



**ENGINEERING REPORT
CONCERNING THE EFFECTS UPON
FCC LICENSED RF FACILITIES
DUE TO CONSTRUCTION OF
PREVAILING WIND PARK
In
BON HOMME, CHARLES MIX & HUTCHINSON COUNTIES,
SOUTH DAKOTA**

**Prepared for
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I. INTRODUCTION

This engineering report describes the results of a study and analysis to determine the locations of federally-licensed (FCC) microwave and other fixed station radio frequency (RF) facilities that may be adversely impacted as a result of the construction of the Prevailing Wind Park in Bon Homme, Charles Mix and Hutchinson Counties, South Dakota. This document describes impact zones and any necessary mitigation procedures, along with recommendations concerning individual wind turbine siting. All illustrations, calculations and conclusions contained in this document are based on FCC database records¹.

Frequently, wind turbines located on land parcels near RF facilities can cause more than one mode of RF impact, and may require an iterative procedure to minimize adverse effects. This procedure is necessary in order to ensure that disruption of RF facilities either does not occur or, in the alternative, that mitigation procedures will be effective. The purpose of this study is to facilitate the siting of turbines to avoid such unacceptable impact.

The Prevailing Wind Park as currently planned involves the construction of up to 61 turbines and up to 3 alternate winter turbine sites. A maximum of 61 turbines would be built. The geographic center of the project area is about 9.6 miles southwest of the City of Tripp, South Dakota. The wind turbines proposed to be erected will have a hub height of up to 110 meters and a rotor radius of about 137 meters. The maximum blade tip height therefore would be up to 178.5 meters AGL.

¹ The databases used in creating the attached tables and maps are generally accurate, but anomalies have been known to occur. Generally, for wind turbine siting, an on-site verification survey is often suggested as part of the due diligence process.



Using industry standard procedures and FCC databases, a search was conducted to determine the presence of any existing microwave paths crossing or near the subject property. A specific turbine layout has been submitted for analysis. Accordingly, this report will address the potential conflicts that may be caused by the proposed turbines.

The following tabulation and analysis consists of three sections:

1. Microwave point-to-point path analysis²
2. Airports, Radar Stations and Military Aircraft Operations
3. NTIA Notification

The attached figures were generated based upon the operating parameters of the FCC-licensed stations as contained in the FCC station database, with corrections of the antenna locations as needed.

The following analysis examines the pertinent FCC licensed services in the area for impact. This analysis assumes that all licensed services have been designed and constructed according to FCC requirements and good engineering practice. If this is not the case, the impacted facility must share responsibility with the Wind Park developer for the costs of any mitigation measures³.

Each of the RF analyses is described separately in the sections that follow.

II. ANALYSIS OF MICROWAVE LINKS

An extensive analysis was undertaken to determine the likely effect of the new wind turbine farm upon the existing microwave paths, consisting of a Fresnel x/y/z axis study. The microwave paths have been overlaid on Google Earth™ maps, and the images of the microwave paths and the proposed turbines are also available in a KMZ file.

Important Note: Microwave path studies are based upon third party and FCC databases that normally exhibit a high degree of accuracy and reliability. Although Evans 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. However, should such situations occur, Evans would perform an engineering analysis to determine how the

² Only point-to point microwave facilities were considered (for instance, a study of earth station facilities is not included).

³ For instance, some microwave paths may have insufficient ground clearances as they are presently configured.



additional facilities can be accommodated or, if wind turbine structures are already built, determine a method to re-direct an impacted beam path.

For this microwave study, *Worst Case Fresnel Zones* (WCFZ) were calculated for each microwave path. The mid-point of a microwave path is the location where the widest (or worst case) Fresnel zone occurs. Possible geographic coordinate errors must be taken into account⁴. The radius R of the Worst Case Fresnel Zone, in meters, is calculated for each path using the following formula:

$$R \cong 8.65 \sqrt{\frac{D}{F_{\text{GHz}}}}$$

where D is the microwave path length in kilometers and F_{GHz} is the frequency in gigahertz.

In general, the WCFZ is defined by the cylindrical area whose axis is the direct line between the microwave link endpoints and whose radius is R as calculated above. This is the zone where the siting of obstructions should be avoided. Evans Engineering Solutions has identified 15 unique point-to-point microwave paths and three point-to-multipoint microwave links from the FCC database that are within 0.5 mile of the project area. These microwave facilities are listed in Table 1 and mapped in Figures 1 and 2.

⁴ Many microwave facilities were built before accurate methods were available to establish exact geographic coordinates (such as GPS). It is not unusual for database errors of up to 4 or 5 seconds to occur, which can affect the positioning of critical turbines located near Fresnel paths.



Call Sign 1	Site 1 Name	Call Sign 2	Site 2 Name	Freq. (MHz)	WCFZ (m)	Licensee
WBL30	Turkey Ridge (W)	WQDV593	Tripp (E)	6900/7100	24.8	South Dakota Board of Directors for Educational Telecommunic
WBL31	Tripp (W)	WQDV612	Stickney (E)	6900/7075	24.4	South Dakota Board of Directors for Educational Telecommunic
WIA867	Tripp	WNEG799	3370	6550.625 6730.625	19.9	East River Electric Power Coop
WIA867	Tripp	WNEG798	0484	6540.625 6718.125	18.2	East River Electric Power Coop
WIA867	Tripp	WPNL979	Lake Andes	5945.2/6197.24	24.0	East River Electric Power Coop
WIA867	Tripp	WPNL977	Turkey Ridge	6123.1/6375.14	26.4	East River Electric Power Coop
WMQ687	Mitchell	WPNB607	Tripp	5974.85 6226.89	26.5	New Cingular Wireless PCS, LLC
WNEO968	Mitchell	WNER900	Tripp	6152.75 6404.79	28.0	NorthWestern Corporation
WNER900	Tripp	<i>Receive only</i>	3024	953.15	46.0	NorthWestern Corporation
WNER900	Tripp	WQMH799	Yankton	6004.5/6256.54	24.7	NorthWestern Corporation
WNER900	Tripp	WQRU421	Tripp Jct	10775/11265	7.3	NorthWestern Corporation
WNER900	Tripp	WQRU420	Tripp City	10815/11305	9.6	NorthWestern Corporation
WNER900	Tripp	WQYY683	Avon Office	10875/11365	9.4	NorthWestern Corporation
WNEY412*	Tripp	--	<i>None documented</i>	928.38125 952.38125	--	NorthWestern Corporation
WPNB606	Pickstown	WPNB607	Tripp	6063.8-6815	21.4	New Cingular Wireless PCS, LLC
WPND588*	Tripp	--	<i>None documented</i>	928.68125 952.68125	--	East River Electric Power Coop
WQON219*	Avon	--	<i>None documented</i>	928.24375 952.24375	--	NorthWestern Corporation
WQST254	Avon Brandt	WQST255	Wagner	5974.85- 6256.54	17.2	New Cingular Wireless PCS, LLC

Table 1 – Licensed Microwave Links in and near Prevailing Wind Park Area

Eleven point-to-point microwave paths, highlighted in orange in Table 1, cross the turbine project area. Three point-to-multipoint microwave link stations, highlighted in yellow, are inside the project area. As seen in Figures 3 through 7, several of the planned turbines would be located within 250 meters of the microwave paths (as measured from the turbine tower to the center of the path); however, as Figures 7 through 11 will show, it appears that these turbines would not penetrate the microwave worst-case Fresnel zones.

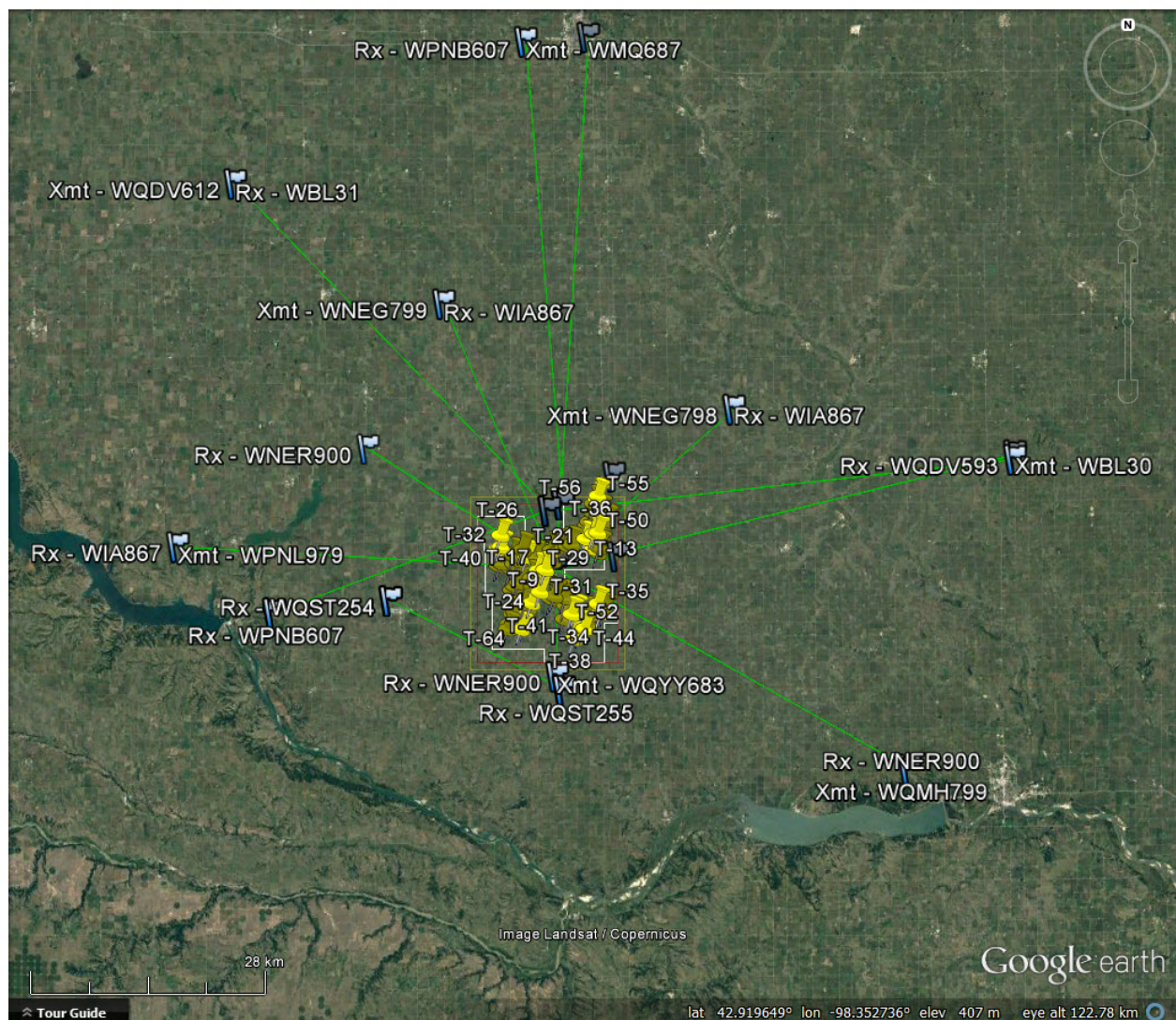


Figure 1 – Licensed Microwave Paths in or near Prevailing Wind Park Area

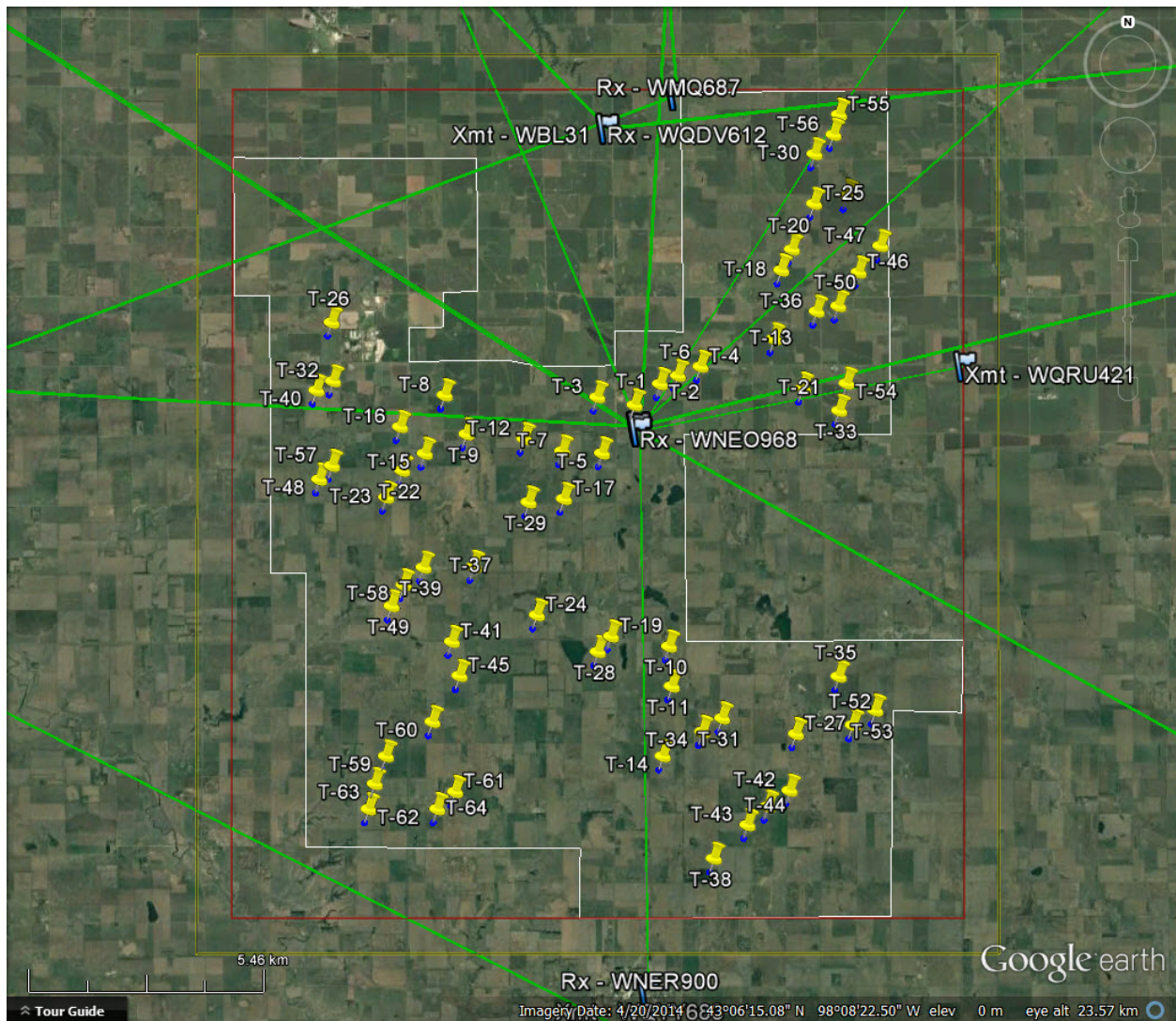


Figure 2 – Close-Up of Licensed Microwave Paths in or near Wind Park Area

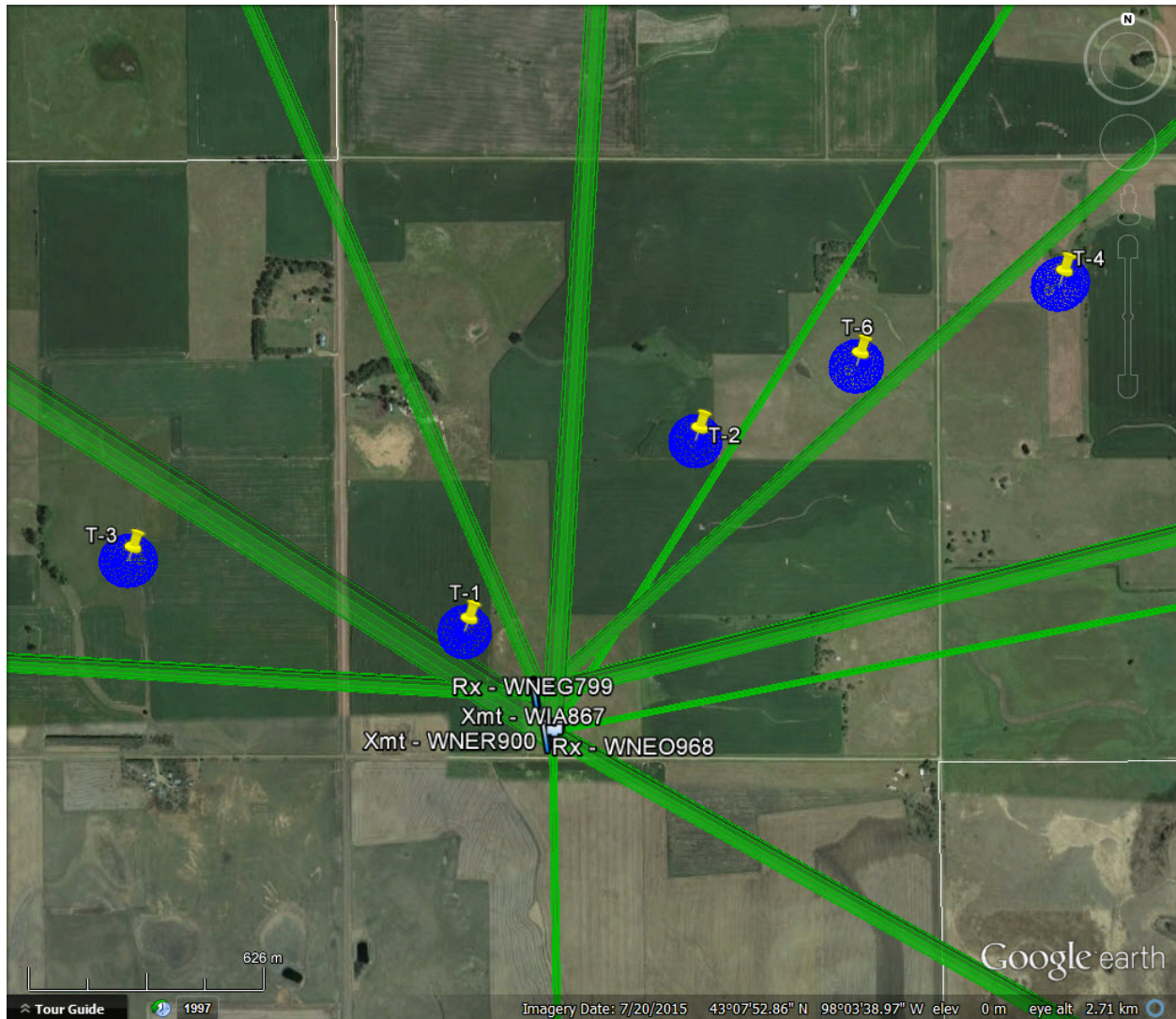


Figure 3 – Turbines 1, 2, 3, 4 and 6 Close to Microwave Paths

As seen in the above figure, Turbine 3 would be clear of any microwave paths, but Turbines 1, 2, 4 and 6 would be very close to paths. Closer views of these turbines are shown in Figures 7 and 8.

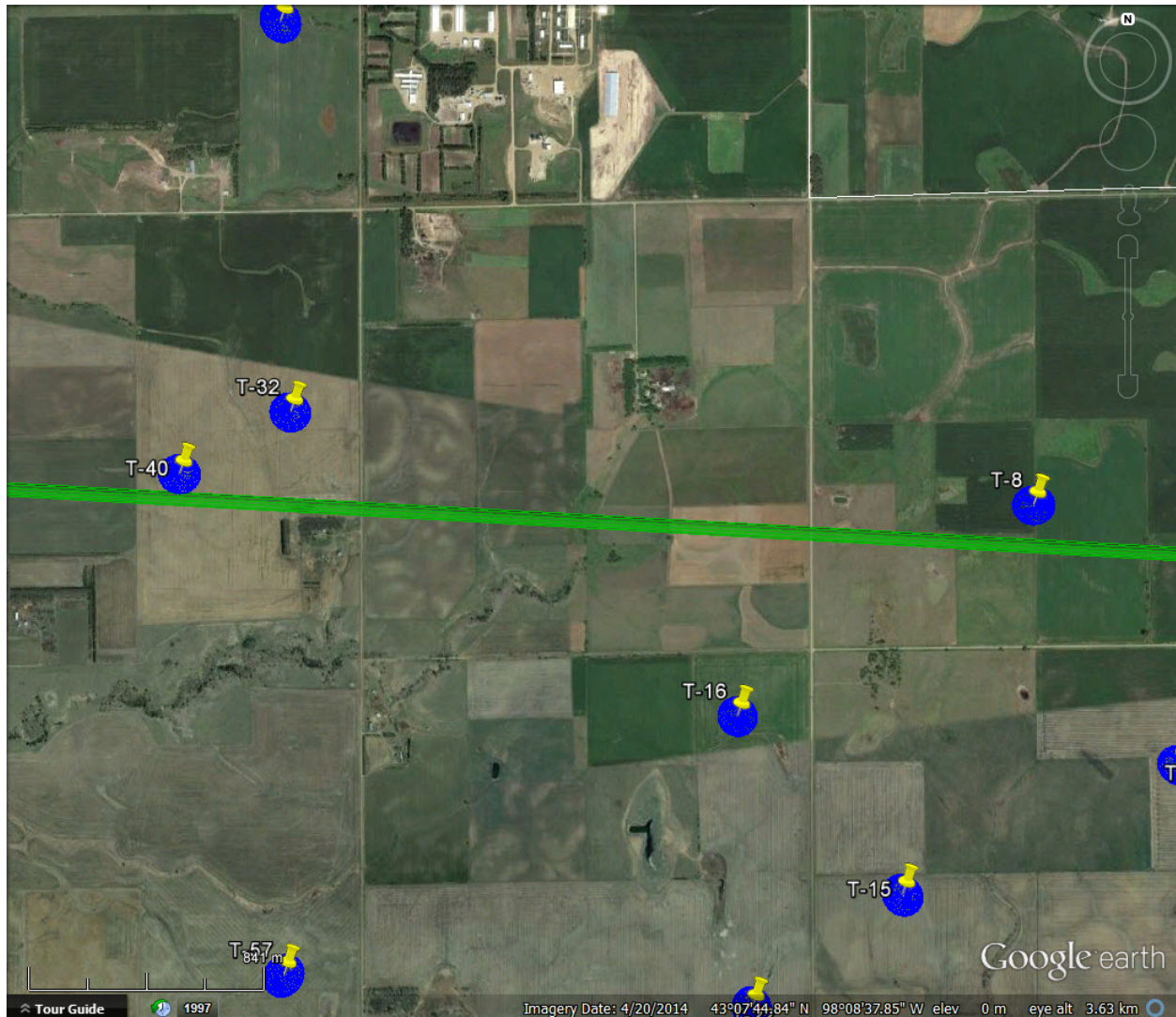


Figure 4 – Turbines 8 and 40 Close to Microwave Path WIA867/WPNL979

As seen in the above figure, Turbine 8 appears to clear the microwave beam, but Turbine 40 is very close to it. A closer view of Turbine 40 is shown in Figure 11.



Figure 5 – Turbines 21 and 54 Close to Microwave Path WNER900/WQRU421

As seen in the above figure, Turbine 54 appears to clear the microwave beam, but Turbine 21 is very close to it. A closer view of Turbine 21 is shown in Figure 9.

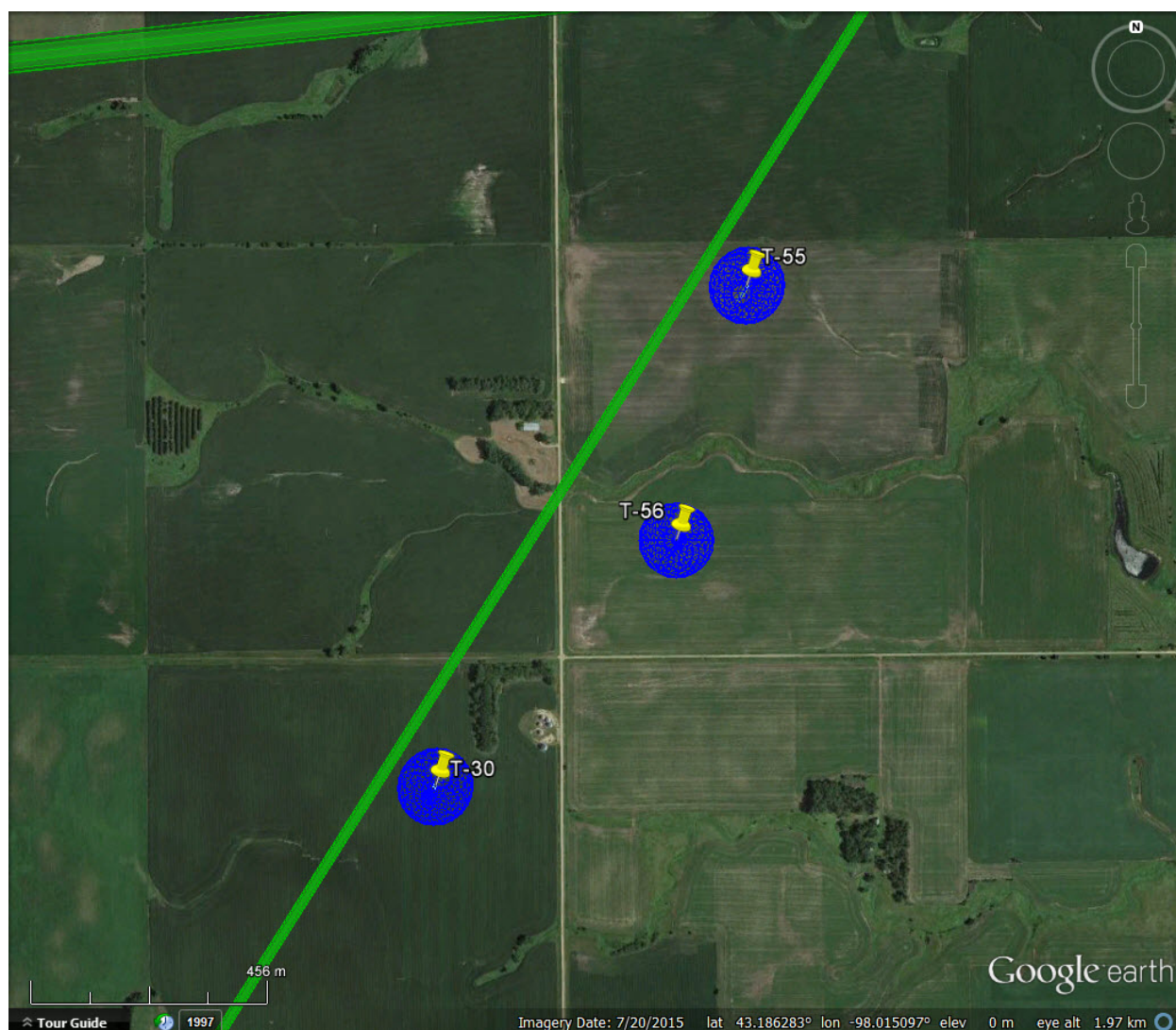


Figure 6 – Turbines 30, 55 and 56 Close to Microwave Path WNER900/WQRU420

As seen in the above figure, Turbine 56 appears to clear the microwave beam, but Turbines 30 and 55 are very close to it. A closer view of Turbines 30 and 55 is shown in Figure 10.



The following turbine sites are within 250 meters of a microwave path. The approximate clearances **in the horizontal plane** between the rotor and the edge of the Worst-Case Fresnel Zone (WCFZ) of the microwave path were calculated and were based on the proposed maximum rotor radius of 68.5 meters.

Turbine	Approx. Dist. to Path (m)*	WCFZ Radius (m)	Approx. Horiz. Rotor Clearance (m)
1	113	46.0	-1.5
2	93	9.6	14.9
3	198	46.0	83.5
4	94	18.2	7.3
6	96	18.2	9.3
8	141	24.0	48.5
21	73	7.3	-2.8
30	98	9.6	19.9
40	87	24.0	-5.5
54	156	7.3	80.2
55	93	9.6	14.9
56	231	9.6	152.9

* As measured from the turbine tower to the center of the microwave path.

A negative clearance number, as is derived for Turbines 1, 21 and 40, indicates possible rotor penetration but does not take into account the difference in vertical elevation between the rotor and the microwave Fresnel Zone. If the elevation of the rotor is higher than that of the microwave beam at the point of the path where the turbine is located, then the rotor is clear of the microwave beam. The figures on the following pages examine the potential turbine-to-microwave conflicts in all three dimensions.

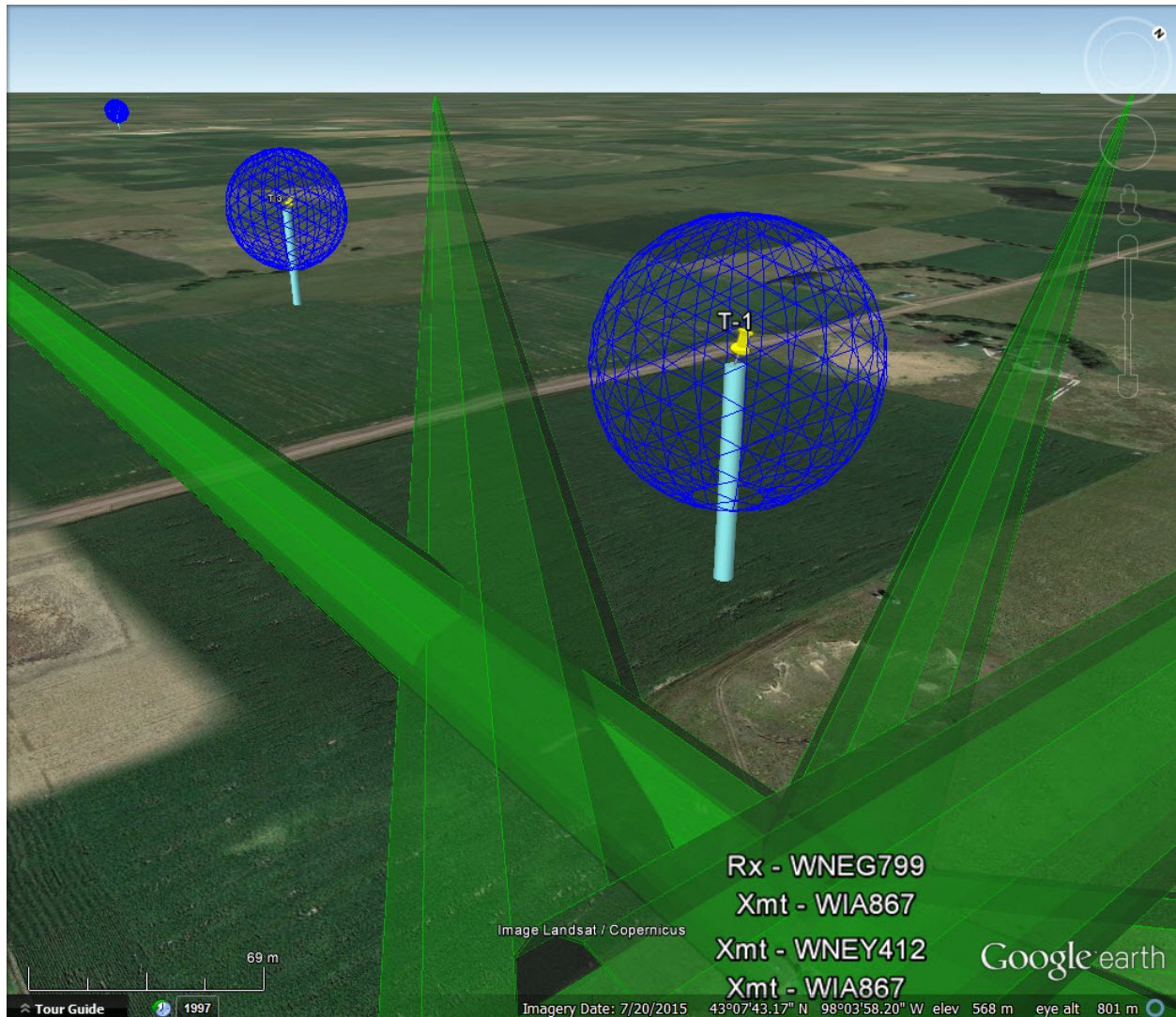


Figure 7 – Turbine 1 Close to Microwave Paths WNER900/Receive-Only & WIA867/WNEG799

As seen in the above figure, Turbine 1 appears to clear the microwave beams.

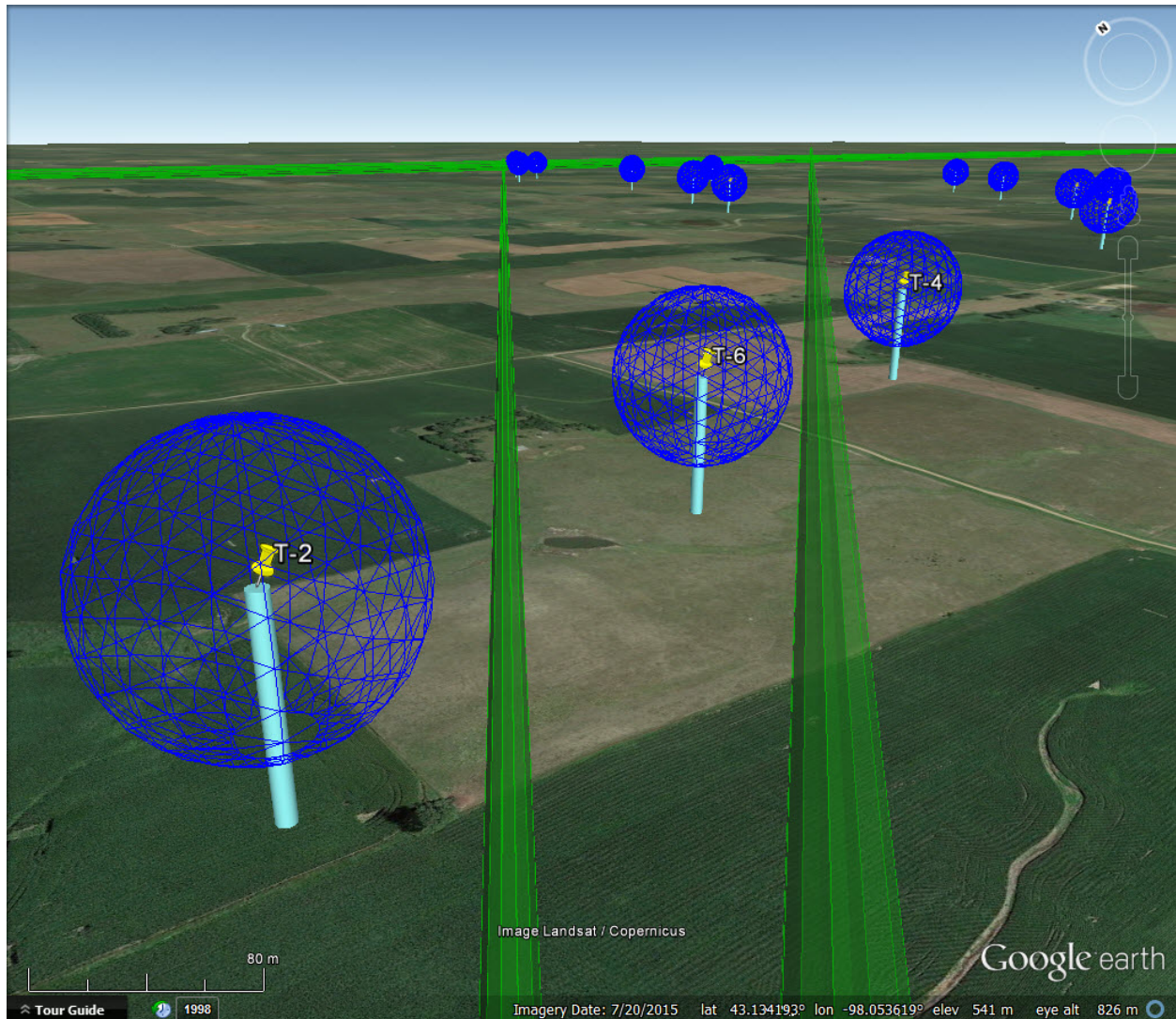


Figure 8 – Turbines 2, 4 and 6 Close to Microwave Paths WNER900/WQRU420 & WIA867/WNEG798

As seen in the above figure, Turbines 2, 4 and 6 appear to clear the microwave beams.

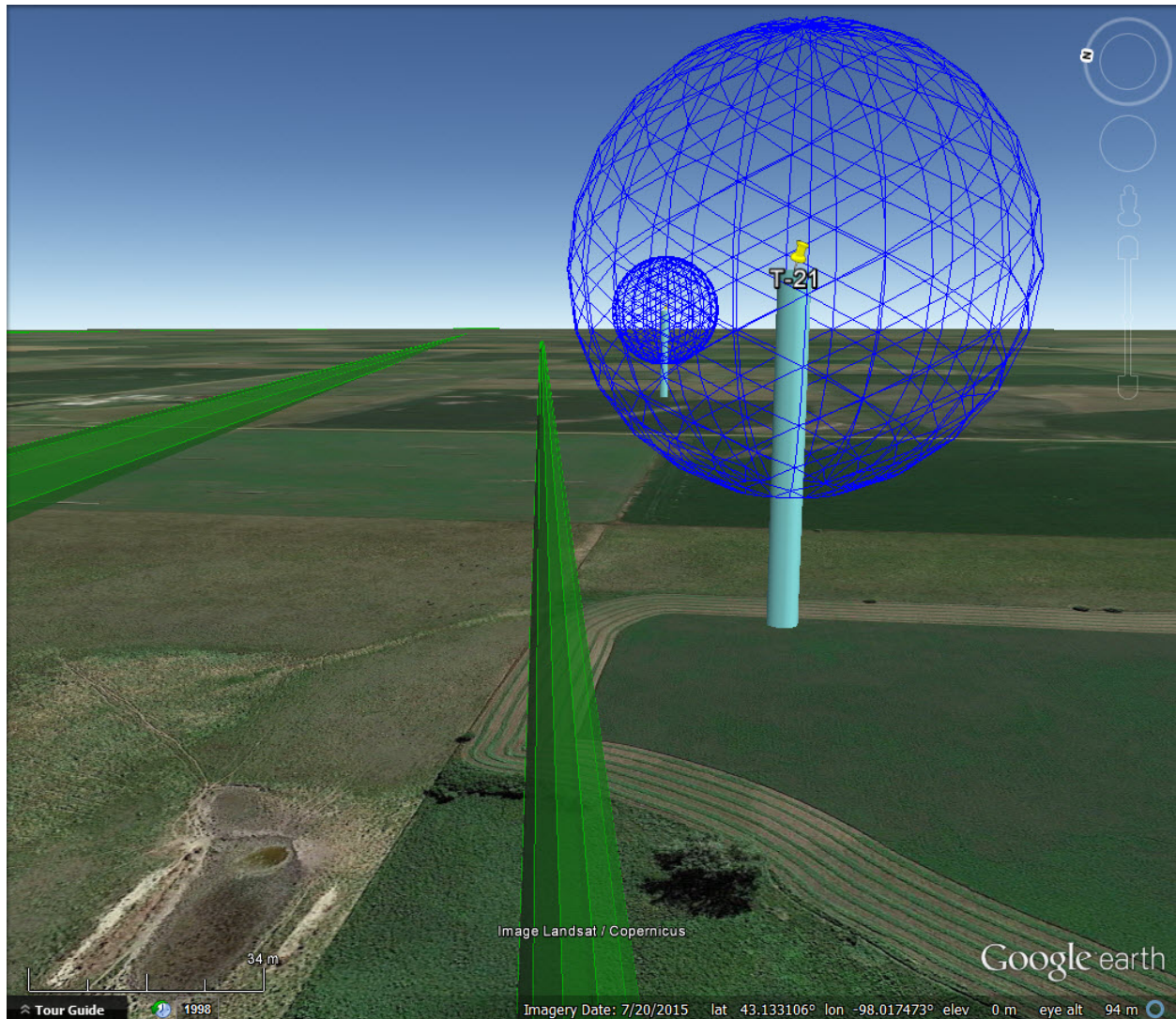


Figure 9 – Turbine 21 Close to Microwave Path WNER900/WQRU421

As seen in the above figure, Turbine 21 appears to clear the microwave beam.

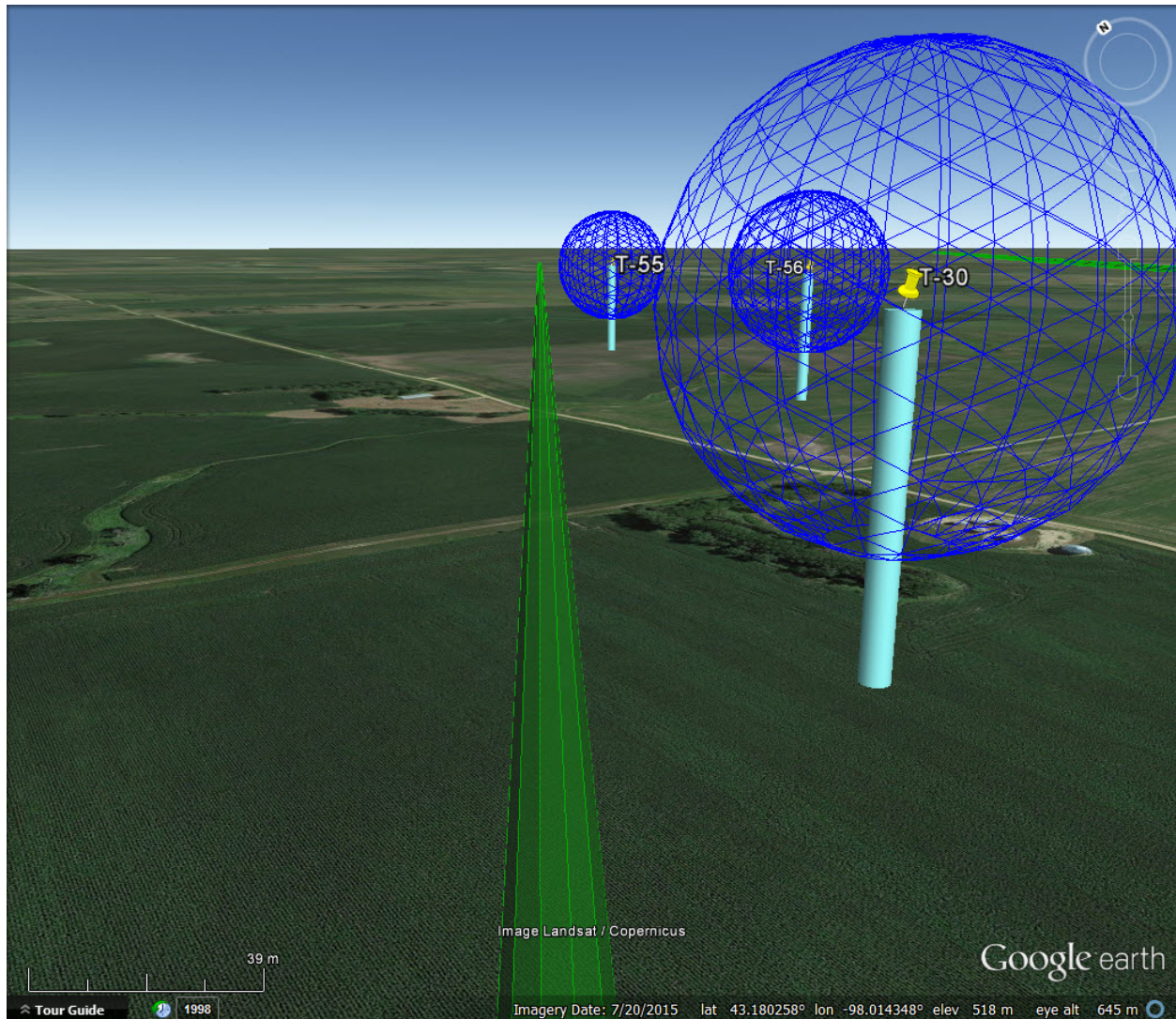


Figure 10 – Turbines 30 and 55 Close to Microwave Path WNER900/WQRU420

As seen in the above figure, Turbines 30 and 55 appear to clear the microwave beam.

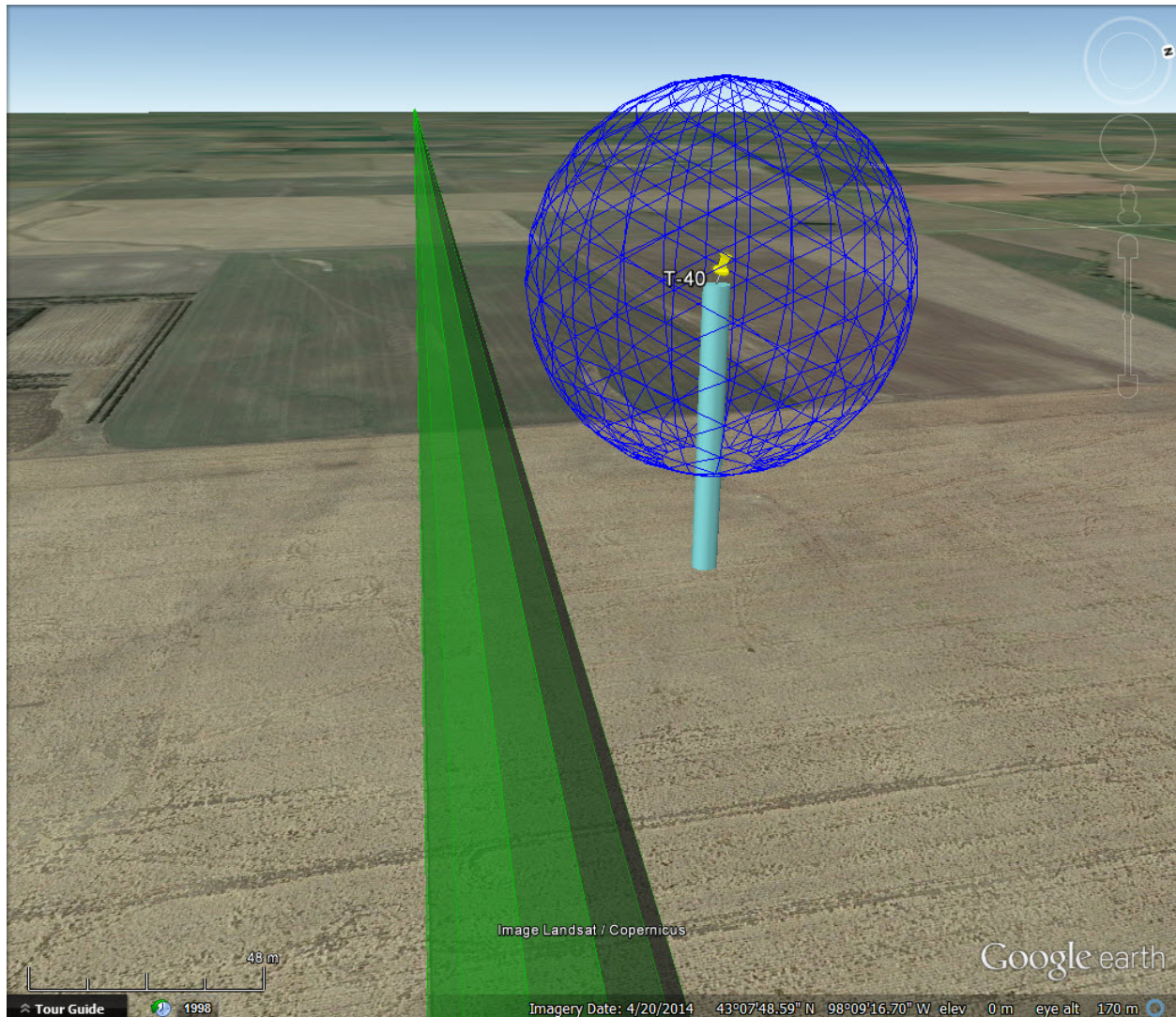


Figure 11 – Turbine 40 Close to Microwave Path WIA867/WPNL979

As seen in the above figure, Turbine 40 appears to clear the microwave beam.



Point-to-Multipoint Microwave Facilities in Project Area

As shown in Table 1, the main transmitter sites of Multiple Address System (MAS) microwave point-to-multipoint stations WNEY412, WPND588 and WQON219 are located inside the Wind Park area, less than 350 meters southeast of the Turbine 1 site. The remote sites for these facilities are not listed in the FCC licenses, so they are known only to their operators. It is the opinion of this engineering firm that adverse impact to any of these stations by the proposed wind turbines is unlikely. However, since the locations of the remote sites are undocumented, the licensees of these stations cannot reasonably expect its microwave links to be protected from the possible effects of new vertical construction.

However, if further due diligence regarding these point-to-multipoint microwave facilities is desired, or required by permitting agencies, additional investigation (beyond the scope of the analyses described in this report), should be conducted, which would include notification of the proposed windfarm construction to the station operators and, if proven to be necessary, performance of studies to determine the possible impact to these microwave facilities.



III. AIRPORTS, RADAR FACILITIES AND MILITARY AIRSPACE

3.1 Airports

The airports and air fields found to be within 20 nautical miles from the center of the Wind Park area are listed in the following Table 2.

FAA ID	Name	Type	City/State	Coordinates	Dist. (nm)	Azimuth(°T)
AGZ	Wagner Munic.	Public AP	Wagner SD	43-03-51.0N 98-17-47.0W	10.18	253.8
SD61	Plihal Farms	Private AP	Tyndall SD	43-01-00.0N 97-52-01.3W	10.69	121.9
1SD1	Burke Field	Private AP	Scotland SD	43-09-55.5N 97-43-51.2W	15.36	77.6
Y03	Springfield Munic.	Public AP	Springfield SD	42-52-52.0N 97-54-05.9W	15.73	151.4
8V3	Parkston Munic.	Public AP	Parkston SD	43-22-38.7N 97-59-23.0W	16.39	13.0

Distance and azimuth are referenced to the center of the project area, determined to be 43-06-39N, 98-04-22W.

Table 2 – Airports within 20 Nautical Miles of Wind Park

A determination as to whether the Prevailing Wind Park as proposed would not be a hazard to airspace navigation can only be made by the Federal Aviation Administration. Prior to construction, sPower has sent or will send FAA 7460-1 notification forms for all of the proposed wind turbines to the FAA to begin the aeronautical study process.

3.2 DoD Radar Concerns

The Department of Defense (DoD) 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. This tool was applied to the Prevailing Wind Park area, and it returned a result of “no anticipated impact” (green) to Air Defense and Homeland Security radars, as seen in Figure 12. However, a definitive determination is obtained only after formal study by the DoD, which is triggered by the FAA 7460-1 notification process.

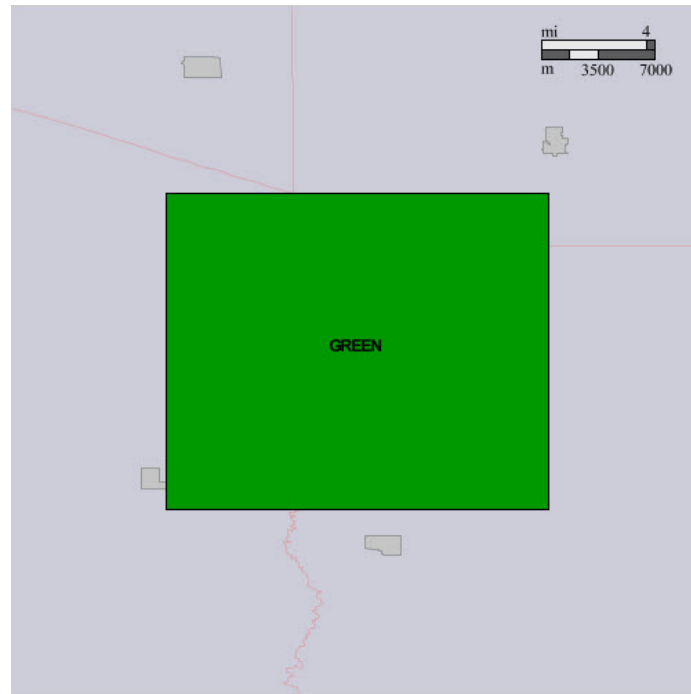


Figure 12 – DoD Long-Range Radar Screening

Map Legend:

- **Green:** No anticipated impact to Air Defense and Homeland Security radars. Aeronautical study required.

3.3 NEXRAD

A pre-screening tool has been developed to evaluate the potential impact of obstructions to the NEXRAD Weather Surveillance Doppler Radar Stations. This tool was applied to the Prevailing Wind Park area, and it returned a result, shown in Figure 13, of “impacts not likely” to weather radar operations. However, a definitive determination is obtained only after the NTIA review process.

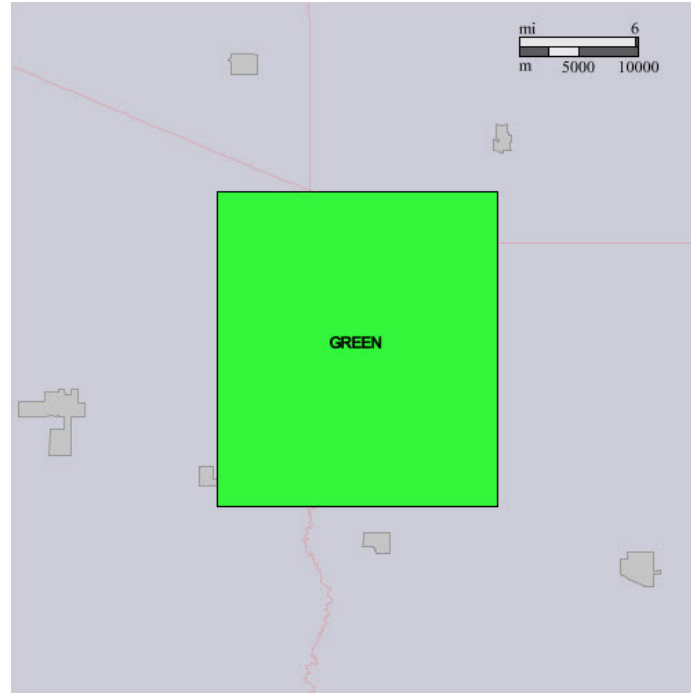


Figure 13 – NEXRAD Weather Radar Screening

Map Legend:

- **Green: No Impact Zone.** Impacts not likely. NOAA will not perform a detailed analysis, but would still like to know about the project.

3.4 MILITARY AIRSPACE

A preliminary review of the Wind Park proposal does not return any likely impacts to military airspace. Confirmation and documentation from the USAF Regional Environmental Coordination Office can be obtained if requested.

IV. NTIA NOTIFICATION

Operation of RF frequencies for federal government use is managed by the National Telecommunication Information Agency (NTIA), which is part of the U.S. Department of Commerce. The technical specifications for most government facilities are unavailable to the public. In order to avoid the derailment of the wind energy project due to late objections from a government agency, the NTIA should be notified of the proposed project during pre-construction



planning. The NTIA has set in place a review process, wherein the Interdepartmental Radio Advisory Committee (IRAC), consisting of representatives from various government agencies, reviews new proposals for wind turbine projects for impact on government frequencies. In almost all cases, no adverse impact is found, and IRAC usually issues a determination in about 60 days.

On April 6, 2018, this office sent a notification of the Prevailing Wind Park to the NTIA, and a determination is expected around the beginning of June 2018.

V. CONCLUSIONS AND RECOMMENDATIONS

1. There are 11 FCC-licensed microwave paths crossing the project area. There appear to be no conflicts between the proposed turbines and the paths.
2. The main sites of three point-to-multipoint microwave MAS facilities are inside the Wind Park area. The locations of the remote sites are undocumented. While it is the belief of this firm that the turbines would not adversely impact these facilities, a follow-up investigation of these microwave links is suggested if further due diligence is desired.
3. If an excessive amount of time goes by before the turbines are to be constructed (six months or more), it is recommended that the microwave study be updated in case new paths have been added to the FCC's database.

Respectfully Submitted,

A handwritten signature in black ink, appearing to read "B. Benjamin Evans", is written over a light blue horizontal line.

B. Benjamin Evans
RF Impact Consultant

April 16, 2018