Appendix E: Telecommunication Studies

Wisconsin Power and Light Company
Docket No. IP7145/WS-24-349

From: Meyer, David
To: Shannon Hansen
Subject: RE: Bent Tree North Wind Farm, Studies
Date: Wednesday, January 15, 2025 2:59:25 PM
Attachments: image001.png
image002.png

Shannon,

Radar - Based on the LOS plots, an 8 meter height increase will not change the results
AM/FM - Based on the separation distances, an 8 meter height increase will not change the results
Microwave - Based on the location of the microwave paths, an 8 meter height increase will not change the results
Land Mobile & EMS - Based on the separation distances, an 8 meter height will not change the results
Off-Air TV - Based on the report considerations, an 8 meter height will not change the results
This does not take into account any changes in the telecommunications environment (licenses added or removed) since the dates the reports were done in 2024.
Regards,

David Meyer
Senior Manager, Spectrum Engineering/Frequency Protection Services

comsearch
A CommScope Company

21515 Ridgetop Circle, Suite 300 | Sterling VA 20166
Office 703 726 5656 | DMeyer@Comsearch.com

From: Shannon Hansen <Shannon.Hansen@westwoodps.com>
Sent: Wednesday, January 15, 2025 2:30 PM
To: Meyer, David <dmeyer@comsearch.com>
Subject: RE: Bent Tree North Wind Farm, Studies

Hi David,
I'm following up to see if you think that increasing the turbine hub height to 120 meters (from 112 meters) would change the results of your reports done for Bent Tree North wind farm.

Let me know if this is something you can determine without re-running the reports.

Thanks!

Shannon Hansen
Sr. Permitting Specialist
shannon.hansen@westwoodps.com

direct (952) 207-7653
main (952) 937-5150
cell (612) 702-0936

Westwood
12701 Whitewater Drive, Suite 300
Minnetonka, MN 55343

westwoodps.com
(888) 937-5150

From: Shannon Hansen <Shannon.Hansen@westwoodps.com>
Sent: Wednesday, January 8, 2025 12:21 PM
To: Meyer, David <David.Meyer@commscope.com>
Subject: RE: Bent Tree North Wind Farm, Studies

Hi David,
I have one last change and question re: Bent Tree project turbines.

Initially, your reports were based on the 112 m hub height (180 m total height). Then I emailed you asking for impacts if they used turbines with 117 m hub height. Now, they are considering turbines with a 120 m hub height.

Are you able to determine if this increase of 8 m will change the results of any of the studies? Or would you need to run some/all of the reports again?

Thanks in advance,
Shannon

Shannon Hansen
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shannon.hansen@westwoodps.com

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From: Meyer, David <David.Meyer@commscope.com>

Sent: Wednesday, October 30, 2024 3:42 PM
To: Shannon Hansen <Shannon.Hansen@westwoodps.com>
Cc: Meyer, David <David.Meyer@commscope.com>
Subject: RE: Bent Tree North Wind Farm, Studies

Shannon,

Impact on each of the individual reports:

Radar - Based on the LOS plots, a 5 meter height increase will not change the results
AM/FM - Based on the separation distances, a 5 height meter increase will not change the results
Microwave - Based on the location of the microwave paths, a 5 height meter increase will not change the results
Land Mobile & EMS - Based on the separation distances, a 5 meter height increase will not change the results
Off-Air TV - Based on the report considerations, a 5 meter height increase will not change the results

Regards,

David Meyer
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From: Shannon Hansen <Shannon.Hansen@westwoodps.com>
Sent: Monday, October 28, 2024 12:19 PM
To: Meyer, David <David.Meyer@commscope.com>
Subject: RE: Bent Tree North Wind Farm, Studies

Good morning David,

I'm working with Alliant on a potential change to the Bent Tree North turbine heights – not number of turbines, just an increase in height.

Initially, the turbines were 112 m hub height (180 m total height). New turbines may be 117 m hub (185 m total height).

Are you able to determine if this increase of about 5 m will change the results of any of the studies? Or would you need to run some/all of the reports again?

Thank you,
Shannon

Shannon Hansen
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shannon.hansen@westwoodps.com

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From: Meyer, David <David.Meyer@commscope.com>
Sent: Thursday, September 19, 2024 3:04 PM
To: Shannon Hansen <Shannon.Hansen@westwoodps.com>
Cc: Meyer, David <David.Meyer@commscope.com>
Subject: RE: Bent Tree North Wind Farm, MN NEXRAD/Doppler Report?

Shannon,

Just finished QC – here is the report, everything looks good!

Regards,

David Meyer
Senior Manager, Spectrum Engineering

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A CommScope Company

21515 Ridgetop Circle, Suite 300 | Sterling VA 20166
Office 703 726 5656 | David.Meyer@commscope.com

From: Shannon Hansen <Shannon.Hansen@westwoodps.com>
Sent: Thursday, September 19, 2024 3:58 PM
To: Meyer, David <David.Meyer@commscope.com>
Subject: RE: Bent Tree North Wind Farm, MN NEXRAD/Doppler Report?

Hi David,
Just checking in to see if you had any questions or need any information in order to run the report for the Bent Tree North Wind Farm project.

Shannon Hansen
Sr. Permitting Specialist
shannon.hansen@westwoodps.com

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From: Shannon Hansen <Shannon.Hansen@westwoodps.com>
Sent: Friday, September 6, 2024 9:47 AM
To: Meyer, David <David.Meyer@commscope.com>
Subject: RE: Bent Tree North Wind Farm, MN NEXRAD/Doppler Report?

Hi David, yes, you have the green light to prepare the study. Let me know if you need anything else.

Thanks,
Shannon

Shannon Hansen
Sr. Permitting Specialist
shannon.hansen@westwoodps.com

direct (952) 207-7653
main (952) 937-5150
cell (612) 702-0936

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Minnetonka, MN 55343

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(888) 937-5150

From: Meyer, David <David.Meyer@commscope.com>
Sent: Friday, September 6, 2024 8:18 AM
To: Shannon Hansen <Shannon.Hansen@westwoodps.com>
Cc: Meyer, David <David.Meyer@commscope.com>
Subject: RE: Bent Tree North Wind Farm, MN NEXRAD/Doppler Report?

Shannon,

Quote attached – please confirm for us to start the study.

Regards,

David Meyer
Senior Manager, Spectrum Engineering

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21515 Ridgetop Circle, Suite 300 | Sterling VA 20166
Office 703 726 5656 | David.Meyer@commscope.com

From: Shannon Hansen <Shannon.Hansen@westwoodps.com>
Sent: Thursday, September 5, 2024 5:09 PM
To: Meyer, David <David.Meyer@commscope.com>
Subject: Bent Tree North Wind Farm, MN NEXRAD/Doppler Report?

Hi David,
I am working with Alliant on preparing their permitting materials for their Bent Tree North Wind project in MN. Because they are a Wisconsin utility, the state of WI requires they also complete a Certificate of Authority/CPCN application. As part of this application, we are required to address possible NEXRAD and Doppler Radar interference.

I know you did the "Doppler and NEXRAD Weather Radar Study" for Dawn Harvest, and was hoping to get a similar report for Bent Tree so we can address the application requirements.

Can you give me an estimate of the cost and timing of this report for Bent Tree North? (you've already done several Comsearch reports for Bent Tree North project).

Thanks!
Shannon

Shannon Hansen
Sr. Permitting Specialist
shannon.hansen@westwoodps.com

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Wind Power GeoPlanner™

AM and FM Radio Report

Bent Tree North Wind Farm

Prepared on Behalf of
Wisconsin Power &
Light Company

June 7, 2024

COMSEARCH®
A CommScope Company

Table of Contents

1. Introduction

Comsearch analyzed AM and FM radio broadcast stations whose service could potentially be affected by the proposed Bent Tree North Wind project in Freeborn, Steele, and Waseca Counties, Minnesota.

2. Summary of Results

AM Radio Analysis
Comsearch found six database records[1] for AM stations within approximately 30 kilometers of the project, as shown in Table 1 and Figure 1. This closest station, KATE, which broadcasts out of Albert Lea, Minnesota, is located 20.46 km from the nearest turbine to the south of the project area of interest (AOI).

ID	Call Sign	Status[2]	Frequency (kHz)	Transmit ERP[3] (kW)	Operation Time	Latitude (NAD 83)	Longitude (NAD 83)	Required Separation Distance[4] (km)	Distance to Nearest Turbine (km)
1	KATE	LIC	1450	1.0	Unlimited	43.633289	-93.371042	0.21	20.46
2	KFOW	LIC	1170	0.005	Nighttime	44.044686	-93.385772	0.26	22.17
3	KFOW	LIC	1170	2.5	Daytime	44.044686	-93.385772	0.26	22.17
4	KFOW	LIC	1170	1.0	Critical Hours	44.044686	-93.385772	0.26	22.17
5	KRFO	LIC	1390	0.5	Daytime	44.073853	-93.180208	0.22	29.29
6	KRFO	LIC	1390	0.094	Nighttime	44.073853	-93.180208	0.22	29.29

Table 1: AM Radio Stations within 30 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.

[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.

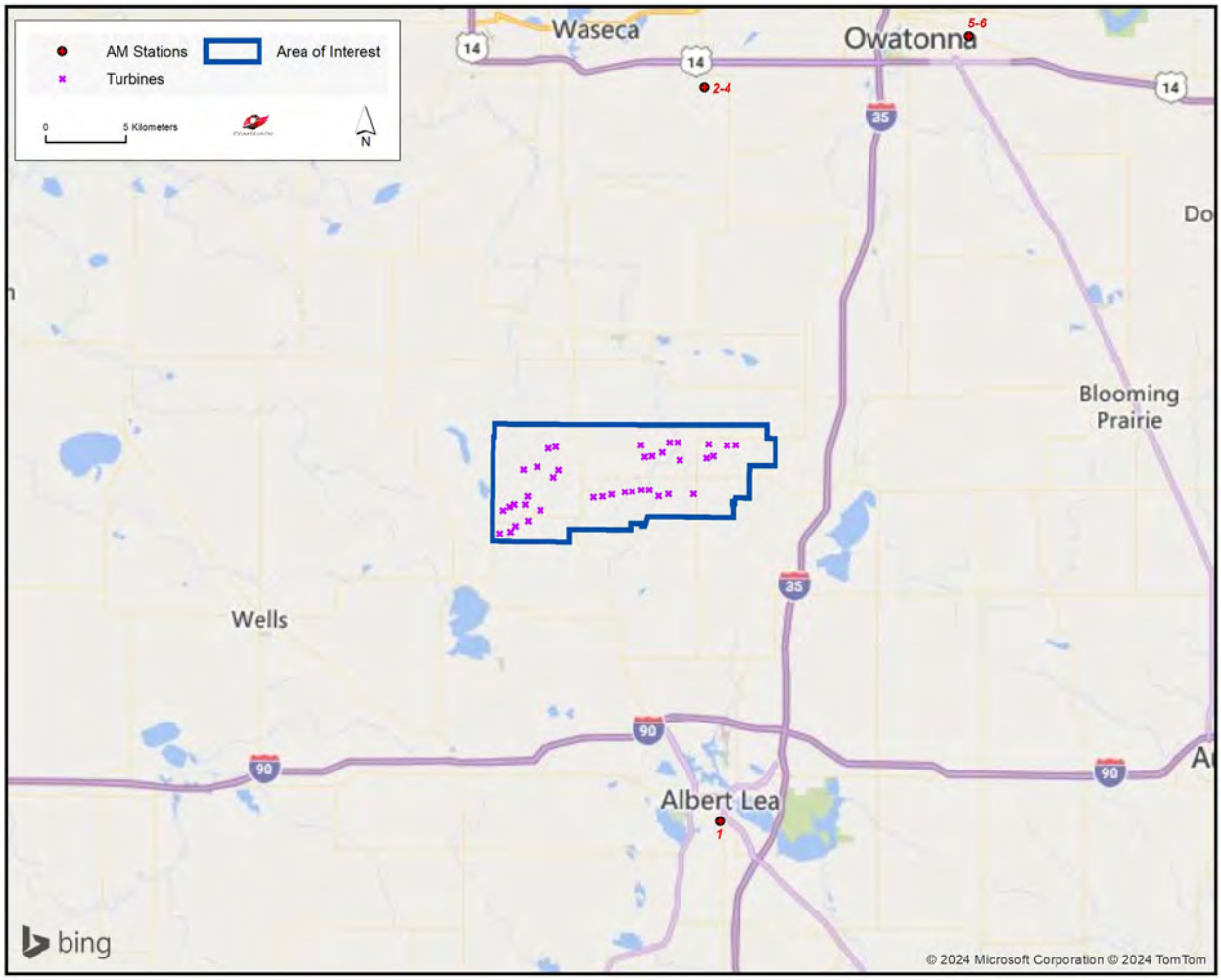

Figure 1: AM Radio Stations within 30 Kilometers of Project Area

FM Radio Analysis

Comsearch determined that there were fifteen database records for FM stations within a 30-kilometer radius of the Bent Tree North Wind project, as shown in Table 2 and Figure 2. All of these stations are currently licensed and operating, eight of which are translator stations that operate with limited range. The closest station is K280EB, which is currently licensed in Albert Lea, Minnesota, to the south of the project AOI, 18.74 km from the nearest proposed turbine location.

ID	Call Sign	Service[5]	Status[6]	Frequency (MHz)	Transmit ERP[7] (kW)	Latitude (NAD 83)	Longitude (NAD 83)	Distance to Nearest Turbine (km)
1	K280EB	FX	LIC	103.9	0.01	43.649111	-93.367694	18.74
2	K270BQ	FX	LIC	101.9	0.25	43.657528	-93.306917	19.00
3	K220AR	FX	LIC	91.9	0.014	43.643556	-93.384083	19.26
4	KCPI	FM	LIC	94.9	5.0	43.633278	-93.371056	20.47
5	K224DM	FX	LIC	92.7		43.627722	-93.363833	21.14
6	K299AL	FX	LIC	107.7	0.25	43.627722	-93.363833	21.14
7	KRUE	FM	LIC	92.1	9.8	44.045528	-93.384111	22.27
8	KOWZ	FM	LIC	100.9	100.0	44.045528	-93.384111	22.27
9	K292GU	FX	LIC	106.3	0.25	44.045528	-93.384111	22.27
10	KQPR	FM	LIC	96.1	25.0	43.616083	-93.213250	26.58
11	KNSE	FM	LIC	90.1	6.0	43.640806	-93.147694	27.79
12	KAUS-FM	FM	LIC	99.9	100.0	43.628278	-93.153528	28.47
13	K234DB	FX	LIC	94.7	0.25	44.073861	-93.180222	29.29
14	KRFO-FM	FM	LIC	104.9	4.7	44.073861	-93.180222	29.29
15	K228DR	FX	LIC	93.5	0.25	44.089778	-93.224833	29.33

Table 2: FM Radio Stations within 30 km

[5] FM = FM broadcast station; FX = FM translator station; FS = FM auxiliary (backup) station; FB = FM booster station.

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

[7] ERP = Transmit Effective Radiated Power.

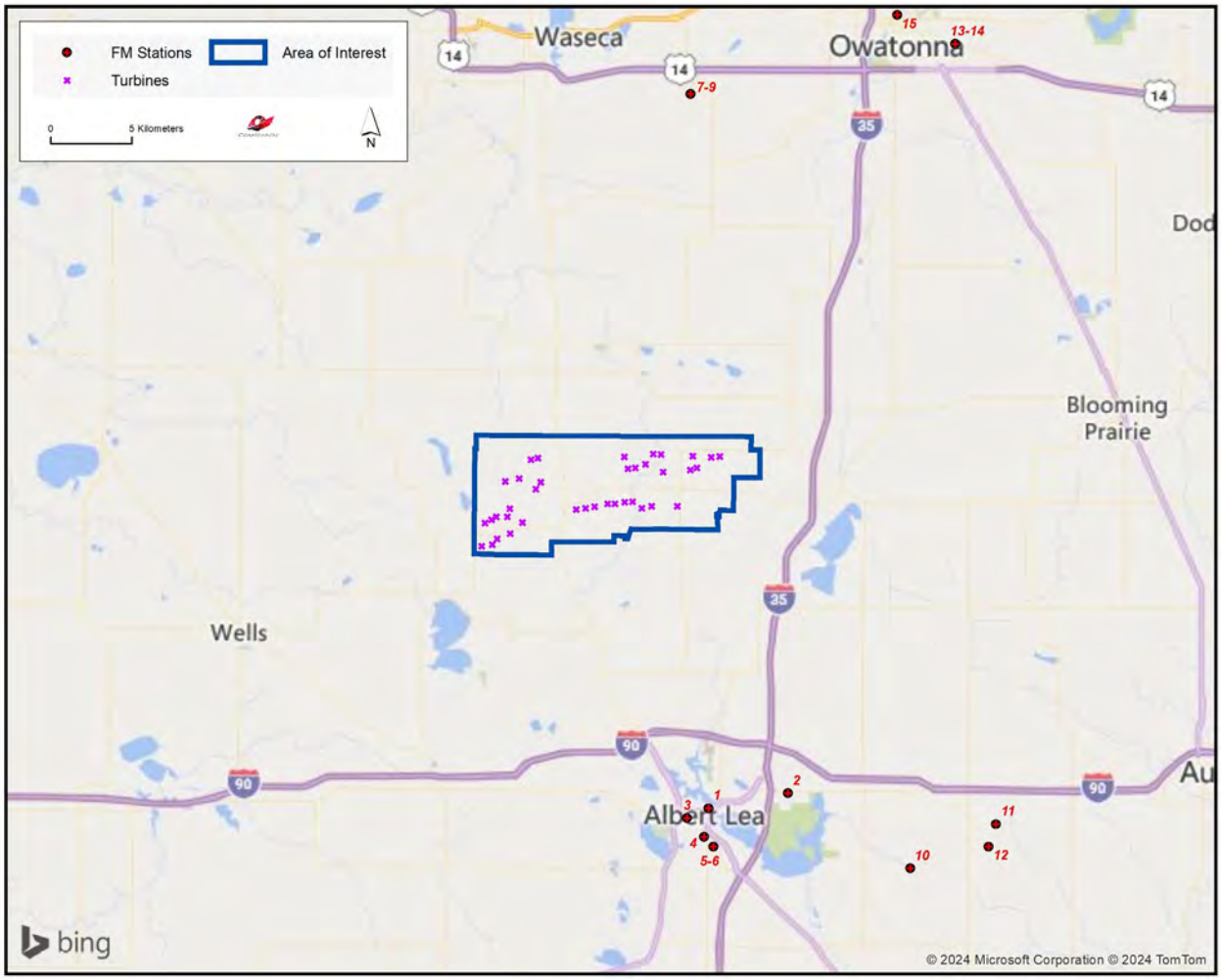

Figure 2: FM Radio Stations within 30 km

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 AM station (KATE) is located 20.46 km from the nearest turbine location. As there were no stations found within 3 kilometers of the 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 sensitive to interference due to wind turbines, especially when large objects (e.g., wind turbines) are located in the far field region of the radiating antenna to avoid the risk of distorting its radiation pattern. Station K280EB would be the nearest FM station to any given turbine at 18.74 km away. At this distance there should be 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:

Contact person:	David Meyer
Title:	Senior Manager
Company:	Comsearch
Address:	21515 Ridgetop Circle, Suite 300, Sterling, VA 20166
Telephone:	703-726-5656
Fax:	703-726-5595
Email:	David.Meyer@CommScope.com
Web site:	www.comsearch.com

Wind Power GeoPlanner™

Land Mobile & Emergency Services Report

Bent Tree North Wind Farm

Prepared on Behalf of
Wisconsin Power & Light
Company

June 10, 2024

COMSEARCH®
A CommScope Company

Table of Contents

1. Introduction

An assessment of the emergency services in the Bent Tree North Wind Farm project area was performed by Comsearch to identify potential impact from the planned turbines. We evaluated the registered frequencies for the following types of first responder entities: police, fire, emergency medical services, emergency management, hospitals, public works, transportation and other state, county, and municipal agencies. We also identified all industrial and business land mobile radio (LMR) systems and commercial E911 operators within the proposed wind energy facility boundaries. This information is useful in the planning stages of the wind energy facility because the data can be used in support of facility communications needs and to evaluate any potential impact on the emergency services provided in that region. An overview of the project area, which is located in Freeborn, Steele, and Waseca Counties, Minnesota, appears below in Figure 1.

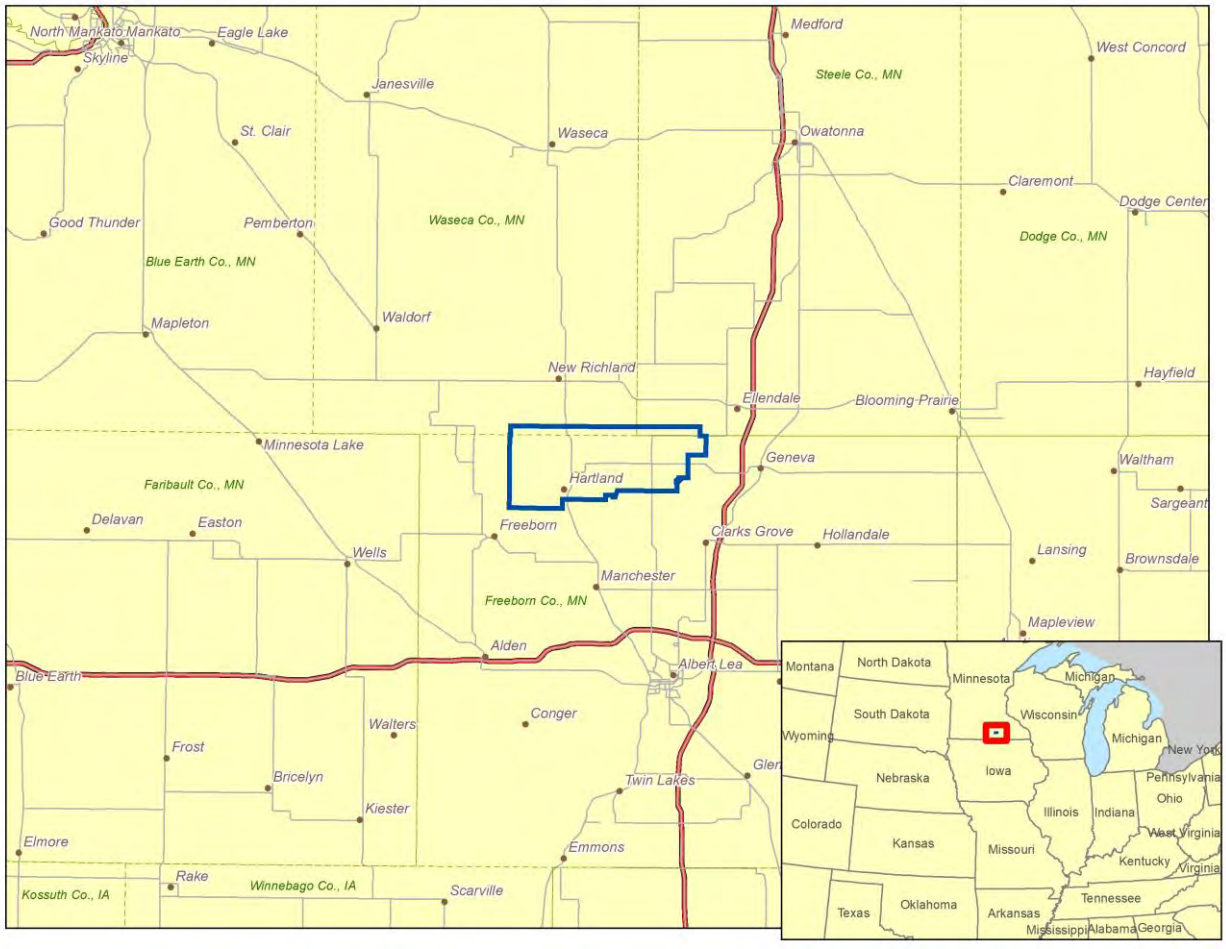

Figure 1: Area of Interest (AOI)

2. Summary of Results

Our land mobile and emergency services incumbent data[1] was derived from the FCC's Universal Licensing System (ULS) and the FCC's Public Safety & Homeland Security bureau. We identified both site-based licenses as well as regional area-wide licenses designated for public safety use.

Site-Based Licenses

The site-based licenses were imported into GIS software and geographically mapped relative to the wind energy project area of interest as defined by the customer. Each site on the map was given an ID number and associated with site information in a data table. A depiction of the fixed-site licenses in the project area appears in Figure 2.

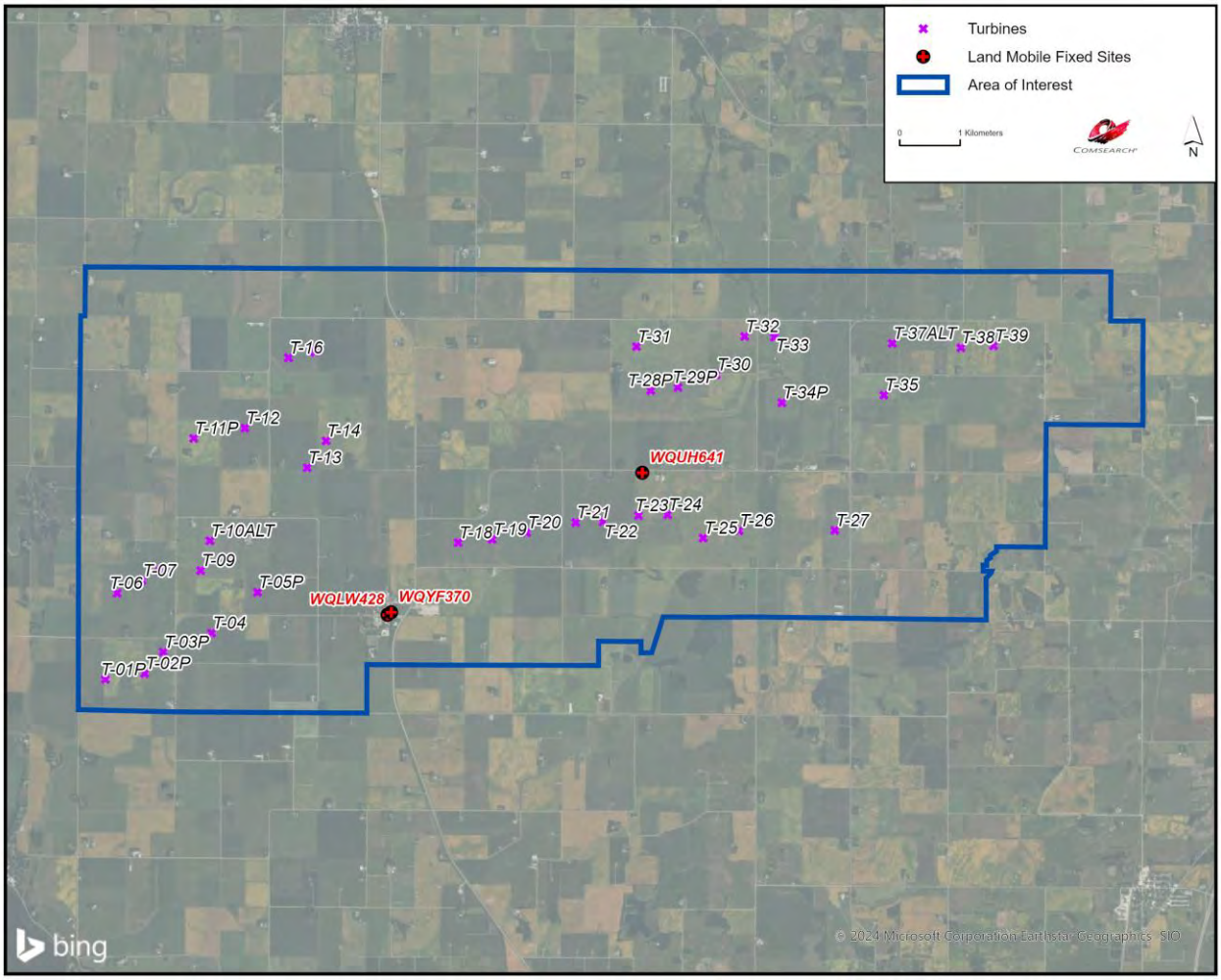

Figure 2: Land Mobile & Emergency Service Sites in Area of Interest

Figure 2 identifies three site-based licenses in the Bent Tree North Wind Farm project area of interest. Specific information about these sites is provided in Table 1.

Call Sign	Frequency Band (MHz)	Licensee	Antenna Height AGL (m)	Latitude (NAD83)	Longitude (NAD83)	Distance to Nearest Turbine (km)
WQUH641	450-470	AG POWER ENTERPRISES	94.2	43.825278	-93.432500	0.71
WQYF370	150-174	HI YIELD	56.4	43.804306	-93.484000	1.60
WQLW428	450-470	WISCONSIN POWER AND LIGHT COMPANY	50.6	43.803944	-93.484722	1.67

Table 1: Land Mobile & Emergency Service Sites in Area of Interest

[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 land mobile station's FCC license and governed by Comsearch's data license notification and agreement located at http://www.comsearch.com/files/data_license.pdf

Mobile Licenses

In addition to the fixed-site licenses above, 435 mobile licenses defined by center point and radius were found to intersect the Bent Tree North Wind Farm project area. Appendix A contains a tabular summary of these stations.

Area-Wide Licenses

The regional area-wide licenses were compiled from FCC data sources and identified for each county intersected by the wind energy project area. The Bent Tree North Wind Farm project is located in Freeborn, Steele, and Waseca Counties, Minnesota, part of Public Safety Region #22, which contains all the counties in Minnesota. The regional public safety operations are overseen by the entity listed below.

Dave Pagel
Chairperson, Public Safety Region #22
Office of Statewide Radio Communications, Minnesota Department of Transportation
1500 W CR B2, Roseville, MN 55113
Phone: 651-234-7970
Email: dave.pagel@state.mn.us

The chairperson for Region #22 serves as the representative for all public safety entities in the area and is responsible for coordinating current and future public safety use in the wireless spectrum. In the bands licensed by the FCC for area-wide first responders, which include 220 MHz, 700 MHz, 800 MHz and 4.9 GHz, as well as the traditional Part 90 public safety pool of frequencies, ten licenses were found for the State of Minnesota, one for the County of Freeborn, two for the County of Steele, and two for the County of Waseca (see Table 2). These area-wide licenses are designated for mobile use only.

ID	Licensee	Area of Operation	Frequency Band (MHz)
1	American National Red Cross	Statewide: MN	25-50
2	City of Minneapolis, MN	Statewide: MN	2450-2500
3	County of Freeborn	Countywide: FREEBORN, MN	800/900
4	GREATER NORTHWEST EMERGENCY MEDICAL SERVICES	Statewide: MN	450-470
5	HENNEPIN, COUNTY OF	Statewide: MN	25-50, 150-174, 406-413, 450-470, 800/900
6	MAYO FOUNDATION FOR MEDICAL EDUCATION AND RESEARCH	Countywide: STEELE, MN	150-174
7	Minnesota Canine Search Rescue and Tracking	Statewide: MN	150-174
8	MINNESOTA DEPARTMENT OF PUBLIC SAFETY	Statewide: MN	150-174
9	Minnesota, State of	Statewide: MN	0-10, 150-174, 450-470, 769-775/799-805, 800/900, 2450-2500, 4940-4990
10	NATIONAL SKI PATROL SYSTEM INC	Statewide: MN	150-174
11	Nevada Division of Forestry	Statewide: MN	150-174
12	SAINT LOUIS, COUNTY OF	Statewide: MN	150-174, 450-470, 800/900
13	Steele County Highway Dept	Countywide: STEELE, MN	150-174
14	WASECA MEDICAL CENTER MAYO	Countywide: WASECA, MN	150-174
15	WASECA, COUNTY OF	Countywide: WASECA, MN	450-470

Table 2: Regional Licenses

E911 Operators

Wireless operators are granted area-wide licenses from the FCC to deploy their cellular networks, which often include handsets with E911 capabilities. Since mobile phone market boundaries differ from service to service, we disaggregated the carriers' licensed areas down to the county level. We have identified the type of service for each carrier in Freeborn, Steele, and Waseca County, Minnesota, in Table 3.

Mobile Phone Carrier	Service[2]
AT&T	700 MHz, AWS, Cellular, PCS, WCS
DISH Network	700 MHz, AWS
TerreStar	AWS
T-Mobile	700 MHz, AWS, PCS
Verizon	700 MHz, AWS, Cellular, PCS

Table 3: Mobile Phone Carriers in Area of Interest with E911 Service

3. Impact Assessment

The first responder, industrial/business land mobile sites, area-wide public safety, and commercial E-911 communications as described in this report are typically unaffected by the presence of wind turbines, and we do not anticipate any significant harmful effect to these services in the Bent Tree North Wind Farm project area. Although each of these services operates in different frequency ranges and provides different types of service including voice, video and data applications, there is commonality among these different networks with regard to the impact of wind turbines on their service. Each of these networks is designed to operate reliably in a non-line-of-sight (NLOS) environment. Many land mobile systems are designed with multiple base transmitter stations covering a large geographic area with overlap between adjacent transmitter sites in order to provide handoff between cells. Therefore, any signal blockage caused by the wind turbines does not materially degrade the reception because the end user is likely receiving signals from multiple transmitter locations. Additionally, the frequencies of operation for these services have characteristics that allow the signal to propagate through wind turbines. As a result, very little, if any, change in their coverage should occur when the wind turbines are installed.

[2] AWS: Advanced Wireless Service at 1.7/2.1 GHz
CELL: Cellular Service at 800 MHz
PCS: Personal Communication Service at 1.9 GHz
WCS: Wireless Communications Service at 2.3 GHz
700 MHz: Lower 700 MHz Service

When planning the wind energy turbine locations in the area of interest, a conservative approach would dictate not locating any turbines within 77.5 meters of land mobile fixed-base stations to avoid any possible impact to the communications services provided by these stations. This distance is based on FCC interference emissions from electrical devices in the land mobile frequency bands. As long as the turbines are located more than 77.5 meters from the land mobile stations, they will meet the setback distance criteria for FCC interference emissions in the land mobile bands.

4. Recommendations

In the event that a public safety entity believes its coverage has been compromised by the presence of the wind energy facility, it has many options to improve its signal coverage to the area through optimization of a nearby base station or even adding a repeater site. Utility towers, meteorological towers or even the turbine towers within the wind project area can serve as the platform for a base station or repeater site.

5. Contact

For questions or information regarding the Land Mobile & Emergency Services Report, please contact:

Contact person:	David Meyer
Title:	Senior Manager
Company:	Comsearch
Address:	21515 Ridgetop Circle, Suite 300, Sterling, VA 20166
Telephone:	703-726-5656
Fax:	703-726-5595
Email:	David.Meyer@CommScope.com
Web site:	www.comsearch.com

Appendix A

ID	Call Sign	Frequency Band (MHz)	Licensee	Mobile Area Radius (km)	Latitude (NAD83)	Longitude (NAD83)
1	WNKW643	450-470	2 WAY RADIO OF MINNESOTA INC	64	44.141639	-93.511889
2	WNRO383	450-470	2 WAY RADIO OF MINNESOTA INC	64	44.141639	-93.511889
3	WNAK990	450-470	2-WAY RADIO OF MINNESOTA INC	64	43.791056	-93.440222
4	WQNQ592	450-470	2-WAY RADIO OF MINNESOTA, INC.	32	44.141667	-93.511944
5	WQCG650	450-470	ADVANCED WIRELESS COMMUNICATIONS	80	44.441639	-93.018000
6	WQUX260	450-470	AFFORDABLE LAWN CARE, INC.	32	44.101667	-93.533194
7	WQUX493	450-470	AG POWER ENTERPRISES	32	43.543056	-93.239167
8	WQUX493	450-470	AG POWER ENTERPRISES	32	43.781028	-93.236361
9	WQXR597	450-470	AG POWER ENTERPRISES	32	43.970722	-93.321889
10	WNSV528	450-470	AGRIMSON, ARNE	121	43.854139	-91.908500
11	WQNS806	450-470	AHRENS FARMS	32	44.037778	-93.120278
12	WQOT276	150-174	Albert Lea Bus Company	32	43.635000	-93.362222
13	WQWQ211	150-174	Albert Lea Medical Center	40	43.652722	-93.372972
14	WRCX375	150-174	ALBERT LEA SCHOOL DISTRICT	40	43.642083	-93.390694
15	WRCX375	150-174	ALBERT LEA SCHOOL DISTRICT	40	43.654472	-93.380222
16	WRCX375	150-174	ALBERT LEA SCHOOL DISTRICT	32	43.631500	-93.356083
17	WRCX375	150-174	ALBERT LEA SCHOOL DISTRICT	40	43.657444	-93.355694
18	WRCX375	150-174	ALBERT LEA SCHOOL DISTRICT	40	43.674167	-93.350694
19	WRCX375	150-174	ALBERT LEA SCHOOL DISTRICT	40	43.674389	-93.350694
20	WQEP441	450-470	Albert Lea Seed House	32	43.647222	-93.392778
21	WQPB280	150-174	ALBERT LEA, CITY OF	32	43.645833	-93.367500
22	WRBL768	450-470	Alden Conger Schools	32	43.672806	-93.574083
23	WPPA626	450-470	ALLIANCE PIPELINE L P	32	43.646639	-93.166861
24	WQCA207	150-174	ALLINA HEALTH SYSTEMS/DBA-OWATONNA HOSPITAL	32	44.111194	-93.250889

ID	Call Sign	Frequency Band (MHz)	Licensee	Mobile Area Radius (km)	Latitude (NAD83)	Longitude (NAD83)
25	WPJU667	450-470	Allnet Wireless LLC	121	44.045806	-94.158278
26	WPJU667	450-470	Allnet Wireless LLC	121	43.983306	-92.208222
27	WPDU983	800/900	Alpha Wireless Communications	113	43.666944	-94.122222
28	WPQC364	450-470	ALPHA WIRELESS COMMUNICATIONS	32	43.557722	-93.662722
29	WNMI988	800/900	ALPHA WIRELESS COMMUNICATIONS CO	113	44.181111	-94.029444
30	WNSX928	800/900	ALPHA WIRELESS COMMUNICATIONS CO	113	44.293333	-94.456667
31	WNVS439	450-470	ALPHA WIRELESS COMMUNICATIONS CO.	121	44.148583	-93.979389
32	WPEY485	800/900	ALPHA WIRELESS COMMUNICATIONS CO.	113	43.968833	-94.646361
33	WQFW336	450-470	AMERICAN TIME	20	43.642500	-93.389194
34	WQFW336	450-470	AMERICAN TIME	20	43.652500	-93.372944
35	WQEI908	450-470	AMERICAN TIME & SIGNAL CO.	20	43.734111	-93.733222
36	WQVN419	450-470	AMERICAN TIME & SIGNAL CO.	20	43.672528	-93.574417
37	WQVN419	450-470	AMERICAN TIME & SIGNAL CO.	20	43.890917	-93.495750
38	WQVN419	450-470	AMERICAN TIME & SIGNAL CO.	20	43.674167	-93.350694
39	WRDL268	450-470	AMERICAN TIME & SIGNAL CO.	20	43.631306	-93.356028
40	WSJ601	450-470	AMUNDSON, BLANE	32	43.914694	-93.738556
41	WQNF678	450-470	ANCOM COMMUNICATIONS INC	32	44.022667	-93.589000
42	WPDS432	450-470	Ancom Communications, Inc	113	44.802750	-93.174389
43	WPQD717	450-470	Ancom Communications, Inc.	32	44.089694	-93.224944
44	WPQD717	450-470	Ancom Communications, Inc.	32	43.676389	-93.003611
45	WPTA322	450-470	Ancom Communications, Inc.	32	43.957750	-93.210472
46	WQBK882	150-174	Arens Heating and Cooling	40	43.666639	-92.971306
47	WQPY461	72-76, 150-174, 450-470, 470-512	Audacy License, LLC, as Debtor-in-Possession	130	44.976444	-93.276111

ID	Call Sign	Frequency Band (MHz)	Licensee	Mobile Area Radius (km)	Latitude (NAD83)	Longitude (NAD83)
48	WQPY464	72-76, 150-174, 450-470, 470-512	Audacy License, LLC, as Debtor-in-Possession	200	44.976472	-93.276139
49	WQAU830	150-174	AUSTIN MEDICAL CENTER	40	43.674417	-92.977972
50	KJZ653	150-174	AUSTIN, CITY OF	40	43.697750	-92.963528
51	WQAW860	150-174	AUSTIN, CITY OF	40	43.666639	-92.966861
52	WQGX781	150-174	AUSTIN, CITY OF	40	43.666639	-92.972417
53	WQWR291	450-470	Autumn Ridge Church	80	44.005528	-92.518972
54	WNGG479	450-470	AVERA MC KENNAN HOSPITAL	322	43.530528	-96.713667
55	KRR779	25-50	BARNETT BROS INC	80	44.352472	-93.606611
56	WPPV679	150-174	BBRH INC.	100	44.291083	-93.294111
57	WQVV961	450-470	BEAUTERRE RECOVERY INSTITUTE	32	44.056389	-93.229722
58	WNLL419	450-470	BECKER, DENNIS	40	43.714389	-93.966333
59	WRCN231	450-470	BEHR, RONALD	159	43.026306	-93.330222
60	WQTY224	450-470	Belshan, Calvin	32	43.558111	-93.155750
61	WRCG220	450-470	BERRY PALLETS, INC.	32	44.063333	-93.510917
62	WQZJ474	450-470	BETHKE, CHAD	32	44.001361	-93.417444
63	WQXK697	450-470	BEYER, CRAIG	32	43.616583	-93.795167
64	WPYW506	450-470	Birds Eye Foods Inc	30	44.082056	-93.540639
65	WPYW506	450-470	Birds Eye Foods Inc	32	44.082056	-93.540639
66	WRCR679	450-470	Bishop, Adam	32	43.850611	-93.010361
67	WROQ406	450-470	Blooming Prairie Elementary School	32	43.868722	-93.056222
68	WPGS831	150-174	BLOOMING PRAIRIE INDEPENDENT SCHOOL DISTRICT 756	40	43.867750	-93.063806
69	KNET617	25-50	BMC AGGREGATES LLC	72	43.256333	-93.420750
70	WNZU248	450-470	BOEHM, DUANE	64	43.375528	-94.093583

ID	Call Sign	Frequency Band (MHz)	Licensee	Mobile Area Radius (km)	Latitude (NAD83)	Longitude (NAD83)
71	WPMN888	450-470	Bosch Auto Svc Solutions	32	44.093028	-93.243833
72	KNGM712	450-470	BRANSTAD MONROE	80	43.167750	-93.618556
73	WRCW833	450-470	BRITTON, PAUL	32	43.967083	-93.588667
74	WQNS579	150-174	BROWNSDALE FIRE DEPARTMENT	40	43.741083	-92.870611
75	WQWR566	450-470	Budach, Gary	32	43.893861	-93.285417
76	WRPW833	450-470	Buscho, Karl	32	44.134583	-93.402028
77	WPIZ281	450-470	Cargill, Incorporated	25	43.869139	-93.487722
78	WQWV937	450-470	Cedar Valley Services	32	44.074917	-93.508472
79	WNRW988	450-470	Cemstone Concrete Materials, LLC	32	43.749167	-93.731111
80	WPPN880	450-470	CENTRAL CO-OP	32	43.873361	-93.305972
81	WPPN880	450-470	CENTRAL CO-OP	32	44.121306	-93.243361
82	WPPN880	450-470	CENTRAL CO-OP	32	43.871806	-93.044639
83	WNAW956	450-470	CHARLSON EXCAVATING INC	80	43.132472	-93.216583
84	KNCN361	150-174	CITY OF WELLS PUBLIC UTILITIES	20	43.736611	-93.726056
85	WNUJ643	150-174	CLAUSSEN, DAVID	48	43.530500	-93.343250
86	WNQG647	450-470	Cole Farms	121	43.269972	-93.041583
87	WRMY453	450-470	Conagra Foods Packaged Foods, LLC	80	44.075778	-93.511944
88	WQOS762	450-470	CRYSTAL VALLEY COOP	32	44.101111	-93.611111
89	WQUN346	450-470	CRYSTAL VALLEY COOP	32	43.960083	-93.277889
90	WNSR429	450-470	CUSTOM COMMUNICATIONS INC	80	44.008306	-92.471000
91	WQHK257	450-470	CUSTOM COMMUNICATIONS, INC.	80	44.001139	-92.487972
92	WOEZ503	150-174	DAHL, CHRISTOPHER	40	43.751333	-93.409111
93	WPBF383	450-470	DAHLBY, DALE	56	43.477444	-93.221028
94	KOK429	450-470	DAIRYLAND POWER COOPERATIVE	116	43.556917	-92.682139
95	WRBV480	450-470	DAIRYLAND POWER COOPERATIVE	32	43.558056	-93.424722

ID	Call Sign	Frequency Band (MHz)	Licensee	Mobile Area Radius (km)	Latitude (NAD83)	Longitude (NAD83)
96	WPPA967	150-174	Dakota Minnesota & Eastern Railroad Corporation	40	44.080528	-93.508556
97	WPPA967	150-174	Dakota Minnesota & Eastern Railroad Corporation	40	44.001444	-93.417444
98	WPRI228	150-174	DAKOTA MINNESOTA & EASTERN RAILROAD CORPORATION	62	44.081639	-93.228000
99	WQYG432	150-174	Dakota Minnesota & Eastern Railroad Corporation	40	44.076917	-93.520417
100	WRCH923	150-174	DAKOTA MINNESOTA & EASTERN RAILROAD CORPORATION	40	44.076667	-93.519722
101	WQNS915	800/900	DAKOTA, COUNTY OF	241	44.714833	-93.124778
102	WNFQ872	150-174	DARLING INGREDIENTS INC	64	43.703278	-94.133861
103	KNIV751	800/900	DEL MONTE CORPORATION	113	44.299972	-94.741639
104	WQTV395	450-470	DEML FARMS	32	43.924556	-93.266833
105	WNHE715	450-470	DEML, ROBERT J	32	44.083306	-93.172250
106	WRON847	450-470	Demlview Farms, LLC	32	43.931639	-93.230917
107	WQVW396	450-470	DEMMER, REED	32	43.791306	-93.440444
108	WRAS682	450-470	DOBBERSTEIN, ALLEN	32	43.877750	-93.365500
109	WQNK457	450-470	DON LOKEN DRAINAGE INC.	32	44.094778	-93.273250
110	KYX730	150-174	Donkers, Marvin & Tim D D	64	44.324139	-93.029111
111	WNPH440	450-470	DONTJE, DALE N	56	43.312444	-93.701611
112	WNPK519	800/900	DUNCANSON GROWERS	48	43.928306	-93.977444
113	WRWX552	450-470	Eaton Sales & Service	40	44.020944	-93.451000
114	WNWL751	450-470	ECKHART, KENNETH	64	43.808000	-93.774111
115	WPLG527	450-470	EHLERT FARMS INC	32	43.639111	-93.796056
116	KNCP898	150-174	EHRICH, GARY	56	43.561889	-94.007444
117	WQSM515	150-174	EILERTSON FARMS	40	43.537333	-93.761222
118	WNGX885	800/900	ELECTRONIC ENGINEERING COMPANY	113	43.120833	-93.193611
119	WNJA778	450-470	ELECTRONIC ENGINEERING COMPANY	64	43.467167	-93.465222

ID	Call Sign	Frequency Band (MHz)	Licensee	Mobile Area Radius (km)	Latitude (NAD83)	Longitude (NAD83)
120	WNGC334	800/900	Electronic Specialties, Inc	112	43.102194	-93.597722
121	WPEQ726	450-470	Electronic Specialties, Inc	80	43.102194	-93.597722
122	WPHQ374	800/900	Electronic Specialties, Inc	113	43.386083	-94.311361
123	WPHS577	800/900	Electronic Specialties, Inc	113	43.068028	-94.202472
124	KNHH478	800/900	Electronic Specialties, Inc.	113	43.357444	-93.308250
125	WNVP259	800/900	Electronic Specialties, Inc.	113	42.862222	-93.610833
126	WNWK644	450-470	Electronic Specialties, Inc.	80	43.365250	-93.133806
127	WNZJ324	450-470	Electronic Specialties, Inc.	64	43.423556	-94.161361
128	WPBQ682	450-470	Electronic Specialties, Inc.	80	43.227750	-93.894667
129	WPEN706	450-470	Electronic Specialties, Inc.	97	43.423278	-93.533556
130	WPGY203	450-470	Electronic Specialties, Inc.	80	43.233861	-94.041611
131	WPGY964	450-470	Electronic Specialties, Inc.	80	43.386083	-94.311361
132	WPGZ200	450-470	Electronic Specialties, Inc.	80	43.369389	-93.779389
133	WPGZ256	450-470	Electronic Specialties, Inc.	80	43.118583	-93.239639
134	WPLD273	150-174	ELLENDALE, CITY OF	24	43.870806	-93.303000
135	WRCB432	150-174	Ellingson Trenchless LLC	80	44.138417	-92.900417
136	WRCN914	450-470	Erickson, Daniel S	32	43.693222	-93.544389
137	WQUI388	450-470	FARMERS COOPERATIVE ASSOCIATION	32	43.533361	-93.700222
138	WQUI388	450-470	FARMERS COOPERATIVE ASSOCIATION	64	43.264944	-93.631889
139	WQCS850	150-174	FENDRICH, MARK	40	43.745556	-93.747222
140	WRUJ630	450-470	Fischer, Nylen	40	43.891639	-94.042167
141	WQUS500	450-470	Flying S Farm	40	43.851028	-92.866611
142	WQZP754	450-470	FOX FARMS, LLC	40	43.989056	-93.665472
143	WQPB547	150-174	FREEBORN COUNTY HIGHWAY DEPT.	32	43.645833	-93.367500
144	WQIM748	150-174	FREEBORN, COUNTY OF	36	43.646306	-93.367917

ID	Call Sign	Frequency Band (MHz)	Licensee	Mobile Area Radius (km)	Latitude (NAD83)	Longitude (NAD83)
145	KNBQ997	450-470	Friesenborg & Larson	56	43.427722	-93.834944
146	WNRK620	450-470	GEBHARDT, MICHAEL:GEBHARDT, ROBERT:GEBHARDT, JAMES DBA GEBHA	48	43.815806	-92.868528
147	WPQK434	450-470	GREAT RIVER ENERGY	32	43.910806	-93.586333
148	WPRF623	450-470	GREAT RIVER ENERGY	32	44.081639	-93.191333
149	WQOP404	450-470	GUARDIAN ENERGY LLC	32	44.111139	-93.677750
150	WPPD445	150-174	GUNDERSEN LUTHERAN MEDICAL CENTER	600	43.794417	-91.249583
151	WRPT808	450-470	H & M Pork Farm, LLC	32	43.643333	-93.618889
152	WQZH272	450-470	Hagen, Allen L	32	43.920611	-93.447167
153	WPEW465	150-174	HAGEN, CHUCK	40	43.858306	-93.408556
154	WNKT451	150-174	HANSEN, TERRY	40	43.861917	-93.536056
155	WQC747	450-470	HANSON, ROBERT J	48	43.552722	-93.907444
156	WRCL913	450-470	HARGUTH FARMS, INC	32	44.017083	-93.493083
157	WPSF577	800/900	HARTLE, WM P	32	43.991389	-93.175556
158	WNGC397	800/900	HDH Leasing Inc.	113	44.524167	-92.576389
159	WQUW526	450-470	Heideman, Steven	32	43.571944	-93.216944
160	WQTT782	450-470	Hemingway, Eric	97	44.412500	-92.594417
161	KNBH660	150-174	Hendricksen, Brian	97	43.848556	-94.345528
162	WQYF370	150-174	HI YIELD	32	43.804306	-93.484000
163	WNUE250	150-174	HI YIELD PRODUCTS CO	48	43.701333	-93.642722
164	WQZF771	450-470	HILDEBRANDT, SCOTT	32	44.068861	-93.623167
165	WNVX591	450-470	Hilltop Communications Inc.	56	44.001361	-93.417444
166	WNVX591	450-470	Hilltop Communications Inc.	56	44.291083	-93.210500
167	WQAU957	450-470	Hilltop Communications Inc.	32	44.001361	-93.417444
168	WSS343	450-470	Hilltop Communications, Inc	80	44.006083	-92.423778

ID	Call Sign	Frequency Band (MHz)	Licensee	Mobile Area Radius (km)	Latitude (NAD83)	Longitude (NAD83)
169	WNRW374	450-470	Hilltop Communications, Inc.	80	44.325250	-92.652972
170	WNYY719	450-470	Hilltop Communications, Inc.	80	44.006083	-92.423778
171	WPGZ803	450-470	Hilltop Communications, Inc.	80	44.325250	-92.652972
172	WPGZ805	450-470	Hilltop Communications, Inc.	80	44.461083	-93.183000
173	WPHA250	450-470	Hilltop Communications, Inc.	80	44.398583	-92.817417
174	WPHA251	450-470	Hilltop Communications, Inc.	80	44.398583	-92.817417
175	WPHD723	450-470	Hilltop Communications, Inc.	80	44.081639	-93.191333
176	WPIC271	450-470	Hilltop Communications, Inc.	121	44.303306	-93.240500
177	WPIE272	450-470	Hilltop Communications, Inc.	121	44.006083	-92.423778
178	WPIF622	450-470	Hilltop Communications, Inc.	121	44.236639	-92.558806
179	WPIF624	450-470	Hilltop Communications, Inc.	121	44.081639	-93.191333
180	WPIF625	450-470	Hilltop Communications, Inc.	121	44.303306	-93.240500
181	WPIF626	450-470	Hilltop Communications, Inc.	121	44.303306	-93.240500
182	WPSM229	450-470	Hilltop Communications, Inc.	32	44.065806	-93.220778
183	WPWP658	450-470	Hilltop Communications, Inc.	32	44.081639	-93.191333
184	WQTZ630	450-470	HOLMES AG SUPPLY	32	43.939750	-93.699583
185	WQXR614	450-470	HUNT, JASON	80	43.993611	-92.448167
186	KNIR216	450-470	HUPER, DAVID A	32	43.675500	-93.683000
187	WRZU258	450-470	Huper, Tom	40	43.697722	-93.731750
188	WYJ839	450-470	IHLENFELD, JOHN:IHLENFELD, MARK DBA IHLENFELD BROTHERS	40	44.097194	-93.200222
189	WRDN661	450-470	INTERSTATE PACKAGING CORPORATION	32	43.628472	-93.357694
190	WQDV323	150-174	Interstate Power & and Light Company	290	43.557167	-93.661056
191	WQDV323	150-174	Interstate Power & and Light Company	290	42.686944	-91.826389
192	WQCT231	800/900	INTERSTATE POWER & LIGHT COMPANY	113	43.372028	-92.100194

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193	WNNH904	800/900	Interstate Power and Light Company	113	43.198722	-94.493389
194	WPBI316	800/900	Interstate Power and Light Company	113	42.988167	-94.014167
195	WPBI316	800/900	Interstate Power and Light Company	113	43.850278	-92.175278
196	WPBI318	800/900	Interstate Power and Light Company	113	43.098028	-93.289889
197	WPBI318	800/900	Interstate Power and Light Company	113	43.240667	-92.973639
198	WPBI318	800/900	Interstate Power and Light Company	113	43.556917	-92.682139
199	WPBI318	800/900	Interstate Power and Light Company	113	43.188056	-92.358333
200	WPBI319	800/900	Interstate Power and Light Company	113	43.557167	-93.661056
201	WPBI319	800/900	Interstate Power and Light Company	113	43.745306	-93.452639
202	WPBI319	800/900	Interstate Power and Light Company	113	43.094167	-93.294167
203	WPXS635	800/900	Interstate Power and Light Company	113	42.980278	-93.608611
204	WQBR912	800/900	Interstate Power and Light Company	113	43.120833	-93.193611
205	WQMM943	450-470	ITC MIDWEST	80	43.959056	-93.466639
206	WQZF388	450-470	J & K CONSTRUCTION	80	43.283611	-92.790556
207	WRUE267	450-470	Jaeger, Michael J	40	43.909417	-93.979389
208	WQOM589	150-174	JANKE, DAVID	32	44.090806	-93.294111
209	WQWN579	450-470	Jensen Farms	40	43.746500	-93.346667
210	WQYD441	450-470	Jensen, Michael D	80	43.703111	-93.568222
211	WQWP909	450-470	JEWISON, BILL	40	44.164167	-93.667556
212	WQPN303	150-174	JOHNSON, MIKE	40	43.585500	-93.844111
213	WNWH930	450-470	JOHNSON, SCOTT	56	43.665222	-93.712722
214	WQEY834	800/900	JOSAND, INC.	15	43.730500	-93.477444
215	WPNS523	450-470	K & K FABRICATION INC	20	43.750250	-93.127972
216	WRWK901	450-470	Kalis Custom, LLC	32	43.729444	-93.826361
217	WQXL673	450-470	KALIS, EMERSON	32	43.767056	-93.900528

ID	Call Sign	Frequency Band (MHz)	Licensee	Mobile Area Radius (km)	Latitude (NAD83)	Longitude (NAD83)
218	WQXL673	150-174	KALIS, EMERSON	40	43.767056	-93.900528
219	WRUE306	450-470	Kalis, Gregory	40	43.710806	-93.843083
220	WRHZ896	450-470	Keltron IOT Corp	80	44.461556	-93.155806
221	WQOQ804	450-470	Kibble Equipment LLC	32	43.679500	-93.888667
222	WQOQ804	450-470	Kibble Equipment LLC	32	43.645583	-93.467833
223	WRMH536	450-470	Klimmek, Harlin	32	43.872861	-93.466278
224	WPMB807	450-470	KLOCKE BROTHERS FARMS INC	32	43.862472	-92.931306
225	WPTX270	150-174	KOSEL, BRIAN J	40	44.147222	-93.325000
226	WSCZ306	450-470	KRAUSHAAR, STEVEN	32	43.583306	-93.151583
227	WQVP932	150-174	Krell, Justin	80	43.864417	-93.061944
228	WPMA951	450-470	KROEGER, LESTER C	32	43.962750	-93.626333
229	WQUT609	150-174	KRUGER, ROGER	40	43.918472	-92.875306
230	KC7907	150-174	KSTP-TV, LLC	161	44.947194	-93.086611
231	KPF364	25-50	KSTP-TV, LLC	241	44.968583	-93.207722
232	WPGJ718	150-174	LAKE MILLS, CITY OF	48	43.419111	-93.534389
233	WNRJ739	450-470	LAKOTA REPEATER ASSOCIATION 1	64	43.384417	-94.074389
234	WQNU581	450-470	Lenz Bus Service Inc	32	44.062111	-93.487333
235	WRZI357	450-470	Lindeland Farms, Inc	32	44.001222	-93.791861
236	WQUW527	450-470	LKQ Minnesota	32	43.667778	-93.298889
237	WRYP421	450-470	Loeffler, Brian	40	44.086611	-93.835639
238	WQFT390	450-470	Loucks, Aaron	32	43.906389	-92.995833
239	WRMQ478	150-174	Lutteke Organics, Inc	40	43.772500	-93.741111
240	WRZJ622	450-470	Lynch, Scott	32	44.083889	-93.749167
241	WRFA373	450-470	LYNNE, ERIC	32	43.815056	-93.512694
242	WQBV417	150-174	MAAS, PAUL	48	44.197750	-93.267167

ID	Call Sign	Frequency Band (MHz)	Licensee	Mobile Area Radius (km)	Latitude (NAD83)	Longitude (NAD83)
243	WRDH860	450-470	Madson, Casey	32	43.765139	-93.488694
244	WPKM649	800/900	MANKATO, CITY OF	32	44.075000	-93.508278
245	WQKJ694	800/900	Mankato, City of	80	44.164472	-93.992750
246	WQKU464	800/900	MANKATO, CITY OF	80	44.164472	-93.992750
247	WNXU938	450-470	MARQUARDT, LEN	48	43.958306	-93.358000
248	WRPT650	450-470	Mayo Clinic	32	44.081750	-93.508222
249	WRPT650	450-470	Mayo Clinic	32	44.081778	-93.508222
250	WRVV570	450-470	Mayo Clinic	32	43.652583	-93.372972
251	WRVV570	450-470	Mayo Clinic	32	44.112056	-93.252472
252	WPJZ280	150-174	MAYO FOUNDATION	24	43.652722	-93.373833
253	WPMA361	800/900	MAYO FOUNDATION	113	44.021639	-92.467111
254	WPMA366	800/900	MAYO FOUNDATION	113	44.021639	-92.467111
255	KNHV592	150-174	MAYO FOUNDATION FOR MEDICAL EDUCATION AND RESEARCH	48	44.158306	-93.966889
256	WRFI973	450-470	MCDONOUGH, MARCUS	32	43.907194	-93.713139
257	WRCL914	450-470	MEYER, DEREK	32	43.767833	-93.536306
258	WQYJ976	450-470	MIDWEST PUMPING	32	43.994167	-93.635833
259	WQYN693	450-470	Minnesota Elevator, Inc.	40	44.103972	-93.859083
260	WQTH200	150-174, 450-470	Minnesota Freezer Warehouse Company	40	43.685000	-92.955278
261	WRDX983	450-470	Minnesota Freezer Warehouse Corp.	24	43.625889	-93.354750
262	KAA869	150-174	MINNESOTA VALLEY ELECTRIC COOPERATIVE	97	44.614972	-93.705528
263	WQDJ729	800/900	MINNESOTA, STATE OF	113	44.529167	-93.408056
264	WQDJ729	800/900	MINNESOTA, STATE OF	113	44.093611	-93.253889
265	WQDJ729	800/900	MINNESOTA, STATE OF	113	44.291111	-93.211389
266	WQDJ729	800/900	MINNESOTA, STATE OF	113	44.048111	-92.962389

ID	Call Sign	Frequency Band (MHz)	Licensee	Mobile Area Radius (km)	Latitude (NAD83)	Longitude (NAD83)
267	WQDJ729	800/900	MINNESOTA, STATE OF	113	44.416556	-92.874306
268	WQDJ729	800/900	MINNESOTA, STATE OF	113	44.342806	-92.642389
269	WQDJ729	800/900	MINNESOTA, STATE OF	113	44.524167	-92.576389
270	WQHE600	800/900	MINNESOTA, STATE OF	40	43.848111	-92.861722
271	WQHK535	800/900	MINNESOTA, STATE OF	113	43.652028	-93.547556
272	WQHK535	800/900	MINNESOTA, STATE OF	113	43.817500	-93.292778
273	WQHK535	800/900	MINNESOTA, STATE OF	113	43.662000	-93.114389
274	WQKR254	800/900	MINNESOTA, STATE OF	40	44.087778	-93.701667
275	WQKR254	800/900	MINNESOTA, STATE OF	40	43.927444	-93.668111
276	WQKR470	800/900	MINNESOTA, STATE OF	40	43.601833	-93.747417
277	WQNG466	150-174	MINNESOTA, STATE OF	40	43.652028	-93.547556
278	WQNG466	150-174	MINNESOTA, STATE OF	40	44.013500	-93.306139
279	WQNG466	150-174	MINNESOTA, STATE OF	40	43.662000	-93.114389
280	WQOH264	150-174	MINNESOTA, STATE OF	40	44.087778	-93.701667
281	WQSK907	800/900	MINNESOTA, STATE OF	40	44.013500	-93.306139
282	WQSK907	800/900	MINNESOTA, STATE OF	40	44.109500	-93.199361
283	WQSK907	800/900	MINNESOTA, STATE OF	40	43.875083	-93.049583
284	WQSK907	800/900	MINNESOTA, STATE OF	40	43.848111	-92.861722
285	WQSK911	800/900	MINNESOTA, STATE OF	40	44.079833	-93.508611
286	WQSK911	800/900	MINNESOTA, STATE OF	40	43.892694	-93.492917
287	WPQJ977	450-470	MOBILE RADIO ENGINEERING INC	121	44.559972	-93.321056
288	WREW807	150-174	Moen Snow Removal	32	43.919944	-93.417028
289	KNAN672	150-174	MORGANS FARM SERVICE	40	44.195250	-93.378833
290	WQVL496	800/900	MOWER, COUNTY OF	40	43.668528	-92.992583
291	WNNU894	450-470	MR SAM COMMUNICATIONS	64	43.645222	-93.468000

ID	Call Sign	Frequency Band (MHz)	Licensee	Mobile Area Radius (km)	Latitude (NAD83)	Longitude (NAD83)
292	WPMT918	450-470	MRS GERRYS KITCHEN INC	20	43.673556	-93.360500
293	WQKJ470	450-470	MUTSCHLER, JONATHAN D	32	43.600250	-93.748750
294	WQYT587	450-470	NELSON, ROBERT	32	43.662583	-93.503611
295	WPQF465	150-174	NELSON, TERRENCE L	40	43.563833	-93.273806
296	WQMK986	450-470	NEUBAUER, TODD	32	43.706500	-93.827222
297	WNNT988	450-470	NEW RICHLAND SCHOOLS #2168	48	43.892500	-93.492778
298	WRZA687	450-470	NEXUS COOPERATIVE	112	43.067500	-92.673611
299	WQUJ671	450-470	Nielsen, Luke	32	43.676944	-93.287778
300	WPPH987	450-470	NORTHERN COUNTRY COOP	30	43.672750	-93.087694
301	WQJR520	450-470	Northern Iowa Windpower II, LLC	80	43.364528	-93.269389
302	WRAR897	450-470	NORTHERN NATURAL GAS COMPANY	1	43.826250	-93.397278
303	KSI896	150-174	NORTHWAY COMMUNICATIONS INC	322	44.888028	-89.652056
304	WNNB993	450-470	NUTRIEN AG SOLUTIONS INC	121	43.008028	-94.056056
305	WNNB993	450-470	NUTRIEN AG SOLUTIONS INC	121	42.972194	-93.796056
306	WXD853	150-174	NUTRIEN AG SOLUTIONS INC	48	43.572167	-93.608556
307	KZJ672	150-174	OSBORN, BRUCE	121	43.144694	-94.541083
308	WNUR625	150-174	OSWALD, RANDY	40	43.557806	-93.927639
309	WQRG718	150-174	OWATONNA BUS COMPANY, INC.	40	44.092500	-93.247778
310	WNQO287	150-174	Owatonna Concrete Products, LLC	40	44.074694	-93.506333
311	WNQO287	150-174	Owatonna Concrete Products, LLC	40	43.722028	-93.359639
312	WNQO287	150-174	Owatonna Concrete Products, LLC	80	44.074972	-93.206056
313	WNQO287	150-174	Owatonna Concrete Products, LLC	80	44.272194	-92.989083
314	WNYS410	150-174	OWATONNA GROUNDSMASTERS INC	40	44.124972	-93.205500
315	WSE810	150-174	Palmer Bus Co.	40	43.686833	-92.980694
316	KNHK641	450-470	Palmer Bus of Waseca Inc.	32	44.107556	-93.526611

ID	Call Sign	Frequency Band (MHz)	Licensee	Mobile Area Radius (km)	Latitude (NAD83)	Longitude (NAD83)
317	WNRD833	450-470	PALMER BUS SERVICE INC	48	44.079972	-93.856056
318	WNMM432	450-470	PETERSEN, DAVID G	40	43.709389	-93.567722
319	WQOM851	450-470	PETERSON, ADRYN	32	43.934278	-93.481889
320	WRDG871	450-470	PETERSON, ROGER	32	43.724694	-93.369639
321	WRJT573	450-470	PETSINGER, DANIEL	32	43.882583	-93.319500
322	WSBY595	450-470	Phillips, Dann	32	43.841889	-93.463722
323	WQXB751	450-470	Powers, Chris	121	44.021278	-92.495806
324	WQOY425	450-470	PRIEM, CALVIN K	32	44.077472	-93.719111
325	WQKD880	800/900	RACOM Corporation	113	43.121389	-93.194444
326	WQKD897	800/900	RACOM Corporation	113	44.689167	-93.072778
327	WQKD910	800/900	RACOM Corporation	113	43.656944	-94.612222
328	WQKD915	800/900	RACOM Corporation	113	43.070556	-94.198056
329	WQKD926	800/900	RACOM Corporation	113	43.970278	-92.418333
330	WRXR229	450-470	Raimann, Richard	32	43.803972	-93.782139
331	WPNZ691	450-470	RAIMANN, TIMOTHY L.	32	43.926639	-93.864111
332	WNWA349	150-174	RAUSCH BROTHERS TRUCKING INC	121	43.034139	-92.451028
333	WSAI934	150-174	Reese, Joe	31	43.823056	-93.267778
334	KAJ271	150-174	RICE, COUNTY OF	64	44.299417	-93.249111
335	WREZ392	450-470	Rise Modular	32	44.068139	-93.254111
336	WPEG804	450-470	RIVERLAND COMMUNITY COLLEGE	32	43.676083	-93.002694
337	WPKV380	450-470	ROCHESTER PUBLIC SCHOOLS	120	44.046361	-92.449333
338	WRUG315	450-470	Roeker, Casey J	40	43.967833	-93.666361
339	WQNG799	150-174	ROEMHILDT GRAIN	40	44.137472	-93.582167
340	WSCI649	450-470	Rollenhagen, Wyatt	40	43.781722	-93.707694
341	WRCI945	450-470	ROONEY TRUCKING, INC.	152	42.643139	-92.912417

ID	Call Sign	Frequency Band (MHz)	Licensee	Mobile Area Radius (km)	Latitude (NAD83)	Longitude (NAD83)
342	WNLK592	450-470	ROSENBERG RICHARD ROSENBERG JEFF DBA ROSENBERG F	64	43.372194	-93.011306
343	WNGS438	450-470	Rowan, John	56	44.284139	-93.250222
344	WQKK341	450-470	SAHRSIDE DAIRY LLP	32	43.617222	-93.786806
345	WNAK403	450-470	SAINT ANSGAR COMMUNITY SCHOOLS	80	43.382472	-92.919639
346	WQXM332	450-470	Sammons, Andrew	48	44.255389	-93.312917
347	WYY356	450-470	SAMPSON, GERALD	72	43.508028	-92.877139
348	WNGG480	450-470	SANFORD USD MEDICAL CENTER	322	43.524972	-96.739222
349	KNBD228	150-174	SCHAPER, ROGER	40	43.638833	-93.834944
350	WSG472	450-470	SCHIRMER, DARIN	40	43.774944	-93.820778
351	KXH817	150-174, 450-470	SCHMELING, ROBERT	32	43.864972	-93.000194
352	WQRI683	25-50	SCHMITTY & SONS BUS COMPANY	113	44.620361	-93.296056
353	WQTM789	450-470	Schultz, Jeff	32	43.689667	-93.690222
354	WRDS659	450-470	SHOWALTER, DANIEL	80	43.485000	-92.870278
355	WRVP248	450-470	SKB Lansing Landfill	32	43.706944	-92.992389
356	WQHA725	150-174	SOHRE, DAVID	40	43.928806	-93.956056
357	WROW264	450-470	SONJA TROM EAYRS, TRUSTEE	32	43.932472	-92.996583
358	WRDH901	450-470	SORENSEN, LYNN JAMES	32	43.751694	-93.539278
359	WRJU500	450-470	Southern Research & Outreach Center	40	44.077472	-93.525778
360	WQCY881	450-470	SOY MOR BIODIESEL, LLC	25	43.658500	-93.294528
361	WQVL604	800/900	Spectrum Solutions Network, LLC	113	44.867917	-93.224444
362	WQVR980	800/900	Spectrum Solutions Network, LLC	113	44.867917	-93.224444
363	WQRX433	450-470	SPINDLER, MARVIN	32	44.011611	-93.118111
364	WNLI259	450-470	Sponberg, David	32	43.943389	-93.459833
365	WNRS509	450-470	ST JOHNS LUTHERAN HOME	32	43.656056	-93.391056

ID	Call Sign	Frequency Band (MHz)	Licensee	Mobile Area Radius (km)	Latitude (NAD83)	Longitude (NAD83)
366	WRP910	150-174	STACYVILLE COOPERATIVE CO	70	43.436361	-92.781306
367	WQPE652	800/900	STEELE, COUNTY OF	40	44.109500	-93.199361
368	WQPN205	800/900	STEELE, COUNTY OF	40	44.109500	-93.199361
369	WQZF632	450-470	STENCEL, TODD	80	43.961611	-93.628333
370	KNFC436	450-470	STEVERMER, TERRY	32	43.808278	-93.872167
371	WPPW914	450-470	STREATERS INC	32	43.623556	-93.357444
372	WRWG250	450-470	Strobel Farms/FAST	40	43.951667	-93.649222
373	WPRG591	450-470	STRODTMAN ELK FARM	32	44.135250	-93.326333
374	KD53854	450-470	SUBLINE CORP RIVERFRONT DBA SUBWAY	113	44.149417	-93.979389
375	WQXP568	150-174	Sunopta	40	43.961639	-93.276611
376	WQJV876	150-174	SWANSON HILLSIDE FARMS	80	43.241667	-93.700000
377	WNBB792	150-174	TERPSTRA, ALLAN	64	44.080250	-93.282722
378	WRNP801	150-174	Thisius Flying Service	40	43.713611	-93.693056
379	WQVA933	450-470	Thompson Sanitation Inc	32	43.766083	-93.328861
380	WQVA933	450-470	Thompson Sanitation Inc	32	43.765806	-93.328722
381	WPIS330	450-470	THOMPSON, RONALD P	32	43.558833	-93.645222
382	WQUZ786	150-174	Tims Spotting Service	40	43.617306	-93.399778
383	WQZY960	150-174	TOMSCHIN ROUND BAILING, LLC	40	43.673722	-93.503944
384	WREJ687	800/900	TPS, INC.	113	44.759306	-93.258222
385	WPXE269	450-470	TRAYNOR TRUCKING INC.	32	43.961944	-93.680833
386	WRAS586	450-470	TRIO, TOM	32	43.809806	-93.916722
387	WNUS633	450-470	TRITON SCHOOLS	48	44.030250	-92.855750
388	WQCD461	450-470	Twin City Concrete Products	121	44.882361	-93.152944
389	WQYC577	450-470	Twin Creek Farms	80	44.071083	-92.897500
390	KNJZ613	150-174	Union Pacific Railroad Company	40	44.120194	-93.086667

ID	Call Sign	Frequency Band (MHz)	Licensee	Mobile Area Radius (km)	Latitude (NAD83)	Longitude (NAD83)
391	WQWE461	450-470	United South Central Public Schools	32	43.733333	-93.735278
392	WPTI620	800/900	Upper Iowa Communications	113	43.381639	-92.107417
393	WNRT481	450-470	VAUBEL FARMS INC	32	43.962500	-93.916639
394	WQSF992	800/900	VERTICAL VENTURES V, LLC	113	44.044722	-92.400278
395	WQSG211	800/900	VERTICAL VENTURES V, LLC	113	44.044722	-92.400278
396	WQPX584	450-470	VIRACON INC	32	44.089417	-93.245778
397	WQWD656	450-470	VOGT, PETER A	32	43.868944	-93.126750
398	WQZG749	450-470	Volsen, Eric	48	43.604972	-93.706917
399	WRPZ658	450-470	Vortex Cold Storage, LLC	24	43.624722	-93.365000
400	WSH917	450-470	VS Family Farms LLC	64	43.834389	-92.787861
401	WQSY895	150-174	Waage, Brian	32	43.869444	-93.204722
402	WNSC224	450-470	WACH, DALE	48	43.774111	-93.845500
403	WSBV205	150-174	WAGNER, RODERICK A	32	44.066917	-93.069083
404	WQAR349	800/900	Wangen, Marlowe	20	43.661472	-93.242556
405	WRZB755	450-470	Warmka, Alex	32	43.732083	-93.825889
406	WNXA696	150-174	WARMKA, THOMAS J	40	43.713278	-93.869667
407	KNHB880	150-174	Waseca County	24	43.938028	-93.696611
408	KNHK408	150-174	Waseca County	27	44.079972	-93.508556
409	WPAX372	450-470	WASECA SAND & GRAVEL INC	64	44.001361	-93.417444
410	KAI475	150-174	WASECA, COUNTY OF	24	43.932472	-93.696722
411	KAI475	150-174	WASECA, COUNTY OF	39	44.075556	-93.591111
412	KAI475	150-174	WASECA, COUNTY OF	24	43.896306	-93.493111
413	KVD603	150-174	WASECA, COUNTY OF	40	43.927444	-93.668111
414	WNSA987	450-470	WAYNE, GREG	64	43.912472	-93.785500
415	WRUY744	150-174	Wayne, Jeffrey	40	43.816944	-93.245389

ID	Call Sign	Frequency Band (MHz)	Licensee	Mobile Area Radius (km)	Latitude (NAD83)	Longitude (NAD83)
416	WPDK773	150-174	WELLS CONCRETE PRODUCTS CO	32	43.747444	-93.720222
417	WQYR274	450-470	WEST UNION TRENCHING LLC	160	42.963556	-91.799028
418	WNUL646	450-470	WETZEL, DOUG	56	43.744389	-93.825778
419	WRDR681	450-470	WHISPERING OAK PLACE	8	43.876611	-93.310944
420	WQVG996	450-470	WILKENSON, DANIEL J	32	43.910583	-93.385083
421	WNQM439	450-470	WILLETTE SEED FARM INC	48	43.718278	-94.031333
422	KD50657	150-174	WISCONSIN POWER AND LIGHT COMPANY	241	43.776389	-90.443333
423	WQLW428	450-470	WISCONSIN POWER AND LIGHT COMPANY	32	43.803944	-93.484722
424	KAN510	150-174	Xcel Energy Services Inc.	40	43.977500	-93.476667
425	WQSY954	150-174	XCEL ENERGY SERVICES INC.	80	44.183028	-93.976611
426	WQSY954	150-174	XCEL ENERGY SERVICES INC.	80	44.299139	-93.249111
427	WQTD982	450-470	XCEL ENERGY SERVICES INC.	80	44.183028	-93.976611
428	WQTD982	450-470	XCEL ENERGY SERVICES INC.	80	44.299139	-93.249111
429	WQUW918	800/900	Xcel Energy Services Inc.	113	44.623889	-92.636944
430	WQXN436	150-174	XCEL ENERGY SERVICES INC.	80	44.183028	-93.976611
431	WQXN436	150-174	XCEL ENERGY SERVICES INC.	80	44.299139	-93.249111
432	WQWN963	450-470	Yost, Donald	32	43.561194	-93.503333
433	WPIU349	450-470	ZIEGLER INC	143	44.849972	-93.300222
434	WQJP654	150-174	ZIEGLER, EARL K	40	43.992667	-93.981222
435	WSH472	150-174	ZIMNY, RAYMOND J	40	43.990528	-93.567167

Table A: Mobile Licenses Intersecting Project Area

Wind Power GeoPlanner™

Microwave Study

Bent Tree North Wind Farm

Prepared on Behalf of
Wisconsin Power & Light
Company

June 7, 2024

COMSEARCH®
A CommScope Company

Table of Contents

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: Bent Tree North Wind Farm
County: Freeborn, Steele, and Waseca
State: Minnesota

Number of Turbines: 38
Blade Diameter: 136 meters
Hub Height: 112 meters

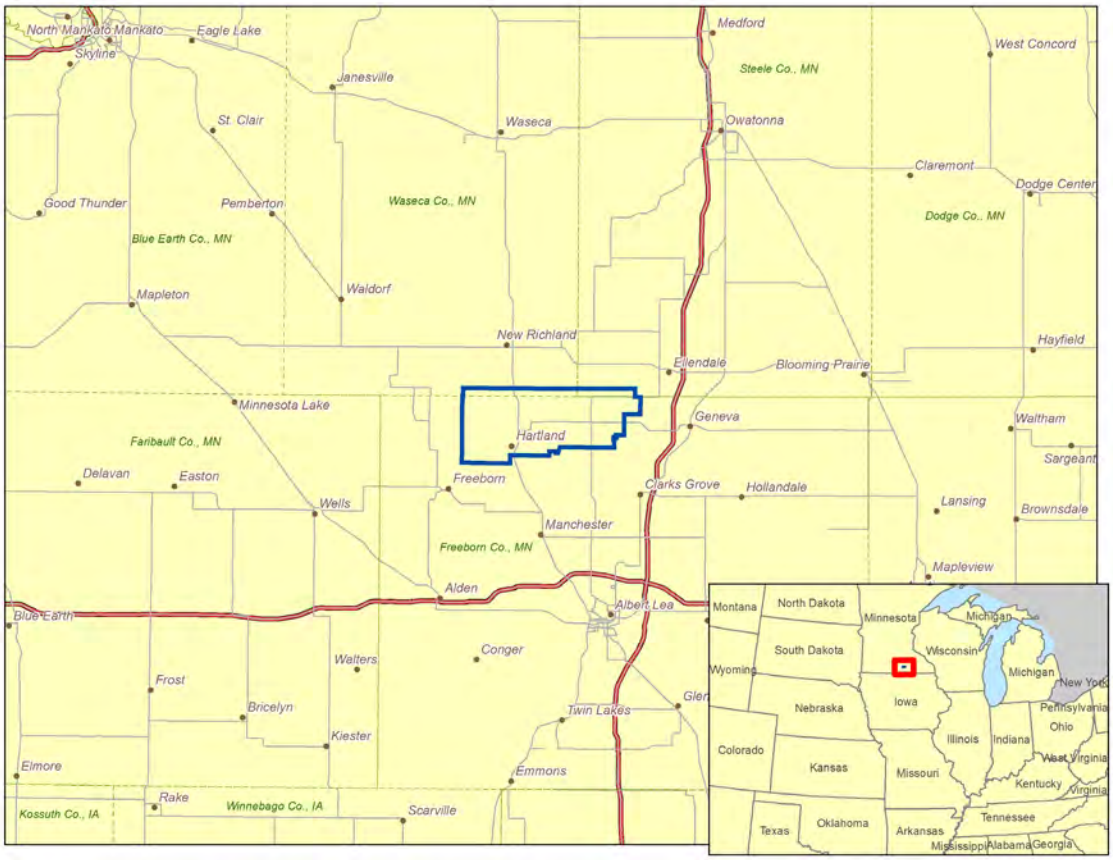


Figure 1: Area of Interest

3. Two-Dimensional 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. These paths and the area of interest that encompasses the planned turbine locations are shown in Figure 2.

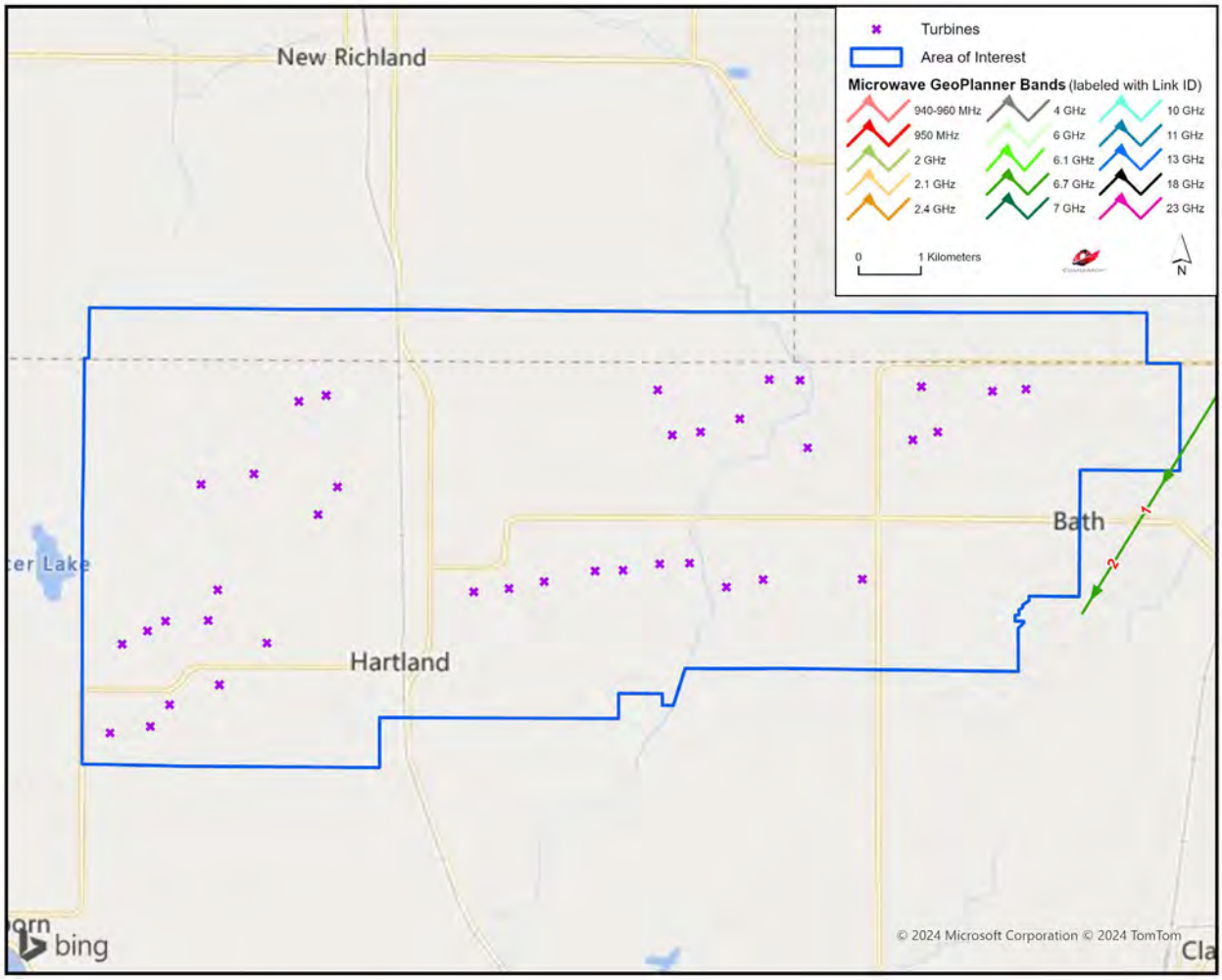


Figure 2: Microwave Paths that Intersect the Area of Interest

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

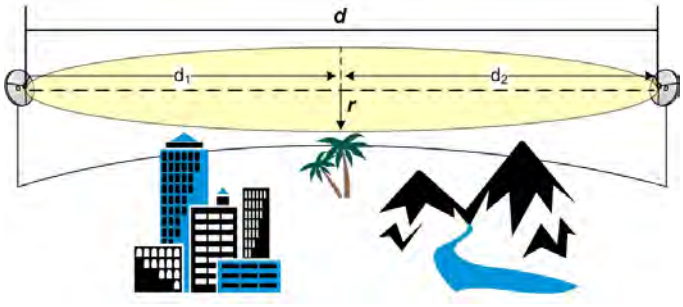
[2] We use FCC-licensed coordinates to determine which paths intersect the area of interest. It is possible that as-built coordinates may differ slightly from those on the FCC license.

ID	Status	Callsign 1	Callsign 2	Band	Path Length (km)	Licensee
1	Licensed	WHI759	WHI758	6.1 GHz	40.19	Union Pacific Railroad Company
2	Licensed	WHI759	WHI758	6.7 GHz	40.19	Union Pacific Railroad Company

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 each 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

In general, this is the area where the planned wind turbines should be avoided, if possible. Likewise, Comsearch recommends that an area directly in front of each microwave antenna should be avoided. This corresponds to the Consultation Zone which measures 1 kilometer along the main beam of the antenna and 24 ft (7.3 meters) wide. A depiction of the Fresnel Zones and Consultation Zones for each microwave path listed can be found in Figure 3, and is also included in the enclosed shapefiles[3,4].

[3] The ESRI® shapefiles enclosed are in NAD 83 UTM Zone 15 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.

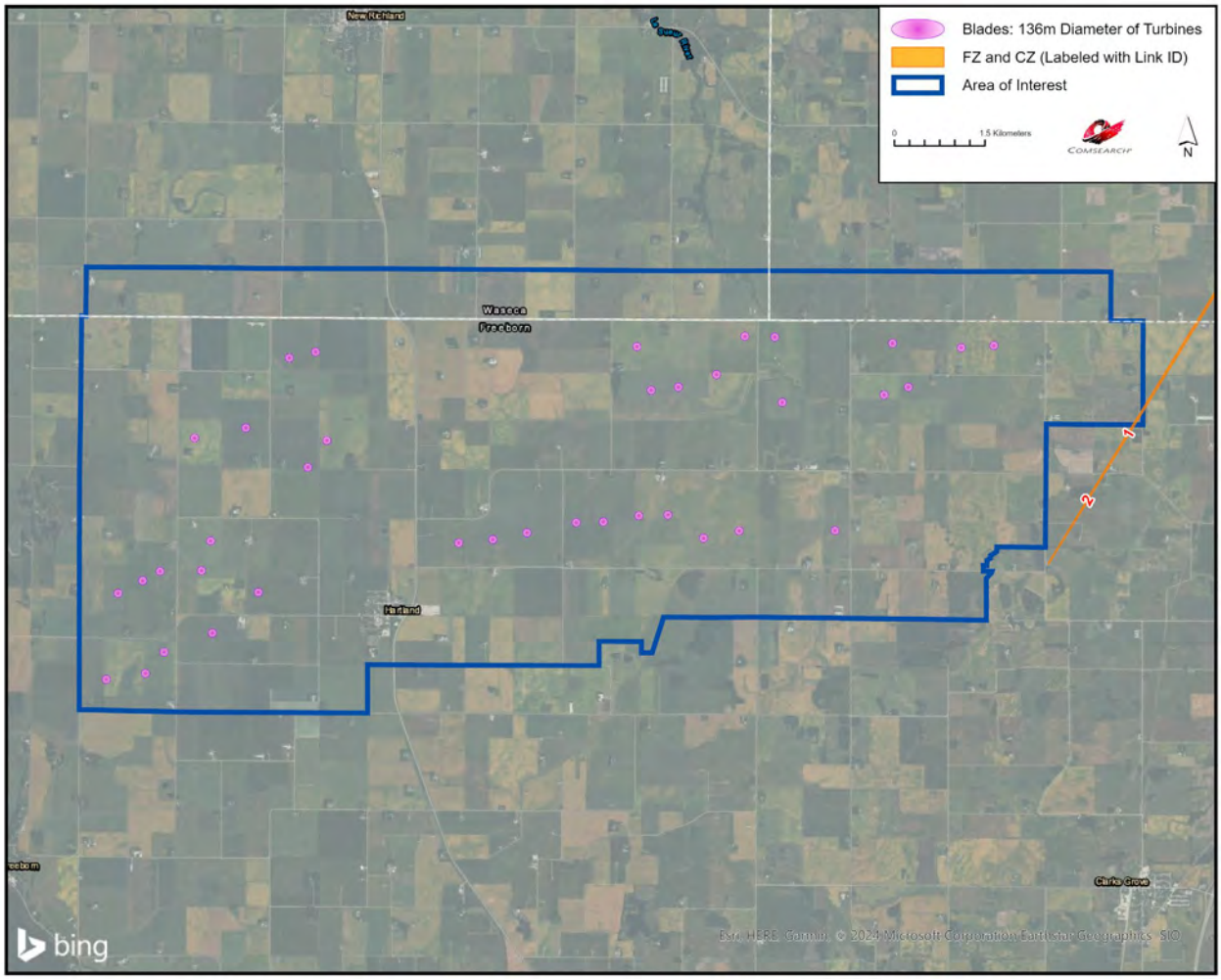


Figure 3: Microwave Paths with Fresnel Zones

4. Conclusion

Total Microwave Paths	Paths with Affected Fresnel Zones	Total Turbines	Turbines intersecting the Fresnel Zones
2	0	38	0

Table 2: Fresnel Zone Analysis Result

Our study identified two microwave paths intersecting the Bent Tree North Wind Farm area of interest. The Fresnel and Consultation Zones for these microwave paths were calculated and mapped in order to assess the potential impact from the turbines. A total of thirty-eight turbines were considered in the analysis, each with a blade diameter of 136 meters and a hub height of 112 meters. Of those turbines, none were found to have potential obstruction with the microwave systems in the area.

5. Contact

For questions or information regarding the Microwave Study, please contact:

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Appendix: Turbine Locations

Name	Latitude	Longitude
T-08ALT	43.810244	-93.531774
T-12	43.831617	-93.514293
T-16	43.842093	-93.505438
T-18	43.814750	-93.470307
T-19	43.815266	-93.463294
T-23	43.818945	-93.433256
T-24	43.819084	-93.427289
T-33	43.845580	-93.405442
T-26	43.816764	-93.412581
T-35	43.837042	-93.382875
T-38	43.844140	-93.367042
T-17P	43.842984	-93.500010
T-25	43.815644	-93.419914
T-39	43.844459	-93.360319
T-34P	43.835841	-93.403851
T-28P	43.837570	-93.430857
T-29P	43.838050	-93.425259
T-31	43.844064	-93.433823
T-37ALT	43.844740	-93.381192
T-04	43.801093	-93.520913
T-01P	43.794073	-93.542707
T-02P	43.795012	-93.534635
T-03P	43.798199	-93.530837
T-14	43.829809	-93.497611
T-36PALT	43.838213	-93.377902
T-32	43.845669	-93.411606
T-13	43.825792	-93.501464
T-06	43.806923	-93.540371
T-07	43.808821	-93.535325
T-10ALT	43.814820	-93.521384
T-05P	43.807200	-93.511507
T-20	43.816316	-93.456269
T-30	43.839963	-93.417430
T-27	43.816872	-93.392841
T-11P	43.830042	-93.524840
T-22	43.818009	-93.440556
T-21	43.817863	-93.446150
T-09	43.810384	-93.523245

Wind Power GeoPlanner™

Doppler and NEXRAD Weather Radar Study

Bent Tree North Wind Farm

Prepared on Behalf of
Wisconsin Power & Light
Company

September 19, 2024

COMSEARCH®
A CommScope Company

Table of Contents

1. Introduction

The purpose of this document is to describe the research, calculations, and analysis performed to assess the impact of the proposed Bent Tree North Wind Farm energy project on the operation of Doppler Weather Radar Systems (owned and operated by television stations and commercial interests) and the NEXRAD radars (jointly operated by the National Weather Service (NWS), the Federal Aviation Administration (FAA), and the U.S. Air Force) within the vicinity of the project. This study was performed for Wisconsin Power & Light Company.

2. Project Area

The location of the Bent Tree North Wind Farm energy project in Freeborn, Steele, and Waseca Counties, Minnesota is shown in Figure 1. The proposed turbines will have a maximum hub height of 112 meters and a rotor diameter of 136 meters, giving the structures an overall maximum height of 180 meters above ground level. At the time of this study, there are 47 turbines proposed for the Bent Tree North Wind Farm. Table 1 lists these turbines and their coordinates within the project area. A detailed view is provided in Figure 2.

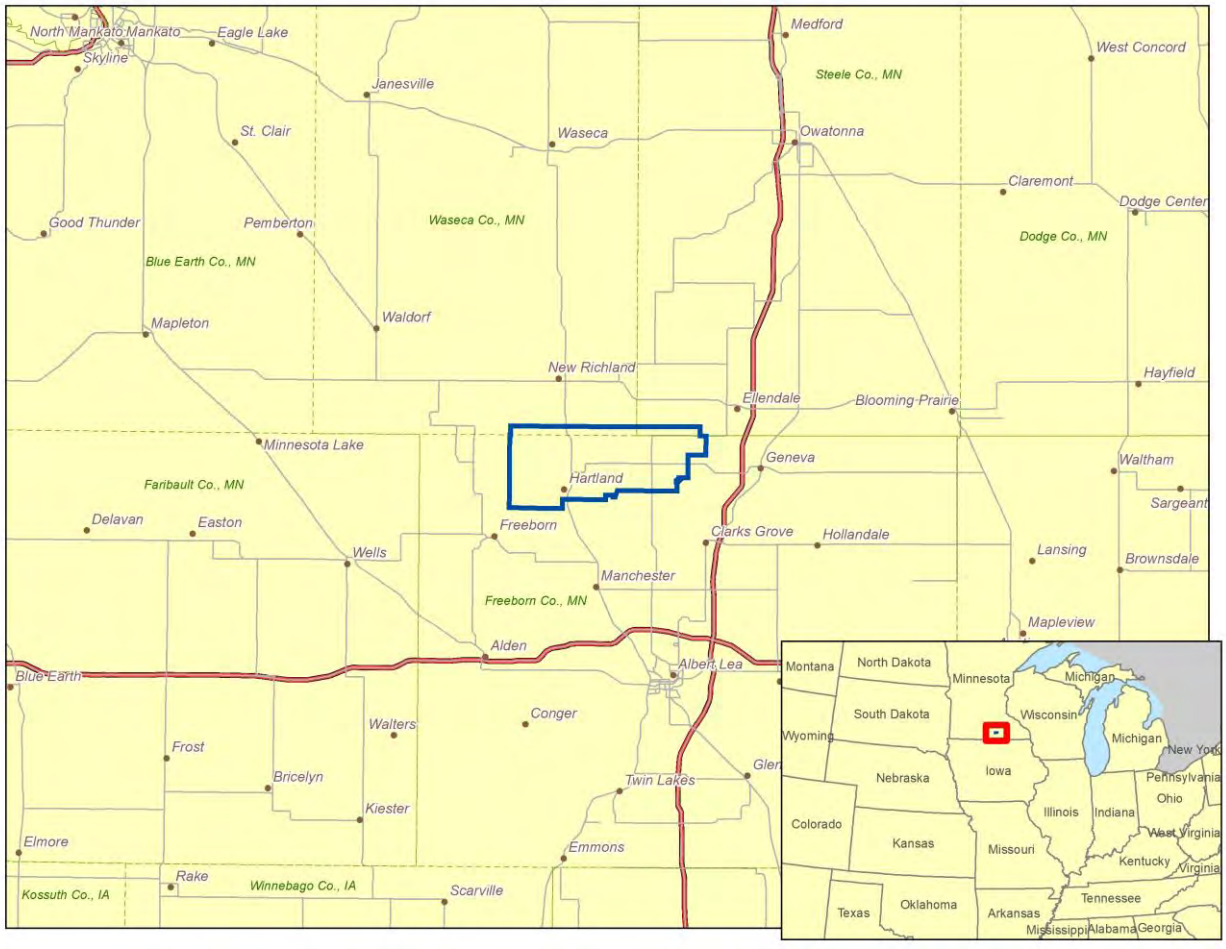

Figure 1: Location of Bent Tree North Wind Farm in the State of Minnesota

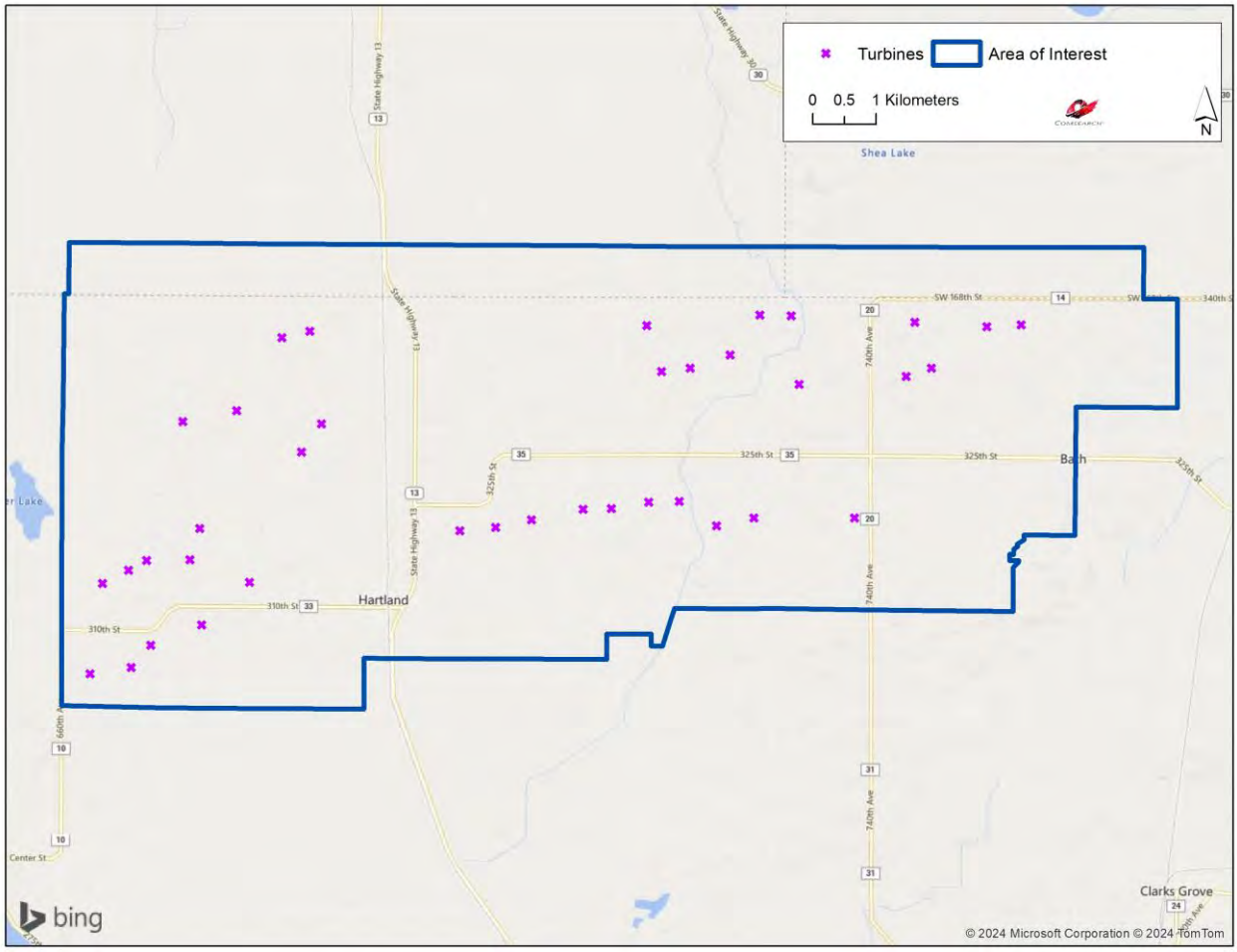

Figure 2: Location of Turbines within Bent Tree North Wind Farm

Turbine ID	Latitude (NAD83)	Longitude (NAD83)	Ground Elevation (m)	Maximum Blade Height Above Mean Sea Level (m)
T-01P	43.794073	-93.542707	379.78	559.78
T-02P	43.795012	-93.534635	374.29	554.29
T-03P	43.798199	-93.530837	375.66	555.66
T-04	43.801093	-93.520913	374.98	554.98
T-05P	43.807200	-93.511507	372.36	552.36
T-06	43.806923	-93.540371	369.48	549.48
T-07	43.808821	-93.535325	370.88	550.88
T-08ALT	43.810244	-93.531774	370.22	550.22
T-09	43.810384	-93.523245	380.23	560.22
T-10ALT	43.814820	-93.521384	380.83	560.83
T-11P	43.830042	-93.524840	374.34	554.34
T-12	43.831617	-93.514293	375.39	555.39
T-13	43.825792	-93.501464	370.94	550.94
T-14	43.829809	-93.497611	370.88	550.88
T-16	43.842093	-93.505438	370.20	550.20
T-17P	43.842984	-93.500010	375.97	555.97
T-18	43.814750	-93.470307	388.72	568.71
T-19	43.815266	-93.463294	384.99	564.99
T-20	43.816316	-93.456269	390.60	570.60
T-21	43.817863	-93.446150	388.65	568.65
T-22	43.818009	-93.440556	394.39	574.39
T-23	43.818945	-93.433256	397.51	577.51
T-24	43.819084	-93.427289	386.56	566.56
T-25	43.815644	-93.419914	387.20	567.20
T-26	43.816764	-93.412581	394.66	574.66
T-27	43.816872	-93.392841	384.59	564.59
T-28P	43.837570	-93.430857	390.78	570.78
T-29P	43.838050	-93.425259	392.89	572.89
T-30	43.839963	-93.417430	391.14	571.14
T-31	43.844064	-93.433823	390.85	570.85
T-32	43.845669	-93.411606	385.75	565.75
T-33	43.845580	-93.405442	384.97	564.97
T-34P	43.835841	-93.403851	382.95	562.95
T-35	43.837042	-93.382875	389.00	569.00
T-36PALT	43.838213	-93.377902	382.53	562.53
T-37ALT	43.844740	-93.381192	382.27	562.27

Turbine ID	Latitude (NAD83)	Longitude (NAD83)	Ground Elevation (m)	Maximum Blade Height Above Mean Sea Level (m)
T-38	43.844140	-93.367042	385.63	565.63
T-39	43.844459	-93.360319	386.70	566.70

Table 1: Wind Turbine Coordinates

3. Technical Data

Based on a preliminary analysis of the terrain within the vicinity of the project and taking into account the maximum height of the proposed wind turbines, a reasonable search radius for radar systems was established at 250 kilometers from the center of the project area. No commercial Doppler radar systems were identified within 250 kilometers of the project. Table 2 and Figure 3 contains the information on the NEXRAD radar systems found within 250 kilometers of the project.

ID	WBAN #	Station ID	Station Name	Latitude (NAD83)	Longitude (NAD83)	Elevation (ft)	Tower Height (m)	Distance to Nearest Turbine (km)
1	94983	KMPX	Minneapolis/St. Paul, MN	44.848889	-93.565556	946	30	111.85
2	94987	KARX	La Crosse, WI	43.822778	-91.191111	1276	20	174.42
3	94984	KDMX	Des Moines, IA	41.731111	-93.722778	981	30	229.56

Table 2: Location and Technical Data for NEXRAD Radar Systems within 250 Kilometers of the Bent Tree North Wind Farm

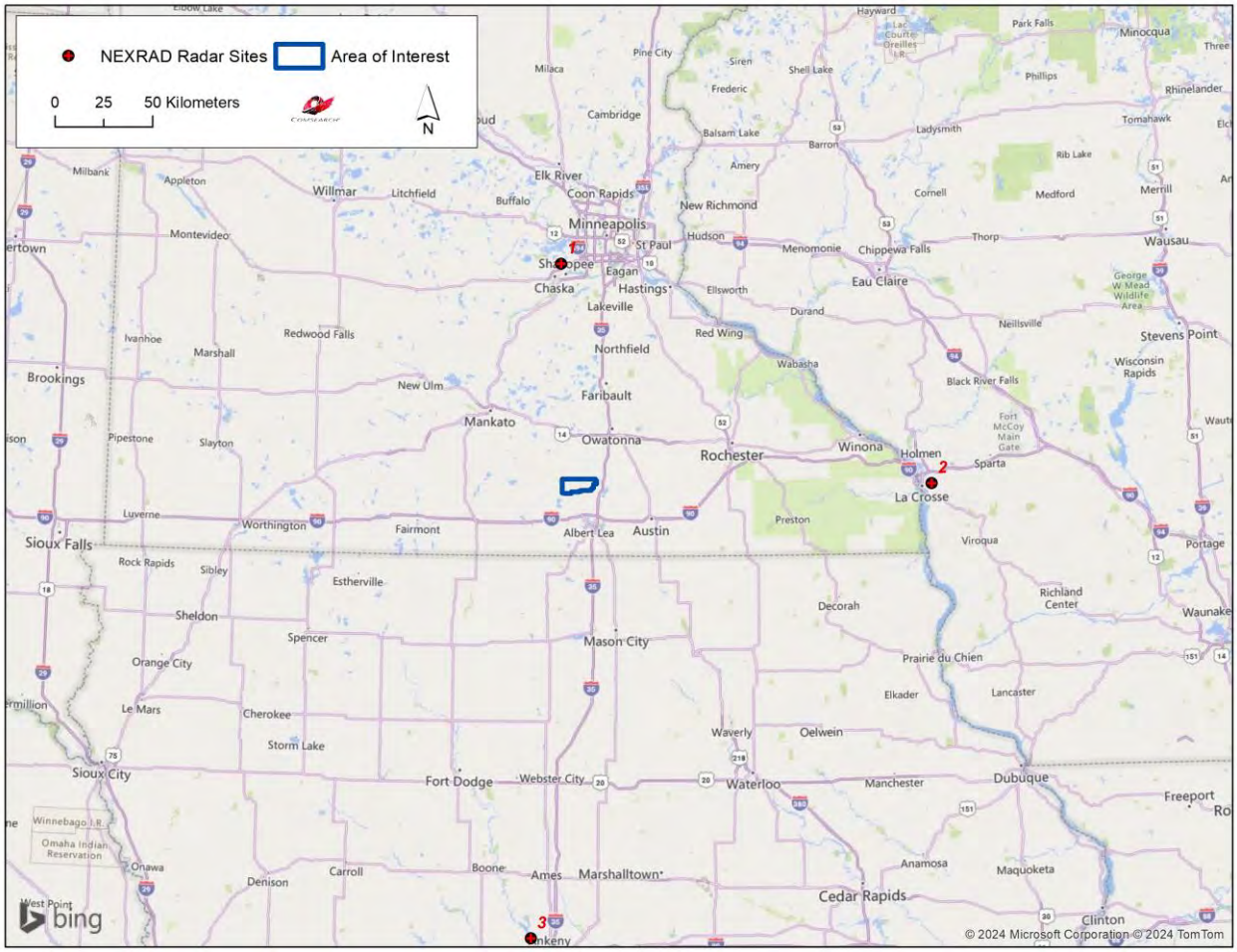

Figure 3: Location of NEXRAD Radar Systems within 250 Kilometers of the Bent Tree North Wind Farm

4. Impact Assessment

The technical approach to determine the potential impact of the turbines on the radar systems in the area is to calculate whether the wind turbines are in line-of-sight (LOS) of the radar systems. The wind turbines of the Bent Tree North Wind Farm have the potential to block radar coverage and produce false targets if the turbines are in line-of-sight of the radar systems' transmitted signals.

To verify the presence or absence of LOS conditions between the Bent Tree North Wind Farm energy project and the radar systems identified in Section 3, LOS coverage plots were generated for each of the radar systems. These plots identify the geographical regions that have LOS to a given radar by taking into account the height of the radar antenna, the maximum height of the wind turbine blades, the curvature of the earth, and potential refractivity in the atmosphere. The plots may be referenced in the Appendix section of this report.

According to the LOS coverage plots, the effective terrain elevations would block LOS between the antennas of all three radars and the wind project area. Therefore, LOS conditions would not exist between the radars and the wind turbines.

5. Conclusions

Based on the analysis described in this report, no radar systems in the vicinity of the Bent Tree North Wind Farm could be impacted by the project's planned wind turbines.

6. Contact

For questions or information regarding the Doppler Radar Study, please contact:

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Email:	David.Meyer@CommScope.com
Web site:	www.comsearch.com

Appendix

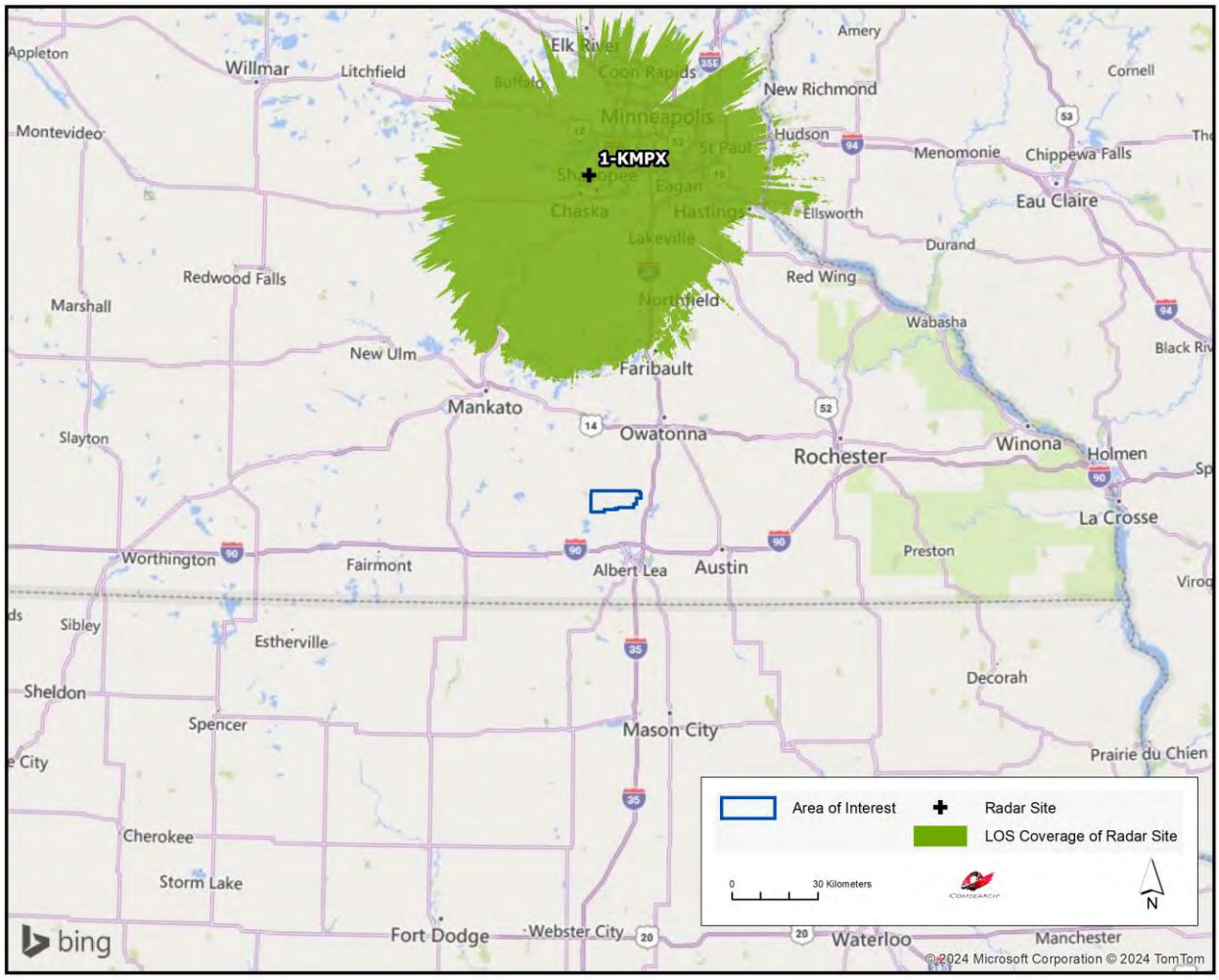

Figure A-1: Line-of-Sight Coverage of KMPX with Respect to Bent Tree North Wind Farm

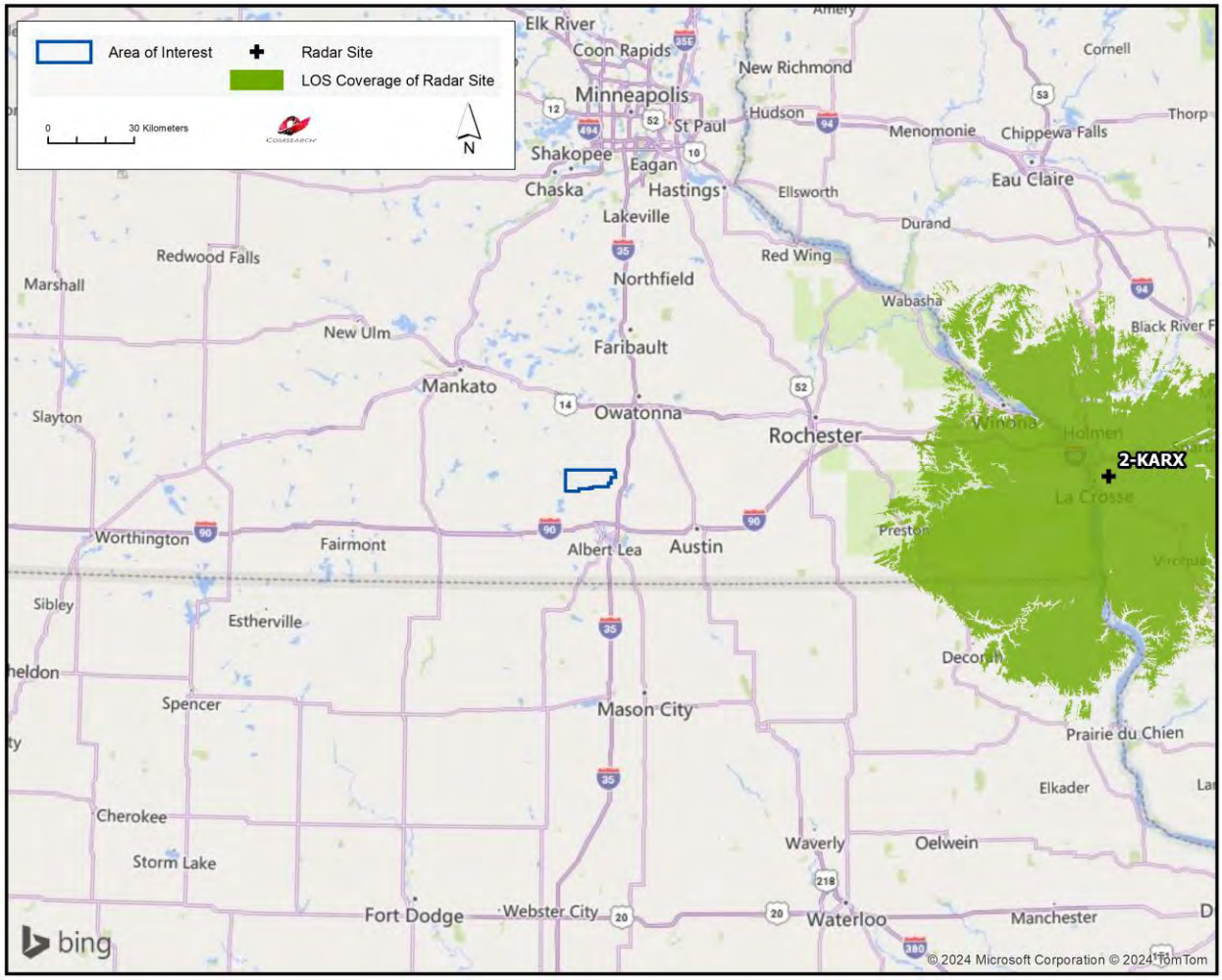

Figure A-2: Line-of-Sight Coverage of KARX with Respect to Bent Tree North Wind Farm

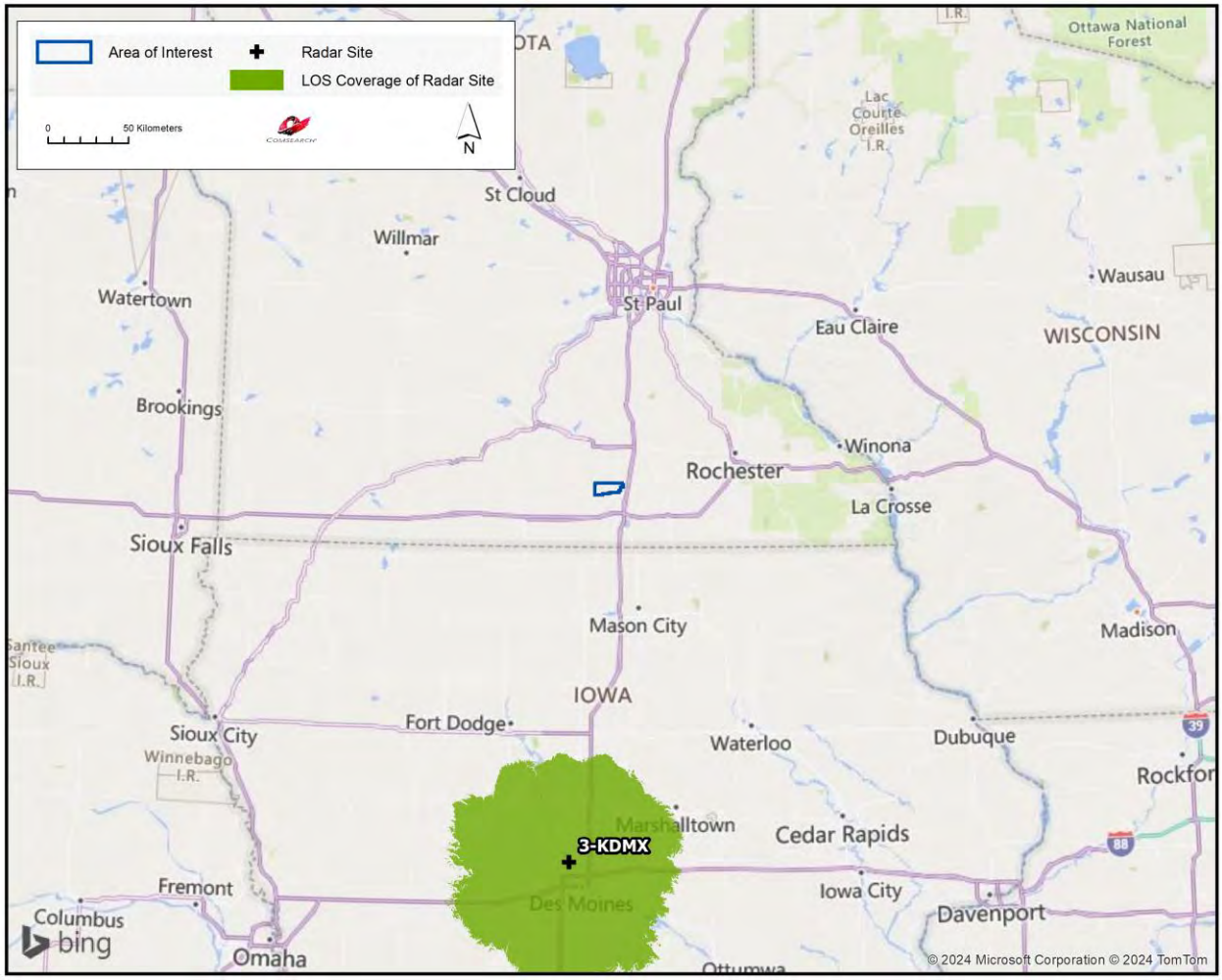

Figure A-3: Line-of-Sight Coverage of KDMX with Respect to Bent Tree North Wind Farm

Wind Power GeoPlanner™

Off-Air TV Analysis

Bent Tree North Wind Farm

Prepared on Behalf of
Wisconsin Power & Light
Company

June 10, 2024

COMSEARCH®
A CommScope Company

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 Bent Tree North Wind Farm wind project in Freeborn, Steele, and Waseca Counties, Minnesota. 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.

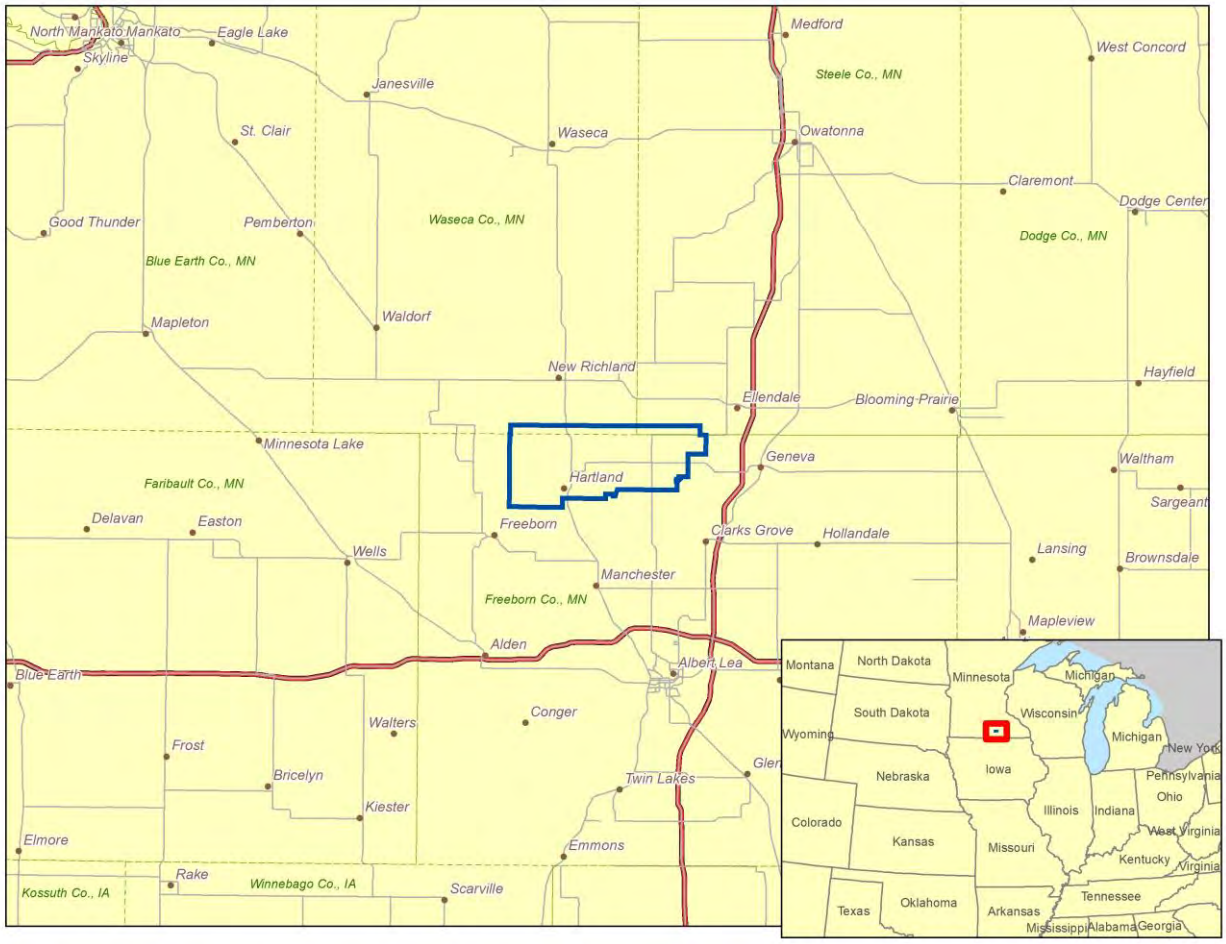

Figure 1: Wind Farm Project Area and Local Communities

To begin the analysis, Comsearch compiled all off-air television stations[1] within 150 kilometers of the proposed turbines. 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, on the next page, and a plot depicting their locations is provided in Figure 2. There are a total of 124 database records for stations within approximately 150 kilometers of the proposed turbines. Of these stations, 109 stations are currently licensed and operating, 90 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.

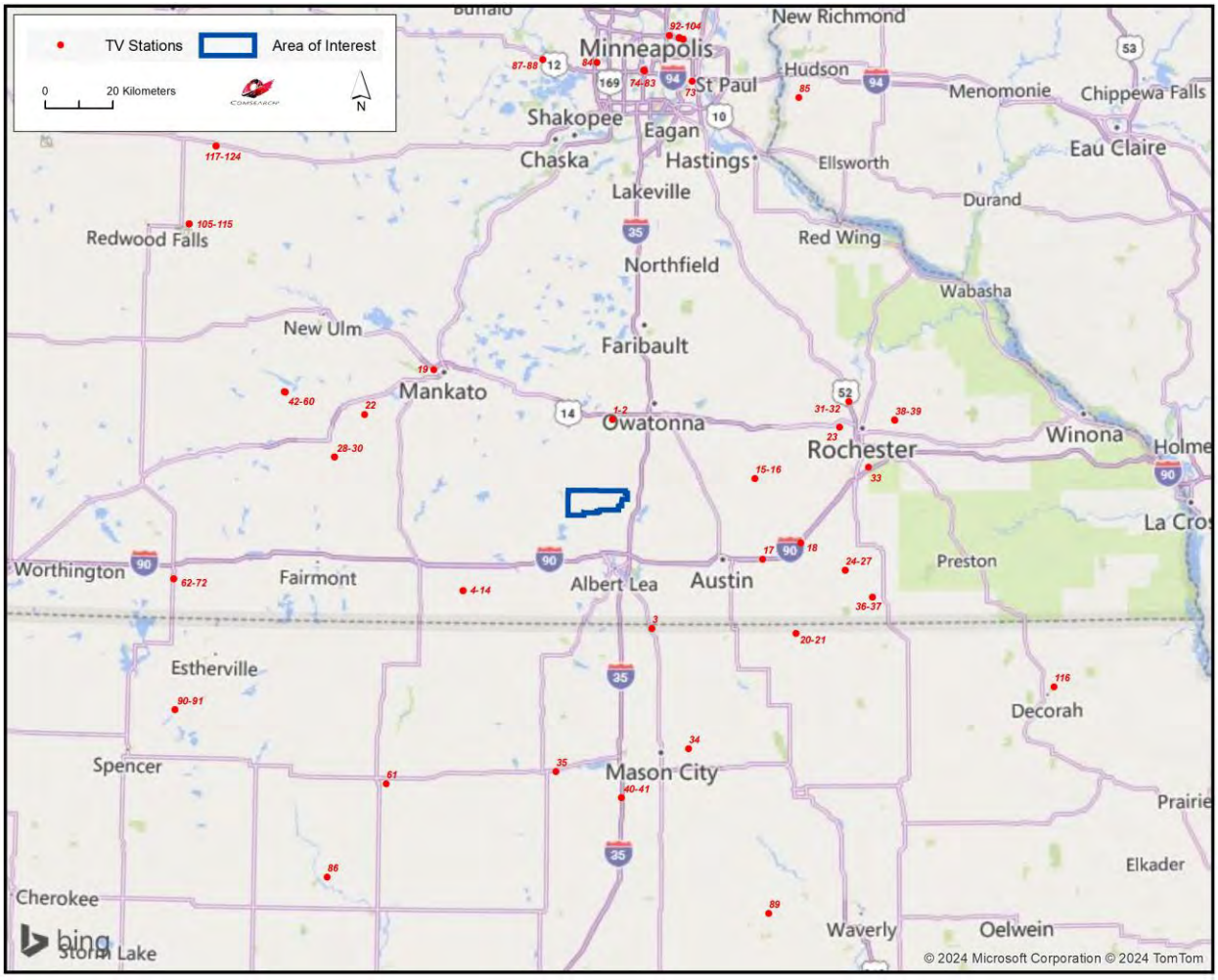

Figure 2: Plot of Off-Air TV Stations within 150 Kilometers of Proposed Turbines

[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 the Closest Turbine (km)
1	K21NU-D	CP	LPD	21	5.0	44.045528	-93.384083	22.27
2	K48KJ-D	LIC	LPD	48	4.92	44.045528	-93.384083	22.27
3	K30QY-D	LIC	LPD	30	0.8	43.488333	-93.236944	38.59
4	K14KD-D	LIC	LPD	14	3.0	43.585833	-93.929722	38.83
5	K16MA-D	LIC	LPT	16	3.0	43.585833	-93.929722	38.83
6	K17MX-D	LIC	LPD	17	3.0	43.585833	-93.929722	38.83
7	K19LJ-D	LIC	LPT	19	3.0	43.585833	-93.929722	38.83
8	K21KF-D	LIC	LPD	21	3.0	43.585833	-93.929722	38.83
9	K23FY-D	LIC	LPT	23	3.0	43.585833	-93.929722	38.83
10	K27FI-D	LIC	LPT	27	3.0	43.585833	-93.929722	38.83
11	K29IF-D	LIC	LPT	29	3.1	43.585833	-93.929722	38.83
12	K31EF-D	LIC	LPT	31	3.0	43.585833	-93.929722	38.83
13	K34NV-D	LIC	LPT	34	3.0	43.585833	-93.929722	38.83
14	K35IU-D	LIC	LPT	35	3.0	43.585833	-93.929722	38.83
15	W22FD-D	APP	LPD	22	6.0	43.888056	-92.857833	40.67
16	W22FD-D	LIC	LPD	22	0.3	43.888056	-92.857833	40.67
17	K27OW-D	LIC	LPT	27	5.62	43.672556	-92.830306	46.74
18	K30RA-D	CP	LPD	30	1.3	43.715806	-92.690000	55.80
19	K33MW-D	LIC	LPD	33	15.0	44.172778	-94.048056	56.65
20	KYIN	LIC	DTV	18	533.0	43.475556	-92.708333	66.65
21	KIMT	LIC	DTV	24	472.0	43.475556	-92.708333	66.65
22	K25QC-D	LIC	LPD	25	7.5	44.051639	-94.301444	66.87
23	K27OW-D	CP	LPT	27	15.0	44.024444	-92.545000	68.42

[2] Definitions of service and status codes:
ACA - Analog Class A
DCA - Digital Class A
DRT - Digital Replacement Translator
DT - ETL testing
DTS - Distributed Transmission System
DTV - Full Service Television
DTX - Digital TV Auxiliary
LPA - Low Power Analog TV
LPD - Low Power Digital TV
LPT - Digital TV Translator
LPX - Analog TV Translator
TS - Legacy Service for Analog TV Auxiliary
TV - Analog TV legacy

LIC – Licensed and operational station
CP – Construction permit granted
CP MOD – Modification of construction permit
APP – Application for construction permit, not yet operational
STA – Special transmit authorization, usually granted by FCC for temporary operation
AMD - Amendment

[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 the Closest Turbine (km)
24	KSMQ-TV	LIC	DTV	20	319.2	43.642778	-92.526667	70.76
25	KXLT-TV	LIC	DTV	26	108.0	43.642778	-92.526667	70.76
26	K35PC-D	LIC	LPD	35	8.7	43.642778	-92.526667	70.76
27	KAAL	LIC	DTV	36	620.0	43.642778	-92.526667	70.76
28	KMNF-LD	LIC	LPT	7	3.0	43.936750	-94.410833	71.41
29	KMNF-LD	CP	LPT	8	3.0	43.936750	-94.410833	71.41
30	KEYC-TV	LIC	DTV	12	52.7	43.936944	-94.410833	71.42
31	K29OE-D	CP	LPD	29	15.0	44.092222	-92.509444	73.59
32	K29OE-D	LIC	LPD	29	1.0	44.092222	-92.509444	73.59
33	K30RA-D	LIC	LPD	30	1.55	43.917250	-92.439083	74.45
34	K30QY-D	CP	LPD	30	15.0	43.168222	-93.101083	75.80
35	KAAL	LIC	DRT	33	8.3	43.105917	-93.585361	76.50
36	KTTC	LIC	DTV	10	43.1	43.570833	-92.427222	81.09
37	KTTC	CP	DTV	10	94.0	43.570833	-92.427222	81.09
38	K25NK-D	LIC	LPD	25	15.0	44.041139	-92.340417	84.71
39	K31LN-D	LIC	LPD	31	0.1	44.042194	-92.340722	84.72
40	K22LJ-D	LIC	LPD	22	0.4	43.037389	-93.346278	85.51
41	K35PA-D	LIC	LPD	35	0.6	43.037389	-93.346278	85.51
42	K14KE-D	LIC	LPD	14	2.0	44.106944	-94.595833	91.01
43	K26CS-D	LIC	LPT	26	1.7	44.106944	-94.595833	91.01
44	K28OH-D	LIC	LPD	28	0.5	44.106944	-94.595833	91.01
45	K30FN-D	LIC	LPD	30	2.0	44.106944	-94.595833	91.01
46	K32GX-D	LIC	LPD	32	1.2	44.106944	-94.595833	91.01
47	K34JX-D	LIC	LPD	34	2.0	44.106944	-94.595833	91.01
48	K16CG-D	LIC	LPD	16	1.8	44.107778	-94.598889	91.27
49	K17MW-D	LIC	LPD	17	0.5	44.107778	-94.598889	91.27
50	K18NE-D	LIC	LPT	18	0.6	44.107778	-94.598889	91.27
51	K19LI-D	LIC	LPD	19	0.5	44.107778	-94.598889	91.27
52	K20LP-D	LIC	LPD	20	1.3	44.107778	-94.598889	91.27
53	K21DG-D	LIC	LPD	21	1.2	44.107778	-94.598889	91.27
54	K22MQ-D	LIC	LPD	22	0.5	44.107778	-94.598889	91.27
55	K23MF-D	LIC	LPD	23	1.8	44.107778	-94.598889	91.27
56	K24JV-D	LIC	LPD	24	1.8	44.107778	-94.598889	91.27
57	K24JV-D	CP	LPD	24	0.35	44.107778	-94.598889	91.27
58	K29IE-D	LIC	LPT	29	3.0	44.107778	-94.598889	91.27
59	K31KV-D	LIC	LPD	31	1.8	44.107778	-94.598889	91.27
60	K35KI-D	LIC	LPD	35	1.8	44.107778	-94.598889	91.27
61	KDIT-LD	LIC	LPD	17	0.5	43.068056	-94.202500	96.71
62	K17MY-D	LIC	LPD	17	2.0	43.603333	-94.992778	118.76
63	K19HZ-D	LIC	LPT	19	3.1	43.603333	-94.992778	118.76
64	K22MY-D	LIC	LPD	22	1.9	43.603333	-94.992778	118.76
65	K23FO-D	LIC	LPT	23	3.1	43.603333	-94.992778	118.76

ID	Call Sign	Status	Service[2]	Channel	Transmit ERP[3] (kW)	Latitude (NAD 83)	Longitude (NAD 83)	Distance to the Closest Turbine (km)
66	K27NF-D	LIC	LPD	27	3.1	43.603333	-94.992778	118.76
67	K28OI-D	LIC	LPD	28	3.1	43.603333	-94.992778	118.76
68	K29LV-D	LIC	LPT	29	3.1	43.603333	-94.992778	118.76
69	K30KQ-D	LIC	LPD	30	2.1	43.603333	-94.992778	118.76
70	K31NT-D	LIC	LPT	31	3.1	43.603333	-94.992778	118.76
71	K34NU-D	LIC	LPT	34	3.1	43.603333	-94.992778	118.76
72	K35IZ-D	LIC	LPT	35	3.1	43.603333	-94.992778	118.76
73	KMWE-LD	LIC	LPD	17	15.0	44.946389	-93.091250	124.26
74	WUMN-LD	LIC	LPD	21	15.0	44.973583	-93.270500	125.62
75	K14RB-D	LIC	LPD	14	15.0	44.976111	-93.272500	125.89
76	KWJM-LD	LIC	LPD	15	15.0	44.976111	-93.272500	125.89
77	KMBD-LD	LIC	LPD	20	3.0	44.976111	-93.272500	125.89
78	KJNK-LD	STA	LPD	25	1.0	44.976111	-93.272500	125.89
79	KJNK-LD	LIC	LPD	25	15.0	44.976111	-93.272500	125.89
80	KJNK-LD	STA	LPD	25	1.0	44.976111	-93.272500	125.89
81	KJNK-LD	LIC	LPT	25	15.0	44.976111	-93.272500	125.89
82	K33LN-D	LIC	DCA	33	15.0	44.976111	-93.272500	125.89
83	KMQV-LD	LIC	LPD	36	15.0	44.976111	-93.272500	125.89
84	KKTW-LD	LIC	LPD	19	8.75	44.995583	-93.449056	127.76
85	W19EN-D	LIC	LPT	19	6.0	44.902778	-92.691111	129.08
86	KTIN	LIC	DTV	25	600.0	42.817417	-94.411639	129.35
87	KTCJ-LD	CP	LPD	13	3.0	45.002778	-93.651944	129.40
88	KHVM-LD	CP	LPD	18	15.0	45.002778	-93.651944	129.40
89	K17MH-D	LIC	LPD	17	11.7	42.729167	-92.811389	129.68
90	K18KG-D	LIC	LPD	18	6.9	43.255556	-94.976667	130.42
91	KBVK-LD	LIC	LPD	20	6.8	43.255556	-94.976667	130.42
92	KMSP-TV	LIC	DTV	9	36.2	45.058333	-93.124444	136.13
93	KTCI-TV	LIC	DTV	23	325.0	45.058333	-93.124444	136.13
94	WFTC	LIC	DTV	29	1000.0	45.058333	-93.124444	136.13
95	KTCA-TV	LIC	DTV	34	662.0	45.058333	-93.124444	136.13
96	WUCW	APP	DTV	22	790.0	45.062222	-93.139444	136.40
97	WUCW	LIC	DTV	22	790.0	45.062222	-93.139444	136.40
98	KSTP-TV	LIC	DTV	35	1000.0	45.062222	-93.139444	136.40
99	KSTC-TV	LIC	DTV	30	1000.0	45.062500	-93.139444	136.43
100	KARE	LIC	DTV	31	1000.0	45.062500	-93.139444	136.43
101	WCCO-TV	LIC	DTV	32	1000.0	45.062500	-93.139444	136.43
102	WDMI-LD	LIC	LPD	26	15.0	45.068639	-93.176417	136.76
103	KHVM-LD	LIC	LPD	48	15.0	45.068639	-93.176417	136.76
104	KTCJ-LD	LIC	LPD	50	15.0	45.068639	-93.176417	136.76
105	K15LS-D	LIC	LPT	15	0.37	44.549694	-94.966944	140.27
106	K16MV-D	LIC	LPT	16	0.5	44.549694	-94.966944	140.27
107	K17BV-D	LIC	LPT	17	0.398	44.549694	-94.966944	140.27

ID	Call Sign	Status	Service[2]	Channel	Transmit ERP[3] (kW)	Latitude (NAD 83)	Longitude (NAD 83)	Distance to the Closest Turbine (km)
108	K19CV-D	LIC	LPT	19	0.395	44.549694	-94.966944	140.27
109	K22KU-D	LIC	LPT	22	0.39	44.549694	-94.966944	140.27
110	K25II-D	LIC	LPT	25	0.387	44.549694	-94.966944	140.27
111	K28LL-D	LIC	LPT	28	0.382	44.549694	-94.966944	140.27
112	K29MQ-D	LIC	LPT	29	0.5	44.549694	-94.966944	140.27
113	K33LB-D	LIC	LPT	33	0.375	44.549694	-94.966944	140.27
114	K35NY-D	LIC	LPT	35	0.5	44.549694	-94.966944	140.27
115	K36KW-D	LIC	LPT	36	0.373	44.549694	-94.966944	140.27
116	K25PE-D	LIC	LPT	25	15.0	43.326667	-91.765833	140.99
117	K15LT-D	CP	LPD	15	1.0	44.759139	-94.873333	149.09
118	K18IR-D	LIC	LPT	18	0.79	44.759139	-94.873333	149.09
119	K20JY-D	LIC	LPT	20	0.79	44.759139	-94.873333	149.09
120	K21NS-D	LIC	LPT	21	0.79	44.759139	-94.873333	149.09
121	K23FP-D	LIC	LPT	23	0.79	44.759139	-94.873333	149.09
122	K31OR-D	LIC	LPT	31	0.79	44.759139	-94.873333	149.09
123	K34OZ-D	LIC	LPT	34	0.79	44.759139	-94.873333	149.09
124	K47JE-D	LIC	LPD	47	0.62	44.759139	-94.873333	149.09

Table 1: Off-Air TV Stations within 150 Kilometers of Proposed Turbines

3. Impact Assessment

Based on a contour analysis of the licensed stations within 150 kilometers of the Bent Tree North Wind Farm, it was determined that seven of the full-power digital stations, identified below in Table 2, along with thirteen low-power digital stations, may have their reception disrupted in and around the project. The areas primarily affected would include TV service locations within 10 kilometers of the turbines 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	Channel	Transmit ERP (kW)	Latitude (NAD 83)	Longitude (NAD 83)	Distance to the Closest Turbine (km)
4	K14KD-D	LIC	LPD	14	3.0	43.585833	-93.929722	38.83
5	K16MA-D	LIC	LPT	16	3.0	43.585833	-93.929722	38.83
6	K17MX-D	LIC	LPD	17	3.0	43.585833	-93.929722	38.83
7	K19LJ-D	LIC	LPT	19	3.0	43.585833	-93.929722	38.83
8	K21KF-D	LIC	LPD	21	3.0	43.585833	-93.929722	38.83
9	K23FY-D	LIC	LPT	23	3.0	43.585833	-93.929722	38.83
10	K27FI-D	LIC	LPT	27	3.0	43.585833	-93.929722	38.83
11	K29IF-D	LIC	LPT	29	3.1	43.585833	-93.929722	38.83
12	K31EF-D	LIC	LPT	31	3.0	43.585833	-93.929722	38.83
13	K34NV-D	LIC	LPT	34	3.0	43.585833	-93.929722	38.83
14	K35IU-D	LIC	LPT	35	3.0	43.585833	-93.929722	38.83
2	K48KJ-D	LIC	LPD	48	4.9	44.045528	-93.384083	22.27
27	KAAL	LIC	DTV	36	620.0	43.642778	-92.526667	70.76
30	KEYC-TV	LIC	DTV	12	52.7	43.936944	-94.410833	71.42
21	KIMT	LIC	DTV	24	472.0	43.475556	-92.708333	66.65
28	KMNF-LD	LIC	LPT	7	3.0	43.936750	-94.410833	71.41
24	KSMQ-TV	LIC	DTV	20	319.2	43.642778	-92.526667	70.76
36	KTTC	LIC	DTV	10	43.1	43.570833	-92.427222	81.09
25	KXLT-TV	LIC	DTV	26	108.0	43.642778	-92.526667	70.76
20	KYIN	LIC	DTV	18	533.0	43.475556	-92.708333	66.65

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

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

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