Fatal Flaw Analysis of Utility-Scale Wind Turbine Generators at the West Haymarket Joint Public Agency

A Study Prepared in Partnership with the Environmental Protection Agency for the RE-Powering America's Land Initiative: Siting Renewable Energy on Potentially Contaminated Land and Mine Sites

Joseph Owen Roberts and Gail Mosey

Produced under direction of the U.S. Environmental Protection Agency (EPA) by the National Renewable Energy Laboratory (NREL) under Interagency Agreement IAG-08-0719 and Task No. WFD3.1001.

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Technical Report
NREL/TP-7A30-58768
August 2013

Contract No. DE-AC36-08GO28308

NATIONAL RENEWABLE ENERGY LABORATORY

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Acknowledgments

The National Renewable Energy Laboratory (NREL) thanks the U.S. Environmental Protection Agency (EPA) for its interest in securing NREL's technical expertise. In particular, NREL and the assessment team for this project are grateful to the West Haymarket Joint Public Agency facility managers, engineers, and operators for their generous assistance and cooperation.

Special thanks go to the West Haymarket Joint Public Agency; Brenda Mumper of the Federal Aviation Administration (FAA); Jessica Trice, Lura Matthews, and Shea Jones of EPA; and Katie Brown, AAAS Science and Technology Policy Fellow hosted by EPA.

Executive Summary

The U.S. Environmental Protection Agency (EPA), in accordance with the RE-Powering America's Land initiative, selected the West Haymarket Joint Public Agency site in Lincoln, Nebraska, for a feasibility study of renewable energy production. The National Renewable Energy Laboratory (NREL) was contacted to provide technical assistance for this project. The purpose of this report is to assess the site for possible wind turbine electrical generator installation and estimate the cost, performance, and site impacts of different wind energy options.

The West Haymarket Joint Public Agency site is approximately 400 acres with approximately 32 acres appropriate for installation of a single utility-scale wind turbine.

A fatal flaw analysis was done to quickly determine if the West Haymarket Joint Public Agency site is worth investing significant development time and capital. Utility-scale wind turbines have many siting considerations, and many of these potential fatal flaws can be identified relatively quickly.

The site must be able to have access for turbine components (new or existing) and an electrical interconnection (or access to one) suitable for the scale of the project. The site must have favorable local ordinances as well as national impact considerations (e.g., Department of Defense radar or flight paths).

The wind resource at the height of the technology selected must be sufficient for a financially viable project. The strength of the wind resource, while a fixed quantity for a given location, does not need to meet a minimum threshold due to other influencing variables, such as incentives, the value of the power generated, and the cost of the technology, construction, financing agreements, and operations and maintenance.

The project must also have an energy user or offtaker with agreements to purchase the power generated. The ownership of the turbine must be defined, but there are many options for ownership.

Special considerations for this site include local regulation prohibiting structures taller than 150 feet above ground level and setback consideration for rail. Site-specific Federal Aviation Administration (FAA) constraints limit the height of a potential wind turbine to 267 feet above ground level at the potential turbine site.

The feasibility of wind systems installed at this site is highly impacted by the available area for a project, wind resource, operating status, ground conditions and restrictions, distance to electrical infrastructure, and distance to major roads. The West Haymarket Joint Public Agency is suitable in area to have a single utility-scale wind turbine, and the wind resource in Lincoln is appropriate.

Due to the local height restrictions, some small wind turbines can be installed with tip heights below the 150- or 275-foot above-ground-level ordinance limit; this, however, drastically reduces the economic viability of a wind turbine installation. As such, the site fails the fatal flaw analysis, and it is not recommended that utility-scale wind turbine installations be pursued further at this site.

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1 Site Background

Under the RE-Powering America's Land initiative, the Environmental Protection Agency (EPA) provided funding to the National Renewable Energy Laboratory (NREL) to support a feasibility study of wind renewable energy generation at the West Haymarket Joint Public Agency site in Lincoln, Nebraska. The purpose of this report is to assess the site for possible wind turbine electrical generator installation and estimate the cost, performance, and site impacts of different wind energy options.

The site is approximately 400 acres with specific consideration of a 32-acre parcel and is located within the city limits of Lincoln.

The site has been utilized as a rail yard and as a gas processing facility for over 100 years. A specific 32-acre parcel was considered as it has a high likelihood of contamination due to possible previous operations on the site. This site has good access to roads, rail, and electrical infrastructure and multiple potential electrical offtakers.

2 Benefits of Renewable Energy

The cost of renewable energy technologies is relatively high. However, there are many compelling reasons to consider moving toward renewable energy sources for power generation instead of fossil fuels, including:

- Using fossil fuels to produce power might not be sustainable
- Burning fossil fuels can have negative effects on human health and the environment
- Extracting and transporting fossil fuels can lead to accidental spills, which can be devastating to the environment and communities
- Foreign sources of fossil fuels can be a threat to national security and economic stability
- Fluctuating electric costs are associated with fossil-fuel-based power plants
- Burning fossil fuels contributes to climate change
- Generating energy without harmful emissions or waste products can be accomplished through renewable energy sources
- Abundant renewable resources are available in Nebraska, particularly wind energy.

3 Wind Energy

Uneven heating of the earth's surface creates motion of the atmosphere and thus kinetic energy in this movement. Variation in heating and factors, such as surface orientation or slope, rate of reflectivity, absorptivity, and transmissivity, also affect the wind resource. In addition, the wind resource can be affected (accelerated, decelerated, or made turbulent) by factors such as terrain, bodies of water, buildings, and vegetative cover.

Wind is air with kinetic energy that can be transformed into useful work via wind turbine blades and a generator. Overall, wind is a diffuse resource that can generate electricity cost effectively and competitively in regions with a good wind resource, high cost of electricity, or both.

3.1 Wind Characteristics

Winds vary with the season, time of day, and weather events. Analysis of wind data focuses on several critical aspects of the data—average annual wind speed, frequency distribution of the wind at various speeds, turbulence, vertical wind shear, and maximum gusts. These parameters allow for estimation of available energy in the wind and the suitability of turbine technology for the site.

The wind speed at any given time determines the amount of power available in the wind. The power available in the wind is given by:

$$P = (A\ \rho V^3)/2$$

where

P = power of the wind [W]

A = windswept area of the rotor (blades) [m^2] = $\pi D^2/4 = \pi r^2$

ρ = density of the air [kg/m^3]

V = velocity of the wind [m/s]

As shown, wind power is proportional to velocity cubed (V^3). This matters because if wind velocity is doubled, wind power increases by a factor of eight ($2^3 = 8$). Consequently, a small difference (e.g., increase) in average speed causes significant differences (e.g., increases) in energy production. Examining ways to increase the wind velocity at a particular site should be considered. Normally, the easiest way to accomplish this is to increase the height of the tower. The wind industry has been moving toward higher towers, and the industry norm has increased from 30 m to 80 m over the last 15–20 years.

The map of the national wind resource can be seen in Figure 1. Wind maps can give a visual approximation of the wind resource in an area but do not provide enough data for estimating annual electricity output at a particular site. On-site wind data collected for a period of 1–3 years is necessary to estimate wind turbine performance. This study used recently collected on-site wind data for its screening level production estimates and analysis.

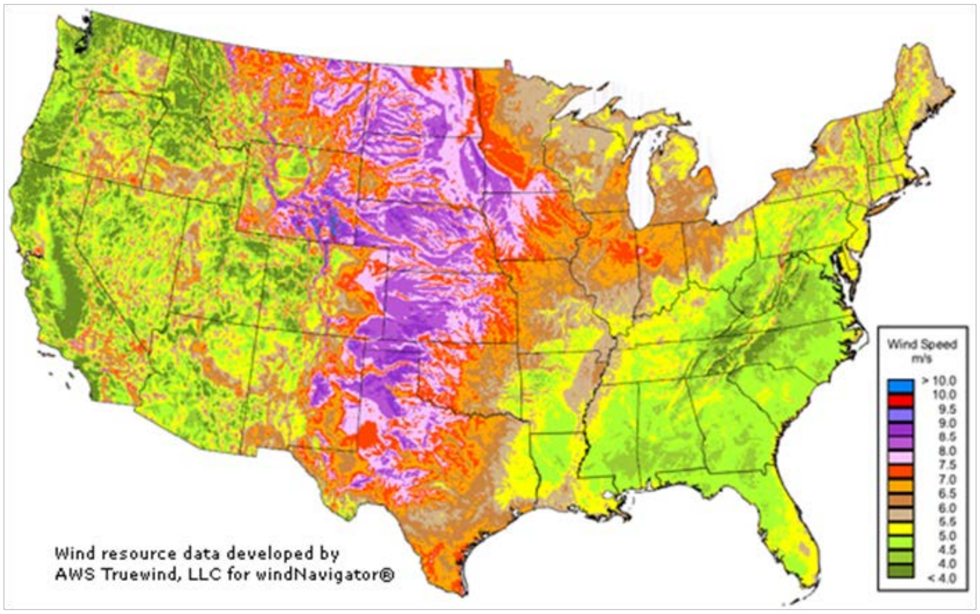


Figure 1. U.S. wind resource map[1]

Figure 2 shows additional detail of the wind resource in the State of Nebraska.

[1] "Wind Powering America." U.S. Department of Energy. Accessed August 27, 2013: http://www.windpoweringamerica.gov/wind_maps.asp.

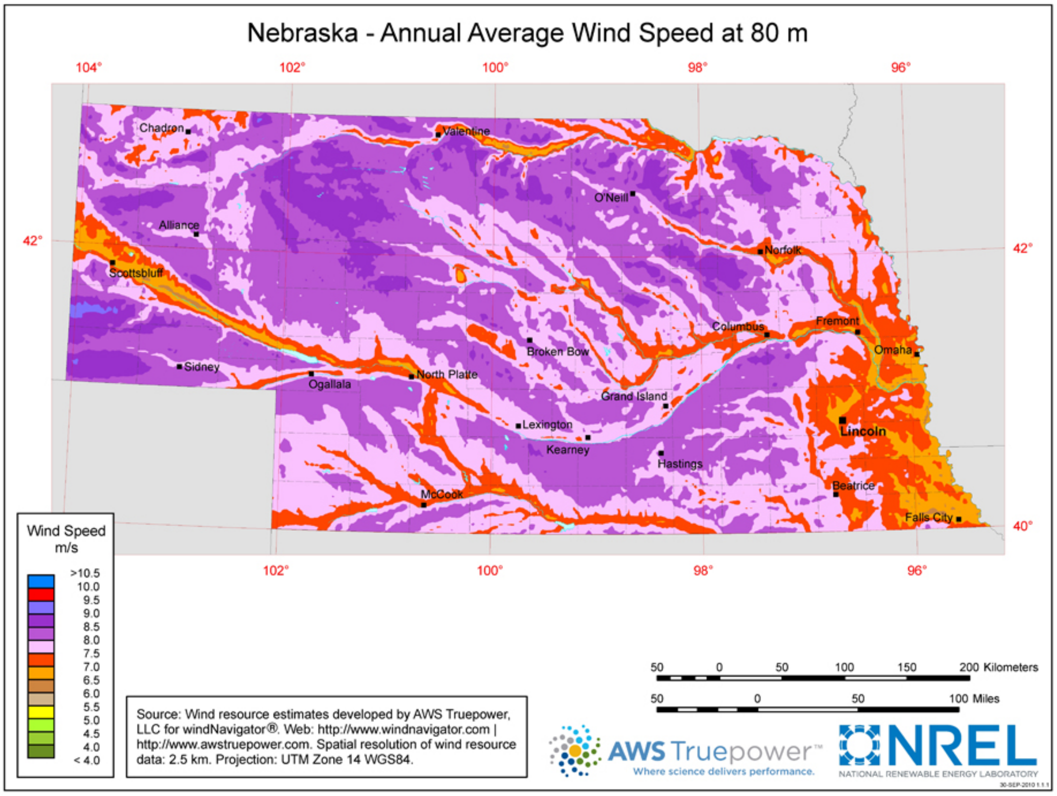


Figure 2. Nebraska 80-m annual average wind speed map[2]

3.2 Wind Turbines

Wind turbines consist of rotating blades that convert the kinetic energy of the wind to electric power. They have a number of moving parts and require regularly scheduled and unscheduled maintenance. Manufacturer warranties cover the first 2–10 years. Professional wind turbine maintenance contractors are recommended after the warranty period. Figure 3 shows large wind turbines that are of the scale and general size that might be considered at the site.

[2] "Wind Powering America." U.S. Department of Energy. Accessed August 27, 2013: http://www.windpoweringamerica.gov/wind_resource_maps.asp?stateab=ne

Figure 3. Modern utility-scale wind turbines. ***Photo by Joseph Owen Roberts***

Wind turbines, at less than wind-farm scale, are typically cost-effective where the average wind speed is high, where the competing energy costs are high, or a combination of both. Large wind farms of 100–500 MW have been driving the industry because of lower installed costs, largely due to economies of scale and improved low wind speed turbine technology, which result in an overall lower cost of energy.

In the United States, about 58,000 MW of wind power have been installed.[3] Turbines are available from as small as 250 W to as large as 5 MW. For the size of the wind plants considered here, large turbines in the range of 1,000 kW to 3,000 kW per turbine would be appropriate.

Wind power became a commercial-scale industry more than 30 years ago. Over that time, wind power has moved from the fringes of the electric power sector to a mainstream resource responsible for 35% of U.S. new power capacity from 2007 through 2011; it is second in new capacity additions only to new natural gas power.[4] In the best resource areas or localities with exceptionally high electricity costs, wind power can be cost-effective even in the absence of direct financial incentives or subsidies. Recent

[3] Wiser, R.; Bollinger, M. *2011 Wind Technologies Market Report*. Washington, D.C.: Department of Energy, 2011. http://www1.eere.energy.gov/wind/pdfs/2011_wind_technologies_market_report.pdf.
[4] E. Williams, J Hensley, *AWEA US Wind Industry Annual Market Report2012* 2013

technological improvements[5] are expected to significantly lower the life cycle cost of wind energy. Initial investment costs for wind power are relatively high compared to natural gas or other forms of generation[6]; however, with zero fuel costs and relatively modest fixed annual operations expenditures, wind-generated electricity is often a favorable generation resource over the long term. Estimated costs for typical projects in the United States for commercial power purchase agreements range from $0.025/kWh to $0.12/kWh.[7]

[5] Wiser, R.; Lantz, E.; Bolinger, M.; Hand, M. (February 2012). *Recent Developments in the Levelized Cost of Energy from U.S. Wind Power Projects.* http://eetd.lbl.gov/ea/ems/reports/wind-energy-costs-2-2012.pdf.

[6] U.S. EIA. *Updated Capital Cost Estimates for Utility Scale Electricity Generation Plants,* April 2013. http://www.eia.gov/forecasts/capitalcost/pdf/updated_capcost.pdf.

[7] Wiser, R.; Bollinger, M. *2011 Wind Technologies Market Report*. Washington, D.C.: Department of Energy, 2011. http://www1.eere.energy.gov/wind/pdfs/2011_wind_technologies_market_report.pdf.

4 Fatal Flaw Analysis

A fatal flaw analysis aims to minimize the investment in feasibility studies to quickly determine if a site is worth investing significant development time and capital. Utility-scale wind turbines have many siting considerations, and many of these potential fatal flaws can be identified relatively quickly.

The site must be able to have access for turbine components (new or existing) and an electrical interconnection (or access to one) suitable for the scale of the project. The site must have favorable local ordinances as well as national impact considerations (e.g., Department of Defense radar or flight paths).

The wind resource at the height of the technology selected must be sufficient for a financially viable project. The strength of the wind resource, while a fixed quantity for a given location, does not need to meet a minimum threshold due to other influencing variables, such as incentives, the value of the power generated, and the cost of the technology, construction, financing agreements, and operations and maintenance.

The project must also have an energy user or offtaker with agreements to purchase the power generated. The ownership of the turbine must be defined, but there are many options for ownership.

A fatal flaw analysis was performed for the West Haymarket Joint Public Agency site to determine the feasibility of installing a utility-scale wind turbine that resulted in the discovery of significant barriers to utility-scale turbines at the site.

4.1 Site Area Available for Turbines

The West Haymarket Joint Public Agency has over 400 acres of land potentially suitable for placement of wind turbines with a specific parcel of 32 acres having the highest likelihood of being suitable for a utility-scale wind turbine. Figure 4 shows the developable area for wind. Some of these areas will be excluded for setback and future development considerations. The site has sufficient setback for a 140+ meter tip height turbine depending on local siting ordinances. It is recommended that if a large utility-scale wind turbine is pursued that engaging the rail companies to understand their setback requirements be understood. The site is also within a potential flood zone, which would increase the cost of the foundation, as turbines constructed in flood plains must be able to maintain structural stability even if the foundation is under water. Typical cost additions for a utility-scale machine for a project of this size would amount to approximately an additional 10% of the foundation cost for a typical spreadfoot foundation and a 2-MW 80-m hub height wind turbine.[8]

The site has good access to road and rail for the transportation of equipment and turbine components. It is assumed that there is an electrical interconnection suitable for the size of turbine (~2 MW) nearby, but specific investigation as to the location and size of such infrastructure should be identified. A typical three-phase line in this area of the city should have more than sufficient capacity for a 2-MW wind turbine, but other

[8] Internal NREL Balance of Station cost estimation tool.

considerations, such as power quality, electrical flicker, and technology selection, should be considered.

Due to the site location and proximity to other industrial users, such as rail and commercial buildings, noise generated by the turbine should not be a likely issue. Visual impacts, such as shadow flicker from the movement of the turbine blades, should be studied and considered due to the proximity of sporting event venues and the adjacent highways and interstates. Figure 4 shows the proximity to local rail lines, the new sports stadium, and local roadways.

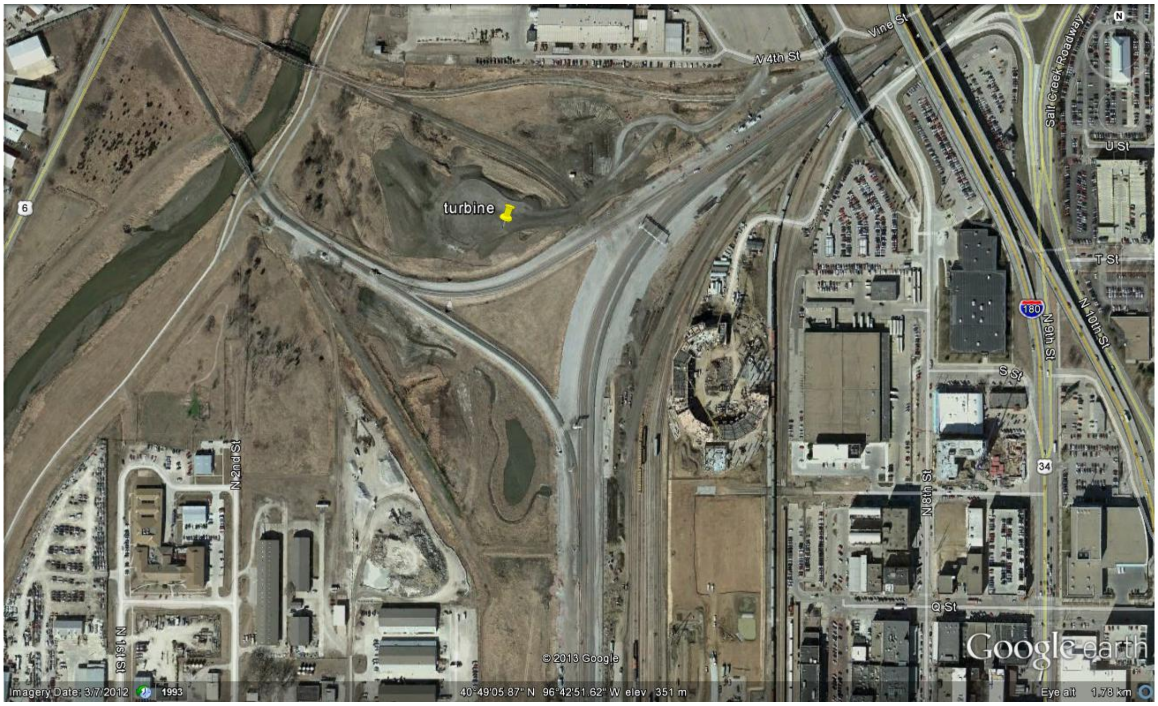


Figure 4. Aerial image of potential turbine location

Image generated using Google Earth

4.2 Wind Resource

This study assumed utility-scale wind turbines of 80 m or greater hub heights. Modern turbine technology, as well as improvements in modeling wind resources, in North America has changed what wind resources are financially cost effective to develop for utility-scale wind energy.

The annual average wind speed at 80 m above ground level is estimated to be 6.67 m/s, but the local surface roughness from buildings could decrease this value in reality. This strength of wind resource is currently considered developable in some areas of the country, but local power prices in Nebraska could decrease the cost effectiveness of a project in this wind regime. It is also worth noting that this area of North America typically has a steep gradient of the change of wind speed versus height above the ground. This phenomenon is called wind shear, and areas such as this site with high wind shear exhibit higher wind speeds as the height above the ground increases. Thus, smaller turbines will experience significantly lower wind speeds than higher hub height machines at this specific site. This decreases the potential energy that could be produced from a smaller, lower hub height wind turbine.

4.3 Permitting and Setbacks

One of the largest constraints to permitting large wind turbines is the requirement that the turbines do not cause interference with air traffic, weather radar, and military operations. The site is within a direct flight path, and the Federal Aviation Administration (FAA) was engaged to determine the overall height potential of a utility-scale turbine. Figure 5 shows that the site is within a flight approach path.

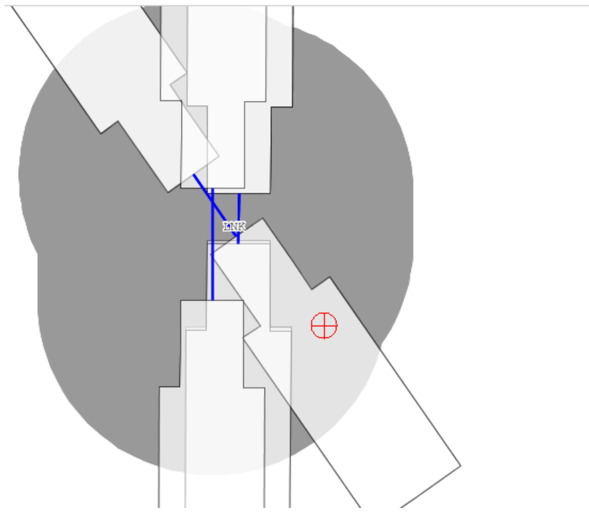


Figure 5. FAA potential impact areas[9]

The FAA determined that a maximum height of either 267 or 302 feet above ground level at the site might be possible.[10]

> …lowering the turbine to 267 ft. AGL / 1419 ft. AMSL would eliminate all impacts and a favorable determination could be issued that would be effective upon issuance.
>
> If the turbine height were lowered to 308 ft. AGL / 1460 ft. AMSL with submission of a 2C accuracy code survey, it would eliminate all impacts to instrument procedures and other obstruction standards except 77.17(a)(2). A favorable determination could be issued for that height that would be subject to the petition process. It would become final 40 days after issuance if no petitions were submitted to FAA Headquarters. If any petitions were to be submitted, the determination would not become final until Headquarters issues a finding.
>
> Best regards,
>
> Brenda Mumper
> Wind Turbine Specialist
> AR, KS, LA, MO, NE, OK, TX and Republic of Panama
> Federal Aviation Administration, Air Traffic Organization
> Obstruction Evaluation Group, AJV-15

[9] Image generated using the FAA Notice Criteria Tool. Accessed May 22, 2013: https://oeaaa.faa.gov/oeaaa/external/gisTools/gisAction.jsp?action=showNoNoticeRequiredToolForm.
[10] See Appendix A for more details from the FAA findings report.

Further investigation into these height restrictions with local stakeholders revealed that local ordinances specify a maximum height of potentially 150–275 feet above ground level.[11] Consideration for local viewshed corridors might also preclude the installation of a tall wind turbine as the city is concerned with initial impressions of patrons.[12]

The zoning regulations thus dictate that at the turbine location just within the outer approach zone restricts the height of structures to a maximum of 275 feet.[13]

Given the intent and proximity of the local ordinances, the likelihood of a utility-scale wind turbine being installed at this site is very low. Other technology scales, such as small wind turbines with tip heights of 150 feet or less, are applicable given the aforementioned constraints, but the potential energy output, quality of wind resource at lower heights, and inherent economies of scale of the technology drastically decrease the financial viability of a wind turbine installation at this site. As such, this site fails the fatal flaw analysis for a utility-scale turbine installation.

Long-range radar can also be affected by the movement of the turbine blades and could cause interference for air traffic control if not mitigated. Figure 6 shows that there is minimal potential for long-range radar impacts. Many turbines have been installed in this potential impact zone, and mitigation measures can vary from ignoring the interference to upgrading the software of the radar to filter this interference.

[11] "Airport Zoning Regulations." 27.59.040(b). Accessed July 3, 2013: http://lincoln.ne.gov/city/attorn/lmc/ti27/ch2759.pdf.
[12] LPlan 2040. "Placemaking." Section 4.3. Accessed July 3, 2013: http://lincoln.ne.gov/city/plan/lplan2040/plan/document/Amended/place.pdf.
[13] "Airport Zoning Regulations." 27.59.040(b). Accessed July 3, 2013: http://lincoln.ne.gov/city/attorn/lmc/ti27/ch2759.pdf.

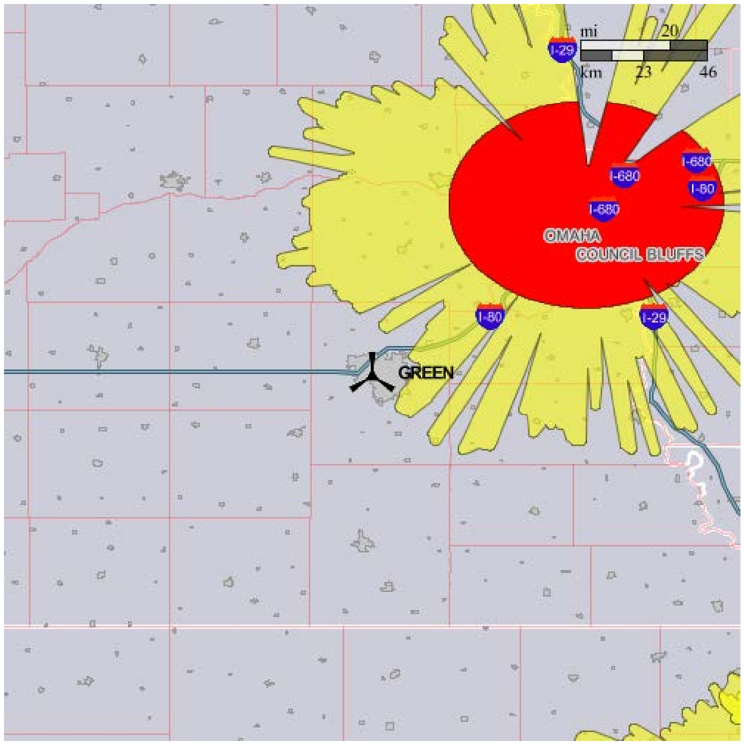


Figure 6. Long-range radar impact potential[14]

Figure 7 shows that the site has a very low probability of interfering with local weather radar.

[14] Image generated using the FAA DoD Preliminary Screening Tool. Accessed May 22, 2013: https://oeaaa.faa.gov/oeaaa/external/gisTools/gisAction.jsp?action=showLongRangeRadarToolForm.

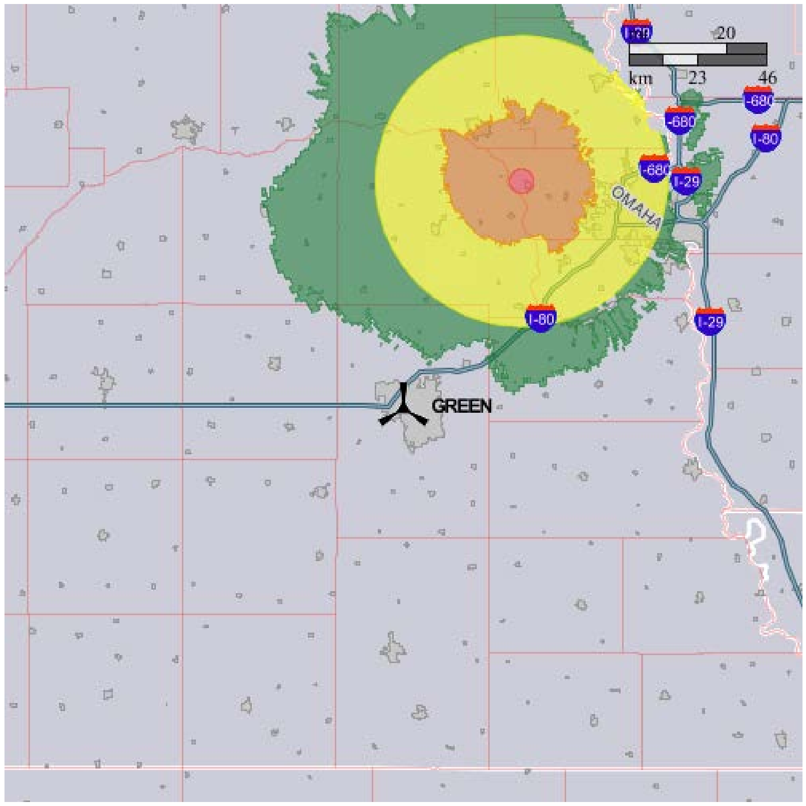


Figure 7. NEXRAD radar impact potential[15]

Figure 8 shows that there is a low probability of a wind turbine at the site interfering with military operations.

[15] Image generated using the FAA Notice Criteria Tool. Accessed May 22, 2013: https://oeaaa.faa.gov/oeaaa/external/gisTools/gisAction.jsp?action=showNoNoticeRequiredToolForm.

Figure 8. Military operation impact potential[16]

[16] Image generated using FAA's Obstruction Evaluation/Airport Airspace Analysis (OE/AAA). Accessed May 22, 2013: https://oeaaa.faa.gov/oeaaa/external/gisTools/gisAction.jsp.

5 Interconnection Considerations

5.1 West Haymarket Joint Public Agency Energy Usage

The West Haymarket Joint Public Agency site could have potential for on-site renewable energy offtakers for behind-the-metering opportunities; however, a specific net-metering agreement would need to be negotiated with the local electrical utility.

5.1.1 Net Metering and Offtake Options

Net metering is an electricity policy for consumers who own renewable energy facilities. "Net," in this context, is used to mean "what remains after deductions"—in this case, the deduction of any energy outflows from metered energy inflows. Under net metering, a system owner receives retail credit for at least a portion of the electricity it generates. As part of the Energy Policy Act of 2005,[17] under Sec. 1251, all public electric utilities are required upon request to make net metering available to their customers:

> (11) NET METERING.—Each electric utility shall make available upon request net metering service to any electric consumer that the electric utility serves. For purposes of this paragraph, the term 'net metering service' means service to an electric consumer under which electric energy generated by that electric consumer from an eligible on-site generating facility and delivered to the local distribution facilities may be used to offset electric energy provided by the electric utility to the electric consumer during the applicable billing period.

Net excess generation (NEG) is carried forward to a customer's next bill. Under prior law, any NEG remaining at the end of each 12-month period was granted to the customer's utility. In 2009, California Assembly Bill 920 (AB920)[18] gave net-metering customers two additional options for the NEG remaining after a 12-month period. They can roll over any remaining NEG from month-to-month indefinitely or they can receive financial compensation from their utility for the remaining NEG.

By January 1, 2011, the renewable energy certificates (RECs),[19] also known as green certificates, green tags, or tradable renewable certificates, became tradable commodities in the United States. They represent proof of electric energy generation from eligible renewable energy resources (renewable electricity). RECs that are associated with the electricity produced and are used on-site remain with the customer-generator. If, however, the customer chooses to receive financial compensation for the NEG remaining after a 12-month period, the utility will be granted the RECs associated with only that surplus they purchase.

[17] For a summary of this bill and its full text, see http://frwebgate.access.gpo.gov/cgi-in/getdoc.cgi?dbname=109_cong_bills&docid=f:h6enr.txt.pdf.
[18] "Assembly Bill No. 920." Accessed July 3, 2013: http://www.leginfo.ca.gov/pub/09-10/bill/asm/ab_0901-0950/ab_920_bill_20091011_chaptered.pdf.
[19] For a description of RECs, see http://apps3.eere.energy.gov/greenpower/markets/certificates.shtml.

Nebraska currently has a limit of 25 kW on net-metered systems,[20] and more recent laws passed to address wind development specifically considering decommissioning.[21] The local utility, Lincoln Electric Systems, currently owns and operates a small wind farm of older 660-kW machines north of Lincoln. Lincoln Electric Systems, as well as some local developers, expressed interest in this project when the FAA request was filed. Lincoln Electric Systems had a request for proposals (RFP) out to developers to repower their small wind farm, and developers were interested in the economies of scale of being able to purchase an additional turbine for this site. As such, Lincoln Electric Systems might be more open to innovative electrical offtake options.

[20] DSIRE. "Nebraska. Net Metering." Accessed July 3, 2013: http://www.dsireusa.org/incentives/incentive.cfm?Incentive_Code=NE07R&re=0&ee=0.
[21] DSIRE. "Nebraska. Solar and Wind Easements and Local Option Rights Laws." Accessed July 3, 2013: http://www.dsireusa.org/incentives/incentive.cfm?Incentive_Code=NE01R&re=0&ee=0.

6 Conclusions and Recommendations

Using land that cannot be used for other purposes would minimize the environmental impact of a wind generation plant. The West Haymarket Joint Public Agency site has the following attributes, which greatly increase the viability of a potential wind project at the site:

- Potentially developable wind resource
- Low potential for nearby opposition
- Adequate access to local electrical infrastructure
- Constructible site with flat terrain.

Despite these attributes, the fatal flaw analysis results determined that the West Haymarket Joint Public Agency site is not suitable for a utility-scale wind turbine due mainly to local height restrictions and flight paths, which constrain the scale of the technology that is feasible at the site.

Other fatal flaw failure criteria, as well as further difficulties to deploying a utility-scale wind turbine at the site include:

- Known FAA and local zoning interference
- Known flood plain requiring buoyant foundation design
- Unknown rail setback requirements
- Potential shadow flicker issues with sports complexes and interstates
- Lack of incentives for conventional net metering for a utility-scale turbine.

Further investigation into specific local ordinance interactions are advised if a turbine of over 150 feet is pursued. Further development of ownership and investment options should be explored.

The site fails the fatal flaw analysis due to the local and federal height restrictions, which constrain the scale of the technology that is feasible at the site. Smaller wind turbines could be installed but the combination of the lesser wind resource at these shorter hub heights combined with the economies of scale for wind turbines greatly increase the cost of energy generated by turbines less than 150 feet tall.

Appendix A. FAA Aeronautical Study Findings

Mail Processing Center
Federal Aviation Administration
Southwest Regional Office
Obstruction Evaluation Group
2601 Meacham Boulevard
Fort Worth, TX 76137

Aeronautical Study No.
2012-WTE-1748-OE

Issued Date: 04/02/2012

EPA
Tim Rehder
EPA Region 8
1595 Wynkoop St
Denver, CO 80202

**** PUBLIC NOTICE ****

The Federal Aviation Administration is conducting an aeronautical study concerning the following:

Structure:	Wind Turbine Lincoln EPA Turbine
Location:	Lincoln, NE
Latitude:	40-49-10.28N NAD 83
Longitude:	96-42-55.24W
Heights:	1152 feet site elevation (SE)
	417 feet above ground level (AGL)
	1569 feet above mean sea level (AMSL)

The structure above exceeds obstruction standards. To determine its effect upon the safe and efficient use of navigable airspace by aircraft and on the operation of air navigation facilities, the FAA is conducting an aeronautical study under the provisions of 49 U.S.C., Section 44718 and, if applicable, Title 14 of the Code of Federal Regulations, part 77.

** SEE REVERSE SIDE FOR ADDITIONAL INFORMATION **

In the study, consideration will be given to all facts relevant to the effect of the structure on existing and planned airspace use, air navigation facilities, airports, aircraft operations, procedures and minimum flight altitudes, and the air traffic control system.

Interested persons are invited to participate in the aeronautical study by submitting comments to the above FAA address or through the electronic notification system. To be eligible for consideration, comments must be relevant to the effect the structure would have on aviation, must provide sufficient detail to permit a clear understanding, must contain the aeronautical study number printed in the upper right hand corner of this notice, and must be received on or before 05/09/2012.

This notice may be reproduced and circulated by any interested person. Airport managers are encouraged to post this notice.

If we can be of further assistance, please contact our office at (405) 954-5189. On any future correspondence concerning this matter, please refer to Aeronautical Study Number 2012-WTE-1748-OE.

Signature Control No: 160902484-161863720 (CIR)

Brenda Mumper
Specialist

Attachment(s)
Part 77
Map(s)

Additional Information for ASN 2012-WTE-1748-OE

Proposal: To construct a(n) Wind Turbine to a height of 417 feet above ground level, 1569 feet above mean sea level.

Location: The structure will be located 2.74 nautical miles southeast of the Lincoln (LNK) Airport reference point.

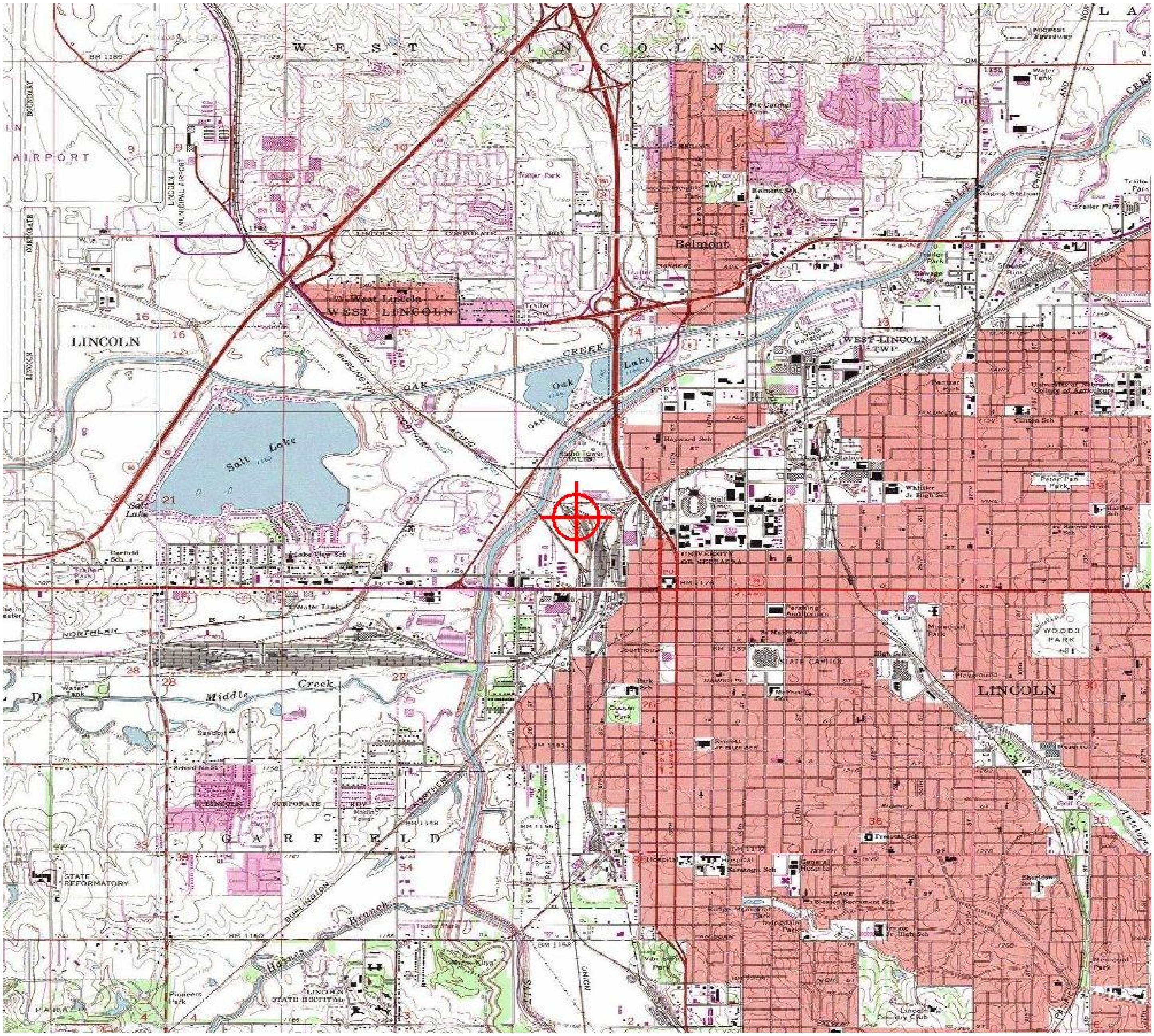
Part 77 Obstruction Standard(s) Exceeded:
Section 77.17 (a) (2) by 150 feet - a height that exceeds 1419 feet above mean sea level within 2.74 nautical miles of LNK.

Section 77.17 (a) (3) by 36 feet - a height that increases a minimum instrument flight altitude within a terminal area (TERPS Criteria). The proposal would necessitate a Notice to Airmen (NOTAM) to add take-off minimums: Runway 14, 400-3 or standard with a minimum climb of 220 ft. per NM to 1700 ft. AMSL. The structure would also increase the circling minimum descent altitude (MDA) for all procedures, Category D to 1940 ft. MSL without a survey or to 1880 ft. MSL with a 2C accuracy code survey.

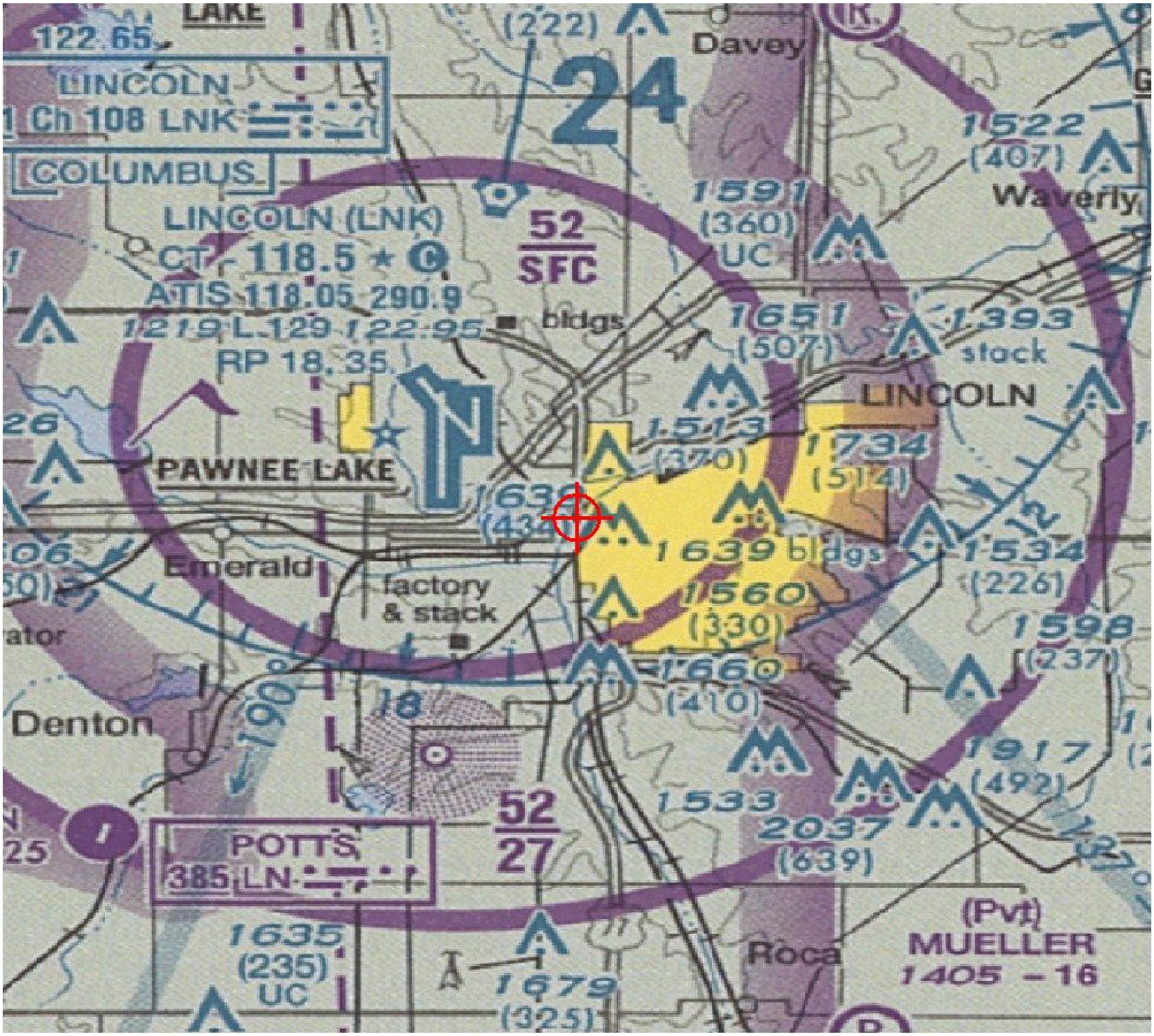
Section 77.17 (a) (5) a height that affects an Airport Surface by penetrating:
Section 77.19 (b) Conical Surface by 59 feet as applied to LNK.
Section 77.19 (d) Approach Surface by 92 feet as applied to LNK.

Preliminary FAA study indicates that the above mentioned structure would:
have no effect on any existing or proposed arrival, departure, or en route visual flight rules (VFR) operations.
not exceed traffic pattern airspace
have no physical or electromagnetic effect on the operation of air navigation and communications facilities.
have no effect on any airspace and routes used by the military.

Map for ASN 2012-WTE-1748-OE



Map for ASN 2012-WTE-1748-OE



Appendix B. Screening Contaminated Lands, Landfills, and Mine Sites for Wind Energy Potential

Through ongoing collaboration, EPA and NREL created a Site Screening Wind Decision Tree to guide state and local governments and other stakeholders through a process for screening sites for their suitability for future redevelopment with wind energy. The tool can be downloaded from the RE-Powering America's Land Initiative Mapping & Screening Tools webpage.[22]

This decision tree can be used to screen individual sites for wind energy potential or for a community-scale evaluation of multiple sites. The process is also applicable for a range of sites, from single turbine installations to large wind farms. It is not intended to replace or substitute the need for a detailed site-specific assessment that would follow an initial screening based on the decision tree.

As a preliminary step, stakeholders can consider the screening criteria below to determine a site's suitability for wind energy potential. These criteria are a subset of those included in the RE-Powering Wind Decision Tree, which contains additional information for each criterion, as well as links to resources and tools that support the screening process.

Table B-1. Wind Resource, Acreage, and Infrastructure

Consideration	Screening Threshold
Resource: Wind Speed[23]	≥ 5.5 m/s at 80-m
Usable/Available Acreage	1-2 turbines: ≥ 2 acres
	Large-scale: ≥ 40 acres
	Utility-scale: ≥ 100 acres
Site Slope	< 12 degrees (~20% grade)
Distance to Transmission Lines	≤ 1 mile
Distance to Graded Roads	≤ 1 mile
Distance to Nearest Residence or Commercial Building	> 1,000 ft
Local Average Retail Price of Electricity	> $0.08/kWh

[22] EPA. "Mapping and Screening Tools." Accessed June 26, 2013: http://www.epa.gov/renewableenergyland/rd_mapping_tool.htm.
[23] DOE. "Wind Powering America." Accessed June 26, 2013: http://www.windpoweringamerica.gov/wind_maps.asp.

Table B-2. Potential Land Use Restrictions and Exclusions

Consideration	Screening Threshold
Within areas with land-use restrictions that preclude wind development	No
Within dense urban area	No
Distance to airport runways	> 10,000 ft
Within restricted areas near radar installations	No
Within or adjacent to water, wetlands, wild and scenic rivers, wilderness study areas, and critical habitat areas for endangered or threatened species	No
Within or adjacent to migratory paths for birds and bats	No
Within designated areas of historical or cultural significance	No

Table B-3. Considerations for Landfills and Potentially Contaminated Lands

Consideration	Screening Threshold
Landfills	
- Capped & closed (at least the portion being evaluated for wind); OR - Capped & pre-remedy; closure plan can readily incorporate wind installation; OR - Uncapped & pre-remedy; geotechnical and resource investigation for wind can help determine cap requirements	Yes
Wind turbine installation compatible with site's long-term monitoring and maintenance plan, including leachate and gas collection systems, erosion control, and storm water management plans	Yes
Potentially or Formerly Contaminated Lands	
• Assessment determines that levels of contamination do not pose unacceptable risk to human health and the environment; OR • Historic uses not likely to have caused significant contamination requiring expensive cleanup; OR • Cleanup costs to redevelop site to residential or commercial space are prohibitive but would not be for wind energy reuse AND site otherwise meets all other wind energy eligibility criteria.	Yes
Wind turbines will not compromise remediation underway or in place during wind turbine construction or operation	Yes
Zoning or other institutional controls limit redevelopment for residential, commercial, or recreational uses AND allow for redevelopment for renewable energy	Yes

Table B-4. Site Owner and Policy Considerations

Consideration	Screening Threshold
Site owner is interested in leasing site for wind energy development	Yes
Site owner is: • A private entity and eligible one or more of government or utility-based incentives available for wind energy; OR • A public entity and has authority to enter into long-term agreements for land lease and/or power purchasing	Yes
State and/or local utility has strong policy support for renewable energy development	Yes

If the site meets these criteria, stakeholders can consider evaluating the site using the complete RE-Powering Wind Decision Tree in order to more fully screen the site for wind energy development potential.

For more information, go to the RE-Powering America's Land Initiative website: www.epa.gov/renewableenergyland or email cleanenergy@epa.gov.