

May 8, 2023

VIA E-MAIL AND FEDERAL EXPRESS

Mr. Steven Kahl
Executive Secretary
North Dakota Public Service Commission
600 E. Boulevard, Dept. 408
Bismarck, ND 58505-0480

**Re: Otter Tail Power Company
Amend – Luverne Wind Farm Upgrade Project
Siting Application – Steele County
Case No. PU-23- __**

Dear Mr. Kahl:

Otter Tail Power Company (Otter Tail) plans to upgrade the Luverne Wind Farm (Upgrade Project) located in Steele County, North Dakota. In support of the Upgrade Project, enclosed for filing in the above-referenced case are an original and six (6) copies of the following documents:

1. Certification of Bradley E. Tollerson with accompanying:
 - a. Exhibit A – Environmental and Regulatory Compliance Memorandum, with associated Figures and the following appendices:
 - i. Appendix A – Acoustic Assessment Results and Sound Waivers;
 - ii. Appendix B – Shadow Flicker Assessment Results;
 - iii. Appendix C – FAA Filings;
 - iv. Appendix D – Microwave Beam Path Study;
 - v. Appendix E – Class I Literature Review – Cultural Resource Report and Unanticipated Discoveries Plan (PUBLIC);
 - vi. Appendix F – IPaC Resource List; and
 - vii. Appendix G – Agency Correspondence.
2. Application to Amend Orders and Certificates.

A check in the amount of \$25,000 for the administrative fee required pursuant to NDCC § 49-22-22 is also enclosed. An unredacted, NON-PUBLIC version of the Class I Literature Review – Cultural Resource Report and Unanticipated Discoveries Plan (the above-referenced Appendix E)

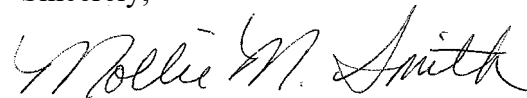
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and associated GIS data will be provided under separate cover with an Application for Protection of Information.

Electronic copies of the enclosed documents and this letter were filed with the Commission today via e-mail. If you have any questions, please let me know.

Sincerely,

A handwritten signature in black ink that reads "Mollie M. Smith". The signature is written in a cursive style with a large initial "M".

MOLLIE M. SMITH

MMS/79019084
Enclosures

cc: Lisa McFarland (w/ enclosures, via e-mail)
Bryce Haugen (w/ enclosures, via e-mail)

5. Due to the increased blade length, the overall turbine height will increase from 121.25 meters (397.8 feet) to 128.5 meters (421.6 feet).

6. The Facility's total nameplate generating capacity would increase to 52.8 MW; however, the Facility's output would remain 49.5 MW in accordance with Otter Tail's Generator Interconnection Agreement.

7. Otter Tail plans to use the existing turbine foundations (with reinforcement, if needed), collection and communications systems, and permanent access roads. Other associated facilities will remain unchanged.

8. During installation of the upgraded equipment, existing access roads will be temporarily widened to accommodate delivery and staging of components and equipment. Temporary crane paths may also be needed to facilitate equipment removal and installation. A temporary laydown yard will also be used during installation. All activities are expected to occur within areas previously disturbed by initial construction.

9. The Upgrade Project activities are wholly within the site designated by the Commission for the Facility in its October 30, 2008 Findings of Fact, Conclusions of Law and Order (Case No. PU-08-34) (2008 Order)², and are to improve the same type of facility for which Certificate of Site Compatibility No. 9 was issued. *See* N.D.C.C. §§ 49-22-03(3)(a)(1), (3) and (4)(b).

10. Otter Tail has conducted an environmental and regulatory compliance analysis for the Upgrade Project, and an associated report prepared by its environmental consultant, Atwell, LLC (Atwell), is provided as **Exhibit A**. As set forth in **Exhibit A**:

² On December 3, 2008, the Commission issued a Certificate of Public Convenience and Necessity (CPCN) to Otter Tail for the Facility (Case No. PU-08-766). On May 20, 2009, the Commission issued an Order Reissuing Certificate and Permit, authorizing the transfer of the 49.5 MW Facility to Otter Tail, issuing First Reissued Certificate of Site Compatibility No. 9 to Otter Tail for the 49.5 MW Facility (Case No. PU-09-73).

a. **Cultural Resources.** The Upgrade Project construction activities will occur primarily within areas previously surveyed for cultural resources, and all construction activities will occur within areas previously disturbed by initial Facility construction. Based on recommendations made by the State Historical Society of North Dakota (SHSND) for Otter Tail's Langdon Wind Energy Center Upgrade Project (Langdon Upgrade Project), if any Upgrade Project crane paths are located outside of areas previously surveyed for cultural resources, Otter Tail will complete cultural resource field surveys and will avoid any resources identified that are eligible or unevaluated for listing on the National Register of Historic Places (NRHP). Therefore, no cultural resources will be affected by the Upgrade Project.

b. **Architectural Resources.** Although not recommended at the time the Facility was originally permitted and constructed, in consultations with SHSND for the Langdon Upgrade Project, SHSND recommended completion of an architectural history survey in the vicinity of wind energy generation facilities to identify architectural resources potentially eligible for NRHP-listing and to evaluate potential impact to those resources. As a result, Otter Tail also plans to complete an architectural history survey for this Upgrade Project. Since the Upgrade Project involves technology upgrades to existing turbines, it is not anticipated that the limited modifications will adversely affect architectural history resources. However, in the event of an adverse impact, Otter Tail will coordinate with SHSND to identify appropriate mitigation.

c. **Wetlands.** Wetlands and waterbodies have been identified within the Upgrade Project Area. No permanent wetland impacts will occur as a result of Upgrade Project activities.

d. **Sound.** At Atwell's direction, Epsilon Associates, Inc. (Epsilon) completed a sound analysis for the Upgrade Project with the proposed upgraded technology. At the time the Facility was permitted, the Commission did not have a sound standard for wind energy facilities. The Commission's current sound level requirement is 45 dBA or less within 100 feet of occupied residences and community buildings. With the upgraded equipment, sound levels within 100 feet of five occupied residences were modeled above 45 dBA, while sound levels were at or below 45 dBA within 100 feet of the remaining residences (no community buildings are present). Otter Tail has obtained sound waivers from the owners of two of the residences modeled above the 45 dBA requirement. With respect to the remaining three residences, Otter Tail is pursuing waivers. Additionally, Otter Tail has confirmed that the Upgrade Project is able to comply with the Commission's sound requirement at those three residences by installing noise-reduction technology, such as noise-reducing operation modes (NRO) and/or low noise trailing edge (LNTE) blades at up to eight turbines (as needed).


e. **Shadow Flicker.** Epsilon completed a shadow flicker assessment for the Upgrade Project with the proposed upgraded technology. The Commission does not have a shadow flicker standard, and shadow flicker was not addressed in the Commission's 2008 Order. The shadow flicker assessment demonstrates that shadow flicker levels are not anticipated to exceed 30 hours per year at any occupied residence.

f. **Exclusion and Avoidance Areas.** Otter Tail has analyzed the Upgrade Project's compliance with the Commission's current exclusion area and avoidance area criteria. With the exception of two turbines that are within the non-participating property line exclusion area, the Upgrade Project complies with all exclusion areas. Otter Tail has identified the owners of the properties at issue and is pursuing waivers. Otter Tail requests

that the Commission grant a variance conditioned upon submission of the waivers. If any landowner is not willing to grant a waiver, Otter Tail will not upgrade equipment at the affected turbine. Accordingly, the Upgrade Project will comply with all current exclusion area and avoidance area criteria, and construction activities associated with the Upgrade Project will not affect any known exclusion or avoidance areas within the designated site. See N.D.C.C. §§ 49-22-03(3)(a)(2) and (4)(a).

11. The Facility will continue to comply with all requirements set forth in the Commission's Orders regarding the Facility, including applicable laws and rules designating the site. See N.D.C.C. §§ 49-22-03(3)(a)(1) and (4)(c).

FURTHER AFFIANT SAYETH NOT.



Bradley E. Tollerson

Subscribed and sworn to before me
this 5th day of May 2023.



Notary Public

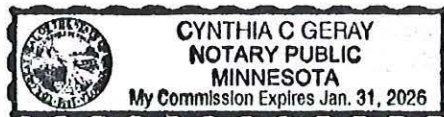


Exhibit A

Environmental and Regulatory Compliance Memorandum Amend – Luverne Wind Farm Upgrade Project Case No. PU-23-_____

Introduction

Otter Tail Power Company (Otter Tail) has retained Atwell, LLC (Atwell) to prepare this memorandum to support Otter Tail's certification of compliance with N.D.C.C. § 49-22-03(3)(a) in connection with equipment upgrading activities (Upgrade Project) for its 49.5 megawatt (MW) Luverne Wind Farm (Facility). Otter Tail, with assistance from Atwell, analyzed the Upgrade Project with respect to environmental, cultural, and natural resources, as well as sound and shadow flicker. The following sections and referenced figures and appendices summarize the results of the analysis.

Description of the Upgrade Project

The Upgrade Project involves replacing the current General Electric (GE) 1.5 MW turbine technology with updated technology. More specifically, the Upgrade Project will consist of removing and replacing the existing GE 82.5 meter (270.7 feet) rotor diameter (RD) blades, hub, and gearbox with a new equipment upgrade package of GE 1.6 MW generator technology and 97 meter (318.2 feet) RD blades, hub, and gearbox. All 33 existing 80 meter (262.5 feet) structural steel towers will be used as well as existing nacelles and, as a result, turbine locations will not change. Otter Tail plans to use the existing turbine foundations (with reinforcement, if needed), collection/communications systems, and permanent access roads. Other associated facilities will remain unchanged.

Once removed, the existing 82.5 meter RD blades will be cut on-site to fit into legal load transportation-size pieces. Loads will be secured and/or covered or other steps will be taken to ensure materials do not escape during transport. Otter Tail's contractor will transport the loads to an out-of-state facility that will grind the blade materials for repurposing, and no blades will be deposited in a landfill.

During installation of the equipment upgrade technology, existing access roads will be temporarily widened to accommodate delivery of components and equipment. Temporary crane paths may also be needed to facilitate equipment removal and installation. A temporary laydown yard will also be used during installation. Otter Tail currently plans to install the equipment upgrade technology in mid-2025.

Figure 1 depicts the Upgrade Project Area and layout. Figure 2 depicts the proposed turbine technology.

Compliance with Exclusion and Avoidance Areas

Exclusion Areas

Per N.D.A.C. §§ 69-06-08-01(1) and (2), the geographical areas listed in Table 1 shall be excluded in the consideration of a site for a wind energy conversion facility. Based on the Commission's

approach in prior equipment upgrade dockets, Otter Tail confirmed the Upgrade Project’s compliance with the Commission’s current exclusion area criteria. With the exception of two turbines that are within the non-participating property line exclusion area, the Upgrade Project complies with all exclusion areas. Otter Tail identified the owners of the properties at issue and is pursuing waivers. Otter Tail requests that the Commission grant a variance conditioned upon submission of the waivers. If any landowner is not willing to grant a waiver, Otter Tail will not upgrade equipment at the affected turbine. Exclusion areas are mapped for the Upgrade Project Area on Figure 3.

Table 1: Summary of Exclusion Areas

General Exclusion Area	Present Within Upgrade Project Area?	Description
Designated or registered national: parks; memorial parks; historic sites and landmarks; natural landmarks; historic districts; monuments; wilderness areas; wildlife areas; wild, scenic, or recreational rivers; wildlife refuges; and grasslands.	None	United States Fish and Wildlife Service (USFWS) administered Waterfowl Production Areas (WPA) are located in the vicinity of the Upgrade Project Area. A minimum 0.25-mile buffer was and continues to be maintained from each WPA.
Designated or registered state: parks; forests; forest management lands; historic sites; monuments; historical markers; archaeological sites; grasslands; wild, scenic, or recreational rivers; game refuges; game management areas; management areas; and nature preserves.	None	N/A
County parks and recreational areas; municipal parks; parks owned or administered by other governmental subdivisions; hardwood draws; and enrolled woodlands.	None	N/A
Areas critical to the life stages of threatened or endangered animal or plant species.	None	N/A
Areas where animal or plant species that are unique or rare to this state would be irreversibly damaged.	None	N/A
Areas within 1,200 feet of the geographic center of an intercontinental ballistic missile (ICBM) launch or launch control facility.	None	N/A

Table 1: Summary of Exclusion Areas

General Exclusion Area	Present Within Upgrade Project Area?	Description
Areas within thirty feet [9.14 meters] on either side of a direct line between an intercontinental ballistic missile (ICBM) launch facility and a missile alert or launch control facilities to avoid microwave interference. This restriction only applies to aboveground structures, not to surface features, such as roads, or belowground infrastructure.	None	N/A
Additional Exclusion Areas for Wind Energy Conversion Facilities – Areas within:		
1.1x the turbine height from the nearest edge of an interstate or state roadway right-of-way (ROW).	None	N/A
1.1x the turbine height plus 75 feet from the centerline of any county or maintained township roadway.	Present	No turbines will be located within these exclusion areas.
1.1x the turbine height from the nearest edge of railroad ROW.	None	N/A
1.1x the turbine height from the neared edge of a 115 kV or higher transmission line ROW.	Present	No turbines will be located within this exclusion area.
1.1x the turbine height from the property line of a non-participating landowner and 3x the height of the turbine from an inhabited rural residence of a non-participating landowner, unless a variance is granted. A variance may be granted if an authorized representative or agent of the permittee, the nonparticipating landowner, and affected parties with associated wind rights file a written agreement expressing all parties’ support for a variance to reduce the setback requirement in this subsection. A nonparticipating landowner is a landowner that has not signed a wind option or an easement agreement with the permittee of the wind energy conversion facility as defined in NDCC Chapter 17-04.	Present	Two turbines would be located within the non-participating property line exclusion area. ¹ Otter Tail is in the process of obtaining waivers from the landowner(s) to support issuance of variances. No turbines will be located within 3x the height of the upgraded turbines from a non-participating inhabited residence.

¹ Note that Turbine 147 is authorized by lease agreement to overhang the adjacent parcel to the west (Berger Parcel). As such, that overhang area is participating and the turbine complies with the non-participating property line setback exclusion area.

Avoidance Areas

Per N.D.A.C. §§ 69-06-08-01(3) and (4), the geographical areas listed in Table 2 may not be approved as a site for an energy conversion facility unless the applicant shows that under the circumstances there is no reasonable alternative or (in the case of the sound limit) a waiver has been obtained. Based on the Commission’s approach in prior equipment upgrade dockets, Otter Tail confirmed the Upgrade Project’s compliance with the Commission’s current avoidance area criteria.

Avoidance Area	Present Within Upgrade Project Area?	Description
Historical resources which are not designated as exclusion areas.	None	No impacts to historical resources are anticipated. An Unanticipated Discoveries Plan has been prepared for the Upgrade Project. A copy of that plan is provided as Appendix E.
Areas within the city limits of a city or the boundaries of a military installation.	None ²	N/A
Areas within known floodplains as defined by the geographical boundaries of the hundred-year flood.	None	N/A
Areas that are geologically unstable.	None	N/A
Woodlands and wetlands.	Present	No wetlands or woodlands will be impacted by the Upgrade Project.
Areas of recreational significance which are not designated as exclusion areas.	None	N/A

² One former military missile site is located within the Upgrade Project Area. The site has been decommissioned and is no longer used for military procedures.

Avoidance Area	Present Within Upgrade Project Area?	Description
A geographic area where, due to the operation of the facility, the sound levels within one hundred feet on an inhabited residence or community building will exceed forty-five dBA. The sound level avoidance area criteria may be waived in writing by the owner of the occupied residence or the community building.	Present	Five residences were initially modeled to have sound levels in excess of the Commission's sound standard with the Upgrade Project. Otter Tail has sound waivers from the owners of two of the residences, and is pursuing waivers from the owners of the other three residences. Additionally, Otter Tail has confirmed that the Commission's sound standard can be met at those three residences by installing noise-reduction technology. As such, Otter Tail will comply with the Commission's sound standard.

Setback Compliance

In addition to compliance with the setbacks set forth above, the Upgrade Project continues to comply with the setback commitments listed in Table 3, which were made at the time a Certificate of Site Compatibility was issued for the Facility.

Setback Type	Distance
Occupied Residence	1,400 feet
USFWS WPA	0.25 miles
Developed Road	400 feet or the fall zone of the wind turbine, whichever is greater
Large (lacustrine) wetland complex (greater than 50 acres)	500 feet

Socioeconomics

The Upgrade Project will have positive impacts on socioeconomics by extending the life of the wind energy facility, which, in turn, extends the time period for which landowners will receive easement payments. In addition, the Upgrade Project will create temporary construction jobs, with associated opportunities for increased local spending.

Land Use

The Upgrade Project will be constructed entirely within the previously-designated site, and turbine and other permanent infrastructure locations will remain the same. As a result, land use will also remain unchanged. The Upgrade Project will result in temporary disturbances, including temporary widening of access roads to accommodate transportation of components and equipment, a temporary laydown yard, and temporary crane paths (as needed). Temporarily impacted areas

will be restored in compliance with applicable provisions of the Commission's Findings of Fact, Conclusions of Law and Order, dated October 30, 2008 (Case No. PU-08-34) (2008 Order.)

Public Services

The Upgrade Project will result in a temporary increase in traffic in and near the Upgrade Project Area, but is not anticipated to interfere with local road use. Otter Tail will coordinate with Steele County and the townships, as appropriate, regarding local road use, will obtain all necessary road use permits, and will restore roads impacted by the Upgrade Project in accordance with the requirements of the Commission's 2008 Order and as required by Steele County and the townships.

Sound, Shadow Flicker, and Human Health and Safety

As noted above, the Upgrade Project continues to maintain a turbine setback of 1,400 feet from occupied residences. Based on an initial sound analysis, sound levels within 100 feet of five occupied residences were modeled above 45 dBA with the Upgrade Project. Otter Tail has obtained sound waivers from the owners of two of the residences. With respect to the remaining three residences, Otter Tail is pursuing waivers. Additionally, Otter Tail has confirmed that the Upgrade Project is able to comply with the Commission's sound requirement by installing noise-reduction technology, such as noise-reducing operation modes (NRO) and/or low noise trailing edge (LNTE) blades at up to eight turbines (as needed). Copies of noise waivers obtained to-date are provided in Appendix A. A copy of the sound study report completed for the Upgrade Project (using GE 1.6 MW turbines with 97 meter hub height and noise-reduction technology) is also provided in Appendix A.

At the time the Facility was permitted, the Commission did not specifically address shadow flicker. However, Otter Tail conducted a shadow flicker assessment for the Upgrade Project utilizing realistic modeling inputs. Based on the assessment, shadow flicker levels from the Upgrade Project will not exceed 30 hours per year at any occupied residences (Appendix B).

Otter Tail has submitted form 7460-1 to the Federal Aviation Administration (FAA) for each turbine (*see* Appendix C). Otter Tail will obtain Determinations of No Hazard from the FAA and will provide copies to the Commission prior to construction.

Comsearch completed a microwave study for the Upgrade Project. Based on the analysis, Comsearch found that none of the turbines would obstruct microwave beam paths in the area with the upgraded equipment (Appendix D).

The Upgrade Project will continue to comply with all safety-related and other conditions of the Commission's October 2008 Order.

Cultural and Architectural Resources

In March of 2023, staff from Atwell conducted background research at the State Historical Society of North Dakota (SHSND) for information on previously identified archaeological sites and architectural properties within one mile (1.6 km) of the Upgrade Project Area and on surveys previously conducted within the Upgrade Project Area (Appendix E – Class I Literature Review).

The Upgrade Project construction activities will occur primarily within areas previously surveyed for cultural resources, and all construction activities will occur within areas previously disturbed by initial Facility construction. Based on recommendations made by the SHSND regarding Otter Tail's Langdon Wind Energy Center Upgrade Project (Langdon Upgrade Project), if any Upgrade Project crane paths are located outside of areas previously surveyed for cultural resources, Otter Tail will complete cultural resource field surveys and will avoid any resources identified that are eligible or unevaluated for listing on the National Register of Historic Places (NRHP). Additionally, Otter Tail has prepared an Unanticipated Discoveries Plan, which will be implemented during Upgrade Project construction (*see* Appendix E).

Although not recommended at the time the Facility was originally permitted and constructed, in consultations with SHSND regarding the Langdon Upgrade Project, SHSND recommended completion of an architectural history survey in the vicinity of wind energy generation facilities to identify architectural resources potentially eligible for NRHP-listing and to evaluate potential impact to those resources. As a result, Otter Tail is also planning to complete an architectural history survey for this Upgrade Project. Since the Upgrade Project involves technology upgrades to existing turbines, it is not anticipated that the limited modifications will adversely affect architectural history resources. However, in the event of an adverse impact, Otter Tail will coordinate with SHSND to identify appropriate mitigation.

The Class I Literature Review, which includes the Unanticipated Discoveries Plan, has been submitted to the SHSND for review (*see* Appendix G).

Recreational Resources

The Upgrade Project will not impact any recreational resources. The Upgrade Project continues to maintain a setback of at least 0.25 miles from nearby WPAs.

Land-Based Economics

The Upgrade Project will not result in any additional long-term land impact; as a result, the Upgrade Project will also not result in any long-term impacts to agricultural use or production. Otter Tail will compensate landowners for any temporary impacts to cropland in accordance with the terms of its wind lease agreements, as applicable.

Soils

Upgrade Project construction may result in minor short-term impacts to soils within the disturbance area. During construction, short-term impacts may include soil compaction, vegetation clearing, and the potential for localized soil erosion and sedimentation. No other impacts are anticipated. Measures to control erosion will be implemented during Upgrade Project construction to avoid or minimize soil erosion. Erosion and sedimentation will be reduced by implementation of best management practices (BMPs) such as mulching, hydroseeding, wildlife-friendly erosion control blankets, silt fence installation, matting, and revegetation, as appropriate. Once construction is completed, soils will be revegetated in accordance with Natural Resources Conservation Service requirements (unless otherwise specified by the landowner and approved by

the Commission). No adverse impacts to soil resources are expected as a result of the Upgrade Project.

Geologic and Groundwater Resources

The Upgrade Project is not expected to disturb any geologic or groundwater resources.

Waterbodies, Wetlands, and Floodplain Resources

Atwell has conducted a desktop review of wetland and waterbody features identified within the Upgrade Project Area by utilizing National Wetland Inventory (NWI) maps, National Hydrography Dataset (NHD) maps, and satellite imagery. The Upgrade Project will remain within the areas previously disturbed by initial Facility construction, and no temporary or permanent impacts wetlands or waterbodies are anticipated. Existing access roads cross NHD watercourses in three locations; however, there are existing culverts at these crossing locations and, as such, no impacts to the watercourses are anticipated.

FEMA floodplains (100-year) are not mapped in Steele County. In addition, haul route turning radii design will be based on existing public roads. As such, impacts to floodplains are not anticipated.

Vegetation

No trees or shrubs will be removed in connection with the Upgrade Project. Otter Tail will comply with the site restoration and reseeding conditions in the Commission's October 2008 Order and all other applicable permitting requirements.

Wildlife

Impacts to wildlife are expected to be minimal as the proposed construction disturbance areas were previously disturbed and are of low-quality habitat. If construction activities are planned during the springtime, ground nesting bird clearance surveys in uncultivated areas will be conducted, as applicable, prior to construction.

The USFWS Information for Planning and Consultation (IPaC) system was reviewed for a list of threatened, endangered, and candidate species that could occur within or near the Upgrade Project Area. The northern long-eared bat, Dakota Skipper, and monarch butterfly have the potential to occur in Griggs County and/or Steele County. According to the USFWS IPaC system, no Designated Critical Habitat is present in the Upgrade Project Area. The existing turbines were built in open terrain outside of forested areas and riparian corridors. Additionally, Upgrade Project construction activities will be confined to previously disturbed areas, and no tree removal is anticipated. As a result, no impacts to these species are anticipated.

The Upgrade Project is not anticipated to have any measurable change in impact on migrating birds or bats. Impacts are expected to be similar to other operating wind projects in the area. Otter Tail will develop a Wildlife Conservation Strategy for the facility, which will outline BMPs that are to be undertaken for the life of the facility to minimize risks to birds, bats, and other wildlife from operation of the wind farm.

A copy of the IPaC Resource List is provided in Appendix F.

Conclusion

Table 4 below summarizes Otter Tail's environmental and regulatory analysis of the Upgrade Project. As indicated in Table 4 and the prior sections, the Upgrade Project complies with the requirements of N.D.C.C. § 49-22-03(3)(a), including the Commission's current exclusion area and avoidance area criteria. Additionally, the Upgrade Project will continue to comply with all applicable siting laws, rules, and Commission orders, including the conditions specified in the Commission's October 2008 Order.

Summary Table

Table 4: Summary of Environmental Resource Impact Analysis and Avoidance/Minimization Measures		
Resource	Potential Impact of Upgrade Project	Avoidance and/or Minimization Measures
Socioeconomics	Positive economic and social impacts.	None proposed.
Land Use	Temporary disturbances only; will utilize previously disturbed areas.	Will restore temporarily impacted areas in compliance with applicable provisions of the Commission's 2008 Order.
Public Services	A temporary increase in traffic due to construction will occur.	Will coordinate with Steele County and applicable townships regarding local road use, obtain all necessary road use permits, and restore roads impacted by the Upgrade Project in accordance with the requirements of the Commission's 2008 Order and as required by Steele County and the townships.
Human Health and Safety	Turbine lighting will continue to meet FAA and Commission requirements. Shadow flicker is predicted to be 30 hours per year or less at all occupied residences.	None proposed.
Sound	Initial modeling analysis determined that the sound may exceed 45 dBA within 100 feet of five occupied residences. Modeling was conducted with NRO and/or LNTE added to up to eight turbines.	Otter Tail has obtained sound waivers from the owners of the two residences with sound levels in excess of the sound limit. Otter Tail is pursuing waivers from the remaining three residences. Additionally, Otter Tail has confirmed that the Commission's sound requirement can be met at those three residences by installing noise-reduction technology. Accordingly, the Upgrade Project will comply with the current sound regulations.

Table 4: Summary of Environmental Resource Impact Analysis and Avoidance/Minimization Measures

Resource	Potential Impact of Upgrade Project	Avoidance and/or Minimization Measures
Cultural/Architectural History Resources	Upgrade Project activities will occur primarily within areas previously surveyed for cultural resources or in areas previously disturbed by initial facility construction. The Upgrade Project is not anticipated to impact cultural or architectural history resources.	Prepared an Unanticipated Discoveries Plan.
Recreational Resources	No impacts to recreational resources are anticipated.	Will continue to maintain a setback of 0.25 miles from nearby WPAs.
Land Based Economics	Minimal cropland will be temporarily impacted during construction. No additional long-term impacts to agricultural use or production are anticipated.	Will compensate landowners for any temporary impacts to cropland in accordance with the terms of its wind lease agreements, as applicable.
Soils	Temporary land disturbance may cause soil surface to become more prone to wind and water erosion.	Will implement Best Management Practices (BMPs) to minimize erosion and sedimentation and will restore temporarily impacted areas.
Geologic and Groundwater Resources	No impacts to geological and groundwater resources are anticipated.	None proposed.
Waterbodies, Wetlands, and Floodplain Resources	No impacts are anticipated.	Will implement BMPs to minimize erosion and sedimentation.
Vegetation	Will utilize previously disturbed areas; no trees or shrubs will be removed.	Will comply with the site restoration and reseeded conditions in the Commission's 2008 Order and all other applicable requirements.

Table 4: Summary of Environmental Resource Impact Analysis and Avoidance/Minimization Measures

Resource	Potential Impact of Upgrade Project	Avoidance and/or Minimization Measures
Wildlife	<p>Construction impacts will be confined to previously disturbed locations and minimal impacts to wildlife anticipated.</p> <p>The Upgrade Project is not anticipated to have an impact on threatened or endangered species or have any measurable change in impact on migrating birds or bats.</p>	<p>Will implement BMPs from the Upgrade Project’s Wildlife Conservation Strategy to minimize risks to birds, bats, and other wildlife.</p>

Attachments

Figure 1. Upgrade Project Area

Figure 2. Wind Turbine Diagram

Figure 3. Exclusion and Avoidance Area Map

Appendix A – Acoustic Assessment Results and Sound Waivers

Appendix B – Shadow Flicker Assessment Results

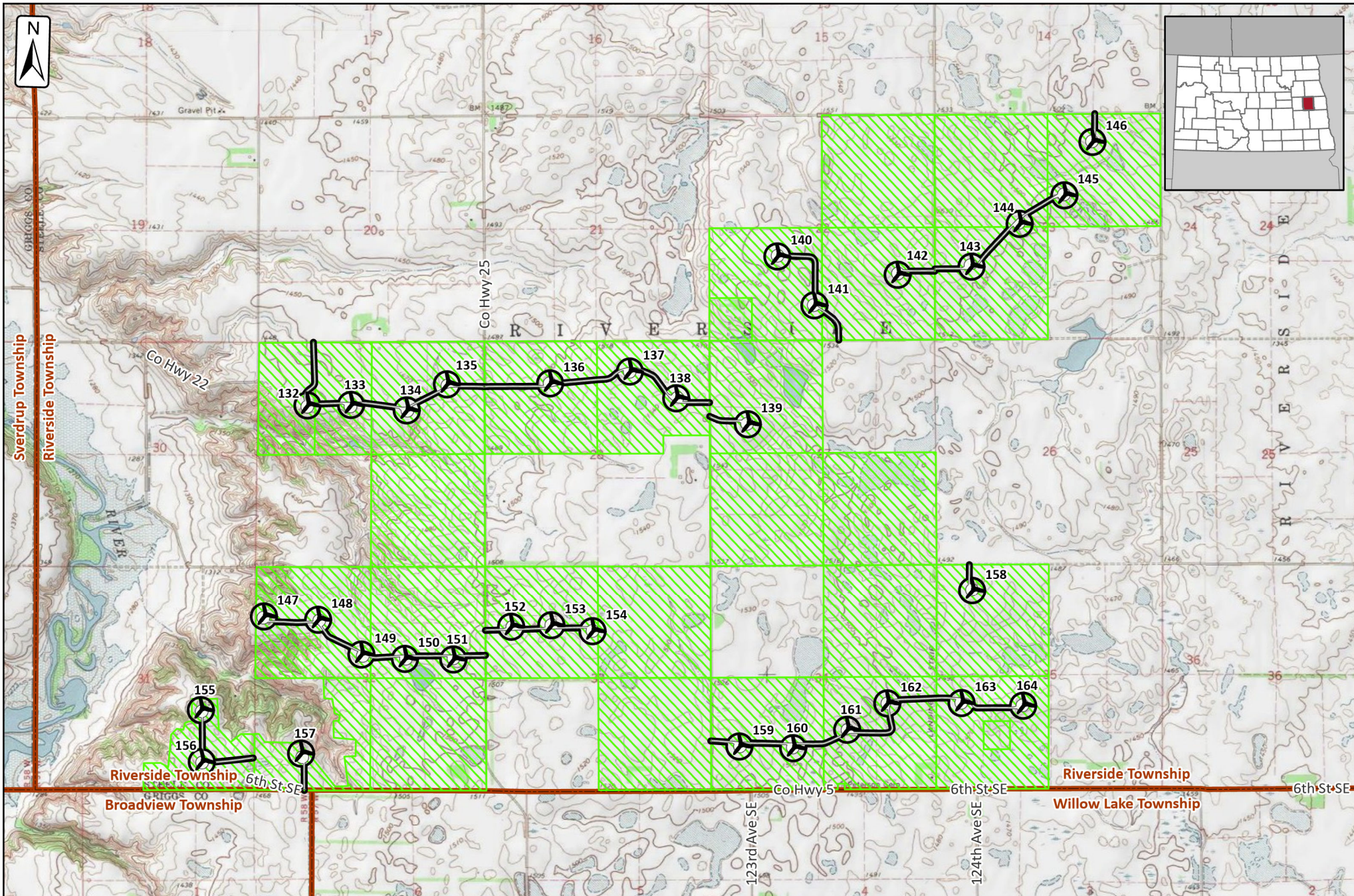
Appendix C – FAA Filings

Appendix D – Microwave Beam Path Study

Appendix E – Class I Literature Review – Cultural Resource Report and Unanticipated Discoveries Plan (PUBLIC)

Appendix F – IPaC Resource List

Appendix G – Agency Correspondence








Luverne Wind Upgrade Project

Figure 1- Site Overview

Steele County, North Dakota

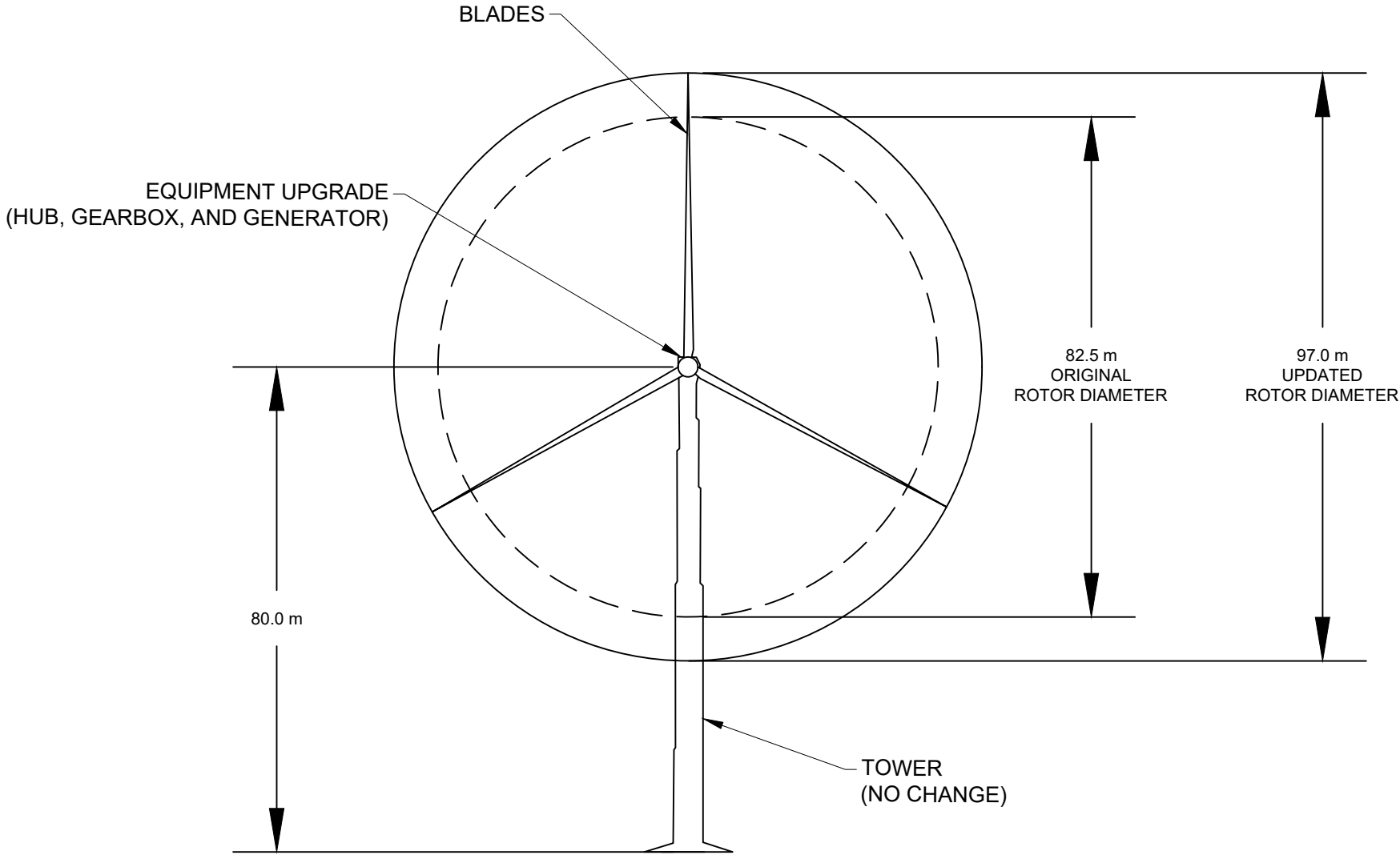
Issue Date: 5/5/2023

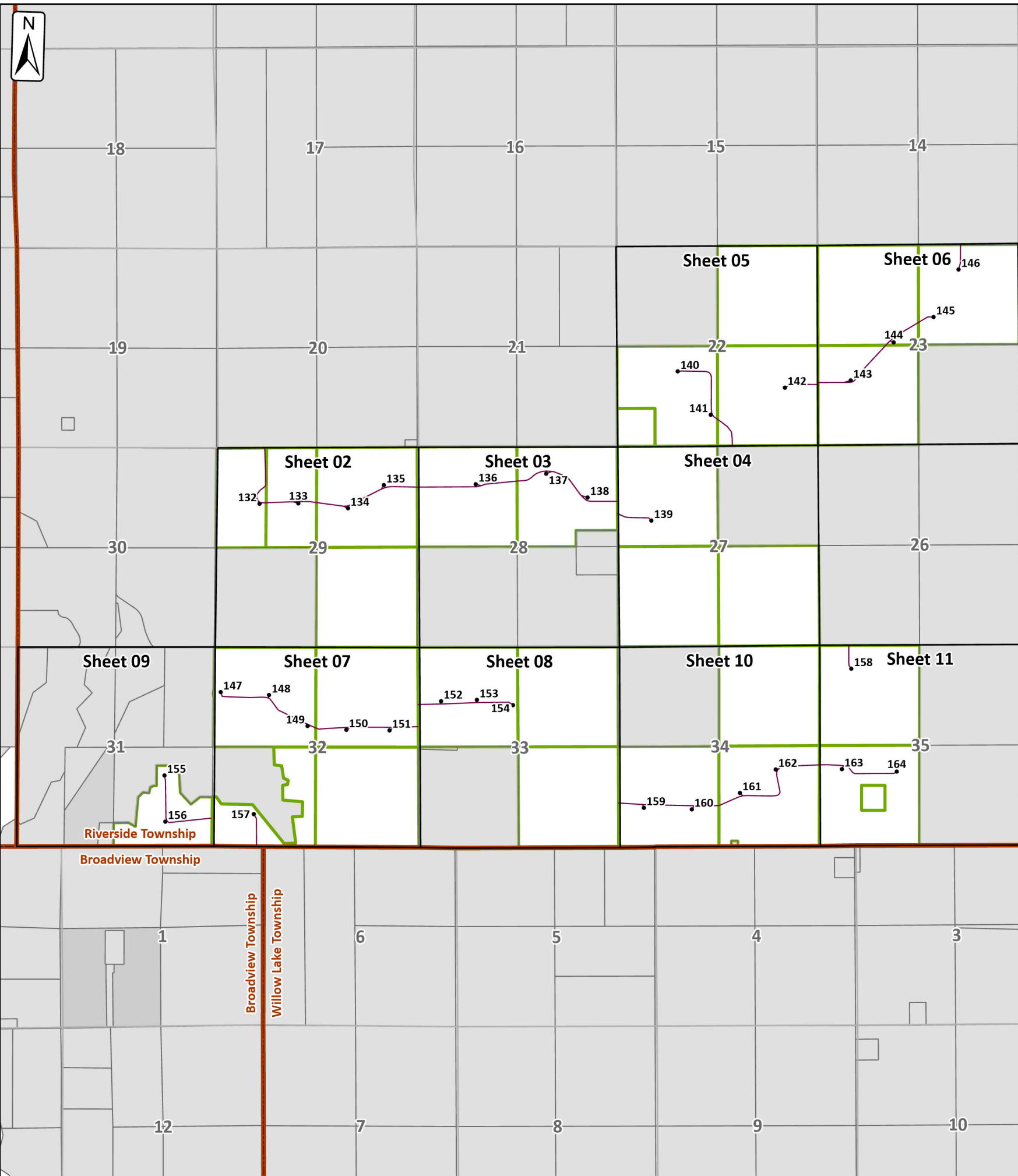
-  Existing Turbine Locations
-  Participating Parcels
-  Disturbance Area (~80 acres)
-  Study Area
-  Township



SOURCE: USGS Topo Maps

FIGURE 2: PROPOSED TURBINE UPGRADE





OTP Luverne Repower Exclusions and Avoidance
Turbine Details: Hub height of 80 meters, Rotor diameter of 97 meters

Public Service Commission			
Setback Requirement	Setback Distance (m/ft)	Closest Turbine	Measured Distance (ft)
1.1x the turbine height from the nearest edge of an interstate or state roadway right-of-way (ROW).	141.4 / 463.7	146	19,361
1.1x the turbine height plus 75 feet from the centerline of any county or maintained township roadway.	164.2 / 538.7	152	606
1.1x the turbine height from the nearest edge of railroad ROW.	141.4 / 463.7	146	23,286
1.1x the turbine height from the nearest edge of a 115 kV or higher transmission line ROW.	141.4 / 463.7	164	477
1.1x the turbine height from the property line of a nonparticipating landowner.	141.4 / 463.7	155 157	178 *waivers to be obtained 295 *waivers to be obtained
3x the height of the turbine from an occupied rural residence of a non-participating landowner.	385.5 / 1,264.8	139	1,758

Previous Commitments (PU-08-034 Reissued PU-09-73)			
Setback Requirement	Setback Distance (ft)	Closest Turbine	Measured Distance (ft)
1,400 ft from Occupied Residence	1400	133	1,501
400 ft or turbine fall zone from any developed road	422	152	606
500 ft from any large (lacustrine) wetland complex (greater than 50 acres)	500	137	1,274
0.25 miles from USFWS Waterfowl Production Area	1,320	140	1,742

- Turbine Location
- Access Road
- Existing Paved State Road Centerline
- Railroad
- ▭ Participating
- ▭ Non-Participating
- ▭ Mapbook Order
- ▭ Section Boundary
- ▭ Township

22, 23, 27, 28, 29, 31, 32, 33, 34, 35	T145N R57W	Riverside Township	Steele County, ND
SECTIONS	TOWNSHIP	TOWNSHIPS	COUNTY, STATE

CLIENT: Otter Tail Power Company
Luverne Wind Upgrade Project
Figure 3: Exclusions and Avoidance

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Section 19
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Section 21
Section 28

BRADLEY L
GJESDAL
16000003318000

JAY WILFRED
MORGAN
16000003317000

STEVEN M JOHNSON
16000003316000

DAVID A JOHNSON
16000003313000

132

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Section 28

Section 29
Section 32

Section 28
Section 33

KROER FARM LLLP
16000003335000

KROER FARM LLLP
16000003319000

KROER FARM LLLP
16000003334000

MARK PEDERSEN
16000003340000

- Turbine Location
- Occupied Residence
- Access Road
- Existing Overhead Transmission Line
- Existing Paved State Road Centerline
- - - Existing Paved County Road Centerline
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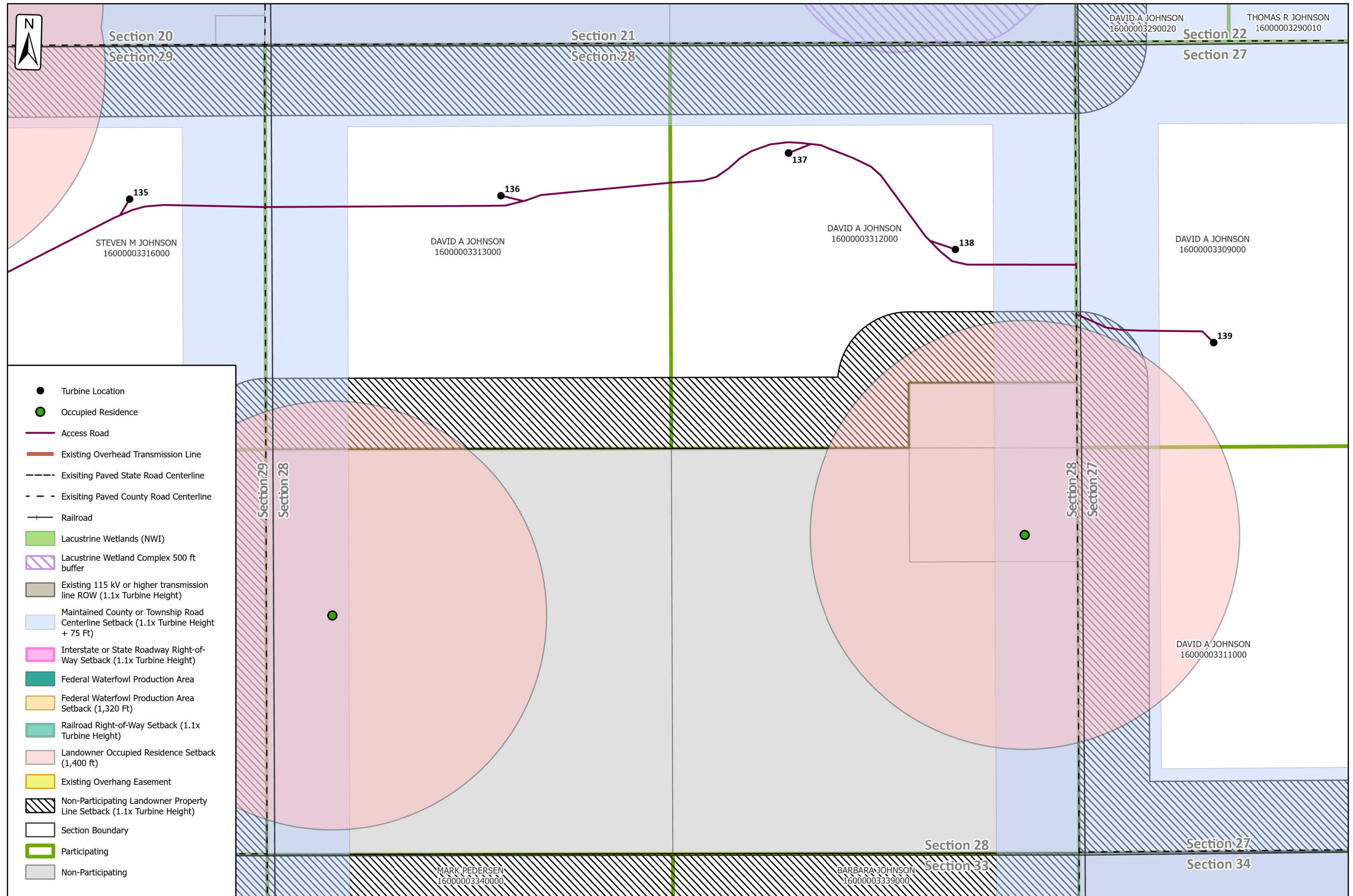
SECTIONS	22, 23, 27, 28, 29, 31, 32, 33, 34, 35
TOWNSHIP	T145N R57W
TOWNSHIPS	Riverside Township
COUNTY, STATE	Steele County, ND

CLIENT: Otter Tail Power Company

Luverne Wind Upgrade Project Figure 3: Exclusions and Avoidance



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- Turbine Location
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COUNTY, STATE	Steele County, ND

CLIENT: Otter Tail Power Company

Luverne Wind Upgrade Project

Figure 3: Exclusions and Avoidance



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DAVID A JOHNSON
16000003290020

THOMAS R JOHNSON
16000003290010

THOMAS R JOHNSON
16000003289000

JEFFERY A
JUSTUSON
16000003294000

Section 21
Section 28

Section 22
Section 27

Section 23
Section 26

DAVID A JOHNSON
16000003312000

138

DAVID A JOHNSON
16000003309000

139

DAVID A JOHNSON
16000003311000

DAVID A JOHNSON
16000003310000

VALERIE DAWN
JOHNSON
16000003343000

VALERIE DAWN
JOHNSON
16000003349000

- Turbine Location
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Luverne Wind Upgrade Project Figure 3: Exclusions and Avoidance



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Section 23

BARBARA JOHNSON
16000003287000

JEFFERY A
JULIUSON
16000003292000

THOMAS R JOHNSON
16000003290010

THOMAS R JOHNSON
16000003289000

JEFFERY A
JULIUSON
16000003294000

DAVID A JOHNSON
16000003290020

DAVID A JOHNSON
16000003309000

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- Turbine Location
- Occupied Residence
- Access Road
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CLIENT: Otter Tail Power Company

Luverne Wind Upgrade Project Figure 3: Exclusions and Avoidance



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Section 23

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Section 24

BARBARA JOHNSON
16000003287000

JEFFERY A
JULIUSON
16000003292000

JEFFERY A
JULIUSON
16000003291000

JEFFERY A
JULIUSON
16000003294000

146

145

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143

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COUNTY, STATE	Steele County, ND

CLIENT: Otter Tail Power Company

Luverne Wind Upgrade Project

Figure 3: Exclusions and Avoidance



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KROER FARM LLLP
16000003319000

GEORGE A BERGER
16000003327000

KROER FARM LLLP
16000003335000

KROER FARM LLLP
16000003334000

MARK PEDERSEN
16000003340000

CHRISTINE MLETVIN
16000003338000

JANICE HINSCHBERGER
16000003336000

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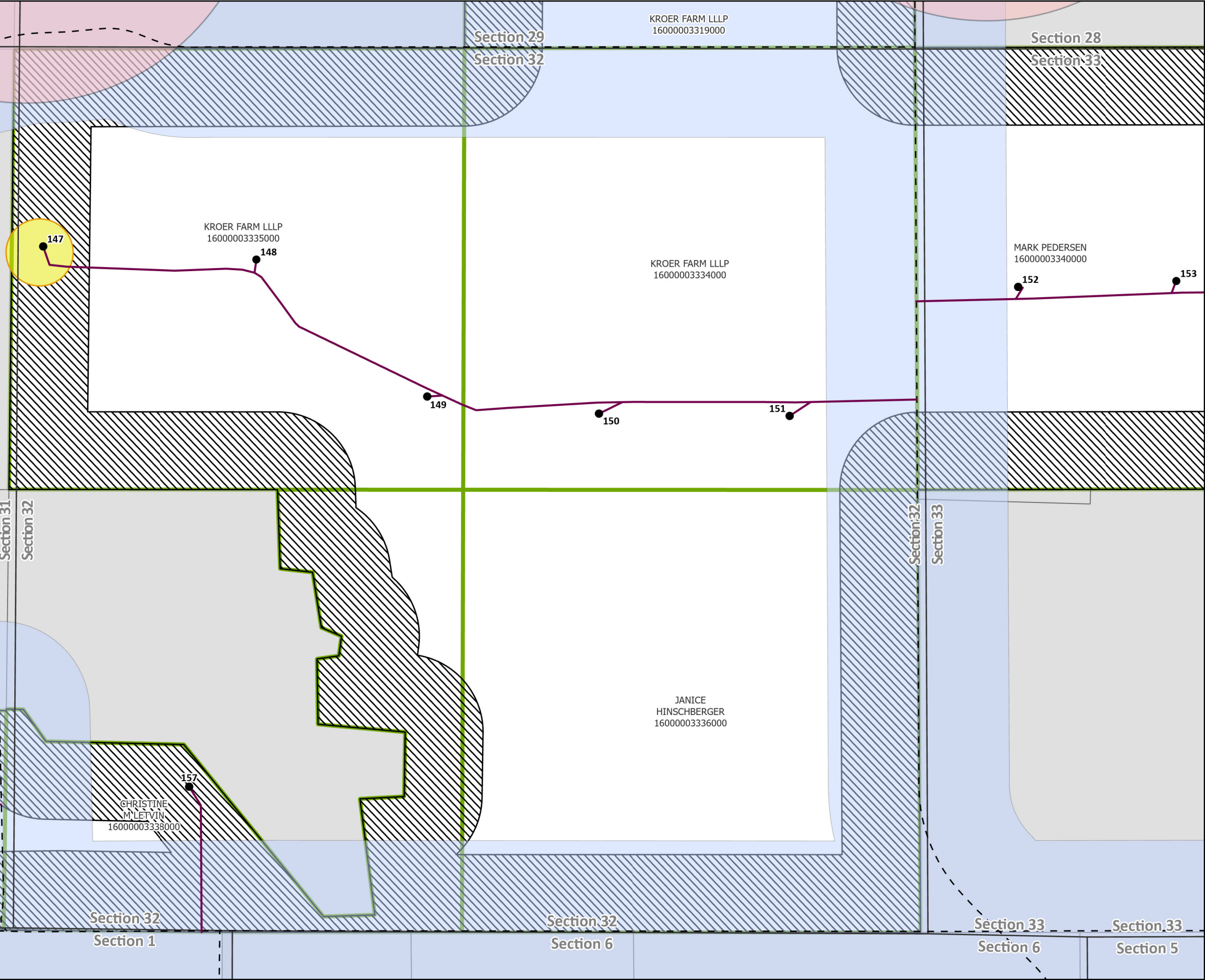
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- Turbine Location
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TOWNSHIP	T145N R57W
TOWNSHIPS	Riverside Township
COUNTY, STATE	Steele County, ND

CLIENT: Otter Tail Power Company

Luverne Wind Upgrade Project Figure 3: Exclusions and Avoidance



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KROER FARM LLLP
16000003319000
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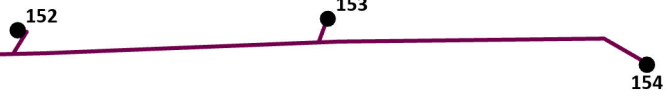
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DAVID A JOHNSON
16000003311000
Section 27
Section 34

KROER FARM LLLP
16000003334000

MARK PEDERSEN
16000003340000

BARBARA JOHNSON
16000003339000



MARK H PEDERSEN
16000003341000

JAMES JACOBSEN
16000003346000



- Turbine Location
- Occupied Residence
- Access Road
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- Section Boundary
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- Non-Participating

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SECTIONS	22, 23, 27, 28, 29, 31, 32, 33, 34, 35
TOWNSHIP	T145N R57W
TOWNSHIPS	Riverside Township
COUNTY, STATE	Steele County, ND

CLIENT: Otter Tail Power Company
Luverne Wind Upgrade Project
Figure 3: Exclusions and Avoidance



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Section 32

GEORGE A BERGER
16000003327000

KROER FARM LLLP
16000003335000

CHRISTINE
M LETVIN
16000003331015

CHRISTINE
M LETVIN
16000003338000

- Turbine Location
- Occupied Residence
- Access Road
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- Non-Participating

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SECTIONS	22, 23, 27, 28, 29, 31, 32, 33, 34, 35
TOWNSHIP	T145N R57W
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COUNTY, STATE	Steele County, ND

CLIENT: Otter Tail Power Company

Luverne Wind Upgrade Project
Figure 3: Exclusions and Avoidance



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Section 33

DAVID A JOHNSON
16000003311000

Section 27
Section 34

DAVID A JOHNSON
16000003310000

Section 26
Section 35

BARBARA JOHNSON
16000003339000

VALERIE DAWN
JOHNSON
16000003343000

VALERIE DAWN
JOHNSON
16000003349000

Section 34
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- Turbine Location
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Section 33
Section 34

JAMES JACOBSEN
16000003346000

VALERIE DAWN
JOHNSON
16000003345000

VALERIE DAWN
JOHNSON
16000003350000

OTTERTAIL
POWER CO
16000003350010

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SECTIONS	22, 23, 27, 28, 29, 31, 32, 33, 34, 35
TOWNSHIP	T145N R57W
TOWNSHIPS	Riverside Township
COUNTY, STATE	Steele County, ND

CLIENT: Otter Tail Power Company

Luverne Wind Upgrade Project
Figure 3: Exclusions and Avoidance



SCALE: 0 130 260
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ATWELL

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DAVID A JOHNSON
16000003310000

Section 27

Section 34

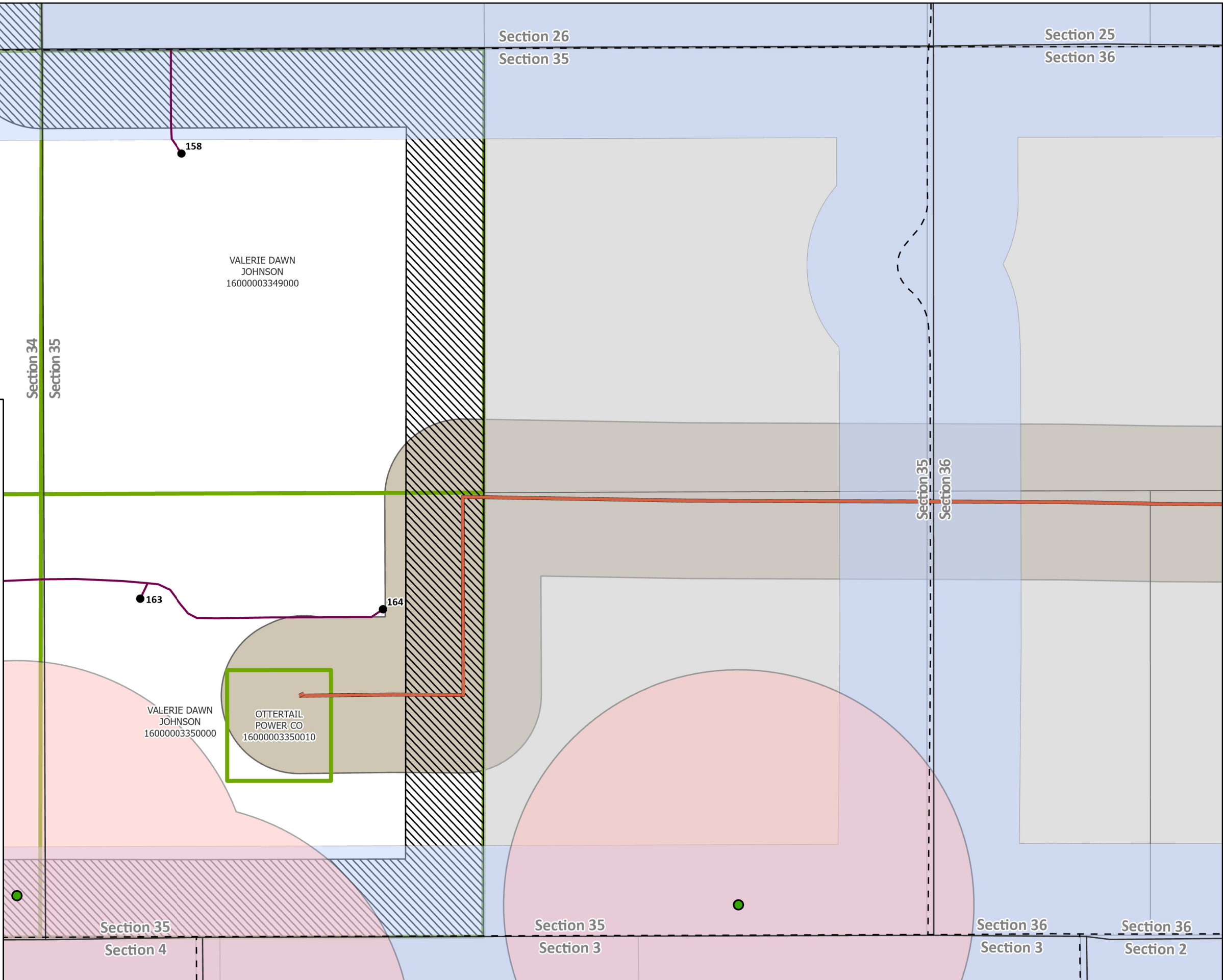
VALERIE DAWN
JOHNSON
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VALERIE DAWN
JOHNSON
16000003349000

VALERIE DAWN
JOHNSON
16000003350000

OTTERTAIL
POWER CO
16000003350010

- Turbine Location
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Luverne Wind Upgrade Project
Figure 3: Exclusions and Avoidance



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Appendix A – Acoustic Assessment Results and Sound Waivers

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SOUND LEVEL ASSESSMENT REPORT

Otter Tail Luverne Wind Repower Project Steele County, North Dakota

Prepared for:

Atwell, LLC
311 North Main
Ann Arbor, Michigan 48104

Prepared by:



Epsilon Associates, Inc.
3 Mill & Main Place, Suite 250
Maynard, MA 01754

April 11, 2023

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1.0 EXECUTIVE SUMMARY

The Luverne Wind Energy Center Repowering Project (the Project) is an existing wind park in Steele County, North Dakota that is planned to be repowered by Otter Tail Power Company (Otter Tail). Atwell has retained Epsilon Associates, Inc. (Epsilon) to conduct a sound level assessment for this Project. This report presents the results of the sound level modeling from the proposed repower in Steele County.

This sound level assessment includes computer modeling to predict worst-case future L_{eq} sound levels from the Project, and a comparison of operational sound levels to the North Dakota Administrative Code Energy Conversion Facility Siting Criteria of 45 dBA within 100 feet of an inhabited residence or community building. Additionally, receptors that have signed noise waivers with Otter Tail Power have been compared to the Waiver criterion of 50 dBA within 200 feet of the inhabited residence or community building. Sound level modeling was conducted for all Otter Tail Luverne Wind Repower wind turbines.

The L_{eq} sound levels modeled at receptors in Steele County ranged from 23 to 48 dBA. The highest L_{eq} sound level modeled at a receptor that has signed a waiver with Otter Tail is 48 dBA. The highest L_{eq} sound level modeled at a receptor that has not signed a waiver with Otter Tail is 45 dBA. Using the mitigation described in this report, the L_{eq} sound levels at all receptors without a signed waiver are at or below the limit of 45 dBA within 100 feet of an inhabited residence or community building. Therefore, the Project meets the State's regulations with respect to sound.

2.0 INTRODUCTION

The proposed repower Project will consist of 33 repowered wind turbines. The proposed wind turbines are all GE 1.5MW units with a rotor diameter of 97 meters and a hub height of 80 meters. Figure 2-1 shows the locations of the 33 wind turbines in Steele County over aerial imagery.

A detailed discussion of sound from wind turbines is presented in a white paper prepared by the Renewable Energy Research Laboratory.¹ A few points are repeated herein. Wind turbine sound can originate from two different sources: mechanical sound from the interaction of turbine components, and aerodynamic sound produced by the flow of air over the rotor blades. Prior to the 1990's, both were significant contributors to wind turbine sound. However, recent advances in wind turbine design have greatly reduced the contribution of mechanical sound. Aerodynamic sound has also been reduced from modern wind turbines due to slower rotational speeds and changes in materials of construction. Aerodynamic sound, in general, is broadband (has contributions from a wide range of frequencies). It originates from encounters of the wind turbine blades with localized airflow inhomogeneities and wakes from other turbine blades and from airflow across the surface of the blades, particularly the front and trailing edges. Aerodynamic sound generally increases with increasing wind speed up to a certain point, then typically remains constant, even with higher wind speeds. However, sound levels in general also increase with increasing wind speed with or without the presence of wind turbines.

This report presents the findings of a sound level modeling analysis for the Project. The Project wind turbines were modeled in CadnaA using sound data from GE technical reports. The results of this analysis are found within this report.

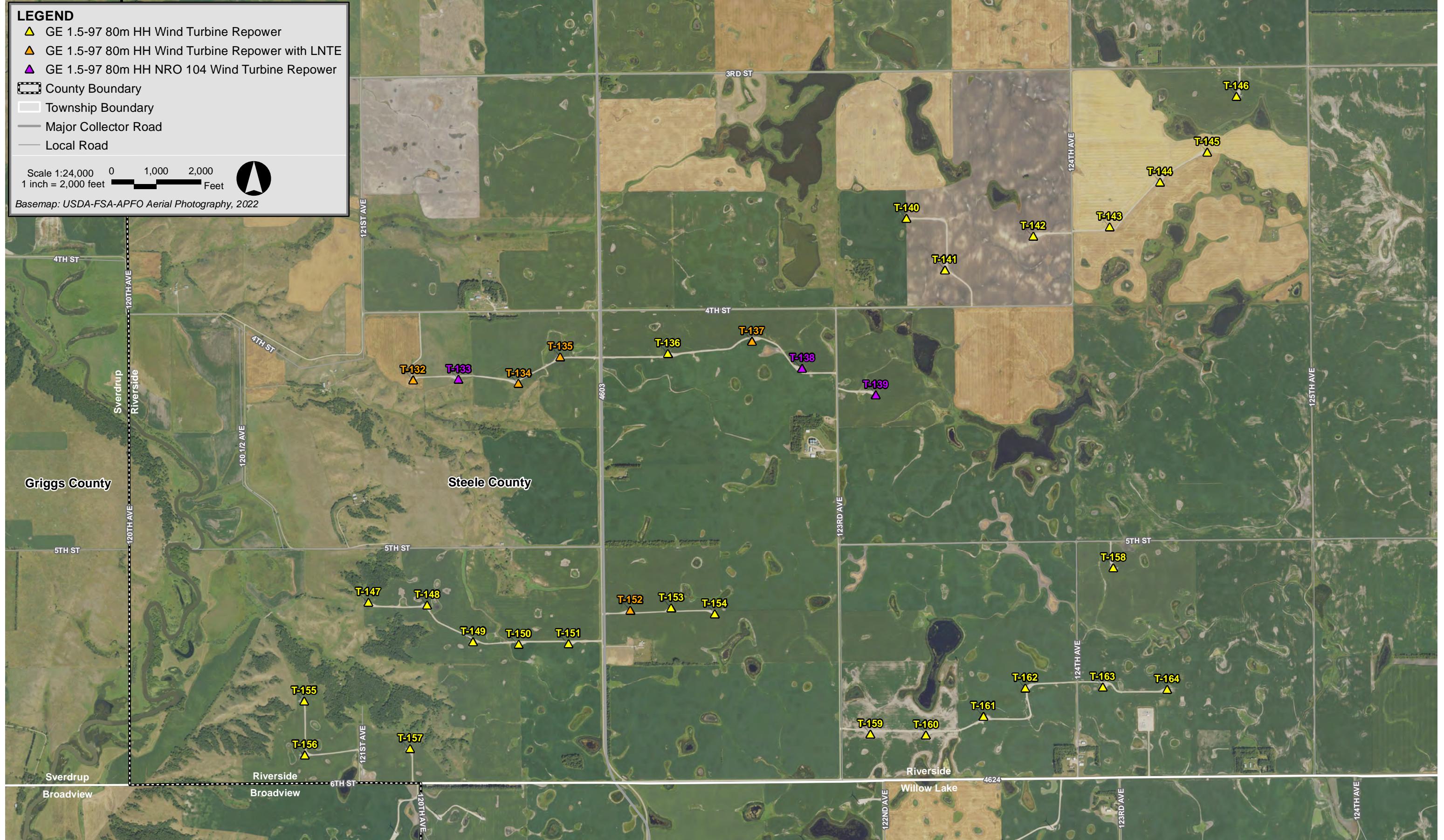
¹ Renewable Energy Research Laboratory, Department of Mechanical and Industrial Engineering, University of Massachusetts at Amherst, Wind Turbine Acoustic Noise, June 2002, amended January 2006.

LEGEND

- ▲ GE 1.5-97 80m HH Wind Turbine Repower
- ▲ GE 1.5-97 80m HH Wind Turbine Repower with LNTE
- ▲ GE 1.5-97 80m HH NRO 104 Wind Turbine Repower
- ▭ County Boundary
- ▭ Township Boundary
- Major Collector Road
- Local Road

Scale 1:24,000
1 inch = 2,000 feet

Basemap: USDA-FSA-APFO Aerial Photography, 2022



Luverne Wind Repower Steele County, North Dakota

3.0 SOUND TERMINOLOGY

There are several ways in which sound levels are measured and quantified. All of them use the logarithmic decibel (dB) scale. The following information defines the sound level terminology used in this analysis.

The decibel scale is logarithmic to accommodate the wide range of sound intensities found in the environment. A property of the decibel scale is that the sound pressure levels of two or more separate sounds are not directly additive. For example, if a sound of 50 dB is added to another sound of 50 dB, the total is only a 3-decibel increase (53 dB), which is equal to doubling in sound energy, but not equal to a doubling in decibel quantity (100 dB). Thus, every 3-dB change in sound level represents a doubling or halving of sound energy. The human ear does not perceive changes in the sound pressure level as equal changes in loudness. Scientific research demonstrates that the following general relationships hold between sound level and human perception for two sound levels with the same or very similar frequency characteristics²:

- ◆ 3 dB increase or decrease results in a change in sound that is just perceptible to the average person,
- ◆ 5 dB increase or decrease is described as a clearly noticeable change in sound level, and
- ◆ 10 dB increase or decrease is described as twice or half as loud.

Another mathematical property of decibels is that if one source of sound is at least 10 dB louder than another source, then the total sound level is simply the sound level of the higher-level source. For example, a sound source at 60 dB plus another sound source at 47 dB is equal to 60 dB.

A sound level meter (SLM) that is used to measure sound is a standardized instrument.³ It contains “weighting networks” (e.g., A-, C-, Z-weightings) to adjust the frequency response of the instrument. Frequencies, reported in Hertz (Hz), are detailed characterizations of sounds, often addressed in musical terms as “pitch” or “tone”. The most commonly used weighting network is the A-weighting because it most closely approximates how the human ear responds to sound at various frequencies. The A-weighting network is the accepted scale used for community sound level measurements; therefore, sounds are frequently reported as detected with a sound level meter using this weighting. A-weighted sound levels emphasize middle frequency sounds (i.e., middle pitched – around 1,000 Hz), and de-emphasize low and high frequency sounds. These sound levels are reported in decibels designated as “dBA”. The C-weighting network has a nearly flat response for frequencies between 63 Hz and 4,000 Hz and is noted as dBC. Z-weighted sound levels are measured sound levels without any weighting curve and are otherwise referred

² Bies, David, and Colin Hansen. 2009. *Engineering Noise Control: Theory and Practice*, 4th Edition. New York: Taylor and Francis.

³ *American National Standard Electroacoustics – Sound Level Meters – Part 1: Specifications*, ANSI S1.4-2014 (R2019), published by the Standards Secretariat of the Acoustical Society of America, Melville, NY.

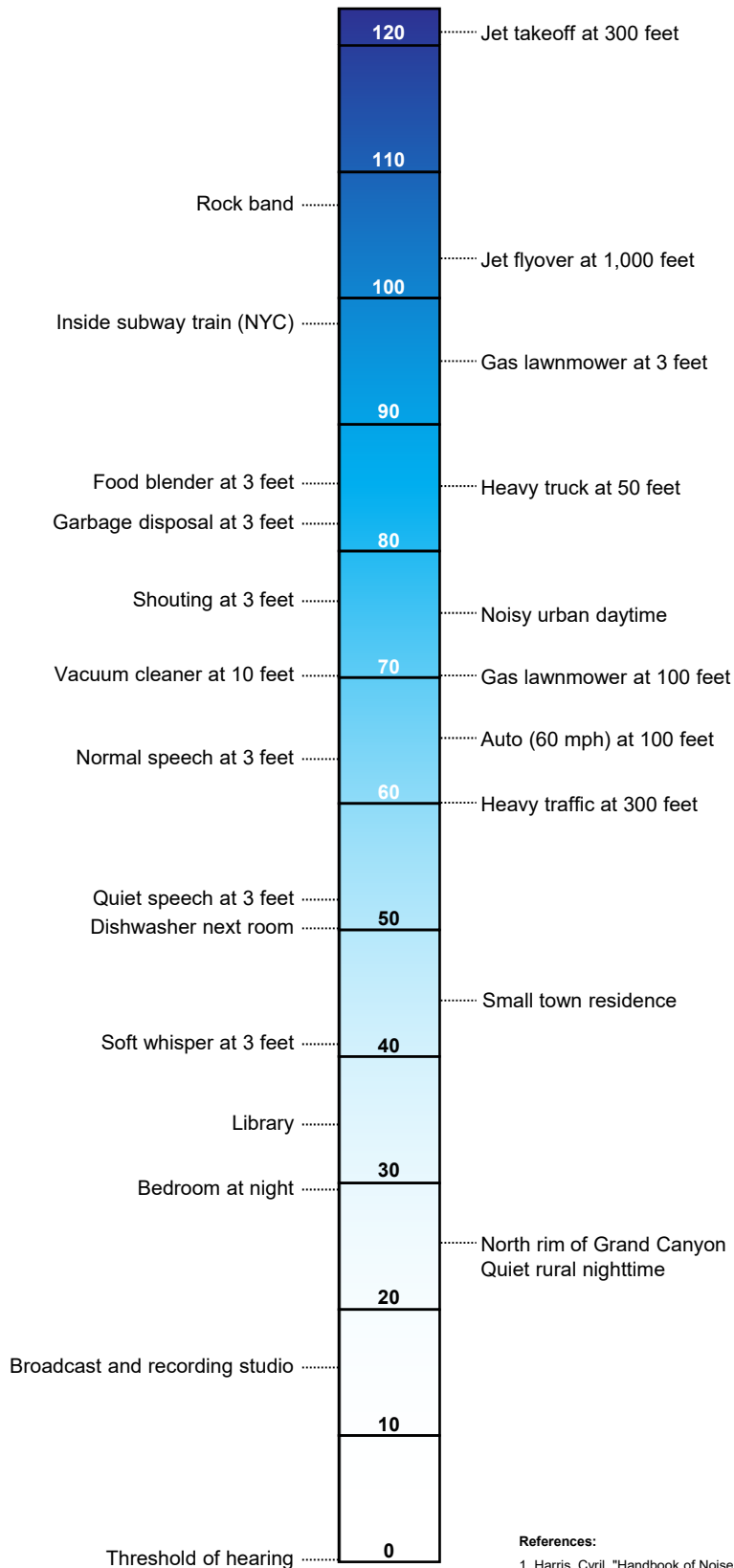
to as “unweighted”. Sound pressure levels for some common indoor and outdoor environments are shown in Figure 3-1.

Because the sounds in our environment vary with time they cannot simply be described with a single number. Two methods are used for describing variable sounds. These are exceedance levels and the equivalent level, both of which are derived from some number of moment-to-moment A-weighted sound level measurements. Exceedance levels are values from the cumulative amplitude distribution of all the sound levels observed during a measurement period. Exceedance levels are designated L_n , where n can have a value between 0 and 100 in terms of percentage. The L_{eq} is a sound level metric that is commonly reported in community sound level monitoring and is utilized in this report. The L_{eq} is described in further detail below.

- ◆ L_{eq} , the equivalent level, is the level of a hypothetical steady sound that would have the same energy (*i.e.*, the same time-averaged mean square sound pressure) as the actual fluctuating sound observed. The equivalent level is designated L_{eq} and is typically A-weighted. The equivalent level represents the time average of the fluctuating sound pressure, but because sound is represented on a logarithmic scale and the averaging is done with linear mean square sound pressure values, the L_{eq} is mostly determined by loud sounds if there are fluctuating sound levels.

Sound Pressure Level, dBA

COMMON INDOOR SOUNDS **COMMON OUTDOOR SOUNDS**



References:

- Harris, Cyril, "Handbook of Noise Acoustical Measurements and Noise Control", p 1-10., 1998
- "Controlling Noise", USAF, AFMC, AFDTIC, Elgin AFB, Fact Sheet, August 1996
- California Dept. of Trans., "Technical Noise Supplement", Oct, 1998

4.0 NOISE REGULATIONS

4.1 Federal Regulations

There are no federal community noise regulations applicable to this Project.

4.2 North Dakota State Regulations

The Project, located in North Dakota, is required to comply with the following sound requirement:

Section 69-06-08-01 Energy Conversion Facility Siting Criteria

4. Additional avoidance areas for wind energy conversion facilities. A wind energy conversion facility site must not include a geographic area where, due to operation of the facility, the sound levels within one hundred feet of an inhabited residence or a community building will exceed forty-five dBA. The sound level avoidance area criteria may be waived in writing by the owner of the occupied residence or the community building.

4.3 Local Regulations

There are no local community noise regulations applicable to this Project.

Therefore, modeling receptors were evaluated in this analysis against the 45 dBA limit.

5.0 MODELED SOUND LEVELS

5.1 Sound Sources

5.1.1 Project Wind Turbines

The sound level analysis for the Project includes 33 wind turbines. These 33 wind turbines are depicted in Figure 5-1. The array consists of one (1) wind turbine model: the GE 1.5-97 at a hub height of 80-meters. Wind turbines T-132, T-134, T-135, T-137, and T152 will have Low Noise Trailing Edge (LNTE) blades. Wind turbines T-133, T-138, and T-139 will be in Noise Reduced Operations (NRO) 104 mode. The GE 1.5-97 wind turbines have a rotor diameter of 97 meters. Technical reports from GE^{4,5,6} were provided to Epsilon which documented the expected sound power levels associated with the GE 1.5-97.

5.2 Modeling Methodology

The sound impacts associated with the proposed wind turbines were predicted using the CadnaA sound level calculation software developed by DataKustik GmbH. This software uses the ISO 9613-2 international standard for sound propagation.⁷ The benefits of this software are a more refined set of computations due to the inclusion of topography, ground attenuation, multiple building reflections (if applicable), drop-off with distance, and atmospheric absorption. The CadnaA software allows for octave band calculation of sound from multiple sources as well as computation of diffraction.

Inputs and significant parameters employed in the model are described below and summarized in Table 5-1 below.

- ◆ *Project Array:* This analysis is for the wind turbine array dated December 20, 2022. The proposed Project array is identified in Figure 5-1. The wind turbine coordinates are provided in Appendix A.
- ◆ *Modeling Receptor Locations:* A modeling receptor dataset dated January 26, 2023 was provided to Epsilon. The dataset included 40 receptors. Atwell provided additional information indicating if each receptor was inhabited or uninhabited, the resulting 39 inhabited receptors were input to the CadnaA model. All modeling receptors were input as discrete points at a height of 1.5 meters above ground level to mimic the ears of a typical standing person. In order to provide robust modeling coverage of each inhabited location, additional modeling locations were included offset by 100 feet

⁴ General Electric Company, Technical Documentation Wind Turbine Generator Systems 1.6-97 RePower – 60 Hz Product Acoustic Specifications, Rev. 02, 2020.

⁵ General Electric Company, Technical Documentation Wind Turbine Generator Systems 1.6-97 RePower with LNTE – 60Hz Product Acoustic Specifications Normal Specifications, Rev. 01, 2021.

⁶ General Electric Company, Technical Documentation Wind Turbine Generator Systems 1.6-97 RePower with LNTE – 60Hz Product Acoustic Specifications Noise Reduced Operation, Rev. 01, 2021.

⁷ *Acoustics – Attenuation of sound during propagation outdoors – Part 2: General method of calculation*, International Standard ISO 9613-2:1996 (International Organization for Standardization, Geneva, Switzerland, 1996).

away (or 200 feet for receptors with signed waivers) from the center point of the receptor in each of the four cardinal directions (north, south, east and west). Therefore, each inhabited location was evaluated at a total of five locations; the center point of the receptor itself, and at the four offset locations on land 100 feet (or 200 feet for receptors with signed waivers) from the receptor. This resulted in a total of 195 receptors. The center points of the modeled locations (receptors) are shown in Figure 5-1. Details of each modeling location are presented in Appendix B.

- ◆ *Modeling Grid:* A modeling grid with 20-meter spacing was calculated for the entire Project Area and the surrounding region. The grid was modeled at a height of 1.5 meters above ground level for consistency with the discrete modeling points. This modeling grid allowed for the creation of sound level isolines.
- ◆ *Terrain Elevation:* Elevation contours for the modeling domain were directly imported into CadnaA which allowed for consideration of terrain shielding where appropriate. The terrain height contour elevations for the modeling domain were generated from elevation information derived from the National Elevation Dataset (NED) developed by the U.S. Geological Survey.
- ◆ *Source Sound Levels:* Sound power levels used in the modeling were described in Section 5.1. Documentation from GE provided levels that represent “worst-case” operational sound level emissions for the Project’s proposed wind turbines were input into the model.
- ◆ *Meteorological Conditions:* A temperature of 10°C (50°F) and a relative humidity of 70% was assumed in the model.
- ◆ *Ground Attenuation:* Spectral ground absorption was calculated using a G-factor of 0 which corresponds to “hard ground” consisting of a hard ground surface. The model, consistent with the standard, allows inputs between 0 (hard ground) and 1 (porous ground). This is a conservative approach as the vast majority of the area is actually agricultural.

Octave band sound power levels corresponding to the highest available wind turbine broadband sound power level for each wind turbine type were input into CadnaA to model wind turbine generated L_{eq} sound pressure levels during conditions when worst-case sound power levels are expected. Sound pressure levels were modeled at 39 receptors within the vicinity of the Project. In addition to modeling at discrete points, sound levels were also modeled throughout a large grid of points, each spaced 20 meters apart to allow for the generation of sound level isolines.

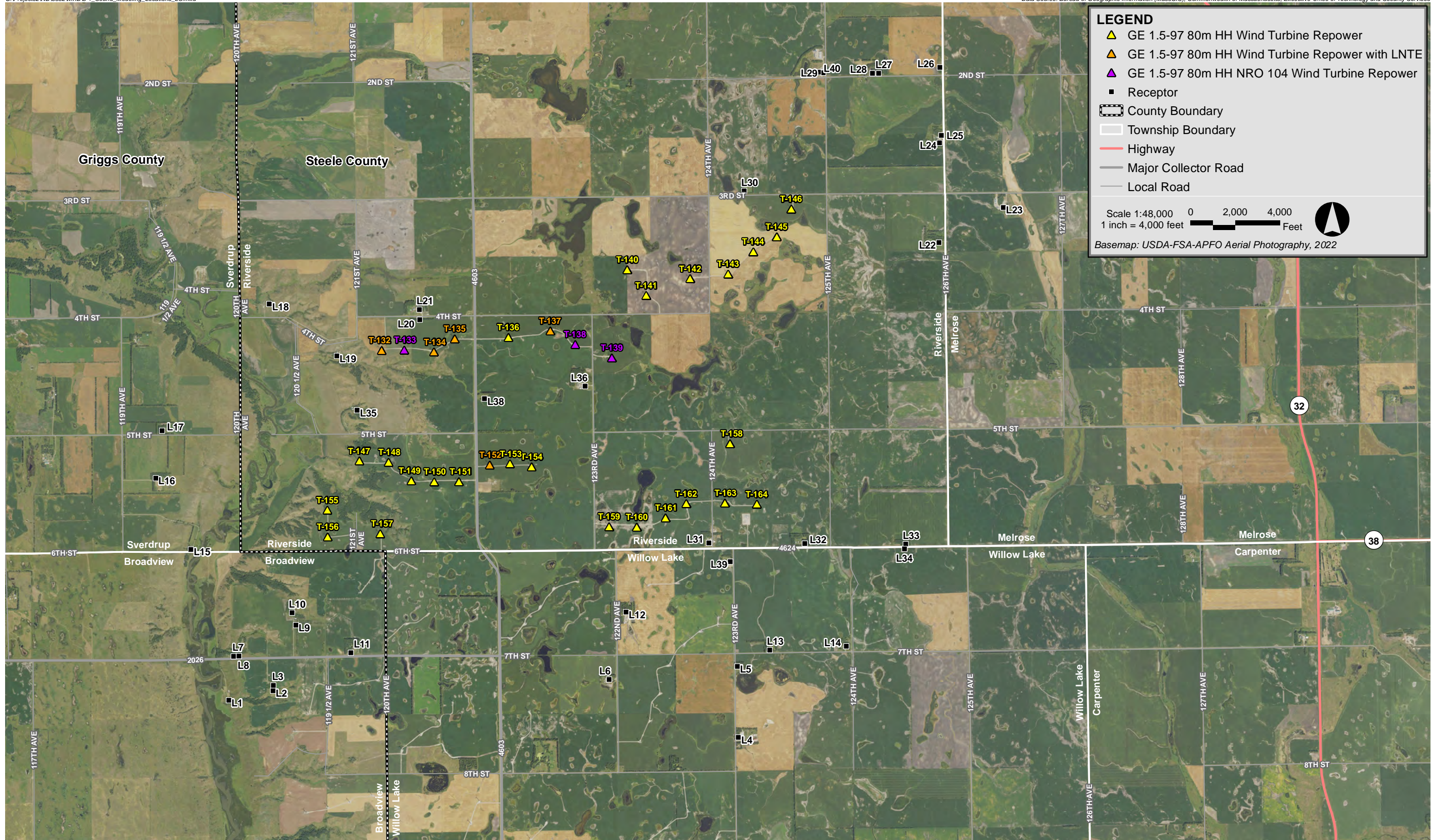
Several modeling assumptions inherent in the ISO 9613-2 calculation methodology, or selected as conditional inputs by Epsilon, were implemented in the CadnaA model to ensure conservative results (i.e., higher sound levels), and are described below:

- ◆ All modeled sources were assumed to be operating simultaneously and at the design wind speed corresponding to the greatest sound level impacts.

- ◆ As per ISO 9613-2, the model assumed favorable conditions for sound propagation, corresponding to a moderate, well-developed ground-based temperature inversion, as might occur on a calm, clear night or equivalently downwind propagation.
- ◆ Meteorological conditions assumed in the model (T=10°C/RH=70%) were selected to minimize atmospheric attenuation in the 500 Hz and 1 kHz octave bands where the human ear is most sensitive.
- ◆ No additional attenuation due to tree shielding, air turbulence, or wind shadow effects was considered in the model.

Table 5-1 Summary of Key Sound Level Modeling Inputs

Modeling Parameter	Description / Value
Wind Turbine Array	Provided by Atwell
Terrain	U.S.G.S. Data
Wind Turbine Sound Power Levels	GE Specifications Documentation
Meteorological Conditions	T=10°C / RH=70%
Ground Absorption Factor	0

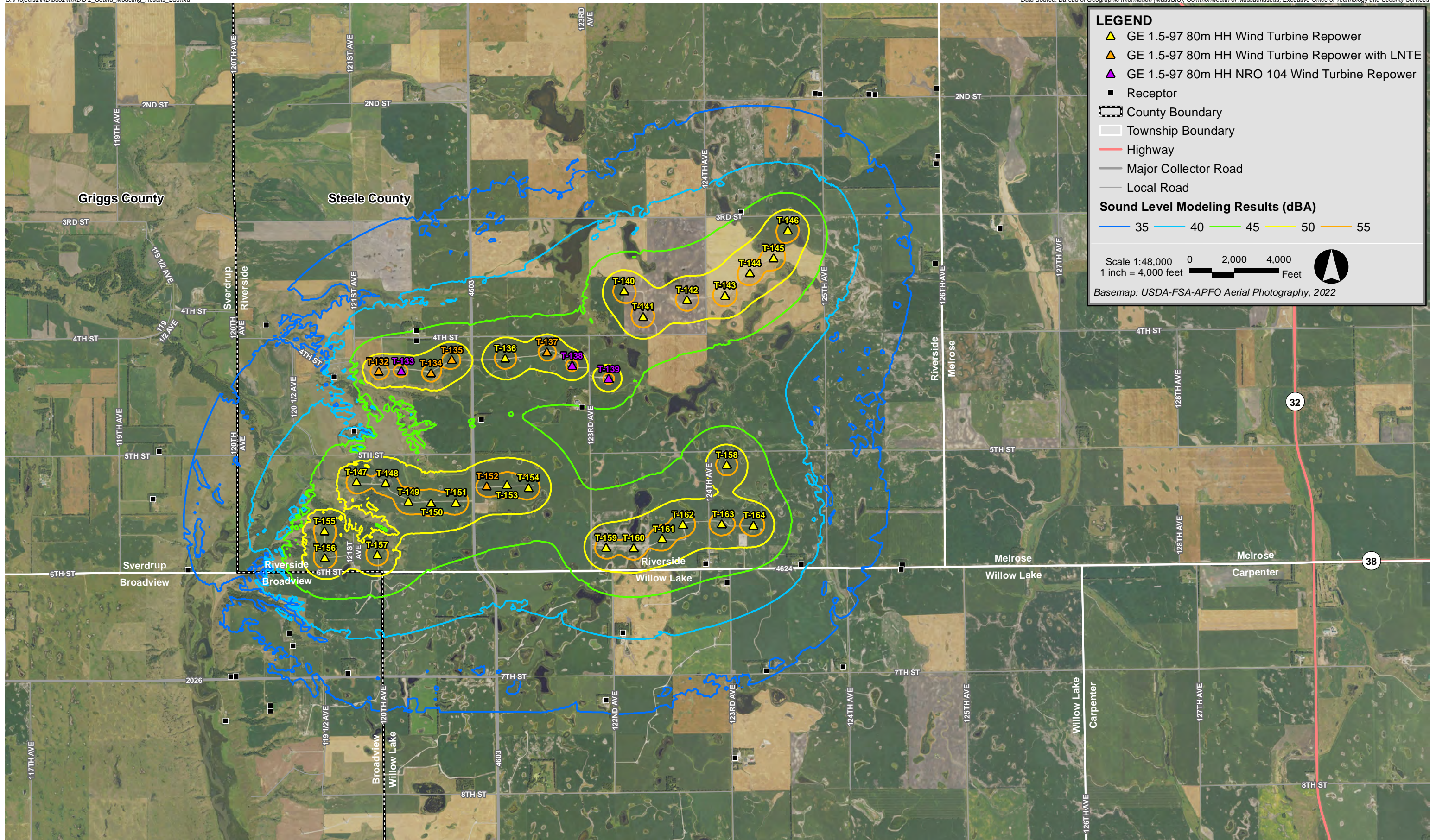


Luverne Wind Repower Steele County, North Dakota

5.3 Sound Level Modeling Results

All modeled sound levels, as output from CadnaA are A-weighted equivalent sound levels (L_{eq} , dBA). Table B-1.1 in Appendix B shows the predicted broadband (dBA) sound levels at the 39 receptors and their additional offset locations modeled for the Project. The broadband L_{eq} sound levels range from 23 to 48 dBA. These sound levels represent the worst-case future L_{eq} sound levels produced by the Project wind turbines. The maximum modeled sound level of 48 dBA occurs at receptors #20 and #31, which have signed waivers with Otter Tail Power. The highest modeled sound level at a receptor which has not signed a waiver with Otter Tail Power is 45 dBA, which occurs at four receptors (#21, #30, #36, and #38). Table B-1.2 in Appendix B shows the predicted sound levels sorted from high to low.

In addition to the discrete modeling points, L_{eq} sound level isolines generated from the modeling grid are presented in Figure 5-2.



Luverne Wind Repower Steele County, North Dakota

6.0 EVALUATION OF SOUND LEVELS

The Project is subject to the requirements contained in the North Dakota Energy Conversion Facility Siting Criteria. Sound levels from operation of the Project are limited by these regulations to 45 dBA within 100 feet of an inhabited residence or community building. Additionally, sound levels from the operation of the Project are limited by the Noise Waiver to 50 dBA within 200 feet of an inhabited residence or community building for any locations which has a signed Noise Waiver with Otter Tail Power. All modeled sound levels, as output from CadnaA and presented in Appendix B, are A-weighted equivalent sound levels (L_{eq} , dBA). These levels may be used in evaluating measured sound pressure levels over typical averaging durations, (i.e., ten (10) minutes or one (1) hour).

A review of Table B-1.2 in Appendix B shows the highest sound level within 100 feet of an inhabited residence or community building that has not signed a waiver with Otter Tail Power in this analysis to be 45 dBA. This occurs at Receptors #21, #30, #36, and #38. The results also show that the highest sound level within 200 feet of an inhabited residence or community building that has signed a waiver with Otter Tail Power in this analysis to be 48 dBA. This occurs at Receptors #20 and #31. Therefore, the Project is in compliance with the North Dakota Administrative Code Energy Conversion Facility Siting Criteria with respect to sound.

7.0 CONCLUSIONS

A comprehensive sound level modeling assessment was conducted for the Otter Tail Luverne Wind Repower Project within Steele County, North Dakota. Sound levels resulting from the operation of all 33 Project wind turbines were calculated at 39 modeling receptors, and isolines were generated from a grid encompassing the area surrounding the wind turbines. The predicted L_{eq} sound levels at all receptors in the study area ranged from 23 to 48 dBA. Predicted sound levels at all receptor locations that have not signed a waiver with Otter Tail Power are at or below the state limit of 45 dBA within 100 feet of an inhabited residence or community building. Predicted sound levels at all receptor locations that have signed waivers with Otter Tail Power are below the waiver limit of 50 dBA within 200 feet of an inhabited residence or community building. Thus, the Project meets the requirements with respect to sound in the regulations.

Appendix A

Sound Source Coordinates

Table A-1: Wind Turbine Coordinates

Wind Turbine ID	Wind Turbine Type	Hub Height (m)	Coordinates NAD83 UTM Zone 14N (meters)	
			X (Easting)	Y (Northing)
T-132	GE 1.5-97	80	578517.24	5244672.39
T-133	GE 1.5-97	80	578826.67	5244676.53
T-134	GE 1.5-97	80	579235.03	5244648.56
T-135	GE 1.5-97	80	579519.62	5244830.47
T-136	GE 1.5-97	80	580251.83	5244851.41
T-137	GE 1.5-97	80	580824.66	5244937.29
T-138	GE 1.5-97	80	581167.19	5244752.82
T-139	GE 1.5-97	80	581668.21	5244570.68
T-140	GE 1.5-97	80	581878.53	5245774.06
T-141	GE 1.5-97	80	582139.93	5245422.35
T-142	GE 1.5-97	80	582741.17	5245652.97
T-143	GE 1.5-97	80	583261.20	5245715.78
T-144	GE 1.5-97	80	583604.29	5246020.87
T-145	GE 1.5-97	80	583926.35	5246225.65
T-146	GE 1.5-97	80	584124.89	5246606.30
T-147	GE 1.5-97	80	578212.34	5243156.78
T-148	GE 1.5-97	80	578613.18	5243139.56
T-149	GE 1.5-97	80	578926.12	5242888.10
T-150	GE 1.5-97	80	579235.93	5242870.26
T-151	GE 1.5-97	80	579576.05	5242874.84
T-152	GE 1.5-97	80	579996.11	5243102.73
T-153	GE 1.5-97	80	580275.47	5243117.98
T-154	GE 1.5-97	80	580570.56	5243077.44
T-155	GE 1.5-97	80	577775.59	5242483.98
T-156	GE 1.5-97	80	577780.43	5242117.25
T-157	GE 1.5-97	80	578497.71	5242160.33
T-158	GE 1.5-97	80	583286.60	5243393.02
T-159	GE 1.5-97	80	581632.29	5242258.43
T-160	GE 1.5-97	80	582010.61	5242252.24
T-161	GE 1.5-97	80	582401.49	5242380.30
T-162	GE 1.5-97	80	582685.87	5242572.91
T-163	GE 1.5-97	80	583215.05	5242580.37
T-164	GE 1.5-97	80	583653.42	5242564.57

Appendix B

Sound Level Modeling Results - Tabular

Table B-1.1: Sound Level Modeling Results Sorted by Receptor ID

Receptor ID	Signed Wavier	Coordinates		Source Only L _{eq} Sound Level (dBA)
		UTM NAD83 Zone 14N		
		X (m)	Y (m)	
L1	No	576423.27	5239881.84	23
L1-E	No	576453.73	5239882.23	23
L1-S	No	576423.66	5239851.37	23
L1-W	No	576392.80	5239881.44	23
L1-N	No	576422.87	5239912.31	23
L2	No	577029.96	5240014.58	28
L2-E	No	577060.43	5240014.98	33
L2-S	No	577030.36	5239984.11	25
L2-W	No	576999.50	5240014.18	25
L2-N	No	577029.57	5240045.05	30
L3	No	577035.85	5240087.47	30
L3-E	No	577066.32	5240087.86	30
L3-S	No	577036.25	5240057.00	30
L3-W	No	577005.39	5240087.07	26
L3-N	No	577035.46	5240117.93	31
L4	No	583399.72	5239374.00	32
L4-E	No	583430.19	5239374.43	32
L4-S	No	583400.15	5239343.53	32
L4-W	No	583369.25	5239373.57	32
L4-N	No	583399.29	5239404.46	32
L5	No	583387.15	5240348.46	35
L5-E	No	583417.62	5240348.89	35
L5-S	No	583387.58	5240317.99	35
L5-W	No	583356.69	5240348.03	35
L5-N	No	583386.72	5240378.93	35
L6	No	581632.42	5240165.69	36
L6-E	No	581662.89	5240166.11	36
L6-S	No	581632.85	5240135.22	36
L6-W	No	581601.96	5240165.26	36
L6-N	No	581632.00	5240196.15	36
L7	No	576491.93	5240485.96	28
L7-E	No	576522.40	5240486.35	28
L7-S	No	576492.32	5240455.49	26
L7-W	No	576461.46	5240485.56	30
L7-N	No	576491.53	5240516.42	25
L8	No	576564.55	5240490.68	31
L8-E	No	576595.02	5240491.08	32
L8-S	No	576564.95	5240460.21	31
L8-W	No	576534.08	5240490.29	30
L8-N	No	576564.15	5240521.15	26
L9	No	577344.04	5240910.55	38
L9-E	No	577374.51	5240910.95	38

Table B-1.1: Sound Level Modeling Results Sorted by Receptor ID

Receptor ID	Signed Wavier	Coordinates		Source Only L _{eq} Sound Level (dBA)
		UTM NAD83 Zone 14N		
		X (m)	Y (m)	
L9-S	No	577344.44	5240880.09	38
L9-W	No	577313.57	5240910.15	37
L9-N	No	577343.64	5240941.02	38
L10	No	577289.60	5241080.11	39
L10-E	No	577320.07	5241080.51	39
L10-S	No	577290.00	5241049.65	39
L10-W	No	577259.13	5241079.71	39
L10-N	No	577289.20	5241110.58	39
L11	No	578096.72	5240534.24	37
L11-E	No	578127.19	5240534.64	37
L11-S	No	578097.13	5240503.77	37
L11-W	No	578066.25	5240533.83	37
L11-N	No	578096.32	5240564.71	37
L12	No	581862.55	5241090.16	41
L12-E	No	581893.02	5241090.59	41
L12-S	No	581862.98	5241059.69	40
L12-W	No	581832.09	5241089.74	41
L12-N	No	581862.13	5241120.63	41
L13	No	583831.22	5240569.56	35
L13-E	No	583861.69	5240569.99	35
L13-S	No	583831.65	5240539.09	35
L13-W	No	583800.75	5240569.12	35
L13-N	No	583830.79	5240600.02	35
L14	No	584880.11	5240621.88	33
L14-E	No	584910.58	5240622.32	33
L14-S	No	584880.55	5240591.42	32
L14-W	No	584849.64	5240621.45	33
L14-N	No	584879.67	5240652.35	33
L15	No	575905.69	5241949.56	35
L15-E	No	575936.16	5241949.95	35
L15-S	No	575906.09	5241919.09	35
L15-W	No	575875.23	5241949.17	35
L15-N	No	575905.30	5241980.03	35
L16	No	575424.70	5242922.41	33
L16-E	No	575455.16	5242922.80	33
L16-S	No	575425.09	5242891.94	33
L16-W	No	575394.23	5242922.02	33
L16-N	No	575424.31	5242952.87	33
L17	No	575509.75	5243573.82	33
L17-E	No	575540.22	5243574.21	33
L17-S	No	575510.14	5243543.35	33
L17-W	No	575479.28	5243573.42	33

Table B-1.1: Sound Level Modeling Results Sorted by Receptor ID

Receptor ID	Signed Wavier	Coordinates		Source Only L _{eq} Sound Level (dBA)
		UTM NAD83 Zone 14N		
		X (m)	Y (m)	
L17-N	No	575509.36	5243604.28	33
L18	No	576978.42	5245308.26	34
L18-E	No	577008.89	5245308.66	34
L18-S	No	576978.82	5245277.79	34
L18-W	No	576947.96	5245307.86	34
L18-N	No	576978.03	5245338.73	34
L19	No	577903.54	5244595.42	40
L19-E	No	577934.00	5244595.83	41
L19-S	No	577903.94	5244564.95	41
L19-W	No	577873.07	5244595.02	40
L19-N	No	577903.13	5244625.89	41
L20	Yes	579040.35	5245093.04	47
L20-E	Yes	579070.82	5245093.45	47
L20-S	Yes	579040.76	5245062.57	48
L20-W	Yes	579009.88	5245092.63	47
L20-N	Yes	579039.94	5245123.51	46
L21	No	579035.09	5245231.44	45
L21-E	No	579065.56	5245231.85	45
L21-S	No	579035.50	5245200.97	45
L21-W	No	579004.62	5245231.03	45
L21-N	No	579034.68	5245261.91	45
L22	No	586144.56	5246150.00	33
L22-E	No	586175.02	5246150.45	33
L22-S	No	586145.00	5246119.54	33
L22-W	No	586114.09	5246149.56	34
L22-N	No	586144.11	5246180.47	31
L23	No	587027.75	5246631.22	30
L23-E	No	587058.22	5246631.67	30
L23-S	No	587028.20	5246600.75	29
L23-W	No	586997.28	5246630.77	30
L23-N	No	587027.30	5246661.68	30
L24	No	586153.90	5247517.22	32
L24-E	No	586184.37	5247517.67	32
L24-S	No	586154.35	5247486.75	32
L24-W	No	586123.43	5247516.77	32
L24-N	No	586153.45	5247547.69	32
L25	No	586178.12	5247618.30	32
L25-E	No	586208.58	5247618.74	31
L25-S	No	586178.56	5247587.83	32
L25-W	No	586147.65	5247617.85	32
L25-N	No	586177.67	5247648.76	32
L26	No	586157.97	5248548.89	30

Table B-1.1: Sound Level Modeling Results Sorted by Receptor ID

Receptor ID	Signed Wavier	Coordinates		Source Only L _{eq} Sound Level (dBA)
		UTM NAD83 Zone 14N		
		X (m)	Y (m)	
L26-E	No	586188.43	5248549.33	30
L26-S	No	586158.41	5248518.42	30
L26-W	No	586127.50	5248548.44	30
L26-N	No	586157.52	5248579.35	30
L27	No	585319.35	5248466.39	29
L27-E	No	585349.81	5248466.83	30
L27-S	No	585319.79	5248435.92	29
L27-W	No	585288.88	5248465.95	28
L27-N	No	585318.90	5248496.86	30
L28	No	585233.95	5248467.61	32
L28-E	No	585264.41	5248468.05	30
L28-S	No	585234.39	5248437.14	33
L28-W	No	585203.48	5248467.16	32
L28-N	No	585233.51	5248498.07	32
L29	No	584561.59	5248475.39	34
L29-E	No	584592.06	5248475.83	34
L29-S	No	584562.03	5248444.93	34
L29-W	No	584531.12	5248474.96	34
L29-N	No	584561.15	5248505.86	33
L30	No	583482.04	5246855.54	45
L30-E	No	583512.51	5246855.97	45
L30-S	No	583482.48	5246825.07	45
L30-W	No	583451.58	5246855.10	45
L30-N	No	583481.61	5246886.00	45
L31	Yes	582997.86	5242037.63	47
L31-E	Yes	583028.33	5242038.05	47
L31-S	Yes	582998.29	5242007.16	47
L31-W	Yes	582967.39	5242037.20	48
L31-N	Yes	582997.43	5242068.09	48
L32	No	584307.76	5242029.53	41
L32-E	No	584338.23	5242029.97	41
L32-S	No	584308.20	5241999.07	41
L32-W	No	584277.29	5242029.10	41
L32-N	No	584307.32	5242060.00	41
L33	No	585692.25	5242020.78	34
L33-E	No	585722.72	5242021.22	33
L33-S	No	585692.70	5241990.31	34
L33-W	No	585661.79	5242020.34	34
L33-N	No	585691.81	5242051.25	34
L34	No	585673.49	5241957.43	33
L34-E	No	585703.96	5241957.87	32
L34-S	No	585673.93	5241926.96	33

Table B-1.1: Sound Level Modeling Results Sorted by Receptor ID

Receptor ID	Signed Wavier	Coordinates		Source Only L _{eq} Sound Level (dBA)
		UTM NAD83 Zone 14N		
		X (m)	Y (m)	
L34-W	No	585643.02	5241956.99	33
L34-N	No	585673.05	5241987.90	34
L35	No	578181.62	5243851.70	37
L35-E	No	578212.08	5243852.11	37
L35-S	No	578182.02	5243821.24	38
L35-W	No	578151.15	5243851.30	37
L35-N	No	578181.21	5243882.17	37
L36	No	581301.12	5244181.87	45
L36-E	No	581331.59	5244182.29	45
L36-S	No	581301.54	5244151.40	45
L36-W	No	581270.65	5244181.45	45
L36-N	No	581300.70	5244212.34	45
L38	No	579925.20	5244012.65	45
L38-E	No	579955.66	5244013.07	45
L38-S	No	579925.61	5243982.18	45
L38-W	No	579894.73	5244012.24	45
L38-N	No	579924.78	5244043.12	45
L39	No	583289.33	5241779.21	44
L39-E	No	583319.80	5241779.64	44
L39-S	No	583289.76	5241748.74	44
L39-W	No	583258.87	5241778.78	44
L39-N	No	583288.90	5241809.68	44
L40	No	584496.45	5248483.45	34
L40-E	No	584526.92	5248483.89	34
L40-S	No	584496.89	5248452.99	34
L40-W	No	584465.99	5248483.01	34
L40-N	No	584496.02	5248513.92	33

Table B-1.2: Sound Level Modeling Results Sorted by Sound Level

Receptor ID	Participation Status	Coordinates		Source Only L _{eq} Sound Level (dBA)
		UTM NAD83 Zone 14N		
		X (m)	Y (m)	
L31-N	Yes	582997.43	5242068.09	48
L20-S	Yes	579040.76	5245062.57	48
L31-W	Yes	582967.39	5242037.20	48
L31	Yes	582997.86	5242037.63	47
L31-E	Yes	583028.33	5242038.05	47
L20-E	Yes	579070.82	5245093.45	47
L20	Yes	579040.35	5245093.04	47
L31-S	Yes	582998.29	5242007.16	47
L20-W	Yes	579009.88	5245092.63	47
L20-N	Yes	579039.94	5245123.51	46
L21-S	No	579035.50	5245200.97	45
L38-S	No	579925.61	5243982.18	45
L38-N	No	579924.78	5244043.12	45
L38	No	579925.20	5244012.65	45
L38-E	No	579955.66	5244013.07	45
L38-W	No	579894.73	5244012.24	45
L30-S	No	583482.48	5246825.07	45
L30-E	No	583512.51	5246855.97	45
L36-N	No	581300.70	5244212.34	45
L21-E	No	579065.56	5245231.85	45
L21	No	579035.09	5245231.44	45
L21-W	No	579004.62	5245231.03	45
L36-E	No	581331.59	5244182.29	45
L36	No	581301.12	5244181.87	45
L36-W	No	581270.65	5244181.45	45
L30	No	583482.04	5246855.54	45
L36-S	No	581301.54	5244151.40	45
L30-W	No	583451.58	5246855.10	45
L21-N	No	579034.68	5245261.91	45
L30-N	No	583481.61	5246886.00	45
L39-N	No	583288.90	5241809.68	44
L39-W	No	583258.87	5241778.78	44
L39	No	583289.33	5241779.21	44
L39-E	No	583319.80	5241779.64	44
L39-S	No	583289.76	5241748.74	44
L32-W	No	584277.29	5242029.10	41
L32-N	No	584307.32	5242060.00	41
L19-N	No	577903.13	5244625.89	41
L32	No	584307.76	5242029.53	41
L32-S	No	584308.20	5241999.07	41
L32-E	No	584338.23	5242029.97	41
L12-N	No	581862.13	5241120.63	41

Table B-1.2: Sound Level Modeling Results Sorted by Sound Level

Receptor ID	Participation Status	Coordinates		Source Only L _{eq} Sound Level (dBA)
		UTM NAD83 Zone 14N		
		X (m)	Y (m)	
L19-E	No	577934.00	5244595.83	41
L12-E	No	581893.02	5241090.59	41
L12	No	581862.55	5241090.16	41
L12-W	No	581832.09	5241089.74	41
L19-S	No	577903.94	5244564.95	41
L12-S	No	581862.98	5241059.69	40
L19	No	577903.54	5244595.42	40
L19-W	No	577873.07	5244595.02	40
L10-N	No	577289.20	5241110.58	39
L10-E	No	577320.07	5241080.51	39
L10	No	577289.60	5241080.11	39
L10-W	No	577259.13	5241079.71	39
L10-S	No	577290.00	5241049.65	39
L9-N	No	577343.64	5240941.02	38
L9-E	No	577374.51	5240910.95	38
L9	No	577344.04	5240910.55	38
L35-S	No	578182.02	5243821.24	38
L9-S	No	577344.44	5240880.09	38
L35-E	No	578212.08	5243852.11	37
L9-W	No	577313.57	5240910.15	37
L35	No	578181.62	5243851.70	37
L11-N	No	578096.32	5240564.71	37
L35-W	No	578151.15	5243851.30	37
L11-E	No	578127.19	5240534.64	37
L11	No	578096.72	5240534.24	37
L35-N	No	578181.21	5243882.17	37
L11-W	No	578066.25	5240533.83	37
L11-S	No	578097.13	5240503.77	37
L6-N	No	581632.00	5240196.15	36
L6-E	No	581662.89	5240166.11	36
L6	No	581632.42	5240165.69	36
L6-W	No	581601.96	5240165.26	36
L6-S	No	581632.85	5240135.22	36
L13-N	No	583830.79	5240600.02	35
L13-W	No	583800.75	5240569.12	35
L13	No	583831.22	5240569.56	35
L13-S	No	583831.65	5240539.09	35
L13-E	No	583861.69	5240569.99	35
L15-E	No	575936.16	5241949.95	35
L5-W	No	583356.69	5240348.03	35
L5-N	No	583386.72	5240378.93	35
L15-N	No	575905.30	5241980.03	35

Table B-1.2: Sound Level Modeling Results Sorted by Sound Level

Receptor ID	Participation Status	Coordinates		Source Only L _{eq} Sound Level (dBA)
		UTM NAD83 Zone 14N		
		X (m)	Y (m)	
L5-S	No	583387.58	5240317.99	35
L15	No	575905.69	5241949.56	35
L15-S	No	575906.09	5241919.09	35
L5	No	583387.15	5240348.46	35
L5-E	No	583417.62	5240348.89	35
L15-W	No	575875.23	5241949.17	35
L18-S	No	576978.82	5245277.79	34
L18	No	576978.42	5245308.26	34
L18-E	No	577008.89	5245308.66	34
L18-W	No	576947.96	5245307.86	34
L33-W	No	585661.79	5242020.34	34
L40-S	No	584496.89	5248452.99	34
L33-N	No	585691.81	5242051.25	34
L29-S	No	584562.03	5248444.93	34
L34-N	No	585673.05	5241987.90	34
L18-N	No	576978.03	5245338.73	34
L33	No	585692.25	5242020.78	34
L33-S	No	585692.70	5241990.31	34
L29-W	No	584531.12	5248474.96	34
L40-W	No	584465.99	5248483.01	34
L22-W	No	586114.09	5246149.56	34
L29	No	584561.59	5248475.39	34
L40	No	584496.45	5248483.45	34
L40-E	No	584526.92	5248483.89	34
L29-E	No	584592.06	5248475.83	34
L34	No	585673.49	5241957.43	33
L29-N	No	584561.15	5248505.86	33
L40-N	No	584496.02	5248513.92	33
L16-E	No	575455.16	5242922.80	33
L34-S	No	585673.93	5241926.96	33
L17-E	No	575540.22	5243574.21	33
L16-S	No	575425.09	5242891.94	33
L16	No	575424.70	5242922.41	33
L17-S	No	575510.14	5243543.35	33
L17	No	575509.75	5243573.82	33
L16-N	No	575424.31	5242952.87	33
L17-N	No	575509.36	5243604.28	33
L22-S	No	586145.00	5246119.54	33
L22	No	586144.56	5246150.00	33
L17-W	No	575479.28	5243573.42	33
L16-W	No	575394.23	5242922.02	33
L34-W	No	585643.02	5241956.99	33

Table B-1.2: Sound Level Modeling Results Sorted by Sound Level

Receptor ID	Participation Status	Coordinates		Source Only L _{eq} Sound Level (dBA)
		UTM NAD83 Zone 14N		
		X (m)	Y (m)	
L33-E	No	585722.72	5242021.22	33
L22-E	No	586175.02	5246150.45	33
L14-E	No	584910.58	5240622.32	33
L14-N	No	584879.67	5240652.35	33
L14-W	No	584849.64	5240621.45	33
L14	No	584880.11	5240621.88	33
L2-E	No	577060.43	5240014.98	33
L28-S	No	585234.39	5248437.14	33
L28-W	No	585203.48	5248467.16	32
L28	No	585233.95	5248467.61	32
L24-W	No	586123.43	5247516.77	32
L4-N	No	583399.29	5239404.46	32
L4-W	No	583369.25	5239373.57	32
L24-S	No	586154.35	5247486.75	32
L28-N	No	585233.51	5248498.07	32
L34-E	No	585703.96	5241957.87	32
L4	No	583399.72	5239374.00	32
L24	No	586153.90	5247517.22	32
L4-E	No	583430.19	5239374.43	32
L4-S	No	583400.15	5239343.53	32
L24-N	No	586153.45	5247547.69	32
L25-W	No	586147.65	5247617.85	32
L25	No	586178.12	5247618.30	32
L25-S	No	586178.56	5247587.83	32
L25-N	No	586177.67	5247648.76	32
L24-E	No	586184.37	5247517.67	32
L14-S	No	584880.55	5240591.42	32
L8-E	No	576595.02	5240491.08	32
L3-N	No	577035.46	5240117.93	31
L8	No	576564.55	5240490.68	31
L8-S	No	576564.95	5240460.21	31
L22-N	No	586144.11	5246180.47	31
L25-E	No	586208.58	5247618.74	31
L3	No	577035.85	5240087.47	30
L8-W	No	576534.08	5240490.29	30
L26-S	No	586158.41	5248518.42	30
L2-N	No	577029.57	5240045.05	30
L26	No	586157.97	5248548.89	30
L7-W	No	576461.46	5240485.56	30
L26-N	No	586157.52	5248579.35	30
L26-E	No	586188.43	5248549.33	30
L26-W	No	586127.50	5248548.44	30

Table B-1.2: Sound Level Modeling Results Sorted by Sound Level

Receptor ID	Participation Status	Coordinates		Source Only L _{eq} Sound Level (dBA)
		UTM NAD83 Zone 14N		
		X (m)	Y (m)	
L23-N	No	587027.30	5246661.68	30
L3-E	No	577066.32	5240087.86	30
L27-E	No	585349.81	5248466.83	30
L27-N	No	585318.90	5248496.86	30
L28-E	No	585264.41	5248468.05	30
L3-S	No	577036.25	5240057.00	30
L23-W	No	586997.28	5246630.77	30
L23-E	No	587058.22	5246631.67	30
L23	No	587027.75	5246631.22	30
L27-S	No	585319.79	5248435.92	29
L23-S	No	587028.20	5246600.75	29
L27	No	585319.35	5248466.39	29
L2	No	577029.96	5240014.58	28
L27-W	No	585288.88	5248465.95	28
L7-E	No	576522.40	5240486.35	28
L7	No	576491.93	5240485.96	28
L3-W	No	577005.39	5240087.07	26
L7-S	No	576492.32	5240455.49	26
L8-N	No	576564.15	5240521.15	26
L7-N	No	576491.53	5240516.42	25
L2-W	No	576999.50	5240014.18	25
L2-S	No	577030.36	5239984.11	25
L1-N	No	576422.87	5239912.31	23
L1-E	No	576453.73	5239882.23	23
L1	No	576423.27	5239881.84	23
L1-W	No	576392.80	5239881.44	23
L1-S	No	576423.66	5239851.37	23

DRAFTED BY AND AFTER RECORDING
RETURN TO:

Vogel Law Firm
218 NP Avenue
PO Box 1389
Fargo, ND 58102
Attn: Dan Bueide

98489

Fee: \$85.00

Pg: 1 of 26

State of North Dakota)
County of Steele)
Recorded: 10/30/2008 At 1:15 PM

(This space reserved for recording information)

WIND FARM EASEMENT AGREEMENT

1. **Parties.** This is an agreement ("Agreement") dated 16th of October, 2008 (the "Effective Date"), between Vernon L. Johnson, a widower, and his successors in interest ("Owner"), as owners of the real property described on attached Exhibit A ("Owner's Property"), and M-Power, LLC, a North Dakota limited liability company, and its successors in interest ("Developer").

2. **Purpose.** This Agreement is a grant by Owner to Developer of the easements and other specified rights in Owner's Property needed by Developer for its wind energy project located in Steele, Griggs and Barnes counties, North Dakota. It also establishes the rights of the parties and their duties to each other with regard to the financing, construction, operation, repair, maintenance, replacement, and removal of all Wind Farm Improvements whether located on or off Owner's Property.

3. **Definitions.** Capitalized terms used in this Agreement have the meaning given them in the text of the agreement or in this definitions section.

"Access Rights" means the right of unobstructed ingress and egress to and from the Wind Farm Improvements by Developer, its agents, contractors, successors and assigns.

"Annual Installment Payments" means the amounts shown in the Easement Compensation Sheet attached as **Exhibit D**. The parties acknowledge and agree that **Exhibit D** will not be included with this Agreement when recorded with the County Recorder, and that so removing **Exhibit D** prior to recording is intentional and does not in any way affect the validity of this Agreement.

"Collection Facilities" means the underground and above ground electrical collection and telecommunications lines, splice boxes, and all other devices and equipment used to connect the Turbines to electrical collection lines connected to the power grid and to the Wind Farm's Met Towers and operations and maintenance facilities.

State of North Dakota)
County of Steele)
Recorded: 10/30/2008 At 1:15 PM

6.6 Noise Easement. Owner grants Developer an easement for the right and privilege to generate and maintain audible noise levels in excess of fifty (50) dbA on and above the Noise Easement Property at any or all times of the day or night ("Noise Easement"). The "Noise Easement Property" shall mean the Owner's Property except those portions within a 200-foot radius circle (or lesser distance with Owner's prior written consent) centered on the inside of each presently existing, occupied residence on the Owner's Property. If noise levels emanating from the Turbines exceed fifty (50) dbA without the Owner's written consent as measured within 200 feet (or lesser agreed distance) from the inside of a presently existing residence on Owner's Property by an independent professional applying commonly accepted measurement instruments and standards, Developer shall reduce the noise level to 50 dbA at 200 feet (or lesser agreed distance) from the residence. Measures to be taken by Developer may include installing insulation or sound deadening material in the offending Turbine(s); installing landscaping, insulation, and sound deadening material at the residence; or, changing the operation of the Turbine(s) to reduce noise output.

6.7 Overhang Easement. Owner grants Developer an easement for the right and privilege to permit the rotors of Turbines located on adjacent properties to overhang a portion of the Owner's Property identified and shown on **Exhibit B** (the "Overhang Easement Property") by no more than 110 feet at a height of at least 100 feet above the ground ("Overhang Easement"). Owner shall not interfere with the operation of Turbine rotors that overhang the Overhang Easement Property.

6.8 Met Tower Site Easement. Owner grants Developer an easement to construct, operate, replace, relocate, remove, and maintain a Met Tower and Collection Facilities on each Met Tower Site identified and located as shown on **Exhibit B**. Each Met Tower Site subject to the burden of this easement is referred to as a "Met Tower Site Easement Property."

6.9 Met Tower Access Easement. Owner grants Developer an easement for vehicular and pedestrian ingress and egress to and from the Met Tower ("Met Tower Access Easement"). This Met Tower Access Easement as identified and shown on **Exhibit B** is an extension of the Access Easement; however, Developer shall not construct roads, lanes or other surface improvements in the Met Tower Access Easement except with the express written consent of Owner which consent will not be unreasonably withheld. Owner reserves the right to continue ordinary farming operations on the Met Tower Access Easement, but shall not otherwise obstruct or in any way interfere with Developer's access or other rights under this Met Tower Access Easement. After each use of the Met Tower Access Easement, Developer to the extent reasonably possible shall restore the Met Tower Access Easement to the condition it was in before Developer's use. Developer shall have the absolute right to remove or destroy crops growing in the Met Tower Access Easement as reasonably necessary to enjoyment of its Met Tower Access Easement rights provided it compensates Owner for the damage in the manner provided in **Exhibit D**.

7. Easement Purchase Price. Developer shall pay Owner the amounts set forth in the attached **Exhibit D** as the consideration for the Easements, pursuant to the terms and conditions set forth in **Exhibit D**.

The undersigned parties have executed this Agreement as of the Effective Date set forth above.

Owner:

Vernon L. Johnson
Vernon L. Johnson

Developer:

M-Power, LLC,
a North Dakota limited liability company

By: Elizabeth H. Berge

Name: ELIZABETH H. BERGE

Title: Treasurer

STATE OF NORTH DAKOTA)
COUNTY OF Steele)

SS:

98489

Fee: \$85.00

Pg: 19 of 26

State of North Dakota)
County of Steele)
Recorded: 10/30/2008 At 1:15 PM

This instrument was acknowledged before me this 16th day of October, 2008, by
Vernon L. Johnson, a widower.

ORRIN DELONG III
Notary Public
State of North Dakota
My Commission Expires on August 15, 2014

Orrin DeLong III

Notary Public

My Commission Expires: August 15, 2014

STATE OF NORTH DAKOTA)
COUNTY OF Steele)

SS:

This instrument was acknowledged before me this 16th day of October, 2008,
by Elizabeth H. Berge, the Treasurer of M-Power, LLC, a North Dakota
limited liability company, on behalf of the limited liability company.

ORRIN DELONG III
Notary Public
State of North Dakota
My Commission Expires on August 15, 2014

Orrin DeLong III

Notary Public

My Commission Expires: August 15, 2014

State of North Dakota)
County of Steele)
Recorded: 10/30/2008 At 1:18 PM

EXHIBIT A

Legal description of Owner's Property

Project Parcel 52: The Northeast Quarter (NE1/4) of Section Thirty-four (34), Township One Hundred Forty-five (145) North, Range Fifty-seven (57) West of the Fifth Principal Meridian, Steele County, North Dakota.

Project Parcel 54: The Southeast Quarter (SE1/4) of Section Thirty-four (34), Township One Hundred Forty-five (145) North, Range Fifty-seven (57) West of the Fifth Principal Meridian, Steele County, North Dakota, less a parcel of land described as follows: Commencing at a point 20 rods East of the Southwest corner of the Southeast Quarter (SE1/4) of Section Thirty-four (34); thence North 8 rods; thence East 10 rods; thence South 8 Rods; thence West 10 rods to the place of beginning.

Project Parcel 56: The Northwest Quarter (NW1/4) of Section Thirty-five (35), Township One Hundred Forty-five (145) North, Range Fifty-seven (57) West of the Fifth Principal Meridian, Steele County, North Dakota.

Project Parcel 57: The Southwest Quarter (SW1/4) of Section Thirty-five (35), Township One Hundred Forty-five (145) North, Range Fifty-seven (57) West of the Fifth Principal Meridian, Steele County, North Dakota.

DRAFTED BY AND AFTER RECORDING
RETURN TO:

Vogel Law Firm
218 NP Avenue
PO Box 1389
Fargo, ND 58102
Attn: Dan Buelde

98500

Fee: \$76.00

Pg: 1 of 23

State of North Dakota
County of Steele
Recorded: 10/30/2008 At 2:50 PM

(This space reserved for recording information)

WIND FARM EASEMENT AGREEMENT

1. **Parties.** This is an agreement ("Agreement") dated 29th of October, 2008 (the "Effective Date"), between Steven M. Johnson and Stephanie Johnson, husband and wife, and their successors in interest ("Owner"), as owners of the real property described on attached **Exhibit A** ("Owner's Property"), and M-Power, LLC, a North Dakota limited liability company, and its successors in interest ("Developer").

2. **Purpose.** This Agreement is a grant by Owner to Developer of the easements and other specified rights in Owner's Property needed by Developer for its wind energy project located in Steele, Griggs and Barnes counties, North Dakota. It also establishes the rights of the parties and their duties to each other with regard to the financing, construction, operation, repair, maintenance, replacement, and removal of all Wind Farm Improvements whether located on or off Owner's Property.

3. **Definitions.** Capitalized terms used in this Agreement have the meaning given them in the text of the agreement or in this definitions section.

"Access Rights" means the right of unobstructed ingress and egress to and from the Wind Farm Improvements by Developer, its agents, contractors, successors and assigns.

"Annual Installment Payments" means the amounts shown in the Easement Compensation Sheet attached as **Exhibit D**. The parties acknowledge and agree that **Exhibit D** will not be included with this Agreement when recorded with the County Recorder, and that so removing **Exhibit D** prior to recording is intentional and does not in any way affect the validity of this Agreement.

"Collection Facilities" means the underground and above ground electrical collection and telecommunications lines, splice boxes, and all other devices and equipment used to connect the Turbines to electrical collection lines connected to the power grid and to the Wind Farm's Met Towers and operations and maintenance facilities.

6.6 Noise Easement. Owner grants Developer an easement for the right and privilege to generate and maintain audible noise levels in excess of fifty (50) dbA on and above the Noise Easement Property at any or all times of the day or night ("Noise Easement"). The "Noise Easement Property" shall mean the Owner's Property except those portions within a 200-foot radius circle (or lesser distance with Owner's prior written consent) centered on the inside of each presently existing, occupied residence on the Owner's Property. If noise levels emanating from the Turbines exceed fifty (50) dbA without the Owner's written consent as measured within 200 feet (or lesser agreed distance) from the inside of a presently existing residence on Owner's Property by an independent professional applying commonly accepted measurement instruments and standards, Developer shall reduce the noise level to 50 dbA at 200 feet (or lesser agreed distance) from the residence. Measures to be taken by Developer may include installing insulation or sound deadening material in the offending Turbine(s); installing landscaping, insulation, and sound deadening material at the residence; or, changing the operation of the Turbine(s) to reduce noise output.

6.7 Overhang Easement. Owner grants Developer an easement for the right and privilege to permit the rotors of Turbines located on adjacent properties to overhang a portion of the Owner's Property identified and shown on **Exhibit B** (the "Overhang Easement Property") by no more than 110 feet at a height of at least 100 feet above the ground ("Overhang Easement"). Owner shall not interfere with the operation of Turbine rotors that overhang the Overhang Easement Property.

6.8 Met Tower Site Easement. Owner grants Developer an easement to construct, operate, replace, relocate, remove, and maintain a Met Tower and Collection Facilities on each Met Tower Site identified and located as shown on **Exhibit B**. Each Met Tower Site subject to the burden of this easement is referred to as a "Met Tower Site Easement Property."

6.9 Met Tower Access Easement. Owner grants Developer an easement for vehicular and pedestrian ingress and egress to and from the Met Tower ("Met Tower Access Easement"). This Met Tower Access Easement as identified and shown on **Exhibit B** is an extension of the Access Easement; however, Developer shall not construct roads, lanes or other surface improvements in the Met Tower Access Easement except with the express written consent of Owner which consent will not be unreasonably withheld. Owner reserves the right to continue ordinary farming operations on the Met Tower Access Easement, but shall not otherwise obstruct or in any way interfere with Developer's access or other rights under this Met Tower Access Easement. After each use of the Met Tower Access Easement, Developer to the extent reasonably possible shall restore the Met Tower Access Easement to the condition it was in before Developer's use. Developer shall have the absolute right to remove or destroy crops growing in the Met Tower Access Easement as reasonably necessary to enjoyment of its Met Tower Access Easement rights provided it compensates Owner for the damage in the manner provided in **Exhibit D**.

7. Easement Purchase Price. Developer shall pay Owner the amounts set forth in the attached **Exhibit D** as the consideration for the Easements, pursuant to the terms and conditions set forth in **Exhibit D**.

The undersigned parties have executed this Agreement as of the Effective Date set forth above.

Owner:

Steven M Johnson
Steven M. Johnson

Stephanie Johnson
Stephanie Johnson

Developer:

M-Power, LLC,
a North Dakota limited liability company

By: Elizabeth H. Berge

Name: ELIZABETH H. BERGE

Title: Treasurer

STATE OF NORTH DAKOTA)
COUNTY OF Steele)

SS:

This instrument was acknowledged before me this 29th day of October, 2008, by Steven M. Johnson and Stephanie Johnson, husband and wife

TRAVIS MOEN
Notary Public
State of North Dakota
My Commission Expires on Aug. 3, 2013

Travis Moen
Notary Public
My Commission Expires: Aug. 3 2013

STATE OF NORTH DAKOTA)
COUNTY OF Steele)

SS:

This instrument was acknowledged before me this 29th day of October, 2008, by Elizabeth H. Berge, the Treasurer of M-Power, LLC, a North Dakota limited liability company, on behalf of the limited liability company.

TRAVIS MOEN
Notary Public
State of North Dakota
My Commission Expires on Aug. 3, 2013

Travis Moen
Notary Public
My Commission Expires: _____

98500 / Fee: \$76.00 Pg: 19 of 23

State of North Dakota)
County of Steele)
Recorded: 10/30/2008 At 2:50 PM

EXHIBIT A

Legal description of Owner's Property

Project Parcel 23: The East Half of the Northwest Quarter (E1/2NW1/4) of Section Twenty-Nine (29), Township One Hundred Forty-five (145) North, Range Fifty-seven (57) West of the Fifth Principal Meridian, Steele County, North Dakota.

Project Parcel 24: The Northeast Quarter (NE1/4) of Section Twenty-Nine (29), Township One Hundred Forty-five (145) North, Range Fifty-seven (57) West of the Fifth Principal Meridian, Steele County, North Dakota.

98500

Fee: \$76.00

Pg: 20 of 23

State of North Dakota)
County of Steele)
Recorded: 10/30/2008 At 2:50 PM

Appendix B – Shadow Flicker Assessment Results

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SHADOW FLICKER MODELING REPORT

Luverne Wind Energy Center Repower Project Steele County, North Dakota

Prepared for:

Atwell, LLC
311 North Main
Ann Arbor, Michigan 48104

Prepared by:



Epsilon Associates, Inc.
3 Mill & Main Place, Suite 250
Maynard, MA 01754

April 11, 2023

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1.0 EXECUTIVE SUMMARY

The Luverne Wind Energy Center Repowering Project (the Project) is an existing wind park in Steele County, North Dakota that is planned to be repowered by Otter Tail Power Company (Otter Tail). Atwell has retained Epsilon Associates, Inc. (Epsilon) to conduct a shadow flicker assessment for the proposed Project. This report presents results of the shadow flicker modeling from the proposed repower in Steele County.

Shadow flicker modeling was conducted for the 33 Otter Tail Luverne General Electric (GE) repowered wind turbines. The purpose of this analysis is to predict the annual durations of wind turbine shadow flicker at nearby receptors. The maximum expected annual duration of shadow flicker at a modeling receptor resulting from the operation of all Otter Tail Luverne Wind wind turbines is 22 hours, 1 minute per year. The modeling results are conservative in that modeling receptors were treated as “greenhouses” (i.e., having windows on all sides) and the surrounding area was assumed to be without vegetation or structures (“bare earth”).

2.0 INTRODUCTION

The Luverne Wind Energy Center Repower Project will consist of 33 repowered wind turbines. The proposed wind turbines are all GE 1.5 MW units with a rotor diameter of 97 meters and a hub height of 80 meters. Figure 2-1 shows the locations of the 33 wind turbines over aerial imagery.

Shadow flicker can be defined as an intermittent change in the intensity of light in a given area resulting from the operation of a wind turbine due to its interaction with the sun. An indoor observer experiences repeated changes in the brightness of the room as shadows cast from the wind turbine blades briefly pass by windows as the blades rotate. In order for this to occur, the wind turbine must be operating, the sun must be shining, and the window must be within the shadow region of the wind turbine, otherwise there is no shadow flicker. A stationary wind turbine only generates a stationary shadow similar to any other structure.

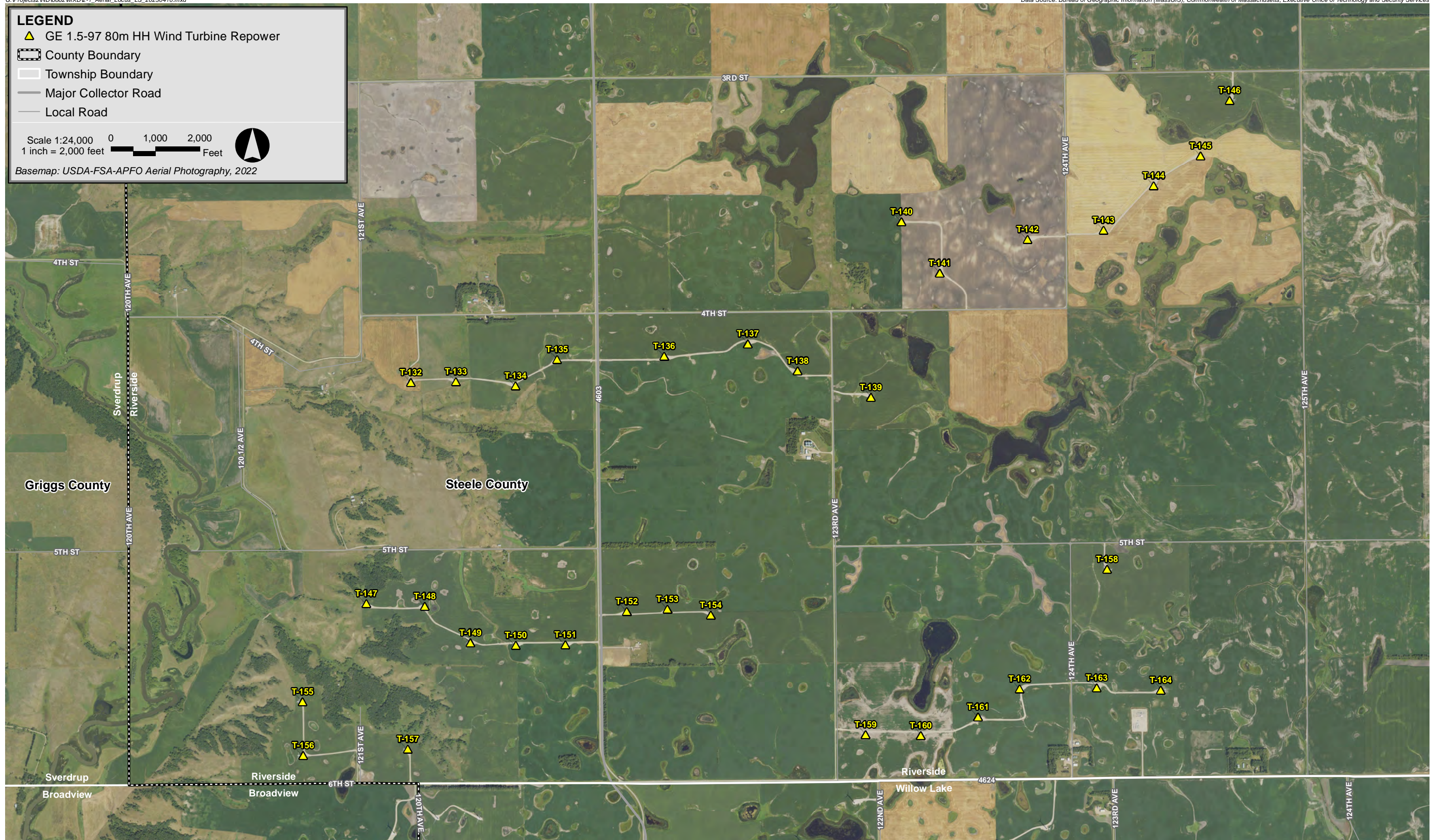
This report presents the findings of a shadow flicker modeling study for the Project. The wind turbines were modeled with the WindPRO software package using information provided by Atwell. The expected annual duration of shadow flicker was calculated at modeling receptors and shadow flicker isolines for the area surrounding the Project were generated. The results of the modeling are found within this report.

LEGEND

- ▲ GE 1.5-97 80m HH Wind Turbine Repower
- ▭ County Boundary
- ▭ Township Boundary
- Major Collector Road
- Local Road

Scale 1:24,000
1 inch = 2,000 feet

Basemap: USDA-FSA-APFO Aerial Photography, 2022



Luverne Wind Repower Steele County, North Dakota

3.0 SHADOW FLICKER MODELING

3.1 Modeling Methodology

Shadow flicker was modeled using a software package, WindPRO version 3.6. WindPRO is a software suite developed by EMD International A/S and is used for assessing potential environmental impacts from wind turbines. Using the Shadow module within WindPRO, worst-case shadow flicker in the area surrounding the wind turbines was calculated based on data inputs including: location of the wind turbines, location of discrete receptor points, wind turbine dimensions, flicker calculation limits, and terrain data. Based on these data, the model was able to incorporate the appropriate sun angle and maximum daily sunlight for this latitude into the calculations. The resulting worst-case calculations assume that the sun is always shining during daylight hours and that the wind turbine is always operating. The WindPRO Shadow module can be further refined by incorporating sunshine probabilities and wind turbine operational estimates by wind direction over the course of a year. The values produced by this further refinement are known as the “expected” shadow flicker. Both worst-case and expected annual shadow flicker durations are presented in this section.

This analysis is for the wind turbine array sent to Epsilon on December 20, 2022. Locations of the turbines are shown in Figure 3-1 and the coordinates are provided in Appendix A. All 33 wind turbines are GE 1.5-97 wind turbines with a 97-meter rotor diameter and a hub height of 80 meters. Each wind turbine has the following characteristics based on the technical data provided by Atwell:

		<u>GE 1.5-97</u>
◆ Rated Power	=	1,500 kW
◆ Hub Height	=	80 meters
◆ Rotor Diameter	=	97 meters
◆ Cut-in Wind Speed	=	3 m/s
◆ Cut-out Wind Speed	=	25 m/s
◆ Maximum RPM	=	16.2 rpm

To-date, there are no federal, state, or local regulations regarding the maximum radial distance from a wind turbine to which shadow flicker should be analyzed applicable to this Project. In the United States, shadow flicker is commonly evaluated out to a distance of ten times the rotor diameter. For this Project, ten times the largest rotor diameter of the proposed wind turbines corresponds to a distance of 0.6 miles (970 m). Conservatively, this analysis includes shadow flicker calculations out to 1.25 miles (2,012 m) from each wind turbine in the model for the proposed layout and existing wind turbines.

A modeling receptor dataset was provided to Epsilon on January 26, 2023. The dataset included 40 receptors. Atwell provided additional information stating that receptor L37 was uninhabited; therefore, a total of 39 receptors were input to the model. Each modeling point was assumed to have a window facing all directions (“greenhouse” mode) which yields conservative results. All

modeling receptors are identified in Figure 3-1. The model was set to limit calculations to 2,012 meters from a wind turbine, the equivalent of 1.25 miles. Consequently, shadow flicker at any of the modeling receptors greater than the corresponding limitation distance from a wind turbine was zero. In addition to modeling discrete points, shadow flicker was calculated at grid points in the area surrounding the modeled wind turbines to generate flicker isolines. A 20-meter spacing was used for this grid.

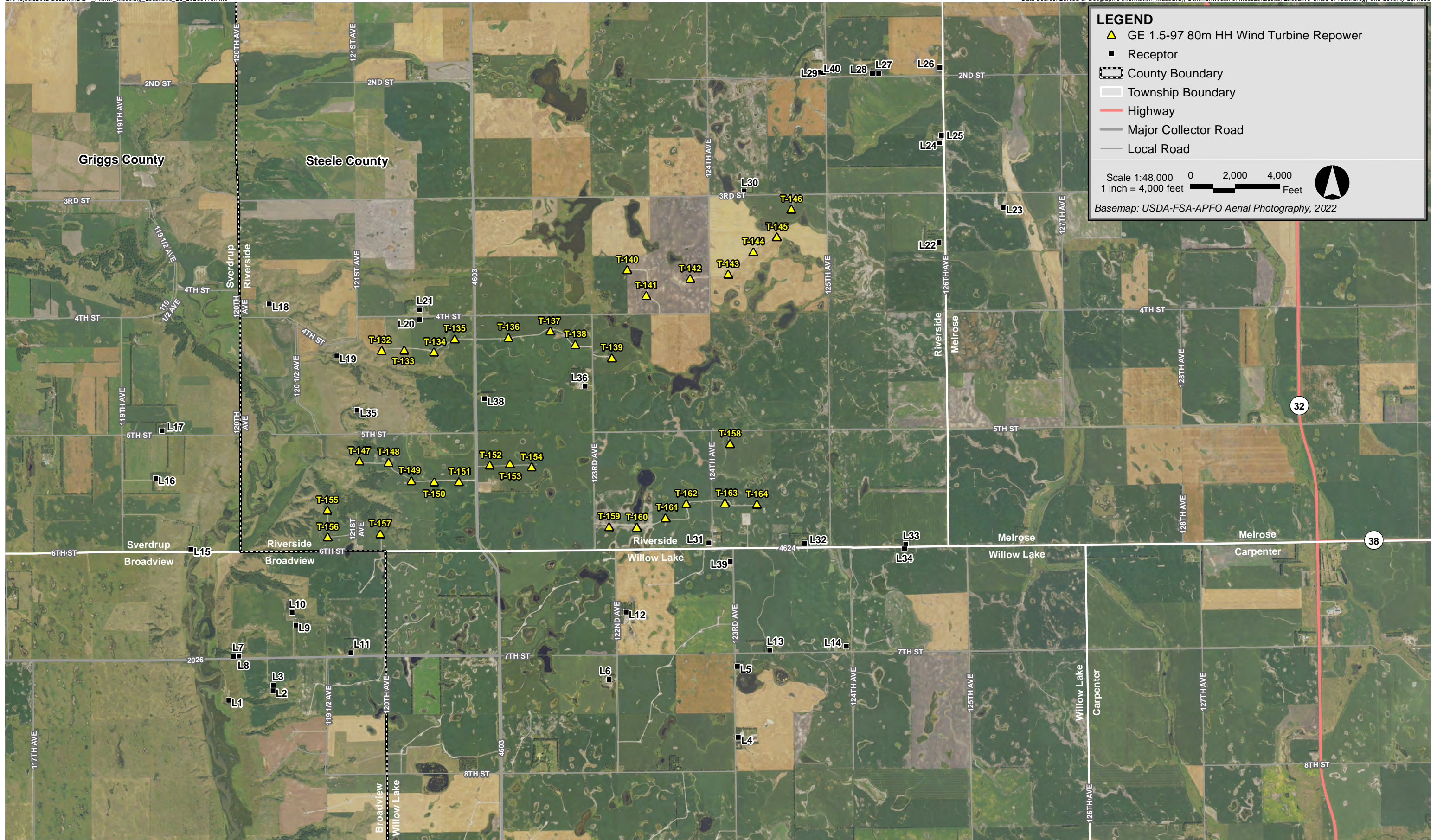
The terrain height contour elevations for the modeling domain were generated from elevation information derived from the National Elevation Dataset (NED) developed by the U.S. Geological Survey. Conservatively, obstacles, i.e., buildings and vegetation, were excluded from the analysis. This is effectively a “bare earth” scenario which is conservative. When accounted for in the shadow flicker calculations, such obstacles may significantly mitigate or eliminate the flicker effect depending on their size, type, and location. In addition, shadow flicker durations were calculated only when the angle of the sun was at least 3° above the horizon.

Monthly sunshine probability values were input for each month from January to December. These numbers were obtained from a publicly available historical dataset for Fargo, North Dakota from the National Oceanic and Atmospheric Administration’s (NOAA) National Centers for Environmental Information (NCEI).¹ Table 3-1 shows the percentage of sunshine hours by month used in the shadow flicker modeling. These values are the percentages that the sun is expected to be shining during daylight hours.

The number of hours the wind turbines are expected to operate for the 16 cardinal wind directions was input into the model. A publicly available dataset² using measured data for a five-year period of hourly wind directions and wind speeds at 3 meters and 10 meters was obtained by Epsilon. Epsilon then scaled this dataset to 80 meters to calculate the typical annual number of operational hours per wind direction sector. These hours per wind direction sector are used by WindPRO to estimate the “wind direction” and “operation time” reduction factors. Based on this dataset, the wind turbines would operate 85% of the year. Table 3-2 shows the distribution of operational hours for the 16 wind directions.

¹ NCEI (formerly NCDC), <https://www1.ncdc.noaa.gov/pub/data/ccd-data/pctpos20.dat>. Accessed in March 2023.

² North Dakota Agricultural Weather Network (NDAWN), 2018-2022, Carrington, ND.



Luverne Wind Repower Steele County, North Dakota

Table 3-1 Monthly Percent of Possible Sunshine

Month	Possible Sunshine
January	52%
February	54%
March	59%
April	57%
May	60%
June	64%
July	74%
August	71%
September	63%
October	51%
November	39%
December	39%

Table 3-2 Operational Hours per Wind Direction Sector

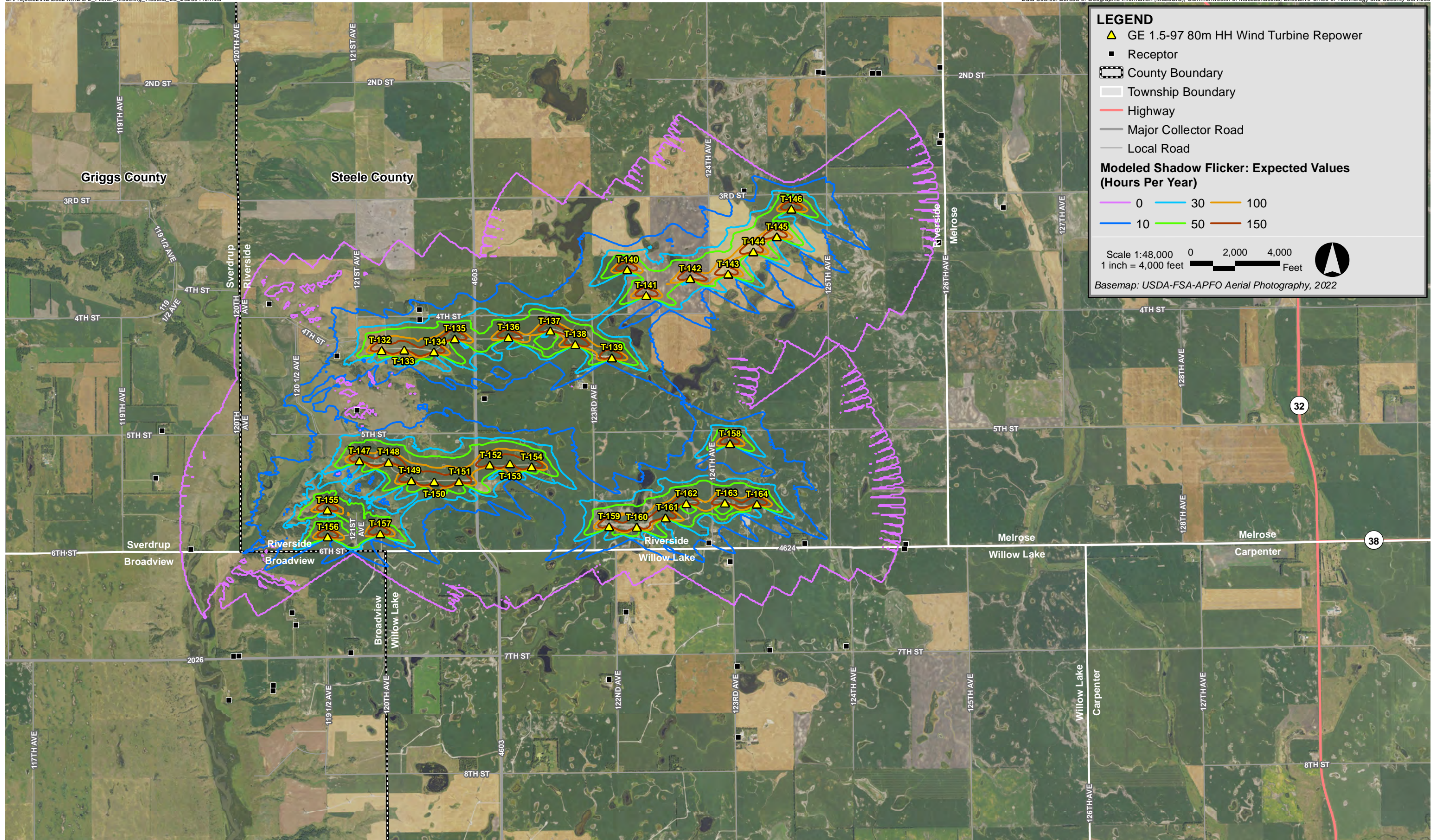
Wind Sector	Operational Hours
N	364
NNE	231
NE	235
ENE	234
E	299
ESE	398
SE	720
SSE	587
S	362
SSW	314
SW	482
WSW	477
W	675
WNW	931
NW	686
NNW	429
Annual	7424

3.2 Results

Following the modeling methodology outlined in Section 3.1, WindPRO was used to calculate shadow flicker at the 39 discrete modeling receptor points. In addition to the discrete modeling points, shadow flicker isolines were generated based on the grid calculations. Table B-1.1 in Appendix B presents the modeling results for the receptors sorted by ID. Table B-1.2 in Appendix B presents the modeling results for the receptors sorted by Expected Flicker. Both worst-case and expected values are presented.

The modeled worst-case annual shadow flicker duration for all 39 receptors ranged from 0 hours, 0 minutes per year to 85 hours, 12 minutes per year. The maximum flicker duration was at receptor L20.

The predicted expected annual shadow flicker duration ranged from 0 hours, 0 minutes per year to 22 hours, 1 minute per year. The maximum expected flicker duration calculated was at receptor L20. Twenty eight (28) of the receptors were predicted to experience no annual shadow flicker. Seven (7) of the receptors were predicted to experience some shadow flicker but less than 10 hours per year. The modeling results showed that four (4) of the receptors would be expected to have between 10 hours and 30 hours of shadow flicker per year. Zero (0) receptors are expected to have over 30 hours of flicker per year. Figure 3-2 displays the modeled flicker isolines (expected hrs/yr) over aerial imagery in relation to modeled wind turbines and modeling receptors.



Luverne Wind Repower Steele County, North Dakota

Appendix A

Wind Turbine Coordinates

Table A-1: Wind Turbine Coordinates

Wind Turbine ID	Wind Turbine Type	Hub Height (m)	Coordinates NAD83 UTM Zone 14N (meters)	
			X (Easting)	Y (Northing)
T-132	GE 1.5-97	80	578517.24	5244672.39
T-133	GE 1.5-97	80	578826.67	5244676.53
T-134	GE 1.5-97	80	579235.03	5244648.56
T-135	GE 1.5-97	80	579519.62	5244830.47
T-136	GE 1.5-97	80	580251.83	5244851.41
T-137	GE 1.5-97	80	580824.66	5244937.29
T-138	GE 1.5-97	80	581167.19	5244752.82
T-139	GE 1.5-97	80	581668.21	5244570.68
T-140	GE 1.5-97	80	581878.53	5245774.06
T-141	GE 1.5-97	80	582139.93	5245422.35
T-142	GE 1.5-97	80	582741.17	5245652.97
T-143	GE 1.5-97	80	583261.20	5245715.78
T-144	GE 1.5-97	80	583604.29	5246020.87
T-145	GE 1.5-97	80	583926.35	5246225.65
T-146	GE 1.5-97	80	584124.89	5246606.30
T-147	GE 1.5-97	80	578212.34	5243156.78
T-148	GE 1.5-97	80	578613.18	5243139.56
T-149	GE 1.5-97	80	578926.12	5242888.10
T-150	GE 1.5-97	80	579235.93	5242870.26
T-151	GE 1.5-97	80	579576.05	5242874.84
T-152	GE 1.5-97	80	579996.11	5243102.73
T-153	GE 1.5-97	80	580275.47	5243117.98
T-154	GE 1.5-97	80	580570.56	5243077.44
T-155	GE 1.5-97	80	577775.59	5242483.98
T-156	GE 1.5-97	80	577780.43	5242117.25
T-157	GE 1.5-97	80	578497.71	5242160.33
T-158	GE 1.5-97	80	583286.60	5243393.02
T-159	GE 1.5-97	80	581632.29	5242258.43
T-160	GE 1.5-97	80	582010.61	5242252.24
T-161	GE 1.5-97	80	582401.49	5242380.30
T-162	GE 1.5-97	80	582685.87	5242572.91
T-163	GE 1.5-97	80	583215.05	5242580.37
T-164	GE 1.5-97	80	583653.42	5242564.57

Appendix B

Shadow Flicker Modeling Results: Modeling Receptors

Table B-1.1: Shadow Flicker Modeling Results at Discrete Points - Sorted by Receptor ID

Receptor ID	Coordinates UTM NAD83 Zone 14N (meters)		Worst Case Shadow Flicker Hours per Year	Expected Shadow Flicker Hours per Year
	X (Easting)	Y (Northing)	(HH:MM/year)	(HH:MM/year)
L1	576423.27	5239881.84	0:00	0:00
L2	577029.96	5240014.58	0:00	0:00
L3	577035.85	5240087.47	0:00	0:00
L4	583399.72	5239374.00	0:00	0:00
L5	583387.15	5240348.46	0:00	0:00
L6	581632.42	5240165.69	0:00	0:00
L7	576491.93	5240485.96	0:00	0:00
L8	576564.55	5240490.68	0:00	0:00
L9	577344.04	5240910.55	0:00	0:00
L10	577289.60	5241080.11	0:00	0:00
L11	578096.72	5240534.24	0:00	0:00
L12	581862.55	5241090.16	0:00	0:00
L13	583831.22	5240569.56	0:00	0:00
L14	584880.11	5240621.88	0:00	0:00
L15	575905.69	5241949.56	4:46	1:41
L16	575424.70	5242922.41	0:00	0:00
L17	575509.75	5243573.82	0:00	0:00
L18	576978.42	5245308.26	4:42	1:30
L19	577903.54	5244595.42	36:50	13:30
L20	579040.35	5245093.04	85:12	22:01
L21	579035.09	5245231.44	74:11	18:51
L22	586144.56	5246150.00	0:00	0:00
L23	587027.75	5246631.22	0:00	0:00
L24	586153.90	5247517.22	0:00	0:00
L25	586178.12	5247618.30	0:00	0:00
L26	586157.97	5248548.89	0:00	0:00
L27	585319.35	5248466.39	0:00	0:00
L28	585233.95	5248467.61	0:00	0:00
L29	584561.59	5248475.39	0:00	0:00
L30	583482.04	5246855.54	18:43	5:57
L31	582997.86	5242037.63	29:26	11:44
L32	584307.76	5242029.53	16:05	6:36
L33	585692.25	5242020.78	0:00	0:00
L34	585673.49	5241957.43	0:00	0:00
L35	578181.62	5243851.70	0:00	0:00
L36	581301.12	5244181.87	3:57	1:05
L38	579925.20	5244012.65	19:58	7:01
L39	583289.33	5241779.21	6:40	2:40
L40	584496.45	5248483.45	0:00	0:00

Table B-1.2: Shadow Flicker Modeling Results at Discrete Points - Sorted by Expected Flicker

Receptor ID	Coordinates UTM NAD83 Zone 14N (meters)		Worst Case Shadow Flicker Hours per Year	Expected Shadow Flicker Hours per Year
	X (Easting)	Y (Northing)	(HH:MM/year)	(HH:MM/year)
L20	579040.35	5245093.04	85:12	22:01
L21	579035.09	5245231.44	74:11	18:51
L19	577903.54	5244595.42	36:50	13:30
L31	582997.86	5242037.63	29:26	11:44
L38	579925.20	5244012.65	19:58	7:01
L32	584307.76	5242029.53	16:05	6:36
L30	583482.04	5246855.54	18:43	5:57
L39	583289.33	5241779.21	6:40	2:40
L15	575905.69	5241949.56	4:46	1:41
L18	576978.42	5245308.26	4:42	1:30
L36	581301.12	5244181.87	3:57	1:05
L1	576423.27	5239881.84	0:00	0:00
L2	577029.96	5240014.58	0:00	0:00
L3	577035.85	5240087.47	0:00	0:00
L4	583399.72	5239374.00	0:00	0:00
L5	583387.15	5240348.46	0:00	0:00
L6	581632.42	5240165.69	0:00	0:00
L7	576491.93	5240485.96	0:00	0:00
L8	576564.55	5240490.68	0:00	0:00
L9	577344.04	5240910.55	0:00	0:00
L10	577289.60	5241080.11	0:00	0:00
L11	578096.72	5240534.24	0:00	0:00
L12	581862.55	5241090.16	0:00	0:00
L13	583831.22	5240569.56	0:00	0:00
L14	584880.11	5240621.88	0:00	0:00
L16	575424.70	5242922.41	0:00	0:00
L17	575509.75	5243573.82	0:00	0:00
L22	586144.56	5246150.00	0:00	0:00
L23	587027.75	5246631.22	0:00	0:00
L24	586153.90	5247517.22	0:00	0:00
L25	586178.12	5247618.30	0:00	0:00
L26	586157.97	5248548.89	0:00	0:00
L27	585319.35	5248466.39	0:00	0:00
L28	585233.95	5248467.61	0:00	0:00
L29	584561.59	5248475.39	0:00	0:00
L33	585692.25	5242020.78	0:00	0:00
L34	585673.49	5241957.43	0:00	0:00
L35	578181.62	5243851.70	0:00	0:00
L40	584496.45	5248483.45	0:00	0:00

Project:

6882 Otter Tail Luverne Wind

Licensed user:

Epsilon Associates, Inc
3 Clock Tower Place, Suite 250
US-MAYNARD MA 01754
978 897 7100
Richard Lampeter / rlampeter@epsilonassociates.com
Calculated:
3/15/2023 9:45 PM/3.6.361

SHADOW - Calendar

Calculation: Points and Grid Shadow receptor: L15 - Shadow Receptor: 1.0 x 1.0 Azimuth: 0.0° Slope: 90.0° (4549)

Assumptions for shadow calculations

Sunshine probability S/S0 (Sun hours/Possible sun hours) []

Reference year for calendar

2023

Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
0.52 0.54 0.59 0.57 0.60 0.64 0.74 0.71 0.63 0.51 0.39 0.39

Operational time

N NNE NE ENE E ESE SE SSE S SSW SW WSW W WNW NW NNW Sum
364 231 235 234 299 398 720 587 362 314 482 477 675 931 686 429 7,424

Table with columns for months (January to December) and rows for days (1 to 31). Each cell contains sun rise/set times and shadow reduction values. Summary rows at the bottom show potential sun hours and various reduction factors.

Table layout: For each day in each month the following matrix apply

Matrix with columns: Day in month, Sun rise (hh:mm), Sun set (hh:mm), Minutes with flicker, First time (hh:mm) with flicker, Last time (hh:mm) with flicker, (WTG causing flicker first time), (WTG causing flicker last time)

SHADOW - Calendar

Calculation: Points and Grid Shadow receptor: L18 - Shadow Receptor: 1.0 x 1.0 Azimuth: 0.0° Slope: 90.0° (4552)

Assumptions for shadow calculations

Sunshine probability S/S0 (Sun hours/Possible sun hours) []

Reference year for calendar

2023

Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
0.52 0.54 0.59 0.57 0.60 0.64 0.74 0.71 0.63 0.51 0.39 0.39

Operational time

N NNE NE ENE E ESE SE SSE S SSW SW WSW W WNW NW NNW Sum
364 231 235 234 299 398 720 587 362 314 482 477 675 931 686 429 7,424

Table with columns for months (January to December) and rows for each day of the month, showing sun rise and set times, and a summary row for potential sun hours and reductions.

Table layout: For each day in each month the following matrix apply

Matrix with columns: Day in month, Sun rise (hh:mm), Sun set (hh:mm), Minutes with flicker, First time (hh:mm) with flicker, Last time (hh:mm) with flicker, (WTG causing flicker first time), (WTG causing flicker last time)

SHADOW - Calendar

Calculation: Points and Grid Shadow receptor: L19 - Shadow Receptor: 1.0 x 1.0 Azimuth: 0.0° Slope: 90.0° (4553)

Assumptions for shadow calculations

Sunshine probability S/S0 (Sun hours/Possible sun hours) []

Reference year for calendar

2023

Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
0.52 0.54 0.59 0.57 0.60 0.64 0.74 0.71 0.63 0.51 0.39 0.39

Operational time

N NNE NE ENE E ESE SE SSE S SSW SW WSW W WNW NW NNW Sum
364 231 235 234 299 398 720 587 362 314 482 477 675 931 686 429 7,424

Table with columns for months (January to December) and rows for days (1 to 31). Each cell contains a time range (e.g., 08:17-16:49) and a numerical value in parentheses (e.g., 16, 28, 27). Summary rows at the bottom show 'Potential sun hours', 'Total, worst case', and 'Total, real' for each month.

Table layout: For each day in each month the following matrix apply

Matrix with columns: Day in month, Sun rise (hh:mm), Sun set (hh:mm), Minutes with flicker, First time (hh:mm) with flicker, Last time (hh:mm) with flicker, (WTG causing flicker first time), (WTG causing flicker last time)

SHADOW - Calendar

Calculation: Points and Grid Shadow receptor: L20 - Shadow Receptor: 1.0 x 1.0 Azimuth: 0.0° Slope: 90.0° (4554)

Assumptions for shadow calculations

Sunshine probability S/S0 (Sun hours/Possible sun hours) []

Reference year for calendar

2023

Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
0.52 0.54 0.59 0.57 0.60 0.64 0.74 0.71 0.63 0.51 0.39 0.39

Operational time

N NNE NE ENE E ESE SE SSE S SSW SW WSW W WNW NW NNW Sum
364 231 235 234 299 398 720 587 362 314 482 477 675 931 686 429 7,424

	January	February	March	April	May	June
1	08:17 16:49	14:32 (28) 16:22 (9)	07:58 17:30	08:28 (19) 16:44 (9)	07:13 18:11	08:30 (19) 19:56
2	08:17 16:50	14:34 (28) 16:23 (9)	07:56 17:31	08:25 (19) 16:43 (9)	07:11 18:13	07:10 19:58
3	08:17 16:51	14:35 (28) 16:23 (9)	07:55 17:33	08:24 (19) 16:43 (9)	07:09 18:14	07:08 19:59
4	08:17 16:52	14:37 (28) 16:24 (9)	07:54 17:34	08:23 (19) 16:42 (9)	07:07 18:16	07:31 (6) 20:00
5	08:17 16:53	14:40 (28) 16:25 (9)	07:53 17:36	08:21 (19) 16:40 (9)	07:05 18:17	07:29 (6) 20:02
6	08:17 16:54	16:09 (9) 16:27 (9)	07:51 17:37	08:21 (19) 16:38 (9)	07:04 18:19	07:27 (6) 20:03
7	08:17 16:55	16:09 (9) 16:28 (9)	07:50 17:39	08:20 (19) 16:34 (9)	07:02 18:20	07:25 (6) 20:05
8	08:17 16:56	16:09 (9) 16:29 (9)	07:48 17:41	08:20 (19) 08:56 (19)	07:00 18:22	07:23 (6) 20:06
9	08:16 16:57	16:09 (9) 16:30 (9)	07:47 17:42	08:18 (19) 08:56 (19)	06:58 18:23	07:21 (6) 20:07
10	08:16 16:58	16:08 (9) 16:31 (9)	07:45 17:44	08:19 (19) 08:58 (19)	06:56 18:25	07:20 (6) 20:09
11	08:16 17:00	16:09 (9) 16:33 (9)	07:44 17:45	08:18 (19) 08:58 (19)	06:54 18:26	07:20 (6) 20:10
12	08:15 17:01	16:08 (9) 16:34 (9)	07:42 17:47	08:17 (19) 08:58 (19)	07:52 18:28	08:21 (6) 20:12
13	08:15 17:02	16:09 (9) 16:36 (9)	07:41 17:48	08:17 (19) 08:59 (19)	07:50 19:29	08:22 (6) 20:13
14	08:14 17:04	16:08 (9) 16:37 (9)	07:39 17:50	08:17 (19) 08:58 (19)	07:48 19:31	08:24 (6) 20:14
15	08:14 17:05	16:08 (9) 16:38 (9)	07:38 17:52	08:16 (19) 08:58 (19)	07:46 19:32	08:09 (17) 20:16
16	08:13 17:06	16:09 (9) 16:40 (9)	07:36 17:53	08:17 (19) 08:59 (19)	07:44 19:34	08:07 (17) 20:17
17	08:12 17:08	16:09 (9) 16:41 (9)	07:34 17:55	08:17 (19) 08:58 (19)	07:42 19:35	08:05 (17) 20:19
18	08:12 17:09	16:09 (9) 16:42 (9)	07:33 17:56	08:17 (19) 08:58 (19)	07:40 19:36	08:12 (17) 20:19
19	08:11 17:10	16:09 (9) 16:43 (9)	07:31 17:58	08:17 (19) 08:57 (19)	07:38 19:38	08:01 (17) 20:21
20	08:10 17:12	16:09 (9) 16:44 (9)	07:29 17:59	08:18 (19) 08:57 (19)	07:36 19:39	08:00 (17) 20:23
21	08:09 17:13	16:09 (9) 16:44 (9)	07:27 18:01	08:18 (19) 08:56 (19)	07:34 19:41	08:02 (17) 20:24
22	08:08 17:15	16:09 (9) 16:44 (9)	07:26 18:01	08:19 (19) 08:55 (19)	07:32 19:42	06:31 20:26
23	08:07 17:16	16:09 (9) 16:45 (9)	07:24 18:02	08:19 (19) 08:54 (19)	07:30 19:44	06:30 20:27
24	08:07 17:18	16:10 (9) 16:45 (9)	07:22 18:04	08:20 (19) 08:53 (19)	07:28 19:45	06:28 20:28
25	08:06 17:19	16:10 (9) 16:45 (9)	07:20 18:05	08:22 (19) 08:52 (19)	07:26 19:46	06:26 20:30
26	08:05 17:21	16:10 (9) 16:45 (9)	07:19 18:07	08:23 (19) 08:50 (19)	07:24 19:48	06:24 20:31
27	08:03 17:22	16:11 (9) 16:45 (9)	07:17 18:08	08:25 (19) 08:48 (19)	07:22 19:49	06:23 20:33
28	08:02 17:24	16:12 (9) 16:46 (9)	07:15 18:10	08:27 (19) 08:45 (19)	07:20 19:51	06:21 20:34
29	08:01 17:25	16:13 (9) 16:46 (9)			07:18 19:52	06:19 20:35
30	08:00 17:27	16:13 (9) 16:45 (9)			07:16 19:53	06:18 20:37
31	07:59 17:28	08:30 (19) 16:45 (9)			07:14 19:55	05:39 21:16
Potential sun hours	277	286	367	406	466	476
Total, worst case	933	1107	1491	1698	2001	2052
Sun reduction	0.52	0.54	0.59	0.57	0.60	0.64
Oper. time red.	0.85	0.85	0.85	0.85	0.85	0.85
Wind dir. red.	0.59	0.70	0.71	0.71	0.71	0.71
Total reduction	0.26	0.32	0.35	0.35	0.35	0.35
Total, real	240	352	470	500	580	590

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	Sun set (hh:mm)	Minutes with flicker	First time (hh:mm) with flicker	Last time (hh:mm) with flicker	(WTG causing flicker first time)	(WTG causing flicker last time)
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SHADOW - Calendar

Calculation: Points and Grid Shadow receptor: L20 - Shadow Receptor: 1.0 x 1.0 Azimuth: 0.0° Slope: 90.0° (4554)

Assumptions for shadow calculations

Reference year for calendar

2023

Sunshine probability S/S0 (Sun hours/Possible sun hours) []

Table with 12 columns (Jan-Dec) and 1 row of values: 0.52 0.54 0.59 0.57 0.60 0.64 0.74 0.71 0.63 0.51 0.39 0.39

Operational time

Table with 16 columns (N to Sum) and 1 row of values: 364 231 235 234 299 398 720 587 362 314 482 477 675 931 686 429 7,424

Main shadow calculation table with columns for months (July-December) and rows for each day of the month, including sunrise/sunset times and reduction percentages.

Table layout: For each day in each month the following matrix apply

Matrix defining day in month, sun rise/set, first/last time with flicker, and WTG causing flicker first/last time.

SHADOW - Calendar

Calculation: Points and Grid Shadow receptor: L21 - Shadow Receptor: 1.0 x 1.0 Azimuth: 0.0° Slope: 90.0° (4555)

Assumptions for shadow calculations

Sunshine probability S/S0 (Sun hours/Possible sun hours) []

Reference year for calendar

2023

Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
0.52 0.54 0.59 0.57 0.60 0.64 0.74 0.71 0.63 0.51 0.39 0.39

Operational time

N NNE NE ESE SE SSE S SSW SW WSW W WNW NW NNW Sum
364 231 235 234 299 398 720 587 362 314 482 477 675 931 686 429 7,424

Table with columns for months (January to December) and rows for each day of the year (1-31), showing sunrise and sunset times in (hh:mm) format. Includes summary rows for 'Potential sun hours', 'Total, worst case', and 'Total, real'.

Table layout: For each day in each month the following matrix apply

Matrix with columns: Day in month, Sun rise (hh:mm), Sun set (hh:mm), First time (hh:mm) with flicker, Last time (hh:mm) with flicker, (WTG causing flicker first time), (WTG causing flicker last time)

SHADOW - Calendar

Calculation: Points and Grid Shadow receptor: L30 - Shadow Receptor: 1.0 x 1.0 Azimuth: 0.0° Slope: 90.0° (4564)

Assumptions for shadow calculations

Sunshine probability S/S0 (Sun hours/Possible sun hours) []

Reference year for calendar

2023

Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
0.52 0.54 0.59 0.57 0.60 0.64 0.74 0.71 0.63 0.51 0.39 0.39

Operational time

N NNE NE E ESE SE SSE S SSW SW WSW W WNW NW NNW Sum
364 231 235 234 299 398 720 587 362 314 482 477 675 931 686 429 7,424

Calendar grid showing shadow data for each day of the year 2023. Columns represent months from January to December. Rows represent days of the month. Each cell contains a time range (e.g., 08:17-16:49) and a shadow reduction value (e.g., 0.52). A summary table at the bottom provides totals for sun hours, reduction, and real time.

Table layout: For each day in each month the following matrix apply

Matrix with 4 columns: Day in month, Sun rise (hh:mm) / Sun set (hh:mm), First time (hh:mm) with flicker / Last time (hh:mm) with flicker, (WTG causing flicker first time) / (WTG causing flicker last time)

Project:

6882 Otter Tail Luverne Wind

Licensed user:

Epsilon Associates, Inc
3 Clock Tower Place, Suite 250
US-MAYNARD MA 01754
978 897 7100
Richard Lampeter / rlampeter@epsilonassociates.com
Calculated:
3/15/2023 9:45 PM/3.6.361

SHADOW - Calendar

Calculation: Points and Grid Shadow receptor: L31 - Shadow Receptor: 1.0 x 1.0 Azimuth: 0.0° Slope: 90.0° (4565)

Assumptions for shadow calculations

Sunshine probability S/S0 (Sun hours/Possible sun hours) []

Reference year for calendar

2023

Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
0.52 0.54 0.59 0.57 0.60 0.64 0.74 0.71 0.63 0.51 0.39 0.39

Operational time

N NNE NE E ESE SE SSE S SSW SW WSW W WNW NW NNW Sum
364 231 235 234 299 398 720 587 362 623 482 477 675 931 686 429 7,424

Table with columns for months (January to December) and rows for each day of the year (1 to 364). Columns include start and end times for shadow and sunshine probability. Summary rows at the bottom show total sun hours, worst case, and reduction percentages.

Table layout: For each day in each month the following matrix apply

Matrix with columns: Day in month, Sun rise (hh:mm), Sun set (hh:mm), Minutes with flicker, First time (hh:mm) with flicker, Last time (hh:mm) with flicker, (WTG causing flicker first time), (WTG causing flicker last time)



Project:

6882 Otter Tail Luverne Wind

Licensed user:

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US-MAYNARD MA 01754
978 897 7100
Richard Lampeter / rlampeter@epsilonassociates.com
Calculated:
3/15/2023 9:45 PM/3.6.361

SHADOW - Calendar

Calculation: Points and Grid Shadow receptor: L32 - Shadow Receptor: 1.0 x 1.0 Azimuth: 0.0° Slope: 90.0° (4566)

Assumptions for shadow calculations

Sunshine probability S/S0 (Sun hours/Possible sun hours) []

Reference year for calendar

2023

Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
0.52 0.54 0.59 0.57 0.60 0.64 0.74 0.71 0.63 0.51 0.39 0.39

Operational time

N NNE NE ENE E ESE SE SSE S SSW SW WSW W WNW NW NNW Sum
364 231 235 234 299 398 720 587 362 314 482 477 675 931 931 931 7,424

Table with columns for months (January to December) and rows for each day of the month, showing sunrise and sunset times, shadow reduction percentages, and operational time. Includes a summary row at the bottom for 'Total, real'.

Table layout: For each day in each month the following matrix apply

Matrix with columns: Day in month, Sun rise (hh:mm), Sun set (hh:mm), Minutes with flicker, First time (hh:mm) with flicker, Last time (hh:mm) with flicker, (WTG causing flicker first time), (WTG causing flicker last time)

SHADOW - Calendar

Calculation: Points and Grid Shadow receptor: L36 - Shadow Receptor: 1.0 x 1.0 Azimuth: 0.0° Slope: 90.0° (4570)

Assumptions for shadow calculations

Sunshine probability S/S0 (Sun hours/Possible sun hours) []

Reference year for calendar

2023

Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
0.52 0.54 0.59 0.57 0.60 0.64 0.74 0.71 0.63 0.51 0.39 0.39

Operational time

N NNE NE ENE E ESE SE SSE S SSW SW WSW W WNW NW NNW Sum
364 231 235 234 299 398 720 587 362 314 482 477 675 931 686 429 7,424

Table with columns for months (January to December) and rows for each day of the year (1-31). Columns include start and end times and a 'Sum' column. Summary rows at the bottom show 'Potential sun hours', 'Total, worst case', and various reduction factors.

Table layout: For each day in each month the following matrix apply

Matrix with 4 columns: Day in month, Sun rise (hh:mm), Sun set (hh:mm), Minutes with flicker, First time (hh:mm) with flicker, Last time (hh:mm) with flicker, (WTG causing flicker first time), (WTG causing flicker last time)

SHADOW - Calendar

Calculation: Points and Grid Shadow receptor: L37 - Shadow Receptor: 1.0 x 1.0 Azimuth: 0.0° Slope: 90.0° (4571)

Assumptions for shadow calculations

Reference year for calendar

2023

Sunshine probability S/S0 (Sun hours/Possible sun hours) []

Table with 12 columns (Jan-Dec) and 1 row of sunshine probability values: 0.52, 0.54, 0.59, 0.57, 0.60, 0.64, 0.74, 0.71, 0.63, 0.51, 0.39, 0.39

Operational time

Table with 16 columns (N to Sum) and 1 row of operational time values: 364, 231, 235, 234, 299, 398, 720, 587, 362, 314, 482, 477, 675, 931, 686, 429, 7,424

Main shadow calculation table with columns for months (January-June) and rows for each day (1-31) showing sun rise/set times, potential sun hours, and various reduction factors.

Table layout: For each day in each month the following matrix apply

Matrix table with 5 columns: Day in month, Sun rise (hh:mm), Sun set (hh:mm), Minutes with flicker, First time (hh:mm) with flicker, Last time (hh:mm) with flicker, (WTG causing flicker first time), (WTG causing flicker last time)

SHADOW - Calendar

Calculation: Points and Grid Shadow receptor: L37 - Shadow Receptor: 1.0 x 1.0 Azimuth: 0.0° Slope: 90.0° (4571)

Assumptions for shadow calculations

Sunshine probability S/S0 (Sun hours/Possible sun hours) []

Reference year for calendar

2023

Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
0.52 0.54 0.59 0.57 0.60 0.64 0.74 0.71 0.63 0.51 0.39 0.39

Operational time

N NNE NE ENE E ESE SE SSE S SSW SW WSW W WNW NW NNW Sum
364 231 235 234 299 398 720 587 362 314 482 477 675 931 686 429 7,424

Table with columns for months (July, August, September, October, November, December) and rows for each day of the month, showing sun rise/set times and shadow reduction factors.

Table layout: For each day in each month the following matrix apply

Matrix with columns: Day in month, Sun rise (hh:mm), Sun set (hh:mm), Minutes with flicker, First time (hh:mm) with flicker, Last time (hh:mm) with flicker, (WTG causing flicker first time), (WTG causing flicker last time)

SHADOW - Calendar

Calculation: Points and Grid Shadow receptor: L38 - Shadow Receptor: 1.0 x 1.0 Azimuth: 0.0° Slope: 90.0° (4572)

Assumptions for shadow calculations

Reference year for calendar

2023

Sunshine probability S/S0 (Sun hours/Possible sun hours) []

Table with 12 columns (Jan-Dec) and 1 row of values: 0.52, 0.54, 0.59, 0.57, 0.60, 0.64, 0.74, 0.71, 0.63, 0.51, 0.39, 0.39

Operational time

Table with 16 columns (N to Sum) and 1 row of values: 364, 231, 235, 234, 299, 398, 720, 587, 362, 314, 482, 477, 675, 931, 686, 429, 7,424

Main shadow calculation table with columns for months (January to June) and rows for each day of the month, including sun rise/set times and reduction factors.

Table layout: For each day in each month the following matrix apply

Matrix defining columns: Day in month, Sun rise (hh:mm), Sun set (hh:mm), Minutes with flicker, First time (hh:mm) with flicker, Last time (hh:mm) with flicker, (WTG causing flicker first time), (WTG causing flicker last time)

Project:

6882 Otter Tail Luverne Wind

Licensed user:

Epsilon Associates, Inc
3 Clock Tower Place, Suite 250
US-MAYNARD MA 01754
978 897 7100
Richard Lampeter / rlampeter@epsilonassociates.com
Calculated:
3/15/2023 9:45 PM/3.6.361

SHADOW - Calendar

Calculation: Points and Grid Shadow receptor: L38 - Shadow Receptor: 1.0 x 1.0 Azimuth: 0.0° Slope: 90.0° (4572)

Assumptions for shadow calculations

Sunshine probability S/S0 (Sun hours/Possible sun hours) []

Reference year for calendar

2023

Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
0.52 0.54 0.59 0.57 0.60 0.64 0.74 0.71 0.63 0.51 0.39 0.39

Operational time

N NNE NE ENE E ESE SE SSE S SSW SW WSW W WNW NW NNW Sum
364 231 235 234 299 398 720 587 362 314 482 477 675 931 686 429 7,424

Table with columns for months (July to December) and rows for each day of the month, showing sun rise/set times and shadow reduction metrics.

Table layout: For each day in each month the following matrix apply

Day in month Sun rise (hh:mm) Sun set (hh:mm) Minutes with flicker First time (hh:mm) with flicker Last time (hh:mm) with flicker (WTG causing flicker first time) (WTG causing flicker last time)

Project:

6882 Otter Tail Luverne Wind

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Richard Lampeter / rlampeter@epsilonassociates.com
Calculated:
3/15/2023 9:45 PM/3.6.361

SHADOW - Calendar

Calculation: Points and Grid Shadow receptor: L39 - Shadow Receptor: 1.0 x 1.0 Azimuth: 0.0° Slope: 90.0° (4573)

Assumptions for shadow calculations

Reference year for calendar

2023

Sunshine probability S/S0 (Sun hours/Possible sun hours) []

Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
0.52 0.54 0.59 0.57 0.60 0.64 0.74 0.71 0.63 0.51 0.39 0.39

Operational time

N NNE NE ENE E ESE SE SSE S SSW SW WSW W WNW NW NNW Sum
364 231 235 234 299 398 720 587 324 482 477 675 931 686 429 7,424

Table with columns for months (January to December) and rows for days (1 to 31). Each cell contains sun rise and set times (hh:mm) and potential sun hours. Summary rows at the bottom show total sun hours and various reduction factors.

Table layout: For each day in each month the following matrix apply

Day in month Sun rise (hh:mm) Sun set (hh:mm) Minutes with flicker First time (hh:mm) with flicker Last time (hh:mm) with flicker (WTG causing flicker first time) (WTG causing flicker last time)

Appendix C – FAA Filings

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**Otter Tail Power Company Luverne Upgrade Project
Federal Aviation Administration (FAA) Filings**

Turbine Number	Structure Name	Latitude	Longitude	ASN	Prior ASN	OE Status
154	LUV-1	47.336111	97.933472	2023-WTE-955-OE	2009-WTE-3170-OE	Work In Progress
153	LUV-2	47.336667	97.937386	2023-WTE-956-OE	2009-WTE-3171-OE	Work In Progress
152	LUV-3	47.336506	97.941117	2023-WTE-957-OE	2009-WTE-3172-OE	Work In Progress
151	LUV-4	47.334461	97.946681	2023-WTE-958-OE	2009-WTE-3173-OE	Work In Progress
150	LUV-5	47.334478	97.951236	2023-WTE-959-OE	2009-WTE-3174-OE	Work In Progress
149	LUV-6	47.334697	97.955342	2023-WTE-960-OE	2009-WTE-3175-OE	Work In Progress
148	LUV-7	47.336983	97.959394	2023-WTE-961-OE	2009-WTE-3176-OE	Work In Progress
147	LUV-8	47.337158	97.964717	2023-WTE-962-OE	2009-WTE-3177-OE	Work In Progress
157	LUV-9	47.328172	97.961142	2023-WTE-963-OE	2009-WTE-3178-OE	Work In Progress
155	LUV-10	47.331211	97.970600	2023-WTE-964-OE	2009-WTE-3179-OE	Work In Progress
156	LUV-11	47.327867	97.970647	2023-WTE-965-OE	2009-WTE-3180-OE	Work In Progress
164	LUV-12	47.331192	97.892775	2023-WTE-966-OE	2009-WTE-3181-OE	Work In Progress
163	LUV-13	47.331389	97.898561	2023-WTE-967-OE	2009-WTE-3182-OE	Work In Progress
158	LUV-14	47.338683	97.897469	2023-WTE-968-OE	2009-WTE-3183-OE	Work In Progress
139	LUV-15	47.349500	97.918656	2023-WTE-969-OE	2009-WTE-3184-OE	Work In Progress
138	LUV-16	47.351172	97.925347	2023-WTE-970-OE	2009-WTE-3185-OE	Work In Progress
137	LUV-17	47.352908	97.929775	2023-WTE-971-OE	2009-WTE-3186-OE	Work In Progress
136	LUV-18	47.352200	97.937375	2023-WTE-972-OE	2009-WTE-3187-OE	Work In Progress
135	LUV-19	47.352147	97.947139	2023-WTE-973-OE	2009-WTE-3188-OE	Work In Progress
134	LUV-20	47.350483	97.950919	2023-WTE-974-OE	2009-WTE-3189-OE	Work In Progress
133	LUV-21	47.350825	97.956303	2023-WTE-975-OE	2009-WTE-3190-OE	Work In Progress
132	LUV-22	47.350825	97.960422	2023-WTE-976-OE	2009-WTE-3191-OE	Work In Progress
162	LUV-23	47.331383	97.905619	2023-WTE-977-OE	2009-WTE-3192-OE	Work In Progress
161	LUV-24	47.329672	97.909372	2023-WTE-978-OE	2009-WTE-3193-OE	Work In Progress
160	LUV-25	47.328633	97.914556	2023-WTE-979-OE	2009-WTE-3194-OE	Work In Progress
159	LUV-26	47.328728	97.919597	2023-WTE-980-OE	2009-WTE-3195-OE	Work In Progress
141	LUV-27	47.357117	97.912325	2023-WTE-981-OE	2009-WTE-3196-OE	Work In Progress
140	LUV-28	47.360283	97.915708	2023-WTE-982-OE	2009-WTE-3197-OE	Work In Progress
142	LUV-29	47.359072	97.904317	2023-WTE-983-OE	2009-WTE-3198-OE	Work In Progress
143	LUV-30	47.359569	97.897367	2023-WTE-984-OE	2009-WTE-3199-OE	Work In Progress
144	LUV-31	47.362306	97.892797	2023-WTE-985-OE	2009-WTE-3200-OE	Work In Progress
145	LUV-32	47.364086	97.888511	2023-WTE-986-OE	2009-WTE-3201-OE	Work In Progress
146	LUV-33	47.367539	97.885797	2023-WTE-987-OE	2009-WTE-3202-OE	Work In Progress

Appendix D – Microwave Beam Path Study

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Wind Power GeoPlanner™

Microwave Study

Luverne



Prepared on Behalf of
Atwell, LLC

March 22, 2023



COMSEARCH
A CommScope Company

Table of Contents

1. Introduction	- 1 -
2. Project Overview	- 1 -
3. Microwave Study Result	- 2 -
4. Contact	- 3 -
Appendix: Turbine Locations	- 4 -

1. Introduction

Microwave bands that may be affected by the installation of wind turbine facilities operate over a wide frequency range (900 MHz – 23 GHz). Comsearch has developed and maintains comprehensive technical databases containing information on licensed microwave networks throughout the United States. These systems are the telecommunication backbone of the country, providing long-distance and local telephone service, backhaul for cellular and personal communication service, data interconnects for mainframe computers and the Internet, network controls for utilities and railroads, and various video services. This report focuses on the potential impact of wind turbines on licensed, proposed and applied non-federal government microwave systems.

2. Project Overview

Project Information

Name: Luverne

County: Griggs & Steele

State: North Dakota

Number of Turbines: 33

Blade Diameter: 97 meters

Hub Height: 80 meters

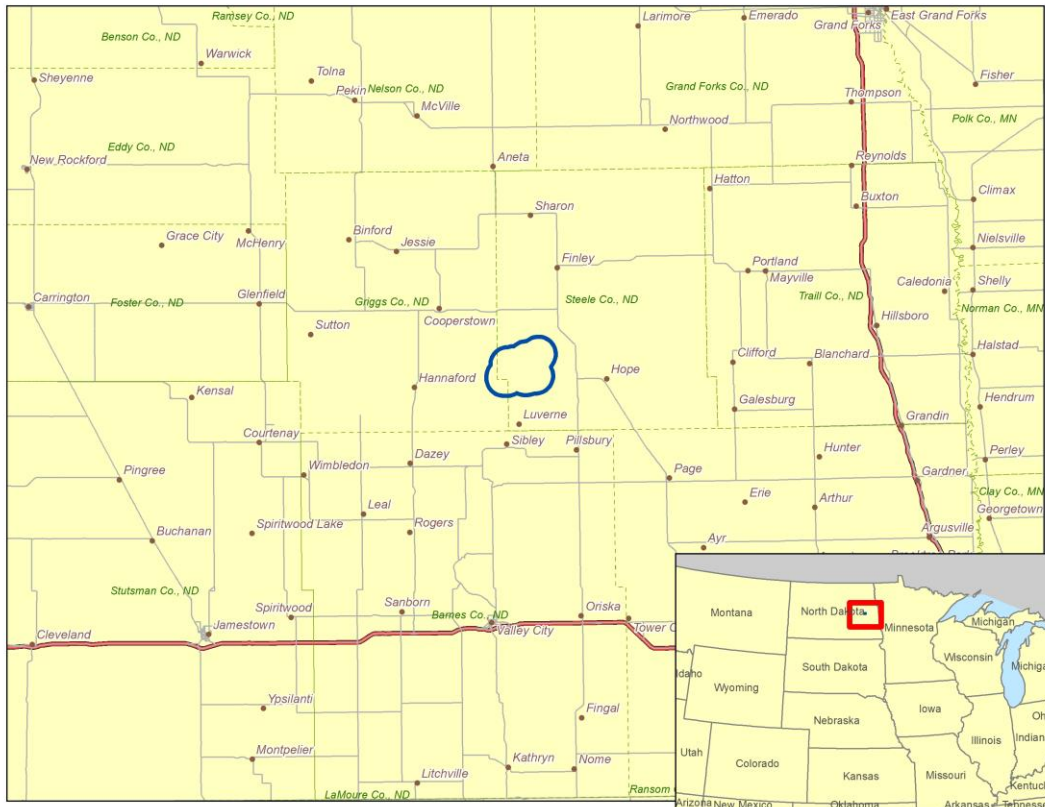


Figure 1: Area of Interest

3. Microwave Study Result

Methodology

Our obstruction analysis was performed using Comsearch’s proprietary microwave database, which contains all non-government licensed, proposed and applied paths from 0.9 - 23 GHz¹. We determined all microwave paths that intersect the area of interest². The area of interest encompasses the planned turbine locations. In this case, Comsearch identified no microwave paths that intersect the project area³.

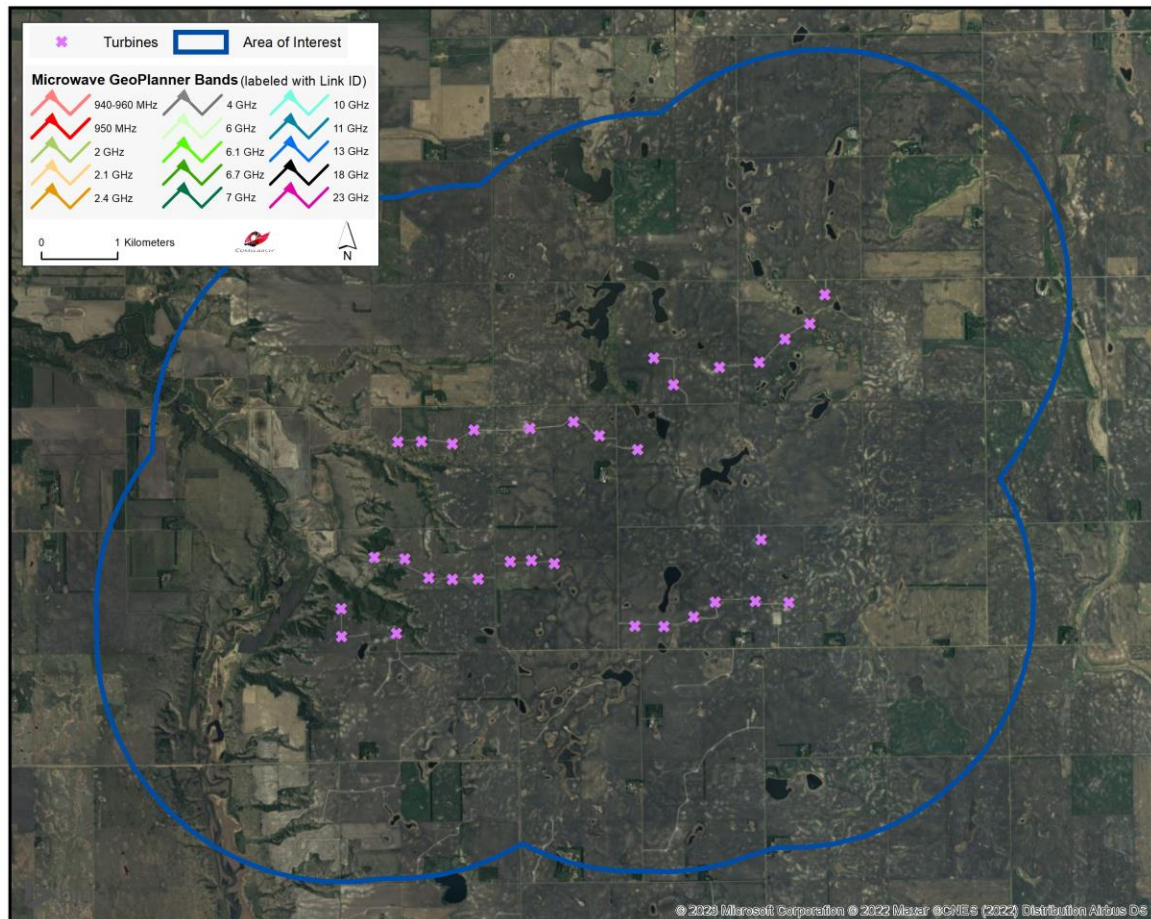


Figure 2: Microwave Paths that Intersect the Area of Interest

¹ Please note that this analysis does not include unlicensed microwave paths or federal government paths that are not registered with the FCC.

² We use FCC-licensed coordinates to determine which paths intersect the area of interest. It is possible that as-built coordinates may differ slightly from those on the FCC license.

³ Comsearch makes no warranty as to the accuracy of the data included in this report beyond the date of the report. The data provided in this report is governed by Comsearch’s data license notification and agreement located at http://www.comsearch.com/files/data_license.pdf.

Discussion of Potential Obstructions

Total Microwave Paths	Paths with Affected Fresnel Zones	Total Turbines	Turbines Obstructions
0	0	33	0

For this project, 33 turbines were considered in the analysis, each with a blade diameter of 97 meters and turbine hub height of 80 meters. Since there were no microwave paths in the area of interest, none of the proposed turbines will cause obstructions.

4. Contact

For questions or information regarding the Microwave Study, please contact:

Contact person: David Meyer
 Title: Senior Manager
 Company: Comsearch
 Address: 21515 Ridgetop Circle, Suite 300, Sterling, VA 20166
 Telephone: 703-726-5656
 Fax: 703-726-5595
 Email: David.Meyer@CommScope.com
 Web site: www.comsearch.com

Appendix: Turbine Locations

Case ID	FAA ASN	Latitude	Longitude
3030635	2009-WTE-3194-OE	47.328590	-97.914589
3030641	2009-WTE-3200-OE	47.362293	-97.892792
3030638	2009-WTE-3197-OE	47.360291	-97.915688
3030637	2009-WTE-3196-OE	47.357094	-97.912292
3030615	2009-WTE-3174-OE	47.334492	-97.951195
3030628	2009-WTE-3187-OE	47.352192	-97.937393
3030642	2009-WTE-3201-OE	47.364094	-97.888489
3030611	2009-WTE-3170-OE	47.336193	-97.933495
3030632	2009-WTE-3191-OE	47.350792	-97.960388
3030639	2009-WTE-3198-OE	47.359093	-97.904289
3030633	2009-WTE-3192-OE	47.331390	-97.905594
3030619	2009-WTE-3178-OE	47.328194	-97.961090
3030636	2009-WTE-3195-OE	47.328693	-97.919594
3030618	2009-WTE-3177-OE	47.337193	-97.964691
3030614	2009-WTE-3173-OE	47.334492	-97.946693
3030626	2009-WTE-3185-OE	47.351192	-97.925293
3030627	2009-WTE-3186-OE	47.352894	-97.929794
3030634	2009-WTE-3193-OE	47.329693	-97.909393
3030629	2009-WTE-3188-OE	47.352093	-97.947090
3030623	2009-WTE-3182-OE	47.331390	-97.898590
3030613	2009-WTE-3172-OE	47.336491	-97.941093
3030625	2009-WTE-3184-OE	47.349491	-97.918694
3030617	2009-WTE-3176-OE	47.336990	-97.959389
3030620	2009-WTE-3179-OE	47.331192	-97.970589
3030612	2009-WTE-3171-OE	47.336594	-97.937393
3030616	2009-WTE-3175-OE	47.334690	-97.955292
3030643	2009-WTE-3202-OE	47.367493	-97.885788
3030631	2009-WTE-3190-OE	47.350792	-97.956291
3030624	2009-WTE-3183-OE	47.338692	-97.897491
3030630	2009-WTE-3189-OE	47.350491	-97.950890
3030621	2009-WTE-3180-OE	47.327892	-97.970589
3030640	2009-WTE-3199-OE	47.359592	-97.897392
3030622	2009-WTE-3181-OE	47.331192	-97.892792

**Appendix E – Class I Literature Review – Cultural Resource Report
and Unanticipated Discoveries Plan**

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CLASS I LITERATURE REVIEW

LUVERNE WIND UPGRADE PROJECT STEELE COUNTY, NORTH DAKOTA

Prepared for

Otter Tail Power Company
215 S. Cascade Street
Fergus Falls, Minnesota 56537

Atwell Project No. 22007288

Submitted by Atwell, LLC

April 6, 2023

EXECUTIVE SUMMARY

In November of 2022, Atwell, LLC (Atwell) was contracted by Otter Tail Power Company (OTP) to conduct a Class I literature review for the proposed Luverne Wind Upgrade Project (Project) located in Steele County, North Dakota (Figure 1). The Project includes replacing current wind turbine technology with longer blades and new hub and gearbox with turbine generators being refurbished at 33 wind turbine locations. The existing Luverne Wind turbines are GE 1.5 megawatt [MW] turbines with a 82.5-meter rotor diameter and a total height of 398 feet (121.25 meters), and these will be replaced with new wind turbine technology (GE 1.5 MW turbines with 97-meter rotor diameter and a total height of 128.5 meters). The existing 33 turbine locations remain the same and OTP plans to use the existing turbine structural steel towers, turbine foundations, collection/communication systems, permanent access roads, and other associated facilities whose locations will not change.

During installation of the repowering technology, existing access roads and the gravel ring around the turbines may be temporarily widened to accommodate delivery and staging of components and equipment. A temporary laydown yard will be utilized during the Repower Project. The laydown yard and all the areas where temporary access roads and construction easements will occur were previously used during initial project construction. In all cases, the planned temporary construction areas meet exclusion and avoidance area criteria.

Currently, no federal trigger has been identified for this Project; therefore, Section 106 regulations do not apply. Should Section 106 be triggered, methods for archaeological and aboveground architectural investigations should be determined through consultation with the lead federal agency and the State Historical Society of North Dakota (SHSND).

The SHSND files were reviewed and rendered the following information:

- One previously identified archaeological site lead is in the Project Area.
- No previously documented architectural resources are in the Project Area.
- No architectural or archaeological resources listed on the National Register of Historic Places are in the Project Area.

Based on a review of the data presented above in conjunction with the fact that the vast majority of the Project Area has been previously surveyed (99.42%) and disturbed by the original construction of the wind farm, Atwell makes the following recommendations:

- The Project proceed as planned without additional archaeological work prior to construction.

PUBLIC DOCUMENT - NON-PUBLIC DATA HAS BEEN EXCISED

Class I Literature Review

Luverne Wind Upgrade Project, Steele County, North Dakota

April 6, 2023

- An Unanticipated Discovery Plan is attached in Appendix A that establishes procedures and relevant contact information in the event that human remains or archaeological deposits are discovered during the construction, operational, and decommission phases of the Project.
 - If buried archaeological resources are encountered, all activity should cease in the immediate area and within a 100-foot buffer area, and the artifacts should be left in place. The Client's archaeologist should be contacted immediately, and unanticipated discovery procedures should be initiated.
 - If human remains are encountered, construction should stop in the immediate area of discovery and within a 100-foot buffer area, and law enforcement should be notified immediately. Law enforcement officials should determine whether the discovery is a crime scene and whether the remains are prehistoric or historic Native American remains. The SHSND should be contacted immediately if the human remains are determined to be prehistoric or historic in nature and/or Native American remains.

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PUBLIC DOCUMENT - NON-PUBLIC DATA HAS BEEN EXCISED

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1 INTRODUCTION

1.1 BACKGROUND

Atwell, LLC (Atwell) was contracted by Otter Tail Power Company (OTP) to conduct a Class I literature review for the proposed Luverne Wind Upgrade Project (Project) located in Steele County, North Dakota (Figure 1). The Project Area is located on approximately 80 acres of mixed-use agricultural land in the following locations: Township 145 North Range 57 West Sections 22, 23, 27, 28, 29, 31, 32, 33, 34, and 35. These areas are located in Riverside Township.

The Project involves replacing current wind turbine technology with longer blades and new hub and gearbox with turbine generators being refurbished at 33 wind turbine locations. The existing Luverne Wind turbines are GE 1.5 megawatt [MW] turbines with a 82.5-meter rotor diameter and a total height of 121.25 meters, and these will be replaced with new wind turbine technology (GE 1.5 MW turbines with 97-meter rotor diameter and a total height of 128.5 meters). The existing 33 turbine locations remain the same and OTP plans to use the existing turbine structural steel towers, turbine foundations, collection/communication systems, permanent access roads, and other associated facilities whose locations will not change.

During installation of the repowering technology, existing access roads and the gravel ring around the turbines may be temporarily widened to accommodate delivery and staging of components and equipment. A temporary laydown yard will be utilized during the Upgrade Project. The laydown yard and all of the areas where temporary access roads and construction easements will occur were previously used during initial project construction. In all cases, the planned temporary construction areas meet exclusion and avoidance area criteria.

1.2 APPLICABLE REGULATIONS

North Dakota does not have laws that mandate cultural resources surveys for private projects lacking characteristics that would trigger Section 106 of the National Historic Preservation Act of 1966, as amended (54 U.S.C. 306108), and its implementing regulations (36 CFR 800). The exception to this is human remains. Human remains are protected under the North Dakota Century Code 23-06-27 (Protection of Human Burial Sites, Human Remains, and Burial Goods).

Currently, no federal trigger has been identified for this project; therefore, Section 106 regulations do not apply. Should Section 106 be triggered, methods for archaeological pedestrian survey and aboveground architectural survey should be determined through

consultation with the lead federal agency and the State Historical Society of North Dakota (SHSND).

An Unanticipated Discovery Plan is being developed to establish procedures and relevant contact information in the event that human remains or archaeological deposits are discovered during the construction, operational, and decommission phases of the Project.

2 METHODS

In March 2023, staff from Atwell conducted background research at the SHSND for information on previously identified archaeological sites and architectural properties within one mile (1.6 km) of the Project Area and on surveys previously conducted within the Project Area.

3 ENVIRONMENT

The Project Area is located in Steele County, North Dakota, in a primarily rural agricultural area that is sparsely populated and supports a mix of grasslands, cultivated cropland, hayfields, and pasturelands. Agricultural use (cultivated crops, hay, and pasture) is the primary land use within the Project Area. The Project Area is bisected by State Highway 66 and is located predominantly east of State Highway 1. Small farmsteads are in the Project Area as well as small tracts of forested areas, wetlands, and natural stream corridors; however, these natural features are of limited size. Small, isolated woodlots, generally associated with wind breaks for farmsteads, are also scattered within the Project Area. Public roads are generally situated in a grid-like arrangement.

The Project Area is located within the Draft Plains ecoregion of the Northern Glaciated Plains (Bryce et al. 1996). According to the United States Geological Service (USGS) ecoregion mapping data, this ecoregion is characterized by the following:

On the Drift Plains, the retreating Wisconsin glaciers left a subtle undulating topography and a thick mantle of glacial till. A greater proportion of temporary and seasonal wetlands are found on the drift plains than in the coteau areas, where semipermanent wetlands are numerous. Because of the productive soil and level topography, this ecoregion is almost entirely cultivated, with many wetlands drained or simply tilled and planted. However, valuable waterfowl habitat still remains, concentrated in state and federally sponsored duck production areas. The historic grassland on the Drift Plains was a transitional mix of tallgrass and shortgrass prairie. The prairie grasses have been largely replaced by fields of spring wheat, barley, sunflowers, and alfalfa (Bryce et al. 1996).

The surficial geology in the region is relatively flat with little visual relief. The surface soil texture is primarily loam that is well drained (USDA 2022). Within the Project Area, the topography is generally flat, with approximate elevations between 1,450 and 1,600 feet above mean sea level (amsl).

Natural Resource Conservation Service (NRCS) Soil Survey data for Steele County identified 16 different types of soils within the Project Area. These soils vary greatly in texture, natural drainage, slope, and other characteristics. The Project Area is dominated by a variety of loam texture soils (Table 1):

Table 1: Soils throughout Project Area

Soil Type	Hydric	Percent of Project Area
G143B: Barnes-Svea loams, 3 to 6 percent slopes	No	53.09%
G144B: Barnes-Buse loams, 3 to 6 percent slopes	No	23.32%
G143C: Barnes-Buse-Langhei loams, 6 to 9 percent slopes*	Yes	10.99%
G147F: Buse-Barnes-Darnen loams, 9 to 35 percent slopes	No	3.43%
G304A: Binford-Coe complex, 0 to 2 percent slopes	No	2.02%
G101A: Hamerly-Wyard loams, 0 to 3 percent slopes	No	1.58%
G147D: Buse-Barnes-Darnen loams, 6 to 15 percent slopes	No	1.45%
G100A: Hamerly-Tonka complex, 0 to 3 percent slopes*	Yes	1.12%
G147C: Buse-Barnes-Darnen loams, 3 to 9 percent slopes	No	0.64%
G304B: Binford-Coe complex, 2 to 6 percent slopes	No	0.61%
G146B: Barnes-Buse-Parnell complex, 0 to 6 percent slopes	No	0.52%
G304E: Coe-Binford sandy loams, 9 to 25 percent slopes	No	0.43%
G167B: Balaton-Wyard loams, 0 to 6 percent slopes	No	0.41%
G12A: Vallery, saline-Parnell complex, 0 to 1 percent slopes*	Yes	0.20%
G3A: Parnell silty clay loam, 0 to 1 percent slopes	No	0.16%
G143B: Barnes-Svea loams, 3 to 6 percent slopes	No	0.02%

4 LITERATURE SEARCH

4.1 PREVIOUS CULTURAL RESOURCES STUDIES

Research indicated that one archaeological survey has been conducted within the current Project Area (Table 2, Figure 2 Map Set).

Table 2. Previously Conducted Cultural Resources Surveys

Survey Number	Authors	Year	Title	Location
000972	Fox, Richard A. Jr.	1980	1978-1979 Cultural Resource Investigations Along the Middle Sheyenne River Valley Including Lake Ashtabula and A Portion of the Sheyenne River, Vol. 1, Barnes Co., Griggs Co., & Steele Co., ND	Within One Mile
011063	Engel, Damita J., and Kimball M. Banks	2009	North Dakota Forest Service 2009 Living Snow Fence Survey: A Class III Cultural Resource Inventory for Proposed Tree Planting Sites in Adams, Benson, Mercer, Oliver, Steele, & Walsh Counties, ND	Within One Mile
011182	Leuchtman, Amy, and Jennifer L. Harty	2009	Luverne Wind Farm: A Class III Cultural Resource Inventory, Barnes, Griggs and Steele Counties, ND	In Project Area
019154	McCarthy, Melinda M.	2021	Ashtabula II Wind Energy Center: A Class III ADLS Location Negative Survey Report	Within One Mile

In 2009, a Class III cultural resources inventory was conducted by Kadrmas, Lee, and Jackson, Inc., on behalf of M Power National Wind, to document cultural resources within the footprint of the proposed Luverne wind farm in Griggs and Steele Counties, North Dakota (Figure 2 Map Set) (Leuchtman and Harty 2009).

4.2 PREVIOUSLY RECORDED ARCHAEOLOGICAL SITES

One archaeological site, 32STX32, has been previously recorded within the current Project Area (see Figure 2 Map Set; Table 3). This isolated find consisted of one fire-cracked quartzite and one light-brown chalcedony, tertiary flake found in a plowed agricultural field. It was recommended as not eligible for the National Register of Historic Places.

Table 3. Previously Documented Archaeological Resources within the Project Area

Site Number	Description	Status
32STX32	KLJ-LWNTK-01, Prehistoric Lithic Isolate	Not Eligible

Three additional sites have been previously identified within one mile of the Project Area (Figure 2 Map Set; Table 4).

Table 4. Previously Documented Archaeological Resources within One Mile

Site Number	Description	Status
32STX51	MAC-ABRxl, Prehistoric Lithic Isolate	Unevaluated
32STX9	KLJ-IF-01, Prehistoric Lithic Projectile Point	Not Eligible
32ST176	KLJ-JFK-01, Historic Artifact Scatter	Not Eligible

4.3 PREVIOUSLY RECORDED ARCHITECTURAL HISTORY PROPERTIES

No historical architectural properties have been recorded within the Project Area. One historical architectural property has been recorded within one mile of the Project Area. (see Figure 2 map set; Table 5). The property designated, 32ST2, has been recorded as both an archaeological site and a historical architectural property. It consists of a suspension bridge with a house foundation now used as a dump. The 1980 report in which the site was recorded recommend it not eligible for the National Register of Historic Places.

Table 5. Previously Documented Architectural Resources within One Mile

Site Number	Description	Status
32ST2	Suspension Bridge and Historic Dump	Not Eligible

5 CONCLUSIONS AND RECOMMENDATIONS

5.1 CONCLUSIONS

As a result of the literature review, Atwell has reached the following conclusions:

- One previously identified archaeological site lead is in the Project Area.
- No previously documented architectural resources are within the Project Area.
- No architectural or archaeological resources listed on the NRHP are within the Project Area.
- No cemeteries are located within the Project Area.

Currently, no federal trigger has been identified for this project; therefore, Section 106 regulations do not apply. Should Section 106 be triggered, methods for archaeological pedestrian survey and aboveground architectural survey should be determined through consultation with the lead federal agency and the SHSND.

5.2 RECOMMENDATIONS

Based on a review of the data presented above in conjunction with the fact that the vast majority of the Project Area has been previously surveyed (99.42%) and disturbed by the original construction of the wind farm, Atwell makes the following recommendations:

- The Project proceed as planned without additional archaeological work prior to construction.
- An Unanticipated Discovery Plan is attached in Appendix A that establishes procedures and relevant contact information in the event that human remains or archaeological deposits are discovered during the construction, operational, and decommission phases of the Project.
 - If buried archaeological resources are encountered, all activity should cease in the immediate area and within a 100-foot buffer area and the artifacts should be left in place. The Client’s archaeologist should be contacted immediately, and unanticipated discovery procedures should be initiated.
 - If human remains are encountered, construction should stop in the immediate area of discovery and within a 100-foot buffer area, and law enforcement should be notified immediately. Law enforcement officials should determine whether the discovery is a crime scene and whether the remains are prehistoric or historic Native American remains. The SHSND should be contacted immediately if the human remains are determined to be prehistoric or historic in nature and/or Native American remains.

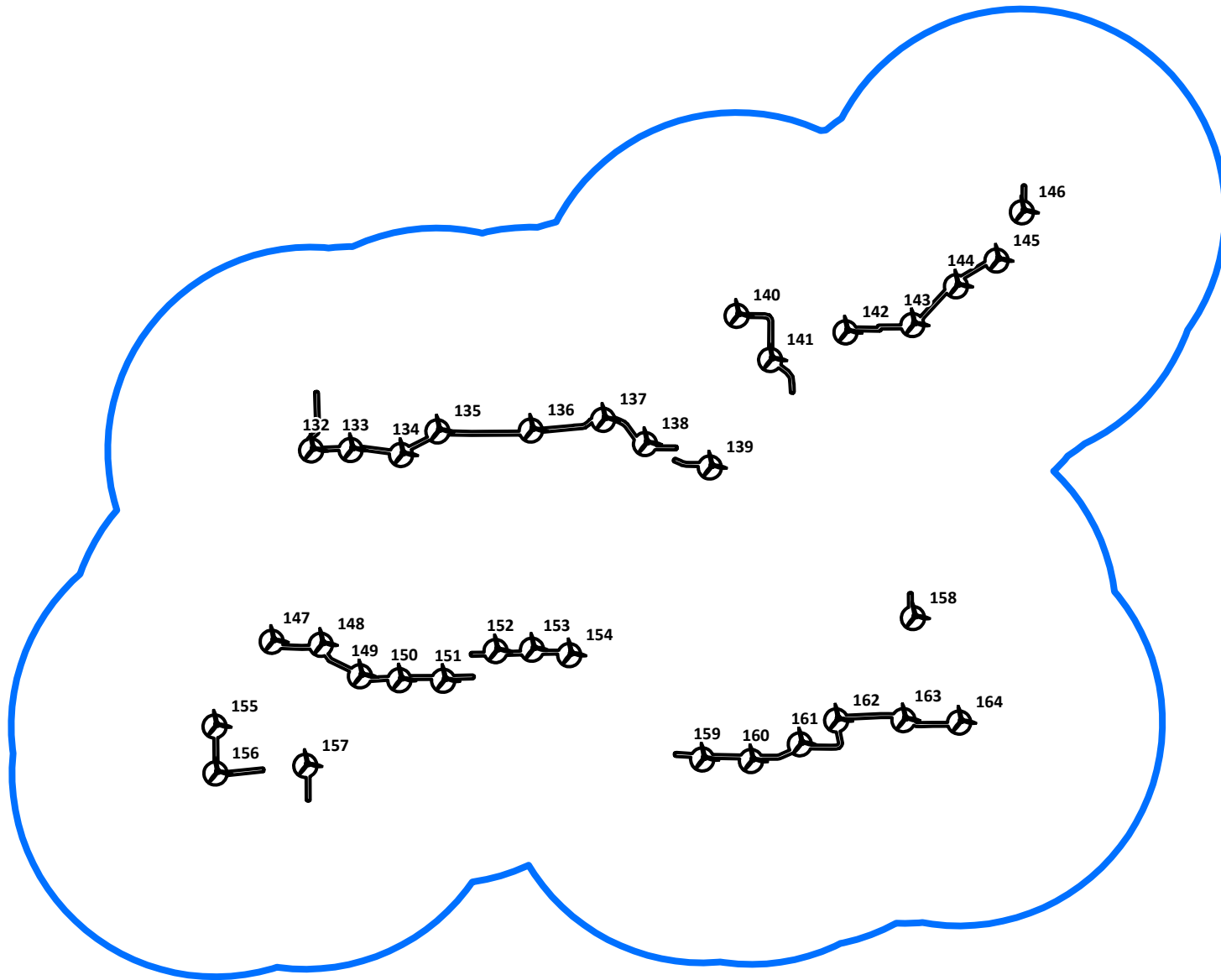
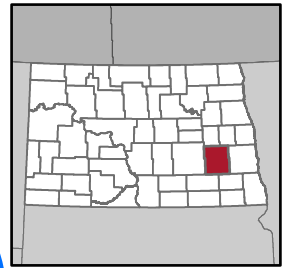
6 REFERENCES

Bryce SA, Omernik JM, Pater DA, Ulmer M, Schaar J, Freeouf J, Johnson P, Kuck P, Azevedo SH. 1996. Ecoregions of North Dakota and South Dakota. Reston, Virginia: U.S. Geological Survey.

Leuchtman A, Harty JL. 2009. Luverne wind farm: a class III cultural resource inventory, Barnes, Griggs and Steele counties, ND.

USDA [U.S. Department of Agriculture]. 2022. Web soil survey. Natural Resources Conservation Service. <https://websoilsurvey.sc.egov.usda.gov/App/HomePage.htm>.




FIGURES



Luverne Wind Upgrade Project

Figure 1 – Site Location












Steele County, North Dakota
Issue Date: 3/7/2023

-  Existing Turbine Locations
-  Study Area
-  1 mile Buffer



SOURCE: USGS Topo Map

**LUVERNE WIND
UPGRADE PROJECT**
**Figure 2 – Known Cultural
Resources Index**
Steele County, North Dakota
Issue Date: 3/7/2023

- | | |
|--|--|
|  Architectural Site (Point) |  Existing Turbine Locations |
|  Archeological Site (Point) |  Existing Access Roads |
|  Architectural Site (Poly) |  Disturbance Area (~80 acres) |
|  Archeological Site (Poly) |  Mapbook Page |
|  Archeological Survey |  Study Area |
| |  1 mile Buffer |



0 1 Miles



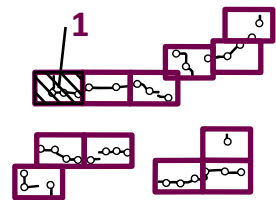
SOURCE: USGS Topo Map

LUVERNE WIND UPGRADE PROJECT

Figure 2 – Known Cultural Resources Index

Steele County, North Dakota
Issue Date: 3/7/2023

- ▲ Architectural Site (Point)
- ▲ Archeological Site (Point)
- Architectural Site (Poly)
- Archeological Site (Poly)
- Archeological Survey
- ✈ Existing Turbine Locations
- Existing Access Roads
- Disturbance Area (~80 acres)
- Study Area
- ▭ Township




SOURCE: Esri World Imagery (2021)

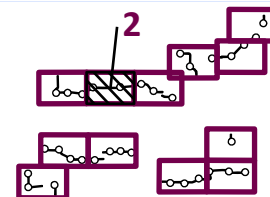
LUVERNE WIND UPGRADE PROJECT

Figure 2 – Known Cultural Resources Index

Steele County, North Dakota
Issue Date: 3/7/2023

- ▲ Architectural Site (Point)
- ▲ Archeological Site (Point)
- Architectural Site (Poly)
- Archeological Site (Poly)
- Archeological Survey
-  Existing Turbine Locations
- Existing Access Roads
- Disturbance Area (~80 acres)
- Study Area
- Township

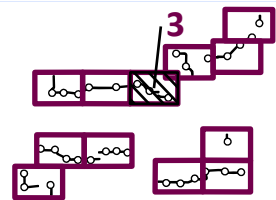
SOURCE: Esri World Imagery (2021)



**Luverne Re-Power
Wind Farm**
**Figure 2 – Known Cultural
Resources Index**
Steele County, North Dakota
Issue Date: 3/7/2023

- ▲ Architectural Site (Point)
- ▲ Archeological Site (Point)
- Architectural Site (Poly)
- Archeological Site (Poly)
- Archeological Survey
- ✈ Existing Turbine Locations
- Existing Access Roads
- Disturbance Area (~80 acres)
- Study Area
- ▭ Township

SOURCE: Esri World Imagery (2021)



The ATWELL logo, consisting of a stylized globe icon and the word "ATWELL" in red capital letters. Below the logo is a scale bar showing a distance of 0.1 miles, with a north arrow icon to the left.

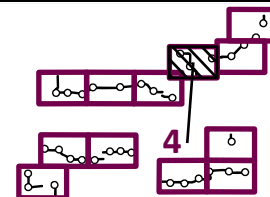
LUVERNE WIND UPGRADE PROJECT

Figure 2 – Known Cultural Resources Index

Steele County, North Dakota
Issue Date: 3/7/2023

- ▲ Architectural Site (Point)
- ▲ Archeological Site (Point)
- Architectural Site (Poly)
- Archeological Site (Poly)
- Archeological Survey
- ✈ Existing Turbine Locations
- Existing Access Roads
- Disturbance Area (~80 acres)
- Study Area
- ▭ Township











SOURCE: Esri World Imagery (2021)



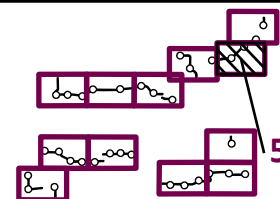
LUVERNE WIND UPGRADE PROJECT

Figure 2 – Known Cultural Resources Index

Steele County, North Dakota
Issue Date: 3/7/2023

-  Architectural Site (Point)
-  Archeological Site (Point)
-  Architectural Site (Poly)
-  Archeological Site (Poly)
-  Archeological Survey
-  Existing Turbine Locations
-  Existing Access Roads
-  Disturbance Area (~80 acres)
-  Study Area
-  Township











SOURCE: Esri World Imagery (2021)



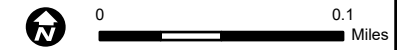
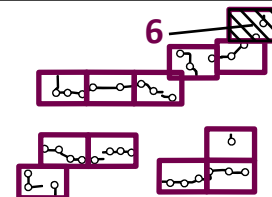
LUVERNE WIND UPGRADE PROJECT

Figure 2 – Known Cultural Resources Index

Steele County, North Dakota
Issue Date: 3/7/2023

-  Architectural Site (Point)
-  Archeological Site (Point)
-  Architectural Site (Poly)
-  Archeological Site (Poly)
-  Archeological Survey
-  Existing Turbine Locations
-  Existing Access Roads
-  Disturbance Area (~80 acres)
-  Study Area
-  Township











SOURCE: Esri World Imagery (2021)

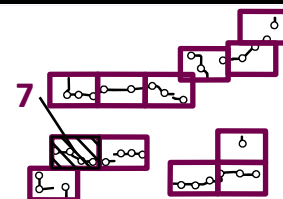


LUVERNE WIND UPGRADE PROJECT

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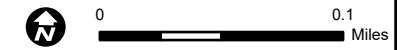
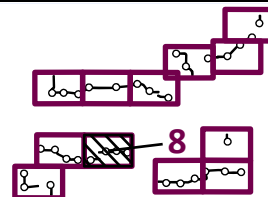
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
SOURCE: Esri World Imagery (2021)



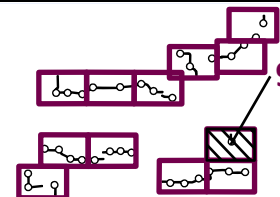
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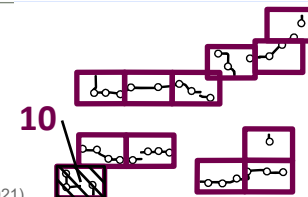


LUVERNE WIND UPGRADE PROJECT

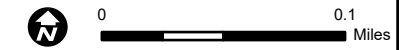
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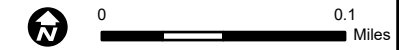
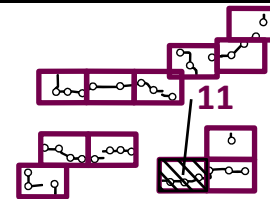
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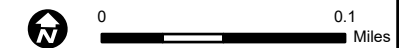
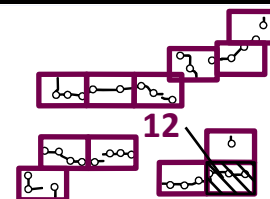
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APPENDIX A
UNANTICIPATED DISCOVERIES PLAN



UNANTICIPATED DISCOVERIES PLAN

LUVERNE WIND UPGRADE PROJECT STEELE COUNTY, NORTH DAKOTA

Prepared for

Otter Tail Power Company
215 S. Cascade Street
Fergus Falls, Minnesota 56537

Atwell Project No. 22007288

Submitted by Atwell, LLC

April 6, 2023

Contents

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Appendix B: Examples of Archaeological Resources

1 Introduction

This Unanticipated Discoveries Plan (UDP) has been developed to lay out specific protocols and procedures to be taken should unanticipated archaeological resources be discovered during construction, operation, or decommission of the proposed Luverne Wind Upgrade Project (Project) located in Steele County, North Dakota. *Unanticipated Discoveries* are previously unknown or unrecorded archaeological resources, including human remains, discovered during Project activities. A series of steps to minimize physical impacts to archaeological resources is outlined in this UDP.

The protocols and procedures in the UDP outline actions to be taken if unanticipated discoveries are encountered during construction, operations, and decommission. The UDP is applicable to ground disturbing work associated with the Project during the construction, operations, and decommissioning phases. It may be revised from time to time to make adjustments in accordance with regulatory changes, approved practices, or expansion into previous non-Project areas.

The UDP includes procedures in accordance with the State Historical Society of North Dakota (SHSND) for compliance with state requirements. In addition, general requirements for meeting the National Historic Preservation Act (NHPA) are included in the UDP.

The objectives of these procedures are to identify and promote avoidance and/or the preservation and recording of any archaeological material discovered. A key component of the UDP is notification of archaeological authorities to resolve any issues that may arise from unanticipated discoveries.

2 Summary of Archaeological Investigations

An archaeological literature review, completed in March of 2023, indicated that one previous archaeological survey had been conducted within the Project Area. The literature review also indicated that one archaeological site lead, 32STX32, has been previously recorded within the current Project Area. No previously recorded architectural resources are located within the Project Area. Previous survey within the site lead boundary, in the vicinity of the Project Area, did not reveal any archaeological deposits.

Based on the literature review in conjunction with the fact that the Project Area has largely been previously surveyed and disturbed by the original construction of the wind farm, Atwell makes the following recommendations:

- The Project proceed as planned without additional cultural resource work prior to construction.
- An UDP be developed to establish procedures and relevant contact information in the event that human remains or archaeological deposits are discovered during the construction, operational, and decommission phases of the Project.
 - If buried archaeological resources are encountered, all activity should cease in the immediate area and within a 100-foot buffer area and the artifacts should be left in place. The Client's archaeologist should be contacted immediately, and unanticipated discovery procedures should be initiated.
 - If human remains are encountered, construction should stop in the immediate area of discovery and within a 100-foot buffer area, and law enforcement should be notified immediately. Law enforcement officials should determine whether the discovery is a crime scene and whether the remains are prehistoric or historic Native American remains. The SHSND should be contacted immediately if the human remains are determined to be prehistoric or historic in nature and/or Native American remains.

The report was submitted to the SHSND on May 4, 2023.

3 Regulatory Background and Authority

The UDP is designed to meet North Dakota and federal regulations governing the discovery of archeological materials and human remains. The applicable state and federal regulations are:

- North Dakota Century Code 55-10-11 – Recognition of Federal Historical Preservation Law;
- North Dakota Century Code 23-06-27 – Protection of human burial sites, human remains, and burial goods;
- Section 106 of the National Historic Preservation Act, (NHPA), as Amended; and

Currently, no federal trigger has been identified for this Project; therefore, Section 106 regulation do not apply. However, this UDP has been designed to comply with Section 106 should a federal trigger be identified in the future.

North Dakota has stringent state laws protecting human burials. A human burial can be marked or unmarked. An “unmarked burial” includes any location where human remains have been or may be found inadvertently and where there is no surficial evidence of a burial site (i.e., cemetery fence lines, tombstones, grave markers, etc.). This includes all prehistoric or historic Native American burials as well as all early historic-period Euro-American, African-American, and other isolated burials and abandoned cemeteries that are no longer being used for internments or being maintained in good condition. Human burials are protected under North Dakota Century Code 23-06-27. This law outlines the penalties for disturbing these resources as well and outlines the reporting protocol in the event an unmarked grave, burial, or historic cemetery is discovered.

4 Unanticipated Discovery Procedures

The general process for managing unanticipated discoveries is outlined in the following section, followed by information specific to archaeological sites and human remains or unmarked burials.

A responsible person who will be involved with all aspects of Project-related ground disturbing work during the construction, operations, and decommissioning phases should be identified. The designated responsible person (cultural liaison) should be present onsite during most Project activities and have some level of training, awareness, and sensitivity to the cultural resources that may be encountered within the Project site. This person will act as the Project liaison with the owner, Project archeologist, and cultural resources authorities in the event of unanticipated discoveries. S/he also will serve as the initial contact in the event of unanticipated discoveries during Project activities and be listed in the contacts section of this UDP.

During the Project kick-off meeting, all contractors will be made aware of the UDP and will be provided contact information for the cultural liaison, who will contact the Project archeologist to evaluate the need for further action. Whenever new personnel are brought onsite, they also will be informed of the UDP and the contact information. A copy of the UDP, including contact information, shall be posted in an accessible location onsite for reference as needed.

4.1 Archaeological Material

For purposes of the UDP, “archaeological material” could be from prehistoric or historic periods and includes, though not exclusively, the following types of materials (see Appendix A for additional examples):

- An area of charcoal or charcoal-stained soils associated with historic-period or prehistoric-period remains, such as bones, pottery sherds, shell, stone tools or chips;
- An arrowhead, pottery sherds, shell, stone tool, or stone chips;
- A historic-period bottle, old glass fragments, square nails, bricks and mortar, decorated white ware ceramics, etc.;
- A cluster of shell, sherds, and/or bones or large field stones or burned rocks in association with stone tools or chips;
- Dredging, pumping, industrial, and/or agricultural equipment older than 50 years;
- Buried structures, brick foundation piers or concrete slabs from remnant outbuildings or residences;
- A cluster of darkened soils in association with bones; and
- Undisturbed mounds of soil in areas that were once wetlands or shorelines.

PUBLIC DOCUMENT - NON-PUBLIC DATA HAS BEEN EXCISED

The following general procedure is to be executed if archaeological material is discovered.

1. The site supervisor/foreman is informed of the discovery. The site supervisor/foreman will then contact the cultural liaison.
2. All construction activity within 100 feet of the discovery area/feature/site will cease immediately.
3. All remains or materials are to be left in place unless in jeopardy because of Project activities.
4. The area will be secured to prevent any damage or loss of removable objects. If feasible, a fence or other barrier will be erected to demarcate and protect the discovery area.
5. The cultural liaison will contact the Project archeologist, who will record the discovery location and delineate the extent of the discovery relative to planned Project activities. The Project archeologist will assess, record, and photograph the find.
6. Within 48 hours of the discovery, the Project archeologist will notify the SHSND and provide a brief written summary of the discovery that will include a recommendation on the NRHP eligibility of the resources, the effect of Project activity on historic properties, if present, and a proposed treatment to resolve adverse effects, if applicable.
7. The SHSND will review the recommendation made by the Project archaeologist and determine the appropriate course of action.
8. If cultural resources or remains have the potential to be culturally significant to a living Native American Tribe, the SHSND will notify the appropriate Tribes.
9. If human remains or unmarked burial sites are discovered, procedures in the next section should be followed.

4.2 Human Remains and Unmarked Burials

It is recommended that the Project follow the unanticipated discoveries protocol outlined in this section if any human remains or unmarked burial sites are discovered during Project activities.

Human remains may include any human body parts. Burial artifacts and burial sites are not easily recognized, but generally would include intact prehistoric pots, clusters of artifacts, or modern grave features (e.g., headstones, coffin parts, etc.). If in doubt whether the bones or other materials are human, it is best to stop work in the immediate area of the discovery and seek advice from the Project archaeologist.

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Procedures for unanticipated discoveries involving human remains or unmarked burials are outlined below. In the event that human remains, an unmarked burial, or an abandoned cemetery is encountered by Project staff, the following procedures are applicable.

1. On discovery of the remains, construction activities (including excavation or any other below ground work) within 100 feet of the discovery will cease.
2. The site supervisor/foreman will be informed of the discovery. The site supervisor/foreman will then notify the cultural liaison.
3. Temporary site protection measures (e.g., high visibility warning tape and stakes, avoidance signs in language[s] understandable to the Project team, etc.) will be installed around the discovery area to prevent unintentional incursion and potential damage to the remains.
4. The cultural liaison will contact local law enforcement (e.g., police department, county sheriff) within 24 hours. Local law enforcement will notify the appropriate medical examiner's office.
5. The cultural liaison will contact the Project archaeologist, who will be or will engage a qualified professional archaeologist who is permitted in North Dakota and who has a background in osteology, forensic anthropology, physical anthropology, or equivalent.
6. The Project archaeologist will notify the SHSND within 48 hours of the discovery and provide the SHSND with a brief summary of the findings and recommendations.
7. The local law enforcement officials must be given site access to assess the nature and age of the remains. If the medical examiner's office determines that the human remains are older than 50 years of age and there is no need for a legal inquiry or criminal investigation, the SHSND will have jurisdiction over the remains.
8. If the SHSND believes the remains may have ethnic affinity with a living Native American Tribe, the SHSND will notify the appropriate Tribal representative(s) of the discovery.
9. Consultation will be initiated between the Project personnel (consisting of OTP or their agent, the Project archaeologist or qualified professional archaeologist, and the cultural liaison) and the SHSND to determine the final disposition of the human remains. The below will be considered during consultation if the remains are determined to be Native American.
 - a. The National Park Services' Native American Graves Protection and Repatriation Act (NAGPRA) (U.S. Code 25, §3001, et seq.) database and Tribal websites.
 - b. Information available at the Great Plains Regional Office of the Bureau of Indian Affairs.
 - c. The potential interest of additional state-recognized Tribes.

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10. No work that will cause a direct effect to the discovery area will proceed until all human remains and associated artifacts have been recovered, and, where applicable, the appropriate regulatory agencies have given clearance for the Project work to proceed.

5 Key Personnel and Officials

In the event of an unanticipated discovery, the key personnel and agency officials listed below should be contacted consistent with the steps outlined above.

Cultural Liaison

Bryce Haugen
Energy Supply
215 S. Cascade St.
Fergus Falls, MN 56537
(701) 739-8385
bhaugen@otpc.com

Project Archaeologist

Matthew Chouest
2 Towne Square
Southfield, MI 48076
(517) 231-2053
mchouest@atwell-group.com

State Historical Society of North Dakota (SHSND)

Andrew J. Robinson
State Archaeologist
State Historical Society of North Dakota
Archaeology and Historic Preservation
612 East Boulevard Avenue
Bismarck, ND 58505-0830
Phone: (701) 328-3575
Email: andrewrobinson@nd.gov

Steele County Sheriff's Office

204 East Pearl Street
Owatonna, MN. 55060
Phone: (507) 444-3800

Steele County Coroner's Office

PO Box 275
Finley, ND 58230
Phone: (701) 524-2442

APPENDIX B - EXAMPLES OF ARCHAEOLOGICAL RESOURCES

Surface or subsurface structures, shelters, facilities, or features, including, but not limited to

- domestic structures
- storage structures
- cooking structures
- ceremonial structures
- artificial mounds
- earthworks
- fortifications
- canals
- reservoirs
- gardens or fields
- bedrock mortars
- grinding surfaces
- rock alignments
- cairns
- trails
- borrow pits
- cooking pits
- refuse pits
- burial pits or graves
- hearths
- kilns
- post molds
- wall trenches

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- middens
- Surface or subsurface artifact concentrations or scatters
- Whole or fragmentary tools, implements, containers, weapons or weapon projectiles, clothing, and ornaments, including, but not limited to:
 - pottery
 - other ceramics
 - cordage
 - basketry
 - other weaving
 - bottles
 - other glassware
 - bone
 - ivory
 - shell
 - metal
 - wood
 - hide
 - feathers
 - pigments
 - flaked stone
 - ground stone
 - pecked stone
- By-products, waste products, or debris resulting from manufacture or use of human-made or natural materials
- Organic waste, including, but not limited to: vegetal and animal remains, coprolites
- Human remains, including, but not limited to: bone, teeth, mummified flesh, burials, cremations

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- Rock carvings, rock paintings, intaglios, and other works of artistic or symbolic representation
- Rock shelters and caves or portions thereof containing any of the above material remains
- All portions of shipwrecks, including, but not limited to: armaments, apparel, tackle, cargo
- Any portion or piece of any of the foregoing

Appendix F – IPaC Resource List

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IPaC resource list

This report is an automatically generated list of species and other resources such as critical habitat (collectively referred to as *trust resources*) under the U.S. Fish and Wildlife Service's (USFWS) jurisdiction that are known or expected to be on or near the project area referenced below. The list may also include trust resources that occur outside of the project area, but that could potentially be directly or indirectly affected by activities in the project area. However, determining the likelihood and extent of effects a project may have on trust resources typically requires gathering additional site-specific (e.g., vegetation/species surveys) and project-specific (e.g., magnitude and timing of proposed activities) information.

Below is a summary of the project information you provided and contact information for the USFWS office(s) with jurisdiction in the defined project area. Please read the introduction to each section that follows (Endangered Species, Migratory Birds, USFWS Facilities, and NWI Wetlands) for additional information applicable to the trust resources addressed in that section.

Location

Griggs and Steele counties, North Dakota



Local office

North Dakota Ecological Services Field Office

☎ (701) 250-4481

📅 (701) 355-8513

3425 Miriam Avenue

Bismarck, ND 58501-7926

NOT FOR CONSULTATION

Endangered species

This resource list is for informational purposes only and does not constitute an analysis of project level impacts.

The primary information used to generate this list is the known or expected range of each species. Additional areas of influence (AOI) for species are also considered. An AOI includes areas outside of the species range if the species could be indirectly affected by activities in that area (e.g., placing a dam upstream of a fish population even if that fish does not occur at the dam site, may indirectly impact the species by reducing or eliminating water flow downstream). Because species can move, and site conditions can change, the species on this list are not guaranteed to be found on or near the project area. To fully determine any potential effects to species, additional site-specific and project-specific information is often required.

Section 7 of the Endangered Species Act **requires** Federal agencies to "request of the Secretary information whether any species which is listed or proposed to be listed may be present in the area of such proposed action" for any project that is conducted, permitted, funded, or licensed by any Federal agency. A letter from the local office and a species list which fulfills this requirement can **only** be obtained by requesting an official species list from either the Regulatory Review section in IPaC (see directions below) or from the local field office directly.

For project evaluations that require USFWS concurrence/review, please return to the IPaC website and request an official species list by doing the following:

1. Draw the project location and click CONTINUE.
2. Click DEFINE PROJECT.
3. Log in (if directed to do so).
4. Provide a name and description for your project.
5. Click REQUEST SPECIES LIST.

Listed species¹ and their critical habitats are managed by the [Ecological Services Program](#) of the U.S. Fish and Wildlife Service (USFWS) and the fisheries division of the National Oceanic and Atmospheric Administration (NOAA Fisheries²).

Species and critical habitats under the sole responsibility of NOAA Fisheries are **not** shown on this list. Please contact [NOAA Fisheries](#) for [species under their jurisdiction](#).

-
1. Species listed under the [Endangered Species Act](#) are threatened or endangered; IPaC also shows species that are candidates, or proposed, for listing. See the [listing status page](#) for more information. IPaC only shows species that are regulated by USFWS (see FAQ).

2. [NOAA Fisheries](#), also known as the National Marine Fisheries Service (NMFS), is an office of the National Oceanic and Atmospheric Administration within the Department of Commerce.

The following species are potentially affected by activities in this location:

Mammals

NAME	STATUS
Northern Long-eared Bat <i>Myotis septentrionalis</i> Wherever found No critical habitat has been designated for this species. https://ecos.fws.gov/ecp/species/9045	Threatened

Insects

NAME	STATUS
Dakota Skipper <i>Hesperia dactotae</i> Wherever found There is final critical habitat for this species. Your location does not overlap the critical habitat. https://ecos.fws.gov/ecp/species/1028	Threatened
Monarch Butterfly <i>Danaus plexippus</i> Wherever found No critical habitat has been designated for this species. https://ecos.fws.gov/ecp/species/9743	Candidate

Critical habitats

Potential effects to critical habitat(s) in this location must be analyzed along with the endangered species themselves.

There are no critical habitats at this location.

Migratory birds

Certain birds are protected under the Migratory Bird Treaty Act¹ and the Bald and Golden Eagle Protection Act².

Any person or organization who plans or conducts activities that may result in impacts to migratory birds, eagles, and their habitats should follow appropriate regulations and consider implementing appropriate conservation measures, as described [below](#).

1. The [Migratory Birds Treaty Act](#) of 1918.
2. The [Bald and Golden Eagle Protection Act](#) of 1940.

Additional information can be found using the following links:

- Birds of Conservation Concern <https://www.fws.gov/program/migratory-birds/species>
- Measures for avoiding and minimizing impacts to birds <https://www.fws.gov/library/collections/avoiding-and-minimizing-incident-take-migratory-birds>
- Nationwide conservation measures for birds <https://www.fws.gov/sites/default/files/documents/nationwide-standard-conservation-measures.pdf>

The birds listed below are birds of particular concern either because they occur on the [USFWS Birds of Conservation Concern \(BCC\)](#) list or warrant special attention in your project location. To learn more about the levels of concern for birds on your list and how this list is generated, see the FAQ [below](#). This is not a list of every bird you may find in this location, nor a guarantee that every bird on this list will be found in your project area. To see exact locations of where birders and the general public have sighted birds in and around your project area, visit the [E-bird data mapping tool](#) (Tip: enter your location, desired date range and a species on your list). For projects that occur off the Atlantic Coast, additional maps and models detailing the relative occurrence and abundance of bird species on your list are available. Links to additional information about Atlantic Coast birds, and other important information about your migratory bird list, including how to properly interpret and use your migratory bird report, can be found [below](#).

For guidance on when to schedule activities or implement avoidance and minimization measures to reduce impacts to migratory birds on your list, click on the PROBABILITY OF PRESENCE SUMMARY at the top of your list to see when these birds are most likely to be present and breeding in your project area.

NAME

BREEDING SEASON

Bald Eagle *Haliaeetus leucocephalus*

Breeds Dec 1 to Aug 31

This is not a Bird of Conservation Concern (BCC) in this area, but warrants attention because of the Eagle Act or for potential susceptibilities in offshore areas from certain types of development or activities.

Black Tern <i>Chlidonias niger</i> This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska. https://ecos.fws.gov/ecp/species/3093	Breeds May 15 to Aug 20
Black-billed Cuckoo <i>Coccyzus erythrophthalmus</i> This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska. https://ecos.fws.gov/ecp/species/9399	Breeds May 15 to Oct 10
Bobolink <i>Dolichonyx oryzivorus</i> This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska.	Breeds May 20 to Jul 31
Chimney Swift <i>Chaetura pelagica</i> This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska.	Breeds Mar 15 to Aug 25
Franklin's Gull <i>Leucophaeus pipixcan</i> This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska.	Breeds May 1 to Jul 31
Golden-winged Warbler <i>Vermivora chrysoptera</i> This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska. https://ecos.fws.gov/ecp/species/8745	Breeds May 1 to Jul 20
Lesser Yellowlegs <i>Tringa flavipes</i> This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska. https://ecos.fws.gov/ecp/species/9679	Breeds elsewhere
Long-eared Owl <i>asio otus</i> This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska. https://ecos.fws.gov/ecp/species/3631	Breeds Mar 1 to Jul 15
Red-headed Woodpecker <i>Melanerpes erythrocephalus</i> This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska.	Breeds May 10 to Sep 10

Short-billed Dowitcher *Limnodromus griseus*

Breeds elsewhere

This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska.

<https://ecos.fws.gov/ecp/species/9480>

Western Grebe *aechmophorus occidentalis*

Breeds Jun 1 to Aug 31

This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska.

<https://ecos.fws.gov/ecp/species/6743>

Probability of Presence Summary

The graphs below provide our best understanding of when birds of concern are most likely to be present in your project area. This information can be used to tailor and schedule your project activities to avoid or minimize impacts to birds. Please make sure you read and understand the FAQ "Proper Interpretation and Use of Your Migratory Bird Report" before using or attempting to interpret this report.

Probability of Presence (■)

Each green bar represents the bird's relative probability of presence in the 10km grid cell(s) your project overlaps during a particular week of the year. (A year is represented as 12 4-week months.) A taller bar indicates a higher probability of species presence. The survey effort (see below) can be used to establish a level of confidence in the presence score. One can have higher confidence in the presence score if the corresponding survey effort is also high.

How is the probability of presence score calculated? The calculation is done in three steps:

1. The probability of presence for each week is calculated as the number of survey events in the week where the species was detected divided by the total number of survey events for that week. For example, if in week 12 there were 20 survey events and the Spotted Towhee was found in 5 of them, the probability of presence of the Spotted Towhee in week 12 is 0.25.
2. To properly present the pattern of presence across the year, the relative probability of presence is calculated. This is the probability of presence divided by the maximum probability of presence across all weeks. For example, imagine the probability of presence in week 20 for the Spotted Towhee is 0.05, and that the probability of presence at week 12 (0.25) is the maximum of any week of the year. The relative probability of presence on week 12 is $0.25/0.25 = 1$; at week 20 it is $0.05/0.25 = 0.2$.
3. The relative probability of presence calculated in the previous step undergoes a statistical conversion so that all possible values fall between 0 and 10, inclusive. This is the probability of presence score.

To see a bar's probability of presence score, simply hover your mouse cursor over the bar.

Breeding Season (■)

Yellow bars denote a very liberal estimate of the time-frame inside which the bird breeds across its entire range. If there are no yellow bars shown for a bird, it does not breed in your project area.

Survey Effort (|)

Vertical black lines superimposed on probability of presence bars indicate the number of surveys performed for that species in the 10km grid cell(s) your project area overlaps. The number of surveys is expressed as a range, for example, 33 to 64 surveys.

To see a bar's survey effort range, simply hover your mouse cursor over the bar.

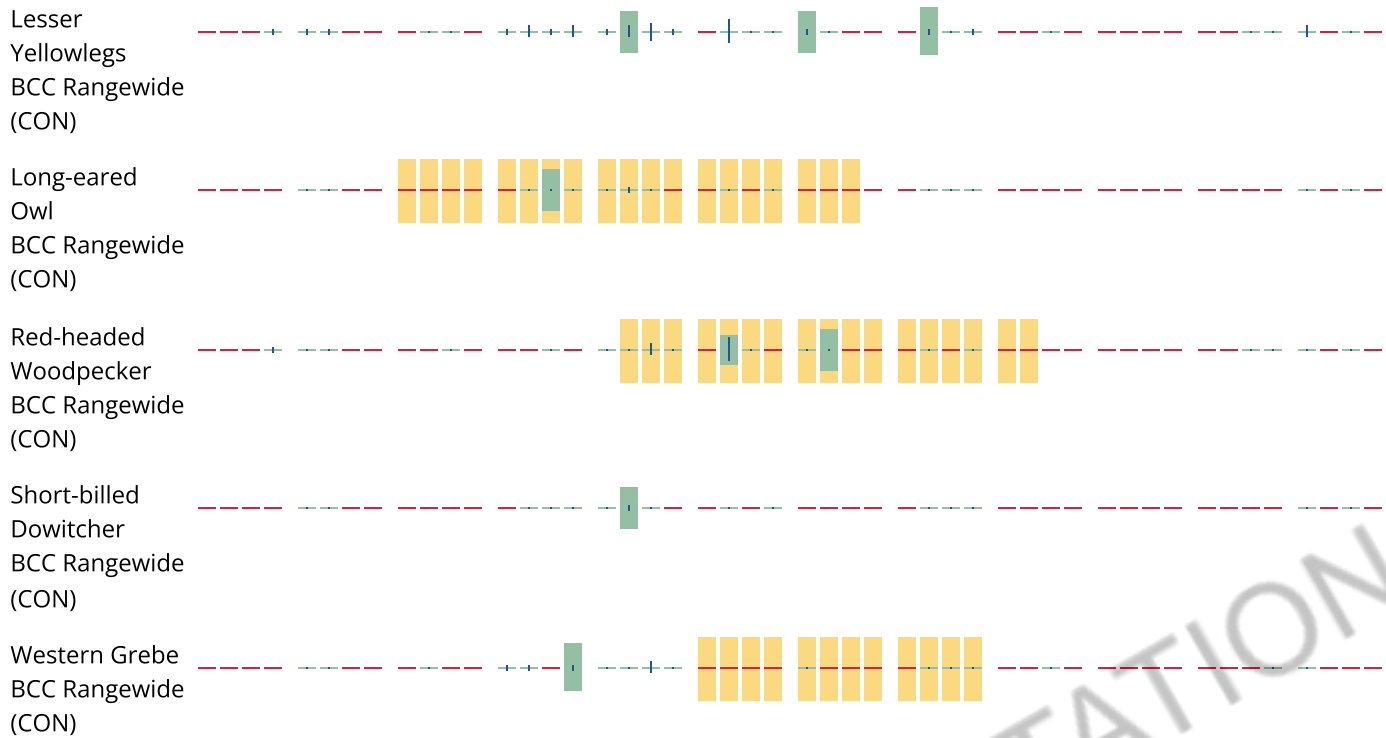
No Data (-)

A week is marked as having no data if there were no survey events for that week.

Survey Timeframe

Surveys from only the last 10 years are used in order to ensure delivery of currently relevant information. The exception to this is areas off the Atlantic coast, where bird returns are based on all years of available data, since data in these areas is currently much more sparse.





Tell me more about conservation measures I can implement to avoid or minimize impacts to migratory birds.

[Nationwide Conservation Measures](#) describes measures that can help avoid and minimize impacts to all birds at any location year round. Implementation of these measures is particularly important when birds are most likely to occur in the project area. When birds may be breeding in the area, identifying the locations of any active nests and avoiding their destruction is a very helpful impact minimization measure. To see when birds are most likely to occur and be breeding in your project area, view the Probability of Presence Summary. [Additional measures](#) or [permits](#) may be advisable depending on the type of activity you are conducting and the type of infrastructure or bird species present on your project site.

What does IPaC use to generate the list of migratory birds that potentially occur in my specified location?

The Migratory Bird Resource List is comprised of USFWS [Birds of Conservation Concern \(BCC\)](#) and other species that may warrant special attention in your project location.

The migratory bird list generated for your project is derived from data provided by the [Avian Knowledge Network \(AKN\)](#). The AKN data is based on a growing collection of [survey, banding, and citizen science datasets](#) and is queried and filtered to return a list of those birds reported as occurring in the 10km grid cell(s) which your project intersects, and that have been identified as warranting special attention because they are a BCC species in that area, an eagle ([Eagle Act](#) requirements may apply), or a species that has a particular vulnerability to offshore activities or development.

Again, the Migratory Bird Resource list includes only a subset of birds that may occur in your project area. It is not representative of all birds that may occur in your project area. To get a list of all birds potentially present in your project area, please visit the [Rapid Avian Information Locator \(RAIL\) Tool](#).

What does IPaC use to generate the probability of presence graphs for the migratory birds potentially occurring in my specified location?

The probability of presence graphs associated with your migratory bird list are based on data provided by the [Avian Knowledge Network \(AKN\)](#). This data is derived from a growing collection of [survey, banding, and citizen science datasets](#).

Probability of presence data is continuously being updated as new and better information becomes available. To learn more about how the probability of presence graphs are produced and how to interpret them, go to the Probability of Presence Summary and then click on the "Tell me about these graphs" link.

How do I know if a bird is breeding, wintering or migrating in my area?

To see what part of a particular bird's range your project area falls within (i.e. breeding, wintering, migrating or year-round), you may query your location using the [RAIL Tool](#) and look at the range maps provided for birds in your area at the bottom of the profiles provided for each bird in your results. If a bird on your migratory bird species list has a breeding season associated with it, if that bird does occur in your project area, there may be nests present at some point within the timeframe specified. If "Breeds elsewhere" is indicated, then the bird likely does not breed in your project area.

What are the levels of concern for migratory birds?

Migratory birds delivered through IPaC fall into the following distinct categories of concern:

1. "BCC Rangewide" birds are [Birds of Conservation Concern](#) (BCC) that are of concern throughout their range anywhere within the USA (including Hawaii, the Pacific Islands, Puerto Rico, and the Virgin Islands);
2. "BCC - BCR" birds are BCCs that are of concern only in particular Bird Conservation Regions (BCRs) in the continental USA; and
3. "Non-BCC - Vulnerable" birds are not BCC species in your project area, but appear on your list either because of the [Eagle Act](#) requirements (for eagles) or (for non-eagles) potential susceptibilities in offshore areas from certain types of development or activities (e.g. offshore energy development or longline fishing).

Although it is important to try to avoid and minimize impacts to all birds, efforts should be made, in particular, to avoid and minimize impacts to the birds on this list, especially eagles and BCC species of rangewide concern. For more information on conservation measures you can implement to help avoid and minimize migratory bird impacts and requirements for eagles, please see the FAQs for these topics.

Details about birds that are potentially affected by offshore projects

For additional details about the relative occurrence and abundance of both individual bird species and groups of bird species within your project area off the Atlantic Coast, please visit the [Northeast Ocean Data Portal](#). The Portal also offers data and information about other taxa besides birds that may be helpful to you in your project review. Alternately, you may download the bird model results files underlying the portal maps through the [NOAA NCCOS Integrative Statistical Modeling and Predictive Mapping of Marine Bird Distributions and Abundance on the Atlantic Outer Continental Shelf](#) project webpage.

Bird tracking data can also provide additional details about occurrence and habitat use throughout the year, including migration. Models relying on survey data may not include this information. For additional information on marine bird tracking data, see the [Diving Bird Study](#) and the [nanotag studies](#) or contact

[Caleb Spiegel](#) or [Pam Loring](#).

What if I have eagles on my list?

If your project has the potential to disturb or kill eagles, you may need to [obtain a permit](#) to avoid violating the Eagle Act should such impacts occur.

Proper Interpretation and Use of Your Migratory Bird Report

The migratory bird list generated is not a list of all birds in your project area, only a subset of birds of priority concern. To learn more about how your list is generated, and see options for identifying what other birds may be in your project area, please see the FAQ "What does IPaC use to generate the migratory birds potentially occurring in my specified location". Please be aware this report provides the "probability of presence" of birds within the 10 km grid cell(s) that overlap your project; not your exact project footprint. On the graphs provided, please also look carefully at the survey effort (indicated by the black vertical bar) and for the existence of the "no data" indicator (a red horizontal bar). A high survey effort is the key component. If the survey effort is high, then the probability of presence score can be viewed as more dependable. In contrast, a low survey effort bar or no data bar means a lack of data and, therefore, a lack of certainty about presence of the species. This list is not perfect; it is simply a starting point for identifying what birds of concern have the potential to be in your project area, when they might be there, and if they might be breeding (which means nests might be present). The list helps you know what to look for to confirm presence, and helps guide you in knowing when to implement conservation measures to avoid or minimize potential impacts from your project activities, should presence be confirmed. To learn more about conservation measures, visit the FAQ "Tell me about conservation measures I can implement to avoid or minimize impacts to migratory birds" at the bottom of your migratory bird trust resources page.

Facilities

National Wildlife Refuge lands

Any activity proposed on lands managed by the [National Wildlife Refuge](#) system must undergo a 'Compatibility Determination' conducted by the Refuge. Please contact the individual Refuges to discuss any questions or concerns.

This location overlaps the following National Wildlife Refuge lands:

LAND	ACRES
STEELE COUNTY WATERFOWL PRODUCTION AREA	92.04 acres

Fish hatcheries

There are no fish hatcheries at this location.

Wetlands in the National Wetlands Inventory (NWI)

Impacts to [NWI wetlands](#) and other aquatic habitats may be subject to regulation under Section 404 of the Clean Water Act, or other State/Federal statutes.

For more information please contact the Regulatory Program of the local [U.S. Army Corps of Engineers District](#).

This location did not intersect any wetlands mapped by NWI.

NOTE: This initial screening does **not** replace an on-site delineation to determine whether wetlands occur. Additional information on the NWI data is provided below.

Data limitations

The Service's objective of mapping wetlands and deepwater habitats is to produce reconnaissance level information on the location, type and size of these resources. The maps are prepared from the analysis of high altitude imagery. Wetlands are identified based on vegetation, visible hydrology and geography. A margin of error is inherent in the use of imagery; thus, detailed on-the-ground inspection of any particular site may result in revision of the wetland boundaries or classification established through image analysis.

The accuracy of image interpretation depends on the quality of the imagery, the experience of the image analysts, the amount and quality of the collateral data and the amount of ground truth verification work conducted. Metadata should be consulted to determine the date of the source imagery used and any mapping problems.

Wetlands or other mapped features may have changed since the date of the imagery or field work. There may be occasional differences in polygon boundaries or classifications between the information depicted on the map and the actual conditions on site.

Data exclusions

Certain wetland habitats are excluded from the National mapping program because of the limitations of aerial imagery as the primary data source used to detect wetlands. These habitats include seagrasses or submerged aquatic vegetation that are found in the intertidal and subtidal zones of estuaries and nearshore coastal waters. Some deepwater reef communities (coral or tubercid worm reefs) have also been excluded from the inventory. These habitats, because of their depth, go undetected by aerial imagery.

Data precautions

Federal, state, and local regulatory agencies with jurisdiction over wetlands may define and describe wetlands in a different manner than that used in this inventory. There is no attempt, in either the design or products of this inventory, to define the limits of proprietary jurisdiction of any Federal, state, or local government or to establish the geographical scope of the regulatory programs of government agencies. Persons intending to engage in activities involving modifications within or adjacent to wetland areas should seek the advice of appropriate Federal, state, or local agencies concerning specified agency regulatory programs and proprietary jurisdictions that may affect such activities.

NOT FOR CONSULTATION

Appendix G – Agency Correspondence

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May 4, 2023

Andrew Robinson
State Archaeologist
Archaeology and Historic Preservation
State Historical Society of North Dakota
612 East Boulevard Avenue
Bismarck, North Dakota 58505-0612

Atwell, LLC Project No. 22007288

**Re: Project Review under North Dakota Century Code 44-22-09 for the
Luverne Wind Upgrade Project
Steele County, North Dakota**

Dear Mr. Robinson,

Atwell, LLC (Atwell), was contracted by Otter Tail Power Company (OTP) to conduct a Class I literature review for the proposed Luverne Wind Upgrade Project (Project) located in Steele County, North Dakota. The Project includes replacing current wind turbine technology with longer blades and new hub and gearbox with turbine generators being refurbished at 33 wind turbine locations. The existing Luverne Wind turbines are GE 1.5 megawatt [MW] turbines with a 82.5-meter rotor diameter and a total height of 398 feet (121.25 meters), and these will be replaced with new wind turbine technology (GE 1.5 MW turbines with 97-meter rotor diameter and a total height of 128.5 meters). The existing 33 turbine locations remain the same and OTP plans to use the existing turbine structural steel towers, turbine foundations, collection/communication systems, permanent access roads, and other associated facilities whose locations will not change.

During installation of the repowering technology, existing access roads and the gravel ring around the turbines may be temporarily widened to accommodate delivery and staging of components and equipment. A temporary laydown yard will be utilized during the Repower Project. The laydown yard and all the areas where temporary access roads and construction easements will occur were previously used during initial project construction. In all cases, the planned temporary construction areas meet exclusion and avoidance area criteria.

Per the Energy Siting Conversion and Transmission Facility Siting Act (North Dakota Century Code 49-22-09), the Project is subject to review by the State Historical Society of North Dakota (SHSND). The Project



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is located on private land and would not utilize state or federal funds or permits. Therefore, Section 106 of the National Historic Preservation Act would not apply to the Project.

As such, Otter Tail Power Company contracted Atwell, LLC, to conduct cultural resources investigations for the Project in compliance with North Dakota Century Code 49-22-09. Atwell has conducted a Class I Cultural Resources Inventory for the Project. We are providing two bound copies of the final report for the Class I inventory herein for your review and concurrence.

Thank you for your assistance in this matter. If you have any questions or require additional information, please do not hesitate to contact me via telephone (517.231.2053) or by email (mchouest@atwell-group.com)

Sincerely,
ATWELL, LLC

A handwritten signature in black ink that reads "M J Chouest".

Matthew Chouest, M.A., RPA
Senior Environmental Consultant

Enclosures:

Class I Cultural Resources Inventory for the Luverne Wind Upgrade Project, Steele County, North
Dakota

STATE OF NORTH DAKOTA
PUBLIC SERVICE COMMISSION

Otter Tail Power Company Amend – Luverne Wind Farm Upgrade Project Siting Application – Steele County	<p style="text-align:right">Case No. PU-23-_____</p> <p style="text-align:center">OTTER TAIL POWER COMPANY’S APPLICATION TO AMEND ORDERS AND CERTIFICATES</p>
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I. Introduction.

Pursuant to N.D.C.C. § 49-22-08(5), Otter Tail Power Company (Otter Tail) submits an application to the North Dakota Public Service Commission (Commission) requesting an amendment of the Commission’s Findings of Fact, Conclusions of Law and Order, dated October 30, 2008 (Case No. PU-08-34) (2008 Order) and Order Reissuing Certificates and Permit, dated May 20, 2009 (Case No. PU-09-073) (2009 Order), along with Certificate of Site Compatibility No. 9 and First Reissued Certificate of Site Compatibility No. 9 (collectively, Orders and Certificates) issued to Otter Tail for its portion of the Luverne Wind Farm (Facility). Specifically, Otter Tail requests that the Commission amend the Orders and Certificates to remove the 1.5 megawatt (MW) per turbine limitation and the overall 49.5 MW limitation.

II. Procedural History.

A brief overview of relevant procedural history is provided below:

- On October 30, 2008, the Commission issued its 2008 Order granting Certificate of Site Compatibility No. 9 to M-Power, LLC (M-Power) for the Luverne Wind Farm consisting of up to 33 1.5 MW wind turbine generators, collection substation and associated facilities (Case No. PU-08-34).
- On December 3, 2008, the Commission issued a Certificate of Public Convenience and Necessity (CPCN) to Otter Tail authorizing the purchase and operation of the 49.5 MW Facility (Case No. PU-08-766).

- On February 20, 2009, Otter Tail and M-Power filed a Joint Application for Transfer of Certificate of Site Compatibility, seeking to transfer to Otter Tail the rights and obligations of Certificate of Site Compatibility No. 9 (Case No. PU-09-073).
- On May 20, 2009, the Commission issued its 2009 Order authorizing transfer of the 49.5 MW Facility to Otter Tail and issuing First Reissued Certificate of Site Compatibility No. 9 to Otter Tail (Case No. PU-09-073). The 2009 Order amended the 2008 Order (Case No. PU-08-34) and transferred the same Facility covered by the CPCN.
- The Facility was constructed in 2009 with the Project beginning commercial operations in 2009.
- On May 8, 2023, Otter Tail filed the Certification of Bradley E. Tollerson, with accompanying documentation, pursuant to N.D.C.C. § 49-22-03(3)(a)(4) regarding planned equipment upgrades at the Facility (Upgrade Project).

III. Planned Upgrade Project.

The Upgrade Project will consist of removing and replacing the existing General Electric (GE) 1.5 MW turbine 82.5 meter (270.7 feet) rotor diameter (RD) blades, hub, and gearbox with an upgraded technology package of GE 1.6 MW generator technology and 97 meter (318.2 feet) RD blades, hub, and gearbox. The 1.6 MW technology offers more optionality and enables better, more efficient turbine operations. The Facility’s total nameplate generating capacity would increase to 52.8 MW; however, the Facility’s output would remain 49.5 MW in accordance with Otter Tail’s Generator Interconnection Agreement.

IV. Amendment Request – Removal of Capacity Limitation.

In order paragraph no. 1 of the 2008 Order, the Commission granted Certificate of Site Compatibility No. 9, which designated a site for “up to 33 1.5 MW wind turbine generators” and associated facilities. Also, in order paragraph no. 6 of the 2008 Order, the Commission authorized construction of “up to 49.5 MW of wind turbines” and associated facilities. In order paragraph no. 2 of the 2009 Order, the Commission issued First Reissued Certificate of Site Compatibility No. 9 to Otter Tail “for the 49.5 MW Phase II portion of the Luverne Wind Farm

... for which the Commission issued Certificate of Public Convenience and Necessity No. 5385.” Likewise, First Reissued Certificate of Site Compatibility No. 9 issued to Otter Tail designates a site for “up to 33 1.5 MW wind turbine generators”.

As noted above, when repowered, the Facility’s nameplate capacity would increase to 52.8 MW, even though the megawatts delivered to the grid will be limited to 49.5 MW. Based on review of prior repower dockets, Otter Tail understands that the Commission has previously concluded that order and certificate amendments are required where a megawatt limitation is specified.¹ Therefore, Otter Tail requests that the Commission amend the Orders and Certificates to remove the per turbine megawatt limitation and the overall megawatt limitation.

V. Conclusion.

For the reasons set forth above, Otter Tail respectfully requests that its application to amend the Orders and Certificates to remove the per turbine megawatt limitation and overall capacity limitation be granted.

Dated this 8th day of May, 2023.

FREDRIKSON & BYRON, P.A.

By 

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¹ See Order, dated December 3, 2019, Ashtabula Wind Energy Center Repower (Case No. PU-19-284); Order, September 5, 2018, Langdon Wind Energy Center Upgrade Project (Case No. PU-18-186); and Order, dated October 27, 2022, Border Winds Energy Project Repower (Case No. PU-22-173).