Environmental Report

Lakefield Wind Project

In the Matter of the Application of Lakefield Wind, LLC for a Certificate of Need for the 205.5 MW Lakefield Wind Project in Jackson County, Minnesota

PUC Docket No. IP-6829/CN-09-1046

Energy Facilities Permitting
85 7th Place East, Suite 500
Saint Paul, MN 55101

July 2, 2010

Responsible Governmental Unit	Applicant
Minnesota Office of Energy Security-Energy Facilities Permitting	**Lakefield Wind Project, LLC**
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Abstract

On September 2, 2009, Lakefield Wind Project, LLC (applicant), filed a certificate of need application with the Minnesota Public Utilities Commission (Commission) for the Lakefield Wind Farm (project). The applicant is proposing to construct a 205.5 megawatt (MW) large wind energy conversion system in Jackson County, Minnesota.

The proposed project is a large energy facility as defined by Minnesota Statute 216B.2421. Such a facility requires a certificate of need from the Commission (Minn. Stat. § 216B.243). Additionally, the Minnesota Department of Commerce must prepare an environmental report (ER) for the project (Minn. Rules 7849.1200).

Office of Energy Security, Energy Facility Permitting (OES EFP) staff is responsible for preparing the environmental report (ER). This ER has been prepared as per Minnesota Rules 7849.1100-2100. The ER is part of the record which the Commission will consider in making a decision on a certificate of need for the project.

Information about the Commission's certificate of need process can be obtained by contacting Bret Eknes, Minnesota Public Utilities Commission, 121 7th Place E., Suite 350, Saint Paul, MN 55101, phone: (651) 201-2257, email: bret.eknes@state.mn.us.

Information about this project can be found on the Commission's energy facilities permitting website: http://energyfacilities.puc.state.mn.us/Docket.html?Id=25684, or obtained by contacting Larry Hartman, Office of Energy Security, 85 7th Place East, Suite 500, St. Paul, Minnesota 55101, phone: (651) 296-5089, email: larry.hartman@state.mn.us.

The record for the certificate of need for this project can be found on the eDockets system at: https://www.eDockets.state.mn.us/EFiling/search.jsp; search on the year "**09"** and number "**1046**".

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1. Introduction

On September 2, 2009, Lakefield Wind Project, LLC (applicant), filed a Certificate of Need application with the Minnesota Public Utilities Commission (Commission) for the Lakefield Wind Project (project). The applicant is proposing to construct a 205.5 megawatt (MW) large wind energy conversion system in Jackson County, Minnesota.

The project will consist of 137 (1.5) MW wind turbines, transformers, collection lines, a short 345 kV transmission line, one substation, access roads, an operation and maintenance facility, and two permanent meteorological towers.

The project area is located in Jackson County in south-central Minnesota north, south, and east of the City of Lakefield (Map 1: Project Vicinity Map). It is comprised of approximately 32,445-acres (50.7 square miles), most of which is agricultural land. Electricity from the project would be collected and transmitted to the project substation via 34.5 kilovolt electric lines. The project would connect to the electrical transmission grid via a 345kV line to the Lakefield Junction substation.

In addition to a certificate of need (CON), the project requires a site permit for the wind farm from the Commission. The site permit is being considered by the Commission in separate docket (WS-09-1239).

The proposed project is a large energy facility as defined by Minnesota Statute 216B.2421 and requires the Minnesota Department of Commerce to prepare an environmental report (ER) (Minn. Rules 7849.1200). Office of Energy Security, Energy Facility Permitting (OES EFP) staff has prepared this ER to fulfill this requirement. The ER is part of the record which the Commission will consider in making a decision on a CON for the project.

The Lakefield Wind project would provide renewable energy to Indianapolis Power and Light (IPL). IPL, an Indiana public utility, would purchase power through the Midwest Independent Transmission System Operator (MISO), a regional transmission organization.[1] IPL is seeking to diversify its electrical generation portfolio with low or zero-carbon generation technologies. Accordingly, alternatives examined in the ER are limited to technologies that support this objective. These alternatives include: (1) a generic 205.5 MW wind generation project sited elsewhere in Minnesota, (2) a 78 MW biomass plant[2], and (3) a "no build," and (4) other renewable energy technologies.

Organization and Content of this Document
This Environmental Report is organized into eight sections:

[1] Midwest Independent Transmission System Operator (MISO), http://www.midwestiso.org/home .

Section 1: Introduction
Section 2: Regulatory Framework
Section 3: Description of the Proposed Project
Section 4: Project Alternatives
Section 5: Availability and Feasibility of Alternatives
Section 6: The No build alternative
Section 7: Potential Human and Environmental Impacts of the Project and Alternatives
Section 8: Additional Permits

Sections three through seven discuss the project, alternatives, associated impacts, and mitigation.

Sources of Information

Information for this report is drawn from multiple sources and cited throughout. The primary source documents used are the applications submitted by Lakefield Wind Project, LLC to the Commission:

- Application for Certificate of Need, 205.5 MW Lakefield Wind Project, September 2, 2009[3]
- Application for Site Permit, 205.5 MW Lakefield Wind Project, November 4, 2009.[4]

Information from other reports issued by the Minnesota Environmental Quality Board and Minnesota Department of Commerce reports have been incorporated as applicable.

[3] Application for Certificate of Need, 205.5 MW Lakefield Wind Project, September 2, 2009 [hereafter CN Application], https://www.edockets.state.mn.us/EFiling/edockets/searchDocuments.do?method=showPoup&documentId={21364163-269C-4042-83B1-4AC544E2226D}&documentTitle=200911-43635-05 .

[4] Application for Site Permit, 205.5 MW Lakefield Wind Project, October 13, 2009 [hereafter Site Permit Application], http://energyfacilities.puc.state.mn.us/resource.html?Id=25685.

2. Regulatory Framework

Lakefield Wind Project, LLC (applicant), is proposing to construct the Lakefield Wind Project in Jackson County, Minnesota. The project is a large wind energy conversion system as defined in the Wind Siting Act (Minn. Stat. Ch. 216F). The project is designed to produce 205.5 megawatts (MW) of power and meets the definition of a large energy facility per Minnesota Statutes section 216B.2421.

In accordance with Minnesota Statutes section 216B.243, no large energy facility may be sited or constructed in Minnesota without issuance of a Certificate of Need (CN) by the Minnesota Public Utilities Commission (Commission). Accordingly, on September 2, 2009, the applicant submitted a Certificate of Need application to the Commission. On December 21, 2009, the Commission issued an order accepting the application as complete and authorizing an informal review process.[5]

The informal review process is designed to develop a record upon which a CN decision is made, including: (1) a notice and comment period, (2) analysis by Department of Commerce, Office of Energy Security, Energy Regulation and Planning (OES-ERP) staff, (3) analysis by Office of Energy Security, Energy Facility Permitting (OES-EFP) staff, and (4) a public hearing conducted by an administrative law judge (ALJ). Based on the ALJ's hearing report and entire record, Commission staff will make a recommendation to the Commission on issuance of the certificate of need. The Commission is the final decision-making body.

2.1 Environmental Report

Pursuant to Minnesota Rule 7849.1200, the analysis provided by EFP staff takes the form of an environmental report (ER). The ER provides an analysis of potential human and environmental impacts of the project, as well as alternatives to the project. To develop the ER, EFP staff is required to conduct at least one public meeting in the proposed project area. The purpose of the meeting is to advise the public of the project and to solicit public input into the scope of the ER. A "scope" is a determination of what needs to be assessed in the ER to fully inform decision-makers and the public about the possible impacts and potential alternatives of the project.

EFP staff held a public information and scoping meeting on April 8, 2010, in Lakefield, Minnesota. Approximately 80 people attended the meeting. A public comment period followed the meeting; the comment period closed on April 29, 2010. Three written comment were received during the comment period. One comment was concerned with setbacks for non-participating landowners and the other comments expressed concerns about impacts to

[5] Order Finding Application Complete and Authorizing Informal Review Process, December 21, 2009, https://www.edockets.state.mn.us/EFiling/edockets/searchDocuments.do?method=showPoup&documentId={96945E12-CE14-42FB-B6D1-84413C81F627}&documentTitle=200912-45289-01 .

existing road infrastructure. A comment letter from the Minnesota Department of Natural Resources was received after the comment period. The comment letter from the Minnesota Department of Natural Resources (January 2010), is comprised of a four page letter, two brochures (one on "Working Lands for Wildlife Initiative" and the other on "Important Bird Areas" from the National Audubon Society), and an aerial photo identifying three exclusion areas (one is outside the project boundary) for turbine placement.

Based on the scoping comments received and the rules governing the scope of an ER (Minn. Rules part 7849.1500), the Director of OES issued a scoping decision on June 4, 2010 (Appendix A). This environmental report has been developed in accordance with the scoping decision.

A public hearing conducted by an ALJ will be held in the project area to further develop the record for a Commission decision. This ER will be introduced into the record by EFP staff.

2.2 Permits

Site Permit

In addition to the Certificate of Need, the proposed project requires a site permit (Minn. Stat. §216F.04). Site permits are issued by the Commission and are considered by the Commission in a separate docket[6]. A site permit authorizes the siting and construction of the project and can not be issued before a certificate of need has been issued for the project (Minn. Stat. section 216B.243).

Additional Permits

In addition to approvals issued by the Commission, the project will require permits and approvals from federal agencies, additional state agencies, and local governments. These permits are discussed in Section 8.

Public Participation

The Commission relies on public participation for the development of a thorough record for the project for both the certificate of need and site permitting process. Citizens are assured state issued notices for the project by placing their name on the appropriate EFP project contact lists. Citizens can sign up for the Lakefield Wind Project lists on-line: http://energyfacilities.puc.state.mn.us/Docket.html?Id=25684 .

Citizens may also join the project mailing list by contacting EFP state permit manger Larry Hartman, phone: (651) 296-25089, email: larry.hartman@state.mn.us.

[6] The Commission docket number for the site permit is: WS-09-1239; see http://energyfacilities.puc.state.mn.us/Docket.html?Id=25684 .

3. Description of the Proposed Project

Lakefield Wind Project, LLC (applicant), is proposing to construct the Lakefield Wind project (project), a 205.5 MW wind farm in Jackson County, Minnesota. Lakefield Wind Project, LLC, is a subsidiary of enXco Development Corporation. Lakefield Wind Project LLC, and its member eDC, will own and oversee the engineering, procurement, and construction of the project and will perform various aspects of the work itself or the use of qualified contractors. EnXco Service Corporation will operate the project. The project would produce renewable energy for the regional electric transmission system (MISO) for consumers in the Midwest.

3.1. Project Location

The Project site is located in Heron Lake, Belmont, Des Moines and Hunter townships about six miles west of Jackson, MN (Map 1 : Project Vicinity and Map 2: Project Location). Lakefield Wind has over 19,780 acres under easement agreement within the proposed 32,445-acre project area.

The Project is situated atop the Altamont moraine, a recessional moraine left behind by the Des Moines lobe, which is some of the highest land in the county. The moraine characteristically has more topographic relief than surrounding portions of the county. The topography of Jackson County can be generally described as nearly level or gently undulating with smaller areas of hilly and steep topography. The site is located on the watershed divide, with the southwestern portion flowing to the Little Sioux River and eventually to the Missouri River, and the northern and eastern portions of the county flowing to the Mississippi River.[7]

3.2. Project Description

The Lakefield Wind Project is a 205.5 MW wind farm consisting of up to 137 General Electric (GE) 1.5 MW wind turbine generators with a hub height of 262.5 feet (80 meters) and a rotor diameter of 252 feet (77 meters). In addition to the wind turbines, the project will include gravel access roads, two permanent meteorological towers, an electrical collection system, junction boxes delivering power the proposed project substation, and short 345 kV transmission line (less than 1,500 ft) connecting the project substation to the Lakefield Junction substation. Existing buildings near the site would likely serve as operations and maintenance facilities. The Lakefield Junction Substation is the point of interconnection to the electrical grid. The project substation and associated transmission line up to the point of interconnection would be permitted through Jackson County. [8]

[7] Site Permit Application, Section 4.12.

[8] Transmission lines less than 1,500 feet in length do not require a route permit from the Minnesota Public Utilities Commission.

Power from each turbine will be fed down the tower from the generator through the power conditioning equipment and breaker panel out to a pad mount transformer. The pad mount transformer steps the voltage up to an internal collector system voltage of 34.5kV. Electricity will run through collection and feeder lines to the project substation and to the point of interconnection on the power grid.

Some site permit conditions for large wind energy conversion systems (LWECS) are based on criteria which are dependent on turbine size.[9] Turbines must be placed within the project boundary and meet all permit conditions. The micrositing of the wind turbines will depend on various factors, including the size of the turbines chosen. Table 1 provides turbine specifications for the GE wind turbine model under consideration. A preliminary turbine layout using 1.5 MW turbines is shown on Map 3 at the end of this document.

Table 1. Wind Turbine Specifications[10]

Characteristic	GE 1.5 MW Wind Turbine
Hub Height	80 m (262 ft)
Rotor Diameter	77 m (253 ft)
Total Height	118.5 m (389 ft)
Cut-in Wind Speed	3.5 m/s (7.8 mph)
Rated Capacity Wind Speed	11.1 m/s (24.8 mph)
Cut-out Wind Speed	25 m/s (55.9 mph)
Rotor Speed	10-20 rpm
Distance to 50 dB(A) Noise Level	190 m (623 ft)
3 Rotor Diameters	231 m (759 ft)
5 Rotor Diameters	385 m (1,265 ft)

m = meters, ft = feet, m/s = meters per second, mph = miles per hour, rpm = revolutions per minute

[9] For example, turbine setbacks from the project boundary and all non-participating lands are expressed in rotor diameters (RD). Rotor diameters vary with turbine size.
[10] Adapted from GE Turbine technical Specifications, http://www.gepower.com/prod_serv/products/wind_turbines/en/15mw/specs.htm

Turbine towers will be secured to concrete foundations that are approximately 40-50 feet on a side.[11] A control panel inside the base of each turbine tower houses communication and electronic circuitry. Each turbine will be connected to a supervisory control and data acquisition (SCADA) system. The SCADA system allows for real-time monitoring and control of turbine operation.

Facilities associated with the project include gravel access roads, a project substation, an operation and maintenance (O&M) building, meteorological towers, and an electrical collection system. The project will connect to the transmission grid through a 345 kV transmission line from the project substation to the existing Lakefield Junction substation. Approximately 400 acres of the 19,000 acres under site control would be impacted by the project. Permanent impacts would affect approximately 150 acres.[12]

Electricity generated by each turbine is stepped up by a pad-mounted transformer at the base of each turbine to a 34.5 kV collection line. The collection lines and SCADA fiber optic cable will be buried. The 345 kV overhead transmission line (1,500 ft) between the project substation and the Lakefield Junction substation, will be an overhead line. The Lakefield Junction substation would be the point of entry into the electrical grid. The location of the project substation would be sited near the geographic center of the project and will be permitted through Jackson County. Power entering the project substation will be transformed to a voltage of 115 kV and transmitted to the existing 3345 kV transmission line.

A road system will be constructed providing access to each turbine for construction, maintenance, and eventual decommissioning. Roads will be sited in areas with stable soils and will be constructed to include appropriate drainage and culverts such that use by agricultural equipment will not be limited. Access roads will be approximately 16 feet wide. Turbine layout will attempt to minimize the length and extent of access roads. Approximately 30 miles of access roads will be constructed for the project. Roads will be constructed of gravel over a graded dirt base and geotextile fabric (as needed). Roads will include appropriate drainage and will be maintained over the life of the project.

The location of the operation and maintenance (O&M) facilities has not yet been determined, although they are usually located adjacent to the project substation. Lakefield Wind is considering the purchase of two existing structures for use as O&M facilities at 502 South Highway 86 in the City of Lakefield. The two buildings total approximately 19,300 square feet.

Once the project is constructed, the applicant will install two permanent meteorological towers within the project area for the duration of the project. These permanent towers will be free standing, galvanized steel towers 80 m in height (262 feet). Meteorological towers provide

[11] Personal communication, Westwood Professional Services, June 2010.
[12] Number of acres impacted by the project includes the total area of turbine pads, access roads, and substations.

complete integration and monitoring. Meteorological towers provide real-time data to the SCADA system and allow for remote monitoring of weather conditions.

3.3. Project Cost and Schedule

The cost of developing and constructing the Lakefield Wind Project is estimated to be $480-$490 million dollars.[13] Operating costs are estimated to be $10 million per year over the life of the project. The applicant anticipates beginning construction in late 2010 or early 2011 (pending receipt of approvals), with commercial operation beginning in 2011. The date of commercial operation depends on interconnection, permitting, and other project development activities.

[13] Site Permit Application, Section 3.6. The range of capital development costs were estimated by multiplying the cost per kilowatt hour ($2,400) by nameplate capacity (205.5 MW): 205.5 MW x (1,000 kW/MW) x ($2,400/kW) = $476 million dollars.

4. Description of Project Alternatives

Minnesota Rule, part7849.1200 requires the Commission to consider alternatives to the proposed project. In addition to evaluating alternatives and their impacts, a no build option must also be evaluated. This section provides a discussion of alternate power sources to the Lakefield Wind project. The alternatives considered would generate an equivalent amount of energy as the proposed project and provide a renewable, low or zero carbon emission energy source to Indianapolis Power and Light.

Alternatives evaluated include: (1) a 205.5 MW wind generation plant (LWECS) sited elsewhere in Minnesota, (2) a 78 MW biomass plant, (3) a "no build" alternative, and (4) other renewable energy technologies.

4.1. 205.5 MW LWECS

An alternative to the proposed Lakefield Wind project in Jackson County, MN, is a large wind energy conversion system (LWECS) project sited elsewhere in Minnesota. Such a project could be a 205.5 MW project or a combination of smaller dispersed projects.

4.2. 78 MW Biomass Plant

One alternative renewable energy source to the proposed project would be a biomass plant of equivalent electricity generation as the proposed project. Biomass is any organic matter that is available on a renewable or recurring basis. It includes all plants and plant derived materials, including agricultural crops and trees, wood and wood residues, grasses, aquatic plants, animal manure, municipal residues, and other residue materials. Plants (on land or in water) use the light energy from the sun to convert water and carbon dioxide to carbohydrates, fats, and proteins along with small amounts of minerals.[14] Combustible gases from landfills or anaerobic digestion of waste material is referred to as biogas.

Solid biomass can be burned like coal to produce steam. It can also be gasified and burned like natural gas. Various forms of biomass are utilized in Minnesota. The St. Paul District Energy, a combined heat and power facility in downtown St. Paul, MN is fueled primarily by woody biomass and has an electric generation capacity of 25 MW. The 55 MW Fibrominn plant in Benson, MN burns turkey litter. The Laurentian Energy Authority operates facilities in Hibbing and Virginia, MN with a combined capacity of 35 MW converts woody and agricultural biomass into electricity.

[14] From the Oak Ridge National Laboratory's Biomass Energy Notebook, http://cta.ornl.gov/bedb/introduction/Biomass_Overview.shtml

The biomass alternative considered in this ER would likely burn a combination of woody and agricultural biomass, such as corn stover, with natural gas as a backup fuel. A similar plant, the 38.5 MW NGPP Minnesota Biomass, LLC, electric generation facility, has undergone environmental review in Minnesota (2003) and provides data on potential impacts. [15] The Lakefield Wind project would have a capacity of 205.5 MW, with an estimated capacity factor of 38 percent. The 78 MW biomass alternative examined in this ER provides the equivalent energy generation as the proposed project.[16]

4.3. No Build Alternative

The no build alternative considers the impacts of taking no action. The analysis for this alternative considers the potential benefits and limitations of not constructing the proposed project.

4.4. Other Renewable Energy Technologies

Solar

Technologies for converting solar energy to electricity include thermal conversion (typically using sunlight to generate steam to turn a turbine) and photovoltaic cells (direct conversion of sunlight to electricity). Thermal systems convert sunlight into heat by concentrating sunlight with mirrors and transferring the resultant energy to a fluid medium (e.g., water, brine).[17] The energy is transferred via a heat exchanger to produce steam, and electricity is produced in steam turbine generators. Photovoltaic cells convert sunlight into electricity through semiconductor modules, typically installed in arrays.[18]

Solar technologies are more commonly employed in areas of the United States with relatively greater solar resources, i.e., the southwestern United States.[19] As an example, utility-scale thermal conversion systems (100 to 1000 MW) are being developed in California.[20] Large scale

[15] EQB Docket No. 03-67-EAW-NGP Biomass [hereafter Minnesota Biomass EAW]; see http://energyfacilities.puc.state.mn.us/Docket.html?Id=4452

[16] 205.5 MW x 0.38 = 78 MW. The biomass alternative, because it has natural gas backup, is assumed for analysis purposes to have a capacity factor of 1.0. Scheduled and unscheduled maintenance would make the effective capacity factor slightly less than 1.0.

[17] Concentrating Solar Power, http://www1.eere.energy.gov/solar/csp_program.html.

[18] Photovoltaics, http://www1.eere.energy.gov/solar/photovoltaics.html.

[19] Concentrated Solar Power Resource Potential, http://www.eia.doe.gov/cneaf/solar.renewables/ilands/fig12.html; Solar Photovoltaic Resource Potential, http://www.eia.doe.gov/cneaf/solar.renewables/ilands/fig11.html.

[20] Large Solar Energy Projects, http://www.energy.ca.gov/siting/solar/index.html. In order to meet California's renewable portfolio standard, large solar energy projects are being proposed in California deserts on federal Bureau of Land Management (BLM) land.

PV systems are more prevalent in Europe; however several large PV systems (230 to 600 MW) are being developed in California.[21]

Hydropower

Hydroelectric power plants convert the potential energy of water into electricity by passing the water through a turbine; the water turns the turbine and connected electric generator, thus producing electrical energy. The electrical generating capacity of a hydropower plant is primarily a function of two variables: (1) flow rate and (2) hydraulic head, which is the pressure created by water flowing from a higher to a lower elevation. Depending on the particular waterway being considered, project design may concentrate on either of these variables.

There are undeveloped hydropower resources in Minnesota with an estimated total electrical generation capacity of 136 MW.[22] This capacity is spread across 40 potential hydropower sites.[23] The nation's first ever commercial hydrokinetic power station is scheduled to come on-line in 2009 near the city of Hastings, Minn.[24] The city is installing the project at its 4.4-megawatt hydropower plant on the Army Corps of Engineers' Lock & Dam No. 2. The power generated by the two hydrokinetic units, each with a nameplate capacity of 100 kilowatts (0.1 MW), will be placed on the electric power grid through the city's existing electrical infrastructure.

Fuel Cells

A fuel cell is an electrochemical device that, without combustion, combines hydrogen and oxygen to produce water, electricity, and heat. Fuel cells require a hydrogen source for operation. This source can be pure hydrogen (hydrogen) or a hydrocarbon (e.g., methanol, natural gas). There are a number of fuel cell designs derived primarily from the electrolyte used to direct electrical charges within the cell.

Fuel cell generation capacities are in the range of 100 kW to 100 MW.[25] Fuel cells are typically used as backup or additional electrical generation capacity for a specific end user. Accordingly, they are usually placed at the point of energy use, e.g., at a specific business location.[26]

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[21] List of Photovoltaic Power Stations, http://en.wikipedia.org/wiki/List_of_photovoltaic_power_stations#Large_systems_in_planning_or_under_construction.

[22] U.S. Hydropower Resource Assessment for Minnesota, July 1996, U.S. Department of Energy (DOE), http://hydropower.inel.gov/resourceassessment/pdfs/states/mn.pdf.

[23] Id.

[24] Hastings Hydrokinetic Power Station USA, http://www.power-technology.com/projects/hastingshydrokinetic/.

[25] Fuel Cell, http://en.wikipedia.org/wiki/Fuel_cell.

[26] Fuel Cells in Backup Power Application, http://www1.eere.energy.gov/femp/pdfs/hydrogenfc_tir.pdf; Bloom Energy Claims a New Fuel Cell Technology, New York Times, February 23, 2010, http://www.nytimes.com/2010/02/24/business/energy-environment/24bloom.html. The article indicates that Google, Bank of America, and Wal Mart are testing fuel cells at their business locations

Anaerobic Digestion

Anaerobic digestion is the decay of organic manner in the absence of oxygen. This decay produces hydrocarbon gases (e.g. methane) whose combustion can used to turn a turbine and electrical generator. There are two primary anaerobic digestion processes used to produce electricity: (1) anaerobic digestion of animal manures creating biogas and (2) anaerobic digestion of municipal solid waste creating landfill gas (LFG).[27] On-farm production of biogas is often limited to dairy farms with more than 400 cows, though small farms can utilize the technology for heating instead of electrical generation. Electrical generation capacity for biogas facilities ranges from kilowatts to over 13 MW.[28]

There are currently seven landfill gas projects in Minnesota, generating a total of 26 MW.[29] The largest facility generates 12 MW. The estimated potential electrical generation capacity of all landfills in Minnesota is 45 MW.[30]

5. Feasibility and Availability of Alternatives

This section describes the feasibility and availability of alternatives to the Lakefield Wind Project.

Lakefield Wind Project

The proposed project is feasible and available.

Generic 205.5 MW LWECS

A generic 205.5 MW LWECS is feasible and likely available. Wind farms are in development across the state and Minnesota's wind resources are sufficient to facilitate a 205.5 MW project. Feasibility and availably are dependent on the ease of interconnection to the electrical transmission grid. In some parts of the state, the transmission grid is very near capacity and the connection of additional generating capacity is not easily achieved.

78 MW Biomass Plant

A 78 MW biomass plant is feasible and likely available. Currently there is not a biomass plant of this size in Minnesota.[31] Many factors could limit the availability of a 78 MW biomass plant, including equipment, financing, and consistently available biomass fuels.

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[27] Energy Policy and Conservation Report, 2008, Minnesota Office of Energy Security, p. 25-27, [hereafter Quad Report 2008], http://www.state.mn.us/mn/externalDocs/Commerce/Quadrennial_Report__2008_091509012935_2008-QuadReport.pdf.

[28] Id.

[29] Id.

[30] Id.

No Build Alternative

The no build alternative is feasible and available, but would not further Minnesota's renewable energy objectives.

Solar

A solar facility is not a feasible alterative to the Goodhue Wind Project. There are thermal and photovoltaic systems in development that are similar in scale to the proposed project. However, most systems are substantially smaller. The output of all photovoltaic systems in Minnesota is just over one megawatt (1 MW).[32] A photovoltaic system designed to replace the Goodhue Wind Project would be among the largest proposed worldwide.[33] Additionally, these systems rely on solar resources which are not available in Minnesota. Solar resources in Minnesota are approximately 40-60 percent of those of the southwestern United States.[34] Of the two solar technologies (thermal and photovoltaic), photovoltaic is a better long term fit for Minnesota's solar resources. Implementation of distributed photovoltaic generation on the scale needed to serve as an alternative to the Lakefield Wind project would likely require supporting public policy, e.g., feed-in tariff.[35]

Hydropower

Hydropower is not feasible or available. To produce the electrical energy equivalent of the Lakefield Wind Project would require developing all of Minnesota's hydropower resources simultaneously and providing appropriate connections to the electrical transmission grid.[36]

Fuel Cells

Fuel cells are commercially available but generally not at a scale similar to the Lakefield Wind Project. Additionally, to date, fuel cells have been used solely as an electrical supply for a

[31] The Fibrominn plant has an output of 55 MW and uses turkey litter as fuel source, http://www.fibrowattusa.com/projects/fibrominn/

[32] Quad Report 2008, p. 28.

[33] Capacity factors for photovoltaic systems are in the range of 0.20 - 0.30. Thus, an appropriately-sized alternative to the proposed project would be approximately 122 MW (78 MW x 0.39/0.25 = 122 MW). The largest proposed solar farm in the United States is the Rancho Cielo Solar Farm, with a project output of 600 MW. See the List of Photovoltaic Power Stations, http://en.wikipedia.org/wiki/List_of_photovoltaic_power_stations#Large_systems_in_planning_or_under_construction.

[34] Concentrated Solar Power Resource Potential, http://www.eia.doe.gov/cneaf/solar.renewables/ilands/fig12.html; Solar Photovoltaic Resource Potential, http://www.eia.doe.gov/cneaf/solar.renewables/ilands/fig11.html.

[35] New Oregon Feed-In Tariff Could Make Solar a Paying Proposition, http://sunpluggers.com/stories/new-oregon-feed-in-tariff-makes-solar-paying-proposition-0555.

[36] The average annual capacity factor for hydroelectric power is approximately 45 percent. Thus, an appropriately-sized hydropower project would be 178 MW (205.5 MW x 0.39/0.45 = 178 MW). This exceeds Minnesota's hydropower potential (178 MW / 136 MW = 1.3). See, Hydropower Program Assumptions, p. L-7, http://www1.eere.energy.gov/ba/pba/pdfs/gpra_fy05_appendix_l.pdf.

specific end user. They have not been used as part of utility's generation portfolio. Finally, current commercial fuel cells are likely not an eligible energy technology such that their implementation would further Minnesota' renewable energy objective. Eligible technologies include those which produce electricity from hydrogen.[37] However, if the hydrogen source for a fuel cell is a geologic hydrocarbon (e.g., natural gas), then the fuel cell would not qualify as an eligible energy technology.[38]

Anaerobic Digestion

Anaerobic digestion is not feasible or available at a scale similar to the proposed project. The largest biogas and LFG facilities in Minnesota are substantially smaller than the proposed project. The current electrical generation capacity of all landfills in Minnesota is 26 MW.

[37] Minn. Stat. § 216B.1691, Subd. 1. Eligible energy technologies include technologies that generate electricity from solar, wind, hydroelectric, hydrogen, or biomass.

[38] Id. The statute notes that hydrogen is an eligible energy technology only if the hydrogen is generated by a renewable energy source, i.e., solar, wind, hydroelectric, biomass.

6. The No Build Alternative

6.1. Impacts

Three primary types of impacts can be identified if the Lakefield Wind Project is not built: (1) Indianapolis Power and Light (IPL) will not meet its objective to diversify its generation assets with zero emission generation technology, (2) potential economic benefits in the project area will not be realized, and (3) negative impacts associated with non-renewable energy sources.

Renewable Energy Objectives

Through recent legislation, Minnesota has encouraged the generation of renewable energy, such as wind power through the Minnesota Renewable Energy Objectives (Minn. Statutes, section 216B.1691). To date, the state of Indiana has not adopted specific renewable energy requirements.[39] However, all Indiana Investor Owned Utilities, including Indianapolis Power and Light, have voluntarily added renewable energy to their portfolios. In addition to state and federal renewable energy efforts, consumer interest in renewable energy has increased the demand for wind power development across the Midwest. This project would allow Indianapolis Power and Light to diversify its generation assets with zero emission generation technology and mitigate the risk of possible future regulation of greenhouse gas emissions.

Loss of Economic Benefits

The Lakefield Wind project would be a zero carbon emission generation project with economic benefits to the State of Minnesota through direct payments to landowners, potential employment opportunities during construction and operation of the project, and production taxes that would be paid to Jackson County. There would be a direct loss of economic benefits in the project area if the proposed project is not built. Landowners would lose wind easement payments over the life of the project and local governments would lose wind energy production tax revenues estimated at $900,000 dollars annually.[40] In addition, the project would generate numerous local temporary jobs during construction and 15 -20 permanent jobs.[41] Employment opportunities and their associated income would be lost if the project is not built.

Replacement with a Non-Renewable Resource

If the Lakefield Wind project is not built, the electrical power it would produce may be replaced with a non-renewable energy resource.[42] While the impacts associated with non-renewable

[39] Certificate of Need Application, Section 1.2.
[40] CN Application, P. 11.
[41] Site Permit Application, Section 4.2.2
[42] In 2008, non-renewable energy sources accounted for approximately 92 percent of Minnesota's electrical energy supply. Energy Policy and Conservation Report ("Quad Report"), 2008, http://www.state.mn.us/mn/externalDocs/Commerce/Quadrennial_Report__2008_091509012935_2008-QuadReport.pdf.

sources vary, it is possible to estimate the potential impacts of replacing the Lakefield Wind project with energy derived from coal. The proposed project will produce approximately 850 gigawatt-hours annually (GWh/yr).[43] If the equivalent amount of energy were produced by a standard coal-fired plant, the plant would emit the approximate levels of pollutants:[44]

- 1154 tons/yr of nitrous oxides (NO_x)
- 1154 tons/yr of sulfur dioxide (SO_2)
- 919,000 tons/yr of carbon dioxide (CO_2)

Nitrous oxides (NO_x) are greenhouse gases that cause ozone and related respiratory illnesses.[45] Sulfur oxides (SO_x) can are associated with acid rain and human respiratory illness.[46] Carbon dioxide (CO_2) is a common greenhouse gas and contributes to climate change and associated impacts.

Benefits
The benefits of not building the Lakefield Wind project would include avoidance of potential human and environmental impacts associated with the project. These would include potential human impacts such as noise and shadow flicker, short term localized emissions from diesel powered construction equipment, and potential impacts to wildlife, particularly avian and bat species.

7. Human and Environmental Impacts

This section discusses the potential human and environmental impacts of the Lakefield Wind Project and project alternatives. The alternatives include: (1) a 205.5 MW wind energy conversion system (LWECS) sited elsewhere in Minnesota, and (2) a 78 MW biomass plant. The potential impacts of the no build alternative are discussed in Section 5. Additionally, this section provides mitigation strategies for potential impacts.

7.1. Air Emissions – Criteria Pollutants

Electric generation facilities have the potential to emit air pollutants during construction and operation. Minnesota Rules part 7849.1500 requires this ER to examine emissions of the following pollutants: sulfur dioxide (SO_2), nitrogen oxides (NO_x), carbon dioxide (CO_2), mercury

[43] 205.5 MW x (1 GW/1000 MW) x (0.38) x (24 hours/day) x (365 days/yr.) = 848 GWh/yr.
[44] Minnesota Energy Planning Report, 2001, http://www.state.mn.us/mn/externalDocs/Commerce/Energy_Planning_Report_121602022402_2002PlanningRpt.pdf. Emission rates per unit of electricity estimated at 0.003 lbs/kWh (NO_x, SO_2) and 2.39 lbs/kWh (CO_2). For this project, kilowatt hours are estimated at 848,000,000 and 848 gigawatts.
[45] Health and Environmental Impacts of NO_x, http://www.epa.gov/air/nitrogenoxides/.
[46] Health and Environmental Impacts of SO_2, http://www.epa.gov/air/urbanair/so2/.

(Hg), and particulate matter (PM). These common pollutants (other than mercury) are known as criteria pollutants.[47]

Lakefield Wind Project

The Lakefield Wind Project will emit no criteria pollutants during operation. A minimal amount of these pollutants will be produced during construction, largely due to the operation of heavy machinery and equipment. Transmission lines, under certain conditions, produce limited amounts of ozone and nitrogen oxide emissions. Emissions of these pollutants would be minimal.

Generic 205.5 MW LWECS

A generic 205.5 MW LWECS would emit no criteria pollutants during operation, and would have ancillary emissions from construction and transmission similar to those from the Lakefield Wind Project.

78 MW Biomass Plant

A 78 MW biomass plant would emit criteria pollutants (Table 2). These pollutants are based on a plant similar to the NGPP Minnesota Biomass plant (see Section 4.2). Each of these pollutants is known to cause environmental health impacts. Sulfur oxides (SO_x) cause acid rain and human respiratory illness.[48] Nitrous oxides (NO_x) are greenhouse gases that cause ozone and related respiratory illnesses.[49] Carbon dioxide (CO_2) is a greenhouse gas contributes to climate change and associated impacts.[50] Mercury can cause impaired neurological development in children.[51] Inhalation of particulate matter causes and contributes to human respiratory illness.[52]

[47] What Are the Six Common Air Pollutants?, http://www.epa.gov/air/urbanair/.
[48] Health and Environmental Impacts of SO_2, http://www.epa.gov/air/urbanair/so2/.
[49] Health and Environmental Impacts of NO_x, http://www.epa.gov/air/nitrogenoxides/.
[50] Climate Change 2007: Synthesis Report, Summary for Policymakers, An Assessment of the Intergovernmental Panel on Climate Change (IPCC), http://www.ipcc.ch/.
[51] Health Effects, http://www.epa.gov/mercury/effects.htm.
[52] Health and Environment, http://www.epa.gov/air/particlepollution/health.html.

Table 2. Rates of Biomass Plant Emissions: Criteria Pollutants[53]

Pollutant	**Emissions Rate** (lbs/kWh)	**Annual Emissions** (tons/year)
Sulfur Dioxide (SO_2)	3.46 E-04	118.2
Nitrogen Oxides (NO_x)	1.98 E-03	676.2
Carbon Dioxide (CO_2)	0.66[2]	2.25 E05
Mercury (Hg)	1.19 E-08	4.06 E-03
Particulate Matter (PM)	7.18 E-04	245.2

lbs/kWh = pounds per kilowatt-hour

Because these pollutants are diffused into the global atmosphere, regional impacts are difficult to quantify. However, impacts due to particulate matter and ground-level ozone can be localized. Particulate matter and ozone are the pollutants of most concern in Minnesota and are tracked regionally by the Minnesota Pollution Control Agency.[54] Because the plant would primarily utilize biomass for generation, net impacts from carbon dioxide will be minimal. Carbon dioxide released by the biomass plant would be utilized by living plants, which in time, would serve as fuel. The plant will operate as a largely closed carbon dioxide loop.[55]

Metallic compounds such as mercury exist throughout the environment. A primary source of mercury in the air is from coal generated power. The biomass plant considered here would use biomass as a primary fuel and natural gas as a backup fuel, with little, if any, mercury emissions.

Mitigation

Emissions of some criteria air pollutants can be mitigated through control technologies. Nitrous oxides emissions could be reduced by approximately 75 percent through use of a selective non-catalytic reduction (SNCR) system on the biomass boiler.[56] Particulate matter emissions could be reduced by 90 percent with add-on devices such as a multi-cyclone and dust collector.[57]

[53] Adapted from Minnesota Biomass EAW, http://energyfacilities.puc.state.mn.us/Docket.html?Id=4452. Boiler heat input capacity = (78/38.5) x 527.5 MMBtu/hr = 1068 MMBtu/hr.

[54] Air Quality Index for Minnesota, http://aqi.pca.state.mn.us/.
[55] Fuels used to collect and transport biomass would likely not be carbon neutral and would create carbon dioxide emissions.
[56] Minnesota Biomass EAW.
[57] Id.

In addition to the use of control equipment to mitigate pollutant impacts, a 78 MW biomass plant would conduct a best available control technology (BACT) analysis. The BACT analysis is a requirement of new facilities under federal new source review prevention of significant deterioration (PSD). A BACT analysis and implementation could limit emissions from the plant to less than those presented in Table 2.

7.2. Air Emissions – Hazardous Air Pollutants and Volatile Organic Compounds

Electric generation facilities have potential to emit air pollutants during construction and operation. Minnesota Rule part 7849.1500 requires this ER to examine emissions of hazardous air pollutants (HAP) and volatile organic compounds (VOC). Individually and in complex interactions with other compounds, these pollutants are either known to or suspected of, causing cancer and other serious health effects.[58]

Lakefield Wind Project

The Lakefield Wind project will not emit HAPs or VOCs during operation. Petroleum-based fluids used in the operation of wind turbines such as gear box oil, hydraulic fluid, and gear grease, have a low vapor pressure and any release of VOCs will be minimal. Impacts from construction will be minimal and localized and would include dust due to earth moving and emissions from diesel-powered construction equipment. Air pollution emissions would not occur as a result of this project.

Mitigation

Dust and emissions associated with the construction of the project would be similar to large scale outdoor construction activities such as road work and residential areas. The project area includes multiple construction "sites" in the form of individual turbines and a network of access roads. Dust from construction traffic can be controlled using standards construction practices such as watering of exposed surfaces, cover of disturbed areas, and reduced speed limits on site. Once project construction is completed, air and dust emissions related to vehicular traffic would be reduced and consist of routine maintenance and repairs.

Generic 205.5 MW LWECS

A generic 205.5 MW LWECS would not have HAP and VOC emissions and mitigation techniques would be the same as for the Lakefield Wind project.

78 MW Biomass Plant

A 78 MW biomass plant would emit HAPs and VOCs (Table 3: Rates of Biomass Plant Emissions). These pollutants are based on a plant similar to the NGPP Minnesota Biomass plant (see Section 4.2). Because these pollutants are diffused into the global atmosphere, regional impacts

[58] About Air Toxics, http://www.epa.gov/ttn/atw/allabout.html;

are difficult to quantify. The only area in Minnesota with a cancer risk due to HAPs greater than 100 in a million is the Minneapolis - Saint Paul metro area.[59] The emissions from the biomass plant would be relatively small compared with other sources.

Mitigation

It is possible to mitigate HAP and VOC emissions with control technologies. However, given the relatively small amounts of HAP and VOC emissions compared with the costs of control equipment, it is likely that control technologies will not be employed.

Table 3. Rates of Biomass Plant Emissions: Hazardous Air Pollutants and Volatile Organic Compounds[60]

Pollutant	Emission Rate (lbs/kWh)	Annual Emission Rate (tons/year)
Hazardous Air Pollutants (HAPs)	1.80 E-04	61.5
Volatile Organic Compounds (VOCs)	5.55 E-04	189

lbs/kWh = pounds per kilowatt-hour

7.3. Aesthetics and Visual Impairment

The large size and high-tech appearance of wind turbines causes them to stand out against the backdrop of the open, rural landscapes in which they are often sited. Additionally, due to their 400-foot height, they can be seen for long distances. Visual impairment would not be an issue with this project because wind turbines do not generate or emit by-products as a result of generation activities. This section discusses visual changes, shadow flicker, and perceptions of aesthetics of the proposed project.

Lakefield Wind Project

Viewshed

The Lakefield Wind Project would alter the current landscape through the introduction of large wind turbines. The project would also create shadow flicker. Many factors influence how a wind energy facility is perceived. Factors may include levels of visual sensitivity of individuals, viewing conditions, visual settings, and individual ideas and experiences. Distance from a turbine(s) and activities within and near the project area, landscape features such as hills and

[59] Summary of Results for the 2002 National-Scale Assessment, http://www.epa.gov/ttn/atw/nata2002/risksum.html.

[60] Adapted from Minnesota Biomass EAW, http://energyfacilities.puc.state.mn.us/Docket.html?Id=4452. Boiler heat input capacity = (78/38.5) x 527.5 MMBtu/hr = 1068 MMBtu/hr.

tree cover, as well an individual's personal feelings about wind energy technology can all contribute to how a wind energy facility is perceived. The Lakefield Wind project will be located in Jackson County, a predominantly rural agricultural area characterized by gently undulating topography.

Aesthetics

Development of an objective measure of aesthetics is a difficult. Current methods used to assess visual impacts include viewshed mapping, photographic simulations, and video animation.[61] All of these methods depend, to some extent, on assessing the current aesthetic resources of the project area, i.e., the aesthetics of the area before construction of a wind farm. Such an assessment can be subjective; however, state and federal agencies perform assessments regularly in the development of parks that have valuable aesthetic resources. The project area does not contain any state or federally designated scenic areas, such as state scenic highway or roads. Within and adjacent to the project boundary are several state wildlife management areas which provide recreational opportunities in a passively managed, "natural" landscape. Public lands provide numerous benefits, including aesthetic and visual. Recreational users would likely see turbines accessing these areas and from within them, potentially diminishing qualities of perceived remoteness and scenic value.

Lighting

Wind turbines, per Federal Aviation Administration (FAA) requirements and because of their height, would be lighted.[62] Generally, turbines have flashing white lights during the day and red lights during the evening. Turbine lighting would be consistent with other lighted towers on the landscape, such as communication towers.

Shadow Flicker

Shadow flicker is the intermittent change in light intensity due to rotating wind turbine blades casting shadows on the ground. Shadow intensity, or how "light" or "dark" a shadow appears at a specific receptor (usually a home), will vary with distance from the turbine. The closer a receptor is to a turbine, the more turbine blades block out a larger portion of the sun's rays and shadows will be wider and darker. Receptors located farther away from a turbine experience thinner and less distinct shadows since the blades block out less sunlight. Shadow flicker is reduced or eliminated when buildings, trees, blinds, or curtains are located between the turbine and receptor.

Visibility Impairment

[61] Visual Considerations: Public Perceptions, Regulatory Environment and Assessment Methods in the Eastern U.S., http://www.nationalwind.org/assets/blog/Allen-NWCC_2009.pdf.

[62] FAA Advisory Circular AC 70/7460-2K, HTTP://RGL.FAA.GOV/REGULATORY_AND_GUIDANCE_LIBRARY/RGADVISORYCIRCULAR.NSF/0/22990146DB0931F186256C2A00721867/$FILE/AC70-7460-2K.PDF.

The proposed project would not impact or otherwise impair visibility. Unlike other types of generation facilities that produce by-products and emissions that may diminish or reduce visibility, wind turbines do not produce emissions.

Mitigation

Mitigation of impacts to aesthetic and visual resources and shadow flicker is best accomplished through micrositing of wind turbines and maintaining designated setbacks from participating and non-participating landowners. In general, siting wind projects in rural areas minimizes human impacts. Aesthetic impacts to public lands can be mitigated by siting wind projects outside of these areas, and utilizing natural features such as topography and vegetation to reduce visual intrusions.

Setbacks from individual turbines, as embodied by Minnesota's general permit standards, mitigate visibility impacts.[63] Wind turbines must be set back from non-participating properties a distance of 5 rotor diameters (RD) on the prevailing wind direction and 3 RD on the non-prevailing wind direction. The potential setback distances for the Lakefield Wind Project are shown in Table 1. Additional setbacks may be required to meet Minnesota noise standards.[64] These setbacks minimize the visibility of the wind turbines and shadow flicker. Finally, turbines are designed to be a uniform off-white color to blend in with the horizon and reduce visibility impacts.

Lighting required by the FAA is similar to that for other tall structures in rural areas, and mitigation is not expected to be necessary.

[63] Commission Order Establishing General Permit Standards, http://energyfacilities.puc.state.mn.us/documents/19302/PUC%20Order%20Standards%20and%20Setbacks.pdf.
[64] Minnesota Rules Chapter 7030 at all residential receivers (homes). Residential noise standard NAC-1, L50 50 dBA during overnight hours.

Generic 205.5 MW LWECS

A generic 205.5 MW LWECS located elsewhere in Minnesota would have similar visual impacts and mitigation strategies. Impacts could potentially be mitigated by locating the project in a more rural area of Minnesota; however, such a location would also need wind resources equivalent to or greater than those in Jackson County. Impacts could also be mitigated by utilizing wind turbines capable of generating more energy. For example, a 205.5 MW project consisting of 1.5 MW turbines requires 137 turbines; a similar project consisting of 3.0 MW turbines requires 68 turbines. The larger turbines would create a larger individual "eyeprint," but the smaller number of turbines would likely create a relatively smaller visual impact for the project.

78 MW Biomass Plant

A 78 MW biomass plant would likely impact visual aesthetics in the immediate area of the facility, and in the surrounding area depending on the height of the stack plume. Shadow flicker would not be an issue due to the absence of rotating exterior parts.

A biomass plant would be industrial in nature with many buildings, conveyors, biomass piles, and a boiler stack. The building housing the boiler is likely to be at least 100 feet tall. The conveyors and biomass piles could range from 30 to 50 feet in height. Buildings, conveyors, and biomass piles would likely be lighted to allow for nighttime operation. Lighting would also be necessary for wood fuel loading/unloading points, truck scales, and vehicle parking areas.

The estimated height for the boiler stack is approximately 150 feet. Particulate matter control devices would capture most of the particulates from the boiler exhaust gas stream. Thus, the majority of the plume from the boiler stack would be water vapor. This plume may be seen during cold weather conditions, but would likely be virtually clear in warm weather. In cold weather, the plume may impair visibility. If taller than 200 feet, the boiler stack may require FAA lighting, similar to wind turbines.

Mitigation

Mitigation of visual impacts could be accomplished through siting of the biomass plant. The plant could be located in an industrial location allowing it to blend in with other industry and be located away from aesthetically valuable resources. However, the biomass plant would need to be located in an area where biomass is readily available in large quantities. Vegetative screening (trees, shrubs) could be used to partially block views of the industrial buildings, silos, conveyors, and boiler stack.

7.4. Ozone Formation

Large electric power generating facilities, such as biomass facilities, have the potential to produce reactive organic gases, which can lead to ground-level ozone formation. Wind turbines

do not produce ozone or ozone precursors. Minnesota Rules 7849.1500, subpart 2 requires that this ER address anticipated ozone formation.

Ozone can cause human health risks, and can also damage crops, trees, and other vegetation.[65]

Lakefield Wind Project

The Lakefield Wind project would not produce ozone or ozone precursors. Thus, there would no human or environmental impacts or mitigation related to ozone formation.

Generic 205.5 MW LWECS

A generic 205.5 MW LWECS would have ozone formation similar to the proposed project.

78 MW Biomass Plant

A 78 MW biomass plant would produce ozone precursors (e.g., NO_x, VOC) that would lead to ozone formation. Impacts from ozone are localized. The state of Minnesota is designated as in attainment for ozone by the Environmental Protection Agency (EPA). Given this status, ground level ozone formation and associated impacts are anticipated to be minimal.

Mitigation

Ozone formation could be mitigated by mitigating ozone precursors. See discussion in Sections 6.1 and 6.2 regarding nitrous oxides (NO_X) and volatile organic compounds (VOC) respectively.

7.5. Fuel Availability

Large electric power generating facilities require some type of fuel. This section discusses the availability of fuel for the proposed project and alternatives.

Lakefield Wind Project

The Lakefield Wind Project relies on wind to generate electricity. Wind is generated by earth and solar processes; accordingly, the fuel for the project is a very long-term renewable resource. Wind is not consumed by wind turbines. Wind turbine blades extract kinetic energy as the wind passes through the blades and creates turbulence downstream. To operative effectively, turbines must be setback from other turbines to compensate for this turbulence known as wake loss.[66]

[65] Ozone, http://www.epa.gov/Ozone/. Air Quality – Ozone, http://www.health.state.mn.us/divs/eh/air/ozone.htm.

[66] The distance between turbines necessary for effective operation is approximately 6 rotor diameters (RD) on the non-prevailing wind axis and 10 RD on the prevailing wind axis. Accordingly, Minnesota requires setbacks of 3 x 5 RD for each turbine. See, PUC Order Establishing General Permit Standards, http://energyfacilities.puc.state.mn.us/documents/19302/PUC%20Order%20Standards%20and%20Setbacks.pdf.

The availability of wind varies considerably across Minnesota, and has been analyzed by the Minnesota Department of Commerce.[67] Extensive wind measurements have been taken and analyzed. These data suggest the mean annual wind speeds at 80 meters, across Jackson County and the project area, to range from 8.1 -8.5 meters per second (mps) (18.1-19 mph).[68] Power generation by the project depends not only on wind speed (how much energy it contains), but also the frequency of attaining optimal wind speeds. Wind turbines generate power only when the wind is blowing.[69] This frequency is expressed as capacity factor, which is expressed as how much power the turbine generates compared to how much it could generate if it was operating all the time. Capacity factors of 35 to 40 percent are common in Minnesota for large wind energy conversion systems. The Lakefield Wind Project is estimated to have a capacity factor in this range.[70]

Generic 205.5 MW LWECS

A generic 205.5 MW LWECS would utilize the wind resources as the proposed project. To be economically feasible, a 205.5 MW LWECS sited elsewhere in Minnesota would need to be sited in area with sufficient wind resources to meet generation projections. The availability of productive, undeveloped wind resources in Minnesota remains high. Impacts on the wind resource would be similar to those for the Lakefield Wind Project.

78 MW Biomass Plant

A combination of wood chips and agricultural biomass would be the primary fuel sources for a 78 MW biomass plant. Natural gas would be used as a fuel backup. Such a plant would consume approximately 100,000 tons of biomass per month. There are currently no biomass plants of this size operating in Minnesota.[71]

It is possible that rail could be used for delivery of fuel to the plant, depending on its location. However, the most likely method of delivery for woody and agricultural biomass fuel would be semi-trailer trucks. Trucks would likely deliver wood and agricultural biomass by loads of 20 tons or greater. The biomass facility would operate 24 hours a day, but fuel delivery would be between the hours of 6 AM and 6 PM. The total number of daily truck trips is estimated to be approximately 100. The origin of the biomass trucks and the total trip length required for delivery would depend on the location of the biomass source relative to the biomass plant.

[67] Wind Resource Analysis Program 2002, http://www.state.mn.us/mn/externalDocs/Commerce/WRAP_Report_110702040352_WRAP2002.pdf.
[68] Site Permit Application, Section 2.0.
[69] See Table 1 which list includes "Cut-in Wind Speeds", i.e., the minimum wind speed necessary for the turbine to operate.
[70] Site Permit Application, Section 2.0.
[71] Xcel Energy's Bay Front power plant in Ashland, Wisconsin generates approximately 76 MW, and is moving toward becoming a 100% biomass plant.

A back-up fuel source would be required for the biomass plant, to assist with plant start-up and to sustain the plant temporarily when the biomass fuel supplies are low. Natural gas would be used as a backup fuel. The construction of a natural gas pipeline would be required to deliver the natural gas to the biomass plant.

Potential impacts to the environment related to fuel for a biomass plant include possible degradation of the environment due to biomass removal (increased soil erosion and productivity due to removal of agricultural biomass and loss of wildlife habitat), air pollution due to biomass transport, and the impacts associated with building a natural gas pipeline.

Mitigation

Impacts related to fuel for a biomass plant could be mitigated by using guidelines for biomass harvesting. These guidelines minimize impacts to natural resources. Siting the plant in a location that reduces biomass transportation will reduce the impacts to air quality associated with ground transportation. The Minnesota Forest Resource Council (MFRC) has developed woody biomass harvest guidelines that reduce impacts to wildlife habitat.[72] If harvesting guidelines are used to mitigate impacts to natural resources and wildlife, suppliers of biomass fuels would need to follow biomass harvest guidelines.

7.6. Associated Transmission Facilities

Electrical generation facilities typically require construction of transmission facilities such as transmission lines and substations to connect to the transmission grid. This section discusses these associated transmission facilities and their potential impacts.

Transmission lines over 100 kilovolts and longer than 1,500 feet are defined as “high voltage transmission lines” and are subject to regulation by the Commission[73]. Wind generation facilities require construction of lower voltage electric infrastructure (typically, 34.5 kV), referred to as feeder or collector lines. Feeder lines collect power generated by the wind turbines and supply the project substation before connecting to the transmission grid.

Lakefield Wind Project

The Lakefield Wind project would construct a project substation near the center of the project area. The project substation would be 345 kV and consist of two 34.5 /345kV transformers, along with the associated switching and protection equipment, metering equipment, and a small control house. Power from the turbines would be collected at the substation and transmitted to the Lakefield Junction Substation via 1/4 –mile of overhead 345 kV transmission line. The Lakefield Junction Substation is the point of interconnect for the project.

[72] Forest Biomass and Biofuels Harvest, http://www.frc.state.mn.us/initiatives_policy_biofuels.html.
[73] Minn. Statute 216E.01, subdivision 4. Under Minn. Statute 216E.05, high voltage transmission lines between 100 and 200 kV may be permitted by local governments.

The Lakefield Wind project would collect the electrical power generated by turbines through a 34.5 kV underground collection system. Collector lines would be buried underground between turbines and carry power to interconnection points. Collector lines may either continue underground or be constructed above ground when they reach public roads or the edge of farm fields. The collection lines carry power to the project substation

Impacts from the project's associated transmission facilities would include impacts due to construction and impacts due to operation. Construction impacts would include impacts related to land clearing and materials transport. Operation impacts would include impacts related to electromagnetic fields (EMF), noise, and visibility. Power moving through a transmission line creates EMF. These fields decrease with distance from a transmission line. Stray voltage can occur with electrical distribution lines to residences and high voltage transmission lines that parallel them. Stray voltage flows through the ground between electrical systems that, by code, must be grounded (i.e., connected to the earth) to ensure safety.[74] This voltage may be commuted and felt by animals standing on the ground.

Stray voltage has been raised as a concern on dairy farms because of its potential to impact dairy cattle and milk production. Impacts, if they occur, are typically related to the grounding of electrical service to the farm (distribution lines) or on-farm electrical wiring.

During wet weather, water can be ionized adjacent to transmission lines creating a crackling noise. Visual impacts of a transmission line depend on context. High visual impacts likely occur when a line is located near areas with relatively higher population densities, e.g., residential, recreational, and scenic areas.

Mitigation

The project substation would be located adjacent to the existing Lakefield Junction Substation transmission line, thus minimizing the transmission corridor needed for interconnection.[75] Siting the project substation near the point of interconnection to the power grid reduces the extent of electric transmission poles and lines and associated impacts. Construction impacts could be mitigated by minimizing the amount of land cleared for the substation. Operation impacts could be mitigated by placing transmission lines away from population densities. Visual impacts could be mitigated by placing collector lines underground, while aesthetic impacts from overhead collector and transmission lines can be mitigated through design and pole placement.

[74] For a discussion of EMF and stray voltage see Brookings County – Hampton 345 kV Transmission Line Project, Draft Environmental Impact Statement [hereafter Brookings DEIS], Section 6.2, http://energyfacilities.puc.state.mn.us/resource.html?Id=25589.

[75] Site Permit Application, Section 3.3.2.

Generic 205.5 MW LWECS

A generic 205.5 MW LWECS would have transmission facilities similar to the proposed project. Potential impacts and mitigation strategies are also similar. The primary impact would be the length and voltage of the transmission line required to interconnect the wind project with the transmission grid. A relatively longer line or higher voltage would create greater construction and operation impacts.

78 MW Biomass Plant

A 78 MW biomass plant would have transmission facilities similar to the Lakefield Wind project; however an electrical collection system and project substation would not be required. The plant would include a transformer at the plant to transform the voltage to transmission levels and a transmission line between the plant and a substation where the power would enter the grid.

Potential impacts and mitigation strategies would be similar to those for the Lakefield Wind project. Again, the primary impact would be the length and voltage of the transmission line required to connect the biomass plant to the transmission grid. A relatively longer line or higher voltage would increase construction and operation impacts.

7.7. Water Appropriations

Large electric power generating facilities may require water for operations. This section discusses potential water appropriation impacts from such facilities.

Lakefield Wind Project

The proposed project would require water appropriations for potable and sanitary water for the operations and maintenance facility. Water would be supplied through the existing rural water supply or a single domestic-sized well. This amount of water used would be roughly equivalent to the amount consumed by a residence or farmstead in the area, and would likely not require mitigation.

Generic 205.5 MW LWECS

A generic 205.5 MW LWECS would have water appropriations similar to the Lakefield Wind Project.

78 MW Biomass Plant

A 78 MW biomass plant would require water appropriations for energy production (process water) and sanitation. Process water could come from a well; however, a municipal water source may also be required. For some aspects of the process, such as in the cooling tower, effluent water from a wastewater treatment facility could be used. The sources of water would depend on the type and availability of water sources near the facility location.

The required quantity of water would be dependent on plant design and water quality. Functions within the plant that require water include cooling, sanitation, washing, and separations. The average anticipated water use would be approximately 1275 gallons per minute. If a source of effluent wastewater were available, the appropriation of well or municipal water would be relatively lower. If the plant used only well or municipal water, the water appropriation would be higher. Based on anticipated water use, the plant would require a water appropriations permit from the Minnesota Department of Natural Resources (DNR).[76]

Mitigation

Mitigation of well water and municipal water use by the plant could be achieved through plant equipment choices and through the use of effluent water (water that has already been appropriated). If municipal water were used for the plant, modifications or an expansion of the municipal water treatment plant be required to accommodate the increase in demand.

7.8. Wastewater

Large electric generation facilities have the potential to generate significant amounts of wastewater. This section discusses potential impacts from wastewater generation.

Lakefield Wind Project

The proposed project does not create wastewater during the generation of electricity. However, wastewater would be created by the operation and maintenance (O&M) building. This wastewater would likely be discharged into a septic system associated with the building. The potential impacts of this wastewater and septic system are anticipated to be minimal. Mitigation of the impacts, beyond a properly functioning septic system, is not anticipated.

Generic 205.5 MW LWECS

A generic 205.5 MW LWECS would have wastewater impacts similar to the Lakefield Wind Project.

78 MW Biomass Plant

A 78 MW biomass plant would have process and sanitary wastewater discharges. The amount of wastewater discharge would depend on the water sources used for the plant (see Section 6.7). If well and municipal water are used, anticipated average wastewater discharge would be approximately 1275 million gallons per year. If effluent water is also utilized, wastewater discharge would increase to approximately 310 million gallons per year.

Mitigation

Wastewater impacts could be mitigated by processing. The most likely scenario is transference of the wastewater to a municipal sewage system for treatment and release. Wastewater could

[76] Water Use Permits, http://www.dnr.state.mn.us/waters/watermgmt_section/appropriations/permits.html.

be held or pre-treated at the biomass plant. Holding could reduce discharges through evaporation. However, holding introduces risks related to storing wastewater away from surface and ground waters.

7.9. Solid and Hazardous Wastes

Large electric generation facilities have the potential to generate solid and hazardous wastes. This section discusses potential impacts from such wastes.

Lakefield Wind Project

The proposed project would create solid and hazardous wastes. Solid wastes would be generated during construction including scrap wood, plastics, cardboard, and wire to name a few. Small amounts of solid and hazardous wastes would be generated during operation, such as oils, grease, hydraulic fluids, and solvents. Lubricants and fluids would be stored at the operation and maintenance building.

Solid and hazardous wastes, if not properly handled, can contaminate surface and ground waters. This contamination can cause human health impacts, e.g., cancer.[77]

Mitigation

Solid wastes would be disposed of according to solid waste plans in Jackson County. Hazardous wastes would be handled appropriately. Leaks or spills would be mitigated using appropriate clean up techniques. A listing of all potentially hazardous materials related to the project will be maintained for the project. It is not anticipated that the project will require a hazardous waste license. Hazardous waste generation would likely fall below the quantity required for a very small quantity generator license (220 pounds per month).[78]

Generic 205.5 MW LWECS

A generic 205.5 MW LWECS would have solid and hazardous waste impacts similar to the Lakefield Wind project.

78 MW Biomass Plant

A 78 MW biomass plant would create solid and hazardous wastes. Solid wastes would be generated during construction, e.g., scrap wood, plastics, cardboard, wire. Solid waste generated from operations would consist primarily of ash from the biomass boiler. Small amounts of hazardous wastes would be generated during operation, e.g., oils, grease, hydraulic fluids, solvents. Hazardous materials would likely be stored on site, e.g., diesel fuel.

[77] Volatile Organic Compounds (VOCs) in Minnesota's Ground Water, http://www.pca.state.mn.us/water/groundwater/gwmap/voc-fs.pdf.
[78] Very Small Quantity Generator Hazardous Waste Collection Program, http://www.pca.state.mn.us/publications/w-hw2-50.pdf.

Mitigation

Mitigation of wastes would be similar to the proposed project. Ash generated by the plant would be held on-site in an ash holding facility or removed to an off-site disposal facility. Storage tanks would be registered and maintained in accordance with Minnesota Pollution Control Agency (MPCA) guidelines.

7.10. Noise

Large electric generation facilities have the potential to generate noise. This section discusses potential impacts from such noise.

Noise can be defined as unwanted or inappropriate sound. Sound has multiple characteristics which determine whether a sound is too loud or otherwise inappropriate. Sound travels in a wave motion and produces a sound pressure level. This sound pressure level is commonly measured in decibels (dB). Sounds also consists of frequencies, e.g., the high frequency (or pitch) of a whistle. Most sounds are not a single frequency but a mixture of frequencies. Finally, sounds can be constant or intermittent. The perceived loudness of a sound depends on all of these characteristics.

A sound meter is used to measure loudness. The meter sums up the sound pressure levels for all frequencies of a sound and calculates a single loudness reading. This loudness reading is reported in decibels, with a suffix indicating the type of calculation used. For example, “dB(A)” indicates a loudness reading using an A-weighted calculation (or “scale”).

The State of Minnesota has promulgated noise standards designed to ensure public health and minimize citizen exposure to inappropriate sounds (Table 4). The rules for permissible noise vary according to land use, i.e., according to their noise area classification (NAC). In a residential setting, for example, noise restrictions are more stringent than in an industrial setting. Rural residential homes are considered NAC 1 (residential), while agricultural land and agricultural activities are classified as NAC 3 (industrial). The rules also distinguish between nighttime and daytime noise; less noise is permitted at night. Sound levels are not to be exceeded for 10 percent and 50 percent of the time in a one-hour survey (L_{10} and L_{50}) for each noise area classification.

Potential human impacts due to noise include hearing loss, stress, annoyance, and sleep disturbance.[79] Table 4 lists Minnesota’s Noise Standards by noise area classification.

[79] Occupational and Community Noise, World Health Organization, http://www.who.int/mediacentre/factsheets/fs258/en/.

Table 4. Minnesota Noise Standards[80]

Noise Area Classification[81]	Daytime		Nighttime	
	L_{50}[82]	L_{10}	L_{50}	L_{10}
1	60	65	50	55
2	65	70	65	70
3	75	80	75	80

Lakefield Wind Project

The operation of wind turbines would produce noise. Turbines produce mechanical noise (noise due to the gearbox and generator in the nacelle) and aerodynamic noise (noise due to wind passing over the turbine blades).[83] Perceived sound characteristics would depend on the type/size of turbine, the speed of the turbine (if turning), and the distance of the listener from the turbine.

Wind turbines produce audible, low frequency sound and sub-audible sound (infrasound). These sounds can have a rhythmic modulation due to the spinning of the turbine blades.[84] Impacts due to these sound characteristics are subjective, i.e., human sensitivity, especially to low frequency sound, is variable. However, in general, low frequency sounds can cause annoyance and sleep disturbance.[85]

[80] Minnesota Rules 7030.0040, https://www.revisor.leg.state.mn.us/rules/?id=7030.0040. Standards expressed in dB (A).
[81] Minnesota Rules 7030.0050, https://www.revisor.leg.state.mn.us/rules/?id=7030.0050. The noise area classification is based on the land use activity at the location of the receiver (listener).
[82] Minnesota Rules 7030.0020, https://www.revisor.leg.state.mn.us/rules/?id=7030.0020. "L_{50}" means the sound level, expressed in dB(A), which is exceeded 50 percent of the time for a one hour survey. "L_{10}" means the sound level, expressed in dB(A), which is exceeded ten percent of the time for a one hour survey.
[83] Public Health Impacts of Wind Turbines, Minnesota Department of Health, May 22, 2009, http://www.health.state.mn.us/divs/eh/hazardous/topics/windturbines.pdf.
[84] Id.
[85] Id.

Mitigation

The primary means of mitigating sound (noise) produced by wind turbines is siting. Turbines must be sited to comply with noise standards in Minnesota Rules 7030.[86] For rural residential areas in Jackson County, this means sound levels must meet an L_{50} standard of 50 dB(A) (Table 4). The distance that turbines are setback from residences would depend on the type and size of turbine. Setback distances to the 50 dB(A) level for turbines under consideration for this project are shown in Table 1. The setback distance for a 1.5 MW turbine is 623 feet. Turbines would not be placed within 1,000 feet of any home. A preliminary site layout can be seen on Map 3 (Preliminary Site Layout) at the end of this report.

Cumulative noise impacts must also be considered. That is, if there are multiple turbines in the vicinity of a residence, the standards set by Minnesota Rules 7030 must still be met. This may require additional setbacks. Setback requirements are enforced by site permits issued by the Commission for wind farms. The Commission is currently reviewing public health setbacks related to wind farms to determine if they remain appropriate and reasonable.[87]

Generic 205.5 MW LWECS

A generic 205.5 MW LWECS would have noise impacts similar to the Lakefield Wind project.

78 MW Biomass Plant

A 78 MW biomass plant would create noise during operation from a variety of sources including the turbine/boiler building, conveyor system, hammer mill and bale choppers, front end loaders, and idling trucks. Based on noise studies, the plant would need to be located approximately 2,100 feet from a residence to the meet the daytime L_{50} standard of 60 dB(A), and approximately 6,200 feet from a residence to meet the nighttime L_{50} standard of 50 dB(A). These are conservative estimates – they are based on maximum equipment operation and have not been adjusted for possible noise shielding.

Mitigation

Sound (noise) from the biomass plant could be mitigated by siting. A study would likely be required to ensure that noise standards are met for all local residents. Enclosure of heavy equipment would reduce noise impacts. Vegetative screening, planted to lessen visual impacts, would also reduce potential noise levels. Fuel windrows could provide noise attenuation. Hours of operation, e.g., for fuel delivery or heavy equipment operation, could be managed to reduce noise impacts and meet daytime and nighttime standards.

[86] Minn. Rules 7030.0040, Noise Standards, https://www.revisor.leg.state.mn.us/rules/?id=7030.0040
[87] Commission Investigation into Large Wind Energy Conversion Systems Permit Conditions on Setbacks and the Minnesota Department of Health Environmental Health Division's White Paper on Public Health Impacts of Wind Turbines, CI-09-845, http://www.puc.state.mn.us/puc/energyfacilities/012254#windhealth.

7.11. Property Values

Large electric generation facilities have the potential to impact property values. This section discusses potential property value impacts from the operation of a generation facility in the project area.

Lakefield Wind Project

The proposed project would be located in Jackson County in southeastern Minnesota. According to the 2000 census the population in Jackson County was 11, 268. In 2009, the population estimate for the county was 10, 786.[88] The home ownership rate as of 2000 is approximately 79.5%, slightly higher than the state average of 74%. [89] There are approximately 16 people per square mile, significantly lower than the state average of 62 persons per square mile. [90]

The impacts on property values due to the project are difficult to quantify. Numerous factors influence a property's market value, including acreage, schools, parks, neighborhood characteristics, and improvements. A direct influence on property value is often the status of the housing/land market at the time of sale.

The Renewable Energy Policy Project (REPP) conducted a statistical analysis to determine the extent to which property values are influenced in the vicinity of wind projects.[91] Ten communities in the United States were studied within a five mile radius of a wind project. The study found that property values were not negatively impacted within the viewshed of a wind project. Lawrence Berkeley National Laboratory recently completed a nationwide study on the potential impacts of wind projects on property values.[92] Results indicate that property values near wind projects are not negatively impacted and that home buyers and sellers consider a property's scenic vista when determining a sale/purchase price.

Seven Counties in southern Minnesota (Dodge, Goodhue, Jackson, Lincoln, Martin, Mower, and Murray Counties) with large wind energy conversion systems were asked about impacts on property values as a result of wind farms[93]. To date, it appears that neither properties hosting turbines nor those adjacent to those properties in the counties listed, are negatively impacted by the presence of wind farms.

[88] U.S. Census Bureau, http://quickfacts.census.gov/qfd/states/27/27063.html .
[89] Id.
[90] Id.
[91] The Effect of Wind Development on Local Property Values, May 2003, http://www.repp.org/articles/static/1/binaries/wind_online_final.pdf.
[92] The Impact of Wind Power Projects on Residential Property Values in the United States: A Multi-Site Hedonic Analysis, December 2009, http://www1.eere.energy.gov/windandhydro/pdfs/wind_power_projects_residential_property_values.pdf.
[93] Stearns County Board of Commissioners Meeting, June 8, 2010.

Mitigation

Negative impacts to property value due to the proposed project are not anticipated and mitigation is not necessary. It is possible that specific, individual property values may be negatively impacted. Such impacts can be mitigated by siting turbines away from residences and viewsheds.

Generic 205.5 MW LWECS

A generic 205.5 MW LWECS would have property value impacts similar to the Lakefield Wind project.

78 MW Biomass Plant

A 78 MW biomass plant would potentially negatively impact property values near the plant site and possibly along roads used to transport biomass. However, as with the Lakefield Wind project, impacts on property values are difficult to quantify because of the many factors that influence a property's market value. For example, if biomass for the plant were supplied by neighboring land parcels, these parcels might experience an increase in property value.

Mitigation

Because the plant is sited in one location, compared to multiple turbine locations, property value impacts could be mitigated by location and siting.

7.12. Historic and Archaeological Resources

Large electric generation facilities have the potential to impact historic and archaeological resources, particularly during construction. This section discusses potential impacts to historic and archaeological resources from the operation of a generation facility in the project area.

Lakefield Wind Project

The proposed project would be located in the Prairie Lake South Archeological Region (2s). This region encompasses the entire project area.[94] The region transitions from woodlands to shortgrass and midgrass prairies. Topography is typified by ground moraine swell and swale terrain. Habitation sites in this region are commonly located near wooded areas and on major river terrace system.[95] Habitation sites are commonly located near lakes and river valleys.

A review of Minnesota state historical records indicates 67 historic architectural properties and 15 archeological locations. Two archeological sites are located within the project area and 13 are located within two miles of the project boundary. Three architectural properties are located

[94] Site Permit Application, Section 4.6.
[95] Id.

within the project boundary.[96] The historic properties include churches, bridges, houses, and a train depot. Archaeological sites include an artifact scatter and a lithic scatter.

Construction of the Lakefield Wind Project would likely not impact historic properties or known archeological sites, but could impact unknown archaeological sites. Construction will include digging, trenching, and movement of soil. These activities could uncover or otherwise impact archaeological sites.

Mitigation

Impacts to known and identified sites would be avoided. If archeological sites are found during construction, the integrity of such sites and significance would be addressed in terms of the site's eligibility for the National Registry of Historic Places. If sites are found to be eligible, mitigative measures would be developed in consultation with Minnesota SHPO, the State Archaeologist, and consultation with Native American communities. Mitigation actions may include adjusting the array of turbines during micrositing.

Generic 205.5 MW LWECS

A generic 205.5 MW LWECS located elsewhere in Minnesota would have impacts to historic and archaeological resources similar to the Lakefield Wind project. Mitigation measures would also be similar. Historic and archaeological resources are distributed throughout the state.[97] Archaeological sites are more typically found near regional water resources, e.g. Mississippi River, Minnesota River, Lake Superior. Because of the dispersed nature of LWECS, turbines, roads, and collector lines are usually able to be located to avoid historic and archaeological resources.

78 MW Biomass Plant

A 78 MW biomass plant may have impacts to historic and archaeological resources similar to the project, depending on location and any known cultural or archaeological sites. The number of turbines within the project area increases the potential to impact cultural and archaeological resources, whereas a biomass plant is less dispersed and occupies a discrete parcel of land. Locating a plant near surface waters may increase the likelihood of encountering archaeological sites Mitigation measures would be similar to those identified for the proposed project. during construction.

[96] Id.
[97] Distribution of Recorded Archaeological Site in Minnesota, http://www.osa.admin.state.mn.us/mnarch/map.html.

7.13. Domesticated Animals

Large electric generation facilities have the potential to impact the health of domesticated animals and livestock directly and through impacts to the ecosystem. This section discusses potential impacts to livestock (a subset of local fauna) due to the operation of a generation facility in the project area. Potential impacts to wildlife are discussed in Section 6.14.

There are few aspects of livestock health that can be considered outside of ecosystem health. Livestock health depends on ecosystem health (clean water, fresh air, healthy soils and crops). Generation facilities that impair ecosystem functions can also negatively impact livestock health, such as through emissions of hazardous air pollutants. Potential ecosystem impacts due to generation facilities are discussed elsewhere in this report (Sections 7.1 and 7.2 discussing air pollutants).

Other potential impacts to livestock health include annoyance or stress. Stress may result from a variety of impacts related to generation facility operations, such as lights, noise, and electrical shock. Impacts from shadow flicker are discussed in Section 7.3 and noise impacts are discussed in section 7.3.

Electrical shock could be caused by stray voltage or induced voltage.[98] Stray voltage occurs with electrical distribution lines to residences and transmission lines that parallel them. Stray voltage flows through the ground. Induced voltage occurs with ungrounded metal objects (e.g., fences) that parallel transmission lines. Induced voltage flows through the metal objects, such as fences, that parallel transmission lines. In general, transmission lines are electrical lines with voltages of 100 kV or higher and distribution lines are electrical lines with voltages less and 100 kV.[99]

Lakefield Wind Project
Livestock in and adjacent to the project area would be exposed to noise and shadow flicker created by wind turbines. Exposure levels would depend on factors such as grazing, housing, and on the distance between livestock and the turbines. Health impacts from turbine noise and shadow flicker are uncertain. Information about impacts to livestock is anecdotal and indicates that livestock are not impacted by turbine operations. Grazing animals appear to graze near, under, and up to turbine towers.

[98] See, for example, the discussion of stray voltage and induced voltage in the draft environmental impact statement for the Brookings County to Hampton 345 kV transmission line project, Section 6.2; http://energyfacilities.puc.state.mn.us/resource.html?Id=25589.
[99] Intermediate voltages, e.g., 69 kV, can, in some instances, serve as transmission lines.

Studies designed to assess turbine impacts on avian wildlife have found that wildlife use areas near wind turbines (e.g., nesting, feeding), but avoid the area surrounding turbine towers.[100] It is unclear whether these species avoid these areas due to stress, noise, shadow flicker, or if they are avoiding potential impact with turbine blades. Studies designed to assess direct turbine impacts to non-avian wildlife (e.g., mice, squirrels, deer) are scarce, presumably because impacts to these species are anticipated to be minimal.

The Lakefield Wind Project does not include distribution lines to residences. The collection lines for the project do not connect to residences and operate at a distribution-level voltage (34.5 kV). No health impacts to livestock from stray or induced voltage are anticipated.

Generic 205.5 MW LWECS

A generic 205.5 MW LWECS located elsewhere in Minnesota would have impacts to livestock similar to the Lakefield Wind project.

78 MW Biomass Plant

A 78 MW biomass plant would have fewer impacts to livestock than those of the proposed project. Biomass plant operations would create noise and lighting that could impact livestock health. The biomass plant could have an associated transmission line that produced stray or induced voltage. However, the plant could be sited away from livestock operations to minimize health impacts. The biomass plant would be a concentrated impact that can be sited away from livestock. Wind turbines represent a diffuse impact that exists within landscapes utilized by livestock.

7.14. Natural Resources

Large electric generation facilities have the potential to impact natural resources, including flora, fauna, habitat, soils, and water. This section discusses potential impacts to natural resources from the operation of a generation facility in the project area.

Land use within the project area is primarily agricultural. In 2007, over 92% of the land in Jackson County was used for agriculture by approximately 969 farms.[101] Figure 1 and Map 6 show land cover types for Jackson County.

Ecological Setting

The Minnesota Department of Natural Resources and the U.S. Forest Service have developed an Ecological Classification System (ECS) for ecological mapping and landscape classification in

[100] Site Permit Application, Section 4.18. For example, studies of grassland nesting passerines (songbirds) show that use of grasslands areas was reduced within 50 meters (164 ft.) of turbines, but that areas further away did not have reduced use.
[101] Id.

Minnesota.[102] Ecological land classifications are used to identify, describe, and map progressively smaller areas of land with increasingly uniform ecological features. The Lakefield Wind project sits in the Coteau Moraines Subsection of the North Central Glaciated Plains in southwestern Minnesota. [103] This area includes part of northwestern Iowa and extends into southeastern South Dakota.

The Coteau Moraines Subsection is a high landform with Buffalo Ridge running along its western edge. The highest point on the ridge is 1,995 feet above sea level, second only to Eagle Mountain in the North Shore Highlands Subsection. Windy conditions are common. Shallow lakes are common, including a few large ones. Prairie wetlands are numerous, making this subsection important for waterfowl. There are a number of small streams here and one larger river, the Des Moines. Before European settlement, prairie covered virtually all of the landscape. Fires were common and critical to maintaining the prairie plant communities. Today, agriculture is the predominant land use and its expansion and intensification have resulted in water quality and water quantity concerns. Tiling and ditching of land, and channelization of the river systems have degraded habitat and disturbed aquatic connectivity. Gravel and boulder mining occur in this subsection, and large-scale wind-power production is expanding dramatically. Many of the remaining prairie-grassland complexes are in private ownership and have been used for grazing. Wetland protection and restoration are important conservation issues.

Soils

Soils in the project area are largely of the Delft-Clarion Association. This association is characterized by nearly level to hilly, well to poorly drained loam that formed in glacial till on uplands. [104]

Surface Waters and Wetlands

Surface waters comprise only 2% of this landscape and wetlands 1%. The abundance of publicly owned wetlands on state and federal wildlife areas and associated grasslands in this landscape provide important habitat for numerous species of birds and waterfowl.

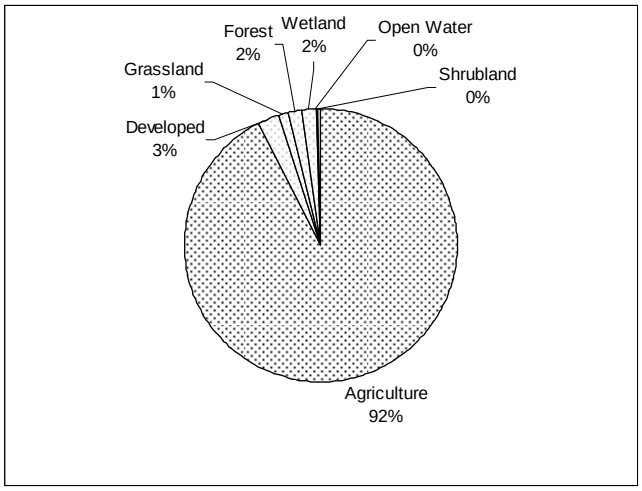
Lakefield Wind Project

The project area is representative of the Coteau Moraine Subsection, with most of the land (over 90%) used for agriculture (see Figure 1). There are 4 lakes adjacent to the project boundary, and one at the western edge of the western boundary in the Summers State Wildlife Management Area. The Des Moines River is approximately 1 mile from the eastern project

[102] See MN DNR Ecologcial Classification System, http://www.dnr.state.mn.us/ecs/index.html
[103] See MN DNR Coteau Morraines Subsection Profile, http://files.dnr.state.mn.us/assistance/nrplanning/bigpicture/cwcs/profiles/coteau_moraines.pdf
[104] Site Application, Section 4.13

boundary. Maps 4 and 5, at the end of this report, show land and water resources of the project area. Land cover can be seen on Map 6.

Figure1: Land Cover in Jackson County, MN[105]



Surface waters in the project area are a mix of natural water bodies and streams and judicial drainage ditches.[106] There are approximately 529 acres of wetlands in the project area, many of which have been partially drained. A calcareous fen has been located in the northwestern part of the project area near South Heron Lake. This fen is identified as outstanding resource value water and has special protections under Minnesota Statutes Chapter 7050.0180.

Data from the Natural Heritage Inventory System identified two mesic prairies and one calcareous fen as the remaining native plant communities in the project boundary. No state listed plants have been identified within the project boundary. The proposed project would be located on agricultural land, with little to no impacts on native vegetation. Turbines are not sited in wildlife management areas or wetlands and would not disturb water resources associated with those areas.

Mitigation

Impacts to native vegetation can be mitigated by siting wind turbines outside of identified areas. No turbines are proposed in native prairies, fens, or other public lands.

Potential impacts to surface and groundwater can be mitigated through construction practices. Prevention of soil loss due to storm water run-off is administered by the Minnesota Pollution Control Agency. Applicants will develop a Stormwater Prevention Pollution Plan to identify erosion and sedimentation control measures to prevent adverse impacts to water quality.[107]

[105] Site Permit Application, Section 4.10
[106] Site Application, Section 4.15
[107] Site Application, Section 4.15

New impermeable surfaces will be developed as a result of this project and will include access roads and turbine pads. The total amount of new impermeable surface area will be approximately150 acres.

Generic 205.5 MW LWECS

A generic 205.5 MW LWECS located elsewhere in Minnesota would have impacts to natural resources similar to those of the proposed project. Depending on site characteristics and natural resources, impacts could be greater or fewer than the Lakefield Wind project. Impacts to soils and waters are primarily due to construction activities. Construction practices can be modified to prevent soil loss and erosion that could directly impact water quality.

78 MW Biomass Plant

A 78 MW biomass plant would be expected to have similar impacts on natural resources as the proposed project depending natural resources on and near the project site. Siting of the biomass plant utilizing construction practices that minimize impacts to soil and surface water would likely mitigate impacts.

7.15. Wildlife

Five wildlife management areas (WMAs) have been identified within the project area and an additional eight have been identified within 4 miles of the project boundary. Other resources near the proposed project include the Des Moines River, Kilen Woods State Park, state Scientific and Natural Areas, county parks, state wildlife production areas, and Nature Conservancy Lands.[108] Map 4 at the end of this document shows wildlife areas in and adjacent to the project area.

A number of common game and non-game wildlife species are adapted to landscape, which includes non-cultivated areas. Crops provide seasonal cover and food, while uncultivated areas provide long-term cover, food, breeding sites, and water. Mammals common to this landscape include gopher, ground squirrels rabbit, deer, fox, raccoon, and skunk.[109] Reptiles and amphibians in this landscape are associated with wetlands, waterways, and forested areas. Typical reptiles and amphibians include snakes, turtles, and frogs. Birds and bats are found in this landscape, including grassland birds, migratory birds, raptors, and waterfowl.

Studies have shown that placement of turbines and auxiliary structures can result in decreased densities of songbirds and other species. The potential for habitat avoidance by wildlife in response to wind turbines and associated infrastructure is highly variable depending on the

[108] Site Permit Application, Section 4.17.
[109] Site Permit Application, Section 4.18.

species under consideration, seasonal and annual variation in weather and migration patterns, and local and individual behavior patterns. [110]

Lakefield Wind Project

The project lies in the Northcentral Glaciated Plains, an area that was historically covered in tall grass prairie.[111] Wet prairies and wooded areas were restricted the margins of rivers and streams. Dominant river systems in this landscape are the Minnesota and Des Moines Rivers. Post-settlement, most of this landscape has been converted into agriculture, with small remnants of pre-settlement vegetation. The project and surrounding areas include numerous wildlife management areas wildlife areas, state parks, and close proximity to the Des Moines River and South Heron Lake.

The Lakefield Wind project would negatively impact wildlife particularly avian and bat species. Temporary impacts would occur during construction while other impacts would be permanent. The project would utilize approximately 2% (400 acres) of the total 19,000 acres within the project boundary. This would include construction of roads, turbine pads, and associated facilities. Environmental impacts from construction would be minimal since turbines and access roads will be placed on land that is currently used for agriculture.

Impacts on mammals, reptiles, and amphibians due to operation of the project would likely be minimal. However, negative impacts to avian and bat species would occur. Impacts would include mortality due to collisions, avoidance of areas near wind turbine for foraging and breeding, potential loss of habitat, and possible increased fragmentation of the landscape. Birds can collide with spinning turbine blades. Bats can avoid turbines blades, but appear to suffer injury to their respiratory systems when they fly through low pressure wakes near turbine blades.[112]

Birds

Studies have been conducted throughout the Midwest in an attempt to quantify bird and bat mortality due to wind turbines. A study of bird mortality rates at a wind farm in Iowa resulted in estimated mortality rates between 0.3 and 0.8 birds per turbine per year.[113] This estimate is similar to results from studies in other states where mortality rates ranged between < 1 to 2.83 birds per turbine per year.[114] Studies conducted in the Buffalo Ridge region of southwestern Minnesota resulted in estimated bird mortality rates between 1.0 and 4.5 birds per turbine per

[110] Lakefield Wind Ecological Risk Assessment, October 2009.
[111] See Minnesota ecological Land Classification System, http://www.dnr.state.mn.us/ecs/251B/index.html
[112] Extreme Pressure Changes near Blades Injures Bat Lungs, http://www.ucalgary.ca/news/aug2008/batdeaths.
[113] Bird and Bat Behavior and Mortality at a Northern Iowa Windfarm, (Jain2005). http://www.batsandwind.org/pdf/Jain_2005.pdf.
[114] Id.

year.[115] Nocturnal migrants suffered relatively more mortalities; local grassland species suffered relatively less. The studies noted that birds tend to avoid turbine towers, but utilize the surrounding habitat.

At least 193 bird species representing 44 families in 14 orders have been documented in Jackson County.[116] An ecological risk assessment for rare species, birds, bats, wetlands, and managed lands was conducted August of 2009.[117] In Jackson County, there are 4 bird species of special concern, 3 threatened species, and 1 state endangered species. Nonne of the species listed is federally endangered. Table 6 lists the threatened and endangered bird species in Jackson County, MN.

Table 5: Threatened and Endangered Bird Species in Jackson County, MN[118]

Common Name	Scientific Name	Federal Status	State Status	Potential to Occur in Project Area
Trumpeter Swan	*Cygnus buccinator*		THR	Moderate
Wilson's Phalarope	*Phalaropus tricolor*		THR	Moderate
Loggerhead Shrike	*Lanius ludovicianus*		THR	Low
King Rail	*Rallus elegans*		END	Low
Forster's Tern	*Sterna forsteri*		SC	Moderate
Franklin's Gull	*Leucophaeus pipixcan*		SC	Moderate
Bald Eagle	*Haliaeetus leucocephalus*		SC	Moderate
Common Moorhen	*Gallimula chloropus*		SC	Moderate

Based on data from the Minnesota Natural Heritage Inventory System (NHIS) there are occurrences of Common Moorhens, Trumpeter Swan, and Upland Sandpiper within the project area and within a two mile buffer of the project boundary. Additionally hundreds of pelicans were observed on Heron Lake and the Boot Lake Waterfowl Production Area. Fatalities of pelicans could be significant since they have been observed in the rotor swept area of the turbine. Migratory birds are known to utilize landscape features such as stream corridors.[119] Due to the close proximity of the Des Moines River to the project boundary (1.5 miles west) and the number of wildlife management areas in an near the project area, it is possible that avian collisions could be higher than other projects in the state. Data are insufficient at this point o make predictions, although additional bird survey work is underway. The study projects impacts to raptors and waterfowl to be low because raptor use of the area is relatively low and

[115] Avian Monitoring Studies at the Buffalo Ridge, Minnesota Wind Resource Area: Results of a 4-Year Study, http://energyfacilities.puc.state.mn.us/documents/AvianMonitoringBuffaloRidge.pdf [hereafter Buffalo Ridge Studies].
[116] Lakefield Wind Project Ecological Risk Assessment, October 2009.
[117] Id.
[118] Lakefield Ecological Risk Assessment, 2009.
[119] Id.

waterfowl because they appear less vulnerable to turbine collisions.[120] Impacts to passerines would likely be higher. Passerine mortalities will likely be greater than 4.5 birds per turbine per year.[121] Avoiding regions of the project area with passerine habitat could reduce these impacts.

In sum, studies of bird mortalities near wind farms indicate that mortalities will occur and that they will vary with bird type (e.g., raptor, passerine) and bird use (habitat). Whether the number of mortalities is significant from a population standpoint is uncertain.

Bats

There are 7 species of bats that occur in Minnesota and 5 of the seven species have a high potential to occur in the project area.[122] Bats typically utilize forests, riparian corridors, and wetlands as feeding habitat due to higher nocturnal insect densities. The Iowa wind farm study estimated bat mortality rates between 6 and 9 bats per turbine per year.[123] A Buffalo Ridge study estimated bat mortality rates at 2.2 bats per turbine per year.[124]

Given the high proportion of agricultural land in the project area, bat habitat would appear to be limited. [125] However, suitable bat habitat would be available along the Des Moines River (1. 5 miles northeast of the project boundary) and in the designated wildlife management areas in and near the project boundary. Bat activity is greatest in late July through mid-August. Bat mortality rates are estimated to be between 1 -2 bats per turbine per year, but could be higher.[126] It is unknown whether this number of mortalities is significantly impacts bat populations.

Mitigation

Impacts to ground animals are expected to be minimal and mitigation is not required. Impacts to birds and bats could be mitigated by siting. Siting turbines away from bird habitat (grasslands, riparian areas) and bat feeding areas (forest, riparian areas) would reduce bird and bat mortalities. Birds and bats fly relatively less in windy conditions. Wind turbines operate in windy conditions and require a minimum wind speed ("cut-in" speed, Table 1). Thus, impacts to

[120] Id., p.13.
[121] The high end of the range from the Buffalo Ridge Studies is 4.5 birds/turbines/year.
[122] Lakefield Wind Project Ecological Risk Assessment, October 2009.
[123] Bird and Bat Behavior and Mortality at a Northern Iowa Windfarm, Jain, 2005 http://www.batsandwind.org/pdf/Jain_2005.pdf.
[124] Bat Interactions with Wind Turbines at the Buffalo Ridge, Minnesota Wind Resource Area, November 2003, http://my.epri.com/portal/server.pt?space=CommunityPage&cached=true&parentname=ObjMgr&parentid=2&control=SetCommunity&CommunityID=404&RaiseDocID=000000000001009178&RaiseDocType=Abstract_id.
[125] Lakefield Wind Project Ecological Risk Assessment, October 2009.
[126] Id. P. 22.

birds and bats could be mitigated by employing turbines with a relatively higher cut-in speed or by using SCADA system controls to increase cut-in speed.[127]

Generic 205.5 MW LWECS

A generic 205.5 MW LWECS located elsewhere in Minnesota would have wildlife impacts similar to or potentially fewer than the Lakefield Wind project assuming the project is located in an area with similar cover type and habitat type. Information about local bird and bat populations within Minnesota is incomplete. The Lakefield Wind Project provides habitat and foraging areas for a wide variety of birds and bats.

78 MW Biomass Plant

A 78 MW biomass plant would have wildlife impacts similar to the Lakefield Wind Project, and fewer impacts on avian and bat species. The biomass plant would be constructed on an approximately 60 acre site. This acreage would be removed from use as wildlife habitat. However, the land used for the project would likely be agricultural land; such land is relatively poorer habitat for wildlife. Impacts from operation of the plant are anticipated to be minimal. Emissions from the plant (e.g., hazardous air pollutants) could, through impacts to the environment, impact wildlife. The extent of this impact is uncertain.

7.16 Communication Signals

Large electric generation facilities have the potential to impact electronic communications (radio, television, internet, cell phone, and microwave). This section discusses potential impacts on communications due to the operation of a large generation facility in the project area.

Lakefield Wind Project

Wind turbines can cause interference with electronic communications by obstructing the reception of communication signals. Digital signals (e.g., digital television, internet, cell phones) are not impacted by wind turbines unless the turbines directly obstruct the signal, i.e., are in the line-of-sight.[128] Analog signals (e.g., AM and FM radio, microwaves) can be interfered with by direct obstruction and by indirect signal interference, e.g., ghosting of television pictures, signal fading.

Potential communications impacts due to the Lakefield Wind project are anticipated to be minimal. There are eight unique microwave paths, 26 land mobile radio facilities, 5 digital TV stations, and 14 FM stations in the project area and within 2 miles of the project boundary.[129]

[127] Effectiveness of Changing Wind Turbine Cut-In Speeds to Reduce Bat Fatalities at Wind Facilities, April 2009, http://www.batsandwind.org/pdf/curtailment_2008_final_report.pdf.
[128] Post Digital Television Transition - The Evaluation and Mitigation Methods for Off-Air Digital Television Reception in-and-around Wind Energy Facilities; http://www.comsearch.com/files/Wind_Energy_White_Paper.pdf.
[129] Site Permit Applications, Section 4.5

Land mobile and radio facilities are wireless communication systems intended for use by users in vehicles, such as those used by emergency first responder organizations, public works organizations, or companies with large vehicle fleets or numerous field staff. FM radio is not impacted by wind turbines or transmission facilities; AM radio can be impacted near transmission facilities, e.g., signal fading underneath a transmission line.

Eight unique microwave paths intersect the project area.[130] Wind turbines can impact microwave communications by interfering with these beam paths (e.g., wind turbine blade slicing through a beam path). Thus, turbines need to be located such that they do not obstruct microwave beam paths.[131]

There is a possibility that broadcast facilities (HDTV and digital television) would be impacted by the proposed project. Outdoor antennas pointed through the turbine area, "rabbit ear" antennas, or older HDTV receivers would be more likely to experience signal disruption (in the form of pixilation or "freezing" of a picture). Interference is more likely to occur in the communities of Lakefield and Jackson due to the proportionally higher number of receivers (homes) and the digital broadcast paths of local TV stations (Table 6). Approximately 10% of homes within 2-3 miles of a wind turbine will experience intermittent television interference[132].

Table 6: Digital Television Stations Serving the Project Area[133]

Call Sign	Network Affiliate	City of License	Power (kW)
KELO-TV	CBS, MyNetwork TV	Sioux Falls, SD	30
KEYC-TV	CBS/FOX	Mankato, MN	15.2
KSFY-TV	ABC	Sioux Falls, ND	22.7
KSMN	PBS	Worthington, MN	200
KDL-TV	NBC	Sioux Falls, SD	1000

Global positioning systems (GPS) use satellite signals to determine locations on the earth's surface and are commonly used to guide agricultural operations.[134] Because GPS uses multiple digital satellite signals, interference with the signals or subsequent uses is not anticipated. Obstruction of any one satellite signal would require direct line-of-sight obstruction due to a wind turbine. Such an obstruction would be temporary (i.e., there is concurrent GPS receiver

[130] Site Permit Application, Appendix C.
[131] Id.
[132] Id.
[133] Site Application, Appendix C.
[134] Precision Farming Tools: Global Positioning Systems (GPS), Virginia Cooperative Extension; http://www.pubs.ext.vt.edu/442/442-503/442-503.html.

movement, satellite movement, and wind turbine blade movement such that the obstruction would be resolved).

Mitigation

Microwave Beam Paths
To prevent disruption of the microwave beam path, turbines should not be sited the centerline of a beam path. Appropriate turbine siting would mitigate potential impacts.

Land Mobile Stations
Wind turbines should not adversely affect the signals of land mobile stations if the turbines are placed at least 400 meters (one-quarter mile) from these stations.

Broadcast Facilities
Satellite, cable service or receiver upgrades would mitigate negative impacts on broadcast facilities if impacts cannot be avoided through turbine placement. Establishment of a program to respond to interference complaints would help determine necessary mitigation efforts. Impacts on broadcast facilities as a result of the project are not yet known.
AM/FM Facilities
No impacts or disruptions are anticipated.

Generic 205.5 MW LWECS

A generic 300 MW LWECS would have communications impacts similar to the Lakefield Wind project and possibly less depending on the proximity of population centers to the project.

78 MW Biomass Plant

A 78 MW biomass plant would have fewer or no impacts on communications than the proposed project. A biomass plant would be shorter than the project's wind turbines and sited in one location.

7.17 Aviation

Large electric generation facilities have the potential to impact aviation. This section discusses potential impacts to aviation from the operation of a generation facility in the project area.

Lakefield Wind Project

Due to their height, wind turbines have the potential to impact aviation in and near a wind project. Wind turbines in the Lakefield Wind project will require notice to and evaluation by the

Federal Aviation Administration (FAA)[135] and the Minnesota Department of Transportation (MN DOT).[136] Airports near the project area are listed in Table 7. The proposed project does not impact the safety zones of these airports.[137]

Table 7: Airports and Heliports near the Project Area[138]

Airport Name	Airport Location	Approximate Distance (miles) from Project Center
Nauerth Land Ranch Airport	Lakefield, MN	6.0 mi WSW
Jackson Medical Center Heliport	Jackson, MN	6.7 mi ESE
Jackson Municipal Airport	Jackson, MN	6.9 mi ESE
Turner Field Airport	Bingham Lake, MN	14.5 mi NNE
Windom Municipal Airport	Windom, MN	16.8 mi N
Dickinson County Memorial Hospital Heliport	Spirit Lake, IA	17.5 mi S
Spirit Lake Municipal Airport	Spirit Lake, IA	19.6 mi S

Wind turbines could impact local aviation operations, such as aerial crop dusting, and make them more difficult. Pilots making such applications would have their attention divided between aircraft systems, spraying requirements, weather conditions, and obstructions.[139] Additionally, when operating, wind turbines create turbulence wakes which would make aircraft operation difficult. However, aerial crop applications are typically made during low wind conditions. In these conditions, wind turbines would not be turning or creating turbulence wakes.

[135] FAA Advisory Circular AC 70/7460-2K, HTTP://RGL.FAA.GOV/REGULATORY_AND_GUIDANCE_LIBRARY/RGADVISORYCIRCULAR.NSF/0/22990146DB0931F186256C2A00721867/$FILE/AC70-7460-2K.PDF
[136] Tall Towers, Minnesota Structure Height Regulations, http://www.dot.state.mn.us/aero/avoffice/talltowers.html.
[137] For Minnesota safety zones, see Minnesota Rules, 8800.2400, https://www.revisor.mn.gov/rules/?id=8800.2400.
[138] Site Permit Application, Section 4.8
[139] Aerial crop sprayers in Wisconsin adopted a resolution in 2009 refusing to provide services within wind farm projects; Glacial Hill FEIS, Section 5.4.2.2.

Wind turbines could impact local helicopter navigation, e.g., emergency medical helicopters needing to land in or near the project area. It is unclear whether the project would significantly increase the risks of helicopter navigation. Officials at the Mayo Clinic in Rochester, Minn., have noted that impacts on helicopter operations due to wind projects have been insignificant.[140]

Mitigation

Potential impacts to aviation can be mitigated by proper siting of the project and adherence to FAA and MN DOT regulations.[141] Impacts to aerial crop spraying would be difficult to mitigate.

Generic 205.5 MW LWECS

A generic 205.5 MW LWECS located elsewhere in Minnesota would have aviation impacts similar to or less than the Lakefield Wind project.

78 MW Biomass Plant

A 78 MW biomass plant would have fewer aviation impacts than the proposed project. A biomass plant would be structurally shorter (other than the height of the stack) and located on a single site, significantly reducing potential impacts.

[140] Mayo Clinic: Turbines do not Hamper Medical Helicopters, Rochester Post-Bulletin, May 18, 2010, http://www.postbulletin.com/newsmanager/templates/localnews_story.asp?z=2&a=452955.
[141] Site Permit Application, Section 4.8.2.

8. Required Permits

The Lakefield Wind project would require permits and approvals from entities other than the Minnesota Public Utilities Commission. Federal, state, and local permits or approvals that have been identified for construction and operation of the project are listed below.

Table 8: Permits and Approvals[142]

Agency	Type of Approval
Federal	
Federal Aviation Administration	Notice of Proposed Construction or Alteration; Determination of No Hazard
U.S. Army Corps of Engineers	Wetland (Section 404) Permit
Natural Resources Conservation Service	Prime Farmland Permit
State of Minnesota	
Minnesota Public Utilities Commission	Certificate of Need; LWECS Site Permit
Minnesota State Historical Preservation Office	Cultural and Historic Resources Review
Minnesota Board of Water and Soil Resources	Wetland Conservation Act Approval
Minnesota Department of Natural Resources	Pubic Water Works Permit
	License to Cross Public Lands and Waters
	Water Appropriations Permit
Minnesota Pollution Control Agency	NDPES Stormwater Permit for Construction
	License for Small Quantity Generator of Hazardous Waste
	Aboveground Storage Tank (AST) Notification Form
	State Water Quality (Section 401) Certification

[142] Potentially required permits and approvals for the Lakefield Wind Project. Adapted from Site Permit Application, Appendix E.

Agency	Type of Approval
Minnesota Department of Health	Water Well Permit; Well Construction Notification
	Plumbing Plan Review
Minnesota Department of Transportation	Utility Access Permit, Highway Access Permit
	Oversize and Overweight Permit
	Aviation Clearance; Tall Towers Permit
Local Permits	
Jackson County	Sign Permits
	Conditional Use Permits (meteorological towers)
	Individual Septic Tank Systems Permit
	Driveway Permit; Utility Permit
	Overwidth/Overweight Permits; Moving Permit
Town of Lakefield	Driveway Permit Building Permit