



Badger Wind Farm

TV Signal Baseline Measurements

Badger Wind, LLC

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Proposed Exhibit 17 - TV Reception Baseline Study
Badger Wind, LLC
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Task and objective:

Complete pre-construction measurements of off-air digital TV broadcast signal strength at the Badger Wind Farm project, located in Logan and McIntosh Counties, North Dakota.

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Issue	Date	Reason for Issue	Prepared by	Verified by	Approved by
A	1 June 2022		F. Gagnon	A. Nercessian	K. Peters

1 INTRODUCTION

Badger Wind LLC (“Badger Wind” or the “Customer”) has requested that DNV provide support for the Badger Wind Project in Logan & McIntosh Counties, North Dakota (the “Project”). The Project is located approximately 60 miles southeast of Bismarck, North Dakota.

DNV completed pre-construction baseline measurements of off-air digital TV broadcast signal strengths in population centers around the project area. As concluded in a previous report¹, five TV channels were of concern (Channels 7, 11, 12, 20, and 31). This report includes a description of the methodology and results of these measurements.

2 METHODOLOGY

DNV mapped the broadcast signal contours based on publicly available data² for the five channels to help identify the most likely communities that could experience interference from the Project and appropriate measurement locations (Figure 1).

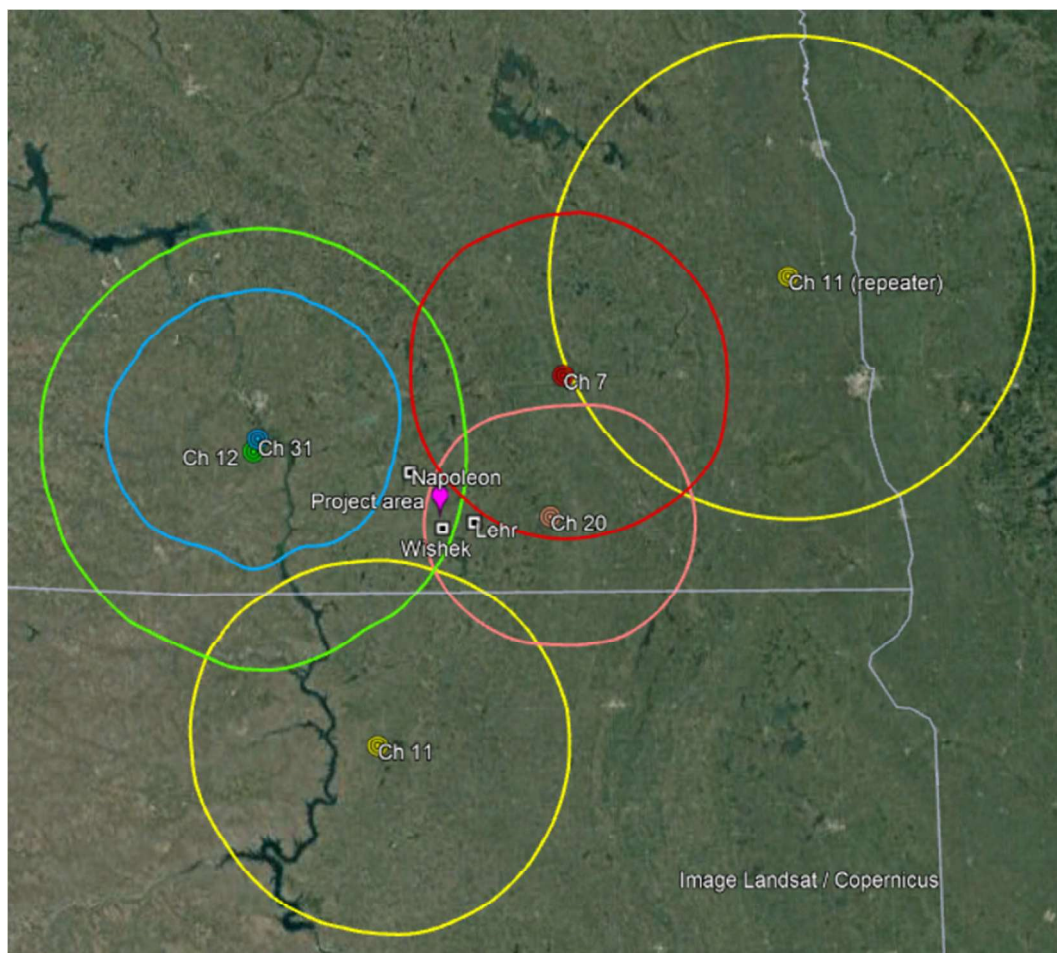


Figure 2-1 Broadcast antenna location and signal contour for the channels of concern

¹ Comsearch, Off-Air TV Analysis, Badger Wind, 20 January 2022.

² Federal Communications Commission, TV Service Contour Data Points, Consulted online in May 2022.
[https://www.fcc.gov/media/television/tv-service-contour-data-points#:~:text=Using%20the%20FCC%27s%20F\(50,elevation%20of%20that%20same%20radial.](https://www.fcc.gov/media/television/tv-service-contour-data-points#:~:text=Using%20the%20FCC%27s%20F(50,elevation%20of%20that%20same%20radial.)

Based on these contours, measurements were taken at three locations within and around each of the communities of Wishek, Lehr and Napoleon. The coordinates of the measurement points are provided in Table 2-1, and illustrated in Figure 2-2, Figure 2-3, and Figure 2-4.

Table 2-1 Measurement point locations

Town	Location	Measurement point	Latitude (NAD83)	Longitude (NAD83)
Wishek	West	1	46° 15' 33.55"N	99° 34' 7.64"W
	Center	2	46° 15' 31.69"N	99° 33' 17.67"W
	East	3	46° 15' 33.02"N	99° 32' 37.84"W
Lehr	North	4	46° 17' 14.15"N	99° 21' 4.29"W
	Center	5	46° 16' 50.29"N	99° 21' 10.73"W
	South	6	46° 16' 42.80"N	99° 21' 7.93"W
Napoleon	West	7	46° 30' 30.06"N	99° 46' 36.95"W
	Center	8	46° 30' 9.22"N	99° 46' 8.16"W
	East	9	46° 30' 3.55"N	99° 45' 31.08"W



Figure 2-2 Location of measurement points - Wishek

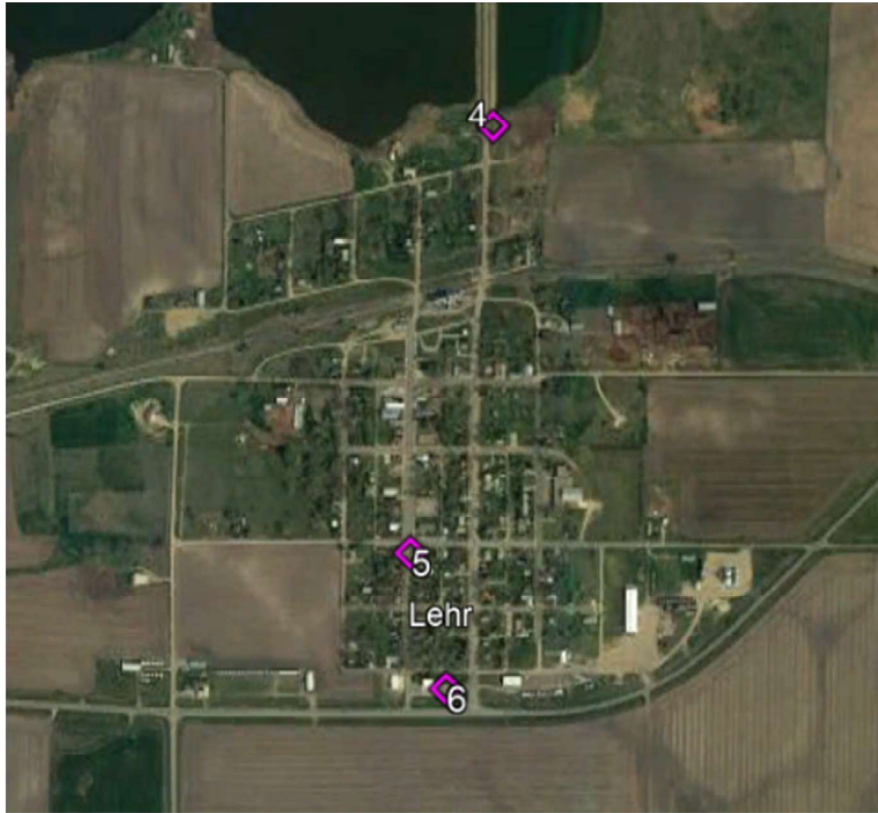


Figure 2-3 Location of measurement points - Lehr

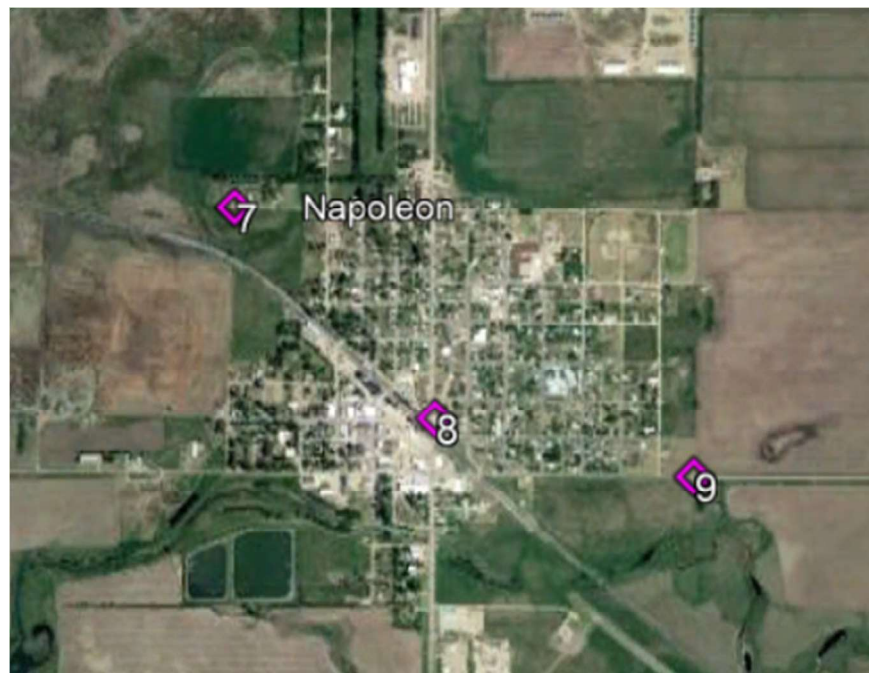


Figure 2-4 Location of measurement points - Napoleon

Signal strength measurements were taken by Scantech Inc. with a Radio Frequency (RF) Explorer spectrum analyzer (Model: WSUB1G+) connected to a laptop. A portable digital TV set to pick up channels on AutoScan was also used as a secondary qualitative indication of practical signal reception to evaluate signal strength. A low-gain antenna was installed on a non-conductive tripod and connected to the spectrum analyzer and portable TV with a 6-inch RG6 triple shielded coaxial cable.

TV signal strength was recorded in decibel-milliwatts (dBm), which uses 0 dBm as a reference for 1 milliWatt RF of power. The more negative the number the weaker the signal. As the reception of off-air digital TV signals is not only dependent of the absolute signal strength but also the signal to noise ratio, the RF noise level was also recorded.

The frequency bands for spectral analysis were identified from the Federal Communications Commission database³ (Table 2-2).

Table 2-2 FCC frequency bands and antenna locations of the channels of concern

Channel	Call sign	Frequency band	Latitude (NAD83)	Longitude (NAD83)
7	KJRR	174 - 180 MHz	46°55'27.00"N	98°46'20.00"W
11	KQSD-TV	198 - 204 MHz	45°16'38.00"N	99°59'11.00"W
11 (repeater)	KQSD-TV	198 - 204 MHz	47°20'31.54"N	97°17'20.46"W
12	KXMB-TV	204 - 210 MHz	46°35'23.00"N	100°48'22.00"W
20	KJRE	506 - 512 MHz	46°17'56.00"N	98°51'57.00"W
31	KFYR-TV	572 - 578 MHz	46°36'20.30"N	100°48'26.40"W

All measurements were taken on 28 May 2022. The weather was cool (approximately 51° Fahrenheit [F]) with intermittent light rain and winds from the northwest averaging 12 miles per hour (mph).

3 RESULTS

The off-air digital TV signal strengths of each channel are presented in Table 3-1 for Wishek, for Lehr and Table 3-3 for Napoleon. In Wishek and Lehr, none of the five channels had a signal to noise ratio sufficiently high for the portable TV to detect. In Napoleon, only channels 12 and 31 had signal to noise ratios high enough for the portable TV to detect.

Table 3-1 TV signal strengths in Wishek

Channel	Signal	Location 1	Location 2	Location 3
7	Absolute Strength (dBm)	-113 dBm	-113 dBm	-113 dBm
	Noise strength (dBm)	-113 dBm	-113 dBm	-113 dBm
	Signal to noise ratio	0 dBm	0 dBm	0 dBm
	TV AutoScan Detection	No	No	No
11	Absolute Strength (dBm)	-113 dBm	-113 dBm	-113 dBm
	Noise strength (dBm)	-113 dBm	-113 dBm	-113 dBm
	Signal to noise ratio	0 dBm	0 dBm	0 dBm
	TV AutoScan Detection	No	No	No

³ Federal Communications Commission, Licensing & Databases Public Inspection File. Online: Consulted in May 2022. [HTTPS://PUBLICFILES.FCC.GOV/](https://publicfiles.fcc.gov/)

Channel	Signal	Location 1	Location 2	Location 3
12	Absolute Strength (dBm)	-109 dBm	-113 dBm	-110 dBm
	Noise strength (dBm)	-113 dBm	-113 dBm	-114 dBm
	Signal to noise ratio	4 dBm	0 dBm	4 dBm
	TV AutoScan Detection	No	No	No
20	Absolute Strength (dBm)	-111 dBm	-110 dBm	-96 dBm
	Noise strength (dBm)	-111 dBm	-110 dBm	-109 dBm
	Signal to noise ratio	0 dBm	0 dBm	13 dBm
	TV AutoScan Detection	No	No	Yes
31	Absolute Strength (dBm)	-103 dBm	-103 dBm	-103 dBm
	Noise strength (dBm)	-111 dBm	-111 dBm	-110 dBm
	Signal to noise ratio	8 dBm	-8 dBm	7 dBm
	TV AutoScan Detection	No	No	Yes

Table 3-2 TV signal strengths in Lehr

Channel	Signal	Location 1	Location 2	Location 3
7	Absolute Strength (dBm)	-113 dBm	-110 dBm	-113 dBm
	Noise strength (dBm)	-113 dBm	-113 dBm	-113 dBm
	Signal to noise ratio	0 dBm	3 dBm	0 dBm
	TV AutoScan Detection	No	No	No
11	Absolute Strength (dBm)	-113 dBm	-112 dBm	-113 dBm
	Noise strength (dBm)	-113 dBm	-113 dBm	-113 dBm
	Signal to noise ratio	0 dBm	1 dBm	0 dBm
	TV AutoScan Detection	No	No	No
12	Absolute Strength (dBm)	-110 dBm	-111 dBm	-113 dBm
	Noise strength (dBm)	-113 dBm	-113 dBm	-113 dBm
	Signal to noise ratio	3 dBm	2 dBm	0 dBm
	TV AutoScan Detection	No	No	No
20	Absolute Strength (dBm)	-106 dBm	-107 dBm	-109 dBm
	Noise strength (dBm)	-110 dBm	-111 dBm	-110 dBm
	Signal to noise ratio	4 dBm	4 dBm	1 dBm
	TV AutoScan Detection	No	No	No
31	Absolute Strength (dBm)	-107 dBm	-113 dBm	-100 dBm
	Noise strength (dBm)	-110 dBm	-111 dBm	-111 dBm
	Signal to noise ratio	3 dBm	2 dBm	1 dBm
	TV AutoScan Detection	No	No	No

Table 3-3 TV signal strengths in Napoleon

Channel	Signal	Location 1	Location 2	Location 3
7	Absolute Strength (dBm)	-113 dBm	-113 dBm	-113 dBm
	Noise strength (dBm)	-113 dBm	-113 dBm	-113 dBm
	Signal to noise ratio	0 dBm	0 dBm	0 dBm
	TV AutoScan Detection	No	No	No
11	Absolute Strength (dBm)	-113 dBm	-112 dBm	-113 dBm
	Noise strength (dBm)	-113 dBm	-113 dBm	-113 dBm
	Signal to noise ratio	0 dBm	1 dBm	0 dBm
	TV AutoScan Detection	No	No	No
12	Absolute Strength (dBm)	-91 dBm	-92 dBm	-92 dBm
	Noise strength (dBm)	-113 dBm	-113 dBm	-113 dBm
	Signal to noise ratio	22 dBm	21 dBm	21 dBm
	TV AutoScan Detection	Yes	Yes	Yes
20	Absolute Strength (dBm)	-111 dBm	-110 dBm	-110 dBm
	Noise strength (dBm)	-111 dBm	-111 dBm	-111 dBm
	Signal to noise ratio	0 dBm	1 dBm	1 dBm
	TV AutoScan Detection	No	No	No
31	Absolute Strength (dBm)	-83 dBm	-90 dBm	-80 dBm
	Noise strength (dBm)	-110 dBm	-111 dBm	-110 dBm
	Signal to noise ratio	27 dBm	21 dBm	30 dBm
	TV AutoScan Detection	Yes	Yes	Yes

Signal strength is influenced by several factors, including distance from the broadcast antenna, directionality of the signal, antenna quality and height, topography, weather, and presence of structures and vegetation. Furthermore, AutoScan capability also depends on the sensitivity of the TV model. TV AutoScan detection typically requires a signal to noise ratio of 20-30 dBm. A signal of +15 dBm will generally not be detected.

The results herein therefore represent typical TV reception conditions in these communities; however, actual channel reception may vary depending on specific conditions.

4 CONCLUSION

Overall, off-air digital TV reception of the target channels in the region of the Project area is generally poor. Non of the five channels provided sufficient signal strength for proper reception in Wishek and Lehr. In Napoleon, only two of the five channels had signals that were sufficiently strong for proper reception.



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