

Wind Power GeoPlanner™

Mobile Phone Carrier Report

Kansas Wind Farm



Prepared on Behalf of
National Renewable
Solutions

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1. Introduction

Comsearch has developed and maintains comprehensive technical databases containing information on licensed mobile phone carriers across the US. Mobile phone carriers operate in multiple frequency bands and are often referred to as Advanced Wireless Service (AWS), Personal Communication Service (PCS), 700 MHz Band, Wireless Communications Service (WCS), and Cellular. They hold licenses on an area-wide basis which are typically comprised of several counties.

This report focuses on the potential impact of wind turbines on mobile phone operations in and around the project area. Comsearch provides additional wind energy services, a description of which is available upon request.

2. Summary of Results

Methodology

Our mobile phone analysis was performed using Comsearch's proprietary carrier database, which is derived from a variety of sources including the Federal Communications Commission (FCC). Since mobile phone market boundaries differ from service to service, we disaggregated the carriers' licensed areas down to the county level. Then we compiled a list of all mobile phone carriers in the main counties that intersect the area of interest. The area of interest was defined by the client and encompasses the planned turbine locations. A depiction of the wind project area and counties appears below.

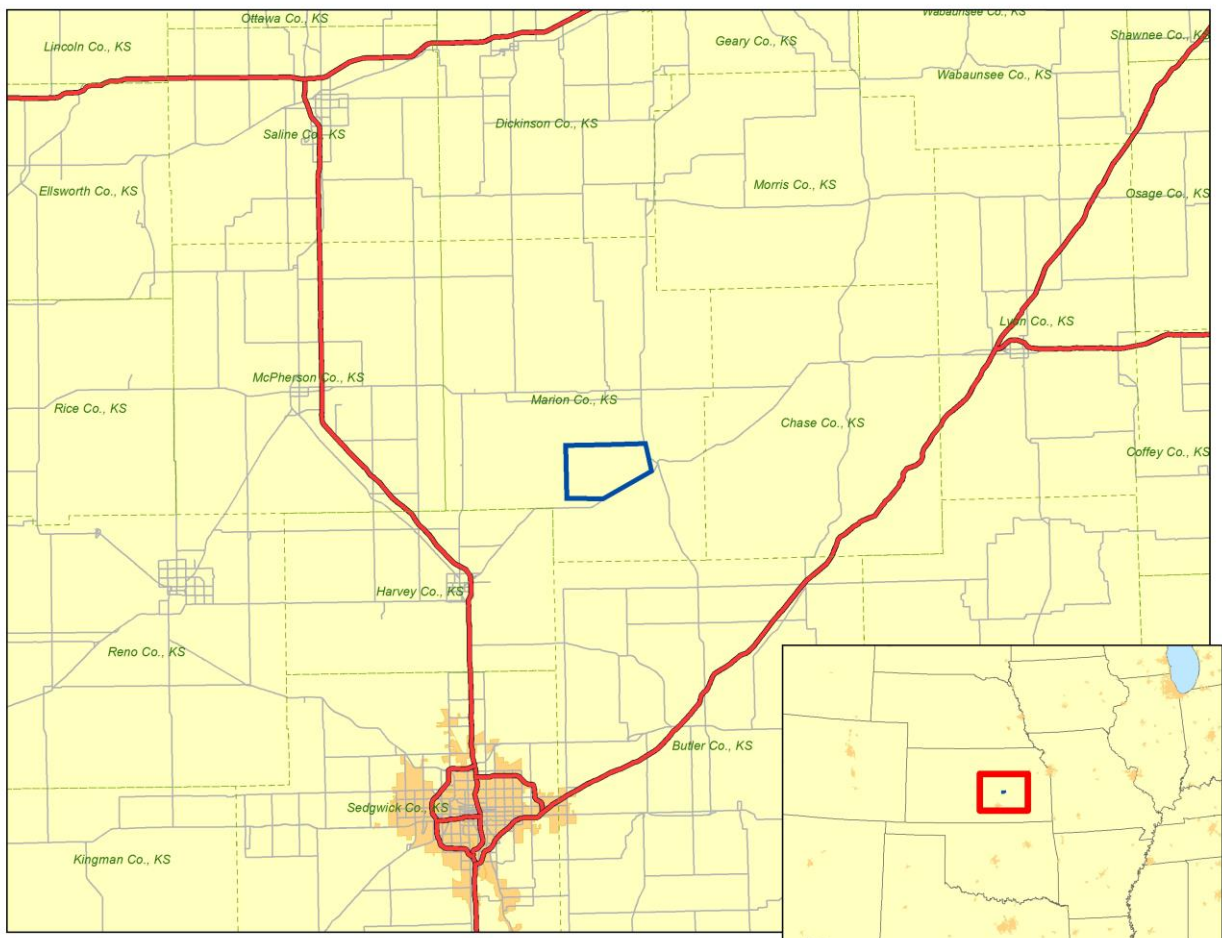


Figure 1: Counties that intersect the Area of Interest

Results

The Kansas Wind Farm Project is located in Marion County, Kansas. We have identified the type of service, channel block, market ID and FCC callsign for each carrier in the county of interest. A description of the various service types and geographic market areas is below with a summary table on the following page.

AWS

AWS licensees won their spectrum in an auction that started in August 2006. The licensees are authorized by 734 Cellular Market Areas (CMA) for Block A, 176 Economic Areas (BEA) for Blocks B and C, and 12 Regional Economic Area Groupings (REAG) for Blocks D, E and F. This spectrum at 1.7 and 2.1 GHz was allocated for mobile broadband and advanced wireless services. Partitioning and leases are permitted in the band.

Cellular

Licensees are authorized by Metropolitan and Rural Statistical Areas, also known as CMAs. Unserved areas can be covered by licensees other than the original A or B block licensee. To determine the most realistic coverage, we compiled the Cellular Geographic Service Areas (CGSA) from the 32 dBu contours defined by Part 22.911(a) of the FCC rules. Mobile services are provided at 800 MHz and partitioning and leases are permitted in the band.

PCS

There have been nine auctions for this band, with the last one being held in August 2008. Licensees are authorized by 51 Major Trading Areas (MTA) for Blocks A and B, 493 Basic Trading Areas (BTA) for Blocks C through F, and 176 Economic Areas (EA) for Block G. This band has been heavily partitioned and disaggregated both by counties and by smaller polygons within counties (known as undefined areas or partial counties). The 1.9 GHz PCS carriers provide mobile services and leases are permitted in the band.

700 MHz Band

Originally used for analog television broadcasting, this band consists of an upper and lower band, each having its own set of frequency blocks. There have been three auctions in this band with the last one (Auction 73) being held in 2008 and mobile phone carriers eventually winning licenses for Blocks A, B, and C of the Lower 700 MHz band and Block C of the Upper 700 MHz band. Licensees are authorized by 176 Economic Areas (EA) for Lower Block A, 734 Cellular Market Areas (CMA) for Lower Blocks B and C, and 12 Regional Economic Area Groupings (REAG) for Upper Block C. Partitioning and leases are permitted in the band.

WCS

Mobile services provided in the 2.3 GHz band occupy frequency blocks above and below the spectrum allocated for Satellite Digital Audio Radio Service (SDARS) from 2320 MHz to 2345 MHz. WCS licensees are authorized by 52 Major Economic Areas (MEA) for Blocks A and B and 12 Regional Economic Area Groupings (REAG) for Blocks C and D. Partitioning and leases are permitted in the band.

Service ¹	Mobile Phone Carrier	Channel Block	County	ST	Market ID	Callsign
AWS	AT&T	A	Marion	KS	CMA435	WQGB409
AWS	Verizon	B	Marion	KS	BEA122	WQGA996
AWS	T-Mobile	C	Marion	KS	BEA122	WQGB367
AWS	AT&T	D	Marion	KS	REA005	WQGA787
AWS	AT&T	E	Marion	KS	REA005	WQGD769
AWS	T-Mobile	F	Marion	KS	REA005	WQGB378
Cellular	US Cellular	A	Marion	KS	CMA435	KNKN563
Cellular	Verizon	B	Marion	KS	CMA435	KNKN590
PCS	AT&T	A	Marion	KS	MTA046	KNLF291
PCS	US Cellular	A	Marion	KS	MTA046	WQKQ521
PCS	Nex-Tech Wireless	A	Marion	KS	MTA046	WRAQ636
PCS	Sprint	B	Marion	KS	MTA046	KNLF292
PCS	AT&T	C	Marion	KS	BTA472	WPOK606
PCS	AT&T	C	Marion	KS	BTA472	WPQW517
PCS	T-Mobile	C	Marion	KS	BTA472	WRAB214
PCS	Verizon	D	Marion	KS	BTA472	WPYQ943
PCS	Verizon	D	Marion	KS	BTA472	WQBI452
PCS	AT&T	E	Marion	KS	BTA472	KNLG905
PCS	AT&T	F	Marion	KS	BTA472	KNLF991
PCS	Sprint	G	Marion	KS	BEA122	WQKT230
700 MHz	US Cellular	Lower A	Marion	KS	BEA122	WQIZ541
700 MHz	US Cellular	Lower B	Marion	KS	CMA435	WQJQ763
700 MHz	Nex-Tech Wireless	Lower C	Marion	KS	CMA435	WPWV480
700 MHz	AT&T	Lower D	Marion	KS	EAG705	WPZA239
700 MHz	DISH Network	Lower E	Marion	KS	BEA122	WQJZ264
700 MHz	Verizon	Upper C	Marion	KS	REA005	WQJQ693
WCS	AT&T	A	Marion	KS	MEA035	KNLB250
WCS	AT&T	B	Marion	KS	MEA035	KNLB211
WCS	AT&T	C	Marion	KS	REA005	KNLB298
WCS	AT&T	D	Marion	KS	REA005	KNLB299

Table 1: Mobile Phone Carriers in the Area of Interest

¹ AWS: Advanced Wireless Service at 1.7/2.1 GHz
 CELL: Cellular Service at 800 MHz
 PCS: Personal Communication Service at 1.9 GHz
 700 MHz: Commercial Mobile Phone at 700 MHz
 WCS: Wireless Communication Service at 2.3 GHz

FCC-Licensed Sites

For competitive and confidentiality reasons, most mobile phone carriers' individual sites are not licensed with the FCC. However, in the cellular band, if a base station extends the existing Cellular Geographic Service Area (CGSA), then it must be recorded with the FCC. We identified five cellular sites near the Kansas Wind Farm area of interest. Figure 2 on the next page depicts its location in relation to the area of interest and Table 2 contains the technical parameters on the FCC license.

Callsign	Licensee	Structure Height to Tip (m)	ASR Number	Location Address	Latitude (NAD83)	Longitude (NAD83)	Distance to the Closest Turbine (m)
KNKN563	US-Cellular	151.2	1001772	NE 1/4 NE 1/4 Section 3, Township 20 S, Range 3 E	38.346139	-97.079750	8387
KNKN590	Verizon	54.3		(Peabody) 111 South Maple	38.164667	-97.104694	3561
KNKN590	Verizon	54.3	1221280	2466 150th	38.246000	-96.939306	3625
KNKN590	Verizon	142.3	1032373	(Marion) 1869 210th	38.374194	-97.043167	12055
KNKN590	Verizon	45.4	1240667	NEC 3RD STREET & ASH	38.360333	-97.204000	13044

Table 2: FCC-Licensed Mobile Phone Sites

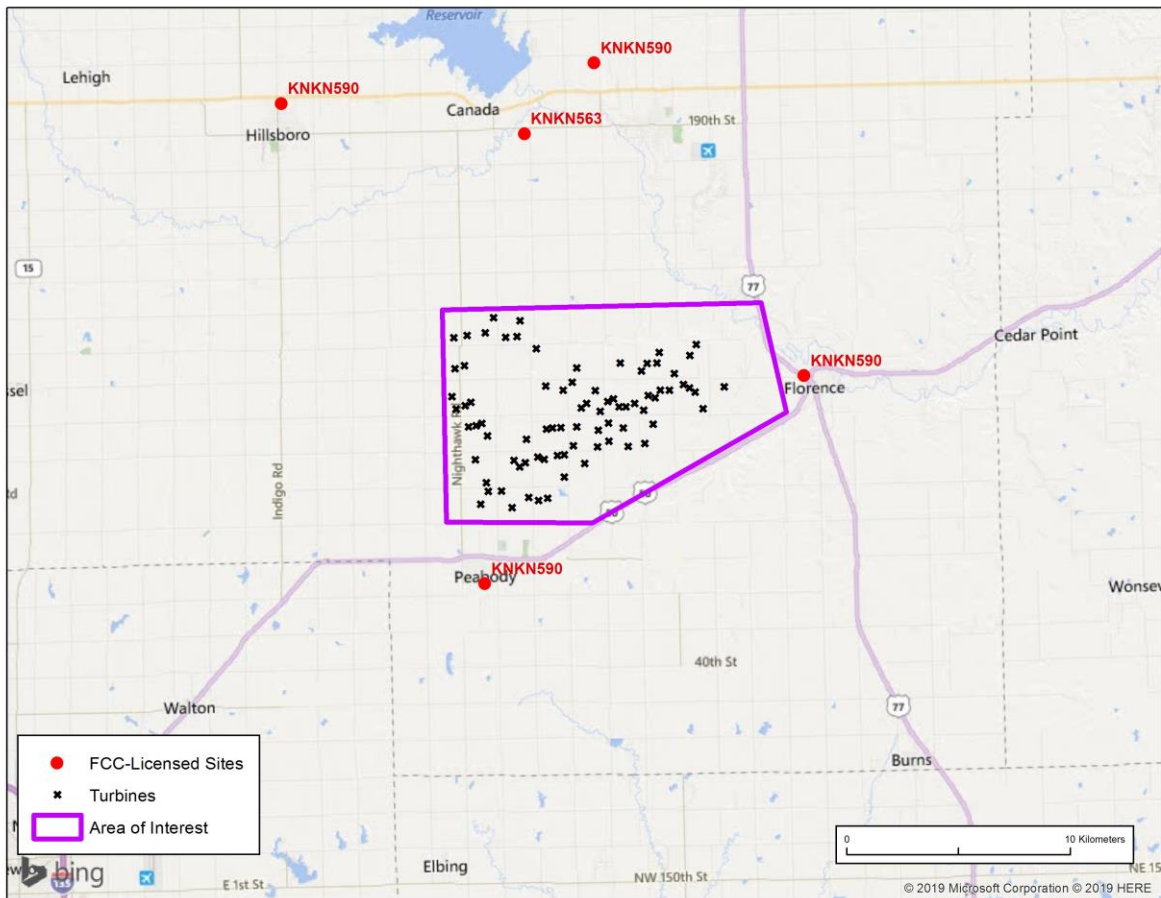


Figure 2: FCC-Licensed Mobile Phone Sites near the Area of Interest

Impact Assessment and Distance Setback Requirements

The cellular mobile phone signal propagation is typically not affected by physical structures because the beam widths of the radiated signal from the base stations and mobile units are very wide and the wavelength of the signal is long enough to wrap around objects such as wind turbine towers and blades. In addition, the cellular network consists of multiple base stations that are designed so that if the connection cannot be made to one base station it will shift to adjacent base stations to make the connection. This enables cellular mobile telephone systems to provide coverage in areas that are congested with physical structures such as downtown urban areas. Areas containing wind turbines have less of a coverage issue than urban areas, so the wind turbines presence does not require any special setback for signal obstruction consideration other than physical clearance of the blades. From an electromagnetic interference standpoint, the emissions from the wind turbines, which are specified by the FCC, should be taken into account to ensure they will not interfere with the base stations or the mobile units. Part 15 of the FCC regulations covers the emissions from unintentional radiating devices, such as wind turbines. The field strength limits for the emissions from unintentional radiators is given in paragraph 15.109 of Part 15 of the FCC rules. The emission limits are stated for a distance of 3 meters or approximately 10 feet and are shown below.

Radiated Emission Limits at 3 Meters

<u>Frequency of Emission (MHz)</u>	<u>Field Strength (microVolts/meter)</u>
30 – 88	100
88 – 216	150
216 – 960	200
> 960	500

From these limits and the receiver sensitivity of the cellular base stations and mobile units we can determine a setback requirement for wind turbines and cellular system. The typical sensitivity of mobile units is -90 dBm (1×10^{-12} Watts) and the typical sensitivity of base stations is -93 dBm (5×10^{-13} Watts). The gain of mobile unit antennas are -10dB or 0.1 and the gain of base station antennas are 17 dB or 50. The effective area (A) of the mobile unit and base station antennas are determined from the following formula.

$$A = G \cdot \lambda^2 / 4 \cdot \pi$$

Where,

G = Antenna Gain, number

λ = Wavelength, 0.353 meters

π = 3.14

This gives us an effective area for the mobile unit antenna of 9.9×10^{-4} meter² and the effective area for the base station antenna of 0.496 meter². Using the typical receiver sensitivities of the mobile and base units above, we can determine their power flux density (P_D) from the following formula:

$$P_D = S/A$$

Where S is defined as the sensitivity for Mobile Unit or for the Base Station expressed in Watts

To calculate the electric field strength (E) we use the following formula:

$$E = (P_D * 377)^{1/2}$$

So for the mobile unit, $P_D = 1.01 \times 10^{-9}$ Watts/meter² and $E = 617$ microVolts/meter. And, for the base station unit, $P_D = 1.008 \times 10^{-12}$ Watts/meter² and $E = 19.4$ microVolts/meter.

These results show that the mobile units' sensitivity expressed as field strength is above the level allowed as an emission for the wind turbines at a distance of 3 meters. Therefore, no setback for the use of a mobile unit is needed beyond 3 meters. Since the base station has field strength sensitivity below the allowed emission level of the wind turbines a setback distance is needed to ensure that the base stations will not be affected. The field strength of the emission is inversely proportional to separation distance in meters. To determine the setback distance to reduce the field strength to 19.4 microVolts/meter the following formula is used.

$$D = (500 \text{ MicroVolts/meter}) * (3 \text{ meters}) / 19.4 \text{ MicroVolts/meter}$$

Where,

D = Setback Distance for Base Station to avoid interference, meters

Thus the setback distance for the cellular tower base station from the wind turbines should be 77.3 meters or greater.

Summary

The telephone communications in the mobile phone carrier bands are typically unaffected by the presence of the wind turbines and we do not anticipate any significant harmful effect to mobile phone services in the Kansas Wind Farm area. Mobile phone systems are designed with multiple base transmitter stations covering a specific area. Since mobile telephone signals are designed with overlap between adjacent base transmitter sites in order to provide handoff between cells, any signal blockage caused by the wind turbines does not materially degrade the reception because the end user may be receiving from multiple transmitter locations. For example, if a particular turbine attenuates the signal reception into a mobile phone, the phone may receive an alternate signal from a different transmit location, resulting in no disruption in service. Mobile phone systems that are implemented in urban areas near large structures and buildings often have to combat even more problematic signal attenuation and reflection conditions than rural areas containing a wind energy turbine facility.

For the cellular towers located within the project area, no setback distance is required from an interference standpoint other than physical clearance of the blades. From an electromagnetic

standpoint, a setback distance of 77.3 meters should be used to meet FCC emission requirements.

In the unlikely event that a mobile phone carrier believes their coverage has been compromised by the presence of the wind energy facility, they have many options to improve their signal coverage to the area through optimization of a nearby base transmitter or even adding a new sector or cell site. Utility towers, meteorological towers or even the turbine towers within the wind project area can serve as the platform for a base transmit site or cell enhancer.

3. Contact Us

For questions or information regarding the Mobile Phone Carrier Report, please contact:

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