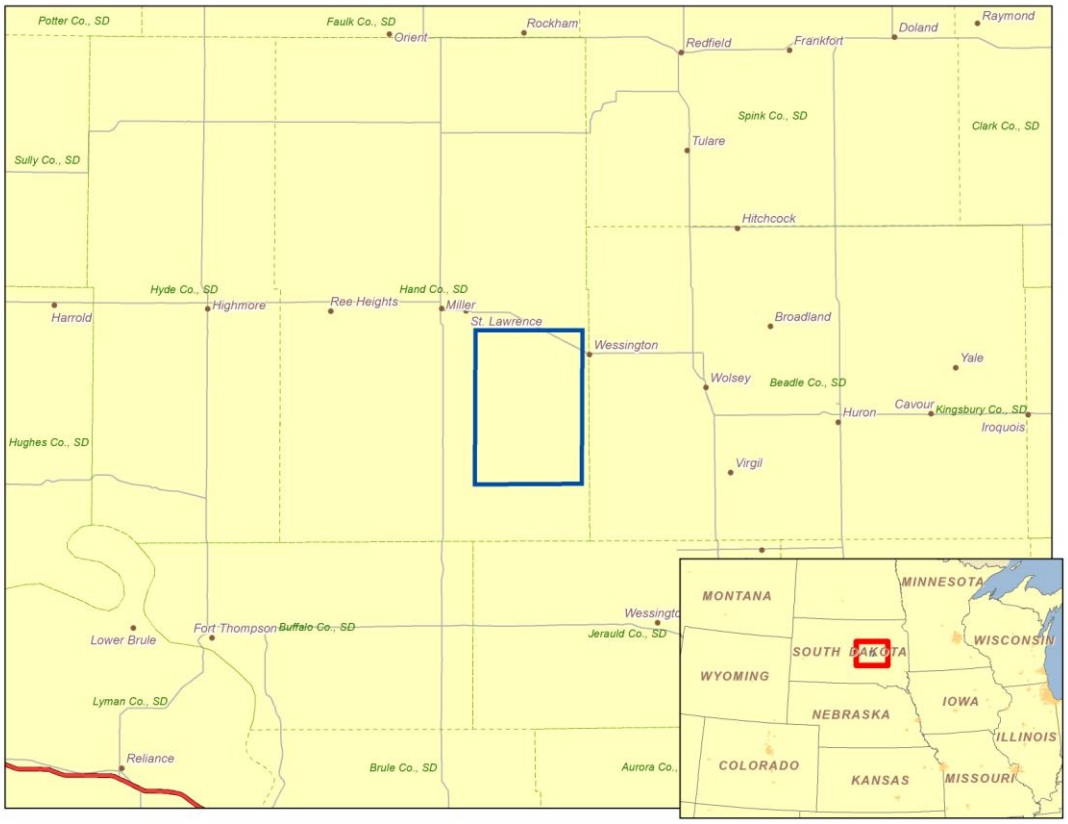


Figure 1: Area of Interest

3. Fresnel Zone Analysis

Methodology

Our obstruction analysis was performed using Comsearch's proprietary microwave database, which contains all non-government licensed, proposed and applied paths from 0.9 - 23 GHz[1]. First, we determined all microwave paths that intersect the area of interest[2] and listed them in Table 1. This path and the area of interest that encompasses the planned turbine locations are shown in Figure 2.

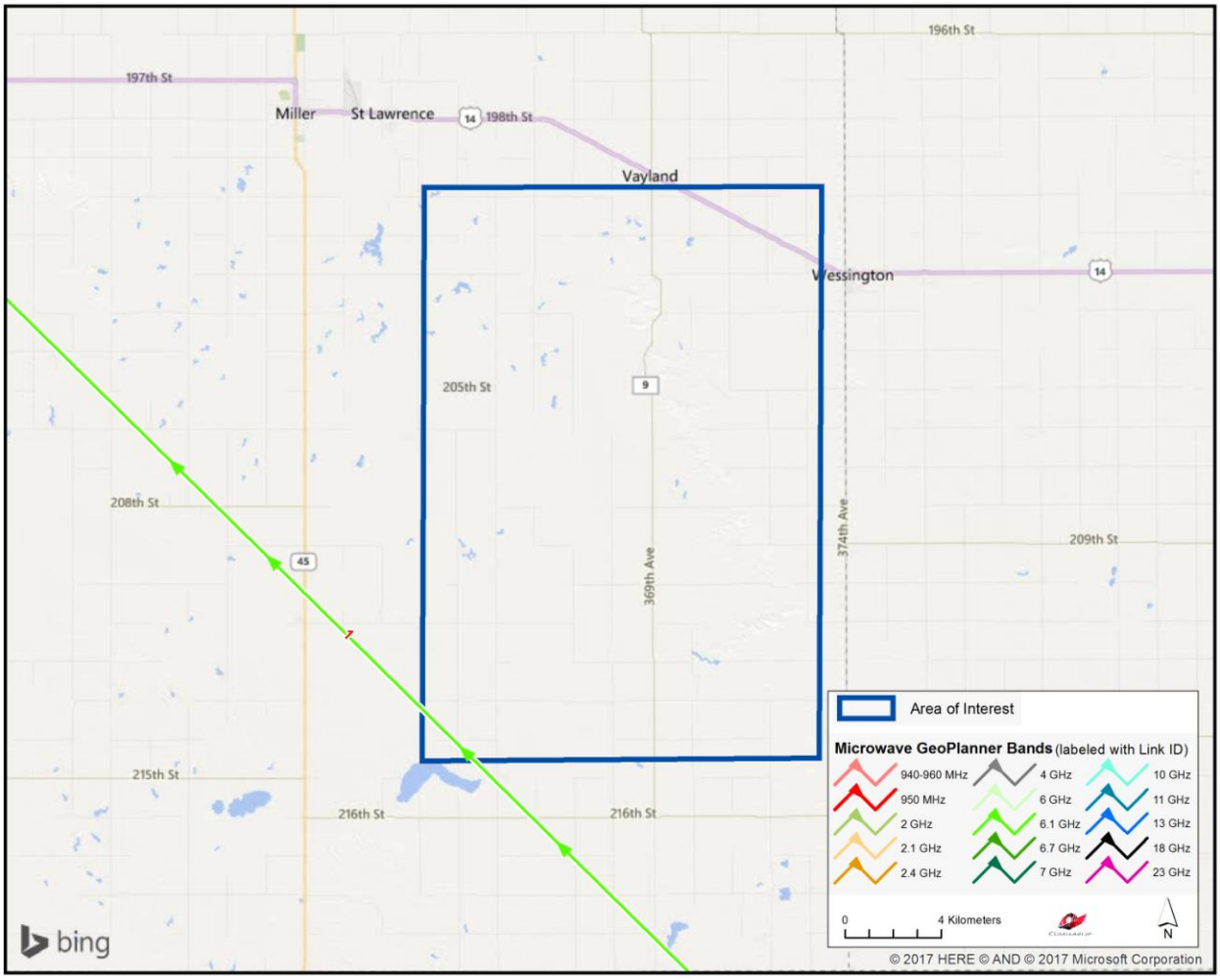


Figure 2: Microwave Path that Intersects the Area of Interest

[1] Please note that this analysis does not include unlicensed microwave paths or federal government paths that are not registered with the FCC.

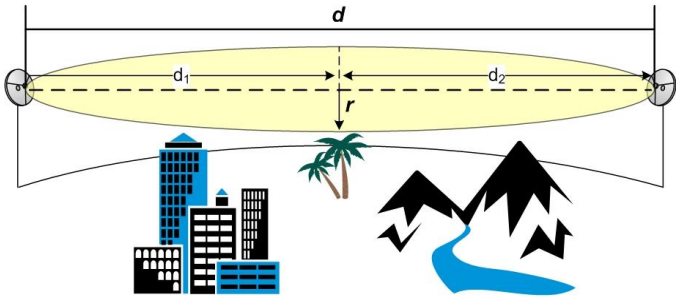
[2] We use FCC-licensed coordinates to determine which paths intersect the area of interest. It is possible that as-built coordinates may differ slightly from those on the FCC license.

ID	Status	Callsign 1	Callsign 2	Band	Path Length (km)	Licensee
1	Licensed	WNEL229	WQKM509	6.1 GHz	67.75	NorthWestern Corporation

Table 1: Summary of Microwave Paths that Intersect the Area of Interest
(See enclosed mw_geopl.xlsx for more information and
GP_dict_matrix_description.xls for detailed field descriptions)

Next, we calculated a Fresnel Zone for this path based on the following formula:

$$r \cong 17.3\sqrt{\frac{n}{F_{GHz}}\left(\frac{d_1 d_2}{d_1 + d_2}\right)}$$



Where,

r	=	Fresnel Zone radius at a specific point in the microwave path, meters
n	=	Fresnel Zone number, 1
F_{GHz}	=	Frequency of microwave system, GHz
d_1	=	Distance from antenna 1 to a specific point in the microwave path, kilometers
d_2	=	Distance from antenna 2 to a specific point in the microwave path, kilometers

The calculated Fresnel Zone shows the narrow area of signal swath and is calculated for the microwave path in the project area. In general, this is the area where the planned wind turbines should be avoided, if possible. A depiction of the Fresnel Zone is shown in Figure 3, and is also included in the shapefiles[3,4].

[3] The ESRI® shapefiles enclosed are in NAD 83 UTM Zone 14 projected coordinate system.

[4] Comsearch makes no warranty as to the accuracy of the data included in this report beyond the date of the report. The data provided in this report is governed by Comsearch's data license notification and agreement located at http://www.comsearch.com/files/data_license.pdf.

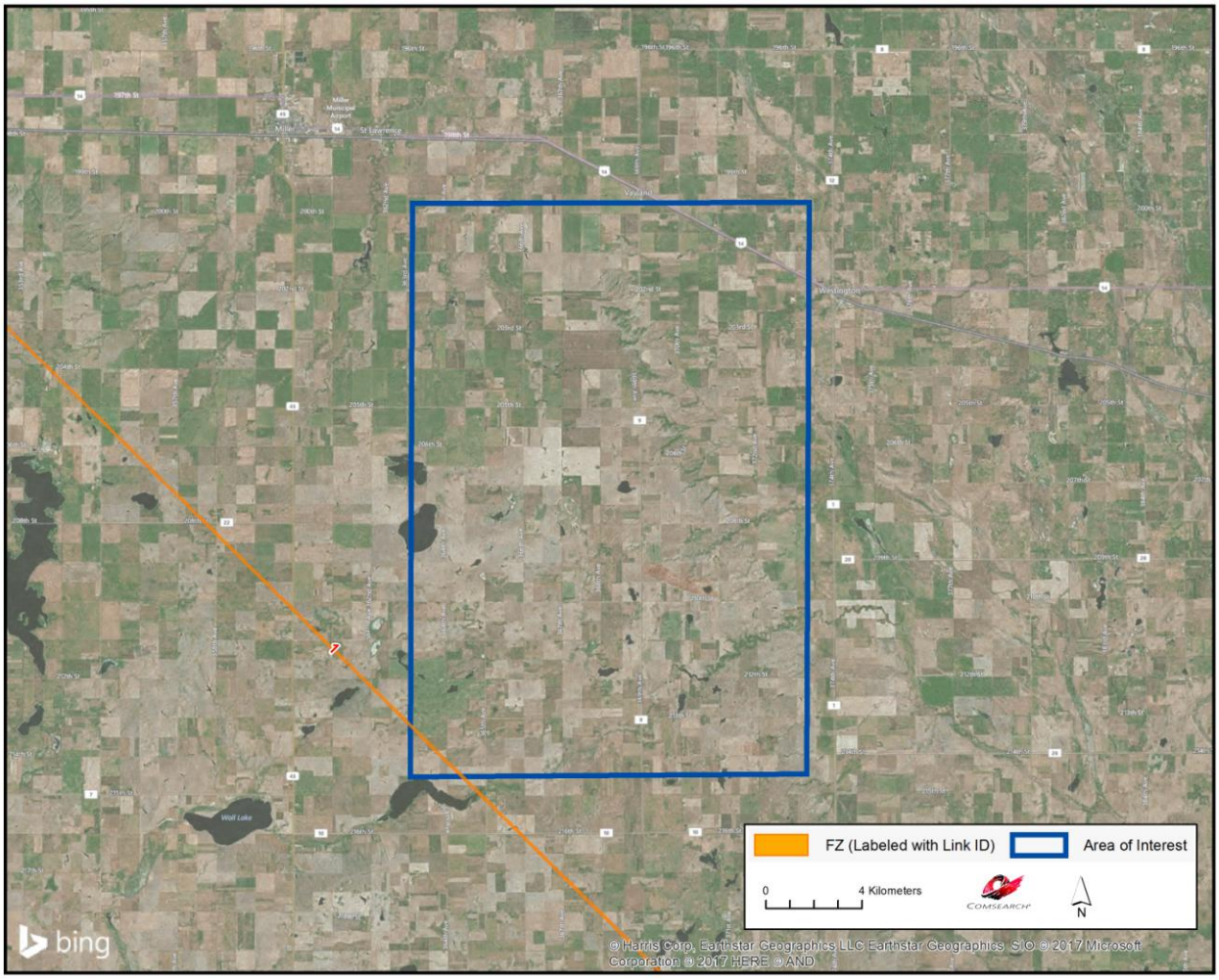


Figure 3: Fresnel Zone in the Area of Interest

Discussion of Potential Obstructions

Total Microwave Paths	Paths with Affected Fresnel Zones	Total Turbines	Turbines intersecting Fresnel Zones
1	N/A	N/A	N/A

For this project, turbine locations were not provided; thus we could not determine if any potential obstructions exist between the planned wind turbines and the incumbent microwave path. If the latitude and longitude values for turbine locations are provided, Comsearch can identify where a potential conflict might exist.

4. Conclusion

Our study identified one microwave path intersecting the Sweetland Wind Farm project area. The Fresnel Zone for this microwave path was calculated and mapped. We recommend that all turbines be sited in locations that will not obstruct the Fresnel Zone.

5. Contact

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Wind Power GeoPlanner™

Off-Air TV Analysis

Sweetland Wind Farm

Prepared on Behalf of
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Table of Contents

1. Introduction

Off-air television stations broadcast signals from terrestrially-based facilities directly to television receivers. Comsearch identified those off-air stations whose service could potentially be affected by the proposed Sweetland Wind Farm project in Hand County, South Dakota. Comsearch then examined the coverage of the stations and the communities in the area that could potentially have degraded television reception due to the location of the proposed wind turbines.

2. Summary of Results

The proposed wind energy project area and local communities are depicted in Figure 1, below.

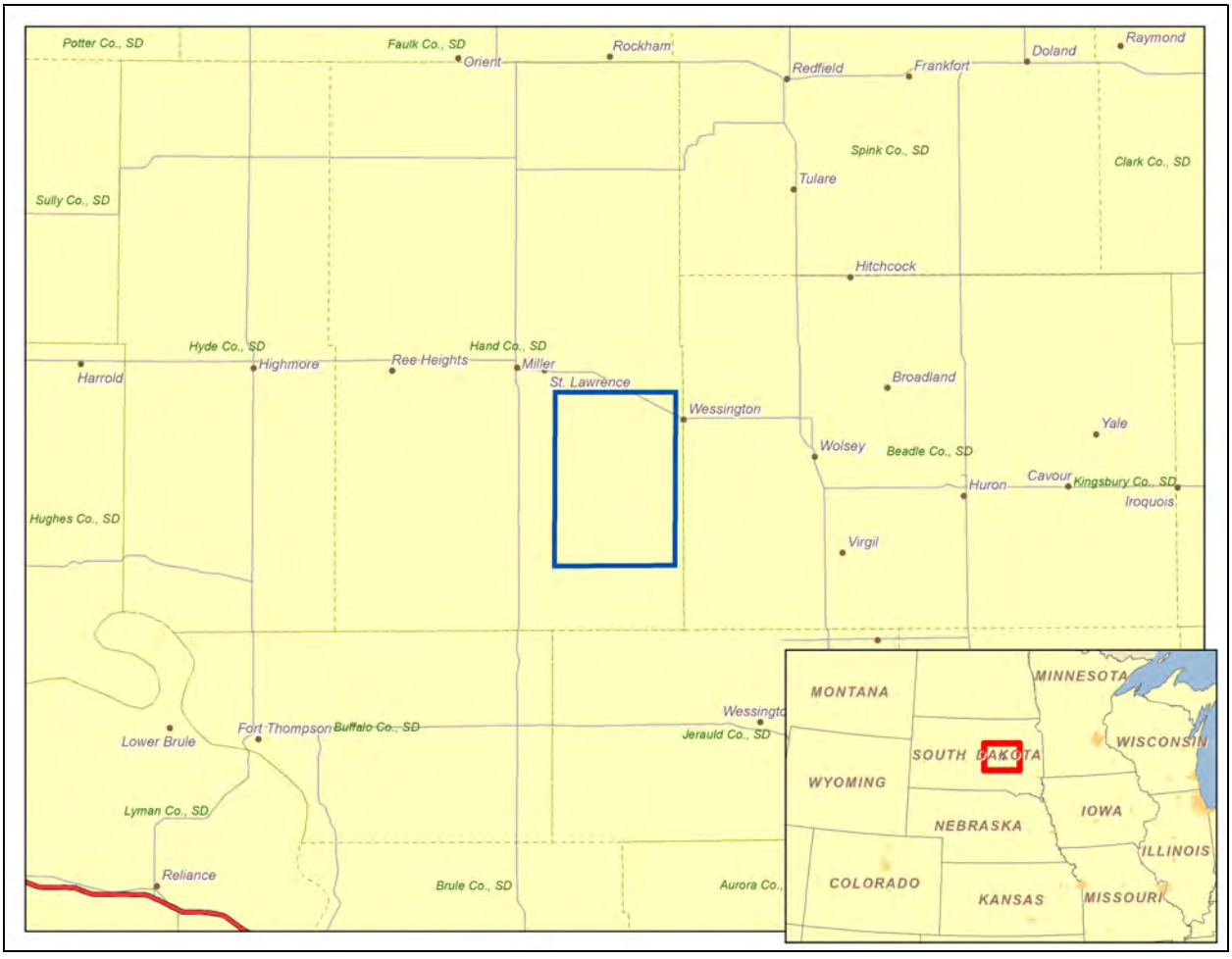

Figure 1: Wind Farm Project Area and Local Communities

To begin the analysis, Comsearch compiled all off-air television stations[1] within 150 kilometers of the project area of interest (AOI). TV stations at a distance of 150 kilometers or less are the most likely to provide off-air coverage to the project area and neighboring communities. These stations are listed in Table 1, below, and a plot depicting their locations is provided in Figure 2. There are a total of seventy-seven database records for stations within approximately 150 kilometers of the limits of the project AOI. Of these stations, only thirty-three are currently licensed and operating, twenty-four of which are low-power stations or translators. Translator stations are low-power stations that receive signals from distant broadcasters and retransmit the signal to a local audience. These stations serve local audiences and have limited range, which is a function of their transmit power and the height of their transmit antenna.

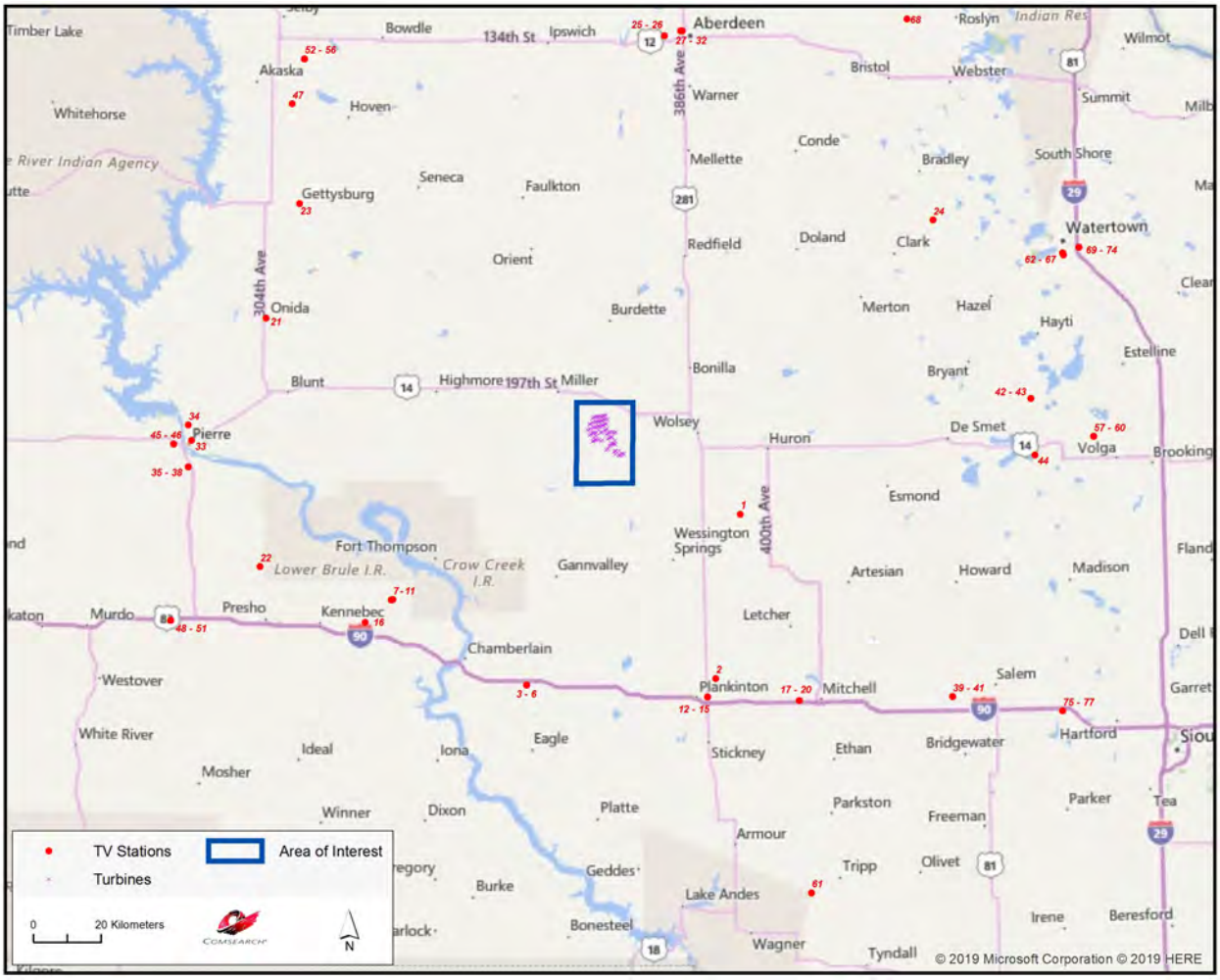

Figure 2: Plot of Off-Air TV Stations within 150 Kilometers of Project Area

[1] Comsearch makes no warranty as to the accuracy of the data included in this report beyond the date of the report. The data presented in this report is derived from the TV station's FCC license and governed by Comsearch's data license notification and agreement located at http://www.comsearch.com/files/data_license.pdf.

ID	Call Sign	Status	Service[2]	Channel	Transmit ERP[3] (kW)	Latitude (NAD 83)	Longitude (NAD 83)	Distance to Nearest Turbine (km)
1	KTTM	LIC	DT	12	12.6	44.194167	-98.318333	38.38
2	KDLV-TV	LIC	DT	26	1000.0	43.759167	-98.412500	71.20
3	K33NI-D	CP	LD	33	2.0	43.743528	-99.104056	72.48
4	K34MW-D	CP	LD	34	2.0	43.743528	-99.104056	72.48
5	K35MB-D	CP	LD	35	2.0	43.743528	-99.104056	72.48
6	K38PB-D	CP	LD	38	2.0	43.743528	-99.104056	72.48
7	KTSD-TV	LIC	DT	10	54.7	43.968056	-99.594722	74.89
8	K30NU-D	CP	LD	30	2.0	43.967083	-99.601361	75.38
9	K36NC-D	CP	LD	36	2.0	43.967083	-99.601361	75.38
10	K40NT-D	CP	LD	40	2.0	43.967083	-99.601361	75.38
11	K47ON-D	CP	LD	47	2.0	43.967083	-99.601361	75.38
12	K15JW-D	CP	LD	15	1.0	43.710722	-98.443361	75.39
13	K19KJ-D	CP	LD	19	1.0	43.710722	-98.443361	75.39
14	K44MB-D	CP	LD	44	1.0	43.710722	-98.443361	75.39
15	K49NB-D	CP	LD	49	1.0	43.710722	-98.443361	75.39
16	KPLO-TV	LIC	DT	13	46.9	43.907500	-99.696389	85.47
17	K24LP-D	CP	LD	24	1.0	43.698917	-98.107722	88.87
18	K28NJ-D	CP	LD	28	1.0	43.698917	-98.107722	88.87
19	K42LT-D	CP	LD	42	1.0	43.698917	-98.107722	88.87
20	K46MT-D	CP	LD	46	1.0	43.698917	-98.107722	88.87
21	K17KW-D	LIC	LD	17	4.0	44.708861	-100.072861	100.21
22	KPRY-TV	LIC	DT	19	311.0	44.051944	-100.084444	104.47
23	K17KW-D	LIC	LD	17	2.0	45.013861	-99.954000	106.94
24	KDLO-TV	LIC	DT	3	14.4	44.965556	-97.589722	112.16
25	K14OJ-D	CP	LD	14	15.0	45.461306	-98.589056	113.16
26	K15IR-D	CP	LD	15	15.0	45.461306	-98.589056	113.16
27	K24DT-D	LIC	LD	24	0.737	45.474722	-98.527222	115.48
28	K33MI-D	LIC	LD	33	15.0	45.474722	-98.527222	115.48
29	K39CZ-D	LIC	LD	36	3.0	45.474722	-98.527222	115.48
30	K39CZ-D	CP	LD	39	2.28	45.474722	-98.527222	115.48
31	K39CZ-D	LIC	LD	39	2.27	45.474722	-98.527222	115.48

[2] Definitions of service and status codes:
DT – Digital television broadcast station
DX – Digital auxiliary (backup) facility
TX – Translator station
LD – Low power digital television broadcast station
DC – Class A digital television broadcast station
LIC – Licensed and operational station
CP – Construction permit granted
CP MOD – Modification of construction permit
APP – Application for construction permit, not yet operational

[3] ERP = Transmit Effective Radiated Power

ID	Call Sign	Status	Service[2]	Channel	Transmit ERP[3] (kW)	Latitude (NAD 83)	Longitude (NAD 83)	Distance to Nearest Turbine (km)
32	K24DT-D	LIC	TX	24	0.674	45.474694	-98.521750	115.56
33	KPLO-TV	LIC	LD	29	0.115	44.382028	-100.342722	116.65
34	K32FW	LIC	TX	32	3.8	44.423056	-100.355278	117.54
35	K14IO-D	LIC	LD	14	1.6	44.311667	-100.352778	118.04
36	K27HJ-D	LIC	TX	27	11.6	44.311667	-100.352778	118.04
37	K27HJ-D	LIC	LD	27	6.76	44.311667	-100.352778	118.04
38	K32FW	CP	LD	32	1.51	44.311667	-100.352778	118.04
39	Q14A-D	CP	LD	14	1.0	43.703333	-97.548250	120.09
40	K30NS-D	CP	LD	30	1.0	43.703333	-97.548250	120.09
41	K40NS-D	CP	LD	40	1.0	43.703333	-97.548250	120.09
42	K35GR-D	LIC	TX	35	11.9	44.487500	-97.239167	120.84
43	K35GR-D	LIC	LD	35	6.76	44.487500	-97.239167	120.84
44	KESD-TV	LIC	DT	8	15.0	44.337778	-97.228611	120.92
45	K32FW	LIC	TX	32	1.61	44.371917	-100.408194	121.91
46	K34GM-D	LIC	LD	34	1.64	44.371917	-100.408194	121.91
47	KQSD-TV	LIC	DT	11	33.72	45.277222	-99.986389	128.01
48	K14QD-D	CP	LD	14	2.0	43.906639	-100.408000	134.72
49	K16LA-D	CP	LD	16	2.0	43.906639	-100.408000	134.72
50	K43OO-D	CP	LD	43	2.0	43.906639	-100.408000	134.72
51	K45MY-D	CP	LD	45	2.0	43.906639	-100.408000	134.72
52	K17KW-D	CP	LD	17	4.0	45.397222	-99.941667	135.61
53	K44ME-D	LIC	LD	44	4.24	45.397222	-99.941667	135.61
54	K46MX-D	LIC	LD	46	4.24	45.397222	-99.941667	135.61
55	K48OQ-D	LIC	LD	48	4.24	45.397222	-99.941667	135.61
56	K50NL-D	LIC	LD	50	4.24	45.397222	-99.941667	135.61
57	K27LB-D	CP	LD	27	2.0	44.383222	-97.010500	138.29
58	K38NI-D	CP	LD	38	2.0	44.383222	-97.010500	138.29
59	K42KO-D	CP	LD	42	2.0	44.383222	-97.010500	138.29
60	K45LV-D	CP	LD	45	2.0	44.383222	-97.010500	138.29
61	K08PM-D	LIC	LD	8	0.03	43.189167	-98.071389	140.27
62	K42FI-D	CP	LD	28	6.516	44.871111	-97.109722	141.66
63	K42FI-D	CP	LD	28	6.516	44.871111	-97.109722	141.66
64	K42FI-D	CP	LD	28	6.516	44.871111	-97.109722	141.66
65	K42FI-D	LIC	TX	42	10.0	44.871111	-97.109722	141.66
66	K42FI-D	LIC	LD	42	6.516	44.871111	-97.109722	141.66
67	K32DK-D	LIC	LD	32	2.28	44.865556	-97.105833	141.74
68	KDSD-TV	LIC	DT	17	37.82	45.498333	-97.674722	146.52
69	K19KH-D	CP	LD	19	2.0	44.884889	-97.048306	146.74
70	K20KZ-D	CP	LD	20	2.0	44.884889	-97.048306	146.74
71	K22KF-D	CP	LD	22	15.0	44.884889	-97.048306	146.74
72	K23LI-D	CP	LD	23	15.0	44.884889	-97.048306	146.74
73	K30LU-D	CP	LD	30	2.0	44.884889	-97.048306	146.74

ID	Call Sign	Status	Service[2]	Channel	Transmit ERP[3] (kW)	Latitude (NAD 83)	Longitude (NAD 83)	Distance to Nearest Turbine (km)
74	K39LN-D	CP	LD	39	2.0	44.884889	-97.048306	146.74
75	K33NF-D	CP	LD	33	1.0	43.659861	-97.147444	149.51
76	K35LZ-D	CP	LD	35	1.0	43.659861	-97.147444	149.51
77	K38OZ-D	CP	LD	38	1.0	43.659861	-97.147444	149.51

Table 1: Off-Air TV Stations within 150 Kilometers of Project Area

3. Impact Assessment

Based on a contour analysis of the licensed stations within 150 kilometers of the Sweetland Wind Farm project, it was determined that five of the full-power digital stations, identified below in Table 2, may have their reception disrupted in and around the project. The areas primarily affected would include TV service locations within 10 kilometers of the wind energy project that have clear line-of-sight (LOS) to a proposed wind turbine but not to the respective station. After the wind turbines are installed, communities and homes in these locations may have degraded reception of these stations. This is due to multipath interference caused by signal scattering as TV signals are reflected by the rotating wind turbine blades and mast.

ID	Call Sign	Status	Service[4]	Channel	Transmit ERP[5] (kW)	Latitude (NAD 83)	Longitude (NAD 83)	Distance to Nearest Turbine (km)
1	KTTM	LIC	DT	12	12.6	44.194167	-98.318333	38.38
2	KDLV-TV	LIC	DT	26	1000.0	43.759167	-98.412500	71.20
7	KTSD-TV	LIC	DT	10	54.7	43.968056	-99.594722	74.89
16	KPLO-TV	LIC	DT	13	46.9	43.907500	-99.696389	85.47
24	KDLO-TV	LIC	DT	3	14.4	44.965556	-97.589722	112.16

Table 2: Licensed Off-Air TV Stations Subject to Degradation

[4] Definitions of service and status codes:
DT – Digital television broadcast station
LIC – Licensed and operational station

[5] ERP = Transmit Effective Radiated Power

4. Recommendations

While TV signals are reflected by wind turbines, which can cause multipath interference to the TV receiver, modern digital TV receivers have undergone significant improvements to mitigate the effects of signal scattering. When used in combination with a directional antenna, it becomes even less likely that signal scattering from wind farms will cause interference to digital TV reception.

Nevertheless, signal scattering could still impact certain areas currently served by the TV station mentioned above, especially those that would have line-of-sight to at least one wind turbine but not to the station antenna. In the unlikely event that interference is observed in any of the TV service areas, it is recommended that a high-gain directional antenna be used, preferably outdoors, and oriented towards the signal origin in order to mitigate the interference.
Both cable service and direct broadcast satellite service will be unaffected by the presence of the wind turbine facility and may be offered to those residents who can show that their off-air TV reception has been disrupted by the presence of the wind turbines after they are installed.

5. Contact

For questions or information regarding the Off-Air TV Analysis, please contact:

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UNITED STATES DEPARTMENT OF COMMERCE
National Telecommunications and Information Administration
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JUL 12 2017

Mr. Frank O'Brien
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Re: Sweetland Project: Hand County, SD

Dear Mr. O'Brien:

In response to your request on May 4, 2017, the National Telecommunications and Information Administration provided to the federal agencies represented in the Interdepartment Radio Advisory Committee (IRAC) the plans for the Sweetland Wind Farm, located in Hand County, South Dakota.

After a 45 day period of review, no agencies had issues with turbine placement in this area.

While the IRAC agencies did not identify any concerns regarding radio frequency blockage, this does not eliminate the need for the wind energy facilities to meet any other requirements specified by law related to these agencies. For example, this review by the IRAC does not eliminate any need that may exist to coordinate with the Federal Aviation Administration concerning flight obstruction.

Thank you for the opportunity to review these proposals.

Sincerely,

Peter A. Tenhula
Deputy Associate Administrator
Office of Spectrum Management

Sweetland Wind Project

Scout Clean Energy

Hand County, South Dakota

Obstruction Evaluation & Airspace Analysis

January 24, 2019

Capitol Airspace Group

capitolairspace.com

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Summary

Capitol Airspace conducted an obstruction evaluation and airspace analysis for the Sweetland wind project in Hand County, South Dakota. The purpose for this analysis was to identify obstacle clearance surfaces established by the Federal Aviation Administration (FAA) that could limit the placement of 499, 584, and 650 foot above ground level (AGL) wind turbines. At the time of this analysis, individual wind turbine locations had not been identified. This analysis assessed height constraints overlying an approximately 37 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 Sweetland wind project range from 2,000 to 2,840 feet above mean sea level (AMSL) and are associated with instrument departure and approach procedures. Proposed structures that exceed these surfaces would require an increase to instrument departure procedure minimum climb gradients and instrument approach procedure minimum altitudes. If the FAA determines that either of 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 instrument approach procedures could limit 499 foot AGL wind turbines in a small southeastern section of the study area. These surfaces could also limit 584 foot AGL wind turbines on higher terrain in eastern sections of the study area. Lastly, these surfaces could limit 650 foot AGL wind turbines in the eastern and southern sections of the study area. However, 499, 584 and 650 foot AGL wind turbines should be feasible throughout the majority of the study area.

This study did not consider electromagnetic interference on communications systems.

Methodology

Capitol Airspace studied the proposed project based upon location information provided by Scout 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 7400.2L 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

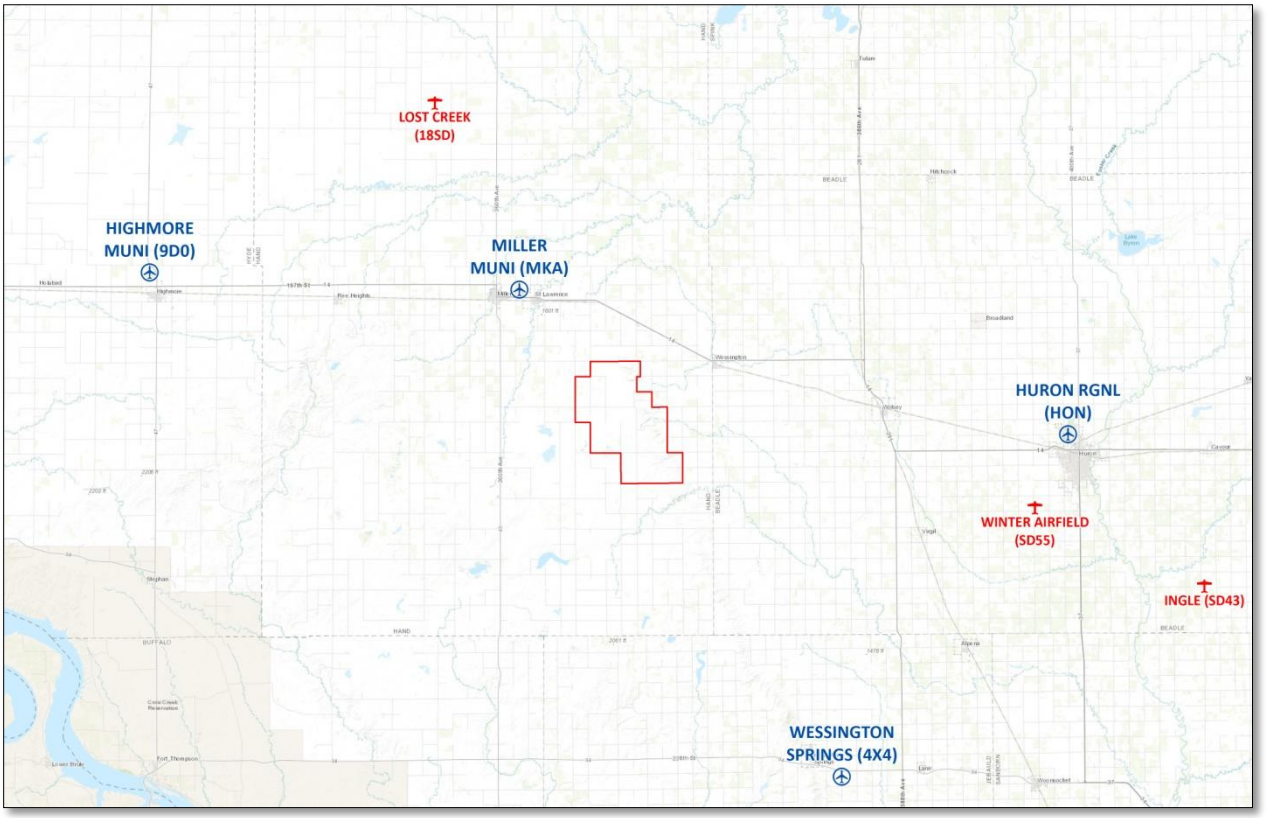


Figure 1: Public-use (blue) and private-use (red) airports in proximity to the Sweetland wind project

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 Sweetland wind project:

Miller Municipal (MKA) [1]
77.17(a)(2): 2,159 to 2,204 feet AMSL

At all of the proposed heights, wind turbines proposed in the northwestern section of the study area (orange areas, ***Figure 2***) will exceed the Miller Municipal Airport 77.17(a)(2) imaginary surface and will be identified as obstructions. Additionally, at 584 and 650 feet AGL, 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.

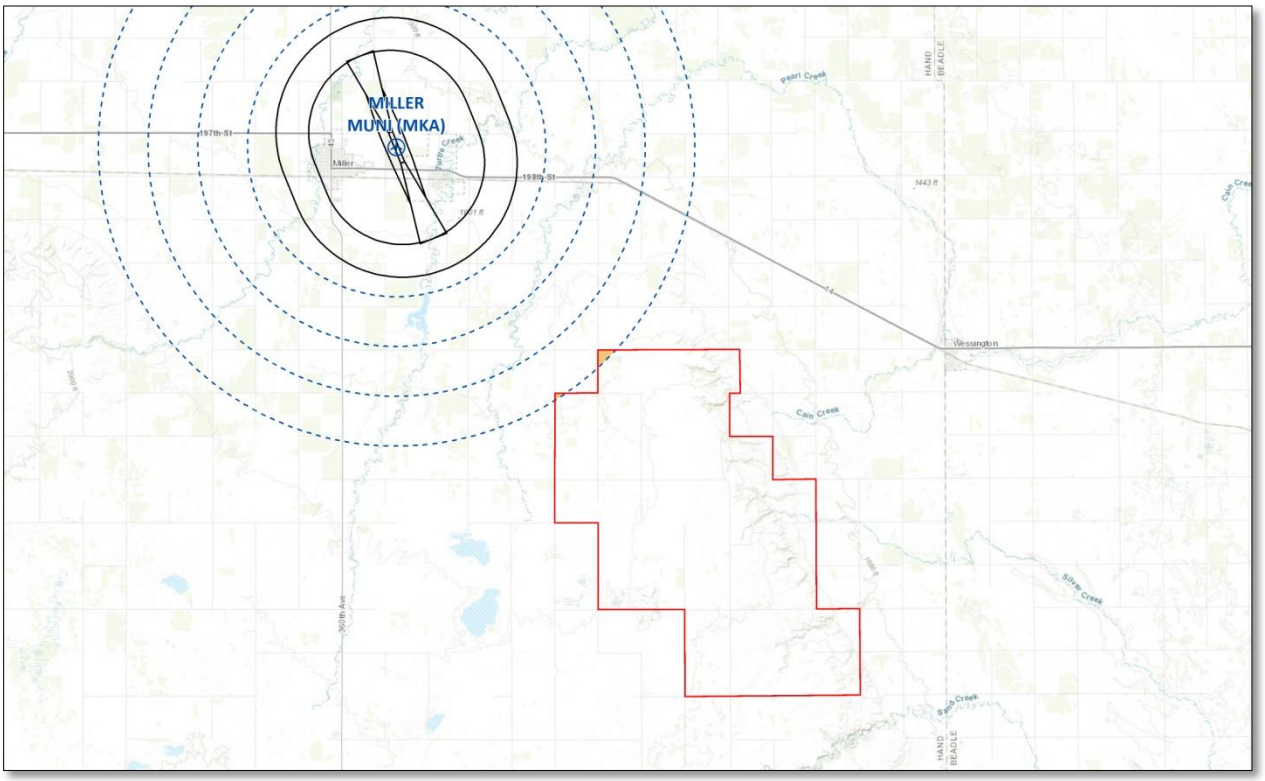


Figure 2: Miller Municipal Airport (MKA) 77.17(a)(2) (dashed blue) and 77.19 (black) imaginary surfaces

[1] Miller Municipal Airport (MKA) has a "plan on file" with the FAA to add a crosswind runway and shift the existing Runway 15/33. As a result, the 77.17(a)(2) surface could differ slightly from those based on the existing airport reference point.

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 does not overlie the Sweetland wind project and should not limit 499, 584 or 650 foot AGL wind turbines within the defined study area (***Figure 3***).

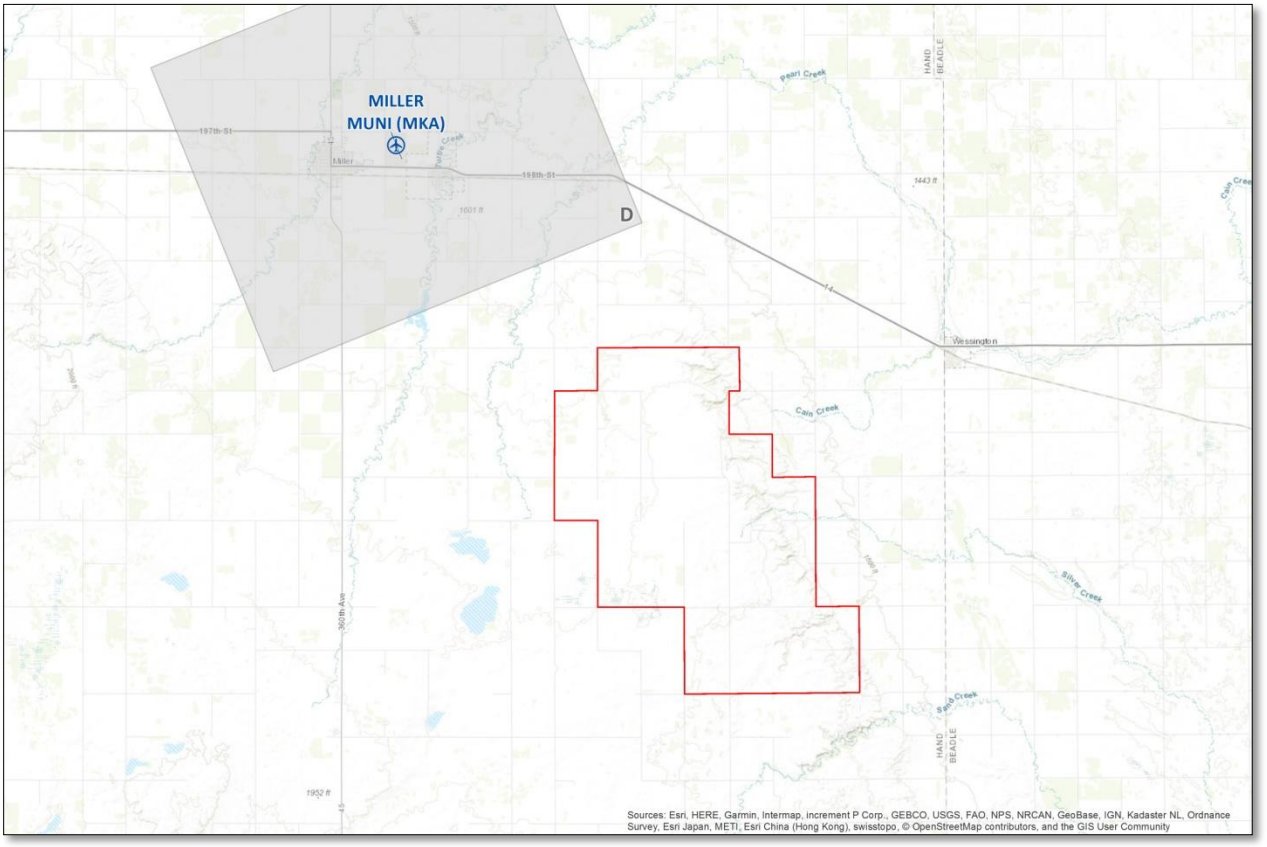


Figure 3: VFR traffic pattern airspace in proximity to the Sweetland wind project

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 Sweetland wind project is located in proximity to highways, railroads, and transmission lines that may be used as VFR routes (***Figure 4***). 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, it could limit wind development in excess of 499 feet AGL and within two statute miles of these landmarks (hatched orange, ***Figure 4***).

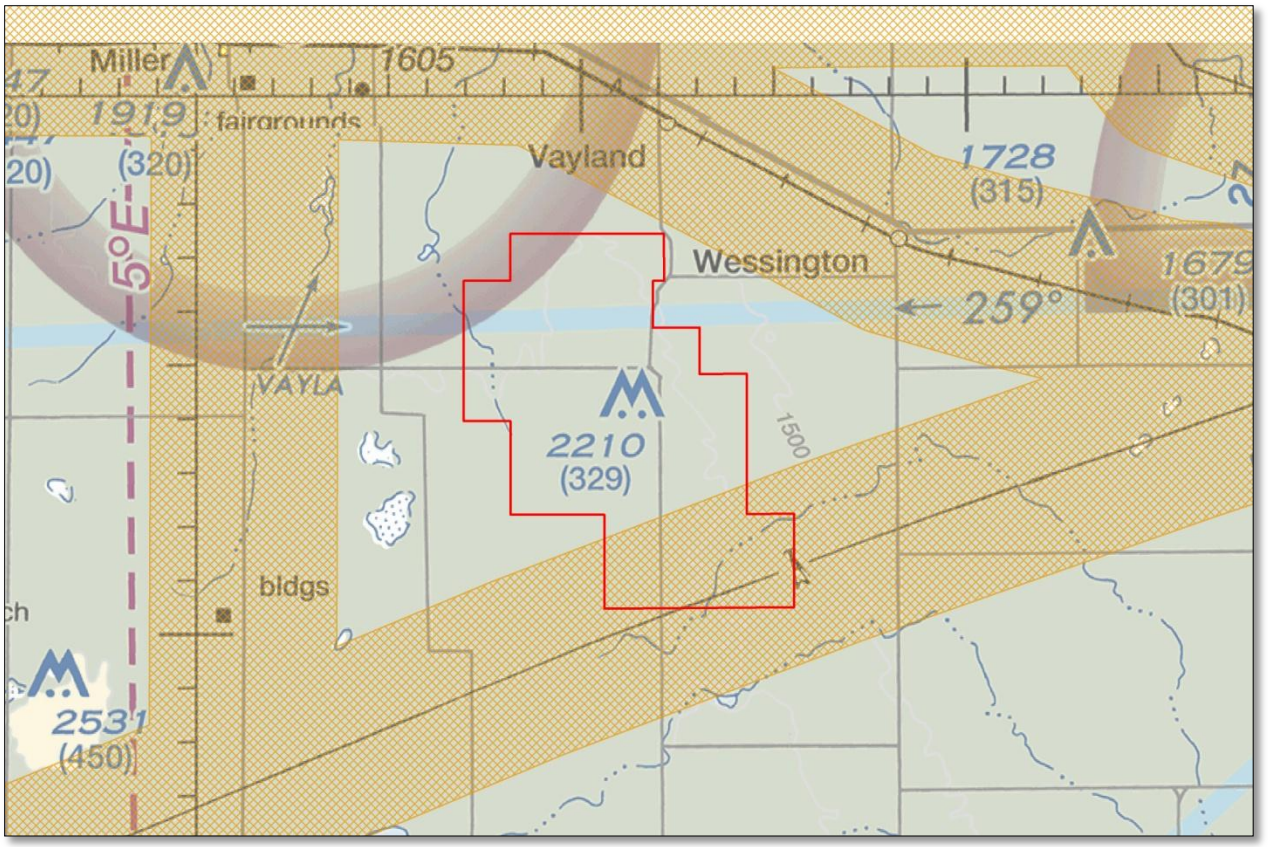


Figure 4: Potential VFR routes in proximity to the Sweetland wind project

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.

Miller Municipal (MKA)

Obstacle Departure Procedure

Obstacle clearance surfaces (red contours, ***Figure 5***) range from 2,390 to 3,704 feet AMSL where they overlie the wind project and are the lowest height constraints in the northern and northwestern sections of the study area. However, USGS elevation data indicates that these surfaces should not limit 499, 584 or 650 foot AGL wind turbines within the defined study area (green area, ***Figure 5***).

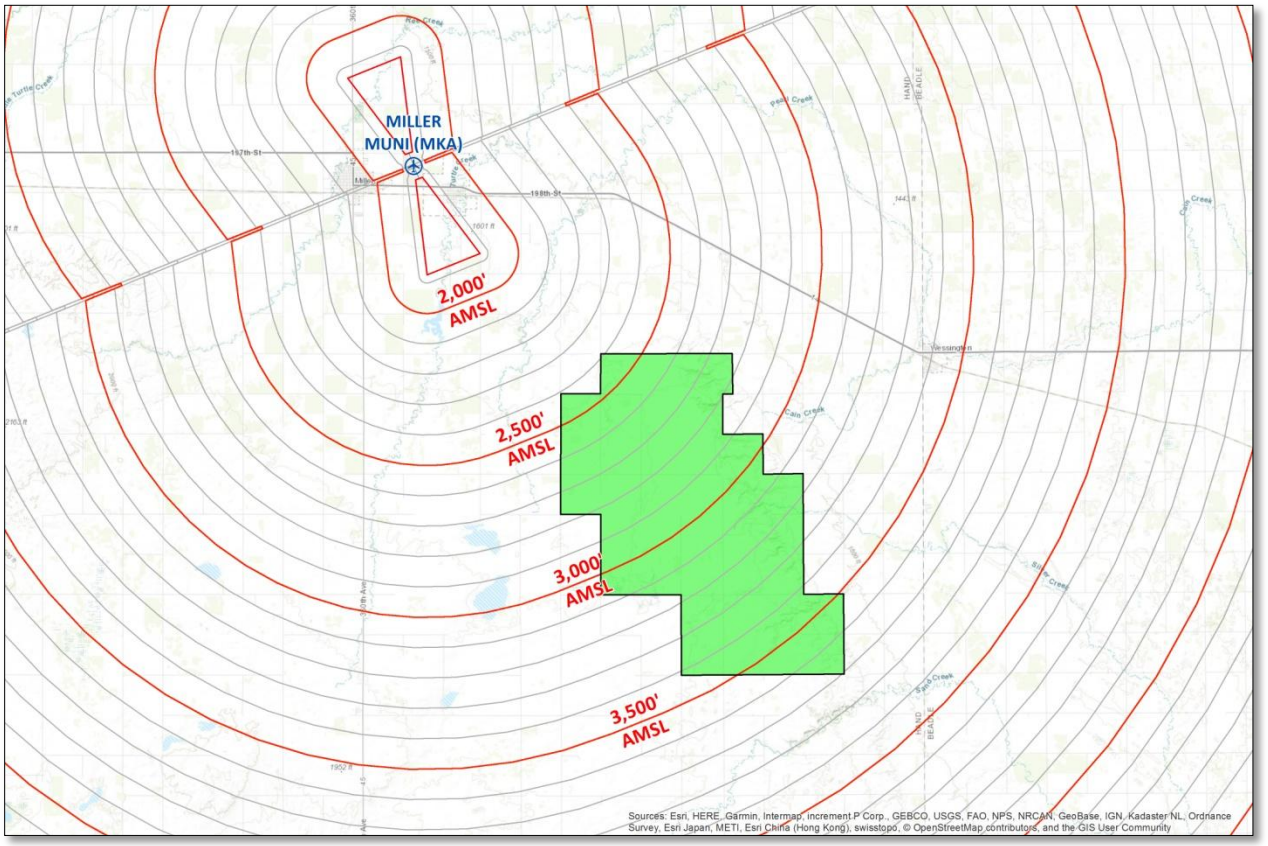


Figure 5: Miller Municipal Airport (MKA) obstacle departure procedure assessment

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 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 11 published instrument approach procedures at four public-use airports in proximity to the Sweetland wind project:

Highmore Municipal (9D0)
RNAV (GPS) Approach to Runway 13
RNAV (GPS) Approach to Runway 31

Huron Regional (HON)
ILS or Localizer Approach to Runway 12
RNAV (GPS) Approach to Runway 12
RNAV (GPS) Approach to Runway 30
Localizer/DME Backcourse Approach to Runway 29
VOR Approach to Runway 12

Miller Municipal (MKA)
RNAV (GPS) Approach to Runway 15
RNAV (GPS) Approach to Runway 33

Wessington Springs (4X4)
RNAV (GPS) Approach to Runway 12
RNAV (GPS) Approach to Runway 30

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.

Huron Regional (HON)

RNAV (GPS) Approach to Runway 12[2]

The *DAKPE* to *HEMES* feeder segment minimum altitude is 3,000 feet AMSL. The associated primary area obstacle clearance surface (inner red outline, ***Figure 6***) is 2,000 feet AMSL and is the lowest height constraint in a small southeastern section of the study area.

USGS elevation data indicates that this surface could limit 499, 584 and 650 foot AGL wind turbines in this area (red area, ***Figure 6***). However, it is possible that the FAA would increase the DAKPE to HEMES feeder segment minimum altitude in order to accommodate 499, 584 and 650 foot AGL wind turbines. This mitigation option is subject to FAA approval and requires that the resulting descent gradients meet instrument approach procedure design criteria.

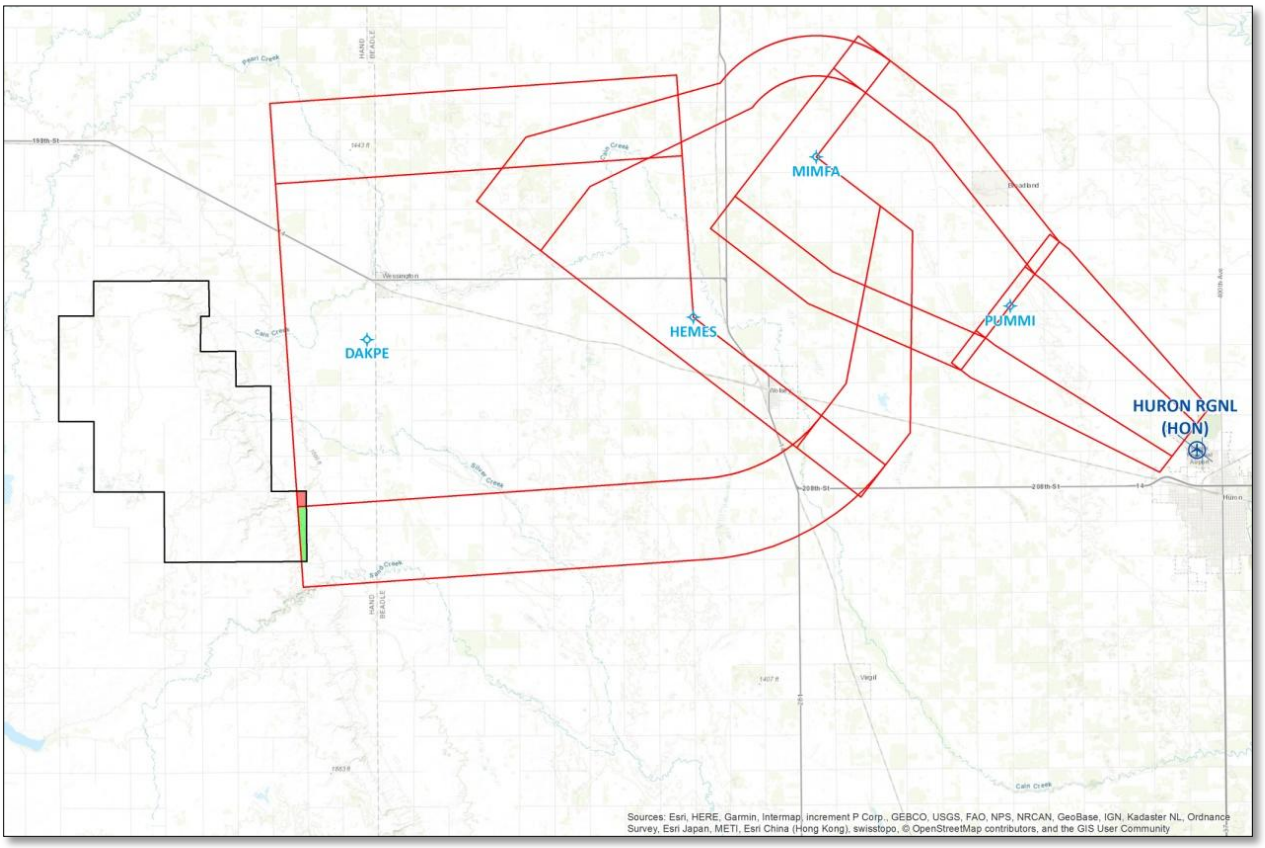


Figure 6: Huron Regional Airport (HON) RNAV (GPS) Approach to Runway 12 DAKPE transition

[2] The Huron Regional Airport (HON) RNAV (GPS) Approach to Runway 12 publication date (August 27, 2009) indicates that it was designed with legacy FAA Order 8260.48 instrument approach procedure design criteria. It is likely that the FAA will use legacy criteria to assess for impact on this approach procedure. As a result, Capitol Airspace constructed this procedure's obstacle evaluation areas (***Figure 6***) in accordance with FAA Order 8260.48 criteria.

Localizer/DME Backcourse Approach to Runway 30

The *DAKPE* to *FARVA* initial-arc segment minimum altitude is 3,400 feet AMSL. The associated primary area obstacle clearance surface (inner red outline, ***Figure 7***) is 2,400 feet AMSL and is the lowest height constraint in the eastern section of the study area.

USGS elevation data indicates that this surface could limit 584 foot AGL wind turbines on higher terrain in the eastern section of the study area (orange area, ***Figure 7***). Additionally, this surface could further limit 650 foot AGL wind turbines in the eastern and southern sections of the study area (orange and yellow areas, ***Figure 7***). However, it is possible that the FAA would increase the initial-arc segment minimum altitude in order to accommodate 584 and 650 foot AGL wind turbines. This mitigation option is subject to FAA approval and requires that the resulting descent gradients meet instrument approach procedure design criteria.

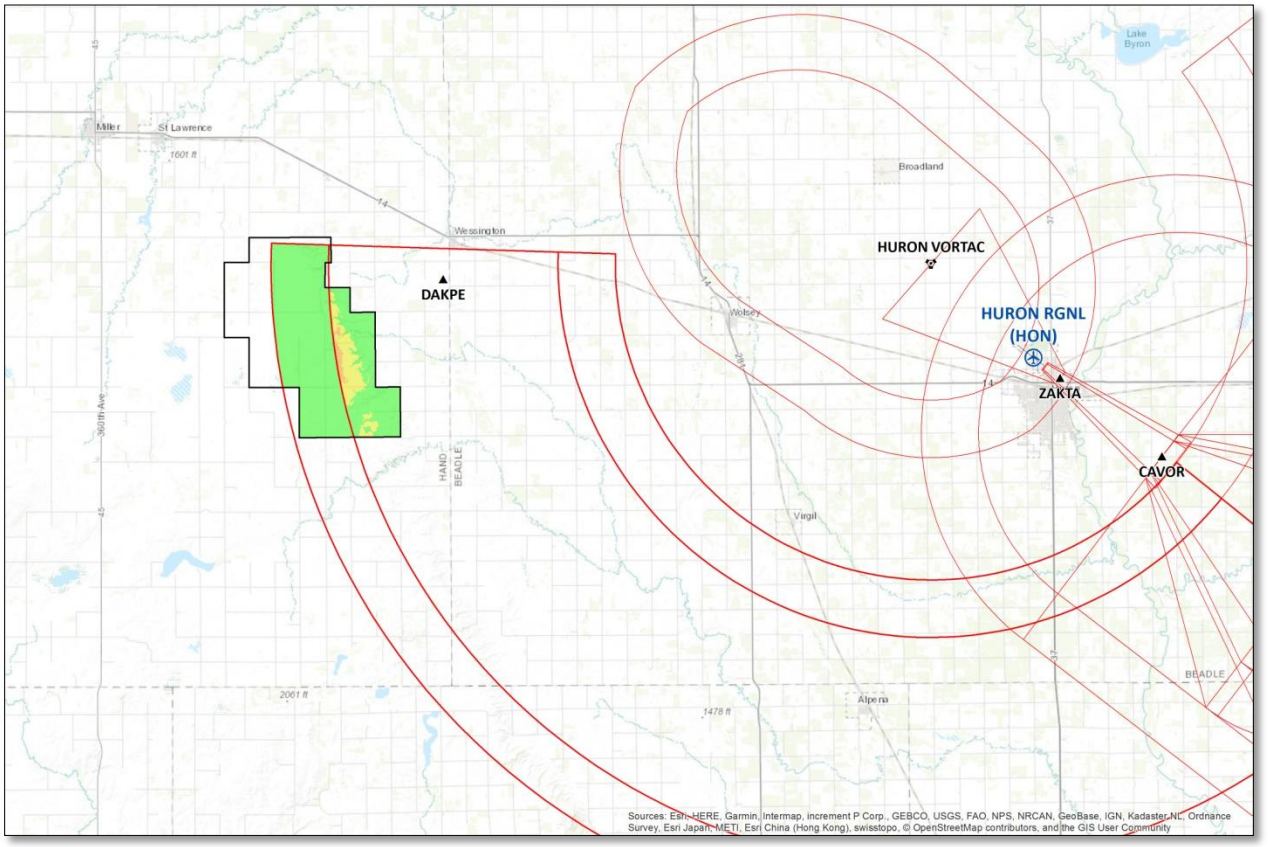


Figure 7: Huron Regional Airport (HON) Localizer/DME Backcourse Approach to Runway 30

Miller Municipal (MKA)

RNAV (GPS) Approach to Runway 15

The missed approach climb-to altitude and *TERNR* minimum holding altitude are 3,700 feet AMSL. The associated primary area obstacle clearance surfaces are 2,700 feet AMSL and are some of the lowest height constraints overlying central and southern sections of the study area. However, USGS elevation data indicates that these surfaces should not limit 499, 584 or 650 foot AGL wind turbines within the defined study area.

RNAV (GPS) Approach to Runway 33 (***Figure 8***)

The *ZONZO* to *PATGE* LNAV final segment minimum altitude is 2,340 feet AMSL. The associated obstacle clearance surfaces (including Paragraph 2-9-10 *obstacle identification surface* [*OIS*]) range from 2,399 to 2,974 feet AMSL and are some of the lowest height constraints in a small northwestern section of the study area. However, USGS elevation data indicates that these surfaces should not limit 499, 584 or 650 foot AGL wind turbines within the defined study area.

The initial segment minimum altitudes and hold-in-lieu of procedure turn minimum altitude are 3,700 feet AMSL. The associated primary area obstacle clearance surfaces are 2,700 feet AMSL and are some of the lowest height constraints overlying central and southern sections of the study area. However, USGS elevation data indicates that these surfaces should not limit 499, 584 or 650 foot AGL wind turbines within the defined study area.

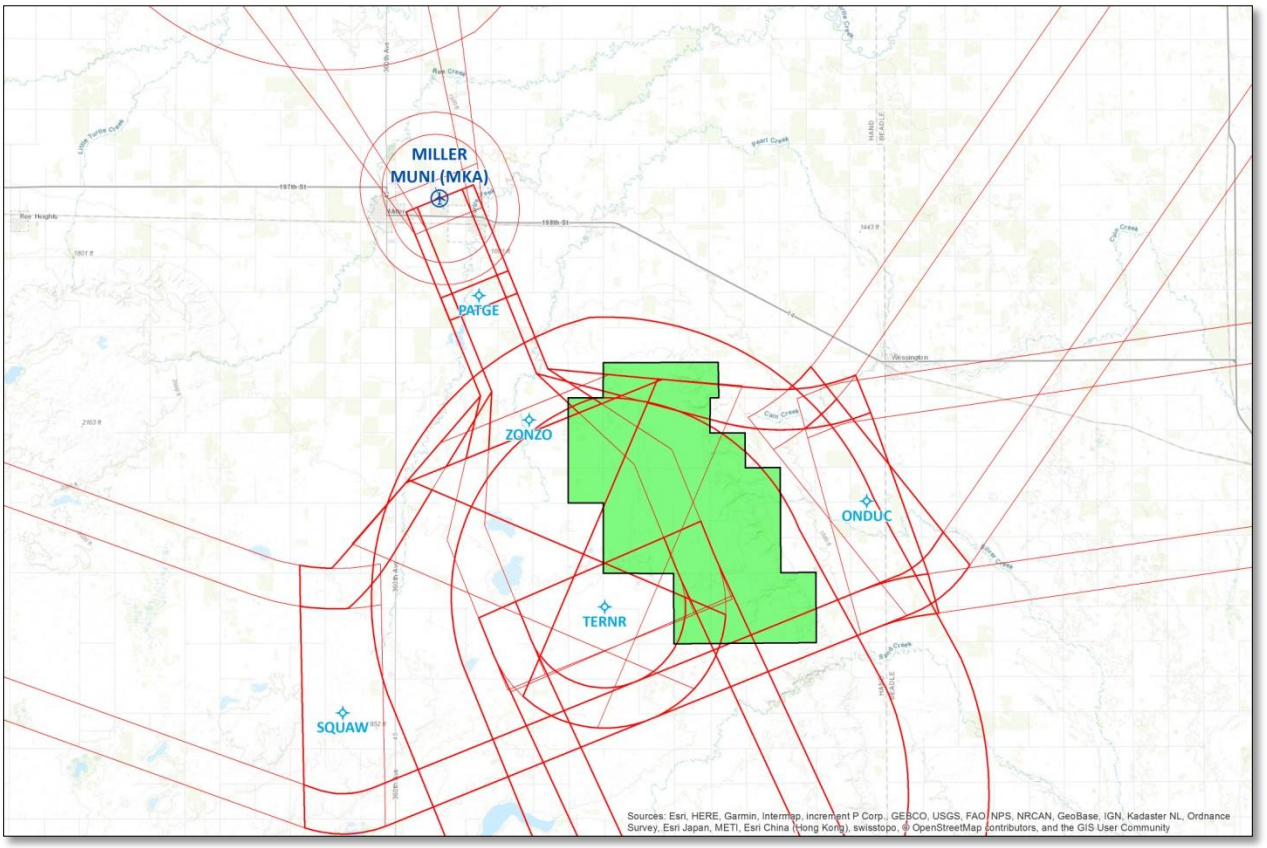


Figure 8: Miller Municipal Airport (MKA) RNAV (GPS) Approach to Runway 33

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 determination of hazard.

Low altitude enroute airways obstacle clearance surfaces (e.g., ***Figure 9***) are in excess of other lower surfaces and should not limit 499, 584 or 650 foot AGL wind turbines within the defined study area.

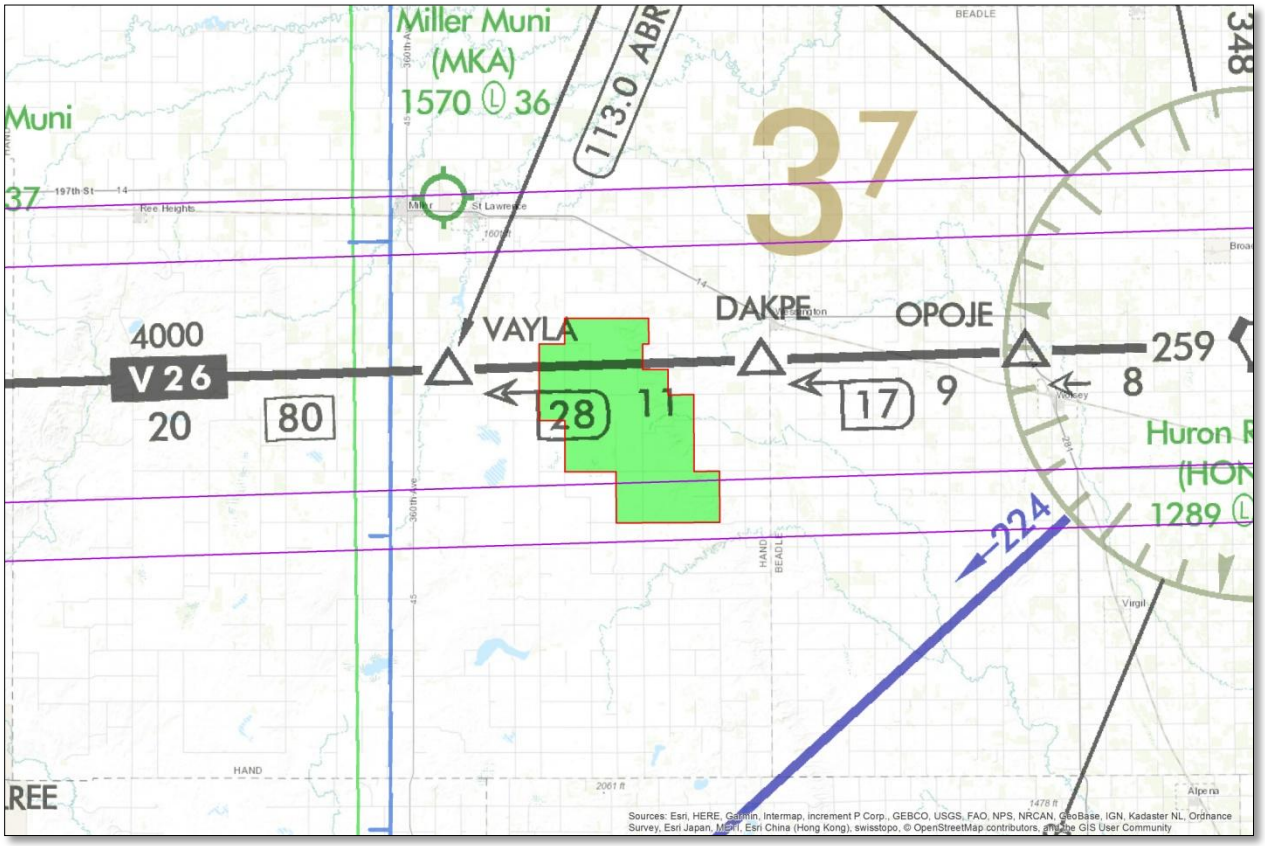


Figure 9: Low altitude enroute chart L-12 with V26 obstacle evaluation areas (purple)

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.

MVA/MIA obstacle clearance surfaces (e.g., ***Figure 10***) are in excess of other lower surfaces and should not limit 499, 584 or 650 foot AGL wind turbines within the defined study area.

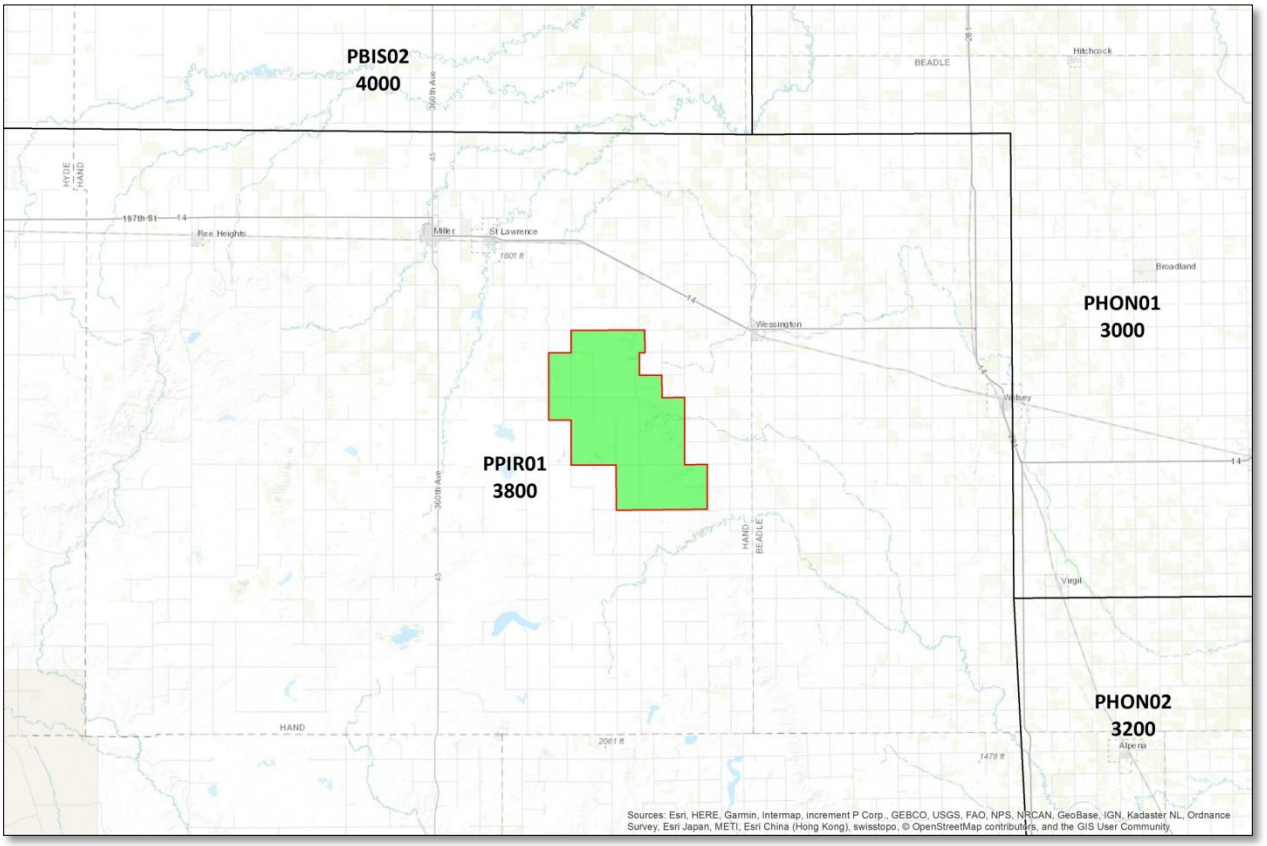


Figure 10: Minneapolis (ZMP) ARTCC minimum IFR altitude sectors (black)

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.

Military airspace and training routes do not overlie the Sweetland wind project (***Figure 11***). Therefore, proximity to these segments of airspace should not result in military objections to proposed wind development.

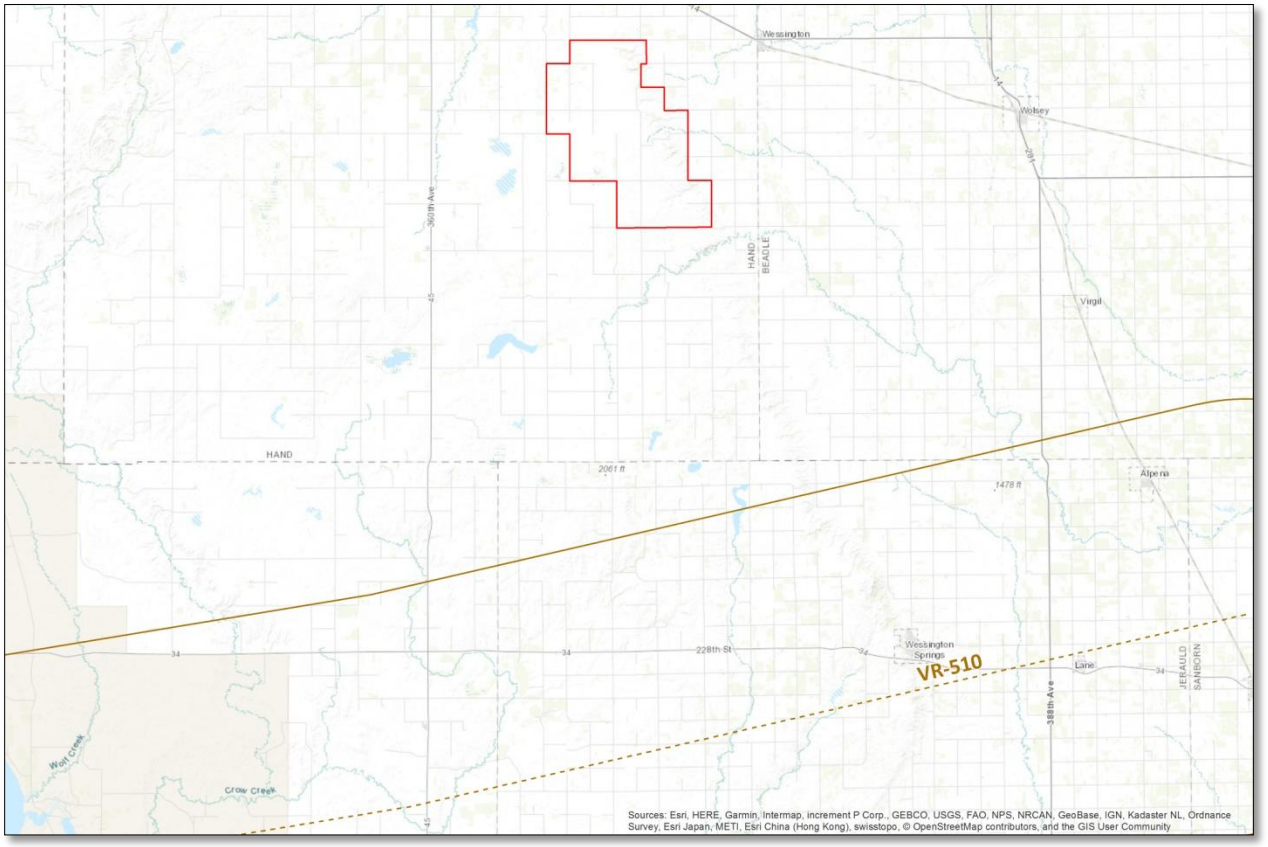


Figure 11: Military airspace and training routes in proximity to the Sweetland wind project

Terminal and Enroute Navaids

The FAA has established screening surfaces in order to identify proposed structures that may have a physical and/or electromagnetic effect on navigation facilities. The surface dimensions vary based on the proposed structure type as well as the navigational facility type. Proposed structures that exceed these surfaces may interfere with navigational facility services and require further review by FAA Technical Operations. If further review determines that proposed structures would have a significant physical and/or electromagnetic effect on navigational facilities it could result in determinations of hazard.

Navaid screening surfaces do not overlie the Sweetland wind project (***Figure 12***). As a result, it is unlikely that proposed wind turbines would have a physical or electromagnetic effect on navigation facilities.

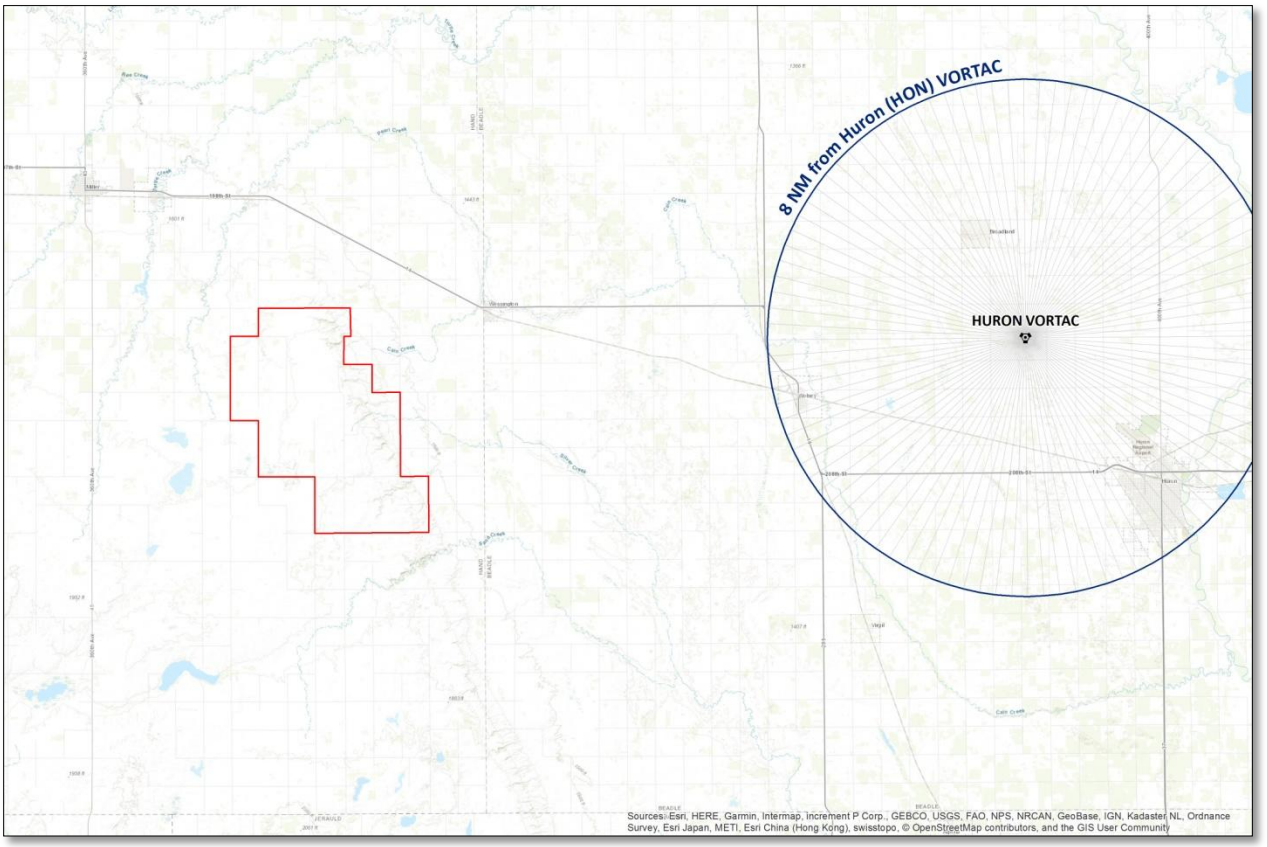


Figure 12: Huron (HON) VORTAC screening surface (blue) and the Sweetland wind project

Radar Surveillance 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	Visible at 584' AGL
Gettysburg Common Air Route Surveillance Radar (CARSR)	**No**
Aberdeen Weather Surveillance Radar Model 1988 Doppler (WSR-88D)	**No**
Sioux Falls WSR-88D	**No**

Table 1: Radar surveillance systems assessed and preliminary RLOS results

The preliminary RLOS analysis (***Table 1***) indicates that 584 foot AGL wind turbines within the Sweetland wind project will not be visible to any air traffic control, air defense, homeland security, or weather radar sites. As a result, proposed wind turbines should not interfere with radar surveillance systems.

Conclusion

At all of the proposed heights, proposed wind turbines in the northwestern section of the study area will exceed the Miller Municipal Airport 77.17(a)(2) imaginary surface (***Figure 2***) and will be identified as obstructions. Additionally, at 584 and 650 feet AGL, 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.

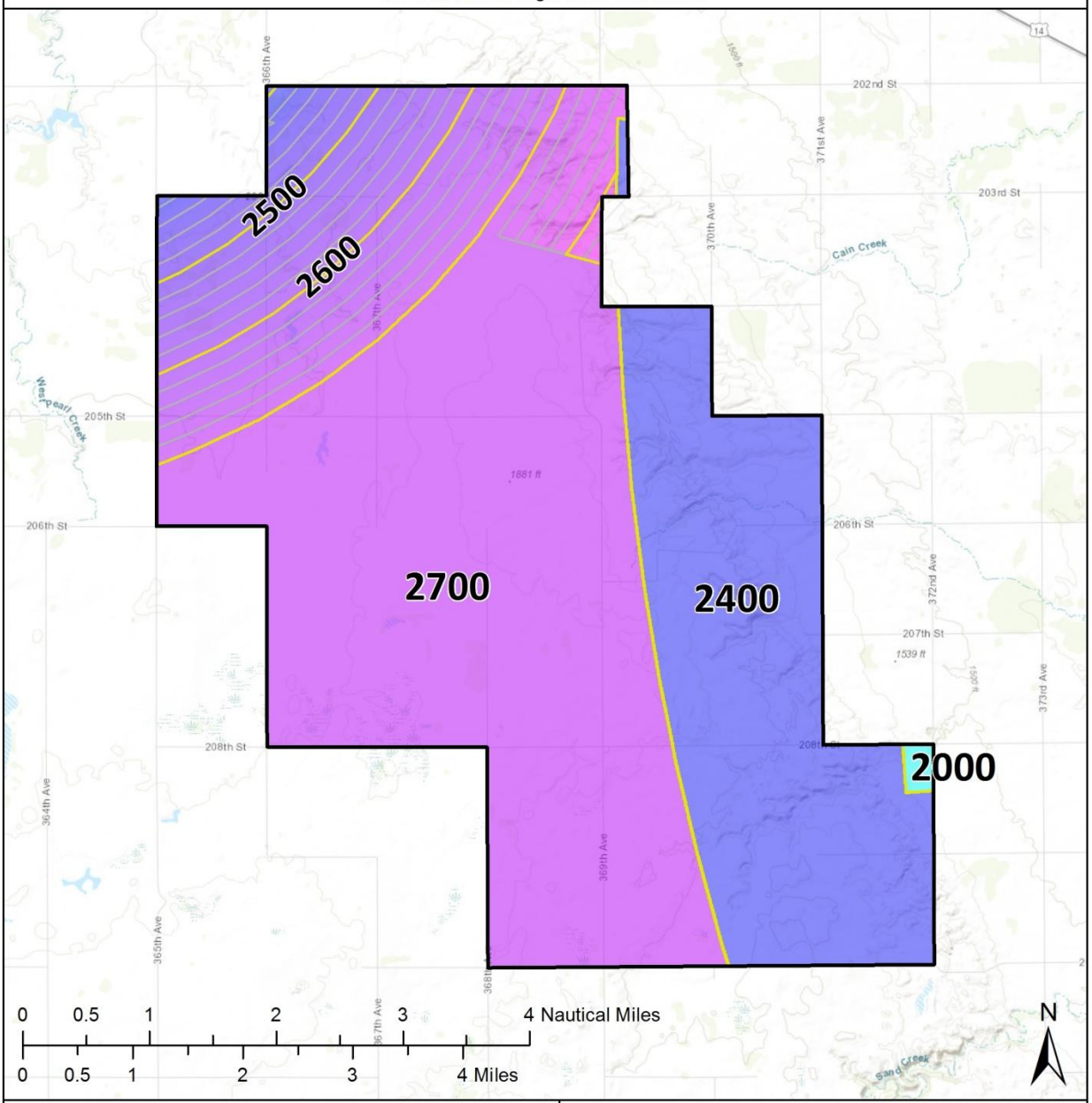
Obstacle clearance surfaces overlying the Sweetland wind project range from 2,000 to 2,840 feet AMSL (***Figure 13***) and are associated with Miller Municipal Airport (MKA) instrument departure (***Figure 5***) and approach procedures (***Figure 8***), as well as Huron Regional Airport (HON) instrument approach procedures (***Figure 6*** & ***Figure 7***).Proposed structures that exceed these surfaces would require an increase to instrument departure procedure minimum climb gradients and instrument approach procedure minimum altitudes. If the FAA determines that either of these impacts would affect as few as one operation per week, it could result in determinations of hazard.

USGS elevation data indicates that the Huron Regional Airport RNAV (GPS) Approach to Runway 12 could limit all of the proposed heights in a small southeastern section of the study area (red area, ***Figure 14***). The Huron Regional Airport Localizer/DME Backcourse Approach to Runway 30 could limit 584 foot AGL wind turbines on higher terrain in eastern sections of the study area (orange areas, ***Figure 14***). Additionally, this surface could limit 650 foot AGL wind turbines in eastern and southern sections of the study area (orange and yellow areas, ***Figure 14***). However, it is possible that the FAA would increase the minimum altitudes associated with these segments of airspace in order to accommodate 499, 584 and 650 foot AGL wind turbines. This mitigation option is subject to FAA approval.

The AGL Clearance Map (***Figure 14***) 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 13***).

If you have any questions regarding the findings of this study, please contact ***Lynn Ray*** or ***Orlando Olivas*** 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 : 2,840

Low : 2,000

Surface Contours

100 Foot

20 Foot

All heights above mean sea level (AMSL)

Sweetland Wind Project
Composite Height Constraint Map

Plot Date:
24 January 2019

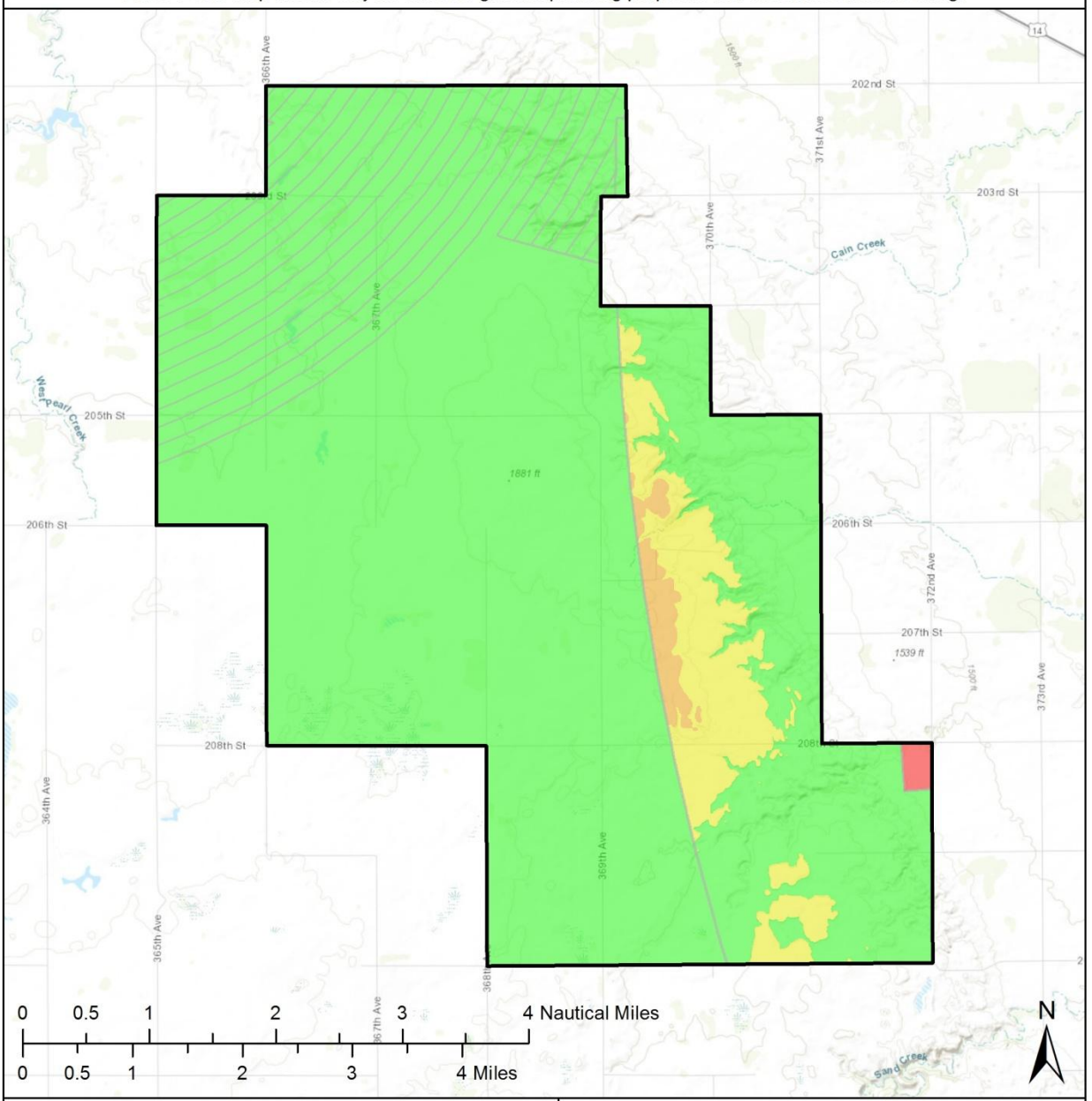
Coordinate System:
NAD 1983 UTM Zone 14N

Orlando Olivas

Figure 13

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

- < 499
- ≥ 499 < 584
- ≥ 584 < 650
- ≥ 650

Sweetland Wind Project
Above Ground Level (AGL) Clearance Map

Plot Date:
24 January 2019

Coordinate System:
NAD 1983 UTM Zone 14N

Orlando Olivas

Figure 14

Capitol Airspace Group

Capitol Airspace Group

5400 Shawnee Road, Suite 304
Alexandria, VA 22312

703-256-2485
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February 7, 2019

Mark Wengierski
Project Manager
Scout Clean Energy
4865 Sterling Drive, Suite 200
Boulder, CO 80301

Re: Evaluation of private-use airstrips near the Sweetland Wind Project

Dear Mr. Wengierski,

Capitol Airspace evaluated various resources and datasets to determine the likelihood of the proposed Sweetland wind project having an adverse effect on private-use, or unregistered, airstrips.[1] This evaluation included direct coordination with the South Dakota Department of Transportation (DOT), analysis of Federal Aviation Administration's (FAA) National Aviation Systems Resources (NASR) dataset, and analysis of high-resolution aerial imagery.

The following was determined:

1) South Dakota DOT does not maintain a state-specific dataset and utilizes airport data maintained by the FAA.
2) The closest private-use airport described in FAA's NASR dataset is more than 17 nautical miles from the proposed wind project.
3) High-resolution aerial imagery indicates that it is unlikely that any private-use, or unregistered, airstrips are in proximity to the proposed wind turbines.[2,3]

Please direct any questions regarding these findings to me at (571) 297-6507 or *joe.anderson@capitolairspace.com*.

Sincerely,

Digitally signed
by Joe Anderson
Date: 2019.02.07
18:03:37 -05'00'

Joe Anderson
Senior Project Manager & Airspace Specialist

[1] Scout Clean Energy provided a total of 89 wind turbine locations located in an eastern section of Hand County, South Dakota.
[2] High-resolution imagery was obtained from the South Dakota Department of Environment & Natural Resources, dated 2016.
[3] Capitol Airspace analyzed aerial imagery within a 1.5 nautical mile buffer. This buffer was used to account for the lateral boundaries of Category B visual flight rules (VFR) traffic pattern airspace and is defined in FAA Order 7400.2M Paragraph 6-3-8, "Evaluating Effect on VFR Operations."