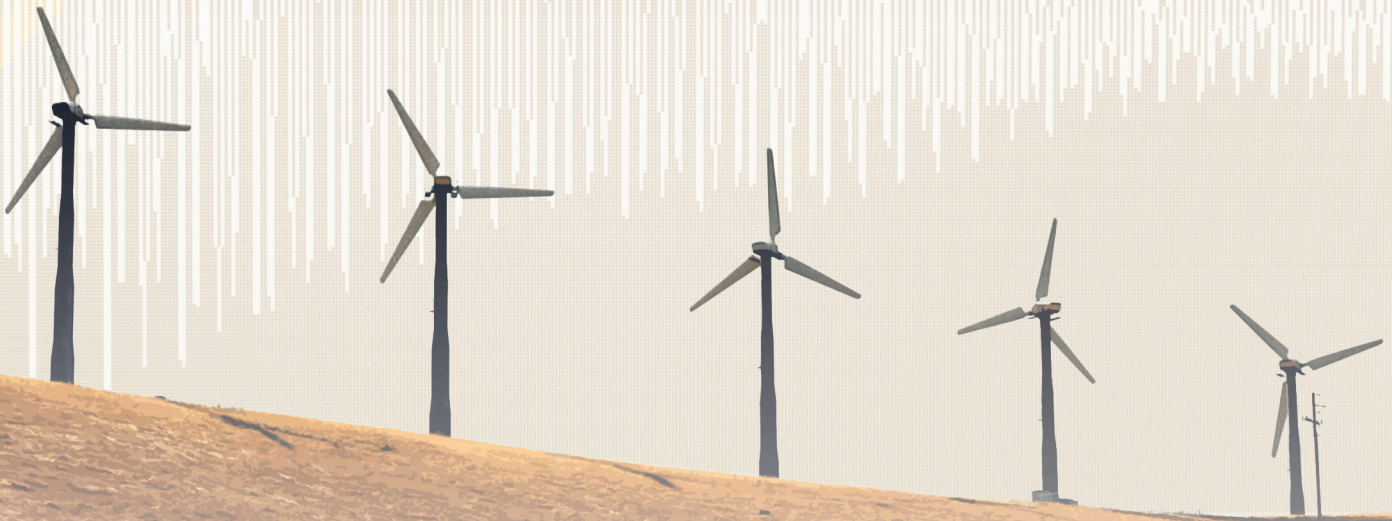


Microwave and Radio Frequency Facilities Analysis

Lindahl Wind Farm Project

Lindahl Wind Project, LLC

March 2015



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I. INTRODUCTION

This report describes the results of a study and analysis to determine the locations of federally licensed (FCC) point-to-point microwave and fixed station radio frequency (RF) facilities that may be impacted as a result of the construction of the Lindahl Wind Farm project in Williams County, ND. This document describes impact zones and possible mitigation procedures. Illustrations, calculations and conclusions contained in this document are subject to on-site verification.

The Lindahl Wind Farm covers 57 square miles extending from approximately two miles north of Tioga ND to ND Highway 50 and from the eastern Williams County line westward approximately nine miles. (See *Figure 1, Project Location.*)

Using industry standard procedures and FCC databases, a search was conducted to determine the presence of any existing microwave paths crossing the subject property, or land mobile facility or broadcast RF facilities within or immediately adjacent to the identified area. A preliminary turbine layout was used for this analysis. Accordingly, this report will address known issues regarding possible impact to RF communications facilities due to the presence of the proposed turbines.

II. ANALYSIS OF MICROWAVE LINKS

A broad analysis was undertaken to determine the likely effect of the new wind turbine farm upon the existing microwave paths, and as needed, a Fresnel x/y axis study and a z-axis (height) evaluation. The microwave paths were overlaid using GIS and data was derived from the FCC data base. No microwave links were found to be traversing the project area within a 40 mile radius. (See *Figure 2, Microwave Beam Paths.*)



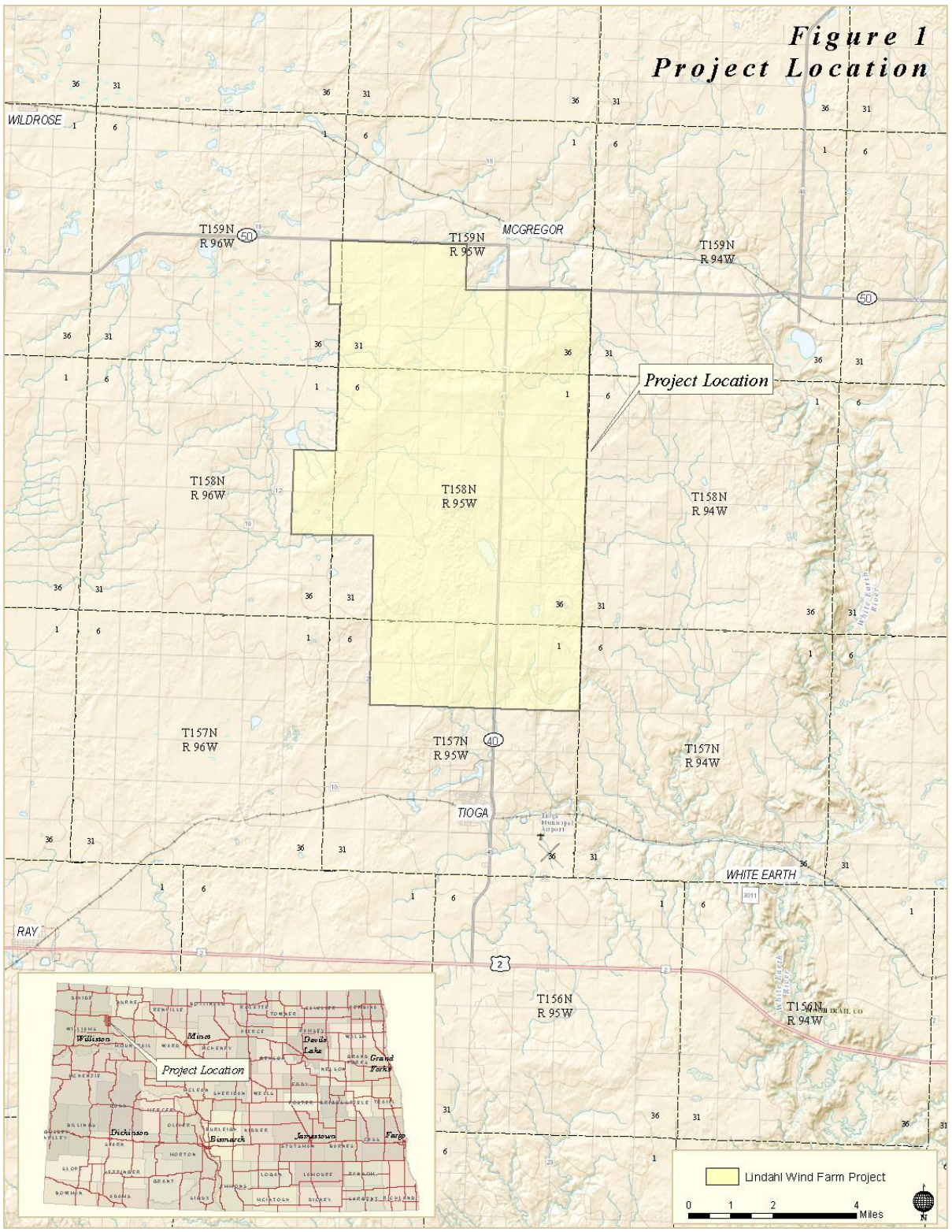


Figure 1, Project Location



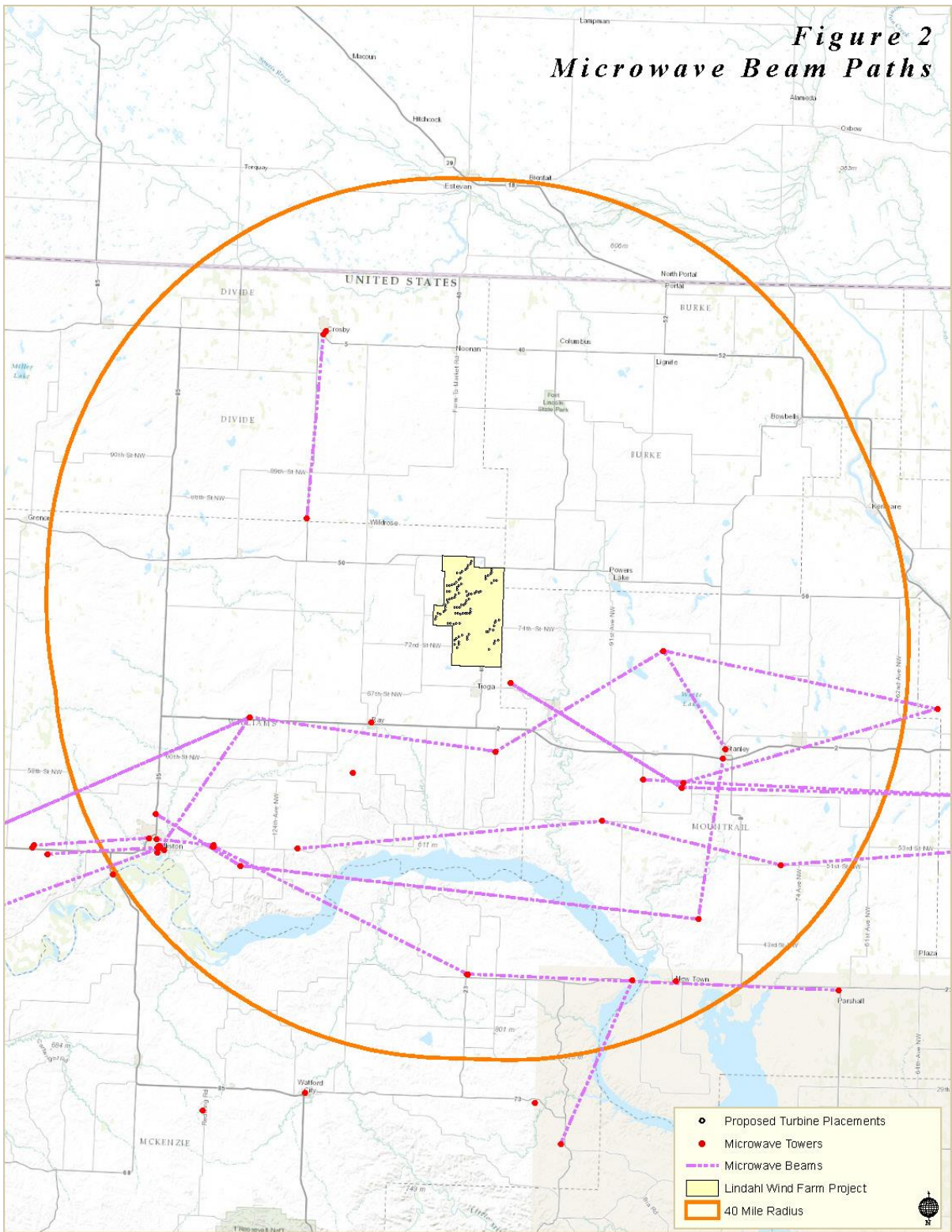


Figure 2, Microwave Beam Paths



III. ANALYSIS OF FIXED RADIO FACILITIES

A. Land Mobile Facilities

There are no land mobile stations and/or public safety stations identified from the FCC’s database that fall within the project area or two miles beyond; however, 14 private land mobile sites were identified and are listed below. Of those 14 site only one site is within 1,320 feet of a current turbine site (highlighted in *Table 1* below and shown on *Figure 3, Land Mobil Stations*). This type of transmitter does not require a clear line of sight and turbine placement should not be considered an obstruction.

Table 1, Land Mobil Stations

LICENSEE	CALL SIGN	CITY	LIC_ID	LAT	LONG
GL Trucking & Rental Inc.	KNIC832	Battleview	1627335	43.34.4 N	102.52.24 W
Petro Hunt LLC	WPBT246	McGregor	1705735	48.35.2 N	102.51.33 W
Sundhagen, Scott	WPCQ417	Tioga	1782250	48.30.9 N	103.3.31 W
Sundhagen, Scott	WPCQ417	Tioga	1782250	48.31.4 N	103.3.40 W
Soo Systems Radio Communications Corporation	WPEN913	Donnybrook	1783054	48.33.2 N	102.57.53 W
Amoco Production Company	KNDR363	Battleview	1837882	48.34.4 N	102.52.8 W
Hess Communications Corporation	WNQN724	Tioga	1841472	48.35.2 N	102.51.21 W
Hess Communications Corporation	WNQN724	Tioga	1841472	48.30.4 N	102.59.29 W
First Energy Service Company dba Basic Energy	KNBS793	Battleview	1850292	48.34.4 N	102.52.8 W
Moberg, Arlo	KZD981	McGregor	1859120	48.34.5 N	102.50.55 W
Gohrick Farms	WPXP604	Tioga	2513817	48.31.5 N	102.58.37 W
McGinnity, Danny	WQEQ228	McGregor	2795567	48.33.4 N	102.59.42 W
Hamm and Phillips Inc.	WQHF568	Killdeer	2929730	48.28.1 N	102.56.12 W
Lalim, Dallas	WQKK227	Tioga	3112585	48.27.1 N	102.54.22 W



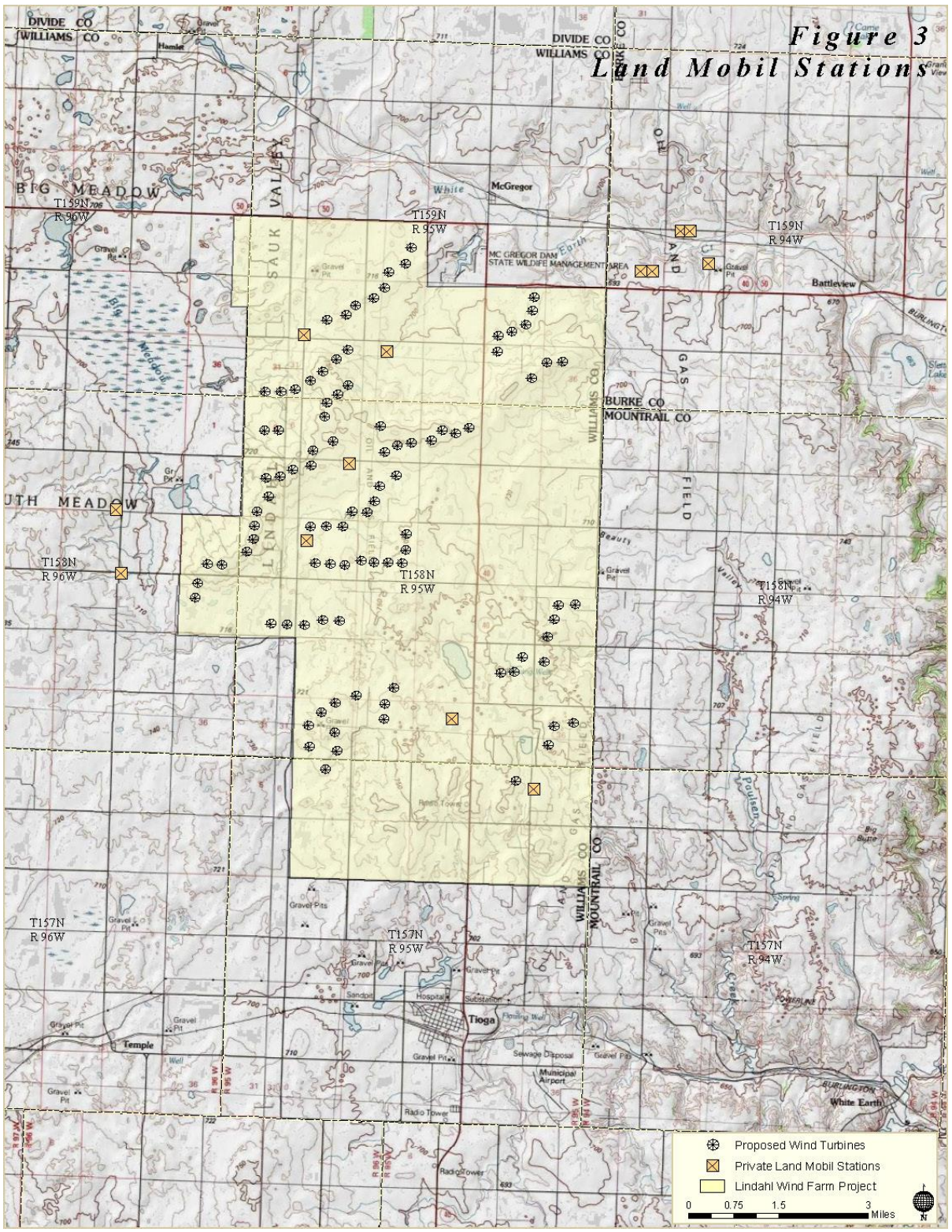


Figure 3, Land Mobil Stations



B. Other Communications Sites

A search of the FCC registered antenna structures database showed that, other than the land mobile sites, there are two registered communications towers located within the project area. (See *Table 2* and *Figure 4, Antenna Structure Registration.*) The project is not expected to cause any turbine related signal transmission problems.

Table 2, Antenna Structure Registration

REG NUM	OWNER	COORDINATES	NEAREST TURBINE
1051850	Portal Pipeline Company	(-102.9297 / 48.4528)	.80 miles WSW
1264659	Northwest Communications Cooperative	(-102.9216 / 48.5484)	.55 miles NE

IV. ANALYSIS OF BROADCAST FACILITIES

A. TV Broadcast Facilities

The rotating blades of a wind turbine have the potential to disrupt over-the-air broadcast TV reception within a few miles of the turbine, especially when the direct path from the viewer's residence is obstructed by terrain. Interference is caused when signals reflected by the blades arrive at the viewer's TV antenna along with the direct signal. This is known as "multipath interference." However, as turbine manufacturers have replaced all-metal blades with blades constructed of mostly nonmetallic materials, this effect has been reduced. Also, the new generation of HDTV receivers is better equipped to deal with minor multipath interference (which is manifested by "pixilating" or "freezing" of the digital picture) than analog TV sets, as special circuitry is employed to suppress the reflected signal. Occasionally, however, multipath interference from one or more turbines can cause video failure in HDTV receivers, especially if the receiver's location is in a valley or other place of low elevation.

The TV stations that have been determined to place a predicted FCC primary over-the-air service signal to at least a portion of the project area are listed in *Table 3* on page 8 and *Figure 5, Over-Air TV Contours* on page 9.



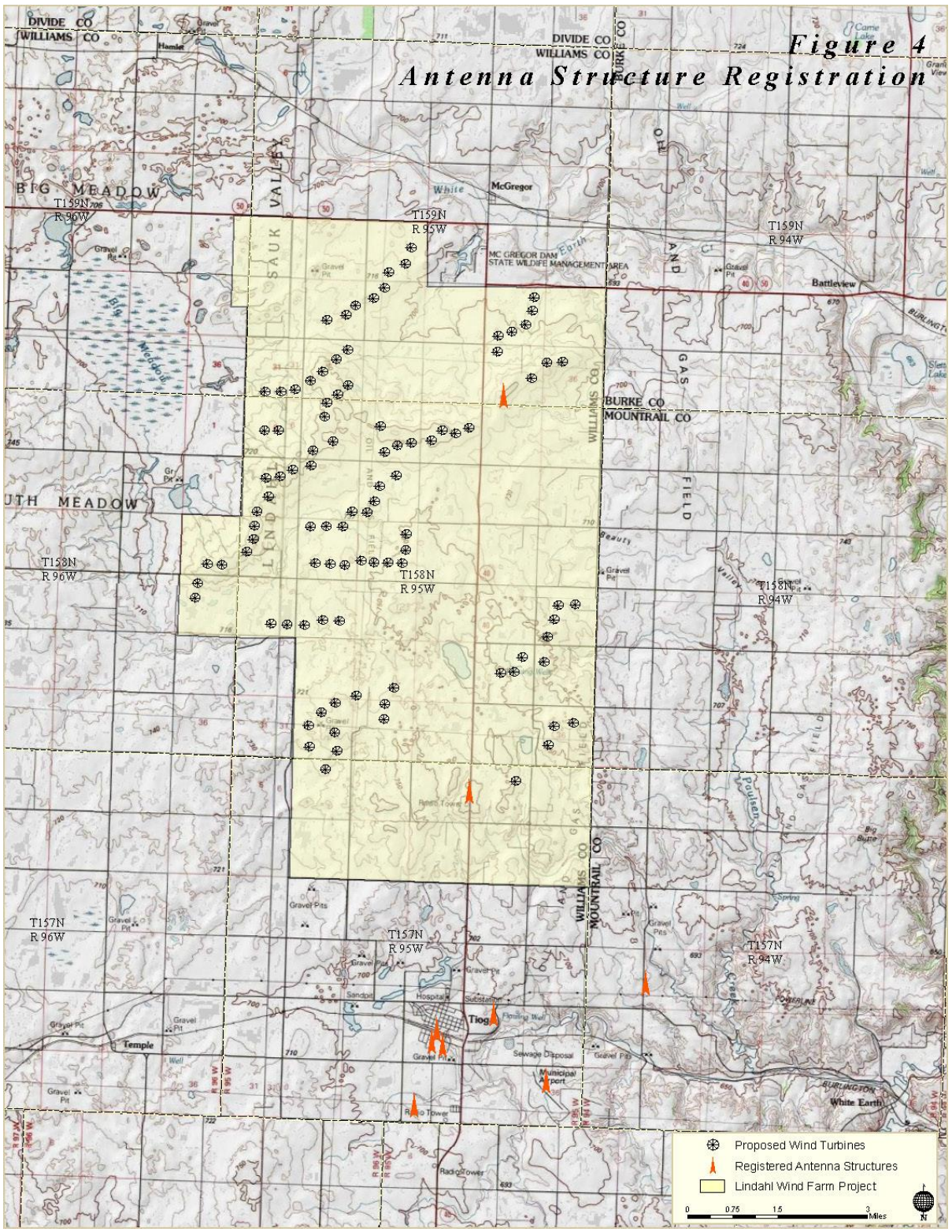


Figure 4, Antenna Structure Registration



Table 3, Over-Air TV Contours

CALL	TYPE	ID	LICENSEE	CITY	CHANNEL	LAT	LONG
KWSE	TV	126369	Prairie Public Broadcasting, Inc.	Williston	4	48.14167	-103.89278
KUMV-TV	TV	305247	North Dakota Television License Sub.	Williston	8	48.13389	-103.86
KXMD-TV	TV	605948	Reiten Television, Inc.	Williston	11	48.14583	-103.88889

The project is not expected to cause perceptible adverse changes to TV reception in the area; however, should disruptions to over-the-air TV viewing occur, methods to resolve them are available on a case by case basis, and are as follows.

1. Relocation of the household antenna to receive a better signal,
2. Installation of a better outside antenna, or one with a higher gain; or
3. Installation of satellite or cable TV.



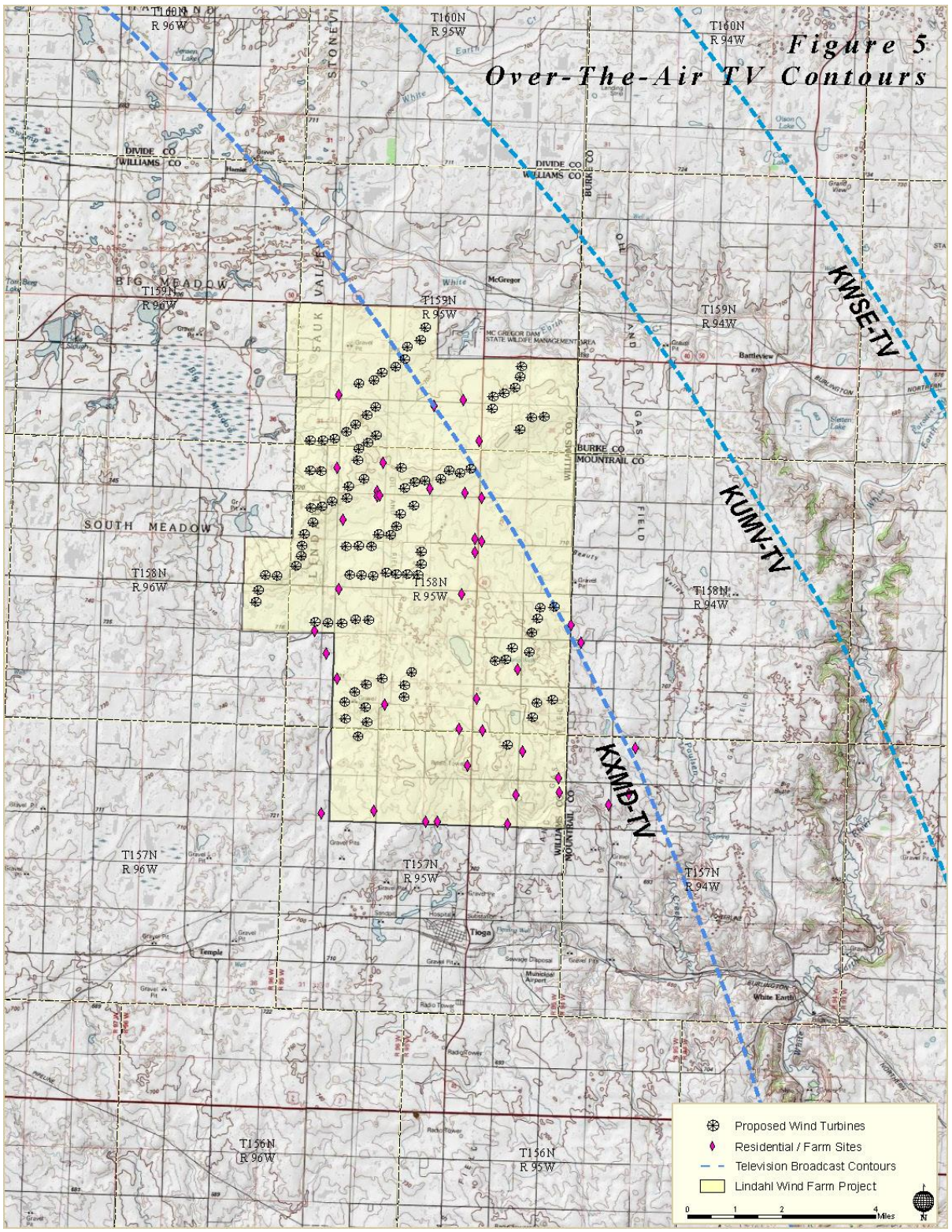


Figure 5, Over-Air TV Contours



B. FM Facilities

The full-service FM stations that place a predicted primary signal over at least part of the project area are listed in the following *Table 4*.

Table 4, Area FM Stations

CALL SIGN	FREQUENCY	DIST./SIGNAL	CITY	FORMAT
KPPW	88.7 FM	47.3 mi	Williston	Public Radio
KMHA	91.3 FM	46.4 mi	Four Bears	Ethnic
K220FH (KPPW)	91.9 FM	0.3 mi	Tioga	Public Radio
KTHC	95.1 FM	53.8 mi	Sidney	Hot AC
KYYZ	96.1 FM	53.8 mi	Williston	Country
KXWI	98.5 FM	54.2 mi	Williston	Country
KDSR	101.1 FM	54.2 mi	Williston	Adult Hits
KZTW	104.1 FM	15.1 mi	Tioga	Religious

Because of the “capture effect” supported by the “discriminator” in FM receivers, significant disruptions to the above facilities are not expected. Although the received signal may vary with the blade rotation at some receiver locations in the immediate area, good quality FM receiver radios will most likely factor out such time-varying signals. In those relatively few cases where significant impact is caused, home FM radios could be connected to the rooftop TV receiver antennas to pull in a stronger direct signal.

C. AM Facilities

Metal structures more than 100 feet above ground, such as wind turbines, can adversely affect the transmitted signals of AM broadcast stations up to 1.86 miles (3 kilometers) away. A search of the FCC’s database revealed no AM facilities within the required notification distance of 1.86 miles beyond the project area boundaries. There should be no reasonable expectations of disruptions in transmitted radiations on the AM band due to the presence of the turbines. Occasionally, depending upon ground conditions, local AM receivers may experience slight signal changes due to local effects, but such anomalies are not recognized by the FCC as having an unduly adverse effect.

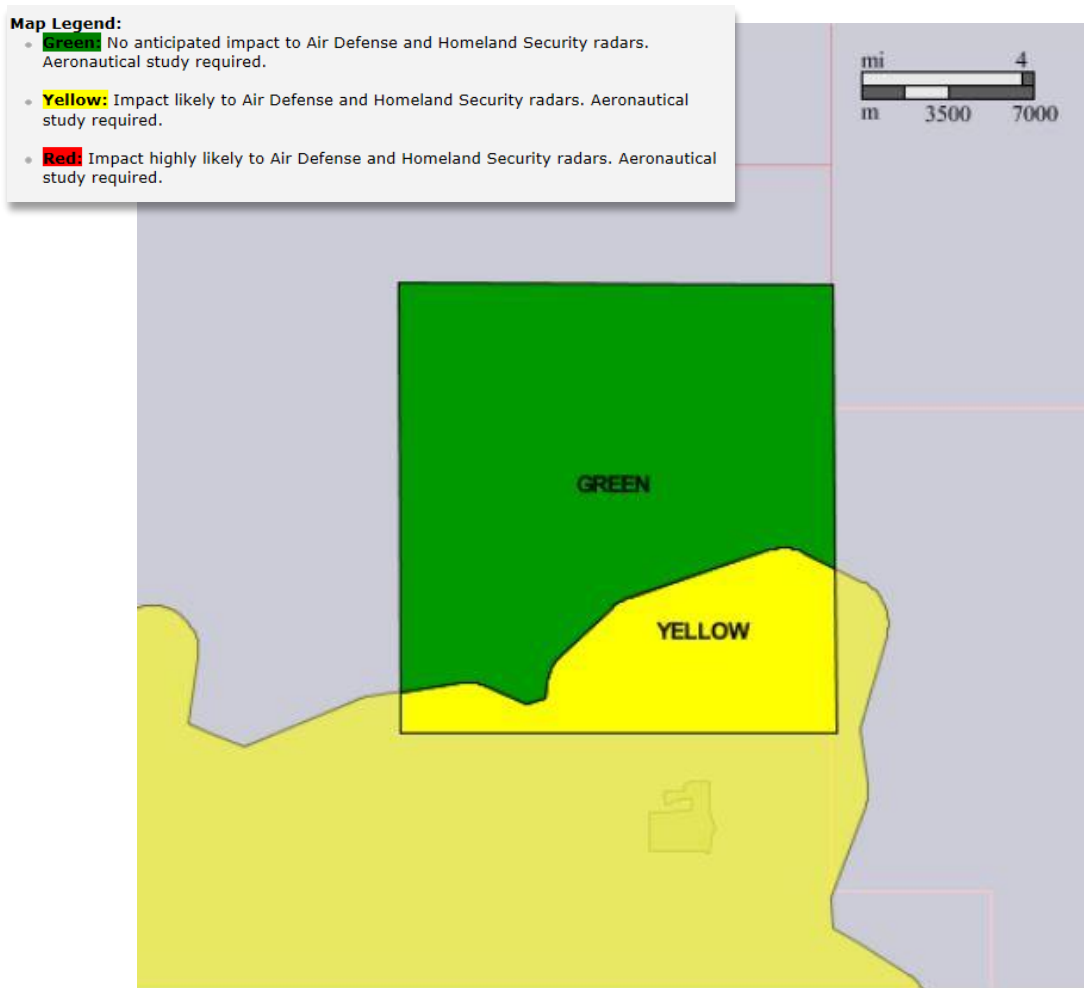
V. CELL PHONE TOWER SEARCH

Search of the FCC data base revealed no cell towers within the project area; however, it should be noted that not all cellular base station towers are individually licensed by the FCC. Since cell phone service is mobile by design, operation of mobile devices in the area should theoretically not be significantly affected. In addition, cellular antennas employ diversity and multiple receivers to compensate for any disruptions at any one location.



VI. FAA AND DOD CONCERNS

The Department of Defense and the Department of Homeland Security Long Range Radar Joint Program Office “JPO” has adopted a “pre-screening tool” to evaluate the impact of wind turbines on air defense long-range radar. The following graphic is a result of that tool’s query. The project area is approximately 75 percent within the green and 25 percent within the yellow.



The public airport closest to the project area is the Tioga Airport, which is 4.8 miles south-southeast of the nearest turbine. While the proposed turbines in all likelihood will not adversely impact operations associated with this airport, the 7460-1 evaluation process is the final determination of the impact, if any, to airspace navigation. (See *Figure 6, Airports.*)



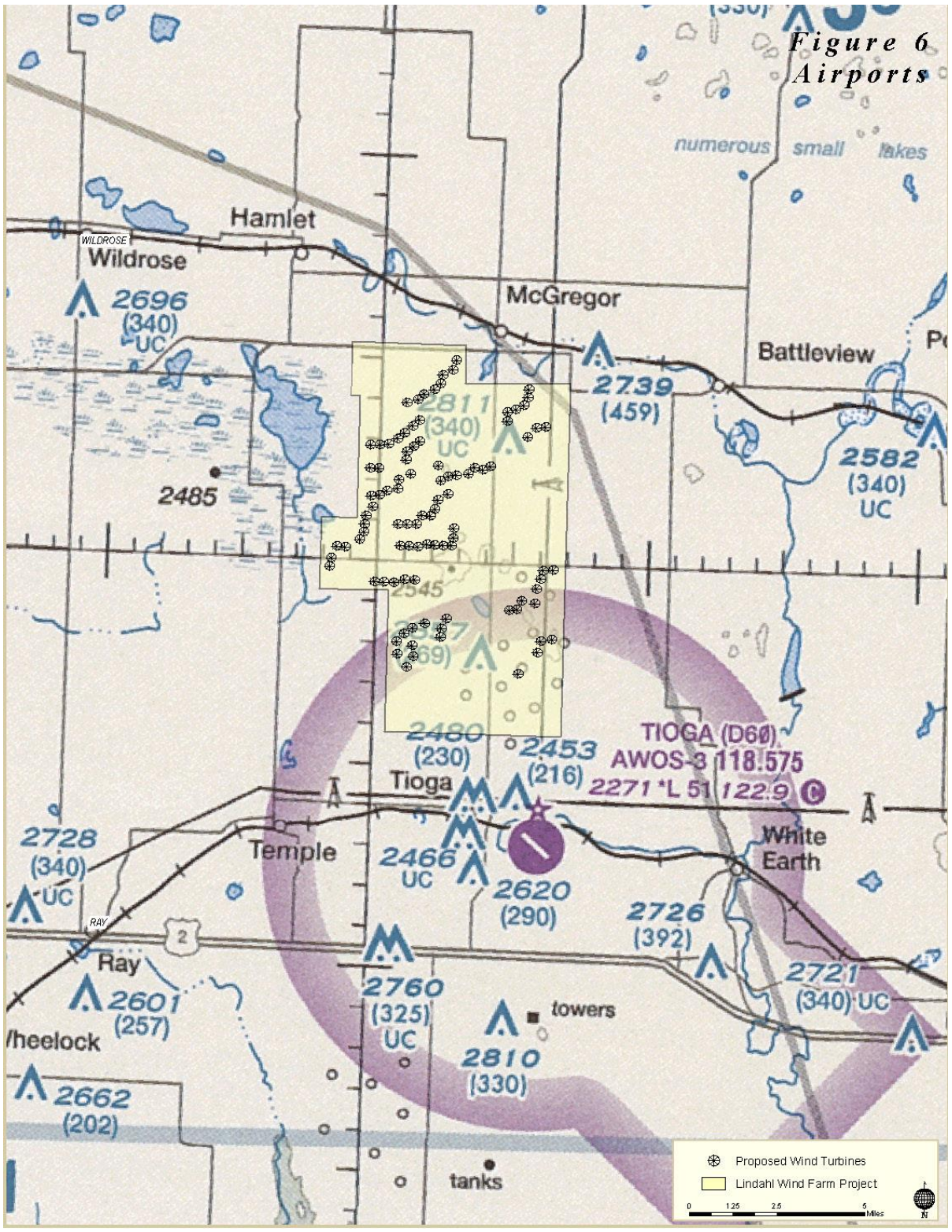
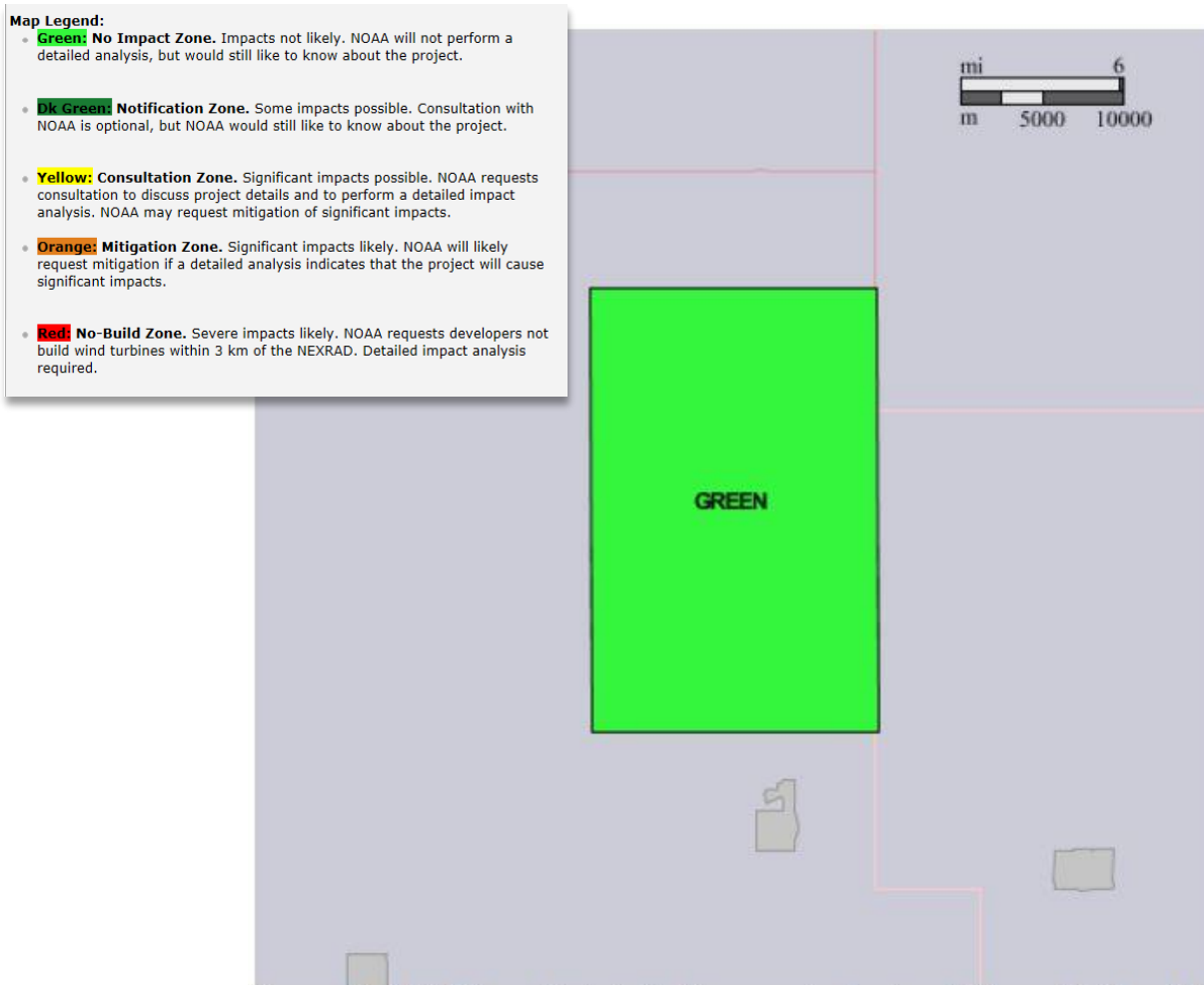


Figure 6, Airports



A pre-screening tool has been developed to evaluate the potential impact of obstructions to the NEXRAD Weather Surveillance Doppler Radar Stations. The following graphic is a result of that tool's query. The project area is approximately 75 percent within the green.



Because the NEXRAD can detect wind turbines occasionally at great distance, NOAA would like to know the location of all wind farm projects so that corrupted radar data can be flagged. Send project information directly to NOAA at wind.energy.matters@noaa.gov or through the National Telecommunications & Information Administration (NTIA) in the Dept. of Commerce. NOAA protects all wind project information as proprietary and sensitive.

This same tool was applied to Military operations and training routes and the query returned that portions of the wind farm may have an impact. The Minot Air Force Base was contacted and returned a letter of no effect (see following *Figure 7*).





DEPARTMENT OF THE AIR FORCE
HEADQUARTERS 5TH MISSION SUPPORT GROUP (AFGSC)
MINOT AIR FORCE BASE NORTH DAKOTA

7 January 2015

2d Lieutenant Benjamin Fonte
Community Planner
5 CES/CEN
445 Peacekeeper Place
Minot AFB, ND 58705-5006

Mr. Grady Wolf
KLJ Engineering
PO Box 1157
Bismarck, ND 58502-1157

Dear Mr. Wolf

It is the responsibility of the community planner to ensure that entities do not encroach Air Force assets. Upon review of the proposed Lindahl Wind Project in Williams County, I have found no issues of encroachment to Air Force assets in the area at this time.

I appreciate your coordination with Minot Air Force Base. Please do not hesitate to contact me for any future coordination. I can be reached by email, benjamin.fonte.1@us.af.mil, or phone, 701-723-4844.

Sincerely

BENJAMIN R. FONTE, 2Lt, USAF
Community Planner, 5th Civil Engineer Squadron

Figure 7, Minot Air Force Base Letter



VII. CONCLUSIONS

The conclusions from the evaluation of potential effects upon FCC licensed radio frequency facilities by the proposed Lindahl Wind Farm:

1. No microwave beam paths are present within the project area.
2. No land mobile transmitting stations are expected to be adversely affected, assuming that their transmitters are located exactly as per their FCC licenses.
3. Cellular telephone transmission and reception is not expected to be adversely affected by the project.
4. Over-the-air TV interference, if it occurs, can be mitigated.

VIII. STUDY LIMITATIONS

Known limitations of the data sources used for the evaluations described in this report are listed below.

1. The FCC database was used for creating the tables and maps provided in this report. Some point-to-point microwave links are not licensed by the FCC, and thus are not searchable in a central database.
2. Microwave path studies are based upon third party and FCC databases that normally exhibit a high degree of accuracy and reliability. Although KLJ performs due diligence to ensure that all existing microwave facilities are represented, we cannot be responsible for errors in FCC databases that may lead to incomplete results.
3. Towers under 200 feet in height may not be required to be registered with the FCC.



IX. REFERENCES

- Federal Communications Commission - Universal Licensing System - <http://www.fcc.gov/>
- Evans Engineering Solutions - Thiensville Wisconsin - <http://evansengsolutions.com/>
- Australian Wind Energy Association - Environmental Wind Energy Information - <http://www.w-wind.com.au/WindEnergyInformation.html>
- Comsearch - Ashburn Virginia - Identifying and Avoiding Radio Frequency Interference for Wind Turbine Facilities - http://www.comsearch.com/support_resources/case_studies_white_papers.jsp
- Epuron - North Sydney, NSW - Telecommunications Impact Assessments - <http://www.epuron.com.au/>

